Basic (Fundamental) Quantities

The physical quantity which does not depend on any other physical quantity is called a fundamental physical quantity such as length.

Quantity	Symbol	SI units	Unit in use
Mass	M	Kilogram	Kg
Length	L	Metre	m
Time	T	Second	s
Temperature	K	Kelvin	K
Electric current	A	Ampere	A
Luminous intensity	Cd	Candela	Cd
Amount of substance	mol	Mole	mol

In addition there are two supplementary units :- radian (rad) for plane angle and Steradian (Sr) for solid angle.

Definitions of Basic Units (Fundamental Units)

Following are the latest definitions of the basic units accepted by the International Bureau of Weights and Measures.

(i) **Meter (m) :** it is the distance travelled by electromagnetic waves in free space in (1/299, 792, 458) part of second. The denominator is the velocity of light in vacuum which is in m/s, and known accurately.

(ii) **Second (s or sec) :-** It is the duration of 9,192, 631, 770 periods of the radiation corresponding to the transition between two hyperfine levels of the ground state of the Ceasium-133 atom. It is called atomic standard of time.

(iii) **Kilogram (kg) :-** The mass of a cylinder made of platinum-iridium alloy kept at International Bureau of Weights and Measures is defined as 1kg.

(iv) Ampere (A) :- It is the constant current which is maintained in two straight parallel conductors of infinite length of negligible circular cross-section and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2 x 10^{-7} Nm^{-1} to their length.

(v) Kelvin (K) :- It is the $\frac{1}{273.16}$ th part of the thermodynamic temperature of the triple point of water.

(vi) Mole (mol) :- The amount of a substance that contains as many elementary entities (molecules or atoms if the substance is monatomic) as there are number of atoms in 0.012 kg. Of carbon-12 is called a mole. This number (number of atoms in 0.012 kg. of carbon-12) is called Avogadro's number and it's best value available is 6.022045 x 10^{23} with an uncertainty of about 0.000031 x 10^{23}.

(vii) Candella (cd) :- It is the luminous intensity, in the perpendicular direction of a surface of (1/600000) m^2 of black body at the temperature of freezing platinum under a pressure of 101325 Nm^{-2}.

Supplementary Units

The supplementary units may be defined as follows:

(i) Radian (rad) : This is the SI unit of plane angle. It is defined as the angle subtended at the centre of a circle by an arc equal in length to the radius of the circle.

(ii) Steradian (Sr) :- It is the SI unit of solid angle. One Steradian is defined as the solid angle that encloses a surface on a sphere equal to the square of its radius.

Different Systems Units

International System of Units: abbreviated SI, is an extended version of the MKS (Metre, Kilo-gram, Second) system.

This system measures

Length in metre (m) Mass in kilogram (kg)

Time in second (s)

C G S System :- (Centimetre, Gram, Second) are often used in Scientific work.

This system measures

Length in centimetre (Cm)

Mass in gram (gm) Time in second (s)

F P S System :- (Foot, Pond, second). It is also called British unit system. This unit measures :-

Length in fool (‘) Mass in gram (gm)

Time in second (s)

Some conventions followed in using SI units

(i) Symbols should be used in singular form e.g. 20 m but 10 ms is wrong.

(ii) Avoid using bar e.g. m/s^2, it should be written as ms^{-2}

(iii) Multiplies and sub-multiplies to units :

The SI units may be too large too small for expressing certain quantities. In such cases, multiplies of the units are used by adding suitable prefixes as shown in the following table :-

Multiple or sub multiple	Prefix	Symbol or abbreviation
10^{-24}	yocto	Y
10^{-21}	zepto	Z
10^{-18}	atto	A
10^{-15}	temto	F
10^{-12}	pico	P
10^{-9}	nano	n
10^{-6}	micro	μ

10^{-3}	mili	m
10^{-2}	centi	C
10^{-1}	deci	D
10^{1}	deca	da or D
10^{2}	hecto	h or H
10^{3}	kilo	k or K
10^{6}	mega	M
10^{9}	giga	G
10^{12}	tetra	T
10^{15}	Peta	P
10^{18}	exa	E
10^{21}	Zetta	Z
10^{24}	Yotta	Y

(iv) Unit which is the name of scientist must be written with first small letter e.g., newton ampere etc. But in symbol it is used as N, for Force, A for ampere etc.

(v) No punctuation mark is required after symbol or units.

Dimensions

It is the relation of physical quantities in terms of base quantities (fundamental quantities). Dimensional equation states by how much power the basic units are raised to get derived units.

Examples

(i) Force = Mass x Acceleration.

The dimensional formula of force

$= [M] [LT^{-2}] = [MLT^{-2}]$

(ii) Density = Mass / Volume

The dimensional formula of density

$$= \frac{[M]}{[L^3]} = [ML^{-3}]$$

Types of physical quantities on the dimensional basis

(i) Dimensional constant

(ii) Dimensionless constant

(iii) Dimensionless variable

(iv) Dimensional variable

Usages of Dimensional equation

(i) Conversion of units

Let us consider a physical quantity 'X' having dimensional formula

$[M^a L^b T^c]$.

If there are two system of units one of which fundamental units M_1, L_1 and T_1 and another one having fundament units as M_2, L_2 and T_2 then the numerical value of the quantity may be n_1 in one system and n_2 in another one. But since they represent the same quantity.

$$X = n_1\left[M_1^a\ L_1^b\ T_1^c\right] = n_2\left[M_2^a\ L_2^b\ T_2^c\right]$$

The conversion factor for 'X' from the first system to second $= \frac{n_2}{n_1} = \left[\frac{M_1}{M_2}\right]^a \times \left[\frac{L_1}{L_2}\right]^b \times \left[\frac{T_1}{T_2}\right]^c$

the ratios $\left(\frac{M_1}{M_2}\right), \left(\frac{L_1}{L_2}\right)$ are called the conversion factors for mass and length respectively for example in the case of conversion from FPS to CGS system M_1 is in pound and M_2 is in grams, L_1 is in foot and L_2 is in centimeter. The conversion factor from pound to gram is $\frac{M_1}{M_2}$ may be calculated as below

$$X = n_1 [M_1] = n_2 [M_2]$$

$$(1\,\text{pound})\,(M_1) = (453.6\ \text{gm})(M_2)$$

$$\Rightarrow \quad \frac{M_1}{M_2} = 453.6$$

The conversion factor from foot to centimeter $\left(\frac{L_1}{L_2}\right)$ may be calculated as follows :

$$(1\ \text{foot})\,(L_1) = (30.48\ \text{cm})\,(L_2)$$

$$\Rightarrow \frac{L_1}{L_2} = 30.48$$

(ii) Checking correctness of equation. Since law of dimensional the homogeneity holds for any physical equation.

(iii) Deriving simple physical relation.

(iv) Knowing units of physical quantities.

Dimensions Of Physical Quantities

(i) (General Physics)

S. No.	Quantity	Formula Used	Dimensional Formula	SI Unit	Symbol of Unit
1.	Area	length x breadth = L x L	L^2	metre^2	m^2
2.	Volume	length x breadth x height = L x L x L	L^3	metre^3	m^3
3.	Plane angle	length (L) / Radius (L)	$M^0 L^0 T^0$	radian	Rad
4.	Solid angle	-	$M^0 L^0 T^0$	steradian	Sr

5.	Velocity, Speed	$\frac{\text{displacement, distance}}{\text{time}} = \frac{L}{T}$	LT^{-1}	metre second^{-1}	Ms^{-1}
6.	Angular Velocity Angular frequency	$\frac{1}{\text{Time}} = \frac{1}{T}$	T^{-1}	Radian second^{-1} or second^{-1}	rad s^{-1} or s^{-1}
7.	Linear frequency or simply frequency	$\frac{1}{\text{Time}} = \frac{1}{T}$	T^{-1}	hertz	Hz
8.	Acceleration	$\frac{\text{Change in Velocity}}{\text{time}} = \frac{LT^{-1}}{T}$	LT – 2	metre second^{-2}	Ms^{-2}
9.	Density	$\frac{\text{Mass}}{\text{Volume}} = \frac{M}{L^3}$	ML^{-3}	Kilogram metre^{-3}	kg m^{-3}
10.	Volumetric flow rate	$\frac{\text{Volume}}{\text{Time}} = \frac{L^3}{T}$	L^3T^{-1}	metre^3 second^{-1}	m^3 s^{-1}
11.	Momentum	Mass x Velocity = M x LT^{-1}	MLT^{-1}	kilogram metre second^{-1}	kg ms^{-1}
12.	Force	Mass x Acceleration = M x LT^{-2}	MLT^{-2}	Newton	N
13.	Impulse	Force x time = MLT^{-2} x T	MLT^{-1}	newton-second	Ns
14.	Moment of inertia	Mass x (distance)^2 = M x L^2	ML^2	kilogram-metre^2	kg m^2
15.	Angular Momentum	Linear momentum x distance= MLT^{-1} x L^2	ML^2T^{-1}	kilogram metre^2 second^{-1}	Kg m^2 s^{-1}

16.	Coefficient of friction	$\mu = \frac{F}{R}, F = MLT^{-2}$ $R = MLT^{-2}, \mu = \frac{MLT^{-2}}{MLT^{-2}}$	$M^0L^0T^0$	No unit	
17.	Momentofforceor Coupleo Torque	Forcex displacement = MLT^{-2} x L	ML^2T^{-2}	Newton metre (Not Joule)	Nm (Not J)
18.	Work, Energy, Heat, Light, Electrical energy	-	ML^2T^{-2}	Joule (not newton metre)	J (Not N m)
19.	Angular acceleration	$\frac{d^2\theta}{dT^2} = \frac{M^0L^0T^0}{T^2}$	T^{-2}	radian second^{-2}	Rad s^{-2} or s^{-2}
20.	Time period	= Time taken in one revolution = T	T	second	s
21.	Gravitational constant	$F = \frac{GM_1 M_2}{R^2}$ $G = \frac{F x R^2}{M_1 M_2}$ $= \frac{MLT^{-2} \times L^2}{MM}$ $= M^{-1} L^3 T^{-2}$	$M^{-1} L^3T^{-2}$	Newton metre^2 kilogram^{-2}	Nm^2 kg^2
22.	Rotational kinetic energy	$= \frac{1}{2} I\omega^2 = MR^2 \left(\frac{d\theta}{dt}\right)^2$ $= ML^2 \times (T^{-1})^2 = ML^2 T^{-2}$	ML^2T^{-2}	Joule	J
23.	Angular displacement	= angle	$M^0L^0T^0$	radian	rad
24.	Radius of gyration	Radius = L	L	metre	M

25.	Pressure, Young's modulus, Bulk, modulus stress	$\frac{Force}{Area} = \frac{MLT^{-2}}{L^2}$	$ML^{-1}T^{-2}$	pascal, newton metre^2	Pa or Nm^{-2}
26.	Thrust	$= Force = MLT^{-2}$	MLT^{-2}	Newton	N
27.	Relative density or specific gravity	$\frac{\text{Density of the body}}{\text{Density of water}}$	$M^0L^0T^0$ or dimensionless	no unit	
28.	Compressibility	$\frac{1}{Pressure} = \frac{1}{ML^{-1}T^{-2}}$	$M^{-1}LT^{-2}$	metre^2 – newton^{-1}	$m^2 N^{-1}$
29.	Strain	$\frac{\text{Change in length}}{\text{original length}} = \frac{\Delta L}{L}$	Dimensionless	No unit	
30.	Strain energy	Dimension of Energy	ML^2T^{-2}	Joule	J
31.	Force constant stiffness, spring constant	Force = spring const. x displacement $MLT^{-2} = K \times L$ $\therefore K = \frac{MLT^{-2}}{L}$	MT^{-2}	Newton metre^{-1}	Nm^{-1}
32.	Surface tension	$\frac{Force}{length} = \frac{MLT^{-2}}{L}$	MT^{-2}	newton metre^{-1}	Nm^{-1}
33.	Coefficient of Viscosity	$\frac{F \times r}{A \times v} = \frac{MLT^{-2} \times L}{L^2 \; LT^{-1}}$ $= ML^{-1}T^{-1}$	$ML^{-1}T^{-1}$	pascal second	Pa s
34.	Power, energy, flux	$\frac{Work}{Time} = \frac{ML^2T^{-2}}{T}$	ML^2T^{-3}	watt or joule second^{-1}	W or Js^{-1}

35.	Flux density	$\frac{\text{Flux}}{\text{Area}} = \frac{ML^2T^{-3}}{T^2}$	MT^{-3}	Watt metre^{-2}	W m^{-2}
36.	Amplitude (if displacement is in metre)	length = L	L	Metre	M
37.	Phse	Angle = $M^0L^0T^0$	$M^0L^0T^0$	radian	Rad
38.	Intensity of a wave or simply intensity or sound intensity	-	MT^{-3}	watt metes^2	W m^2

(ii) Physics of the Atom

1	Specific charge	$\frac{\text{Charge}}{\text{Mass}} = \frac{IT}{M} = M^{-1}IT$	M^{-1} TA	coulomb kilogram^{-1}	C kg^{-1}
2	Planck's constant	$\frac{\text{Energy}}{\text{Frequency}} = \frac{ML^2T^{-2}}{T^{-1}} = ML^2T^{-1}$	ML^2T^{-1}	Joule second	Js
3	Work function	Energy = ML^2T^{-2}	ML^2T^{-2}	volt, electron volt, joule	V,eV,J
4	Rydberg consant	Rydberg const. $\propto \frac{1}{\text{Wavelength}} \Rightarrow \frac{1}{L} = L^{-1}$	L^{-1}	metre^{-1}	m^{-1}
5	Radioactive decay constant	$\frac{0.6932}{T_{1/2}} = \frac{1}{T} = T^{-1}$	T^{-1}	Becquerel	Bq
6	Binding energy	Simply energy ML^2T^{-2}	ML^2T^{-2}	joule, million electron volt	J, MeV

7	Mass absorption coefficient	$\frac{\text{Area}}{\text{Mass}} = \frac{L^2}{M} = M^{-1} L^2$	$M^{-1}L^2$	metre^2 kilogram^{-1}	m^2 kg^{-1}

(iii) Heat

1.	Heat	It is the form of Energy = ML^2T^{-2}	ML^2T^{-2}	joule	J
2.	Specific heat capacity	$\frac{\text{Heat}}{\text{Mass} \times \text{Kelvin}} = \frac{ML^2T^{-2}}{M \times K}$ $= L^2T^{-2}K^{-1}$	$L^2T^{-2}K^{-1}$	joule kilogram^{-1} kelvin^{-1}	J $kg^{-1}K^{-1}$
3.	Latent heat of vapourisation	$\frac{\text{Heat}}{\text{Mass}} = \frac{ML^2T^{-2}}{M}$ $= L^2T^{-2}$	L^2T^{-2}	joule kilogram^{-1}	J kg^{-1}
4.	Water equivalent	–	M	kilogram	kg
5.	Thermal capacity	$\frac{\text{Heat}}{\text{Kelvin}} = \frac{ML^2T^{-2}}{K}$ $= ML^2T^{-2}K^{-1}$	$ML^2T^{-2}K^{-1}$	joule kelvin^{-1}	JK^{-1}
6.	Coefficient of thermal expansion	$\frac{\text{Change in dimension}}{\text{Original dimension} \times \text{temperature}}$ $= K^{-1}$	K^{-1}	kelvin^{-1}	K^{-1}
7.	Amount of gas	-		mole	Mol

8.	Molar heat capacity	$\frac{\text{Heat Capacity}}{\text{Mole}} = \frac{ML^2T^{-2}K^{-1}}{\text{Mole}} = ML^2T^{-2}K^{-1}\text{Mole}^{-1}$	$ML^2T^{-2}K^{-1}$ mole^{-1}	joule kelvin^{-1} mole^{-1}	JK^{-1} mol^{-1}
9.	Boltzmann's constant	$K = \frac{2E}{\text{temp.}} = \frac{ML^2T^{-2}}{K} = ML^2T^{-2}K^{-1}$	$ML^2T^{-2}K^{-1}$	joule kelvin^{-1}	JK^{-1}
10.	Rate of heat loss	$\frac{\text{Energy}}{\text{Time}} = \frac{ML^2T^{-2}}{T} = ML^2T^{-3}$	ML^2T^{-3}	joule kelvin^{-1}	$J\ s^{-1}$
11.	Rate of fall of temperature	$\frac{\text{Temp.}}{\text{time}} = \frac{K}{T} = KT^{-1}$	$K\ T^{-1}$	Kelvin second^{-1}	Ks^{-1}
13.	Thermal conductivity	$\frac{H \times l}{A \times \text{Change in temp.} \times T} = \frac{ML^2T^{-2} \times L}{L^2 \times K \times T} = MLT^{-3}K^{-1}$	$MLT^{-3}K^{-1}$	watt metre^{-1} Kelvin^{-1} (cgs unit :calorie centimeter e^{-1} second^{-1}) Per degree celsius	Ks^{-1} W. $m^{-1}K^{-1}$ cal cm^{-1} s^{-1} $(^oC)^{-1}$
14.	Thermal resistance	$\frac{\text{Change in temp.} \times T}{\text{H. Supplied}} = \frac{K \times T}{ML^2T^{-2}K} = M^{-1}L^{-2}T^3K$	$M^{-1}L^{-2}T^3K$	Joule^{-1} second kelvin	J^{-1} sK

15.	Stefan's constant	$\frac{E}{\text{Area} \times \text{Time} \times (\text{Temp.})^4}$ $= \frac{ML2T^{-2}}{L^2 \times T \times K^4}$ $= MT^{-3} K^{-4}$	$MT^{-3}K^{-4}$	$\frac{\text{watt}}{\text{metre}^{-2}\ \text{kelvin}^{-4}}$ metre kelvin	W m^{-2} K^{-4}
16.	Wien's displacemen t constant	Wavelength × Temp. i.e. $\lambda_m \times T$ $= L \times K = LK$	LK	metre Kelvin	m K
17.	Emissive Power, Energy flux density	$\frac{\text{Heat}}{\text{Area} \times \text{Time}}$ $= \frac{ML^2 T^{-2}}{L^2 \times T} = MT^{-3}$	MT^{-3}	watt metre^{-2}	W m^{-2}
18.	Power, energy flux	$\frac{\text{Work done}}{\text{Time taken}}$ $= \frac{ML^2 T^{-2}}{T} = ML^2T^{-3}$	ML^2T^{-3}	watt	W
19.	Entropy	$\frac{\text{Change in Heat}}{\text{Temp.}}$ $= \frac{\Delta\theta}{K}$ $= \frac{ML^2 T^{-2}}{K} = ML^2 T^{-2} K^{-1}$	$ML^2T^{-2}K^{-1}$	joule kelvin^{-1}	J K^{-1}

(iv) Electricity and Magnetism

S. No.	Quantity	Formula Used	Dimensional Formula	SI Unit	Symbol of Unit
1.	Electric current	-	A	ampere	A

2.	Current density	Current Per unit area $=\frac{I}{A}=\frac{I}{L^2}$ $=IL^{-2}$	$L^{-2}A$	ampere metre^{-2}	A m^{-2}
3.	Charge	Current × Time = I × T	TA	coulomb	C
4.	Electric voltage, e.m.f.	$\frac{\text{Work done}}{\text{Charge}}$ $=\frac{ML^2\ T^{-2}}{I.T}$ $=ML^2\ T^{-3}\ I^{-1}$	$ML^2T^{-3}A^{-1}$	volt, joule coulomb^{-1}	V, J C^{-1}
5.	Electric field	$\frac{\text{Force}}{\text{Charge}}=\frac{MLT^{-2}}{IT}$ $=MLT^{-3}\ I^{-1}$	$MLT^{-3}\ A^{-1}$	volt metre^{-1} newton coulomb^{-1}	V m^{-1}, NC^{-1}
6.	Dielectric constant or specific inductive capacity or relative permittivity	-	Dimensio-nless	No unit	
7.	Permittivity	Since $F=\frac{1}{4\pi\in}=\frac{q1q2}{r^2}$ $\therefore \in=\frac{q1q2}{4\pi Fr^2}$ $=\frac{(IT)\times(IT)}{MLT^{-2}\times L^2}$ $=M^{-1}\ L^{-3}\ T^4\ I^2$	$M^{-1}L^{-3}T^4A^2$	farad metre1, (coulomb b^{-2} newton metre^{-2})	F m1 I = C^2N^{-1} m^{-2})

8.	Magnetic Pole strength	$\frac{\text{Magnetic dipole moment}}{2 \times \text{length}}$ $= \frac{L^2 I}{L} = LI$	LA	ampere metre	A m
9	Capacitance	$\frac{\text{Charge}}{\text{Potential}} = \frac{IT}{ML^2 T^{-3} I^{-1}}$ $= M^{-1} L^{-2} T^4 I^2$	$M^{-1}L^{-2}T^4A^2$	farad	F
10.	Electric resistance, impedance	$\frac{\text{Potential Difference}}{\text{Current}}$ $\frac{M^2 T^{-3} I^{-1}}{I}$ $= ML^2 T^{-3} I^{-2}$	$ML^2T^{-3}A^{-2}$	ohm	Ω
11.	Resistivity or specific resistance	$\frac{\text{Resistance} \times \text{Area}}{\text{length}}$ $\frac{ML^2 T^{-3} I^{-2} \times L^2}{L}$ $= ML^3 T^{-3} I^{-2}$	$ML^3T^{-3}A^{-2}$	ohm metre	Ωm
12.	Electric conductance	$\frac{1}{\text{Resistance}}$ $\frac{1}{ML^2 T^{-3} I^{-2}}$ $= M^{-1} L^{-2} T^3 I^2$	$M^{-1}L^{-2}T^3A^2$	siemens	S
13.	Electric conductivity	$\frac{1}{\text{Resistivity}}$ $\frac{1}{ML^3 T^{-3} I^{-2}}$ $= M^{-1} L^{-3} T^3 I^2$	$M^{-1}L^{-3}T^3A^2$	siemens metre^{-1}	S m^{-1}
14.	Electricity dipole moment	Charge $\times$ distance $= IT \times L = LIT$	LTA	coulomb metre	Cm

15.	Temperature coefficient of resistance	$\frac{1}{\text{Temperature}} = K^{-1}$	K^{-1}	kelvin^{-1}	K^{-1}
16.	Electric potential energy	Electric potential × charge $ML^2T^{-3}I^{-1} \times IT$ $= ML^2T^{-2}$	ML^2T^{-2}	joule, electron volt	J, eV
17.	Inductance	Since e.m.f. $e = \frac{dI}{dt}$ $\therefore L = e\frac{dt}{dI}$ $= \left(\frac{\text{Work}}{\text{Charge}}\right) \times \frac{dt}{dI}$ $= \frac{ML^2T^{-2}}{I.T} \times \frac{T}{I}$ $= ML^2T^{-2}I^{-2}$	$ML^2T^{-2}A^{-2}$	henry	H
18.	Magnetic intensity or magnetisatio n	Since $dB = \frac{\mu o}{4\pi} \times \frac{Id\,I\sin\theta}{r^2}$ $\therefore H = \frac{B}{\mu o} = \left[\frac{IdI}{r^2}\right]$ $= \frac{AL}{L^2} = AL^{-1}$	$L^{-1}A$	ampere metre^{-1}	Am^{-1}
19.	Magnetic flux	$\frac{I}{\text{Impedance}} = \frac{1}{\text{Resistance}}$ $= \frac{1}{ML^2T^{-3}I^{-2}}$ $= M^{-1}L^{-2}T^3I^2$	$ML^2T^{-2}A^{-1}$	weber	Wb

20.	Magnetic induction	$B = \frac{\text{Force}}{\text{Charge} \times \text{velocity}}$ $= \frac{MLT^{-2}}{IT \times LT^{-1}} = MT^{-2}I^{-1}$	$MT^{-2}A^{-1}$	tesla	T
21.	Magnetic moment (Magnetic dipole moment)	Current × Area $= I \times L^2 = M^0L^2T^0I$	L^2A	ampere metre^2	Am^2
22.	Permeability	Since the force in magetic field $F = \frac{\mu o}{4\pi}\frac{m_1 m_2}{r^2}$ where m_1 and m_2 are pole strength $\therefore \mu o = \frac{F \times r^2}{m_1 \times m_2}$ $= \frac{MLT^{-2} \times L^2}{LI \times LI}$ $= MLT^{-2}I^{-2}$	$MLT^{-2}A^{-2}$	Newton A^{-2}	NA^{-2}
23.	Electric flux	Electric field Area $= MLT^{-3}I^{-1} \times L^2$ $= ML^3T^{-3}I^{-1}$	$ML^3T^{-3}A^{-1}$	volt metre, newton metre^2 coulomb^{-1}	Vm, Nm^2C^{-1}

24.	Electric moment	Charge × distance $= IT \times L = LTI$	LTA	Coulomb metre	Cm
25.	Electric polarisation	$\frac{Pe}{Volume} = \frac{IT \times L}{L^3} = TIL^{-2}$	$L^{-2}TA$	coulomb metre^{-2}	Cm^{-2}
26.	Electric Displacement vector	$\in \times$ Electric field $= M^{-1}L^{-3}T^4I^2\ MLT^{-3}I^{-1}$ $= L^{-2}TI = TIL^{-2}$	L^2TA	coulomb metre^{-2}	Am^{-2}
27.	Displacement current density	$\frac{Current}{Area} = \frac{I}{L^2} = IL^{-2}$	L^2A	ampere metre^{-2}	Am^{-2}
28.	Reluctance	-	$M^{-1}L^{-2}T^2A^2$	ampere weber^{-1}	Wb^{-1} A

29.	Electrochemi-cal equivalent	Since mass = electrochemical equivalent × Current × Time $m = Z \times I \times T$ $\therefore Z = \frac{m}{IT} = \frac{M}{IT}$ $= MI^{-1}T^{-1}$	-$MT^{-1}A^{-1}$	kilogram coulomb^{-1}	kg C^{-1}
30.	Electric energy density, magnetic energy density	$\frac{\text{Energy}}{\text{Volume}} = \frac{ML^2T^{-2}}{L^3}$ $= MI^{-1}T^{-2}$	$ML^{-1}T^2$	joule metre^{-3}	Jm^{-3}
31.	Susceptibility	$\frac{I}{\text{Impedance}} = \frac{1}{\text{Resistance}}$ $= \frac{1}{ML^2T^{-3}I^{-2}}$ $= M^{-1}L^{-2}T^3I^2$	$M^{-1}L^{-2}T^3A^2$	$(\text{Ohm})^{-1}$ or Mho	
32.	Admittance	similar to susceptibility $= M^{-1}L^{-2}T^3I^2$	$M^{-1}L^{-2}T^3A^2$	$(\text{Ohm})^{-1}$ or mho	-

(v) Optics

S. No.	Physical Quantity	Formula Used	Dimensional Formula	SI unit	Symbol of units

1.	Light energy	Simply energy = ML^2T^{-2}	ML^2T^{-2}	Joule	J
2.	Light radiation Power, (Radiation flux)	Simply power = ML^2T^{-3}	ML^2T^{-3}	watt	W
3.	Light intensity, radiation flux density	Power per unit area = $\frac{ML^2T^{-3}}{L^2} = MT^{-3}$	MT^{-3}	watt metre^{-2}	W m^{-2}
4.	Photon flux, particle flux	Flow of Particles per unit time = $\frac{1}{T} = T^{-1}$	T^{-1}	second T^{-1}	s^{-1}
5.	Photon flux density, particle flux density	Particle Flux per unit Area = $\frac{T^{-1}}{L^2} = L^{-2}T^{-1}$	$L^{-2}T^{-1}$	metre^{-2} second^{-1}	$m^{-2}s^{-1}$
6.	Poynting vector	$\frac{1}{2\pi} \times \text{Electric Field} \times$ Magnetic field = $MLT^{-3}A^{-1}$ x ML^2A^{-1} = $M^2L^3T^{-3}A^{-2}$	$M^2L^3T^{-3}A^{-2}$	watt metre^{-2}	W m^{-2}
7.	Luminous intensity	It is a Power = ML^2T^{-3}	ML^2T^{-3}	candela	Cd
8.	Luminous energy, quantity of light	Simply energy	ML^2T^{-2}	lumen second	lm s (=s, cd, sr)
9.	Luminous emittance	-	MT^{-3}	lumen metre^2	lm m^{-2} (m^{-2} cd, sr)

10.	Illuminance	Simply Luminous emittance = MT^{-3}	MT^{-3}	lux	lx (= $lm.m^2$)
11.	Luminance		MT^{-3}	Lux	Lx (=$lm.m^2$)
12.	Radiation intensity	Energy per unit time = $\frac{ML^2T^{-2}}{T} = ML^2T^{-3}$	ML^2T^{-3}	watt Steradian	$W.sr^{-1}$ (=$kg.m^2 s^{-3}.sr-1$)
13.	Radiation emittance, irradiance		MT^{-3}	watt $metre^{-2}$	Wm^{-2}
14.	Radiance		MT^{-3}	watt $metre^{-2}$ $steradian^{-1}$	$W\ m^{-2}$, sr^{-1} (= $kg.s^{-3}.sr^{-1}$)
15.	Power of lens	$\frac{1}{\text{Focal length}} = \frac{1}{F} = \frac{1}{L} = L^{-1}$	L^{-1}	Dioptre	D
16.	Magnifying Power	$\frac{v}{u} = \text{dimensionless}$			