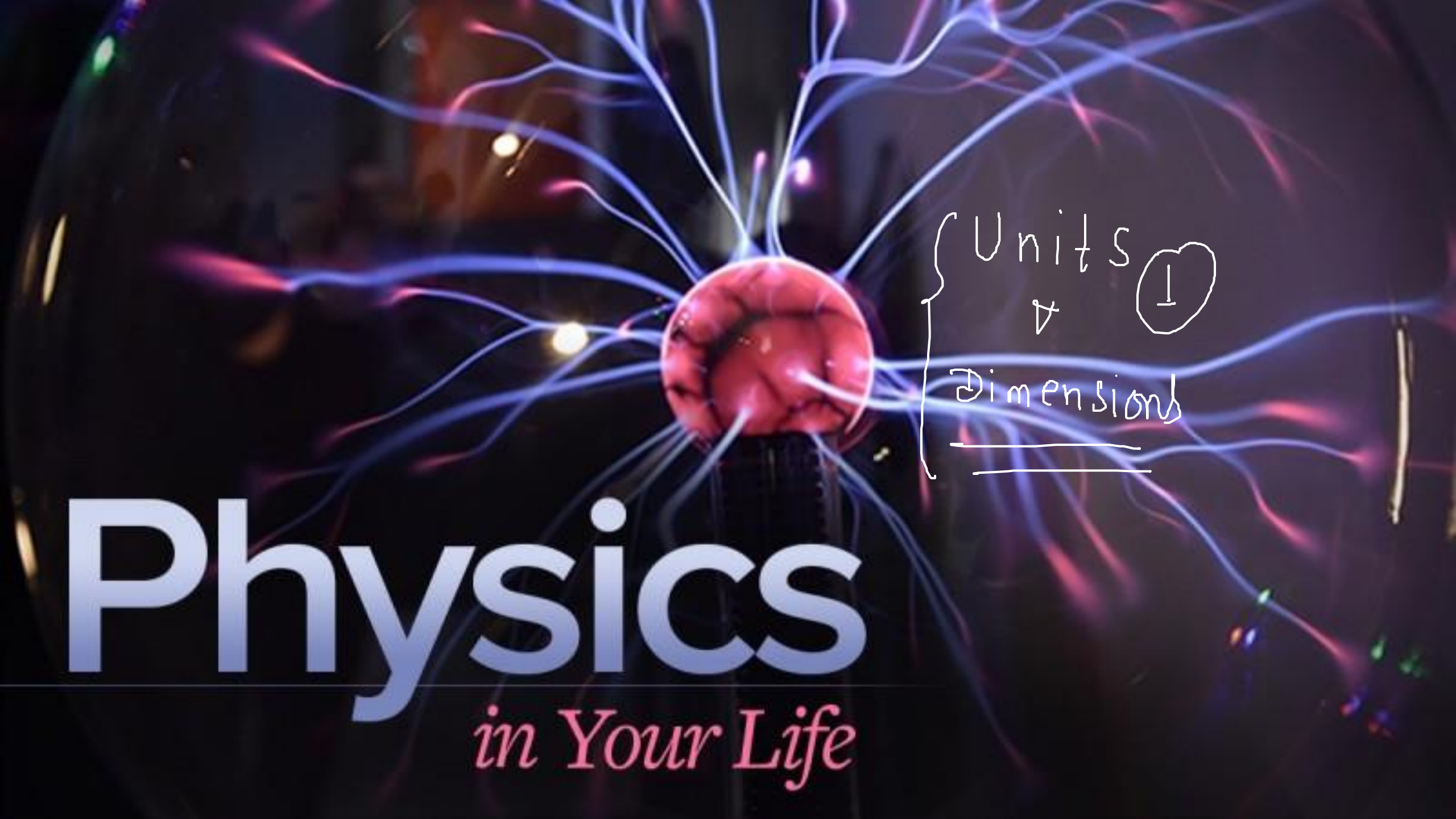




SAFALTA CLASSTM

An Initiative by **अमरउजाला**



Units ①
&
Dimensions

Physics

in Your Life

CLASS - 1

UNITS

&

DIMENSIONS

Fundamental and Derived Quantities (मौलिक और व्युत्पन्न मात्राएँ)

- The quantities that are independent of other quantities are called **fundamental quantities**.

अन्य राशियों से स्वतंत्र होने वाली राशियों को मौलिक राशियाँ कहा जाता है।

- The units that are used to measure these fundamental quantities are called **fundamental units**.

मूल मात्रक

- इन मूलभूत मात्राओं को मापने के लिए जिन इकाइयों का उपयोग किया जाता है, उन्हें मूलभूत इकाइयाँ कहा जाता है।

- There are four systems of units namely C.G.S, M.K.S, F.P.S, and SI.
C.G.S, M.K.S, F.P.S, और SI जैसी इकाइयों की चार प्रणालियाँ हैं।

- The quantities that are derived using the fundamental quantities are called **derived quantities**.

मौलिक मात्राओं का उपयोग करके जो मात्राएँ प्राप्त की जाती हैं, उन्हें व्युत्पन्न मात्राएँ कहा जाता है।

मूल मात्राक $\Rightarrow 7$

- The units that are used to measure these derived quantities are called **derived units**.

इन व्युत्पन्न मात्राओं को मापने के लिए उपयोग की जाने वाली इकाइयों को व्युत्पन्न इकाइयाँ कहा जाता है।

Fundamental Quantity	System of units		
	$\begin{matrix} \text{cm} & \text{gm} & \text{sec} \\ \uparrow & \uparrow & \uparrow \\ \text{C.G.S.} \\ \text{L M T} \end{matrix}$	$\begin{matrix} \text{m} & \text{kg} & \text{sec} \\ \uparrow & \uparrow & \uparrow \\ \text{M.K.S.} \Rightarrow \text{SI} \end{matrix}$	$\begin{matrix} \text{Foot} \\ \text{pound} & \text{Sec} \\ \uparrow & \text{---} \end{matrix}$
Length	centimeter ✓	Meter ✓	foot
Mass	gram	Kilogram	pound
Time	second	Second	second

7 FUNDAMENTAL UNITS

Physical quantity	Unit	Symbol
Length लम्बाई	Meter ✓	✓m
Mass द्रव्यमान	<u>kilogram</u>	<u>kg</u>
Time समय	<u>second</u>	<u>s</u>
<u>Electric current</u> विद्युत धारा	<u>ampere</u>	<u>A</u>
<u>Thermodynamic temperature</u> तापमान	<u>kelvin (SI)</u>	<u>K</u>
<u>Intensity of light</u> ज्योति तीव्रता	<u>candela</u>	<u>cd</u>
<u>Quantity of substance</u> पदार्थ की मात्रा	<u>mole</u>	mol

Supplementary Quantities:

⇒ Plane angle ✓✓	radian ✓	rad
⇒ Solid angle <u>ठोस</u>	steradian ✓✓	sr

DERIVED UNITS: (चयुचय-तः मीटर)

$$\text{Area} = l \times b = \underline{m} \times \underline{m}$$

$$\underline{\underline{\text{Derived}}} = \underline{\underline{m^2}} \checkmark$$

* Length :- लम्बाई :-

① Small Units:- (i) Fermi (1 Fermi = 10^{-15} m)
↳ Nucleus का Radius.

(ii) 1 Å = 10^{-10} m

(iii) 1 nm = 10^{-9} m

(Wavelength of light)

(iv) 1 μ m = 10^{-6} m, (v) 1 mm = 10^{-3} m

• Some Important Conclusions:

- Angstrom is the unit of length used to measure the wavelength of light. $1 \text{ \AA} = 10^{-10} \text{ m}$.
- Fermi is the unit of length used to measure nuclear distances. $1 \text{ Fermi} = 10^{-15} \text{ meter}$.
- A light year is the unit of length for measuring astronomical distances.
- Light year = distance traveled by light in 1 year = $9.4605 \times 10^{15} \text{ m}$.
- Astronomical unit = Mean distance between the sun and earth = $1.5 \times 10^{11} \text{ m}$.

✓ Parsec = 3.26 light years = 3.084×10^{16} m

⇒ Parsec (पारसेक) ⇒ Largest Unit.
[1 parsec = 3.08×10^{16} m]

✓ Barn is the unit of area for measuring scattering cross-section of collisions.

Imp: ① 1 Light Year = 1 year में light द्वारा चली दूरी

1 barn = 10^{-28} m².

[$c = 3 \times 10^8$ m/s] [1 LY = 9.46×10^{15} m]

✓ Chronometer and metronome are time measuring instruments. The quantity having the same unit in all the systems of units is time.

1 AU = 1 खगोलीय दूरी = Sun → earth (Avg Dist)

* 1 AU = 1.496×10^{11} m. ⇒ दूरी का मापक

* 1 parsec = 3.26 LY ✓

MACRO Prefixes

Kilo (K) 10^3 ✓

Mega (M) 10^6

Giga (G) 10^9

Tera (T) 10^{12}

Peta (P) 10^{15}

Exa (E) 10^{18}

Zetta (Z) 10^{21} ✗

Yotta (y) 10^{24} ✗

MICRO Prefixes

Milli (m) 10^{-3} ✓

(μ) 10^{-6} ✓

nano (n) 10^{-9}

pico (p) 10^{-12}

femto (f) 10^{-15} → femto

atto (a) 10^{-18} } femto

zepto (z) 10^{-21} ✗

yocto (y) 10^{-24} ✗

Mass :- (द्रव्यमान) :-

$$\begin{aligned} \text{I Chandrasekher Limit} &= 1.5 \times \text{Mass of Sun} \\ \text{I चन्द्रशेखर सीमा} &= \underline{\underline{1.5}} \times \underline{\underline{\text{सूर्य का द्रव्यमान}}} \end{aligned}$$

① Black Hole \rightarrow ✓✓

② White Dwarf \rightarrow ✓✓

** 1 Bar (1 बार) \Rightarrow Pressure (दाब) की मात्रक

CGS \Rightarrow 1 Bar = 10^6 Dyne/cm² $\left\{ \begin{array}{l} \because \text{Dyne} \rightarrow \text{Force} \\ \hookrightarrow \text{CGS} \end{array} \right\}$

* \Rightarrow 76 cm of Hg = 1.013×10^6 Dyne/cm²
(प्रति)

** 1 km/h = $\frac{5}{18}$ m/s

* 1 Dyne = 10^{-5} N

* 1 eV = 10^{-19} J

* 1 Horse Power

1 HP = 746 Watt

* 1 kWh = 3.6×10^6 J

* 1 cal = 4.2 J

Dimensions : विधि : Verification of formulas.

- **Dimensions** of a physical quantity are the powers to which the fundamental units are raised to obtain one unit of that quantity.
- भौतिक मात्रा के आयाम वे हैं, जिनके लिए मौलिक इकाइयों को उस मात्रा की एक इकाई प्राप्त करने के लिए उठाया जाता है।

① Square Bracket:- [] ✓

② Capital letter:- A, B ... ✓

** Length \rightarrow m \rightarrow [L] ✓
* MASS \rightarrow kg \rightarrow [M] ✓
* Time \rightarrow Sec \rightarrow [T]
* Temp \rightarrow K \rightarrow [K, θ] ✓
* Current \rightarrow Amp \rightarrow [A] ✓

* Lum: Intensity \rightarrow cad \rightarrow [cd]

* Amount of substance \rightarrow mol \rightarrow [mol] } X

* Area (क्षेत्रफल) \Rightarrow $A = l \times b$
 $= m \times m$
 $= [L] [L]$

Area Dim = $[L^2]$

* Volume :- आयतन \Rightarrow $V = l \times b \times h$
 $= m \times m \times m$
 $= [L] [L] [L]$
Dim = $[L^3]$

* Density: (घनत्व) :-

$$D = \frac{m}{V} = \frac{\text{द्रव्यमान}}{\text{आयतन}}$$

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

$$\underline{\underline{D = [ML^{-3}]}}$$

* Velocity / Speed:-

विज्ञा \Rightarrow ?

$$v = \frac{D}{T} = \frac{[L]}{[T]} = \underline{\underline{[LT^{-1}]}}$$

* acceleration (त्वरण):-

$$\vec{a} = \frac{dv}{dt} = \frac{[LT^{-1}]}{[T]} = \underline{\underline{[LT^{-2}]}}$$

* Force:- $F = m a$

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

* Work:- $W = F \cdot d = [MLT^{-2}] [L]$

$$\underline{\underline{W = [ML^2T^{-2}]}}$$

* Energy (ऊर्जा): Dimension = $[ML^2T^{-2}]$

* $K.E. = \frac{1}{2} \underline{m} \underline{v}^2 = \underline{[ML^2T^{-2}]}$

Potential = Kinetic

$P.E. = \underline{\underline{mgh}}$

* Work की विमा = ऊर्जा की विमा = Torque की विमा
 (Energy) = $\frac{\text{बल आघूर्ण}}{\text{दूरी}}$
 = $[ML^2 T^{-2}]$

* G = ?

$F = G \frac{m_1 m_2}{r^2}$

G की विमा = ? $G = \frac{F \cdot r^2}{m_1 m_2}$

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

* $g = ?$ Gravitational Acceleration
गुरुत्वीय त्वरण

$$\underline{\underline{[LT^{-2}]}}$$

* ϵ_0 (epsilon not) ✓ ✓ $F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$

$$\epsilon_0 = \frac{[AT] [AT]}{[MLT^{-2}] [L^2]}$$

$$\epsilon_0 = \frac{q_1 q_2}{4\pi F r^2} \Rightarrow \frac{q_1 q_2}{F r^2}$$

$$\Rightarrow \underline{\underline{[M^{-1}L^{-3}A^2]}}$$
 ✓ ✓

* Charge (ભાર):

$$Q = IT$$

$$q = \underline{i}t$$

$$= [A][T] = \underline{\underline{[AT]}}$$

⇒