PHYSICS
FORM 3
PAPER 1
END TERM 2 2025
MARKING SCHEME

SECTION A (25 MARKS)

Answer All the questions in this the spaces provided section in the spaces provided

1. Figure 1 shows a micrometer screw gauge being used to measure the diameter of a glass rod.

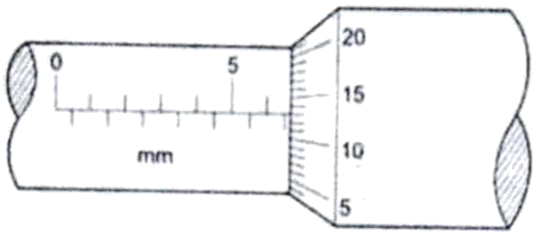


Figure 1

(a) State the pitch of the micrometer. (1 mark)

50 x 0.01 = 0.5 MM

(b) If the apparatus has a zero error of + 0.08mm, determine the diameter of the glass rod if the diagram above shows the reading when the glass rod is in between the anvil and spindle. (3 marks)

S.S = 6.50 MM
T.S = 13 x 0.01

= 6.50
+ 0.13
6.63 MM

6.63 MM
- 0.08
6.55
= 6.55 MM

2. The mass of a density bottle is 20.0g when empty, 70.0g when full of water and 55.0g when full of a second liquid x. Calculate the density of the liquid (take density of water to be 1g/cm3) (3marks)

$M_w = 70 - 20$
$= 50g$

$M_x = 55 - 20$
$= 35g$

$\rho_w = 1gcm^{-3}$

$V_w = \frac{M_w}{\rho_w}$

$V_w = \frac{50g}{1gcm^{-3}}$

$V_w = 50cm^3$

$V_w = V_{bottle} = V_x$

$\therefore V_x = 50cm^3$

$\rho_x = \frac{M_x}{V_x}$

$\rho_x = \frac{35g}{50cm^3}$

$\rho_x = 0.7gcm^{-3}$

Must have units.

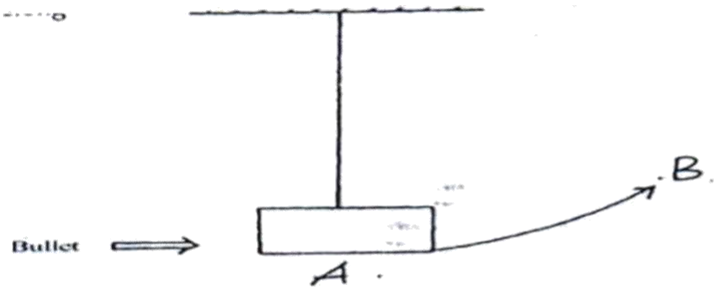
3. Give a reason why gases are more compressible than liquids. (2mks)

- Gases have larger intermolecular distance than liquids. When compressing force is exerted on both, gases are moving towards each other to fill the larger gap btn its particles.

4. Explain the cause of random motion of smoke particles as observed in Brownian motion experiment using a smoke cell. (2mks)

- Smoke particles are bright, therefore when they collide with the randomly moving invisible air particles, they are also seen to be moving in a continuous random motion.

5. A bullet of mass 150g moving at an initial velocity of 80m/s strikes a suspended block of mass 2.5kg



The block swings from point A to B. Determine the vertical displacement between A and B (3mks)

$(M_1u_1 + M_2u_2) = (M_T v_2)$

$(150\times10^{-3}\times80) + (2.5\times0) = (150\times10^{-3} + 2.5)V$

$V = \frac{150\times10^{-3}\times80}{150\times10^{-3}+2.5}$

$V = \frac{12}{2.65} = 4.53 m/s$

$\frac{1}{2}Mv^2 = Mgh$

$\frac{1}{2}(0.15+2.5)2.05^2 = (0.15+2.5)gh$

$= 27.176 = 2.65\times10h.$

$h = \frac{27.176}{26.5}$

$h = 1.025 M$

6. (a) State the Newton's third law of motion. (1mark)

- For an action force, there is an equal and opposite reaction force.

(b) Figure 5 shows a balloon filled with air.

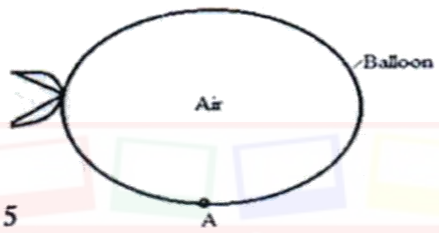


Figure 5

Explain why the balloon moves upwards when point A is pierced with a sharp needle. (2marks)

- Air in the balloon is forced out at a higher speed/ force which intuitively causes an equal and opposite force on the baloon making it move upwards [action and reaction]

7. (a) Sate two liquids which are used in thermometer. (1mk)

- Mercury
- Alcohol

(b) With a reason, state which of the two liquids in 7 (a) above is used to measure temperature in areas where temperatures are: (4mks)

(i) below -40°c

Alcohol because it has a freezing point of $-115^\circ c$

(ii) 150°c

Mercury because its boiling point is $357^\circ c$

8. A block of metal with mass of 40kg requires a horizontal force of 90N to pull it with uniform velocity along a horizontal surface. Calculate the coefficient of friction between the surface and the block. (take g =10ms-2). (3marks)

$F_r = \mu R$

F_r = applied force

$R = Mg$

$F_r = 90N$

$R = 400N$

$\mu = \frac{F_r}{R}$

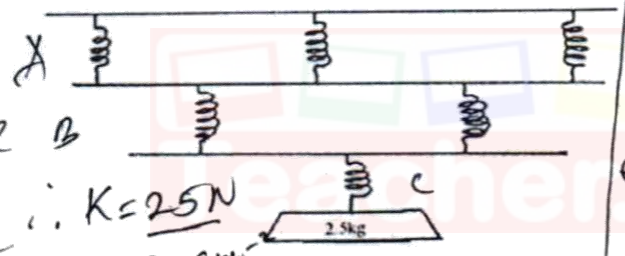
$\mu = \frac{90N}{400}$

$\mu = 0.225$

SECTION B (55 marks)

Answer ALL the questions in this section in the spaces provided

9. A single light spring extends by 3.6cm when supporting a load of 2.5kg. What is the total extension in the arrangement shown below. (Assume the springs are identical) (4mks)



$F = ke$

$k = \frac{F}{e}$ $\therefore K = \frac{25N}{3.6 \times 10^{-2}}$

$K = 694.4 N/m$

$e_A = \frac{F}{nk} = \frac{25N}{3 \times 694.4}$

$e_A = 0.012M$

$e_B = \frac{25N}{2 \times 694.4}$

$e_B = 0.018M$

$e_c = \frac{25}{694.4}$

$e_c = 0.036M$

$e_T = e_A + e_B + e_c$

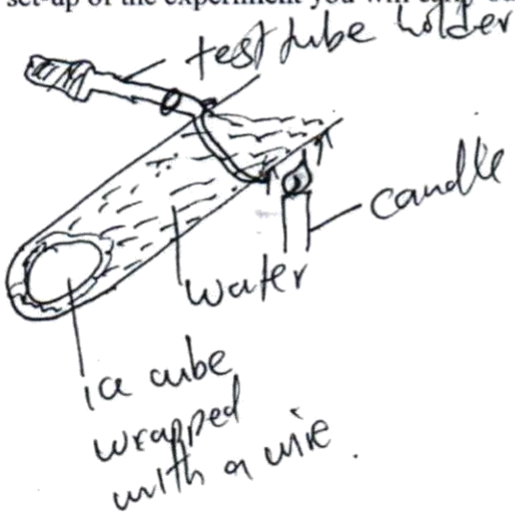
$= 0.012 + 0.018$

$= 0.036$

$e_T = 0.066M / 6.6cm$

10. In an experiment, you are provided with a boiling tube, ice cube wrapped with a wire gauze, a candle, water and a test tube holder.

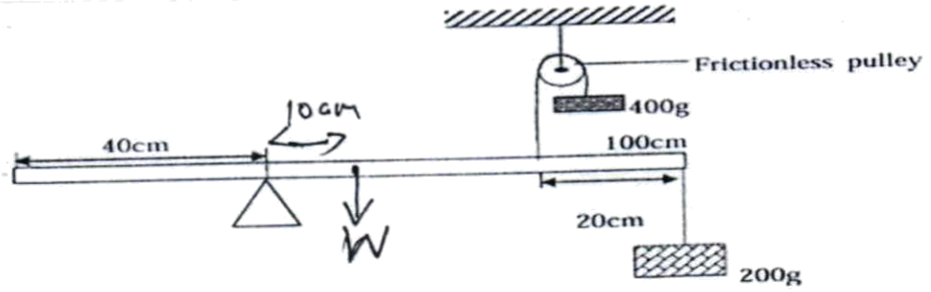
(a) Draw a set-up of the experiment you will carry out to test for thermal conductivity of water (2mks)



(b) State and explain the observations made (2msks)

- Ice will not melt, ~~but~~ water only boils on top of the tube. The ice does not melt because water is a bad conductor of heat hence water only boils in the heated region.

11. Figure 4 below shows a uniform meter rule in equilibrium under the forces shown



Determine the weight of the meter rule (4mks)

C.M = A.C.M.

$(W \times 10) + (200 \times 60) = 40 \times 400$

$10W + 12000 = 16,000$

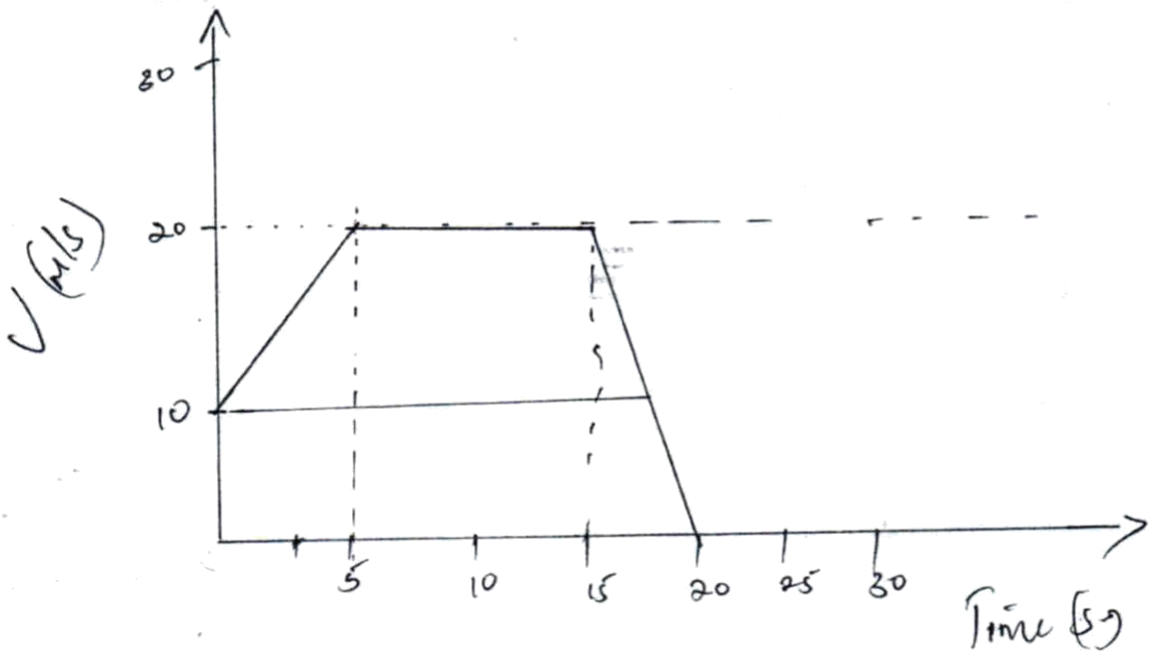
$10W = 16000 - 12000$

$\frac{10W}{10} = \frac{4000}{10}$

$W = 400g$

12. A car starting at a velocity of 10m/s accelerates to 20m/s in 5s. It then travels at the speed attained for 10s and then decelerates to rest in 5s.

(a) Sketch a velocity time graph of the motion. (2mks)



$\frac{1}{2} \times 5(20+10)$ | 20×10 | $\frac{1}{2} \times 20 \times 5$

$\frac{1}{2} \times 5 \times 30^{15} = 75M$ | $= 200M$ | $= 50M$

(b) From the graph determine

(i) The total distance covered. (3mark)

D = Area under the Curve. | $= \frac{1}{2} \times 10(30)^{5}$ | $D = 75 + 200 + 50$

$A_T = \frac{1}{2}(a+b)h$. | $= 150M$ | $= 325M$

$A_2 = \frac{1}{2} \times 10($

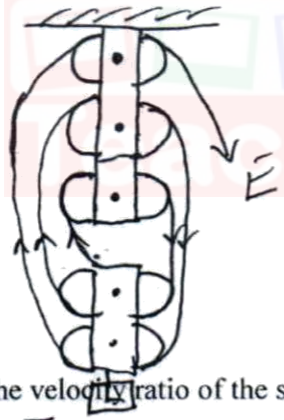
(ii) The average velocity of the car. (3mks)

$V_A = \frac{d}{t}$ | $\frac{325}{20}$

$V_A = 16.25 M/s$

13. (a) A block and tackle system has three pulleys in the upper block and two pulleys in the lower movable block.

(i) Draw a diagram to show how the system can be set in order to lift a load and indicate the position of the load and effort. (2mks)



(ii) State the velocity ratio of the set up. (1 marks)

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(iii) In such a block and tackle system an effort of 300 N is required to lift a load of 800N. Determine its efficiency. (4marks)

$\eta = \frac{MA}{VR} \times 100$ | $\eta = \frac{2.667}{5} \times 100$

$MA = \frac{L}{E} = \frac{800}{300}$ | $\eta = 53.33\%$

$= 2.667$

(c) State one reason why the efficiency of a machine is not 100%. (1 mark)

- Some energy is used to lift some parts of the machine
- friction between moving parts of the machine.

14. In an experiment to estimate the size of an oil molecule, 50 drops of oil are run from a burette. The reading on the burette changes from 0.0 cm3 to 0.8 cm3. One of these drops is placed on a large water surface dusted lightly using lycopodium powder. It spreads to form a uniform patch of area 0.02 m2.

(a) State the purpose of the lycopodium powder. (1 mark)

- To make the oil patch visible.

(b) State two assumptions made in determining the volume of one drop. (2 mark)

- drops are identical in size.
- drops are spherical

(c) Explain what makes the oil to spread into a thin oil film. (2 marks)

Oil being an impurity reduces the surface tension of water at the point of contact. Greater surface tension of water around the oil pulls it outwards forming an oil patch.

(d) Determine the size of the oil molecule. (3 marks)

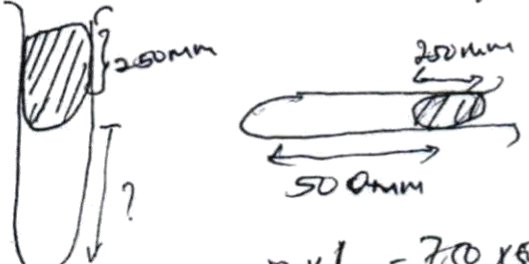
$$h = \frac{V}{A} = \frac{(0.8 \div 50) \times 10^{-6}}{0.02}$$

$$h = 8.0 \times 10^{-7} \text{ m}$$

(e) State one source of error in this experiment. (1 mark)

- in measuring the volume of the drops

15. A capillary tube of uniform cross-section and closed at one end has a column of air trapped in it by a thread of mercury of length 250mm. When the tube is horizontal, the length of air column is 50cm. Taking atmospheric pressure to be 750mmHg, determine the length of the air column when the tube is held vertically with the open end facing Up (4marks)



$P_1 L_1 = P_2 L_2 = 1000 \times L_1 = 750 \times 500$

$\frac{1000 L_1}{1000} = \frac{375,000}{1000}$

$L_1 = 375 \text{ mm}$

$L_1 = 37.5 \text{ cm}$

15. (a) State two ways in which heat loss by conduction is minimized in a vacuum flask (2 marks)

- Vacuum between the two silvered walls
- Rubber cork/lid does not conduct heat away after convection.

(b) State two differences between boiling and evaporation. (2 marks)

- Evaporation happens over a range of temperature while boiling takes place at a specific temperature.

(c) In a certain experiment, 90g of dry steam at 100°C was directed into some crushed ice at 0°C. (Latent heat of vaporization of water 2.26 x 106 Jkg-1, specific heat capacity of water is 4.2 x 10^3 Jkg-1 and latent heat of fusion of ice is 3.34 x 10^5 J/Kg. Determine the:

(i) Quantity of heat lost by steam to change to water at 100°C (4 marks)

Heat lost = heat gained

$M_s = 90g$

$L_v = 2.26 \times 10^6 \, Jkg^{-1}$

$Q_{heat\ lost} = ML_v = \frac{90}{1000} \times 2.26 \times 10^6$

$= 2.034 \times 10^5$ Joules

(ii) Quantity of heat lost by water to cool to 0°C (3marks)

~~$T_{ice} = 0°$~~

$L_f = 4.20 \times 10^3 \, Jkg\,K^{-1}$

$\Delta T = 100$

$Q_H = MC\Delta T$

$= \frac{90}{1000} \times 4.2 \times 10^3 \times 100.$

$= 3.78 \times 10^4$ Joules

(iii) Mass of Ice melted at 0°C (3 marks)

Heat lost by steam + Heat lost by water = Heat gained by ice

$2.0 \times 10^5 + 3.78 \times 10^4 = M \times 3.34 \times 10^5$

$M = \frac{2.0 \times 10^5 + 3.78 \times 10^4}{3.34 \times 10^5}$

$M = 0.712$ Kg