Practice Exam Three – Chemistry 121 Name: **Key**

Part One: Multiple Choice (45 points)

Choose the best answer for each question. There is only one correct answer.

1. What is the molar mass of ammonium sulfate ($(NH_4)_2SO_4$ – an important synthetic fertilizer?
   a. 70.g/mol b. 92 g/mol c. 114 g/mol **d. 132 g/mol** e. 146 g/mol

2. Given: $N_2 + 3H_2 \rightarrow 2NH_3$ How many grams of ammonia are produced if 5.0 grams of nitrogen react with unlimited hydrogen?
   a. 3.0 g **b. 6.1 g** c. 10.0 g d. 12.2 g e. none of these

3. How many sulfur atoms are there in 25g of Al_2S_3? ($N_A = 6.022 \times 10^{23}$)
   a. 1.0×10^{23} b. 2.0×10^{23} c. **3.0×10^{23}** d. 4.5×10^{21} e. 6.0×10^{21}

4. How many moles of iron are contained in 6.09 g of iron?
   a. 0.0480 moles b. 0.0558 moles **c. 0.109 moles** d. 0.917 moles

5. What is the percentage of sulfur in copper (I) sulfide, Cu_2S by mass?
   a. **20.1%** b. 33.5% c. 46.5% d. 79.9% e. 84.3%

6. Analysis of a hydrocarbon showed that it contained 14.4% hydrogen and 85.6% carbon by mass. What is its simplest (empirical) formula?
   a. CH **b. CH_2** c. CH_3 d. C_2H_3 e. C_2H_5

7. If 50.0 g of O_2 are mixed with 50.0 g of H_2 and the mixture is ignited to produce water, what mass of water is produced?
   a. 50.0 g **b. 56.3 g** c. 65.7 g d. 71.4 g e. 100.0 g

8. $H_2SO_3 \rightarrow SO_{2(g)} + H_2O_{(l)}$ is which type of reaction?
   a. **decomposition** b. combination c. single displacement d. double displacement

9. $Zn_{(s)} + FeCl_{3(aq)} \rightarrow ZnCl_{2(aq)} + Fe_{(s)}$ is which type of reaction?
   a. decomposition b. combination **c. single displacement** d. double displacement

10. A flexible container is filled with 1.5 L of gas at sea level, where the pressure is 1.0 atm. What will the volume be when the pressure is 0.85 atm if the temperature remains constant?
    a. 1.3 L b. 1.5 L **c. 1.8 L** d. 2.0 L e. 2.3 L

11. The volume of a sample of gas measured at 25.0°C and 1.00 atm is 10.0 L. What must the final temperature be in order for the gas to have a final volume of 7.5 L at 1.00 atm pressure?
    a. -55°C **b. -50. °C** c. -45 °C d. -35 °C e. 19 °C

12. How many moles of gas are in a gas sample occupying 0.250L at 215 mmHg (1.0 atm = 760 mmHg) and 25°C?
    a. 0.00217 **b. 0.00289** c. 0.0345 d. 0.416 e. 1.27

13. When the equation: $Al(OH)_3 + H_2SO_4 \rightarrow Al_2(SO_4)_3 + H_2O$ is balanced, the sum of the coefficients is:
    a. 9 b. 11 c. 13 d. 15 **e. none of these (12)**

14. Which of the following contains the largest number of moles?
    a. 1.0 g Ba b. 1.0 g Cu c. 1.0 g K d. 1.0 g Si **e. 1.0 g C**

15. Which of these gases has the highest density at STP?
    a. N_2O b. NO_2 **c. SO_2** d. Cl_2 e. HCN

Part Two: Short Answer (20 points)

Write your answer in the space provided

1. List the four types of chemical equations and use A, B, AB, CD, etc. to give examples of each type.

A + B → C — **combination**
A → B + C — **decomposition**
AB + C → AC + B or AB + C → CB + A — **single replacement**
AB + CD → AD + CB — **double replacement**

2. What is the difference between an endothermic reaction and an exothermic reaction?

An endothermic reaction absorbs heat from the surroundings and the surroundings become colder. An exothermic reaction produces heat and the surroundings become hotter.

3. Is a gas more likely to behave as an ideal gas in low pressure conditions or high pressure conditions? Why?

A gas will behave more ideally is the pressure is low. As the pressure increases the gas molecules are more likely to stick together when they collide resulting in non-ideal gas behavior.

4. What is a mole? **A mole is 6.022 X 10 ^{23} objects.**

Part Three: Problem Solving (35 points) – Please show all calculations.

1. Determine the MOLECULAR FORMULA for a compound that is 25.26% carbon and 74.74% chlorine and has a molecular weight of 284.8 g/mole. (10 points)

25.26/12.01 = 2.10/2.10 = 1
74.74/35.5 = 2.10/2.10 = 1

CCl = 12.01 + 35.45 = 47.46

284.8/47.46 = 6

C_6Cl_6 is the molecular formula.

2. Sodium carbonate reacts with ammonium chloride in a double displacement reaction. Write the balanced reaction that occurs: (5 points)

$Na_2CO_3 + 2NH_4Cl \rightarrow 2NaCl + (NH_4)_2CO_3$

3. Given the reaction: $4HCl_{(aq)} + O_{2(g)} \rightarrow 2Cl_{2(g)} + 2H_2O_{(l)}$ How many liters of chlorine gas would be produced at STP if 25ml of 6M HCl are reacted with excess oxygen? (T=273K P=1.00 atm) (10 points)

25mL X 1L/1000mL = 0.025 L
0.25 L X 6M = 1.5 mole HCl

1.5 mole HCl X $2Cl_2/4HCl$ = 0.75 mol Cl_2

V = nRT/P = 0.75 X 0.0821 X 273 / 1 = 16.81 L

4. Carbon disulfide, CS_2, can be made from coke (C) and sulfur dioxide (SO_2):

$$3C_{(s)} + 2SO_{2(g)} \rightarrow CS_{2(s)} + 2CO_{2(g)}$$

If the actual yield of CS_2 is 83.0% of the theoretical yield, what mass of coke is needed to produce 1.00 kg of CS_2?

1000 g CS_2 X 1mol/76.12g X 3C/1CS_2 X 12.01 = 473 grams C

This is the amount that would be needed if the percentage yield was 100%

To make this amount with a yield LESS THAN 100% you will need to have MORE C.

0.83 X Amount Needed = 473 g C

Amount Needed = 570. g C (You need to divide 473 by the percent yield)

Note: The word coke has nothing to do with coca-cola. This word has been around for a long time. Coke is a solid carbonaceous leftover derived from destructive distillation of low-ash, low-sulfur bituminous coal. The volatile constituents of the coal, including water, coal-gas and coal-tar, are driven off by baking in an airless oven at temperatures as high as 1,000 degrees Celsius so that the fixed carbon and residual ash are fused together. Coke is essentially composed only of carbon.

Some useful information:

R=0.0821 L-atm/mol K

$N_A = 6.022 \times 10^{23}$

Molarity is defined as moles of solute divided by liters of solution.