STATES OF MATTER

Matter:- Any substance or anything which have some mass and it take some place.

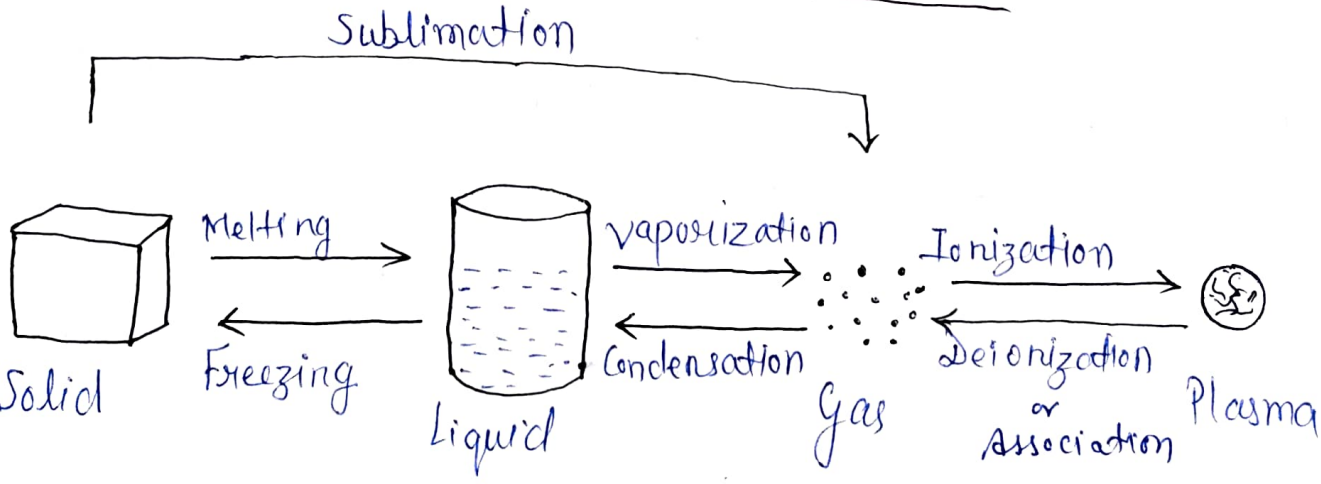
There are three state of matter -

1. Solid
2. Liquid
3. Gas

⇒ One more state of matter is common in universe not on earth is - plasma.

Properties	Solid	Liquid	Gas
• Intermolecular space	Less	S < L < G	more
• Compressibility	Less	S < L < G	more
• Shape	fixed	not fixed	not fixed
• Size	fixed	not fixed	not fixed
• Volume	fixed	fixed	not fixed
• Kinetic Energy	Less	S < L < G	more

Changes in the state of Matter



⇒ A change of state of matter → is a physical change

↓

these are reversible change (no changes in chemical composition of the matter.)

⇒ Latent heat :-

⇒ Latent heat is → energy absorbed or release by a substance during a change in its physical state (phase)

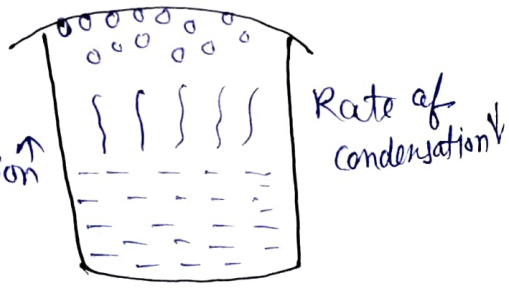
↓

this occur without changing its temperature.

⇒ The latent heat normally expressed as - joules or calories

⇒ Vapour Pressure :-

The pressure of a vapour in contact with its solid or on liquid form.



⇒ when both is equal or gas is in equilibrium, that time, the pressure exerted by vapour on any surface is called vapour pressure.

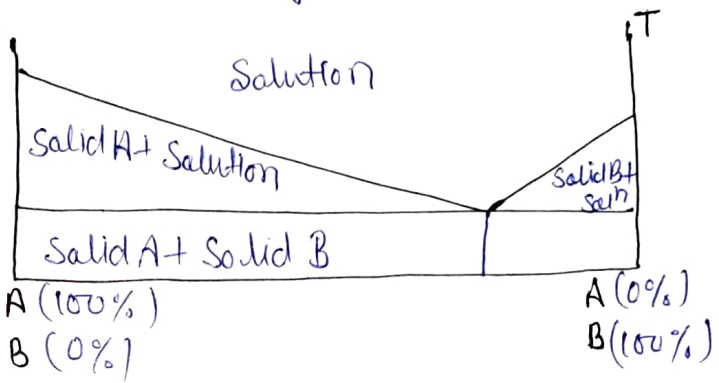
⇒ Pascal (Pa) is a unit for vapour pressure. Sometimes mm Hg is also used as an unit of vapour pressure.

Sublimation critical Point :-

Sublimation critical point refers to the maximum or minimum temperature and pressure beyond which the state of the matter cannot be changed.

Eutectic Mixture :-

It is a mixture where two solid particles mixed together and reduce their melting point.
Ex. Menthal, thymal.



Aerosols :-

Aerosol can be defined as → the disperse phase system
⇓
in which very fine solid drug particles
or
liquid droplets
⇓
get dispersed in the propellants (gas)
⇓
which acts as continuous phase.

or,

It can be defined as a pressurized dosage form containing one or more therapeutic active ingredients which actuation emit a fine dispersion of liquid or solid materials in gaseous medium.

Principle :-

If pressure is applied on gas the temperature kept below the critical point or temperature, the gas will liquified when pressure is released molecule of gas is expent and back up in gaseous state.

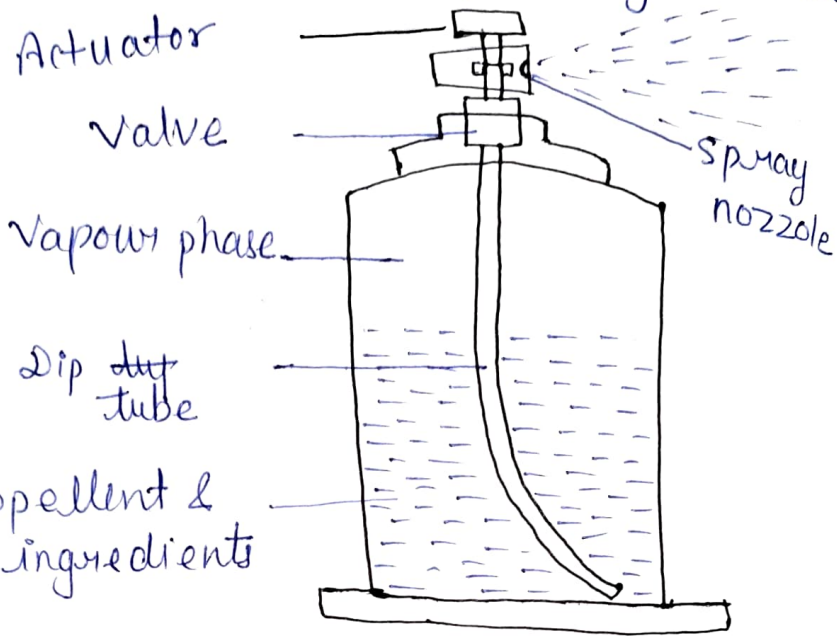


Fig. Aerosol Container

Working :-

When the vapour phase develops pressure in container, against the walls of the container, At valve assembly and the surface of the liquid phase, this contains the liquified gas and product concentrate.

⇒ This pressure which is responsible for actuation of the aerosal valve, forces the liquid phase up to the dip tube and through the orifice of the valve contents will be released into the atmosphere.

Inhalers :- Several type of device are used to deliver the medicine in a fine mist directly to lungs.

⇒ Inhalers are a medical device that holding a medicine that you take by breathing.

Use :

⇒ Inhalers are the main treatement in the Asthma and lungs disease.

Ralative Humidity :-

It may be define as the ratio of amount of water vapour in air and the maximum amount of water that the air can hold.

$$R_H = \frac{\text{amount of water vapour in air}}{\text{maximum amount of water that air can hold}} \times 100$$

or

$$R_H = \frac{\text{Actual water in air}}{\text{maximum water air can hold}} \times 100$$

⇒ It measured by - Phycrometer.

Liquid Or Complexes :-

Complexes fluid are a binary mixture that have co-existance between two phase like -

Solid + liquid ⇒ Suspension

Solid + Gas ⇒ Foam

Liquid + Liquid ⇒ Emulsion.

Liquid Crystals :-

Some organic solid having long rod like molecule

⇓

they do not melt to give the liquid substance

⇓

passes through an intermediate state

⇓ called

Liquid Crystal state

Ex- Many proteins, Detergent, Cell membrane.

Glassy State :-

⇒ Glasses Combines → Some properties of crystal
↳ Some of liquid.

⇒ Glass has → mechanical Strength of crystals
↳ random arrangement of molecule like liquid.

⇒ Glasses are formed by

⇓

melting crystal material at very high temperature

⇓

at high temp. material fuse together

⇓

then they are cooled rapidely and forming a rigid structure.

Solid :- Matter in which passes rigidity and hence definite size and shape.

Properties :-

- Shape ⇒ Definite
- Volume ⇒ Definite
- Density ⇒ High
- Intramolecular force ⇒ High
- Intramolecular space ⇒ minimum
- Compressibility ⇒ minimum
- Rigidity ⇒ High
- Kinetic energy ⇒ very low

Crystalline Solid :-

In ~~cy~~ Crystalline Solid the constituent particles (ie. ~~atom~~ & molecules or ions) are arranged in a definite geometry (way).

⇒ They undergo clean cleavage.

⇒ They have long rang order.

⇒ They have definite melting point, boiling point and heat of fusion.

⇒ They are unisotropic.

Ex- Diamond, Sugar, Calcium.

Amorphous (Non-Crystalline Solid)

In amorphous solid constituents particles are arranged in irregular way.

⇒ They have short range order.

⇒ They do not have definite melting point, boiling point and heat of fusion.

⇒ They are an isotropic.

⇒ They undergo irregular cleavage.

Ex Glass, rubber, plastic.

⇒ **Polymorphism** :- having many forms.

⇒ Existance of a solid material in more than one form.

⇒ It is a chemical state.

⇒ It is a condition in which a solid substance or chemical compound exist more than one form.

Ex- Chloramphenical palmitate - has 3 polymorphs.

Physiochemical properties of drug molecules

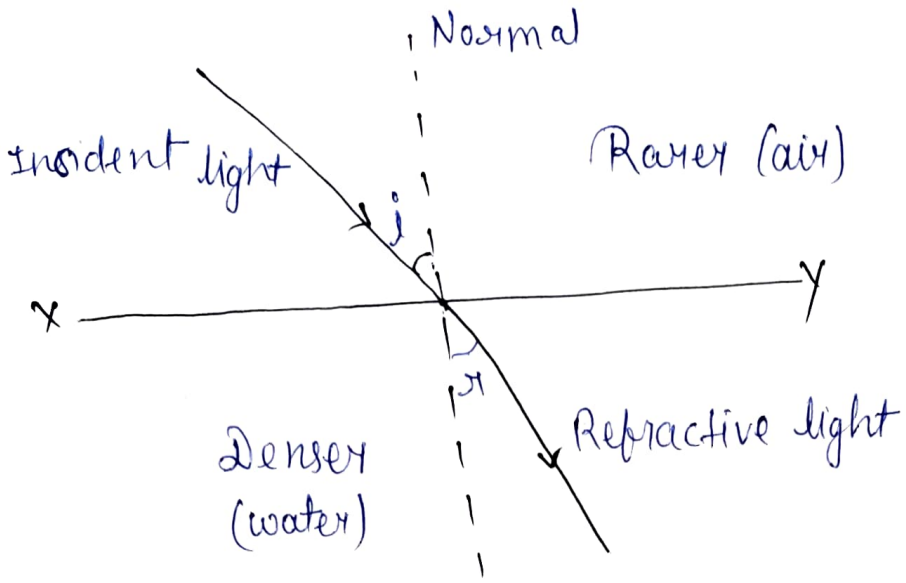
Refractive index :-

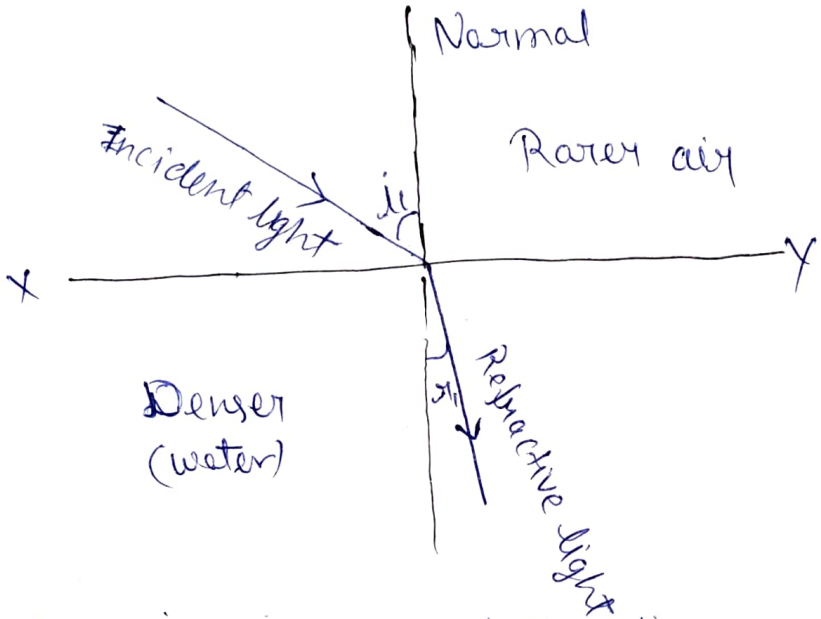
Determination :- The refractive index determine the how much path of light is bents or refracted when entering a material.

⇒ They are follow shell's law -

that are -

$$\frac{\sin i}{\sin r} = \text{Constant}$$





If media is same in both diagram - than

$$\frac{\sin i}{\sin r} = \frac{\sin i_1}{\sin r_1} = \text{constant}$$

It is known as Snell's law.

⇒ The ratio of sin i and sin r remains constant untill the media is same.

$$R_I = \frac{\text{speed of light in vaccum}}{\text{speed of light in medium}} \quad \text{or} \quad R_I = \frac{C}{V}$$

Application :-

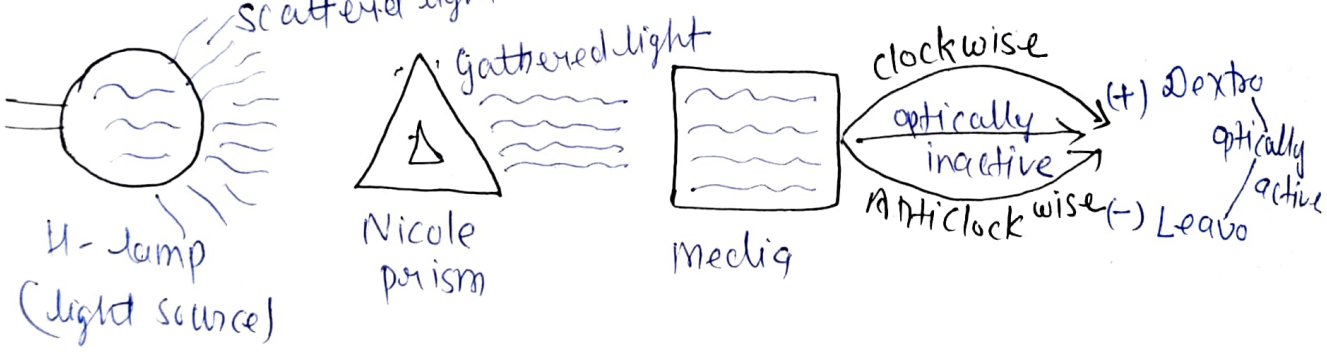
⇒ It is a fundamental property used to control the purity of a product.

⇒ It is used to designed the lenses of camera, microscope and other optical instrument.

⇒ It is used to measure the concentration of solute in aqueous solution.

Optical Rotation

Determination:- When a light pass through a medium, if light turn or rotate then it is optically active and if it is not turn or not rotate then, it is optically inactive.



- Rotate ⇒ Clockwise ⇒ Dextro (+)
- Rotate ⇒ Anticlockwise ⇒ Leavo (-)] optically active
- Not Rotate ⇒ Linear ⇒ optically inactive.

Application :-

⇒ Identification of optical isomers

⇒ Determine the optically active substance

⇒ Amount of sugar present in urine of a diabetic patient

Dielectric Constant :-

Dielectric constant is defined as ratio of force of charge in a media and force of charge in free space.

or

the ratio of permittivity of the substance to the permittivity of free space.

$$\text{Dielectric Constant}^{(\varepsilon)} = \frac{\text{Permittivity in media}}{\text{permittivity in vaccum}}$$

$$K = \varepsilon = \frac{\varepsilon_m}{\varepsilon_0}$$

K = Relative permittivity
ε_m = permittivity of material
ε_0 = permitivity of vaccum
↳ 8.85×10^{-12} Farads/meter.

Permittivity :- Capacity of a substance to store the electric energy.

Application :-

⇒ The major role of dielectric materials in capacitor is to store electric energy.
⇒ Mineral oil is used extensively inside electrical transformers as fluid dielectric and assist in cooling.
⇒ It is used to manufacture capacitors.
⇒ It can be used in formulation design such as crystallization.

Dipole Moment :-

⇒ Such a molecule with positive charge at one end and a negative charge at other end.

⇓

referred to as an electric dipole or simply dipole.

⇒ The degree of polarity of a polar molecule is

⇓

measured by dipole moment (μ)

" The dipole moment of a polar molecules is given by the product of charge at one end and distance between the opposite charges. "

$$\mu = q \times d$$

⇒ The dipole moment (μ) is a vector quantity.

⇓

represented by an arrow with crossed tail.

Unit ⇒ ~~Coulumb/~~ Coulomb.'meter

CGS unit ⇒ debye (D)

Application :-

⇒ Determination of degree of polarity.

⇒ Used in predicting nature of molecules

⇒ Prediction of nature of bond.

Dissociation Constant :-

Strength of an acid or base is defined as the concentration of H^+ ion or OH^- ion, respectively in its aqueous solution at given temperature. (According to Arrhenius law)

$$HA + H_2O \rightleftharpoons H^+ + A^-$$

(A^- : conjugate base)

Applying Law of Mass action -

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

where - K_a = acid dissociation constant.
$[HA]$ ⇒ Undissociated Acid

Similarly for bases -

$$BOH \rightleftharpoons B^+ + OH^-$$

Applying law of mass Action -

$$K_b = \frac{[B^+][OH^-]}{[BOH]}$$

where, K_b = base dissociation constant

⇒ The most common way to represent dissociation constant ↓ by taking $-\log_{10}$ of dissociation constant ↓ represented as pka

$$\boxed{pK_a = -\log_{10}(K_a)}$$

Application :

⇒ to check the acidity and basicity of a substances.

⇒ define the physiochemical properties of a substance.

⇒ Used as pH indicator.

⇒ essential for working with buffers.

Measurment of Dissociation Constant :-

⇒ K_a or K_b or pka can be determined by-

① Potentiometric titration.

② Spectrophotometric method

③ NMR titration (Nucleic Magnetic Resonance)

④ Liquid chromatography.

⑤ Capillary electrophoresis.