# PHYSICAL PHARMACEUICS-I



## UNIT => 2

## IMPORTANT Questions.

1) Discuss in detail properties of the various states of matter. How does transition take place from one state of matter to other?

2) Define the following —
i) Enthalpy ii) Entropy iii) triple point
iv) vapour pressure.

3) Explain the principle of sublimation with the help of neat diagram?

4) Explain Eutectic Mixtures with examples.

5) what is charle's law? Explain it.

6) Give the statement & postulates of kinetic Molecular theory of ideal gases.

7) write a short note on —
i) Relative humidity.
ii) Liquid complexes.
iii) Liquid crystals.
iv) glassy state.

8) Differentiate b/w crystalline solid and amorphous solid.

9) Define crystalline solid. what are the types of crystals? Enlist and Explain characteristics of crystals.

10) What do you mean by or understand by polymorphism? write its importance in pharmacy.

11) write down method of determination and applications of any three of the following -

i) dielectric constant
ii) Refractive index
iii) Dipole movement
iv) Dissociation constant

# STATES OF MATTER AND PROPERTIES OF MATTER

→ Matter :

- Matter is a substance which occupies space and possesses rest mass, specially as distinct ~~for~~ from energy.

- Matters can be classified as :

* Physical classification :

i) solid : A substance which ~~has~~ have definite, shape, size & volume.

ii) liquid : A substance which have definite, volume but shape & size not fixed

iii) Gas : A substance which have shape, size and volume not fixed.

* Chemical classification :

i) Pure substance : Eg => Elements & compounds.

ii) Mixture : Eg => Homogeneous & Heterogeneous.

↓ uniform composition in mixture

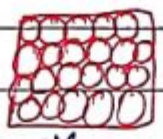
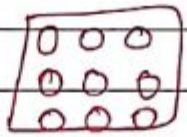
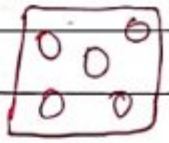
↓ composition vary in mixture.

## * Comparision of solid, liquid & gases :

→ **Solids :**
- Max. force of attraction.
- closely packed particles.

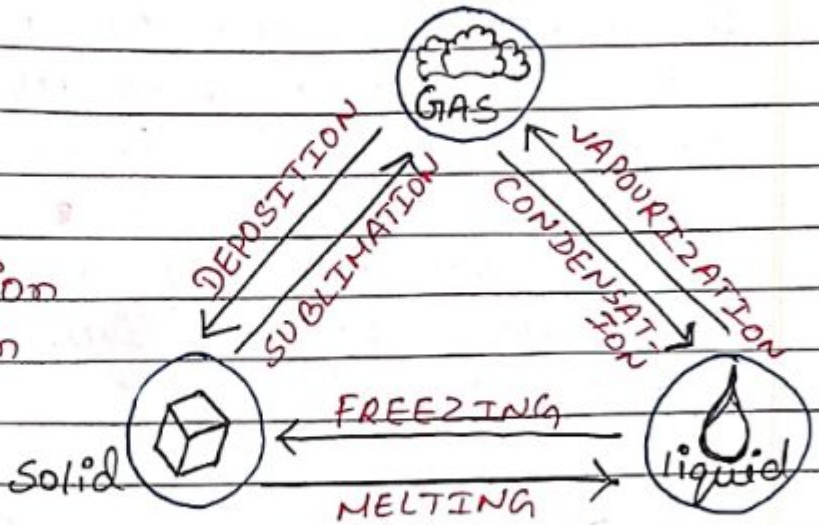
→ **Liquids :**
- lesser intermolecular force of attraction.
- Particle move/flow with each other.

→ **Gases :**
- Minimum intermolecular force of attraction.
- Particles flow independently.

| Properties | Solid | Liquid | Gas |
|---|---|---|---|
| • Intermolecular space |  |  |  |
| • weight | very High | High | low |
| • shape | fixed | not fix | not fixed |
| • size | fixed | not fix | not fixed |
| • volume | fixed | fixed | Not fixed. |
| • flow Properties | No [very less] | More than solid | very high. |

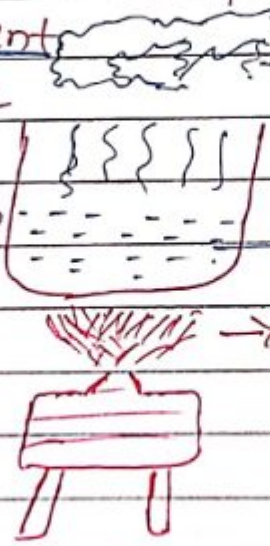
## Changes in the state of matter:

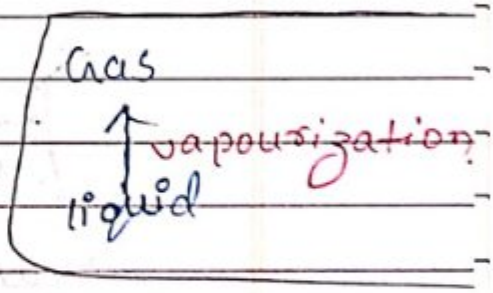
1. Freezing
2. Melting
3. Deposition
4. Sublimation
5. Vapourization
6. Condensation




## Latent heats

- When energy is absorbed as heat by solid or liquid, the temperature of the object doesnot necessarily rise [no change in temperature if we provide heat] i.e., hidden heat which change the phase, or state of an object to another. called latent heat or the heat of transformation

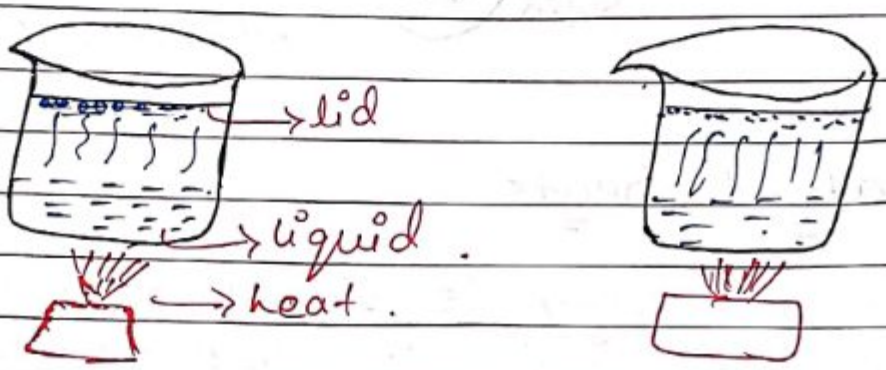



- It is denoted by L.

# Vapour Pressure :

- The vapour pressure of a liquid is the equilibrium pressure of a vapour above its liquid i.e., the pressure of the vapour resulting from evaporation of a liquid above the sample of the liquid in the closed container.



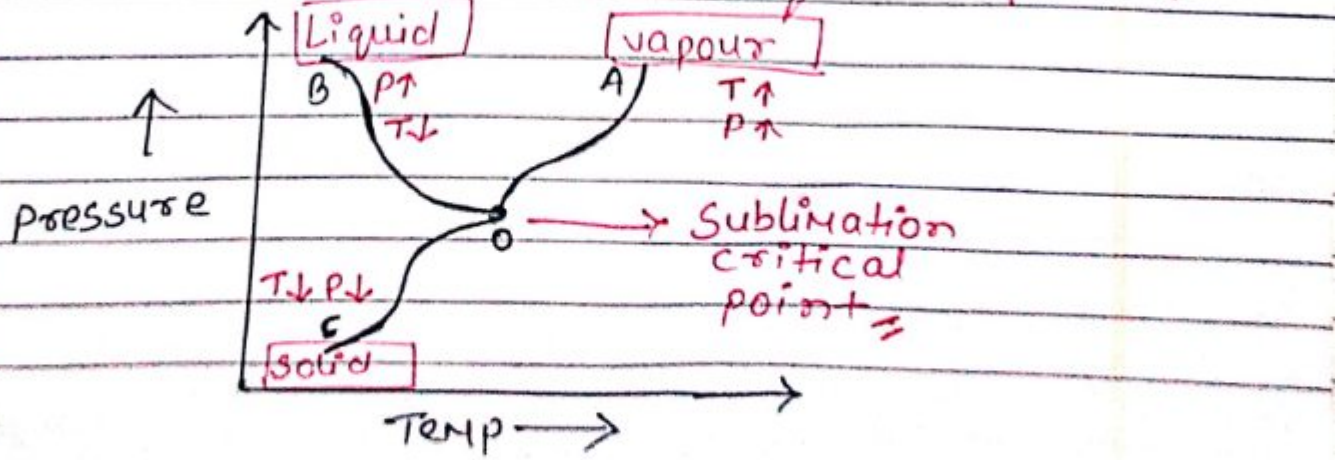

Initial.
Rate of evaporation is High.
Rate of condensation is low

Intermediate
Rate of Evaporation is low
Rate of condensation is High.

Equilibrium
Rate of Evaporation
= (equal to)
Rate of condensation.

# Sublimation Critical Point :

- Sublimation is a ~~point~~ process in which any solid is directly converted into gas without convert in liquid.
- We know that the phase of any matter can be change by change in temperature and pressure.
- O is the point where all phase of matter are in equilibrium state.
- Line OA represents, when we ↑ Temp. & ↑ Pressure then any solid directly convert into gas.
- Line OB represents, when we ↑ Pressure and ↓ temperature then any substance exist in liquid form.



- Line OC represents when we ↓ Temp. & ↓ Pressure then substance exist in solid phase.

- The point at which this sublimation process takes place is called sublimation critical point.

→ Advantages :

- The main advantages of sublimation is for purification process.

- The minimum amount of product is loss.

- Solvents are not used.

- When the substance weights less than 100mg the best method for purification is sublimation.

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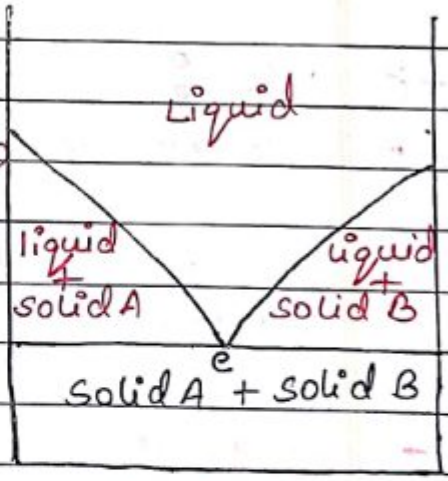
## # Eutectic Mixture :

- A Eutectic mixture is defined as a mixture of two or more components which usually do not interact to form a new chemical compound, but at certain ratios inhibit the crystallization state or process of one another resulting in a system having a lower melting point of individual component.

Eg ⇒ Ibuprofen, Thymol. $\xrightarrow{\text{Mix.}}$ Eutectic Mixture
M.P ⇒ 62°C M.P ⇒ 42°C M.P ⇒ 37°C

### → Principle :

- Below the eutectic temp. the Mixture of the two substance will exist as a solid.
- while above it the Mixture will convert into a liquid.




e = Eutectic point

- Point 'e' is the lowest melting point.

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→ factors governing eutectic mixture formation :-

- The component must be miscible in a liquid state & mostly immiscible in solid state.
- The molecules which are in accordance to modified Van Hoff's equation can form eutectic mixtures.
- The component should have chemical groups that can interact to form physical bonds such as intermolecular hydrogen bonding etc.

→ uses :

- commonly used in drug designing.
- For identification of the compounds having similar melting point.
- local anesthetics in case of children (useful medication for providing pain relief).

# Gases :

→ Properties of gases :-

- Gases are compressible.
- They have no definite shape and volume.
- The density of gases are much smaller then liquids and solids.
- weak force of attraction between the particles. (So, they are freely move).

→ Gas laws :

1) Boyle's law :

- It states that the pressure of a gas is inversely proportional to the volume of gas at constant temp.

$$p \propto \frac{1}{V}$$

2) charle's law :

- It states that the volume of a gas is directly proportional to the temp. of gas at fixed pressure.

$$V \propto T$$

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3) Gay-Lussac's law :

- The pressure of a gas is directly proportional to the temp. at constant volume.

$$P \propto T \qquad P = kT$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

4) Avagadro's law :

- The volume is directly proportional to the no° of moles of gas.

- At constant T & P.

$$V \propto n$$

$$V = kn$$

$$\frac{V}{n} = k \text{ (const.)}$$

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

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## Aerosols : [Biphasic Preparation]



- Aerosols is a suspension of fine solid particles or liquid droplets in air or another gas.

Eg ⇒ Perfumes → fog.

→ Inhalers :

- An inhaler is a device that filled with medicine & directly goes into our lungs.
- people inhaled medicine in mouth through inhalers.
- Eg ⇒ Asthma pump, COPD [chronic obstructive pulmonary disease]

→ Relative humidity

- It is the ratio of water vapor present in the air drop to the saturated air × 100.

$$\frac{\text{water droplets in air}}{\text{saturated air}} \times 100$$

→ Liquid complexes : These are binary mixtures that have coexistence b/w two phases.

- solid - liquid (suspension)
- liquid - ~~foams~~ gas (foams) eg ⇒ shaving cream.
- liquid - liquid (emulsion)

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→ Liquid crystals :

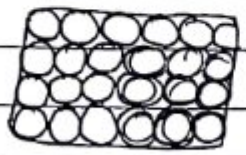
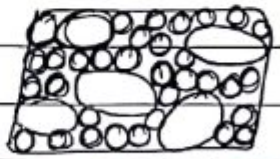
- They are matter in a state that has properties between a solid and a liquid.
- eg ⇒ cholestryl benzoate (145°-178°)

solid $\xrightarrow{145^\circ}$ semi liquid $\xrightarrow{178^\circ}$ liquid

→ Glassy state : → super cooled liquid

- ~~sol~~
- liquid $\xrightarrow{\text{cool}}$ solid $\xrightarrow[\text{continuous}]{\text{very cool}}$ super cooled liquid ↓ Glassy state.

→ Solid : A substance that have definite = shape, size and volume.

| Crystalline solid | Non-crystalline solid (Amporphous solid) |
|---|---|
|  |  |
| • which have shape & size fixed & pattern of intermolecular are fixed. | • the atoms and molecules are not arranged in a definite pattern. |
| • eg ⇒ Metal, ice etc. | • eg ⇒ Glass, plastic, etc. |
| • Melting point & Boiling point sharp. | • Melting & Boiling point wide range. |
| • Sharp cutting is possible | • No sharp cutting is possible. |

→ Polymorphism : These are compounds has ability to change their form according to situation.

eg ⇒ carbon → Diamond in a cubic.

# Physicochemical Properties of Drug Molecules :

## 1) Refractive Index :

- It is the ratio of velocity of light in empty space or vaccum divided by its velocity in the selected Medium.
- It is expressed as :

$$n = \frac{c}{v}$$

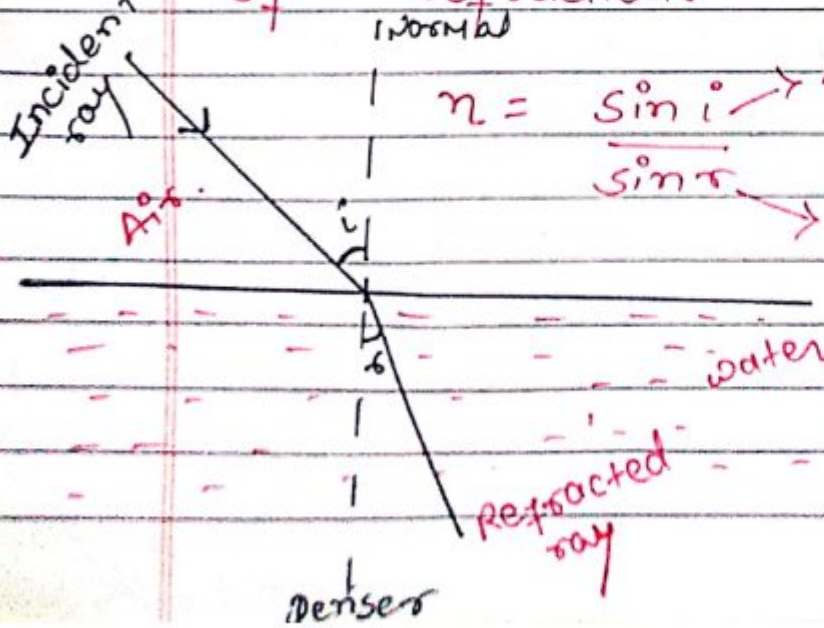
where,

c = velocity of light in vaccum

v = velocity of light in selected Medium.

→ Snell's law :

- It gives the relation between the angle of incidence and angle of refraction.




$n = \frac{\sin i}{\sin r}$ → Angle of incidence

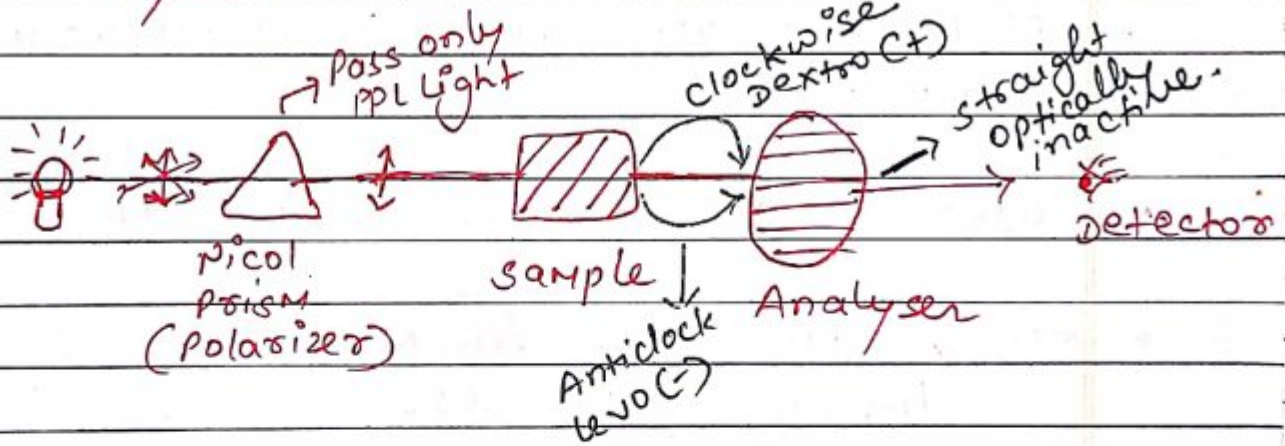
→ Angle of refraction

## 2) Optical Rotation :

- When we pass light through a medium, if light turn or rotate then it is optical active & if the light not rotate then our ~~med~~ sample is optically inactive.

- Polarimeters use to measure the degree of rotation of polarised light.

- A polarimeter consists of :
  - Polarized light source
  - Polarizer
  - Analyzer
  - Sample tube
  - Detector.




- Light rotate → optically active
- Light not rotate → optically inactive
- clockwise rotate → Dextro (+)
- Anticlock wise rotate → Levo (-).

3) Dielectric Constant :

- A quantity measuring the ability of a substance to store electrical energy in a electric field.
- It is the ratio b/w the permitivity of the medium to the permitivity of free space ($\varepsilon_0$).

$$\text{Dielectric constant} = \frac{\varepsilon}{\varepsilon_0}$$

→ Applications

- Dielectrics are used to manufacture capacitors.
- used to manufacture transformers.
- They are used in measuring & heating processes.

4) Dipole Moment :

- It is the product of the magnitude of the separated charge and the distance of the separator.

$$\mu = q \cdot r$$

$r$ → distance b/w them

$q$ → magnitude of separated charge

4) Application: 

- To predict the nature of the molecule.
- To predict the nature of the chemical bond.
- The measurement of the dipole moment given an idea of the degree of polarity in an diatomic molecule.

5) Dissociation constant:

- $H_2O \rightleftharpoons H^+ + OH^-$

A/c to law of mass action

$$\text{Rate of rkn} \propto \frac{[H^+][OH^-]}{[H_2O]}$$

$$\frac{dx}{dt} = k_a \frac{[H^+][OH^-]}{[H_2O]}$$

$$k_a = \frac{[H_2O]}{[H^+][OH^-]} \cdot \frac{dx}{dt}$$

↓

Dissociation const.

- It is define as tendency of particular substance in solution to dissociate into ions.

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→ Application

- It is important for the quantative evaluation of systems involving acid - base equilibrium.
- Dissociation constant is also important for working with buffers and pH indicators.