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. Alkali metal cations have a charge of:
   a. 1–  b. 2–  c. 2+  d. 1+  
   1. ______

2. The density of mercury metal (a liquid) is 13.5 g/mL. What is the mass in pounds of 1 liter of mercury?
   (1 lb = 454 g)
   a. 0.034 lb  b. 6.13 lb  c. 13.5 lb  d. 29.7 lb
   2. ______

3. Which of the following is a strong electrolyte in water?
   a. CO₂  b. CaCO₃  c. HF  d. NaNO₃
   3. ______

4. How many moles of NH₄NO₃, are in 1 kg of the substance?
   a. 0.0125 mol  b. 0.125 mol  c. 80 mol  d. 1000 mol
   4. ______

5. Which of the following is an isotope of ¹⁴C?
   a. ¹²C  b. ¹⁴N  c. ²⁸Si  d. none of the above
   5. ______

6. How many protons are present in ¹⁹⁹Hg?
   a. 80  b. 119  c. 199  d. 200
   6. ______

7. How many nitrogen atoms are present in 3 molecules of Al(NO₃)₃?
   a. 1  b. 3  c. 9  d. 27
   7. ______
8. Which of the following are examples of transition metals?
   a. Cl and Br  b. Ag and Au  c. Mg and Ca  d. Li and Na
   8.  B

9. High density polyethylene is more dense than low density polyethylene 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. The biggest difference in the structure of polyvinylchloride and polyethylene is
    a. different monomer  b. different amount of branching
    c. different polymer backbone  d. all of the above
    10.  A

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

   iron (II) bromide $\text{FeBr}_2$
   sodium sulfate $\text{Na}_2\text{SO}_4$

   ammonium chloride $\text{NH}_4\text{Cl}$
   lead (II) sulfide $\text{PbS}$

   carbon tetrachloride $\text{CCl}_4$
   aluminum oxide $\text{Al}_2\text{O}_3$

   dinitrogen pentoxide $\text{N}_2\text{O}_5$
   calcium carbonate $\text{CaCO}_3$

(8) III.
   a. Complete the following reaction and balance the equation assuming the reaction is run in water.
   b. Write the total ionic equation.
   c. Write the net ionic equation.

   a) $\text{HBr} + \text{KOH} \rightarrow \text{KBr} + \text{H}_2\text{O}$
   b) $\text{H}^+ + \text{Br}^- + \text{K}^+ + \text{OH}^- \rightarrow \text{K}^+ + \text{Br}^- + \text{H}_2\text{O}$
   c) $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$
IV. Hydrogen gas, \( \text{H}_2 \), burns in air to produce water.

a. Write a balanced equation for the combustion of hydrogen.

\[
\text{H}_2 + \frac{1}{2} \text{O}_2 \rightarrow \text{H}_2\text{O} \quad \text{or} \quad 2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}
\]

b. What mass of water is produced from the burning of 100 g of hydrogen? Show all work.

\[
\begin{align*}
\text{H}_2 & \quad 2 \times 1 = 2 \text{g/mol} \\
(100 \text{ g})(\frac{1 \text{ mol}}{2 \text{ g}}) &= 50 \text{ mol} \\
(50 \text{ mol})(\frac{18 \text{ g}}{1 \text{ mol}}) &= 900 \text{ g}
\end{align*}
\]

(12) V. Paraffin wax, \( \text{C}_{22}\text{H}_{52} \), is used in a wide range of applications, including candles, crayons, waxes for skis and snowboards, and coatings for waxed paper.

a. Write a balanced chemical equation for the burning of a candle assuming it is pure \( \text{C}_{22}\text{H}_{52} \).

\[
\text{C}_{22}\text{H}_{52} + 38 \text{O}_2 \rightarrow 22\text{CO}_2 + 26\text{H}_2\text{O}
\]

b. Paraffin wax, as commonly used, is actually a complex mixture of hydrocarbons. The compounds in the mixture typically have carbons ranging in number from 20-40. Which hydrocarbon, one with 20 carbons or one with 40 carbons, would you expect to have a higher melting point? Why?

\( 40 \text{ carbon hydrocarbon would have greater m.p.} \)  
\( \text{The m.p. tends to increase with increasing size of the molecule.} \)

\( \text{The Wikipedia article on paraffin wax states that in industrial applications, paraffin wax is often modified to produce different properties "by adding branching to the existing carbon backbone chain".} \) What is meant by carbon backbone? What is branching?

\( \text{All of the carbons are connected together as a long chain in "backbone".} \)
\( \text{Instead of a linear arrangement, branching is when carbons are bonded as short branches off of the main long chain.} \)

(8) VI. One of the compounds being put on roadways to melt ice during the recent ice storm is magnesium chloride.

a. Write the formula for magnesium chloride.

\( \text{MgCl}_2 \)

b. Would you expect magnesium chloride to be a solid or a liquid? Why?

\( \text{solid, because it is ionic} \)

\( \text{solid, because it is ionic} \)

\( \text{solid, because it is ionic} \)

\( \text{soluble in water, most chlorides are soluble} \)  
\( \text{(Mg}^{2+} \text{ is not one of the insoluble exceptions)} \)