AHMAD IBRAHIM SECONDARY SCHOOL
GCE O-LEVEL PRELIMINARY EXAMINATION 2018

PHYSICS
PAPER 1

6091/01

Sec 4 Express

Date: 16 August 2018
Duration: 1 hour

Name: ……( ) Class: ……

READ THESE INSTRUCTIONS FIRST:

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class number and registration number on the optical answer sheet (OAS) provided.

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 optical answer sheet (OAS) provided.

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 question paper.
The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of **20** printed pages

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1 Pendulum **A** makes 20 complete oscillations in 10 s. Pendulum **B** makes 15 complete oscillations in 15 s. Both pendulums were displaced by a small angle before their oscillations.

Which of the following statements must be true?

A Pendulum **B** has a shorter period than pendulum **A**.

B The string of pendulum **B** is longer than that of pendulum **A**.

C The mass of the bob of pendulum **B** is smaller than that of pendulum **A**.

D The angle of swing of release for pendulum B is smaller than that of pendulum **A**.

2 A pair of vernier calipers is used to measure the thickness of a coin.

Diagram 1 shows the reading with the jaws closed. Diagram 2 shows the reading when the jaws are closed around the coin.

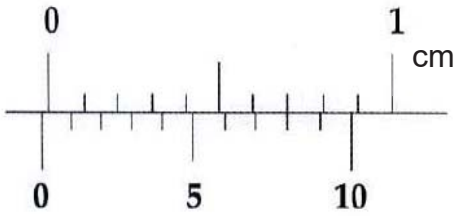


Diagram 1

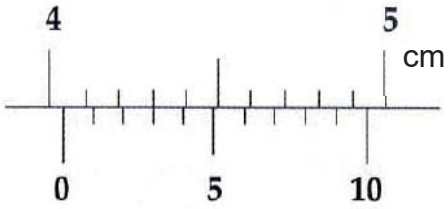


Diagram 2

What is the zero error and the actual thickness of the coin?

	Zero error / cm	**Corrected reading / cm**
A	-0.02	4.05
B	-0.02	4.01
C	+0.08	3.95
D	+0.08	4.11

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3 A student uses a micrometer screw gauge to measure the diameter of a ball bearing. Diagram 1 shows the zero error of the gauge and diagram 2 shows the measurement of the diameter before it is corrected.

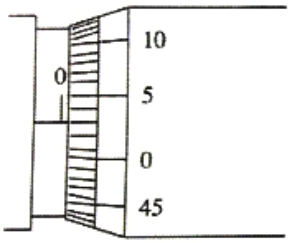


Diagram 1

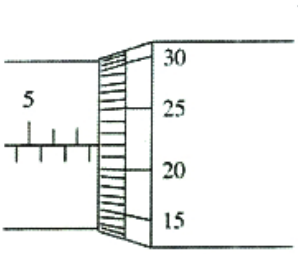
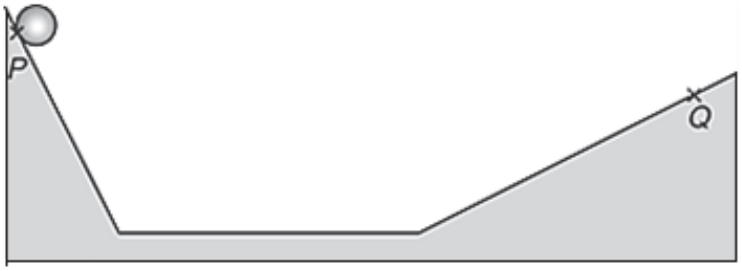


Diagram 2

What is the true diameter of the ball bearing?

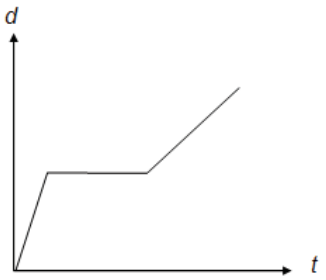
A 7.19 mm **B** 7.69 mm **C** 7.72 mm **D** 7.75 mm

4 A sphere runs along a smooth rail from **P** to **Q** as shown.

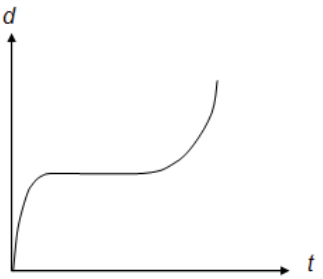


Which of the following graphs best represents the variation of the distance *d* travelled by the sphere with time *t*?

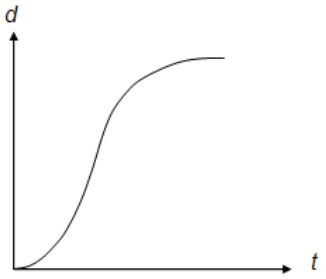
A



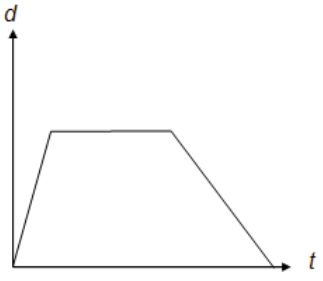
B



C



D



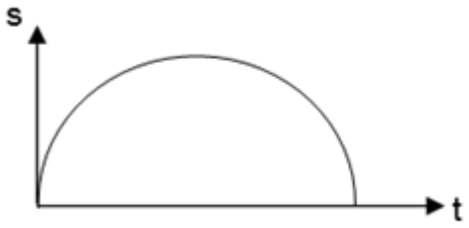
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5 A bicycle accelerates from a speed of 2.0 m/s to 10 m/s in 8.0 s.

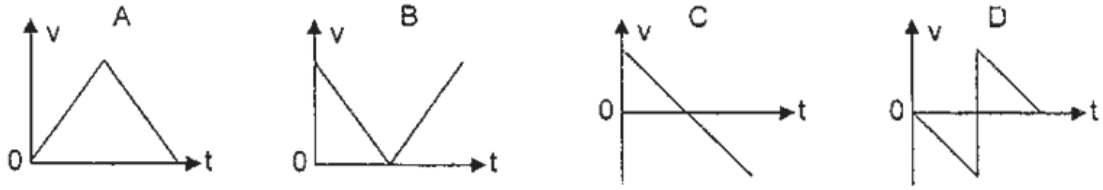
What is its average speed during the journey?

A 4.0 m/s **B** 5.0 m/s **C** 6.0 m/s **D** 7.0 m/s

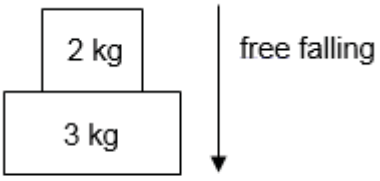
6 The diagram shows the graph of displacement ***s*** against time ***t*** for a body moving in a straight line.



Which of the following shows the graph of speed ***v*** against time ***t*** for this body?



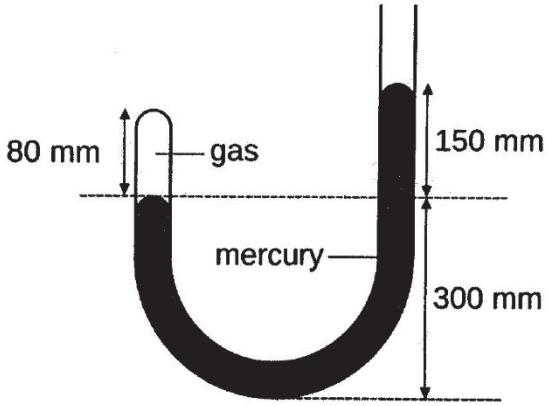
7 Two metal blocks are stacked one on top of the other as shown in the diagram below. They are dropped in vacuum, falling together freely under earth's gravitational field. What is the net force acting on the 3 kg metal block during the fall?



A 10 N **B** 20 N **C** 30 N **D** 40 N

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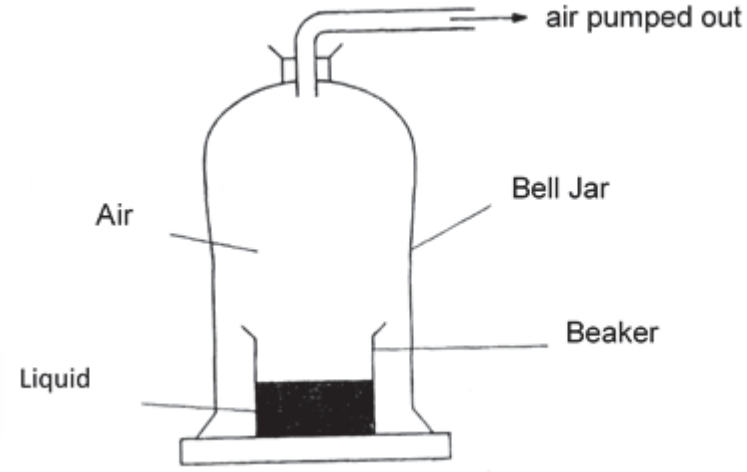
8 The diagram shows a gas trapped in the left arm of a manometer containing mercury.



If the atmospheric pressure is 760 mm Hg, what is the pressure of the trapped gas?

A 80 mm Hg **B** 150 mm Hg **C** 680 mm Hg **D** 910 mm Hg

9 A beaker of liquid is placed under a bell jar. The pressure of the air above the liquid is reduced and some liquid evaporates. This causes the liquid to become colder.



Why does the temperature of the liquid fall?

A The air molecules blow away the liquid molecules.

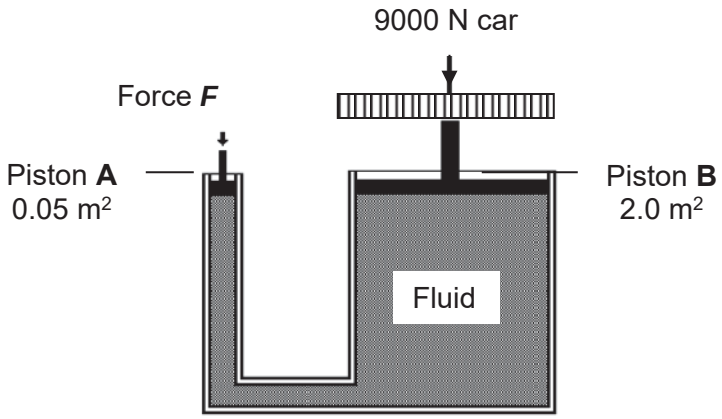
B The air molecules cool down the liquid.

C The higher energy molecules leave the liquid.

D There are fewer molecules of liquid in the beaker.

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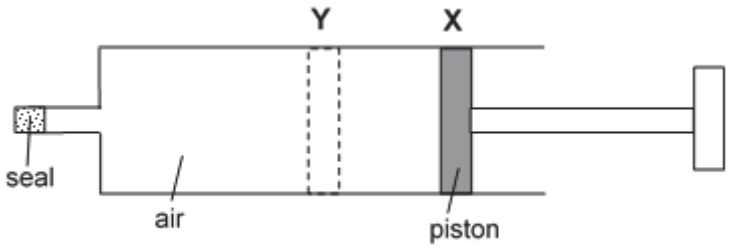
10 A hydraulic lift is used to support a car of weight 9000 N.



Piston **A** has a cross-sectional area of 0.05 m^2 while piston **B** has a cross-sectional area of 2.0 m^2. What is the force **F** needed to support the weight of the car?

A 225 N **B** 450 N **C** 900 N **D** 3600 N

11 The outlet of a syringe is sealed and air is trapped in the syringe. The temperature of the air is kept constant.



Why does the pressure of the air increase when the piston is pushed from **X** to **Y**?

A The air molecules are moving faster.

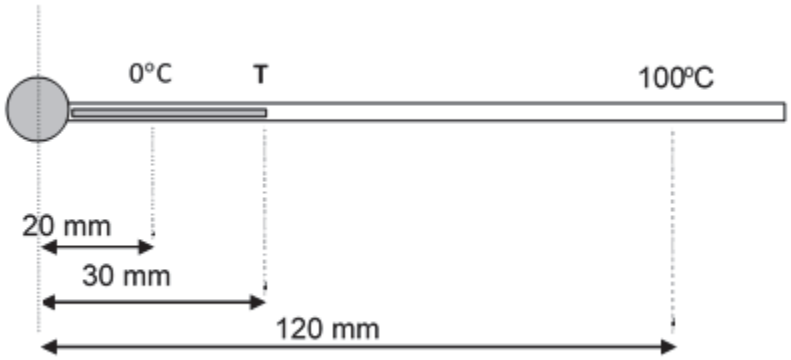
B The collision between the air molecules increases.

C The forces between air molecules increases.

D The rate of collision of the air molecules with the wall increases.

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12 A mercury-in-glass thermometer is shown. What is the temperature when the mercury thread is at **T**?



A 10 °C **B** 25 °C **C** 30 °C **D** 40 °C

13 Water of mass 0.87 kg at 90 °C is poured into an insulated metal container of mass 0.50 kg at 20 °C. The final temperature of water is 86.2 °C. If the specific heat capacity of water is 4200 J $kg^{-1}K^{-1}$, what is the specific heat capacity of the metal in J $kg^{-1}K^{-1}$?

A 360 **B** 380 **C** 420 **D** 480

14 Which statement about a fixed mass of gas is correct?

A As pressure increases at constant temperature, the volume decreases.

B As pressure increases at constant temperature, the volume increases.

C As temperature increases at constant pressure, the volume decreases.

D As temperature increases at constant volume, the pressure decreases.

15 What describes the volume and shape of a gas or liquid at constant temperature?

A The volume of a gas is fixed but its shape is not fixed.

B The volume of a gas is not fixed and its shape is not fixed.

C The volume of a liquid is fixed and its shape is fixed.

D The volume of a liquid is not fixed but its shape is fixed.

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16 Air in a closed container contains smoke, illuminated by bright light. When viewed through microscope, bright specks of light are seen moving at random.
Which statement is correct?

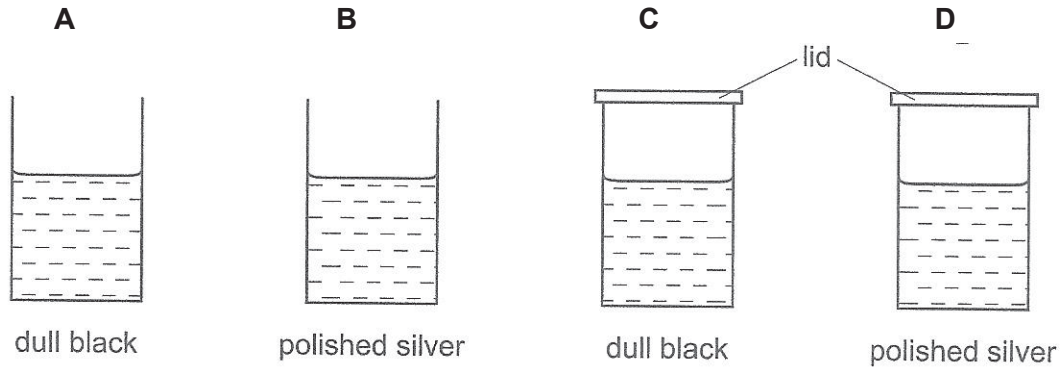
A The random motion of the specks is faster in a vacuum.

B The specks move faster when the air is at a higher temperature.

C The specks seen are molecules of air in rapid random motion.

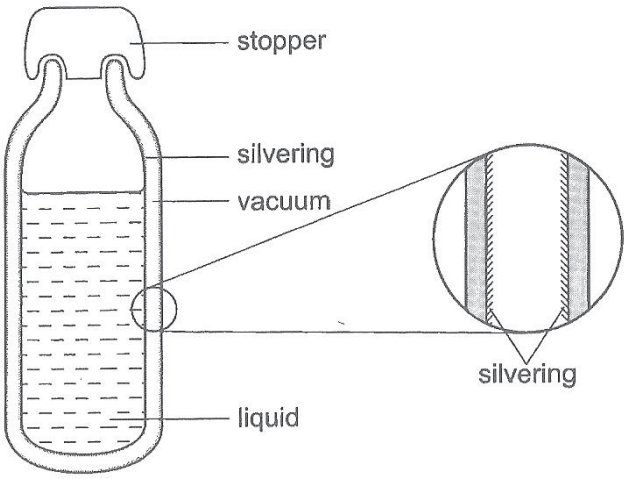
D When the light is turned off, the specks slow down and stop moving.

17 The diagram shows four identical cans with their outside surfaces painted either dull black or polished silver. Each can contains the same volume of water, initially at 80 °C.
After five minutes in a cool room, which can contains the hottest water?



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18 The diagram shows a vacuum flask and an enlarged view of a section through the flask wall.



The main reason for the silvering is to reduce heat transfer by

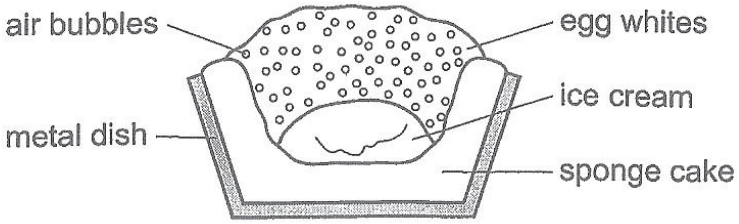
A conduction only.

B conduction and convection.

C radiation only.

D radiation and convection.

19 A cook makes the pudding 'baked Alaska'.



The pudding is placed in a very hot oven until the top of the egg white turns brown. It is then removed from the oven.

Why does the ice cream stay cold?

A Air is a good conductor of heat and conducts the heat away from the ice cream.

B Air is a poor conductor of heat and slows the heat from reaching the ice cream.

C The metal dish is a good conductor of heat and conducts the heat away from the ice cream.

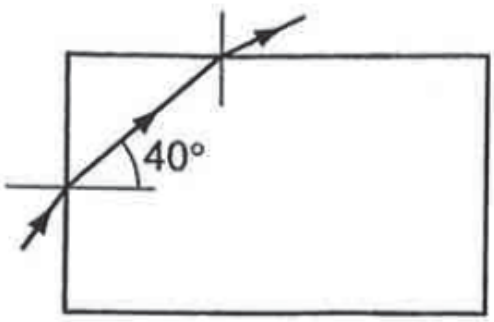
D The metal dish is a poor conductor of heat and slows the heat from reaching the ice cream.

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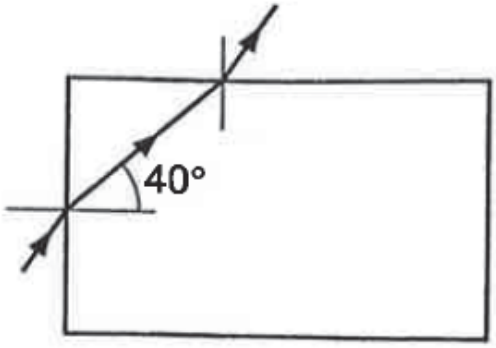
20 A ray of light is incident on one side of a rectangular glass block. The angle of refraction is 40° in the glass. The critical angle for light in glass is 42°.

Which diagram shows the path of this ray?

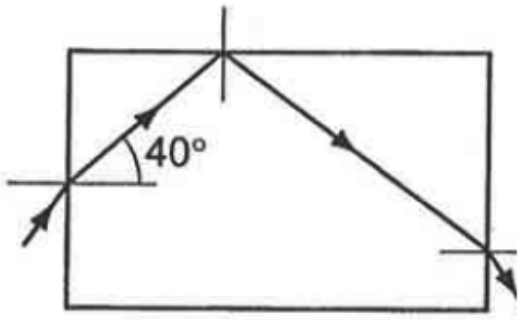
A



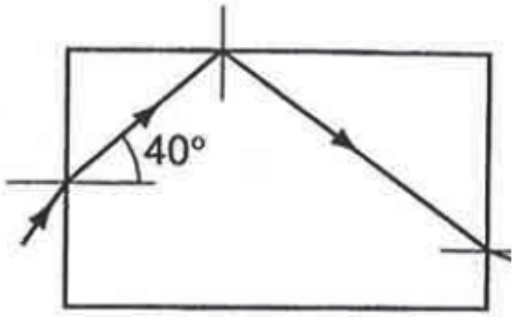
B



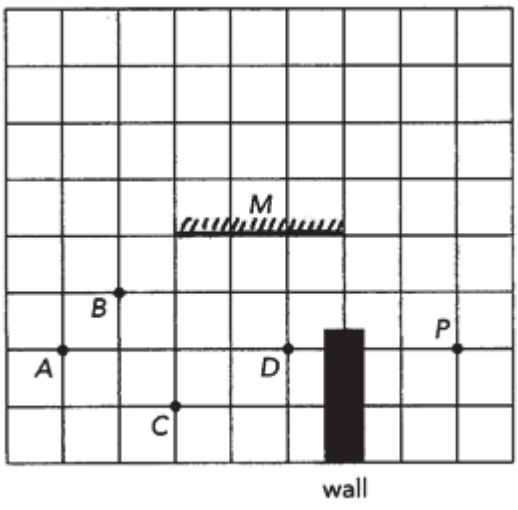
C



D



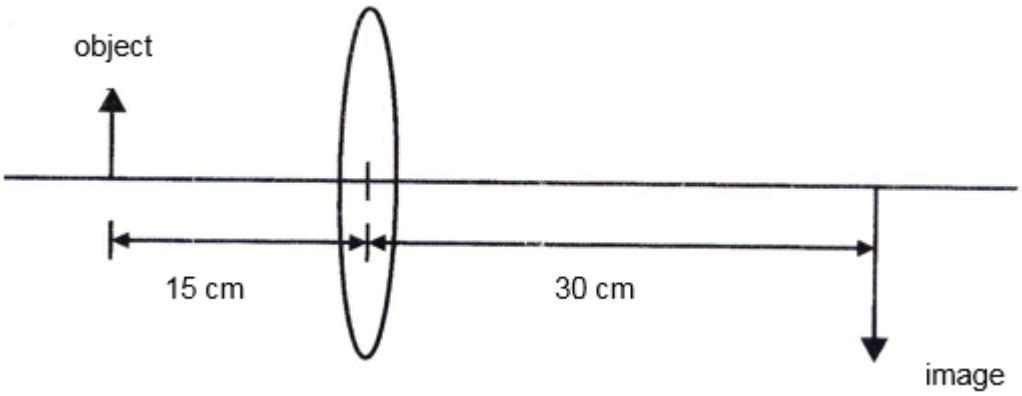
21 The figure below shows the top view of an empty room with a vertical plane mirror **M** at the middle. Rachel stands at point **P** and looks into the mirror.



Which object **cannot** be seen by Rachel in the mirror?

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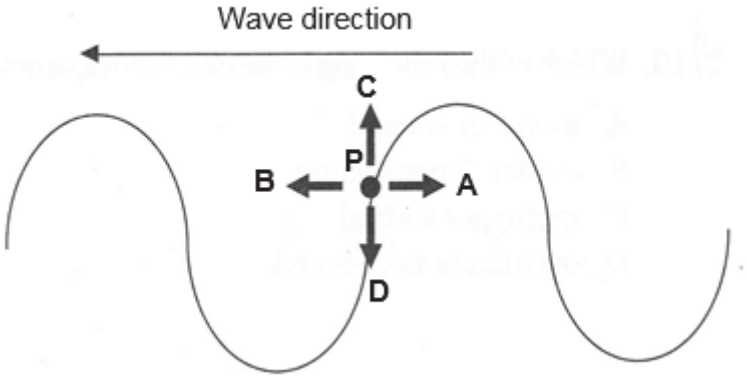
22 When an object is placed 15 cm in front of a convex lens the image is formed 30 cm behind the lens.



How would the size of the image and the image distance change when the object is moved 5 cm further away from the lens?

	Size of image	Image distance
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

23 A point **P** is marked on a rope before the rope is set to oscillate. At the particular instance shown, what is the direction of movement of the point **P**?

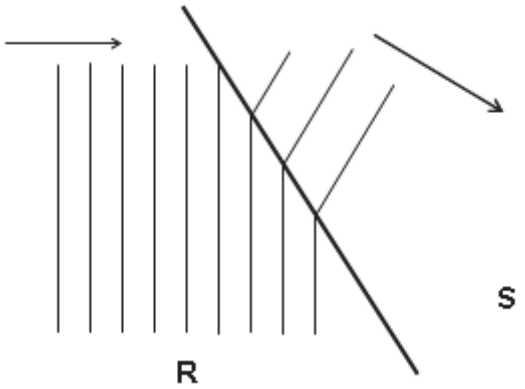


24 It takes 0.25 s to generate one complete wavelength in a ripple tank. The wavelength of each wave produced is 6.0 cm. What is the speed of the wave?

A 0.0417 cm s^{-1} **B** 1.5 cm s^{-1} **C** 3.0 cm s^{-1} **D** 24.0 cm s^{-1}

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25 The figure shows water traveling from Section **R** to **S** in a ripple tank.



Which statement is correct?

A The frequency is higher in section **S**.

B The water is shallower in section **S**.

C The water is deeper in section **S**.

D The waves move slower in section **S**.

26 Waves **P** and **Q** are components of the electromagnetic spectrum. **P** has a longer wavelength than **Q**. Which of the following statements is **true** about **P** and **Q**?

A **P** is radiowave and **Q** is infrared radiation.

B **P** can travel faster than **Q** in vacuum.

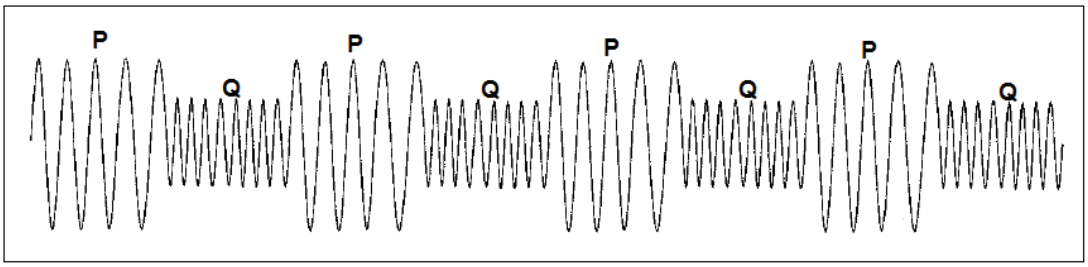
C **Q** has a lower frequency than **P**.

D **Q** is ultraviolet ray and **P** is X-ray.

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27 A police sounds its siren when travelling to an emergency. The siren produces two different sounds **P** and **Q**, which are emitted alternately.

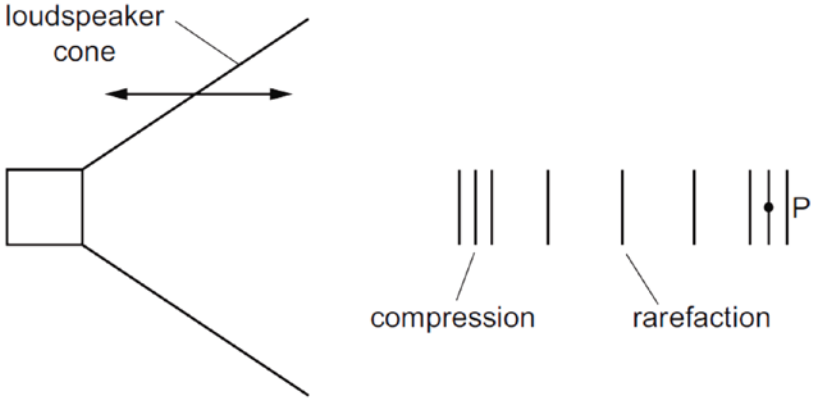
The diagram represents the sound emitted by the siren.



Which of the two sounds **P** and **Q** is the softer and which has the lower pitch?

	Softer sound	Sound of lower pitch
A	P	P
B	P	Q
C	Q	P
D	Q	Q

28 Compressions and rarefactions are sent out from a loudspeaker cone as it vibrates backwards and forwards. The frequency of vibration is 50 Hz.

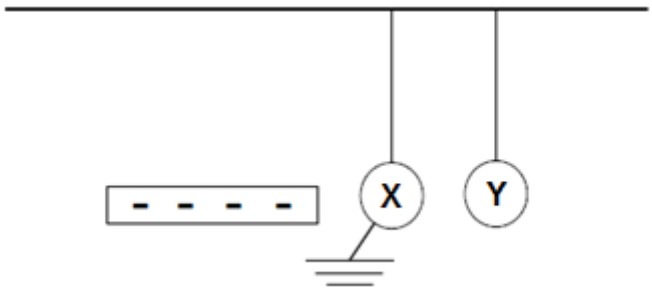


A compression is at point **P**. How much time elapses before the next rarefaction arrives at **P**?

A 0.010 s **B** 0.020 s **C** 25 s **D** 50 s

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29 A negatively charged rod is brought near two isolated metal balls **X** and **Y**. **X** is then earthed momentarily as shown in the diagram. If the rod is then removed, how would the balls be charged?



	X	Y
A	negative	positive
B	neutral	neutral
C	positive	negative
D	positive	neutral

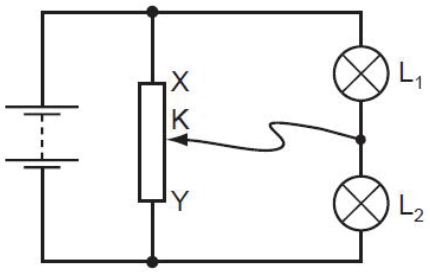
30 A resistor with resistance **R** is made from a length **L** of resistance wire with a cross-sectional area **A**. A second resistor with resistance 3**R** is made from wire of the same material with a cross-sectional area of 0.5**A**.

What length of wire is needed for the second resistor?

A 2 **L** **B** 1.5 **L** **C** **L** **D** 0.5 **L**

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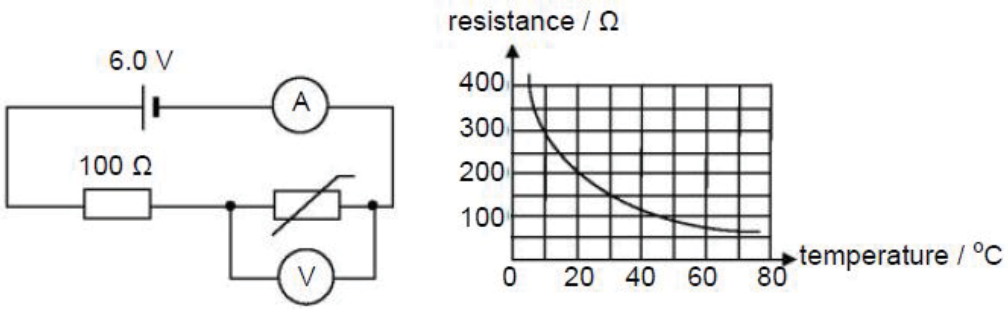
31 The diagram shows a potential divider circuit with two identical lamps L_1 and L_2.



What will happen to the brightness of the lamps when contact **K** is moved towards **X**?

	lamp L_1	lamp L_2
A	Brighter	Brighter
B	Brighter	Dimmer
C	Dimmer	Brighter
D	Dimmer	Dimmer

32 The diagram shows the resistance–temperature graph of a thermistor in a circuit.

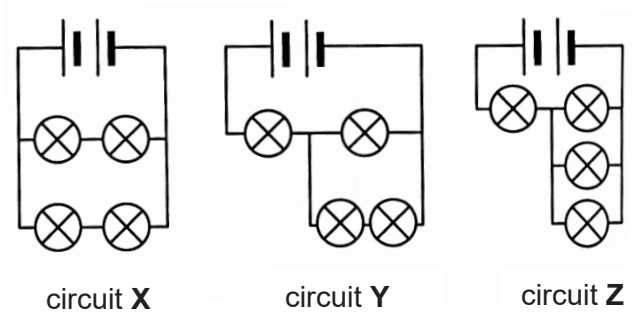


What are the current and voltage when the temperature of the thermistor is 30 °C?

	Current /A	Voltage / V
A	0.024	2.4
B	0.024	3.6
C	0.040	2.4
D	0.040	3.6

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33 In circuits **X**, **Y** and **Z** shown, all the lamps are identical and they use identical dry cells.



circuit **X** circuit **Y** circuit **Z**

What is the descending order of resistance in each circuit?

A **X**, **Y** and **Z**

B **X**, **Z** and **Y**

C **Y**, **Z** and **X**

D **Z**, **Y** and **X**

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 cable insulation becomes damaged and the bare metal wires are exposed. Five possible events may occur.

- A person touches the earth wire.
- A person touches the neutral wire.
- A person touches the live wire.
- The live wire touches the neutral wire.
- The live wire touches the earth wire.

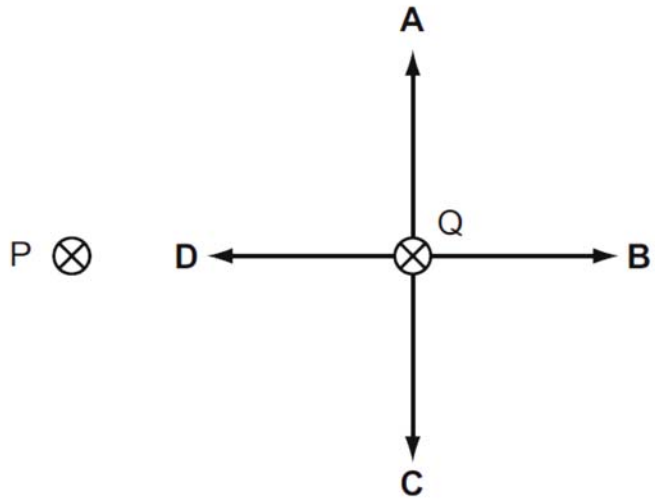
How many of these events will cause the fuse in the plug to blow?

A 2 **B** 3 **C** 4 **D** 5

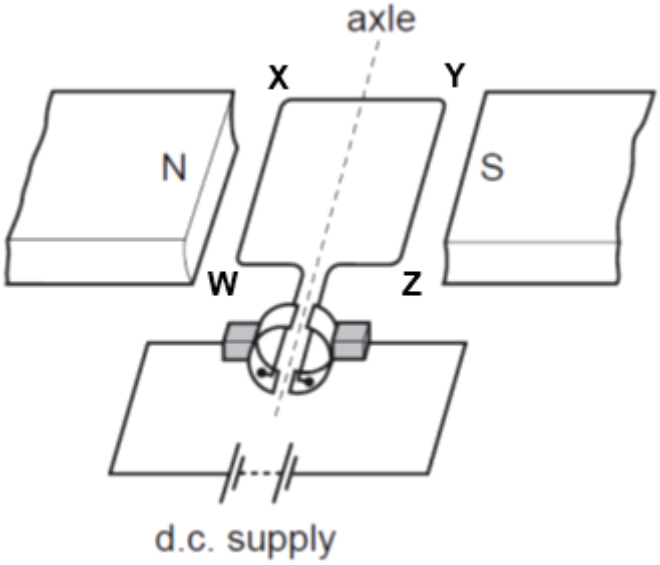
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35 **P** and **Q** represent two, parallel, straight wires carrying currents into the plane of the paper. **P** and **Q** exert a force on each other.

Which arrow shows the force on **Q**?



36 The diagram below shows a simple d.c. motor.



When the switch is closed, which of the following statements is/are correct?

I A current will flow round the coil in the direction **WXYZ**.

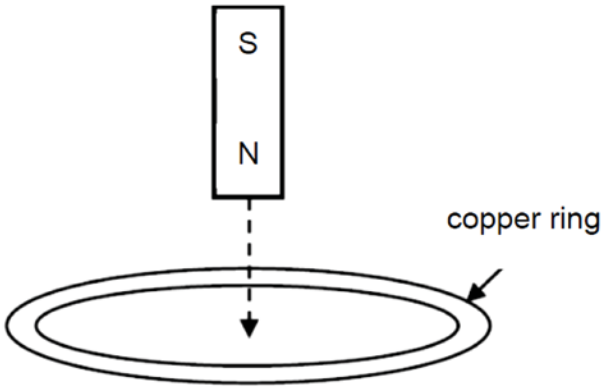
II The coil will rotate in a clockwise direction about the axle.

III The split-ring commutator will reverse the direction of the current every 360°.

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

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37 A magnet is dropped vertically through a copper ring.



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

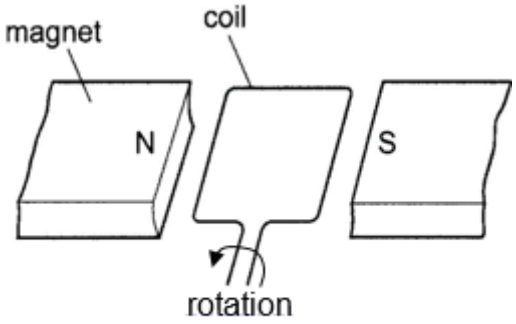
A A current flows in the ring just before the magnet passes through the ring.

B A current flows in the ring just after the magnet passes through the ring.

C The magnet slows down just before it passes through the ring.

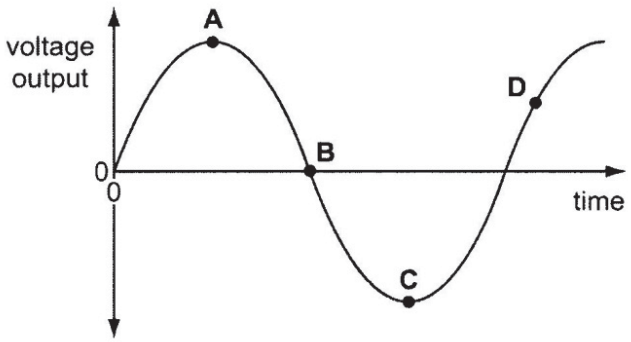
D The magnet accelerates just after it passes through the ring.

38 The diagram shows part of an a.c. generator when its coil is in a horizontal position.



The graph below shows the voltage output plotted against time.

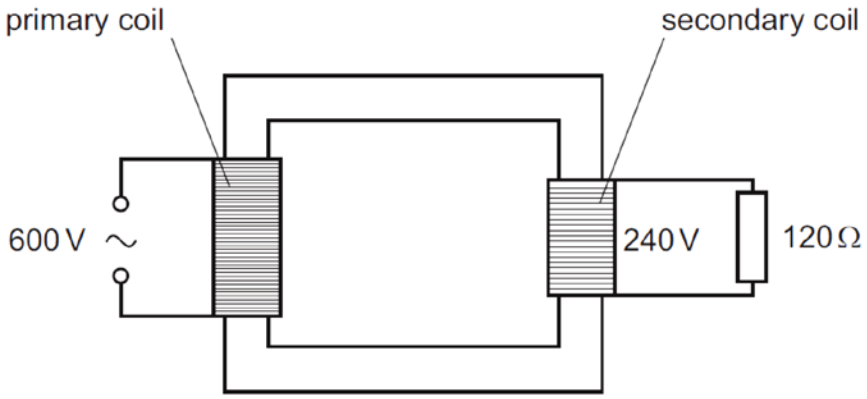
Which point on the graph shows the coil in a vertical position?



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39 An ideal transformer has a primary voltage of 600 V and a secondary voltage of 240 V.

The secondary coil is attached to a resistor of resistance 120 Ω.



What is the power dissipated in the resistor and the current in the primary coil?

	Power / W	Current / A
A	120	0.20
B	120	5.0
C	480	0.80
D	480	1.3

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40 An oscilloscope is used to display the waveforms of 2 alternating current (a.c.) input.

Diagram 1 shows the oscilloscope trace produced by the first input of voltage 2.0 V and frequency 50 Hz.

Diagram 2 shows the trace produced by the second input. The controls on the oscilloscope are set at the same values.

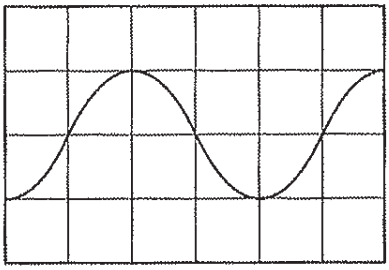


Diagram 1

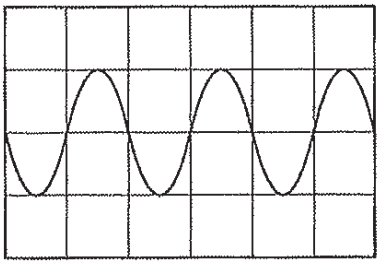


Diagram 2

What is the voltage and frequency of the second input?

	Voltage / V	Frequency / Hz
A	1.0	50
B	2.0	25
C	2.0	100
D	4.0	50

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AHMAD IBRAHIM SECONDARY SCHOOL
GCE O-LEVEL PRELIMINARY EXAMINATION 2018

PHYSICS
PAPER 2

6091/02

Sec 4 Express

Date: 14 August 2018
Duration: 1 h 45 min

Name: ……( ) Class: ……

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Write down your name, class and register number on this page and on any additional writing papers.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer all questions. Question 12 has a choice of parts to answer.

Information for candidates:
Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
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 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 question paper consists of **19** printed pages

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Section A

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

1 A rubber ball is dropped freely from a height of 20 m. The ball hits the ground at time *t* and rebounds vertically upwards with half its maximum velocity. The maximum velocity of the ball just before it hits the ground for the first time is *V*.

(a) In the axes below, sketch the velocity-time graph of the ball from the point of release to the time when it has rebounded to its new maximum height. (Ignore air resistance) [2]



(b) Using information from the graph, determine the velocity of the ball just before it hits the ground for the first time.

velocity = ... [2]

(c) Find the displacement of the ball after it has rebounded to its maximum height.

displacement = ... [2]

(d) State the change in velocity of the ball during its rebound.

change in velocity = ... [1]

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2 Fig. 2.1 shows three cylinders **X**, **Y** and **Z** are supported by three ropes that passes through ring **R**.

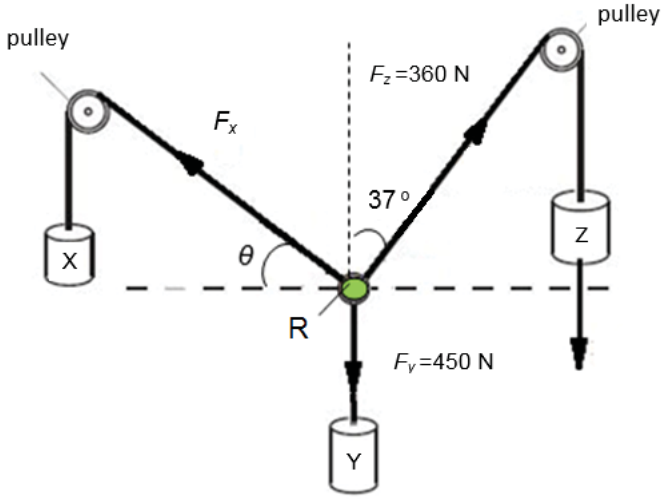


Fig. 2.1

Ring **R** is in equilibrium under the action of three forces F_x, F_y and F_z.

Draw a vector diagram to find F_x and angle θ.

F_x = ...

angle θ = ... [4]

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3 A uniform rod **AB** of length 3 m weighs 10 N. It is suspended by two identical strings at points **X** and **Y** as shown in Fig. 3.1. T_1 and T_2 are the tension in the strings.

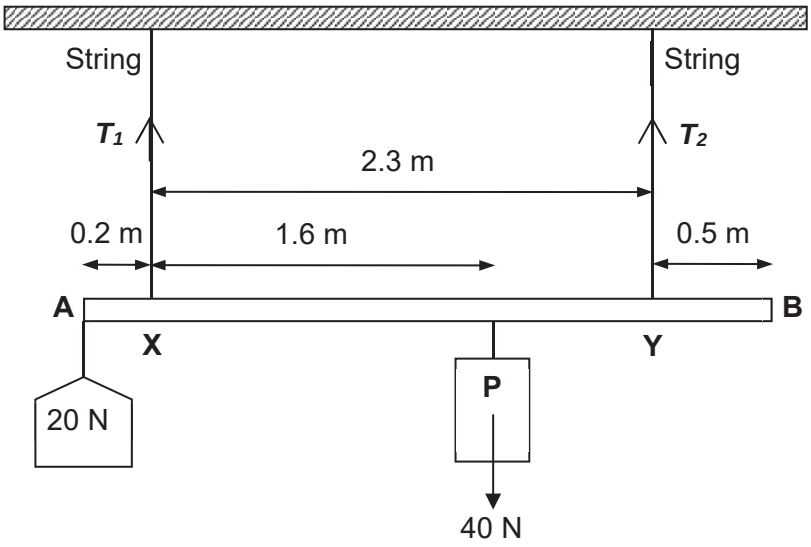


Fig. 3.1

Two weights, 20 N and **P**, are hung from the rod at point **A** and 1.6 m from **X** respectively.

(a) Draw the weight of the rod in Fig. 3.1 and label it **W**. [1]
Indicate clearly its distance from point **A**.

(b) Determine T_2, the tension of the string at **Y**.

T_2 = ... [2]

(c) Hence, or otherwise, determine T_1, the tension of the string at **X**.

T_1 = ... [1]

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4 A small jet plane which can carry six people is shown in Fig. 4.1.

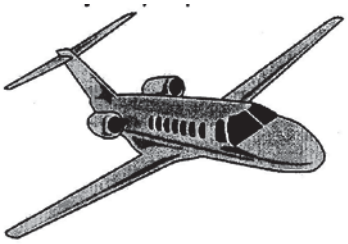


Fig. 4.1

The mass of the fully-loaded jet plane is 2560 kg. It is initially at rest. When the jet plane is taking off, the two jet engines can exert a total thrust force of 8000 N and the friction between the wheels and the ground is 340 N. Both forces remain constant at these values during take-off.

(a) Calculate the acceleration of the plane as it starts to move.

acceleration = ... [2]

(b) Explain what happens to this acceleration as the jet plane speeds up.

.....

.....

..... [2]

(c) The average acceleration during take-off is 2.2 m/s^2.

(i) Calculate the time that the jet plane will take to reach a take-off speed of 55 m/s.

time = ... [1]

(ii) Determine the minimum length of the runway that is required for the jet plane to take off.

minimum length = ... [2]

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(d) Suggest why the wheels of the jet plane are folded into the body of the jet plane after take-off.

……

…… [1]

5 Fig. 5.1 below shows a long vertical glass tube with one end immersed in mercury and the other connected to a vacuum pump at **A**. The tube fits tightly into a bell jar. With an opening at **B** and all air in the glass tube pumped out via **A**, the mercury rises to a maximum height of 76.0 cm above the dish.

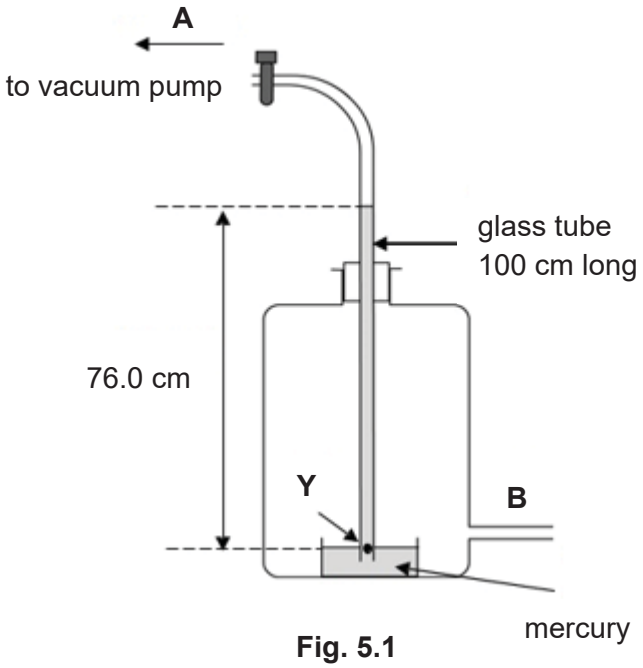


Fig. 5.1

(a) Explain why the mercury only can rise to a maximum height of 76.0 cm.

……

……

…… [2]

(b) If the density of mercury is 13600 kg/m^3, calculate the pressure at **Y** in pascals.

pressure = …… [2]

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(c) A container of air initially at atmospheric pressure is connected to **B** and heated over a flame as shown in Fig. 5.2.

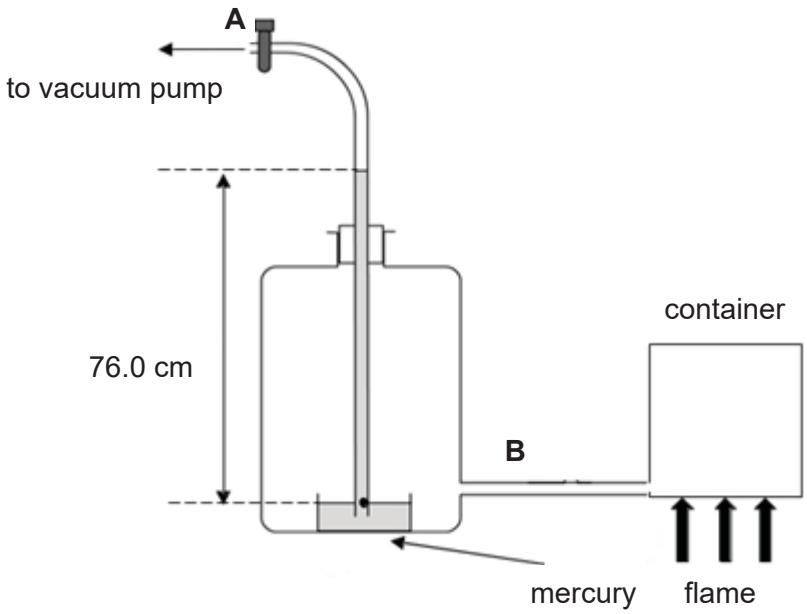


Fig. 5.2

Using kinetic theory of matter, explain whether the height of mercury column rises, falls or remains the same.

……

……

……

…….... [3]

6 John conducts an experiment to determine the specific latent heat of vaporisation of water.

He places an immersion heater fully immersed in water in an open steel container. The voltage across the immersion heater is 240 V and the current which passes through the heating element is 1.6 A. John measures the mass of water after steady boiling is achieved, and again after another 8 minutes. He discovers that the mass of water in the container decreases by 0.075 kg during the 8 minutes.

(a) Calculate the specific latent heat of vaporisation of water.

specific latent heat of vaporisation = ……. [2]

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(b) Is the value calculated in (a) higher than the actual specific latent heat of vaporization of water? Explain why.

……

……

…… [2]

(c) John's friend Ali comments that it is better to use a vacuum flask to contain water rather than a steel container. Explain why this is so.

……

…… [1]

7 A collector views a postage stamp of height 1.5 cm through a lens. The lens is 2.0 cm from the stamp and the ratio of height of image to height of object is 3.0.

(a) In Fig. 7.1, complete the full scale ray diagram to determine the image of the stamp [3]

position of the lens

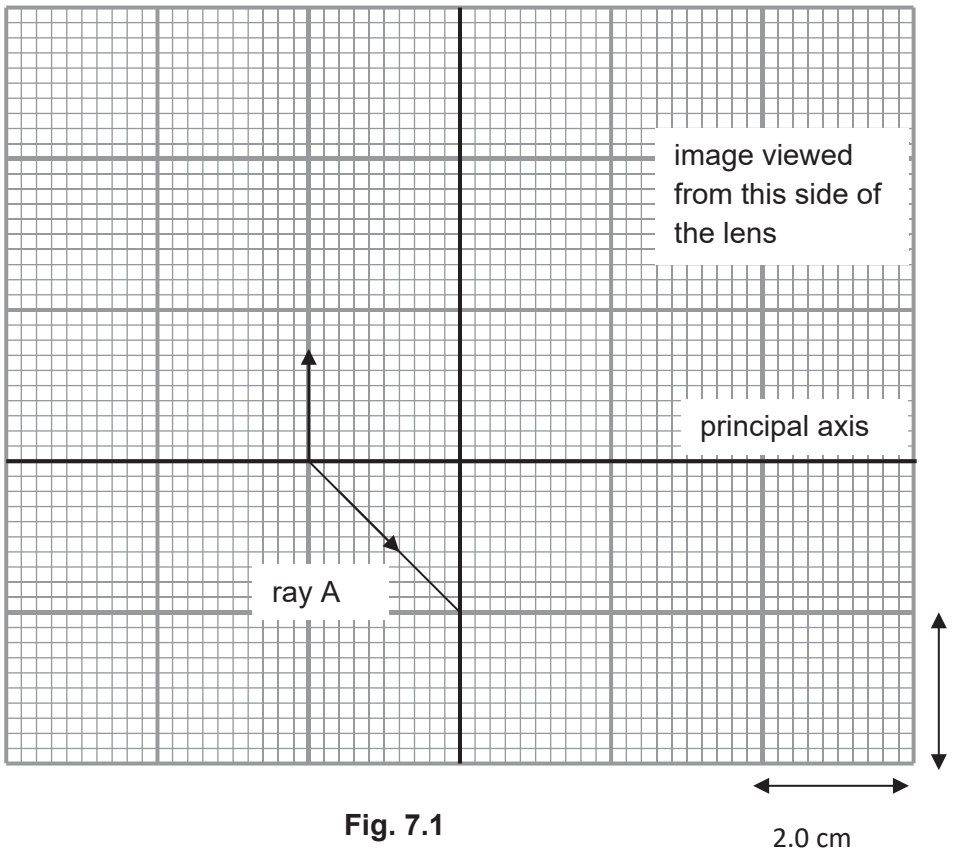


Fig. 7.1

(b) State what is meant by a virtual image.

……

…… [1]

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(c) Use your drawing to determine the focal length of the lens.

focal length = ……. [1]

(d) On Fig. 7.1, complete the path of ray A after passing through the lens. [1]

8 **(a)** An acetate rod held in the hand may be charged positively by rubbing it with a cloth, but a copper rod held in the hand cannot be charged this way.

(i) Explain how the acetate rod acquires positive charges when rub with a cloth.

……

……

…… [2]

(ii) Explain why a copper rod held in a hand cannot acquire charges by rubbing with a cloth.

……

…… [1]

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(b) Fig. 8.1 shows a light positively charged acetate rod hung freely with an insulating thread. An earthed metal sphere is then brought near it.

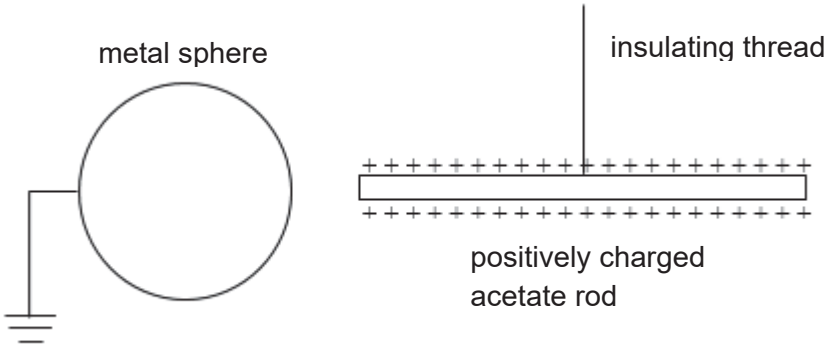


Fig. 8.1

(i) State what happens to the light acetate rod?

……

…… [1]

(ii) Draw the charges on the metal sphere in Fig. 8.1. [1]

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9 Fig. 9.1 shows part of a power transmission system. Electricity from the power station is transmitted to end users via transmission cables.

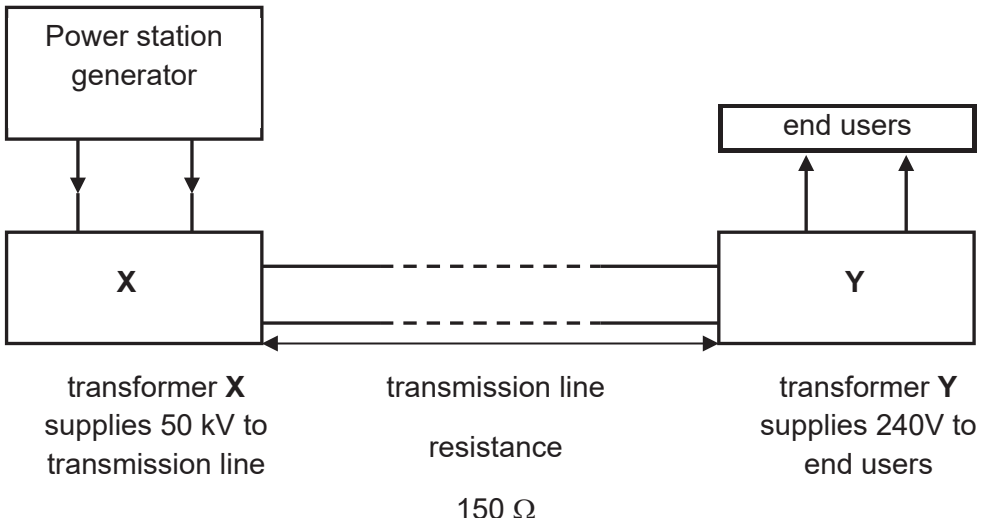


Fig. 9.1

(a) If the power station is transmitting a power of 3.0 kW at 50 kV from transformer **X** to transformer **Y**, calculate the current flowing through the transmission lines.

current = ... [1]

(b) Calculate the power loss in the transmission lines which has 150 Ω resistance.

power loss = ... [1]

(c) With reference to your answers from (a) and (b), explain why the power station does not transmit the same power to the houses at 240 V?

.....

.....

..... [2]

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Section B

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Q12**.

10 Some countries do not have enough supply of water from rain or from rivers. The scientists in these countries are exploring new ways of getting water. In Canada, one scientist suggests making use of icebergs found in the Atlantic Ocean to obtain water. Icebergs, which are made from fresh water, can be towed to a port in the country. Once they arrive, they are allowed to melt either in the sun or by energy from a local power station.

Based on the Table 10.1, you are required to evaluate the feasibility of towing an iceberg to a port in Canada to obtain fresh water.

Distance between the iceberg and the port in Canada	1.2×10^4 km
Average towing speed	0.75 m/s
Effective surface area of iceberg exposed to the sun	4.5×10^5 m^2
Sun's radiation at the Earth's surface	700 W/m^2
Mass of iceberg	1.5×10^{11} kg
Specific latent heat of fusion of ice	3.4×10^5 J/kg
Electrical power output from local power station	550 MW

Table 10.1

(a) Explain what is meant by the statement *ice has a specific latent heat of fusion of 3.4 x 10^5 J/kg.*

……..

…….. [1]

(b) What is the time taken to tow the iceberg to the port in Canada?

time taken = ……. [1]

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(c) Calculate the total amount of solar energy absorbed by the iceberg while it is towed to the port.

solar energy = ……. [2]

(d) **(i)** Estimate the mass of ice melted by the sun as the iceberg is towed to the port.

mass of ice = ……. [2]

(ii) State an assumption that you have made in **(d)(i)**.

……

…… [1]

(e) Once the iceberg reaches the port, it can be melted either in the sun or by energy from a local power station. Which is a faster method to melt the ice? Support your answer with appropriate calculations.

……...

……...

……... [2]

(f) Suggest a possible environmental problem of using this method to obtain fresh water.

…….. [1]

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11 **(a)** Fig. 11.1 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.

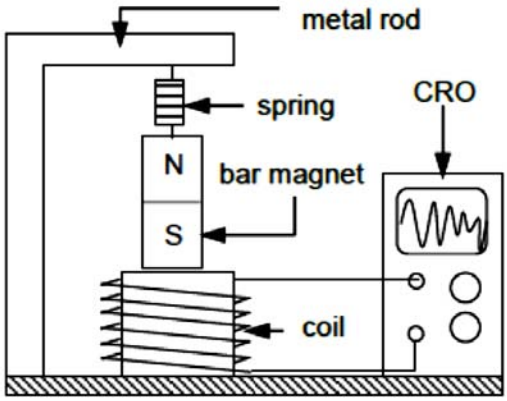


Fig. 11.1

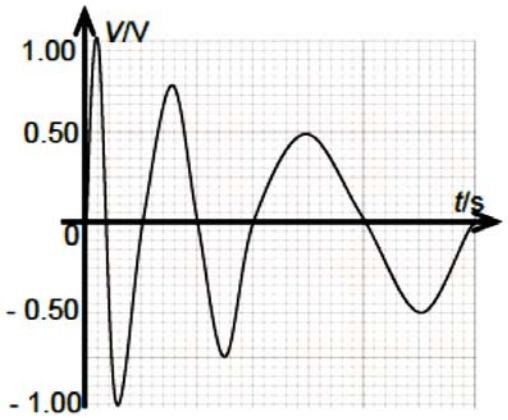


Fig. 11.2

Fig. 11.2 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. 11.2 is obtained when there is an earthquake.

.....

.....

.....

.....

..... [4]

(ii) On Fig. 11.1, indicate the direction of the current in the coil when the south pole of the magnet is moving into the coil. [1]

(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]

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(ii) Calculate the current in the primary coil.

current = ……. [2]

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

……

……

…… [2]

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12 EITHER

A student makes a 2.0 V battery by connecting two cells of electromotive force (e.m.f.) 2.0 V in parallel. The battery, an ammeter with different ranges and three different resistors are used to set up the circuit shown in Fig. 12.1.

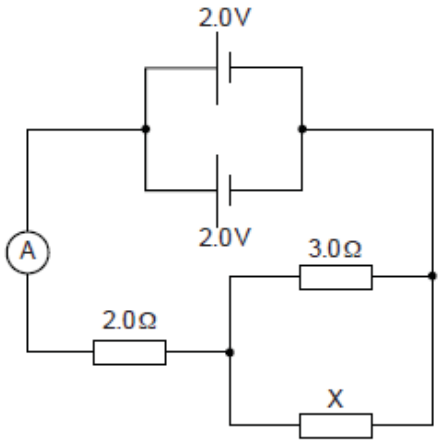


Fig. 12.1

(a) State and explain one advantage of using two cells in parallel rather than using a single 2.0 V cell.

……..

……..

…….. [2]

(b) The total resistance of the circuit is 4.0 Ω.

Calculate the resistance of **X**.

resistance of **X** = …… [2]

(c) **(i)** Determine the reading of the ammeter.

reading = …… [1]

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(ii) Suggest a suitable range for the ammeter.

…… [1]

(d) State the potential difference (p.d.) across the [1]

(i) 2.0 Ω resistor, and

p.d. = ……

(ii) 3.0 Ω resistor.

p.d. = ……

(e) The student sets up a second circuit using a variable d.c. power supply, an ammeter and a 12 V metal filament lamp. The circuit is shown in Fig. 12.2.

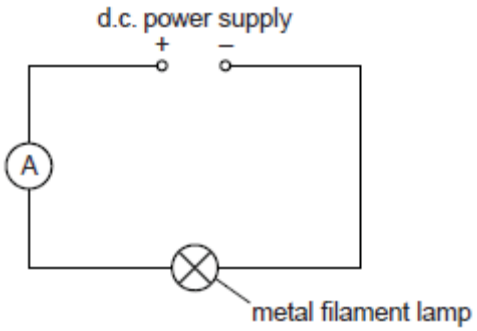


Fig. 12.2

The d.c. power supply is set to 12 V and the ammeter reading is 1.5 A. The student changes the e.m.f. of the d.c. power supply to 6.0 V. The lamp dims and the ammeter reading changes.

(i) State and explain what happens to the resistance of the filament lamp.

……

……

…… [2]

(ii) State whether the new ammeter reading is less than, equal to or greater than 0.75 A.

…… [1]

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12 OR

(a) In a particular light experiment, a ray of light is passed through water into air as shown in Fig. 12.3.

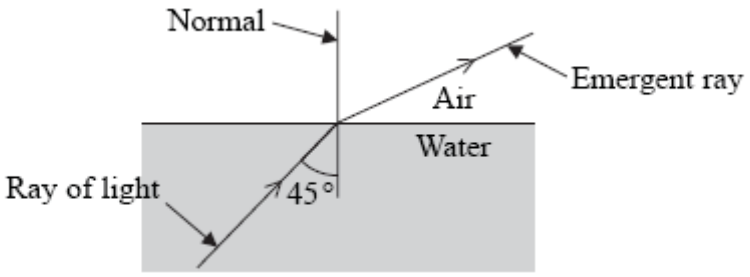


Fig. 12.3

Explain why the ray of light changes its direction when it emerges from water as shown.

……..

……..

…….. [2]

(b) The experiment in (a) is repeated using a semicircular glass block as shown in Fig. 12.4. The refractive index of glass is 1.60.

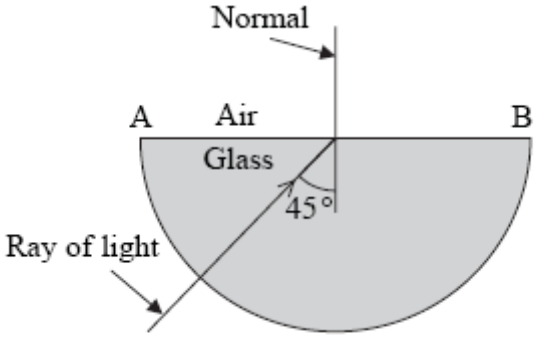


Fig. 12.4

(i) Explain why the ray of light does not change direction when it enters the glass.

……

…… [1]

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(ii) Explain why the ray of light does not emerge from the straight edge **AB** of the glass block. Show relevant working.

……

……

…… [4]

(iii) On Fig. 12.4, draw accurately the complete path for the ray of light until it emerges from the glass block again. [1]

(iv) The speed of light in air is 3.00×10^8 m / s. Calculate the speed of light in the glass block.

speed = …… [2]

END OF PAPER
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Answers to 2018 PRELIM 4E Physics 6091

Paper 1

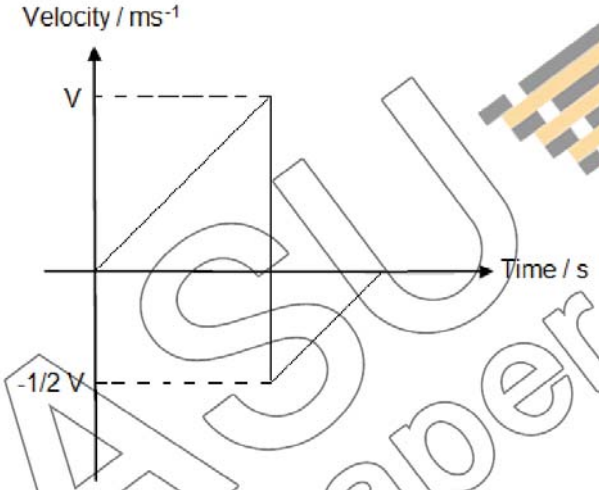
1	B	**11**	D	**21**	D	**31**	C
2	A	**12**	A	**22**	A	**32**	B
3	B	**13**	C	**23**	C	**33**	C
4	C	**14**	A	**24**	D	**34**	A
5	C	**15**	B	**25**	C	**35**	D
6	C	**16**	B	**26**	A	**36**	A
7	C	**17**	D	**27**	C	**37**	D
8	D	**18**	C	**28**	A	**38**	B
9	C	**19**	B	**29**	D	**39**	C
10	A	**20**	C	**30**	B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

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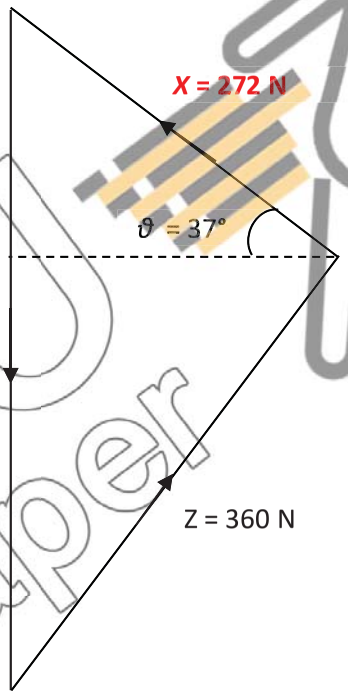
Paper 2

Section A

QN		SOLUTION	MARKER'S REPORT
1	(a)	Correct shape before rebound [1] Correct shape after rebound [1]  	
	(b)	a = (v-u)/t 10 = (v-0)/t t = v/10 ½ x t x v = 20 ½ x (v/10) x v = 20 [1] v^2 = 400 v = 20 m/s [1]	
	(c)	Rebound height = ½ x 1 x 10 = 5m [1]	

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	(d)	Displacement of the ball = 20 – 5 = 15 m [1] Changed in velocity = 20 – (-10) = 30 m/s [1]	
2		θ = 37° [1] (accepts 36° to 38°) X = 272 N [1] (accepts X ranges from 250 to 290 N) All arrows points in the correct directions [1] Scale marks only given to students who give a scale **1:50 +/- 10N** only, provided the forces Y and Z are represented correctly and accurately. Else, no mark even if the scale is correct [1]  	
3	**(a)**	Downward arrow drawn in the middle of the rod. W indicated for weight. Must indicate distance (e.g. 1.5 m from point X) [1]	
	(b)	Taking moments about X, at equilibrium (T_2 x 2.3) + (20 x 0.2) = (10 x 1.3) + (40 x 1.6) [1] [M1: award 1 mark if there are 2 correct calculation of moments] T_2 = 31.739 = 31.7 N [1] (3sf)	

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	(c)	Total Upwards Force = Total Downwards Force T1 = 70 N – 31.7 N =38.3N [1]	
4	**(a)**	F = ma 8000 – 340 = 2560 x a [1] a = 2.99 m/s^2 [1]	
	(b)	Acceleration will decrease till it becomes zero [1] Resultant force will decrease because air resistance has increased [1] Acceleration becomes zero when forward force equal air resistance.	
	(ci)	a = (v – u)/ t 2.2 = (55 – 0)/ t t = 25 s [1]	
	(cii)	Distance = Area under Speed Time Graph Dist = ½ (25)(55) [1] Dist = 688 m [1]	
	(d)	To provide a streamline body In order to reduce air resistance [1]	
5	**(a)**	At B, it is open to the atmosphere. Since atmospheric pressure is 76 cm Hg, the mercury can rise to a maximum height of 76 cm. [1] At A, the tube is connected to a vacuum, this means that there is no gas pressure acting on the top surface of liquid in the tube, therefore the mercury will rise to a maximum of 76 cm Hg. [1]	
	(b)	P = hpg = 0.76 x 13600 x 10 [1] = 1.03 x 10^5 Pa [1]	

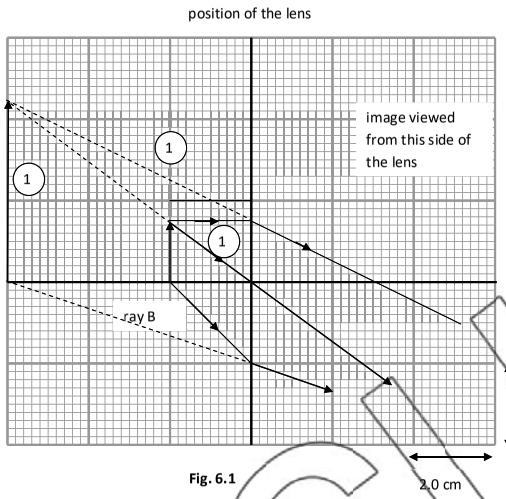
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	(c)	Height <u>increases</u> as pressure on mercury surface increases. [1] When temperature increases, average k.e. of molecules increases. Molecules move faster and hit the mercury surface with <u>greater force</u> and at <u>higher frequency</u>. [1] causing <u>force per unit area</u> or <u>pressure to increase</u>. [1]	
6	**(a)**	$Q = ml_v$ $VIt = ml_v$ $240 \times 1.6 \times 8 \times 60 = 0.075 \times l_v$ [1] $l_v = 2460\ J\ g^{-1}$ or $2,460,000\ J\ kg^{-1}$ [1]	
	(b)	Yes, it is higher. [1] There is **heat lost** to the surroundings by conduction, convection and radiation. The amount of heat received by the water for boiling is thus **smaller** than the calculated value. [1]	
	(c)	The use of vacuum flask reduces heat lost to the surroundings by conduction, convection and radiation. [1]	

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7	**(a)**	 Fig. 6.1	
	(b)	A virtual image is an image that cannot be formed on a screen. [1]	
	(c)	f = 3.0 cm [1]	
	(d)	correct drawing using concept ray from of bottom of object originate from bottom of image [1]	
8	**(ai)**	The **electrons** are transferred from atoms of the acetate rod to the cloth due to friction of rubbing. [1] Acetate rod loses electrons and become positively charged. [1]	
	(aii)	Copper is a **conductor**. The acquired charges by rubbing will be neutralized by the hand. [1]	
	(bi)	The acetate rod is attracted to the sphere. It moves closer to the sphere. [1]	
	(bii)	Negative charges on the right side of sphere [1]	

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9	**(a)**	Current = Power/Voltage = 3000/50000 = 0.06 A [1]	
	(b)	Power loss = 0.06 x 0.06 x 150 = 0.54 W [1]	
	(c)	If the voltage is 240 V, I = 3000/240, will be high. [1] When this current flows through the transmission cable of 150 Ω, the heat generated will be very high. This results in energy loss and monetary loss.[1]	

Section B

QN		SOLUTION	MARKER'S REPORT
10	**(a)**	3.4 x 10^5 J of thermal energy is required to change 1 kg of ice from solid to liquid state (or vice versa) without a change in temperature. [1]	
	(b)	Time required = (1.2 x 10^4 x 1000) / 0.75 = 1.6 x 10^7 s [1]	
	(c)	Effective solar power received = (4.5 x 10^5) x 700 = 3.15 x 10^8 W [1] From P = E / t, E = 3.15 x 10^8 x 1.6 x 10^7 = 5.04 x 10^{15} J [1]	

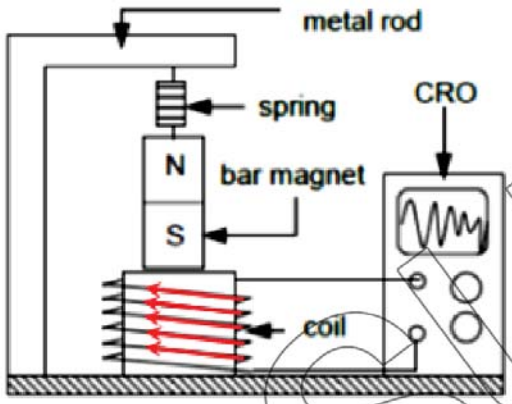
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	(di)	From $Q = ml_f$, $m = (5.04 \times 10^{15}) / 3.4 \times 10^5$ [1] $= 1.48 \times 10^{10}$ kg [1] ecf given	
	(dii)	There is no heat gain by the surrounding / All the energy supplied by the sun is absorbed by the iceberg. [1]	
	(e)	Rate of heating by the sun = $(4.5 \times 10^5) \times 700 = 3.15 \times 10^8$ W Rate of heating by the power station = 550 MW = 5×10^8 W [1] Using energy from the power station is a more efficient way to melt the ice. [1]	
	(f)	The ice that melts during the towing process will contribute to rising sea levels which can cause flooding in low-lying areas./ Loss of habitats [1]	
11	**(ai)**	During an earthquake, the magnet moves in and out of coil, producing a change in magnetic flux linking the coil, thus inducing an emf at the solenoid. By Lenz's Law, the direction of the emf changes when the magnet moves in and out of the coil, [1] 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. [1]	

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	(aii)	 [1]	
	(bi)	Soft iron [1]	
	(bii)	V_s = 50 x 2.0 = 100 V 0.75 x $V_p I_p$ = $V_s I_s$ 0.75 x 2.0 x I_p = 100 x 0.0024 [1] I_p = 0.16 A [1]	
	(biii)	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]	
12E	**(a)**	Any one of: • The cells last longer Reason: Each cell supplies half the current needed. • The circuit continues to work if one cell is flat. Reason: The circuit is still a closed circuit. • A cell can be replaced without switching off. Reason: The circuit is still a closed circuit. [2]	
	(b)	Total R of circuit= R of 2.0 + (Total R of 3.0 & X in parallel) 4.0 = 2.0 + $(1/(3.0) + 1/R_X)^{-1}$ [1] 2.0 = $(1/(3.0) + 1/R_X)^{-1}$ 1/(2.0) = 1/(3.0) + $1/R_x$	

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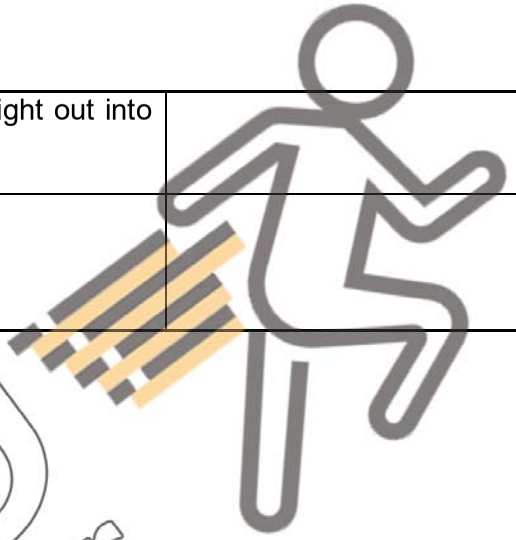
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		$1/R_X = 1/(6.0)$ $R_X = 6.0\ \Omega$ (2 s.f.) [1]	
	(ci)	I = V/R = (2.0)/(4.0) = 0.50 A (2 s.f.) [1]	
	(cii)	0 A to 0.50 A (accept till 5.0 A) [1] e.c.f given	
	d(i) **d(ii)**	p.d.=1.0 V p.d.=1.0 V [1]	
	(ei)	The resistance of the filament lamp decreases. [1] With less voltage across the filament lamp (and hence less current through the lamp), the temperature of the filament lamp decreases. [1]	
	(eii)	The new ammeter reading is less than 0.75 A. [1]	
12O	**(a)**	-Air is optically less dense than water. -Speed of light increases as it gets from water to air -Causing light to bend away from normal 2 marks for all 3 points 1 mark for ½ points	
	(bi)	Angle of incidence is 0^o / incident ray lies along the normal. [1]	
	(bii)	n = 1 / sin c c = $\sin^{-1}$ (1 / 1.60) [1] = 38.7 ^{o} [1] Angle of incidence greater than critical angle AND total internal reflection occurs. [1] Light moving from optically denser medium (glass) to optically less dense medium (air). [1]	

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	(biii)	45 ° at point of incidence AND Reflected ray straight out into air. [1]	
	(c)	n = c / v 1.60 = 3.00 × 10^8 / v [1] v = 1.88 x 10^8 m / s [1]	



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