Class	Register Number	Name

BARTLEY SECONDARY SCHOOL

GCE O-LEVEL PRELIMINARY EXAMINATIONS II

SCIENCE (PHYSICS, ~~CHEMISTRY~~) 5076/01

Sec 4 Express / 5 Normal (Academic)

Paper 1 Multiple Choice

19 Sep 2017

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your class, register number and name on the Answer Sheet in the spaces provided.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the data sheet is printed on page 17.
A copy of the Periodic Table is printed on page 18.
The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, submit the Multiple Choice Answer Sheet.

This document consists of **18** printed pages.

Set by: LHL & YBH

[Turn over

1 The lengths of four different objects were measured.

Which measurement is the **shortest** length?

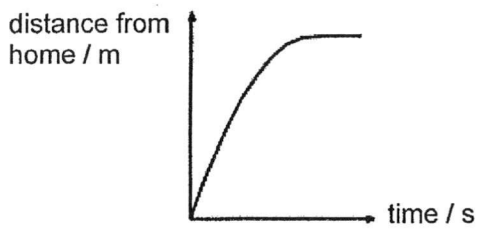
A 3.2 cm **B** 320 μm

C 3.2×10^{-4} km **D** 3.2 m

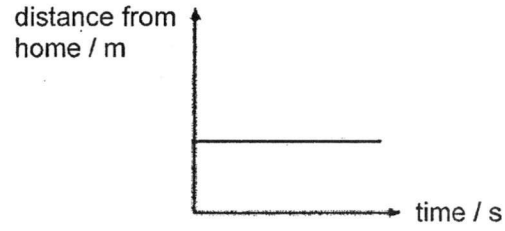
2 Benny is riding his bicycle from home to school. As he is almost late, he is riding with increasing speed.

Which graph correctly shows how his distance from home varies with time?

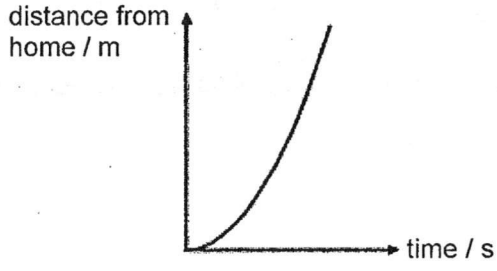
A



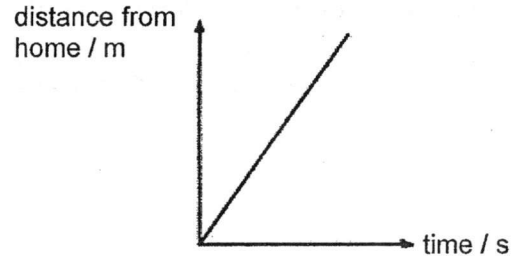
B



C



D



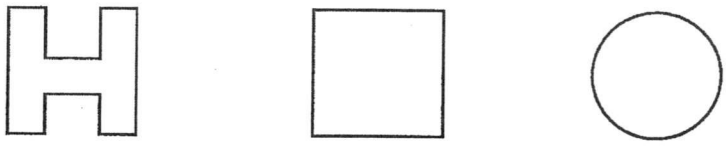
3 When a wooden block of mass 5.0 kg is pulled with a force of 20 N along a rough surface, it moves with a constant velocity of 1.0 m/s.

What is the size of the frictional force on the rough surface?

A 0 N **B** 5.0 N

C 15 N **D** 20 N

4 The following three objects are cut from the same sheet of aluminium.



Which statement is correct?

A All objects have the same density.

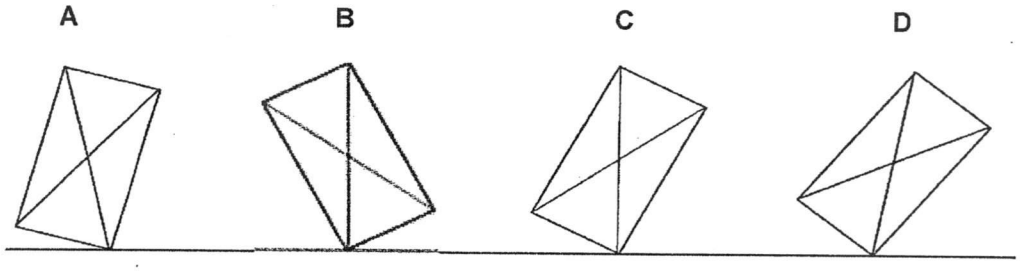
B The circular-shaped object has the greatest density.

C The H-shaped object has the greatest density.

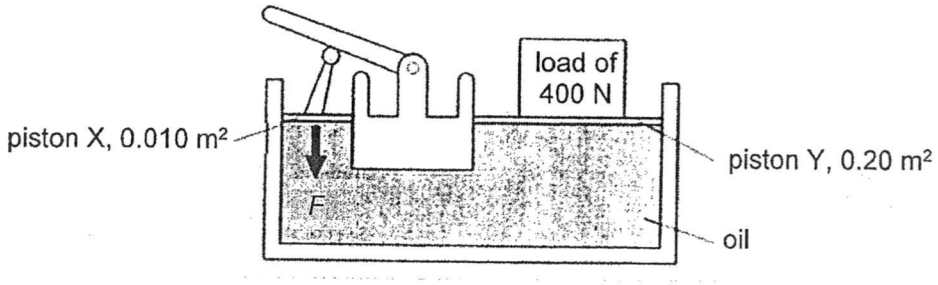
D The square-shaped object has the greatest density.

5 Four identical metal blocks are tilted at different angles as shown below.

Which metal block will topple to the left when released?



6 The hydraulic system shown in the diagram below contains oil. A downward force *F* is applied at piston X to support the load of 400 N placed at piston Y.



Which is the magnitude of force *F*?

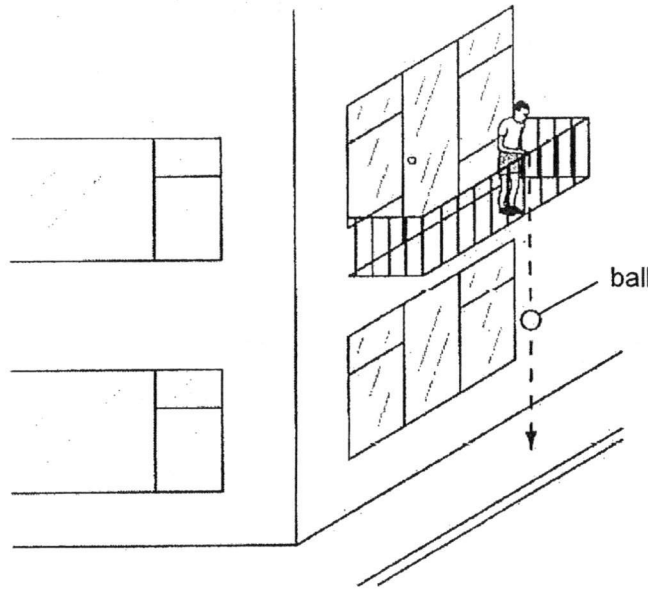
A 0.80 N

B 20 N

C 400 N

D 8 000 N

7 A ball is held over the edge of a balcony. The ball is released and falls to a concrete path below, before bouncing back up.



Which row shows the correct order of the energy transformations?

A chemical energy → elastic energy → kinetic energy → gravitational potential energy

B chemical energy → kinetic energy → gravitational potential energy → kinetic energy

C gravitational potential energy → elastic energy → kinetic energy → chemical energy

D gravitational potential energy → kinetic energy → elastic energy → kinetic energy

8 Which row correctly explains why liquids have fixed volume but not fixed shape?

	intermolecular forces	movement of particles
A	strong	vibrate about their fixed positions
B	strong	slide over each other
C	weak	vibrate about their fixed positions
D	weak	slide over each other

9 Electronic components generate a lot of heat when electrical current passes through them. Heat sinks are often attached to these electronic components to dissipate heat to the surroundings so that the electronic components do not get overheated.

Which material, **A**, **B**, **C** or **D**, is the most suitable material to make a heat sink?

material	characteristics
A	black metal with rough surface
B	black metal with smooth surface
C	silver metal with rough surface
D	silver metal with smooth surface

10 Which statement about evaporation is **not** true?

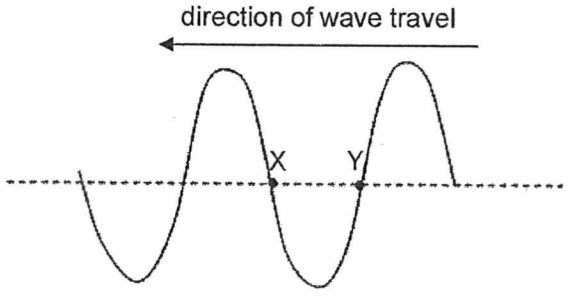
A Evaporation causes the temperature of a liquid to be lower.

B Evaporation occurs only at the surface of a liquid.

C Evaporation takes place only when a liquid has reached certain temperature.

D Evaporation takes place by absorbing energy from the surroundings.

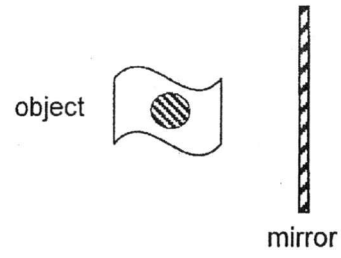
11 A transverse wave travels steadily from right to left as shown below.



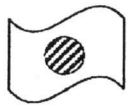
Which row shows the directions of movement of the particles X and Y correctly?

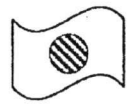
	X	Y
A	downwards	upwards
B	upwards	downwards
C	to the left	to the right
D	to the right	to the left

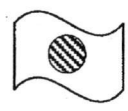
12 An object is placed in front of a plane mirror as shown below.



Which diagram shows the correct mirror image of the object?

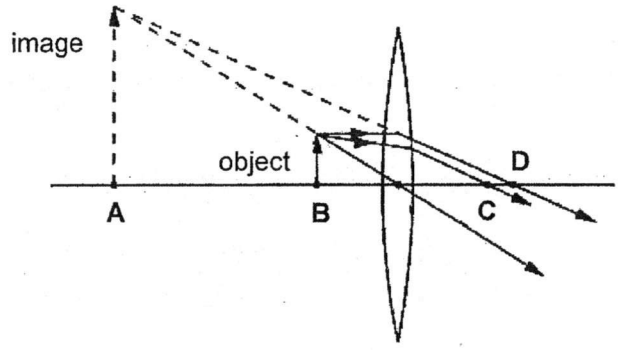
A 

B 

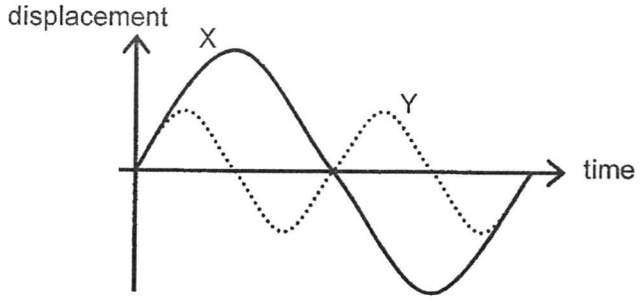
C 

D 

13 In the diagram below, which point is the focal point of the lens?



14 A tuning fork produces two pure notes, X and Y. The displacement-time graph of these two notes are shown below.



Which statement about the two notes is correct?

A X is louder than Y and has a higher pitch than Y.

B X is louder than Y and has a lower pitch than Y.

C Y is louder than X and has a higher pitch than X.

D Y is louder than X and has a lower pitch than X.

15 An insulating rod carries a positive charge after it is rubbed with a woollen cloth.

Which statement correctly describes the transfer of charges?

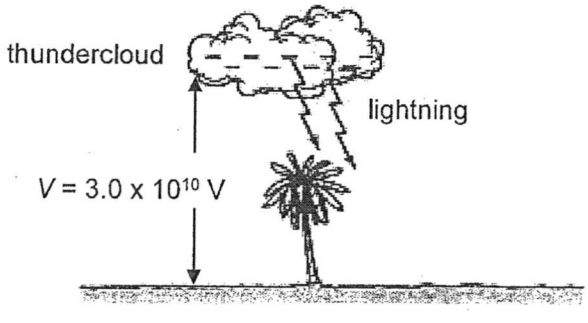
A Positive charges are transferred from the cloth to the rod.

B Positive charges are transferred from the rod to the cloth.

C Electrons are transferred from the rod to the cloth.

D Electrons are transferred from the cloth to the rod.

16 During a thunderstorm, lightning sent an electric charge of 90 C from a thundercloud to the earth as shown in the diagram below. The potential difference, V, between the thundercloud and the earth was 3.0×10^{10} V during the discharge.



How much energy was produced during the lightning?

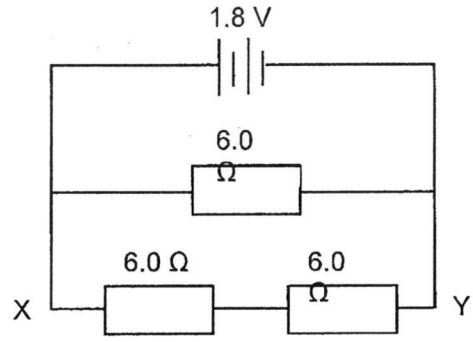
A 3.0×10^{-9} J

B 3.3×10^{8} J

C 2.7×10^{12} J

D 2.4×10^{14} J

17 A 1.8 V power supply is connected to a circuit of three 6.0 Ω resistors.



What is the potential difference across XY?

A 0.60 V **B** 0.90 V

C 1.2 V **D** 1.8 V

18 The cable to an electric fan becomes so worn that the live wire makes electrical contact with the metal case. The case is earthed. The plug to the fan contains a 5.0 A fuse. There is a current of 4.0 A when the fan works normally.

What will happen when the switch to the fan is turned on?

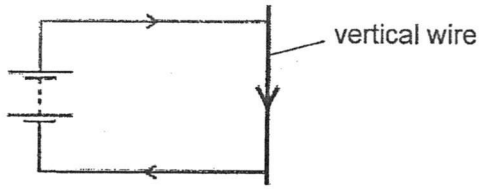
A The current will flow to the earth and electrical energy is wasted.

B The fan will work normally because all safety measures have been taken.

C The fuse will melt and switch off the circuit.

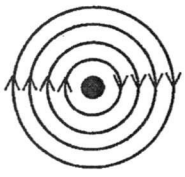
D The metal case will become live and dangerous.

19 A straight vertical wire carries a current flowing down its length.

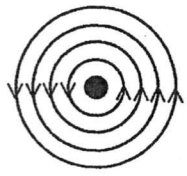


What is the pattern of the magnetic field around the wire, when seen from above?

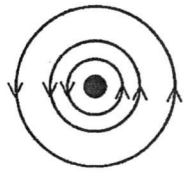
A



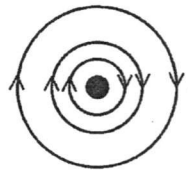
B



C



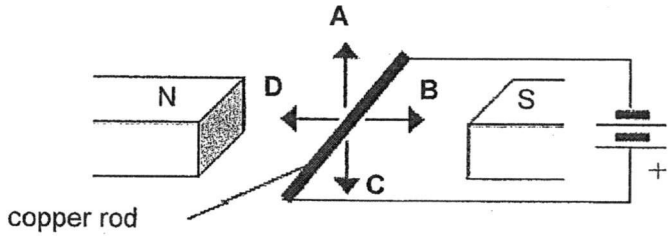
D



20 The diagram shows a copper rod within a magnetic field.

When the switch is closed, a current flows through the rod.

In which direction will the rod experience a force?



Class	Register Number	Name

BARTLEY SECONDARY SCHOOL

GCE O-LEVEL PRELIMINARY EXAMINATIONS II

SCIENCE (PHYSICS, ~~CHEMISTRY~~) 5076/02

Sec 4 Express / 5 Normal (Academic)

Paper 2 Physics

15 Sep 2017

1 hour 15 minutes

Candidates answer on the Question Paper.
No additional materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

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

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

At the end of the examination, submit this question paper.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

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

Set by: LHL

[Turn over

Section A

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

1 A pair of vernier calipers is used to measure the thickness of a book. Only one reading is taken. Fig. 1.1 shows part of the scales of the vernier calipers.

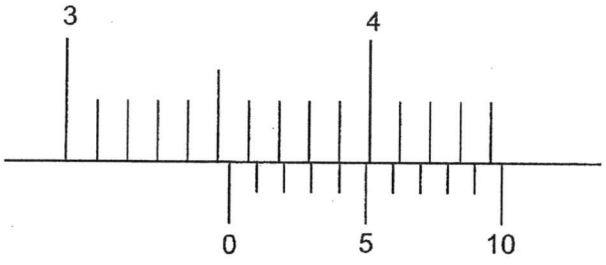


Fig. 1.1

(a) State the reading of the vernier calipers.

reading = ...[1]

(b) Describe briefly how you could obtain a more accurate measurement of the thickness of the book.

.....

.....

.....

.....[2]

(c) Explain why the micrometer screw gauge is not a suitable instrument to measure the thickness of the book.

.....

.....[1]

2 Pail A is filled with sand and is hung on a long string close to the surface of the Earth. An identical pail B is filled with the same mass of sand and hung in the same way, with the same length of string, close to the surface of the Moon.

To start each pail moving, both pails are given a sideways push with forces F_E and F_M as shown in Fig. 2.1.

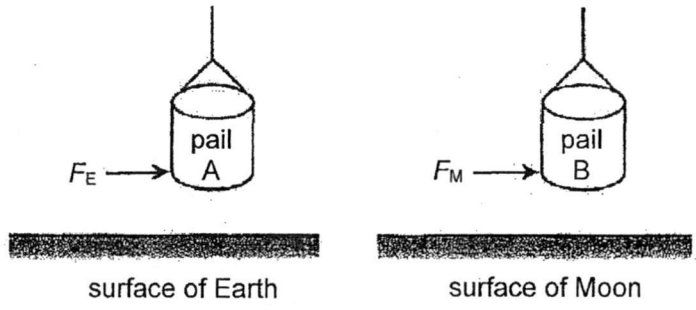


Fig. 2.1

(a) State which pail moves more easily when pushed.

.....[1]

(b) Hence, explain whether there will be any difference in the magnitudes of F_E and F_M.

.....

.....

.....

.....[2]

3 Fig. 3.1 shows a typical barrier found in a carpark. It consists of a 600 N counterweight attached to an arm of weight 200 N. Both are pivoted at P and are held in the horizontal position by a rope tied to the ground.

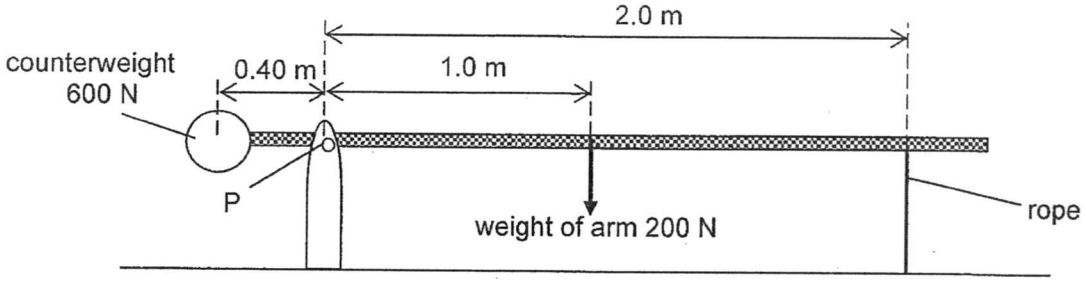


Fig. 3.1

(a) Define *centre of gravity*.

.....

.....[1]

(b) The centre of gravity of the arm is 1.0 m from P and the rope is 2.0 m from P.

When the arm is horizontal as shown above, calculate

(i) the moment of the counterweight about P,

moment = ...[1]

(ii) the tension in the rope.

tension =.....[2]

(c) Suggest one way to reduce the tension in the rope while keeping the arm horizontal.

.....

.....[1]

4 A lorry of mass 4.4×10^4 kg travels along a straight, horizontal road at 20 m/s.

(a) Calculate the kinetic energy of the lorry.

kinetic energy = ... [2]

(b) The lorry driver sees an obstruction ahead and applies the brakes. The lorry slows down and comes to a stop. The lorry stops at a distance of 40 m from where the driver first applies the brakes. This distance is known as the braking distance, *d*.

As the lorry slows down, work is done by the braking force, F_b, exerted on the lorry.

(i) State the formula that relates work done to the average braking force.

.....[1]

(ii) Calculate the average braking force exerted on the lorry.

average braking force = ...[2]

(c) The lorry has a total of 6 wheels. The contact area of each wheel with the ground is 355 cm^2.

Calculate the pressure exerted by the lorry on the ground, leaving your answer in Pa. The gravitational field strength is 10 N/kg.

pressure = ...[2]

5 Fig. 5.1 shows sea waves approaching a beach at a speed of 1.5 m/s. Two complete waves hit the sand every 10 s.

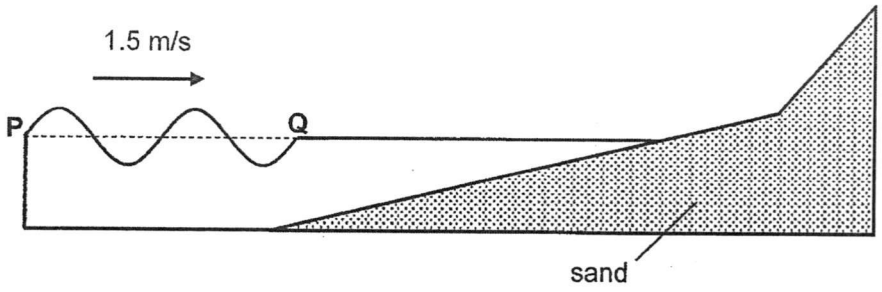


Fig. 5.1

(a) Determine the frequency of the wave.

frequency = ...[1]

(b) Calculate the wavelength of the wave between P and Q.

wavelength = ...[2]

(c) Determine the distance between P and Q.

distance = ...[1]

6 A lens has a focal length of 3.0 cm. The image of an object is found to be at the location as shown in Fig. 6.1. The focal points of the lens are marked "*F*".

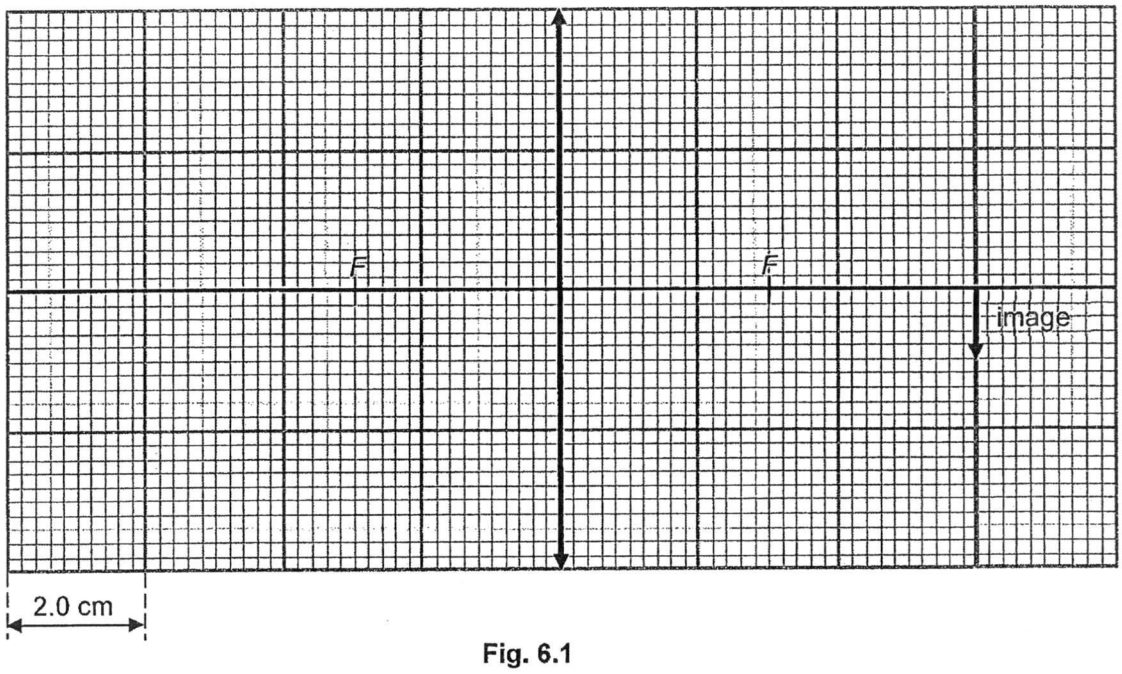


Fig. 6.1

(a) On Fig. 6.1, draw two rays to locate the object. Label the object "*O*". [3]

(b) State the characteristics of the new image formed when the object is shifted to a distance of 2.8 cm from the lens.

.....[1]

7 Fig. 7.1 shows a battery, with an electromotive force of 6.0 V, connected to three resistors.

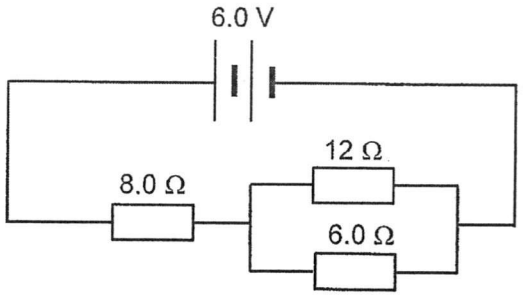


Fig. 7.1

(a) Calculate the effective resistance of the 12 Ω and 6.0 Ω resistors.

effective resistance = ...[2]

(b) Calculate the effective resistance of the circuit.

effective resistance = ...[1]

(c) Calculate the current that flows in the 8.0 Ω resistor.

current = ...[2]

(d) Determine the amount of charge that passes through the 8.0 Ω resistor in 5.0 minutes.

charge = ...[2]

(e) A light bulb of resistance 4.0 Ω is now added in parallel to the 6.0 Ω resistor. Explain what happens to the current that flows through the battery.

.....

.....

.....

.....[2]

8 A spotlight in a television studio is operating at its full brightness. The lamp inside the spotlight is powered by a 240 V supply and the power of the spotlight is 6.0 kW.

(a) Fuses of ratings 10 A, 27 A and 42 A are available. State what fuse rating should be used with the spotlight. Show the calculations that helped you arrive at this fuse rating.

fuse rating = ...[2]

(b) The cost of using one kilowatt-hour (kWh) of electricity is 24 cents. Calculate the weekly cost of using the spotlight for 30 minutes each day.

cost = ...[2]

9 A simple electromagnet is shown in Fig. 9.1.

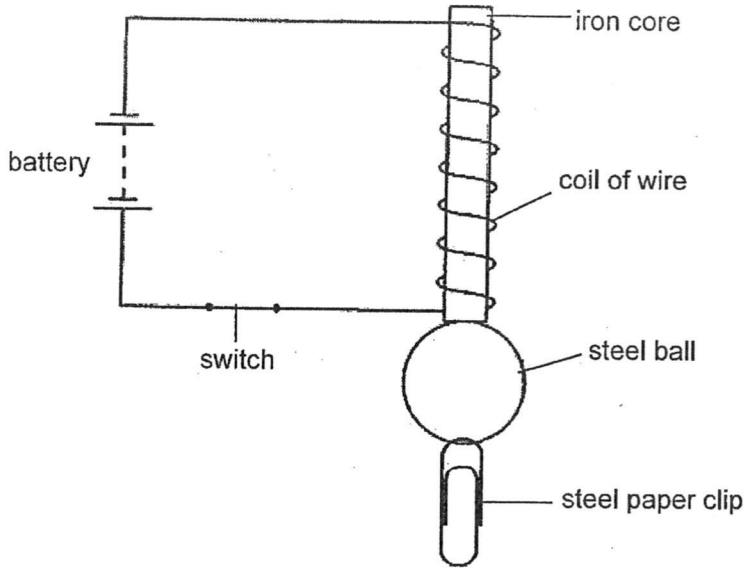


Fig. 9.1

(a) When the switch is closed, a steel ball is attracted to the iron core. The steel paper clip is attracted to the steel ball.

(i) State the magnetic pole that is formed at the end of the iron core closest to the steel ball.

.....[1]

(ii) Explain why there is an attractive force between the steel ball and the paper clip.

.....

.....

.....

.....

.....[2]

(b) The switch is now open. Explain why the steel ball and the paper clip remain attracted to the iron core before they eventually fall off.

.....

.....

.....[2]

Section B

Answer any **two** questions in this section. Write your answers in the spaces provided.

10 A man pushes a bobsleigh with some occupants along an ice track at a constant speed of 5.0 ms^{-1} for 30 s. The forces acting on the bobsleigh are shown in Fig. 10.1. The frictional force is constant throughout the entire ice track. When the man stops pushing, the bobsleigh decelerates uniformly and comes to a rest after 20 s.

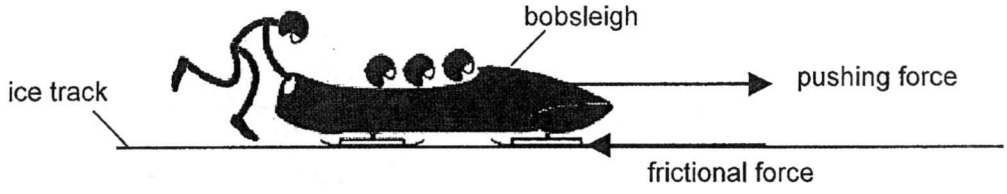


Fig. 10.1

(a) Explain, in terms of forces, why the bobsleigh is travelling at a constant speed initially.

.....

.....

.....

.....[2]

(b) Explain why the bobsleigh comes to a stop after some time.

.....

.....

.....

.....[2]

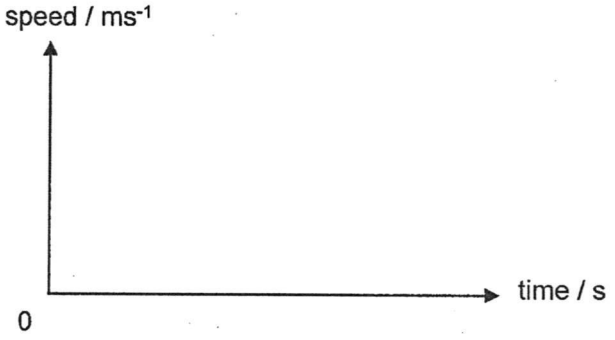
(c) Calculate the deceleration of the bobsleigh.

deceleration = ...[2]

(d) Hence, calculate the magnitude of the frictional force. The total mass of the bobsleigh and its occupants is 250 kg.

frictional force = ...[2]

(e) On the axes below, sketch the speed-time graph of the bobsleigh for the entire 50 s period.



[2]

11 (a) Fig. 11.1 shows a frozen pack placed in a box. The box is then used to keep frozen food cold.

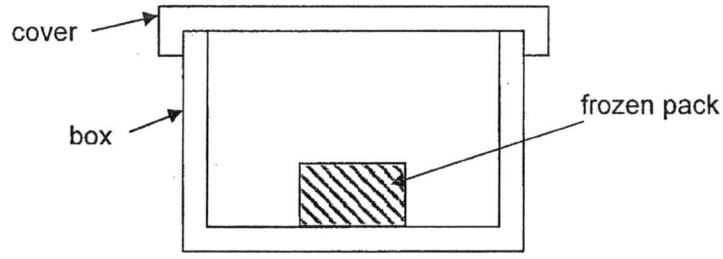


Fig. 11.1

(i) It is discovered that some of the food that is placed near the cover is **not** kept cold. Explain why it is ineffective to place the frozen pack at the bottom.

.....

.....

.....

.....

.....

.....

.....[3]

(ii) The frozen pack, which is sticky on the outer surface, can be placed at any position in the box.

Suggest a better position to place the frozen pack in order to keep the food cold.

.....[1]

(iii) Would you use plastic or metal as the walls of the box? Explain your answer.

.....

.....

.....

.....

.....[3]

(b) Fig. 11.2 shows a puddle of water on the road after it has rained.

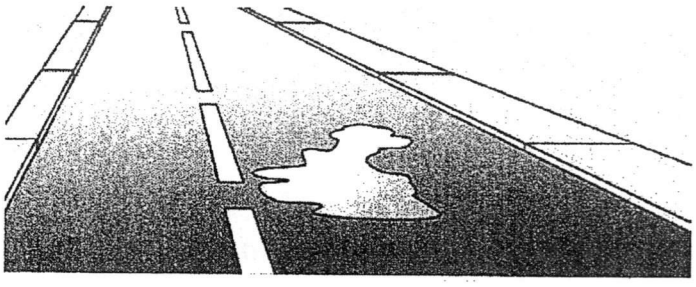


Fig. 11.2

(i) State the process that causes the water to dry up after some time.

.....[1]

(ii) Describe **two** changes in weather which would cause the puddle of water to dry up faster.

.....

.....[2]

12 (a) A student goes for a walk along Bukit Timah hill. During a storm, she sees lightning above the top of the hill. Several seconds later, she hears the thunder caused by the lightning.

(i) Explain why she hears the thunder several seconds after she sees the lightning.

.....

.....[1]

(ii) Explain how sound is transmitted through air.

.....

.....

.....

.....

.....[2]

(b) During a major sports event, live coverage can be viewed from any part of the world through the communication between transmitting and receiving stations on Earth and the satellites in space, as shown in Fig. 12.1.

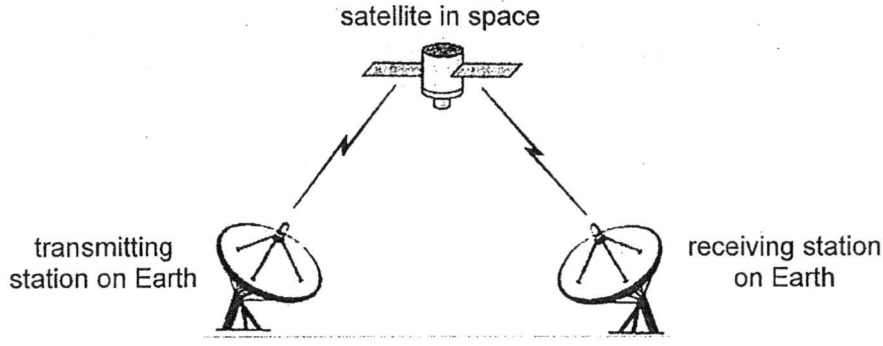


Fig. 12.1

(i) Name the electromagnetic wave used in this type of communication.

.....[1]

(ii) The electromagnetic wave in **(i)** has a wavelength of 2.0 cm. Calculate the frequency of the electromagnetic wave.

frequency = ... [2]

(c) A student performs an experiment with a semi-circular glass block and a ray of white light. Fig. 12.2 shows the path taken by this ray of light as it enters the glass at R till it hits point S.

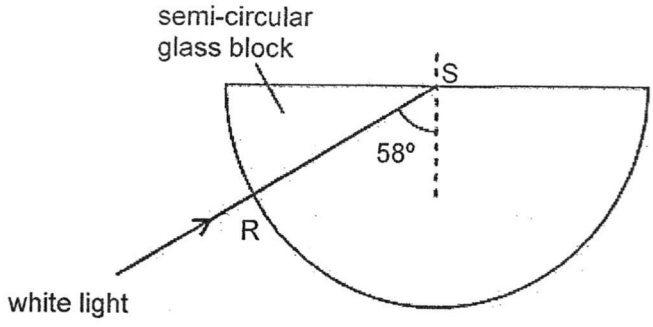


Fig. 12.2

(i) Explain why the ray does not change direction when it enters the glass block at R.

.....

.....[1]

(ii) Given that the refractive index of the glass block is 1.5, determine the critical angle for light in this glass.

critical angle = ...[2]

(iii) On Fig. 12.2, draw the path of the light ray after it hits point S and indicate the value of the angle that it makes with the normal at S. [1]

For Examiner's Use

1 In this experiment you will investigate how the speed of a water wave changes as the depth of the water is altered. To do this, you will use the apparatus as shown in Fig. 1.1.

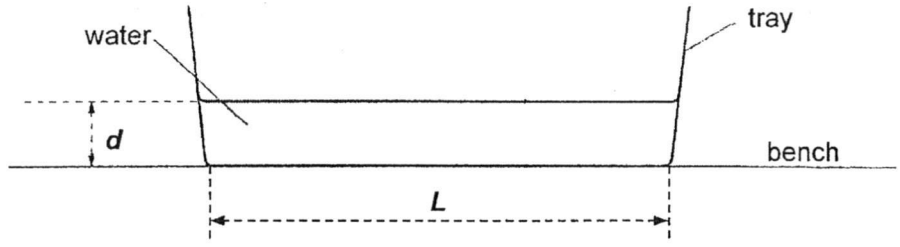


Fig. 1.1

(a) Measure the length of the tray, ***L***, and record this value in mm.

length of the tray, ***L*** = ...mm [1]

(b) Practice

With the tray flat on the bench, carefully pour water into it so that the depth, ***d***, is 10 mm. Use the marked stick provided to help you measure this depth.

Raise one side of the tray, **A**, by about 15 to 20 mm, as shown in Fig. 1.2, and then let it drop back to the bench.

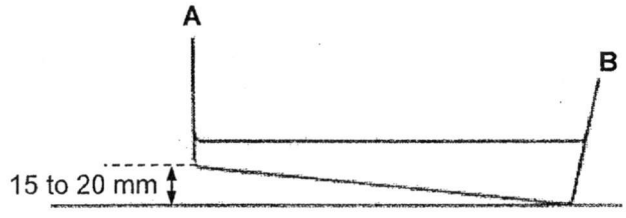


Fig. 1.2

You should see a wave move forwards and backwards across the surface of the water several times, as shown in Fig. 1.3.

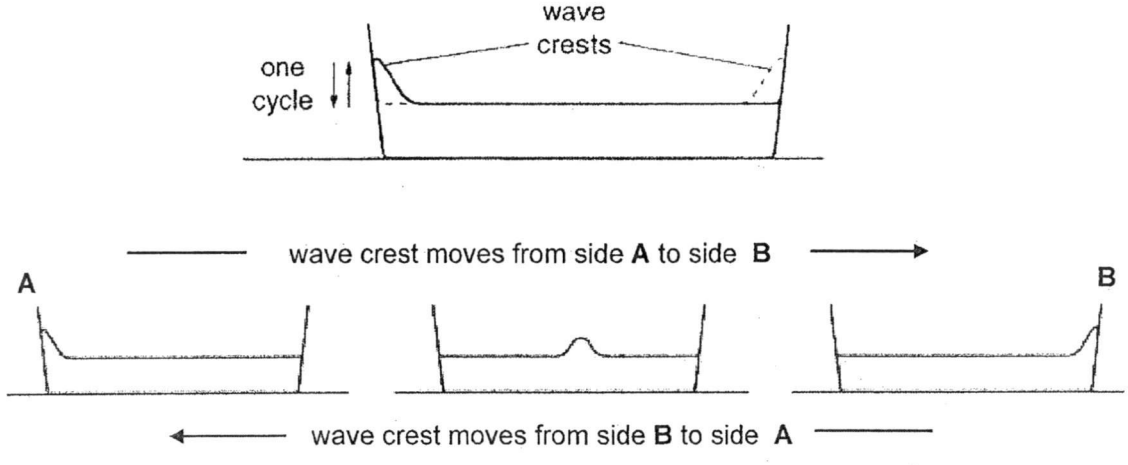


Fig. 1.3

For Examiner's Use

You will need to measure the time it takes for a wave crest to make three cycles. One cycle consists of a wave crest travelling from side **A** of the tray across to side **B** and back again to side **A**.

You should start timing when side **A** of the tray drops, and stop timing when the wave crest returns to side **A** of the tray for the **third time**.

You may find it easier to view the wave crest from the side as shown in Fig. 1.3.
Repeat this process several times until you are confident that you know what to do.

Only then should you start to record your measurements.

(c) (i) Experiment 1

1. Using the procedure you practised in **part (b)**, for a depth of 10 mm, measure the time taken for a wave crest to complete **three** cycles.

2. Record this time, t_1, to the nearest 0.01 s, in Table 1.1.

3. Repeat this procedure two more times. Record these times, t_2 and t_3, to the nearest 0.01 s, in Table 1.1.

(ii) Experiments 2 to 5

With the tray flat on the bench, pour more water into it until the depth is 20 mm. Use the marked stick provided to help you measure the depth.

Repeat the procedure described in **part (c)(i)**, recording all of the times, t_1, t_2 and t_3, to the nearest 0.01 s, in Table 1.1.

Repeat the experiment using water depths of 30 mm, 40 mm and 50 mm. Each time, use the marked stick provided to help you measure the depth.

For each depth, record t_1, t_2 and t_3, to the nearest 0.01s, in Table 1.1.

For Examiner's Use

(iii) Complete Table 1.1 for each set of data by calculating the

- average time, t_a , giving your answers to the nearest 0.01 s
- average speed of the wave, c, using the formula below, where L is the length measured in **part (a)**, giving your answers to the nearest mm / s

$$c = \frac{6L}{t_a}$$

- square root of the depth, $\sqrt{d}$, for each depth, giving your answers to **two** decimal places.

Table 1.1

depth, d / mm	first time t_1 / s	second time, t_2 / s	third time t_3 / s	average time, t_a / s	speed c in mm /s	$\sqrt{d}$ in $\sqrt{\text{mm}}$
10						
20						
30						
40						
50						

[4]

(d) On Fig. 1.4, plot a graph of the average speed, c, against the square root of the depth, $\sqrt{d}$.

Draw the best-fit straight line taking into account all your plotted points. [4]

(e) Determine the gradient of the line, showing clearly on your graph how you did this.

gradient = ...[2]

(f) Use your graph to determine the average speed of a wave when the depth of the water, d, is 35mm.

Show clearly how you obtained your answer.

average speed when d is 35 mm = ...mm/s [1]

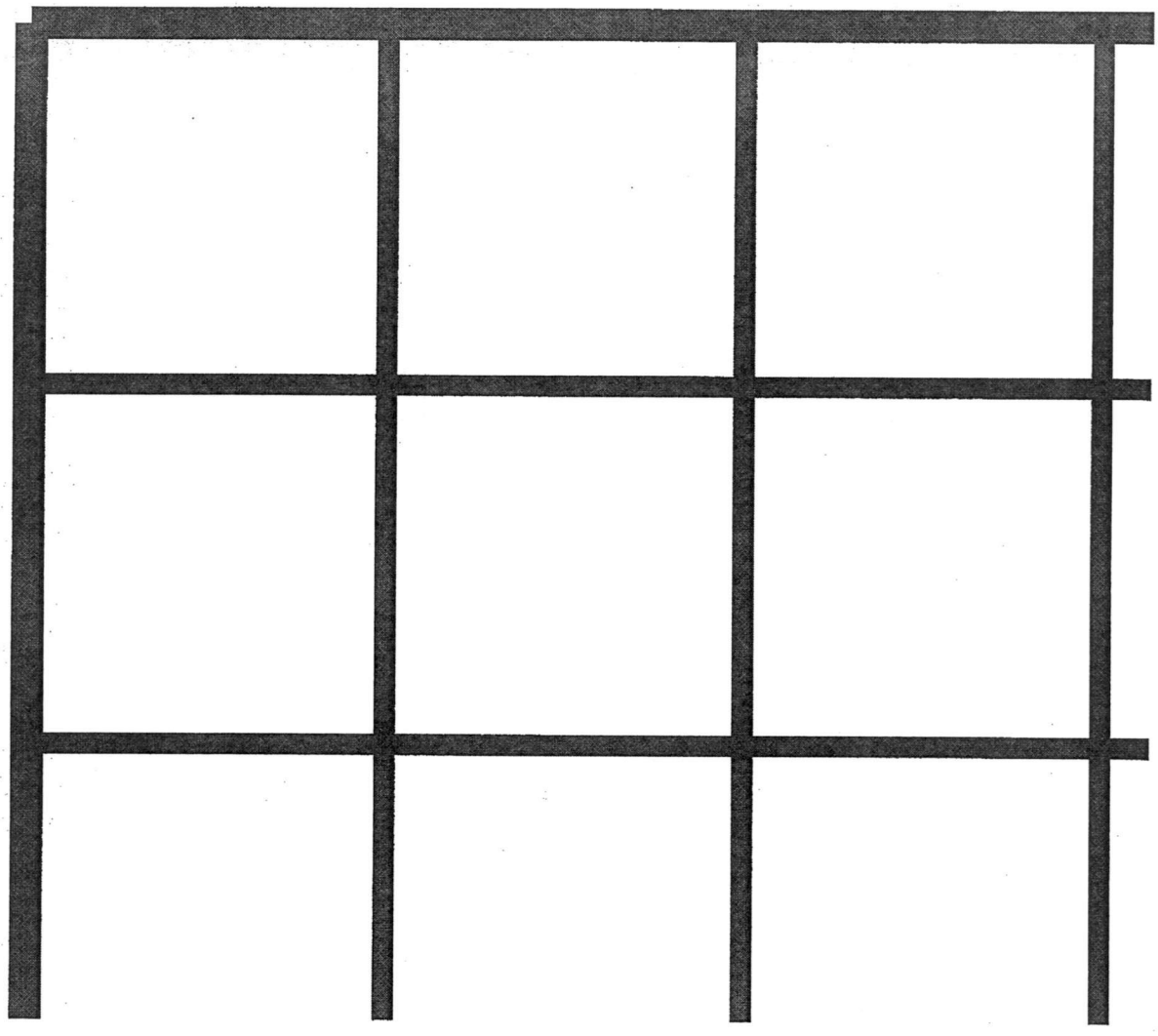


Fig. 1.4

(g) There are various reasons why your calculated values for ***c*** are likely to be inaccurate.

(i) No matter how precisely it is measured, length ***L*** is likely to cause the values obtained for the speed, ***c***, to be inaccurate.

Look at Fig. 1.1. Suggest one reason why the use of length ***L*** may lead to errors in ***c***.

.....

.....

.....[1]

(ii) Will this error cause the values calculated for **c** to be too high or too low? Explain your answer.

For Examiner's Use

.....

.....

..... [1]

(iii) Suggest and explain **one** other source of error which is likely to affect the accuracy of ***c***.

.....

.....

..... [1]

4E5N Sci(Phy) Prelim 2 Exam 2017 Marking Scheme

Paper 1

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	C	D	A	A	B	D	B	A	C
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
A	A	D	B	C	C	D	C	D	C

Paper 2
Section A (Structured Qns) (45 marks)

1 (a) 3.54 cm — A1

(b) Take several measurements at different points of the book and — B1
then calculate the average reading. — B1

(c) The thickness of the book exceeds the range of the micrometer screw gauge. — B1
OR the micrometer screw gauge can only measure lengths up to 2.5 cm.

2 (a) Both pails move just as easily (or Both pails move equally easily). — B1

(b) Both pails have the same mass and same inertia. — B1
Hence both F_E and F_M have the same magnitude. — B1
Or both pail needs the same amount of force to start moving.

3 (a) The point where the whole weight of the object seems to act. — B1

(b)(i) Moment = 600 x 0.4 = 240 Nm — A1

(ii) Taking moments about P,
sum of anti-clockwise moment = sum of clockwise moment
240 = 200 x 1.0 + T x 2.0 — C1
T = 20 N — A1

(c) **Any one of the following answers.** — B1
- Use a lighter counterweight
- Move counterweight closer to pivot
- Use a heavier arm
- Place the rope further away from P.

4 (a) KE = $\frac{1}{2}mv^2$
= $\frac{1}{2} \times 4.4 \times 10^4 \times 20^2$ — C1
= 8.8 MJ — A1

(b)(i) work done = average braking force x braking distance — B1
Or work done = $F_b \times d$

(ii) average braking force x 40 = 8.8×10^6 Allow ECF from (a) — C1
average braking force = 220 kN — A1

(c) $P = \frac{F}{A}$

$= \frac{4.4 \times 10^4 \times 10}{6 \times 355 \times 10^{-4}}$ C1

$= 2.07 \times 10^6$ Pa Award 1 mark if students did every correct calculation and left answer in N/cm^2 A1

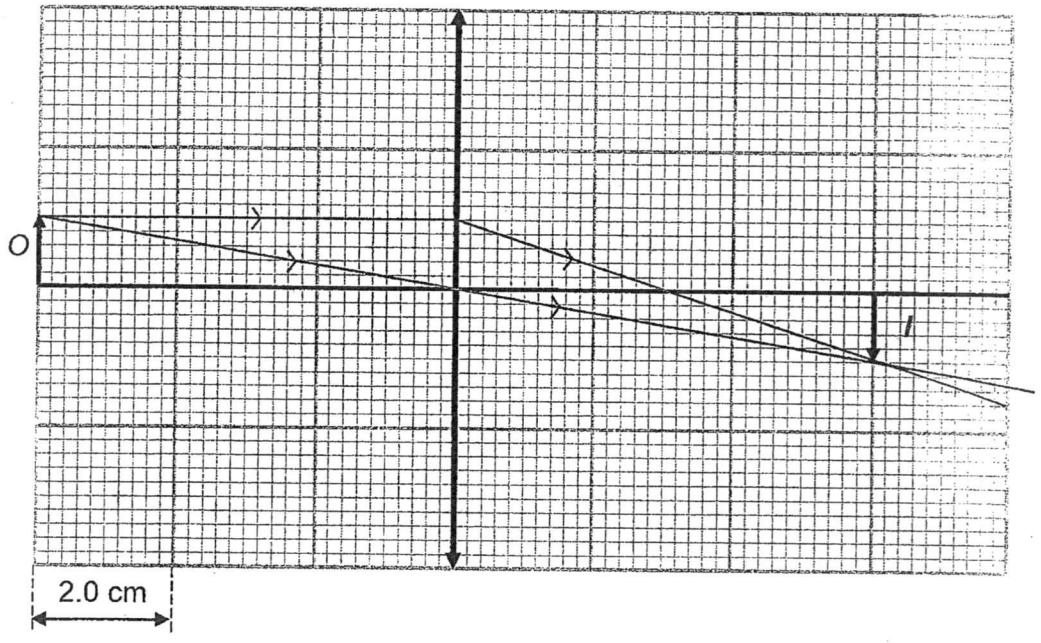
5 (a) Frequency = 2/10 = 0.20 Hz A1

(b) $\lambda = \frac{v}{f} = 1.5/0.2$ Allow ECF from (a) C1

$= 7.5$ m A1

(c) d = 2 x 7.5 = 15 m Allow ECF from (b) A1

6(a)



Award 1 m for each ray drawn correctly. Do not penalize if arrows not drawn. B2
However deduct 1 mark for arrows drawn in wrong direction.

Award 1 m for object drawn and labelled correctly. B1
Deduct 1 mark if object is not drawn or not labelled.

(b) Virtual, upright and magnified B1

7(a) $R_{eff} = (\frac{1}{12} + \frac{1}{6.0})^{-1}$ C1

$= 4.0\ \Omega$ A1

(b) effective resistance of circuit = 8.0 + 4.0 = 12 Ω Allow ECF from (a) A1

(c) $I = \frac{V}{R} = \frac{6.0}{12}$ Allow ECF from (b) C1

$= 0.50$ A A1

(d) $Q = It$

$= 0.50 \times 5.0 \times 60$ Allow ECF from **(c)** C1

$= 150$ C A1

(e) Current passing through the battery is larger B1

As the total resistance of the circuit has decreased B1

8(a) $I = \frac{P}{V} = \frac{6000}{240}$ C1

$= 25$ A

Appropriate fuse rating = 27 A A1

(b) Total energy used = $6.0 \times 0.5 \times 7$ = 21 kWh C1

Cost = $21 \times \$0.24$ = \$5.04 A1

Award 1 mark if student did every correct calculation but left answer as daily cost

9(a) (i) North pole B1

(ii) The iron core is magnetized and causes both the steel ball and paper clips to become induced magnets. B1

The bottom of the steel ball and the top of the paper clip have unlike poles and unlike poles attract. B1

(b) Steel is a hard magnetic material [B1] that retains magnetism for a long time [B1]

Section B

10(a) The pushing force is equal to the frictional force, B1

Hence the resultant force acting on the bobsleigh is zero. B1

(b) When the pushing force is removed, B1

and friction opposes motion of the bobsleigh. B1

Hence, it decelerates and comes to a stop after some time.

(c) $a = \frac{v - u}{t}$

$= \frac{0 - 5}{20}$ C1

$= -0.25$ m/s^2

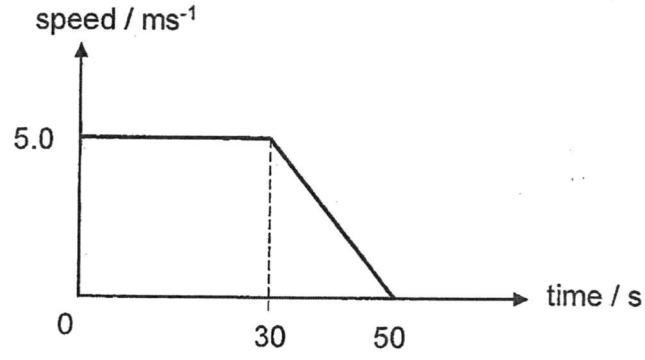
Deceleration = 0.25 m/s^2 A1

(d) F = ma

= 250 x 0.25 Allow ECF from (c) C1

= 62.5 N A1

(e)



Award 1 mark for the correct shapes for both sections of the graph.

Award 1 mark for having the correct times and speeds.

11 (a)(i) As cold air around the frozen pack is denser and sinks, B½

the surrounding hot air is less dense and rise. B½

No convection current is set up in the box to cool the food that is placed near the cover of the box. B1

And air is a poor heat conductor. B1

(ii) Any one of the following answers: B1

- Place the frozen pack under the cover of the box.
- Place the frozen pack at side of the box but high up

(iii) I would use plastic as the walls. B1

Plastic are poorer heat conductors than metals, B1

therefore they conduct heat from the surrounding into the box slowly. B1

(b)(i) Evaporation B1

(ii) Any two of the following answers: B2

- Hotter weather
- Stronger wind
- Lower humidity

12(a)(i) The speed of **sound** is **slower than** the speed of **light**. B1

(ii) The air particles move through a series of compressions and rarefactions
Or the air particles move parallel to the direction that the sound wave travels. B1
The sound energy is passed as the air particles collide with each other. B1

(b)(i) Microwave A1

(ii) $f = \frac{v}{\lambda} = \frac{3.0 \times 10^8}{0.02}$ C1

$= 1.5 \times 10^{10}$ Hz A1

(c)(i) Light ray enters the glass block with angle of incidence of 0° / enters glass block perpendicularly/ Light ray lies along the normal at R
B1

(ii) $\sin c = \frac{1}{n} = \frac{1}{1.5}$ C1

$c = 41.8°$ A1

(iii) Light ray to be reflected back into glass block with angle of reflection of 58°. B1
Award mark as long as angle of reflection is labelled 58° regardless of its accuracy
Allow ECF from (c)(ii)

For Examiner's Use

1 In this experiment you will investigate how the speed of a water wave changes as the depth of the water is altered. To do this, you will use the apparatus as shown in Fig. 1.1.

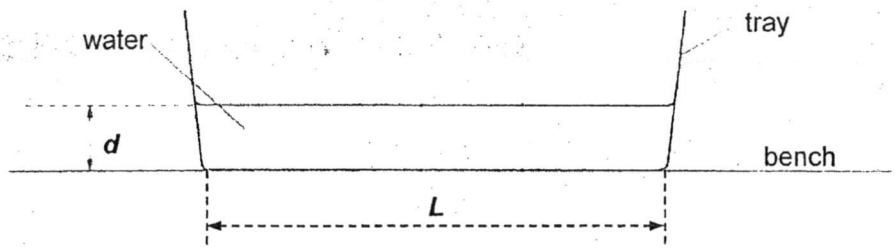


Fig. 1.1

(a) Measure the length of the tray, ***L***, and record this value in mm.

length of the tray, ***L*** = 174 mm [1]

(b) Practice

With the tray flat on the bench, carefully pour water into it so that the depth, **d**, is 10 mm. Use the marked stick provided to help you measure this depth.

Raise one side of the tray, **A**, by about 15 to 20 mm, as shown in Fig. 1.2, and then let it drop back to the bench.

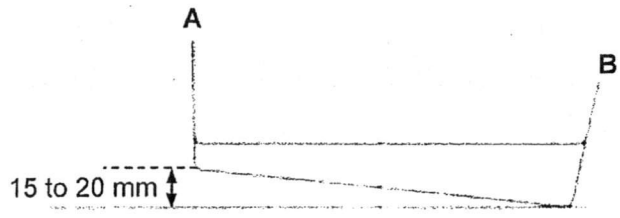


Fig. 1.2

You should see a wave move forwards and backwards across the surface of the water several times, as shown in Fig. 1.3.

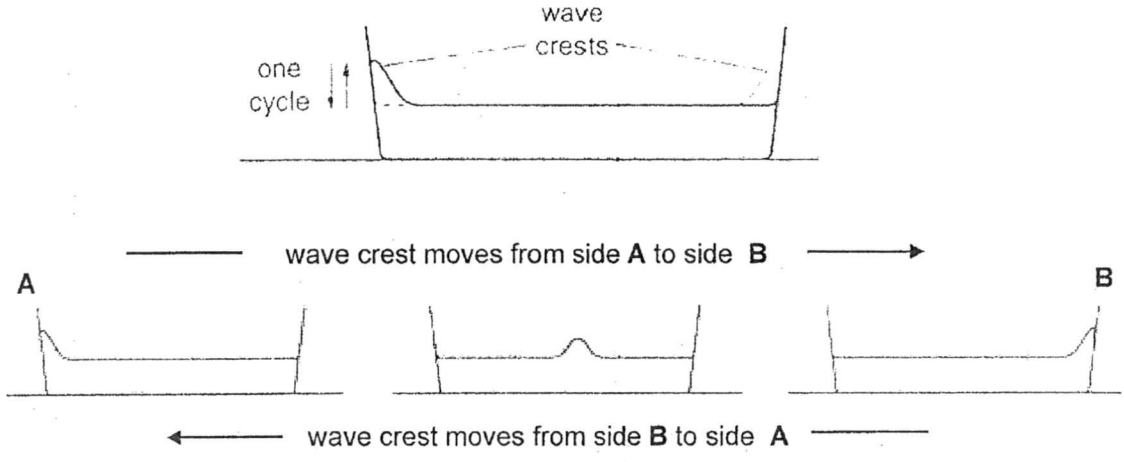


Fig. 1.3

For Examiner's Use

You will need to measure the time it takes for a wave crest to make-three cycles. One cycle consists of a wave crest travelling from side **A** of the tray across to side **B** and back again to side **A**.

You should start timing when side **A** of the tray drops, and stop timing when the wave crest returns to side **A** of the tray for the **third time**.

You may find it easier to view the wave crest from the side as shown in Fig. 1.3.
Repeat this process several times until you are confident that you know what to do.

Only then should you start to record your measurements.

(c) (i) Experiment 1

1. Using the procedure you practised in **part (b)**, for a depth of 10 mm, measure the time taken for a wave crest to complete **three** cycles.

2. Record this time, t_1, to the nearest 0.01 s, in Table 1.1.

3. Repeat this procedure two more times. Record these times, t_2 and t_3, to the nearest 0.01 s, in Table 1.1.

(ii) Experiments 2 to 5

With the tray flat on the bench, pour more water into it until the depth is 20 mm. Use the marked stick provided to help you measure the depth.

Repeat the procedure described in **part (c)(i)**, recording all of the times, t_1, t_2 and t_3, to the nearest 0.01 s, in Table 1.1.

Repeat the experiment using water depths of 30 mm, 40 mm and 50 mm. Each time, use the marked stick provided to help you measure the depth.

For each depth, record t_1, t_2 and t_3, to the nearest 0.01s, in Table 1.1.

For Examiner's Use

(iii) Complete Table 1.1 for each set of data by calculating the

- average time, t_a , giving your answers to the nearest 0.01 s
- average speed of the wave, c, using the formula below, where L is the length measured in **part (a)**, giving your answers to the nearest mm / s

$$c = \frac{6L}{t_a}$$

- square root of the depth, $\sqrt{d}$, for each depth, giving your answers to **two** decimal places.

Table 1.1

depth, d / mm	first time t_1 / s	second time, t_2 / s	third time t_3 / s	average time, t_a / s	speed c in mm /s	$\sqrt{d}$ in $\sqrt{mm}$
10	3.63	3.85	3.84	3.77	273	3/16
20	2.66	2.59	2.62	2.62	393	4.47
30	2.38	2.31	2.37	2.35	439	5.48
40	2.25	2.19	2.31	2.26	459	6.32
50	1.88	1.87	1.94	1.90	544	7.07

[4]

(d) On Fig. 1.4, plot a graph of the average speed, c, against the square root of the depth, $\sqrt{d}$.

Draw the best-fit straight line taking into account all your plotted points. [4]

(e) Determine the gradient of the line, showing clearly on your graph how you did this.

$$\text{gradient} = \frac{540 - 285}{7.05 - 3.30}$$

$$= 68.0 \text{ (3 s.f.)}$$

gradient = 68.0 [2]

(f) Use your graph to determine the average speed of a wave when the depth of the water, d, is 35 mm.

Show clearly how you obtained your answer.

average speed when d is 35 mm = 460 mm /s [1]

For Examiner's

Use

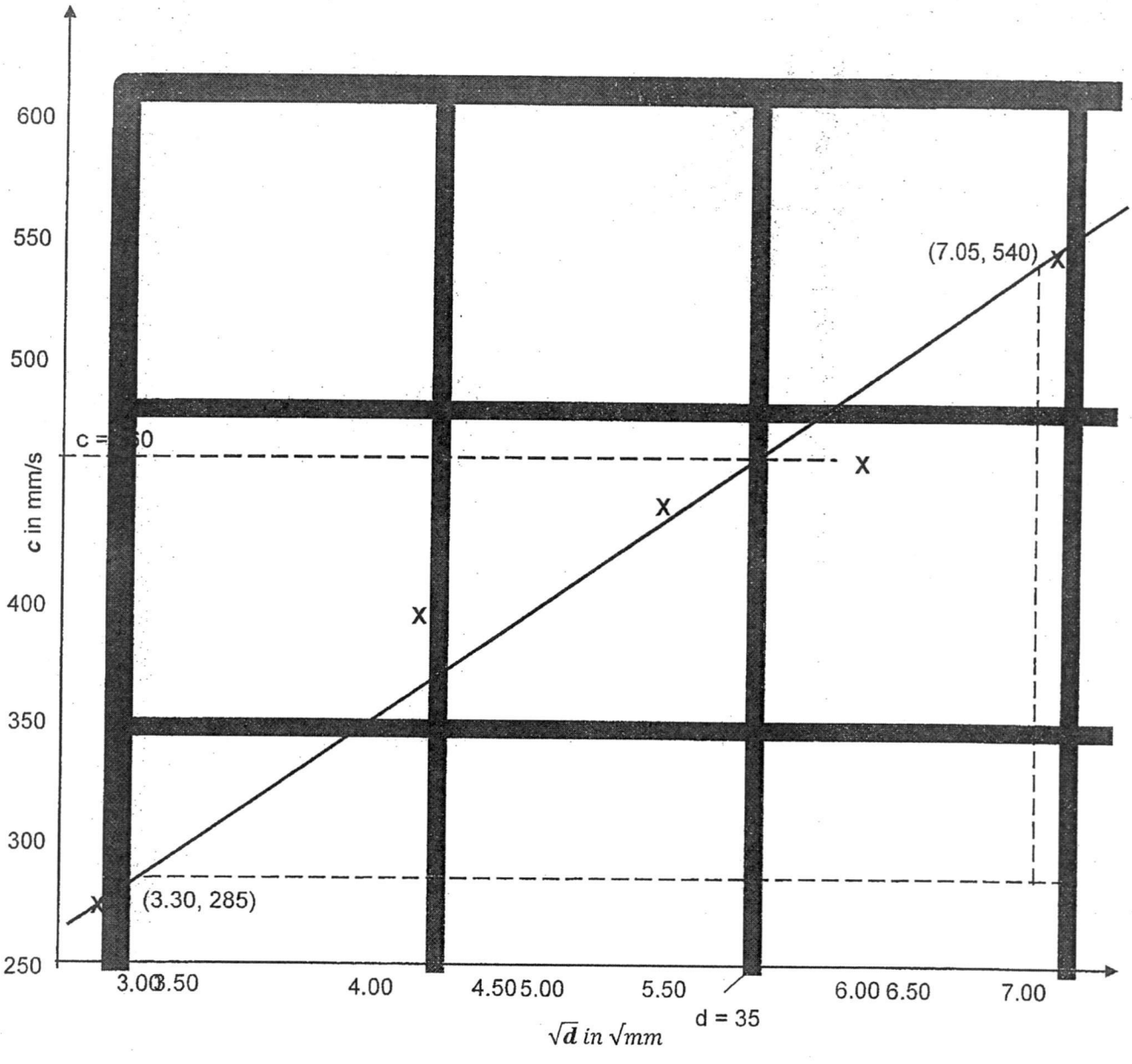


Fig. 1.4

(g) There are various reasons why your calculated values for ***c*** are likely to be inaccurate.

(i) No matter how precisely it is measured, length ***L*** is likely to cause the values obtained for the speed, ***c***, to be inaccurate.

Look at Fig. 1.1. Suggest one reason why the use of length ***L*** may lead to errors in ***c***.

The sides of the tray are not vertical. At different points of the water, the length that the wave travels differ. [1]

For Examiner's Use

(ii) Will this error cause the values calculated for **c** to be too high or too low? Explain your answer.

The calculated values are low. The length *L* is measured at the base but at the top of the water, the length is actually longer than *L*. [1]

(iii) Suggest and explain **one** other source of error which is likely to affect the accuracy of ***c***.

The human reaction time affects accuracy in the measurement of t_1, t_2 and t_3 and t_a. [1]