Light

Nature :- This is a transverse wave which does not require a medium for transmission.

- This is a kind of EM wave.
- Wave length - 3900A - 7800 A

- The nature of light is dual nature.
- The theory of dual was given by De Broglie.

~~The~~ i.) wave form [In this, phenomena like reflection, refraction, diffraction etc. are explained]

- It was given by Huygens.

ii.) Particle form [The electrical effect of light is defined]

- Told Newton
- Electrical effect of light was explained by Einstein.

$(E = Mc^2)$ [E = Energy, M = Mass, C = speed of light]

Movement of Light :- 3×10^8 mt/sec (Vaccom)

water = 2.25×10^8 mt/sec

Turpentine oil = 2.04×10^8 mt/sec

Mirror = 2×10^8 mt/sec

Nylon = 1.96×10^8 mt/sec

Air = $2.97/2.99 \times 10^8$ mt/sec

Time taken to reach earth = 8 Min. 20 sec. (approx.)

Order of Movement = Vaccum > Gas > liquid > solid

Types of Medium :-

1) Transparent :- Those substances through which objects can be seen clearly.
Ex :- Mirror, Water, Air etc.

2) Translucent :- Those substances through which objects cannot be seen clearly.
Ex :- Sunglasses, Vegetable oil.

3) Opaque :- Those substances through which objects cannot be seen.
Ex :- Wood, Metal.

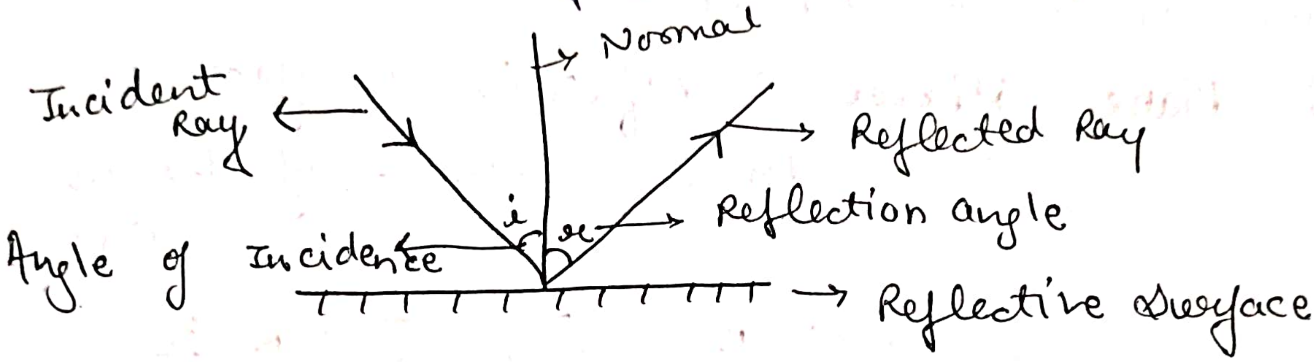
→ There are two types of objects on the basis of light

i) Luminous object - objects that have their own light.
Ex :- Sun, Bulb, Burning of Candle.

ii) Adipta object - objects that do not have their own light.
Ex :- Moon.

Reflection of Light

When a light ray hits a reflective surface and returns back to the same medium, it is called reflection.



R-1 :- Incident Ray, Reflected ray and Normal all lie in the same plane.

R-2 :- The value of the angle of incidence is equal to the angle of reflection.

Angle of Incidence = Angle of Reflection

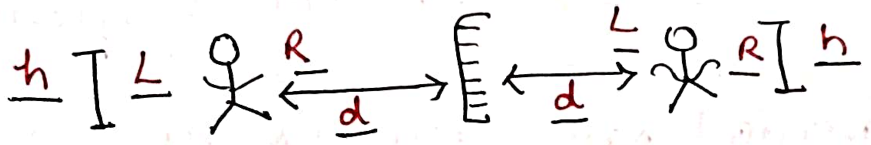
$$\angle i = \angle r$$

* The laws of reflection apply to all reflective surfaces.
* A plane mirror is a good reflector of light.
* Silver is a good example of reflection of light.

Mirror - In this one surface is Reflective
↳ $AgNO_3$ (silver nitrate) is coated on the second surface. ZnO or mercury is also used.

Two Kinds of Mirror -

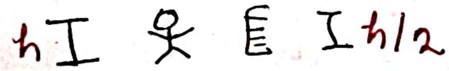
i) Plane Mirror → Reflective surface :- Plane, Distance of Focus = ∞ (Infinity)



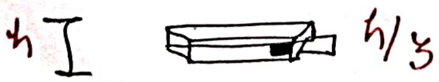
Characteristics of Image → Virtual, side reverse (L ⇌ R), Equal height

- The object is far from the mirror then image is also far its distance are similar in b/w them.

Some S.P. Points : i) If the height of a person is h, then to see his complete image, the height of the mirror will be taken as h/2.



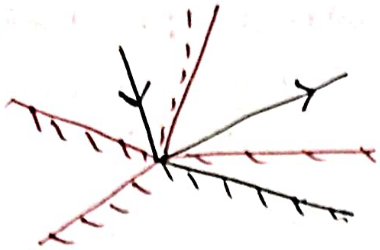
ii) To fully see the wall in front of the mirror, take a mirror of h/3 wall height.



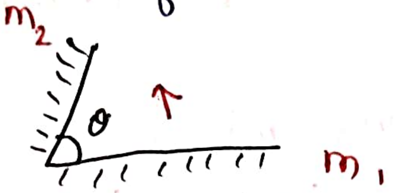
iii) If a plane mirror is rotated by one degree θ, the reflected ray will rotate by 2θ degrees.

Diagram

Incident ray → No change



iv) If the medium of plane mirror is θ angle, then the no. of image.

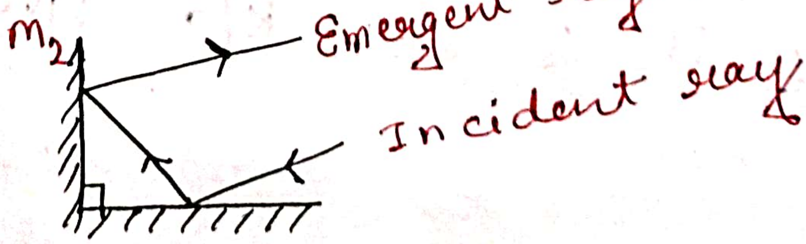


No. of images → $\frac{360^\circ}{\theta} = K$

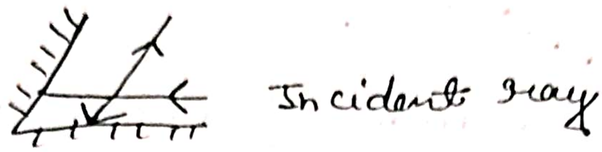
- Even: $(K-1 = n)$
- Odd
  - Not Symmetry: $n = K$
  - There is symmetry: $K-1 = n$

- If it is said that the object is Kept. similar b/w the two mirrors $K-1 = n$. If it is not symmetry, then it will $K = n$.
- If nothing is said in the question, then it is consider similar.

NOTE → If the medium of two Plane Mirror is 90° angle. then incident ray and emergent ray are similar to each other.



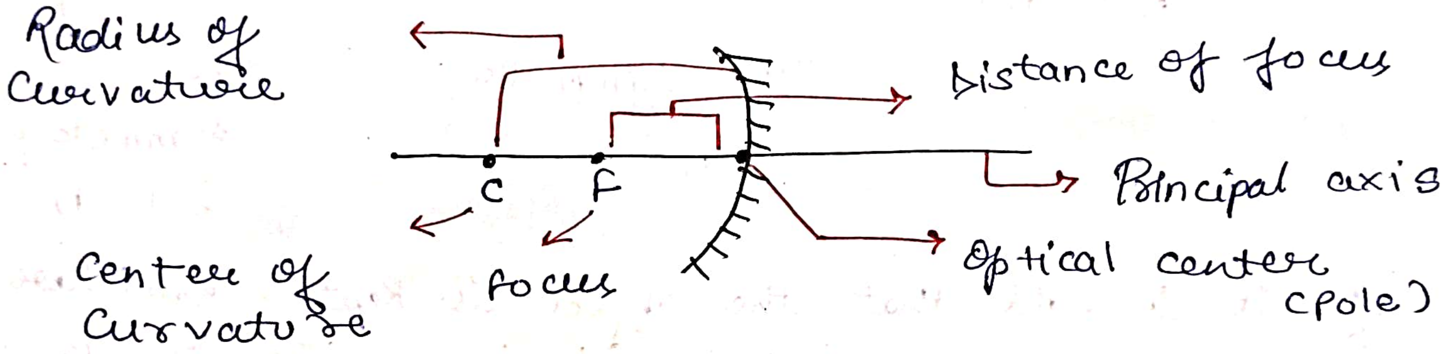
NOTE → If the incident ray comes parallel to M_1, then the emergent ray goes parallel to M_2



Uses of Plane Mirror :- In Bathroom, Periscope (In submarine)

Spherical Mirror → Those mirror whose Reflective surface are spherical, those mirror are K/a Spherical mirror.

1) Concave Mirror - The reflective surface is recessed inwards.



→ Concave mirror works to focus light, that's why it is also K/a converging mirror.

2) Convex Mirror - The reflective surface bulges outward.

Convex Mirror is used to diffuse light. that's why it is also K/a Diverging Mirror.

Some Definations :-

1) Center of Curvature → The center of the hollow sphere of which the spherical mirror is a part is called the center of curvature.

2) Radius of Curvature → The radius of the hollow sphere of which the spherical mirror is a part is called the radius of curvature.

3) Principal axis → Imaginary line joining the pole and center of curvature of the mirror is called the principal mirror.

4) Pole / Optical center → Mid point of reflective surface is K/a Pole / Optical center.

5) focus → The point at which rays of light coming parallel to the Principal axis meet or appear to meet. that point is K/a focus.

6) (F) Distance of focus → Distance b/w focus & Point is K/a Distance of focus.

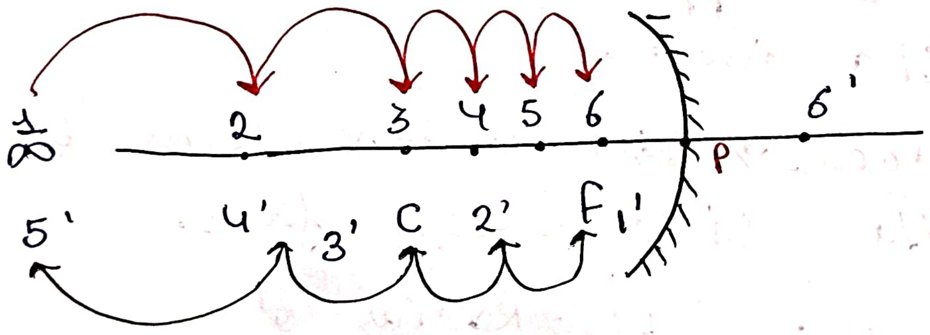
$(R = 2f)$ ⇒ Relations b/w Radius of Curvature and Distance of focus.

R = Radius of Curvature.
f = Distance of focus.

Formation of Image

Concave Mirror

Condition of object	Condition of Image	Characteristics	Size
i) (at Infinity)	F (on focus)	Real, Opposite	Very Small
ii) ∞ – C (B/w)	F–C (B/w)	Real, Opp.	Small
iii) On C	On C	Real, Opp.	Equal
iv.) C – F (B/w)	C–∞ (B/w)	Real, Opp.	Big / large
v.) On F	On ∞	Real, Opp.	Very big / large
vi.) B/w F & P	Behind the mirror	Virtual, Erect	Enlarged



Images of Convex Mirror :-

1) object at on the infinity :-

Image → Virtual, direct, at focus behind the mirror, very small.

2) Object b/w the Infinity and focus :-

Image → Virtual, direct, Behind the mirror, small

Uses of Spherical Mirror :-

1) Concave Mirror → Solar Cooker, Telescope, Headlight, ENT Doctor, Search light (Torch)

2) Convex Mirror → In Street light, in side glasses, in rear view mirror of Vehicles.

Some Imp. Points →

Uses of Parabolic Mirror → In astronomical telescope

To concentrate the Mirror wave signal coming from satellite in dishantenna.

- In Automobile headlight (in fog lamp)

formula of Mirror → $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

v = Distance from Pole to image
u = Distance from Pole to object
f = Distance of focus

$$\frac{u+v}{vu} = \frac{1}{f} \quad \left[f = \frac{vu}{v+u} \right]^{*}$$

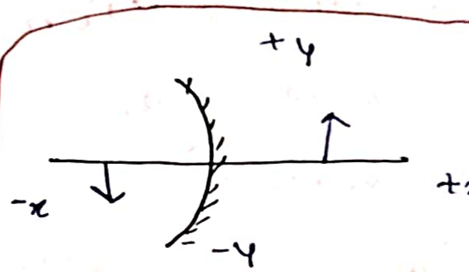
Magnification (m) = $\frac{\text{Height of Image}}{\text{Height of object}}$

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

m >1 - Then - large Image
m <1 - Then - Small Image

m = negative - image - real - concave
m = positive - Image - virtual - *convex, concave
m = 1 - plane mirror

NOTE - If m = 2 for a plane mirror then the image is twice as large.



+ve - real
-ve - virtual
dist. of object → -ve

Q. In front of mirror the image of object magnification is m = -1, then the name of mirror and position of object is? ↓ concave
position ↓ Centre of curvature

m = 1, then because of -ve sign
image will be → Real
Concave Mirror

m = -1, then the height of image is equal to height of object.

$m = \frac{h'}{h} = 1 \rightarrow$ object is on centre of curvature of mirror.

Properties → Real, Invert, Equal

NOTE → focal length of concave = −ve
focal length of convex = +ve

Q: The focal length of concave mirror is 2m. and the image formation distance is 4m. then, find the dist. of object.

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{4} + \frac{1}{u} = \frac{1}{2}$$

$$\frac{1}{u} = \frac{1}{2} - \frac{1}{4}$$

$$\frac{1}{u} = \frac{2-1}{4} = \frac{1}{4}$$

$$\boxed{u = -4}$$

or

$F = 2m$
$v = 4m$

$R = 2f$ (if double value)

$\boxed{u = -4}$ ans

The colour of an object depends on the light reflected by it.

a) Red light is reflected on a read coloured object, hence it appears red.

b) An object appears black when light of all colours is absorbed by it.

c) An object appears white when all the colours are reflected by it.

*d) A red coloured object appears black in green glass.

e) Light synthesis is max^m in the mixture of red & blue colours and least in green light.

Q. An object on a mirror is 30 cm far, then what is the distance of its image?

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

Plane mirror.

→ focus dist. - 10 cm ⟶ (concave)

→ In plane mirror, where the object is placed, the image is also placed at same dist.

30 cm

$v = u$

ii)

| u = 30 cm
| f = -10 cm

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} - \frac{1}{30} = -\frac{1}{10}$$

$$\frac{1}{v} = -\frac{1}{10} + \frac{1}{30}$$

$$\frac{-3+1}{30} = \frac{1}{v} = \frac{-2}{30}$$

$$v = -15$$

Q.4 ★ from 1 concave mirror, how far should an object placed so that its image is double than object and erect (सीधा) occurs.

प्रतिबिम्ब वस्तु का दुगुना, सीधा

m (आवर्धन) = +2 → सीधा, आभासी

अवतल दर्पण मे सीधा व, आभासी तभी प्राप्त होगा जब वस्तु F व P के मध्य हो

u<f (बिम्ब की दूरी)

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

$$\frac{1}{v} = \frac{u-f}{uf},$$

$$v = \frac{uf}{u-f}$$

$$\boxed{m = \frac{-v}{u}}$$

$$m = (-)\frac{\frac{uf}{(u-f)}}{u}$$

$$m = (-)\frac{f}{(u-f)}$$

अवतल = f = -ive

$$m = (-)\frac{(-f)}{u-(-f)}$$

$$\frac{2}{1} = \frac{f}{u+f}$$

$$f = 2(u+f)$$

$$f = 2u + 2f$$

$$2u = +2 - f$$

$$2u = f$$

$$u = \frac{f}{2}$$ ans 4

Q.4 In front of a convex mirror, where should an object be placed so that its image is half dist. of focal length? (U=?)

~~a) -f~~
b) f/2
c) f/4
d) 2 f

$V = +\frac{f}{2}$
↳ virtual, erect

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{(f/2)} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{u} = \frac{1}{f} - \frac{2}{f}$$

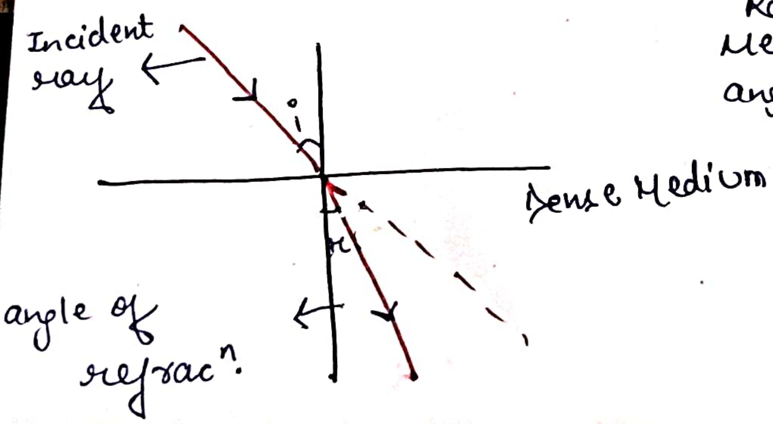
$$\frac{1}{u} = \frac{1-2}{f}$$

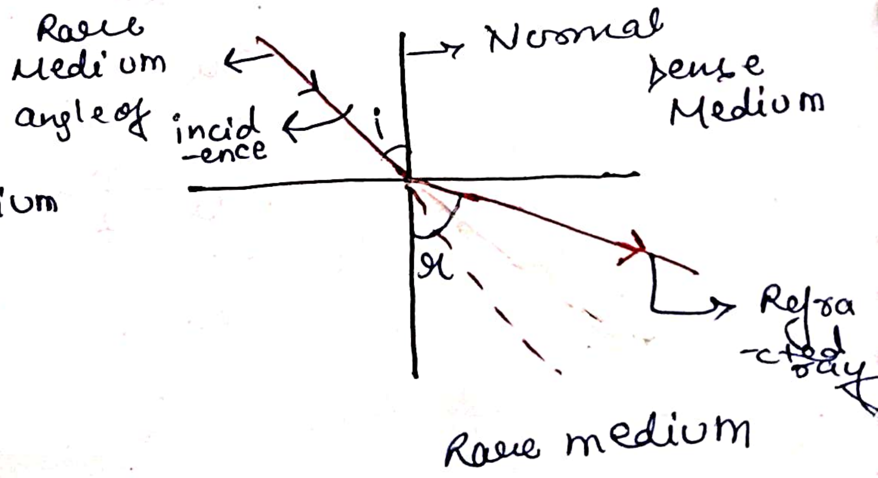
$$\frac{1}{u} = \frac{-1}{f}$$

$$\boxed{u = -f}$$ → distance of an object

Refraction of light

When a ray of light enters from one medium to another, it deviates from its path. This is K/a refraction of light.





When Ray
Dense to Rare then - far from Normal $v\uparrow$ $\lambda\uparrow$
frequency - No change

Rare to Dense then - near to Normal $v\downarrow$ $\lambda\downarrow$
frequency - No change

Rule of Refraction

R①:- Present in the plane of the incident ray, refracted ray and normal.

R②:- $\frac{\sin i}{\sin r}$ = Const. Refraction follows Snell's law

This const. value denote ($\frac{\mu}{n}$)

$\frac{\mu}{n}$ → Refractive index

The ratio of the sines of the two angles is called the refractive index.

Ex:- - Twinkling of stars,
- The slant of a pencil kept in water is visible when it is dipped.
- Ponds, buckets, swimming pool bottom raised.
- visibility of the sun even before sunrise & after sunset.

*Q. Twinkling of stars and visibility of the sun even before sunrise and after sunset is example of which event?

a) Refracn
b) Reflection
✓c) Env. Refraction/Atmospheric
d) Total internal refracn

NOTE → Pond / bucket / Swimming pool virtual depth is $\frac{3}{4}$ th of Actual depth.

Q.4 The actual depth of a pond is 10 m then find virtual depth ?

virtual depth is $\frac{3}{4}$ of actual depth

virtual depth ~~10 × 30/4~~

$10 \times \frac{3}{4} = \frac{30}{4} = \frac{15}{2} = 7.5$ mt.

raised part $= 10 - 7.5$

$= 2.5$ m

Value of Refractive Index of some medium →

- ★ Air = 1.0003
- ★ water = 1.33
- Ice = 1.5
- Crown Glass = 1.52
- Canada Balsam = 1.53
- ★ Diamond = 2.42
- Vaccum = 1.00
- Glass = 1.5

Relative Refractive Index

Refractive Index of one medium related to another

n_{21} :- $\frac{n_2}{n_1}$ = $\frac{\text{I}^{st} \text{ medium of the movement / wavelength / Curvature radius}}{\text{II}^{nd} \text{ medium of the movement / wavelength / Curvature radius}}$

n_{12} :- $\frac{n_1}{n_2}$ = $\frac{\text{II}^{nd} \text{ medium of the movement / wavelength / Curvature radius}}{\text{I}^{st} \text{ medium of the movement / wavelength / Curvature radius}}$

Ex :- $n_{wa} = \frac{n_w}{n_a} = \frac{4}{3}$ [1.33 water]

(water related to air)

$n_{aw} = \frac{n_a}{n_w} = \frac{3}{4}$

(air related to water)

Q.4 The speed of light in air is 3×10^8 m/s. then, find the speed of light in water?

$V_{air} \rightarrow 3 \times 10^8$ m/s

$V_{water} \rightarrow ?$

water relative of air, refractive Index $= \frac{4}{3}$

$n_{wa} = \frac{n_w}{n_a} = \frac{4}{3} = \frac{3 \times 10^8 \text{ m/s}}{V_{water}}$

$9 \times 10^8 = 4 V_{water}$

$V_{water} = \frac{9 \times 10^8}{4} = 2.25 \times 10^8$ m/s

Q.4 The speed of light in glass is 2×10^8 mt/sec. then, find speed of light in air →?

$$n_{ga} = \frac{n_g}{n_a} = \frac{3}{2}$$

$$\frac{n_g}{n_a} = \frac{V_{air}}{2\times10^8}$$

$$\frac{3}{2} = \frac{V_{air}}{2\times10^8}$$

$$2V_{air} = 6\times10^8$$

$$V_{air} = \frac{6}{2}\times10^8 = 3\times10^8 \text{ mt/sec.}$$

Q.4 The wavelength of light in air is 6000 A°. ~~then,~~ if this light pass through daimond, then, find its wavelength ?

[Reflective index of daimond → 2.42]

wavelength of air = 6000 A°

" " daimond = ?

$$n_{Da} = \frac{n_D}{n_a} = 2.42$$

$$\frac{n_D}{n_a} = \frac{6000 A^\circ}{n_D}$$

$$2.42 = \frac{6000}{n_D}$$

$n_D = \frac{6000}{2.42} = 2500 A^\circ$ ans

* $\left[n_{21} = \frac{1}{n_{12}} \right]$

* $\left[n_{21} \times n_{12} = 1 \right]$

Ex → $n_{wa} = \frac{4}{3}$

$n_{aw} = \frac{3}{4}$

$n_{wa} = \frac{1}{n_{aw}}$

$\frac{4}{3} = \frac{1}{\frac{3}{4}}$

$\frac{4}{3} = \frac{4}{3}$

Q. जल का वायु के सापेक्ष Refractive index $\frac{4}{3}$ and glass का ,, ,, ,, ,, ,, $\frac{3}{2}$ है तो जल का glass के सापेक्ष Refractive index ज्ञात करो।

$n_{wa} = \frac{4}{3}$

$n_{ga} = \frac{3}{2}$

$n_{wg} = ?$

$n_{wg} = \frac{n_w}{n_g}$

$= \frac{3}{2 \cdot 4} \times \frac{2}{3}$ ~~$\frac{1}{2}$~~

~~$= \frac{4}{3} \times \frac{3}{2} = 2$~~

$n_{wg} = \frac{4/3}{3/2} = \frac{4 \times 2}{3 \times 3} = \frac{8}{9}$ ans

$n_{gw} = \frac{n_g}{n_w} = \frac{3/2}{4/3} = \frac{3 \times 3}{4 \times 2} = \frac{9}{8}$ ans

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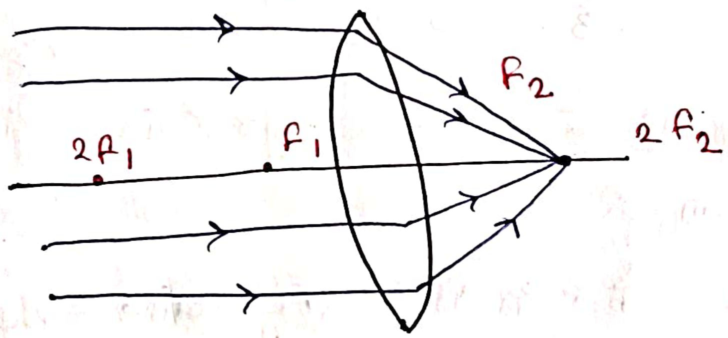
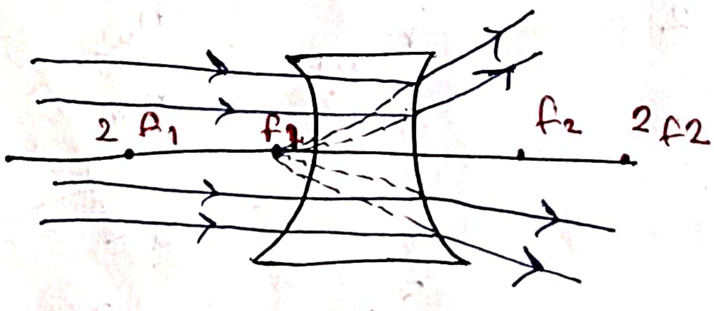
Lens

A transparent medium surrounded by two reflecting surface, one or both of which are spherical. This is known as lens.

Convex lens / Biconvex lens / Converging lens
Two focus / Two center of curvature



Concave lens / Biconcave lens / Diverging lens
Two focus / Two center of curvature



Formation of Image (Convex lens)

Condition of Image	Condition of Image	Characteristic	Size
i) On ∞	On ∞	Real, opposite	very small
ii) B/w ∞ - $2f_1$	f_2 - $2f_2$ B/w	" , "	Small
iii) On $2f_1$	on $2f_2$	" , "	Equal
iv) B/w $2f_1$ - f_1	B/w $2f_2$ - ∞	" , "	large
v) On f_1	On ∞	" , "	very large
vi) B/w f_1 - P	B/w f_1 - P	virtual, Erect	large

Concave lens :-

i) object on the Infinity then :-

On Image f_1 , virtual, Erect, very small

ii) B/w the object ∞ and lens then :-

Image b/w f_1 and P , virtual , erect ,
small.

Some imp. points →

formula of Lens = $\boxed{\frac{1}{f} = \frac{1}{v} - \frac{1}{u}}$

f → focus length

v → Image distance

u → Object "

$$\text{Magnification} = \frac{h'}{h} = \frac{v}{u}$$

Capability of lens → The reciprocal of the focal length is clld the power of the lens.

$$\left[P = \frac{1}{f}\right] = \frac{1}{\text{Dis. of focus}}$$

$$= \frac{1}{Mt} = Mt^{-1} / \text{Director}$$

f → +ive, P → +ive then lens - Convex

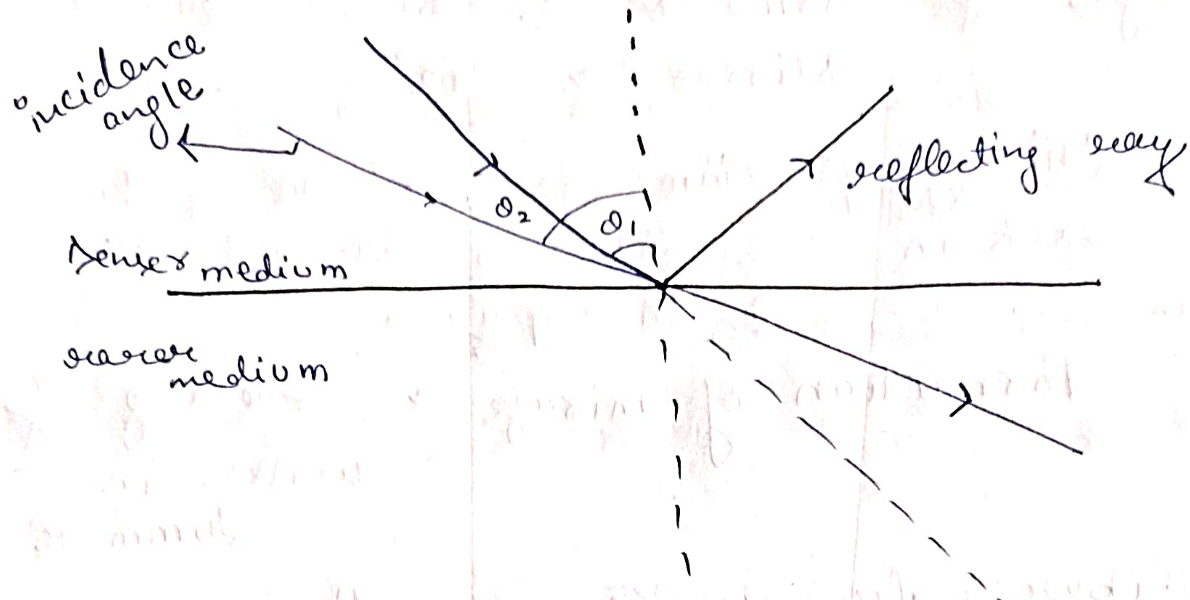
f → -ive, P → -ive then lens - Concave

Q.4 focus dist. of convex lens is 50 cm. then, find the capability of lens?

$$P = \frac{1}{f} = \frac{1}{50} = 2D \text{ ans.}$$

Total Internal reflection →

when a ray of light enters a rare medium from a dense medium, then if it returns back to this medium after refraction, then it is called T I R.

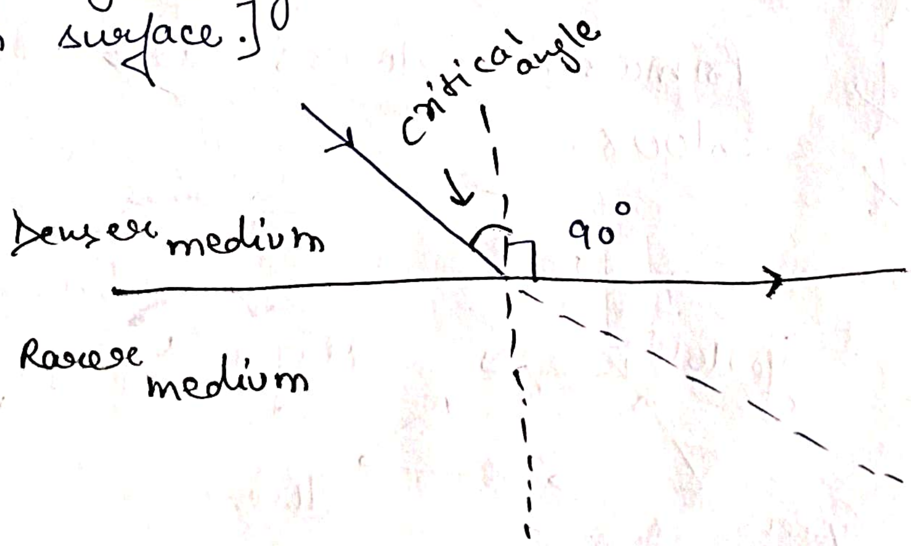


There are 2 conditions always apply for TIR.

Cond. - I :- Rays should always enter from denser medium to rarer medium.

Cond. - II :- The value of angle of incidence should be greater than the critical angle.

Critical angle → The angle at which a ray is incident, after refraction the refracted ray makes an angle of 90° with the normal. [parallel on surface.]



Critical angle of Diamond → 24°
" " " Mirror → 42°

Example → Shining of diamonds, bleam of a crack in the glass, bubble glow in water, Endoscopy, formation of mirage → feeling of water in summer

*NOTE
↓
Optical fiber also works on the principle of TIR.

Colour

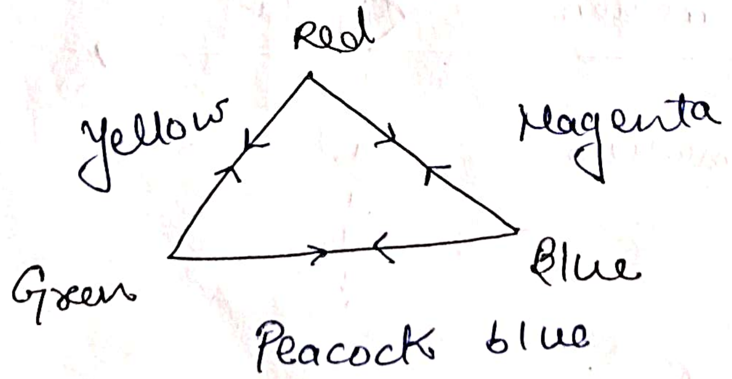
Two types of Colour →

i.) Primary colour → Colour that cannot be obtained by mixing other colour.

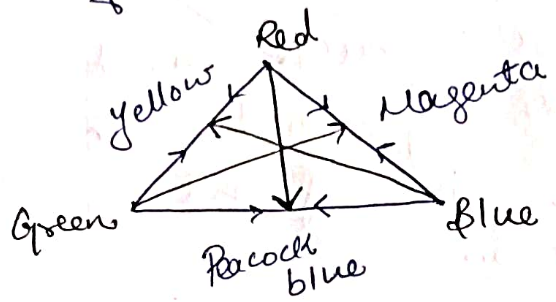
Red, Green, Blue is the primary colours

NOTE → These are broadcasted in colour T.V. and projectors.

ii.) Secondary Colour → Colour made by mixing of primary colours are called secondary colour.



iii.) Complementary Colours →
white colour obtained by mixing primary and secondary colours are complementary Colours.



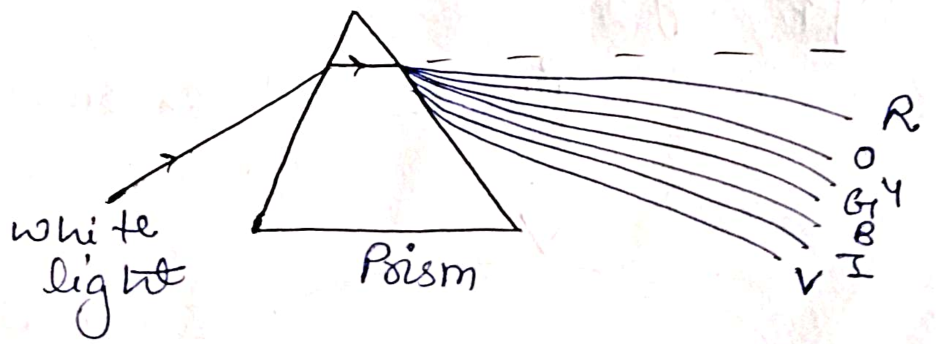
Red + Peacock = white
Green + Magenta = white
* Blue + Yellow = white

Orders of Colours →

V I B G Y O R →

Wavelength (λ) ↑ (v)↑ velocity
frequency (ν) ↓

Dispersion of light → When white light is passed through the Prism of the glass it gets divided into 7 colours. This is k/a Dispersion of light



Max^m Moving → violet
Lowest " → Red

Rainbow :- When the sun is behind the observer's back and water droplets are present in the atmosphere in front, a rainbow is formed.

NOTE
Rainbow is the eg. of total internal reflection, refraction, dispersion and reflection.

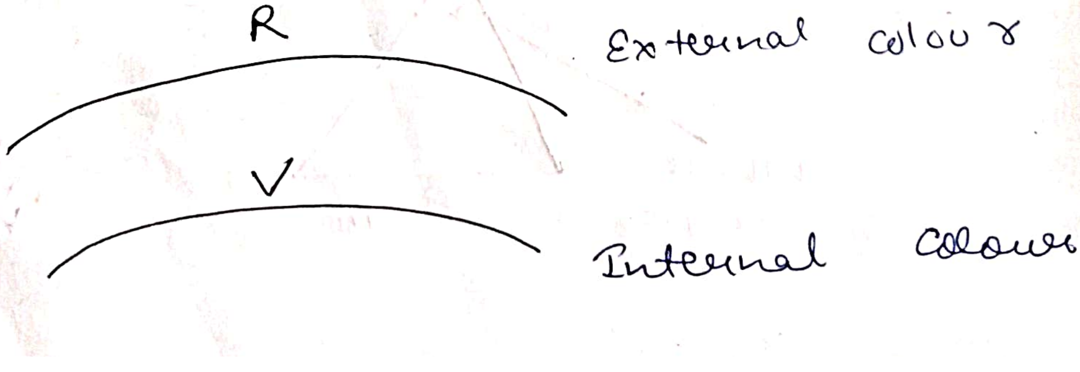
Primary Rainbow → In this, refraction occurs twice & Total/complete internal reflection occurs once.

→ This include the outer colour (top colour) → Red

→ In this, the inner colour (bottom) → Purple

→ More bright

→ An angle of 42° is formed by the eye of the observer.

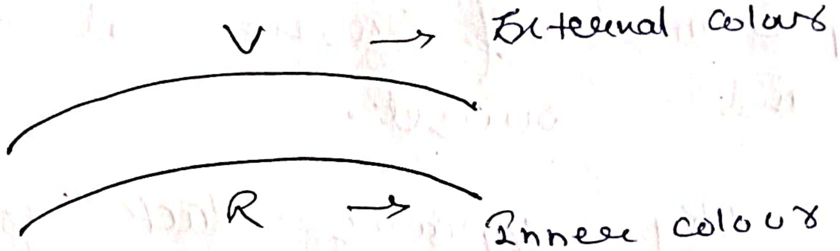


Secondary Rainbow :-

In this, refraction occurs twice and Total Internal reflection occurs only twice.

Outer colour → ~~Purple~~ Violet

Inner colour → Red



Less bright / blur

An angle of 52° 5' is formed by the observer's eye.

NOTE → (SSC 2022) ① Red colour is used in emergency lights and signal lights because its dispersion is the lowest & the wavelength is the highest.

② School buses are yellow in colour because yellow colour is less irritating to the eyes.

Scattering of light → When rays of light enter the atmosphere, they collide with water vapour and dust particles present in the atmosphere and get deviated in diff^t directions. This is called scattering effect of light.

→ Violet scatters the most and red scatters the least.

Ex → Sky appears blue,
Sea appears blue,
Appearance of redness at sunrise and sunset.

NOTE ① The sky appears black from space because there is no atmosphere.

② Clouds appears white (There is more water vapour in it) due to which all the colours get scattered.

③ Acc. to ~~Rot~~ Releigh, Blue colour scatters most in sunlight.

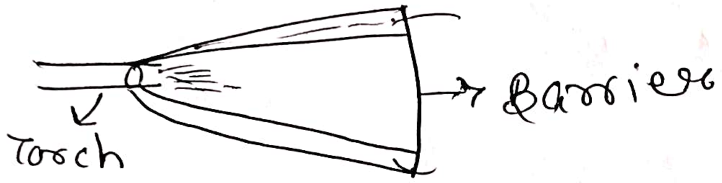
④ White light emanates from the sun.

⑤ The phenomenon of scattering of light by particles present in colloid solution is called Tyndall effect.

⑥ The colour of stars is different because their temp. are different.

Diffraction of light :-

When light hits a barrier surface, its direction changing and spreading around the barrier is called diffraction of light. Ex → Colourful appearence of CD

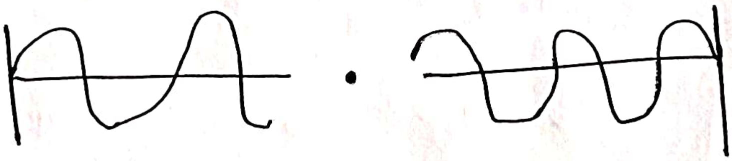


Interference of light :-

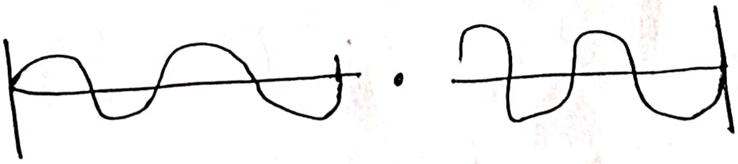
When two rays of light having the same frequency and amplitude reach any point in the medium simultaneously, redistribution of energy occurs.

If both are in equal phase then the energy increases and if they are in unequal phase then the energy decreases.

Constructive
↓
Max^m intensity

Equal phase 

Destructive
↓
Min^m intensity

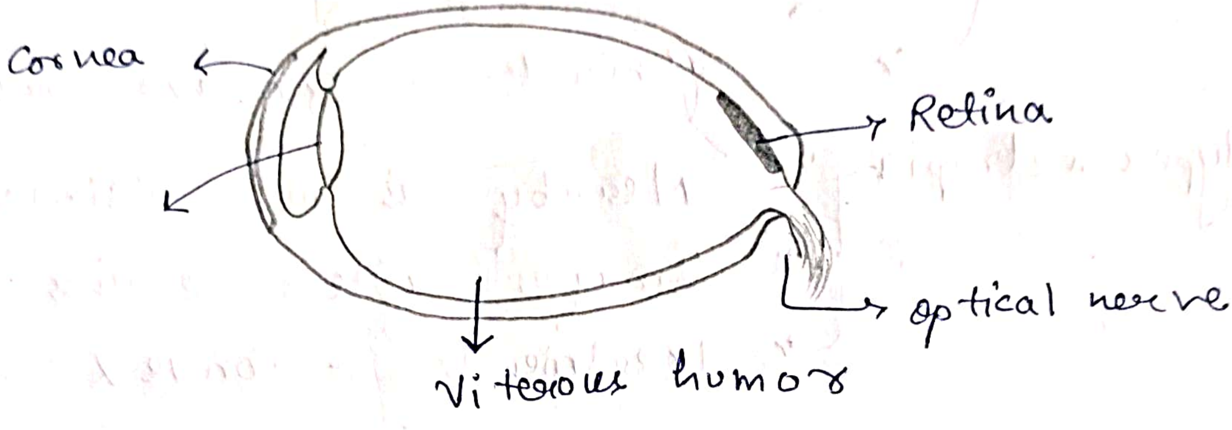
Unequal phase 

Eg → Colourful appearance of soap bubbles.

→ Kerosene oil layer appearing coloured on the water surface.

→ Light House also works on this phenomenon.

EYE



- The image is received on the retina. this image is always real and inverted.
- The retina also works to convert image signals into optical signals.
- Apparent distance for normal eye = 25 cm
- Minimum focus distance = 1.7 cm / 17mm
- Capacity of the lens of the eye = 60 D (60 Director)
- The human eye works like a 576 mega pixel camera.
- When donate an eye, the cornea part of the eye is donated.

Defects of vision

i) Myopia →
- Distant objects are not visible.
- Before the image retina.
- Treatment - concave lens

ii) Hyper metropia →
- Nearby is not visible
- Image after retina
- Treatment - Convex lens

iii) Presbyopia →
- Neither near, nor far
- The flexibility of the lens is lost.
- Treatment - Use of bifocal lenses.

iv) Astigmatism → Unable to see horizontally and vertically at equal distances.

→ If horizontal lines are clearly visible then vertical lines appear curved. The opposite is also true. 

Treatment - Cylindrical lens

v) Colour Blindness → No identity of colours.
→ [Red & Green] → This looks like Black

→ No any treatment

→ Genetic Diseases.

vi) Cataracts →

white membrane form in front of cornea by which a net like str. is form in front of Eyes.

Treatment by surgery

Some Imp. Points

→ The objects' smallest shadow is formed at 12 o'clock.

→ * Flint glass is used to make lenses.

→ The image formed on the retina of the human eye is real, inverted.

→ The image remains on the retina of the eye for 1/16 sec.

→ A bubble formed inside water behaves like a concave lens.

→ Water drop behaves like a convex lens.

→ The mass of resting photon is zero.

→ Scattering does not follow the laws of reflection.

→ Acc. to Davison German, the nature of electron is also dual.

→ Periscope works on the principle of total internal reflection. or reflecn

→ If the lens is immersed in a liquid, then

Condition - I (Refractive Index) liquid < lens

→ In this the focal distance of the lens ↑

→ Nature - no change

Condition - II (Refractive Index) Liquid = lens

→ focus distance becomes infinite.

→ Capacity exhausted, work like a flat plate, lens not visible in liquid.

Condition - III (Refractive Index) liquid > lens

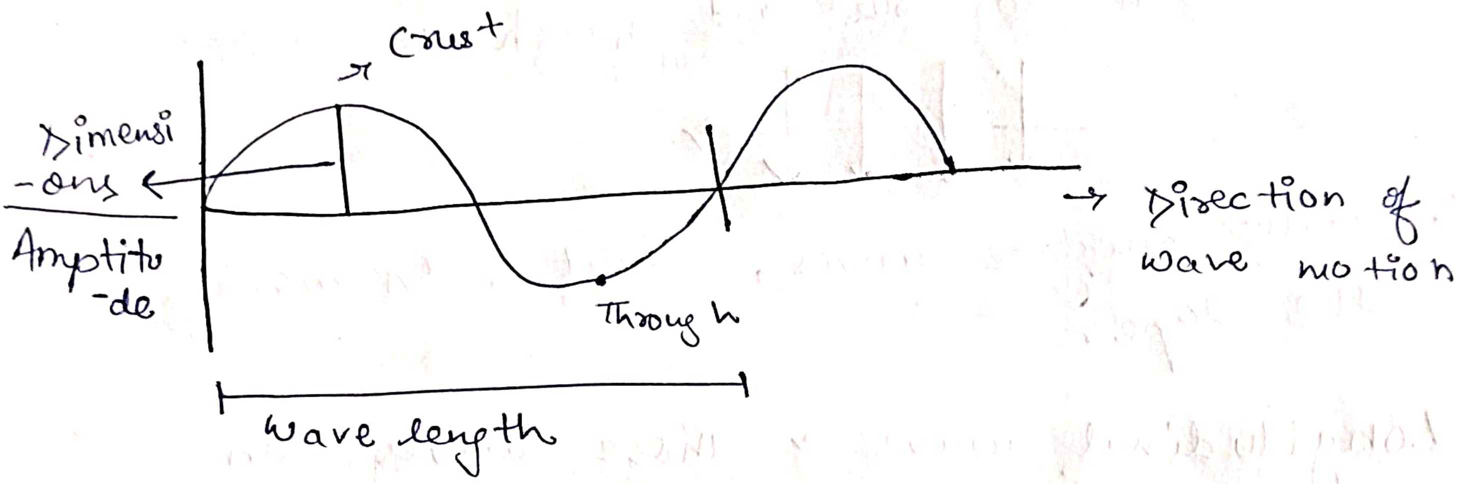
→ Nature - change

→ (Convex ⇌ Concave)

Sound and wave

Wave is a type of Disturbance, which transmits in medium or in enviroment. Vaccum

waves transfer energy and momentum from one place to another.



On the basis of presence of medium there are two types of wave :-

Wave
- Mechanical wave [Elasticity wave)
  - on basis of vibration
    - Transverse
    - longitudinal
- Non-Mechanical wave (E.M. wave)
  - e.g. → X-Ray, γ-ray, light etc.

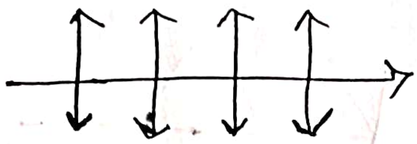
Mechanical wave :- the waves that require a medium for transmission. K/a mechanical wave.

~~EM wave~~

There are two types of Mechanical wave.

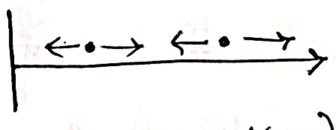
1) Transverse wave → Those waves whose direction of propagation is Perpendiculare to the direction of vibration in the particles of the medium.

In this Crust and Through are made.



E.g. Water surface waves, light, on moving the rope.

2) Longitudinal wave → Those waves in which the direction of propagation is parallel to the direction of vibration of the particles of the medium.

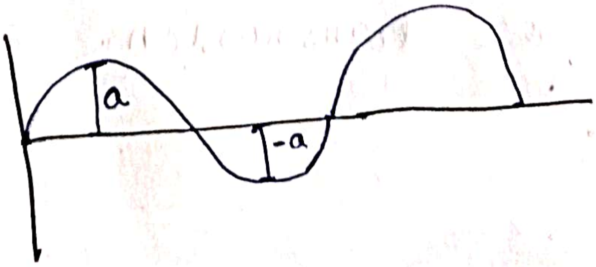


E.g. Sound waves, P-waves (in Earthquake)

This made contraction and rarefaction

Some Imp. Definations →

1) (a) Amplitude → The maximum displacement from the middle position is called amplitude.



→ The amplitude of the wave and the amplitude of the vibrations generated in an object both are equal.

→ Unit → Meter

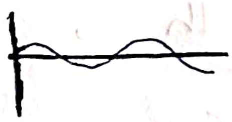
→ Dependence :- Emphasis on the loudness and softness of sound and force

→ Loudspeaker always increases amplitude.

2) frequency (ν) :- The no. of oscillations made in a unit time.

The no. of waves passing through a point in a unit time.


(High)


(low)

$$\text{frequency} = \frac{1}{\text{Time Period}}, \quad \nu = \frac{1}{T} =$$

$$\frac{\text{no. of oscillations}}{\text{Time}}$$

Unit — Hertz (sec^{-1})

Q. An object makes 10 oscillations per second, find its frequency.

$$\text{frequency} = \frac{\text{no. of oscillations}}{\text{Time}} = \frac{10}{1} = 10 \text{ Hertz}$$

Q.4 A particle simple (S H M) due to 200 oscillation in 15 sec. time then frequency →

$\frac{200}{15} = \frac{40}{3} = 13.33$ Hz

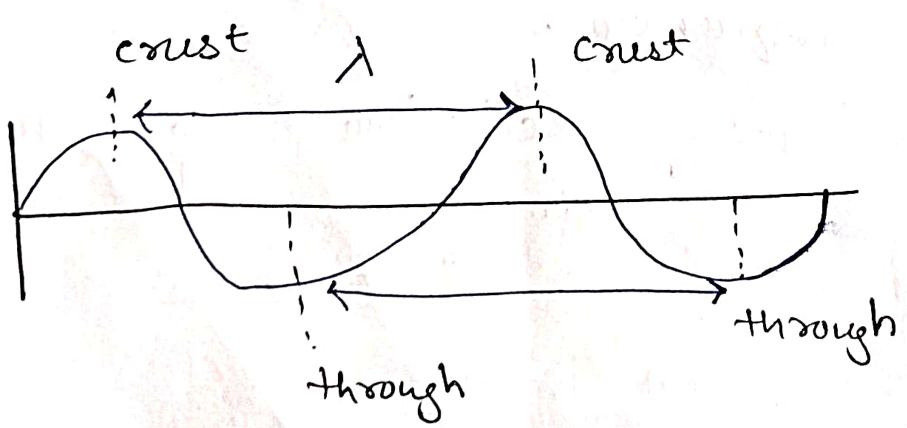
Time Period :- The time taken to complete one cycle of oscillation or vibration is called Time Period.

$$\text{Time period} = \frac{1}{\text{frequency}} = \text{sec.}$$

Wavelength :- The horizontal distance b/w two consecutive throughs or two consecutive peaks / crust

The distance b/w two consecutive compressions or two rarefactions

Unit = Å (10^{-10} m)



Speed of waves → The distance traveled by a wave in one sec is called the speed of the wave.

$$\text{Speed} = \frac{\text{Distance covered}}{\text{Time taken}} = \frac{\lambda}{T}$$

$V = \frac{\lambda}{T}$ | $\frac{1}{T} = \nu$

$[V = \lambda \nu]$ [frequency $\propto \frac{1}{\text{Wavelength}}$]

[Speed $\propto$ wavelength]

Q. Speed of sound is 400 mt/sec. if its wavelength is 10 mm / 1 cm. then find its frequency?

$\lambda = 10mm / 1cm = 1 \times 10^{-2}$ mt

$V = 400$ mt/sec

$V = \nu \lambda$

$\nu = \frac{V}{\lambda} = \frac{400}{10^{-2}}$

$= 400 \times 10^{2}$

$= 40 \times 10^{3}$ Hz

Factors affecting the speed of sound :-

i) Elasticity :- Speed of sound ↑es as elasticity ↑es.

Solid > Liquid > Gas {Highest elasticity of solid.

ii) Density :- The speed of sound is inversely proportional to density.

$$\text{Speed} \propto \frac{1}{\text{Density}}$$

iii) Pressure :- Unaffected

No effect in the speed of sound.

If the pressure is 2 times in a medium then density also will be 2 times.

iv) Temperature :- The speed of sound increases as the temperature of the medium increases.

$$V \propto \sqrt{T}$$

[T → Kelvin]

$[T_K = T_C + 273]$

Note → By increasing 1°c, the speed of sound increases by ·61 m/s.

Q.4 27°C पर ध्वनि की चाल ज्ञात करो ?

$[0°c = 332 \text{ mt/sec}]$

$27°c \rightarrow 0.61 \times 27°c = 16.47 \text{ mt/sec}$

$\rightarrow 332 + 16.47 = 348.47 \text{ mt/sec}$

Q.4 वह ~~ताप~~ (Temp.) जिस पर ध्वनि की चाल का मान 0°C पर चाल का 2 times हो जाए।

$T_1 = 273$ $\quad V_1 = V$

$T_2 = (T_2 + 273)$ $\quad V_2 = 2V$

$V \propto \sqrt{T}$

$$\frac{V_1}{V_2} = \sqrt{\frac{273}{T_2 + 273}}$$

$$\frac{V}{2V} = \sqrt{\frac{273}{T_2+273}}$$

$$\frac{1}{4} = \frac{273}{T_2+273}$$

$$4 \times 273 = T_2 + 273$$

$$T_2 = 4 \times 273 - 273$$

$$T_2 = 3 \times 273$$

$$= 819 \text{ K}.$$

Q.4 If The temp. of a medium is 4 times then what will be the velocity?

$T \longrightarrow 4T$

$V \propto \sqrt{T}$

$V = \sqrt{4T}$

$V = 2$ $\quad$ therefore, velocity will be double.

→ The speed of sound increases with increase in humidity.

→ With increase in hardness the speed of sound increases.

→ If the direction of the wind is in the direction of sound then the speed of sound increases.

Types of sound wave on the basis of frequency →

i) Infrasonic wave → these waves whose frequency is less than 20 Hertz.

Eg → Earthquakes waves, Volcano waves, sea waves, walk of elephant, Horse.

ii) Ultrasonic waves / Ultra sound → Those frequency is more than 20,000 Hz. Human can't hear.

Eg → Dogs (50KHz)
Monkey
Bat (120K Hz)
Cat, Dolphin, fish, Porpoises etc. can hear.

Eg → Bats, Cats and Dogs also produce.

Uses :-
Medicine and industries,
Detecting tumors,
Removing smog at airports,
Clearing arteries of the factory.

→ To know the location of submarines and icebergs.

→ To find out the depth of sea and lake.

→ These waves are converted into electrical signals and displayed on the monitor. this is K/a Ultrasonography.

↳ Examination of the foetus during Pregnancy, detecting congenital defects.

↳ To obtain the image of the heart by reflecting UV rays this is K/a electo cardiography. [ECG]

↳ ~~this~~ ultra sound is used to break small calculus into fine particles.

★ Range of Hearing → [20 Hz – 20,000 Hz.]

NOTE – Children up to 5 years of age can hear 25,000 Hz.

SONAR → Sound Navigation And Ranging

Uses → In measuring the distance of bodies situated in water.

→ In detecting communities of Iceberg and submarine fishes. [By U.V waves]

→ The distance, direction and speed of objects underwater are determined. [Infrasonic rays]

NOTE → The speed of infrasonic, ultrasonic and range of hearing is always same.

Characteristic of sound →

i) Intensity of sound → Sound energy passing through unit area in unit time is k/a intensity of sound.

→ The intensity of sound depends on its amplitude.
→ Unit → Decibel [1 Bell = 10 Decibel]
→ Other Unit → phone, Bell, Sone

* General whisper → 15 - 20 dB
* General conversation → 50 - 60 dB
* Category of pollution → more than 80 dB

NOTE → To reduce noise pollution, the central govt. has started a scheme called Green muffler, under which trees are planted on both sides of the roads.

ii) Pitch → Pitch depends on frequency.

{Pitch ∝ frequency}

→ heavyness and shrillness voice occur becoz. of this.

→ Pitch increases as the frequency increases and sound become thinner and sharper.

→ As frequency decreases, pitch also decreases and the sound becomes thick and flat.

NOTE → Pitch of lion's roar is lower than that of a mosquito's buzzing sound.

[iii] Loudness :- The measure of sensitivity of a person's ears is called loudness.

→ It depends on the medium of sound.

→ Loudness depends on amplitude.

→ Any one sound is loud or strong for a person. It may be soft for others.

[iv] Quality / Timbre → The quality of differentiating b/w sounds of equal pitch and intensity produced by two different musical instruments is called quality of sound.

→ flute, violin, sitar and tanpura etc. were recognized on the basis of quality.

[V] Speed of Sound → depend on the properties of the medium and the temp.

Air → 22°C = 324 mt/sec
25°C = 243 mt/sec

Al → 5420 mt/sec

Ni → 6040 mt/sec

Steel → 5960 mt/sec

Iron → 5950

Water → 1498 mt/sec

water (sea) → 1531 mt/sec

Air → 346 mt/sec

O_2 → 316 mt/sec

Be → 12890 mt/sec

$[V_{solid} > V_{liquid} > V_{gas} > V_{vaccum}]$

*NOTE → when a sound wave passes through a medium, its amplitude, wavelength & speed change but its frequency remains unchanged.

Sonic Boom → If an object moves faster than the speed of sound, then that speed is called supersonic speed.

[Bullet, rocket, jet - airplane]

→ Due to their movement, shock waves are generated in the air. Their energy is very high, causing changes in air pressure, which produces a very loud, powerful sound. This is called sonic boom.

→ The energy of the sonic boom is high, which causes damage to windows and buildings.

NOTE → The speed of sound in air is less than the speed of light. for this reason, lightning appears first during the rainy season, the flash of lightning is seen first and the sound is heard later.

Reflection of sound → when sound hits the reflecting surface and returns through the same medium, it is called reflection of sound.

→ follows the laws of reflection

→ Due to the longer wavelength of sound, its reflection is greater from larger sized surface.

Eg. → Wall, Mountains, Earth, floor etc.

Uses → Stethascope, horn, megaphone, loud speaker work on the principle of reflection.

NOTE → That's why the roof of the halls are made semi circle ~~square~~. Sound can be reflected and reach all parts.

Echo :- When a person shouts loudly in front of a suitable reflective surface, after some time he hears his own sound, which is called an echo.

→ To hear a clear echo, there should be a time interval of at least 0.1 second b/w the original sound and the reflected sound.

→ To hear a clear echo, the min^n. distance b/w the source and the barrier should be 17.2 mt.

→ The sound of thunder is produced as a result of repeated reflection from many reflective surfaces (clouds, land)

Eg → wells, closed room, empty room.

Reverberation → (Due to frequent reflection)

The sound heard in a hall for some time even after switching off the sound source is called Reverberation.

Ex :- Thunder of clouds is an ex. of Reverbera^n.

→ The walls of hole are made rough to prevent unnecessary reverberation in the hall or cinema hall.

→ The floor is carpeted to prevent reverberation.

→ Heavy curtains are placed on doors and windows to absorb this sound.

Refraction of sound → When sound waves enter from one medium to another, they deviate from their position. This is called refraction of sound.

Due to refraction of sound, sound is heard at a greater distance at night than during the day.

Diffraction of sound → The property of sound due to which sound bends around the edges of a barrier surface and travels in different directions.

It is due to diffraction that the person sitting in the room hears the outside sound.

Resonance :-

When a particle of the medium is oscillating freely and an external force (wave) of uniform frequency is applied on it, its amplitude increases. This phenomenon is called resonance.

Eg. → Radio works on the principle of resonance.

→ while crossing the bridge, army personnel are advised not to keep pace.

NOTE → Sound waves increase the amplitude of the free particle.

Doppler effect :- When there is relative motion b/w the sound source and the source, the frequency of the sound heard by the source is different from the frequency of the original sound.

The frequency of sound is inversely proportional to the distance b/w the source and the listener.

$$\left[f \propto \frac{1}{d} \right]$$

f → frequency

d → distance

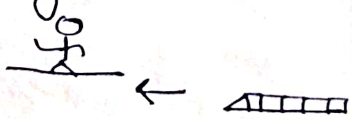
Uses → In determining the movements of aircrafts and submarines.

→ To find out the motion of stars.

→ Guiding the aircraft at the airport

→ The velocity of the aircraft can be calculated by the difference in the frequencies of the waves sent from the station to the aircraft and received from the aircraft at the station.

i) If a train is approaching, the sound - loud, high frequency.



ii) If train is going, the sound is sparse, low frequency. 

NOTE → Due to Doppler effect, relative motion is mandatory

→ Both the source and the listener can be moving. One of the two may be dynamic.

E M waves

→ These waves do not require a medium for transmission.

→ E.M waves are also called non-mechanical waves.

→ E. M waves, AC circuit are propagated or emitted by continuously changing current.

Properties → Generated by accelerated charge.
↳ Transmission does not require a medium.
↳ In free space these waves travel at the speed of light 3×10^8 mt/ sec.

E.M waves	Discoverer	Frequency range	Source	uses
(i) γ-rays	Becquerel and Curie	$10^{21}-10^{19}$ Hz	when the nuclei of atoms disintegrate	*In cancer treatment, str. of the nucleus of the atom.
(ii) X-rays	Ranjan ↓ first Nobel Prize in Physics	$10^{19}-10^{16}$ Hz	By hitting a heavy target with fast moving e-	In Body X-Ray, In lungs disease, To detect a bullet hidden in the body, in radio therapy, In CT-scan
(iii) UV-Rays	Ritter	$10^{16}-7.5\times10^{14}$ Hz	Sun through electric arc spark ionized gas	Checking false doors, food items preservation, in photo-electric effect, Killing bacteria in diseases, *water purification.
(iv) Visible radiation	Newton	$7.5\times10^{14}-3.7\times10^{14}$ Hz	from ionized gases and incandescent objects.	Electric bulb, Sodium lamp. fluorescent tube, To find out the str. of molecules, In the view, In photography, in astronomy, in optical microscope, In Photosynthesis.

E.M. waves	Discoveror	frequency range	Source	Uses
(V) Infrared radiation	Herschel	$3.7\times10^{4}-10^{11}$ Hz	from hot objects from the sun	To heat plants in nurseries, In physical therapy (muscle stretching), In weather forecast, Solar cooker, solar heater, Purity of chemicals, *T.V. Remote, *Night vision camera, *Thermal Imaginary, laser.
(VI) Micro waves	Percy Spencer	$10^{11}-10^{7}$ Hz	from electrical circuit, from a vaccum tube clld magneton, Passing current in the oscillator	In satellites, in comm^n, In radar systems, In micro waves. In oven, Mobile, wi-fi, Police Radar, ~~Bet~~. BT
(VII) Radio waves	Marconi	from less then 10^{7}	from an oscillating electric circuit	Radio, TV transmission, in air current naviga^n, Radar, toy cars, in remotes

min ——— wavelength ———→ max.

min ——— Diffraction ———→ max.

γ-Ray, X-Ray, UV Ray, light, Infra wave, micro wave, Radio wave.

max ←——— Refraction/ Scattering ——— min

max ←——— energy, frequency ——— min

α, β, γ - Rays - Radio active rays

Vin's displacement law $\left[\lambda \propto \frac{1}{T}\right]$ λ → wavelength
T → Temp.

The colour of star gives information about its temp. and energy.

wavelength of red colour λ↑ than T↓

Some Imp. Points →

↳ ** Pyrometers are used to measure high temp.

↳ The speed of electromagnetic waves →

Vaccum > Gas > liquid > solid

↳ The electromagnetic spectrum was studied by James Clark Maxwell.

↳ The particles / molecules of the medium do not move from one place to another - Only energy moves from one place to another.

Super Sonic Missile

Speed → 2.8 Mak

1 mak = 340.29 mt/sec

fire power → 290 Km

↳ Efforts to increase it to 600 Km

→ It is named after the Brahmaputra of India and the Moskva River of Russia.

Speed → 0.8 Mak → 1.2 Mak → Sub-Sonic missile

1.2 Mak → 5 Mak → super-sonic "

More than 5 mak → Hyper-Sonic "

Fluorescence → when high frequency light (blue / UV rays) is shined on a source, the object glows. This process is K/a fluorescence.

uses → X-rays & UV rays produce reactions on barium platinum cyanide.

→ Direction boards installed on the road are painted with reflective paint, so that they can shine when light falls on them at night.

Phosphorescence → There are some substances which continue to emit light for some time even after removing the light. then it is K/a phosphorescence.

Eg → Clocks hands, Electrical boards.

↳ Infrared radiation is also K/a thermal radiation.

↳ Every hot object emits infrared rays.

↳ The greenhouse effect, which warms the earth's atmosphere, is also caused by infrared rays.

↳ Co - 60 → Y - ray released from Co - 60.

↳ Police use radio waves to measure the speed of an oncoming car.

↳ Noise is measured in dB.

↳ SONAR → Sound Navigation & Ranging

↳ RADAR → Radio detection and Ranging

↳ to find the position & speed of aircraft & missiles.

↳ LIDAR → Light Detection and Ranging

↳ Height of mountains, in weather forcast.

↳ LASAR → Light Amplification by stimulated Emission of Radiation.

↳ discover by ~~[illegible]~~ TH मैन, भारत में → डॉ. होमी

~~MASAR~~ uses → Holography,

Electrical circuit,

Super computer

↳ MASAR → Microwaves Amplification by stimulated emission of Radiation.

→ In sending msg in space & sea.
→ In complicated operations, cancer
→ for treatment of eye diseases.

Units and Dimensions

Physics → That branch of science in which the relationship b/w matter and energy is studied.

Matter → is that thing which occupies space, which has weight and which can be felt or experienced by our senses.

Mass → The amount of substances in any object is called mass.
The value of mass is fixed.

weight → The force with which the earth attracts any object towards itself.

$$\boxed{w = mg}$$

| w → weight
| m → mass
| g → Gravitational acceleration $\simeq 9.8\ mt/sec^2$

→ The value of weight depends on the acceleration due to gravity.

→ The value of load keeps changing acc. to place.

→ The weight increases as we move from the equator to the polar regions.

Physical quantities → 2 types

1) **Scalar quantities** → To express these physical quantities, only magnitude is required.

Eg :- Mass, time, Distance, speed, ~~Ratio~~ Density, Energy, Temp., work, Electrical potential, electrical current, power, pressure, frequency, charge, potential, specific heat.

2) **Vector quantities** → Those physical quantities which require magnitude as well as direction to be expressed.

Eg :- Velocity, momentum, acceleration, force, torque, displacement, impulse, weight, angular velocity, electric field, magnetic field, magnetic intensity, magnetic moment, electric intensity etc.

Units are used for precise measurement of any physical quantity.

Types of unit :-

1) Standard / Basic Unit → Units that do not depends on other units. this is K/a Basic standard units.

There are 7 basic units in present time →

Mass → Kg
length → mt
Time → sec
Temp. → ~~Celsius~~ Kelvin
Electric Current → Ampire
light intensity → candela
Amount of substance → Mole

→ Earlier there were only three basic units → Kg, Mt, sec.

2) Derived unit → Those units which require two or more basic units to express them.
Eg → Area, Volume, Speed etc.

3) Complementary Units → Units that are used in Complementary quantities.
↳ Complementary unit is neither a unit nor a derived unit.

Eg. → Plane angle
↳ Radian unit

Cubic angle
↳ Steradian

Method of Units →

1) M.K.S method → Distance - mt, Mass - kg, Time - sec

2) C.G.S method → Distance - cm, Mass - gm, Time - sec
↳ Popular in france.

3) F.P.S method → Distance - ft, Mass - Pan, Time - sec.
↳ Method of British, Before indipendence in India.

1 ft = 30.48 cm = .3048 mt

1 kg = 2.2 lbs

S.I. Method → (International system of unit)

→ This method was adopted as a global method in a conference held in Geneva in 1960.

→ modified form of M.K.S.

Some Important Points →

i) Distance → Astoononical unit
$1 AU = 1.496 \times 10^{11}$ mt / 1.5×10^{11} mt.

the distance of stars is measured in light years.

light years :- $1 ly = 9.46 \times 10^{15}$ mt.

Speed of light $= 3 \times 10^{8}$ mt/sec (in vacuum)

ii) Parsec → 3.08×10^{16} mt.

→ In measuring the distance b/w celestial bodies.

iii.) Height :- 1 inch = 0.0254 mt, * 1 ft = 0.3048 mt,

1 yard = 0.9144 mt.

1 mill = 1.609×10^3 mt, * 1 Notical mille

↳ = 1.852×10^3 mt.

↳ use in distance in Ocean

iv.) Area :- 1 Brn = 10^{-2} mt^2, * 1 acre = 4047 mt^2,

1 Mt = 10^4 mt^2 = 2.5 acre,

1 pound = .4536 kg = 16 ounce

* 1 Carat = 200 ~~mg~~ m.

1 Atomic unit = 1 amu = 1.66×10^{-27} kg

v.) Time :-

Solar day → The time taken by the earth to rotate on its axis. (24 hr)

vi.) Solar year → Time taken by the earth to complete one revolution around the sun.

1 Solar year = 365.26 (any solar day)

vii.) Lunar Month → Time taken by the Moon to complete its revolution around the earth.

1 lunar Month = 27.3 day

viii.) sec → smallest unit of time = 10^{-8} sec.

ix.) Pressure → 1 Bar = 1 Atmospheric pressure

= 10^5 N/mt^2 = 10^5 pascal

1 Milli Bar = 10^2 Pascal

1 Tor = 1 mm of Hg

* The Hubble constant is used to measure the expansion of the universe.

10^{-1} → Desi
10^{-2} → Centi = 1cm
10^{-3} → Mili = 1mm
10^{-6} → Micro = 1 mt
10^{-9} → Nano = 1nmt
10^{-10} → angstrom = 1A

10^{-12} → Pico
10^{-15} → fermi
10^{-18} → E-10

10^{1} = Deca
10^{2} = Hecto
10^{3} = Kilo
10^{6} = Mega
10^{9} = Giga
10^{12} = Tera
10^{15} = Penta
10^{18} = Hexa

NOTE → Nano and fermi are used in nuclear radius and a is used in atomic radius.

Table

	formula	Units	Dimensions
Height	—	Meter	$[M^0 L^1 T^0]$
Mass	—	Kg	$[M^1 L^0 T^0]$
Time	—	second	$[M^0 L^0 T^1]$
Temp.	—	Kelvin	$[M^0 L^0 T^0 K^1]$
Vol^m	—	$Meter^3$	$[M^0 L^3 T^0]$
Distance	—	Meter	$[M^0 L^1 T^0]$
displace^t	—	Meter	$[M^0 L^1 T^0]$
Speed/ velocity	Distance/ displacement / Time	mt/sec	$[M^0 L^1 T^{-1}]$
Accelera^n/ decelera^n	Velocity / c-velocity / Time	mt/sec^2	$[M^0 L^1 T^{-2}]$
weight/ force	weight = Mass x g; force = Mass x accelera^n	$\frac{Kg \cdot mt}{sec^2}$ = 1 Newton = 10^5 Dyine	$[M^1 L^1 T^{-2}]$
Pressure/ stress	Pressure = $\frac{force}{Area}$; Stress = $\frac{Pressure}{Area}$	Pascal	$[M^1 L^{-1} T^{-2}]$
Heat/ work/ energy	Heat = MCΔT; work = force x displacement	$\frac{Kg \times mt^2}{sec^2}$ = Newton x mt = joule	$[M^1 L^2 T^{-2}]$

Power	work / energy	watt	$[M^1 L^2 T^{-3}]$
Momentum	Mass x velocity	Kg x mt/sec	$[M^1 L^1 T^{-1}]$
Electric charge	$Q = IT$	Amp. x sec = Coulomb	$[M^0 L^0 T^1 A^1]$
electric current	$I = \frac{\text{charge}}{\text{Time}}$	Ampere	$[M^0 L^0 T^0 A^1]$
voltage	Electric current x Resistance $V = IR$	Volts	$[M L^2 T^{-3} A^{-1}]$
Capacity		faraday	$[M^{-1} L^{-1} T^4 A^2]$
Resistance	$R = \frac{V}{I}$	Om	$[M L^2 A^{-2} T^{-3}]$
Conduction	$\frac{1}{R}$	Simons	—
Density	$\frac{\text{Mass}}{\text{volume}}$	$\frac{Kg}{mt^3}$	$[M^1 L^{-3} T^0]$
frequency	$\frac{1}{T} = \frac{1}{\text{Turnover time}}$	Hertz = sec^{-1}	$[M^0 L^0 T^{-1}]$

Some Imp. Points -

i) The dimension of moment is the same as that of energy.

ii) The dimension of momentum is the same as that of impulse.

iii) Magnetic induction = Henry, Magnetic permeability = Henry / mt.
Magnetic = weber or Maxwell., flux density = Tesla.
Radio activity = Becural, wavelength = Å,
light intensity = lux

iv) Dimensionless = Relative density, radian, steradian, specific gravity, strain.

v) work, energy, heat and torque have the same dimensions

* Universal gravity constant (G)

$$G = 6.67 \times 10^{-11} \frac{N\text{-}M^2}{Kg^2} = [M^{-1} L^3 T^{-2}]$$

* Universal Gas Constant (R)

$$R = 8.314 \frac{J}{Mole \cdot Kelvin} = [ML^2 T^{-2} Mole^{-1} \theta^{-1}]$$

* Planck's constant

$$h = 6.6 \times 10^{-34} \ J/sec = [ML^2 T^{-1}]$$

NOTE → Planck's constant and angular momentum have the same formula.

Motion

→ The change in the position of an object, particle or body with time is called Motion.

Eg :- Birds flying in the air, trains moving on tracks.

→ If the state of an object does not change with time then it is at rest.

Eg :- Book relative to the table.

Types of Motion :-

1) One-dimensional motion → when the position of an object changes in one direction.

Eg :- speed of train, speed* when an object is released from a certain height, person speed on road.

2) Two-dimensional motion → when the position of an object changes in two direction

→ The motion which occurs on one plane.

Eg :- Insects crawling on the surface, Earth's revolution around the sun.

3) Three-dimensional motion → when the position of an object changes in three direction.

Eg :- Movement of an objects in space, Kites, movement of gas molecules, movement of birds.

Types of motion of bodies →

1) Rectilinear Motion → when a particle moves in a straight line, its motion is called rectilinear motion.

→ If an object moves in a straight line then it is called translational motion.

2) Circular motion or Rotational motion :- when a particle moves on a circular Path, it has circular motion.

→ when an object makes circular motion around a (fixed) axis, it is called rotational motion.

NOTE → i) The motion of a बैलगाड़ी while moving on the road is an Eg. of translational and rotational motion.

ii) Circular motion is always accelerated motion because the direction keeps changing.

iii) A four - wheeler traveling at high speed on a tight circular track will over turn on its inner wheels and slide outwards.

Oscillatory and Vibratory Motion :-

→ If a certain point moves here and there in a certain period of time, it is called an Oscillatory motion.

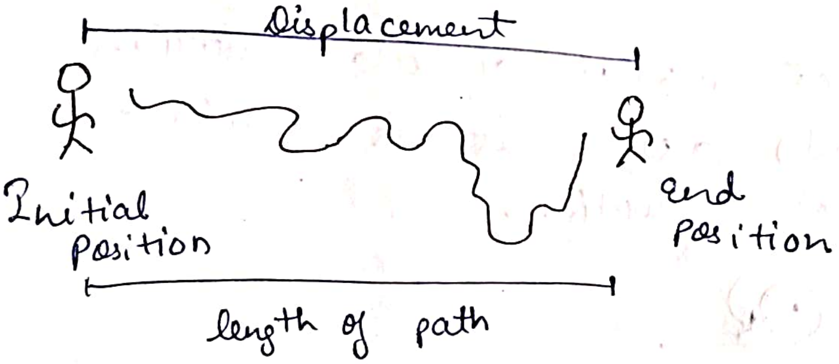
→ In Oscillatory motion the amplitude is minimum, then the motion is called Vibratory Motion.

Some Basic Terms →

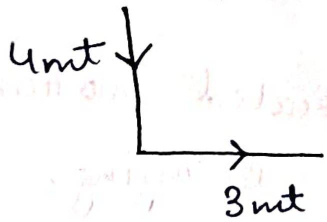
i) Distance or path length → The length traveled by a moving particle or object on a path.

ii) Displacement → when an object moves from one position to another, the minimum distance b/w its initial and final position is called Displacement.

→ The displacement of a moving object may be 0, but not the distance.



→ Value of displacement = -ve, +ve & zero possible.



Distance = 7mt

Displacement = 5mt

[Displacement ≤ Distance]

$$\left[\frac{\text{Displacement}}{\text{Distance}} \leq 1\right]$$

→ Speed :- The distance covered by an object in a certain period of time is called speed.

→ The distance covered by an object in unit time.

$V = \frac{s}{t} = m/sec$ <Scalar> $[M^0 L^1 T^{-1}]$

Uniform

objects covering equal distances in equal period of time.

10sec	10sec	10sec	10sec	10sec
7	7	7	7	7

Unequal

Covering unequal distances in equal period of time.

10sec	10sec	10sec	10sec	10sec
7	7	7	5	6

Velocity :- The distance covered by an object in a certain direction in a unit time is called velocity.

→ The rate of change in displacement of an object is called velocity.

$$V = \frac{d}{t} = m/sec, \text{ vector}$$

NOTE → Velocity is the movement of a body in a certain direction.

Uniform

To cover equal displacement in equal period of time.

Unequal

To cover unequal displacement in equal period of time.

Average Speed :-

$$\text{average speed} = \frac{\text{Total distance}}{\text{Total time}}$$

① $$\left[V_{ag.} = \frac{d_1 + d_2 + d_3 - - - -}{t_1 + t_2 + t_3 - - -} \right]$$

when the question deals with distance - time.

(2) $\left[V_{ag} = \frac{v_1 t_1 + v_2 t_2 \cdots}{t_1 + t_2 \cdots} \right]$ | Distance = speed × Time

when the question deals with ~~distance~~ speed - time.

(3) $\left[V_{ag} = \frac{d_1 + d_2 \cdots}{\frac{d_1}{v_1} + \frac{d_2}{v_2} \cdots} \right]$ | $\text{Time} = \frac{\text{Distance}}{\text{speed}}$

when the question deals with speed - distance.

(4) If the time of each given Part is same.

$$V_{ag} = \frac{V_1 + V_2}{2}, \quad V_{ag} = \frac{V_1 + V_2 + V_3}{3}$$

(5) If the distance of each given part is same.

$$V_{ag} = \frac{2}{\frac{1}{V_1} + \frac{1}{V_2}}, \quad V_{ag} = \frac{3}{\frac{1}{V_1} + \frac{1}{V_2} + \frac{1}{V_3}}$$

~~$\frac{V_1 + V_2 + V_3}{3}$~~

P.4 If a vehicle covers 40 Km distance in the first 20 minutes of its journey, 60 Km distance in the next 30 minutes and 20 Km distance in the last 10 minutes, then the average speed is = ?

$$\frac{40}{20} + \frac{60}{30} + \frac{20}{10} = \frac{120}{1} = 120 \text{ Km/hr}$$

(20 + 30 + 10) → 60 min → 1 hr

$$120 \times \frac{5}{18} = 33.33 \text{ Mt/sec}$$

$\frac{Km}{hr} \xrightarrow{5/18} \frac{mt}{sec}$

$\xleftarrow{18/5}$

Q. If a vehicle travels at a speed of 80 Km/h for the first 1 hour of its 3 hours of journey and at a speed of 100 Km/h for the remaining time, then the average speed is = ?

$$\left[V_{ag} = \frac{V_1 t_1 + V_2 t_2 - - -}{t_1 + t_2 - - -} \right]$$

$$\frac{80 \times 1 + 100 \times 2}{1 + 2} = \frac{80 + 200}{3}$$

$$\frac{280}{3} = 93.3 \text{ Km/hr}$$

Q. A car travels at a speed of 60 Km/h for the first half of its journey and at 80 Km/h for the remaining half of the same time. Then the average speed is = ?

$$V_{ag} = \frac{V_1 + V_2}{2}$$

$$= \frac{60 + 80}{2} = \frac{140}{2} = 70 \text{ Km/hr}$$

Q. A car journey, a distance of 100 Km is covered at a speed of 40 Km/h and a distance of 90 Km is covered at a speed of 60 Km/h. Then the average speed of car.

$$\left[\text{Speed} = \frac{\text{dist.}}{\text{Time}} \right] \quad V_{ag} = \frac{d_1 + d_2}{\frac{d_1}{V_1} + \frac{d_2}{V_2}} \Rightarrow \frac{100 + 90}{\frac{100}{40} + \frac{90}{60}}$$

$$= \frac{190}{2.5 + 1.5} = \frac{190}{4} = 47.5 \text{ Km/h.}$$

Q.4 There if he travels the first half distance of his journey at a speed of 60 Km/hr and the remaining half at a speed of 80 Km/h then the average speed is ?

$$V_{av} = \frac{2}{\frac{1}{V_1} + \frac{1}{V_2}} \rightarrow \frac{2}{\frac{V_2 + V_1}{V_1 V_2}} \rightarrow \left[\frac{2 V_1 V_2}{V_1 + V_2}\right] *$$

$$= \frac{2 \times 60 \times 80}{60 + 80} = \frac{2 (4800)}{140} = \frac{560}{14} = 40$$

[Total → Distance ↓ दो समान भागों]

$$= \frac{480}{7} = 68.5 \text{ Km/h}$$ ans 4

Related to Train

Time = $\frac{\text{Distance}}{\text{Speed}}$ [length of train + length of bridge]

Train - Train [face to face]

Time = $\frac{\text{Distance}}{\text{Speed}}$ (length of both trains) (speed of both trains)

Relative Speed = In same direction = ⊖
In opposite direction = ⊕

Instantaneous speed :-
Digital speedometers of vehicles measure instantaneous speed.

Graph →

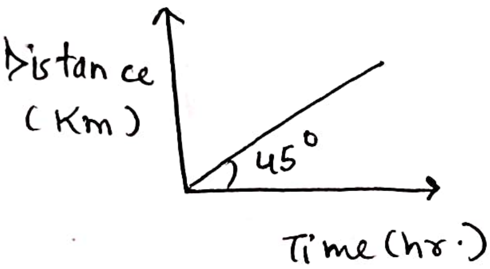
Slope of the graph = tan θ = $\frac{\text{Perpendicular}}{\text{Base}}$ = $\frac{\text{Distance}}{\text{Time}}$ = speed

$\tan 30^\circ = \frac{1}{\sqrt{3}}$

$\tan 45^\circ = 1$

$\tan 60^\circ = \sqrt{3}$

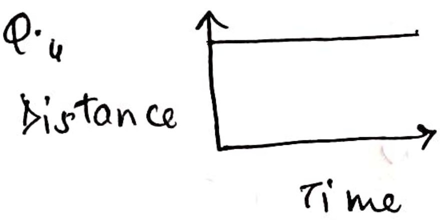
Q. The distance - time graph of a car is given, then the speed of the car will be = ?



i) 1 Km/sec
ii) 1 m/sec
iii) 5/18 m/sec
iv) 18/5 km/hr

tan 45° = 1 = 1 Km/hr ⇒ $\frac{5}{18}$ mt/sec.

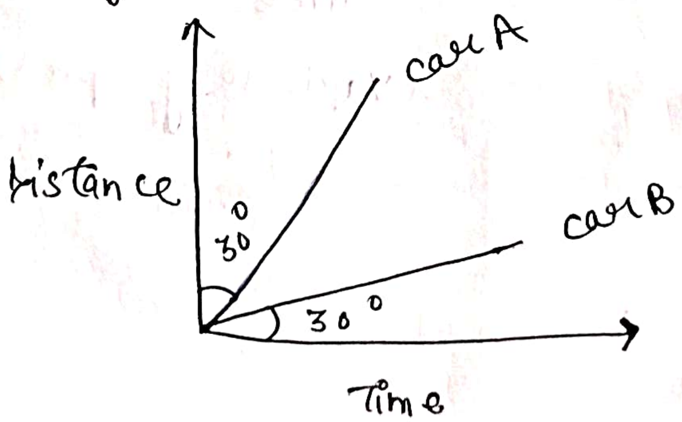
Q.



In this state, the speed of the particle will be -
i) Uniform speed
ii) zero speed
iii) Non - Uniform speed
iv) None

tan 0° = 0
चाल = 0

Q. The ratio of the speeds of car A & B will be -



i) 1 : 3
ii) 3 : 1
iii) 1 : 1
iv) None

[angle value always measurement on Time axis]

$$\frac{\tan 60^\circ}{\tan 30^\circ} = \frac{\sqrt{3}}{\frac{1}{\sqrt{3}}} = \frac{\sqrt{3} \times \sqrt{3}}{1} = \frac{3}{1}$$

$= 3 : 1$

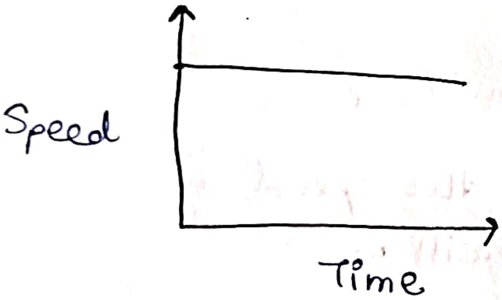
Q.4 In the above question, the correct relation b/w the speeds of the car V_A and V_B will be –

i) $V_A = V_B$

ii) $V_A < V_B$

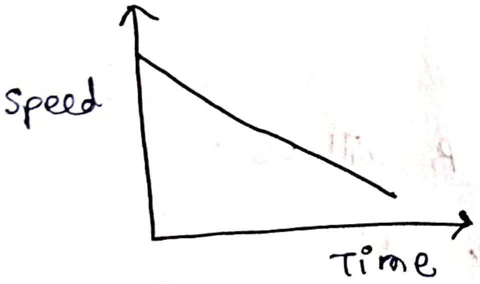
~~iii)~~ $V_B < V_A$

iv) None

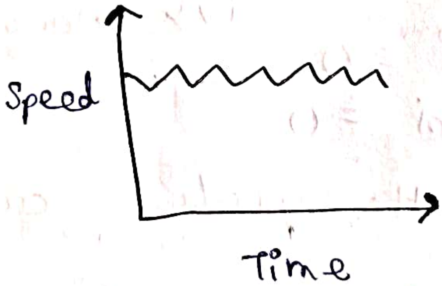


(Const. Speed)

(Increase of speed)



(Decrease of speed)



(Variable of speed)

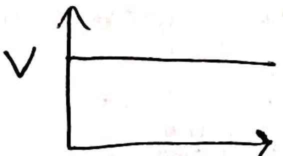
Acceleration :- The rate of change in velocity is called acceleration.

$$\text{Acceleration} = \frac{\text{Velocity}}{\text{Time}} = \frac{v}{t} \quad m/sec^2 \quad , \text{vector}$$

NOTE → If the acceleration is -ve then they are working opposite to the direction of velocity and if the acceleration is +ve then they are working in the direction of velocity.

→ If acceleration is zero then velocity is constant.

-ve ↓
+ve ↑
0 constant velocity



(accelera^n = 0)

(accelera^n = change)

NOTE →

i) average velocity = $\frac{\text{Initial velocity} + \text{final velocity}}{2}$

ii) avg. Acceleration = $\frac{\text{final velocity} - \text{Initial velocity}}{\text{Time}}$

Equations of Motion -

Condi. = Uniform acc. - Then apply

$v = u + at$ < Velocity - Time equation

$S = ut + \frac{1}{2} at^2$ = < Time - position eq.

$v^2 = u^2 + 2as$ = < velocity - Position eq.

[v = final velocity
u = Initial velocity
S = Distance/displacement
a = Acceleration
t = time

→ for equal acceleration motion this equation is k/a Galileo equation.

In n^{th} sec distance covered = $\left[S_n = u + \frac{a}{2}(2n-1) \right]$

Q.4 एक वस्तु को 500 mt/sec के प्रा. वेग से ऊर्ध्व फेंकने पर 10 sec बाद उसका वेग क्या होगा ? ऊर्ध्वाधर

$u = 500$ mt/sec

$t = 10$ sec

$v = u + at$

$a = ?$

$g = -10$ mt/sec

$v = u \pm gt$

$v = 500 - 10 \times 10$

$= 500 - 100$

$= 400$ mt/sec

Q.4 In the above que. In how much time the max^m hight will be तय होगी?

$u = 500$ mt/sec

$t = ?$

$v = 0$

$g = -10$

$v = u + at$

$0 = 500 - 10 \times t$

$= 500 - 10t$

$10t = 500$

$t = \frac{500}{10} = 50$ sec

Q.4 गतिशील वाहन में ब्रेक द्वारा 4 mt/sec² का accelera^n (-ve) उत्पन्न कर उसे 10 sec में रोक दिया जाता है। तो वाहन की प्रा. चाल / वेग -?

$v = 0$

$g = -10$

$t = 10$ sec

$u = ?$

$a = -4$

$v = u + at$

$0 = u + (-4 \times 10)$

$0 = u - 40$

$u = 40$ mt/sec

Q.4 In above que. ~~रु~~ रुकने से पूर्व तय कि गई दूरी ज्ञात करो ?

$S = ut + \frac{1}{2} a t^2$

$S = 40 \times 10 + \frac{1}{2}(-4) \times (10)^2$

$S = 400 + (-200)$

$S = 200$ mt

Q.4 एक गेंद को 60 mt/sec के वेग से ऊपर की ओर फेंकने पर उसके द्वारा

i) 3 sec में तय दूरी

ii) 3^{rd} sec में तय दूरी

$u = 60$
$g = -10$
$t = 3$ sec

i)

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

$$= 60 \times 3 - \frac{1}{2} \times 10 \times 3 \times 3$$

$$= 150 - 45$$

$$= 105 \text{ mt}$$

ii)

$$S_n = u + \frac{1}{2}a(2n-1)$$

$$= 50 - \frac{10}{2}(2 \times 3 - 1)$$

$$= 50 - 5 \times 5$$

$$= 50 - 25$$

$$= 25 \text{ mt}$$

Q.4 एक वाहन स्थिरावस्था से गति प्रारम्भ करता है। इसका इंजन इसमें 6 mt/sec^2 का त्वरण उत्पन्न करता है। तो 100 mt दूरी तय करने के पश्चात वेग = ?

अब यदि ड्राइवर सामने किसी जानवर को आता देख 10 mt/sec^2 का मंदक (-ve accel^n) ब्रेक द्वारा उत्पन्न करता है। तो वाहन द्वारा रुकने से पूर्व तय की गई कुल दूरी → ?

$$v^2 = u^2 + 2as$$

$$v^2 = 0 + 2 \times 6 \times 100$$

$$v^2 = 1200$$

$$v = \sqrt{1200}$$

$$v = 20\sqrt{3}$$

$a = -10$ mt/sec^2
$v = 0$

~~$v^2 = u^2 + 2as$~~

~~$1200 = 20\sqrt{3} + 2(-10)(100)(s)$~~

→

start → u=0
stop → v=0

$v^2 = u^2 + 2as$

$0 = (20\sqrt{3})^2 - 2 \times 10 \times s$

$= 1200 - 20s$

$s = \frac{1200}{20} = 60$

कुल दूरी $= 100 + 60 = 160$ mt

Some Points →

→ when an object is freely dropped, its initial velocity is zero.

→ when an object is thrown vertically upwards, its final velocity is zero.

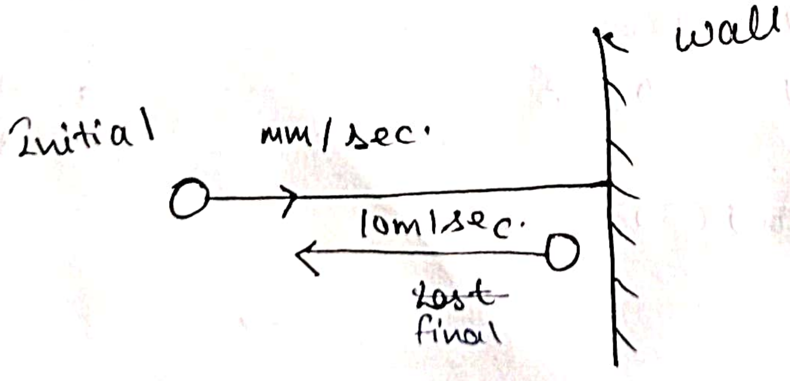
→ Velocity is zero at the point of max^m height.

→ An object thrown vertically upwards with a certain velocity, returns to the same place with the same velocity i.e. the time taken to go up and to come down from the top is the same.

→ when an object is thrown upwards with velocity u, the time taken to reach the maximum height is $\left[t = \frac{u}{g}\right]$.

→ when an object is freely dropped from a height h, its final velocity is $V = \sqrt{2gh}$

Q.4



80
1st

a) Did the velocity change? a) yes

b) If yes, then how much?

c) If the time taken is 0.1 second, then the acceleration is?

b) $V_{change} = V_{final} - V_{Initial}$
$= -10 - 10$
$= -20$ mt/sec

c) $a = \frac{\Delta V}{\Delta t} = \frac{20}{0.1} = 200$ mt/sec^2

Q.4 The ratio of the distances covered by a freely falling particle in successive 1st, 2nd, 3rd ... sec. = ?

$u = 0$

n^{th} sec $\Rightarrow h_n = u + \frac{g}{2}(2n-1)$

1^{st} sec $\Rightarrow h_1 = 0 + \frac{g}{2}(2\times1-1) = \frac{g}{2}$

2^{nd} sec $\Rightarrow h_2 = 0 + \frac{g}{2}(2\times2-1) = \frac{3g}{2}$

3^{rd} sec $\rightarrow h_2 = 0 + \frac{g}{2}(2\times3-1) = \frac{5g}{2}$

$\frac{g}{2} : \frac{3g}{2} : \frac{5g}{2}$ ... $=$ 1 : 3 : 5 : ......

It is clear from the above example that the distance covered by a freely falling particle increases with time and the velocity of the particle also increases but remember that its value does not depend on the mass of the particle.

Eg:- If a leaf and a stone fall freely in a vaccum, both will reach the floor at the same speed.

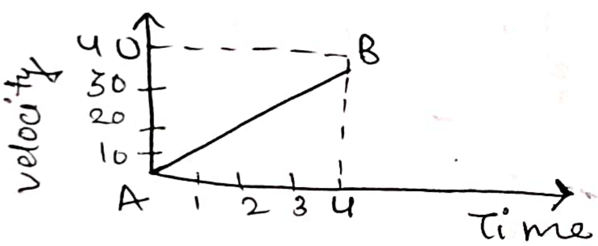
→ The slope of the position time graph represents the velocity.

→ The slope of the velocity time graph represents the acceleration.

→ The area of the shaded portion of the acceleration time graph (along the time axis) is equal to the velocity.

→ The area of the shaded portion of the velocity time graph is equal to the position.

Q4 The velocity time graph of a particle in one dimensional motion is as follows (AB → straight line)



a) Particle acceleration

b) Displacement / position of the particle in 4 sec.

a) वेग - समय की ढाल → त्वरण

$\tan\theta$ = त्वरण

= लंबवत / आधार = $\frac{40}{4}$ = 10 mt/sec²

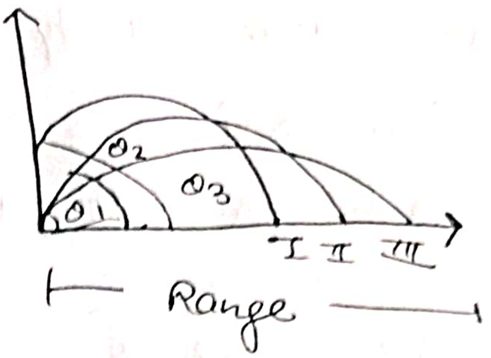
b) विस्थापन = Δ का क्षेत्रफल

= ½ × आधार × ऊंचाई

= ½ × 4 × 40

= 80 mt

Range of Projectile :-



→ To get max^m horizontal range the body or object should be projected or thrown at an angle of 45°.

NOTE :- In sport of long jump, a player jumps at an angle 45° to the horizontal, so as to cover the max^m distance.

→ An athlete runs fast before jumping into a long jump so as to achieve maximum velocity before reaching the finishing point.

Force

An external factor (push / pull) that can change the shape or position of a body or cause a body to change its state of rest or uniform motion it is known as force.

[Change of stage = Moving phase ⇌ Rest phase]

$F = ma$, Dimension $= M^1 L^1 T^{-2}$, vector quantity

SI unit = Newton, CGS unit = Dyne

<1 Newton = 10^5 Dyne>

[1 Dyne = 10^{-5} N]

1 Newton :- It is the magnitude of force which produces an acceleration of $1\ mt/sec^2$ in an object of mass 1Kg.

There are 4 types of main forces in nature :-

1) Gravitational force →

Each particle attracts the other particle due to its own mass.

→ The force of attraction b/w two particles is called gravitational force.

↳ The force of gravity also depends on the distance b/w two object.

↳ The weakest force among the existing forces.

↳ Depend on mass.

2) Electromagnetic force → (electrostatic)

Electric and magnetic forces together are called electro magnetic forces.

Electric force acts b/w two stationary charges, while both electric and magnetic forces act b/w two moving charges.

Magnetic force depend on charge and b/w distance.

3) Weak Nuclear force →

It is the force b/w elementary particles with short lifetimes.

It is 10^{25} times more powerful than the force of gravity.

4) Strong nuclear force :-

The force acting b/w proton - proton or neutron inside the nucleus.

It is a very short range force.

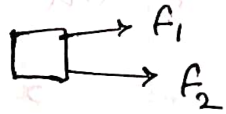
Its range is 10^{-15} mt degree. [1 फर्मी]

NOTE :- force changes the direction and state of an object's speed and motion.

→ when two equal forces are acting on a body and in opposite directions, then the force acting on the body becomes zero. there is a decrease in speed.
[due to friction]

→ If the forces are acting in one direction then the resultant force will be the total sum.

$$f_{eq} = f_1 + f_2$$



→ If the forces acts in the opposite direction of motion then the speed increases.

$$[f_{eq} = f_1 - f_2]$$

Newton's laws of Motion :-

First Law :- acc. to this, if an object is at rest, it will remain at rest, if an object is in motion, it wants to remain in motion unless any external force is applied.

~~This law is also~~

The property of an object's resistance to change in its state is called inertia.

This law is also called the law of inertia or Galileo's Law.

Inertia :- the word inertia literally means resistance to change in the state of an object.

There are 3 types of inertia :-

i) Inertia of rest :-
Inertia of resistance to change in state of rest.

eg- i) a stationary bus is pushed backwards when it suddenly starts moving.

ii) Dust particles are removed when a blanket is beaten.

iii) fruits falling from a tree

iv) Carrom board pieces.

ii) Inertia of Motion :- Inertia is the resistance to change in dynamic state.

eg - i) falling forward when a moving bus is braked.

ii) falling when jumping from a moving bus.

iii) fall of a horse rider.

iv) a bullet leaves a round hole in glass, whereas a stone breaks when hit.

iii) Inertia of direction :- Inertia is the resistance to change in direction of motion.

eg - 1) Passengers fall from a moving bus on a curve.

2) Umbrella protects us from rain, it is the inertia of direction.

NOTE :- The greater the mass of an object, the greater its inertia.

NOTE :- * force is defined by the 1st laws of motion.

Second law :- The rate of change of momentum of an object is proportional to the force applied on it.

$$f \propto \frac{d}{dt} mv \Rightarrow f \propto m\frac{dv}{dt} \quad [P = mv] \quad \left[\frac{dv}{dt} = a\right]$$

[P = mv]
↓
$[M^1 L^1 T^{-1}]$

$f \propto ma$

$f = kma$

$\boxed{f = ma}$ eqⁿ of force [K = 1]

Case (i) →

If the momentum of two moving objects of different masses is same.

Car v/s Truck

$P_1 = P_2$

$m_1 v_1 = m_2 v_2 \rightarrow \frac{v_1}{v_2} = \frac{m_2}{m_1}$

$v \propto \frac{1}{m} \Rightarrow$ $\boxed{\begin{matrix} m \downarrow = v \uparrow \\ m \uparrow = v \downarrow \end{matrix}}$

→ The dirⁿ of momentum is the same as the dirⁿ of the force applied on the object.

→ It is also called the law of momentum impulse

→ The formula of force is obtained from its rule.

e.g. • In the sport of high jumping, injuries are less likely to occur when an ~~athlete~~ athlete falls on a bed of mattress or sand.

• A cricket player draws his hand back while catching the ball.

• Vehicles like cars, buses, trucks etc. come with shockers.

• Ceramic utensils and glass utensils are packed wrapped in paper or straw so that the pressure takes more time to reach these utensils.

Principle of linear momentum Conservation :-

→ The product of an object's mass & linear velocity is called momentum of that object.

$$\boxed{P = mv}$$

→ If no external force acts on a system of two or more bodies then the linear momentum of the system remains constant.

→ The more momentum changes in a body, the more the momentum changes in the opposite direction. This is called the principle of linear momentum conservation.

e.g. Rocket launch, collision b/w two ~~do~~ bodies, jet engines work on the principle of linear momentum, gun-bullet, तोप, गोला [cannon recoil velocity]

Cannon recoil velocity

M = mass of cannon

m = mass value of sphere

v = velocity of sphere

V = cannon velocity

$$V = \frac{mv}{M}$$

Impulse :- The change in momentum of an object is called Impulse.

→ If force acts on an object for a short period of time, the product of force and time interval is called Impulse of that object.

Impulse ⇒ Momentum - change
⇒ force × time interval

$$[\vec{J} / \vec{I} = \vec{F} . t]$$

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

Unit = Newton × sec
= Kg × mt/sec

• Dimension of momentum is same dimension of impulse.

Third Law :- In the action two objects, if one object exerts a force on the other object, the second object also exerts the same force on the first object in the opposite direction. That is, for every action there is an equal but opposite reaction. This law is also called the force law of reaction.

Eg :- walking, boating, swimming

- A blow to the shoulder when a gun is fired.
- flight of a jet plane or rocket
- The rubber ball bounces again, difficulty walking on sand and snow.
- The boat moves backwards while jumping.

Q4. when a ball of mass 100 gm is freely dropped from a height of 500 mt, its momentum at the bottom is ?

$$v^2 = u^2 + 2as$$

$$v^2 = 0 + 2 \times 10 \times 500$$

$$v^2 = 10000$$

$$v = 100$$

$u = 0$
$a = g = 10 \, mt/s$

$$P = mv$$

$$= .1 \times 100$$

$$= 10 \ Kg \cdot mt/sec$$

$m = 100gm$
$= .1 \, Kg$

Q. The batsman throws a ball coming at a speed of 100 m/sec. in the same direction at a speed of 50 m/sec. If the mass of the ball is 200 gm then the effective impulse is = ?

$m = 200\ gm = \frac{1}{5}\ Kg = .2$

$I = m\,\Delta V$

$\Delta V = 100 + 50 = 150\ mt/sec$

$I = \frac{1}{5} \times 150 = 30\ \frac{Kg \cdot mt}{sec}$

Q. If in the above question the contact time between bat and ball is 0.1 sec then the effective force?

Impulse = force × time interval

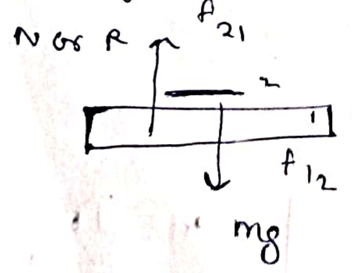
$30 = f \times 0.1$

$f = \frac{30}{0.1} = 300\ N$ ans.

Q. A book of mass 5 Kg is placed on the table, then the value of normal reaction on the book by the table?

$f_{12} = f_{21}$

$[f_{12} + f_{21} = 0]$



N or $R = mg$

$= 5 \times 10 = 50\ N$ ans.

Q. If a bullet of mass 100 gm is fired from a gun of mass 1 Kg at 100 m/sec, then the recoil velocity of the gun is = ?

$$V = \frac{m v}{M}$$

$m = 100\,gm = .1\,Kg = \frac{1}{10}\,Kg$

$v = 100\,mt/sec$

$M = 1\,Kg$

$$= \frac{\frac{1}{10} \times 100}{1}$$

$= 10\,mt/sec$

Q. A ball of mass 4 kg colides with another stationary ball of mass 2 Kg at a velocity of 40 m/sec and after collision both move together. their combined velocity is = ?

(4 Kg) → 40 mt/sec (2 Kg) ⟹ (4 Kg)(2 Kg) → V

टक्कर से पहले | टक्कर के बाद

$m_1 v_1 + m_2 v_2 = 6V$

$4 \times 40 + 2 \times 0 = 6v$

$160 = 6v$

$v = \frac{160}{6} \Rightarrow 26.66\,mt/sec.$

Q. A ball of mass 4 kg coming from the front at a velocity of 20m/sec. Collides with a ball of mass 1 kg at 5 m/sec. After colliding with each other, the ball of heavier mass moves in the same direction at a velocity of m/sec. Then the velocity of the lighter ball is = ?

टक्कर से पहले — टक्कर के बाद

$$m_1 v_1 + m_2 v_2 = m_1 v_1 + m_2 v_2$$

$$4 \times 20 + 1 \times (-5) = 4 \times 10 + 1 \times v_2$$

$$80 - 5 \qquad 40 + v_2$$

$$75 = 40 + v_2$$

$v_2 = 75 - 40 = 35$ mt/sec → +ve दिशा में

Friction

When an object slides or rolls on the surface of another object or tries to do so, the force opposing the relative motion b/w them is called friction.

Works opposite to the direction of motion.

except rear tire of bicycle.

<u>NOTE</u> :- i) If there is no friction b/w our feet and the ground, we can't walk.

ii) vehicles or people slip due to reduced friction on wet & muddy / oil roads.

iii) Brakes of vehicles work due to friction.

iv) Building a wall is also possible only through friction.

v) The pen on the blackboard moves due to friction.

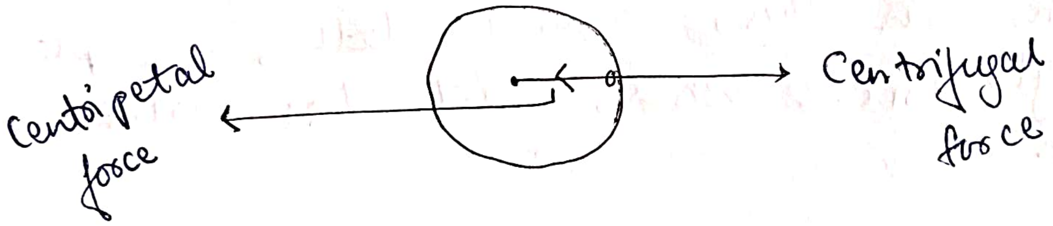
Centripetal force :- when a particle is moving on the circumference of a circle, the magnitude of its velocity remains constant but the direction keeps changing, due to which an external force acts on the particle. The direction of this force is directed towards the center of the fast, this force is K/a centripetal force.

Centripetal force acting towards the center of the circle

$$\left[F = \frac{m v^2}{r} \right]$$

m = mass of particle
v = velocity " "
r = radius

Centrifugal force :- In any circular motion, a force is felt acting outward it is called centrifugal force.
This is virtual force.



NOTE :- The motion of the Moon around the earth is an eg. of centripetal force.

NOTE :- Railway tracks are bent on curves, this is an eg. of Centripetal force.

Some Imp. Points

→ at the turn, the road is slightly higher on the outside so that the vehicle can achieve the required centripetal force.

→ The centripetal force for circular motion of a body tied to a string is obtained from the tension of the string.

→ On the mountains, circular road are made inwards, so that the necessary centripetal force can be achieved.

→ The cream expeller machine is based on "centripetal" force, the fat particles move inward, the milk particles move out.

Washing machine drier :- It is a device that dries wet clothes. In this, the wet clothes are placed in a cylindrical vessel, which has holes in its wall.

NOTE :- when a machine runs, energy is expended in the form of heat. (due to friction)

NOTE :- The phenomenon of lifting the upper part of a road bend is called baking.

NOTE :- when a piece of paper and a ball are released together from a height in a vaccum, they will reach the ground simultaneously.

Contact force → the force which created by touching the object
eg → muscle force

Non- Contact force → without touching force.
gravitational force, magnetic force, electric current.

→ e^- moves around nucleus is centripetal force.

Work, Power and Energy

Work :- When the state of an object is changed by applying force then it is called work.

$$w = f \cdot s$$

SI unit = Newton × Meter or Joule

CGS unit = Arg , Scalar zodiac sign

[1 Joule = 10^7 Arg]

Done at same angle $w = f \cdot s \cos\theta$ < ($f \cdot d \cos\theta$)

Types of Work :-

1) Positive work :- when force and displacement are in the same direction.

+ve work means that external forces provide energy to the system or object.

eg :- work done on stretching the spring
when a person lifts a body above the earth's surface.

2) Negative work :- when force and displacement are in opposite directions then work done is negative.

eg → when a person lifts a body above the surface of the earth, the work done by the force of gravity will be negative.

- when a body slides on a rough surface when force is applied, the work done by the friction force will be -ve.

3) Zero work :- when force and displacement are in perpendicular direction, the work done by the force will be zero.

Eg → The work done by the porter is zero.
↳ $\theta \to 90°$

→ when an object moves in a circular path with uniform speed, the work done by the centripetal force will be zero.

→ If displacement is zero then work will be zero.

→ The work done by a simple pendulum during complete oscillator will be zero because the displacement is zero.

→ The work done in pushing the wall will be zero because the displacement is zero.

→ The work done in swinging the load will be zero because the displacement is zero.

→ The work done on a smooth surface will be zero. because not apply friction.

NOTE :- If the work done by a force does not depend on its path then it is called a conservative force. If it depends on the path then it is called non-conservative force.

NOTE :- Work done by one rotation of conservative force is zero.

Power

the rate of work done by a machine or a worker is called Power / efficiency.

$$\text{Power} = \frac{\text{Work}}{\text{Time}} = \frac{w}{t} = \frac{\text{Joule}}{\text{Second}} = \text{watt}$$

CGS unit = Arg / sec

1 kilo watt = 1000 watt = 10^3 watt = 10^{10} Arg / sec.

1 MW = 10^6 watt , 1 Horse power = 746 watt

1 Kw · hour = 3.6×10^6 Joule = 3.6 Mega Joule

→ The power of a machine is measured in horse power.

→ The capacity of an ordinary human being is 0.05 HP – 0.1 HP

$$\text{average power} = \frac{\text{Total energy used}}{\text{Total Time}}$$ [Power = force × velocity]

Energy :- the ability to do work is called energy.

SI unit (MKS) = Joule , CGS = Arg

→ Kilowatt hour (Business unit) :- 1 kwh = 3.6×10^6 Joule

→ Calorie (Energy of food) = 1 Cal = 4.2 Joule

→ Electron volts (ev) = 1.6×10^{-19} Joule

This happens if an object has energy and exerts a force on another object. Then the energy will change from one form to another.

NOTE :- Energy and power are different from each other. Energy means work, while power means the rate of doing work.

Different forms of energy

i) Heat Energy :- Energy generated due to the heating of an object.

ii) Chemical Energy :- The energy released or absorbed during a chemical reaction is called chemical energy.

iii) Electrical Energy :- The energy required to maintain the flow of current in electrical equipment.

Types of Energy :-

i) Kinetic Energy :- The energy generated due to the motion of an object is called Kinetic energy.

$$KE = \frac{1}{2} mv^2 = \frac{P^2}{2m}$$

P = Impulse
m = Mass
v = velocity
KE = Kinetic Energy

Eg - when a fast moving ball hits the wicket, the wicket moves away and falls due to kinetic energy.

→ The ability to fly in a blind, the ability to rotate the blades of a turbine with flowing water is due to kinetic energy.

→ when the hammer hits the nail, the nail gets driven into the wood due to kinetic energy.

→ Everything moving is an eg. of kinetic energy

Special point for KE :-

i) Kinetic energy increases with increasing speed.

ii) If the mass is doubled, the kinetic energy also doubles.

iii) If the velocity is doubled, its kinetic energy becomes four times

* iv) when an object is dropped from a height the kinetic energy will be maximum before it touches the ground.

v) At maximum height the kinetic energy is zero because the velocity is zero.

vi) In three states of matter, gas has the heighest kinetic energy.

vii) Heat stored during change in temp. of a substance is kinetic energy.

viii) Two bodies of same mass are thrown from the top of a tower with equal speed. If one body is thrown vertically downwards and the other horizontally, both will reach the ground with equal Kinetic energy.

ix) If the momentum is doubled, its Kinetic energy becomes four times.

Potential Energy :- The energy possessed by an object due to its position or configuration is called its Potential energy.

Potential Energy = mgh | m = mass, g = gravitational acceleration, h = height

Potential energy also changes with change in height.

Eg- Energy of water stored in dams, the energy of stones placed on a roof, a stretched arch and compressed spring etc are an eg. of Potential energy.

→ Stuffing the Keys into the toy car.

[Mechanical energy = K.E + P.E]

NOTE → a flying jet represents both Kinetic and Potential energy.

Some Imp. Points →

→ Hydroelectric power is a natural renewable resource.

→ More than 23% of water is used in electric power generation in the country.

→ wind energy is the cleanest source of energy.

~~Kinetic energy is used in electric power generation~~

→ Kinetic energy is used while grinding wheat in a wind mill.

→ The energy which is obtained from the heat of the earth's surface is called geothermal energy.

→ Geothermal energy is the oldest energy known to man.

Work - Energy theorem → the work done by a force applied on a particle is equal to the change in its kinetic energy.

[work done = change in Kinetic Energy]

Law of Conservation of energy → Energy can neither be destoyed nor created. It is always fixed, only it can change from one form to another.

Energy converting devices -

1) Microphone → Sound energy into electrical energy.
2) Turbine → Kinetic energy into mechanical energy.
3) Photovoltaic → Solar energy into electrical energy.
4) Dynamometer → Mechanical energy into electrical energy.
5) Rectifier → AC ⟶ DC
6) Hydroelectric power station → P.E → K.E
7) Electric pump → mechanical energy → in Hydroelectric power

8) Telephone lines - Electrical energy flows.

9) Battery - Chemical energy into electrical energy.

10) Electric motor - Electric energy - In mechanical energy

11) Thermo couple :- Electric Energy → In thermal energy

12) freely falling body :- P.E → In K.E.

13) Generator :- Mechanical energy → In electric energy

14) Gramophone :- Sound energy ⇄ Electrical energy

→ When the bow is pulled with an arrow, the muscle energy is converted into potential energy.

Heat, Temperature and Thermodynamics

Heat :- It is a form of energy that causes a feeling of warmth.

↳ It responsible for the change in the thermal state of an object.

Flow of Heat High temp ⟶ moving towards low temp.

(MKS) Unit = Joule , Cgs Unit = Calorie

→ The heat required to raise the temp. of 1 gm of water by 1°C is 1 Calorie.

[1 Calorie = 4.186 Joule = 4.2 Joule]

1 Joule = 0.24 Calorie

Conductors or Insulators of Heat =

Conductor :- Those substances which allow heat to flow easily are called conductors.

→ There is presence of electrons in them because of this they conduct electricity.

<u>like</u> :- Silver, Iron, Copper, lead, Al, Graphite, Tungsten, Gold.

Room Temp. [Summer = 27°C (Normal Condition)
Winter = 15°C

→ *Mica is a conductor of heat, but is a bad conductor of electricity.

→ Transmission of electricity is better in copper as compared to iron wire.

Silver > Copper > Al > Steel
↳ order of conductors

Insulator :- Those substance which do not allow heat to flow are called insulator.

Eg → Glass, Paper, wool, rubber, diamond, wood bakelite, ceramic borosilicate mica quartz, * nitrogen, *oxygen, sulphur asbestos.

→ Metal utensils have wooden handles because wood is a insulator of heat.

→ Compared to brick houses, mud houses are cooler in summer and warmer in winter because mud is a Insulator.

→ Ice packed in sawdust does not melt quickly because it is a Insulator of heat.

→ *Malamine is a thermo setting plastic. It resists fire and is a Insulator of heat.

Temperature :- The property of an object that determines how hot or cold the object is called temperature.

→ The physical factor that determines the flow of thermal energy from one object to another.

→ Temperature is measured by a thermometer. Thermometer was invented by Galileo. He told that gas expands when heat is applied.

→ Gas thermometer is more sensitive than liquid thermometer because gas is more diffuse than liquid and the Coefficient of expansion, of gas is higher.
↳ (vol^n ↑)

NOTE → Alcohol is commonly used in liquid thermometers.

→ Mercury is commonly used because of its high conductivity and galinstan is used in thermometers as an alternative to mercury.

Temperature Scale :- Two fixed points are taken to measure temp.

Freezing point → the point at which water turns to ice.

Boiling point → the point at which water turns into steam.

→ Boiling of a liquid occurs when its vapour pressure becomes equal to the atmospheric pressure.

** → Temp. remains constant at the boiling point of a liquid

→ The boiling point of a liquid depends on atmospheric pressure.

→ If salt is added while cooking vegetables, it get cooked faster because the boiling point of water increases.

→ The temperature of boiling at hill stations is higher than it sea level.

Relationship b/w thermal sequences

* $\frac{C}{100} = \frac{F-32}{180} = \frac{R}{80} = \frac{K-273}{100} = \frac{Ra-460}{212}$

* Celsius Scale → freezing point = 0°C, Boiling point = 100°C

* $\frac{C}{100} = \frac{F-32}{180}$

$\frac{F-32}{180} = \frac{K-273}{100}$

$\frac{C}{100} = \frac{K-273}{100}$

$C = K-273 \Rightarrow \boxed{K = 273 + C^{\circ}}$

→ The scale is permanent at temp. zero and the scale is divided into 100 equal parts which are called degrees.

→ A clinical thermometer has a temp. of 35°C to 45°C [Discoverer = Anders Celsius].

* Fahrenheit scale → freezing point = 32°F

Boiling point = 212°F

→ This scale is divide into 180 equal parts.

→ [Discovered by - Grebeal Fahrenheit]

Kelvin Scale :- freezing point = 273 K
Boiling point = 373 K

→ Scale is divided into 100 equal parts.
→ [Discovered by - Kelvin]

Rumor Scale :- freezing point = 0 R, Boiling point = 80 R
→ [Discovered by - R. A Rumor]
→ Divides into 80 parts.

Racine Scale :- freezing point = 460 Ra,
[Ra] Boiling point = 672 Ra

→ [Discovered by JM Racine], Divides into 212 parts.

* Some important points
→ freezing point of water = 273.15 K = 32 F° = 0°C
→ The melting point of ice at the sea level at Atmospheric pressure and a latitude of 45° is 271.16 K.
→ Max. density of water = 277 K = 4°c
→ Room temp. = 300 K = 27°C = 80.6°F
→ Celsius and Fahrenheit scale is equal on (-40°)
→ The water in the well is warm in winter because the temp. of the earth heats the water.

→ If the surface of water in a lake starts freezing the temp. of the bottom will be 4°C.

→ when heated from 0°C to 100°C, the volume of a given mass of water will decrease and then increase.

Only for water

$0°C \xrightarrow[\text{Vol. of min.}]{\text{density max.}} 4°C \xrightarrow[\text{Vol.} \uparrow]{\text{density} \downarrow} 100°C \xrightarrow[\text{Vol.} \uparrow]{\text{density} \downarrow}$

→ with every 165 mt of width, the temp. ↓ by 1°C.

*→ Fahrenheit and Kelvin scale are equal on 574.25°C.

→ The temp. of an object cannot be less than (−273.15°C) This is called absolute zero temp. and 'OK' is written in the Kelvin scale.

→ Temp. near 'OK' is measured by Cryogenic and higher temp. is measured by pyrometer.

→ Temp. of body = 37°C = 310.5 K = 98.4 F
= 29.4 R

order of temp. of body. $\boxed{T_K > T_F > T_C > T_R}$

→ In cold countries the temp. goes up (−40°C) and mercury thermometere are not used becoz. mercury freezes at (−39°C), whereas alcohol thermometers are used there [because (OH⁻) freezes at −115°C]

$$\frac{T_C}{5} = \frac{T_K - 273}{5} = \frac{T_F - 32}{9} = \frac{T_R}{4}$$

Q.4 At water temp. 50°C at different stages of temp. find the value of it.

Sol.

$T_C = 50°C$

① $\frac{T_C}{5} = \frac{K - 273}{5} \Rightarrow \frac{50}{5} = \frac{K - 273}{5}$

$T_K = 273 + 50$

$T_K = 323°$

② $\frac{T_C}{5} = \frac{T_F - 32}{9}$

$9 \times \frac{50}{5} = T_F - 32$

$\frac{450}{5} = 90 = T_F - 32$

$T_F = 90 + 32 = 122 F$

③ $\frac{T_C}{5} = \frac{T_R}{4} \Rightarrow \frac{50}{5} = \frac{T_R}{4} \Rightarrow \frac{50 \times 4}{5} = T_R$ (10)

$T_R = 40 R$

Minimum value of Temp. Scale :-

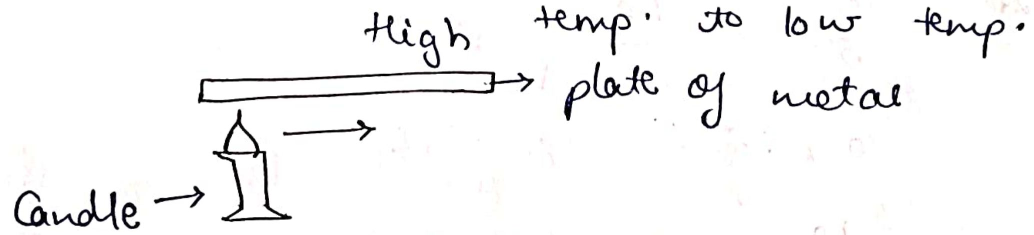
Kelvin = 0K , Celsius = $-273.15°C$

Fahrenheit = $-459.4°F$, Racine = $-218.4R$

<u>Transmission of Heat</u> :- Transfer of heat from one place to another is called transmission.

1. <u>Conduction</u> - In this, heat passes from one particle to another and the particles do not change their place.

- Heat transfer in solid occurs by conduction.
- Thermal conduction in metals occurs due to vibrations of atoms and free e^{-}s.



- Dipping a wooden stick into a cup of ice-cream will not keep the other end cold.

2. <u>Convection</u> - In this, particles move from one place to another carrying energy and are replaced by other particles.

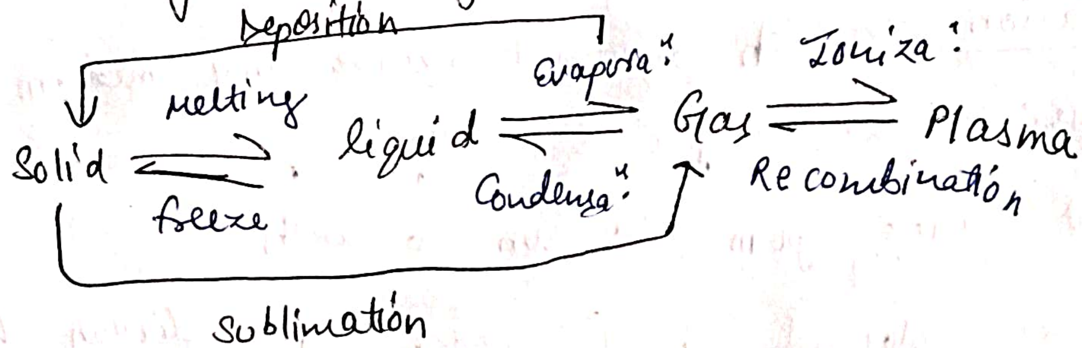
- Heat transfer occurs in liquid and gases.
- The actual movement of molecules from high temp. to low temp.
- Chimneys in kitchens and factories are also based on the principle of Convection.
- In a Refrigerator the freezer is placed at the top because convection currents flow from top to bottom.
- Ocean currents are an e.g. of convection.
- There are holes at the top and bottom of the lantern, through which hot air can go out and normal air can come in.

3. <u>Radiation</u> - which does not require any medium
In this, heat transfer is a rapid process.
Light coming from the sun to earth
Darker coloured objects absorb more radiation than lighter coloured objects.

→ The amount of radiation depends on the nature of the substance, temperature of the substance and the type of surface of the substance.

- The velocity of heat radiation in vaccum is equal to the speed of light.
- Within the environment, convection is a horizontal transfer of heat.
- The harm caused to the human body due to radiation is measured in rems.
- In the desert, the days are very hot and the nights are very cold, because sand is a good absorber of heat as well as a good emitter.
- A cloudy night is warmer than a clear sky night. This is because the earth gets heated by the sun's head during the day. It gets cooled at night due to radiation. from a clear sky, radiation goes out, whereas if it is cloudy, it gets transformed and return back.

Transformation of Phase



→ To liquefy a gas easily, it must have low temperature and high pressure.

Dry ice :- Solid CO_2, becomes sublimated at room temp.

Note → **Plasma** - It is the fourth state of matter. It has no permanent shape or volume.

Humidity - The amount of water vapour in the atmosphere is called humidity.

→ water will not evaporate when there is 10 % humidity.

Absolute Humidity - The amount of water vapour is a fixed volume of air.

→ when temperature and pressure change, the volume of air also changes, due to which the absolute humidity also changes.

Specific Heat → The amount of heat required to raise the temperature of 1 gm of a substance by 1°C is called specific heat.

$$S = \frac{Q}{m \Delta t}$$

Q = Heat given to substance
m = mass
Δt = Change in temp.

Unit → $\frac{\text{Calorie}}{\text{gm}\,^\circ\text{C}}$ or $\frac{\text{Joule}}{\text{gm}\,^\circ\text{C}}$

→ Gas has two types of specific heats.

i) Specific heat at constant volume (C_v) :-
The heat used to raise the temperature of 1 gm by 1°C at a constant volome.

ii) Specific heat at Constant Pressure (C_p) :-
The heat used to raise the temperature of 1gm by 1°C at a constant Pressure.

R = Gas Constant

$[C_p - C_v = R]$

$= 1.99 \simeq 2 \frac{Cal}{Mole\ K} = 8.31 \frac{Joule}{Mole\ K}$

→ Water is used in Radius because the specific heat is higher.

→ Lithium is among those alkali metals which have high specific heat.

Latent Heat :- The heat given to change the state of 1 gm quantity of a substance at a Constant temperature is called latent heat of that substance.

→ The latent heat is vaporization in inversely proportional to temperature and is maximum at 0°c.

→ Steam burns are more serious than boiling water burns because the latent heat of steam is higher.

→ Latent heat of vaporization of steam = 540 cal/gm.

→ Latent heat of melting ice = 80 cal/gm.

NOTE → The unit of Calorie value of a fuel is measured in Kg Joule / Kg ☆☆

NOTE → The atmosphere is heated mainly by radiation.

Newton's law of ~~motion~~ cooling → the rate of heat loss of a hot object is proportional to the temperature difference b/w the object and its surroundings.

$$\frac{dQ}{dt} \propto (T - T_0)$$

$\frac{dQ}{dt}$ = Loss rate of heat
T = Temp. of object
T_0 = Temp. of environment

→ When the temp. difference is doubled, the rate of heat loss will also double.

Black body :- A body which completely absorbs radiation of any wavelength is called a perfect black body.

→ A body which is a good absorber of heat is also a good emitter.

→ Cooking utensils are usually left black on the bottom because the black surface is a good absorber of heat.

→ A white and smooth surface is a poor absorber and good reflector of heat.

Thermal Expansion :- The tendency of matter to change shape, area, density with change in temperature.

Eg :- A gap is kept b/w the railway tracks to allow for expansion & contraction of the track during summer & winter.

→ The ~~E~~ Eiffel Tower becomes taller in summer due to thermal radiation

→ when a metal ring is heated, its hole expands.

→ Air expands when it is heated.

Thermal Conductivity :- measures heat transfer

- ↑ in gas temp. than Thermal conductivity ↑
- ↑ in water temp. " " " ↓
- ↑ in metal temp. " " " ↓

order → silver > Copper > Al > steel

Some Imp. Points :-

↳ when hot liquid is poured into a glass, cracks appear in it because glass is a poor conductor of heat due to which the inner surface expands.

↳ Supercooling means Cooling a liquid to a temp. below the freezing point.

↳ ~~Haze~~ Haze/fog is caused by water vapour at low temp.

↳ In mountainous areas, water pipes often burst on cold nights, because water freezes in the pipes, causing water to fail when frozen.

↳ During hot weather, a fan provides a comfortable feeling because our sweat evaporates faster.

↳ Cooling by desert cooler is based on the law of evaporation.

↳ Heating by the sun, winds, & the Coriolis force are the primary forces that affect ocean currents.

→ woolen clothes keep us warm in winter because they prevent body heat from escaping.

→ In winter, two thin shirts can keep us warmer than one thick shirt because the layer of air b/w the two shirts behaves like an insulating medium.

→ Skylights are installed near the ceiling of the room because hot air rises and goes outside.

→ The physical state of water at 257°C is gaseous.

→ Abnormal spread of water :- volume ↓ from 0°c to 4°c

- Above 4°c the vol^n ↑.

→ Air humidity ∝ Temp.

→ The value of relative humidity is high than the process of evaporation is slow & there is a feeling of moisture.

→ The value of relative humidity is low than the process of evaporation is high & there is a feeling of dryness.

→ Excessive increase in relative humidity is an indicator of rainfall.

[Heat given off by a hot object = Heat taken by a cold object]

→ Leaving the fridge open will increase the room temperature.

→ The melting point decreases as pressure increases.

→ As atmospheric pressure decreases, the boiling point also decreases.

→ Zeroth law of thermodynamics :- Provide the concept of heat.

→ first law of thermodynamics :- Define internal energy.

→ Second law of thermodynamics :- The engine capacity was always less than unit.

Cooling rate :- Dependent on temp. (Body & environment)

↳ on the nature of the radiating surface.

↳ Radiative surface area.

Sources of Energy :- any device or system capable of providing useful energy at a fixed rate and conveniently for a long time is called a source of energy.

Classification of sources of energy -

1. Renewable sources of energy - those sources of energy which are continuously available without any interruption from nature.

Ex. Solar energy, wind energy, bio fuel (wood, biogas and alcohol), hydrogen energy obtained from the sea (tidal energy, energy obtained from sea waves) etc.

→ Energy is continuously available from these sources for a long time.

→ Like the energy received from the sun by the earth.

→ These are the sources available in free state from nature.

→ These sources do not spread pollution.

2. Non - renewable sources of energy :- These sources have been accumulating on the earth over a long period of time. They cannot be easily converted from one form to another. And a day will come when

all these sources will be destroyed.

Ex → fossil fuels like coal, Petrol, natural gas, etc. are also called traditional sources of energy.

Disadvantages :- They will be destroyed soon due to excessive use.

→ It is very difficult to find all these sources.

→ The environment gets polluted due to all these sources.

→ **Fuel** :- substances which give heat on burning are called fuel.

Ex :- Coal, LPG (liquefied Petroleum gas), biogas, & CNG (Compressed Natural Gas), Petrol, diesel, Kerosene etc.

Characteristics of ideal fuel :-

- the calorific value of the fuel should be high, so that it can give more heat per unit weight.
- the combustion temperature and ignition temperature of the fuel should be appropriate so that it can be easily burnt.
- the amount of non-flammable substances in the fuel should be less, so that less amount of residue is obtained.
- No toxic and harmful gas should be produced on burning the fuel, so that air pollution is not caused.

→ The fuel chosen should not be very useful for other purposes.

→ The fuel should be cheap and easily available.

→ The fuel can be transported from one place to another conveniently and safety.

Traditional sources of energy :-

Fossil fuel :- this fuel is formed from plant remains buried deep in the earth's surface for millions of years. These are energy - rich organic compounds.

Ex :- Coal, Petroleum, natural gas etc.

→ Nowadays, organic gases (methane) are also used as fuel.
↳ marsh gas

→ Disadvantages of fossil fuels :-

→ Fossil fuels are non - renewable sources of energy. And they cannot be used again after using them once.

→ Fossil fuels pollute the air when they burn. And greenhouse gases are released.

→ Fossil fuels release gases when they burn. Due to which acid rain occurs when dissolved in rainwater. Due to which water and soil sources are affected.

Thermal Power Plant :- when fuel is burnt in it, it converts heat energy into electrical energy.

Hydroelectric Power Plant :- These plants convert the ~~static~~ kinetic energy of flowing water into electrical energy.

→ The electrical energy produced by this plant is called hydro electricity.

Biomass :- waste material of cattle (dung), dead parts of animals and plants are called biomass.

Example :- wood in houses & factories, crop residues, bagasse (residue of sugarcane) cattle dung.

Bio gas :- It is a mixture of methane, hydrogen $[H_2S]$ sulphide, CO_2 & hydrogen.

→ when dung, waste left after harvesting crops like various pipes & sewage are decomposed in the absence of oxygen. Then bio gas (bio gas) is released.

It is called cow dung gas.

Wind energy :- Moving air is called wind. The energy obtained from it is called wind energy.

→ It is a kinetic energy.

→ The largest windmill farm is located in Muppandal, Tamil Nadu. whose capacity is 1500 MW.

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→ Denmark is called the country of winds.

→ More than 25 % of the country's electricity is supplied windmills.

→ India ranks fifth among countries producing electricity through wind energy.

Solar Energy :- The energy emitted by the sun is called Solar energy. It gives heat and light.

Solar cell :- Through this, Solar energy is directly converted into electrical energy.

→ These cells are made of semi-conductor material (silicon, germanium).

→ Solar cell is also called Photo voltaic cell.

→ Solar panels are made by connecting solar cells to each other.

→ The world's largest solar furnace is located in France.

Tidal energy :- Due to the attraction of the moon, the water of the sea rises and falls. The waves formed due to this are called tidal waves. The energy obtained from this action is called tidal energy.

→ The rising of waves is called tide & the falling of water is called ebb.

Wave energy :- Due to high air flow, the waves of water move very fast on the surface of the sea. The energy obtained from its Kinetic energy is called wave energy.

Ocean energy :- There is some difference in the temperature of the water on the surface of the ocean and the water at depth. The energy obtained from this temperature difference is called Ocean energy.

Geothermal energy :- This energy is obtained from the heat inside the earth.