Name: _____ ( ) **Class:** _____

WHITLEY SECONDARY SCHOOL

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PRELIMINARY EXAMINATION 2025

SUBJECT	**:**	**PHYSICS PAPER 2 (6091/02)**
LEVEL	**:**	**Sec 4 G3**
DATE	**:**	**29 August 2025**
DURATION	**:**	**1 hr 45 mins**
SETTER	**:**	**Mr Krishan Sanjay**
VETTER	**:**	**Ms Keira Htay**

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

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

Section B
Answer only **one** question.
Write your answers in the spaces provided.

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	**/ 70**
Section B	**/ 10**
Total	**/ 80**

Section A

Answer all the questions in this section.

1 Fig. 1.1 shows a rocket just after its launch. At its launch, the rocket and its contents have a total mass of 1.2 x 10^5 kg. Fig. 1.2 shows how the upward thrust on the rocket changes with time in the first 40 s after the launch. The gravitational field strength g is 10 N/kg.

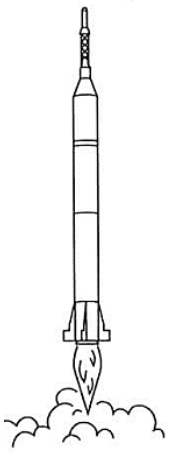

Fig. 1.1

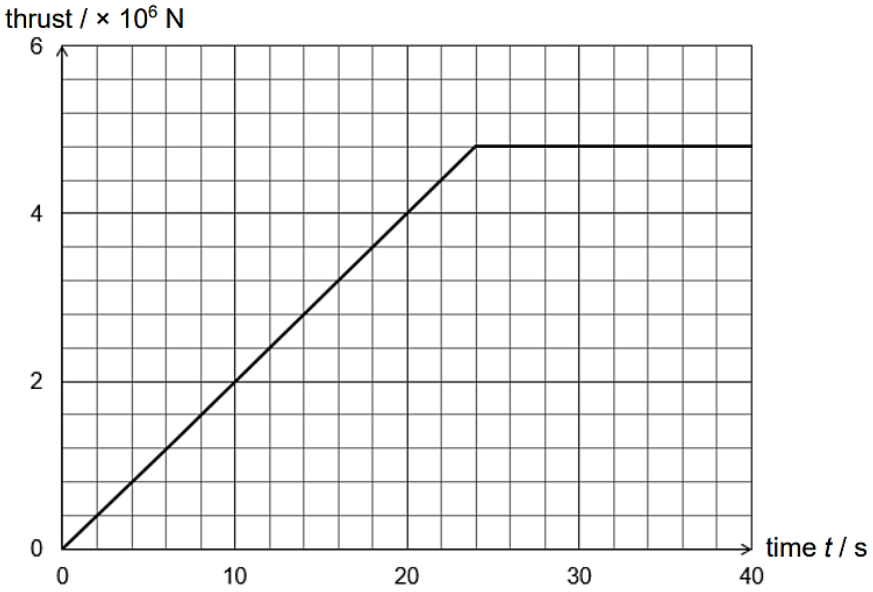

Fig. 1.2

(a) Calculate the weight of the rocket just before its launch.

weight = ... [1]

(b) At the point of launching, the rocket does not take off immediately. State the time when the rocket starts to take off and explain your answer.

.....

.....

..... [2]

(c) Calculate the acceleration of the rocket at t = 30 s.

acceleration = …… [2]

(d) 30 s after launch, the total weight of the rocket and its content decreases significantly as fuel is being burnt off while the thrust remains the same.
Describe the motion of the rocket after 30 s.

……

…… [1]

2 Fig. 2.1 shows an electric kettle and the live, neutral and earth wires of a household electricity supply. The kettle has a power rating of 2.0 kW. The supply voltage is 240 V.

(a) Complete Fig. 2.1 to show how the kettle should be connected to the supply. Include a switch and a fuse in your drawing. [2]

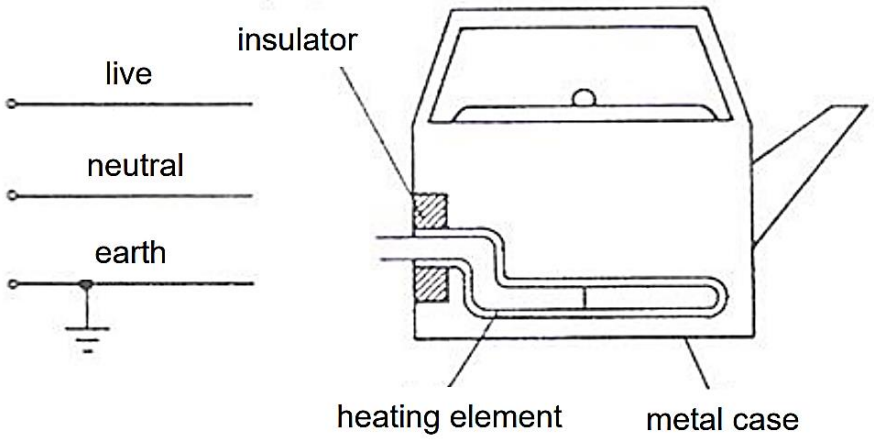

Fig. 2.1

(b) The live wire becomes loose and touches the metal case. Explain why a person who later touches the case feels no shock and is not harmed.

.....

.....

.....

..... [3]

3 Fig 3.1 shows a mercury manometer connected to a gas supply.

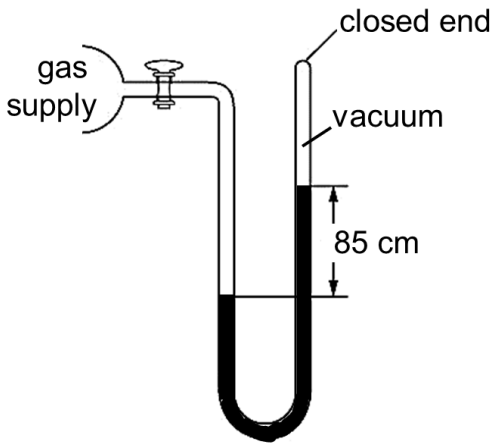

Fig. 3.1

(a) Explain, using the kinetic model of matter, how the gas supply exerts a pressure.

.....

..... [1]

(b) The atmospheric pressure is 74 cmHg. Determine the pressure of the gas supply.

gas pressure = ... cmHg [1]

(c) Some air leaks into the closed end and the reading of the manometer changes to 78 cm. Determine the pressure within the closed end.

pressure in the closed end = …… cmHg [2]

4 Fig. 4.1 shows a walking stick that has a metal head and a rubber foot. It balances on a pencil placed 0.50 m from its rubber foot. The walking stick has a total length of 0.80 m.

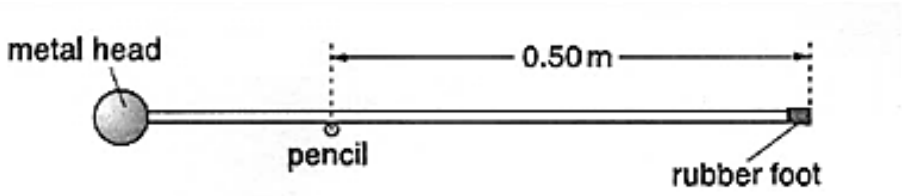

Fig. 4.1

(a) **(i)** State the definition of *centre of gravity*.

…… [1]

(ii) State the distance between the *centre of gravity* of the walking-stick and the end of the rubber foot.

…… [1]

(b) Fig 4.2 shows a truck of mass *M* of 5000 kg crossing a horizontal bridge of uniform mass *m* 1000 kg and length *l* of 100 m.

The bridge is supported at its ends.

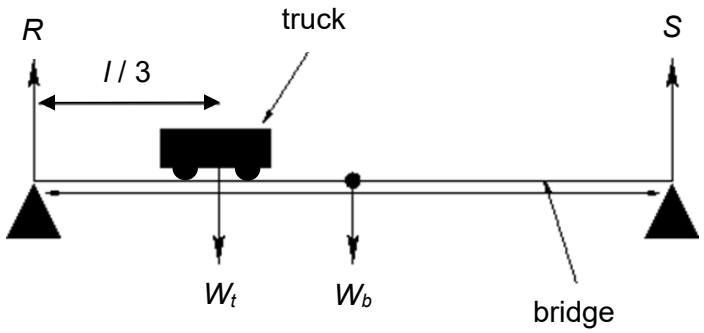

Fig. 4.2

Calculate the forces *R* and *S*, acting on the bridge when the truck is one-third of the way across the bridge. Show your working clearly.

R = ...

S = ... [3]

5 Fig. 5.1 shows a section of a solar heating system which helps to provide hot water for a house. It consists of a solar panel placed outdoor on a roof. Connected to this panel are water pipes. Heat from the Sun warms the water in these pipes which is then pumped to a hot water tank inside the house. Inside the hot water tank, the hot water transfers its heat, becomes cooled and circulates back to the solar panel.

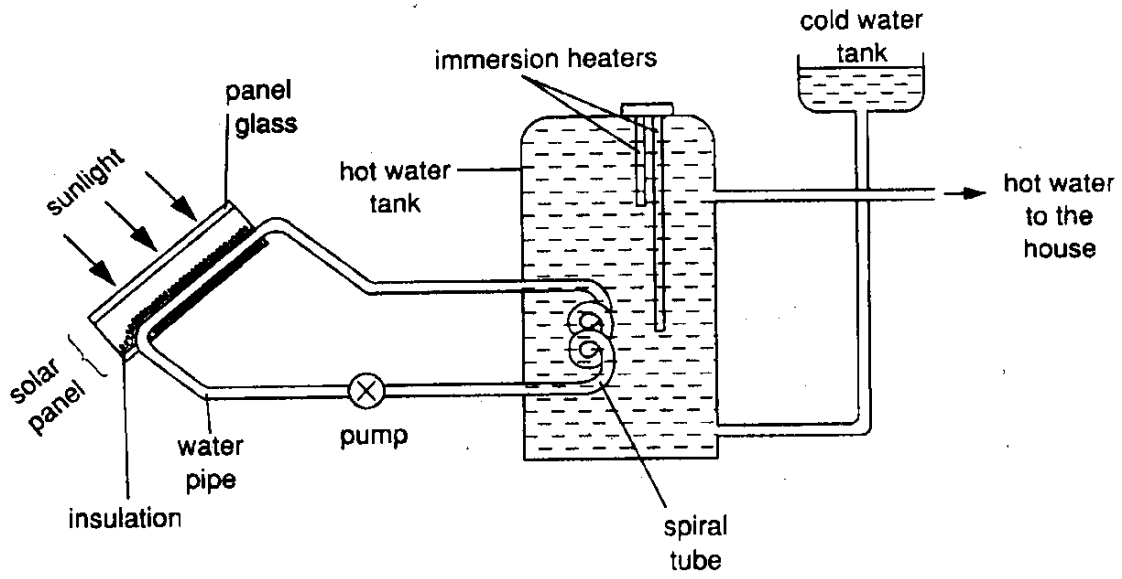

Fig. 5.1

(a) Explain the purpose of the following features:

(i) there is an insulation for the water pipe in the solar panel, and

……..

…….. [1]

(ii) the water pipe in the hot water tank is spiral and painted black.

……..

……..

…….. [2]

(b) In the hot water tank, the water enters at a higher temperature than the surrounding metal of the tank.

Explain why the water eventually cools down.

……

……

…… [2]

6 Fig. 6.1 shows a rigid rectangular card which has a rectangular hole cut out in the centre. Fig. 6.2 shows the setup used to measure the acceleration of the card as it falls freely to the ground. A torchlight which is directed towards the light dependent resistor (LDR) is turned on. A computer is used to measure the potential difference across RS.

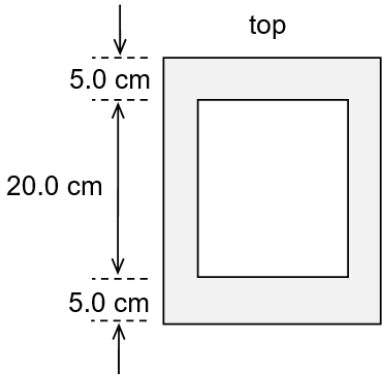

Fig. 6.1

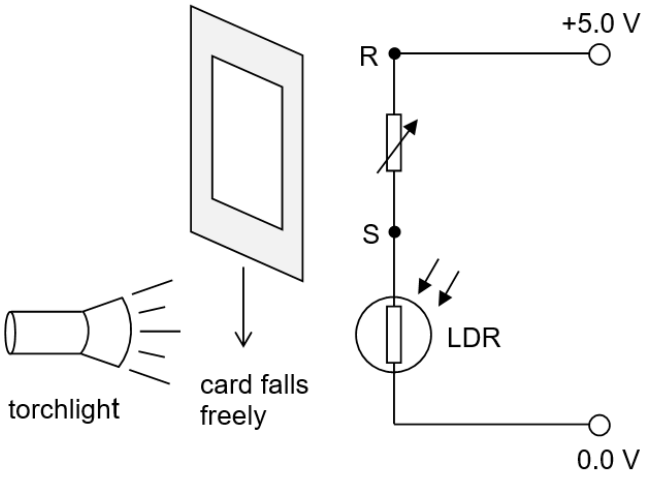

Fig 6.2

Fig. 6.3 shows the graph of potential difference (p.d.) across RS against time.

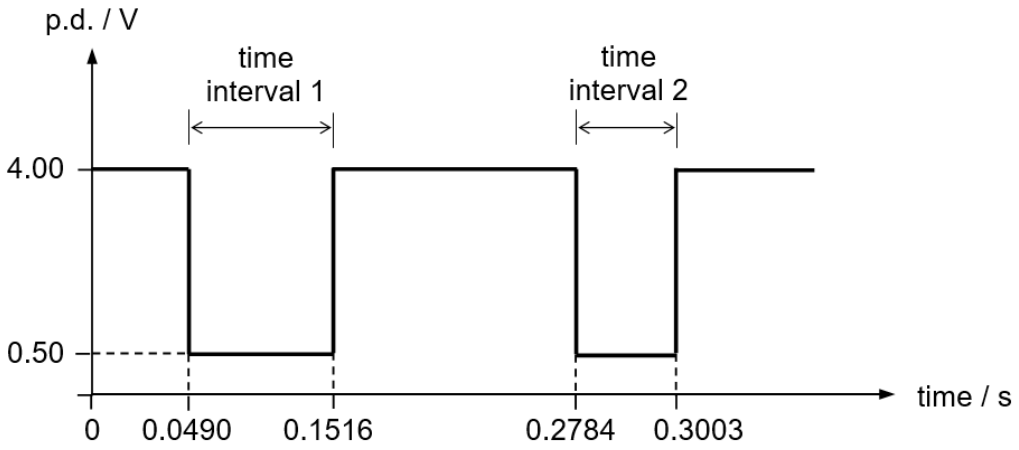

Fig. 6.3

(a) State what happens to the resistance of the LDR as the card falls.

……

……

……

…… [2]

(b) Explain why the p.d. across the variable resistor drops to 0.50 V.

……

……

……

…… [2]

(c) Explain why time interval 1 is longer than time interval 2 (as shown in Fig.6.3) when the rigid card falls.

……

……

…… [2]

7 Fig. 7.1 shows the object and its image with ray **X** moving towards a converging lens.

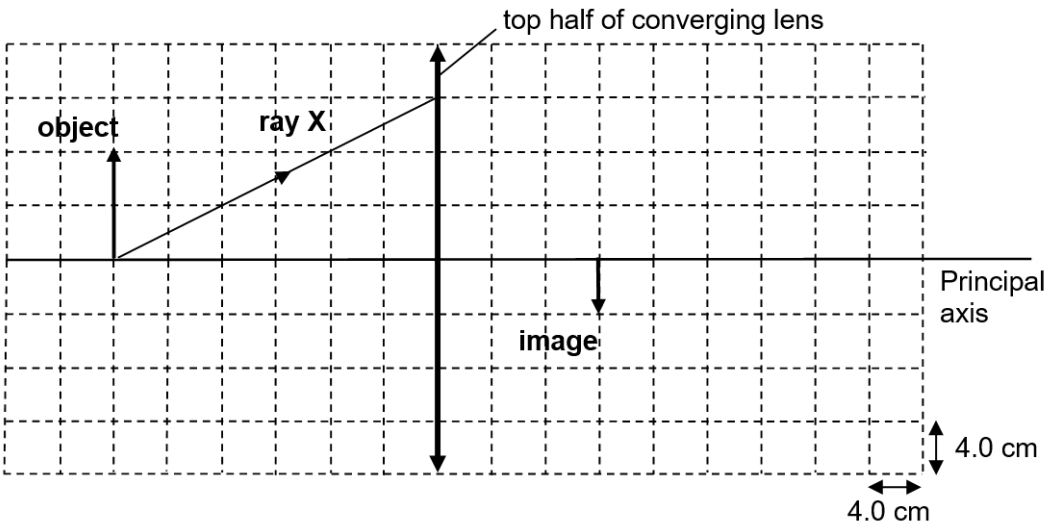

Fig. 7.1

(a) Draw, on Fig. 7.1, one ray to locate the focal point of the lens. Mark the focal point with the letter **F**. [1]

(b) Determine the focal length of the lens in Fig. 7.1.

focal length = …… [1]

(c) Complete the path for ray **X** on Fig. 7.1. [1]

(d) If the top half of the converging lens is removed, state and explain whether the image is still formed.

……

…… [2]

8. Fig 8.1 shows a light conducting sphere S hangs vertically on an insulating thread. A negatively charged plate P on an insulating stand is brought near to the sphere. Sphere S is observed to move towards plate P.

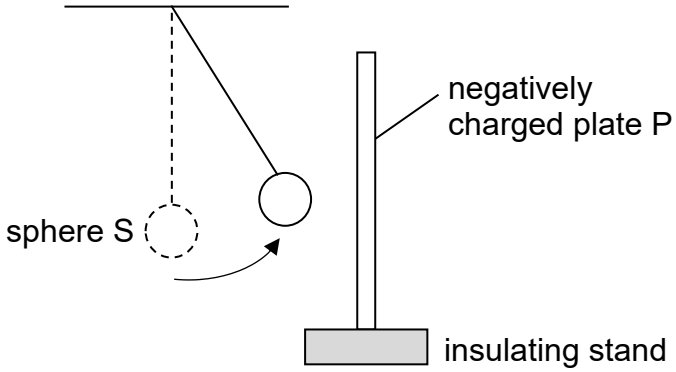

Fig. 8.1

(a) It is said that there is an electric field between sphere S and plate P.

Describe what is meant by an *electric field*.

……

…… [1]

(b) Explain what can be deduced about the charge on sphere S.

……

……

……

…… [3]

9 Fig 9.1 shows a student holding a permanent magnet directly above a small paper clip of negligible mass. The paper clip was connected to a bench by a string.

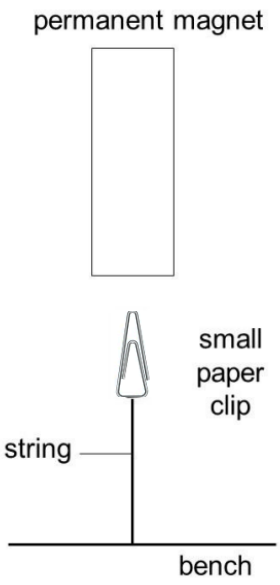

Fig. 9.1

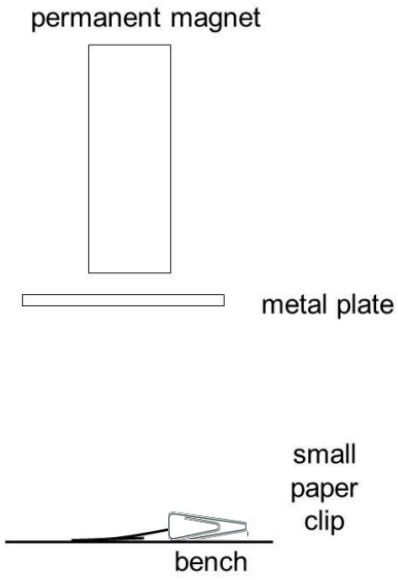

Fig 9.2

(a) Explain why the small paper clip is attracted to the magnet shown in Fig. 9.1.

……

……

…… [2]

(b) The permanent magnet is removed, and the small paper clip is then brought near some iron filings. The iron filings are attracted to the paper clip.

Suggest and explain what material the paper clip is likely made of.

……

……

…… [2]

10 A liquid containing some radioactive material is injected into the patient's blood stream. This radioactive material would be absorbed by the kidneys and then passed to the patient's bladder.

A special camera is used to detect the radiation coming from the patient's kidneys.

The half-life of four gamma sources W, X, Y and Z are listed in the Table 10.1.

Table 10.1

radioactive Source	half- life
W	2 min
X	5 min
Y	4 hours
Z	8 days

(a) The initial count rate of Y is 8000 counts per minute.

What is the count rate of Y after 24 hours?

count rate = …… counts per min [2]

(b) The examination of the patient lasts for 15 minutes

State and explain which radioactive source would be most suitable for the examination.

……

…… [2]

(c) Radioactive materials that emit alpha particles are never injected into the body to obtain medical images of parts of the body.

State two reasons why alpha emitting materials are unsuitable.

……

…… [2]

(d) Protactinium-234 ($^{234}_{91}Pa$) is a radioactive isotope of protactinium that decays to uranium-234 ($^{234}_{92}U$).

Complete the equation: $^{234}_{91}Pa \rightarrow {}^{234}_{92}U +$ ..... [1]

11 Fig. 11.1 represents wavefronts of a sound wave travelling in air from left to right.

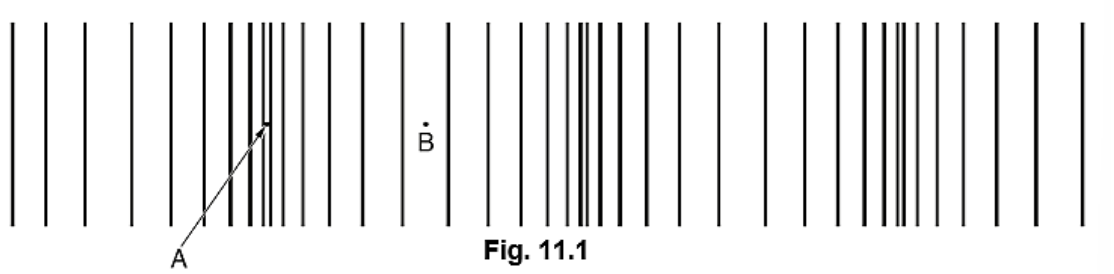

Fig. 11.1

(a) State the name given to the:

(i) region around A in the diagram .....

(ii) region around B in the diagram ..... [1]

(b) On Fig. 11.1, draw a double-headed arrow to show **one** wavelength. [1]

(c) State what is meant by *wave motion*.

.....

..... [1]

(d) State what is meant by a *wavefront*.

.....

..... [1]

(e) The loudness of the sound increases at the same pitch.

State and explain any change there would be in the pattern of wavefronts shown in Fig. 11.1.

……

……

……

…… [3]

(f) The wave passes into water.

State and explain any change in the pattern of wavefronts shown in Fig. 11.1.

……

……

……

…… [3]

12 Read the passage carefully and answer the questions that follow.

The microwave oven is now commonly used in kitchens to quickly heat up pre-prepared and fresh food. It produces microwave radiation of frequency 2500 MHz that is absorbed by water molecules. The water molecules have charge distributions which are not symmetric. When the electromagnetic field in the microwave radiation is incident on them, the water molecules increase in vibration. The microwaves can only penetrate a short distance inside the food.

The typical power in the microwave beam is 750 W. Over each distance of 3 mm, the power available from the microwave decreases by 60%.

(a) Explain what is meant by a frequency of 2500 MHz.

……

…… [1]

(b) Calculate the wavelength of the microwave used in the microwave oven.
Take the speed of the microwave as 3.0×10^8 m/s.

Wavelength of the microwave = …… [2]

(c) Use information in the passage to sketch a graph showing how the power available from the microwave varies with depth. Plot points at depths of 0, 3, and 6 mm on Fig. 12.1.

Draw the curve of best fit for these plotted points. [3]

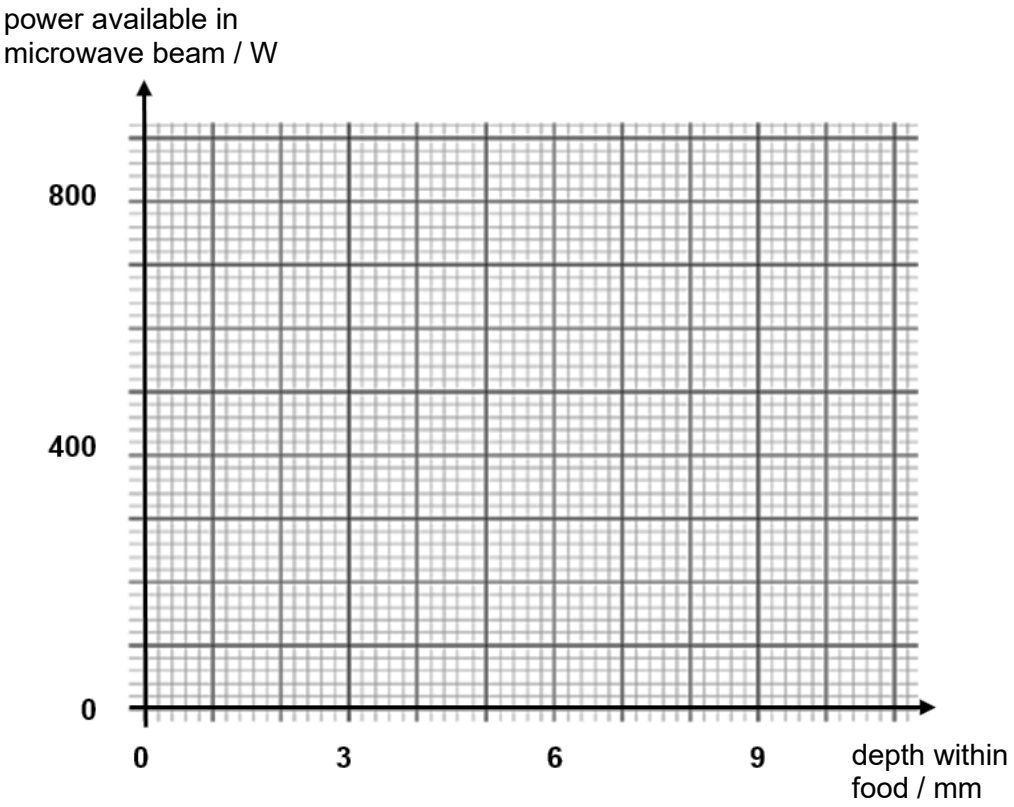

Fig. 12.1

(d) The soup is initially at -18 ºC and is to be just turned into liquid at 0 ºC. The soup can be assumed to be made entirely of water. Estimate the minimum time it will take a 750 W microwave oven to thaw 0.25 kg of frozen soup. Take the specific heat capacity of ice as 2100 J/(kg ºC) and the specific latent heat of fusion of ice as 340 000 J/kg.

Minimum time to thaw the frozen soup = …… [3]

Section B

Answer **one** question from this section

13 In a car test, a dummy driver is placed in a car seat which is 0.6 m from the steering wheel as shown in Fig 13.1. The car is made to crash into a wall at a constant speed of 15 m / s. During the collision, the front of the car collapses and is shortened by 0.5 m before the car comes to rest as shown in Fig. 13.2. The dummy continues forward freely during the impact. The total mass of the car is 1200 kg.

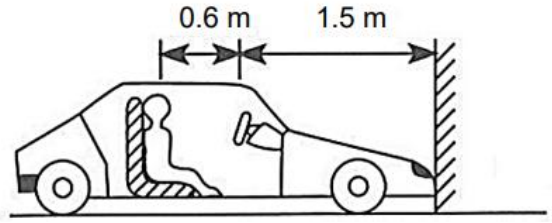

Fig. 13.1

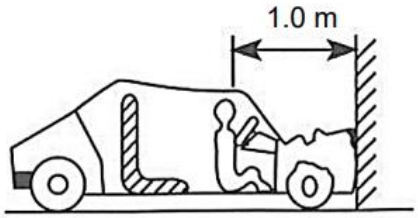

Fig. 13.2

(a) Calculate the energy in the kinetic store of the car before it crashes into the wall.

energy in the kinetic store = …… [2]

(b) Work is done by a force acting on the car at the point of the collision to slow it down.

(i) On Fig. 13.1, draw and label the action-reaction pair of forces at the point of collision. [1]

(ii) Calculate the average force acting on the car during the collision when the front of the car collapses by 0.5 m.

average force = ……. [2]

(iii) Using the answer in (b)(ii), calculate the duration of collision between the car and the wall.

time = ……. [2]

(c) **(i)** Explain why the dummy continues to move forward upon impact.

……..

……..

…….. [2]

(ii) A seat belt is secured over the dummy.
Explain how this can protect the dummy from the accident in (c)(i).

……..

……..

…….. [1]

14 A battery of electromotive force (e.m.f.) 4.5 V is connected to two filament lamps P and Q and a resistor R, as shown in Fig. 14.1.

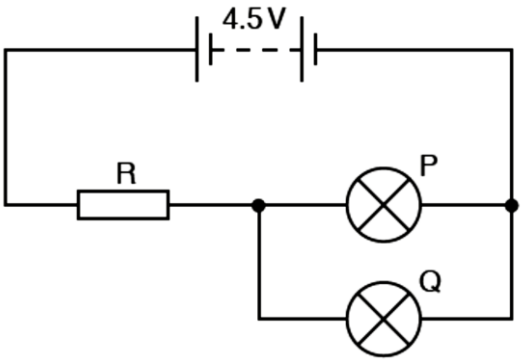

Fig. 14.1

The *I*–*V* characteristics of the filament lamps are shown in Fig. 14.2.

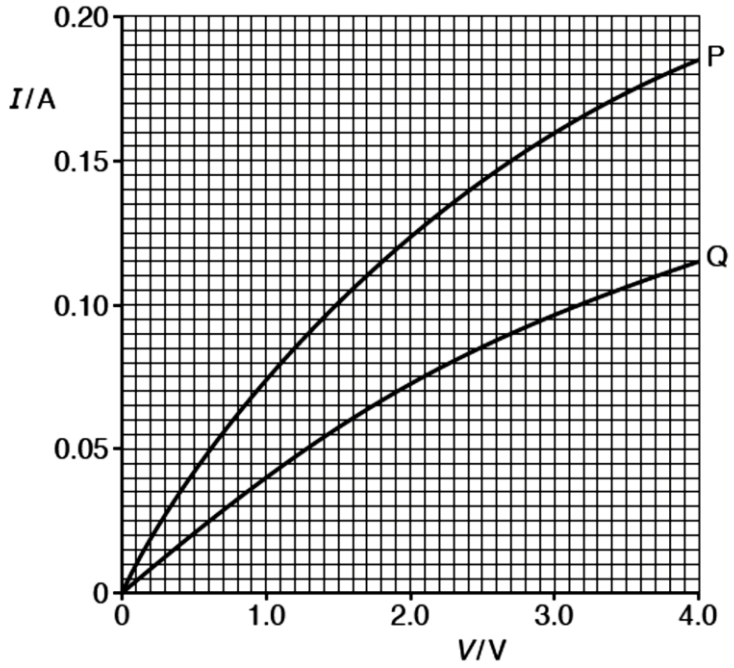

Fig. 14.2

(a) Define *e.m.f.*

.....

..... [1]

(b) The filament lamps do not obey Ohm's Law.

(i) Describe how Fig. 14.2 shows that the filament lamps do **not** obey Ohm's Law.

……..

…….. [1]

(ii) Explain why the filament lamps do **not** obey Ohm's Law.

……..

…….. [1]

(c) **(i)** The current in lamp P is 0.15 A.
Calculate the resistance of resistor R.

resistance = ……. [2]

(ii) The filament wires of the two lamps are made from material with the same resistivity at their operating temperature in the circuit. The diameter of the wire of lamp P is twice the diameter of the wire of lamp Q.

Determine the ratio of $\frac{\text{length of filament wire of lamp P}}{\text{length of filament wire of lamp Q}}$.

ratio = …….. [3]

(iii) The filament wire of lamp Q breaks and stops conducting.
With reference to Fig. 14.2, state and explain qualitatively, the effect on the resistance of lamp P.

……

……

…… [2]

End of Paper

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