Unit 1 – Stoichiometry Review Sheet

Things to Memorize:

1. Mole = 6.02×10^{23}
2. Molar Mass- mass of one mole of a substance.
3. *Rules for Significant Figures:*
    1. Non-zero digits are always significant.
    2. Any zeros between 2 significant digits are significant.
    3. A final zero or trailing zeros in the decimal portion ONLY are significant.

- When measurements are added or subtracted, the answer can contain no more **decimal places** than the least accurate measurement.
- When measurements are multiplied or divided, the answer can contain no more **total significant figures** than the least accurate measurement.
- *Rules for Scientific Notation:*
    1. The coefficient number should be between 1 and 10.
    2. Multiply this by base 10.
    3. The value of the exponent is the number of place values between where the decimal was and where the decimal will be.
    4. When expressing a large number (greater than 1) in scientific notation, the sign of the exponent will be positive.
    5. When expressing a small number (less than 1) in scientific notation, the sign of the exponent will be negative.
- Conservation of Mass- Mass in an isolated system is neither created nor destroyed by chemical reactions or physical transformations.
- Qualitative- relating to, measuring, or measured by the quality of something rather than its quantity.
- Quantitative- referring to, measuring, or measured by the quantity of something rather than its quality.
- Extensive- a property that changes when the size of the sample changes.
- Intensive- a property that does not change when you take away some of the sample.
- Solute- a substance dissolved in another substance
- Solvent- a substance that dissolves a solute.
- Solution- a homogeneous mixture composed of two or more substances.
- *Steps for Dimensional Analysis:*
    1. Start with the number given as a numerator over 1.
    2. Multiply by a new fraction.
    3. Place a conversion with the same unit on the denominator of the new fraction.
    4. Multiply numerators, divide denominators.
    5. For gases at STP, use 22.4L.
    6. For atoms or molecules, use 6.02×10^{23}.
- *Steps to Calculate Limiting Reactant:*
    1. Find moles of each.
    2. Convert to moles of product.
    3. Lower number is limiting reactant.

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- *Solubility Rules:*
    1. All alkali metals are always soluble.
    2. All ammonium (NH_4^+) salts are always soluble.
    3. Nitrate ion (NO_3^-) is always soluble.
    4. Acetate ion ($C_2H_3O_2^-$) is always soluble.
- *Stock System Naming:*
    1. Name the cation followed by the name of the anion.
    2. Give anion the suffix **-ide.**
    3. If the cation of an element has several ions of different charges (as with transition metals) use a Roman numeral after the metal name.
    4. The Roman numeral used gives the charge of the metal.
- <u>Empirical Formula-</u> any molecular formula in its reduced form. Ex.) CH_3, NO_2, NH_3.
- <u>Molecular Formula-</u> some multiple of an empirical formula. Ex.) C_3H_9, N_2O_4, N_4H_{12}.
- *Steps to Finding the Molecular Formula Given the Empirical Formula:*
    1. Find the mass of the empirical formula.
    2. Divide the mass given by the empirical mass.
    3. Distribute your answer through the empirical formula.
- <u>Hydrate-</u> contains a specific number of moles of water attached to a molecule.
- <u>Anhydrate-</u> a hydrate that has lost its water molecules.
- $\text{Percent Yield} = \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100$
- $\text{Percent by Mass} = \frac{\text{Mass of Part}}{\text{Mass of Whole}} \times 100$
- <u>Concentrated-</u> contains large amounts of solute dissolved in solvent.
- <u>Dilute-</u> contains small amounts of solute dissolved in solvent.
- <u>Concentration-</u> the amount of solute in a solvent.
- <u>Molarity-</u> moles of solute per liter of solution.
- <u>Dilution-</u> a procedure for preparing a less concentrated solution from a more concentrated solution.
- $M_1V_1 = M_2V_2$
- *Steps to Dilute a Solution:*
    1. Solve $M_1V_1 = M_2V_2$.
    2. Measure the volume with a higher molarity into a pipet or graduated cylinder.
    3. Add to a volumetric flask.
    4. Fill with water until it reaches the total volume.

<u>Practice Problems:</u>

1. Use dimensional analysis to convert the following:
    a) A volume of 55.67 L of carbon dioxide gas to moles at STP.
    b) A sample of 2.73 moles of nitrogen dioxide to molecules.
    c) A sample of 4.58×10^{24} atoms of zinc to grams.
    d) A sample of 1.54×10^{21} molecules of O_2 to liters at STP.

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2. Water decomposes into its elements when electrified at high voltages. If 24.0 grams of water is completely decomposed, how many grams of oxygen will be produced?

3. Put into scientific notation:
    a) 56200000
    b) 0.00000258
    c) .00000739
    d) 6300000
4. Count the number of significant figures:
    a) 4.050g
    b) 1000 mL
    c) 4,1000,000 mm
    d) .505 ppm
    e) 3.05 mm
5. Consider the following reaction: $3Si + 2N_2 \rightarrow Si_3N_4$
    a) When 21.44 moles of Si reacts with 17.62 moles of N_2, how many moles of Si_3N_4 are formed?
    b) What is the limiting reactant?
    c) For the reactant in excess, how many moles are left over at the end of the reaction?

6. A compound has the empirical formula CH_2O and a gram-formula mass of 60g/mol. What is the molecular formula of this compound?
7. The molecular formula of glucose is $C_6H_{12}O_6$. What is the empirical formula of glucose?

8. <u>Mass of crucible:</u> 28.00 g
   <u>Mass of crucible and hydrate:</u> 29.60 g
   <u>Mass of crucible and anhydrate:</u> 29.24 g

    a) Calculate the hydrate formula and the percent water if the anhydrate is $CuSO_4$.

9. A student is given 2.00L of 5.00M NaOH and must dilute to create a 1.25M solution of NaOH. Calculate the amount of water that must be added to the original solution.
10. Outline the correct laboratory procedure for diluting a stock solution of 18.4M sulfuric acid to produce 1.0L of 1.84M sulfuric acid. Take care to include any calculations; safety procedures and how you would use appropriate glassware in your answer.
11. If 178.8g of water is separated into hydrogen and oxygen gas, and the hydrogen gas has a mass of 20.0g, what is the mass of the oxygen gas produced?
12. Name these compounds using the stock system:
    a) $CuCl_2$
    b) FeF_3
    c) $CrBr_2$
    d) PbO_2