3.5 PHYSICS (232)

3.5.1 Physics Paper 1 (232/1)

SECTION A: (25 marks)

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

1 A student measured the length of a wire four times using a metre rule and obtained the following readings: 18.6 cm; 18.5 cm; 18.6 cm and 18.5 cm. Determine the length the student should record. (2 marks)

2 **Figure 1** shows a magnified scale of a micrometer screw gauge.

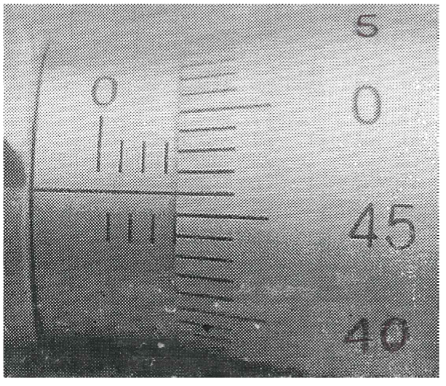


Figure 1

Record the reading indicated. (1 mark)

3 State the reason why it is **not correct** to quote the weight of solid objects in kilograms. (1 mark)

4 **Figure 2** shows a section of a curved surface **ABCD**. Point **A** is higher than point **B** while **BCD** is horizontal. Part **ABC** is smooth while **CD** is rough. **A** mass **m** is released from rest at **A** and moves towards **D**.

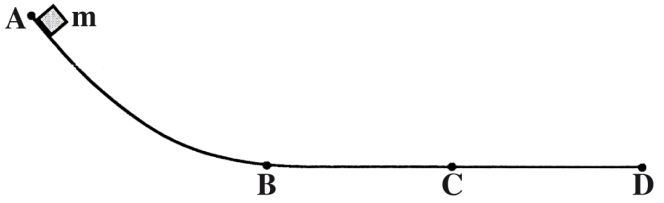


Figure 2

State the changes in the velocity of **m** between:

(a) **B** and **C**; (1 mark)

(b) **C** and **D**. (1 mark)

5 **Figure 3** shows two cylinders of different cross-sectional areas connected with a tube. The cylinders contain an incompressible fluid and are fitted with pistons of cross-sectional areas 4 cm^2 and 24 cm^2.

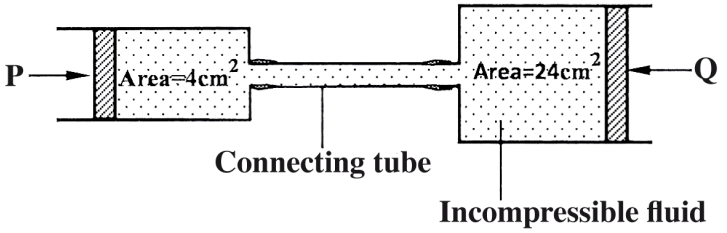


Figure 3

Opposing forces **P** and **Q** are applied to the pistons such that the pistons do not move. If the pressure on the smaller piston is 5 N cm^{-2}. Determine force **Q**. (2 marks)

6 An oil drop of volume V m^3 introduced on the surface of water spreads to form a patch whose area is A m^2. Derive an expression for obtaining the diameter, d of a molecule of oil. (2 marks)

7 **Figure 4** shows a source of heat placed at equal distances from two identical flasks **X** and **Y** containing air. The surface of **X** is painted black while **Y** is clear.

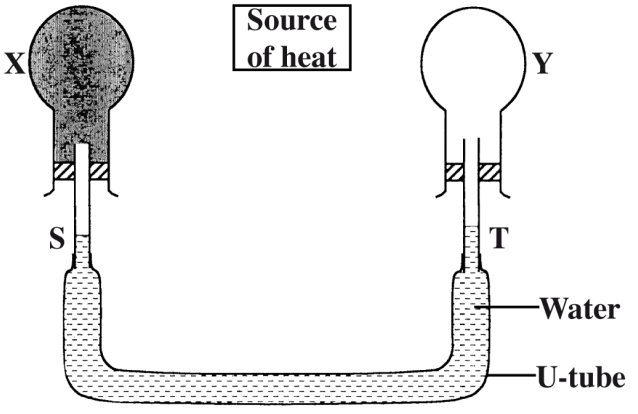


Figure 4

X and **Y** are linked by a U-tube filled with water whose levels **S** and **T** are initially the same. It is later observed that **S** falls while **T** rises. Explain this observation. (2 mark)

8 **Figure 5** shows a uniform rod 4 m long and of mass 2 kg. It is pivoted 1 m from one end and balanced horizontally by a string attached near the other end.

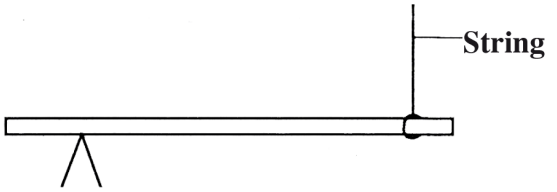


Figure 5

Determine the position where a mass of 5 kg should be placed on the rod so that the rod remains horizontal and the tension in the string is zero. (3 marks)

9 **Figure 6** shows two identical rods **JK** and **LK** connected with a hinge at **K**.

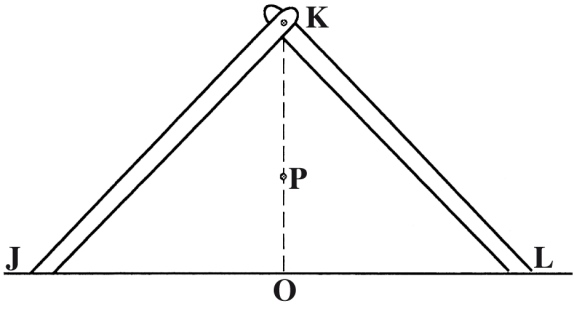


Figure 6

The position of the centre of gravity for the system is at **P**. The arrangement is now adjusted so that **J** and **L** move equal distances towards **O**. Sketch the new arrangement on the same diagram and mark the new position of the centre of gravity. (2 marks)

10 A light spiral spring extends by 4 mm when loaded with a weight W. The spring is connected in series with an identical spring. The combination is loaded with the weight W. Determine the extension of the combination. (2 marks)

11 **Figure 7** shows an incompressible fluid flowing through a pipe, A_1 and A_2 are the cross-sectional areas of the pipes in the larger section and smaller section of the pipe respectively, while V_1 and V_2 are speeds of the fluid at the two sections of the pipe.

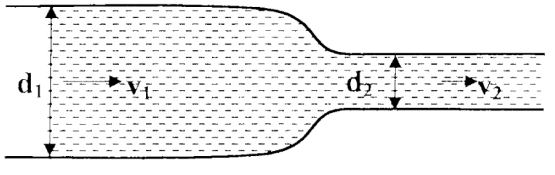
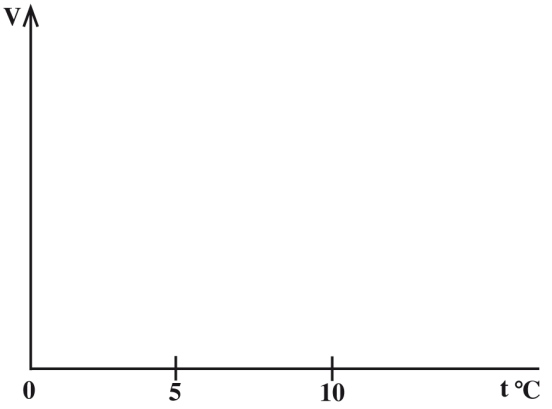


Figure 7

Derive an expression for the ratio of the speeds $\frac{V_2}{V_1}$ in terms of A_1 and A_2. (2 marks)

12 On the axis provided, sketch the graph which shows the relationship between volume and temperature of a fixed mass of water in the temperature range 0°C to 10°C. (1 mark)



13 **Figure 8** shows a graph of the variation of temperature with time for a pure substance heated at a constant rate.

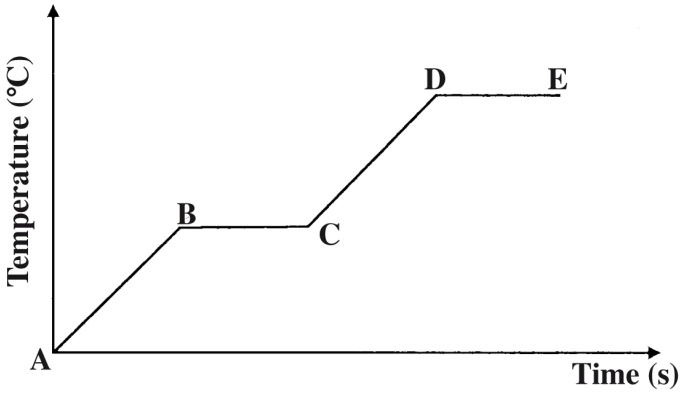


Figure 8

Assuming that heat transfer to the surroundings is negligible, state the changes observed on the substance in region:

(a) **BC**; (1 mark)

(b) **DE**. (1 mark)

14 In a smoke cell experiment to demonstrate Brownian motion, smoke particles are seen moving randomly. State the cause of the randomness. (1 mark)

SECTION B: (55 marks)

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

15 **Figure 9** shows a velocity-time graph for the motion of a body of mass 2 kg.

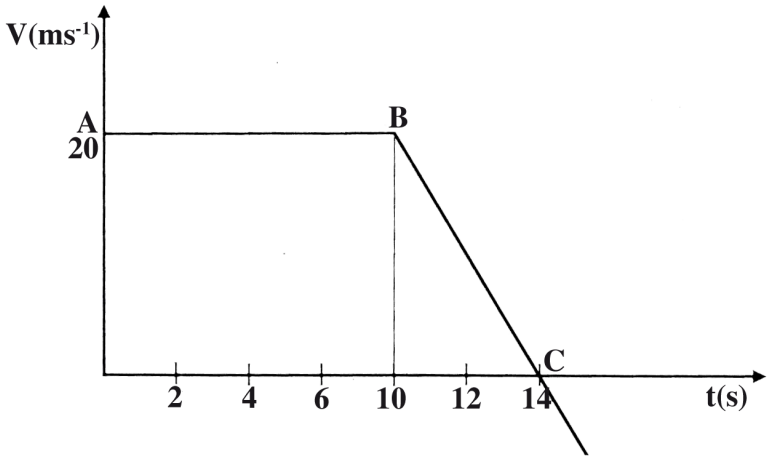


Figure 9

(a) Use the graph to determine the:

(i) displacement of the body after 8 seconds. (3 marks)

(ii) acceleration after point **B**; (3 marks)

(iii) force acting on the body in part (a) (ii). (3 marks)

(b) Sketch a displacement-time graph for the motion from point **A** to **C**. (2 marks)

16 **Figure 10** shows a trolley of weight 20 N pulled by a force of 4 N from the bottom to the top of an inclined plane at a uniform speed.

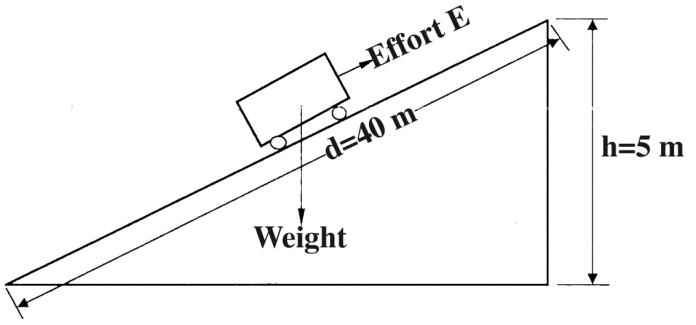


Figure 10

(a) (i) State the value of the force acting downwards along the inclined plane. (1 mark)

(ii) Explain how the value in part (a) (i) is obtained. (2 marks)

(b) For the system, determine the:

(i) mechanical advantage; (3 marks)

(ii) velocity ratio; (3 marks)

(iii) efficiency. (2 marks)

17 (a) A long horizontal capillary tube of uniform bore sealed at one end contains dry air trapped by a drop of mercury. The length of the air column is 142 mm at 17°C. Determine the length of the air column at 25°C. (3 marks)

(b) The pressure of the air inside a car tyre increases if the car stands out in the sun for some time on a hot day. Explain the pressure increase in terms of the kinetic theory of gases. (3 marks)

(c) In an experiment to determine the specific latent heat of vapourization of water, steam of mass 10 g at 100°C is passed into 100 g of water initially at 20°C in a container of negligible heat capacity. The temperature of the water rises to 70°C.
(Take the specific heat capacity of water as 4.2×10^3 *J kg^{-1} K^{-1} and the boiling point of water as 100°C)*

(i) Determine the specific latent heat of vapourization of water. (4 marks)

(ii) State **two** sources of error in this experiment. (2 mark)

18 (a) When a bus goes round a bend on a flat road, it experiences a centripetal force. State what provides the centripetal force. (1 mark)

(b) State the purpose of banking roads at bends. (1 mark)

(c) A student whirls a stone of mass 0.2 kg tied to a string of length 0.4 m in a vertical plane at a constant speed of 2 revolutions per second.
(Take acceleration due to gravity g as 10 ms^{-2})

(i) State **two** forces acting on the stone when it is at the highest point. (2 marks)

(ii) Determine the:

I angular velocity of the stone; (3 marks)

II tension in the string when the stone is at the highest point; (3 marks)

19 **Figure 11** shows a test–tube whose cross-sectional area is 2 cm^2 partially filled with lead shot floating vertically in water.

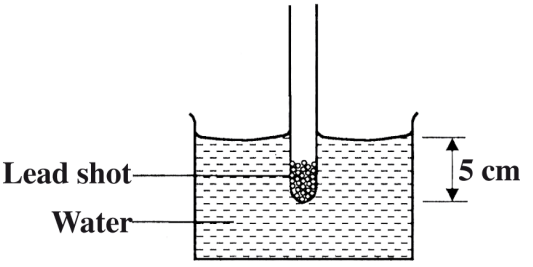


Figure 11

(Take gravitational acceleration as 10 ms^{-2} and density of water ρ_w as 1 g cm^{-3})

(a) (i) Determine the:

I volume of the water displaced; (2 marks)

II weight of water displaced. (3 marks)

(ii) State the combined weight of the test–tube and the lead shot. (1 mark)

(iii) Determine the length of the test–tube that would be submerged in a liquid of density 0.8 g cm^{-3}. (4 marks)

(b) The set up in **figure 11** can be used as a hydrometer to measure densities of liquids. State how such a hydrometer would be improved to measure small differences in densities of liquids. (1 mark)

(ii) how the heating can be minimized. (1 mark)

(b) The input voltage of a transformer is 240 V and its output is 12 V. When an 80 W bulb is connected across the secondary coil, the current in the primary coil is 0.36 A. Determine:

(i) the ratio $\frac{N_P}{N_S}$ of the transformer, (*where Np is the number of turns in the primary coil and Ns is the number of turns in the secondary coil*) (3 marks)

(ii) the power input of the transformer. (3 marks)

(iii) the power output of the transformer. (1 mark)

(iv) the efficiency of the transformer. (2 marks)

16 (a) **Figure 7** shows resistors R_1 and R_2 connected in parallel. Their ends are connected to a battery of potential difference V volts.

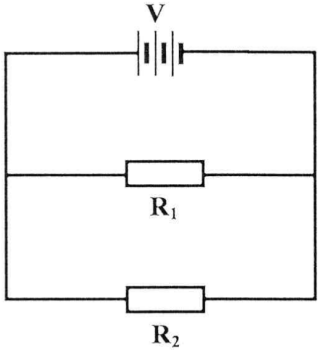


Figure 7

(i) In terms of V_1, R_1 and R_2, write an expression for:

(I) current I_1 through R_1. (1 mark)

(II) current I_2 through R_2; (1 mark)

(III) total current I in the circuit. (1 mark)

(ii) Show that the total resistance R_T is given by $R_T = \frac{R_1 R_2}{R_1 + R_2}$. (3 marks)

(b) **Figure 8** shows a negatively charged rod placed near an uncharged conductor resting on an insulating support.

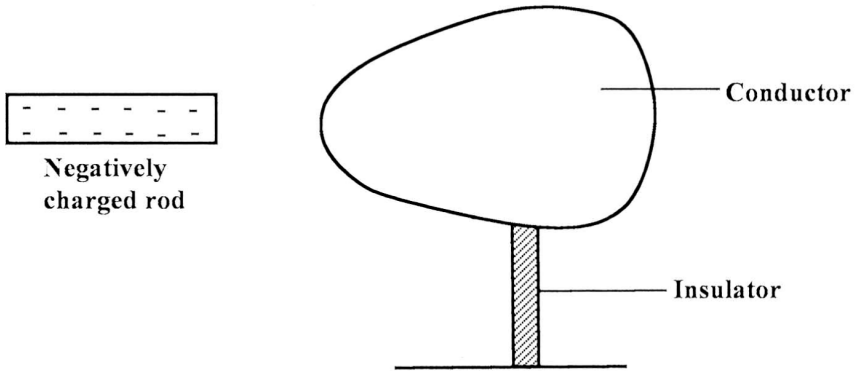


Figure 8

(i) Show the charge distribution on the conductor. (2 marks)

(ii) State the effect:

(I) of momentarily touching the conductor with a finger while the charged rod is still near the conductor. (1 mark)

(II) on the charge distribution of withdrawing the negatively charged rod after momentarily touching the conductor. (1 mark)

(iii) In the space provided, sketch a diagram to show how the charge in ii (II) would have been distributed if the conductor was a sphere. (1 mark)

17 (a) **Figure 9** shows two speakers S_1 and S_2 which produce sound of the same frequency. They are placed equidistant from a line AB and a line PQ. (*PQ is perpendicular to line AB*).

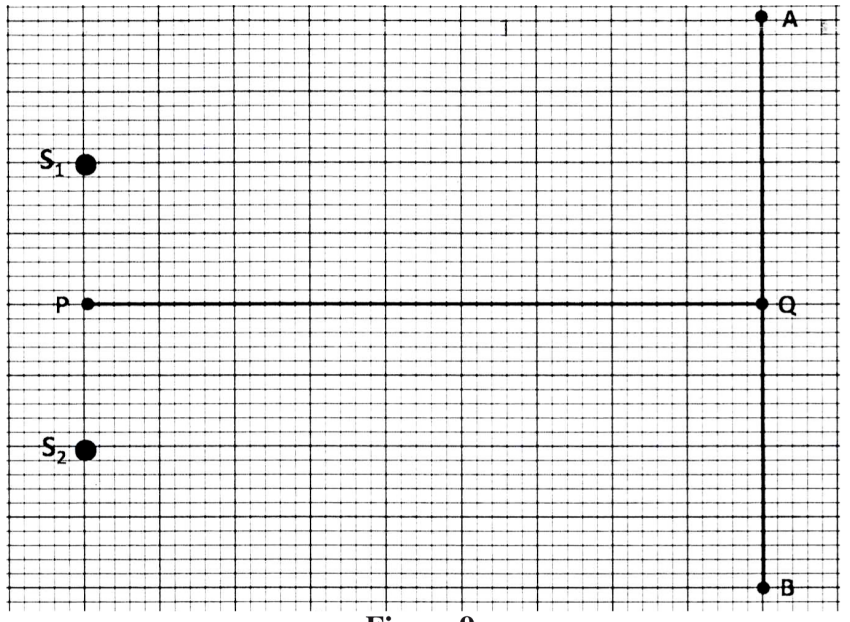


Figure 9

(i) A student walking from A to B hears alternating loud and soft sounds. Explain why at some point the sound heard is soft. (2 marks)

(ii) The student now walks along line PQ. State with reason the nature of the sound the student hears. (3 marks)

(b) **Figure 10** shows sound waves in air produced by a vibrating tuning fork. R is an air molecule on the path of the waves.

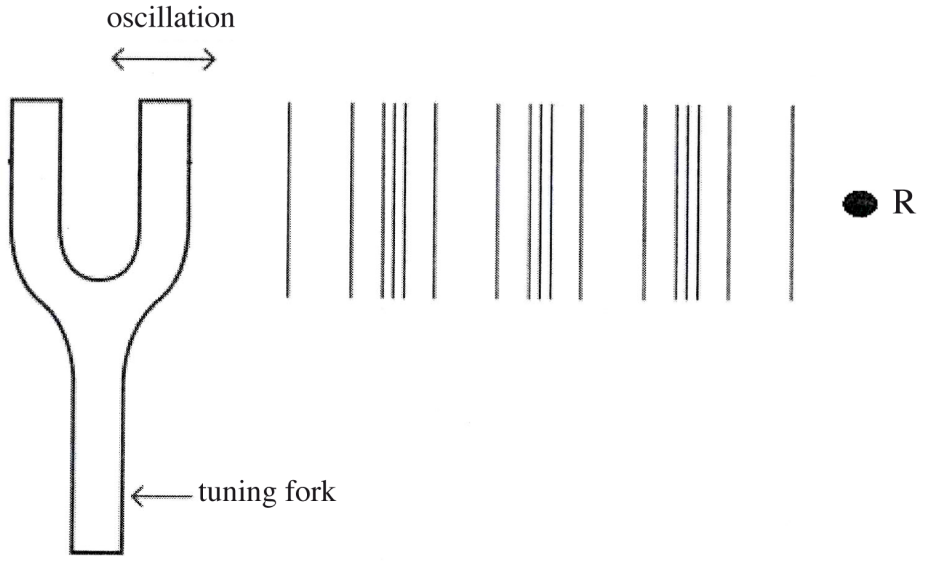


Figure 10

(i) Using a line, indicate on the diagram a distance **d** equal to one wavelength of the wave. (1 mark)

(ii) In the space provided, show with an arrow the direction of motion of the air molecule R as the waves pass. (1 mark)

(iii) Explain the reason for the answer in (ii). (2 marks)

18 **Figure 11** shows an object placed 10 cm infront of a concave mirror whose radius of curvature is 40 cm.

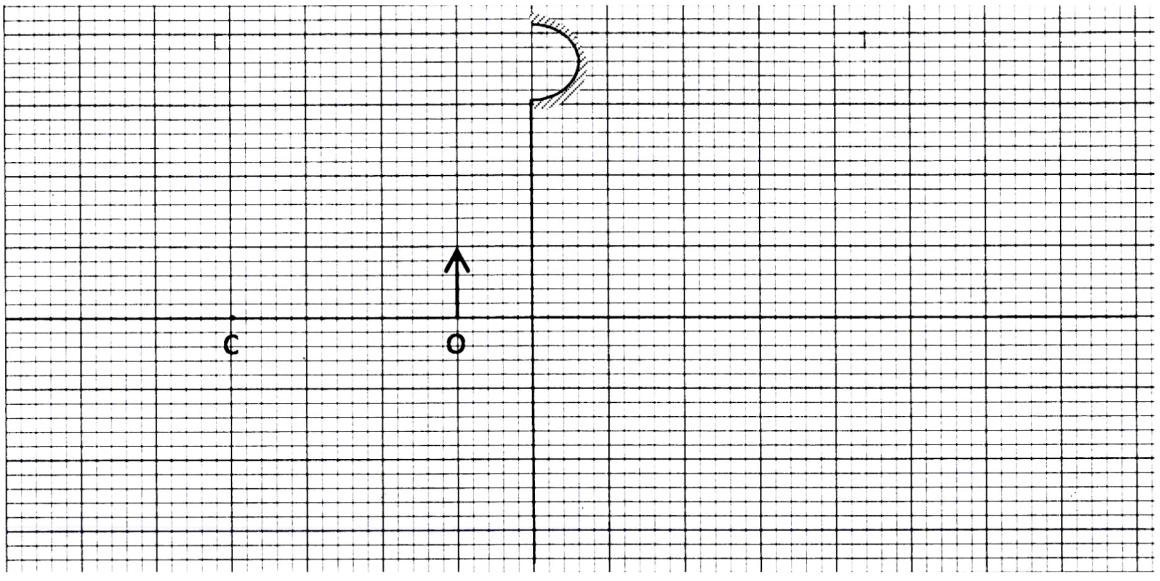


Figure 11

(a) (i) On the same figure, draw a ray diagram to show the position of the image formed. (3 marks)

(ii) Use the ray diagram to determine:

(I) the image distance. (1 mark)

(II) the magnification. (3 marks)

(iii) State where the position of the image would be if the object had been placed at the principal focus. (1 mark)

(b) Draw a ray diagram to show the formation of a partially dark shadow and a totally dark shadow during the eclipse of the sun. (3 marks)