Colligative properties of strong electrolytes

- need to take into account the dissoc. into ions

ex: $NaCl \xrightarrow{H_2O} Na^+(aq) + Cl^-(aq)$ $i = 2$

$Ca(NO_3)_2 \xrightarrow{H_2O} Ca^{2+}(aq) + 2NO_3^-(aq)$ $i = 3$

$Fe(HCO_3)_3 \xrightarrow{H_2O} Fe^{3+}(aq) + 3HCO_3^-(aq)$ $i = 4$

iron(III) bicarbonate

van't Hoff factor (#particles formed when formula unit dissolves)

eq's become:

$$\Delta T_f = m \cdot K_f = i \cdot m \cdot K_f$$
$$\Delta T_b = m \cdot K_b = i \cdot m \cdot K_b$$
$$\Pi = M \cdot R \cdot T = i \cdot M \cdot R \cdot T$$

Q: What's osmotic pressure of 0.010M calcium nitrate(aq) @ 33°C

$R = 0.08206 \frac{atm \cdot L}{mol \cdot K}$

$+273.15 = 306.15K$

$Ca(NO_3)_2(aq)$

$\Pi = i \cdot M \cdot R \cdot T$

$Ca(NO_3)_2(aq) \rightarrow Ca^{2+}(aq) + 2NO_3^-(aq)$

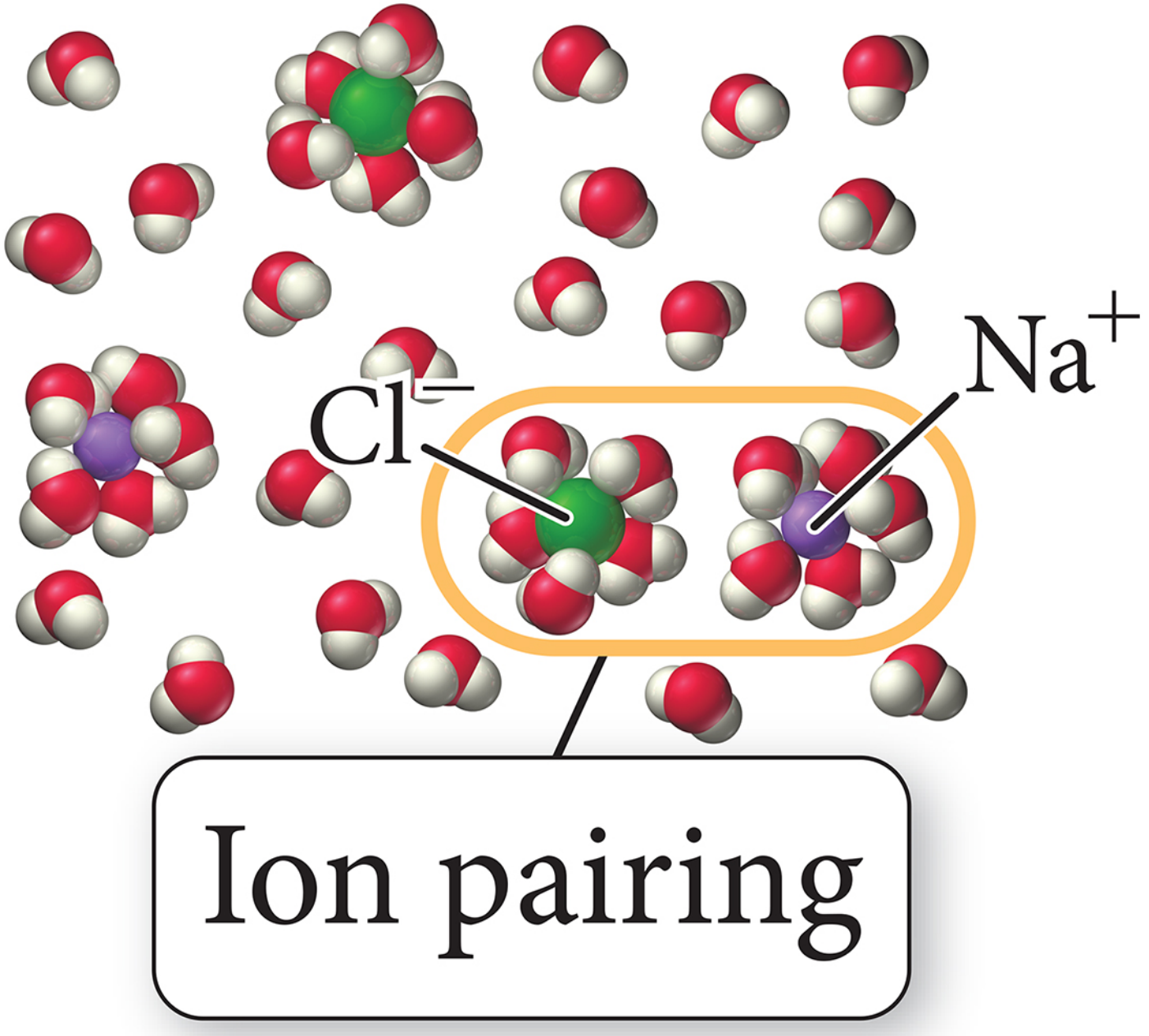
$i = 3$

$$= 3 \times 0.010 \frac{mol}{L} \times 0.08206 \frac{atm \cdot L}{mol \cdot K} \times 306K$$

$$= 0.75 \text{ atm}$$

TABLE 13.9 Van't Hoff Factors at 0.05 *m* Concentration in Aqueous Solution

Solute	*i* Expected	*i* Measured
Nonelectrolyte	1	1
NaCl	2	1.9
$MgSO_4$	2	1.3
$MgCl_2$	3	2.7
K_2SO_4	3	2.6
$FeCl_3$	4	3.4



Ch 14 — Chemical Kinetics

~ Rates (speeds) of chem. rxns.

What <u>IS</u> the rate (or speed) of a chem rxn?

$$\text{Car Speed} = \frac{\text{change in distance}}{\text{change in time}} = \frac{\Delta x}{\Delta t}$$

$$\text{Rxn ~~speed~~ rate} = \frac{\text{change in molar conc}}{\text{change in time}} = \frac{\Delta c}{\Delta t} = \frac{\Delta [\ ]}{\Delta t}$$

for a rxn: $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

conc decreases — conc increases

3× as fast as N_2 is consumed — 2× as fast a change as N_2 is used up.

$$\text{rate} = \ominus \frac{\Delta [N_2]}{\Delta t} = \ominus \frac{1}{3} \frac{\Delta [H_2]}{\Delta t} = \frac{1}{2} \frac{\Delta [NH_3]}{\Delta t}$$

($\ominus$: M; Δt: s)

$\frac{M}{s}$ or $M \cdot s^{-1}$

in general: $aA + bB \rightarrow cC + dD$

$$\text{rate} = -\frac{1}{a}\frac{\Delta [A]}{\Delta t} = -\frac{1}{b}\frac{\Delta [B]}{\Delta t} = +\frac{1}{c}\frac{\Delta [C]}{\Delta t} = +\frac{1}{d}\frac{\Delta [D]}{\Delta t}$$