Chemistry 1415.001  
September 19, 2008  
Exam I

NAME (please print): Answer Key
SIGNATURE: 

Watch the time! Show all work on these pages.

(100) Total 

(30) I. Put the letter of the correct answer in the blank to the right.

1. How many oxygen atoms are present in 6 molecules of Eu(NO₃)₃?
   a. 3   b. 9   c. 18   d. 54  
   1. D

2. An ethanol plant begins a production run with sufficient reactants to predict a theoretical yield of 1250 metric tons of ethanol. The process produces 1178.6 metric tons. What is the percent yield for this production run?
   a. 94.29 %   b. 82.10 %   c. 106.1 %   d. 99.23 %  
   2. A

3. Which of the following are examples of transition metals:
   a. Fe and Cr   b. Sb and I   c. Pm and Gd   d. As and Ga  
   3. A

4. Given that AgNO₃(aq) + KCl(aq) → AgCl(s) + KNO₃(aq), which of the following species is classified as a spectator ion?
   a. Ag⁺¹   b. NO₃⁻¹   c. AgCl   d. Cl⁻¹  
   4. B

5. Alkaline earth metal cations carry a charge of:
   a. 1⁺   b. 2⁺   c. 2⁻   d. 1⁻  
   5. B

6. Consider the ²⁰³Hg. How many neutrons are present in this nuclide?
   a. 203   b. 80   c. 283   d. 123  
   6. D

7. If the density of a liquid is 0.8 g/mL, what is the density in units of µg/ml?
   a. 0.8 µg/ml   b. 80 µg/ml   c. 8.0 x 10⁻⁹ µg/ml   d. 8.0 x 10⁻⁶ µg/ml  
   7. A
8. During a test, an automobile engine consumed $4.40 \times 10^{-3}$ mol of octane and $5.50 \times 10^{-2}$ mol of oxygen. What condition best describes the fuel mix?
   a. too lean (too much oxygen)  b. reasonably correct  c. too rich (too little oxygen)  8. B

9. High density polyethylene is dense due to
   a. addition of heavy metals  b. oxygen links between the carbons
   c. branching side chains along the polymer  d. only straight chain polymers  9. D

10. A car’s engine coolant is good to -23 F°. What is this temperature on the Celsius scale?
    a. -31 °C  b. -1.2 °C  c. -99 °C  d. -1.25 °C  10. A

(16) II. Write the correct molecular formula for each of the following compounds

   a. ammonium chloride
      \[ \text{NH}_4\text{Cl} \]
   b. iron (II) bromide
      \[ \text{FeBr}_2 \]
   c. diphosphorus pentoxide
      \[ \text{P}_2\text{O}_5 \]
   d. aluminum sulfate
      \[ \text{Al}_2(\text{SO}_4)_3 \]

(14) III. Write a molecular, total ionic, and net ionic equation for the reaction of nitric acid and potassium hydroxide in aqueous solution. Would you expect the final solution to conduct electricity? Why or why not?

\[
\text{HNO}_3 + \text{KOH} \rightarrow \text{KNO}_3 + \text{H}_2\text{O} \\
\text{H}^+ + \text{NO}_3^- + \text{K}^+ + \text{OH}^- \rightarrow \text{K}^+ + \text{NO}_3^- + \text{H}_2\text{O} \\
\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}
\]

Yes, the solution would be conductive since it contains the charged ions \( \text{K}^+ \) and \( \text{NO}_3^- \).
(20) IV. 100.0 g of hexane, C<sub>6</sub>H<sub>14</sub>, reacts with excess oxygen.
   a. Write a balanced chemical equation.
   b. How many grams of carbon dioxide would be produced?
   c. Based on your knowledge of other hydrocarbons, would you expect hexane to be a solid, liquid, or gas
   at normal room temperature and pressure? Explain your answer.

   \[
   \begin{align*}
   C_6H_{14} + \text{O}_2 & \rightarrow CO_2 + H_2O \\
   \text{(6 moles)} & \rightarrow 6 \text{moles} + 7 \text{moles}
   \end{align*}
   \]

   \[
   \frac{100.0 \text{g} \text{C}_6\text{H}_{14}}{86.3 \text{g/mol}} = 1.16 \text{ moles C}_6\text{H}_{14}
   \]

   \[
   \frac{1.16 \text{ moles C}_6\text{H}_{14}}{6 \text{ moles CO}_2} = 0.96 \text{ moles CO}_2
   \]

   \[
   \frac{0.96 \text{ moles CO}_2}{44.0 \text{ g/mol}} = 30.6 \text{ g CO}_2
   \]

(20) V. A 25.00 mL sample of sulfuric acid, H<sub>2</sub>SO<sub>4</sub>, is titrated to neutralization with 22.64 mL of 2.00 M NaOH. What is the molarity of the sulfuric acid?

\[
\begin{align*}
\text{H}_2\text{SO}_4 + 2\text{NaOH} & \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O} \\
0.0226 \text{mole} + 0.045 \text{mole} & = 0.0453 \text{mole NaOH}
\end{align*}
\]

\[
0.045 \text{mole NaOH} \times \frac{1 \text{ mole H}_2\text{SO}_4}{2 \text{ mole NaOH}} = 0.0226 \text{ mole H}_2\text{SO}_4
\]

\[
\text{Molarity} = \frac{\text{mol solute}}{\text{L solution}} = \frac{0.0226 \text{ mole}}{0.0250 \text{ L}} = 0.906 \text{ M}
\]