How Many Moles Of Tunsten Are In 4.8 X 10^25

How Many Moles Of Tungsten Are In 4.8 X 10^25

Understanding the quantity of a substance in terms of moles is fundamental in chemistry, especially when dealing with large quantities such as 4.8 × 10^25 particles. In this article, we will explore how to convert this number into moles specifically for tungsten, a transition metal known for its high melting point and robust physical properties. By the end of this comprehensive guide, you'll be able to accurately determine how many moles of tungsten are present in this vast number of atoms or particles.

Understanding the Concept of the Mole

What Is a Mole in Chemistry?

The mole is a standard SI unit used to quantify the amount of substance. It provides a bridge between the microscopic world of atoms and molecules and the macroscopic quantities we can measure in the laboratory.

- Definition: One mole contains exactly 6.02214076 × 10^23 elementary entities (atoms, molecules, ions, etc.).
- Significance: This number is known as Avogadro's number and serves as a fundamental constant in chemistry.

Why Use Moles?

Using moles simplifies calculations involving large numbers of particles because it converts microscopic counts into manageable quantities. For example, instead of counting individual tungsten atoms, chemists can work with moles to facilitate stoichiometric calculations, reactions, and mass conversions.

Calculating Moles From Particles or Number of Atoms

The Conversion Formula

To convert a given number of particles to moles, use the fundamental relationship:

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

Where:
- Number of particles = 4.8 × 10^25 (as given)
- Avogadro's number = 6.022 × 10^23

Applying the Formula

Plugging in the values:

$$
\text{Moles of tungsten} = \frac{4.8 \times 10^{25}}{6.022 \times 10^{23}}
$$

Step-by-Step Calculation

1. Simplify the Numerical Part

Divide the coefficients:

$$
\frac{4.8}{6.022} \approx 0.796
$$

2. Simplify the Exponents

Recall that when dividing powers of 10:

$$
10^{25} ÷ 10^{23} = 10^{25 - 23} = 10^2
$$

3. Combine the Results

Putting it all together:

$$
\text{Moles of tungsten} \approx 0.796 \times 10^{2} = 0.796 \times 100 = 79.6
$$

Result: There are approximately 79.6 moles of tungsten in 4.8 × 10^25 particles.

Understanding the Significance of the Result

Implications in Chemistry and Industry

Knowing the number of moles helps in various applications:

- Material Science: Estimating the mass of tungsten in manufacturing processes.
- Chemical Reactions: Calculating reactant quantities in tungsten-related chemical reactions.
- Research: Understanding atomic-scale phenomena involving tungsten atoms.

Mass of Tungsten Corresponding to 79.6 Moles

To find the mass, multiply the number of moles by the molar mass:

- Atomic mass of Tungsten (W): approximately 183.84 g/mol.

$$
\text{Mass} = 79.6 \text{ mol} \times 183.84 \text{ g/mol} \approx 14649.6\, \text{g}
$$

which is roughly 14.65 kilograms of tungsten.

Additional Factors and Considerations

Assumptions in the Calculation

This calculation assumes that the particles are individual atoms of tungsten, not molecules or compounds.

Application in Real-World Contexts

- Bulk Material: If dealing with tungsten in bulk form, mass measurements are often more relevant.
- Atomic vs. Molecular: Since tungsten is a metal, it exists as a lattice of atoms rather than molecules, so counting atoms directly aligns with the calculation.

Limitations

- The calculation doesn’t account for isotopic variations of tungsten, which are typically negligible in

everyday calculations.
- For reactions involving tungsten compounds, molar conversions would need to consider molecular weights instead.

Summary and Key Takeaways

- To find the number of moles in a given number of particles, divide the total particles by Avogadro's number.
- For 4.8 × 10^25 particles of tungsten, the calculation yields approximately 79.6 moles.
- The corresponding mass of tungsten for this number of moles is approximately 14.65 kilograms.
- Understanding these conversions is essential for practical applications in chemistry, industry, and research.

Practical Tips for Calculations

- Always verify the units and constants used.
- Use scientific notation carefully to simplify calculations involving large or small numbers.
- Remember that the molar mass is crucial when converting moles to grams or vice versa.
- When dealing with large quantities, double-check calculations to avoid errors.

Conclusion

Converting between the number of particles and moles is a foundational skill in chemistry, enabling scientists and students to bridge the microscopic and macroscopic worlds. In this case, by dividing 4.8 × 10^25 particles of tungsten by Avogadro's number, we find that there are approximately 79.6 moles of tungsten. This knowledge is vital for various scientific and industrial applications, from material synthesis to chemical reaction planning.

By mastering these calculations, you gain a powerful tool to analyze and interpret quantities at the atomic level, broadening your understanding of the material world and enhancing your proficiency in chemistry.

Frequently Asked Questions

How do I calculate the number of moles from a given number of atoms or particles?

To calculate moles from particles, divide the total number of particles by Avogadro's number (6.022×10^{23}).

What is the number of moles of tungsten in 4.8×10^{25} atoms?

The number of moles is approximately 79.7 moles, calculated by dividing 4.8×10^{25} by 6.022×10^{23}.

How do I perform the calculation for moles given the number of atoms?

Use the formula: moles = number of atoms / Avogadro's number. For 4.8×10^{25} atoms, divide by 6.022×10^{23}.

What is Avogadro's number and why is it important in this calculation?

Avogadro's number is 6.022×10^{23}, representing the number of particles in one mole of substance. It's used to convert between particles and moles.

Is 4.8×10^{25} atoms of tungsten a large or small amount?

It's a very large quantity, corresponding to approximately 79.7 moles of tungsten atoms.

Can I use this method to find moles of other elements given their number of atoms?

Yes, the same method applies to any element: divide the number of atoms by Avogadro's number to find the number of moles.

If I have 1 mole of tungsten atoms, how many atoms is that?

One mole of tungsten contains exactly 6.022×10^{23} atoms, by definition of a mole.

Why is understanding moles important in chemistry?

Moles allow chemists to count particles and relate microscopic quantities to measurable amounts in laboratory reactions.

What is the approximate mass of 79.7 moles of tungsten?

Since the molar mass of tungsten is about 183.84 g/mol, the mass is approximately $79.7 \times 183.84 \approx 14{,}661$ grams or about 14.66 kilograms.

Additional Resources

How Many Moles Of Tungsten Are In 4.8×10^{25}?
Understanding how to convert a quantity of atoms or particles into moles is a fundamental skill in chemistry, especially when dealing with large numbers like 4.8×10^{25}. When asked, "How many moles of tungsten are in 4.8×10^{25}?" the question hinges on understanding the relationship between the number of particles and the mole unit. Tungsten, known for its high melting point and durability, is represented by the chemical symbol W and has a molar mass of approximately 183.84 g/mol. This guide will walk you through the process of converting a given number of tungsten atoms into moles, explaining the underlying concepts, the necessary calculations, and practical applications.

Understanding the Concept of a Mole

Before diving into calculations, it's essential to grasp what a mole represents in chemistry. The mole is a standard SI unit used to quantify the amount of substance. One mole contains exactly 6.022×10^{23} particles (atoms, molecules, ions, etc.), known as Avogadro's number.

Key Points:
- 1 mole = 6.022×10^{23} particles
- The mole bridges the gap between the microscopic world of atoms and the macroscopic world of grams and liters.
- Converting between particles and moles involves dividing or multiplying by Avogadro's number.

Step-by-Step Breakdown of the Conversion Process

Given:
- Number of tungsten atoms: 4.8×10^{25}

Goal:
- Find how many moles of tungsten are in this number of atoms.

Step 1: Write the conversion formula

The basic relation:

Number of moles (n) = Number of particles / Avogadro's number

Mathematically:

$n = N / N_A$

Where:
- n = number of moles
- N = number of particles (atoms, molecules)
- N_A = Avogadro's number = 6.022×10^{23}

Step 2: Substitute the known values

Plugging in the given values:

$n = 4.8 \times 10^{25} / 6.022 \times 10^{23}$

Step 3: Carry out the division

Divide the coefficients and subtract the exponents:

- Coefficients: 4.8 / 6.022 ≈ 0.7967
- Exponents: 25 - 23 = 2

So,

$n \approx 0.7967 \times 10^{2}$

Step 4: Simplify the scientific notation

$n \approx 7.967 \times 10^{1}$

Final Result:

Approximately 79.7 moles of tungsten are in 4.8×10^{25} atoms.

Additional Considerations

While the above calculation directly answers the question, understanding related aspects can deepen your grasp of the topic.

Molar Mass of Tungsten (W)

- Atomic weight: 183.84 g/mol
- Useful when converting moles to grams, or vice versa.

Practical Applications

- Calculating the mass of tungsten corresponding to a specific number of atoms
- Estimating quantities in industrial processes or laboratory experiments
- Converting microscopic particle counts into macroscopic quantities

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How Many Grams of Tungsten Correspond to 79.7 Moles?

If you want to determine the mass of 79.7 moles of tungsten:

Mass (g) = Moles × Molar mass

$\text{Mass} = 79.7 \text{ mol} \times 183.84 \text{ g/mol} \approx 14666.45 \text{ g}$

This is roughly 14.67 kilograms of tungsten, illustrating the massive scale of particles involved when dealing with such large atom counts.

Summary and Key Takeaways

- To find the number of moles from a given number of atoms, divide by Avogadro's number.
- For 4.8×10^{25} atoms of tungsten:
- Number of moles ≈ 79.7 mol
- Understanding these conversions is critical in fields like materials science, chemistry, and engineering.

Practical Tips for Performing Similar Conversions

1. Always identify the particle count and what unit it’s in.
2. Recall Avogadro's number: 6.022×10^{23}.
3. Use the formula:
Number of moles = Particles / Avogadro's number
4. When converting moles to grams, multiply by the molar mass of the element or compound.
5. Pay attention to scientific notation to avoid errors with large or small numbers.

Final Thoughts

Calculating how many moles are in a certain number of atoms might seem daunting at first, but with a clear understanding of the mole concept and straightforward algebra, the process becomes manageable. Recognizing that 4.8×10^{25} atoms of tungsten correspond approximately to 79.7 moles helps bridge the microscopic and macroscopic worlds, enabling scientists and students alike to quantify substances accurately. Whether for academic purposes, industrial applications, or research, mastering these conversions is a fundamental skill in the chemist’s toolkit.

References

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- Avogadro’s Number and Its Applications. (n.d.). Royal Society of Chemistry.

This guide aims to provide a comprehensive understanding of how to convert large numbers of atoms into moles, using tungsten as an example. With practice, such calculations become second nature, allowing for precise quantification in various scientific contexts.

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