How To Prepare This Solution : Using A 100 Ml Graduated Cyylinder Measure Out 5.47 Ml Of A 3.20 M Mgcl2

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Introduction

Preparing precise chemical solutions is a fundamental task in laboratories, research facilities, and educational settings. Whether you're conducting experiments, performing titrations, or preparing standards, accuracy in measurement is crucial for obtaining reliable and reproducible results. In this article, we will guide you step-by-step on how to prepare a specific volume of magnesium chloride ($MgCl_2$) solution at a defined molarity, using a 100 mL graduated cylinder to measure out exactly 5.47 mL of a 3.20 M $MgCl_2$ stock solution.

Understanding the Context

Magnesium chloride ($MgCl_2$) is a common salt used in various applications including chemical syntheses, biological research, and industrial processes. Ensuring the correct concentration of $MgCl_2$ in your solution is vital for experimental integrity. The process involves two main steps:

1. Measuring the exact volume of the concentrated $MgCl_2$ stock solution.
2. Diluting this volume with a solvent, typically distilled water, to achieve the desired final concentration and volume.

This guide emphasizes accuracy, safety, and best practices to ensure your solution is prepared correctly.

Prerequisites and Safety Precautions

Before beginning, ensure you have the following:

- A clean, dry 100 mL graduated cylinder
- A pipette or syringe capable of measuring small volumes accurately
- Distilled or deionized water
- Personal protective equipment (gloves, lab coat, safety goggles)
- Analytical balance (if needed for further calculations)
- Stirring rod or magnetic stirrer (optional)

Safety notes:

- Handle $MgCl_2$ with care; although it is relatively safe, avoid ingestion or inhalation of dust.
- Always wear appropriate PPE.
- Work in a well-ventilated area.
- Dispose of waste solutions according to your institution's safety protocols.

Step-by-Step Procedure

Step 1: Calculate the Volume of $MgCl_2$ Stock Solution Needed

The key to preparing your solution is understanding the relationship between molarity, volume, and moles.

Given Data:

- Desired concentration (C_1): Not specified directly, but the question involves measuring 5.47 mL of a 3.20 M $MgCl_2$ solution.
- Stock solution molarity (C_2): 3.20 M
- Volume of stock solution to measure (V_2): 5.47 mL (0.00547 L)

First, determine the number of moles of $MgCl_2$ in the measured volume:

Number of moles (n):

$n = C_2 \times V_2$

$n = 3.20 \text{ mol/L} \times 0.00547 \text{ L}$

$n \approx 0.017504 \text{ mol}$

This is the amount of $MgCl_2$ in the volume you will measure.

Step 2: Decide on the Final Concentration and Volume

Suppose your goal is to prepare a specific volume of a diluted $MgCl_2$ solution at a certain molarity (for example, 0.1 M). To determine the final volume (V_f), use the dilution formula:

$C_1 \times V\_f = C_2 \times V_2$

Where:

- C_1 = final desired molarity
- V_f = final volume
- C_2 = stock solution molarity (3.20 M)
- V_2 = volume of stock solution used (5.47 mL)

Assuming you want the final solution to be 0.1 M:

$V\_f = (C_2 \times V_2) / C_1$

$V\_f = (3.20 \text{ mol/L} \times 0.00547 \text{ L}) / 0.1 \text{ mol/L}$

$V\_f \approx 0.017504 \text{ mol} / 0.1 \text{ mol/L}$

$V\_f \approx 0.17504 \text{ L}$ or approximately 175.04 mL

Hence, to prepare 175 mL of 0.1 M $MgCl_2$ solution, you need to dilute 5.47 mL of 3.20 M $MgCl_2$ stock solution to a total volume of 175 mL with distilled water.

Note: Adjust calculations according to your specific target concentration and volume.

Step 3: Measure the $MgCl_2$ Solution Using a 100 mL Graduated Cylinder

- Ensure the graduated cylinder is clean and dry before use.
- Place the cylinder on a flat, stable surface.
- Carefully pour the 3.20 M $MgCl_2$ stock solution into the graduated cylinder

until it reaches the 5.47 mL mark.
- To improve accuracy, eye the measurement at eye level, aligning your line of sight with the meniscus (the curve of the liquid surface).
- Use a pipette or syringe for more precise measurement if available, especially for small volumes.

Step 4: Transfer the Measured $MgCl_2$ Solution

- Gently transfer the measured 5.47 mL of $MgCl_2$ stock solution into a clean container (beaker or volumetric flask).
- Rinse the graduated cylinder with a small amount of distilled water and add this rinse to the container to ensure complete transfer.

Step 5: Dilute to Final Volume

- Add distilled water to the container containing the $MgCl_2$ solution.
- Carefully add water until the total volume reaches your calculated final volume (e.g., 175 mL).
- Mix thoroughly by swirling or using a magnetic stirrer to ensure uniform concentration.

Step 6: Verify the Solution

- If precise molarity is critical, consider verifying the concentration via titration or other analytical methods.
- Label the container with the solution name, concentration, date, and any safety notes.

Additional Tips for Accuracy

- Always use calibrated equipment to ensure measurement precision.
- When measuring small volumes, using a pipette or syringe is recommended over a graduated cylinder.
- Perform measurements at room temperature, as volume can vary with temperature.
- Record all measurements and calculations for reproducibility.

Understanding Dilution and Concentration Calculations

Dilution calculations are fundamental in solution preparation. The key formula:

$C_1 \times V\_f = C_2 \times V_2$

allows you to determine the necessary volumes and concentrations for your desired final solution.

Example Application:

Suppose you need 200 mL of a 0.05 M $MgCl_2$ solution:

$V_2 = (C_1 \times V\_f) / C_2$

$V_2 = (0.05 \text{ mol/L} \times 0.2 \text{ L}) / 3.20 \text{ mol/L}$

$V_2 \approx 0.003125 \text{ L or } 3.125 \text{ mL}$

Measure 3.125 mL of 3.20 M $MgCl_2$ stock solution using a pipette, then dilute to 200 mL with distilled water.

Conclusion

Preparing accurate solutions like this $MgCl_2$ solution requires careful calculations, precise measurement, and proper technique. By following the steps outlined above, you can reliably measure 5.47 mL of a 3.20 M $MgCl_2$ solution using a 100 mL graduated cylinder, then dilute it to your desired final concentration and volume. Remember, attention to detail and adherence to safety protocols are essential for successful solution preparation in any laboratory setting.

Whether you're a student performing a chemistry experiment or a researcher preparing standards, mastering these techniques will ensure your work is accurate, reproducible, and scientifically sound.

Frequently Asked Questions

What are the steps to accurately measure 5.47 mL of $MgCl_2$ solution using a 100 mL graduated cylinder?

First, ensure the graduated cylinder is clean and dry. Carefully pour the $MgCl_2$ solution into the cylinder until the level reaches approximately 5.47 mL. Use the meniscus at eye level to read the measurement precisely, adjusting until the bottom of the meniscus aligns with the 5.47 mL mark.

How do I ensure accurate measurement when using a graduated cylinder for small volumes like 5.47 mL?

Use the graduated cylinder on a flat, stable surface and read the meniscus at eye level to avoid parallax errors. For small volumes, consider using a smaller measuring device like a pipette for greater precision.

What safety precautions should I follow when handling $MgCl_2$ solutions in this measurement process?

Wear appropriate personal protective equipment such as gloves and safety goggles. Work in a well-ventilated area, and handle the solution carefully to avoid spills or ingestion. Wash hands thoroughly after handling.

How do I calculate the amount of $MgCl_2$ needed to prepare this solution at a concentration of 3.20 M?

Use the formula: moles = molarity × volume in liters. For 5.47 mL (0.00547 L), the moles of $MgCl_2$ required are 3.20 mol/L × 0.00547 L ≈ 0.0175 mol. Then, multiply moles by molar mass of $MgCl_2$ (95.21 g/mol) to find the mass needed: 0.0175 mol × 95.21 g/mol ≈ 1.66 g.

What is the purpose of using a graduated cylinder in preparing this solution?

A graduated cylinder provides an accurate and precise measurement of liquid volumes, ensuring the correct amount of $MgCl_2$ solution is used for the preparation process.

Can I prepare this solution directly in the graduated cylinder, or should I use a different container?

It's best to prepare the solution in a beaker or volumetric flask for better mixing and accuracy. Use the graduated cylinder solely for measuring the volume of the solution or solvent needed.

How do I dilute the $MgCl_2$ solution to achieve the desired molarity if starting from a concentrated stock?

Determine the volume of stock solution needed using the dilution formula: $M_1V_1 = M_2V_2$, where M_1 is the stock molarity, V_1 the volume to take, M_2 the desired molarity, and V_2 the final volume. Transfer the calculated volume of stock into a container and add distilled water up to the final volume.

What are common mistakes to avoid when measuring and preparing this solution?

Avoid parallax errors by reading the meniscus at eye level, ensure the graduated cylinder is clean and dry, measure volumes carefully, and double-check calculations for molarity and mass. Also, avoid overfilling or spilling the solution.

How should I store the prepared $MgCl_2$ solution to ensure its stability?

Store the solution in a clean, airtight container labeled with concentration and date. Keep it in a cool, dry place away from direct sunlight and incompatible substances to prevent degradation or contamination.

What equipment do I need besides a 100 mL graduated cylinder to prepare this solution?

You will need a balance for weighing $MgCl_2$, a beaker or volumetric flask for mixing, distilled water for dilution, safety equipment like gloves and goggles, and possibly a pipette or transfer pipette for precise transfers.

Additional Resources

How To Prepare This Solution: Using A 100 mL Graduated Cylinder Measure Out 5.47 mL Of A 3.20 M $MgCl_2$ is a common task in chemistry labs that requires precision and understanding of basic solution preparation techniques. Whether you're a student conducting an experiment or a professional preparing reagents for a larger procedure, knowing how to accurately measure and dilute solutions is essential. This guide provides a comprehensive, step-by-step approach to achieve this specific task, ensuring accuracy, safety, and best laboratory practices.

Understanding the Objective

Before diving into the procedure, it's important to clarify what we're doing:

- Goal: To measure out 5.47 mL of a 3.20 M $MgCl_2$ stock solution.
- Purpose: You might be preparing a diluted solution for a specific assay, calibration, or further reaction.

The challenge here is to accurately measure a small volume (5.47 mL) using a 100 mL graduated cylinder, which is typically designed for larger volumes but can still be used with care for smaller measurements.

Why Use a 100 mL Graduated Cylinder?

A 100 mL graduated cylinder is a common laboratory measuring instrument that offers a good balance between capacity and precision. While it isn't as precise as a burette or micropipette, with proper technique, it can provide reasonably accurate measurements for volumes in the milliliter range.

Key considerations:

- Graduation marks: Usually every 1 mL, sometimes more precise depending on the model.
- Precision: For small volumes like 5.47 mL, extra care is needed to read the meniscus accurately.
- Alternative tools: For even better accuracy, consider using a pipette or a volumetric flask, but for this guide, we'll focus on using the graduated cylinder.

Step-by-Step Guide to Measuring 5.47 mL of a 3.20 M $MgCl_2$ Solution

1. Gather Necessary Materials and Equipment

Ensure you have the following:

- 100 mL graduated cylinder
- The 3.20 M $MgCl_2$ stock solution
- A clean, dry container or beaker
- A pipette or dropper (if available) for more precise measurement
- Distilled or deionized water (for dilution, if needed)
- Lab notebook and pen for recording measurements
- Personal protective equipment: gloves, lab coat, safety goggles

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2. Prepare Your Workspace

- Clean your workspace to avoid contamination.
- Check the graduated cylinder for cleanliness and damage.
- Put on appropriate PPE.
- Ensure the $MgCl_2$ solution is well-mixed before measurement.

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3. Understand Your Measurement Precision

Given that the volume to measure is 5.47 mL, which is less than 6 mL, you

need to:

- Use the bottom of the meniscus at eye level for accurate reading.
- Be aware of the graduation interval (likely 1 mL).
- Recognize that readings may be approximate to within ±0.1 mL — for more precision, consider using a pipette.

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4. Measure the Volume of $MgCl_2$ Solution

Method A: Direct Measurement Using the Graduated Cylinder

- Place the graduated cylinder on a flat, stable surface.
- Carefully pour the $MgCl_2$ solution into the cylinder until the level reaches approximately 6 mL.
- Slowly add or remove small amounts of solution to reach exactly 5.47 mL, reading the meniscus at eye level.
- To do this:

- Pour the solution slowly to avoid overshoot.
- When close to 5.5 mL, add or remove tiny increments.
- When near 5.47 mL, add or remove drops carefully.

Note: Since the graduated cylinder's graduation may be in 1 mL increments, achieving exactly 5.47 mL can be challenging. In such cases, consider:

- Using a pipette or a syringe for more precise measurement.
- If only the graduated cylinder is available, estimate the volume between graduation marks based on the meniscus position.

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5. Enhanced Precision with a Pipette (Recommended)

For high accuracy, especially for small volumes like 5.47 mL:

- Use a micropipette or a volumetric pipette calibrated for 5.47 mL.
- Draw the solution into the pipette carefully, avoiding air bubbles.
- Dispense slowly into the measuring container or directly into the final solution.

Advantage: Pipettes provide a higher degree of accuracy and are preferable for such specific measurements.

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6. Record Your Measurement

- Document the exact volume read from the graduated cylinder.
- Note any observations about the measurement process.
- Repeat the measurement if necessary to ensure consistency.

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7. Transfer the Measured Solution

- Carefully transfer the measured $MgCl_2$ solution into your intended container or to the next step in your procedure.

- Avoid splashing or spilling to maintain accuracy.

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8. Proceed with Dilution or Use as Needed

- If the goal is to prepare a diluted solution, calculate the required dilution factor based on your target concentration.
- Mix thoroughly if diluting.

Additional Tips for Accurate Solution Preparation

- Calibrate your equipment regularly: Ensure your graduated cylinder and pipettes are accurate.
- Use appropriate techniques: Pour slowly, and avoid parallax errors when reading measurements.
- Temperature considerations: Solutions expand or contract with temperature; perform measurements at room temperature.
- Record all measurements: Keep a detailed lab notebook for reproducibility.

Calculations and Considerations

Understanding the concentration:

- Your stock solution: 3.20 M $MgCl_2$
- Volume to measure: 5.47 mL = 0.00547 L

Calculating the amount of $MgCl_2$ in moles:

$$\text{Moles} = \text{Concentration} \times \text{Volume}$$

$$\text{Moles} = 3.20\, \text{mol/L} \times 0.00547\, \text{L} \approx 0.0175\, \text{mol}$$

This value helps if you are preparing dilution solutions or calculating reagent amounts.

Summary

Preparing a precise volume of a solution using a graduated cylinder involves careful measurement, proper technique, and sometimes auxiliary tools like pipettes for greater accuracy. When measuring 5.47 mL of a 3.20 M $MgCl_2$ solution with a 100 mL graduated cylinder:

- Use eye-level readings and read the meniscus carefully.
- Consider using a pipette for better precision.
- Record your measurements meticulously.
- Handle the solution safely, following lab protocols.

By following these detailed steps, you can confidently measure out small volumes of concentrated solutions accurately and reliably, ensuring the success of your experimental procedures.

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