Colligative Properties Formula Sheet:

Useful Notes:

$$\Delta T = T_{solution} - T_{solvent}$$

$T_{solution} \rightarrow FP\ or\ BP\ of\ solution$
$T_{solvent} \rightarrow FP\ or\ BP\ of\ solvent$

Adding Salt to Water:

$$Salt \uparrow \rightarrow BP \uparrow \quad \pi \uparrow \quad VP \downarrow \quad FP \downarrow$$

Boiling Point (BP) Elevation:

$$\Delta T = K_b \cdot \boldsymbol{m} \cdot i$$

Freezing Point (FP) Depression:

$$\Delta T = K_f \cdot \boldsymbol{m} \cdot i$$

For H_2O: $K_b = 0.51\ °C/m$ $\quad K_f = -1.86\ °C/m$

Molarity:

$$\boldsymbol{M} = \frac{moles\ of\ solute}{Liters\ of\ Solution} \qquad \boldsymbol{M} = \frac{n}{V}$$

Molality:

$$\boldsymbol{m} = \frac{moles\ of\ solute}{Kg\ of\ Solvent}$$

Osmotic Pressure:

$$\pi = \boldsymbol{M}RTi$$

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

$$T_K = T_C + 273.15$$

Substance:	Van't Hoff Factor:
$C_6H_{12}O_6$	$i = 1$
$NaCl$	$i = 2$
$MgBr_2$	$i = 3$
$AlCl_3$	$i = 4$
$Al_2(SO_4)_3$	$i = 5$

Van't Hoff Factor:

$$i = \frac{moles\ of\ particles\ in\ solution}{moles\ of\ solute\ dissolved}$$

Ion Pairing: $i_{observed} < i_{ideal}$

Note: $\boldsymbol{m} \uparrow \quad ion\ pairing \uparrow$

Mole Fraction for Solutions:

$$X_A = \frac{n_A}{n_T} \qquad n_T = n_A + n_B + n_C + \ldots$$

Vapor Pressure of a Solution:

$$P_{soln} = X_{solvent} \cdot P_{solvent}$$

Mole Fraction of Gases in the Vapor Phase:

$$X_A = \frac{P_A}{P_T} \qquad P_T = P_A + P_B + P_C + \ldots$$

Solution Vapor Pressure: (2 Volatile Components)

$$P_{soln} = P_A + P_B$$

$$P_{soln} = X_A {P_A}^o + X_A {P_B}^o$$

$\boldsymbol{P_A} \rightarrow Partial\ Pressure\ of\ Gas\ A$
$\boldsymbol{{P_A}^o} \rightarrow Vapor\ Pressure\ of\ Gas\ A$
$\boldsymbol{P_{soln}} \rightarrow Vapor\ Pressure\ of\ Solution$
$\boldsymbol{P_{solvent}} \rightarrow Vapor\ Pressure\ of\ Solvent$

Partial Pressure:

$$P_A = X_A {P_A}^o \qquad P_B = X_B {P_B}^o$$

Vapor Pressure:

$$P_2 = P_1 e^{-\frac{\Delta H_{Vap}}{R}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]}$$

Note:

$P_{H2O} = 23.76\ torr\ at\ 25\ °C$

$P_{H2O} = 17.5\ tor\ at\ 20\ °C$

Clausius -Clapeyron Equation:

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

Note:

$\Delta H_{Vap} = 43.9\ kJ/mol\ at\ 25\ °C$

$\Delta H_{Vap} = 40.7\ kJ/mol\ at\ 100\ °C$

$R = 8.3145\ J/mol * K$

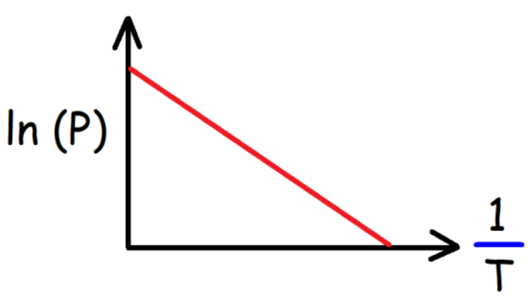
Temperature:

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

Enthalpy of Vaporization:

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

Graph: $\ln(P_{Vap})\ vs\ \left(\frac{1}{T}\right)$



Slope-Intercept Form:

$$\ln(P_{Vap}) = -\frac{\Delta H_{Vap}}{R}\left(\frac{1}{T}\right) + C$$

$$y = mx + b$$

Slope of Straight-Line Plot: $\ln(P_{Vap})\ vs\ \left(\frac{1}{T}\right)$

$$m = -\frac{\Delta H_{Vap}}{R}$$