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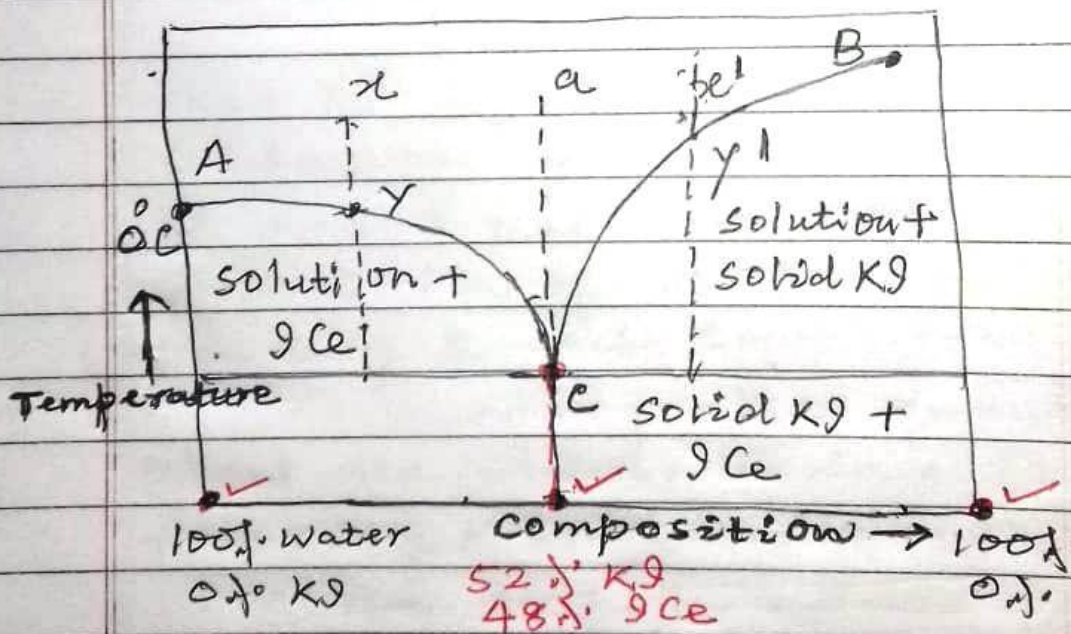
For Deg II Chemistry Hons Paper-III

Phase-Rule (Two Component system)

KI - Water system

The KI - water system is a typical example of a two components system which forms a eutectic mixture. The various features of this system are illustrated in the T – C diagram.

Here Pressure is considered Constant at 1- Atmospheric Pressure



Curve AC:- Point A denotes the freezing of water at 1 Atmospheric Pressure the temperature is 0°C, when increasing Quantities of KI is

are added, the freezing point of water is lowered along the curve AC. Thus AC may be called freezing point curve of water.

Along the curve AC, the solution of KI in H_2O is in contact with ice. Thus there are two phases. Applying the Reduced Phase rule to any point on this ~~curve~~ Area

$$F = C - P + 1 = 2 - 2 + 1$$

$$\therefore F = 1.$$

Thus the system is univariant i.e has one degree of freedom. It means that there will be definite composition of the solution corresponding to each temperature.

When further quantities of KI are added, the lowering of freezing point continues along the curve AC till the point C is reached. Here the solution becomes saturated with respect to solid KI and freezes at a constant temperature ($-22^\circ C$) and fixed composition 52% KI.

Curve BC :- This is known as the solubility curve of KI in water at different ~~composition~~ temperature The solubility increases with rise of temperature and becomes maximum at the point B, ie the boiling point of saturated solution Allow the saturated solution of KI to cool at B.

The solution will freeze along the curve BC, During this, solid KI crystallises. This crystallisation of KI continues till the temperature and composition corresponding to point C is reached At this point the solution freezes as a whole with fixed composition Along the curve BC, solid KI is in equilibrium with solution.

Again applying the Reduced Phase rule to this system We obtain

$$F = C - P + 1 = 2 - 2 + 1$$

or $F = 1$

Thus the system is univariant ie has one degree of freedom.

The steep rise of curve BC indicates that the solubility of KI increases slowly with rise of temperature.

Point C :-

It is the eutectic or cryohydric point. At the point C, the two curves AC and BC meet. This point corresponds to a definite temperature $-22^{\circ}C$ and definite composition 52% KI + 48% Ice.

At the point C, Ice, solution and solid KI are in equilibrium. This point has no degree of freedom which is evident from Phase rule equation.

$$F = C - P + 1 = 2 - 3 + 1$$

or $F = 0$ (Zero)

Thus C is a non-variant point.

Area above ACB

If the point lies above the curve AC it means that the dilute solution of KI is there. But the area above the curve BC represents the concentrated solution of KI.

Cooling :- Three cases may arise

(1) Consider a dilute solution represented by the Point x. On cooling, the temperature will lower along the curve xy without change in composition. This continues till the Point y is reached.

At this Point, ice separates out. Here the system will become univariant and further cooling will take place along the curve yC. This is continued till the Point C is reached. At this Point ice and KI freezes as a whole with fixed composition ie eutectic mixture.

(2) Consider a Concentrated Solution represented by the Point x'. Allow it to cool. This cooling continues without any change in composition along the curve x'y'. At this Point y', solid KI separates out.

Further cooling will Proceed along the curve y'C until the point C is reached. At this Point ice and KI freezes as a whole to give the eutectic mixture KI = 52% and Ice = 48%.

(3) Consider a solution which is represented by the Point a. This point lies vertically above the eutectic Point C. When the solution is allowed to cool, the temperature will lower along the curve aC until the eutectic Point C is reached. At this Point ice and KI separates out simultaneously. The mixture of KI and Ice deposited at the eutectic Point is known as "Cryohydrate".

The End