23/11/2020
MONDAY

PHYSICS

STD - XI
class - 04

Assignment

1) In the equation $\left(P + \frac{a}{V^2}\right)(V-b) = RT$, Find the dimensions of constant 'a'.

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

P = pressure a, b = constant
V = volume R = Universal gas constant
T = absolute temperature

As pressure can be added only to pressure,

$\therefore \frac{a}{V^2} = P$

$a = PV^2 = \left(ML^{-1}T^{-2}(L^3)^2\right)$

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

2) Check the dimensional consistency of the following equations.

1. $Fx = P \times V$

Ans) F = force, P = Pressure x = displacement
V = volume

$Pressure = \frac{Force}{Area}$

$P = ML^{-1}T^{-2}$

Volume = Area x Length $V = L^3$

Force = Mass x Acceleration

$F = MLT^{-2}$

$x = L$ $\therefore PV = Fx$

$\therefore ML^{-1}T^{-2} \times L^3 = MLT^{-2} \times L$

$ML^2T^{-2} = ML^2T^{-2}$

Since the dimensions on both sides are equal, the given equation is dimensionally correct.

2. $V = \sqrt{\frac{GM}{R}}$ V = velocity G = Gravitational constant
M = mass
R = radius

$G = \frac{Nm^2}{kg^2}$ $\therefore G = [M^{-1}L^3T^{-2}]$

$M = kg$ $\therefore M = [M]$

$R = m$ $\therefore R = [L]$

$V = \frac{m}{s}$ $\therefore V = [LT^{-1}]$

$\therefore V = \sqrt{\frac{GM}{R}} = \frac{[M^{-1}L^3T^{-2}][M]}{[L]}$

$= LT^{-1}$

$\therefore$ equation is dimensionally correct.

3. $2\pi\sqrt{\frac{k}{m}}$ f = frequency
k = force constant
m = mass

$f = 2\pi\sqrt{\frac{k}{m}}$

Squaring both sides

$F^2 = \frac{4\pi^2 k}{m}$

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

$\therefore$ equation is dimensionally correct.