**Homework Packet – The Mole**

*Calculate the molar mass of the following compounds.*

1. *List and count the atoms*
2. *Multiply the number of atoms by the molar mass from the periodic table (use the entire number from the table)*
3. *Add the mass to obtain the total mass of the compound*

|  |  |  |  |
| --- | --- | --- | --- |
| **Compound** | **Molar Mass Calculation****(show work)** | **Compound** | **Molar Mass Calculation****(show work)** |
| NaCl |  | Ca(OH)2 |  |
| H2O |  | Zn(NO3)2 |  |
| CO2 |  | Al2(SO4)3 |  |

**Mass to mole conversions**

*Convert each of the following masses (g) to moles. Show all work, including units and sig figs.*

1. How many moles are in 55.8 grams of iron?
2. How many moles are in 32.43 grams of boron?
3. How many moles are in 150.6 grams of ammonium phosphate?
4. How many moles are in 662.4 grams of lead(II) nitrate?

**Mole to mass conversions**

*Convert each of the following moles to masses (g). Show all work, including units and sig figs.*

1. How many grams are in 3.00 moles of zinc chloride?
2. How many grams are in 4.50 moles of water?
3. How many grams are in 0.75 moles of silver?
4. How many grams are in 1.58 moles of copper (II) nitrate?

**Mole to particle conversions**

*Remember that 1 mole = 6.02 x 10****23*** *particles.*

*Particles can be atoms, formula units, molecules or ions*

*Convert each of the following moles to particles. Show all work, including units and sig figs.*

1. How many atoms are in 3.50 moles of gold?
2. How many molecules are in 5.14 moles of carbon tetrachloride?
3. How many formula units are in 2.17 moles of sodium chloride?
4. How many ions are in 1.33 moles of PO**4-3**?

**Particle to mole conversions**

*Remember that 1 mole = 6.02 x 10****23*** *particles.*

*Particles can be atoms, formula units, molecules or ions*

*Convert each of the following particles to moles. Show all work, including units and sig figs.*

1. How many moles are in 2.85 x 10**23** atoms of silver?
2. How many moles are in 1.88 x 10**23** formula units of calcium hydroxide?
3. How many moles are in 1.21 x 10**24** ions of Cl**-**
4. How many moles are in 8.94 x 10**23** molecules of water?

**Particle to mass and mass to particle conversions**

*Remember that 1 mole = 6.02 x 10****23*** *particles.*

*Particles can be atoms, formula units, molecules or ions*

*Convert each of the following masses (g) to particles or particles to mass (g) Show all work, including units and sig figs.*

1. How many atoms of gold are in a pure gold nugget ring having a mass of 3.15 grams?
2. How many grams of helium are in a balloon containing 5.50 x 10**22** atoms?
3. 4.77 x 1023 molecules of hydrochloric acid equal how many grams?
4. Given 168.5 grams of beryllium iodide equal how many formula units?

**Molar Volume**

The molar volume of a gas is the volume that one mole occupies at 0.00oC and 1.00 atm.

These conditions are called standard temperature and pressure (STP).

At STP 1 mole =22.4 liters.

1. What is the volume of 0.881 moles of hydrogen gas at STP?
2. Calculate the number of moles in 53.76 L of oxygen gas at STP?

**Percent Composition** - *the percent by mass of each element in the compound. The mass of an element in a compound divided by the total mass of the compound multiplied by 100.*

 % Composition = Mass of Element x 100

 Total mass of the compound

1. Find the percent composition of carbon and chlorine in carbon tetrachloride
2. Find the percent composition of copper, nitrogen and oxygen in Cu(NO**3**)**2**

**Empirical and Molecular Formulas**

*Empirical formula – a formula that shows the lowest whole-number ratio of the elements of a compound, and may or may not be the same as the actual formula.*

*Molecular formula – the true or actual formula of the compound. May not be written in the lowest whole - number ratio.*

Determine the empirical formulas of the following compounds, and give the ratio.

1. C**6**H**8**O**6**

1. C**6**H**6**
2. P**4**O**10**
3. C**6**H**8**
4. C**6**H**12**O**6**
5. B**4**O**8**

**Empirical and Molecular Formulas**

1. Determine the empirical formula for methyl acetate, which has the following chemical analysis: 48.64% carbon, 8.16% hydrogen and 43.20% oxygen.
2. Find the empirical formula of a compound composed of 66.0% calcium and 34.0% phosphorus.
3. Find the empirical formula of a compound composed of 4.04 grams of cesium and 1.08 grams of chlorine.

**Determine the molecular formula of the compounds with the following empirical formulas and molar masses.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Empirical Formula** | **Empirical mass** | **Molecular Mass** | **Molecular Formula** |
| SNH |  | 188.35 g/mol |  |
| NPCl2 |  | 347.64 g/mol |  |

**Molecular Formulas**

1. The molecular mass of benzene is 78.0 g/mol and it empirical formula is CH. What is the molecular formula?
2. What is the molecular formula of dichloroacetic acid if the empirical formula is CHOCl and the molecular mass is 129.0 g/mol?
3. Find the molecular formula of a compound with the percent composition of 85.6% carbon and 14.4% hydrogen and a molecular mass of 42.1 g/mol.