

# Ontario High School Grade 11 Chemistry

Summer 2024, Chapter 5 Notes

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These notes were created on Jun 6th, 2024

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## 👋 Welcome to Your Course Notes

I'm Dana, your Wizeprep chemistry tutor. I put these notes and the corresponding online course together especially for Grade 11 Chemistry at Ontario High School. It's formulated to tell you everything you need to know, in a quick and easy format so you can get better grades, spend less time studying, and more time living.

Dana 4.4/5 ★

MSc

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# Table of Contents

## Chapter 5. Quantities in Chemistry

### 5.1. The Mole and Molar Mass

5.1.1. Moles

5.1.2. Example: Using Avogadro's Number

5.1.3. Practice Level 1

5.1.4. Practice Level 2

5.1.5. Practice Level 3

### 5.2. Empirical Formulas

5.2.1. Percent Composition

5.2.2. Empirical Vs Molecular Formulas

5.2.3. Example: Percent Composition using Experimental Mass

5.2.4. Practice Level 1

5.2.5. Practice Level 2

5.2.6. Practice Level 3

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# 5. Quantities in Chemistry

## 5.1 The Mole and Molar Mass

### 5.1.1

#### Moles and Molar Mass

- A **mole** is the exact number of atoms in 12g of carbon
- If we know that:  $1 \text{ dozen} = 12$ , then  $1 \text{ mole} = 6.022 \times 10^{23}$
- The above value,  $6.02 \times 10^{23}$  is referred to as **Avogadro's number ( $N_A$ )**

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

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## Molar Mass

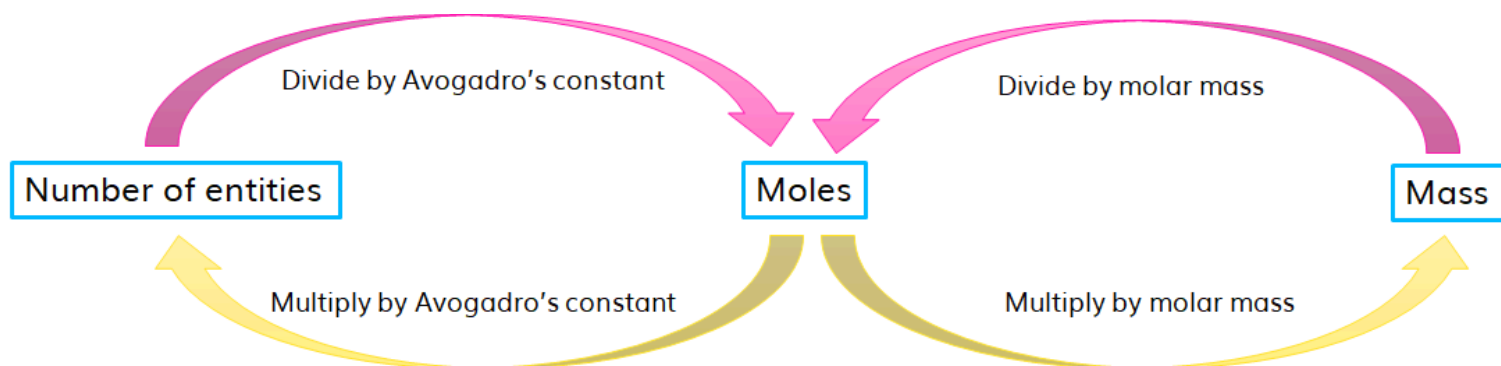
- **Molar mass** is the mass of one mole of particles of that substance
- Units for molar mass are **g/mol**.
- Molar mass is abbreviated using the symbol **M**  
*Example:* Molar mass of elemental oxygen can be represented as  $M_{O_2}$

## Molar Mass of Elements

- Found in periodic table.  
*Example:* Molar mass of sodium
- When looking at molar mass of molecular elements, you have to multiply the molar mass of the element by the number of atoms per molecule  
*Example:* Molar mass of elemental chlorine

## Molar Mass of Ionic and Molecular Compounds

- The molar mass of a compound is equal to the sum of the molar mass of each entity in the compound.  
*Example:* Molar mass of sulfuric acid,  $H_2SO_4$



Watch the video tutorial for this lesson (06:20)

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## Example: Using Avogadro's Number

Calculate the number of Cu atoms if you have 0.635g of Cu.

Solution available online

**Watch the video tutorial for this lesson (02:35)**

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5.1.3

## Practice: Calculating Molar Mass

Calculate the molar mass of  $\text{H}_2\text{O}$ . Give your answer rounded to the nearest whole integer; do not include units.

Answer

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5.1.4

## Practice: Using Avogadro's Number and Molar Mass

### Part 1

If we are told that a sample of  $\text{CO}_2(\text{s})$  weighs 11g, how many moles of  $\text{CO}_2$  are present in the sample?

Answer

---

## Practice: Using Avogadro's Number and Molar Mass

### Part 2

How many molecules are present in the sample?

Answer

## Practice: Using Avogadro's Number and Molar Mass

### Part 3

How many oxygen atoms there in this sample of  $\text{CO}_2$ ?

Answer

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## Practice: Converting Mass to Number of Atoms

Calculate the number of nitrogen atoms in 2.25 g of  $\text{Bi}(\text{NO}_3)_3$ .

☐  $1.03 \times 10^{22}$  atoms

☐  $1.03 \times 10^{21}$  atoms

☐  $3.43 \times 10^{21}$  atoms

☐  $3.43 \times 10^{22}$  atoms

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## 5.2 Empirical Formulas

### 5.2.1

#### Percent Composition

- The **percent composition** shows the amount that each element in a compound contributes to the overall mass of that compound.
- The **law of definite proportions** states that the elements in a chemical compound are always present in the same proportions by mass.  
*Example:* A pinch of salt will have the same percent composition as a cup of salt.
- To determine the percent composition of a compound, divide the mass of a particular element by the total mass of the compound and multiply by 100 to get a percentage

$$\% \text{ composition by mass} = \frac{\text{mass contribution of element}}{\text{total mass of compound}} \times 100\%$$

---

*Example: Percent Composition using Chemical Formula*

What is the percent composition by mass of oxygen in sodium hydroxide, NaOH? \_\_\_\_\_

Solution available online

**Watch the video tutorial for this lesson (03:50)**

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## Empirical Vs Molecular Formulas

- **Molecular formulas** tell us exactly how many atoms make up a molecule.

*Example:*  $C_6H_6$  tells us that for each molecule of  $C_6H_6$ , there are \_\_\_\_\_ C atoms and \_\_\_\_\_ H atoms.

- **Empirical formulas** are the smallest possible "unit" of the molecular formula.

*Example:* The empirical formula of  $C_6H_6$  would be: \_\_\_\_\_

- 
- When a molecular formula cannot be reduced, the molecular formula and empirical formula of the compound are the same

*Example:*  $\text{NO}_2$

- Many molecules can have the same empirical formula

*Example:*  $\text{C}_2\text{H}_2$  and  $\text{C}_6\text{H}_6$  have the same empirical formula of CH

**Watch the video tutorial for this lesson (03:34)**

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## Example: Percent Composition using Experimental Mass

A 27.0 g sample of a compound contains 7.20 g of carbon, 2.20 g of hydrogen and 17.6 g of oxygen. Calculate the percent composition of the compound.

Solution available online

**Watch the video tutorial for this lesson (02:48)**

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5.2.4

## Practice: Percent Composition

What percent of iron (III) hydroxide,  $\text{Fe}(\text{OH})_3$ , is oxygen? Round your answer to the nearest whole integer; do not include any symbols.

Answer

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## Practice: Finding Empirical Formula

A compound has the following mass composition: C = 86.59%, H = 8.36% and N = 5.05%. What is the empirical formula of this compound?

☐  $\text{C}_7\text{H}_8\text{N}_3$

☐  $\text{C}_{20}\text{H}_{23}\text{N}$

☐  $\text{C}_{87}\text{H}_8\text{N}_5$

☐  $\text{C}_3\text{H}_3\text{N}$

☐  $\text{C}_{14}\text{H}_{14}\text{N}$

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## Practice: Finding Molecular Formula

A sample of a compound contains 1.52g of N atoms and 3.47g of O atoms. The molar mass of the compound is 92.02g/mol. Determine the molecular formula.

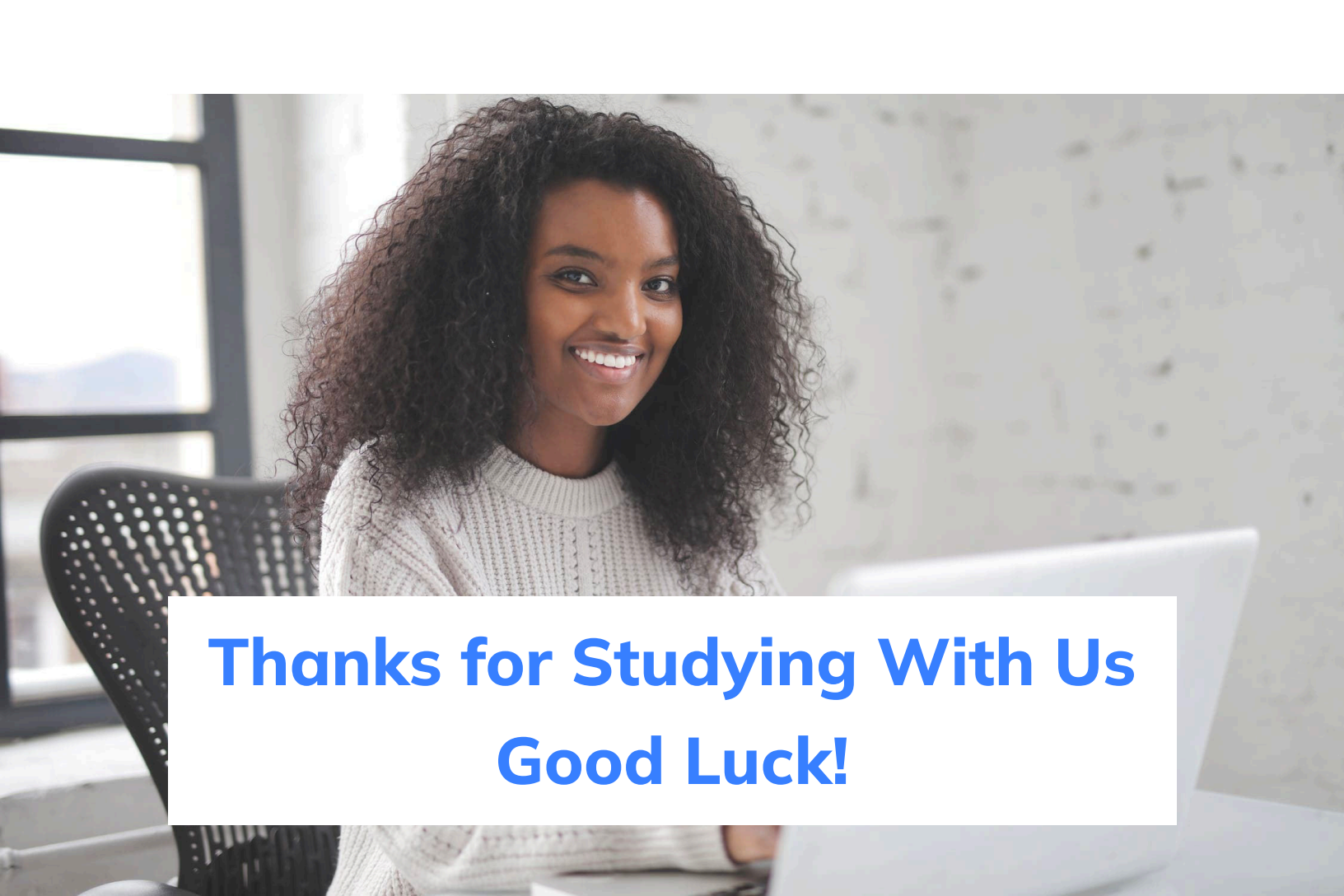
☐  $\text{N}_2\text{O}_4$ ☐ NO☐  $\text{N}_2\text{O}$ ☐  $\text{N}_2\text{O}_2$ ☐  $\text{NO}_2$ 

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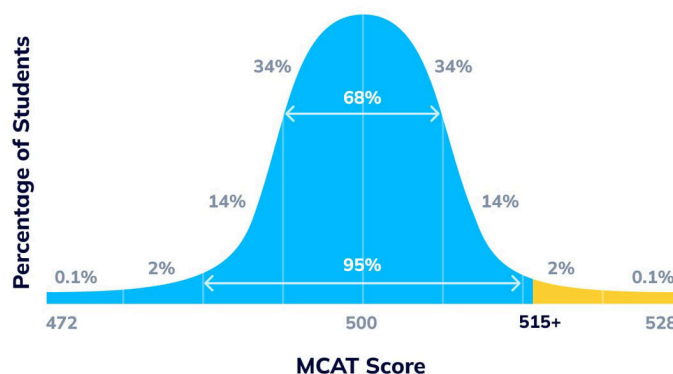
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