* Some identities :-

$\sin^2\theta + \cos^2\theta = 1$

$\sec^2\theta - \tan^2\theta = 1$

$\mathrm{cosec}^2\theta - \cot^2\theta = 1$

$\sin(A+B) = \sin A \cos B + \cos A \sin B$

$\sin(A-B) = \sin A \cos B - \cos A \sin B$

$\cos(A+B) = \cos A \cos B - \sin A \sin B$

$\cos(A-B) = \cos A \cos B + \sin A \sin B$

$\sin 2\theta = 2\sin\theta\cos\theta$

$\cos 2\theta = \cos^2\theta - \sin^2\theta$

$\tan 2\theta = \dfrac{2\tan^2\theta}{1-\tan^2\theta}$

$\tan(A+B) = \dfrac{\tan A + \tan B}{1 - \tan A \tan B}$

* Important term in Differentiation :-

$\dfrac{dy}{dx} \rightarrow$ It mean y is changing w.r.t x.

* $y = x^n \qquad \dfrac{dy}{dx} = nx^{n-1}$

$y = u+v \cdot \dfrac{dy}{dx} = \dfrac{du}{dx} + \dfrac{dv}{dx}$

$y = uv \qquad \dfrac{dy}{dx} = u\dfrac{dv}{dx} + v\dfrac{du}{dx}$

* Differtiantion of :

$\log x = \frac{1}{x}$

$\cos x = -\sin x$
$\sin x = \cos x$
$\tan x = \sec^2 x$
$e^x = e^x$
$\cot x = -\operatorname{cosec}^2 x$
$\sec x = \sec x \cdot \tan x$
$\operatorname{cosec} x = -\operatorname{cosec} x \cdot \cot x$

Ist quadrant $\rightarrow$ All +ve
IInd quad. $\rightarrow$ sin +ve
IIIrd quad. $\rightarrow$ tan +ve
IV th quad. $\rightarrow$ Cos +ve

Function do not change at $180°$, $360°$

1) $\sin 120$
$\Rightarrow \sin(90+30)$ $\quad (\sin(90+\theta) = \cos\theta)$
$\cos 30 = \frac{\sqrt{3}}{2}$

2) $\sin(-30)$
$\Rightarrow -\sin 30° = \frac{-1}{2}$

3) $\cos 135°$
$\Rightarrow \cos(90+45)$ $\quad (\cos(90+\theta) = -\sin\theta)$
$-\sin 45° = \frac{-1}{\sqrt{2}}$

4) $\sin 210°$
$\sin(180+30)$ $\quad (\sin(180+\theta) = -\sin\theta)$
$-\sin 30° = \frac{-1}{2}$

5) $\tan 150°$
$\Rightarrow \tan(180-30°)$
$-\tan 30° = \frac{-1}{\sqrt{3}}$

(1) $y = x^6$
$\frac{dy}{dx} = 6x^{6-1} = 6x^5$

(2) $y = \frac{1}{x^3} = x^{-3}$
$\frac{dy}{dx} = -3x^{-3-1} = -3x^{-4}$

(3) $\frac{1}{\sqrt{x}} = y = \frac{1}{x^{1/2}} = x^{-1/2}$
$\frac{dy}{dx} = \frac{-1}{2}x^{\frac{-1}{2}-1} = \frac{-1}{2}x^{-3/2}$

(4) $4x^3 - 3x^2 + \frac{4}{x^2} - 3$
$\Rightarrow \frac{d(4x^3)}{dx} - \frac{d(3x^2)}{dx} + \frac{d(4)}{dx\,x^2} - \frac{d(3)}{dx}$
$\Rightarrow 4x^3 - 3x^2 + 4x^{-2} - 3$
$\Rightarrow 4\cdot3x^{3-1} - 3\cdot2x^{2-1} + 4x - 2x^{-2-1} - 0$
$\Rightarrow 12x^2 - 6x - 8x^{-3}$
$\Rightarrow 12x^2 - 6x - \frac{8}{x^3}$

(5) $5x^4 + 4x^{3/4} - 3x^2 + 2x = y$
$\frac{d(5x^4)}{dx} + \frac{d(4x^{3/4})}{dx} - \frac{d(3x^2)}{dx} + \frac{d(2x)}{dx}$
$5\cdot4x^{4-1} + \cancel{4}\cdot\frac{3}{\cancel{4}}x^{\frac{3}{4}-1} - 3\cdot2x^{2-1} + 2\cdot1x^{1-1}$
$20x^3 + 3x^{-\frac{1}{4}} - 6x + 2$
$20x^3 + \frac{3}{x^{\frac{1}{4}}} - 6x + 2$

(6) $(\underset{u}{4x+2})\ (\underset{v}{5x^2+4})$

$$\frac{dy}{dx} = (4x+2)\frac{d}{dx}(5x^2+4) + (5x^2+4)\frac{d}{dx}(4x+2)$$

$$= (4x+2)\ (5\cdot 2x^{2-1}) + (5x^2+4)(4)$$

$$= (4x+2)\ (10x) + (5x^2+4)(4)$$

$$= 40x^2 + 20x + 20x^2 + 16$$

$$= 60x^2 + 20x + 16$$

(7) $\sin 2x$

$\Rightarrow \cos 2x \cdot 2 \cdot 1 x^{1-1}$

$\Rightarrow \cos 2x \cdot 2x^0$

$\Rightarrow 2\cos 2x$

(8) $\sin^3 x$

$\Rightarrow 3(\sin x)^{3-1}$

$\Rightarrow 3\sin^2 x$

$\Rightarrow 3\sin^2 x \cdot \cos x$

(9) $\left(\frac{\sqrt{x}}{u}\right)\ \left(\frac{x^2+7}{v}\right)$

$\Rightarrow (x^{1/2})\ (x^2+7)$

$$\Rightarrow \frac{dy}{dx} = (x^{1/2})\frac{d(x^2+7)}{dx} + (x^2+7)\left(\frac{1}{2}x^{-\frac{1}{2}}\right)$$

$$\Rightarrow (\sqrt{x})\ (2x) + (x^2+7)\ \left(\frac{1}{2}\cdot\frac{1}{\sqrt{x}}\right)$$

$$\Rightarrow 2x^{3/2} + (x^2+7)\left(\frac{1}{2\sqrt{x}}\right)$$

Teacher's Signature.........

* Integration of :-

1) $\int \frac{1}{x}\cdot dx = \log x$

2) $\int \cos x \cdot dx = \sin x$

3) $\int \sin \cdot dx = -\cos x$

4) $\int \sec^2 x \cdot dx = \tan x$

5) $\int \sec x \cdot \tan x\, dx = \sec x$

6) $\int \operatorname{cosec}^2 x \cdot dx = -\cot x$

7) $\int \operatorname{cosec} x \cot x\, dx = -\operatorname{cosec} x$

8) $\int x^n dx = \frac{x^{n+1}}{n+1}$

9) $\int dx = x$

10) $\log m + \log n = \log(m+n$

1) $\int_0^{\frac{\pi}{3}} \sec x \cdot \tan x\, dx$

$\int_0^{60/2} \sec x$

$\sec 60^\circ - \sec 0^\circ$

$2-1$

1

2) $\int_2^4 x^{-1}\, dx$

$\int_2^4 \log x$

$\log^4 - \log^2$

$\log \frac{4^2}{2_1}$

$\log 2$

3) $\int_0^{30} \sin 7x \cdot dx$

$\int_0^{30} -\frac{\cos 7x}{7}$

$-\frac{\cos 210}{7} - \frac{\cos 0}{7}$

$-\frac{\sqrt{3}}{14} - \frac{1}{7}$

$\frac{-\sqrt{3}-2}{14}$

Teacher's Signature.........

(b) Length -
The distance between two points in space is called length. S.I unit of length (m)

(c) Time -
Time is what a clock reads or it is a measurement of gap b/w two successive events. S.I unit = Second.

(d) Temprature -
Temp. is the measurement of hotness, coldness of body. S.I unit ⟶ Kelvin

(e) Current -
The rate of flow of charge is called current. S.I unit of current is Ampere.

(f) Luminious Intensity -
The brightness of light is called luminious intensity. S.I unit is Candela.

(g) Quantity of matter -
The amount of matter inside a body is called quantity of matter. S.I unit is mole.

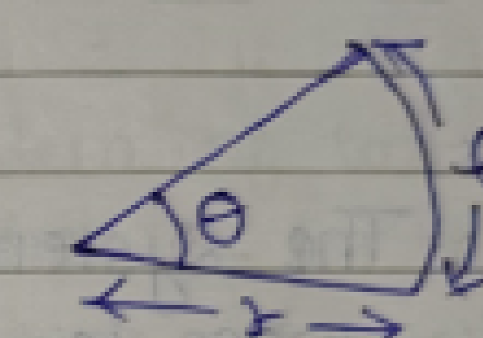
ii) Derived physical quantity -
These are those quantities which are obtained from fundamental quantity. Ex- Speed, momentum etc.

iii) Supplementary physical quantity -
There are two Supplementary quantity related to mathematics.

(a) Plane Angle -
Angle b/w two line is called plane angle. It is used in 2 dimension. (2D)

$$\theta = \frac{l}{r}$$

S.I unit is Radian.



(b) Solid angle -
It is defined for (3D). For example Angle mode at the corner of a room. It's SI unit is steradian.

$$\text{Solid angle} = \frac{\text{Surface area}}{(\text{radius})^2}$$

* Unit :-
A unit is a thing or a way in which physical quantity is measured.
For ex → Unit of mass is k.g.

Characterstics of Units -

1) It should be well defined.
2) It should be of proper size.
3) It must be eaisly provided to anyone.
4) It should not change with time, temp., pressure.
5) It should be internationally accepted.
6) It can be made eaisly again.

$F = \frac{Kq_1q_2}{r^2} \Rightarrow$ K is constant

* The decreasing order of their magnitude is given by strong nuclear force > Electrostatic > Weak nuclear force > Gravitational force.

$10^{38} : 10^{36} : 10^{25} : 1 \longleftarrow$ Order

[CHAPTER – 2]

(physical quantities)

physical quantity –

A quantity which can be measured directly or indirectly is called physical quantity. Ex → Mass.

Physical quantity can be represented on

$\theta = nu \rightarrow$ unit
$\downarrow$
Numerical value

For ex → $V = 20\,ms^{-1} \rightarrow$ unit
$\downarrow$
Numerical value.

* There are three type of physical quantity ÷

1) Fundamental physical quantity.
2) Derived physical quantity.
3) Supplementary quantity.

i) Fundamental physical quantity –

There are the basis quantities and do not depend on other quantity.

* There are 7 fundamental physical quantity –

(a) Mass – The matter contained in a body is called mass.
SI unit of Mass is Kilogram (K.g)

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Conservation laws ÷

1) Law of conservation of energy - Acc. to this law energy can neither be created nor be destroyed. It can transfer from one form of energy into another form of energy such that total energy of a system is conserved constant.

2) Law of Conservation of charge - Acc. to this law charge can neither be created nor be destroyed but it can transfer from one body to another body such that total charge of system remains conserve.

3) Law of conservation of linear momentum ÷ If external force acting on a body is zero then linear momentum remains conserve.

$$\vec{F_{ex}} = \frac{d\vec{p}}{dt}$$

If $\vec{F_{ex}} = 0$

$$\frac{d\vec{p}}{dt} = 0$$

($\vec{P}$ constant)

4) Law of conservation of angular momentum - If external torque acting on a body is zero then the angular momentum will be conserve.

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$$\vec{\tau} = \frac{d\vec{L}}{dt}$$

If $\vec{\tau} = 0$ then ($\vec{L}$ = constant)

Type of forces in nature ÷

* Gravitational force - It is a force acting b/w two mass body. It is given by Newton's law of Gravitation.

$$F = \frac{Gm_1m_2}{r^2}$$

Where G = Gravitational constant = $6.67 \times 10^{-11} \, Nm^2/kg^2$

* Strong Nuclear force - Each atom has nucleus and electron. Electron revolve around the nucleus. All proton have positive charge situated in nucleus. There is a stronger force which bound the proton and neutron inside the nucleus which is called strong nuclear force.

* Weak Nuclear force - There are some elementary particle like β-particle, Meson, positron present in the atom. The nuclear force b/w these elementary particle is called weak nuclear force. It is smaller than strong nuclear force but greater than gravitational force.

* Electrostatic force - The force b/w two charge particle is called Electrostatic force.

Teacher's Signature..........

[UNIT - 1st]

(CHAPTER - 1)

Physical World and Measurment

* Physics → Physics is the branch of science which deals with nature and natural phenomenon.

Most common five theory of physics which can explain all phenomenon :-

* Mechanics -
  The theory of motion of natural object at loss speed.

* Thermodynamics -
  The theory of heat, temp. and the behaviour of a system of large no. of particle.

* Electromagnetism :-
  The theory of electricity, magnetism and electro magnetic radiation.

* Relativity :-
  The theory of invariance in nature and the theory of motion of high speed particle.

* Quantams Mechanics -
  The theory of mechanical behaviour of sub microscopic particle.

Physics in relation to other science :-

* Physics in relation to Mathematics -
  The theory in physics make use of various mathematical concept and it has proved to be the most powerful tool in the development of physics.

* Physics in relation to Chemistry -
  The structure of atom, radioactivity, X-rays diffraction has brought about a revolution in the present century chemistry.

* Physics in relation to Biology -
  Astronomy Different type of discovery and instrument of physics help in medical science. For ex - Microscope, X-rays.

* Physics in relation to Astronomy :-
  Astronomy is the branch of science which deals with study of heavy bodies like sun, star etc. Astronomical telescope is used to see sun, star.

* Physics in relation to seismology -
  Seismology is a branch of science which is used to study about earthquake. By using physics we can study about earthquake and its effects.

Teacher's Signature........

$\omega = 2\pi\nu$

Angular velocity $\frac{\text{Angular Disp.}}{\text{time}}$ $\frac{1}{T}$ $[M^0L^0T^{-1}]$

Moment of Intertia mr^2 $m \times L^2$ $[M^1L^2T^0]$

Stress $\frac{\text{Force}}{\text{Area}} = \frac{M^1L^1T^{-2}}{L^2}$ $[M^1L^{-1}T^{-2}]$

Strain $\frac{\text{change in Dime.}}{\text{original Dim.}}$ $[M^0L^0T^0]$

Cofficient of elasticity $\frac{\text{Stress}}{\text{Strain}}$ $\frac{M^1L^{-1}T^{-2}}{M^0L^0T^0}$ $[M^1L^{-1}T^{-2}]$

Yang's modulas elastiaity ” $[M^1L^1T^{-2}]$

Bulk modulas of elasticity ” $[M^1L^1T^{-2}]$

Planks constant $E = h\nu$ $\frac{\text{Energy}}{\text{Frequency}}$ $\frac{M^1L^2T^{-2}}{t^{-1}}$ $[M^1L^2T^{-1}]$

Temp. K $[M^0L^0T^0]$

Gravitational Constant $\frac{Fr^2}{m_1m_2} = \frac{M^1L^1T^{-2} \times L^2}{M \times M}$ $[M^{-1}L^3T^{-2}]$

Charge Current x time = A x T $[M^0L^0T^1A^1]$

Potential diff. $\frac{\text{Work}}{\text{charge}} = \frac{M^1L^2T^{-2}}{AT}$ $[M^1L^2T^{-3}A^{-1}]$

Resistance $\frac{\text{Potential diff.}}{\text{Current}}$ $\frac{M^1L^2T^{-3}A^{-1}}{A} = [M^1L^2T^{-3}A^{-2}]$

Force gradient $\frac{\text{Force}}{\text{Dist.}} = \frac{M^1L^1T^{-2}}{L} = [M^1L^0T^{-2}]$

Pressure gradient $\frac{\text{Pressure}}{\text{Dist.}} = \frac{M^1L^{-1}T^{-2}}{L} = [M^1L^{-2}T^{-2}]$

Surface tension → $\frac{\text{force}}{\text{Length}} = \frac{M^1L^1T^{-2}}{L} = [M^1L^0T^{-2}]$

Reynold number — $[M^0L^0T^0]$

Poission number $\frac{\text{Lateral strain}}{\text{Longitud. strain}} = \frac{M^0L^0T^0}{M^0L^0T^0} = [M^0L^0T^0]$

Wavelength $\frac{\text{velocity}}{\text{fq}} = [M^0L^1T^0]$

* All trignometric function (cosθ, sinθ)---, numerical value (0,1,2) --- logrithm, exponential unit, angle do not have dimension formula i.e they are the dimensionless.

Classification of physical quantities on basis of dimensional formula ÷

i) Dimension variable quantity – The quantities which have dimensional formula and whose magnitude is variable are called Dimension variable quantity. Ex- Length, Force etc.

the speed of radiowave then,
Total dist. travelled by radiowave ⇒

$D+D = 2D$

Distance = Speed x time

$2D = c \times t$

$D = \frac{c \times t}{2}$

where $c = 3 \times 10^8 ms^{-1}$

iii) S.O.N.A.R Method (Sound Navigation and Ranging)

This method is used to detect the hidden rocks submarines in sea. In this method high frequencies ultrasonic wave are sent towards the object. After striking the object, ultrasonic wave reflect back.
Let 'D' be the dist. b/w source and target object 't' be the time taken by reflected wave, 'v' be the speed of ultrasonic wave then,

The total Dist. travelled by radiation = $D+D = 2D$

Dist. = Speed x Time

$2D = v \times t$

$D = \frac{v \times t}{2}$

* LASER (Light Amplification by Stimulating Emmission of Radiation)

* Dimensional formula -
It is used to represent a given quantity in terms of power of fundamental quantity.

Physical quantity	formula/unit	Dimensional F.L
Mass	kg	$[M^1L^0T^0]$
Length	m	$[M^0L^1T^0]$
Time	sec.	$[M^0L^0T^1]$
Dist./Displacement	m	$[M^0L^1T^0]$
Velocity/speed	$\frac{Dis./Disp}{time}$	$[M^0L^1T^{-1}]$
Acceleration	$\frac{velocity}{Time} = \frac{LT^{-1}}{t}$	$[M^0L^1T^{-2}]$
Area	Length x Breadth $(L \times L = L^2)$	$[M^0L^2T^0]$
Volume	$L \times B \times H$ $(L \times L \times L) = L^3$	$[M^0L^3T^0]$
Force	Mass x acceleration $kg \times ms^{-2}$	$[M^1L^1T^{-2}]$
Work/Energy	Force x Displac. $[M^1L^1T^{-2} \times L^1]$	$[M^1L^2T^{-2}]$
Power	$\frac{Work/Energy}{time}$ $\frac{M^1L^2T^{-2}}{t^1}$	$[M^1L^2T^{-3}]$
Linear momentum(p)	$m \times v$ $M \times LT^{-1}$	$[M^1L^1T^{-1}]$
Angular momentum (L)	$r \times p$ $L \times M^1L^1T^{-1}$	$[M^1L^2T^{-1}]$
Torque (τ)	$r \times f$ $L \times M^1L^1T^{-2}$	$[M^1L^2T^{-2}]$
Impulse (I)	$F_{av} \times \Delta t$ $M^1L^1T^{-2} \times T$	$[M^1L^1T^{-1}]$
Frequency (ν)	$\frac{1}{Time\ period}$ $\frac{1}{T}$	$[M^0L^0T^{-1}]$
Angular disp. (θ)	$\frac{l}{r}$ $\frac{L^1}{L^1}$	$[M^0L^0T^0]$

If 1 A.U length of arc subtend an angle of 1 sec then radius of circle will be one parsec.

as $\theta = \frac{l}{r}$ or $r = \frac{l}{\theta}$

$$r = \frac{1\ A.U}{1''} = \frac{1.496 \times 10^{11}}{1''}$$

$$1'' = \frac{1'}{60} = \frac{1^\circ}{60 \times 60} \times \frac{\pi}{180} \text{ radian}$$

$$1 \text{ Parsec} = 3.08 \times 10^{16} m.$$

* Relation b/w l.y and A.U ÷

$$1\ l.y = 9.46 \times 10^{15} m$$

$$1\ A.U = 1.5 \times 10^{11} m$$

$$\frac{1\ l.y}{1\ A.U} = \frac{9.46 \times 10^{15}}{1.5 \times 10^{11}} = 6.3 \times 10^4 m.$$

$$1\ l.y = 6.3 \times 10^4 \cancel{m}\ A.U$$

* Relation b/w ly and parsec ÷

$$\frac{1 \text{ parsec}}{1\ l.y} = \frac{3.08 \times 10^{16}}{9.46 \times 10^{15}}$$

$$= 3.26$$

* Relation b/w parsec and Astronomical unit ÷

$$\frac{1 \text{ parsec}}{1\ A.U} = \frac{3.08 \times 10^{16}}{1.5 \times 10^{11}}$$

$$= 2.05 \times 10^5$$

Methods of measurement of length ÷

There are Commonly 3 methods of measurement of length. These are indirect method.

i) Parallax method -

This method is used to find out distance b/w earth and star. The distance b/w the two point of observation is called basis. The angle b/w left and right observation is called parallax angle.

Distance of moon/star from earth

Consider earth as sphere let m be the moon and S_1 and S_2 be the star making an ϕ_1 and ϕ_2 with observation point A and B resp.

$$\text{As} \quad \theta = \frac{l}{r}$$

$$r = \frac{l}{\theta}$$

here, $\theta = \phi_1 + \phi_2$

$l = AB$

$\boxed{r = AM}$

ii) RADAR (Radio Detection and Ranging) ÷

This method is used to detect the missiles, fighter planes etc. In this method radiowave are sent to the object. After striking the object radiowav reflect back.

Let 'D' be the dis. b/w source and target object 't' be the time taken by reflected wave, 'c' be

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* System of Units -
A complete set of unit which is used to measure diff. fundamental and derived physical quantities. is called system of units.

There are three system of units :-

1) F.P.S →
The system in which length is measured in foot, mass is measured in pound and time is measured in second is called F.P.S system of units.

ii) M.K.S (S.I) →
The system in which length is measured in metre, mass is measured in kilogram, time is measured in second is called M.K.S system of unit. The system is internationally accepted.

iii) C.G.S →
The system in which length is measured in centimetre, mass is measured in gram, time is measured in second is called C.G.S system of units.

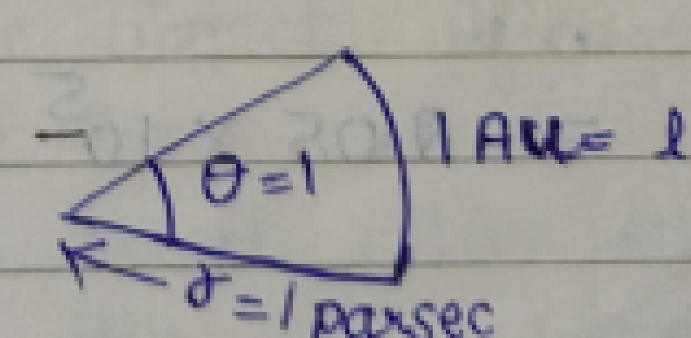
* Advantages of SI unit system -

- This system of unit is internationally accepted.
- It is a coherent system of unit because all derived quantities can be obtained by multiplying and dividing the fundamental quantities.
- It is a metric system because multiple and sub-multiple of S.I unit can be expressed in power of 10.
- We can easily change S.I units into C.G.S unit and vice-versa.
- It is an absolute system of unit such that does not depend on other.
- It is a rational system of units because it uses only one unit for given physical quantity.

* Practical units of length :-

1) Astronomical unit :-
The average distance b/w sun and earth is called Astronomical unit.
$1 A.U = 1.496 \times 10^{11} m$
$\simeq 1.5 \times 10^{11} m$.

2) Light year :-
Distance travelled by light in one year is called one light year (l.y)
Distance = Velocity × time
$= 3\times10^{8} \times 365 \times 24 \times 60 \times 60$
$= 9.46 \times 10^{15} m$.

3) Parsec -


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④ $v = \frac{K \cdot n}{r \cdot g}$ where v = velocity, n = coefficient of viscosity

r = radius, ρ = density

→ $L.H.S = v = [M^0 L^1 T^{-1}]$

$R.H.S = \frac{K \cdot n}{r \cdot \rho} = \frac{[M^1 L^{-1} T^{-1}]}{[L^1][M^1 L^{-3} T^0]}$

$= \frac{[M^1 L^{-1} T^{-1}]}{[M^1 L^{-2} T^0]}$

$= [M^0 L^1 T^{-1}]$

$L.H.S = R.H.S$

Given eqn is Correct.

⑤ A body of mass m revolving in a circle of radius 'r' with angular velocity '(ω)'. find an expression for centerpital force acting on it.

$F \propto M^a R^b w^c$

$F = K(M^a R^b W^c)$ —— ①

$[M^1 L^1 T^{-2}] = K[M^1 L^0 T^0]^a [M^0 L^1 T^0]^b \cdot [M^0 L^0 T^{-1}]^c$

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

now equating the power on both side

$a = 1, \quad b = 1, \quad c = +2$

put all value in eqn ①

$F = K M^1 L^1 W^{+2}$

⑥ The escape velocity 'v' of a planet depend upon acc. due to gravity 'g' and radius of planet 'r'.

$v \propto g^a r^b$

$v = K(g^a r^b)$ —— ①

$[M^0 L^1 T^{-1}] = K[M^0 L^1 T^{-2}]^a \cdot [L^1]^b$

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

now equating the power on both side

$2a = 1 \qquad a + b = 1$

$a = \frac{1}{2} \qquad \frac{1}{2} + b = 1$

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

Put all value in eqn ①

$v = K g^{1/2} r^{1/2}$

$v = K\sqrt{gr}$

⑦ The wavelength 'λ' associated with a particle depend upon 'm', velocity (v), planks constant (h). Show that

$\lambda \propto \frac{h}{m \cdot v}$

$\lambda \propto m^a v^b h^c$

$\lambda = K(m^a v^b h^c)$ — — ①

$[M^0 L^1 T^0] = K[M]^a \cdot [LT^{-1}]^b \cdot [M^1 L^2 T^{-1}]^c$

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

now equating power on both side

$a + c = 0$

$b + 2c = 1$

$-b - c = 0 \Rightarrow c = -b$

$b - 2b = 1$

$-b = 1$

$b = -1$

$c = 1$

$a = -1$

put all these value in eqn 1.

$\lambda = K m^{-1} v^{-1} h^1$

$\lambda = \frac{K h}{mv}$

Teacher's Signature.............

$$\nu = \frac{KT^{1/2}}{l\, m^{1/2}}$$

$$\nu = \frac{K}{l}\sqrt{\frac{T}{m}}$$

R $M^1 L^2 T^{-3} A^{-2}$

e $M L^{1} T^{3} A^{2}$

C $M^{-1} L^{-2} T^{4} A^{2}$

ε_0 $M^{-1} L^{-3} T^{4} A^{2}$

μ_0 $M L T A \longrightarrow \frac{N}{A^2}$

L,M $\to [M^1 L^2 T^{-2} A^{-2}]$

* The gravation constant (G) depend upon force (F) distance (r) and mass of body (m).

$G \propto F^a r^b m^c$

$G = K F^a r^b M^c$ — ①

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

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

now equating power of M, L, T from both side

$a+c=-1$

$a+b=3$

$\cancel{-}2a=\cancel{-}2$

$\boxed{a=1}$

$1+c=-1$

$\boxed{c=-2}$

$1+b=3$

$\boxed{b=2}$

put these value in eqn 1st

$G = KF^1 r^2 m^{-2}$

$G = \frac{KFr^2}{M^2}$

① Check the correction of the relation :-

$\tau = I\cdot\alpha$ where τ = torque, I = moment of inert

α = angular acceleration.

L.H.S $\rightarrow \tau = [M^1L^2T^{-2}]$

R.H.S $\rightarrow I\cdot\alpha = [M^1L^2T^0]\cdot[M^0L^0T^{-2}]$

$= [M^1L^2T^{-2}]$

L.H.S = R.H.S

Hence, it is correct.

② Check the correction of the relation

$\nu = \sqrt{\frac{F}{\rho}}$ where V = velocity, F = cofficent of elosticity, ρ = density

L.H.S = $\nu = [M^0L^1T^{-1}]$

R.H.S = $\frac{\sqrt{F}}{\rho} = \left[\frac{M^1L^{-1}T^{-2}}{M^1L^{-3}T^0}\right]^{1/2}$

$= [M^0L^2T^{-2}]^{1/2}$

$= [M^0L^1T^{-1}]$

L.H.S = R.H.S

Given eqn is correct.

③ $\nu = \sqrt{\frac{2G\cdot M}{R}}$ where G = Gravitational Constant

M = Mass of earth

R = Radius of earth.

L.H.S = $\nu = [M^0L^1T^{-1}]$

R.H.S = $\sqrt{\frac{2G\cdot M}{R}} = \left(\frac{[M^{-1}L^3T^{-2}]\,[M^1]}{[L^1]}\right)^{1/2}$

$= [M^0L^2T^{-2}]^{1/2}$

$= [M^0L^1T^{-1}]$

L.H.S = R.H.S

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* Time period a pendullum is given by $t = 2\pi \cdot \frac{l}{g}$
where L = Length and g = accerlation due to gravity
Taking L.H.S $= T = [M^0L^0T^{-1}]$
R.H.S
$$\Rightarrow 2\pi \cdot \frac{1}{g} = \frac{1}{LT^{-2}} = \frac{1}{T^{-2}} = T^2 = [M^0L^0T^2]$$

L.H.S $\neq$ R.H.S

The given formula is incorrect.

* To derive a formula of a given physical quantity:-

The time period (t) of a simple pendullum depend upon mass pendullum (m), length of pendullum, and acceleration due to gravity (g)

$$t \propto M^a L^b g^c$$
$$t = k\, m^a l^b g^c \quad \text{———} \circledast$$
$$[M^0L^0T^1] = [M]^a [L]^b [LT^{-2}]^c$$
$$[M^0L^0T^1] = [M^a L^{b+c} T^{-2c}]$$

now equating power of M, L, T from both side

$a = 0$
$b + c = 0$
$-2c = 1$
$c = \frac{-1}{2}$

Put value of c eqn 1
$b = \frac{1}{2}$

Put all these value in eqn $\circledast$
$$t = m^0 l^{\frac{1}{2}} g^{-1/2}$$
$$t = k \frac{l^{1/2}}{g^{1/2}}$$

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$$t = k\sqrt{\frac{l}{g}}$$
where $k = 2\pi$

* The frequency of oscillation (ν) of a string depend upon length of string (l), tension of the string (T) and mass per unit length (m). Derive a formula for frequency (ν).

$$\nu \propto l^a t^b m^c$$
$$\nu = k\, l^a t^b m^c \quad \text{——} ①$$
$$[M^0L^0T^{-1}] = [L]^a [M^1L^1T^{-2}]^b [M^1L^{-1}T^0]^c$$
$$[M^0L^0T^{-1}] = [M^{b+c} L^{a+b-c} T^{-2b}]$$

now equating power of M, L, T from both side

$b + c = 0$
$a + b - c = 0$
$-2b = -1$
$b = \frac{1}{2}$

$\frac{1}{2} + c = 0$

$c = \frac{-1}{2}$

$a + \frac{1}{2} - (-\frac{1}{2}) = 0$

$a + \frac{1}{2} + \frac{1}{2} = 0$

$a + 1 = 0$
$\boxed{a = -1}$

Put these value in eqn 1
$$\nu = k\, L^{-1} T^{\frac{1}{2}} M^{-1/2}$$

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ii) **Non-Dimensional variable Quantity** ÷

The quantities which have not dimensional formula and whose magnitude is variable are called Non-dimensional variable quantity. Ex- Angular displacement, strain.

iii) **Dimensional constant Quantity** -

The quantities which have dimensional formula and whose magnitude is constant are called dimension constant quantity.
Ex:- Plank's constant, Gravitational constant etc.

iv) **Non-Dimensional Constant quantity** -

The quantity which do not have dimensional formula and whose magnitude is constant are called Non-Dimensional constant quantity. Ex - π, 1, 2 --- etc.

Principle of Homogenety ÷

According to the principle only like quantities are added or subtracted.
For ex - Length can be added to length, speed can be added into speed.

$L + L = L$ $\quad S + S = S$ $\quad \begin{bmatrix} L = \text{Length} \\ S = \text{Speed} \end{bmatrix}$

$L - L = L$ $\quad S - S = S$

* **Application of dimensional formula** ÷

1) To check the correction of a given formula ÷

To check the correctness of a given formula write down the dimension formula of L.H.S and R.H.S of eqn.

If,
Dimension of L.H.S = Dimension of R.H.S
then given formula is correct.

* $V = u + at$

where v, u are velocity, a = acceleration, t = time

Taking L.H.S

$V = [M^0L^1T^{-1}]$

R.H.S

$u + at = [M^0L^1T^{-1}] + [M^0L^1T^{-2}][T]$
$= [M^0L^1T^{-1}] + [M^0L^1T^{-1}]$
$= [M^0L^1T^{-1}]$

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

u = velocity
a = accerlation
t = time

Taking L.H.S

$S = [M^0L^1T^0]$

R.H.S = $ut + \frac{1}{2}at^2$

$ut + \frac{1}{2}at^2 = [LT^{-1}][T] + [LT^{-2}][T^2]$
$= [LT^0] + [LT^0]$
$= [M^0L^1T^0]$

L.H.S = R.H.S

The given formula is Correct.

$V = IR$

* Propagation combination of error in addition ÷

Let a and b be the two quantities and

$X = a + b$

$\pm\Delta a$, $\pm\Delta b$ be the error in a and b respect.

$\pm\Delta x$ be the error in x.

$X \pm \Delta X = (a \pm \Delta a) + (b \pm \Delta b)$

$X \pm \Delta X = a + b \pm \Delta a \pm \Delta b$

$\cancel{X} \pm \Delta X = \cancel{X} \pm \Delta a \pm \Delta b$

$\pm \Delta X = \pm \Delta a \pm \Delta b$

There are four possiblities.

$\Delta X = \Delta a + \Delta b$

$\Delta X = -\Delta a - \Delta b$

$\Delta X = -\Delta a + \Delta b$

$\Delta X = \Delta a - \Delta b$

Maximum value will be

$\boxed{\Delta X = \Delta a + \Delta b}$

* Propagation Combination of error in Subtraction:-

Let a and b be the two quantities

$X = a - b$

$\pm\Delta a$, $\pm\Delta b$ be the error in a and b respect.

$\pm\Delta x$ be the error in X.

$X \pm \Delta X = (a \pm \Delta a) - (b \mp \Delta b)$

$X \pm \Delta X = a - b \mp \Delta a \mp \Delta b$

$\cancel{X} \pm \Delta X = \cancel{X} \mp \Delta a \mp \Delta b$

$\pm \Delta X = \mp \Delta a \mp \Delta b$

There are four possiblities

$\Delta x = \Delta a + \Delta b$

$\Delta X = \Delta a - \Delta b$

$\Delta X = -\Delta a - \Delta b$

$\Delta X = -\Delta a + \Delta b$

Maximum value will be

$\Delta X = \Delta a + \Delta b$

① The length of a rod is 11.05 ± 0.05 cm what is the length of two such rods.

Soln - Length of two rods will be - $(L) = 2L$

and $L \pm \Delta L = 2l \pm 2\Delta l$

$= (11.05 + 11.05) + (0.05 + 0.05)$

$\boxed{L \pm \Delta L = 22.10 \pm 0.10 \text{ cm}}$

② The initial temp of a body is $(10 \pm 0.5)^\circ C$ and final temp is $(80 \pm 0.3)^\circ C$ then find the increase in temp.?

Soln - Initial temp. — $(T_1 \pm \Delta T_1) = (10 \pm 0.5)^\circ C$

Final temp. — $(T_2 + \Delta T_2) = (80 \pm 0.3)^\circ C$

Increase in temp.

$T_2 - T_1 = 80 - 10 = 70$

$\Delta T_2 + \Delta T_1 = 0.5 + 0.3 = 0.8$

Total increase in temp. $= (70 \pm 0.8)^\circ C$.

③ If absolute error in q and 'r' is 0.06 and 0.01 Find absolute error in p

Given = $P = q + 3r$

Soln - $\Delta P = \Delta q + 3\Delta r$

$\Delta P = 0.06 + 3 \times 0.01$

$\Delta P = 0.06 + 0.03$

$\boxed{\Delta P = 0.09}$

[CHAPTER = 3]

[ERROR]

Error ÷

The difference between true value and measured value is called error.

Error = True value − Measured Value

For ex − Error = 2 − 1.7 = 0.3 kg error.

Types of Error ÷

1) **Systemetic error** —

The error which arise due to defect in measuring instrument or in experience of a person is called systemetic error.
These error arise due to external conditions like temp., pressure, wind velocity.

3) ~~Random~~ Gross **error ÷**

These type of error came due to carelessness or greediness.

2) **Random error ÷**

The word random means uncertain. These errors occur irregularly. The cause of these error is unknown.

Least Count —

The smallest value which can be measured by an instrument is known as least count of that instrument.
Least count error is the error which arise due to limit imposed by least count of that instrument.

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* **True value** −

True value is the accurate value of a given system.

* **Absolute error ÷**

The diff. b/w true value and average value is called absolute error.
It is represented by Δ.
For ex → Δa is the error in 'a'.

* **Mean absolute error ÷**

The average or mean of all absolute error is called mean absolute error. It is represented by $\overline{\Delta a}$, Δa_m

$$\Delta a = \frac{\Delta a_1 + \Delta a_2 + \Delta a_3 + \dots + \Delta a_n}{n}$$

* **Relative error ÷**

It is defined as the ratio of mean absolute error to the true value.

$$\text{Relative error} = \frac{\overline{\Delta a}}{a}$$

* **Percentage error ÷** Relative error × 100

$$\Rightarrow \frac{\overline{\Delta a}}{a} \times 100$$

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

$$'' = 6.67 \times 10^{-11} \left(\frac{kg}{g}\right)^{-1} \left(\frac{m}{cm}\right)^3 \left(\frac{\cancel{sec}}{\cancel{sec}}\right)^{-2}$$

$$'' = 6.67 \times 10^{-11} \left(\frac{10^3 \cancel{g}}{\cancel{g}}\right)^{-1} \left(\frac{10^2 \cancel{cm}}{\cancel{cm}}\right)^3 (1)^{-2}$$

$$'' = 6.67 \times 10^{-11} \; (10^{-3}) \; (10^6) \; (1^{-2})$$

$$'' = 6.67 \times 10^{-11} \times 10^3 \times 1^{-2}$$

$$n_2 = 6.67 \times 10^{-8}$$

$$n_1 u_1 = n_2 u_2$$

$$6.67 \times 10^{-11}\, Nm^2 kg^{-2} = 6.67 \times 10^{-8} \text{ dyne } cm^2 g^{-2}$$

To find dimension of unknown quantity:-

* $F = \dfrac{a}{b+t}$

Acc. to principle of homogenety

$$b+t = t+t$$

$$= t \; [M^0 L^0 T^1]$$

$$a = F \times (b+t)$$

$$= [M^1 L^1 T^{-2}] \; [M^0 L^0 T^1]$$

$$= [M^1 L^1 T^{-1}]$$

* $P = \dfrac{c}{t} + D \cdot t$

where P = power and t = time

Acc. to principle of homogenety $\frac{c}{t}$ and $d \cdot t$ have same dimensional formula.

$$D.F\left(\frac{c}{t}\right) = D.F(d \cdot t) = D.F(\text{power})$$

$$D.F(p) = D.F\left(\frac{c}{t}\right)$$

$$[M^1 L^2 T^{-3}] = \frac{c}{[M^0 L^0 T^1]}$$

$$[M^1 L^2 T^{-3}]\,[T^1] = c$$

$$D.F(c) = [M^1 L^2 T^1]$$

$$D.F(p) = D.F(d \cdot t)$$

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

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

$$D.F(d) = [M^1 L^2 T^{-4}]$$

* $\left(P + \dfrac{a}{V^2}\right)(V - b) = \text{Constant}$

where P = pressure , V = volume

$$P + \frac{a}{V^2} = \text{pressure}$$

$$[M^1 L^{-1} T^{-2}] = \frac{a}{V^2}$$

$$[M^1 L^{-1} T^{-2}] = \frac{a}{(L^3)^2}$$

$$[M^1 L^{-1} T^{-2}]\,[L^6] = a$$

$$D.f(a) = [M^1 L^5 T^{-2}]$$

$$V - b = \text{volume}$$

then, $b = d.f(\text{volume})$

$$b = [M^0 L^3 T^0]$$

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* Conversion of one system of unit into another system of unit ÷

Let 'Q' be the physical quantity, $n_1 u_1$ be the numerical value and unit in one system of unit. $n_2 u_2$ be the numerical value and unit in another system of unit. As

$$Q = n_1 u_1 \quad \text{Ist system}$$
$$Q = n_2 u_2 \quad 2^{nd} \text{ system}$$
$$n_1 u_1 = n_2 u_2$$
$$n_2 = \frac{n_1 u_1}{u_2}$$

$$u_1 = [M_1^a L_1^b T_1^c]$$
$$u_2 = [M_2^a L_2^b T_2^c]$$

Then, $n_2 = n_1 \left(\frac{M_1}{M_2}\right)^a \left(\frac{L_1}{L_2}\right)^b \left(\frac{T_1}{T_2}\right)^c$

* Convert one Joule into erg

$Q =$ Work | Energy

Work | Energy $= [M^1 L^2 T^{-2}]$

$a = 1$

$b = 2$

$c = -2$

1 Joule $= n_1 u_1$

$n_1 = 1$

$u_1 =$ M.K.S

$n_2 = ?$

$u_2 =$ C.G.S

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

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$$" = 1 \left(\frac{kg}{g}\right)^1 \left(\frac{m}{cm}\right)^b \left(\frac{s}{s}\right)^c$$
$$" = 1 \left(\frac{1000g}{g}\right)^1 \left(\frac{100cm}{cm}\right)^b \left(\frac{s}{s}\right)^c$$
$$" = 1 \times 1000\ (100)^2\ (1)^{-2}$$
$$" = 1 \times 10^3 \times 10^4 \times 1^{-2}$$
$$n_2 = 10^7 \text{ erg}$$

* Convert 1 dyne into Newton

Force $= [M^1 L^1 T^{-2}]$

$a = 1$

$b = 1$

$c = -2$

$u_1 =$ dyne (C.G.S) $\quad n_2 = ?$

$u_2 =$ M.K.S

$m_1 = g$, $L_1 = cm$, $T_1 = s$, $M_2 = kg$, $L_2 = m$, $T_2 = s$

$$n_2 = n_1 \left(\frac{M_1}{M_2}\right)^a \left(\frac{L_1}{L_2}\right)^b \left(\frac{T_1}{T_2}\right)^c$$
$$" = 1 \left(\frac{g}{kg}\right)^1 \left(\frac{cm}{m}\right)^1 \left(\frac{s}{s}\right)^{-2}$$
$$" = 1 \left(\frac{10^{-3}kg}{kg}\right)^1 \left(\frac{10^{-2}m}{m}\right)^1 (1)^{-2}$$
$$" = 1 \times 10^{-3} \times 10^{-2} \times 1^{-2}$$
$$n_2 = 10^{-5} \text{ Newton.}$$
$$n_1 u_1 = n_2 u_2$$
$$1 \text{ dyne} = 10^{-5} \text{ newton.}$$

* Value of universal gravitational constant $G =$ $6.67 \times 10^{-11}\ Nm^2 kg^{-2}$ into c.g.s system

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

$a = -1$

$b = 3$

$c = -2$

$n_1 = 6.67 \times 10^{-11}$

$m_1 = kg$, $L_1 = m$, $T_1 = sec$

$m_2 = g$, $L_2 = cm$, $T_2 = sec$

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* **Propagation combination of error in ~~additic~~ Multipl-**

Let a and b be the two quantities and

$$x = a\cdot b$$

$\pm\Delta a$, $\pm\Delta b$ be the error in a and b resp.
$\pm\Delta x$ be the error in x.

$$x \pm \Delta x = (a\pm\Delta a)\cdot(b\pm\Delta b)$$

$$x\left(1\pm\frac{\Delta x}{x}\right) = a\left(1\pm\frac{\Delta a}{a}\right)\cdot b\left(1\pm\frac{\Delta b}{b}\right)$$

$$x\left(1\pm\frac{\Delta x}{x}\right) = ab\left(1\pm\frac{\Delta a}{a}\right)\left(1\pm\frac{\Delta b}{b}\right)$$

$$\cancel{x}\left(1\pm\frac{\Delta x}{x}\right) = \cancel{x}\left(1+\frac{\Delta a}{a}\right)\left(1\pm\frac{\Delta b}{b}\right)$$

$$\cancel{1}\pm\frac{\Delta x}{x} = \cancel{1}\pm\frac{\Delta b}{b}\pm\frac{\Delta a}{a}+\left[\left(\pm\frac{\Delta a}{a}\right)\left(\pm\frac{\Delta b}{b}\right)\right]$$

$$\pm\frac{\Delta x}{x} = \pm\frac{\Delta a}{a}\pm\frac{\Delta b}{b}+\left[\left(\pm\frac{\Delta a}{a}\right)\left(\pm\frac{\Delta b}{b}\right)\right]$$

Here $\frac{\Delta a}{a}$, $\frac{\Delta b}{b}$ are small.

So, $\left(\pm\frac{\Delta a}{a}\right)\left(\pm\frac{\Delta b}{b}\right)$ is very very small, Thus, it is neglacted

$$\pm\frac{\Delta x}{x} = \pm\frac{\Delta a}{a}\pm\frac{\Delta b}{b}$$

$$\pm\frac{\Delta x}{x} = \pm\frac{\Delta a}{a}+\frac{\Delta b}{b},\ \frac{\Delta a}{a}-\frac{\Delta b}{b}$$

$$\frac{\Delta x}{x} = \frac{-\Delta a}{a}-\frac{\Delta b}{b},\ -\frac{\Delta a}{a}+\frac{\Delta b}{b}$$

Max. value will be

$$\left[\frac{\Delta x}{x} = \frac{\Delta a}{a}+\frac{\Delta b}{b}\right]$$

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* **Propagation combination of error in Division -**

Let a and b be the two quantities and, $x = \frac{a}{b}$

$\pm\Delta a$, $\pm\Delta b$ be the error in a and b resp.
$\pm\Delta x$ be the error in x.

$$x\pm\Delta x = \frac{a\pm\Delta a}{b\pm\Delta b}$$

$$x\left(1+\frac{\Delta x}{x}\right) = \frac{a\left(1\pm\frac{\Delta a}{a}\right)}{b\left(1+\frac{\Delta b}{b}\right)}$$

$$\cancel{x}\left(1+\frac{\Delta x}{x}\right) = \cancel{x}\frac{\left(1+\frac{\Delta a}{a}\right)}{\left(1+\frac{\Delta b}{b}\right)}$$

$$1\pm\frac{\Delta x}{x} = \left(1\pm\frac{\Delta a}{a}\right)\left(1\pm\frac{\Delta b}{b}\right)$$

$$1+\frac{\Delta x}{x} = 1+\frac{\Delta a}{a}\mp\frac{\Delta b}{b}+\left(1+\frac{\Delta b}{b}\right)\left(1+\frac{\Delta a}{a}\right)$$

but $\left(1+\frac{\Delta a}{a}\right)\left(1+\frac{\Delta b}{b}\right)$ are very small

Thus it is Neglacted.

$$\pm\frac{\Delta x}{x} = \pm\frac{\Delta a}{a}\mp\frac{\Delta b}{b}$$

Max. value will be.

$$\left[\frac{\Delta x}{x} = \frac{\Delta a}{a}+\frac{\Delta b}{b}\right]$$

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* Relative error in 'x'

$$X = \frac{a^p b^q}{c^r}$$

Then relative error in 'x' will be

$$\frac{\Delta x}{x} = p\frac{\Delta a}{a} + q\frac{\Delta b}{b} + r\frac{\Delta c}{c}$$

Percentage error will be

$$\frac{\Delta x}{x} \times 100 = \frac{p\Delta a}{a}\times 100 + q\frac{\Delta b}{b}\times 100 + r\frac{\Delta c}{c}\times 100$$

* A physical quantity is given by

$$P = \frac{a^2 b^3}{c\sqrt{d}}$$

then % error in a, b, c, d are 1%, 2%, 3% and 4% respec. Find % error in measurement of P.

Soln-

$$\frac{\Delta P}{P}\times 100 = 2\times\frac{\Delta a}{a}\times 100 + 3\frac{\Delta b}{b}\times 100 + \frac{\Delta c}{c}\times 100 + \frac{1}{2}\frac{\Delta d}{d}\times 100$$

% error in p = 2×% error + 3×per. error + 1% error + $\frac{1}{2}$% error

$= 2\times 1\% + 3\times 2\% + 1\times 3\% + \frac{1}{2}\times 4\%$

$= 13\%$

* Heat generated in a resistor is given by $H = I^2Rt$ where I is ~~error~~ current, R is resist., t is time taken. If % error in measuring I, R, t is 2%, 3%, 1% respec. Then find % error?

Soln- $H = I^2Rt$

$$\frac{\Delta H}{H} = 2\times\frac{\Delta I}{I} * \frac{\Delta R}{R} * \frac{\Delta t}{t}$$

$= 2\times\frac{\Delta I}{I}\times 100 + \frac{\Delta R}{R}\times 100 + \frac{\Delta t}{t}\times 100$

$\Rightarrow 2\times 2\% + 3\% + 1\%$

$\Rightarrow 8\%$

* What will be the % error in measuring time period of a simple pendulam of % error in length of pendulam (l) and acceleration due to gravity (g) are 2% and 4% respect. Given that $t = 2\pi\sqrt{\frac{l}{g}}$

$$\frac{\Delta t}{t}\times 100 = \frac{1}{2}\times\frac{\Delta l}{l}\times 100 + \frac{1}{2}\frac{\Delta g}{g}\times 100$$

$= \frac{1}{2}\times 2\% + \frac{1}{2}\times 4\%$

$= 1 + 2$

$= 3\%$

* If error measured in radius of a sphere is 3%. then find % error in measurement of its volm.

Soln Volm of sphere = $\frac{4}{3}\pi r^3$

$100\times\frac{\Delta V}{V} = 3\frac{\Delta r}{r}\times 100$

$= 3\times 3\%$

$= 9\%$

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* In an exp. refractive index of glass were obser. 1.45, 1.56, 1.54, 1.44, 1.54, 1.53. Calculate
1) Mean value
2) Mean absolute error
3) Relative error
4) Percentage error
Express the result in terms of absolute error and percentage error.

→ i) Mean value $= \dfrac{1.45+1.56+1.54+1.44+1.54+1.53}{6}$

$= \dfrac{9.06}{6} = 1.51$

ii) Mean absolute error –

$1.51 - 1.45 = 0.06$
$1.51 - 1.56 = 0.05$
$1.51 - 1.54 = 0.03$
$1.51 - 1.44 = 0.07$
$1.51 - 1.54 = 0.03$
$1.51 - 1.53 = 0.02$
$\overline{0.26}$

$\Rightarrow \dfrac{0.26}{6} = 0.043$

iii) Relative error → $\dfrac{\Delta a}{a}$

→ $\dfrac{0.04}{1.51} = 0.02$

iv) Percentage error $= \dfrac{\Delta a}{a} \times 100$

$= 0.02 \times 100$
$= 2\%$

$a \pm \Delta a \longrightarrow 1.51 \pm 2\%$

* Length of rod A is 3.25 ± 0.01 cm and that of B is 4.19 ± 0.01 cm. find how much rod B is larger than rod A.

→ $x \pm \Delta x = ?$
$\Delta x = \Delta a + \Delta b$
$x = a + b$
$x = a - b$
$4.19 - 3.25 = 0.94$
$\Rightarrow 0.01 + 0.01 = 0.02$
0.94 ± 0.02

* The resistance R is given by $R = \dfrac{V}{I}$, $V = 100 \pm 5$, $I = 10 \pm 0.02$ A what is % error.

→ $\dfrac{\Delta R}{R} = \dfrac{\Delta V}{V} + \dfrac{\Delta I}{I}$

$\Delta R = R\left(\dfrac{5}{100} + \dfrac{0.2}{10}\right)$

$\Delta R = 10\,(0.05 + 0.02)$

$\Delta R = 10\,(0.07)$

$\Delta R = 0.7\,\Omega$

* The mass and the volume of a body are found to be (5.00 ± 0.05) kg and $(1.00 + 0.05)\,m^3$. Find max possible % error?

* Significant figure :-

The no. of digits which are significant in a measurement are called significant figures. These include certain term and one uncertain

Rules to find out significant figures -

i) All non-zero digit are significant.
Ex- 23415 - having 5 significant figure.

ii) All zero b/w two non-zero digits are significant. Ex- 23.045 → 5 significant no.

iii) If a no. is less than 1, the zero left to the non-zero digit are not significant.
Example - 0.0099 → 2 significant (9,9)

iv) If a no. less than 1, the zero right to the non-zero digit are significant.
Example - 0.0048600 → 5 significant no. (4,8,6,0,0)

v) If a unit is not given then no. of zeros after non-zero digit will not be significant, but unit is given then no. of zero after non-zero digit will be significant.
Ex - 2341000 — 4 significant, 2431000 sec → 7 significant no.

vi) If the no. is in scientific form, then power of ten are not considered for significant fig.

Ex - 2.3×10^5 → 2 significant no. (2,3)

Rules for rounding off in measurement

1) Rule I -
If digit to be removed is less than 5 then the digit before the taken digit remain unchanged. Ex - 4.73 → 4.7 → Two significant

2) Rule II -
If digit to be removed is greater than 5, then the digit before the taken is increased by 1. Example - 4.79 → 4.8

3) Rule III -
If digit to be removed is 5 the preceding digit remain unchanged if it is even.
Ex - 3.85 → 3.8, 3.75 → 3.8

4) Rule IV -
If digit to be removed is five then preceding digit increased by 1 if it is odd.
Ex - 3.75 → 3.8.

* Rule I -

If Addition/subtraction take place, the final result should have minimum no. of decimal place, as the no. involve in addition/substraction.
Ex - 7.25, 8.3, 6.999 → 22.549
→ 22.55
$\boxed{22.6}$

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* **Rule II** -

In multiplication/Division the final result have minimum no. of significant figure or number. → 2.342 × 2.1

⇒ 4.9182

⇒ 4.918 → 4.92

⇒ 4.9

Q = 1) The mass of a box measured is 2.3 kg. Two gold peices of mass 20.15g and 20.17g are added to the box

i) What is total Mass of box?

ii) What is the diff. of mass in gold upto significan figure.

→ Total Mass = 0.02015
0.02017
+ 2.3
2.34032

V. Good
8/5/23

Teacher's Signature.........

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Chapter-1 (Motion and vector)

* **Motion** :-
A body is said to be in motion if its position changes continuosly with respect to a referance.

* **Refrance** :-
A refrence is a thing with respect to which a body is in motion or in rest. Refrence is taken for comparision.

* **Types of motion** :-
There are three types of motion.

i) **Rectilinear or Translatory motion** :-
If a body travels along a straight line then the motion is called Rectlinear motion.

ii) **Circular or Rotational motion** :-
If a body travels along a circular path, then the motion is called circular motion.
If a body moves about a fix point or line then the motion is called rotational motion.
The fix point or line is called axis.
For example- Motion of a fan.

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