

Virden Collegiate Institute

30S

Chemistry

**Chemical Reactions:
The Mole
Student Study Guide**

The Mole

Section 11.1 Measuring Matter

Main Idea

Details

Scan Section 1, using the checklist below to preview your text.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about this subject.

Write three questions that come to mind from your reading.

1. _____
2. _____
3. _____

New Vocabulary

Use your text to define each term.

Mole

Avogadro's number

Counting Particles

Use with page 309.

List three common counting units and their values.

1. _____
2. _____
3. _____

Section 11.1 Measuring Matter (continued)

Main Idea

Use with page 310.

Details

Describe *why chemists needed to invent a new counting unit.*

List *three forms of substances that can be measured using moles.*

1.

2.

3.

**Converting Moles
to Particles and
Particles to
Moles**

Use with page 311.

Analyze *the usefulness of a conversion factor.*

Write *the equation for finding the number of representative particles in a number of moles.*

Explain *how you would find the number of moles that are represented by a certain number of representative particles.*

Section 11.1 Measuring Matter (continued)

Main Idea

Converting Number of Representative Particles to Moles

Use with Example
Problem 11-1, page 312.

Details

Summarize Fill in the blanks to help you take notes as you read
Example Problem 11-1.

Problem

Convert 4.50×10^{24} atoms of Zn to find the number of mol of Zn.

1. Analyze the Problem

Known: number of atoms = _____

1 mole Zn = _____ atoms of Zn

Unknown: mole Zn = _____

2. Solve for the Unknown

the number of atoms \times conversion factor = number of moles

_____ atoms Zn \times

= number of moles

= _____

3. Evaluate the Answer

The answer has _____ significant digits and is less than _____.

REAL-WORLD CONNECTION

Suppose you were given each of the following tasks. Analyze which task(s) the mole would be an effective unit for counting. Explain your answer.

A. Counting the atoms in a single grain of salt.

B. Counting the grains of salt in a very large mine.

C. Counting the grains of salt in the world.

The Mole

Section 11.2 Mass and the Mole

Main Idea

Details

Scan Section 2, using the checklist below as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about this subject.

List four things you expect to learn from the chapter.

1. _____

2. _____

3. _____

4. _____

New Vocabulary

Use your text to define this term.

Molar mass

Section 11.2 Mass and the Mole (continued)

Main Idea

The Mass of a Mole

Use with pages 313–314.

Using Molar Mass

Use with pages 314–317.

Details

Analyze molar mass by completing the following statements.

The mass of one mole of carbon-12 atoms is ____ grams.

The mass of one mole of hydrogen is ____ gram and is ____ the mass of one mole of ____.

The mass of one mole of helium-4 is ____ the mass of one mole of ____ and is equal to ____ grams.

One mole of manganese is equal to ____ atoms of Mn.

Organize the following equations by drawing a line from type of conversion to the correct equation.

mole to mass mass $\times \frac{1 \text{ mole}}{\text{number of grams}}$

mass to mole mass $\times \frac{1 \text{ mole}}{\text{number of grams}}$

moles $\times \frac{6.02 \times 10^{23}}{1 \text{ mole}}$

mass to atoms number of moles $\times \frac{\text{number of grams}}{1 \text{ mole}}$

atoms to mass atoms $\times \frac{1 \text{ mole}}{6.02 \times 10^{23}}$

moles $\times \frac{\text{number of grams}}{1 \text{ mole}}$

Section 11.2 Mass and the Mole (continued)

Main Idea

Using Molar Mass

Mass to Atoms Conversion

Use with Example
Problem 11-4, page 317.

Details

Solve Read Example Problem 11-4.

You Try It.

Problem

Determine how many atoms are in 10 g of pure copper (Cu).

1. Analyze the Problem

Known: mass = _____

Unknown: molar mass

number of atoms

2. Solve for the Unknown

Use the periodic table to find the atomic mass of copper and convert it to g/mol.

Complete the conversion equations.

mass Cu \times conversion factor = moles Cu

_____ \times _____ g Cu = _____ moles Cu

moles Cu \times conversion factor = atoms Cu

_____ mol Cu \times _____

atoms Cu

3. Evaluate the Answer

Restate the answer with correct significant digits.

The Mole

Section 11.3 Moles of Compounds

Main Idea

Chemical Formulas and the Mole

Use with page 320.

Mole Relationships from a Chemical Formula

Use with Example Problem 11-6, page 321.

Details

Skim Section 3 of your text. Write three questions that come to mind from your reading.

1. _____
2. _____
3. _____

Describe the relationship between the mole information of a substance and its chemical formula.

Summarize Fill in the blanks to help you take notes as you read Problem 11-6.

Problem

Determine the number of moles of Al^{3+} ions in 1.25 moles of Al_2O_3 .

1. Analyze the Problem

Known: number of moles of alumina = _____

Unknown: number of moles = _____

2. Solve for the Unknown

Write the conversion factor: \square mol Al^{3+} ions / \square mol Al_2O_3

Multiply the known number of moles by the conversion factor.

\square mol $\text{Al}_2\text{O}_3 \times \square$ mol Al^{3+} ions / \square mol Al_2O_3

= \square mol Al^{3+} ions

3. Evaluate the Answer

Restate the answer with correct significant digits:

Section 11.3 Moles of Compounds (continued)

Main Idea

The Molar Mass of Compounds

Use with page 322.

Details

Describe the molar mass of a compound.

Investigate the process of finding molar mass by completing the table below.

Number of Moles	Molar Mass	=	Number of Grams
mol K	g K/1 mol K	=	g
mol Cr	g Cr/1 mol Cr	=	g
mol O	g O/1 mol O	=	g
molar mass of K_2CrO_4		=	g

Converting Moles of a Compound to Mass

Use with page 323.

Analyze the process of converting moles of a compound to molar mass by completing the table below. Refer to Example Problem 11-7.

Number of Moles	Molar Mass	=	Number of Grams
2×3 mol C	g C/1 mol C	=	g
2×5 mol H	g H/1 mol H	=	g
1 mol S	g S/1 mol S	=	g
molar mass of $(C_3H_5)_2S$		=	g

Section 11.3 Moles of Compounds (continued)

Main Idea

Converting the Mass of a Compound to Moles

Use with page 324.

Converting the Mass of a Compound to Number of Particles

Use with page 325.

Details

Investigate the process of converting the mass of a compound to moles by completing the following.

Number of Moles	Molar Mass	=	Number of Grams
1 mol Ca	g Ca/1 mol Ca	=	g
2×1 mol O	g O/1 mol O	=	g
2×1 mol H	g H/1 mol H	=	g
molar mass of Ca(OH)_2		=	g

Conversion factor: _____ g of Ca(OH)_2 /1 mol Ca(OH)_2

g Ca(OH)_2 x conversion factor = mol Ca(OH)_2

_____ \times _____ / _____ = _____ mol Ca(OH)_2

Explain the steps in converting the mass of a compound to number of particles.

- Determine the _____.
- Multiply by the _____ of the molar mass to convert to _____.
- Multiply by _____ to calculate the number of _____.
- Use the ratios from the _____ to calculate the number of _____.
- Calculate the _____ per formula unit.

The Mole

Section 11.4 Empirical and Molecular Formulas

Main Idea

Details

Skim Section 4 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. _____

2. _____

3. _____

New Vocabulary

Use your text to define each term.

percent composition

empirical formula

molecular formula

Academic Vocabulary

Define the following terms.

stable

environment

Section 11.4 Empirical and Molecular Formulas (continued)

Main Idea

Percent Composition

Use with pages 328–329.

Empirical Formula

Use with pages 331–332.

Details

Write the equation for determining the percent by mass for any element in a compound.

Describe the general equation for calculating the percent by mass of any element in a compound.

Explain empirical formula by completing the following statements.

To determine the empirical _____ for a compound, you must first determine the smallest _____ of the moles of the elements in the compound. This ratio provides the _____ in the empirical formula. If the empirical formula differs from the molecular formula, the molecular formula will be a _____ multiple of the empirical formula. The data used to determine the chemical formula may be in the form of _____ or it may be the actual masses. When the percent composition is given, you can assume that the total mass of the compound is 100.0 g to simplify calculations. The _____ of elements in a compound must be _____ to whole numbers to be used as _____ in the chemical formula.

Section 11.4 Empirical and Molecular Formulas (continued)

Main Idea

Molecular Formula

Use with pages 333–335.

Details

Explain how a molecular formula distinguishes two distinct substances sharing the same empirical formula.

Investigate molecular formulas by completing the steps below. Refer to Example Problem 11-12 in your text.

empirical formula = $C_2H_3O_2$

molar mass = 118.1 g/mol

Identify the molar mass of the compound.

Moles of Element	Mass of Element/ 1 Mol of Element	=	Mass of Element
2 mol C	g C/mol C	=	g C
3 mol H	g H/mol H	=	g H
2 mol O	g O/mol O mol C/mol	=	g O
empirical molar mass of $C_2H_3O_2$		=	g

Divide the molar mass of the substance by the molar mass of the compound to determine n .

$$n = \frac{\text{molar mass of substance}}{\text{molar mass of compound}} = \quad = \quad \boxed{}$$

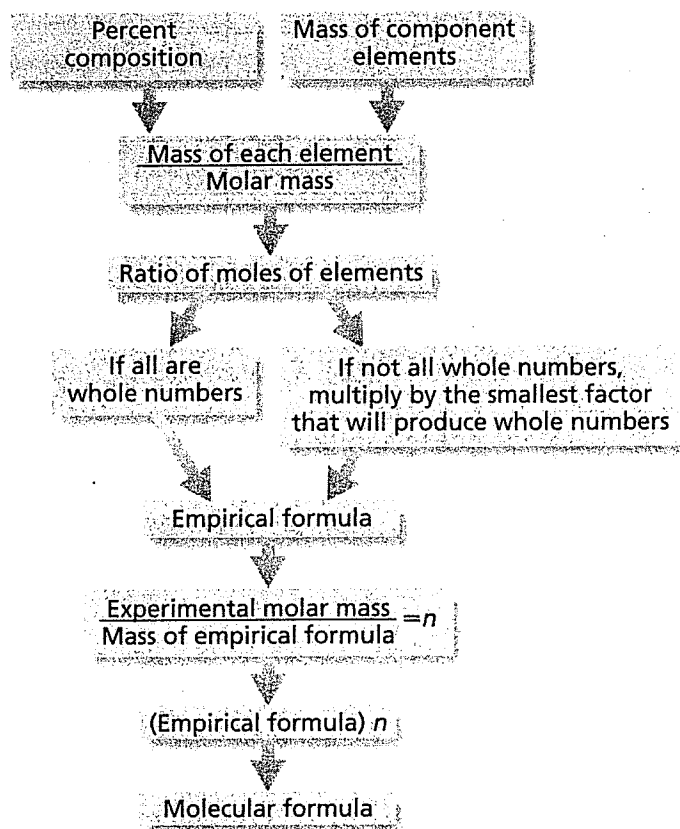
Multiply the subscripts in the empirical formula by n . Write the molecular formula.

Section 11.4 Empirical and Molecular Formulas (continued)

Main Idea

Details

Examine the flow chart below. Write the steps in determining empirical and molecular formulas from percent composition or mass data next to the relevant boxes in the flow chart.



The Mole

Section 11.5 The Formula for a Hydrate

Main Idea

Details

Skim Section 5 of your text. Write three questions that come to mind from reading the headings and the illustration captions.

1. _____
2. _____
3. _____

New Vocabulary

Use your text to define the following term.

hydrate

Naming Hydrates

Use with page 338.

Explain how hydrates are named by completing the table below.

Prefix	Molecules of Water
mono-	1
	2
	3
	4
	5
	6
	7
	8
nona-	9
	10

Section 11.5 The Formula for a Hydrate (continued)

Main Idea

Analyzing a Hydrate

Use with page 339.

Determining the Formula for a Hydrate

Use with Example Problem 11-14, page 340.

Details

Describe an anhydrate.

Solve Read Example Problem 11-14 in your text.

You Try It

Problem

A 5.00 g sample of barium chloride hydrate was heated in a crucible. After the experiment, the mass of the solid weighed 4.26 g. Determine the number of moles of water that must be attached to BaCl_2 .

1. Analyze the Problem

Known: mass of hydrated compound = ____ g $\text{BaCl}_2 \cdot x \text{H}_2\text{O}$
mass of anhydrous compound = ____ g BaCl_2
molar mass of H_2O = ____ g/mol
molar mass of BaCl_2 = 208.23 g/mol

Unknown: formula for hydrate
name of hydrate

Section 11.5 The Formula for a Hydrate (continued)

Main Idea

Details

2. Solve for the Unknown

Subtract the mass of the anhydrous compound from the hydrated compound.

Calculate the number of moles of H_2O and anhydrous BaCl_2 using the conversion factor that relates moles and mass based on the molar mass.

$$4.26 \text{ g BaCl}_2 \times \quad = \underline{\hspace{2cm}}$$

$$0.84 \text{ g H}_2\text{O} \times \quad = \underline{\hspace{2cm}}$$

Determine the value of x .

$$x = \frac{\text{moles H}_2\text{O}}{\text{moles BaCl}_2} = \underline{\hspace{2cm}}$$

3. Evaluate the Answer

The ratio of H_2O to BaCl_2 is $\underline{\hspace{1cm}}$ so the formula for the hydrate is $\underline{\hspace{2cm}}$, and the name of the hydrate is $\underline{\hspace{2cm}}$.

REAL-WORLD CONNECTION

storage and shipping.

Explain why hydrates are useful in

The Mole Chapter Wrap-Up

Now that you have read the chapter, review what you have learned and list three things you have learned about moles.

1. _____
2. _____

3. _____

Review

Use this checklist to help you study.

- Study your Science Notebook for this chapter.
- Study the definitions of vocabulary words.
- Review daily homework assignments.
- Reread the chapter and review the tables, graphs, and illustrations.
- Review the Section Assessment questions at the end of each section.
- Look over the Study Guide at the end of the chapter.

SUMMARIZE

Summarize the important conversions you have learned in this chapter.
