51) $F=\frac{\mu_0}{4\pi}\frac{m_1m_2}{r^2} \rightarrow \mu_0 \rightarrow \frac{Fr^2}{m_1m_2} \rightarrow \frac{Newton\times m^2}{Amp^2\times m^2}$ [1]

$\mu_0 \rightarrow \frac{kg\times m}{sec^2\times Amp^2} \rightarrow [M^1L^1T^{-2}A^{-2}]$

52) $m\propto V^xF^yE^z \rightarrow [M^1]=[L^1T^{-1}]^x[M^1L^1T^{-2}]^y\times[M^1L^2T^{-2}]^z$ [4]

$[M^1]=[M^{y+z}L^{x+y+2z}T^{-x-2y-2z}]$

$y+z=1,\quad x+y+2z=0,\quad -\cancel{x}-2y-2\cancel{z}=0$

$\cancel{x}+y+\cancel{2z}=0$

$-y=0\rightarrow y=0$

$z=1$

$x+0+2=0\rightarrow x=-2$

$\therefore m\rightarrow V^{-2}F^0E^1$

[2]

53) $\bar{A}\cdot\bar{B}=r_1r_2\cos(\theta_1-\theta_2)$ $=28\cos60^\circ=28\times\frac{1}{2}=14$

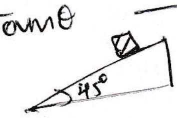
$=7\times4\times\cos(130^\circ-70^\circ)$

[1]

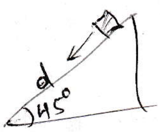
54) $\frac{A_x}{B_x}=\frac{A_y}{B_y}=\frac{A_z}{B_z} \rightarrow \frac{2}{-4}=\frac{3}{-6}=\frac{-1}{-\lambda} \Rightarrow \lambda=2$

[2]

55) $\mu=\tan\theta \rightarrow \tan\theta=1 \rightarrow \theta=45^\circ$



[1]

56) 

Rough inclined plane $a=g(\sin\theta-\mu\cos\theta)$

$=g[\sin45^\circ-\mu\cos45^\circ]$

$a=\frac{g(1-\mu)}{\sqrt{2}}$

$t=t_1,\ S=ut+\frac{1}{2}at^2,\ u=0,\ s=d \rightarrow d=\frac{1}{2}at_1^2$

$d=\frac{g(1-\mu)}{2\sqrt{2}}t_1^2 \rightarrow (1)$.

on smooth plane $a=g\sin\theta=g\sin45^\circ \rightarrow a=g/\sqrt{2}$

$d=\frac{1}{2}at_2^2 \rightarrow d=\frac{g}{2\sqrt{2}}t_2^2 \rightarrow (2)$

and given $t_1=nt_2$, from (1),(2) $\frac{g}{2\sqrt{2}}t_2^2=\frac{g(1-\mu)}{2\sqrt{2}}t_1^2$

$t_2^2=(1-\mu)t_1^2$

$t_2^2=(1-\mu)n^2t_2^2$

$1=(1-\mu)n^2$

$1-\mu=\frac{1}{n^2} \Rightarrow \mu=1-\frac{1}{n^2}$

57) $t_a=1$ sec. $\quad \frac{u\sin\theta}{g}=1 \rightarrow u\sin\theta=10$ [1]

$H=?$ $\quad H=\frac{u^2\sin^2\theta}{2g}$

$g=10$ $\quad =\frac{(10)^2}{2\times10}=\frac{100}{20}=5$ m.

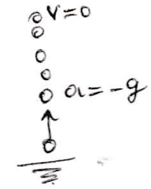
[4]

58) given $R=\frac{R_{max}}{2}$, R_{max} is possible for 45° angle.

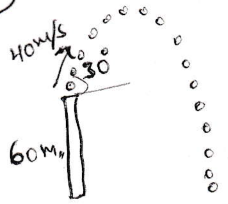
$R_{max}=\frac{u^2\sin2(45^\circ)}{g}=\frac{u^2}{g}$,

$\frac{u^2\sin2\theta}{g}=\frac{u^2/g}{2} \rightarrow \sin2\theta=\frac{1}{2} \rightarrow 2\theta=30^\circ$

$\rightarrow \theta=15^\circ$.

59) 

vertically thrown up $\Rightarrow$ $a=-g$ constant
$v=0$ at Max height
v decreases gradually. [1]

60) 

vertical velocity $v_y = u\sin\theta = 40\sin 30^\circ = 20$ m/s.
time taken to reach ground is [3]

$s = -ut + \frac{1}{2}gt^2 \Rightarrow 60 = -20t + 5t^2$

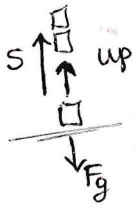
$\Rightarrow 5t^2 - 20t - 60 = 0$

$\Rightarrow t^2 - 4t - 12 = 0$

$\Rightarrow t^2 - 6t + 2t - 12 = 0$

$\Rightarrow t(t-6) + 2(t-6) = 0$

$\Rightarrow (t+2)(t-6) = 0 \rightarrow t = 6$ sec.

61) 

$W = FS\cos\theta$
$= F_g \times S \times \cos 180^\circ$
$= -F_g S$ Negative. [1]

62) 

$U = \frac{1}{2}kx^2$, $x \Rightarrow Nx \rightarrow U_1 = \frac{1}{2}k(Nx)^2 = N^2U$ [3]

63) non renewable energies $\rightarrow$ oil, coal, electricity ---- [1]

64) $T = \frac{0.16V}{A} \rightarrow 3.5 = \frac{0.16 \times 20 \times 15 \times 5}{A} \rightarrow A = 68.57$ sabine. [2]

$\Sigma a \times s = A \rightarrow a = \frac{A}{S} = \frac{68.57}{2[20\times15 + 15\times5 + 20\times5]}$

(Wrong data in the Question $T = 3.5$ sec)

$a = \frac{68.57}{950} = 0.07$

65) $n' = \left(\frac{V+V_0}{V}\right)n = \left(\frac{340+34}{340}\right) \times 450 = \left(\frac{374}{340}\right) \times 450 = 495$ Hz. [4]

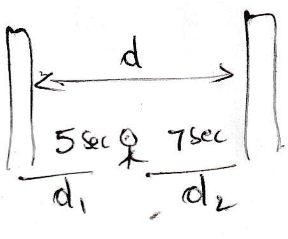
66) The effective gravitational acceleration $g_{eff} = g\left[1 - \frac{d_l}{d_b}\right]$ [4]

$d_l = \frac{d_b}{8} \rightarrow g_e = g\left[1 - \frac{1}{8}\right] = \frac{7}{8}g.$

$\therefore T_1 = 2\pi\sqrt{\frac{l}{\frac{7}{8}g}} = \sqrt{\frac{8}{7}}\,T$

67) $V = \omega\sqrt{A^2 - x^2}$, $V = 2\omega$, $A = x\sqrt{2}$ $\rightarrow 2\omega = \omega\sqrt{(x\sqrt{2})^2 - x^2}$ [1]

$4 = 2x^2 - x^2 \longrightarrow x = 2.$

68) 

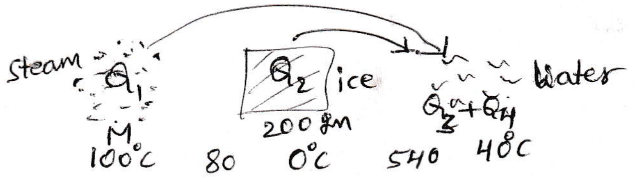
$d = d_1 + d_2$, $c = \frac{2d}{t}$ [3]

$= \frac{ct_1}{2} + \frac{ct_2}{2}$

$= \frac{340}{2}(5+7) = 340 \times 6$

$d = 2040$ metre

69) from conservation of energy



[3]

Heat lost by steam = Heat gained by ice

$Q_1 + Q_2 = Q_3 + Q_4$

Heat lost during condensation + Heat Lost while cooling from 100°c to 40°c =

Heat gained during melting + Heat gained while warming from 0°c to 40°c

$M \times L_{steam} + M \times C_{water} \times (100-40) = 200 \times L_{ice} + 200 \times C_{water} \times (40-0)$

$M \times 540 + M \times 1 \times 60°c = 200 \times 80 + 200 \times 1 \times 40$

$600M = 24000 \longrightarrow \underline{M = 40\,gm}$ [4]

70) $C_p - C_v = R = 8.31 =$ constant. [1]

71) heat & work are path functions [2]

72) $PV^{\gamma} =$ constant $\rightarrow dp\,v^{\gamma} + P\gamma v^{\gamma-1} dv = 0$

$\rightarrow \frac{dP}{P} = -\frac{dv}{v} \cdot \gamma$ [1]

73) $\underset{>0}{dQ} = \underset{<0}{du} + \underset{>0}{dw}$ [4]

74) $i_c = \sin^{-1}\left(\frac{1}{\mu}\right)$ Max i_c for Min μ. [1]

75) $P = \frac{h}{\lambda} \rightarrow P = \frac{h}{c/\nu} \rightarrow P = \frac{h\nu}{c} = \frac{hf}{c}$