

Calculate The Molarity Of A Solution Prepared By Diluting 7.0 ML Of 4.0 M Solution To A Volume Of 30

Calculate The Molarity Of A Solution Prepared By Diluting 7.0 ML Of 4.0 M Solution To A Volume Of 30 is a common problem encountered in chemistry laboratories and academic settings. This calculation involves understanding the relationship between concentration, volume, and molarity, especially when diluting a concentrated solution to a desired volume. Whether you're a student preparing for exams or a professional working in a lab, mastering this concept is essential for accurate solution preparation and analysis. In this article, we will explore the fundamentals of molarity, the process of dilution, step-by-step calculation methods, and practical applications to ensure you have a comprehensive understanding of how to determine the molarity of a diluted solution.

Understanding Molarity and Dilution in Chemistry

What Is Molarity?

Molarity (M) is a measure of concentration that expresses the number of moles of solute dissolved in one liter of solution. It is defined as:

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

For example, a 4.0 M solution contains 4.0 moles of solute per liter of solution.

What Is Dilution?

Dilution refers to the process of decreasing the concentration of a solute in a solution by adding more solvent without adding additional solute. The key principle behind dilution is that the number of moles of solute remains constant before and after the process.

The fundamental formula for dilution is:

$$C_1V_1 = C_2V_2$$

Where:

- C_1 = initial concentration (molarity)
- V_1 = initial volume
- C_2 = final concentration (molarity)
- V_2 = final volume

This equation is derived from the fact that:

$$n_{\text{moles before}} = n_{\text{moles after}}$$

$$C_1V_1 = C_2V_2$$

Step-by-Step Calculation of Molarity After Dilution

Given the problem: You have an initial solution of 4.0 M concentration, volume of 7.0 mL, which you dilute to a total volume of 30 mL. Your goal is to find the molarity of the final solution, C_2 .

Step 1: Convert Volumes to Liters

Since molarity calculations are based on liters, convert all volumes from milliliters to liters:

- Initial volume V_1 :

$$7.0 \text{ mL} = 7.0 \times 10^{-3} \text{ L}$$

- Final volume V_2 :

$$30 \text{ mL} = 30 \times 10^{-3} \text{ L} = 0.030 \text{ L}$$

Step 2: Apply the Dilution Formula

Using the formula:

$$C_1V_1 = C_2V_2$$

Plugging in the known values:

$$4.0 \text{ M} \times 7.0 \times 10^{-3} \text{ L} = C_2 \times 0.030 \text{ L}$$

Step 3: Solve for C_2

Rearranged formula:

$$C_2 = \frac{C_1V_1}{V_2}$$

Calculating:

$$C_2 = \frac{4.0 \times 7.0 \times 10^{-3}}{0.030}$$

$$C_2 = \frac{0.028}{0.030}$$

$$C_2 \approx 0.933 \text{ M}$$

Final answer:

The molarity of the diluted solution is approximately 0.93 M.

Additional Considerations and Practical Tips

Precision in Measurement

- Always use precise measuring equipment, such as micropipettes or burettes, when measuring small volumes.
- Ensure all measurements are in consistent units (liters for volume, molarity in mol/L).

Significant Figures

- Maintain the appropriate number of significant figures based on the precision of your measurements.
- In the example, since volumes are given to two significant figures, the molarity is rounded to two significant figures.

Common Mistakes to Avoid

- Forgetting to convert milliliters to liters.
- Mixing up initial and final volumes or concentrations.
- Using incorrect units or inconsistent units throughout the calculation.
- Assuming the solution's volume is additive without proper calculation.

Practical Applications of Molarity Calculations

Laboratory Solution Preparation

Knowing how to accurately calculate molarity after dilution is essential for preparing solutions with precise concentrations required for experiments, titrations, or chemical reactions.

Pharmaceuticals and Medical Applications

Molarity calculations help in preparing drug solutions, ensuring correct dosages and concentrations for patient safety.

Industrial Chemistry

Manufacturers rely on molarity calculations for mixing chemicals, quality control, and process optimization.

Environmental Chemistry

Calculating concentrations of pollutants or nutrients in water samples often involves similar molarity calculations.

Additional Examples and Practice Problems

Example 1:

A 2.5 M stock solution is diluted to 250 mL to prepare a 0.5 M solution. What was the initial volume of the stock solution used?

Solution:

Using $(C_1V_1 = C_2V_2)$:

$$V_1 = \frac{C_2V_2}{C_1}$$

$$V_1 = \frac{0.5\text{ M} \times 0.250\text{ L}}{2.5\text{ M}}$$

$$V_1 = \frac{0.125}{2.5} = 0.05\text{ L} = 50\text{ mL}$$

Answer: 50 mL of the 2.5 M stock solution is needed.

Practice Problem:

You have a 10.0 M hydrochloric acid (HCl) solution. How much of this solution should you dilute with water to prepare 500 mL of a 0.1 M HCl solution?

Solution:

$$V_1 = \frac{C_2V_2}{C_1}$$

$$V_1 = \frac{0.1\text{ M} \times 0.500\text{ L}}{10.0\text{ M}}$$

$$V_1 = \frac{0.05}{10} = 0.005\text{ L} = 5\text{ mL}$$

Answer: Use 5 mL of 10 M HCl and dilute to 500 mL total volume.

Conclusion

Calculating the molarity of a solution after dilution is a fundamental skill in chemistry that ensures accurate solution preparation and proper experimental results. The key is understanding the relationship between initial and final concentrations and volumes, encapsulated in the dilution formula $(C_1V_1 = C_2V_2)$. By carefully converting units, applying the formula correctly, and considering practical measurement tips, chemists and students can confidently determine the molarity of their solutions. Whether preparing solutions for lab experiments, industrial processes, or research, mastering these calculations enhances precision, safety, and scientific integrity.

Summary of Key Points

- Molarity expresses the concentration of solute per liter of solution.
 - Dilution involves decreasing concentration by adding solvent, keeping moles constant.
 - The core formula: $(C_1V_1 = C_2V_2)$.
 - Always convert milliliters to liters before calculations.
 - Maintain significant figures based on measurement precision.
 - Practical applications span laboratories, industry, medicine, and environmental science.
-

By understanding and applying these principles, you can confidently calculate the molarity of any diluted solution, ensuring accuracy and efficiency in all your chemical endeavors.

Frequently Asked Questions

How do you calculate the molarity of a diluted solution when a known volume of a concentrated solution is diluted to a larger volume?

You can use the dilution formula $M_1V_1 = M_2V_2$, where M_1 and V_1 are the molarity and volume of the original solution, and M_2 and V_2 are those of the diluted solution. Rearranged, $M_2 = (M_1 \times V_1) / V_2$.

What is the molarity of a solution prepared by diluting 7.0 mL of a 4.0 M solution to a total volume of 30 mL?

Using the dilution formula: $M_2 = (M_1 \times V_1) / V_2 = (4.0 \text{ M} \times 7.0 \text{ mL}) / 30 \text{ mL} = 28 / 30 \approx 0.93 \text{ M}$. So, the molarity of the diluted solution is approximately 0.93 M.

Why is it important to keep units consistent when calculating

molarity after dilution?

Maintaining consistent units (e.g., mL or L) ensures accurate calculations. If volumes are in different units, conversions are necessary; otherwise, the calculated molarity will be incorrect.

If you dilute a 4.0 M solution of 7.0 mL to 30 mL, what is the percentage decrease in molarity?

The molarity decreases from 4.0 M to approximately 0.93 M. The percentage decrease is $((4.0 - 0.93) / 4.0) \times 100\% \approx 76.75\%$.

What are common mistakes to avoid when calculating molarity after dilution?

Common mistakes include forgetting to convert volumes to the same units, using incorrect values for initial or final volumes, and not applying the dilution formula correctly. Double-check all units and calculations to ensure accuracy.

Additional Resources

Calculate The Molarity Of A Solution Prepared By Diluting 7.0 mL Of 4.0 M Solution To A Volume Of 30 mL is a common yet fundamental problem in chemistry that illustrates the principles of solution dilution. Understanding how to perform this calculation is essential for students, researchers, and professionals working in laboratories where precise concentrations are critical. This guide provides a comprehensive step-by-step approach to solving such problems, ensuring clarity and confidence in your calculations.

Introduction to Solution Dilution and Molarity

In chemistry, molarity (M) is a measure of concentration expressed as moles of solute per liter of solution. When a solution is diluted — that is, when its volume is increased without adding more solute — the number of moles of solute remains constant, but the concentration decreases. Recognizing the relationship between the initial and final states of a solution is key to understanding and calculating molarity after dilution.

The core principle that underpins dilution calculations is the dilution formula:

$$C_1 V_1 = C_2 V_2$$

Where:

- C_1 = initial concentration (molarity)
- V_1 = initial volume
- C_2 = final concentration (molarity)
- V_2 = final volume

This equation assumes no loss of solute during the process, making it ideal for calculating unknown molarities after dilution.

Step-by-Step Guide to Calculating Final Molarity

Let's break down the problem: You start with 7.0 mL of a 4.0 M solution and dilute it to a final volume of 30 mL. Your goal is to find the molarity (C_2) of the resulting solution.

Step 1: Identify Known Values

- Initial volume, $(V_1) = 7.0 \text{ mL}$
- Initial molarity, $(C_1) = 4.0 \text{ M}$
- Final volume, $(V_2) = 30 \text{ mL}$
- Final molarity, $(C_2) = ?$ (unknown)

Step 2: Convert Volumes to Consistent Units

Since molarity is expressed in mol/L, convert milliliters to liters:

$$V_1 = 7.0 \text{ mL} = 0.007 \text{ L}$$
$$V_2 = 30 \text{ mL} = 0.030 \text{ L}$$

Step 3: Apply the Dilution Formula

Plug known values into the equation:

$$C_1 V_1 = C_2 V_2$$

Rearranged to solve for (C_2) :

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

Substituting the known values:

$$C_2 = \frac{(4.0 \text{ M})(0.007 \text{ L})}{0.030 \text{ L}}$$

Step 4: Perform the Calculation

Calculate numerator:

$$4.0 \text{ M} \times 0.007 \text{ L} = 0.028 \text{ mol}$$

Now, divide by the final volume:

$$C_2 = \frac{0.028 \text{ mol}}{0.030 \text{ L}} \approx 0.933 \text{ M}$$

Final answer:

$$\boxed{\text{The molarity of the diluted solution is approximately } 0.933 \text{ M}}$$

Additional Considerations and Tips

Understanding the Impact of Dilution

- When a solution is diluted, the total number of moles of solute remains unchanged.
- The molarity decreases proportionally to the increase in volume.

Practical Applications

- Preparing solutions of precise molarity for titrations.
- Adjusting concentrations in chemical experiments.
- Diluting stock solutions to desired working concentrations.

Common Mistakes to Avoid

- Forgetting to convert volumes to liters.
- Mixing up initial and final volumes.
- Assuming molarity remains the same after dilution.

Tips for Accurate Calculations

- Always double-check unit conversions.
- Keep track of significant figures based on the given data.
- Use a calculator for precise division, especially when dealing with small or large numbers.

Additional Practice Problems

1. If 5.0 mL of a 2.0 M solution is diluted to 50 mL, what is the molarity of the new solution?
2. A scientist prepares 100 mL of a 0.5 M solution by diluting 10 mL of a 2.0 M stock solution. Is this calculation correct? If not, what volume of stock solution should be used?
3. How much of a 6.0 M solution is needed to prepare 250 mL of a 0.2 M solution?

Conclusion

Mastering the calculation of molarity after dilution is a foundational skill in chemistry that enables precise solution preparation and experimentation. By understanding the dilution formula and practicing with real-world examples, chemists can confidently manipulate solution concentrations to meet specific experimental needs. Remember to pay attention to units, maintain the conservation of moles, and verify calculations to ensure accuracy in all your chemical endeavors.

Final Remarks

Whether you're preparing reagents, conducting experiments, or solving academic problems, the ability to calculate the molarity of a diluted solution is invaluable. With practice, this process becomes second nature, empowering you to handle a wide array of solution preparation challenges with confidence and precision.

Calculate The Molarity Of A Solution Prepared By Diluting 7 0 Ml Of 4 0 M Solution To A Volume Of 30

Calculate The Molarity Of A Solution Prepared By Diluting 7 0 Ml Of 4 0 M Solution To A Volume Of 30

Related Articles

- [After 12.6 S, A Spinning Roulette Wheel Has Slowed Down To An Angular Velocity Of 1.32 Rad/s. During](#)
- [Consider Historical Data Showing That The Average Annual Rate Of Return On The S&P 500 Portfolio](#)
- [A Train Moves Away From A Station At 50 M/s. The Train Blows Its Whistle That Has A Frequency Of 520](#)

[Back to Home](#)