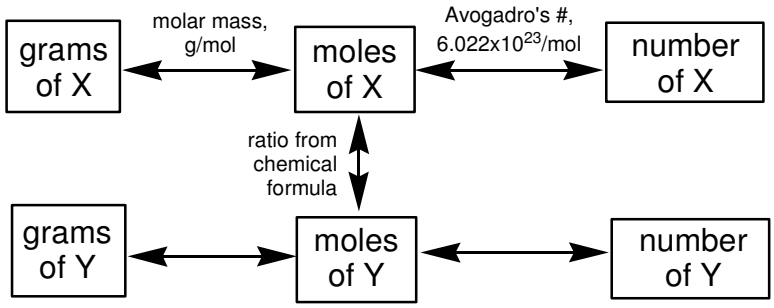
Part A: Review Problem From Exam #3

1) One of the most common mistakes on the last exam dealt with the type of problem where we are given the mass of a sample and asked to find the number of atoms in the sample. Because we are starting with the whole "sample" and ending with "atoms", at some point in our calculation we need to switch between "X" and "Y" on the flowchart below.



a) Use the above generic flowchart to write out an actual flowchart relating the "grams of lead(IV) thiosulfate" to "number of atoms". Be sure to label all units.

b) What is the formula for lead(IV) thiosulfate? What is its molar mass?

c) Write out the conversion factor that relates the "moles of atoms/moles of lead(IV) thiosulfate".

d) Following your flowchart from question 1a) and using the conversion factors that you have identified in questions 1b) and 1c), determine how many atoms are in a 6.0 g sample of lead(IV) thiosulfate. Be sure to show all of your work with labeled units and correct significant figures.

Part B: Calculations Based on Chemical Reactions

It turns out that we can use the generic flowchart from the previous page to also do a new type of calculation. The *mole X* ↔ *mole Y* part of the flowchart can be based on a chemical formula (as we saw in Part A of this worksheet), but it can also be based on a balanced chemical reaction. Let's work through an example:

2) Solid aluminum reacts with hydrochloric acid to produce aluminum chloride and hydrogen gas.
   a) Write the balanced chemical equation for this process.

   b) Use your balanced reaction from question 2a) to write a conversion factor that relates the moles of Al to moles of H_2 gas.

   c) Use the conversion factor from question 2b) to determine the number of moles of H_2 gas that can be generated starting with 2.8 moles of Al.

Using molar mass, we can go one step further with these calculations and incorporate grams into our work. For example, if we know that we need to make a certain number of grams of H_2 gas, we should be able to figure out how many grams of Al we need to start with…

   d) Draw a flowchart that shows how you could start with "grams of H_2" and relate it to "grams of Al".

   e) Use the flowchart you made in question 2d) and the conversion factor you made in question 2b) to determine how many grams of Al are needed if we want to be able to make 4.5 g of H_2 gas. Be sure to show all of your work with labeled units and correct significant figures.

Part C: Extra Problems If You Have Time

3) The carbon dioxide exhaled by astronauts must be removed from the spaceship atmosphere. 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 spaceships?

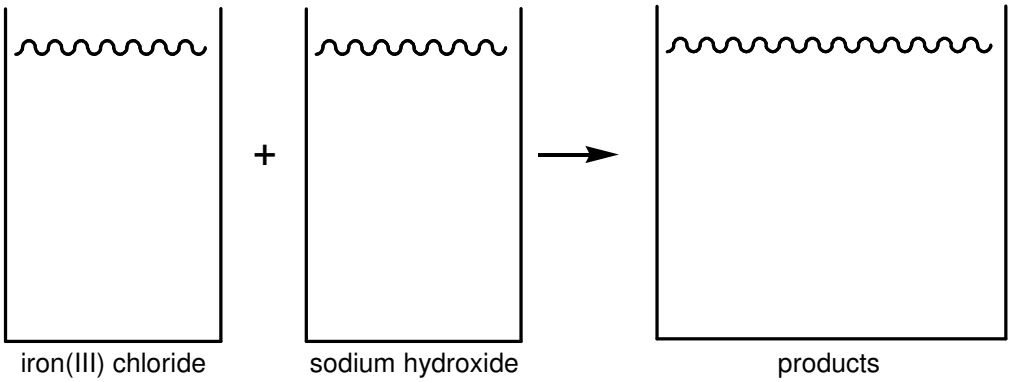
4) The following questions all deal with the reaction between aqueous solutions of iron(III) chloride and sodium hydroxide.
   a) Write the *molecular equation* for the above reaction. Be sure it has the correct products, is balanced, and the state of each compound is properly labeled based on solubility 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) Starting with the *complete ionic* equation from question 4d) write the *net ionic equation (NIE)* for this reaction.

5) When eaten, dietary carbohydrates are digested to yield glucose ($C_6H_{12}O_6$), which is then metabolized in what is essentially 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), what volume of CO_2, in L, is generated from the combustion of 65 g of glucose?