Name:

WP Practice
Exam 6: Stoichiometry
(Also review pretest packet for Unit 9: Stoichiometry)

1. 0.126 g of a metal, M, reacts with HCl (aq) to form hydrogen gas and MCl_3. It is found that 7.00×10^{-3} mole of hydrogen forms. Calculate the atomic mass (g/mol) of the metal and give the chemical symbol.

$$\underline{2}\,M + \underline{6}\,HCl \rightarrow \underline{3}\,H_2 + \underline{2}\,MCl_3$$

0.126 g; 7.00×10^{-3} mol

atomic mass of M = $\frac{g\ M}{mol\ M}$ ← have; get from mol H_2

$$7.00 \times 10^{-3}\ mol\ H_2 \times \frac{2\ mol\ M}{3\ mol\ H_2} = 4.67 \times 10^{-3}\ mol\ M$$

$$\frac{0.126\ g\ M}{4.67 \times 10^{-3}\ mol\ M} = \boxed{27.0\ g/mol} \Longrightarrow \boxed{Al}$$

find on p-table

2. 0.303 g of a metal, M, reacts with H_2SO_4 to form hydrogen gas and M_2SO_4. It is found that 0.0066 mole hydrogen forms. Calculate the atomic mass of the metal and give the chemical symbol.

$$\underline{2}\,M + H_2SO_4 \rightarrow H_2 + M_2SO_4$$

0.303 g; 0.0066 mol

$$0.0066\ mol\ H_2 \times \frac{2\ mol\ M}{1\ mol\ H_2} = 0.013\ mol\ M$$

$$\frac{0.303\ g\ M}{0.013\ mol\ M} = \boxed{23\ g/mol} \Longrightarrow \boxed{Na}$$

3. Hydrogen combines with oxygen to produce water. If the yield for the reaction is 45.0%, how many grams of oxygen will have to be started in the reaction to yield 97.2 grams of water, assuming excess hydrogen? (Hint: use the formula for % yield and solve for theoretical yield)

$$\underline{2}\,H_2 + O_2 \rightarrow \underline{2}\,H_2O$$

? g; 97.2 g (actual yield)

% yield = $\frac{actual}{theoretical}$

theoretical = $\frac{actual}{\%\ yield}$

$$\frac{97.2\ g\ H_2O}{0.450} = 216\ g\ H_2O \text{ (theoretical yield)}$$

$$216\ g\ H_2O \times \frac{1\ mol\ H_2O}{18.02\ g\ H_2O} \times \frac{1\ mol\ O_2}{2\ mol\ H_2O} \times \frac{32.00\ g\ O_2}{1\ mol\ O_2} = \boxed{192\ g\ O_2}$$

4. Nitrogen combines with hydrogen to produce NH_3. If the yield for the reaction is 28.6%, how many grams of hydrogen will have to be started in the reaction to yield 85.5g NH_3, assuming excess nitrogen? (Hint: use the formula for % yield and solve for theoretical yield)

$$N_2 + \underset{?\,g}{3H_2} \longrightarrow \underset{85.5\,g\ \text{actual}}{2NH_3}$$

$$\frac{85.5\,g\,NH_3}{0.286} = 299\,g\,NH_3 \text{ (theoretical)}$$

$$299\,g\,NH_3 \times \frac{1\,mol\,NH_3}{17.04\,g\,NH_3} \times \frac{3\,mol\,H_2}{2\,mol\,NH_3} \times \frac{2.02\,g\,H_2}{1\,mol\,H_2} = \boxed{53.2\,g\,H_2}$$

5. Pentane, C_5H_{12}, burns in oxygen to give carbon dioxide and water according to the following equation:

$$C_5H_{12} + 8\,O_2 \rightarrow 5\,CO_2 + 6\,H_2O$$

In one experiment, a mixture of 0.480 mol of pentane was burned in 0.995 mol of oxygen in a sealed steel vessel.

a) Calculate the theoretical yield, in moles, of water.

$$0.480\,mol\,C_5H_{12} \times \frac{6\,mol\,H_2O}{1\,mol\,C_5H_{12}} = 2.88\,mol\,H_2O$$

$$0.995\,mol\,O_2 \times \frac{6\,mol\,H_2O}{8\,mol\,O_2} = \boxed{0.746\,mol\,H_2O}$$

b) Find the limiting reactant, if any.

O_2 is limiting

c) How many moles of the excess reactant are leftover from the reaction?

$$0.746\,mol\,H_2O \times \frac{1\,mol\,C_5H_{12}}{6\,mol\,H_2O} = 0.124\,mol\,C_5H_{12}$$

$$0.480\,mol\,C_5H_{12} - 0.124\,mol\,C_5H_{12} = \boxed{0.356\,mol\,C_5H_{12}\text{ in excess}}$$