A 145 ML Flask Contains Argon At 1.3 Atm And 65 C. What Amount Of Ar Is Present? Answer In Units Of Mol.

A 145 ML Flask Contains Argon At 1.3 Atm And 65 C. What Amount Of Ar Is Present? Answer In Units Of Mol.

Understanding the precise amount of a gas in a given container is fundamental in chemistry, especially when dealing with gases under various conditions. Whether you're a student preparing for exams, a researcher conducting experiments, or a professional working in industries like welding, cryogenics, or gas manufacturing, being able to calculate the number of moles of a gas like argon is essential. This article provides a comprehensive guide on how to determine the amount of argon present in a 145 mL flask at specified temperature and pressure conditions, expressed in units of moles.

Introduction to Gas Laws and Their Relevance

Gases are unique among the states of matter because they are highly compressible and their behavior can be accurately described using mathematical relationships known as gas laws. These laws relate the pressure, volume, temperature, and amount of gas (in moles). The ideal gas law, in particular, is widely used for calculations involving gases under a range of conditions.

The ideal gas law is expressed as:

$$ PV = nRT $$

Where:
- P = Pressure (in atmospheres, atm)
- V = Volume (in liters, L)
- n = Number of moles (mol)
- R = Ideal gas constant ($0.0821\, \text{L·atm/(mol·K)}$)
- T = Temperature (in Kelvin, K)

Applying this law allows us to determine the number of moles of argon in the flask given the pressure, volume, and temperature.

Understanding the Given Data

Before performing any calculations, it's important to interpret and convert the given data into compatible units:

- Volume (V): 145 mL
- Pressure (P): 1.3 atm
- Temperature (T): 65°C

Since the ideal gas law requires volume in liters and temperature in Kelvin, conversions are necessary:

- Volume: $145\, \text{mL} = 0.145\, \text{L}$
- Temperature: $65\,^\circ C = 65 + 273.15 = 338.15\, \text{K}$

The pressure is already in atm, which is compatible with the gas constant used.

Calculating the Number of Moles of Argon

Using the ideal gas law:

$$n = \frac{PV}{RT}$$

Substituting the known values:

$$n = \frac{(1.3\, \text{atm}) \times (0.145\, \text{L})}{(0.0821\, \text{L·atm/(mol·K)}) \times (338.15\, \text{K})}$$

Let's perform the calculation step-by-step:

1. Calculate the numerator:

$$1.3 \times 0.145 = 0.1885$$

2. Calculate the denominator:

$$0.0821 \times 338.15 \approx 27.754$$

3. Compute the moles:

$$n = \frac{0.1885}{27.754} \approx 0.0068\, \text{mol}$$

Result: The flask contains approximately 0.0068 moles of argon.

Understanding the Significance of the Calculation

Determining the number of moles of argon in the flask provides vital information for various applications:

- Industrial Gas Storage: Ensuring the correct amount of argon is stored for welding or laboratory use.
- Chemical Reactions: Calculating reactant quantities in processes involving argon.
- Laboratory Experiments: Maintaining precise gas amounts for controlled experiments.
- Safety and Compliance: Verifying pressure and volume relationships to prevent leaks or over-pressurization.

Knowing how to perform such calculations enhances precision and efficiency across scientific and industrial fields.

Additional Considerations in Gas Calculations

While the ideal gas law offers a straightforward method, real gases can deviate from ideal behavior, especially under high pressure or low temperature. For argon, which is a noble gas with relatively low intermolecular forces, the ideal gas approximation is generally valid under standard laboratory conditions.

Factors to consider:

- Non-ideal Behavior: At high pressures or low temperatures, corrections might be needed using Van der Waals equation.
- Gas Purity: Impurities can affect the calculations if the sample isn't purely argon.
- Container Conditions: Ensure the container is at equilibrium and the gas is uniformly distributed.

Practical Example: Step-by-Step Summary

To summarize, here is a quick step-by-step guide to calculating the number of moles of a gas in a container:

1. Identify the given data:

- Volume in mL or cm^3
- Pressure in atm, Pa, or other units
- Temperature in °C or K

2. Convert units to standard units compatible with the ideal gas law:
- Volume to liters
- Temperature to Kelvin
- Pressure to atm (if necessary)

3. Apply the ideal gas law:

$$ n = \frac{PV}{RT} $$

4. Perform the calculation carefully, considering significant figures.

Conclusion

In this comprehensive guide, we've demonstrated how to determine the amount of argon in a 145 mL flask at 1.3 atm and 65°C, expressed in moles. Using the ideal gas law, the calculation yields approximately 0.0068 mol of argon. This process underscores the importance of unit conversions and understanding gas behavior principles. Mastery of these calculations is invaluable across scientific disciplines, ensuring accurate measurements and safe practices in handling gases.

Remember: Always verify the units before plugging values into the ideal gas law, and consider real-world deviations when working under extreme conditions. With this knowledge, you're well-equipped to analyze and interpret gas-related scenarios confidently and accurately.

Frequently Asked Questions

How do you calculate the amount of argon in moles in a flask given its volume, pressure, and temperature?

Use the Ideal Gas Law: n = (PV) / (RT), where P is pressure in atm, V is volume in liters, R is the gas constant (0.0821 L·atm/(mol·K)), and T is temperature in Kelvin.

What is the molar amount of argon in a 145 mL flask at 1.3 atm and 65°C?

First, convert volume to liters: 0.145 L. Convert temperature to Kelvin: 65 +

273.15 = 338.15 K. Then, apply the ideal gas law: n = (1.3 atm × 0.145 L) / (0.0821 L·atm/(mol·K) × 338.15 K) ≈ 0.0072 mol.

Why do we convert temperature to Kelvin when calculating moles using the Ideal Gas Law?

Because the ideal gas law requires temperature to be in Kelvin to ensure proportionality and avoid negative or invalid values, as Kelvin is an absolute temperature scale.

If the pressure or temperature changes, how does it affect the amount of argon calculated in the flask?

Increasing pressure or temperature will increase the calculated number of moles if volume remains constant, according to the ideal gas law. Conversely, decreasing either will reduce the molar amount.

What assumptions are made when using the ideal gas law for calculating the amount of argon in the flask?

The assumptions include that the gas particles do not interact and occupy negligible volume, and that the gas behaves ideally under the given conditions.

Additional Resources

A 145 ML Flask Contains Argon At 1.3 Atm And 65°C. What Amount Of Ar Is Present? Answer In Units Of Mol.

Understanding the amount of a gas present in a container is fundamental in chemistry, especially in fields like gas law applications, industrial processes, and laboratory experiments. Today, we delve into a practical problem involving argon gas within a flask, exploring how to determine its molar quantity based on given parameters. This investigation combines principles of the ideal gas law with real-world measurement units, offering a comprehensive guide for students and professionals alike.

Fundamentals of Gas Laws in Context

Before tackling the specific problem, it’s essential to revisit the core principles governing gases. The Ideal Gas Law is the cornerstone of such calculations:

$$ PV = nRT $$

Where:
- P = pressure (in atmospheres, atm)
- V = volume (in liters, L)
- n = number of moles (mol)
- R = ideal gas constant (0.0821 L·atm/(mol·K))
- T = temperature (in Kelvin, K)

This equation relates the measurable physical properties of gases to the amount of substance, providing a pathway to compute molar quantities when other parameters are known.

Step-by-Step Breakdown of the Problem

The problem provides:
- Volume of the flask: 145 mL
- Pressure: 1.3 atm
- Temperature: 65°C

Our goal: Determine the number of moles of argon gas (Ar) present inside the flask.

Key points:
- Convert units as necessary to align with the ideal gas law.
- Use the ideal gas law to solve for n.

---

1. Converting Units for Compatibility

Since the ideal gas law uses volume in liters and temperature in Kelvin, the initial step involves unit conversions.

- Volume Conversion:

$$
145\, \text{mL} = \frac{145}{1000} = 0.145\, \text{L}
$$

- Temperature Conversion:

Celsius to Kelvin:

\[

$$
T(K) = T(°C) + 273.15
$$

$$
T = 65 + 273.15 = 338.15\, \text{K}
$$

For simplicity, we can round to 338.15 K or 338.2 K as needed.

- Pressure:

Already given in atm, no conversion necessary.

Applying the Ideal Gas Law

With all units properly converted, we can substitute the known values into the ideal gas law:

$$
n = \frac{PV}{RT}
$$

Where:
- $P = 1.3\, \text{atm}$
- $V = 0.145\, \text{L}$
- $R = 0.0821\, \text{L·atm/(mol·K)}$
- $T = 338.15\, \text{K}$

Calculating:

$$
n = \frac{(1.3\, \text{atm})(0.145\, \text{L})}{(0.0821\, \text{L·atm/(mol·K)})(338.15\, \text{K})}
$$

Breaking down numerator and denominator:

- Numerator:

$$
1.3 \times 0.145 = 0.1885
$$

- Denominator:

$$
0.0821 \times 338.15 \approx 27.75
$$

\]

Now, compute:

\[
n = \frac{0.1885}{27.75} \approx 0.0068\, \text{mol}
\]

Result:

\[
\boxed{
\text{Number of moles of argon} \approx 0.0068\, \text{mol}
}
\]

Interpreting the Result: Significance and Applications

The calculation reveals that approximately 6.8 millimoles of argon are contained within the flask. While this might seem like a small quantity, it’s typical in laboratory settings where precise measurements of gases are crucial.

Implications:

- Industrial processes: Knowing the molar amount helps in scaling reactions or ensuring correct gas proportions.
- Research experiments: Accurate molar calculations underpin the reproducibility of experimental results.
- Storage and safety: Understanding the quantity of inert gases like argon aids in safe handling and storage.

Additional Considerations and Real-World Factors

While the ideal gas law provides an excellent approximation, several factors can influence the actual amount of gas, including:

- Gas deviation from ideality: At high pressures or low temperatures, gases may deviate from ideal behavior. Argon, being a noble gas, behaves fairly ideally under typical conditions, but corrections might sometimes be necessary.

- Container integrity: Ensuring the flask is perfectly sealed and at uniform temperature is crucial for accurate calculations.

- Measurement accuracy: Slight errors in volume measurement, temperature reading, or pressure gauge calibration can affect the final molar calculation.

Advanced considerations:

- For more precise calculations, especially at extreme conditions, real gas equations like Van der Waals might be used.
- When dealing with non-idealities, correction factors can be applied to the ideal gas law.

Conclusion: Harnessing Fundamental Principles for Practical Problems

Determining the amount of argon in a flask using fundamental gas laws exemplifies the practical application of theoretical chemistry. By converting units appropriately and applying the ideal gas law, we find that approximately 0.0068 mol of argon resides in the 145 mL flask under the given conditions. This calculation underscores the importance of understanding gas behavior, unit conversions, and the assumptions underlying the ideal gas law in real-world scenarios.

Whether in the lab, industry, or research, mastering these calculations enhances our ability to manipulate and predict gas quantities with confidence and precision, contributing to advancements across scientific disciplines.

A 145 Ml Flask Contains Argon At 1 3 Atm And 65 C What Amount Of Ar Is Present Answer In Units Of Mol

A 145 Ml Flask Contains Argon At 1 3 Atm And 65 C What Amount Of Ar Is Present Answer In Units Of Mol

Related Articles

- According To The Passage, The Most Likely Recipient Of A Microloan, Under The Original Concept By Yunus,

- 1. Adichie Claims That Power Affects Which Stories Are Told, How They Are Told, And Which Stories Become
- According To Michel Foucault, The Development Of Modern Medicine Transformed Perceptions Of Disease From

Back to Home