CHAPTER 10 STUDY GUIDE

The Mole

Section 10.1 Measuring Matter

In your textbook, read about counting particles.

In Column B, rank the quantities from Column A from smallest to largest.

Column A	Column B
0.5 mol	**1.** ______________
200	**2.** ______________
5	**3.** ______________
6,000,000,000	**4.** ______________
6.02×10^{23}	**5.** ______________
dozen	**6.** ______________
four moles	**7.** ______________
gross	**8.** ______________
pair	**9.** ______________
ream	**10.** ______________

In your textbook, read about converting moles to particles and particles to moles.

In the boxes provided, write the conversion factor that correctly completes each problem.

11. 1.20 mol Cu $\times$ $\boxed{}$ $= 7.22 \times 10^{23}$ Cu atoms

12. 9.25×10^{22} molecules CH_4 $\times$ $\boxed{}$ $= 1.54 \times 10^{-1}$ mol CH_4

13. 1.54×10^{26} atoms Xe $\times$ $\boxed{}$ $= 2.56 \times 10^{2}$ mol Xe

14. 3.01 mol F_2 $\times$ $\boxed{}$ $= 1.81 \times 10^{24}$ molecules F_2

Section 10.2 Mass and the Mole

In your textbook, read about the mass of a mole.

For each statement below, write *true* or *false*.

______________ **1.** The isotope hydrogen-1 is the standard used for the relative scale of atomic masses.

______________ **2.** The mass of an atom of helium-4 is 4 amu.

______________ **3.** The mass of a mole of hydrogen atoms is 1.00×10^{23} amu.

______________ **4.** The mass in grams of one mole of any pure substance is called its molar mass.

______________ **5.** The atomic masses recorded on the periodic table are weighted averages of the masses of all the naturally occurring isotopes of each element.

______________ **6.** The molar mass of any element is numerically equal to its atomic mass in grams.

______________ **7.** The molar mass unit is mol/g.

______________ **8.** If the measured mass of an element is numerically equal to its molar mass, then you have indirectly counted 6.02×10^{23} atoms of the element in the measurement.

In your textbook, read about using molar mass.

For each problem listed in Column A, select from Column B the letter of the conversion factor that is needed to solve the problem. You may need to use more than one conversion factor to solve the problem.

Column A	Column B
________ **9.** Find the number of moles in 23.0 g of zinc.	**a.** $\frac{65.4 \text{ g Zn}}{1 \text{ mol Zn}}$
________ **10.** Find the mass of 5.0×10^{20} zinc atoms.	**b.** $\frac{1 \text{ mol Zn}}{65.4 \text{ g Zn}}$
________ **11.** Find the mass of 2.00 moles of zinc.	**c.** $\frac{6.02 \times 10^{23} \text{ atoms Zn}}{1 \text{ mol Zn}}$
________ **12.** Find the number of atoms in 7.40 g of zinc.	**d.** $\frac{1 \text{ mol Zn}}{6.02 \times 10^{23} \text{ atoms Zn}}$
________ **13.** Find the number of moles that contain 4.25×10^{27} zinc atoms.	
________ **14.** Find the number of atoms in 3.25 moles of zinc.	

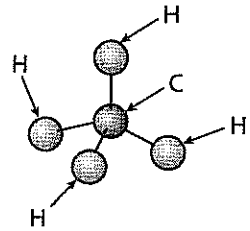
Name ______________________ Date ____________ Class ____________

Section 10.3 Moles of Compounds

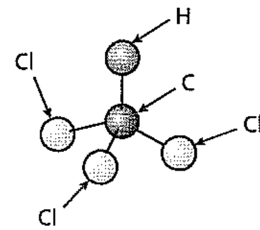
In your textbook, read about chemical formulas and the mole, the molar mass of compounds, and conversions among mass, moles, and number of particles.

Study the table and the diagram of a methane molecule and a trichloromethane molecule. Then answer the following questions.

Element	Molar Mass (g/mol)
Hydrogen	1.01
Carbon	12.01
Chlorine	35.45



CH_4



$CHCl_3$

1. What elements and how many atoms of each does a molecule of methane contain?

____

2. What elements and how many atoms of each does a molecule of trichloromethane contain?

____

3. How many moles of each element are in a mole of methane?

____

4. How many moles of each element are in a mole of trichloromethane?

____

5. Which of the following values represents the number of carbon atoms in one mole of methane? 6.02×10^{23}; 12.0×10^{23}; 18.1×10^{23}; 24.1×10^{23}

____

6. Which of the following values represents the number of chlorine atoms in one mole of trichloromethane? 6.02×10^{23}; 1.20×10^{24}; 1.81×10^{24}; 2.41×10^{23}

____

7. Which of the following values represents the molar mass of methane? 13.02 g/mol; 16.05 g/mol; 52.08 g/mol; 119.37 g/mol

____

8. Chloromethane (CH_3Cl) has a molar mass of 50.49 g/mol. Which of the following values represents the number of molecules of CH_3Cl in 101 grams of the substance? 3.01×10^{23}; 6.02×10^{23}; 1.20×10^{24}; 6.08×10^{26}

____

Section 10.4 Empirical and Molecular Formulas

In your textbook, read about percent composition.

Answer the following questions.

1. What is the percent composition of a compound?

____

____

2. Describe how to find the percent composition of a compound if you know the mass of a sample of a compound and the mass of each element in the sample.

____

____

In your textbook, read about empirical and molecular formulas.

Circle the letter of the choice that best answers the question.

3. Which information about a compound can you use to begin to determine the empirical and molecular formulas of the compound?
   a. mass of the compound
   b. number of elements in the compound
   c. percent composition of the compound
   d. volume of the compound

4. You have determined that a compound is composed of 0.300 moles of carbon and 0.600 moles of oxygen. What must you do to determine the mole ratio of the elements in the empirical formula of the compound?
   a. Multiply each mole value by 0.300 mol.
   b. Multiply each mole value by 0.600 mol.
   c. Divide each mole value by 0.300 mol.
   d. Divide each mole value by 0.600 mol.

5. The mole ratio of carbon to hydrogen to oxygen in a compound is 1 mol C : 2 mol H : 1 mol O. What is the empirical formula of the compound?
   a. CHO
   b. CH_2O
   c. C_2HO_2
   d. $C_2H_2O_2$

6. You calculate the mole ratio of oxygen to aluminum in a compound to be 1.5 mol O : 1 mol Al. What should you do to determine the mole ratio in the empirical formula of the compound?
   a. Multiply each mole value by 1.5.
   b. Multiply each mole value by 2.
   c. Divide each mole value by 1.5.
   d. Divide each mole value by 2.

7. What is the relationship between the molecular formula and the empirical formula of a compound?
   a. (molecular formula)(empirical formula) = n
   b. molecular formula = $\dfrac{\text{empirical formula}}{n}$
   c. molecular formula = (empirical formula)n
   d. molecular formula = $\dfrac{n}{\text{empirical formula}}$

Section 10.4 *continued*

8. You know that the empirical formula of a compound has a molar mass of 30.0 g/mol. The experimental molar mass of this compound is 60.0 g/mol. What must you do to determine the value of *n* in the relationship between the molecular formula and the empirical formula?

a. Add 30.0 g/mol and 60.0 g/mol.
b. Divide 30.0 g/mol by 60.0 g/mol.
c. Divide 60.0 g/mol by 30.0 g/mol.
d. Multiply 30.0 g/mol by 60.0 g/mol.

9. You know that the experimental molar mass of a compound is three times the molar mass of its empirical formula. If the compound's empirical formula is NO_2, what is its molecular formula?

a. NO_2
b. NO_6
c. N_3O_2
d. N_3O_6

Solve the following problem. Show your work in the space provided.

10. A sample of a compound contains 7.89 g potassium, 2.42 g carbon, and 9.69 g oxygen. Determine the empirical and molecular formulas of this compound, which has a molar mass of 198.22 g/mol.

Section 10.5 The Formula for a Hydrate

In your textbook, read about naming and analyzing hydrates.

Use each of the terms below just once to complete the passage.

anhydrous	crystal structure	desiccants	formula unit
hydrate	hydration	water molecules	water of hydration

A(n) **(1)** ____________ is a compound that has a specific number of water molecules bound to its atoms. Molecules of water that become part of a hydrate are called waters of **(2)** ____________. In the formula for a hydrate, the number of **(3)** ____________ associated with each **(4)** ____________ of the compound is written following a dot.

The substance remaining after a hydrate has been heated and its waters of hydration released is called **(5)** ____________. The ratio of the number of moles of **(6)** ____________ to one mole of the anhydrous compound indicates the coefficient of H_2O that follows the dot in the formula of the hydrate. Because the anhydrous form of the hydrate can absorb water into its **(7)** ____________, hydrates are used as **(8)** ____________, which are drying agents.

Complete the table of hydrates.

Chemical Formula	Name
$CdSO_4$	Cadmium sulfate, anhydrous
$CdSO_4 \cdot H_2O$	**9.**
10.	Cadmium sulfate tetrahydrate

Solve the following problem. Show your work in the space provided.

11. A 2.00-g sample of a hydrate of iron(II) chloride produces 1.27 g of anhydrous iron(II) chloride ($FeCl_2$) after heating. Determine the empirical formula and the name of the hydrate.