ABLES KOTA

1 mol NaCl $\longrightarrow$ 1 mol Na^+ + mol Cl^-

N_A Particles

2 N_A Particles.

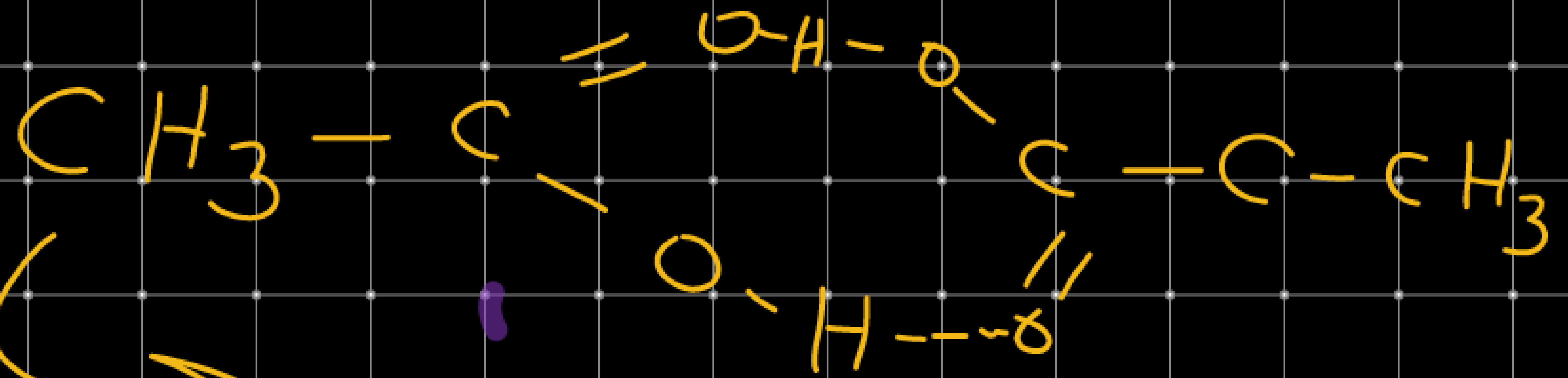
1 mol NaCl $\longrightarrow$ 58.5 g. $\longrightarrow$ m.w.

2 mol $\longrightarrow$ 58.5 g.

1 mol $\longrightarrow$ $\frac{58.5}{2}$ = 29.25 g

$$2\,\boxed{CH_3COOH} \xrightarrow{\text{Benzene}} (CH_3COOH)_2$$

1 mol → 60



1 mol → 120

Abnormal Colligative propertys & Abnormal molecular weight :-

It has been observed that difference in the observed and calculated molecular mass of solute is due to dissociation or Association of solute molecules in solution.

It results change in no of particles in solution

Vant Hoff factor (i) :-

It tells relationship between normal colligative property and abnormal colligative property.

$$i = \frac{\text{Abnormal (observed) colligative property}}{\text{Normal (calculated) colligative property}}$$

$$i = \frac{\text{no. of particles after dissociation or association}}{\text{no. of particles befor dissociation or association}}$$

$$i = \frac{\text{normal (Calculated) Molecular weight}}{\text{Abnormal (observed) molecular weight.}}$$

$$\boxed{i = \frac{M_{normal}}{M_{Abnormal}}}$$

(i) If $i = 1 \Rightarrow$ Neither dissociation nor association ex:- Urea, glucose

(ii) if $i > 1 \Rightarrow$ dissociation occur ex:- $NaCl$, $CaSO_4$, Na_2SO_4

(iii) if $i < 1 \Rightarrow$ association occur ex:- CH_3COOH in benzene form diamer benzoic acid in benzene form dimer

Case – 1 Dissociation of Solute

No. of solute particles in solution increases

observed/abnormal Colligative Property > theoritical/normal Colligative Property

Observed/abnormal molecular weight of solute < theoritical/normal molecular weight of solute.

$\therefore$ C.P. $\propto \dfrac{1}{\text{Molecular weight of Solute}}$

Calculation of 'i'

let Solute is A_xB_y (electrolyte)

$$A_xB_y \longrightarrow xA^{+y} + yB^{-x}$$

	A_xB_y	xA^{+y}	yB^{-x}
initially	1 mol	—	—
after dissociation	$(1-\alpha)$	$x\alpha$	$y\alpha$

Total no. of particles before dissociation = 1

— " — after dissociation = $1-\alpha+\underline{x\alpha+y\alpha}$

$= 1-\alpha+\alpha(x+y)$ $\{x+y=n\}$

$= 1-\alpha+n\alpha$

$i = \dfrac{1-\alpha+n\alpha}{1} \Rightarrow i = 1-\alpha+n\alpha$

$i-1 = n\alpha-\alpha$

$i-1 = \alpha(n-1)$

$$\boxed{\alpha = \frac{i-1}{n-1}}$$

Here $n = x + y \Rightarrow$

total no. of ions.

When $\alpha = 100\%$

$$\boxed{\alpha = 1}$$

$$1 = \frac{i-1}{n-1} \Rightarrow n-\cancel{1} = i-\cancel{1}$$

$$\boxed{i = n}$$

if $\alpha = 100\%$ then $i = n$ (total no. of ions)

$NaCl \longrightarrow \underline{Na^+} + \underline{Cl^-}$

$n = 1 + 1 = 2$

$Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-}$

$n = 2 + 1 = 3$

Case 2 :- Association of Solute :-

No. of Solute particles in solution decreases.

Abnormal/obeserved C.P. < Normal/Calculated C.P.

Abnormal/obeserved molecular weight > Normal/Calculated molecular weight.

Calculation of i :-

$$nA \longrightarrow A_n$$

initially 1 mol —

after association $1-\alpha$ α/n

$$\left\{ \begin{array}{l} n \longrightarrow \alpha \\ 1 \longrightarrow \frac{\alpha}{n} \end{array} \right\}$$

no. of particles befor association = 1

— " — after association = $1-\alpha+\alpha/n$

$$i = \frac{1-\alpha+\alpha/n}{1}$$

$$i = 1 - \alpha + \frac{\alpha}{n}$$

$$i - 1 = \frac{\alpha}{n} - \alpha$$

$$i - 1 = \alpha\left(\frac{1}{n} - 1\right)$$

$$\boxed{\alpha = \frac{i-1}{\frac{1}{n}-1}} \quad \text{or} \quad \boxed{\alpha = \frac{1-i}{1-\frac{1}{n}}}$$

Here $n \Rightarrow$ no of particles

which are associated

ex: $2A \longrightarrow A_2$

dimer

$n = 2$

$3A \longrightarrow A_3$

trimer

$n = 3$

$i = \frac{\text{Abnormal C.P.}}{\text{Normal C.P.}}$

$$\boxed{\text{Abnormal C.P./Observed} = i \cdot \text{Normal C.P./Calculated}}$$

(1) $\left(\frac{P_A^\circ - P_S}{P_A^\circ}\right)_{obs} = i\, X_B$

(2) $(\Delta T_b)_{obs} = i\, k_b \cdot m$

(3) $(\Delta T_f)_{obs.} = i\, k_f\, m$

(4) $(\pi)_{obs.} = i\, C R T$

Ques. 1 An aq. soln of mercurous chloride (Hg_2Cl_2) dissociate to 80%. Cal. Vant Hoff factor (i)

Sol.

$$Hg_2Cl_2 \rightleftharpoons Hg_2^{2+} + 2Cl^-$$

$\alpha = 80\%$. $n = 1+2$; $\alpha = \dfrac{i-1}{n-1} \Rightarrow 0.8 = \dfrac{i-1}{2} \Rightarrow i-1 = 1.6$

$\boxed{\alpha = 0.8}$, $\boxed{n = 3}$; $\Rightarrow \boxed{i = 2.6}$

Q.2. The degree of association of following change is 60%. $4A \rightleftharpoons A_4$; cal i

$\alpha = 60\%$; $n = 4$

$\alpha = 0.6$;

$$\alpha = \frac{1-i}{1-\frac{1}{n}}$$

$$0.6 = \frac{1-i}{1-\frac{1}{4}}$$

$$0.6 = \frac{1-i}{3/4}$$

$$1-i = \overset{0.3}{\cancel{0.6}} \times \frac{3}{\cancel{4}_{2}}$$

$$1-i = \frac{0.9}{2}$$

$$1-\frac{0.9}{2} = i$$

$$\frac{2-0.9}{2} = i \Rightarrow \boxed{i = \frac{1.1}{2} = 0.55}$$