ANDERSON SECONDARY SCHOOL
Preliminary Examination 2015
Secondary Four Express & Five Normal

CANDIDATE NAME:

CLASS: / INDEX NUMBER:

PHYSICS **5059/01**

Paper 1 (Multiple Choice)

1st September 2015

1 hour

1300 – 1400h

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Answer **all** the questions.

For each question, there are four possible answers, **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the Multiple Choice Answer Sheet.

At the end of the examination, hand in the completed Multiple Choice Answer Sheet and the question paper separately.

INFORMATION FOR CANDIDATES

Take *acceleration due to gravity, g* as 10 m/s^2.

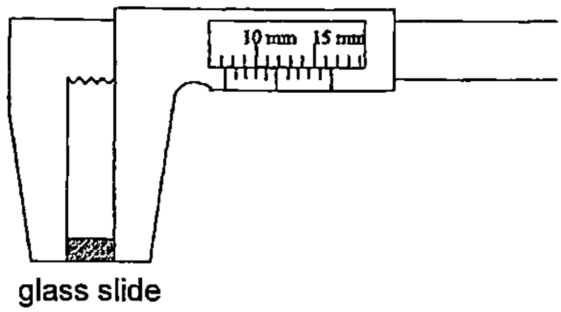
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

This document consists of **17** printed pages

Setter: Mrs Hui Ching Hong Christine

1 The diagram below shows a vernier caliper being used to measure the length of a thin glass slide.



What is the length of the glass slide?

A 6.3 mm

B 7.3 mm

C 7.6 mm

D 10.5 mm

2 Four physical quantities P, Q, R and S are related by the equation:

$$P = Q - RS$$

Which one of the following statements is certainly **true**?

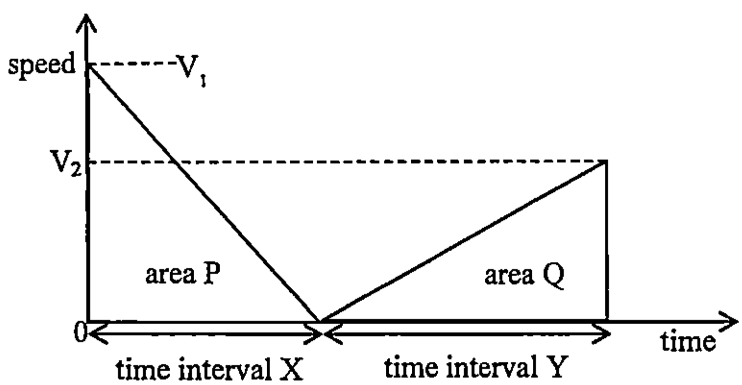
A P, Q, R and S all have the same units.

B P, Q, R and S are all scalar quantities.

C The product of RS has the same units as P/Q.

D The product of RS is numerically equal to (Q-P).

3 The graph below shows the speed-time graph of the motion of a bus.



What is the average speed of the bus throughout the journey?

A $(V_2-V_1)/2$

B $(P-Q)/(X+Y)$

C $(V_2-V_1)/2$

D $(P+Q)/(X+Y)$

4 The velocity of a car, which is decelerating uniformly, changes from 30 m/s to 15 m/s in 75 m. After what further distance will it come to a rest?

A 15 m

B 25 m

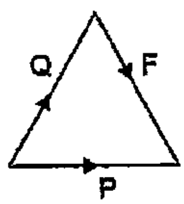
C 20 m

D 50 m

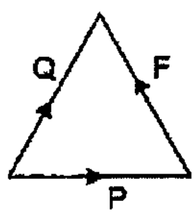
5 A body is acted on by 2 forces, P and Q. A frictional force F holds the body in equilibrium.

Which vector triangle could represent the relationship between these forces?

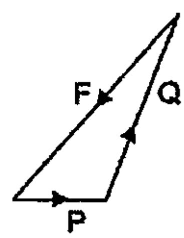
A



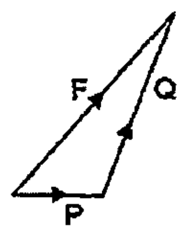
B



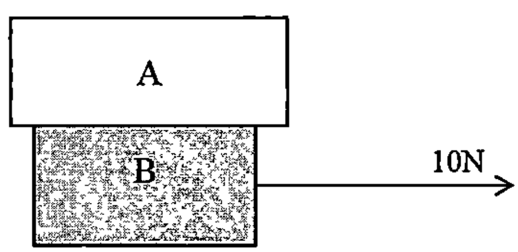
C



D



6 Two objects, A and B of mass 3.0 kg and 2.0 kg respectively, are stacked one on top of the other as shown. B lies on a smooth surface.



Determine the acceleration of A, when B is pulled by a force of 10N.

A 5.0 ms^{-2}

B 3.3 ms^{-2}

C 2.0 ms^{-2}

D 0.0 ms^{-2}

7 When a horizontal force of up to 4.0 N is applied to a wooden block of mass 2.0 kg on a horizontal surface, the block moves with a constant velocity. If the applied force is now increased to 12.0 N, determine the acceleration of the block.

A $2.0\ ms^{-2}$ C $6.0\ ms^{-2}$

B $4.0\ ms^{-2}$ D $8.0\ ms^{-2}$

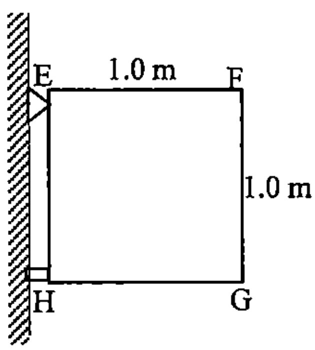
8 A lunar landing module is descending to the Moon's surface at a steady velocity of $10\ ms^{-1}$. At a height of 120 m, a small object falls from its landing gear.

Taking the Moon's gravitational field strength to be 1.6 N/kg, at what speed does the small object strike the Moon?

A $22\ ms^{-1}$ C $17\ ms^{-1}$

B $20\ ms^{-1}$ D $10\ ms^{-1}$

9 A square shop sign EFGH, of sides 1.0 m, is pivoted on a vertical wall by a hinge at E.



If the mass of the sign is 5.0 kg, determine the force exerted by the wall support at H.

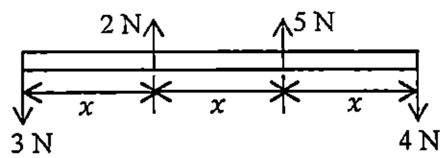
A 25 N C 75 N

B 50 N D 100 N

10 The diagrams below show all the forces acting on a beam of length $3x$.

Which of the following causes only rotational motion of the beam without any linear movement?

A



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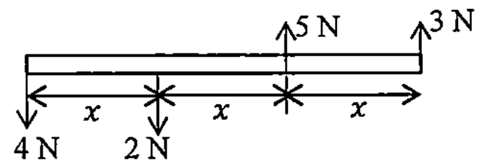
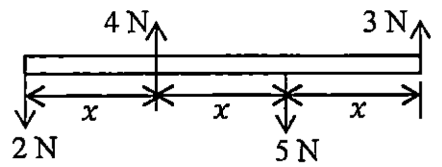


B



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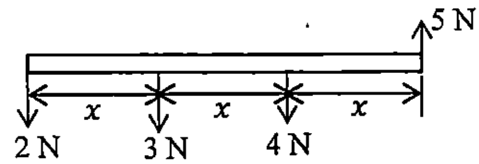
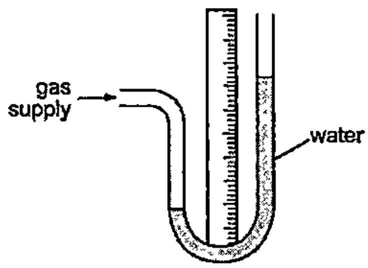
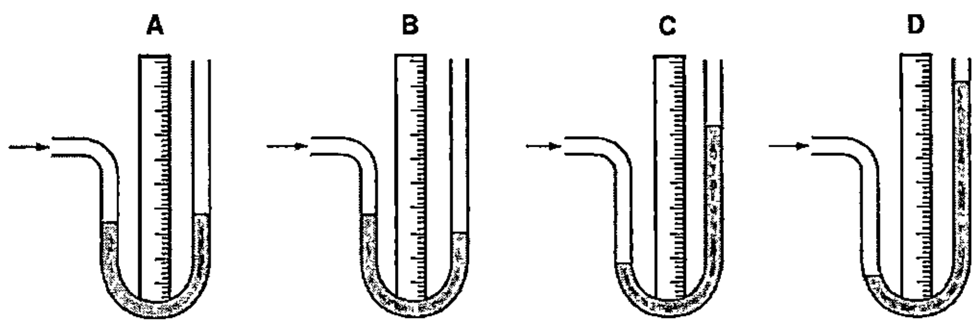


11 A water manometer is connected to a gas supply. The figure below showsthe water levels.

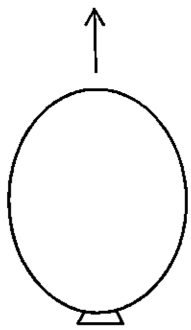


The water is replaced by mercury, which is denser than water.

Which diagram shows the mercury levels when the manometer is connected to the same gas supply?



12 A hydrogen balloon rises from the ground level to an altitude of 300 m. Its volume increases as it rises.



Which pressure changes have occurred within the balloon and the air outside the balloon?

	Pressure change in the balloon	Pressure change of air outside
A	Decrease	Decrease
B	Decrease	Increase
C	Increase	Decrease
D	Increase	Increase

13 A man of mass 80 kg is raised by a lift of 500 kg at a constant speed of 2.0 ms^{-1}. What is the power of the lift's motor?

(Acceleration due to gravity = 10 ms^{-2})

A 160 W

B 320 W

C 1 160 W

D 11 600 W

14 A motorcar of mass 500 kg generates a power of 10 000W. How much time does the motorcar need to accelerate from a speed of 10 ms^{-1} to 20 ms^{-1}?

A 2.5 s

B 5.0 s

C 7.5 s

D 10 s

15 In a Brownian motion experiment involving smoke particles in air, heavy smoke particles settle quickly but very small smoke particles remain suspended for long periods of time.

Which one of the following statements explains why the small smoke particles do not settle?

A Air pressure has greater effect on smaller particles.

B The small smoke particles have the same density as the air.

C The Earth's gravitational field does not act on very small particles

D Random molecular bombardment by air molecules keeps the particles suspended.

16 House owners are being urged to reduce heat loss from roofs by laying a matting of fibre-glass, which consists of a very large number of intertwined fine glass fibres with trapped air in between, on the floor of the roof space. Which of the following is the main reason why fibreglass is effective as a heat insulator?

A Fibre-glass are good reflectors of thermal radiation and so the heat loss is greatly reduced.

B Fibre-glass will not absorb much heat and its low heat capacity results in good insulation.

C Fibre-glass prevents the faster moving air molecules escaping into the roof from the room below.

D Fibre-glass reduces air movement within the fibreglass matting and stationary air is a very good insulator.

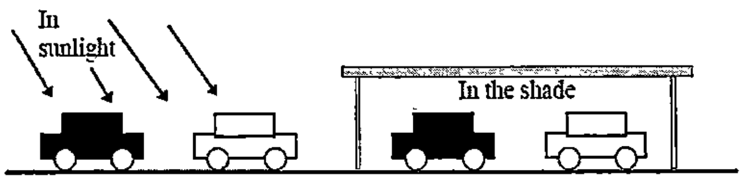
17 The distance between the 20 ^{o}C and the 100 ^{o}C mark on a mercury thermometer is 25.0 cm. When the mercury level is 5.0 cm below the 100 ^{o}C mark, the temperature is approximately

A 64 ^{o}C **C** 84 ^{o}C

B 80 ^{o}C **D** 90 ^{o}C

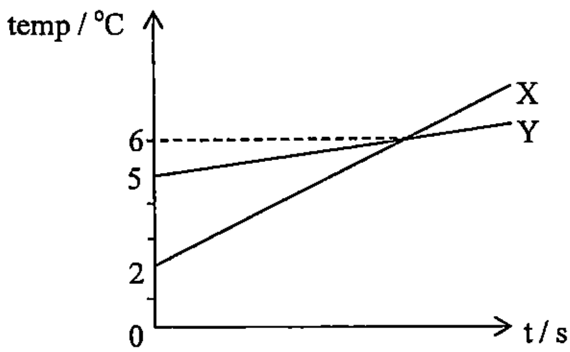
18 Two cars, one painted dull black and another white, were left in the sun. Which car will heat up faster?

When the two cars reached a surface temperature of 40 ^{0}C, they were driven into the shade. Which of the following will be observed?



	In the sun	In the shade
A	White car heats up faster.	White car cools down faster.
B	White car heats up faster.	Black car cools down faster.
C	Black car heats up faster.	White car cools down faster.
D	Black car heats up faster.	Black car cools down faster.

19 Two blocks, X and Y, which are made of the same metal, are heated by heaters of the same power rating. The variations of temperature with time are given in the figure below.



What is the ratio of the mass of X to the mass of Y?

A 1 : 3

B 1 : 4

C 3 : 4

D 3 : 1

20 An immersion heater rated at 150 W is fitted into a large block of ice at 0 °C. The specific latent heat of fusion is 300 J/g. How long does it take to melt 10 g of ice?

A 2 s

B 20 s

C 5 s

D 150 s

21 A brass block of mass 50 g was heated to 100 °C in boiling water and immersed in m grams of "cold" water at 30 °C. The final temperature of the "mixture", θ, was recorded.

The specific heat capacity of water is 4.2 kJ kg^{-1} K^{-1}.The results obtained were used to calculate the specific heat capacity, c, of brass using the equation.

$$50\,c\,(100-\theta) = 4.2m(\theta-30)$$

The actual value of specific heat capacity of brass compared to the calculated value is

A higher because of heat loss to surrounding air.

B lower because heat is absorbed by the calorimeter.

C higher as droplets of boiling water may have been transferred to the cold water.

D lower because of heat loss to surrounding air.

22 The figure below shows a waveform. Determine its wavelength, in cm.

(in cm)

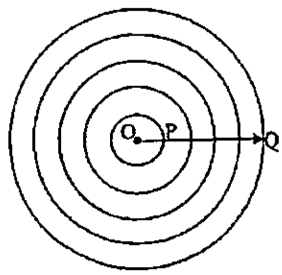
A 7 cm

B 10 cm

C 13 cm

D 16 cm

23 The figure below illustrates circular wavefronts radiating from a point source O.



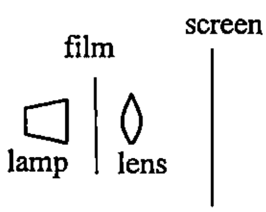
Given that the time taken for the wave to travel from P to Q is 10 s, and the wavelength of the waves is 200 cm, determine the speed of the wave.

A 0.08 ms^{-1} **C** 0.80 ms^{-1}

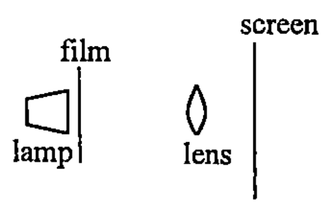
B 1.0 ms^{-1} **D** 8.0 ms^{-1}

24 Which of the following diagrams correctly shows the arrangement of a lamp, lens and film in a photographic enlarger?

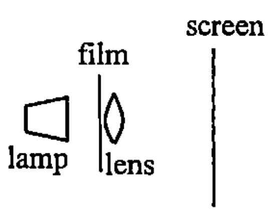
A



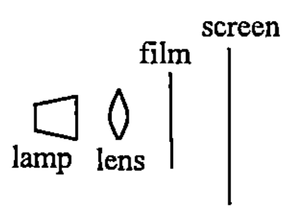
C



B

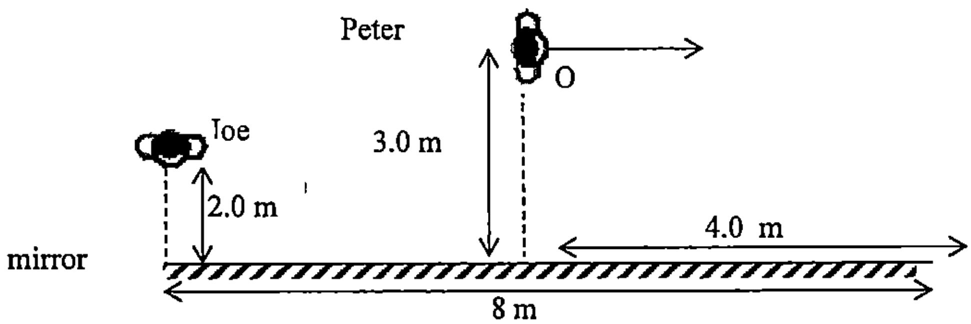


D



25 The figure below shows Joe and Peter standing in front of a 8.0 m long mirror. Joe stands 2.0 m away from the left edge of the mirror, facing it. Peter stands 3.0 m from the mirror at point O, but faces the direction towards the right.

What is the furthest distance that Peter can walk away to the right of O just before Joe loses sight of his image in the mirror?



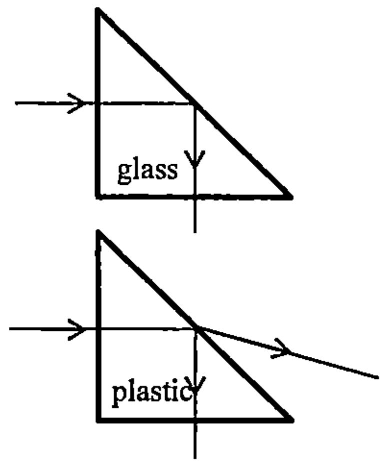
A	4 m	**C**	12 m
B	8 m	**D**	16 m

26 **X** and **Y** are different waves. In air, **X** travels much faster than **Y** but has a much shorter wavelength.

Which of the following correctly describes **X** and **Y**?

	X	**Y**
A	Microwaves	Red light
B	Sound	Ultraviolet
C	Ultraviolet	Sound
D	Red light	Gamma rays

27 A ray of light is incident on 2 prisms of identical shape and size, as shown in the figure below. One prism is made of glass and the other is made of plastic.



State a reason for the difference in the paths of the ray?

A Glass is more transparent than plastic.

B Plastic cannot totally reflect light.

C The plastic surface disperses the light.

D The critical angle for plastic is greater than that for glass.

28 P and Q are the displays on a C.R.O. as two musical instruments are sounded together. Which of the following statements is <u>**NOT**</u> correct?

A The waves have different amplitudes.

B The frequency of P is lower than that of Q.

C The wavelength of P is longer than that of Q.

D The speeds of the waves produced by P and Q are different.

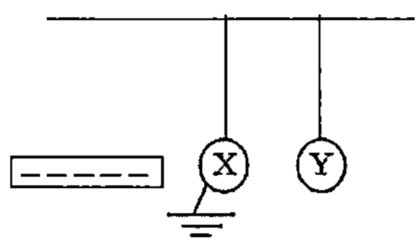
29 A car, which is travelling normally towards a cliff at a speed of 50 ms^{-1}, sounds its horn when it is 0.7 km away. Taking speed of sound to be 300 ms^{-1} in air, find the time taken for the driver to hear its echo.

A 0.0040 s
C 4.7 s
B 4.0 s
D 28.0 s

30 During a thunderstorm, the clouds formed have negative charges at their bottom. Which of the following is correct about a lightning forming between the clouds and a building on the ground?

	Lightning direction	Electron flow
A	From building to clouds	Upwards
B	From building to clouds	Downwards
C	From clouds to building	Upwards
D	From clouds to building	Downwards

31 A negatively charged rod is brought near two isolated metals balls **X** and **Y**. **X** is then earthed momentarily as shown in the diagram. If the rod is then removed, what charge would the balls possess?



	X	Y
A	Positive	Negative
B	Positive	Neutral
C	Negative	Positive
D	Negative	Neutral

32 Which of the following will cause a fuse to melt?

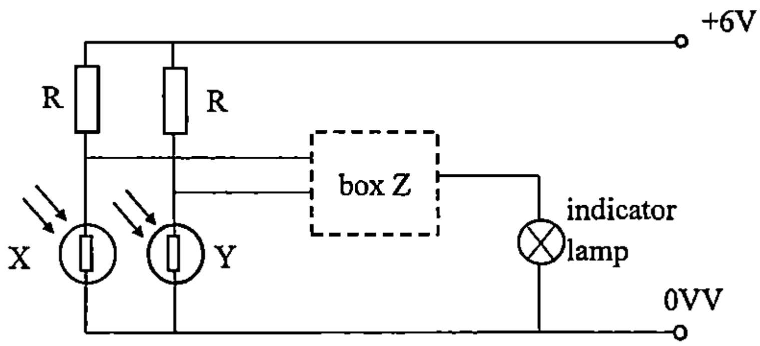
i Short circuiting
ii Over-loading
iii Open circuit

A i only
B ii only
C i & ii
D i, ii & iii

33 Amy turned on her Hi-Fi system for 8 hours. If the Hi-Fi is operating at 200 W and the unit cost of electricity is 85 cents, what is the cost of using the system for 8 hours?

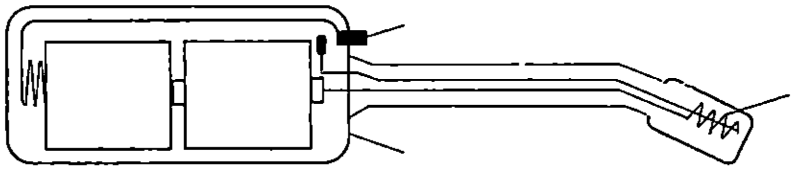
A $1.36
B $21.25
C $13.60
D $48.96

34 The diagram below shows a circuit with 2 LDRs, namely X and Y.
What is the potential difference across X if the resistance of resistors R is 500 Ω each and the resistance of X is 1500 Ω?



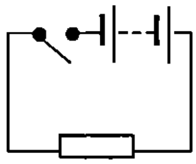
A 0.0 V
B 1.5 V
C 2.0 V
D 4.5 V

35 The figure below shows the components of a lighter for a gas cooker.

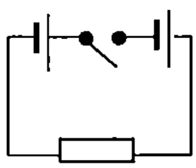


Which of the following circuit diagrams is correct for this lighter?

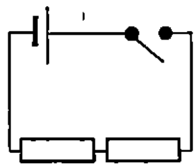
A



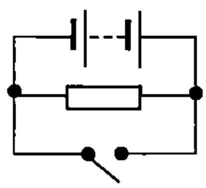
B



C



D



36 A student tries to magnetise a short steel rod. Which one of these tests will show that he has been successful?

A Both poles of a permanent magnet attract the rod.

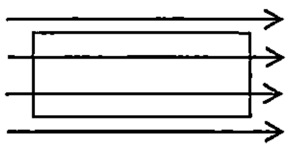
B One pole of a permanent magnet repels the rod.

C The rod picks up a small piece of paper.

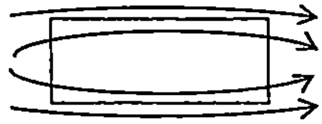
D When freely suspended, the rod points in a random direction.

37 A uniform magnetic field (parallel to the plane of paper) exists in space initially in a direction from left to right. Which of the following diagrams A, B, C or D shows the change in the magnetic field when a piece of soft iron bar is placed in the region of the field?

A



C



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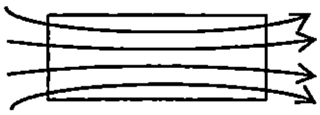
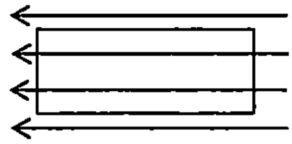
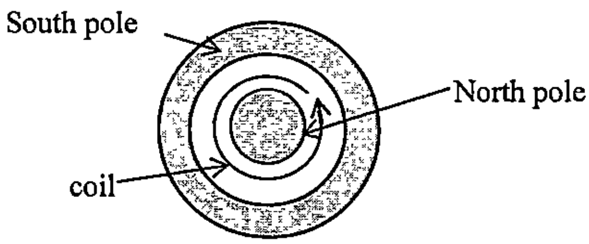


D



38 The diagram shows the front view of a loudspeaker, which consists of magnets and a coil amongst other items.



If the current is flowing in the speaker's coil in an anticlockwise direction as shown, determine the direction the coil will move.

A To the right.

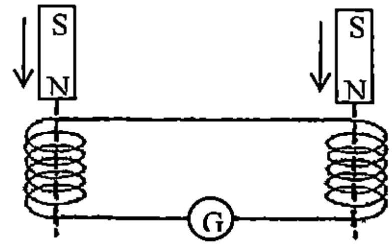
B To the left.

C Out of the page.

D Into the page.

39 Two small coils are connected in series to a sensitive galvanometer. A magnet is held above each coil as shown in the figure below.

When only the magnet in the left coil is dropped, the ammeter needle deflects towards the right.



Both magnets are now dropped at the same time. Determine the motion of the galvanometer needle?

A The needle deflects towards the left and with a greater magnitude.

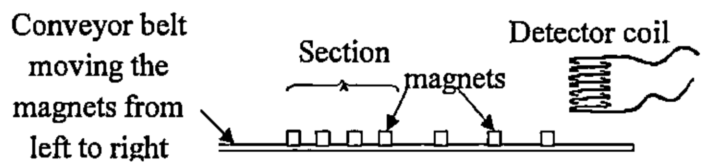
B The needle deflects towards the right and with a greater magnitude.

C The needle deflects towards the right and with the same magnitude.

D The needle does not move.

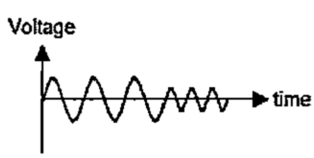
40 The diagram shows a detector coil placed above a conveyor belt carrying magnets from left to right. The belt is moving at a constant speed and the magnets are expected to be spaced out evenly along the belt.

However, the magnets in section A have been spaced closer together due to a programming fault.

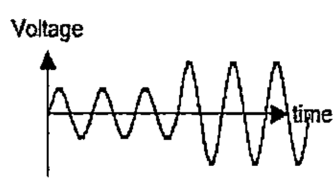


Which graph best represents the voltage signal generated in the detector coil?

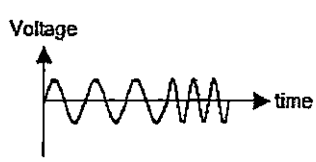
A



C



B



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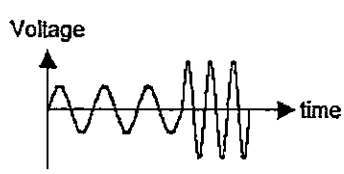

– END OF PAPER –

ANDERSON SECONDARY SCHOOL
Preliminary Examination 2015
Secondary Four Express & Five Normal

CANDIDATE NAME:

CLASS: /   INDEX NUMBER:

PHYSICS **5059/02**

Paper 2 Theory

1 September 2015

1 hour 45 minutes

1045 – 1230h

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. The last question is in the form **EITHER / OR**.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

You may use a calculator.
Leave your answers in 2 significant figures unless stated otherwise.

You may take g, the gravitational field strength of Earth, to be 10 N/kg.

For Examiner's Use	
Section A [50]	
Section B [30]	
Total [80]	

This document consists of **16** printed pages.

Setter: Mr Ng Wei Da

Section A [50 marks]

Answer **all** the questions in this section.

1 Fig. 1.1 is the speed-time graph for a rocket from the moment that the fuel starts to burn at time $t = 0$.

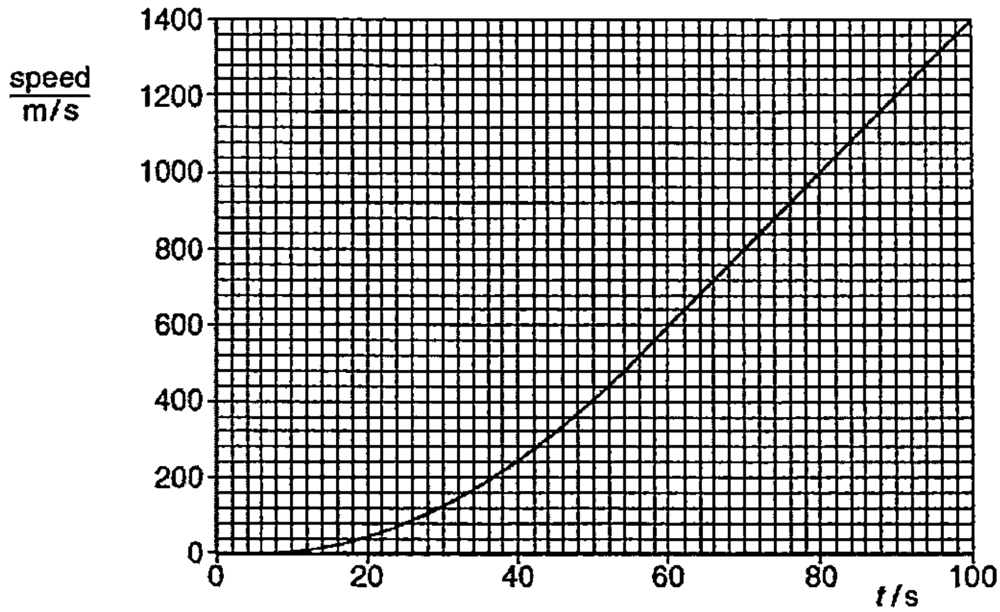

Fig. 1.1

(a) **(i)** State what happens to the acceleration of the rocket between $t = 5$ s and $t = 80$ s.

.... [1]

(ii) Calculate the acceleration of the rocket at $t = 80$ s.

acceleration = ... [2]

(iii) The total mass of the rocket at $t = 80$ s is 1.6×10^6 kg. Calculate the upward force on the rocket at this time, caused by the burning fuel.

upward force = ... [2]

For Examiner's Use

(b) As the rocket burns fuel, it ejects hot gas downwards. Explain how Newton's third law of motion applies to the upward force on the rocket and to the force on the hot gas.

....

.... [1]

2 Fig. 2.1 illustrates the journey of a cyclist from point A to point B. Points A and B are at the same height.

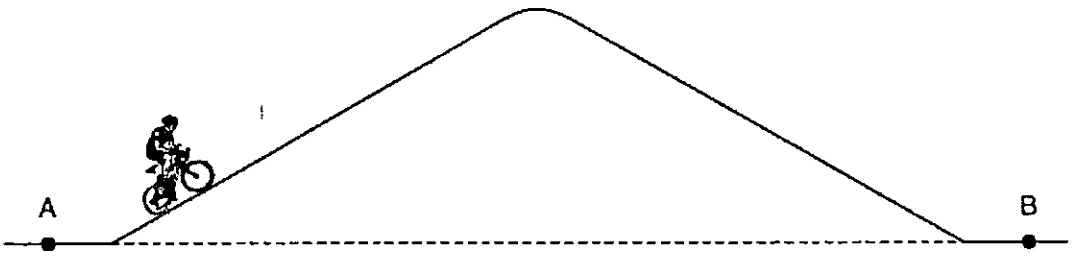

Fig. 2.1

The cyclist starts from rest at A and pedals up and over a hill. Near the bottom of the hill, she starts to brake and comes to rest at B.

(a) Describe the energy changes that take place as she pedals up the hill at constant speed.

....

....

.... [2]

(b) Explain how the law of conservation of energy applies to the complete journey from A to B.

....

....

.... [2]

(c) At one point in the journey, the gravitational potential energy of the cyclist has increased by 5400 J. The mass of the cyclist is 60 kg.

Calculate the height above A of the cyclist at this point.

height = ... [2]

3 Fig. 3.1 shows a refrigerator. A fluid pumped through the pipes removes thermal energy from the ice box for freezing to occur. This energy passes into the air at the back of the refrigerator through the black metal fins.

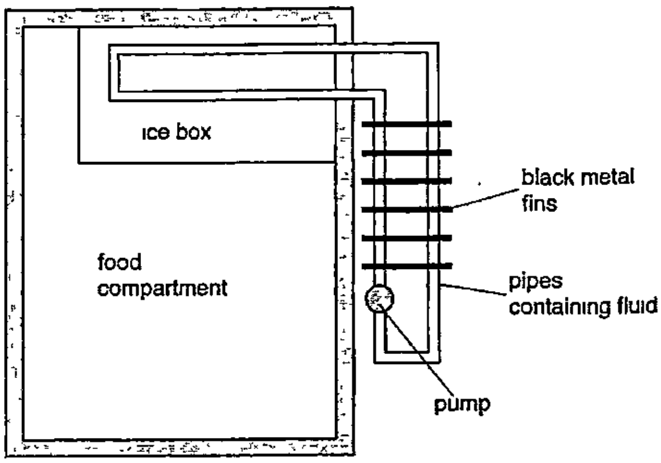

Fig. 3.1

(a) Explain why the fins at the back of the refrigerator are painted black and are made of metal.

....

....

.... [2]

(b) Explain how using a fluid with high specific heat capacity increases the efficiency of the refrigerator.

....

....

.... [2]

(c) A student fills a plastic tray with 400 cm^3 of water which has an initial temperature of 25 °C. The ice box removes thermal energy from the water at a rate of 35 W. Using the information below, estimate the time taken for all the water in the tray to freeze into ice.

Density of water = 1000 kg/m^3
Specific heat capacity of water = 4.2 kJ/(kg°C)
Specific latent heat of fusion of water = 330 kJ/kg

time taken = ... [3]

4 Fig. 4.1 shows circular wavefronts produced at the centre of a circular ripple tank.

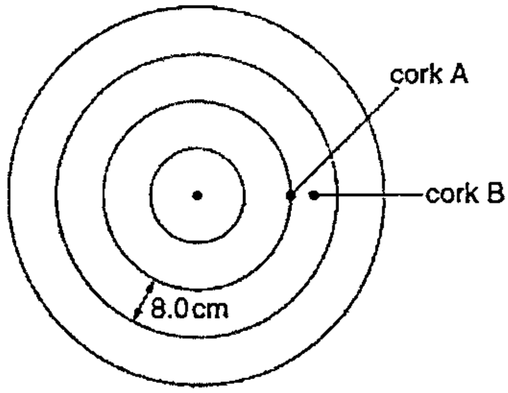

Fig. 4.1

Two corks, A and B, float on the water in the ripple tank. They move up and down on the surface of the water as the wave passes. The wavelength of the wave is 8.0 cm.

Fig. 4.2 shows how the displacement of A varies with time.

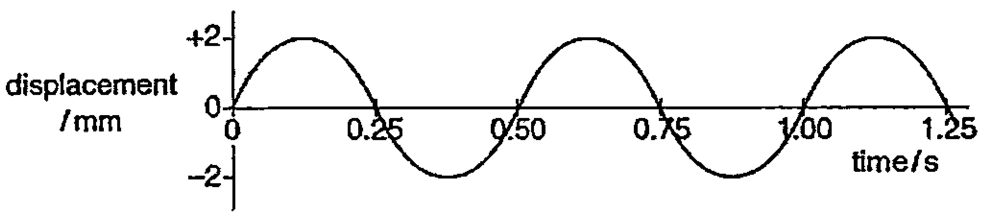

Fig. 4.2

(a) Define what is meant by *wavefront*.

....

.... [1]

(b) **(i)** Use Fig. 4.2 to determine the frequency of the wave.

frequency = ... [1]

(ii) Hence, calculate the speed of the wave.

speed = ... [2]

(c) The horizontal distance between A and B is half the wavelength of the wave.

On Fig. 4.2, sketch a graph to show how the displacement of B varies with time. [2]

5 Fig. 5.1 represents a simple camera which makes use of a converging lens of focal length *f*.

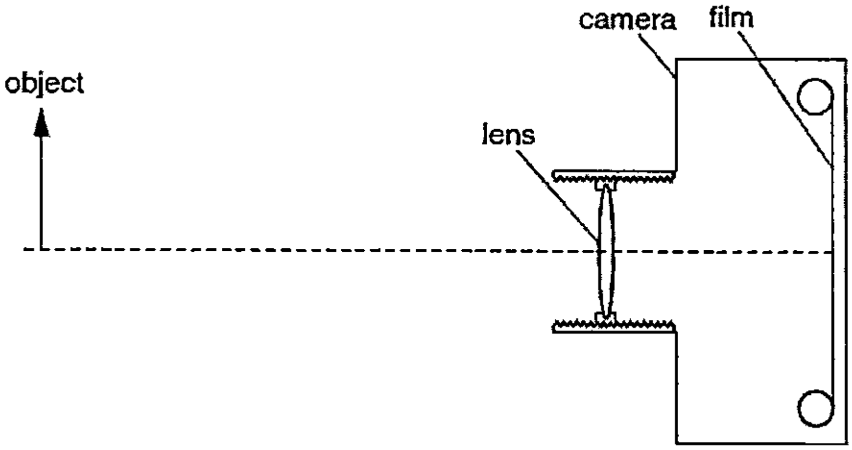

Fig. 5.1 (to scale)

(a) Define what is meant by *focal length*.

....

.... [1]

(b) Draw two rays from the top of the object to show how the image is formed on the film.
Mark and label the image on the film. [2]

(c) Fig. 5.1 is drawn to scale. Determine the linear magnification of the object shown in Fig. 5.1.

linear magnification = ... [1]

(d) Explain why, when taking photographs of other objects, it may be necessary to move the lens towards the film.

....

....

.... [2]

6 The fluorescent tube shown in Fig. 6.1 converts electrical energy into light more efficiently than a filament lamp.

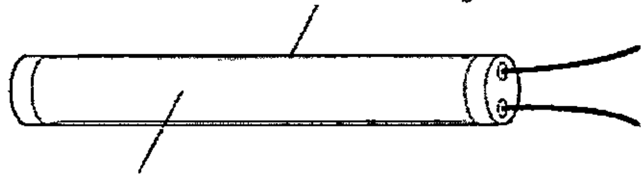

Fig. 6.1

In the gas inside the tube, both light and ultraviolet radiation are produced.

There is a fluorescent coating on the inside surface of the tube.

(a) **(i)** Explain the purpose of the fluorescent coating.

....

.... [1]

(ii) Suggest why the fluorescent tube is more efficient than a filament lamp.

....

....

.... [2]

(b) State the name of one region of the electromagnetic spectrum with wavelengths shorter than ultra-violet radiation.

.... [1]

(c) The ultra-violet radiation inside the tube has a wavelength of 3.6×10^{-7} m. Calculate the frequency of the ultra-violet radiation.

frequency = ... [2]

7 Fig. 7.1 shows part of a circuit that includes a variable resistor R and a battery of e.m.f. 9.0 V.

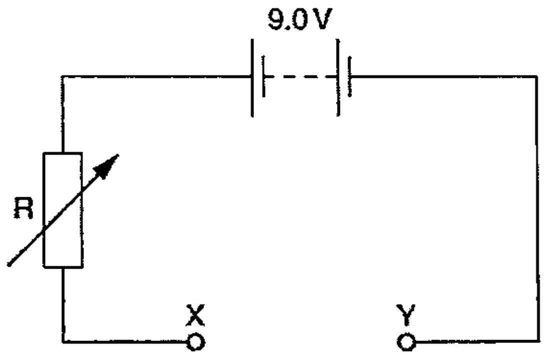

Fig. 7.1

(a) State one similarity and one difference between electromotive force (e.m.f.) and potential difference (p.d.).

similarity: ....

....

difference: ....

....

.... [3]

(b) A light-emitting diode (LED) is connected between points X and Y, so that it emits light.

On Fig. 7.1, draw the symbol for the LED connected between points X and Y. [1]

(c) The LED is marked "maximum current 25 mA when the p.d. is 1.7 V". Calculate the minimum value of the resistance of R.

resistance = ... [2]

For Examiner's Use

8 Fig. 8.1 shows the structure of a circuit-breaker that uses an electromagnet. The circuit-breaker operates when the current is 10 A.

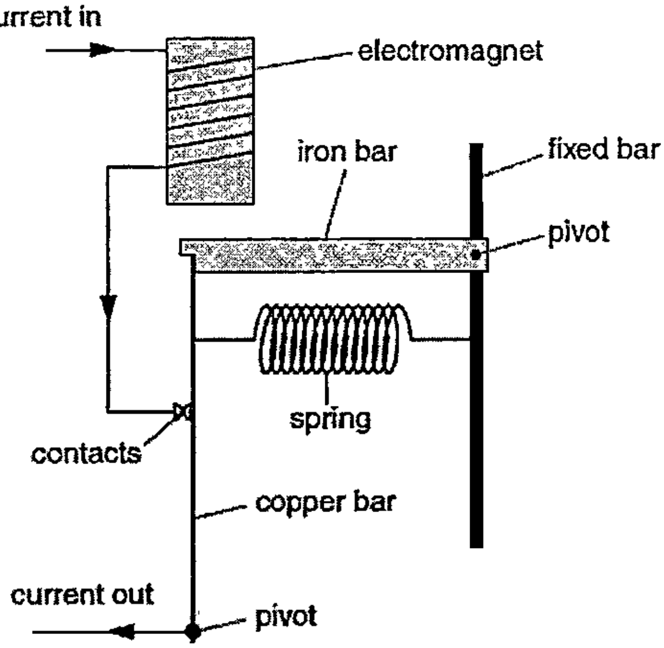

Fig. 8.1

(a) On Fig. 8.1, mark with an arrow the force on the iron bar caused by the electromagnet. [1]

(b) Suggest a reason why the iron bar does not move when the current is less than 10 A.

....

.... [1]

(c) When the current is greater than 10 A, the circuit-breaker stops the current. Explain what happens in the circuit-breaker when this occurs.

....

....

....

.... [3]

(d) State and explain how the electromagnet can be altered so that the circuit-breaker stops the current at less than 10 A.

....

....

.... [2]

SECTION B [30 marks]

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

For Examiner's Use

9 **(a)** Fig. 9.1 shows a simple setup that can be used to detect seismic waves from earthquakes. The setup consists of a bar magnet suspended from a spring hanging from a metal rod. The metal rod transmits vibrations from the Earth and the magnet moves in and out of the coil when there is an earthquake. The coil is connected to a cathode-ray oscilloscope (c.r.o.) that monitors the e.m.f across the coil.

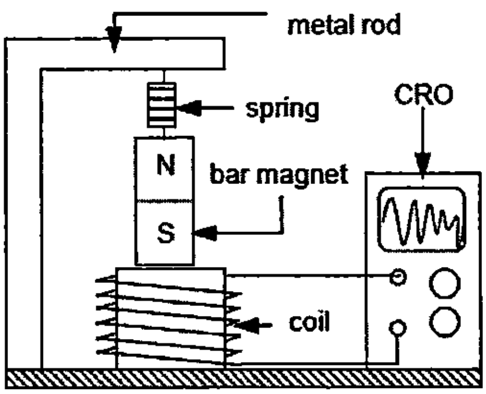

Fig. 9.1

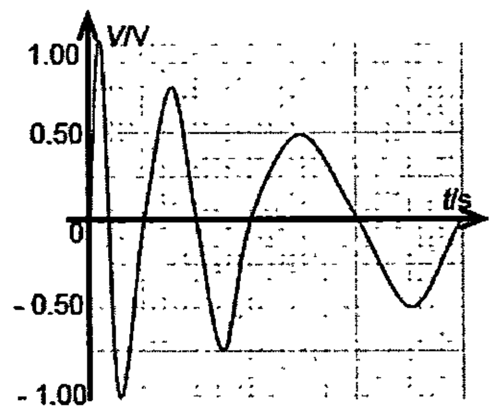

Fig. 9.2

Fig. 9.2 shows the trace that was displayed on the c.r.o. during a particular earthquake. Each complete oscillation of the same magnitude represents one tremor.

(i) Describe and explain how a trace shown on the c.r.o. in Fig. 9.2 is obtained when there is an earthquake.

....

....

....

....

....

....

....

.... [4]

(ii) On Fig. 9.1, indicate the direction of the current in the coil when the South pole of the magnet is moving into the coil. [1]

For Examiner's Use

(b) An output voltage of 2.0 V from a generator is connected to the primary coil of a step-up transformer with a turns ratio of 1:50. The current in the secondary coil is 2.4 mA. The transformer is 75% efficient.

(i) State the metal used for the core of a transformer.

.... [1]

(ii) Calculate the current in the primary coil.

current = ... [2]

(iii) State two reasons why a typical transformer is not 100% efficient.

....

....

....

.... [2]

10 (a) In an experiment to measure the specific heat capacity of water, an electric heater heats water in a glass beaker. The temperature of the water is measured at regular intervals of time. Fig. 10.1 shows how the temperature varies with time t.

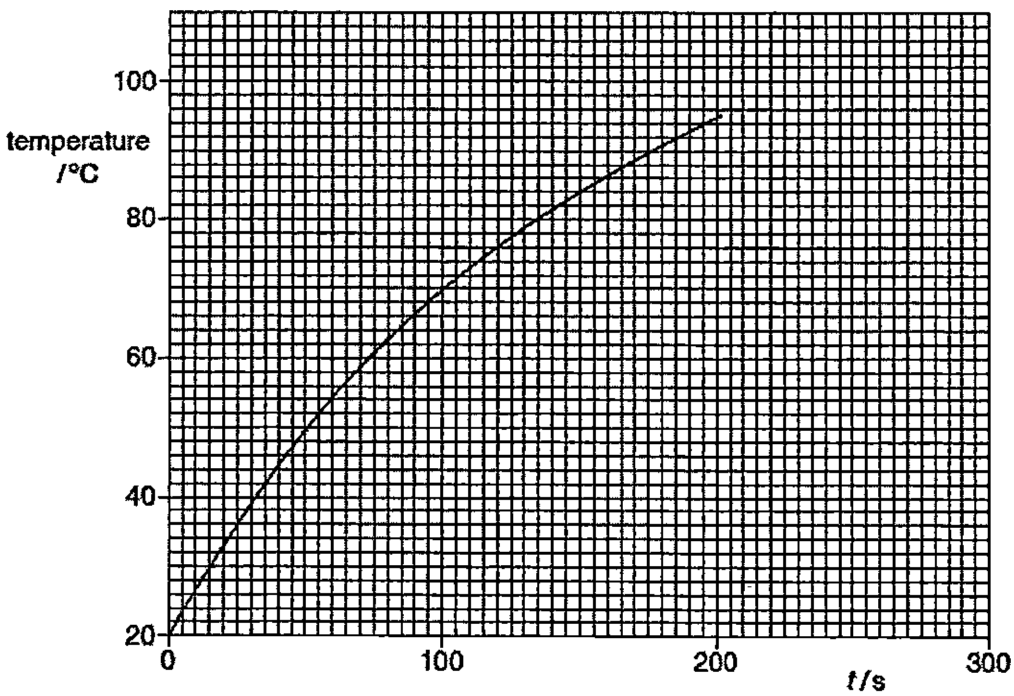

Fig. 10.1

(i) Use Fig. 10.1 to determine the change in temperature between

$t = 0$ and $t = 100$ s, change = ...

$t = 100$ s and $t = 200$ s. change = ... [1]

(ii) Explain why the values in **(i)** are different.

....

....

.... [2]

(b) (i) The experiment in **(a)** is repeated using 72 g of water. The heater supplies 7400 J of thermal energy to the water and the temperature rise of the water is 23 °C. Calculate the specific heat capacity of water.

specific heat capacity = ... [2]

(ii) A bullet of mass 72 g is fired from a gun at a speed of 450 m/s. Calculate the kinetic energy of the bullet.

kinetic energy = ... [2]

(iii) The amount of internal energy gained by the water and the amount of kinetic energy gained by the bullet are approximately equal.

Describe the change in the motion of the molecules of the water and of the molecules of the bullet caused by this addition of energy.

water: ....

....

....

bullet: ....

....

.... [3]

For Examiner's Use

11 EITHER

A crankshaft is a shaped metal bar that is part of a car engine. It is free to rotate about an axis, as shown in Fig. 11.1a.

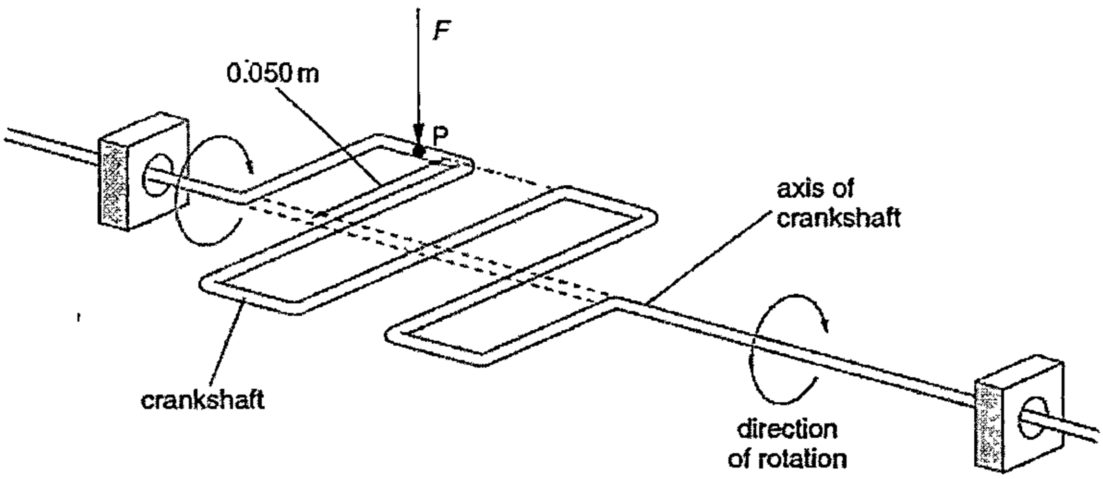

Fig. 11.1a

When the crankshaft is horizontal, a vertical force F of 8200 N acts downwards on the crankshaft at P. This causes the crankshaft to rotate. The distance between P and the axis of the crankshaft is 0.050 m.

(a) **(i)** State what is meant by the *moment* of a force.

....

.... [1]

(ii) The crankshaft is horizontal. Calculate the moment of F about the axis of the crankshaft.

moment = ... [2]

(iii) The size and direction of the vertical force F, acting on the crankshaft at P, remain constant. Explain what happens to the moment of F as the crankshaft rotates through a small angle.

....

....

.... [2]

(b) The force *F* on the crankshaft at P is exerted by a metal rod connected to a piston. The piston traps high-pressure gas in a cylinder, as shown in Fig. 11.1b.

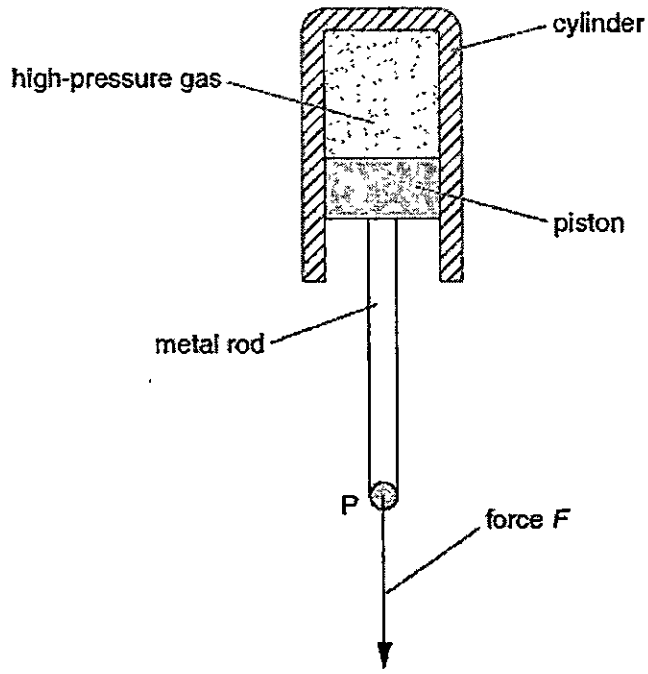

Fig. 11.1b

The force *F*, of 8200 N, acts because the high-pressure gas pushes down on the piston. The air pressure outside the cylinder is 1.0×10^5 Pa and the cross-sectional area of the piston is 0.0067 m^2.

(i) Calculate the minimum value of the pressure of the gas in the cylinder.

pressure = ... [2]

(ii) Suggest why, in practice, the pressure of the gas in the cylinder is greater than the value calculated in **(i)**.

....

....

.... [2]

(iii) The piston moves in the cylinder and the gas expands. State what happens to the force *F*.

.... [1]

11 OR

Fig. 11.2a shows a diver salvaging items from a plane wreck below the surface of a lake. The density of the water in the lake is 1000 kg/m^3 and the atmospheric pressure at the surface is 1.0 x 10^5 Pa.

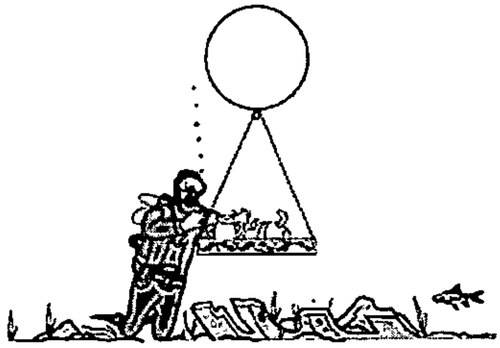

Fig. 11.2a

The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

(a) Calculate the total pressure at 15 m below the surface of the lake.

pressure = ... [2]

(b) The air in the balloon occupies a volume of 0.048 m^3 at the pressure calculated in **(a)**. The diver releases the tray and the balloon, and they begin to rise. The temperature of the air in the balloon does not change.

(i) Calculate the volume occupied by the air in the balloon at atmospheric pressure.

volume = ... [2]

(ii) The pressure of the air inside the balloon is less at the surface than at a depth of 15 m. Explain, in terms of the air molecules inside the balloon, why the pressure is less.

....

....

.... [2]

For Examiner's Use

(c) When the diver releases the tray, the balloon accelerates upwards and reaches a constant speed before it arrives at the surface.

(i) Explain how the forces acting on the balloon cause it to behave in this way.

....

....

....

....

.... [3]

(ii) On the axes in Fig. 11.2b, sketch the distance-time graph for the balloon as it travels 15 m to the surface. [1]

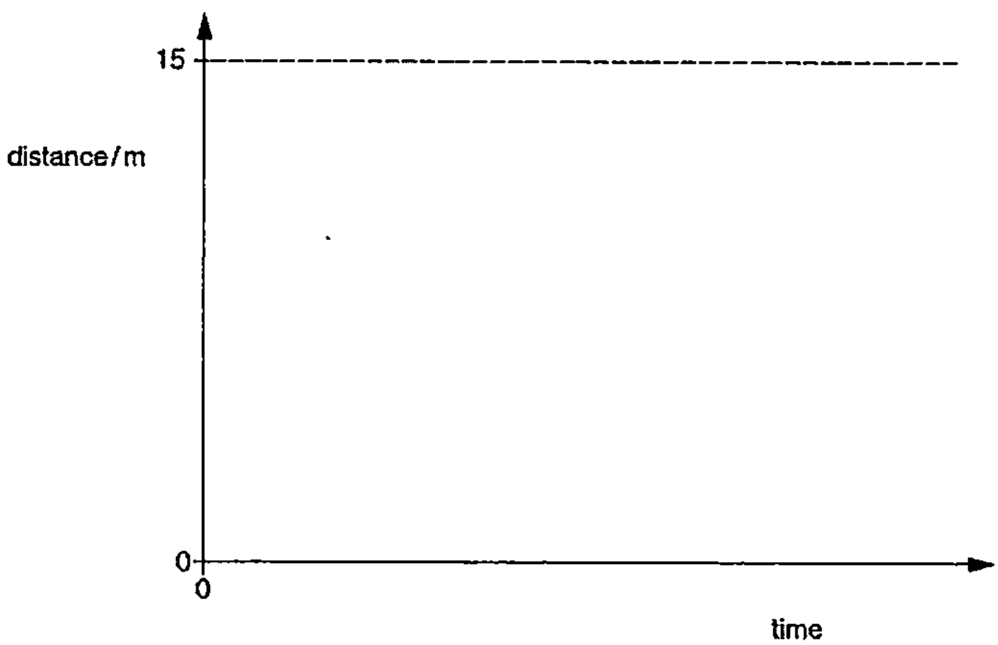

Fig. 11.2b

– END OF PAPER –

Anderson Secondary School
2015 Secondary 4 Express Preliminary Examination

Physics (5059)
Paper 1 Answers

1	2	3	4	5	6	7	8	9	10
B	D	D	B	C	C	B	A	A	B
11	12	13	14	15	16	17	18	19	20
A	A	D	C	D	D	C	D	B	B
21	22	23	24	25	26	27	28	29	30
A	D	C	A	D	C	D	D	B	B
31	32	33	34	35	36	37	38	39	40
B	C	A	D	A	B	B	D	B	D

ANDERSON SECONDARY SCHOOL
Preliminary Examination 2015
Secondary Four Express & Five Normal

CANDIDATE NAME: SUGGESTED ANSWERS

CLASS: /

INDEX NUMBER:

PHYSICS **5059/02**

Paper 2

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For Examiner's Use	
Section A [50]	
Section B [30]	
Total [80]	

This document consists of **16** printed pages.

Setter: Mr Ng Wei Da

Section A [50 marks]

Answer **all** the questions in this section.

For Examiner's Use

1 Fig. 1.1 is the speed-time graph for a rocket from the moment that the fuel starts to burn at time $t = 0$.

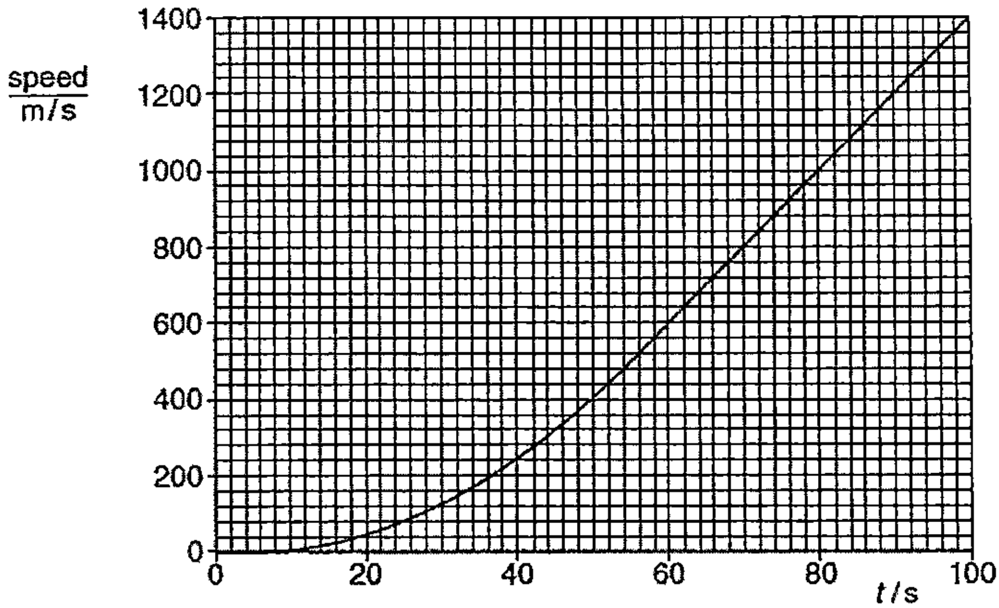


Fig. 1.1

(a) **(i)** State what happens to the acceleration of the rocket between $t = 5$ s and $t = 80$ s.

It **increases** and **eventually reaches a constant value.** [1]

(ii) Calculate the acceleration of the rocket at $t = 80$ s.

Acceleration = gradient of speed-time graph
= (1400 – 400) / (100 – 50) **[1]**
= $\underline{20 \text{ m/s}^2}$ **[1]**

acceleration = 20 m/s^2 [2]

(iii) The total mass of the rocket at $t = 80$ s is 1.6×10^6 kg. Calculate the upward force on the rocket at this time, caused by the burning fuel.

Net force = ma $= 1.6 \times 10^6 \times 20$
$= 3.2 \times 10^7$ N **[1]**

Upward force $= 3.2 \times 10^7 + (1.6 \times 10^6 \times 10)$
$= \underline{4.8 \times 10^7 \text{ N}}$ **[1]** **Max 1m ecf from (ii)**

upward force = 4.8×10^7 N [2]

(b) As the rocket burns fuel, it ejects hot gas downwards. Explain how Newton's third law of motion applies to the upward force on the rocket and to the force on the hot gas.

The upward force on the rocket is **equal in magnitude and opposite** to the **downward force acting on the hot gas.** [1]

2 Fig. 2.1 illustrates the journey of a cyclist from point A to point B. Points A and B are at the same height.

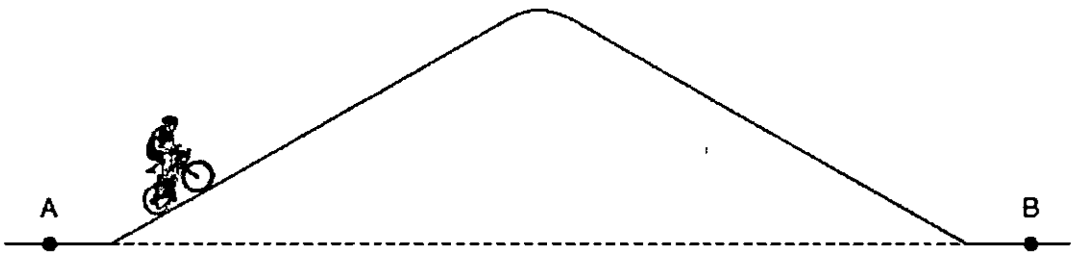


Fig. 2.1

The cyclist starts from rest at A and pedals up and over a hill. Near the bottom of the hill, she starts to brake and comes to rest at B.

(a) Describe the energy changes that take place as she pedals up the hill at constant speed.

Chemical potential energy in the cyclist is **converted to gravitational** [1] **potential energy** as she pedals **up the hill**. Some of it is also **converted to thermal energy/heat** due to **friction** on the road. [2] [1]

(if KE is mentioned, an idea of no net gain in KE must be conveyed)

(b) Explain how the law of conservation of energy applies to the complete journey from A to B.

From A to B, **all the chemical potential energy** used by the cyclist is **converted to thermal energy / heat**. Since the **total energy remains** [1] **constant (or energy is not created nor destroyed)**, the law of [1] conservation of energy applies to this journey. [2]

(c) At one point in the journey, the gravitational potential energy of the cyclist has increased by 5400 J. The mass of the cyclist is 60 kg.

Calculate the height above A of the cyclist at this point.

Using GPE = mgh,

$5400 = 60 \times 10 \times h$ **[1]**

h = <u>9.0 m</u> **[1]**

height = 9.0 m [2]

3 Fig. 3.1 shows a refrigerator. A fluid pumped through the pipes removes thermal energy from the ice box for freezing to occur. This energy passes into the air at the back of the refrigerator through the black metal fins.

For Examiner's Use

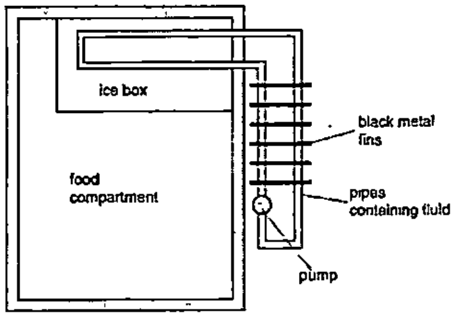


Fig. 3.1

(a) Explain why the fins at the back of the refrigerator are painted black and are made of metal.

Black surfaces are **good emitters of infrared radiation** *(accept good radiators / emitters of heat but emphasise correct phrase in class)*. At the same time, metals are **good conductors of heat**, so the black metal fins are able to **transfer heat** <u>to the surroundings</u> **quickly/effectively etc.** [2]

[1] [1] must be mentioned

(b) Explain how using a fluid with high specific heat capacity increases the efficiency of the refrigerator.

A given mass of the fluid will be able to **absorb a larger amount of thermal** energy from the ice box **per unit temperature change**, hence the pump **does not need to circulate the liquid as quickly / time taken to cool the contents will be shorter.** [2]

[1] [1]

(c) A student fills a plastic tray with 400 cm^3 of water which has an initial temperature of 25 °C. The ice box removes thermal energy from the water at a rate of 35 W. Using the information below, estimate the time taken for all the water in the tray to freeze into ice.

Density of water = 1000 kg/m^3
Specific heat capacity of water = 4.2 kJ/(kg°C)
Specific latent heat of fusion of water = 330 kJ/kg

Mass of water = $1000 \times 400 \times 10^{-6} = 0.40$ kg [1]

Total energy absorbed $= ml_f + mc\Delta\theta$
$= 0.40 \times 330\,000 + 0.40 \times 4200 \times 25$
$= 174\,000$ J [1]

Time taken = E / P = 174000 / 35
= <u>5000 s (2sf)</u> [1]

Max 1 mark awarded if mass is wrongly calculated

time taken = <u>5000 s (2sf)</u> [3]

4 Fig. 4.1 shows circular wavefronts produced at the centre of a circular ripple tank.

For Examiner's Use

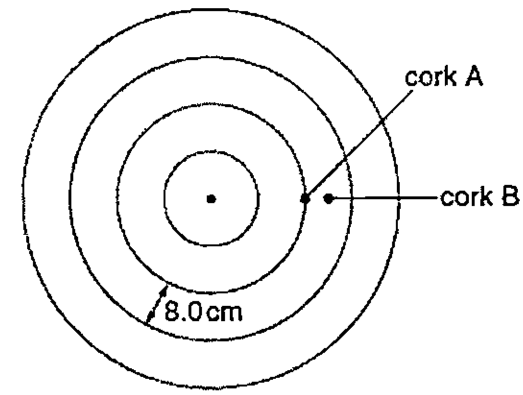


Fig. 4.1

Two corks, A and B, float on the water in the ripple tank. They move up and down on the surface of the water as the wave passes. The wavelength of the wave is 8.0 cm.

Fig. 4.2 shows how the displacement of A varies with time.

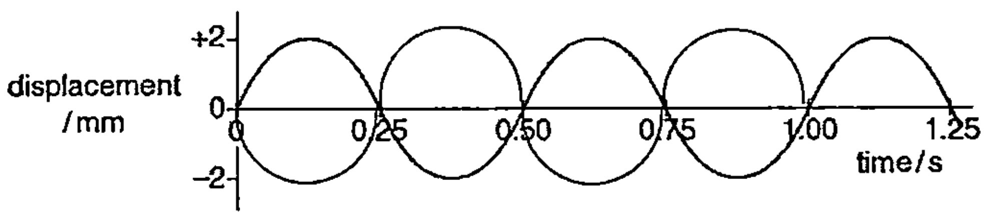


Fig. 4.2

[1] same amplitude and period

[1] opposite phase with at least 2 waves drawn

(a) Define what is meant by *wavefront.*

A wavefront is a(n) (imaginary) line on a wave that joins all adjacent points that are in phase. [1]

(b) **(i)** Use Fig. 4.2 to determine the frequency of the wave.

f = 1/ T = 1 / 0.50 = 2.0 Hz

frequency = 2.0 Hz [1] cao

(ii) Hence, calculate the speed of the wave.

$v = f\lambda = 2.0 \times 8.0$ [1]

$= 16$ cm/s or 0.16 m/s [1]

speed = 16 cm/s (0.16 m/s) [2] max. 1m ecf

(c) The horizontal distance between A and B is half the wavelength of the wave.

On Fig. 4.2, sketch a graph to show how the displacement of B varies with time. [2]

For Examiner's Use

5 Fig. 5.1 represents a simple camera which makes use of a converging lens of focal length *f*.

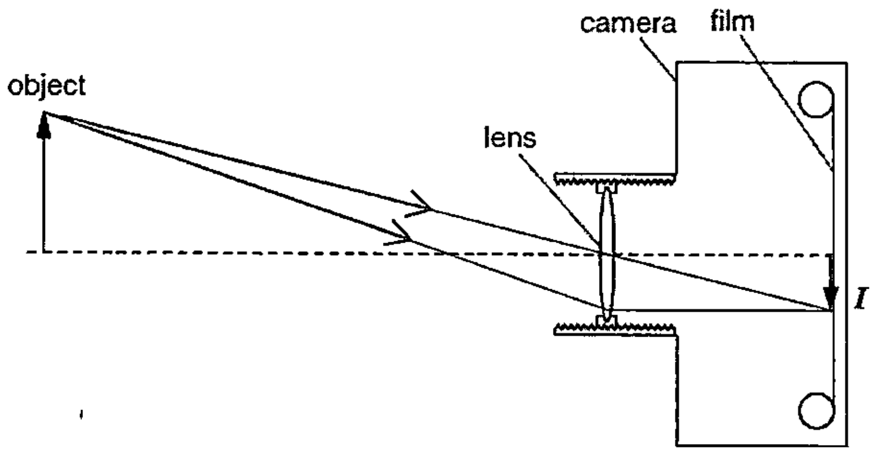


Fig. 5.1 (to scale)

[1] both rays correctly drawn

[1] image correctly drawn and labelled

(1m penalty for missing arrows)

(a) Define what is meant by *focal length*.

It is the distance between the optical centre and focal point of a converging lens. [1]

(b) Draw two rays from the top of the object to show how the image is formed on the film.
Mark and label the image on the film. [2]

(c) Fig. 5.1 is drawn to scale. Determine the linear magnification of the object shown in Fig. 5.1.

Linear magnification = 0.40 (± 0.05) (can accept 1 sf)

linear magnification = 0.40 (± 0.05) [1]

(d) Explain why, when taking photographs of other objects, it may be necessary to move the lens towards the film.

For other **objects which are further away (or increased object distance)**, the lens has to move towards the film in order for the **light rays to converge onto the film** and **produce a sharp image**. [2]

[1]

[1]

6 The fluorescent tube shown in Fig. 6.1 converts electrical energy into light more efficiently than a filament lamp.

For Examiner's Use

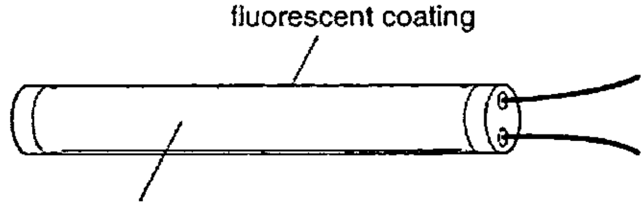


Fig. 6.1

In the gas inside the tube, both light and ultra-violet radiation are produced.

There is a fluorescent coating on the inside surface of the tube.

(a) **(i)** Explain the purpose of the fluorescent coating.

The fluorescent coating **gives out light / glows** when it is **hit by ultraviolet radiation** produced in the tube. [1]

(ii) Suggest why the fluorescent tube is more efficient than a filament lamp.

In a filament lamp, most of the energy is **converted to / lost as** **[1]**
(unwanted) heat while in a fluorescent tube, some energy is
converted to **uv radiation** which **can also produce light.** [2] **[1]**

(b) State the name of one region of the electromagnetic spectrum with wavelengths shorter than ultra-violet radiation.

X-rays / gamma rays [1] **cao**

(c) The ultra-violet radiation inside the tube has a wavelength of 3.6×10^{-7} m. Calculate the frequency of the ultra-violet radiation.

Using $v = f\lambda$,

$3.0 \times 10^{8} = f \times 3.6 \times 10^{-7}$ **[1]**
$f = \underline{8.3 \times 10^{14}\ \text{Hz}}$ **[1]**

frequency = 8.3×10^{14} Hz [2]

7 Fig. 7.1 shows part of a circuit that includes a variable resistor R and a battery of e.m.f. 9.0 V.

For Examiner's Use

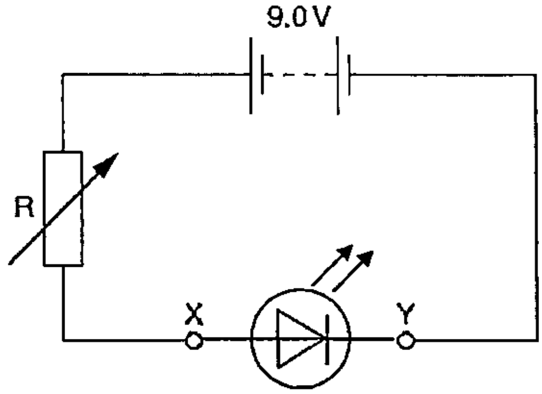


Fig. 7.1

(a) State one similarity and one difference between electromotive force (e.m.f.) and potential difference (p.d.).

similarity: Both involve energy (or work done) per unit charge / are measured in V (or J/C) / measured using a voltmeter (**any one**). [1]

difference: In e.m.f., energy is converted from **chemical (accept 'other forms') to electrical energy**, while in p.d., the energy change is **from** [1] **electrical to other forms (accept heat/light energy).** OR [1]
In e.m.f., the work done is to **drive a unit charge around the circuit** but [1]
in p.d., the work done is to drive a unit charge **across a component.** [3] [1]

(The difference mentioned must be a like-for-like comparison, or else 1 mark penalty.)

(b) A light-emitting diode (LED) is connected between points X and Y, so that it emits light.

On Fig. 7.1, draw the symbol for the LED connected between points X and Y. [1]

Correct symbol and direction

(c) The LED is marked "maximum current 25 mA when the p.d. is 1.7 V". Calculate the minimum value of the resistance of R.

p.d. across R = 9.0 - 1.7
= 7.3 V

Minimum value of R = V/I
= 7.3 / 0.025 [1]
= <u>290 Ω (2 s.f.)</u> [1]

- 1 mark for wrong sf

resistance = 290 Ω [2]

8 Fig. 8.1 shows the structure of a circuit-breaker that uses an electromagnet. The circuit-breaker operates when the current is 10 A.

For Examiner's Use

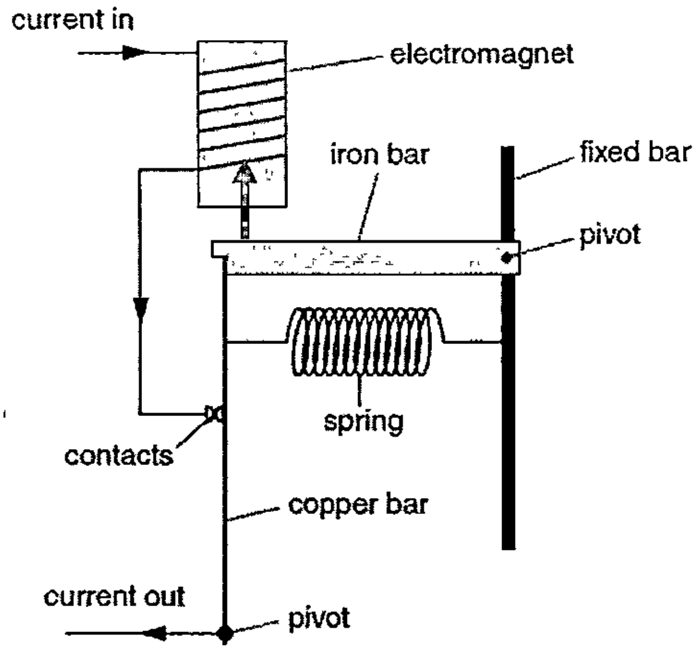


Fig. 8.1

(a) On Fig. 8.1, mark with an arrow the force on the iron bar caused by the electromagnet. [1]

Must be drawn from Iron bar

(b) Suggest a reason why the iron bar does not move when the current is less than 10 A.

When the current is less than 10 A, the **attractive force** exerted by the **magnetised electromagnet is not strong** enough to lift the iron bar. [1] **[1]**

(c) When the current is greater than 10 A, the circuit-breaker stops the current. Explain what happens in the circuit-breaker when this occurs.

When the current is greater than 10 A, the electromagnet becomes **strongly magnetised** and **attracts the iron bar upwards**. The **spring** **[1]**

contracts and **pulls the copper bar**, breaking the contacts. The **circuit** **[1]**

is now **open** and the **current stops flowing**. [3] **[1]**

(d) State and explain how the electromagnet can be altered so that the circuit-breaker stops the current at less than 10 A.

Increase the number of turns in the coil. **[1]**

This will **increase the attractive force** acting on the iron bar when **[1]**

the current is less 10 A. **(accept other answers involving force on the iron bar)** [2]

SECTION B [30 marks]

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

9 **(a)** Fig. 9.1 shows a simple setup that can be used to detect seismic waves from earthquakes. The setup consists of a bar magnet suspended from a spring hanging from a metal rod. The metal rod transmits vibrations from the Earth and the magnet moves in and out of the coil when there is an earthquake. The coil is connected to a cathode-ray oscilloscope (c.r.o.) that monitors the e.m.f across the coil.

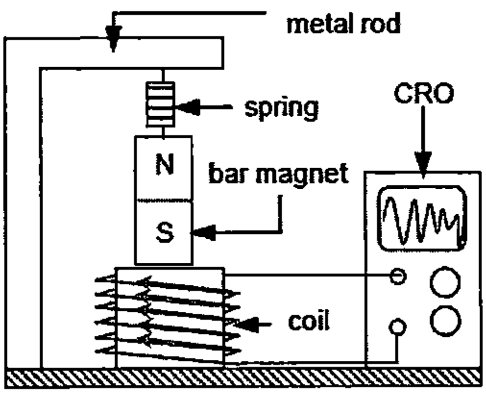


Fig. 9.1

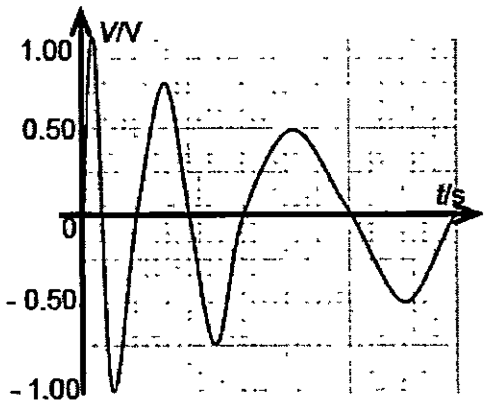


Fig. 9.2

Fig. 9.2 shows the trace that was displayed on the c.r.o. during a particular earthquake. Each complete oscillation of the same magnitude represents one tremor.

(i) Describe and explain how a trace shown on the c.r.o. in Fig. 9.2 is obtained when there is an earthquake.

During an earthquake, the magnet moves in and out of the coil, **producing a change in magnetic flux linking the coil**, thus **inducing an emf.** [1]

By **Lenz's Law**, the **direction of the emf changes** when the magnet moves in and out of the coil, hence **an alternating trace** is produced. [1]

By **Faraday's Law**, the **magnitude** of the induced emf is **proportional to the rate of change of magnetic flux linkage,** [1]

hence a **larger tremor** will produce a trace with a **higher amplitude.** [4] [1]

(ii) On Fig. 9.1, indicate the direction of the current in the coil when the South pole of the magnet is moving into the coil. [1]

For Examiner's Use

(b) An output voltage of 2.0 V from a generator is connected to the primary coil of a step-up transformer with a turns ratio of 1:50. The current in the secondary coil is 2.4 mA. The transformer is 75% efficient.

(i) State the metal used for the core of a transformer.

Soft iron [1] **cao**

(ii) Calculate the current in the primary coil.

$V_s = 50 \times 2.0$
$= 100$ V **[1]**

$0.75 \times V_pI_p = V_sI_s$
$0.75 \times 2.0 \times I_p = 100 \times 0.0024$
$I_p = \underline{0.16 \text{ A}}$ **[1]**

current = 0.16 A [2]

(iii) State two reasons why a typical transformer is not 100% efficient.

Induced (eddy) currents are formed in the core of the transformer. / There is **heat loss due to the resistance in the wires.** / There is **magnetic flux leakage** between the primary and secondary coil. **(any two)** [2]

10 (a) In an experiment to measure the specific heat capacity of water, an electric heater heats water in a glass beaker. The temperature of the water is measured at regular intervals of time. Fig. 10.1 shows how the temperature varies with time t.

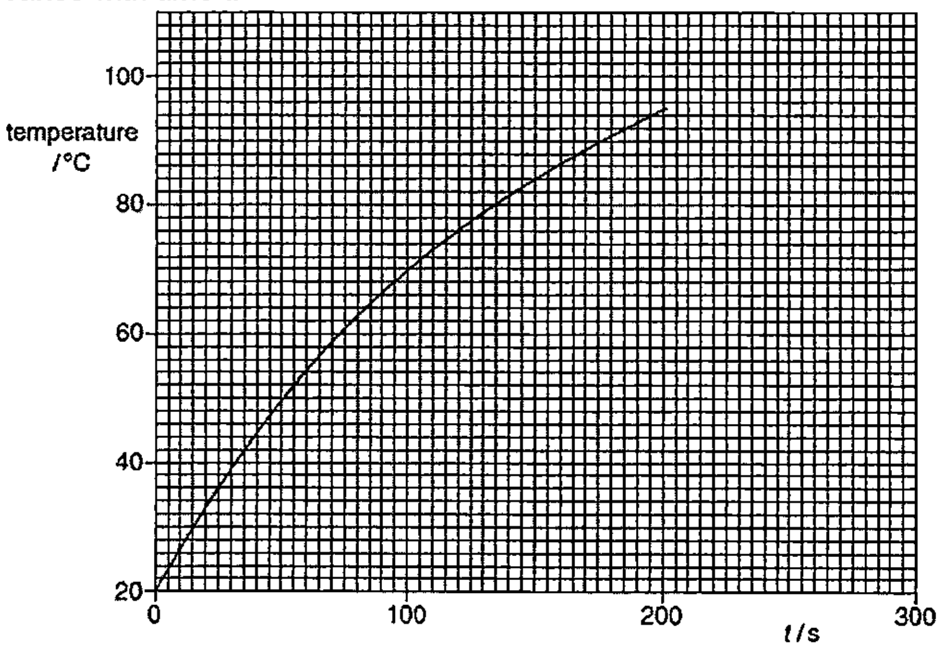


Fig. 10.1

For Examiner's Use

(i) Use Fig. 10.1 to determine the change in temperature between

t = 0 and t = 100 s, change = 50 °C

t = 100 s and t = 200 s. change = 25 °C [1] **[1] for <u>both</u>**

(ii) Explain why the values in (i) are different.

At a later time, the **temperature of the water is higher**, hence **[1]**
there is **greater heat loss due to evaporation / greater heat loss** **[1]**
to the surrounding, so temp increases at a slower rate. OR
At a later time, some of the thermal energy supplied is **starting to**
be used to overcome the attractive forces of attraction **[1]**
between molecules **instead of being used to increase their** **[1]**
speed, hence the temp rise increases at a slower rate. [2]

(b) (i) The experiment in **(a)** is repeated using 72 g of water. The heater supplies 7400 J of thermal energy to the water and the temperature rise of the water is 23 °C. Calculate the specific heat capacity of water.

$Q = mc\Delta\theta$
$c = 7400 / (72 \times 23)$ **[1]**
$= \underline{4.5\ \text{J} / (\text{g °C}) \text{ or } 4500\ \text{J} / (\text{kg °C})}$ **[1]**

specific heat capacity = 4500 J / (kg °C) [2]

(ii) A bullet of mass 72 g is fired from a gun at a speed of 450 m/s. Calculate the kinetic energy of the bullet.

$KE = \frac{1}{2} mv^2$
$= \frac{1}{2} \times 0.072 \times 450^2$ **[1]**
$= \underline{7300\ \text{J (2 s.f.)}}$ **[1]**

kinetic energy = 7300 J [2]

(iii) The amount of internal energy gained by the water and the amount of kinetic energy gained by the bullet are approximately equal.

Describe the change in the motion of the molecules of the water and of the molecules of the bullet caused by this addition of energy.

water: The water molecules **move faster**. However, the **motion** **[1]**
is still random as the molecules slide over each other in the **[1]**
liquid.

bullet: All the molecules of the bullet **move/vibrate faster about**
their fixed positions. [3] **[1]**

11 EITHER

A crankshaft is a shaped metal bar that is part of a car engine. It is free to rotate about an axis, as shown in Fig. 11.1a.

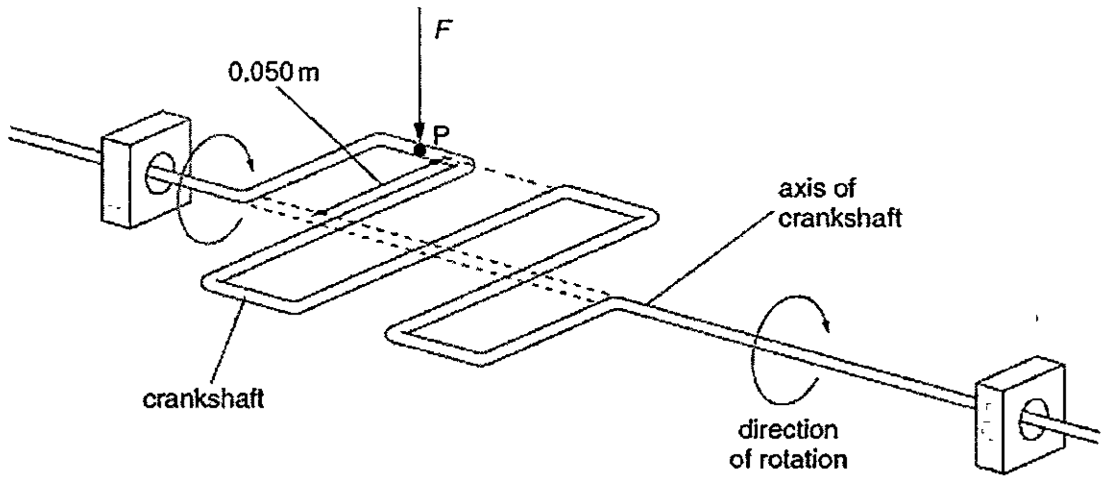


Fig. 11.1a

When the crankshaft is horizontal, a vertical force *F* of 8200 N acts downwards on the crankshaft at P. This causes the crankshaft to rotate. The distance between P and the axis of the crankshaft is 0.050 m.

(a) **(i)** State what is meant by the *moment* of a force.

The moment of a force is the product of the force and the

perpendicular distance from its line of action to the pivot. [1]

(ii) The crankshaft is horizontal. Calculate the moment of *F* about the axis of the crankshaft.

Moment = F x perpendicular d

= 8200 x 0.050 **[1]**

= <u>410 Nm</u> **[1]**

moment = 410 Nm [2]

(iii) The size and direction of the vertical force *F*, acting on the crankshaft at P, remain constant. Explain what happens to the moment of *F* as the crankshaft rotates through a small angle.

When the crankshaft rotates through a small angle, the

perpendicular distance decreases / force is no longer **[1]**

perpendicular and hence the **moment of F decreases**. [2] **[1]**

For Examiner's Use

(b) The force F on the crankshaft at P is exerted by a metal rod connected to a piston. The piston traps high-pressure gas in a cylinder, as shown in Fig. 11.1b.

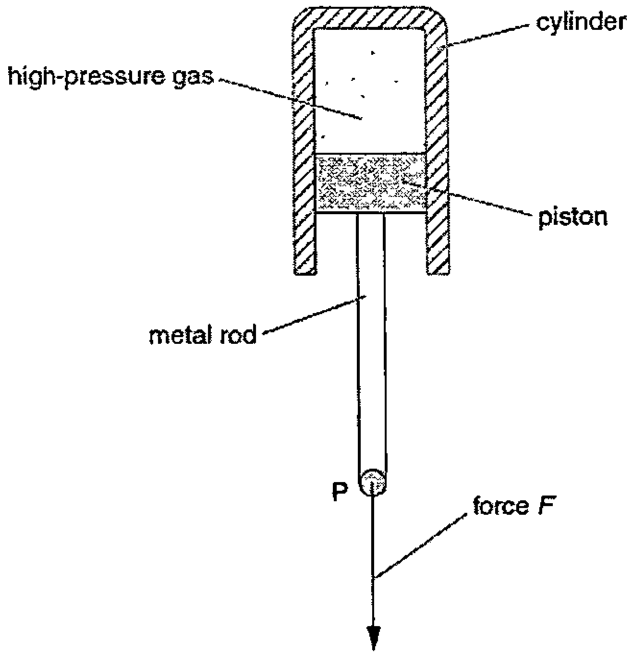


Fig. 11.1b

The force F, of 8200 N, acts because the high-pressure gas pushes down on the piston. The air pressure outside the cylinder is 1.0×10^5 Pa and the cross-sectional area of the piston is 0.0067 m^2.

(i) Calculate the minimum value of the pressure of the gas in the cylinder.

Pressure due to F = F / A
= 8200 / 0.0067
= 1.22×10^6 Pa **[1]**

Hence minimum pressure = $1.22 \times 10^6 + 1.0 \times 10^5$
= $\underline{1.3 \times 10^6 \text{ Pa}}$ **[1]**

pressure = 1.3×10^6 Pa [2]

(ii) Suggest why, in practice, the pressure of the gas in the cylinder is greater than the value calculated in **(i)**.

In practice, there is **friction** between **the piston and the cylinder** **[1]**

which **opposes the motion of the piston**, hence a larger gas **[1]**

pressure is required to **overcome** it. [2]

(iii) The piston moves in the cylinder and the gas expands. State what happens to the force F.

The gas pressure decreases and hence ***F* decreases.** [1]

11 OR

For Examiner's Use

Fig. 11.2a shows a diver salvaging items from a plane wreck below the surface of a lake. The density of the water in the lake is 1000 kg/m^3 and the atmospheric pressure at the surface is 1.0 x 10^5 Pa.

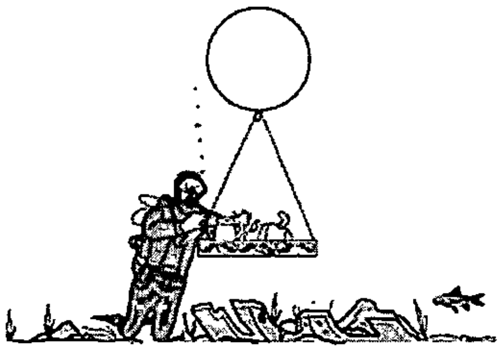


Fig. 11.2a

The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

(a) Calculate the total pressure at 15 m below the surface of the lake.

Total pressure = $h\rho g + P_{atm}$
$= 15 \times 1000 \times 10 + 1.0 \times 10^5$ **[1]**
$= \underline{2.5 \times 10^5 \text{ Pa}}$ **[1]**

pressure = 2.5 x 10^5 Pa [2]

(b) The air in the balloon occupies a volume of 0.048 m^3 at the pressure calculated in **(a)**. The diver releases the tray and the balloon, and they begin to rise. The temperature of the air in the balloon does not change.

(i) Calculate the volume occupied by the air in the balloon at atmospheric pressure.

Using $P_1V_1 = P_2V_2$,
$2.5 \times 10^5 \times 0.048 = 1.0 \times 10^5 \times V_2$ **[1]**
$V_2 = \underline{0.12 \text{ m}^3}$ **[1]**
max 1m ecf

volume = 0.12 m^3 [2]

(ii) The pressure of the air inside the balloon is less at the surface than at a depth of 15 m. Explain, in terms of the air molecules inside the balloon, why the pressure is less.

At the surface, the air molecules inside the balloon **occupy a large space / are further apart**, hence the **frequency of collisions with the inner walls** of the balloon is **lower.** [2]

[1]
[1]

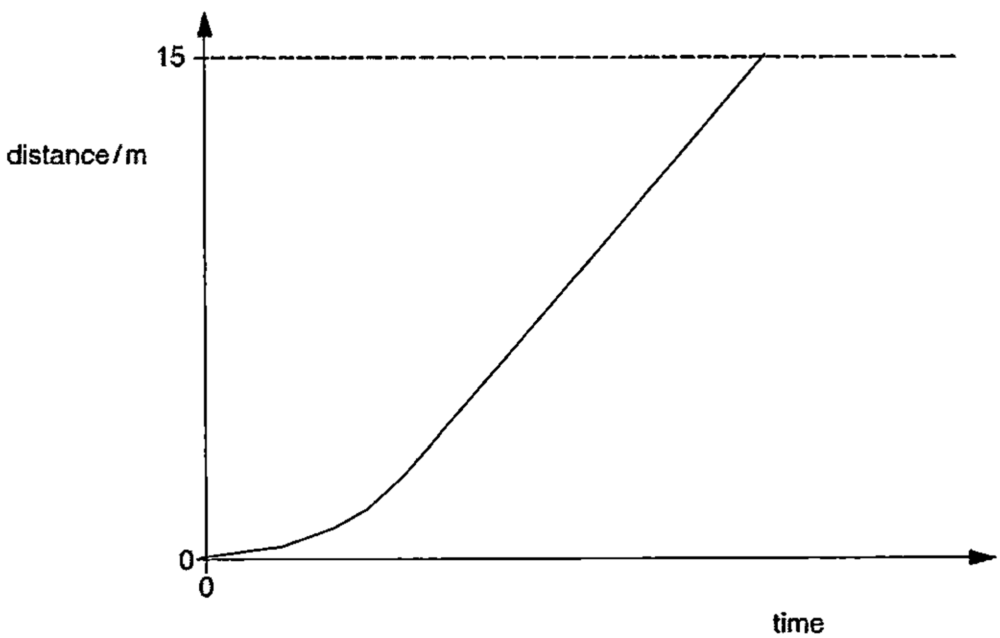
For Examiner's Use

(c) When the diver releases the tray, the balloon accelerates upwards and reaches a constant speed before it arrives at the surface.

(i) Explain how the forces acting on the balloon cause it to behave in this way.

When the diver first releases the tray, the **unbalanced / net upward force** causes the balloon to accelerate. [1] As it moves upwards, the **downwards water resistance / friction increases**. [1] Eventually, when there is **no net force** / the **upwards force is balanced by the downwards force**, the balloon will move at a constant speed. [1] [3]

(ii) On the axes in Fig. 11.2b, sketch the distance-time graph for the balloon as it travels 15 m to the surface. [1]



starts from (0,0)

gradient increases initially

constant gradient

graph ends at 15 m

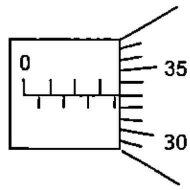
– END OF PAPER –

CHUNG CHENG YISHUN

Section A [40 marks]

1 What is the reading of the micrometer screw gauge?

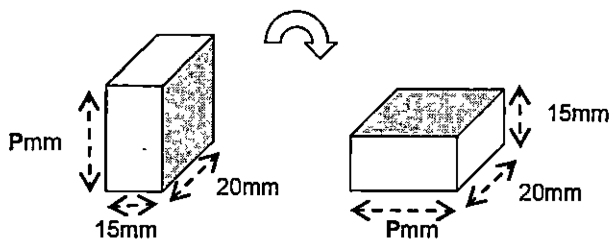
A 3.33 mm
B 3.83 mm
C 4.33 mm
D 4.83 mm



2 An object is launched from the Earth into an orbit.
What happens to the density and the weight of the satellite ?

	Density	*Weight*
A	stays constant	stays constant
B	stays constant	decreases
C	decreases	stays constant
D	decreases	decreases

3 A block of metal is shown below standing on the floor. It is than turned onto one of its longer faces.



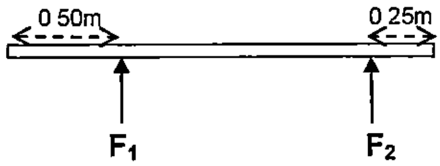
If the pressure between the block and the floor is reduced by 4 times as a result, what is the length of **P** ?

A 40 mm
B 60 mm
C 75 mm
D 80 mm

4 An aircraft moves to the start of the runway at $5.0ms^{-1}$ and from this speed it accelerates at $8.0ms^{-2}$ for the 10s until it takes off. What is the length of the runway ?

A 85 m
B 320 m
C 400 m
D 450 m

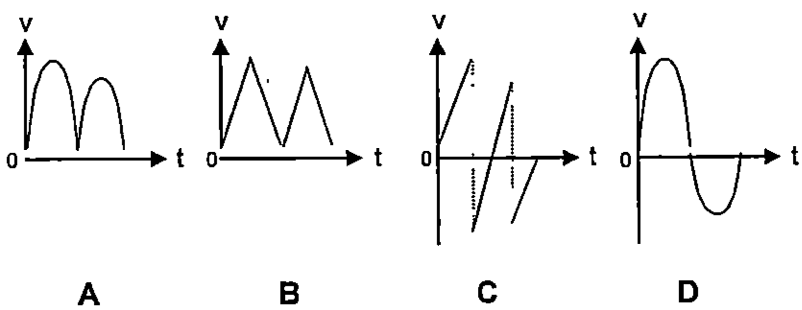
5 A heavy uniform plank of length 2.0m is supported by 2 forces F_1 and F_2 at 2 points of distance 0.25m and 0.50m from both ends of the plank as shown in the diagram below.



What is the ratio of F_1 / F_2 ?

A 2 / 1
B 3 / 2
C 5 / 2
D 15 / 4

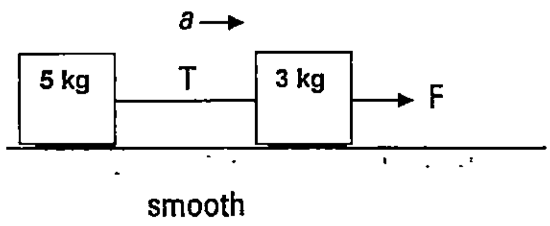
6 Assuming **negligible air resistance,** which of the following most likely show the velocity-time graph for a bouncing ball ?



7 When a wooden box of mass 10 kg was pushed along a floor with a force of 40N, it moved with a constant speed of 0.4 m/s. When the box was pushed along the same floor with a force of 100 N, it moved with a constant ______.

A speed of 4.0 m/s.
B speed of 6.0 m/s.
C acceleration of 0.6 m/s^2.
D acceleration of 6.0 m/s^2.

8 A force F pulls two blocks connected by a string as shown below:

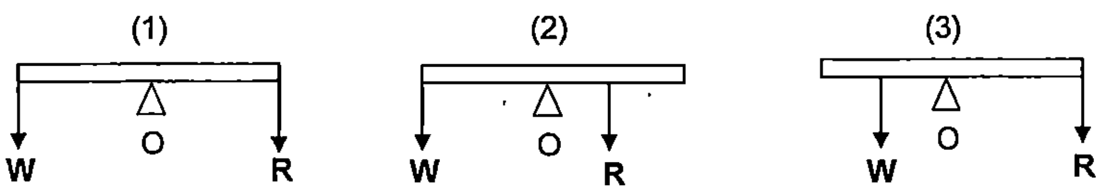


If the blocks are moving with **acceleration of 2 m/s^2**, find the **force F** and **the tension T** in the string,

A F = 10N, T = 16N
B F = 16N, T = 10N
C F = 10N, T = 10N
D F = 16N, T = 16N

9 In the following figures, the metre rule is pivoted at the middle **O**. A fixed weight **W** is loaded on one side and a **variable** weight **R** is loaded on the other side in order to balance the rule horizontally.

Arrange the magnitude of the reaction force at **O** in **descending** order ?

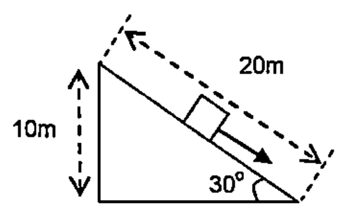


A (1),(2),(3)
B (1),(3),(2)
C (2),(1),(3)
D (2),(3),(1)

10 A block of mass 4kg slides from rest through a distance of 20m down a frictionless slope, as shown in the diagram.

What is the speed of the block at the bottom of the slope?

A 8m/s
B 10m/s
C 12m/s
D 14m/s



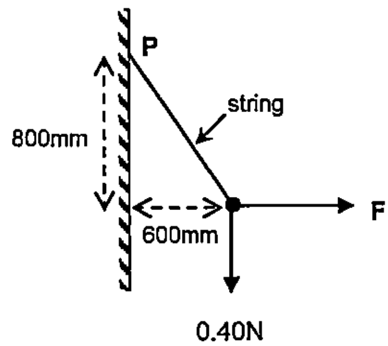
11 If a boy of mass 90kg takes 3 minutes to run up a flight of 60 steps of height 20cm each, what is his average power?

A 60W
B 360W
C 3600W
D 6000W

12 A small pendulum bob , weight 0.40N, is suspended by a string from a point **P**. The bob is drawn aside by a horizontal force **F**, as shown in the diagram, so that the string makes an angle with the vertical. The bob remains at rest in this position.

What is the magnitude of the force **F**?

A 0.13N
B 0.25N
C 0.30N
D 0.53N

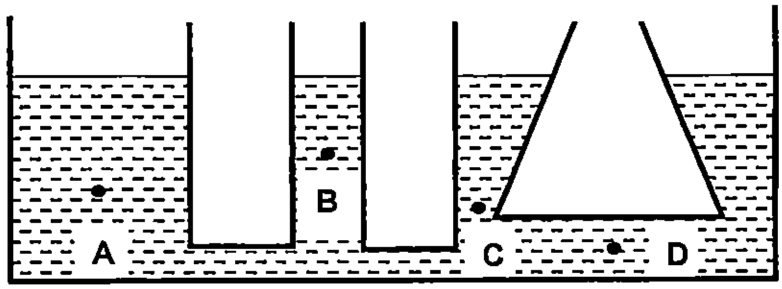


13 The volume of a constant mass of gas in a cylinder is increased at constant temperature.

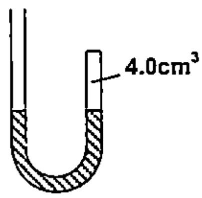
The pressure exerted by the molecules of the gas decreases because

A the density of the gas decreases.
B the gas molecules collide with each other less often.
C the gas molecules strike the cylinder walls less often.
D there is a smaller area of cylinder in contact with the gas.

14 The diagram shows a container with openings of different shapes filled with a liquid. Which of the points **A** to **D** has the greatest pressure ?



15 A J-shaped tube below contains 4.0cm^3 of air trapped by mercury at the same level in both arms of the tube. The atmospheric pressure is equivalent to 76cm of mercury.



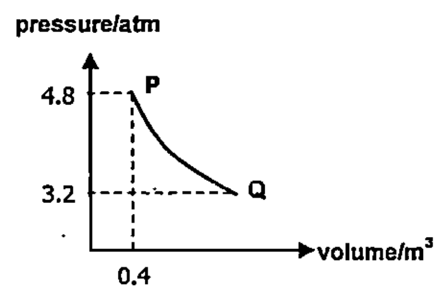
If more mercury is poured into the open tube until the volume of air trapped is 3.8cm^3, what is the eventual difference in the mercury levels ?

A 3.80cm
B 4.00cm
C 5.20cm
D 8.00cm

16 The graph below shows the changes of pressure and volume of a fixed mass of gas. **PQ** represents a change taking place at constant temperature of 30°C.

What is the volume of **Q** ?

A 0.26 m^3
B 0.38 m^3
C 0.60 m^3
D 1.28 m^3



17 When ice changes into water at 0°C,

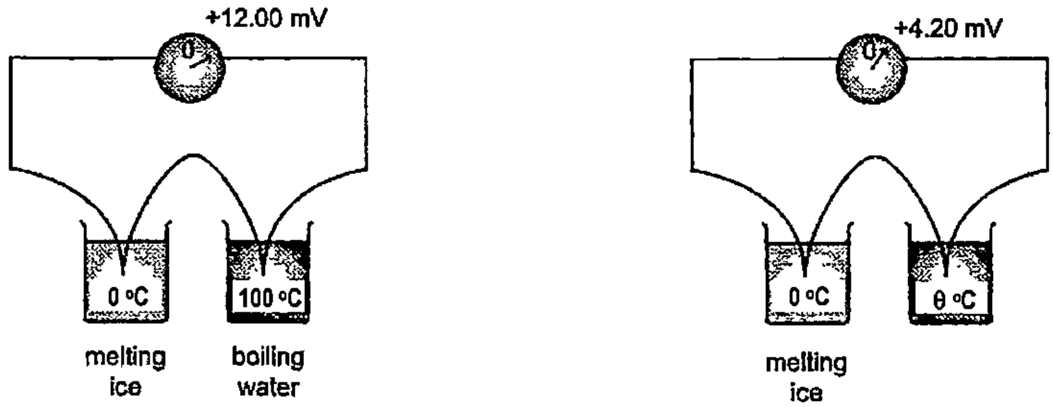
I work is done in breaking the molecular structure of ice in solid state.
II internal energy is increased.
III energy is absorbed to raise the temperature.

A I only
B II only
C I and II only
D I, II and III

18 A gas **Y** expands linearly with temperature change. If the volume is 25cm^3 when the temperature is -10°C and 50cm^3 when the temperature is 190°C, what is the temperature when the volume indicates 60cm^3?

A 180°C
B 200°C
C 250°C
D 270°C

19 The figure below show a thermocouple set up with the cold junction placed in melting ice at 0°C. When the hot junction is placed in boiling water, the e.m.f. measured is 12 mV. When the hot junction is placed in liquid with temperature θ, the e.m.f. measured is 4.20 mV. What is the temperature of the liquid?



A 3.5 $^\circ$C **B** 35.0 $^\circ$C **C** 50.4 $^\circ$C **D** 286 $^\circ$C

20 Two different liquids, **P** and **Q** with the same mass and initial temperature, are heated by the same heat source. Liquid **P** reaches a temperature of 80°C faster than liquid **Q**. This shows that _________________________.

A liquid **P** has a higher specific heat capacity than liquid **Q**.

B liquid **P** has a lower specific heat capacity than liquid **Q**.

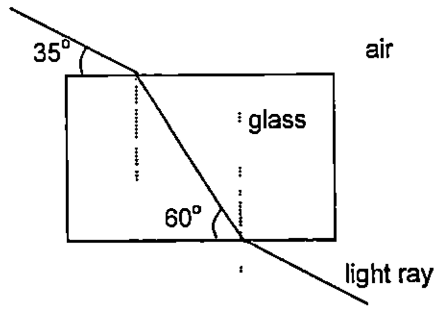
C liquid **P** has a higher specific heat of vapourisation than liquid **Q**.

D liquid **P** has a lower specific heat of vapourisation than liquid **Q**.

21 In the process of convection, energy is transferred _________________________.

A because of temperature differences.
B because of density differences in a fluid.
C by the diffusion of molecules through a fluid.
D by the vibration of molecules about a mean position.

22 Light is incident on a rectangular block of glass as shown in the diagram below.



What is the refractive index of the glass ?

A 0.66
B 0.94
C 1.51
D 1.64

23 Which of the following statement is **true** about **R** in the following electromagnetic spectrum?

Radiowave	**P**	**Q**	Visible light	**R**	**S**	Gamma ray

A It comes from radioactive materials.
B It has the shortest wavelength.
C It is given out by a hot object.
D It causes tanning of the skin.

24 Water waves were produced in a ripple tank using a vibrator of frequency 4Hz. Which of the following values of speed and wavelength could the waves have had ?

	speed (m/s)	*wavelength(m)*
A	4	2
B	8	4
C	6	4
D	16	4

25 A marine survey ship sends a sound wave straight to the sea bed. It receives an echo 1.5s later. The speed of the sound in sea water is 1.5km/s. How deep is the sea at this position?

A 500 m
B 1000 m
C 1125 m
D 2250 m

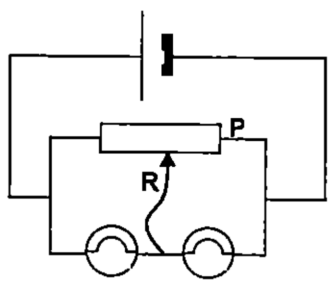
26 When an ebonite rod is rubbed with a duster, the rod becomes negatively charged. The reason is because ________________________.

A the duster gains protons.
B the duster loses electrons.
C the rod gains protons.
D the rod loses electrons.

27 A wire has a current of 500mA in it. How much charge passes a point in the wire in 3 minutes ?

A 25 C
B 90 C
C 167 C
D 1500 C

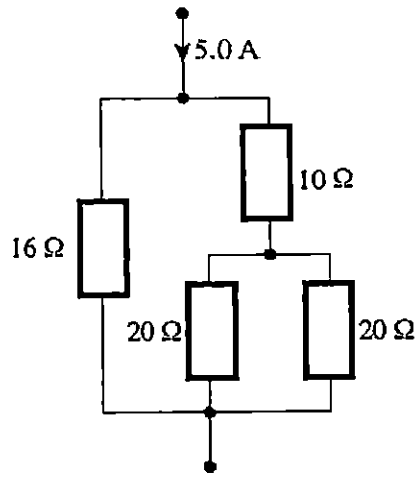
28 The diagram below shows a potential divider circuit.



What happens to the brightness of the lamps as the contact, **R**, is moved towards the P on the potential divider ?

	Lamp 1	***Lamp 2***
A	brighter	brighter
B	brighter	stays same
C	brighter	dimmer
D	dimmer	brighter

29 The following diagram shows part of a complete circuit. What is the current through the 16 Ω resistor?



A 1.11 A **B** 1.39 A **C** 2.22 A **D** 2.78 A

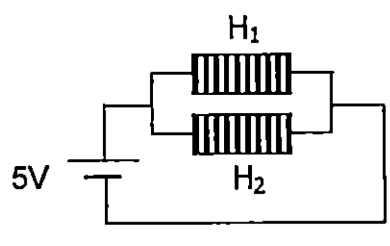
30 An electric heater converts 300kJ of electrical energy from a 250V supply in 5 minutes when operating normally.

What is the current used by the heater ?

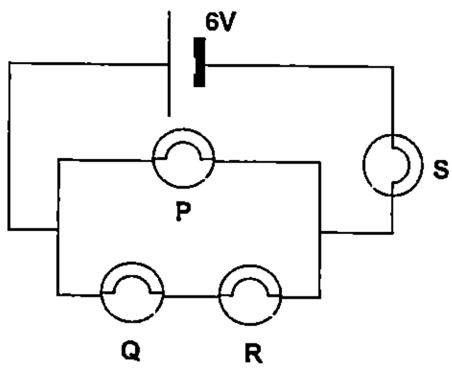
A 3.5 A
B 4.0 A
C 6.0 A
D 7.5 A

31 The diagram below shows a 10V, 50W heater H_1 connected in parallel to a 10V, 25W heater H_2. If P_1 and P_2 are the powers dissipated H_1 in H_2 and respectively. Which is correct ?

	P_1	P_2
A	50W	25W
B	25W	50W
C	25W	12.5W
D	12.5W	6.25W



32 The circuit below shows 4 identical light bulbs connected to a 6V battery. Which of the bulb(s) is(are) the dimmest ?



A S only
B P only
C Q and R only
D P, Q and R only

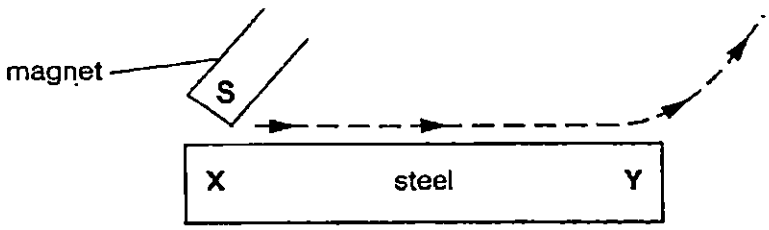
33 Which of the following changes to a wire will increase its resistance by four times ?

	Diameter	***Length***
A	double	double
B	halve	no change
C	no change	halve
D	halve	double

34 Electricity cost 15 cents per kilowatt-hour. What is the cost of using a 900W hi-fi set for 45 minutes?

A 10 cents
B 15 cents
C 25 cents
D 45 cents

35 A piece of steel can be magnetised by stroking it with a magnet.



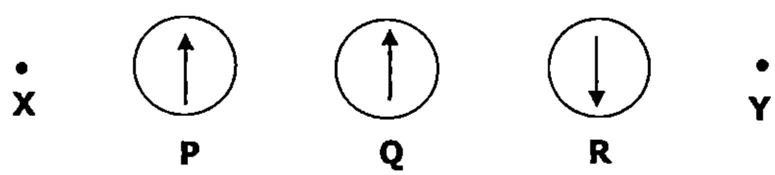
When the magnet is moved in the direction shown, which poles are produced at X and at Y?

	X	Y
A	north	north
B	north	south
C	south	north
D	south	south

36 Which of the following proves that a piece of metal is already a magnet?

- **A** A magnet is attracted to it.
- **B** A copper wire is attracted to it.
- **C** Both ends of a compass are attracted to it.
- **D** One end of the compass needle is repelled by it.

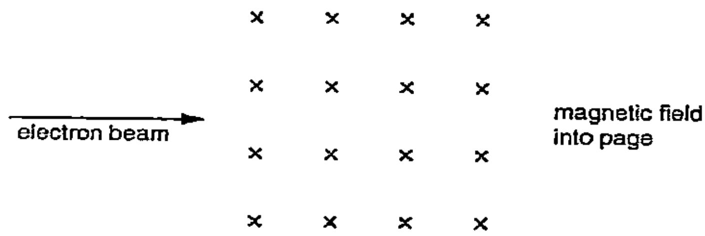
37 X and Y are wires carrying electric currents at right angles to the paper. P, Q and R are plotting compasses. Q is placed mid way between X and Y. Any effect of the earth magnetic field has been ignored.



What is true about the direction and size of the currents?

	Direction of currents	Size of currents
A	Same	Larger in X than in Y
B	Same	Same in X as in Y
C	Same	Smaller in X than in Y
D	Different	Larger in X than in Y

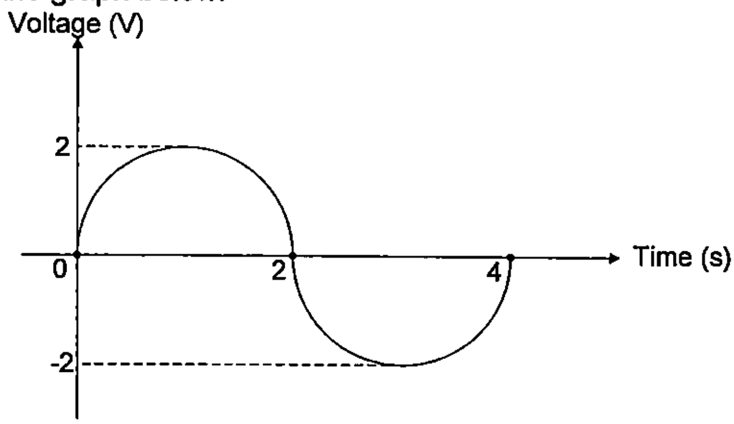
38 The diagram below shows a beam of electrons entering a magnetic field. The direction of the field is into the page.



What will be the initial direction of the deflection of the electrons as the beam passes?

A Down towards the bottom of the page
B Up towards the top of the page
C Into the page
D Out of the page

39 A simple a.c. generator produces a voltage which varies with time as shown in the graph below.

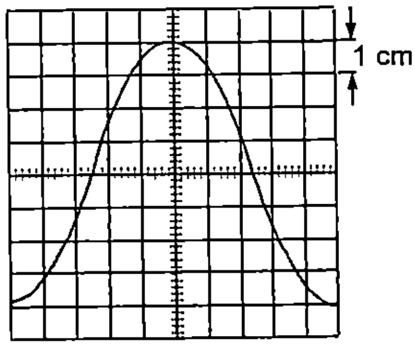


Which of the following reflects how the correct voltage varies with time when the generator rotates at half the original speed?

	Maximum Voltage (V)	Frequency (Hz)
A	1	0.125
B	1	0.50
C	4	0.125
D	4	0.50

40 The diagram shows a waveform obtained on a CRO screen with a peak value of 1 V, 50 Hz a.c. input.

What is the setting of the Y-gain control? What is the time-base setting?



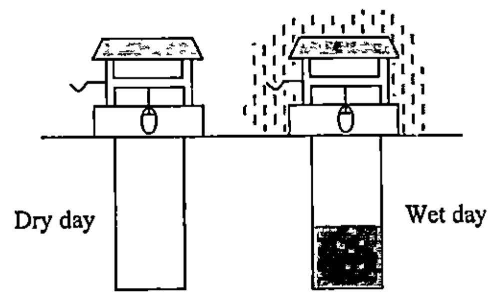
	Y-gain setting	Time-base setting
A	0.25 V/cm	2 ms/cm
B	0.50 V/cm	4 ms/cm
C	1.00 V/cm	2 s/cm
D	4.00 V/cm	10 s/cm

- End of Paper -

SECTION A [50 marks]

Answer all of the following questions in the spaces provided

1. (a) When a well is dry, a stone dropped from rest at the top takes 4.0 s to hit the bottom (Assuming there is negligible air resistance).



(i) What is the speed of the stone just before hitting the bottom of the well? [2]

____

____

(ii) What is the depth of the well? [2]

____

____

(iii) On a day when there is some water in the well, a stone dropped from rest at the top takes 2.0 s before hitting the water surface. How deep is the water in the well? [2]

(b) A soccer player accelerates a 0.50-kilogram soccer ball by kicking it with a net force of 5.0 N.

(i) Calculàte the magnitude of the acceleration of the ball. [2]

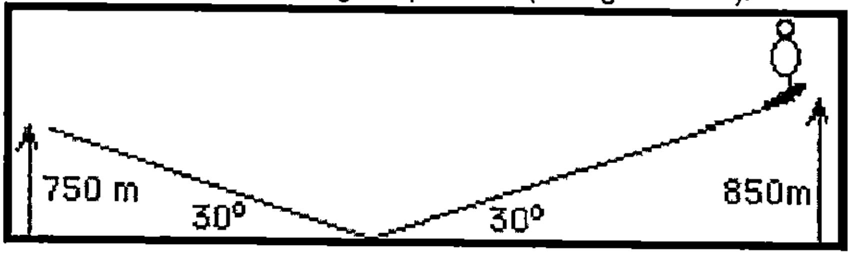
(ii) Suggest the magnitude of the force applied by the player's foot on the soccer ball if [2]

1. there is no air resistance. ....

2. the air resistance acting on the ball is 1.0 N.

   ....

2. Two snowy peaks are 850 m and 750 m above the valley between them. A ski run extends from the top of the higher peak and back up to the top of the lower one, a total length of 3.2 km and an average slope of 30° (see figure below).



(a) A 80 kg skier starts from rest on the higher peak. At what speed will he arrive at the top of the lower peak if he just coasts without using the poles? Ignore friction. [3]

____

____

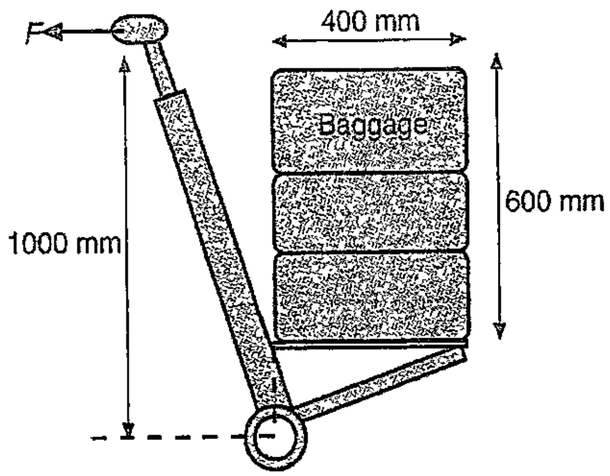
____

(b) Now consider the effects of friction on the skier. If the skier arrives at the top of the 750 m hill with no kinetic energy, what amount of energy has been dissipated by friction? [1]

____

____

3. An airplane passenger places his baggage, of mass 60 kg, onto a trolley as shown below. He applies a force F at the handle to raise the cases to the horizontal position shown. (Acceleration due to gravity = 10 Nkg^{-1})



(a) On the diagram, draw an arrow to represent the weight W of the luggage. [1]

(b) The axle of the wheels acts as a pivot. Calculate the moment of the weight of the luggage about this axle. [2]

____

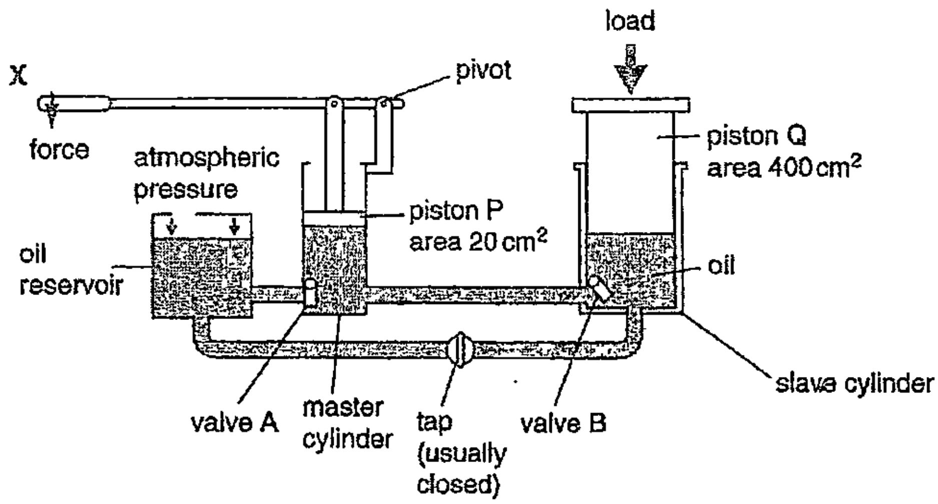
____

(c) Calculate the force F required on the handle to keep the luggage horizontal as shown. [2]

____

____

4. The figure below shows a hand – operated hydraulic press.



A force is applied downwards at **X** as shown. When piston P moves downwards, valve A closes, valve B opens and oil is forced through to raise piston Q in the slave cylinder.

(a) The area of piston P is 20cm^2 and the area of piston Q is 400 cm^2. Piston P exerts a downward force of 400N on the oil.
Calculate the pressure in N/cm^2, exerted by piston P on the oil. [2]

____

____

(b) State the value of the pressure in the slave cylinder [1]

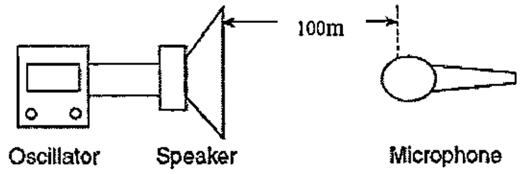
____

(c) Calculate the force exerted by the oil on piston Q. [2]

____

____

5. (a) A system consists of an C.R.O. and a speaker that emits a 1,000 hertz sound wave. A microphone detects the sound wave 100 meter from the speaker.



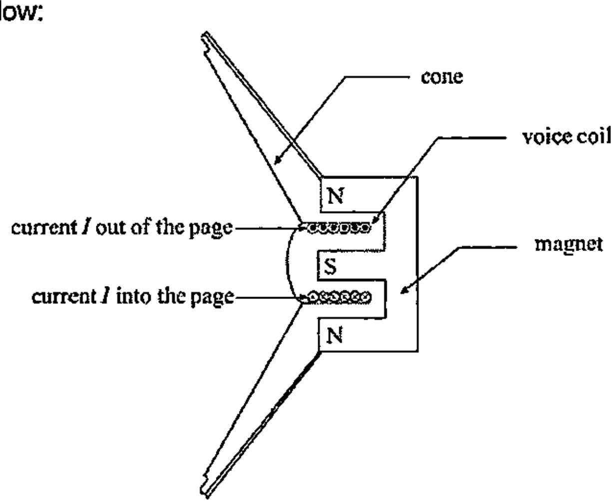
(i) Which type of wave is emitted by the speaker? [1]

____

(ii) The microphone is moved to a new fixed location 0.50 meter in front of the speaker. What is the main difference shown in the C.R.O. display and, why? [2]

____

(b) The main components of a moving-coil loudspeaker are shown in the diagram below:



The current *I* in the top part of the voice coil is directed out of the page.
The current *I* in the bottom part of the voice coil is directed into the page.

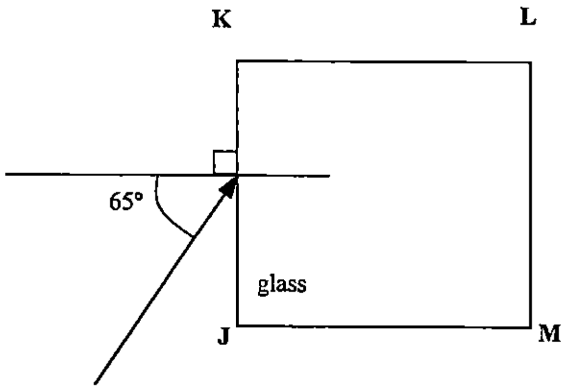
(i) State the direction of the electromagnetic force acting on the voice coil when the current is in the direction shown. [1]

____

(ii) State *one* quantity that may be changed to increase the electromagnetic force acting on the voice coil. [1]

____

6. The figure below shows a square block of glass **JKLM** with a ray of light incident on side **JK** at an angle of incidence of 65°. The refractive index of the glass is 1.50.



(a) Calculate the angle of refraction of the ray. [2]

(b) Calculate the critical angle for a ray of light in this glass. [2]

(c) Explain why the ray shown in the figure cannot emerge from side KL but will emerge from side LM. [3]

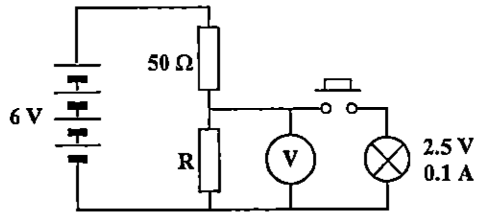
____

____

____

____

7. A pupil studying potential dividers sets up the circuit as shown in the diagram below. The bulb has the rating of 2.5 V, 0.1 A



When the switch is not pressed the voltmeter shows a reading of 2.5 V.

(a) (i) What is the potential difference across the 50 Ω resistor? [1]

(ii) Calculate the current in the 50 Ω resistor. [1]

(iii) Calculate the value of R. [1]

(b) The pupil now closes the switch.

(i) Explain why the reading shown on the voltmeter reduces. [1]

____

____

(ii) Calculate the reading shown on the voltmeter when the switch is closed. [3]

8. Figure 8.1a shows a positively charged conducting rod put near an uncharged light ball suspended at the end of an insulating thread. The surface of the ball has been coated with conducting paint. Figure 8.1b shows what happens after the ball has been allowed to touch the rod.

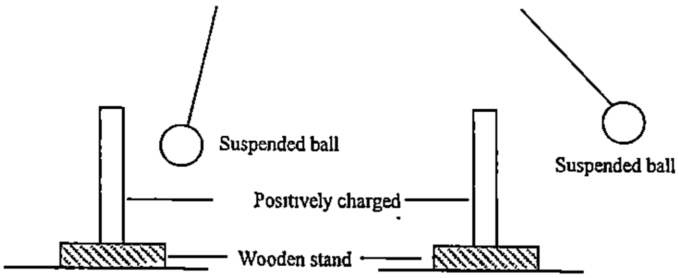


Figure 8.1a Figure 8.1b

(a) (i) Explain why in Figure 8.1a, the ball is displaced from the vertical. [2]

____

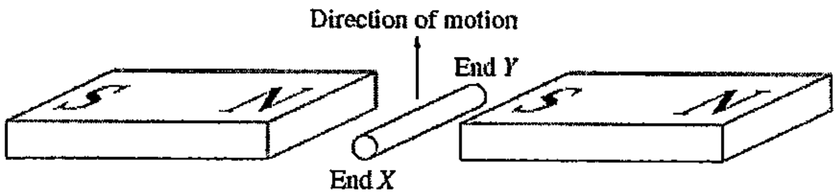
____

(ii) Explain what happens after the ball has been allowed to touch the rod [2]

____

____

(b) When the metal rod, which is connected to a circuit, is moved upwards through the magnetic field as shown in the diagram, an emf is induced between the two ends.



(i) State the direction of current flow in the rod. [1]

____

(ii) Explain how the emf is produced in the rod. [2]

____

____

____

SECTION B [30 marks]

Answer 3 questions in this section. Questions 9 and 10 are compulsory. Choose EITHER Question 11 OR Question 12 to answer.

9 (a) State what is meant by specific latent heat of fusion of ice. [2]

(b) A student performed an experiment using the apparatus as illustrated in Fig. 9.1.

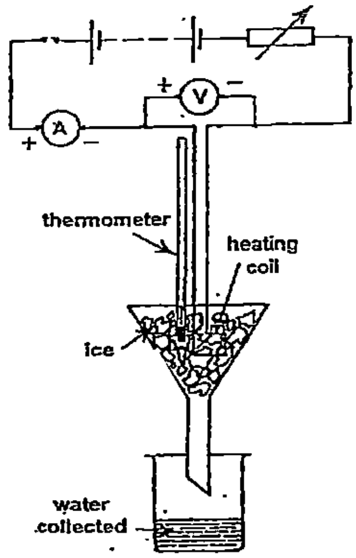


Fig 9.1

A heating coil was placed in a filter funnel and surrounded by lumps of ice. The potential difference V across the heater and mass m of water collected in time t of 500 s were measured for various values of the heater current I.

The values were recorded and a spreadsheet was used to make calculations as shown in table below.

	A	B	C	D	E
No.	Potential difference, V / V	Current, I / A	Mass of water collected, m / g	Time taken, t / s	Thermal energy supplied / J
1	4.0	2.0	14.9	500	4000
2	6.0	3.0	29.8	500	9000
3	7.0	3.5	39.5	500	12250
4	8.0	4.0	50.6	500	

(i) Explain how the values for the thermal energy supplied by the heating coil in column E were calculated from the relevant columns in the table [1]

(ii) Calculate the thermal energy supplied when the mass of the water collected was 50.6 g. [2]

(iii) The student wishes to find out the value of the specific latent heat of fusion of ice. He chose the values from row 4 to do the calculation. Write down the energy equation that will help him get started. (You should define symbols that are used in the equation.) [1]

(iv) Hence, determine the value of the specific latent heat of fusion of ice. [2]

(v) Later, the student discovered that all four values of the specific latent heat of fusion of ice calculated from each row of data were less than actual value of 336J/g. Suggest a reason to explain the discrepancy. [2]

10 (a) An appliance is connected to the *live*, *neutral* and *earth* conductors of the mains supply. The current in the circuit is 4.0 A and the rating of the fuse is 5 A Explain what is meant by [2]

(i) *live*

(ii) *neutral*

(b) When a fault occurs in the appliance, no damage or injury is caused provided that the correct fuse is used and the metal case is connected to earth. Explain why there is a risk of damage or injury if [2]

(i) the 5 A fuse was replaced by a 30 A fuse.

(ii) the earth was *not* connected to the metal case. [2]

(c) State *one* advantage of using a circuit breaker rather than a fuse to protect the appliance. [1]

(d) Describe, with the aid of a diagram, an experiment to check that a fuse blows at 5 A. [3]

EITHER

11 A small wind-powered generator is placed on a hill above a campsite It is connected to a caravan on the site by a pair of cables, each 160 m long. Fig. 11.1 shows how a pair of transformers has been included to raise the efficiency of this transmission system.

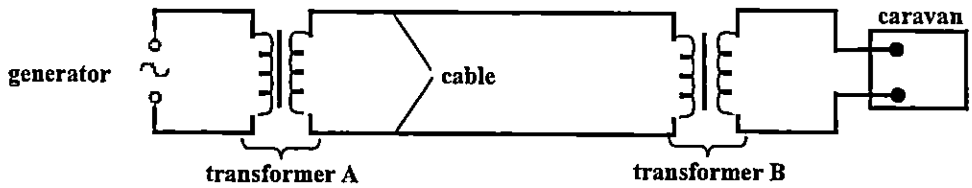


Fig. 11.1

[1]

(a) From Fig. 11.1, state the name of the transformer which you think would be a step-down one.

(b) The step-down transformer has 1 000 turns of wire on its primary coil and 50 turns on its secondary coil and it can be assumed as ideal. The caravan requires an a.c. power supply with a potential difference of 24 V and a current of 16 A.

For the primary coil of the step-down transformer, calculate

(i) the potential difference across it, [2]

(ii) its current, [2]

(iii) the rate at which electrical energy is being delivered. [1]

(c) Each cable has a resistance per unit length of 0.120 Ωm^{-1}. Calculate the total rate at which electrical energy is transferred to heat energy in the two cables. (Correct your answer to 3 significant figures.) [2]

(d) Calculate the output power of the secondary coil in transformer **A**. (Correct your answer to 3 significant figures.) [1]

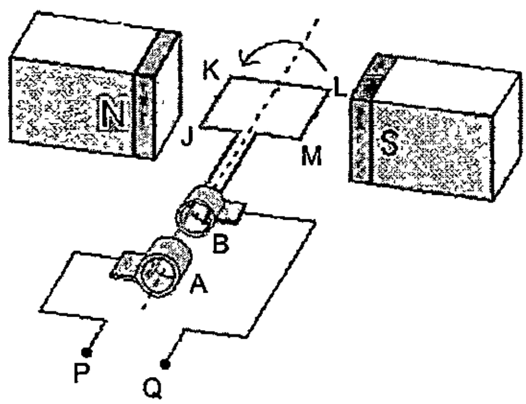
(e) State the advantage of doubling the number of turns of wire on the secondary coil in transformer **A**. [1]

____

____

OR

12 The diagram below shows a simple a.c. generator.



(a) Explain: [1]

(i) the function of the slip-rings A and B,

____

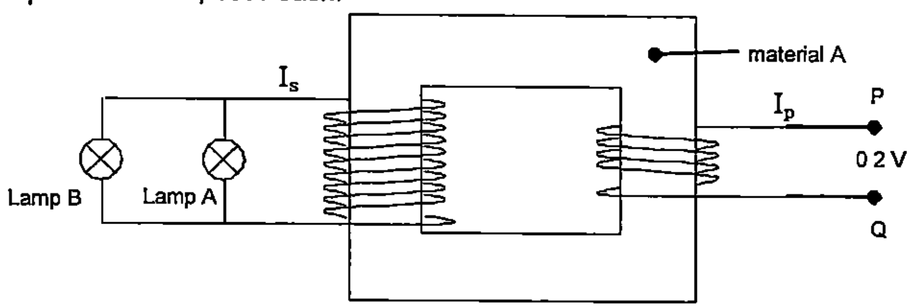
____

(ii) why an emf is induced in the coil as it rotates [1]

(b) State and explain the direction of induced current created in coil J-K-L-M as it rotates anti-clockwise. [2]

(c) The coil of the generator rotates 100 times per second. At this speed, the maximum induced emf is 0.2 V. Sketch a graph of emf against time for a time interval of 20 ms from the instant shown above. Label your axes clearly. [2]

(d) The ends P and Q are connected to a step-up transformer that is 100% efficient. The diagram below shows the setup for the transformer connected to identical lamps rated at 2V, 10W each.



number of turns in both primary and secondary coils are not drawn accurately

(i) Explain why material A cannot be made from steel. [1]

(ii) If both lamps are operating at optimum brightness, calculate the currents in both primary and secondary circuits, I_p and I_s [3]

END OF PAPER

CCHY Pure Physics Prelim P1 MS

Question	Answer
1	B
2	B
3	B
4	D
5	B
6	C
7	D
8	B
9	C
10	D
11	A
12	C
13	C
14	D
15	B
16	C
17	C
18	D
19	B
20	B
21	B
22	D
23	D
24	D
25	C
26	B
27	B
28	C
29	D
30	B
31	D
32	C
33	B
34	A
35	C
36	D
37	A
38	A
39	A
40	A

Physics Prelim 2 Paper 2 Marking Scheme

Section A

1(a)(i)

$$a = \frac{v-u}{t}$$

$$10 = \frac{v-0}{4} \qquad [1]$$
$$v = 40m/s \qquad [1]$$

1(a)(ii)

$$d = \frac{1}{2} \times 4 \times 40 \quad [1]$$

$$= 80m \qquad [1]$$

1(a)(iii)

$$d = \frac{1}{2} \times 2 \times 20 \quad [1]$$

$$= 20m$$
$$depth = 80 - 20 = 60m \quad [1]$$

1(b)(i)

$$a = \frac{F_{net}}{m}$$
$$a = \frac{5.0\,\text{N}}{0.50\,\text{kg}}$$
$$a = 10.\ \text{m/s}^2 \ \text{ or } \ 10.\ \text{N/kg} \quad [1]$$

1(b)(ii)

1. 5.0N [1]
2. 6.0N [1]

2(a)

mgh = ½ mv^2 + mgh

(10)(850) = ½ v^2 + 750 [1]

V^2 = 2000 → [1] so, v = 44.7ms^{-2} → [1]

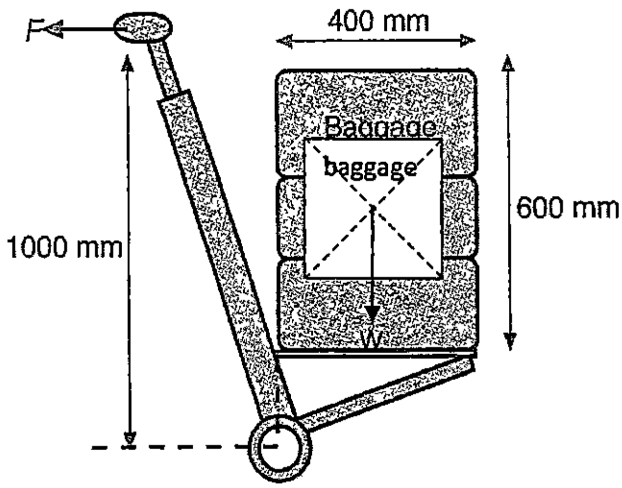
2(b)

$mgh_1 = mgh_2$ + energy lost due to friction (E_{lost})

$E_{lost} = 80(10(850) - 80(10)(750)$ [1]

$E_{lost} = 80kJ$ [1]

3(a)



[1]

3(b)

W = mg

= 60 x 10 = 600 N [1]

M= Fd

= 600 x 0.2

= 120 Nm [1]

3(c)

F x 1 = 120 [1]

F = 120 N [1]

4(a)

P = F/A = 400/20 [1] =20 N/cm^2 [1]

4(b)

20 N/cm^2

4(c)

$F = PA = 20 \times 400$ [1]

$= 8000$ N [1]

5(a)(i)

Longitudinal wave [1]

5(a)(ii)

The waveform captured by the CRO will have a larger amplitude [1] as the sound will be louder. [1]

5(b)(i)

Towards the right [1]

5(b)(ii)

The magnitude of current can be increased. [1]

6(a)

$1.50 = \sin i / \sin r$

$= \sin 65° / \sin r$ [1]

$r = \sin^{-1}(\sin 65° / 1.5)$

$= 37.2°$ [1]

6(b)

$n = 1/ \sin c$

$1.5 = 1/ \sin c$ [1]

$c = \sin^{-1}(1/1.5)$

$= 41.81... = 41.8°$ [1]

6(c)

At the boundary KL, the angle of incidence is greater than the critical angle [1], therefore the light ray cannot emerge from KL but will undergo total internal reflection [1].

At boundary LM, the angle of incidence is less than critical angle, therefore the ray will be refracted [1] and emerged from LM.

7(a)

(i) $V = 6 - 2.5 = 3.5V$ [1]

(ii) $I = \frac{3.5}{50} = 0.07A$ [1]

(iii) $R = \frac{2.5}{0.07} = 35.7\Omega$ [1]

7(b)(i)

When the switch is closed, the total resistance connected in parallel will be lesser than the original R value, thus the voltage reading will drop [1].

7(b)(ii)

$R_{bulb} = \frac{2.5}{0.1} = 25\Omega$ [1]

$\frac{1}{R_T} = \frac{1}{140} + \frac{1}{25} = \frac{5}{140}$ [1]

$R_T = 21.2\Omega$

$V_R = \frac{21.2}{100 + 21.2} \times 6 = 1.05V$ [1]

8(a)

The positively charged rod induced charges on the suspended ball [1]. Since unlike charges attracts, the ball will be attracted to the positively charged rod [1].

8(b)

The electrons from the ball will flow to the rod to neutralise some of the positive charges on the rod [1]. The ball would then be positively charged and since like charges repel, it will move away from the rod [1].

(i) End Y to End X

(ii) An emf is induced in the rod due to a change in the rate at which magnetic field lines are being cut / change in magnetic flux linkage / rate of change of magnetic field experienced by the rod[1] according to Faraday's law [1].

Section B

9. (a) Amount of energy needed to change 1kg of ice to water or water to ice [1] without a change in temperature. [1]

(b)

(i) Thermal energy = V I t , values from column A, B D are multiplied [1]
(ii) E = 8 x 4 x 500 [1] = 16, 000 J [1]
(iii) Energy needed = mass x specific latent heat of fusion
Or
$Q = m\ l_f$ (m and l_f should be defined) [1]
(iv) 16000 = 50.6 x l_f [1]
l_f = 316.2 J/g [1]
(v) Heat was absorbed from the surrounding by the ice. [1] As such, more mass of ice was melted causing calculated value of l_f to be lesser than 336 J/g [1]

10.(a) (i) Live cable is connected to the high voltage of the mains supply. [1]

(ii) Neutral cable is maintained at zero volts. [1]

(b)(i) With a 30 A fuse, when the current exceeds 5 A the fuse will not blow. [1] The cable connected to the appliance may overheat and catch fire.

(b)(ii) If the live cable touches the metal case due to an electrical fault, the metal case is raised to a high voltage when the switch is closed. [1]

Anyone who touches the metal case will receive an electric shock as there is no alternative path for the high current. [1]

(c) If a fuse blows, the fuse wire has to be replaced. If a circuit breaker trips, it can easily be reset. [1]

(d)

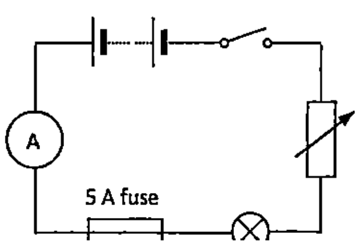
Circuit diagram: [1]

Description: [2]

1. Set up the circuit shown and adjust the rheostat to the maximum resistance.

2. Adjust the rheostat to increase the current gradually.

Note the ammeter reading when the lamp goes off.



11(a) Transformer B [1]

(b) (i) $\frac{V_p}{V_s} = \frac{N_p}{N_s}$ [1]

Vp = (1000/ 50) x 24

=480 V [1]

(b) (ii) $\frac{N_s}{N_p} = \frac{Ip}{Is}$

$50/1000 = I_p/ 16$

$I_p = 0.8$ A

(iii) $P = V_p I_p$

= 480 x 0.8

= 384 W [1]

(c) $P = I^2R$ [1]

$= (0.8)^2 \times (0.120 \times 160 \times 2)$

= 24.6 W [1]

(d) Output power = 384 + 24.6

= 409 W [1]

(e) less power lost as heat. [1]

12(a)

(a) (i) Transfers induced emf to external circuit [1]

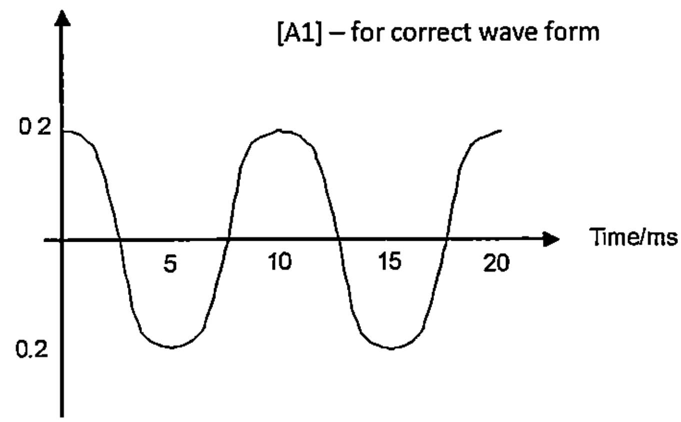
(ii) When a conductor experiences changing magnetic field, emf is induced inside it. Similarly when the coil rotates, it experiences changing magnetic field, hence emf is induced inside the coil. [1]

(b) Current flows in the (anti-clockwise) direction from M-L-K-J [1]

By Fleming's Right Hand Rule, and taking arm J-K as [1] reference, when J-K moves downwards, thumb points downwards while the pointer finger points from North to South direction. Thus the middle finger would indicate the direction of induced current which is from K to J.

(c) [A1] – for all correct labelling

[A1] – for correct wave form



(d) **(i)** Steel is not easily magnetized and retains its [1] magnetism permanently.

(ii) At optimum brightness, this means that pd across both lamps is 2 V.

Current across each lamp = P/V = 10/2 = 5A

So $I_s = 2 \times 5 = \underline{10A}$ [1]

and from $V_s = 2V$

Turns ratio is $V_s/V_p = 2 / 0.2 = \underline{10}$ [1]

$I_p/I_s = Vs/Vp$

$I_p = 10 \times 10 = \underline{100A}$ [1]

COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2015

PHYSICS (5059/1)

PAPER 1

Name: ______________________________ (   ) Class: __________

SECONDARY FOUR EXPRESS

1 September 2015
0945h – 1045h
1 h

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the OTAS.

Read very carefully the instructions on the OTAS.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

Take the gravitational field strength on Earth, g to be 10 Nkg^{-1}.

1 Which instrument is used to measure directly the circumference of a golf ball?

A calipers
B micrometer
C rule
D tape

2 A micrometer is used to measure the thickness of a copper rod. Fig 2.1 shows the zero error of the micrometer used. Fig 2.2 shows the micrometer reading before correction.

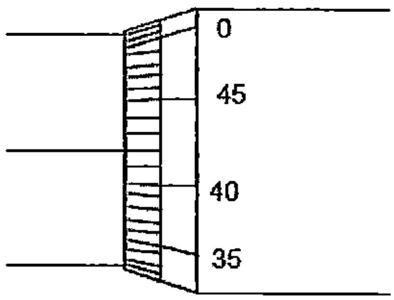


Fig 2.1

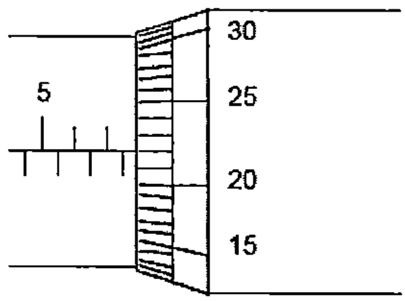


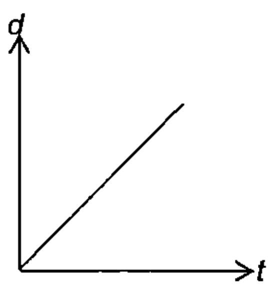
Fig 2.2

What is the thickness of the rod?

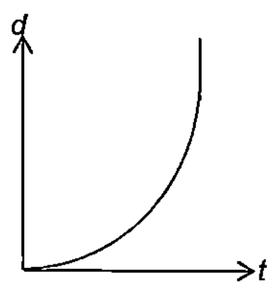
A 5.30 mm
B 7.30 mm
C 7.80 mm
D 10.14 mm

3 Which graph shows how the distance fallen *d* varies with time *t* for a body falling from rest through air from a very tall building?

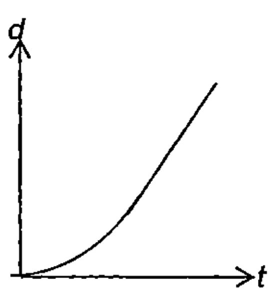
A



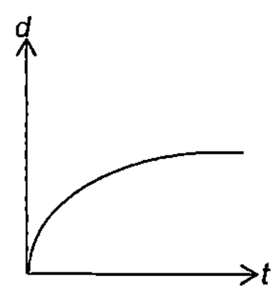
B



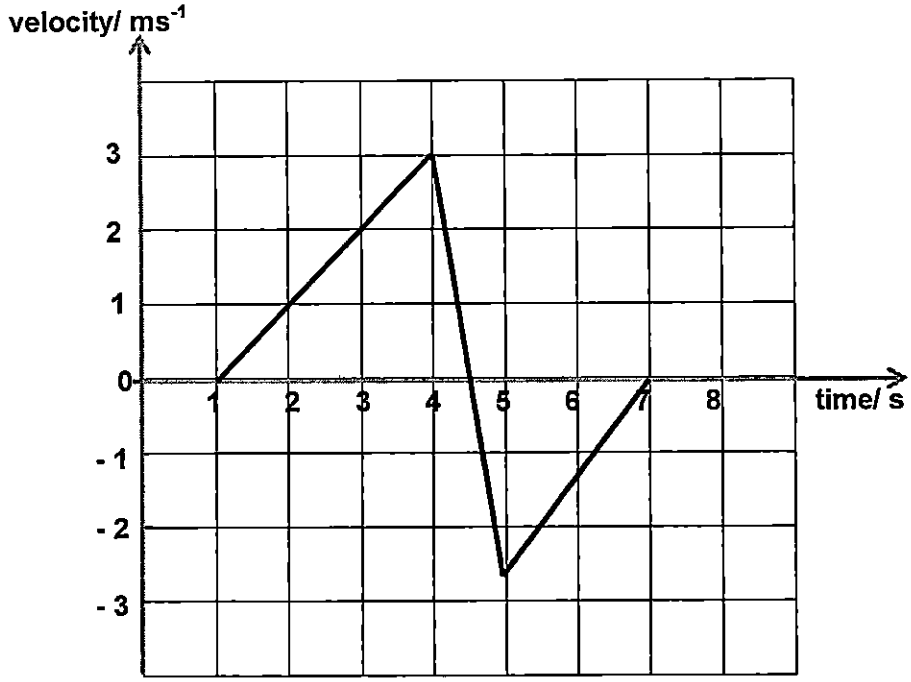
C



D



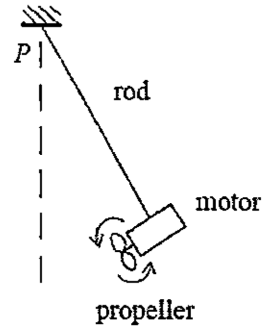
4 A ball is released from rest at a certain height, h, above the ground. The diagram below shows the velocity-time graph of the ball.



Calculate the height, h.

A 4.50 m
B 5.25 m
C 6.00 m
D 6.75 m

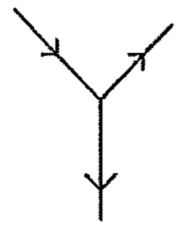
5 The diagram below shows a propeller-motor system connected by a light, rigid rod to a fixed point P on the ceiling. The system remains stationary when the motor is on.



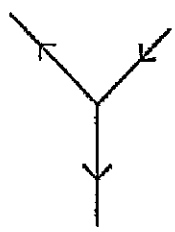
Which of the following diagrams correctly represents the forces acting on the propeller motor system?

A

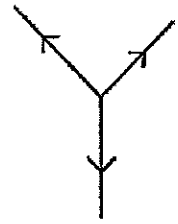
B



C



D



6 Which statement about gravitational fields is correct?

A Gravitational fields exert forces on objects because the objects are charged.
B Only planets and stars have gravitational fields.
C The gravitational field of the Earth acts inwards towards the centre of the Earth.
D The gravitational field strength on the surface of the Moon is less than that on the surface of the Earth because there is no atmosphere on the Moon.

7 A trolley runs down a slope with a constant acceleration a. The mass of the trolley is doubled and the trolley is allowed to run down the same slope. In both cases effects of friction and air-resistance are negligible.

Which statement is correct?

A The accelerating force is the same as before.
B The acceleration is doubled.
C The acceleration is halved.
D The acceleration is same as before.

8 Gold has a density of 19.3 g/cm^3.

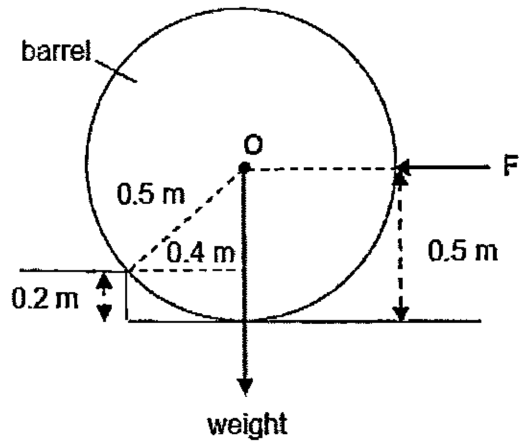
What is the mass of a cube of gold with sides of length 2 mm?

A 0.154 g
B 3.86 g
C 9.65 g
D 24.1 g

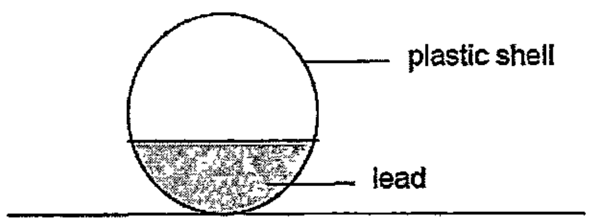
9 A horizontal force **F** is applied to a barrel through the centre **O** as shown below. The barrel has a mass of 300 kg.

Given that the radius of the barrel is 0.5 m, what is the smallest value of **F** to cause the barrel to roll up the step?

A 2250 N
B 2400 N
C 3000 N
D 4000 N

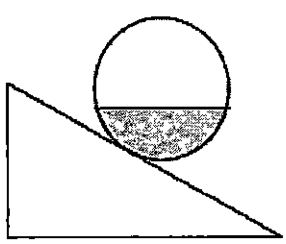


10 Tumbling Kelly is a toy which returns to its upright position after it is being tilted. The diagram shows the interior structure of a Tumbling Kelly toy.

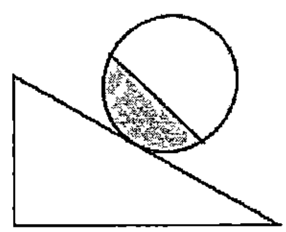


Which of the following best illustrates the final rest position of the toy when it is placed on a slope?

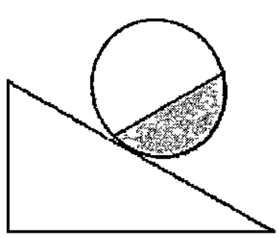
A



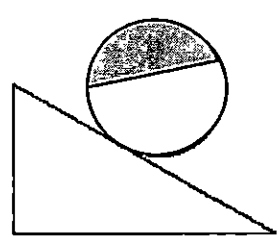
B



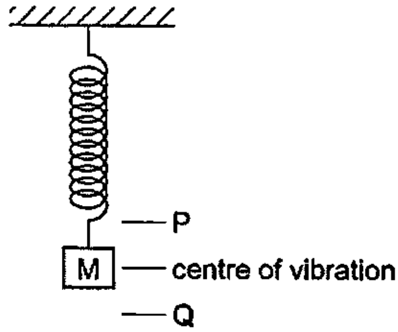
C



D



11 A mass M is hung from a spring. It is then pulled down slightly and allowed to vibrate vertically between P and Q.



Which row is correct?

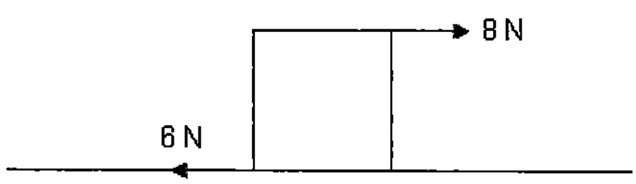
	energy at point P	energy at point Q
A	Kinetic	kinetic
B	Kinetic	potential
C	Potential	kinetic
D	Potential	potential

12 Different sources of energy can be used in a power station to generate electrical energy. Some sources of energy are renewable while some are not.

Which of the following is correct?

	renewable sources of energy	non-renewable sources of energy
A	geothermal	solar, nuclear
B	geothermal	nuclear
C	solar, nuclear	geothermal
D	Nuclear	fossil fuel

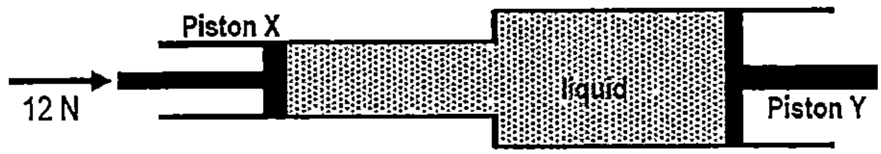
13 A box is pushed 10 m along a horizontal surface by a force of 8 N. The frictional force opposing the motion is 6 N as shown below.



How much of the work done is converted to thermal energy and kinetic energy of the box respectively?

	thermal energy/ J	kinetic energy/ J
A	20	60
B	60	20
C	60	80
D	80	60

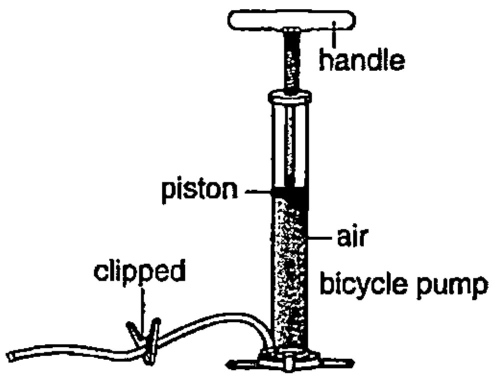
14 The diagram shows a cylinder fitted with two pistons **X** and **Y** of diameters 5.0 cm and 10.0 cm respectively. The piston **X** is pushed by a force of 12 N.



What is the force exerted on piston **Y**?

A 3.0 N
B 6.0 N
C 24 N
D 48 N

15 The figure shows a bicycle pump with its outlet tube sealed with a strong clip.



When the handle is pushed downwards, the air pressure inside the pump increases. Which of the following is a cause for this?

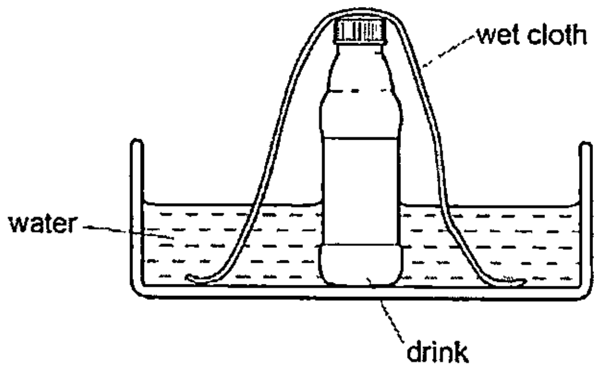
A The average distance travelled by the air molecules before colliding with the walls of the pump has decreased.
B The average speed of the air molecules has decreased.
C The number of air molecules has increased.
D The rate of collision between the air molecules has increased.

16 When one junction of a thermocouple is placed in pure melting ice at 0 °C and the other junction in steam at 100 °C the e.m.f. is 6.0 mV. The hot junction is then removed from steam and placed in a liquid at constant temperature. The e.m.f. is now -1.5 mV.

What is the temperature of the liquid?

A - 75 °C
B - 25 °C
C 25 °C
D 75 °C

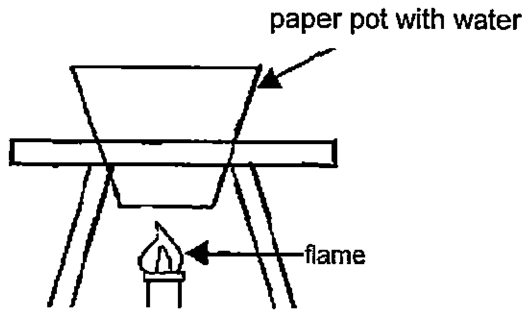
17 On a hot day, a drink in a bottle can be kept cool by standing it in a bowl of water and placing a wet cloth over it.



Why did the drink remain cold?

A Hot air cannot escape from the bottle.
B The cloth conducts heat from the bottle into the water.
C The drink cannot evaporate from the bottle.
D Water evaporating from the cloth cools the drink.

18 Some Japanese restaurants use paper pots for their customers to boil the food themselves.

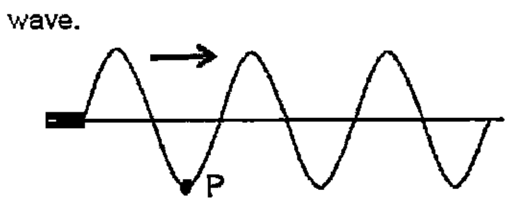


Why does the paper pot not catch fire when in contact with the flame?

I. The paper is thin and therefore heat is conducted quickly to the water in the paper pot.
II. Water has a boiling point lower than the burning temperature of the paper.
III. The paper is thick enough to withstand the high temperature of the flame.

A I and II only
B I and III only
C II and III only
D I, II and III

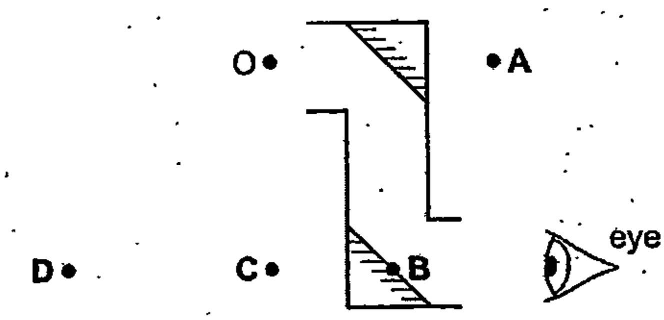
19 The transverse wave showed below was moving from left to right. At one instant, a student observed particle **P** of the wave was 5.0 cm away from the source and at the trough of the wave.



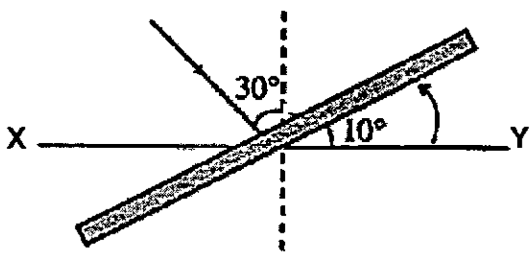
After a time lapse of one and half periods, the position of particle **P** would be at

A one and half wavelength horizontally to the right.
B one and half wavelength horizontally to the left.
C the crest of the wave vertically upward.
D the original position as seen by the student.

20 The diagram shows an object O viewed using two mirrors.
A person looks into the mirrors as shown. At which position is the image of O seen?



21 A ray of light incident on a plane mirror **XY** at 30°. The mirror is then rotated anticlockwise with an angle of 10° as shown in the diagram below.



Through which angle does the direction of the reflected ray change?

A 10°
B 20°
C 30°
D 40°

22 A ray of light in a glass block is incident on a boundary with air at an angle of incidence of 40°. The critical angle at this boundary is 43°.

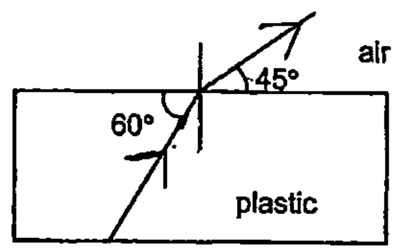
What happens to the ray of light at the boundary?

A It is partly reflected back into the glass and partly refracted along the boundary.
B It is partly reflected back into the glass and partly refracted into the air.
C It is totally reflected back into the glass
D It is totally refracted into the air

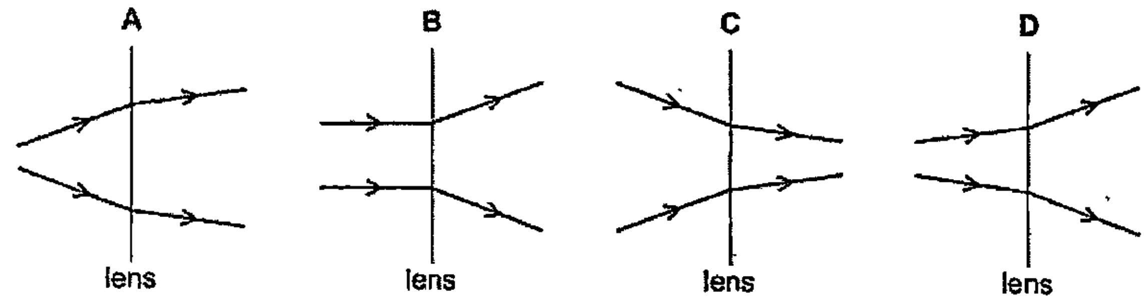
23 A ray of light from the bottom of a plastic block is incident at the plastic surface as shown below.

Calculate the refractive index of the plastic.

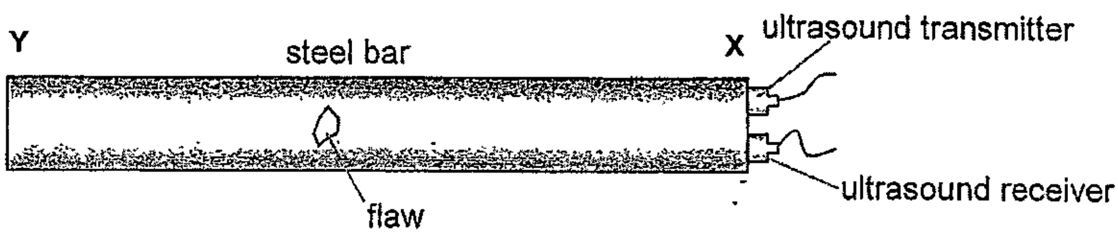
A 0.71
B 0.82
C 1.22
D 1.41



24 Which diagram shows rays of light passing through a converging lens?



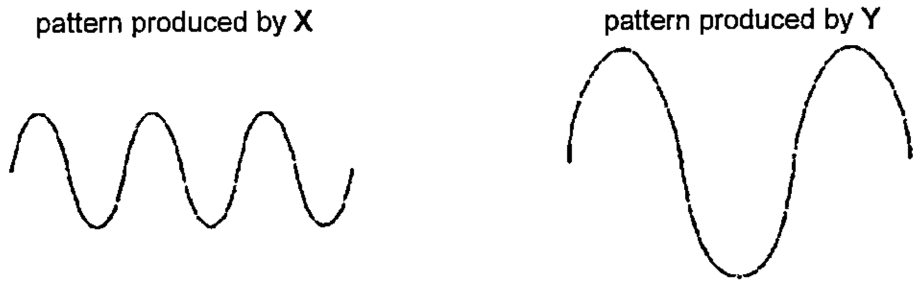
25 There is a flaw in a steel bar **XY**. An ultrasonic transmitter and receiver are installed at position **X**. An ultrasonic pulse is sent to end **Y** and two pulses are received 150 μs and 200 μs later.



Given speed of sound in steel is 5800 ms^{-1}, what is the distance of the flaw from end **X**?

A 0.15 m
B 0.44 m
C 0.58 m
D 0.87 m

26 Two men **X** and **Y** whistle to a microphone connected to an oscilloscope in turn. The patterns produced on the oscilloscope are shown in the figures below.



Which of the following statements gives the correct comparison?

A Both whistle at the same pitch but **Y** whistles louder than **X**.
B Both whistle at the same loudness but **Y** whistles at higher pitch.
C **X** whistles louder than **Y** but with a lower pitch.
D **Y** whistles louder than **X** but with a lower pitch.

27 Which property distinguishes electromagnetic waves from all other types of waves?

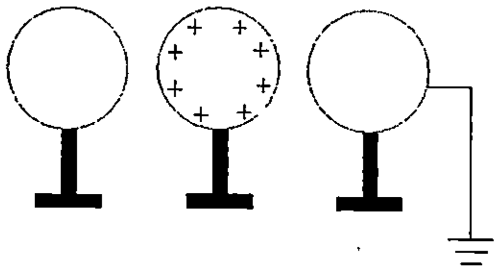
A They are charged.
B They are deflected by magnets.
C They are transverse waves.
D They can travel through vacuum.

28 X-rays are used in clinical diagnosis for taking X-ray films because

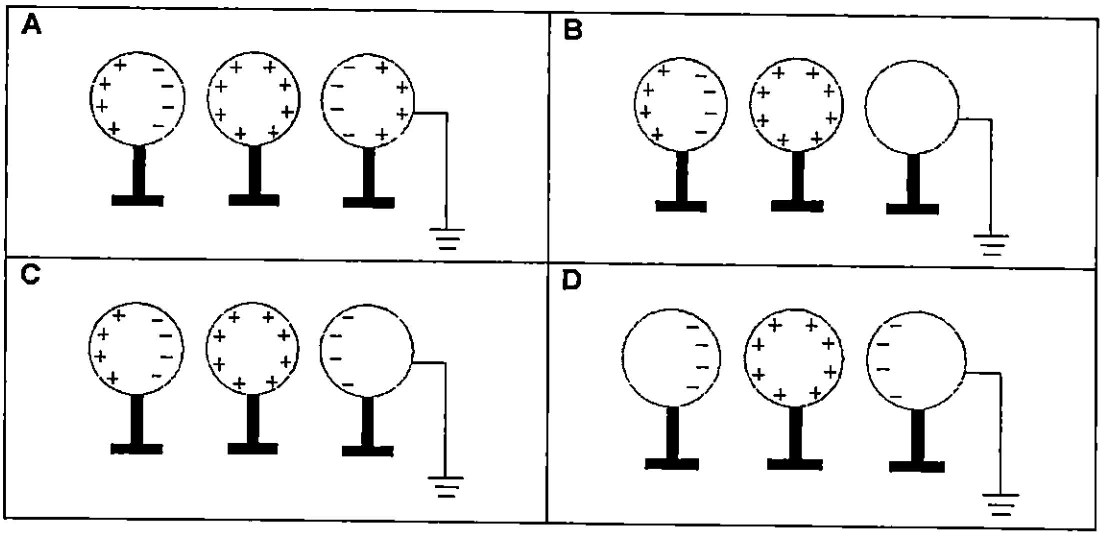
I. X-rays affect photographic plates.
II. X-rays cause ionization.
III. the absorption of X-rays is different for different materials.

A I and II only
B II and III only
C I and III only
D I, II and III

29 A positively charged metal sphere is placed between two uncharged metal spheres, where one of which is grounded to the earth.



Which diagram correctly shows how the charges are distributed on the spheres?



30 Which of the following changes to a wire will double its resistance?

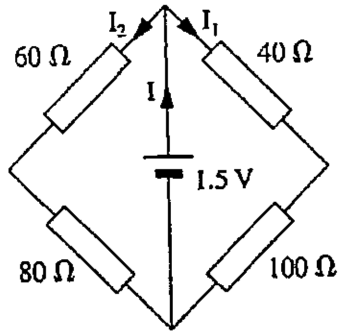
	cross-sectional area	length
A	double	double
B	double	no change
C	no change	halve
D	halve	no change

31 A charged cloud carrying a charge of 160 C passes all its charge to the earth through lightning. The lightning lasts for 0.5 ms.

What is the lightning current?

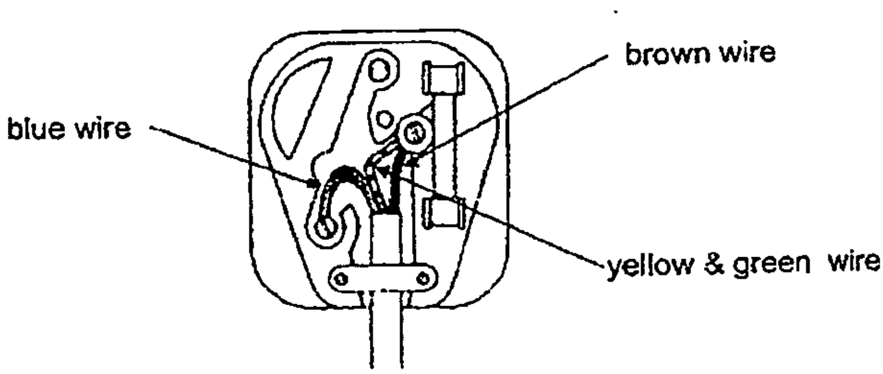
A 80 A
B 3.2×10^2 A
C 3.2×10^5 A
D 0.8×10^5A

32 What is the current I?



- **A** 5.4 mA
- **B** 10.7 mA
- **C** 21.4 mA
- **D** 42.9 mA

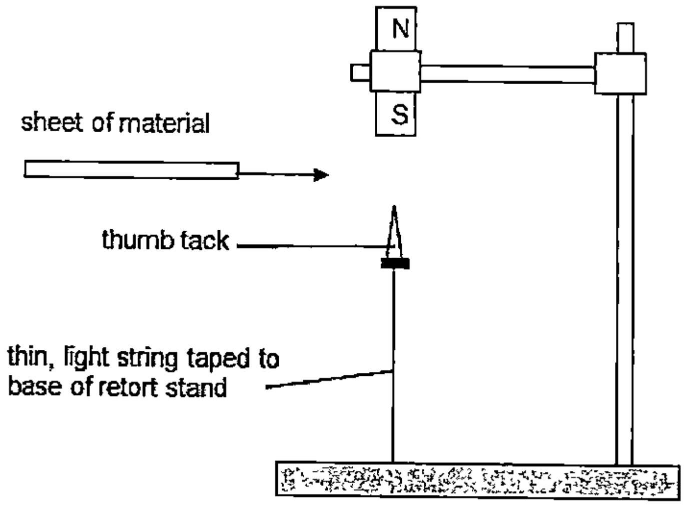
33 A plug is wrongly wired as shown in the diagram. It is connected to a washing machine which has a metal case.



Which of the following is **true**?

- **A** The earth leakage circuit breaker will trip as soon as the socket is switched on.
- **B** The wire in the 13 A fuse in the plug will definitely melt as soon as the socket is switched on.
- **C** The main circuit breaker will trip as soon as the appliance is switched on.
- **D** A person touching the washing machine may get an electrical shock and the fuse wire in the plug will melt.

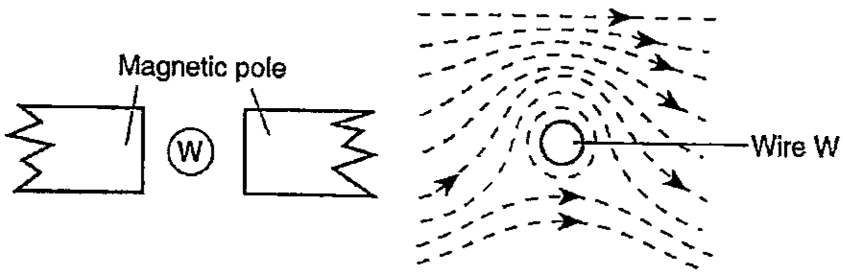
34 A light thumb tack is held in equilibrium mid-air due to the attractive force from a magnet and the gravitational force, as shown in the diagram below.



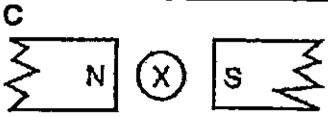
Four different sheets of material are inserted in turn between the magnet and the thumb tack. Which one will cause the thumb tack to drop?

A paper
B plastic
C iron
D copper

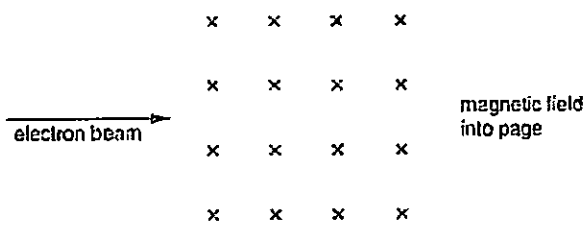
35 A long straight wire W is placed between the poles of two magnets. The pattern of the magnetic field produced is as shown below.



Which arrangement will give rise to the pattern of magnetic field observed?

A 	**B** 
C 	**D** 

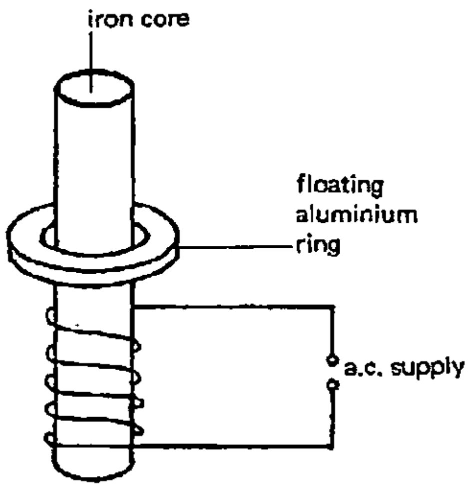
36 The diagram shows a beam of electrons entering a magnetic field. The direction of the field is into the page.



What will be the initial direction of the deflection of the electrons as the beam passes through the field?

- **A** into the page
- **B** out of the page
- **C** towards the bottom of the page
- **D** towards the top of the page

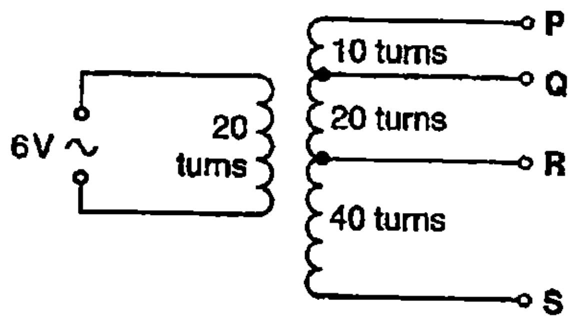
37 A coil is wound on an iron core and is connected to an A.C. supply. An aluminium ring floats above the coil.



Which of the following describes how the ring moves when the a.c. supply is replaced with d.c. supply of equivalent e.m.f?.

- **A** The ring moves upward to the same position.
- **B** The ring moves downward to a position nearer to the coil.
- **C** The ring moves upward to same position momentarily and finally rests on top of the coil.
- **D** The ring moves upward and downward repeatedly and finally rests on top of the coil.

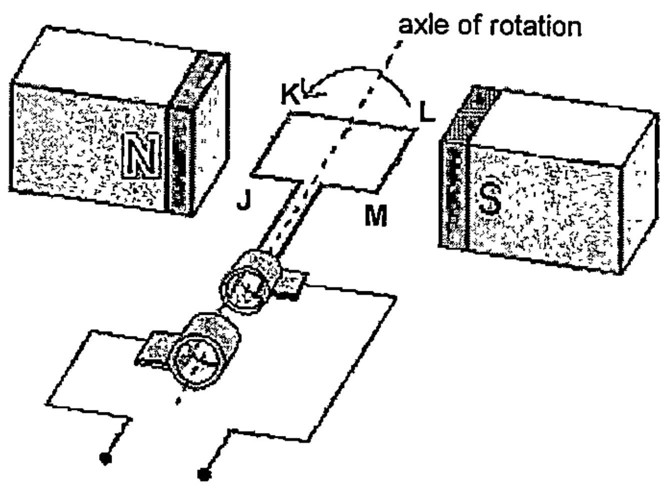
38 The number of turns between each pair of output terminals of a transformer is shown in the diagram.



Between which two terminals will the output be 12 V?

A P and Q
B Q and R
C R and S
D P and R

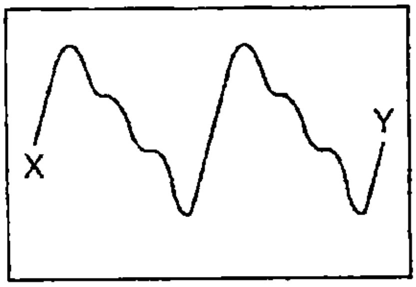
39 The diagram below shows a generator turning in the anti-clockwise direction.



Which row is correct?

	direction of current flow through the coil at the position shown	position of coil when current through the coil is maximum
A	J→K→L→M	horizontal
B	J→K→L→M	vertical
C	M→L→K→J	horizontal
D	M→L→K→J	vertical

40 The diagram shows the trace on the screen of a cathode-ray oscilloscope (c.r.o.).



The spot takes $\frac{1}{400}$ second to move across the screen from X to Y.

What is the frequency of the input signal to the c.r.o.?

A 100 Hz
B 200 Hz
C 400 Hz
D 800 Hz

Answer

1.D	11. D	21. B	31. C
2.C	12. B	22. B	32. C
3.C	13. B	23. D	33. D
4.A	14. D	24. A	34. C
5.D	15. A	25. B	35. C
6.C	16. B	26. D	36. C
7.D	17. D	27. D	37. C
8.A	18. A	28. C	38. C
9.D	19. C	29. C	39. C
10. B	20. D	30. D	40. D

COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2015

PHYSICS (5059/2)

PAPER 2

Name: ________________________________ (   )   Class: __________

SECONDARY FOUR EXPRESS

26 August 2015
0800 - 0945
1 h and 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.
Write in dark blue or black pen.

Section A (50 marks)
Answer all questions.
Write your answers in the spaces provided on the question paper.

Section B (30 marks)
Answer all three questions.
Question 12 has a choice of parts to answer.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
Candidates are reminded that all quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

Take the gravitational field strength *g* on Earth to be 10 Nkg^{-1}.

At the end of the examination, ensure that you have submitted all your work.

For Examiner's Use	
Paper 1	40
Paper 2 Section A	50
Paper 2 Section B	30
Total	120
Parents'/Guardian's Signature	

SECTION A (50 marks)

Answer **all** questions. Write your answers in the spaces on the question paper.

1 A sky diver whose mass is 100 kg falls from a height of 5000 m above the ground. He falls for a while before opening his parachute. The table below shows the air resistance that acts on him during the first 6 seconds of his jump.

Time/s	Air resistance/N
0	0
1	100
2	300
3	600
4	1 000
5	1 000
6	2 000

(a) Calculate the downwards force that is acting on the sky diver. [1]

Force = ...

(b) Determine the time required for the diver to reach terminal velocity. [1]

Time = ...

(c) For the first 4 seconds of his jump, explain why the air resistance would increase as the sky diver falls. [1]

....

....

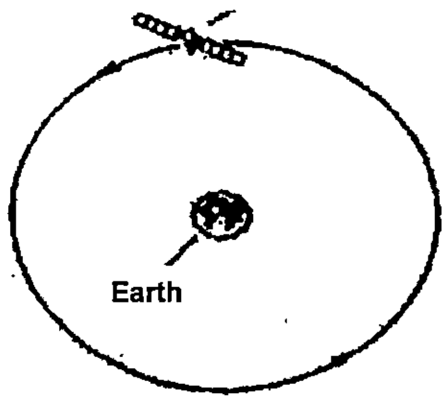
(d) Describe and explain how his acceleration changes for the first 3 seconds.[2]

....

....

....

2 A navigation satellite moves in a circular orbit above the Earth's atmosphere.



The mass of the satellite is 80 kg. It orbits the Earth at a speed of 4000 ms^{-1}. It is constructed mainly from a metal alloy of specific heat capacity 320 $Jkg^{-1}{}^{\circ}C^{-1}$.

(a) Calculate the kinetic energy of the satellite when in orbit. [2]

Kinetic energy = ...

(b) Calculate the change in the temperature of the satellite if all its kinetic energy is rapidly converted to thermal energy as the satellite comes back to earth. [2]

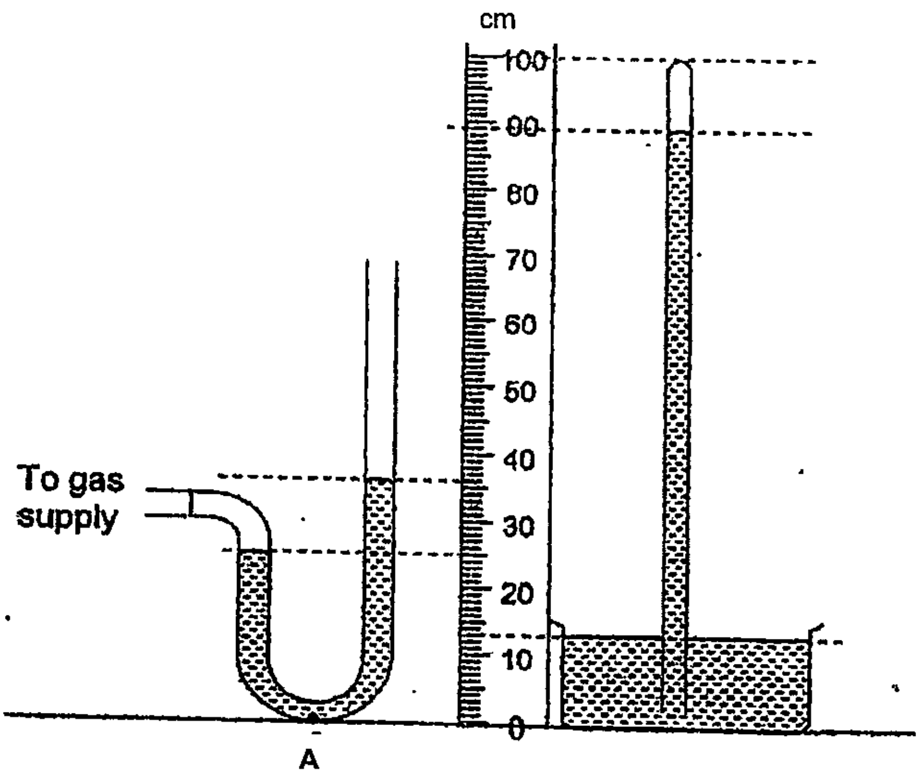
Change in temperature =..........................

(c) Suggest why in practice the change in temperature you have calculated in **part (b)** will not be obtained. [1]

....

....

3 The diagram shows a mercury barometer and a manometer filled with mercury connected to a gas supply.



(a) (i) Determine the atmospheric pressure as indicated by the mercury barometer. [1]

Atmospheric pressure = ...

(ii) State what is meant by *atmospheric pressure.* [1]

....

....

(iii) Determine the pressure of the gas as indicated by the manometer. [1]

Pressure = ...

(iv) Determine the pressure at point A, at the bottom of the mercury in the manometer. [1]

Pressure = ...

(b) Explain, in terms of the motions of the molecules,

(i) why the gas exerts a pressure on the mercury, [2]

....

....

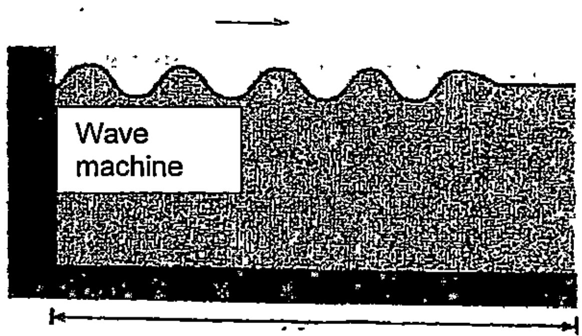
....

(ii) why the gas pressure increases when the temperature of the gas increases. [2]

....

....

4 In the swimming pool at a new leisure centre, there is a 'wave machine' as shown in the diagram.



This machine makes waves in the water at one end of the pool at a frequency of 0.25 Hz. The waves take 12.0 s to travel 15 m along the pool.

(a) Define *transverse waves.* [1]

....

....

....

(b) Calculate the speed of the waves. [1]

Speed = ...

(c) Calculate the wavelength of the waves. [2]

Wavelength = ...

(d) The swimming pool operator wants to reduce the speed of the waves by reducing the frequency of the wave generated by the 'wave machine'. Explain if reducing the frequency of the wave would reduce the speed of the wave. [1]

....

....

5 A lamp is operated from a 12 V d.c supply. The brightness of the lamp is to be varied continuously over a wide range. This is made possible by using a variable resistor **AB** of maximum resistance 6.0 Ω with sliding contact X. Two circuits for achieving the desired results are suggested and shown in Fig 5.1 and 5.2.

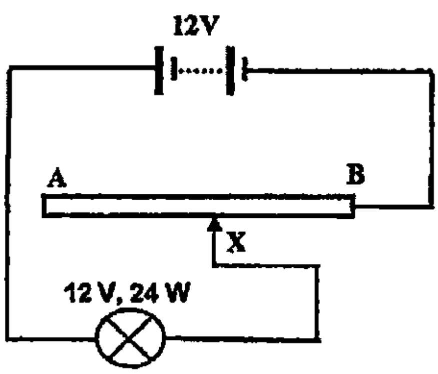


Fig 5.1

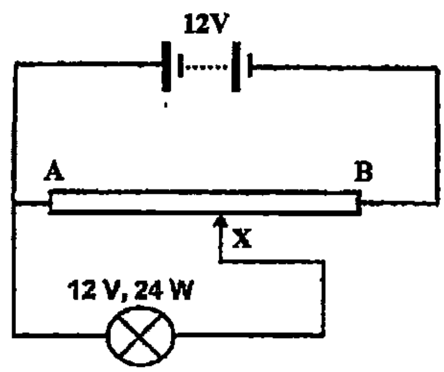


Fig 5.2

(a) Calculate the resistance of the lamp. [2]

Resistance = ...

(b) Calculate the maximum and minimum current flowing through the lamp in

(i) Circuit in Fig. 5.1, [2]

Maximum current = ...

Minimum current = ...

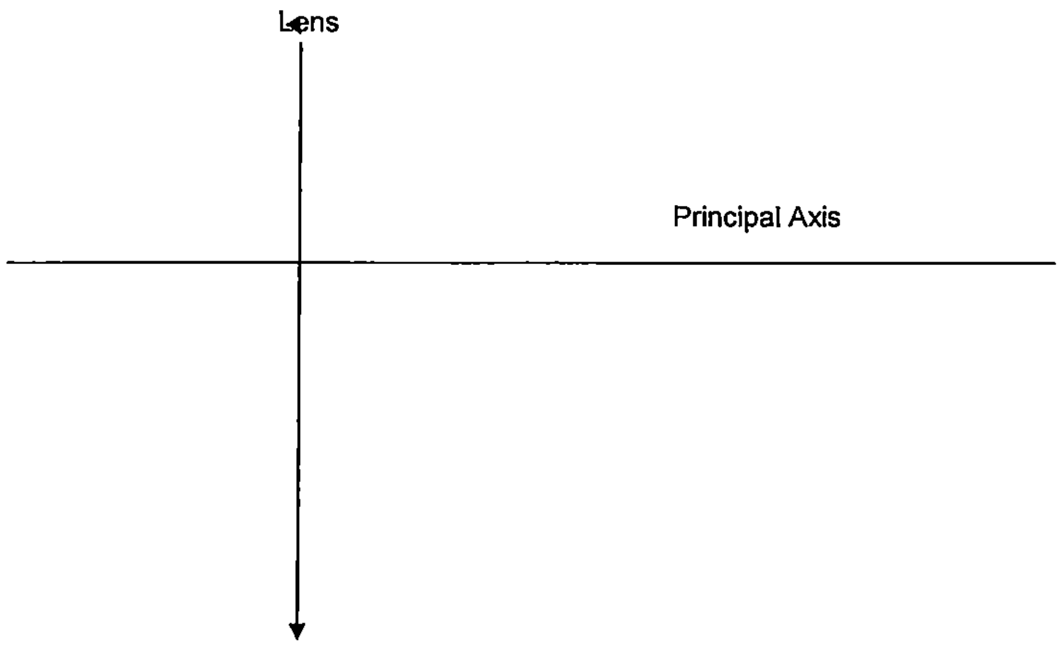
(ii) Circuit in Fig. 5.2. [2]

Maximum current = ...

Minimum current = ...

6 A student wants to project a magnified image of a 5 cm x 5 cm slide onto a screen using the apparatus given: *lamp with slide, a converging lens, a screen.* He finds that a clear image appears when the distance between the slide and the lens is 2.0 cm and the distance between the lens and the screen is 10.0 cm.

(a) By drawing a ray diagram in the space below, determine the focal length of the lens. [3]



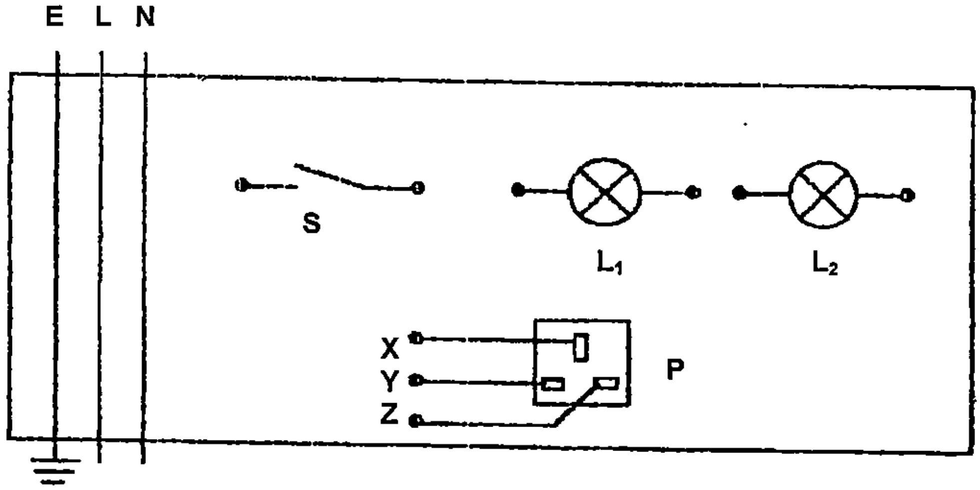
Focal length = ...

(b) Describe and explain what the student would see on the screen as he moves the slide until it is 1.0 cm from the lens. [2]

....

....

7 The diagram shows the incomplete wiring of a power supply (240 V) in a room.

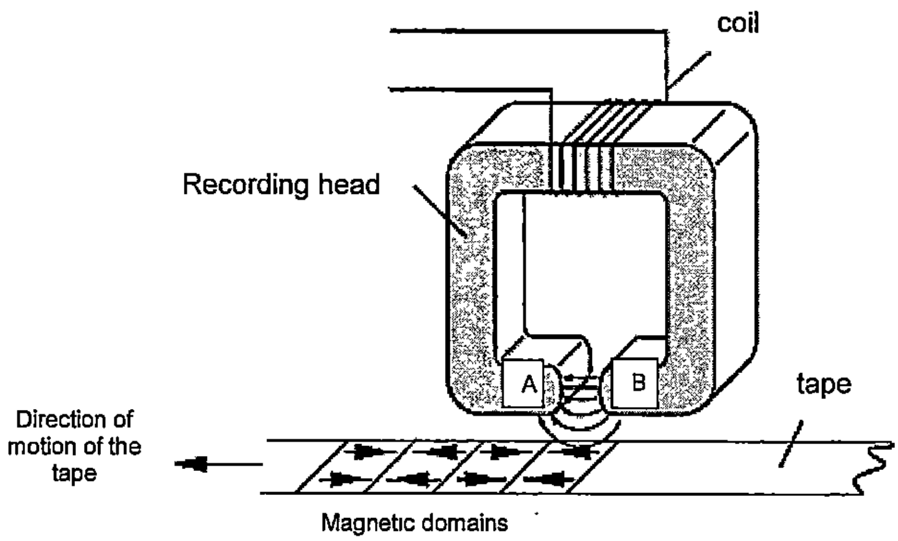


S is the switch for both the lamps L_1 and L_2. L_1 and L_2 are connected in parallel.

P is a power socket. **E**, **L** and **N** stand for Earth, Live and Neutral wires respectively.

Complete the diagram to show the wiring for the lamps and the power socket to the power supply. Include a fuse in the lighting circuit. [4]

8 The diagram shows a piece of recording tape passing under the recording head of a tape recorder at a particular time t_1. An alternating current is passed through the coil. The tape is coated with a magnetic material that becomes magnetised.



(a) **(i)** Determine the pole of the ends A and B of the recording head at t_1.[1]

A = ...

B = ...

(ii) On the diagram, indicate the direction of the current at t_1. [1]

(b) The diagram shows that sections of the tape are magnetised in opposite directions. Explain why they become magnetised in opposite directions. [2]

....

....

....

(c) The tape is moved faster past the recording head. State how this changes the pattern on the tape. [1]

....

....

(d) The direction of the magnetic domains on the recording tape can be used to store data. Explain why iron is not a suitable material to be used for the coating on the recording tape and suggest an alternative material. [3]

....

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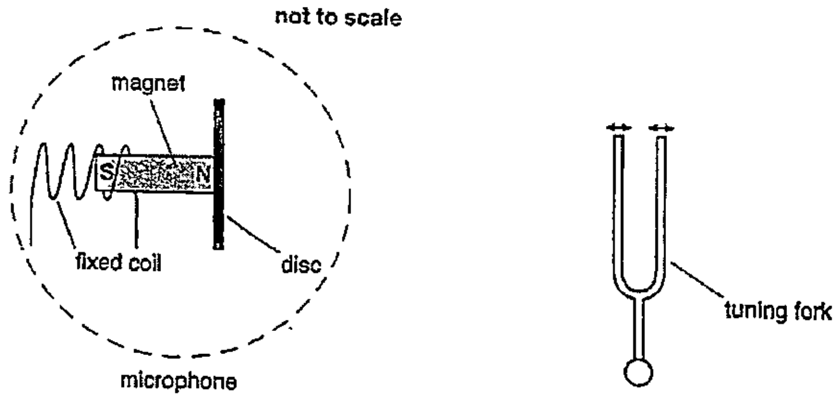
9 The following diagram shows a microphone and a tuning fork.



The microphone contains a small disc attached to a magnet. The coil inside the microphone is fixed in position and does not move.

When the tuning fork vibrates, an alternating e.m.f. is induced in the coil.

Explain in detail how the vibration of the tuning fork induces an e.m.f. in the coil. [4]

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SECTION B (30 marks)

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12.**

10(a) Being under the sun's radiation for a period of time not only gets you hot, but you could also end up with a sunburn. A sunburn is basically the killing or damaging of skin cells by a particular form of ultraviolet (UV) radiation called 'UVB' from the sun.

Clothes can provide some protection from UV radiation. A common way of protecting the skin is to apply sunscreen.

Sunscreen reflects or absorbs UV radiation and blocks it from penetrating into the skin layer. Sunscreens are usually labelled with an SPF, or Sun Protection Factor. The SPF is a multiplying factor which estimates how long the sunscreen could protect you from UVB radiation. Suppose you can stay in the sun for 10 minutes without getting burnt. By applying a sunscreen of SPF 50, you could stay for 500 minutes without getting burnt. The higher the SPF, the more effective it is of reflecting or blocking the UV rays.

(i) State and explain whether dark-coloured or light-coloured clothes offer better protection against UV radiation. [1]

....

....

(ii) Anna intends to spend 3 hours at the beach. She can stay in the sun for 12 minutes without getting burnt.

What is the minimum SPF sunscreen that she should use? Commonly available SPF are 4, 8, 15, 30 and 45. [1]

Minimum SPF = ...

Read this next section and answer parts (iii) to (iv).

UV is part of the spectrum of electromagnetic radiation. UVB has wavelength between 280 to 315 nanometres (nm). Visible light is also part of the spectrum and can be found between 400 to 700 nanometres. UV radiation is reflected by different surfaces. Snow can reflect around 80% of UVB; and beach sand can reflect around 25%.

Figure 10.1 shows the percentage of UV radiation reflected off grass, normal sand, and concrete.

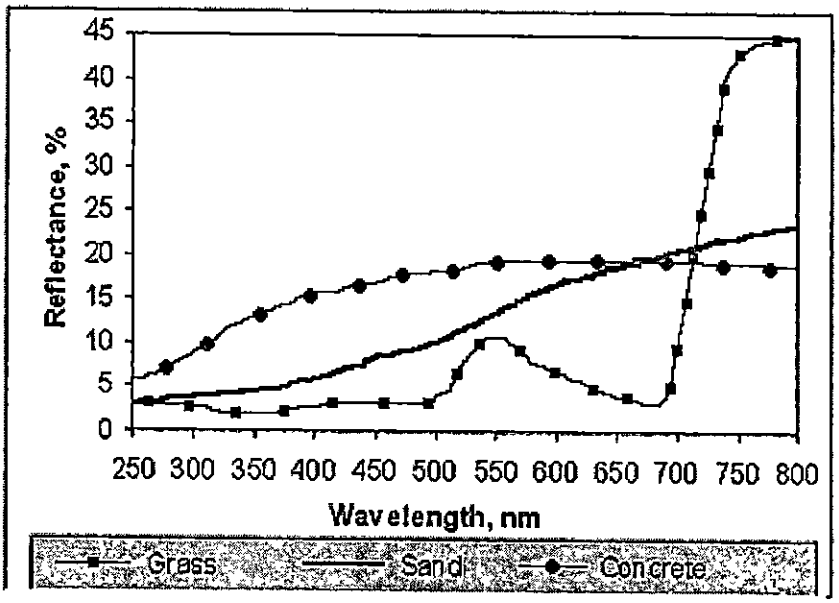

Fig. 10.1

(iii) Rank *snow, beach sand, grass, sand* and *concrete* in order of poorest to best reflector of UV radiation. [1]

....

....

(iv) Suggest why you could get snow-blinded as well as very badly sunburned when skiing. [3]

....

....

....

....

(b) The efficiency of solar energy exists primarily because it takes advantage of renewable energy, the sun, unlike typical energy solutions which use fossil fuels. The efficiency of solar energy harnesses the energy received from the sun and channels it into existing electrical grids.

One way of measuring the efficiency of solar panels is to calculate the percentage of the solar energy that a panel converts into electricity. A typical solar panel converts **15% of the sun's energy into electricity.**

Adapted from: http://www.construction21.eu/articles/h/efficiency-of-solar-energy-harvesting.html

(i) State what is meant by *renewable energy*. [1]

....

....

(ii) 6.44 Wm^{-2} of sunlight falls on a typical solar cell of surface area 2.0 m^2. Calculate the amount of electrical energy harnessed from the sun over a period of 30 hours. [2]

Electrical energy = ...

(iii) Discuss briefly, how, when compared to a conventional fuel, solar powered panels can be considered 'pollution free'. [1]

....

....

11 (a) A veterinarian wants to do some minor surgery on a dog. She sterilizes her instruments, comprising of a scalpel and a hemostat, by immersing them in 2.0 kg of boiling water for 30 minutes. She then quickly transfers the instruments to a well-insulated tray containing 200 g of sterilized water at room temperature (28°C) which fully covers the instruments. After a few minutes, the instruments and water reach the same temperature, y °C.

The mass of the scalpel is 50 g and the mass of the hemostat is 70 g. Both are made from steel with a specific heat capacity of 450 J/kgK. The specific heat capacity of water is 4200 J/kgK.

(i) Determine, in terms of y, the

1. heat lost by the scalpel and hemostat [2]

Heat lost = ...

2. heat gained by the sterilized water [1]

Heat gained = ...

(ii) From **(i)**, write an equation relating the heat exchange between the scalpel, hemostat and water. [1]

....

....

(iii) Hence or otherwise, determine y. [1]

y = ...

(b) The apparatus are set up to determine the specific latent heat of fusion of ice as shown in Fig. 11.1.

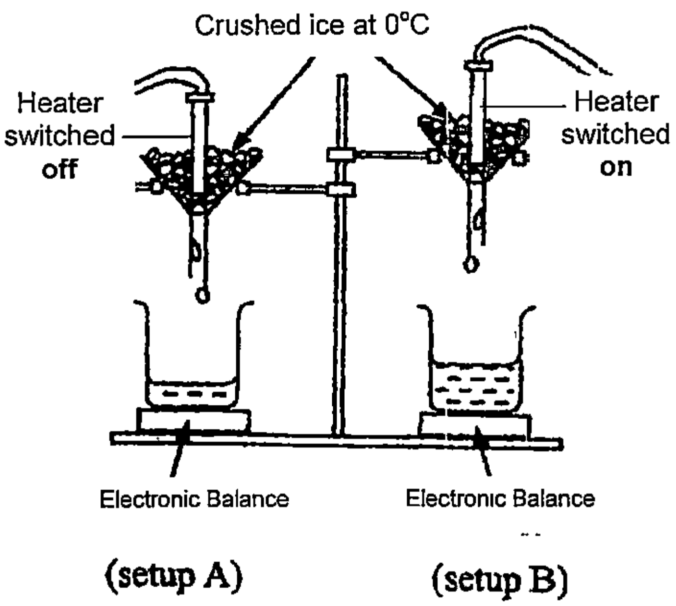

Fig. 11.1

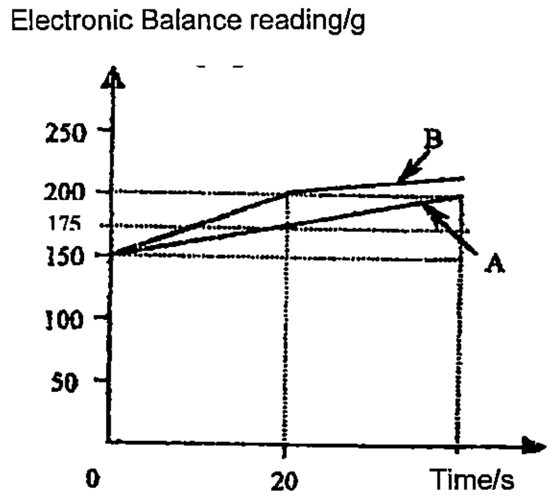

Fig. 11.2

Both setups used similar apparatus and materials. The heater in A is switched off while the heater in B is switched on. The balance readings are recorded at regular time intervals and the results are plotted against time as shown in Fig. 11.2.

(i) State what is meant by the *specific latent heat of fusion* of ice. [2]

....

....

....

(ii) Determine the mass of ice melted by the heater in the first 20 s. [1]

Mass of ice = ...

(iii) If energy is being supplied at a rate of 400 Js^{-1}, calculate the specific latent heat of fusion of ice, assuming that all the energy released from the heater is absorbed by the ice. [2]

Specific latent heat of fusion = ...

12 **EITHER**

(a) Figure 12.1 shows the I-V characteristics of a filament lamp.

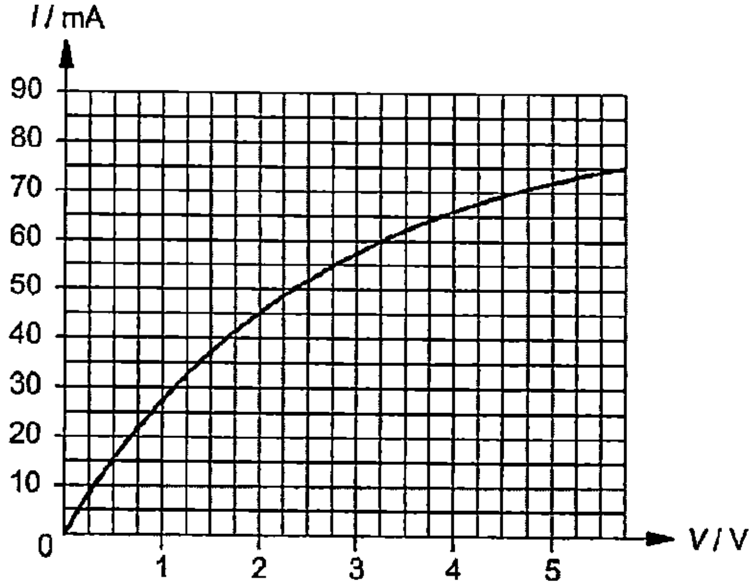

Fig. 12.1

(i) Explain why the filament lamp is a non-ohmic conductor. [1]

....

....

....

(ii) Calculate the resistance of the filament lamp when V = 2.0 V. [2]

Resistance = ...

(b). A thermistor is an input transducer that has a resistance which changes with temperature.

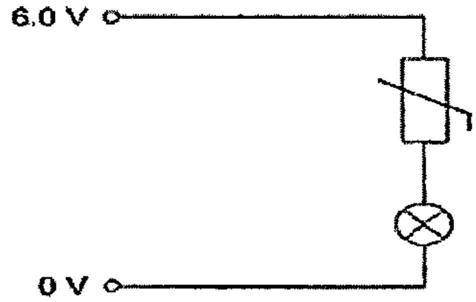

Fig. 12.2

Figure 12.2 shows the filament lamp in (a) connected in series with a thermistor and a 6.0 V source. The thermistor is an NTC (Negative Temperature Coefficient) type.

If the ambient temperature increases, **state** and **explain** whether the resistance of the filament lamp will increase or decrease. [4]

....

....

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....

(c) A thermistor has a resistance of 3 900 Ω at 0°C. It is connected to a circuit as shown in Fig. 12.3 in order to monitor temperature changes.

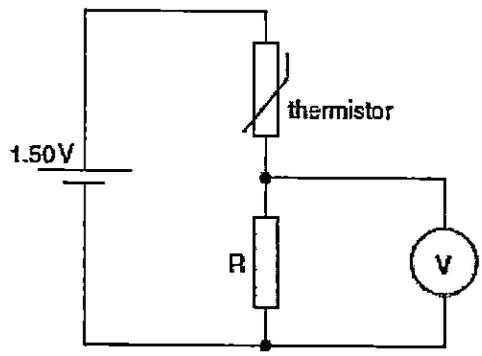


Fig. 12.3

A battery, with negligible internal resistance, has an e.m.f. of 1.50 V. The voltmeter is assumed to be an ideal voltmeter with infinite resistance.

(i) State what is meant by an *e.m.f. of 1.50 V.* [1]

....

....

....

(ii) If the voltmeter has a reading of 1.00 V at 0°C, calculate the resistance of resistor R. [2]

Resistance of resistor R = ...

12 **OR**

A boy of mass 30 kg riding on a skate scooter is shown in Fig. 12.4 below.

Fig 12.4

The boy pushes off with his rear foot momentarily to accelerate. He then cruises for a while and allows resistive forces to slow him down. He then pushes off with his rear foot again. The cycle is repeated.

Fig 12.5 shows how the velocity of the boy changes over the first 6.0 s of his journey.

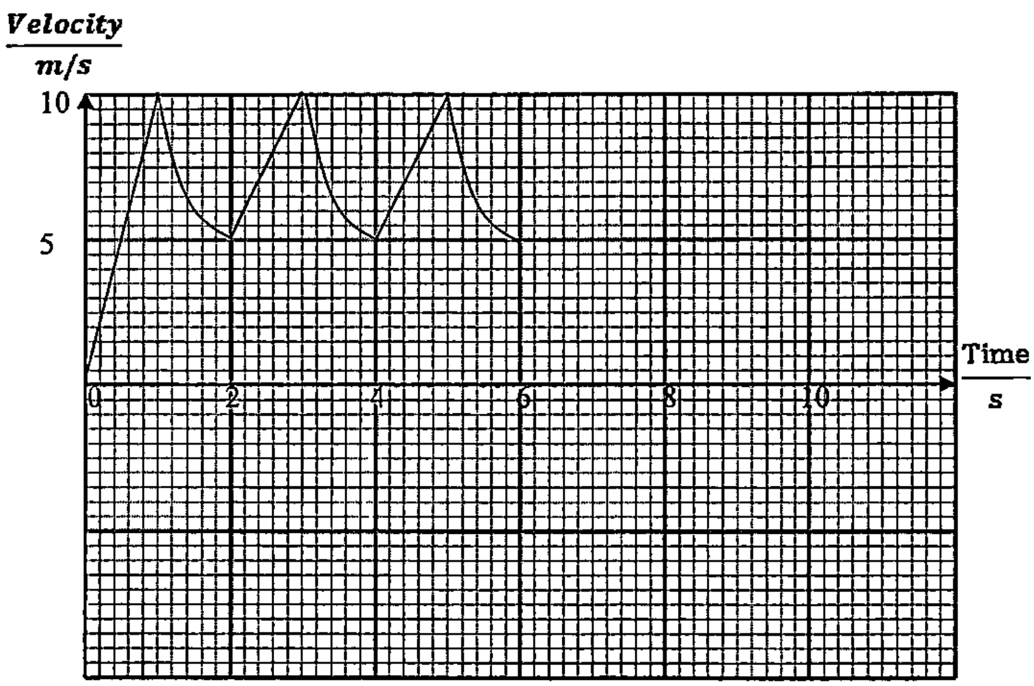


Fig 12.5

(a) Describe the boy's acceleration over the first 2.0 s of his journey. [2]

....

....

....

(b) Determine the

(i) value of the instantaneous velocity at 1.0 s. [1]

Instantaneous velocity = ...

(ii) total displacement at 1.0 s. [1]

Total displacement = ...

(iii) value of the average velocity at 1.0 s. [1]

Average velocity = ...

(c) Calculate the

(i) acceleration of the boy at 0.50 s. [1]

Acceleration = ...

(ii) resultant force of the boy at 0.50 s. [2]

Resultant force = ...

(iii) forward driving force acting on the boy at 0.50 s if the total resistive force acting on him is 5.0 N. [1]

Forward driving force = ...

(d) Describe the other force that is part of an action-reaction pair with the forward driving force calculated in **(c)(iii)**. [1]

....

....

COMMONWEALTH SECONDARY SCHOOL
SECONDARY FOUR EXPRESS PHYSICS
PRELIMINARY EXAMINATION 2015
MARK SCHEME & EXAMINERS' REPORT

Section A (50 marks)

1 **(a)** Force $= m \times g = 100\text{ kg} \times 10\text{ Nkg}^{-1}$
$= \mathbf{1000\ N}$ [1]

(b) **4 seconds** (accept 2 or 3 s.f.) [1]

(c) As sky diver falls, his **speed/velocity increases** [1]
Or: sky diver accelerates
Or: KE increases

(d) **Acceleration decreases** [1]
Resultant force decreases as air resistance increases [1]

Total mark for Q 1 **[5]**

2 **(a)** K.E $= \frac{1}{2}mv^2$
$= \frac{1}{2}(80\text{ kg})(4000\text{ ms}^{-1})^2$ [1]
$= 6.4 \times 10^8\text{ J}$ [1]

(b) $6.4 \times 10^8\text{ J} = mc\Delta\theta$
$6.4 \times 10^8\text{ J} = 80\text{ kg} \times 320\text{ Jkg}^{-1}{}^\circ\text{C}^{-1} \times \Delta\theta$ [1]
$\Delta\theta = 25000^\circ\text{C}$ [1]

e.c.f. from (a)

(c) The satellite would **melt** before this temperature could be reached. [1]
Or: Energy is lost to surrounding.
Or: Not all energy is converted to thermal energy.
Or: Some energy is converted to other forms or heat or light

Total mark for Q2 **[5]**

3 **(a)** **(i)** **76 cmHg** [1]
(ii) Atmospheric pressure is the pressure caused by **the weight of the atmosphere** acting on the **surface of the earth.** [1]
(iii) 76 + 11 = **87 cmHg.** [1]
e.c.f. from (i)

(iv) 76 + 36 = **112 cmHg** [1]
e.c.f. from (i)

Or: 87 cmHg + 25 cmHg
= **112 cm Hg**

e.c.f. from (iii)

Accept unit in mmHg or Pa provided conversion/calculation is correct.

(b) (i) The gas molecules **hit/collide** the mercury and exert a **force** on the mercury. [1]

The **force** that acts on the mercury **per unit area** is the gas pressure. [1]

(ii) Gas molecules **move faster** or possess **greater kinetic energy** [1]
thus colliding on the walls of the manometer (or mercury)
more frequently and
forcefully (or more vigorously or greater force per collision) [1]

Total mark for Q 3 **[8]**

4 **(a)** Transverse waves are waves that **travel in a direction perpendicular to the direction of vibration.** [1]

(b) Speed of wave, v = 15 m / 12.0 s
= **1.25 ms^{-1}** (accept unit as m/s) [1]

(c) L = v / f
= **1.25 ms^{-1} / 0.25 Hz** [1]
= **5.00 m** (accept 2 s.f.) [1]
e.c.f. from (ii)

(d) No, he will not be successful. Since the **depth/medium of the pool remains unchanged,** the speed of the waves will not change. [1]

Total mark for Q4 **[5]**

5 **(a)** $P = V^2 / R$
$R = V^2/P$
= **$(12\ V)^2 / 24\ W$** [1]
= **6.0 Ω** (accept 3 s.f.) [1]

(b) (i) Maximum current $= \frac{12}{6.0}$

= **2.0 A** [1]

Minimum current $= \frac{12}{6+6}$

= **1.0 A** [1]

e.c.f. from (a)

(ii) Maximum current $= \frac{12}{6.0}$

$= \mathbf{2.0\ A}$ [1]

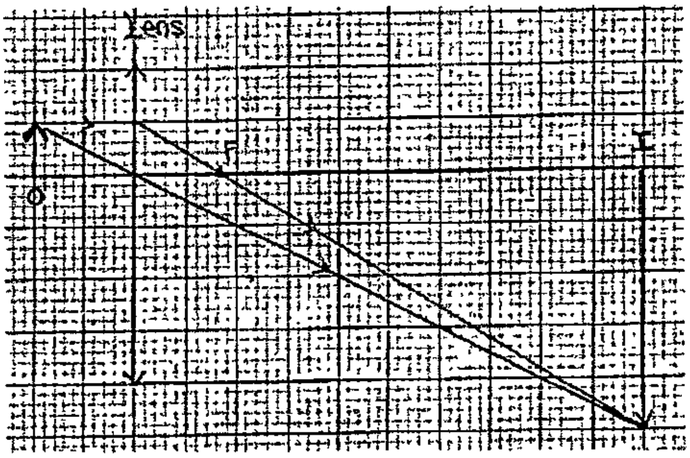
Minimum current $= \dfrac{0}{6.0}$ (accept if working is not written)

$= \mathbf{0\ A}$ [1]

e.c.f. from (a)

Total mark for Q 5 **[6]**

6 **(a)**



focal length in the range **1.5 cm to 1.8 cm** [1] 2 light rays correctly drawn with arrows [1] To penalise if dotted lines are drawn for rays. Correct object and image distances (+/- 0.1 cm) [1]

(b) **No image** is formed on the screen. [1]

The **object distance is smaller than the focal length** of the lens, hence image is **virtual.** [1]

e.c.f. from (a); one mark for description of the image and another mark for correct corresponding explanation.

Total mark for Q 6 **[5]**

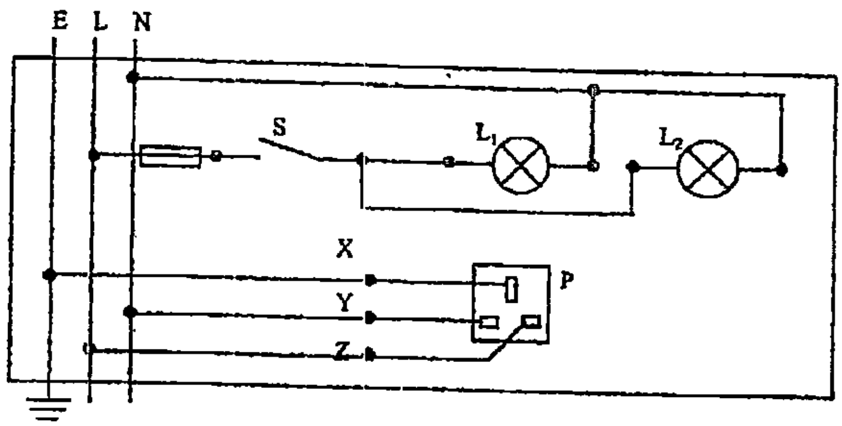
7 **Fuse** on **live** wire [1]
Award mark only if **symbol** of fuse is correctly drawn.

Switch on **live** wire and **controls both** L_1 and L_2 [1]

L_1 and L_2 connected to **both Live and Neutral wire** [1]
To penalize (in third mark) if L_1 and L_2 are not in parallel or if the lamps do not work as intended.

X, Y and Z connected correctly [1]

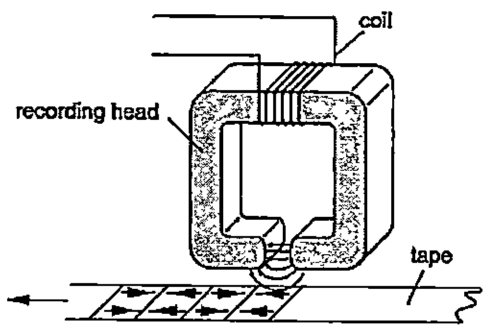
To penalize once for inconsistent use of dots to show connection of wires.



Total mark for Q 7 **[4]**

8 (a) (i) A: South
B: North [1]

(ii) Correct direction for current [1]
e.c.f. from (a) (i)



(b) **Direction of current changes** periodically or current is alternating [1]

Magnetic poles of A and B of the recording head near to the tape also **changes accordingly** and thus, sections of tape are magnetized in opposite direction due to induced magnetism. [1]

Accept: alternating poles or field

(c) **Longer length / sections** of the tape will be magnetized in the same direction. [1]

(d) The tape must **not lose magnetism/does not get demagnetised easily.** [1]
Thus, iron being a **soft magnetic material**, is not suitable as it will **lose its magnetism easily.** [1]

A suitable material will be **steel.** [1]

Total mark for Q 8 **[8]**

9 Any two of the following. One mark each. [2]

- As the tuning fork vibrates, the **air particles/molecules** between the tuning fork and the disc **vibrate to and fro (or left and right)**
  Or: **along the direction of the sound wave**
  Or: **the tuning fork shifts layers of air inward and outward.**

- Sound is **longitudinal wave.**

- Hence creating a series of **compressions and rarefactions.**

As a result, the disc and the magnet **vibrate in and out of the coil.** [1]

This **changes the magnetic field linking the coil** [1]
Or: The **magnetic flux** in the coil **changes**

Total mark for Q9 **[4]**

Section B (30 marks)

10(a) **(i)** **Dark-coloured clothes** as they are **better absorber** of UV **radiation.** [1]

(ii) $(3 \times 60) \mid 12 = \mathbf{15}$
The minimum SPF is **15.** [1]

(iii) Grass, sand, concrete, beach sand, snow [1]

(iv) Snow is a **good reflector** of **UV radiation** (or **light** or **both**), [1]
or Snow can **reflect 80% of UVB.**

When skiing, we are exposed to **more UV radiation** (or **light** or **both**) that is being **reflected by snow** to us. [1]

Our **eyes and skin** receive this additional UV/light hence resulting in snow-blindness and severe sunburn respectively. [1]

(b) **(i)** Renewable energy is defined as energy from sources that **can be replenished** naturally. [1]

(ii) Sun's energy $= 6.44\ \text{Wm}^{-2} \times 2.0\ \text{m}^2 \times (30 \times 3600)\ \text{s}$
$= \mathbf{1.39 \times 106\ J}$ [1]

Electrical Energy harnessed $= 15\ \%$ of 1.39×106 J
$= \mathbf{2.09 \times 10^5\ J}$ [1]

(iii) **Air pollutants** are produced when conventional fuels are burned. [1]
Or: No air pollutants or greenhouse gases produced for solar cells

Total mark for Q 10 **[10]**

11 **(a)** **(i)** **1.** Heat lost by scalpel and hemostat

= **(0.050 kg + 0.070 kg) x (450 J/kgK) x (100°C -*y*)** [1]
= (0.120 x 450 x 100) J - (0.12 x 450 x *y*) J
= **(5 400- 54 *y*) J** or **54(100 –y) J** [1]

Do not penalize if unit is not written.

2. Heat gained by the sterilized water, Q=mcθ
= 0.200 kg x 4 200 J/kgK x (*y*-28°C)
= **(840y - 23 520) J** or **840(y -28) J** [1]

Do not penalize if unit is not written.

(ii) **Heat lost by scalpel and hemostat = heat gained by water** [1]
Accept symbols instead of statement

e.c.f. from (i)

(iii) 5 400 - 54y = 840*y* -23520
5 400 + 23520= 840 *y* + 54 *y*
28920 = 894*y*
y= **32** or **32.3** [1]

Do not penalize if unit for y is written.

e.c.f. from (i) or (ii)

(b)(i) Specific latent heat of fusion of ice is the **amount of thermal energy required** to change **1 kg** of ice from its **solid to liquid state,** without a change in temperature. [2]

[1] for '1 kg' or unit mass
[1] for 'amount of thermal energy required to change from solid to liquid state without a change in temperature'
Deduct one mark if students wrote 'body' or 'substance' instead of 'ice'.

(ii) Mass of ice melted by the heater alone in the first 20 s = 200 g – 175 g
= **25 g** [1]

(iii) Latent heat gained by ice = heat supplied by heater
Specific latent heat of fusion = Pt / m
= **400 J/s × 20s / 25g** [1]
= **320 J/g** [1]
e.c.f. from (b) (ii)

Total mark for Q 11 **[10]**

12 **EITHER**

(a) (i) The current flowing through the filament lamp is **not directly proportional** to the p.d./ **not proportional** to the p.d across it. [1]

(ii) R = V/ I

$= 2.0\ V / 45 \times 10^{-3} A$ [1]
$= 44.4\ \Omega$ [1]

(b) As temperature increases, the **resistance of the thermistor decreases.** [1]

Hence the **p.d. across thermistor decreases**. [1]

Since the e.m.f. is shared between the filament lamp and thermistor, **the p.d. across the filament lamp will increase.** [1]

Based on the I-V graph of the filament lamp, the **resistance of the lamp will increase.** [1]

(c) **(i)** The work done to drive an unit charge through the complete circuit is 1.50 J. [1]

(ii) $[R / (R + 3900\ \Omega)] \times 1.5\ V = 1.0\ V$ [1]
$1.5 R = R + 3900$
$R = 7800\ \Omega$ [1]

Total mark for Q 12 EITHER **[10]**

12 **OR**

(a) From 0 s to 1.0 s: positive **uniform/constant** acceleration [1]
From 1.0 s to 2.0 s: **negative** and **non-uniform** acceleration [1]
Or: Acceleration is non-uniform and becoming less negative.

(b) **(i)** $\mathbf{10\ ms^{-1}}$ [1]

(ii) Total displacement $= ½(1.0\ s)(10\ ms^{-1})$
$= \mathbf{5.0\ m}$ [1]
e.c.f. from (i)

(iii) Average velocity = total displacement/total time
$= 5.0\ m / 1.0\ s$
$= \mathbf{5.0\ ms^{-1}}$ [1]
e.c.f. from (ii)

(c) **(i)** $a = (10\ ms^{-1} - 0\ ms^{-1})/(1.0\ s - 0\ s)$
$= \mathbf{10\ ms^{-2}}$ [1]

Or: $a = (5\ ms^{-1} - 0\ ms^{-1})/(0.5\ s - 0\ s)$
$= \mathbf{10\ ms^{-2}}$

(ii) Resultant force = $\mathbf{30\ kg \times 10\ ms^{-2}}$ [1]
$= \mathbf{300\ N}$ [1]

e.c.f. from (c) (i)

(iii) **300 N = forward force – 5.0 N**
Forward force = **305 N** [1]

e.c.f. from (c) (ii)

(d) (Backward) Force on the floor/ground by the boy [1]

Total mark for Q 12 OR **[10]**

O

GAN ENG SENG SCHOOL
Preliminary 2 Examination 2015

CANDIDATE NAME

CLASS

INDEX NUMBER

PHYSICS
Paper 1 Multiple Choice

5059/01

15 September 2015
1 hour

Sec 4 Express

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number on the OTAS.

There are forty questions in this paper. Answer all questions. For each question there are four possible answers **A**, **B**, **C**, and **D**.
Choose the one you consider correct and record your choice in soft pencil on the separate OTAS.

Read the instructions on the OTAS very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

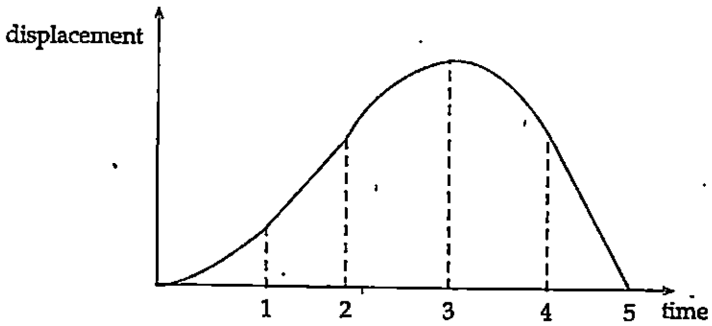
Total Marks
40

1 Which instrument is used to measure directly the circumference of a table tennis ball?

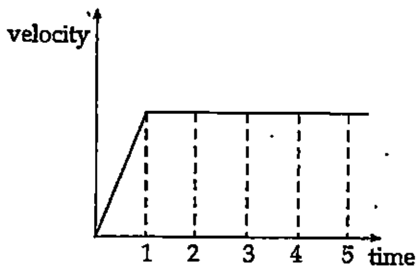
A measuring tape B metre rule

C micrometer D vernier calipers

2 The graph shows the displacement-time graph of the journey of a car.



What is the shape of the velocity-time graph for the journey of the car?

A


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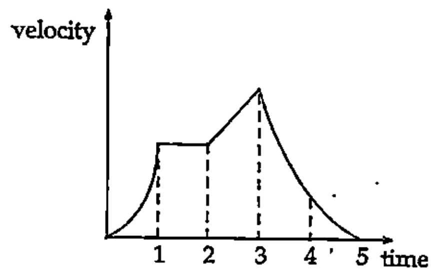
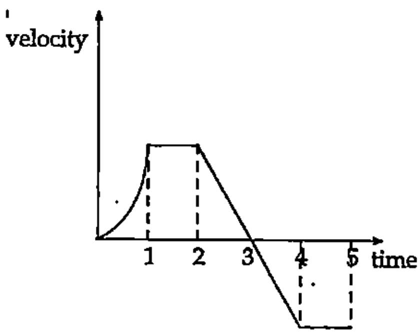


C


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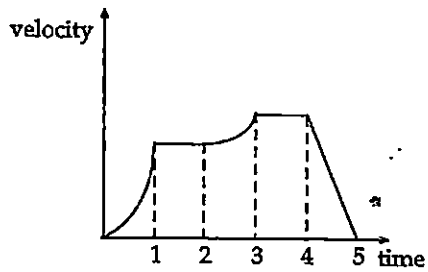


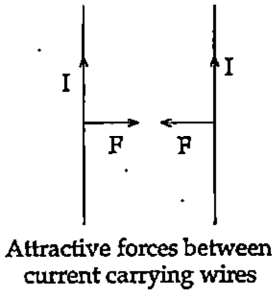
3 A bus travelling at 3 m s^{-1} passes a bus stop. What is the speed of the bus when it has travelled 150 m if it has been accelerating at 2 m s^{-2}?

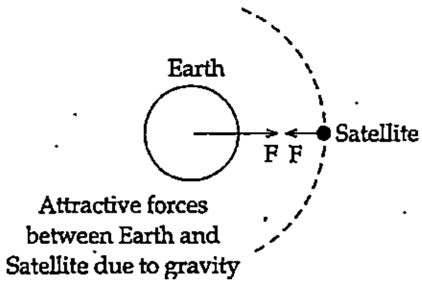
A 25 m s^{-1} B 30 m s^{-1} C 35 m s^{-1} D 50 m s^{-1}

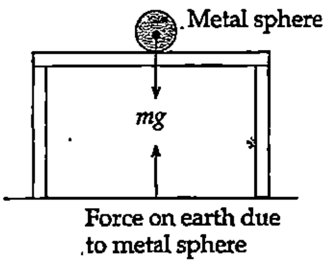
4 At lift off, the mass of the Long March 3C rocket is 3.45×10^5 kg. The rocket engines produce a thrust of 4 443 kN. The gravitational field strength g is 10 N/kg. What is the initial acceleration of the rocket?

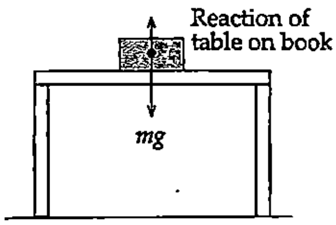
A 0.0777 m s^{-2} B 2.88 m s^{-2} C 1.29 m s^{-2} D 12.9 m s^{-2}

5 Which of the following pairs of forces is not a valid example of action and reaction forces according to Newton's third law of motion?

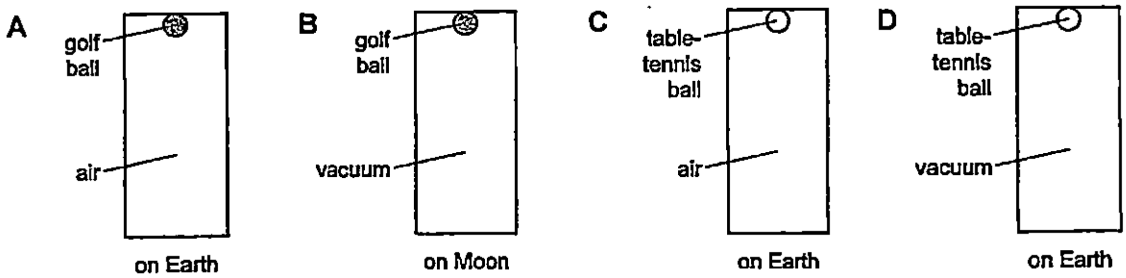
A


B


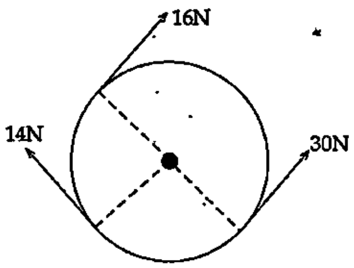
C


D


6 The diagrams show four experiments in which a ball falls from the top to the bottom of identical sealed glass tubes. In which experiment does the ball take the shortest time to reach the bottom of the tube?



7 Three forces of magnitude 14 N, 16 N and 30 N are applied on a wheel as shown.



Which of the statements regarding resultant force and resultant moment are correct?

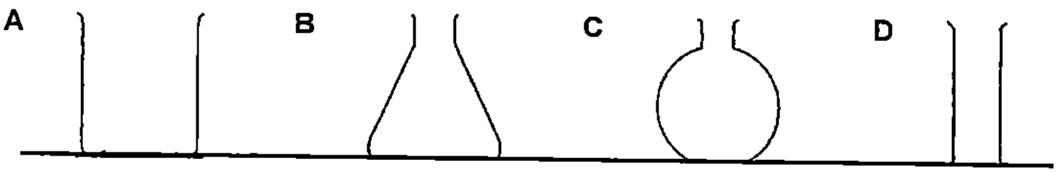
A Both resultant force and resultant moment are non-zero.

B Both resultant force and resultant moment are zero.

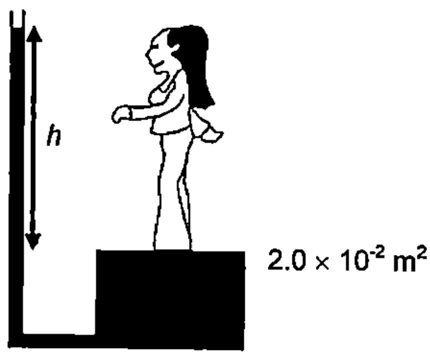
C Resultant force is non-zero but resultant moment is zero.

D Resultant force is zero but resultant moment is non-zero.

8 The diagram shows four containers made from thin glass. Which empty container is the **most** stable?



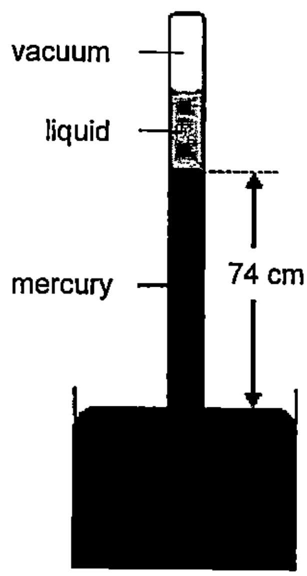
9 The diagram (not drawn to scale) below shows Ziqian of mass 50 kg standing on a platform over the piston of area 2.0×10^{-2} m^2.



What is the height of water h that will just support her? Assume that the density of water is 1 000 kg m^{-3}.

A 0.25 m **B** 2.5 m **C** 5.0 m **D** 10 m

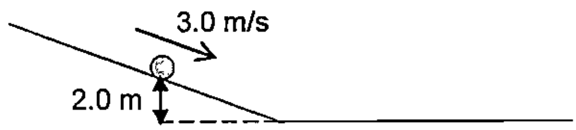
10 The diagram shows a barometer containing a liquid density 1 200 kg m^{-3} above the mercury column. Given that the density of mercury is 13 600 kg m^{-3}.



If the atmospheric pressure is 76 cm Hg, then the height of the liquid is ....

A 2 cm **B** 11.3 cm **C** 22.7 cm **D** 76 cm

11 A ball of mass 400 g rolls down a hill. 2.0 m above the bottom of the hill, the speed of the ball is 3 0 m/s.



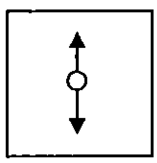
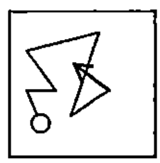
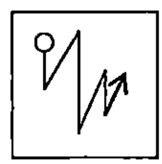
The gravitational field strength g is 10 N/kg. Ignoring the effects of friction and air resistance, what is the kinetic energy of the ball at the bottom of the hill?

A 1.8 J **B** 8.0 J **C** 8.6 J **D** 9.8 J

12 The motor which drives a lift is working at 80 % of its maximum power. The mass of the lift and its load is 500 kg and they are moving vertically upwards at a constant speed of 2 m s^{-1}. What is the maximum power of the motor? (Take g = 10 m s^{-2}.)

A 1 000 W **B** 8 000 W **C** 10 000 W **D** 12 500 W

13 Which one of the following diagrams represents Brownian motion?

A  **B**  **C**  **D** 

14 The pressure of a fixed mass of gas at constant volume is smaller at a lower temperature because ....

A energy transferred to the walls during collision decreases

B molecules travel shorter distances between collisions with one another

C the mean time between molecular collisions becomes shorter

D the molecules collide with the container walls less frequently

15 The bulb of a thermometer is wrapped in a tube of cotton fabric. The fabric is dipped into water at room temperature and left for some time. The thermometer wrapped in wet fabric is then removed and evaporation takes place. What happens to the thermometer reading?

A It falls. **B** It remains unchanged.

C It rises. **D** It rises and then falls.

16 Four bars, all of exactly the same size, are each placed with one end in boiling water. The times taken for the temperature of the other end to increase by 2 °C are measured.

material of bar	time for 2 °C rise / s
aluminium	10
copper	5
cork	800
styrofoam	1 200

To make a large metal tank with the least heat loss, which materials should be used for the walls of the tank and its insulation?

	tank	insulation
A	aluminium	cork
B	aluminium	styrofoam
C	copper	cork
D	copper	styrofoam

17 A heated body is allowed to cool in air. Which of the following statements is **incorrect**?

A Loss of heat at moderate temperatures under ordinary conditions is mainly through convection.

B Loss of heat by conduction through the air is inefficient because air is a bad conductor.

C Loss of heat through radiation is most effective for small temperatures excesses.

D The processes of conduction, convection and radiation are in operation.

18 Which of the following statement(s) is/are **incorrect**?

I An object of higher mass will have higher internal energy than another object of lower mass.

II An object of higher temperature will have higher internal energy than another object of lower temperature

III Two different solid objects of the same mass and temperature will have the same internal energy.

A III only

B I and II only

C I, II and III

D none of the above

19 The energy required to change liquid water into water vapour at the same temperature is called latent heat of vaporisation. What does this energy do?

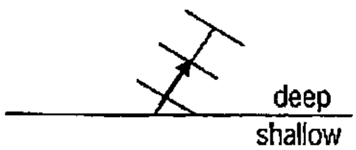
A increases the average separation of the water molecules

B increases the average speed of the water molecules

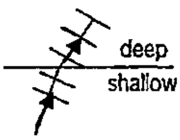
C raises the temperature of the air near the water

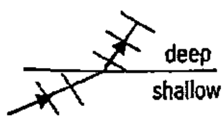
D splits the water molecules into their separate atoms

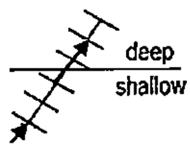
20 The diagram shows planar water waves travelling from shallow water into deep water.

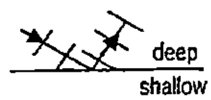


Which one of the following diagrams best describes the water in the shallow water?

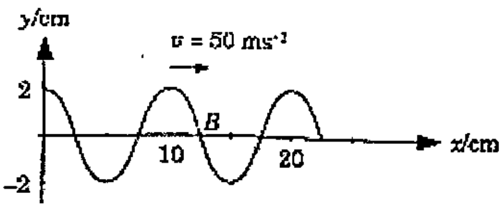
A 

B 

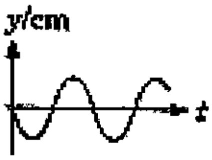
C 

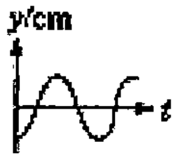
D 

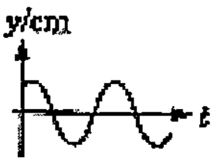
21 The graph represents the shape at a particular instant of part of a transverse wave travelling along a string with a speed of 50 m s^{-1} to the right.

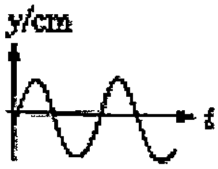


Which of the following graphs represents the subsequent displacement-time relation for particle *B* situated at x = 12.5 cm?

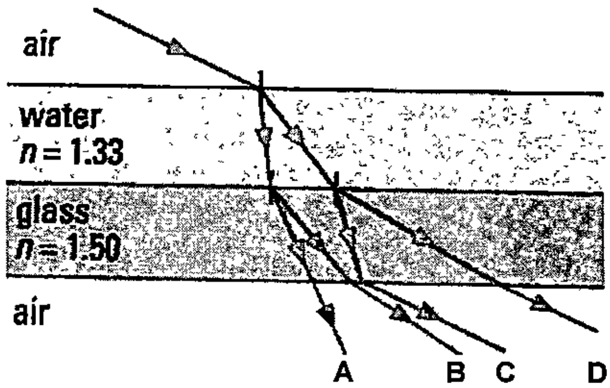
A 

B 

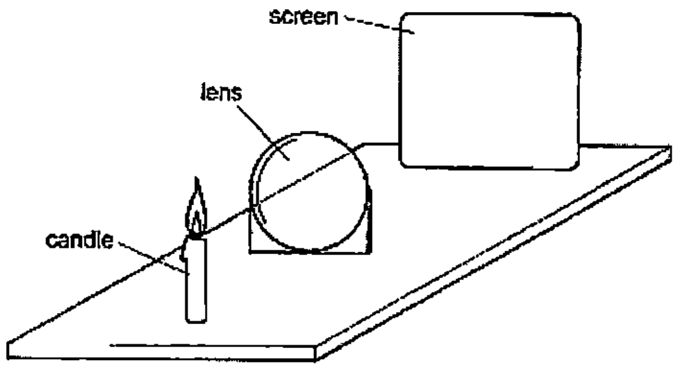
C 

D 

22 The diagram shows a ray of light passing from air through water, from water through glass and finally into air. Which of the following is the path taken by the light ray?



23 A thin converging lens is used to produce, on a screen, a focused image of a candle.



Various focused images are produced on the screen by moving the lens and the screen backwards and forwards. Which statement is **always** correct?

A The image is at the principal focus (focal point) of the lens.

B The image is bigger than the object.

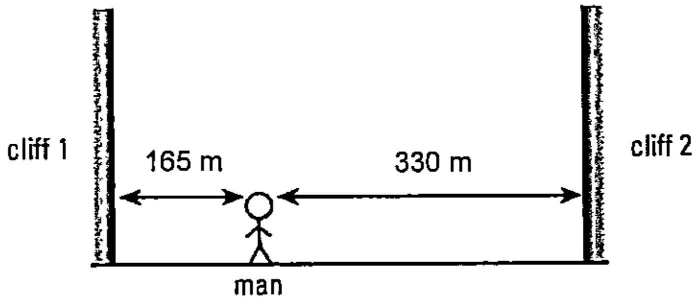
C The image is closer to the lens than the object is.

D The image is inverted.

24 The wavelength of X-rays is roughly the size of an atom. What is the frequency of the X-rays?

A 1×10^{-9} Hz **B** 3×10^{8} Hz **C** 1×10^{9} Hz **D** 3×10^{17} Hz

25 Ryan stands between two tall cliffs as shown in the diagram.



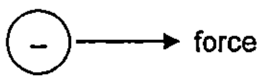
He fires a starting pistol and hears some echoes. Assuming the speed of sound in air is 330 m s^{-1}, what is the time interval between the two loudest echoes?

A 0.5 s **B** 1.0 s **C** 1.5 s **D** 3.0 s

26 Two notes are played on a piano. The second note has a lower pitch but is louder. Which of the following is true of the amplitude and frequency of the second note?

	Amplitude	**Frequency**
A	higher	higher
B	higher	lower
C	lower	higher
D	lower	lower

27 A stationary negative charge in an electric field experiences an electric force in the direction shown.



What is the direction of the electric field?

A horizontally to the left **B** horizontally to the right

C vertically downwards **D** vertically upwards

28 Shernis holds a rod in one hand and rubs the rod with a thin sheet of material held in her other hand. Both the rod and the thin sheet become charged and remain charged. From what could the rod and the thin sheet be made?

	rod	thin sheet
A	copper	silk cloth
B	glass	aluminium foil
C	iron	paper handkerchief
D	nylon	woollen duster

29 Why can birds stand on an overhead high voltage transmission line without suffering any harm?

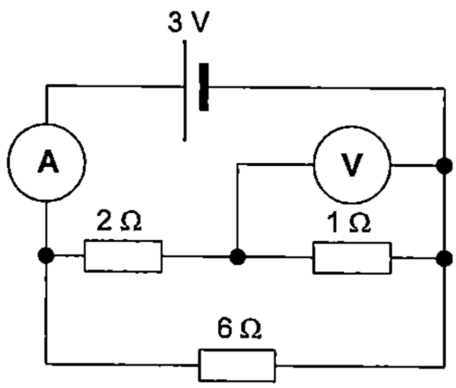
A They are not connected to earth.

B The spaces between their feathers act as insulators.

C Their feet are very good insulators.

D Their bodies have a very high resistance.

30 The circuit diagram shows an ammeter of negligible resistance, a voltmeter of infinite resistance, three resistors and a cell.



What is the ammeter and voltmeter reading?

	ammeter	voltmeter
A	0.5 A	0.5 V
B	1.5 A	1 V
C	3 A	3 V
D	6 A	6 V

31 The diagram shows a long transmission line supplying energy at 230 V to two house X and Y without using transformers In both houses, electric heaters are switched on.

The occupier of house X switches off the heaters in his house. What happens in house Y?

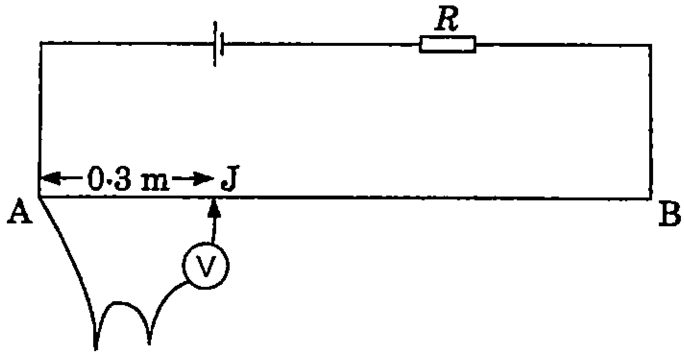
A There is a fall in the voltage supplied and in the power used.

B There is a fall in the voltage supplied but no change in the power used.

C There is a rise in the voltage supplied and in the power used.

D There is a rise in the voltage supplied but no change in the power used.

32 The diagram shows a simple potentiometer circuit adapted to measure the electromotive force (e.m.f.) of a thermocouple.



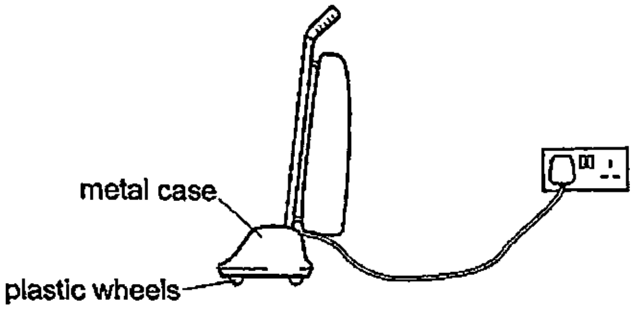
The metre wire AB has a resistance of 5.0 Ω and the cell has an e.m.f. of 2 V. If a balance is obtained 0.3 m along AB when measuring a thermocouple e.m.f. of 6 mV, what is the value of the resistance *R*?

A 95 Ω   B 195 Ω   C 495 Ω   D 995 Ω

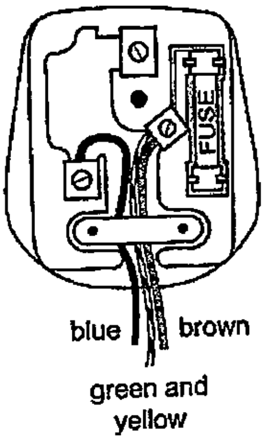
33 A torch light bulb takes a current of 0.2 A from a 1.5 V supply for 3 minutes. How much electrical energy and power is used?

	energy	power
A	0.3 J	54 W
B	0.9 J	7.5 W
C	7.5 J	0.9 W
D	54 J	0.3 W

34 The diagram shows an old vacuum cleaner with plastic wheels and a metal case.



The plug of the vacuum cleaner is wrongly wired as shown.



What is the effect of using the plug wired this way?

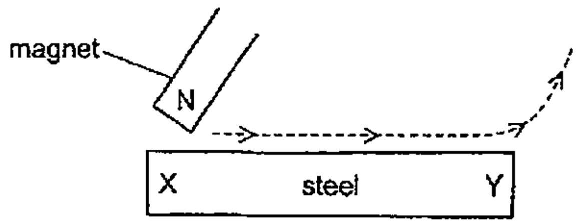
A The fuse in the plug blows.

B The metal case becomes live.

C The vacuum cleaner catches fire.

D The vacuum cleaner does not work.

35 A piece of steel can be magnetised by stroking it with a magnet.



When the magnet is moved in the direction shown, which poles are produced at X and at Y?

	X	Y
A	North	North
B	South	North
C	North	South
D	South	South

36 What correctly describes the field produced in the region surrounding a solenoid that carries a current?

A A region where electric charges gain energy.

B A region where magnetic poles experience a force.

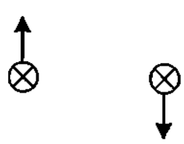
C A region where magnetic poles gain energy.

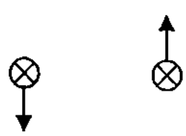
D A region where stationary electric charges experience a force.

37 Each diagram is a cross-section through two parallel current-carrying conductors. In both conductors, the current direction is **into** the plane of the paper. Which diagram shows the forces on the two conductors?

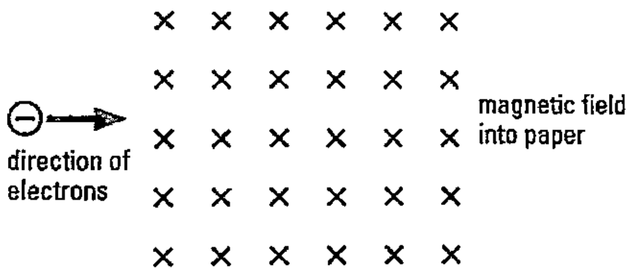
A 

B 

C 

D 

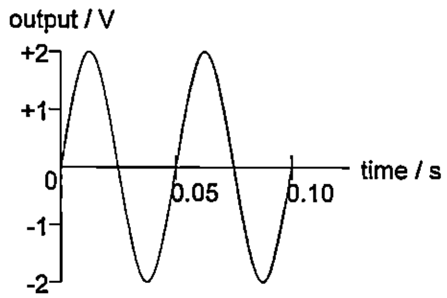
38 The diagram shows a beam of electrons moving into a magnetic field. The direction of the magnetic field is **into** the paper.



As the electron beam passes through the field, in which direction will the electron beam be deflected?

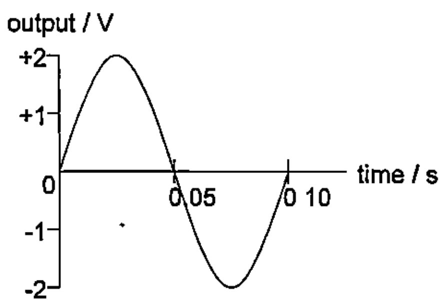
A downwards **B** into the paper **C** out of the paper **D** upwards

39 The graph shows the output of an a.c. generator. The coil in the generator rotates 20 times in one second.

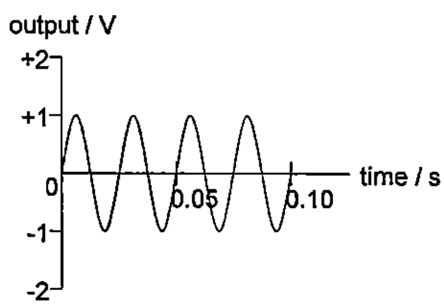


Which graph shows the output when the coil rotates 10 times in one second?

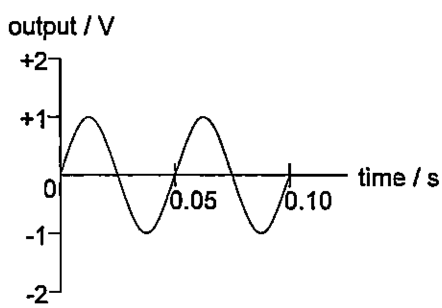
A



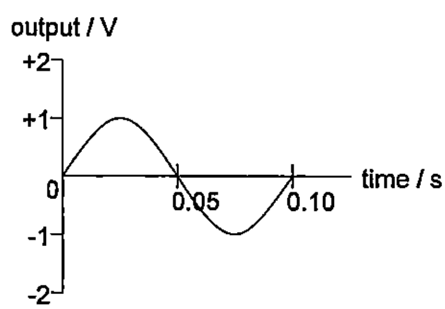
B



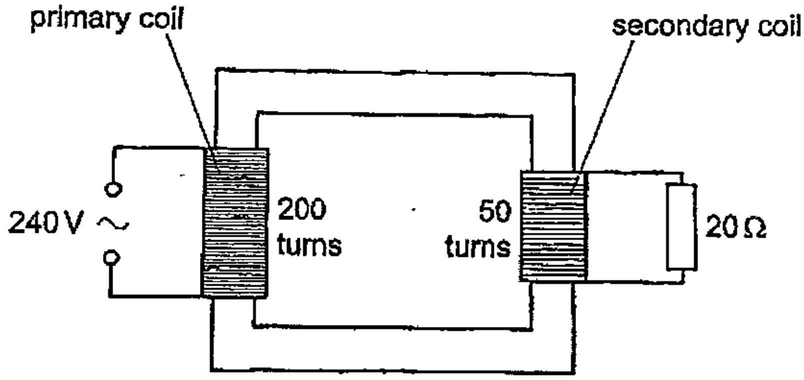
C



D



40 The secondary coil of an ideal transformer is connected to a 20 Ω resistor.

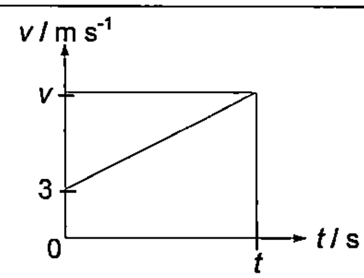


What is the current in the **primary** coil?

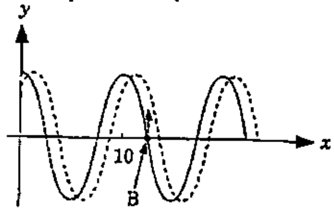
A 0.75 A **B** 1.3 A **C** 3.0 A **D** 12 A

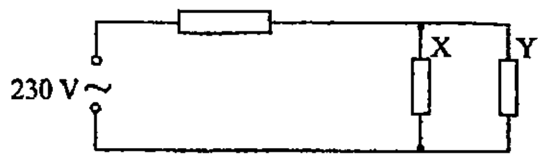
END OF PAPER

GESS Prelim 2 2015 Physics 5059/01

Question	Answer	Explanation
1	A	While vernier calipers can be used to measure the diameter of the table tennis ball and the circumference can be calculated, it is not the direct method. The most direct method would be to use measuring tape.
2	C	gradient of displacement-time graph = velocity
3	A	$a = \frac{v-u}{t}$ $2 = \frac{v-3}{t}$ $t = \frac{v-3}{2}$ area under velocity-time graph = displacement travelled ½ (3 + v) t = 150 $(3+v)\left(\frac{v-3}{2}\right) = 300$ $v^2 - 3^2 = 600$ $v \approx$ <u>25 m s⁻¹</u> 
4	B	Using Newton's 2nd Law, ↑ thrust – weight = mass × acceleration ↑ $(4\,443 \times 10^3) - [(3.45 \times 10^5) \times 10] = (3.45 \times 10^5) \times a$ ↑ $a \approx$ <u>2.88 m s⁻²</u>
5	D	Action and reaction forces cannot be acting on the same body.
6	D	The shortest time taken would be the experiment which has the least air resistance (i.e. vacuum) and the largest acceleration due to gravity (i.e. on Earth and not on Moon).
7	C	Resultant force is non-zero as the directions and magnitudes of the three forces are different. Clockwise moment = $(14 \times r) + (16 \times r)$ Anti-clockwise moment = $(30 \times r)$ ∴ Resultant moment = <u>0 N m</u>
8	B	The most stable container is the one with the broadest base. Both beaker and conical flask have the same base area but conical flask is more stable as its top is narrower than its base.
9	B	$\frac{F}{A} = h\rho g$ $\frac{(50 \times 10)}{(2.0 \times 10^{-2})} = h \times 1000 \times 10$ h = <u>2.5 m</u>

Question	Answer	Explanation
10	C	Liquid pressure = 76 cm Hg – 74 cm Hg = 2 cm Hg $h \times 1\,200 \times 10 = 2 \times 13\,600 \times 10$ h = 22.7 cm
11	D	By the principle of conservation of energy, E_k at the bottom = sum of E_p and E_k at 2.0 m $= mgh + \frac{1}{2}mv^2$ $= (0.4 \times 10 \times 2.0) + (\frac{1}{2} \times 0.4 \times 3.0^2)$ = 9.8 J
12	D	$P = Fv$ $= (500 \times 10) \times 2$ = 10 000 W Maximum power = 10 000 ÷ 0.8 = 12 500 W
13	B	Brownian motion is the haphazard and random motion of gaseous and liquid molecules. The particle won't be able to move in a curvy path for Newton's first law of motion states that an object in motion will continue to move with constant speed in a straight line unless a net force acts on it.
14	D	At lower temperature, molecules have lesser kinetic energy and move slower. Hence, they collide with the container walls less often.
15	A	When water evaporates from the bulb of the thermometer, it takes away thermal energy from the thermometer, thus causing the temperature to fall.
16	B	To reduce heat loss, both the insulation and the metal tank should take a longer time to heat up. The best insulator is styrofoam and should be used as the insulation. For the metal tank, it should be aluminium which is a poorer conductor of heat than copper.
17	C	Radiation losses are significant only when temperature differences between the hot body and the surroundings are large. When moderate temperature differences are considered, convection is a more important process of heat loss.
18	C	The internal energy of an object depends on mass, specific heat capacity and temperature ($Q = mc\Delta\theta$).
19	A	During boiling, the intermolecular bonds are broken, thus their separation increases. However, as there is no change in temperature during boiling, therefore the kinetic energy of the molecules (and hence average speed) is constant.
20	A	When water travels from shallow region to deep region, its speed increases. The spacing between the wavefronts in the shallow region is smaller than that in the deep region. The water waves in the deep region bend away from the normal.

Question	Answer	Explanation
21	C	As the wave progresses to the right, particle at x = 12.5 cm will next be displaced upwards. 
22	C	When light travels from an optically less dense medium to an optically denser medium, it bends towards the normal, and vice versa.
23	D	All real images formed by thin converging lens are inverted.
24	D	X-ray has wavelength between 10 nm and 0.1 nm. Let the wavelength of X-ray be 1×10^{-9} m. Assume the speed of X-ray = 3×10^{8} m/s. Using $v = f\lambda$, $f = (3 \times 10^{8}) \div (1 \times 10^{-9})$ $= \underline{3 \times 10^{17}\ \text{Hz}}$
25	B	The loudest echo must be the first echo. Time taken for the first echo from cliff 1 to reach Ryan = (165 × 2) ÷ 330 = 1.0 s Time taken for the first echo from cliff 2 to reach Ryan = (330 × 2) ÷ 330 = 2.0 s Time interval between the two loudest echoes = 2.0 s – 1.0 s = <u>1.0 s</u>
26	B	The louder the sound, the higher the amplitude is. The lower the pitch of the sound, the lower the frequency is.
27	A	The direction of electric field lines shows the movement of a positive charge when placed in the electric field. Since this is a negative charge which moves to the right, the direction of the electric field must be to the left.
28	D	For both objects to remain charged, they must be insulators.
29	A	Their feet are on the same high voltage transmission line, thus there is no potential difference between them. No current can flow through them. However, if one foot is connected to earth and the other is on the high voltage transmission line, then current will be able to flow through them.

<table>
<tr><th>Question</th><th>Answer</th><th>Explanation</th></tr>
<tr><td>30</td><td>B</td><td>p.d. across 2 Ω and 1 Ω resistors = p.d. across 6 Ω resistor = 3 V
$\therefore$p.d. across 1 Ω resistor = $\frac{1}{(2+1)}\times 3$
$= \underline{1\ \text{V}}$
total current = $\frac{3}{(2+1)}+\frac{3}{6}$
$= \underline{1.5\ \text{A}}$</td></tr>
<tr><td>31</td><td>C</td><td>As it is a long transmission line, there will be a considerable amount of resistance in the transmission line and can be represented in the circuit diagram below.

When the heaters in X are switched off, Y and the transmission line are connected in series.
Since Y has a higher resistance than the total resistance of X and Y, it should have a potential difference (voltage).
Since $P=\frac{V^2}{R}$ and the resistance of Y remains the same while the voltage across Y is larger, the power supplied to Y also increases.</td></tr>
<tr><td>32</td><td>C</td><td>When balanced, V_{AJ} = 6 mV.
$\therefore\ V_{AB} = \frac{1}{0.3}\times 6$
$= 20$ mV
$V_{AB} = \frac{R_{AB}}{R_{total}}\times 2$
$20\times 10^{-3} = \frac{5}{5+R}\times 2$
$R = \underline{495\ \Omega}$</td></tr>
<tr><td>33</td><td>D</td><td>$E = VIt$
$= 1.5\times 0.2\times (3\times 60)$
$= \underline{54\ \text{J}}$
$P = VI$
$= 1.5\times 0.2$
$= \underline{0.3\ \text{W}}$</td></tr>
<tr><td>34</td><td>B</td><td>As the earth wire (green and yellow) which is connected to the metal casing is also touching the live wire (brown), it makes the metal casing live. A user who touches the metal casing would therefore get an electric shock.</td></tr>
<tr><td>35</td><td>C</td><td>During magnetisation by stroking, the end of the magnet that touches the object first will have the same pole.</td></tr>
</table>

Question	Answer	Explanation
36	B	When a current passes through a solenoid, a magnetic field is generated.
37	A	Wires carrying current in the same direction will attract each other.
38	A	Use Fleming's Left Hand Rule. The direction of the electron beam is opposite to the direction of the current.
39	D	When the generator rotates 10 times in one second, its frequency is halved, fewer waves are generated. A lower frequency of rotation reduces the amplitude of the output e.m.f..
40	A	$\frac{N_p}{N_s}=\frac{V_p}{V_s}$ $\frac{200}{50}=\frac{240}{V_s}$ $V_s=\frac{50}{200}\times 240$ $= 60\text{ V}$ current in secondary coil = $\frac{60}{20}$ $= 3\text{ A}$ Since this is an ideal transformer, there is no power loss. $I_pV_p = I_sV_s$ $I_p \times 240 = 3 \times 60$ $I_p = \underline{0.75\text{ A}}$

GAN ENG SENG SCHOOL
Preliminary 2 Examination 2015

O

GESS ONWARD FOUNDED A.D.1885

CANDIDATE NAME	

CLASS			INDEX NUMBER		

PHYSICS
Paper 2

5059/02

1 September 2015
1 hour 45 minutes

Sec 4 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. **Question 12** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	50
Section B	30
Total	80

Section A [50 marks]

For Examiner's Use

Answer **all** the questions in this section.

1 A stone falls from the top of a cliff into the sea, as shown in Fig. 1.1. The speed-time graph for the stone is shown in Fig. 1.2.

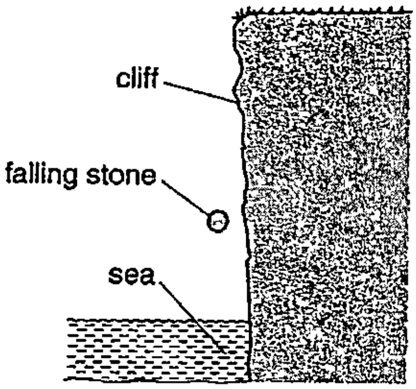


Fig. 1.1

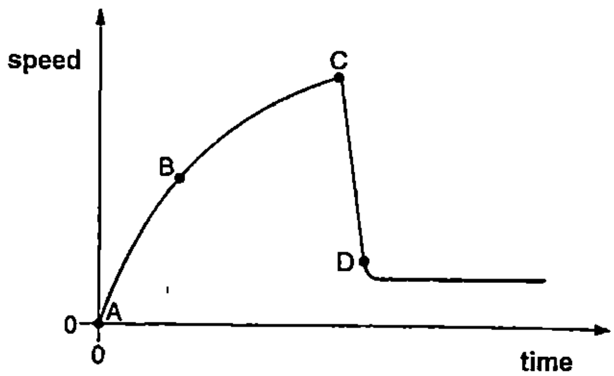


Fig. 1.2

(a) State how the acceleration is found from a speed-time graph.

....

.... [1]

(b) Describe how the acceleration of the stone changes between point A and point D.

....

....

....

....

....

.... [3]

(c) Explain, in terms of the forces acting, why the acceleration changes between point A and point B.

....

....

....

....

....

.... [3]

1 (d) Explain how Fig. 1.2 shows that the stone does not reach terminal velocity in the air.

....

....

....

.... [1]

2 A ball is tied to a string and hung from the ceiling. A steady horizontal wind is blowing against the ball. The mass of the ball is 200 g and the string makes an angle of 15 ° with the vertical as shown in Fig. 2. Draw a scaled diagram to determine the force acting on the ball due to the wind.

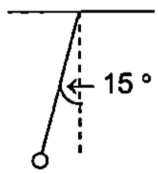


Fig. 2

force acting on the ball due to the wind = ...

[3]

3 Fig. 3.1 shows a helicopter stationary in air. Vertical lift forces are produced by the front rotor and by the back rotor.

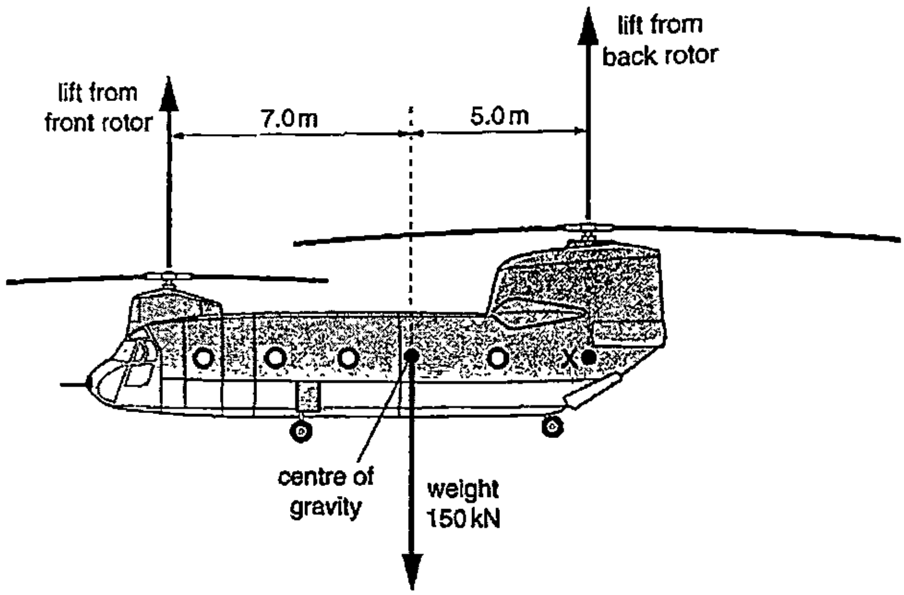


Fig. 3.1

The weight of the helicopter is 150 kN. Horizontal distances are marked on Fig. 3.1.

(a) **(i)** Describe the difference between mass and weight.

....

....

....

.... [1]

(ii) Determine the mass of the helicopter. The gravitational field strength g is 10 N/kg.

mass = ... [1]

For Examiner's Use

3 (b) (i) By taking moments about point X, calculate the lift force from the front rotor.

lift force = ... [2]

(ii) Calculate the lift force from the back rotor.

lift force = ... [1]

(c) The helicopter pilot adjusts the lift forces at the front and back of the helicopter. The front of the helicopter tilts down, whilst the centre of gravity of the helicopter stays at the same height. State how the lift forces from the rotors are adjusted to achieve this effect.

....

....

....

.... [1]

For Examiner's Use

4 A stationary Quah Ting Wen starts to swim by pushing off from the side of a swimming pool, as shown in Fig. 4.1.

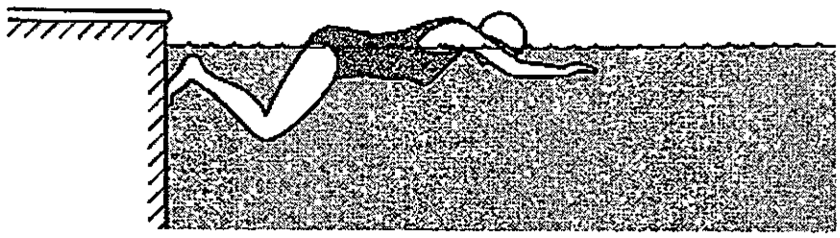


Fig. 4.1

(a) State the useful energy change that occurs as Ting Wen pushes off from the side.

....

.... [1]

(b) Ting Wen has a mass of 60 kg. Calculate her kinetic energy when she is moving at a speed of 0.80 m/s.

kinetic energy = ... [2]

(c) **(i)** Describe how Ting Wen does work on the water.

....

.... [1]

(ii) State what eventually happens to the work done by Ting Wen on the water.

....

.... [1]

For Examiner's Use

5 Fig. 5.1 shows the inner tube of a bicycle tyre, and a bicycle pump.

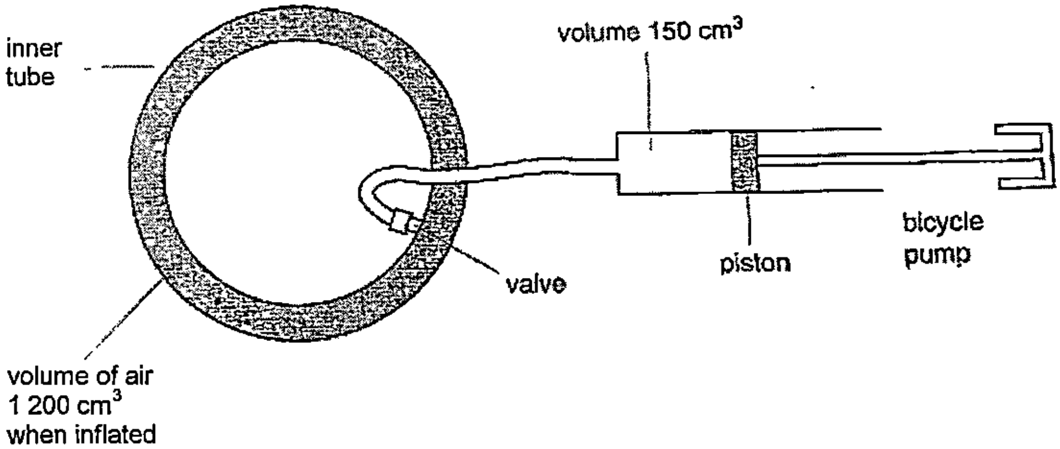


Fig. 5.1

Each stroke of the bicycle pump pushes 150 cm^3 of air at a pressure of 1.0×10^5 Pa from the pump into the inner tube. The inner tube is initially deflated and has no volume. After 10 strokes, the volume of air inside the inner tube is 1 200 cm^3. The temperature of the air remains constant.

(a) Determine the pressure of the air inside the inner tube after 10 strokes. State the formula that you use in your calculation.

pressure = ... [3]

(b) After 10 strokes, more air is pumped into the inner tube. The volume of the air inside the inner tube remains constant. Explain, in terms of the molecules of air, why the pressure inside the tube increases with each stroke.

....

....

....

....

....

.... [2]

6 (a) In an ordinary refrigerator, the freezer is at the top. State the advantage of placing the freezer in this position.

....

....

.... [1]

(b) Explain why the bottom of a saucepan is usually dull and black but its sides are often shiny and polished.

....

....

....

.... [2]

7 Fig. 7.1 gives some information about two types of lamp that can be used in a desk light.

	input electrical power / W	**efficiency %**
filament lamp	40	9
compact fluorescent lamp	10	40

Fig. 7.1

(a) (i) State what is meant by *efficiency*.

....

.... [1]

(ii) Determine which lamp produces the greater useful output power. Show your working. [1]

7 (a) (iii) The desk light is used for 600 hours per year. The cost of 1 kW h is 25 cents. Calculate the saving in cost of using the 10 W lamp for one year rather than the 40 W lamp.

saving = ... [3]

(b) The filament lamp emits electromagnetic radiation with a range of wavelengths. Fig. 7.2 shows the energy emitted per second at each wavelength.

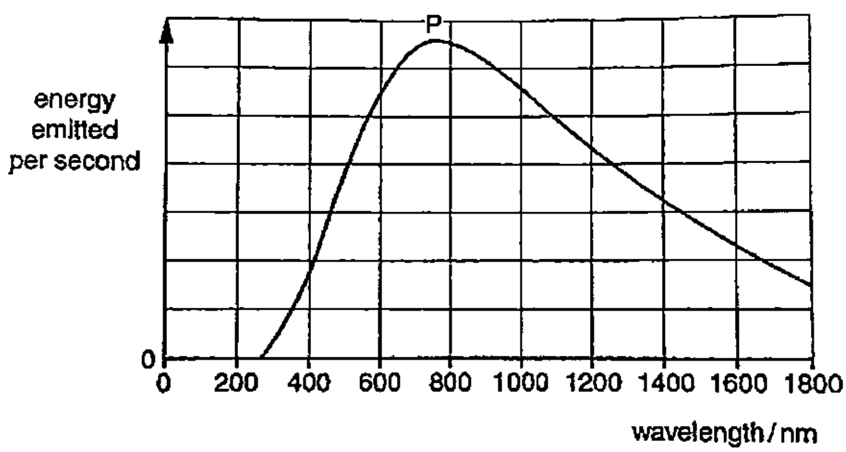


Fig. 7.2

The wavelength of visible light is between 400 nm and 700 nm.

(i) The point P on Fig. 7.2 shows the wavelength at which most energy is emitted. State the component of the electromagnetic spectrum that contains this wavelength.

.... [1]

(ii) Use Fig. 7.2 to explain why the efficiency of the filament lamp is low.

....

....

.... [1]

For Examiner's Use

7 (b) (iii) The glass of the filament lamp transmits about 96 % of all radiation with a wavelength greater than 400 nm. Rilwan suggests using less absorbent glass in the filament lamp. He suggests that the efficiency of the filament lamp will then be close to the efficiency of the fluorescent lamp. Explain whether the suggestion is correct.

....

....

.... [1]

8 A perfectly lagged container of negligible heat capacity contains 80 g of water and 20 g of ice at 0 °C. The specific heat capacity of water is 4.2 J g^{-1} $°C^{-1}$ and the specific latent heat of fusion of ice is 336 J g^{-1}.

(a) Calculate the total amount of energy required to melt the ice and raise the temperature of all the water to 30 °C. [3]

(b) If the heating coil is rated at 200 W, calculate the time taken to melt the ice and raise the temperature of all the water to 30 °C. [2]

For Examiner's Use

9 **(a)** A liquid is 45 cm deep and its refractive index is 1.25.

(i) Calculate its apparent depth when viewed from the top. [1]

(ii) Calculate the critical angle of the liquid. [1]

(iii) The speed of light in air is 3.0×10^8 m s^{-1}. Calculate the speed of light in the liquid. [1]

(b) Draw two rays on Fig. 9.1 to locate the image. Label the image as *I*. [3]

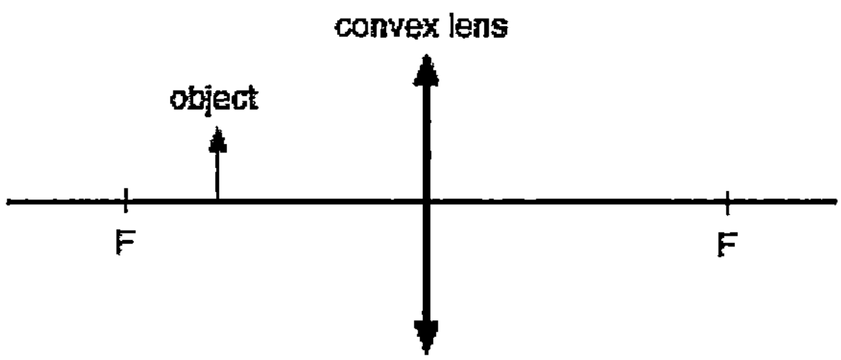


Fig. 9.1

State all the three characteristics of the image formed by the thin converging lens as shown in Fig. 9.1.

.... [1]

For Examiner's Use

Section B [30 marks]

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 12.**

10 Jade wanted to build a temperature probe so she set up the circuit as shown in Fig. 10.1.

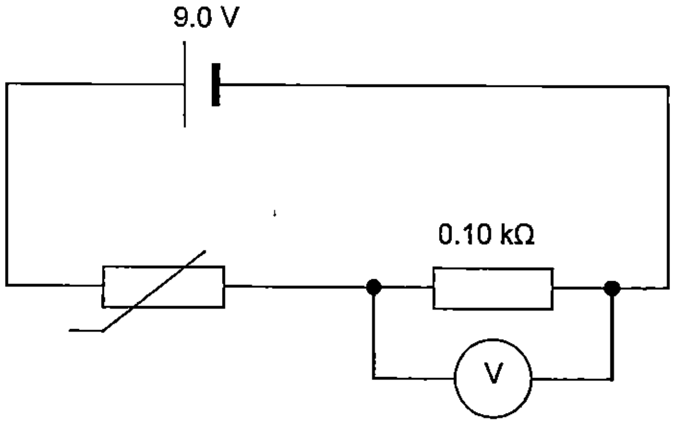


Fig. 10.1

The battery has e.m.f. 9.0 V and negligible internal resistance and the voltmeter has infinite resistance. The calibration curve for the thermistor is shown in Fig. 10.2.

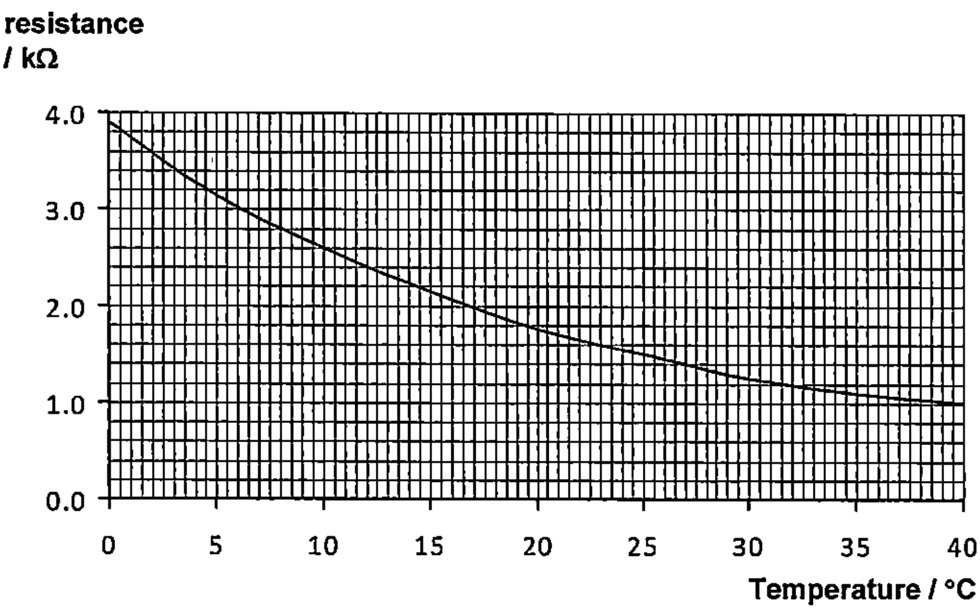


Fig. 10.2

10 Joey decided to modify the temperature probe designed by Jade in Fig. 10.1 and set up the circuit shown in Fig. 10.3.

She replaced the battery with an a.c. supply of 50 Hz which has a peak voltage 9.0 V. The circuit also includes a diode and the voltage output V_0 across the terminals M, N are connected to the Y-plates of a CRO.

As the same thermistor is used, the calibration curve in Fig. 10.2 is still valid.

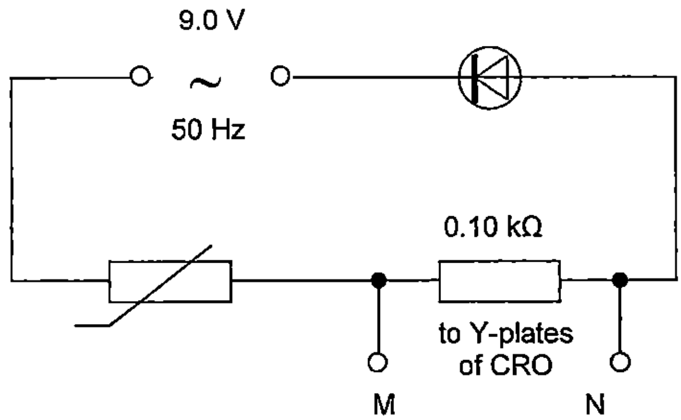


Fig. 10.3

Before using the probe to measure temperature, Joey investigated theoretically the results. A spreadsheet is used to make the calculations below.

She inputs: the temperature (T),

the corresponding resistance (R_T) of the thermistor,

the resistance (R) of the fixed resistor and

the peak voltage (V_P) of the supply.

	A	B	C	D	E	F
1	Temperature of thermistor	Resistance of thermistor	Resistance of fixed resistor	Peak voltage of supply	Current through thermistor	Voltage output to CRO
2	T / °C	R_T / k Ω	R / k Ω	V_P / V	I / mA	V_0 / V
3	0	3.90	0.10	9.0	2.3	0.23
4	5	3.15	0.10	9.0	2.8	0.28
5	10	2.60	0.10	9.0	3.3	0.33
6	15	2.15	0.10	9.0	4.0	0.40
7	20	1.75	0.10	9.0	4.9	0.49
8	25	1.50	0.10	9.0	5.6	0.56
9	30	1.25	0.10	9.0	6.7	0.67
10	35	1.10	0.10	9.0	7.5	0.75

For Examiner's Use

10 **(a)** How are the values in **column B** obtained?

....

.... [1]

(b) Giving an example in each case, explain how the calculations are performed to find

(i) the current values in **column E**, and

....

....

....

....

....

.... [3]

(ii) the voltage output values in **column F**.

....

....

....

.... [2]

(c) Joey dipped the probe into water at 15 °C and the output voltage is connected to the CRO. The time base of the CRO is 5.0 ms cm^{-1} and the Y-sensitivity is 0.20 V cm^{-1}. Draw and explain the shape of trace seen on the CRO screen in Fig. 10.4. [4]

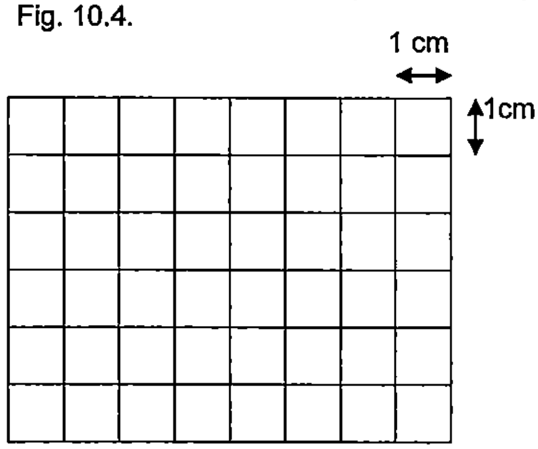


Fig.10.4

....

....

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....

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....

For Examiner's Use

11 Fig.11.1 shows how the currents in a lamp L and in a wire W vary with the potential difference (p.d.) applied.

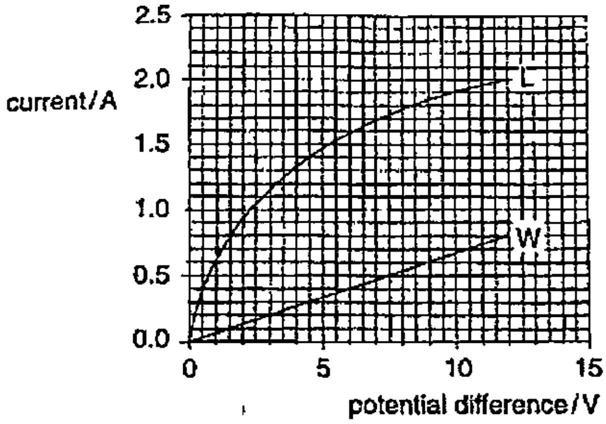

Fig. 11.1

(a) Describe how the resistance of lamp L varies as the p.d. increases.

....

....

.... [1]

(b) Fig. 11.2 shows the lamp and the wire connected in series. The current is 0.8 A.

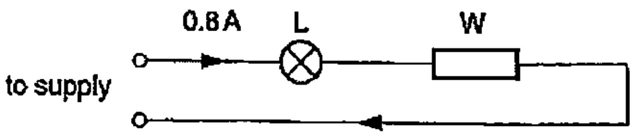

Fig. 11.2

(i) Use the graph to determine the p.d. of the supply.

p.d. = ... [2]

(ii) Calculate the resistance of the lamp L in the circuit shown in Fig. 11.2.

resistance = ... [2]

For Examiner's Use

11 **(c)** Fig. 11.3 shows the lamp and the wire connected in parallel. A p.d. of 12 V is connected across them.

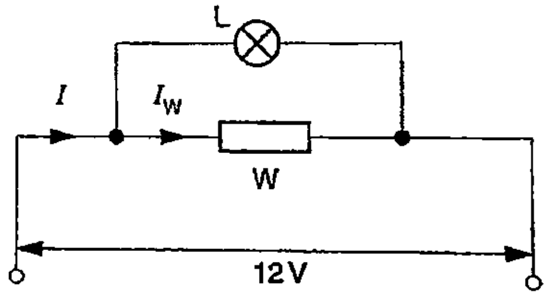

Fig. 11.3

(i) Use the graph to determine the current I_w in the wire W.

current = ... [1]

(ii) Use the graph to determine the current I in the circuit.

current = ... [2]

(iii) Calculate the resistance of the wire W.

resistance = ... [1]

(iv) Calculate combined resistance of the lamp and wire in the parallel circuit of Fig.11.3.

resistance = ... [1]

For Examiner's Use

12 EITHER

(a) Fig. 12.1 shows a d.c. motor. Fig. 12.2 shows how the moment acting on the coil depends on time.

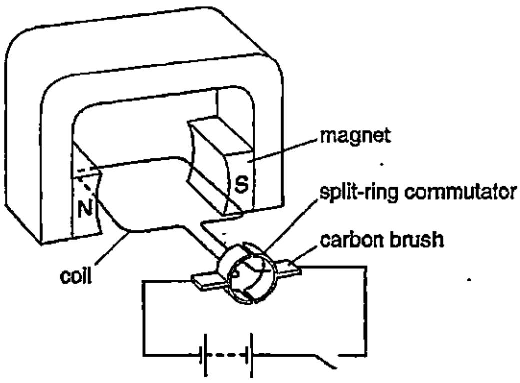

Fig. 12.1

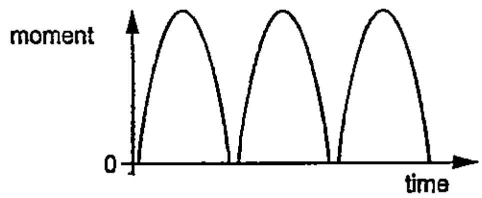

Fig. 12.2

The coil is horizontal, as shown in Fig. 12.1.

(i) Explain why the coil turns when the switch is closed.

....

....

....

.... [2]

(ii) Explain why the coil continues to turn in the same direction when it has turned 180 °.

....

....

....

.... [2]

(iii) On Fig. 12.2, mark with a letter H one time when the coil is horizontal. [1]

(iv) The e.m.f. of the battery is increased. State two changes that this causes to Fig. 12.2.

1. ....

2. .... [2]

For Examiner's Use

12 **(b)** Fig. 12.3 shows a setup to illustrate how the wind power can be used to generate electricity When the wind blows, the blades of the generator turn, causing the magnet to turn.

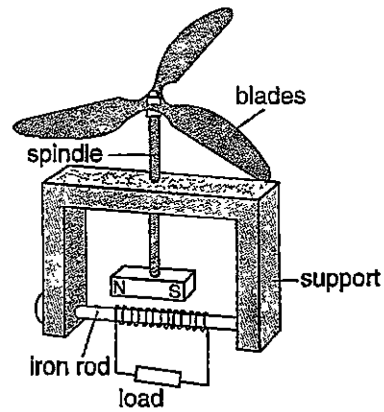

Fig. 12.3

(i) Explain how electricity can be generated when the blades turn.

....

....

....

.... [2]

(ii) State one advantage of a rotating magnet generator over a rotating coil generator.

....

.... [1]

For Examiner's Use

12 OR

(a) Fig. 12.4 shows a beam of positively charge particles passing between the poles of a powerful U-shaped electromagnet.

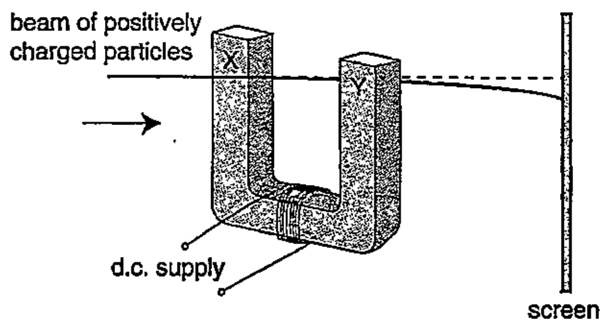

Fig. 12.4

(i) State the polarity of the magnet at X and Y.

.... [1]

(ii) State the material that the magnet can be made of and explain your answer.

....

....

....

.... [2]

(iii) Explain why the power supply must be a direct current and show the direction of the current in Fig. 12.4.

....

....

....

.... [2]

(iv) Suggest two ways to increase the distance through which the beam is deflected.

....

....

....

.... [2]

For Examiner's Use

12 (b) The generators at a power plant produce a voltage of 25 000 V. For long distance transmission, on overhead power lines, this is stepped up to 480 000 V. It is later stepped down to 240 V for domestic use.

(i) Explain why the voltage is stepped up for long distance transmission.

....

....

....

.... [2]

(ii) Calculate the ratio of the number of turns in the primary coil to the number of turns in the secondary coil for the transformer used to step down the power for domestic use. [1]

END OF PAPER

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GAN ENG SENG SCHOOL
Preliminary 2 Examination 2015

CANDIDATE NAME

CLASS

INDEX NUMBER

Marking Scheme

PHYSICS
Paper 2

5059/02

1 September 2015
1 hour 45 minutes

Sec 4 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. **Question 12** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	50
Section B	30
Total	80

This paper consists of 20 pages including the cover page

Section A [50 marks]

For Examiner's Use

Answer **all** the questions in this section.

1 A stone falls from the top of a cliff into the sea, as shown in Fig. 1.1. The speed-time graph for the stone is shown in Fig. 1.2.

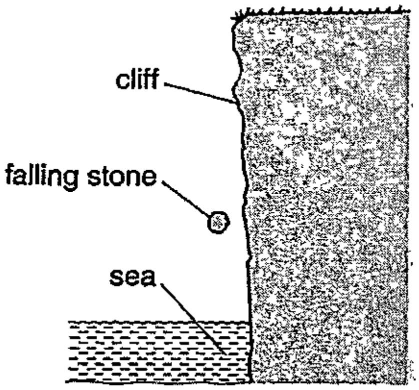


Fig. 1.1

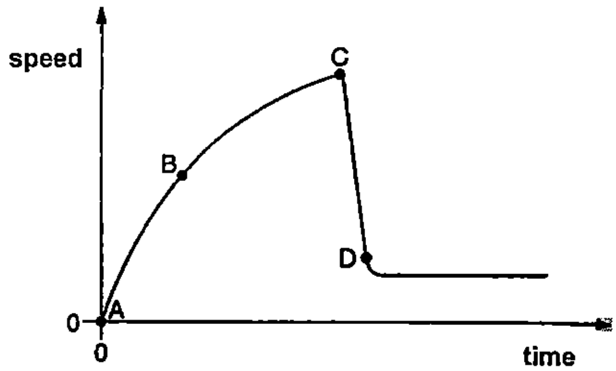


Fig. 1.2

(a) State how the acceleration is found from a speed-time graph.

The acceleration is the gradient of the speed-time graph. [B1]

(b) Describe how the acceleration of the stone changes between point A and point D.

From A to C, the acceleration of the stone decreases as the gradient of the graph decreases. [B1] **From C to D, the acceleration of the stone is negative and constant.** [B1] **The constant deceleration in CD is greater than the decreasing acceleration in AC.** [B1]

(c) Explain, in terms of the forces acting, why the acceleration changes between point A and point B.

When the stone is falling, its weight is acting downwards while air resistance acts against it. [B1] **As the stone's speed increases from A to B, there is also increasing upward air resistance.** [B1] **Since the stone's weight remains the same, the resultant downward force is reduced, thus resulting in decreasing acceleration.** [B1]

(d) Explain how Fig. 1.2 shows that the stone does not reach terminal velocity in the air.

The stone hits the water at C. From the graph, the stone does not have a constant velocity from A to C, thus showing that the stone does not reach the terminal velocity in the air. [B1]

2 A ball is tied to a string and hung from the ceiling. A steady horizontal wind is blowing against the ball. The mass of the ball is 200 g and the string makes an angle of 15 ° with the vertical. Draw a scaled diagram to determine the force acting on the ball due to the wind.

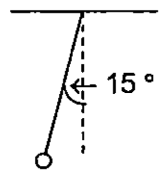
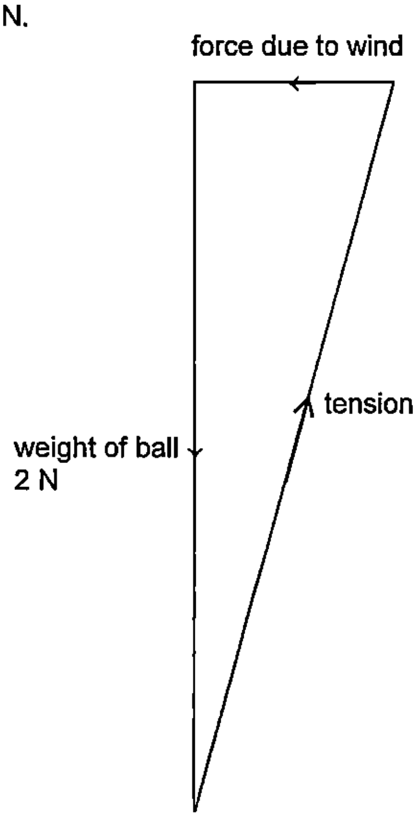


Fig. 2

Let 1 cm represent 0.2 N.



force acting on the ball due to the wind = **<u>0.54 ± 0.02 N</u>** [B1]

[B1] for drawing the weight of the ball ↓ to scale
[B1] for drawing the enclosed right-angled triangle to scale

For Examiner's Use

3 Fig. 3.1 shows a helicopter stationary in air. Vertical lift forces are produced by the front rotor and by the back rotor.

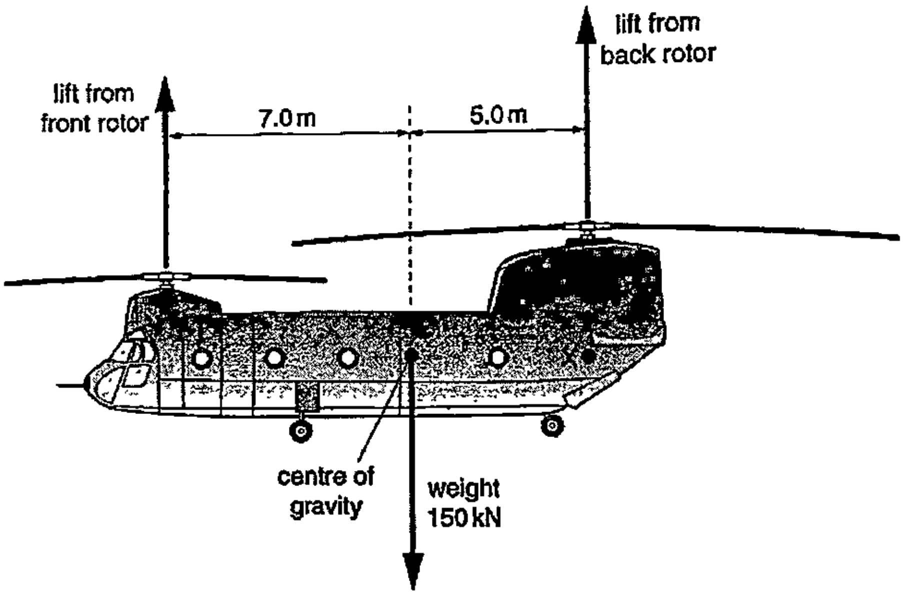


Fig. 3.1

The weight of the helicopter is 150 kN. Horizontal distances are marked on Fig. 3.1.

(a) **(i)** Describe the difference between mass and weight.

Mass is the amount of matter in an object but weight is the gravitational force acting on the object. [B1]

Can also accept other differences as long as there is a comparison between mass and weight.

(ii) Determine the mass of the helicopter. The gravitational field strength g is 10 N/kg.

$$W = mg \Rightarrow m = \frac{W}{g}$$
$$= \frac{(150 \times 10^3)}{10}$$
$$= 15\ 000 \text{ kg}$$

mass = **15 000 kg** [B1]

For Examiner's Use

3 (b) (i) By taking moments about point X, calculate the lift force from the front rotor.

By the principle of moments,
total clockwise moments about X = total anti-clockwise moments by X
$F \times (7.0 + 5.0) = (150 \times 10^3) \times 5.0$ [M1]
$F = 62\ 500$ N

lift force = **62 500 N** [A1]

(ii) Calculate the lift force from the back rotor.

↑ lift force from the front and back rotors = weight of helicopter
↑ lift force from the back rotor + 62 500 = 150×10^3
↑ lift force from the back rotor = 87 500 N

lift force = **87 500 N** [B1]

(c) The helicopter pilot adjusts the lift forces at the front and back of the helicopter. The front of the helicopter tilts down, whilst the centre of gravity of the helicopter stays at the same height. State how the lift forces from the rotors are adjusted to achieve this effect.

For the front of the helicopter to tilt down, the lift from the front rotor must be reduced, while the lift from the back rotor is increased to keep its centre of gravity at the same height. [B1]

For Examiner's Use

4 A stationary Quah Ting Wen starts to swim by pushing off from the side of a swimming pool, as shown in Fig. 4.1.

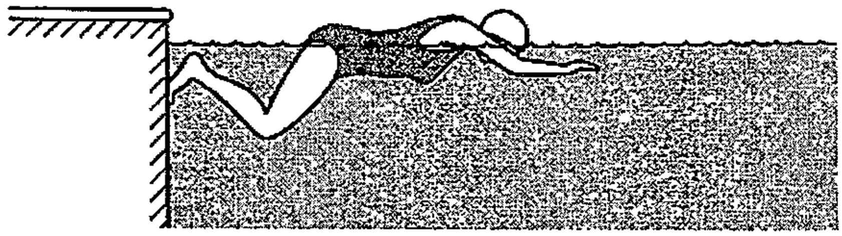


Fig. 4.1

(a) State the useful energy change that occurs as Ting Wen pushes off from the side.

Chemical potential energy is converted to kinetic energy. [B1]

(b) Ting Wen has a mass of 60 kg. Calculate her kinetic energy when she is moving at a speed of 0.80 m/s.

$E_k = ½ mv^2$
$= ½ \times 60 \times 0.80^2$ [M1]
$= 19.2$ J

kinetic energy = **19.2 J** [A1]

(c) (i) Describe how Ting Wen does work on the water.

She does work on the water to overcome the water resistance and to push aside the water so that she can pass through the water. [B1]

(ii) State what eventually happens to the work done by Ting Wen on the water.

The work done on the water is converted to kinetic energy of the water and eventually converted to thermal energy of the water. [B1]

For Examiner's Use

5 Fig. 5.1 shows the inner tube of a bicycle tyre, and a bicycle pump.

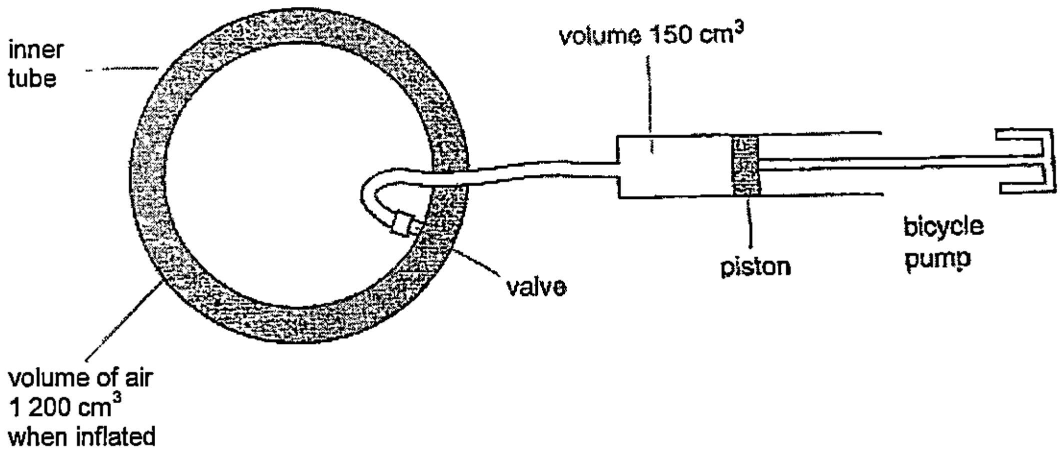


Fig. 5.1

Each stroke of the bicycle pump pushes 150 cm^3 of air at a pressure of 1.0×10^5 Pa from the pump into the inner tube. The inner tube is initially deflated and has no volume. After 10 strokes, the volume of air inside the inner tube is 1 200 cm^3. The temperature of the air remains constant.

(a) Determine the pressure of the air inside the inner tube after 10 strokes. State the formula that you use in your calculation.

$P_1V_1 = P_2V_2$ [B1]
$(1.0 \times 10^5) \times (10 \times 150) = P_2 \times 1\,200$ [M1]
$P_2 = 125\,000$ Pa

pressure = **125 000 Pa** [A1]

(b) After 10 strokes, more air is pumped into the inner tube. The volume of the air inside the inner tube remains constant. Explain, in terms of the molecules of air, why the pressure inside the tube increases with each stroke.

By pumping more air molecules into the inner tube and keeping the volume constant, the space between the air molecules become smaller. The number of air molecules per unit volume increases. [B1] **Hence, the frequency of molecules hitting the wall of the tube increases. The pressure increases because more molecules per second hit the tyre walls.** [B1]

For Examiner's Use

6 **(a)** In an ordinary refrigerator, the freezer is at the top. State the advantage of placing the freezer in this position.

The space below the freezer is cooled by convection currents of the cooled air from the freezer. [B1]

(b) Explain why the bottom of a saucepan is usually dull and black but its sides are often shiny and polished.

The bottom of a saucepan is dull and black so as to be good absorbers of radiation for the content in the saucepan to heat up quickly. [B1] **The sides of the saucepan are often shiny and polished so as to be poor emitters of radiation to minimise heat lost to the surroundings.** [B1]

7 Fig. 7.1 gives some information about two types of lamp that can be used in a desk light.

	input electrical power / W	efficiency %
filament lamp	40	9
compact fluorescent lamp	10	40

Fig. 7.1

(a) **(i)** State what is meant by *efficiency*.

Efficiency is the ratio of the amount of useful output power to the total input power. [B1]

(ii) Determine which lamp produces the greater useful output power. Show your working. [1]

output power of filament lamp $= \frac{9}{100} \times 40$
$= 3.6\text{ W}$

output power of compact fluorescent lamp $= \frac{40}{100} \times 10$
$= 4\text{ W}$

Compact fluorescent lamp produces greater useful output power. [B1]

(iii) The desk light is used for 600 hours per year. The cost of 1 kW h is 25 cents. Calculate the saving in cost of using the 10 W lamp for one year rather than the 40 W lamp.

Saving in cost $= \left[\left(\frac{40}{1000} \times 600\right) \times \$0.25\right] - \left[\left(\frac{10}{1000} \times 600\right) \times \$0.25\right]$ [M1, M1]
$= \$4.50$

saving = **$4.50** [A1]

For Examiner's Use

7 (b) The filament lamp emits electromagnetic radiation with a range of wavelengths. Fig. 7.2 shows the energy emitted per second at each wavelength.

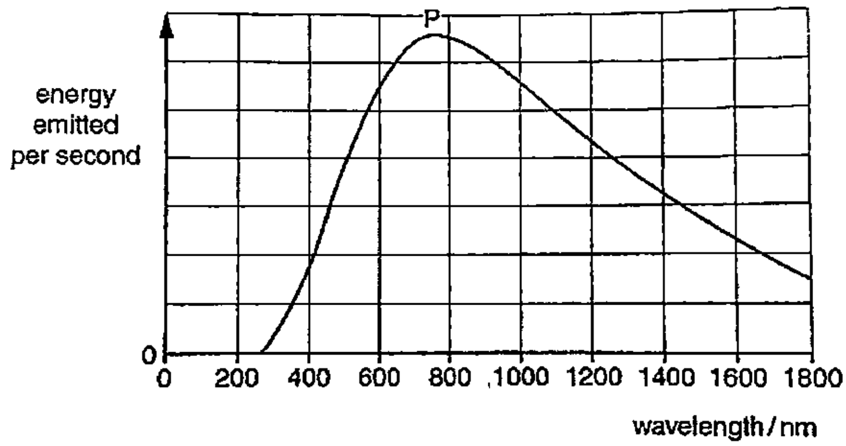


Fig. 7.2

The wavelength of visible light is between 400 nm and 700 nm.

(i) The point P on Fig. 7.2 shows the wavelength at which most energy is emitted. State the component of the electromagnetic spectrum that contains this wavelength.

infrared [B1]

(ii) Use Fig. 7.2 to explain why the efficiency of the filament lamp is low.

Much of the energy emitted by the filament lamp is in the infrared region which is thermal energy and not useful as a lamp. [B1]

(iii) The glass of the filament lamp transmits about 96 % of all radiation with a wavelength greater than 400 nm. Rilwan suggests using less absorbent glass in the filament lamp. He suggests that the efficiency of the filament lamp will then be close to the efficiency of the fluorescent lamp. Explain whether the suggestion is correct.

The suggestion is not correct. The current efficiency of filament lamp is 9 % which means only 9 % of the energy input is being transmitted as visible light. Even if the glass allows for 100 % transmission of radiation, it would not increase the efficiency to 40 % which is the efficiency of the compact fluorescent lamp. [B1]

For Examiner's Use

8 A perfectly lagged container of negligible heat capacity contains 80 g of water and 20 g of ice at 0 °C. The specific heat capacity of water is 4.2 J g^{-1} $°C^{-1}$ and the specific latent heat of fusion of ice is 336 J g^{-1}.

(a) Calculate the total amount of energy required to melt the ice and raise the temperature of all the water to 30 °C. [3]

20 g of ice at 0 °C → 100 g of water at 0 °C → 100 g of water at 30 °C

Total amount of energy = (20 × 336) + [(20 + 80) × 4.2 × 30] [M1, M1]
= 19 320 J
= **<u>19 300 J</u>** [A1]

(b) If the heating coil is rated at 200 W, calculate the time taken to melt the ice and raise the temperature of all the water to 30 °C. [2]

time taken = 19 320 ÷ 200 [M1]
= **<u>96.6 s</u>** [A1]

For Examiner's Use

9 (a) A liquid is 45 cm deep and its refractive index is 1.25.

(i) Calculate its apparent depth when viewed from the top. [1]

$$n = \frac{\text{real depth}}{\text{apparent depth}}$$

apparent depth = 45 ÷ 1.25
= **36 cm** [B1]

(ii) Calculate the critical angle of the liquid. [1]

$$\sin c = \frac{1}{n}$$

c = **53.1 °** [B1]

(iii) The speed of light in air is 3.0×10^8 m s^{-1}. Calculate the speed of light in the liquid. [1]

$$n = \frac{\text{speed of light in air}}{\text{speed of light in liquid}}$$

speed of light in liquid = $(3.0 \times 10^8) \div 1.25$
= **2.4×10^8 m s^{-1}** [B1]

(b) Draw two rays on Fig. 9.1 to locate the image. Label the image as *I*. [3]

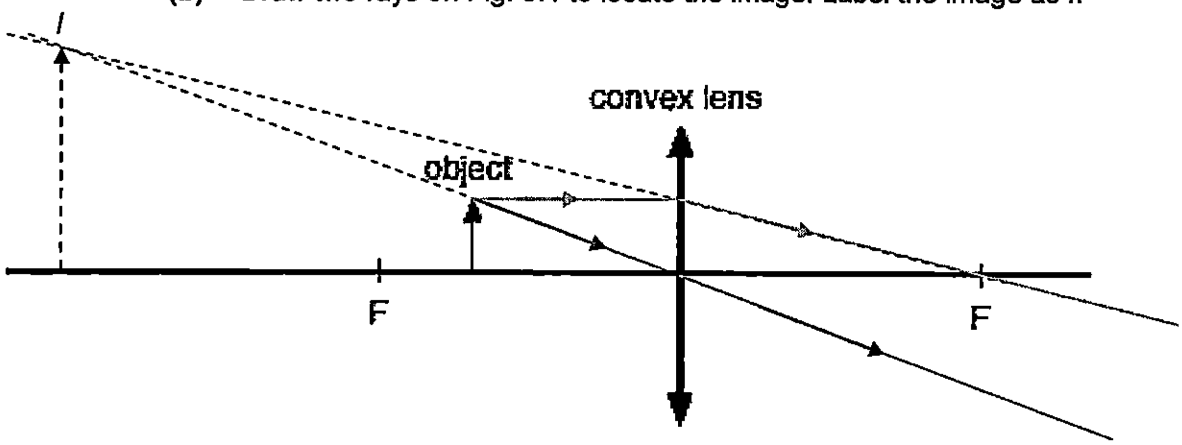


Fig. 9.1

[B1] for each correct light ray drawn
[B1] for drawing and labelling image (dotted lines) correctly

State all the three characteristics of the image formed by the thin converging lens as shown in Fig. 9.1.

The image is virtual, upright and magnified. [B1]

Section B [30 marks]

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 12**.

10 Jade wanted to build a temperature probe so she set up the circuit as shown in Fig. 10.1.

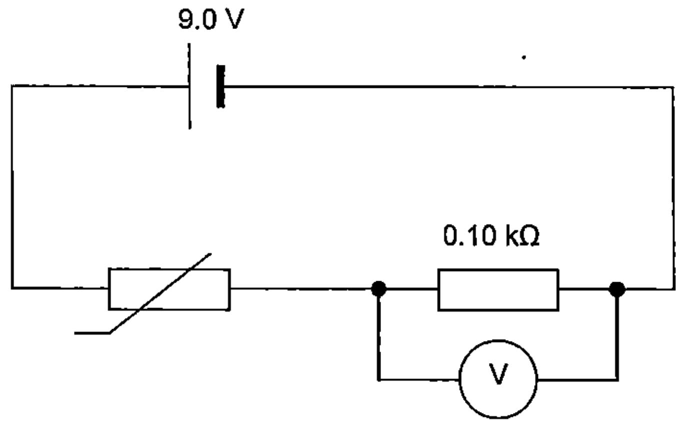


Fig. 10.1

The battery has e.m.f. 9.0 V and negligible internal resistance and the voltmeter has infinite resistance. The calibration curve for the thermistor is shown in Fig. 10.2.

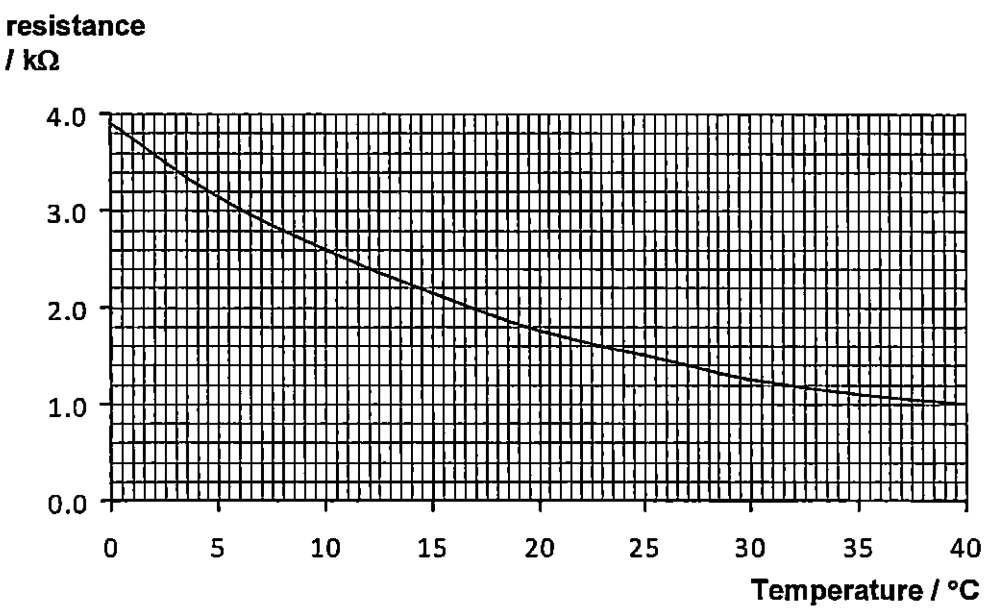


Fig. 10.2

For Examiner's Use

10 Joey decided to modify the temperature probe designed by Jade in Fig. 10.1 and set up the circuit shown in Fig. 10.3.

She replaced the battery with an a.c. supply of 50 Hz which has a peak voltage 9.0 V. The circuit also includes a diode and the voltage output V_0 across the terminals M, N are connected to the Y-plates of a CRO.

As the same thermistor is used, the calibration curve in Fig. 10.2 is still valid.

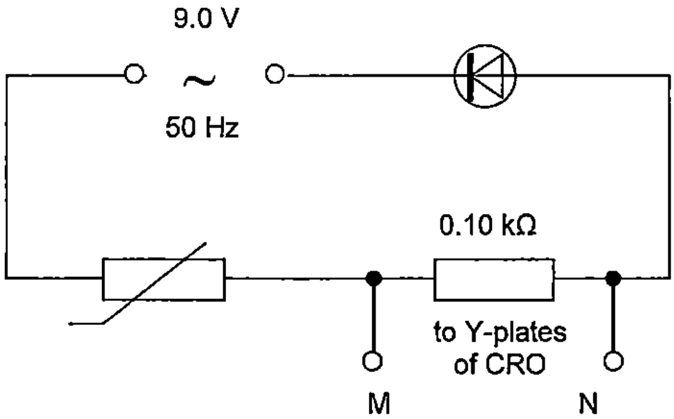


Fig. 10.3

Before using the probe to measure temperature, Joey investigated theoretically the results. A spreadsheet is used to make the calculations below.

She inputs: the temperature (T),

the corresponding resistance (R_T) of the thermistor,

the resistance (R) of the fixed resistor and

the peak voltage (V_P) of the supply.

	A	B	C	D	E	F
1	Temperature of thermistor	Resistance of thermistor	Resistance of fixed resistor	Peak voltage of supply	Current through thermistor	Voltage output to CRO
2	T / °C	R_T / k Ω	R / k Ω	V_P / V	I / mA	V_0 / V
3	0	3.90	0.10	9.0	2.3	0.23
4	5	3.15	0.10	9.0	2.8	0.28
5	10	2.60	0.10	9.0	3.3	0.33
6	15	2.15	0.10	9.0	4.0	0.40
7	20	1.75	0.10	9.0	4.9	0.49
8	25	1.50	0.10	9.0	5.6	0.56
9	30	1.25	0.10	9.0	6.7	0.67
10	35	1.10	0.10	9.0	7.5	0.75

For Examiner's Use

10 (a) How are the values in **column B** obtained?

They are read from the calibration curve in Fig. 10.2. [B1]

(b) Giving an example in each case, explain how the calculations are performed to find

(i) the current values in **column E**, and

Use $I = \dfrac{V_P}{R_T + R}$ [B1]

e.g. E3 = D3 / (B3 + C3) [B1]

The calculation is repeated down the column. [B1]

(ii) the voltage output values in **column F**.

Use $V_0 = \dfrac{R}{R_T + R} \times V_P$ or $V_0 = I \times R$ [B1]

e.g. F3 = (C3 / (B3 + C3) * D3 or F3 = E3 * C3 [B1]

The calculation is repeated down the column.

(c) Joey dipped the probe into water at 15 °C and the output voltage is connected to the CRO. The time base of the CRO is 5.0 ms cm^{-1} and the Y-sensitivity is 0.20 V cm^{-1}. Draw and explain the shape of trace seen on the CRO screen in Fig. 10.4. [4]

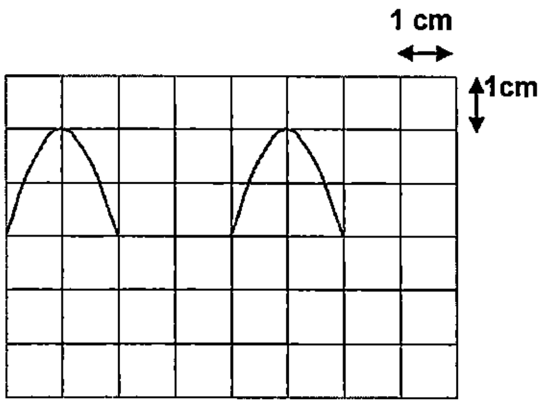


Fig.10.4

shape [B1]

positive part the curve is shown, negative part is not shown [B1]

vertical height = 2 cm (because voltage = 0.40 V) [B1]

horizontal length = 4 cm (because time = 1 / 50 Hz = 0.02 s = 20 ms) [B1]

For Examiner's Use

11 Fig.11.1 shows how the currents in a lamp L and in a wire W vary with the potential difference (p.d.) applied.

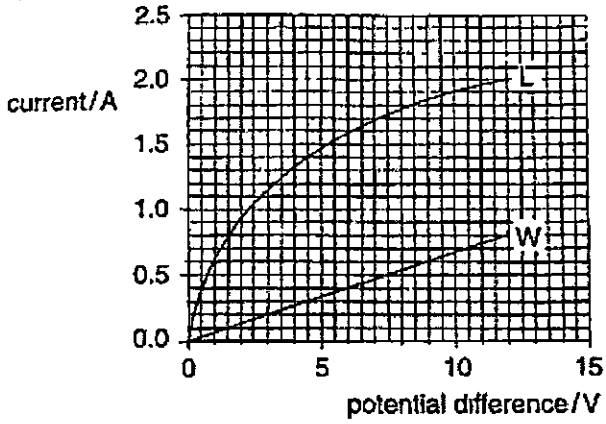


Fig. 11.1

(a) Describe how the resistance of lamp L varies as the p.d. increases.

The curve is showing decreasing gradient which indicates an increasing resistance as this is a I-V graph. The resistance of lamp L increases as the p.d. increases. [B1]

(b) Fig. 11.2 shows the lamp and the wire connected in series. The current is 0.8 A.

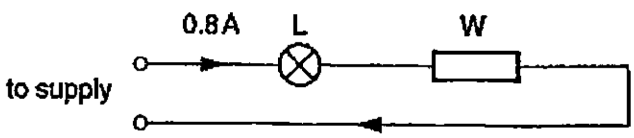


Fig. 11.2

(i) Use the graph to determine the p.d. of the supply.

When I = 0.8 A, p.d. of lamp L and wire W are 1.5 V and 12.5 V respectively from the graph.
Since lamp L and wire W are connected in series as shown in Fig. 11.2,
p.d. of the supply = 1.5 V + 12 V [M1]
= 13.5 V

p.d. = **13.5 V** [A1]

(ii) Calculate the resistance of the lamp L in the circuit shown in Fig. 11.2.

$$R = \frac{V}{I}$$
$$= \frac{1.5}{0.8}$$ [M1]
$= 1.875\ \Omega$
$= 1.88\ \Omega$

resistance = **1.88 Ω** [A1]

For Examiner's Use

11 **(c)** Fig. 11.3 shows the lamp and the wire connected in parallel. A p.d. of 12 V is connected across them.

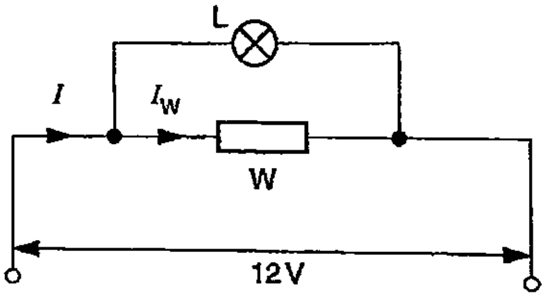


Fig. 11.3

(i) Use the graph to determine the current I_w in the wire W.

current = **0.8 A** [B1]

(ii) Use the graph to determine the current I in the circuit.

From the graph, the current in lamp L is 2.0 A.
Since lamp L and wire W are connected in parallel as shown in Fig. 11.3,
$I = 0.8 + 2.0$ [M1]
$= 2.8$ A

current = **2.8 A** [A1]

(iii) Calculate the resistance of the wire W.

$$R = \frac{V}{I} = \frac{12}{0.8} = 15\ \Omega$$

resistance = **15 Ω** [B1]

(iv) Calculate combined resistance of the lamp and wire in the parallel circuit of Fig.11.3.

$$R = \frac{V}{I} = \frac{12}{2.8} = 4.29\ \Omega$$

resistance = **4.29 Ω** [B1]

For Examiner's Use

12 EITHER

(a) Fig. 12.1 shows a d.c. motor. Fig. 12.2 shows how the moment acting on the coil depends on time.

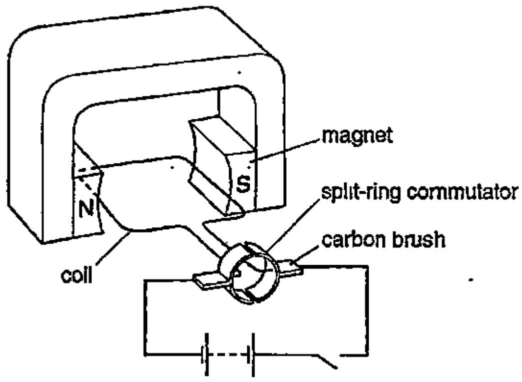


Fig. 12.1

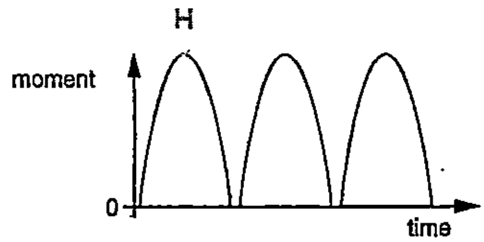


Fig. 12.2

The coil is horizontal, as shown in Fig. 12.1.

(i) Explain why the coil turns when the switch is closed.

When the switch is closed, a current flows in the circuit and the coil. Since there is a current in a magnetic field between the magnets, a force is produced. [B1] The force produced is upwards on the left side and downwards on the right side. As a result, the coil turns. [B1]

(ii) Explain why the coil continues to turn in the same direction when it has turned 180 °.

After a 180 ° rotation, the split-ring commutator reverses the direction of the current in the coil. [B1] This causes the force acting on the coil to reverse direction and ensures that the force on the side of the coil next to the N-pole was always in the same direction, allowing the coil to turn continuously as the force on the top side of the coil is now upwards and on the bottom side of the coil downwards. [B1]

(iii) On Fig. 12.2, mark with a letter H one time when the coil is horizontal. [B1]

(iv) The e.m.f. of the battery is increased. State two changes that this causes to Fig. 12.2.

1. The maximum moment exerted will be greater (stretched vertically). [B1]

2. The period of the wave will be shorter (compressed horizontally). [B1]

For Examiner's Use

12 (b) Fig. 12.3 shows a setup to illustrate how the wind power can be used to generate electricity. When the wind blows, the blades of the generator turn, causing the magnet to turn.

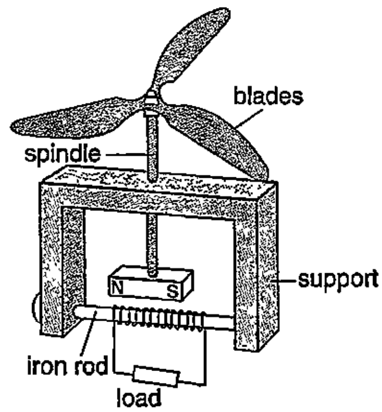


Fig. 12.3

(i) Explain how electricity can be generated when the blades turn.

As the magnet turns, it creates a changing magnetic field. [B1] **This changing magnetic field induces an e.m.f. in the coil of wire and an induced current flows in the circuit.** [B1]

(ii) State one advantage of a rotating magnet generator over a rotating coil generator.

Slip rings and carbon brushes are not needed in a rotating magnet generator. [B1]

For Examiner's Use

12 OR

(a) Fig. 12.4 shows a beam of positively charge particles passing between the poles of a powerful U-shaped electromagnet.

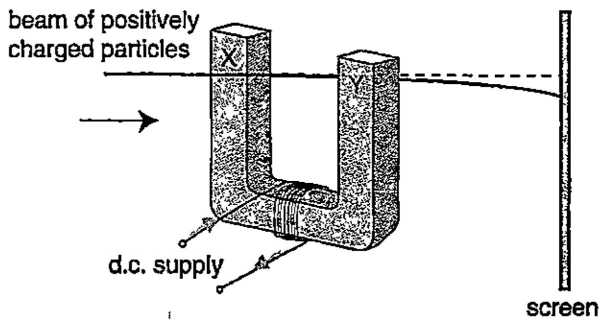


Fig. 12.4

(i) State the polarity of the magnet at X and Y.

X is north pole and Y is south pole. [B1]

(ii) State the material that the magnet can be made of and explain your answer.

The magnet can be made of iron. [B1] **Iron is a soft magnetic material that can be magnetised and demagnetised easily, thus it is suitable for use as an electromagnet.** [B1]

(iii) Explain why the power supply must be a direct current and show the direction of the current in Fig. 12.4.

For the poles of the magnet to be fixed, the supply must be a direct current. [B1]

(iv) Suggest two ways to increase the distance through which the beam is deflected.

Increase the current in the power supply to the electromagnet. [B1]
Increase the charge of the particles. [B1]

For Examiner's Use

12 **(b)** The generators at a power plant produce a voltage of 25 000 V. For long distance transmission, on overhead power lines, this is stepped up to 480 000 V. It is later stepped down to 240 V for domestic use.

(i) Explain why the voltage is stepped up for long distance transmission.

When power is transmitted at high voltage, the current through the wires is low. [B1] **Hence, power loss in the cables is reduced.** [B1]

(ii) Calculate the ratio of the number of turns in the primary coil to the number of turns in the secondary coil for the transformer used to step down the power for domestic use.

Ratio = 480 000 : 240
= **2 000 : 1** [B1]

END OF PAPER

Geylang Methodist School (Secondary)
Preliminary Examination 2015

PHYSICS **5059/01**

Paper 1 **Sec 4 Express**

Additional materials : OAS

1 hour

Setter : Mr Sng PH

31 July 2015

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Do not open this booklet until you are told to do so.

Answer **all** questions. Shade your answers on the OAS provided.

At the end of the examination, submit OAS and the question paper separately.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark.

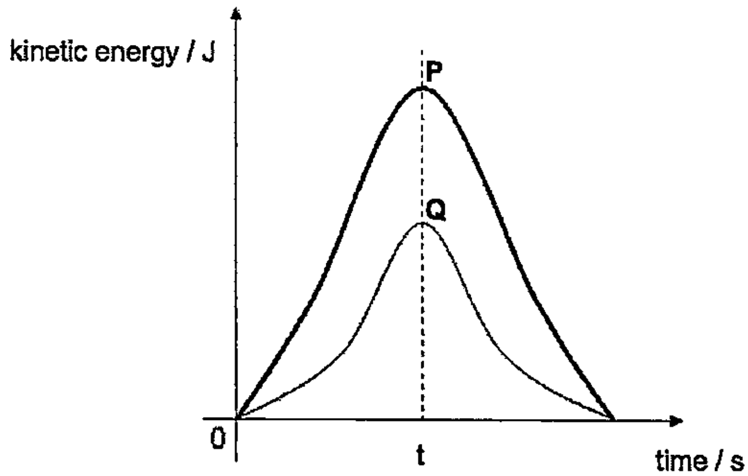
Any rough work should be done in this booklet.

Acceleration due to gravity, ***g***, is assumed to be 10 m/s^2 and gravitational field strength, ***g***, is assumed to be 10 N/kg, unless otherwise specified.

This document consists of **18** printed pages.

[Turn over

1 The diagram shows the kinetic energy – time graph of two pendulums oscillating.



Which of the statements made below is/are correct?

1 The graph shows both pendulums swinging through 1 complete oscillation.

2 The pendulum P's bob has a larger mass than pendulum Q's.

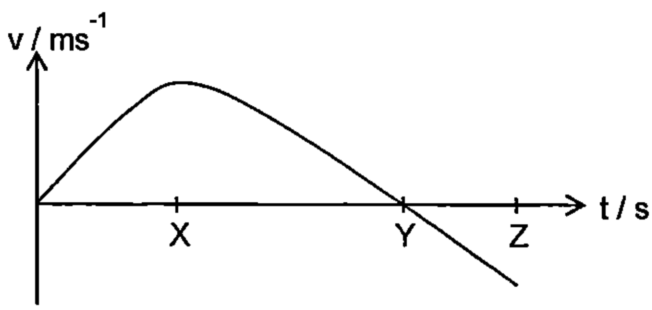
3 At instantaneous time *t*, both pendulums are at their lowest point of their oscillation.

4 Both pendulums have the same length.

A 3 only **B** 2 and 3 only

C 1, 2 and 3 only **D** 2, 3 and 4 only

2 A water rocket is launched vertically upwards. The velocity-time graph below shows the relationship between the velocity of the rocket and time.



Which of the following statements is/are correct?

1 The rocket reaches the highest position at instant X.

2 The resultant force acting on the rocket is zero at instant Y.

3 The rocket is still in the air at instant Z.

A 1 only **B** 3 only

C 1 and 2 only **D** 2 and 3 only

3 Which of the following represents the shortest length?

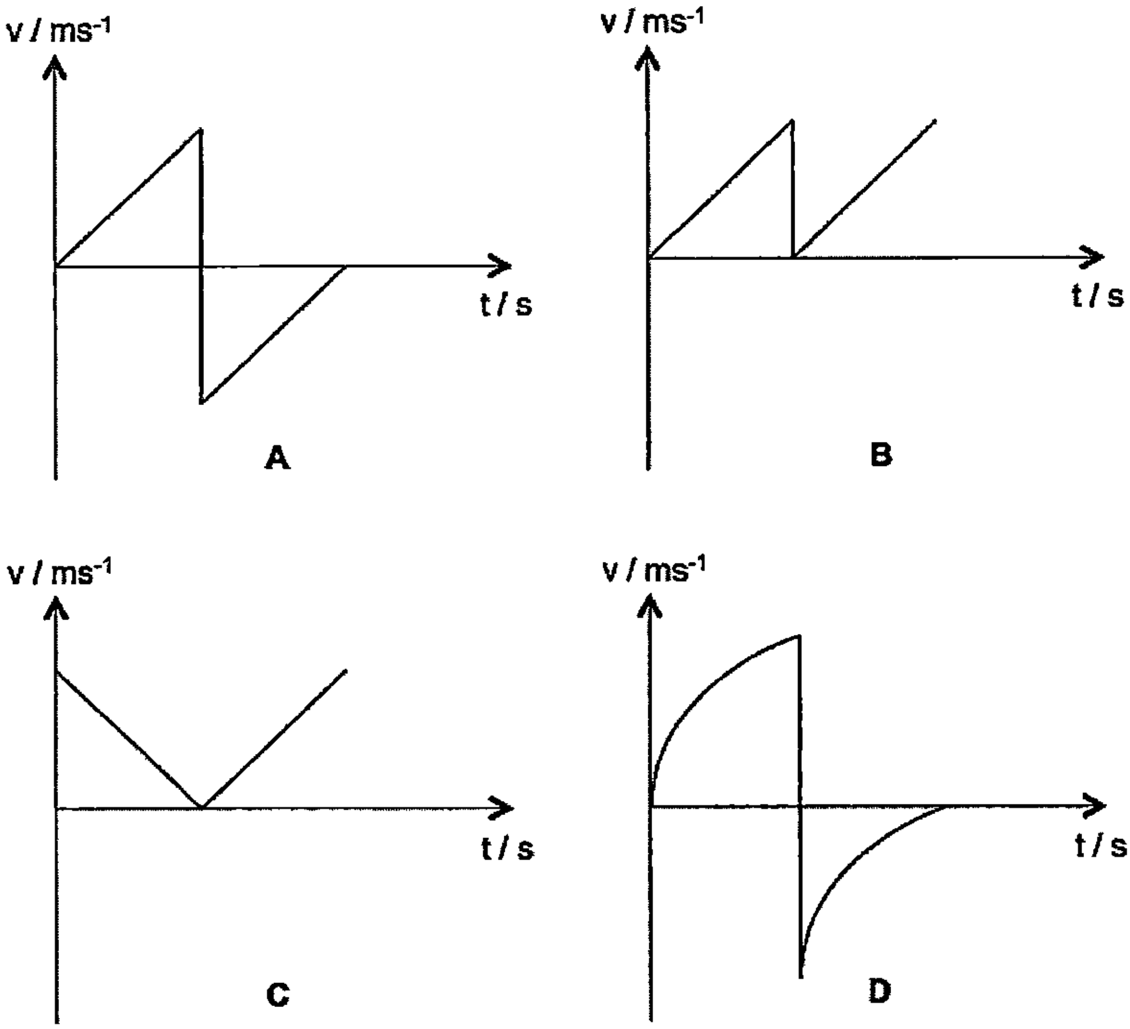
A 1.2×10^4 Mm

B 1.2×10^5 km

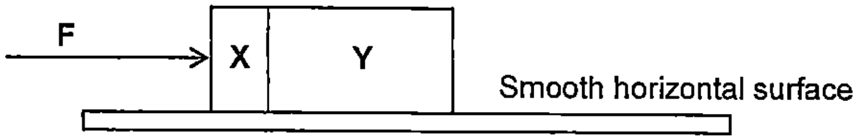
C 1.2×10^7 m

D 1.2×10^{11} mm

4 A ball is dropped from the top of a ladder. It falls vertically through air and rebounds in a vertical path upon hitting the ground. Assuming that no energy is lost during its impact with the ground and negligible air resistance, which of the following velocity-time graph best describes the motion of the ball?



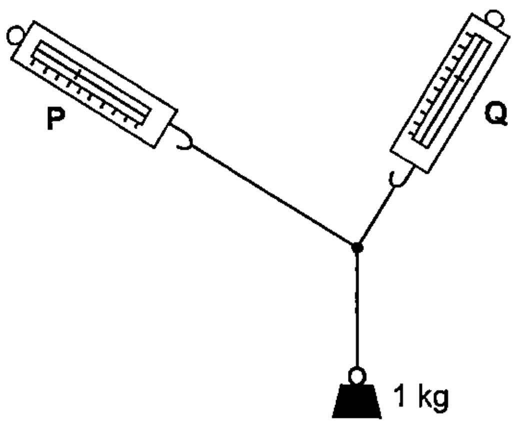
5 Two blocks X and Y, of masses m and $3m$ respectively, are accelerated along a smooth horizontal surface by a force F applied to the block X as shown.



What is the magnitude of the force exerted by block Y on block X during this acceleration?

A 0.25 F **B** 0.33 F **C** 0.50 F **D** 0.75 F

6 The diagram below shows a 1 kg mass being supported by two strings, connected to spring balances, P and Q.



Which of the following statements is correct?

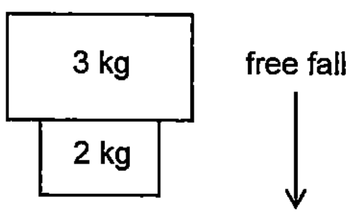
A The reading on the two spring balances will be the same.

B The reading on P will be greater than that of Q.

C If a 3 kg mass is used, both readings will triple.

D The sum of the two reading will be 10 N.

7 Two separate concrete blocks are falling freely from a building under construction.



What is the net force acting on the 2 kg block?

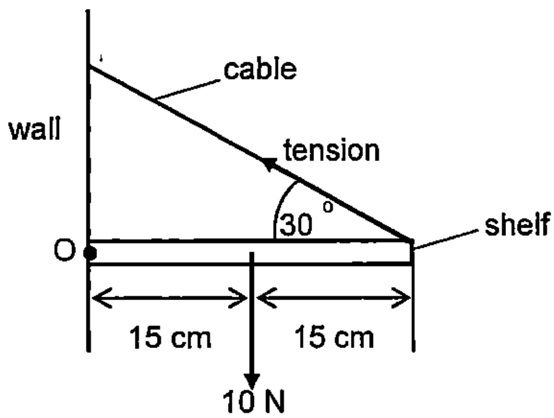
A 10 N **B** 20 N **C** 30 N **D** 50 N

8 Nichrome is an alloy that consists of 90 % Nickel and 10 % Chromium by mass. A piece of Nickel with a mass 90 g and volume of 10 cm^3, is mixed with a piece of Chromium. The Nichrome alloy formed has a density of 8.4 g/cm^3.

Calculate the density of Chromium used.

A 3.0 g/cm^3 **B** 5.3 g/cm^3 **C** 7.8 g/cm^3 **D** 9.6 g/cm^3

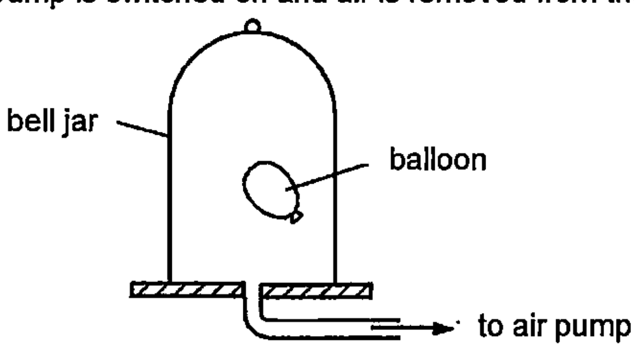
9 The diagram shows a horizontal, uniform bookshelf hinged to a vertical wall at point O and supported by a cable, which makes an angle of 30° with the shelf.



Given that the weight of the shelf is 10 N, what is the tension in the cable?

A 2.5 N **B** 5.0 N **C** 5.7 N **D** 10.0 N

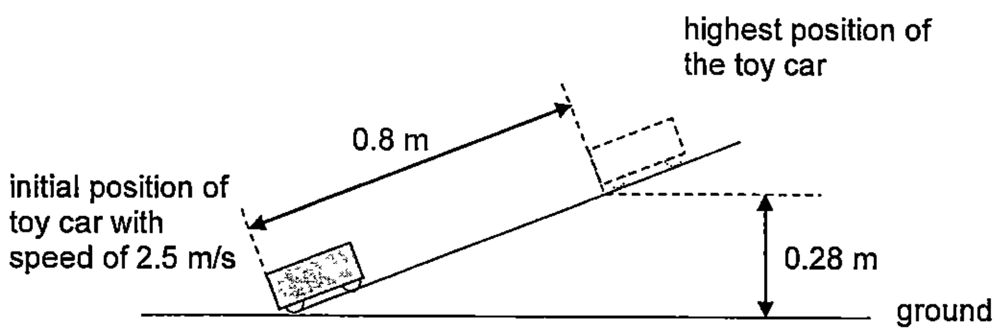
10 A partially-inflated balloon is placed inside a bell jar. The bell jar is connected to an air pump. The air pump is switched on and air is removed from the bell jar.



What happens to the pressure and to the volume of the gas inside the balloon?

	pressure	volume
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	Increases	increases

11 The diagram below shows a 0.5 kg toy car being pushed from the base of a slope with an initial speed of 2.5 m/s. It is able to move a distance of 0.8 m up the slope to its highest point 0.28 m above the ground.



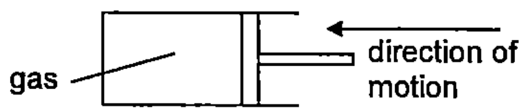
What would be the average frictional force acting on the toy car as it moves up the slope?

A 0.203 N **B** 1.400 N **C** 1.560 N **D** 1.950 N

12 A lift of mass 1000 kg rises 50 m in 2.0 minutes. If the efficiency of the lift is 80%, what is the power supplied to the motor?

A 3.33 kW **B** 5.00 kW **C** 5.21 kW **D** 250 kW

13 Gas inside a cylinder is cooled slowly to a lower temperature. The pressure inside the cylinder remains constant as the piston moves inwards.



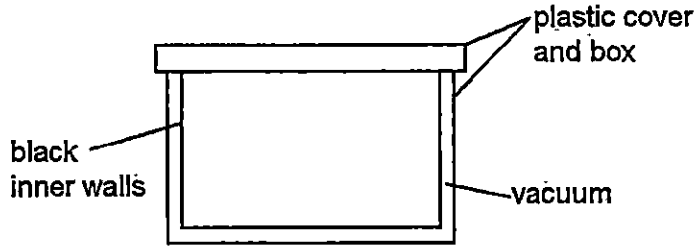
How do the speed of the particles and their rate of collisions with the cylinder and piston compare with their initial values at the higher temperature?

	average speed	rate of collision
A	lower	reduced
B	lower	increased
C	same	same
D	same	reduced

14 Which of the following correctly shows the changes, if any, in the potential energy and the kinetic energy of the particles as a solid melts?

	potential energy	kinetic energy
A	decreases	increases
B	decreases	stays the same
C	increases	stays the same
D	stays the same	increases

15 The diagram below shows the cross-section of a plastic container that a manufacturing company has created.



The company claims that the container can keep food warm for a duration that surpasses other brands of container. It offers the following explanations to justify their claims:

1 The plastic cover will reduce heat loss through conduction as plastic is a poor conductor of heat.

2 The black inner walls will absorb heat from the environment to keep food warm since black surfaces are good absorbers of heat.

3 The vacuum between the interior and exterior walls of the container will prevent heat losses to the surroundings through conduction, convection and radiation.

Which of the statements is/are correct?

A 1 only

B 1 and 2 only

C 2 and 3 only

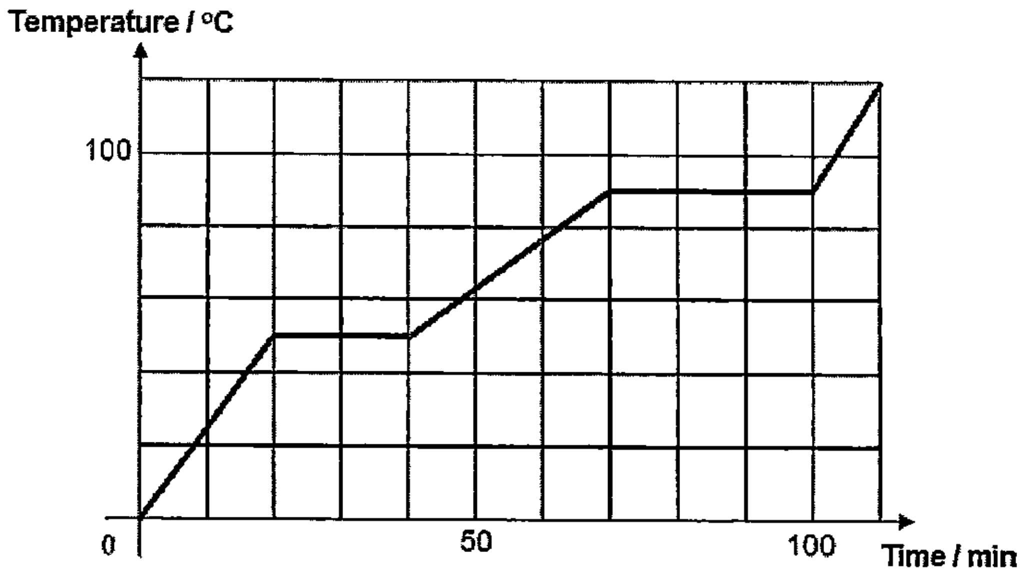
D All of the above

16 A tungsten wire has a resistance of 30 Ω at -10 °C and 50 Ω at 90 °C.

What is the working temperature of the wire if its resistance is 70 Ω?

A 100 °C B 170 °C C 190 °C D 210 °C

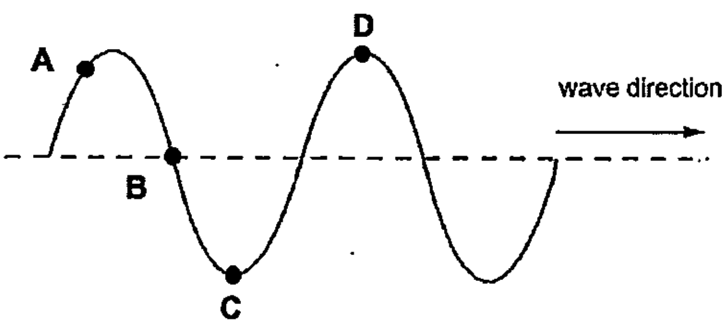
17 The graph shows the change in temperature when heat is supplied at 200 W to 1 kg of the substance.



The specific latent heat of vaporisation of the substance is _________.

A 4000 J/kg B 6000 J/kg C 240000 J/kg D 360000 J/kg

18 The diagram below shows an instantaneous position of a water wave travelling in the direction shown.



Which of the flowing statement is/are correct?

1 The particle B is momentarily at rest.

2 The particles A and D are vibrating in phase.

3 The particles C and D are vibrating at the highest speed.

4 All the particles in the string vibrate with same frequency.

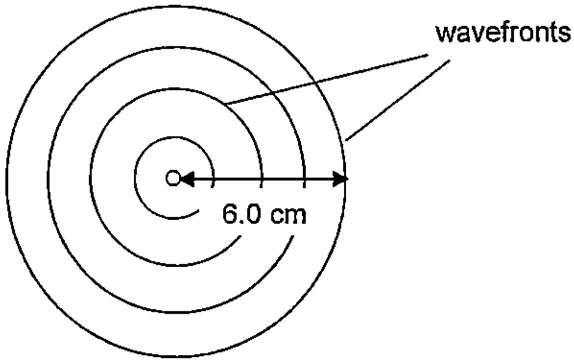
A 1 only

B 4 only

C 1 and 3 only

D 1, 2 and 3 only

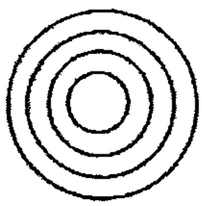
19 The diagram below shows circular wavefronts radiating from a point source **P**.



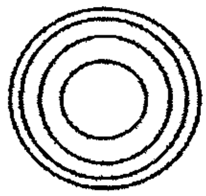
The point source is then set to vibrate with a gradually decreasing frequency.

Which of the following shows the possible resulting wavefronts?

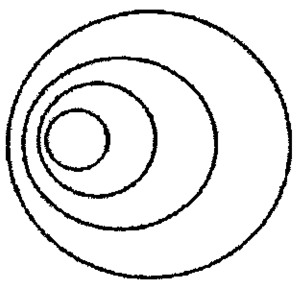
A



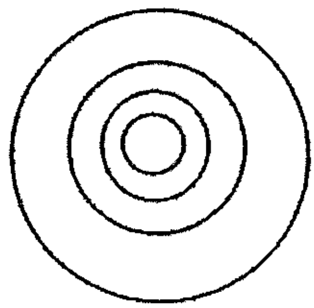
B



C



D



20 Which statement about the process of evaporation is **NOT** correct?

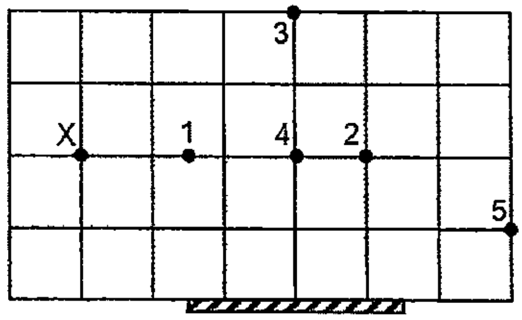
A A moist atmosphere decreases the rate of evaporation from a water surface.

B Evaporation can cause cooling.

C Liquids with lower boiling points evaporate more easily.

D The rate of evaporation increases with increased pressure.

21 A person stands at point **X** as shown in the diagram below.



Which of the pins (1, 2, 3, 4, 5) will the person be able to see the image in the mirror?

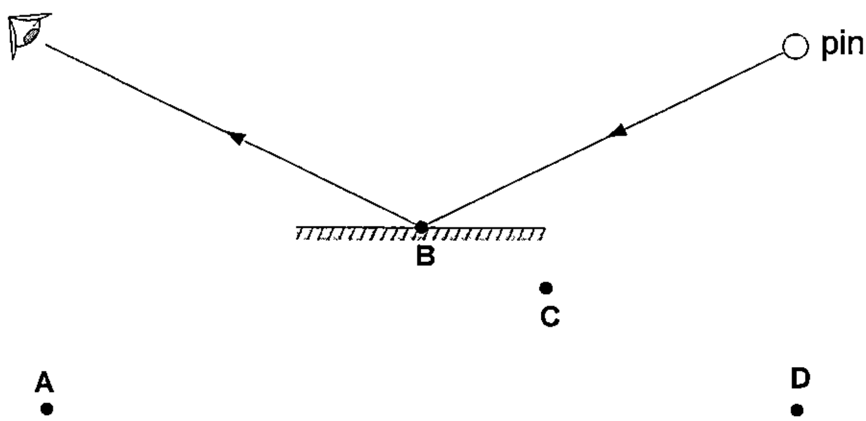
A Pins 1 and 3 only

B Pins 2 and 4 only

C Pins 2, 3 and 4 only

D Pins 2, 4 and 5 only

22 A pin is placed in front of a plane mirror as shown.



Where is the image of the pin?

23 The critical angle for a certain crystal is 41 °.

What is the speed of light in this crystal?

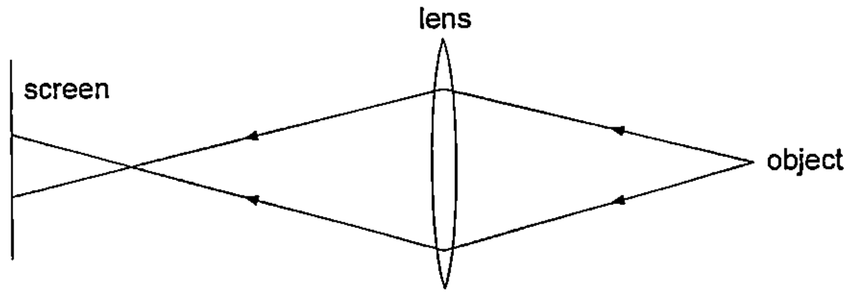
A 1.37×10^8 m/s

B 1.97×10^8 m/s

C 2.26×10^8 m/s

D 3.00×10^8 m/s

24 A lens forms a blurred image of an object on a screen.



How can the image be focused on the screen?

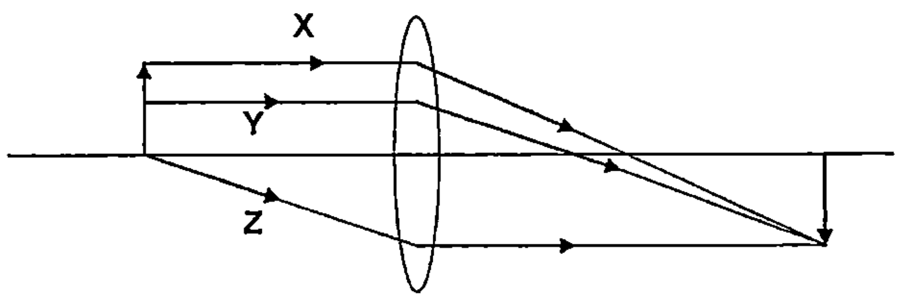
A Use a lens with a shorter focal length at the same position.

B Move the screen away from the lens.

C Move the object closer to the lens.

D Use a brighter object at the same position.

25 Which ray(s) is/are correctly drawn in the diagram below?



A Ray X only	**B** Ray Y only
C Ray X and Y only	**D** Rays X, Y and Z

26 Which of the following statements is/are **NOT** true about radio waves?

1 Radio waves can travel in vacuum.

2 Radio waves travel faster than ultrasound waves.

3 Radio waves from radio are within human audible range.

4 Radio waves cannot be reflected.

A 1 and 4 only	**B** 2 and 3 only
C 2 and 4 only	**D** 3 and 4 only

27 John attended a horse riding session at Gallop Stable at Punggol. During the ride, the horse heard something that John could not hear. Given that the wavelength of the sound heard by the horse is 1.1 cm, which of the following is a possible audible frequency range of the horse?

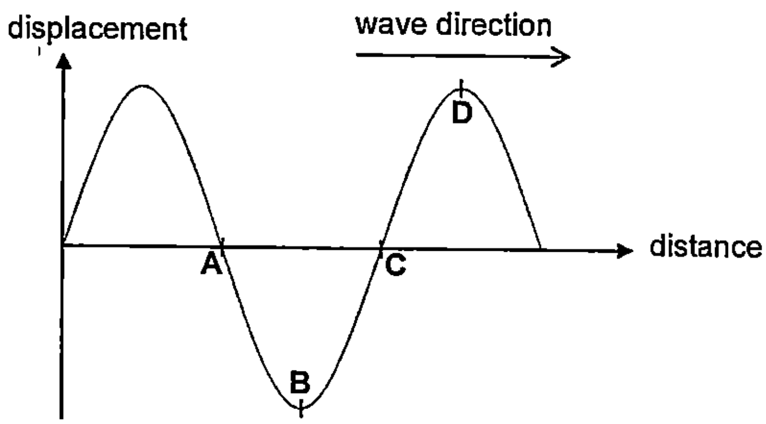
A 10 Hz to 10 000 Hz

B 15 Hz to 20 000 Hz

C 20 Hz to 20 000 Hz

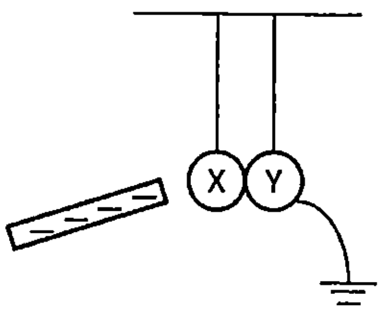
D 50 Hz to 35 000 Hz

28 The diagram below shows a sound wave with the wave direction as shown.



Which point, A,B,C or D, corresponds with compression of the wave?

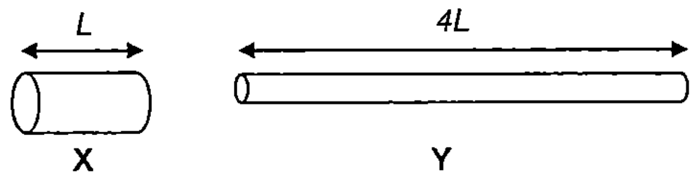
29 The diagram below shows two metal spheres X and Y in contact are suspended by insulating threads. Sphere Y is earthed.



A negatively charged plastic rod is held near to sphere X. What is the net charge on X and Y respectively?

	sphere X	sphere Y
A	positive	negative
B	positive	neutral
C	positive	positive
D	neutral	neutral

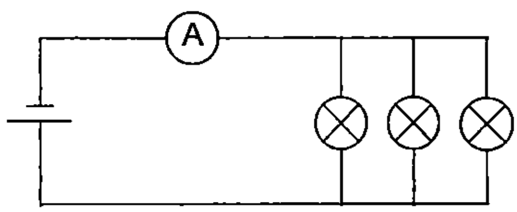
30 Two copper wires X and Y have the **same volume**. Wire Y is four times as long as wire X.



What is the ratio of the resistance of wire Y to resistance of wire X?

A 4 **B** 8 **C** 16 **D** 64

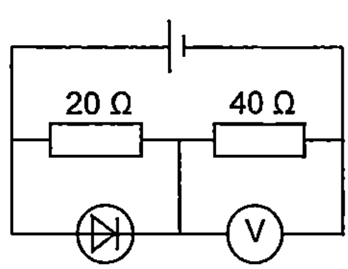
31 Three identical light bulbs are connected in parallel to a D.C. supply. Each bulb operates at normal brightness.



What will happen to the ammeter reading and brightness of the remaining bulbs if one of the bulb blows?

	ammeter reading	bulb brightness
A	increases	increases
B	increases	unchanged
C	decreases	unchanged
D	decreases	decreases

32 In the given circuit, the voltmeter reads 12V. If the diode is reversed, what is the reading of the voltmeter?



A 6 V **B** 8 V **C** 12 V **D** 16 V

33 Ben connects a fuse along the neutral wire of a fan. Which of the following statement(s) is/are correct?

1 The fan will be safe to touch after the fuse blows.

2 The fan will still be connected to the high voltage source when the fuse blows.

3 There is no current passing through the neutral wire after the fuse blows.

A 2 only **B** 1 and 2 only

C 1 and 3 only **D** 2 and 3 only

34 An electrical cable contains three wires: live, neutral and earth. The cable is correctly wired to a plug which contains a 3 A fuse. The insulation becomes damaged and bare metal wires are exposed. Five possible events can occur.

1 A person touches the earth wire.

2 A person touches the neutral wire.

3 A person touches the live wire.

4 The live wire touches the neutral wire.

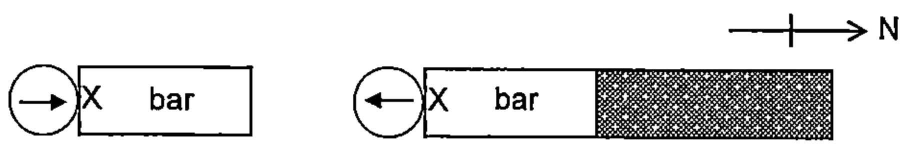
5 The live wire touches the earth wire.

Which of these events can cause the fuse to blow?

A 1 and 3 only **B** 2 and 3 only

C 4 and 5 only **D** 3, 4 and 5 only

35 The direction of a compass needle placed at one end of an unknown bar, is as shown below. When a magnet is brought near it, the compass direction is reversed.



Which of the following statements is/are possible conclusion/s?

1 The unknown bar is made of a material such as nickel.

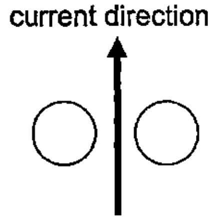
2 The unknown bar is made of a material such as aluminium.

3 The unknown bar is a magnet with X as the north pole.

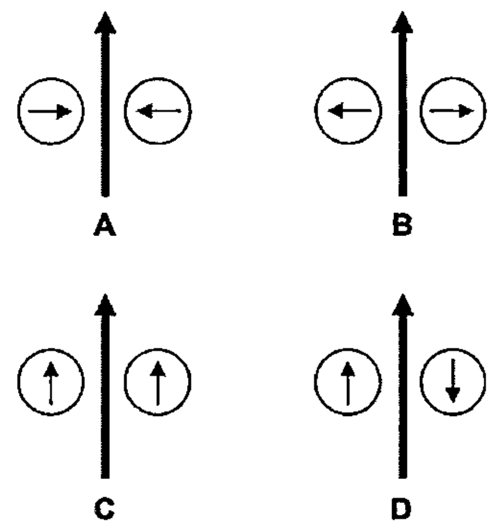
A 1 only **B** 2 only

C 1 and 2 only **D** 1 and 3 only

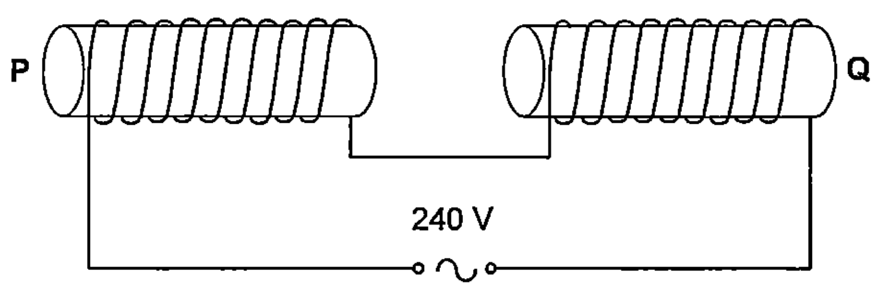
36 Two plotting compasses and a current carrying wire are placed on a table. The compasses are placed on either sides of the wire as shown below.



In which direction will the compass needles point?



37 Two iron bars P and Q are placed inside two solenoids as shown below.



When the solenoids are connected to an a.c power supply, P and Q will

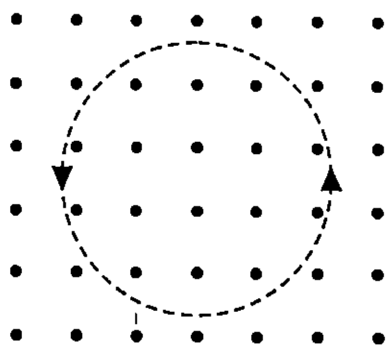
A repel each other.

B attract each other.

C oscillate towards and away from each other.

D oscillate upwards and downwards.

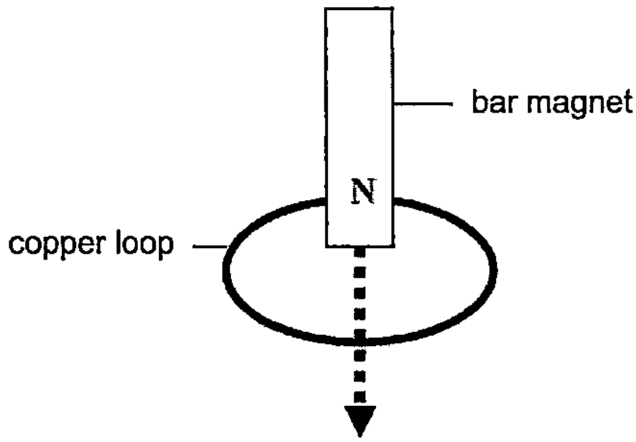
38 The diagram below shows the circular anti-clockwise path of a charged particle in a field. The direction of the field is out of the paper.



Ignoring the effect of gravity, which of the following correctly describes a possible state of charge of the particle and the nature of the field?

	charge	field
A	negative	magnetic
B	positive	electric
C	negative	electric
D	positive	magnetic

39 A bar magnet is dropped through a loop of copper wire as shown.



Which of the following statement(s) is/are correct?

1 When the magnet approaches the copper loop, a current is induced in the loop that flows in clockwise as seen by the observer from the top of the loop.

2 When the magnet moves through the copper loop, the current induced in the copper loop sets up a magnetic field that always repel the magnet.

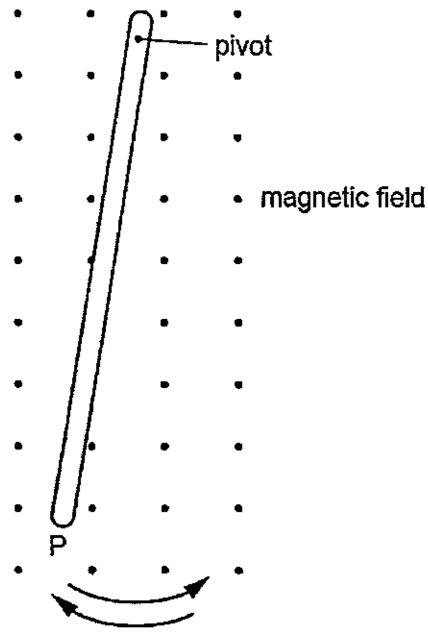
3 Heat is produced in the copper loop.

4 The magnet falls through the copper loop with an acceleration that is lower than the acceleration of free fall due to gravity.

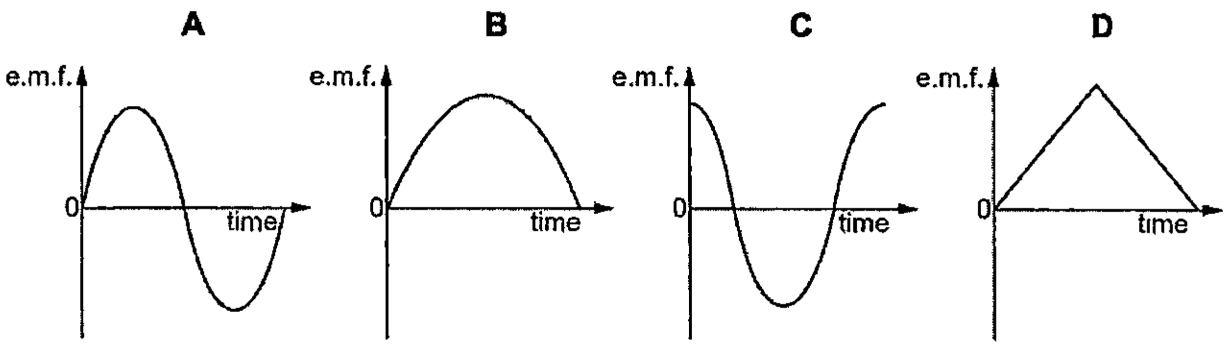
A 2 only **B** 1 and 2 only

C 2 and 3 only **D** 3 and 4 only

40 The diagram shows a metal bar swinging like a pendulum across a uniform magnetic field. The motion induces an e.m.f. between the ends of the bar.



Which graph represents this e.m.f. during one complete oscillation of the bar, starting and finishing at P?



END OF PAPER

Geylang Methodist School (Secondary)
Preliminary Examination 2015

Candidate Name			
Class		Index Number	

PHYSICS **5059/02**

Paper 2 Physics **Sec 4 Express**

Additional materials : Nil **1 hour 45 minutes**

Setter : Mr Sng Peng Hock **31 July 2015**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
Write your answers to **Section A** in the spaces provided in the Question Paper.
Write your answers to **Section B** on the writing papers provided.
Question 12 has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include appropriate units. You are advised to show all your working in a clear, orderly manner.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Acceleration due to gravity, ***g***, is assumed to be 10 m/s^2 and gravitational field strength, ***g***, is assumed to be 10 N/kg, unless otherwise specified.

For Examiner's Use	
Section A	/50
Section B	/30
Total	/80

This document consists of **15** printed pages and **1** blank page.

SECTION A

Answer **all** questions in this section.
Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 shows the variation of the resultant force acting on a moving object in the direction of motion. The object moves along a horizontal surface in a straight path.

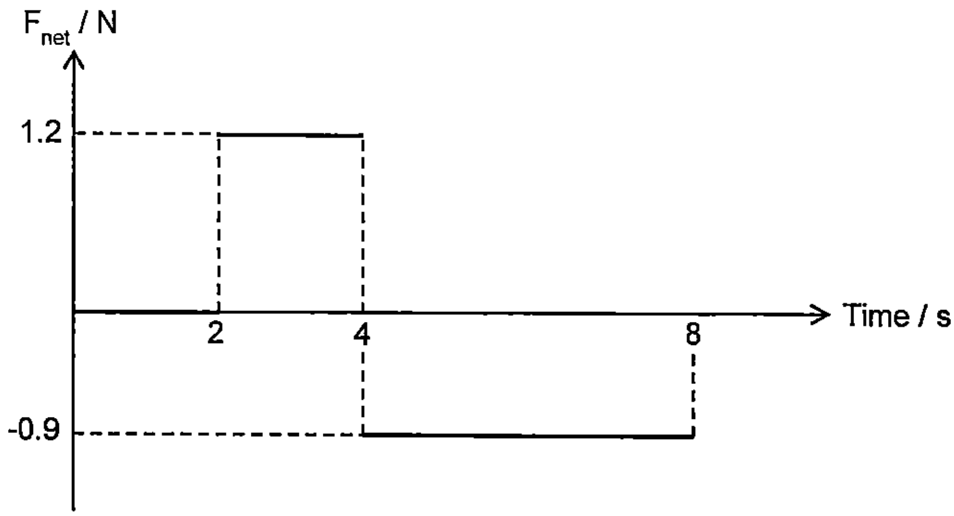


Fig 1.1

The object has a mass of 0.3 kg and a velocity of 6 m/s at t = 0.

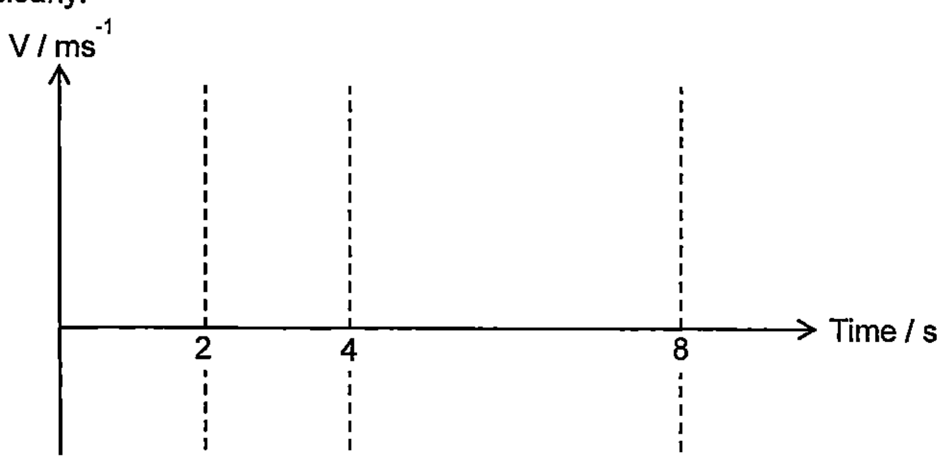
(a) State the object's acceleration at t = 1.

acceleration = ... [1]

(b) Calculate the velocity of the object at t = 4.

velocity = ... [2]

(c) On Fig.1.2, draw the velocity-time graph of the object, showing all values clearly.



[3]

Fig 1.2

2 A uniform plank of length 4.0 m and weight 500 N is suspended by two strings at X and Y. A box of mass 3.5 kg is placed as shown in Fig. 2.1.

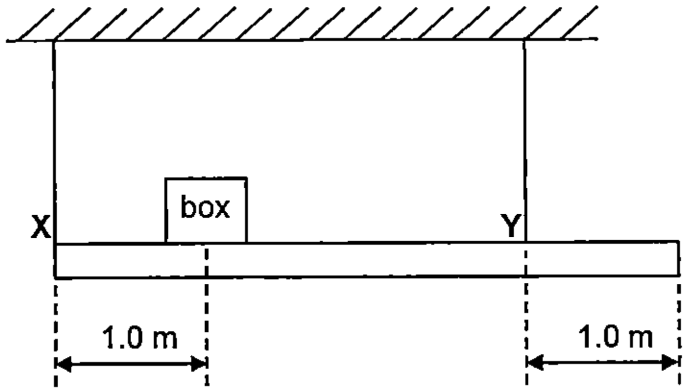


Fig. 2.1

(a) On Fig. 2.1, draw arrows to represent **all** the forces acting on the plank. [2]

(b) The plank is balanced. Calculate the force in the string at X by taking moments about Y.

force at X = ... [2]

(c) Hence or otherwise, calculate the force in the string at Y.

force at Y = ... [1]

(d) An additional weight is suspended from the plank directly below point Y.

State and explain how this will affect the force in the string at X.

....

....

.... [2]

3 Fig. 3.1 shows a diver working below the surface of a lake. The density of the water in the lake is 1000 kg/m^3, the atmospheric pressure at the surface is 1.0×10^5 Pa.

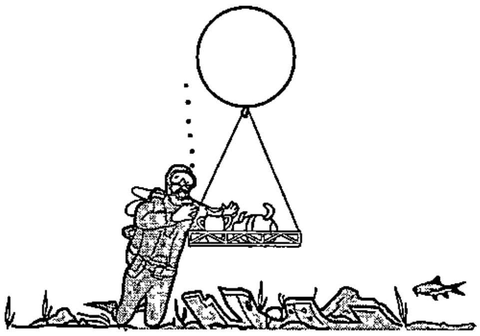


Fig. 3.1

The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

(a) Calculate the total pressure acting on the balloon, at 15 m below the surface of the lake.

pressure = ... [2]

(b) The diver releases the tray and the balloon, and they begin to rise. The temperature of the air in the balloon does not change. The volume of the balloon is 0.3 m^3 at 15 m depth.

Calculate the volume of the balloon when it reaches the surface.

volume = ... [2]

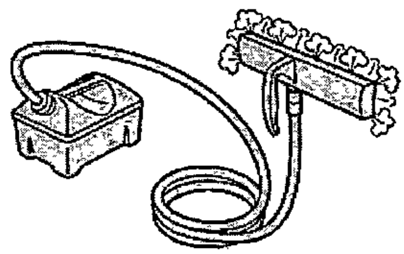
(c) Explain, in terms of the air molecules inside the balloon, why the air pressure in the balloon is less at the surface.

....

....

.... [2]

4 Arnold uses the steam wallpaper stripper, as shown in Fig. 4.1, to help him remove wallpaper in his living room.



Machine Specifications

Power rating = 2.5 kW
Voltage = 240 V
Capacity = 5.0 litres

Fig. 4.1

The water in the machine is heated until it boils and produces steam. The steam nozzle is held against the wall and the steam will soften the wallpaper, making it easy for Arnold to scrape it off.

Given that:
Specific heat capacity of water = 4200 J/kg °C
Specific latent heat of vaporization of water = 2260×10^3 J/kg
One litre of water has a mass of one kilogram.

(a) Arnold fills the machine to its full capacity using tap water at 20 °C and turns on the switch.
Calculate the time he needs to wait before the machine starts producing steam.

time = ... [3]

(b) Arnold uses the machine continuously for one hour since the time he turns on the switch.
Calculate the mass of the water left in the machine.

mass = ... [3]

5 Fig. 5.1 below shows circular wavefronts produced at the centre of a circular ripple tank.

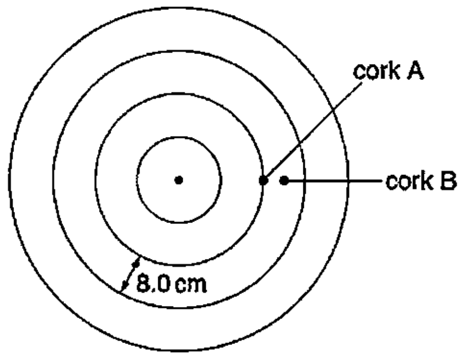


Fig 5.1

Two corks, A and B, float on the water in the ripple tank. The distance between successive wavefronts is 8.0 cm. Fig. 5.2 shows how the displacement of cork A varies with time.

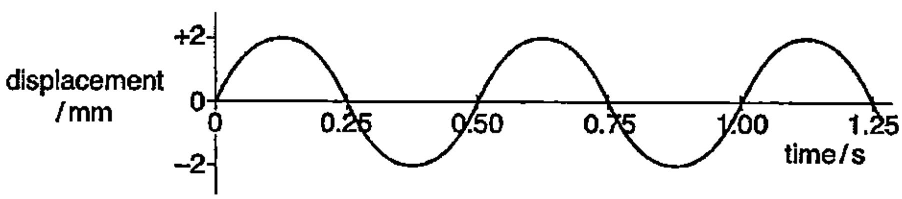


Fig 5.2

(a) State the displacement of cork B, when the displacement of cork A is 2 mm.

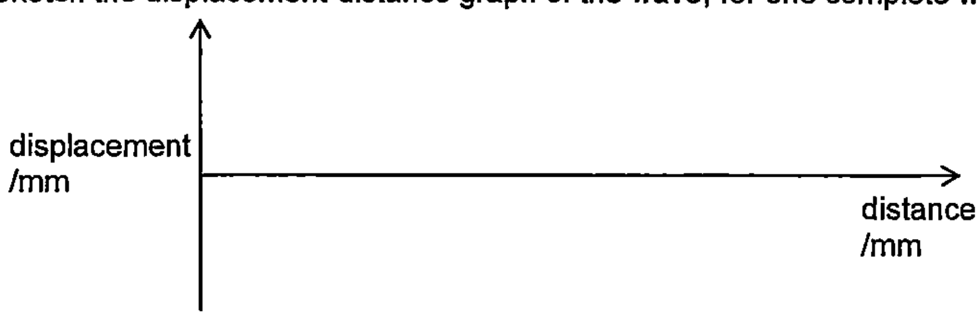
displacement = ... [1]

(b) The diameter of the ripple tank is 80 cm.

Determine the time taken by a wavefront to travel from the centre of the tank to the edge.

time = ... [2]

(c) Sketch the displacement-distance graph of the wave, for one complete wave.



[2]

6 A ray of light from an under water laser pointer, is incident upon a spherical air bubble as shown in Fig. 6.1. The refractive index of water is 1.33.

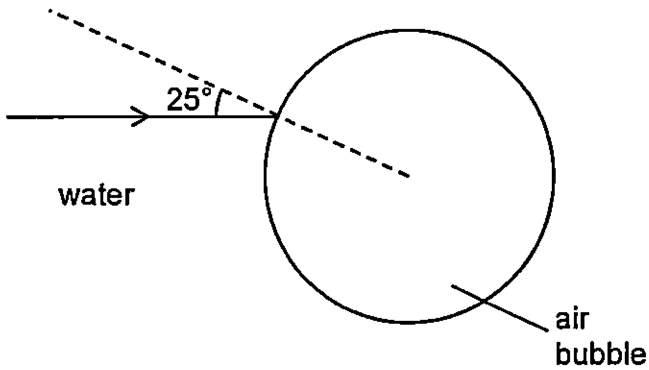


Fig 6.1

Complete the path of the ray until it exits the air bubble, showing clearly all angles at the boundaries. Show the workings to calculate these angles in the space below. [3]

7 Fig. 7.1 shows a positively charged sphere held with an insulating handle. When the sphere is brought near the metal plate, the galvanometer needle deflects momentarily.

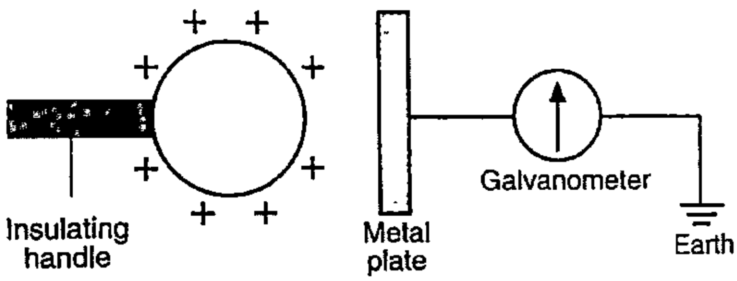


Fig 7.1

(a) Explain clearly why there is momentary deflection in the galvanometer needle?

....

....

....

....

....

.... [3]

(b) Suggest a method that would increase the magnitude of the deflection.

....

.... [1]

(c) State clearly what can be observed when the positively charged sphere is removed quickly.

....

.... [1]

8 Fig. 8.1 below shows a circuit connected to a battery of unknown e.m.f.

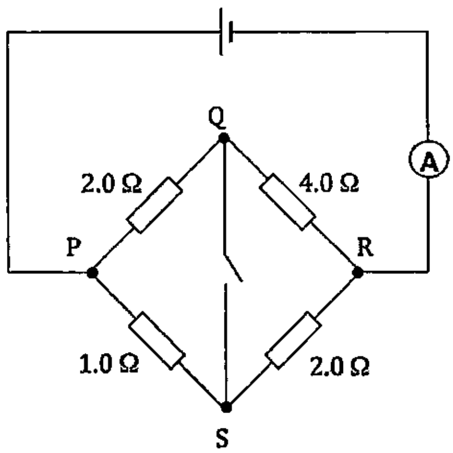


Fig. 8.1

(a) When the switch is opened, the ammeter reads 3.0 A.

(i) Calculate the e.m.f of the battery.

e.m.f = ... [3]

(ii) Calculate the current passing through PSR.

current = ... [1]

(b) The switch is now closed.

Explain if a current will flow through QS. If yes, how much is the current.

....

....

....

.... [3]

9 If small cracks in steel pipes can be detected before they become larger, the cost of repairing the damage can be greatly reduced. Fig. 9.1 shows a method to detect cracks using a coil of insulated copper wire carrying a current. Iron filings are sprinkled over the pipe and will cluster around any crack that is perpendicular to the axis of the pipe.

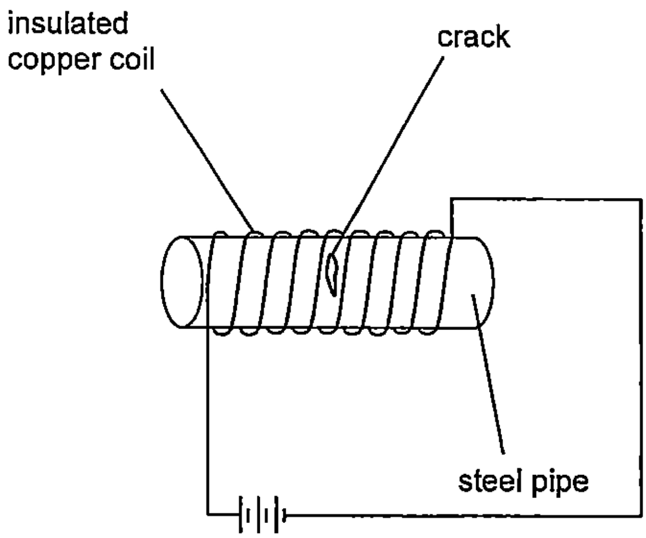


Fig. 9.1

(a) Draw on Fig. 9.1, the magnetic field lines generated by the current carrying coil if there is no crack and state clearly the magnetic poles formed. [2]

(b) Explain why iron filings cluster around the crack when there is a current in the coil.

....

....

....

....

.... [2]

(c) Explain why this method will not work on copper pipes.

....

.... [1]

SECTION B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12.**
Write your answers on the writing papers provided unless stated otherwise.

10 A 40 kg mass is initially at rest on a rough bench and a 20 kg mass is attached to it via an inextensible string, as shown in Fig 10.1. The string goes over a smooth pulley with negligible friction.

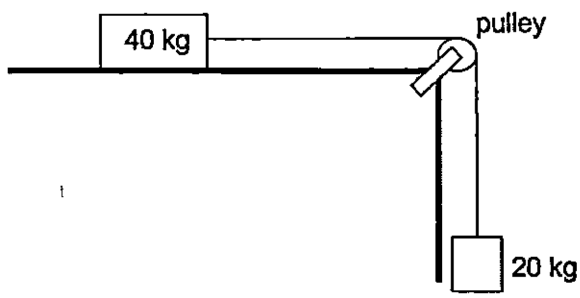


Fig. 10.1

When the 20 kg mass is released, the masses start to move together. The friction between the 40 kg mass and the bench is 20 N.

(a) Using Newton's Third Law of motion, state the action reaction pair of the weight of the 40 kg mass. [1]

(b) Calculate the acceleration of the masses when they start to move. [3]

(c) Calculate the tension in the string when the masses start to move. [2]

(d) Fig. 10.2 shows a car brake system.

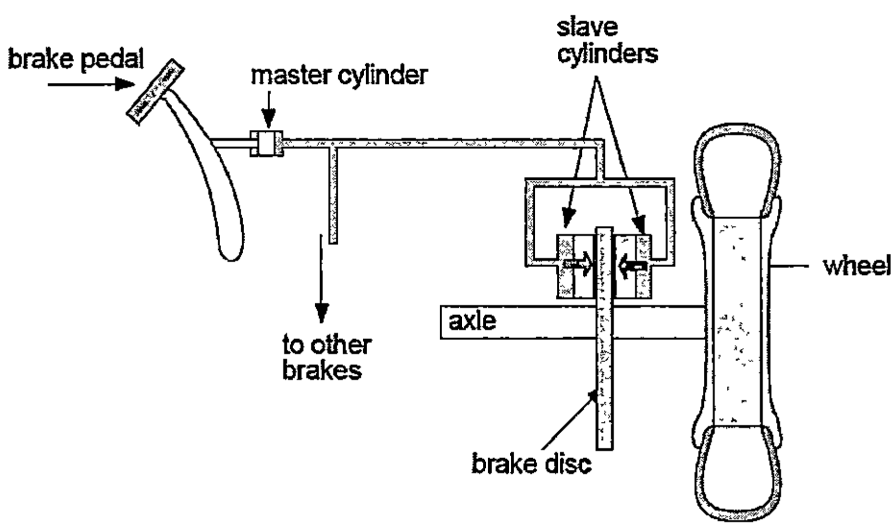


Figure 10.2

The pipes between the master cylinders and the slave cylinders are filled with incompressible brake fluid, forming a closed system. The diameter of the master cylinder is 10 cm and that of the each slave cylinder is 20 cm.

Calculate the ratio of the master cylinder area to the slave cylinder area. [1]

(e) The car requires a braking force of 4500 N on each brake disc to stop.

How much force should be applied to the master cylinder in order to achieve this? [3]

11 The issue of haze generated from forest fire has become a yearly problem for many countries. This is not only an expensive problem but has become a critical health hazard for many who are exposed to its effect. Moreover the generation of greenhouse gases from these fires has caused alarm as it will most likely further contribute to changes in the world's climate and weather pattern. One way in which the regional government has sought to combat this problem of forest fire is through the use of infra-red thermal imaging. Satellites equipped with infra-red sensors are used to detect problem spots. With this information, the local authorities are then mobilised to put out the fire before it spreads and worsens.

Visible light is unable to pass through clouds and haze, but infra-red radiation can.

How does the infrared (IR) sensor work?

The infra-red (IR) sensors mounted on satellites detect the relative thermal energies emitted by objects like burning trees, fields and streams. With the aid of a signal processor, this information is converted into a colour coded visual presentation showing regions with varying range of temperature. The IR band is often subdivided into smaller sections, coded as shown in the table below:

Section Code	NIR	SWIR	MWIR	LWIR	FIR
Wavelength/µm	0.75 – 1.4	1.3 – 3	3 – 8	8 – 15	15 – 1000

IR radiations that fall into individual sections are assigned colour codes by the signal processor. Forest fires which are normally detected in the range of 3 to 4.5 µm and hence falls under the MWIR section may be assigned the colour red.

Bodies of water which are cooler like rivers fall in the range of 10+ µm and as such the LWIR section may be assigned the colour blue.

As a result, a coloured image of red for hot and blue for cold objects can be constructed and used to detect hot spots.

(a) Which IR radiation, MWIR or LWIR, travels at a higher speed to the sensors on the satellites? [1]

(b) State the IR section code that is nearest to the electromagnetic band of visible light. [1]

(c) Calculate the range of the IR frequencies for the MWIR section code. [4]

(d) Deduce from the information above, if the method of IR imaging is more useful in detecting exact spots of forest fire compared to a normal coloured photograph taken from a satellite. Explain your deduction. [2]

(e) Besides the application above, state two other applications of infra-red radiation. [2]

EITHER

12 Fig. 12.1 shows a flowmeter that measures the volume of oil passing through a pipe.

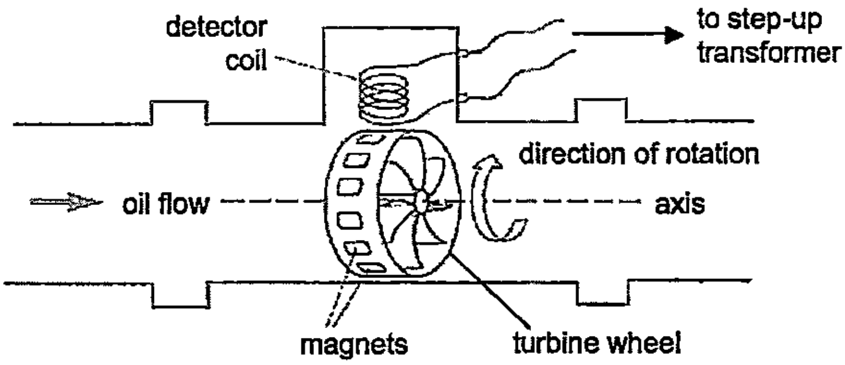


Fig.12.1

Twenty identical magnets are spaced equally around a turbine wheel. As oil flows, the turbine wheel rotates about the axis as shown. The detector coil is connected to the primary coil of a step-up transformer (Fig. 12.2) to amplify the voltage signal, which is then displayed on a cathode ray oscilloscope.

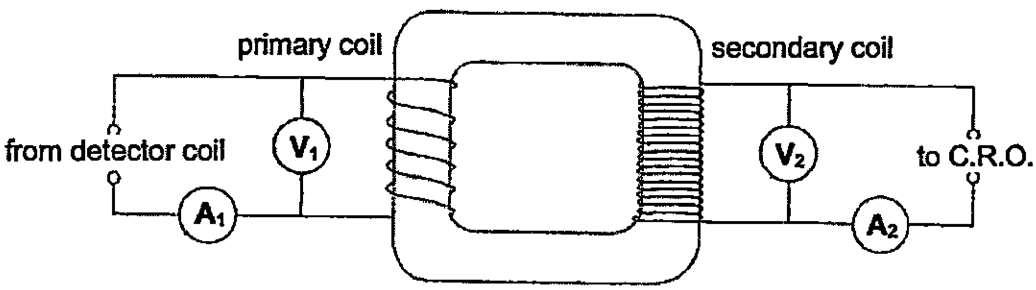


Fig. 12.2

Fig. 12.3 shows the data for two different oil flow rates. Some values are missing from the table.

oil flow rate/ $cm^3 s^{-1}$	period of turbine spin / s	transformer			
		A_1 / A	V_1 / V	A_2 / A	V_2 / V
15	2	1.8	6	0.8	12
30	1	1.8		0.8	

Fig. 12.3

(a) Explain why an alternating e.m.f. is induced in the detector coil. [3]

(b) Sketch a graph below to show how the induced e.m.f. in the primary coil varies with time for a flow rate of 15 cm^3/s. [2]

(c) State if the transformer is 100% efficient. Explain by showing your working clearly. [2]

(d) Calculate the ratio of the number of turns in the secondary coil to the number of turns in the primary coil. [2]

(e) Calculate the missing values for V_1 and V_2. [1]

OR

12 Fig. 12.1 shows a simple experimental set-up to study the motion of a motor. AB and CD are solenoids connected to a battery. F and G are connected to an external voltage supply. The graph of the external voltage supplied is as shown in Fig. 12.2 (Positive voltage indicates that the potential of F is higher than of G).

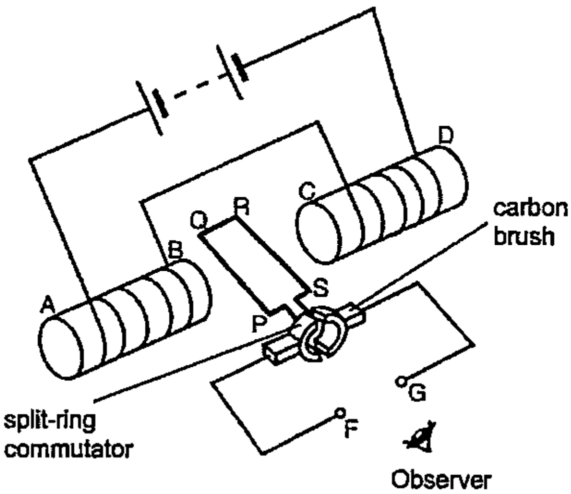


Fig. 12.1

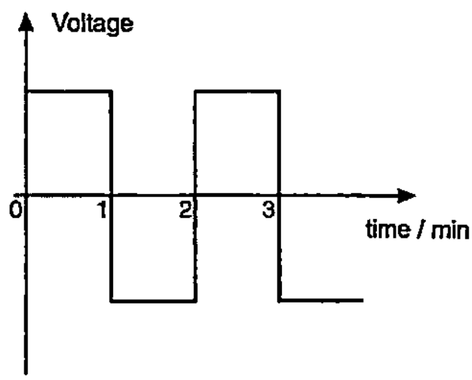


Fig. 12.2

It is observed that the coil makes 5 rotations in one minute.

(a) Identify the magnetic poles at B and C. [1]

(b) How would the coil PQRS turn (clockwise or anticlockwise direction) during the first minute? [1]

(c) Explain how you arrived to the answer in **(c)**. [2]

(d) Fig. 12.3 shows the solenoids and the coil PQRS from the observer's point of view.

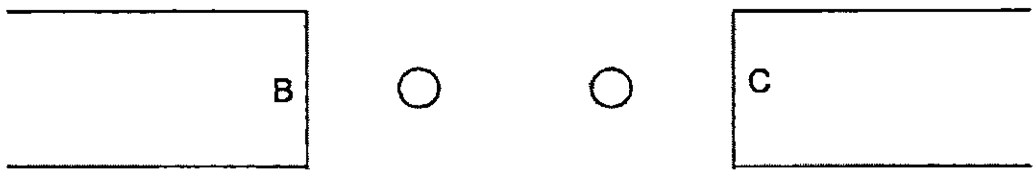


Fig. 12.3

Copy Fig. 12.3 and draw the magnetic field pattern between the two solenoids. The two circles represent PQ and RS. Indicate the direction of the current using dot and cross notation. [2]

(e) State what would happen to the coil during the 1-2 minute interval. [1]

(f) State the purpose of the split-ring commutators. [1]

(g) A longer wire of the same material and cross-sectional area as the one used in PQRS is used to make a coil with greater number of turns. This coil is used to replace PQRS.

State and explain what can be observed of the movement of the new coil. [2]

END OF PAPER

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Geylang Methodist School (Secondary)
Preliminary Examination 2015

Candidate Name

Class

Index Number

PHYSICS **5059/02**

Paper 2 Physics **Sec 4 Express**

Additional materials : Nil **1 hour 45 minutes**

Setter : Mr Sng Peng Hock **31 July 2015**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
Write your answers to **Section A** in the spaces provided in the Question Paper.
Write your answers to **Section B** on the writing papers provided.
Question 12 has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include appropriate units. You are advised to show all your working in a clear, orderly manner.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Acceleration due to gravity, g, is assumed to be 10 m/s^2 unless otherwise specified.

For Examiner's Use	
Section A	/50
Section B	/30
Total	/80

This document consists of **15** printed pages.

[Turn over

SECTION A

Answer **all** questions in this section.
Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 shows the variation of the resultant force acting on a moving object in the direction of motion. The object moves along a horizontal surface in a straight path.

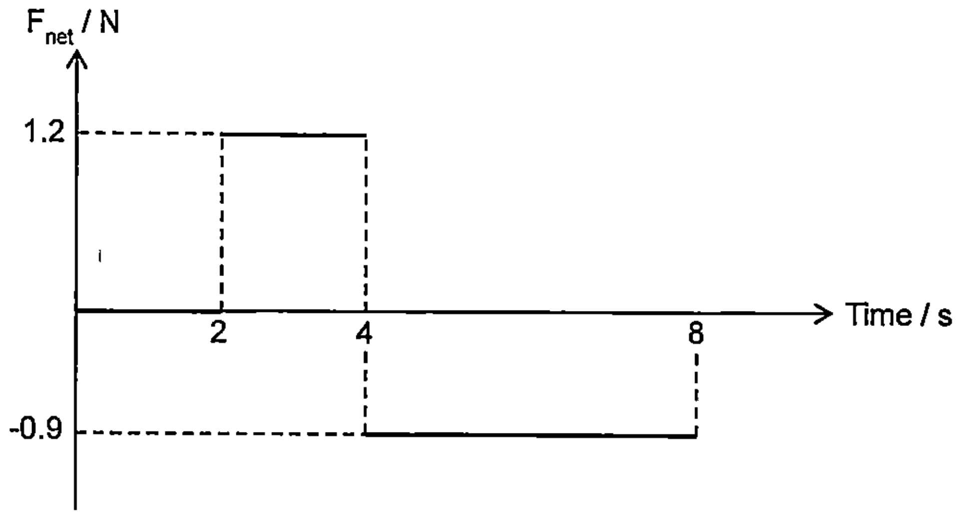


Fig 1.1

The object has a mass of 0.3 kg and a velocity of 6 m/s at t = 0.

(a) State the object's acceleration at t = 1.

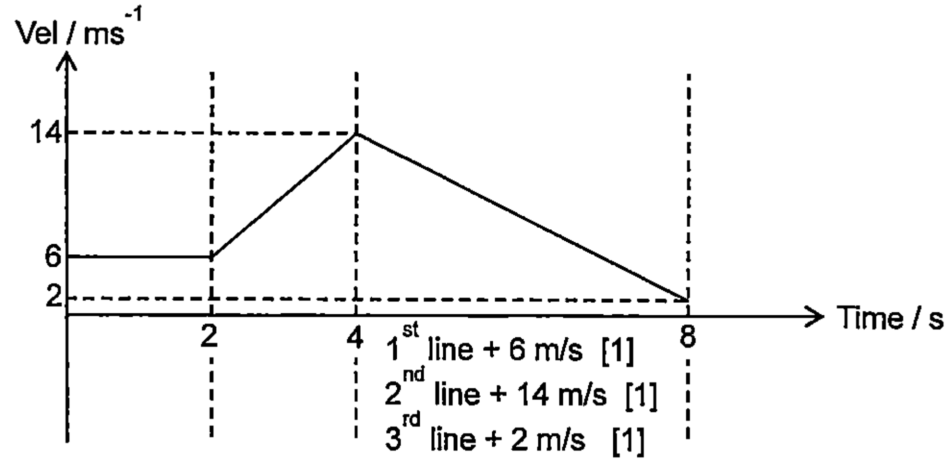
acceleration = ...0 m/s^2.................. [1]

(b) Calculate the velocity of the object at t = 4.

a = 1.2 / 0.3 = 4 m/s^2 [1]
(v – u) / t = a
(v – 6) / 2 = 4
v = 14 m/s [1]

velocity = ... [2]

(c) On fig.1.2, draw the velocity-time graph of the object, showing all values clearly.



[3]

Fig 1.2

2 A uniform plank of length 4.0 m and weight 500 N is suspended by two strings at **X** and **Y**. A box of mass 3.5 kg is placed as shown in Fig. 2.1. Take g = 10 N/kg.

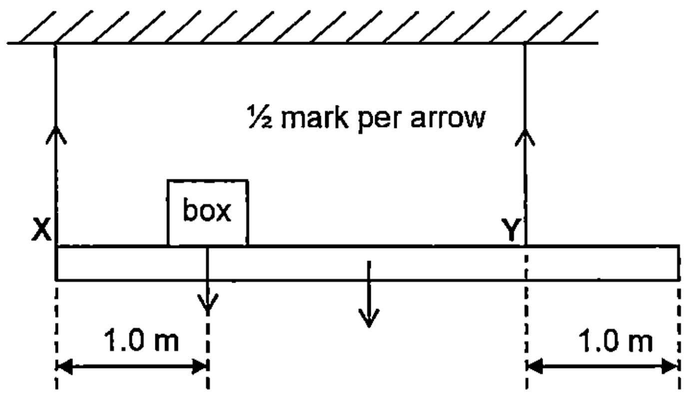


Fig. 2.1

(a) On Fig. 2.1, draw arrows to represent **all** the forces acting on the plank. [2]

(b) The plank is balanced. Calculate the force in the string at **X** by taking moments about **Y**.

Since the plank is balanced, taking moment about Y,
sum of clockwise moments = sum of anticlockwise moments.
$F_x \times 3 = 500 \times 1 + 35 \times 2$ [1]
$F_x = 190$ N [1]

force at **X** = ... [2]

(c) Hence or otherwise, calculate the force in the string at Y.
$500 + 35 = 190 + F_y$
$F_y = 345$ N [1]

force at **Y** = ... [1]

(d) An additional weight is suspended from the plank directly below point **Y**.

State and explain how this will affect the force in the string at **X**.

This will not affect the force at X. [1]
Taking moments about Y, the calculation of the force at X is the same as per part (b). [1]

[2]

3 Fig. 3.1 shows a diver working below the surface of a lake. The density of the water in the lake is 1000 kg/m^3, the atmospheric pressure at the surface is 1.0×10^5 Pa and the gravitational field strength is 10 N/kg.

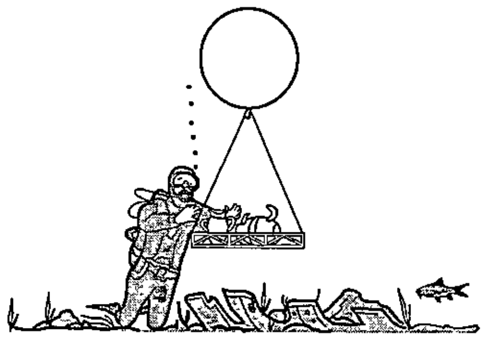


Fig. 3.1

The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

(a) Calculate the total pressure acting on the balloon, at 15 m below the surface of the lake.

Total pressure = $1.0 \times 10^5 + 1000 \times 10 \times 15$ [1]
= 2.5×10^5 Pa [1]

pressure = ... [2]

(b) The diver releases the tray and the balloon, and they begin to rise. The temperature of the air in the balloon does not change. The volume of the balloon is 0.3 m^3 at 15 m depth.

Calculate the volume of the balloon when it reaches the surface.

$P_1V_1 = P_2V_2$
$2.5 \times 10^5 \times 0.3 = 1.0 \times 10^5 \times V_2$ [1]
$V_2 = 0.75$ m^3 [1]

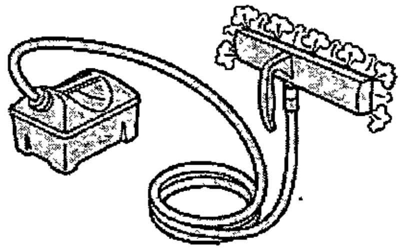
volume = ... [2]

(c) Explain, in terms of the air molecules inside the balloon, why the air pressure in the balloon is less at the surface.

As the balloon rises, its volume increases. The rate of air molecules colliding with the wall of the balloon is lower. [1] This leads to a lower average force per unit area acting on the wall of the balloon, thus the pressure is reduced. [1]

[2]

4 Arnold uses the steam wallpaper stripper, as shown in Fig. 4.1, to help him remove wallpaper in his living room.



Machine Specifications

Power rating = 2.5 kW
Voltage = 240 V
Capacity = 5.0 litres

Fig. 4.1

The water in the machine is heated until it boils and produces steam. The steam nozzle is held against the wall and the steam will soften the wallpaper, making it easy for Arnold to scrape it off.

Given that:
Specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$
Specific latent heat of vaporization of water = 2260 x 10^3 J kg^{-1}
One litre of water has a mass of one kilogram.

(a) Arnold fills the machine to its full capacity using tap water at 20 °C and turns on the switch.
Calculate the time he needs to wait before the machine starts producing steam.

$mc\Delta\theta$ = 5 x 4200 x (100 – 20) [1]
= 1.68 x 10^6 J [1]
time = energy / power = 1.68 x 10^6 / 2.5 x 10^3 = 672 s [1]

time = ... [3]

(b) Arnold uses the machine continuously for one hour since the time he turns on the switch.
Calculate the mass of the water left in the machine.

Total energy supplied 2.5 x 10^3 x 60 x 60 = 9.0 x 10^6 J

9.0 x 10^6 J - 1.68 x 10^6 J = 7.32 x 10^6 J [1]

Q = ml
7.32 x 10^6 = m x 2260 x 10^3
m = 3.24 kg [1]
mass left = 5 – 3.24 = 1.76 kg [1]

mass = ... [3]

5 Fig. 5.1 below shows circular wavefronts produced at the centre of a circular ripple tank.

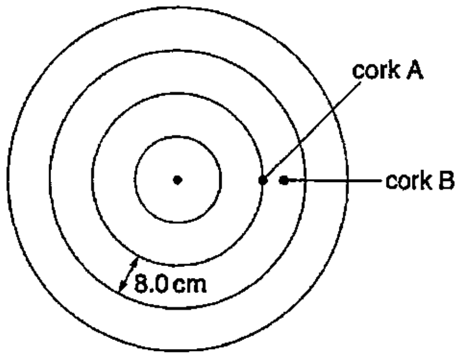


Fig 5.1

Two corks, A and B, float on the water in the ripple tank. The distance between successive wavefronts is 8.0 cm. Fig. 5.2 shows how the displacement of cork A varies with time.

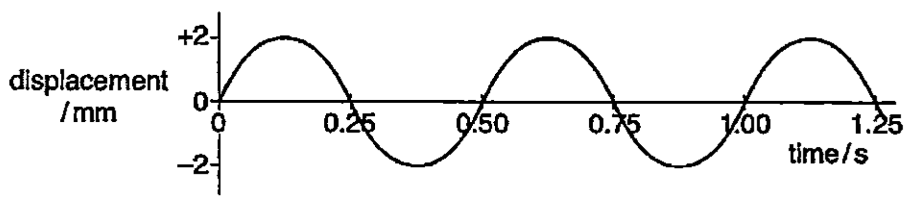


Fig 5.2

(a) State the displacement of cork B, when the displacement of cork A is 2 mm.

displacement = ...-2 mm..................... [1]

(b) The diameter of the ripple tank is 80 cm.

Determine the time taken by a wavefront to travel from the centre of the tank to the edge.

T = 0.5 s

v = f λ

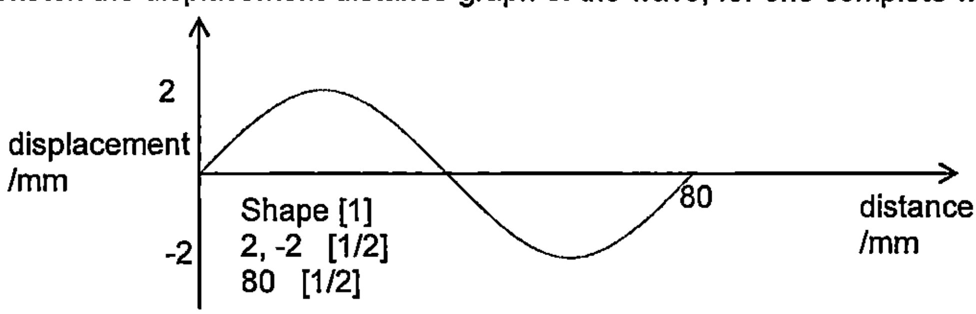
= 1/0.5 x 8 = 16 cm/s [1]

Distance from centre to edge = 80 / 2 = 40 cm [1]

time taken = 40 / 16 = 2.5 s [1]

time = ... [3]

(c) Sketch the displacement-distance graph of the wave, for one complete wave.



[2]

6 A ray of light from an under water laser pointer, is incident upon a spherical air bubble as shown in Fig. 6.1. The refractive index of water is 1.33.

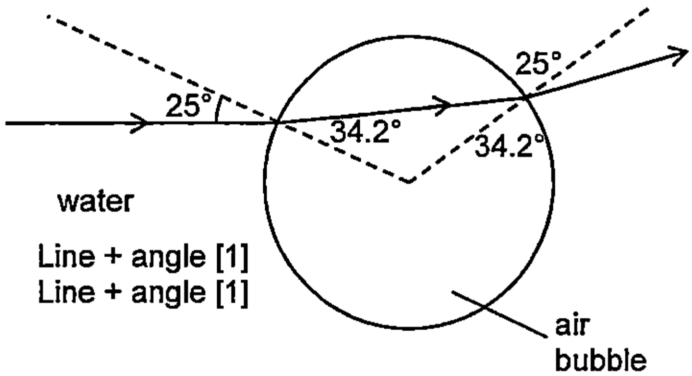


Fig 6.1

Complete the path of the ray until it exits the air bubble, showing clearly all angles at the boundaries. Show the workings to calculate these angles in the space below. [3]

(sin r) / (sin i) = n = 1.33

r = $\sin^{-1}$ (1.33 x sin 25)

= 34.2° [1]

n = 1/(sin c)

c = $\sin^{-1}$ (1 / 1.33)

= 48.8° (optional)

7 Fig. 7.1 shows a positively charged sphere held with an insulating handle. When the sphere is brought near the metal plate, the galvanometer needle deflects momentarily.

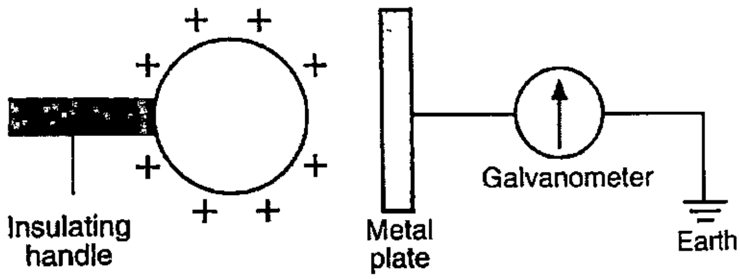


Fig 7.1

(a) Explain clearly why there is momentary deflection in the galvanometer needle?

When the sphere is brought near, electrons from the earth are attracted to the sphere and flowed to the surface of the plate. [1] This flow of electrons causes a current in the wire, deflecting the needle of the galvanometer. [1] When sufficient electrons are concentrated at the plate, the current stops and the deflection in the galvanometer stops. [1]

[3]

(b) Suggest a method that would increase the magnitude of the deflection.

Increase the positive charge of the sphere / Move sphere nearer to the plate [1]

[1]

(c) State clearly what can be observed when the positively charged sphere is removed quickly.

The needle of the galvanometer deflects momentarily in the opposite direction. [1]

[1]

8 Fig. 8.1 below shows a circuit connected to a battery of unknown e.m.f.

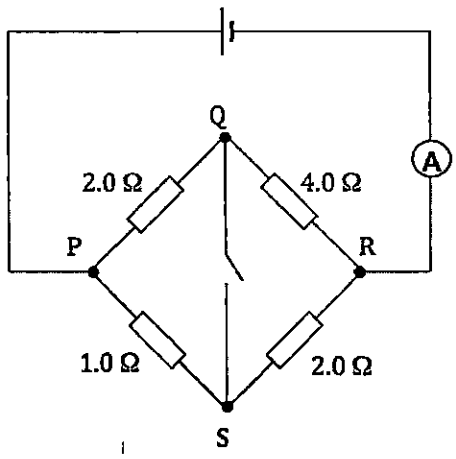


Fig. 8.1

(a) When the switch is opened, the ammeter reads 3.0 A.

(i) Calculate the e.m.f of the battery.

$1 / R_T = 1/6 + 1/3$ [1]
$R_T = 2\ \Omega$ [1]
$V = IR = 3 \times 2 = 6$ V [1]

e.m.f = ... [3]

(ii) Calculate the current passing through PSR.

$I = V/R = 6/3 = 2$ A [1]

current = ... [1]

(b) The switch is now closed.

Explain if a current will flow through QS. If yes, how much is the current.

No current flows through QS. [1]
Potential at Q = $2/6 \times 6 = 2$ V [1/2]
Potential at S = $1/3 \times 6 = 2$ V [1/2]
Since there is no potential difference between Q and S, no current will flow. [1]

[3]

9 If small cracks in steel pipes can be detected before they become larger, the cost of repairing the damage can be greatly reduced. Fig. 9.1 shows a method to detect cracks using a coil of insulated copper wire carrying a current. Iron filings are sprinkled over the pipe and will cluster around any crack that is perpendicular to the axis of the pipe.

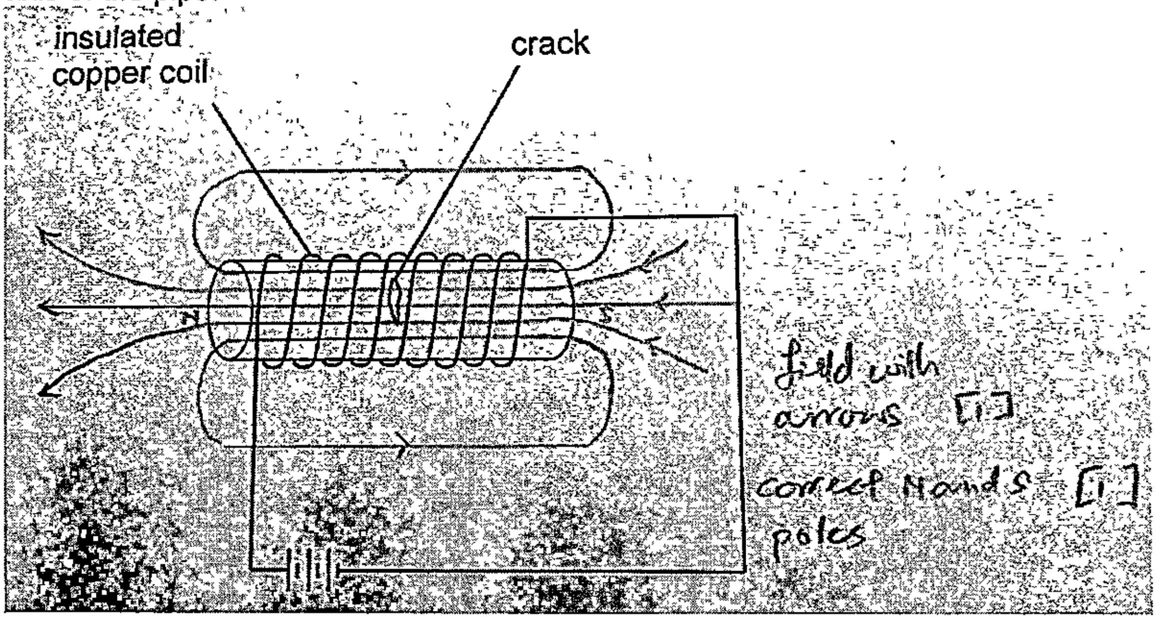


Fig. 9.1

(a) Draw on Fig. 9.1, the magnetic field lines generated by the current carrying coil if there is no crack and state clearly the magnetic poles formed. [2]

(b) Explain why iron filings cluster around the crack when there is a current in the coil.

When a current passes through the coil, a magnetic field is induced in the pipe. [1]
The edges of the crack acts like magnetic poles, attracting more iron filings. [1]
OR
The crack causes magnetic field leakage, attracting more iron filings. [2]

(c) Explain why this method will not work on copper pipes.

Since copper is not a magnetic material, it will not affect the magnetic field formed with or without cracks. [1]

[1]

SECTION B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12.**
Write your answers on the writing papers provided unless stated otherwise.

10 A 40 kg mass is initially at rest on a rough bench and a 20 kg mass is attached to it via an inextensible string, as shown in Fig 10.1. The string goes over a smooth pulley with negligible friction.

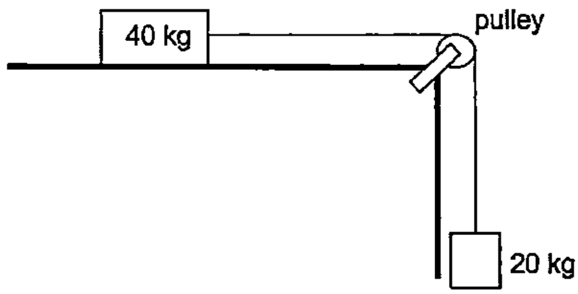


Fig. 10.1

When the 20 kg mass is released, the masses start to move together. The friction between the 40 kg mass and the bench is 20 N.

(a) Using Newton's Third Law of motion, state the action reaction pair of the weight of the 40 kg mass. [1]
The Earth pulls the 40 kg mass with a force of 400 N and the 40 kg mass pulls the Earth with a force of 400 N in the opposite direction.

(b) Calculate the acceleration of the masses when they start to move. [3]
$F_{net} = ma$ [1]
$200 - 20 = (20 + 40)a$ [1]
$a = 3 \text{ m/s}^2$ [1]

(c) Calculate the tension in the string when the masses start to move. [2]
$T - 20 = 40 \times 3$ [1]
$T = 140 \text{ N}$ [1]

(d) Fig. 10.2 shows a car brake system.

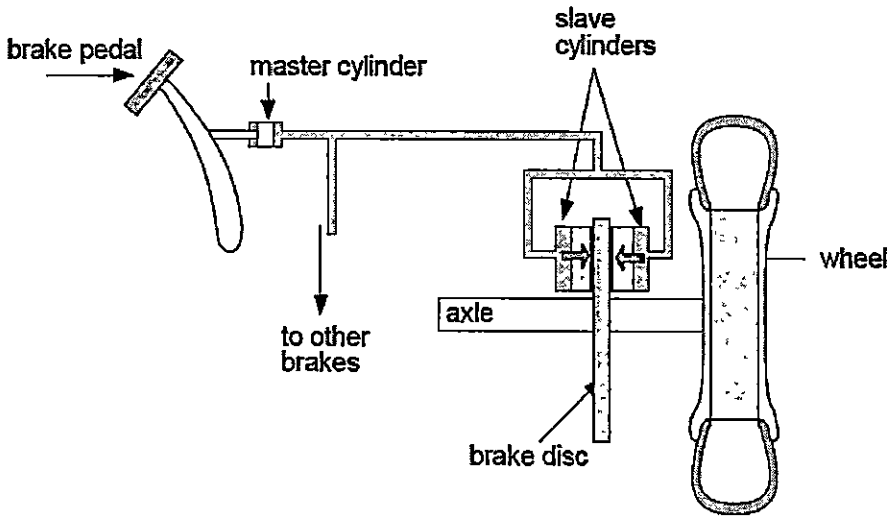


Figure 10.2

The pipes between the master cylinders and the slave cylinders are filled with incompressible brake fluid, forming a closed system. The diameter of the master cylinder is 10 cm and that of the each slave cylinder is 20 cm.

Calculate the ratio of the master cylinder area to the slave cylinder area. [1]
master cylinder area : slave cylinder area
$(10/2)^2 : (20/2)^2 = 1 : 4$ [1]

(e) The car requires a braking force of 4500 N on each brake disc to stop.

How much force should be applied to the master cylinder in order to achieve this? [3]
force at each slave cylinder = 4500/2 = 2250 N [1]
$F_m/A_m = F_s/A_s$ [1]
$F_m/1 = F_s/4$
$F_m = 2250/4 = 562.5$ N [1]

11 The issue of haze generated from forest fire has become a yearly problem for many countries. This is not only an expensive problem but has become a critical health hazard for many who are exposed to its effect. Moreover the generation of greenhouse gases from these fires has caused alarm as it will most likely further contribute to changes in the world's climate and weather pattern. One way in which the regional government has sought to combat this problem of forest fire is through the use of infra-red thermal imaging. Satellites equipped with infra-red sensors are used to detect problem spots. With this information, the local authorities are then mobilised to put out the fire before it spreads and worsens.

Visible light is unable to pass through clouds and haze, but infra-red radiation can.

How does the infrared (IR) sensor work?

The infra-red (IR) sensors mounted on satellites detect the relative thermal energies emitted by objects like burning trees, fields and streams. With the aid of a signal processor, this information is converted into a colour coded visual presentation showing regions with varying range of temperature. The IR band is often subdivided into smaller sections, coded as shown in the table below:

Section Code	**NIR**	**SWIR**	**MWIR**	**LWIR**	**FIR**
Wavelength/μm	0.75 – 1.4	1.3 – 3	3 – 8	8 – 15	15 – 1000

IR radiations that fall into individual sections are assigned colour codes by the signal processor. Forest fires which are normally detected in the range of 3 to 4.5 μm and hence falls under the MWIR section may be assigned the colour red.

Bodies of water which are cooler like rivers fall in the range of 10+ μm and as such the LWIR section may be assigned the colour blue.

As a result, a coloured image of red for hot and blue for cold objects can be constructed and used to detect hot spots.

(a) Which IR radiation, MWIR or LWIR, travels at a higher speed to the sensors on the satellites? [1]
Both travel at the same speed of 3.0×10^8 m/s [1]

(b) State the IR section code that is nearest to the electromagnetic band of visible light. [1]
NIR, shortest wave length. [1]

(c) Calculate the range of the IR frequencies for the MWIR section code. [4]
For 3 μm,
$f = 3.0 \times 10^8 / 3.0 \times 10^{-6}$ [1]
$= 1.0 \times 10^{14}$ Hz [1]
For 8 μm,
$f = 3.0 \times 10^8 / 8.0 \times 10^{-6}$ [1]
$= 3.75 \times 10^{13}$ Hz [1]
Range: 3.75×10^{13} Hz to 1.0×10^{14} Hz

(d) Deduce from the information above, if the method of IR imaging is more useful in detecting exact spots of forest fire compared to a normal coloured photograph taken from a satellite. Explain your deduction. [2]
An IR image is more useful [1] than a photograph.
If clouds or haze is present, they will block out the spots [1] which are on fire, rendering a photograph useless.

(e) Besides the application above, state two other applications of infra-red radiation. [2]
Heat treatment for illnesses / intruder alarm / remote control / thermometer [any 2 correct answers]

EITHER

12 Fig. 12.1 shows a flowmeter that measures the volume of oil passing through a pipe.

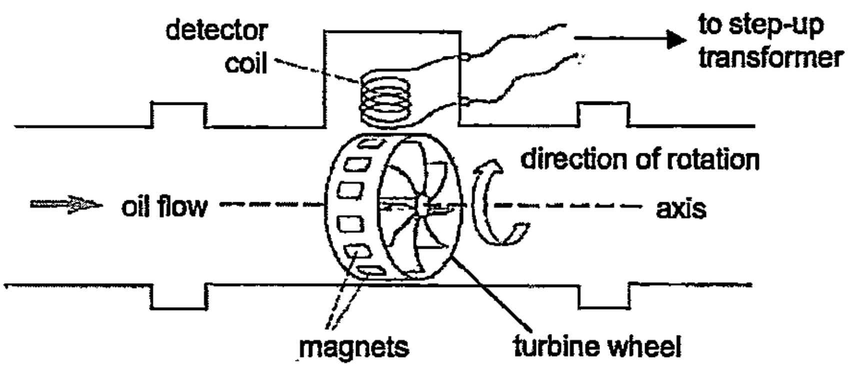


Fig.12.1

Twenty identical magnets are spaced equally around a turbine wheel. As oil flows, the turbine wheel rotates about the axis as shown. The detector coil is connected to the primary coil of a step-up transformer (Fig. 12.2) to amplify the voltage signal, which is then displayed on a cathode ray oscilloscope.

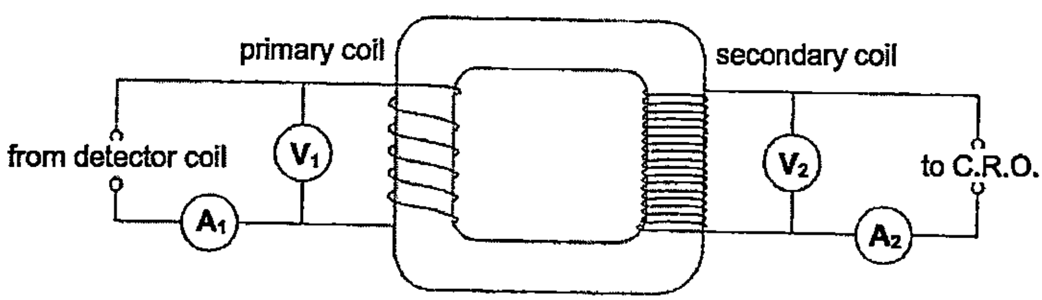


Fig. 12.2

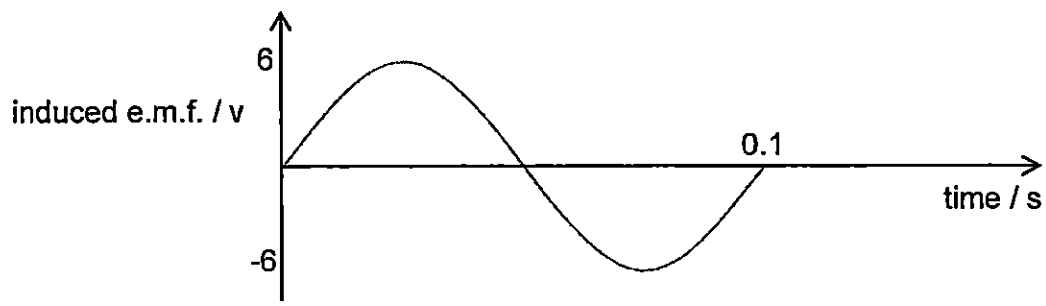
Fig. 12.3 shows the data for two different oil flow rates. Some values are missing from the table.

oil flow rate/ $cm^3 s^{-1}$	period of turbine spin / s	transformer			
		A_1 / A	V_1 / V	A_2 / A	V_2 / V
15	2	1.8	6	0.8	12
30	1	1.8		0.8	

Fig. 12.3

(a) Explain why an alternating e.m.f. is induced in the detector coil. [3]
As the turbine wheel turns, the magnets move with respect to the detector coil. When a magnet approaches the coil, the change in magnetic flux linking the coil generates an induced e.m.f. in the coil. [1] As the same magnet leaves the coil, it generates an induced e.m.f. of the opposite polarity. [1] The cycle repeats with each approaching magnet, inducing an alternating e.m.f. in the detector coil. [1]

(b) Sketch a graph below to show how the induced e.m.f. in the primary coil varies with time for a flow rate of 15 cm^3s^{-1}. [2]



shape and +6, -6 [1]
0.1 for period [1]

(c) State if the transformer is 100% efficient. Explain by showing your working clearly. [2]
input power = 1.8 x 6 = 10.8 W, output power = 0.8 x 12 = 9.6 W [1]
since output power lower than input power, efficiency is lower than 100%. [1]

(d) Calculate the ratio of the number of turns in the secondary coil to the number of turns in the primary coil. [2]
$V_s/V_p = N_s/N_p$
$N_s/N_p = 12 / 6$ [1]
= 2 : 1 [1]

(e) Calculate the missing values for V_1 and V_2. [1]
$V_1 = 12$ V and $V_2 = 24$ V [1]

OR

12 Fig. 12.1 shows a simple experimental set-up to study the motion of a motor. AB and CD are solenoids connected to a battery. F and G are connected to an external voltage supply. The graph of the external voltage supplied is as shown in Fig. 12.2 (Positive voltage indicates that the potential of F is higher than of G).

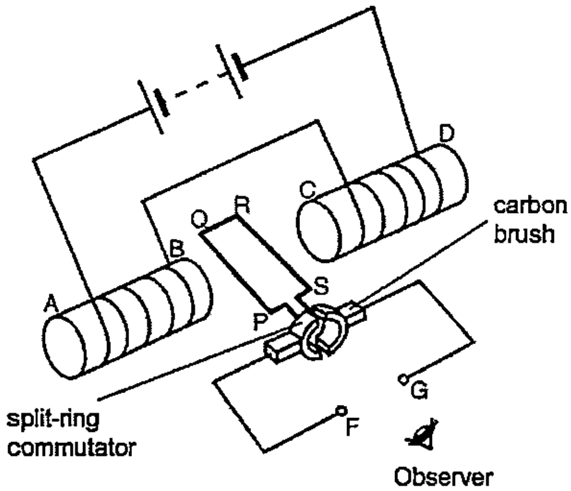


Fig. 12.1

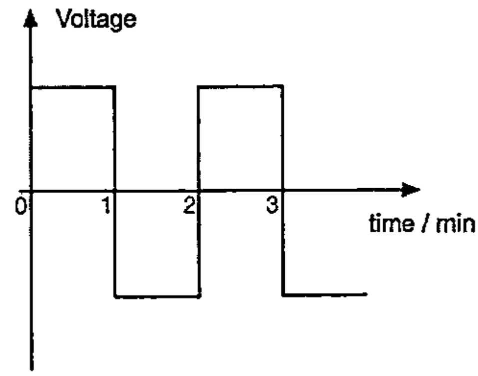


Fig. 12.2

It is observed that the coil makes 5 rotations in one minute.

(a) Identify the magnetic poles at B and C. [1]
B north, C south [1]

(b) How would the coil PQRS turn (clockwise or anticlockwise direction) during the first minute? [1]
anticlockwise [1]

(c) Explain how you arrived to the answer in **(c)**. [2]
With the magnetic field pointing from B to C and the current moving from P to Q, [1]
using Fleming's Left Hand rule, where the index finger is pointing in the N-S direction and the middle finger in the direction of the current, the thumb will show the direction of the force, in which the coil will turn. [1]

(d) Fig. 12.3 shows the solenoids and the coil PQRS from the observer's point of view.

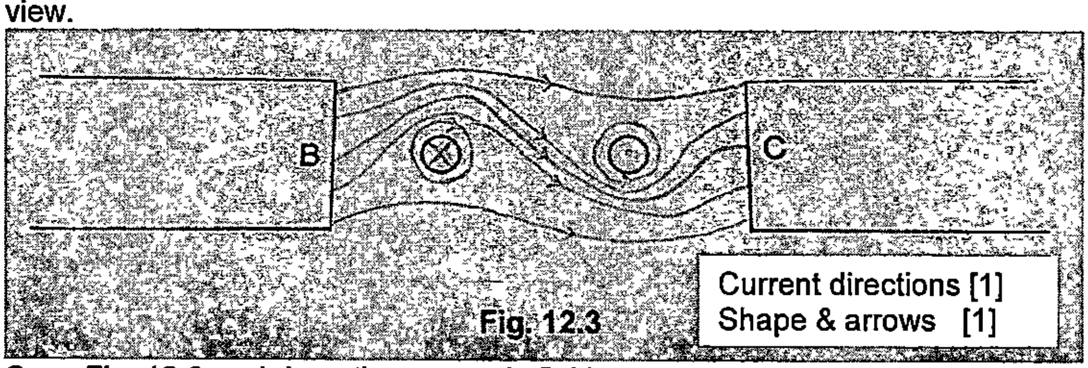


Fig. 12.3

Copy Fig. 12.3 and draw the magnetic field pattern between the two solenoids. The two circles represent PQ and RS. Indicate the direction of the current using dot and cross notation. [2]

(e) State what would happen to the coil during the 1-2 minute interval. [1]
The coil will begin to change direction of rotation. [1]

(f) State the purpose of the split-ring commutators. [1]
The split-ring commutators reverse the direction of the current in the coil after every half revolution. [1]

(g) A longer wire of the same material and cross-sectional area as the one used in PQRS is used to make a coil with greater number of turns. This coil is used to replace PQRS.

State and explain what can be observed of the movement of the new coil. [2]
The coil will spin faster. [1]
The turning effect of the DC motor can be increased by increasing the number of turns of the coil [1]
OR
There is now a longer length of current carrying conductor within the permanent magnets' magnetic field, causing a stronger turning effect.

END OF PAPER

Paper 1 answers

1 D	2 B	3 C	4 A	5 D	6 C	7 B	8 B	9 D	10 B
11 A	12 C	13 B	14 C	15 A	16 C	17 D	18 B	19 B	20 D
21 D	22 D	23 B	24 C	25 A	26 D	27 D	28 A	29 B	30 C
31 C	32 B	33 D	34 C	35 C	36 C	37 B	38 A	39 D	40 A

Name:	Index Number:	Class:

HUA YI SECONDARY SCHOOL

4E Preliminary Examination 2015 **4E**

PHYSICS **5059/01**

Paper 1 Multiple Choice 14 September 2015

1 hour

Candidates answer on the Multiple Choice Answer Sheet
Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your Name, Index Number and Class on the Answer Sheet in the spaces provided.

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions.

For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

For Examiner's Use	
Paper 1	

This document consists of **15** printed pages including the cover page.

[Turn Over

Setter: Mr Chong ML Chris

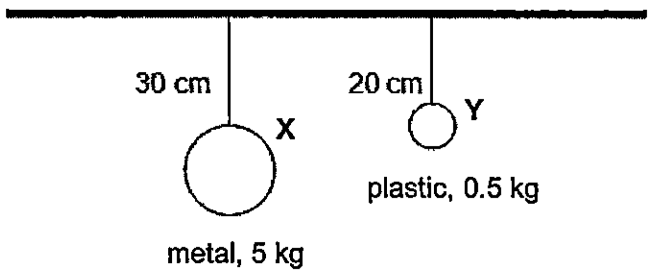
1 Keith uses a micrometer screw gauge to measure the thickness of a pipe.

Diagram 1 shows the reading when it is closed without the pipe.
Diagram 2 shows the reading when it is closed with the pipe.

What is the thickness of the pipe?

A 10.51 mm
B 10.57 mm
C 12.76 mm
D 12.82 mm

2 In the diagram, **X** and **Y** are two pendulums of different lengths, masses, sizes and materials.



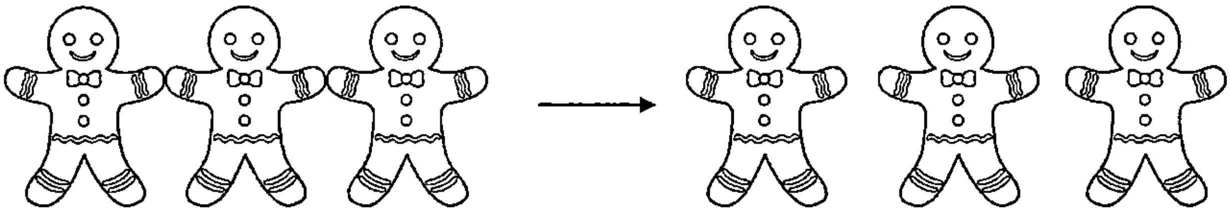
Which of the following statements is true?

A **Y** will swing faster as it is shorter.
B **X** will swing faster as it is larger in size.
C **Y** will swing faster as it has a smaller mass.
D **X** will swing faster as it is longer.

3 An object weighs 200 N on the Earth and 12 N on an asteroid.
What is the acceleration due to gravity on the asteroid?

A 0.6 m/s^2
B 1 2 m/s^2
C 10 m/s^2
D 12 m/s^2

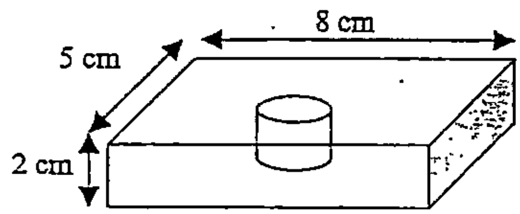
4 A piece of biscuit made of three ginger bread men has a density of 3.0 kg/m^3.
It has been broken into three identical pieces.



What is the density of each piece?

A 0 kg/m^3 B 1.0 kg/m^3
C 3.0 kg/m^3 D 9.0 kg/m^3

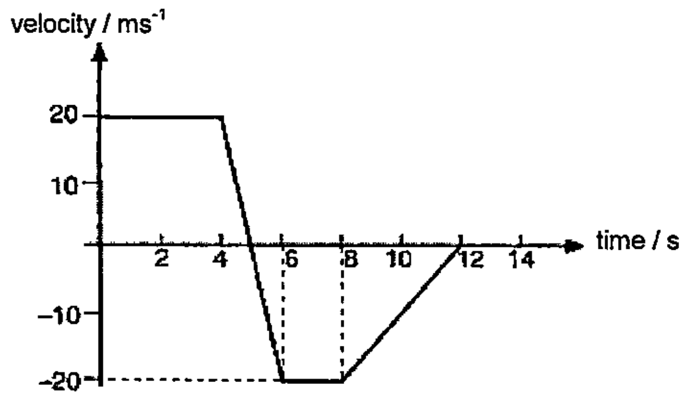
5 A rectangular block of steel has a cylindrical hole bored through it as shown.
The density of steel is 8 g/cm^3 and the mass of the block with the hole is 560 g.



What is the cross-sectional area of the hole?

A 5.0 cm^2 B 10 cm^2
C 35 cm^2 D 40 cm^2

6 The velocity-time graph below represents the motion of a particle along a straight line.

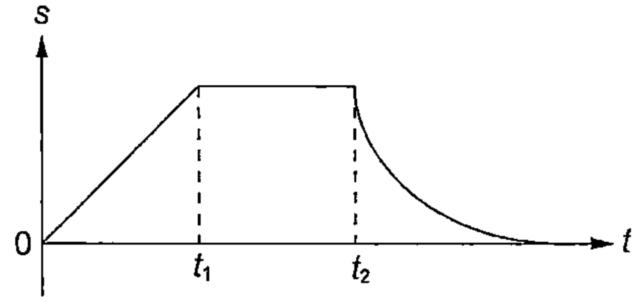


Which of the following statements are true?

I The particle's velocity is momentarily zero at t = 5 s.
II The particle comes back to its starting point in 12 s.
III The particle is furthest away from the starting point at t = 12 s.
IV The particle travels in the opposite direction between t = 5 s and t = 12 s.

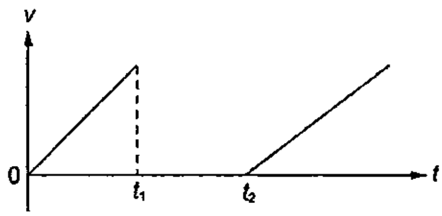
A I and III only B I and IV only
C I, II and IV only D I, III and IV only

7 A displacement-time graph of an object is as shown.

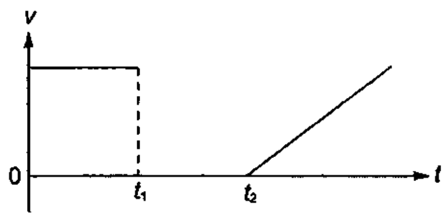


Which of the following graphs is its corresponding velocity-time graph?

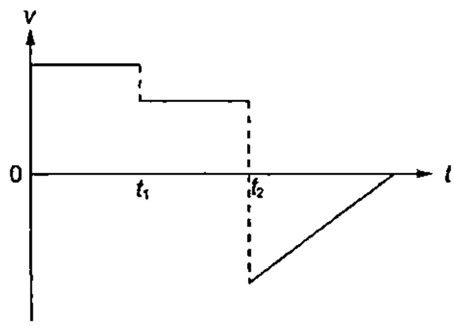
A



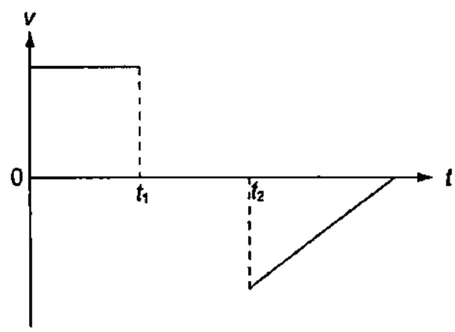
B



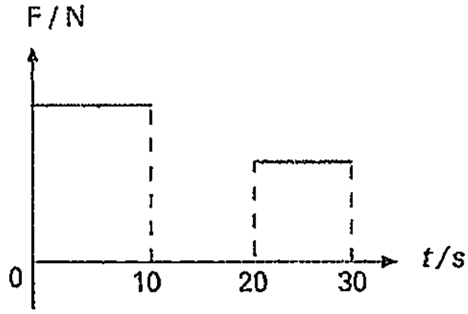
C



D

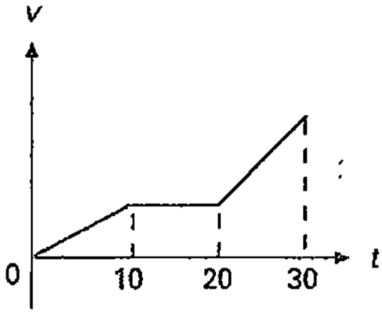


8 An object at rest experiences a force as shown in the resultant force against time graph.

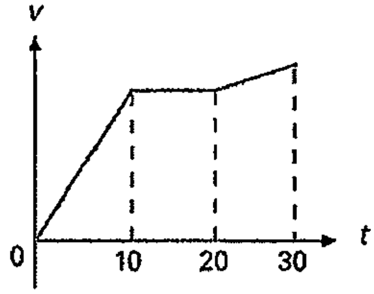


Which of the following velocity-time graphs is correct?

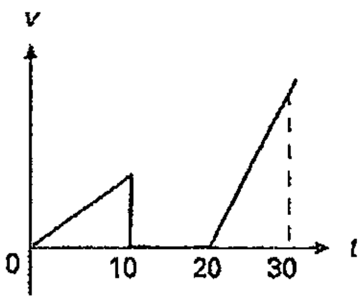
A



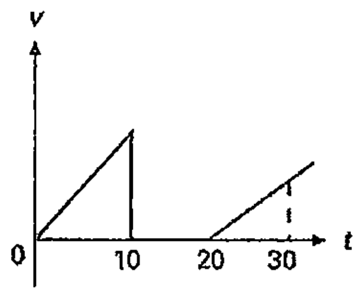
B



C



D

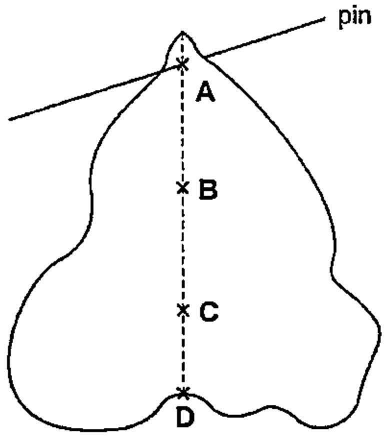


9 A box of mass 2 kg moves horizontally with a constant speed of 0.5 m/s when a force of 7 N is applied.

What force should be applied to the box for it to have an acceleration of 4.0 m/s^2?

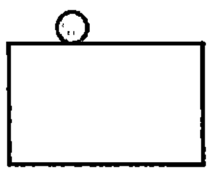
A 1.0 N **B** 7.0 N
C 8.0 N **D** 15.0 N

10 A piece of card of uniform thickness is suspended freely from a horizontal pin. Which of the points shown is its centre of gravity?



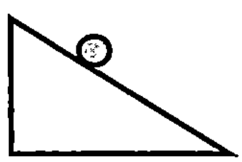
11 Which of the following shows a sphere in stable equilibrium?

A

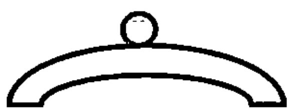


B

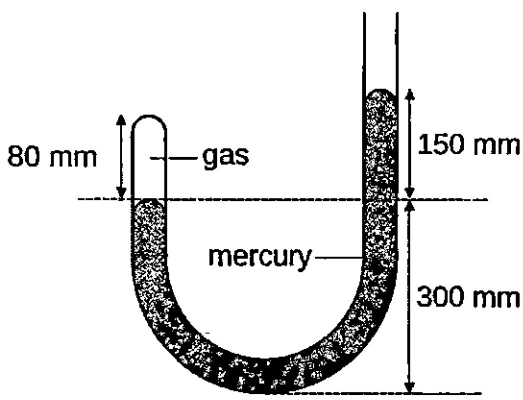
C



D



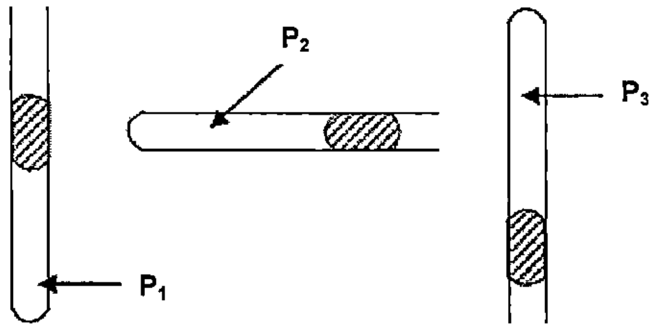
12 The diagram shows gas trapped in the left arm of a manometer containing mercury.



If the atmospheric pressure is 760 mmHg, what is the pressure of the trapped gas?

A	80 mmHg	**B**	150 mmHg
C	680 mmHg	**D**	910 mmHg

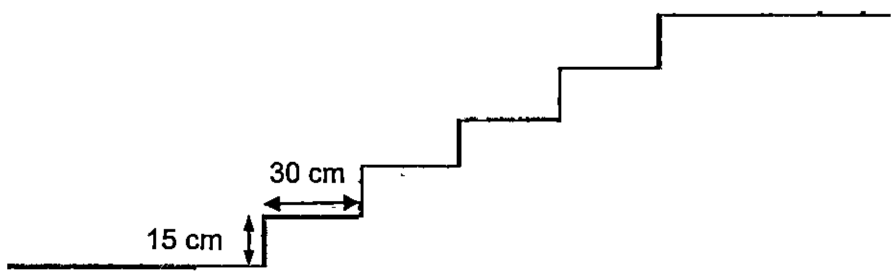
13 A column of dry air is trapped by a pellet of mercury in a capillary tube. The capillary tube is held in different positions as shown.



Which of the following correctly represents the pressures P_1, P_2 and P_3 of the enclosed air in the capillary tube?

A $P_1 = P_2 = P_3$
B $P_1 > P_2 > P_3$
C $P_1 > P_3 > P_2$
D $P_3 > P_2 > P_1$

14 The diagram shows a set of five steps. A student, of mass 50 kg, runs up the steps.



What is the work done by the student?

A 112.5 J
B 375 J
C 750 J
D 11 250 J

15 A person exerts a horizontal force of 700 N on a box that also experiences a friction force of 300 N.

If it takes 4.0 seconds to move the box 3.0 m, what is the power exerted by the person?

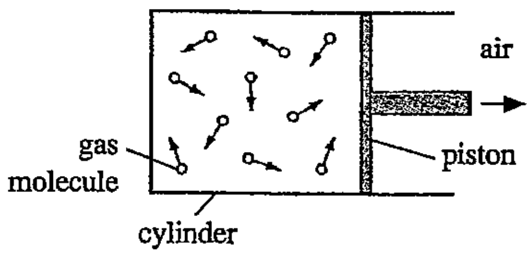
A 225 W   **B** 300 W
C 525 W   **D** 750 W

16 On a spray can containing insecticide, there is a warning label stating that it is dangerous to throw the can, even if empty, into a fire.

Why is it dangerous to throw an empty spray can into a fire?

A When the can is heated, the gas molecules inside the empty can will become very hot and explode.
B When the can is heated, the gas molecules inside the empty can will expand and the pressure within the container will build up until the can explodes.
C When the can is heated, the gas molecules inside the empty can will move faster and the pressure within the container will build up until the can explodes.
D When the can is heated, the can will melt and the gas inside it will explode.

17 Gas inside a cylinder is heated slowly to a higher temperature. The pressure inside the cylinder remains constant as the piston moves outwards.



How do the speed of the gas molecules and their rate of collision with the piston compare with their initial values at the lower temperature?

	speed of molecules	rate of collision
A	greater	greater
B	greater	reduced
C	greater	same
D	same	greater

18 A resistance thermometer was used to measure the temperature of a water bath. The readings on the resistance thermometer are:

960 Ω when the junction is in pure melting ice (at standard atmospheric pressure).
1200 Ω when the junction is in steam above boiling water (at standard atmospheric pressure).
1056 Ω when the junction is in a water bath.

What is the temperature of the water bath?

A 12 °C **B** 25 °C
C 40 °C **D** 50 °C

19 When you stand with one foot on a cement floor and the other foot on a carpet in a cold room, the cement floor feels colder than the carpet.

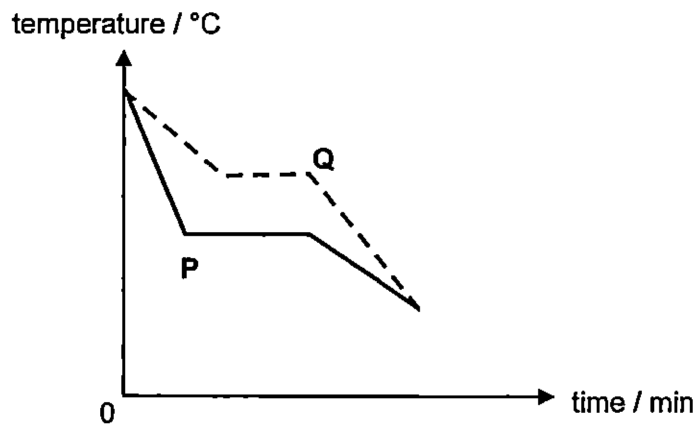
Which is the most likely explanation?

A Air is unable to circulate through the carpet fibres.
B The cement floor is at a lower temperature than the carpet
C There is a higher rate of heat transfer from the carpet to your foot than from the cement floor to your foot.
D There is a higher rate of heat transfer from your foot to the cement floor than from your foot to the carpet.

20 Which of the following statements describes why cooling always accompanies evaporation?

A The air molecules cool the liquid.
B The more energetic molecules leave the liquid.
C There are fewer liquid particles left in the liquid.
D The molecules in the liquid absorb energy from the air.

21 Two liquids, **P** and **Q**, of the same masses are placed in a room for cooling. Their cooling curves are as shown.



Which statement is correct?

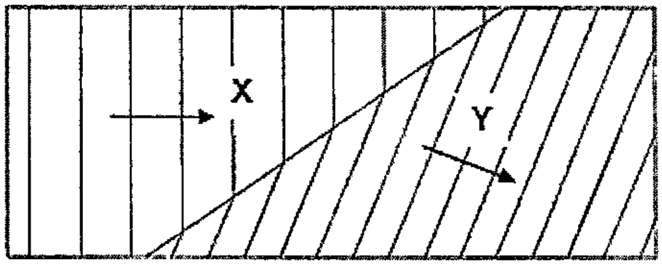
A Both liquid **P** and liquid **Q** have the same freezing point.
B Liquid **P** has a higher specific heat capacity than liquid **Q**.
C Liquid **P** has a lower specific latent heat of fusion than liquid **Q**.
D Solid **P** has a higher specific heat capacity than solid **Q**.

22 A piece of aluminium of mass 2 kg at 700 °C is placed into 2 kg of water at 20 °C until it reaches thermal equilibrium. (specific heat capacity of aluminum = 900 J kg^{-1} $°C^{-1}$, specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$, specific latent heat of vaporisation of water = 2.27 x 10^6 J kg^{-1})

What is the mass of water which will be vaporised at 100 °C?

A 0.09 kg
B 0.18 kg
C 0.27 kg
D 0.36 kg

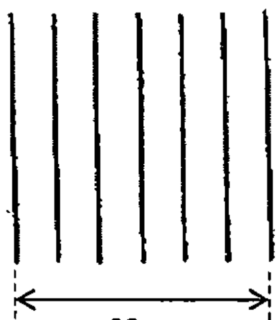
23 The diagram shows water waves travelling from section **X** to section **Y** in a ripple tank.



Which statement is correct?

A The water is shallower in section **Y**.
B The water is deeper in section Y.
C The frequency is lower in section Y.
D The waves move faster in section **Y**.

24 In a ripple tank experiment, plane water waves are projected onto a screen as shown. The vibrator vibrates at 50 times per second.



What is the wavelength and speed of the wave?

	wavelength	speed
A	4.0 cm	2.0 m/s
B	4.0 cm	12.5 m/s
C	5.0 cm	2.5 m/s
D	5.0 cm	10 m/s

25 Waves **P** and **Q** are components of the electromagnetic spectrum. **P** has a longer wavelength than **Q**.

Which statement about **P** and **Q** is likely to be true?

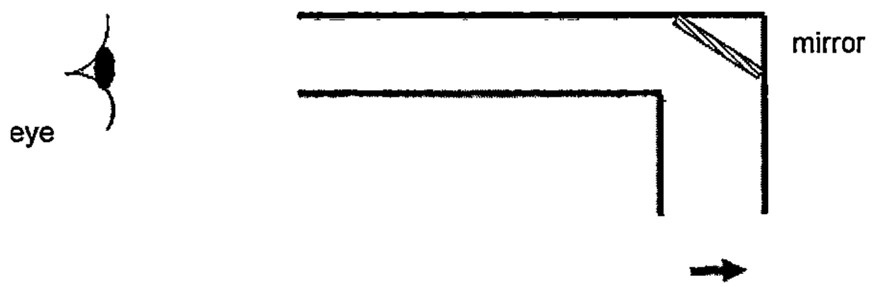
A **P** can travel faster in vacuum than **Q**.
B **P** is radio wave and **Q** is infra-red radiation.
C **Q** has a lower frequency than **P**.
D **Q** is ultra-violet radiation and **P** is X-ray.

26 The frequencies of two musical notes **X** and **Y** are 256 Hz and 512 Hz respectively. If **X** and **Y** have the same amplitude, which of the following statements is/are true?

I	**Y** has a higher pitch than **X**.
II	The loudness of **X** is larger than that of **Y**.
III	The wavelength of **Y** is longer than that of **X**.

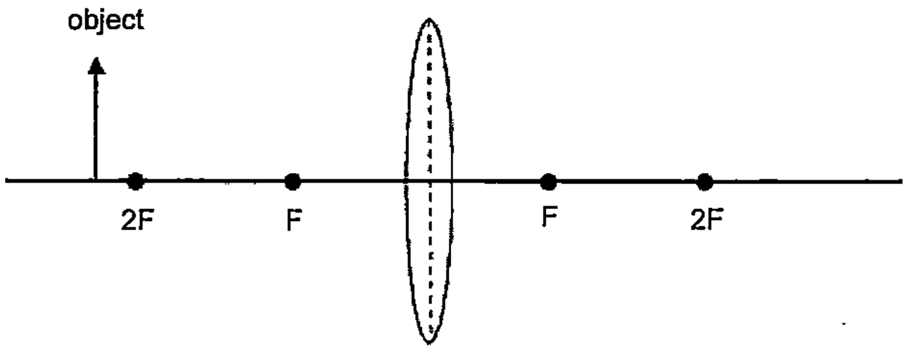
A I only **B** **III** only
C **I** and **II** only **D** **II** and **III** only

27 The diagram shows an observer looking at an object through a pipe with a mirror installed at its corner.



Which of the following shows the image seen by the observer?

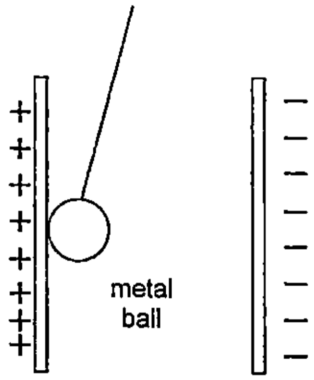
28 An object is placed in front of a thin converging lens as shown.



Which of the following has the above set-up?

A camera
B magnifying glass
C photocopier
D projector

29 A neutral metal ball of negligible weight, suspended between two conducting charged plates, touches the positively charged plate as shown.



What will be the subsequent motion of the metal ball between the positively charged conducting plate and the negatively charged conducting plate?

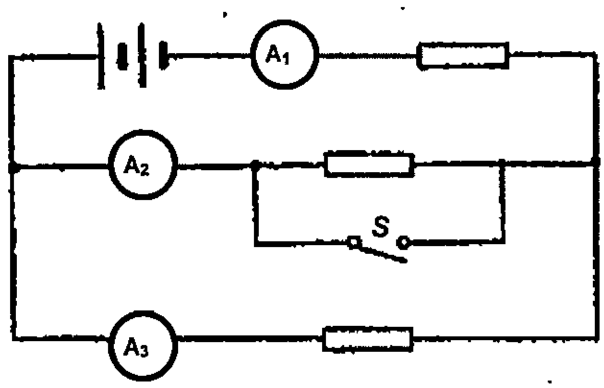
A The metal ball will remain attracted to the positive plate.
B The metal ball will be attracted to the negative plate.
C The metal ball will oscillate to and fro between the conducting plates.
D The metal ball will stay at the centre of the two conducting plates.

30 A resistor with resistance R is made from a length L of resistance wire with a cross-sectional area A. A second resistor with resistance $2R$ is made from a wire of the same material with a cross-sectional area of $\frac{1}{4}A$.

What length of wire is needed for the second resistor?

A $\frac{1}{2}L$ **B** L
C $2L$ **D** $8L$

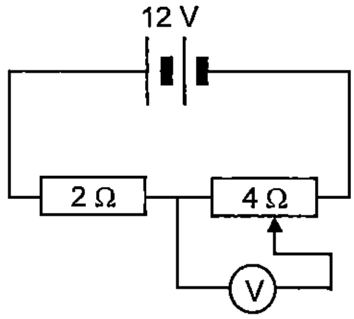
31 A circuit with three ammeters and three resistors is shown.



What will happen to the readings of the three ammeters when switch S is closed?

	A_1	A_2	A_3
A	increases	increases	increases
B	increases	becomes zero	remains unchanged
C	decreases	increases	becomes zero
D	increases	increases	becomes zero

32 A potential divider is connected in series with a fixed resistor as shown in the circuit.



By adjusting the potential divider, what are the minimum and maximum readings on the voltmeter?

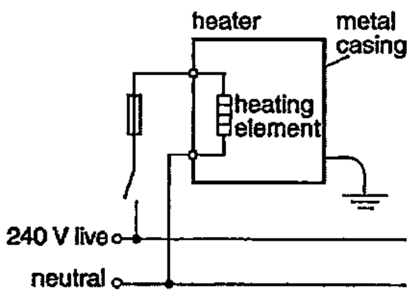
	minimum reading / V	maximum reading / V
A	0.00	4.00
B	0.00	8.00
C	0.00	9.00
D	4.00	12.00

33 Why can birds stand on an overhead high voltage transmission line without getting electrocuted?

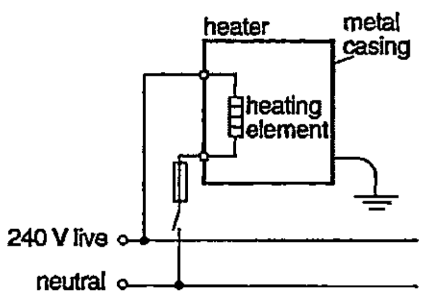
A They are not connected to Earth.
B Their feet are very good insulators.
C Their bodies have very high resistance.
D The air spaces between their feathers act as insulators.

34 Which of the following correctly shows how a water heater should be connected to the mains?

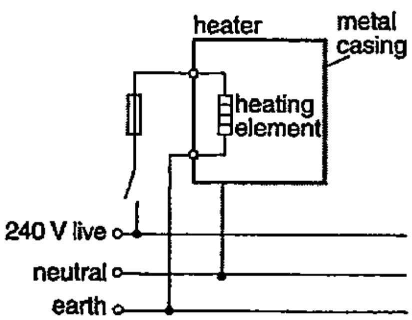
A



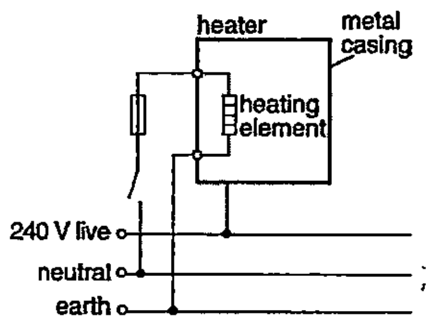
B



C



D

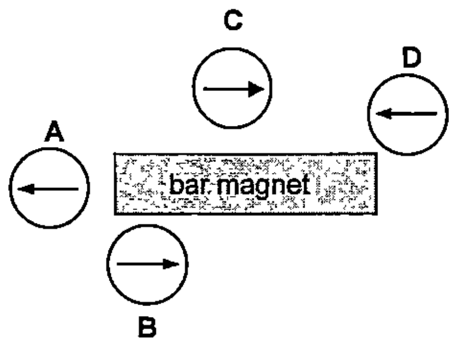


35 When one end of an iron rod is placed near a compass,

A any pole of the compass may point towards it.
B it is always the N-pole of the compass that points towards it
C it is always the S-pole of the compass that points towards it.
D the compass needle will not be affected by the rod.

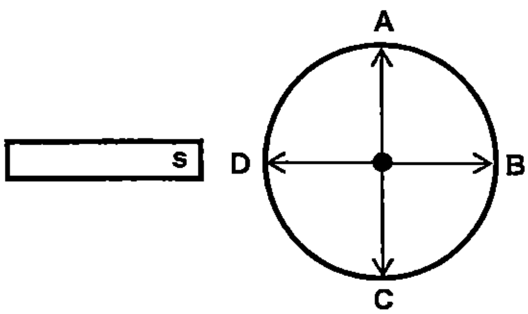
36 Four magnetic compasses are placed near a bar magnet as shown.

Which compass is faulty?

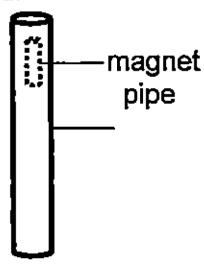


37 The diagram shows the screen of an electron gun. A beam of electron hits the center of the screen initially when going into the screen.

When the south pole of a magnet is placed at the position as shown, what direction will the beam deflect?



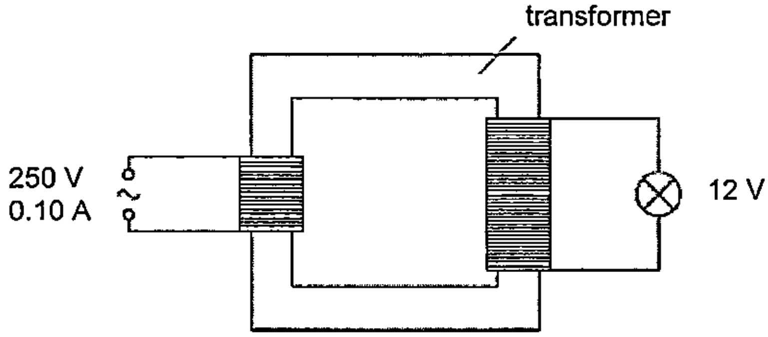
38 A cylindrical shaped magnet is dropped into an aluminium pipe as shown. The magnet falls through the pipe at a slow speed.



As the magnet falls,

A the air resistance increases and it opposes the motion of the magnet.
B similar polarity is induced in the bottom half of the pipe and like poles repel.
C it induces a current in the pipe and the pipe heats up, therefore there is resistance against motion of the magnet.
D it induces a current in the pipe which creates a magnetic field that opposes the motion of the magnet.

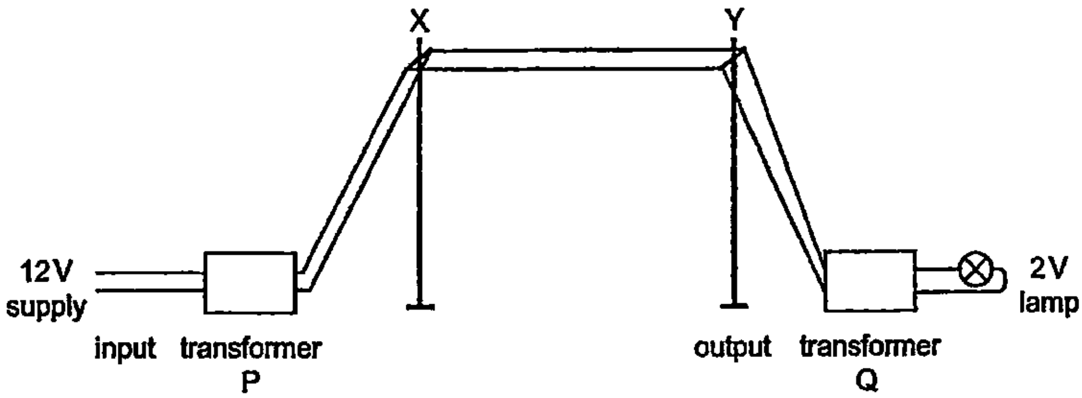
39 A transformer is used to operate a 12 V lamp from a 250 V mains supply. The mains current is 0.10 A and the efficiency of the transformer is 75 %.



What is the current in the lamp?

A 1.56 A
B 2.08 A
C 2.78 A
D 3.12 A

40 The diagram represents a model power line experiment set up in a school laboratory.



Which statement is **not** true?

A Transformer **P** is a step-up transformer.
B The current decreases along the power line **XY**.
C The voltage across the power line at **X** is greater than the voltage across the line at **Y**.
D The lamp lights up if the power supply is a.c. but not if it is d.c.

End of Paper

Name:	Index Number:	Class:

4E

HUA YI SECONDARY SCHOOL

Preliminary Examination 2015

4E

PHYSICS

5059/2

Paper 2

26 August 2015
1 hour 45 minutes

Candidates answer on the Question Paper
Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your Name, Index Number and Class at the top of this page.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **all** the questions. Question 12 has a choice of parts to answer.
Candidates are reminded that all quantitative answers should include appropriate units.
Candidates are advised to show all their workings in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.
At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE		
Section A		
Section B		
10		
11		
12		
TOTAL		

This document consists of **19** printed pages including the cover page.

[Turn Over

Setter: Mr Chong ML Chris

Section A [50 marks]
Answer **all** the questions in this section.

1 Fig. 1.1 shows a ship-to-ship cable, **ABC**, used by the navy to transfer people and goods from one ship to another in dangerous conditions. Initially, the angle of declination from each ship is 20° when a 1200 N object is suspended at the mid-point.

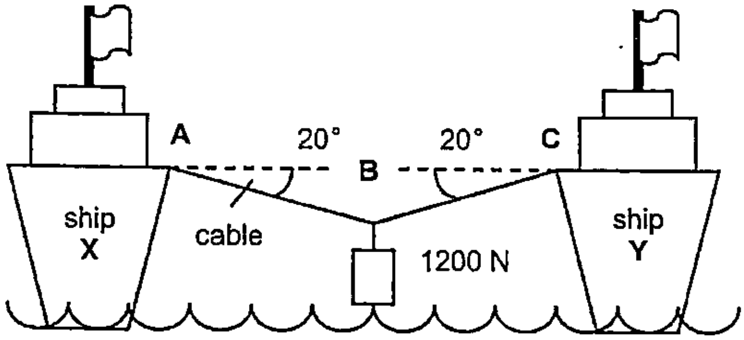


Fig. 1.1

(a) The tension in the cables **AB** and **CD** are the same. By using a suitable scale drawing, determine the tension in the cable **AB**.

tension = ... [3]

(b) In very stormy weather, the sailors are always worried when they see the cable becoming horizontal because they know from experience that this can cause the cable to break. Such a broken cable often whips incredibly fast back to the decks of the ships causing severe injury or death.

Explain why an almost horizontal cable is very likely to break.

....

.... [1]

[Total: 4]

2 Fig. 2.1 shows a method of lifting water from a river. The bucket and its contents weigh 60 N and is suspended from **Q**, 0.80 m from the pivot. The lever is uniform and has a weight 10 N. A man pushes down on the lever with a vertical force ***F*** at point **P**, 1.2 m from the pivot.

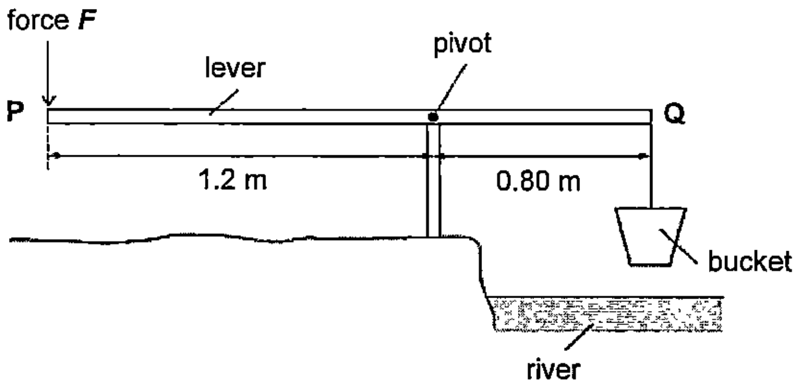


Fig. 2.1

(a) Indicate the weight of the lever with its centre of gravity **G** on Fig. 2.1. [1]

(b) Calculate the force ***F*** that the man exerts at point **P** to keep the lever balanced.

force = ... [2]

(c) The bucket is lifted by a vertical height of 5 m at a constant speed of 3 m/s. The gravitational field strength is 10 N/kg.

Calculate the power exerted by the man in lifting the bucket and water.

power = ... [2]

[Total: 5]

3 Fig. 3.1 shows a solar heating system. A 3000 W boiler serves as a back-up system in the event that the solar heating system could not provide sufficient heat.

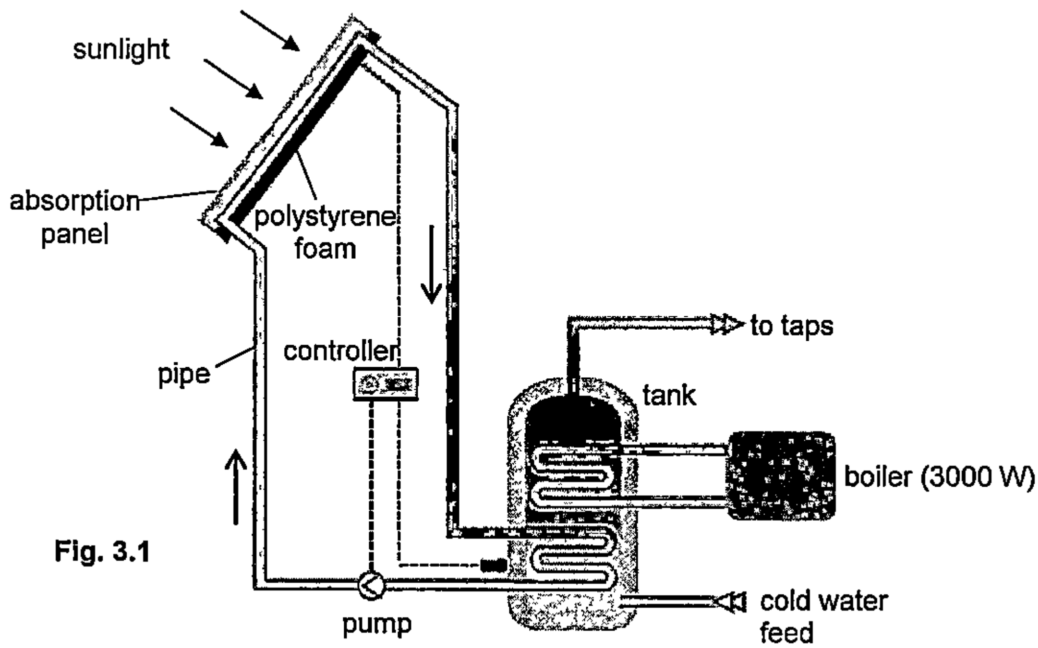


Fig. 3.1

(a) State the process by which energy is transferred

(i) from the sun to the absorption panel,

.... [1]

(ii) from the pipe to the water inside it.

.... [1]

(b) Explain why polystyrene foam is used as the backing board of the absorption panel.

....

....

.... [2]

(c) State a feature of the pipe in the water tank that allows the water to be heated up faster.

.... [1]

(d) The boiler was switched on for 96 minutes to provide more heat to the water.
Calculate the cost of using the boiler at a cost of 25 cents per kWh.

cost = ... [2]

[Total: 7]

4 Fig. 4.1 shows the heating curve of a substance **X**. The amount of **X** used in the experiment was 400 g. The heater used was rated at 200 W.

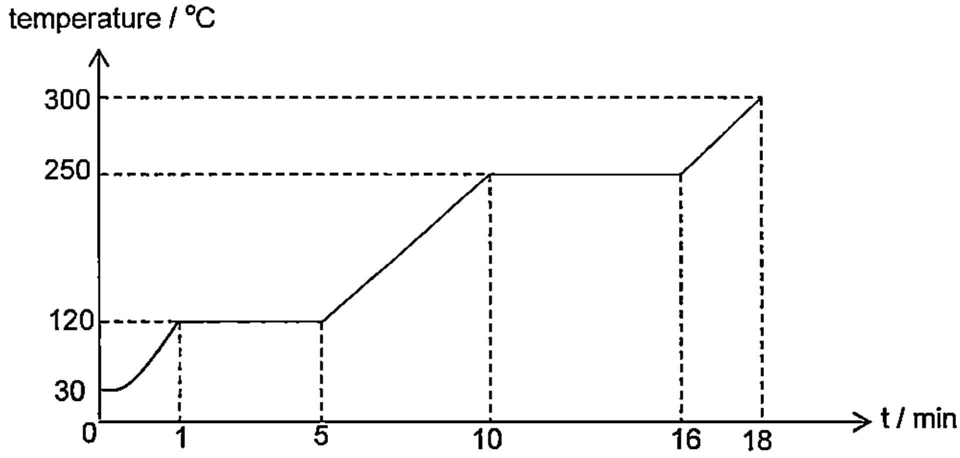


Fig. 4.1

(a) Using the kinetic theory of matter, explain why the temperature remains constant from t = 10 min to t = 16 min.

....

....

.... [2]

(b) Calculate

(i) the amount of energy required for melting substance **X**,

energy = ... [2]

(ii) the specific latent heat of vaporisation for substance **X**.

specific latent heat of vaporisation = ... [2]

[Total: 6]

5 When moving from position **G** to **L**, a ship sends pulses of ultrasonic waves at a frequency of 45 000 GHz continuously to the bottom of the sea. The variation of the time interval, t, between the emission of a pulse and the reception of its reflection is shown in Fig. 5.1. The speed of sound in water is 1350 m/s.

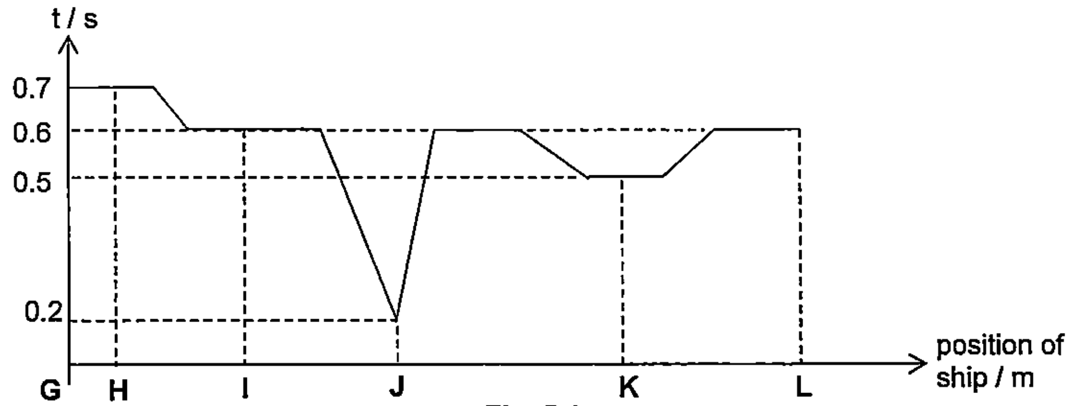


Fig. 5.1

(a) Calculate the depth difference between position **J** and **L**.

depth difference = ... [2]

(b) Calculate the wavelength of the ultrasound waves in water.

wavelength = ... [2]

(c) State one reason why the depth of the seabed changes abruptly within a few metres from **I** to **J**.

.... [1]

(d) State one other application of ultrasound.

.... [1]

[Total: 6]

6 Fig. 6.1 shows a regular hexagonal glass piece of refractive index 1.42. The ray of light entering the glass piece is parallel to its top surface.

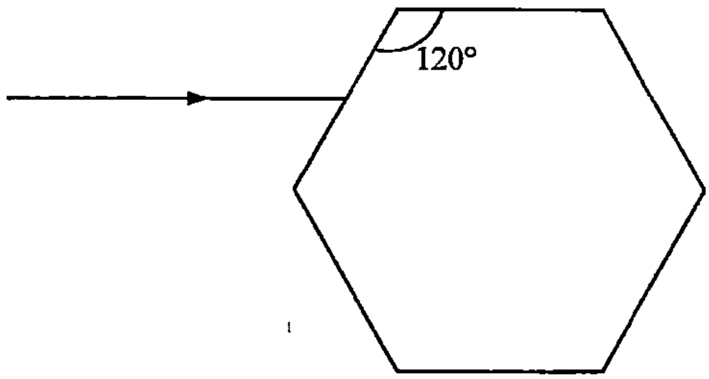


Fig. 6.1

(a) Calculate the critical angle of the glass.

critical angle = ... [1]

(b) Determine the angle of refraction of the light ray when it enters the glass piece.

angle of refraction = ... [2]

(c) Complete Fig. 6.1 to show how the light ray continues after it meets the glass piece.
Mark all the angles of incidence and angles of refraction clearly.
Show relevant working clearly in the space below. [4]

[Total: 7]

7 Fig. 7.1 shows two conducting spheres. Sphere **B** is connected to earth through a sensitive ammeter. Sphere **B** is initially uncharged. Sphere **A** has a very large positive charge on it. When sphere **B** is brought near to sphere **A**, a spark jumps between the two spheres and the ammeter needle moves rapidly up the scale and then back to zero.

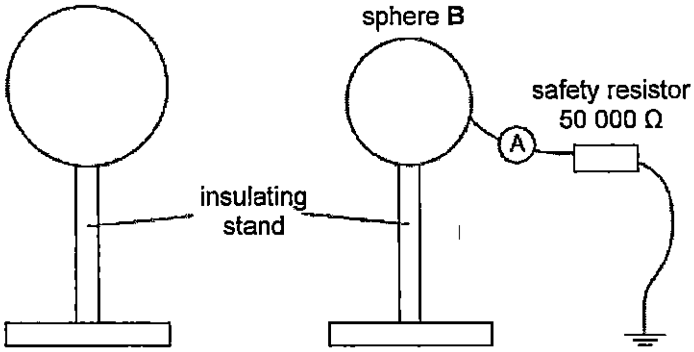


Fig. 7.1

(a) On Fig. 7.1, draw how the charges distribute itself on sphere **B** when it is brought near to sphere **A**. [1]

(b) Explain why the ammeter needle moves and returns to zero.

....

....

.... [2]

(c) The current through the ammeter is 0.0012 mA.
Calculate the potential difference across the safety resistor.

potential difference = ... [1]

[Total: 4]

8 Fig. 8.1 shows a circuit with 11.0 V direct current supply, three resistors and four voltmeters.

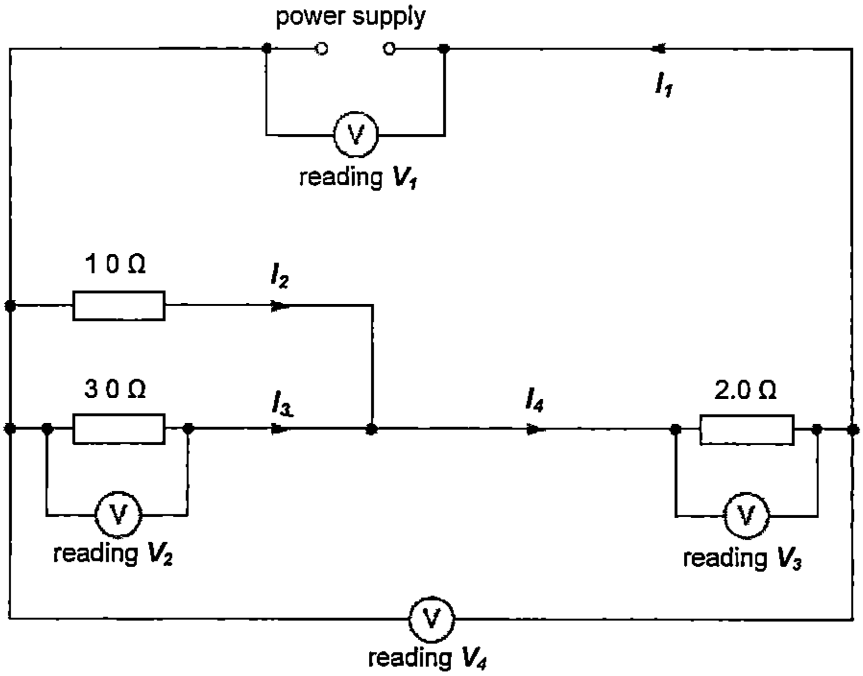


Fig. 8.1

The reading of voltmeter V_2 is 3.0 V.

(a) State the readings of

(i) V_4,

V_4 = ... [1]

(ii) V_3.

V_3 = ... [1]

(b) Calculate the currents I_2 and I_3.

I_2 = ... [1]

I_3 = ... [1]

(c) Calculate the current I_1.

I_1 = ... [1]

[Total: 5]

9 Fig. 9.1 shows a circuit breaker with the contacts closed.

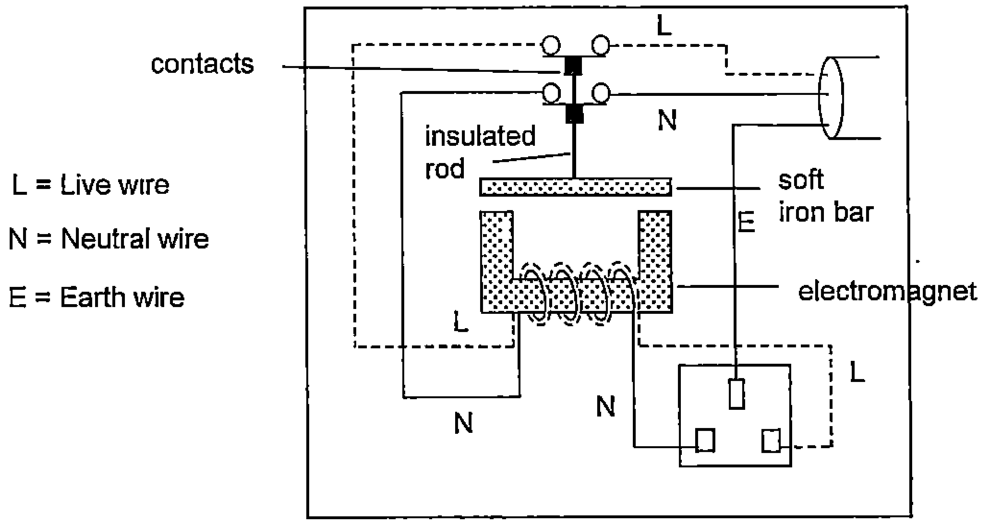


Fig. 9.1

(a) State a hazard which happens in the household circuit which causes this device to be triggered.

.... [1]

(b) Explain how this device helps to switch off the mains supply whenever the hazard stated in **(a)** occurs.

....

....

....

.... [3]

(c) State two ways of making the circuit breaker more sensitive.

....

.... [2]

[Total: 6]

Section B [30 marks]

Answer **all** the questions in this section.

Answer only **one** of the **two** alternative questions in Question 12.

10 Fig. 10.1 shows a rigid rectangular card which has a rectangular hole cut out in the centre. Fig. 10.2 shows the setup used to measure the acceleration of the card as it falls freely to the ground. A torchlight which is directed towards the **LDR** is turned on. A computer is used to measure the potential difference across **RS**.

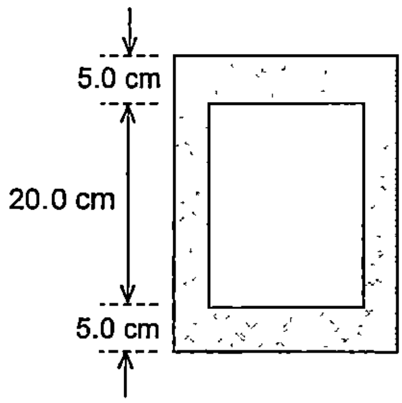


Fig. 10.1

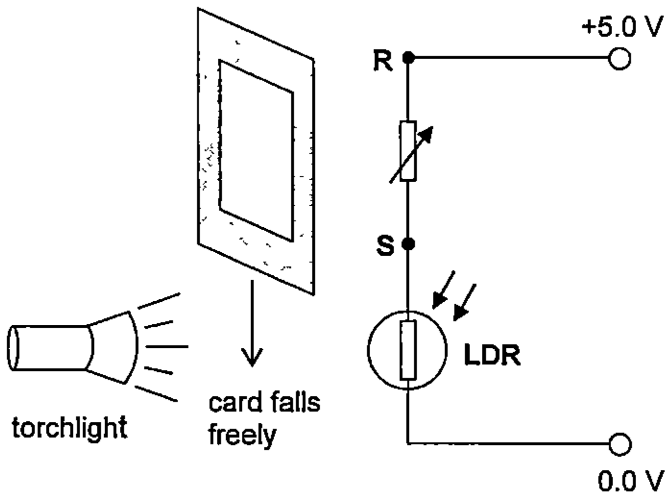


Fig. 10.2

Fig. 10.3 shows the graph of potential difference across **RS** against time.

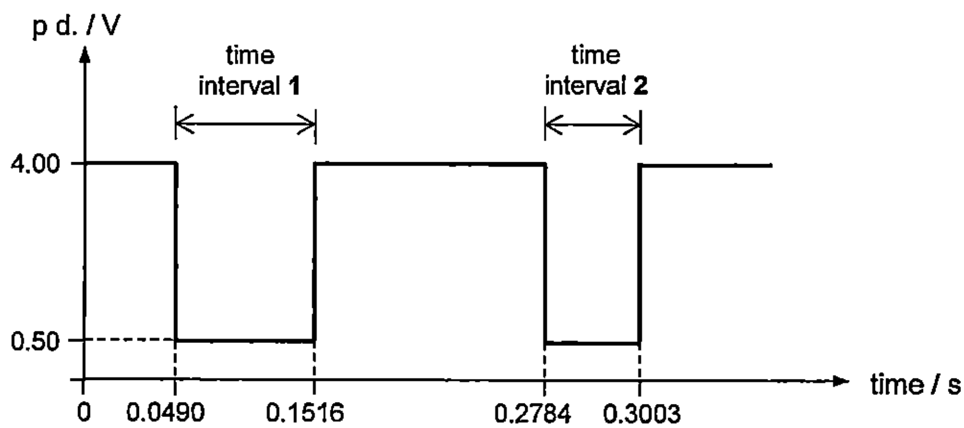


Fig. 10.3

(a) State what happens to the resistance of the **LDR** as the card falls.

....

....

.... [2]

(b) Explain why the p.d. across the variable resistor drops to 0.50 V.

....

....

....

.... [3]

(c) Explain why time interval **1** is longer than time interval **2** (as shown in Fig. 10.3) when the rigid card falls.

....

....

.... [2]

(d) Calculate the average acceleration of the card in cm/s^2.

average acceleration = ... [3]

[Total: 10]

11 Fig. 11.1 shows a skydiver of mass 70 kg falling towards the Earth after jumping from an aeroplane.

Fig. 11.1

At time t = 0 s, he jumps from the aeroplane. He opens his parachute 12 seconds later. Fig. 11.2 shows the speed-time graph for the skydiver.

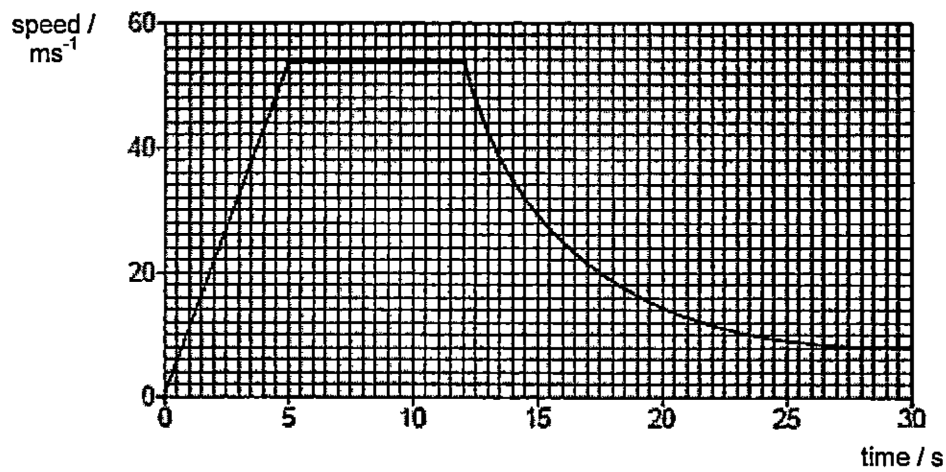


Fig. 11.2

(a) Determine the resultant force of the diver at t = 3 s.

resultant force = ... [3]

(b) State the terminal velocity of the skydiver before he opens his parachute.

terminal velocity = ... [1]

(c) Determine the distance travelled by the skydiver when his weight is equal to the air resistance.

distance = ... [2]

(d) Describe the motion of the skydiver for the period between t = 12 and t = 30 s.

....

....

.... [2]

(e) Explain your answer in **(d)** in terms of forces acting on the skydiver.

....

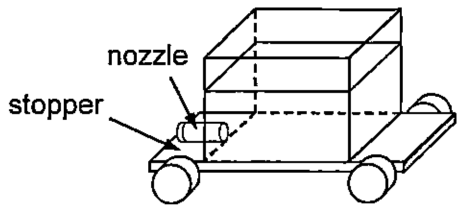
....

.... [2]

[Total: 10]

12 Either

Fig. 12.1 shows an experimental trolley which uses pressure to propel it forward. The trolley has an enclosed rectangular rigid tank filled with water and the air inside the tank is pressurised. There is a nozzle at the bottom of the tank which allows the water to rush out when the stopper is removed.



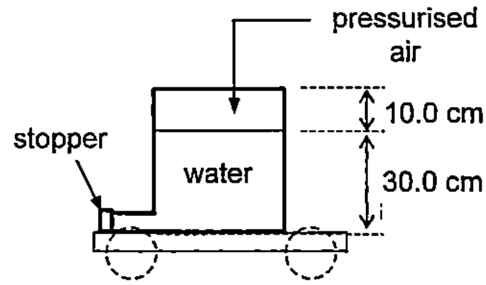


Fig. 12.1

The following information is provided.

initial height of the water in the tank	30.0 cm
initial height of the air in the tank	10.0 cm
initial air pressure in the tank	2.50×10^5 Pa
cross-sectional area of the nozzle	4.00×10^{-4} m^2
atmospheric pressure	1.00×10^5 Pa
density of water in the tank	1000 kg/m^3

(a) Calculate the total pressure exerted on the stopper due to the air and water inside the tank.

total pressure = ... [2]

(b) The calculated pressure in **(a)** is larger than the atmospheric pressure.
Explain why the stopper is **not** forced out of the nozzle.

....

.... [1]

(c) When the stopper is removed, the water would push out of the nozzle, which causes a forward force and propels the trolley to move forward.

Calculate the maximum forward force due to this propulsion.

forward force = ... [2]

(d) After a short period of time, the height of the water drops to 15.0 cm.
Explain the pressure changes of the air inside the tank using kinetic model of matter.

....

....

....

.... [3]

(e) The cross-sectional area of the nozzle is enlarged.
State two changes that will occur with reference to the trolley.

....

....

.... [2]

[Total:10]

12 Or

A coil of wire wound round a soft iron core is connected to a switch and batteries in series. A permanent magnet is suspended with its North pole near one end of the core as shown in Fig.12.2.

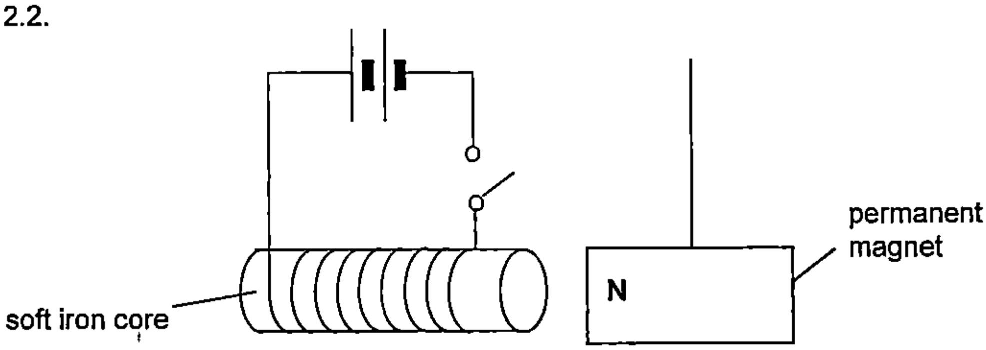


Fig. 12.2

(a) Describe and explain what will happen to the magnet when the switch is closed.

....

....

.... [2]

(b) The switch and batteries connected to the coil are now removed and replaced by a sensitive voltmeter. Small permanent magnets, attached to a conveyor belt, are moved under the coil which act as a detecting device as shown in Fig.12.3.

The voltmeter records voltage pulses as the conveyor belt moves along positions **A**, **B**, **C** and **D** at constant speed.

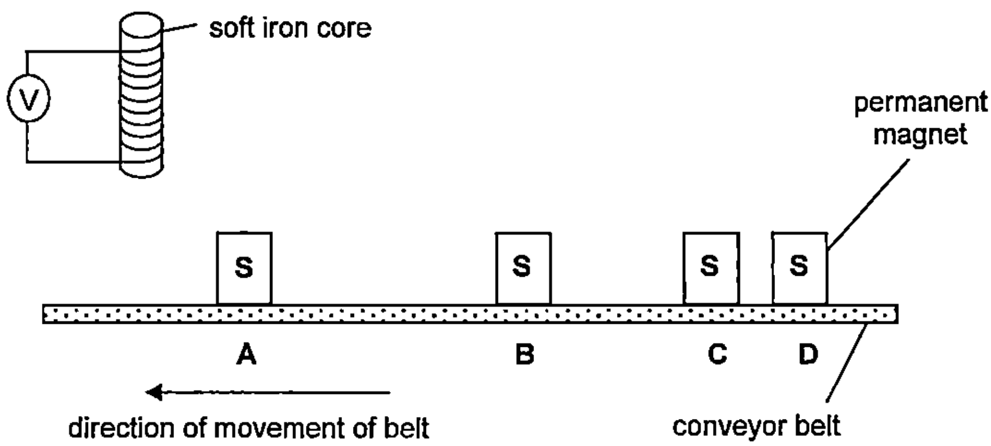


Fig. 12.3

Fig. 12.4 shows the graph of voltmeter reading against time, with the letters **A**, **B**, **C** and **D** corresponding to the positions of the belt as each magnet passes under the coil.

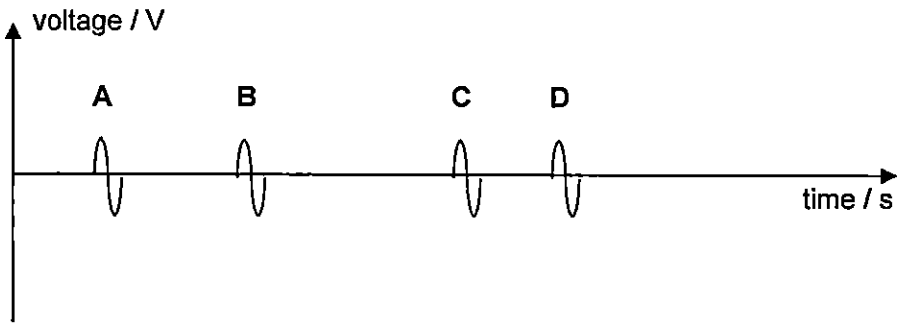


Fig. 12.4

(i) Explain why the voltage pulses occur.

....

.... [1]

(ii) Explain why the pulse produced by each magnet has a positive and a negative value as it passes the coil.

....

....

.... [2]

(iii) State one way to produce a voltage pulse of greater amplitude.

....

.... [1]

(c) A rectangular coil can be balanced in a horizontal position when current flows through it as shown in Fig. 12.5. The coil is pivoted at two fulcrums and connected to a d.c. power supply. A weighing pan of 100 g mass is hung at side **WX**, while side **YZ** is placed inside a magnetic field.

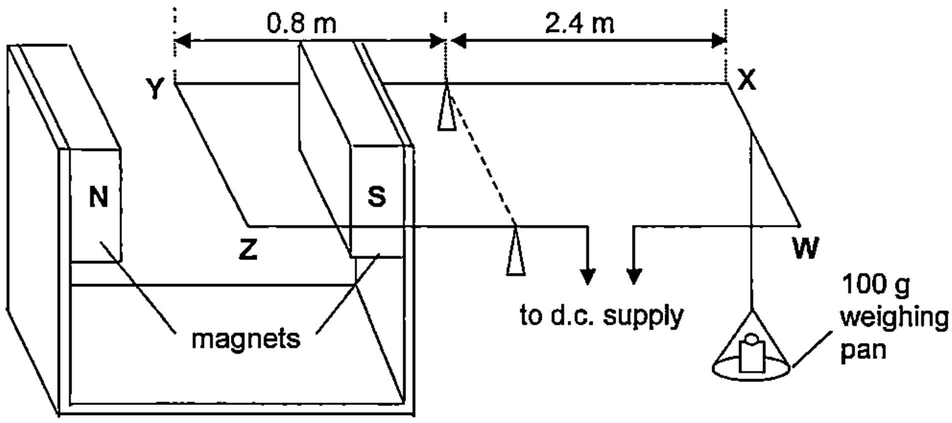


Fig. 12.5

(i) Calculate the moment produced by the weighing pan about the pivot and state the direction of this moment.

moment = ... [1]

direction = ... [1]

(ii) Hence, state the direction of the current flowing in **YZ** and explain how you derived your answer.

....

....

.... [2]

[Total: 10]

End of paper

HUA YI SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2015

SECONDARY FOUR EXPRESS

PHYSICS

ANSWER SCHEME

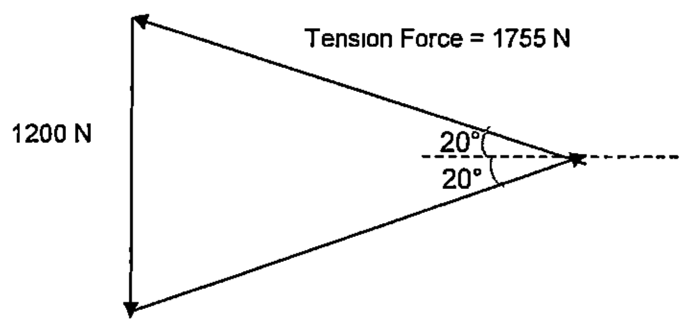
Paper 1 (40 marks)

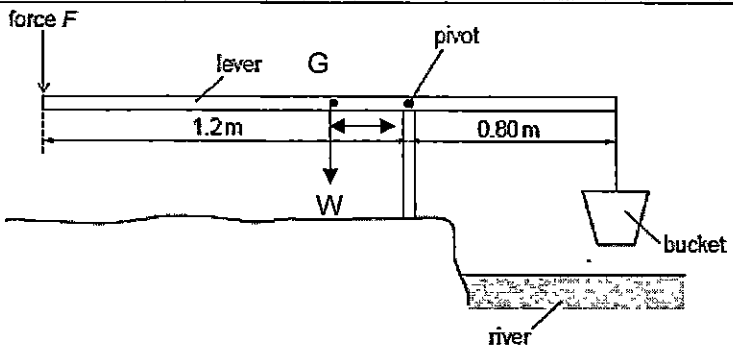
Qns	Ans	Solution
1	C	zero error = +0.03 mm thickness = 12.79 – (+0.03) = 12.76 mm
2	A	Period of pendulum is affected by length of pendulum. But independent of mass. The shorter the length, the shorter the period, the faster the swing.
3	A	M = W / g = 200N / 10 Nkg^{-1} = 20 kg F = ma, a = F / m = 12 N / 20 kg = 0.60 m/s^2
4	C	Density depends on material. The density of a material will be same no matter how many pieces it is divided into.
5	A	Density = mass / vol Vol of block with hole = mass / density = 560 / 8 = 70 cm^3 Vol of block w/o hole = 8 × 5 × 2 = 80 cm^3 Vol of hole = 80 – 70 = 10 cm^3 Cross-sectional area of hole = 10 / 2 = 5.0 cm^2
6	C	
7	D	Gradient of s-t graph gives the value of v Gradient was constant, then 0, then negative and decreasing, so v is also constant, then 0, then decreasing from a negative value to 0.
8	B	Constant resultant force gives a constant acceleration due to F = ma Acceleration has a constant high value, followed by 0 acceleration (constant speed), then a lower constant acceleration. The gradient of a v-t graph gives the value of acceleration. *note: Ans is not D. when acceleration is 0, it is at constant speed instead of at rest. Reason being to be at rest from a moving motion, object needs to slow down first. To slow down, F must be –ve, but F was never –ve in the graph.
9	D	Friction = 7 N since resultant force = 0 N when at constant speed F = ma = 2 × 4 = 8 N Applied force = 8 + 7 = 15 N
10	C	C.G. will shift towards the part of the object with more mass.
11	B	An object is considered to be at stable equilibrium if it can return to its original position after being shifted.
12	D	Pressure of gas = atmospheric pressure + 150 mm Hg = 760 mm Hg + 150 mm Hg = 910 mm Hg
13	B	
14	B	Work done = f × d Direction of d must be same as f which is weight in this case, so we only consider vertical distance travelled. Distance d should be in m. Work done = [(50 × 10) × (15 ×5)] / 100 = 375 J

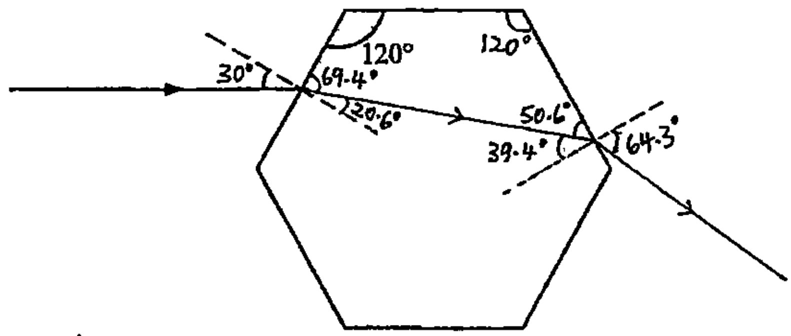
15	C	Work done = applied force × d Common mistake: many often use resultant force × d Disregarding friction which is a distractor, P = E/t = (700 × 3) / 4 = 525 W *note: if qns asks for **useful** power, then we subtract friction to get resultant force and calculate energy from there, in which the answer would be 300 W, as 225 W of power is wasted through friction.
16	C	
17	B	When molecules are heated, temp increase and K.E. increases, thus speed increases. When the piston goes outwards, volume increases but no. of molecules stays the same. Since no. of molecules per unit volume decreases, rate of collision decreases. However, when speed of molecules increases, there is also an increase in rate of collision, which we are not sure if it makes up for the decrease in rate of collision due to larger volume. However, bearing in mind overall pressure did not change, and that pressure due to the faster molecules hitting the walls harder increase. The rate of collision with the walls must then decrease.
18	C	1200 Ω - 960 Ω = 240 Ω ➔ represents a difference of 100 °C 1056 Ω - 960 Ω = 96 Ω Temp of water bath = 100 / 240 ×96 = 40 °C
19	D	Cement is a better conductor of heat than carpet, thus it conducts heat faster away from the feet.
20	B	Energetic surface molecules escape, leaving less energetic molecules behind in the liquid. Having less K.E. means having a lower temp which shows that cooling happened.
21	D	Having a higher specific heat capacity means more energy is required to change temp of object per kg, meaning more time is needed for to change temperature.
22	B	Final temp = 100 °C Energy loss by aluminium = energy gained by water $mc\Delta T = mc\Delta T + m\,l_f$ $(2 \times 900 \times 600) = (2 \times 4200 \times 80) + (m \times 2.27 \times 10^6)$ $m = 408\,000 / 2.27 \times 10^6 = 0.18$ kg
23	A	Wavelength is shorter in Y. Frequency will never change once wave is created, thus speed v = fλ is slower in Y. Speed of wave is slower in shallow regions so Y is shallower than X.
24	C	Frequency = 50 Hz Wavelength = 30 / 6 = 5.0 cm Speed v = fλ = 50 × 5 = 250 cm/s = 2.5 m/s
25	B	All EM waves travel at the same speed in vacuum. v = fλ, with a constant v, if P has a longer λ, then it will have a lower frequency than Q. radiowaves have longer wavelength and lower frequency than infra-red radiation.
26	A	
27	D	
28	A	The object distance is more than 2f, thus a real and diminished image will be produced. A camera is an application than gives such an image.
29	C	After making contact with each plate, the sphere will either give away electrons (to the positive plate) or gain electrons (from negative plate), until it has like charges with the plates and will repel. The process

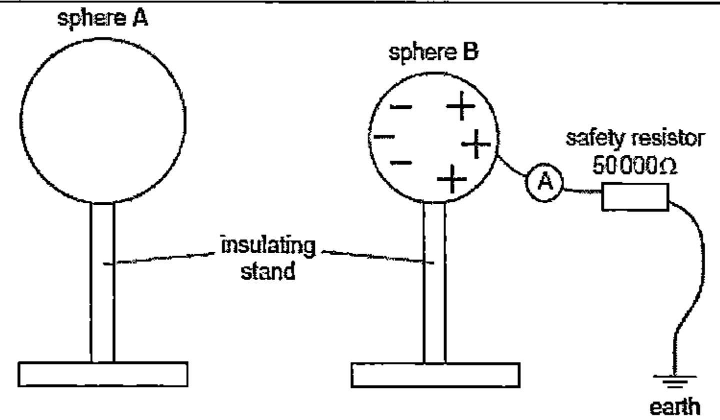
		repeats continuously, making the sphere oscillate.
30	A	$R_1 = \rho L_1 / A_1$. $L_1 = (R_1 \times A_1) / \rho$ $L_2 = (2R_1 \times ¼ A_1) / \rho = ½ L_1$
31	D	All the current will flow through A_2 (and no current flows through A_3). The circuit becomes a series circuit and total resistance of circuit decreases, thus current in A_1 decreases. A_2 will be the same as A_1.
32	B	
33	A	
34	A	The fuse and switch should be on the live wire and the earth wire should be connected to the metal casing.
35	A	The compass is a permanent magnet, so any pole of the compass would be attracted to iron, a magnetic material.
36	D	
37	C	Magnetic field direction is towards the S pole. Current direction is out of paper since it is opposite to electron direction. Using Fleming LH rule, electron will deflect downwards.
38	D	
39	A	$P_p = V_pI_p = 250\ V \times 0.10\ A = 25\ W$ $P_s = 0.75 \times 25\ W = 18.75\ W$ $I_s = 18.75 / 12 = 1.56\ A$
40	B	

Paper 2
Section A (50 marks)

Question No.		Solution	Marks
1	(a)	Appropriate scale [B1] (can only award if there is something drawn, not only scale written) Diagram drawn accurately with arrows and labels [M1] $T_{AB} = T_{BC} = 1755\ N$ [A1]  	3
	(b)	When the cable becomes horizontal, the **tension force in them is much greater** [B1] in order to balance with the weight of the object. This results in the cable breaking.	1
		[Total : 4]	

2	(a)			1
	(b)		By the principle of moment, take moment about the pivot: (10 N x 0.2 m) + (F x 1.2 m) = 60 N x 0.8 m [M1] F = 38.3 N (to 3 sf) [A1]	2
	(c)		Power = force x speed = 60 N x 3 m/s [M1] = 180 W [A1]	2
			[Total: 5]	
3	(a)	(i)	Radiation [B1]	1
		(ii)	Conduction [B1]	1
	(b)		Polystyrene foam is a **poor conductor of heat** [B1 with its trapped air], thus it **reduces heat loss from the panel to the surroundings through conduction** [B1].	2
	(c)		The pipe is **long**, making it have a **larger surface area** [B1]. Alternative answer: the pipe is **located at the bottom of the water tank** [B1], making convection more effective.	1
	(d)		Cost of using the boiler = 3 kW x 1.6 x 25 [M1] = 120 cents [A1] (give M1 even if there are conversion errors)	2
			[Total: 7]	
4	(a)		During boiling, **energy is absorbed to weaken the intermolecular forces** [B1], thus **internal potential energy increases and kinetic energy remains constant** [B1]. Since K.E. is constant, temperature is also constant.	2
	(b)	(i)	energy = P x t = 200 W x (4 x 60)s [M1] = 48 000 J [A1]	2
		(ii)	200 x (6 x 60) = 0.4 x l_f [M1] l_f = 72000/0.4 = 180 000 J/kg [A1]	2
			[Total: 6]	

5	(a)	time difference = 0.6 – 0.2 = 0.4 s 2d = v × t 2d = 1350 x 0.4 [M1] d = 540/2 = 270 m [A1]	2
	(b)	v = fλ 1350 = 4500 x 10^9 x λ [M1] λ = 3.00 x 10^{-11} m [A1]	2
	(c)	There might be a **school of fishes** [B1] swimming through at that time. Alternative: Debris	1
	(d)	Checking of cracks in structures [B1] Alternatives: Prenatal scanning / obtain images of fetuses	1
		[Total: 6]	
6	(a)	sin c = 1/n = 1/1.42 c = 44.8° (3 sf) [A1]	1
	(b)	i = $120^0 – 90^0 = 30^0$ [B1] n = sin i / sin r 1.42 = sin 30^0 / sin r sin r = sin 30^0 / 1.42 r = 20.6^0 (3 sf) [A1]	2
	(c)	 Working : i = $90^0 – 50.6^0 = 39.4^0$ [B1] since i < c , refraction occurs (ecf allowed) n = sin r / sin i 1.42 = sin r / sin 39.4^0 sin r = 1.42 sin 39.4^0 r = 64.3^0 (3 sf) [B1] refracted ray [B1] emergent ray [B1] lack of arrows for both rays or failure to label relevant angles: -1	4
		[Total: 7]	

7	(a)		1
	(b)	Left side of sphere B is negatively charged, while the right side is earthed means that **electrons move from the earth to neutralise the positive charges on the right side of B** [B1]. The **movement of electrons through the ammeter caused the needle to deflect. Once the right side of B is neutralised, there is no deflection** [B1] as no electron is needed to move through B.	2
	(c)	V = IR = 0.0012×10^{-3} A x 50 000 Ω = 0.060 V (2 s.f.) [A1]	1
		[Total: 4]	

8	(a)	(i)	11.0 V [A1]	1
		(ii)	11.0 V – 3.0 V = 8.0 V (2 s.f.) [A1]	1
	(b)	$I_3 = \frac{V_2}{3.0\,\Omega} = \frac{3.0\text{ V}}{3.0\,\Omega}$ = 1.0 A [A1] $I_2 = \frac{V_2}{1.0\,\Omega} = \frac{3.0\text{ V}}{1.0\,\Omega}$ = 3.0 A [A1]		2
	(c)	$I_1 = I_4 = I_2 + I_3$ = 1.0 + 3.0 A = 4.0 A [A1, ecf allowed]		1
		[Total: 5]		
9	(a)	**Short circuit** [B1] Alternative: **Overloading**		1
	(b)	The **large current causes the solenoid to become a stronger electromagnet** [B1] that can **attract the soft iron bar** [B1] downwards. This causes the **circuit to become open** [B1] and current no longer flows through it.		3
	(c)	Increase the number of turns of coil in the electromagnet [B1] Decrease the distance between the electromagnet and the soft iron bar. [B1] Not accepted: Use soft iron core, increase current through circuit.		2
		[Total: 6]		

Section B (30 marks)

10	(a)	When **light** from torchlight is **blocked by the card**, the **resistance of the LDR increases** [B1]. When the **light** is not blocked by the card and **reaches the LDR**, the **resistance of the LDR decreases** [B1].	2
	(b)	When light is blocked by the card, the **brightness around the LDR is low**, hence the **resistance of the LDR increases.** [B1] When **resistance of LDR increases**, the **potential difference across the LDR also increases.** [B1] Since the variable resistor is in series with the LDR, when **p.d. of LDR increases**, the **p.d. across the variable resistor will decrease.** [B1]	3
	(c)	The **time interval 1 is caused by the bottom of the card** which **reaches the LDR level first** OR **time interval 2 is caused by the top of the card** which it reaches the LDR level. [B1] (Mark can be given if student somewhat makes the correct link between the time intervals and the part of the card) When the **top of the card reaches the LDR level**, the **speed of the card is faster** [B1] due to acceleration caused by gravity, hence the shorter time in interval 2.	2
	(d)	Initial speed = 5.0 / (0.1516 – 0.0490) = 48.733 cm/s Final speed = 5.0 / (0.3003 – 0.2784) = 228.311 cm/s [M1 for both correct speeds] Time interval = (0.3003 + 0.2784) / 2 - (0.1516 + 0.0490) / 2 = 0.18905 s [M1] Average acceleration = (v-u) / t = (228.311 – 48.733) / 0.18905 = 950 cm/s^2 (to 3 s.f.) [A1, ecf allowed]	3
		[Total: 10]	
11	(a)	Acceleration at 3 s = acceleration between 0 and 5 s = (54 – 0) / 5 [M1] = 10.8 m/s^2 [B1] F = ma = 70 kg × 10.8 m/s^2 = 756 N [A1, ecf allowed]	3
	(b)	54 m/s [A1]	1
	(c)	When weight = air resistance, resultant force = 0 N and speed is constant Distance travelled = area under graph = 54 x 7 [M1] = 387 m [A1]	2

	(d)	The skydiver is undergoing **decreasing deceleration** [B1] from t = 12 s up to around t = 28 s, where he is moving at **constant speed** [B1] thereafter.	2
	(e)	As the parachute was opened, the **air resistance increased to be more than the weight** [B1] due to increase in surface area. The skydiver then slows down due to resultant force being negative. As he **slows down, the air resistance decreases, thus rate of deceleration decreases** [B1]. The air resistance will decrease until it is equal to weight, making resultant force = 0 N and he then moves at constant speed.	2
		[Total: 10]	
12 E	(a)	P = hρg = 0.30 x 1000 x 10 = 3000 Pa [M1] total pressure = 3 000 + 250 000 = 253 000 Pa (3 s.f.) [A1]	2
	(b)	The **friction between the stopper and the nozzle** prevents the stopper from coming off. [B1]	1
	(c)	F = P A = (253 000 – 100 000) x (4.00 x 10^{-4}) [M1] = 61.2 N (to 3 s.f.) [A1]	2
	(d)	As the water level decreases, the volume of air in the tank increases. This causes the **no. of molecules per unit volume to decrease** [B1]. The **frequency of collision between the air molecules and the walls of the tank decreases** [B1]. This reduces the force per unit area exerted on the walls, thus **reducing pressure of the air** in the tank [B1].	3
	(e)	The **forward force** on the trolley is **increased.** [B1] The trolley will **be in motion for a shorter duration.** [B1] Alternative: acceleration of the trolley increases / attain a higher speed in a shorter time	2
		[Total: 10]	

12 Or	(a)	When switch is closed and current flows in the coil, the **end of the coil facing the magnet becomes a North pole** [B1] Hence the magnet **repels** from the coil as like poles repel. [B1]		2
	(b)	(i)	As the magnet moves with the conveyor belt, the coil experiences a **changing magnetic flux**, thus **inducing an emf in the coil.** [B1]	1
		(ii)	As the magnets **approach** the coil, the coil experiences a **changing magnetic** flux that induces an **emf in one direction to try to repel the magnet.** [B1] As the magnets **move away** from the coil, the coil **experiences a changing magnetic flux, producing an emf in the opposite direction to try to attract the magnet.** [B1]	2

		(iii)	Increase the speed of the conveyor belt [B1] Alternatives: increase the number of turns of coil around the iron core / use stronger permanent magnets with stronger magnetic field strength.	1
	(c)	**(i)**	Moment = f x perpendicular d from pivot = 1N x 2.4 m = 2 4 Nm [A1] Direction: clockwise [B1]	2
		(ii)	**Force on YZ needs to be downwards to produce an anticlockwise moment** as balance the moment of the pan. [B1] **Using Fleming's Left Hand Rule**, the **current should flow from Z to Y** to produce a downward force. [B1]	2
		[Total: 10]		

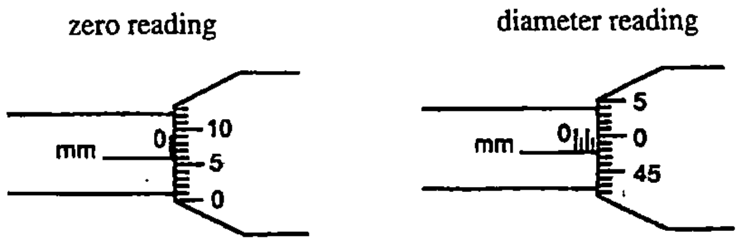
End of Paper

Maris Stella School
Priliminary Examination
Pure Physics 2015

MARIS STELLA.

MCQ (Answer All Questions)

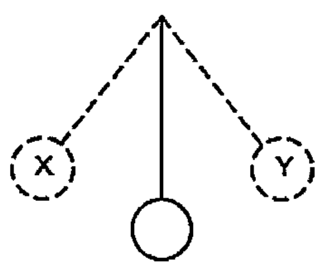
1 The diameter of a ball is measured using a micrometer screw gauge. A student takes an intial zero error reading and then a reading of the diameter. The diagrams show an enlargment of the screw gauge readings.



What is the diameter of the ball?

A 1.42 mm
B 1.92 mm
C 1.98 mm
D 2.04 mm

2 It takes 36.5 s for a pendulum to swing from X to Y and back again twenty times.



What is the frequency of the pendulum?

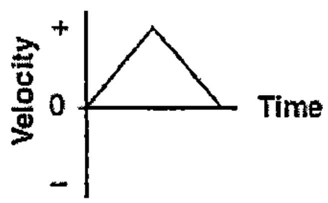
A 0.274 Hz
B 0.548 Hz
C 1.830 Hz
D 2.740 Hz

3 A stone is thrown vertically upwards with a velocity of 5.0 m/s. After time *t*, it reaches the original position. Neglecting air resistance, the time required for the ball to reach the highest position is

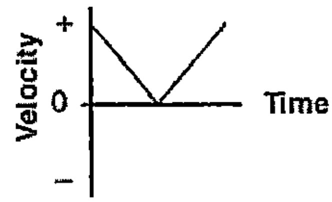
A 10.0 t
B 5.0 t
C 2.5 t
D 0.5 t

4 A student throws a baseball vertically upward and then catches it. If vertically upward is considered to be the positive direction, which graph best represents the relationship between velocity and time for the baseball? [Assume air resistance is negligible.]

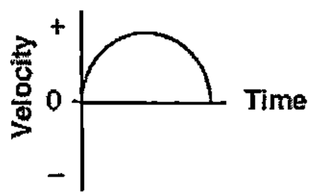
A



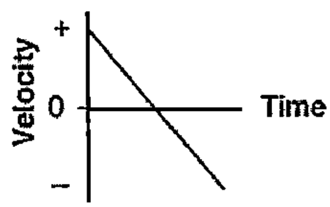
B



C



D



5 Which of the following statements concerning the motion of a body is/are correct?

(I) A body can have zero acceleration but still in motion.
(II) A body can have zero velocity but is also accelerating.
(III) A body can have constant speed but varying velocity.

A (I) and (II) only
B (I) and (III) only
C (II) and (III) only
D (I), (II) and (III)

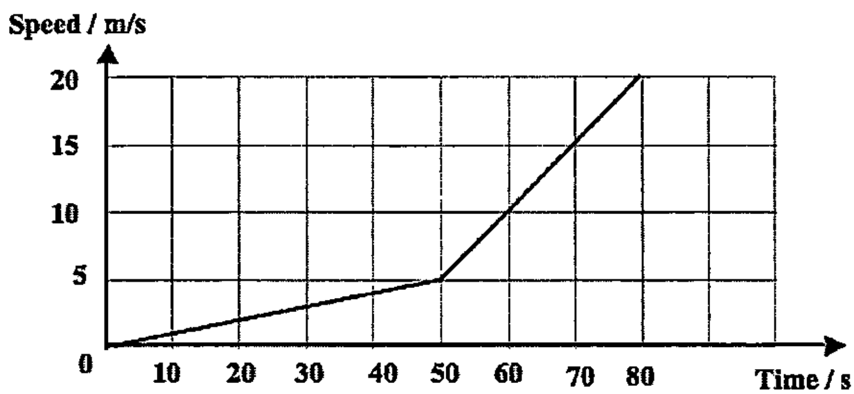
6 A wooden block of mass 3.0 kg moves with uniform speed when it is pulled by a constant horizontal force of 6.0 N on a horizontal surface. What will happen to the motion of the wooden block if the horizontal force is increased to 12.0 N?

A Moves at a constant speed of 2.0 m/s.
B Moves at a constant speed of 4.0 m/s.
C Moves with an acceleration of 2.0 m/s^2.
D Moves with an acceleration of 4.0 m/s^2.

7 A bullet of mass 0.010 kg travelling horizontally at 100 m/s is stopped after penetrating through 0.20 m of wood. What is the average retarding force applied to the bullet by the wood?

A 10 N
B 250 N
C 500 N
D 1000 N

8 The graph below shows how the speed of a car varies over a 80 s period.



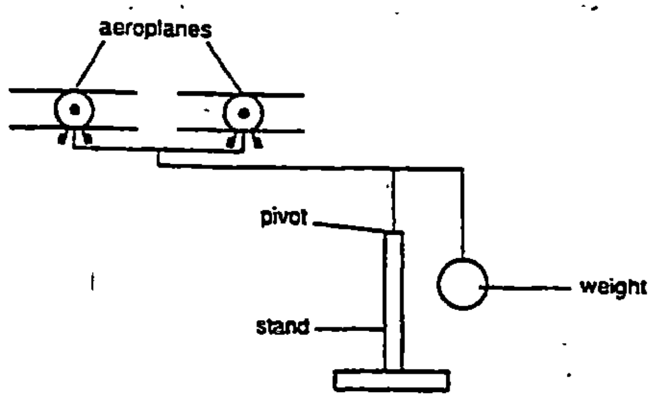
What is the average speed of the car?

A 3.25 m/s
B 6.25 m/s
C 7.25 m/s
D 12.5 m/s

9 The density of a metal bar is 12.0 g cm^{-3}. When a hole of volume 1.0 cm^3 is drilled into the bar, what will its density be?

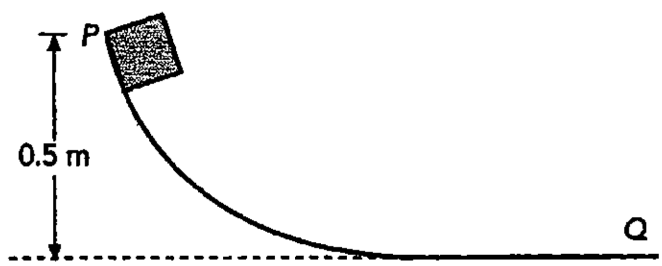
A 11.0 g cm^{-3}
B 12.0 g cm^{-3}
C 12.5 g cm^{-3}
D 13.0 g cm^{-3}

10 The diagram shows a balancing toy pivoted on a stand.If the toy is tilted slightly, it does not overbalance but returns to its original position.
This is because the centre of gravity of the toy is



A between the aeroplanes.
B below the pivot.
C exactly at the pivot.
D inside the weight.

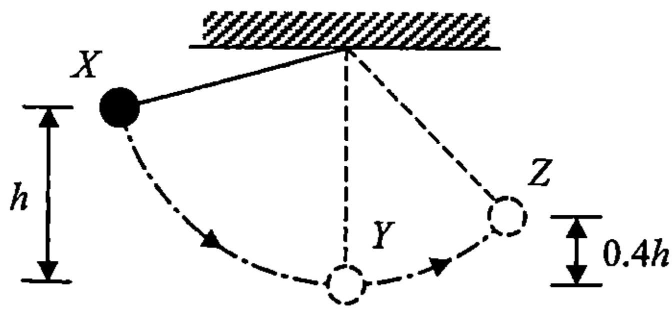
11 A block of mass 2.0 kg is released from rest at point P as shown in the figure below. It is found that the block finally comes to rest at point Q.



Length of the track PQ is 2.5 m. What is the average value of frictional force acting on the block when it is moving from P to Q?

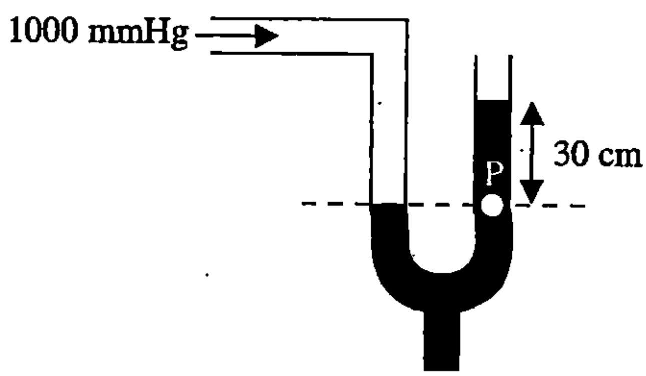
A 2.0 N
B 2.5 N
C 3.0 N
D 4.0 N

12 A pendulum bob is released from rest at position **X** which is at a height ***h*** above its lowest position Y and then passes through position **Z**. Position **Z** is 0.4***h*** above Y. Assuming air resistance is negligible, find the ratio of the speed of the bob at position **Y** to that at position **Z**.



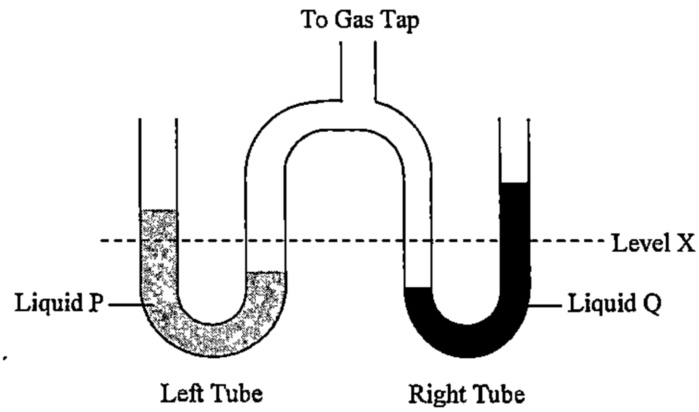
A 1.29 : 1
B 1.58 : 1
C 1.67 : 1
D 2.50 : 1

13 A manometer is connected to a 1000 mmHg air pressure at one end and the other end is left open as shown below. Given that the manometer is filled with mercury, what is the pressure at point **P**?



A 300 mmHg
B 700 mmHg
C 1000 mmHg
D 1300 mmHg

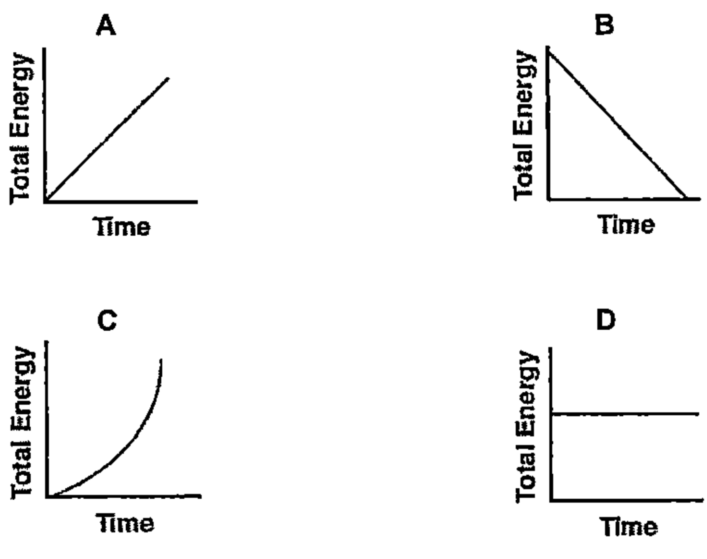
14 The apparatus shown is connected to a gas tap in order to measure the pressure of the gas. The left tube contains liquid P whereas the right tube contains liquid Q. The levels in the tube were originally at X.



When the gas tap is turned on, liquid Q in the open limb of the right tube rises to a higher level than liquid P in the open limb of the left tube as shown. Why is this so?

- **A** Liquid P has a higher density than liquid Q.
- **B** The right tube has a smaller cross-sectional area than the left tube.
- **C** There is more liquid Q in the right tube than liquid P in the left tube.
- **D** The gas exerts a greater pressure on the right tube as it is nearer to the gas inlet.

15 A ball is dropped from the top of a cliff. Which graph best represents the relationship between the ball's total energy and elapsed time as the ball falls to the ground? (Assume air resistance is negligible.)

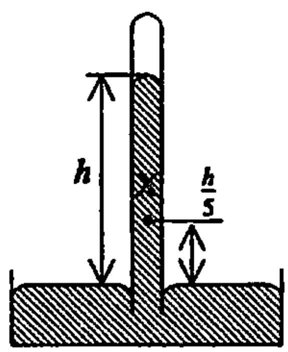


16 In the Brownian motion experiment involving smoke particles in the air, heavy particles settle quickly but very small particles remain suspended for long periods of time. This is because

A air pressure has a greater effect on smaller particles.
B the small smoke particles have the same density as air.
C the Earth's gravitational field has a negligible effect on very small particles.
D smaller particles are more easily affected by the bombardments of the air molecules.

17 The height of a mercury barometer is ***h*** when the atmospheric pressure is 100 000 Pa.
What is the pressure at **X**?

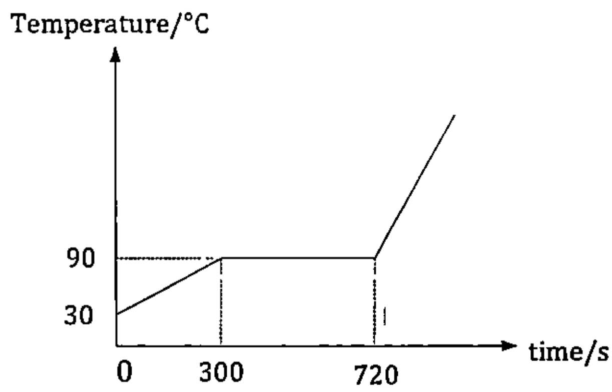
A 20 000 Pa
B 80 000 Pa
C 120 000 Pa
D 180 000 Pa



18 A piece of aluminium of mass ***m*** has a specific heat capacity of **c.** A piece of metal Y of mass ***2m*** has a specific heat capacity of ***2c***. Both of these metals receive the same quantity of heat and the temperature of the metal Y rises by 10°C. By how much did the temperature of the aluminium rise?

A 5°C
B 10°C
C 20°C
D 40°C

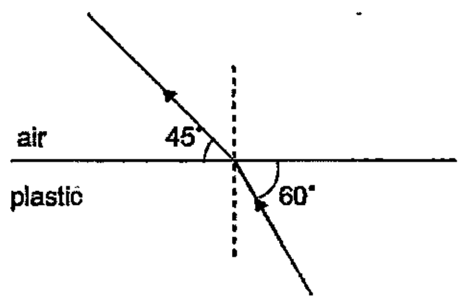
19 The diagram shows a graph of temperature against time when 0.5 kg of salt is being heated.



If thermal energy is supplied to the salt at a rate of 100 W, what is the specific latent heat of fusion of the salt?

A 1.4×10^3 J/kg
B 2.1×10^4 J/kg
C 8.4×10^4 J/kg
D 1.4×10^5 J/kg

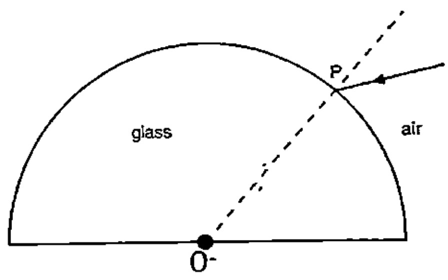
20 The diagram shows a ray of light moving from plastic to air.



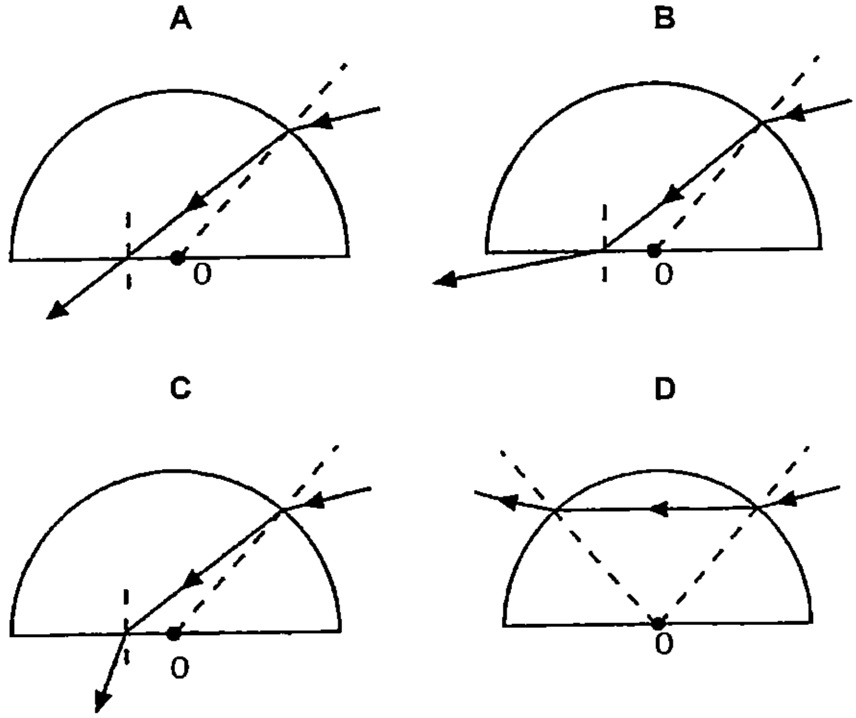
What is the refractive index of plastic?

A 0.707
B 0.816
C 1.22
D 1.41

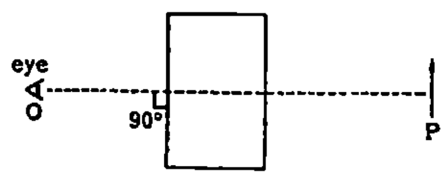
21



A ray of light in air is incident on a semicircular block of glass at point **P**, as shown in the diagram above. **OP** is a radius of the semicircle. Which of the following ray diagrams shows how the ray will pass through the block and into the air again?



22 An observer looks straight through a rectangular glass block at an object P, as shown below. How does the object appear to the observer?

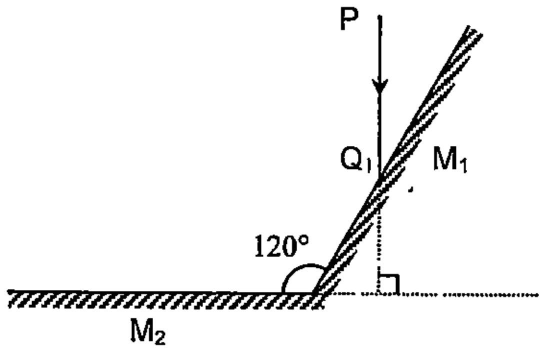


A Moved to the right
B In its true position
C Laterally inverted
D Nearer

23 When an object is placed 20 cm from a thin converging lens, a real image equal in size to the object is formed. The object is then moved 5 cm towards the lens. Which of the following describes the new image formed?

	Image Distance	Image Size
A	more than 20 cm	magnified
B	more than 20 cm	diminished
C	less than 20 cm	magnified
D	less than 20 cm	diminished

24 The following diagram shows two mirrors inclined at 120 °.



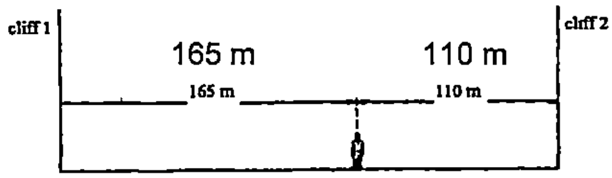
An incident ray **PQ**, whose direction of propagation is perpendicular to **M$_2$**, is reflected by **M$_1$**. What is the angle of reflection at **M$_2$** ?

A 30°
B 45°
C 60°
D 75°

25 Which is one practical application of infra-red radiation?

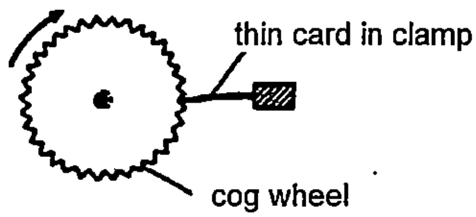
A Used to produce vitamin E
B Used to check for flaws in metals
C Used in the remote controls for various electrical appliances
D Used in mobile phones

26 A man stands between two cliffs as shown in the diagram and claps his hand once.
Assuming that the velocity of sound in air is 330 m/s, what will be the time interval between the two loudest echoes?



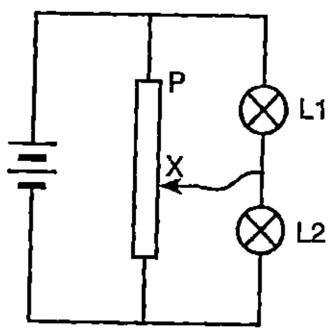
A 1/6 s
B 1/3 s
C 2/3 s
D 5/6 s

27 A piece of thin card was held against the teeth of a cog wheel. When the wheel is turned at the high speed a note is heard. How may the pitch of this note be raised?



A Using a thicker card
B Using a longer card
C Pressing the card against the teeth with a greater force
D Turning the wheel more quickly

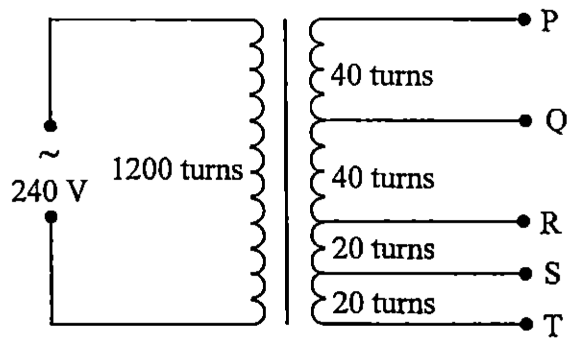
28 The diagram shows a potential divider circuit.



What happens to the brightness of lamp **1** and lamp **2** as the contact **X** is moved away from point **P** of the potential divider?

	lamp 1	lamp 2
A	brighter	stay the same
B	brighter	dimmer
C	dimmer	stay the same
D	dimmer	brighter

29 A transformer consists of one coil with 1200 turns and a second coil, with a total of 120 turns, which can be tapped at various points as shown.



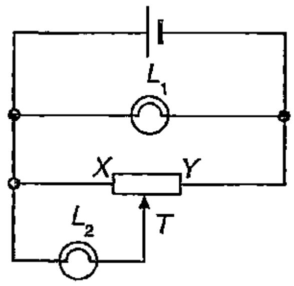
Which pair of terminals should be connected to a 12 V, 24 W lamp for it to be lit normally?

A PS
B QS
C RT
D PT

30 The school hall is fitted with 20 units of air-conditioner, each rated 2400 W. During the 10 days of school examination, the air-conditioners had to be switched on twice a day and each session lasted for 3 hours. If each unit of electricity costs 25 cents, how much do the school have to pay to provide air-conditioning for the students during the examination?

A \$36.00
B \$360.00
C \$72.00
D \$720.00

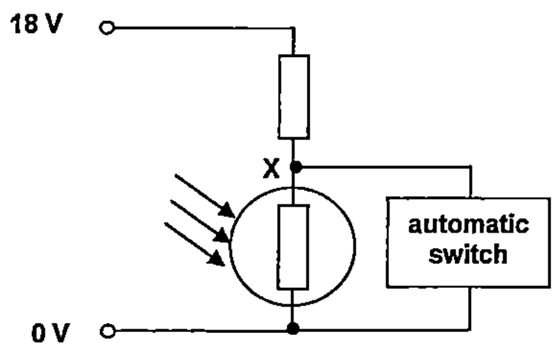
31 The figure below shows an electric circuit.



Which one of the following describes the brightness of **L2** in the given circuit when the tab **T** of the potential divider is moved slowly from **X** to **Y**?

A It is originally as bright as **L_1** and then dims gradually.
B It is originally half as bright as **L_1** and then dims gradually.
C Its brightness increases gradually and is finally as bright as **L_1**.
D Its brightness increases gradually and is finally half as bright as **L_1**.

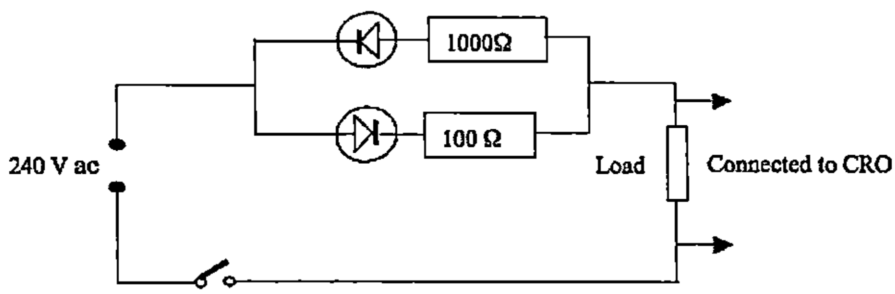
32 The circuit shown below is connected to an automatic switch for the lights in the garden. The automatic switch needs a voltage at **X** of 12 V or higher for the lights to be on. The lights are to come on at sunset and the value of the fixed resistor is 400 Ω.

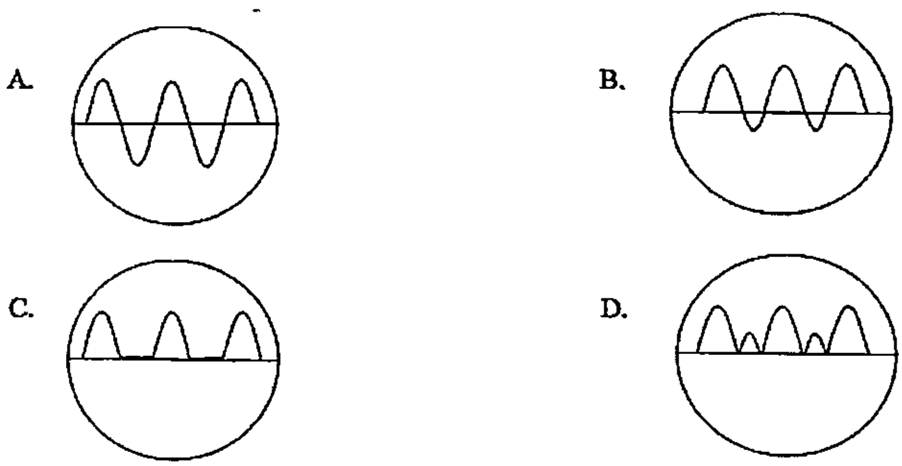


What must be the minimum resistance of the light-dependent resistor in order for the lights to come on at sunset?

A 400 Ω
B 800 Ω
C 1200 Ω
D 1600 Ω

33 A circuit is set up as shown in the diagram below and a load is connected to the CRO. Which is the correct waveform on the CRO when the switch is closed?



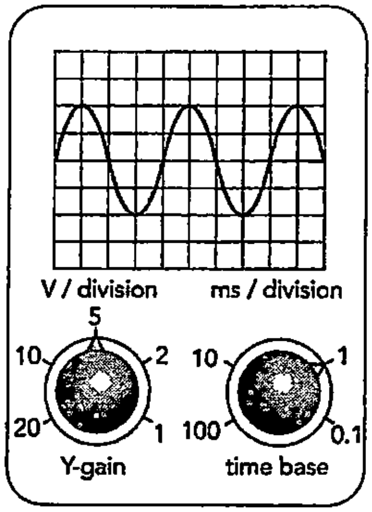


34 Two foam balls which are wrapped with aluminium foil, suspended from adjacent silk threads, attract each other. Which of the following is/are possible explanations for this scenario?

(I) The magnetism is strong
(II) They are oppositely-charged.
(III) Only one of them is charged.

A (I) only
B (II) only
C (I) and (II) only
D (II) and (III) only

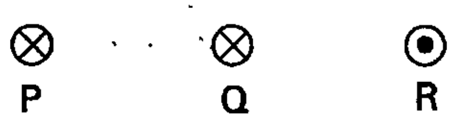
35 An alternating voltage signal is displayed on an oscilloscope, with the settings shown in the figure below.



Which of the following combinations gives the correct values for the peak voltage and frequency of the signal?

	Peak voltage / V	Frequency / Hz
A	10	100
B	10	250
C	20	250
D	20	1000

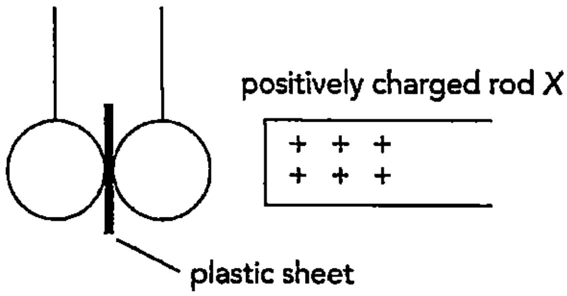
36 The figure below shows three parallel long straight wires **P**, **Q** and **R**. **P** and **Q** carry currents flowing into the paper and **R** carries a current flowing out of the paper.



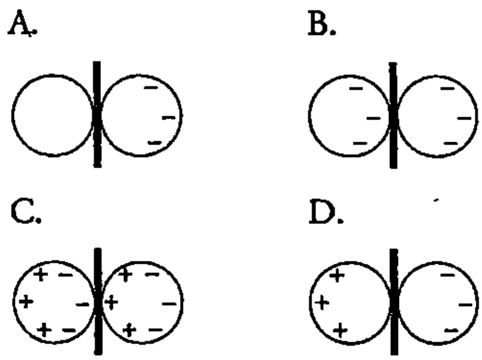
What is the direction of the resultant force acting on **Q**?

A ↑ **B** ↓ **C** ← **D** →

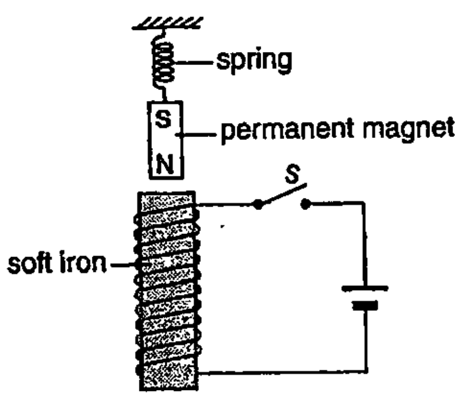
37 The figure below shows two uncharged metal spheres suspended by insulating threads and separated by a plastic sheet. A positively charged rod **X** is brought near them as shown.



Which of the following diagrams shows the resulting charge distribution on the spheres?



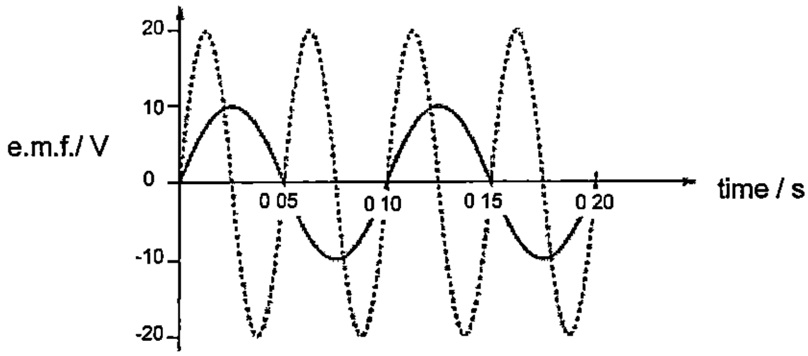
38 The figure below shows a permanent magnet suspended from a spring placed right on top of an electromagnet.



What will happen to the permanent magnet once the switch **S** is turned on?

A The magnet is pulled downwards.
B The magnet is pushed upwards.
C The magnet is stationary.
D The magnet starts to swing from left to right.

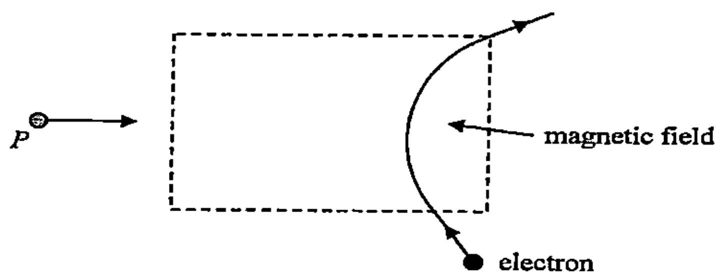
39 In the graph shown, the solid curve shows how the e.m.f. produced by a simple generator varies with time. The dashed curve is the output from the same generator after a modification has been made to the generator.



Which modification was made to produce the result shown?

A The area of the coil was doubled.
B A split-ring commutator was added.
C The number of turns in the coil was doubled.
D The speed of rotation of the coil was doubled.

40 When an electron enters a magnetic field, it is deflected in the direction as shown below.
When a positively-charged particle P enters the magnetic field from the left, it will be deflected



A to the top
B to the bottom
C out of the paper
D into the paper

For Examiner's Use

Section A (50 marks)
Answer all Questions

1 A ball was given a push and it rolled up a smooth slope. **Figure 1** below describes the motion of the ball.

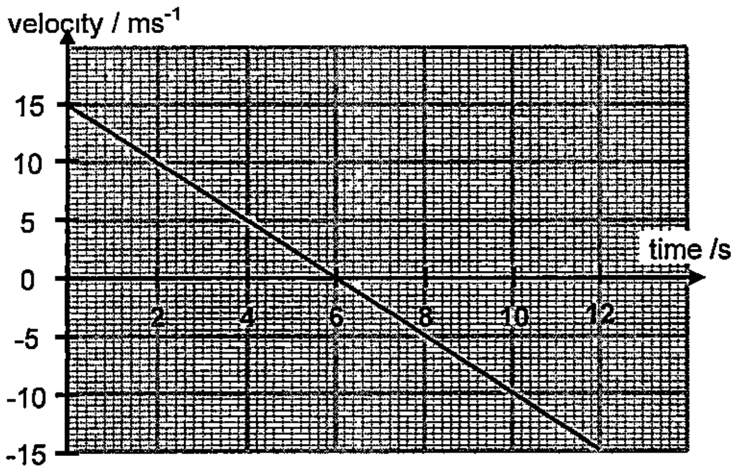


Figure 1

(a) Describe the motion of the ball for the **first half of the journey.** [1]

(b) Find the displacement of the ball for the first 8.0 s. [2]

(c) Define the term ***velocity.*** [1]

(d) Define Newton's First Law of Motion [1]

---

2 A large vessel is towed by two tug boats P and Q as shown in **Figure 2.** [4]
The vessel of mass 5000 kg moves forward with an acceleration of 1.2 ms^{-2}.

By drawing a suitable scaled diagram, determine the tension in the two ropes $\mathbf{T_P}$ and $\mathbf{T_Q}$.

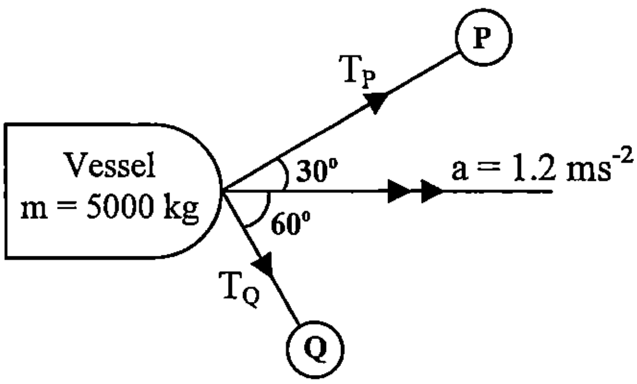
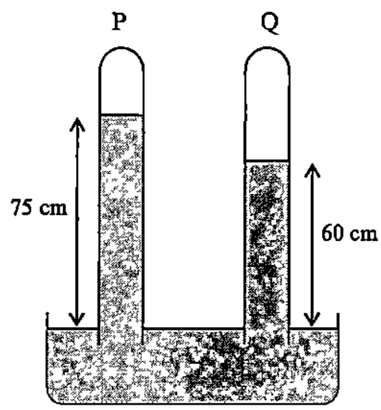


Figure 2

3 Figure 3 below shows two vertical tubes **P** and **Q**, each closed at the upper end. The space above the mercury meniscus of tube **P** is a vacuum but not that of tube **Q**.

The density of mercury is 1.36×10^4 kg/m^3.



(a) (i) Determine the pressure, in Pa, exerted by the air in the space above the mercury meniscus of tube **Q**. [2]

(ii) Tube **Q** is pushed further into the trough such that its lower end is immersed more deeply in the reservoir of mercury. How would the height of the mercury column in tube **P** and tube **Q** be affected respectively? [1]

(b) Explain in terms of the movement of the molecules,

(i) how the air inside a car tyre exerts a pressure on the walls of the tyre, [2]

(ii) why the air pressure in the car tyre increases after a long journey. [2]

----

4 Some electrical components are easily damaged if electric charge is placed on them. They are often stored by placing them in contact with a conductor.

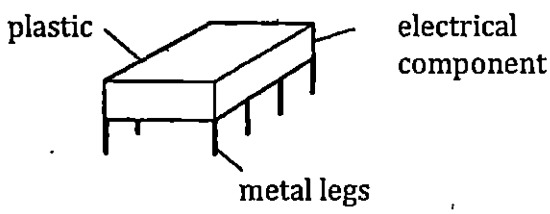


Figure 4.1

(a) When the component shown in **Figure 4.1** is rubbed with a cloth, the metal legs become negatively charged. Explain how this happens. [1]

(b) **Figure 4.2** shows the negatively charged metal legs placed near a piece of aluminium foil which rests on an insulator.

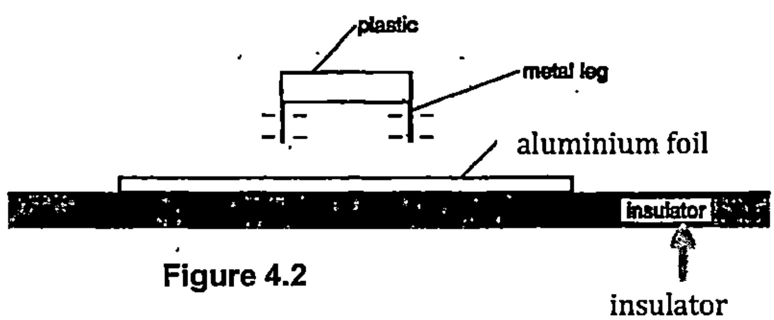


Figure 4.2

(i) On **Figure 4.2**, draw the induced charges that form on the aluminium foil. [1]

(ii) The metal legs are placed in contact with the aluminium foil. Describe what happens to the foil and on the legs. [2]

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5 **Figure 5** shows a simple setup used to study the flow of current from terminal **X** to terminal **Y** through the solenoid.

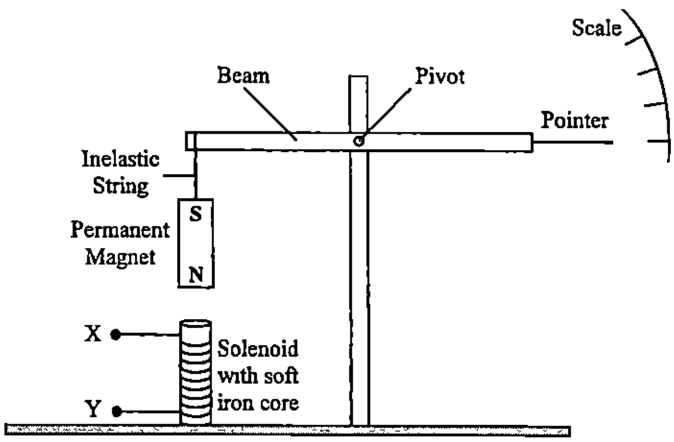

Figure 5

(a) Describe how the setup works to measure the magnitude of current flow. [3]

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(b) Suggest two ways to increase the sensitivity of this setup. [1]

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(c) The setup will not work if the polarity of the current flow is reversed (i.e. current flows from terminal **Y** to terminal **X** through the solenoid).

(i) Explain why this is so. [2]

(ii) Suggest and explain how the setup can be modified to correct this problem. [2]

---

6 **Figure 6.1** shows a drill that is being spun with a magnet attached to the drillbit. A coil of wire around an iron core is placed above the rotating magnet. The ends of the coil are connected to the y-input of the cathode ray oscilloscope(CRO).

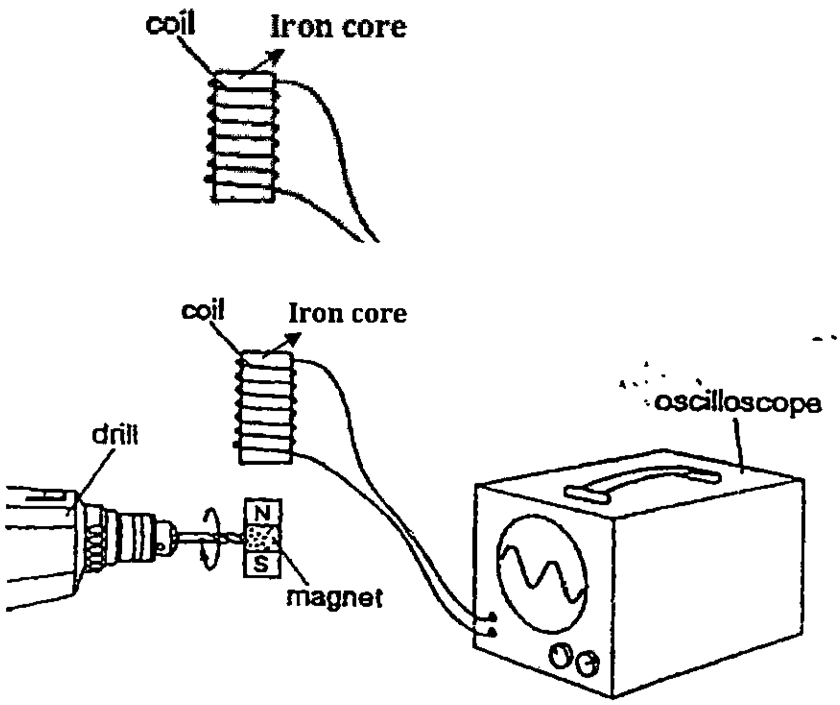

Figure 6.1

(a) Explain why there is a current induced in the coil when the drillbit rotates. [1]

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(b) Draw clearly on **Figure 6.1** the direction of the current in the coil as the N-pole of the magnet approaches the coil. [1]

(c) The following display **B** is seen on the CRO screen in **Figure 6.2**. Draw on the figure, the display when the speed of the drill bit is halved. Label it as **curve C**. [2]

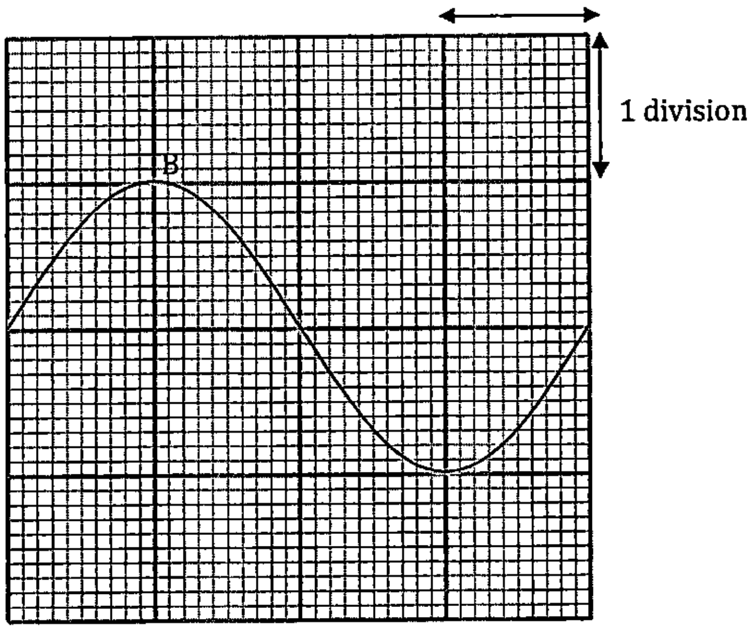

Figure 6.2

(d) The time-base of the CRO is currently 6 ms/division. Draw also on **Figure 6.2** what happens to **curve B** when the time-base is doubled to 12 ms/division. Label it as **curve D.** [1]

(e) State the effects on the amplitude and frequency of the display if the soft iron core is replaced by a copper core. [1]

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7 The graph in **Figure 7.1** shows the relationship between temperature, **θ** , and time, **t** , of two objects Y and Z of the same material and water. The masses of Y, Z and water are $\mathbf{m_1}$ kg and $\mathbf{3m_1}$ kg and **1.5** kg respectively. They are heated with the same heater for the same period of time. The specific heat capacity of water is 4200 J/kg.

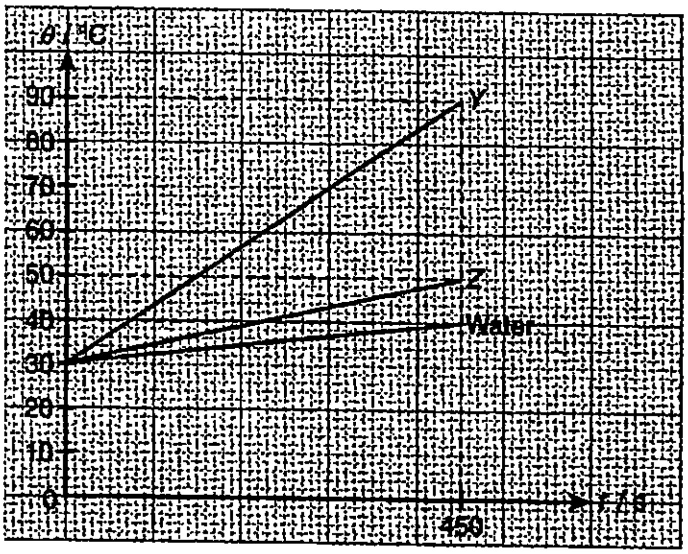

Figure 7.1

(a) From the graph, find the heat capacity of Y and Z. [2]

(b) If m_1 = 2 kg, what is the specific heat capacity of objects Y and Z? [2]

8 **Figure 8.1** shows a rectangular glass block **KLMN**.

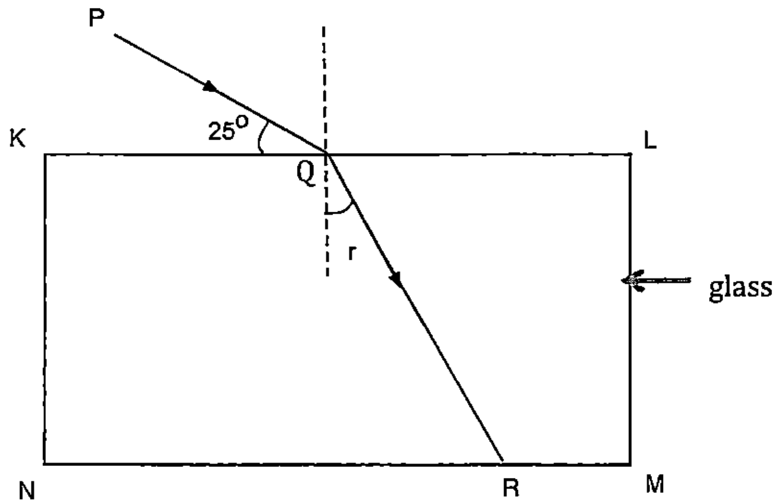

Figure 8.1

The refractive index of the glass is 1.50. The ray of light **PQ** is refracted when passing through the rectangular glass block.

(a) Explain why the ray is refracted. [1]

(b) Calculate angle of refraction, **r** of the ray **PQ** passing through the surface **KL**. [1]

(c) The rectangular glass block is displaced slightly to the left, as shown in **Figure 8.2**.

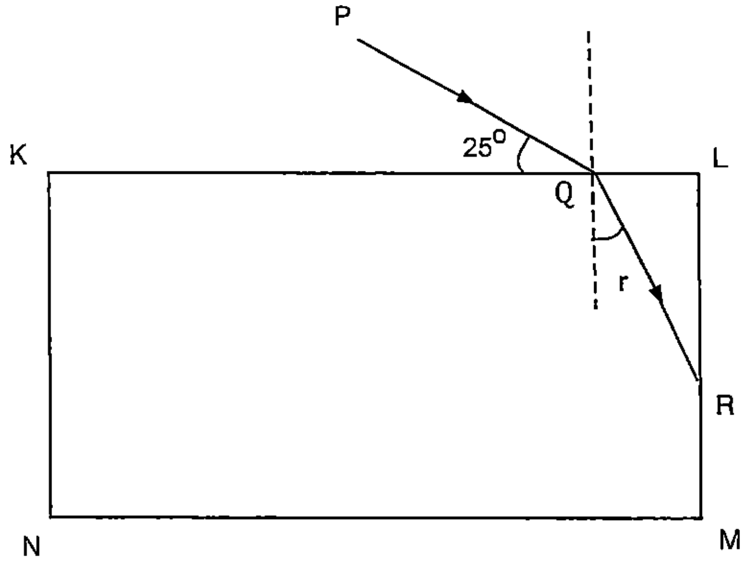

Figure 8.2

(i) Using a pen, complete the diagram in **Figure 8.2** to show the path of the ray immediately after it strikes the surface **LM** till it emerges from the glass block. [1]

(ii) Explain your answer in **(c)(i).** [2]

(d) What are the two conditions required for total internal reflection to take place? [1]

For Examiner's Use

9 **Figure 9.1** shows a converging lens producing an image I of an object **O**. It is drawn to scale.

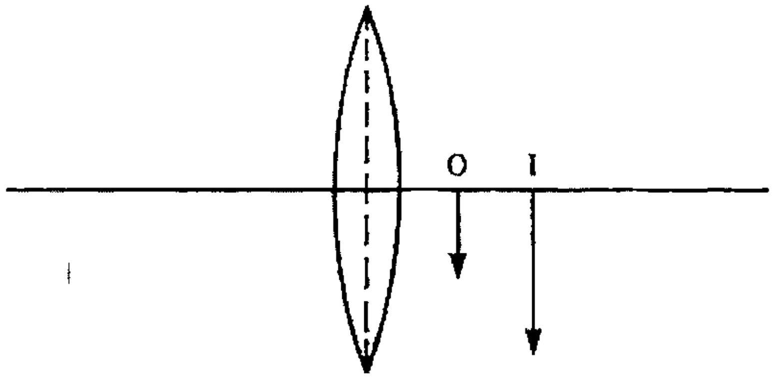

Figure 9.1

(a) (i) By adding rays to the diagram, find the position of the principal focus and label it **F**. Hence, determine the focal length of the lens. [2]

(ii) Name one use of this arrangement. [1]

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(b) Optical fibres have taken the place of wires in telecommunications. A length of a glass optical fibre carrying a ray of light is shown in **Figure 9.2** below. In this situation the glass has a refractive index of 1.5.

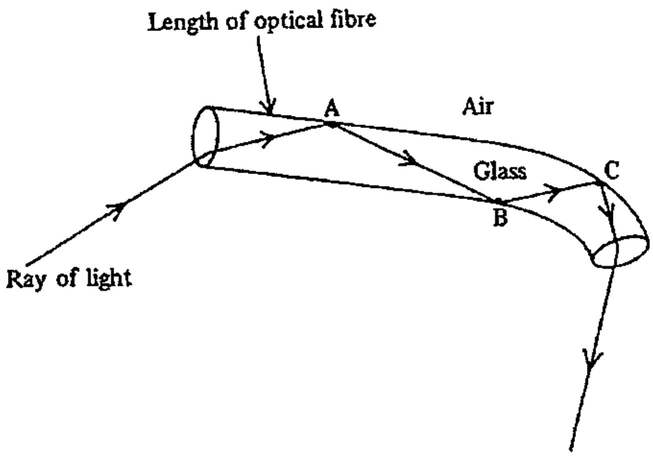


Figure 9.2

(i) Calculate the size of the largest angle that the light ray can make with the walls so that it does not escape through them. [1]

(ii) State two advantages of the use of optical fibre in telecommunications as compared to using copper wires. [2]

For Examiner's Use

Section B (30 marks)

Answer all the Questions in this section. **Question 12** has a choice of parts to answer. Answer only one of the two alternative questions in **Question 12**.

10 **Figure 10.1** shows a wind turbine used to produce electricity. The turbine blades are turned by the wind and are connected to a d.c. electrical generator which then charges a battery.

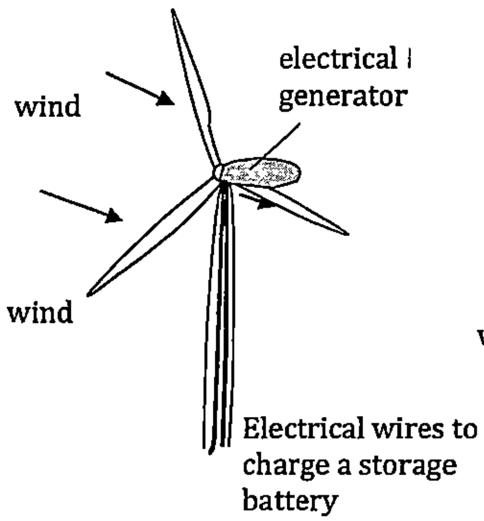


Figure 10.1

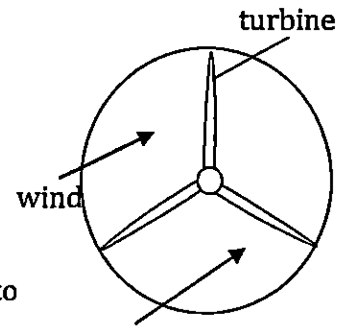


Figure 10.2

In one revolution the blades sweep out a circle as shown in **Figure 10.2**. In 60 s a mass of 54,000 kg of air traveling at a speed of 6.0 m/s is incident on that circle. 25% of this moving air hits the blades and leaves the turbine at a speed of 2.0 m/s. The rest of the moving air passes straight through the circle with the original speed of 6.0 m/s.

(a) Calculate

(i) the loss of kinetic energy of air in 60 s. [2]

(ii) the power of the turbine that is available to charge a storage battery. [2]

(b) The storage battery is used to light up street lamps, each having a power of 240 W.
Each street lamp is to be switched on for 8 hours per day.

(i) Calculate the amount of energy used by each lamp, in kWh. [1]

(ii) Estimate the maximum number of street lamps that can be operated if the wind is available for 10 hours per day. [2]

(c) Explain briefly why more energy is produced per second if

(i) the wind blows faster, [1]

(ii) the turbine blades are longer [1]

(iii) the turbine is more efficient. [1]

----

11 Ruth uses a mobile phone.

(a) She sets the ring tone of her mobile phone to produce a sound consisting of two notes, one after another. **Figure 11.1** shows the trace on a cathode-ray oscilloscope (CRO) screen produced by the first of the notes.

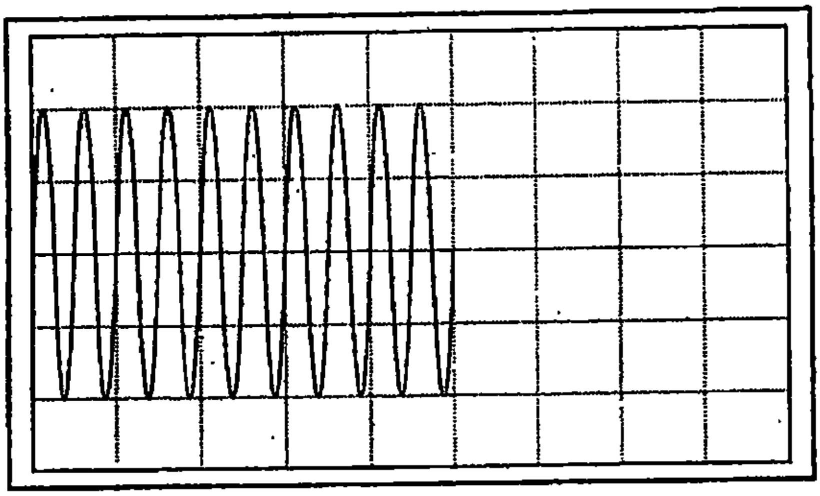


Figure 11.1

The second note is softer and has lower pitch. [2]

On **Figure 11.1**, continue the trace to show what happens when the second note is played.

(b) Ruth wonders if the energy from the radio waves of her mobile may cause a significant temperature rise in her brain. To investigate this effect, she calculates the heating effect of the mobile phone on a beaker of water placed next to it, as shown in **Figure 11.2**.

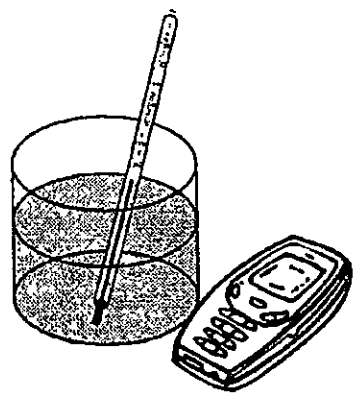
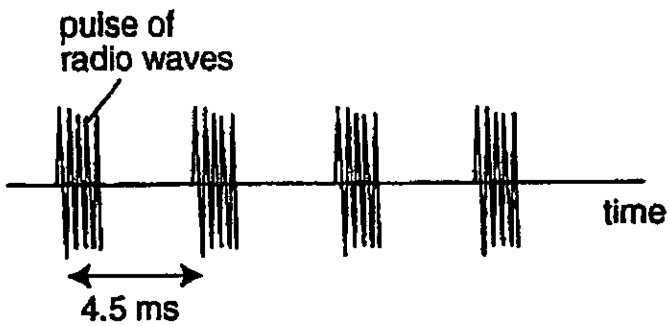


Figure 11.2

Figure 11.3 shows the relevant information about the mobile phone taken from the manual.

Information from manufacturer



The mobile phone emits pulses of radio waves.
Each pulse of waves has energy 1.6×10^{-4} J.
The time between each pulse is 4.5 ms.

Figure 11.3

The mobile phone is used for 5 minutes next to a beaker containing 40 g of water.

(i) Determine the number of pulses of radio waves produced during the mobile phone call. [1]

(ii) Determine the total energy of the radio waves emitted during the mobile phone call. [1]

(iii) Determine the maximum temperature rise produced in 40 g of water if all the energy calculated in **(b)(ii)** is absorbed by the water. (The specific heat capacity of water is 4.2 J/gK). [1]

(iv) Explain why motorists choose to use water as the liquid in the car radiator? [1]

(v) Define the specific latent heat of fusion of a substance. [1]

(c) A small quantity of crushed ice was allowed to warm up from a temperature of -2°C. The graph in **Figure 11.4** below shows how the temperature of the ice varied with time.

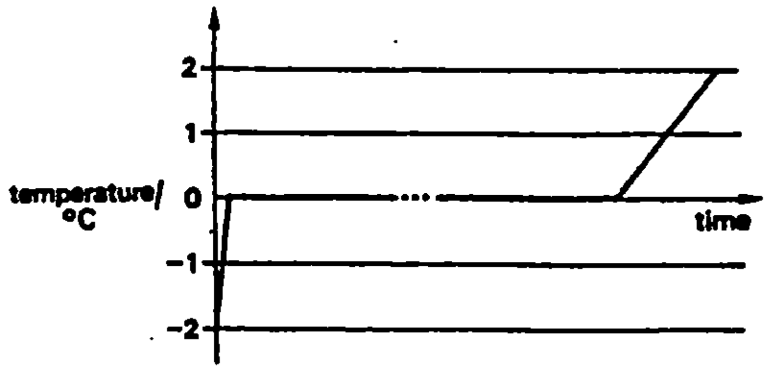


Figure 11.4

(i) Explain why, after an initial rise to 0°C, the temperature of the body remained constant. [2]

(ii) Suggest why the slope of the graph between -2°C and 0°C is greater than that between 0°C and +2°C. [1]

Answer only **one** of the following choice questions.

EITHER

12 **Figure 12** shows two insulated copper coils, **P** and **Q** mounted close together on a wooden rod. Coil **P** is connected to switch **S** and a battery. Coil **Q** is connected to a sensitive voltmeter V.

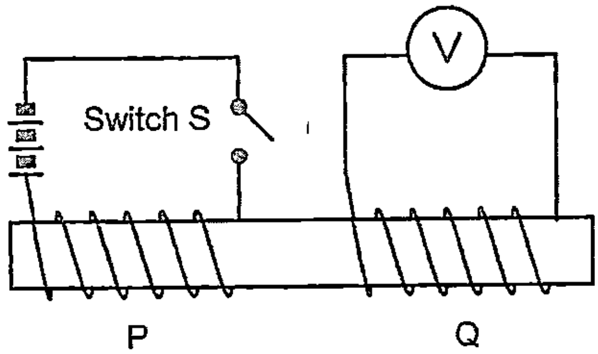


Figure 12

(a) When the switch S is closed, a deflection is seen on the meter. This deflection lasts for a very short time.

State the direction of the current flow through the meter? Justify your answer. [2]

(b)(i) Give two ways in which the efficiency of a transformer can be improved. [1]

(ii) Explain why the primary coil is made of thin wire and the secondary coil made of thick wire for a step-down transformer. [1]

(c) Define Faraday's Law of Electromagnetic Induction. [1]

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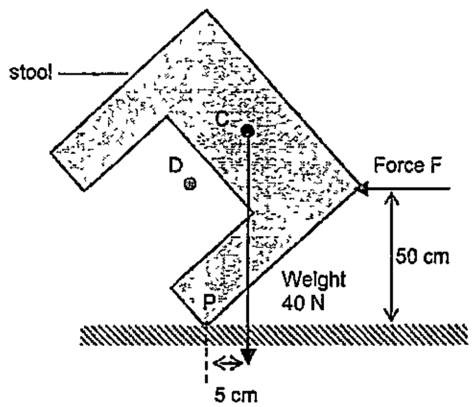
(d) The figure below shows a stool. A horizontal force **F** keeps the stool balanced. **C** is the centre of gravity of the stool and the weight of the stool is 40 N.



(i) On the figure above, draw and label an arrow to show the vertical force that acts on the stool. [1]

(ii) Explain why a stool is more stable with a centre of gravity at **D** rather than at **C**. [2]

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(iii) State two ways in which you can make a double-decker bus more stable? [1]

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(iv) Define the centre of gravity of an object. [1]

OR

12 Jonah poured 250 g of hot tea into a container. He placed a temperature sensor into the tea and started measuring the temperature with respect to time. After a while, he added some ice cubes into the tea.
Figure 12.1 below shows the temperature-time graph obtained.

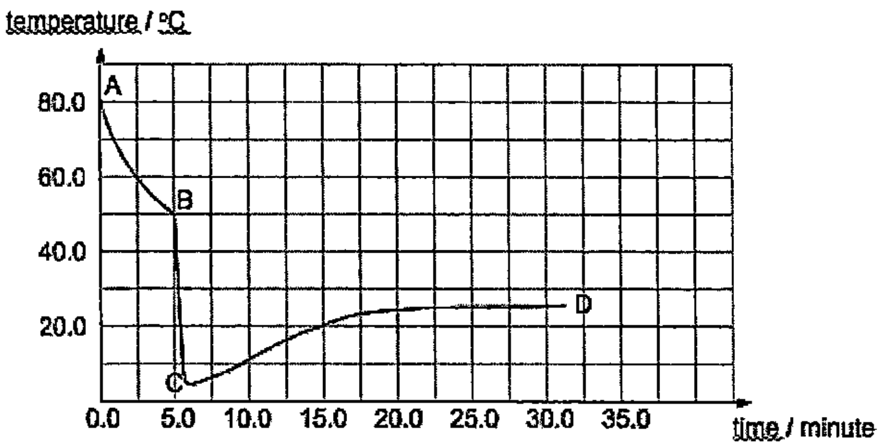


Figure 12.1

The following information is provided :

specific latent heat of fusion of ice	3.36×10^5 J kg^{-1}
specific latent heat of vaporisation of water or *tea*	2.26×10^6 J kg^{-1}
specific heat capacity of ice	2.10×10^3 J kg^{-1} °C^{-1}
specific heat capacity of water or *tea*	4.20×10^3 J kg^{-1} °C^{-1}

Assume there is no loss of thermal energy to the surrounding and the temperature of the ice cubes before being added into the hot tea is 0 °C.

(a) State the time that Jonah added the ice cubes into the tea. Explain your answer. [2]

(b) Calculate the loss of thermal energy in the hot tea from **B** to **C**. [2]

(c) Calculate the total mass of the ice cubes added into the hot tea. [2]

(d) Explain why the temperature of the tea increases from **C** to **D**. [2]

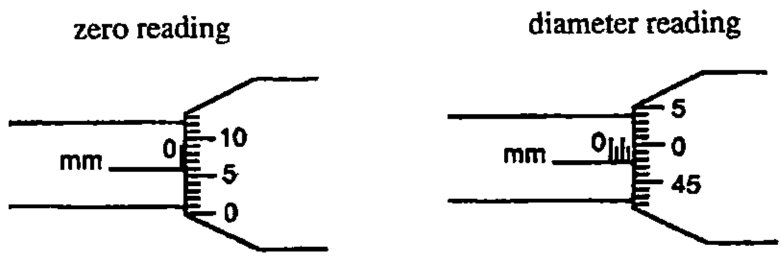
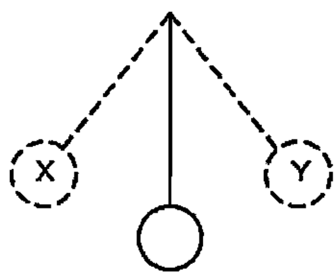
(e) Estimate the temperature of the surrounding. [1]

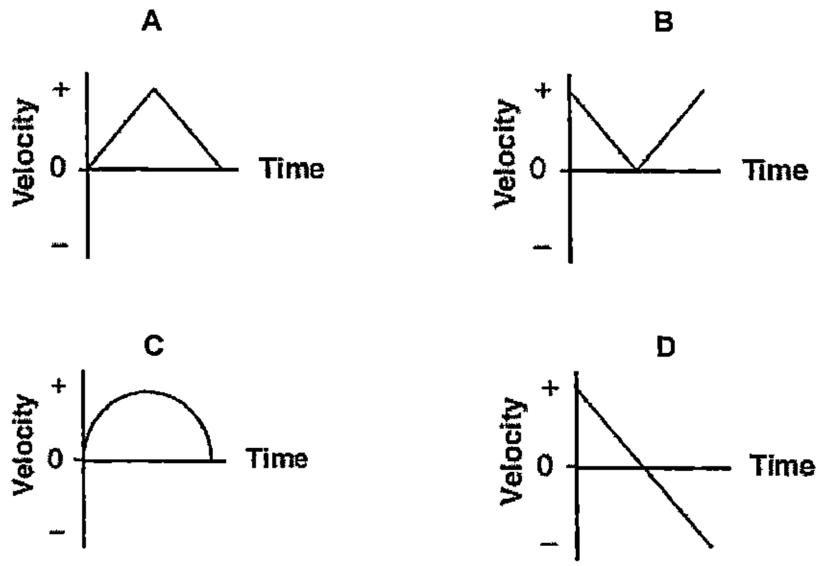
(f) In another experiment, Jonah placed 250 g of hot tea in the same empty container. When the temperature of the hot tea was 80 °C, he started the stopwatch. He continued to measure the temperature of the tea without adding any ice cubes.

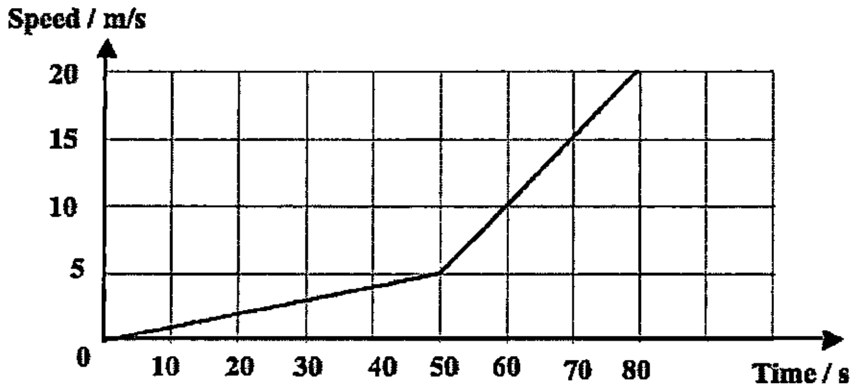
Draw the temperature-time graph for the second experiment on the same graph in **Figure 12.1**. [1]

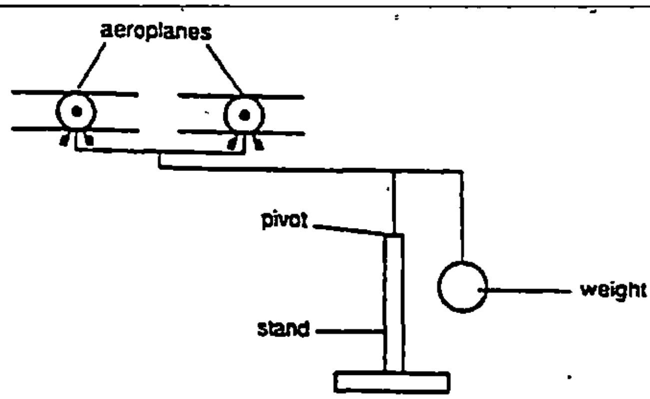
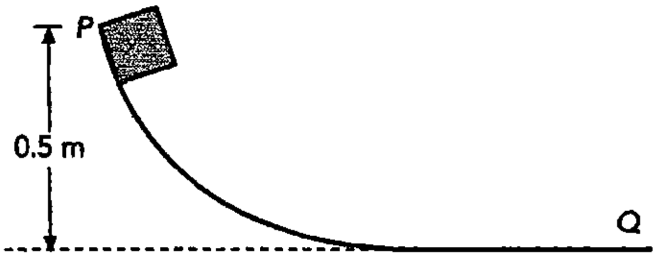
≈ End of Paper ≈

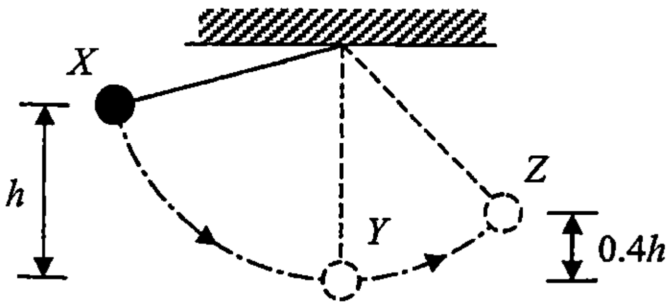
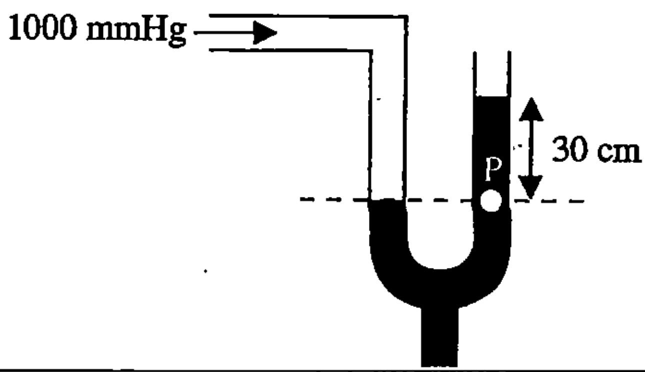
MCQ (Answer All Questions)

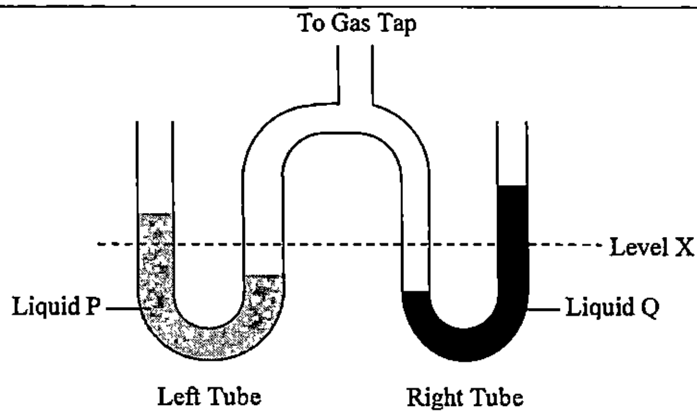
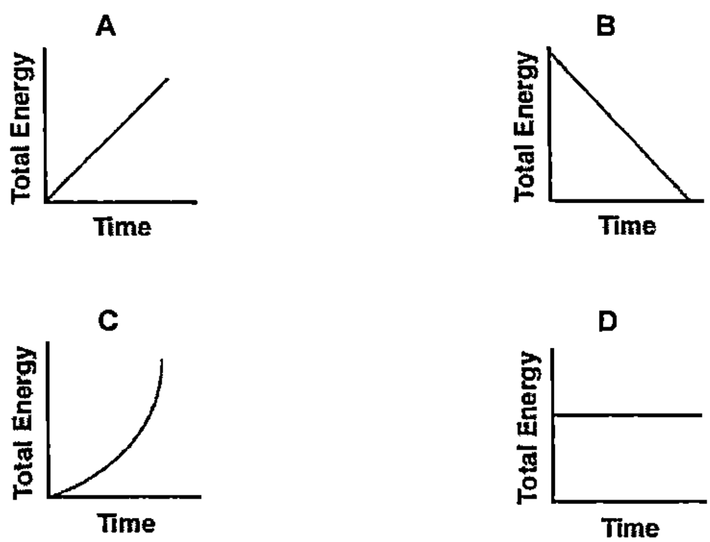
1	The diameter of a ball is measured using a micrometer screw gauge. A student takes an intial zero error reading and then a reading of the diameter. The diagrams show an enlargment of the screw gauge readings.	
		
	What is the diameter of the ball?	
	A 1.42 mm **B** 1.92 mm **C** 1.98 mm **D** 2.04 mm	B
2	It takes 36.5 s for a pendulum to swing from X to Y and back again twenty times.	
		B
	What is the frequency of the pendulum?	
	A 0.274 Hz **B** 0.548 Hz **C** 1.830 Hz **D** 2.740 Hz	
3	A stone is thrown vertically upwards with a velocity of 5.0 m/s. After time ***t***, it reaches the original position. Neglecting air resistance, the time required for the ball to reach the highest position is	
	A 10.0 t **B** 5.0 t **C** 2.5 t **D** 0.5 t	D

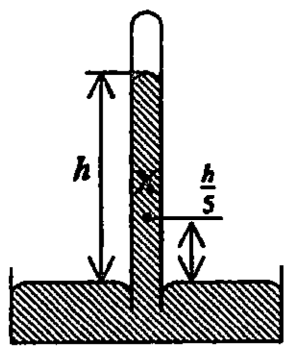
4	A student throws a baseball vertically upward and then catches it. If vertically upward is considered to be the positive direction, which graph best represents the relationship between velocity and time for the baseball? [Assume air resistance is negligible.]	
		D
5	Which of the following statements concerning the motion of a body is/are correct?	
	(I) A body can have zero acceleration but still in motion. (II) A body can have zero velocity but is also accelerating. (III) A body can have constant speed but varying velocity.	
	A (I) and (II) only **B** (I) and (III) only **C** (II) and (III) only **D** (I), (II) and (III)	D
6	A wooden block of mass 3.0 kg moves with uniform speed when it is pulled by a constant horizontal force of 6.0 N on a horizontal surface. What will happen to the motion of the wooden block if the horizontal force is increased to 12.0 N?	
	A Moves at a constant speed of 2.0 m/s. **B** Moves at a constant speed of 4.0 m/s. **C** Moves with an acceleration of 2.0 m/s^2. **D** Moves with an acceleration of 4.0 m/s^2.	C

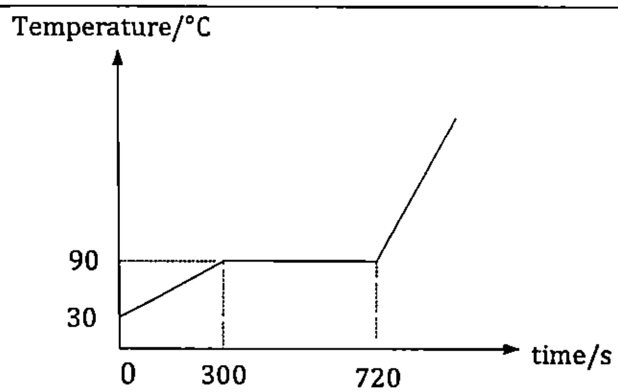
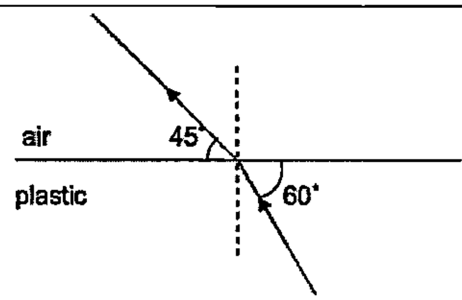
7	A bullet of mass 0.010 kg travelling horizontally at 100 m/s is stopped after penetrating through 0.20 m of wood. Find the average retarding force applied to the bullet by the wood.	
	A 10 N **B** 250 N **C** 500 N **D** 1000 N	B
8	The graph below shows how the speed of a car varies over a 80 s period.	
		
	What is the average speed of the car?	
	A 3.25 m/s **B** 6.25 m/s **C** 7.25 m/s **D** 12.5 m/s	B
9	The density of a metal bar is 12.0 g cm^{-3}. When a hole of volume 1.0 cm^3 is drilled into the bar, what will be its density be?	
	A 11.0 g cm^{-3} **B** 12.0 g cm^{-3} **C** 12.5 g cm^{-3} **D** 13.0 g cm^{-3}	B

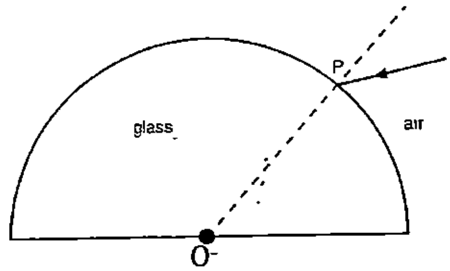
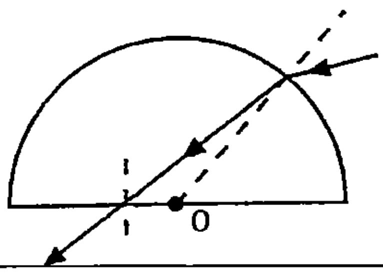
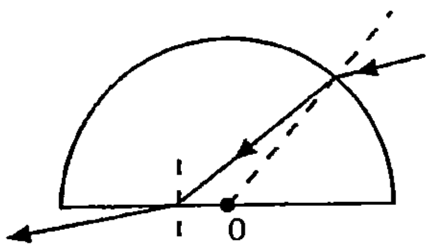
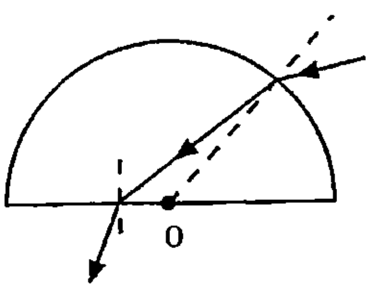
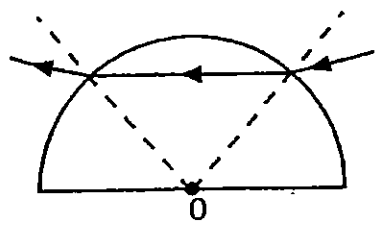
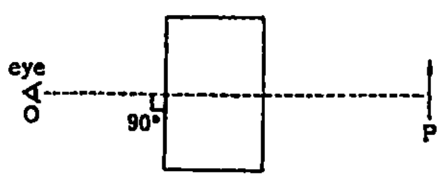
10	The diagram shows a balancing toy pivoted on a stand.If the toy is tilted slightly, it does not overbalance but returns to its original position. This is because the centre of gravity of the toy is	
	 	
	A between the aeroplanes. **B** below the pivot. **C** exactly at the pivot. **D** inside the weight.	B
11	A block of mass 2.0 kg is released from rest at point P as shown in the figure below. It is found that the block finally comes to rest at point Q.	
	 	
	Length of the track PQ is 2.5 m. What is the average value of frictional force acting on the block when it is moving from P to Q?	
	A 2.0 N **B** 2.5 N **C** 3.0 N **D** 4.0 N	D

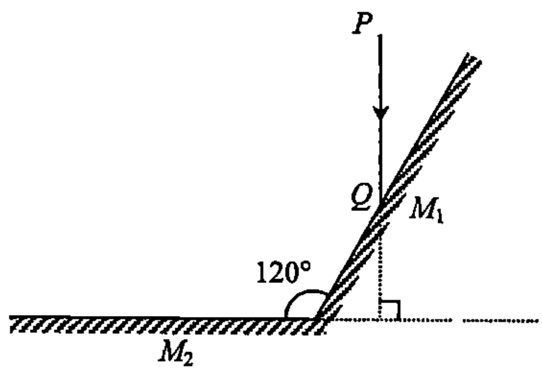
12	A pendulum bob is released from rest at position **X** which is at a height ***h*** above its lowest position **Y** and then passes through position **Z**. Position **Z** is 0.4***h*** above **Y**. Assuming air resistance is negligible, find the ratio of the speed of the bob at position **Y** to that at position **Z**.	
		
	A 1.29 : 1 **B** 1.58 : 1 **C** 1.67 : 1 **D** 2.50 : 1	A
13	A manometer is connected to a 1000 mmHg air pressure at one end and the other end is left open as shown below. Given that the manometer is filled with mercury, what is the pressure at point **P**?	
		
	A 300 mmHg **B** 700 mmHg **C** 1000 mmHg **D** 1300 mmHg	C

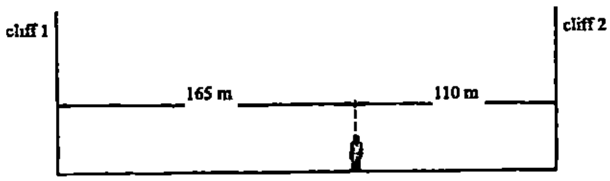
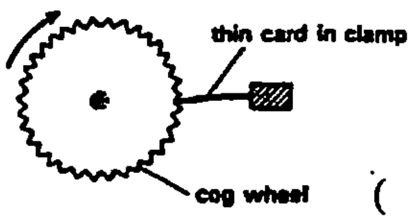
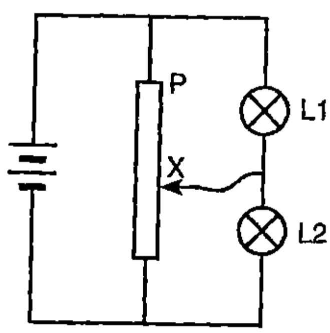
14	The apparatus shown is connected to a gas tap in order to measure the pressure of the gas. The left tube contains liquid P whereas the right tube contains liquid Q. The levels in the tube were originally at X.	
		
	When the gas tap is turned on, liquid Q in the open limb of the right tube rises to a higher level than liquid P in the open limb of the left tube as shown. Why is this so?	-
	A Liquid P has a higher density than liquid Q. **B** The right tube has a smaller cross-sectional area than the left tube. **C** There is more liquid Q in the right tube than liquid P in the left tube. **D** The gas exerts a greater pressure on the right tube as it is nearer to the gas inlet.	A
15	A ball is dropped from the top of a cliff. Which graph best represents the relationship between the ball's total energy and elapsed time as the ball falls to the ground? (Assume air resistance is negligible.)	
		D

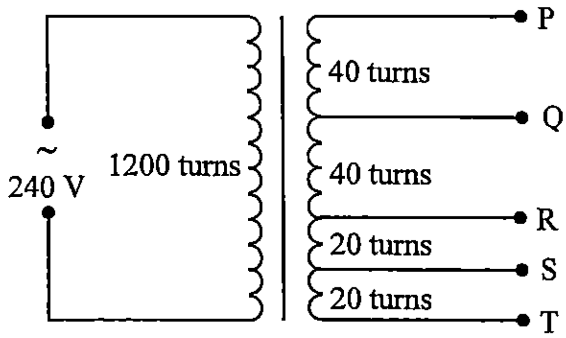
16	In the Brownian motion experiment involving smoke particles in the air, heavy particles settle quickly but very small particles remain suspended for long periods of time. This is because	
	A air pressure has a greater effect on smaller particles. **B** the small smoke particles have the same density as air. **C** the Earth's gravitational field has a negligible effect on very small particles. **D** smaller particles are more easily affected by the bombardments of the air molecules.	C
17	The height of a mercury barometer is h when the atmospheric pressure is 100 000 Pa. What is the pressure at **X**?	
	A 20 000 Pa **B** 80 000 Pa **C** 120 000 Pa **D** 180 000 Pa  	B
18	A piece of aluminium of mass m has a specific heat capacity of **c**. A piece of copper of mass **2*m*** has a specific heat capacity of **2*c***. Both of these metals receive the same quantity of heat and the temperature of the copper rises by 10°C. By how much did the temperature of the aluminium rise?	
	A 5°C **B** 10°C **C** 20°C **D** 40°C	D

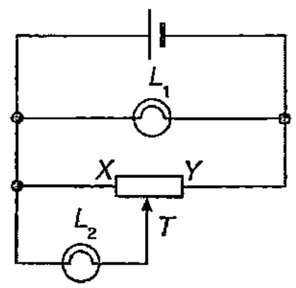
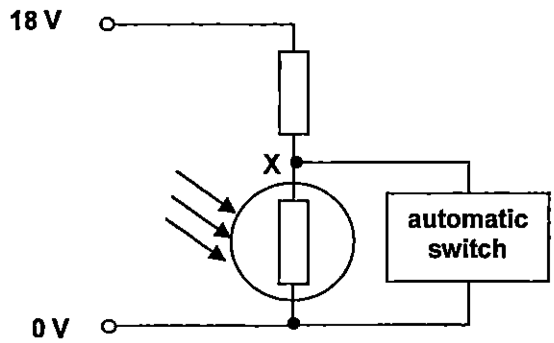
19	The diagram shows a graph of temperature against time when 0.5 kg of salt is being heated.	
		
	If heat energy is supplied to the salt at a rate of 100 W, what is the specific latent heat of fusion of the salt?	
	A 1.4×10^3 J/kg **B** 2.1×10^4 J/kg **C** 8.4×10^4 J/kg **D** 1.4×10^5 J/kg	C
20	The diagram shows a ray of light moving from plastic to air.	
		
	What is the refractive index of plastic?	
	A 0.707 **B** 0.816 **C** 1.22 **D** 1.41	D

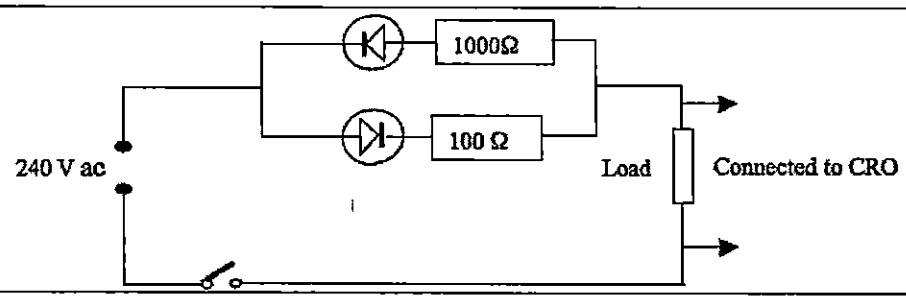
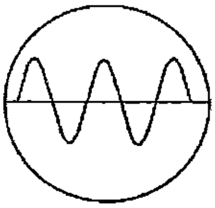
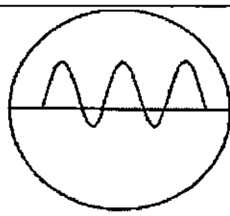
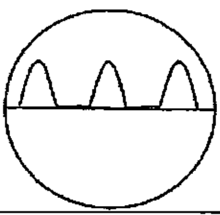
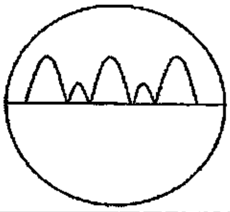
21		
	A ray of light in air is incident on a semicircular block of glass at point **P**, as shown in the diagram above. **OP** is a radius of the semicircle. Which of the following ray diagrams shows how the ray will pass through the block and into the air again?	
	A  **B** 	B
	C  **D** 	
22	An observer looks straight through a rectangular glass block at an object **P**, as shown below. How does the object appear to the observer?	
		
	A Moved to the right **B** In its true position **C** Laterally inverted **D** Nearer	D

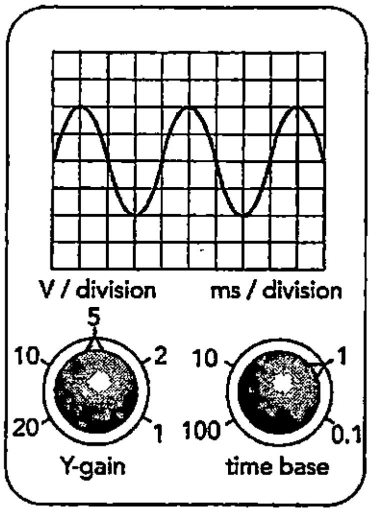
23	When an object is placed 20 cm from a thin converging lens, a real image equal in size to the object is formed. The object is then moved 5 cm towards the lens. Which of the following describes the new image formed?	
	Image Distance — **Image Size**	
	A more than 20 cm — magnified **B** more than 20 cm — diminished **C** less than 20 cm — magnified **D** less than 20 cm — diminished	A
24	~~The following diagram shows two mirrors inclined at 120 °.~~	
		
	An incident ray **PQ**, whose direction of propagation is perpendicular to $\mathbf{M_2}$, is reflected by $\mathbf{M_1}$. What is the angle of reflection at $\mathbf{M_2}$?	
	A 30° **B** 45 ° **C** 60 ° **D** 75 °	C
25	Which is one practical application of infra-red radiation?	
	A Used to produce vitamin E B Used to check for flaws in metals C Used in the remote controls for various electrical appliances D Used in mobile phones.	C

26	A man stands between two cliffs as shown in the diagram and claps his hand once. Assuming that the velocity of sound in air is 330 m/s, what will be the time interval between the two loudest echoes?	
		
	A 1/6 s **B** 1/3 s **C** 2/3 s **D** 5/6 s	B
27	A piece of thin card was held against the teeth of a cog wheel. When the wheel is turned at the high speed a note is heard. How may the pitch of this note be raised?	
		
	A Using a thicker card **B** Using a longer card **C** Pressing the card against the teeth with a greater force **D** Turning the wheel more quickly	D
28	The diagram shows a potential divider circuit.	
		
	What happens to the brightness of lamp **1** and lamp **2** as the contact **X** is moved away from point **P** of the potential divider?	
	lamp 1 **lamp 2**	
	A brighter — stay the same **B** brighter — dimmer **C** dimmer — stay the same **D** dimmer — brighter	B

29	A transformer consists of one coil with 1200 turns and a second coil, with a total of 120 turns, which can be tapped at various points as shown.	
		
	Which pair of terminals should be connected to a 12 V, 24 W lamp for it to be lit normally?	
	A PS **B** QS **C** RT **D** PT	B
30	The school hall is fitted with 20 units of air-conditioner, each rated 2400 W. During the 10 days of school examination, the air-conditioners had to be switched on twice a day and each session lasted for 3 hours. If each unit of electricity costs 25 cents, how much do the school have to pay to provide air-conditioning for the students during the examination?	
	A \$36.00 **B** \$360.00 **C** \$72.00 **D** \$720.00	D

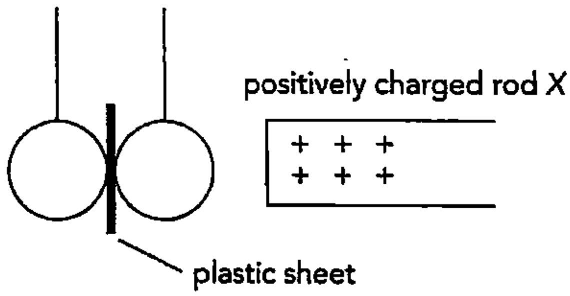
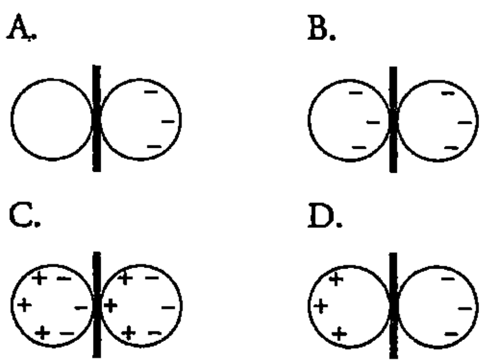
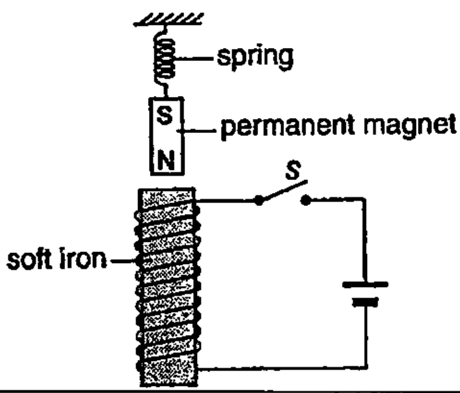
31	The figure below shows an electric circuit.	
		
	Which one of the following describes the brightness of **L_2** in the given circuit when the tab **T** of the potential divider is moved slowly from **X** to **Y**?	
	A It is originally as bright as L_1 and then dims gradually. **B** It is originally half as bright as L_1 and then dims gradually. **C** Its brightness increases gradually and is finally as bright as L_1. **D** Its brightness increases gradually and is finally half as bright as L_1.	C
32	The circuit shown below is connected to an automatic switch for the lights in the garden. The automatic switch needs a voltage at **X** of 12 V or higher for the lights to be on. The lights are to come on at sunset and the value of the fixed resistor is 400 W.	
		
	What must be the minimum resistance of the light-dependent resistor in order for the lights to come on at sunset?	
	A 400 W **B** 800 W **C** 1200 W **D** 1600 W	B

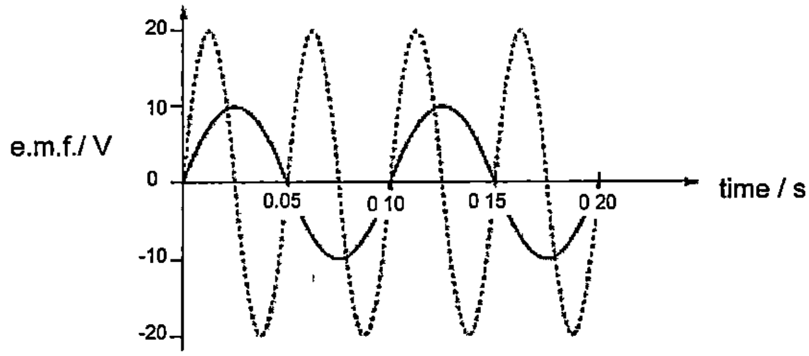
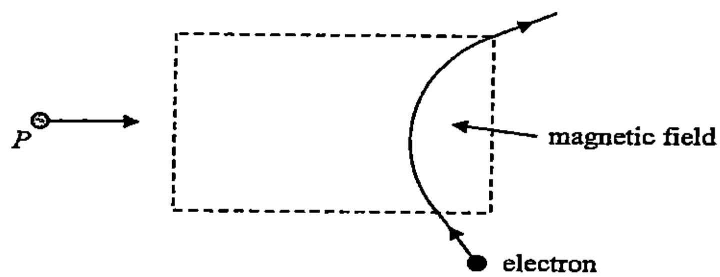
33	A circuit is set up as shown in the diagram below and a load is connected to the CRO. Which is the correct waveform on the CRO when the switch is closed?	
		
	A.  B.  C.  D. 	B
34	Two foam balls which are wrapped with aluminium foil, suspended from adjacent silk threads, attract each other. This indicates that	
	(I) the magnetism is strong (II) they are oppositely-charged. (III) only one of them is charged.	
	A (I) only B (II) only C (I) and (II) only D (II) and (III) only	D

35	An alternating voltage signal is displayed on an oscilloscope, with the settings shown in the figure below.	
		
	Which of the following combinations gives the correct values for the peak voltage and frequency of the signal?	
	(table below)	B

	Peak voltage / V	Frequency / Hz
A	10	100
B	10	250
C	20	250
D	20	1000

36	The figure below shows three parallel long straight wires **P**, **Q** and **R**. **P** and **Q** carry currents flowing into the paper and **R** carries a current flowing out of the paper.	
		
	What is the direction of the resultant force acting on **Q**?	
	A  B  C  D 	C

37	The figure below shows two uncharged metal spheres suspended by insulating threads and separated by a plastic sheet. A positively charged rod **X** is brought near them as shown.	
		
	Which of the following diagrams shows the resulting charge distribution on the spheres?	
		C
38	The figure below shows a permanent magnet suspended from a spring placed right on top of an electromagnet.	
		
	What will happen to the permanent magnet once the switch **S** is turned on?	
	A The magnet is pulled downwards. **B** The magnet is pushed upwards. **C** The magnet is stationary. **D** The magnet starts to swing from left to right.	A

39	In the graph shown, the solid curve shows how the e.m.f. produced by a simple generator varies with time. The dashed curve is the output from the same generator after a modification has been made to the generator.	
		
	Which modification was made to produce the result shown?	
	A The area of the coil was doubled. **B** A split-ring commutator was added. **C** The number of turns in the coil was doubled. **D** The speed of rotation of the coil was doubled.	D
40	When an electron enters a magnetic field, it is deflected in the direction as shown below. When a positively-charged particle **P** enters the magnetic field from the left, it will be deflected	
		
	A to the top **B** to the bottom **C** out of the paper **D** into the paper	A

Answers for Paper 1 MCQ (Prelim 2 2015)

Qn No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans	B	B	D	D	D	C	B	B	B	B	D	A	C	A	D	C	B	D	C	D
Qn No	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans	B	D	A	C	C	B	D	B	B	D	C	B	B	D	B	C	C	A	D	A

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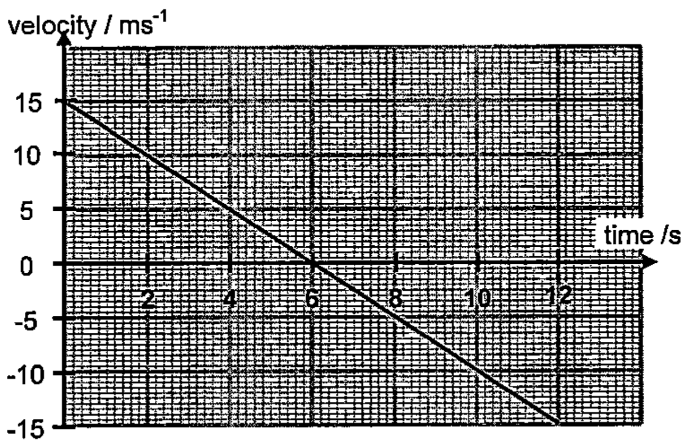
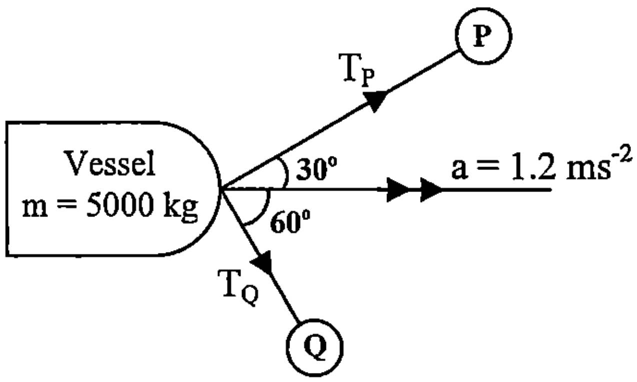
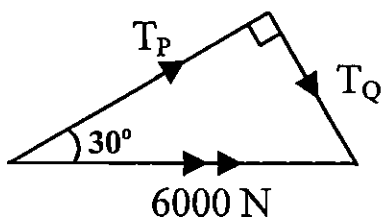
Section A (50 marks)
Answer all Questions

1	A ball was given a push and it rolled up a smooth slope. **Figure 1** below describes the motion of the ball.	
		
	Figure 1	
(a)	Describe the motion of the ball for the **first half of the journey**.	[1]
	For the first 6.0s the velocity decreases at a constant rate . [1/2] It has a constant deceleration of 2.5 ms^{-2}. [1/2]	
(b)	Find the displacement of the ball for the first 8.0 s.	[2]
	Displacement = Area under the graph **Displacement = ½ (15 x 6) + ½ (-5x 2) [1]** **= 45 – 5** **= 40 m [1]**	
(c)	Define the term ***velocity.***	[1]
	Velocity is the rate of change of displacement. [1]	
(d)	Define Newton's First Law of Motion	[1]
	Newton's First Law of Motion states that every object will continue in its state of rest or uniform motion in a straight line [1/2] unless a resultant force acts on it. [1/2]	

2	A large vessel is towed by two tug boats P and Q as shown in **Figure 2.** The vessel of mass 5000 kg moves forward with an acceleration of $1.2\ ms^{-2}$. By drawing a suitable scaled diagram, determine the tension in the two ropes $\mathbf{T_P}$ and $\mathbf{T_Q}$.	[4]
		
	Figure 2	
	Scale: 1 cm to 500 N [1/2 mark] $F = ma$ $F=5000\times1.2$ $F=6000N$ [1/2 mark] $T_P=5150N$ to $5250N$ [1 mark] $T_Q=2950N–3050N$ [1 mark] ½ mark – correct diagram ½ mark – arrows drawn correctly 	
3	Figure 3 below shows two vertical tubes **P** and **Q**, each closed at	

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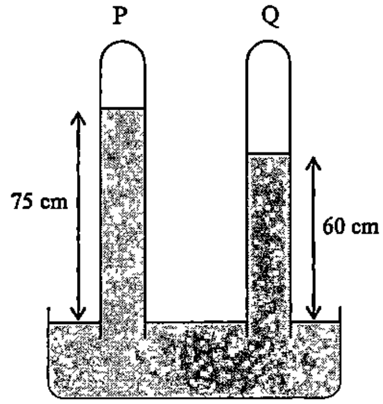
	the upper end. The space above the mercury meniscus of tube **P** is a vacuum but not that of tube **Q**. The density of mercury is 1.36×10^4 kg/m^3.	
	 	
(a)	Determine the pressure, in Pa, exerted by the air in the space above the mercury meniscus of tube **Q**.	[2]
	$P = \rho g h$ $P = 13600 \times 10 \times (0.75 - 0.60)$ [1 mark] $P = 20400$ Pa [1 mark]	
	Tube **Q** is pushed further into the trough such that its lower end immersed more deeply in the reservoir of mercury. How would the height of the mercury column in tube **P** and tube **Q** be affected respectively?	[1]
	The height of the mercury column is tube P remains unaffected. [1/2] The height of the mercury column is tube Q is shortened. [1/2]	
(b)	Explain in terms of molecular properties,	
(i)	how the air inside a car tyre exerts a pressure on the walls of the	[2]

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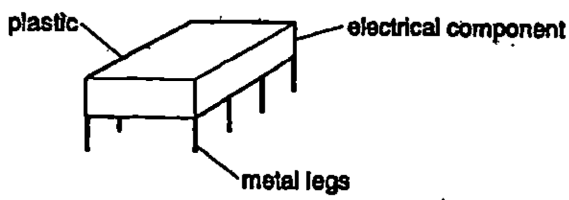
	tyre,	
	The air molecules in the car tyre is **moving about randomly[1/2]** and continuously and **will hit/bombard on the interior wall[1]** of the tyre. The **average force per unit area** [1/2] of the tyre is the pressure of the tire	
(ii)	why the air pressure in the car tyre increases after a long journey.	[2]
	Friction [1/2] between the tyre and the road produces heat. **Kinetic energy** of the air molecules **increases**.[1/2] The **velocity of the molecules is higher** [1/2] and they bombard the walls of the tire. This **increases** the **force per unit area[1/2]** exerted onto the walls of tyre. So, air pressure in the car tyre increases.	
4	Some electrical components are easily damaged if electric charge is placed on them.They are often stored by placing them in contact with a conductor.	
(a)	When the component shown in **Figure 4.1** is rubbed with a cloth, the metal legs become negatively charged. Explain how this happens.	[1]
	 **Figure 4.1**	
	When the component is rubbed with cloth, its metal legs are **negatively charged** [1/2] because the **electrons moves from the cloth onto the component. [1/2]**	
(b)	Figure 4.2 shows the negatively charged metal legs placed near a piece of aluminium foil which rests on an insulator.	

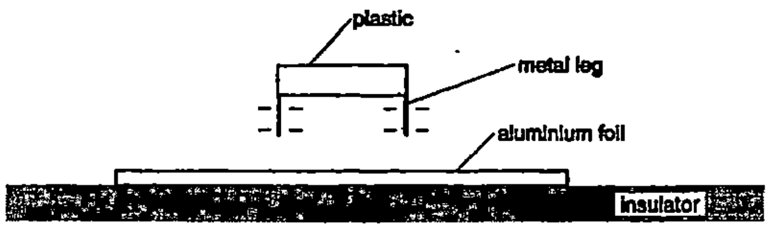


Figure 4.2

(i)	On **Figure 4.2**, draw the induced charges that form on the aluminium foil.	[1]
(ii)	The metal legs are placed in contact with the aluminium foil. Describe what happens to the charges on the foil and on the legs.	[2]
	When metal legs are placed in contact with the aluminium foil, the **negative charges on the legs move to the aluminium foil [1/2]. There will be no more excess positive charges [1/2]** on the top surfaces of the aluminium foil. Unlike charges attract each other. There is now **excess negative charges in the foil**. [1/2] Hence, **the aluminium foil becomes negatively charged.[1/2]** The metal legs will still have excess negative charges on it and remains negatively charged.	
5	**Figure 5** shows a simple setup used to study the flow of current from terminal **X** to terminal **Y** through the solenoid.	

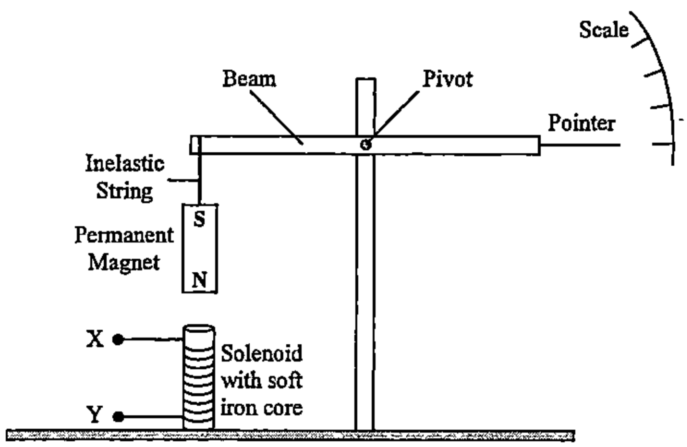


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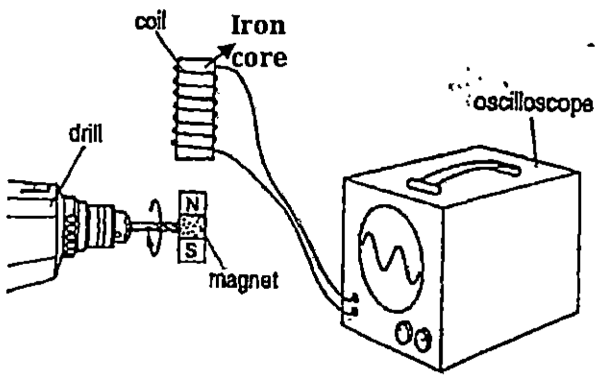
	Figure 5	
(a)	Describe how the setup works to measure the magnitude of current flow.	[3]
	As the current flow from terminal X to terminal Y through the solenoid, **a magnetic field is produced**. [1/2] Using right hand grip rule, it can be determined that **the top end is south pole[1/2]** and the bottom end is north pole. This cause the **solenoid to attract the permanent magnet.[1/2]** When the permanent magnet is pulled down due to the attraction, it causes **the horizontal beam to rotate anticlockwise about the pivot** [1/2] and the pointer will move up the scale according. An **increase in the magnitude of current flow will result in stronger magnetic attraction** [1/2] and **hence a greater deflection** [1/2] as displayed by the pointer on the scale.	
(b)	Suggest two ways to increase the sensitivity of this setup.	[1]
	Any two of these: [1/2 mark each] 1. Increase the number of turns of the solenoid 2. Use a stronger permanent magnet 3. Shift the pivot of the horizontal beam to the left, nearer the permanent magnet	
(c)	The setup will not work if the polarity of the current flow is reversed (i.e. current flows from terminal Y to terminal X through the solenoid).	
(i)	Why is that so?	[2]
	If the polarity of the current flow is reversed, then the **top end of the solenoid will be north pole**.[1/2] Since like poles repel, the permanent **magnet will be repelled away from the solenoid**. [1/2] The permanent magnet is **suspended on an inelastic string**.[1/2] The repelled magnet will still be hanging down (to the left or right side of the solenoid) due to its weight/gravitational force. Hence the horizontal beam will **remain unaffected by the repulsive push upward. [1/2]**	

(ii)	How can we modify the setup to correct this problem? Explain your answer.	[2]
	The permanent magnet is **replaced by a soft iron bar**. [1/2] The solenoid will be able **to induce magnetism in the soft iron bar** [1/2]. The polarity of the induced magnetic field in the soft iron bar will be such that **the bottom end of it will have an unlike pole** [1/2] to the solenoid polarity. The electromagnet formed by the solenoid is able to **attract the soft iron bar regardless of its polarity** [1/2] due to the current flow and the magnetic field.	
6	**Figure 6A** shows a drill that is being spun with a magnet attached to the drillbit. A coil of wire around an iron core is placed above the rotating magnet. The ends of the coil are connected to the y-input of the cathode ray oscilloscope(CRO).	
	 **Figure 6A**	
(a)	Explain why there is a current induced in the coil when the drillbit rotates.	[1]
	When the drillbit rotates, the magnet rotates with it and this produces a change in the magnetic flux linked to the coil [1/2]. This induces an emf and therefore a current [1/2] in the coil.	

(b)	Draw on Figure 6A the direction of the current in the coil as the N-pole of the magnet approaches the coil.	[1]
(c)	The following display B is seen on the CRO screen in Figure 6B. Draw on the figure, the display when the speed of the drill bit is halved. Label it as **curve C**.	[2]

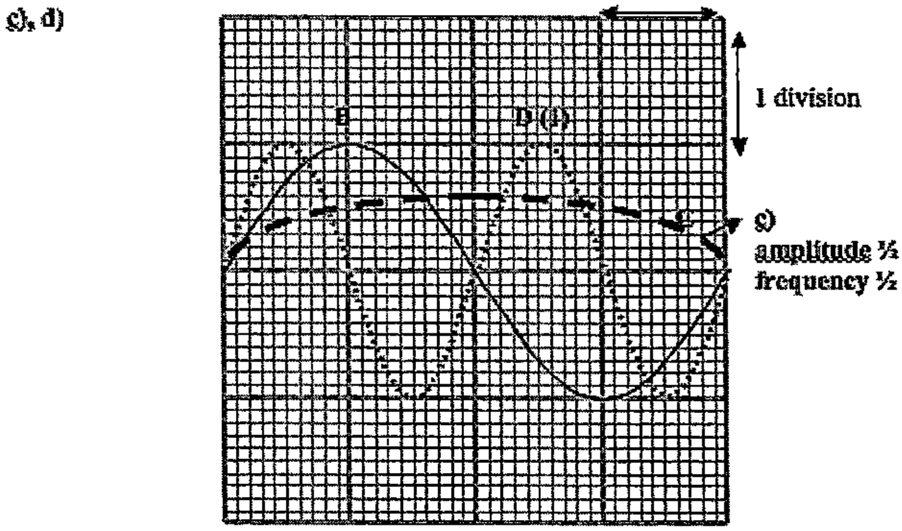


Figure 6B

	c) amplitude -1/2 [1 mark], frequency-1/2 [1 mark]	
(d)	The time-base of the CRO is currently 6 ms/division. Draw also on Figure 6B what happens to curve B when only the time-base is doubled to 12 ms/division. Label it as **curve D.**	[1]
(e)	State the effects on the amplitude and frequency of the display if the soft iron core is replaced by a copper core.	[1]
	Amplitude _decreases [1/2] _Frequency remains unchanged [1/2]	
7	The graph in **Figure 7.1** shows the relationship between temperature, **θ** , and time, **t** , of two objects **Y** and **Z** of the same material and **water**. The masses of Y, **Z** and **water** are $\mathbf{m_1}$ kg and $\mathbf{3m_1}$ kg and **1.5** kg respectively. They are heated with the same heater for the same period of time. The specific heat capacity of water is 4200 J/kg.	

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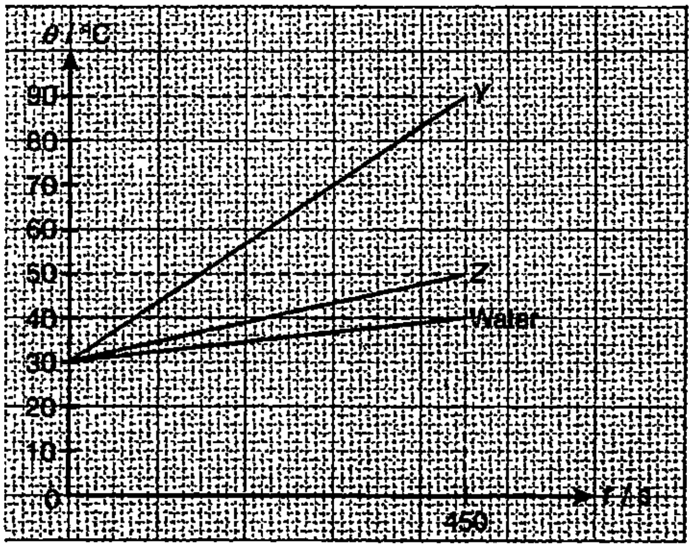

Figure 7.1

(a) From the graph, find the heat capacity of Y and Z. [2]

From the graph of water, the heat energy supplied by the heater in 450 s

$= m\, c_w\, \theta$

$= 1.5 \times 4200 \times (40 - 30)$

$= 63\,000$ J

For Y: $63\,000 = c_y \times (90 - 30)$ [1/2]

$c_y = 1050$ J/°C [1/2]

For Z: $63\,000 = c_z \times (50 - 30)$ [1/2]

$C_z = 3150$ J/°C [1/2]

(b) If $m_1 = 2$, what is the specific heat capacity of objects Y and Z? [2]

For Y: $c_y = mc$

$1050 = 2 \times c$ [1/2]

$c = 525$ J /kg°C [1/2]

Since Y and Z are of the same material, their specific heat capacity is the same i.e.

Specific heat capacity of Z is also equals to 525 J /kg°C [1]

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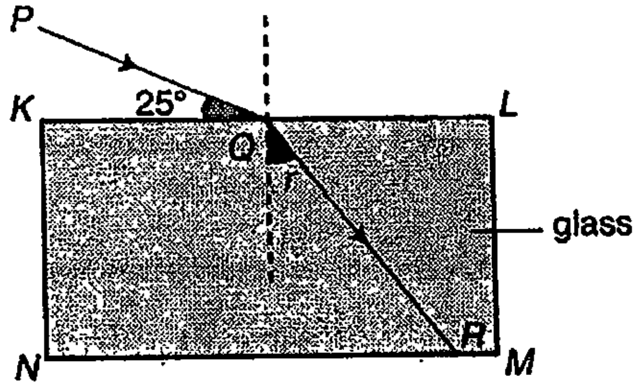
8	Figure 8.1 shows a rectangular glass block **KLMN**.	
		
	Figure 8.1	
	The refractive index of the glass is 1.50. The ray of light **PQ** is refracted when passing through the rectangular glass block.	
(a)	Explain why the ray is refracted.	[1]
	There is a **change of speed of light** [1/2] as the ray travels from a medium (air) to another (glass) of **different optical density**. [1/2]	
(b)	Calculate angle of refraction, **r** of the ray **PQ** passing through the surface **KL**.	[1]
	n = sin i / sin r sin r = sin i / n = sin 65° / 1.50 [1/2] = 0.6042 r = 37° [1/2]	
(c)	The rectangular glass block is displaced slightly to the left, as shown in **Figure 8.2**.	

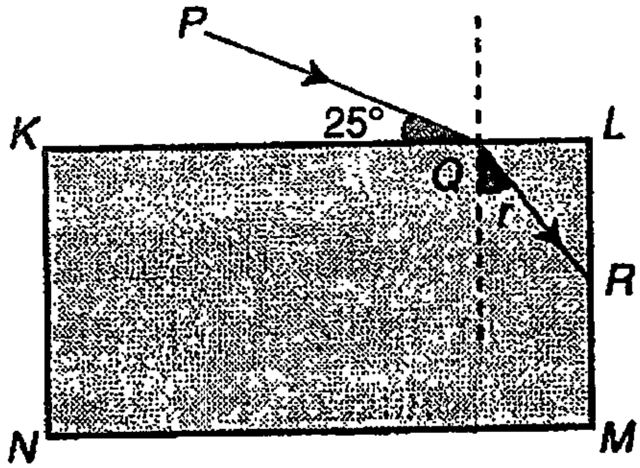


	Figure 8.2	
(i)	Using a pen, complete the diagram in **Figure 8.2** to show the path of the ray immediately after it strikes the surface **LM** till it emerges from the glass block.	[1]
	drawing shows total internal reflection at surface LM [1/2 mark for total internal reflection and side LM; ½ mark for refraction on emerging and side MN]	
(ii)	Explain your answer in **(c)(i).**	[2]
	$\sin c = 1 / n$ $= 1 / 1.50$ $= 0.6667$ critical angle , $c = 42^\circ$ [1/2] angle of incidence at the surface LM, $r_1 = 90^\circ - 37^\circ$ $= 53^\circ$ [1/2] since r_1 at the surface LM is more than the critical angle, the ray will undergo total internal reflection. [1/2] At the surface MN, the ray of light hits the interface at an incident angle of 37° which is less than the critical angle. Therefore, it can emerge from the side MN. [1/2]	
(d)	What are the two conditions required for total internal reflection to take place?	[1]
	Total internal reflection will take place when: 1) a ray of light travels from an optically denser medium to an optically less dense medium, and [1/2] 2) the angle of incidence in the optically denser medium is greater than the critical angle of the denser medium. [1/2]	

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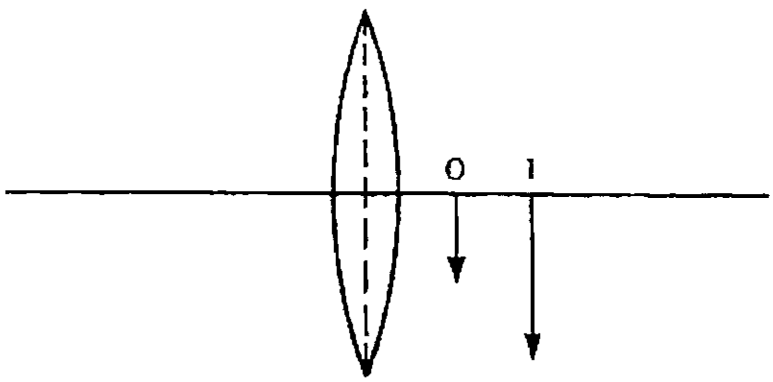
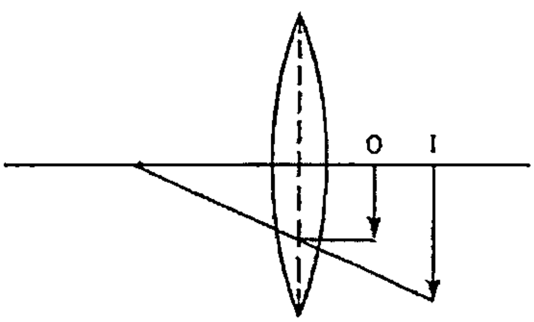
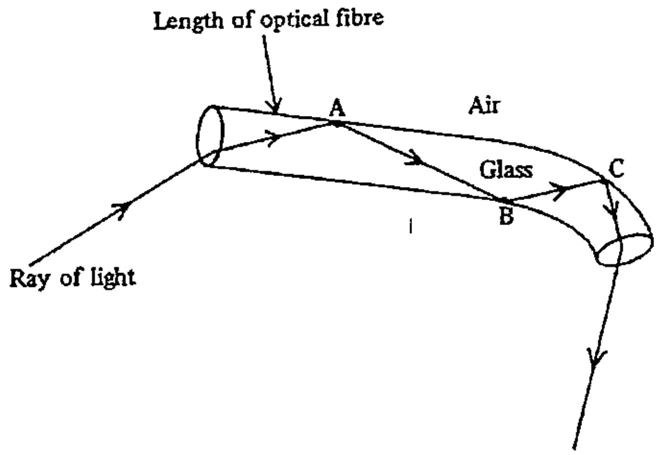
9	The diagram shows a converging lens producing an image I of an object O.	
		
(i)	By adding rays to the diagram, find the position of the principal focus and label it **F**. Hence, determine the focal length of the lens.	[2]
	Ray from top of object, parallel to principal axis to centre of lens [1/2] Ray from top of image through centre of lens to principal axis [1/2] **F** labelled 28 ± 2 mm from centre of lens [1/2] **Answer: Focal length = 28 ± 2 mm** from centre of lens [1/2] 	
(ii)	Name one use of this arrangement.	[1]

	Magnifying glass [1]	
(b)	Optical fibres have taken the place of wires in telecommunications. A length of a glass optical fibre carrying a ray of light is shown below. In this situation the glass has a refractive index of 1.5.	
		
(i)	Calculate the size of the largest angle that the light ray can make with the walls so that it does not escape through them.	[1]
	Sin c = 1/1.5 c = 41.8° [1/2] largest angle = 90° − 41.8° = **48.2°** [1/2] (NB: The critical angle is the largest angle of incidence that the light can make with the *normal*. The question asks for the largest angle with the *walls*.)	
(ii)	State two advantages of the use of optical fibre in telecommunications as compared to using copper wires.	[2]
	Advantages (Any two from the following): [1 each] A fibre can carry much more information over long distances than a copper wire. Optical Fibres experience much less signal loss as compared to wires. Optical wires are lighter and cheaper to manufacture than copper wires.	

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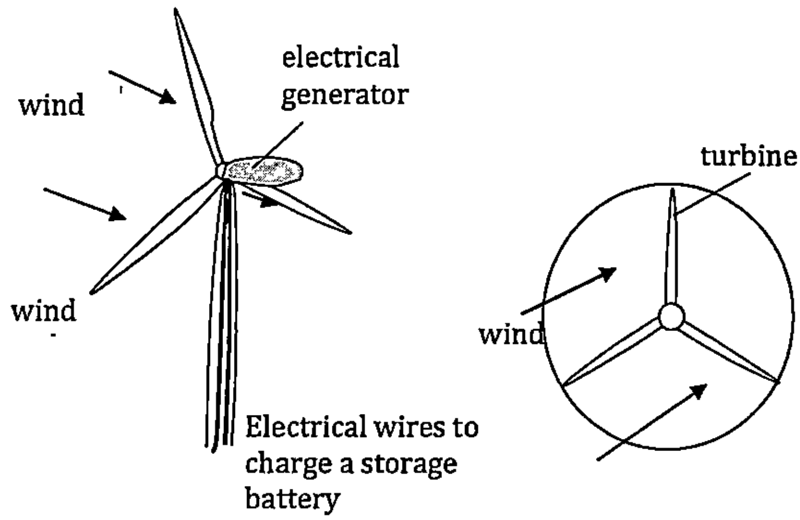
Section B (30 marks)

Answer all the Questions in this section. **Question 12** has a choice of parts to answer.

10	**Figure 10A** shows a wind turbine used to produce electricity. The turbine blades are turned by the wind and are connected to a d.c. electrical generator which then charges a battery.	
		
	Figure 10A **Figure 10B**	
	In one revolution the blades sweep out a circle as shown in **Figure 10B**. In 60 s, a mass of 54,000 kg of air traveling at a speed of 6.0 m/s is incident on that circle. 25% of this moving air hits the blades and leaves the turbine at a speed of 2.0 m/s. The rest of the moving air passes straight through the circle with the original speed of 6.0 m/s.	
(a)	Calculate	
(i)	the loss of kinetic energy of air in 60 s.	[2]
	Loss of KE= Initial KE – Final KE **Loss of k.e. =** $\frac{1}{2} \times 25\% \times 54{,}000 \times 6^2 - \frac{1}{2} \times 25\% \times 54{,}000 \times 2^2$ **[1]** $= 216{,}000$ J $= 2.2 \times 10^5$ J **[1]**	

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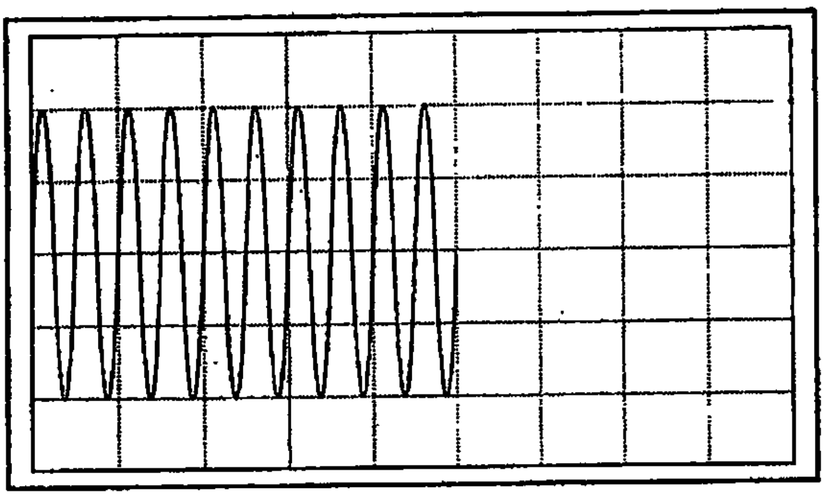
(ii)	the power of the turbine that is available to charge a storage battery.	[2]
	Power= Energy available / time = 216,000 J / 60 s [1] ecf for E=216000J[-1/2 mark] = 3600 W = 3.6×10^2 W [1]	
(b)	The storage battery is used to light up street lamps, each having a power of 240 W. Each street lamp is to be switched on 8 hours per day.	
(i)	Calculate the number of kWh used by each lamp.	[1]
	Energy used = P x t = (240/1000) kW x 8 h [1/2] = 1.96 kWh = 2.0 kWh [1/2]	
(ii)	Estimate the maximum number of street lamps that can be operated if the wind is available for 10 hours per day.	[2]
	Max. energy produced by turbine = p x t = (3600/1000) kW x 10 h ecf for available E=3600 W [-1/2 mark] = 36 kWh [1] Thus, max. number of lamps = 36 kWh / 1.96 kWh = 18.4 Ecf for energy used by each lamp= 2 kWh [-1/2 mark] The max. number of lamps to be operated is 18 [1]	
(c)	Explain briefly why more energy is produced per second if	
(i)	the wind blows faster,	[1]
	When the wind blows faster, the turbine will move faster at a **<u>higher velocity</u>**. There will be **<u>more k.e. per unit mass of air</u>** [1/2] available as **k.e. is related to square of speed as in ½mv^2.** In a generator, the **<u>higher rate of change of the magnetic flux linked to the coil induces a larger current</u>** [1/2] and therefore, more energy is produced.	
(ii)	the turbine blades are longer	[1]
	Longer blades: A longer blade enables more air to hit against it. The energy of the moving air can then be converted to the Kinetic energy of the moving blade. A **<u>great mass of moving air will impinge on the blades</u>**. [1/2] This also makes more k.e. available because **<u>k.e. is also related to mass [1/2]</u>** of moving air as in ½mv^2	
(iii)	the turbine is more efficient.	[1]
	Higher efficiency means that **<u>less energy is wasted in</u>**	

	overcoming friction[1/2] of the moving parts of the turbine. More energy will be converted to the useful form (which is electrical energy in this case).[1/2] [Alternative answer to (iii): Higher efficiency means that a **higher % of moving air is captured by the blades**. [1/2] This results in greater amount of energy being harnessed per unit time.[1/2]	
11	Ruth uses a mobile phone.	
(a)	She sets the ring tone of her mobile phone to produce a sound consisting of two notes, one after another. **Figure 11.1** shows the trace on a cathode-ray oscilloscope (CRO) screen produced by the first of the notes.	
		
	Figure 11.1	
	The second note is softer and has lower pitch. On **Figure 11.1**, continue the trace to show what happens when the second note is played.	[2]
	smaller amplitude [1] lower frequency (longer period) [1] minus 1 m if the drawing is not accurate e.g. amplitude or frequency is not uniform.	
(b)	Ruth wonders if the energy from the radio waves of her mobile may cause a significant temperature rise in her brain. To	

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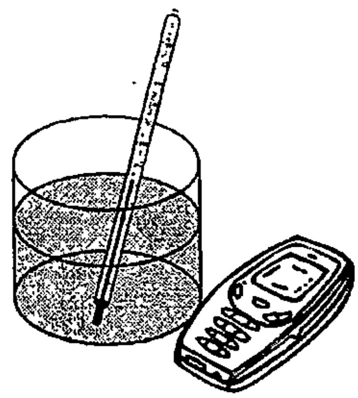
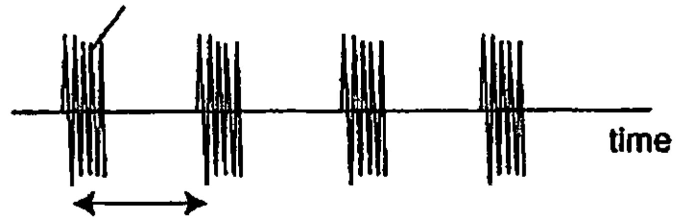
	investigate this effect, she calculates the heating effect of the mobile phone on a beaker of water placed next to it, as shown in **Figure 11.2**.	
		
	Figure 11.2	
	Figure 11.3 shows the relevant information about the mobile phone taken from the manual.	
	 **The mobile phone emits pulses of radio waves.** **Each pulse of waves has energy 1.6 × 10^{-4} J.** **The time between each pulse is 4.5 ms.**	
	Figure 11.3	
	The mobile phone is used for 5 minutes next to a beaker containing 40 g of water.	
(i)	Determine the number of pulses of radio waves produced during the mobile phone call.	[1]
	Number of pulses = $(5 \times 60) / 4.5 \times 10^{-3}$ [1/2] = 6.7×10^{4} [1/2[	
(ii)	Determine the total energy of the radio waves emitted during the	[1]

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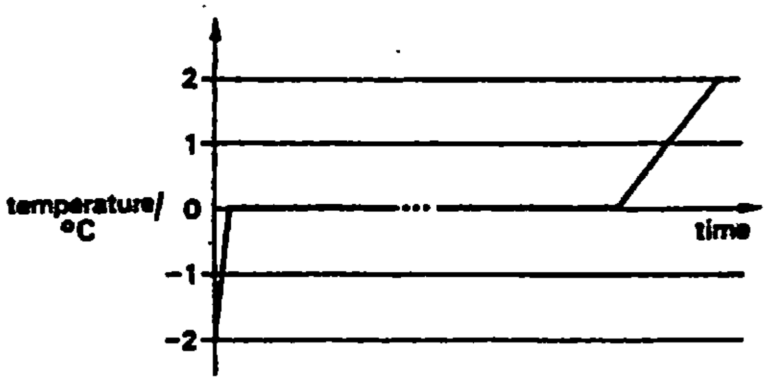
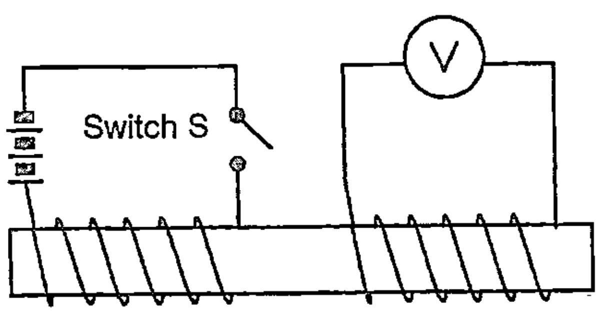
	mobile phone call.	
	Total energy = $(1.6 \times 10^{-4}) \times (6.7 \times 10^{4})$ [1/2] ecf no of pulses=6.7*10⁴ [-1/2 mark] = 10.7 J [1/2]	
(iii)	Determine the maximum temperature rise produced in 40 g of water if all the energy calculated in **(b)(ii)** is absorbed by the water. (The specific heat capacity of water is 4.2 J/gK).	[1]
	$Q = mc\theta$ $\theta = Q / mc = 10.7 / (40 \times 4.2)$ [1] ecf for Q= 10.7 J [-1/2 mark] = 0.064 °C [1]	
(iv)	Why do motorists choose to use water as the liquid in the car radiator?	[1]
	Water has a high specific heat capacity.	
(v)	Define the specific latent heat of fusion of a substance.	[1]
	The specific latent heat of a substance is the amount of thermal energy required to change unit mass of the substance from solid state to liquid state, [1/2] without a change in temperature.[1/2]	
(c)	A small quantity of crushed ice was allowed to warm up from a temperature of -2°C. The graph in the figure below shows how the temperature of the ice varied with time.	
		
(i)	Explain why, after an initial rise to 0°C, the temperature of the body remained constant.	[2]
	Ice melts at 0°C. The energy supplied to the ice is used to **overcome the attractive intermolecular forces[1/2]** between the molecules. The **potential energy of the molecules increases** [1/2]but the **average kinetic energy of the molecules remains the same**. [1/2] Since the **average KE does not increase**, the temperature of the substance does not increase. [1/2] The energy supplied is the	

	latent heat of fusion. When all the solid ice has melted into a liquid, the temperature will then start rising.	
(ii)	Suggest why the slope of the graph between -2°C and 0°C is greater than that between 0°C and +2"C.	[1]
	<u>Specific heat capacity of ice is less</u> than that of water. Thus, the rate of rise in temperature is greater for ice.	
12	Answer only **one** of the following choice questions.	
	EITHER	
12 (a)	**Figure 12** shows two insulated copper coils, P and Q mounted close together on a wooden rod. Coil P is connected to switch S and a battery. Coil Q is connected to a sensitive voltmeter V.	
		
	Figure 12	
	When the switch S is closed a deflection is seen on the meter. This deflection lasts for a very short time.	
(i)	Does the current flow through the meter from left to right or from right to left? Justify your answer.	[2]
	The current flow through the meter from <u>left to right</u>. [1/2]According to **Lenz's Law of electromagnetic induction states that the <u>direction of induced current is always such hat its magnetic effect always oppose the change producing it</u>. [1/2]** Since the **<u>current flows from the positive terminal and back to negative terminal of battery in coil P</u>**,[1/2] the **<u>induced current flows in coil Q in the opposite direction</u> [1/2]**to oppose the increase in the magnetic flux linkage in coil P.	

(ii)	Give two ways in which the efficiency of a transformer can be improved.	[1]
	Any two – ½ mark each (a) Use low-resistance copper wires for the coil to avoid losing energy in the form of thermal energy (b) Use a laminated core to reduce eddy currents (c) Use a soft magnetic material for the core to reduce energy losses when the magnetic field changes direction (d) Use a special core design to ensure minimal leakage of magnetic field lines	
(iii)	In a step-down transformer, why is the primary coil made of thin wire and the secondary coil made of thick wire?	[1]
	The **current flowing in the secondary coil is higher** than that flowing in the primary coil, thus the secondary coil has to be made of thicker wire.	
(iii)	Define Faraday's Law of Electromagnetic Induction.	[1]
	Faraday's Law of Electromagnetic Induction states that the magnitude of the induced emf [1/2] in a circuit is directly proportional to the rate of change of magnetic flux in the circuit.[1/2]	
(b)	The figure below shows a stool. A horizontal force F keeps the stool balanced. C is the centre of gravity of the stool and the weight of the stool is 40 N.	

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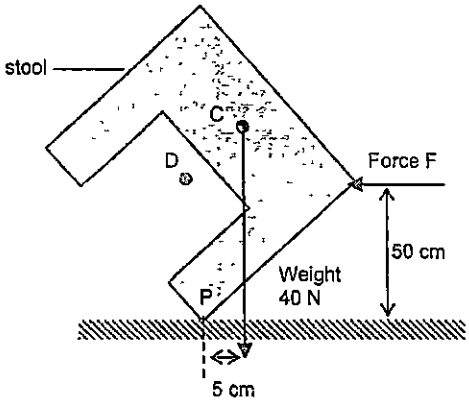
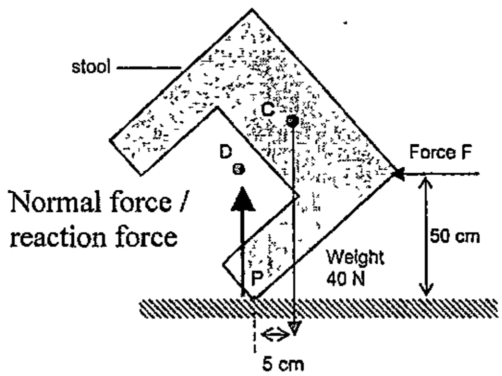


(i)	On the figure above, draw and label an arrow to show the vertical force that acts on the stool.	[1]



(ii)	Explain why a stool is more stable with a centre of gravity at D rather than at C.	[2]
	If the stool has **lower centre of gravity at D** , it can be **tilted at a greater angle [1/2] before the line of action of weight lies outside its base area /pivot point [1] and topple** as compared **to a higher centre of gravity at C,** so the stool will be more stable when the centre of gravity is at D.[1/2]	
(iii)	What are the two ways in which you can make a double-decker bus stable?	[1]
	1. Make the centre of gravity lower. 2. Make the base larger.	

(iv)	Define the centre of gravity of an object.	[1]
	The centre of gravity of an object is defined as the point through which its <u>whole weight appears to act</u>, for any orientation of the object.	
	OR	
12 (a)	Jonah poured 250 g of hot tea into a container. He placed a temperature sensor into the tea and started measuring the temperature with respect to time. After a while, he added some ice cubes into the tea.	
	The figure below shows the temperature-time graph obtained.	

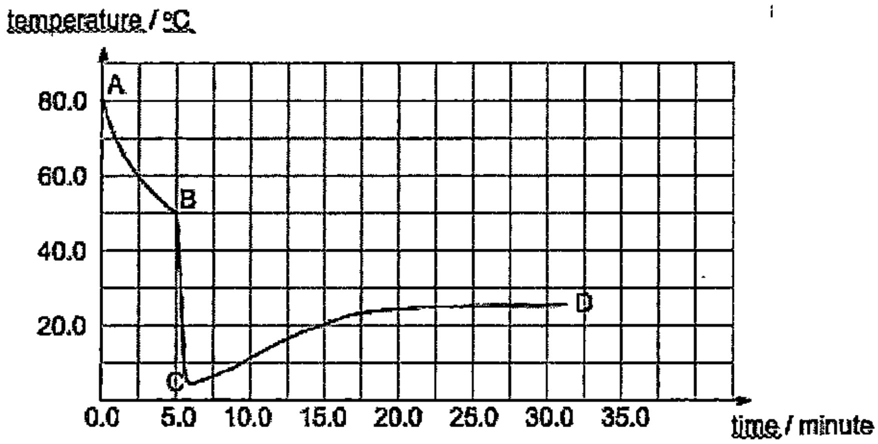


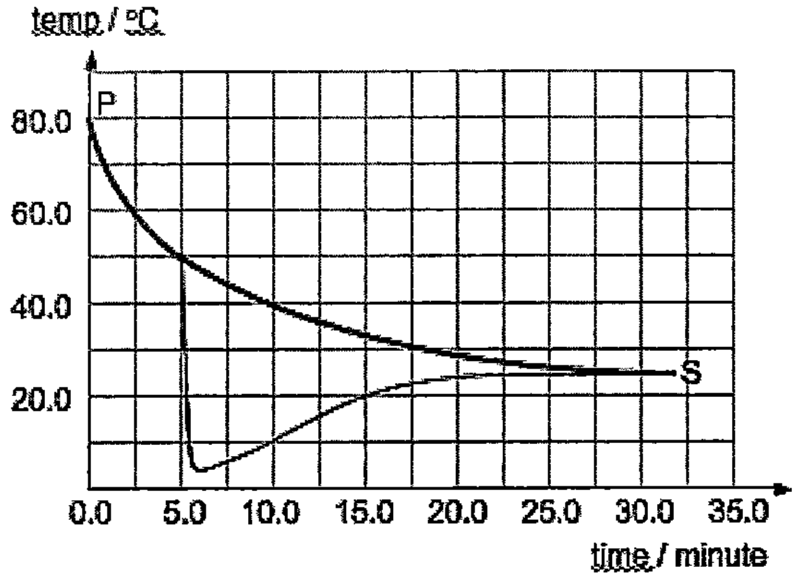
Figure 12.1

	The following information is provided : *specific latent heat of fusion of ice* = 3.36×10^5 J kg^{-1} *specific latent heat of vaporisation of water* or *tea* = 2.26×10^6 J kg^{-1} *specific heat capacity of ice* = 2.10×10^3 J kg^{-1} °C^{-1} *specific heat capacity of water* or *tea* = 4.20×10^3 J kg^{-1} °C^{-1}	
	Assume there is no loss of thermal energy to the surrounding and the temperature of the ice cubes before being added into the hot tea is 0 °C.	
(a)	At what time did Jonah add the ice cubes into the tea? Explain your answer.	[2]
	The ice cubes were added at **<u>5.0 minutes</u>**. [1] This is because there is a **<u>sudden drop in temperature</u>** from 5.0 minutes onwards. [1]	

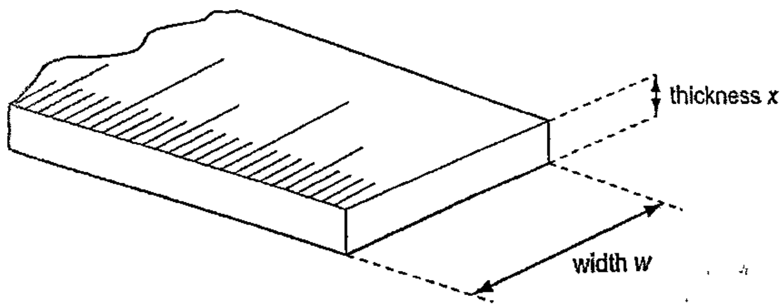
For Examiner's Use

(b)	Calculate the loss of thermal energy in the hot tea from B to C.	[2]
	Loss in thermal energy $= mc\theta$ $= 0.25 \times 4200 \times (50.0 - 5.0)$ [1] $= 47{,}250$ J = **47,300 J** (or 47,000 J) [1]	
(c)	Calculate the total mass of the ice cubes added into the hot tea.	[2]
	Heat loss from tea = heat gained by ice cubes $47{,}250 = (m \times 3.36 \times 10^5) + (m \times 4200 \times 5.0)$ [1] ecf for heat loss = 47250 J [-1/2 mark] $= 336{,}000\ m + 21{,}000\ m$ $m = 47{,}250 / 357{,}000$ [1/2] = **0.132 kg** (or 132 g) [1/2]	
(d)	Explain why the temperature of the tea increases from C to D.	[2]
	Since there is a **temperature difference** [1] between the tea and the surrounding, **thermal energy is transferred from the surrounding to the tea,**[1] hence the temperature increase.	
(e)	Estimate the temperature of the surrounding.	[1]
	25.0 °C (or 25 °C)	
(f)	In another experiment, Jonah placed 250 g of hot tea in the same empty container. When the temperature of the hot tea was 80 °C, he started the stopwatch. He continued to measure the temperature of the tea without adding any ice cubes.	
	Draw the temperature-time graph for the second experiment on the same graph in Figure 12.1	[1]
	- **No mark** if graph never reach 25°C	

For Examiner's Use



1 In an experiment, the width *w* and the thickness *x* of a metre rule are to be measured as precisely as possible using regular laboratory apparatus.



Which combination of instruments is most appropriate for these measurements?

	measurement of *w*	measurement of *x*
A	half-metre rule	half-metre rule
B	half-metre rule	vernier caliper
C	vernier caliper	half-metre rule
D	vernier caliper	vernier caliper

2 Diagram 2.1 shows a measuring cylinder containing water.

Five identical steel balls are now lowered into the measuring cylinder.

Diagram 2.2 shows the new water level in the cylinder.

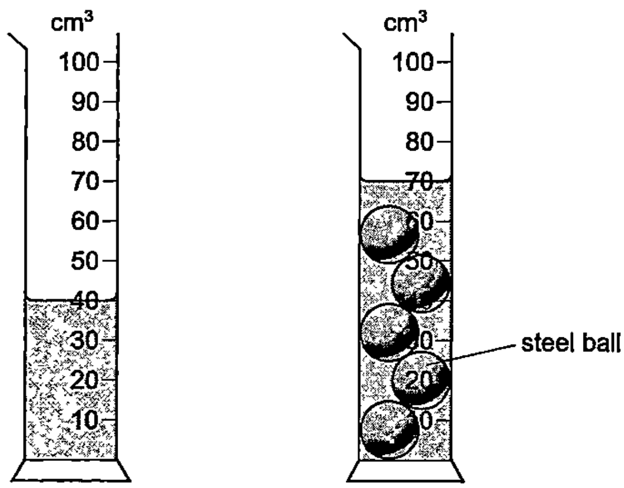
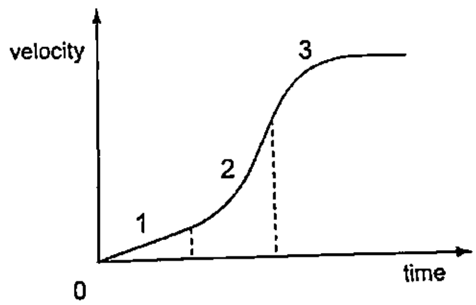


diagram **2.1** diagram **2.2**

What is the volume of each steel ball?

A 6 cm^3 **B** 14 cm^3 **C** 30 cm^3 **D** 70 cm^3

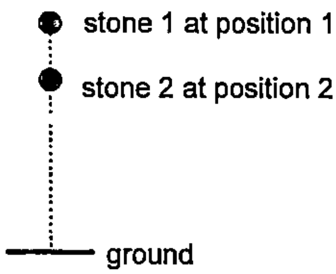
3 The graph shows how the velocity of a racing car changes with time.



Which statement describes the acceleration of the racing car for sections 1, 2 and 3?

	section		
	1	2	3
A	constant and positive	increases positively	negative
B	increases positively	increases positively	decreases to zero
C	positive	increases positively	decreases to zero
D	starts from zero	increases positively	decreases to zero

4 Two identical stones are dropped simultaneously from different heights.
Air resistance is negligible.



As the stones fall, how will the distance between them vary?

A decrease until they touch
B increase continuously
C increase initially then remain constant
D remain constant

5 To avoid an accident, the brakes of a car travelling at 30 m/s were applied suddenly.

If the driver has a mass of 80 kg and it takes 3.0 s for the car to decelerate to rest, what is the average force exerted by the safety belt on the driver during deceleration.

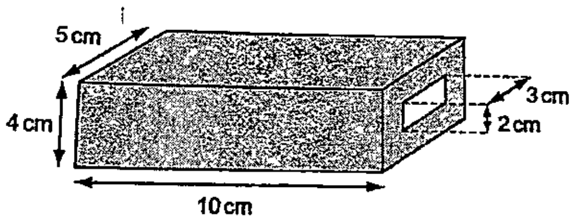
A 240 N
B 400 N
C 500 N
D 800 N

6 While on the moon, an astronaut gives a horizontal push to a 20 kg object, which is hanging freely.

What would be the difference in effort needed on the moon compared with the effort needed on Earth?

A It is easier to push the object on the moon than on Earth.
B It is more difficult to push the object on the moon than on Earth.
C It requires no effort to push the object on the moon.
D It requires the same effort to push the object both on the moon and on Earth.

7 A hollow rectangular metal block has the dimensions shown.



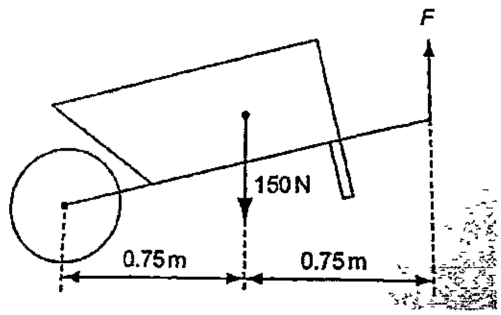
The hole in the middle goes all the way through the block.

The density of the metal is 10 g/cm^3.

What is the mass of the block?

A 14 g
B 400 g
C 1400 g
D 2000 g

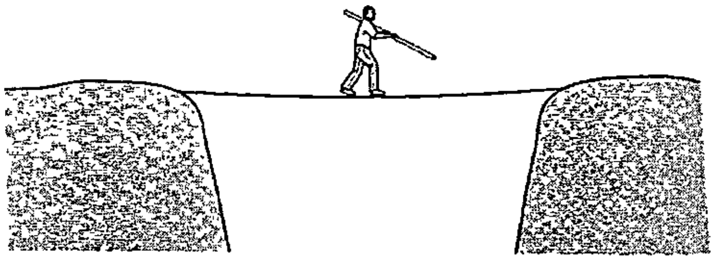
8 The diagram shows a wheelbarrow and its load, which have a total weight of 150 N. This is supported by a vertical force F at the ends of the handles.



What is the value of F?

A 75 N **B** 150 N **C** 225 N **D** 300 N

9 A man walks along a tight rope, carrying a long pole.



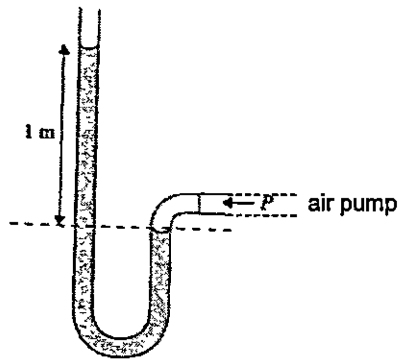
Why does he carry the pole?

A to keep his centre of gravity over the rope.
B to raise his centre of gravity
C to reduce his pressure on the rope
D to spread out his weight

10 Which of the following locations experiences the highest atmospheric pressure?

A At sea level.
B In a coal mine 100 m below sea level.
C Inside a skyscraper.
D On top of Mount Everest.

11 A manometer is connected to an air pump as shown.



The manometer is filled with water of density 1 000 kg/m^3 and the atmospheric pressure is 100 000 Pa.

What is the air pressure P exerted by the air pump? (g=10 N/kg)

A 100 00 Pa
B 110 000 Pa
C 200 000 Pa
D 210 000 Pa

12 Which energy resource is used to boil water to generate electricity?

A hydroelectric
B nuclear
C tides
D waves

13 A person exerts a horizontal force of 600 N on a box that also experiences a frictional force of 200 N.

If it takes 4.0 s to move the box 3.0 m, what is the average useful power?

A 150 W
B 300 W
C 450 W
D 600 W

14 Illuminated smoke particles, suspended in air, are viewed with a microscope. They are seen to move randomly.

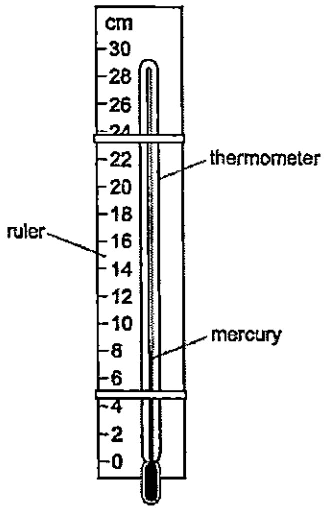
Which of the following best explains the motion of the smoke particles?

A bombarded continually and randomly by air molecules
B moved about by convection currents
C shaken by the vibration of the molecules within them
D supplied with energy by the light illuminating them

15 What is a property of both liquid and gases?

A They always fill their containers.
B They are incompressible.
C They can flow.
D They have molecules in fixed positions.

16 A mercury thermometer with no scale is taped to a ruler as shown.



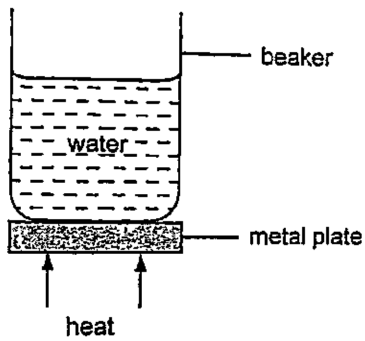
When the thermometer is placed in steam, the mercury level rises to 22.0 cm.

When the thermometer is placed in pure melting ice, the mercury level falls to 2.0 cm.

Which temperature is shown by the mercury level in the diagram?

A 6 °C **B** 8 °C **C** 30 °C **D** 40 °C

17 Four beakers containing the same amount of water at the same temperature are placed on hot metal plates.



The lower surfaces of the metal plates are kept at the same temperature. The plates are all the same size but are made from four different metals, **A**, **B**, **C** and **D**. The times taken to produce stated temperature rises of the water are given below.

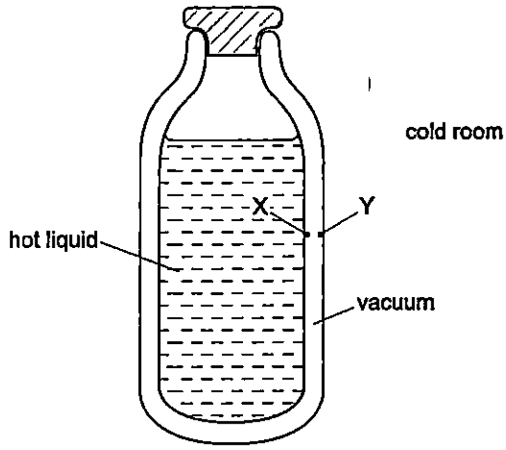
Which metal is the poorest conductor?

plate	temperature rise / °C	time / s
A	11	100
B	13	100
C	17	200
D	19	200

18 Which line in the table is correct about conduction and convection?

	conduction	convection
A	can happen in a solid	can happen in a solid
B	can happen in a solid	only happens in fluids
C	only happens in fluids	can happen in a solid
D	only happens in fluids	only happens in fluids

19 The diagram shows the cross-section of a vacuum flask containing a hot liquid in a cold room.



X and Y are points on the inside surfaces of the walls of the flask.

How is thermal energy transferred between X and Y?

A by conduction and convection
B by conduction only
C by radiation and convection
D by radiation only

20 Four objects of the same mass but different material are placed near each other. The specific heat capacities are indicated in table 20.1.

description	specific heat capacity (J/kg/°C)
bone	440
gold	129
marble	880
wood	1700

table 20.1

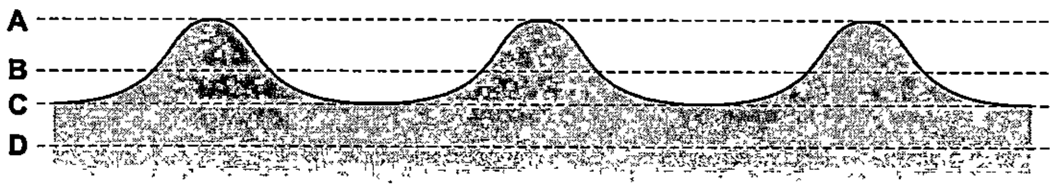
The same quantity of thermal energy is given to each object.

Which object shows the greatest rise in temperature?

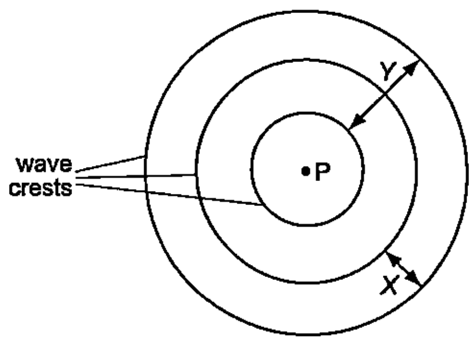
A bone
B gold
C marble
D wood

21 The diagram shows a section through a series of waves on water.

Which dotted line shows the position of the still water surface after the waves have passed?



22 A vertical stick is dipped up and down in water at P.

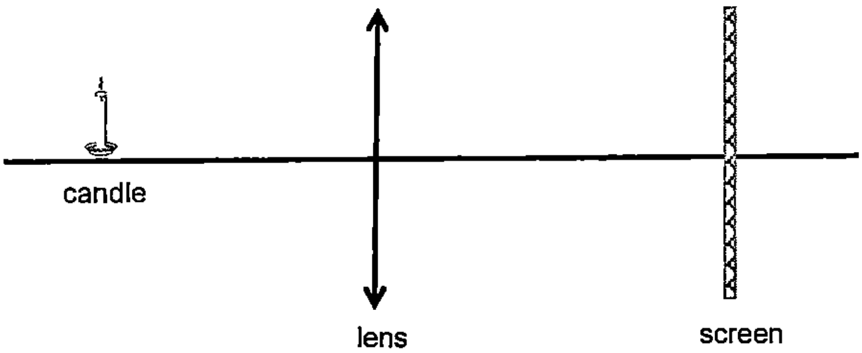


In two seconds, three wave crests are produced on the surface of the water.

Which statement is correct?

A Distance X is the amplitude of the waves.
B Distance Y is the wavelength of the waves.
C Each circle represents a wavefront.
D The frequency of the waves is 3 Hz.

23 A thin converging lens is used to produce, on a screen, a focused image of a candle.

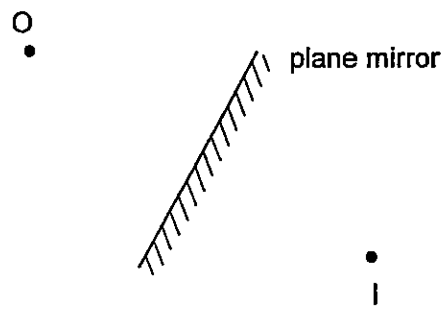


Various focused images are produced on the screen by moving the lens and the screen backwards and forwards.

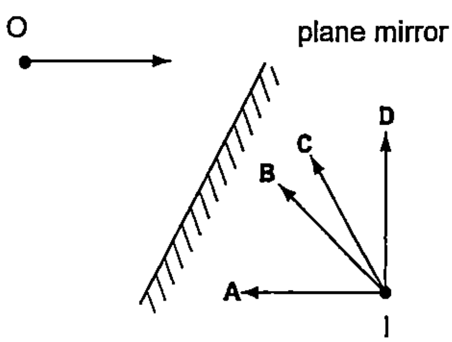
Which statement about the image is always correct?

A The image is at the principal focus (focal point) of the lens.
B The image is bigger than the object.
C The image is closer to the lens than the object is.
D The image is inverted.

24 An object placed in front of a plane mirror at O produces an image at I.



If the object moves towards the mirror in the direction shown by the arrow, in which direction does the image move?

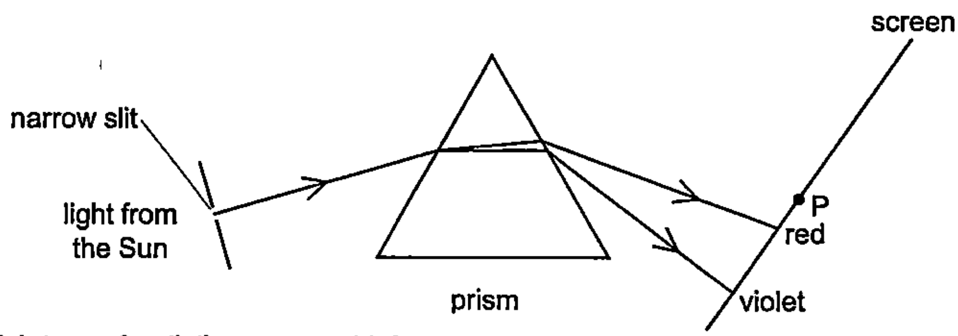


25 Which statement about ultraviolet waves is correct?

- **A** They are used in television remote controllers.
- **B** They can be detected by the human eye.
- **C** They travel as longitudinal waves.
- **D** They have the same speed in a vacuum as radio waves.

26 Light from the Sun passes through a prism and a spectrum is produced on a screen.

A thermometer placed at P shows a large temperature rise.



Which type of radiation causes this?

- **A** infra-red
- **B** microwave
- **C** ultra-violet
- **D** visible light

27 A sound is played on a flute. A sound of the same pitch is played on a trumpet.

Which of the following correctly compares the two sound waves?

	frequency	speed
A	different	different
B	different	same
C	same	different
D	same	same

28 A polythene rod repels an inflated balloon hanging from a nylon thread.

Why do the rod and balloon repel?

- **A** The rod and the balloon have opposite charges.
- **B** The rod and the balloon have like charges.
- **C** The rod is charged but the balloon is not.
- **D** The balloon is charged but the rod is not.

29 Three objects X, Y and Z are metal spheres, each on an insulated stand.

Objects X and Y experience a force of attraction. Objects X and Z experience a force of attraction

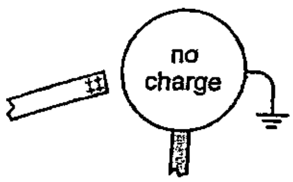
Which set of charges CANNOT be correct?

	charge on X	charge on Y	charge on Z
A	positive	negative	negative
B	positive	negative	positive
C	uncharged	positive	negative
D	uncharged	positive	positive

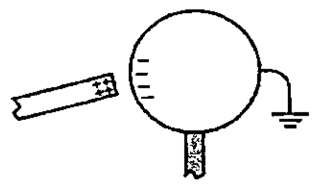
30 A charged rod is held close to one side of a metal ball and the other side is earthed.

Which diagram shows the final charge distribution?

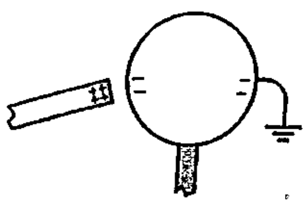
A



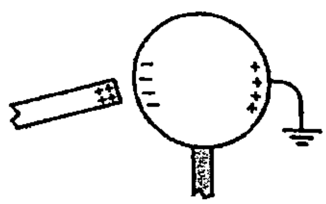
B



C



D

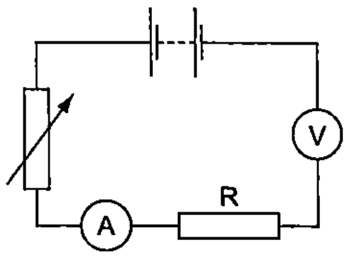


31 Which copper wire would have the smallest electrical resistance?

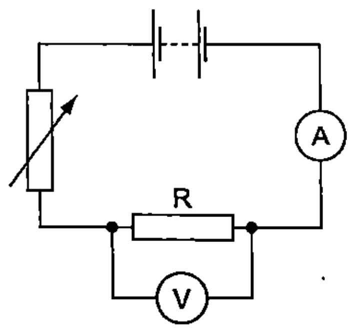
A a long, thick wire
B a long, thin wire
C a short, thick wire
D a short, thin wire

32 Which circuit could be used to determine the resistance of the resistor R?

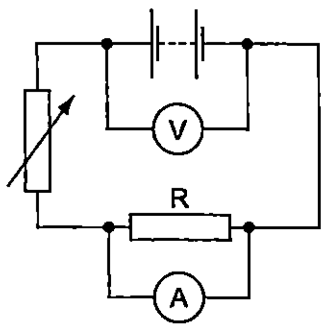
A



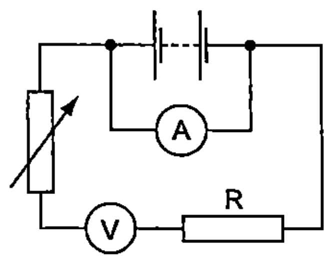
B



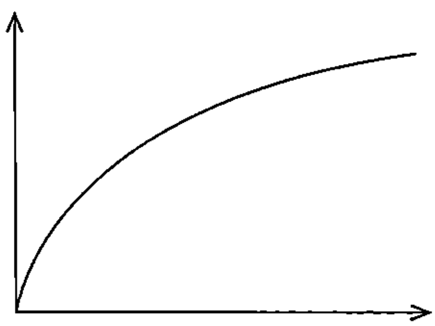
C



D



33 The graph shows how the current through a lamp filament varies with the potential difference across it.



Which statement explains the shape of this graph?

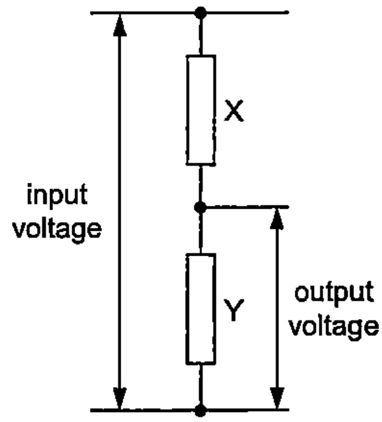
A As the filament temperature rises, electrons can pass more easily through the filament.

B It takes time for the filament to reach its working temperature.

C The power output of the filament is proportional to the square of the current through it.

D The resistance of the filament increases with a rise in temperature.

34 An engineer uses the potential divider shown in the diagram.



He needs the output voltage to be one tenth (1/10) of the input voltage.

Which pair of values could he use for the two resistors X and Y?

	X / kΩ	Y / kΩ
A	1.0	9.0
B	1.0	10.0
C	9.0	1.0
D	10.0	1.0

35 The cost of electrical energy is $ 0.22 per kWh.

What is the cost of using a 1800 W kettle for the total of 30 min?

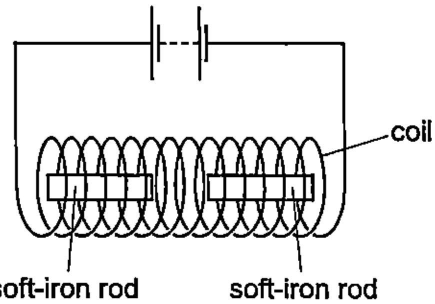
A $ 0.12 **B** $ 0.20 **C** $ 0.22 **D** $ 22

36 A mains electrical circuit uses insulated copper cable and the cable overheats.

To prevent the cable from overheating, how should the cable be changed, and why?

A Use thicker copper cable which has less resistance.
B Use thicker insulation to reduce conduction.
C Use thinner copper cable which has more resistance.
D Use thinner insulation to reduce conduction.

37 Two soft-iron rods are placed end to end inside a coil which is connected to a battery.

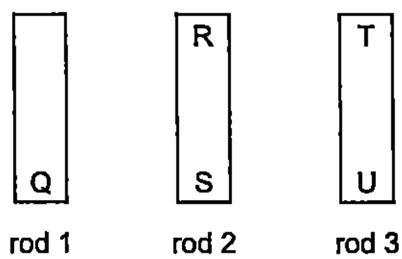


The connections from the battery to the coil are now reversed.

What happens to the soft-iron rods in each case?

	battery connections as shown	battery connections reversed
A	rods attract	rods attract
B	rods attract	rods repel
C	rods repel	rods attract
D	rods repel	rods repel

38 The ends of three metal rods are tested by holding end Q of rod 1 close to the others in turn.



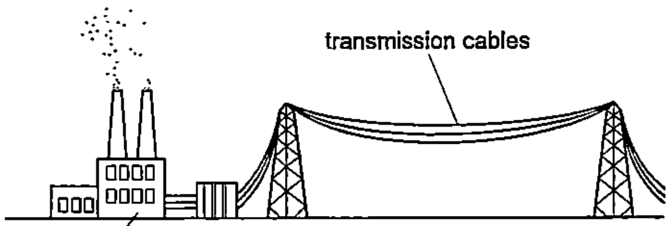
The results are as follows.

End Q: attracts end R, attracts end S, attracts end T, repels end U.

Which of the metal rods is a magnet?

A rod 1 only
B rod 1 and rod 2
C rod 1 and rod 3
D rod 3 only

39 The diagram shows cables used in the transmission of electrical energy.

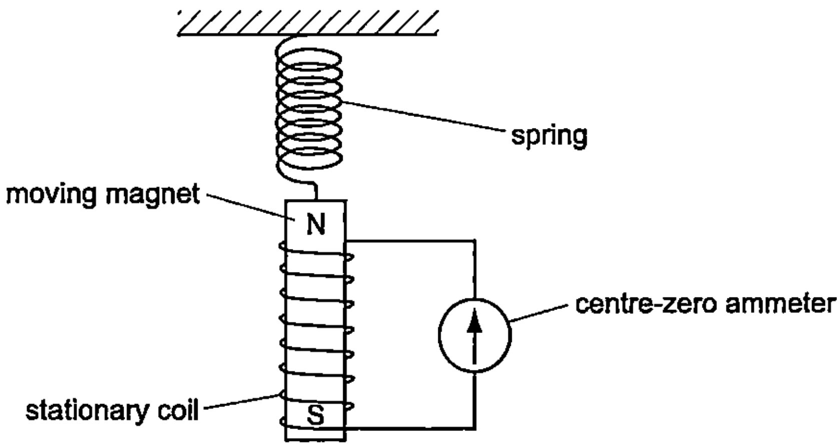


High voltages are used for the transmission.

Why are high voltages used for the transmission of electrical energy?

- **A** Fear of high voltages stops people from interfering with the cables.
- **B** Heat loss in the cables is smaller than if low voltages are used
- **C** High voltages increase the current in the cables.
- **D** High voltages produce large magnetic fields, so less insulation is needed.

40 A magnet is suspended from a spring so that it can move freely inside a coil. The coil is connected to a sensitive centre-zero ammeter.



How does the ammeter needle behave when the magnet repeatedly moves slowly up and down?

- **A** The needle remains at the zero reading.
- **B** The needle swings from left to right and right to left.
- **C** The needle swings to the left and remains stationary.
- **D** The needle swings to the right and remains stationary.

End of Paper

Section A [50 marks]

Answer **all** the questions in this section in the spaces provided.

1 **(a)** Fig 1.1 shows an airplane cruising in air at a constant velocity.

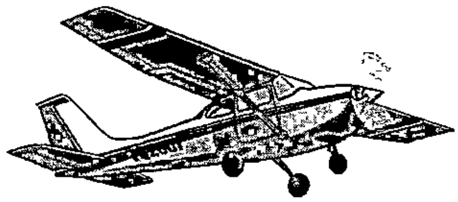


Fig 1.1

When the airplane is moving, there is resistive force from the air acting on the airplane.

(i) Explain why the forward force acting on the airplane must be greater than the resistive force for the airplane to accelerate.

....

....[1]

(ii) The resistive force is 2 000 N and the mass of the airplane is 20 000 kg. The airplane accelerates at 5.0 m/s^2.

Calculate the minimum forward force that the airplane requires to accelerate.

minimum force =............................

[2]

(b) Fig 1.2 shows the top view of the airplane at cruising height, making an angle 45° with North.

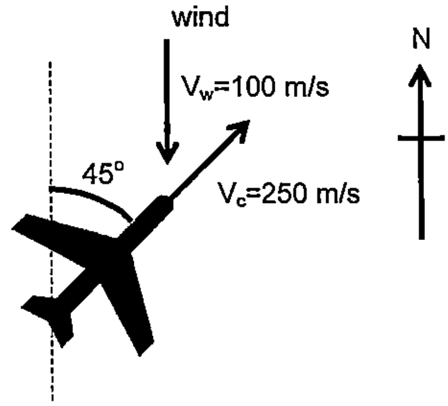


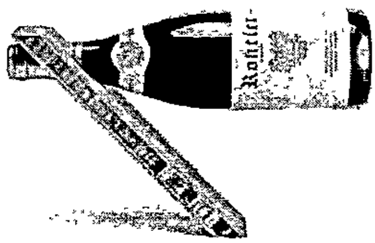
Fig 1.2

The cruising velocity, v_c of the airplane is 250 m/s. The airplane encounters a strong wind blowing due South at v_w = 100 m/s.

In the space below, determine graphically, the size of the resultant velocity of the airplane and the angle between the resultant velocity and the direction North. Include the scale that you used in the answer.

[4]

2 Fig 2.1 shows a wine bottle holder supporting a full wine bottle (without trapped air) in mid air.



wine bottle holder

Fig 2.1

(a) Fig 2.2 shows a side view of the wine bottle holder.

Indicate the position of centre of gravity, CG of the setup and indicate in Fig 2.2 with **X**.

[1]

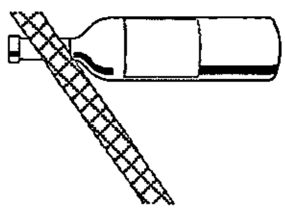


Fig 2.2

(b) Hence, explain how the wine bottle holder is able to support the wine bottle in this position without toppling.

....

....

....[2]

(c) The bottle, completely empty of wine is placed on the wine bottle holder again. The empty bottle topples.

Suggest a reason for this, in terms of the position of the CG.

....

....

....[2]

3 Fig 3.1 shows a bicycle wheel being inflated with air by a bicycle pump.

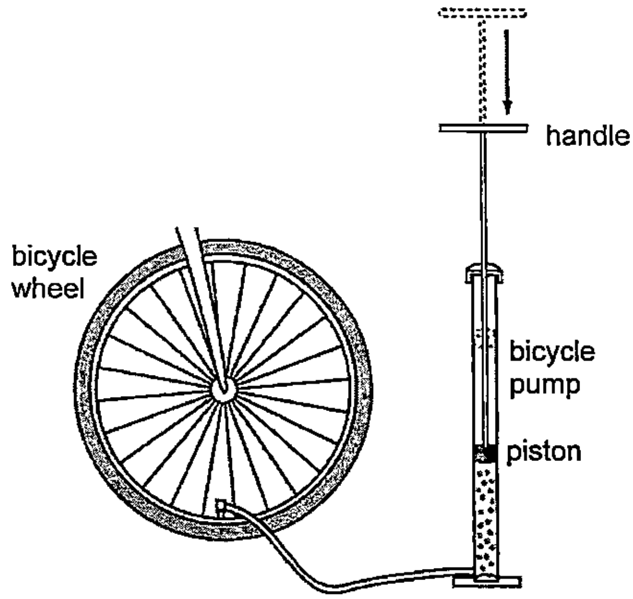


Fig 3.1

(a) **(i)** State the definition of pressure.

....[1]

(ii) The air pressure in the tyre is now 300 kPa. The cross sectional area of the piston is 1.26×10^{-3} m.

Calculate the force exerted on the piston by the air in the tyre.

Force =................................[2]

(b) As the air pressure in the tyre increases, the temperature of the air in the tyre rises.

Using the kinetic model of gases, explain why this happens.

....

....

....

....

....[3]

4 A copper rod and a plastic rod each pass through holes in rubber bungs, so that their ends are inside a tank, as shown in Fig 4.1

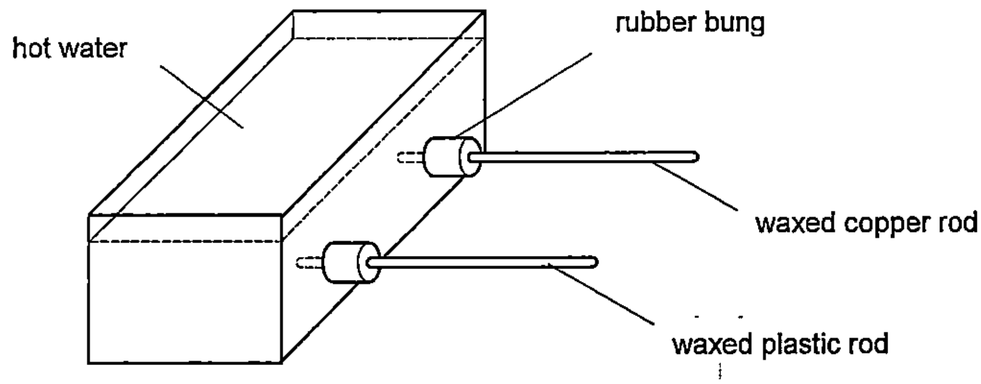


Fig 4.1

Both rods are covered with wax.

Very hot water is poured into the tank, covering the end of each rod.

(a) Suggest what will be observed on each rod after a prolonged period of time.

....

....

.... [2]

(b) Explain how thermal energy is transferred across the copper rod in terms of molecular motion.

....

....

.... [2]

5 Fig 5.1 shows a ray of light PQRS as it enters and leaves a semi-circular glass block.

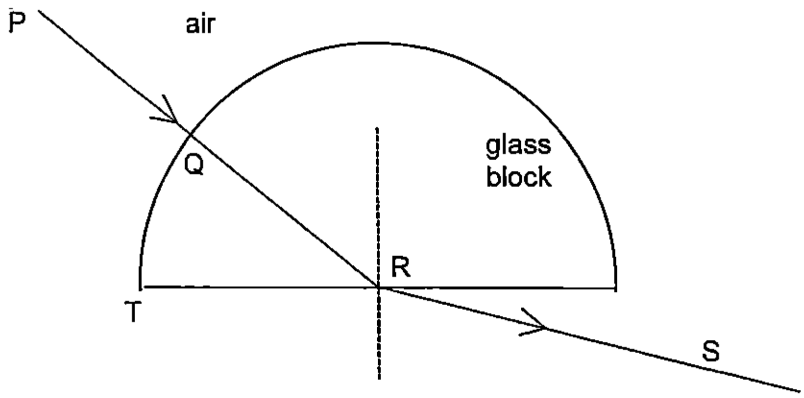


Fig 5.1

The refractive index of glass is 1.5.

(a) Explain why there is no change in the direction of the ray as it enters the block at Q

....

.... [1]

(b) **(i)** State the relationship of the refractive index of a medium with reference to the speed of light.

[1]

(ii) Calculate the speed of the light ray QR in the glass block.

speed of light = ...[2]

(c) The incident light ray PQ is rotated anti-clockwise about R (i.e. R is at the centre of rotation), towards T.

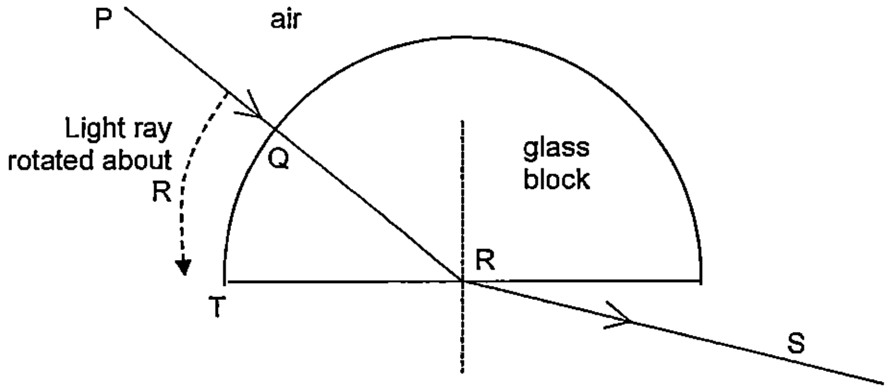


Fig 5.2

Describe what happens to light ray RS as light ray PQ is rotated.

....

.... [2]

6 The setup of an experiment shown in Fig 6.1 was carried out to measure the speed of sound.

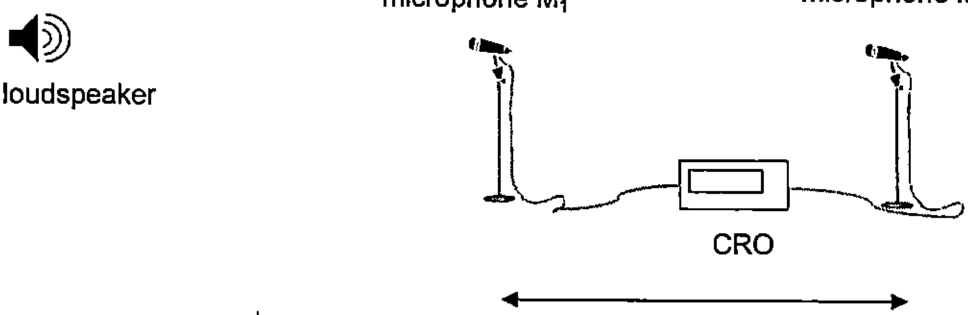


Fig. 6.1

Two microphones M_1 and M_2 are placed 2.0 m apart and are connected to a Cathode Ray Oscilloscope (CRO). The CRO is used to measure the time taken for sound to travel between M_1 and M_2.

(a) Suggest a reason why the CRO is used to measure the time taken for sound to travel between M_1 and M_2 instead of a student using a stopwatch.

....[1]

(b) The loudspeaker produces a loud bang and the time taken recorded by the CRO is 5.9 ms.

Calculate the speed of sound in air.

speed of sound in air = ...[2]

(c) Suggest a modification to the experimental set-up to improve the accuracy of the time for sound to travel between M_1 and M_2.

....

....[1]

7 **(a)** A piece of plastic is held in the hand and rubbed with a cloth. Both the plastic and the cloth become charged.

(i) Describe how the plastic becomes negatively-charged and the cloth becomes positively-charged.

....

....

....

.... [2]

(ii) Suggest why a piece of metal held in the hand does not become charged when it is rubbed with the cloth.

....

....

.... [2]

(b) Fig 7.1 shows a positively charged rod placed near to two conducting spheres mounted on insulating stands. The spheres are in contact with each other.

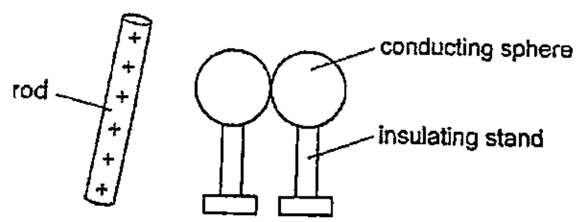


Fig 7.1

The spheres are separated and the charged rod is then removed.

In Fig 7.2, draw the charges on the spheres, after the charged rod is removed.

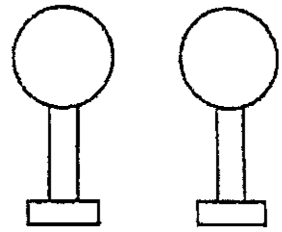


Fig 7.2

[2]

8 A student connects the circuit shown in Fig. 8.1.

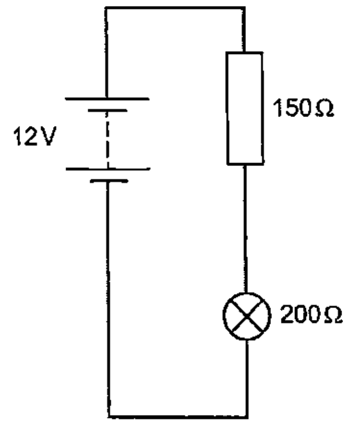


Fig 8.1

(a) Calculate the current in the circuit.

current =................................[2]

(b) Calculate the potential difference (p.d.) across the lamp.

potential difference = ...[1]

(c) Using appropriate circuit symbols, draw on Fig. 8.1 to suggest how the circuit may be modified with additional electrical component so that the brightness of the lamp can be controlled.

[1]

(d) The circuit is re-arranged as shown in Fig. 8.2.

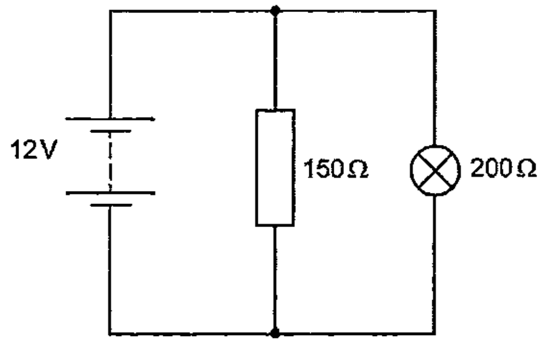


Fig 8.2

Explain how the brightness of the lamp in Fig. 8.2 compares with the lamp in Fig. 8.1.

....

.... [2]

9 Fig 9.1 shows a solenoid carrying a current.

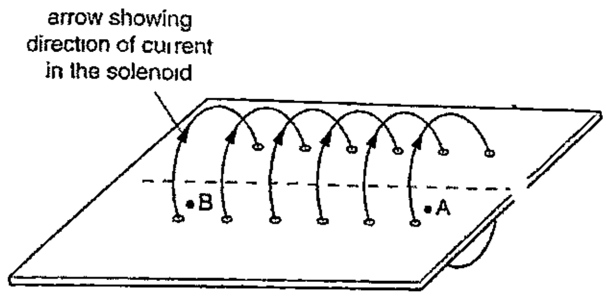


Fig 9.1

The current in the solenoid creates a magnetic field.

(a) A magnetic field line passes through A and B. Fig 9.2 shows the top view of the solenoid.

Draw the magnetic field lines created by the solenoid and the polarities of the solenoid in Fig 9.2.

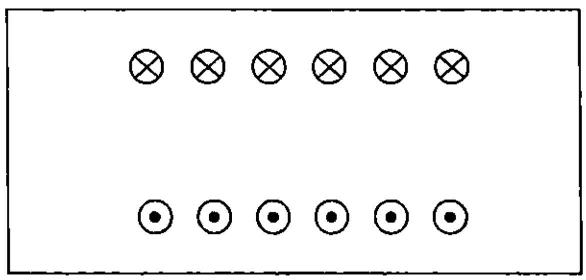


Fig 9.2

[2]

(b) **(i)** The current in the solenoid is reversed.

State the effect this has on the strength and direction of the magnetic field lines.

....

....[2]

(ii) State how the pattern of the magnetic field lines inside the solenoid changes when the current through the solenoid increases.

....

....[2]

Section A [50 marks]

Answer **all** the questions in this section in the spaces provided.

Class	Index Number

Name: ____________________

Section B (30 marks)

Answer **all** the questions in this section.

Answer only one of the two alternative questions in **Question 12.**

10 Fig. 10.1 shows the lens of a simple camera being used to photograph an object.

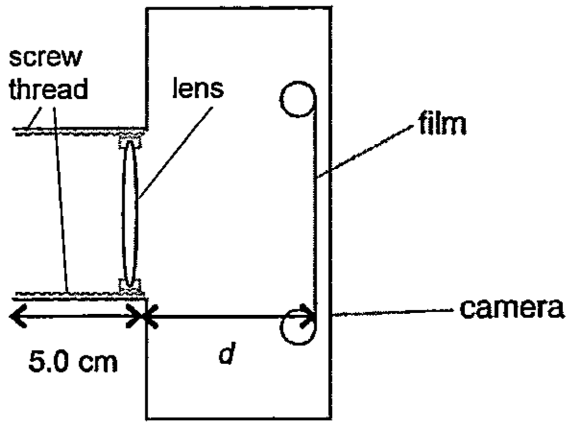


Fig. 10.1

(a) **(i)** The object in Fig. 10.1 is very far away from the camera. The lens is then adjusted to distance *d* from the film so that the sharpest image is produced.

State what distance *d* represents of a lens.

.... [1]

(ii) State the characteristics of the image formed.

.... [1]

(b) The lens used in the camera may also be used to produce a virtual image of an object.

State where the object is placed, relative to the lens, for a virtual image to be formed.

.... [1]

(c) Fig. 10.2 shows the lens forming a focused image of the object on the film when the object distance, u, is changed.

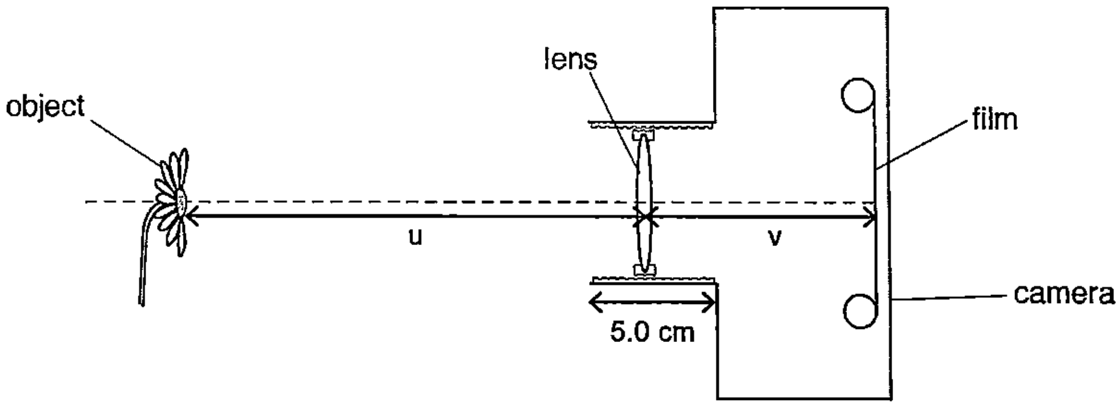


Fig. 10.2

Fig. 10.3 shows the information gathered based on different object distances, u.

Data Set	**Object distance, u / cm**	**Image distance, v / cm**	**Object height, h_o / cm**	**Image height, h_i / cm**
1	300.0	10.3	20.0	0.7
2	200.0	10.5	20.0	1.1
3	100.0	11.1	20.0	2.2
4	50.0	12.5	20.0	5.0
5	25.0	16.7	20.0	13.3

Fig. 10.3

(i) 1. Based on the data set **4** from Fig. 10.2, use the grid below to draw a scaled ray diagram of the set-up.

2. Determine the focal length of the converging lens used.

.... [1]

(ii) Explain why the rays of light change direction as they enter the lens.

....

.... [1]

(iii) Using Fig. 10.3, determine which data set shows the situation when the camera is unable to focus a sharp image on the film.

.... [1]

(iv) Explain your answer in **(c)(iii)**.

.... [1]

(v) Describe what would happen to the image formed for Data Set 1 if the lower half of the converging lens is chipped off.

.... [1]

11 **(a)** Fig. 11.1 shows a setup with an electric current I passing through wire XY.

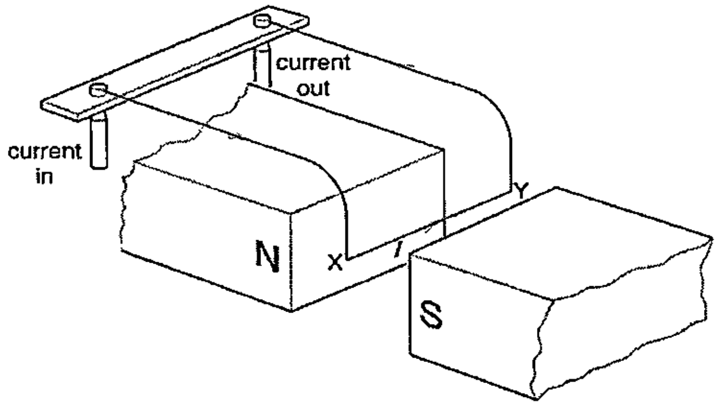


Fig. 11.1

State the direction of the force acting on XY and describe how Fleming's Left Hand rule is used to determine this force.

....

....

.... [2]

(b) In order to measure the force exerted on wire XY in **(a)**, Fig. 11.2 shows a pan and some weights added to the setup. The force exerted on XY is then measured by putting weights in the pan until XY is brought back up to its original position.

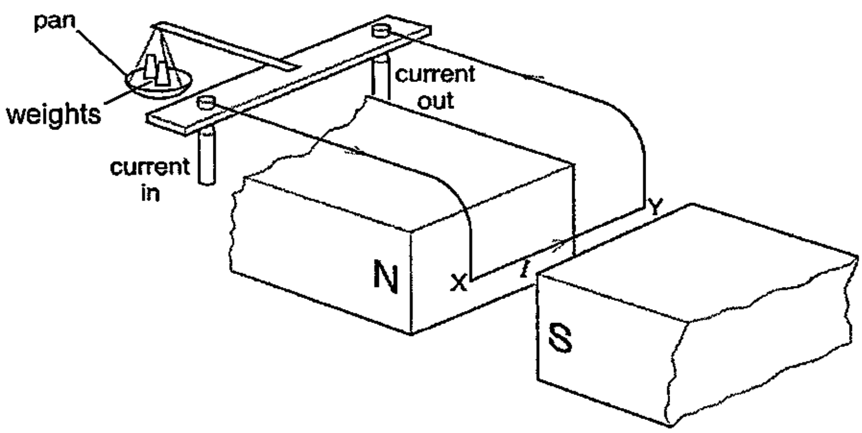


Fig. 11.2

(i) State whether the pan will move up, move down or remain at the original position when the two magnets are brought closer to each other.

.... [1]

(ii) Explain your answer in **(b)(i)**.

....

....

.... [2]

(c) An iron bar has many turns of wire wrapped around it, as shown in Fig. 11.3. The wire is connected to an alternating current supply. Some more wire is made into a flat coil and connected across a low voltage lamp.

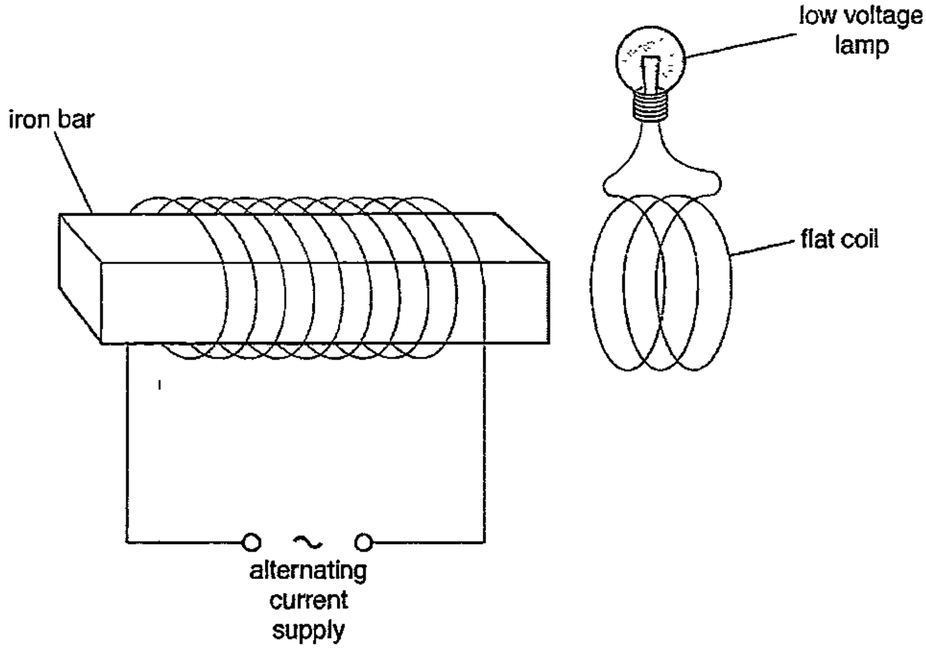


Fig. 11.3

(i) When the flat coil is held close to the end of the iron bar, the lamp glows.

Explain why this happens.

....

....

....

....

....

....

.... [3]

(ii) An alternating current of a lower frequency is then supplied to the set up in Fig. 11.3.

Explain what would be observed of the lamp in Fig. 11.3.

....

....

.... [2]

12 EITHER

Fig. 12.1 shows the horizontal forces as a cyclist travels forward from A to B.

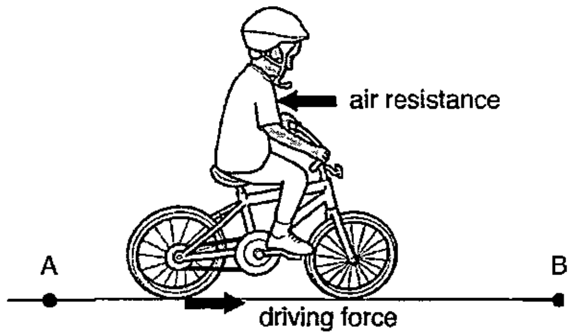
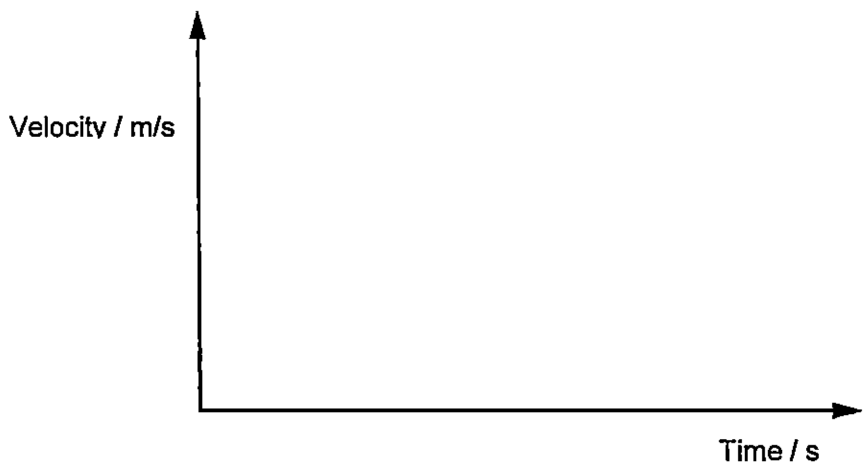


Fig. 12.1

The cyclist produces a constant driving force that acts on the back wheel. As her speed increases, the air resistance increases.

She accelerates from rest at A until a velocity of 4.0 m/s is reached. She then continues at that constant velocity towards B.

(a) Complete the velocity-time graph of the bicycle until the constant velocity is reached. [2]



(b) The total mass of the bicycle and the cyclist is 75.0 kg.

Calculate the kinetic energy of the bicycle and the cyclist at B.

kinetic energy = ... [2]

(c) Fig. 12.2 shows the subsequent journey taken by the cyclist beyond point B.

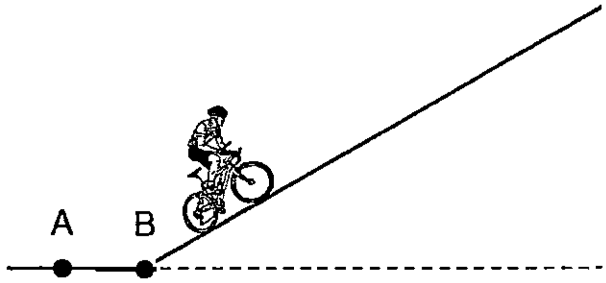


Fig. 12.2

Describe the energy changes that take place as she pedals up the hill at constant speed.

....

....

....

....

....

....

.... [3]

(d) Some bicycle frames are made from low density materials. Suggest and explain, in terms of energy changes, why this is an advantage.

....

....

....

....

....

....

.... [3]

OR

Fig. 12.3 shows a room heater used during winter in some countries. Fig. 12.4 is a diagram of the electric circuit of the heater.

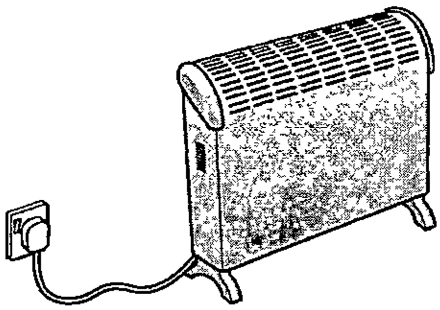


Fig. 12.3

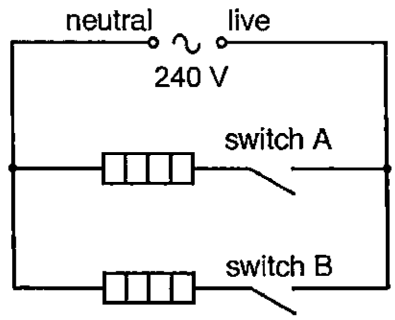


Fig. 12.4

The fuse has not been drawn on the circuit diagram in Fig. 12.4.

(a) **(i)** On Fig. 12.4, draw the symbol for a fuse in the correct position. [1]

(ii) Describe why it can be dangerous when a fuse of the wrong value is used in the plug.

....

.... [1]

(iii) State the part of the room heater to which the earth wire is connected.

.... [1]

(iv) The earth wire reduces the chance of an electric shock if a fault develops in the room heater.

1. State one fault that causes an electric shock when a person uses the room heater without an earth connection.

....

.... [1]

2. Explain how using an earth connection prevents an electric shock.

....

....

....

....

.... [2]

(b) Fig. 12.5 shows the power output of the room heater when each switch is closed.

	power / W
switch A only closed	600
switch B only closed	1500
both switches closed	2100

Fig. 12.5

(i) Determine the current through the room heater when only switch B is closed.

current = ... [2]

(ii) The room heater is used with both switches closed for 2.5 hours.
Calculate the energy output of the room heater in joules.

energy = ... J [1]

(c) Fig. 12.6 shows a mains extension lead. The six sockets allow several electrical appliances to be connected to the mains supply through one cable.

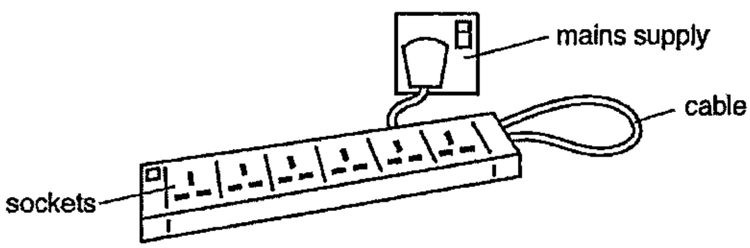


Fig. 12.6

Six powerful lamps are plugged into the sockets and switched on, one by one.

Suggest what happens in the cable as the lamps are switched on, one by one.

....

.... [1]

--- End of Paper ---

Answer Scheme (Sec 4 Prelim Exam 2015)

Paper 1 - MCQ

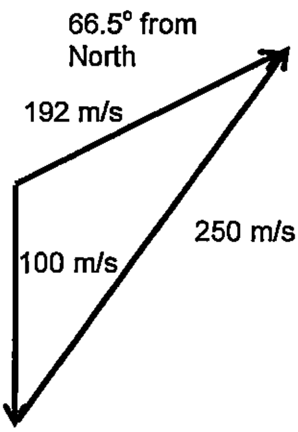
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
D	A	C	D	D	D	C	A	A	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	B	B	A	C	C	C	B	D	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	C	D	C	D	A	D	B	B	B
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
C	B	D	C	B	A	A	C	B	B

Section (A)

1 **(a)** **(i)** A <u>resultant force and acceleration</u> is produced when the forward force is greater than the frictional force. B1

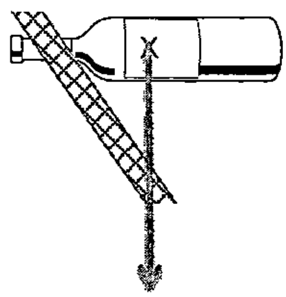
(ii) F=frictional F – ma = 2000 + (20000 x 5) C1
= 102,000 N A1

(b)



B1 – arrow is correct direction & shape of triangle
B2 – accuracy of answers
B1 – appropriate scale used (diagram should fit the space given in the paper)

2 (a)

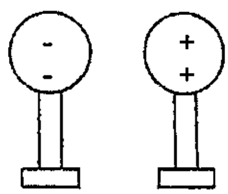


B1

(b) Line of action of force of CG acts at the base of the bottle holder — B1, B1

2	(b)	Line of action of force of CG acts at the	B1
		base of the bottle holder	B1
	(c)	The line of action of force of CG is not located within the base of the bottle holder.	B1
		Net moment is not zero. OR CW moments is more than ACW moments OR ACW moments is more than CW moments OR any statement to that effect	B1
3	(a) (i)	Pressure is force per unit area.	B1
	(ii)	$F = PA = 300 \times 10^{3} \times 1.26 \times 10^{-3}$	C1
		$= 378$ N	A1
	(b)	Workdone by pump on gas increases internal energy	B1
		Energy is transformed into faster movement of air molecules, having more collisions	B1
		Avg KE of air molecules increase	B1
4	(a)	Wax in both rods melts.	B1
		Wax on Cu rod will melt more quickly.	B1
	(b)	Thermal energy is transferred from hot end to cold end through particles colliding with less energetic neighbours.	B1
		Free electron diffusion – when heated, free e- gain energy and move faster across to colder region	B1
5	(a)	Incident ray is same angle as normal.	B1
	b(i)	N=speed of light in vacuum/speed of light in medium	B1

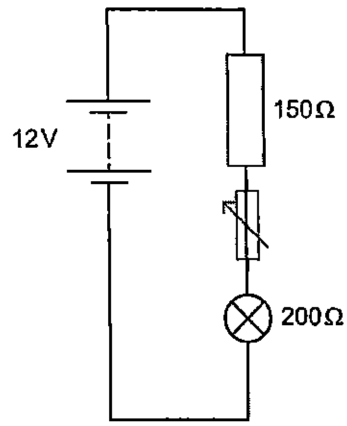
	(b)	$c/v = n$		
	(ii)	$v = 3\text{x}10^8/1.5$		C1
		$= 2.0\text{x}10^8$ m/s		A1
	(c)	Ray RS will <u>move anti clockwise</u> towards glass block boundary.		B1
		RS <u>- TIR will occur</u> after the ray PR (incident angle) <u>exceeds critical angle</u>.		B1
6	(a)	<u>Human reaction time</u> to operate stop watch is too slow to measure the time duration.		B1
	(b)	$V=d/t = 2/5.9\text{x}10^{-3}$		C1
		=339 m/s		A1
	(c)	Relocate loudspeakers to opposite ends to reduce effects of wind.		B1
7	(a)	(i)	Friction <u>removes e- from cloth and transfers to the plastic</u>.	B1
			Cloth has <u>excess +ve charges</u>.	B1
		(ii)	<u>Metal is a conductor that conducts charges through the skin</u> and is able to	B1
			<u>discharge the excess charges to earth</u>	B1
	(b)			



B1 correct placement of +ve and –ve charges
B1 Same # of charges for both spheres.

8	(a)	V/R=I	
		12/350 =	C1
		0.034 A	A1
	(b)	V=IR	
		=200 x 0.034	A1
		= 6.8 V	

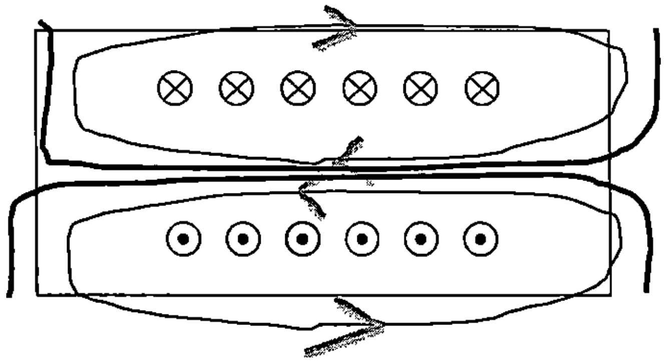
(c) B1



variable resistor symbol drawn in suitable position on circuit (symbol must be correct)
LDR is accepted (provided correct symbol is used)

(d) brighter B1
p.d. / voltage (across lamp) and/or current is greater B1

9 **(a)**



B1 Correctly identify polarity
B1 correct magnetic field lines drawn

(b) (i) Polarity is reversed but B1
magnetic field strength remains unchanged. B1

(ii) More magnetic field lines and B1
more densely packed. B1

Section B

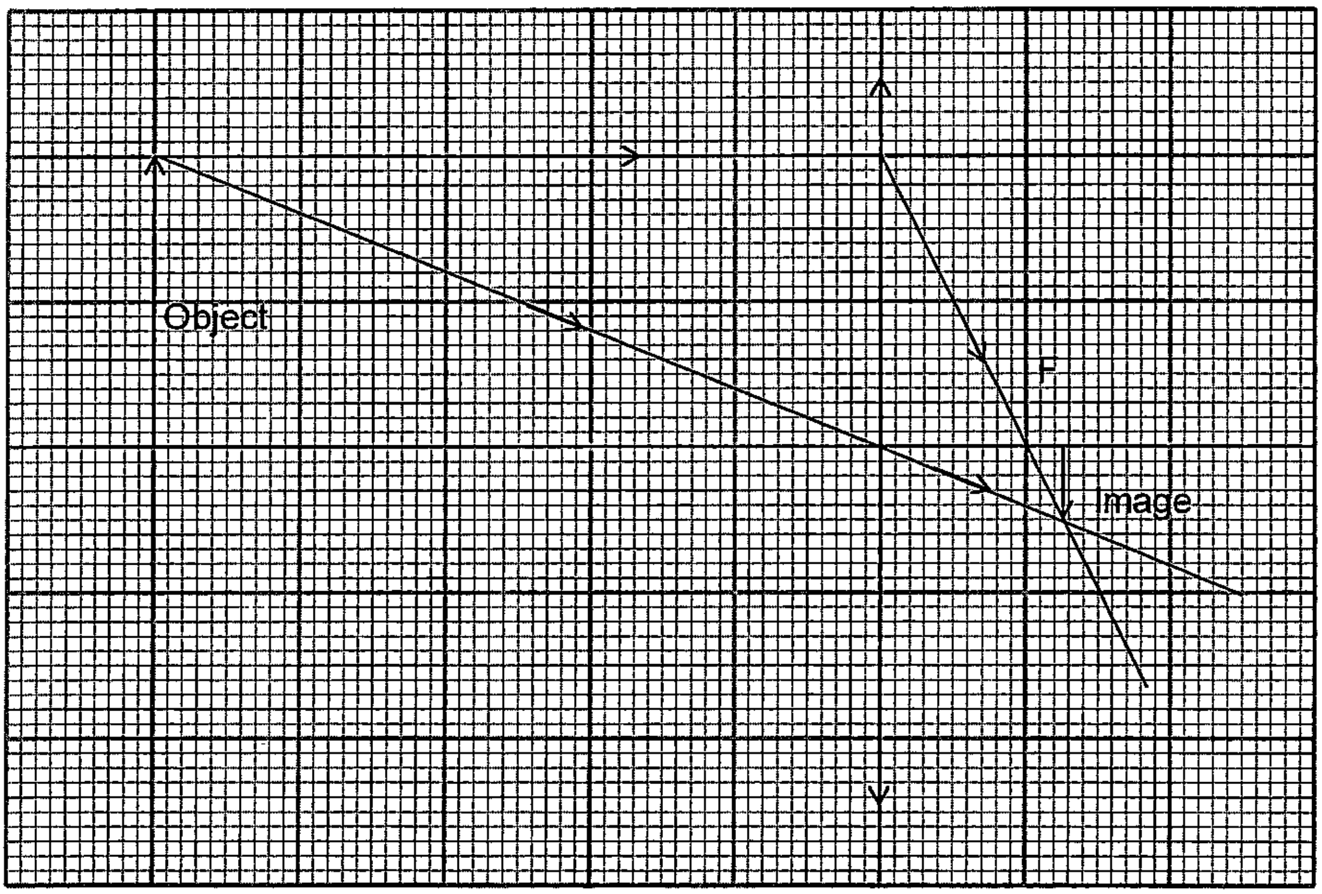
10 (a) (i) focal length of the lens [B1]

10 (a) (ii) inverted, real and diminished [B1]

10 (b) at a distance less than the focal length / d.
OR distance between focal point and the (optical centre of the) lens [B1]

10 (c) (i) 1. [B2] 2 rays correctly drawn

[B1] correctly identified focal length



2. focal length = 10.0 ± 1.0 cm (to the correct d.p., this is a measurement!)

10 (c)(ii) As light enters the lens, ***the speed of light decreases as it moves from an optically less dense to an optically denser medium.***
OR There is a ***change in speed of light as it travels from one medium to another.*** [B1]

10 (c) (iii) Data Set 5 [B1]

10 (c) (iv) (ecf on focal length)

The ***maximum distance between the lens and the film is 15.0 cm*** (5.0 cm + focal length).

OR image will not be able to focus any sharp image when the ***image distance greater than 15.0 cm.*** [B1]

10 (c) (v) ***Dimmer / less bright*** but no difference in the image formed [B1]

11 (a) Downwards [B1]

Thumb to point to the force that results due to magnetic field indicated by the index (1^{st}) finger, and the middle (2^{nd}) finger to point in the direction of the current *at right angle to each other* [B1]

11 (b) (i) Pan moves up [B1]

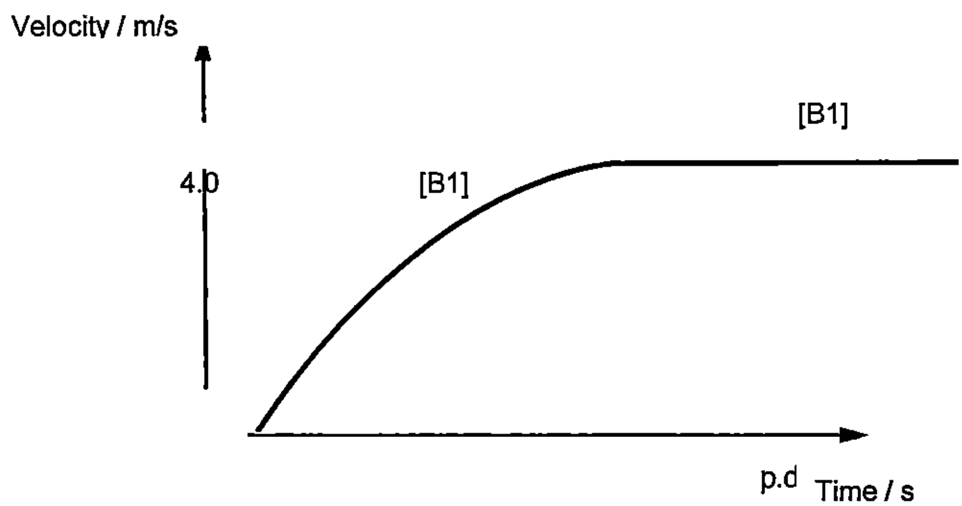
11 (b) (ii) magnetic field strength increases / stronger magnetic field / magnetic field lines are closer [B1]

a larger clockwise moment about pivot is produced [B1]

11 (c) (i) changing magnetic field [B1]
magnetic flux linkage / magnetic field lines being cut etc. [B1]
induced emf / current / electricity [B1]

11 (c) (ii) lamp will be blinking / flickering at a lower rate (speed)
OR dimmer [B1]
Lower rate of cutting of magnetic field lines / magnetic flux linkage [B1]

12 Either
(a)



(b) $E = \frac{1}{2} mv^2$

= ½ (75) $(4)^2$ [C1]
= 600 J [A1]

(c) Kinetic Energy remains constant throughout [B1]

chemical (potential) energy at start ⇒ GPE *increases* [B1]

+ thermal energy/heat/internal energy produced [B1]

(d) lower mass / weight of cycle, *with volume constant* [B1]

Any of the following:
- less energy / work (input) to go uphill [B1]
- due to less friction / [B1]

OR
- less kinetic energy / ½ mv^2 less
- able to travel at the same speed / less stopping distance

OR
- keeping kinetic energy the same
- travel at a higher speed move faster

OR
- less GPE
- greater distance moved up the hill

12 OR

(a) (i) fuse symbol correct and in live wire before junction of two elements [B1]

(a) (ii) (wire) melts/causes fire (not blows/melts fuse) [A1]

(a) (iii) the (metal) case/outside [B1]

(a) (iv) 1. live wire touches case [B1]

2. earth wire of a low resistance [B1]
current goes to earth [B1]

(b) (i) I = 1500 / 240 = **6.25 A**
[C1, A1]

(b) (ii) Energy in Joule = 2100 x 2.5 x 3 600
= **18.9 MJ = 1.89 x 10^7 J** [A1]

(c) (wire) heats up/current increases/electrons move faster [C1]

--- End of Paper ---

Name: Register Number: Class:

For Marker's Use

南僑中學

NAN CHIAU HIGH SCHOOL
PRELIMINARY EXAMINATION THREE 2015
SECONDARY FOUR EXPRESS

PHYSICS **5059/01**

Paper 1 Multiple Choice

16 September 2015
Wednesday

1 hour

Candidates answer on the OTAS.

INSTRUCTIONS TO CANDIDATES

Write your name, class and register number in the spaces provided at the top of this page.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the OTAS.

Each correct answer will score one mark.

The total marks for this paper is 40.
g = 10 N/kg on earth

1 Diagram 1 shows the reading on a pair of vernier calipers when the jaws are closed.
Diagram 2 shows the reading when a ball is placed between the jaws. What is the diameter of the ball ?

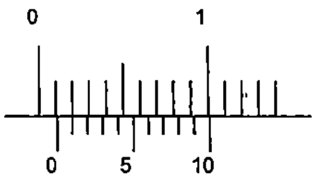


Diagram 1

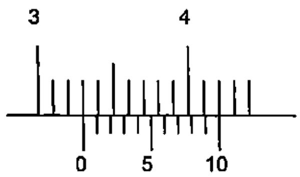


Diagram 2

A 3.19 cm
B 3.29 cm
C 3.31 cm
D 3.41 cm

2 Which of the following pairs of physical quantities **do not** have the same unit?

A	friction	electrostatic force
B	heat capacity	latent heat
C	latent heat	kinetic energy
D	rate of energy conversion	power

3 A body is moving in a circle at a constant speed. Which of the following statement is **true**?

A The acceleration of the body is 0 ms^{-2}.
B There is a resultant force acting on the body.
C There is no resultant force acting on the body.
D The velocity of the body is 0 ms^{-1}.

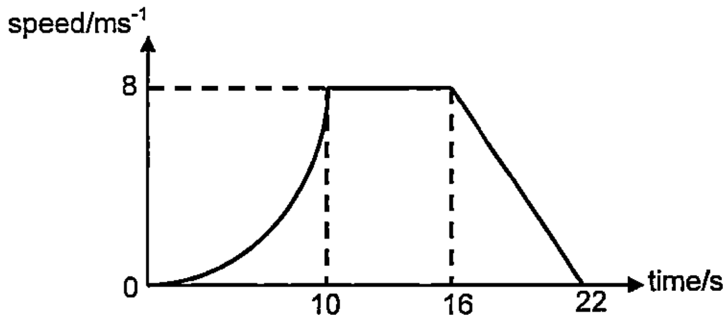
4 A car starting from rest undergoes different acceleration during different time of its motion. The information about its motion is shown in the table below.

time	constant acceleration	average speed
0 s to 3 s	x	3
3 s to 7 s	y	8

What is the speed of the car at t = 7 s?

A 6 ms^{-1}
B 8 ms^{-1}
C 10 ms^{-1}
D 12 ms^{-1}

5 The graph shows how the speed of a toy car changes as it moves across a floor.



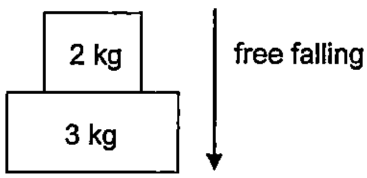
How far does the toy car travel at constant acceleration?

A 24 m **B** 48 m **C** 72 m **D** 112 m

6 An object falls under earth's gravitational field and air resistance is present. Which of the following describes the changes in the air resistance and acceleration on the object before the object reaches terminal velocity?

	air resistance	acceleration
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

7 Two metal blocks are stacked one on top of the other as shown in the diagram below. They are dropped in vacuum, falling together freely under earth's gravitational field. What is the net force acting on the 3 kg metal block during the fall?

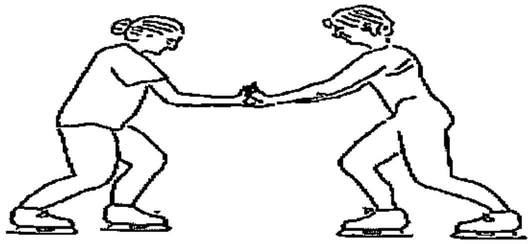


A 10 N **B** 20 N **C** 30 N **D** 40 N

8 The mass of a body resists changes to its motion.
Which property of the body is responsible for this statement?

A density
B gravitational potential energy
C inertia
D kinetic energy

9 A girl and a boy at an ice skating rink push each other as shown below. The girl exerts a force of 20 N on the boy while the boy exerts a force of 25 N on the girl. What is the net horizontal force experienced by the girl?



A 5 N B 20 N C 25 N D 45 N

10 A bottle full of mercury has a mass of 730 g. When the same bottle is filled with an unknown liquid **P**, its mass is 100 g. If the mass of the empty bottle is 50 g, calculate the density of the unknown liquid **P**. (Density of mercury = 13600 kg/m^3)

A $1.0 g/cm^3$
B $2.0 g/cm^3$
C $7.3 g/cm^3$
D $14.6 g/cm^3$

11 Which of the following object is in neutral equilibrium?

A A balancing toy which returns to its original position when displaced.
B A cone resting on its circular base.
C A cylinder resting on its curved surface.
D A heavy circular disc resting on its circular base.

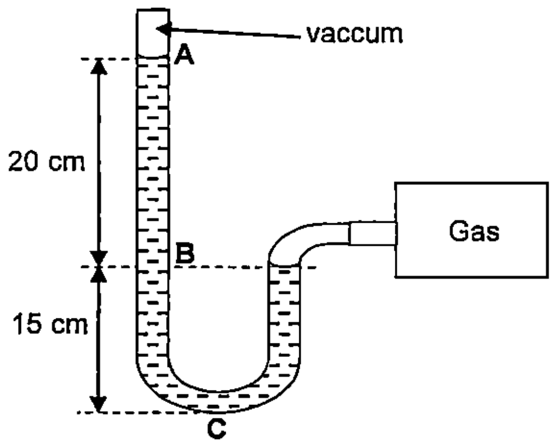
12 A square solar panel has dimensions of 0.5 m x 0.5 m, it converts solar energy to electrical energy. The sunlight shining on the panel has an intensity of 1000 Wm^{-2}. Intensity is the power transferred per unit area. The solar panel delivers a current of 2.0 A at a voltage of 20 V. What is the efficiency of this solar panel in converting solar energy to electrical energy?

A 16 % B 20 % C 50% D 80%

13 An object is pulled up a rough slope at a constant speed. Which of the following statement is **true**?

A Work done by the pulling force is equal to the gain in gravitational potential energy minus the work done against friction and kinetic energy.
B Work done by the pulling force is equal to the gain in gravitational potential energy plus the work done against friction and kinetic energy.
C Work done by the pulling force is equal to the gain in gravitational potential energy minus the work done against friction.
D Work done by the pulling force is equal to the gain in gravitational potential energy plus the work done against friction.

14 The diagram below shows a manometer filled with water, measuring the pressure of a gas supply. The atmospheric pressure is 100 000 Pa. (Density of water is 1000 kg/m^3)



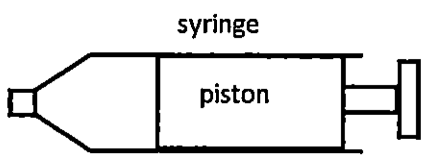
What is the pressure of the gas?

A 2000 Pa
B 3500 Pa
C 102 000 Pa
D 103 500 Pa

15 Which of the following is **true** about thermometric property?

A Expansion of a fixed mass of liquid is a thermometric property because it varies linearly and continuously with temperature.
B Ice point and steam point is a thermometric property because it is easily obtainable and reproducible.
C Melting point and boiling point of a substance is a thermometric property because they vary continuously with temperature.
D Volume of a fixed mass of liquid is a thermometric property because it varies linearly and continuously with temperature.

16 A fixed mass of gas is heated in a frictionless syringe under constant pressure.



Which of the following statements is **false**?

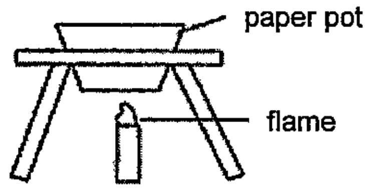
A The average distance between the gas molecules increases.
B The average force of the molecules on the wall of the piston increases.
C The average speed of the gas molecules increases.
D The frequency of collisions of the gas molecules on the wall of the syringe increases.

17 Which of the following is **true** when ice changes to water at its melting point?

(1) Thermal energy is absorbed to break the forces of attraction between the particles.
(2) Thermal energy is absorbed to increase the temperature.
(3) Kinetic energy is increased.
(4) Internal energy is increased.

A all of the above
B (1), (2) and (3)
C (1), (3) and (4)
D (1) and (4)

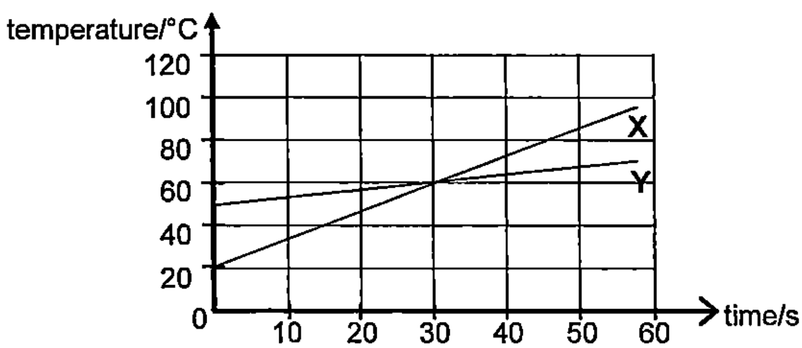
18 Some Japanese restaurants use paper pots for their customers to boil the food. What are the reasons for the paper pot not catching fire when in contact with the flame?



(1) Water has a boiling point lower than the burning temperature of the paper.
(2) The paper is thin and therefore heat is conducted quickly to the water in the paper pot.
(3) The paper is thick enough to withstand the high temperature of the flame.

A (1) and (2) only.
B (1) and (3) only.
C (2) and (3) only.
D all of the above.

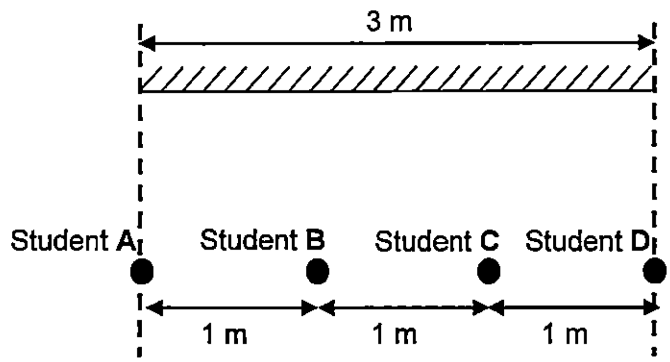
19 Two blocks **X** and **Y**, which are made of the same metal, are heated by heaters at the same power rating. The variations of temperature with time are given below.



What is the ratio of masses **X** to **Y**?

A 1 : 3 **B** 1 : 4 **C** 3 : 1 **D** 4 : 1

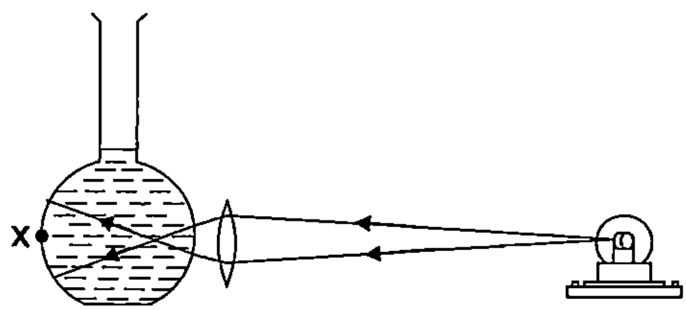
20 Four students stand in a row 1 m apart parallel to a plane mirror that is 3 m long as shown below.



How many students can see the images of the other three students?

A 1 B 2 C 3 D 4

21 A converging lens is placed in front of a flask filled with water. When a light bulb is placed in front of the converging lens, no sharp image is formed at point **X** as shown in the diagram below.



Which of the following can cause a sharp image to be formed at point **X**?

(1) Replace the lens with a thicker one.
(2) Replace the liquid with one of lower optical density.
(3) Replace the converging lens with a diverging lens.
(4) Move the light bulb nearer to the lens.

A (1) and (2) only
B (2) and (3) only
C (2), (3) and (4) only
D All of the above

22 The wavelength of a transverse wave is the

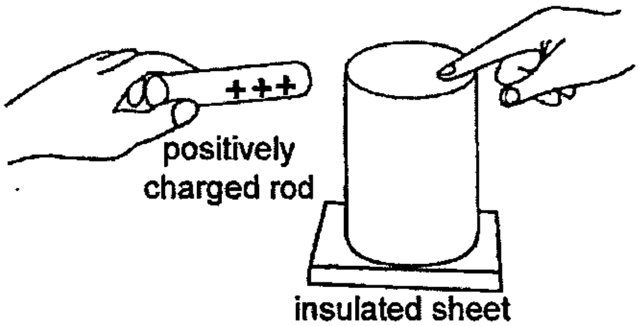
A distance moved by the trough to the next crest.
B horizontal distance from one crest to the nearest crest.
C maximum displacement of the particles from their equilibrium positions.
D vertical distance from the crest to the trough.

23 Which of the following groups of electromagnetic waves is in the order of increasing frequency?

A	Gamma ray	⟶	Ultra-violet	⟶	Radio wave
B	Gamma ray	⟶	Visible light	⟶	Ultra-violet
C	Microwave	⟶	Ultra-violet	⟶	X-ray
D	Visible light	⟶	Infra-red	⟶	X-ray

24 Jessie tries to charge a metal cylinder in the following way:

1. Bring a positively charged rod near the cylinder.
2. Touch the cylinder with a finger.
3. Remove the positively charged rod.
4. Remove the finger.



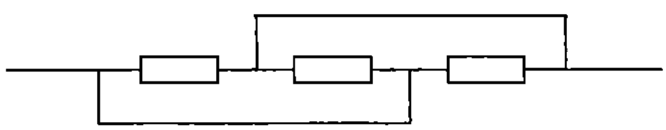
After this process, the cylinder would most likely be

A neutral.
B positively charged.
C negatively charged.
D positively charged on one side and negatively charged on the other.

25 The potential difference across two identical resistors in series is 8.0 V. How much energy is dissipated in one of the resistors when 5.0 C of charge flows through it?

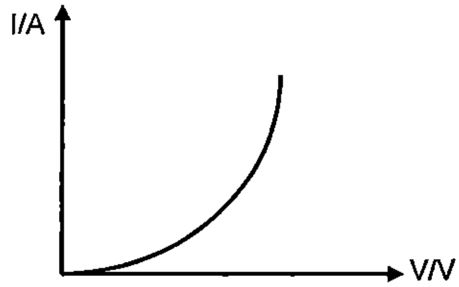
A 0.8 J **B** 1.6 J **C** 20 J **D** 40 J

26 What is the effective resistance of the diagram below if each resistor has a resistance of 12 Ω?



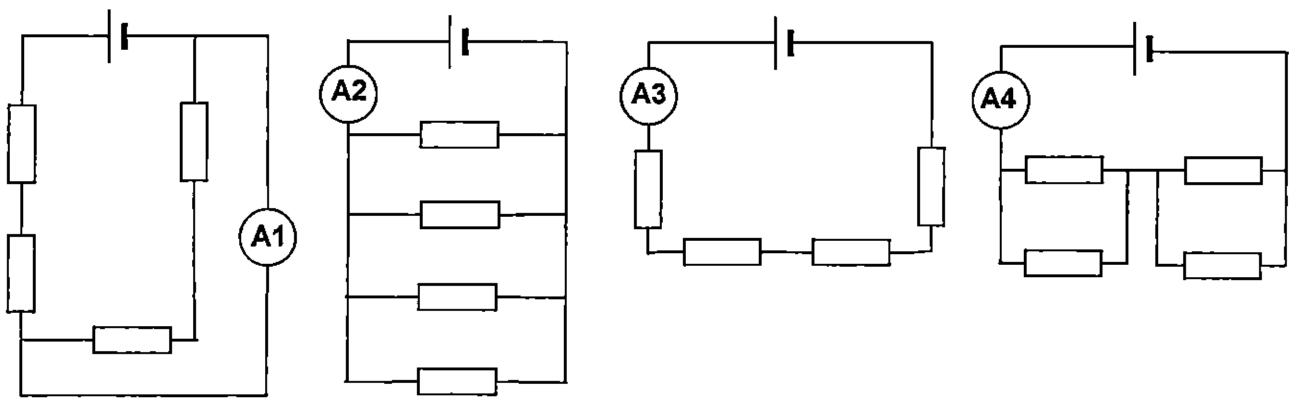
A 0 Ω **B** 3 Ω **C** 4 Ω **D** 12 Ω

27 The graph of current I against potential difference V for a conductor is shown below. Which of the following can be deduced from the graph?



A The conductor is an ohmic conductor.
B The resistance of the conductor decreases as the potential difference increase.
C The resistance of the conductor increases when the temperature increases.
D The resistance of the conductor is zero when no current flows in it.

28 The diagrams below show four circuits. All the resistors, dry cells and ammeters are identical.



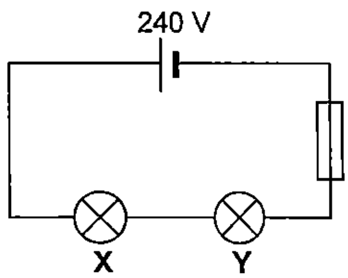
Which of the following shows the correct order of the ammeter readings?

A A1 = A2 = A3 = A4 **B** A1 = A4 < A2 < A3
C A3 < A1 < A4 < A2 **D** A4 = A1 < A3 < A2

29 A water heating system consists of a heater and a small light bulb next to the switch. Both the heater and the light bulb are controlled by the same switch. The switch turns on the 2000 W water heater and the 50 W light bulb together. In one month, the lamp alone uses 1 kWh of electrical energy. If the cost of electricity is \$0.30/kWh, how much does it cost to use the water heating system in that month?

A \$ 0.62 **B** \$ 0.75 **C** \$ 12.30 **D** \$ 15

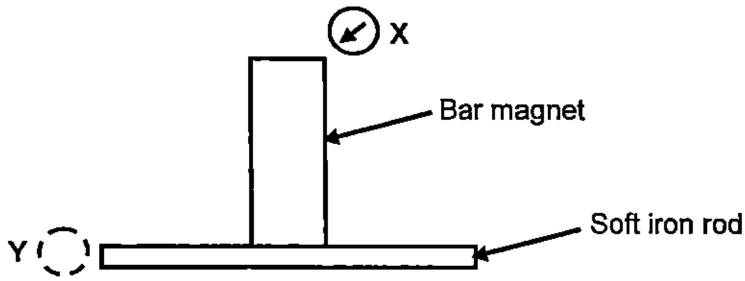
30 Two light bulbs **X** and **Y** are connected in a circuit as shown below. The rating of light bulb **X** is 120 V, 240 W, and the rating of light bulb **Y** is 120 V, 120 W.



What is a suitable fuse rating for the circuit?

A 1 A **B** 2 A **C** 13 A **D** 20 A

31 Which of the following shows the correct position of the compass needle when it is moved from position **X** to position **Y**. (Ignore earth's magnetic field)



A 

B 

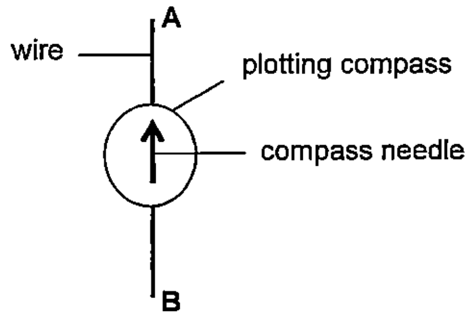
C 

D 

32 Which material is the most suitable to make the needle of a plotting compass?

A aluminium
B brass
C steel
D iron

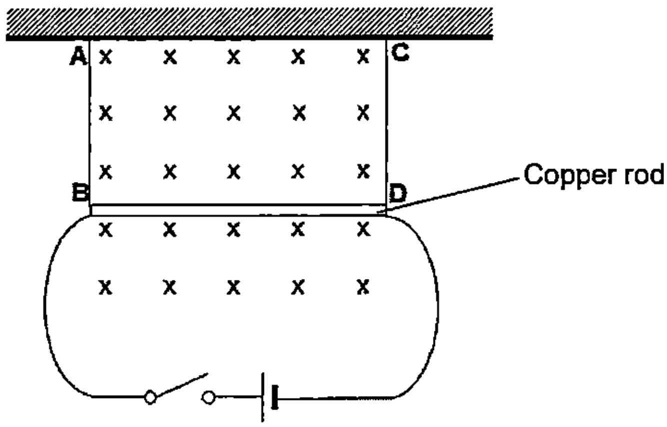
33 A small plotting compass is placed above a copper wire **AB**. The diagram shows the direction of the compass needle when there is no current flowing through the wire.



Which direction would the compass needle point when a current passes through the wire from **A** to **B**?

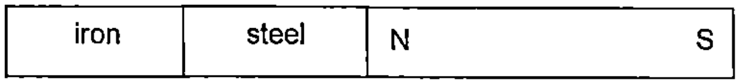
A into the page
B out of the page
C to the left
D to the right

34 The figure below shows a 4 kg copper rod in a magnetic field suspended horizontally by the two insulating strings **AB** and **CD**. What happens when the switch is closed?



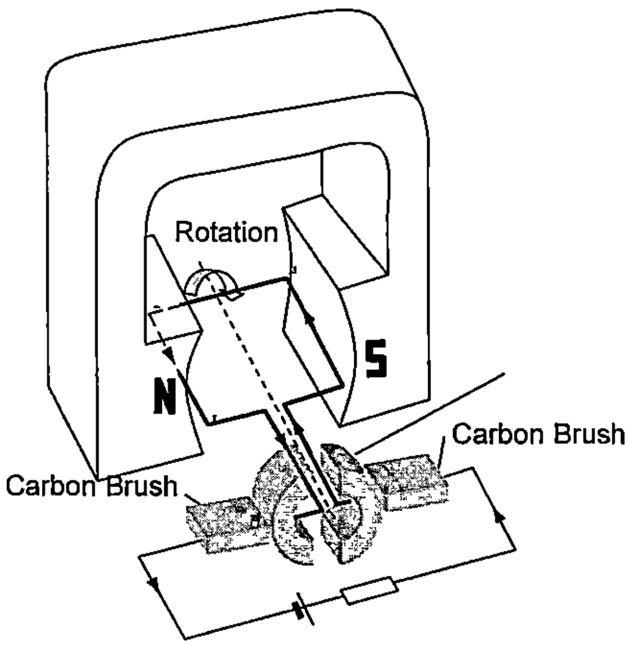
A The rod moves into the plane of the paper.
B The rod moves out of the plane of the paper.
C The tension in string AB and CD decrease.
D The tension in string AB and CD increase.

35 A light steel bar and a light iron bar are attracted to a magnet as shown. What will happen when the magnet is removed?



A Both the steel and iron bars lose their magnetism.
B The iron bar retains its magnetism and steel bar loses its magnetism.
C The steel and iron bars remain attracted to each other.
D The steel and iron bars repel each other.

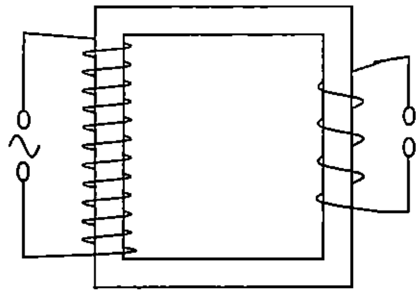
36 The diagram shows a simple d.c. motor.



The current reverses as the coil rotates. How many times is the current reversed if the coil is rotated through an angle of 290° from the position shown?

A 0 **B** 1 **C** 2 **D** 3

37 The diagram shows a 100% efficient step-down transformer connected to a 500 V alternating voltage supply. The ratio $N_P:N_S$ is 10:1.



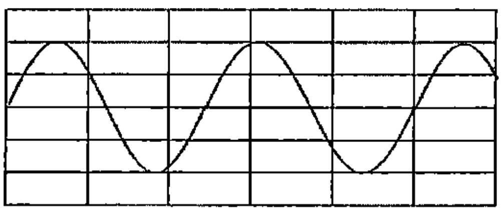
What is the output voltage?

A 0 V **B** 40 V **C** 50 V **D** 400 V

38 Why is electrical energy usually transmitted at high voltage?

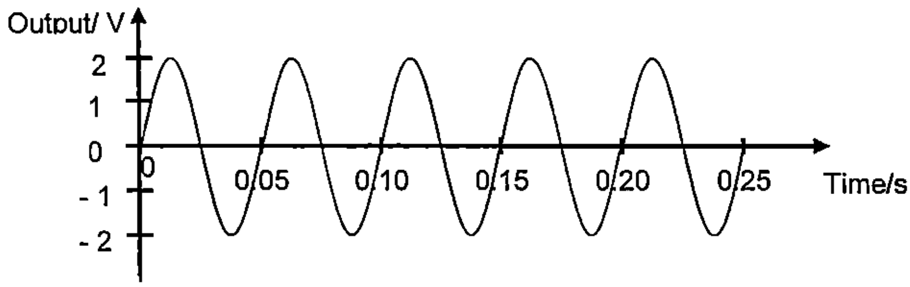
A As little energy as possible is wasted in the transmission cables.
B The current in the transmission cables is as large as possible.
C The resistance of the transmission cables is as small as possible.
D The transmission system does not require a transformer.

39 The cathode ray oscilloscope displays a trace when an alternating voltage of frequency 50 Hz is applied. The Y-gain is set at 5 V/div and the time base setting is unknown. Which of the following shows the correct peak voltage of the supply and time base setting?



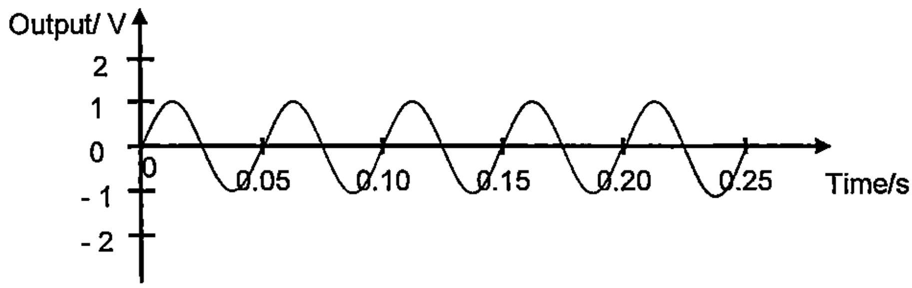
	peak voltage	time base setting
A	1.0 V	2 ms/div
B	1.0 V	8 ms/div
C	10.0 V	2 ms/div
D	10.0 V	8 ms/div

40 The graph below shows the output of an a.c. generator. The coil has 20 turns and the generator rotates 20 times in one second.

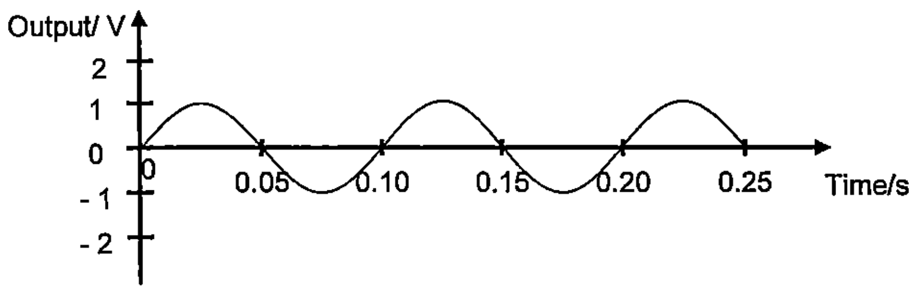


Which graph shows the output when the coil has 30 turns and rotates 10 times in one second.

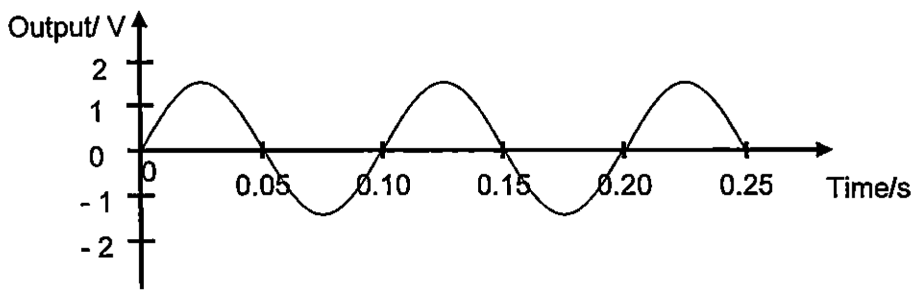
A



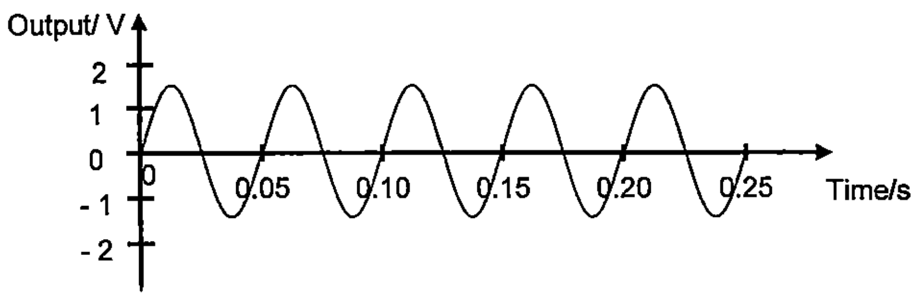
B



C



D



- End of Paper –

Name: **Register Number:** **Class:**

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南僑中學

NAN CHIAU HIGH SCHOOL
PRELIMINARY EXAMINATION THREE 2015
SECONDARY FOUR EXPRESS

PHYSICS **5059/02**

Paper 2 Theory **15 Sep 2015, Tuesday**

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

INSTRUCTIONS TO CANDIDATES

Write your name, class and register number in the spaces provided at the top of this page.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer **all** questions. Question 12 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
You may lose marks if you do not show your working or if you do not use appropriate units.
The number of marks is given in brackets [ ] at the end of each question or part question.

The total marks for this paper is 80.
g = 10.0 N/kg on earth

This paper consists of **20** printed pages including the cover page

Section A

Answer **all** the questions in this section

1. (a) Define velocity. [1]

....

(b) A solid rubber ball drops and hits the floor 0.60 s later. A velocity-time graph of the motion is shown in Fig. 1.1 below.

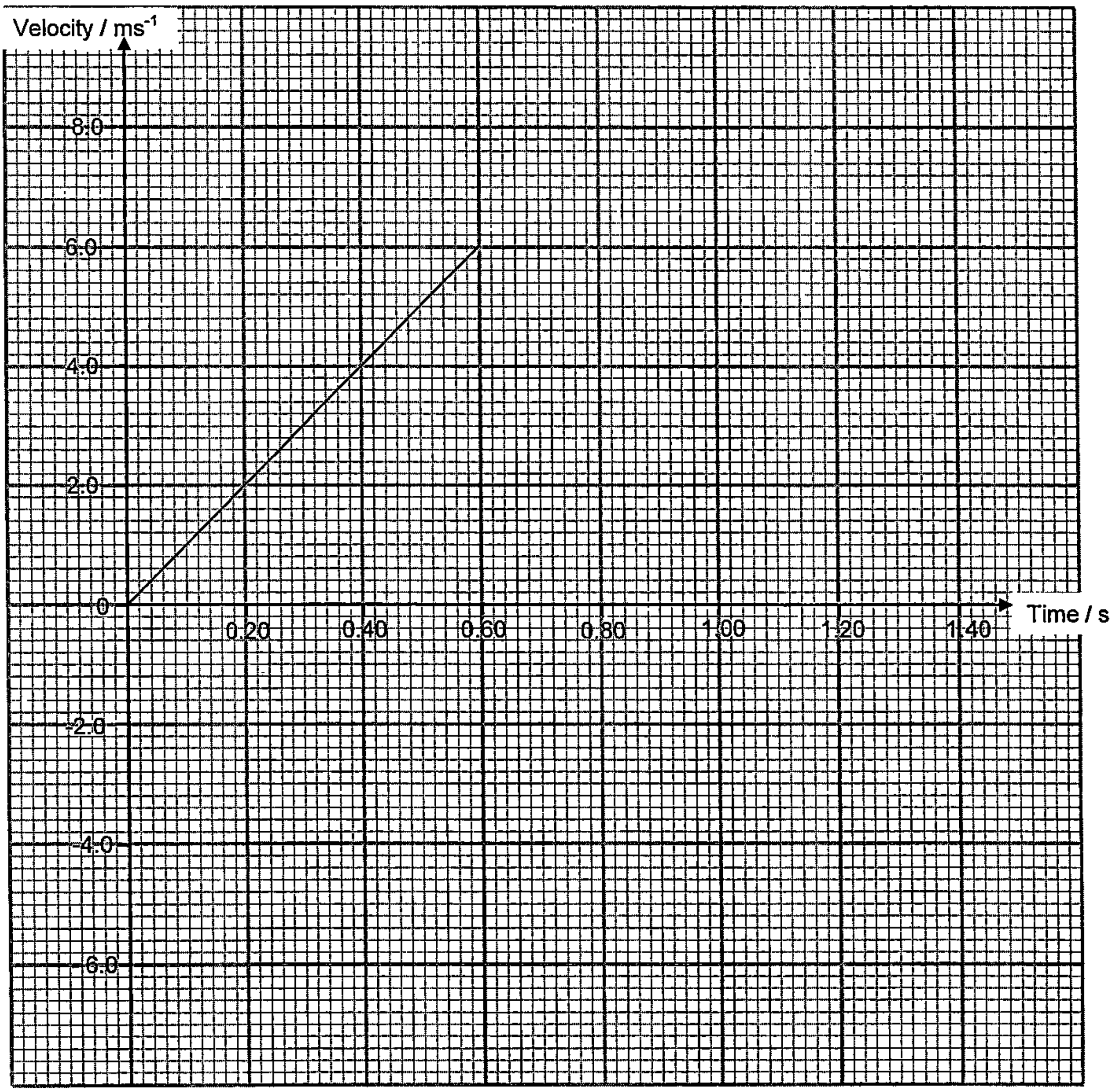

Fig. 1.1

1. (b) The ball makes contact with the floor for 20 ms, after which it **rebounds vertically** with an initial **speed** of 5.6 ms^{-1}.

(i) Calculate the acceleration of the ball while it makes contact with the floor and rebounds. [2]

(ii) Calculate the maximum height during the ball's bound. [1]

(iii) Draw on Fig. 1.1 the velocity-time graph for the ball during its rebound to the maximum height. [2]

2. A box with a mass of 4.0 kg was pushed by a force of 18 N along a table-top as shown in Fig. 2.1. The displacement-time graph of the motion is given in Fig. 2.2.

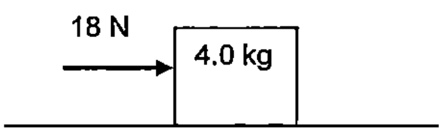

Fig. 2.1

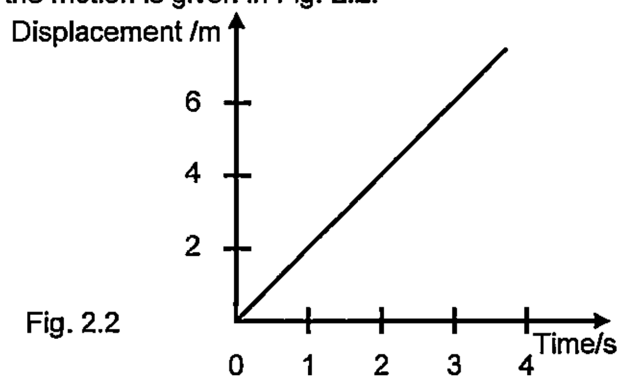

Fig. 2.2

(a) From Fig. 2.2, determine the frictional force acting on the block when the box is moving. Explain your answer. [2]

....

....

....

(b) While the box is still moving on the same surface, the push was increased to 20 N. Describe the subsequent motion of the box after the change in force occurs, giving numbers where necessary. [2]

....

....

3. A uniform trap door weighs 80 N. It is lifted up and held stationary by a force of 50 N as shown in Fig. 3. The centre of gravity of the trap door is located at 60.0 cm from the hinge as shown.

(a) State the meaning of centre of gravity. [1]

....

....

(b) By means of a scaled diagram, determine the reaction at the hinge of the trap door. [3]

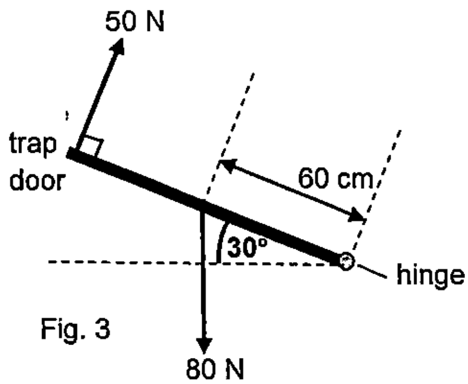

Fig. 3

4. A 1.00 m long barometer tube was filled with mercury to the brim of the tube. The open end was held carefully by the thumb and then inverted in a trough of mercury. The thumb was then removed. Fig. 4.1 shows the barometer at the instant when the thumb was just removed.

(a) (i) Show that the level of mercury in the tube above the surface of mercury in the trough would become 0.743 m eventually.
The atmospheric pressure has been determined to be 101000 Pa and mercury has a density of 13.6 g/cm^3. [2]

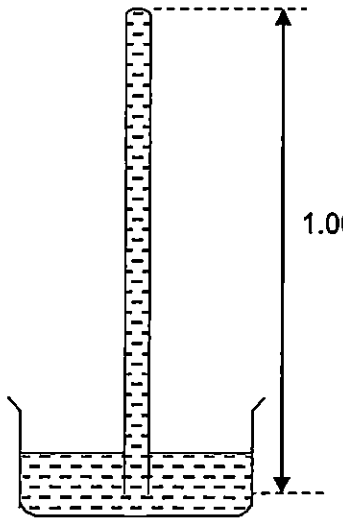

Fig. 4.1

(ii) Suggest a simple way to check that the barometer reads only the atmospheric pressure and not any additional pressure due to any gas trapped in the tube. [1]

....

....

(b) A mercury barometer is shown in Fig. 4.2. Draw the new level of the mercury level in the barometer and the reservoir when the barometer is brought to a mountain top, which has an altitude of 4000 m. Assume that the density of air is constant at 1.23 kg/m^3 and atmospheric pressure on the sea level is 103360 Pa. Show all calculations clearly. [2]

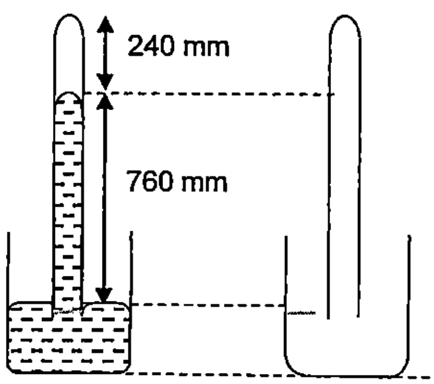

Fig. 4.2

5. Fig 5.1 below shows a hand-operated hydraulic jack.

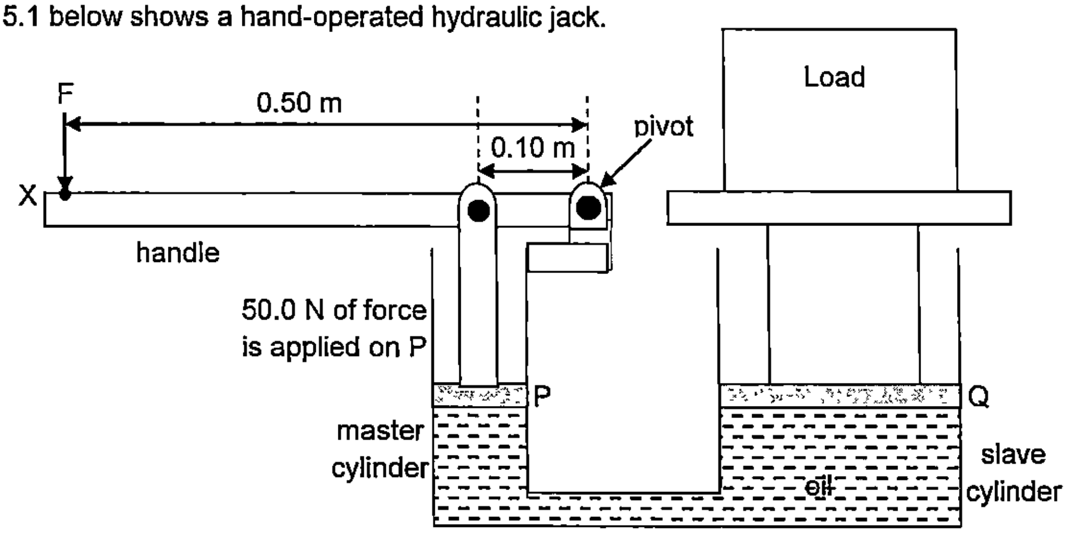

Fig. 5.1

Piston P and the handle are linked through the same pivot. When a force is applied downwards at point X, piston P in the master cylinder is pushed down with a force of 50.0 N, causing oil to flow into the slave cylinder.

(a) Calculate the moment of the force of 50.0 N applied on piston P. [1]

(b) The area of piston P is 20.0 cm^2 and the area of piston Q is 800 cm^2.
Calculate the load being pushed upwards by piston Q. [2]

(c) If piston P moved a distance of 10.0 cm downwards, determine the distance moved by piston Q upwards. [2]

6. (a) State a difference between boiling and evaporation. [1]

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(b) In an experiment to demonstrate how the boiling point of water depends on the surrounding pressure, a beaker containing hot water at 80 °C was placed inside a bell jar, which was all sealed up other than allowing for an exit to a vacuum pump.

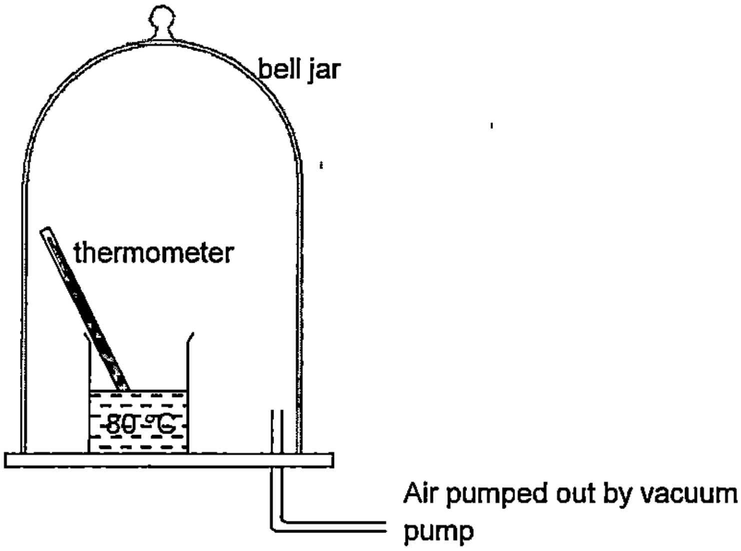

Fig. 6.1

Explain using kinetic model of matter,

(i) why some of the water boil when the air was being pumped out? [2]

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(ii) why the temperature of the remaining water becomes lower? [2]

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7. At coastal areas, the sea breeze is formed at around 3.00 p.m.

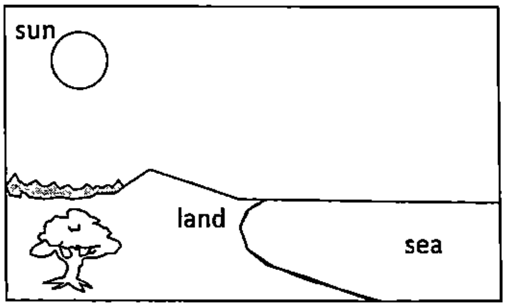

Fig. 7.1

(a) (i) In Fig. 7.1, draw the direction of the convection currents to form the sea breeze. [1]

(ii) Explain how the sea breeze could have been formed. [2]

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(b) The following data may be useful in this question.
Specific heat capacity of water = 4.20 kJ kg^{-1} K^{-1}.
Specific heat capacity of aluminium at 100°C = 0.910 kJ kg^{-1} K^{-1}.
Latent heat of vaporisation of water = 2260 kJ kg^{-1}.
Latent heat of fusion of water = 334 kJ kg^{-1}.

A 3.00 kg block of aluminium is heated to 600°C. It is placed in a container holding 2.00 kg of water at 25°C. The hot aluminium brings the water to its boiling point at 100°C quickly.

(i) Calculate the amount of energy given out by the aluminium block when its temperature is lowered to 100°C. [1]

(ii) Calculate the mass of water which will boil when the temperature of aluminium is at 100°C and 5000 J of energy has heated up the air surrounding the container. [3]

8. (a) A positively-charged sphere is placed near a neutral metal plate which was placed on an insulator shown in Fig. 8.1.
Draw the electric field between the sphere and the metal plate. [2]

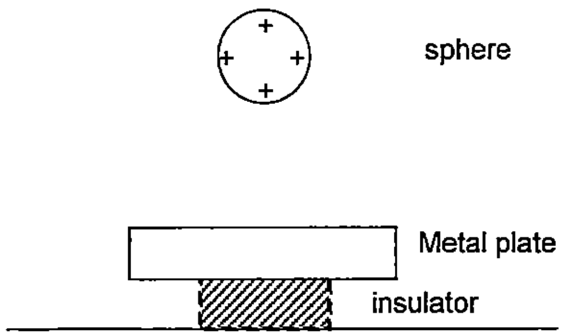

Fig. 8.1

(b) Fig. 8.2 shows part of an electrostatic spray gun applying paint onto a piece of metal part. The nozzle sprayed out fine paint droplets. The droplets are charged positively as they emerged.

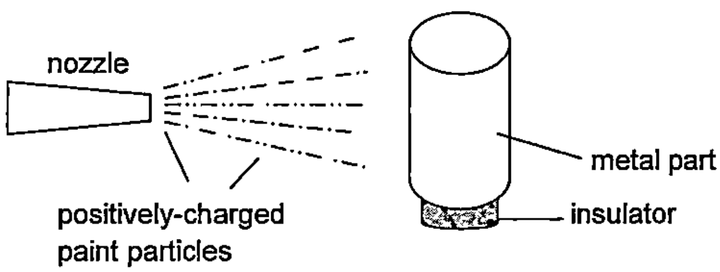

Fig. 8.2

(i) Explain why the positively-charged paint droplets are attracted to the neutral metal part. [2]

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(ii) Explain how the positively-charged paint droplets are spread out evenly to form a coat of paint on the metal part. [2]

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9. (a) A 200 m long spool of wire has a diameter of 0.30 mm. If the wire has a reistance of 48.8 Ω, calculate the resistivity of the wire. [2]

(b) A circuit is connected as shown in Fig. 9.1. The bulb is intended to be lit up when the surroundings has become darker.

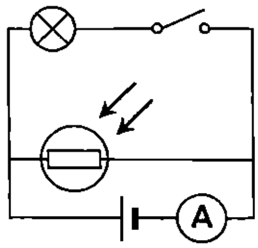

Fig. 9.1

(i) Explain why the circuit in Fig. 9.1 will not work as intended after the switch is closed. [2]

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(ii) A second identical bulb is connected in parallel to the first bulb as shown in Fig. 9.2.

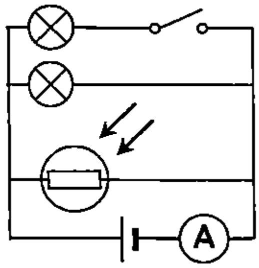


Fig. 9.2

Describe how the additional bulb affects the ammeter reading when the switch is closed [1]

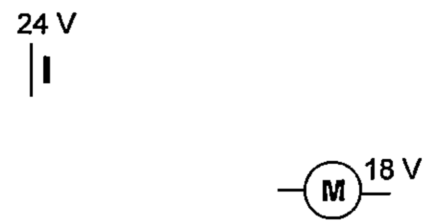
....

9. (c) John wants to construct a circuit that switches on a 18 V fan motor for his computer when the temperature is high.

(i) Complete the design of the circuit below to switch on the fan motor when the temperature rises. No calculation is required.

Choose from the following components:

- Light dependent resistor,
- light emitting diode (LED),
- rheostat,
- connecting wires,
- switch and
- negative temperature-coefficient thermistor. [2]



(ii) Explain how the circuit would be switched on. [1]

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Section B

Answer **all** the questions in this section.

Answer only one of the two alternative questions in **Question 12**.

10. (a) (i) What do you understand by the refractive index of water is 1.33? [1]

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(b) A ray of light is incident towards the centre of a semi-circular glass block as shown in Fig. 10.1. X is the curved surface area of the semi-circular glass block.

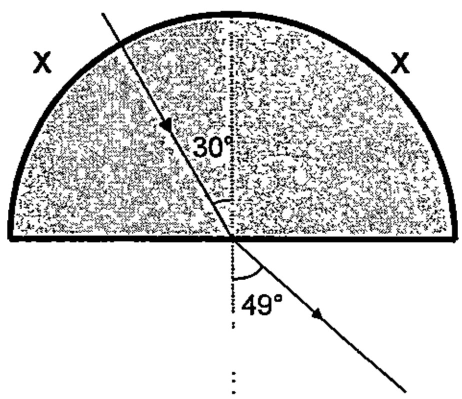

Fig. 10.1

(i) Explain why the ray of light will not undergo total internal reflection if it is incident on anywhere along X. [1]

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(ii) Calculate the critical angle of the glass block in Fig. 10.1. [2]

10. (c) What do you understand by the focal length of a converging lens is 6.0 cm? [1]

....

(i) Fig. 10.2, which was drawn to full scale, shows rays from a distant object reaching a converging lens with a focal length of 6.0 cm.
Complete the ray diagram in Fig. 10.2 to show how the converging lens forms an image. [3]

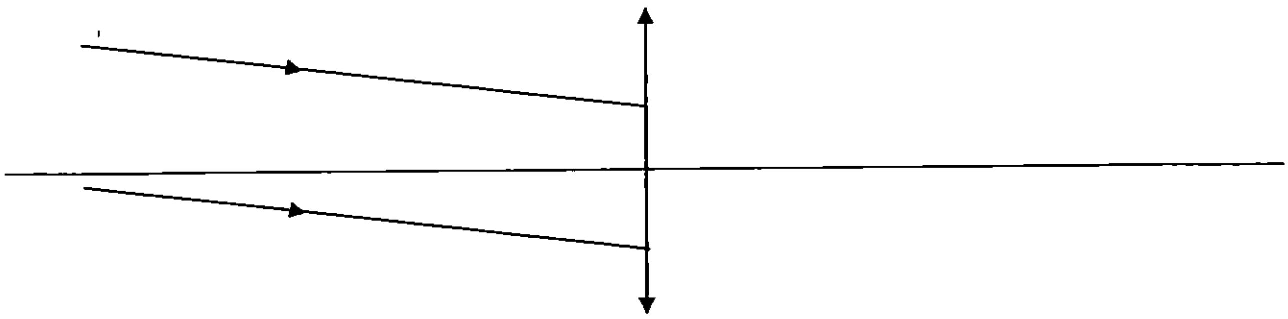

Fig. 10.2

Describe the effect on the image [1]

(ii) as the lens is moved towards the left side,

....

(iii) when half of the lens is cut away as shown in Fig. 10.3. [1]

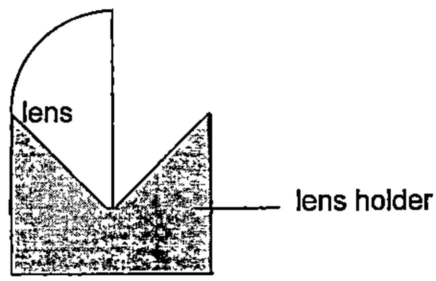

Fig. 10.3

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11. An ignition coil (see Fig. 11.1) is used to produce sparks to ignite fuel in the engine. The ignition coil produces high-voltage pulses from a d.c. supply. An ignition coil consists of a transformer made from two coils of insulated copper wire wound around a common iron core. One wire forms the external primary coil, with the secondary coil wrapped within the primary coil.

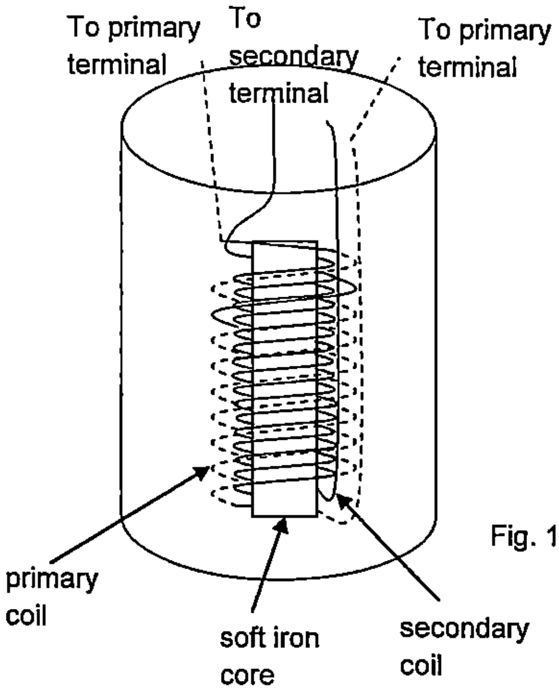

Fig. 11.1

Some information of the device is presented in Fig. 11.2.

Type A	Primary coil	Secondary Coil
Voltage (V)	12	30000
Current (A)		0.050
Number of turns	100	250000

Type B	Primary coil	Secondary Coil
Voltage (V)	36000	12
Current (A)	0.042	
Number of turns	300000	100

Fig. 11.2

(a) Explain why a voltage is developed across the secondary coil when the current in the primary coil is interrupted suddenly. [1]

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(b) State and explain which transformer, Type A or B is suitable as an ignition coil. [2]

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11. (c) The primary voltage (V_p) versus time graph is shown in Fig. 11.3, when t_1 and t_2 are the times when the controlling switch is closed and opened respectively.
Sketch the corresponding secondary voltage (V_s) versus time graph on the given axis. [2]

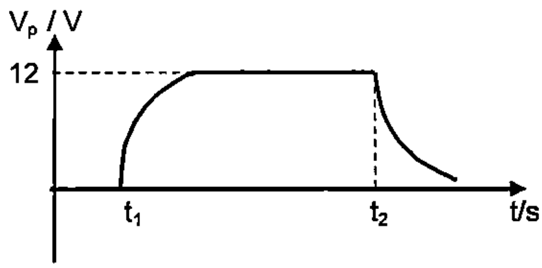
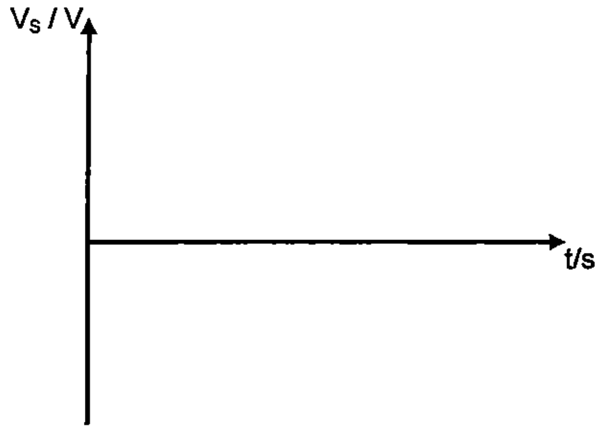


Fig. 11.3



(d) Explain with a reason if the wire used for the primary coil solenoid should be thick or thin.[1]

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(e) The secondary winding of an ignition coil is connected as shown in Fig. 11.4 to a light bulb. Explain why the light bulb did not lit up continously when the switch is closed. [1]

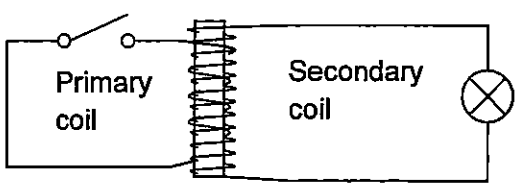

Fig. 11.4

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11. (f) In a set-up to demonstate motional electromotive force, a conducting rod was moved across a magnetic field from right to left in Fig. 11.5. The magnetic field is going perpendicularly into the paper. The rod was sliding on fricitonless metal rails which were linked by connecting wires with crocodile clips.

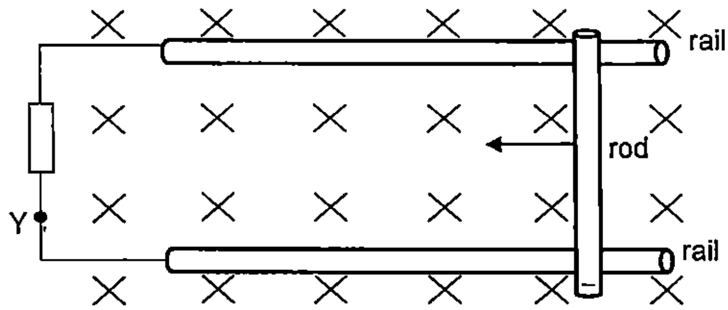

Fig. 11.5

(i) Determine the direction of the current flow in the external circuit by marking an arrow at point Y in Fig 11.5. [1]

(ii) Explain your answer [2]

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12. EITHER

Infrared toasters are considered parts of the modern day convenience in kitchen and food preparations. An infrared toaster, rated at 650 W 230 V, operates through 2 infrared lamps positioned above and below the holding tray (sees Fig. 12.1).

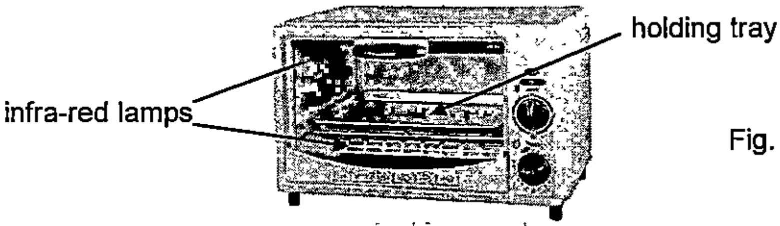

Fig. 12.1

(a) (i) Explain why the interior of the toaster is silver-coloured and smooth. [1]

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(ii) Discuss why the infrared toaster cooks the same quantity and type of food in a shorter time compared to a conventional oven which is much bigger physically. [2]

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(iii) Calculate the current drawn when the infrared toaster is switched on. [1]

(b) The insulation of the mains cable has worn away and this causes the live wire to make contact with the outer metal casing of the infrared toaster.

(i) Explain the hazard that results if the outer metal casing is not earthed. [1]

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(ii) Explain how connecting the earth wire to the outer metal casing and using a circuit breaker of a suitable rating removes this hazard. [2]

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(b) (iii) Fig. 12.2a and Fig. 12.2b show a circuit breaker before and after it has been activated respectively.

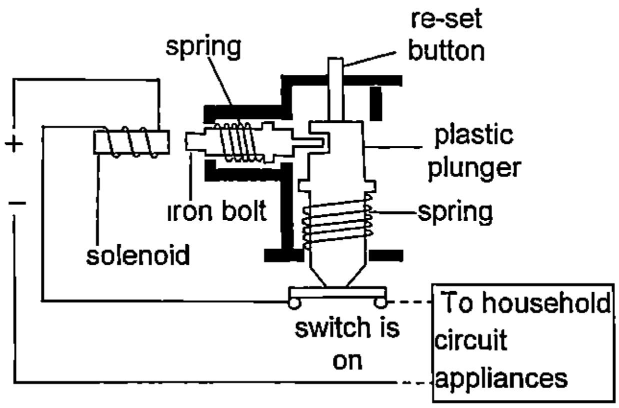

Fig. 12.2a

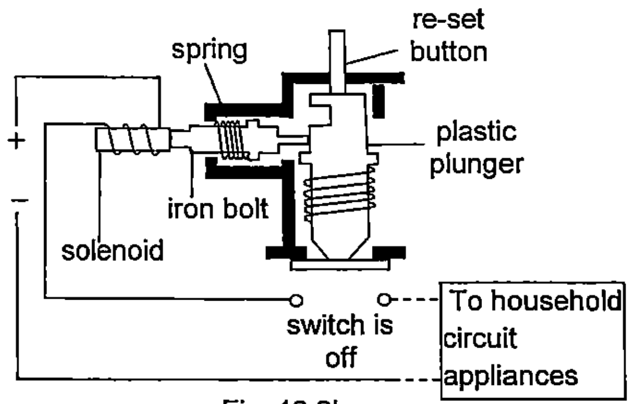

Fig. 12.2b

Referring to Fig. 12.2a and Fig. 12.2b, explain how the circuit breaker works when a fault occurs. [3]

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OR

Fig. 12.3 shows circular wavefronts produced at the centre of a wave pool. Two plastic buoys, A and B, float on the water in the pool Buoy A is on the crest of a wave at the instant shown.

(a) State the meaning of a wavefront. [1]

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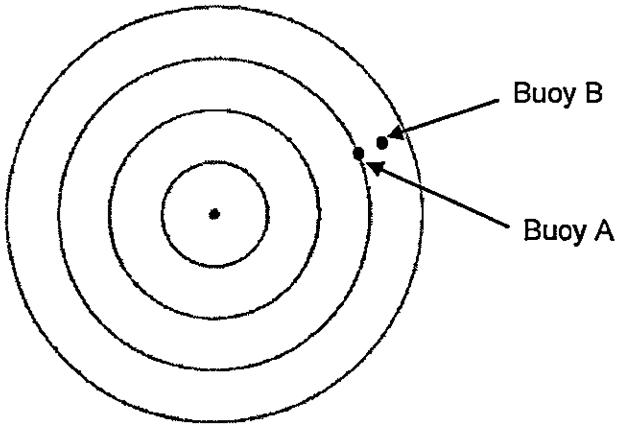

Fig. 12.3

(b) Fig. 12.4 shows a snapshot of the displacement-distance graph of A and B. A wave takes 0.800 s to move from A to B.

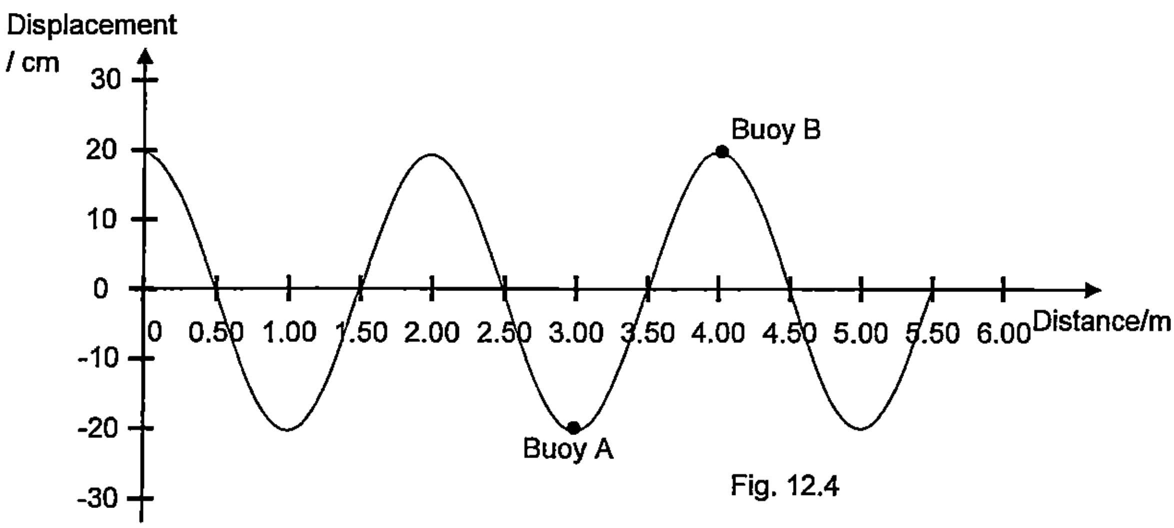

Fig. 12.4

(i) Calculate the frequency of the wave. [2]

(ii) Sketch a displacement–time graph of buoy B, starting from the instant shown in Fig. 12.3. Draw at least 2 cycles in your graph. [2]

(c) A vessel is detecting schools of fish in the ocean. Sonar is used to locate schools of fish and the depth of the seabed in the sea. The sonar sends pulses of ultrasound of frequency 45 kHz from the bottom of the ship to determine the depth of the seabed The reflected pulses are picked up by a receiver and displayed on a cathode-ray oscilloscope (c.r.o.) as shown in Fig 12.5. The time-base of the c.r.o. is set to be 50 ms/ div. The speed of the ultrasound in water is known to be 1450 m s^{-1}.

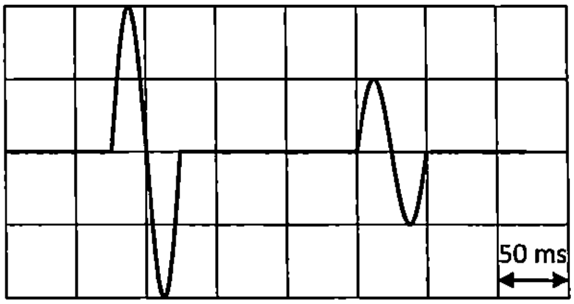

Fig. 12.5

(i) On Fig. 12.5, label the reflected pulse as *R*. Explain your choice. [1]

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(ii) Calculate the wavelength of the ultrasound. [1]

(iii) Determine the depth of the seabed. [2]

(d) If the frequency of the ultrasound is doubled, what is the effect on the speed of the wave? [1]

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End of paper

Marking Scheme NCHS Physics 5059 Prelim 3 2015 Paper 2

Scheme for Physics Paper1

1. (a) Rate of change of displacement. B1

(b) (i) $a = \Delta v / \Delta t = = (-5.6 - 6.0) / 20 \times 10^{-3}$ M1

$= - 580\ ms^{-2}$ A1

(ii) $v^2 = u^2 + 2as$, $s = (0^2 - 5\ 6^2) / 2(-10.0) = 1.568$

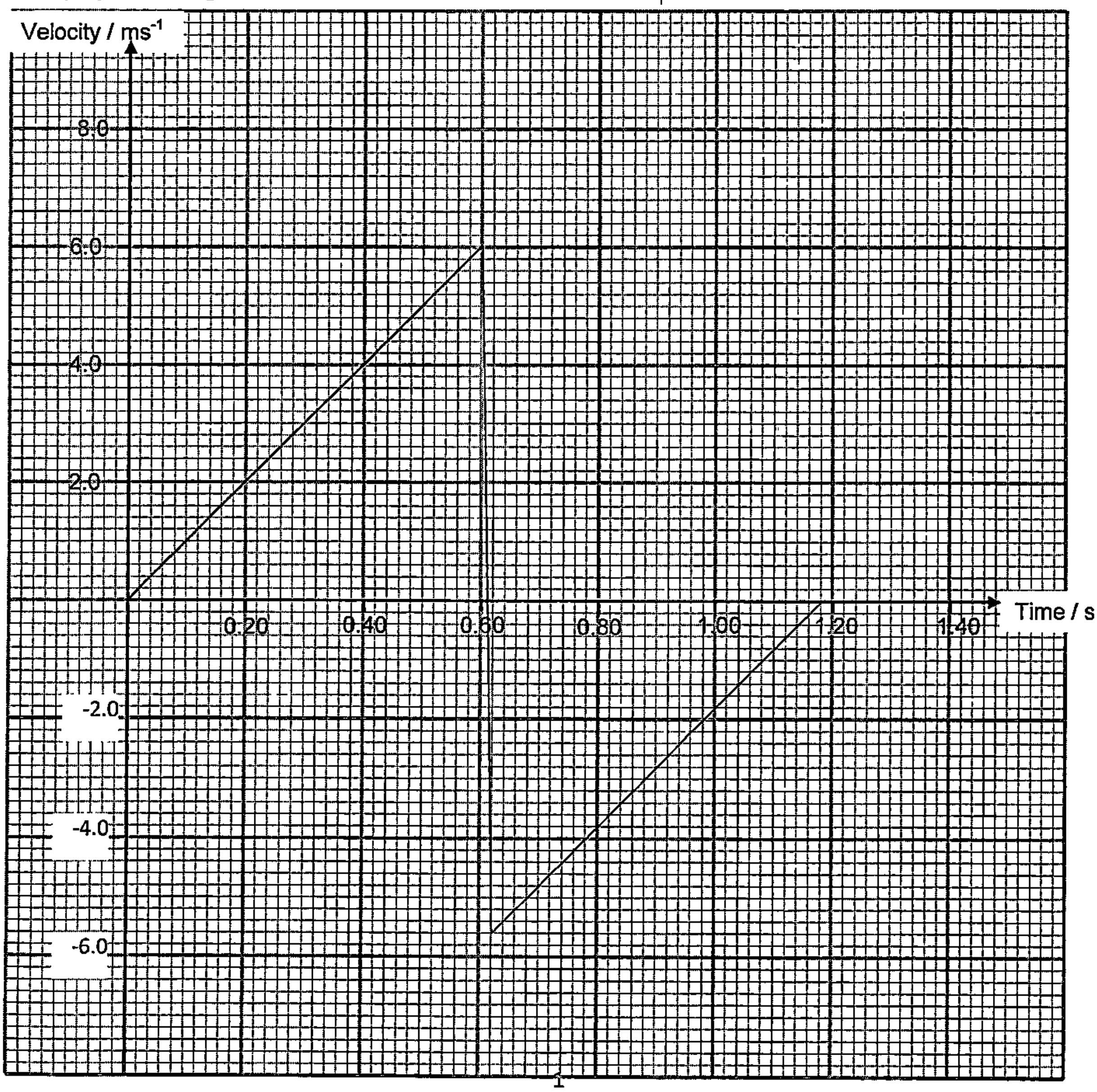
$s = 1.6$ m (2 sf) B1

(iii) $v = u + at$, $t = (0 - 5.6) / (-10.0)$ B1

$t = 0.56$ s (2 sf) A1

(B1may be awarded if student failed to draw any line), allow ecf

B1 for line from (0.60, 6.0) to (0.62 ,-5.6) and B1 for line from (0.62 ,-5.6) to (1.18, 0); without proper marking on axes deduct 1 m



2 (a) Friction = 18 N as slope of the graph gives us velocity of the box. Since the slope of the position time graph is constant, velocity of the box is also constant. As a result, acceleration of the box becomes zero indicating the forces acting on box are balanced.

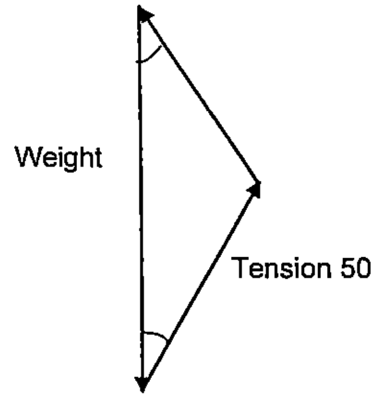
(b) The box starts to accelerate [B1] at a = (20 -18) / 4 = 0.50 ms^{-2} (B1 for magnitude).

3(a) It is a point where the entire weight of the object appears to act irrespective of its orientation. [B1]

(b) Scale. 1 cm : 5 N [B1]

Reaction = 44.0 N [B1]

Correct closed triangle [B1]



4 (a) (i) P = hρg

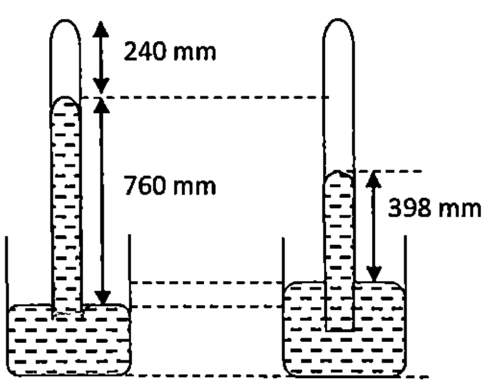
101000 = h x (13600) x 10.0 [M1]

h= 0.74265

= 0.743 m [A1]

(ii) To test for a faulty vacuum, incline the tube until its top end is below the horizontal level extended from 0.743 m of the height above the reservoir. If the whole of mercury fills the tube then there is no air trapped inside. [B1]

(b)



$h_{atm}\rho_{air} = h_{Hg}\rho_{Hg}$

$h_{atm}(1.23) = 0.760 \times 13600$

$h_{atm} = 8403.3$ m

Hence at 4000m height h_{Hg} = (8403.3 -4000) / 8403.3 x x 0.760

= 0.398 m Hg (3 sf) [B1]

Drawing [B1]

5(a) Moment = 50 x 0.10 = 5.0 Nm [B1]

(b) At P, Pressure P = F/A = 50.0 / 20.0 = 2.50 Ncm^{-2} [B1]

This pressure is transmitted to Piston Q.

Hence $F_Q = P \times A_Q$ = 2.50 x 800 = 2000 N [B1]

(c) Method 1: work done is same at P and Q,

$F_P \times D_P$ = 50.0 x 0.100 = 5.00 J [B1]

Hence $D_Q = 5.00 / F_Q$ = 5.00 / 2000 = 2.5 x 10^{-3} m [B1]

OR Method 2: Volume of fluid is conserved

At P volume of fluid pushed downwards, V = 20.0 x 10.0 = cm^3

At Q, rise in height = V / A_Q = 200 / 800 = 0.250 cm = 2.5 x 10^{-3} m

6 (a) Any of the 6 differences Eg no bubbles against bubbles (boiling); boiling occurs at a fixed temperature ... [B1]

(b)(i) The air pressure in the bell jar is lower than atmospheric pressure as less air particles are present now. [B1]

Although the internal work done to overcome forces of attraction between molecules remains unchanged, the external work done against the atmosphere has been reduced significantly. This reduces the amount of PE required by the water particles to vaporise. [B1]

(ii) As the temperature of a substance is directly proportional to its sum of KE, the more energetic molecules still need sufficient energy to **overcome attractive forces** due to other molecules to escape from the surface into the atmosphere. As less energetic molecules are left behind, the **average** kinetic energy of the molecules **decreases** and the temperature **decreases.[B1]**

7(a)(i) Shows convection current in clockwise direction from the sea.
7(a)(ii) Land and the adjacent water body are subjected to the uneven heating during the daytime. The land, which has a low specific heat capacity heats up much more quickly than water. (B1)
As the land warms up, the air next to it heats by conduction and rises. (or first B1 here)
As the warmer air rises by **due to its lower density,** cooler air is drawn from the ocean to fill the void. The warmer air mass returns to sea at higher levels to complete a convective **current.** (need to write different density for second B1)

(b)

(i) Energy given up by the aluminium in cooling to 100°C

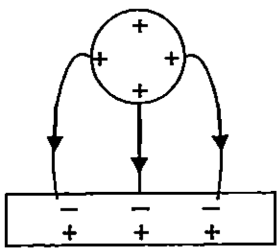
$= mc\Delta\theta = 3 \times 910 \times (600 - 100) = 1365000$ J. B1

(ii) To heat 2 kg of water from 25°C to 100°C requires $2 \times 4200 \times (100 - 25) = 630000$ J. B1

Available energy for boiling water = 1365000 J – 630000 – 5000 = 730000 J B1

Mass of water boiled away = E/l = 730000 / 2260000 = 0.323 kg. A1

8 (a)



B1 direction

B1 pattern

(b) (i) When the positively charged particles are brought near to the metal, the electrons of the metal part are induced to the surface nearer to the positively charged paint particles. [B1] Since unlike charges attract, the positively charged particles will be attracted to the electrons of the metal. [B1]

(ii) All paint particles are positively charged of the same amount. [B1]
Since like charges repel, the particles will be repelled away from each other, allowing them to be spread out more uniformly on the metal. [B1]

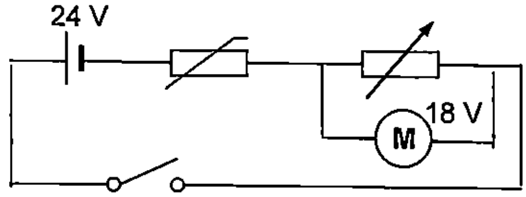
9 (a)$\rho = RA / l = 48.8 \times [(3.142/4 \times (0.30 \times 10^{-3})^2] / (200)$ [M1]

$= 1.73 \times 10^{-8} = 1.7 \times 10^{-8}\ \Omega$m A1 (2 sf) check sf here

9 (b) (i) No. When the intensity of light reduces, the resistance of LDR increases but potential **difference across lamp remains unchanged as lamp is connected in parallel.** [B1] **Current flowing through lamp does not change** and therefore the lamp remains lit throughout when the switch is closed. [B1]

(b) (ii) ammeter reading increases [B1]

(c) (i) thermistor drawn in series with variable resistor.[B1]
motor in parallel with variable resistor [B1]



(ii) (When the switch is closed) and temperature rises, the potential difference across the variable resistor would become higher than the thermistor. Hence there is enough pd to drive the motor. [B1]

10 (a) (i) The ratio of the speed of light in vacuum to the speed of light in water is 1.33. [B1]

(ii) The ray of light is incident from an optically less dense (rarer) medium to optically denser medium. Hence TIR cannot occur.[B1]

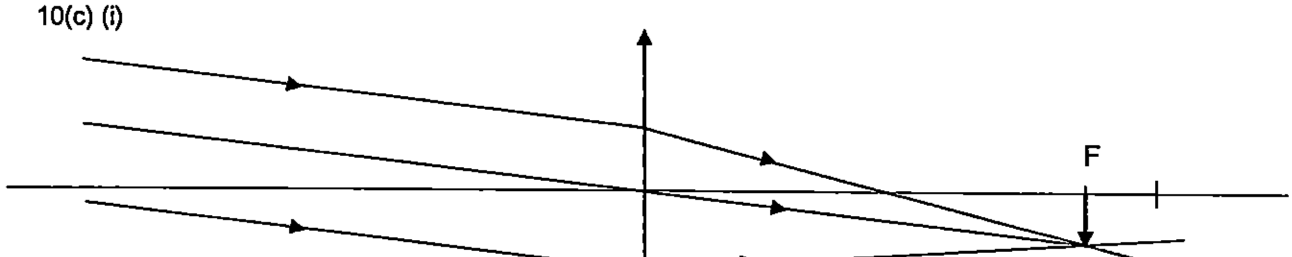
(iii) $n_1 \sin i = n_2 \sin r$

$n_2 = (1) \times \sin 49 / \sin 30 = 1.51$ [B1]

$c = \sin^{-1}(1/1.51) = 41.5°$ [B1]

10(b) The distance between the optical centre and principal focus is 6.0 cm

10(c) (i)



B1: centre ray

B1: 2 rays to join at F at 6.0 cm

B1: inverted image at 6.0 cm

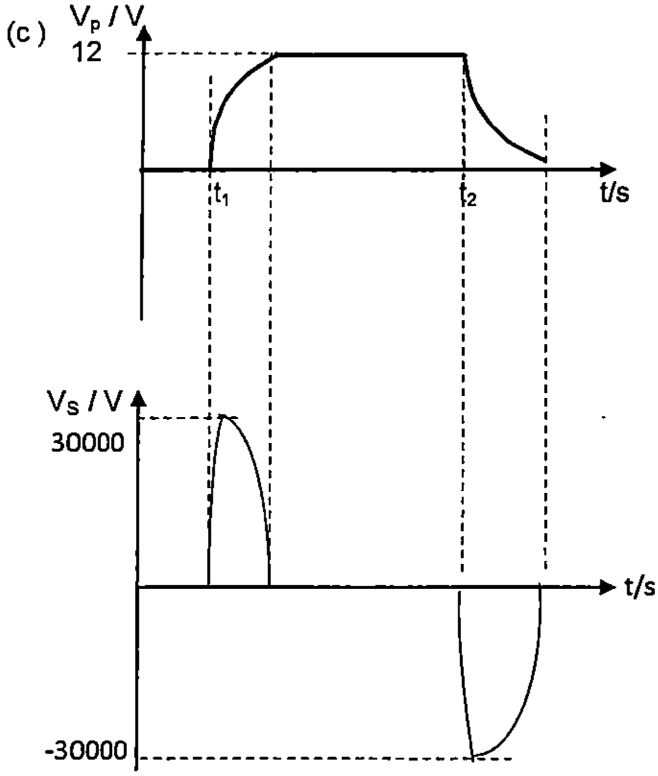
10(c)(ii) Image remains unchanged in size. Still inverted. [B1]

(iii) The image becomes less bright, while still being inverted [B1]

11 (a) The change in current in the primary coil sets up changing magnetic flux linkage within the secondary coil and hence induce an emf in it according to Faraday's law of EMI. B1

11(b) Type A. A High output or secondary voltage is required for a spark to be formed.[B1]

(c)



B1: 2 peaks on opposite sides of t axis

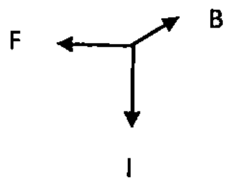
B1: No voltage when dc voltage in, primary is constant at 12 V

(d) Thick wires should be used to reduce heating effect or power loses during transmission of power. (Note the current is 165 A in the primary circuit) [B1]

(e) Battery is absent and there will be no change in magnetic flux linkage.[B1]

(f) (i) ↑ [B1]

(ii) From Flemings Right Hand Rule [B1]
the induced current is down the rod and the current flows in an clockwise loop. [B1]



12 Either

(a) (i) The silver and smooth surfaces are good reflectors / poor absorbers of infra-red radiation, hence making the cooking faster. [B1]
(ii) Infra-red energy is transmitted directly to the food via radiation at 3×10^8 m/s, heating up the molecules on the surface of the food, [B1]
For the oven, heat energy is used to heat up the air in the convection current before reaching the food and conduction. [B1]

(iii) I = P / V = 650 / 230 = 2.83 A [B1]

(b) (i) The metal casing becomes live (or will be at high electrical potential) and hence poses a hazard of electric shock to the user. [B1]

(b)(ii) when the live wire touches the casing in the presence of an earth wire, a large current will flow through the earth wire due to its low resistance. [B1]
The large current cause the circuit breaker to trip and disconnect the appliance from the mains, thus breaking the circuit or breaks the circuit or cause the appliance to be at a low potential. [B1]

b(iii) When a fault occurs, the solenoid in the circuit breaker becomes a very strong electromagnet. [B1]
Through magnetic induction the iron bolt is attracted to the solenoid. [B1]
The spring will now push the plunger and switch up and the circuit is now opened. [B1]
The circuit breaker remains **tripped until it has been reset by pushing the reset button. [B1 optional]**

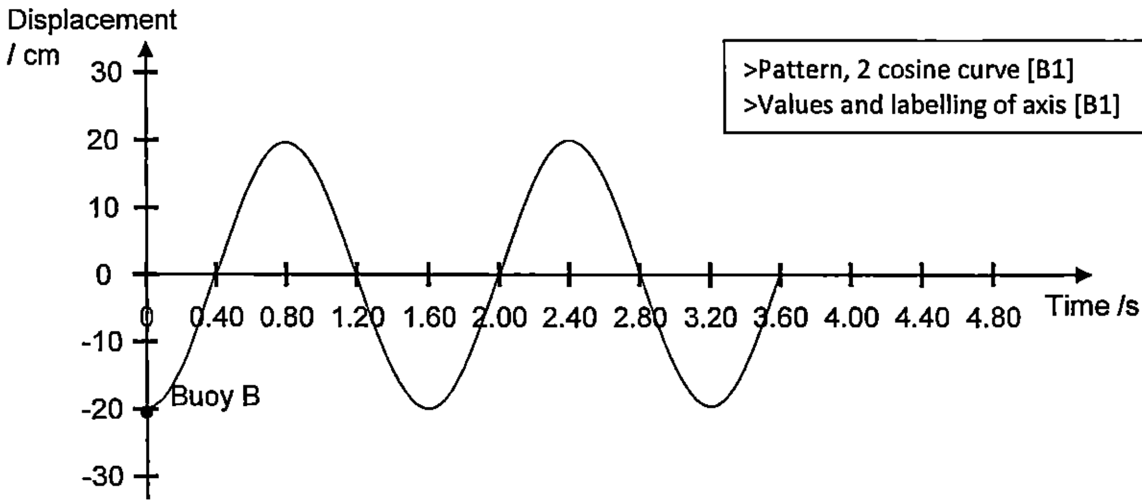
12 OR

(a) A wavefront is an imaginary line joining all the points of an advancing wave in the same phase.[B1]

(b) (i) As 0.80 s is required for half a wavelength, then T = 2 x 0.800 = 1.60 s [B1]

Hence f = 1 / 1 6 = 0.625 Hz [B1]

(ii)



>Pattern, 2 cosine curve [B1]
>Values and labelling of axis [B1]

(c) (i) Label the smaller pulse. The weaker pulse is lower in energy hence lower in amplitude. [B1]

(ii) v = fλ
1450 = 45000 x λ [B1]
λ = 0.0322 m [B1]

(iii) total time elapsed = 3.5 x 50 x 10^{-3} = 0.175 s
Time for one passage = 0.175 /2 = 0 0875 s [B1]
Hence depth = v x t
= 1450 x 0 0875
= 127 m [B1]

(d) The speed is unaffected. (At 1450 m/s) [B1]

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
A	B	B	C	A	C	C	C	D	A
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
C	A	D	A	D	D	D	A	B	D
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
C	B	C	A	C	C	B	C	C	B
Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
B	C	C	C	C	C	C	A	D	C

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2015

SUBJECT	:	PHYSICS 5059 (PAPER 1)	DATE	:	31 AUG 2015
LEVEL	:	SECONDARY 4 EXPRESS	DURATION	:	1 HOUR

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write your name, class and index number on the **Question Paper** and the **Optical Answer Sheet** in the spaces provided. **It is also required that you WRITE and SHADE your index number on the Optical Answer Sheet.**

2. Answer **ALL** questions on the **Optical Answer Sheet** provided.

3. Throughout the paper, the **acceleration due to gravity on Earth** is taken as 10 N/kg **unless stated otherwise.**

4. Calculators may be used where necessary. **Where numerical answers are not exact, give answers to THREE (3) significant figures.**

5. Submit the **Optical Answer Sheet** and the **Question Paper SEPARATELY** at the end of the examination.

This question paper consists of 16 *printed pages.*

Each question is provided with ***four*** *possible answers (**A**, **B**, **C** and **D**). Select the most appropriate answer and* ***shade*** *your choice on the* ***Optical Answer Sheet*** *provided.*

1 Which one of the following is **correct**?

A The length of a bus is about 1×10^2 m.
B The diameter of an atom is about 1×10^{-5} m.
C The diameter of the Earth is about 1×10^7 m.
D The thickness of a human's hair is about 1×10^{-3} m.

2 **Figure I** shows the reading of the zero error of the micrometer screw gauge.
Figure II shows the reading of the same instrument when it is used to measure the width of an object.

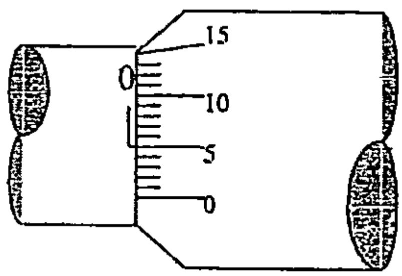


Figure I

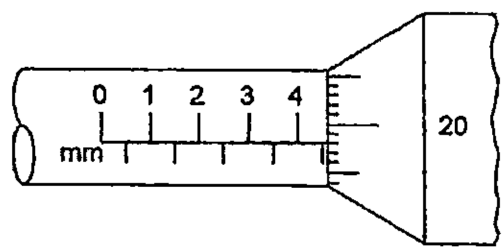


Figure II

What is the **actual** width of the object?

A 4.63 mm
B 4.73 mm
C 4.83 mm
D 4.85 mm

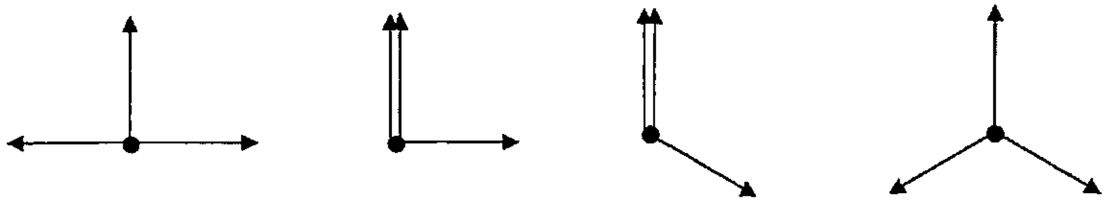
3 A pendulum clock is found to be too slow.

Which one of the following would set the clock right?

A Increase the angle of displacement
B Increase the length of the pendulum
C Decrease the angle of displacement
D Decrease the length of the pendulum

4 Three forces of the same magnitude **F** act simultaneously on a small object.

Which one of the following combination of forces will give the greatest resultant force?



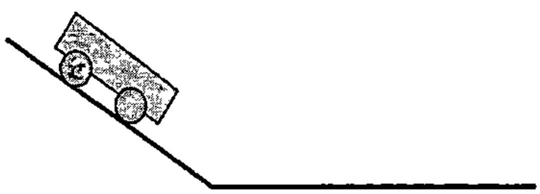
A B C D

5 A car, initially travelling at 20 m/s, took 5 seconds to slow down to 5 m/s.

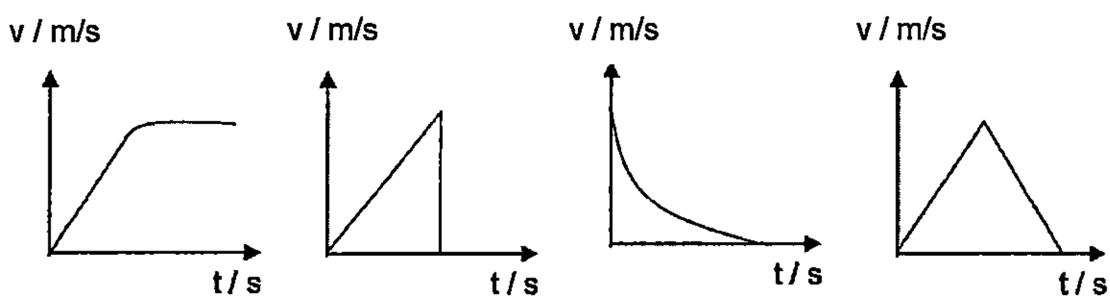
What was the average deceleration of the car?

A	$-5\ m/s^2$	**B**	$-3\ m/s^2$
C	$3\ m/s^2$	**D**	$5\ m/s^2$

6 The diagram shows a trolley that starts rolling down a sloping runway connected to a flat floor. All the surfaces are smooth.

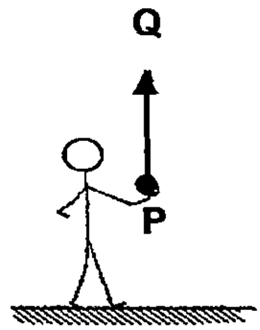


Which one of the following velocity-time graphs best illustrates the motion of the trolley?



A **B** **C** **D**

7 A ball is thrown vertically upwards from a point **P**. It reaches the greatest height at **Q** and then falls back to **P** where it is caught.



Neglecting air resistance, which of the following statement(s) is/are **correct**?

I Acceleration at **Q** is zero.
II The total displacement of the ball is zero.
III The ball experiences a steady decreasing upward force when it rises from **P** to **Q**.

A I only **B** II only
C II and III only **D** I, II and III

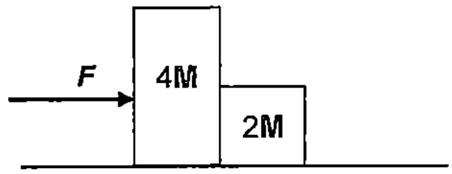
8 A motorist travelling at 10 m/s can bring his car to rest in a distance of 10 m. If he had been travelling at 30 m/s, in what distance could he bring the car to rest using the same braking force?

A 17 m **B** 30 m
C 52 m **D** 90 m

9 A car travelling at 30 m/s has to brake suddenly to avoid an accident. If the man inside weighs 80 kg and it takes 3 seconds to stop completely, what is the average force the safety belt exerts on the man?

A 240 N **B** 400 N
C 500 N **D** 800 N

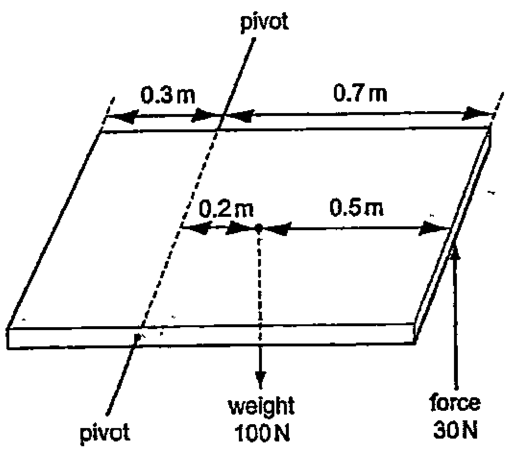
10 Two blocks with masses 4M and 2M are pushed along a horizontal frictionless surface by a horizontal applied force F as shown in the diagram. During the motion, both blocks exert equal and opposite forces against each other. What is the magnitude of the force?



A $\frac{F}{3}$ **B** $\frac{F}{2}$

C $\frac{2F}{3}$ **D** F

11 A pivoted window, weighing 100 N, is opened with a force of 30 N.

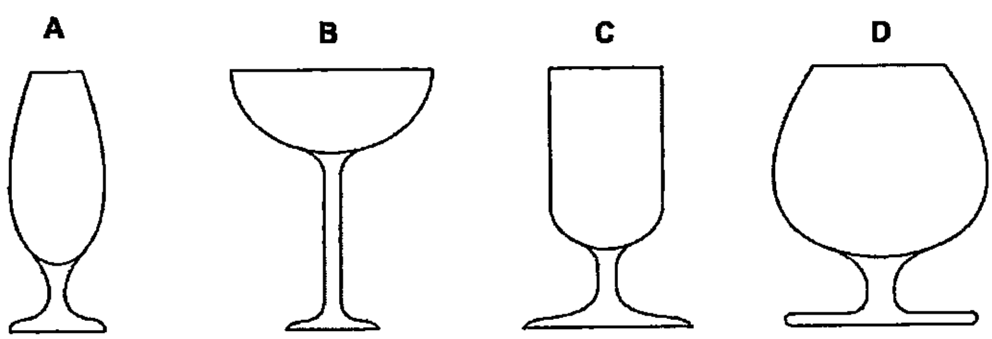


What is the magnitude of the resultant moment about the pivot?

A 1 Nm **B** 5 Nm
C 35 Nm **D** 41 Nm

12 The diagrams show the cross-section of different glasses.

Which one is the **least** stable when filled with a liquid?

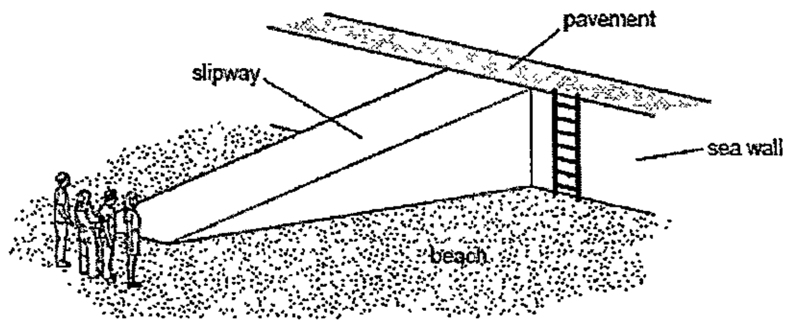


13 A ball is released from a height $\boldsymbol{h}$ above a table. The air resistance is assumed to be negligible and 50% of its kinetic energy is lost at each bounce. What is the speed of the ball right before it touches the ground for the third bounce?

A $\frac{gh}{\sqrt{4}}$ **B** $\frac{gh}{\sqrt{2}}$

C $\sqrt{\frac{gh}{4}}$ **D** $\sqrt{\frac{gh}{2}}$

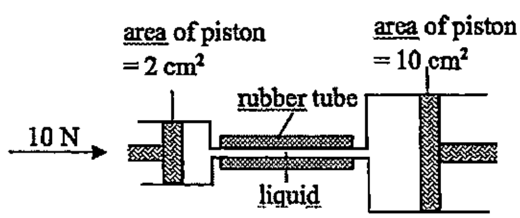
14 Four people of equal weight are standing on a beach. Each of them uses a different route to get to the top of a sea wall.



Which person produces the **greatest** average power?

	Route	Time taken /s
A	Runs up the slipway	5
B	Runs across the beach and climbs up the ladder	8
C	Walks up the slipway	10
D	Walks across the beach and climbs up the ladder	16

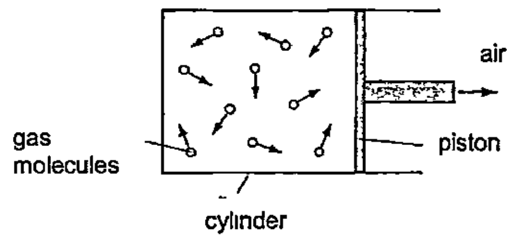
15 The diagram shows two syringes connected by a rubber tube. The space between the two pistons is filled with a liquid. The areas of the small piston and the large piston are 2 cm^2 and 10 cm^2 respectively. A force of 10 N is applied to the small piston. What is the ratio of the pressure acting on the small piston to the pressure acting on the large piston?



A 1 : 1 **B** 1 : 2

C 1 : 5 **D** 5 : 1

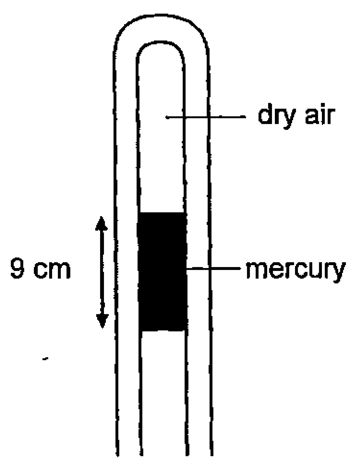
16 Gas inside a cylinder is heated slowly to a higher temperature. The pressure inside the cylinder remains constant as the piston moves outwards.



How does the speed of the gas molecules and their rate of collision with the piston compare with their initial values at the lower temperature?

	Speed of molecules	Rate of collision
A	Greater	Greater
B	Greater	Reduced
C	Greater	Same
D	Same	Greater

17 The diagram shows a column of air enclosed in a narrow capillary tube by a thread of mercury 9 cm in length. The atmospheric pressure is 76 cm Hg.



What is the pressure on the trapped air?

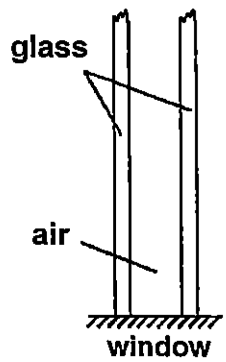
A 9 cm Hg B 67 cm Hg
C 76 cm Hg D 85 cm Hg

18 When an object is being heated, which of the following statements is/are **true?**

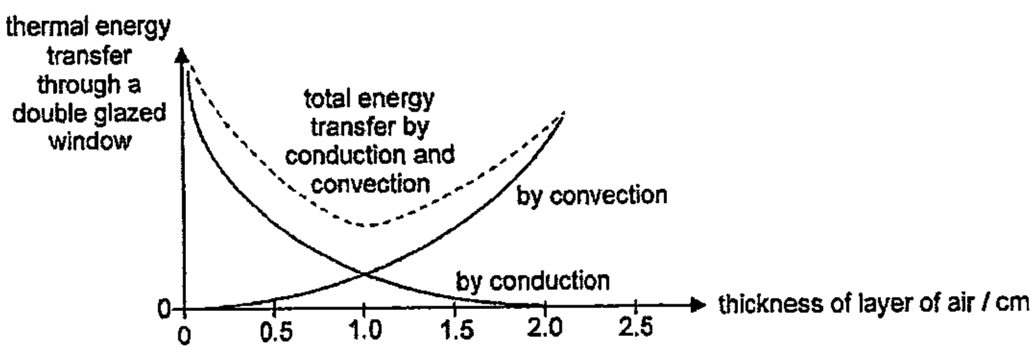
I The object's temperature will increase continuously.
II The total internal energy of the object will increase.
III The kinetic and potential energy of the particles of the object cannot rise at the same time.

A I only B I and II only
C II and III only D I, II and III

19 A double-glazed window has two sheets of glass separated by a layer of air.



Thermal energy is transferred through the layer of air by conduction and and convection. The amount of conduction and convection depends on the thickness layer of air as shown in the graph.



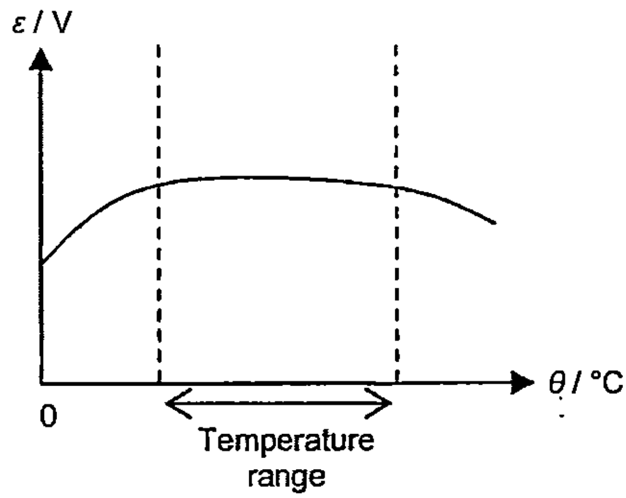
A specially designed room is to be installed with these double-glazed windows. The temperature of this room is kept constant with fluctuations in temperature to be kept to a minimal. What thickness layer of air of the installed double-glazed windows will best maintain the temperature of the room and why?

A 0.5 cm because there is little convection.
B 1.0 cm because the total thermal energy transfer is minimal.
C 1.5 cm because the total thermal energy transfer is small and conduction is low.
D 2.0 cm because there is little conduction.

20 Which one of the following observations shows that conduction is a faster mode of heat transfer than convection and radiation?

A The people sitting around a camp fire feel the heat.
B Food in microwave oven seldom takes more than 3 minutes to cook.
C The barbeque sausage usually has a burnt pattern alike the barbeque mesh when left unattended for some time.
D Heating the base of a test tube of water with some ice floating at the top of the tube usually takes some time for the ice to melt.

21 The diagram shows a graph of how the e.m.f., ε / V, of a thermocouple varies with temperature, θ / °C.



Why is the thermocouple inappropriate for measurement of temperature in the range as shown?

A The thermocouple produces an e.m.f. at 0 °C.
B The relationship between ε *and* θ is non-linear.
C The thermocouple does not always indicate a unique value of e.m.f..
D The e.m.f. has not been measured using temperatures using the kelvin scale.

22 Four bars, all exactly the same size, are placed with one end in boiling water. The time taken for the temperature of the other end to increase by 2 °C are measured.

Material of bar	Time for 2 °C rise / s
1	10
2	5
3	800
4	1200

To design a kettle with a heating element with the least heat loss, which materials should be used for the heating element of the kettle and its insulation?

	Heating element	Insulation
A	1	3
B	1	4
C	2	3
D	2	4

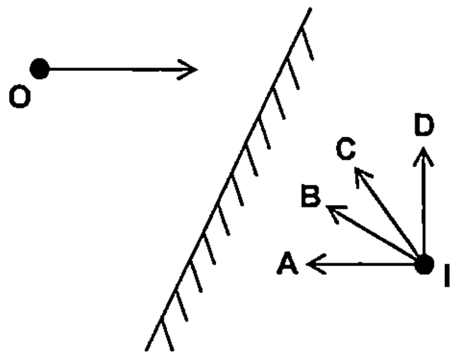
23 A copper container has a mass of 84 g. It contains 84 g of cold water at 10 °C. 46 g of hot water at 100 °C is poured into the water in the copper container.

Given that the specific heat capacity of water is 4200 J/(kg°C) and the specific heat capacity of copper is 400 J/(kg°C).

What is the final temperature of the mixture in the container?

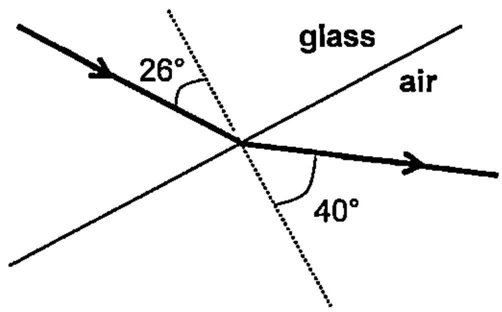
A 10.0 °C B 26.7 °C
C 40.0 °C D 80.0 °C

24 An object placed in front of a plane mirror at **O** produces an image at I.



If the object moves towards the mirror in the direction shown, in which direction does the image move?

25 The diagram shows a ray of light traveling from glass into air.



The angle of incidence is 26° and the angle of refraction is 40°.

If the speed of the light in air is 3.0×10^8 m/s, what is the speed of light in the glass block?

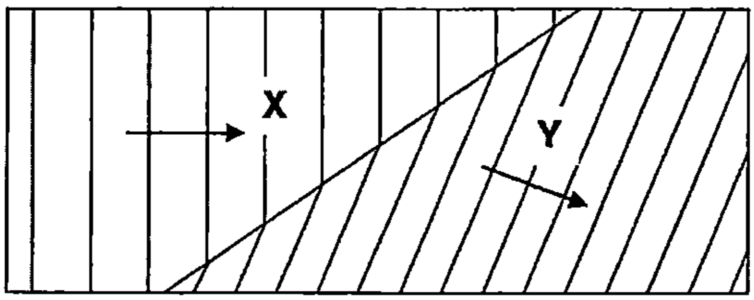
A 1.7×10^8 m/s B 2.0×10^8 m/s
C 2.2×10^8 m/s D 4.4×10^8 m/s

26 Converging lenses **A** and **B** have the same focal length, but **B** is only half the diameter of **A**. Both lenses are used to form images of a distant object on a screen on two separate occasions.

Which one of the following statements is **correct** about the images formed?

A Both the images are real and inverted.
B Both the images are of the same brightness.
C Image formed by **B** is bigger than image formed by **A**.
D Image formed by **B** is closer to the lens than image formed by **A**.

27 The diagram shows water waves travelling from section X to section Y in a ripple tank.

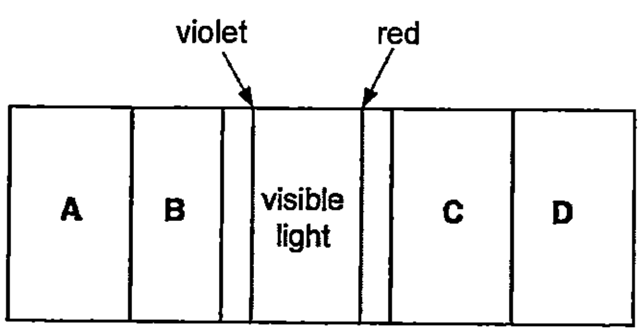


Which of the following statement(s) is/are **correct**?

I Section X is deeper than section Y.
II The speed of the waves in section X is higher than that of the waves in section Y.
III The frequency of the waves in section X is equal to that of the waves in section Y.

A I only	**B** III only
C I and II only	**D** I, II and III

28 The diagram shows the electromagnetic spectrum, with the blue and red ends of the visible spectrum marked. Which section of the spectrum has waves that are used in satellite communication?



29 A man stands between two parallel walls. When he claps his hands once, he hears the first two echoes 0.4 s and 0.8 s later. If the speed of sound in air is 340 m/s, what is the distance between the walls?

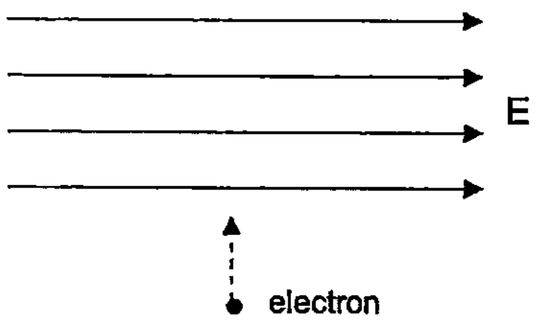
A 68 m
B 136 m
C 204 m
D 408 m

30 Which of the following will affect the speed of sound in air?

I The loudness of the sound.
II The frequency of the sound.
III The temperature of the air.

A I only
B III only
C I and II only
D I, II and III

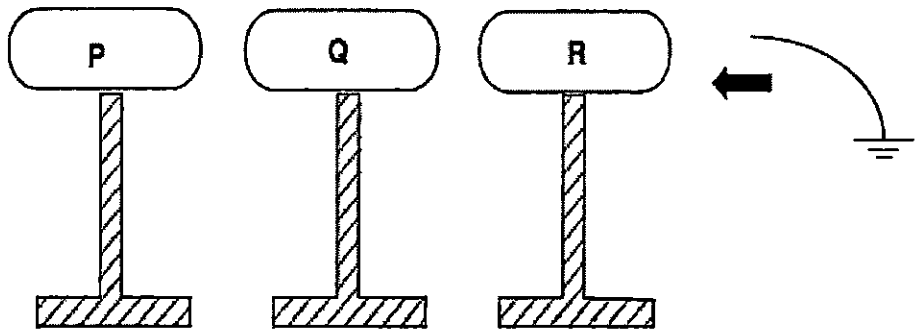
31 An electron is projected at right angles to a uniform electric field **E** as shown in the diagram.



In the absence of other fields, in which direction is the electron deflected?

A To the left
B To the right
C Into the plane of the paper
D Out of the plane of the paper

32 P, **Q** and **R** represent blocks of copper mounted on insulating stands that are apart from each other as shown in the diagram.

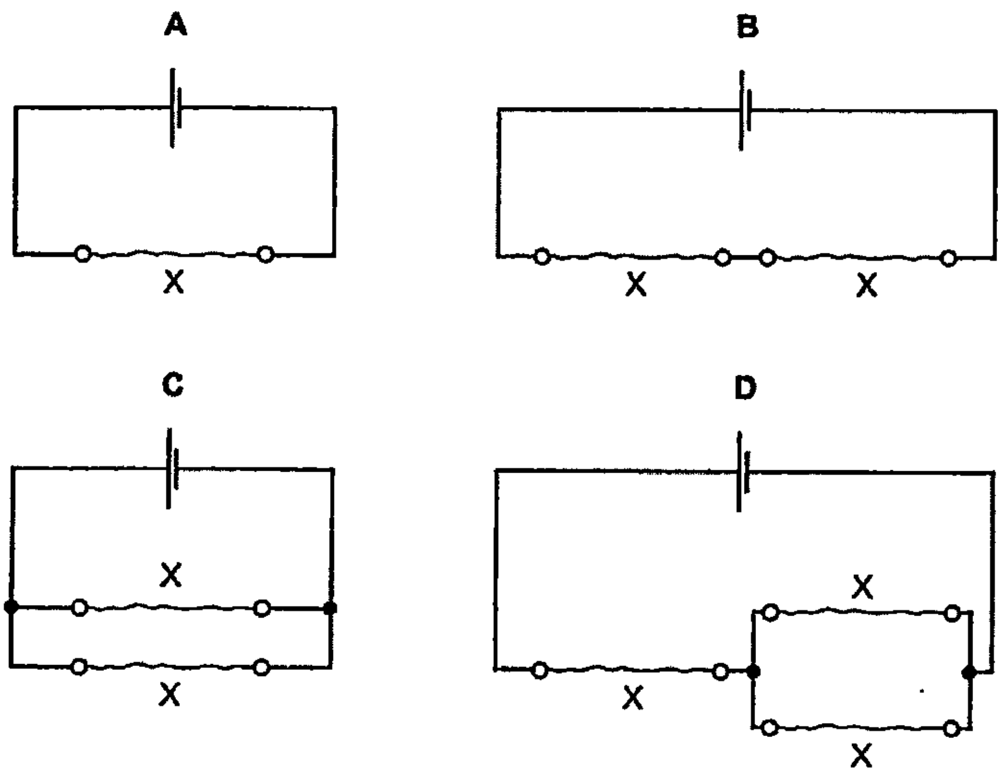


At the start of an experiment, **P** was charged positively while **Q** and **R** were electrically neutral. When **R** is momentarily earthed, which one of the following statements describes **correctly** the charges on **Q** and **R**?

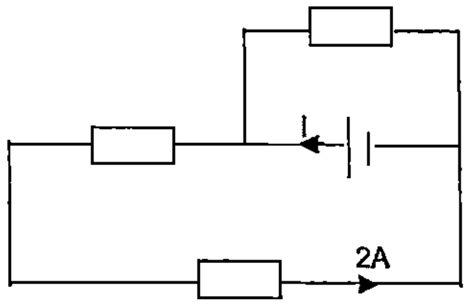
A **Q** and **R** both carry positive charges.
B **Q** and **R** both carry negative charges.
C **Q** remains neutral but **R** carries negative charges.
D **Q** carries negative charges but **R** carries positive charges.

33 The circuit diagrams show identical pieces of resistance wire **X** connected to the same cell in different ways.

In which circuit will the cell lose its energy at the **fastest** rate?



34 Three identical resistors are connected in a circuit as shown.



Find the value of the current, **I**.

A	2 A	**B**	3 A
C	4 A	**D**	6 A

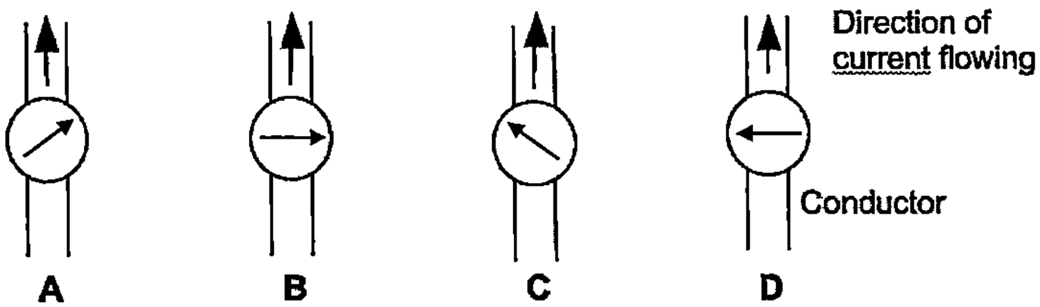
35 Why is it dangerous to connect many appliances with high power ratings to one socket?

A The current in each appliance will increase.
B The current in each appliance will decrease.
C The voltage supplied to each appliance will increase.
D A large current will flow in the mains supply causing the main cable to overheat.

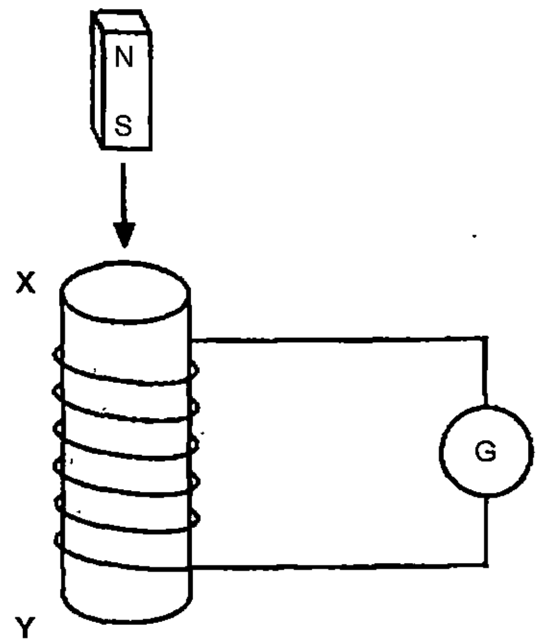
36 An electrical household appliance uses 12 kWh of electrical energy after 4 hours of operation. If one unit of electricity costs 26 cents, find the electrical power of the appliance and the cost of energy usage.

	Electrical power / kW	Cost / cents
A	3	104
B	3	312
C	12	312
D	48	1248

37 Which one of the following diagrams **correctly** indicates the position of a small compass needle placed above a straight conductor carrying current flowing as shown?



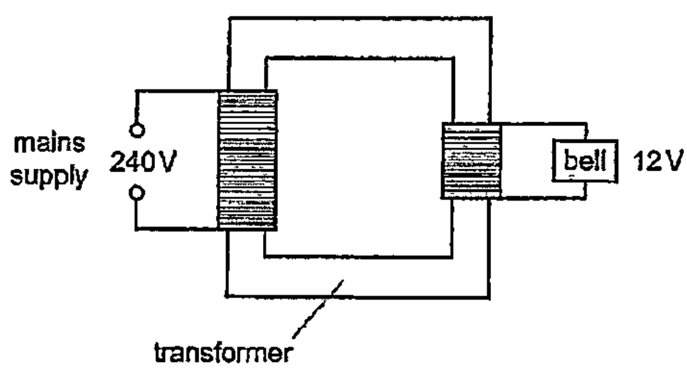
38 A magnet enters a coil at **X** and leaves at **Y**.



What is the polarity of the two ends of the coil when the magnet is entering and leaving the coil?

	Polarity of X (Magnet entering)	Polarity of Y (Magnet leaving)
A	N	N
B	N	S
C	S	N
D	S	S

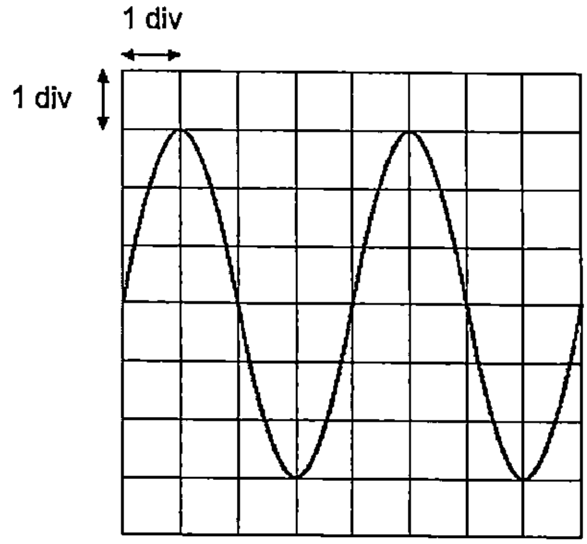
39 The diagram shows a transformer operating a door bell.



The mains supply of 240 V is connected to the transformer. The bell has a resistance of 8.0 Ω and the output voltage from the transformer is 12 V. What is the current drawn from the mains supply?

A 0.075 A **B** 0.40 A
C 1.5 A **D** 30 A

40 The diagram shows a voltage output waveform of an a.c. generator as displayed on a cathode-ray oscilloscope (C.R.O.).



If the frequency is 25 Hz and the voltage is 12 V, which one of the following shows the **correct** settings for the time-base and the Y-gain?

	Time-base	Y-gain
A	10 ms / div	4.0 V / div
B	10 ms / div	2.0 V / div
C	20 ms / div	2.0 V / div
D	20 ms / div	4.0 V / div

END OF PAPER

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2015

SUBJECT	:	PHYSICS 5059 (PAPER 2)	DATE	:	24 AUG 2015
LEVEL	:	SECONDARY 4 EXPRESS	DURATION	:	1 H 45 MIN

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write your name, class and index number on the **Question Paper** in the spaces provided.
2. Answer **ALL** questions in **Section A** in the spaces provided.
3. Answer **ALL** questions in **Section B** in the spaces provided. Question **12** is an **EITHER / OR QUESTION. SELECT ONLY ONE PART OF THIS QUESTION**.
4. Throughout the paper, the **acceleration due to gravity on Earth** is taken as 10 N/kg **unless stated otherwise.**
5. Candidates are reminded that **all** quantitative answers should include appropriate units. The use of an approved scientific calculator is expected, where appropriate.
6. Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.
7. **DO NOT DETACH** any sections from this paper.
8. Submit this paper at the end of the examination.

For Examiner's Use Only

Section	A [50 m]	B [30 m]	P1 [40 m]	Total [120 m]	Grade	Target Grade
Score						

This question paper consists of 20 printed pages.

SECTION A : [50 marks]

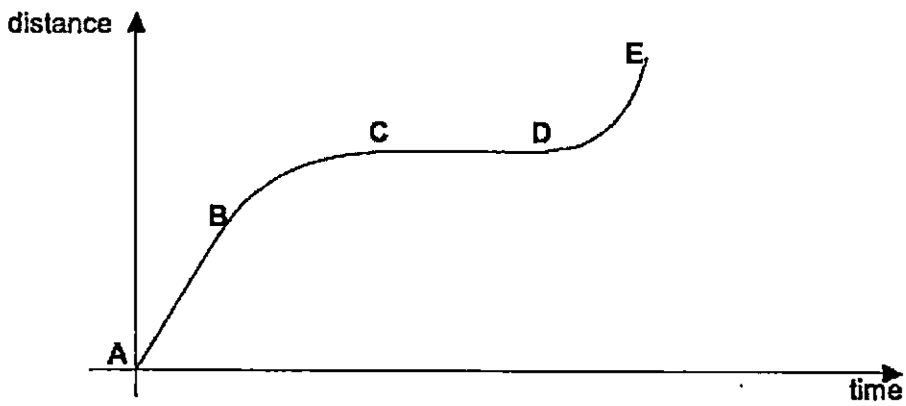
Answer ALL *questions in this section. Show your working and write your answers in the space provided.*

1 **(a)** State a difference between ***speed*** and ***velocity***.

____

____ **[1]**

(b) The diagram shows a distance-time graph for an object.



Describe the motion of the object from **A** to **E**.

____

____

____

____ **[2]**

(c) State how you can obtain the average speed of the object for the entire journey.

____ **[1]**

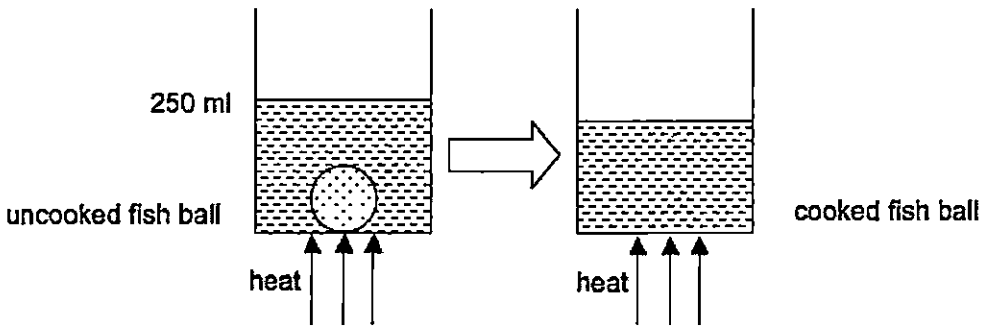
(d) The object travels in a straight line and in the same direction from **A** to **E**. Would the ***average speed*** and the ***average velocity*** of the object be the same for the entire journey? Explain your answer.

____

____

____ **[2]**

2 An uncooked fish ball of 52 g is placed into a beaker of 200 ml water and the water rises to 250 ml. Heat is applied to the beaker of water. The process is shown in the diagram.



(a) Calculate the density of the uncooked fish ball.

[2]

(b) Draw in the diagram, the position of the **cooked fish ball**. Explain your answer.

____

____

____

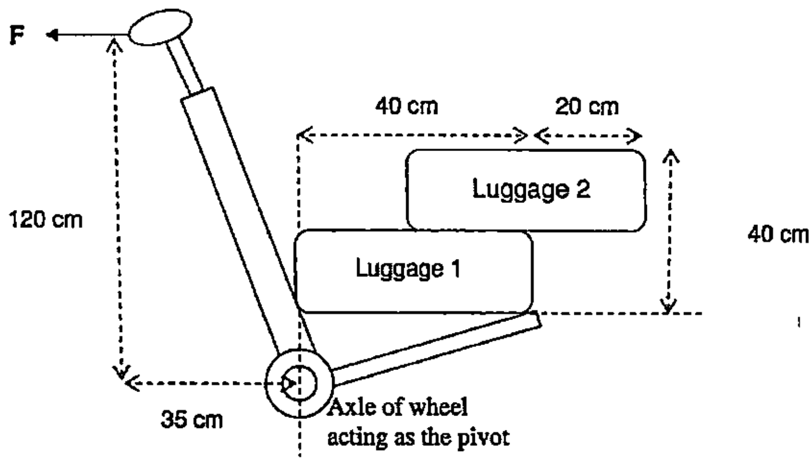
____ [3]

(c) The process is repeated using salt water, with a density of 1.2 g/cm^3. State any observation(s) when both uncooked and cooked fish ball are placed in the beaker.

____

____ [1]

3 An airplane passenger places two identical luggages, each of mass 15 kg, onto a trolley as shown in the diagram. The centre of mass of each luggage is in the middle of each luggage. He applies a force **F** at the handle to raise the luggages to the horizontal position shown.



(a) Calculate the force **F** applied at the handle to keep the luggage horizontal.

[2]

(b) The airplane passenger wheels the trolley as shown in the diagram for a distance of 150 m. The frictional force on the trolley is 25 N. What is the useful work done by passenger?

[2]

(c) If the airplane passenger let go of the handle, the trolley will become upright. What will happen to **luggage 1** and **2**? Explain your answer.

____

____

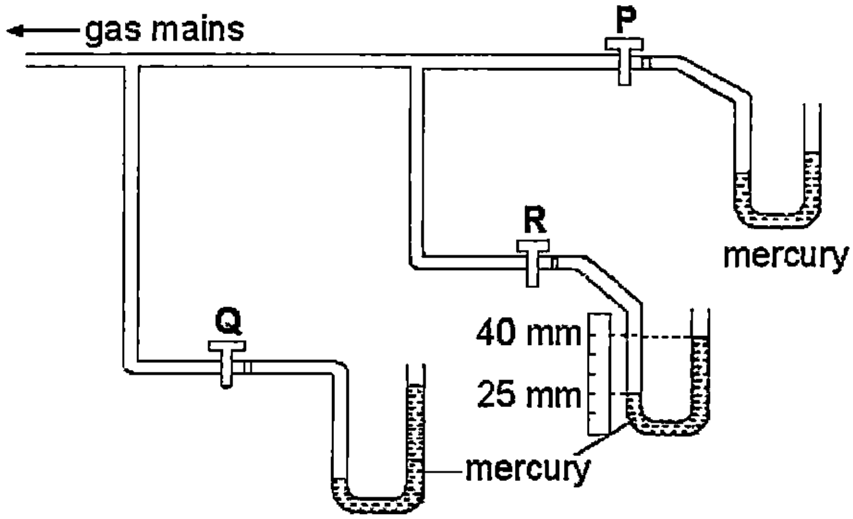
____

____

____

____ [3]

4 The diagram shows three identical mercury manometers connected to three gas taps for a particular experiment.



(a) At which gas taps **P**, **Q** or **R** is the gas pressure highest? Explain your answer.

____

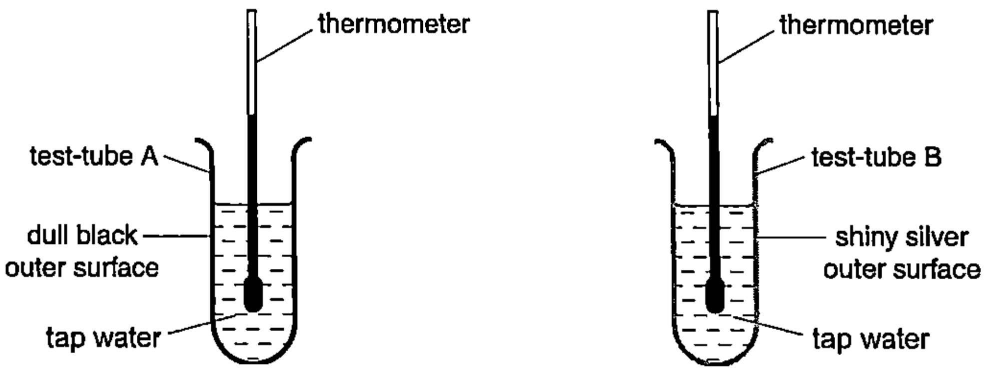
____

____ [2]

(b) At gas tap **R**, a ruler is placed by the manometer to find the difference in height of the two limbs. The readings in millimetres are shown in the figure. What is the gas pressure at **R** in Pa? Take atmospheric pressure to be 1×10^5 Pa, density of mercury to be 13600 kg/m^3 and gravitational field strength to be 10 N/kg.

[2]

5 The effect of surface colour on heating an object is investigated. The diagram shows two sets of apparatus used in this investigation.



Test-tube **A** has a dull black outer surface and test-tube **B** has a shiny outer surface. The test tubes containing tap water to be heated. Readings are taken every minute to allow heating curves to be plotted.

(a) Explain why it can be assumed that the tap waters in both test tubes are of the same temperature.

____

____ **[2]**

(b) On the graph, the room temperature is indicated. **Sketch and label clearly** the shape of the heating curves for test-tube **A** and for test-tube **B**.

[3]

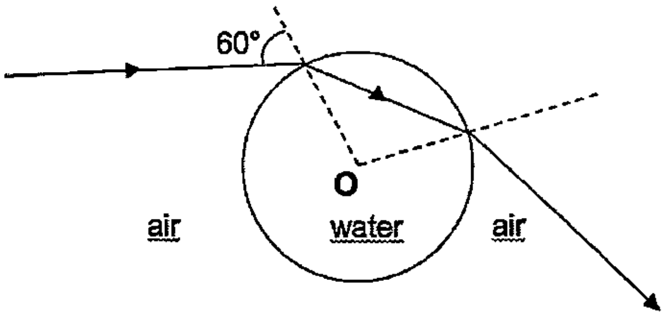
(c) Explain how the different surfaces of the test-tubes affect the shapes of the heating curves you have drawn in **(b)**.

____

____

____ **[2]**

6 The diagram shows the path of a light ray in a spherical water drop.



O is the centre of the water drop. The angle of incidence of the light ray to the water drop surface is 60°.

(a) Given the refractive index of water is 1.33, calculate the angle of refraction of the light ray in the water drop.

[2]

(b) Calculate the critical angle of water.

[2]

(c) Regardless of the angle of incidence of the light ray at the air-water boundary, the light ray will not exhibit total internal reflection at the water-air boundary as shown. By comparing the relevant angles at these two boundaries, explain why this is so.

____

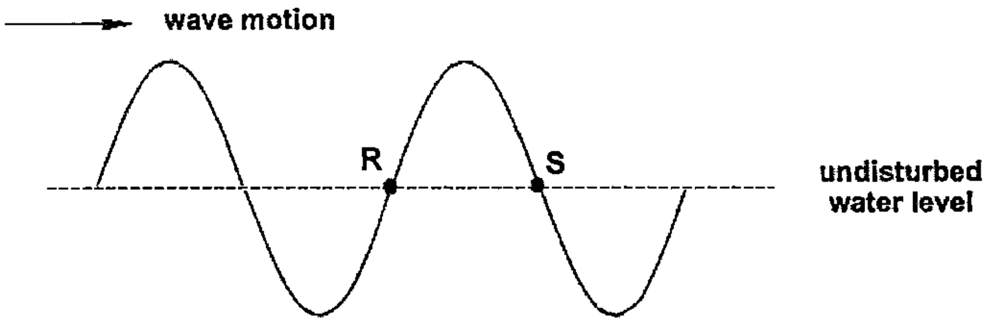
____

____

____

____ [2]

7 A water wave is travelling from left to right across the water surface of a pond at a speed of 24 cm/s. The diagram shows a snapshot of the wave at a certain moment. **R** and **S** are two water particles on the water surface. **R** moves up and down 50 times in one minute.



(a) What is the type of wave generated? Explain your answer.

____

____

____ **[2]**

(b) Determine

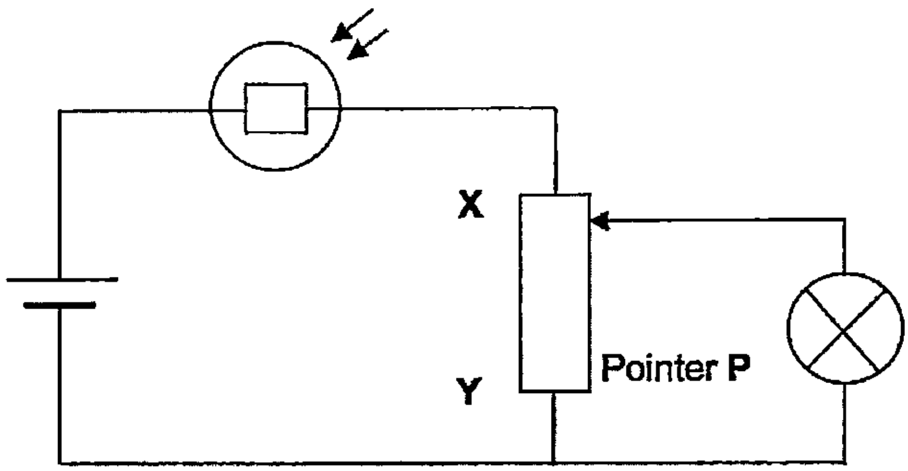
(i) the distance between **R** and **S**.

[2]

(ii) the time taken for **R** to reach the highest point.

[2]

8 The diagram shows a circuit consists of a light dependent resistor (LDR), a potentiometer **XY** and a lamp.



When little light falls on the LDR, its resistance is 3000 Ω. When the light of strong intensity falls on the LDR, its resistance is 500 Ω.

Describe and explain the conditions where the light bulb will be at its brightest.

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____

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____

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____

____

____ [3]

9 An iron ball is held at rest in the manner shown in **Figure I**.

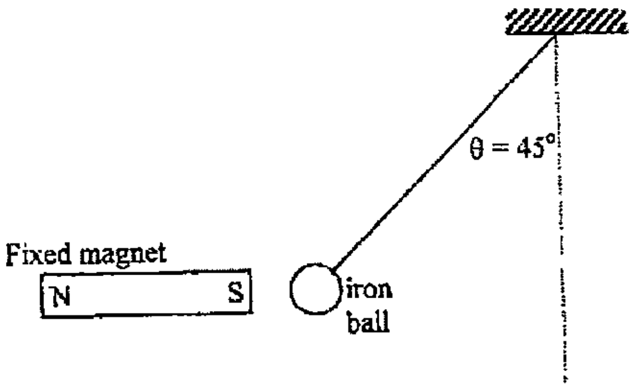


Figure I

When a horizontal bar magnet is held firmly about 2 cm away from the iron ball, the string attached to the iron ball makes an angle of $\theta = 45°$ from the vertical.

(a) Draw three arrows in **Figure I** showing the three forces acting on the iron ball. **[1]**

(b) If an iron cube is held firmly between the bar magnet and the iron ball as shown in **Figure II**, the angle θ would increase slightly.

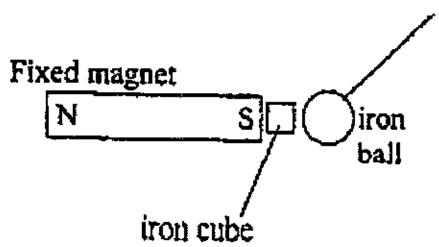


Figure II

Explain why θ increases.

____

____

____ **[2]**

(c) A wide iron sheet, instead of the iron cube, is placed between the bar magnet and the iron ball is shown in **Figure III**. The iron ball falls and finally comes to rest in the position shown.

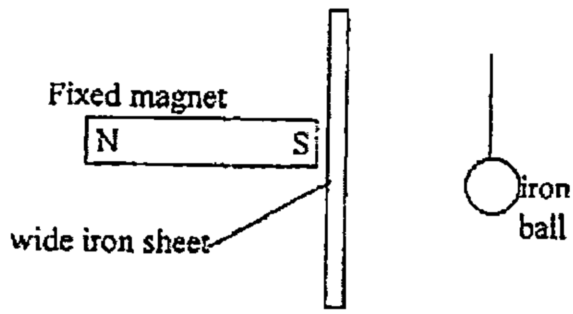


Figure III

Explain this. (You may draw a diagram to make your answer clear.)

____

____

____ [2]

SECTION B : [30 marks]

Each question is worth **10 marks.** *Answer* **ALL** *questions in this section.* **Question 3** *is an* **EITHER / OR QUESTION.** ***SELECT ONLY ONE PART OF THIS QUESTION.*** *Show your working and write your answers in the spaces provided.*

10 A wind turbine uses renewable energy source to generate electricity.

(a) **Figure I** shows how the power output of a wind turbine varies with wind speed.

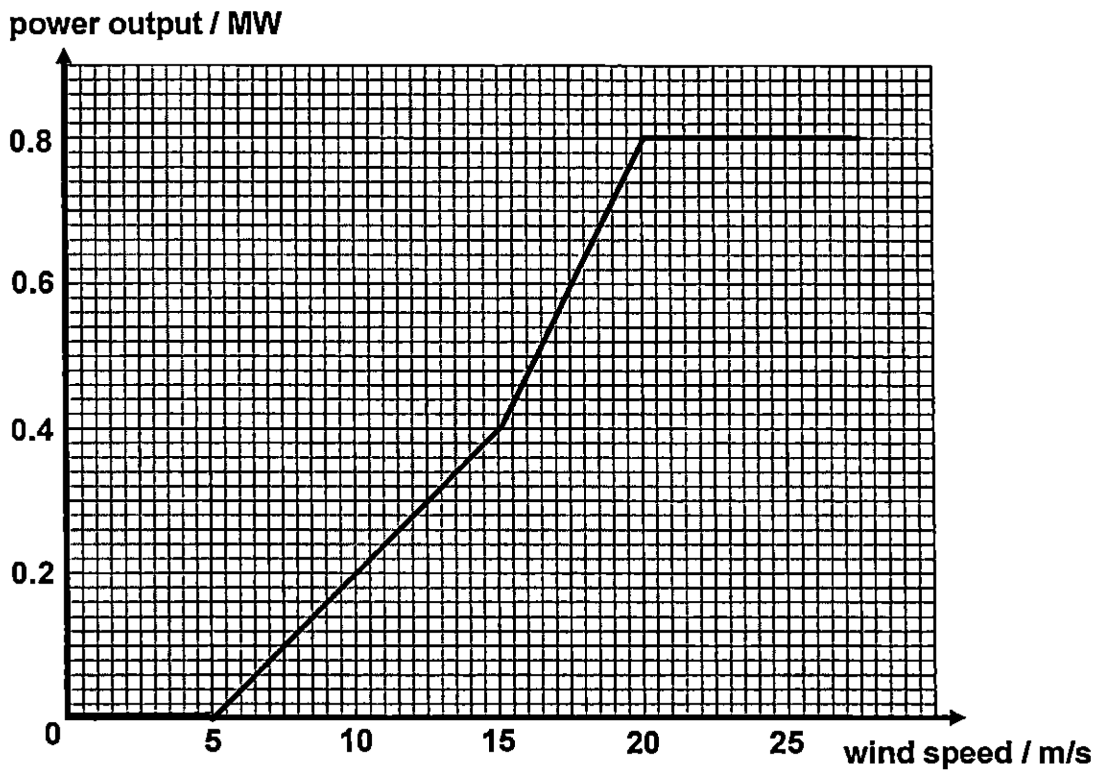


Figure I

(i) Calculate the rate of power output (in MW / m/s) of the wind turbine for wind speed of 10 m/s.

[1]

(ii) Using the graph, describe how the power output varies with the wind speed of 5 m/s to 25 m/s. In your description, you are to include any numerical value(s) where necessary.

____

____

____

____

____ [3]

(iii) The wind speed is recorded at two minute intervals as shown in **Figure II**.

time / min	0	2	4	6	8	10	12	14	16	18
wind speed / m/s	2	3	6	18	1	0	15	15	20	22

Figure II

Using the data provided in **Figure I** and **Figure II**, estimate the total energy produced in the twenty minute interval. Give your answer in joules.

[3]

(iv) Explain why your answer in **(a)(iii)** is only an estimate and suggest one way to improve the accuracy of the estimation.

____

____

____

____ [1]

(b) A wind turbine produces an alternating voltage of 600 V. Electric cables connect the wind turbine to houses some distance away. Energy is wasted within the cable.

State and explain one method to reduce the amount of energy that is wasted.

____

____

____

____ [2]

11 **Figure I** shows a simple d.c. motor. Seen from the front, the coil **ABCD** rotates in a clockwise direction as shown.

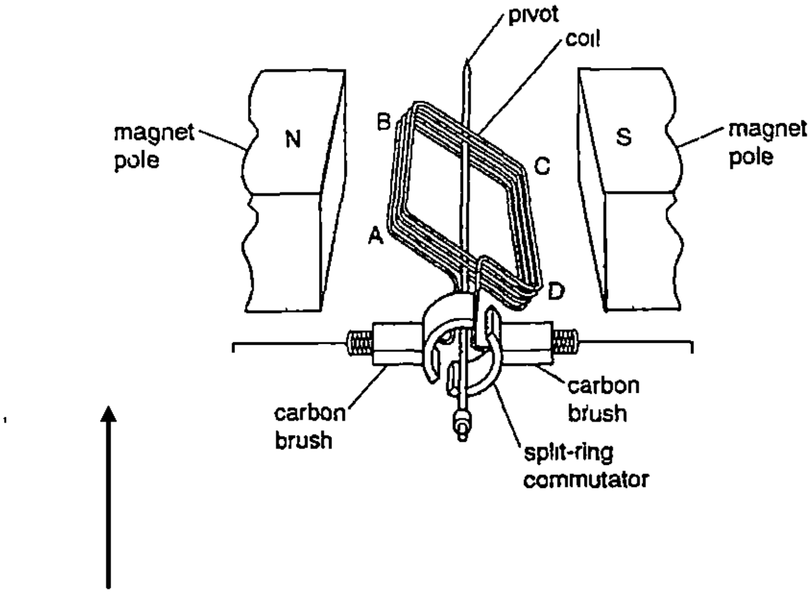


Figure I

(a) Complete the circuit in **Figure I** by including a correctly connected battery and a variable resistor. **[2]**

(b) **Figure II** shows the permanent magnets and the wires as seen from the front view. The wire from the front view are represented by the two circles **A** and **D**.

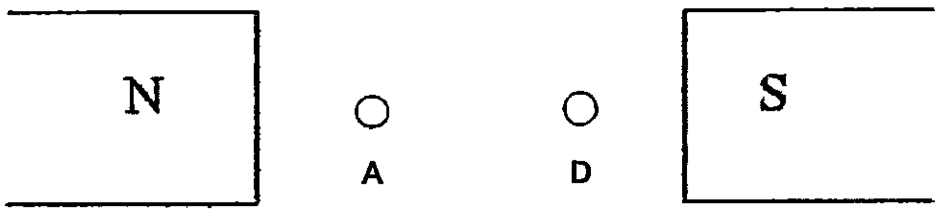


Figure II

(i) In **Figure II**, indicate the direction of the current using dot and cross notation such that the motor rotates in the clockwise direction. **[1]**

(ii) Draw the magnetic field pattern between the permanent magnets. **[1]**

(c) Explain why a split-ring commutator is necessary.

____

____

____ [2]

(d) Suggest **two** ways to increase the speed of rotation of the motor.

____

____

____ [2]

(e) After a prolonged period of use of the motor, the wires in the coil start to heat up. Explain why this has a slowing effect on the motor.

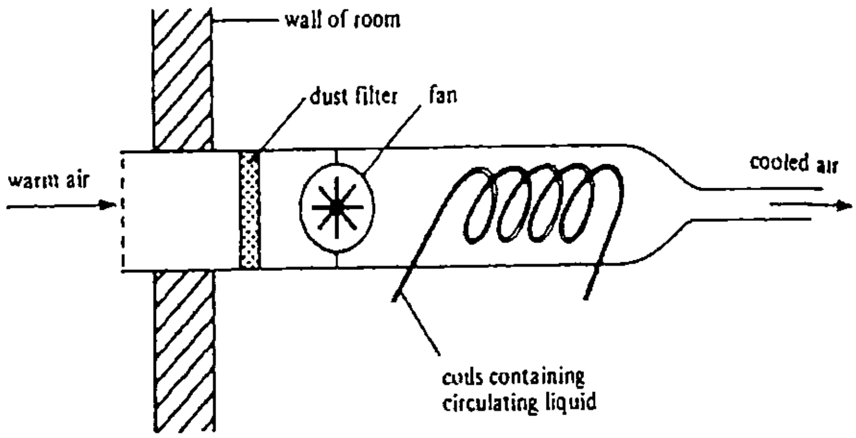
____

____

____ [2]

12 EITHER

In an air-conditioning unit, air is cooled when it is blown past coils in which a liquid is continuously evaporated, as illustrated in the diagram.



(a) Why does evaporation of the liquid cause the air flowing past the coils to be cooled?

____

____

____ **[2]**

(b) What effect will increasing the surface area of the coils have on the cooling achieved? Explain your answer.

____

____

____ **[2]**

(c) Why should the air-conditioning unit be placed high up in the room?

____

____

____ **[2]**

(d) The air conditioning unit has a cooling power of 1200 W. It is installed in a room containing 100 kg of air at 30 °C. What will be the temperature of the room if the unit has been switched on for 30 minutes? You are to state any assumption made in your calculation. The specific heat capacity of air is to be taken as 1000 J/(kg °C).

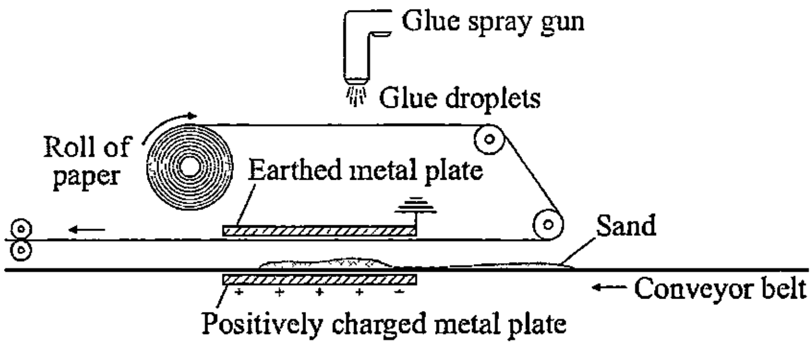
Calculation:

Assumption: ____

____ [4]

12 OR

(a) The diagram shows a method of producing sandpaper using static electricity.



Glue is sprayed onto a moving strip of paper. As the glue leaves the spray gun, the glue breaks up into tiny negatively charged droplets which coat the paper. The sticky paper passes between two metal plates. Sand moving on a conveyor belt also passes between the metal plates.

(i) What is the advantage of having all the glue droplets with the same (negative) charge?

____

____

____ [2]

(ii) Explain why the sand moves towards the sticky paper.

____

____

____ [2]

(b) Thunderclouds contain charges. The buildup of charges on the clouds causes a large potential difference between the cloud and the ground.

(i) Explain, in terms of energy, what is meant by ***potential difference*** in this context.

____

____

____ **[2]**

(ii) There is a potential difference of 1000 MV between a cloud and earth. In a lightning discharge from the cloud to earth, a charge of 20 C passes. Calculate the energy involved in this discharge.

[2]

(iii) A lightning conductor is placed at the top of a building to help to reduce the chance of a lightning discharge. Describe how this is achieved.

____

____

____

____ **[2]**

END OF PAPER

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2015

SUBJECT : PHYSICS 5059 DATE : 24 AUG 2015 (P2) 31 AUG 2015 (P1)

LEVEL : SECONDARY 4 EXPRESS DURATION :

PAPER 1 [40 marks] (DURATION: 1 HOUR)

1	2	3	4	5	6	7	8	9	10
C	A	D	B	C	A	B	D	D	A

11	12	13	14	15	16	17	18	19	20
A	B	D	A	A	C	B	C	B	C

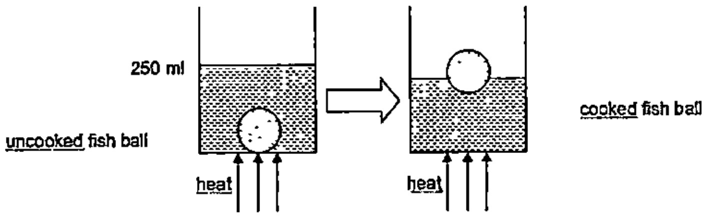
21	22	23	24	25	26	27	28	29	30
C	D	C	C	B	A	D	C	C	B

31	32	33	34	35	36	37	38	39	40
A	C	C	D	D	B	B	D	A	A

PAPER 2 (DURATION: 1 HOUR 45 MIN)

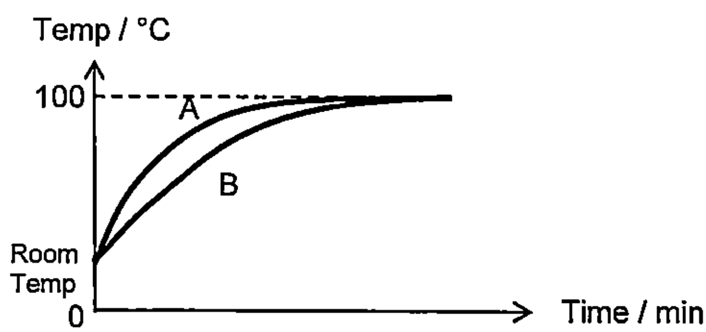
Section A [50 marks]

QN	Suggested Answers	Sub Ttl	Ttl
1a	Any one of the suggested answer below: Speed is distance covered per unit time while velocity is displacement covered per unit time. Speed is a scalar quantity while velocity is a vector quantity.	1	6
1b	AB: Constant speed BC: Deceleration / Decreasing speed CD: At rest DE: Acceleration / Increasing speed Any two correct answers: 1 m All correct answers: 2 m	2	
1c	Average speed is obtained using the **total** distance travelled divided by the **total** time taken. **If student indicates on the graph the final distance and final time taken, the one mark is to be awarded.**	1	
1d	The average speed and average velocity will be the same [1]. For the same time taken, both the **total distance** travelled and the **displacement** are the **same** [1].	2	

QN	Suggested Answers	Sub Ttl	Ttl
2a	$\rho = m \div v$ $= 52 \div 50$ [Volume 1] $= 1.04$ g/cm^3 or 1,040 kg/m^3 [1]	**2**	**5**
2b	 Drawing: The cooked fish ball is floating on the water. [1] When the fish ball is cooked, it expands. As its volume increases but mass remains unchanged [1], its density decreases [1] causing it to float in the water.	**3**	
2c	Both the uncooked and cooked fishballs will be floating [1] in the salt water.	**1**	

QN	Suggested Answers	Sub Ttl	Ttl
3a	$F \times 120 = 150 \times 20 + 150 \times 40$ [1] $F = 75$ N [1]	**2**	**7**
3b	Useful work done $= (75 - 25) \times 150$ [1] $= 7500$ J [1] Do not accept the unit for workdone as Nm. [deduct 1 m]	**2**	
3c	Luggage 1 will remain on the trolley while Luggage 2 will fall off the trolley. [1] The line of action of weight of luggage 1 falls within the base of the trolley, hence it remains on the trolley / the weight of the luggage provides an anticlockwise moment causes the luggage to fall back onto the trolley. [1] The line of action of weight of luggage 2 falls outside the base of the trolley. There is a clockwise moment of its weight about the edge of the base of the trolley. [1]	**3**	

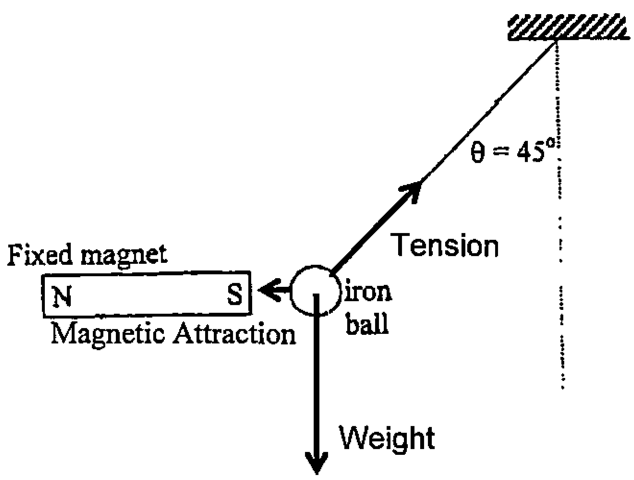
QN	Suggested Answers	Sub Ttl	Ttl
4a	At **Q**, the gas pressure highest [1]. The column of mercury at the right side is the highest [1] above the mercury level on the left side.	**2**	**6**
4b	Pressure at R $= 1 \times 10^5 + 0.015 \times 13600 \times 10$ [1] $= 100\ 000 + 2040$ $= 102\ 040$ Pa $= 102\ 000$ Pa (3sf) [1]	**2**	

QN	Suggested Answers	Sub Ttl	Ttl
5a	The waters from the tap have been in the surrounding for a long time [1] and has reached thermal equilibrium [1] with the surrounding. Other points accepted: The waters have reached room temperature. The waters are obtained from the same source.	**2**	**7**
5b	 Shape of graphs A and B [1] Graph of A above graph of B [1] Boiling point reached by both A and B [1]	**3**	
5c	The dull black surface of test tube **A** is a better absorber [1] of radiation compared to the shiny surface of test tube **B**, hence test tube A gains heat faster [1] and therefore heats up faster.	**2**	

QN	Suggested Answers	Sub Ttl	Ttl
6a	$\eta = \sin i \div \sin r$ $1.33 = \sin 60° \div \sin r$ [1] $r = \sin^{-1} (\sin 60° \div 1.33)$ $= 40.628°$ $\approx 40.6°$ [1]	**2**	**6**
6b	$\eta = 1 \div \sin c$ $1.33 = 1 \div \sin c$ [1] $c = \sin^{-1} (1 \div 1.33)$ $= 48.753°$ $\approx 48.8°$ [1]	**2**	
6c	The angle of incidence at the water-air boundary (exit) is always equal to the angle of refraction at the air-water (entrance) boundary [1]. Since the angle of refraction will always be less than [1] the critical angle of 48.8 °, total internal reflection cannot occur. OR The angle of incidence at the air-water boundary (entrance) is always equal to the angle of refraction at the water-air (exit) boundary [1]. Since the angle of incidence is always less than [1] 90°, the angle of refraction is always less than 90°.	**2**	

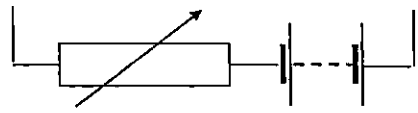
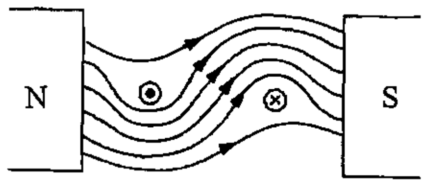
QN	Suggested Answers	Sub Ttl	Ttl
7a	Transverse wave [1]. The direction of vibration of particle is perpendicular [1] to the direction in which the wave travels.	**2**	**6**
7bi	$\lambda = v \div f$ $= 24 \div (50 \div 60)$ $= 28.8$ cm [1] Distance **RS** $= \lambda \div 2$ $= 28.8 \div 2$ $= 14.4$ cm [1]	**2**	
7bii	At the moment shown, R is moving downwards. Time taken to reach the highest point $= \frac{3}{4} T$ [1] $= \frac{3}{4} (1 \div f)$ $= \frac{3}{4} (60 / 50)$ $= 0.900$ s [1]	**2**	

QN	Suggested Answers	Sub Ttl	Ttl
8	The bulb will be at its brightest under strong light intensity and when point P is at end X of the potentiometer. [1] Under strong intensity, LDR resistance is the lowest, leaving a greater fraction of the e.m.f across the potentiometer [1]. With P at point X, the potential difference across bulb is the largest [1].	3	3

QN	Suggested Answers	Sub Ttl	Ttl
9a	 Note: Tension must be in the string. The force of attraction by the magnet must in contact with the iron ball. The weight of the iron ball must be drawn from the c.g. of the iron ball.	1	5
9b	Magnetic field concentrates [1] through the iron cube and thus produces a stronger attractive force [1].	2	
9c	Magnetic field flows along [1] iron sheet causing the iron ball to be protected by magnetic shielding [1].	2	

Section B [30 marks]

QN	Suggested Answers	Sub Ttl	Ttl
10ai	Rate of power output = 0.4 ÷ 10 = 0.040 MW / m/s [1]	**1**	**10**
10aii	For wind speed from 5 m/s to 15 m/s, the power output increases at a constant rate of 0.040 MW every 1 m/s [1]. For wind speed from 15 m/s to 20 m/s, there is a the power output increases of 0.080 MW every 1 m/s [1]. For wind speed greater than 20 m/s, there is a constant power output of 0.80 MW [1].	**3**	
10aiii	Total energy produced = $(0.04 + 0.64 + 0.4 + 0.4 + 0.8 + 0.8) \times 10^6 \times 2 \times 60$ [1] = 3.70×10^8 J [1] [1 m for the correct power output]	**3**	
10aiv	As the wind speed is measured every 2 minute interval, it is assumed that the wind speed is constant throughout that interval which may not be true. To increase the accuracy of estimation is to measure the speed of the wind at smaller time interval. [1]	**1**	
10b	By transmitting the power at high voltages [1] with the help of a step up transformer, the current flowing in the cable will be smaller [1] and thus the power loss due to the resistance of the cable will be reduced.	**2**	

QN	Suggested Answers	Sub Ttl	Ttl
11a	 Battery with correct polarity [1] Variable resistor [1]	**2**	**10**
11bi **11bii**	 Dot and cross as shown in diagram [1] Centre lines passing above and below wires (at least two lines) Line above and line below [1] [-1] for wrong/missing arrows	**2**	
11c	To reverse the direction [1] of the current in the coil every half a revolution, to ensure the coil will always turn in the same direction [1]. OR To reverse the current [1] in the coil each time it passes the vertical position [1]	**2**	
11d	Any two: Increase the current. Increase the number of turns. Increase the strength of the magnet. Increasing the voltage of the battery. Insert a soft iron core. **<u>In this context:</u>** Reducing the resistance of the variable resistance	**2**	
11e	As temperature increases, the resistance of the wire increases [1], causing current to decrease [1] and hence the force on the coil decreases.	**2**	

Either

QN	Suggested Answers	Sub Ttl	Ttl
12a	Evaporation of liquid is achieved by absorbing thermal energy from the surrounding. [1] Thus the thermal energy from the warm air is lost to the liquid and the air becomes cooled. [1]	**2**	**10**
12b	Increasing surface area of the coils will cool the air even more. [1] Increase of surface area increases the rate of thermal energy transfer.[1]	**2**	
12c	So that a convection current can be achieved in the room where the cooled [1], denser air will sink and the warmer air rises [1] to be cooled by the air-conditioning unit.	**2**	
12d	$E = Pt$ $= 1200 \times 30 \times 60$ $= 2160000$ J [1] $Q = mc\Delta\theta$ $= 100 \times 1000 \times (30 - T)$ [1] $100000 \times (30 - T) = 2160000$ $30 - T = 21.6$ $T = 8.4$ °C [1] Assumptions: • There is **no heat gained** from the surrounding. • The **heat** loss by the air in the room **is removed** by the air conditioning unit. • The mass of the air in the room is 100 kg. No air enters or leaves the room.[1]	**3**	

Or

QN	Suggested Answers	Sub Ttl	Ttl
12ai	The droplets will repel [1] each other, resulting in even coating [1] of glue/sand on the paper.	**2**	**10**
12aii	The sand becomes positively charged [1]. They are attracted to [1] the negatively charged paper as unlike charges attract.	**2**	
12bi	Potential difference is the energy [1] in carrying a unit charge from the ground at zero potential to the charged cloud [1].	**2**	
12bii	E $= Q \times V$ $= 20 \times 1000 \times 10^6$ [1] $= 2 \times 10^{10}$ J [1]	**2**	
12biii	There is a great potential difference between the cloud and the lightning conductor and this causes the air between to ionize [1]. The oppositely charged ionized air will discharge the charges in the cloud preventing the charges in the cloud to accumulate [1]. This reduces the potential difference between the cloud and the lightning conductor. Thus, the chance of lightning striking is much reduced.	**2**	

Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2015

PHYSICS **5059/01**

Paper 1 Multiple Choice **31 Aug 2015**

Monday 0800 - 0900 **1 hour**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid or tape.

There are **forty** questions in this section. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

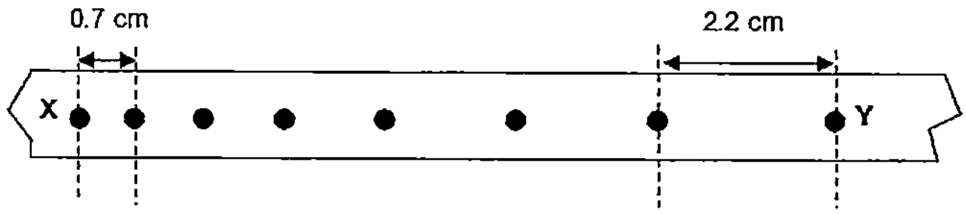
The use of an approved scientific calculator is expected, where appropriate.

Read the instructions on the Answer Sheet very carefully.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

1. Which of the following increases the period of a pendulum?

   A a smaller pendulum bob is used
   B a thicker string is used
   C the amplitude of oscillation is decreased
   D the length of string used is increased

2. The diagram shows part of a paper tape which is produced by a moving toy car under a ticker-tape timer of frequency 50 Hz.



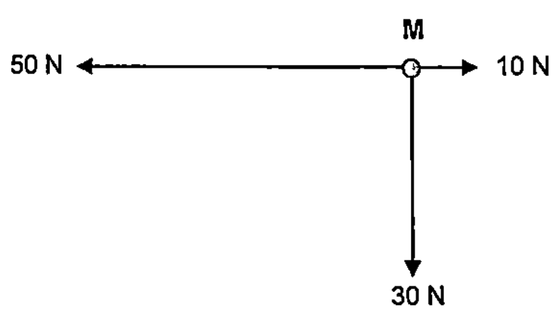
   Which of the following statements is **false**?

   A The acceleration of the car is 536 cm/s^2.
   B The time taken for the car to move from **X** to **Y** is 0.14 s.
   C The velocity of the car at **X** is 35 cm/s.
   D The velocity of the car at **Y** is 110 cm/s.

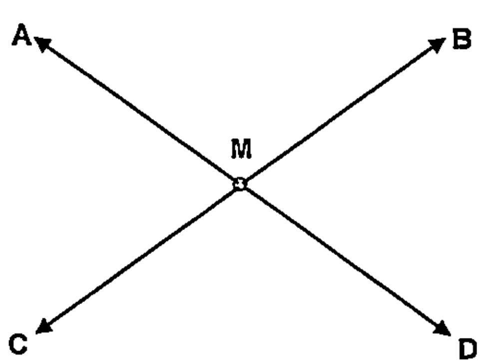
3. An object falls from rest through air and the air resistance acting on it increases. The object reaches terminal velocity after some time. Which quantity decreases until it reaches its terminal velocity?

   A acceleration **B** kinetic energy **C** speed **D** weight

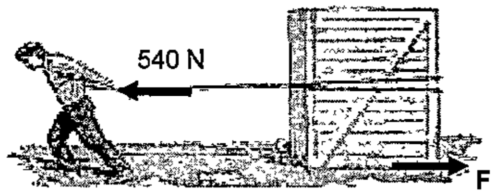
4. An object **M** has the following forces acting on it.



   Which of the following shows the direction of the resultant force acting on **M**?



5. A block of mass 60 kg is pulled across a rough surface by a 540 N force, against a friction force **F**.



The acceleration of the block is 6 m/s^2. What is the value of **F**?

A 90 N **B** 180 N **C** 360 N **D** 540 N

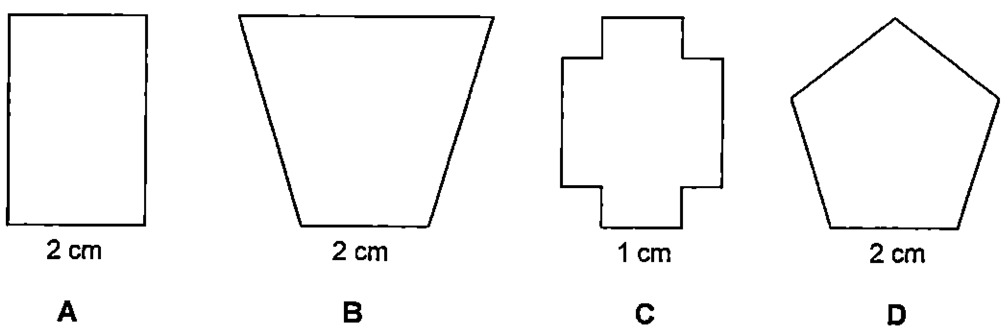
6. A student does an experiment to estimate the density of an irregular-shaped stone. Which of the following is needed?

A a measuring cylinder containing water
B a ruler and a measuring cylinder containing water
C an electronic balance and a measuring cylinder containing water
D an electronic balance and a ruler

7. Which of the following does **not** illustrate the effect of inertia?

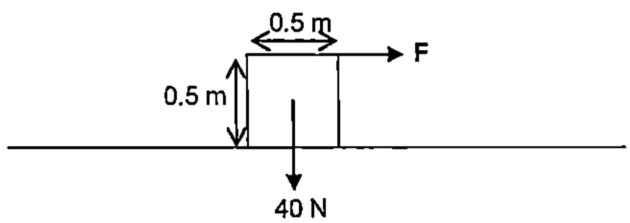
A It is easier to slide a heavy box up a ramp to a certain height than to lift it vertically to the same height.
B When a bus starts to move, a person inside may be jerked backwards.
C If a pile of coins is placed on a table, the bottom one can be flicked away without disturbing the others.
D It is difficult to push a trolley full of shopping and especially difficult to stop it when it is moving

8. The diagrams show cross-sections of four solid objects.



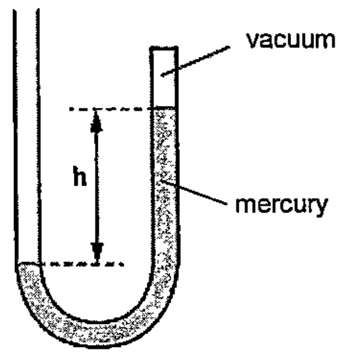
Which object is the most stable?

9. In the diagram shown, what is the force **F** needed to just tilt the cube weighing 40 N?



A 10 N **B** 20 N **C** 40 N **D** 80 N

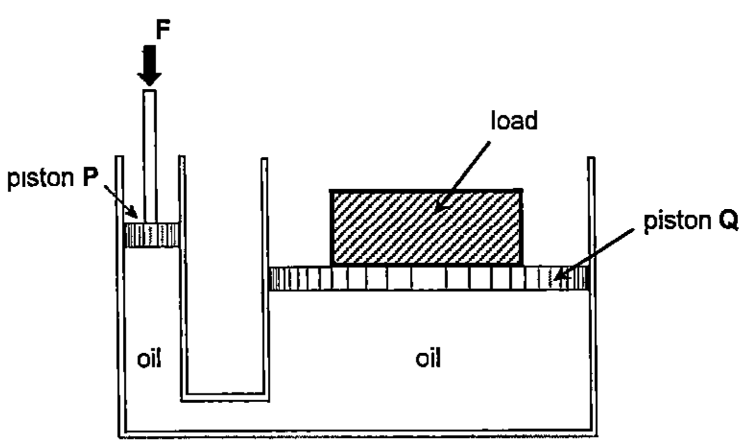
10. The diagram shows a manometer containing mercury that is sealed at one end.



What happens to the distance **h** when the manometer is taken to the top of a mountain?

A It decreases as atmospheric pressure decreases with height.
B It decreases as atmospheric pressure increases with height.
C It increases as atmospheric pressure decreases with height.
D It increases as atmospheric pressure increases with height.

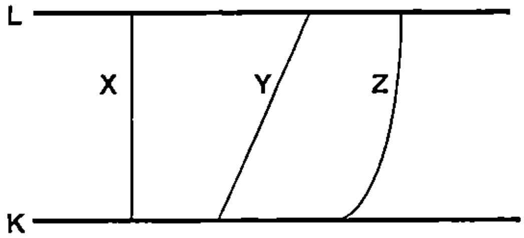
11. The diagram shows a simple hydraulic system.



Which of the following comparison is **true**?

A The force **F** is the same as the weight of the load.
B The force **F** is greater than the weight of the load.
C The pressure on piston **P** is the same as the pressure on piston **Q**.
D The pressure on piston **P** is smaller than the pressure on piston **Q**.

12. A load is to be lifted from level **K** to a higher level **L** along different paths labelled **X**, **Y** and **Z**.



Which of the following statements is **correct**?

A Path **X** requires the greatest amount of work as it is the shortest path.
B Path **Z** requires the greatest amount of work as it is the longest path.
C Paths **Y** and **Z** requires more work than path **X**.
D All paths require the same amount of work.

13. An object travelling on a horizontal surface at 20 m/s has 500 J of energy. After being accelerated, its kinetic energy is increased to 2000 J. What is its new speed?

A 40 m/s **B** 50 m/s **C** 60 m/s **D** 80 m/s

14. Some gas is heated in a sealed container. Which of the following does **not** increase?

A the average distance between gas molecules
B the average kinetic energy of gas molecules
C the force of collision between gas molecules and the container walls
D the number of collisions per unit time by gas molecules on the container walls

15. Which of the following best describes the molecules of a gas at room temperatures?

A close together and vibrating
B close together and moving randomly
C far apart and stationary
D far apart and moving randomly

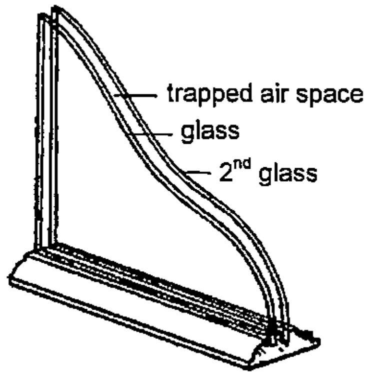
16. A new liquid was tested to decide whether it is suitable for use in a liquid-in-glass thermometer. Which of the following explains why this new liquid was subsequently rejected?

A It boils at 55°C.
B It expands linearly with temperature.
C It freezes at - 20°C.
D It is a transparent liquid.

17. Two objects are placed in contact with each other. Which of the following statements is **correct?**

A Heat is transferred from the object with a greater amount of heat to the one with a lower amount of heat.
B Heat is transferred from the object with a greater mass to the one with a lower mass.
C Heat is transferred from the object with a greater specific heat capacity to the one with a lower specific heat capacity.
D Heat is transferred from the object with a greater temperature to the one with a lower temperature.

18. Double-glazed windows have trapped air between two panes of glass. They are used to prevent unnecessary loss of heat from inside the house during winter.



Which of the following is/are reduced by the double-gazed window?

A conduction
B convection
C radiation
D conduction and radiation

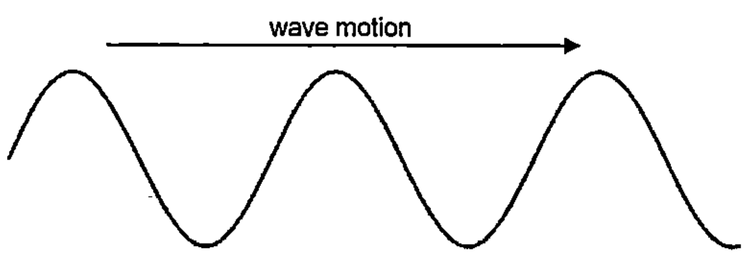
19. Energy is absorbed by ice to change its state from solid to liquid. During melting, what is this energy used for?

A to expand the ice particles
B to increase the temperature of the ice
C to strengthen the inter-molecular forces between the ice particles
D to weaken the inter-molecular forces between the ice particles

20. An ice tray contains 0.3 kg of water which has an initial temperature of 20°C. The ice tray and water are placed into a freezer that has a constant temperature of - 4°C. If the specific heat capacity of water is 4180 J/(kg°C), the specific latent heat of fusion of water is 3.34×10^5 J/kg and the specific heat capacity of ice is 2100 J/(kg°C), what is the energy that is needed to be removed in order to change the water into ice at - 4 °C?

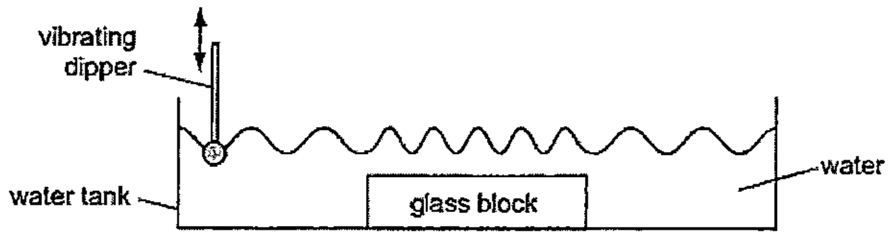
A 17.6 kJ
B 27.6 kJ
C 117.8 kJ
D 127.8 kJ

21. A transverse wave of amplitude **A** and wavelength λ is travelling along a piece of rope. Which of the following statements is **correct**?



A A rope particle moves a distance of **A** in one wave period.
B A rope particle moves a distance of λ in one wave period.
C The wave moves a distance of **A** in one wave period.
D The wave moves a distance of λ in one wave period.

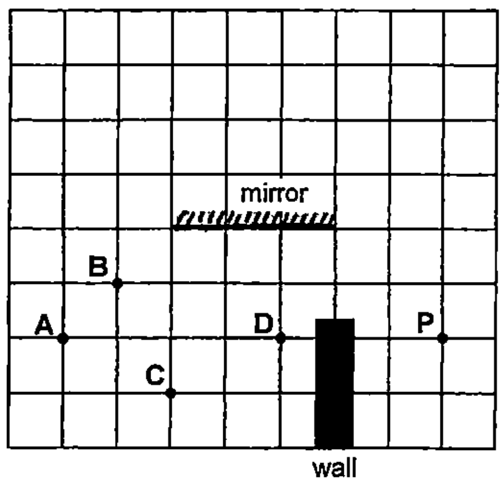
22. A ripple tank is used to show wave behaviour. The dipper vibrates up and down at a constant frequency.



What happens to the speed and frequency of the wave as it reaches the glass block?

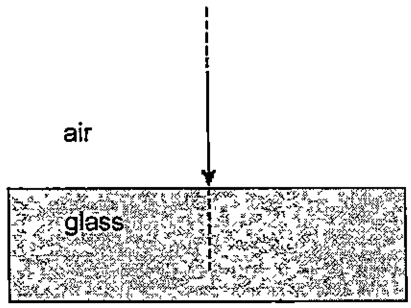
	speed	**frequency**
A	decreases	decreases
B	increases	decreases
C	decreases	remains the same
D	increases	remains the same

23. The figure shows the top view of an empty room with a vertical plane mirror at the middle. Rachel stands at point **P** and looks into the mirror.



Which object cannot be seen by Rachel in the mirror?

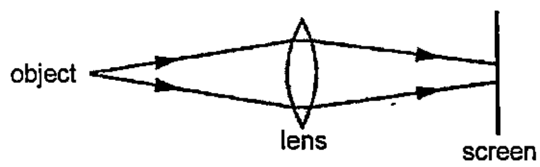
24. A ray of light enters from air into a glass block perpendicularly as shown.



Which of the following is correct?

	angle of incidence	the speed and direction of the light ray as it passes into the glass
A	0°	only speed changes
B	0°	both speed and direction change
C	90°	only direction changes
D	90°	only speed changes

25. A converging lens forms a blurred image of an object on a screen.



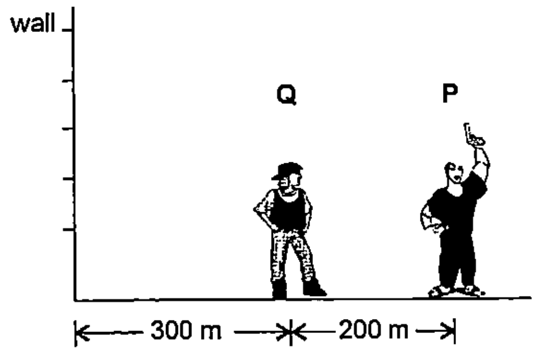
How can the image be made sharp and in focus on the screen?

A by moving the object closer to the lens and screen
B by moving the screen closer to the lens and object
C by using a dimmer object at the same position
D by using a lens of shorter focal length at the same position

26. Which of the following devices does **not** make use of electromagnetic waves in its operation?

A a camera
B a loudspeaker
C a remote controller
D a sun-tan machine

27. Two men, **P** and **Q**, stand in a straight line at different distances from a wall as shown.



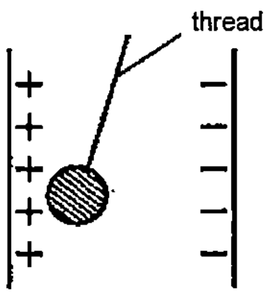
P fires a starting pistol and **Q** sees the gun-flash and hears the shot 0.67 s later. How long after **P** fires the shot will **Q** hear the echo from the wall?

A 1.0 s **B** 1.7 s **C** 2.0 s **D** 2.7 s

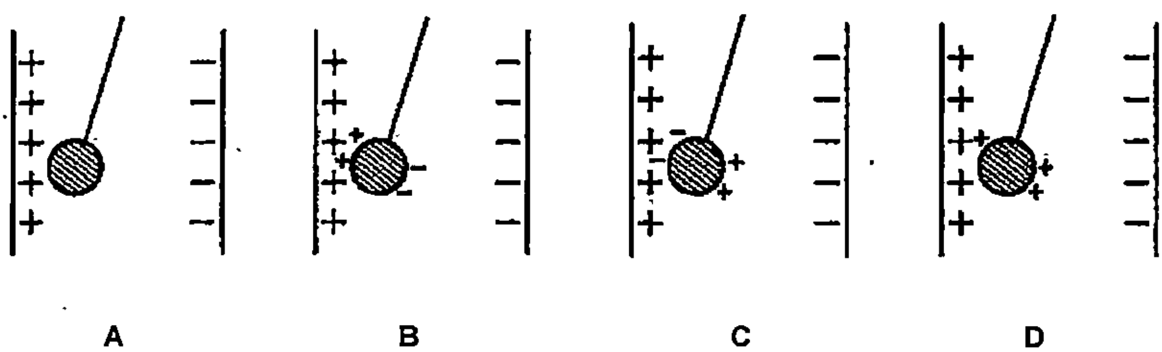
28. How are the regions of compressions and rarefactions of a sound wave in air formed?

A The air molecules gain energy as the sound wave passes by.
B The air molecules vibrate perpendicularly to the direction of the sound wave.
C The movement of air molecules produces pressure fluctuations.
D The sound wave undergoes refraction as it travels from one medium to another.

29. A light uncharged conducting ball is moved towards a positively charged plate.



Which diagram correctly shows the charges on the ball just after it has touched the positively charged plate?



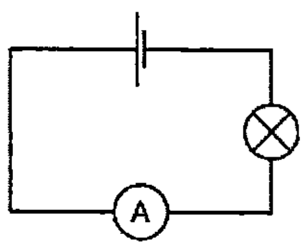
30. A student carried out an investigation to increase the size of current flowing through copper rods. He tried the following methods:

    (1) allowing more charges to flow through a rod per second
    (2) using a longer rod while maintaining the potential difference across the rod
    (3) using a rod of larger cross-sectional area while maintaining the potential difference across the rod

    Which of the following methods will work?

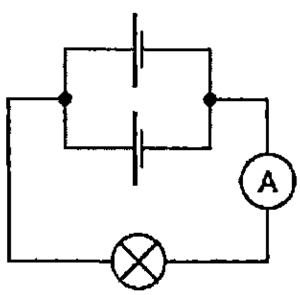
    A (1) only
    B (3) only
    C (1) and (3) only
    D (2) and (3) only

31. In the setup shown, the reading on the ammeter is 1 A.

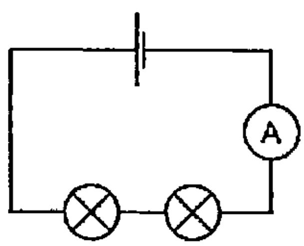


If identical lamps and cells are used, in which of the following circuits will the reading on the ammeter be 2 A?

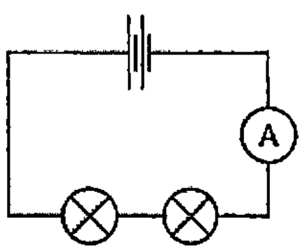
A



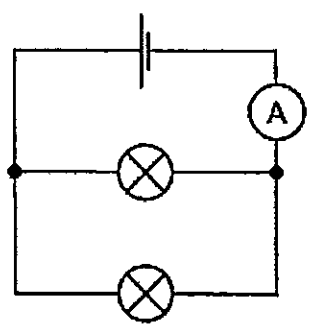
B



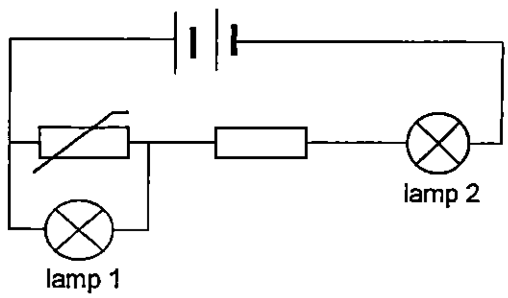
C



D



32. The diagram shows a thermistor circuit. The resistance of the thermistor decreases as the temperature increases.



What are the effects on the thermistor and the lamps when the temperature of the thermistor increases?

	potential difference across thermistor	brightness of lamp 1	brightness of lamp 2
A	decreases	decreases	decreases
B	decreases	decreases	increases
C	decreases	remains the same	decreases
D	increases	remains the same	remains the same

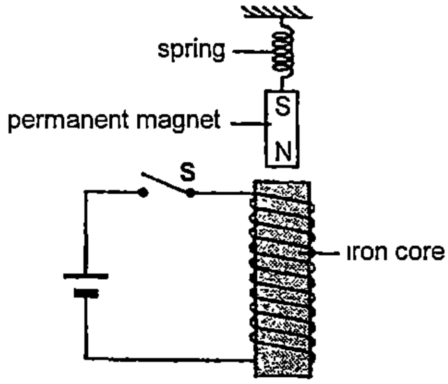
33. A heater, which is to be used on a 240 V mains circuit, has a 5 A fuse in its plug. Which of the following is the most powerful heater that can be used with this fuse?

A 50 W **B** 300 W **C** 900 W **D** 1500 W

34. Which of the following best explains why energy from solar cells is preferred as compared to energy from the mains supply?

A No habitats are destroyed during the installation of solar cells.
B No polluting gases are given off during energy generation.
C Less cost is involved during the installation of the solar cells.
D Less radioactive waste products is produced.

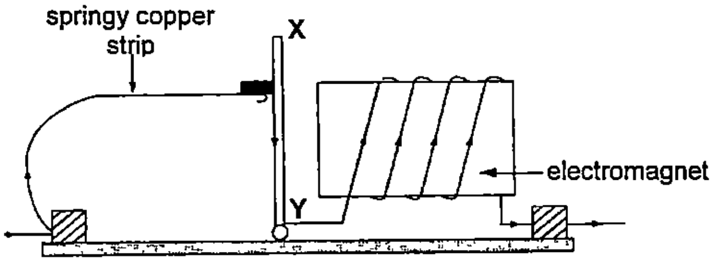
35. The diagram shows a permanent magnet suspended from a spring placed right on top of an electromagnet



What will happen to the permanent magnet once the switch **S** is closed?

A The magnet is pulled downwards.
B The magnet is pushed upwards.
C The magnet oscillates vertically up and down.
D The magnet remains stationary.

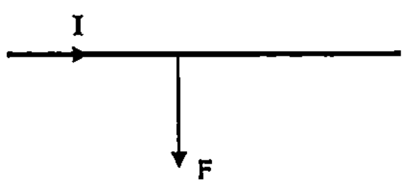
36. The diagram shows a model circuit breaker. If the current flowing in the circuit is excessive, the electromagnet attracts the metal bar **XY** to break the circuit.



Which of the following statements about the circuit breaker is **incorrect**?

A Placing a piece of soft iron inside the electromagnet will affect its strength.
B The circuit breaker works with both alternating and direct currents.
C The material used to make the bar **XY** is copper.
D The material used to make the coil of the electromagnet is copper.

37. The diagram shows a straight wire carrying a current **I** in a uniform magnetic field. The force **F** acting on the wire is indicated by an arrow but the magnetic field is not shown.



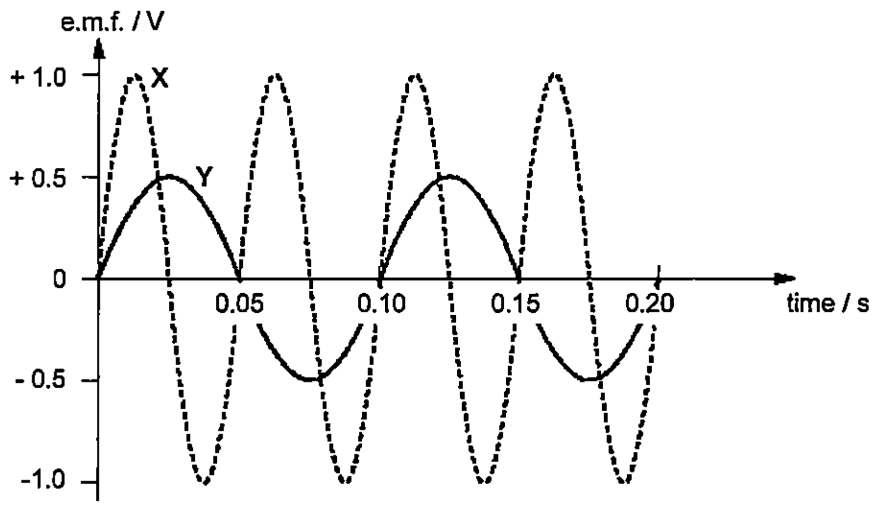
Which of the following best describes the direction of the magnetic field?

A to the left B upwards C into the page D out of the page

38. What is the purpose of the split ring commutator in a d.c. motor?

A to control the speed of rotation of the coil
B to enable the coil to turn continuously
C to increase the number of magnetic field lines passing through the coil
D to reverse the direction of the induced current every half-cycle

39. Graph **X** shows how the e.m.f. output of an a.c. generator varies with time. Graph **Y** shows the output from the same generator after a modification has been made to the generator.



What was the modification made to produce the graph **Y**?

A The area of the coil was doubled.
B The number of turns in the coil was halved.
C The speed of rotation of the coil was halved.
D The strength of the magnet was halved.

40. A student wants to obtain 12 V from a 240 V power supply. What type of transformer should the student use?

A step-down transformer with a 1000 turn primary coil and a 50 turn secondary coil
B step-down transformer with a 2000 turn primary coil and a 400 turn secondary coil
C step-up transformer with a 100 turn primary coil and a 2000 turn secondary coil
D step-up transformer with a 400 turn primary coil and a 2000 turn secondary coil

End of Paper

Answers to Prelim 2015 4E Pure Physics Paper 1

1	D	**11**	C	**21**	D	**31**	D
2	A	**12**	D	**22**	C	**32**	B
3	A	**13**	A	**23**	D	**33**	C
4	C	**14**	A	**24**	A	**34**	B
5	B	**15**	D	**25**	D	**35**	B
6	C	**16**	A	**26**	B	**36**	C
7	A	**17**	D	**27**	D	**37**	D
8	D	**18**	A	**28**	C	**38**	B
9	B	**19**	D	**29**	D	**39**	C
10	A	**20**	D	**30**	C	**40**	A

Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2015

PHYSICS **5059/02**

Paper 2 Theory **24 August 2015**

Monday 1130 – 1315 **1 hour 45 minutes**

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer all questions.

Section B
Answer **all** questions. Question **12** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.
The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

Section A [50 marks]

Answer **all** questions.

1 Fig. 1.1 shows how a simple ride in a water theme park works. The loaded carriage starts from rest at A, which is at the top of the track and rolls down the track until it reaches X which is 12 m below A. Beyond X, the track becomes horizontal and the carriage decelerates as it passes through a trough containing water.

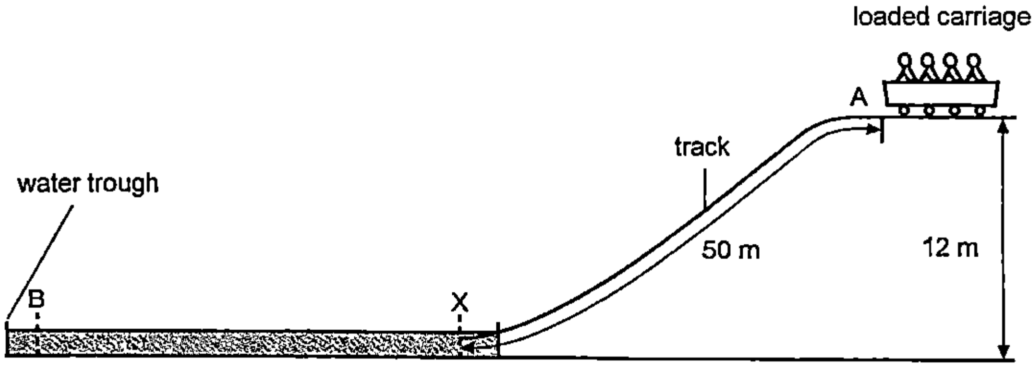


Fig. 1.1

The mass of the loaded carriage is 800 kg.
The carriage is moving at a horizontal speed of 8 m/s at X.
Take gravitational field strength to be 10 N/kg.

(a) Describe the energy changes that take place as the loaded carriage moves from A to X, and from X to B in Fig. 1.1.

....

....

.... [2]

(b) Calculate the efficiency of the carriage when it moves from A to X.

efficiency = ... [2]

(c) The carriage comes to rest at B five seconds after passing X. Determine the average retarding force exerted by the water on the carriage.

retarding force = ... [2]

2 Fig. 2.1 shows a section through a vertical locker door with a horizontal hinge along its lower edge. C_1 is the position of the centre of gravity (CG) of the door, and the door opens in the direction indicated. Fig. 2.2 shows the door with a piece of wood, P, attached to it so that the door is less likely to fall open. The new position of the CG of the door and the wood is C_2. The door is 8.0 cm thick.

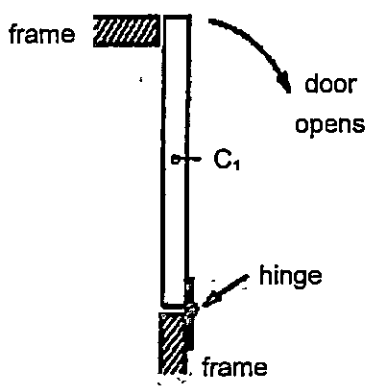


Fig. 2.1

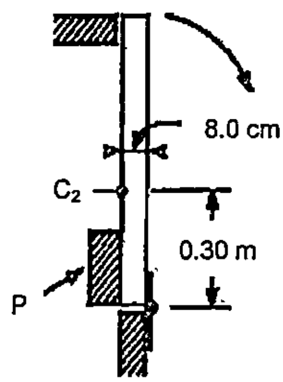


Fig. 2.2

(a) Suggest one reason why the door is less likely to fall open with wood P attached to it.

....

....

....

.... [2]

(b) The combined weight of the door and the wood P is 35 N.
Calculate the moment holding the door closed when it is in the vertical position shown in Fig. 2.2.

moment = ... [2]

(c) Calculate the loss in gravitational potential energy E_p of the door and the wood P as it swings from the vertical position shown in Fig. 2.2 to the horizontal position.

loss in E_p = ... [2]

3 Fig. 3.1 shows a section of a solar heating system which helps to provide hot water for a house.

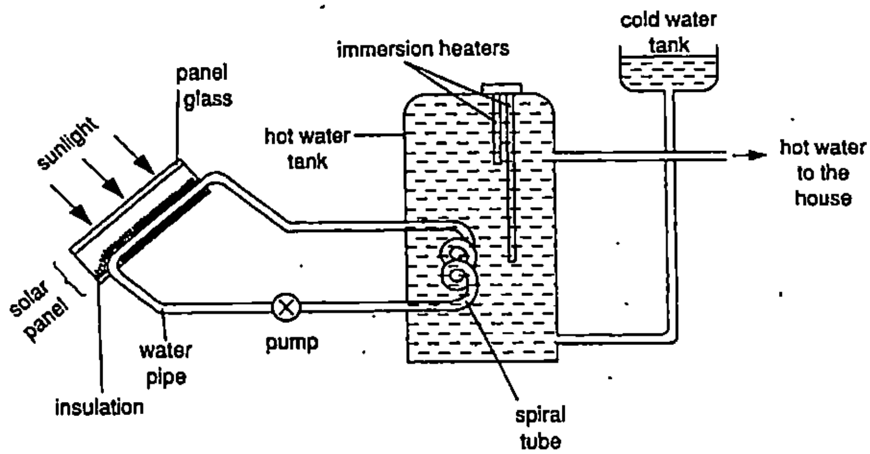


Fig. 3.1

It consists of a solar panel placed outdoor on a roof. Connected to this panel are water pipes. Heat from the Sun warms the water in these pipes which is then pumped to a hot water tank inside the house. Inside the hot water tank, the hot water transfers its heat, becomes cooled and circulates back to the solar panel.

Explain the purpose of the following features:

(a) the solar panel is covered with a sheet of glass,

....

.... [1]

(b) there is an insulation for the water pipe in the solar panel, and

....

.... [1]

(c) the water pipe in the hot water tank is spiral and painted black.

....

....

....

.... [2]

4 A sound wave in air (not drawn to scale) is illustrated in Fig. 4.1. The wave has frequency 2000 Hz and speed 320 m/s.

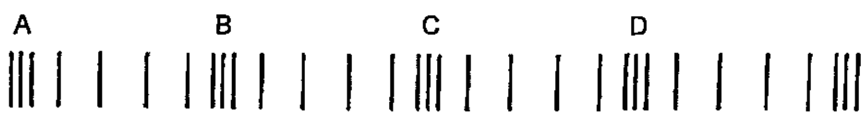


Fig. 4.1

Points A, B, C and D are at the centres of regions of compression.

(a) Describe what happens to the air molecules and the air pressure as one complete sound wave moves past a point.

air molecules: ....

....

air pressure: ....

.... [2]

(b) Explain what is meant by *frequency* of a wave.

....

.... [1]

(c) Calculate the distance between the points A and D.

distance = ... [2]

(d) The time taken for 1 oscillation in another sound wave is 3.0 ms. Calculate the frequency of the wave.

frequency = ... [1]

5 Fig. 5.1 shows a positively charged glass rod being lowered into a metal can. The base of the can is an insulator.

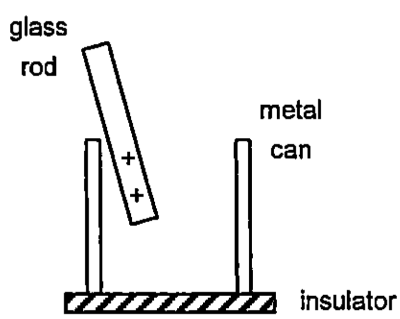


Fig. 5.1

(a) Indicate on Fig. 5.1 the charge distribution on the metal can when the rod is lowered into the can. [1]

(b) The side of the can is then connected to a galvanometer and then to a water tap which is grounded as shown in Fig. 5.2.

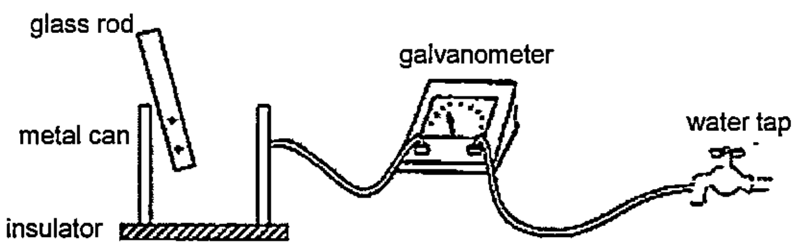


Fig. 5.2

Explain why the galvanometer shows a momentary deflection.

....

.... [1]

(c) Suggest, giving a reason, how the result of the experiment will change, if any, if the glass rod is replaced by a similarly charged metal rod held in the hand of a student.

....

....

....

.... [2]

6 Singapore has one of the highest lightning strike rates in the world. An average lightning strike transfers a charge of 5.0 C and releases as much energy as a 100 W lamp switched on for a duration of 5.5×10^6 s. There are, on average, at least 190 lightning strikes in Singapore per year.

(a) Determine the total energy released by all the lighting strikes in Singapore in each year.

energy = ... [2]

(b) Calculate the average electromotive force (e.m.f.) of a lighting strike.

e.m.f. = ... [2]

(c) Apart from a lightning conductor, state the name of one device that uses electrostatic charging.

.... [1]

7 A circuit is set up as shown in Fig. 7.1. The bulb has a rating of '3.5 V, 0.35 W'.

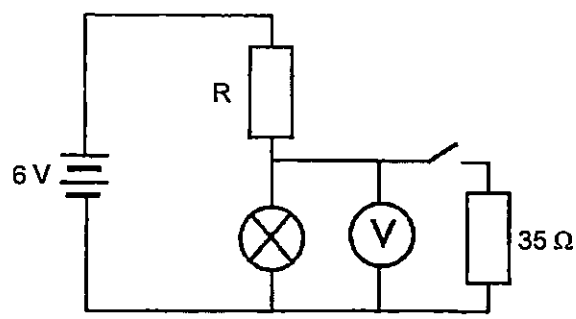


Fig. 7.1

(a) State what is meant by the rating of '3.5 V, 0.35 W'.

....

.... [1]

(b) When the switch is open, the bulb shows normal brightness.

(i) Calculate the overall current in the circuit.

current = ... [2]

(ii) Calculate the value of R.

R = ... [2]

(c) The switch is then closed. The resistance of the light bulb is 35 Ω.
Calculate the new voltmeter reading.

voltmeter reading = ... [3]

8 An electric iron which consists of two heating elements, a 100 Ω and a 50 Ω resistor, is shown in Fig. 8.1. The heating elements can be connected to the electrical mains supply of 240 V in various ways so that the heating power can be varied.

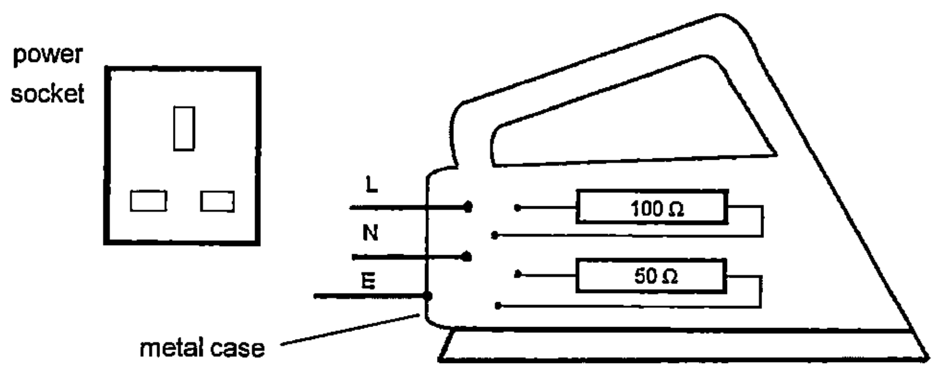


Fig. 8.1

(a) Complete the circuit in Fig. 8.1 to show

(i) how the Live (L), Neutral (N) and Earth (E) wires should be connected to the power socket, [1]

(ii) how the heating elements can be connected to give the highest heating power. [1]

(b) The live wire (L) in Fig. 8.1 becomes loose and touches the metal case.
Explain why a person who later touches the case feels no shock and is not harmed.

....

....

....

.... [2]

(c) Another electric kettle is doubly insulated and unlike the kettle in Fig. 8.1, there is no wire connected to its case. Explain why this kettle is safe to use.

....

....

.... [1]

9 Fig. 9.1 shows the quality control setup of a factory producing magnets. Newly produced permanent magnets which are positioned on a conveyor belt are moved under a detecting device. The device consists of a coil of wire, wound on a soft-iron core and connected to a sensitive voltmeter.

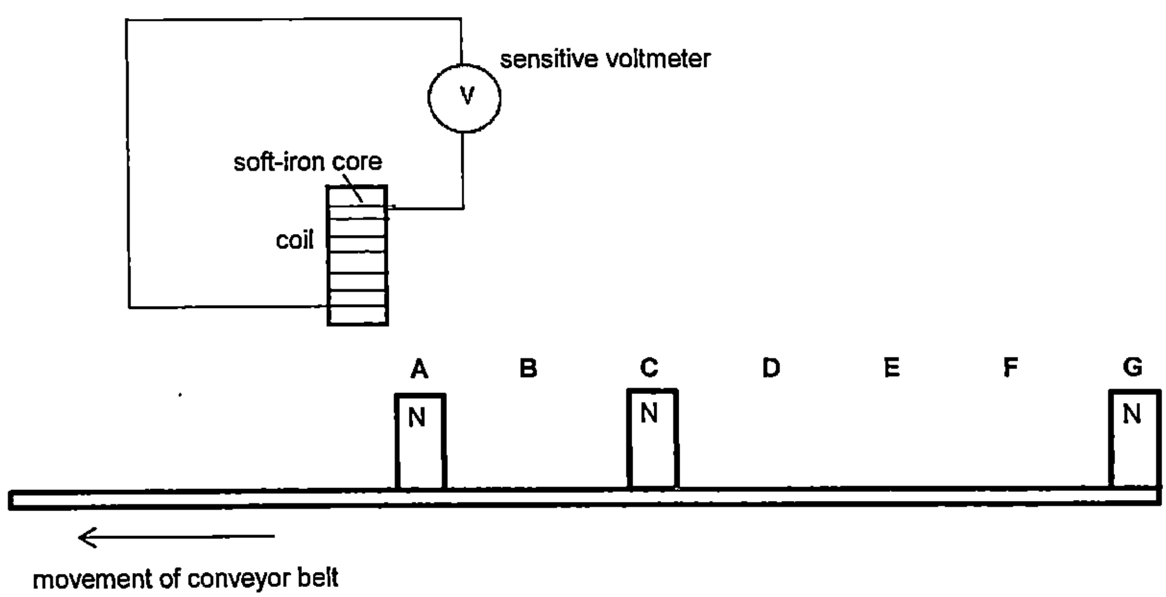


Fig. 9.1

As the conveyor belt moves along at constant speed, voltage pulses are recorded by the meter. These pulses are sent to a cathode ray oscilloscope (C.R.O.) and they are displayed in Fig. 9.2. The letters correspond to the positions on the belt as each magnet passes under the coil.

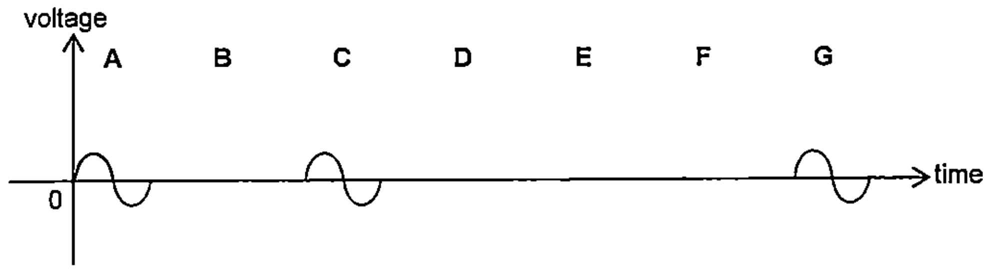


Fig. 9.2

(a) Explain why the pulses occur in Fig. 9.2.

....

....

.... [2]

(b) Explain the purpose of the soft-iron core inside the coil in Fig. 9.1.

....

.... [1]

(c) On Fig. 9.2, draw the pulses if the belt is made to move slightly faster. [2]

(d) In Fig. 9.3 and Fig. 9.4, the sensitive voltmeter is replaced by an ammeter.
Fig. 9.3 shows a magnet moving towards the soft iron core, and Fig. 9.4 shows the same magnet moving away from the iron core.

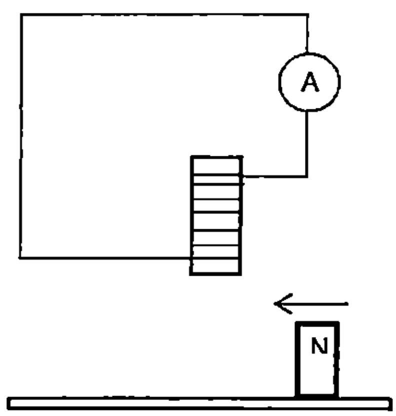


Fig. 9.3

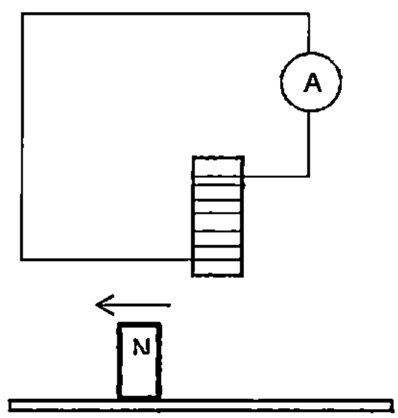


Fig. 9.4

Indicate the direction of the current in the coils in both figures. [1]

Section B [30 marks]

Answer **all** questions. Question **12** has a choice of parts to answer.

10 (a) A ray of light is passed from air into a semi-circular glass block as shown in Fig. 10.1.

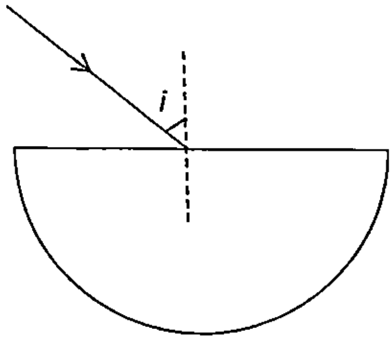


Fig. 10.1

The solid line in Fig. 10.2 shows how the angle of incidence, *i*, varies with the angle of refraction, *r*.
The solid line in Fig. 10.3 shows how the sine of angle of incidence (sin *i*) varies with the sine of the angle of refraction (sin *r*).

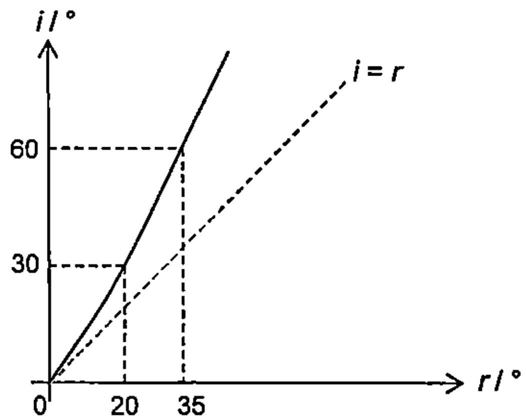


Fig. 10.2

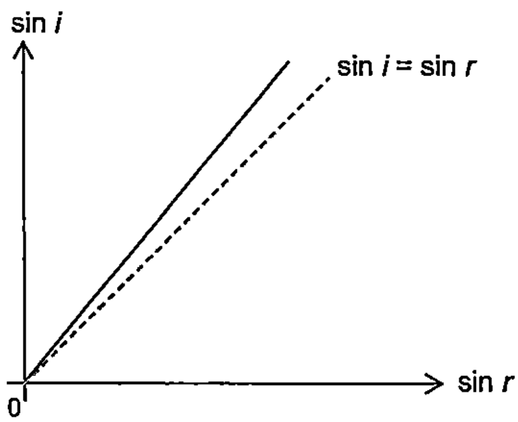


Fig. 10.3

(i) Use the graph in Fig. 10.2 to explain how the light ray travels through the glass block.

....

....

.... [2]

(ii) Explain why the graph in Fig. 10.3 is a straight line passing through the origin.

....

....

.... [2]

(b) The ray of light is now reversed, i.e. it travels from the same glass block into air as shown in Fig. 10.4.

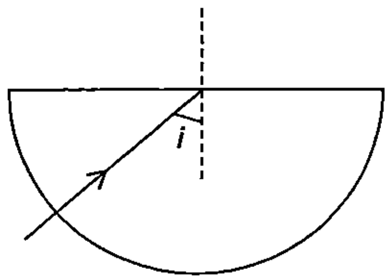


Fig. 10.4

The angle of incidence *i* and angle of refraction *r* are recorded as shown in Fig. 10.5.

i / °	10	20	25	31	35	39	41
r / °	15	30	40	50	60	70	80

Fig. 10.5

(i) Use the data in Fig. 10.5 to explain why the critical angle for glass is more than 41°.

....

....

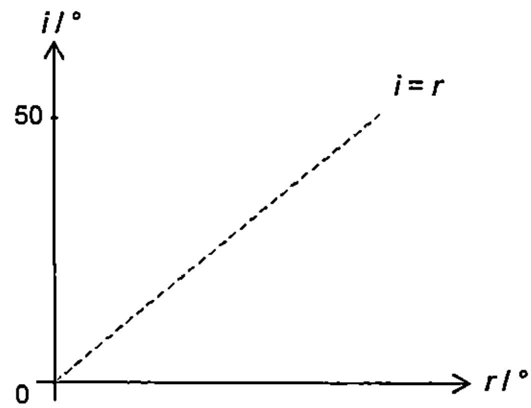
....

.... [2]

(ii) Determine the critical angle for glass to 2 significant figures.

critical angle = ... [2]

(iii) Using information in Fig. 10.5 and your answer in b(ii), sketch a graph to show how *i* varies with *r* for $0° \leq i < 50°$ on Fig. 10.6.



[2]

Fig. 10.6

11 (a) A town is supplied with electrical energy from a power station some distance away by power cables as shown in Fig. 11.1.

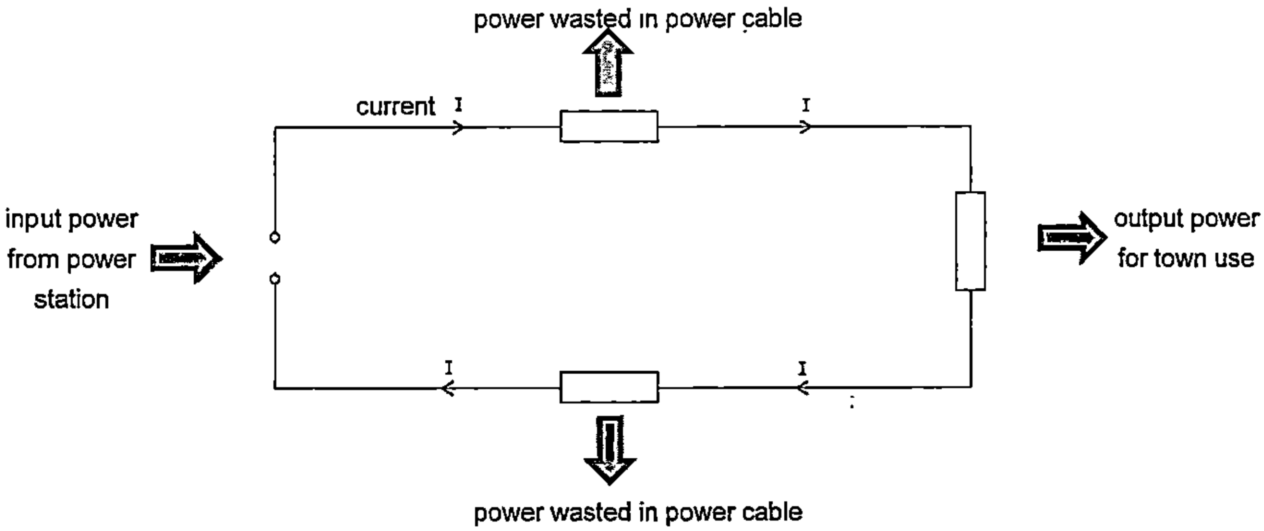


Fig. 11.1

The input power from the power station is 80 kW, at 770 V. The total resistance of the cables is 5.0 Ω. Calculate

(i) the current I in the cables,

current I = ... [1]

(ii) the power loss in the cables,

power loss = ... [2]

(iii) the voltage supplied to the town.

voltage = ... [2]

(b) Fig. 11.2 shows another way of supplying electrical energy to the town using transformers. In order for a voltage of 250 V to be received at the town, a step-down transformer of turns ratio 1/40 is used to convert the high voltage power supply transmitted over a long distance.

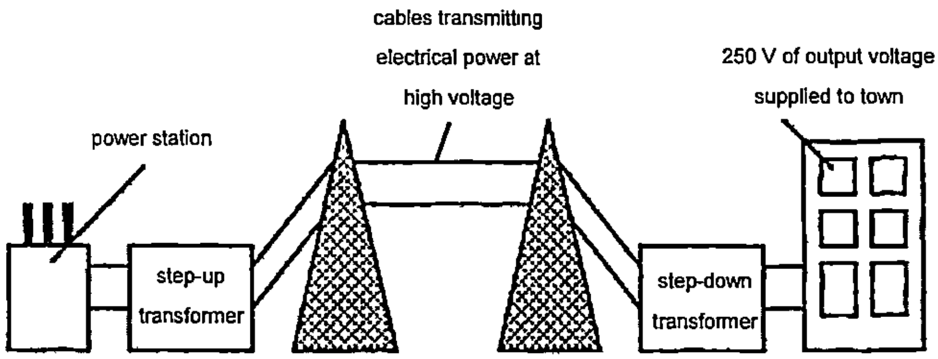


Fig. 11.2

(i) Explain why a high voltage is used to transmit the electrical power from the power station to the step-down transformer.

....

....

....

.... [2]

(ii) Explain why the power cables used have to be quite thick.

....

.... [1]

(iii) Calculate the voltage supplied to the primary coil of the step-down transformer.

voltage = ... [2]

EITHER

12 Fig. 12.1 shows a stone being projected vertically upwards from a point A at the top of a building and it reaches the highest point B.
The velocity-time graph for its 8.0 s of motion is shown in Fig. 12.2.

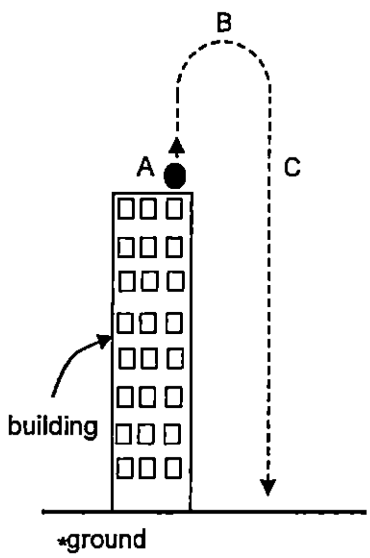


Fig. 12.1

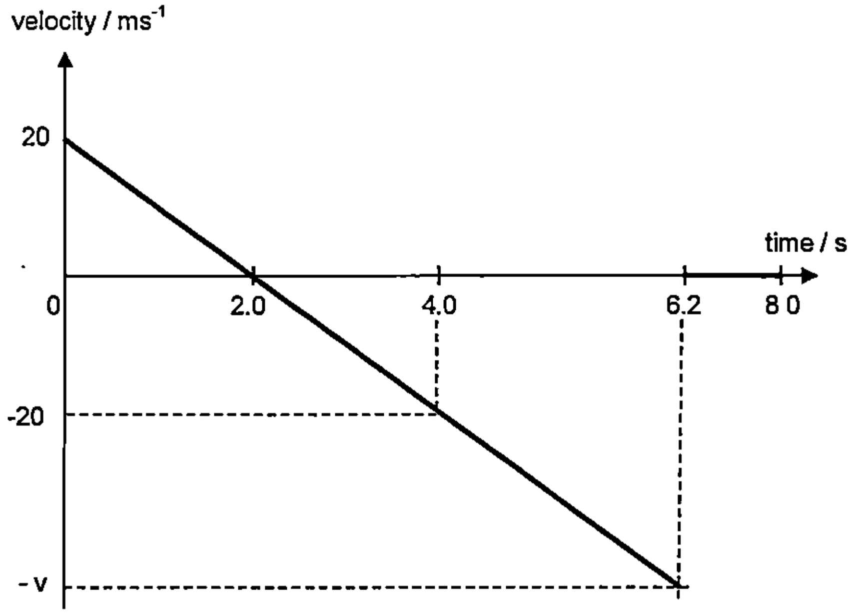


Fig. 12.2

The weight of the stone is 5.0 N. The acceleration due to gravity is 10 m/s^2.

(a) Explain how Fig. 12.2 shows that the stone is moving in opposite direction after a period of time.

....

....

.... [1]

(b) State the assumption made in order to obtain the straight line graph in Fig. 12.2.

....

.... [1]

(c) State the magnitude of the acceleration of the stone at the positions:

A: .... B: .... C: .... [1]

(d) Determine the change in velocity of the stone in the first four seconds of the motion.

.... [1]

(e) State the resultant force acting on the stone at point B. .... [1]

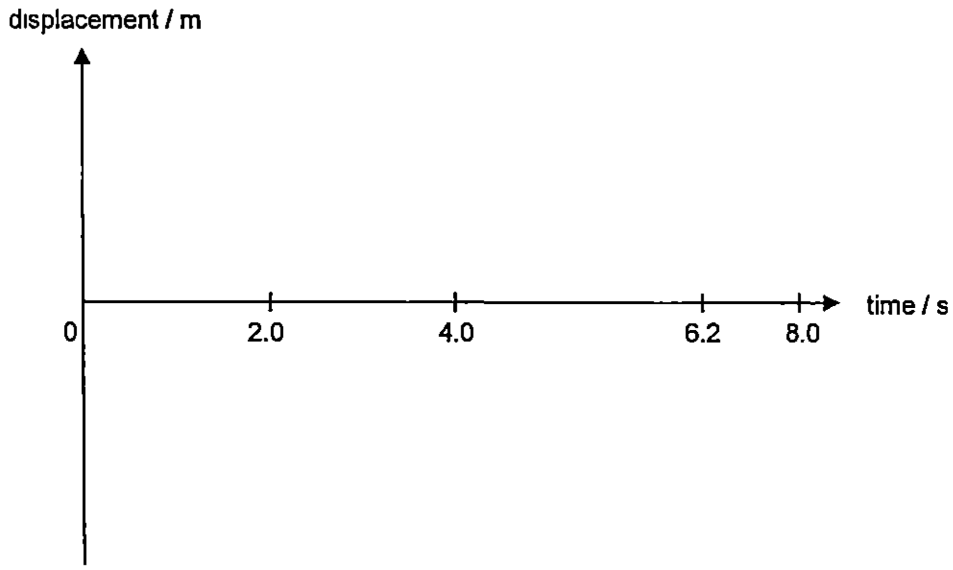
(f) Describe what v represents in Fig. 12.2.

.... [1]

(g) Determine the height of the building.

height = ... [2]

(h) Sketch the displacement-time graph in Fig. 12.3 for the stone from time = 0 to 8.0 s.



[2]

Fig. 12.3

OR

12 Fig. 12.4 shows a rectangular block of wood of cross-sectional area A and thickness t floating horizontally in a liquid. The block floats when its lower face is at a depth d in the liquid of density ρ.

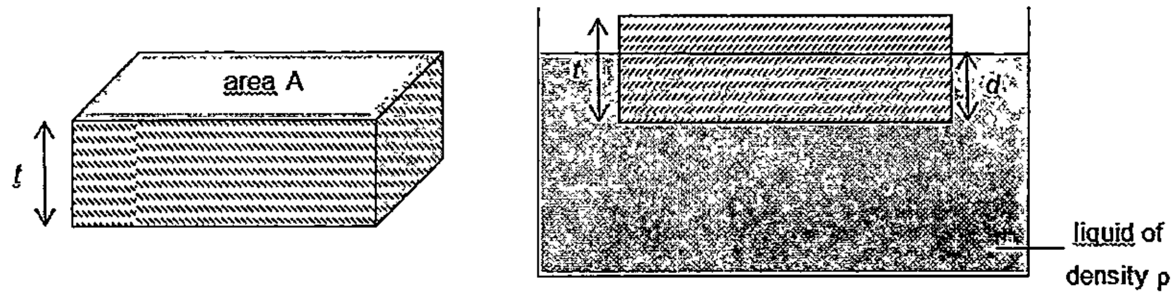


Fig. 12.4

(a) Write an expression for the pressure P acting on the lower surface of the block due to the liquid.

.... [1]

(b) Show that the force F acting on the lower surface of the block is related to the volume V of the block in the liquid by the expression: $F = V \rho g$ where g is the acceleration due to gravity.

[2]

(c) When the temperature of the liquid is increased, both the internal energy of the liquid molecules and the pressure acting on the lower surface of the block by the liquid increase.

(i) State what is meant by the internal energy of the liquid molecules.

....

.... [1]

(ii) Using ideas about molecules, explain why the pressure acting on the lower surface of the block increases when the temperature of the liquid increases.

....

....

....

.... [2]

(d) The wooden block is submerged in the liquid by a rope tied to a sinker as shown in Fig. 12.5.

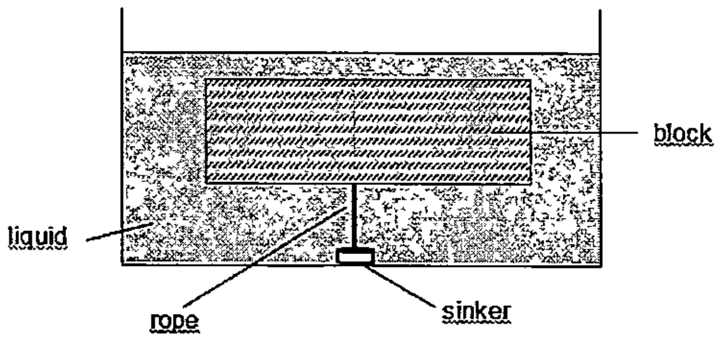


Fig. 12.5

The volume and mass of the block is 6.5×10^{-2} m^3 and 30 kg respectively. The density of the liquid is 1.1×10^3 kgm^{-3}. The acceleration due to gravity is 10 m/s^2.

(i) State the forces acting on the block.

....

.... [2]

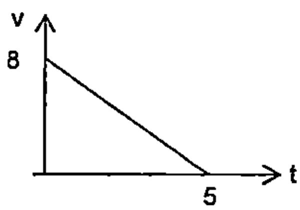
(ii) Using the expression in (b), determine the tension of the rope.

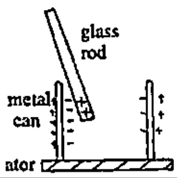
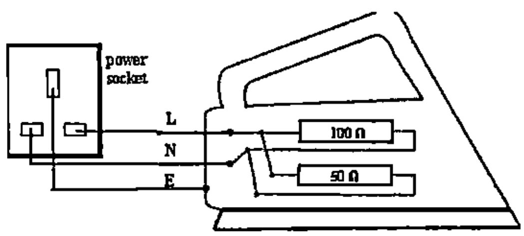
tension = ... [2]

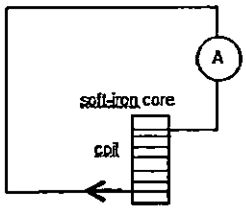
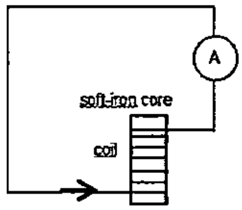
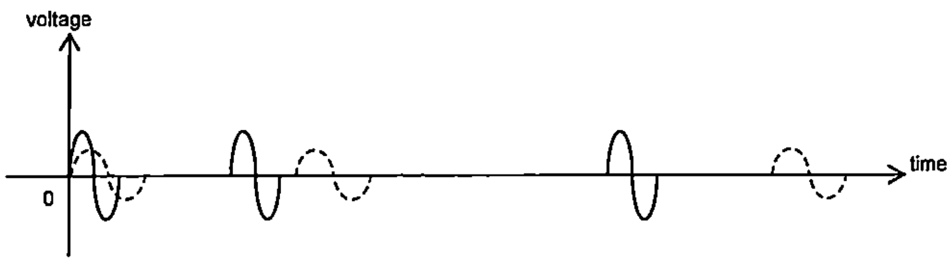
END OF PAPER

Preliminary Examination 2015
5059 Sec 4 Pure Physics (Marking Scheme)

Paper 2: Section A: Structured Questions [50 marks]

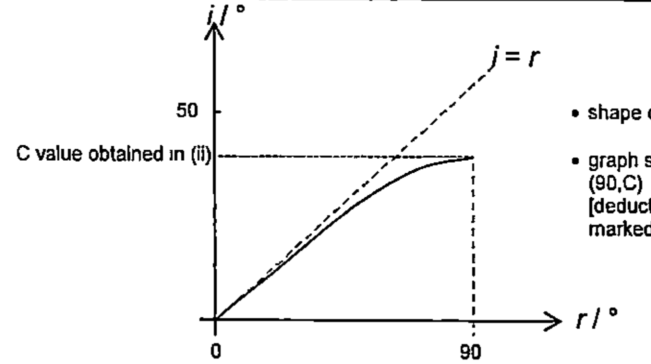
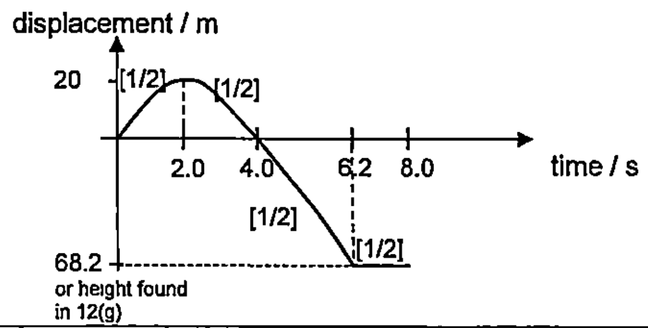
Qn	Suggested Answer	Marks
1(a)	From A to X, GPE of the loaded carriage is converted to KE of the carriage, thermal and sound energies. From X to B, the KE of the carriage is converted to thermal and sound energies	[0.5,0.5] [0.5,0.5]
(b)	efficiency = energy converted to useful output / total energy input x 100% = ½ mv^2 / mgh x 100% = ½ x 8^2 / (10 x 12) x 100% = 27%	 [1] [1]
(c)	 acceleration = (v – u) / t = (0 – 8) / 5 = - 8/5 = - 1.6 m/s^2 resultant force = ma = 800 x (- 1.6) = - 1280 N retarding force = 1280 N **Alternatively,** work done against water resistance = Loss in KE F x d = ½ mv^2 F x ½ (5 x 8) = ½ 800 x 8^2 retarding force, F = 1280 N	 [1] ecf[0.5] [0.5] or [1] [1]
2(a)	With the addition of wood P, CG of the door and wood (C$_2$) becomes lower. The lower the CG, the more stable an object is. or C$_2$ becomes further away from the hinge than before. / the perpendicular distance from the line of action of the weight to the hinge is now larger. The anti-clockwise moment that keeps the door closed has become larger than before.	[1] [1] or [1] [1]
(b)	moment = F x d = 35 x 0.080 = 2.8 Nm (or 280 Ncm)	[1,1]
(c)	loss in E$_p$ = (mg)h = 35 x (0.30 – 0.08) = 7.7 J ≈ 11 J	[1,1]
3(a)	Glass allows infrared rays into solar panel but prevents it from leaving / heat is trapped in the solar panel.	[0.5,0.5]
(b)	It reduces heat loss from the water in the pipe by conduction to the solar panel when the Sun is not shinning.	[0.5,0.5]
(c)	Spiral increase surface area to allow more heat to be transferred to water by conduction / radiation. Black is a good emitter of infra-red radiation. These increase rate of radiation to water / enable water to be heated up quickly.	[0.5,0.5] [0.5] [0.5]
4(a)	Air molecule: As a sound wave moves past a point, the air molecules move from left to right (or vice versa or parallel to the direction of the wave) and back **to its original position.** Air pressure: The air pressure increases and then decreases (or vice versa) before returning **to its original pressure.** (deduct ½ mark if 'original position' or 'original pressure' is not mentioned)	[0.5] [0.5] [0.5] [0.5]

(b)	The number of complete waves generated in one second.	[1]
(c)	Wavelength = speed / frequency = 320 / 2000 = 0.16 m Distance between A and D = 3 x wavelengths = 3 x 0 16 = 0 48 m	[1] ecf[1]
(d)	Frequency = 1 / period = 1 / (3 x 10^{-3}) = 333 Hz	[1]
5(a)	 Total number of positive and negative charges on each side of the metal can should be equal.	[1]
(b)	Electrons from ground (or water tap) moves through the galvanometer to metal can.	[1]
(c)	As metal rod is a good conductor of electricity, it will be discharged when held in the hand of a student. No charges will be induced in the metal can and no deflection is shown in the galvanometer	[0.5,0.5] [0.5,0.5]
6(a)	Energy released by 100 W lamp = Pt = 100 x (5.5 x 10^6) J = 5.5 x 10^8 J Total energy, E = 190 x E = 190 x 5.5 x 10^8 = 1.05 x 10^{11} J	[1] [1]
(b)	E.m.f. = E / Q = 5.5 x 10^8 / 5 0 = 1.1 x 10^8 V	[1,1]
(c)	Ink jet printer / Photocopier / Electrostatic spray painting / Electrostatic precipitator	[1]
7(a)	It means when a p.d. of 3.5 V is connected across the bulb, 0.35 J of energy is dissipated by the bulb in each second (or 0.35 W of power is released by the bulb).	[0.5,0.5]
(bi)	I = P / V = 0.35 / 3.5 = 0.10 A	[1,1]
(ii)	R = V / I = (6 – 3.5) / 0.10 = 25 Ω	ecf[1,1]
(c)	1 / Resistance for parallel connection = 1 / 35 + 1 / 35 ⇨ Resistance for parallel connection = 17.5 Ω Voltmeter reading, V = IR = total current in circuit x resistance for parallel connection = [6 / (17.5 + 25)] x 17.5 = 2.47 V ≈ 2.5 V Alternatively, Voltmeter reading, V = R1 / (R1 + R2) x V = [17.5 /(17.5 + 25)] x 6 = 2.47 V ≈ 2.5 V	[1] ecf[1] [1] ecf[1] [1]
8(a) (i), (ii)	L, N & E wires are correctly connected to the power socket [1]. The 100Ω and 50Ω resistors are connected in parallel [1]. 	[2]

(b)	When the live wire touches the metal case, the earth wire will carry the large current to earth. This large current will melt the fuse and break the circuit. A person who later touches the metal case will not experience an electric shock.	[1] [1]
(c)	The case is made of poor conductor of electricity. When the wire insulation is damaged such that the live wire touches the case (or when there is an electrical fault), the case will be not be 'live'. Hence, anyone who touches it will not get an electric shock.	[0.5, 0.5]
9(a)	As the magnets move past the coil, the coil experiences changing magnetic field as the field lines cut the coil. An e.m.f. is induced in the circuit which is displayed as voltage pulses by the C.R.O.	[1] [1]
(b)	To concentrate the magnetic field in the coil so as to increase the magnitude of the induced e.m f. [Do not accept 'it can be easily magnetized'.]	[0.5, 0.5]
(d)	 Fig. 9 3  Fig. 9.4 • Correct current direction for Fig. 9 3 – [0.5] • Current direction in Fig. 9 4 is opposite of Fig. 9 3 – [0 5]	[1]
(c)	 Magnitude of the induced e.m.f. increases / The periodic time reduces / The time between each generated pulse decreases. (All 3 correct – 2 marks; 2 correct only – 1 mark; 1 correct – 0 mark)	[2]

Section B [30 marks]

10(ai)	The graph shows that i is greater than r. Hence, the light ray bends towards the normal as it enters glass.	[1,1]
(ii)	The graph is a straight line passing through the origin because the ratio sin i / sin r is constant. This ratio is constant because it is the refractive index of glass which is a constant.	[1] [1]
(bi)	The data shows that i increases with r, and r is only 81° at i = 41°. Since critical angle is the value of i when r = 90°, the critical for glass has to be more than 41°.	[1] [1]
(ii)	n = sin r / sin i = 1 / sin C (use i and r from Fig. 10.5) eg. sin 30° / sin 20° = 1 / sin C => C = 43° accept $41° \leq C \leq 43°$	[1] [1]

(iii)	 • shape of graph – [1] • graph starts at (0,0) and ends at (90,C) - [1] [deduct ½ mark if the value of C is not marked on the axis]	[2]
11(ai)	P = VI => 80 000 = 770 x I => I = 104 A	[1]
(ii)	Power loss = I^2R = 104^2 x 5.0 = 54 080 W ≈ 54 000 W	ecf[1,1]
(iii)	Voltage drop = IR = 104 x 5 0 = 520 V Voltage supplied to town = 770 – 520 = 250 V Alternatively, Useful power = 80 000 – 54 000 = 26 000 W Voltage supplied to town, V = P / I = 26 000 / 104 = 250 V	ecf[1] ecf[1]
(bi)	As Power = Voltage x Current, when a high voltage is used, electrical current transmitted will be lower. This results in less electrical power loss from cables since power loss = $(\text{current})^2$ x resistance of the cables.	[0.5,0.5] [0.5,0.5]
(ii)	Thick cables have lower resistance than thinner cables, and can carry large amount of current with less heat loss.	[0.5,0.5]
(iii)	Ns / Np = Vs / Vp => 1 / 40 = 250 / Vp Vp = 10 000 V	[1] [1]
	Either	
12(a)	After 2s, the velocity changes from positive to negative.	[0.5,0.5]
(b)	The assumption is that there is no air resistance acting on the stone or the acceleration of the stone is constant throughout the motion.	[1]
(c)	Acceleration at A, B and C = 10 m/s^2 (3 correct answers – [1], 2 correct answers – [0.5], 1 correct answer – [0])	[1]
(d)	20 – (– 20) = 40 m/s or – 20 – 20 = – 40 m/s	[1]
(e)	resultant force = weight of stone = 5.0 N	[1]
(f)	v represents the velocity of the stone just before hitting the ground.	[1]
(g)	v / 20 = (6.2 – 2.0) / (4.0 – 2.0) v = 42 m/s height = area under the graph from 4.0s to 6.2s = ½ x (6.2 – 4.0) x (20 + 42) = 68.2 m	 [1] [1]
(h)		[2]

	OR	
12(a)	$P = d \rho g$	[1]
(b)	$F = \underline{P \times A} = (d \rho g) \times A = \underline{(A d) \rho g = V \rho g}$	[1,1]
(ci)	It is the potential energy and kinetic energy of the molecules.	[1]
(ii)	An increase in temperature increases the kinetic energy and the speed of the liquid molecules. This increases the frequency of collision / number of molecules colliding with the lower surface of the block and hence a larger force is exerted per unit area of the surface i.e. pressure increases.	[0.5,0.5] [0.5] [0.5]
(di)	Tension in the string, weight of the block, upthrust by the liquid (or upward force on the block by the liquid) (3 correct answers – [2], 2 correct answers – [1], 1 correct answer – [0.5])	[2]
(ii)	F = tension + weight of block tension = F - weight of block $= \underline{(6.5 \times 10^{-2} \times 1.1 \times 10^{3} \times 10) - (30 \times 10)}$ $= \underline{415\ N}$	 [1] [1]

THE END

1 A ray of light hits and transfers energy to an area. The *intensity* of the light ray is defined as the energy transferred per unit area per unit time. What is the unit of *intensity*?

A kg s^{-2} **B** kg s^{-3} **C** kg m^2 s^{-2} **D** kg m^2 s^{-3}

2 What is equivalent to 0.62 g cm^{-3}?

A 62 kg m^{-3} **B** 6.2×10^2 kg m^{-3} **C** 6.2×10^3 kg m^{-3} **D** 6.2×10^4 kg m^{-3}

3 An object X of mass *m* is released from a height *h*. Another object Y of mass *4m* is released from a height *4h* simultaneously. If both objects fall freely, which statement is true?

A The distance between them decreases and Y overtakes X.

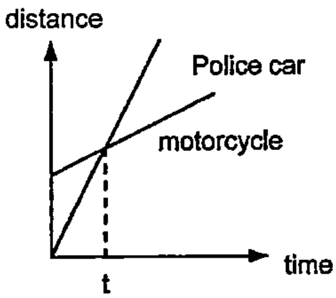
B The distance between them remains constant.

C The distance between them increases as X falls faster.

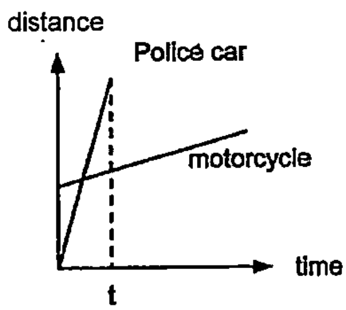
D The velocities of both objects are constant.

4 A police car starts from rest and accelerates to catch up with a speeding motorcycle within *t* minutes. Which graph describes the above scenario?

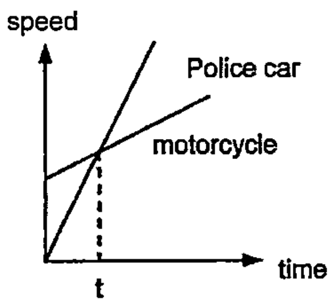
A



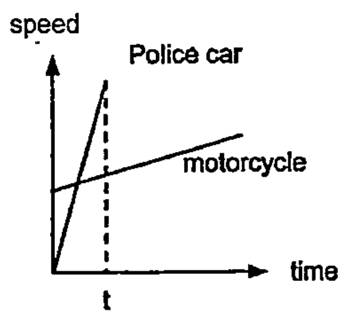
B



C



D



5 Which is a vector quantity?

A energy B speed C temperature D tension

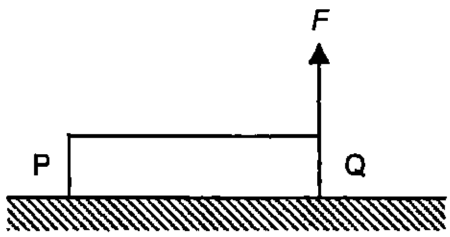
6 A ball bearing is released and sinks into a liquid. It falls vertically until it reaches terminal velocity. In this duration, the resultant force on the ball bearing is

A zero. B decreasing. C constant. D increasing.

7 Ice of mass 10 g, volume 11 cm^3 and temperature -3°C is added with water of mass 20 g, volume 20 cm^3 and temperature 30°C in a cup. The ice melted and all the water returns to 30°C. What is the final density of the water?

A 0.91 g cm^{-3} B 0.95 g cm^{-3} C 0.97 g cm^{-3} D 1.00 g cm^{-3}

8 A uniform bar has mass 25 kg and length 8 m. A man lifts edge Q vertically up with a force *F* such that the bar pivots at edge P. What is the magnitude of force *F* to just lift edge Q off the floor?



A 12.5 N B 62.5 N C 125 N D 250 N

9 Which object is in neutral equilibrium?

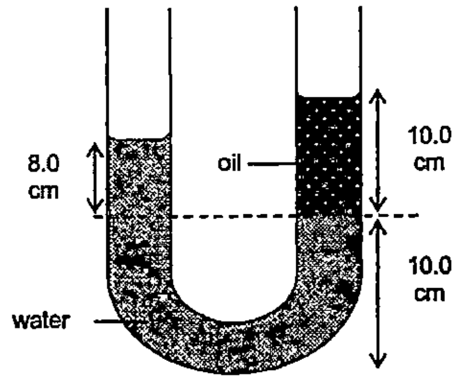
A a pencil balanced on its sharp tip

B a playground swing that is at rest

C a traffic cone that is upright

D an ice cream cone resting on its slant edge

10 An U-tube contains water of density 1.00 g cm^{-3} and oil. What is the density of the oil?



A 0.80 g cm^{-3} **B** 0.90 g cm^{-3} **C** 1.11 g cm^{-3} **D** 1.25 g cm^{-3}

11 When a barometer is taken up in a hot air balloon, the mercury level

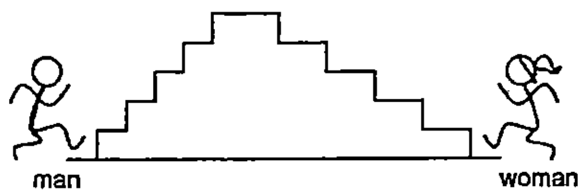
A increases as the atmospheric pressure increases.

B increases as the atmospheric pressure decreases.

C decreases as the atmospheric pressure increases.

D decreases as the atmospheric pressure decreases.

12 A man of mass 67 kg and a woman of mass 48 kg runs up to the same stage via two different flight of steps. If they reach the stage at the same time, which statement is true?



A The man runs faster than the woman.

B The man is more powerful than the woman.

C The man gains more gravitational potental energy than the woman.

D The man gains more kinetic energy than the woman.

13 A car of mass 800 kg brakes and decelerates uniformly from 80 km h^{-1} to rest in 12 s. All the kinetic energy of the car is converted to thermal energy (work done against friction). At what rate must the braking surfaces lose thermal energy to keep their temperatures constant?

A 16.5 kW **B** 161 kW **C** 198 kW **D** 213 kW

14 A motor drives a pump that raises 0.20 m^3 of water up by 5.0 m in 10 minutes. If the efficiency of the pump is 75 %, what is the power generated by the motor? Take density of water to be 1000 kg m^{-3}.

A 12.5 W **B** 22.2 W **C** 556 W **D** 1330 W

15 A gas is heated in a rigid sealed container. Which quantity does **not** change?

A the average speed of the gas particles

B the average force exerted on the walls of the container by the gas particles

C the average distance between the gas particles

D the frequency of collisions on the walls of the container by the gas particles

16 Which substance contracts the most when cooled?

A air **B** iron **C** mercury **D** water

17 A metal ring is cooled from 80°C to 30°C. Which statement is true?

A The external diameter decreases while the internal diameter increases.

B The external diameter increases while the internal diameter decreases.

C Both the external and internal diameters decrease.

D Both the external and internal diameters increase.

18 A boy is wrapping a sweet corn in aluminium foil for a barbeque. Which side should be on the outside and why?

A The shiny side, as it is a better absorber of thermal radiation.

B The shiny side, as it is a better conductor of thermal radiation.

C The dull side, as it is a better absorber of thermal radiation.

D The dull side, as it is a better emitter of thermal radiation.

19 The intellectual beings in M-universe use a different set of units for measurements.

They measure temperature using the Thor, where the melting and boiling points of water are 25 Thor and 75 Thor respectively.

They measure energy using the Hulk, where one Hulk is the amount of thermal energy needed to increase the temperature of one gram of water by one Thor.

What is the specific heat capacity of water in M-universe?

A 1 Hulk per gram per Thor	**B** 25 Hulk per gram per Thor
C 50 Hulk per gram per Thor	**D** 75 Hulk per gram per Thor

20 When some ether is spilled onto someone's hand, the hand feels very cold. If water is spilled under the same conditions, the hand will not feel the change in temperature because

A water does not evaporate as quickly as ether.

B water has a higher boiling point.

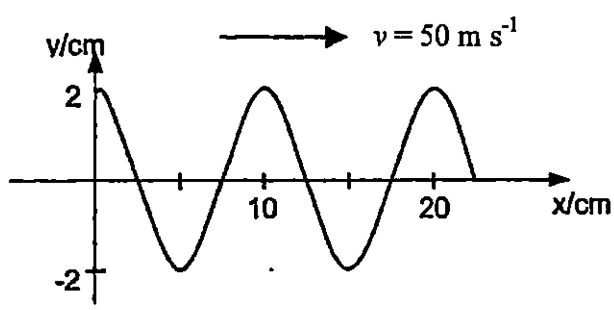
C water has a higher specific latent heat of vaporisation.

D water has a lower specific heat capacity.

21 A dipper sends ripples across the surface of a water body. The distance between ripples decreases as they travel further away from the dipper as the

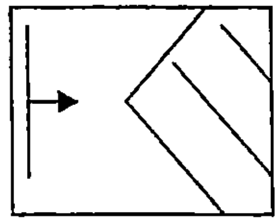
A frequency of the wave decreases.	**B** frequency of the wave increases.
C speed of the wave decreases.	**D** speed of the wave increases.

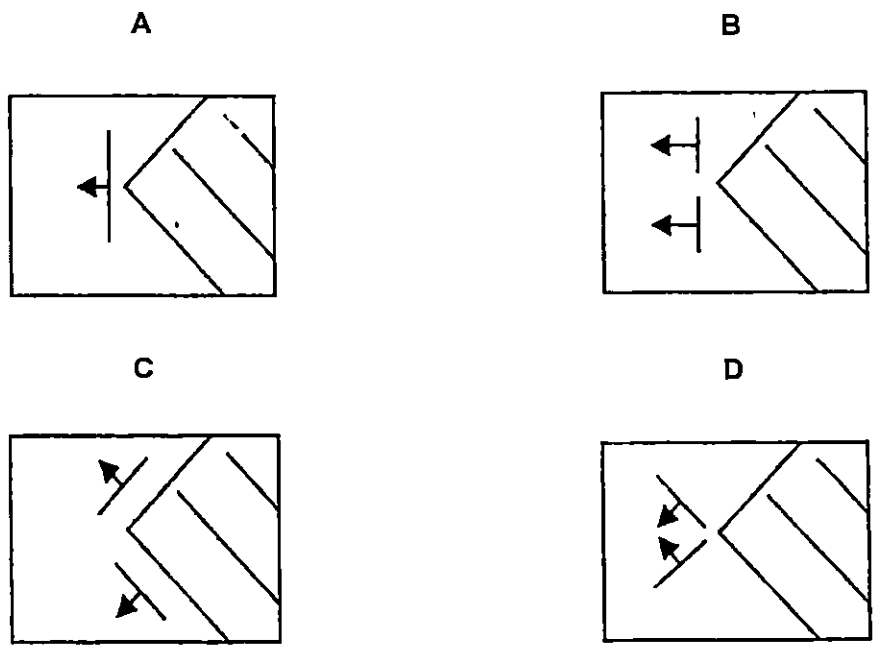
22 One end of a rope is vibrated up and down and the rope wave travels from left to right. If the speed of the rope wave is 50 m s^{-1}, what is the period of the rope wave?



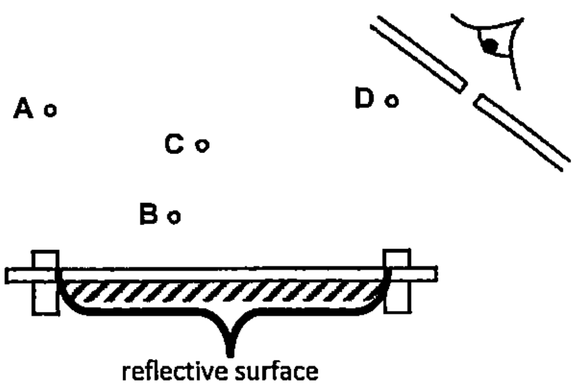
A 1 ms	**B** 2 ms	**C** 5 ms	**D** 10 ms

23 A wave approaches a triangular reflecting surface. Which diagram shows the correct reflected wave?



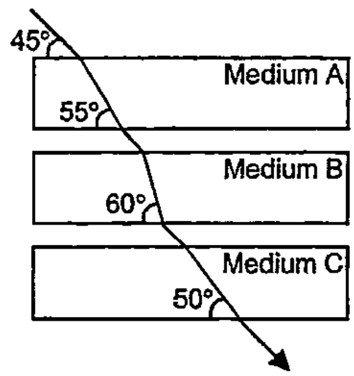


24 A coach tries to observe four dancers through a small glass panel on the door of a dance studio. Whose image in the mirror **cannot** be seen by the coach?



Top View of Dance Studio

25 A ray of light passes three transparent media, A, B and C. Which statement is true?



Not drawn to scale

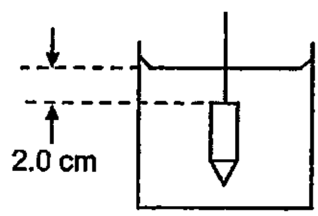
A Medium B has a lower refractive index than medium C.

B Medium B has the smallest refractive index.

C Light travels slower in medium A than in medium C.

D Light travels the fastest in medium A.

26 A pencil is suspended by a string in a tank of liquid such that its round end is 2 cm below the surface of the liquid. When viewed in air from the top of the tank, the pencil appears to be 2 cm long and 1 cm below the surface of the liquid. What is the real distance between the tip of the pencil and the surface of the liquid?

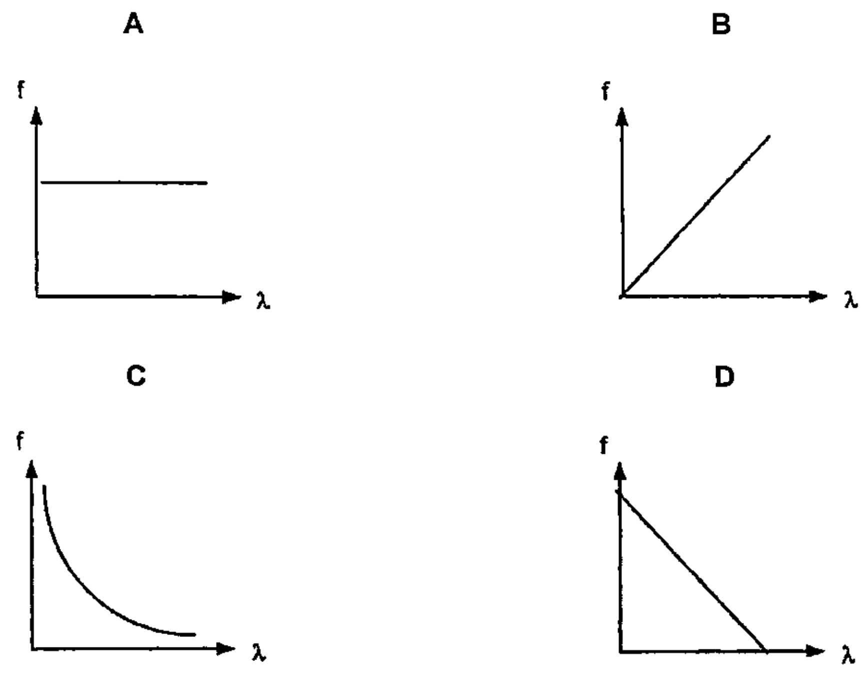


A 3 cm **B** 4 cm **C** 5 cm **D** 6 cm

27 When travelling in air, wave M travels much faster than wave N but also has a much shorter wavelength. What are waves M and N?

	M	N
A	gamma ray	visible light
B	radio wave	visible light
C	radio wave	sound wave
D	infrared wave	sound wave

28 Which graph shows the correct relationship between the frequency, *f* and the wavelength λ of a wave that is travelling in one particular material?



29 The SCDF sounds the "All Clear" siren which produces a note of constant pitch, *P*. An officer walks directly towards to the speaker and then retracts his path at constant speed. What does he hear?

	going towards speaker	going away from speaker
A	a note of constant pitch, P	a note of constant pitch, P
B	a note of increasing pitch from P	a note of decreasing pitch from P
C	a note of constant pitch lower than P	a note of constant pitch higher than P
D	a note of constant pitch higher than P	a note of constant pitch lower than P

30 The speed of sound in air depends on the

A temperature of the air.

B pitch of the sound.

C loudness of the sound.

D distance between the source and receiver of the sound.

31 Which object will **not** attract tiny pieces of paper?

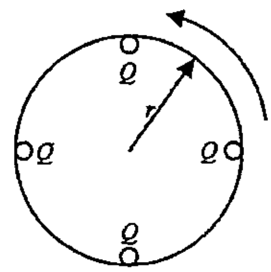
A a metal knife sharpened with a knife sharpener

B a ceramic spoon wiped with a kitchen cloth

C a plastic comb combed through dry hair

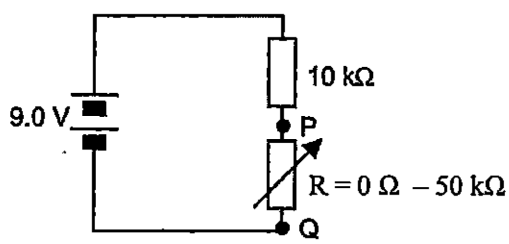
D a wooden pencil rubbed with an eraser

32 Four spheres, each given a charge of Q, are spread apart evenly on the circumference of a round insulating disc. When the disc is rotated about an axle at its centre with a period of T, the electric current at a particular point on the circumference is



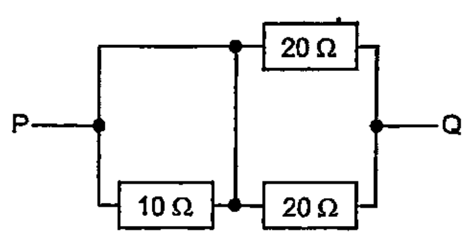
A $\dfrac{2Q}{\pi r T}$ B $\dfrac{4Q}{T}$ C $\dfrac{8\pi r Q}{T}$ D $4QT$

33 What is the possible range of readings on a voltmeter connected across P and Q?



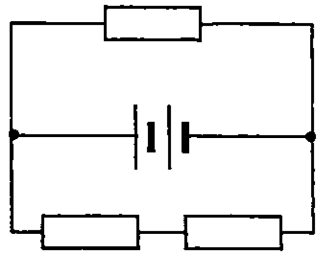
A 0 – 1.5 V   B 0 – 7.5 V   C 1.5 – 7.5 V   D 1.5 – 9.0 V

34 What is the effective resistance between P and Q?



A 10 Ω   B 20 Ω   C 40 Ω   D 50 Ω

35 Given that the current flowing through the 8.0 Ω resistor is 200 mA, what is the voltage across the 6.0 Ω resistor?



A 0.40 V **B** 1.20 V **C** 10 V **D** 30 V

36 Which is a consequence of connecting several electrical appliances to the same power socket?

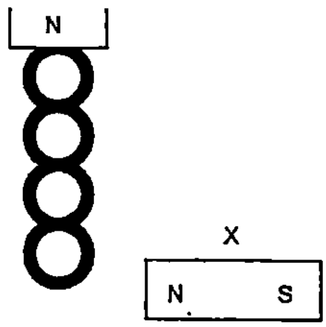
A Current drawn by each appliance is decreased.

B Total energy consumption is decreased.

C Total energy consumption is increased.

D Voltage drawn by each appliance is decreased.

37 A strong permanent magnet attracts a chain of four iron rings. A weaker permanent magnet, X is moved near to the right side of the lowest iron ring. What happens?



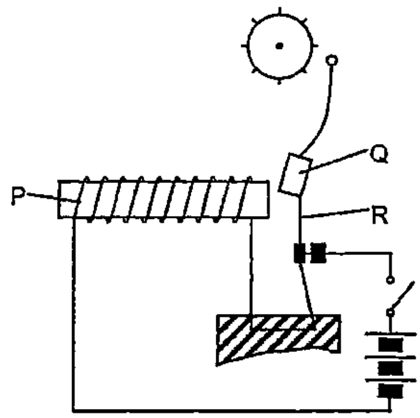
A The chain will bend away from X.

B The chain will bend towards from X.

C The chain will oscillate elliptically in 3-dimensions.

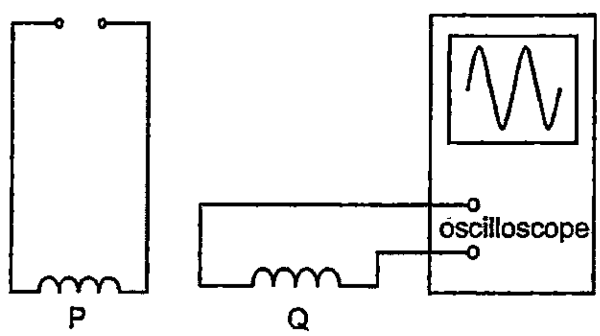
D The chain will swing to-and-fro X in 2-dimensions.

38 In an electric bell, what are parts P, Q and R made of?



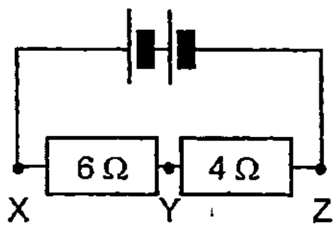
	P	Q	R
A	copper	soft-iron	spring steel
B	copper	steel	spring steel
C	steel	soft-iron	copper
D	steel	steel	copper

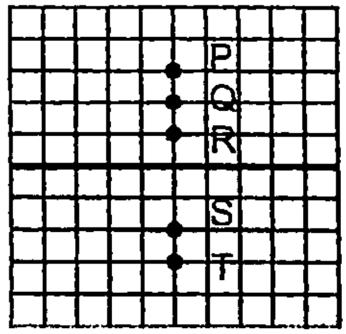
39 An alternating current flows through coil P. Coil Q is connected to a C.R.O. on which a sinusoidal trace appears. What happens to the trace if P and Q are linked by a soft-iron core?



	height	number of cycles
A	remains the same	increases
B	remains the same	remains the same
C	increases	increases
D	increases	remains the same

40 When the two input pins of a C.R.O. is connected to points X and Y of the electric circuit, a bright spot appears on the screen at T. If the input pin at point X is removed and reconnected to point Z of the electric circuit, where will the bright spot move to?





A T→P **B** T→Q **C** T→R **D** T→S

End of Paper

Section A

Answer **all** the questions in this section.

For Examiner's Use

1 The roof of a bungalow is constructed using ceramic tiles. One tile of mass 300 g starts to slide down the roof from rest. It experiences a constant frictional force of 0.40 N and slides for 3.5 m before reaching and falling off the edge of the roof.

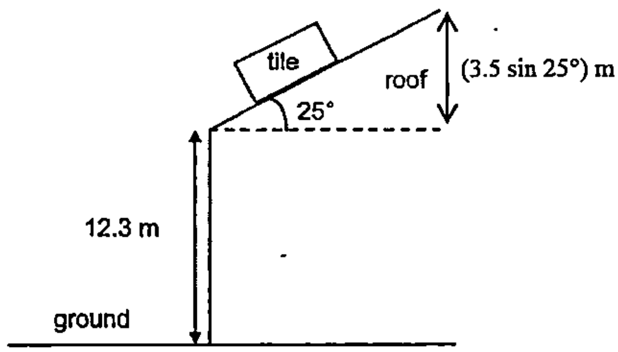


Fig. 1.1

(a) Find the speed of the tile just before it falls off the edge of the roof.

speed = ... [3]

(b) Find the time taken for the tile to hit the ground after falling off the edge of the roof. Hint: Speed in **(a)** is not vertical.

For Examiner's Use

time taken = ... [4]

[Total: 7]

2 Pure gold is usually mixed with copper so that the harder alloy can be used to make jewellery with better form. Auntie Leticia bought a gold necklace which the jeweller claimed was rated 22 karats (91.7% pure). She doubted the claim as the necklace was relatively cheap, so she used some kitchen equipment and found that the mass and volume of the necklace were 88 g and 6.0 cm^3 respectively.

Given that the densities of pure gold and pure copper are 19.3 g cm^{-3} and 8.92 g cm^{-3} respectively, find the percentage of pure gold in Auntie Leticia's necklace.

percentage = ... [4]

[Total: 4]

For Examiner's Use

3 **(a)** The atmospheric pressure at sea level is 101 kPa. An aeroplane takes off from sea level and travels a vertical height of 6.0 km. The average density of air between sea level and that altitude is 1.1 kg m^{-3}. Find the atmospheric pressure at an altitude of 6.0 km.

atmospheric pressure = ... [3]

(b) The aeroplane ascends further to an altitude of 11 km where the atmospheric pressure is 22.5 kPa. The cabin pressure is maintain at 78 kPa. Given that each passenger window on the aeroplane has an area of 0.050 m^2 and is secured by 14 screws, find the tensional force in each screw.

tensional force = ... [2]

[Total: 5]

For Examiner's Use

4 Electronic components are easily overheated and damaged. They are thus usually attached to heat sinks which will transfer thermal energy from the electronic components to the surroundings.

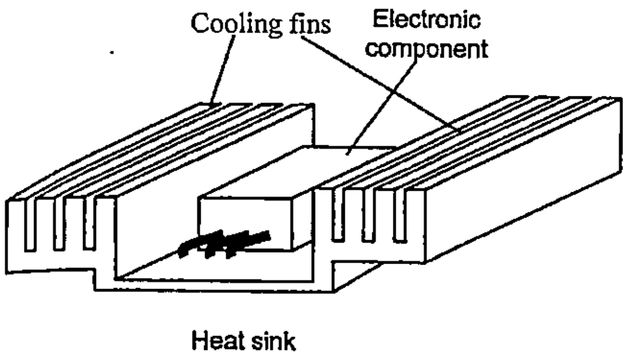


Fig. 4.1

(a) **(i)** Suggest a material for the heat sink and explain why.

....

.... [2]

(ii) Suggest a colour for the heat sink and explain why.

....

.... [2]

(b) Heat sinks are characterised by their *thermal resistances*. The heat sink shown in Fig. 4.1 has a *thermal resistance* of 2 °C W^{-1}. This means its temperature will rise by 2 °C when the electronic component dissipates 1 J of thermal energy per second.

(i) Find the temperature rise of the heat sink when the electronic component dissipates a thermal power of 10 W.

temperature rise = ... [2]

(ii) The electronic component continues to dissipate heat. Suggest a reason why the temperature of the heat sink will be constant after some time.

....

.... [1]

[Total: 7]

5 Fig. 5.1 shows particles in a medium. A wave moves from the left to the right.

Fig. 5.1

(a) Describe the movement of the particles if the wave is a transverse wave.

....

.... [1]

(b) Draw a full-scale graph of the transverse wave of amplitude 20 mm and wavelength 50 mm. Draw at least two waves and label the graph appropriately. [2]

(c) Find the speed of the transverse wave if its period is 400 ms.

speed = ... [2]

[Total: 5]

For Examiner's Use

6 (a) White light from a lamp is viewed through a piece of green glass. State and explain the difference, if any, in the brightness of the light.

....

....

.... [2]

(b) Another lamp is put inside an opaque box with a hole on one side. A thin vertical wire spans across the hole. Light from the lamp exits the box via the hole, passes through a converging lens and falls onto a plane mirror.

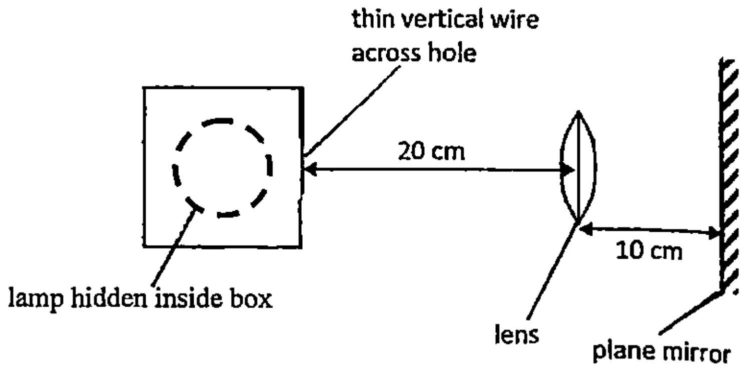


Fig. 6.1

(i) When the distance between the wire and the lens is 20 cm and the distance between the lens and the mirror is 10 cm, a sharp image of the wire is formed on a screen on the same plane as the hole. What is the focal length of the lens?

focal length = ... [1]

(ii) The distance between the wire and the lens is kept at 20 cm but the distance between the lens and the mirror is changed to 15 cm. State and explain the difference, if any, in sharpness of the image of the wire.

....

....

.... [2]

(iii) The mirror is replaced with another screen. The distance between the wire and the lens and the distance between the lens and the screen are both adjusted until a sharp image of the wire is formed on the screen. The image is inverted and of the same size as the wire. State the distance between the wire and the lens.

distance = ... [1]

[Total: 6]

For Examiner's Use

7 Fig. 7.1 shows a metal can connected to a galvanometer.

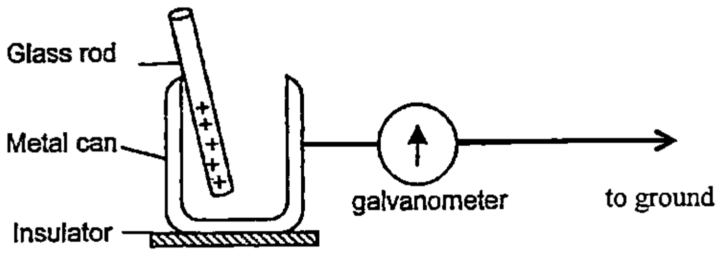


Fig. 7.1

(a) When a positively-charged glass rod is lowered into the metal can, the galvanometer shows a deflection but returns to zero soon after. Explain what has happened.

....

....

....

....

.... [2]

(b) State one way to

(i) increase the deflection of the galvanometer and

....

.... [1]

(ii) change the direction of the deflection of the galvanometer.

....

.... [1]

(c) A student holds a copper rod, tries to charge it and then lowers it into the metal can. State and explain what happens.

....

....

.... [2]

[Total: 6]

8 **(a)** In the evacuated glass tube of a cathode-ray oscilloscope, the current between the cathode and the anode is 135 μA.

(i) Find the time taken for a charge of 0.54 C to reach the anode.

time taken = ... [2]

(ii) Find the number of electrons emitted by the cathode in one second. Charge of one electron is -1.6×10^{-19} C.

no.of electrons = ... [2]

(b) Fig. 8.1 shows that an ammeter with a range of 0 A to 3.0 A has an internal resistance of 6.0 Ω. In order to increase the range of the ammeter, a technician connected another 3.0 Ω resistor in parallel to the original circuit.

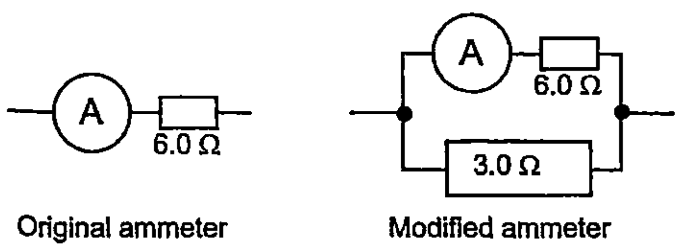


Fig. 8.1

(i) State the new range of the modified ammeter.

new range = ... [1]

(ii) State one disadvantage of the using the modified ammeter.

....

.... [1]

[Total: 6]

For Examiner's Use

9 Fig. 9.1 shows a piece of permanent magnet being released from rest to fall through a copper cylinder.

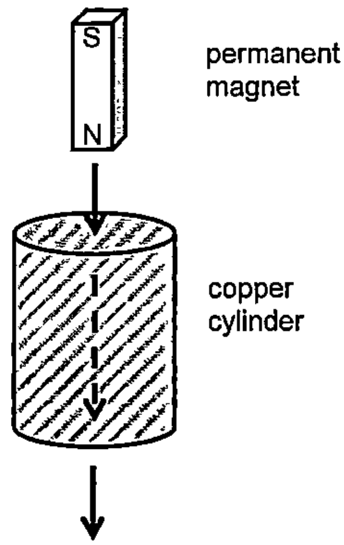


Fig. 9.1

(a) State if copper is a magnetic material.

.... [1]

(b) Using principles in electromagnetic induction, describe and explain the movement of the permanent magnet from the time it is released to the time it totally enters the copper cylinder.

....

....

....

....

....

....

....

.... [3]

[Total: 4]

Section B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12**.

For Examiner's Use

10 The Super Power Group (SPG) is a leading energy utility company in the Acia Pasific. It owns and operates the electricity network on Leo Island. Over two million consumers (households, commercial, industries) benefit from SPG's world-class electricity transmission and distribution systems and enjoy more reliable electricity supply than consumers in other global cities.

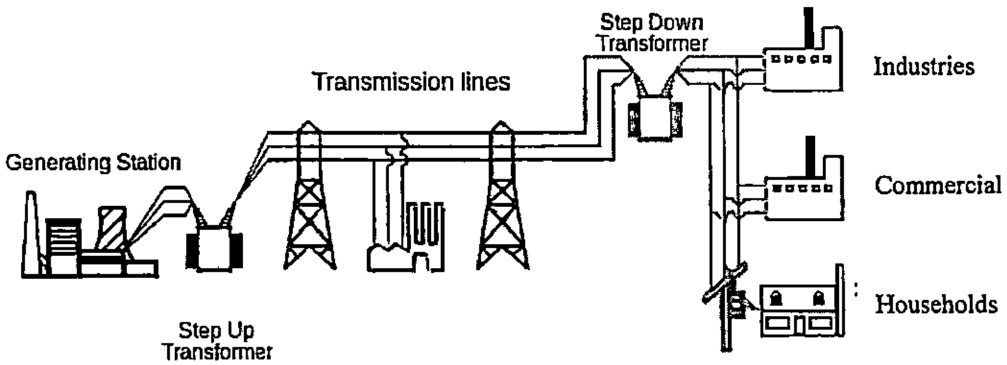


Fig. 10.1

As one of Leo Island's largest corporations, SPG achieved revenue of $4.8 billion and managed $17 billion of assets in 2014.

Its assets include underground electrical cables and substations in service.
- Total cable length in service: 25,000 km
- Cable diameters of 2 cm, 4 cm and 5 cm
- No. of 400 kV substations: 3
- No. of 230 kV substations: 18
- No. of 66 kV substations: 88
- No. of 22 kV substations: 5,590
- No. of 6.6 kV substations: 4,877

It is planning to build a new network branch, to provide electricity from Rurong town to Ris Pasir estate. To increase its revenue yet still maintain the company's competitive edge, it needs to reduce power loss during transmission.

(a) Suggest the type of substation to construct in Rurong and explain why.

....

....

.... [2]

(b) Suggest the type of cable to use as transmission lines and explain why.

....

....

.... [2]

(c)

Fixed specifications:
Power at substation in Rurong is 800 MW
Electrical resistivity of copper is 1.68×10^{-8} Ωm
Distance between substations in Rurong and Ris Pasir is 38 km
Consumers in Ris Pasir to receive voltages at 240 V

For Examiner's Use

Given the information above, find the percentage of power loss during transmission.

percentage of power loss = ... [6]

[Total: 10]

11 In the construction industry, cranes are used to lift girders. A crane is made up of two parts, a cab (the body) and a jib (the hand).

The weight of the cab acts through its midpoint F and is 200 kN. The weight of the jib acts through its midpoint E and is 25 kN.

Cables AB and AC are disjoint. The weights of the cables and hooks are negligible.

Each girder weighs 5 kN.

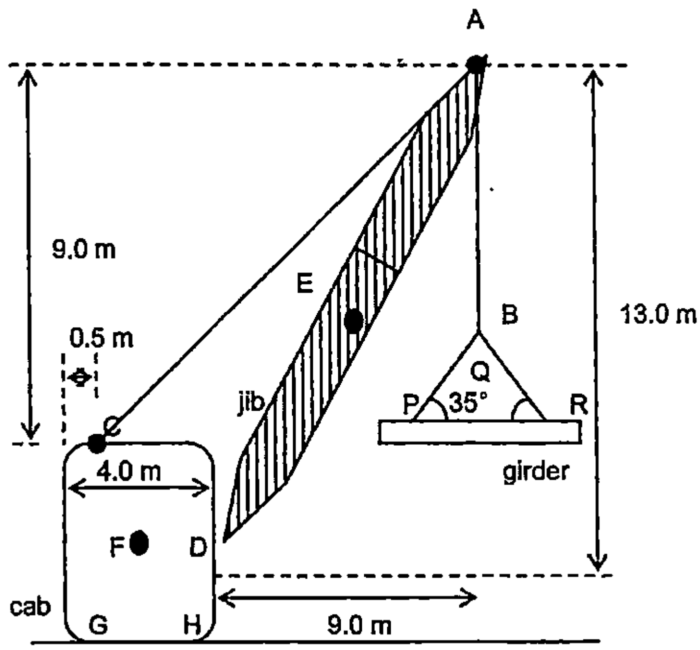


Fig. 11.1

(a) **(i)** The crane is lifting one girder up at constant speed. State the tension in cable AB. Explain how you arrived at your answer.

tension in AB = ... [1]

Explanation:

....

.... [1]

(ii) Hence, find the tension in cable PQ.

tension in PQ = ... [2]

(b) **(i)** On Fig. 11.2 below, draw and label the external forces acting on the crane. [2]

For Examiner's Use

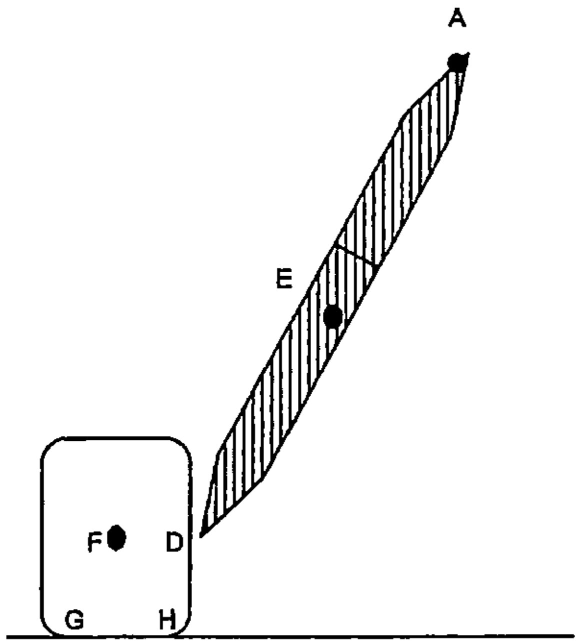


Fig. 11.2

(ii) State which one of the external forces will **not** produce a turning effect when the crane is just about to topple about point H.

.... [1]

(iii) Hence, find the maximum tension cable AB can withstand when the crane is just about to topple about point H.

maximum tension = ... [2]

(iv) Hence, find the maximum number of girders the crane can lift at any one time.

no. of girders = ... [1]

[Total: 10]

12 EITHER

For Examiner's Use

In an experiment, a coil of wire of resistance 28.0 Ω, is submerged in a beaker of water. When current is passed through the wire, the water heats up. Student P uses a current of 2.5 A while student Q uses a current of 2 0 A. They plot the increase in temperature of the water, θ against time taken, t.

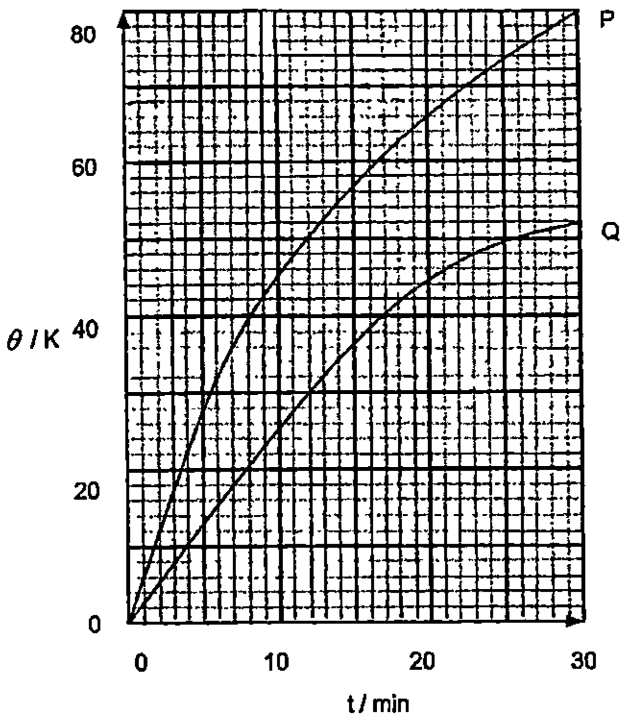


Fig. 12.1

(a) **(i)** Find the power input in each of the two experiments.

power input in P = ... [1]

power input in Q = ... [1]

(ii) Hence, state and explain the difference between graph P and graph Q.

....

....

....

.... [2]

For Examiner's Use

(b) State and explain the relationship between the increase in temperature of the water, θ and time taken, t.

....

....

....

....

.... [3]

(c) **(i)** Derive a formula to calculate power P, in terms of mass of water m, increase in temperature of the water θ, specific heat capacity of water c and time taken t.

formula: .... [1]

(ii) Hence, find the mass of water m, used in experiment P if the gradient of graph P at t = 0 min is 12 K min^{-1}. Specific heat capacity of water is 4.2 J g^{-1} K^{-1}.

mass of water: .... [2]

[Total: 10]

For Examiner's Use

12 OR

To investigate the make-up of the underground, an explosion is created on the Earth's surface and the sound is picked up by a detector. Fig. 12.2 shows four possible paths of the sound waves.

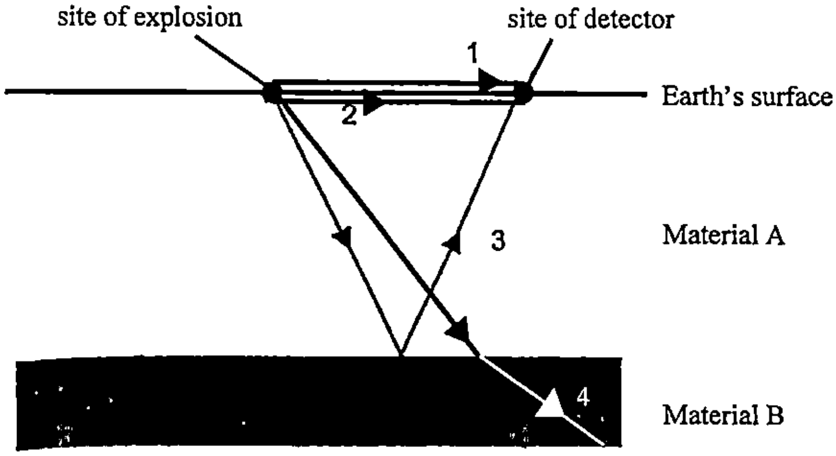


Fig. 12.2

Table 12.1 shows the timings taken for the sounds to be detected.

Path	1 (in air)	2 (through material A)	3 (reflected by material B)	4 (refracted into material B)
Time taken for sound to be detected / s	0.60	0.15	1.75	not detected

Table 12.1

(a) Using principles in particulate theory, explain why sound travels faster along path 2 than path 1.

....

....

.... [2]

(b) **(i)** Find the distance between the site of the explosion and the detector. Speed of sound in air is 330 m s^{-1}.

distance = ... [2]

(ii) Hence, find the speed of sound in material A.

For Examiner's Use

speed in material A = ... [2]

(c) Path 3 and path 4 shows that sound waves can be both reflected and refracted.

(i) State the Laws of Reflection.

....

....

....

.... [2]

(ii) State and explain if sound travels faster in material A or material B.

....

....

....

.... [2]

[Total: 10]

End of Paper

5059 Physics (SPA) Marking Scheme
Xinmin Sec 4E Preliminary Examination 2015

Paper 1

Qn	1	2	3	4	5	6	7	8	9	10
Ans	B	B	B	D	D	B	D	C	D	A

Qn	1	2	3	4	5	6	7	8	9	10
Ans	D	C	A	B	C	A	C	C	A	A

Qn	1	2	3	4	5	6	7	8	9	10
Ans	C	B	C	D	C	D	D	C	D	A

Qn	1	2	3	4	5	6	7	8	9	10
Ans	A	B	B	A	B	C	A	A	D	B

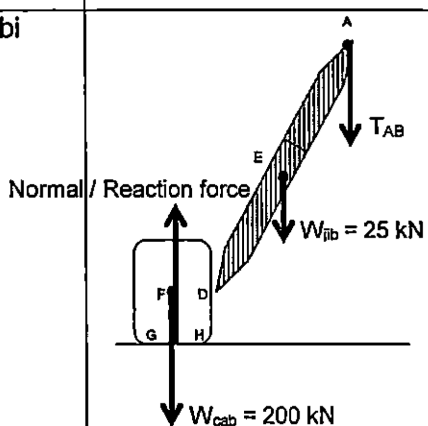
Paper 2 Section A

Qns	Answers	Remarks
1a	Loss in GPE = Gain in KE + WD against friction $mgh = ½mv^2 + Fd$ $(0.300)(10)(3.5 \times \sin 25°) = (½)(0.300)(v^2) + (0.40)(3.5)$ $v = 4.499... = 4.50 \text{ m s}^{-1}$	[1] calculates GPE [1] calculates WD [1] ans
1b	Vertical component of v = $(\sin 25°)(4.50 \text{ m s}^{-1}) = 1.901... = 1.90 \text{ m s}^{-1}$ Distance = Area under v-t graph = ½ x base x sum of parallel sides $12.3 = (½)(t)(1.9 + v_f)$ --- eqn 1 Acceleration = Gradient of v-t graph $10 = (v_f - 1.9)/t$ $v_f = 10t + 1.9$ --- eqn 2 Sub eqn 2 into eqn 1 and solve for t: t = 1.389... = 1.39 s	[1] vertical component [1] any one of the 2 eqns [1] working [1] ans
		Total 7m
2	$m_g + m_c = 88$ $m_c = 88 - m_g$ --- eqn 1 $V_g + V_c = 6.0$ $(m_g/19.3) + (m_c/8.92) = 6.0$ --- eqn 2 Sub eqn 1 into eqn 2 and solve for m_g: $m_g = 64.11... = 64.1$ g percentage purity = 64.1/88 x 100% = 72.85... = 72.9%	[1] eqn 1 [1] eqn 2 [1] working [1] ans
		Total 4m
3a	Pressure due to 6 km column of air $= \rho gh = (1.1)(10)(6.0 \times 10^3) = 66$ kPa Atmospheric pressure at altitude 6 km = Atmospheric pressure at sea level – Pressure due to 6 km cloumn = 101 – 66 = 35 kPa	[1] column [1] subtraction [1] ans

3b	Resultant pressure = 78 – 22.5 = 55.5 kPa Resultant force on each window = pA = $(55.5 \times 10^3)(0.050)$ = 2775 N Tensional force in each screw = 2775/14 = 198.2... = 198 N	 [1] working [1] ans
		Total 5m
4ai	Material: Any type of metal, eg. aluminium Explanation: Metals are <u>better conductors</u> of thermal energy <u>than non-metals</u>.	[1] [1] [-1] if not conductor but absorber or emitter [-½] if not compared to non-metals
4aii	Colour: Any dark colours, eg black Explanation: Dark colours are <u>better emitters</u> of thermal energy <u>than light colours</u>.	[1] [1] [-1] if not emitter but conductor or absorber [-½] if not compared to light colours, unless student wrote "darker"
4bi	Temperature rise = $(2°C\ W^{-1})(10\ W)$ = 20°C	[1] working, [1] ans
4bii	Rate of conduction of thermal energy from electronic component = rate of emission of thermal thermal energy to surroundings	[1]
		Total 7m
5a	Up and down	[1]
5b	Vertical axis labelled "amplitude/mm" or "displacement/mm" Horizontal axis labelled "distance/mm" Amplitude 20 mm Wavelength 50 mm	[½] [½] [½] [½] [-½] if not full-scale [-½] if less than 2 waves
5c	Speed = $\lambda/T = (50 \times 10^{-3})/(400 \times 10^{-3}) = 0.125\ m\ s^{-1}$	[1] working, [1] ans
		Total 5m
6a	Difference: Light is less bright. Explanation: Only green light is allowed to pass through; light of other colours are absorbed by the green glass.	[1] [1]
6bi	20 cm *p.s. To get a sharp image, the light rays from the lens must be parallel to one another. Thus u = f.*	[1]
6bii	Difference: Image is still/equally sharp. No difference. Explanation: As the object distance is unchanged/still equals to focal length, light rays from the lens are parallel to one another/angle of incidence (and angle of reflection) is zero on the mirror.	[1] [1]

6biii	40 cm *p.s. The descriptions of the image suggest that u = 2f.*	[1]
		Total 6m
7a	Unlike charges attract. Electrons from the outer layer of the can are attracted to the inner layer by the positively-charged glass rod. Electrons from the ground are attracted to the outer layer of the can. The electron flow causes a deflection. Once the charges are balanced, there is no more electron flow and the deflection is zero.	[½] [½] [½] [½]
7bi	Increase the charge of the positively-charged (glass) rod. ~~OR~~ ~~Increase the speed at which the positively-charged (glass) rod is lowered.~~	[1]
7bii	Use a negatively-charged (glass) rod. OR Withdraw positively-charged (glass) rod.	[1]
7c	Nothing happens. No deflection on the galvanometer. A copper rod cannot be charged when the student is holding it as the rod is earthed.	[1] [1]
		Total 6m
8ai	Time = Q/I = $0.54/(135 \times 10^{-6})$ = 4000 s	[1] working, [1] ans
8aii	No. of electrons = $0.54/(1.6 \times 10^{-19}) = 3.375 \times 10^{18} = 3.38 \times 10^{18}\ e^-$	[1] working, [1] ans
8bi	0 A – 9.0 A *p.s. Since max 3 A flows through 6 Ω, then max 6 A can flow through 3 Ω (same p.d. and bigger R ⇔ smaller I)*	[1]
8bii	The ammeter is less sensitive; increase in current in less visible on ammeter.	[1]
		Total 6m
9a	No	[1]
9b	As the N-pole of the magnet approaches the top of the cylinder, the <u>change in magnetic flux linkage</u> between the magnetic field from the magnet and the cylinder <u>induces a current in the cylinder</u> (Faraday's Law). The induced current in the cylinder flows in a <u>direction</u> that produces a magnetic field and hence a magnetic force that <u>opposes</u> the fall of the magnet (Lenz's Law). Hence, the magnet <u>falls with an acceleration of less than 10 m s^{-2}</u>.	[1] [1] [1]
		Total 4m

Paper 2 Section B

Qns	Answers	Remarks
10a	Type of substation: 400 kV substation Explanation: Electricity should be transmitted at <u>high voltages</u> (low current) to <u>reduce power loss</u>.	[1] [1]
10b	Type of cable· Cable of diameter 5 cm Explanation: The bigger the cross-sectional area of a wire/cable, the <u>smaller its resistance</u>, hence <u>reducing power loss</u>.	[1] [1]
10c	Current in cable = P/V = $(800 \times 10^6)/(400 \times 10^3)$ = 2000 A Resistance of cable = $\rho l/A = (1.68 \times 10^{-8})(38 \times 10^3)/(\pi)(2.5 \times 10^{-2})^2$ = 0.3251... = 0.325 Ω Power loss = $I^2R = (2000)^2(0.325)$ = 1 300 537... = 1.30 MW Percentage of power loss = $(1.30 \times 10^6)/(800 \times 10^6) \times 100\%$ = 0.16256... = 0.163%	[1] ; allow ecf from 10a [1] [1] ; allow ecf from 10b [1] [1] [1]
		Total 10m
11ai	Tension in AB = 5 kN Explanation. Since the girder is lifted at constant speed (zero acceleration), the <u>resultant force</u> on it must be <u>zero</u>. Thus tension in AB is equal to weight of girder.	[1] [1]
11aii	Tension in PQ = Tension in QR = 2.5 kN T_{PQ} = 2.5/(sin 35°) = 4.358... = 4.36 kN	[1] [1]
11bi		[½] for each force *Reaction force by cab on jib = Reaction force by jib on cab (CANCELLED)* *Tension by C on A = Tension by A on C (CANCELLED)*
11bii	Normal / Reaction force	[1]
11biii	By the Principle of Moments, to have rotational equilibrium, taking moments about pivot H, Sum of Anti-clockwise Moments = Sum of Clockwise Moments $(200)(2.0) = (25)(4.5) + (T_{max})(9.0)$ T_{max} = 31.94... = 31.9 kN	 [1] working [1] ans
11biv	Max no. of girders = 31.9/5 = 6.3... = 6 girders	[1]
		Total 10m

EITHER		
12ai	Power in P = I^2R = $(2.5^2)(28.0)$ = 175 W Power in Q = I^2R = $(2.0^2)(28\ 0)$ = 112 W	[1] [1]
12aii	Difference between P & Q: The rate of temperature rise in P is greater than the rate of temperature rise in Q. Explanation: The rate of input of thermal energy in P is greater than the rate of input of thermal energy in Q.	[1] [1]
12b	Relationship between θ and t: (In both P & Q) As t increases, θ increases at a decreasing rate. Explanation: - As t increases, temperature of water increases. The <u>temperature difference between the water and the surroundings increases</u>. - The <u>rate of heat loss to the surroundings increases</u>, so temperature rise decreases.	[1] [1] [1]
12ci	$Q = mc\theta \rightarrow Q/t = mc\theta/t \rightarrow P = mc\theta/t$	[1]
12cii	θ/t is gradient of graph Power in P = mc(θ/t) = mc(gradient) 175 = (m)(4.2)(12 K min^{-1}) = (m)(4.2)(0.2 K s^{-1}) m = 0.2083… = 0.208 g	 [1] working [1] ans
		Total 10m
OR		
12a	Sound travels in a <u>solid along path 2</u> while sound travels in a <u>gas along path 1</u>. As particles in a <u>solid are closely packed together</u>, sound energy can be transferred from particle to particle at a higher speed than in a <u>gas, where particles are far apart from one another</u>.	[1] [1]
12bi	Distance = vt = 330 x 0.60 = 198 m	[1] working [1] ans
12bii	Speed in material A = d/t = 198/0.15 = 1320 m s^{-1}	[1] working [1] ans
12ci	Law #1: Angle of incidence *i* is equal to angle of reflection *r*. Law #2: The incident ray, the reflected ray and the normal all lies in the same plane.	[1] [1]
12cii	Sound travels faster in material B. Explanation: The sound wave bends away from the normal when it travels from material A to material B.	[1] [1]
		Total 10m