Geylang Methodist School (Secondary)
Preliminary Examination 2018

PHYSICS **6091/01**

Paper 1 **Sec 4 Express**

Additional materials : OAS

1 hour

Setter : Mr Yip Cheng Hou

24 August 2018

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 on Earth and 6.67 m/s^2 on Moon unless otherwise specified.

This document consists of **16** printed pages

[Turn over

1 Pressure can be determined using the following formula:

$$\mathbf{P = F \div A}$$
$$\mathbf{F = m \times a}$$

where **P**= pressure (pascal, Pa) **A** = area (m^2) **m** = mass (kg)

F = force (newtons, N) **a** = acceleration ($\frac{m}{s^2}$)

The unit, pascal, is equivalent to

A $\frac{kg}{sm}$ **B** $\frac{s^2}{kgm}$ **C** $\frac{1}{kgs^2m}$ **D** $\frac{kg}{s^2m}$

2 **Fig. 2** shows Jenny's setup of the following experiment.

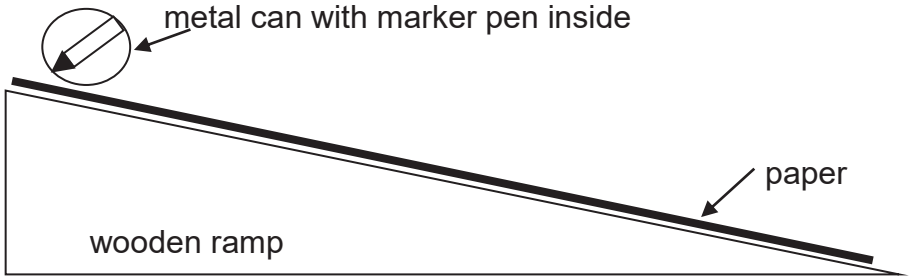
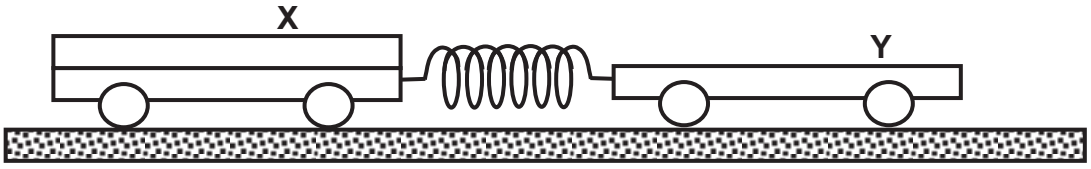


Fig. 2

Jenny released the can and it rolled freely down the ramp without slipping. What would she observe on the paper made by the marker pen?

A The dots get farther apart.
B The dots get closer together.
C The dots gets closer then further apart.
D The dots are equidistant from each other.

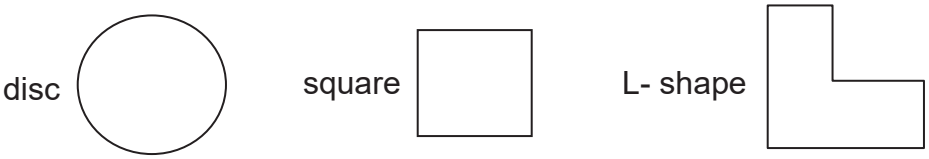
3 Trolley **X** and trolley **Y** are joined together by a stretched spring. Trolley **X** has twice the mass of trolley **Y**. When the trolleys are released, the acceleration of **X** is 1.0 m s^{-2} to the right.



What is the initial acceleration of trolley **Y** to the left?

A 0.5 m s^{-2} **B** 1.0 m s^{-2} **C** 2.0 m s^{-2} **D** 4.0 m s^{-2}

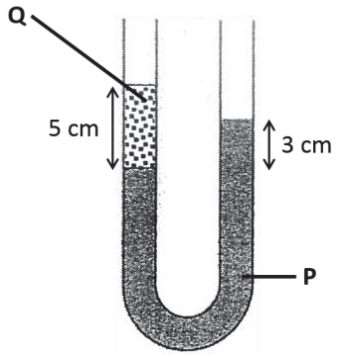
4 Three objects are cut from the same big sheet of metal. They have the same volume but different shapes.



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

A They have different mass and position of C.G.
B They have different mass but same position of C.G.
C They have the same mass and position of C.G.
D They have the same mass but different position of C.G.

5 The diagram below shows two immiscible liquids, P & Q, which have been poured into a manometer which is exposed to the atmosphere at the top of both arms.



What is the ratio of the density of Liquid Q to Liquid P?

A 3:5 **B** 5:8 **C** 5:3 **D** 8:3

6 The diagram below shows a uniform metre ruler with a weight of 10 N, under the action of a vertical force of 30.0 N.

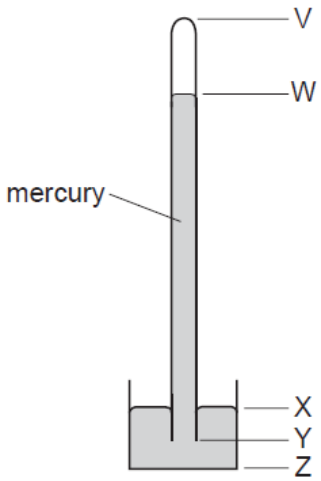
At what mark must a fulcrum be placed to hold the ruler in equilibrium?

A 12.5 cm **B** 16.7 cm **C** 25.0 cm **D** 37.5 cm

7 Which of the following objects has the **least** inertia?

A A robot of weight 300 N travelling on the Moon.
B A robot of weight 300 N travelling on Earth.
C A stationary rock of mass 150 kg on the Moon.
D A stationary rock of mass 150 kg on Earth.

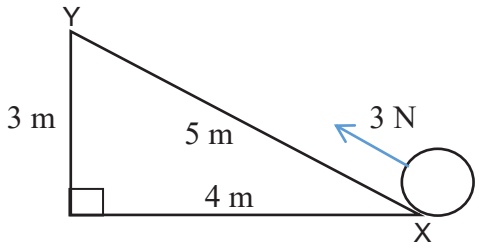
8 The diagram shows a simple mercury barometer.



When the atmospheric pressure increases, which distance increases?

A VW **B** XY **C** YZ **D** WX

9 A ball, which weighs 2 N, is moved up a slope from X to Y, by applying a force of 3 N as shown in the diagram below.



Assuming no energy is lost to the surrounding, what is the gain in kinetic energy, gain in gravitational potential energy and work done on the ball?

	Kinetic Energy	Gravitational Potential Energy	Work Done
A	6 J	6 J	6 J
B	6 J	9 J	6 J
C	15 J	6 J	15 J
D	9 J	6 J	15 J

10 A powerful fan uses a 50 W battery. The fan generates 20 J of heat every second as its motor turns.

What is the efficiency of this fan?

A 28.6 % **B** 40.0 % **C** 60.0 % **D** 250 %

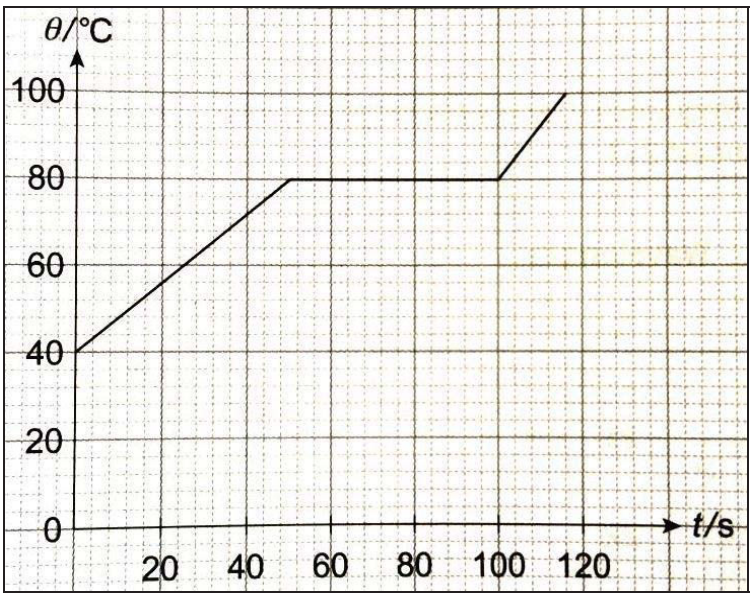
11 Which gives the states of matter in which molecules, at a given temperature, have the smallest spacing between them and move at the lowest speed?

	Smallest spacing between molecules	Molecules have the lowest speed
A	Solid	Solid
B	Liquid	Solid
C	Solid	Liquid
D	Liquid	Liquid

12 Which of these examples has the wrong type of heat transfer associated with it?

	Example	Type of heat transfer
A	Heat from flame to flying pan	Conduction
B	Sunlight warming the interior of a car	Convection
C	Cooling a cup of coffee with a steel spoon	Conduction
D	Heat from burning logs to person beside fire place	Convection

The graph below shows the changes in temperature of a 400 g solid when it is heated by a heater with a rating of 80 W. Use it to answer questions 13 to 15.



13 Which of the following statements show a difference between heat and temperature.

A When 80 W of heat is supplied, the temperature reached 80 °C.
B Heat has a SI unit in Kelvin while temperature SI unit is in °C
C Heat increases when temperature increases.
D Heat remains constant regardless whether temperature changes.

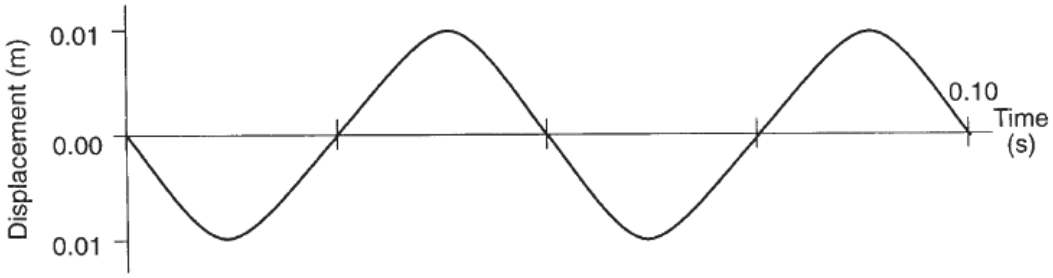
14 Assuming there is negligible energy loss to the surroundings, what is the specific heat capacity of the liquid?

A 10 J/kg°C **B** 160 J/kg°C **C** 240 J/kg°C **D** 1160 J/kg°C

15 Assuming there is negligible energy loss to the surroundings, what is the specific latent heat of fusion of the solid?

A 10 J/kg **B** 167 J/kg **C** 200 J/kg **D** 10000 J/kg

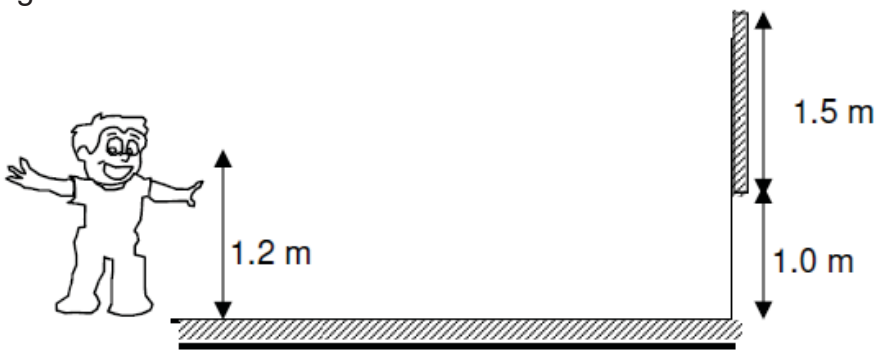
16 The graph shows the vertical displacement of an object floating on water as a wave passes through the water.



What is the frequency of the wave?

A 10 Hz **B** 20 Hz **C** 50 Hz **D** 100 Hz

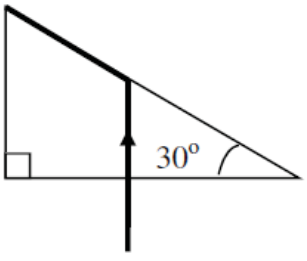
17 A plane mirror 1.5 m in length is hung on a vertical wall with its bottom 1.0 m above ground. A boy with his eyes 1.2 m above ground looks into the mirror to see the image of himself.



What length of himself (below his eyes) can be seen in the mirror?

A 0.4 m **B** 0.8 m **C** 1.0 m **D** 2.0 m

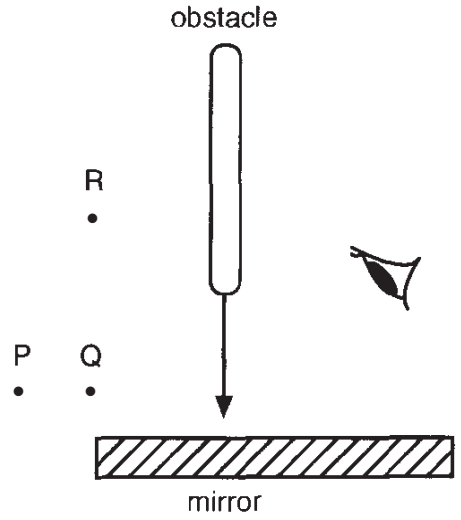
18 A ray of light enters a prism made of material **X** and travels along the path as shown in the figure below.



What is the refractive index of the material **X**?

A 0.50 **B** 1.20 **C** 1.50 **D** 2.00

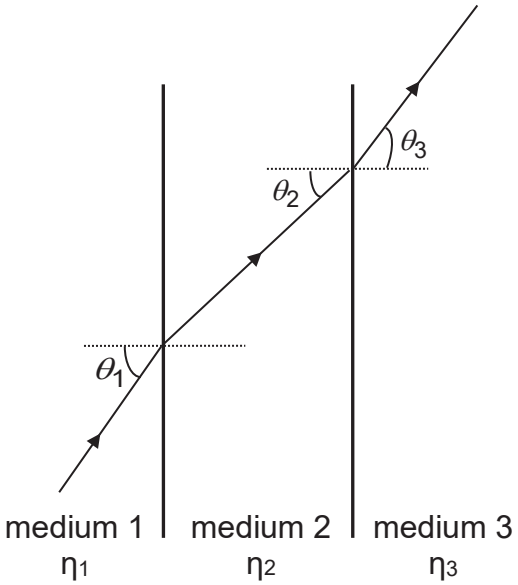
19 Three objects, **P**, **Q** and **R**, are viewed through a plane mirror as shown. An obstacle moves towards the mirror as indicated by the arrow.



Which image will disappear first and which image will disappear last?

	disappears first	disappears last
A	**P**	**Q**
B	**P**	**R**
C	**Q**	**R**
D	**R**	**Q**

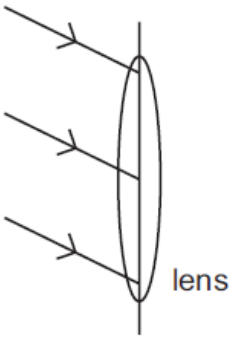
20 A light ray passes through three media of refractive indices η_1, η_2 and η_3 respectively.



Given that $\theta_1 > \theta_3 > \theta_2$, which of the following is correct?

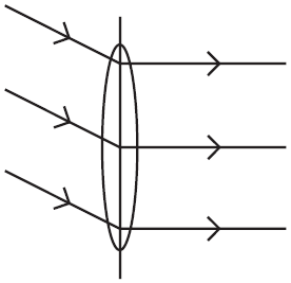
A $\eta_1 > \eta_2 > \eta_3$ **B** $\eta_2 > \eta_1 > \eta_3$ **C** $\eta_1 > \eta_3 > \eta_2$ **D** $\eta_2 > \eta_3 > \eta_1$

21 Three rays of light fall on a converging lens as shown.

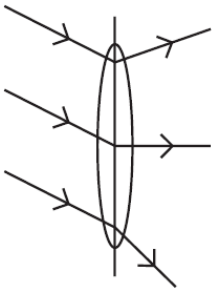


Which diagram shows the path of the rays after passing through the lens?

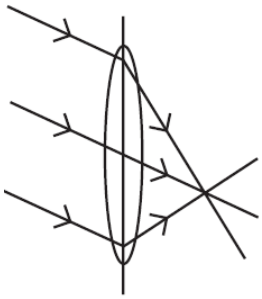
A



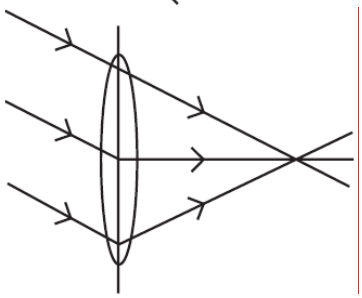
B



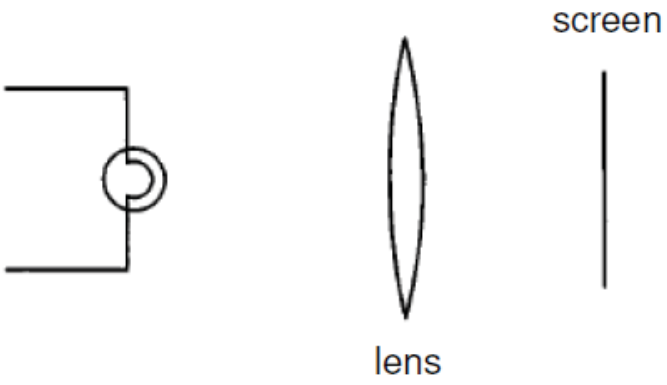
C



D



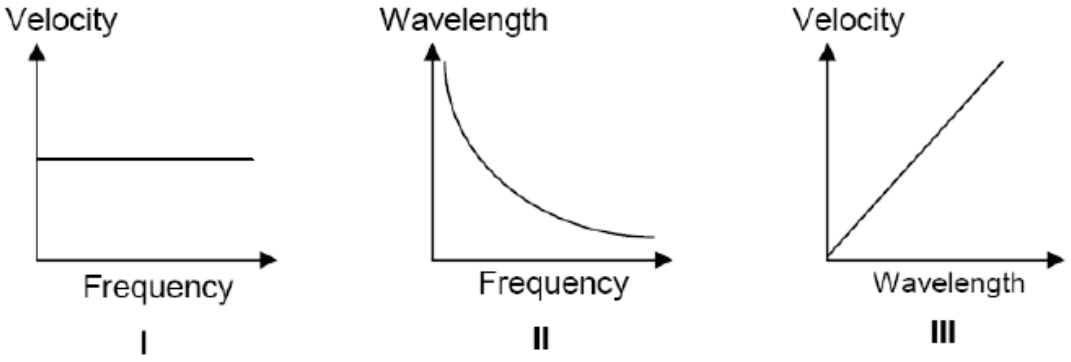
22 A student arranges an illuminated object, a lens and a screen such that the size of the image is twice that of the object. Keeping the distance between the screen and the illuminated object fixed, he exchanges the position of the screen and the illuminated object.



What would be observed on the screen?

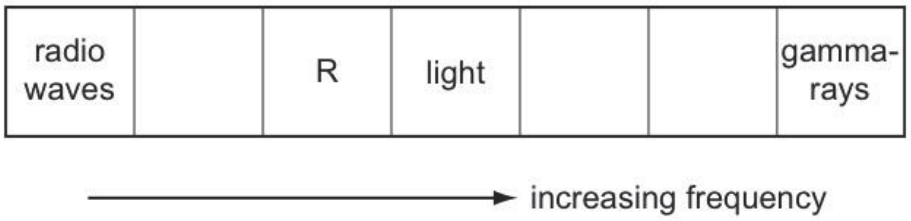
A A blurred, magnified image.
B A blurred, diminished image.
C A sharp image twice the size of the object.
D A sharp image half the size of the object.

23 Which of the following graphs about electromagnetic waves travelling in vacuum is/are correct?



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

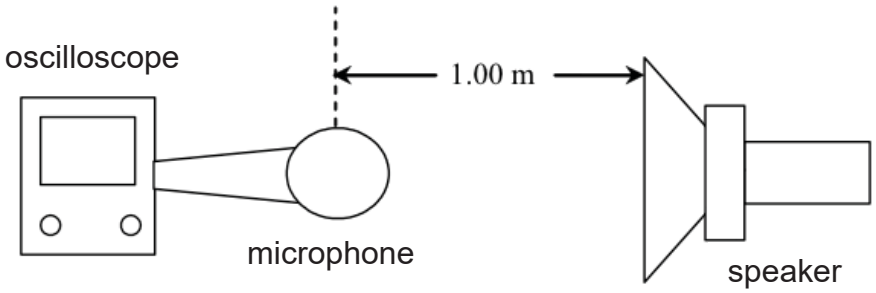
24 The diagram shows the main sections of the electromagnetic spectrum in order of increasing frequency. Some of the sections are labelled. The section R has a frequency just below that of light.



Which application uses the section R?

A Sterilisation
B Satellite television
C Bread toaster
D Laser pointer

25 The set-up shown in the diagram below consists of an oscilloscope and a speaker that emits a sound wave with frequency 1000 Hz. A microphone placed 1.00 m from the speaker detects the sound emitted by the speaker. A waveform is observed on the oscilloscope representing the sound emitted.



The speaker is then moved to a distance 0.5 m towards the microphone and a new waveform is observed on the oscilloscope. Compared to the earlier waveform, this new waveform has a greater _____.

A speed **B** amplitude **C** frequency **D** wavelength

26 **Fig. 26.1** is a **full-scale** diagram that shows air particles at their equilibrium positions (represented by dotted lines). When a sound wave passes, particles are displaced into new positions shown in **Fig. 26.2**. **Q** represents a particle.

Fig. 26.1

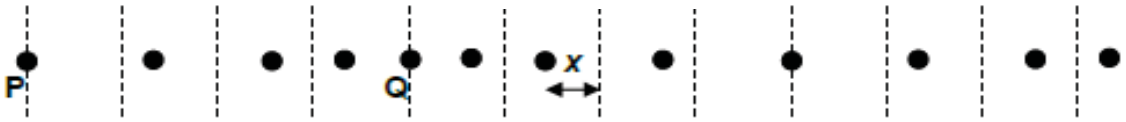
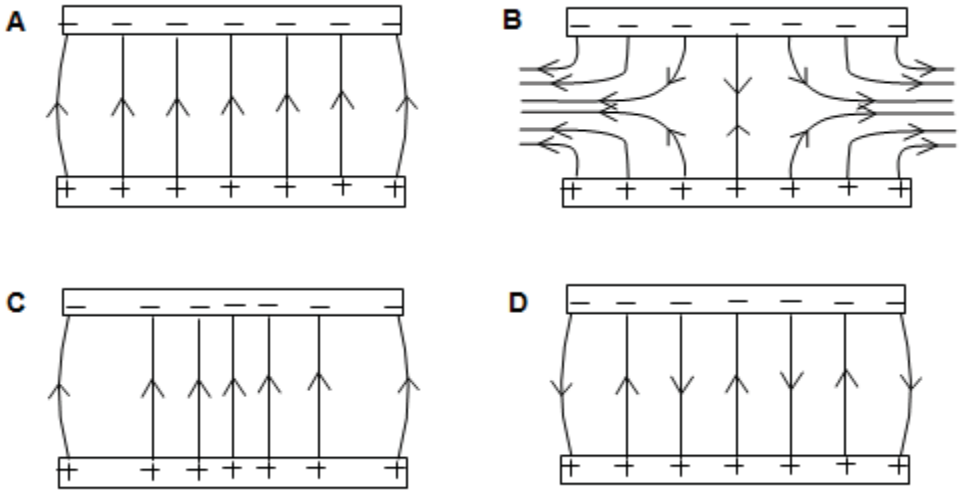


Fig. 26.2

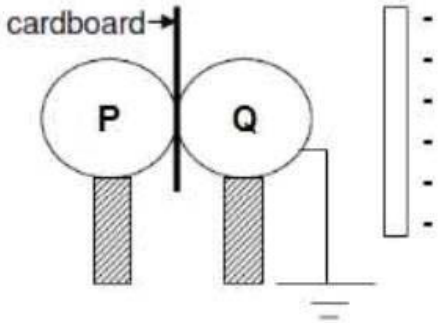
Which of the following statements is false?

A Point **Q** is the centre of a rarefaction.
B Particles next to **Q** are moving in opposite direction.
C The amplitude of the wave is 1.0 cm.
D The wavelength of the wave is 10.3cm

27 Which of the following diagrams correctly shows the uniform electric field between two charged parallel metal plates?



28 Two uncharged metal spheres **P** and **Q** are placed together with a thick cardboard inserted between them. Both spheres are supported by insulating stands and **Q** is earthed with a wire.

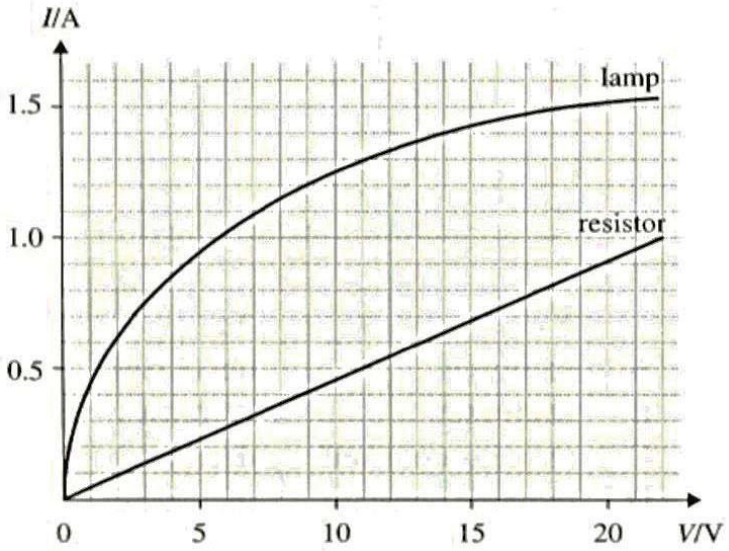


A negatively-charged rod is brought near the spheres as shown.

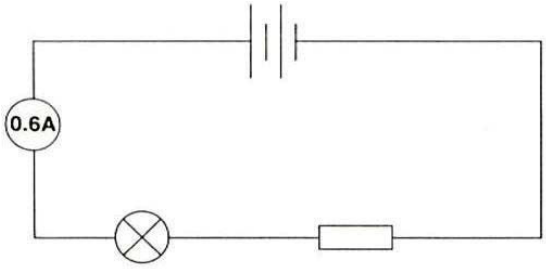
What would be the distribution of charges on spheres **P** and **Q** when the wire is removed followed by the charged rod?

	P	Q
A	negative	positive
B	negative	neutral
C	neutral	positive
D	neutral	neutral

Refer to the following information for Questions 29 and 30.
The graph below shows how the current in a lamp and a resistor varies with the potential difference applied.



The lamp and the resistor are connected in series as shown below, and the ammeter reading is 0.6 A.



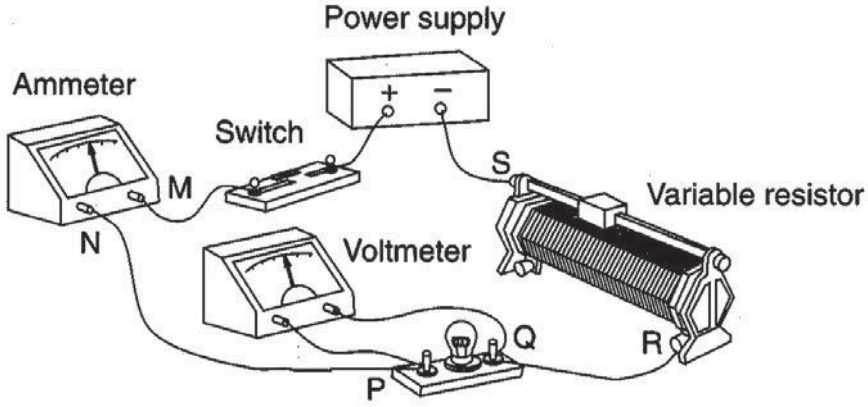
29 Determine the e.m.f. of the circuit.

A 2.0 V **B** 11.0 V **C** 13.0 V **D** 15.0 V

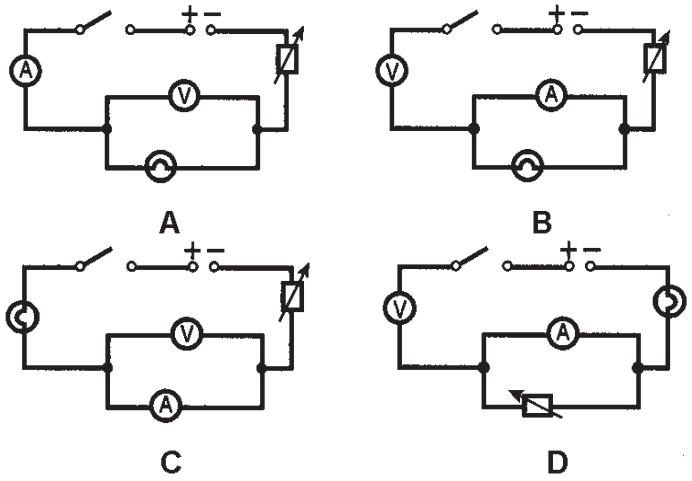
30 Determine the resistance of the resistor.

A 0.046 Ω **B** 0.091 Ω **C** 11.0 Ω **D** 22.0 Ω

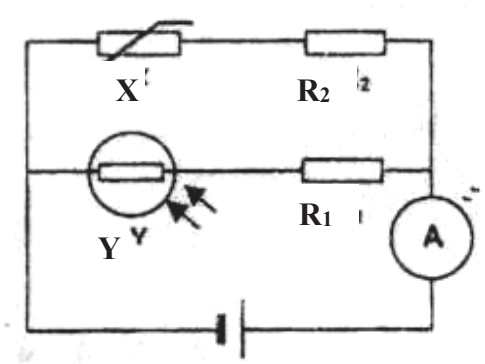
31 The diagram shows an experimental set-up of an electric circuit to determine the resistance of a bulb.



Which one of the following shows the correct circuit diagram?



32 In the circuit shown, R_1 and R_2 are identical resistors.



Which of the following changes to the electrical components **X** and **Y** will decrease the reading of the ammeter by the greatest amount?

A Immerse **X** in a beaker of ice water and decrease the light intensity on **Y**.
B Immerse **X** in a beaker of ice water and increase the light intensity on **Y**.
C Immerse **X** in a beaker of hot water and decrease the light intensity on **Y**.
D Immerse **X** in a beaker of hot water and increase the light intensity on **Y**.

33 In a 3-pin plug of a vacuum cleaner, the fuse is missing.
Which of the following statement is correct?

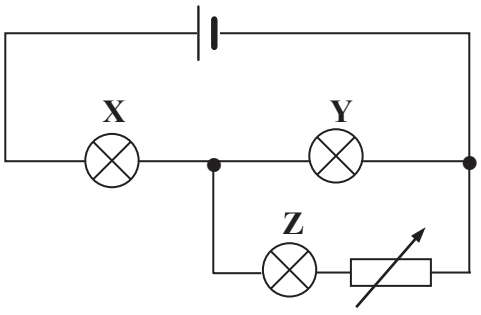
A The vacuum cleaner can be turned on but in the event of an electrical fault, the vacuum cleaner will be live.

B The vacuum cleaner can be turned on but in the event of an electrical fault, the vacuum cleaner will be safe to handle because the current will flow to earth.

C The vacuum cleaner, once turned on, will shut down at once.

D The vacuum cleaner cannot be turned on.

34 Three identical lamps X, Y and Z are connected in a circuit as shown below.



What will happen to the brightness of the lamps if the resistance of the rheostat is increased?

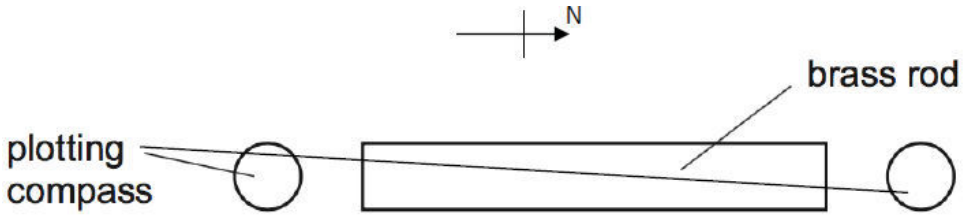
	X	Y	Z
A	Brighter	dimmer	dimmer
B	brighter	brighter	dimmer
C	dimmer	brighter	dimmer
D	dimmer	brighter	brighter

35 A student carries out four tests with a magnet.

Which result shown is **not** correct?

	arrangement		Result
A	S magnet N	S magnet N	Attracts
B	S magnet N	iron bar	attracts
C	N magnet S	iron bar	repel
D	N magnet S	copper bar	no effect

36 A brass rod is arranged in a north-south direction and plotting compasses are placed at each of it ends.



Which diagram shows the positions of the needles of the plotting compasses?

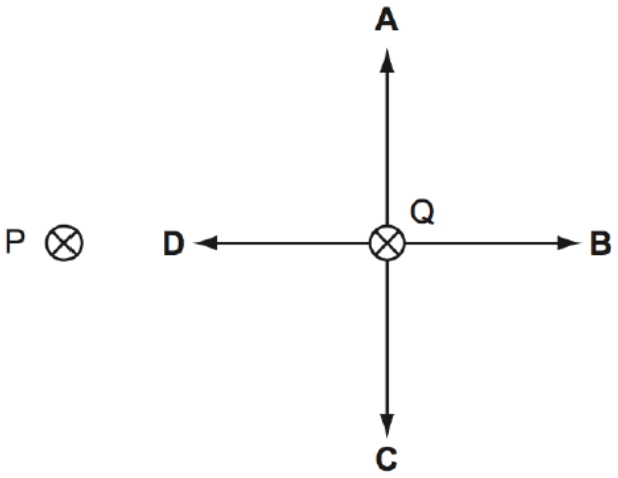
A

B

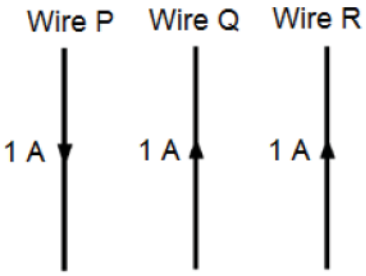
C

D

37 P and Q represents two parallel, straight, wires carrying currents. P and Q exert force on each other. Which arrow shows the force on Q?



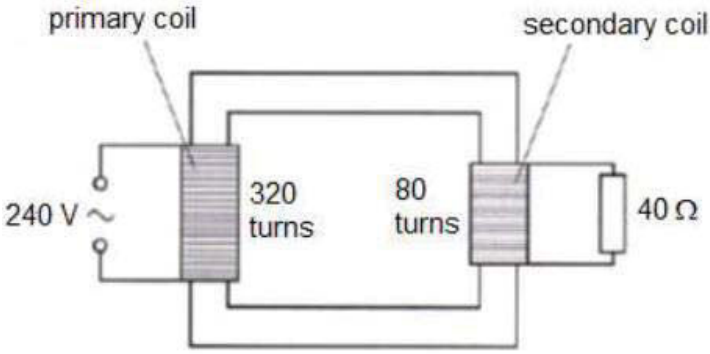
38 Three wires **P**, **Q** and **R** are each carrying a current of 1 A in the direction as shown in the diagram below.



What are the directions of forces acting on the three wires?

	Wire P	Wire Q	Wire R
A	left	left	left
B	right	left	right
C	left	right	left
D	right	right	right

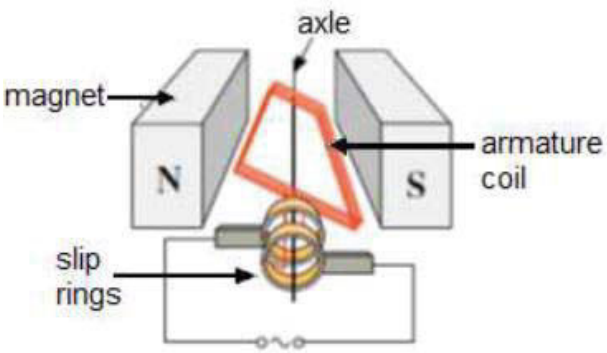
39 The figure below shows an ideal transformer with the secondary coil connected to a 40 Ω load.



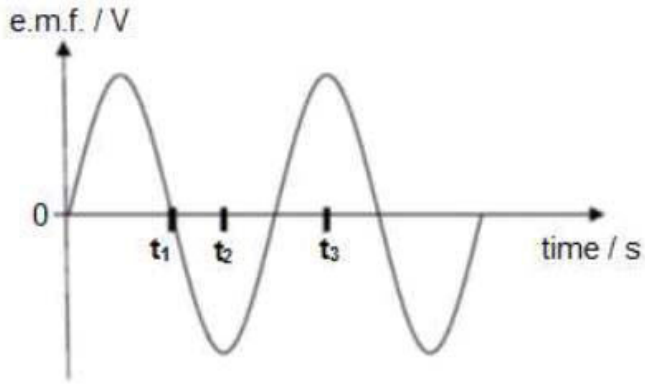
What is the current in the primary coil?

A 0.38 A **B** 1.5 A **C** 2.7 A **D** 6.0 A

40 The diagrams show a simple a.c. generator and the graph illustrating the waveform of the e.m.f. output of the a.c. generator.



simple a.c generator



waveform of the e.m.f. output

Which of the following diagrams correctly shows the plane of the armature coil of the generator, as viewed along the axle from the position of the slip rings, at time intervals denoted by t_1, t_2 and t_3 on the graph?

	t_1	t_2	t_3
A			
B			
C			
D			

END OF PAPER 1

Geylang Methodist School (Secondary)
Preliminary Examination 2018

Candidate Name			
Class		Index Number	

PHYSICS **6091/02**

Paper 2 Physics **Sec 4 Express**

Additional materials : Writing Papers **1 hour 45 minutes**

Setter : Mr Yip Cheng Hou **24 August 2018**

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** in writing papers provided.
Question 13 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 **19** printed pages and 1 blank page.

[Turn over

Section A

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

1 Fig. 1.1 shows a virtual image **I** formed by a converging lens from an object of height 1.0 cm.

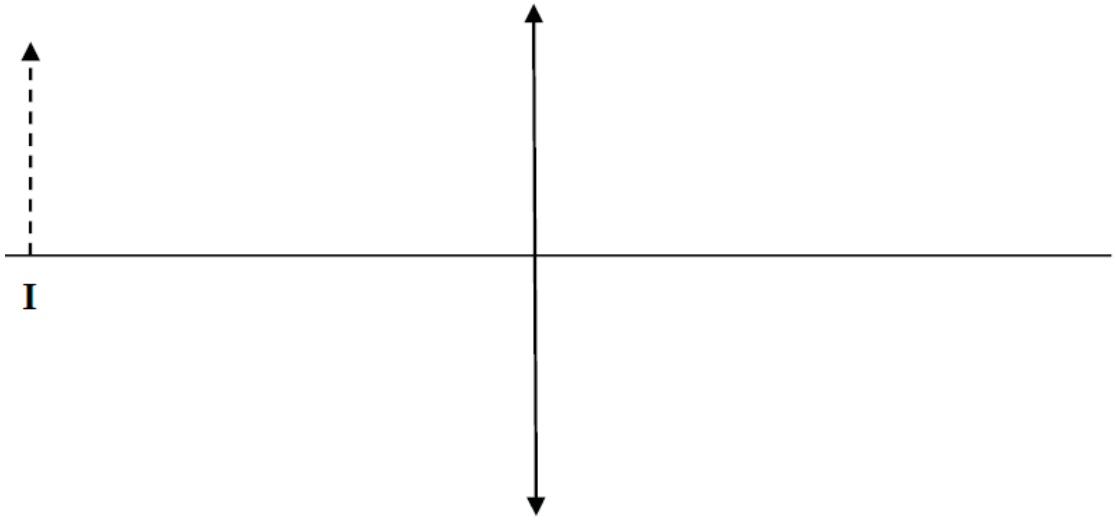


Fig. 1.1

(a) On Fig. 1.1 above, draw rays to determine

(i) the position of the object, Label the object **O**.

(ii) the focal length of the lens.

focal length = …… [2]

(b) Fig. 1.2 shows a light ray travelling in the converging lens of refractive index 1.5. The diagram is not drawn to scale.

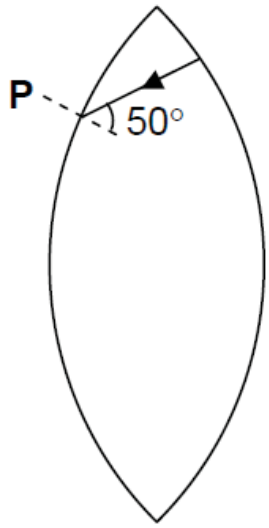


Fig. 1.2

Calculate the critical angle and explain the behaviour of the light after it is incident to the surface P.

……

[2]

……

(c) State a use of a component of the electromagnetic spectrum with the smallest wavelength and describe the effect of absorbing this electromagnetic wave.

……

[2]

……

2 The speed of an ultrasound in air is 340 m/s.

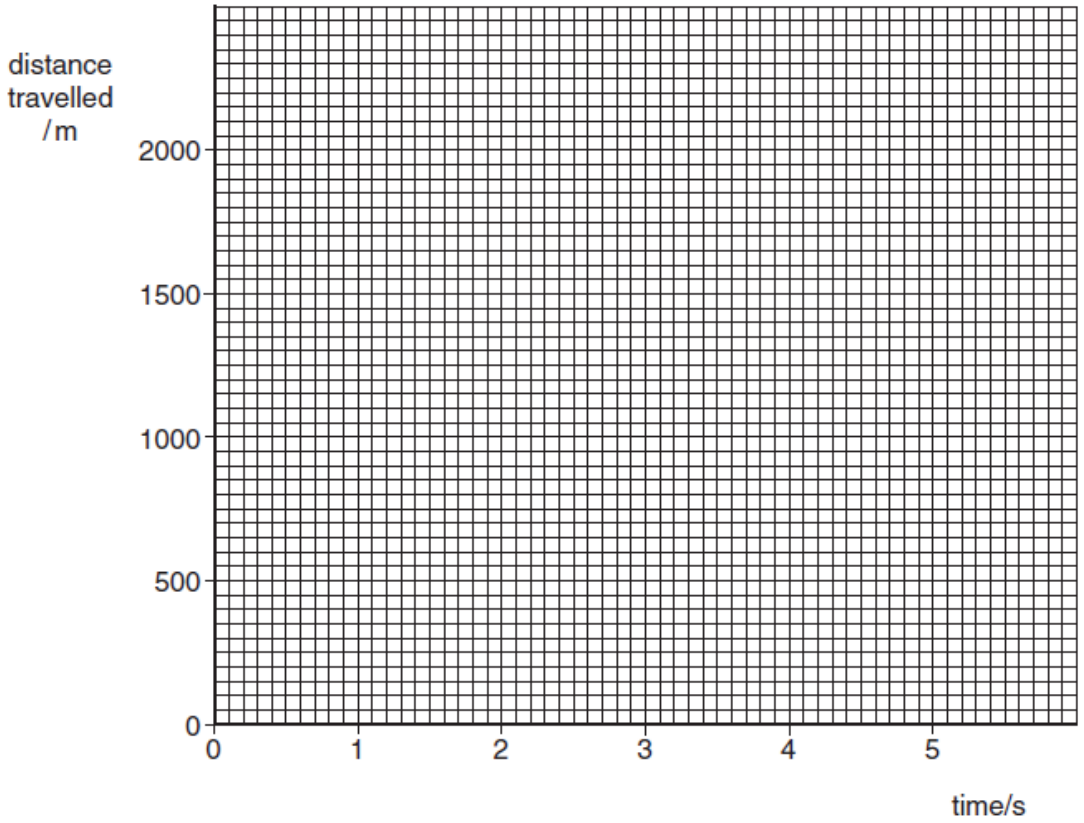
(a) Complete Fig. 2.1 to show how far the ultrasound wave has travelled 2, 3, 4 and 5 seconds after the ultrasound was produced.

time elapsed/s	0	1	2	3	4	5
distance travelled/m	0	340				

[1]

Fig. 2.1

(b) On Fig. 2.2, draw the graph of distance travelled against time for the ultrasound wave.



[3]

Fig. 2.2

(c) State and describe which type of wave is ultrasound.

.....

..... [1]

(d) Explain what is wavelength and state the maximum wavelength of the ultrasound.

.....

..... [3]

3 In Experiment one, two blocks of mass 5 kg and 10 kg were attached and pulled across a rough ground in the direction shown in **Fig. 2.1**.

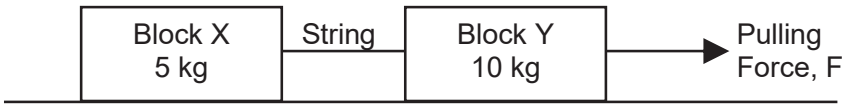


Fig. 2.1

The experiment is then repeated on the same surface but with a different pulling force. The changes in velocities of the blocks for both experiments were measured and tabulated in **Fig. 2.2**.

	Velocity / cms^{-1}	
Time/s	**Experiment One**	**Experiment Two**
1	4	5
2	8	5
3	12	5
4	16	5
5	20	5

Fig. 2.2

(a) Using the values in Experiment One as shown in **Fig. 2.2**, calculate the:

(i) acceleration of the blocks.

acceleration = …… [2]

(ii) tension in the string given that the friction between the ground and block X is 3.0 N.

tension = …… [2]

(iii) magnitude of the pulling force, F.

pulling force, F = …… [2]

(b) In terms of forces, explain why the velocity of the blocks in Experiment One changes over time but remains unchanged in Experiment Two.

.....

.....

.....

..... [2]

4 Fig. 4.1 shows a rectangular block of wood on a flat, rough horizontal board.

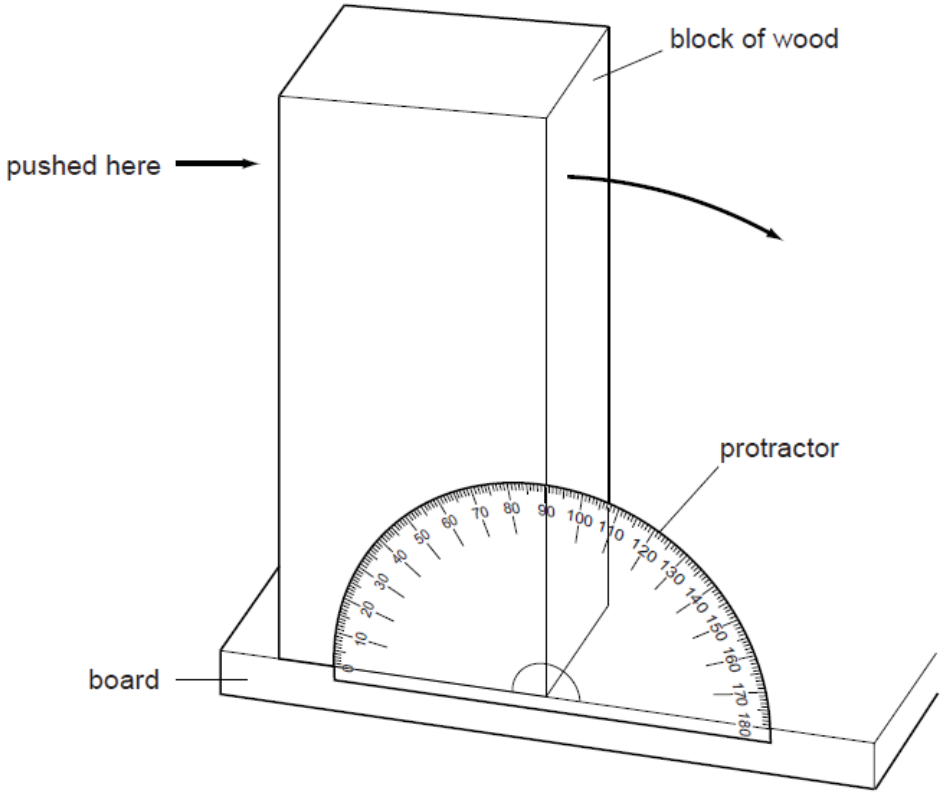


Fig. 4.1

The block is pushed at the top, as shown in Fig. 4.1, and it tilts to the right.

(a) On the front face of the block, draw the line that will be vertical at the instant before the block topples over. [1]

(b) Use the protractor shown on Fig. 4.1 to measure the angle through which the block tilts before it topples over.

angle = ... [1]

(c) The block is put back on the board, as in Fig. 4.1. This time, instead of the block being pushed, the left-hand edge of the board is raised.

State the angle that the board makes with the horizontal at the instant the block topples over.

angle = …… [1]

(d) Explain, in terms of C.G. and stability, how your answer to **(c)** might differ if the procedure is repeated after the height of the block is reduced.

.....

..... [2]

5 **(a)** The principle of conservation of energy states that energy can neither be created nor destroyed. What, then, *does* happen to the energy supplied to a device such as a motor or a television?

.....

..... [1]

(b) The television in Fig. 5.1 is switched on to watch a programme. During this time, 720 kJ of electrical energy is supplied.

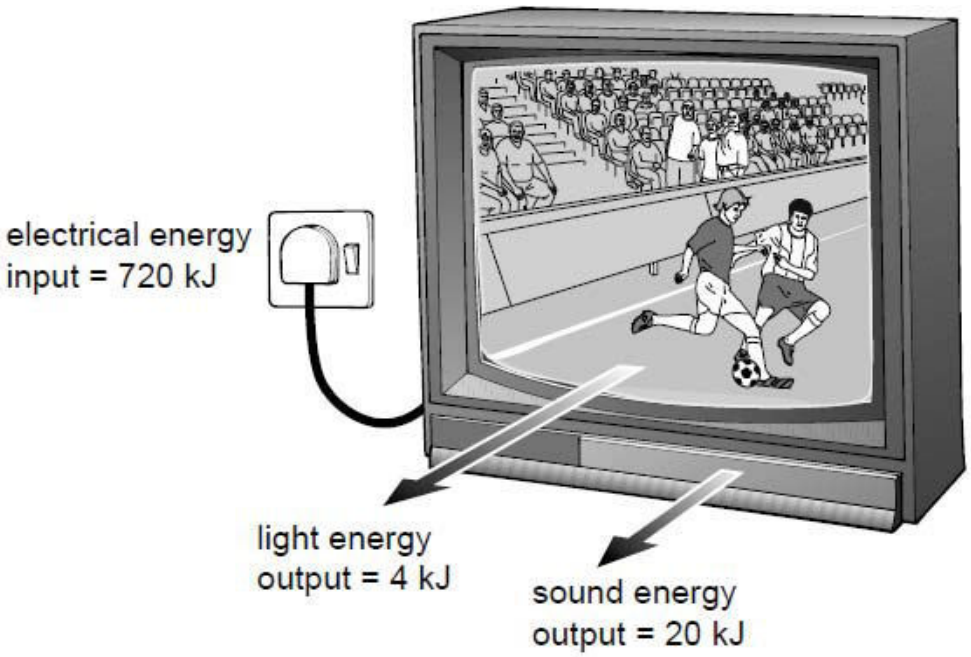


Fig. 5.1

(i) From the information on Fig. 5.1, find the total energy provided for the viewer to see and hear the television during this programme.

energy = ... [1]

(ii) Suggest what happens to the rest of the energy supplied.

.....

..... [1]

(iii) Calculate how much energy is involved in **(b)(ii)**.

energy = ... [1]

(iv) Calculate and comment on the efficiency of the television.

.....

..... [2]

6 Fig. 6.1 shows an evaporative cooler, which is a device that cools air through the continuous evaporation of water. Air is cooled by being blown past a cooling pad containing water. The cooling pad is wet by a pump which pumps water up to the top of the pad, from where it trickles down.

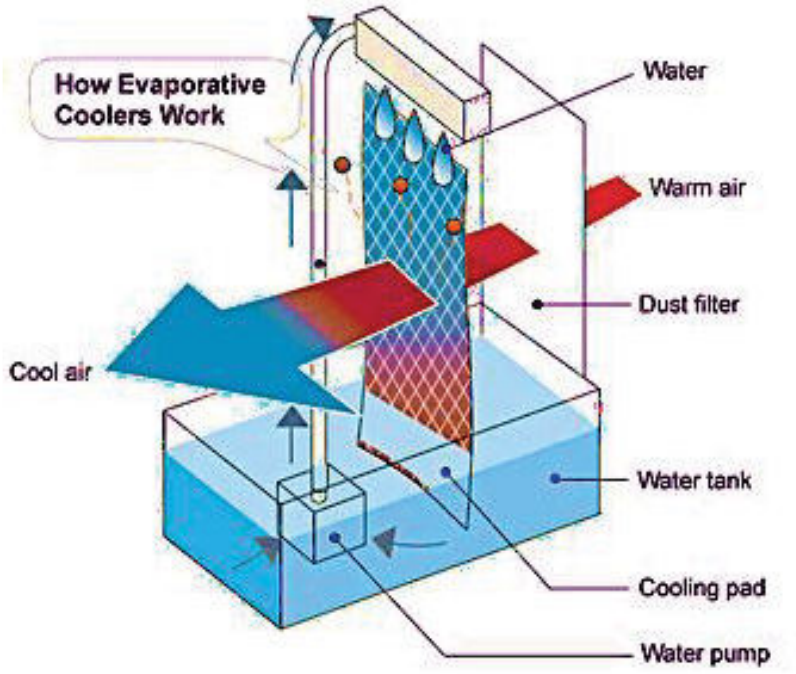


Fig. 6.1

(a) In terms of kinetic model of matter, explain how continuous evaporation of the water causes the air flowing past the cooling pad to be cooled.

……

……

……

……

……

……

…… [2]

(b) Explain whether such evaporative cooling system is more effective in dry or humid atmospheres.

……

…… [1]

(c) Suggest one modification that can be made to the design of the evaporative cooler such that the rate of cooling increases.

……

…… [1]

7 Two metal saucepans contain the same mass of hot water at the same initial temperature. Pan A is white and pan B is black, but otherwise the two saucepans are identical. Both saucepans are uncovered and cool under the same conditions. The cooling curves for the two saucepans are shown in Fig. 7.1.

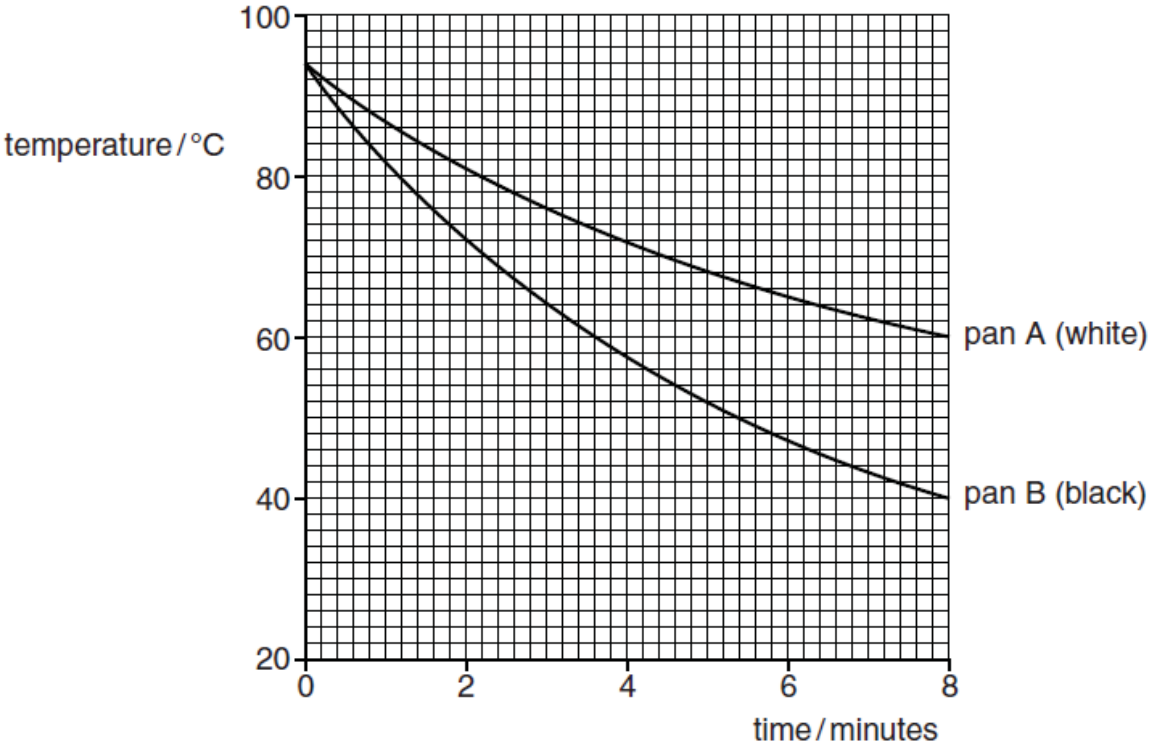


Fig. 7.1

(a) Explain why pan B cools faster than pan A.

.....

..... [1]

(b) Describe and explain how Fig. 7.1 is different when the pans are covered and the experiment is repeated.

.....

.....

..... [2]

(c) Explain what is meant by the specific heat capacity of water is 4200 J/(kg °C).

.....

..... [1]

(d) The specific heat capacity of water is very high. Suggest one disadvantage of this when water is used for cooking.

.....

..... [1]

(e) The water in pan A cools for 8 minutes, as shown in Fig. 7.1. During this time, the water loses an average of 9000 J of thermal energy per minute.

(i) Calculate the mass of water in pan A.

mass = ……

(ii) The mass of water in pan B is the same as that in pan A.
Calculate the thermal energy lost from the water in pan B during the 8 minutes.

loss of thermal energy = …… [3]

8 A teacher demonstrates magnetic screening. When a magnet is placed near a small cardboard box, paper clips on the other side of the box are picked up, as shown in Fig. 8.1. When a small piece of soft iron is placed inside the box as shown in Fig. 8.2, the paper clips fall off. Magnetic field lines in each diagram are shown as thin lines.

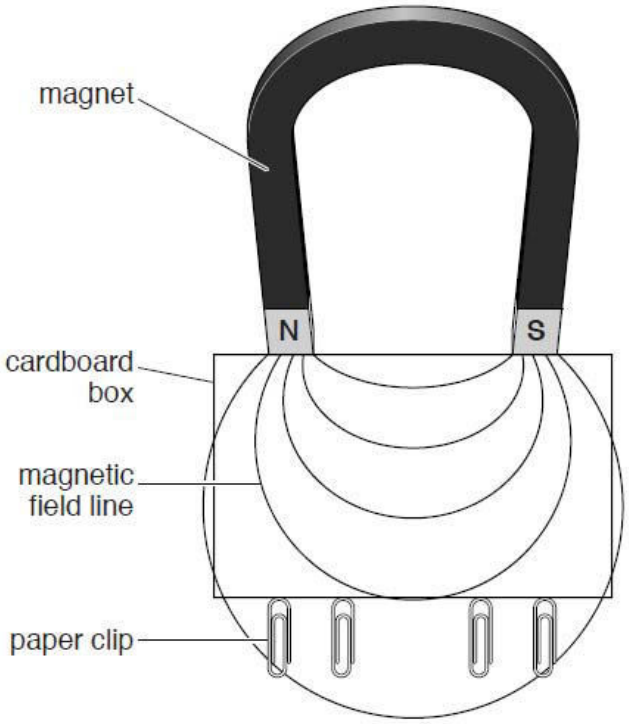


Fig. 8.1

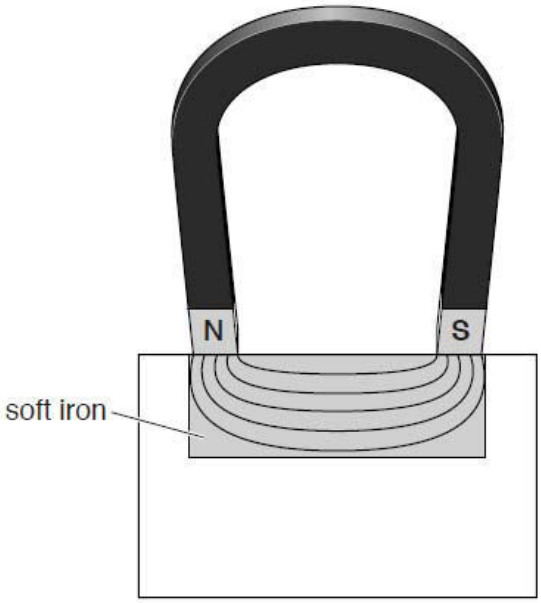


Fig. 8.2

(a) On Fig. 8.1, mark an arrow on each of the magnetic field lines to show its direction. [1]

(b) Explain why placing the soft iron in the box causes the paper clips to fall off.

.....

.....

.....

[2]

9 The apparatus in Fig. 9.1 is called a force-on-conductor balance. When there is an electric current I as shown in XY, there is a force on XY. This force is measured by putting weights in the pan until XY is brought back to its original position.

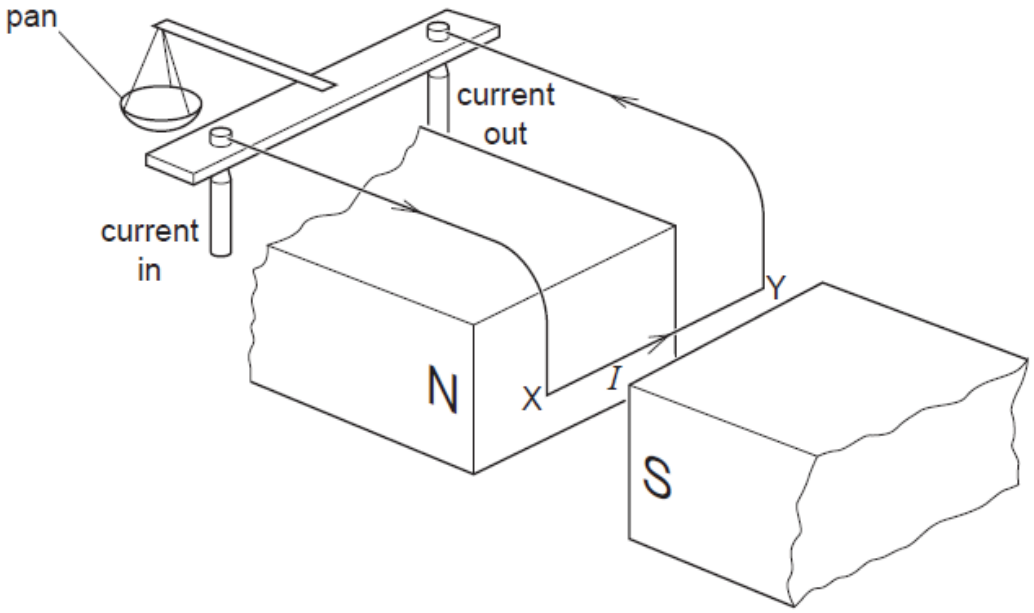


Fig. 9.1

(a) State what would happen if the current direction were from Y to X.

[1]

……

(b) A student uses the balance to determine the force F on XY for different currents I. He concluded that F is directly proportional to I based on his results given below.

I/A	0	0.5	1.0	1.5	2.0
F/N	0	0.012	0.023	0.035	0.047

Show clear workings to estimate the force on XY when the current is 1.6 A.

force = …… [2]

END OF SECTION A

Section B

Answer **all** the questions from this section in writing papers provided.
Answer only one of the two alternative questions in **Question 13**.

11 A measuring cylinder contains water which has a density of 1000 kg/m^3.

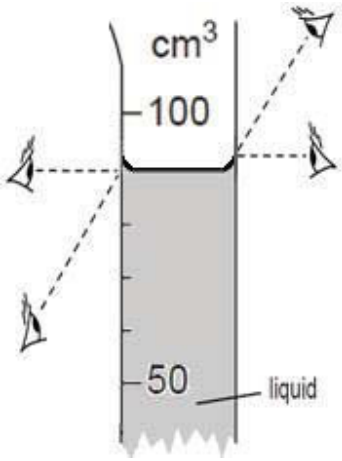


Fig. 11.1

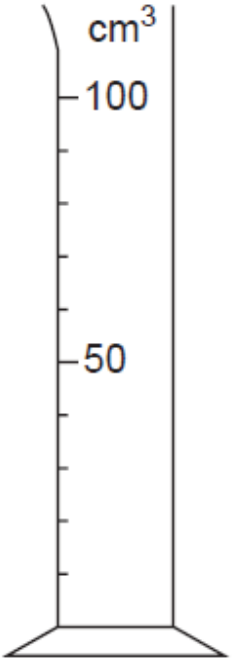


Fig. 11.2

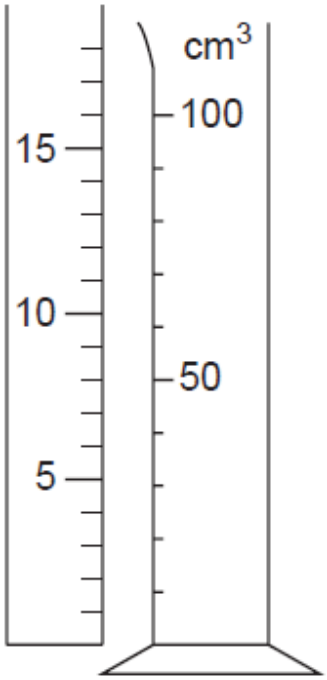


Fig. 11.3

(a) Fig. 11.1 indicates four ways the observer's eye could look when taking the reading from the measuring cylinder. Put a circle around the eye position that gives the correct reading and state the volume of water in the cylinder. [1]

(b) In order to fill the measuring cylinder up to the 100 cm^3 mark, 80 drops of the liquid are added to the liquid already in the measuring cylinder. Calculate the average volume of one drop. [2]

(a) 20 cm^3 of the water in Fig.11.1 is poured into a beaker. On Fig. 11.2, mark the level of the water left in the cylinder. [1]

(b) A rule, calibrated in cm, is placed alongside the measuring cylinder, as shown in Fig. 11.3. What is the length of the measuring cylinder, from zero up to the 100 cm^3 mark? [1]

(c) The volume of a cylinder is found using the equation

volume = cross-sectional area x length.

Determine the cross-sectional area of the cylinder containing water. [2]

(d) Hence, or otherwise, determine the pressure acting on the base by the water left in the cylinder. [3]

12 The circuit in Fig. 12.1 is connected up.

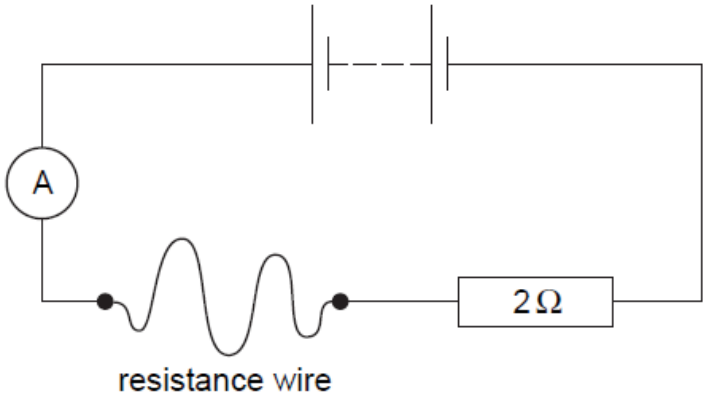


Fig. 12.1

(a) State how does the current in the resistance wire compare with the current in the 2 Ω resistor? [1]

(b) A voltmeter connected across the resistance wire shows the same reading as a voltmeter connected across the 2 Ω resistor. Calculate the combined resistance of the wire and the resistor. [2]

(c) The wire and resistor are disconnected and then reconnected in parallel, as shown in Fig. 12.2.

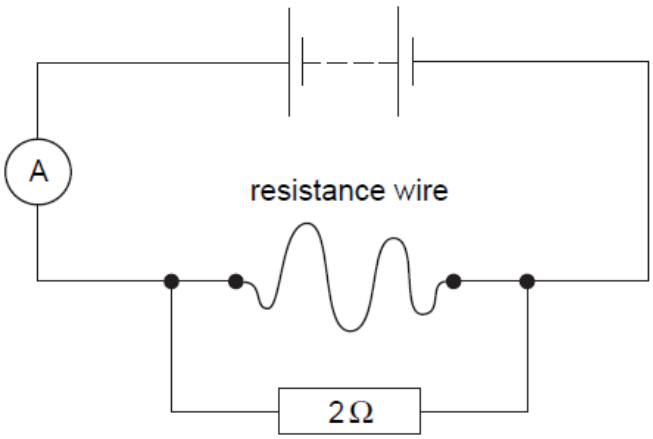


Fig. 12.2

(i) Calculate the new combined resistance of the wire and the resistor. [1]

(ii) Compare the current measured in Fig. 12.2 with the current in Fig. 12.1. [2]

(d) Walls in buildings sometimes develop cracks. The width of a crack can be monitored by measuring the resistance of a thin wire stretched across the crack and firmly fixed on either side of the crack, as illustrated in Fig. 12.3.

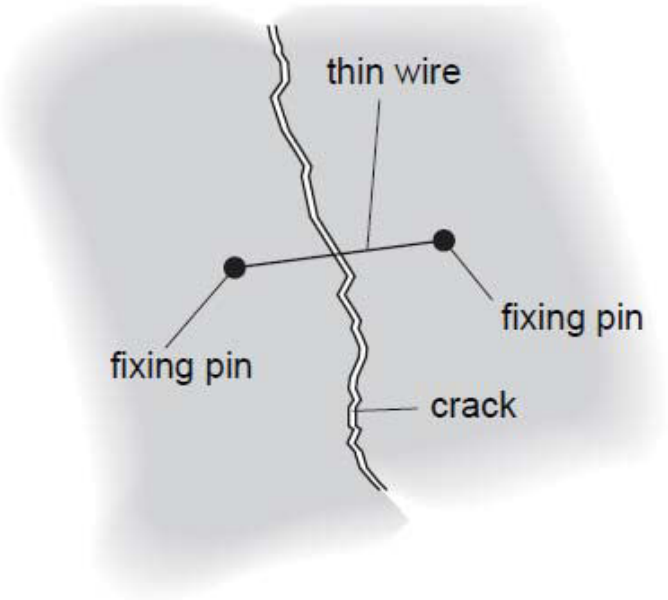


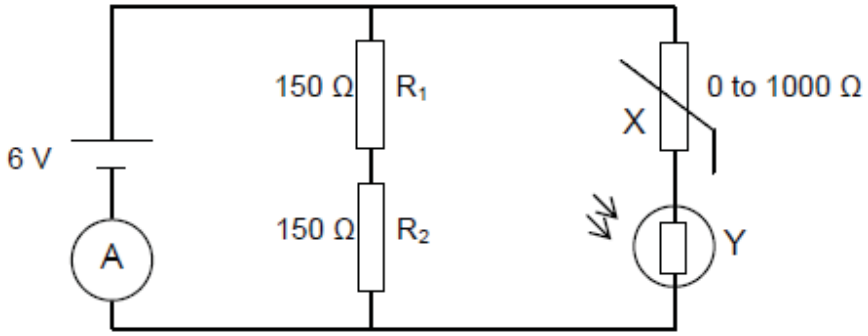
Fig. 12.3

(i) The wall moves and the crack widens slightly. Explain what happens to the resistance of the wire. [2]

(ii) Copy a suitable circuit from Fig. 12.1 or Fig. 12.2 and add a LED light bulb to light up when the crack widens [2]

13 EITHER

The circuit below consists of a 6 V battery source, two resistors of 150 Ω each, LDR and thermistor. The V_{out} across the LDR is connected to a fan which will be switched on when the V_{out} = 6.0 V.



(a) The table shows the range of resistance value for the LDR and thermistor. The resistance of the thermistor varies linearly with temperature.

Instrument	Temperature	Light intensity	Resistance
Thermistor	10 °C		200 Ω
	30 °C		0 Ω
LDR		Bright noon day	50 Ω
		Night	100 Ω

(i) Explain whether the LDR and thermistor are ohmic conductors. [2]

(ii) Calculate the equivalent resistance of the whole circuit when it is during the night and the temperature is 10 °C. [2]

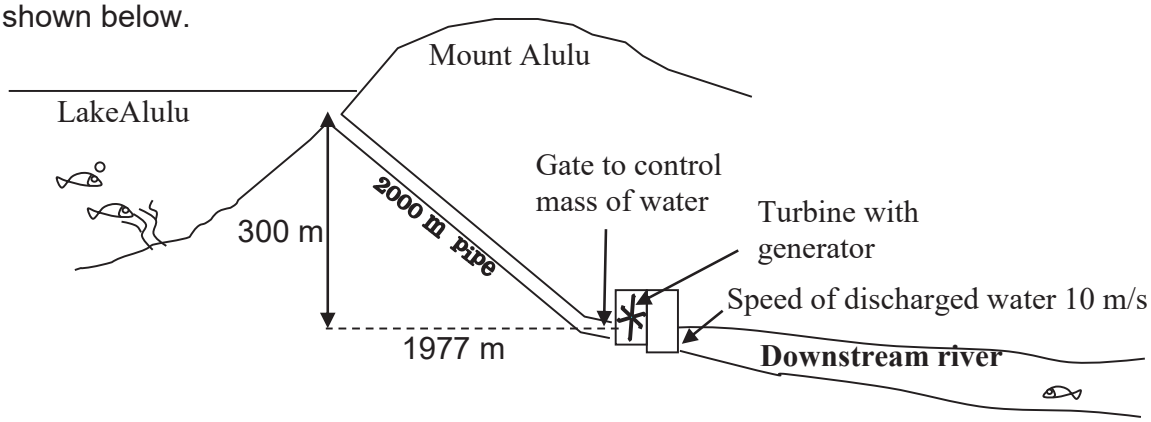
(iii) Find the reading of the ammeter. [1]

(b) **(i)** Show, with clear workings and calculations, whether the fan will be switched on when the temperature is 10 °C during the night. [2]

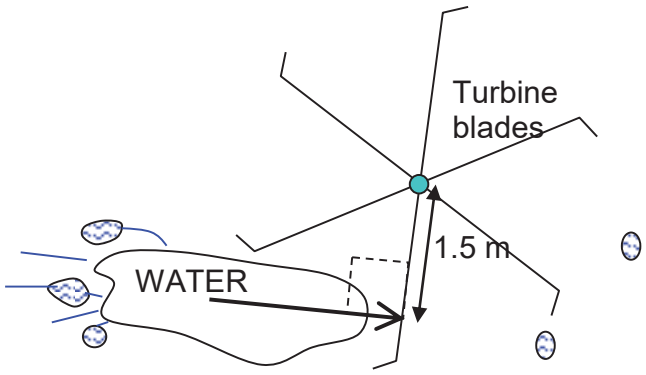
(ii) Show, with clear workings and calculations, a possible pair of conditions for the temperature and light intensity which will cause the fan will to be switched on. [3]

13 OR

The turbine of a hydro-electric power station is built below the level of a lake as shown below.



The turbine is rotated by the running water. It then rotates a group of magnets around a coil in an a.c. generator. The generator is designed such that the magnets would rotate at a constant speed generating an e.m.f of 50,000 V across a coil. The water would be discharged at a constant speed of 10 m/s into the downstream river. The mass of water passing through the blades per second would be controlled by an automatic gate. If a current is drawn from the generator coil, there would be a clockwise moment opposing the rotation of the turbine. The running water would need to produce an anti-clockwise moment by hitting the blades in order to overcome the resisting moment and keep the blades moving at the required constant speed to generate the e.m.f.of 50,000 V. If 10 A of current is drawn from the generator, 17,160 Nm of moment would oppose the rotation and 169.5 kg of water would be needed to hit the blades per second.



The table below shows the data of Mount Alulu hydroelectric power station:

Generated e.m.f. / V	Current drawn from generator / A	Moment required to turn the turbine / Nm	Mass of water hitting the blades per second / kg s^{-1}	Speed of discharged water / ms^{-1}
50,000	10	17,160	169.5	10
50,000	20	34,320	339.0	10

(a) Assuming that water hits one blade at a time at a perpendicular distance of 1.5 m from the the axle as shown below, estimate the force it must exert on the blade when a current of 10 A is drawn from the generator.

(b) Explain why "*If a current is drawn from the generator coil, there would be a clockwise moment opposing the rotation of the turbine*"?

(c) Calculate the amount of energy per second available to the generator when 500 kg of water flows through the turbine per second.

(d) Estimate the current that flows in the generator when 500 kg of water flows through the turbine per second.

(e) Explain briefly why the actual current flowing should be less than your estimated value in **(d)** when 500 kg of water flows through the turbine per second.

END OF PAPER 2

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Geylang Methodist School (Secondary)
Preliminary Examination 2018

PHYSICS **5059/01**

Paper 1 ANSWERS **Sec 4 Express**

Additional materials : OAS

1 hour

Setter : Mr Yip Cheng Hou

24 August 2018

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 on Earth and 6.67 m/s^2 on Moon unless otherwise specified.

This document consists of **16** printed pages

[Turn over

1 Pressure can be determined using the following formula:

$$\mathbf{P = F \div A}$$
$$\mathbf{F = m \times a}$$

where **P**= pressure (pascal, Pa) **A** = area (m^2) **m** = mass (kg)

F = force (newtons, N) **a** = acceleration ($\frac{m}{s^2}$)

The unit, pascal, is equivalent to

A $\frac{kg}{sm}$ **B** $\frac{s^2}{kgm}$ **C** $\frac{1}{kgs^2m}$ **D** $\frac{kg}{s^2m}$

2 **Fig. 2** shows Jenny's setup of the following experiment.

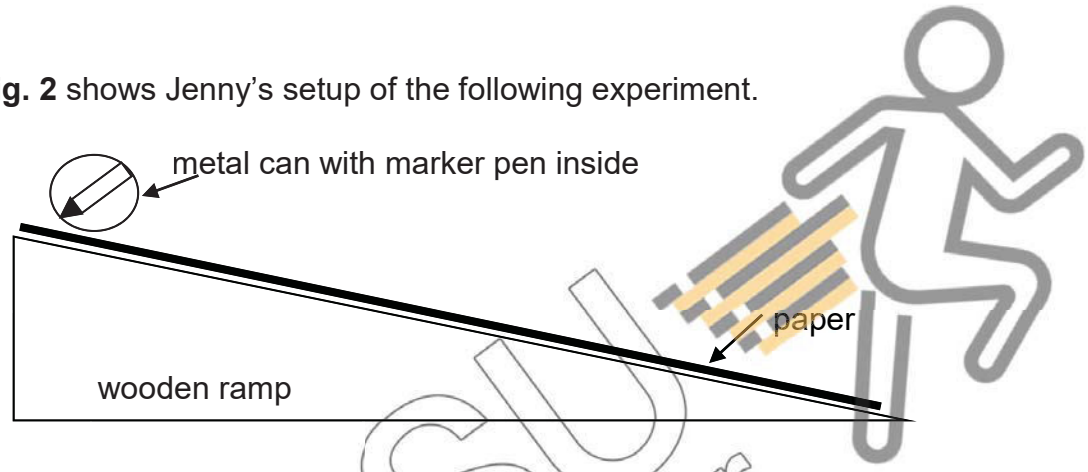
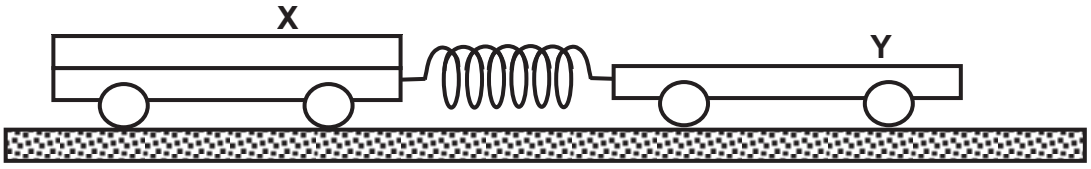


Fig. 2

Jenny released the can and it rolled freely down the ramp without slipping. What did she observe on the paper made by the marker pen?

A The dots get farther apart.
B The dots get closer together.
C The dots gets closer then further apart.
D The dots are equidistant from each other.

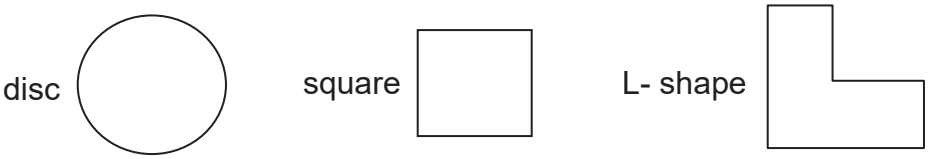
3 Trolley **X** and trolley **Y** are joined together by a stretched spring. Trolley **X** has twice the mass of trolley **Y**. When the trolleys are released, the acceleration of **X** is 1.0 m s^{-2} to the right.



What is the initial acceleration of trolley **Y** to the left?

A 0.5 m s^{-2} **B** 1.0 m s^{-2} **C** 2.0 m s^{-2} **D** 4.0 m s^{-2}

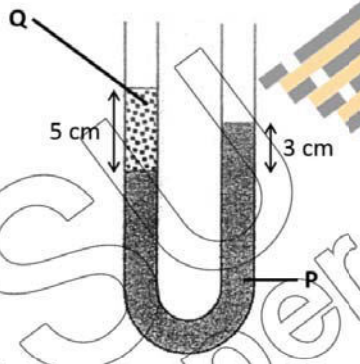
4 Three objects are cut from the same big sheet of metal. They have the same volume but different shapes.



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

A They have different mass and position of C.G.
B They have different mass but same position of C.G.
C They have the same mass and position of C.G.
D They have the same mass but different position of C.G.

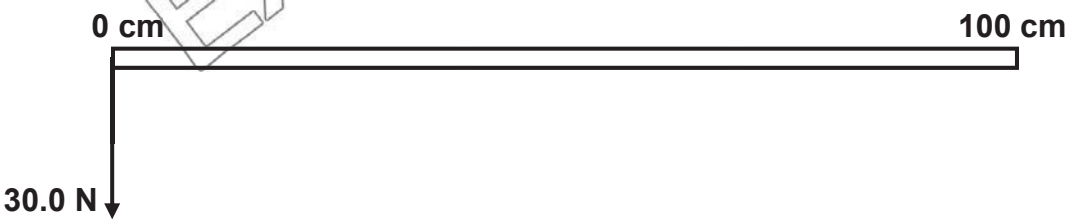
5 The diagram below shows two immiscible liquids, P & Q, which have been poured into a manometer which is exposed to the atmosphere at the top of both arms.



What is the ratio of the density of Liquid Q to Liquid P?

A 3:5 **B** 5:8 **C** 5:3 **D** 8:3

6 The diagram below shows a uniform metre ruler with a weight of 10 N, under the action of a vertical force of 30.0 N.



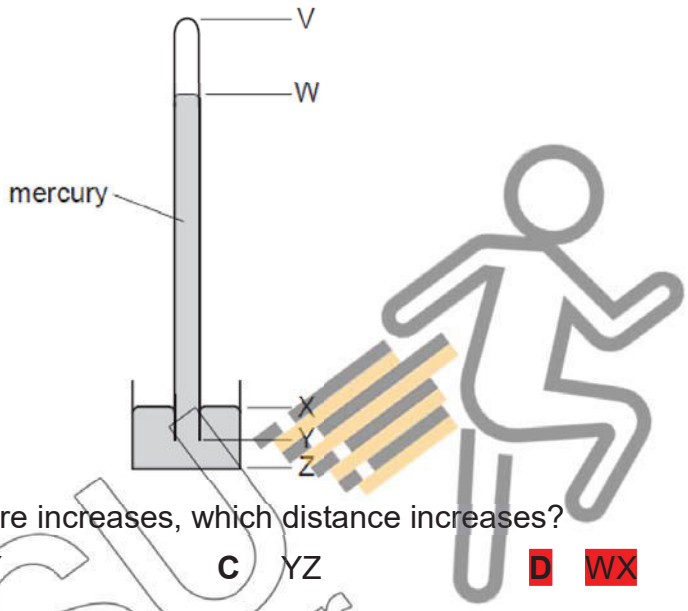
At what mark must a fulcrum be placed to hold the ruler in equilibrium?

A 12.5 cm **B** 16.7 cm **C** 25.0 cm **D** 37.5 cm

7 Which of the following objects has the **least** inertia?

A A robot of weight 300 N travelling on the Moon.
B A robot of weight 300 N travelling on Earth.
C A stationary rock of mass 150 kg on the Moon.
D A stationary rock of mass 150 kg on Earth.

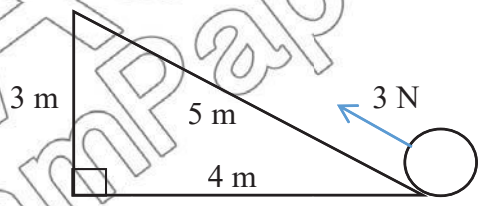
8 The diagram shows a simple mercury barometer.



When the atmospheric pressure increases, which distance increases?

A VW **B** XY **C** YZ **D** WX

9 A ball, which weighs 2 N, is moved up a slope from X to Y, by applying a force of 3 N as shown in the diagram below.



Assuming no energy is lost to the surrounding, what is the gain in kinetic energy, gain in gravitational potential energy and work done on the ball?

	Kinetic Energy	Gravitational Potential Energy	Work Done
A	6 J	6 J	6 J
B	6 J	9 J	6 J
C	15 J	6 J	15 J
D	9 J	6 J	15 J

10 A powerful fan uses a 50 W battery. The fan generates 20 J of heat every second as its motor turns.

What is the efficiency of this fan?

A 28.6 % **B** 40.0 % **C** 60.0 % **D** 250 %

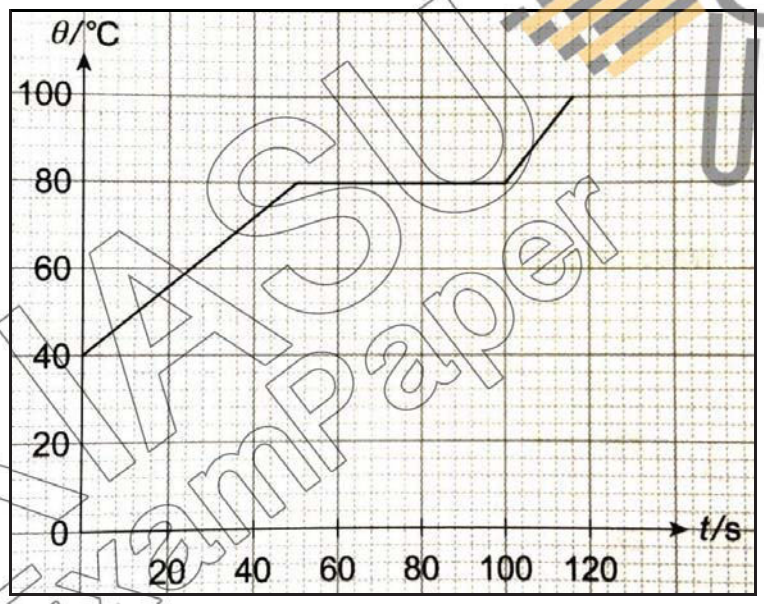
11 Which gives the states of matter in which molecules, at a given temperature, have the smallest spacing between them and move at the lowest speed?

	Smallest spacing between molecules	Molecules have the lowest speed
A	Solid	Solid
B	Liquid	Solid
C	Solid	Liquid
D	Liquid	Liquid

12 Which of these examples has the wrong type of heat transfer associated with it?

	Example	Type of heat transfer
A	Heat from flame to flying pan	Conduction
B	Sunlight warming the interior of a car	Convection
C	Cooling a cup of coffee with a steel spoon	Conduction
D	Heat from burning logs to person beside fire place	Convection

The graph below shows the changes in temperature of a 400 g solid when it is heated by a heater with a rating of 80 W. Use it to answer questions 13 to 15.



13 Which of the following statements show a difference between heat and temperature.

A When 80 W of heat is supplied, the temperature reached 80 °C.
B Heat has a SI unit in Kelvin while temperature SI unit is in °C
C Heat increases when temperature increases.
D Heat remains constant regardless whether temperature changes.

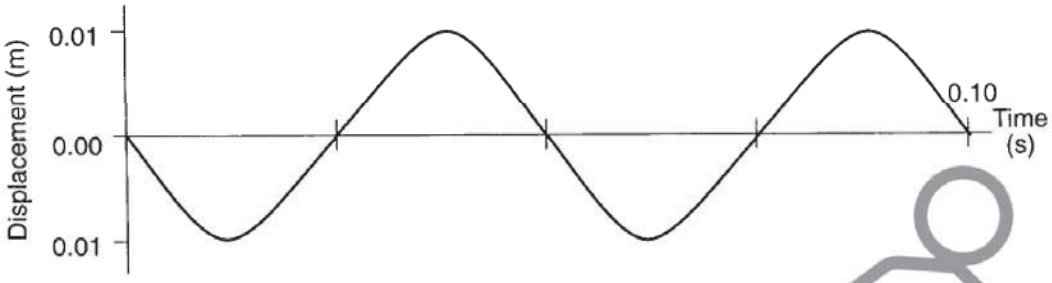
14 Assuming there is negligible energy loss to the surroundings, what is the specific heat capacity of the liquid?

A 10 J/kg°C **B** 160 J/kg°C **C** 240 J/kg°C **D** 1160 J/kg°C

15 Assuming there is negligible energy loss to the surroundings, what is the specific latent heat of fusion of the solid?

A 10 J/kg **B** 167 J/kg **C** 200 J/kg **D** 10000 J/kg

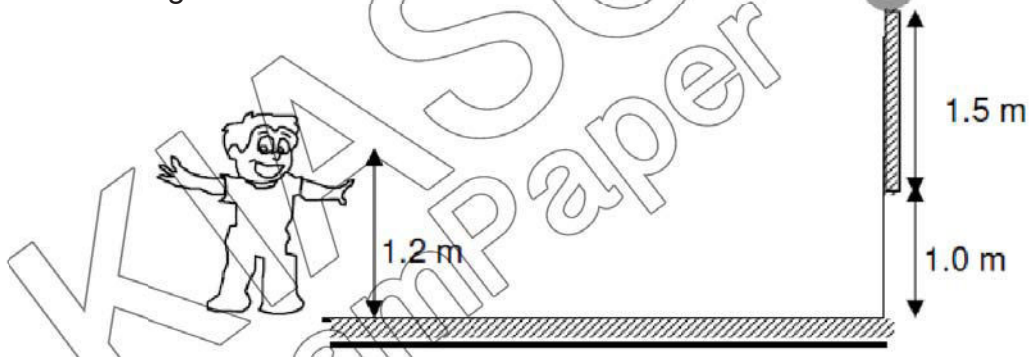
16 The graph shows the vertical displacement of an object floating on water as a wave passes through the water.



What is the frequency of the wave?

A 10 Hz **B** 20 Hz **C** 50 Hz **D** 100 Hz

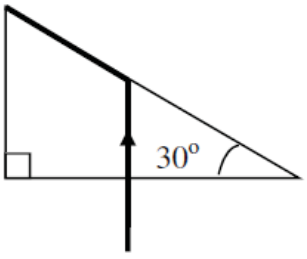
17 A plane mirror 1.5 m in length is hung on a vertical wall with its bottom 1.0 m above ground. A boy with his eyes 1.2 m above ground looks into the mirror to see the image of himself.



What length of himself (below his eyes) can be seen in the mirror?

A 0.4 m **B** 0.8 m **C** 1.0 m **D** 2.0 m

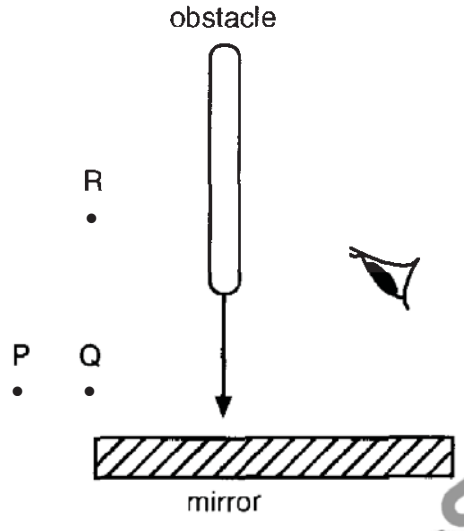
18 A ray of light enters a prism made of material **X** and travels along the path as shown in the figure below.



What is the refractive index of the material **X**?

A 0.50 **B** 1.20 **C** 1.50 **D** 2.00

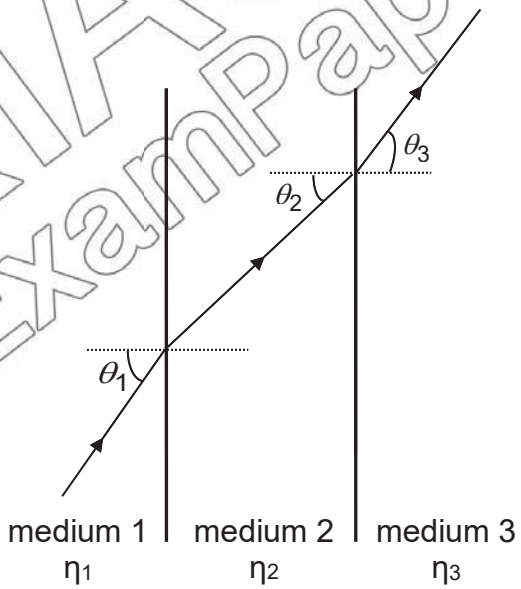
19 Three objects, **P**, **Q** and **R**, are viewed through a plane mirror as shown. An obstacle moves towards the mirror as indicated by the arrow.



Which image will disappear first and which image will disappear last?

	disappears first	disappears last
A	**P**	**Q**
B	**P**	**R**
C	**Q**	**R**
D	**R**	**Q**

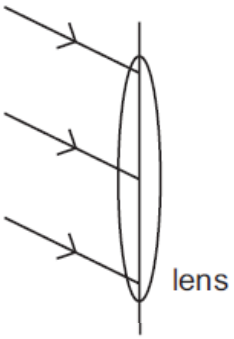
20 A light ray passes through three media of refractive indices η_1, η_2 and η_3 respectively.



Given that $\theta_1 > \theta_3 > \theta_2$, which of the following is correct?

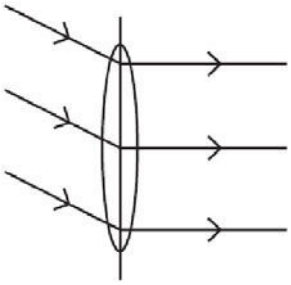
A $\eta_1 > \eta_2 > \eta_3$ **B** $\eta_2 > \eta_1 > \eta_3$ **C** $\eta_1 > \eta_3 > \eta_2$ **D** $\eta_2 > \eta_3 > \eta_1$

21 Three rays of light fall on a converging lens as shown.

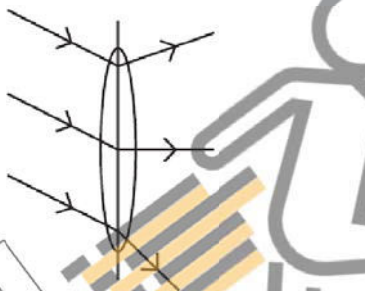


Which diagram shows the path of the rays after passing through the lens?

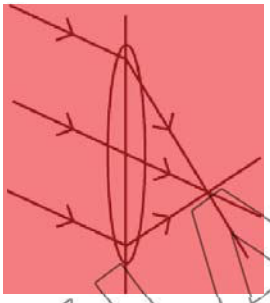
A



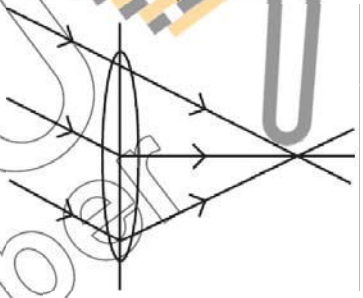
B



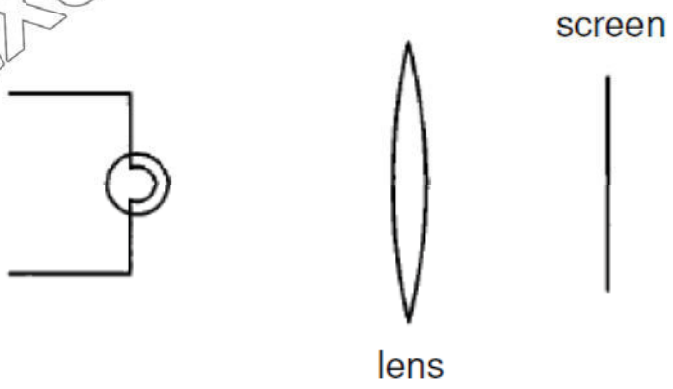
C



D



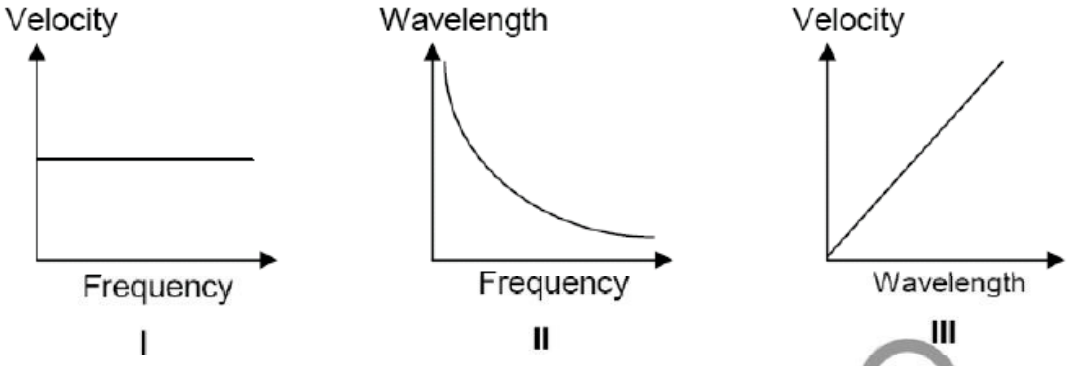
22 A student arranges an illuminated object, a lens and a screen such that the size of the image is twice that of the object. Keeping the distance between the screen and the illuminated object fixed, he exchanges the position of the screen and the illuminated object.



What would be observed on the screen?

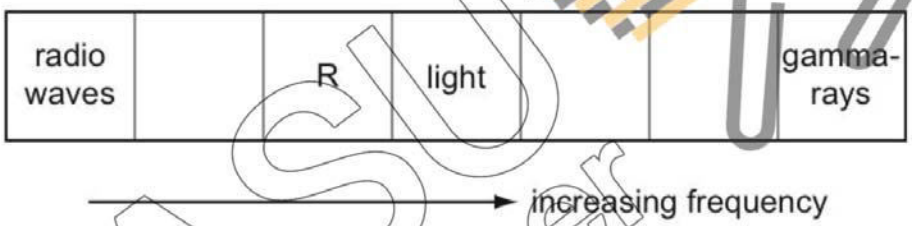
A A blurred, magnified image.
B A blurred, diminished image.
C A sharp image twice the size of the object.
D A sharp image half the size of the object.

23 Which of the following graphs about electromagnetic waves travelling in vacuum is/are correct?



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

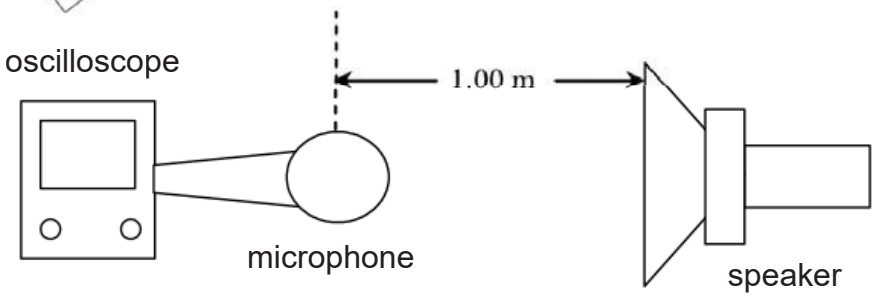
24 The diagram shows the main sections of the electromagnetic spectrum in order of increasing frequency. Some of the sections are labelled. The section R has a frequency just below that of light.



Which application uses the section R?

A Sterilisation
B Satellite television
C Bread toaster
D Laser pointer

25 The set-up shown in the diagram below consists of an oscilloscope and a speaker that emits a sound wave with frequency 1000 Hz. A microphone placed 1.00 m from the speaker detects the sound emitted by the speaker. A waveform is observed on the oscilloscope representing the sound emitted.



The speaker is then moved to a distance 0.5 m towards the microphone and a new waveform is observed on the oscilloscope. Compared to the earlier waveform, this new waveform has a greater _____.

A speed **B** amplitude **C** frequency **D** wavelength

26 **Fig. 26.1** is a **full-scale** diagram that shows air particles at their equilibrium positions (represented by dotted lines). When a sound wave passes, particles are displaced into new positions shown in **Fig. 26.2**. **Q** represents a particle.

Fig. 26.1

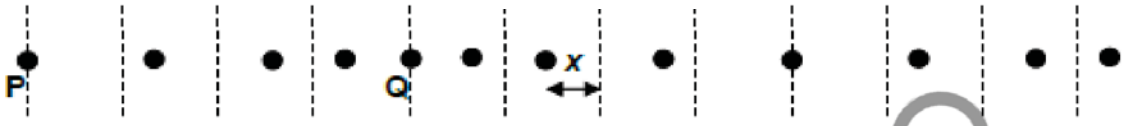
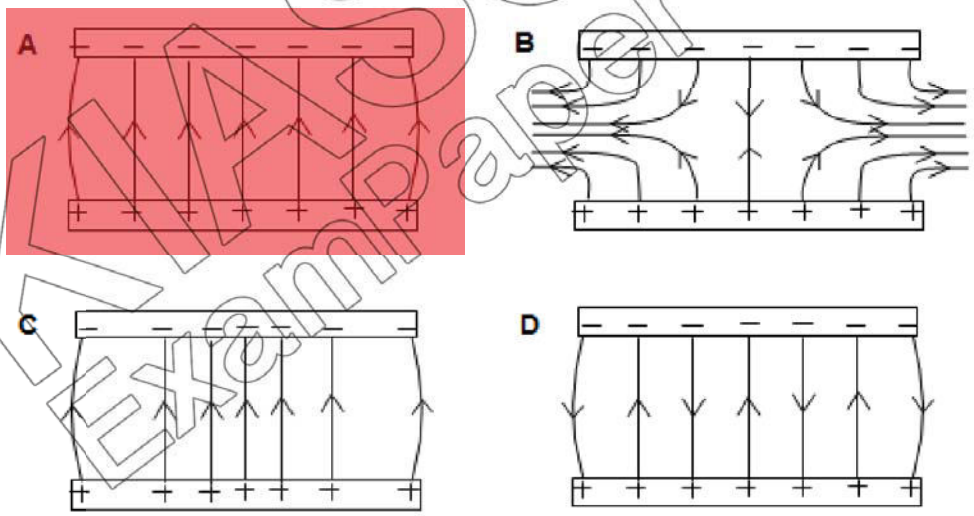


Fig. 26.2

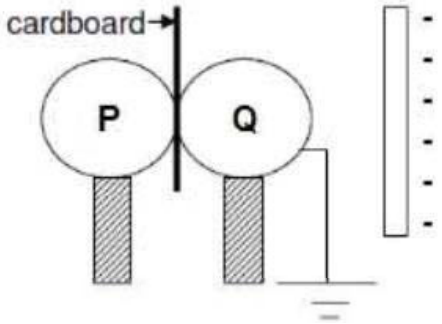
Which of the following statements is false?

A Point **Q** is the centre of a rarefaction.
B Particles next to **Q** are moving in opposite direction.
C The amplitude of the wave is 1.0 cm.
D The wavelength of the wave is 10.3cm

27 Which of the following diagrams correctly shows the uniform electric field between two charged parallel metal plates?



28 Two uncharged metal spheres **P** and **Q** are placed together with a thick cardboard inserted between them. Both spheres are supported by insulating stands and **Q** is earthed with a wire.



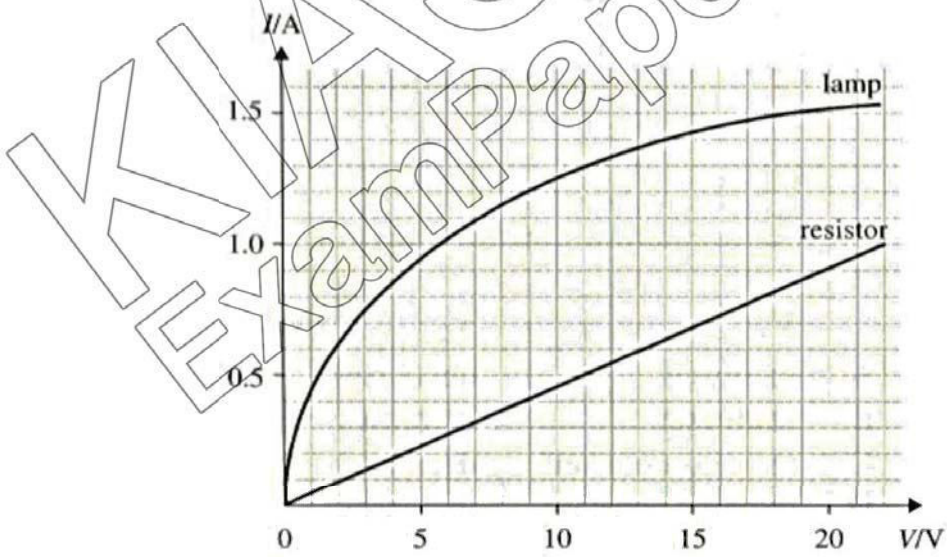
A negatively-charged rod is brought near the spheres as shown.

What would be the distribution of charges on spheres **P** and **Q** when the wire is removed followed by the charged rod?

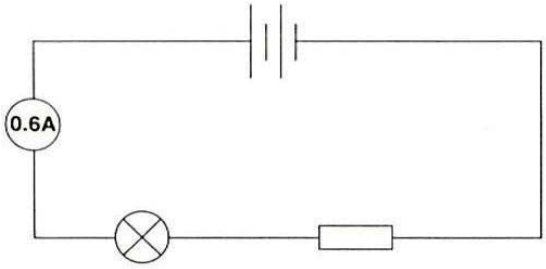
	P	Q
A	negative	positive
B	negative	neutral
C	neutral	positive
D	neutral	neutral

Refer to the following information for Questions 29 and 30.

The graph below shows how the current in a lamp and a resistor varies with the potential difference applied.



The lamp and the resistor are connected in series as shown below, and the ammeter reading is 0.6 A.



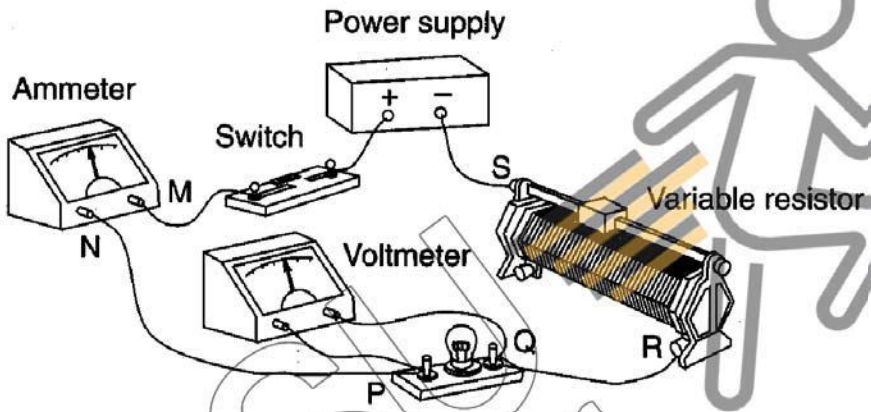
29 Determine the e.m.f. of the circuit.

A 2.0 V **B** 11.0 V **C** 13.0 V **D** 15.0 V

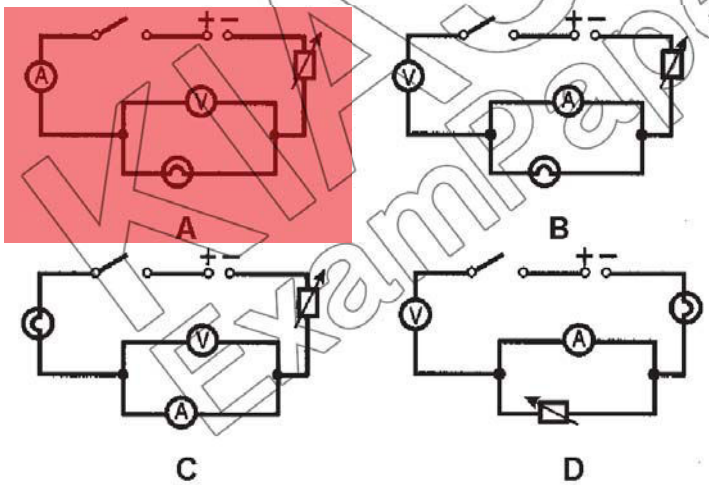
30 Determine the resistance of the resistor.

A 0.046 Ω **B** 0.091 Ω **C** 11.0 Ω **D** 22.0 Ω

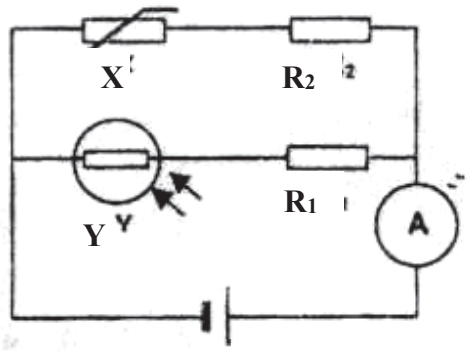
31 The diagram shows an experimental set-up of an electric circuit to determine the resistance of a bulb.



Which one of the following shows the correct circuit diagram?



32 In the circuit shown, R_1 and R_2 are identical resistors.



Which of the following changes to the electrical components **X** and **Y** will decrease the reading of the ammeter by the greatest amount?

A Immerse **X** in a beaker of ice water and decrease the light intensity on **Y**.
B Immerse **X** in a beaker of ice water and increase the light intensity on **Y**.
C Immerse **X** in a beaker of hot water and decrease the light intensity on **Y**.
D Immerse **X** in a beaker of hot water and increase the light intensity on **Y**.

33 In a 3-pin plug of a vacuum cleaner, the fuse is missing.
Which of the following statement is correct?

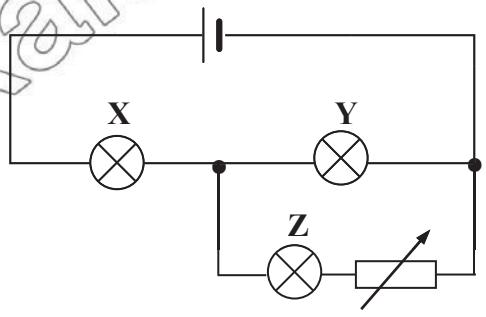
A The vacuum cleaner can be turned on but in the event of an electrical fault, the vacuum cleaner will be live.

B The vacuum cleaner can be turned on but in the event of an electrical fault, the vacuum cleaner will be safe to handle because the current will flow to earth.

C The vacuum cleaner, once turned on, will shut down at once.

D The vacuum cleaner cannot be turned on.

34 Three identical lamps X, Y and Z are connected in a circuit as shown below.



What will happen to the brightness of the lamps if the resistance of the rheostat is increased?

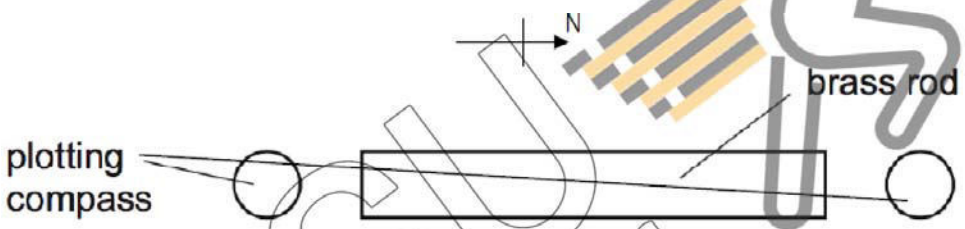
	X	Y	Z
A	Brighter	dimmer	dimmer
B	brighter	brighter	dimmer
C	dimmer	brighter	dimmer
D	dimmer	brighter	brighter

35 A student carries out four tests with a magnet.

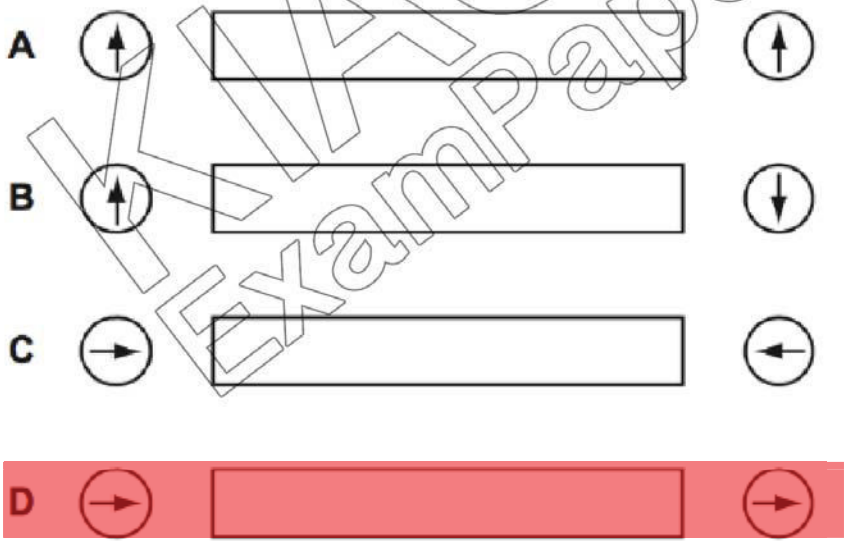
Which result shown is **not** correct?

	arrangement		Result
A	S magnet N	S magnet N	Attracts
B	S magnet N	iron bar	attracts
C	N magnet S	iron bar	repel
D	N magnet S	copper bar	no effect

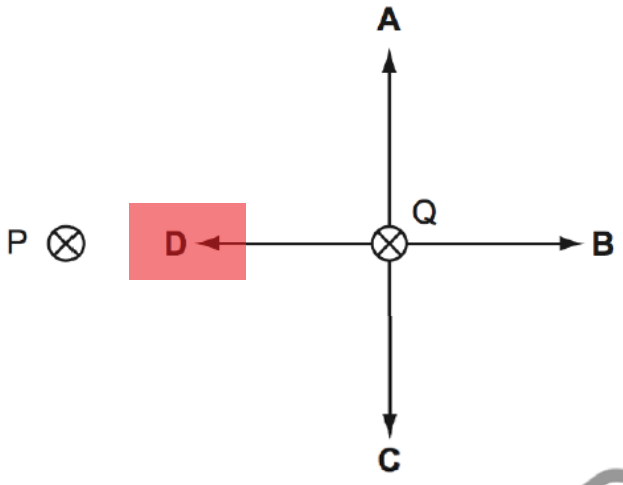
36 A brass rod is arranged in a north-south direction and plotting compasses are placed at each of it ends.



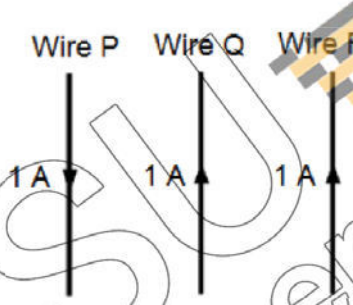
Which diagram shows the positions of the needles of the plotting compasses?



37 P and Q represents two parallel, straight, wires carrying currents. P and Q exert force on each other. Which arrow shows the force on Q?



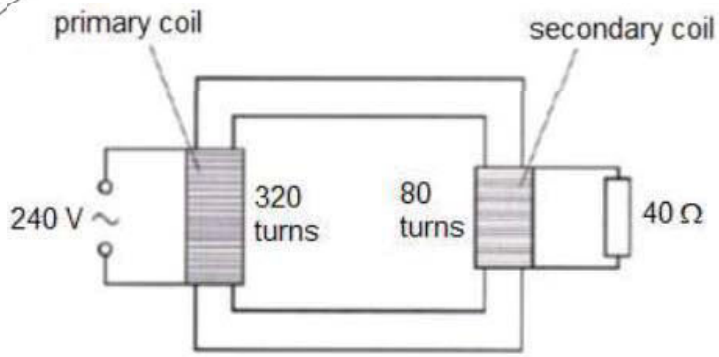
38 Three wires **P**, **Q** and **R** are each carrying a current of 1 A in the direction as shown in the diagram below.



What are the directions of forces acting on the three wires?

	Wire P	Wire Q	Wire R
A	left	left	left
B	right	left	right
C	left	right	left
D	right	right	right

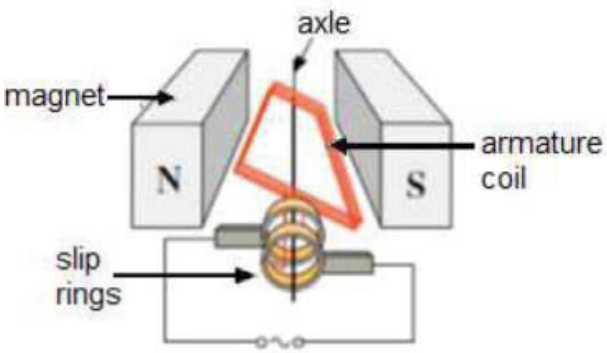
39 The figure below shows an ideal transformer with the secondary coil connected to a 40 Ω load.



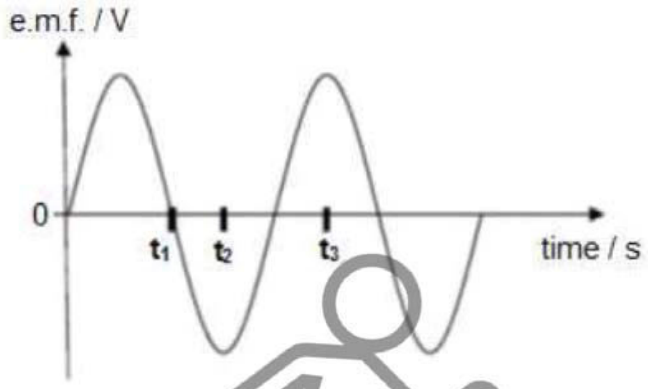
What is the current in the primary coil?

A 0.38 A **B** 1.5 A **C** 2.7 A **D** 6.0 A

40 The diagrams show a simple a.c. generator and the graph illustrating the waveform of the e.m.f. output of the a.c. generator.



simple a.c generator



waveform of the e.m.f. output

Which of the following diagrams correctly shows the plane of the armature coil of the generator, as viewed along the axle from the position of the slip rings, at time intervals denoted by t_1, t_2 and t_3 on the graph?

	t_1	t_2	t_3
A			
B			
C			
D			

END OF PAPER 1

Geylang Methodist School (Secondary)
Preliminary Examination 2018

Candidate Name	ANSWERS		
Class		Index Number	

PHYSICS

5059/02

Paper 2 Physics

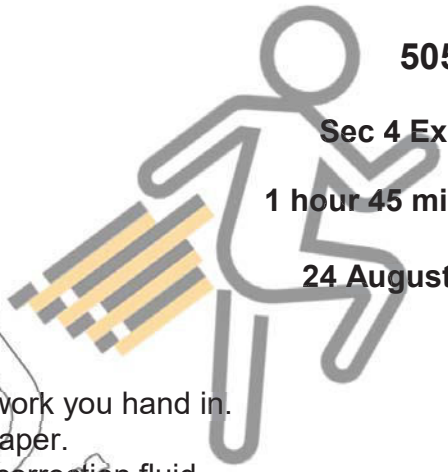
Sec 4 Express

Additional materials : Writing Papers

1 hour 45 minutes

Setter : Mr Yip Cheng Hou

24 August 2018



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** in writing papers provided.
Question 13 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 **16** printed pages.

[Turn over

Section A

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

1 Fig. 1.1 shows a virtual image **I** formed by a converging lens from an object of height 1.0 cm.

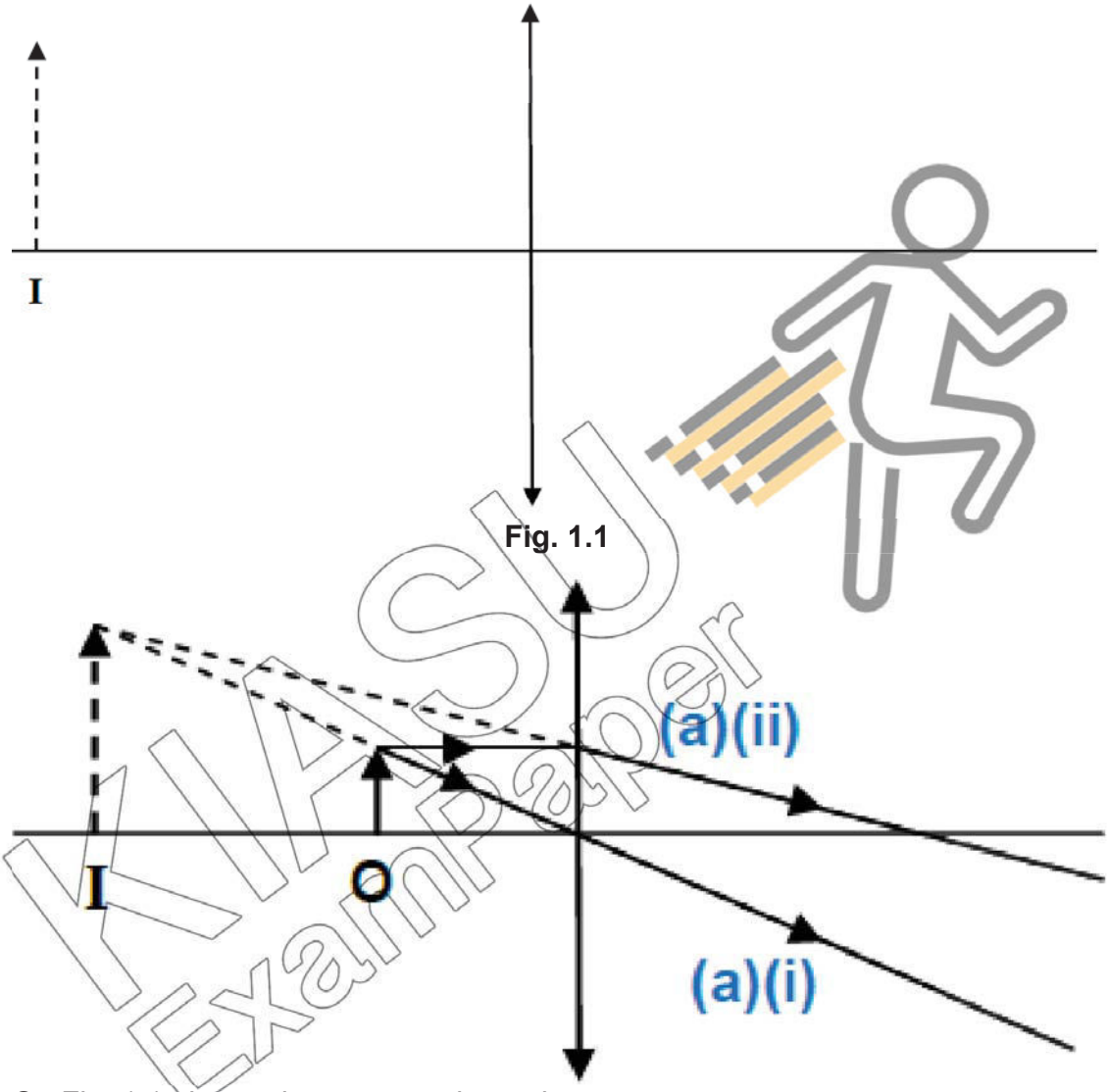


Fig. 1.1

(a) On Fig. 1.1 above, draw rays to determine

(i) the position of the object, Label the object **O**.

(ii) the focal length of the lens.

4.1 cm (± 0.3 cm)

focal length = ... [2]

(b) Fig. 1.2 shows a light ray travelling in the converging lens of refractive index 1.5. The diagram is not drawn to scale.

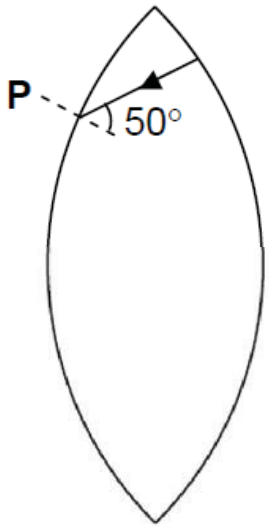


Fig. 1.2

Calculate the critical angle and explain the behaviour of the light after it is incident to the surface P.

.....

n = 1 / sin c
1.5 = 1 / sin c
c = 41.8°
angle of incidence of 50° which is greater than critical angle of 41.8° so the ray will go through total internal reflection [2]

.....

(c) State a use of a component of the electromagnetic spectrum with the smallest wavelength and describe the effect of absorbing this electromagnetic wave.

.....

cancer treatment by destroying cancer cells OR sterilising of surgical instruments destroys or modifies / mutates living tissues and cells [2]

.....

2 The speed of an ultrasound in air is 340 m/s.

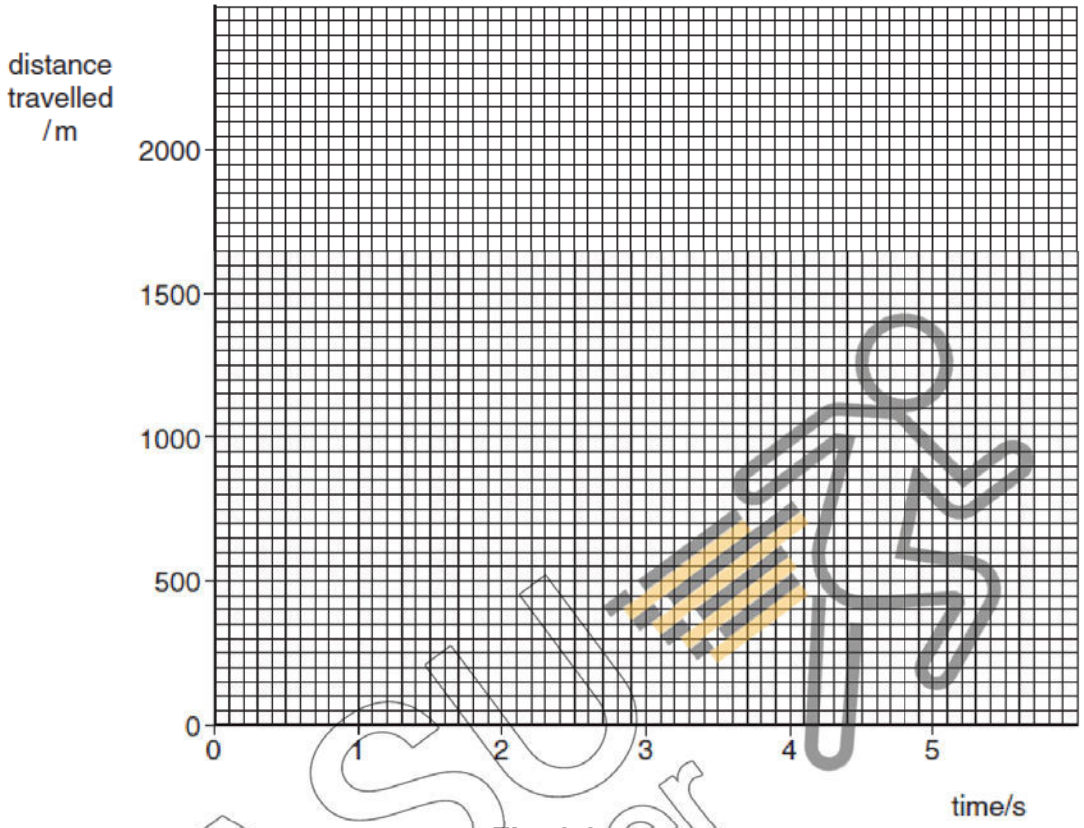
(a) Complete Fig. 2.1 to show how far the ultrasound wave has travelled 2, 3, 4 and 5 seconds after the ultrasound was produced.

time elapsed/s	0	1	2	3	4	5
distance travelled/m	0	340				

[1]

Fig. 2.1

(b) On Fig. 2.2, draw the graph of distance travelled against time for the ultrasound wave.



[3]

Fig. 2.2

(680 1020 1360 1700) 5 points plotted ± ½ small square, ignore 0,0 (e.c.f.)
reasonable best-fit line through points drawn with rule

(c) State and describe which type of wave is ultrasound.

……

Longitudinal wave that travels parallel to the vibration of wave particles.

…… [1]

(d) Explain what is wavelength and state the maximum wavelength of the ultrasound.

……

Wavelength is the distance between 2 successive points on the wave that are in phase. Max wavelength = Speed ÷ Min frequency = 0.017 m [3]

……

3 In Experiment one, two blocks of mass 5 kg and 10 kg were attached and pulled across a rough ground in the direction shown in **Fig. 2.1**.

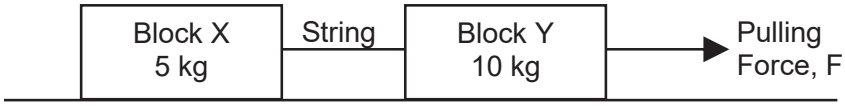


Fig. 2.1

The experiment is then repeated on the same surface but with a different pulling force. The changes in velocities of the blocks for both experiments were measured and tabulated in **Fig. 2.2**.

	Velocity / cms^{-1}	
Time/s	**Experiment One**	**Experiment Two**
1	4	5
2	8	5
3	12	5
4	16	5
5	20	5

Fig. 2.2

(a) Using the values in Experiment One as shown in **Fig. 2.2**, calculate the:

(i) acceleration of the blocks.

acceleration = (v - u) / t
= (20 - 4) / 4
= 4 cm/s^2 (2)

acceleration = ... [2]

(ii) tension in the string given that the friction between the ground and block X is 3.0 N.

T – Friction = Resultant Force
T – 3.0 N = (5 kg)(0.04 m/s^2) (1)
T = 3.2 N (1)

tension = ... [2]

(iii) magnitude of the pulling force, F.

F – Friction – Tension = Resultant Force
F – 3N – 3.2N = (10 kg)(0.04 m/s^2) (1)
F = 6.6 N (1)

pulling force, F = ... [2]

(b) In terms of forces, explain why the velocity of the blocks in Experiment One changes over time but remains unchanged in Experiment Two.

In experiment 1, there is a resultant force whereas in experiment 2, there is zero resultant force. (1) Hence in experiment 2, the pulling force is equal to the frictional force. Hence, acceleration is zero (1) indicating that the blocks are moving at constant velocity. [2]

4 Fig. 4.1 shows a rectangular block of wood on a flat, rough horizontal board.

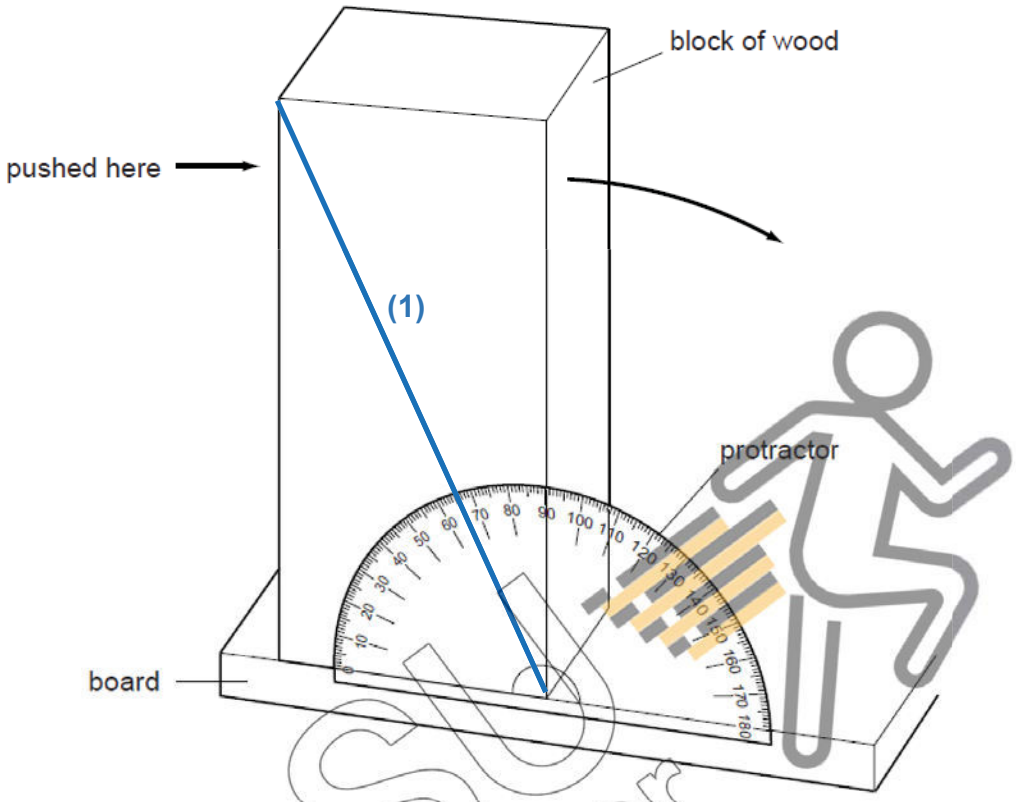


Fig. 4.1

The block is pushed at the top, as shown in Fig. 4.1, and it tilts to the right.

(a) On the front face of the block, draw the line that will be vertical at the instant before the block topples over. [1]

(b) Use the protractor shown on Fig. 4.1 to measure the angle through which the block tilts before it topples over.

24 ~ 26 °

angle = ... [1]

(c) The block is put back on the board, as in Fig. 4.1. This time, instead of the block being pushed, the left-hand edge of the board is raised.

State the angle that the board makes with the horizontal at the instant the block topples over.

same answer as (b)

angle = ... [1]

(d) Explain, in terms of C.G. and stability, how your answer to **(c)** might differ if the procedure is repeated after the height of the block is reduced.

The angle of tilt to topple the block will increase (1) because the C.G of
.....
the block has been lowered so it is more stable (1).
..... [2]

5 **(a)** The principle of conservation of energy states that energy can neither be created nor destroyed. What, then, *does* happen to the energy supplied to a device such as a motor or a television?

It has been changed / converted / transferred into other forms of

.....

energy.

..... [1]

(b) The television in Fig. 5.1 is switched on to watch a programme. During this time, 720 kJ of electrical energy is supplied.

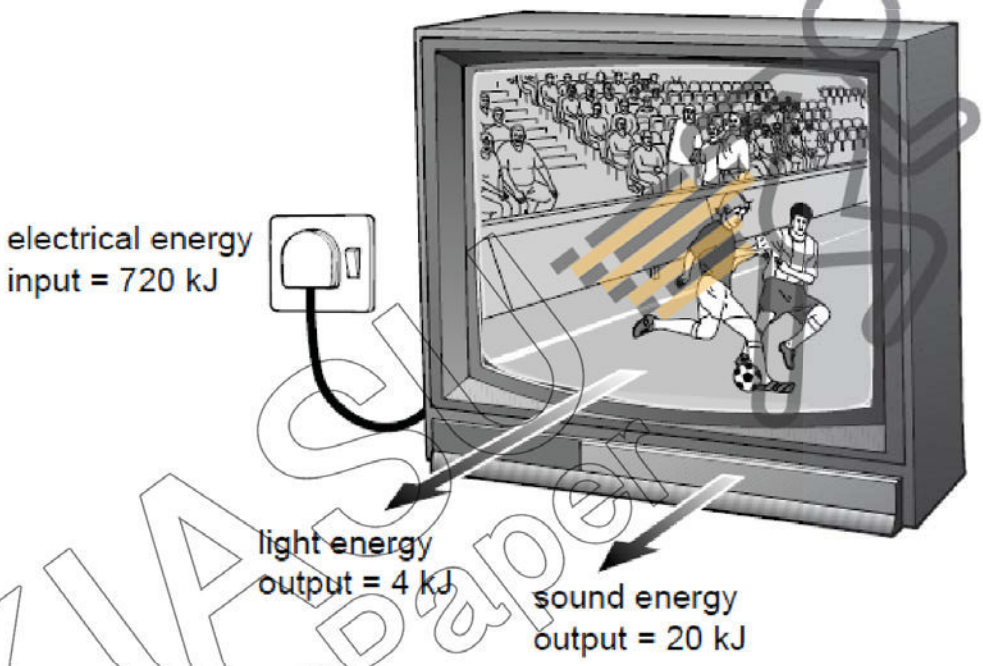


Fig. 5.1

(i) From the information on Fig. 5.1, find the total energy provided for the viewer to see and hear the television during this programme.

24 kJ

energy = ... [1]

(ii) Suggest what happens to the rest of the energy supplied.

Lost to the surrounding / converted into energy that are not useful.

.....

..... [1]

(iii) Calculate how much energy is involved in **(b)(ii)**.

720 - 24 = 696 kJ

energy = ... [1]

(iv) Calculate and comment on the efficiency of the television.

Useful o/p ÷ total i/p x 100% = 24 / 720 x 100% = 3.33% (1)

.....

Very low in efficiency / very high loss or waste in energy (1)

..... [2]

6 Fig. 6.1 shows an evaporative cooler, which is a device that cools air through the continuous evaporation of water. Air is cooled by being blown past a cooling pad containing water. The cooling pad is wet by a pump which pumps water up to the top of the pad, from where it trickles down.

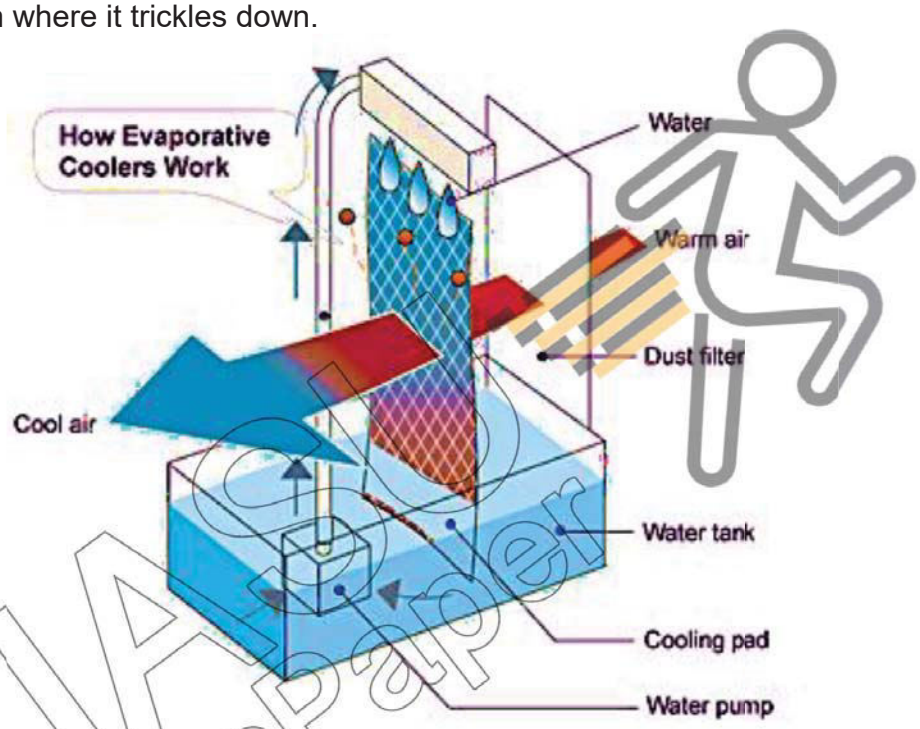


Fig. 6.1

(a) In terms of kinetic model of matter, explain how continuous evaporation of the water causes the air flowing past the cooling pad to be cooled.

The water molecules on the surface of cooling pad absorb thermal

.....

energy from the warm air,(1) increasing their internal energy till their

.....

overcome strong intermolecular forces enabling them to vaporize,

.....

leaving behind less energetic cooler water molecules. (1) The air then

.....

exits the cooling pad as cool air. As the new wave of warm air flows

.....

past the cooling pads, the same process repeats relying on the cooling

.....

process of evaporation.

..... [2]

(b) Explain whether such evaporative cooling system is more effective in dry or humid atmospheres.

It is more effective in dry atmospheres, because places with high humidity reduces the rate of evaporation.

..... [1]

[That is why windows and entryways must be closed while running a ventilation system]

.....

(c) Suggest one modification that can be made to the design of the evaporative cooler such that the rate of cooling increases.

Increasing surface area of the cooling pad increases the rate

.....

of thermal loss from the air to the liquid.

..... [1]

7 Two metal saucepans contain the same mass of hot water at the same initial temperature. Pan A is white and pan B is black, but otherwise the two saucepans are identical. Both saucepans are uncovered and cool under the same conditions. The cooling curves for the two saucepans are shown in Fig. 7.1.

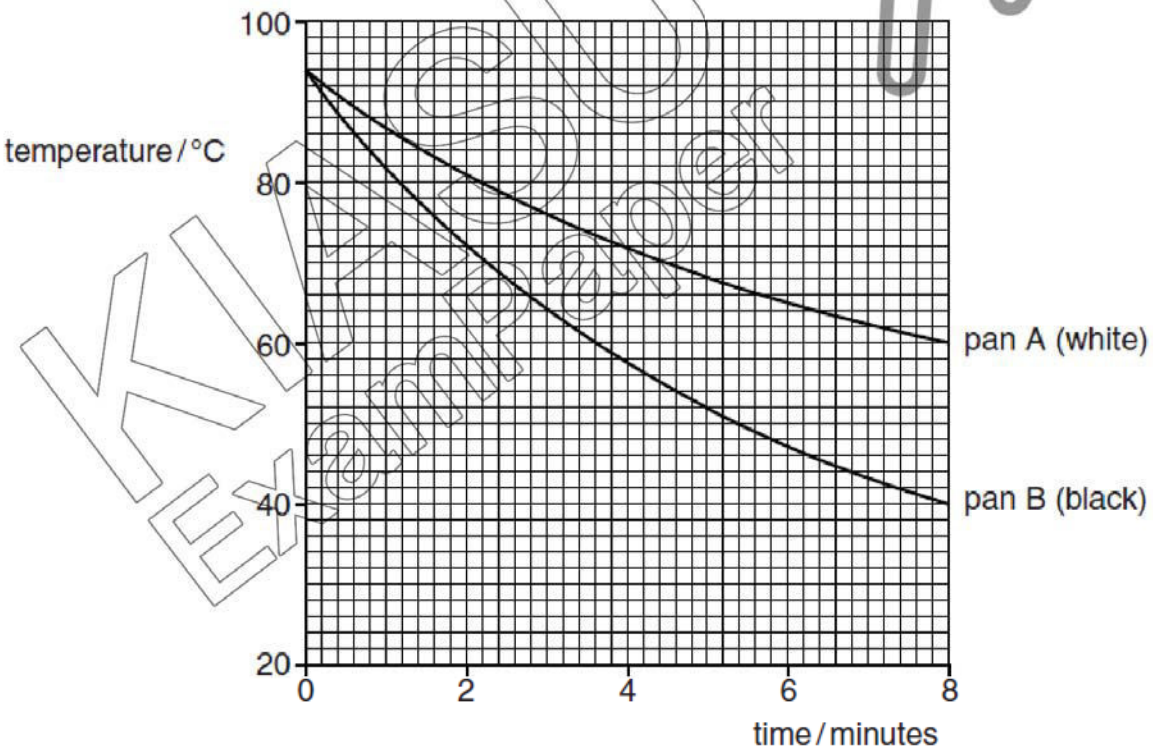


Fig. 7.1

(a) Explain why pan B cools faster than pan A.

Pan B is black which is a better emitter of heat compared to white (1)

..... [1]

(b) Describe and explain how Fig. 7.1 is different when the pans are covered and the experiment is repeated.

The rate of cooling will be lower OR temperature will take a longer time to drop to a same temperature (1). This is because the cover will reduce heat loss by convection (1).

..... [2]

(c) Explain what is meant by the specific heat capacity of water is 4200 J/(kg °C).

4200 J of heat is required to increase / decrease the temperature of 1kg of water by 1 °C.

..... [1]

(d) The specific heat capacity of water is very high. Suggest one disadvantage of this when water is used for cooking.

It will require a high amount of heat (or require a longer time of heating) in order to raise the temperature of water for cooking.

..... [1]

(e) The water in pan A cools for 8 minutes, as shown in Fig. 7.1. During this time, the water loses an average of 9000 J of thermal energy per minute.

(i) Calculate the mass of water in pan A.

$Q = mc\Delta\theta$
$9000\ J \times 8\ min = m \times 4200\ J/kg°C \times (94°C - 60°C)$
$m = \underline{0.504\ kg}$ (3 s.f.)

mass = ...

(ii) The mass of water in pan B is the same as that in pan A.
Calculate the thermal energy lost from the water in pan B during the 8 minutes.

$Q = mc\Delta\theta$
$Q = 0.504\ kg \times 4200\ J/kg°C \times (94°C - 40°C)$
$Q = \underline{114000\ J}$ (3 s.f.)

loss of thermal energy = ... [3]

8 A teacher demonstrates magnetic screening. When a magnet is placed near a small cardboard box, paper clips on the other side of the box are picked up, as shown in Fig. 8.1. When a small piece of soft iron is placed inside the box as shown in Fig. 8.2, the paper clips fall off. Magnetic field lines in each diagram are shown as thin lines.

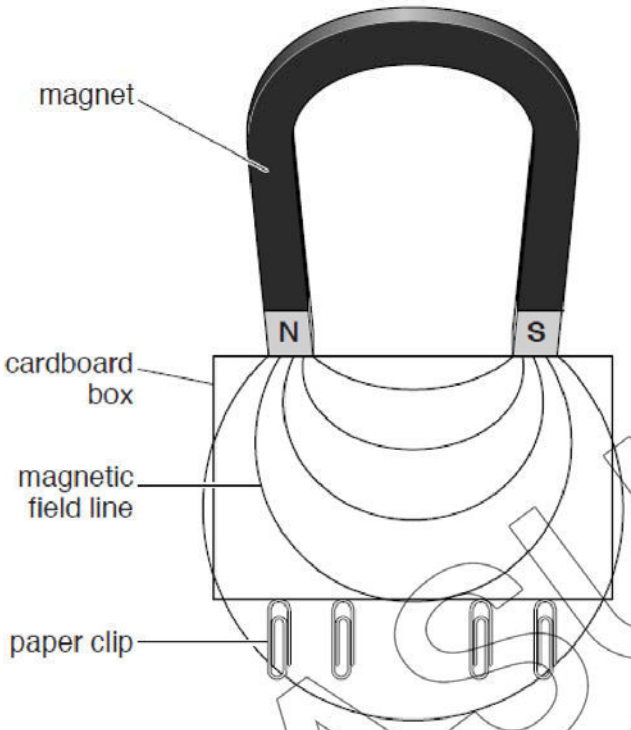


Fig. 8.1

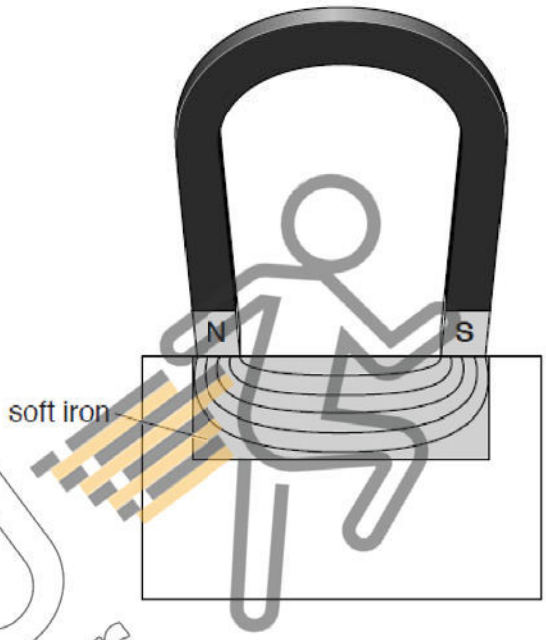


Fig. 8.2

(a) On Fig. 8.1, mark an arrow on each of the magnetic field lines to show its direction. **North to South** [1]

(b) Explain why placing the soft iron in the box causes the paper clips to fall off.

Soft iron is highly permeable to magnetic field (1).

.....

Magnetic field from the magnet does not reach the paper clips so they

.....

demagnetized and fell off (1). [2]

.....

9 The apparatus in Fig. 9.1 is called a force-on-conductor balance. When there is an electric current I as shown in XY, there is a force on XY. This force is measured by putting weights in the pan until XY is brought back to its original position.

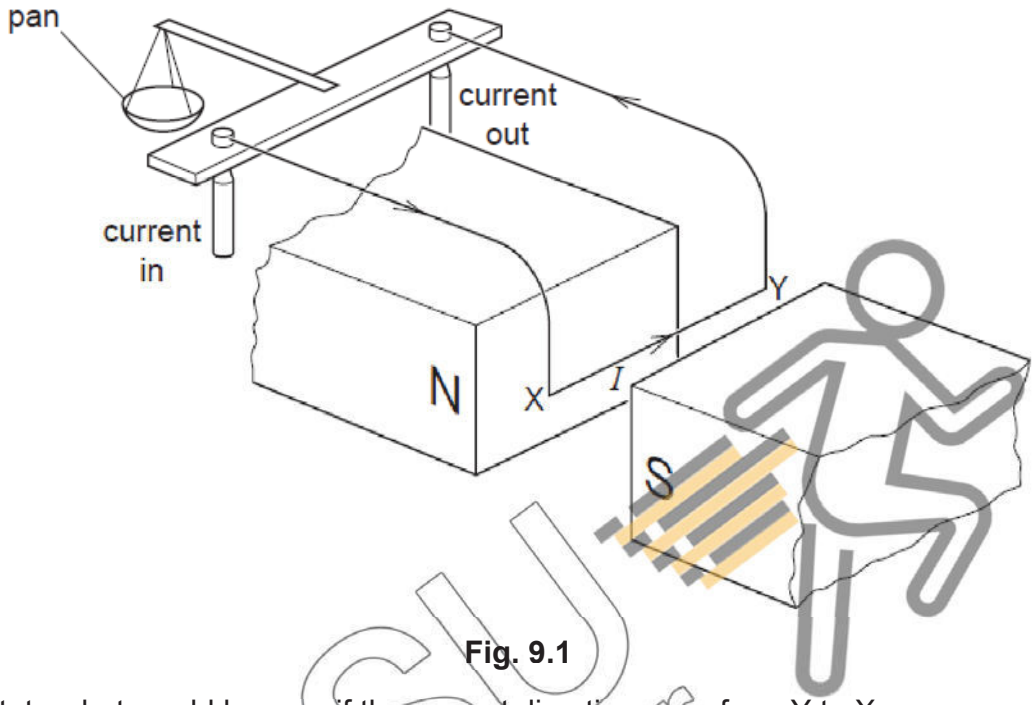


Fig. 9.1

(a) State what would happen if the current direction were from Y to X.

XY would move up / anticlockwise / motion reversed / pan moves down [1]

.....

(b) A student uses the balance to determine the force F on XY for different currents I. He concluded that F is directly proportional to I based on his results given below.

I/A	0	0.5	1.0	1.5	2.0
F/N	0	0.012	0.023	0.035	0.047

Show clear workings to estimate the force on XY when the current is 1.6 A.

Assuming (2.0,0.047) is on the best-fit line
m = 0.047 ÷ 2.0 = 0.0235
Using y = mx
y = 0.0235 x 1.6
= 0.036 ~ 0.038 N

force = ... [2]

END OF SECTION A

Section B

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 13**.

11 A measuring cylinder contains water which has a density of 1000 kg/m^3.

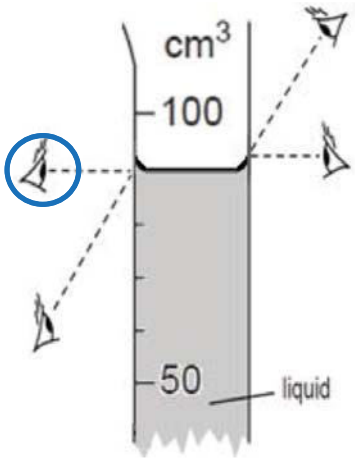


Fig. 11.1

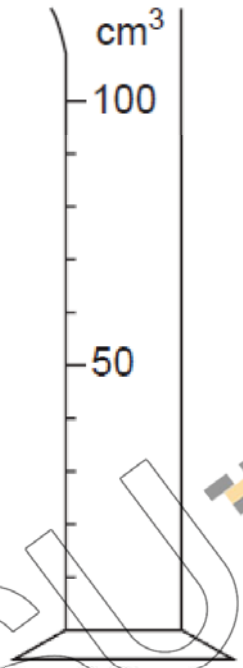


Fig. 11.2

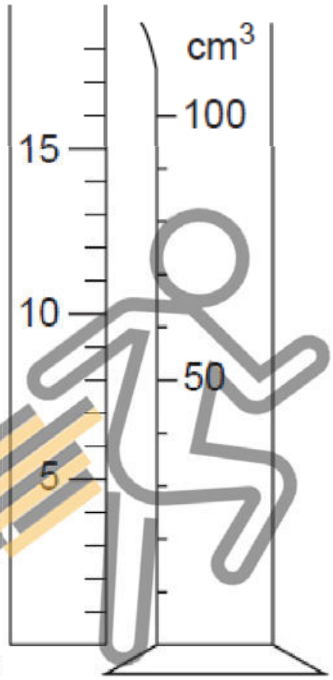


Fig. 11.3

(a) Fig. 11.1 indicates four ways the observer's eye could look when taking the reading from the measuring cylinder. Put a circle around the eye position that gives the correct reading and state the volume of water in the cylinder.

90 cm^3

volume = _____ [1]

(b) In order to fill the measuring cylinder up to the 100 cm^3 mark, 80 drops of the liquid are added to the liquid already in the measuring cylinder. Calculate the average volume of one drop.

10 cm^3 / 80 = 0.125 cm^3

volume = _____ [2]

(a) 20 cm^3 of the water in Fig.11.1 is poured into a beaker. On Fig. 11.2, mark the level of the water left in the cylinder. [1]

level shown at 70 (ignore meniscus) ± 1mm

(b) A rule, calibrated in cm, is placed alongside the measuring cylinder, as shown in Fig. 11.3. What is the length of the measuring cylinder, from zero up to the 100 cm^3 mark?

16 cm

length = _____ [1]

(c) The volume of a cylinder is found using the equation

volume = cross-sectional area x length.

Determine the cross-sectional area of the cylinder containing water.

100 cm^3 = area x 16 cm (1)
area = 100 cm^3 ÷ 16 cm [2]
= 6.25 cm^2 (1)

cross-sectional area = _____

(d) Hence, or otherwise, determine the pressure acting on the base by the water left in the cylinder.

P = Force / Area
= 1000 kg/m^3 x 70 cm^3 x 10 N/kg ÷ 6.25 cm^2 (1) [3]
= (1 g/cm^3 x 70 cm^3)÷1000 x 10 N/kg ÷ 0.000625 m^2 (1)
= 1120 N/kg or 1120 Pa (1)

pressure = _____

12 The circuit in Fig. 12.1 is connected up.

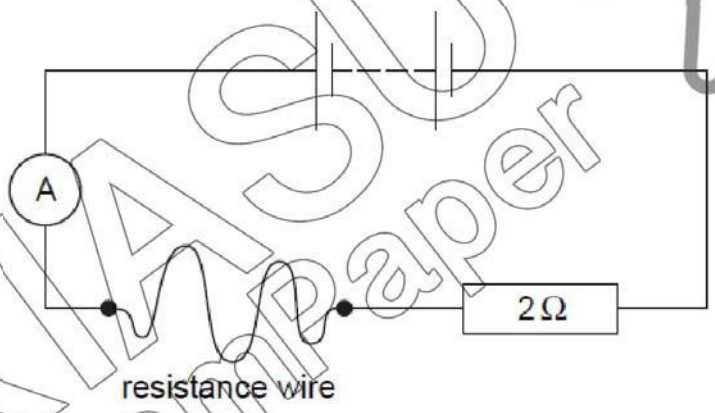


Fig. 12.1

(a) State how does the current in the resistance wire compare with the current in the 2 Ω resistor?

They are the same in amount / magnitude.

.....

..... [1]

(b) A voltmeter connected across the resistance wire shows the same reading as a voltmeter connected across the 2 Ω resistor. Calculate the combined resistance of the wire and the resistor.

Same voltmeter reading implies resistance wire is also 2 Ω (1)
∴ combined resistance in series = 2 + 2 = 4 Ω (1)

combined resistance = …… [2]

(c) The wire and resistor are disconnected and then reconnected in parallel, as shown in Fig. 12.2.

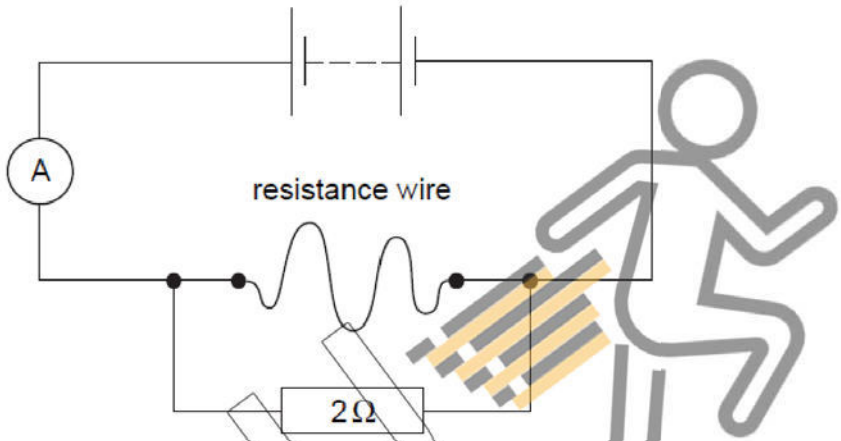


Fig. 12.2

(i) Calculate the new combined resistance of the wire and the resistor.

New combined resistance in parallel = (2x2)/(2+2) = 1 Ω (1)

combined resistance = …… [1]

(ii) Compare the current measured in Fig. 12.2 with the current in Fig. 12.1.

Since combined resistance decreased by 4 times, new current will
.....
increase (1) by 4 times (1).
.....
[2]

(d) Walls in buildings sometimes develop cracks. The width of a crack can be monitored by measuring the resistance of a thin wire stretched across the crack and firmly fixed on either side of the crack, as illustrated in Fig. 12.3.

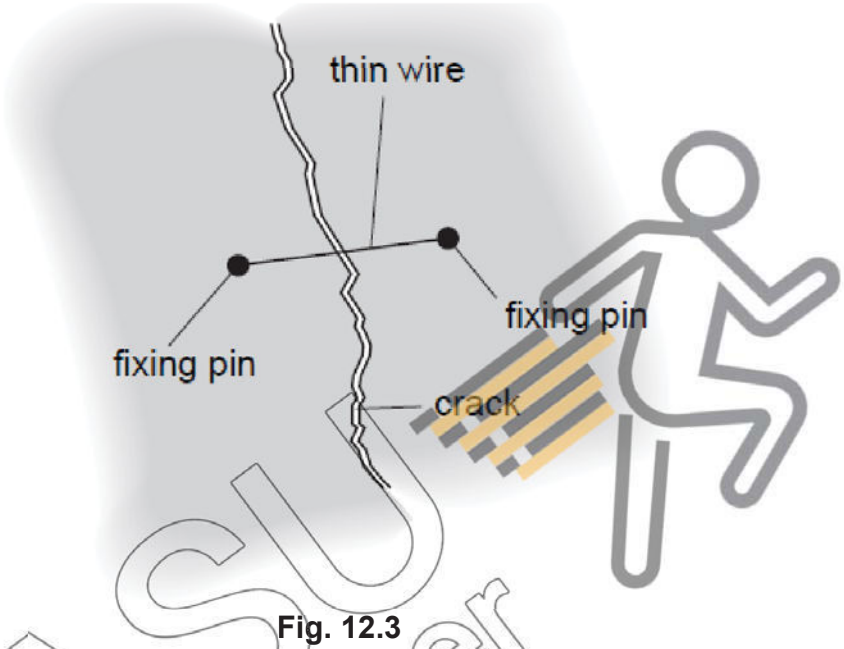


Fig. 12.3

(i) The wall moves and the crack widens slightly. Explain what happens to the resistance of the wire.

Wire stretches/length increases/cross-sectional area decreases (1)

.....

causing the resistance to increase (1).

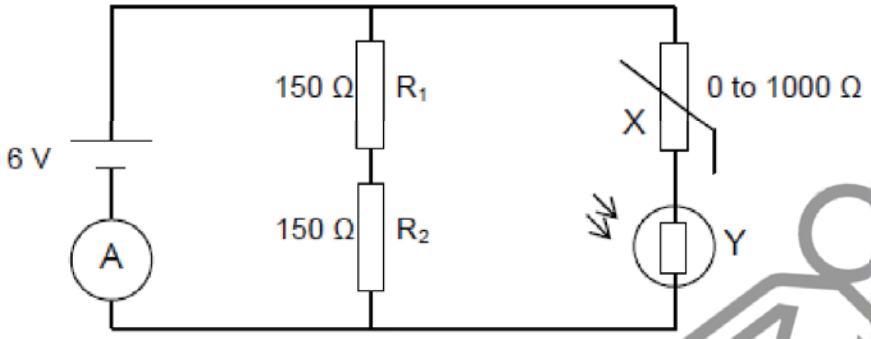
..... [2]

(ii) Copy a suitable circuit from Fig. 12.1 or Fig. 12.2 and add a LED light bulb to light up when the crack widens. [2]

Suitable circuit chosen from Fig. 12.1 (1) Correct LED symbol connected parallel to the wire (1)

13 EITHER

The circuit below consists of a 6 V battery source, two resistors of 150 Ω each, LDR and thermistor. The V_{out} across the LDR is connected to a fan which will be switched on when the V_{out} = 6.0 V.



(a) The table shows the range of resistance value for the LDR and thermistor. The resistance of the thermistor varies linearly with temperature.

Instrument	Temperature	Light intensity	Resistance
Thermistor	10 °C		200 Ω
	30 °C		0 Ω
LDR		Bright noon day	50 Ω
		Night	100 Ω

(i) Explain whether the LDR and thermistor are ohmic conductors. [2]

No they are non-ohmic because their resistance is not constant / current flowing through them is not directly proportional to the p.d across them.

(ii) Calculate the equivalent resistance of the whole circuit when it is during the night and the temperature is 10 °C. [2]

$1/R_1 + 1/R_2 = 1/R_{net}$
$1/(150 + 150) + 1/(200 + 100) = 1/R_{net}$
$R_{net} = 150\ \Omega$

(iii) Find the reading of the ammeter. [1]

I = V/R
= 6 / 150
= 0.04 A

(b) **(i)** Show, with clear workings and calculations, whether the fan will be switched on when the temperature is 10 °C during the night. [2]

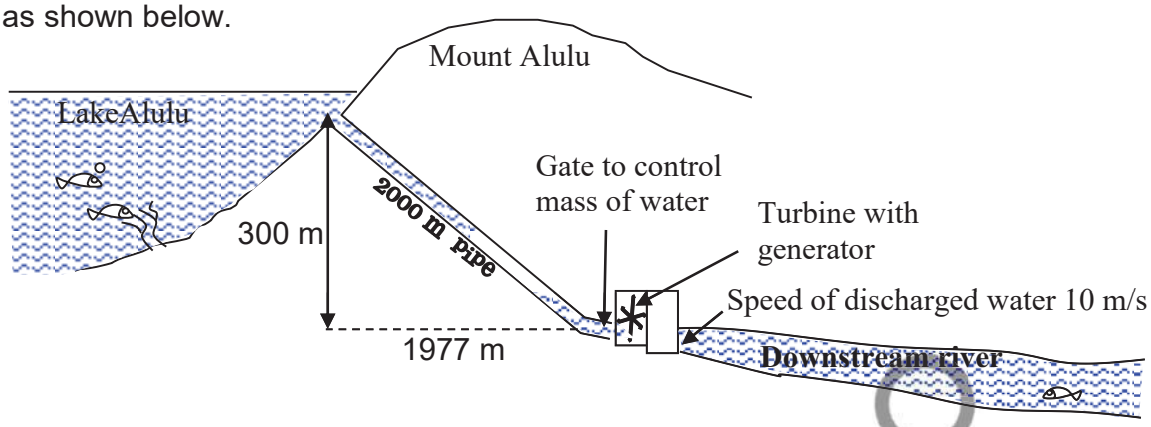
$R_1/(R_2 + R_1) \times 6 = 100/300 \times 6 = 2$ V
No, fan will not switch on.

(ii) Show, with clear workings and calculations, a possible pair of conditions for the temperature and light intensity which will cause the fan will to be switched on. [3]

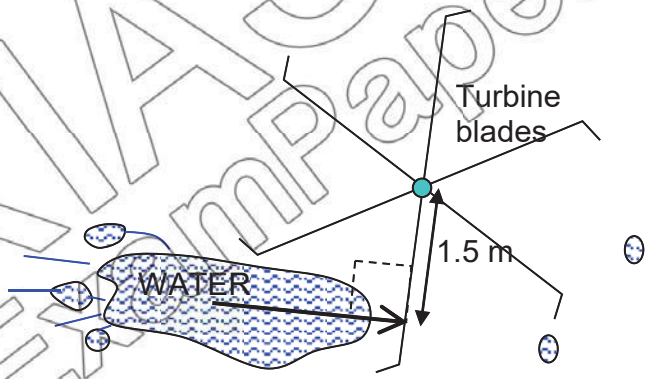
Temperature = 30 ^{o}C
Light intensity = night (1)
$V_{out} = R_1/(R_2 + R_1) \times 6$
$= 100/100 \times 6$ (1)
= 6 V (1)

13 OR

The turbine of a hydro-electric power station is built below the level of a lake as shown below.



The turbine is rotated by the running water. It then rotates a group of magnets around a coil in an a.c. generator. The generator is designed such that the magnets would rotate at a constant speed generating an e.m.f of 50,000 V across a coil. The water would be discharged at a constant speed of 10 m/s into the downstream river. The mass of water passing through the blades per second would be controlled by an automatic gate.
If a current is drawn from the generator coil, there would be a clockwise moment opposing the rotation of the turbine. The running water would need to produce an anti-clockwise moment by hitting the blades in order to overcome the resisting moment and keep the blades moving at the required constant speed to generate the e.m.f.of 50,000 V. If 10 A of current is drawn from the generator, 17,160 Nm of moment would oppose the rotation and 169.5 kg of water would be needed to hit the blades per second.



The table below shows the data of Mount Alulu hydroelectric power station:

Generated e.m.f. / V	Current drawn from generator / A	Moment required to turn the turbine / Nm	Mass of water hitting the blades per second / kg s^{-1}	Speed of discharged water / ms^{-1}
50,000	10	17,160	169.5	10
50,000	20	34,320	339.0	10

(a) Assuming that water hits one blade at a time at a perpendicular distance of 1.5 m from the the axle as shown below, estimate the force it must exert on the blade when a current of 10 A is drawn from the generator. [2]

Moment = F x d
17160 = F x 1.5 m (1)
∴ F = 11440 N (1)

(b) Explain why "*If a current is drawn from the generator coil, there would be a clockwise moment opposing the rotation of the turbine*"? [2]

According to Lenz's Law, induced current must oppose the change causing it (1). Hence a resisting moment or force is produced by the induced current (1).

(c) Calculate the amount of energy per second available to the generator when 500 kg of water flows through the turbine per second. [3]

Loss in E_p = mgh
= 500 x 10 x 300
= 1 500 000 J (1)
Gain in E_k = ½mv²
= ½ x 500 x 10^2
= 25,000 J (unused energy) (1)
Energy available = 1 500 000 – 25 000 = 1 475 000 J (1)

(d) Estimate the current that flows in the generator when 500 kg of water flows through the turbine per second. [2]

P = V I
E x t = V I
1 475 000 x 1 = 50 000 x I (1)
∴ I = 29.5 A (1)

(e) Explain briefly why the actual current flowing should be less than your estimated value in (d) when 500 kg of water flows through the turbine per second. [1]

Some work needs to be done to overcome friction in the axle of the turbine. The energy used in this way is converted to heat in the axle.

END OF PAPER 2