Name _____ **Chemistry** ___/___/___

Stoichiometry Test
Part I: Multiple Choice – Circle & enter your answer on the line provided (4pts each).

1. **A** **$4Fe + 3O_2 \rightarrow 2Fe_2O_3$** – How many liters of O_2 are needed to create 1.00 gram of Fe_2O_3?
a. 0.211 L b. 0.421 L c. 22.4 L d. 67.2 L e. none of the above

2. **A** **$4HCl + O_2 \rightarrow 2H_2O + 2Cl_2$** – How many moles of H_2O can be produced from 30. moles of HCl?
a. 15 moles b. 30. moles c. 45 moles d. 60. moles e. none of the above

3. **B** **$2H_2 + O_2 \rightarrow 2H_2O$** – How many moles of water can be produced from 18.0 grams of H_2 and excess O_2?
a. 4.5 moles b. 9.0 moles c. 18.0 moles d. 162 moles e. none of the above

4. **C** **$2Na + Cl_2 \rightarrow 2NaCl$** – How many grams of NaCl can be produced from 1.00 mole of sodium?
a. 2.50 grams b. 29.3 grams c. 58.5 grams d. 117 grams e. none of the above

5. **E** **$4Al + 3O_2 \rightarrow 2Al_2O_3$** – How many liters of O_2 are needed to react with 162 grams of Al?
a. 67.2 L b. 96.0 L c. 269 L d. 384 L e. none of the above

6. **C** **$2SO_2 + O_2 \rightarrow 2SO_3$** – How many liters of SO_3 can be produced from 5.00 liters of oxygen?
a. 2.50 L b. 5.00 L c. 10.0 L d. 20.0 L e. none of the above

7. **D** **$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$** – How many liters of CO_2 are produced from burning 88.0 grams of C_3H_8?
a. 44.8 L b. 67.2 L c. 89.6 L d. 134 L e. none of the above

8. **D** **$Na_2CO_3 \rightarrow Na_2O + CO_2$** – How many liters of CO_2 can be produced from 3.00 moles of Na_2CO_3?
a. 3.00 L b. 22.4 L c. 33.6 L d. 67.2 L e. none of the above

9. **D** **$Zn + 2HCl \rightarrow ZnCl_2 + H_2$** – How many moles of HCl are needed to react with 65.4 moles of Zn
a. 2.00 moles b. 22.4 moles c. 44.8 moles d. 131 moles e. none of the above

10. **C** **$2Al + 3FeO \rightarrow Al_2O_3 + 3Fe$** – A student uses 54.0 grams of aluminum and produces 150.4 grams of iron. What is his percent yield?
a. 10.2% b. 35.9% c. 89.8% d. 98.7% e. none of the above

11. **D** **$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$** - Using 32.0 grams of methane Lisa was able to produce 63.0 grams of water. Calculate her percent yield?
a. 17.5% b. 57.1% c. 77.8% d. 87.5% e. none of the above

12. **B** **$3H_2 + N_2 \rightarrow 2NH_3$** - Given 28.1 grams of N_2 and 30.0 liters of H_2, which is your limiting reagent?
a. N_2 b. H_2 c. NH_3 d. both H_2 & N_2 e. can't be determined

13. **A** **$2Al + 3S \rightarrow Al_2S_3$** - Aluminum reacts with sulfur to produce aluminum sulfide. If I have 81 grams of Al and 81 grams of S, what is my limiting reagent?
a. S b. Al c. Al_2S_3 d. both Al & S e. can't be determined

14. **B** **$2KClO_3 \rightarrow 2KCl + 3O_2$** - Potassium chlorate decomposes to form potassium chloride and oxygen gas. How many liters of oxygen gas are produced from 490.4 grams of potassium chlorate?
a. 59.7 L b. 134 L c. 192 L d. 268 L e. none of the above

15. **C** If the theoretical value is 4.75 grams and in the lab you measure 3.23 grams, what is the percent yield?
a. 1.52 % b. 1.47 % c. 68.0 % d. 87.4 % e. none of the above

Part II – Problems. Solve each of the following and write your answer on the line. Be sure to include the substance and its unit. You must show all work or you will not receive any credit.

1. $N_2 + 3H_2 \rightarrow 2NH_3$
Nitrogen gas reacts with hydrogen gas to form ammonia. You have 73.5 liters of hydrogen and 35.7 liters of nitrogen gas.
(a) Identify the limiting reactant. Support your answer with calculations. (3 points)
(b) How much of the excess reagent remains? (3 points)
(c) Calculate the volume of ammonia produced. (3 points)
(d) If 24.6 liters of ammonia are actually produced, what is the percent yield? (3 points)

(a) $\frac{73.5\text{ L } H_2}{1} \times \frac{1\text{ mole } H_2}{22.4\text{ L } H_2} \times \frac{2\text{ mole } NH_3}{3\text{ moles } H_2} \times \frac{22.4\text{ L } NH_3}{1\text{ mole } NH_3} =$ **49.0 L NH_3**

$\frac{35.7\text{ L } N_2}{1} \times \frac{1\text{ mole } N_2}{22.4\text{ L } N_2} \times \frac{2\text{ moles } NH_3}{1\text{ mole } N_2} \times \frac{22.4\text{ L } NH_3}{1\text{ mole } NH_3} =$ **71.4 L NH_3**

Limiting Reagent: **H_2** Excess Reagent: **N_2**

(b) $\frac{73.5 \text{ L } H_2}{1} \times \frac{1 \text{ mole } H_2}{22.4 \text{ L } H_2} \times \frac{1 \text{ mole } N_2}{3 \text{ moles } H_2} \times \frac{22.4 \text{ L } N_2}{1 \text{ mole } N_2} =$ **24.5 L N_2 needed**

35.7 – 24.5 = **11.2 L of excess N_2**

(c) $\frac{73.5 \text{ L } H_2}{1} \times \frac{1 \text{ mole } H_2}{22.4 \text{ L } H_2} \times \frac{2 \text{ moles } NH_3}{3 \text{ moles } H_2} \times \frac{22.4 \text{ L } NH_3}{1 \text{ mole } NH_3} =$ **49.0 L NH_3**

(d) Percent Yield = $\frac{24.6}{49.0} \times 100 =$ **50.2%**

2. $2Al + 3CrO \rightarrow Al_2O_3 + 3Cr$

Aluminum reacts with aqueous chromium(II) oxide to form aluminum oxide and chromium. 217.0 grams of chromium(II) oxide were reacted with 189.0 grams of aluminum.
(a) Identify the limiting reactant. Support your answer with calculations. (3 points)
(b) How much of the excess reagent remains? (3 points)
(c) Calculate the mass of aluminum oxide produced (3 points)
(d) If 91.0 grams of aluminum oxide are actually produced, what is the percent yield? (3 points)

(a) $\frac{217.0 \text{ g CrO}}{1} \times \frac{1 \text{ mole CrO}}{68.00 \text{ g CrO}} \times \frac{1 \text{ mole } Al_2O_3}{3 \text{ moles CrO}} \times \frac{101.96 \text{ g } Al_2O_3}{1 \text{ mole } Al_2O_3} =$ **108.5 g Al_2O_3**

$\frac{189.0 \text{ g Al}}{1} \times \frac{1 \text{ mole Al}}{26.98 \text{ g Al}} \times \frac{1 \text{ mole } Al_2O_3}{2 \text{ moles Al}} \times \frac{101.96 \text{ g } Al_2O_3}{1 \text{ mole } Al_2O_3} =$ **357.2 g Al_2O_3**

Limiting Reagent: **CrO** Excess Reagent: **Al**

(b) $\frac{217.0 \text{ g CrO}}{1} \times \frac{1 \text{ mole CrO}}{68.00 \text{ g CrO}} \times \frac{2 \text{ mole Al}}{3 \text{ moles CrO}} \times \frac{26.98 \text{ g Al}}{1 \text{ mole Al}} =$ **57.40 g Al needed**

189.0 – 57.4 = **131.6 grams of excess Al**

(c) $\frac{217.0 \text{ g CrO}}{1} \times \frac{1 \text{ mole CrO}}{68.00 \text{ g CrO}} \times \frac{1 \text{ mole } Al_2O_3}{3 \text{ moles CrO}} \times \frac{101.96 \text{ g } Al_2O_3}{1 \text{ mole } Al_2O_3} =$ **108.5 g Al_2O_3**

(d) Percent Yield = $\frac{91.0}{108.5} \times 100 =$ **83.9%**

3. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

Zinc reacts with hydrochloric acid to form zinc chloride and hydrogen gas. 98.2 grams of zinc and 98.2 grams of hydrogen chloride react?
(a) Identify the limiting reactant. Support your answer with calculations. (3 points)
(b) How much of the excess reagent remains? (3 points)
(c) Calculate the volume of hydrogen gas produced (3 points)
(d) If 12.5 liters of hydrogen gas are actually produced, what is the percent yield? (3 points)

(a) $\frac{98.2 \text{ g Zn}}{1} \times \frac{1 \text{ mole Zn}}{65.39 \text{ g Zn}} \times \frac{1 \text{ mole } H_2}{1 \text{ mole Zn}} \times \frac{22.4 \text{ L } H_2}{1 \text{ mole } H_2} =$ **33.6 L H_2**

$\frac{98.2 \text{ g HCl}}{1} \times \frac{1 \text{ mole HCl}}{36.46 \text{ g HCl}} \times \frac{1 \text{ mole } H_2}{2 \text{ moles HCl}} \times \frac{22.4 \text{ L } H_2}{1 \text{ mole } H_2} =$ **30.2 L H_2**

Limiting Reagent: **HCl** Excess Reagent: **Zn**

(b) $\frac{98.2 \text{ g HCl}}{1} \times \frac{1 \text{ mole HCl}}{36.46 \text{ g HCl}} \times \frac{1 \text{ mole Zn}}{2 \text{ mole HCl}} \times \frac{65.39 \text{ g Zn}}{1 \text{ mole Zn}} =$ **88.1 g Zn needed**

98.2 – 88.1 = **10.1 g of excess Zn**

(c) $\frac{98.2 \text{ g HCl}}{1} \times \frac{1 \text{ mole HCl}}{36.46 \text{ g HCl}} \times \frac{1 \text{ mole } H_2}{2 \text{ moles HCl}} \times \frac{22.4 \text{ L } H_2}{1 \text{ mole } H_2} =$ **30.2 L H_2**

(d) Percent Yield = $\frac{12.5}{30.2} \times 100 =$ **41.4%**