What Volume (in Ml) Of 0.0887 M Mgbr2 Solution Is Needed To Make 275.0 Ml Of 0.0224 M Mgbr2 Solution?

What Volume (in Ml) Of 0.0887 M Mgbr2 Solution Is Needed To Make 275.0 Ml Of 0.0224 M Mgbr2 Solution?
Determining the volume of a concentrated magnesium bromide ($MgBr_2$) solution required to prepare a specific volume of a more dilute solution is a common calculation in chemistry. This process, known as dilution, involves understanding concentrations, molarity, and the relationships between volume and molar amounts. In this article, we will explore how to calculate the volume of 0.0887 M $MgBr_2$ solution needed to produce 275.0 mL of a 0.0224 M $MgBr_2$ solution. We will break down the steps involved, explain the underlying concepts, and discuss practical applications of this calculation in laboratory settings.

Understanding the Basics: Molarity and Dilution

What is Molarity?

Molarity (M) is a measure of concentration in chemistry, expressed as moles of solute per liter of solution. It indicates how many moles of a substance are dissolved in a specific volume of solution. The formula for molarity is:

$$
\text{Molarity} (M) = \frac{\text{moles of solute}}{\text{liters of solution}}
$$

For example, a 0.0887 M $MgBr_2$ solution contains 0.0887 moles of $MgBr_2$ per liter of solution.

What is Dilution?

Dilution involves decreasing the concentration of a solution by adding solvent, usually water, without changing the amount of solute. The key relationship in dilution is:

$$
C_1 V_1 = C_2 V_2
$$

Where:
- C_1 = initial concentration (molarity)
- V_1 = volume of the initial concentrated solution needed
- C_2 = final concentration after dilution
- V_2 = final volume of the diluted solution

This formula allows us to determine the required volume of concentrated stock solution to prepare a desired volume of diluted solution at a specific concentration.

Step-by-Step Calculation of the Required Volume

Given Data:

- Initial concentration, $C_1 = 0.0887\, \text{M}$
- Final concentration, $C_2 = 0.0224\, \text{M}$
- Final volume, $V_2 = 275.0\, \text{mL}$

Step 1: Convert Final Volume to Liters

Since molarity is expressed in moles per liter, convert the final volume from milliliters to liters:

$$
V_2 = 275.0\, \text{mL} \times \frac{1\, \text{L}}{1000\, \text{mL}} = 0.275\, \text{L}
$$

Step 2: Apply the Dilution Formula

Using $C_1 V_1 = C_2 V_2$, solve for V_1:

$$
V_1 = \frac{C_2 \times V_2}{C_1}
$$

Plugging in the values:

$$
V_1 = \frac{0.0224\, \text{M} \times 0.275\, \text{L}}{0.0887\, \text{M}}
$$

Calculate numerator:

$$
0.0224 \times 0.275 = 0.00616
$$

Now, divide by C_1:

$$
V_1 = \frac{0.00616}{0.0887} \approx 0.0694\, \text{L}
$$

Convert back to milliliters:

$$
V_1 = 0.0694\, \text{L} \times 1000 = 69.4\, \text{mL}
$$

Therefore, approximately 69.4 mL of 0.0887 M $MgBr_2$ solution is needed to prepare 275.0 mL of 0.0224 M $MgBr_2$ solution.

Practical Applications and Considerations

Laboratory Preparation of Diluted Solutions

Knowing how to calculate the required volume of a stock solution is essential for chemists and laboratory technicians. Whether preparing solutions for experiments, calibration standards, or industrial processes, accurate calculations ensure consistency and reliability.

Key Points to Remember:

- Always convert volumes to liters when working with molarity.
- Use the dilution formula carefully, ensuring units are consistent.
- Round calculations appropriately, considering the precision required for your application.
- Use accurate measuring equipment to transfer the calculated volume.

Safety Tips When Handling $MgBr_2$ Solutions

- Wear appropriate personal protective equipment, such as gloves and goggles.
- Handle solutions in a well-ventilated area.
- Follow proper waste disposal protocols for chemical solutions.

Additional Tips for Accurate Dilution Calculations

- Double-check your initial and final concentrations before performing calculations.
- Use calibrated pipettes and volumetric flasks for precise measurement.
- When scaling up or down, always maintain the ratio $C_1 V_1 = C_2 V_2$.
- Keep records of calculations and measurements for reproducibility.

Summary of the Calculation Process

To summarize, here are the key steps involved in calculating the volume of a concentrated $MgBr_2$ solution needed:

1. Convert the desired final volume from milliliters to liters.
2. Apply the dilution formula $V_1 = \frac{C_2 \times V_2}{C_1}$.
3. Substitute the known values into the formula.
4. Perform the calculation to find V_1.
5. Convert the result back to milliliters for practical measurement.

By following these steps, you can confidently determine the volume of stock solution needed for your specific dilution requirements.

Conclusion

Calculating the volume of a concentrated $MgBr_2$ solution required to prepare a diluted solution is a fundamental skill in chemistry, vital for accurate experimental work. In this scenario, approximately 69.4 mL of 0.0887 M $MgBr_2$ solution is needed to produce 275.0 mL of a 0.0224 M $MgBr_2$ solution. Mastery of dilution concepts not only ensures precise laboratory procedures but also enhances understanding of solution chemistry principles. Whether you're a student, researcher, or professional chemist, understanding and applying these calculations is essential for successful experimental outcomes.

Frequently Asked Questions

How do I calculate the volume of 0.0887 M $MgBr_2$

solution required to prepare 275.0 mL of 0.0224 M $MgBr_2$ solution?

You can use the dilution formula: $C_1V_1 = C_2V_2$. Plugging in the values: $V_1 = (C_2 \times V_2) / C_1 = (0.0224\ M \times 275.0\ mL) / 0.0887\ M \approx 69.4\ mL$.

What is the significance of molarity when preparing solutions of $MgBr_2$?

Molarity indicates the concentration of $MgBr_2$ in moles per liter, which helps determine the precise volume needed for dilution to achieve a desired concentration.

If I only have 50 mL of 0.0887 M $MgBr_2$ solution, can I prepare the 275.0 mL of 0.0224 M $MgBr_2$ solution?

No, because you need approximately 69.4 mL of the stock solution to make the desired dilution. With only 50 mL available, you cannot prepare the full 275.0 mL at the target concentration.

What is the role of the dilution equation in preparing solutions?

The dilution equation ($C_1V_1 = C_2V_2$) relates the concentrations and volumes of concentrated and diluted solutions, allowing accurate calculation of the volume needed from the stock solution.

How does the concentration of the stock solution (0.0887 M) affect the volume needed to prepare a lower concentration (0.0224 M)?

The higher the concentration of the stock solution, the smaller the volume required to reach the desired lower concentration through dilution, illustrating the inverse relationship between concentration and volume in the dilution equation.

Why is it important to mix thoroughly after adding the calculated volume of $MgBr_2$ stock solution when preparing the diluted solution?

Thorough mixing ensures the solution is homogeneous, providing an accurate and uniform concentration throughout the entire volume.

Additional Resources

What Volume (in Ml) Of 0.0887 M Mgbr2 Solution Is Needed To Make 275.0 Ml Of 0.0224 M Mgbr2 Solution?

In the realm of chemistry, solutions are foundational to countless applications—from laboratory experiments to industrial processes. A common challenge faced by chemists and students alike is determining the amount of a concentrated solution required to prepare a desired volume and concentration of a diluted solution. Today, we explore a specific example involving magnesium bromide ($MgBr_2$), a compound frequently used in various chemical contexts. The question at hand is: What volume (in milliliters) of a 0.0887 M $MgBr_2$ solution is necessary to produce 275.0 mL of a 0.0224 M $MgBr_2$ solution?

This problem exemplifies the concept of dilution, a fundamental principle in chemistry that allows us to modify solution concentrations by adding solvent. Through a detailed step-by-step calculation, an understanding of molarity and the dilution formula will be established, providing clarity on how to approach similar questions in laboratory settings.

Understanding the Core Concepts: Molarity and Dilution

Before tackling the problem, it is essential to understand two key concepts: molarity and dilution.

What is Molarity?

Molarity (M) is a measure of concentration, defined as the number of moles of solute dissolved in one liter (1000 mL) of solution. Its formula is:

$$
\text{Molarity (M)} = \frac{\text{moles of solute}}{\text{liters of solution}}
$$

For example, a 0.0887 M $MgBr_2$ solution contains 0.0887 moles of $MgBr_2$ per liter of solution.

The Principle of Dilution

Dilution involves adding solvent (usually water) to a solution to decrease

its concentration without changing the amount of solute. The fundamental relationship governing dilution is:

$$
C_1 V_1 = C_2 V_2
$$

Where:
- C_1 = initial concentration (molarity) of the stock solution
- V_1 = volume of the stock solution needed
- C_2 = desired concentration of the diluted solution
- V_2 = final volume of the diluted solution

This equation assumes no loss of solute during the process, making it ideal for precise laboratory calculations.

Applying the Dilution Formula to $MgBr_2$ Solutions

With the foundational concepts in hand, we now approach the specific problem:

- Stock solution concentration, $C_1 = 0.0887\, \text{M}$
- Desired solution concentration, $C_2 = 0.0224\, \text{M}$
- Final volume of the diluted solution, $V_2 = 275.0\, \text{mL}$

Our goal is to find the volume of the stock solution, V_1, necessary to prepare this diluted solution.

Step 1: Convert Volumes to Consistent Units

Since molarity is in mol/L, convert the final volume from milliliters to liters:

$$
V_2 = 275.0\, \text{mL} = \frac{275.0}{1000} = 0.275\, \text{L}
$$

Similarly, the volume V_1 we seek will be in milliliters, but for the calculation, it is often easier to keep all volumes in liters.

Step 2: Rearrange the Dilution Equation

The formula:

$$
V_1 = \frac{C_2 V_2}{C_1}
$$

allows us to directly compute V_1.

Step 3: Perform the Calculation

Plugging in the known values:

$$
V_1 = \frac{0.0224\, \text{M} \times 0.275\, \text{L}}{0.0887\, \text{M}}
$$

Calculating numerator:

$$
0.0224 \times 0.275 = 0.00616\, \text{mol}
$$

Now, divide by C_1:

$$
V_1 = \frac{0.00616\, \text{mol}}{0.0887\, \text{mol/L}} \approx 0.0694\, \text{L}
$$

Convert back to milliliters:

$$
V_1 = 0.0694\, \text{L} \times 1000 = 69.4\, \text{mL}
$$

Result: Approximately 69.4 mL of the 0.0887 M $MgBr_2$ solution is required to prepare 275.0 mL of a 0.0224 M $MgBr_2$ solution.

Interpreting the Result and Practical Considerations

Having arrived at the numerical answer, it's important to interpret and consider practical aspects:

- Precision: The calculation provides a precise volume, but in the laboratory, measurement uncertainties can influence the exact amount. Using calibrated pipettes or burettes ensures accuracy.

- Preparation Steps: To prepare the diluted solution:
1. Measure approximately 69.4 mL of the concentrated $MgBr_2$ solution.
2. Transfer it to a volumetric flask.
3. Add distilled water gradually until reaching the total volume of 275.0 mL.
4. Mix thoroughly to ensure homogeneity.

- Safety and Handling: $MgBr_2$ solutions should be handled with appropriate safety measures, including gloves and eye protection, especially at higher concentrations.

Broader Implications in Laboratory and Industrial Settings

This calculation exemplifies a common task in chemistry labs—preparing solutions of specific concentrations from stock solutions. Understanding dilution principles is crucial for:

- Experimental consistency: Ensuring solutions are prepared accurately for reproducible results.
- Resource management: Using concentrated stock solutions efficiently to minimize waste.
- Safety compliance: Avoiding unnecessary handling of large volumes of concentrated chemicals.

In industrial contexts, such principles underpin large-scale manufacturing processes, quality control, and formulation of products.

Conclusion: Mastering the Art of Dilution

Calculations

The problem of determining the volume of a concentrated $MgBr_2$ solution needed to create a desired diluted solution underscores a fundamental aspect of chemical preparation. By leveraging the dilution equation $C_1 V_1 = C_2 V_2$, chemists can accurately plan and execute solution preparations with precision. In this specific case, approximately 69.4 mL of a 0.0887 M $MgBr_2$ solution is needed to produce 275.0 mL of a 0.0224 M solution.

Mastering such calculations enhances laboratory efficiency, safety, and reproducibility—cornerstones of good scientific practice. Whether in academic research, clinical labs, or industrial manufacturing, understanding and applying the principles of molarity and dilution remain vital skills for chemists and scientists worldwide.

What Volume In Ml Of 0 0887 M Mgbr2 Solution Is Needed To Make 275 0 Ml Of 0 0224 M Mgbr2 Solution

What Volume In Ml Of 0 0887 M Mgbr2 Solution Is Needed To Make 275 0 Ml Of 0 0224 M Mgbr2 Solution

Related Articles

- . To Simplify The Analysis Of Demand Shocks In An Open, Two-economy, Short-run Model, We Assume All Of
- Which Approach To Addressing Resistance To Change Is Most Commonly Used In A Crisis When Leaders Need
- 2.66 The Device Shown Consists Of A Disk That Is Rotated By A Shaft. The Disk Is Positioned Very Close

Back to Home