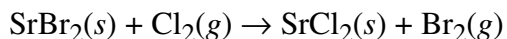


**Problem Set 2** (For January 20)**Recommended Text Problems:** 3.59, 3.61, 3.66, 3.103, 4.14, 4.16, 4.30, 4.33

1. One common type of reaction is a “substitution” reaction, in which one element is simply substituted for another. For example, at high temperature, chlorine can substitute for bromine in the compound strontium bromide, SrBr<sub>2</sub>, through the net reaction



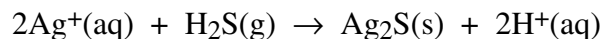
If 14.3 g of SrBr<sub>2</sub> is consumed in this reaction, what mass of SrCl<sub>2</sub> is formed? What is the minimum mass of Cl<sub>2</sub> needed to carry out this reaction?

2. The compound calcium carbide, CaC<sub>2</sub>, is a solid that reacts spontaneously and completely with water to produce acetylene gas, C<sub>2</sub>H<sub>2</sub>, calcium ions, Ca<sup>2+</sup>, and hydroxide ions, OH<sup>-</sup>. (This reaction was used to generate flammable acetylene in “miner’s lamps.” The acetylene would be burned to provide a simple light source.) What mass of CaC<sub>2</sub> would be needed to generate 5.00 g of acetylene? There is a naturally occurring isotope of hydrogen known as deuterium which has a neutron and a proton in its nucleus instead of just a proton. Deuterium has the common symbol “D” (it’s really <sup>2</sup><sub>1</sub>H and behaves chemically like ordinary H), and the compound D<sub>2</sub>O, called “heavy water,” is readily available. If CaC<sub>2</sub> is reacted with D<sub>2</sub>O, the gas that forms is C<sub>2</sub>D<sub>2</sub>, “deuteroacetylene.” What mass of C<sub>2</sub>D<sub>2</sub> could we synthesize from the same mass of CaC<sub>2</sub> that produced 5.00 g of C<sub>2</sub>H<sub>2</sub>?

3. Here’s a calculation that will let you practice ideas about the role of a limiting reagent in a reaction. The “extent of reaction” method, discussed in class and summarized on the web site, may be useful here, but use any method you *understand* to answer the following questions. The solid aluminum sulfide, Al<sub>2</sub>S<sub>3</sub>, reacts with water, producing solid aluminum hydroxide, Al(OH)<sub>3</sub>, and hydrogen sulfide gas, H<sub>2</sub>S. Write the balanced net reaction for this process first. Now, suppose we react 15.28 g of Al<sub>2</sub>S<sub>3</sub> with 8.51 g of water. How many grams of H<sub>2</sub>S do we produce, and what mass of which reactant is left over?

4. This problem will give you practice with ideas from the first lab as well as the solution concentration concept from Chapter 4 and the limiting reagent concept! Work your way through it step by step. Suppose you have a solution formed by dissolving 0.700 mol of the strong electrolyte Na<sub>2</sub>SO<sub>4</sub> in 350 mL of water. You also have a solution of the strong electrolyte BaCl<sub>2</sub> at a concentration of 1.6 M. You pour 550 mL of this BaCl<sub>2</sub> solution into your 350 mL of Na<sub>2</sub>SO<sub>4</sub> solution and observe a precipitate form. Identify the precipitate, write the net ionic reaction for its formation, and finally calculate the concentrations of all the ionic species in the final solution along with the mass of the precipitate.

5. (This is from a Chem 5 exam I gave in 1991!) 4.52 g of silver sulfate, Ag<sub>2</sub>SO<sub>4</sub>, is dissolved in water. Hydrogen sulfide gas (H<sub>2</sub>S) is bubbled through the solution, which causes insoluble Ag<sub>2</sub>S(s) to precipitate from the solution according to the net reaction



The Ag<sub>2</sub>S is gathered, dried, and weighed. The solution left behind is now boiled to remove the last traces of dissolved, excess H<sub>2</sub>S. Next, an excess of a solution of barium nitrate, Ba(NO<sub>3</sub>)<sub>2</sub>, is added to the solution. A white solid precipitates, which subsequent analysis proves to be a compound containing 58.84% Ba, 13.74% S, and 27.42% O by mass. Show that the analysis data on the second solid is consistent with the molecular formula BaSO<sub>4</sub>. What are the ions left in solution once the two precipitated solids have been removed? What is the mass of Ag<sub>2</sub>S collected during the course of the experiment?