Date __/__/__ Part (II) Hons

Topic – Physical properties of solvents

Physical properties of solvents

Some important physical properties due to which it is considered as good solvent are as follows.

1) Melting point and boiling point.
2) Latent heat of fusion and latent heat of vaporisation
3) Dielectric constant.
4) Viscosity.
5) oxidation-reduction characteristic of the solvent.

1) Melting point and boiling point

The melting and boiling points of a solvent indicate the range of temperature over which it can exist in the liquid state under atmospheric pressure.

For example by compairing m.p and b.p of water and ammonia as follows.

	m.p.	b.p
Water	0°c	100°c
NH_3	77·7°c	33·35°C

We conclude that water exists as liquid at ordinary temperature and pressure while ammonia exists as gases under these conditions. These gases therefore act as solvents only at low temperatures

Saathi

Date ___/___/______

2 Latent heat of fusion and Latent heat of vaporisation.

Latent heat of fusion → The heat absorbed by one mole of a substance to change from solid to liquid state is called its Latent heat of fusion.

Latent heat of vaporisation → The heat absorbed by one mole of a substance to change from liquid to vapour state is called Latent heat of vaporisation.

* The heats of fusion and vaporisation indicate the nature and strength of forces with which the molecules of solvent are held together in the solid or the liquid state.

* A high heat of fusion and vaporisation indicate the nature and strength of forces.

* A high heat of vaporisation of a liquid indicates that the ~~in~~intermolecular binding forces in it are strong.

* $$\text{intermolecular binding force} = \frac{\text{heat of vaporisation}}{\text{boiling point}}$$

* Trouton Constant → The ratio of the heat of vaporisation expressed in joules to the boiling point (K) is a constant known as Trouton constant.

* The Trouton constant for normal liquid is $90 JK^{-1}$!
* A higher value of Trouton constant indicates association of molecules.

* The molecules of liquids which undergo association are polar. Examples are water, ammonia, alcohols, hydrogen fluorides.
* The forces which hold molecules together in water and ammonia are of same magnitude.
* The force holding SO_2 molecules together is stronger while the force holding HF molecule is weaker.
* These results are based upon different heat of fusion for these molecules.

3 Dielectric constant :→

The coulombic Force F between a cation and an anion is given by the expression $F = q_1 q_2 / D(r_1+r_2)^2$

where q_1 and q_2 are the charges on cation and anion

r_1 and r_2 are radii of the two ions.

and the constant D is called dielectric constant.

* The electrolytic behaviour of the solvent is related to its dielectric constant D.

* Dielectric constant in general determines

Date __/__/____

the ability of a solvent to dissolve ionic compounds

* Solvents with higher dielectric constants behave as better electrolytic solvents than those with lower dielectric constants

* For example solvents such as anhydrous hydrogen fluoride and water are the best solvents for ionic and polar compounds due to their high dielectric constant.

* while solvents like ammonia and liquid sulphur dioxide show decreased ability to dissolve ionic compounds especially those containing multi-charged ions due to their low dielectric constant.

4 Viscosity -

* Viscosity is an important property of a liquid solvent.

* It is easy to handle solvents with low viscosity.

* The process of precipitation, crystallization and filtration are carried out with difficulty in solvents of high viscosity.

* The solvents having low viscosity promotes greater ionic mobilities.

Date ___ / ___ / ___

5 Oxidation - reduction characteristics of the solvent

· Oxidising agents cannot be used in liquid NH_3 because the solvent is a reducing agent. Hence oxidising agents reacts immediately with ammonia giving nitrogen gas

$$2NH_3 + 3O \rightarrow N_2 + 3H_2O$$

Strong reducing agents cannot be used in water; because water itself undegoes reduction to give hydrogen.

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$