How Many Atoms Of Hydrogen Are There In 36 G OfNH4NH4?explain In Detail Plz

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Understanding the number of atoms in a chemical compound is fundamental in chemistry. When dealing with compounds like ammonium, represented as NH4NH4, questions often arise about how to determine the total number of specific atoms, such as hydrogen atoms, in a given mass. In this article, we will explore in detail how to calculate the number of hydrogen atoms present in 36 grams of NH4NH4, breaking down each step for clarity and comprehension.

Introduction to NH4NH4 and Its Composition

Before diving into calculations, it's essential to understand the chemical structure of NH4NH4, also known as ammonium ammonium or ammonium salt.

What Is NH4NH4?

- NH4NH4 is a chemical compound consisting of two ammonium (NH4+) ions bonded together.
- It is often represented as (NH4)2, indicating two ammonium ions per molecule.
- The molecular formula is (NH4)2, which can be expanded as N2H8.

Component Elements in NH4NH4

- Nitrogen (N): 2 atoms per molecule
- Hydrogen (H): 8 atoms per molecule

Understanding the Atomic Composition of NH4NH4

Knowing the total number of atoms per molecule is crucial:

- Total atoms in one molecule of NH4NH4:
- Nitrogen atoms: 2
- Hydrogen atoms: 8

This means that in every mole of NH4NH4, there are:

- 2 moles of nitrogen atoms
- 8 moles of hydrogen atoms

Calculating the Molar Mass of NH4NH4

The molar mass allows us to relate the mass of the compound to the number of moles.

Atomic Masses (approximate):

- Nitrogen (N): 14.01 g/mol
- Hydrogen (H): 1.008 g/mol

Calculating the Molar Mass of NH4NH4

- Molar mass of one NH4 group:
- N: 14.01 g/mol
- H4: 4 × 1.008 g/mol = 4.032 g/mol
- Total for NH4: 14.01 + 4.032 = 18.042 g/mol
- Since NH4NH4 contains two NH4 groups:
- Total molar mass = 2 × 18.042 g/mol = 36.084 g/mol

Therefore:
- Molar mass of NH4NH4 ≈ 36.084 g/mol

This is a critical point because the mass given (36 g) is very close to the molar mass, suggesting we are dealing with approximately 1 mole of NH4NH4.

Step-by-Step Calculation of Hydrogen Atoms in 36 g of NH4NH4

Now, let's proceed with the calculation:

Step 1: Determine the number of moles in 36 g of NH4NH4

- Number of moles (n) = mass / molar mass
- n = 36 g / 36.084 g/mol ≈ 0.9988 mol

In practical terms, this is approximately 1 mole.

Step 2: Find the total moles of hydrogen atoms

- Each mole of NH4NH4 contains 8 moles of hydrogen atoms.
- Total moles of H atoms = 8 × number of moles of NH4NH4
- Total moles of H = 8 × 0.9988 ≈ 7.9904 mol

Step 3: Convert moles of hydrogen to atoms

- Use Avogadro's number (6.022 × 10^23 atoms/mol)
- Total hydrogen atoms = moles of H × Avogadro's number
- Total H atoms ≈ 7.9904 mol × 6.022 × 10^23 atoms/mol

Calculating:

7.9904 × 6.022 × 10^23 ≈ 4.81 × 10^24 atoms

Summary of Calculation

- In 36 g of NH4NH4:
- Approximately 0.9988 moles
- Corresponds to roughly 7.99 moles of hydrogen atoms
- Which equals about 4.81 × 10^24 hydrogen atoms

Key Takeaways

- The molar mass of NH4NH4 is approximately 36.084 g/mol.
- 36 g of NH4NH4 is roughly equivalent to 1 mole.
- Each mole contains 8 moles of hydrogen atoms.
- Therefore, in 36 g, there are approximately 4.81 × 10^24 hydrogen atoms.

Additional Insights and Practical Applications

Understanding how to calculate the number of atoms from a given mass is crucial in various fields:

- Chemical Reactions: Knowing the number of atoms helps in balancing reactions and determining reactant/product quantities.
- Material Science: Calculations guide the synthesis of compounds and measurement of atomic compositions.
- Pharmacology: Precise atom counts are vital in designing molecules and understanding their properties.

Common Mistakes to Avoid

- Mixing up molar masses of different compounds.
- Forgetting to multiply the moles of compound by the number of atoms per molecule.
- Using incorrect values for atomic masses or Avogadro’s number.

Conclusion

Calculating the number of hydrogen atoms in a specific mass of a compound like NH4NH4 involves understanding its molecular structure, molar mass, and the fundamental constants like Avogadro’s number. In the case of 36 grams of NH4NH4, the process reveals that there are approximately 4.81 × 10^24 hydrogen atoms. Mastery of these calculations is essential for chemists, students, and professionals involved in molecular science, enabling precise quantification and understanding of matter at the atomic level.

Meta Description: Learn how to calculate the number of hydrogen atoms in 36 grams of NH4NH4 with detailed step-by-step explanations, including molar mass calculations and atomic conversions for comprehensive understanding.

Frequently Asked Questions

How do you determine the number of hydrogen atoms in 36 g of NH4NH4?

First, find the molar mass of NH4NH4, then calculate how many moles are in 36 g, and finally multiply by the number of hydrogen atoms per molecule (8 H atoms in total).

What is the molar mass of NH4NH4 (ammonium compound)?

The molar mass of NH4NH4 is approximately 68.16 g/mol, calculated by summing atomic masses: N (14.01) + 4×H (4×1.008) for each NH4 group, doubled for the molecule.

How many moles of NH4NH4 are present in 36 grams?

Number of moles = 36 g / 68.16 g/mol ≈ 0.5276 mol.

How many hydrogen atoms are there per molecule of NH4NH4?

Each NH4 group contains 4 hydrogen atoms; since there are two such groups in NH4NH4, total H atoms per molecule = 8.

How do you calculate the total number of hydrogen atoms in 36 g of NH4NH4?

Multiply the number of moles of NH4NH4 by the number of molecules (using Avogadro's number) and then by 8 (hydrogen atoms per molecule): 0.5276 mol × 6.022×10^{23} × 8.

What is Avogadro's number and why is it important here?

Avogadro's number is 6.022×10^{23} molecules per mole; it allows us to convert between moles and individual molecules, essential for counting atoms.

Can you provide the step-by-step calculation for the number of hydrogen atoms?

Yes. First, calculate moles: 36 g / 68.16 g/mol ≈ 0.5276 mol. Then, total molecules: 0.5276 mol × 6.022×10^{23} ≈ 3.18×10^{23} molecules. Multiply by 8 H atoms per molecule: 3.18×10^{23} × 8 ≈ 2.55×10^{24} hydrogen atoms.

Why is understanding molecular composition important in chemistry calculations?

It helps in determining the number of atoms, molecules, or ions involved in reactions, essential for stoichiometry, yields, and chemical analysis.

What assumptions are made in this calculation?

Assumption that the compound is pure, the molar masses are accurate, and Avogadro's number is used as a constant for counting molecules.

Additional Resources

How Many Atoms Of Hydrogen Are There In 36 G Of NH_4NH_4? Explain In Detail Please

Understanding the precise number of atoms within a given mass of a compound is fundamental in chemistry, especially when quantifying elements at the atomic level. In this detailed investigation, we will explore the question: How many atoms of hydrogen are there in 36 grams of NH_4NH_4? We will methodically dissect the problem, covering molecular structure, molar calculations, and the conversion between grams and atomic counts, providing a comprehensive explanation suitable for educational and academic review.

Introduction and Context

The compound in question, NH_4NH_4, is a chemical entity that at first glance appears to be a molecular form of ammonium. However, its precise structure and nomenclature are critical to correctly ascertaining the number of constituent atoms, especially hydrogen atoms. The question hinges on understanding the molecular composition, molar mass, and how to translate a mass measurement into a count of individual atoms.

Deciphering the Molecular Formula: What Is NH_4NH_4?

Interpreting NH_4NH_4

The notation NH_4NH_4 suggests a compound consisting of two ammonium groups linked together. It can be viewed as a molecule with the formula:

- NH_4 (ammonium ion)
- NH_4 (another ammonium ion)

When written as NH_4NH_4, it implies a di-ammonium species, potentially a dimer or a compound formed from two ammonium units.

Possible interpretations include:

- A di-ammonium molecule: $(NH_4)_2$
- A salt or a complex: e.g., ammonium hydrazinium or similar structures, but these are less common.

Given the notation, the most straightforward assumption is that the compound has the formula:

$(NH_4)_2$

which is the di-ammonium molecule, with two ammonium groups attached.

Therefore, the molecular formula is:

- $(NH_4)_2$

Determining the Molecular Weight of $(NH_4)_2$

Atomic masses (approximate):

- Hydrogen (H): 1.008 g/mol
- Nitrogen (N): 14.007 g/mol

Calculating molar mass of NH_4

- N: 14.007 g/mol
- H_4: 4 × 1.008 g/mol = 4.032 g/mol

Total molar mass of NH_4:

14.007 + 4.032 = 18.039 g/mol

Molar mass of $(NH_4)_2$

- 2 × 18.039 g/mol = 36.078 g/mol

This matches the given mass of 36 g quite closely, indicating that the molar mass of the compound is approximately 36.078 g/mol. The slight difference is due to rounding.

Calculating the Number of Moles in 36 g of $(NH_4)_2$

The core approach involves converting the given mass into moles:

Number of moles = mass / molar mass

- Mass given: 36 g
- Molar mass of $(NH_4)_2$: 36.078 g/mol

Number of moles:

36 g / 36.078 g/mol ≈ 0.9977 mol

This essentially implies that 36 g of $(NH_4)_2$ is nearly 1 mole of the compound.

Counting the Atoms: Hydrogen in $(NH_4)_2$

Understanding the composition per mole

Since $(NH_4)_2$ contains:

- 2 nitrogen atoms (one per ammonium group)
- 8 hydrogen atoms (4 per ammonium group × 2)

Per mole of $(NH_4)_2$:

- N atoms: 2 mol
- H atoms: 8 mol

Given that in 36 g of $(NH_4)_2$, there are approximately 0.9977 mol, we can determine the total number of atoms by multiplying the moles by Avogadro's number.

Avogadro's Number

- Number of atoms per mole: approximately 6.022×10^{23} atoms

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Calculating Total Hydrogen Atoms

Total hydrogen atoms = number of moles of $(NH_4)_2$ × hydrogen atoms per mole × Avogadro's number

$$
\text{Hydrogen atoms} = 0.9977 \text{ mol} \times 8 \text{ H atoms/molecule} \times 6.022 \times 10^{23} \text{ atoms/mol}
$$

Calculating:

$$
0.9977 \times 8 = 7.9816
$$

then,

$$
7.9816 \times 6.022 \times 10^{23} \approx 7.9816 \times 6.022 \times 10^{23}
$$

Multiplying:

$$
7.9816 \times 6.022 \approx 48.045
$$

Final total number of hydrogen atoms:

$$
\boxed{
\approx 4.8045 \times 10^{24} \text{ hydrogen atoms}
}
$$

Summary and Conclusions

- The compound NH_4NH_4 can be interpreted as $(NH_4)_2$, a di-ammonium molecule.
- The molar mass of $(NH_4)_2$ is approximately 36.078 g/mol.
- In 36 g of this compound, we have roughly 0.9977 mol, nearly 1 mole.
- Each mole of $(NH_4)_2$ contains 8 hydrogen atoms.
- Therefore, 36 g contains approximately 7.98 mol of hydrogen atoms.
- Multiplying by Avogadro's number yields roughly 4.80×10^{24} hydrogen atoms.

Thus, in 36 grams of NH_4NH_4, there are approximately 4.8 quadrillion billion hydrogen atoms.

Additional Considerations and Clarifications

- Structural ambiguities: If the compound were a different form, such as a salt or a different molecular species, the calculation would vary accordingly.
- Purity and isotopic variations: The calculation assumes 100% pure compound and standard atomic weights.
- Relevance: This level of atomic quantification is essential in fields like materials science, pharmacology, and chemical manufacturing, where precise atomic counts influence reaction stoichiometry and material properties.

Final Remarks

This detailed analysis highlights the importance of understanding molecular formulas, molar masses, and atomic numbers when converting macroscopic measurements into atomic counts. By carefully interpreting the molecular structure, performing molar conversions, and applying Avogadro’s number, chemists can precisely determine the number of atoms within any given mass of a compound. The methodology demonstrated here is broadly applicable across chemical calculations, ensuring accuracy and clarity in scientific communication.

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