**Salt Lake Community College, Chemistry Department**

**Chem 1110 Workshop 8**

**Topic: Mole and Mass Relationship**

***Objective***

* Molecular and Empirical Formula
* Molecular Weight vs. Formula Weight
* Stoichiometry
* Grams of reactants converted to moles and Moles of product converted back to grams
* Calculation of relative quantities of reactants and products

**Molecular and Empirical Formula**

1. Empirical formula: the formula of a compound with the simplest whole number ratio of elements involved in the compound- Empirical Formula for Glucose (C6H12O6) is CH2O
2. Molecular formula: the types and actual number of atoms in a compound Glucose (C6H12O6)

**Molecular Weight vs. Formula Weight**

* Given the molecular formula of a compound, we find the molecular weight by finding the sum of the masses of all the atoms in the compound
* The mass of individual atoms is found on the Periodic Table and is given in amu
* Examples
	1. Sodium chloride: 22.99 amu + 35.45 amu = 58.44 amu

**Stoichiometry**

* As defined by Ebbing "calculation of the quantities of reactants and products involved in a chemical reaction"
* Note: a balanced chemical equation is essential to stoichiometry; a knowledge of molar masses is often also necessary

**Grams to moles, mole to mole and Moles to grams conversion:**

 

**Practice Problems:**

* 1. Please fill the following tables

|  |  |
| --- | --- |
| **Molecular Compounds** | **Molecular Weight** |
| Cl2 | 2(35)= 70 amu |
| H2O | 2(1)+ 16= 18 amu |
| NH3 | 14+ 3(1)= 17 amu |

|  |  |
| --- | --- |
| **Ionic Compounds** | **Formula Weight** |
| NaCl | 23+ 35= 58 amu |
| MgBr2 | 24+ 2(80) = 184 amu |
| BaS | 137 + 32 = 169 amu  |

|  |  |
| --- | --- |
| **1 Mole** | **Molar Mass** |
| Mg(NO3)2 | 24 + 2(14) + 6(16)= 148 g/mol |
| Br | 80 g/mol |

1. Convert 54.0 g of H2O to moles of H2O.

**54.0 g H2O x 1 mol/ 18 g= 3.0 mole of H2O**

1. Find the mass of 0.647 moles of CO2.

**Step 1:** MM CO2 = 12 + 32= 44 g/mol

**Step 2:** 0.647 mol CO2 x 44g/ mol= 28.5 g of CO2

1. How many moles of Ca2+ and Cl− ions are there in 1 mole of CaCl2?

**1 mole of Ca2+ : 2 moles of Cl-**

1. How many moles of copper would be produced from 6 moles of copper (I) oxide according to the following equation:

**Cu2S (s) + 2Cu2O(s) 🡪 6Cu (s) + SO2 (g)**

6 mole of Cu2O x 6 mol Cu/ 2 mol Cu2O= **18 mol Cu**

1. If 30.4 grams of CO2 can be produced in the reaction of C2H2 with O2 to form CO2 and H2O, how many grams of H2O can be produced in the reaction?

Combustion Reaction

 2(C2H2 +2.5 O2 🡪 2CO2 + H2O)

**Step 1: balance the chemical equation:** 2C2H2 +5 O2 🡪 4CO2 + 2H2O

**Step 2: Covert mass🡪 moles (using molar mass)**

30.4 g x 1 mole/ 44 g= 0.70 mol CO2

**Step 3: mole to mole relationship**

0.70 mol CO2 x 2 mole H2O/ 4 mole CO2 = 0.35 mol H2O

**Step 4: mole to mass (MM)**

0.35 mol H2O x 18 g/ 1 mole H2O= 6.3 g H2O

1. Elemental iron is produced according to the following reaction:

**Fe2O3(s)  + 2Al(s) ---> Al2O3(s) + 2Fe(s)**

**Limiting reactant: Fe2O3**

If 5.34 g Fe2O3 is allowed to react with excess Al, **what is the theoretical yield (g) of elemental iron for this reaction?**

**Step 1:** balance the chemical equation.

**Step 2:** mass (g)🡪 moles (Molar Mass)

**5.34 g** Fe2O3 x 1 mole/ 160 g = 0.0334 mol Fe2O3

**Step 3:** mole 🡪 mole (based on the balanced chemical equation)

0.0334 mol Fe2O3 x 2 mole Fe/ 1 mol Fe2O3 = 0.066 mol Fe

 **Step 4:** moles🡪 mass (g) (Molar Mass)

 0.066 mol Fe x 56 g Fe/ 1 mol Fe= **3.70 g Fe (Theoretical yield)**