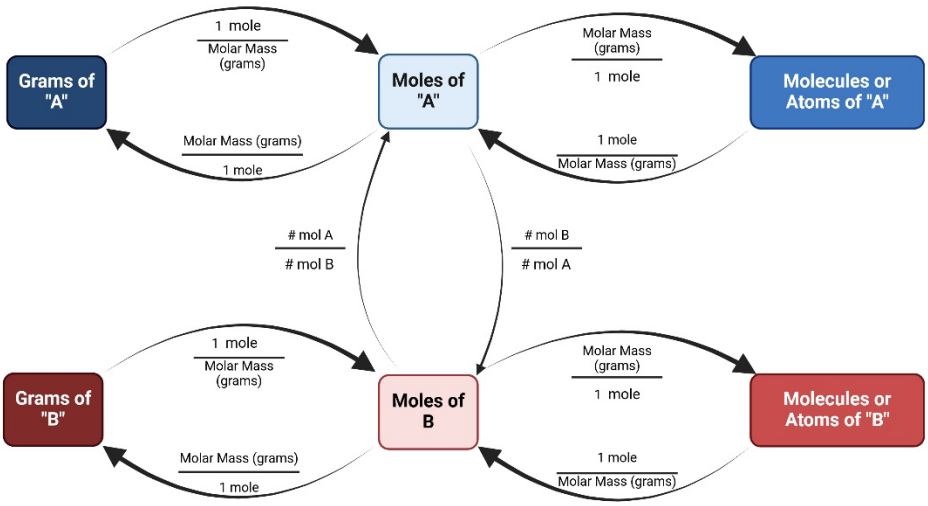
Part I: The Mole Map

The mole map shown below can help do the calculations in this worksheet should you get stuck .

$$aA + bB \longrightarrow xX + yY$$

N_A= Avogadro's Number = 6.022×10^{23}



Part II: Mole to Mole Conversions of Chemical Reactions

1. Solid aluminum reacts with hydrochloric acid to produce aluminum chloride and hydrogen gas.

   a. Write the balanced chemical equation for this process.

   ____$Al_{(s)}$ + ____$HCl_{(aq)}$ → ____$AlCl_{3\ (aq)}$ + ____$H_{2\ (g)}$

   b. Use your balanced reaction from **part a** to write a conversion factor that relates the moles of aluminum to moles of hydrogen gas.

   c. Use the conversion factor from **part b** to determine the number of moles of hydrogen gas that can be generated starting with 2.8 moles of aluminum.

2. Calculating just the moles of compounds in reactions is not practical and we will need to incorporate molar mass to determine the amount of grams. For example, if we know that we need to make a certain number of grams of hydrogen gas, we should be able to figure out how many grams of aluminum we need to start with…

a. Map out how you will go from grams of aluminum to grams of hydrogen gas.

b. Use the map you made for question **2a** and the conversion factor you made for question **1b** to determine how many grams of aluminum are needed if we want to be able to make 4.5 g of hydrogen gas. Be sure to show all of your work with labeled units and correct significant figures.

Part III: More Reaction Calculations

3. The carbon dioxide exhaled by astronauts must be removed from the atmosphere of space shuttles. This is typically done by reacting the gaseous carbon dioxide with solid lithium hydroxide to produce solid lithium carbonate and liquid water.

a. Write the balanced equation for this reaction.

b. The average astronaut exhales 1.0 kg of carbon dioxide each day. What is the total mass, in g, of carbon dioxide exhaled by a 6-day spaceflight with 5 crew members?

c. How much lithium hydroxide should the spaceship engineers plan on packing for the mission described in question **3b**? Be sure to show all of your work with labeled units and correct significant figures.

d. Potassium hydroxide is considerably cheaper than lithium hydroxide and undergoes the same reaction to remove carbon dioxide. Repeat the calculation in question **3c** using potassium hydroxide. Briefly explain why you think that they use the more expensive lithium hydroxide on space shuttles.

4. The following questions all deal with the reaction between aqueous solutions of iron(III) chloride and sodium hydroxide.

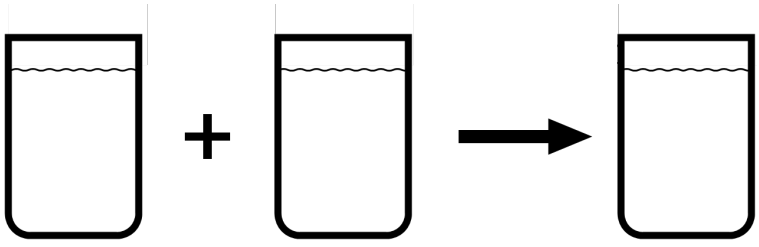
a. Write the molecular equation for the above reaction. Be sure it has the correct products, is balanced, and the state of each compound is properly labeled based on solubility rules.

b. Based on your balanced reaction, what is the conversion factor that allows you to relate moles of sodium hydroxide to moles of precipitate?

c. If the solution contained 5.40 g of sodium hydroxide, what is the maximum mass, in grams, of solid that can be formed? Be sure to show all of your work with labeled units and correct significant figures.

d. Starting with the molecular equation from question **4a**, write the *complete ionic equation* for this reaction.

e. Draw pictures that represent the above complete ionic equation.



f. Write the *net ionic equation* for this reaction. Start by using the *total ionic equation* from **4b**.

5. When we eat carbohydrates, our body breaks them down into molecules of glucose ($C_6H_{12}O_6$). Glucose is then broken down even more in a process resembling a combustion reaction.

a. Write the balanced equation for the combustion of glucose.

b. Based on your balanced reaction, what is the conversion factor that allows you to relate moles of $C_6H_{12}O_6$ to moles of CO_2?

c. If 1 mole of CO_2 occupies 22.4 L, what is the density of CO_2 in g/L.

d. Using your answers to questions **5b** and **5c**, how many liters of CO_2 are produced from the combustion of 65 grams of glucose.