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Deg. I. Chem. Hons, Paper – II

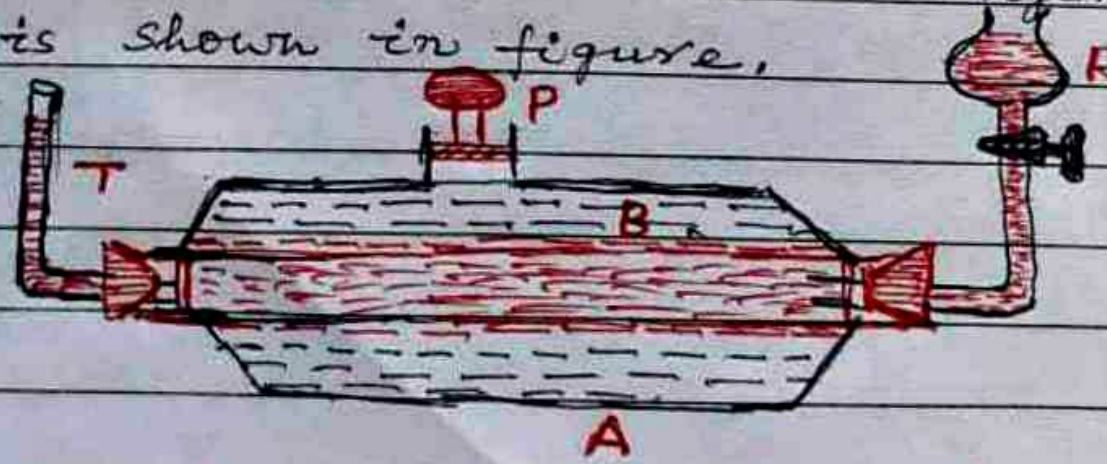
Topic :- Colligative Properties

Experimental measurement of osmotic Pressure.

Berkeley & Hartley's method :–

In this method instead of measuring the pressure developed as a result of the entry of the solvent into the solution, a gradually increasing Pressure is applied on the solution itself and the pressure which is just enough to prevent the entry of the solvent into the solution is noted.

The experimental arrangement is shown in figure,



A = outer Jacket containg the solution

B = Inner Jacket containg water (solvent) which is a porous pot

P = Piston, R = water reservoir

T = side tube

The Porous Pot (Inner Jacket B) Containg the Semipermeable membrane of Copper ferrocyanide $Cu_2[Fe(CN)_6]$ is filled with the solvent (water), and is surrounded by a outer Jacket A Containg the solution under examination.

A pressure is applied on the Solution by means of the Piston P so asto maintain the water level in the side tube T ie the water level in the side become static, the pressure applied on the Piston gives the osmotic Pressure.

Laws of osmotic Pressure

Van't Hoff, a Dutch Scientist showed the existence of close analogy between gases and dilute solutions which is as follows —

(1) Effect of Concentration on osmotic Pressure:—

At constant temperature, the osmotic Pressure (P) of a solution varies inversely as the volume (V) Containing

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1 mole of a solute.

$P \propto \frac{1}{V}$ (At Constant temperature)

The above relationship is similar to Boyle's law for gases and is known as Boyle-van't Hoff law for solutions

The Product pV is approximately equal to 22.6 litre-atmosphere If P = 1 Atmosphere V = 22.6 litre at 0°C. Thus the volume (V) of a solution containing 1 mole of a solute at 0°C is 22.6 litres when the osmotic Pressure is 1 Atmosphere. This value is quite close to the Gram molecular volume of the gases and the value is 22.4 litre at N.T.P Hence Avogadro's law is also applicable to dilute solution

(2) Effect of temperature on Osmotic Pressure

Vant Hoff showed that the osmotic Pressure of the solution varies directly as the absolute temperature

$P \propto T$ or P/T = Constant

which is analogous to Charle's law for gas. and is known as Charle's - Vant Hoff law