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Understanding the concept of moles and how to calculate the number of moles in a given mass of a chemical compound is fundamental in chemistry. When working with compounds like ethyl chloride (C_2H_5Cl), knowing how to determine the total number of moles in a specific mass can help in stoichiometry, laboratory preparations, and chemical reactions. This article provides an in-depth explanation about calculating the total number of moles in 80.0 grams of C_2H_5Cl, focusing on the importance of molar mass, the calculation process, and practical applications. We will explore the steps involved, key concepts, and tips to ensure accurate calculations, all optimized for SEO to help students, educators, and chemistry enthusiasts alike.

Understanding Moles and Molar Mass

What Is a Mole?

A mole is a fundamental unit in chemistry that quantifies the amount of a substance. One mole contains exactly $6.02214076 \times 10^{23}$ particles (atoms, molecules, ions, etc.), known as Avogadro's number. This allows chemists to relate microscopic particles to macroscopic quantities measurable in the lab.

The Significance of Molar Mass

Molar mass (or gram formula mass) is the mass of one mole of a substance, expressed in grams per mole (g/mol). It is calculated by summing the atomic masses of all atoms in a chemical formula based on the periodic table. Molar mass acts as a bridge between the mass of a substance and the number of moles it contains.

Calculating the Molar Mass of C_2H_5Cl

Step-by-Step Calculation

To determine the number of moles in 80.0 grams of C_2H_5Cl, first, find the molar mass of C_2H_5Cl:

- Carbon (C): 12.01 g/mol
- Hydrogen (H): 1.008 g/mol

- Chlorine (Cl): 35.45 g/mol

Calculate the molar mass:
1. Carbon: 2 atoms × 12.01 g/mol = 24.02 g/mol
2. Hydrogen: 5 atoms × 1.008 g/mol = 5.04 g/mol
3. Chlorine: 1 atom × 35.45 g/mol = 35.45 g/mol

Adding these:
24.02 + 5.04 + 35.45 = 64.51 g/mol

Thus, the molar mass of C_2H_5Cl is 64.51 grams per mole.

Calculating the Total Number of Moles

The Formula

The fundamental formula to find the number of moles (n) from mass (m) and molar mass (M) is:

$$ n = \frac{m}{M} $$

Where:
- $ n $ = number of moles
- $ m $ = mass of the substance (in grams)
- $ M $ = molar mass of the substance (in g/mol)

Applying the Formula to 80.0 grams of C_2H_5Cl

Given:
- $ m = 80.0 $ grams
- $ M = 64.51 $ g/mol

Calculating:
$$ n = \frac{80.0}{64.51} $$

Using a calculator:
$$ n ≈ 1.239 \text{ moles} $$

Rounding to the nearest hundredth:
$$ n ≈ 1.24 \text{ moles} $$

Therefore, there are approximately 1.24 moles of C_2H_5Cl in 80.0 grams.

Practical Applications of Moles Calculation

1. Stoichiometry in Chemical Reactions

Accurately converting mass to moles allows chemists to predict reactant and product quantities, optimize yields, and ensure proper balancing of chemical equations.

2. Laboratory Preparations

Knowing the mole quantity helps in preparing solutions with precise molarity, which is crucial for experiments requiring exact concentrations.

3. Industrial Chemical Production

Mass-to-mole conversions assist in scaling reactions from laboratory scale to industrial production, ensuring efficiency and safety.

Important Tips for Accurate Moles Calculations

- Always double-check atomic weights from a reliable periodic table.
- Ensure the chemical formula is correctly interpreted, including all atoms.
- Use proper significant figures based on input data precision.
- Be consistent with units, especially when working with different measurement systems.
- Utilize calculator functions carefully to avoid rounding errors during intermediate steps.

Summary

Calculating the total number of moles in a given mass of a compound like C_2H_5Cl involves understanding the concepts of molar mass and the mole unit. For 80.0 grams of ethyl chloride, the molar mass is approximately 64.51 g/mol, leading to a total of about 1.24 moles when rounded to the nearest hundredth. This fundamental calculation serves as a cornerstone in various aspects of chemistry, from academic studies to industrial applications, highlighting the importance of precise measurements and calculations.

Conclusion

Mastering the process of determining the number of moles from mass and molar mass enhances your chemistry skills, enabling accurate analysis and reaction planning. Whether you're preparing for exams, conducting laboratory experiments, or involved in chemical manufacturing, understanding how to convert grams to moles with precision is invaluable. Remember to always verify atomic

weights and perform calculations carefully to achieve the most accurate results.

In summary, in 80.0 grams of C_2H_5Cl, there are approximately 1.24 moles, based on the molar mass of 64.51 g/mol.

Frequently Asked Questions

How do you calculate the number of moles in 80.0 grams of C2H5Cl?

To calculate the moles, divide the mass by the molar mass of C2H5Cl: Moles = 80.0 g / 78.96 g/mol ≈ 1.01 moles.

What is the gram formula mass of C2H5Cl?

The gram formula mass of C2H5Cl is approximately 78.96 grams per mole.

Why is it important to find the total number of moles in a compound?

Calculating the number of moles helps in stoichiometry calculations, determining reactant and product quantities, and understanding chemical reactions more precisely.

What is the rounded number of moles in 80 grams of C2H5Cl to the nearest hundredth?

The total number of moles is approximately 1.01 mol.

If you have 80.0 grams of C2H5Cl, how many molecules does that represent?

Using Avogadro's number (6.022 x 10^23 molecules/mol), 1.01 mol corresponds to approximately 6.09 x 10^23 molecules.

How does the molar mass of C2H5Cl influence the calculation of moles from grams?

The molar mass acts as a conversion factor; dividing grams by molar mass yields the number of moles.

Can you explain what 'to the nearest hundredth' means in the context of moles calculation?

It means rounding the calculated number of moles to two decimal places for precision, e.g., 1.01 mol.

What are the steps to determine the total moles in a given mass of a compound like C2H5Cl?

First, find the molar mass of the compound, then divide the given mass by this molar mass: Moles = mass / molar mass.

Additional Resources

What Is The Total Number Of Moles, To The Nearest Hundredth, In 80.0 Grams Of C_2H_5Cl (Gram Formula Mass)

Understanding the concept of moles in chemistry is fundamental for anyone delving into chemical reactions, stoichiometry, or molecular calculations. When asked, "What is the total number of moles, to the nearest hundredth, in 80.0 grams of C_2H_5Cl (gram formula mass)?", it's essential to break down the problem step by step. This process involves calculating the molar mass of the compound, converting grams to moles, and then rounding the result accurately. This guide will provide a comprehensive overview, from understanding the basics to performing the calculation accurately, ensuring you grasp both the theoretical and practical aspects involved.

Understanding the Concept of Moles in Chemistry

In chemistry, the mole is a fundamental unit representing a specific number of particles — specifically, atoms, molecules, ions, or other entities. The number of particles in one mole is known as Avogadro's number, approximately 6.022×10^{23} particles per mole.

Why Moles Matter

- Quantitative Analysis: Moles allow chemists to measure and compare quantities of substances in a standardized way.
- Stoichiometry: Moles are essential for balancing chemical equations, calculating reactants needed, and products formed.
- Conversions: Moles serve as a bridge between mass, volume, and number of particles.

The Compound: Ethyl Chloride (C_2H_5Cl)

Before calculating the number of moles, it's important to understand the compound involved.

Molecular Formula: C_2H_5Cl

- Carbon (C): 2 atoms
- Hydrogen (H): 5 atoms
- Chlorine (Cl): 1 atom

This compound, ethyl chloride, is a common organic halide used in various chemical processes and as a solvent.

Calculating the Gram Formula Mass (Molar Mass) of C_2H_5Cl

The gram formula mass (or molar mass) is the sum of the atomic masses of all atoms in one molecule of the compound. This value is expressed in grams per mole (g/mol).

Atomic Masses (Approximate)

- Carbon (C): 12.01 g/mol
- Hydrogen (H): 1.008 g/mol
- Chlorine (Cl): 35.45 g/mol

Step-by-Step Calculation

1. Carbon: 2 atoms × 12.01 g/mol = 24.02 g/mol
2. Hydrogen: 5 atoms × 1.008 g/mol = 5.04 g/mol
3. Chlorine: 1 atom × 35.45 g/mol = 35.45 g/mol

Total molar mass of C_2H_5Cl:

24.02 + 5.04 + 35.45 = 64.51 g/mol

This means one mole of C_2H_5Cl weighs approximately 64.51 grams.

Converting Mass to Moles

The core calculation involves converting the given mass into moles using the molar mass.

The Formula:

$$\text{Number of Moles} = \frac{\text{Mass in grams}}{\text{Molar mass in grams per mole}}$$

Applying to Our Data:

- Given mass: 80.0 grams
- Molar mass: 64.51 g/mol

Plugging in the values:

$$\text{Number of Moles} = \frac{80.0 \text{ g}}{64.51 \text{ g/mol}}$$

Step-by-Step Calculation

1. Perform the division:

$$\frac{80.0}{64.51} \approx 1.239$$

2. Round to the nearest hundredth:

- The decimal value 1.239 rounds to 1.24.

Final Answer: Total Number of Moles

The total number of moles, to the nearest hundredth, in 80.0 grams of C_2H_5Cl is approximately 1.24 moles.

Additional Considerations

Precision and Rounding

- Always retain sufficient decimal places during intermediate calculations to maintain accuracy.
- Round only after completing the division to the appropriate decimal place.

Practical Applications

Knowing the number of moles in a sample allows chemists to:

- Determine how much of a reactant is needed for a reaction.
- Calculate theoretical yields.
- Convert between mass and particle counts.

Summary

- Step 1: Find the molar mass of the compound (C_2H_5Cl) by summing atomic masses.
- Step 2: Divide the given mass by the molar mass to find moles.
- Step 3: Round the result to the nearest hundredth for precision.

In this case, 80.0 grams of ethyl chloride corresponds to approximately 1.24 moles.

Final Thoughts

Mastering the conversion from grams to moles is a cornerstone of chemical calculations. Whether you're preparing for exams, working in a lab, or analyzing chemical data, understanding how to accurately convert mass to moles—and vice versa—empowers you to approach chemical problems with confidence and precision. Remember, always verify your molar masses and ensure proper rounding to avoid errors in your calculations.

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