Qu. 1st order phase transition.

Ans. The quantity of matter is homogeneous in physical structure and chemical composition it is called a phase. A substance with the same chemical composition but different physical structure can exist in different phases such as solid, liquid or gaseous phases. Transition from one to another of these phases, fusion, vaporization and sublimation are called 1st order phase transitions. The Gibbs potential G is extremely useful in dealing with phase transition which take place at constant temperature and pressure. With a few exception, the system that we have considered so far are perfect gases; that is, system in which the interaction between particles can be neglected, while nitrogen and oxygen a room temperature are good examples of such gases, they constitute only a tiny fraction of the substances which we come across in nature; greatly from ideal gas behavior a high pressure or low temperature. The most dramatic effect of this interaction is consideration of the gas to a liquid or solid. This occur when the inter-molecular attraction is strong enough, and the temperature low. The energy gained by bringing the molecules in to close proximity overcomes the reduction in entropy due to condensation.

Clausius – Clapeyron equations.

Let us consider a system consisting of two phases of the same substance in equilibrium with liquid and its vapour in a cylinder fitted with a piston. The system is in thermal contact with a reservoir at temperature T, and is maintained at constant pressure P.

The chemical potential of the i^{th} species is releated to G by

$$\mu_i = \left(\frac{\partial G}{\partial N_i}\right)_{P,T} \quad \text{and} \qquad (1)$$

$$G = \sum N_i \mu_i$$

At constant temperature and pressure, the both phases are in equilibrium has a minimum value of G and for a reversible transformation under these conditions dG = 0, since the total number of the particle becomes conserved.

$$dG = -SdT + VdP + \mu_i dN_i$$
$$= 0$$

If dN particles condensed at constant temperature and pressure, so that the change in the number N_i of the particles in the liquid phase is - dN and change in the number N_2 in the vapour phase is + dN . Hence,

$$dG_1 = dG_2$$
$$d\mu_1 = d\mu_2$$
$$dN_1 = dN_2.$$

Therefore $\mu \equiv \mu$ [constant T,P]