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Test – I

ans:1 (a) (1) pressure = Energy per unit volume

(b) dimensional formula of angle is $M^0L^0T^0$ and S.I. unit is radian.

(c) Given,

$$F = Kv^2$$

$$\therefore [k] = \frac{[F]}{[v]^2} = \frac{M^1L^1T^{-2}}{[LT^{-1}]^2}$$

$$= \frac{M^1L^1T^{-2}}{M^0L^2T^{-2}} = [M^1L^{-1}]$$

(d) we know,

density = mass / volume

$$= \frac{5.74}{1.2}$$

$$= 4.783 \text{ g/cm}^3$$

$\therefore$ density = 4.8 g/cm^3 since least ~~count~~ significant figure is 2.

ns: 2 Given,

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

$\therefore$ [v] = [u] are velocities.

i.e. $= [M^0L^0T^{-1}]$

~~$[a] = [M$~~

acceleration $= [a] = [M^0 L^1 T^{-2}]$

distance $= [s] = [M^0 L^1 T^0]$

$L.H.S = [v]^2 = [M^0 L^1 T^{-1}]^2$

$= [M^0 L^2 T^{-2}]$ —(I)

$R.H.S = [u]^2 + [2as] = [M^0 L^1 T^{-1}]^2 + [M^0 L^1 T^{-2}]\,[M^0 L^1 T^0]$

$= [M^0 L^2 T^{-2}] + [M^0 L^2 T^{-2}]$

$= [M^0 L^2 T^{-2}]$ —(II)

From (I) and (II), we get

$R.H.S = L.H.S$

Hence, the equation is correct.

(b) Given,

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

Now,

Dimension of P = Dimension of $\frac{a}{V^2}$ —(I)

Dimension of V = Dimension of b —(II)

From (I),

Dimension of $v^2[a]$

$= [M^1 L^{-1} T^{-2}] \times [L^5]^2$

$= [M^1 L^5 T^{-2}]$

unit of a = unit of p × unit of v^2

$= \frac{N}{m^2} \times m^6$

$= Nm^4$

From (ii), $[b] = [V] = [M^0 L^3 T^0]$

$\therefore$ unit of b = unit of $V = m^3$

$\therefore [ab] = [M^1 L^5 T^{-2}][M^0 L^3 T^0]$

(c) (i) 3

(ii) 3

(iii) 4

(iv) 1

d) Given,

$$A = \frac{a^2 b^3}{c\sqrt{a}}$$

$\therefore \frac{\Delta a}{a} \times 100 = 1\%$, $\frac{\Delta c}{c} \times 100 = 2\%$

$\frac{\Delta b}{b} \times 100 = 3\%$, $\frac{\Delta d}{d} \times 100 = 2\%$

$$\therefore \frac{\Delta A}{A} \times 100 = 2\frac{\Delta a}{a} \times 100 + 3\frac{\Delta b}{b} \times 100 +$$

$$\frac{\Delta c}{c} \times 100 + \frac{1}{2} \times \frac{\Delta d}{d} \times 100$$

$$= 2 \times 1 + 3 \times 3 + 2 + \frac{1}{\cancel{2}} \times \cancel{2}$$

$$= 2 + 9 + 2 + 1$$

$$= 14\ \%$$

Ans: 3 (a) ~~Ist~~ Let,

$$\nu \propto l^a T^b m^c$$

where,

$[l] = M^0 L^1 T^0$

$[T] = M^1 L^1 T^{-2}$ (force)

$[m] = M^1 L^{-1} T^0$

Now,

$$[M^0 L^0 T^{-1}] = [M^0 L^1 T^0]^a [M^1 L^1 T^{-2}]^b [M^1 L^{-1} T^0$$

$$[M^0 L^0 T^{-1}] = [M^0 L^a T^0] [M^b L^b T^{-2b}] [M^c L^{-c}$$

Then,

$b + c = 0$ — (I)

$a + b - c = 0$ — (II)

$-2b = -1$ — (III)

$\therefore b = 1/2$

$\therefore c = -1/2$

$a = 1$

$$\therefore \nu \propto 1/l \sqrt{T/m}$$

(i) Avearage length

$$= \frac{2.48 + 2.46 + 2.49 + 2.50 + 2.52 + 2.43}{6}$$

$$= \frac{14.88}{6} = 2.48\ m$$

~~Mean absolute error~~

Now, #

$\Delta l_1 = \cancel{(\Delta t} \cdot 2.48 - 2.48 = 0\ m$

$\Delta l_2 = 2.48 - 2.46 = 0.02\ m$

$\Delta l_3 = 2.48 - 2.49 = -0.01\ m$

$\Delta l_4 = 2.48 - 2.50 = -0.02\ m$

$\Delta l_5 = 2.48 - 2.52 = -0.04\ m$

$\Delta l_6 = 2.48 - 2.43 = 0.05\ m$

Now,

mean absolute error

$$= \frac{|0| + |0.02| + |-0.01| + |-0.02| + |-0.04| + |0.05|}{6}$$

$$= \frac{0 + 0.02 + 0.01 + 0.02 + 0.04 + 0.05}{6}$$

$$= \frac{0.14}{6} = 0.023\ m$$

% error $= \frac{0.02}{2.48} \times 100$

$= 0.008 \times 100 = 0.8\%$

$\therefore$ Length $= (2.48 \pm 0.02)$ m

(c) Parallactic angle is the angle made between ~~great circle~~ passing the two lines of sight of a distance planet or a star from the two observation from the surface of the earth.

$$\phi = 2^\circ 36' = 156' = (156 \times 60)''$$
$$= 156 \times 60 \times 4.85 \times 10^{-6}$$
$$= 45,396 \times 10^{-6}$$
$$= 45.396 \times 10^{-2} \text{ m}$$

Also, $d = 552$ Km
$$= 552 \times 10^{3} \text{ m}$$

$$\therefore D = \frac{d}{\phi} = \frac{552 \times 10^{3}}{45.396 \times 10^{-2}}$$
$$= 12.15 \times 10^{5} \text{ m}$$

(d) Given,

$$\cancel{T \propto P^a} \; \& \; T \propto P^a \rho^b E^c$$
$$T = K P^a \rho^b E^c \quad \text{—— (1)}$$

$$[T] = [ML^{-1}T^{-2}]^a [ML^{-3}]^b [ML^2T^{-2}]^c$$

So, we get,

$$0 = a + b + c \quad \text{—— (ii)}$$

$0 = -a - 3b + 2c$ —— (III)
$1 = -2a - 2c$ —— (IV)

From, (IV),

$a + c = -\frac{1}{2}$ —(V)

Inserting it in (II), we get,

$0 = b - \frac{1}{2}$

$\Rightarrow b = \frac{1}{2}$

From eqn (5),

$a = -\frac{1}{2} - c$

Putting values of a and b in (III),

$0 = -\left(-\frac{1}{2} - c\right) - 3 \times \frac{1}{2} + 2c$

$0 = +\frac{1}{2} + c - \frac{3}{2} + 2c$

$\Rightarrow 3c = 1$

$\Rightarrow c = \frac{1}{3}$

Then, value of (c) in (5)

$a + \frac{1}{3} = -\frac{1}{2}$

$\Rightarrow a = -\frac{1}{2} - \frac{1}{3}$

$\therefore a = -\frac{5}{6}$

$\therefore a = -\frac{5}{6}$, $b = \frac{1}{2}$ and $c = \frac{1}{3}$