CHEM 101—General Chemistry

Exam #2

19 November 2004

Name _____

1. (20 points) Silicon tetrachloride, an important synthetic building block in the electronics industry, is made by reaction of silicon dioxide with carbon and chlorine:

   $SiO_2(s) + C(s) + Cl_2(g) \rightarrow SiCl_4(\ell) + CO(g)$

   Balance this equation and determine the percent yield if 509.1 g SiO_2 reacts with excess carbon and chlorine to produce 1378.6 g of $SiCl_4$.

2. (10 points) Solutions of nitric acid (HNO_3) and potassium hydroxide (KOH) are mixed. Write the net ionic equation for the reaction that occurs.

3. (10 points) A solution of sodium hydroxide, NaOH, is added to a solution of aluminum nitrate, $Al(NO_3)_3$. Identify all species present after the solutions have been mixed.

4. (20 points) A 50.0 mL solution of $NH_3(aq)$ was titrated with 21.87 mL of hydrochloric acid. The concentration of the acid was 0.1092 M. Determine the concentration of the ammonia solution.

5. (20 points) For the following redox reaction, identify:

$$MnO_4^-(aq) + Fe(s) + H_3O^+(aq) \rightarrow Mn^{2+}(aq) + Fe^{2+}(aq) + H_2O$$

a. the oxidation states of each element in each species

b. the species being reduced and oxidized

c. the total number of electrons transferred in the reaction.

d. Write a balanced chemical equation for the chemical reaction

6. (10 points) Describe one way in which energy is stored as potential energy in molecules.

7. (20 points) Using the following set of reactions, determine $H^{o}_{f,298}$ for $CO_2(g)$.

$2\ C(s) + O_2(g) \rightarrow 2\ CO(g)$	$H^{o}_{rxn,298} = -221.1$ kJ/mol
$H(g) + CO_2(g) \rightarrow OH(g) + CO(g)$	$H^{o}_{rxn,298} = 104.2$ kJ/mol
$OH(g) + H(g) \rightarrow H_2O(g)$	$H^{o}_{rxn,298} = -498.7$ kJ/mol
$2\ H(g) + \frac{1}{2}\ O_2(g) \rightarrow H_2O(g)$	$H^{o}_{rxn,298} = -677.7$ kJ/mol

8. (20 points) The heat capacity of a calorimeter was measured to be 10.17 kJ/(mol K). A 1.521 g sample of benzoic acid ($C_7H_6O_2$) was then combusted, and temperature of the calorimeter rose 3.95 K. Determine the heat of combustion for benzoic acid.

9. (20 points) You are working in Antarctica conducting experiments on the foraging habits of King Penguins during the southern winter month of August. While sitting on an iceberg in -48 ºC (-54 ºF) weather, you decide to drink some hot chocolate to try to warm up a little. But the chocolate, at a temperature of 184.3 ºC, is too hot and burns your mouth, so you decide to put a little snow in to cool it down. You add 50. g of snow to 250 mL of chocolate. What is the final temperature of the chocolate?

$\rho_{chocolate} = 1.13$ g/mL
$c_{chocolate} = 4.2$ J/(g K)
$H^{o}_{fus,ice} = 6.01$ kJ/mol