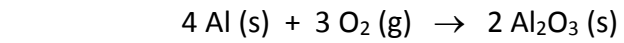
<u>Ungraded</u> "Problem Set" 3.5 – Stoichiometry
A key will be posted online on Thurs., Oct. 3, 2019.

1. Aluminum reacts with oxygen to give aluminum oxide:



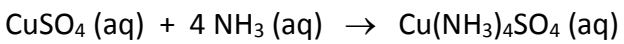
$$4\ Al\ (s)\ +\ 3\ O_2\ (g)\ \rightarrow\ 2\ Al_2O_3\ (s)$$

What amount of O_2 in moles is needed for complete reaction of 6.0 mol of aluminum? What mass of Al_2O_3 in grams can be produced?

2. Iron metal reacts with oxygen to give iron(III) oxide (Fe_2O_3).
   a. Write a balanced equation for this reaction.
   b. If an ordinary iron nail (assumed to be pure iron) has a mass of 2.68 g, what mass of Fe_2O_3 in grams is produced if the nail is completely converted to iron(III) oxide (rust)?
   c. What mass of O_2 in grams is required for the reaction in (b)?

3. Like other hydrocarbons, hexane (C_6H_{14}) can be combusted.
   a. Write a balanced equation for the complete combustion of C_6H_{14}.
   b. If 215 g of C_6H_{14} is mixed with 215 g of O_2, what mass of each product is produced in the reaction?
   c. What mass of the excess reactant remains after reaction is complete?

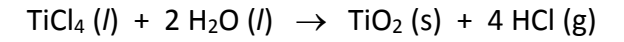
4. The deep blue compound $Cu(NH_3)_4SO_4$ is made by the reaction of copper(II) sulfate and ammonia:



$$CuSO_4\ (aq)\ +\ 4\ NH_3\ (aq)\ \rightarrow\ Cu(NH_3)_4SO_4\ (aq)$$

   a. If you use 10.0 g of $CuSO_4$ and excess NH_3, what is the theoretical yield of $Cu(NH_3)_4SO_4$?
   b. If you isolate 12.6 g of $Cu(NH_3)_4SO_4$, what is the percent yield of $Cu(NH_3)_4SO_4$?

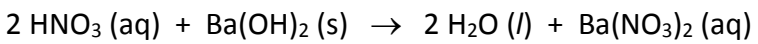
5. Some metal halides react with water to produce metal oxide and the appropriate hydrogen halide. For example:



$$TiCl_4\ (l)\ +\ 2\ H_2O\ (l)\ \rightarrow\ TiO_2\ (s)\ +\ 4\ HCl\ (g)$$

   a. Name the four compounds involved in this reaction.
   b. If you begin with 14.0 mL of $TiCl_4$ (d = 1.73 g/mL), what mass of water in grams is required for complete reaction?
   c. What mass of each product can be produced?

6. What volume of 0.109 M HNO_3 in mL is required to completely react with 2.50 g of $Ba(OH)_2$?



$$2\ HNO_3\ (aq)\ +\ Ba(OH)_2\ (s)\ \rightarrow\ 2\ H_2O\ (l)\ +\ Ba(NO_3)_2\ (aq)$$