Department of Chemistry  
University of Missouri-St. Louis

Name ________________________  
Chem 5  

September 17, 1999  
Exam I

1. (15 pts)
   a. Express the width of a human hair, 0.000008 m in scientific notation
      \[8 \times 10^{-6} \text{ m}\]
   
b. How many significant figures are there in the following number? 11.005
      5
   
c. Multiply the following and express the product with the appropriate number of
      significant figures. Be sure to round off if necessary.
      \[25.0 \times 10.5 = 263\]

2. (16 pts) The following nutrition information is listed on a box of crackers:
   
   Serving size: 0.5 oz (6 crackers)
   Fat: 4 g per serving, sodium: 0.14 g per serving
   
   a. If the box has a net weight (contents only) of 8.0 oz, about how many crackers are
      in the box?
      \[16 \text{ crackers/0.5 oz} \times 8 \text{ oz} = 16 \text{ crackers}\]
   
   b. If you ate 10 crackers, how many grams of fat are you consuming?
      \[10 \text{ crackers} \times 4 \text{ g fat/ cracker} = 40 \text{ g fat}\]
   
   c. How many grams of sodium are used to prepare 50 boxes of crackers?
      \[96 \text{ crackers/box} \times 50 \text{ boxes} \times 0.14 \text{ g sodium/ cracker} = 68 \text{ g sodium}\]
d. Do you think that the element sodium is directly used to make crackers? Why?

No, pointy NaCl is used.

3a. (20pts) Using the periodic table given as the last page on this examination, complete the following table for neutral atoms.

<table>
<thead>
<tr>
<th>Name of Element</th>
<th>Symbol</th>
<th>Atomic Number</th>
<th>Mass Number</th>
<th>Number of Protons</th>
<th>Number of Neutrons</th>
<th>Number of Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>C</td>
<td>6</td>
<td>12</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Oxygen</td>
<td>O</td>
<td>8</td>
<td>16</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Sodium</td>
<td>Na</td>
<td>11</td>
<td>23</td>
<td>11</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Bromine</td>
<td>Br</td>
<td>35</td>
<td>79</td>
<td>35</td>
<td>44</td>
<td>35</td>
</tr>
<tr>
<td>Calcium</td>
<td>Ca</td>
<td>20</td>
<td>40</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

b. How many valence electrons do each of the following elements have?
1. Na   1
2. N    5
3. C    4
4. F    7

4. (8pts) If the atomic weight of an element is the sum of the number of neutrons and protons in the nucleus, explain why the atomic weight of B is listed as 10.8.

B is a mixture of isotopes.

5. (12pts) Balance the following nuclear reactions:

a. \( \frac{11}{6} \text{C} \rightarrow \ ^0_1 \nu + ? \quad \frac{5}{5} ? \quad ? = \ _{5}^{11} \text{B} \)

used in positron emission tomography

b. Determine what X is when Tc-99 emits a gamma ray

\( \frac{99}{43} \text{Tc} \rightarrow X + \gamma \quad X = \frac{58}{43} \text{Tc} \)
c. When Al-27 is bombarded by an alpha particle, it forms Si-30. What is the other particle produced?
\[
\frac{27}{13} \text{Al} + \frac{4}{2} \text{He} \rightarrow \frac{30}{14} \text{Si} + \frac{\text{?}}{\text{?}} + \frac{\text{?}}{\text{?}}
\]

6. (8pts) If the half life of a radioactive element is 5 years, how much of an original 4.0 g sample would remain after 20 yrs?

7. (15 pts) Draw electron dot diagrams for each of the following compounds and describe their shape:

a. \( \text{H}_2\text{S} \)

\[
\begin{array}{c}
\text{H} \quad \text{S} \\
\text{H} \quad \text{S} \\
\end{array}
\]

b. \( \text{CCl}_4 \)

\[
\begin{array}{c}
\text{C} \quad \text{Cl} \\
\text{C} \quad \text{Cl} \\
\end{array}
\]

c. \( \text{PH}_3 \)

\[
\begin{array}{c}
\text{P} \quad \text{H} \\
\text{H} \quad \text{H} \\
\text{H} \quad \text{H} \\
\end{array}
\]

8. (6 pts) Using the octet rule and the periodic table as a guide, what would be the formula expected for the ionic substances: calcium (Ca) chloride (Cl), lithium (Li) fluoride (F), and potassium (K) oxide (O)?

- Calcium chloride: \( \text{CaCl}_2 \)
- Lithium fluoride: \( \text{LiF} \)
- Potassium oxide: \( \text{K}_2\text{O} \)
Periodic Table of the Elements