Mole Ratios

- Start with a balanced equation.
  for example: $1\ SiCl_4(\ell) + 2\ H_2O(\ell) \longrightarrow 1\ SiO_2(s) + 4\ HCl(aq)$

- Identify the coefficients for each of the reactants and products.
  In order to write the process mathematically, the substances will be represented as A, B, C and D.
  The coefficients will be shown as C_A, C_B, C_C and C_D.
  The number of moles used or produced will be shown as N_A, N_B, N_C and N_D.
- When determining the "Limiting Reagent", calculate the ratios of the moles supplied to the coefficient for each substance given. The smallest of these values indicates the limiting reagent and all other quantities are to be determined by this value.

$$\frac{N_A}{C_A}; \frac{N_B}{C_B}$$

- After the limiting reagent is identified, that ratio is used to calculate the number of moles of each of the other substances in the reaction. Taking the limiting reagent to be identified as 'L' (even though it is already identified as A, B, C or D), the following formula is used to calculate the unknown values:

$$\frac{N_L}{C_L} = \frac{N_A}{C_A} = \frac{N_B}{C_B} = \frac{N_C}{C_C} = \frac{N_D}{C_D}$$

- As an example: If 1.3 moles of $SiCl_4$ were reacted with 2.3 moles of water, which would be the limiting reactant?

$$\frac{1.3}{1} = 1.3; \frac{2.3}{2} = 1.15$$

- Since 1.15 < 1.3, water is the limiting reagent and all of the other substances will have the same mole ratio:

$$\frac{2.3}{2} = 1.15 = \frac{N_A}{C_A} = \frac{N_A}{1}; N_A = 1.15$$

  Substance A is $SiCl_4$ and only 1.15 moles will be used even though 1.3 moles were supplied.
- Using the same method, we determine that 1.15 moles of SiO_2 are produced and 4.6 moles of HCl are produced.

$$\frac{2.3}{2} = 1.15 = \frac{N_C}{C_C} = \frac{N_C}{1}; N_C = 1.15$$

$$\frac{2.3}{2} = 1.15 = \frac{N_D}{C_D} = \frac{N_D}{4}; N_D = 4.60$$

Mass Ratios:

- Mass ratios are calculated in a similar way with two additional steps. One at the beginning and one at the end.
- Starting again with the balanced equation, the molar mass of each substance must be calculated. The molar mass is the mass of exactly ONE mole. The coefficients have not effect on this calculation.
- NEW STEP ONE: Find the number of moles of the given substance(s) by dividing the mass given by the molar mass.
- Do all of the calculations outlined above for the substances whose values are required.
- NEW STEP TWO: Multiply the number of moles calculated for each required substance to determine the mass of that substance involved in the reaction.