**Name: _____** **Section: 1 2 3 4 5**

**Stoichiometry Workshop – Week of September 20**

1. The thermite reaction, which is used to weld rails together in the building of railroads, is described by the following (*unbalanced*) equation:

   $Fe_2O_{3\,(s)} + Al_{(s)} \rightarrow Al_2O_{3\,(s)} + Fe_{(\ell)}$

   Calculate the mass of iron that can be prepared from 150 g of aluminum and 250 g of iron(III) oxide.

2. Vitamin A has a molar mass of 286.4 g and a general molecular formula of $C_xH_yE$, where E is an unspecified element. Vitamin A is 83.86% C and 10.56% H by mass. Determine the molecular formula of vitamin A.

3. The gasoline additive MTBE (methyl *tert*-butyl ether) improves the performance of gasoline and makes it burn more cleanly. However, its use is being phased out due to concerns about groundwater contamination and adverse effects on human health.

   MTBE is composed of carbon, hydrogen, and perhaps oxygen. When a 10.00 g sample of MTBE is burned in an excess of oxygen gas, the products are 24.96 g of carbon dioxide and 12.27 g of water.

   a. Determine the minimum mass of oxygen gas that is required for complete combustion of 10.00 g MTBE. Hint: it is *not* necessary to know the formula of MTBE to answer this question.

   b. Determine the empirical formula of MTBE.

c. The mass of a sample of MTBE vapor is found to be approximately twice the mass of an equal volume of carbon dioxide gas at the same temperature and pressure. Determine the molecular formula of MTBE.

d. Write a balanced reaction for the combustion of MTBE.

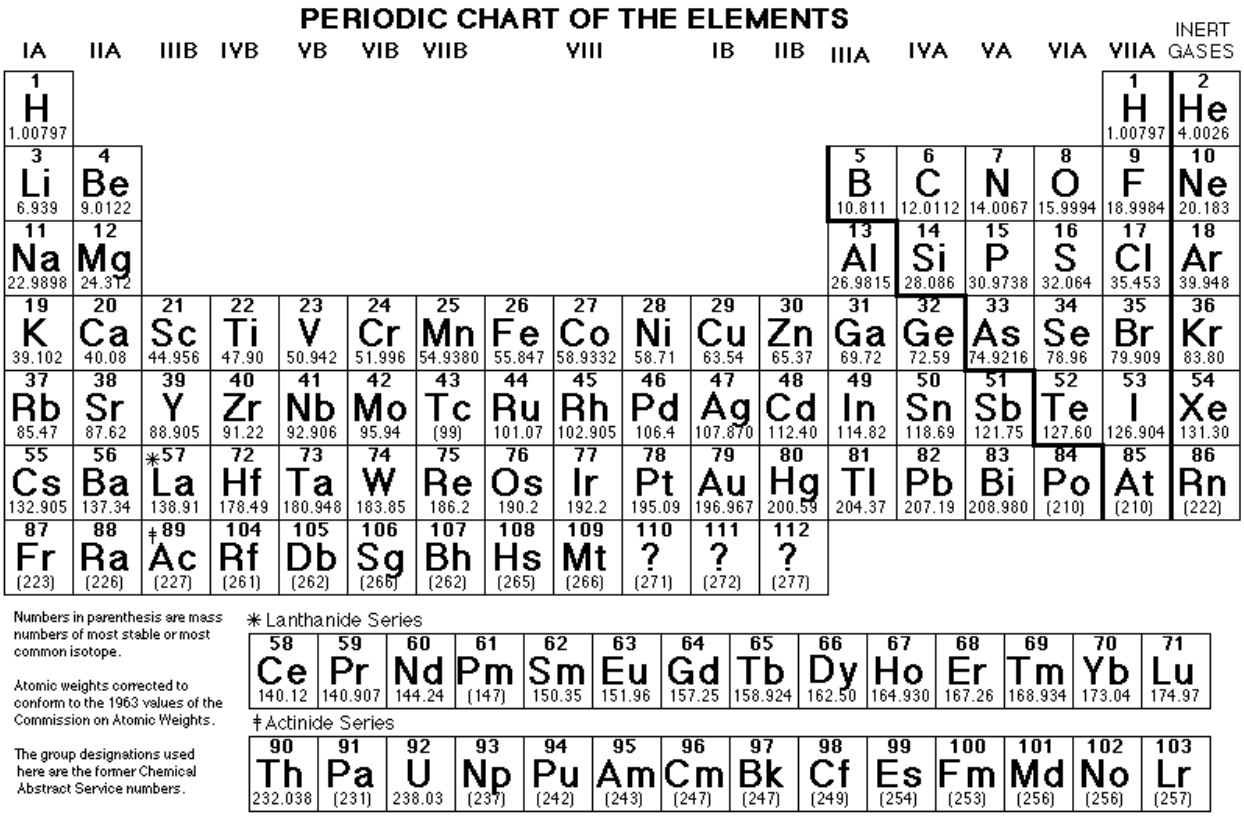
4. Farmers in western Massachusetts condition their soil with lime, which is a mixture of 80% calcium carbonate (by mass) and 20% magnesium carbonate (by mass).
   a. Write a balanced reaction for the reaction of calcium carbonate with hydrochloric acid to form calcium chloride, carbon dioxide, and water.

   b. Write a balanced reaction for the reaction of magnesium carbonate with hydrochloric acid to form magnesium chloride, carbon dioxide, and water.

c. Calculate how much carbon dioxide would be given off upon treatment of 1.000 g of lime with an excess of hydrochloric acid.

d. Calculate the minimum amount of 1 M hydrochloric acid that is required to react completely with 1.000 g of lime.

e. A different sample contains a mixture of only magnesium carbonate and calcium carbonate in an unknown ratio. When 1.000 g of this sample is treated with an excess of hydrochloric acid, 0.500 g of carbon dioxide is formed. Calculate the mass percent of magnesium carbonate and calcium carbonate in the mixture. Note: this question is *hard*!




http://chemlab.pc.maricopa.edu/periodic/printable.gif

H = hydrogen
C = carbon
O = oxygen
Mg = magnesium
Al = aluminum
Cl = chlorine
Ca = calcium
Fe = iron