CHEM-1110 TEST # 1 NAME_____
Sept. 25, 2002

SHOW ALL WORK. MESSY AND UNORGANIZED WORK WILL NOT BE MARKED. STRICT ADHERENCE TO INDEPENDENT WORK.

1. For the following equation:

$$Na_2Cr_2O_7(s) + 6\ NaCl(s) + 7\ H_2SO_4(aq) \rightarrow 3\ Cl_2(g) + Cr(SO4)_3(aq) + 4\ Na_2SO_4(aq) + 7\ H_2O(l)$$

a) If a total of 6.41 g of $Na_2Cr_2O_7$ (MM=262.00) is added to 7.68 g of NaCl (MM=58.45) and an excess of H_2SO_4, a total of 3.44 g of Cl_2 (MM=70.90) was isolated. Determine the percent yield of the reaction and the mass of the excess reagent left over at the end of the reaction. **[8]**

2. A 500.0 mg tablet containing antacids plus inert material was dissolved in 50.00 mL of 0.5000 M HCl. The resulting solution required 26.50 mL of 0.3770 M NaOH for neutralization.

$$HCl(aq) + NaOH \rightarrow NaCl(aq) + H_2O(l)$$

a) How many moles of OH^- were in the tablet? **[5]**

b) If the tablet contained equal masses of $Al(OH)_3$ and $Mg(OH)_2$, what is the percent, by mass, of each hydroxide in the tablet? **[6]**

3. A 5.00 g mixture of zinc and aluminum was reacted with HCl(aq). 3.78 L of hydrogen gas produced was collected over water at 22.0°C and 760.0 mmHg. Vapor pressure of water at 22.0°C = 19.8 mmHg. The reactions are:

$$Zn(s) + 2\ HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

$$2\ Al(s) + 6\ HCl(aq) \rightarrow 2\ AlCl_3(aq) + 3\ H_2(g)$$

Calculate the percent by mass of zinc in the original mixture. **[8]**

4. The density of xylene, a compound containing only carbon and hydrogen is 4.74 g/L at STP. In another experiment, combustion of 5.00 g of xylene gave 16.60 g of CO_2. Calculate the molecular formula of xylene. **[5]**

5. A sample of a sulfide of metal M (formula M_xS_y) is analyzed. The sulfur in the system is recovered as 120.0 mL of 0.250 M Na_2S solution. The metal in the same sample is recovered as 40.0 mL of 0.500 M solution of the metal ion. The molar mass of the sulfide of the metal is 150.3 g/mol. Find the formula of the metal sulfide and identify M. **[5]**

6. A miniature laboratory volcano can be made from ammonium dichromate, $(NH_4)_2Cr_2O_7$. When ignited it decomposes in a fiery display. The reaction is:

$$(NH_4)_2Cr_2O_7(s) \rightarrow N_2(g) + 4\ H_2O(g) + Cr_2O_3(s)$$

If the decomposition of 5.00 g of ammonium dichromate is done and gases are trapped in a 2.00 L flask at 27°C, what is the total gaseous pressure and the partial pressures of gases? **[6]**

7. Write balanced equations for the following nuclear reactions. **[6]**

a) Pb-204 emits an alpha particle.

b) Se-73 emits a positron.

c) An atom of plutonium-239 is bombarded by a neutron, splitting into atom of Iodine-135, 4 neutrons, plus another element.

d) An atom of Beryllium-9 collides with an atom of americium-242 to produce a new element and three neutrons.

e) Pa-234 emits a beta particle.

f) Indium-110 undergoes electron capture.

8. The nuclide ^{210}Po (atomic mass = 209.9829 amu) decays by alpha decays to ^{206}Pb (atomic mass = 205.9745 amu). Mass of alpha particle is 4.0026 amu' mass of a proton = 1.007276 amu, mass of a neutron = 1.008665 amu, and mass of an electron = 0.00055 amu. 1 amu = 931.5 MeV. Calculate the average binding energy for ^{210}Po. **[4]**