Diploma Physics (1)

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Syllabus of Physics

~~UFWRPH~~, ~~WOECESM~~

1. Units & Dimensions.
2. Force & motion
3. Work, Power & Energy
4. Rotational motion.
5. Properties of Matter
6. Heat & temperature
7. Wave motion & its application.
8. optics.
9. Electrostatics
10. Current Electricity
11. Electromagnetism.
12. Semiconductor physics.
13. Modern physics.

1. Units & Dimensions

Physics → Physics is the branch of science that deals with the study of basic laws of nature & their manifestation in various natural phenomena.

Physical quantities → length, mass, ~~time~~ tempr, speed, force, electric current etc.

Physical quantity are of two type:–

(I) Fundamental quantities (II) Derived quantities.

There are seven fundamental or base quantities

(a) Mass (b) length (c) time (d) electric current (f) tempr (g) luminous intensity (h) amount of substance

~~TL MELTA~~ / ~~METALTE~~

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(2) (II) Derived quantities :— All physical quantities other than the seven fundamental quantities are derived quantities.
Example → velocity, acceleration, force, Momentum etc.

System of units :— A complete set of units which is used to measure all kinds of fundamental & derived quantities is called a system of units.

(I) C.G.S. system → (cm, gm, sec) system
Length → cm.
Mass → gm.
time measure → sec.

(II) F.P.S. system → foot, pound & second system
(III) M.K.S. system → Metre, kilogram & second system
(IV) SI :— The International system of units.

Basic SI quantities & units

S.No	Basic physical quantity	Basic unit	symbol.
1.	Length	metre.	m.
2.	Mass	kilogram	kg.
3.	Time	second	s
4.	Temperature	kelvin	K.
5.	Electric current	ampere	A
6	Luminous Intensity	Candela	cd
7	Quantity of Matter	mole	mol

Supplementary S.I. units.

S.No.	Supplementary quantity	Basic unit	symbol.
1.	Plane angle	radian	rad.
2.	Solid angle	steradian	sr.

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3) Unit And Measurments

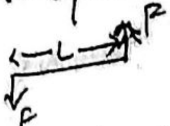
[Metre] | length → [m]
Mass → Kg [M]
time → Sec [S]

Dimensional Formulae.

Physical Quantity	Relation with other quantities	Dimensional Formulae	S.I Unit.
1. Area	length x breadth	$L \times L = L^2$ $[M^0 L^2 T^0]$	m^2
2. Volume	length x breadth x height	$L \times L \times L = L^3$ $[M^0 L^3 T^0]$	m^3
3. Density	$\frac{\text{Mass}}{\text{volume}}$	$\frac{M}{L^3} = [M L^{-3} T^0]$	$Kg m^{-3}$
4. Speed or Velocity	$\frac{\text{Distance}}{\text{Time}}$	$\frac{L}{T} = [M^0 L T^{-1}]$	ms^{-1} or m/sec
5. Acceleration	$\frac{\text{Change in velocity}}{\text{Time}}$	$\frac{LT^{-1}}{T} = LT^{-2}$ $= [M^0 L T^{-2}]$	Ms^{-2}
6. Momentum =	Mass x Velocity	$M \times LT^{-T}$ $= [MLT^{-1}]$	$Kgms^{-1}$
7. Force	Mass x Acceleration	$M \times LT^{-2}$ $= [MLT^{-2}]$ $Kg\text{-}m/sec^2$ →	N (Newton)
8. Work	Force x Distance	$MLT^{-2} \times L$ $= [ML^2T^{-2}]$ $[Kg\,m^2/sec^2]$	J (Joule)
9. Energy	Amount of work.	$[ML^2T^{-2}]$	J (Joule)
10. Power	$\frac{\text{Work}}{\text{Time}}$	$\frac{ML^2T^{-2}}{T} = [ML^2T^{-3}]$	W (Watt)

(4)

11. Pressure	$\frac{\text{Force}}{\text{Area}}$	$\frac{MLT^{-2}}{L^2} = [ML^{-1}T^{-2}]$	Pa or Nm^{-2} (Pascal)
12. Moment of Force or Torque	Force × ⊥ar distance (⊥ar = Perpendicular)	$MLT^{-2} \times L = [ML^2T^{-2}]$	Nm
13. Gravitational constant 'G'.	$\frac{\text{Force} \times (\text{distance})^2}{\text{Mass} \times \text{Mass}}$	$\frac{MLT^{-2} \times L^2}{M \times M} = [M^{-1}L^3T^{-2}]$	$Nm^2 Kg^{-2}$
14. Impulse of a force	Force × Time	$MLT^{-2} \times T = [MLT^{-1}]$	Ns
15. Stress	$\frac{\text{Force}}{\text{Area}}$	$\frac{MLT^{-2}}{L^2} = [ML^{-1}T^{-2}]$	Nm^{-2}
16. Strain	$\frac{\text{Change in dimension}}{\text{Original dimension}}$	$[M^0L^0T^0]$ (Dimensionless)	
17. Coefficient of Elasticity	$\frac{\text{Stress}}{\text{Strain}}$	$\frac{ML^{-1}T^{-2}}{1} = [ML^{-1}T^{-2}]$	Nm^{-2}
18. Surface Tension	$\frac{\text{Force}}{\text{Length}}$	$\frac{MLT^{-2}}{L} = [ML^0T^{-2}]$	Nm^{-1}
19. Surface Energy	$\frac{\text{Work}}{\text{Area}}$	$\frac{ML^2T^{-2}}{L^2} = [ML^0T^{-2}]$	Jm^{-2}
20. Cofficient of Viscosity	$\frac{\text{Force} \times \text{distance}}{\text{Area} \times \text{Velocity}}$	$\frac{MLT^{-2} \times L}{L^2 \times LT^{-1}} = [ML^{-1}T^{-1}]$	$Nm^{-2}s$ or Pa s



$F = G \cdot \frac{m_1 m_2}{r^2}$ ∴ $G = \left[\frac{Fr^2}{m_1 m_2}\right]$

$[MLT^{-2}L^{-2}T] = [ML^{-1}T^{-2}\ T]$ — Pa Sec. = Pa s

Dimensional equation →

→ The dimensional equation of force is

$[Force] = [MLT^{-2}]$

→ The dimensional equation for pressure is

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

Principle of homogeneity of dimensions :-

A physical equation will be dimensionally correct if the dimensions of all the terms occuring on both sides of the equation are the same.

Thus, only the physical quantities of the same kind can be added, subtracted or compared. Thus, velocity can be added to velocity but not to force.

Applications of dimensional equations :-

(a) To find the unit of a given physical quantity.

eg. volume = $l \times b \times h = [L] \times [L] \times [L] = m^3$

(b) to find dimensions of physical constants or coefficients.

eq. $G = \frac{Fr^2}{m_1 m_2} = \frac{[MLT^{-2}][L^2]}{[M][M]} = [M^{-1}L^3T^{-2}]$

$= m^3/kg\,s^2$

(c) Conversion of system of unit (only force, work in syllabus)

Example → Convert one Newton into dyne.

Dimensional formula for Newton $= [MLT^{-2}]$

or $1N = 1\,kg\,m/s^2$ || But $1\,kg = 10^3\,g$

& $1\,m = 10^2\,cm$

$\therefore 1N = (10^3\,g)(10^2\,cm)/sec^2$

$= 10^5\,gm\,cm/sec^2 = 10^5$ dyne

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(b) (ii) Convert one jule into erg.

Joule S.I unit of energy
erg c.g.s unit of energy

Dimensional formula of energy = $[ML^2T^{-2}]$

Energy = force × distance
$= [MLT^{-2}][L] = [ML^2T^{-2}]$
unit = kg-m²/sec²
1 Joule = 1 kg-m²/sec²
= 1000 gm × (100 cm)²/sec²
= 10^7 gm-cm²/sec²
1 Joule = 10^7 erg

∴ a = 1
b = 2
c = −2

S.I	C.G.S
M_1 = 1 kg = 1000 gm	M_2 = 1 gm
L_1 = 1 m = 100 cm	L_2 = 1 cm
T_1 = 1 sec	T_2 = 1 sec
n_1 = 1 Joule	n_2 = ? erg

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

$$\therefore n_2 = n_1\left[\frac{M_1}{M_2}\right]^a\left[\frac{L_1}{L_2}\right]^b\left[\frac{T_1}{T_2}\right]^c$$

$$= 1\left[\frac{1000}{1}\right]^1\left[\frac{100}{1}\right]^2\left[\frac{1}{1}\right]^{-2}$$

$$= 1 \times 10^3 \times 10^4 = 10^7$$

∴ **1 Jule = 10^7 erg.**

(q) Checking of correctness of equation:

(a) Check whether the following equation is dimensionally correct:

$$\frac{1}{2}mv^2 = mgh$$

Soln → $[\frac{1}{2}mv^2] = [M][LT^{-1}]^2 = [ML^2T^{-2}]$

$[mgh] = [M][LT^{-2}][L] = [ML^2T^{-2}]$

∵ g = a

∴ Dimension of LHS = Dimension of RHS

Hence the given eqn is dimensionally correct.

(b) Chec...

Wh...

(b) Check the Correctness of the equation.

$$FS = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$$

Where F is the force acting on a body of mass m and s is the distance moved by the body when its velocity changes from u to v.

Soln

$$[FS] = [MLT^{-2}][L] = [ML^2T^{-2}]$$

$$[\tfrac{1}{2}mv^2] = M[LT^{-1}]^2 = [ML^2T^{-2}]$$

$$[\tfrac{1}{2}mu^2] = M[LT^{-1}]^2 = [ML^2T^{-2}]$$

Since dimensions of all the terms in the given equation are same.

Hence the given equation is dimensionally correc

(c) Check the dimension accuracy of the eqn.

$$s = ut + \frac{1}{2}at^2$$

Soln -

$$[S] = [L]$$

$$ut = [LT^{-1}][T] = [L]$$

$$[\tfrac{1}{2}at^2] = [LT^{-2}][T^2] = [L]$$

Since all the terms in the given eqn. are same.

Hence the given eqn is dimensionally correct.

1. Units and Dimensions

Physics → Physics is the branch of science that deals with the study of basic laws of nature and their manifestation in various natural phenomena.

Physical Quantities → length, Mass, Temperature, Speed, force etc.

2 type

I Fundamental Quantities

II Derived Quantities

I Fundamental Quantities

↓ 7 types

7 types	Basic unit	Symbol
① Mass →	Kilogram	Kg
② Length →	metre	m
③ Time →	second	s
④ Electric current →	Ampere	A
⑤ Temperature →	Kelvin	K
⑥ Luminous intensity →	candela	cd
⑦ Amount of substance →	mole	mol

II Derived Quantities

Derived Quantities → All physical quantities other than the seven fundamental quantities

Example
↳ Velocity, acceleration, force, Momentum etc

System of units

↳ A complete set of units which is used to measure all kinds of fundamental and derived Quantities is called a system of units.

4 system

CGS system [Centi-Gram-Sec] system

- Length – cm
- Mass – gm
- time → sec.

F.P.S system [Foot-Pound-Sec] system

- Length – foot
- Mass – Pound
- time – sec

M.K.S System [Metre-Kilogram-Sec] system

- Length – Metre
- Mass – Kilogram
- time – sec.

SI → International system of unit.

Supplementary SI units

		unit	symbol
1.	plane angle →	radian	rad
2.	solid angle →	Steradian	sr.