TOPIC : UNIT & DIMENSIONS
EXERCISE # 1

SECTION (A)

1. Watt hour = $\left(\frac{\text{Joule}}{\text{sec}}\right)$. (60 × 60 sec) = 3.6 × 10^3 Joule

3. Micron, light year & angstrom are units of length and radian is unit of angle.

4. According to Stefan's law,
$E \propto T^4$ or $E = \sigma T^4$
Here, σ is proportionality constant called the Stefan's constant.
The unit of stefan's constant is watt metre $^{-2}$ kelvin^{-4} or W/m^2-K^4.

14. n u = constant so $n \propto \frac{1}{u}$

15. $n_1 u_1 = n_2 u_2$
$n_2 = n_1 \frac{u_1}{u_2} = n_1 \frac{[M_1L_1T_1^{-2}]}{[M_2L_2T_2^{-2}]}$ ⇒ $n_2 = 100\left[\left(\frac{1}{1000}\right)\cdot\left(\frac{1}{100}\right)\cdot\left(\frac{1}{60}\right)^{-2}\right]$ = 3.6

16. $a = \frac{S^2}{t^4} = \frac{(\text{metre})^2}{(\text{second})^4}$ = $m^2\ s^{-4}$

17. Angular momentum L = mvr
(L) = (kg) $\left(\frac{m}{\text{sec}}\right)$. (m) = kg $m^2\ s^{-1}$
(L) = (kg $m^2\ s^{-2}$). (s) = Joule – s

18. 1 Joule = 10^7 erg
1 eV = 1.0 × 10^{-19} Joule = 1.6 × 10^{-19} × 10^7 erg = 1.6 × 10^{-12} erg

19. $[G] = [M^{-1} L^3 T^{-2}]$ ⇒ $\frac{\text{metre}^3}{\text{kg}\,\text{sec}^2} = \frac{(100\,\text{cm})^3}{(1000\,\text{gram})\,\text{sec}^2}$
1 SI = 1000 CGS
$\frac{\text{SI}}{\text{CGS}}$ = 1000

21. $[E] = [M^1 L^2 T^{-2}] = (3M)^1 (3L)^2 T^{-2}$
$[E] = 27\ [ML^2 T^{-2}]$

22. New unit = x metre
1 metre = $\frac{1}{x}$ new unit
1 m^2 = $\left(\frac{1}{x}\right)^2$ (new unit)^2

24. $Q = \sigma T^4 = \frac{\text{Energy}}{\text{area} \times \text{Time}}$
$\sigma = \frac{\text{Energy}}{\text{area} \times \text{Time} \times (\text{Temp})^4}$

In SI. unit of $\sigma = \dfrac{\text{Joule}}{m^2\,\text{sec}\times\text{kelvin}^4}$

In CGS. unit of $\sigma = \dfrac{\text{Energy}}{cm^2\,\text{sec}\times\text{kelvin}^4}$

Value of $\sigma = C_1 . \dfrac{\text{Joule}}{\text{metre}^2 - \text{sec}\times\text{kelvin}^4}$

Value of σ in CGS = $C_1 . \dfrac{10^7\,\text{erg}}{10^4\,cm^2\,\text{sec.kelvin}^4}$ (Take C_1 is constant number) = $1000C_1 . \dfrac{\text{erg}}{cm^2\,\text{sec.kelvin}^4}$

Value of σ in SI = C_1 SI
Value of σ in CGS = 1000 C_1 CGS
Ratio of SI to CGS.
C_1 SI = 1000 C_1 CGS

$\dfrac{SI}{CGS} = 1000$

25. KE. = $\frac{1}{2}$ mV^2
[KE] = $[ML^2 T^{-2}]$
If unit of M and L are doubled
Then unit of K.E.
K.E. = $[(2M)(2L)^2 T^{-2}] = 8\,[ML^2 T^{-2}]$
unit of K.E. is 8 times.

26. Parallactic second is a unit of distance.

29. Substitute the units for all the quantities involved in an expressioin written for permittivity of free space.
By coulomb's law, the electrostatic force

$F = \dfrac{1}{4\pi\varepsilon_0}\times\dfrac{q_1q_2}{r^2}$ $\Rightarrow$ $\varepsilon_0 = \dfrac{1}{4\pi}\times\dfrac{q_1q_2}{r^2F}$

Substituting the units for q, and F, we obtain unit of

$\varepsilon_0 = \dfrac{\text{coulomb}\times\text{coulomb}}{\text{newton}-(\text{metre})^2} = \dfrac{(\text{coulomb})^2}{\text{newton}-(\text{metre})^2}$

$= C^2/\,N\text{-}m^2$

SECTION (B)

1. $\dfrac{1}{\ell}\sqrt{\dfrac{T}{m}} = \dfrac{1}{[L]}\sqrt{\dfrac{MLT^{-2}}{ML^{-1}}} = \dfrac{1}{[L]}\,[L\,T^{-1}] = \dfrac{1}{[L]}$ = [frequency]

2. (1) S = $\frac{1}{2}$ at^2, $[L] = [LT^{-2}]\,[T^2] = [L]$

(2) V = $\sqrt{\dfrac{T}{m}}$, $[LT^{-1}] = \left[\dfrac{MLT^{-2}}{ML^{-1}}\right]^{1/2} = [LT^{-1}]$

(3) t = $\dfrac{2h}{g}$, $[t] = [T]$

$\left[\dfrac{2h}{g}\right] = \left[\dfrac{L}{LT^{-2}}\right] = T^2$ not equal to [T]

(4) a = $\dfrac{V^2}{r}$ $\Rightarrow$ $[LT^{-2}] = \dfrac{[LT^{-1}]^2}{[L]} = [LT^{-2}]$

3. [Dipole moment] = LIT, $[\phi_E] = ML^3/IT^3$ $[E] = ML/IT^3$.

4. Magnetic flux (ϕ) through a surface of area (A) is the total number of magnetic lines of induction passing through that area normally. Mathematically, magnetic flux

$\phi = BA$

but magnetic force

$F = Bil$ or $B = \frac{F}{il}$

putting the value of B in Eq. (1), we have

Thus, dimensions of $\phi = \frac{[MLT^{-2}][L^2]}{[AL]} = [ML^2 T^{-2} A^{-1}]$

5. $E = h\nu \Rightarrow h$ = planck's constant $= \frac{E}{V}$ $\therefore [h] = \frac{[E]}{[V]} = \frac{[ML^2T^{-2}]}{[T^{-1}]} = [ML^2T^{-1}]$

(a) Linear momentum = mass × velocity

or $p = m \times v$ or $[p] = [m]\times[v] = [M][LT^{-1}] = [MLT^{-1}]$

(b) Energy $[E] = [ML^2 T^{-2}]$

(c) Angular momentum = moment of inertia × angular velocity

or $L = I \times \omega = mr^2 \omega$ $[\because I = mr^2]$

$\therefore$ $[L] = [L^2][T^{-1}] = [ML^2T^{-1}]$

(d) Power = froce × velocity or $P = F \times V$ $\therefore [P] = [MLT^{-2}][LT^{-1}] = [ML^2 T^3]$

Hence, option (C) is correct.

6. Substitute the dimensions for thequantities involved in an expressioin written for gravitational constant. According to Newton's law of gravitation, the force of attraction between two masses m_1 and m_2 separated by a distance r is,

$F = \frac{Gm_1m_2}{r^2} \Rightarrow G = \frac{Fr^2}{m_1m_2}$

Substituting the dimensions for the quantities on the right hand side, we obtain

dimensions of $G = \frac{[MLT^{-2}][L^2]}{[M^2]}$

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

15. The dimensions of torque and work are $[ML^2 T^2]$

16. h = Planck’s constant = J–s = $[ML^2T^{-1}]$

P =momentum = kg m/s = $[MLT^{-1}]$

17. As we know that formula of velocity is

$v = \frac{1}{\sqrt{\mu_0\varepsilon_o}}$ $\therefore$ $v^2 = \frac{1}{\mu_0\varepsilon_o} = [LT^{-1}]^2$ $\therefore$ $\frac{1}{\mu_0\varepsilon_o} = [L^2 T^{-2}]$

18. $F = at^{+1} + bt^{+2}$

$[a] = \left[\frac{F}{t}\right] = \left[\frac{MLT^{-2}}{T}\right] = [MLT^{-3}]$ $[b] = \left[\frac{F}{t^2}\right] = \left[\frac{MLT^{-2}}{T^2}\right] = [MLT^{-4}]$

20. $\beta = \frac{\Delta P}{\Delta V / V}$

$[\beta] = ML^{-1} T^{-2}$

21. $x = K a^m t^n$

$[L] = [L T^{-2}]^m [T]^n$

$[L] = [L^m T^{n-2m}]$

$m = 1$, $n - 2m = 0$ $n = 2$

22. $[J] = [mvr]$ $[P] = [mv]$ $\Rightarrow$ $\left[\frac{J}{P}\right] = \left[\frac{mvr}{mv}\right] = [r] = L^1$

r ⇒ distance

23. $[\tau] = [F.\ r]$
$[MLT^{-2}.L] = [ML^2T^{-2}]$

24. (1) Angular momentum $J = n\dfrac{\lambda}{2\pi}$ n and 2π are dimensionless so $[J] = [\lambda]$
(2) $[W] = [ML^2T^{-2}] = [\text{Torque}]$
(3) Impulse = change in momentum. = ΔP. P and ΔP have same dimensions
(4) $[\text{Torque}] = [ML^2T^{-2}]$ [moment of inertia] = $[ML^2T^0]$ Not same

5. $[\omega] = \left[\dfrac{v}{r}\right] = [T^{-1}]$

26. (1) $[G] = [M^{-1} L^3 T^{-2}]$
(2) $\varepsilon_r = \dfrac{\varepsilon}{\varepsilon_0}$ unit less and dimension less because ε and ε_0 are permittivity of medium and vaccum having same dimensions.
(3) relative velocity $V_{AB} = V_A - V_B$ dimension of velocity
(4) Density = ML^{-3}

27. $\left[\dfrac{\text{Energy}}{\text{mass} \times \text{length}}\right] = \left[\dfrac{ML^2T^{-2}}{ML}\right] = [LT^{-2}]$ same as acceleration

28. $[G] = \left[\dfrac{Fr^2}{m_1m_2}\right] = [M^{-1} L^3 T^{-2}]$

29. $S = a + bt + c\,t^2$
unit of C = unit of $\dfrac{S}{t^2}$ = metre sec^{-2} = [work]

31. $[mc^2] = [M\,(LT^{-1})^2] = [ML^2T^{-2}]$

32. $S_n = a + \dfrac{a}{2}(2n + 1)$
S_n is displacement in n^{th} sec. So, $[S_n] = [M^0\,L^1T^0]$

33. Light year is distance travelled by light in one year.

34. $[G] = [M^{-1}\,L^3\,T^{-2}]$ rest are ratios of similar quantities so dimensionless.

35. All are ratios of similar quantities.

36. $F = at + bt^2$
$[a] = \left[\dfrac{F}{t}\right] = MLT^{-3}$ ⇒ $[b] = \left[\dfrac{F}{t^2}\right] = MLT^{-4}$

37. A and B of different dimensions then only $\dfrac{A}{B}$ is correct among the options given. Addition is possible for quantities of same dimension for logarithm and exponential are taken to dimension less quantity.

38. $10^{at} + 3$, powers are dimensionless. So, $[at] = M^0L^0T^0$
$[a] = [M^0L^0T^{-1}$

39. $[M] = [F^a\, T^b\, V^c]$
$[M^1L^0T^0] = [(MLT^{-2})^a\, (T)^b\, (LT^{-1})^c]$
Equating dimensions of M, L and T
$1 = a, \quad 0 = a + c, \qquad 0 = -2a + b - c$
$a = 1, \quad c = -1, \qquad b = 1$
$[M] = F^1\, T^1\, V^{-1}$

40. $[F] = [P^a\, V^b\, T^c]$
$[MLT^{-2}] = [(ML^{-1}\, T^{-2})^a\, (LT^{-1})^b\, (T)^c]$
equating powers of M, L and T
$1 = a, \quad 1 = -a + b, \qquad -2 = -2a - b + c$
$a = 1, \quad b = 2, \quad c = 2$
$[F] = [pV^2\, T^2]$

41. $n = cm^xk^y$
$[n] = [cm^x\, k^y]$
$[T^{-1}] = \left[M^x\left(\frac{F}{x}\right)^y\right]$
$[M^0\, L^0\, T^{-1}] = \left[M^x\left(\frac{MLT^{-2}}{L}\right)^y\right]$
Equating power of M, L and T
$0 = x + y$
$-1 = -2y \qquad y = \frac{1}{2}, \qquad x = -\frac{1}{2}$

42. $[V] = [g^p\, h^q]$
$[LT^{-1}] = [(LT^{-2})^p\, (L)^q]$
Equating power of L and T
$1 = p + q, \qquad -1 = -2p, \qquad p = \frac{1}{2} \quad q = \frac{1}{2}$

43. $[V] = [E^b\, d^a]$
$[LT^{-1}] = [(ML^{-1}T^{-2})^b\, (ML^{-3})^a]$
equating power of M, L and T
$0 = b + a, \qquad 1 = -b - 3a$
$-1 = -2b, \qquad \Rightarrow \qquad b = \frac{1}{2}, \qquad a = -\frac{1}{2}$

44. $[Y] = [F^a\, A^b\, D^c]$
$[ML^{-1}\, T^{-2}] = [(MLT^{-2})^a\, (L^2)^b\, (ML^{-3})^c]$
equating power of M, L and T
$1 = a + c, \qquad -1 = a + 2b - 3c$
$-2 = -2a \qquad a = 1, \qquad c = 0$
$b = -1$
$[Y] = F\, A^{-1}\, D^0$

45. $[T] = [M^0\, L^0\, T^1] \qquad$ as $F = 6\pi\eta rv$
(1) $[\eta] = \left[\frac{F}{rv}\right] = \left[\frac{MLT^{-2}}{LLT^{-1}}\right] = [ML^{-1}\, T^{-1}] \quad \Rightarrow \quad \left[\frac{mr^2}{6\pi\eta}\right] = \left[\frac{ML^2}{ML^{-1}T^{-1}}\right] = [L^3T]$
(2) $\left[\sqrt{\frac{6\pi\eta mr}{g}}\right] = \left[\left(\frac{ML^{-1}T^{-1}M.L}{LT^{-2}}\right)^{\frac{1}{2}}\right] = \left[ML^{-1/2}\; T^{-1/2}\right]$
(3) $\left[\frac{m}{6\pi\eta rv}\right] = \left[\frac{M}{MLT^{-2}}\right] = [L^{-1}\, T^2]$
None of the three options have dimension of time.

46. $F = 6\pi\eta rv$

$[\eta] = \frac{[F]}{[r][V]} = \frac{[MLT^{-2}]}{[L][LT^{-1}]}$

$[\eta] = [ML^{-1} T^{-1}]$

48. From Newton's formula

$\eta = \frac{F}{A\left(\Delta v_x / \Delta z\right)}$ ∴ Dimensions of $\eta = \frac{\text{dimensions of force}}{\text{dimensions of area} \times \text{dimensions of velocity} - \text{gradient}} = \frac{[MLT^{-2}]}{[L^2]\,[L^{-1}]} = [ML^{-1} T^{-1}]$

EXERCISE # 2

1. $T \propto P^a d^b E^c$

Pressure $[P] = [ML^{-1} T^{-2}]$

Density $[d] = [ML^{-3}]$

Energy $[E] = [ML^2 T^{-2}]$

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

$[M^0 L^0 T^1] = [M^{a+b+c} L^{-a-3b+2c} T^{-2a-2c}]$

$\Rightarrow \quad a + b + c = 0$ ....(1)

$\Rightarrow \quad -a - 3b + 2c = 0$ ....(2)

$\Rightarrow \quad -2a - 2c = 1$ ....(3)

(1) and (2) $-2b + 3c = 0$ ....(4)

put in (1)

$a + \frac{3c}{2} + c = 0 \qquad a = -\frac{5c}{2}$

put in (3)

$-2\left(\frac{-5c}{2}\right) - 2c = 1 \qquad 3c = 1 \qquad c = \frac{1}{3}$

$a = \frac{-5}{2}c. \quad = \frac{-5}{2}\left(\frac{1}{3}\right) = -\frac{5}{6}$

Put $c = \frac{1}{3}$ in (4)

$b = \frac{3c}{2} = \frac{1}{2}$

$T \propto P^{-5/6} d^{1/2} E^{1/3}$

2. $V = \alpha t + \frac{\beta}{t + \gamma}$

$[V] = [\alpha\, t] \qquad [\alpha] = \frac{[V]}{[t]}$

$[\alpha] = \frac{[LT^{-1}]}{[T]} = [LT^{-2}]$

$t + \gamma$ says that dimension of γ

$[\gamma] = [t] \quad \Rightarrow \quad [\gamma] = [T]$

$[V] = \left[\frac{\beta}{t + \gamma}\right] \quad \Rightarrow \quad [\beta] = [V]\,[T]$

$[\beta] = [LT^{-1}]\,[T] = [L]$

3. $V \propto \lambda^a d^b g^c$

$[V] = [\lambda]^a [d]^b [g]^c$

$[M^0 LT^{-1}] = [L]^a [ML^{-3}]^b [LT^{-2}]^c$

$b = 0,\quad a - 3b + c = 1,\quad -2c = -1$

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

$V \propto \lambda^{1/2} g^{1/2} \Rightarrow V^2 \propto \lambda g$

4. $y = a \sin (At - Bx + C)$

$At - Bx + C$ is angle, so it has no dimension

$[At] = [M^0 L^0 T^0] \Rightarrow [A] = [T^{-1}] \quad \because [t] = [T]$

$[Bx] = [M^0 L^0 T^0] \Rightarrow [B] = [L^{-1}] \quad \because [x] = [L]$

$[C] = [M^0 L^0 T^0]$

5. $\frac{1}{\lambda} = R Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

Here, Z, n_1 & n_2 are dimensionless & $[\lambda] = L$. So, $[R] = L^{-1}$

7. $x = A^2 \sin kt$

t denote time

As angle is dimensionless so $[kt] = M^0L^0T^0$

$[k] = \frac{1}{[t]} = \frac{1}{T}$. So, unit of k is Hertz

8. $F = a \sin k_1x + b \sin k_2t$

Here F, x & t denote force, distance and time again angle is dimensionless.

so $[k_1x] = M^0 L^0 T^0$, So, $[k_1] = \frac{1}{[x]} = L^{-1} \Rightarrow$ metre^{-1}

$[k_2 t] = M^0 L^0 T^0$, So, $[k_2] = \frac{1}{[x]} = T^{-1} \Rightarrow$ sec^{-1}

9. E, m, J and G are Energy, mass, angular momentum and gravitational constant respectively

$\left[\frac{EJ^2}{m^5G^2}\right] = \left[\frac{(ML^2T^{-2}).(ML^2 T^{-1})^2}{M^5 (M^{-1}L^3T^{-2})^2}\right] = M^0 L^0 T^0$

Angle is dimensionless quantity among given options.

10. $[m] = [C]^x [G]^y [h]^z$

$[M^1L^0T^0] = [M^0LT^{-1}]^x [M^{-1} L^3T^{-2}]^y [ML^2T^{-2}]^z$

equating dimensions at M, L, T

$1 = -y + z$ .....(1)

$0 = x + 3y + 2z$ .....(2)

$0 = -x - 2y - z$ .....(3)

(2) and (3)

$0 = y + z$ .....(4)

by (1) and (4)

$z = \frac{1}{2},\quad y = -\frac{1}{2},\quad x = -2y - z = 1 - \frac{1}{2} = \frac{1}{2}$

$x = \frac{1}{2}\quad [m] = C^{1/2} G^{-1/2}h^{1/2}$

11. $F = \frac{X}{\text{density}}$ + cthen $[x] = [F.\ \text{density}]$

$[x] = [MLT^{-2} . ML^{-3}] = [M^2 L^{-2} T^{-2}]$

12. $[V] = [P]^x [\rho]^y$
$[M^0 L^1 T^{-1}] = [ML^{-1} T^{-2}]^x [ML^{-3}]^y$
equating dimensions of M and L
$0 = x + y,$ ......(1)
$1 = -x - 3y$ ....(2)
$1 = -x + 3x$ $x = \frac{1}{2}$, $y = -\frac{1}{2}$
$[V] = P^{1/2} \rho^{-1/2}$

13. $y = A\sin(\omega t - kx)$
$\omega t - kx$ is angle i.e., dimensionless.
$[\omega t] = [kx]$ $\Rightarrow$ $\left[\frac{\omega}{k}\right] = \left[\frac{x}{t}\right] = LT^{-1}$ Velocity

14. Magnetic potential energy stored in inductor
$U = \frac{1}{2} Li^2$
$[Li^2] = ML^2 T^{-2}$

15. $[a] = LT^{-2}$ $[c] = T$ $[b] = L$

17. $[k x] = M^0L^0T^0$ $[k] = L^{-1}$

18. $E = k F^a A^b T^c$
$[ML^2T^{-2}] = [MLT^{-2}]^a [LT^{-2}]^b [T]^c$
$[ML^2T^{-2}] = [M^a L^{a+b} T^{-2a-2b+c}]$
$a = 1,$ $a + b = 2,$ $-2a - 2b + c = -2$
$a = 1, b = 1, c = 2$
$E = k FAT^2$

20. $X = 3YZ^2$
$[X] = [Y] [Z]^2$
$[Y] = \frac{[X]}{[Z]^2} = \frac{M^{-1}L^{-2}Q^2T^2}{M^2Q^{-2}T^{-2}} = M^{-3}L^{-2}Q^4T^4$

21. (None of the four choices) $\frac{1}{2} \epsilon_0 E^2$ is the expression of energy density (Energy per unit volume)
$\therefore$ $\left[\frac{1}{2}\epsilon_0 \; E^2\right] = \left[\frac{ML^2T^{-2}}{L^3}\right]$ $\Rightarrow$ $[ML^{-1} T^{-2}]$

→ From this question, students can take a lesson that even in IIT-JEE, questions may be wrong or there may be no correct answer in the given choices. So don't waste time if you are confident.

22. Joule = (Newton) (Metre) = $\frac{4\text{Newton}}{4} \times \frac{4\text{Metre}}{4} = \frac{\text{Joulea}}{16}$
Hence 1 Joulea = 16 joule (Joulea is new unit of energy)

EXERICSE # 3
PART - I

1. (i) Dimension of velocity $= [M^0L^1T^{-1}]$ Here, a = 0, b =1 , c = –1
(ii) Dimensions of acceleration $= [M^0L^1T^{-2}]$ Here, a = 0, b = 1 , c = –2
(iii) Dimensions of force $= [M^1L^1T^{-2}]$ Here, a = 1, b =1 , T = –2
(iv) Dimensions of pressure $= [M^1L^{-1}T^{-2}]$ $\therefore$ Here, a = 1, b = –1 , c = –2
$\therefore$ The physical quantity is pressure.

2. Energy density of an electric field E is

$u_E = \frac{1}{2}\varepsilon_0 E^2$ where ε_0 permittivity of free space

$\frac{\text{Energy}}{\text{Volume}} = \frac{ML^2T^{-2}}{L^3} = ML^{-1}T^{-2}$ Hence, the dimension of $\frac{1}{2}\varepsilon_0 E^2$ is $ML^{-1}T^{-2}$

3. In CGS $\Rightarrow$ $d = 4\frac{g}{cm^3}$ If unit of mass is 100 g and unit of distance is 10 cm

So density = $\frac{4\left(\frac{100g}{100}\right)}{\left(\frac{10}{10}cm\right)^3} = \frac{\left(\frac{4}{100}\right)}{\left(\frac{1}{10}\right)^3}\frac{(100g)}{(10cm)^3}$ = 40 unit

4. $F = M \times \frac{L}{T^2} = \frac{ML}{TT}$ $\Rightarrow$ $F = \frac{MV}{T}$ $\Rightarrow$ $FTV^{-1} = M$

5. Let surface tension $\sigma = E^a V^b T^c$

Equating the dimension of LHS and RHS $\frac{M^1L^1T^{-2}}{L} = (M^1L^2T^{-2})^a\left(\frac{L}{T}\right)^b (T)^C$

$M^1L^0T^{-2} = M^aL^{2a+b}\,T^{-2a-b+c}$

$\Rightarrow$ $a = 1,\ 2a + b = 0,$ $-2a - b + c = -2$

$\Rightarrow$ $a = 1,\ b = -2\ c = -2$

PART - II

1. $\rho = \frac{M}{L^3}$

$n_1 u_1 = n_2 u_2$

$\therefore 128\left|M_1L_1^{-3}\right| = n_2\left|M_2L_2^{-3}\right|$ $\therefore$ $n_2 = 128 \times \left[\frac{M_1}{M_2}\right]\left[\frac{L_2}{L_1}\right]^3 = 128 \times \left[\frac{1000}{50}\right] \times \left[\frac{25}{100}\right]^3 = 128 \times 20 \times \frac{1}{64} = 40$

2. Let $Y = f(V, F, A)$

$\therefore$ $[Y] = [V]^x [F]^y [A]^z$

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

$-x - 2y - 2z = 2$

$\therefore$ $x + 2y + 2z = 2$

$\therefore$ $x + 2z = 0$

$\therefore$ $Y = K V^x F^y A^z$, K → Unit less

$\therefore$ $[ML^{-1}T^{-2}] = [LT^{-1}]^x [MLT^{-2}]^y [LT^{-2}]^z$

$\therefore$ $y = 1,\ x + y + z = -1$

$\therefore$ $x + z = -2$

$\therefore$ $z = 2,\ x = -4$

$\therefore$ $[Y] = [V^{-4} F A^2]$

3. $\left[\frac{L}{CVR}\right] = \left[\frac{L}{R}\frac{R}{CRV}\right] = \left[\frac{L}{R}\right]\left[\frac{1}{RC}\right]\left[\frac{R}{V}\right]$

$= [T]\left[\frac{1}{T}\right]\left[\frac{R}{V}\right] = \left[\frac{R}{V}\right] = \left[\frac{1}{I}\right] = A^{-1}$