

A 1.50 Molar Dextrose Solution Is Diluted By Taking 86.8 MLs Of The Solution And Diluting It To A Final

A 1.50 Molar Dextrose Solution Is Diluted By Taking 86.8 MLs Of The Solution And Diluting It To A Final is a common procedure in laboratories and medical settings, involving precise calculations to achieve desired concentrations for various applications. Whether preparing intravenous fluids, conducting research experiments, or manufacturing food products, understanding how to accurately dilute a molar solution like dextrose (glucose) is essential. This article will explore the process of diluting a 1.50 M dextrose solution, including the underlying chemistry principles, step-by-step procedures, and practical considerations to ensure accuracy and safety.

Understanding Molarity and Its Importance in Dilution Processes

What Is Molarity?

Molarity (M) is a measurement of concentration representing the number of moles of solute (in this case, dextrose) dissolved in one liter of solution. It is expressed as moles per liter (mol/L). A 1.50 M solution contains 1.50 moles of dextrose per liter of solution, making it a relatively concentrated form suitable for various medical and scientific uses.

Why Dilute a Molar Solution?

Dilution is performed to adjust the concentration of a solution to meet specific requirements. For instance:

- Creating IV fluids with appropriate glucose levels
- Preparing laboratory standards for experiments
- Adjusting concentrations for food manufacturing

Diluting a higher molarity solution like 1.50 M dextrose allows for precise control over the final concentration, ensuring safety and efficacy.

Calculating the Dilution: Key Principles and Formulas

The Basic Dilution Equation

The primary formula used for dilutions is:

$$C_1 V_1 = C_2 V_2$$

where:

- C_1 = initial concentration (1.50 M)
- V_1 = volume of concentrated solution used (86.8 mL)
- C_2 = final concentration after dilution (desired)
- V_2 = final total volume of the diluted solution (to be determined)

This equation ensures the amount of solute remains constant during dilution, only spread over a larger volume.

Determining the Final Volume or Concentration

Depending on the goal, you might:

- Calculate the final volume based on a desired concentration
- Determine the final concentration after diluting a known volume

For example, if you want to find the final volume (V_2) when diluting 86.8 mL of 1.50 M dextrose to a specific concentration, you can rearrange the formula:

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

Conversely, to find the final concentration after diluting 86.8 mL to a known final volume, you can use:

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

Practical Step-by-Step: Diluting 86.8 mL of 1.50 M Dextrose Solution

Step 1: Gather Materials and Equipment

Ensure you have:

- 1.50 M dextrose stock solution
- Measuring cylinders or pipettes capable of measuring 86.8 mL
- Graduated mixing container or volumetric flask
- Distilled or sterile water (or appropriate diluent)
- Stirring rod or magnetic stirrer
- Personal protective equipment (gloves, goggles)

Step 2: Calculate the Desired Final Concentration or Volume

Suppose your goal is to prepare 500 mL of a lower concentration solution, say 0.50 M, from the 1.50 M stock.

Using the dilution formula:

$$V_1 = \frac{C_2 V_2}{C_1} = \frac{0.50 \text{ M} \times 500 \text{ mL}}{1.50 \text{ M}} \approx 166.67 \text{ mL}$$

In this case, you would need approximately 166.67 mL of the 1.50 M solution and dilute it to 500 mL total volume.

Alternatively, if you are asked specifically to dilute 86.8 mL of 1.50 M dextrose solution, and want to find the final concentration after dilution to a specific volume, proceed accordingly.

Step 3: Measure the Stock Solution

Using a graduated cylinder or pipette, accurately measure 86.8 mL of the 1.50 M dextrose solution.

Step 4: Add Diluent to Reach Final Volume

Choose the appropriate final volume based on your calculation. For example:

- If diluting to 200 mL total volume, transfer 86.8 mL of stock solution into a volumetric flask or container.
- Add distilled water gradually until the total volume reaches 200 mL.

Stir gently to ensure homogeneity.

Step 5: Verify and Record the Final Concentration

Calculate the final concentration:

$$C_2 = \frac{C_1 V_1}{V_2} = \frac{1.50 \text{ M} \times 86.8 \text{ mL}}{200 \text{ mL}} = 0.651 \text{ M}$$

This means the final solution has approximately 0.651 M dextrose.

Practical Applications and Safety Considerations

Applications of Diluted Dextrose Solutions

Diluted dextrose solutions are extensively used in:

- Intravenous therapy for providing calories and hydration
- Laboratory experiments requiring specific glucose concentrations
- Food manufacturing for sweetening or preservation
- Research studies involving cell culture or biochemical assays

Safety Tips and Best Practices

When handling dextrose solutions:

- Always wear appropriate PPE to prevent contamination or exposure
- Use calibrated equipment for measurement to ensure accuracy
- Label solutions clearly with concentration, date, and preparation details
- Follow proper disposal procedures for chemical waste
- Ensure sterility if preparing solutions for medical use

Common Troubleshooting and Tips for Accurate Dilution

Ensuring Precision in Measurements

- Use high-quality, calibrated pipettes and volumetric flasks.
- Avoid parallax errors when reading measurements.
- Perform multiple measurements if necessary to confirm accuracy.

Dealing with Concentration Variations

- Always verify the concentration of stock solutions before dilution.
- Account for temperature effects, as they can influence volume and concentration.
- When diluting large volumes, consider preparing intermediate dilutions to improve accuracy.

Conclusion: Mastering the Art of Dilution in Laboratory Settings

Diluting a 1.50 M dextrose solution by taking 86.8 mL of it and adjusting to a desired final volume is a fundamental skill in scientific and medical laboratories. Understanding the principles of molarity, precise calculations, and careful measurement practices ensures the creation of accurate, safe, and effective solutions for a variety of applications. Whether preparing solutions for intravenous therapy, research, or food industry processes, mastering dilution techniques is vital for achieving consistent and reliable results.

By following the step-by-step procedures outlined above and adhering to safety guidelines, professionals can confidently perform dilutions, contributing to successful outcomes in their respective fields. Remember, meticulous attention to detail and proper laboratory practices are the keys to ensuring accuracy and safety in every dilution process.

Frequently Asked Questions

How do you calculate the concentration of a diluted dextrose solution after taking 86.8 mL from a 1.50 M stock solution?

You can use the dilution formula $C_1V_1 = C_2V_2$, where C_1 is the initial concentration (1.50 M), V_1 is the volume taken (86.8 mL), and V_2 is the final volume after dilution. Rearranging gives $C_2 = (C_1 \times V_1) / V_2$.

What is the final concentration of dextrose if 86.8 mL of a 1.50 M solution is diluted to a total volume of 500 mL?

Using the dilution formula: $C_2 = (1.50 \text{ M} \times 86.8 \text{ mL}) / 500 \text{ mL} = 0.260 \text{ M}$. Therefore, the final concentration is approximately 0.260 M.

Why is it important to accurately measure the volume when diluting a dextrose solution?

Accurate measurement ensures the correct final concentration, which is critical for medical, laboratory, or industrial applications where precise glucose levels are necessary.

Can you dilute a 1.50 M dextrose solution by taking a smaller volume and diluting to a larger volume? How does this affect the concentration?

Yes, by taking a smaller volume and diluting it to a larger volume, the concentration decreases proportionally. The final concentration depends on the initial volume taken and the total volume after dilution, following the dilution formula.

What safety precautions should be taken when preparing and diluting a dextrose solution in the laboratory?

Wear appropriate personal protective equipment such as gloves and goggles, work in a well-ventilated area, ensure accurate measurement tools are used, and dispose of any waste according to safety protocols to prevent contamination and exposure.

Additional Resources

A 1.50 Molar Dextrose Solution Is Diluted By Taking 86.8 mL Of The Solution And Diluting It To A Final Volume

Introduction

In the realm of laboratory and clinical chemistry, precise solution preparation is fundamental for accurate experimentation and diagnostics. Among these, dextrose (glucose) solutions are pivotal, serving roles ranging from nutritional support in hospitals to calibration standards in analytical chemistry. A common laboratory procedure involves diluting a concentrated stock solution to achieve a desired molarity or concentration tailored for specific applications. This article explores the detailed process of diluting a 1.50 M dextrose solution by extracting 86.8 mL of it and diluting it to a final volume, examining the principles, calculations, and practical considerations involved.

Understanding the Basics: Molarity and Dilution Principles

What Is Molarity?

Molarity (M) is a measure of concentration expressing the number of moles of solute per liter of solution. For dextrose, a molar solution of 1.50 M indicates that each liter contains 1.50 moles of glucose molecules.

The Concept of Dilution

Dilution involves reducing the concentration of a solute in solution by adding solvent, usually water, without altering the amount of solute present. The fundamental relation governing dilution is:

$$C_1 V_1 = C_2 V_2$$

Where:

- C_1 = initial concentration
- V_1 = initial volume taken
- C_2 = final concentration
- V_2 = final volume

This formula ensures the amount of solute remains constant before and after dilution.

Practical Scenario: Diluting 86.8 mL of 1.50 M Dextrose Solution

Step 1: Establishing the Known Quantities

- Initial concentration (C_1): 1.50 M
- Volume taken (V_1): 86.8 mL (which is 0.0868 L)
- Target: Final volume (V_2): To be determined based on desired final concentration or volume.

Suppose the goal is to prepare a specific volume of diluted solution with a certain molarity, or simply to understand how the concentration changes upon dilution.

Calculations and Analytical Approach

Determining the Amount of Dextrose in the Taken Sample

First, compute the moles of glucose in the 86.8 mL sample:

$$\text{Moles of glucose} = C_1 \times V_1 = 1.50 \, \text{mol/L} \times 0.0868 \, \text{L} = 0.1302 \, \text{mol}$$

This value remains constant regardless of the final volume, as no solute is added or removed during dilution.

Calculating Final Concentration for a Given Final Volume

If, for example, the diluted solution is to be 1 liter (1000 mL), then:

$$C_2 = \frac{\text{Moles of glucose}}{V_2} = \frac{0.1302 \, \text{mol}}{1.000 \, \text{L}} = 0.1302 \, \text{M}$$

$$C_2 = \frac{\text{moles of glucose}}{V_2} = \frac{0.1302 \text{ mol}}{1.0 \text{ L}} = 0.1302 \text{ M}$$

Alternatively, if the desired final concentration is specified, the final volume can be calculated accordingly.

Practical Applications and Implications

Laboratory Preparation of Dextrose Solutions

In many laboratories, preparing solutions of accurate molarity is vital for experiments, calibration, or medical formulations. The process involves:

1. Measuring a precise volume of a concentrated stock solution.
2. Diluting it to a known final volume with solvent.
3. Ensuring homogeneity and stability.

This process allows for flexibility in preparing solutions with specific molarities, whether for biological assays, cell culture media, or infusion preparations.

Medical and Clinical Significance

In clinical settings, dextrose solutions are used intravenously to provide energy and hydration. The concentration must be carefully controlled to prevent complications such as hyperglycemia or osmotic imbalances. Understanding dilution principles ensures safe preparation and administration.

Practical Considerations in Dilution Procedures

Accuracy of Measurement

- Use calibrated pipettes or burettes for measuring small volumes.
- Ensure that the container used for final volume measurement is precise and clean.

Homogeneity of the Solution

- Mix thoroughly after dilution to ensure uniform concentration.
- Use magnetic stirrers or gentle swirling where appropriate.

Stability and Storage

- Some dextrose solutions may have limited stability; prepare fresh when possible.
- Store solutions at appropriate temperatures to prevent microbial growth or degradation.

Advanced Topics: Dilution Strategies and Error Minimization

Serial Dilutions

When preparing very dilute solutions, serial dilutions—successively diluting in steps—can improve accuracy and reduce errors.

Error Propagation

Small inaccuracies in volume measurement can lead to significant deviations in concentration. Employing precise instruments and techniques minimizes such errors.

Calculating Dilution Factors

The dilution factor (DF) is:

$$DF = \frac{V_2}{V_1}$$

For example, if you dilute 86.8 mL to a final volume of 868 mL, the dilution factor is 10, and the final concentration becomes:

$$C_2 = \frac{C_1}{DF} = \frac{1.50}{10} = 0.15 \text{ M}$$

Case Study: Designing a Dilution Protocol

Suppose a researcher needs 500 mL of a 0.50 M dextrose solution from a 1.50 M stock solution. The steps would be:

1. Calculate V_1 :

$$V_1 = \frac{C_2 \times V_2}{C_1} = \frac{0.50 \text{ M} \times 0.5 \text{ L}}{1.50 \text{ M}} = \frac{0.25}{1.50} \approx 0.167 \text{ L} = 167 \text{ mL}$$

2. Procedure:

- Measure 167 mL of the 1.50 M stock solution.
- Transfer it to a volumetric flask.
- Add distilled water to reach the final volume of 500 mL.
- Mix thoroughly.

This method exemplifies the practical application of dilution calculations in real-world laboratory settings.

Environmental and Safety Considerations

- Handle solutions with care, avoiding spills and ingestion.
- Dispose of excess solutions following safety guidelines.
- Use appropriate personal protective equipment (PPE).

Conclusion

Diluting a 1.50 M dextrose solution by extracting 86.8 mL and adjusting to a desired final volume encapsulates core principles of solution chemistry—namely, molarity, volume measurement, and precise calculation. Such procedures are foundational in both research and clinical environments, emphasizing the importance of accuracy and understanding in solution preparation. Whether for experimental calibration, medical infusion, or biochemical assays, mastering dilution techniques ensures reliability, safety, and efficacy in scientific and medical practice.

Understanding the underlying principles not only facilitates correct solution preparation but also enhances appreciation of how concentration, volume, and molar calculations interrelate—cornerstones of analytical chemistry and laboratory science.

Note: The specific final volume and concentration depend on the experimental or clinical requirements. The calculations and procedures outlined here serve as a comprehensive guide adaptable to various contexts involving dextrose solution dilutions.

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