3.1 – 3.2

Mass Relations in Chemistry; Stoichiometry

Worksheet B

A. Which of the following statements is/are true? If the statement is false, make it true.
   1. The compound $C_6H_{12}O_2N$
      a. has the simplest formula $C_3H_6ON_{\frac{1}{2}}$.
      b. contains 21 atoms per mole.
      c. has twice as many atoms of carbon as hydrogen.
      d. has three times as many moles of carbon as moles of oxygen atoms.
      e. has half as many grams of hydrogen as carbon.

   2. A 6.539 g sample of zinc has
      a. 65.39 moles of zinc.
      b. 6.022×10^{23} atoms of zinc.
      c. a hundred times as many atoms as 0.197 g of gold (Au).
      d. twice as many moles as 13.08 g of sulfur.

B. Iron is important in the body primarily because it is present in red blood cells and acts to carry oxygen to the various organs. There are about 2.6×10^{13} red blood cells in all of the blood of an adult human. All of adult human blood contains a total of 2.9 g of iron.
   1. How many moles of iron are present in all of the blood of an adult human?

   2. How many iron atoms are there in each blood cell?

C. A compound is made up of carbon, hydrogen, and oxygen atoms. When burned in oxygen, 3.584 g of CO_2 and 1.957 g of H_2O are formed. The mass of oxygen in the compound is 36.3% that of the CO_2 produced.
   1. How much sample was burned?

   2. What is the empirical formula of the compound?

D. Box A contains 5 molecules of nitrogen (N_2) and 15 molecules of hydrogen (H_2). Box B contains 10 molecules of NH_3.

1. Make a pictorial representation of Box A and Box B using open circles to represent N atoms and squares to represent H atoms.

2. Compare box A and box B with respect to
   a. number of atoms of N and H.
   b. number of discrete particles.
   c. mass.
   (Do not use your calculator. Use only logical reasoning.)

3. a. If the contents of Box A are the reactants and those of box B the products, write a reaction to represent boxes A and B.
   b. Reduce the coefficients of the reaction in (a) to smallest whole number coefficients.

E. A sample contains only carbon and hydrogen atoms. It was burned in oxygen producing 18.48 g of CO_2 and 6.30 g of H_2O.

1. What is the simplest formula of the compound?

2. How many grams of sample were burned?

3.3 – 3.4

Mass Relations in Chemistry; Stoichiometry

Worksheet A

A. Circle the true statements and make the false statements true. There can be more than one true statement for each number.

1. For the reaction

   $2\,H_2S\,(g) + SO_2\,(g) \rightarrow 3\,S\,(s) + 2\,H_2O\,(g)$

   a. 3 moles of S are produced per mole of H_2S.
   b. 1 mole of SO_2 is consumed per mole of H_2S.
   c. 1 mole of H_2O is produced per mole of H_2S.
   d. The total number of moles of products is always equal to the total number of moles of reactants used.

2. If 1.00 mol of ammonia reacts with 1.00 mol of oxygen according to the reaction

   $4\,NH_3\,(g) + 5\,O_2\,(g) \rightarrow 4\,NO\,(g) + 6\,H_2O\,(\ell)$

   a. All the oxygen is consumed.
   b. 4.00 mol of NO is produced.
   c. 1.50 mol of water is produced.
   d. 0.20 mol of ammonia is left over.
   e. The statement does not provide enough information to determine percent yield.

3. In the reaction of 2.0 mol CCl_4 with an excess of HF, 1.7 mol CCl_2F_2 is obtained.

   $CCl_4\,(\ell) + 2\,HF\,(g) \rightarrow CCl_2F_2\,(\ell) + 2\,HCl\,(g)$

   a. The theoretical yield for CCl_2F_2 is 1.7 mol.
   b. The actual yield for CCl_2F_2 is 1.0 mol.
   c. The percent yield for the reaction is 85%.
   d. Theoretical yield cannot be determined unless the exact amount of HF used is known.

B. Dinitrogen pentaoxide can be produced by the reaction between nitrogen and oxygen.
   1. Write a balanced equation for the reaction.
   2. Write the same balanced equation pictorially. Use a square to represent **an atom** of nitrogen and a circle to represent **an atom** of oxygen. You may NOT use any letters or numbers, only squares, circles, + and $\rightarrow$. *(Remember:* Nitrogen and oxygen are diatomic molecules.)
   3. If there are six molecules of both nitrogen and oxygen, show pictorially a before and after representation of the reaction.
   4. A reaction uses 4.50 grams of oxygen and an excess of nitrogen. How many grams of dinitrogen pentaoxide are produced?
   5. Another reaction uses 3.87 g of both nitrogen and oxygen.
      a. How many grams of dinitrogen pentaoxide are produced?
      b. How many grams of the reactant in excess is left over?
      c. If 3.87 g of dinitrogen pentaoxide is obtained after the experiment, what is the percent yield?