28.__ How Many Moles Are Present In 155 G Of Lead (II)acetate?

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Understanding how to calculate the number of moles in a given mass of a compound is a fundamental skill in chemistry. In this article, we will explore the process of determining the number of moles present in 155 grams of Lead (II) acetate, a commonly encountered chemical compound in various laboratory and industrial applications. By following a systematic approach, you will learn to convert mass to moles, appreciate the significance of molar mass, and understand the practical implications of these calculations.

What Is Lead (II) Acetate?

Definition and Chemical Formula

Lead (II) acetate, also known as plumbous acetate, is an inorganic compound with the chemical formula $Pb(C_2H_3O_2)_2$. It consists of a lead cation (Pb^{2+}) and two acetate anions ($C_2H_3O_2^-$). This compound appears as a white or colorless crystalline solid and has been used historically in various applications, although its toxicity limits current uses.

Uses and Applications

- Historical use in medicine and cosmetics
- Laboratory reagent for titrations and chemical synthesis
- Involving in lead-based compounds for illustrative purposes in chemistry education

Understanding Moles and Molar Mass

What Is a Mole?

The mole is a fundamental unit in chemistry representing a specific number of particles,

atoms, molecules, or ions. One mole equals approximately 6.022 x 10^{23} entities, known as Avogadro's number. This concept allows chemists to relate the microscopic world to macroscopic measurements such as grams.

Why Is Molar Mass Important?

The molar mass of a compound represents the mass in grams of one mole of its entities. It is calculated as the sum of atomic masses of all atoms in the molecule, expressed in atomic mass units (amu). The molar mass enables conversion between mass (grams) and moles, which is essential for stoichiometric calculations.

Calculating the Molar Mass of Lead (II) Acetate

Atomic Masses of Elements

- Lead (Pb): approximately 207.2 g/mol
- Carbon (C): approximately 12.01 g/mol
- Hydrogen (H): approximately 1.008 g/mol
- Oxygen (O): approximately 16.00 g/mol

Calculating the Molar Mass

Given the chemical formula $Pb(C_2H_3O_2)_2$, we can calculate its molar mass as follows:

1. Mass contributed by lead (Pb): 1 x 207.2 g/mol = 207.2 g/mol
2. Mass contributed by carbon atoms: 2 x 12.01 g/mol = 24.02 g/mol
3. Mass contributed by hydrogen atoms: 3 x 1.008 g/mol = 3.024 g/mol
4. Mass contributed by oxygen atoms: 4 x 16.00 g/mol = 64.00 g/mol

Adding these up, the molar mass of Lead (II) acetate is:

207.2 + 24.02 + 3.024 + 64.00 = 298.244 g/mol

Calculating the Number of Moles in 155 g of Lead (II) Acetate

Step-by-Step Calculation

With the molar mass determined, calculating the number of moles is straightforward using the formula:

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Number of moles = Mass (g) / Molar mass (g/mol)
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Applying the Values

- Mass of Lead (II) acetate = 155 g
- Molar mass of Lead (II) acetate = 298.244 g/mol

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Number of moles = 155 g / 298.244 g/mol ≈ 0.5197 mol
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Final Answer

Therefore, there are approximately **0.52 moles** of Lead (II) acetate in 155 grams of the compound.

Significance of the Calculation

Stoichiometry and Chemical Reactions

Knowing the number of moles allows chemists to predict the amounts of reactants needed or products formed in chemical reactions involving Lead (II) acetate. It is crucial for balancing equations and planning chemical syntheses.

Laboratory Applications

- Preparing solutions of specific molarity
- Calculating yields and efficiencies

- Understanding stoichiometric ratios in titrations

Additional Considerations

Purity of the Sample

The calculation assumes that the sample is pure Lead (II) acetate. Impurities or moisture can affect the actual molar amount. Always consider purity when performing precise calculations.

Unit Conversions and Precision

While the calculation used approximate atomic weights, for more precise work, use more exact atomic masses from the periodic table. Also, maintain appropriate significant figures based on the precision of your measurements.

Practical Examples and Applications

Example 1: Preparing a Lead (II) Acetate Solution

Suppose you need to prepare 1 liter of a 0.5 M Lead (II) acetate solution. How much solid should you weigh?

- Moles required: 0.5 mol
- Molar mass: 298.244 g/mol

Mass needed = 0.5 mol x 298.244 g/mol = 149.122 g

Thus, weigh approximately 149.12 grams of Lead (II) acetate to prepare 1 liter of 0.5 M solution.

Example 2: Calculating the Number of Molecules

From the 0.52 moles calculated earlier, the total number of molecules is:

$$\text{Number of molecules} = 0.52 \text{ mol} \times 6.022 \times 10^{23} \text{ molecules/mol} \approx 3.13 \times 10^{23} \text{ molecules}$$

This illustrates the immense scale of particle counts in chemical substances.

Summary and Key Takeaways

- The molar mass of Lead (II) acetate is approximately 298.244 g/mol.
- In 155 grams of Lead (II) acetate, there are roughly 0.52 moles.
- Understanding molar calculations is essential for stoichiometry, solution preparation, and chemical analysis.
- Always consider purity and measurement accuracy for precise scientific work.

Conclusion

Calculating the number of moles in a given mass of a chemical compound is a vital aspect of chemistry that bridges the gap between the microscopic and macroscopic worlds. By knowing the molar mass and applying simple division, scientists and students can accurately determine the amount of substance present, facilitating effective experimentation, synthesis, and analysis. In the case of Lead (II) acetate, 155 grams correspond to approximately 0.52 moles, a figure that can be used for further reactions or calculations in laboratory settings. Mastery of these calculations enhances understanding and proficiency in chemical principles and laboratory procedures.

Frequently Asked Questions

How do you calculate the number of moles in 155 g of Lead (II) acetate?

To calculate the number of moles, divide the given mass by the molar mass of Lead (II) acetate. Moles = mass (g) / molar mass (g/mol).

What is the molar mass of Lead (II) acetate ($Pb(C_2H_3O_2)_2$)?

The molar mass of Lead (II) acetate is approximately 325.26 g/mol.

What is the formula to find the number of moles from given mass?

Number of moles = mass (g) / molar mass (g/mol).

How many moles of Lead (II) acetate are present in 155 g?

Number of moles = 155 g / 325.26 g/mol ≈ 0.476 mol.

Why is it important to know the molar mass when calculating moles?

The molar mass converts grams to moles, providing a relationship between mass and the number of particles in a substance.

Can you explain the steps to find the moles in a given mass of Lead (II) acetate?

Yes. First, find the molar mass of Lead (II) acetate. Then, divide the given mass (155 g) by this molar mass to get the number of moles.

What are common applications of calculating moles in chemistry?

Calculating moles helps chemists determine the proportions of reactants and products in chemical reactions, prepare solutions, and understand reaction stoichiometry.

Additional Resources

How Many Moles Are Present In 155 G Of Lead (II) Acetate?
Understanding the concept of moles and how to calculate the amount of substance in chemical compounds is fundamental in chemistry. In this article, we will explore 28.__ How Many Moles Are Present In 155 G Of Lead (II) Acetate? by walking through the step-by-step process to determine the number of moles in a given mass of lead (II) acetate. Whether you're a student preparing for exams or a professional refining your chemical calculations, this comprehensive guide will clarify the process, including calculating molar mass, understanding chemical formulas, and applying the mole concept.

Introduction to the Mole Concept

Before diving into the specific calculations, it’s important to understand what a mole represents in chemistry. A mole is a fundamental unit in chemistry that measures the amount of a substance. One mole contains exactly 6.022 x 10^{23} particles (atoms, molecules, ions, etc.) — this number is known as Avogadro's number.

Knowing how to convert between mass and moles allows chemists to quantify reactions, determine reactant and product amounts, and understand molecular relationships. The key formula used in these calculations is:

Number of moles (n) = Mass of substance (g) / Molar mass (g/mol)

Step 1: Understanding Lead (II) Acetate

Lead (II) acetate is a chemical compound with the formula:

$Pb(C_2H_3O_2)_2$

This formula indicates that each molecule consists of one lead (Pb) atom and two acetate ($C_2H_3O_2$) groups.

Chemical Structure Breakdown:

- Pb: Lead atom
- $(C_2H_3O_2)_2$: Two acetate groups attached to lead

Step 2: Calculating the Molar Mass of Lead (II) Acetate

To find the number of moles in 155 grams of lead (II) acetate, we need to determine its molar mass.

Step-by-step calculation:

Element	Atomic Weight (amu)	Number of Atoms	Total Contribution (g/mol)
Lead (Pb)	207.2	1	207.2
Carbon (C)	12.01	4 (2 per acetate, 2 acetate groups)	12.01 x 4 = 48.04
Hydrogen (H)	1.008	6 (3 per acetate, 2 acetate groups)	1.008 x 6 = 6.048
Oxygen (O)	16.00	4 (2 per acetate, 2 acetate groups)	16.00 x 4 = 64.00

Note:
- Each acetate group ($C_2H_3O_2$) contains 2 carbons, 3 hydrogens, and 2 oxygens.
- Since there are two acetate groups, multiply each element's count by 2.

Adding these together:

- Lead: 207.2 g/mol
- Carbon: 48.04 g/mol
- Hydrogen: 6.048 g/mol
- Oxygen: 64.00 g/mol

Total molar mass of lead (II) acetate:

207.2 + 48.04 + 6.048 + 64.00 = 325.288 g/mol

For simplicity, we can round this to 325.29 g/mol.

Step 3: Calculating the Number of Moles in 155 G of Lead (II) Acetate

Using the molar mass, apply the mole formula:

n = mass / molar mass

Substituting the known values:

n = 155 g / 325.29 g/mol ≈ 0.476 mol

Therefore, there are approximately 0.476 moles of lead (II) acetate in 155 grams.

Additional Considerations

How precise does the calculation need to be?

In most practical scenarios, rounding to three decimal places (0.476 mol) is sufficient. However, for more precise scientific work, consider using more accurate atomic weights and avoiding premature rounding.

Variations in the compound

If the compound is hydrated (contains water molecules), the molar mass would change accordingly. Make sure to verify the chemical formula before performing calculations.

Step 4: Summary of the Calculation Process

To recap, here are the key steps to determine the number of moles in a given mass of a chemical compound:

1. Identify the chemical formula of the compound.
2. Calculate the molar mass by summing the atomic weights of all constituent atoms.
3. Use the mole formula:
Number of moles = mass of sample / molar mass of compound.
4. Plug in the values and perform the division to find the number of moles.

Practical Applications and Significance

Understanding how many moles are present in a sample is fundamental for various chemistry applications:

- Stoichiometry: Calculating reactant and product quantities in chemical reactions.
- Solution Preparation: Determining molarity and dilutions.

- Chemical Analysis: Quantifying substances in mixtures.
- Industrial Processes: Managing material quantities for manufacturing.

In the context of lead (II) acetate, knowing the moles present helps in:

- Conducting reactions involving lead compounds.
- Calculating yields in synthesis procedures.
- Ensuring proper safety measures due to lead's toxicity.

Frequently Asked Questions

Q1: Can I use the molar mass of lead (II) acetate directly from a periodic table?
Yes. The molar mass is the sum of atomic weights of all atoms in the chemical formula, as calculated above.

Q2: What if the compound is hydrated?
Add the molar mass of water molecules to the molar mass of the anhydrous compound. For example, if lead (II) acetate trihydrate ($Pb(C_2H_3O_2)_2 \cdot 3H_2O$) is used, include 3 x 18.015 g/mol for the water molecules.

Q3: How precise should my calculations be?
For most educational and practical purposes, rounding to three decimal places is sufficient, but always consider the context.

Final Thoughts

Mastering the calculation of moles from a given mass is a cornerstone skill in chemistry. The example of determining how many moles are present in 155 g of lead (II) acetate exemplifies the application of fundamental principles — from understanding chemical formulas to applying basic arithmetic operations. With practice, these calculations become second nature, empowering you to analyze and interpret chemical data confidently.

In summary:

- The molar mass of lead (II) acetate ($Pb(C_2H_3O_2)_2$) is approximately 325.29 g/mol.
- In 155 grams of the compound, there are roughly 0.476 moles.
- The process involves identifying the chemical formula, calculating molar mass, and applying the mole formula.

Armed with this knowledge, you are now better equipped to tackle similar problems involving molar calculations and deepen your understanding of chemical quantities.

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