Question 3Not YetansweredPoints Out OfIf You Dissolve 2.70 G Of NaCl In 425 ML Of Water, What Is The

Question 3Not YetansweredPoints Out OfIf You Dissolve 2.70 G Of NaCl In 425 ML Of Water, What Is The query revolves around understanding the concentration of a sodium chloride (NaCl) solution. This type of problem is common in chemistry, especially when dealing with solution preparation, molarity calculations, and solution properties. To accurately determine what is asked, let's explore the key concepts involved, the steps to solve such problems, and practical applications.

Understanding the Problem: Dissolving NaCl in Water

Before jumping into calculations, it’s essential to understand what the problem entails. The question involves dissolving a specific mass of sodium chloride into a given volume of water and then determining a property of the resulting solution. Typically, such questions ask for molarity, molality, or concentration in terms of mass percentage.

In our case, we are given:
- Mass of NaCl: 2.70 grams
- Volume of water: 425 milliliters (mL)

The goal is likely to compute the molarity, which is a common measure of solution concentration.

Key Concepts and Definitions

1. Molarity (M)

Molarity is defined as the number of moles of solute (NaCl) dissolved in one liter of solution:

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

2. Moles of NaCl

To find moles, we need the molar mass of NaCl:
- Sodium (Na): approximately 22.99 g/mol
- Chlorine (Cl): approximately 35.45 g/mol

Total molar mass of NaCl:

$$ 22.99 + 35.45 = 58.44 \text{ g/mol} $$

3. Volume Conversion

Since the volume is given in milliliters, convert it to liters:
$$ 425\, \text{mL} = 0.425\, \text{L} $$

Step-by-Step Solution Approach

1. Calculate the moles of NaCl dissolved.

2. Determine the concentration in molarity.

3. Discuss possible other concentration measures if needed.

Calculating Moles of NaCl

Given:
- Mass of NaCl = 2.70 g
- Molar mass of NaCl = 58.44 g/mol

The number of moles:
$$ \text{moles} = \frac{\text{mass}}{\text{molar mass}} = \frac{2.70\, \text{g}}{58.44\, \text{g/mol}} $$

Calculating:
$$ \text{moles} \approx 0.0462\, \text{mol} $$

Calculating Molarity of the Solution

Using the volume in liters:
$$ \text{volume} = 0.425\, \text{L} $$

Molarity:
$$ M = \frac{0.0462\, \text{mol}}{0.425\, \text{L}} \approx 0.1087\, \text{M} $$

Thus, the solution has a molarity of approximately 0.109 mol/L.

Additional Concentration Measures

Apart from molarity, other ways to express the concentration include:

1. Mass Percent

This measures the mass of solute relative to the total solution:
$$ \text{Mass percent} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100 $$

Assuming the density of water is approximately 1 g/mL:
- Mass of water = 425 mL × 1 g/mL = 425 g
- Total mass of solution = 2.70 g + 425 g = 427.70 g

Mass percent:
$$ \frac{2.70\, \text{g}}{427.70\, \text{g}} \times 100 \approx 0.63\% $$

2. Molality (m)

Molality is moles of solute per kilogram of solvent:
$$ m = \frac{\text{moles of solute}}{\text{kg of solvent}} $$

Mass of water in kg:
$$ 425\, \text{g} = 0.425\, \text{kg} $$

Molality:
$$ m = \frac{0.0462\, \text{mol}}{0.425\, \text{kg}} \approx 0.108\, \text{mol/kg} $$

Practical Applications and Significance

Understanding how to calculate the concentration of a solution has numerous applications:

1. Preparing Solutions for Laboratory Experiments

Knowing how much NaCl to dissolve in water to achieve a desired molarity ensures experiment accuracy.

2. Industrial Processes

In industries like food preservation, pharmaceuticals, and chemical manufacturing, precise concentration calculations are vital.

3. Environmental Monitoring

Determining salt concentrations in water bodies helps assess environmental health and pollution levels.

4. Educational Purposes

These calculations are fundamental for students learning about solution chemistry and preparing for exams.

Common Mistakes to Avoid

- Incorrect volume conversions: Always convert mL to L when calculating molarity.
- Using incorrect molar masses: Double-check molar masses from reliable periodic tables.
- Ignoring density assumptions: When calculating mass percent, the density of water is assumed to be 1 g/mL, which is accurate for dilute solutions.
- Not considering significant figures: Maintain appropriate significant figures based on initial data.

Summary

To summarize, dissolving 2.70 grams of NaCl in 425 mL of water results in a solution with approximately 0.109 mol/L concentration (molarity). Additionally, the solution has a mass percent of about 0.63%, and a molality near 0.108 mol/kg.

Understanding these calculations enables chemists, students, and industry professionals to prepare solutions accurately, interpret experimental results, and ensure quality control. Mastery of solution concentration calculations is fundamental in chemistry, impacting various scientific and practical fields.

Final Thoughts

The process of determining solution concentration from given mass and volume data is straightforward once the key concepts are understood. Always start by converting units properly, calculate moles accurately, and then determine the desired concentration measure. With practice, these calculations become second nature, supporting a wide range of scientific and industrial applications.

If you have further questions about solution chemistry, molarity calculations, or related topics, consult reputable chemistry textbooks or educational websites for more detailed explanations and practice problems.

Frequently Asked Questions

What is the molar mass of NaCl used in calculating its dissolution?

The molar mass of NaCl is approximately 58.44 g/mol.

How do you calculate the molarity of NaCl when dissolving 2.70 g in 425 mL of water?

First, convert grams to moles (2.70 g ÷ 58.44 g/mol), then divide by the volume in liters (0.425 L).

What is the molarity of NaCl in this solution?

The molarity is approximately 0.109 mol ÷ 0.425 L ≈ 0.256 M.

Does dissolving NaCl in water produce a solution that conducts electricity?

Yes, NaCl dissociates into ions in water, making the solution conductive.

What factors affect the solubility of NaCl in water?

Temperature, pressure, and the purity of water influence NaCl's solubility.

Can the solubility of NaCl change significantly with temperature?

NaCl's solubility slightly increases with temperature, but not dramatically.

What is the significance of calculating molarity in solutions like this?

Molarity helps quantify the concentration of solutes, which is essential for reactions and solutions preparations.

Are there any safety precautions when dissolving NaCl in water?

NaCl is generally safe, but handling large quantities or concentrated solutions should be done with proper precautions to avoid spills or irritation.

Additional Resources

Question 3Not YetansweredPoints Out OfIf You Dissolve 2.70 G Of NaCl In 425 ML Of Water, What Is The

The process of dissolving sodium chloride (NaCl) in water is a fundamental concept in chemistry, touching on principles of solubility, molarity, and solution chemistry. The core question—"If you dissolve 2.70 g of NaCl in 425 mL of water, what is the concentration of the solution?"—serves as an excellent example to explore the essential calculations involved in solution preparation and dilute solutions. This article provides a comprehensive, detailed analysis of this problem, delving into the theoretical background, step-by-step calculation procedures, and interpretations relevant to both students and professionals interested in solution chemistry.

Understanding the Problem: Key Concepts and Terminology

Before diving into calculations, it is crucial to understand the core concepts embedded in the question:

What is NaCl?
NaCl, or sodium chloride, is a common salt composed of sodium (Na^+) and chloride (Cl^-) ions. It is highly soluble in water, making it an ideal substance for solution chemistry experiments and applications.

What does "dissolve" mean?
Dissolving NaCl in water involves breaking the ionic bonds in the crystalline salt and dispersing ions uniformly throughout the solvent, creating a homogeneous aqueous solution.

What is the significance of the quantities involved?
- Mass of NaCl (2.70 g): This determines the amount of solute present.
- Volume of water (425 mL): The solvent volume affects the concentration of the resulting solution.

What is the primary goal?
The objective is to determine the concentration of the resulting NaCl solution, typically expressed in molarity (M), which indicates moles of solute per liter of solution.

Step-by-Step Approach to the Solution

Breaking down the problem involves several key steps: converting mass to moles, converting volume to liters, and calculating molarity. Let's explore each in detail.

1. Calculating the molar mass of NaCl

The molar mass of NaCl is obtained by summing atomic masses:

Element	Atomic Mass (g/mol)
Sodium (Na)	22.99
Chlorine (Cl)	35.45

Molar mass of NaCl = 22.99 + 35.45 = 58.44 g/mol

2. Converting grams of NaCl to moles

Using the molar mass, convert the given mass to moles:

$$
\text{Moles of NaCl} = \frac{\text{Mass of NaCl}}{\text{Molar mass of NaCl}} = \frac{2.70\, \text{g}}{58.44\, \text{g/mol}} \approx 0.0462\, \text{mol}
$$

3. Converting milliliters of water to liters

Since molarity is expressed in moles per liter, convert 425 mL to liters:

$$
425\, \text{mL} = 0.425\, \text{L}
$$

4. Calculating the molarity of the solution

Finally, determine the molarity:

$$
\text{Molarity} (M) = \frac{\text{Moles of solute}}{\text{Liters of solution}} = \frac{0.0462\, \text{mol}}{0.425\, \text{L}} \approx 0.1087\, \text{M}
$$

Result: The solution contains approximately 0.109 molar NaCl.

Additional Considerations and Implications

While the calculation appears straightforward, several additional factors and implications merit discussion.

A. Solubility of NaCl in Water

NaCl is highly soluble in water, with a maximum solubility of about 357 g per liter at room temperature (25°C). The amount dissolved in this case (2.70 g in 0.425 L, or roughly 6.35 g/L) is well below the solubility limit, confirming that the salt will dissolve completely under these conditions.

B. Impact of Temperature

Temperature influences solubility; increased temperature generally increases the amount of salt that can dissolve. For this calculation, room temperature assumptions are standard unless specified otherwise.

C. Significance of Solution Concentration

The calculated molarity (~0.109 M) indicates a dilute solution, typical in laboratory settings. Such solutions are used in various applications, including calibrations, titrations, and biological experiments.

D. Real-World Applications

Understanding how to accurately prepare solutions and calculate their molarity is essential for:

- Pharmacology (preparing saline solutions)
- Food industry (salt content analysis)
- Environmental science (water quality testing)
- Industrial processes (chemical manufacturing)

Common Mistakes and Troubleshooting

When performing such calculations, several common pitfalls can occur. Recognizing and avoiding these enhances accuracy:

- Using incorrect molar mass: Always double-check atomic weights.
- Misconverting units: Ensure volume is converted correctly from mL to L.
- Ignoring significant figures: Maintain appropriate precision throughout calculations.
- Assuming complete dissolution without verification: Confirm that the amount of solute is within solubility limits.

Extending the Analysis: Related Calculations and Concepts

The fundamental calculation can be extended to explore various related topics:

1. Mass Percent of NaCl in Solution
Mass percent indicates the mass of solute per 100 g of solution:

$$
\text{Mass percent} = \frac{\text{Mass of NaCl}}{\text{Mass of solution}} \times 100
$$

Assuming the density of water (~1 g/mL), the total solution mass:

$$
\text{Mass of water} \approx 425\, \text{mL} \times 1\, \text{g/mL} = 425\, \text{g}
$$

Total mass of solution:

$$
2.70\, \text{g} + 425\, \text{g} = 427.70\, \text{g}
$$

Mass percent:

$$
\frac{2.70}{427.70} \times 100 \approx 0.63\%
$$

2. Preparing Solutions of Different Concentrations

If a different molarity is desired, the amount of NaCl to add can be calculated:

$$
\text{Mass of NaCl} = \text{Desired molarity} \times \text{Volume in liters} \times \text{Molar mass}
$$

3. Understanding Dilution and Concentration Changes

Adding more water dilutes the solution, decreasing molarity proportionally. Conversely, evaporating water concentrates the solution.

Conclusion: The Significance of Accurate Solution Calculations

The calculation of solution concentration, as exemplified by dissolving 2.70 g of NaCl into 425 mL of water, underscores the importance of precision and understanding in chemical preparations. This process is foundational in laboratory practices, industrial applications, and scientific research. Accurate molarity calculations enable scientists and technicians to reproduce experiments reliably, ensure safety, and meet quality standards.

By systematically converting units, applying stoichiometric principles, and considering practical factors like solubility and temperature, professionals can create solutions with desired concentrations efficiently and accurately. Moreover, mastering these calculations fosters a deeper appreciation for the physical and chemical principles governing aqueous solutions, reinforcing their critical role in chemistry and related disciplines.

In summary, dissolving a small amount of NaCl in water and calculating its molarity exemplifies core analytical skills in chemistry—skills that are essential for both academic pursuits and practical applications across various scientific fields.

Question 3not Yetansweredpoints Out Ofif You Dissolve 2 70 G Of Nacl In 425 Ml Of Water What Is The

Question 3not Yetansweredpoints Out Ofif You Dissolve 2 70 G Of Nacl In 425 Ml Of Water What Is The

Related Articles

- TRUE / FALSE. The Need To Interact With Other People Is A Social Need That Different Housing Options
- Read The Following Passage From The Count Of Monte Cristo By Alexandre Dumas.The Jailer Shrugged His
- Pioneer Athletics Inc. Wants To Provide Better Landing Mats For Gymnasts. It Therefore Asks Its Foam

Back to Home