

Candidate Name

Candidate Number

Centre Name

Centre Number

Paper 1: Physics

For Examination December 2023

(2 hours)

It is necessary to respond on the answer sheets provided alongside this question paper. Additionally, you must have a soft pencil (preferably of type B or HB), a clean eraser and a dark blue or black pen.

INSTRUCTIONS:

- You must write your name, candidate number, centre name and centre number on the answer sheets in the designated spaces.
- Objective section consists of 25 questions, and it is essential that you attempt all of them.
- Each question has four options labelled A, B, C, and D. Select the option that you think is correct. Mark it on the multiple choice answer sheet using a soft pencil.
- Attempt all the questions from subjective section using a dark blue or black pen.
- It is important to follow the instructions provided on the answer sheets.
- Do not use correction fluid.
- Avoid writing on any bar codes.

INFORMATION:

- This paper has a total of 100 marks.
- In objective section there are 25 questions, each carries one mark. There is no negative marking for incorrect responses.
- In subjective section, 45 marks are for extended theory and 30 marks for practical component.
- The number of marks assigned for every question or its parts is indicated within brackets []

Multiple Choice (25 questions)

Question 1

A car travels 100 km. The journey takes two hours. The highest speed of the car is 80 km/h, and the lowest speed is 40 km/h.

What is the average speed for the journey?

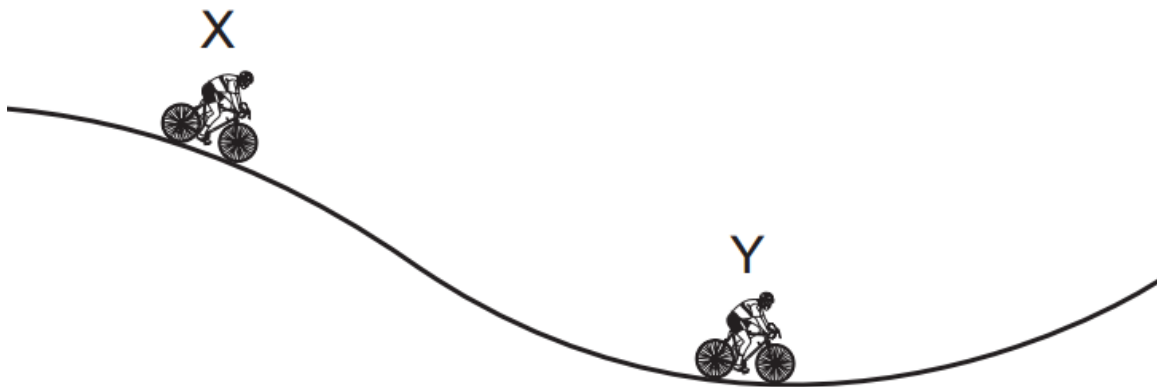
- A. 40 km/h B. 50 km/h C. 60 km/h D. 120 km/h

Question 2

Which energy resource is used to generate electricity without using any moving parts?

- A. Geothermal B. hydroelectric C. Nuclear D. Solar

Question 3



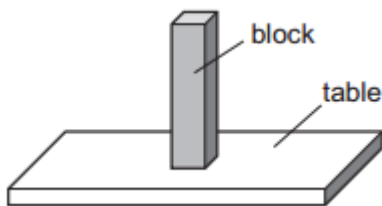
A cyclist is travelling down a hill from rest, at point X, without pedalling. The cyclist applies his brakes and the cycle stops at point Y.

Which energy changes have taken place between X and Y?

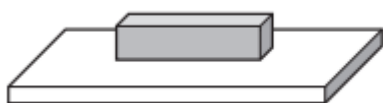
- A. Gravitational potential → kinetic → thermal (heat)
B. Gravitational potential → thermal (heat) → kinetic
C. Kinetic → gravitational potential → thermal (heat)
D. Kinetic → thermal (heat) → gravitational potential

Question 4

A block that has flat, rectangular sides rests on a table as shown below.



The same block is now turned so that it rests with its largest side on the table.



How has this change affected the force and the pressure exerted by the block on the table?

	force	pressure
A	decreased	decreased
B	decreased	unchanged
C	unchanged	decreased
D	unchanged	unchanged

Question 5

Thermal energy travels through space from the Sun to the Earth. Space is a vacuum.

How is thermal energy transferred from the Sun to the Earth?

- A. By conduction only
- B. By convection only
- C. By radiation only
- D. By convection and radiation

Question 6

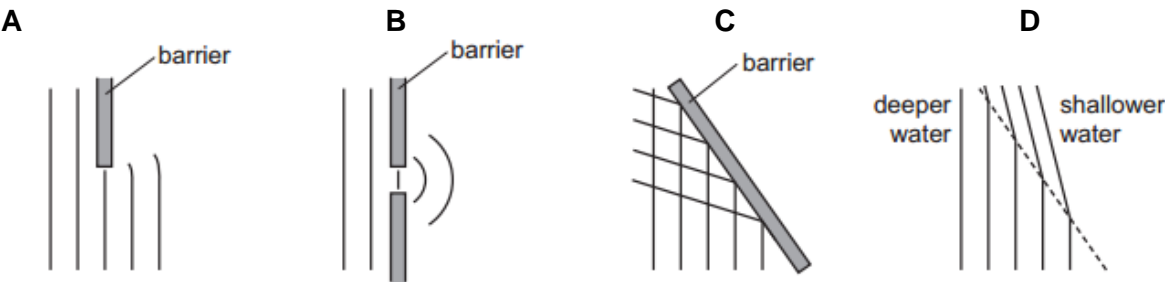
What is the number of wavefronts per second that pass a fixed point?

- A. The amplitude of the wave
- B. The frequency of the wave
- C. The speed of the wave
- D. The wavelength of the wave

Question 7

The diagrams represent water waves in a high school tank.

Which diagram represents a wave that changes speed?



Question 8

The diagram shows the electromagnetic spectrum, in order of increasing wavelength.

Three types of radiation are missing from the spectrum diagram (P, Q, R).

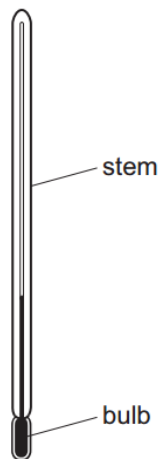
Gamma rays	X-rays	P	Visible light	Q	Microwaves	R
------------	--------	---	---------------	---	------------	---

Which types of electromagnetic radiation are represented by P, by Q, and by R?

	P	Q	R
A	infra-red	Radio waves	ultraviolet
B	infra-red	ultraviolet	Radio waves
C	ultraviolet	Infra-red	Radio waves
D	ultraviolet	Radio waves	infra-red

Question 9

The thermometer in the diagram has no scale.



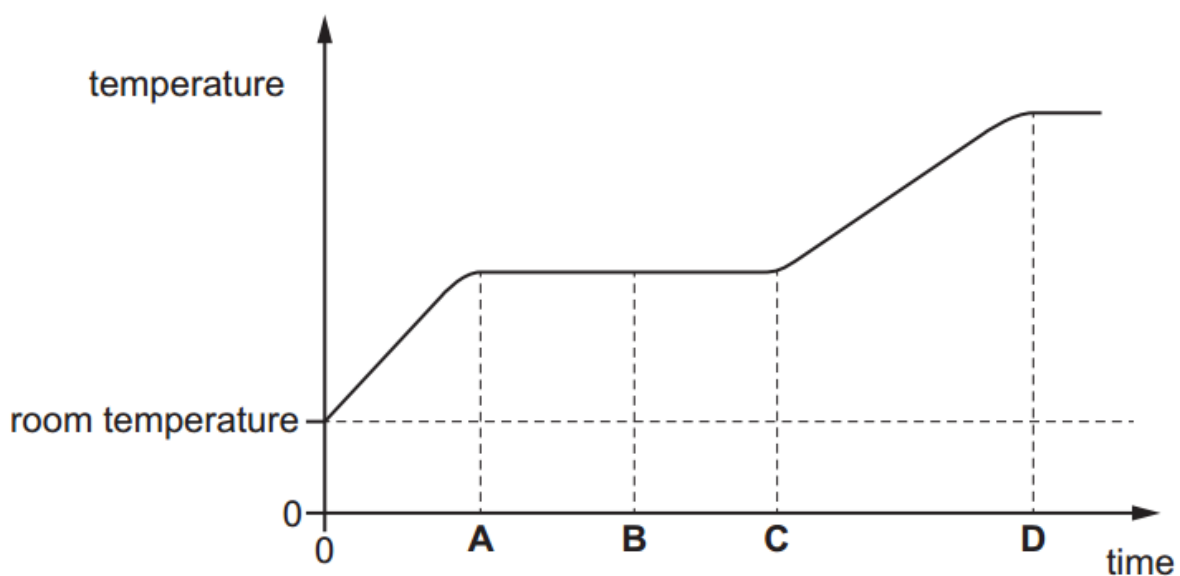
Where must the bulb section be placed so that 0°C can be marked on the stem section?

- A. In a freezer B. In pure boiling water C. In pure cold water D. In pure melting ice

Question 10

A solid piece of ice is heated from room temperature. The graph shows how its temperature changes with time as it gets heated constantly.

At which time has it just become **completely** liquid?

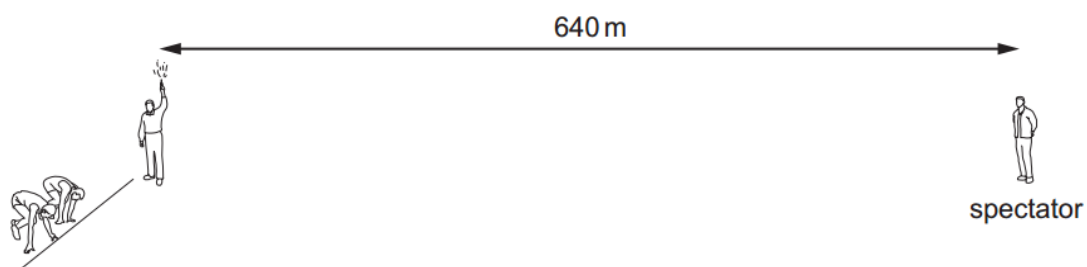


Question 11

Which row states two properties of sound waves?

	Can travel through	Type of wave
A	A vacuum	longitudinal
B	A vacuum	transverse
C	water	longitudinal
D	water	transverse

Question 12



A man holding a starting pistol stands 640m away from a spectator.

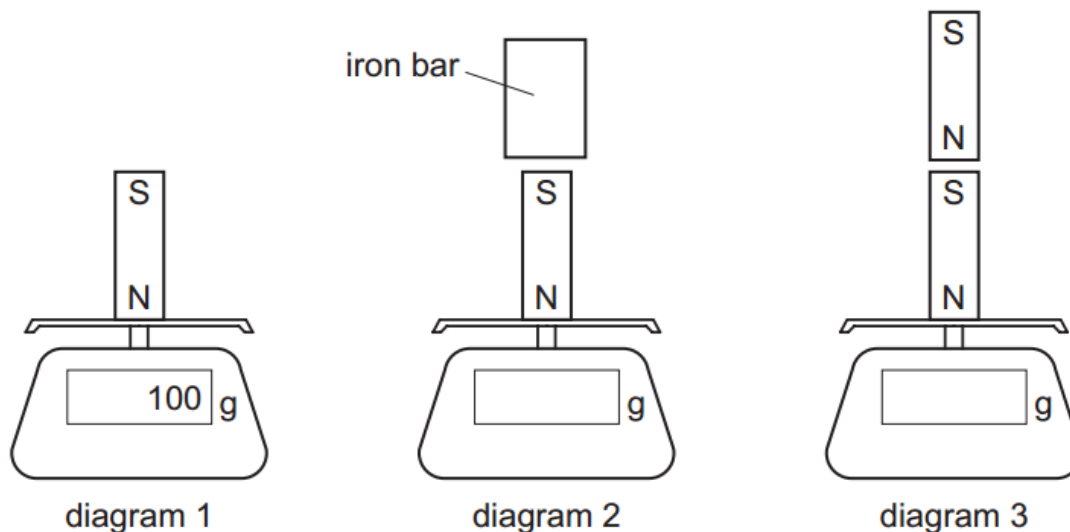
The spectator next hears the sound of the starting pistol 2.0s after seeing the flash from the pistol.

From this information, what is the speed of sound in air?

- A. 160 m/s B. 320 m/s C. 640 m/s D. 1280 m/s

Question 13

A magnet is placed onto a balance. The reading on the balance changes when an iron bar or a different magnet is held close to the first magnet.



Which row gives the balance reading in diagram 2 and in diagram 3?

	Balance reading in diagram 2 / g	Balance reading in diagram 3 / g
A	Less than 100	Less than 100
B	Less than 100	More than 100
C	More than 100	Less than 100
D	More than 100	More than 100

Question 14

The diagram shows a piece of metal resistance wire.



Which wire, made of the same metal, has a smaller resistance?

- A. A wire of the same length with a larger diameter
- B. A wire of the same length with a smaller diameter
- C. A wire of greater length with the same diameter
- D. A wire of greater length with a smaller diameter

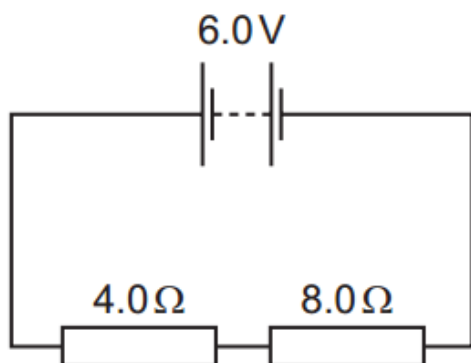
Question 15

What is the unit of electromagnetic force (e.m.f.)?

- A. Ampere
- B. Joule
- C. Volt
- D. Watt

Question 16

The circuit diagram shows a $4.0\ \Omega$ resistor and an $8.0\ \Omega$ resistor connected to a $6.0\ \text{V}$ battery.



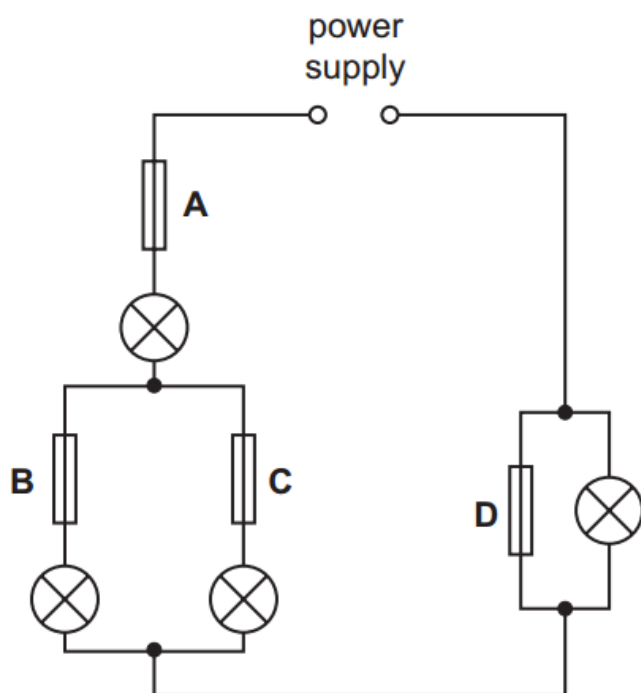
What is the resulting current in the battery?

- A. $0.50\ \text{A}$ B. $0.75\ \text{A}$ C. $1.5\ \text{A}$ D. $2.0\ \text{A}$

Question 17

In the circuit shown, only one of the fuses has unfortunately blown, but none of the lamps is now lit.

Which fuse has blown?



Question 18

What is an advantage of transmitting electricity at a high voltage?

- A. It is faster
B. It is safer
C. Less energy is wasted
D. Less equipment is needed

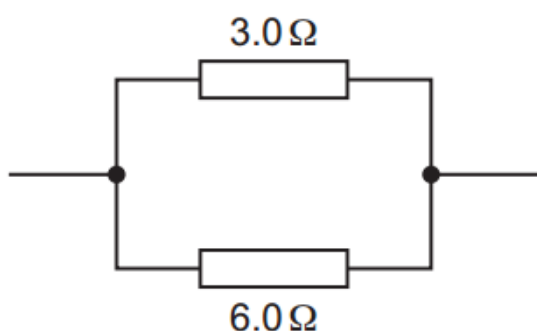
Question 19

Which row gives the properties of the radiation from radioactive materials?

	Most penetrating radiation	Most highly ionising radiation
A	α	β
B	β	γ
C	γ	α
D	γ	γ

Question 20

The diagram shows a $3.0\ \Omega$ resistor and a $6.0\ \Omega$ resistor connected in parallel.



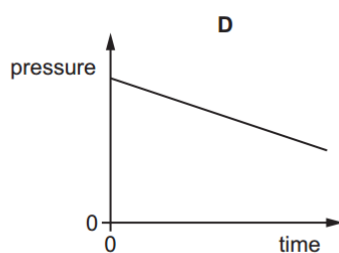
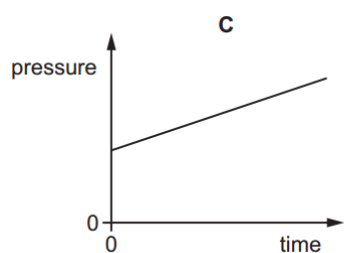
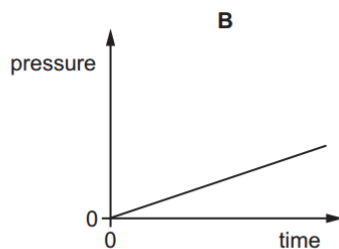
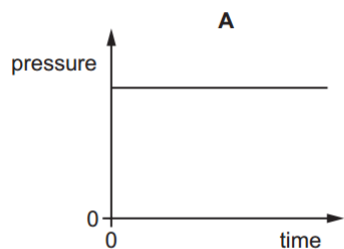
What is the total resistance of this arrangement?

- A. Less than $3.0\ \Omega$
- B. $3.0\ \Omega$
- C. $4.5\ \Omega$
- D. More than $6.0\ \Omega$

Question 21

The pressure of a fixed mass of gas in a cylinder is measured. The temperature of the gas in the cylinder is then slowly increased. The volume of the cylinder does not change.

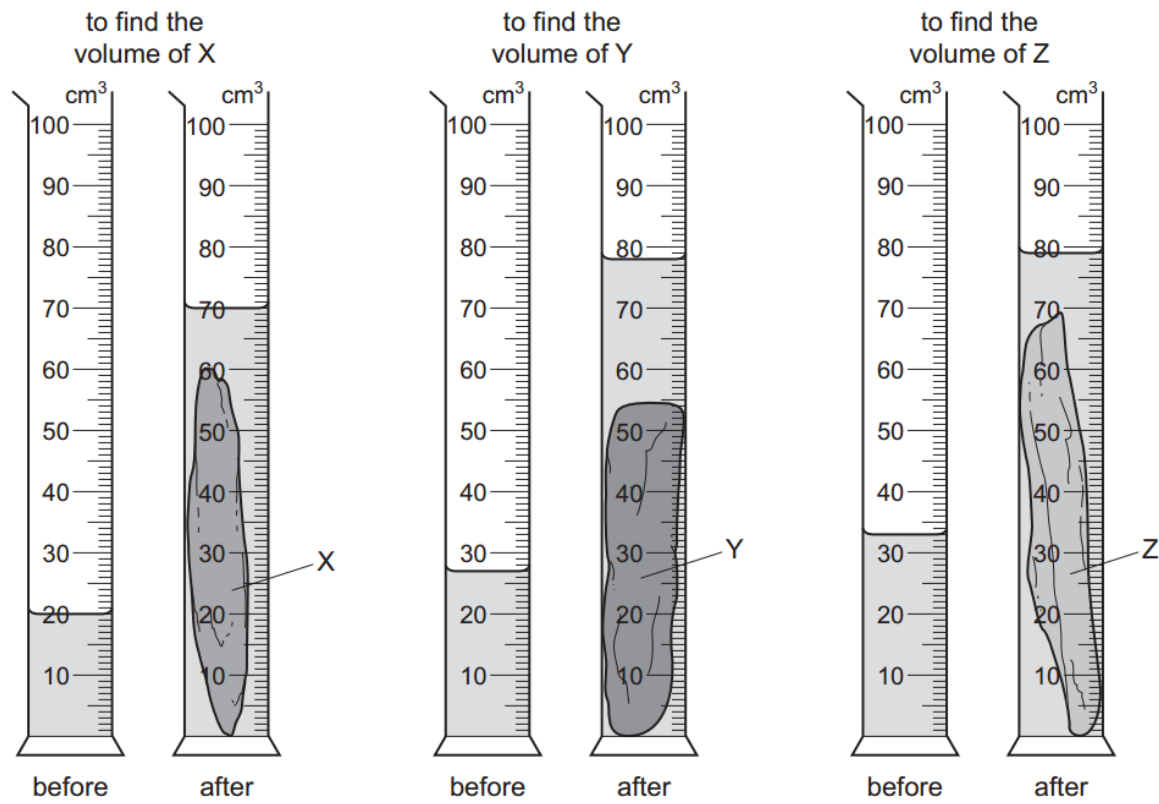
Which graph shows the pressure of the gas during this process?



Question 22

A geologist compares the volumes of three rocks, X, Y and Z. Three measuring cylinders contain different volumes of water. He places each rock into one of the measuring cylinders.

The diagrams show the measuring cylinders before and after the rocks are put in.



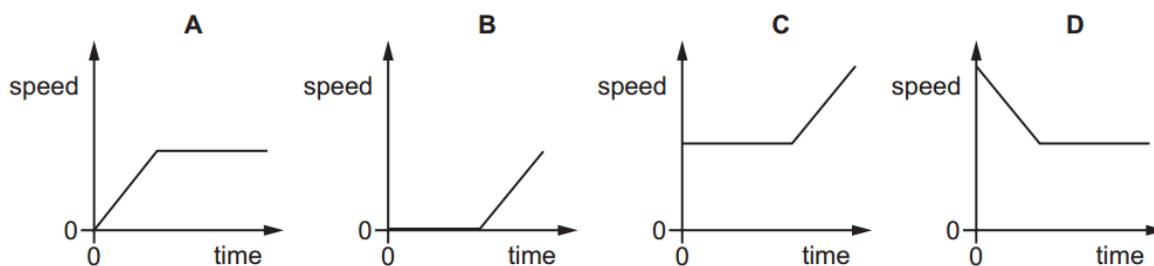
Which row in the table below shows the volume of X, Y and Z in order, from largest to smallest?

	Largest volume → Smallest volume		
A	X	Z	Y
B	Y	X	Z
C	Y	Z	X
D	Z	Y	X

Question 23

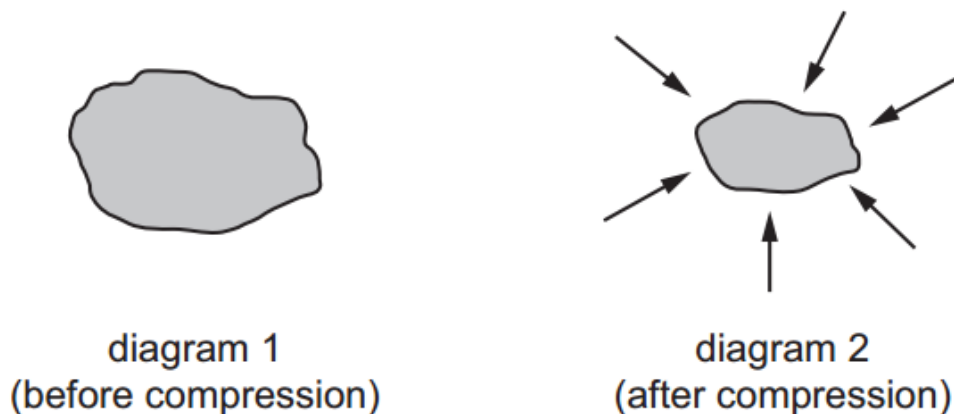
A car moves with constant speed and then constant acceleration.

Which graph is the speed-time graph for the car?



Question 24

Diagram 1 shows a piece of foam rubber that contains numerous pockets of air. Diagram 2 shows the same piece of foam rubber after it has been compressed so that its volume decreases.



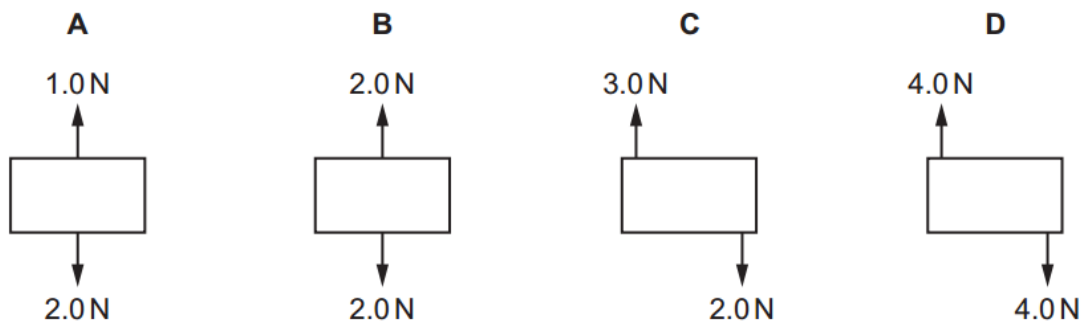
What happens to the mass and the weight of the foam rubber when it is compressed?

	mass	weight
A	increases	increases
B	increases	No change
C	No change	increases
D	No change	No change

Question 25

Four objects are each acted on by only two forces, as shown below.

Which object is in equilibrium?



Extended Theory (45 marks)

Question 1

Fig. 1.1 shows a distance-time graph for a falling object.

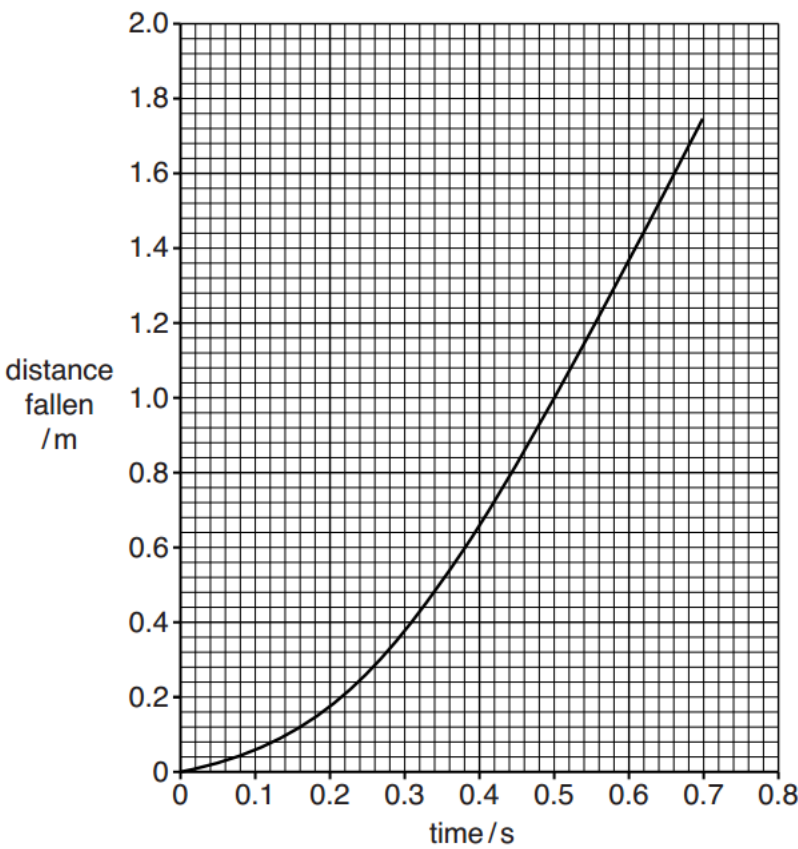


Fig. 1.1

(a) Use this graph to find the time it takes the object to fall from 0.60 m to 1.60 m.

time = s [1]

(b) State and explain what the graph shows about the motion of the falling object.

.....
.....
.....[2]

[Total: 3]

Question 2

Fig. 2.1 shows an irregularly shaped piece of card.

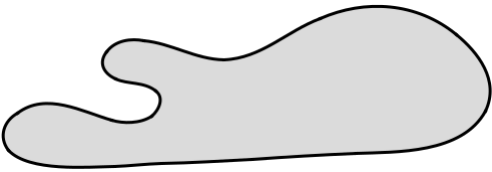


Fig. 2.1

A student is asked to find the centre of mass of the card. The student is provided with a clamp and stand, a small mass attached to a thin string and a long pin.

(a) Describe the procedure for finding the centre of mass of the card. You may draw a diagram.

.....

.....

.....

.....

.....[3]

(b) What simple test can be carried out to confirm that the centre of mass has been found?

.....

.....[1]

[Total: 4]

Question 3

A student has a beaker of liquid as shown in Fig. 3.1.

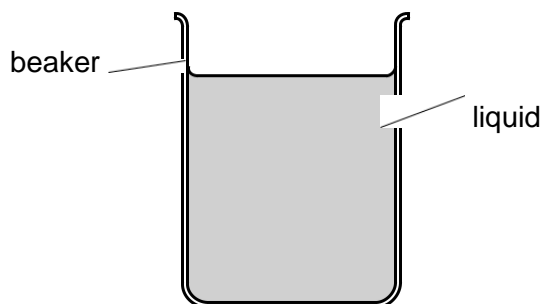


Fig. 3.1

(a) The student makes some measurements. His results are shown in the table.

mass of beaker and liquid	280 g
mass of empty beaker	120 g
volume of liquid	200 cm ³

(i) Calculate the mass of the liquid in the beaker.

mass of liquid = g [1]

(ii) Calculate the density of the liquid.

density = g / cm³ [3]

- (b) The student warms the beaker and liquid on an electric heater as shown in Fig. 3.2.

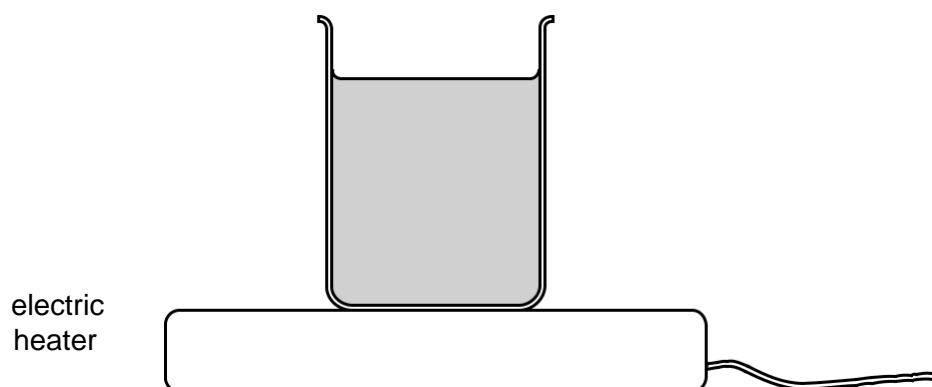


Fig. 3.2

- (i) State the name of the process by which thermal energy is transferred through the glass of the beaker.

.....[1]

- (ii) Explain how thermal energy is transferred throughout the liquid by convection.

.....
.....
.....
.....[3]

- (c) After heating for 20 minutes, the student re-weighs the beaker and liquid. He finds that the mass of the beaker and liquid has decreased to 260 g.

- (i) State the name of the process that causes this decrease in mass.

.....[1]

- (ii) In terms of molecules, explain how this process occurs.

.....
.....
.....
.....[2]

[Total: 11]

Question 4

At a party, three balloons are filled with a gas less dense than air. The balloons are tied to an empty drink can. The can floats, without moving, in the air above a table, as shown in Fig. 4.1.

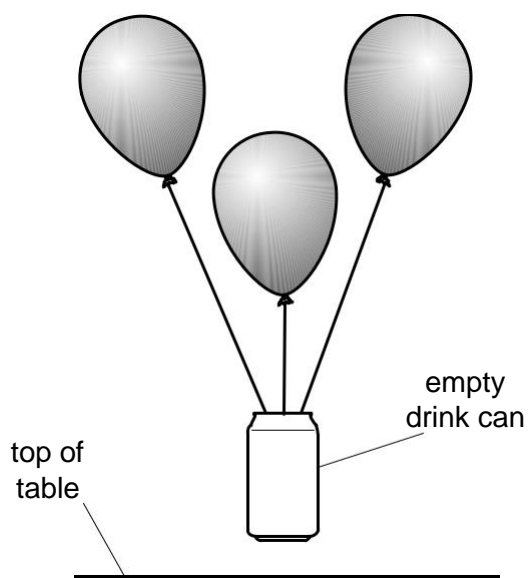


Fig. 4.1



Fig. 4.2

- (a) Fig. 4.2 represents the vertical forces acting on the can as it floats in the air. State the name given to the downward force labelled Y.

.....[1]

- (b) In terms of the vertical forces acting on the can, explain why the can does not rise or fall.

.....
.....[2]

- (c) A window is opened, causing a draught of air into the room. The window is to the left of the balloons and can, and at the same height.

On Fig. 4.1, draw an arrow indicating the direction of the resultant force on the can. [1]

- (d) One of the balloons suddenly bursts.

State and explain what happens to the can.

.....
.....
.....[1]

[Total: 5]

Question 5

A footballer kicks a football and it bounces to another player. Fig. 5.1 shows part of the path taken by the ball.

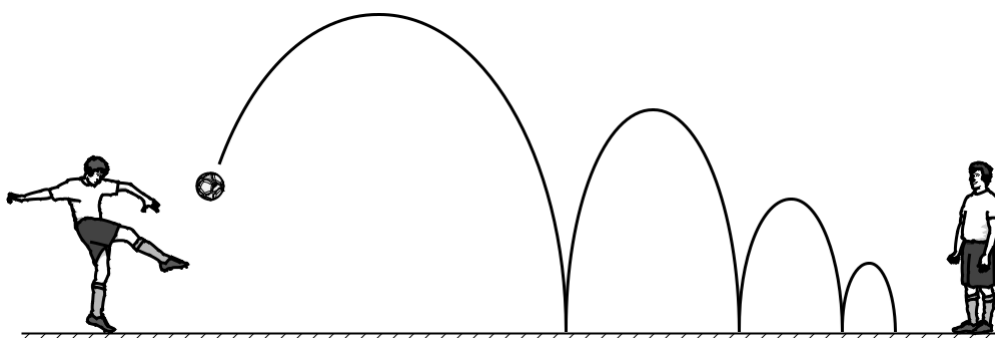


Fig. 5.1

- (a) Use words from the box to complete the sentences below. Each word may be used once, more than once, or not at all.

direction downwards forwards mass shape slower upwards
--

- (i) Each time the football moves, it gains gravitational potential energy. [1]
- (ii) Each time the football hits the ground, it changes, and this results in energy stored as strain energy (elastic potential energy). [1]
- (b) Each time the football hits the ground, energy is transferred away from the ball.

- (i) State how you can tell this from the diagram.

.....
[1]

- (ii) State what happens to the energy that is transferred away from the ball.

.....[1]

[Total: 4]

Question 6

Fig. 6.1 shows a hydroelectric power station.

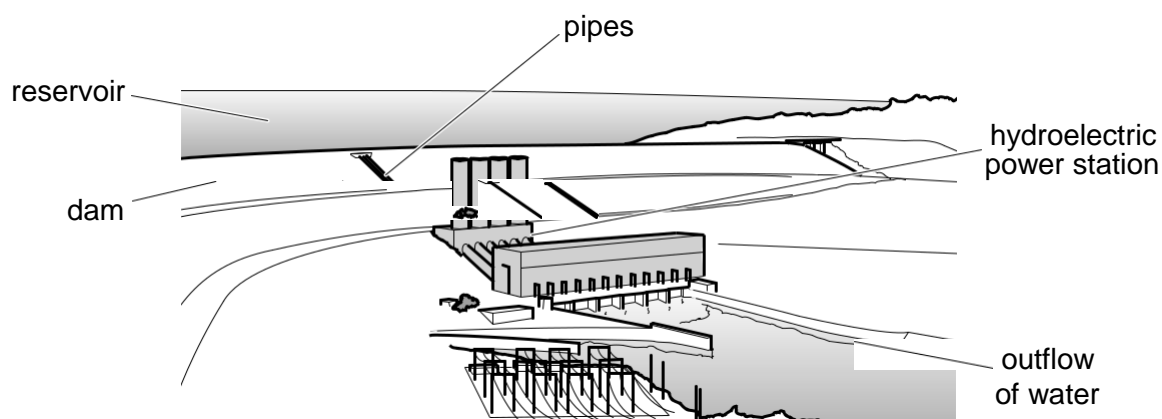


Fig. 6.1

(a) These are some of the stages explaining how the power station works. They are not in the correct order.

- A The electromagnets turn inside a large coil.
- B Water flows down pipes from the reservoir to the turbine.
- C Inside the generator, the spinning shaft turns electromagnets.
- D The falling water keeps the turbine spinning.

Use the letters A, B, C and D to complete the flow chart to explain how the power station works.

Rainwater flows off the hills into the reservoir behind the dam.



The turbine transfers energy by a spinning shaft to a generator.



Electricity is generated.

[3]

(b) Hydroelectric power is described as a renewable source of energy. Explain what is meant by the term *renewable*.

.....
.....[1]

(c) Using a renewable source of energy is one advantage of hydroelectric power compared with other energy sources.

(i) State two other advantages of hydroelectric power.

1.
2.
[2]

(ii) State one disadvantage of hydroelectric power.

.....[1]

[Total: 7]

Question 7

Fig. 7.1 shows a car and a snow tractor.

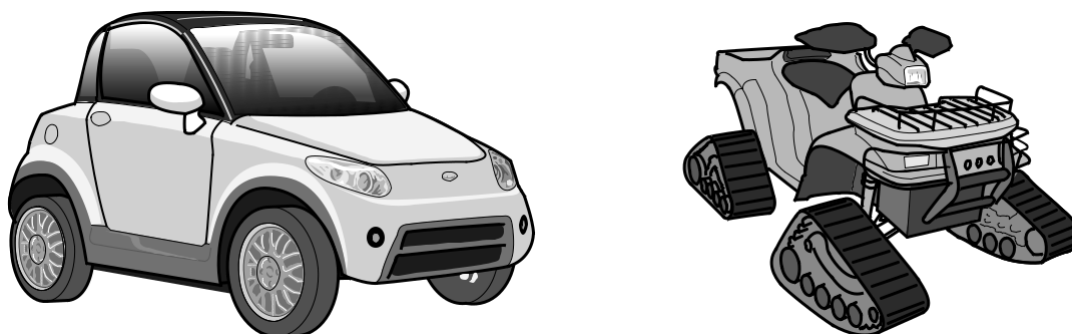


Fig. 7.1

The car and the snow tractor have the same weight.

- (a)** Explain why the snow tractor can travel across soft snow without sinking, but the car cannot.

.....

.....

.....

.....

.....[3]

- (b)** The car driver checks his tyre pressure in a warm garage. The pressure of the air inside the tyre when it is warm is 24.0 N / cm^2 .

The car is driven outside and left in the snow.

- (i)** Suggest a value for the pressure of the air inside the tyre when it is cold.

pressure = N / cm^2 [1]

- (ii)** In terms of the air molecules inside the tyre, explain the change in the pressure of the air.

.....

.....

.....

.....[2]

[Total: 6]

Question 8

(a) A student arranges two 45° prisms as shown in Fig. 8.1. He aims a ray of red light to hit the surface of one of the prisms at 90° .

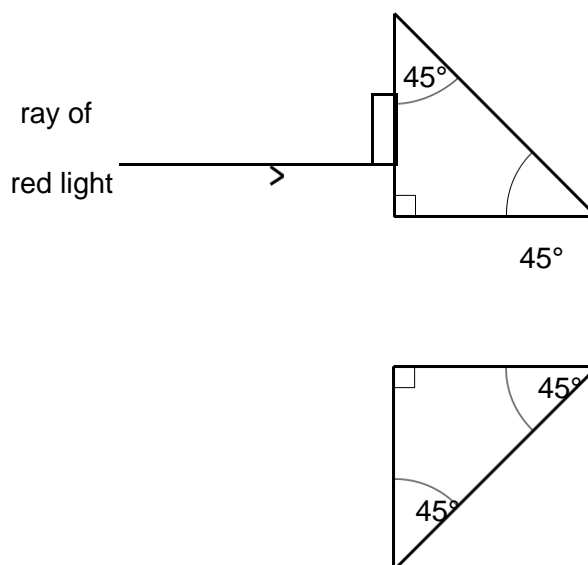


Fig. 8.1

The critical angle for the glass is 42° .

On Fig. 8.1, draw the path of the light through the prisms.

[2]

(b) Visible light is one region of the electromagnetic spectrum, as represented in Fig. 8.2.

radio waves	microwaves	infra-red waves	visible light	ultraviolet waves		
long wavelength					short wavelength	

Fig. 8.2

(i) Two regions of the electromagnetic spectrum are missing from Fig. 8.2. State the name of the missing region with the longer wavelength.

(ii) State two properties that are the same for all electromagnetic waves. [1]

1.

2.

[2]

[Total: 9]

Part C: Practical-based skills (30 marks)

Question 1

In an electrical experiment, a student set up a circuit to measure current and potential difference. Part of the circuit is shown in Fig.1.

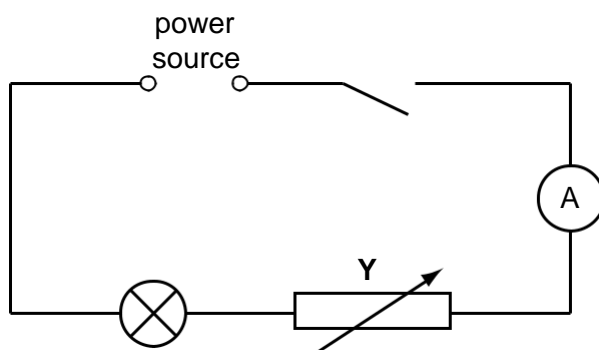


Fig. 1

- (c) (i) Complete the circuit diagram by drawing in a voltmeter connected across the lamp.
(ii) Name the component labelled Y. [2]
(ii) The first reading on the voltmeter was 2.2 V. On the voltmeter face shown in Fig. 2, show the position of the pointer giving the reading 2.2 V.

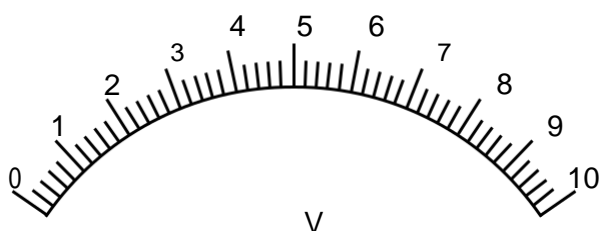


Fig. 2

[1]

- (iii) The readings of V and I obtained by the student are given in the table below.

$V/$	$I/$	$R/$
2.2	0.36	
4.1	0.62	
6.0	0.86	
7.9	0.98	
9.8	1.20	

- (d) Calculate the resistance R of the lamp filament for each set of V and I readings and write the values in the table. Use the equation

$$R = \frac{V}{I} .$$

- (ii) Complete the column headings in the table.

[6]

[Total: 9 marks]

Question 2

An International GCSE class watched a demonstration experiment to show that a metal rod expands when heated. The apparatus is shown in Fig 3.

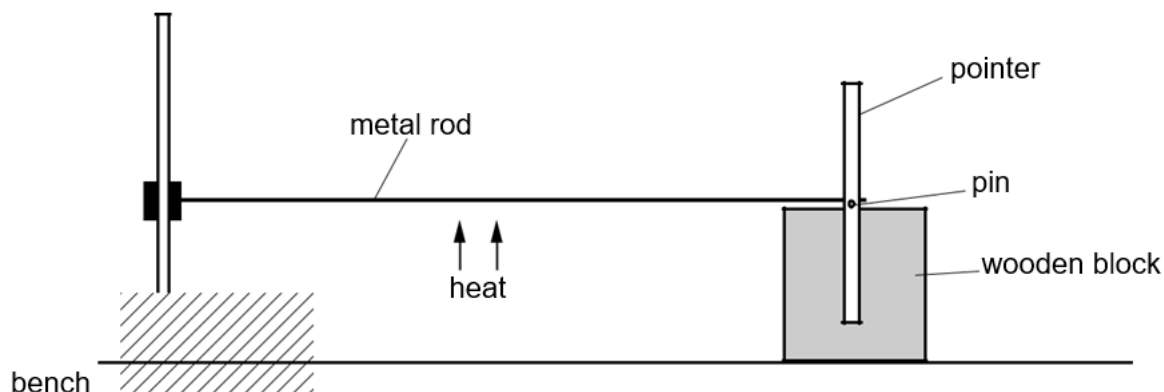


Fig. 3

When the rod expands, it rolls the pin which moves the pointer. So a very small expansion moves the pointer far enough to be seen clearly.

- (a) One student wanted to find out how much longer the rod became when heated above room temperature with a Bunsen burner. The rod was 0.750 m long at room temperature. To find the circumference of the pin, the student wrapped a piece of string 10 times round the pin, marked the string at the beginning and end of the 10 turns, and then measured the length of the string between the marks. Fig. 4 shows the string actual size.

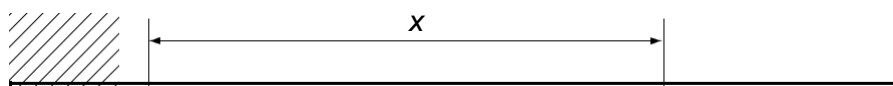


Fig. 4

- (b) Use your ruler to measure the distance x between the marks on the string on Fig. 4.

$x = \dots\dots\dots$ [1]

- (c) Calculate the circumference c of the pin.

$c = \dots\dots\dots$

[2]

- (d) A second student measured the diameter d of the pin using a micrometer screw gauge.

The diameter was 1.20 mm. When the rod was heated, the pointer moved through 90° .

Calculate the circumference c using the equation $c = \pi d$.

$$c = \dots\dots\dots[2]$$

- (e) Use this value of the circumference to calculate the increase e in the length of the rod when heated.

$$e = \dots\dots\dots[1]$$

- (f) Calculate the length l of the heated rod.

$$l = \dots\dots\dots[1]$$

- (g) The micrometer screw gauge is a very accurate instrument. Suggest why the string and rule method of finding the circumference, used by the first student, was inaccurate.

.....
.....[2]

[Total: 9 marks]

Question 3

A student was asked to carry out an experiment to compare the insulating properties of cotton wool, cardboard and polystyrene. The apparatus provided was hot water, a thermometer, a stopcock and a copper can with a lid, as shown in Fig. 5.

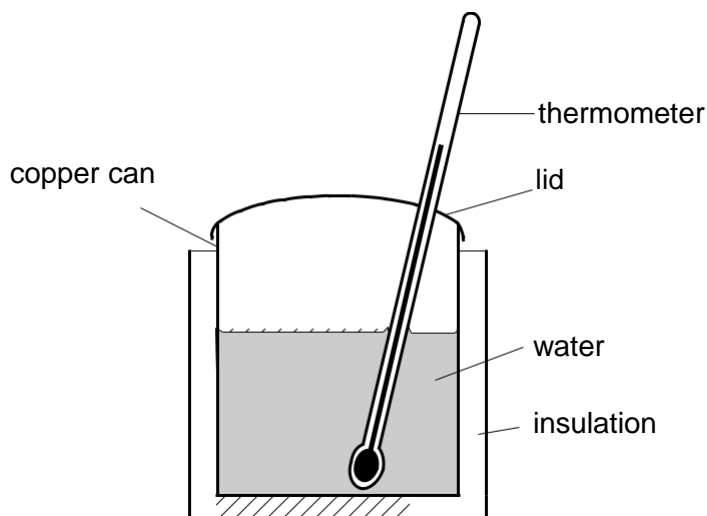


Fig. 5

The student wrapped one of the insulators around the can, poured hot water into the can, and then took temperature and time readings as the water cooled. This was then repeated for each insulator. The graph in Fig. 6 shows how the student displayed his readings.

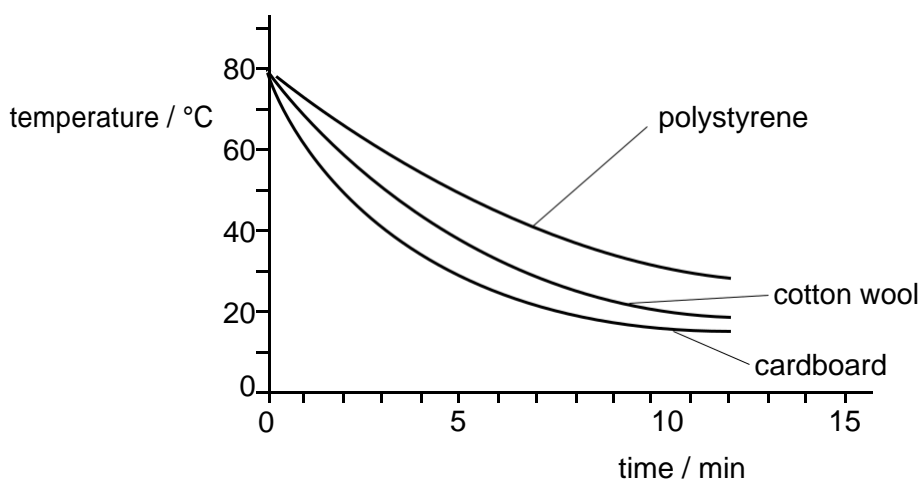


Fig. 6

(i) Using the information on the graph, which material appears to be the best insulator?

.....[1]

(ii) Justify your answer by referring to the information on the graph.

.....
.....
.....

[3]

(iii) In this experiment, it is important to control the variables. Suggest five variables that the student should keep constant for this experiment.

1.
2.
3.
4.
5.

[5]

(iv) In this experiment, what are three possible sources of error? List them below.

1.
2.
3.

[3]

[Total: 12 marks]

END OF PAPER