

### 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<sub>2</sub>?                    [molar mass of CO<sub>2</sub> = 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?**

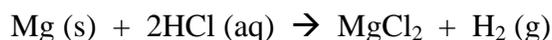
## Chemistry 12 – Stoichiometry Review

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

$$\begin{aligned}\# \text{ of molecules} &= 0.125 \text{ mol} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \\ &= 7.53 \times 10^{22} \text{ molecules}\end{aligned}$$

### **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:



If 4 moles of HCl is used, how many moles of MgCl<sub>2</sub> will be formed in the reaction?

**Step (1): What is the mole ratio for HCl to MgCl<sub>2</sub>?**

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

**Step (3): Calculate the number of moles of MgCl<sub>2</sub> formed.**

\_\_\_\_\_ mol MgCl<sub>2</sub>

### **Grams → Grams Conversions:**

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



**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<sub>3</sub> → grams H<sub>2</sub>O

Road Map: Grams NH<sub>3</sub> → Moles NH<sub>3</sub> → Moles H<sub>2</sub>O → Grams H<sub>2</sub>O

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

First do Grams NH<sub>3</sub> → Moles NH<sub>3</sub>:

$$10.0 \text{ g NH}_3 \times \frac{1 \text{ mol NH}_3}{17.0 \text{ g NH}_3} = 0.588 \text{ mol NH}_3$$

Next do Moles NH<sub>3</sub> → Moles H<sub>2</sub>O:

$$0.588 \text{ mol NH}_3 \times \frac{6 \text{ mol H}_2\text{O}}{4 \text{ mol NH}_3} = 0.882 \text{ mol H}_2\text{O}$$

Finally do Moles H<sub>2</sub>O → Grams H<sub>2</sub>O:

$$0.882 \text{ mol H}_2\text{O} \times \frac{18.0 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 15.9 \text{ g H}_2\text{O}$$

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:

$$M_i V_i = M_f V_f$$

Where: M<sub>i</sub> is the Initial Concentration of Solution  
V<sub>i</sub> is the Initial Volume of Solution  
M<sub>f</sub> is the Final Concentration of Solution  
V<sub>f</sub> 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<sub>i</sub> = 0.500 M ; V<sub>i</sub> = 200.0 mL ; V<sub>f</sub> = (200.0 + 300.0) mL = 500.0 mL ; M<sub>f</sub> = ?

$$M_i V_i = M_f V_f$$

$$(0.500 \text{ M})(200.0 \text{ mL}) = M_f (500.0 \text{ mL})$$

$$M_f = 0.200 \text{ M}$$

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