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CHAPTER 7 REVIEW

Chemical Formulas and Chemical Compounds

SECTION 7-1

SHORT ANSWER **Answer the following questions in the space provided.**

1. c In a Stock 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. c The result of changing a subscript in a correctly written chemical formula is to ____.

(a) change the number of moles represented by the formula
(b) change the charges on the other ions in the compound
(c) change the formula so that it no longer represents the compound it previously represented
(d) have no effect on the formula

3. The explosive TNT has the molecular formula $C_7H_5(NO_2)_3$.

4 elements **a.** How many elements make up this compound?

6 oxygen atoms **b.** How many oxygen atoms are present in one molecule of $C_7H_5(NO_2)_3$?

21 atoms **c.** How many atoms in total are present in one molecule of $C_7H_5(NO_2)_3$?

4.2×10^{24} atoms **d.** How many atoms are present in a sample of 2×10^{23} molecules of $C_7H_5(NO_2)_3$?

4. How many atoms are present in each of these formula units?

11 atoms **a.** $Ca(HCO_3)_2$

45 atoms **b.** $C_{12}H_{22}O_{11}$

10 atoms **c.** $Fe(ClO_2)_3$

9 atoms **d.** $Fe(ClO_3)_2$

5. N_2O_5 **a.** What is the formula for the compound dinitrogen pentoxide?

carbon(IV) sulfide **b.** What is the Stock name for the covalent compound CS_2?

H_2SO_3 **c.** What is the formula for sulfurous acid?

phosphoric acid **d.** What is the name for the acid H_3PO_4?

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SECTION 7-1 continued

6. Some binary compounds are ionic, others are covalent. The types of bonding partially depend 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 typically form from nonmetals.

True

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

True

c. Binary compounds involving metalloids are always ionic.

False; metalloids form both ionic and covalent compounds.

7. Refer to Table 7-2 on page 210 of the text and Table 7-5 on page 214 of the text for examples of names and formulas for polyatomic ions and acids.

a. Derive a generalization for when an acid name will end in the suffix *-ic* or *-ous*.

In general, if the anion name ends in *-ate*, the corresponding acid name will end in a suffix of *-ic*. In general, if the anion name ends in *-ite*, the corresponding acid name will end in a suffix of *-ous*.

b. Derive a generalization for when an acid name will begin with the prefix *hydro-* and when it will not.

In general, if the anion name ends in *-ide*, the corresponding acid name will end in a suffix of *-ic* and begin with a prefix of *hydro-*. The prefix *hydro-* is never used for anions ending in *-ate* or *-ite*.

8. Fill in the blanks in the table below.

Compound name	Formula
Aluminum sulfide	Al_2S_3
Aluminum sulfite	$Al_2(SO_3)_3$
Lead(II) chloride	$PbCl_2$
Ammonium phosphate	$(NH_4)_3PO_4$
Hydroiodic acid	HI

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CHAPTER 7 REVIEW

Chemical Formulas and Chemical Compounds

SECTION 7-2

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:

+4 **a.** S in H_2SO_3

+6 **b.** S in $MgSO_4$

−2 **c.** S in K_2S

+1 **d.** Cu in Cu_2S

+6 **e.** Cr in Na_2CrO_4

+1 **f.** H in $(HCO_3)^-$

+4 **g.** C in $(HCO_3)^-$

−3 **h.** N in $(NH_4)^+$

2. SCl_2 **a.** What is the formula for the compound sulfur(II) chloride?

nitrogen(IV) oxide **b.** What is the Stock name for NO_2?

3. fluorine **a.** Use electronegativity values to determine the one element that always has a negative oxidation number when it appears in any binary compound.

0; F_2 **b.** What is the oxidation number and formula for the element described in part a when it exists as an uncombined element?

4. Tin has possible oxidation numbers of +2 and +4 and forms two known oxides. One of them has the formula SnO_2.

tin(IV) oxide **a.** Give the Stock name for SnO_2.

SnO **b.** Give the empirical formula for the other oxide of tin.

5. Scientists believe that two separate reactions contribute to the depletion of the ozone layer, O_3. The first reaction involves oxides of nitrogen. The second involves free chlorine atoms. Both reactions follow. When a compound is not stated as a formula, write the correct formula in the blank beside its name.

Oxides of nitrogen:

a. NO (nitrogen monoxide) + $O_3 \rightarrow$ NO_2 (nitrogen dioxide) + O_2

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SECTION 7-2 continued

Free chlorine:

b. $Cl + O_3 \rightarrow$ ClO (chlorine monoxide) + O_2

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

N_2O_3 **a.** What is the formula for dinitrogen trioxide?

+3 **b.** What is the oxidation number assigned to each N atom in this compound? Explain your answer.

The three oxygen atoms have oxidation states of −6 total, and because the algebraic sum of the oxidation states in a neutral compound must be zero, the two nitrogen atoms must have oxidation states of +6 total, therefore +3 each.

nitrogen(III) oxide **c.** Give the Stock name for dinitrogen trioxide.

7. The oxidation numbers assigned to the atoms in some organic compounds sometimes give unexpected results. Assign oxidation numbers to each atom in the following compounds:

a. CO_2

Carbon is +4, and each oxygen is −2.

b. CH_4 (methane)

Carbon is −4, and each hydrogen is +1.

c. $C_6H_{12}O_6$ (glucose)

Each carbon is 0, each hydrogen is +1, and each oxygen is −2.

d. C_3H_8 (propane gas)

Each carbon is −8/3 and each hydrogen is +1.

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

a. Rust, Fe_2O_3, forms on an old nail.

Each iron is +3 and each oxygen is −2.

b. Nitrogen dioxide, NO_2, pollutes the air as smog.

Nitrogen is +4 and each oxygen is −2.

c. Chromium dioxide, CrO_2, is used to make recording tapes.

Chromium is +4 and each oxygen is −2.

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CHAPTER 7 REVIEW

Chemical Formulas and Chemical Compounds

SECTION 7-3

SHORT ANSWER **Answer the following questions in the space provided.**

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

True — **a.** If the formula mass of one molecule is *x* amu, the molar mass is *x* g/mol.

False — **b.** Samples of two different chemicals with equal numbers of moles must have equal masses as well.

True — **c.** Samples of two different chemicals with equal numbers of moles must have equal numbers of molecules as well.

2. How many moles of each element are present in a 10.0 mol sample of $Ca(NO_3)_2$?

10 mol of calcium, 20 mol of nitrogen, 60 mol of oxygen

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 C_3H_4 to answer the following questions.

0.250 mol — **a.** How many moles are present in this sample?

1.51×10^{23} molecules — **b.** How many molecules are present in the C_3H_4 sample?

4.53×10^{23} carbon atoms — **c.** How many carbon atoms are present in this sample?

Name _____ Date _____ Class _____

SECTION 7-3 continued

10.0% **d.** What is the percentage composition of hydrogen in the sample?

4. The chief source of aluminum metal is the ore alumina, Al_2O_3.

52.9% **a.** Determine the percentage composition of Al in this ore.

2100 lb **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.

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

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

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

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CHAPTER 7 REVIEW

Chemical Formulas and Chemical Compounds

SECTION 7-4

SHORT ANSWER **Answer the following questions in the space provided.**

1. Write empirical formulas to match the following molecular formulas:

CH$_3$O$_2$ **a.** $C_2H_6O_4$

N$_2$O$_5$ **b.** N_2O_5

HgCl **c.** Hg_2Cl_2

CH$_2$ **d.** C_6H_{12}

2. C$_4$H$_8$ A certain hydrocarbon has an empirical formula of CH_2 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.

Na$_2$S$_2$O$_3$ **a.** What is its empirical formula?

neither **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 7-11 on pages 227–228 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

36% **a.** Determine the percent water of hydration in the original sample.

Name _____ Date _____ Class _____

SECTION 7-4 continued

5 **b.** The compound has the formula $CuSO_4 \cdot xH_2O$. Determine value of *x*.

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

The second heating is to ensure that all the water in the sample has been driven off.

If the mass is less after the second heating, more water was still present.

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

CF_2 **a.** Determine the empirical formula of gas X.

C_4F_8 **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.

$CuClO_3$ **a.** Determine its empirical formula.

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

copper(I) chlorite

Name _____ Date _____ Class _____

CHAPTER 7 REVIEW

Chemical Formulas and Chemical Compounds

MIXED REVIEW

SHORT ANSWER **Answer the following questions in the space provided.**

1. Write formulas for the following compounds:

$CuCO_3$ **a.** copper(II) carbonate

Na_2SO_3 **b.** sodium sulfite

$(NH_4)_3PO_4$ **c.** ammonium phosphate

SnS_2 **d.** tin(IV) sulfide

HNO_2 **e.** nitrous acid

2. Write the Stock names for the following compounds:

magnesium perchlorate **a.** $Mg(ClO_4)_2$

iron(II) nitrate **b.** $Fe(NO_3)_2$

iron(III) nitrite **c.** $Fe(NO_2)_3$

cobalt(II) oxide **d.** CoO

nitrogen(V) oxide **e.** dinitrogen pentoxide

3. 13 atoms **a.** How many atoms are represented by the formula $Ca(HSO_4)_2$?

4.0 mol **b.** How many moles of oxygen atoms are in a 0.50 mol sample of this compound?

+6 **c.** Assign the oxidation number to sulfur in the HSO_4^- anion.

4. Assign the oxidation number to the element specified in each of the following:

+1 **a.** hydrogen in H_2O_2

−1 **b.** hydrogen in MgH_2

0 **c.** sulfur in S_8

+4 **d.** carbon in $(CO_3)^{2-}$

+6 **e.** chromium in $Na_2Cr_2O_7$

+4 **f.** nitrogen in NO_2

Name _____ Date _____ Class _____

MIXED REVIEW continued

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

5. c, b, d, a

Following are samples of four different compounds. Arrange them in order of increasing mass, from smallest to largest.

a. 25 g of oxygen gas
b. 1.00 mol of H_2O
c. 3×10^{23} molecules of C_2H_6
d. 2×10^{23} molecules of $C_2H_6O_2$

6. NaOH

a. What is the formula for sodium hydroxide?

40.00 g/mol

b. What is the formula mass of sodium hydroxide?

10. g

c. What is the mass in grams of 0.25 mol of sodium hydroxide?

7. 80% C, 20% H

What is the percentage composition of ethane gas, C_2H_6, to the nearest whole number?

8. $C_5H_{10}O_5$

Ribose is an important sugar (part of RNA),with a molar mass of 150.15 g/mol. If its empirical formula is CH_2O, what is its molecular formula?

Name _____ Date _____ Class _____

MIXED REVIEW continued

9. Butane gas, C_4H_{10}, is often used as a fuel.

174 g **a.** What is the mass in grams of 3.00 mol of butane?

1.81×10^{24} molecules **b.** How many molecules are present in that 3.00 mol sample?

C_2H_5 **c.** What is the empirical formula of the gas?

10. $C_{10}H_8$ Naphthalene is a soft covalent solid that is often used in mothballs. Its molar mass is 128.18 g/mol and it contains 93.75% carbon and 6.25% hydrogen. Determine the molecular formula of napthalene from this data.

11. Nicotine has the formula $C_xH_yN_z$. To determine its composition, a sample is burned in excess oxygen, producing the following results:

1.0 mol of CO_2
0.70 mol of H_2O
0.20 mol of NO_2

Assume that all the atoms in nicotine are present as products.

1.0 mol **a.** Determine the number of moles of carbon present in the products of this combustion.

Name _____ Date _____ Class _____

MIXED REVIEW continued

1.40 mol **b.** Determine the number of moles of hydrogen present in the combustion products.

0.20 mol **c.** Determine the number of moles of nitrogen present in the combustion products.

C_5H_7N **d.** Determine the empirical formula of nicotine based on your calculations.

162 g/mol **e.** In a separate experiment, the molar mass of nicotine is found to be somewhere between 150 and 180 g/mol. Calculate the molar mass of nicotine to the nearest gram.

12. When $MgCO_3(s)$ is strongly heated, it produces solid MgO as gaseous CO_2 is driven off.

52.2% **a.** What is the percentage loss in mass as this reaction occurs?

Mg is +2, C is +4, and O is −2 **b.** Assign the oxidation number to each atom in $MgCO_3$?

No **c.** Does the oxidation number of carbon change upon forming CO_2?