FORM A

 Name

CHEM 1364
Test #2
Fall 2008 (Buckley)

Show your work on all numerical problems to receive credit.

1. (10 points) Name each of the following compounds.

   Name
   a. KNO₃ POTASSIUM NITRATE
   b. BaF₂ BARIUM FLUORIDE
   c. Fe₂O₃ IRON (III) OXIDE
   d. PF₃ PHOSPHORUS TRIFLUORIDE
   e. (NH₄)₃PO₄ AMMONIUM PHOSPHATE
   f. Cu(OH)₂ COPPER (II) HYDROXIDE
   g. Cr₂(SO₄)₃ CHROMIUM (III) SULFATE
   h. SrCO₃ STRONTIUM CARBONATE
   i. IF₅ IODINE PENTAFLUORIDE
   j. HCl HYDROGEN CHLORIDE

2. (5 points) Write the formula for each of the following named compounds.

   Formula
   a. barium chlorate \( \text{Ba(ClO}_3\text{)}_2 \)
   b. magnesium nitrate \( \text{Mg(NO}_3\text{)}_2 \)
   c. indium (III) sulfide \( \text{In}_2\text{S}_3 \)
   d. sulfur tetrafluoride \( \text{SF}_4 \)
   e. cesium hydroxide \( \text{CsOH} \)
3. (10 points) Balance each of the following chemical equations.

\[ 2 \text{Be (s)} + 3 \text{O}_2 \text{(g)} \rightarrow 2 \text{BeO (s)} \]

\[ 2 \text{CH}_3\text{NH}_2 \text{(g)} + \frac{3}{2} \text{O}_2 \text{(g)} \rightarrow 3 \text{H}_2\text{O (g)} + 2 \text{CO}_2 \text{(g)} + \text{N}_2 \text{(g)} \]

\[ \text{BaCl}_2 \text{ (aq)} + 2 \text{AgNO}_3 \text{ (aq)} \rightarrow \text{Ba(NO}_3)_2 \text{ (aq)} + 2 \text{AgCl (s)} \]

\[ 2 \text{Na}_3\text{PO}_4 \text{ (aq)} + 7 \text{BaCl}_2 \text{ (aq)} \rightarrow 6 \text{NaCl (aq)} + \text{Ba}_3\text{(PO}_4)_2 \text{ (s)} \]

\[ \text{S}_8 \text{ (s)} + 4 \text{Cl}_2 \text{ (g)} \rightarrow 8 \text{S}_2\text{Cl}_2 \text{ (l)} \]

4. (10 points) Make each of the following conversions. Show your work.

a. How many grams of CH\textsubscript{2}I\textsubscript{2} are contained in 3.45 \times 10^2 \text{ mol of CH}_2\text{I}_2?

\[ 2 \text{g CH}_2\text{I}_2 = \frac{3.45 \times 10^2 \text{ mol CH}_2\text{I}_2}{1} \times \frac{268}{1} \text{ g CH}_2\text{I}_2 = 9.25 \text{ g CH}_2\text{I}_2 \]

b. How many F atoms are contained in 75.0 g of CHF\textsubscript{3}?

\[ 24 \text{ F atoms} = \frac{75.0 \text{ g CHF}_3}{1} \times \frac{3 \times 6.02 \times 10^{23} \text{ F atoms}}{70 \text{ g CHF}_3} = 1.94 \times 10^4 \text{ F atoms} \]

c. How many molecules of CH\textsubscript{3}CH\textsubscript{3} are required to obtain 750.0 g of CH\textsubscript{3}CH\textsubscript{2}?

\[ 750.0 \text{ g CH}_2\text{CH}_3 = \frac{750.0 \text{ g CH}_2\text{CH}_3}{1} \times \frac{6.02 \times 10^{23} \text{ molecules CH}_2\text{CH}_3}{30 \text{ g CH}_2\text{CH}_3} = 1.51 \times 10^3 \text{ molecules} \]

d. How many grams of bromine are contained in 350.0 g of CaBr\textsubscript{2}?

\[ 350.0 \text{ g CaBr}_2 = \frac{350.0 \text{ g CaBr}_2}{1} \times \frac{2 \times 79.9 \text{ g Br}}{135.5 \text{ g CaBr}_2} = 279.7 \text{ g Br} \]

e. Which contains more grams of S: 150.0 g of H\textsubscript{2}S or 200.0 g of H\textsubscript{2}SO\textsubscript{4}?

\[ \text{H}_2\text{S:} \quad \frac{150.0 \text{ g H}_2\text{S}}{1} \times \frac{32}{1} \text{ g S} = 481.2 \text{ g S} \]

\[ \text{H}_2\text{SO}_4: \quad \frac{200.0 \text{ g H}_2\text{SO}_4}{1} \times \frac{32}{1} \text{ g S} = 640.0 \text{ g S} \]
5. (5 points) A compound is found to have a composition of 54.6% C, 9.1% H, and 36.4% O. The molar mass of the compound is 352. Find both the empirical formula and molecular formula for the compound.

\[
\begin{align*}
\text{C} & \quad \frac{54.6}{12} = 4.55/2.75 = 2 \\
\text{H} & \quad 9.1/1 = 9.1/2.75 = 3.3 \\
\text{O} & \quad 36.4/16 = 2.275/2.75 = 1
\end{align*}
\]

\[
\text{C}_2\text{H}_4\text{O} \quad \text{Empirical Formula}
\]

\[
\text{FW} = 44
\]

\[
\frac{352}{44} = 8
\]

\[
\text{C}_6\text{H}_{12}\text{O}_8 \quad \text{Molecular Formula}
\]

6. (10 points) Sodium nitrate decomposes according to the reaction:

\[
2 \text{NaNO}_3 (s) \rightarrow 2 \text{NaNO}_2 (g) + \text{O}_2 (g)
\]

\[
2 \times 85.0 \quad 2 \times 69.0 \quad 1 \times 32.0
\]

15.0-g of sodium nitrate are decomposed. Answer the following questions in relation to this reaction.

a. How many grams of NaNO₂ could be formed in the reaction?

\[
\frac{15.0 \text{ g} \text{NaNO}_3}{1} \times \frac{2 \times 69.0 \text{ g} \text{NaNO}_2}{2 \times 85.0 \text{ g} \text{NaNO}_3} = 12.2 \text{ g} \text{NaNO}_2
\]

b. How many moles of oxygen could be formed in the reaction of the 15.0-g of sodium nitrate?

\[
\frac{15.0 \text{ g} \text{NaNO}_3}{1} \times \frac{1 \text{ mol} \text{O}_2}{2 \text{ mol} \text{NaNO}_3} = 8.82 \times 10^{-2} \text{ mol O}_2
\]

c. Suppose the reaction is carried out with 15.0-g of sodium nitrate and 9.54-g of NaNO₂ are formed, what is the percent yield of NaNO₂?

\[
\frac{9.54 \text{ g}}{12.2 \text{ g}} \times 100\% = 78.2\%
\]
7. (10 points) The Haber-Bosch reaction is an important industrial process.

\[ 2 \text{NO}_2 + 8 \text{H}_2 \rightarrow 3 \text{H}_2 \text{(g)} + 2 \text{N}_2 + 2 \text{NH}_3 \text{(g)} \]

\[ 3 \times 2 \times 69.75 \text{ g} \text{H}_2 \text{ g} \quad 1 \times 2 \times 71 \text{ g} \text{N}_2 \text{ g} \quad 2 \times 17 \text{ g} \text{NH}_3 \text{ g} \]

a. 2.50-g of H\(_2\) is allowed to react with 8.50-g of N\(_2\). Which of these is the limiting reactant? **SHOW YOUR WORK.**

\[
\text{Ratio:} \quad \frac{2.50}{3 \times 2} = 0.833 \\
\text{N}_2 \text{ limit since the smaller ratio.}
\]

b. How many grams of NH\(_3\) could be produced from the reactants in part a?

\[
\text{g NH}_3 = \frac{8.50 \text{ g N}_2 \times 2 \times 17 \text{ g NH}_3}{1 \times 2 \times 27 \text{ g N}_2} = 10.7 \text{ g NH}_3
\]

c. How many grams of the excess reactant would remain after the reaction of part a? **H\(_2\) to EXCESS** – FInd out how MUCH reacted

\[
\text{g H}_2 = \frac{8.50 \text{ g N}_2 \times 3 \times 2 \text{ g H}_2}{1 \times 2 \times 27 \text{ g N}_2} = 1.82 \text{ g H}_2 \text{ reacted} \quad \text{EXCESS is} \ 7.30 - 1.82 \ \text{(0.68 g EXCESS)}
\]

d. If after the reaction of part a only 9.25-g of NH\(_3\) are formed, what is the percent yield?

\[
\frac{9.25}{10.78} \times 100\% = 86.3\%
\]
Periodic Table of The Elements

In the periodic table the elements are arranged in order of increasing atomic number. Vertical columns headed by Roman numerals are called Groups. A horizontal sequence of elements is called a Period. The most active elements are at the top right and bottom left of the table. The staggered line (Groups II A–VI A) roughly separates metallic from non-metallic elements.

Groups—Elements within a group have similar properties and contain the same number of electrons in their outside energy shell.

1. The first group (IA) includes hydrogen and the alkali metals.
2. The last (VIII A) contains the inert gases.
3. Group VII A includes the halogens.
4. The elements intervening between groups I A and II A are called transition elements.
5. Short vertical columns without Roman numeral headings are called sub-groups.

Periods—in a given period the properties of the elements gradually pass from a strong metallic to a strong non-metallic nature, with the last number of a period being an inert gas.

Key

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<th>Information</th>
<th>Color</th>
<th>Name of Element</th>
<th>Atomic Weight</th>
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