CHEMISTRY

Q WHAT ARE COLLIGATIVE PROPERTIES

The properties which depend on the number of solute particles and not on their nature are called Colligative properties.

IMPORTANT COLLIGATIVE PROPERTIES

1) Relative Lowering of Vapour Pressure & Its EXPRESSION

When a non-volatile solute is added to a pure solvent, the vapour pressure of resulting solution is lower than that of pure solvent. The difference between the vapour pressure of pure solvent and than that of solution is called lowering of vapour pressure (ΔP)

$$P_A = P_A^\circ X_A$$

where P_A = Vapour pressure
P_A° = Pure vapour pressure
X_A = Mole Fraction

where A is (solvent).
B is solute

Now

$$X_A + X_B = 1$$

$$P_A = P_A^\circ (1 - X_B)$$

$$P_A = P_A^\circ - P_A^\circ X_B$$

$$\frac{P_A - P_A^\circ}{-P_A^\circ} = X_B$$

$$\text{or } \frac{-(P_A^\circ - P_A)}{-P_A^\circ} = X_B \Rightarrow \boxed{X_B = \frac{P_A^\circ - P_A}{P_A^\circ}}$$

(2) ELEVATION OF BOILING POINT (ΔT_b)

When a non-volatile solute is added to pure solvent, the boiling point of the resulting solution is always greater than that of pure solvent.

The difference between boiling point of solution and that of pure solvent is called Elevation of Boiling Point (ΔT_b)

ΔT_b = Boiling point of Solution − Boiling point of pure solvent

$$\Delta T_b = T_b - T_b^o$$

For dilute solution, Elevation of boiling point is directly proportional to molality (m).

i.e. $\Delta T_b \propto m$

$$\Delta T_b = K_b m \quad \text{---(i)}$$

{where K_b is called Boiling Point Elevation constant}

Value of $m = \frac{w_2 \times 1000}{M_2 \times w_1}$

Putting value of m in Eq^n

$$\Delta T_b = \frac{K_b \times w_2 \times 1000}{M_2 \times w_1}$$

or $$\Delta T_b = \frac{1000\, K_b w_2}{w_1 \times M_2}$$

By using this equation, we can calculate molar mass of unknown solute

(3) DEPRESSION IN FREEZING POINT (ΔT_f)

When a non-volatile solute is added to pure solvent, its vapour pressure decreases It would become equal to that of solid solvent at lower temperature. Thus the freezing point of solvent decreases. The difference between freezing point of pure solvent (T_f°) and that of the solution (T_f) is called Depression in Freezing point (ΔT_f)

$$\text{i.e } \Delta T_f = T_f^\circ - T_f$$

For dilute solutions, it is found that the depression of freezing point (ΔT_f) is directly proportional to molality.

$$\Delta T_f \propto m$$

$$\Delta T_f = K_f m$$

{ where K_f is a constant called Freezing Point Depression Constant

We know

$$m = \frac{w_2 \times 1000}{M_2 \times w_1}$$

$$\Delta T_f = \frac{K_f \times w_2 \times 1000}{M_2 \times w_1}$$

$$\Delta T_f = \frac{1000\, K_f w_2}{w_1 \times M_2}$$

(4) Osmosis & Osmotic Pressure

Osmosis is the flow of solvent molecules from lower concentration side to a higher concentration side through a semi-permeable membrane.

Osmotic Pressure is defined as the excess pressure that must be applied on solution side to stop osmosis.

For dilute solution, Osmotic Pressure is proportional to molarity (C) and Temperature (T)

i.e $\pi = CRT$

$$\pi = \frac{n_2 RT}{V} \quad \left\{ \because C = \frac{n_2}{V} \right\}$$

$$\pi V = n_2 RT$$

$$\pi V = \frac{W_2 \cdot RT}{M_2} \quad \left\{ \because n_2 = \frac{W_2}{M_2} \right\}$$

$$\text{or } M_2 = \frac{W_2 RT}{\pi V}$$

ADVANTAGES OF OSMOTIC PRESSURE OVER OTHER COLLIGATIVE PROPERTY

1) Osmotic Pressure measurement can be done at room temperature.
2) Magnitude of Osmotic Pressure is large even for very dilute solutions
3) Here molarity is used instead of molality, which can be determined easily.

WHAT IS RATE OF (CHEMICAL) REACTION?

The rate of a chemical reaction is the change in concentration of any one of the reactant or product in unit time.

FACTORS AFFECTING RATE OF REACTION

1) **Concentration:** Chemical Reaction rate increases with increase in concentration and decreases with decrease in concentration of reactants.

2) **Temperature:** As per collision theory, a chemical reaction that takes place at a higher temperature generates more energy than a reaction at lower temperature

3) **Catalyst:** presence of catalyst increases the speed of reaction in both forward & reverse reaction.

AVERAGE & INSTANTANEOUS RATE OF REACTION

Average Rate of Reaction: The rate of a reaction at a particular interval of time is called Average Rate of Reaction. The rate of ~~reaction~~ reaction is measured over a long time interval.

$$\text{Avg. Rate} = \frac{\Delta x}{\Delta t}$$

{where Δx is change in concentration. Δt is large interval of time}

Instantaneous Rate: It is the rate of reaction where average time is taken over a particular moment of time.

$$\text{Instantaneous Rate} = \frac{dx}{dt}$$

{dx small change in concentration. dt is small time}

Be Positive...

DATE: __/__/__

RATE LAW OR RATE LAW EXPRESSION OR RATE EQUATION

The representation of rate of reaction in terms of molar concentration of reactants as experimentally determined is called Rate Law.

MOLECULARITY OF A REACTION

The number of molecules / atoms / ions which must collide simultaneously in order to bring about a chemical reaction.

ORDER OF REACTION

It is the sum of powers of concentration of reactants in the rate law expression

Difference Between Molecularity & Order.

Order	Molecularity
1) Write above def.	1) Write above def.
2) It is an experimental quantity	2) It is a theoretical quantity
3) It can be zero or fractional	3) It can't be zero or fractional