**8. Chemical Calculations homework problems**

Instructions

Create space in the Word document below, and write or type your answers. Turn in your completed work as an email attachment.

(10 questions, 100 points possible)

1. What is the molecular weight of each compound? In other words, how many grams per mole are there in each compound?
   1. H2O water example: H=1, O=16, therefore H2O = 18 g/mole
   2. H2SO4 sulfuric acid
   3. NH4OH ammonia
   4. HNO3 nitric acid
   5. NaCl sodium chloride (table salt)
   6. Fe2O3 iron oxide (rust)
   7. CuSO4 copper sulfate (blue powder)
   8. Na2CO3 sodium carbonate (washing soda)
   9. NaHCO3 sodium bicarbonate (baking soda)
   10. Ca(OH)2 calcium hydroxide (lime)
   11. KNO3 potassium nitrate (saltpeter)
   12. MgSO4 magnesium sulfate (epsom salt)
2. State Avogadro’s number (just write it out)
3. What is the significance of Avogadro’s number? What does it tell us? What is it?
4. Explain why excess reactants often remain after a chemical reaction occurs? In other words, after a reaction has occurred in a beaker, why would one or more of the reactants still be present? Why wouldn’t there only be products in the beaker at that point? Try to state at least two reasons we discussed in class:
5. Percent composition:

Limestone consists of calcium carbonate. If 50 kg of CaCO3 contain 6 kg C, 20 kg Ca, and 24 kg O, what is the percent composition (by mass) of CaCO3?

1. Percent composition:

Gypsum is calcium sulfate. If 70 g of CaSO4 contain 20.6 g Ca, 16.4 g S, and 33.0 g O, what is the percent composition (by mass) of CaSO4?

1. What is meant by “percent yield”? How is the term used in chemical reactions? How does it compare to “theoretical yield”? What’s the difference?

For problems 8 and 9, remember: a “mole” of something is just 6.02 x 1023 particles. You can talk about a “mole of atoms”, a “mole of molecules”, a “mole of a compound”, or a “mole of jelly beans”. You have to specify what particles you’re talking about. One mole just means you have 6.02 x 1023 of them.

1. Atoms:
   1. Calcium hydroxide (lime): how many Ca atoms are in 100 g of Ca(OH)2?
   2. Sodium hydroxide (caustic soda): how many Na atoms are in 200 g of NaOH?
   3. Ammonium hydroxide (household ammonia): how many N atoms are in 300 g of NH4OH?
2. Mass:
   1. Iron: how many grams of Fe are in 2 moles of Fe atoms?
   2. Aluminum: how many grams of Al are in 5 moles of Al atoms?
   3. Iron sulfate: how many grams of Fe are in 2 moles of FeSO4?
   4. Aluminum sulfate: how many grams of Al are in 5 moles of Al2(SO4)3?
3. Bleach is an aqueous solution of sodium hypochlorite, NaOCl. Bleach is used extensively in many, many industries, and is produced in large quantity around the world. If you could invent a cheaper method of making bleach, you would be a millionaire many times over. Currently, bleach is made by reacting chlorine gas with caustic soda as follows:

2NaOH + Cl2 → NaCl + NaOCl + H2O

Caustic soda chlorine gas salt bleach water

Hint: For the following problems, be sure to use “mole bridge”. This means we convert everything to “moles” first, before crossing from reactants to products in a chemical reaction.

* 1. How many moles of NaOCl will be produced from 10 moles of Cl2?
  2. How many moles of NaOH must react to produce 10 moles of NaOCl?
  3. How many grams of H2O will be produced if 11.11 moles of NaOH react?
  4. How many grams of Cl2 must react to produce 1.41 moles of NaCl?
  5. What is the *theoretical yield* of NaOCl in grams in this reaction if 80 g of NaOH react?
  6. If instead of the theoretical yield from question (e) you *measured* only 66.6 g of NaOCl, what is the *actual* percent yield? In other words, if you only produced 66.6 g of NaOCl from 80 g of NaOH, what does that mean your actual percent yield was?