SOLVED EXAMPLES

Ex.1 Which of the following sets connot enter into the list of fundamental quantities in any newly proposed system of units ?

(A) length, mass and velocity **(B)** pressure, density and velocity

(C) force, velocity and time **(D)** force, momentum and time

Sol. For **(A)** Length [L], Mass [M] and velocity $[LT^{-1}]$ are independent.

For **(B)** Pressure $[M^1L^{-1}T^{-2}]$, density $[M^1L^{-3}T^0]$ and velocity $[M^0LT^{-1}]$ are dependent as

$$\begin{vmatrix} 1 & -1 & -2 \\ 1 & -3 & 0 \\ 0 & 1 & -1 \end{vmatrix} = 1(3-0)+1(-1-0)-2(1-0)=0$$

Note : Like coplanar vectors, for dependent quantities, determinant of powers of M, L, T's must be zero.

For **(C)** Force $[MLT^{-2}]$, velocity $[LT^{-1}]$ and time [T] are independent as

$$\begin{vmatrix} 1 & 1 & -2 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{vmatrix} = 1(1-0)-1(0-0)-2(0-0)=1\neq 0$$

For **(D)** Force $= \dfrac{\text{momentum}}{\text{time}}$ $\Rightarrow$ force, momentum and time are dependent.

Ex. 2 Find the dimensional formulae of following quantities :

(A) The surface tension S, **(B)** The thermal conductivity k and **(C)** The coefficient of viscosity η.

Some equation involving these quantities are

$$S=\frac{\rho g r h}{2} \qquad Q=k\frac{A(\theta_2-\theta_1)t}{d} \qquad \text{and} \qquad F=-\eta A\frac{(v_2-v_1)}{x_2-x_1}$$

Sol. **(A)** $S=\dfrac{\rho g r h}{2}$

or $[S]=[\rho][g]L^2=\dfrac{M}{L^2}.\dfrac{L}{T^2}.L^2=MT^{-2}$

(B) $Q=k\dfrac{A(\theta_2-\theta_1)t}{d}$

or $k=\dfrac{Qd}{A(\theta_2-\theta_1)t}$

Here , Q is the heat energy having dimension $ML^2T^{-2}, \theta_2-\theta_1$ is temperature, A is area, d is thickness and t is time.

Thus,

$$[k]=\frac{ML^3T^{-2}}{L^2KT}=MLT^{-3}K^{-1}$$

(C) $F=-hA\dfrac{v_2-v_1}{x_2-x_1}$ or $MLT^{-2}=[\eta]L^2\dfrac{L/T}{L}=[\eta]\dfrac{L^2}{T}$ or , $[h]=ML^{-1}T^{-1}$.

Ex.3 If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, then the dimensions of surface tension will be. **(Surface tension = force/length)**

(A) $EV^{-2}T^{-1}$ **(B)** $EV^{-1}T^{-2}$ **(C)** $E^{-2}V^{-1}T^{-3}$ **(D)** $EV^{-2}T^{-2}$

Sol. [surface tension] = [force/length] = $M^1L^0T^{-2}$

suppose [surface tension] = $E^aV^bT^c$

$\therefore \quad M^1L^0T^{-2} = \left[M^1L^2T^{-2}\right]^a \left[L^1T^{-1}\right]^b [T]^c$

Matching dimensions of M $\Rightarrow$ a = 1

Matching dimensions of L $\Rightarrow$ 2a + b = 0 $\Rightarrow$ b = – 2

Matching dimensions of T $\Rightarrow$ –2a – b + c = –2 $\Rightarrow$ c = – 2

$\therefore$ [surface tension] = $EV^{-2}T^{-2}$

Ex.4 If A and B are two physical quantities having different dimensions then which of the following can denotes a new physical quantity ?

(A) $A + \frac{A^3}{B}$ **(B)** $\exp\left(-\frac{A}{B}\right)$ **(C)** AB^2 **(D)** $\frac{A}{B^4}$

Sol. For **(A)** : A and $\frac{A^3}{B}$ may have same dimension.

For **(B)** : As A and B have different dimension so $\exp\left(-\frac{A}{B}\right)$ is meaningless

For **(C)** : AB^2 is meaningful For **(D)** : AB^{-4} is meaningful

Ex.5 The dimensional formula of product and quotient of two physical quantities A and B are given by

$[AB] = \left[ML^2T^{-2}\right]; \left[\frac{A}{B}\right] = \left[MT^{-2}\right]$. The quantities A and B respectively are

(A) Force and velocity **(B)** Force and displacement

(C) Momentum and displacement **(D)** Work and velocity

Sol. $[A]^2 = [AB].\left[\frac{A}{B}\right] = \left[M^2L^2T^{-4}\right] \Rightarrow [A] = \left[MLT^{-2}\right] \equiv$ Force

$[B] = \frac{[AB]}{[A]} = [L] \Rightarrow [A] = \left[MLT^{-2}\right] \equiv$ **Displacement**

Ex.6 Suppose A = B^nC^m, where A has dimensions LT, B has dimensions L^2T^{-1}, and C has dimensions LT^2. Then the exponents n and m have the values :

(A) 2/3 : 1/3 **(B)** 2 ; 3 **(C)** 4/5 : 1/5 **(D)** 1/5 ; 3/5

Sol. $LT = \left[L^2T^{-1}\right]^n \left[LT^2\right]^m$

$LT = L^{2n+m}T^{2m-n}$

2n + m = 1 ... **(i)**

–n + 2m = 1 ... **(ii)**

On solving $n = \frac{1}{5}, m = \frac{3}{5}$

Ex.7 Given that In $(\alpha / p\beta)$ = $= \alpha z / K_B\theta$ where p is pressure, z is distance, K_B is Boltzmann constant and θ is temperature, the dimensions of β are (useful formula Energy = $K_B \times$ temperature)

(A) $L^0M^0T^0$ **(B)** $L^1M^{-1}T^2$ **(C)** $L^2M^0T^0$ **(D)** $L^{-1}M^1T^{-2}$

Sol. $\ln\left(\frac{\alpha}{p\beta}\right) = \frac{\alpha z}{k_B \theta}$ $\qquad [\alpha z] = [k_\beta \theta]$

Also $[\alpha] = [p\beta]$ $\qquad [p\beta z] = [k_\beta \theta]$

$$[\beta] = \frac{(k_\beta \theta)}{pz} = \frac{ML^2T^{-2}K^{-1}K}{ML^{-1}T^{-2}L} = L^2$$

Ex.8 The SI and CGS units of energy are joule and erg respectively. How many ergs equal to one joule ?

Sol. Dimensionally, Energy = mass × (velocity)^2

$$= \text{mass} \times \left(\frac{\text{length}}{\text{time}}\right)^2 = ML^2T^{-2}$$

Thus, 1 joule = (1 kg) (1 m)^2 (1 s)$^{-2}$

and 1 erg = (1 g) (1 cm)^2 (1 s)$^{-2}$

$$\frac{1\,\text{joule}}{1\,\text{erg}} = \left(\frac{1\text{kg}}{1\text{g}}\right)\left(\frac{1\text{m}}{1\text{cm}}\right)^2\left(\frac{1\text{s}}{1\text{s}}\right)^{-2}$$

$$= \left(\frac{1000\text{g}}{1\text{g}}\right)\left(\frac{1000\text{cm}}{1\text{cm}}\right)^2 = 1000 \times 10000 = 10^7 \qquad 1\text{ joule} = 10^7\text{ erg.}$$

Ex.9 Young`s modulus of steel is 19 × 10^{10} N/m^2. Express it in dyne/cm^2. Here dyne is the CGS unit of force.

Sol. The unit of Young`s modulus in N/m^2

This suggest that it has dimensions of $\frac{\text{Force}}{(\text{area})}$.

Thus, $[Y] = \left[\frac{F}{L^2}\right] = \frac{MLT^2}{L^2} = ML^{-1}T^{-2}$

N/s^2 is in SI units.

So, 1 N/m^2 = (1 kg) (1 m)$^{-1}$ (1s)$^{-2}$

So, $\frac{1\text{N/m}^2}{1\text{dyne/cm}^2} = \left(\frac{1\text{kg}}{1\text{g}}\right) = \left(\frac{1\text{m}}{1\text{cm}}\right)^{-1}\left(\frac{1\text{s}}{1\text{s}}\right)^{-2} = 1000 \times \frac{1}{100} \times 1 = 10$

or, 1 N/m^2 = 10 dyne/cm^2

or, 19 × 10^{10} N/m^2 = 19 × 10^{11} dyne/cm^2

Ex.10 The dimension of $\frac{a}{b}$ in the equation $P = \frac{a - t^2}{bx}$ where P is pressure, x is distance and t is time are ________?

Sol. $P = \frac{a - t^2}{bx}$

⇒ Pbx = a – t^2

⇒ [Pbx] = [a] – [T^2]

or $[b] = \frac{[T^2]}{[P][x]} = \frac{[T^2]}{[ML^1T^2][L]} = [M^{-1}T^{-4}]$

∴ $\left[\frac{a}{b}\right] = \frac{[T^2]}{[M^1T^4]} = [MT^{-2}]$

Ex.11 The Vanderwall`s equation for n moles of a real gas is given by $\left(P+\frac{n^2a}{V^2}\right)(V-nb)=nRT$, where

P = pressure of gas V = volume of gas T = temperature of gas R = molar gas constant

a & b = Vander walls constants

Which of the following have the same dimensions as those of nRT.

(A) PV **(B)** $\frac{aV}{b^2}$ **(C)** $\frac{PV^2}{nb}$ **(D)** $\frac{na}{b}$

Sol. Here $[P]=\left[\frac{n^2a}{V^2}\right],[V]=[nb]$

So $[PV]=[nRT]$

Also $\left[\frac{aV}{b^2}\right]=\left[\left(\frac{PV^2}{n^2}\right)\frac{V}{(V/n)^2}\right]=[PV]=[nRT]$ $\Rightarrow$ $\left[\frac{PV^2}{nb}\right]=n^2a$

Ex. 12 to 14

A physical quantity X depends on another physical quantities as X = Y $Fe^{-\beta r^2}+ZW\sin(\alpha r)$ where r, F and W represents distance, force and work respectively & Y and Z are unknown physical quantities and α, β are positive constants.

Ex.12 If Y represent displacement then $\dim\left(\frac{\alpha YZ}{\beta F}\right)$ is equal to

(A) $M^{-1}LT^2$ **(B)** $M^{-1}L^2T^{-2}$ **(C)** $M^1L^1T^{-2}$ **(D)** None of these

Ex.13 If Y represent velocity then $\dim(X)$ is equal to

(A) ML^2T^{-3} **(B)** $M^{-1}L^2T^{-3}$ **(C)** ML^2T^{-3} **(D)** None of these

Ex.14 If Z represent velocity then choose the correct alternative

(A) The dimension of X is $\left[ML^1T^{-3}\right]$

(B) The dimensions of Y $\left[M^0LT^{-1}\right]$

(C) The dimension of β is $\left[M^0L^{-1}T^0\right]$

(D) The dimension of α is $\left[M^0L^1T^0\right]$

Sol. 12 **(A)**

Given $X=YFe^{-\beta r^2}+ZW\sin(\alpha r)$ Here $Dim(\beta)=L^{-2}Dim(\alpha)=L^{-1}$

Also $Dim(X)=Dim(YF)$ ....**(i)** & $Dim(X)=Dim(ZW)$ .....**(ii)**

Now If $Dim(Y)=L$

So $Dim(X)=\left[LMT^{-2}\right]=\left[ML^2T^{-2}\right]$ from equation **(i)**

& $\quad Dim(Z) = Dim\left(\frac{X}{W}\right) = \left[\frac{ML^2T^{-2}}{ML^2T^{-2}}\right] = \left[M^0L^0T^0\right]$

Thus $\quad \text{Dim}\left(\frac{\alpha YZ}{\beta F}\right) = \left[\frac{L^{-1}L}{L^{-2}MLT^{-2}}\right] = \left[M^{-1}LT^2\right]$

Sol. 13 **(A)**

If $D(Y) = \left[LT^{-1}\right]$. Then $D(X) = \left[LT^{-1}MLT^{-2}\right] = \left[ML^2T^{-3}\right]$ from equation **(i)**

Sol. 14 **(B)**

If $D(Z) = T^{-1}$. Then D(Y) = ?

from equation **(ii)** $D(X) = \left[T^{-1}ML^2T^{-2}\right] = \left[ML^2T^{-3}\right]$

So from equation **(i)** $D(Y) = \frac{D(X)}{D(F)}\frac{\left[ML^2T^{-3}\right]}{\left[MLT^{-2}\right]} = \left[LT^{-1}\right]$

Ex.15 A problem in I.E. Irodov`s book is given as below :

" A particle of mass m is located in a region where its potential energy [U(x)] depends on the position x as Potential Energy $\left[U(x)\right] = \frac{a}{x^2} - \frac{b}{x}$ here a & b are positive constants..."

(i) Write dimensional formula of a and b.

(ii) If the time period of oscillation which is calculated from above formula is stated by a student as $T = 4\pi a\sqrt{\frac{ma}{b^2}}$, check whether his answer is dimensionally correct.

Sol. **(i)** $[a] = \left[Ux^2\right] = ML^2T^{-2} = \left[ML^4T^{-2}\right]$; $[b] = [Ux] = ML^2T^{-2}L = \left[ML^3T^{-2}\right]$

(ii) $T = 4\pi a\sqrt{\frac{ma}{b^2}} = 4\pi\sqrt{\frac{ma^3}{b^2}}$;

Dimension of RHS $= \left[4\pi\sqrt{\frac{ma^3}{b^2}}\right] = \sqrt{\frac{MM^3L^{12}T^{-6}}{M^2L^6T^{-4}}} \neq T$

So his answer is dimensionally incorrect

Ex.16 The density of a material in CGS system is $2g/cm^3$. In a system of units in which of length is 2 cm and unit of mass is 4 g, what is the numerical value of the material ?

Sol. $n_1u_1 = n_2u_2 \quad \Rightarrow \quad n_2 = n_1\left[\left[\frac{M_1}{M_2}\right]\left[\frac{L_1}{L_2}\right]^{-3}\right] = 2\left[\left(\frac{1g}{4g}\right)\left(\frac{1cm}{2cm}\right)^{-3}\right] = 2\times\frac{1}{4}\times 8 = 4$

Ex.17 In a new system (say TK system) of measurement, the fundamental quantities length, mass and time are measured In Akshay, Shahrukh and Aamir respectively.

1 Akshay = 1 km

1 Shahrukh = 1 Quintal (100 kg)

1 Aamir = 1 minute

	Column I		Column II
(A)	One unit of acceleration in TK system.	(P)	$\frac{5}{18}\times10^{-4}$ SI unit
(B)	One unit of kinetic energy in TK system.	(Q)	$\frac{5}{18}\times10^{-3}$ MSK unit
(C)	One unit of pressure in TK system	(R)	$\frac{5}{18}\times10^{0}$ MSK unit
(D)	One unit of TK system	(S)	$\frac{5}{18}\times10^{4}$ MSK unit
		(T)	$\frac{5}{18}\times10^{5}$ SI unit

Sol. (A) → (R) ; (B) → (T) ; (C) → (P) ; (D) → (T)

For (A) : ✈ [Acceleration] = $[LT^{-2}]$

∴ unit of acceleration = $(1\text{ km})(1\text{min})^{-2} = \frac{5}{18}\text{ m/s}^2$

For (B) : ✈ [Kinetic energy] = $[ML^2T^{-2}]$

∴ Unit of kinetic energy = $(1\text{ Quintal})(1\text{ km})^2(1\text{ min})^{-2} = \frac{5}{18}\times10^5\text{ kgm}^2\text{s}^{-2}$

For (C) : ✈ [Pressure] = $[ML^{-1}T^{-2}]$

∴ Unit of pressure = $(1\text{ Quintal})(1\text{ km})^{-1}(1\text{ min})^{-2} = \frac{5}{18}\times10^{-4}\text{ kgm}^1\text{s}^{-2}$

For (D) : ✈ [Work] = $[ML^2T^{-2}]$

∴ Unit of work = $(1\text{ Quintal})(1\text{ km})^2(1\text{min})^{-2} = \frac{5}{18}\times10^5\text{ kgm}^2\text{s}^{-2}$

Exercise # 1

[Single Correct Choice Type Questions]

1. In the S.I. system the unit of energy is -

(A) erg (B) calorie (C) joule (D) electron volt

2. The dimensions of the ratio of angular momentum to linear momentum is

(A) $\left[M^0LT^0\right]$ (B) $\left[MLT^{-1}\right]$ (C) $\left[ML^2T^{-1}\right]$ (D) $\left[M^{-1}L^{-1}T^{-1}\right]$

3. The dimensional formula for angular momentum is -

(A) ML^2T^{-2} (B) ML^2T^{-1} (C) MLT^{-1} (D) $M^0L^2T^{-2}$

4. In the S.I. system, the unit of temperature is -

(A) degree centigrade (B) Kelvin

(C) degree celsius (D) degree Fahrenheit

5. If Force = (x/density) + C is dimensionally correct, the dimension of x are -

(A) MLT^{-2} (B) MLT^{-3} (C) ML^2T^{-3} (D) $M^2L^{-2}T^{-2}$

6. The velocity of a moving particle depends upon time t as v = at + $\frac{b}{t+c}$. Then dimensional formula for b is -

(A) $\left[M^0L^0T^0\right]$ (B) $\left[M^0L^1T^0\right]$ (C) $\left[M^0L^1T^{-1}\right]$ (D) $\left[M^0L^1T^{-2}\right]$

7. For $10^{(at+3)}$, the dimension of a is-

(A) $M^0L^0T^0$ (B) $M^0L^0T^1$ (C) $M^0L^0T^{-1}$ (D) None of these

8. If F = ax + bt² + c where F is force, x is distance and t is time. Then what is dimension of $\frac{a\times c}{bt^2}$?

(A) $\left[ML^2T^{-2}\right]$ (B) $\left[MLT^{-2}\right]$ (C) $\left[M^0L^0T^0\right]$ (D) $\left[MLT^{-1}\right]$

9. The pairs having same dimensional formula -

(A) Angular momentum, torque (B) Torque, work

(C) Plank`s constant, boltzman`s constant (D) Gas constant pressure

10. The frequency of oscillation of an object of mass m suspended by end of spring of force constant K is given by f = Cm^xK^y,where C is dimension less constant. The value of x and y are :

(A) $x=\frac{1}{2}, y=\frac{1}{2}$ (B) $x=-\frac{1}{2}, y=\frac{1}{2}$ (C) $x=\frac{1}{2}, y=-\frac{1}{2}$ (D) $x=-\frac{1}{2}, y=-\frac{1}{2}$

11. Which of the following physical quantities do not have the same dimensions

(A) Pressure, Youngs modulus, stress (B) Electromotive force, voltage, potential

(C) Heat, work Energy (D) Electric dipole, electric field, flux

12. Out of the following pair, which one does NOT have identical dimensions is

(A) angular momentum and Planck`s constant (B) impulse and momentum

(C) moment of inertia and moment of a force (D) work and torque

13. If force, time and velocity are treated as fundamental quantities then dimensional formula of energy will be

(A) [FTV] (B) $[FT^2V]$ (C) $[FTV^2]$ (D) $[FT^2V^2]$

14. In a new system of units, unit of mass is 10 kg, unit of length is 100m, unit of time is 1 minutes. Then magnitude of 1 N force in new system of units will be

(A) 36 **(B)** 60 **(C)** 3.6 **(D)** 0.06

15. A wave is represented by -

y = a sin (At - Bx + C)

where A, B, C are constants. The dimensions of A, B, C are

(A) $T^{-1}, L, M^0L^0T^0$ **(B)** $T^{-1}, L^{-1}, M^0L^0T^0$

(C) T, L, M **(D)** T^{-1}, L^{-1}, M^{-1}

16. $P = \frac{\alpha}{\beta}\exp\left(-\frac{\alpha z}{K_B\theta}\right)$

$\theta \rightarrow$ Temperature $P \rightarrow$ Pressure

$K_B \rightarrow$ Boltzmen constant $Z \rightarrow$ Distance

Dimension of (α/β) is

(A) $M^0L^0T^0$ **(B)** $M^{-1}L^1T^2$ **(C)** $M^0L^2T^0$ **(D)** ML^2T^{-2}

17. The distance covered by a particle in time t is given by x = a + bt + ct^2 + dt^3. The dimensions of a and d are -

(A) L, T^{-3} **(B)** L, LT^{-3} **(C)** L^0, T^3 **(D)** None of these

18. Vander waal`s gas equation is

$\left(P + \frac{a}{V^2}\right)(V - b) = RT$. The dimensions of constant a as given above are -

(A) ML^4T^{-2} **(B)** ML^5T^{-2} **(C)** ML^3T^{-2} **(D)** ML^2T^{-2}

19. If E, M, J and G denote energy, mass, angular momentum and gravitational constant then $\frac{EJ^2}{M^2G^2}$ has the dimensions of-

(A) length **(B)** angle **(C)** mass **(D)** time

20. If x = k sin(klt), where x is displacement and t is time then dimensional formula for *l* will be (k, *l* = constant)

(A) $[M^0L^0T^0]$ **(B)** $[M^0L^1T^0]$ **(C)** $[M^0L^{-1}T^{-1}]$ **(D)** $[ML^{-1}T^{-1}]$

Exercise # 2 Part # I [Multiple Correct Choice Type Questions]

1. A parameter a is given by $\alpha = \frac{h}{\sigma\theta^4}$ (here σ = stefan`s constant, h = Planck`s constant, θ = absolute temperature) then

(A) Dimension of 'a' will be L^2T^2 **(B)** Unit of 'a' may be $m^2 s^2$ **(C)** Unit of 'a' may be $\frac{(\text{weber})(\Omega)^2(\text{Farad})^2}{(\text{Tesla})}$

(D) Dimension of 'a' will be equal to dimension of $\left(\frac{Ri}{\phi_m}\right)$ where R = gas constant, i = Electrical current, ϕ_m = magnetic flux

2. Choose the correct statement(s) :

(A) All quantities may be represented dimensionally in terms of the base quantities.

(B) A base quantities cannot be represented dimensionally in terms of the rest of the base quantities.

(C) The dimension of a base quantity in other base quantities is always zero.

(D) The dimension of a derived quantity is never zero in any base quantity.

3. Choose the correct statement(s) :

(A) A dimensionally correct equation may be correct. **(B)** A dimensionally correct equation may be incorrect.

(C) A dimensionally incorrect equation may be correct **(D)** A dimensionally incorrect equation must be incorrect.

4. If the unit of length be double then the numerical value of the universal gravitation constant G will become (with respect to present value)

(A) Double **(B)** Half **(C)** 8 times **(D)** 1/8 times

5. A dimensionless quantity

(A) Never has a unit **(B)** Always has a unit **(C)** May have a unit **(D)** Does not exist

6. When a wave transverses in a medium, the displacement of a particle located at distance x at time t is given by y = a sin(bt – cx) where a, b and c are constants of the wave. The dimension of b/c are same as that of :

(A) Wave velocity **(B)** Wavelength **(C)** Wave amplitude **(D)** Wave frequency

7. The Bernoulli`s equation is given by $P + \frac{1}{2}\rho v^2 + h\rho g = k$. where P = pressure, ρ = density, v = speed, h = height of the liquid column, g = acceleration due to gravity and k is constant. The dimensional formula for k is same as that for:

(A) Velocity gradient **(B)** Pressure gradient **(C)** Modulus of elasticity **(D)** Thrust

8. Two quantities A and B are related by A/B = m where m is linear mass density and A is force. The dimensions of B will be same as that of -

(A) Pressure **(B)** Work **(C)** Momentum **(D)** Latent heat

9. A physical quantity x can be dimensionally represented in terms of M, L and T that is $x = M^a L^b$ and T^c. The quantity time-

(A) May be dimensionally represented in term of x, M and L if c $\neq$ 0

(B) May be dimensionally represented in term of x, M and L if c = 0

(C) May be dimensionally represented in term of x, M and L if irrespective of value of c

(D) Can never be dimensionally represented in term of x, M and L

10. If the velocity of light c, gravitational constant G and Planck`s constant h be taken as fundamental units the dimension of mass in the new system will be -

(A) $c^{1/2}h^{1/2}G^{1/2}$ **(B)** $c^{1/2}h^{1/2}G^{-1/2}$ **(C)** $c^{3/2}h^{1/2}G^{1/2}$ **(D)** $c^{-5/2}h^{1/2}G^{1/2}$

Part # II [Assertion & Reason Type Questions]

These questions contains, Statement 1 (assertion) and Statement 2 (reason).
(A) Statement-I is true, Statement-II is true ; Statement- II is correct explanation for Statement-I.
(B) Statement-I is true, Statement-II is true; Statement-II is NOT a correct explanation for statement-I.
(C) Statement-I is true, Statement-II is false.
(D) Statement-I is false and Statement-II is true.
(E) Statement- I is false, Statement-II is false.

1. **Statement-I :** If x and y are the distance along x and y axes respectively then the dimensions of $\frac{d^3y}{dx^3}$ is $M^0L^{-2}T^o$

Statement- II : Dimensions of $\int_a^b yxd \text{ is } M^0L^2T^o$

2. **Statement-I :** Force cannot be added to pressure.
Statement -II : Because their dimensions are different.

3. **Statement-I :** When ever charge the unit of measurement of a quantity, its numerical value changes.
Statement-II : Smaller the unit of measurement smaller is its numerical value.

4. **Statement- I :** When an algebraic equation has been derived, it is advisable to check it for dimensional consistency.
Statement-II : This guarantee that the equation is correct.

5. **Statement-I :** Velocity volume and acceleration can be taken as basic variables
Statement-II : All the three are independent from each other.

6. **Statement- I :** The dimensional method cannot be used to obtain the dependence of the work done by a force F on the angle θ between force F and displacement x.
Statement-II : All trigonometric functions are dimensionless.

7. **Statement- I :** Method of dimensions cannot be used for deriving formula containing trigonometrical ratios.
Statement-II : This is because trigonometrical ratios have no dimensions.

8. **Statement- I :** The distance covered by a body is given by $S = u + \frac{1}{2}\frac{a}{t}$, where the symbols have usual meaning.

Statement-II : We add quantities, subtract or equate quantities with the same dimensions.

Exercise # 3 Part # I [Matrix Match Type Questions]

1. Match the following :

Physical quantity	Dimension	Unit
(1) Gravitational constant 'G'	(P) $M^1L^1T^{-1}$	(A) N.m
(2) Torque	(Q) $M^{-1}L^3T^{-2}$	(B) N.s
(3) Momentum	(R) $M^1L^{-1}T^{-2}$	(C) Nm^2/kg^2
(4) Pressure	(S) $M^1L^2T^{-2}$	(D) pascal

2. Match the following :

	Column-I		Column-II
(A)	Base unit	(P)	N
(B)	Derived unit	(Q)	hp
(C)	Improper unit	(R)	kgwt
(D)	Practical unit	(S)	rad
(E)	Supplementary unit	(T)	kg

3. Match the following :

	Column-I		Column-II
(A)	1 fermi	(P)	10^{-13}m
(B)	1 X-ray unit	(Q)	10^{-15}m
(C)	1 angstrom	(R)	10^{-10}m
(D)	1 Astronomical unit	(S)	9.46×10^{15}m
(E)	1 Light year	(T)	3.26 Light year
(F)	1 Parsec	(U)	3.08×10^{16}m
		(V)	1.49×10^{11} m

4. Match the following :

	Column-I		Column-II
(A)	Moment of inertia	(P)	newton/metre^2
(B)	Surface tension	(Q)	kg/(metre-sec)
(C)	Angular acceleration	(R)	kg-metre^2
(D)	Coefficient of viscosity	(S)	newton/metre
(E)	Modulus of elasticity	(T)	radian/sec^2

5. Match the following :

	Column-I		Column-II
(A)	Dimensional variable	(P)	π
(B)	Dimensionless variable	(Q)	Force
(C)	Dimensional constant	(R)	Angle
(D)	Dimensionless constant	(S)	Gravitational constant

Part # II [Comprehension Type Questions]

Comprehension # 1

The vander Waals gas equation is $\left(P+\frac{a}{V^2}\right)(V-b)=RT$, where P is pressure , V is molar volume and T is the temperature of the given sample of gas. R is called molar gas constant, a and b are called vander Walls constant.

1. The dimensional formula for b is same as that for

(A) P **(B)** V **(C)** PV^2 **(D)** RT

2. The dimensional formula for a is same as that for

(A) V^2 **(B)** P **(C)** PV^2 **(D)** RT

3. Which of the following does not posses the same dimensional formula as that for RT

(A) PV **(B)** Pb **(C)** $\frac{a}{V^2}$ **(D)** $\frac{ab}{V^2}$

4. The dimensional formula for $\frac{ab}{RT}$ is

(A) ML^5T^{-2} **(B)** $M^0L^3T^0$ **(C)** $ML^{-1}T^{-2}$ **(D)** $M^0L^6T^0$

5. The dimensional formula of RT is same as that of

(A) Energy **(B)** Force **(C)** Specific heat **(D)** Latent heat

Comprehension # 2

In a certain system of absolute units the acceleration produced by gravity in a body falling freely is denoted by 3, the kinetic energy of a 272.1 kg shot moving with velocity 448 metres per second is denoted by 100, and its momentum by 10.

1. The unit of length is

(A) 15.36 m **(B)** 153.6 m **(C)** 68.57 m **(D)** None of these

2. The unit of time is

(A) 68.57 s **(B)** 0.6857 s **(C)** 6.857 s **(D)** None of these

3. The unit of mass is

(A) 544.2 kg **(B)** 54.42 kg **(C)** 5442 kg **(D)** None of these

Exercise # 4 [Subjective Type Questions]

1. The intensity of X-rays decreases exponentially according to the law $I = I_0 e^{\mu x}$, where I_0 is the initial intensity of X-rays and I is the intensity after it penetrates a distance x through lead. If μ be the absorption coefficient, then find the dimensional formula for μ.

2. If the velocity of light (c), gravitational constant (G) and the Planck`s constant (h) are selected as the fundamental units, find the dimensional formulae for mass, length and time in this new system of units.

3. The frequency of vibration of a string depends on the length L between the nodes, the tension F in the string and its mass per unit length m. Guess the expression for its frequency from dimensional analysis.

4. Find the dimensions of Planck`s constant h from the equation E = hv where E is the energy and v is the frequency.

5. Find the dimensions of

(a) the specific heat capacity c, **(b)** the coefficient of linear expansion α and **(c)** the gas constant R.

Some of the equations involving these quantities are Q = mc $(T_2 - T_1) l_t = l_0[1 + \alpha(T_2 - T_1)]$ and PV = nRT. (where Q = heat energy, m = mass, T_1 and T_2 = temperature, l_t = length at temperature t°C, l_0 = length at temperature 0 °C, P = pressure, V = volume, n = mole)

6. A particle is in a unidirectional potential field where the potential energy (U) of a particle depends on the x-coordinate given by U_x = k(1 – cosax) and k and a are constants. Find the physical dimensions of a and k.

7. Consider a planet of mass (m), revolving round the sun. The time period (T) of revolution of the planet depends upon the radius of the orbit (r), mass of the sun (M) and the gravitational constant(G). Using dimensional analysis, verify Kepler`s third law of planetary motion.

8. The distance moved by a particle in time from centre of ring under the influence of its gravity is given by x = asin ωt where a and ω are constants. If ω is found to depend on the radius of the ring (r), its mass (m) and universal gravitation constant (G), find using dimensional analysis an expression for ω in terms of r, m and G.

9. Test if following equation is dimensionally correct $v = \frac{1}{2\pi}\sqrt{\frac{mgl}{I}}$ where ,v = frequency, I = moment of inertia, m = mass, l = length, g = acc. due to gravity.

10. The resistance force arising due to pressure difference at the front and rear sides of a body in a fluid stream depends upon the density of the fluid, the velocity of flow and the maximum area of cross-section perpendicular to the flow. Show that the force varies as the square of the velocity.

11. A sphere of incompressible liquid is distorted from the spherical form and released. Deduce by the method of dimensions an expression for the period of its subsequent oscillations assuming that the only forces which need to be considered arise from its own surface tension.

12. Laplace correct Newton`s calculation for the velocity of sound. Laplace said that speed of sound in a solid medium depends upon the coefficient of elasticity of the medium under adiabatic conditions (E) and the density of the medium (ρ). Prove that $v = k\sqrt{\frac{E}{\rho}}$

13. Test the following equations are dimensionally correct :

(a) s = $\rho rgh / \cos\theta$ **(b)** $v = \sqrt{\frac{\gamma RT}{M_0}}$ **(c)** $V = \frac{\Pr^4 t}{\eta l}$ **(d)** $f = \sqrt{\frac{mgl}{I}}$

where h = height, S = surface tension, v = speed of sound, ρ = density, P = pressure, V = volume, η = coefficient of viscosity, f = frequency and I = moment of inertia.

Exercise # 5 Part # I [Previous Year Questions] [AIEEE/JEE-MAIN]

1. Identify the pair whose dimensions are equal **[AIEEE-2002]**

(A) Torque and work **(B)** Stress and energy
(C) Force and stress **(D)** Force and work

2. The physical quantities not having same dimensions are - **[AIEEE-2003]**

(A) stress and Young`s modulus **(B)** speed and $(\mu_0 \in_0)^{-1/2}$
(C) torque and work **(D)** momentum and Planck constant

3. Dimensions of $\frac{1}{\mu_0 \in_0}$ where symbols have their usual meaning are - **[AIEEE-2003]**

(A) L^2T^{-2} **(B)** L^2T^2 **(C)** $L^{-1}T$ **(D)** LT^{-1}

4. The dimensions of the coefficient of viscosity are - **[AIEEE-2004]**

(A) $ML^{-1}T^{-1}$ **(B)** MLT **(C)** $M^{-1}L^{-1}T^{-1}$ **(D)** $M^0L^0T^0$

5. Out of the following pairs, which one does not have identical dimensions ? **[AIEEE-2005]**

(A) Angular momentum and Planck`s constant **(B)** Impulse and momentum
(C) Moment of inertia and moment of a force **(D)** Work and torque

6. Which of the following units denotes the dimensions ML^2/Q^2, where Q denotes the electric charge ? **[AIEEE-2006]**

(A) H/m^2 **(B)** Weber (Wb) **(C)** Wb/m^2 **(D)** Henry (H)

7. The dimension of magnetic field in M, L, T and C (Coulomb) is given as **[AIEEE-2008]**

(A) MT^2C^{-2} **(B)** $MT^{-1}C^{-1}$ **(C)** $MT^{-2}C^{-1}$ **(D)** $MLT^{-1}C^{-1}$

8. Let $[\in_0]$ denotes the dimensional formula of the permittivity of vacuum, If M = mass, L = length, T = time and A = electric current, then : **[JEE-MAIN-2013]**

(A) $[\in_0] = [M^{-1}L^{-3}T^2A]$ **(B)** $[\in_0] = [M^{-1}L^{-3}T^4A^2]$
(C) $[\in_0] = [M^{-1}L^2T^{-1}A^{-2}]$ **(D)** $[\in_0] = [M^{-1}L^2T^{-1}A]$

Part # II [Previous Year Questions][IIT-JEE ADVANCED]

1. The pairs of physical quantities that have the same dimensions are : **[JEE - 1995]**

(A) Reynolds number and coefficient of friction **(B)** Latent heat and gravitational potential

(C) curie and frequency of light wave **(D)** Planck`s constant and torque

2. In the formula X = 3YZ^2 , X and Z have dimensions of capacitance and magnetic induction respectively. What are the dimensions of Y in MKSQ system ? **[JEE - 1995]**

(A) $\left[M^{-3}L^{-1}T^{3}Q^{4}\right]$ **(B)** $\left[M^{-3}L^{-2}T^{4}Q^{4}\right]$

(C) $\left[M^{-2}L^{-2}T^{4}Q^{4}\right]$ **(D)** $\left[M^{-3}L^{-2}T^{4}Q^{1}\right]$

3. Which of the following pairs have same dimensions : **[JEE - 1996]**

(A) Torque and work **(B)** Angular momentum and work

(C) Energy and young`s modulus **(D)** Light year and wavelength

4. Which of the following is not the unit of length : **[JEE - 1998]**

(A) micron **(B)** light year

(C) angstrom **(D)** radian

5. The S.I unit of inductance, the Henry can be written as : **[JEE - 1998]**

(A) weber/ampere **(B)** volt-second/ampere

(C) joule/(ampere)^2 **(D)** ohm-second

6. Let $\left[\varepsilon_0\right]$ denote the dimensional formula of the permittivity of the vacuum, and $\left[\mu_0\right]$ that of the permeability of the vacuum. If M = mass, L = length, T = time and I = electric current : **[JEE - 1998]**

(A) $\left[\varepsilon_0\right] = M^{-1}L^{-3}T^{2}I$ **(B)** $\left[\varepsilon_0\right] = M^{-1}L^{-3}T^{4}I^{2}$

(C) $\left[\mu_0\right] = MLT^{-2}I^{-2}$ **(D)** $\left[\mu_0\right] = ML^{2}T^{-1}I$

7. The dimensions of $\left(\frac{1}{2}\right)\varepsilon_0 E^2$ (ε_0 : permittivity of free space; E : electric field) are : **[JEE (Scr.)- 2000]**

(A) MLT^{-1} **(B)** $ML^{-2}T^{-2}$

(C) MLT^{-2} **(D)** $ML^{2}T^{-1}$

(E) $ML^{-1}T^{-2}$

[**Note -** there was no correct option in IIT so we made the correct option]

8. A quantity X is given by $\varepsilon_0 L\frac{\Delta V}{\Delta t}$, where ε_0 is the permittivity of free space, L is length, ΔV is potential difference and Δt is time interval. The dimensional formula for X is the same as that of **[JEE(Scr.) - 2001]**

(A) resistance **(B)** charge

(C) voltage **(D)** current

9. In the relation ; $P\frac{\alpha}{\beta}e^{-\frac{\alpha z}{k\theta}}$ P is pressure, Z is distance, k is Boltzman constant and θ is the temperature. The dimensions of β will be **[JEE (Scr.) - 2004]**

(A) $\left[M^{0}L^{2}T^{0}\right]$ **(B)** $\left[ML^{2}T\right]$ **(C)** $\left[ML^{0}T^{-1}\right]$ **(D)** $\left[M^{0}L^{2}T^{-1}\right]$

10. Which of the following set have different dimensions ? **[JEE (Scr.) - 2005]**

(A) Pressure, Young`s modulus, Stress
(B) Emf, Potential difference, Electric potential
(C) Heat, Work done, Energy
(D) Dipole moment, Electric flux, Electric field

11. Some physical quantities are given in Column-I and some possible SI units in which these quantities may be expressed are given in Column-II. Match the physical quantities in Column-I with the units in Column-II. **[IIT-JEE - 2007]**

	Column-I		Column-II
(A)	GM_eM_s G - universal gravitational constant, M_e - mass of the earth, Ms - mass of the sun	**(P)**	(volt) (coulomb) (metre)
(B)	$\frac{3RT}{M}$ R - universal gas constant, T - absolute temperature, M - molar mass	**(Q)**	(kilogram) (metre)^3 (second)$^{-2}$
(C)	$\frac{F^2}{q^2B^2}$ F - force, q - charge, B - magnetic field	**(R)**	(metre)^2 (second)$^{-2}$
(D)	$\frac{GM_e}{R_e}$ G - universal gravitational constant, M_e - mass of the earth, R_e - radius of earth	**(S)**	(farad) (volt)^2 (kg)$^{-1}$

12. Match List- I with List- II and select the correct answer using the codes given below the lists : **[JEE ADVANCED - 2013]**

	List - I		List - II
(P)	Boltzman constant	**1.**	$[ML^2T^{-1}]$
(Q)	Coefficient of viscosity	**2.**	$[ML^{-1}T^{-1}]$
(R)	Planck constant	**3.**	$[MLT^{-3}K^{-1}]$
(S)	Thermal conductivity	**4.**	$[ML^2T^{-2}K^{-1}]$

Codes :

	P	Q	R	S
(A)	3	1	2	4
(B)	3	2	1	4
(C)	4	2	1	3
(D)	4	1	2	3

13. To find the distance d over which a signal can be seen clearly in foggy conditions, a railways engineer uses dimensional analysis and assumes that the distance depends on the mass density ρ of the fog, intensity (power/area) S of the light from the signal and its frequency f. The engineer finds that d is proportional to $S^{1/n}$. The value of n is **[JEE ADVANCED - 2014]**

14. Planck's constant h, speed of light c and gravitational constant G are used to form a unit of length L and a unit of mass M. Then the correct option (s) is (are). **[JEE ADVANCED - 2015]**

(A) $M \propto \sqrt{c}$ **(B)** $M \propto \sqrt{G}$ **(C)** $L \propto \sqrt{h}$ **(D)** $L \propto \sqrt{G}$

15. In terms of potential difference V, electric current I, permittivity ε_0, permeability μ_0 and speed of light c, the dimensionally correct equation (s) is (are) **[JEE ADVANCED - 2015]**

(A) $\mu_0 I^2 = \varepsilon_0 V^2$ **(B)** $\varepsilon_0 I = \mu_0 V$ **(C)** $I = \varepsilon_0 cV$ **(D)** $\mu_0 cI = \varepsilon_0 V$

16. A length-scale (●) depends on the permittivity (ε) of a dielectric material, Boltzmann constant (k_B), the absolute temperature (T), the number per unit volume (n) of certain charged particles, and the charge (q) carried by each of the particles. Which of the following expression(s) for ● is(are) dimensionally correct? **[JEE ADVANCED - 2016]**

(A) $l = \sqrt{\left(\frac{nq^2}{\varepsilon k_B T}\right)}$ **(B)** $l = \sqrt{\left(\frac{\varepsilon k_B T}{nq^2}\right)}$ **(C)** $l = \sqrt{\left(\frac{q^2}{\varepsilon n^{2/3} k_B T}\right)}$ **(D)** $l = \sqrt{\left(\frac{q^2}{\varepsilon n^{1/3} k_B T}\right)}$

MOCK TEST

SECTION - I : STRAIGHT OBJECTIVE TYPE

1. The ratio of the dimensions of Plank's constant and that of the moment of inertia is the dimension of :
(A) frequency **(B)** velocity **(C)** angular momentum **(D)** time

2. In a system of units if force (F), acceleration (A) and time (T) are taken as fundamental units, then the dimensional formula of energy is :
(A) FA^2T **(B)** FAT^2 **(C)** FA^2T^3 **(D)** FAT

3. The dimensions of quantity L/C is identical to :
(A) $(\text{resistance})^{-1}$ **(B)** $(\text{time})^{-2}$ **(C)** $(\text{resistance})^2$ **(D)** none of these

4. $\frac{E^2}{\mu_0}$ has the dimensions (E = electric flux, μ_0 = permeability of free space)
(A) $[M^2L^3T^{-2}A^2]$ **(B)** $[MLT^{-4}]$ **(C)** $[ML^3T^{-2}]$ **(D)** $[M^{-1}L^2TA^{-2}]$

5. The dimensions of σb^4 (σ = Stefan's constant and b = Wein's constant) are :
(A) $[M^0L^0T^0]$ **(B)** $[ML^4T^{-3}]$ **(C)** $[ML^{-2}T]$ **(D)** $[ML^6T^{-3}]$

6. The dimensions of $\frac{a}{b}$ in the equation $P = \frac{a - t^2}{bx}$ where P is pressure, x is distance and t is time are :
(A) $[M^2LT^{-3}]$ **(B)** $[MT^{-2}]$ **(C)** $[ML^3T^{-1}]$ **(D)** $[ML^{-3}]$

7. In the equation $\int \frac{dt}{\sqrt{2at - t^2}} = a^x \sin^{-1}\left[\frac{t}{a} - 1\right]$ The value of x is :
(A) 1 **(B)** – 1 **(C)** 0 **(D)** 2

8. The dimensions of the quantity $\eta c \left(\text{where } \eta = \frac{h}{2\pi}\right)$ is :
(A) $[ML^2T^{-1}]$ **(B)** $[MLT^{-1}]$ **(C)** $[ML^3T^{-2}]$ **(D)** $[ML^3T^{-1}]$

9. A particle of mass m is executing oscillations about the origin on the x-axis. Its potential energy is $U(x) = K|x|^3$, where K is a positive constant. If the amplitude of oscillation is a, then its time period T is :
(A) proportional to $\frac{1}{\sqrt{a}}$ **(B)** independent of a **(C)** proportional to $\sqrt{a}$ **(D)** proportional to $a^{3/2}$

10. In the formula $X = 3YZ^2$, X and Z have dimensions of capacitance and magnetic induction respectively. What are the dimensions of Y in MKSQ system ?
(A) $[M^{-3}L^{-1}T^3Q^4]$ **(B)** $[M^{-3}L^{-2}T^4Q^4]$ **(C)** $[M^{-2}L^{-2}T^4Q^4]$ **(D)** $[M^{-3}L^{-2}T^3Q^1]$

11. The dimensions of $\frac{1}{2}\varepsilon_0 E^2$ (ε_0 : permittivity of free space ; E : electric field) is :
(A) $[MLT^{-1}]$ **(B)** $[ML^{-1}T^{-2}]$ **(C)** $[MLT^{-2}]$ **(D)** $[ML^2T^{-1}]$

12. In the relation $P = \frac{\alpha}{\beta} e^{\frac{\alpha Z}{k\theta}}$

P is pressure, Z is distance, k is Boltzmann constant and θ is the temperature. The dimensional formula of β will be:
(A) $[M^0L^2T^0]$ **(B)** $[M^1L^2T^1]$ **(C)** $[M^1L^0T^{-1}]$ **(D)** $[M^0L^2T^{-1}]$

13. Which of the following sets have different dimensions ?
(A) Pressure, Young's modulus, Stress
(B) Emf, Potential difference, Electric potential
(C) Heat, Work done, Energy
(D) Dipole moment, Electric flux, Electric field

SECTION - II : MULTIPLE CORRECT ANSWER TYPE

14. Let $[\varepsilon_0]$denote the dimensional formula of the permittivity of the vacuum and $[\mu_0]$ that of the permeability of the vacuum. If M = mass, L = length, T = time and I = electric current, then :
(A) $[\varepsilon_0] = [M^{-1} L^{-3} T^2 I]$ (B) $[\varepsilon_0] = [M^{-1} L^{-3} T^4 I^2]$ (C) $[\mu_0] = [MLT^{-2} I^2]$ (D) $[\mu_0] = [ML^2 L^{-1} I]$

15. The SI nit of the inductance, the henry can by written as :
(A) weber/ ampere (B) volt-second/ampere (C) joule/$(\text{ampere})^2$ (D) ohm-second

16. The pair(s) of physical quantities that have the same dimensions is (are) :
(A) volumetric strain and coefficient of friction
(B) disintegration constant of a radioactive substance and frequency of light wave
(C) heat capacity and gravitational potential
(D) Plank's constant and torque.

17. Units of CR^2 is /are
(C = capacitance and R = resistance)
(A) henry (B) $\frac{\text{volt} - \text{second}}{\text{ampere}}$ (C) $\frac{\text{volt}}{\text{ampere}}$ (D) $\frac{\text{joule}}{\text{ampere}^2}$

18. $\varepsilon_0 E^2$ has the dimensions of
(ε_0 = permittivity of free space, E = electric field)
(A) pressure (B) kT (C) R/T (D) all of these
Here, K = Boltzmann constant
T = absolute temperature
R = universal gas constant.

SECTION - III : ASSERTION AND REASON TYPE

19. **Statement - 1** Unit of torque is joule.
Statement - 2 Unit torque should be N-m and that is called joule.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True
(E) Statement-1 is False, Statement-2 is also False

20. **Statement - 1** Velocity, volume and acceleration can be taken as basic variables
Statement - 2 All the three are independent from each other.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True
(E) Statement-1 is False, Statement-2 is also False

21. **Statement - 1** If two physical quantities have same dimensions, than that can be certainly added or substracted.

Statement - 2 If the dimensions of both the quantities are same then both the physical quantities should be similar.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

(E) Statement-1 is False, Statement-2 is also False

SECTION - IV : MATRIX - MATCH TYPE

22. Some physical quantities are given in **Column I** and some possible SI units in which these quantities may be expressed are given in **Column II**. Match the physical quantities in **Column I** with the units in **Column II.**

	Column I		Column II
(A)	GM_eM_s G - universal gravitational constant, M_e - mass of the earth, M_s - mass of the Sun	**(P)**	(volt) (coulomb) (metre)
(B)	$\frac{3RT}{M}$ R - universal gas constant, T - absolute temperature, M - molar mass	**(Q)**	(kilogram) $(\text{metre})^3$ $(\text{second})^{-2}$
(C)	$\frac{F^2}{q^2B^2}$ F - force, q - charge, B - magnetic field	**(R)**	$(\text{metre})^2$ $(\text{second})^{-2}$
(D)	$\frac{GM_e}{R_e}$ G - universal gravitational constant, M_e - mass of the earth R_e - radius of the earth	**(S)**	(farad) $(\text{volt})^2$ $(\text{kg})^{-1}$

ANSWER KEY

EXERCISE - 1

1. C **2.** A **3.** B **4.** B **5.** D **6.** D **7.** C **8.** B **9.** B **10.** B **11.** D **12.** C **13.** A
14. C **15.** B **16.** D **17.** B **18.** B **19.** B **20.** C

EXERCISE - 2 : PART # I

1. A,B,C **2.** A,B,C **3.** A,B,D **4.** D **5.** C **6.** A **7.** C **8.** B **9.** A **10.** B

PART # II

1. A **2.** C **3.** C **4.** A **5.** E **6.** A **7.** A **8.** D

EXERCISE - 3 : PART # I

1. $(1)\rightarrow(Q)\rightarrow(c)$ $(2)\rightarrow(S)\rightarrow(a)$ $(3)\rightarrow(P)\rightarrow(b)$ $(4)\rightarrow(R)\rightarrow(d)$

2. $(A)\rightarrow(t)$; $(B)\rightarrow(p)$; $(C)\rightarrow(r)$; $(D)\rightarrow(q)$; $(E)\rightarrow(s)$

3. $(A)\rightarrow(q)$; $(B)\rightarrow(p)$; $(C)\rightarrow(r)$; $(D)\rightarrow(v)$; $(E)\rightarrow(s)$; $(F)\rightarrow(t, u)$

4. $(A)\rightarrow(r)$; $(B)\rightarrow(s)$; $(C)\rightarrow(t)$; $(D)\rightarrow(q)$; $(E)\rightarrow(p)$

5. $(A)\rightarrow(q)$; $(B)\rightarrow(r)$; $(C)\rightarrow(s)$; $(D)\rightarrow(p)$

PART # II

Comprehension # 1 : **1.** B **2.** C **3.** C **4.** D **5.** A

Comprehension # 2 : **1.** B **2.** C **3.** A

EXERCISE - 4

1. $[\mu]=\frac{1}{L}=L^{-1}$ **2.** $M = kc^{-1/2}, G^{-1/2}, h^{1/2}$, $L = kc^{-3/2}G^{1/2}h^{1/2}$, $T = kc^{-5/2}G^{1/2}h^{1/2}$ **3.** frequency $=\frac{k}{L}\sqrt{\frac{F}{m}}$

4. $[h] = M L^2 T^{-1}$ **5.** **(a)** $[c] = L^2T^{-2}k^{-1}$ **(b)** $[\alpha] = k^{-1}$ **(c)** $[R] = ML^2T^{-2}k^{-1}\,mol^{-1}$ **6.** $[a] = L^{-1}$, $[k] = ML^2T^{-2}$

7. $T^2=\frac{K^2r^3}{GM}$ **8.** $\omega = k\sqrt{\frac{GM}{r^3}}$

EXERCISE - 5 : PART # I

1. A **2.** B **3.** C **4.** A **5.** C **6.** D **7.** B **8.** B

PART # II

1. A,B,C **2.** B **3.** A,D **4.** D **5.** A,B,C,D **6.** B,C **7.** E **8.** D **9.** A **10.** D

11. $(A)\rightarrow(P),(Q)$; $(B)\rightarrow(R),(S)$; $(C)\rightarrow(R),(S)$; $(D)\rightarrow(R),(S)$ **12.** C **13.** 3 **14.** A,C,D **15.** A,C **16.** B,D

MOCK TEST

1. A **2.** B **3.** C **4.** B **5.** B **6.** B **7.** C **8.** C **9.** A **10.** B **11.** B **12.** A **13** D
14. B,C **15.** A,B,C,D **16.** A,B,C **17.** A,B,D **18.** A,B **19.** E **20.** E **21.** E
22. $A\rightarrow P,Q$; $B\rightarrow R, S$; $C\rightarrow R, S$; $D\rightarrow R, S$