Concentration Formula Sheet:

Mass Percent:

$$mass\ \% = \frac{mass\ of\ solute}{mass\ of\ solution}\ x\ 100\%$$

Volume Percent:

$$Volume\ \% = \frac{Volume\ of\ solute}{Volume\ of\ solution}\ x\ 100\%$$

Solutions:

$$Solute\ (\mathbf{NaCl}) + Solvent\ (\mathbf{H2O}) = Solution$$

Dilution:

$$M_1V_1 = M_2V_2$$

Mole Fraction:

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

Density:

$$d = \frac{mass}{Volume} \qquad d = \frac{m}{V}$$

Molarity:

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

molality:

$$\mathbf{molality} = \frac{moles\ of\ solute}{Kg\ of\ Solvent}$$

Normality:

$$\mathbf{N} = \frac{\#\ of\ gram\ equivalent\ weight\ of\ solute}{Liters\ of\ Solution}$$

# of Gram Equivalent Weight:

$$\#\ of\ gram\ EW = \frac{mass\ of\ solute}{Equivalent\ Weight}$$

Equivalent Weight:

$$EW = \frac{Molar\ mass}{n}$$

Normality:

$$\mathbf{N} = M \times n$$

Normality – Simplified Formula:

$$\mathbf{N} = \frac{m * n}{V * M_w}$$

$m \rightarrow mass\ (g)$
$V \rightarrow Volume\ (Liters\ of\ Solution)$
$M_w \rightarrow Molecular\ Weight\ or\ Molar\ mass$
$n \rightarrow number\ of\ H^+\ or\ OH^-\ ions\ per\ formula\ unit$

Acid Base Neutralization Reactions:

$$N_1V_1 = N_2V_2$$

Parts Per Million: (ppm)

$$ppm\ (m/m) = \frac{mass\ of\ solute}{mass\ of\ solution}\ x\ 10^6$$

$$ppm\ (V/V) = \frac{Volume\ of\ solute}{Volume\ of\ Solution}\ x\ 10^6$$

$$ppm\ (m/V) = \frac{mass\ of\ solute\ (\boldsymbol{g})}{Volume\ of\ Solution\ (\boldsymbol{mL})}\ x\ 10^6$$

$$ppm\ (m/V) = \frac{mass\ of\ solute\ (\boldsymbol{mg})}{Volume\ of\ Solution\ (\boldsymbol{L})}$$

Note: $1\ ppm = 1\ \boldsymbol{mg/L}$ $\quad 1\ ppb = 1\ \boldsymbol{ug/L}$

Parts Per Billion: (ppb)

$$ppb\ (m/m) = \frac{mass\ of\ solute}{mass\ of\ solution}\ x\ 10^9$$

$$ppb\ (V/V) = \frac{Volume\ of\ solute}{Volume\ of\ Solution}\ x\ 10^9$$

$$ppb\ (m/V) = \frac{mass\ of\ solute\ (\boldsymbol{g})}{Volume\ of\ Solution\ (\boldsymbol{mL})}\ x\ 10^9$$

$$ppb\ (m/V) = \frac{mass\ of\ solute\ (\boldsymbol{ug})}{Volume\ of\ Solution\ (\boldsymbol{L})}$$

Note: $1\ ppm = 1000\ ppb$

Concentration Vs Solubility:

Unsaturated Solution:	$C < S$	(Dissolution)
Saturated Solution:	$C = S$	(Equilibrium)
Supersaturated Solution:	$C > S$	(Precipitation)

Henry's Law:

$$\frac{P_2}{P_1} = \frac{S_2}{S_1} \qquad S = kP \qquad \frac{S_1}{P_1} = \frac{S_2}{P_2}$$

Note: $k \rightarrow Solubility\ gas\ constant\ \left(\frac{mol}{L*atm}\right)$

Enthalpy of Solution:

$$\Delta \boldsymbol{H_{Solution}} = \Delta H_{Hydration} - \Delta H_{Lattice\ Energy}$$

$$\Delta \boldsymbol{H^o_{solution}} = \sum n\,H^o{}_f(products) - \sum n\,H^o{}_f(reactants)$$