Gram → Mole Conversions

- The use of the MOLAR MASS allows us to calculate the mass of a given number of moles of a substance, and the calculation of the number of moles in a given mass of a substance.
- The unit for moles is "**mol**"
- In order to calculate from grams to moles, you need to use a **conversion factor**!
- Conversion factors are used to relate the number of moles to the mass of material present.
- Since 1 mole of a given substance "X" has a mass of (molar mass of X) g…

$$\frac{1\text{ mol}}{\text{molar mass}} \quad \text{or} \quad \frac{\text{molar mass}}{1\text{ mol}}$$

***Example*:**

What is the mass of 3.25 mol of CO_2? [molar mass of CO_2 = 44.0g]

What you want = (What you have) X (Conversion Factor)

$$\text{Mass of } CO_2 = 3.25 \text{ mol } CO_2 \times \frac{\text{molar mass of } CO_2}{1 \text{ mol of } CO_2}$$

$$= 3.25 \text{ mol } CO_2 \times \frac{44.0 \text{ g } CO_2}{1 \text{ mol } CO_2}$$

$$= 143 \text{ g } CO_2$$

Moles → Molecules Conversions

- There are times when chemists would like to know the number of particles or molecules involved in a reaction.
- Thus, we need another set of Conversion Factors!

$$\frac{1\text{ mol particles}}{6.02 \times 10^{23}\text{ particles}} \quad \text{or} \quad \frac{6.02 \times 10^{23}\text{ particles}}{1\text{ mol particles}}$$

Example:

How many molecules are there in 0.125 mol of molecules?

Chemistry 12 – Stoichiometry Review

What you want = (What you have) X (Conversion Factor)

$$\text{\# of molecules} = 0.125 \text{ ~~mol~~} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ ~~mol~~}}$$

$$= 7.53 \times 10^{22} \text{ molecules}$$

MOLE RATIOS (using the three step method)

Magnesium metal reacts with hydrochloric acid to produce magnesium chloride and hydrogen gas. The chemical equation is given as the following:

$$Mg\ (s) + 2HCl\ (aq) \rightarrow MgCl_2 + H_2\ (g)$$

If 4 moles of HCl is used, how many moles of $MgCl_2$ will be formed in the reaction?

Step (1): What is the mole ratio for HCl to $MgCl_2$?

Step (2): Write two conversion factors for this mole ratio.

Step (3): Calculate the number of moles of $MgCl_2$ formed.

_____mol $MgCl_2$

Grams → Grams Conversions:

Put everything that you've learned together…here's an example:

$$4NH_3 + 5O_2 \rightarrow 6H_2O + 4NO$$

If 10.0 g of ammonia is used, how many grams of water will be produced?

Step 1: Make a Road Map!

We need to get from grams NH_3 → grams H_2O

Road Map: Grams NH_3 → Moles NH_3 → Moles H_2O → Grams H_2O

Step 2: Carry out the conversions one step at a time!

First do Grams NH_3 → Moles NH_3:

$$10.0\ g\ NH_3 \times \frac{1\ mol\ NH_3}{17.0\ g\ NH_3} = 0.588\ mol\ NH_3$$

Next do Moles NH_3 → Moles H_2O:

$$0.588\ mol\ NH_3 \times \frac{6\ mol\ H_2O}{4\ mol\ NH_3} = 0.882\ mol\ H_2O$$

Finally do Moles H_2O → Grams H_2O:

$$0.882\ mol\ H_2O \times \frac{18.0\ g\ H_2O}{1\ mol\ H_2O} = 15.9\ g\ H_2O$$

15.9 g of water are produced from 10.0 g of ammonia

Simple Dilution Calculations:

When a chemical solution is mixed with water (or with another solution), the chemical will have a **smaller** concentration than what it started out with.

To calculate the new concentration, use the following equation:

$$M_iV_i = M_fV_f$$

Where: M_i is the Intial Concentration of Solution
V_i is the Initial Volume of Solution
M_f is the Final Concentration of Solution
V_f is the Final Volume of Solution

Example:

If 200.0 mL of 0.500 M NaCl is added to 300.0 mL of water, what is the resulting [NaCl] in the mixture?

Let $M_i = 0.500$ M ; $V_i = 200.0$ mL ; $V_f = (200.0 + 300.0)$ mL = 500.0 mL ; $M_f = ?$

$$M_iV_i = M_fV_f$$

$$(0.500\ M)(200.0\ mL) = M_f\ (500.0\ mL)$$

$$M_f = 0.200\ M$$

Therefore, the resulting [NaCl] in the mixture is 0.200 M after dilution.