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Engineering Chemistry

Phase Rule - Tutorial 1

1) State Gibb's Phase Rule

Ans 1) Gibb's phase rule states that in every homogeneous system in equilibrium, the sum of the number of phases and degree of freedom is greater than the number of components by 2.

2) This is mathematically expressed as

$$P + F = C + 2 \quad \text{or} \quad F = C - P + 2$$

where P is the number of phases present in equilibrium, C is the number of components for the system and F is the number of degree of freedom for the equilibrium.

3) This rule is valid for any system at equilibrium at definite temperature and pressure provided the equilibrium between any number of phases is not influenced by gravity, by electrical or magnetic forces or by surface action; and is only influenced by temperature, pressure and concentration.

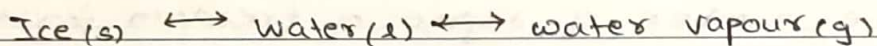


2) Define phase and give three examples to explain it.

Ans 1) A phase is defined as any homogeneous, physically distinct, mechanically separable portion of the system which is separated from other parts of the system by definite boundary surfaces.

2) Examples:

(i) In a freezing water system, ice, liquid water and water vapour constitute three phases. Each of the phases is distinct, homogeneous and mechanically separable.



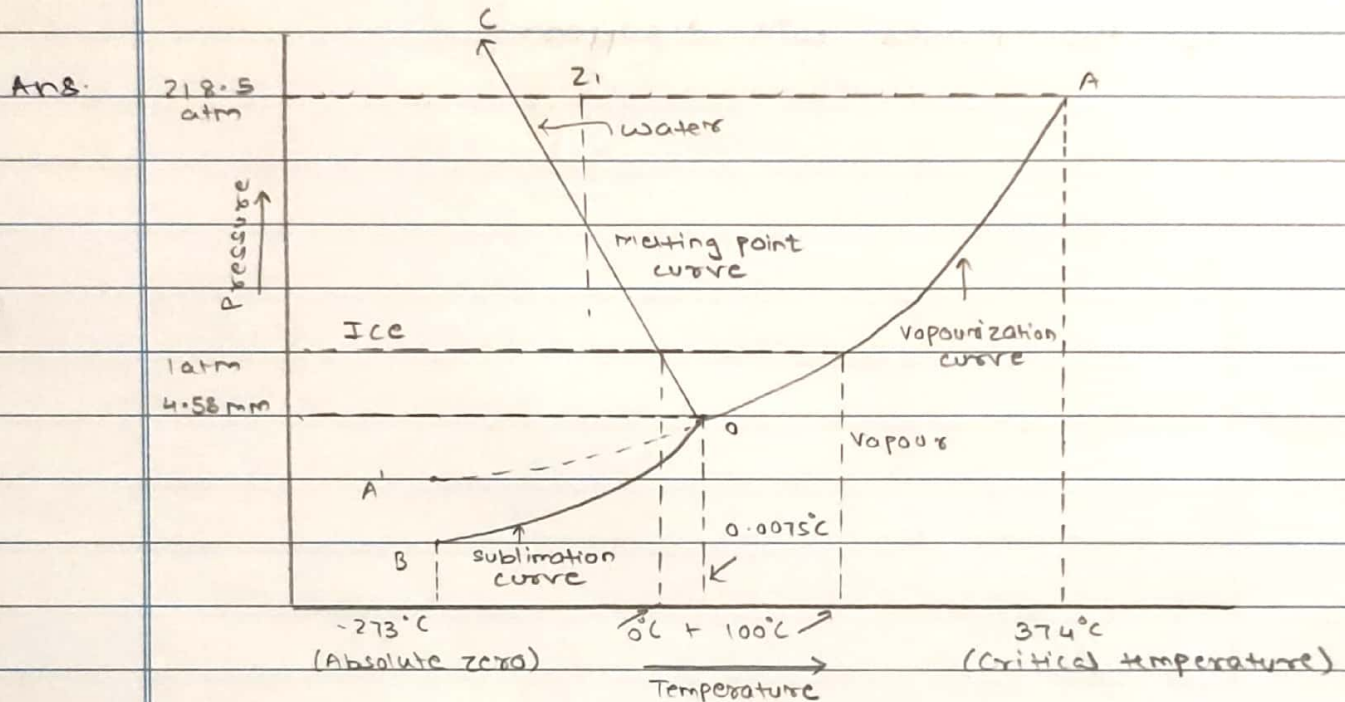
(2) A gaseous mixture, being thoroughly miscible in all proportions, constitutes one phase only. Thus, a mixture of N_2 and H_2 forms one phase only.

(3) Two miscible liquids form one liquid phase only.

Eg: ethyl alcohol and water.



3) Draw neat and labelled phase diagram of water system and explain triple point.



PHASE DIAGRAM OF WATER SYSTEM

Triple point.

- 1) It has been found experimentally that the curves OA, OB and OC meet in a point O. This is called the triple point where all the three phases viz. Ice, water and vapour co-exist.
- 2) Only at a particular value of temperature and pressure represented by the triple point, all the three phases co-exist. So the system has no degrees of freedom at this point.
- 3) The triple point corresponds to a temperature of



0.0075°C and a pressure of 4.588 mm. At this point if we change either temperature or pressure, one of the phases will disappear.