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General science

physics

Electricity

Suneel Eng. Academy (SEA)

=> **Electric Current :-**

"The amount of charge flowing through a Particular area in unit time".

(or)

"It is the rate of flow of charge".

-> If a net charge 'Q' flows across any cross-section of a conductor in time t, then the current I, through the cross section is

** $I = \frac{Q}{t}$.

Q -> charge -> units -> columb (c)

t -> time -> in secs.

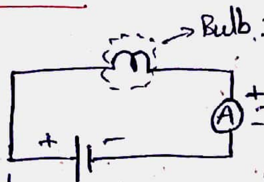
(*) SI units of current -> Ampere (Amps)

m.A. (or) μA.

-> An Instrument "Ammeter" measures electric current.

This ammeter always connected "in series" to measure current.

-> Electric current flows in a ckt,



from +ve terminal to the Bulb -> Ammeter —V-> -ve terminal.

-> current flows only when the ckt is closed.

-> for open ckt the ~~the~~ Resiance (R) ≈ ∞ . So I = 0.

-> Ideal Ammeter has zero ~~infinite~~ internal ~~parallel~~ resistance (0).

Resistance :- Resistance is nothing but which opposes the flow of current.

→ 'R' → $R = \frac{\rho l}{A}$; $R \propto l$ → length

$R \propto \frac{1}{A}$ → A → cross sectional Area

ρ → ~~conductivity~~ Resistivity

→ Resistance also depends on temperature. (T)

Temperature co-efficient of Resistance $(\alpha) = \frac{R_t - R_o}{R_o t}$ /°C

**→ For conductors, 'α' is +ve → As Temp ⇑ → R ⇑.

for Semiconductors 'α' is -ve → As Tem ⇑ → R ⇓.

→ $R = \frac{V}{I}$ (As per ohm's law) units → 1 Volt/amp (or) ohm's.

Ex:- 1) A current of 0.5 A. is drawn by a filament of an electric bulb for 10 m. then charge Q = ?

sol $I = \frac{Q}{t}$ ⇒ $Q = It$. $= 0.5A \times 600\,S = 300$ coulombs.

for Better understanding of current

⇒ We know that water constitutes water current in rivers. similarly, if electric charge flows through a conductor, we say that there is an electric current in the conductor.

*⇒ current always flows from higher potential (high 'V') to lower potential. (low V).

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Potential difference:-

→ Let us considering analogy of flow of water.

→ water in a Perfectly horizontal tube doesn't flow, in the same way charges do not flow in a copper wire by themselves.

⇒ If we connect one End of tube at higher level of tank, & at another End at lower level, then water flows from higher End to lower End. becoz of Pressure difference.

⇒ In the same way for flow of charges in a metal wire difference of Electric Pressure is required. & that is diff of Electric Pressure is called "Potential difference". (P.D)

→ This P.D produces by battery.

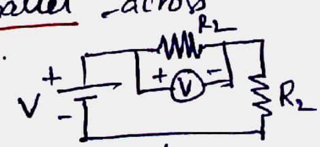
→ P.D b/w two points :-

(*) $V = \dfrac{\text{work done (W)}}{\text{charge (Q)}}$ → Joule/C. (or) Volt

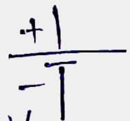
$\boxed{1\text{ volt} = 1\text{J}/\text{Coulomb}}$.

→ The P.D / also called voltage is measured by device called "voltmeter". (V)

→ This voltmeter is always connected "parallel" across which voltage we have to measured.



→ Ideal voltmeter have ~~"zero"~~ Infinite "Internal Resistance" ($R_{int} = \infty$)

⇒ dc voltage source symbol  , AC → 

→ for short ckts, $V = 0$ & I = very high.

Ex:- → How much work done in moving a charge of 2C, across two points having voltage 12V?

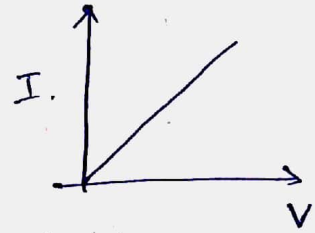
sol $V = \frac{W}{Q} \rightarrow W = V \cdot Q = 12V \times 2C = 24J$.

⇒ (*) ohm's law:- Gives the Relationship b/w 'V' & I.

A/c to ohm's law, at constant temperature

$V \propto I$.

$\frac{V}{I}$ = constant = 'R'.



(**) $\boxed{V = IR}$; $\boxed{I = V/R}$, $\boxed{R = \frac{V}{I}}$

Here we know $R = \frac{\rho l}{A}$.

ρ → Resistivity → It is property of material. → units "Ω-m."

** It depends on "nature of material"

→ Metals have low Resistivity → $10^{-8}\,\Omega$-m to $10^{-6}\,\Omega$-m.

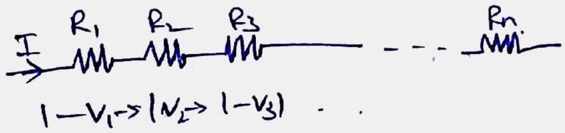
→ Insulator have high Resistivity → $10^{12}\,\Omega$-m to $10^{17}\,\Omega$-m.

→ Semiconductor b/w Metals & Insulators.

for silver → 1.6×10^{-8}

copper → 1.62×10^{-8}.

(*) Resistors in Series :



$R_{Total} = R_1 + R_2 + R_3 + \dots + R_N.$

$V_{Total} = V_1 + V_2 + V_3 + \dots + V_N.$

$I_{Total} = I$ only. [

→ In case of series, current is common through all the Resistors.

$I_{R_1} = I_{R_2} = \dots I_{R_N} = I$ only.

for '2' Resistors, $\boxed{R_T = R_1 + R_2}$ **

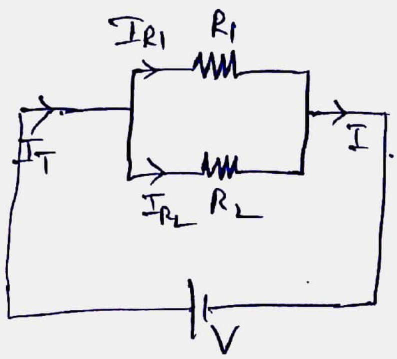
$V_T = V_1 + V_2.$

$I_{R_1} = I_{R_2} = I$ only.

| $V_1 = IR_1$
| $V_2 = IR_2.$

(*) Resistors in Parallel :-

$$\frac{1}{R_{Total}} = \frac{1}{R_1} + \frac{1}{R_2}. \Rightarrow R_{Total} = \frac{R_1 R_2}{R_1 + R_2}.$$ **



for 'n' Resistor $\frac{1}{R_{Total}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_N}$

→ Voltage is same for across all Resistors.

$V_{R_1} = V_{R_2} = V.$

$I_{Total} = I_{R_1} + I_{R_2}.$; | $I_{R_1} = \frac{V}{R_1}$
$I_{R_2} = \frac{V}{R_2}$. //.

⇒ For domestic purpose i.e house hold wirings, done "parallel arrangement"

Power (P) :- $P = V \times I$. (or) $P = IR \times I = I^2R$.

(or) $P = V \times \frac{V}{R} = \frac{V^2}{R}$.

units of Power is watts $\quad$ 1 Watt = 1 Volt × 1 Amp.

(*) **Heating Effect of Electric current (I)**

Energy supplied to the ckt by source in time 't' is

$E = P \times t$. → This Energy dissipated as Heat. so,

Heat $H = P \times t = VIt$. (or) $H = I^2Rt$ (or) $H = \frac{V^2}{R} \times t$

↳ This Energy is used in heaters.

(*) **Electrical Energy** :- Energy = Power × time

$E = P \times t$. → "units watt-hour (or) k.w.h."

→ commercially unit of Electrical Energy is "unit" → i.e kwh

$1\,kwh = 1000\,W \times hour = 1000\,W \times 3600\,sec$.

$= 3.6 \times 10^6$ watt-sec

$1\,Kwh = 3.6 \times 10^6$ Joules

Ex:- An Electric refrigerator rated 400W, operates 8 h/day. what is cost of the Energy to operate it for 30 days at 3.Rs per kwh.

sol Total Energy $= 400 \times 8 \times 30 = 96000\,wh = 96\,kwh$.

cost = 96 kwh × Rs 3.00 per kwh = 288 Rs.

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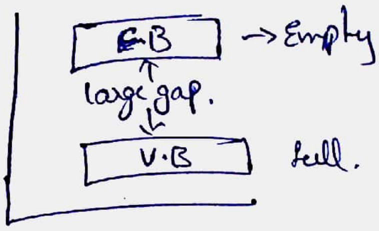
(*) conductors, semi conductors, Insulators.

=> **Insulators** :- Insulators are those in which valance Electrons are bound very tightly. So very large electric field required to remove them.

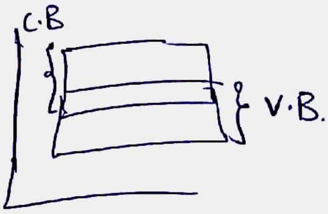


-> which does'nt allows electricity through them

-> Empty C.B (conduction Band) & full V.B. (valance Band)

-> Large Energy gap i.e several eV.

=> **Conductors** :- which allows electricity through them



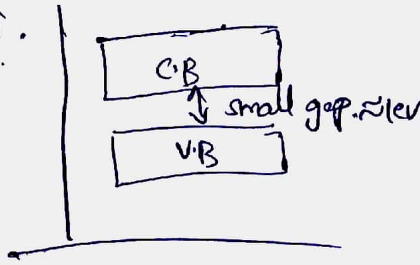
-> C.B & V.B are overlapped

-> Absence of Energy gap

-> Total current is flow of electrons only.

-> There are Positive temp co-efficient of Resistance (PTC).
i.e As temp ↑↑ -> Resistance ↑↑.

=> **Semi conductors** :-



-> Energy gap is ≈ 1 eV.

-> Partially filled V.B & partially filled C.B.

-> There are NTC. (Negative temp co-efficient of Resistance)

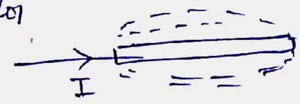
As Temperature ↑↑ -> R ↓↓ (Resistance)

Ex:- Ge, Si.
4 valance electrons.

@ SEA

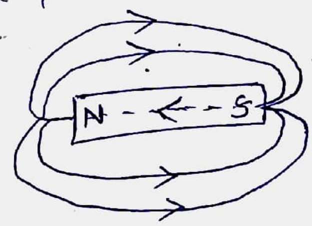
"Magnetic Effects" of Electric current

=> Whenever current passes through a conductor, magnetic field is developed around the conductors.. & that conductor behaves a magnet & this type of magnet is called "Electromagnet".



-> Electromagnets can provide strong magnetic field than permanent magnets & also can provide variable mag. field.

-> when current flows through conductor North & south poles are created.



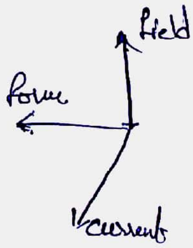
Amp (*) Magnetic lines of force (flux) flow from N -> S outside & S to N inside of bar magnet.

(*) Force on a Current carrying conductor in Mag. field :-

when a current carring conductor placed in a mag field it produces a "force". , $F = B.I.L \sin\theta$.

-> If the direction of current & magnetic field are perpendicular to each other then the force is perpendicular to both of them. It is Explained by simple rule called Fleming left hand rule.

A/c to F.L.H.R :- stretch the thumb, fore finger & Middle finger of L.H, are mutually Perpendicular



fore finger Points to ⟶ direction of field
Middle " " " ⟶ direction of current
then thumb indicates direction of Motion / force acting on conductor

(*) **Electric Motor** :- converts Electrical Energy $\longrightarrow$ Mechanical Energy

(*) **Principale** :- when a current carrying conductor placed in a magnetic field, force is developed & this force moves the motor.

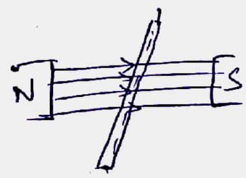
(*) **Electro magnetic Induction** :-

faradays laws :-

1st law :- When ever a conductor cuts the magnetic field an Em.f is induced in that conductor

(or)

whenever a magnetic flux linking with any ckt changes, an Emf is induced in it.



-> **2nd law** :- The magnitude of the induced emf in a coil is directly propostional to the rate of change of flux linkages.

$$e \propto \frac{d\phi}{dt}.$$

$$e = N\frac{d\phi}{dt}.$$

$$\boxed{e = -N\frac{d\phi}{dt}}$$

'-' is due to "Lenz" law.
Amp

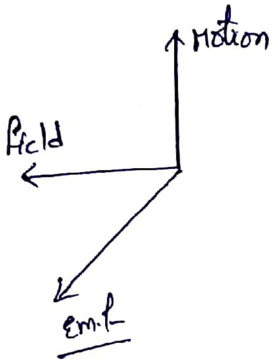
(i.e) the produced Em.f opposes the change in flux.

-> The direction of induced Em.f (current) is given by Fleming right hand rule.

The Fleming Right hand rule :-

↳ Gives direction E.m.f / current

when → stretch Thumb, fore finger & Middle finger Perpendicular to each other then



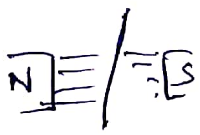
fore finger points to → direction of mag. field.

Thumb " " " → direction of Motion.

Then Middle finger gives → direction of E.m.f / current.

Electric generator :-

Based on the Faraday's laws of Electro magnetic Induction, Electric generator works.



↳ It converts mechanical Energy → Electrical Energy.

Summary :-

V.V. Amp

Generator → F. Right hand Rule → Gives E.m.f direction

Motor → F. L. H. Rule → Gives Force direction

[M.L.A)

(*) Work, Power & Energy

⇒ **Work :-** Work is said to be done by a force when it produces motion in the direction of the force.

If force (F) acting on a body moves it distance (s') in its direction then workdone $W = F \times S$. unit N-m / Jolue

$W = m a \times s$. 1 Joule = 1 N × 1 m.

→ work is scalar quantity.

(*) SI unit of work → "Joule"

⇒ **Power :-** Power is rate of doing work.

$$\text{Power} = \frac{\text{work}}{\text{time}} = \frac{F \times S}{t} = F \times V \qquad [V = S/t].$$

Power is scalar quantity.

(*) SI unit of Power → watt. ⇒ 1 watt = 1 J/sec.

Another unit of power is Horse power (HP)

$\boxed{1\ H.P = 746\ \text{watts}}$.

⇒ **Energy :-** capacity of doing work

SI unit is Joule.

→ Energy is scalar quantity.

Mechanical Energy has two forms
1) Potential Energy (P.E)
2) kinetic Energy (K.E)

⇒ **Potential Energy (P.E):-** It is the Energy is Possesed by a body by virtue of its position (or) state of strain (or) configuration

V.Imp Ex:- water stored in reservoir.

Bent bow., streched rubber → Take rubber band, Hold it one End & pull from the other. If we release it It will tend to retain back with some Energy i.e P.E.

keying a car.

$P.E = mgh$ → $m \to$ mass, $h \to$ height, $g \to$ graviation force

→ A Body at a certain hight from ground level posses P.E.

⇒ **Kinetic Energy (K.E):-**

It is the Energy possessed by a body by virtue of its motion.

V.Imp Ex:- Bullet from gun, moving car, running water etc.

(*) $K.E = \frac{1}{2}mv^2$, $m \to$ mass, $v \to$ velocity.

Relation b/w K.E & momentum (p)

$K.E = \frac{1}{2}mv^2$; $P = mv$. → $p^2 = m^2v^2$

$\frac{p^2}{m} = mv^2$.

$\frac{1}{2}\frac{p^2}{m} = \frac{1}{2}mv^2 = K.E.$

(*) $\boxed{K.E = \frac{p^2}{2m}}$

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(X) Motion

⇒ Rest & Motion :-

A Body is said to be at rest if it continuous to occupy same position for any length of time.

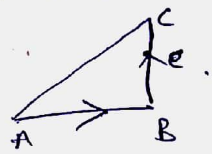
Motion is change of position with time.

⇒ Distance & Displacement.

→ Distance :- length of the path covered by body without considering direction.

→ It is scalar quantity.

→ Displacement :- The change of position of a body in a Particular direction is called "displacement"



⇒ speed & velocity :-

→ speed :- $\text{speed} = \dfrac{\text{distance}}{\text{time}}$ m/s. → SI unit

→ It is scalar quantity.

→ velocity :- $\text{velocity} = \dfrac{\text{Displacement}}{\text{Time}}$ SI unit m/s.

uniform velocity :- same direction &
covers Equal distances in Eq. interval of time.

non-uniform velocity :- The velocity said to be non-uniform

(i) If its speed changes (or)
(ii) If its direction of motion changes.
(iii) If both magnitude & direction change.

⇒ Accelaration :- Rate of change of velocity.

$$\text{Accelaration (a)} = \frac{\text{change of velocity}}{\text{time (t)}}$$

V.Amp → SI unit → m/s^2.

If initial velocity 'u', final velocity v then

$$(*)\ (a) = \frac{v-u}{t}.$$

⇒ Decelaration / Retardation :-

If the velocity increases → Accelation is +ve,

but if " decreases → " " is −ve.

→ Negative accelaration is called "decelaration"

Equations of Motion of uniformly Accelarated Body along a straight line :-

u → initial velocity at t=0.

v → final velocity after t sec.

a → uniform accelaration.

s → distance in time (t) sec.

1. $v = u + at$.

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

3. $v^2 - u^2 = 2as$.

Ex:- A train starting from rest attains a velocity of 72 km/h in 5 m. (i) a (ii) Distance travelled by train for attain this velocity.

$72\ km/h \rightarrow 72 \times \frac{5}{18} \rightarrow 20\ m/s$

sol $a = \frac{v-u}{t} = \frac{20-0}{300s} = 1/15\ m/s^2;$

$v^2 - u^2 = 2as$. so $\Rightarrow$ $u = 0$ $\Rightarrow$ $s = \frac{v^2}{2a} = \frac{(20)^2}{2 \times 1/15} = 3000\,m = 3km$.

(*) **Acceleration due to gravity** :- Denoted by 'g'.

-> force of attraction is called gravity

-> The value of 'g' is same for all bodies at same place.
but it changes from one place to another place.

-> It is maximum at the poles & Minimum at Equ.

Generally $g = 9.8\, m/s^2$.

=> The Equ of motion under gravity. $[a = g)$ & $s = h$.

1) $v = u + gt$ [

2) $h = ut + \frac{1}{2}gt^2$

3) $v^2 - u^2 = 2gh$.

=> for freely falling Body $[u = 0]$

1) $v = gt$

2) $h = \frac{1}{2}gt^2$

3) $v^2 = 2gh$.

Imp -> If the body is falling vertically downwards $g \rightarrow +ve$
upwards $g \rightarrow -ve$

-> If a Body thrown upwards then max. hight $h_{max} = \frac{u^2}{2g}$.

$v^2 - u^2 = 2gh$ $[v = 0$ & $g = -g]$

$-u^2 = -2gh$ $\Rightarrow$ $\boxed{h = \frac{u^2}{2g}}$ * V.Imp

Time of accent (t_1) → Time taken to reach highest point

Time of decent (t_2) → " " " return to the starting point from highest point

∴ Time of accent (t_1) = Time of decent (t_2) $= \sqrt{\frac{2h}{g}} = \sqrt{\frac{\cancel{2} \times \frac{u^2}{\cancel{2}g}}{g}} = \sqrt{\frac{u^2}{g^2}}$

$= \frac{u}{g}$.

∴ Time of flight $(T) = t_1 + t_2 = \frac{u}{g} + \frac{u}{g} = \frac{2u}{g}$ ✓.

v.Imp **Some Imp. points :-**

1) If a body starts from rest $u = 0$

2) If a body brought to rest $v = 0$

3) If a Body moves with uniform velocity $a = 0$.

4) ~~At~~ highest point $v = 0$.

5) If a body dropped from a certain height $u = 0$.

6) If body thrown upwards vertically $a = -g$.

7) " " " downwards " $a = g$

8) A Body when thrown up.

Times of accent = Time of decent.

9) A Body thrown upwards with a certain velocity will return to the point of projection with same velocity.

$v = u$. ✓

(*) Laws of Motion & force :-

1. Newton's first law of motion :-

" Every body maintains its initial state of rest or motion with uniform speed on a straight line unless an external force acts on it.

AMP → It is also called "law of inertia"

Inertia :- It is the property of a body by virtue of which the body opposes change in its initial state of rest (or) motion with uniform speed on a straight line.

→ If a body is at rest it tends to remain at rest.
If it is moving it tends to keep moving.

Ex :- V.AMP

1. when a bus/train starts suddenly, the passenger bends backward.
2. When a running horse stops suddenly, the rider bends forward.
3. when a blanket/coat is beaten by a stick, the dust particles are removed.

⇒ 1st law gives the definition of force :- and force is External cause which changes the initial state of rest / Motion of body.

⇒ Newton's 2nd law of Motion:-

The rate of change in momentum of a body is directly proportional to the applied force.

→ Momentum:- 'p' → p = mass x velocity , change in momentum = $P_2 - P_1$

$= mv - mu$

$= m(v-u)$

$$F \propto \frac{m(v-u)}{t}$$

$F \cancel{=} k.m.a$ [k=1]

$$\boxed{F = ma}$$

m → mass
a → acceleration.

units → $kg.m/s^2$ (or) N.

→ 2nd law gives magnitude of force

~~Ex~~ → force is proportinal to the Mass & acceleration.

Ex:- 1) We can easily move Empty basket than loaded basket coz loaded basket has higher mass.

2) If we apply same force on, football & same size of stone, then foot ball has high accelaration & stone has very less accelation. & It may chance no moment of stone.

3) for getting same accelaration, we have to apply heavy force on stone than foot ball.

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⇒ Newtons 3rd law of Motion :-

"To Every action, there is an Equal & opposite reaction.

$F_1 = -F_2$.

(*) Ex:- 1) Recoil of a gun

2) Motion of rocket

3) Swimming [→ water ~~throw~~ backward. → swimmer move forward]

4) Sailor Jumps out a rowing boat. [sailor → in ~~back war~~ forward) boat → in backward.

(*) Gravitation

⇒ Gravitation:- Every body attracts other body by a force called force of gravitation.

→ Ex:- fall of apple from tree. due to graviatation of earth.

→ An object when thrown upwards, reaches a certain height & then falls down ~~falls~~ wards due to gravitation.

⇒ Newton's law of Gravitation :-

The force of gravitational attraction b/w two bodies is directly proportional to the product of their masses & inversely proportional to the square of distance b/w them.

consider two bodies of masses m_1, m_2 placed a distance 'd'.

Then force $F \propto \frac{m_1 m_2}{d^2}$; $F = G . \frac{m_1 m_2}{d^2}$

G → universal gravitation constant. $G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

→ Mass of Earth → 6×10^{24} kg.

Moon → 7.4×10^{22} kg.

distance b/w Earth & Moon $r = 3.84 \times 10^{8}$ m.

then force exerted by the earth on the moon $= 2.02 \times 10^{20}$ N.

→ weight of an object on the Moon:–

$$\frac{\text{weight of the object on the moon}}{\text{'' '' '' Earth}} = \frac{1}{6}.$$

$W_{moon} = \frac{1}{6} \times W_{earth}$; If a Man weight at Earth = 60kg.

then $W_{Moon} = \frac{1}{6} \times 60kg = 10kg$ only.

→ weight of object on Moon lesser than ~~at~~ Earth becoz of Mass of the moon is less then Earth.

g → gravity :– The gravitional force of earth is called gravity.

g → Acceleration due to gravity → denoted by 'g'.

$g = 9.8 m/s^2$.

→ It is independant of shape, size, mass of body.

& It changs with place i.e height or depth.

→ g value decreas with high / depth from Earth surface

→ g is Max at poles & Min at Equator.

→ $\downarrow g \propto \frac{1}{\text{angular speed of Earth} \uparrow}$

(*) Weight of a body in a lift :-

→ 1) If lift is stationary / moving with uniform speed :

weight of body = true weight of body.

→ 2) If lift is going up with accelaration.

weight of body > true weight

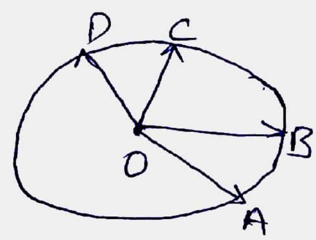
→ 3) If lift is going down with accelaration.

weight of body < true weight.

4) If the cord of lift is broken, it falls freely. In this situation weight of body in lift ≈ zero (0).

(*) kepler laws of planetary motion :-

1. All the planets move around the sun in Elliptical orbits, with the sun being at rest at ~~the~~ one focus of the ~~Earth~~ orbit



2. The line joining the planet and the sun sweep Equal areas in equal intervals of time.

ie Time of travel from A to B is same as time of travel from C to D.

(ie) velocity of planet around the sun is constant.

consequence of this law is that the speed of planet increases when plant is closer to the sun & decreases when the planet is far away from sun.

planet near to the sun have higher speed than planet far from the sun.
[less time to ratate)
[higher time].

3) Square of the period of revolution of planet around sun is directly proportion to the cube of mean distance of planet from the sun.

$$T^2 \propto r^3.$$

→ Near planet to sun has smaller period of revolution

Ex:- Nearest plant Mercury → Time period → 88 days

→ farthest planet Pluto → time period → have 247.7 years.

↓ has larger period of revolution.

(*) Waves & Sound

→ A wave is a disturbance which propogates energy from one place to other place without the transport of matter.

→ Waves are two types.

1) Mechanical Wave:- The waves which require material medium (solid, liquid, gas.) for their propagation are called Mechanical waves.

These are '2' types.

(i) Longitudinal wave:-

→ All the particles vibrate "parallel to" the direction of propogation of wave

→ In this compressions & rarefractions are formed.

→ The distance b/w '2' successive compressions / rarefractions is equal to wavelength.

Imp.
Ex:- waves on springs / sounds waves in air.

(ii) Transverse waves:-

→ All the particles vibrate "perpendicular" to the direction of propogation of wave

→ In this wave crests and troughs are formed. & distance b/w 2 successive crests (or) troughs is equal to 'λ'. wavelength.

→ At any time the arrangement of particles resembles sine wave

V.Imp Ex:- waves along stretched string, ~~light waves~~, waves on the surface of water.

2) Non- Mechanical / Electromagnetic waves:-

↳ These are waves do not require medium for propagation.

(i.e)

They can propogate through vaccum also.

Ex:- Light, heat are examples.

→ Wave length of Electromagnetic waves is 10^{-14}m to 10^{4}m.

Properties :-

→ They propegate as transverse wave → so light propogate as transverse wave

→ They are neutral.

→ They propogate with the velocity of light.

Ex:- Imp. Electromagnetic waves ⇒ γ, Rays, X-Rays, Ultraviolet rays Infrared rays.

→ NON - electromagnetic waves :- cathode rays, α rays, β rays, ultrasonic waves.

→ Micro wave rays wave length is 10^{-3}m to 10^{-2}m.

↳ used in ovens.

Wave Motion in Medium:- ~~In~~ solids & liquids, can transmit both Transvese & longitudunal waves. but gases can transmit only logitudunal waves.

Main applications of ultrasonic

-> Measuring the depth of sea
-> sterlizing liquid.
-> cleaning cloths, aeroplanes etc...
-> To Detect tumors in human body, & treatment of cancer.

Noise :- Noise is sound that is unwanted, unpleasant & which cause discomfort. -> It is measured in dB.

~~Measurement of Noise / unit of sound.~~

~~-> Intensity of sound is measured in decibel (dB).~~

~~$1\,dB = \frac{1}{10^{th}}$ of bel.~~

~~-> Max intensity can be bare without pain is 120dB.~~

=> Intensity :- Intensity (I) is the power of the sound passing through unit area.

** $(I) \propto A^2$ (Amplitude)^2

$I \propto \frac{1}{d^2}$ (distance of point from source)^2

units are watt/m^2 (or) DB. [$1\,dB = \frac{1}{10^{th}}$ of bel].

Min. audible intensity $= 10^{-12}$ watt/m^2 (or) '0' dB.

-> Max intensity can bare without pain = 120 dB.

So sound wave in air/gas is longitudinal type.

=> The velocity of wave = frequency x wave length

$(v) = n\lambda$.

Sound / sound waves

=> Sound waves are longitudinal mechanical waves.

=> Sound is produced by a vibrating body

=> Sound waves are divided into '3' categories..

(*) 1. Audible sound waves

↳ frequency lie b/w 20 Hz to 20 kHz (20,000 Hz)

-> These are sensitive to human ear.

(*) 2. Infrasonic waves :-

↳ $f < 20\,Hz$.

Ex:- produced by sources of bigger size. such as

Earth quakes, ocean waves. ..

(*) 3. Ultrasonic waves :-

↳ $f > 20,000$ (Hz) (20 kHz)

-> Human ear can't detect but, certain creatures Ex.

dog, bat, mosquito can detect.

-> Bat not only detect but also produce ultrasonic waves.

-> They can be produced by quartz crystals, Galton whistle,

Hartman's Generators.

(*) **Echo** :- The sound waves recieved after being reflected from a hillsides / Mountains (or) building / borders of forest is called echo.

-> To hear echo, the Min. distance b/w person & reflector should be 16.6 m ($\approx$ 17m) -> due to refraction, sound is heared at longer distances in night than a day.

(*) -> Persistance of ear is 1/10 sec.
↳ (Effect of sound on ear)

Applications of echo's :-
1) Echo sounder -> used to find the depth of the sea beneath the ship
2) Sonar -> " " locating under water objects.
3) Radar -> (Radio detection & Ranging) -> to detect the ships, air craft.

(*) **Beats** :- when two progressive sound waves of nearly equal frequencies (n_1, n_2) travelling in same direction combine, beats are produced.

combined freq -> $\frac{n_1+n_2}{2}$. 

Due to these, the loudness of the sound alternatively increases / decreases.

If n_1, n_2 are the freq. of the sound producing beats,

the no. of beats per sec = $n_1 \sim n_2$.
(beat freq).

& one Max & one Min sound constitute a beat.

-> A Person can perceive 10 beats / sec.

(*) **Loudness:-** It depends upon intensity of sound & sensitivity of ear. units → dB. and another unit is phon.

pitch:- characteristic of sound. depends on frequency. & increases with frequency.

(*) **speed of sound:-**

speed of sound is different in diff. mediums. It depends upon Elasticity & density of medium.

→ Maximum in solids & Min in gases, speed → solid > liquid > ga

→ speed of sound is independant of freq.

Effect of pressure:- speed of sound is independant of pressure.

Effect of Temp:- speed of sound is increases with increase in temp. Temp↑ → speed ↑ → ↑Temp

At temp ↑ → 1°C → speed of sound increases by 0.61 m/s.

Effect of humidity:-

speed of sound is more in humid air than dry air. becoz density of humid air < density of dry air.

(*) **Doppler Effect**:- The Apparant change observed in the sound, Produced by a source, due to the relative motion b/w the observer & source is called Doppler's effect.

(i.e) When the distance b/w source & observer ⇓ (decrease) the apparant freq ⇑. vice versa

Ex:- 1) When a train aproaching the platform whistling sound of certain frequency, then the listener who is at plot form. hears a sound of higher frequency. [coz distance ⇓ → f ⇑]

• when moving away from the plot form the listner hears low freq. sound (coz distance ⇑ → f ⇓).

V.Imp **Applications** →

1) Used in accurate navigation of air craft
2) Accurate target bombing
3) Used to measure the automobile speeds by traffic police.
4) Used to measure velocity of stars with r. to Earth

⇒ speed of sound is << speed of light.

⇒ Super sonic plane fly with speed > speed of sound.

⇒ The Effect of Multiple reflection is called Reverberation

⇒ Dead room is the room which has zero Reverberation

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Pressure

Sunil Eng. Academy

(*) **Pressure:-** The force acting on a unit area of a surface is called Pressure.

$$\text{pressure } (P) = \frac{\text{Force } (F)}{\text{unit Area } (A)} \rightarrow N/m^2 \text{ (or) pascal}$$

→ Pressure is scalar quantity.

V. Imp $P \propto \frac{1}{A}$ (Area of contact)

→ As Area of contant increases ⇑ → Pressure is ⇓

→ smaller the Area, larger the Pressure. for same force.

Ex:- Why Porters place a round peice of cloth on their heads, when they carry heavy loads? : By doing this they increases the area of contanct of load. (⇑) → pressure on their head reduced.

⇒ **Pressure Exerted by liquids & Gases:-**

Liquids & Gases exert pressure, on the walls of their containers.

Ex:- leaks in a pipe → Exam → air filled Balloons

Pressure in liquid:- Force excerted on unit area of wall or base of the container by the molecules of the liquid is, Pressure of liquid.

$P = hdg$ → h- depth of the point from surface
→ d- density

⇒ In a static liquid at same horizontal level, pressure is same at all points

⇒ Pressure at a point has same value in all directions.

⇒ Pressure at a point in liquid $\propto$ Depth of the point from the surface & density of the liquid.

__pascal law for pressure of liquid:-__

⇒ If gravitational attraction is negligible, in equilibrium condition, pressure is same at all points in a liquid.

⇒ If an External pressure is applied to an Enclosed fluid, it is transmitted to Every direction.

__Ex:-__ Hydrolic lift, Hydrolic brake work on pascal law.

Effect of Pressure on Melting point (M.P) & Boiling (Point) (B.P)

1) The M.P of substances, which expands on fusion, increase with increase in pressure Ex:-> wax.

2) The M.P of substances, which contacts on fusion, decreases with increase in Pressure. Ex:- ice

3) B.P. of all the substances, increase, with increase in Pressure.

Atmospheric Pressure:-

→ we know that The envolop of air is Atmosphere.

⇒ The pressure excerted by there atmospher air (or) Air around is called "Atmospheric Pressure"

(or)

The pressure which is exerted by a Mercury column of 76 c.m length at $0^\circ C$ at 45° latitude at the sea-level

⇒ It is equal to weight of 76c.m [760mm] column of Mercury of Area $1 c.m^2$.

⇒ (*) Genually it is measured in bar..

$$1 \text{ bar} = 10^5 N/M^2.$$

$1 \text{ pas} = 1 N/m^2$

$$1 \text{ atm unit} = 1013 \text{ m.bars.}$$
$$= 1.01 \text{ bars.}$$
$$= 1.01 \times 10^5 N/m^2 = 101 \times 10^3 N/M^2 = 101 \times 10^3 \text{ pascal}$$
$$= 101 \text{ K.Pa}.$$
$$= 760. \text{ mm Hg}.$$
$$= 760 \text{ torr}.$$

[1 torr = 1mm. Hg].

⇒ Atmospheric pressure some times called as Barometric pressure.

⇒ Measured by barometer. → with the help of this barometer We can forecast weather. → weather fore cast Made by this barometer.

⇒ Atmospheric pressure decreases with altitude (height from Earth surface.

So Thats why the fountain pen of a passenger leaks in aeroplane at flight.

→ It is difficult to cook on the mountain.

Vimp Indications of barometer

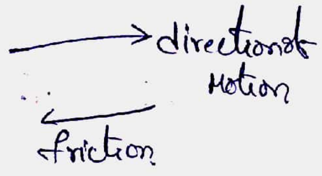
→ Sudden fall in barometric reading is indication of storm

→ slow " " " " " " of rain

→ slow rise " " " " " " " clear weather

(*) Friction

=> The force, which act opposite to the direction of motion is called friction.



=> Friction opposes the relative Motion b/w two surfaces.

=> Friction depends upon the nature of the two surfaces of the bodies in contact.

=> Examples of friction in daily life:-

-> We will not able to walk on the smooth wet floor, becoz of the absence of friction but we can walk on a road / rough surface due to this friction.

-> If there is no friction, we can't drive any vehicles. becoz breakes cannot work without friction.

=> Friction is caused by the irregularities on the two surfaces in contact.

=> Increasing & Decreasing friction:-

=> If we Make the surface More rough / irregular then friction is increases.

-> ex:- soles of shoes & Tyres of vehicles surfaces Made with irregular to increase friction

=> To decrease the friction we have to make surfaces smooth. / By polishing surfaces.

~~Ex~~ We can also Reduce the friction, by the substances called lubricants. ex:- greece, oil.

-> By using these we can reduce the friction

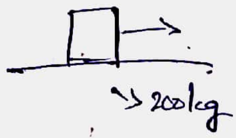
Ans -> friction can never be entirely eleminated. No surface is perfectly smooth. Some irregularities are always present.

(*) Types of friction:-

1. static friction

Force of friction which keeps a body stationary (or) static against an applied force is called static friction.

=> If The applied / pulling force is increased beyond the certain value, then body Just begins to move, that Max. value of friction is called limiting friction



II) Dynamic friction / kinetic friction | sliding friction:

-> The frictional force which comes into play after the motion has started is called kinetic friction.

III Rolling friction:- When a body rolls over the surface of another body, the resistance to its motion is called rolling friction.
(opposition)

This Rolling friction is very less than the sliding friction.

Ex:- Luggage bag with wheels have less friction than without wheels.

⇒ Laws of static friction / limiting friction.

1. The Mag. of static (liming) friction depends upon the nature of surfaces in contact. i.e. Nature of materials, surface finish, lubrication of surfaces.

2. The force of frigtion is tangential (or) parallel) to the surfaces in contact.

3. It is independant of the area & shap of the surfaces in contactact

4. The value $F_s \propto$ Normal reaction (R)
↳ force exerted by the surface against the body.

$F_s = \mu_s R$.
↳ co.efficient of static friction

$$\boxed{\mu_s = \frac{F_s}{R}}$$

⇒ Law of kinetic Friction

→ kinetic friction is independant of velocity.

→ $F_k \propto R$; $F_k = \mu_k R$. μ_k → co.efficient of kinetic friction.

$$\boxed{\mu_k = \frac{F_k}{R}}$$

V.Ao Methods of Reducing friction

1. Polishing.
2. Lubricants
3. Ball Bearings.
4. Anti friction metals → ex:- steel
5. streamlining :- friction due to air reduced by giving suitable shape to automobile & aeroplanes.

(*) Surface Tension

=> It is the property of a liquid by virtue of which it has the tendency to have the Area of its free surface Minimum as it results the liquid becoming spherical.

=> It is the surface force tends to make the area of the surface Minimum, resulting in the liquid becoming spherical.

Common observation :- Rain drop falling on to the ground is spherical
↳ We know that, for a given volume, a sphere has Minimum Area of surface.

=> Denoted by T,

T is Ratio of tangential force to the length of 'l' along which it acts.

$T = \frac{F}{l} \rightarrow$ N/M.

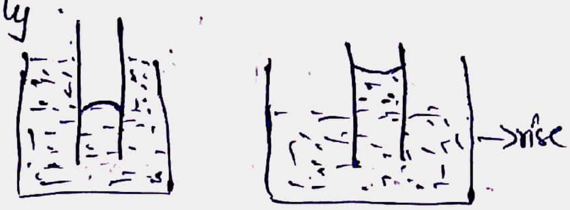
F → ~~At~~ Perpendicular to the line AB.
↳ tangential to the surface

=> cohesion / cohesive force :-
Force of attraction b/w molecules of the same substance of.

Adhesion :- force of attraction b/w molecules of the diff. substances

=> Surface Tension of a liquid decreases with the increase in temperature & Becomes zero at critical temperature.

Capillarity:- The phenomoneon of rise / fall of liquid in capillarity tube due to surface tension when it is dipped vertically into a liquid is called capillarity.



Capillarity tube :- Tube having very narrow & uniform bore is called capillarity tube.

=> The height of liquid rise / fall in a capillary tube depends upon the radius of tube.

=> Capillarity depends on the nature of liquid.

Ex:- If a capillary tube is dipped in water, water rises in the tube, & shape of water meniscus is concave.

=> If a capillary tube is dipped in Mercury, Mercury fall in the tube & shape of mercury menisus is convex.

VIMP **Ex:-** => Root of haire of plants draws water from the soil.

=> Kirosine stove working

Expression of Surface Tension Based on Capillarity

$$T = \frac{\left(h+\frac{r}{3}\right) rdg}{2\cos\theta}$$

If $\frac{r}{3} < h$ then

$$T = \frac{rhdg}{2\cos\theta}$$

d - density.

r -> radius of capillar tube
h -> height
θ -> angle of contact.

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For water their angle of contact is $\theta = 0$, $\cos 0 = 1$

$$T = \frac{rhdg}{2} \ N/M.$$

⇒ Effect of impurities

-> Surface Tension of the liquid is lowered by the Presence of impurities

⇒ Viscosity :- It is the property of liquid ; It opposes the Relative motion b/w the different layers of liquid/gases.

-> Viscosity of liquid is due to cohesive force b/w Molecules

-> " " Gases is due to diffusion of its molecules.

-> Viscosity of Gases << liquids.

⇒ No viscosity in solids.

⇒ Viscosity of ideal fluid is zero.

Imp ⇒ liquids :- Temp ⇑ -> viscosity ⇓.

Gases :- Temp ⇑ -> viscosity ⇑.

-> co-efficient of viscosity $\eta = \dfrac{F/A}{\frac{dv}{dx}}$ -> velocity gradients.

C.G.S unit -> poise.

SI unit -> poiseuille ($N\text{-}s/m^2$ (or) pascal second)

↳ 1 poiseuille = 1 pascal second..

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(*) Examples :- The force of viscosity of water (air) opposes the motion of ships / (aeroplanes)

=> Due to viscosity of air, rain drops fall with less uniform velocity.

-> Due to viscosity high waves on sea are subsided.

=> Applications :-

=> Essential in the designs of ships, aeroplanes, motor cars.

=> The quality of fountain pen ink depends on its viscosity.

=> Character of Lubricants oil based on viscosity.

(*) Elasticity:-

The Property of a material body to regain its original condition (shape & size) on the removal of the deforming forces is called Elasticity.

⇒ When deforming forces are removed, the body tends to recover to its original condition.

⇒ Prefectly Elastic bodies:- Bodies which can recover completely thier original condition, on the removal of the deforming forces are said to be P.E. Bodies.

Ex:- Rubber, quartz, metals etc..

⇒ plastic Bodies:- Bodies which dont show any tendency to recover the original condition are plastic bodies.

Ex:- putty, wet clay; wax, chewing gum.

⇒ stress:- The restoring / Recovering force per unit Area set up inside the body.

force which acts to recover its original position.
↓
opposite direction to deforming force.

$$\text{stress} := \frac{\text{restoring force}}{\text{Area}} = \frac{F}{A}$$

C.G.S → dyne/c.m²

S.I units → pascals. / N/M²

strain:- The relative change in dimension / shape of body is called strain.

** ⇒ It has no units. → V.Imp

Elastic limit :- Max stress upto which the body exhibits the property of elasticity.

Hooke's law :- A/c to this law.

stress $\propto$ strain within the Elastic limit.

$\hookrightarrow \dfrac{\text{stress}}{\text{strain}} = \text{constant} = E.$ $\hookrightarrow$ co-effecient of Elasticity (or) Modulus

Modulus of Elasticity :- (E).

3 Types.

1) young's Modulus (Y) :- $Y = \dfrac{\text{Longuitudinal stress}}{\text{Longuitudinal strain}}$

Applied force is ⊥lar to Area of x-section.

L. stress $= \dfrac{F}{A}$, L. strain $= \dfrac{dL}{L}$.

2) Bulk Modulus :- $K = \dfrac{\text{volume stress}}{\text{volume strain}} = \dfrac{F/A}{dv/v}$.

Pressure in side a closed vessel.

$\dfrac{1}{K} \rightarrow$ compressibility.

3) Rigidity Modulus (η) :- $\eta = \dfrac{\text{tangential stress (shearing)}}{\text{shearing strain}}$

volume is not changed & shape changed

$= \dfrac{F/A}{\theta}.$

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=> **Units & Dimensions :-**

Unit :- The quantity used as the standard of measurement is called unit.

System of units :- There are '4' system of units.

1) **F.P.S system :-** In this the unit of

Length → foot
Mass → Pound
Time → Second.

[F P S]

2) **C.G.S system :-** In this the unit of

length → Centimeter
Mass → Gram.
Time → Second.

3) **M.K.S System :-**

Length → metre
Mass → kilo gram
Time → Second.

4) **International system of units :- (SI) :-** In this system there are 7 base units & 2 supplementary units.

⇒ 7 - base units.

S. NO	Quantity	Name of unit	symbol.
1.	Length	Metre	m
2.	Mass	kilogram	kg
3.	Time	Second	s
4.	Electric current	Ampere	A
5.	Thermodinemic temp.	kelvin.	K
6.	Luminous Intensity	candela	cd
7.	Amount of substane	Mole	mol.

2 - Supplemantary units

1.	plane angle	radian	rad
2.	Solid angle	steradian	sr.

Fundamental & Derived units

↳ The unit of length, mass & time, etc.. are called fundamental units. & These are independant of each other.

All the other units can be derived from fundamental units are called Derived units.

Ex:- Velocity → m/s.

Accelaration → m/s^2.

Dimensions:- Every physical quantity canbe expressed in terms of fundamental quantities.

length	L
Mass	M
Time	T
Electric current	I
Temperature	K
Luminous intensity	C

Ex:- Velocity $= \dfrac{\text{distance}}{\text{time}} = \dfrac{m}{s} = \dfrac{L}{T} = LT^{-1}$.

Force $= M \times a = MLT^{-2}$. $a \to \dfrac{dv}{dt} \to m/s^2 \to L/T^2$

Area $=$ length x bredth $= L \times L = M^0 L^2 T^0$.

Work / Energy $=$ Force x distane $= MLT^{-2} \times L$

$= ML^2T^{-2}$

Power $= \dfrac{\text{work}}{\text{time}} = \dfrac{ML^2T^{-2}}{T} = ML^2T^{-3}$.

$Q = I.T$

$\Rightarrow$ For Electric Potential $\rightarrow \frac{\text{work}}{\text{charge}} = \frac{ML^2T^{-2}}{I.T} = ML^2T^{-3}I^{-1}$

Resistane $R = \frac{V}{I} = \frac{ML^2T^{-3}I^{-1}}{I} = ML^2T^{-3}I^{-2}$.

$\Rightarrow$ Boltzman's constant $= \frac{\text{Energy}}{\text{Temperature}} = \frac{ML^2T^{-2}}{K} = ML^2T^{-2}K^{-1}$.

$\Rightarrow$ Universal gas constant :- $R = \frac{PV}{T} = \frac{F/A \times V}{T} = \frac{MLT^{-2}}{L^2} \times \frac{L^3}{K}$.

$= ML^2T^{-2}K^{-1}$

$\Rightarrow$ Gravitational constant :- $G = \frac{F \times r^2}{m_1 m_2} = \frac{MLT^{-2} \times L^2}{M^2} = M^{-1}L^3T^{-2}$

$\Rightarrow$ Pressure/ stress :- $\frac{\text{Force}}{\text{Area}} \Rightarrow \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$.

$\Rightarrow$ Surface Tension :-

$\frac{\text{force}}{\text{length}} = \frac{MLT^{-2}}{L} = MT^{-2}$

$= ML^0T^{-2}$

S.No.	Physical Quantities	Units C.G.S	Units S.I
1.	Distance or displacement	cm	m
2.	Area	cm^2	m^2
3.	Volume	cm^3(c.c)	m^3
4.	Density	gm/c.c	kg/m^3
5.	Velocity	cm/s	m/s
6.	Angular velocity $\left(\omega = \frac{\theta}{t}\right)$	rad/s	rad/s
7.	Acceleration	cm/s^2	m/s^2
8.	Angular acceleration	rad/s^2	rad/s^2
9.	Mass	gm	kg
10.	Linear momentum	gm-cm/s	kg-m/s
11.	Angular momentum or Moment of momentum	erg-sec	joule-sec
12.	Force	dyne	newton
13.	Torque or moment of a force or moment of a couple	dyne-cm	newton-metre(N-m)
14.	Impulse	dyne-second	newton-second(N-s)
15.	Work, Energy, Power	erg	joule(J)
16.	Power	erg/second	watt
17.	Pressure	dyne/cm^2	newton/metre^2 $(N/m)^2$ or pascal
18.	Strain	No unit	No unit
19.	Stress	dyne/cm^2	newton/metre^2 or Pascal (P_a)

S.No.	Physical Quantities	Units C.G.S	Units S.I
20.	Modulus of elasticity (Young's modulus, Bulk modulus, Rigidity modulus)	dyne/cm^2 or Pascal (P_a)	newton/$metre^2$
21.	Frequency	hertz(Hz)	hertz(Hz)
22.	Surface tension	dyne/cm	newton/metre(N/m)
23.	Coefficient of viscosity	$\frac{\text{dyne} - \text{sec ond}}{\text{cm}^2}$	$\frac{\text{newton} - \text{sec ond}}{\text{metre}^2}$
24.	Quantity of heat	calorie	joule
25.	Specific heat (or specific heat capacity)	cal/gm/^{0}C	joule/kg/kelvin
26.	Thermal capacity	cal/^{0}C	Joule/Kelvin(JK^{-1})
27.	Water equivalent	gm	kg
28.	Latent heat	cal/gm	joule/kg(J Kg^{-1})
29.	Gas constant	erg/^{0}C/gm-mole	J $mol^{-1}K^{-1}$
30.	Coefficient of thermal conductivity	cal/sec/cm/^{0}C	watt/metre/kelvin($Wm^{-1}K^{-1}$)
31.	Stefan's constant	erg/cm^2/$(^0C)^4$	watt/$metre^2$/$(kelvin)^4$($Wm^{-2}K^{-4}$)
32.	Focal power	dioptre	dioptre
33.	Refractive index	No unit	No unit
34.	Permeability of free space	-	henry/metre
35.	Magnetic pole strength	-	ampere-metre
36.	Strength or intensity of magnetic field oersted	-	ampere turns/metre
37.	Electric charge or quantity of electricity	-	coulomb

S.No.	Physical Quantities	Units C.G.S	Units S.I
38.	Current strength (electric current)	-	ampere (A)
39.	Electromotive force or potential difference or voltage	- -	volt
40.	Resistance	-	ohm
41.	Specific resistance	ohm-cm	ohm-metre
42.	Conductance	-	mho
43.	Magnetic flux	maxwell	weber
44.	Coefficient of self induction or self inductance	-	henry
45.	Coefficient of mutual induction or mutual inductance	-	henry
46.	Planck's constant	-	Joule-second(J-s)

Dimensional formulae of important Physical Quantities:

S.No.	Physical Quantity	Expression	Dimensional formulae
1.	Area	Length x breadth	LXL = L^2 or $M^0L^2T^0$
2.	Volume	length x breadth x height	LxLxL=L^3 or $M^0L^3T^0$
3.	Velocity	$\frac{\text{displacement}}{\text{time}}$	$\frac{L}{T} = LT^{-1}$ or M^0LT^{-1}
4.	Acceleration	$\frac{L}{T} \times \frac{1}{T} = \frac{L}{T^2} = LT^{-2}$ or M^0LT^{-2}	
5.	Angle	$\frac{\text{arc}}{\text{radius}}$	$\frac{L}{L} = M^0L^0T^0$
6.	Density	$\frac{\text{mass}}{\text{volume}}$	$\frac{M}{L^3} = ML^{-3}$ or $ML^{-3}T^0$
7.	Angular velocity	$\frac{\text{angle}}{\text{time}}$	$\frac{1}{T} = T^{-1} = M^0L^0T^{-1}$

Physical Quantity	Expression	Dimensional formulae
Angular acceleration	$\frac{\text{angular velocity}}{\text{time}}$	$\frac{T^{-1}}{T} = T^{-2}$ or $M^0L^0T^{-2}$
Force, weight of a body	mass x acceleration	M x LT^{-2} or MLT^{-2}
Work or energy or torque	force x distance	MLT^{-2} x $L = ML^2T^{-2}$
Power	$\frac{\text{work}}{\text{time}}$	$\frac{ML^2T^{-2}}{T} = ML^2T^{-2}$
Momentum	mass x velocity	M x $LT^{-1} = MLT^{-1}$
Impulse	force x time	MLT^{-2}x $T = MLT^{-1}$
Frequency	$\frac{\text{No. of vibrations}}{\text{time}}$	$\frac{1}{T} = T^{-1}$ or $M^0L^0T^{-1}$
Pressure or stress	$\frac{\text{force}}{\text{area}}$	$\frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$
Coefficient of viscosity	$\frac{\text{force}}{\text{area}} \times \frac{\text{velocity}}{\text{dis tan ce}}$	$\frac{MLT^{-2}}{L^2} \div \frac{LT^{-1}}{L} = ML^{-1}T^{-1}$
Surface tension	$\frac{\text{force}}{\text{length}}$	$\frac{MLT^{-2}}{L} = MT^{-2}$ or ML^0T^{-2}
Specific heat	$\frac{\text{Quantity of heat (energy)}}{\text{mass} \times \text{temperature difference}}$	$\frac{ML^2T^{-2}}{M \times K} = M^0L^2T^{-2}K$
Thermal capacity	$\frac{\text{quantity of heat}}{\text{temperature difference}}$	$\frac{ML^2T^{-2}}{K} = ML^2T^{-2}K^{-1}$
Latent heat	$\frac{\text{quantity of length}}{\text{mass}}$	$\frac{ML^2T^{-2}}{M} = M^0L^2T^{-2}$
Coefficient of thermal conductivity	$\frac{\text{quantity} \times \text{length of conductor}}{\text{area} \times \text{temperatue} \times \text{time differenc}}$	$\frac{ML^2T^{-2} \times L}{L^2 \times K \times T} = MLT^{-3}K^{-1}$
Universal gas constant	$\frac{\text{pressure} \times \text{volume}}{\text{n.temperature}}$	$\frac{MLT^2}{L^2} \times \frac{L^3}{K} = ML2T^{-2}K^{-1}md^{-1}$
Electric current	current	1 or $M^0L^0T^0I$
Electric charge	current x time	1 x T = 1 T or $M^0L^0T^{-1}$

Physical Quantity	Expression	Dimensional formulae
Electric potential	$\frac{\text{work}}{\text{charge}}$	$\frac{ML^2T^{-2}}{I\times T}=ML^2T^{-3}I^{-1}$
Resistance	$\frac{\text{potential difference}}{\text{current}}$	$\frac{ML^2T^{-3}I^{-1}}{I}=ML^2T^{-3}I^{-2}$
Specific resistance	$\frac{\text{resistance}\times\text{area}}{\text{length}}$	$\frac{NL^2T^{-3}I^{-2}\times L^2}{L}=ML^3T^{-3}I^{-2}$
Planck's constant	work x time	$ML^{-2}T^{-2}\times T=ML^2T^{-1}$
Boltz mann's constant	$\frac{\text{Energy}}{\text{temperature}}$	$\frac{ML^2T^{-2}}{K}=ML^2T^{-2}K^{-1}$
Gravitational constant	$G=\frac{F\times r^2}{m_1m_2}$	$\frac{ML^3T^{-2}}{M^2}=M^{-1}L^3T^{-2}$
Stefan's constant	$\frac{\text{Heat energy}}{\text{Area}\times\text{time}\times\text{Temp}^4}$	$\frac{ML^2T^{-2}}{L^2\times T\times K^4}=MT^{-3}K^{-4}$
Magnetic induction or flux density (B)	$B=\frac{\text{Force}}{\text{Current}\times\text{Length}}$	$\frac{MLT^{-2}}{I\times L}=MT^{-2}I^{-1}$
Magnetic flux(ϕ)	ϕ = flux x area density	$MT^{-2}I^{-1}\times L^2=ML^2T^{-2}I^{-1}$
Self inductance (L)	$\frac{\text{Magnetic flux}}{\text{current}}$	$\frac{ML^2T^{-2}I^{-1}}{I}=ML^2T^{-2}I^{-2}$
Mutual inductance (M)	$\frac{\text{Magnetic flux}}{\text{current}}$	$\frac{ML^2T^{-2}I^{-1}}{I}=ML^2T^{-2}I^{-2}$
Capacitance	$C=\frac{\text{charge}}{\text{potential}}$	$\frac{IT}{ML^2T^{-3}I^{-1}}=M^{-1}L^{-2}T^{4}I^{2}$

Dimensionless quantities:

The following are some of the dimensionless quantities.

(a) Number (b) Ratio (c) Angle
(d) Specific gravity (e) Strain (f) Refractive index etc.,

CONCLUSIONS

1. The relation between numerical value and unit is $N \alpha \frac{1}{U}$ or $N_1U_1 = N_2U_2$

2. The physical quantities having only units without dimensional formulae are
   i) Plane Angle ii) Solid Angle

3. The physical quantities having No. units and dimensional formulae are

   i) Strain ii) Relative density or specific gravity

   iii) Poisson's Ratio iv) Coefficient of friction

   v) Refractive index vi) Reynold Number

   vii) Relative permeability viii) Dielectric constant etc.

4. The physical Quantities having same dimensional formulae

   i) momentum and impulse $\rightarrow MLT^{-1}$

   ii) Work,Energy, Quantity of heat torque $\rightarrow ML^2T^{-2}$

   iii) Angular velocity, frequency velocity gradient and decay constant $\rightarrow T^{-1}$

   iv) Surface tension and force constant $\rightarrow MT^{-2}$

   v) Angular momentum Plank's constant and angular impulse $\rightarrow ML^{-2}T^{-1}$

   vi) Stress, Pressure, Modulli of Elasticity $\rightarrow ML^{-1}T^{-2}$

   vii) Thermal capacity, gas constant Boltzman constant $\rightarrow ML^2T^{-2}K^{-1}$

   viii) Latent heat, Gravitational Potential $\rightarrow L^2T^{-2}$

   ix) Ryaberg constant, wave number $\rightarrow L^{-1}$

   x) Force, thrust, Tension retorting force $\rightarrow MLT^{-2}$

   xi) Acceleration, Acceleration due to gravity, intensity of gravitational field $\rightarrow LT^{-2}$

   xii) Speed, velocity velocity of light $\rightarrow LT^{-1}$

5. Some physical quantities having negative dimension for mass.

   i) Gravitational constant $M^{-1}L^3T^{-2}$ ii) Specific volume $M^{-1}L^3$

   iii) Capacity $M^{-1}L^{-2}T^4I^2$ iv) Permitivity $M^{-1}L^{-3}T^4I^2$

   v) Conductivity $M^{-1}L^{-3}T^3I^2$ vi) Conductance $M^{-1}L^{-2}T^3I^2$

Light

Light :- Which makes things visible is called light.

-> how we see any object? we may say that with the help of eyes, but eyes alone can't see any object. i.e In dark we can't see any object. When there is a light that falls on object we may see the object.

=> So light is a form of energy that makes us to see.

=> Light is propogated as electromagnetic waves, So light is "transverse wave"

Speed of light:-

Speed of light was first measured by Reomer.

-> speed of light is Max in Vaccum and air $= 3\times10^8$ m/s.

Refractive index:- $\mu = \frac{c}{v} = \frac{\text{speed of light in Vaccum}}{\text{speed of light in the medium}}$

$\uparrow$ speed of light in the medium $\propto \frac{1}{\mu}$. $\downarrow$

=> Light takes 8 Min 19 sec. (499 sec) to reach from sun to Earth

=> The light reflected from moon takes 1.28 sec. to reach earth.

=> Light travels in a straight line.

Material can be classified as

1. Transparent :- The objects which are allowing light to pass through them. Ex:- Glass, water → i.e we are able to see clearly through an object.

2. Translucent :- The object allows light to pass through them partially. i.e we are able see but not clearly.

   Ex:- oiled paper.

3. Opaque :- The objects which don't allow light through them. i.e we can't see through an object.

   Ex:- Metal, wood etc

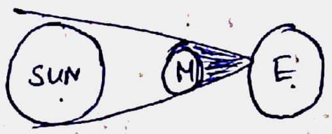
⇒ Shadow :- When an opaque body placed in front of source of light, then behind the opaque body a black (or) dark region appears, which is called shadow.

⇒ If the sources of light is point source, then shadow is called umbra but for extended source of light is penumbra.

Eclipse :- It is a natural phenomenon caused due to Sunlight.

There are two types.

(i) Solar Eclipse :-

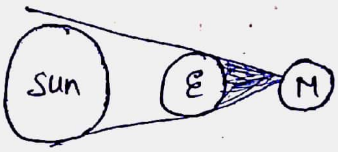


solar Eclipse

When the MOON comes b/w the SUN & the earth, then the shadow of the MOON falls upon the earth and from the shadow region the sun is not visible & thus position is called solar Elipse.

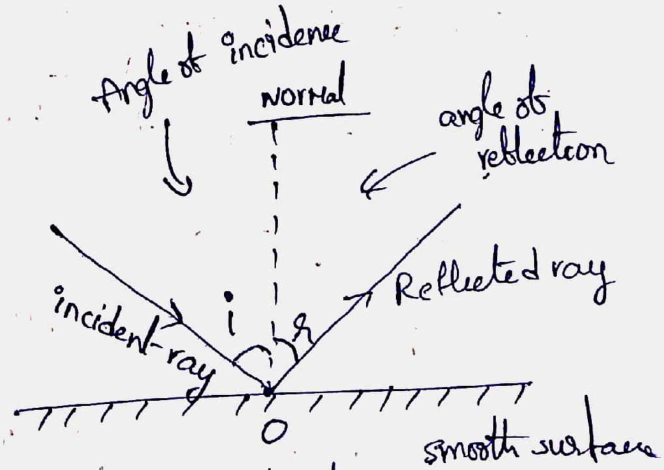
→ Full solar Eclipse occurs on the day of full MOON.

(ii) Lunar Eclipse :-



When Earth comes b/w the SUN & the MOON then the shadow of the Earth falls on the moon, then, & sunlight not reached to the MOON.

Reflection of light :-



The law of reflection :-

1) ⇒ The incident ray, the reflected ray, & Normal to the reflecting surface at point of surface all lie in the same plane.

2) Angle of incidence is always equal to the angle of reflection.

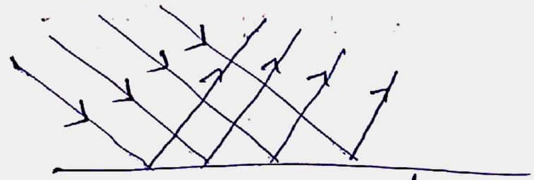
Regular & Diffused Reflection

Rays reflected from irregular surface

When all parallel rays reflected from a rough / irregular surface not parallel, the, the reflection is known as diffused / irregular reflection.

→ It is caused by irregularities.

⇒ ON other hand, reflection from smooth surface like mirror is called regular reflection



Regular reflection

Human eye & working :-

Cornea → transparent front part is called cornea

⇒ Behind the cornea, we find a dark muscular structure called iris → In this there is a small opening called pupil.

↳ It is part of eye which gives its distinctive colour.

↳ This iris controls the amount of light entering into eye.

→ Behind the pupil of the eye is a lens which is thicker in the center.

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Mirrors :-

→ polished surface, which reflects almost all the light that is incident on it.

Types of Mirror

1. Plane Mirror :-

→ reflecting surface of a mirror is plane.

Image formed by a plane mirror has following properties

→ Always virtual & erect.

→ The size of image is equal to the size of the object

→ The image is formed is far behind the mirror as the object is infront of it.

→ Linear magnification produced by plane mirror is "1".

Linear Magnification :- 'm'.

The Ratio of size of image (I) to the size of object. (O)

$$\boxed{m = \frac{I}{O}}$$

→ same for both concave & convex Mirror

→ when $m > 1$, image formed is enlarged.

$m < 1$, image formed is diminished.

when m is +ve, image must be erect (i.e virtual)

m is -ve " " " inverted (i.e real)

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The Min. size of the Mirror required to see the full image of an observer is half the height of the observer. If the plane Mirror is rotated in the plane of incidence by an angle θ, then the reflected ray rotates by angle 2θ.

=> Focal length of a plane Mirror is infinity.

=> If the object is displaced by a distance 'a' towards (or) away from Mirror, then its image will be " " " " 'a' " " " away from Mirror.

=> When '2' plane Mirrors are facing each other at angle θ, & and an object is placed b/w them, then

(a) number of images is given by $n = \frac{360^\circ}{\theta} - 1$, if $\frac{360^\circ}{\theta}$ is even (or) object lies Symmetrically

(b) $n = \frac{360^\circ}{\theta}$, if $\frac{360^\circ}{\theta}$ is odd (or) object lies asymmetrically.

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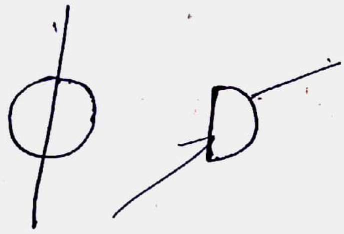
=> Cancave Mirror → m can be +ve / -ve.

but convex Mirror → m is +ve only.

2) Spherical Mirror :-

A highly polished curved surface whose reflecting surface is a cut part of a hallow glass sphere is called spherical mirror.



=> Inner surface of spoon acts → cancave Mirror &

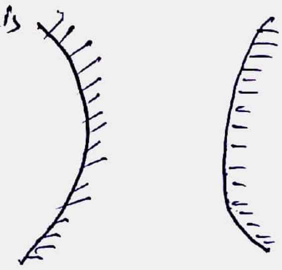
=> Cancave Mirror :-

If the reflecting surface of a spherical mirror is cancave, then it is cancave mirror.

→ Reflecting surface is inwards & outer surface is Polished

→ Also called as coverging Mirror.

→



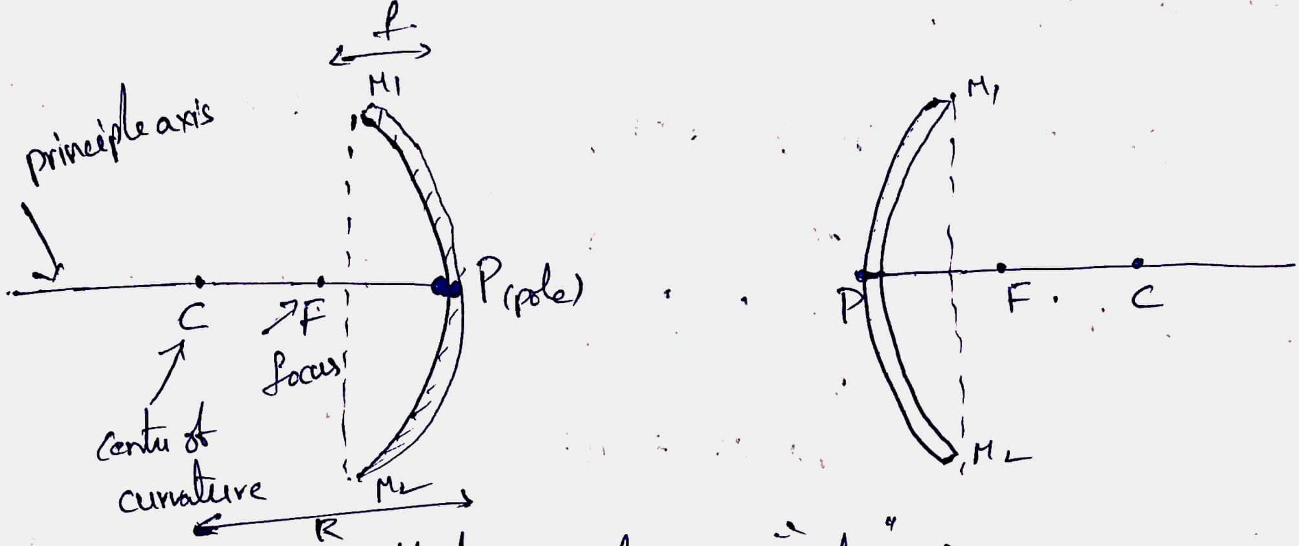
Cancave Mirror Convex Mirror

Convex Mirror :-

If the reflecting surface of a spherical mirror is convex, then it is convex Mirror.

→ Reflecting surface is out wards & inner surface is polished.

→ Also called as ~~conv~~ diverging Mirror



-> Centre point of Reflecting surface is "pole" (P)

-> The reflecting surface of a Mirror forms a part of sphere. This sphere has a Centre i.e called Centre of curvature (C).

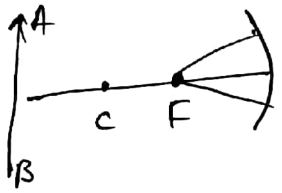
-> If lies out side its reflecting surface

=> Radius of curvature (R) :- Radius of the sphere

=> The straight line Joining the pole (P) & 'C' is called principal axis

=> focal length -> $f = R/2$

Formation of Image by a concave Mirror:- for different Positions:-

Position of Object	Position of Image	Size of the image	Nature of image
1) At infinity.	 At the focus F.	Highly diminished, Point sized	Real & inverted
2) Beyond 'c'	B/w F & C	Diminished	Real & inverted
3) At C	At C	same size	Real & inverted
4) B/w C & F	Beyond C	Enlarged	Real & inverted
5) At F	At infinity	highly enlarged	Real & inverted
6) B/w P & F	Behind Mirror.	Enlarged	virtual & Erect.

Convex

→ At infinity	At the focus F,	Highly diminished, Point sized	virtual & Erect
→ B/w infinity & the pole	B/w P & F.	Diminished	virtual & Erect.

Mirror formulae:-

let us take → u - object distance from its pole

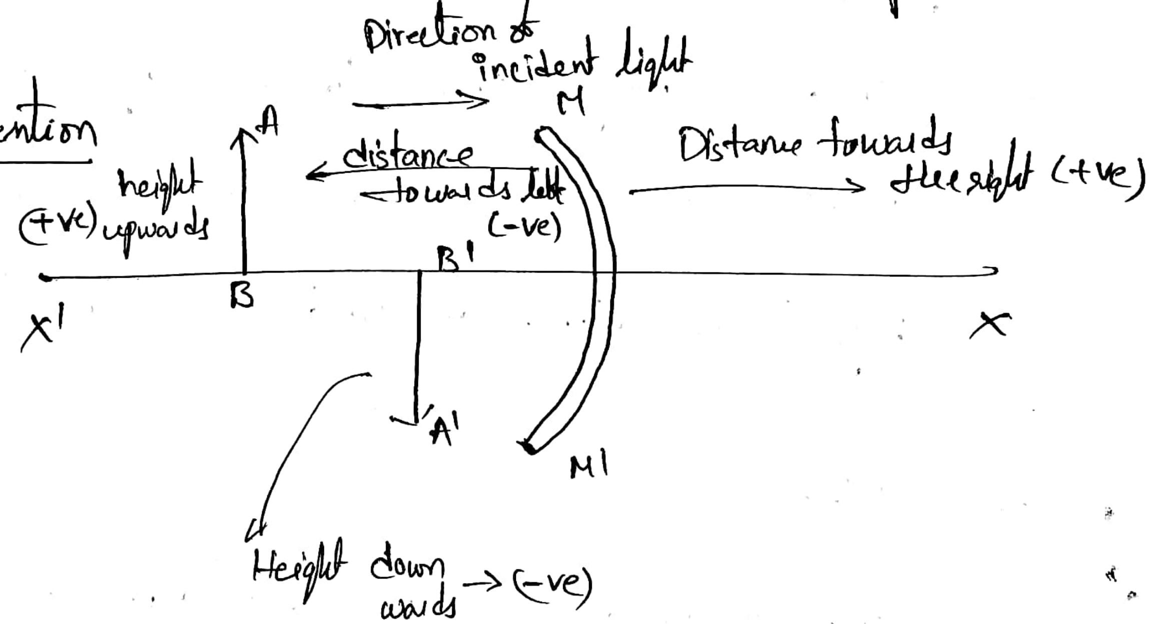
v - image distance from its pole.

f → focal length = $\frac{R}{2}$; distance of the principal focus from the pole.

then

The Mirror formula $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$. valid for all spherical mirrors.

Sign convention



Magnification :- 'm' = $\frac{\text{height of image } (h')}{\text{height of object } (h)}$

$$m = \frac{h'}{h} = \frac{-v}{u}.$$

m → +ve Means image is virtual

m → -ve " image is real.

uses of plane Mirrors:-

=> plane Mirrors are commonly used as looking Glass.

=> Making Periscopes, which is is used in submarines.

Concave Mirrors:-

=> Commonly used in torches, search light's, headlights to get powerful beam

=> Used as shaving mirrors to see larger image of the face

=> Dentists use concave Mirrors to see large images of teeth

=> Large canve Mirrors are used in solar furnaces.

Convex Mirros:-

=> Commonly used as rear view mirrors in vehicles. becoz they give erect image & have wider field of view as they curved outwards.

=> Big convex Mirrors are used as shop security Mirrors.

problem :- A convex Mirror used for rear-view on an automobile has a radius of curvature of 3.00 m. At a bus is located at 5.00 am from this Mirror, find the position, nature & size of the image.

sol. $R = 3m.$, object distance $u = -5\,m.$; $f = +\frac{R}{2} = 3/2 = +1.5$

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{+1.5} - \frac{1}{(-5)}$$

$$\frac{1}{v} = \frac{5+1.5}{7.5} = 4$$

$$\boxed{V = +1.15\,m}$$

The image is 1.15m at the back of the mirror.

$$m = \frac{h'}{h} = -\frac{v}{u} = -\frac{1.15m}{-5} = +0.23.$$

'+' → image is virtual, erect & small in size by a factor of 0.23 //

(P) An object, 4.0 c.m is size, is placed at 25 c.m in front of a concave mirror of focal length 15 c.m. At what distance from the mirror should a screen be placed in order to obtain a sharp image? find the nature & size of the image sol

$h = 4$ C.M

$u = -25.0$ C.M

$f = -15$cm.

$v = ?$

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{V} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-15} - \frac{1}{-25} \Rightarrow$$

$V = -37.5$ C.M.

The screen should be placed at 37.5 C.M in front of the Mirror. The image is real.

Height of the image $h' = ?$ $\Rightarrow$ $m = \frac{h'}{h} = -\frac{v}{u}$

$$h' = -\frac{vh}{u} = -\frac{[-37.5][4]}{(-25)}$$

$h' = -6.0$ C.M.

The image is inverted & enlarged.

Refraction by spherical lenses :-

lens is a transparent medium bounded by two surfaces, of which one/ Both surfaces are spherical.

lenses are two types.

1. Convex (or) Converging lens :-

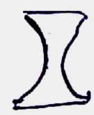
A lens in which thicker → at centre &
thinner → at Ends. called

convex lenses are 3- types 1. Double convex
2. plano convex
3. Concavo-Convex

→ Double convex lens is simply called convex lens.

2. Concave (or) Diverging lens :-

A lens which is thinner at the Centre &
thicker at its End is called



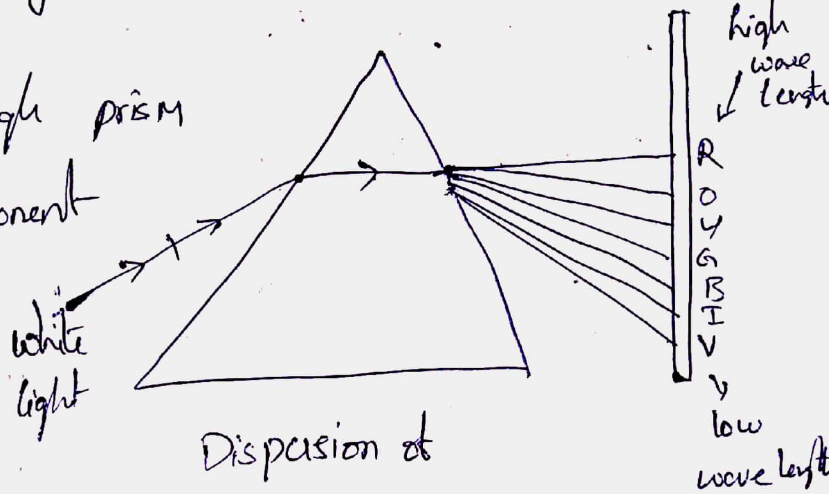
concave lens. There are also 3 types same as convex lens.

lens formulae: This formula gives relationship b/w object distance (u), Image distance(v) & focal length (f) lens formula $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$.

~~Ross~~

Dispersion of white light by a Glass prism :-

when white light passes through prism it splitting into its component colours. is called "dispersion"



Dispersion of

→ We can get seven colour band VIBGYOR: (called spectrum)

→ Issac Newton was the first one to use a glass prism to obtain spectrum of light.

⇒ The Red light has Max wave length → It travels fastest

Violet light has Min wave length → It travel slowest

Rain Bow :- Natural spectrum appearing in the sky especially after rain.

⇒ It is caused by dispersion of sun light by tiny water droplets present in atmosphere. act as small prisms.

⇒ Rain Bow is always formed in direction opposite to the sun. • Due to the dispersion of light a total internal reflection, different colours reach observers eye.

⇒ Sign Lens formula → $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Sign Convention :- focal length of a convex lens is +ve
concave lens is -ve.

Magnification   Magnification produced by lens

$$m = \frac{\text{Height of Image}}{\text{height of object}} = \frac{h'}{h} = \frac{v}{u}$$

Ex:- A concave lens has focal length of 15 C.M. At what distance should the object from the lens be placed so that it forms an image of 10 C.M from the lens? Also find 'm'?

sol Concave lens always forms virtual, erect image on the same side of object.

image dis $v = -10$ C.M.

$f = -15$ i.e concave

$u = ?$ $\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{u} = \frac{1}{v} - \frac{1}{f}$.

$$\Rightarrow \frac{1}{u} = \frac{1}{-10} - \frac{1}{(-15)} = \frac{-1}{10} + \frac{1}{15} = -30 \text{ C.M.}$$

object distance is 30 C.M from lens.

$m = \frac{v}{u} = \frac{-10}{-30} = \frac{1}{3} = +0.33$.   + sign shows image is virtual & it is 1/3rd of object.

(P) A 2.0 C.M tall object is placed perpendicular to the principal axis of convex lens of focal length 10 C.M. The distance of the object from the lens is 15 C.M. Nature, position & size of image, m = ?

sol

height = + 2.0 C.M

f = + 10 C.M → convex

u = − 15 C.M.

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ ⇒ $\frac{1}{v} = \frac{1}{u} + \frac{1}{f}$ ⇒ $\frac{1}{v} = \frac{1}{-15} + \frac{1}{10} = \frac{1}{30}$

$\boxed{v \Rightarrow +30}$ +30 → image is formed distane of 30 C.M on othe side of optical center

image is real & inverted.

$m = \frac{h'}{h} = \frac{v}{u}$ ⇒ $h' = \frac{h(v)}{u} = \frac{2[\cancel{30}^{2}]}{\cancel{-15}} = -4$ C.M

$m = \frac{-4}{2} = -2$. → image is inverted & real & formed below the Principle axis.

h = +2 & h' → 4 M → image is '2' times Enlarged.

Power of lens :-

It is defined as reciprocal of its focal length

denoted by 'P' → $P = 1/f$.

→ SI unit of 'P' → "diopter" → "D". → $1D = \frac{1}{m} = m^{-1}$

⇒ Power of convex lens → +ve.

concave lens → -ve.

Ex :- If lens prescribed = + 2.0 D.

It means + → convex. → $f = \frac{1}{P} = \frac{1}{2} = +0.5M$

In the same way -2.5D → concave → $f = \frac{1}{-2.5} = -0.4M$.

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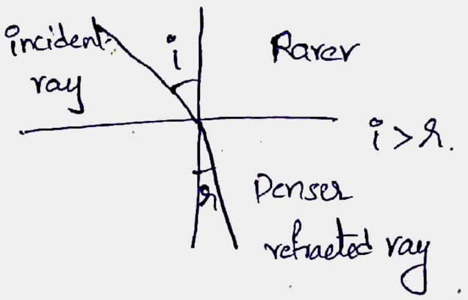
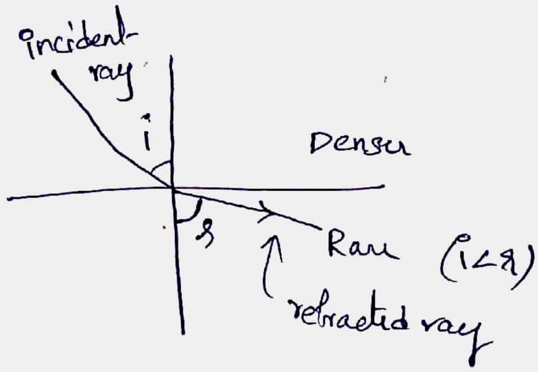
Refraction of light:-

Change in direction of propagation of light when it passes from one medium to other medium is called "refraction of light".

=> When light travels from a rarer medium to a denser medium it bends towards the normal ($i > r$). &

=> When travels from a denser medium to rarer one, it bends away from the normal ($i < r$)





=> The medium in which the speed of light is more is called Rarer Medium., & If speed of light is less then

=> it is called denser medium.

Some Examples of Refraction:-

1) Bending of linear object when it is partially dipped in a liquid
2) Twinkling of stars.
3) Oval shape of sun in Morning & evening
4) A fish in a pond when viewed from air appears to be small depth than actual depth

=> The letters appear raised when viewed through glass slab placed over the document.

=> A lemon kept in water in a glass tumbler appears to be bigger than actual size.

Causes of Refraction :-

=> speed of light :. becoz. speed of light different in different mediums. lesser in denser medium & greater in rarer medium. so that's wh

when light enter one medium to other it refracted. ~~it~~ (bends)

Refractive index :- $\mu = \frac{\text{speed of light in vacuum ~~air~~}}{\text{in medium}}$

=> i) $\mu \propto \frac{1}{\text{wave length}}$ (ii) $\mu \rightarrow$ Max for violet, Min for Red. (iii) $\mu \propto \frac{1}{\text{Temp}}$

Laws of Refraction :-

(i) The incident ray, the refracted ray & the normal at the point of incident all three are lie in same plane

(ii) Snell's law :-

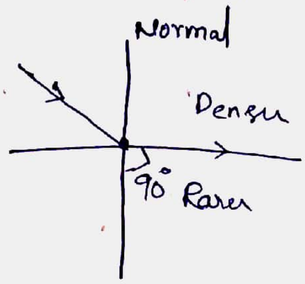
For a given colour of light,
The ratio of sin of angle of incidence to the sin of angle of refraction remains constant.

(ie) $\frac{\sin i}{\sin r}$ = constant ($^1\mu_2$)

called relative refractive index

critical angle:-

The angle of incidence in denser medium for which the angle of refraction in rarer medium becomes 90° is called critical angle (c)



-> 'c' depends upon nature of two media & colour of light

-> Refractive index of denser Medium $\mu = \frac{1}{\sin c}$.

Atmospheric Refraction

-> The refraction of light due to the atmospheric layers then it is called atmospheric Refraction.

Ex:- Twinkling of stars. & stars seem higher than they actual

-> Advanced sun rise & Delayed sun set.

Scattering of light:-

The Reflection of light from a comparably smaller sized particle in all directions, is called scattering of light.

-> Depends upon size of scattering particles.

-> fine particles scatter mainly -> Blue light
large size particle " " -> Red light.

=> The blue light present in sunlight is scattered 10 times more than Red.

⇒ colour of the sky is blue at day time becoz of size of particles in atmosphere are smaller than wave length of visible light. So, small particles scattered the blue colour. → It enters to our eye → sky appears as blue.

⇒ ~~At~~ colour of the sun at sunset & sunrise appears Red.

Total internal Reflection (TIR)

If light is propagating from denser medium to rarer medium & angle of incidence is more than criticale angle, then the light is reflected back into denser medium. & here no. part is absorbed.

Necessary condition for TIR

→ Light must be propagating from denser to rare medium

→ Angle of incedence (i) must exceeds critical angle (c).

Ex:- 1. Sparkling of diamond.

2. Shining of air buble in water

3. Mirage & looming.

4. optical fibre :- working principle T.I.R.

↳ frequently used in Telecommunication.

Optical Instruments :-

-> camera , Microscope , Telescope

Camera :- Camera consists of light proof box, at one End on which a converging lens system is fitted. At another End A light sensitive film is fixed, opposite to the lens system.

f- Number for a Camera :- Represents the size of aperture

$$f\text{-Number} = \frac{\text{Focal length of the lens}}{\text{Diameter of lens}}$$

=> The Amount of Light Entering the camera is directly proportional to the area of the aperture.

$$L \propto A \propto d^2 \quad (d\text{- diameter of lens})$$

$$\text{Brightness of image} \propto \frac{d^2}{f^2} \quad (f - \text{focal length of lens})$$

Microscope :- Which provides Magnified image of a small nearby object & thus we can see small objects as bigger in size & distinct.

There are mainly two types of Microscopes

1. Simple Microscope :- (Magnifying glass)

It consists of converging lens of small focal length

2. Compound Microscope :-

It is a combination of two convex lenses, separated by a distance

1. Objective lens -> lens nearer to object

2. Eye piece. -> Nearer to the eye.

Telescopes :- It is used to look at very large distant objects such as star, planet .. etc.

=> It is also combination of two convex lenses called objective lens & eye piece separated by distance.

Interference of Light :-

-> Redistribution of Energy due to superposition of waves is called interference of light.

-> when '2' light waves of similar 'f', having a zero (or) constant phase diff. propogate in a medium separately in same direction, then due to their superposition

Max. intensity is obtained at few point & minimum intensity at other few points.

=> The interference taking place at points of max. intensity is called constructive interference.

=> The interence taking place at point of min intensity is called destructive interference.

Ex:- When kerosene oil spread on the water, it seems to have decent colour due to interference of light.

=> Soap bubbles have also brilliant colour in sunlight

Diffraction of light:-

The phenomenon of bending of light around the corners & the spreading of light with geometrical shadow of the opaque obstacles is called diffraction of light.

↳ The light deviates from its linear path is called Diffraction.

Appli:-

1) Due to Diffraction, high quality Microscopes show blur images

2).

Doppler's Effect of light :-

Whenever there is a relative motion b/w a source of light & observer, the apparent freq. of light recieved by observer, is diff. from true frequency of light.

=> Whenever source & observer approch each other the

$\Delta\nu$ (change in freq) is +ve. i.e apparent freq ⇑. It is called Blue shift

=> When source & observer away from each other $\Delta\nu \rightarrow$ −ve. apparant freq ⇓. called Red shift.

uses of Doppler's Effect

=> Measuring speed of galaxies & speed of stars.

=> " " speed of rotation of sun.

=> Estimation of velocity of aeroplanes, rockets, submarines etc.

Magnets & Magnetism

Magnets :- It is an object, which attracts iron particles.

Different types of Magnets are available, Ring, Bar, horseshoe

Magnets have two poles North & South.

Magnetic flux lines passes from N → S (outside)

But inside S → N.

Laws

=> Poles always exist in pair (N&S)

=> likepoles always repel, unlike attract

=> The Magnetic lines of forces are continous & always forms closed loop. They never cross one another

Magnetic substances:- which are attracted by Magnet.

Ex:- iron, nickel, cobalt, alloys etc.

NON-Magnetic :- which are not attracted by magnet

Ex:- wood, copper aluminium..

Magnetic field:- The region surrounding the Magnet in which it has force of attraction

Based on this mag. field, Magnetic substances are divided into 3 types

1. Dia
2. Para
3. Ferro.

Dia Magnetic substances:-

Which are weakly magnetised in the opposite direction of magnetic field when placed in strong Mg. field.

Ex:- Copper, Zinc, silver, gold, Mercury, H, antimony, Bismuth. quartz etc.

Prop:-

⇒ Magnetism produced in these substances doesn't change with Temp.

⇒ ~~prm~~ Permeability is less than "one" $\mu < 1$

↙ ability of Mag. field ↳ ability of magnetic flux flow through the Material

⇒ Susceptibility is small & negative.

↳ Measure of how much a material become magnetised in an applied Mag. field.

Para :- Which are weakly magnetised in the same direction of mag. field when placed in strong Mag field.

Ex:- Al, Platinum, chromium, Manganese ..

Prop:- 1) Magnetism of these sub, ⇊ with increase in Temp ⇈

2) $\mu > 1$

3) susceptibility is small & +ve.

Ferro magnetic

=> Which are strongly magnetised in same direction of mag. field when placed in strong mag. field

Ex:- iron, cobalt, nickel, etc.

=> As Temp ⇑ → Magnetism produced ⇓

=> Permeability $\mu >> 1$

=> susceptibility is large & +ve

Permanent Magnet :-

↳ which retain its magnetic property for a long period of time

Ex:- Ferro magnetic materials are used to make Permanent Magnet

Ex:- alnico, cobalt, steel

Electro Magnet :- current carrying conductor behaves as Electro Magnet.

Comparision b/w Electric & Magnetic ckts :-

Electric ckt	Mag. ckt
1) voltage / E.m.f. → which drives the Electrons from one point to another point → cause	1) M.M.F :- Magnetic Motive force which drives the flux.
2) flow of Electrons is called current → Effect. $I \rightarrow$ units → Amp.	2) Magnetic field lines (or) Magnetic lines of force around magnet called flux (ϕ) units → webers, $1wb = 10^8$ lines
3) ohm's law → $V = IR$. which opposes the flow of current (units → Ω) $R = \frac{\rho l}{a}$ Resistivity → $\frac{1}{\rho} = \sigma$ conductivity. ability / property of the material to allow current through it	3) $MMF = \phi . S$ Reluctance which opposes the flow of flux $S = \frac{l}{\mu a}$ $\mu \rightarrow$ permeability. ability / property of the Material ~~to~~ to allow the flux through it.
⇒ Electric field intensity $E = \frac{V}{d}$, units → V/m	⇒ Magnetic field intensity $H = \frac{MMF}{l} = \frac{N.I}{l}$. ↳ $\frac{A.T}{m}$.
⇒ Electric currents Density → $J = I/A$ → units. Am/m2	⇒ Magnetic flux density $B = \frac{\phi}{A} \rightarrow wb/m^2$ Tesla
→ Electric flux density $D = \epsilon E$	$B = \mu H$.

⇒ Centre of Mass

⇒ The point at which the Entire Mass of the body is concentrated is called "Centre of Mass".

If a body is composed of 'n' num of particles having Masses $m_1, m_2, \ldots m_n$. located at distance $r_1, r_2 \ldots r_n$. then the position vector of Centre of Mass is

$$r_{CM} = \frac{m_1 r_1 + m_2 r_2 + \cdots + m_n r_n}{m_1 + m_2 + \cdots + m_n}$$

⇒ The Position of Centre of Mass depends on the shape & size of body. & distribution of its mass

⇒ The Centre of Mass of body changes in translatory Motion But not in rotatory Motion.
↳ Motion is rotational

Torque :- Rotating force is called Torque.

$T = F \times \omega$ → angular velocity

$T = F \times d$ → Perpendicular distance of force from axis of ~~r~~otatation.

⇒ **Centre of Gravity :-**

It is a point where the weight of the body acts & The total gravitational torque on the body is zero.

Centripetal force :-

The External force required to maintain the circular Motion of the body is called Centripetal force.

Centripetal force $= F = \frac{mv^2}{R}$

m - Mass
R → Radius of circular Path.

⇒ Due to this force Bike riders rotate their bikes speedly in circular paths in circus.

Centrifugal force :- It is the force which is Equal & opposite to the Centripetal force

✓ always try to Maintain circular Motion

but **Centrifugal** → try to regain its linear Motion (ie) natural straight line path.

Ex :- **Cream separator :-** It has a vessel containing Milk ON fast rotation, the lighter particles of cream, & skimmed Milk are separated.

⇒ **Washing Machine drier :-**

Heat

=> Sensation of warm. (or) warm Sensation.

=> Heat is form of Energy which flows from higher temp to lower temperature. when they are in contact.

SI units → Joules → practical units → calorie.

1 calorie = 4.18 Joule

Some relations:-

1. B.Th.U = 252 calorie

1. Thermal = 10^5 B.Th.U.

1 Pound calorie = 453.6 calorie.

Temperature:- which expresses the degree of hotness (or) coldness of body. Heat flows one body to another body due to the temperature diff.

↳ It decides the direction of flow of heat. [H.Temp → low.Temp]

Thermometer → Temperature is measured by this device.

Temperature scales:- To measure temp. 2 fixed points are taken

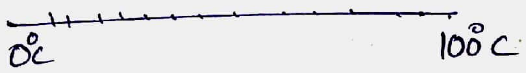
1. → freezing point → ice point. [at which temp. water → ice]

2. → Boiling point → steam point [at which temp water → steam]

Types of Temp. Scales

=> **Celsius scale :- (°C) :-** Initially known as Centigrade)

-> freezing point -> 0°C.
Boiling point -> 100°C.
} b/w these scale divided int 100 Equal parts.



=> **Fahrenheit scale :- (°F) :-**

-> freezing point -> 32°F
Boiling point -> 212°F.
} divided int 180° Equal points.

=> **kelvin scale :- (K)**

-> freezing point -> 273°K
-> Boiling point -> 373K.
} 100 Equal parts

=> **Reaumur scale :- (R)**

-> F.P -> 0°R
B.P -> 80°R.

=> **Rankine scale :- (Ra)**

F.P -> 460°Ra
B.P -> 672°Ra.

	celsius	fahrenheit	kelvin	Reaumur	Rankine scale
F. P.	0°c	32°F	273 K	0°R	460° Ra
B. P.	100°c.	212°F.	373K	80° R	672° Ra.

Relation b/w various Temp. scales

$$\frac{C}{5} = \frac{F-32}{9} = \frac{K-273}{5} = \frac{R}{4} = \frac{Ra-460}{10.6}$$

0°c → kelvining

$$\frac{C}{\cancel{5}} = \frac{K-273}{\cancel{5}}$$

$$0 = K-273 \Rightarrow K = 273\,K$$

0°c → 273K.

0°c → Fahrenheit ,

$$\frac{C}{5} = \frac{F-32}{9}$$

$$F = 32°$$

0°c → 32°F.

100° c → F. helafte →

$$\frac{C}{5} = \frac{F-32}{9}$$

$$\frac{\cancel{100}^{20}}{\cancel{5}} = \frac{F-32}{9}$$

$$180 + 32 = F.$$

$$F = 212$$

100° → 212°F.

4

Some Imp. Temp. on Various scales

Temp	Celsius (°C)	(°F)	kelvin (K)
F.P of water	0°C	32°F	273 K.
B.P.	100°C	212°F	373 K.
Normal room temp	27°C	80.6°F	300K.
Normal temp	37°C	98.6°F	310K

↳ More than this we can say fever.

Clinical thermometer :- The scale is Marked from 96°F to 110°F.

used to Measure temp of human. [Mercury thermometer]

But at present we use Electronic Thermometer

↳ we use thermistor → whose Resistance change with Temp.

⇒ In Celsius scale → reads 35°C to 42°C.

⇒ laboratory thermometer scale → −10°C to 110°C

Thermal Expansion :-

If Temp changes ⇒ dimensions of body [length, breadth, thickness) changes.

Solids :- As temp increases → dimensions are Increases.

we can observe it → summer → Metals are Expand. &

winter → Metals are contracts.

Three types of Expansions in solid

1) **linear** As Temp T ⇑ → length (l) ⇑ → It is Linear Expansion.

$$\text{Co-efficient of linear Expansion} = \frac{\Delta l}{l \times \Delta Temp} \quad /^\circ C \text{ or } /K$$

2) **Superficial Expansion** :- As Temp ⇑ → Area ⇑.

$$\text{coeffi. of s. Expa. } \beta = \frac{\Delta A}{A \times \Delta Temp.}$$

3) **Volume Exp** :- As Temp ⇑ → volume ⇑.

$$\gamma = \frac{\Delta V}{V \times \Delta Temp.}$$

Relation :- $\alpha : \beta : \gamma = 1 : 2 : 3$. , $\beta = 2\alpha$, $\gamma = 3\alpha$.

Thermal Expansion of liquids :-

If you take vessel & pour water in it and heated up firstly → vessel expands & then liquid.

Gases :- As Temp ⇑ → Gases also Expands.

At ordinary temp → The gasses Expands more than liquids & solids.

Anomalous Expansion of water :-

↳ water shows Anomalous behaviour on heating.

Temp from $0°C \rightarrow 4°C \rightarrow$ volume of water decreases

(ice) → water

$4°C \rightarrow$ higher → volume of water ⇑.

Density of water is Max. at 4°C.

Transmission of Heat

⇒ Conduction :- direct heating (direct contact of heat)

Ex:- for solids.

⇒ Convection :- Indirect heating → By using Medium

we heated. ~~the~~. It is in liquid & gases.

we have to take any vessel & take water (liquid)

in that & heated that vessel to heat liquid.

heat transfered from vessel to → liquid/gas.

Radiation :- with out actual contact / with out Medium

heat transfer takes place.

⇒ We can observe Black / dark coloured materials observe heat / Temp than light colour. That's why In summer If we wear dark colour then we feel so hot.

Newton's law of cooling:-

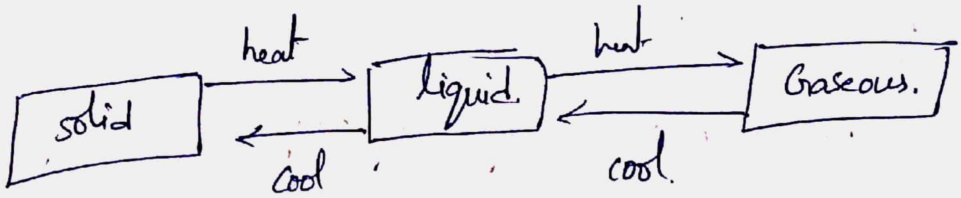
A/c to law, The rate of cooling of body is directly proportional to the Temp. diff. of body and its sourroundings.

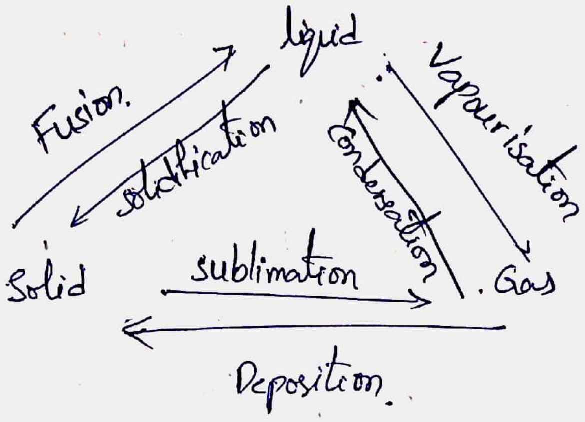
Rate of heat loss $\propto$ diff. of temp b/w body & sorroundings.

i.e hotter an object is the quicker it cools down.

=> At hot water & fresh tap water kept in refrigerator the rate of cooling of hot water will be faster than tap water.

Hot water takes much less time to cool from $100^\circ C$ to $95^\circ C$ than normal water cools from $25^\circ C$ to $15^\circ C$. //

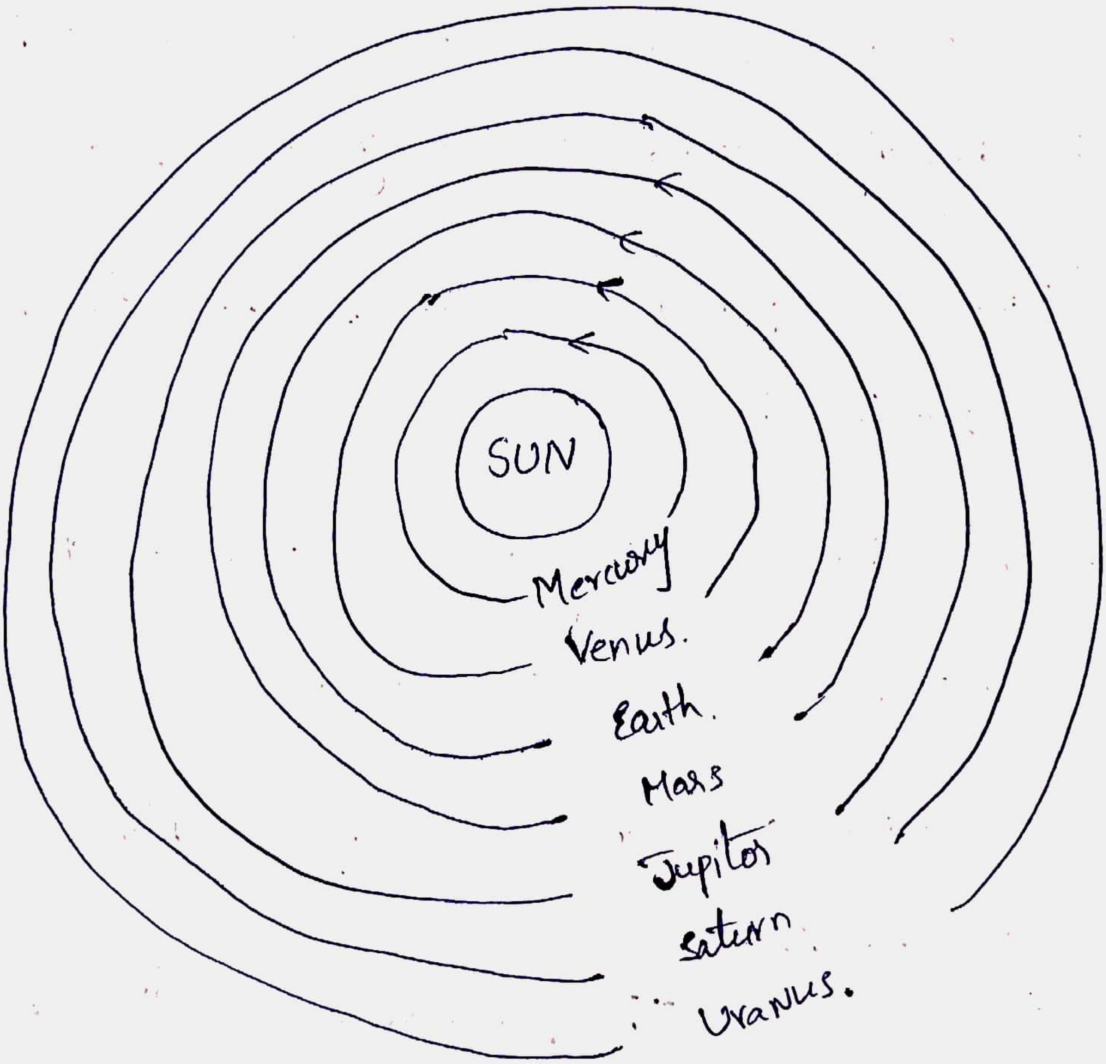




Interconversion

=> ~~We can~~

Solar system.



sun → is at center → All the planets revolving around the sun

planets in their order of distance, from sun are :- 1. Mercury
2. Venus
3. Earth
4. Mars.
5. Jupitor
6. Saturn
7. Uranus.

The Sun :- Nearest Star to the Earth.

→ The Sun is source of almost all Energy on the Earth

→ Sun is the Main Source of Heat & light for all planets.

→ Sun is Revolving around our galaxy with speed of 250 km/s

planets :- Do, you know the Difference of planets & stars. stars twinkle, But planets do not.

⇒ planet has definite path.. in which it revolves around the sun. That path is called orbit.

period of Revolution :- Time taken by a planet to complete '1' revolution.

↳ The period of Revolut. ↑↑ → As distance ↑ from SUN.

So → Mercury has less period of rotation

→ Uranus has high period of " "

" Revolution → complete movement around the sun

Rotation → one complete Movement around its own axis

Inner planets

Mercury (Budha) :-

→ Nearest planet to sun. & smallest planet.

→ Mercury takes 88 days for one revolution.

→ It has no satellites.

→ There is no atmosphere on Mercury.

(ii) Venus :- (shukra) :-

↳ Earth nearest Neibour.

-> It is brightest planet in

↳ Becoz of cloudy atmosphere of venus, sends back almost 3/4th of sunlight that fall on it. so it is brightest

-> Sometime It appears in the Eastern sky before sunrise. &

Sometimes it appears in the western sky just after sunset

So It is called Morning (or) Evening star.

-> It has no Moon / satellite.

-> Rotation is unusual. It rotate from East to West.

while ~~best~~ Earth " " West to east.

-> It is consider as hottest planet.

[It absorbs higher amount of heat the Mercury]

(iii) The Earth (Prithvi)

↳ only planet on which life is known to exist.

called blue planet

-> From space, The Earth appears blue-green due to the Reflection of light from water & land Mass of its surface

=> Our Earth rotates from West to East about its axis.

with speed of 1610 km/h. & complete '1' ~~revolution~~ rotation in 23 h 56 Min. & 4.09 sec. → due to this we are observing day & Night.

=> 3rd nearest planet to the sun.

=> It completes one revolution around the sun in 365 days, 5h, 48M & 45.5 sec. [365 1/4 day) with speed of 1,07,160 (KM/h. [1.07 lak K.M/h].

=> It revolves in an elliptical orbit around sun.

=> Mass ⟶ 5.97×10^{24} kg Density ⟶ $5.52\,g/cm^3$.

=> Earth has only one Natural satellite ⟶ MOON.

-> Distance b/w MOON & Earth is ⟶ 3,84,400 K.M.

-> Neil Armstrong, 1st person foot on the Moon on 21st July, 1969.

=> <u>Mars</u> :- (Mangal)

↳ 1st outside the orbit of the Earth

↳ It appears reddish so called as Red planet.

↳ It has '2' Natural satellite named <u>phobos</u> & <u>Deimos</u>.

Do you know about <u>Mangalyan</u> ⟶ ISRO launched india's 1st Mars orbiter Mission

- Manglyan, ON Nov. 5, 2013.

-> It was successfully placed into an orbit of Mars on Sep. 24th 2014.

-> With this India became 1st country in the world to do so in its first attempth.

=> Outer Planets

=> **Jupitor** (Brihaspati) :-

-> Largest planet. [Equal to 1300 Earths), Its Mass = 318 times of Earth.

-> It has nearly 16 satellites.

-> It takes 11 years 11 Months for orbit.

=> **Saturn** :- It appears yellowish in colours. & it has 3 'rings. which Makes uniq in. solar system

↳ It has nearly 18 satellites.

↳ It takes 29 years, 5 Months for '1' orbit.

Imp. ↳ It is the least dense among all the planets.

↳ It's density is less than that of water.

=> **Uranus** :- -> discovered by william Herschel, in 1781.

↳ like venus, Uranus also rotates from East to west.

↳ It has highly tilted rotational axis.

↳ It takes 84 years for '1' orbit.

-> It has 17 satellites.

//

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20. Scientific Instruments

Instrument	Use
Altimeter	Measures altitudes (used in aircraft)
Ammeter	Measures strength of electric current
Anemometer	Measures force and velocity of wind and directions
Audiometer	Measures intensity of sound
Barograph	Continuous recording of atmospheric pressure
Barometer	Measures atmospheric pressure
Binoculars	To view distant objects
Bolometer	To measure heat radiation
Callipers	Measure inner and outer diameters of bodies
Calorimeter	Measures quantities of heat
Cardiogram (ECG)	Traces movements of the heart; recorded on a Cardiograph
Cathetometer	Determines heights, measurement of levels, etc., in scientific experiments
Chronometer	Determines longitude of a vessel at sea.
Colorimeter	Compares intensity of colours
Commutator	To change/reverse the direction of electric current; Also used to convert AC into DC
Cryometer	A type of thermometer used to measure very low temperatures, usually close to 0°C
Cyclotron	A charged particle accelerator which can accelerate charged particles to high energies
Dilatometer	Measures changes in volume of substances
Dyanamo	Converts mechanical energy into electrical energy
Dynamometer	Measures electrical power
Electro encephalo grameg (EEC)	Measures and records electrical activity of brain
Electrometer	Measures very small but potential difference in electric currents
Electroscope	Detects presence of an electric charge
Electromicroscope	To obtain a magnifying view of very small objects Capable o magnifying up to 20,000 times
Endoscope	To examine internal parts of the body
Fathometer	Measures depth of the ocean
Fluxmeter	Measures magnetic flux
Galvanometer	Measures electric current
Hydrometer	Measures the relative density of liquids
Hygrometer	Measures level of humidity
Hydrophone	Measures sound under water
Hygroscope	Shows the changes in atmospheric humidity
Hypsometer	To determine boiling point of liquids

Instrument	Use
Kymograph	Graphically records physiological movement. (e.g., blood pressure/ heartbeat)
Lactometer	Measures the relative density of milk to determine purity
Machmeter	Determines the speed of an aircraft in terms of the speed of sound
Magnetometer	Compares magnetic moments of magnets and fields
Manometer	Measures the pressure of gases
Micrometer	Measures distances/angles
Microphone	Converts sound waves into electrical vibrations
Microscope	To obtain a magnified view of small objects
Nephetometer	Measures the scattering of light by particles suspended in a liquid
Ohmmeter	To measure electrical resistance in ohms
Ondometer	Measures the frequency of electromagnetic waves, especially in the radio-frequency band
Periscope	To view objects above sea level (used in submarines)
Photometer	Compares the luminous intensity of the source of light
Polygraph	Instrument that simultaneously records changes in physiological processes such as heartbeat, blood-pressure and respiration; used as a lie detector
Pyknometer	Determines the density and coefficient of expansion of liquids
Pyrheliometer	Measures components of solar radiation
Pyrometer	Measures very high temperature
Quadrant	Measures altitudes and angles in navigation and astronomy
Radar	To detect the direction and range of an approaching aeroplane by means of radiowaves, (Radio, Angle, Detection and Range)
Radio micrometer	Measures heat radiation
Refractometer	Measures refractive indices
Salinometer	Determines salinity of solutions
Sextant	Used by navigators to find the latitude of a place by measuring the elevation above the horizon of the sun or another star; also used to measure the height of very distant objects
Spectroscope	To observe or record spectra
Spectrometer	Spectroscope equipped with calibrated scale to measure the position of spectral lines (Measurement of refractive indices)
Spherometer	Measures curvature of spherical objects
Sphygmometer	Measures blood pressure
Stereoscope	To view two-dimensional pictures
Stethoscope	Used by doctors to hear and analyze heart and lung sounds
Stroboscope	To view rapidly moving objects
Tachometer	To determine speed, especially the rotational speed of a shaft (used in aeroplanes and motor-boats)

Instrument	Use
Tacheometer	A theodolite adapted to measure distances, elevations and bearings during survey
Tangent Galvanometer	Measures the strength of direct current
Telemeter	Records physical happenings at a distant place.
Teleprinter	Receives and sends typed messages from one place to another
Telescope	To view distant objects in space
Thermometer	Measures Temperature
Thermostat	Regulates temperature at a particular point
Tonometer	To measure the pitch of a sound
Transponder	To receive a signal and transmit a reply immediately
Udometer	Rain gauge
Ultrasonoscope	To measure and use ultrasonic sound (beyond hearing); use to make a Ecogram to detect brain tumours, heart defects and abnormal growth
Venturimeter	To measure the rate of flow of liquids
Vernier	Measures small sub-division of scale
Viscometer	Measures the viscosity of liquid
Voltmeter	To measure electric potential difference between two points
Wattmeter	To measure the power of an electric circuit
Wavemeter	To measure the wavelength of a radiowave

21. Inventions

Invention	Inventor	Country	Year
Adding machine	Pascal	France	1642
Aeroplane	Wright brothers	USA	1903
Balloon	Jacques and Joseph Montgolfier	France	1783
Ball-point pen	C. Biro	Hungary	1938
Barometer	E. Torricelli	Italy	1644
Bicycle	K. Macmillan	Scotland	1839
Bicycle Tyre	J.B. Dunlop	Scotland	1888
Calculating machine	Pascal	France	1642
Centrigrade scale	A. Celsius	France	1742
Cinematograph	Thomas Alva Edison	USA	1891
Computer	Charles Babbage	Britain	1834
Cine camera	Friese-Greene	Britain	1889
Cinema	A.L. and J.L. Lumiere	France	1895
Clock (machanical)	Hsing and Ling-Tsan	China	1725
Clock (pendulum)	C. Hugyens	Netherlands	1657
Diesel engine	Rudolf Diesel	Germany	1892
Dynamite	Alfred Nobel	Sweden	1867

Invention	Inventor	Country	Year
Dynamo	Michael Faraday	England	1831
Electric iron	H.W. Seeley	USA	1882
Electric lamp	Thomas Alva Edison	USA	1879
Electromagnet	W. Sturgeon	England	1824
Evolution (theory)	Charles Darwin	England	1858
Film (with sound)	Dr Lee de Forest	USA	1923
Fountain Pen	LE. Waterman	USA	1884
Gas lighting	William Murdoch	Scotland	1794
Gramophone	T.A. Edison	USA	1878
Jet Engine	Sir Frank Whittle	England	1937
Lift	E.G. Otis	USA	1852
Locomotive	Richard Trevithick	England	1804
Machine gun	Richard Gatling	USA	1861
Match (safety)	J.E. Lurdstrom	Sweden	1855
Microphone	David Hughes	USA	1878
Microscope	Z. Jansen	Netherlands	1590
Motor car (petrol)	Karl Benz	Germany	1885
Motorcycle	Edward Butler	England	1884
Neon-lamp	G. Claude	France	1915
Nylon	Dr W.H. Carothers	USA	1937
Photography (paper)	W.H. Fox Tablot	England	1835
Printing press	J. Gutenberg	Germany	1455
Radar	Dr A.H. Taylor and L.C. Young	USA	1922
Radium	Marie and Pierre Curie	France	1898
Radio	G. Marconi	England	1901
Rayon	American Viscose Co.	USA	1910
Razor (safety)	K.G. Gillette	USA	1895
Razor (electric)	Col. J. Schick	USA	1931
Refrigerator	J. Harrison and A. Catlin	Britain	1834
Revolver	Samuel Colt	USA	1835
Rubber (vulcanized)	Charles Goodyear	USA	1841
Rubber (waterproof)	Charles Macintosh	Scotland	1819
Safety lamp	Sir Humphrey Davy	England	1816
Safety pin	William Hurst	USA	1849
Sewing machine	B. Thimmonnier	France	1830
Scooter	G. Bradshaw	England	1919
Ship (steam)	J.C. Perier	France	1775
Ship (turbine)	Sir Charles Parsons	Britain	1894
Shorthand (modem)	Sir Issac Pitman	Britain	1837
Spinning frame	Sir Richard Arkwight	England	1769

Invention	Inventor	Country	Year
Spinning jenny	James Hargreaves	England	1764
Steam engine (piston)	Thomas Newcome	Britain	1712
Steam engine (condenser)	James Watt	Scotland	1765
Steel production	Henry Bessemer	England	1855
Stainless Steel	Harry Brearley	England	1913
Tank	Sir Ernest Swington	England	1914
Telegraph code	Samuel F.B. Morse	USA	1837
Telephone	Alexander Graham Bell	USA	1876
Telescope	Hans Lippershey	Netherlands	1608
Television	John Logie Bared	Scotland	1926
Terylene	J. Whinfield and H. Dickson	England	1941
Thermometer	Daniel Gabriel Fahrenheit	Germany	1714
Tractor	J. Froelich	USA	1892
Transistor	Bardeen, Shockley	USA & UK	1949
Typewriter	C. Sholes	USA	1868
Valve of radio	Sir J.A. Fleming	Britain	1904
Watch	A.L. Breguet	France	1791
X-ray	Wilhelm Roentgen	Germany	1895
Zip fastener	W.L. Judson	USA	1891

22. Important Discoveries in Physics

Discovery	Scientist	Year
Laws of motion	Newton	1687
Law of electrostatic attraction	Coulomb	1779
Atom	John Dalton	1808
Photography (On metal)	J. Neepse	1826
Law of Electric resistance	G.S. Ohm	1827
Law of floatation	Archemedes	1827
Electromagnetic Induction	Michael Faraday	1831
Photography (On paper)	W.Fox Talbot	1835
Dynamite	Alfred Nobel	1867
Periodic table	Mandeleev	1888
X-Rays	Roentgen	1895
Radioactivity	Henry Becquerel	1896
Electron	J.J. Thomson	1897
Radium	Madam Curie	1898
Quantum theory	Max Plank	1900
Wireless Telegram	Marconi	1901
Diode Bulb	Sir J. S. Fleming	1904
Photo electric effect	Albert Einstein	1905
Principle of Relativity	Albert Einstein	1905
Triode Bulb	Lee de Forest	1906
Atomic Structure	Neil Bohr & Rutherford	1913