The reading indicated by the spring balance is 2.0N. Work out the mass of the metal rod. (g = 10N/kg) ((3marks)

Clockwise Moment = Anticlockwise Moment ✓

$48 \times m = 20 \times 82$ ✓

$w = \frac{20 \times 82}{48}$ ✓ $\quad m = 34.17\,kg$ ✓

5. Heat transfer by radiation is faster than heat transfer by conduction. Explain. [(1mark)

Radiation does not require Material Medium to take place while Conduction need Material Medium

5 The tape shown in **figure 3** below was pulled through a ticker timer by a trolley down a runway length. The frequency of the ticker timer was 50Hz

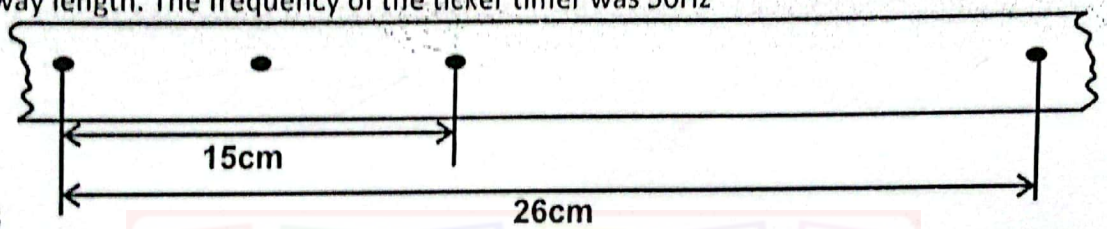


Figure 3

Find the acceleration of the trolley in cm/s^2 (3mks)

$u = \frac{12}{0.04}$ $\quad V = \frac{11\,cm}{0.02}$ $\quad a = \frac{V-u}{t}$

$u = 300\,cm/s$ ✓ $\quad V = 550\,cm/s$ ✓ $\quad a = \frac{550-300}{0.03} = \frac{250}{0.03} = 8333.3\,cm/s^2$ ✓

OR $83.33\,m/s^2$

6. If you are a weatherman stationed in the arctic region **(at the earth poles)** state with a reason the thermometric liquid most suitable for your thermometer.**(2marks)**

Mercury ✓

- Mercury has higher density ✓ hence lower Mercury column

7. State a reason why more energy is required to change ice from 0^0C to water at 1^0C, than to change equal mass of water from 0^0C to 1^0C. **(1mark)**

- The Specific heat Capacity of Water is greater than the Specific heat Capacity of Ice ✓

8. State a reason why an air bubble increases in volume as it rises up the surface in a boiler. **(1mk)**

- It experiences less pressure and it therefore expands

9. A car of mass 800kg is initially moving at 25m/s, calculate the force needed to bring the car to rest over a distance of 20m. **(2mks)**

$F = \frac{m(v-u)}{t}$ $\quad -625 = 40a$

$V^2 = u^2 + 2as$ $\quad a = -15.625$ ✓

$(0)^2 = (25)^2 + 2 \times a \times 20$ $\quad F = ma$ ✓

$= 800 \times -15.625 = -12,500N$

10. An electric kettle with shiny outer surface is more efficient than one with a dull outer surface, give a reason for this. (1mark)

• dull surface absorbs more heat than the shiny surface. ✓

11. The system in **figure 4** is in equilibrium

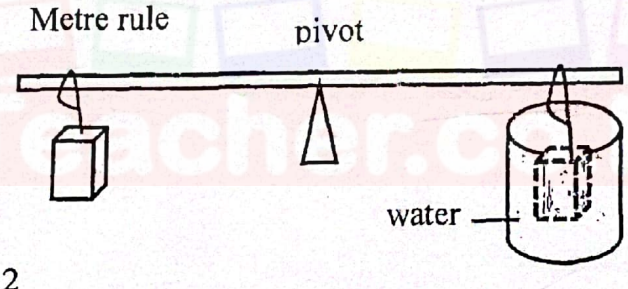


Figure 2

When the temperature of the water is raised the system is observed to tilt to the right, state the reason for this observation (2marks)

• As the temperature rises the density of water reduces hence the upthrust reduces ✓

12. A student observed the smoke particles in a smoke cell and noted that they moved in a random way. Explain this observation. (1mark)

• Smoke particles are constantly hit or bombarde by invisible air particles which are in continu random motion

13. The **figure 5** below shows a glass tumbler filled with water at room temperature.

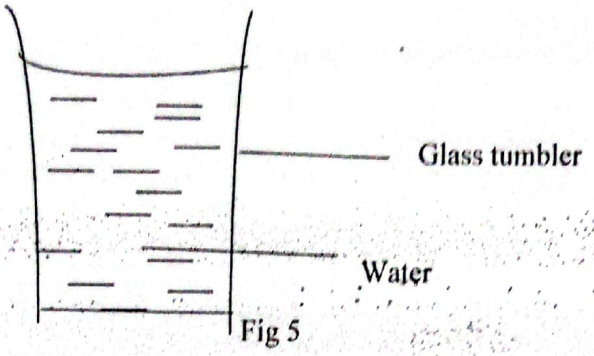


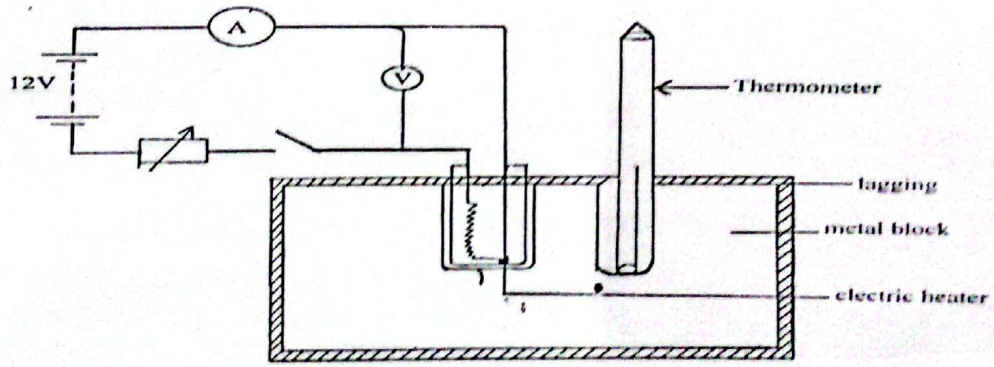
Fig 5

Briefly explain what happens to the stability of the tumbler when water is cooled to a temperature of0°from 5°C. (2 marks)

• Volume of water reduces lowering the position of Centre of gravity hence becomes more stable ✓

SECTION B [55MARKS]

14. The figure below shows a set up that can be used to determine the specific heat capacity of a metal block.



(i) State the measurement that should be taken in the experiment to determine specific heat capacity of the metal block. (3marks)

→ Voltmeter reading ⇒ Thermometer reading
→ Ammeter reading → time taken.
} any 3

(ii) Show how the measurement above can be used to determine the specific heat capacity of the metal block (2marks)

$IVt = MC\Delta\theta$ ✓

$C = \frac{IVt}{M\Delta\theta}$ ✓

(iii) State the function of the drops of oil in the holes containing thermometer and the electric heater [1mark]

• To enhance Conductivity of heat ✓

(b) A copper can together with stirrer of total heat capacity 600J/K contains 200g of water at 15^0C. Dry steam at 100^0C is passed through the water while stirring until it reaches a final temperature of 55^0C. Calculate the mass of the steam condensed. Take specific heat of capacity of water as 4200J/Kg/k and specific latent heat of steam as 2,260,000J/kg (4marks)

Heat gained = Heat lost

Heat gained $= \frac{200}{1000} \times 4200 \times 40 + 600 \times 40$

$= 33,600 + 24000$

$= 57,600$ ✓

Heat lost $= M \times 2260,000 + M \times 4200 \times 45$

$= 2260000M + 189,000M$ ✓

$2449,000M = 57,600$ ✓

$M = 0.0235$ kg OR 23.5g ✓

15. (a) Sometimes work is not done even if there is an applied force. Give a reason (1mk)

Work is done when force acts in the direction of the body

(b) A lorry weighing 6400kg is lifted with a jack screw of 11mm pitch. If the handle is 28cm From the screw

(i) Find the velocity ratio (2mks)

$V.R = \frac{2\pi R}{\text{pitch}} = \frac{2 \times 3.142 \times 0.28}{0.011} = 159.96$ ✓

(ii) Neglecting the frictional force, Calculate mechanical advantage, MA (1mk)

159.96 ✓

(iii) Determine the force applied (2mks)

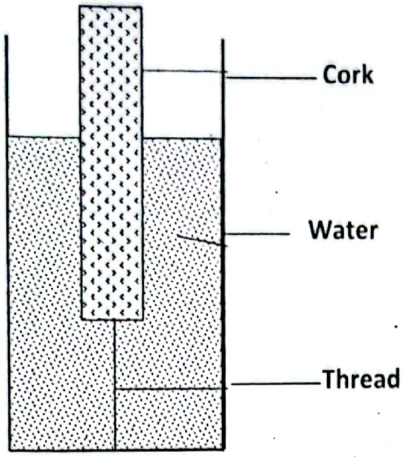
$159.96 = \frac{L}{E}$

$159.96 = \frac{64000}{E}$ ✓

$E = \frac{64000}{159.96}$

$E = 400.10$ N ✓

16. The figure below shows a cork floating on water and held to the bottom of the beaker by a thin thread



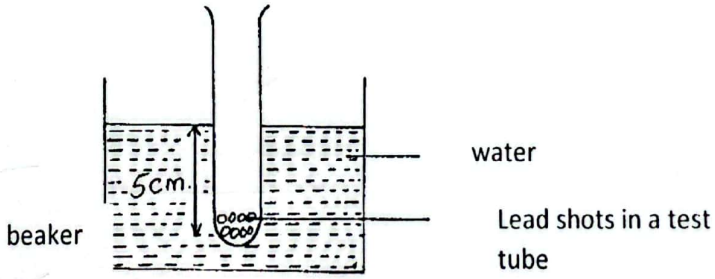
(i) Name the forces acting on the cork (3mks)

- Upthrust ✓
- Tension ✓
- weight ✓

(ii) State how each of the forces mentioned in (i) above changes when water is added into the beaker until it is filled up (3mks)

- Weight remains the same ✓
- Upthrust Increases ✓
- Tension Increases ✓

(b) A test tube of mass 10g and uniform cross-sectional area $4cm^2$ is partly filled with lead shots and floats vertically in water with 5cm of its length submerged.



Find the Length of the test tube that would be submerged in a liquid of density $0.75g/cm^3$. Given the density of water is $1g/cm^3$ (4 marks)

Volume displaced = 4×5
$= 20cm^3$

Weight of water displaced = evg

$W = 1000 \times 20 \times 10^{-6} \times 10$

$W = 0.2N$

Volume liquid = $4 \times L$
$= 4Lcm^3$

$750 \times 4L \times 10^{-6} \times 10 = 0.2$

$0.03L = 0.2$

$L = 6.67m$

c) Abaloon weighs 10N and it has a gas capacity of $2m^3$. The gas in the baloon has a density of $0.1kg/m^3$. If the density of the air is $1.3kg/m^3$ calculate the resultant force on the balloon when it is floating in air.
(3marks)

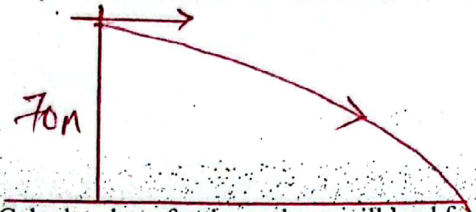
Upthrust = evg
$= 1.3 \times 2 \times 10$
$= 26N$ ✓

Its weight = $10 + 2 \times 0.1 \times 10$
$= 12N$ ✓

Resultant force = $26 - 12 = 14N$ ✓

17.(a) In areas of the world where a plane is unable to land, free fall drops can be used to deliver supplies. A plane travelling at a speed of 80m/s and at a height of 70m releases a package of supplies.

i) Sketch the path of the falling package. (1 mark)



ii) Calculate how far the package will land from the drop zone. (3 marks)

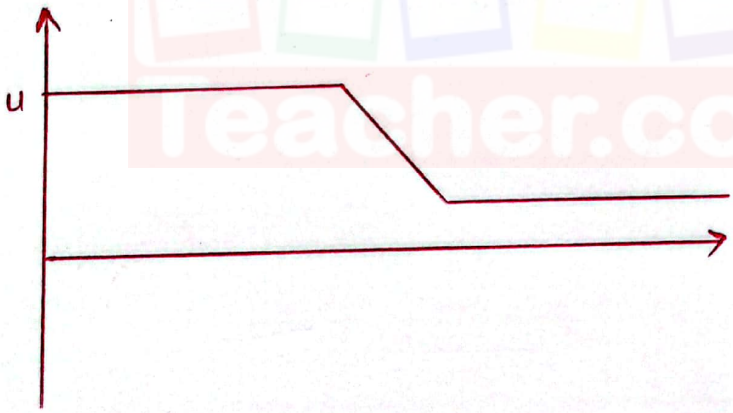
$S = \frac{1}{2}gt^2$ ✓ $t^2 = \frac{70}{5}$ $t = \sqrt{14} = 3.74$ ✓

$70 = \frac{1}{2} \times 10 \times t^2$ $t^2 = 14$

$70 = 5t^2$

$R = 80 \times 3.74 = 299.33m$ ✓

(b) Sketch a velocity – time graph for a body initially moving at a velocity **u** before a force F acting in the opposite direction is applied to it for 5 seconds and thereafter the force F is withdrawn. (2 marks)



(c) Explain the importance of safety belts to a passenger in a vehicle. (1 mark)

• To overcome Inertia ✓

(d).i) Distinguish between elastic and inelastic collision. (1 mark) • In elastic collision both Momentum and Kinetic energy are Conserved while in Inelastic collision Only Momentum is Conserved

ii)An object of mass 150kg moving at 20ms-1 collides with a stationary object of mass 90kg. They couple after collision. Determine their common velocity after collision. (2 marks)

Momentum before = $150 \times 20 + 90 \times 0$ $3000 = (150+90)v$ ✓

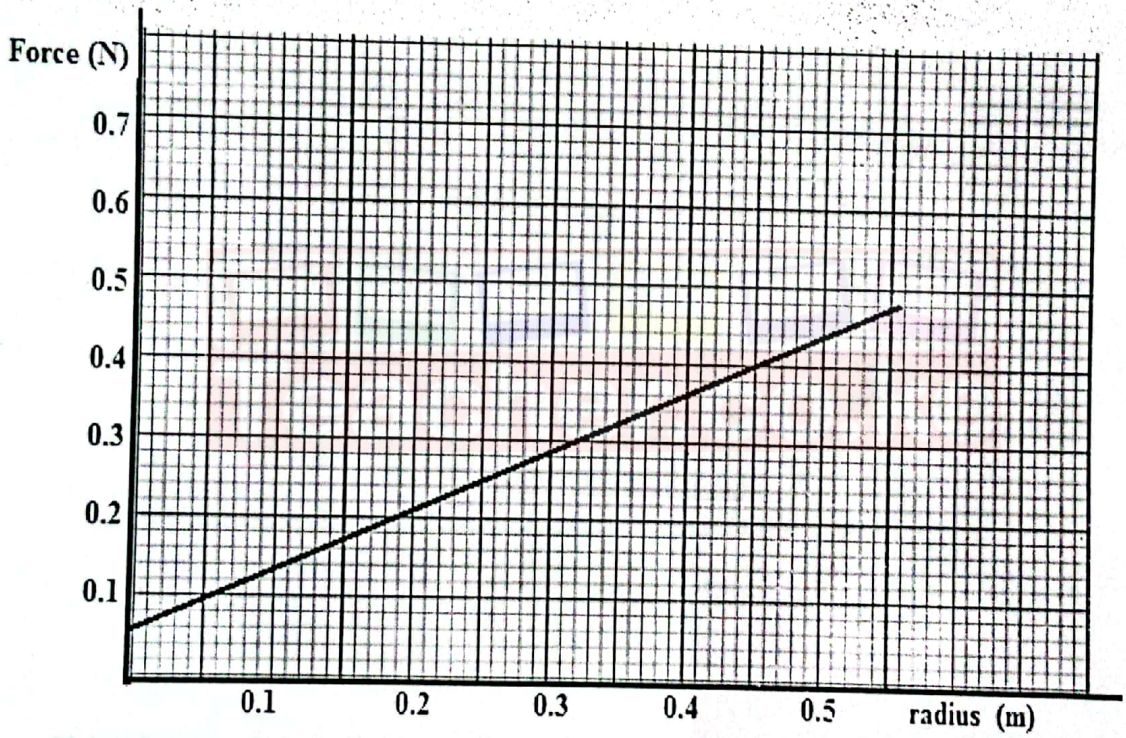
$= 3000$

$v = \frac{3000}{240} = 12.5 m/s$ ✓

18.(a)Give reason why a body moving in a circular path with constant speed is said to be accelerating(1mark)

• There is change in the direction of Instantaneous Velocity at various points along the Circular path hence the body accelerates.

(b) The graph below was obtained when an experiment to investigate the variation ofthe centripetal force, F, with the radius, r of the circle on a turntable.



,Given that the relationship between force, F, and radius, r, is of the form $F = mw^2r + C$. Where c is a constant. Determine the angular velocity, w and the constant C of the body given that m= 100g (4 marks)

gradient = Mw^2 ✓

gradient = $\frac{0.36 - 0.06}{0.4 - 0}$

$= \frac{0.30}{0.4}$

$= 0.75$ ✓

$0.75 = Mw^2$

$0.75 = 0.1 \times w^2$

$w^2 = 7.5$

$w = 2.74 rad/sec$ ✓

9

$C = 0.06N$ ✓

C. Astone of mass 1kg is attached to the end of a string 1m long of breaking strength 600N And is whirled in a horizontal circle on a frictionless table top. The other end of the string is kept fixed. Find the maximum velocity that the stone can achieve without breaking the string. (3marks)

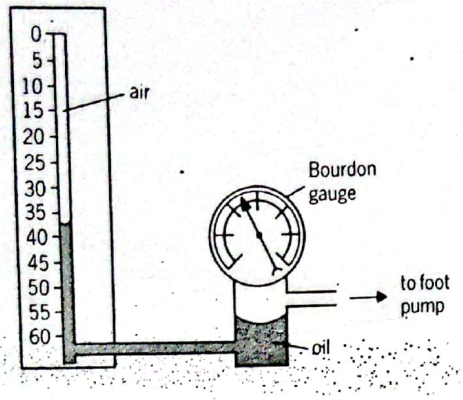
$600 = \frac{MV^2}{r}$ ✓

$600 = \frac{1 \times V^2}{1}$

$V^2 = 600$ ✓

$V = \sqrt{600} = 24.49 \text{ m/s}$ ✓

19 a.Figure shows a set up that may be used to verify Boyle's law.



(i) Describe the measurements that should be taken in the experiment (3marks)

- Pressure of the gas
- Height of trapped gas

(ii) Explain how the measurements taken in (i) above may be used to verify Boyle's law (2marks)

- ✓ Record the pressure and corresponding volume
- ✓ Plot a graph of pressure against volume, the product of PV is constant.

(b). A certain mass of hydrogen gas occupies a volume of $1.6m^3$ at a pressure of 1.5×10^5 N/M^2 and a temperature of 27^0C. Determine the volume when the temperature is 0^0C at a pressure of $8.0\ 10^4$ N/M^2. (3marks)

$V_1 = 1.6$

$P_1 = 1.5 \times 10^5$

$T_1 = 300K$

$T_2 = 273$

$P_2 = 8.0 \times 10^4$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \quad \checkmark$$

$$\frac{1.5 \times 10^5 \times 1.6}{300} = \frac{8.0 \times 10^4 \times V_2}{273}$$

$$V_2 = \frac{1.5 \times 10^5 \times 1.6 \times 273}{300 \times 8.0 \times 10^4} \quad \checkmark$$

$V_2 = 2.73 m^3$ ✓