

Unit 5: The Mole

Mrs. Snyder
Chemistry

Unit Learning Objectives:

By the end of the unit students will be able to...

- Define the quantity of one mole by stating Avogadro's number.
- Determine the number of atoms of each element in a given compound from the chemical formula.
- Define molar mass.
- Determine the molar mass for a given element/compound with the appropriate units.
- Perform conversions between moles, mass, and atoms/molecules and solve problems involving these quantities, giving answers with the appropriate units and significant figures.
- Name and write formulas for hydrates
- Determine the percent composition for a compound from the chemical formula. Determine the percent composition of water in a hydrate.

Monday	Tuesday	Wednesday	Thursday	Friday
November				2
				OWL Candy Activity Notes Avogadro's Number
5	6	7	8	9
Mole Conversions Molar Mass	Mole Conversions 2 Step Problems	Mole Conversions 2 Step Problems	Mole Conversions	Hydrates/Percent Composition
12	13	14	15	16
No School Veteran's Day	Mole Lab	Quiz: Mole Conversions	Jig Saw: Chemical Reaction Types	Review
19	20	21	22	23
Types of Chemical Reactions Lab	Unit 5 POU: Challenge Problem Unit 5 Review	Unit 5 Test Homework packet Due	Happy Thanksgiving!	

It is important to be able to determine the number of atoms of each element in a compound. The number of atoms of each element can be found from the subscripts in the chemical formula. If there are parenthesis in the formula, the number of atoms of an element is calculated by multiplying the number outside the parenthesis by the subscript for that element.

Example: how many atoms of each element are in the molecule?

1. CaCO_3
2. $\text{Mg}_3(\text{PO}_4)_2$
3. $\text{Fe}(\text{C}_2\text{H}_3\text{O}_2)_2$

However, chemists do not work with such small amounts of atoms/molecules all the time. They work with much larger numbers and therefore chemists count in terms of the MOLE. In your OWL Candy Activity you learned about the MOLE.

What is the mole?

What is Avogadro 's number?

Chemists study chemical reactions, therefore it is important for chemists to be able to express how much of a given substance is present at both the start and end of a reaction. For this reason chemists have to be able to calculate in terms of

- Moles
- Mass
- Number of particles (number of atoms/molecules)

Chemists also need to be able to convert between any of the above three.

To convert between moles and particles use Avogadro's number

Avogadro's number can be written as two different conversion fractions:

Note: Atoms are used to express the number of particles for substances with only one atom of one element. (ex. Cr, He, Fe, etc.), molecules are used to express the number of particles for substances with more than one atom, and /or more than one element (H_2O , F_2 etc.)

Example: How many atoms of carbon are in 0.033 moles of carbon?

Example: How many moles of $C_{12}H_{22}O_{11}$ contain 3.4×10^{22} molecules?

Practice: Complete each of the following examples.

1. How many atoms are in 0.200 mol of Au?

2. How many atoms are in 23.8 moles of magnesium chloride?

3. How many atoms are in 0.45 mol of carbon?

4. How many mol are in 7.8×10^{23} molecules of NaCl?

Molar Mass

Molar Mass is the mass, in grams, of 1 mole of an element or compound. (Units= g/mol)

Molar mass for elements can be found below the element on the periodic table (molar mass for elements is equivalent to atomic mass)

Example:

Element	Molar Mass (g/mol)
Sulfur	
Zinc	
Mercury	
uranium	

The molar mass of a compound can be determined by adding the molar mass of all of the elements in the compound. Taking into account the number of atoms of each element. Do not round the calculated values for molar mass.

Example

1. What is the molar mass of NaCl?
2. What is the molar mass of Na₂O?
3. What is the molar mass of sodium sulfate?
4. What is the molar mass of fluorine?

Molar Mass Conversions

To convert between mass and moles, use **MOLAR MASS**

Example: What is the mass of 1.5 moles of chromium?

Example: How many moles are in 55.0 g of carbon dioxide?

*To convert between mass and atoms/molecules, **the moles must first be calculated.***
(Two Step Conversions)

Example: What is the mass of 8.25×10^{22} molecules of NaF?

Example: How many molecules are contained in 0.850 kg of K_3PO_4 ?

Find the number of atoms of EACH element in K_3PO_4

Practice: Mole conversions

1. How much does 4.04×10^{24} molecules of potassium chlorate weigh?

2. How many molecules are in 29 g of dinitrogen trioxide? How many atoms are there of each element?

Mole Conversion Summary Table

- To convert between mass and moles use _____
- To convert between moles and atoms/molecules use _____
- To convert between mass and atoms/molecules use _____ and _____ . These are _____ .

HYDRATES

- _____

- _____

- _____

- _____

- _____

Example: Name each hydrate.



Example: Write the formula for each hydrate

1. Lithium nitrate trihydrate

2. Nickel (II) sulphate hexahydrate

Percent Composition

How to determine percent composition

1. _____
2. _____
3. _____
4. _____
5. _____

Example: What is the percent composition of each element in SrCl_2 ?

Practice:

1. What is the percent composition of each element in CaC_2O_4 ?

2. What is the percent composition of each element in $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$?
* Note: The coefficient in front of water multiplies the subscript for both hydrogen and oxygen to determine the number of atoms of each of these elements.

3. What is the percent composition of water in the compound?

Review: Percent Composition and Hydrates

1. Name the following hydrate: $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
2. Calculate the percent composition of each element in the hydrate
3. Calculate the percent composition for water in the hydrate

Summary: Fill out the following table.

Calculation	What Information do I need?	Where do I find this information?
To determine molecules/atoms when given a mole		
To determine the number of moles when given molecules/atoms		
To determine molar mass		
To determine molecules/atoms when given molar mass		
To determine molar mass when given molecules/atoms		
To name hydrates		
To write the formula for hydrates		
To determine percent composition		