$$m = \frac{M}{d - M \cdot MW}$$

(MW in kg mol^{-1}, d in kg L^{-1})

$$m = \frac{M \times 1000}{1000 \cdot d - M \cdot MW}$$

(MW in g mol^{-1}, d in g mL^{-1})

$$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{vap.}}{R} \cdot \left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

(P_2 and P_1 are vapour pressures at temperatures T_1 and T_2)

$P_A = P^0_A \cdot x_A$
(P_A = Partial VP, P^0_A = VP of pure liquid)

Henry's Law (Gas dissolved in liquid)
m $\propto$ p
(m = mass of gas dissolved per unit volume of solvent,
p = VP at equilibrium)
$P_{gas} = K_h \cdot x_{gas}$

Relative Lowering of Vapour Pressure

$$\frac{\Delta P}{p^0} = \frac{p^0 - p}{p^0} = x_2$$

Osmotic Pressure

$$\pi = CRT$$

$$\pi V = nRT$$

$$\pi = \frac{W_B RT}{VM_B}$$

Elevation in Boiling Point

$$\Delta T_b = K_b \cdot m$$

$$K_b = \frac{M_1 R (T_b^0)^2}{\Delta H_{vap.} \times 1000}$$

$$K_b = \frac{R (T_b^0)^2}{L_v \times 1000}$$

$$\Delta T_b = \frac{K_b W_2 \times 1000}{W_1 M_2}$$

(M_1 = MW of Solvent, ΔT_b^0 = Boiling Point of Solvent, L_v = Latent Heat of Vaporization of pure solvent in g^{-1} , W_1 = Weight of Solvent, $\Delta H_{vap.}$ = Molar Enthalpy of Vaporization of Solvent)

Depression in Freezing Point

$$\Delta T_b = K_b \cdot m$$

$$K_f = \frac{M_1 R (T_f^0)^2}{\Delta H_f \times 1000}$$

$$K_f = \frac{R (T_f^0)^2}{L_f \times 1000}$$

$$\Delta T_f = \frac{W_2 K_f \times 1000}{M_2 W_1}$$

(M_1 = MW of Solvent, T_f^0 = Freezing Point of Solvent, L_f = Latent Heat of Fusion of pure solvent in g^{-1} , W_1 = Weight of Solvent, ΔH_f = Molar Enthalpy of Fusion of Solvent)

Association: $\alpha = \frac{1-i}{1-1/n}$ Dissociation: $\alpha = \frac{i-1}{n-1}$

For a reaction $aA + bB \rightarrow cC + dD$
Rate of the reaction (w.r.t. A, B, C, D):

$$Rate = -\frac{1}{a} \cdot \frac{d[A]}{dt} = -\frac{1}{b} \cdot \frac{d[B]}{dt} = \frac{1}{c} \cdot \frac{d[C]}{dt} = \frac{1}{d} \cdot \frac{d[D]}{dt}$$

$$Rate\, of\ Disappearance = -\frac{d[A]}{dt} = -\frac{d[B]}{dt}$$

$$Rate\, of\ Appearance = \frac{d[C]}{dt} = \frac{d[D]}{dt}$$

Law of Mass Action:

$$Rate = k[A]^a[B]^b$$

Units for Rate Constant of n^{th} order reaction

$$k = [mol\, L^{-1}]^{1-n}\, s^{-1}$$

$$k = [atm]^{1-n}\, s^{-1}$$

Integrated Rate Law (First Order)

$$k = \frac{1}{t} \cdot \ln \frac{[A_0]}{[A_t]}$$

$$[A_t] = [A_0] \cdot e^{-kt}$$

Integrated Rate Law (Second Order)

$$k = \frac{1}{t}\left[\frac{1}{[A]} - \frac{1}{[A_0]}\right]$$

Half Lives ($t_{1/2}$):

$$Zero\ Order = \frac{[A_0]}{2k}$$

$$First\ Order = \frac{0.693}{k}$$

$$Second\ Order = \frac{1}{k \cdot [A_0]}$$

Amount left after n half-lives = $\frac{[A_0]}{2^n}$

$$t_f \propto \frac{1}{[A_0]^{n-1}}$$

$$Arrhenius\ Equation \rightarrow k = Ae^{-E_a/RT}$$

$$k = Ze^{-E_a/RT}$$

$$Z \propto \sqrt{T}$$

$$\ln \frac{k_2}{k_1} = \frac{E_a}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$