Name BETH "KEY" Period _____

Review Problems: Stoichiometry

1. Vanadium metal is prepared by the following unbalanced reaction:

$$VCl_2 + H_2 \rightarrow V + 2HCl$$

How many liters of hydrogen are needed to produce 1.0 grams of vanadium metal at STP? How many grams of vanadium chloride are needed for this reaction?

0.44 L H_2

2.4 g VCl_2

2. For the following unbalanced reaction:

$$3Mg + 2H_3PO_4 \rightarrow Mg_3(PO_4)_2 + 3H_2$$

how many grams of magnesium metal are needed to react completely with 50.0 g of phosphoric acid (H_3PO_4)? How many liters of hydrogen would be produced in this reaction at STP?

18.6 g Mg

17.1 L H_2

3. It is desired to prepare 50.0 grams of water by synthesis. How many liters of hydrogen must be used at STP? How many liters of oxygen at STP?

62.2 L H_2

31.1 L O_2

4. For the following unbalanced reaction between sulfuric acid and potassium hydroxide:

$$H_2SO_4 + KOH \rightarrow H_2O + K_2SO_4$$

how many formula units of potassium sulfate can be produced if you have 150.0 grams of sulfuric acid to begin with and sufficient potassium hydroxide to completely react the sulfuric acid?

9.209×10^{23} form. units K_2SO_4

5. When steam is passed over iron, hydrogen gas and iron (III) oxide are formed. What mass of steam would be needed to completely react with 8.25×10^{24} atoms of iron?

$$2Fe + 3H_2O \rightarrow 3H_2 + Fe_2O_3$$

370. g H_2O

6. If steel wool (iron) is heated until it glows and is placed in a bottle containing pure oxygen, the iron reacts spectacularly to produce iron (III) oxide. If 1.25 g of iron is heated and placed in a bottle containing 0.0204 mol of oxygen gas, what mass of iron (III) oxide is produced?

$$\text{L.R.} \rightarrow 4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

1.25g
0.0224mol

1.79 g Fe_2O_3

7. DDT, an insecticide harmful to fish, birds, and humans, is produced by the following reaction:

$$2C_6H_5Cl + C_2HOCl_3 \rightarrow C_{14}H_9Cl_5 + H_2O$$

Chlorobenzene — Chloral — DDT

In a government lab, 1142 g chlorobenzene is reacted with 485 g of chloral.

a. What mass of DDT is formed?

1.17×10^3 g DDT

b. Which reactant is limiting? Which is in excess?

C_2HOCl_3 = L.R.

C_6H_5Cl = Excess

c. What mass of excess reactant is left over?

$$3.29 \text{ mol } C_2HOCl_3 \times \frac{2 \text{ mol } C_6H_5Cl}{1 \text{ mol } C_2HOCl_3} = 6.58 \text{ mol } C_6H_5Cl \text{ USED}$$

10.15 mol C_6H_5Cl present − 6.58 mol C_6H_5Cl used = 3.57 mol excess C_6H_5Cl

3.57 mol × 112.56 g/mol = 402 g excess C_6H_5Cl

d. If the actual yield of DDT is 200.0 g, what is the percent yield?

$$\frac{200.0 \text{ g DDT (actual)}}{1.17 \times 10^3 \text{ g DDT (theoretical)}} \times 100 = 17.1\%$$