Part A: Chemical Formulas as Conversion Factors

By this point, you should be comfortable converting between *grams* ↔ *moles* ↔ *number of atoms or molecules* for any element or compound. Next we add to our toolbox the use of chemical formulas as conversion factors. For example, if we wanted to convert between moles of NH_3 and moles of H atoms, we see that every 1 mole of NH_3 has 3 moles of H atoms, which leads to the conversion factor:

$$\frac{3\,\text{mol H atoms}}{1\,\text{mol NH}_3}$$

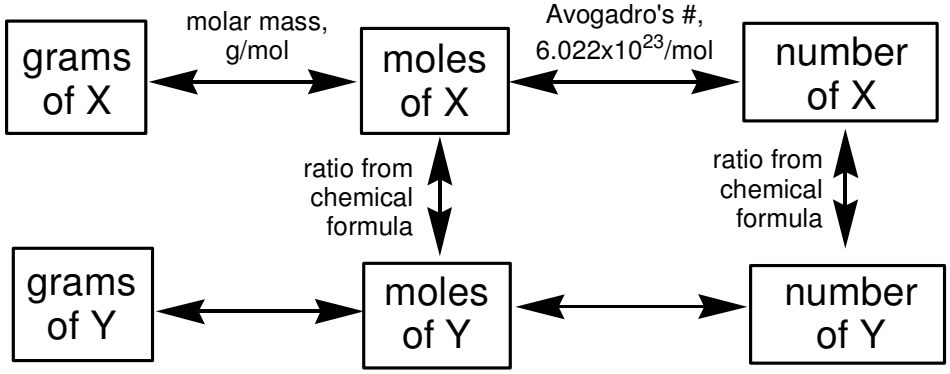
1) The following question refers to copper(II) hydrogen carbonate. Show all your work and report your answer with correct units and significant figures.
   a. What is the formula for copper(II) hydrogen carbonate?

   b. Write a conversion factor that relates the moles of oxygen atoms to the moles of copper(II) hydrogen carbonate.

   c. Using the conversion factor from question 1b, determine how many moles of O atoms are present in 15.8 moles of copper(II) hydrogen carbonate.

   d. Using the conversion factor from question 1b, determine how many moles of copper(II) hydrogen carbonate you must have if you have a sample of copper(II) hydrogen carbonate containing 2.50 moles of O atoms?

Being able to write these new conversion factors, literally allows us to double the flowchart we used on the previous page. Notice the expanded flowchart below that uses *"ratio from chemical formula*" in order to relate *moles of one substance (X)* to *moles of a second substance (Y)*. Although this new type of conversion factor can also be used to relate the *number of X* to *the number of Y*, it <u>cannot</u> be used to directly relate *grams of X* to *grams of Y*.



2) Sodium thiosulfate has many uses including as an antidote to cyanide poisoning since it acts as a sulfur donor that converts the cyanide into a substance that is not harmful. How many S atoms are in 2.8 g of sodium thiosulfate?

   a. What is the formula for sodium thiosulfate?

   b. Write a conversion factor that relates the moles of S atoms to the moles of sodium thiosulfate.

   c. Using the flowchart from page 1 as a guide, write out your plan for determining the number of S atoms in 2.8 g of sodium thiosulfate. Be sure to write all the units in your flowchart; for example, clearly identify when you are talking about the "sodium thiosulfate" and when you are talking about the "S atoms".

   d. Show all your work, including ALL units, for this calculation. Report your answer with the correct number of significant figures.

Part B: Additional Practice If You Have Time

For the following problems, be sure to follow the steps we practiced in the last question (i.e. write a flowchart with units and then solve the problem).

3) How many atoms are in 15 g of C_2H_6? [Hint: the answer is not 3.0×10^{23} atoms]

4) A sample of sodium hydroxide has 2.8×10^{24} atoms. What is the mass of the sample, in g?

5) We can also use these conversion factors based on chemical formulas to relate the elements in a given compound to each other.
   a. Write a conversion factor that relates the moles of O to the moles of Sn in the compound $Sn_3(PO_4)_4$.

   b. A sample of $Sn_3(PO_4)_4$ is found to contain 8.5 g of Sn. How many O atoms are in the sample?

6) A sample of magnesium sulfate weighs 23 g. What is the mass (in g) of O in the sample?