

**City College, Chemistry Department
Chemistry 10301, sections T, T2, T3, Prof. T. Lazaridis
First Midterm exam, Oct. 2, 2007**

Name (last name first): _____

I.D. Number: _____

Workshop leader: _____

Note: There are 7 questions in this exam (check both sides of the sheet).

Fill in your answer in the blank space provided immediately following each question. Half a point will be subtracted every time you report a numerical result with an incorrect number of significant figures. A copy of the periodic table is attached. Good luck!

1. a. (4) What is the chemical formula of aluminum hydroxide?



- b. (4) What is the name of the compound CH_3OH ?

methanol

- c. (4) How many protons and electrons does the chloride ion have?

17 protons, 18 electrons

- d. (4) What is the molar mass of NaOH ?

22.99 + 16.00 + 1.008 = 40.00

- e. (4) Give the atomic symbol of the elements:

silicon: **Si**

silver: **Ag**

titanium: **Ti**

potassium: **K**

2. Write a balanced equation for each of the following reactions (it is not necessary to indicate the states of each substance):

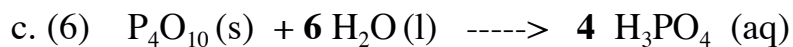
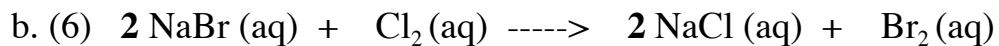
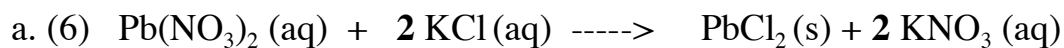
a. (6) Burning of acetone (CH₃COCH₃) in oxygen



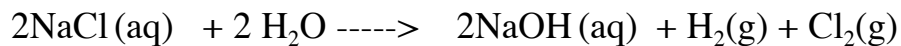
b. (6) Sodium metal reacts with water to give hydrogen gas and sodium hydroxide.



3. Balance the following chemical equations:



4. (15) Caustic soda (NaOH) is prepared commercially by passing an electric current through a concentrated solution of sodium chloride in water:



(a) (10) Calculate the theoretical yield of caustic soda if 125 Kg of NaCl is electrolyzed.

Molar mass of NaCl = 22.99 + 35.45 = 58.44 and of NaOH = 40.00 g/mol

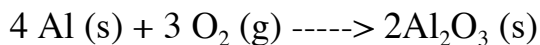
$125 \times 10^3 \text{ g NaCl} / 58.44 \text{ (g/mol)} = 2.14 \times 10^3 \text{ mol}$

This will produce $2.14 \times 10^3 \text{ mol NaOH} \times 40.00 \text{ g/mol} = 85.6 \text{ Kg}$

(b) (5) Calculate the percent yield if the electrolysis in part (a) produces 55.4 Kg of caustic soda.

$$55.4/85.6 \times 100\% = 64.7 \%$$

5. (15) The following reaction occurs when aluminum is heated with oxygen:



A reacting mixture contains 50.0 Kg of Al and 50.0 Kg of oxygen.

a) (5) Find the limiting reactant

$50.0 \times 10^3 \text{ g Al} / 26.98 \text{ (g/mol)} = 1.85 \times 10^3 \text{ mol Al}$

$50.0 \times 10^3 \text{ g O}_2 / 32.00 \text{ (g/mol)} = 1.56 \times 10^3 \text{ mol O}_2$

$1.85 \times 10^3 \text{ mol Al}$ requires $1.85 \times 10^3 * \frac{3}{4} = 1.39 \times 10^3 \text{ mol O}_2$.

We have 1.56×10^3 , so O_2 is in excess

=> Al is limiting.

b) (5) How many grams of aluminum oxide will form ?

$$\begin{aligned} \text{Molar mass of Al}_2\text{O}_3 & \text{ is } 2 \times 26.98 + 3 \times 16.00 = 101.96 \text{ g/mol} \\ 1.85 \times 10^3 \text{ mol Al will react with } & 1.39 \times 10^3 \text{ mol O}_2 \text{ to form} \\ 1.85 \times 10^3 \times 2/4 = 0.925 \times 10^3 \text{ mol Al}_2\text{O}_3 & * 101.96 \text{ g/mol} \\ & = 94.3 \times 10^3 \text{ g Al}_2\text{O}_3 \end{aligned}$$

c) (5) How many grams of excess reactant will remain?

$$(1.56 - 1.39) \times 10^3 = 0.17 \times 10^3 \text{ mol O}_2 \times 32.00 \text{ g/mol} = 5.44 \times 10^3 \text{ g O}_2$$

6. (10) Calculate the percentage composition in the compound oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$).

$$\text{Molar mass: } 2 \times 1.008 + 2 \times 12.01 + 4 \times 16.00 = 90.04 \text{ g/mol}$$

$$\text{H: } 2 \times 1.008 / 90.04 \times 100\% = 2.239 \%$$

$$\text{C: } 2 \times 12.01 / 90.04 \times 100\% = 26.68 \%$$

$$\text{O: } 4 \times 16.00 / 90.04 \times 100\% = 71.08 \%$$

7. (10) Calculate the empirical formula of the compound formed when 6.58 g of nitrogen combines with 1.42 g of hydrogen.

$$\text{N: } 6.58 / 14.01 = 0.470 \text{ mol} \quad \text{divide by smallest} \quad /0.470 = 1$$

$$\text{H: } 1.42 / 1.008 = 1.41 \text{ mol} \quad /0.470 = 3$$

So empirical formula is NH_3