Shortcut and Direct Formula Session
Courtesy: Olaye Fortune
CHAPTER 1: STOICHIOMETRY

- *Mole(n)*

The number of mole formula is given by:

$$n = \frac{mass\ of\ substance}{molar\ mass\ of\ substance}$$
$$n = \frac{Number\ of\ particles}{6.02 \times 10^{23}}$$
$$n = \frac{Concemtration \times Volume(in\ mL)}{1000}$$
$$n = Concentration \times Volume(\ in\ L)$$

Note: The formulas can be related/equated to each other, when a question has more than two parameters.

- *Percentage Composition*

$$\%\ of\ element = \frac{molar\ mass\ of\ element}{molar\ mass\ of\ compound} \times 100\%$$
$$\%\ of\ element = \frac{mass\ of\ element}{mass\ of\ compound} \times 100\%$$

- *Percentage Yield*

$$\%\ yield = \frac{Actual\ yield}{Theoritical\ yield} \times 100\%$$

- *Mass Percent and Mole fraction*

$$Mass\ solute = \frac{mass\ solute}{mass\ of\ solute + mass\ of\ solvent} \times 100\%$$
$$\rightarrow Mass\ of\ solute + Mass\ of\ solvent = masss\ of\ solutuion$$
$$Mole\ fraction\ of\ element\ A = \frac{Number\ of\ moles\ of\ A}{Total\ Number\ of\ moles}$$

- *Molarity, Molality and Normality*

$$Molarity = \frac{No\ of\ moles\ of\ solute}{Volume\ of\ solution\ in\ Litres}$$

$$Molarity = \frac{mass\ of\ solute}{molar\ mass\ of\ solute} \times \frac{1000}{Volume\ in\ mL}$$

$$Molality = \frac{No\ of\ moles\ of\ solute}{Mass\ of\ Solvent\ in\ Kg}$$

$$Molality = \frac{Mass\ of\ solute}{Molar\ mass\ of\ solute} \times \frac{1000}{Mass\ of\ solvent\ in\ g}$$

$$Normality = \frac{number\ of\ equivalent}{Volume\ of\ solution\ in\ L}$$

$$Normality = \frac{mass\ of\ solute}{molar\ mass\ of\ solute} \times \frac{Reacting\ unit}{Volume\ of\ solution\ in\ L}$$

→The Reacting unit is the reacting of a compound, that is;
1. The Reacting unit of an acid is equal to the **Basicity of the Acid.** Hence for H_2SO_4 it is **two**, for H_3PO_4 it is **3**.
2. The Reacting unit for oxidizing or reducing agent, it the **number of electrons gains or lost** during the reaction. Hence for $KMnO_4$ it is **5** and for $K_2Cr_2O_7$ it is **3**.

- *Relationship between Molarity and Normality*
$$Normality = Molarity \times Reacting\ unit$$

- *Relationship between Molarity and Molality*
$$\frac{1}{Molality} = \frac{density}{Molarity} - \frac{molar\ mass\ of\ solute}{1000}$$

- *Stock Solution/Dilution Principle*
$$C_1V_1 = C_2V_2$$
$$V_2 = V_1 + Volume\ of\ water\ added$$
$$C_1 \& C_2\ are\ the\ initial\ and\ final\ concentration$$

CHAPTER 2: INTRODUCTION TO REDOX REACTION

- For complex redox equation questions, you can easily get your answers from the option rather than going through the long approach. *To do this:*
  - i) *Firstly, balance your atoms on the left and right side of the equation. That is, the total number of atoms on the left must equal that on the right.*
  - ii) *Secondly, balance your charges on the left and right side of the equation. That is, the total number of charges on the left must equal that on the right.*
- In other simple redox reduction, asking for the reducing agents or/and oxidizing agents. *Note these;*
  - i) The oxidizing agent is element that gained an electron. Examples; **Most Non-metallic elements, $KMnO_4$, $K_2Cr_2O_7$ etc.**
  - ii) The reducing agent is the element that lost electron(s). Examples; **Most Metallic elements, $LiAlH_4$, $NaBH_4$ etc**

CHAPTER 3&4: ACID, BASE AND SALT:REACTIONS

- $pH = -log_{10}[H^+]$
- $pOH = -\log[OH^-]$
- $[H^+][OH^-] = 10^{-14}$
- To determine the pH of an weak acid in a buffer solution use the equation;

$$pH = pK_a + \log[\frac{Salt\ concentration}{Acid\ concentration}]$$

The pKa is calculated using:

$$pK_a = -log_{10}[K_a]$$

K_a is the acid dissociation constant.

- To determine the pOH of an weak base in a buffer solution use the equation;

$$pOH = pK_b + \log[\frac{Salt\ concentration}{Base\ concentration}]$$

The pKb is calculated using:

$$pK_b = -log_{10}[K_b]$$

K_b is the base dissociation constant.

- If a minimal strong acid or base is added to the buffer solution, the equation can be given as:

$$pH = pK_a + \log[\frac{salt - Added\ acid}{Acid + Added\ Acid}]$$

$$pH = pK_a + \log[\frac{salt + Added\ Base}{Acid - Added\ Base}]$$

$$pOH = pK_b + \log[\frac{salt + Added\ acid}{Base - Added\ Acid}]$$

$$pOH = pK_b + \log[\frac{salt - Added\ base}{Base + Added\ base}]$$

Note that the value of the salt, acid, base and added base is in $moldm^{-3}$.

- *Solubility product(K_{sp})*

If you have a salt, given by:

$$X_pY_q$$

The solubility is given by:

$$K_{sp} = (p^p \times q^q)(solubility)^{p+q}$$

Examples 1: $AgCl$

$$K_{sp} = (1^1 \times 1^1)(solubility)^{1+1}$$
$$K_{sp} = (solubility)^2$$

Example 2: $PbCl_2$

$$K_{sp} = (1^1 \times 2^2)(solubility)^{1+2}$$
$$K_{sp} = 4(solubility)^3$$

- *Solubility product in another solvent(common ion effect)*

The shortcut is given as: If salt XY_n is dissolved in salt ZY_r of concentration P, the solubility of salt XY_n is given as:

$$x = \frac{K_{sp}\ of\ XY_n}{[rP]^n}$$

If you still don't understand contact FORTUNE (08163721142)

CHAPTER 5: COLLIGATIVE PROPERTIES OF SOLUTION

- *Raoult's Law*

$$P_{solutiion} = X_{solvent} \cdot P^0_{solvent}$$
$$\Delta P = X_{solute} \cdot P^0_{solvent}$$

ΔP is the vapor pressure change, $P_{solution}$ is the new vapor pressure, $X_{solvent}$ & X_{solute} are the mole solvent and mole solute, $P^0_{solvent}$ is pure vapour pressure of the solvent.

- *Elevation Of Boiling point of the solvent*

$$\Delta T_b = \frac{mass\ of\ solute \times 1000 \times K_b}{molar\ mass\ of\ solute \times mass\ of\ solvent\ in\ g}$$
$$New\ B.P - Normal\ B.P = \Delta T_b$$

K_b is the molar boiling point elevation constant

- *Depression of the Freezing point of the solvent*

$$\Delta T_f = \frac{mass\ of\ solute \times 1000 \times K_f}{molar\ mass\ of\ solute \times mass\ of\ solvent\ in\ g}$$
$$New\ F.P - Normal\ F.P = \Delta T_f$$

K_f is the molar freezing point depression constant

- *Osmotic Pressure*

$$\pi = MRT$$
$$\pi = \frac{dRT}{M_O}$$

π is the osmotic pressure in atm ,M is molar concentration in $moldm^{-3}$,d is density, Mo is molar mass, T is temperature in K &R is the gas constant.

Solvent	B.P	K_b	F.P	K_f
Water	100	0.512	0	1.86
Benzene	80	2.53	5.5	5.12

CHAPTER 6: CHEMICAL EQUILIBRIUM

- $mA + nB \leftarrow\rightarrow pC + qD$

$$K_c = \frac{[C]^p[D]^q}{[A]^m[B]^n}$$
$$\Delta n = (p + q) - (m + n)$$

- $K_p = K_c(RT)^{\Delta n}$

Note:
1. $\Delta n > 0: Then\ K_p > K_c$
2. $\Delta n < 0: Then\ K_p < K_c$
3. $\Delta n = 0: Then\ K_p = K_c$

K_p is the is the equilibrium pressure constant & K_c is the equilibrium constant, R is the gas constant and T is temperature