1. What Is The Mass Of 8.5510 23atoms Of Neon ? Grams 2. How Many Neon Atoms Are There In 35.1 Grams

1. What Is The Mass Of 8.5510 x 1023 atoms Of Neon ? Grams 2. How Many Neon Atoms Are There In 35.1 Grams

Understanding the fundamental properties of elements and their atomic structures is essential in chemistry. Neon, a noble gas known for its inertness and bright orange-red glow when electrified, often appears in discussions about atomic mass and quantities. This comprehensive guide explores two key questions: first, how to calculate the mass in grams of a given number of neon atoms, specifically 8.5510 x 1023 atoms; and second, how many neon atoms are present in 35.1 grams of the element. By delving into atomic theory, molar mass calculations, and stoichiometric conversions, this content aims to provide a clear understanding of these topics, supporting students, educators, and science enthusiasts alike.

Understanding Atomic Mass and Avogadro's Number

Before tackling the specific questions, it is crucial to grasp fundamental concepts:

Atomic Mass of Neon

- Neon (Ne) has an atomic number of 10, meaning it has 10 protons.
- Its atomic mass, as listed on the periodic table, is approximately 20.180 amu (atomic mass units).
- This value represents the average mass of neon atoms, accounting for naturally occurring isotopes.

Avogadro's Number

- Defined as 6.022 x 1023 particles/mol, Avogadro's number is a fundamental constant in chemistry.
- It indicates the number of atoms, molecules, or particles in one mole of a substance.
- This allows chemists to convert between microscopic (atoms) and macroscopic (grams) quantities.

Calculating the Mass of 8.5510×10^{23} Neon Atoms

This section explains step-by-step how to find the mass in grams of a specified number of neon atoms.

Step 1: Understand the Given Data

- Number of neon atoms: 8.5510 x 1023 atoms

Step 2: Connect Atoms to Moles

- Use Avogadro's number to convert atoms to moles:

$$
\text{Number of moles} = \frac{\text{Number of atoms}}{\text{Avogadro's number}}
$$

$$
\text{Number of moles} = \frac{8.5510 \times 10^{23}}{6.022 \times 10^{23}} \approx 1.42\, \text{moles}
$$

Step 3: Calculate the Mass in Grams

- Multiply the number of moles by the molar mass of neon:

$$
\text{Mass} = \text{moles} \times \text{molar mass}
$$

$$
\text{Mass} = 1.42\, \text{mol} \times 20.180\, \text{g/mol} \approx 28.7\, \text{grams}
$$

Final Answer:

- The mass of 8.5510 x 1023 neon atoms is approximately 28.7 grams.

Determining the Number of Neon Atoms in 35.1 Grams

This section covers how to find the total number of neon atoms contained in a given mass.

Step 1: Convert Grams to Moles

- Use the molar mass of neon:

$$
\text{Moles of neon} = \frac{\text{Mass in grams}}{\text{Molar mass}}
$$

$$
\

$$
\text{Moles} = \frac{35.1\, \text{g}}{20.180\, \text{g/mol}} \approx 1.74\, \text{moles}
$$

Step 2: Convert Moles to Number of Atoms

- Multiply moles by Avogadro's number:

$$
\text{Number of atoms} = \text{moles} \times \text{Avogadro's number}
$$

$$
\text{Number of atoms} = 1.74 \times 6.022 \times 10^{23} \approx 1.048 \times 10^{24}
$$

Final Answer:

- There are approximately 1.05 x 1024 neon atoms in 35.1 grams.

Additional Insights and Practical Applications

Understanding these calculations has practical importance across various scientific and industrial fields.

Applications in Industry and Research

- Determining quantities for neon gas in lighting and advertising signs.
- Calculating the amount of neon used in scientific experiments involving gas laws.
- Estimating the amount of neon in environmental samples or astrophysical observations.

Educational Significance

- These calculations reinforce foundational concepts such as atomic mass, molar conversions, and stoichiometry.
- They serve as practical examples for students learning about real-world applications of chemistry principles.

Common Mistakes to Avoid

1. Using incorrect atomic mass values; always verify the latest periodic

table data.

2. Mixing units incorrectly; ensure molar mass is in grams per mole and Avogadro's number is used properly.

3. Misplacing decimal points during calculations; double-check arithmetic steps for accuracy.

Summary and Key Takeaways

- To find the mass of a given number of neon atoms, convert the atoms to moles by dividing by Avogadro's number, then multiply by neon's molar mass.
- To determine the number of neon atoms in a specific mass, convert grams to moles, then multiply by Avogadro's number.
- The molar mass of neon is approximately 20.180 g/mol, and Avogadro's number is 6.022 x 1023 atoms/mol.
- These calculations exemplify the practical application of atomic theory and stoichiometry in both academic and industrial contexts.

By mastering these concepts, students and professionals can accurately perform similar calculations for other elements and compounds, enhancing their proficiency in chemical quantification and analysis.

Meta Description:
Learn how to calculate the mass of 8.5510 x 1023 neon atoms and determine how many neon atoms are in 35.1 grams. Step-by-step explanations of atomic mass, molar conversions, and practical applications.

Frequently Asked Questions

What is the mass of 8.5510×10^{23} atoms of neon in grams?

The mass is approximately 0.022 grams. Using the molar mass of neon (20.18 g/mol) and Avogadro's number (6.022×10^{23} atoms/mol), the calculation is: (8.5510×10^{23} atoms) / (6.022×10^{23} atoms/mol) = 1.42 mol; then, 1.42 mol x 20.18 g/mol ≈ 28.7 grams. However, since the question specifies 8.5510×10^{23} atoms, the precise mass is about 0.0287 grams.

How many neon atoms are present in 35.1 grams of neon?

There are approximately 1.055×10^{24} neon atoms in 35.1 grams. First, find the number of moles: 35.1 g / 20.18 g/mol ≈ 1.74 mol. Then, multiply by Avogadro's number: 1.74 mol x 6.022×10^{23} atoms/mol ≈ 1.048×10^{24} atoms.

How do you calculate the mass of neon given a specific number of atoms?

To calculate the mass, divide the number of atoms by Avogadro's number to find moles, then multiply by the molar mass of neon. For example, mass = (number of atoms / 6.022×10^{23}) x 20.18 g/mol.

If you have 8.5510×10^{23} neon atoms, what is the equivalent amount in moles?

The number of moles is approximately 1.42 mol, calculated by dividing the atoms by Avogadro's number: $8.5510 \times 10^{23} / 6.022 \times 10^{23} \approx 1.42$ mol.

What is the significance of Avogadro's number in calculating the mass and number of atoms of neon?

Avogadro's number (6.022×10^{23}) is used to convert between atoms and moles, allowing you to calculate the mass of a given number of atoms or the number of atoms in a given mass of neon.

Additional Resources

What Is The Mass Of 8.5510×10^{23} Atoms Of Neon? Grams & How Many Neon Atoms Are There In 35.1 Grams?

Understanding the fundamental properties of elements such as neon not only deepens our grasp of chemistry but also enhances our appreciation for the atomic universe that constitutes everything around us. Neon, a noble gas, is renowned for its vibrant glow in neon signs and its role in various scientific applications. Two common yet intriguing questions often arise for students and enthusiasts alike: What is the mass of a specific number of neon atoms? and How many neon atoms are contained within a given mass? Addressing these questions necessitates a clear understanding of atomic mass, Avogadro's number, and the basic principles of molar relationships in chemistry.

Understanding the Foundations: Atomic Mass, Molecules, and Avogadro's Number

Before diving into the specific calculations, it’s essential to establish a solid conceptual framework.

Atomic Mass of Neon

Neon (Ne), with atomic number 10, is a noble gas characterized by a stable electron configuration. Its atomic mass, as listed on the periodic table, is approximately 20.1797 atomic mass units (amu). This value indicates that one mole of neon atoms weighs about 20.1797 grams. Atomic mass (or molar mass) is fundamental for converting between the number of atoms and mass because it links the microscopic world of atoms to macroscopic measurements.

Avogadro's Number

Avogadro's number, approximately 6.022×10^{23}, is a universal constant that defines the number of particles (atoms, molecules, etc.) in one mole of a substance. This number bridges the gap between atomic scale measurements and laboratory-scale quantities, enabling chemists to perform conversions between atoms and grams seamlessly.

Part 1: Calculating the Mass of 8.5510×10^{23} Neon Atoms

This section focuses on translating a given number of neon atoms into grams. The problem asks: What is the mass in grams of 8.5510×10^{23} neon atoms?

Step-by-Step Calculation

Step 1: Recognize what is given

- Number of neon atoms = 8.5510×10^{23} atoms
- Atomic mass of neon = 20.1797 g/mol
- Avogadro's number = 6.022×10^{23} atoms/mol

Step 2: Find the number of moles represented by the given atoms

The number of moles corresponds to the ratio of the number of atoms to Avogadro's number:

$$
\text{Moles of neon} = \frac{\text{Number of atoms}}{\text{Avogadro's number}}
$$

$$
= \frac{8.5510 \times 10^{23}}{6.022 \times 10^{23}}
$$

Dividing the coefficients:

$$
= \frac{8.5510}{6.022} \times 10^{23-23} = 1.420 \times 1 = 1.420 \text{ mol}
$$

Step 3: Convert moles to grams

Using the molar mass:

$$
\text{Mass} = \text{moles} \times \text{molar mass}
$$

$$
= 1.420 \text{ mol} \times 20.1797 \text{ g/mol}
$$

Calculating:

$$
\approx 1.420 \times 20.1797 = 28.695 \text{ grams}
$$

Final Answer:

The mass of 8.5510×10^{23} neon atoms is approximately 28.695 grams.

Part 2: How Many Neon Atoms Are There In 35.1 Grams?

This question offers a different perspective: given a mass of neon, how many atoms does it contain?

Step-by-Step Calculation

Step 1: Recognize what is given

- Mass of neon = 35.1 g
- Atomic mass of neon = 20.1797 g/mol
- Avogadro's number = 6.022×10^{23} atoms/mol

Step 2: Convert grams to moles

The number of moles in 35.1 grams:

$$
\text{Moles} = \frac{\text{Mass}}{\text{Molar mass}} = \frac{35.1}{20.1797} \approx 1.740 \text{ mol}
$$

Step 3: Convert moles to atoms

Number of atoms:

$$
\text{Atoms} = \text{moles} \times \text{Avogadro's number} = 1.740 \times 6.022 \times 10^{23}
$$

Calculating:

$$
1.740 \times 6.022 \times 10^{23} \approx (1.740 \times 6.022) \times 10^{23} = 10.471 \times 10^{23} = 1.0471 \times 10^{24}
$$

Final Answer:

There are approximately 1.047×10^{24} neon atoms in 35.1 grams of neon.

Implications and Applications of These Calculations

Significance of Atomic and Molar Calculations

These calculations exemplify core principles of stoichiometry, a cornerstone of chemistry. They demonstrate how atomic-scale quantities translate into measurable quantities in the laboratory. Such conversions are vital in various scientific contexts:

- Industrial Gas Production: Estimating the amount of neon needed for manufacturing processes.
- Scientific Research: Determining the number of atoms involved in experiments involving noble gases.
- Environmental Monitoring: Quantifying atmospheric neon levels.

Practical Considerations

While the calculations above provide straightforward numeric results, real-world applications often involve additional factors:

- Purity of Neon Samples: Commercial neon gases are rarely 100% pure, impacting calculations.
- Measurement Uncertainties: Precision in atomic masses and constants affects the accuracy.
- Temperature and Pressure Conditions: For gases, volume and pressure influence measurements, although for atomic calculations, these are secondary.

Limitations and Assumptions

The calculations assume ideal conditions:

- The atomic mass is constant; however, isotopic variations can slightly alter molar mass.
- Avogadro's number is exact for practical purposes, though it is a defined constant.
- The sample is pure neon, with no contamination.

Conclusion: Bridging the Atomic and Macroscopic Worlds

The exploration of neon's atomic and molar quantities reveals the elegant simplicity of atomic theory and its practicality in everyday measurements. Calculating the mass of a specific number of atoms (or vice versa) underscores the importance of fundamental constants like the atomic mass and Avogadro's number. These calculations are not merely academic exercises but are integral to scientific research, industrial applications, and understanding the universe at its most fundamental level.

By mastering these conversions, scientists and students alike can appreciate the remarkable scale of atomic matter and harness this knowledge for innovations in chemistry, physics, and engineering. Neon, with its

characteristic glow and stability, thus serves as an ideal example of how microscopic properties influence macroscopic phenomena, illustrating the profound interconnectedness of the atomic realm and our tangible world.

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