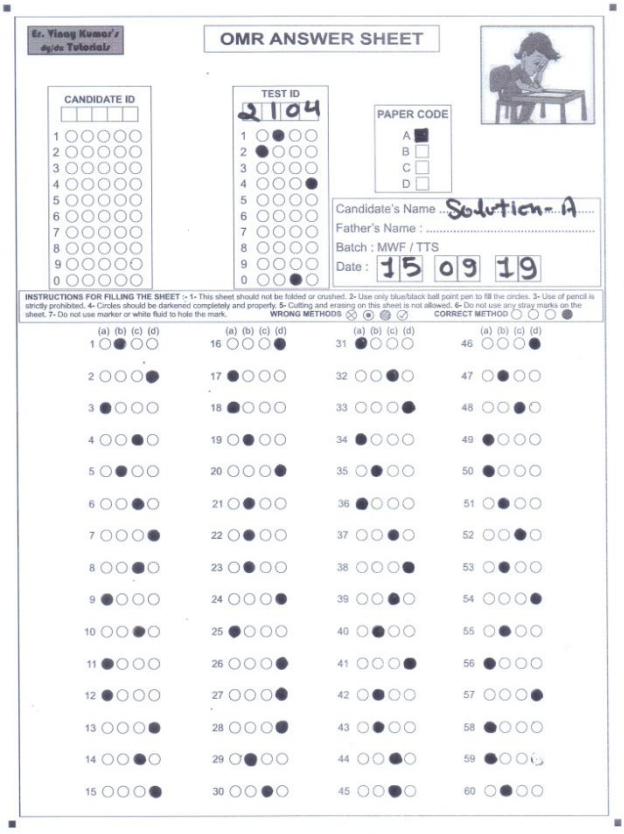
SET-A



Q1. $1M = \dfrac{1\,cm}{20} = 0.05\,cm$

$$LC = \left(\frac{n-n'}{n}\right)M \;\Rightarrow\; LC = \left(\frac{50-48}{50}\right)\times .05$$

$$\Rightarrow\; LC = \frac{2}{50}\times .05 = 0.002\,cm$$

Q3. $LC = \left(\dfrac{n-n'}{n}\right)M \;\Rightarrow\; 0.1\,mm = \left(\dfrac{n-n'}{n}\right)1\,m$

$$\Rightarrow \frac{n-n'}{n} = \frac{1}{10} \;\Rightarrow 1-\frac{n'}{n} = \frac{1}{10} \;\Rightarrow \frac{n'}{n} = 1-\frac{1}{10}$$

$$\Rightarrow \frac{n'}{n} = \frac{9}{10} \;\Rightarrow\; n' = 9,\; n = 10$$

Q4. Measurement with error $\Rightarrow$

First cylinder = 2.25 ± 0.01 cm [error = least count of caliper]

Second cylinder = 1.31 ± 0.01 cm

Total length $l = l_1 + l_2 = 2.25 + 1.31 = 3.56$ cm

Total error $\Delta l = \Delta l_1 + \Delta l_2 = 0.01 + 0.01 = 0.02\,cm$

Combined length = (3.56 ± 0.02) cm

Q5. Zero error = - (N + n × LC)

= - (0+5 × 0.1) = - 0.5 mm

Q6. $LC = \left(\dfrac{n-n'}{n}\right)1M = \left(\dfrac{10-9}{10}\right)\times 1\,mm = 0.1\,mm$

Edge of the cube

= N + n × LC=10mm + 1 × 0.1=10.1 mm

= 1.01 cm

Volume = $(1.01)^3$=1.03 cm^3 (balancing the significant figures)

Density

$$= \frac{mass}{volume} = \frac{2.736}{1.03} = 2.656$$

=2.66 g/cc (balancing the sig. figures)

Q7. $LC = \left(\dfrac{n-n'}{n}\right)1M = \left(\dfrac{10-9}{10}\right)\times 1\,mm = 0.1\,mm$

= 0.01 cm

Zero error = + (N + n × L.C.)

= + (0+5 × .01) = + 0.05 cm

Reading of length = N + n × LC = 3.2 + 4 × .01

= 3.2 +.04 = 3.24 cm

True length of the cylinder = 3.24 – (+0.05)

= 3.24 – 0.05 = 3.19 cm

Q8. $L.C. = \dfrac{1\,mm}{100} = 0.01\,mm$

Zero error = + (N+n × LC) = + (0+4 × 0.01)

Measured diameter = N + n × LC = 2+ 67 × 0.01

= 2.67 mm

True diameter = 2.67 – (+0.04) = 2.63 mm

Q9. $pitch = \dfrac{1.5\,mm}{5} = 0.3\,mm$

$$LC = \frac{pitch}{number\ divisions\ on\ circular\ scale} = \frac{0.3}{50} = 0.006\,mm$$

Q10. L.C. of vernier

$$= \left(\frac{n-n'}{n}\right)1M = \left(\frac{25-24}{25}\right)\times \frac{1\,cm}{20}$$

$$= \frac{1}{25}\times\frac{1}{20} = 0.002\,cm$$

LC of Screw gauge

$$= \frac{1\,mm}{50} = 0.02mm = 0.002\,cm$$

Precision of measurement depends on LC of the instruments. Instrument with less LC will give

more precision and since both the instruments have same LC both of them give equal precision.

Q11. Reading $= N + n \times LC = 2 + 31 \times \dfrac{0.5}{100}$

= 2+0.155 = 2.155 mm

Q13. $z = lnx^2 y \Rightarrow z = lnx^2 + \ln y$

$\Rightarrow \quad z = 2lnx + lny \Rightarrow \Delta z = 2\dfrac{\Delta x}{x} + \dfrac{\Delta y}{y}$

$\Rightarrow \quad \Delta z = 2 \times \dfrac{1}{100} + \dfrac{2}{100} = 0.02 + 0.02 = 0.04$

Q14. $P = \dfrac{7.13 \times 21.54}{415.3} = 0.3698 \simeq 0.370$

Q15. $y = a - b \Rightarrow \Delta y = \Delta a - \Delta b$

$\Rightarrow \quad \dfrac{\Delta y}{y} = \dfrac{\Delta a - \Delta b}{a - b}$

Max. error

$\Rightarrow \quad \dfrac{\Delta y}{y} = \dfrac{\Delta a + \Delta b}{a - b} = \dfrac{\frac{2}{100} \times 5 + \frac{3}{100} \times 3}{5 - 3}$

$= \dfrac{0.1 + 0.09}{2} = \dfrac{0.19}{2} = 0.095$

% error $= \dfrac{\Delta y}{y} \times 100 = 0.095 \times 100 = 9.5\%$

Q16. $\rho = \dfrac{M}{V} \Rightarrow \rho = \dfrac{M}{\pi r^2 l} \Rightarrow \rho \propto \dfrac{M}{r^2 l}$

$\Rightarrow \quad \dfrac{\Delta\rho}{\rho} = \dfrac{\Delta M}{M} - 2\dfrac{\Delta r}{r} - \dfrac{\Delta l}{l}$

Max. error $\Rightarrow \quad \dfrac{\Delta\rho}{\rho} = \dfrac{\Delta M}{M} + 2\dfrac{\Delta r}{r} + \dfrac{\Delta l}{l}$

Max. % error

$\Rightarrow \quad \dfrac{\Delta\rho}{\rho} \times 100 = \dfrac{\Delta M}{M} \times 100 + 2\dfrac{\Delta r}{r} \times 100 + \dfrac{\Delta l}{l} \times 100$

$= \dfrac{0.003}{0.3} \times 100 + 2 \times \dfrac{0.005}{0.5} \times 100$

$+ \dfrac{0.06}{6} \times 100$

= 1 + 2+ 1 = 4%

Q17. $P = \dfrac{a^3 b^2}{c\sqrt{d}}$

$\Rightarrow$ max. % error

$\Rightarrow \quad \dfrac{\Delta P}{P} \times 100 = 3\dfrac{\Delta a}{a} \times 100 + 2\dfrac{\Delta b}{b} \times 100 + \dfrac{\Delta c}{c} \times 100$

$+ \dfrac{1}{2} \times \dfrac{\Delta d}{d} \times 100$

$= 3 \times (1\%) + 2 \times (3\%) + (4\%) + \dfrac{1}{2} \times (5\%)$

= 3 + 6 + 4 + 2.5 = 15.5%

Q18. More significant figure represents more accuracy. 200.0 m has maximum significant figures equal to 4.

Q20. $(12.5)^2$ = 156.25 $\Rightarrow$ 156 (into 3 sig. figures)

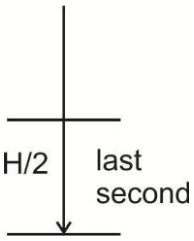
Q21.

$$\begin{array}{rr} 10.4 & \Rightarrow \quad 10.4 \\ -2.01 & -\ 2.0 \\ \hline & 8.4 \text{ cm} \end{array}$$

Q22. $S_T = \dfrac{1}{2} g\,(2T - 1)$

$\Rightarrow \quad \dfrac{H}{2} = \dfrac{1}{2} g\,(2T - 1)$ …….. (1)

$H = \dfrac{1}{2} g\,T^2$ …….. (2)



$\dfrac{(1)}{(2)} \Rightarrow \dfrac{1}{2} = \dfrac{2T - 1}{T^2}$

$\Rightarrow \quad T^2 = 4T - 2 \Rightarrow T^2 - 4T + 2 = 0$

$T = \dfrac{4 \pm \sqrt{16 - 4 \times 1 \times 2}}{2} = \dfrac{4 \pm \sqrt{8}}{2}$

$= \dfrac{4 \pm 2\sqrt{2}}{2} = 2 \pm \sqrt{2} \Rightarrow$ possible

$T = 2 + \sqrt{2} > 1\,\text{sec.}$

Q23. $S = ut + \dfrac{1}{2} at^2$

$\Rightarrow \quad S = (+4.9) \times 2 + \dfrac{1}{2}(-9.8) \times 2^2$

= 9.8 – 2× 9.8 = - 9.8 m

Height = 9.8 m

Q24. $L = \dfrac{1}{2} g \sin\theta T^2 \Rightarrow L$ is same for both the cases.

$\Rightarrow \quad T^2 \propto \dfrac{1}{\sin\theta}$

$\Rightarrow \quad T \propto \dfrac{1}{\sqrt{\sin\theta}} \Rightarrow \dfrac{T_f}{T_i} = \sqrt{\dfrac{\sin\theta_i}{\sin\theta_f}}$

$\Rightarrow \quad \dfrac{T_f}{3} = \sqrt{\dfrac{\sin 30^o}{\sin 60^o}}$

$$\Rightarrow \frac{T_f}{3}=\sqrt{\frac{\frac{1}{2}}{\frac{\sqrt{3}}{2}}} \Rightarrow \frac{T_f}{3}=\frac{1}{\sqrt{\sqrt{3}}}$$

$$=T_f=\frac{3}{3^{1/4}}=3^{1-\frac{1}{4}}=3^{\frac{3}{4}}$$

Q25. $u=g\sin\theta T \Rightarrow 20=10\times\sin\theta\times 4$

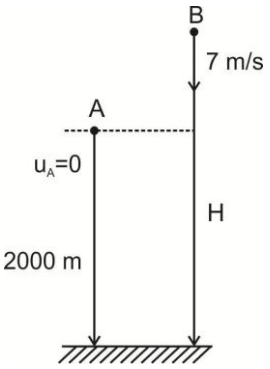
$$\Rightarrow \sin\theta=\frac{1}{2} \Rightarrow \theta=30^o$$

Q26. **<u>For body A</u>**

$$2000=\frac{1}{2}gT^2$$

$$\Rightarrow 2000=\frac{1}{2}\times 10\times T^2$$

$$\Rightarrow T^2=400 \Rightarrow T=20\sec.$$



<u>For body B</u>

$$H=7T+\frac{1}{2}gT^2$$

$$=7\times 20+2000=2140\,m$$

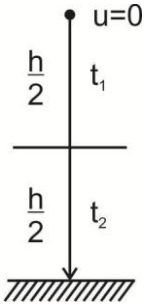
Q27. $\frac{h}{2}=\frac{1}{2}gt_1^2$ ……..(1)

$$h=\frac{1}{2}g(t_1+t_2)^2 \ \ldots\ldots\ldots(2)$$

$$\frac{(1)}{(2)} \Rightarrow \frac{1}{2}=\frac{t^2}{(t_1+t_2)^2}$$

$$\Rightarrow \frac{1}{\sqrt{2}}=\frac{t_1}{t_1+t_2} \Rightarrow t_1+t_2=\sqrt{2}\,t_1$$

$$\Rightarrow t_2=(\sqrt{2}-1)\,t_1$$



Q28. A u_A=8 a_A=0 ⇒ A u_r=8 - 0=8, a_r=0 - 4 = - 4

B u_B=0 a_B=4 B•

[in frame of B]

$$S_r=U_rt+\frac{1}{2}a_rt^2 \Rightarrow 0=8t+\frac{1}{2}(-4)t^2$$

$$\Rightarrow 0=8t-2t^2 \Rightarrow 8t=2t^2 \Rightarrow t=4\sec.$$

Q29. $s=ut+\frac{1}{2}at^2 \Rightarrow 0=ut+\frac{1}{2}(-a)t^2$

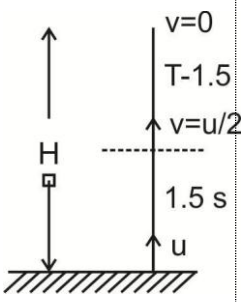
$$\Rightarrow ut=\frac{1}{2}at^2 \Rightarrow t=\frac{2u}{a}$$

Q30. $u=gT$ …….(1)

$$\frac{u}{2}=g\,(T-1.5) \ \ldots\ldots..(2)$$

$$\frac{(1)}{(2)} \Rightarrow 2=\frac{T}{T-1.5}$$

$$\Rightarrow 2T-3=T \Rightarrow T=3\sec.$$



$$H=\frac{1}{2}g\,T^2=\frac{1}{2}\times 10\times 3^2=45\,m$$

Q31. $S_r=U_rt+\frac{1}{2}a_rt^2$

a_r = g – g = 0

u_r = 10 – 5 = 5 m/s

$S_r=5\times 1+0=5m$

Q32. s_r = - 150 m

<u>in frame of B :</u>

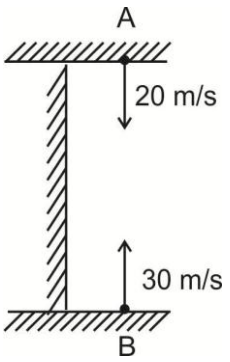
u_r = - (20 + 30) = - 50 m/s

a_r = g – g = 0

$s_r = u_rt + \frac{1}{2}a_rt^2$

⇒ - 150 = - 50 t + 0

⇒ t = 3 sec.



Q33. A u_A=25 m/s ⟵ a_A=1 m/s² B u_B=15 m/s

<u>In frame of A;</u>

u_r = - (25 – 15) = - 10 m/s

a_r = + 1 m/s²

$$v_r^2=u_r^2+2a_r\,s_r \Rightarrow 0=(-10)^2+2\times 1\times s_r$$

$$\Rightarrow 2s_r=-100 \Rightarrow s_r=-50\,m$$

Q34. In the frame of lift

$$u_r=0, \quad a_r=-(g+2)=-(10+2)$$

$$\Rightarrow a_r=-12m/s^2$$

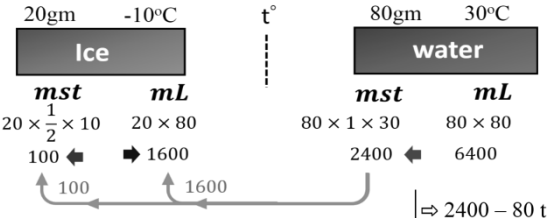
s_r = - 1.5 m

$$s_r=u_rt+\frac{1}{2}a_rt^2$$

$$-1.5=0+\frac{1}{2}(-12)\,t^2 \Rightarrow t^2=\frac{1.5\times 2}{12}$$

$$\Rightarrow t^2=\frac{1}{4} \Rightarrow t=\frac{1}{2}=0.5\sec.$$

Q35.



To find temperature of the final mixture:
Let the final temp. be 't'

Heat given by water = heat taken by ice

$80\times1\times(30-t)$

$=20\times\frac{1}{2}\times[0-(-10)]$ Heat for raising temp. of ice to 0°C

$+20\times80$ Heat for melting of ice

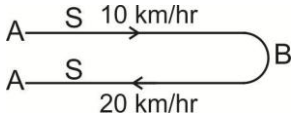
$+20\times1\times(t-0)$ Heat which increases temp. of water formed by ice.

$\Rightarrow 2400-80\,t = 100+1600+20t$

$\Rightarrow 100\,t = 700$

$\Rightarrow t = 7°C$

Q36.



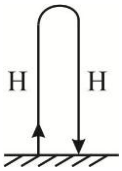
$$\overline{v_S}=\frac{S+S}{t_1+t_2}=\frac{2S}{\frac{S}{10}+\frac{S}{20}}$$

$$\Rightarrow \overline{v_S}=\frac{2S}{\frac{2S+S}{20}}=\frac{2S\times20}{3S}$$

$$=\frac{40}{3}=13.3\,km/hr$$

Q37. $t_1 = 4$sec, $t_2 = 6$ sec.

$T = t_1 + t_2 = 4 + 6 = 10$ sec.



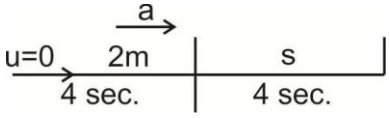
$$H=\frac{1}{2}g\left(\frac{T}{2}\right)^2=\frac{1}{2}\times10\times\left(\frac{10}{2}\right)^2=125\,m$$

distance $=2H=2\times125=250m$

Q38. $$S=\frac{1}{2}a_{eff}\,t^2=\frac{1}{2}\times\left(\frac{4\times6}{4+6}\right)\times10^2=\frac{1}{2}\times\frac{24}{10}\times10^2$$

$$=\frac{240}{2}=120\,m$$

Q39.



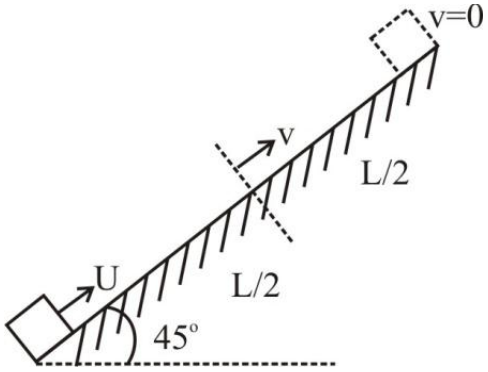
$[s=ut+\frac{1}{2}at^2] \Rightarrow 2=0+\frac{1}{2}a\times4^2$

$\Rightarrow a=\frac{1}{4}m/s^2$

$2+s=\frac{1}{2}a\,(4+4)^2 \Rightarrow 2+s=\frac{1}{2}\times\frac{1}{4}\times8^2$

$\Rightarrow 2+s=8 \Rightarrow s=8-2 \Rightarrow s=6m$

Q40.



$U^2=2g\sin45^o.L$

$=2\times10\times\frac{1}{\sqrt{2}}\times20\sqrt{2} \Rightarrow U=20m/s$

$U^2=2g\sin45^o.L$ ..... (1)

$v^2=2g\sin45^o.\frac{L}{2}$ ..... (2)

$\frac{(2)}{(1)} \Rightarrow \frac{v^2}{U^2}=\frac{1}{2} \Rightarrow v^2=\frac{U^2}{2}$

$\Rightarrow v=\frac{U}{\sqrt{2}} \Rightarrow v=\frac{20}{\sqrt{2}}=10\sqrt{2}\,m/s$

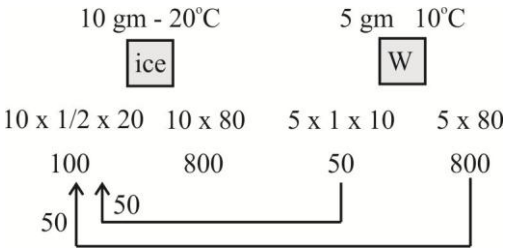
Q41. $v^2=u^2+2as$

$(-20)^2=(+10)^2+2(-10)S$

$\Rightarrow 400=100-20S \Rightarrow S=-15$ m

Height = 15 m

Q42.



Let the mass of water freezed be $m \Rightarrow$

$Q=mL \Rightarrow 50=m\times80 \Rightarrow m=\frac{5}{8}$

Mass of ice in final mix $\Rightarrow$

$m=10+\frac{5}{8}=\frac{85}{8}=10.6\,gm$

Q43. $m\times0.46\times(200-100)+m\times540+m\times1\times(100-70)$

$=(500+200\times0.08)\times1\times(70-20)$

$46\,m+540\,m+30\,m=516\times50$

$616m=516\times50 \Rightarrow m=41.9\,gm$

Q44. $\Rightarrow$ slope $\propto \frac{1}{S}$ ……..(1)

Slope of solid portion $= \frac{2T-T}{t-0} = \frac{T}{t}$ .....(2)

Slope of liquid portion $= \frac{4T-2T}{7t-4t} = \frac{2T}{3t}$ ..... (3)

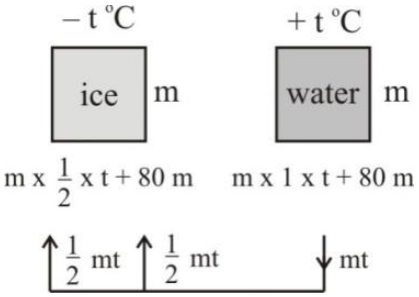
From eq (1)

$$\frac{(slope)_{solid}}{(slope)_{liquid}} = \frac{(sp\ heat)\ liquid}{(sp\ heat)\ solid}$$

$$\Rightarrow \frac{T/t}{2T/3t} = \frac{(sp\ heat)_{liquid}}{(sp\ heat)_{solid}}$$

$$\frac{(sp\ heat)_{liquid}}{(sp\ heat)_{solid}} = \frac{3}{2} = 1.5$$

Q45.



ice melted 25% of $m = \frac{25}{100}m = \frac{m}{4}$

heat required for melting of ice⇨$\boldsymbol{Q = mL}$

$$\Rightarrow \frac{1}{2}mt = \frac{m}{4} \times 80 = \Rightarrow t = 40^{\circ}C$$