51) mass $m = F^x V^y T^z$ [1]

Dimensions on both sides $[M^1] = [M^1L^1T^{-2}]^x \times [L^1T^{-1}]^y \times [T^1]^z$

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

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

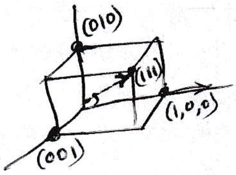
$z = 2(1)+(-1) = 1 \Rightarrow m = F^1 V^{-1} T^1$

52) power $= \frac{W}{t} = \frac{F.S}{t} = F.V$ [3]

$P_1 = F.V \rightarrow$ doubled Force, velocity

$\rightarrow$ then power $P_2 = 2F \times 2V = 4P_1$ 4 times increases (Quadrupled)

53) $|\bar{A}| = \sqrt{3^2+2^2+12^2} = \sqrt{9+4+144} = \sqrt{157}$ [1]

54) 

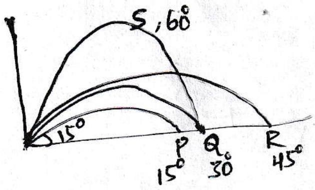
The diagonal makes same angle with 3 axes at the origin. [3]

$\bar{A} = \hat{i}+\hat{j}+\hat{k} \rightarrow (1,1,1)$

$\bar{B} = \hat{i}+0+0 \rightarrow (1,0,0)$

$\bar{A}.\bar{B} = |\bar{A}||\bar{B}|\cos\theta \rightarrow 1+0+0 = \sqrt{1+1+1} \times \sqrt{1+0+0}\cos\theta$

$1 = \sqrt{3}\cos\theta \rightarrow \theta = \cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

55) 

$R = \frac{U^2 \sin 2\theta}{g}$ [2]

$\theta = 15^\circ \rightarrow R_1 = \frac{U^2}{2g} = 50\%$ ✓ Low

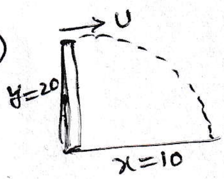
$\theta = 30^\circ \rightarrow R_2 = \frac{\sqrt{3}}{2}\frac{U^2}{g} \rightarrow 86\%$

$\theta = 45^\circ \rightarrow R_3 = \frac{U^2}{g} \rightarrow 100\%$ high

$\theta = 60^\circ \rightarrow R_4 = \frac{\sqrt{3}}{2}\frac{U^2}{g} \rightarrow 86\%$

[3]

56) $\mu_s < \mu_k$

57) 

$y = Ax^2 \rightarrow y = \left(\frac{g}{2U^2}\right)x^2$ [2]

$U^2 = \frac{gx^2}{2y} = \frac{10 \times 10^2}{2 \times 20} = \frac{1000}{40} = 25$

$U = \sqrt{25} = 5$ m/s.

[4]

58) $F = ma \Rightarrow m = \frac{10}{2} = 5$ kg

59) $R = H_{max} \rightarrow \frac{U^2 \sin 2\theta}{g} = \frac{U^2 \sin^2\theta}{2g} \rightarrow 2\sin\theta\cos\theta = \frac{\sin^2\theta}{2}$ [1]

$\rightarrow 4\cos\theta = \sin\theta \rightarrow \tan\theta = 4$

$\rightarrow \theta = \tan^{-1}(4)$

[3]

60) $x = 2t^2+t+5$

velocity $v = \frac{dx}{dt} = 4t+1$

acceleration $a = \frac{dv}{dt} = 4 \rightarrow$ constant (uniform).

[1]

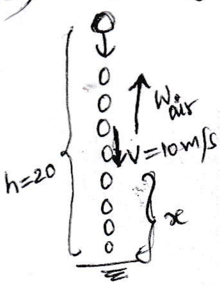
61) $W = \int F.ds \rightarrow W = \int_0^5 (8-4x+3x^2)\,dx$

$= (8x - 2x^2 + x^3)_0^5$

$= 40 - 50 + 125 - 0 + 0 - 0$

$\underline{W = 115 \text{ Joule.}}$

62) $M = 5\,kg$



Total work done = P.E on ground

$W = mgh = 5 \times 10 \times 20 = 1000\,J$

Body moving with 10m/s to get some K.E

$K.E = \frac{1}{2}mv^2 = \frac{1}{2} \times 5 \times 10^2 = 250\,J$

Conservation of energy $W = K.E + P.E$

$mgh = \frac{1}{2}mv^2 + mgx$

P.E from 'x' height $P.E = 1000 - 250 = 750\,J$

it is same & opposition work by Air $\rightarrow -750\,J$ [2]

63) Power = $\frac{\text{pressure} \times \text{volume}}{\text{time}}$ $\because P = \frac{\text{work}}{\text{time}}$

fluids $\rightarrow$ $W = F \times l = \frac{F}{A} \times V = P_r \times V$ [1]

$\therefore$ Power = $\frac{19500 \times 1cc}{1 sec} = 19500 \times (10^{-2})^3$

$P = 19500 \times 10^{-6} = 0.0195$ Watt. [2]

64) SHM $\rightarrow$ (Force) $F \propto -x$ (displacement) [3]

65) SHM $\rightarrow$ displacement $y = A\sin(\omega t \pm \phi)$ $\hookrightarrow$ phase

$\phi \rightarrow$ used for both the position & direction. [1]

66) Second's pendulum $T = 2$ sec.

$T = 2\pi\sqrt{\frac{l}{g}} \rightarrow l = \frac{gT^2}{4\pi^2} = \frac{9.8 \times 4}{4 \times \pi^2} = 0.99m$,

$l = 1m \rightarrow 100\,cm$. [2]

67) $T_1 = \frac{0.16V}{A} = 1$ sec.

Now double dimensions $\rightarrow$ volume $\rightarrow 2l \times 2b \times 2h \rightarrow 8V$

Area $\rightarrow 4A$

$\therefore T_2 = \frac{0.16 \times 8V}{4A} = 2 \times \frac{0.16V}{A} = 2 \times 1 = 2$ sec. [4]

68) $\Delta\nu = |\nu_1 - \nu_2| = 1000 - 500 = 500\,Hz$ [3]

69) All gases laws obeys at high temp & Low pressure. $\rightarrow$ ideal gas. [3]

70) $\eta = \frac{W}{Q} = 1 - \frac{T_C}{T_H}$

$T_C = 127 + 273 = 400\,K$

$T_H = 227 + 273 = 500\,K$

$W = 10^4\,J$

$Q = ?$

$\frac{10^4}{Q} = 1 - \frac{400}{500} \longrightarrow \frac{10^4}{Q} = \frac{100}{500} \rightarrow Q = 5 \times 10^4$ Joule. [1]

71) Adiabatic process

PV^γ = constant

$dP\,V^\gamma + \gamma P V^{\gamma-1} dV = 0$

$dP + \gamma \frac{dV}{V} P = 0$

$\frac{dP}{P} = -\frac{\gamma dV}{V}$

72) $dQ = dU + dW$

$400 \text{ cal} = dU + 1000 \text{ Joule}$ [1]

$400 \times 4.2 \text{ Joule} = dU + 1000 \text{ Joule}$

$dU = (400 \times 4.2) - 1000 = 1680 - 1000 = 680 \text{ Joule.}$

73) $P = \text{constant} \rightarrow V \propto T$ [2]

$\frac{V_1}{V_2} = \frac{T_1}{T_2} \rightarrow \frac{V_1}{3V_1} = \frac{300}{T_2}$

$\rightarrow T_2 = 900 \text{ K.}$

[1]

74) $h\nu = h\nu_0 + W$

$20 = h\nu_0 + 10 \rightarrow h\nu_0 = 10 \rightarrow \nu_0 = \frac{10}{h}$ [4]

75) Superconductor $\longrightarrow$ No Resistance, Resistivity. with diamagnetism.