

In Each Of The Given Solutions, Identify The Solvent And The Solute. A. Solution Containing 25.0 G KBr

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Understanding solutions in chemistry involves recognizing the components that make up the mixture: the solvent and the solute. When analyzing a solution, particularly one containing a known amount of a substance like potassium bromide (KBr), it is essential to identify which component is acting as the solvent and which is the solute. In this context, we examine a solution that contains 25.0 grams of KBr and determine the roles of each component within the solution. This process provides insight into solution composition, concentration calculations, and the principles governing solubility and solution formation.

What Is a Solution?

Definition of a Solution

A solution is a homogeneous mixture composed of two or more substances. The substance present in the greatest amount is called the solvent, while the other substances dissolved in the solvent are called solutes. Solutions can exist in various states—liquid, solid, or gas—but liquid solutions are most common in chemistry.

Components of a Solution

- **Solvent:** The component present in the highest quantity. It determines the phase of the solution.
- **Solute:** The component(s) dissolved in the solvent. It is present in lesser quantities.

Analyzing the Solution Containing 25.0 G of KBr

What Is KBr?

Potassium bromide (KBr) is an ionic compound composed of potassium (K^+) and bromide (Br^-) ions. It is highly soluble in water, making it a common solute in aqueous solutions. When KBr dissolves, it dissociates into its constituent ions, distributing evenly throughout the solvent, usually water.

Identifying the Solvent and Solute

1. **Given Data:** The solution contains 25.0 grams of KBr.
2. **Nature of KBr:** As an ionic compound, KBr readily dissolves in polar solvents, especially water.
3. **Common Solvent:** The most common solvent for KBr solutions is water because of its high polarity and ability to dissolve ionic compounds effectively.
4. **Conclusion:** Since the problem specifies a solution with KBr and does not specify any other solvent, it is reasonable to deduce that water is serving as the solvent.

Understanding Solvent and Solute in This Context

Why Water Is the Solvent

Water is often called the "universal solvent" due to its ability to dissolve a wide variety of substances, especially ionic and polar compounds like KBr. When KBr dissolves in water, the ionic bonds between K^+ and Br^- are broken, and the ions become surrounded by water molecules—a process known as hydration.

The Role of KBr as the Solute

The 25.0 grams of KBr in the solution act as the solute, the substance that is dissolved. The amount (mass) of KBr indicates how much of the solute is present in the solution, which can be used to determine concentration or molarity if the volume of the solution is known.

Calculations and Further Analysis

Calculating Moles of KBr

Knowing the molar mass of KBr is essential to convert the given mass into moles:

- **Molar mass of KBr:** $K (39.1 \text{ g/mol}) + Br (79.9 \text{ g/mol}) = 119.0 \text{ g/mol}$

Number of moles of KBr:

$$n = \text{mass} / \text{molar mass} = 25.0 \text{ g} / 119.0 \text{ g/mol} \approx 0.2101 \text{ mol}$$

Implications of the Calculation

- This molar amount can be used to calculate molarity if the volume of the solution is known.
- It aids in understanding the solution's concentration, which is critical in various chemical applications.

Additional Considerations

Solubility of KBr

At room temperature, KBr is highly soluble in water, with a solubility of about 64 g per 100 mL of water. This high solubility ensures that 25.0 g of KBr can dissolve completely in less than 100 mL of water, forming a homogeneous solution.

Concentration Units

Depending on the context, the solution's concentration can be expressed in various units:

- **Molarity (M):** Moles of solute per liter of solution.
- **Mass percent (%):** Mass of solute per 100 g of solution.
- **Mass/volume percent:** Grams of solute per 100 mL of solution.

Summary

In the solution containing 25.0 grams of KBr, water acts as the solvent because of its polar nature and ability to dissolve ionic compounds like KBr. The KBr itself functions as the solute, being the substance dissolved within the solvent to form a homogeneous mixture. Recognizing the roles of the solvent and solute is fundamental in understanding solution chemistry, calculating concentrations, and predicting the behavior of solutions in various applications.

Conclusion

To summarize, in the given solution, water is the solvent, providing the medium for dissolving the KBr, which is the solute. This fundamental distinction underpins many principles in chemistry, including solubility, solution concentration, and the process of dissolving ionic compounds. Accurate identification of these components allows chemists to manipulate and utilize solutions effectively in laboratory and industrial settings.

Frequently Asked Questions

In the solution containing 25.0 g of KBr, what is the solvent?

The solvent is typically water, as KBr is usually dissolved in water to form an aqueous solution.

What is the solute in the solution that contains 25.0 g of KBr?

The solute is potassium bromide (KBr).

How do you identify the solvent in a solution with 25.0 g of KBr?

The solvent is the substance in which the solute (KBr) is dissolved; in most cases, it is water unless specified otherwise.

Why is water considered the solvent in a solution with KBr?

Because KBr readily dissolves in water, which acts as the medium to disperse the solute uniformly.

If the solution contains 25.0 g of KBr, what role does KBr play?

KBr acts as the solute, the substance dissolved in the solvent.

Can the solvent in the solution with 25.0 g KBr be other than water?

Yes, if KBr is dissolved in another solvent such as ethanol or acetone, then that solvent would be the solvent; however, water is most common.

How would you determine the solvent and solute if given the total solution mass and the mass of KBr?

Subtract the mass of KBr from the total solution mass; the remainder is the mass of the solvent, which can then be identified based on the solvent's identity or context.

What are the typical physical states of the solvent and solute in this solution?

The solute, KBr, is a solid, and the solvent, water, is a liquid.

Why is it important to identify the solvent and solute in chemical solutions?

Identifying the solvent and solute helps understand the solution's properties, behavior, and how it can be used or processed in chemical reactions.

Additional Resources

Understanding the Composition of a Solution: Identifying Solvent and Solute in a 25.0 g KBr Solution

When studying solutions in chemistry, a fundamental concept is understanding the roles of the components involved—particularly the solvent and the solute. In the context of a solution containing 25.0 grams of potassium bromide (KBr), it's essential to analyze which substance acts as the solute and which as the solvent. This detailed exploration will help clarify these roles, their physical and chemical characteristics, and the principles governing their interactions.

Introduction to Solutions: Basic Concepts

Before diving into the specifics of the KBr solution, it's important to establish foundational knowledge about solutions:

- Definition of a Solution: A homogeneous mixture composed of two or more substances where the solute(s) are uniformly distributed within the solvent.
- Components:
 - Solvent: The component present in the largest amount, responsible for dissolving other substances.
 - Solute: The component(s) present in lesser amounts, which are dissolved in the solvent to form the solution.
- Physical State of Components:
 - Solvent is often a liquid but can be gases or solids.
 - Solutes can be solids, liquids, or gases.

Analyzing the Solution Containing 25.0 g KBr

When considering a solution with 25.0 grams of KBr, the key question is: What is the solvent? To answer this, we need to explore the characteristics of KBr and typical solvents.

Properties of Potassium Bromide (KBr)

Chemical and Physical Nature of KBr:

- Chemical Formula: KBr
- Physical State: Solid at room temperature
- Molecular Weight: Approximately 119.00 g/mol
- Solubility:
 - Highly soluble in water (~75 g per 100 mL at 20°C)
 - Slightly soluble in ethanol
- Uses:
 - As a medicinal sedative
 - In photographic processing
 - In chemical synthesis

Given its high solubility in water, KBr readily dissolves when introduced into aqueous solutions.

Possible Solvents in the Solution

The primary candidates for the solvent in such a solution are:

- Water:
 - Most common solvent for ionic compounds like KBr.
 - Polar solvent with high dielectric constant.
 - Capable of dissolving a wide range of salts, including KBr.
- Ethanol or Organic Solvents:
 - Less likely in typical aqueous solutions.
 - Less effective at dissolving ionic compounds like KBr.

Since the question does not specify the solvent, the most logical and typical choice is water, owing to its compatibility and capacity to dissolve KBr efficiently.

Identifying the Solvent in the Solution

Why Water Is the Solvent

- High Solubility: KBr dissolves readily in water, which indicates water's role as the solvent.
- Common Laboratory Practice: Solutions containing ionic salts like KBr are almost always aqueous unless specified otherwise.

- Physical Evidence:
- The solution's appearance (clear and colorless) aligns with aqueous salt solutions.
- The process of dissolving 25.0 g of KBr in water is straightforward and typical.

Conclusion: In this context, water is the solvent.

Determining the Solute in the Solution

KBr as the Solute

- Definition: The substance dissolved in the solvent, in this case, KBr.
- Role:
- The component present in lesser amount (25.0 g).
- Responsible for the properties of the solution, such as conductivity, color, and reactivity.

Why KBr is the Solute

- Mass and Composition:
- Given as 25.0 g, which is significantly less than the typical mass of solvent (water).
- Its dissolution creates a characteristic ionic solution.
- Chemical Behavior:
- Dissolves into K^+ and Br^- ions.
- Alters the solution's properties, such as increasing ionic conductivity.
- Physical State in Solution:
- Crystalline solid initially, but exists as dispersed ions in the solution.

Conclusion: KBr is the solute in the solution.

Quantitative Aspects and Concentration

To deepen understanding, it's relevant to consider the concentration of the solution:

- Calculating Moles of KBr:
- Moles = mass / molar mass = $25.0 \text{ g} / 119.00 \text{ g/mol} \approx 0.210 \text{ moles}$.
- Implication:
- The amount of solute (KBr) determines the molarity if the volume of solvent is known.
- For example, if the solution is prepared with 1 liter of water, the molarity is approximately 0.210 M.

Impact of the Solvent and Solute on Solution Properties

Understanding which component is solvent and which is solute influences the interpretation of various physical and chemical properties:

- Boiling and Melting Points:
 - Presence of KBr (solute) elevates boiling point and depresses freezing point due to colligative properties.
- Conductivity:
 - Ionic nature of KBr makes the solution conductive.
- Vapor Pressure:
 - Reduced relative to pure water because of dissolved KBr.
- Osmotic Pressure:
 - Elevated due to dissolved ions.

Practical Considerations in Laboratory Settings

Preparation of the Solution:

- The typical procedure involves weighing 25.0 g of KBr.
- Dissolving it in a known volume of water.
- Ensuring complete dissolution for homogeneity.

Analytical Applications:

- Such solutions are used in calibration and standardization processes.
- Used in spectroscopic analysis where ionic solutions are relevant.

Summary and Final Remarks

In conclusion:

- Solvent: Water
 - Because of its high polarity, ability to dissolve ionic salts, and common use in solution preparation.
- Solute: Potassium Bromide (KBr)
 - Because of its finite amount (25.0 g), crystalline form prior to dissolution, and role in defining the solution's properties.

Understanding the interplay between solvent and solute in this context highlights essential principles of solution chemistry, including solubility, molecular interactions, and solution properties. Recognizing

these roles allows chemists to manipulate solutions for various applications, from laboratory experiments to industrial processes.

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