CHAPTER 7 REVIEW

Chemical Formulas and Chemical Compounds

SECTION 1

SHORT ANSWER Answer the following questions in the space provided.

1. In a Stock system name such as iron(III) sulfate, the Roman numeral tells us
   (a) how many atoms of Fe are in one formula unit.
   (b) how many sulfate ions can be attached to the iron atom.
   (c) the charge on each Fe ion.
   (d) the total positive charge of the formula unit.

2. Changing a subscript in a correctly written chemical formula
   (a) changes the number of moles represented by the formula.
   (b) changes the charges on the other ions in the compound.
   (c) changes the formula so that it no longer represents the compound it previously represented.
   (d) has no effect on the formula.

3. The explosive TNT has the molecular formula C7H5(NO2)3.
   a. How many elements make up this compound?
   b. How many oxygen atoms are present in one molecule of C7H5(NO2)3?
   c. How many atoms in total are present in one molecule of C7H5(NO2)3?
   d. How many atoms are present in a sample of 2.0 × 10^23 molecules of C7H5(NO2)3?

4. How many atoms are present in each of these formula units?
   a. Ca(HCO3)2
   b. C12H22O11
   c. Fe(ClO2)3
   d. Fe(ClO3)2

5. a. What is the formula for the compound dinitrogen pentoxide?
   b. What is the Stock system name for the compound FeO?
   c. What is the formula for sulfurous acid?
   d. What is the name for the acid H3PO4?
6. Some binary compounds are ionic, others are covalent. The type of bond favored partially depends on the position of the elements in the periodic table. Label each of these claims as True or False; if False, specify the nature of the error.

a. Covalently bonded binary molecular compounds are typically composed of nonmetals.  
   ____________________________
   ____________________________
   ____________________________

b. Binary ionic compounds are composed of metals and nonmetals, typically from opposite sides of the periodic table.  
   ____________________________
   ____________________________

7. Refer to the text for examples of names and formulas for polyatomic ions and acids.

a. Derive a generalization for determining whether an acid name will end in the suffix -ic or -ous.  
   ____________________________
   ____________________________
   ____________________________

b. Derive a generalization for determining whether an acid name will begin with the prefix hydro- or not.  
   ____________________________
   ____________________________
   ____________________________

8. Fill in the blanks in the table below.

<table>
<thead>
<tr>
<th>Compound name</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum sulfide</td>
<td></td>
</tr>
<tr>
<td>Cesium carbonate</td>
<td>PbCl₂</td>
</tr>
<tr>
<td></td>
<td>(NH₄)₃PO₄</td>
</tr>
<tr>
<td>Hydroiodic acid</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 7 REVIEW

Chemical Formulas and Chemical Compounds

SECTION 2

SHORT ANSWER Answer the following questions in the space provided.

1. Assign the oxidation number to the specified element in each of the following examples:
   a. S in $\text{H}_2\text{SO}_3$
   b. S in $\text{MgSO}_4$
   c. S in $\text{K}_2\text{S}$
   d. Cu in $\text{Cu}_2\text{S}$
   e. Cr in $\text{Na}_2\text{CrO}_4$
   f. N in $\text{HNO}_3$
   g. C in $(\text{HCO}_3)^-$
   h. N in $(\text{NH}_4)^+$

2. a. What is the formula for the compound sulfur(II) chloride?
   b. What is the Stock system name for NO$_2$?

3. a. Use electronegativity values to determine the one element that always has a negative oxidation number when it appears in any binary compound.
   b. What is the oxidation number and formula for the element described in part a when it exists as a pure element?

4. Tin has possible oxidation numbers of +2 and +4 and forms two known oxides. One of them has the formula SnO$_2$.
   a. Give the Stock system name for SnO$_2$.
   b. Give the formula for the other oxide of tin.

5. Scientists think that two separate reactions contribute to the depletion of the ozone, O$_3$, layer. The first reaction involves oxides of nitrogen. The second involves free chlorine atoms. The equations that represent the reactions follow. When a compound is not stated as a formula, write the correct formula in the blank beside its name.
   a. ______ (nitrogen monoxide) + O$_3$ → ______ (nitrogen dioxide) + O$_2$
SECTION 2 continued

b. \(\text{Cl} + \text{O}_3 \rightarrow \text{________} \) (chlorine monoxide) + \(\text{O}_2\)

6. Consider the covalent compound dinitrogen trioxide when answering the following:

__________________________ a. What is the formula for dinitrogen trioxide?

__________________________ b. What is the oxidation number assigned to each nitrogen atom in this compound? Explain your answer.

__________________________ c. Give the Stock name for dinitrogen trioxide.

7. The oxidation numbers assigned to the atoms in some organic compounds have unexpected values. Assign oxidation numbers to each atom in the following compounds: (Note: Some oxidation numbers may not be whole numbers.)

a. \(\text{CO}_2\)

__________________________

__________________________ b. \(\text{CH}_4\) (methane)

__________________________

c. \(\text{C}_6\text{H}_{12}\text{O}_6\) (glucose)

__________________________

d. \(\text{C}_3\text{H}_8\) (propane gas)

__________________________

8. Assign oxidation numbers to each element in the compounds found in the following situations:

a. Rust, \(\text{Fe}_2\text{O}_3\), forms on an old nail.

__________________________

b. Nitrogen dioxide, \(\text{NO}_2\), pollutes the air as a component of smog.

__________________________

c. Chromium dioxide, \(\text{CrO}_2\), is used to make recording tapes.

__________________________
CHAPTER 7 REVIEW

Chemical Formulas and Chemical Compounds

SECTION 3

SHORT ANSWER Answer the following questions in the space provided.

1. Label each of the following statements as True or False:

   a. If the formula mass of one molecule is \( x \) u, the molar mass is \( x \) g/mol.

   b. Samples of equal numbers of moles of two different chemicals must have equal masses as well.

   c. Samples of equal numbers of moles of two different molecular compounds must have equal numbers of molecules as well.

2. How many moles of each element are present in a 10.0 mol sample of \( \text{Ca(NO}_3\text{)}_2 \)?

   

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

3. Consider a sample of 10.0 g of the gaseous hydrocarbon \( \text{C}_3\text{H}_4 \) to answer the following questions.

   a. How many moles are present in this sample?

   b. How many molecules are present in the \( \text{C}_3\text{H}_4 \) sample?

   c. How many carbon atoms are present in this sample?
SECTION 3 continued

d. What is the percentage composition of hydrogen in the sample?

4. One source of aluminum metal is alumina, Al₂O₃.

a. Determine the percentage composition of Al in alumina.

b. How many pounds of aluminum can be extracted from 2.0 tons of alumina?

5. Compound A has a molar mass of 20 g/mol, and compound B has a molar mass of 30 g/mol.

a. What is the mass of 1.0 mol of compound A, in grams?

b. How many moles are present in 5.0 g of compound B?

c. How many moles of compound B are needed to have the same mass as 6.0 mol of compound A?
CHAPTER 7 REVIEW

Chemical Formulas and Chemical Compounds

SECTION 4

SHORT ANSWER Answer the following questions in the space provided.

1. Write empirical formulas to match the following molecular formulas:
   ____________  a. C₂H₆O₄
   ____________  b. N₂O₅
   ____________  c. Hg₂C₁₂
   ____________  d. C₆H₁₂

2. ____________ A certain hydrocarbon has an empirical formula of CH₂ and a molar mass of 56.12 g/mol. What is its molecular formula?

3. A certain ionic compound is found to contain 0.012 mol of sodium, 0.012 mol of sulfur, and 0.018 mol of oxygen.
   ____________  a. What is its empirical formula?
   ____________  b. Is this compound a sulfate, sulfite, or neither?

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

4. Water of hydration was discussed in Sample Problem K in Section 4 of the text. Strong heating will drive off the water as a vapor in hydrated copper(II) sulfate. Use the data table below to answer the following:

| Mass of the empty crucible | 4.00 g |
| Mass of the crucible plus hydrate sample | 4.50 g |
| Mass of the system after heating | 4.32 g |
| Mass of the system after a second heating | 4.32 g |

   ____________  a. Determine the mass percentage of water in the original sample.
SECTION 4 continued

b. The compound has the formula CuSO₄ • xH₂O. Determine the value of x.

c. What might be the purpose of the second heating?

5. Gas X is found to be 24.0% carbon and 76.0% fluorine by mass.

a. Determine the empirical formula of gas X.

b. Given that the molar mass of gas X is 200.04 g/mol, determine its molecular formula.

6. A compound is found to contain 43.2% copper, 24.1% chlorine, and 32.7% oxygen by mass.

a. Determine its empirical formula.

b. What is the correct Stock system name of the compound in part a?