NAME:.....MARKING.....SCHEME..... INDEX NO:.....................................

232/1
PHYSICS
PAPER 1
(THEORY)
JUNE, 2022
TIME: 2 HOURS

CANDIDATE'S SIGN:.....................

DATE:.....................................

SUKELLEMO JOINT EXAMINATIONS – 2022

INSTRUCTIONS TO THE CANDIDATE:
(a) Write your **name** and **index number** in the spaces provided above.
(b) **Sign** and write the **date** of examination in the spaces provided above.
(c) This paper consists of **two** Sections **A** and **B**.
(d) There are 14 printed pages, with 18 questions check to confirm that your paper is complete.
(e) Answer **all** the questions in sections **A** and **B** in the spaces provided.
(f) All working **must** be clearly shown in the spaces provided.
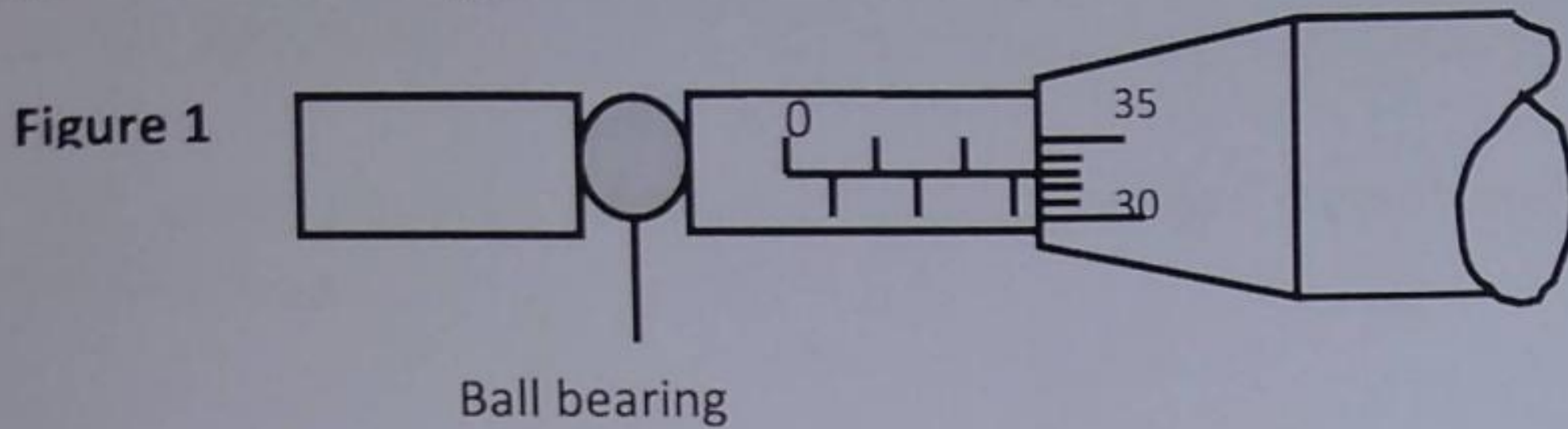(g) Mathematical tables and electronic calculators **may be** used.

FOR EXAMINER'S USE ONLY:

Section	Question	Maximum Score	Candidate's Score
A	1 – 12	25	
B	13	08	
	14	10	
	15	09	
	16	07	
	17	12	
	18	09	
Total Score		80	

SECTION A: (25 MARKS)

1. A ball bearing is held between the anvil and spindle of a micrometer screw gauge as shown in the **Figure 1** below.

Figure 1

Ball bearing

What is the diameter of the ball bearing? (1 mark)

$$2.50$$
$$+ 0.33$$
$$2.88 \, mm \quad ✓ ①$$

2. State two properties of a liquid that is suitable for use in a thermometer. (2marks)

– Does not wet the glass. ✓ ①

– Has a wide range of temperature. ✓ ①   Any other correct.
– Is a good heat conductor.

3. In an experiment to determine the relative density of a substance using a density bottle the following measurements were taken. (Take density of water to be $1g/cm^3$)

- Mass of empty density bottle = 43.2 g
- Mass of bottle full of water = 66.4 g
- Mass of bottle filled with liquid X = 68.2g

Use the data to determine the density of the liquids. (3marks)

Water. | Liquid X.   ✓ ①

$m = 66.4 - 43.2 = 23.2g$ | $m = 68.2 - 43.2 = 25.0g$

$\therefore V = 23.2 \, cm^3$ ✓ ① | $\rho = \dfrac{m}{V} = \dfrac{25}{23.2} = 1.078 g/cm^3$ ✓ ①

4. Why are gases more compressible while liquids and solids are almost incompressible?

(1mark)

Gases have larger intermolecular spaces than liquids and solids.

5. The graph shows variation of extension and stretching force F for a spring which obeys Hooke's law.
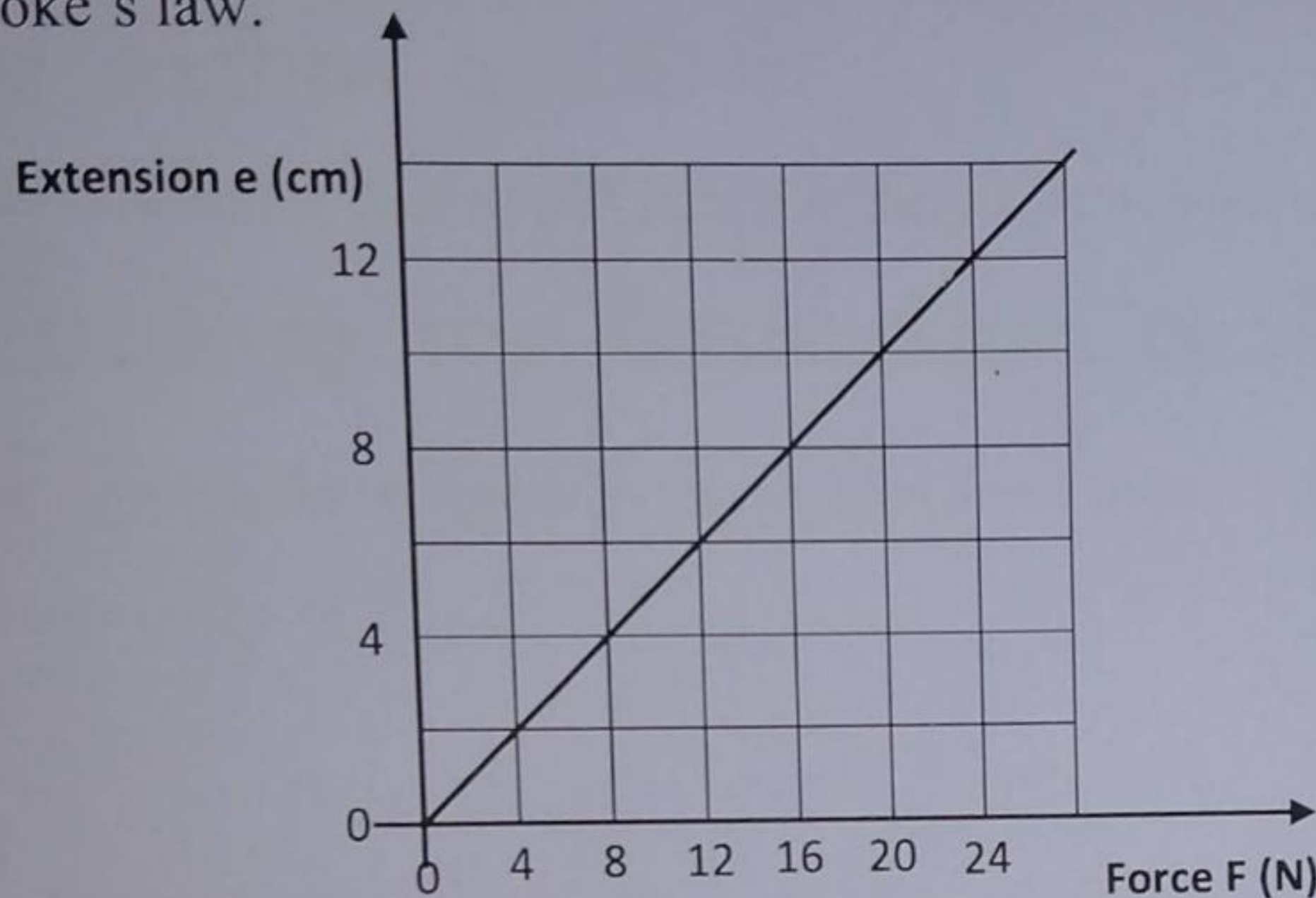
(i) Determine the spring constant in SI units. (1mark)

$$K = \frac{F}{e} = \frac{24-0}{12-0} = \frac{24}{12} = 2 N/cm \cdot \quad \frac{1}{2}.$$

$$= 200 N/m \cdot \quad \frac{1}{2}$$
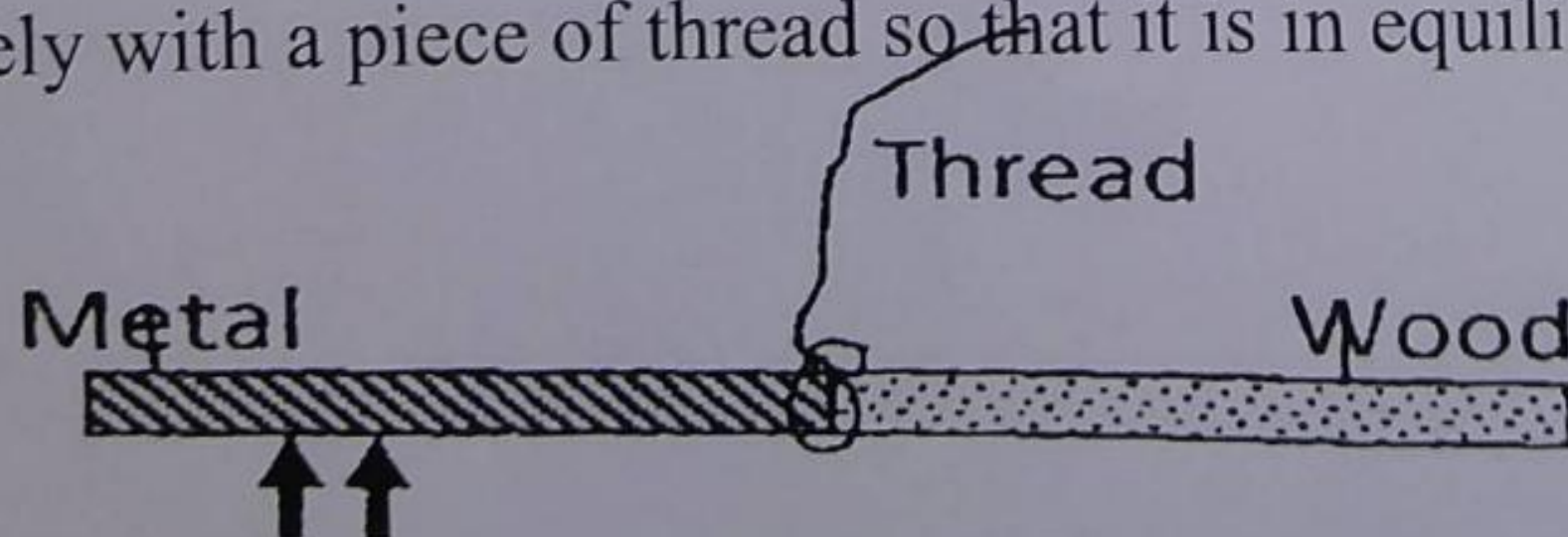
(ii) The energy stored when the extension is 20cm. (2marks)

$$E = \frac{1}{2} F e$$

$$= \frac{1}{2} \times k e^2$$

$$= \frac{1}{2} \times 200 \times 0.2^2 \quad ① \qquad = 20 \times 0.2$$

$$= 4J \cdot \quad ① \cdot$$

6. The figure 2 below shows a rod made of wood on one end and metal on the other end suspended freely with a piece of thread so that it is in equilibrium.

The side made of metal is now heated with a Bunsen flame. State with a reason, the side to which the rod is likely to tilt. (2 marks)

It tilts in anticlockwise direction. ✓①   shifting

When the metal was heated, it expanded hence the position of C·O·G. ✓①

7. State one factor that would increase the surface tension of pure water in a beaker of water. (1 mark)

• Lowering the temperature of the water. ✓①

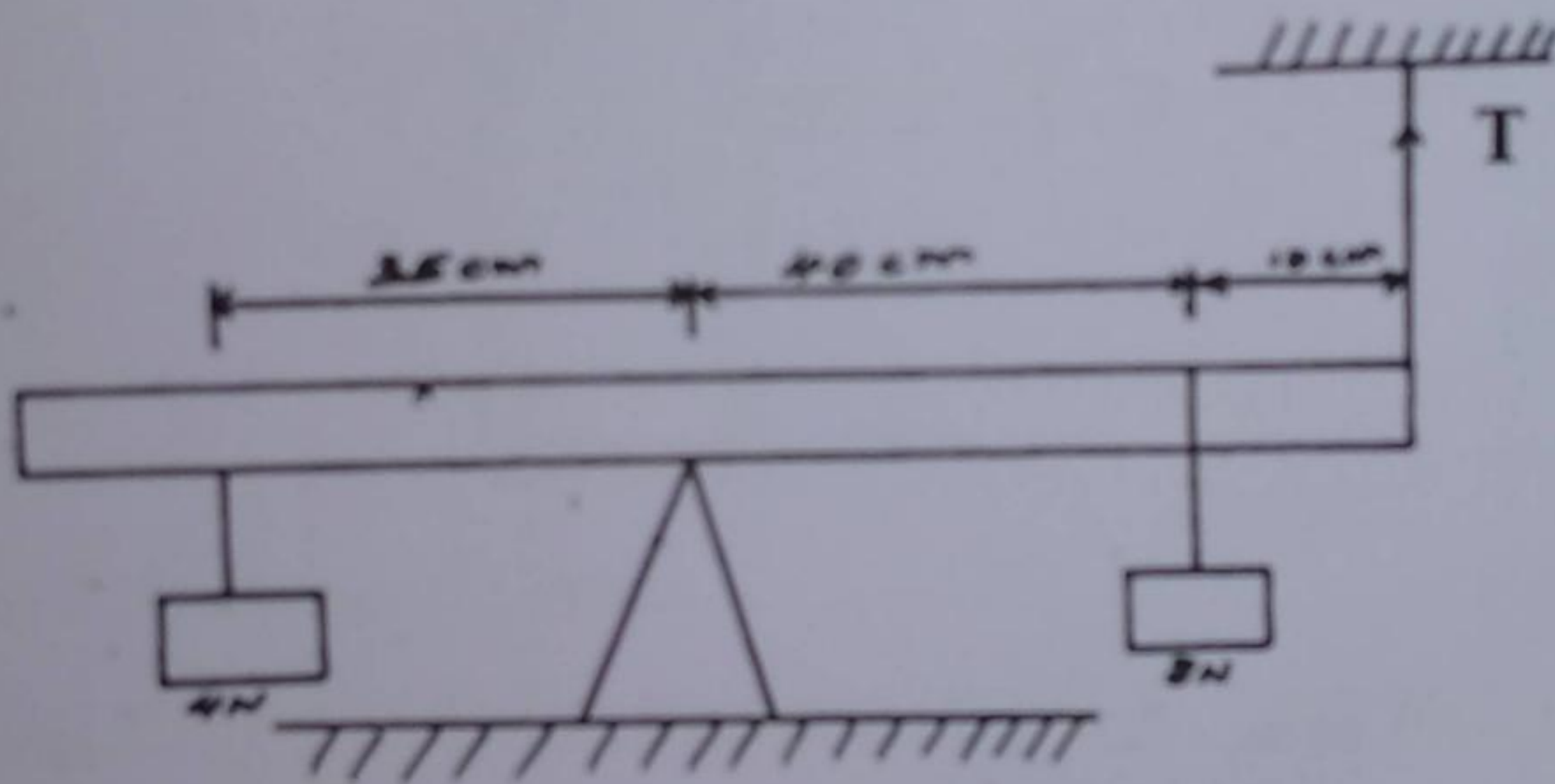8. The figure below (figure 3) shows a uniform metal rod balanced at its Centre by different forces.

Figure 3

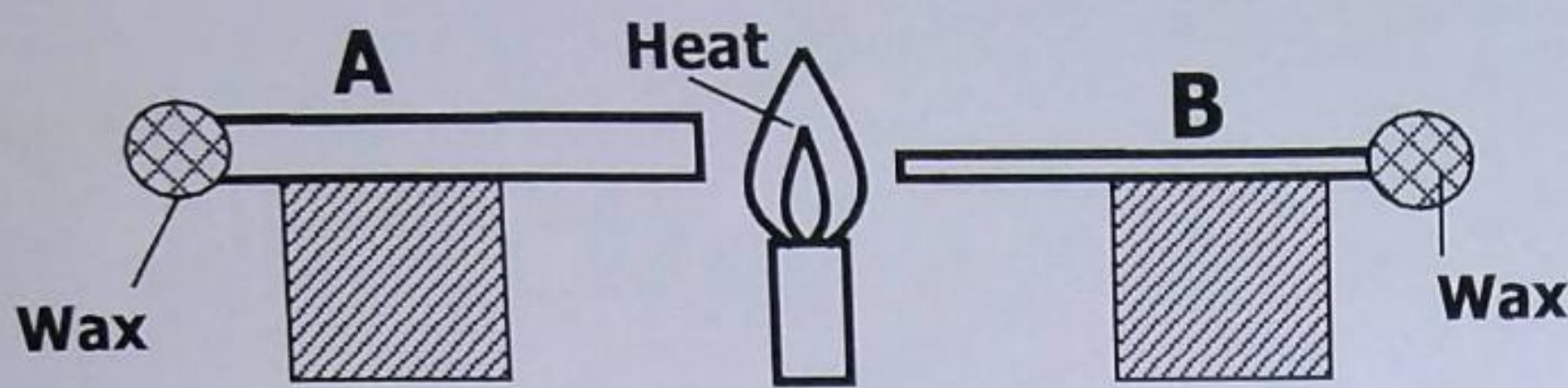Determine the value of T. (3 marks)

$$F_1 d_1 + F_2 d_2 = F_3 d_3$$ ✓①

$$(4 \times 0.35) + (T \times 0.5) = (8 \times 0.4)$$ ✓①

$$1.4 + 0.5T = 3.2$$

$$0.5T = 1.8$$

$$T = 3.6 N$$ ✓①

9. Two rods of copper **A** and **B** of the same length but different thickness with candle wax attached to either end are heated as shown below.

State and explain the observation made. (2 marks)

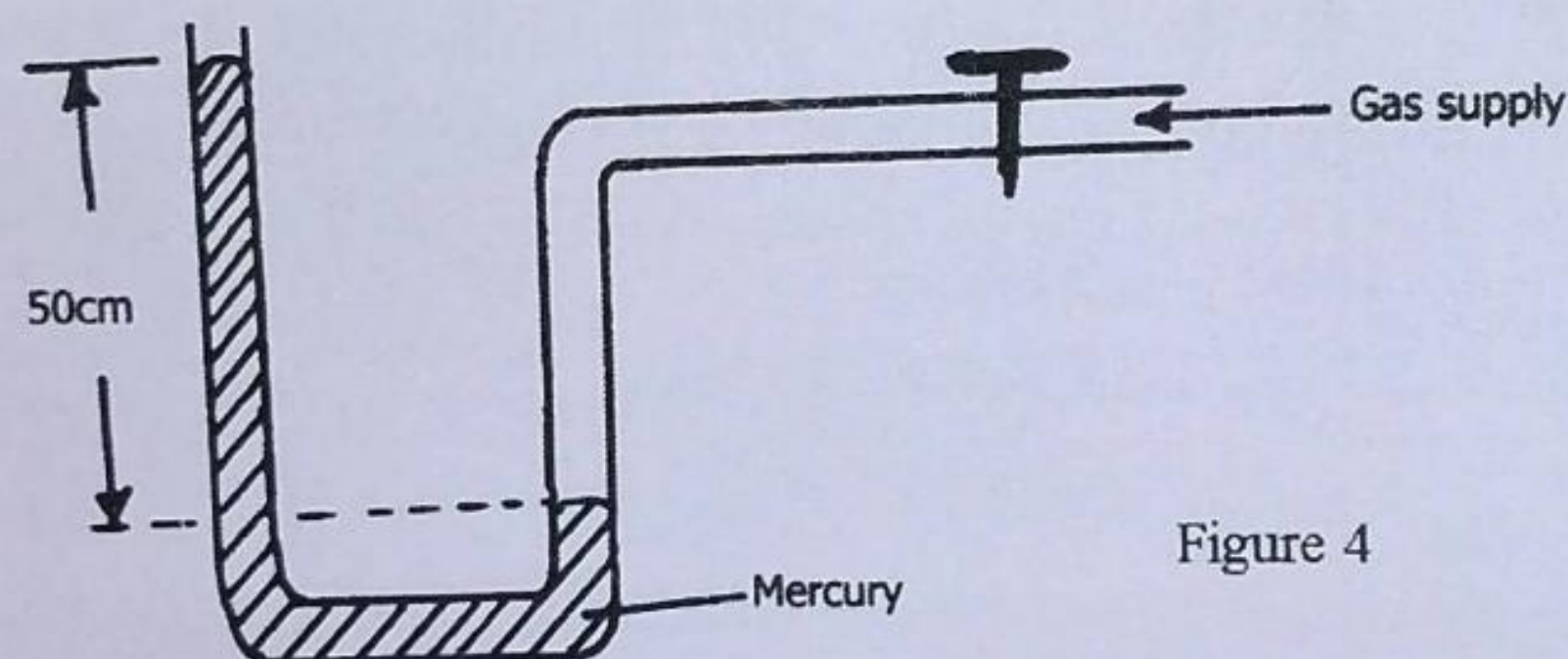The wax on rod A falls off first then from B later.

A has a larger cross-sectional area hence conducts heat faster than B.

10. Figure 4 shows a manometer attached to a gas supply. If the atmospheric pressure is 1.0336 x 10⁵Pa. Calculate the pressure of the gas supply.

(Density of mercury = 13600kg/m³) (2 marks)

Figure 4

$P_{atm} + P_{mercury} = P_{gas}$.

$P_{mercury} = h\rho g = 0.5 \times 13600 \times 10 = 68,000$ Pa. ✓①

$P_{gas} = 103360 + 68000 = 171,360$ Pa. ✓①

11. A block of wood measuring 0.8m by 0.5m by 2m floats in water. 1.2m of the block is submerged. (Density of water = 1000kg/m³ , g=10N/kg) Determine the weight of the water displaced. (3 marks)

Volume of water displaced = $0.8 \times 0.5 \times 1.2 = 0.48 m^3$ ✓①

mass = $\rho V = 1000 \times 0.48 = 480$ Kg. ✓①

$W = mg = 480 \times 10 = 4800$ N ✓①

12. The figure 5 below shows two light sheets of paper arranged as shown.

Fig. 5
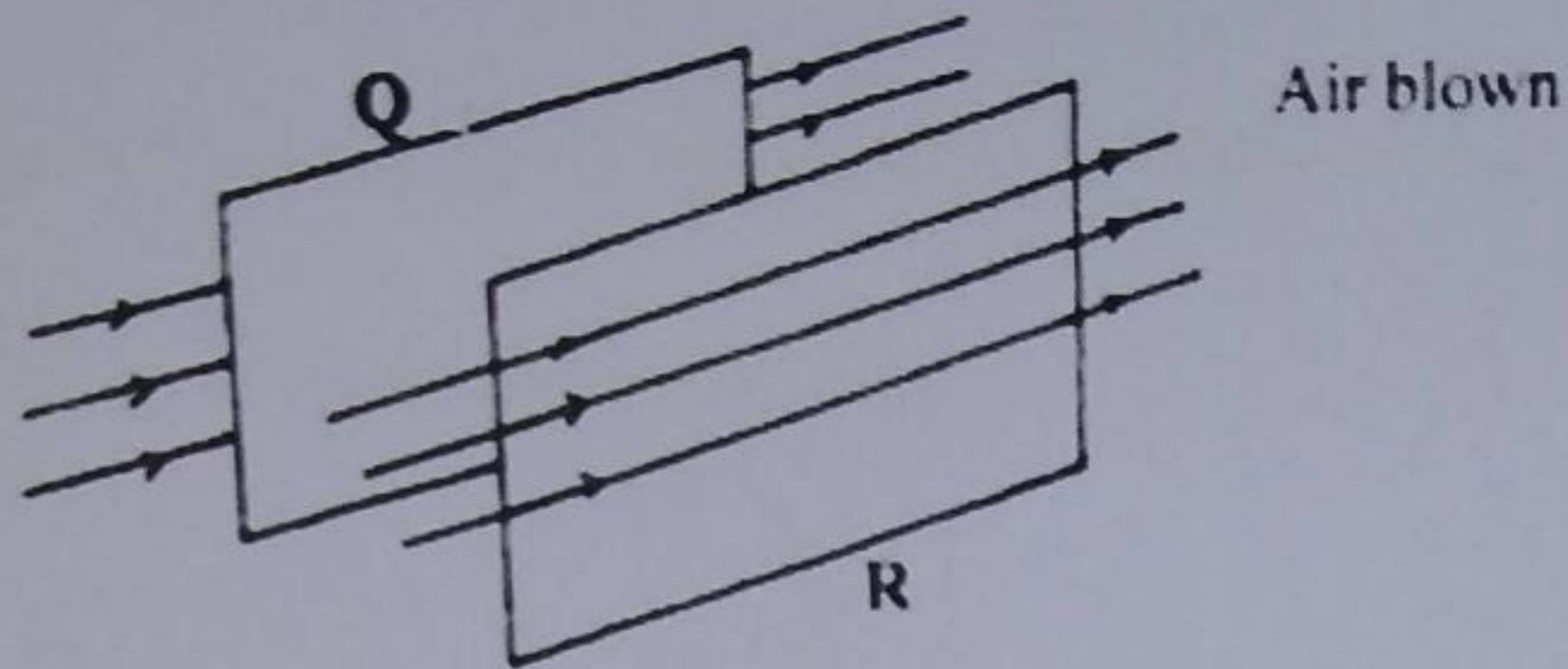
Its observed that the papers move away from each other when strong air is blown at the same time behind paper Q and in front of paper R as shown. Explain (2 marks)

When air is blown, air moves at high velocity on the outer sides of the papers producing a region of low pressure. Higher atmospheric pressure between them pushes them out.

13. A block and tackle is made up of three pulley wheels on top and two pulley wheels at the bottom in figure 6
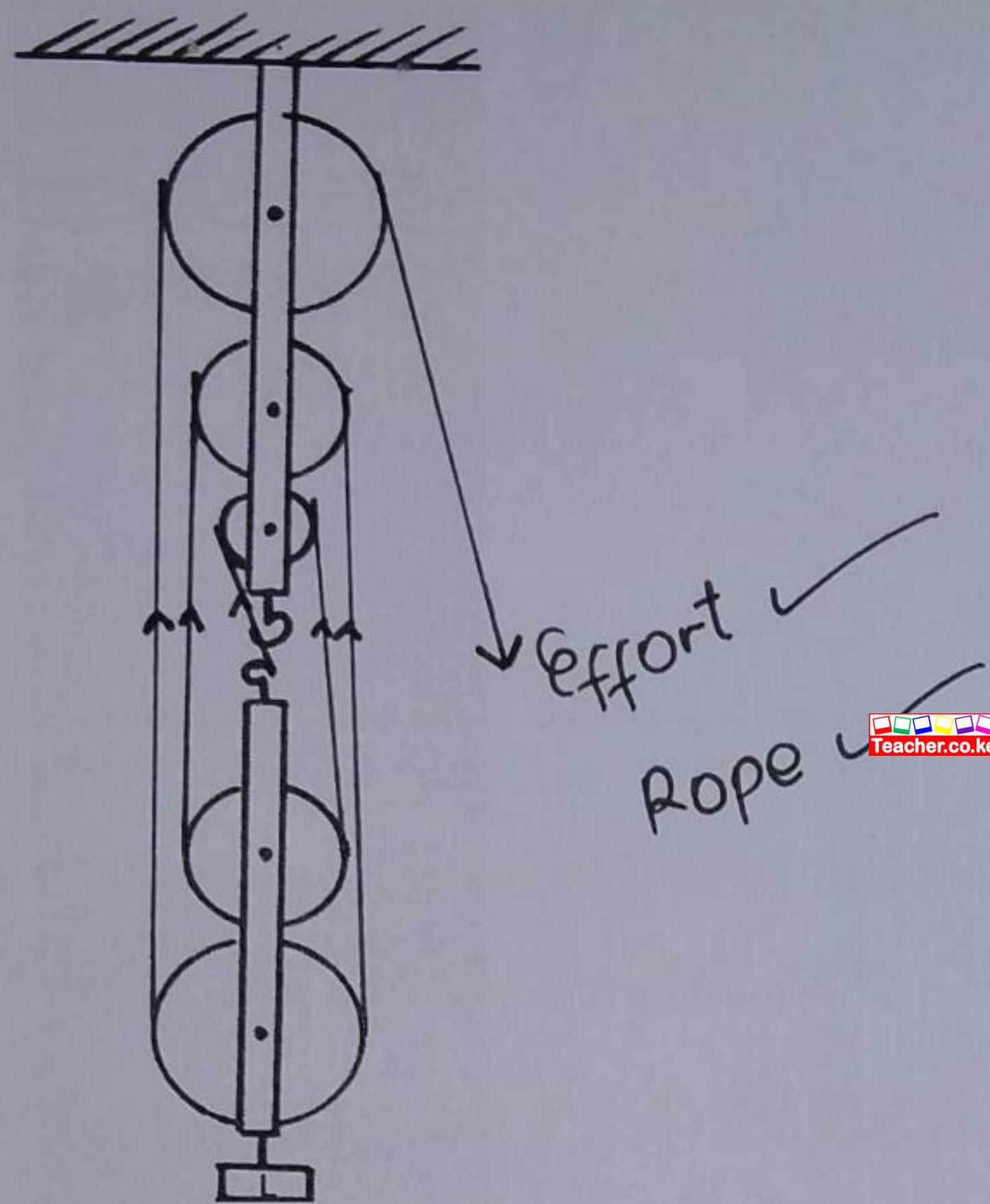

Figure 6

(a)   Complete the diagram by drawing the chain which passes over the wheels and indicate where the effort is applied   (2 marks)

(b)   What is the velocity ratio (V.R) of the machine   (1 mark)

5.   ✓ 1

(c)   A load of 1120N is lifted by an effort of 250N

Determine

(i)   The mechanical advantage (M.A) of the system   (2 mark)

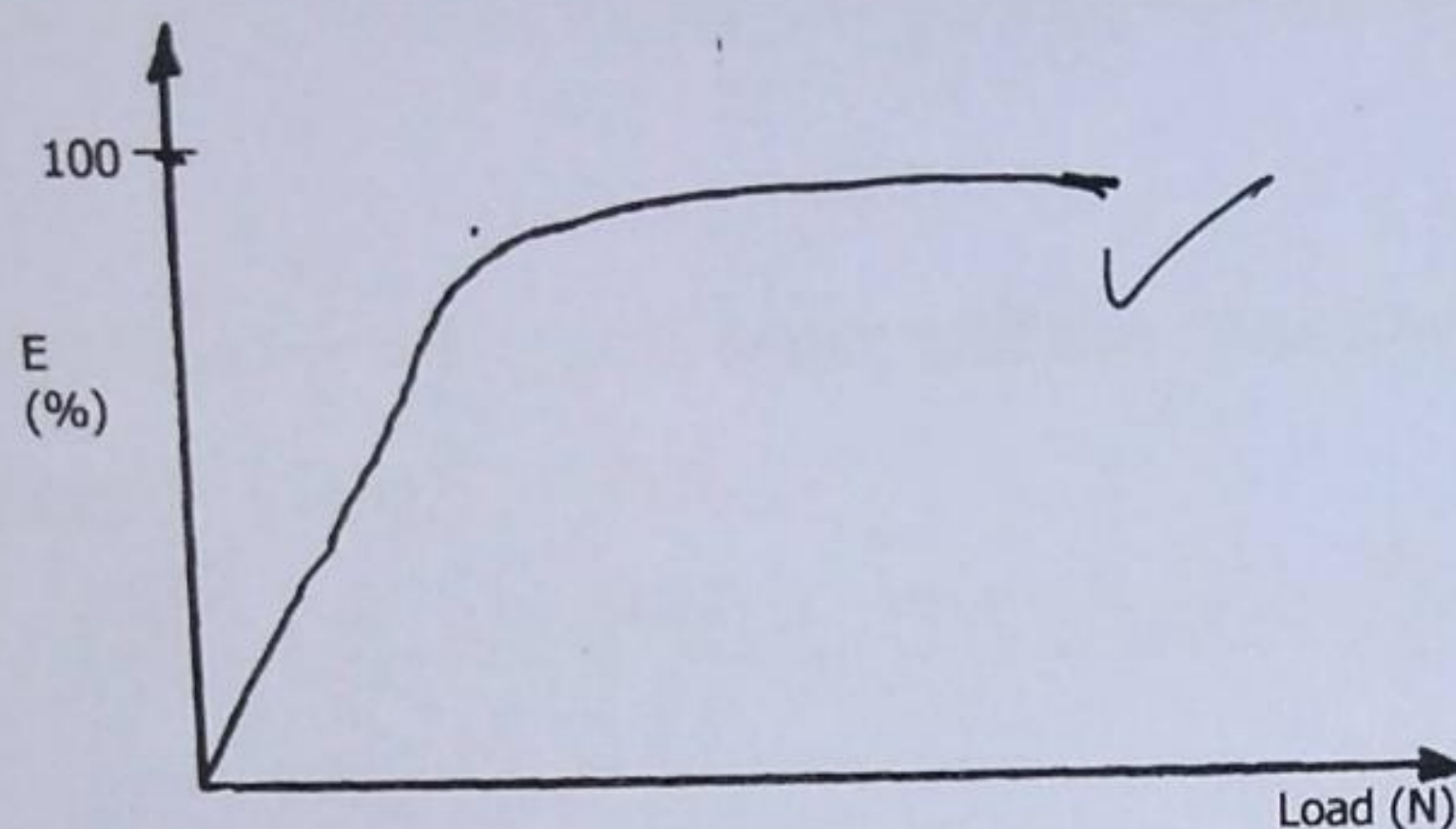$$MA = \frac{L}{E} = \frac{1120}{250} ① = 4.48 ✓ ①$$

(ii)   The efficiency, E, of the system   (2 marks)

$$\text{Efficiency} = \frac{M.A}{V.R} \times 100\% \quad \checkmark ①$$

$$\frac{4.48}{5} \times 100\% \quad = 89.6\% \quad \checkmark ①$$

(e)   Using the axes given below, sketch a graph of efficiency, E, against load

(1 mark)

The curve should be below 100%

14.(a)   What is meant by the term specific latent heat of fusion of a substance? (1 mark)

This is the amount of heat required to change unit mass of a substance from solid to liquid(melt) completely at constant temperature. $\checkmark ①$

(b)   Water of mass 200g at a temperature of 60°C is put in a well lagged copper calorimeter of mass 80g. A piece of ice at 0°C and mass 20g is placed in the calorimeter and the mixture stirred gently until all the ice melts. The final temperature of the mixture is then measured (Latent heat of fusion of ice = 334000Jkg^{-1}, specific heat capacity of water = 4200Jkg^{-1}K^{-1})

Determine:

(i)   The heat absorbed by the melting ice at 0°C   (2 marks)

Water	Calorimeter	Ice	Heat absorbed by ice.
200g.	80g	0°C	$= mL_f$ $\checkmark ①$
60°C.	60°C	20g	$= \frac{20}{1000} \times 334000$
T	T.	T	$= 6680J$ $\checkmark ①$

(ii)   The heat absorbed by the melted ice (water) to rise to temperature T   (2 marks)

Heat $= mc\,\Delta\theta$. ✓ ①

$\qquad = 0.02 \times 4200 \times T$

$\qquad = 84T \quad J$ ✓ ①

(iii)   The heat lost by the warm water and the calorimeter (Specific heat capacity of the

calorimeter $= 900\,Jkg^{-1}K^{-1}$)   (3 marks) ✓

Heat lost by water $= mc\,\Delta\theta = 0.2 \times 4200 \times (60-T)$ ✓ ①

$\qquad\qquad\qquad = 840(60-T) = 50400 - 840T$

Heat lost by calorimeter $= mc\Delta\theta = 0.08 \times 900 \times (60-T)$ ✓ ①

$\qquad\qquad\qquad = 72(60-T) = 4320 - 72T$

Total lost by water & calorimeter $= (54720 - 912T)\ J.$ ✓ ①

(iv)   The final temperature T of the mixture   (3 marks)

Heat lost $=$ Heat gained. ✓ ①

$54720 - 912T$ ① $= 6680 + 84T.$

$\qquad 48040 \qquad = 996T$

$\qquad T = 48.23°C$ ✓ ①

15. A lead shot of mass 40g is tied to a string of length 70cm. It is swung vertically at 5 revolutions per second. (Take g=10m/s²)

(a) Determine;

(i) Periodic time,   (1 mark)

$r = 0.7m.$ $T = \frac{1}{f} = \frac{1}{5} = 0.2s$ ①

$f = 5Hz.$

(ii) Angular velocity   (2 marks)

$\omega = 2\pi f$ ①

$= 2\pi \times 5 = 31.42 \, rad/s.$ ①

(iii) Linear velocity   (2 marks)

$v = \omega r$ ①

$= 31.42 \times 0.7 = 21.99 \, m/s$ ①

(iv) Maximum tension in the string.   (2 marks)

$Max \, T = \frac{mv^2}{r} + mg$ ①
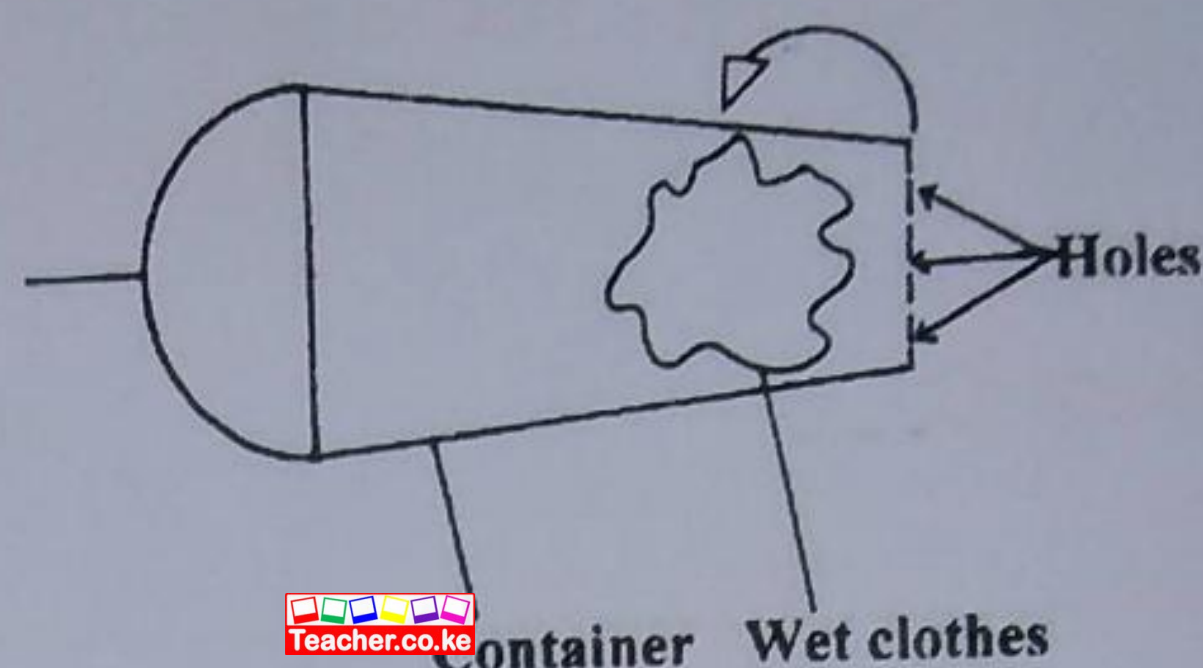
$= \frac{0.04 \times 21.99^2}{0.7} + 0.04 \times 10.$

$= 27.64 + 0.4$

$= 28.04N$ ①

(b)   The figure 7 below shows a container with small holes at the bottom in which wet clothes have been put. When the container is whirled in air at high speed as shown, it is observed that the clothes dry faster. Explain how the rotation of the container causes the clothes to dry faster.   (2 marks)

Fig 7

Holes

Container   Wet clothes

Water being denser and more massive, the clothes occupy ✓① the furthest end of the container hence spilling off through the holes. ✓①

16.(a)   Give a reason why the inside of a helmet is lined with sponge.   (1 mark)

* It increases the time of impact hence reducing the impulsive force produced during an accident. ✓①

(b)   The figure below shows a balloon filled with air.

air   balloon
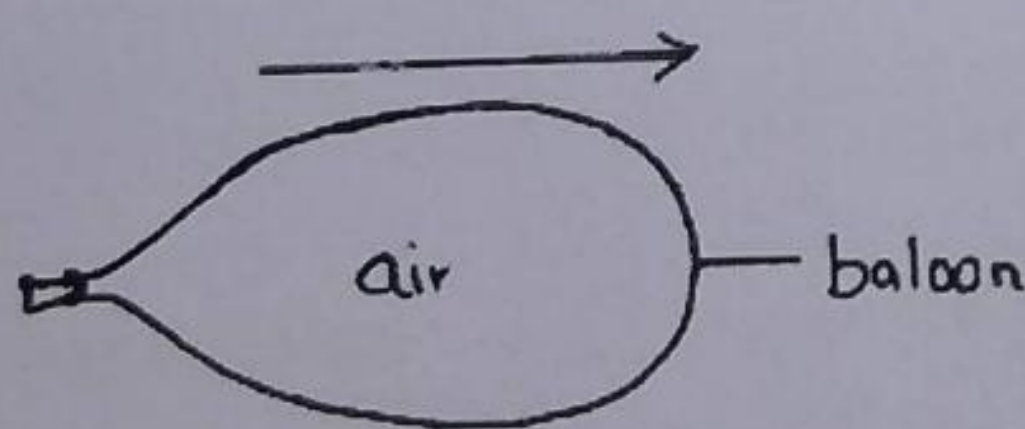
When the mouth is suddenly opened, the balloon moves in the direction shown above by the arrow. Explain that observation.   (2 marks)
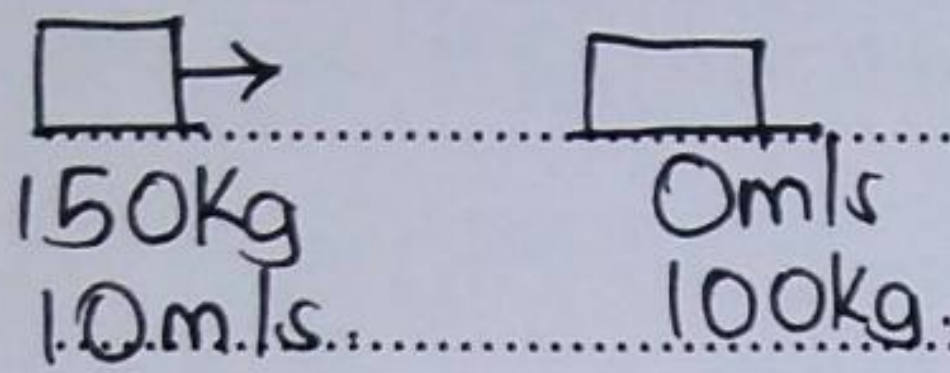
The leaving air exerts ① an action force which produces an equal but opposite reaction. ✓①

(c) A rock of mass 150kg moving at 10m/s collides with a stationary rock of mass100kg. They fuse after collision. Determine the

(i)   Total momentum before collision.   ✓ ① (2 marks)

150Kg   Omls
1.0.m.ls.   100kg.

$$Momentum = m_1u_1 + m_2u_2$$
$$= 150 \times 10 + 100 \times 0.$$
$$= 1500 \ Kg \ m/s . \ ✓ ①$$

(ii)   Their common velocity after collision.   (2 marks)

$$Final \ momentum = (m_1 + m_2)v$$
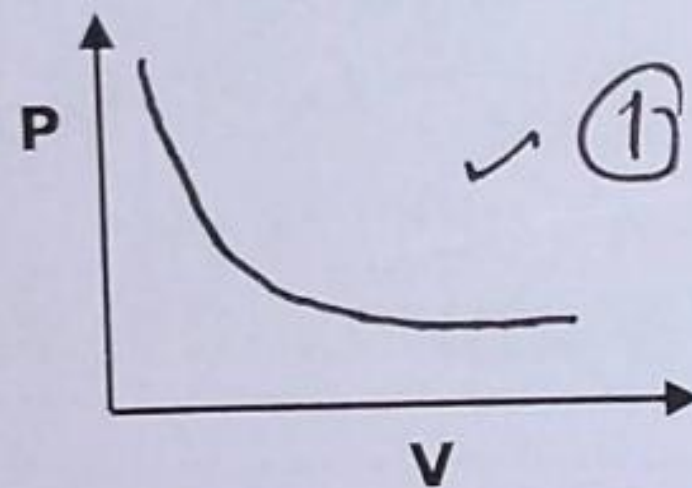$$= (100 + 150)v = 250V . \ ✓ ①$$
$$Initial \ momentum = Final \ momentum$$
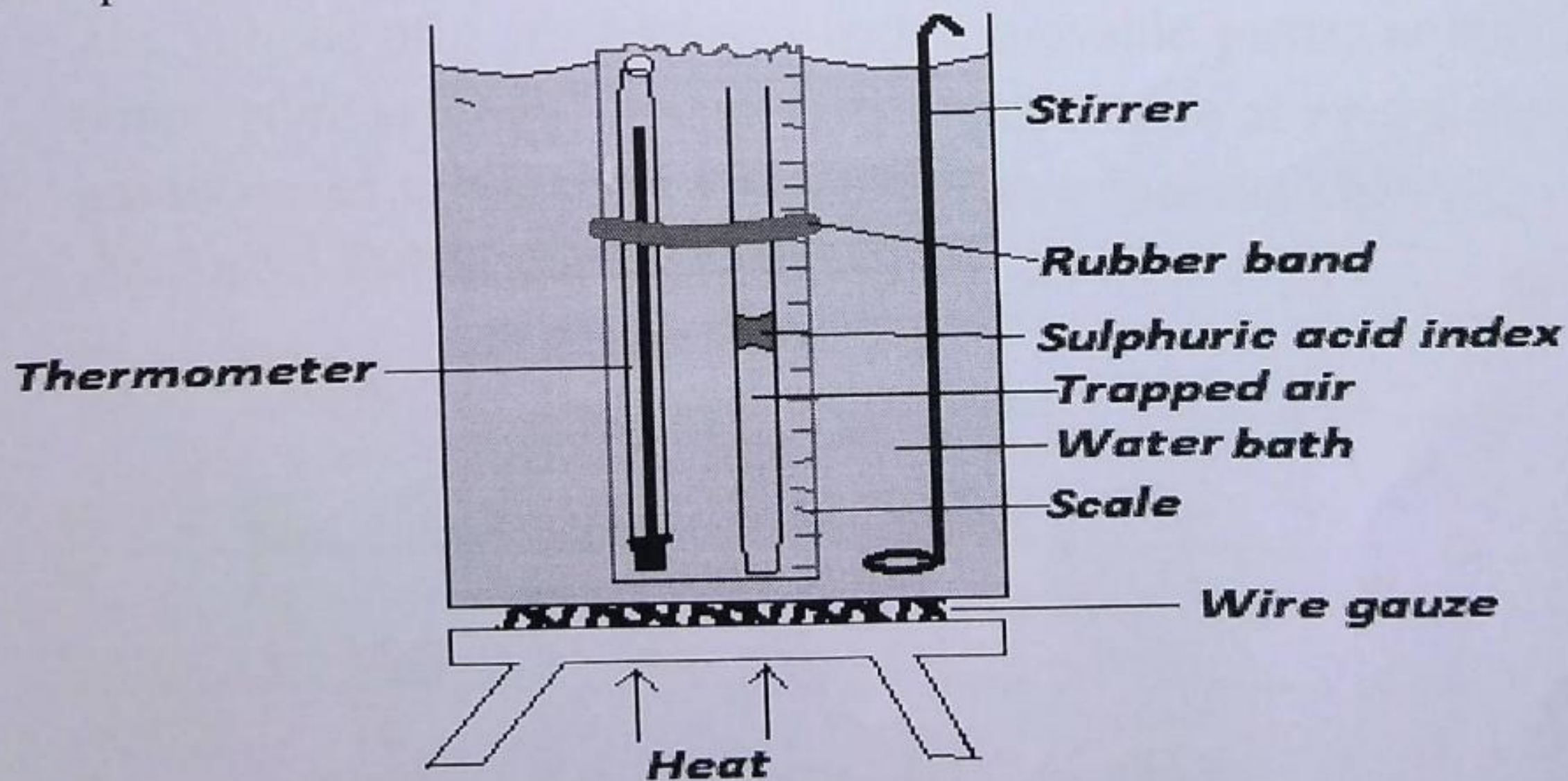$$1500 = 250V .$$
$$\therefore V = 6m/s . \ ✓ ①$$

17.(a) On the axis below, sketch a graph to show how the pressure of a fixed mass of a gas varies with volume at constant temperature.   (1 mark)

✓ ①

(b) The set-up below shows an arrangement that can be used to Verify Charles' law.

(i)   State any one use of sulphuric acid index in the above set up.   (1 mark)

✓ ①   (any one correct)

- Dry the trapped air.
- Indicate the level of the trapped air.   ①

Scanned by TapScanner

(ii) What is the use of the stirrer? (1 mark)

To distribute heat in the water evenly. ①

(iii) State two measurements that should be taken in this experiment. (2 marks)

- Temperature of water ①
- Height of trapped air. ①

(iv) Describe how the set up can be used to verify Charles' law. (4 marks)

× Initial length of air column is taken and recorded, as well as initial thermometer reading. ①

* Water bath is heated and new height of air column is recorded with its corresponding temperature reading.
* This is repeated several times at suitable temperature intervals to get several pairs of results. ①
* A graph of Volume (height) against Absolute Temperature is plotted. ①
* It is a straight line with a positive gradient
* This shows that the volume is directly proportional to the absolute temperature. ①

* Reject temperature alone.

(c) The volume of a gas enclosed with a movable piston is 300 cm³ when the temperature is 290K. Determine the temperature at which the volume of the gas increases to 355 cm³ (Assume pressure does not change) (3 marks)

$V_1 = 300 cm^3$ $V_2 = 355 cm^3$

$T_1 = 290K$ $T_2 = ?$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\frac{300}{290} = \frac{355}{T_2}$ ✓ ①

$T_2 = \frac{355 \times 290}{30} = 343.2K$ ✓ ① ①

18. (a). The section of the tape shown below was produced when a tape running down an incline plane was attached to a **ticker-tape timer** of frequency **50Hz**.
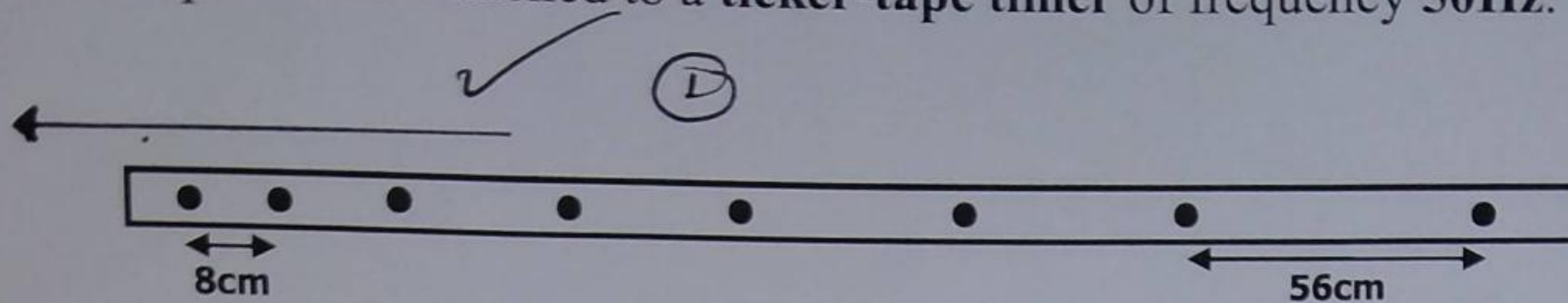
i) Indicate above the tape the direction in which the trolley was moving. (1 mark)

ii) What type of current was used to operate the ticker timer? (1 mark)

...... Alternating Current ✓ ...... ①

iii) Find the acceleration of the trolley in SI units. (3 marks)

$u = \dfrac{d}{t} = \dfrac{8cm}{0.025} = 400cm/s$

$= 4m/s$ ✓ ①

$v = \dfrac{56}{0.02} = 2800cm/s = 28m/s$ ✓ ①

$a = \dfrac{v-u}{t} = \dfrac{28-4}{6\times0.02} = \dfrac{24}{0.12} = 200m/s^2$ ✓ ①

(b). A stone is projected vertically upwards with initial velocity of 40m/s from the ground.

Calculate:

i) Time taken to reach maximum height (2 marks)

$v = 0.$ $v = u - gt$ ✓ ①

$u = 40m/s$ $0 = 40 - 10t$

$g = 10$ $10t = 40$

           $t = 4s$ ✓ ①

ii) Maximum height reached (2 marks)

$v^2 = u^2 - 2gs$ ✓

$0^2 = 40^2 - 2\times10s$ ①

$20s = 1600$

$s = 80m$ ✓ ①

THIS IS THE LAST PRINTED PAGE. BEST OF LUCK.