

0.8 Gram Of Divalent Metal Was Dissolved In 100 CC Of 1.28 N HCl And The Solution Was Diluted To 200

0.8 Gram Of Divalent Metal Was Dissolved In 100 CC Of 1.28 N HCl And The Solution Was Diluted To 200 is a fundamental procedure in chemical analysis, particularly in the context of preparing and analyzing solutions for titration, spectrophotometry, and other laboratory techniques. This process exemplifies the principles of solution preparation, molarity calculation, and acid-base reactions, which are essential in fields such as analytical chemistry, pharmaceutical manufacturing, and industrial chemical processes. Understanding how to accurately dissolve a specific amount of divalent metal in hydrochloric acid (HCl) and dilute the resulting solution is crucial for ensuring precise analytical results and reproducibility in experiments.

Understanding the Dissolution of Divalent Metals in Hydrochloric Acid

What is a Divalent Metal?

A divalent metal is an element that has a valency of two, meaning it can form ions with a charge of +2. Common divalent metals include:

- Calcium (Ca^{2+})
- Magnesium (Mg^{2+})
- Zinc (Zn^{2+})
- Copper (Cu^{2+})
- Iron (Fe^{2+})

These metals are frequently involved in various chemical reactions, especially in aqueous solutions where they tend to form soluble salts with acids like hydrochloric acid.

Properties of Hydrochloric Acid (HCl)

Hydrochloric acid is a strong, monoprotic acid with the chemical formula HCl. It dissociates completely in aqueous solution, providing a source of chloride ions (Cl^-) and hydrogen ions (H^+). The normality (N) of HCl indicates the concentration of reactive hydrogen ions, which directly impacts the dissolution process of metals:

- 1.28 N HCl means 1.28 equivalents of HCl per liter.
- This concentration influences how much metal can be dissolved in a given volume.

Preparation of Metal Solution: Step-by-Step Process

1. Weighing the Metal

The precise measurement of the metal is essential for accurate chemical analysis. In this case:

- 0.8 grams of the divalent metal are carefully weighed using an analytical balance.
- Proper handling ensures no loss due to adhesion or spillage.

2. Dissolving Metal in HCl

The process involves:

- Adding 100 cc (or mL) of 1.28 N HCl to a beaker.
- Gradually introducing the metal to the acid while stirring.
- Observing the reaction: the metal reacts with HCl, producing hydrogen gas and a soluble chloride salt.

Chemical Reaction Example (for zinc):



Key points:

- The reaction proceeds until the metal is fully dissolved.
- Safety precautions include working in a fume hood due to hydrogen evolution.

3. Ensuring Complete Dissolution

- Gentle heating may be employed to expedite the process, but overheating should be avoided.
- Continuous stirring ensures uniform dissolution.
- Confirming the absence of residual metal particles ensures complete reaction.

Dilution to Final Volume and Concentration Calculation

1. Initial Volume and Concentration

- The original solution contains dissolved metal ions at a certain molarity, determined by the amount of metal and volume of acid used.

2. Dilution to 200 cc

- The solution is then diluted from its initial volume (100 cc) to a total volume of 200 cc.
- This effectively halves the concentration of metal ions in solution, following the dilution principle.

Dilution formula:

$$C_1 V_1 = C_2 V_2$$

- Where:
- C_1 = initial concentration
- V_1 = initial volume (100 cc)
- C_2 = final concentration
- V_2 = final volume (200 cc)

Given the initial parameters, the final concentration of metal ions in the diluted solution can be accurately calculated.

Applications of Metal Dissolution in Acid Solutions

1. Analytical Chemistry

- Determining the purity of metal samples.
- Conducting titrations to quantify metal content.
- Preparing standard solutions for calibration.

2. Industrial Processes

- Metal plating and electrolysis.
- Extraction and processing of metals.
- Waste treatment involving metal removal.

3. Research and Development

- Synthesis of new metal complexes.
- Studying reaction mechanisms involving divalent metals.

Key Factors Influencing Metal Dissolution in HCl

1. Metal Surface Area

- Finely divided metals dissolve faster due to increased surface area.
- Use of powders vs. larger chunks affects reaction rate.

2. Acid Concentration

- Higher normality accelerates dissolution.
- Excessively concentrated acids can cause rapid reactions and safety hazards.

3. Temperature

- Elevated temperatures increase reaction rates.
- Controlled heating enhances efficiency but must be managed carefully.

4. Reaction Time

- Sufficient time ensures complete dissolution.
- Monitoring and controlling reaction duration is crucial for reproducibility.

Safety Considerations in Metal Dissolution Procedures

1. Handling Strong Acids

- Use of appropriate PPE (gloves, goggles, lab coat).
- Working in well-ventilated areas or fume hoods.

2. Managing Hydrogen Gas Evolution

- Hydrogen is flammable; avoid ignition sources.
- Use of proper ventilation and gas traps.

3. Waste Disposal

- Neutralizing residual acids before disposal.
- Following institutional and environmental regulations.

Optimizing the Dissolution and Dilution Process

1. Precise Measurement

- Use high-accuracy balances and volumetric glasses.
- Record initial weights and volumes meticulously.

2. Controlled Reaction Conditions

- Maintain consistent temperature.
- Stir continuously for uniform dissolution.

3. Accurate Dilution

- Use calibrated volumetric flasks.
- Add acid or water gradually to prevent errors.

4. Validation of Results

- Confirm complete dissolution visually and through testing.
- Repeat procedures to ensure reproducibility.

Conclusion: Significance of Accurate Solution Preparation in Chemistry

The process of dissolving 0.8 grams of a divalent metal in 100 cc of 1.28 N HCl and diluting the solution to 200 cc is a fundamental technique in chemical laboratories. It exemplifies core principles such as stoichiometry, molarity calculations, and solution handling. Proper execution of this process ensures precise and reproducible results, which are vital in analytical determinations, industrial applications, and research. Mastery of such procedures enhances the reliability and accuracy of chemical analyses, ultimately contributing to advancements across scientific disciplines.

Summary of Key Points:

- Accurate measurement and handling are critical.
- Understanding chemical reactions involved ensures safety and effectiveness.
- Proper dilution techniques optimize solution concentrations.
- Safety measures protect personnel and the environment.
- Application spans analytical chemistry, industry, and research.

By mastering the dissolution and dilution process, chemists and laboratory technicians can

confidently prepare solutions that form the backbone of countless experiments and industrial processes, ensuring scientific integrity and operational efficiency.

Keywords for SEO Optimization:

Dissolution of divalent metals, hydrochloric acid solutions, solution preparation in chemistry, metal dissolution procedure, molarity calculation, acid-metal reaction, laboratory solution dilution, analytical chemistry techniques, precise chemical measurements, safety in chemical lab

Frequently Asked Questions

What is the initial amount of divalent metal dissolved in the solution?

0.8 grams of divalent metal were initially dissolved in the solution.

What volume of HCl solution was used to dissolve the metal?

100 cc (milliliters) of 1.28 N HCl was used.

What is the normality of the hydrochloric acid solution used?

The HCl solution has a normality of 1.28 N.

To what volume was the solution diluted after dissolving the metal?

The solution was diluted to a total volume of 200 cc.

How does the dilution affect the concentration of the metal in the solution?

Dilution decreases the concentration of the metal ions in the solution by half, from the original concentration to a lower concentration in the 200 cc volume.

How can the molar amount of metal dissolved be calculated from the given data?

The molar amount can be calculated using the mass (0.8 g), molar mass of the metal, and the volume and normality of HCl; for instance, by calculating moles of HCl reacted and

relating it to the metal's molar mass.

Why is hydrochloric acid used for dissolving divalent metals?

HCl effectively reacts with divalent metals to form soluble metal chlorides, facilitating their dissolution.

How would the concentration of metal ions change after dilution?

The concentration of metal ions in the solution would be halved after diluting from 100 cc to 200 cc, assuming no other reactions or losses.

What factors influence the solubility of the divalent metal in HCl?

Factors include the metal's reactivity, temperature, concentration of HCl, and the presence of other complexing agents.

What is the significance of knowing the normality of HCl in this context?

Knowing the normality helps determine the equivalent amount of acid reacting with the metal, which is essential for stoichiometric calculations and understanding the reaction extent.

Additional Resources

0.8 Gram Of Divalent Metal Was Dissolved In 100 CC Of 1.28 N HCl And The Solution Was Diluted To To 200

In a typical laboratory setting, precise chemical procedures are fundamental to the success of analytical experiments, synthesis, and characterization. A common procedure involves dissolving a known amount of a metal in an acid solution, followed by dilution to a specified volume to prepare a solution of known concentration. Recently, a standard experiment was conducted in which 0.8 grams of a divalent metal—such as magnesium (Mg^{2+}), calcium (Ca^{2+}), or zinc (Zn^{2+})—was dissolved in 100 cubic centimeters (cc) of 1.28 normal hydrochloric acid (HCl), and then the solution was diluted to 200 cc. This process exemplifies fundamental principles in solution chemistry and analytical techniques, providing insights into acid-metal reactions, solution preparation, and concentration calculations.

This article offers a comprehensive overview of this procedure, exploring the chemical interactions involved, calculations of molarity and normality, and implications in analytical chemistry. It aims to be both technical and accessible, shedding light on the scientific rationale behind each step.

Understanding the Components of the Procedure

The Divalent Metal: Characteristics and Significance

The experiment centers around a divalent metal, which refers to a metal ion with a charge of +2. Common examples include magnesium (Mg^{2+}), calcium (Ca^{2+}), zinc (Zn^{2+}), and nickel (Ni^{2+}). These metals are often involved in biological, industrial, and analytical contexts.

- Properties of Divalent Metals:
 - Tend to form stable compounds with halides, oxides, and sulfates.
 - React with acids to produce corresponding metal salts and hydrogen gas (if applicable).
 - Play vital roles in biological systems and industrial applications.
- Relevance in Analytical Chemistry:
 - Used as standard samples for calibration.
 - Their reactions with acids are well-understood, making them ideal for quantitative analysis.

For this experiment, the specific identity of the metal influences the stoichiometry but not the general procedure.

Hydrochloric Acid (HCl): Concentration and Role

The acid used is 1.28 N HCl, which signifies a normality of 1.28 equivalents per liter.

- Understanding Normality:
 - Normality measures the reactive capacity of a solution based on the number of equivalents of reactive species (here, H^+ ions).
 - For HCl, which supplies one H^+ per molecule, normality equals molarity.
- Calculating Molarity:

Since HCl is monoprotic, the molarity is also 1.28 M.
- Function in the Reaction:
 - Provides H^+ ions necessary to react with the metal.
 - Ensures complete dissolution of the metal by forming soluble metal chlorides.

The Significance of the Solution Volume and Dilution

The initial dissolution occurs in 100 cc (or 100 mL) of acid solution, which is then diluted to 200 cc (or 200 mL). These volumes are critical for calculating concentrations.

- Dilution Principles:

- Based on the conservation of moles, the concentration after dilution is halved if only the volume doubles, assuming no chemical reaction occurs during dilution.
- Implications for Concentration Calculations:
- Knowing initial amount dissolved and final volume allows for determination of the molarity of the final solution.

Step-by-Step Analysis of the Dissolution and Dilution Process

Step 1: Dissolving the Metal in HCl

The process begins with adding 0.8 grams of the divalent metal into 100 mL of 1.28 N HCl. The reaction can be summarized as:



- Reaction Stoichiometry:
 - 1 mole of metal reacts with 2 moles of HCl to produce 1 mole of metal chloride and hydrogen gas (if the metal is reactive enough).
 - The amount of metal (grams) can be converted to moles using its molar mass.
 - Calculating Moles of Metal:

Suppose the metal is magnesium (Mg), with a molar mass of 24.305 g/mol.

 - Moles of Mg: $\left(\frac{0.8 \text{ g}}{24.305 \text{ g/mol}} \right) \approx 0.0329 \text{ mol}$
 - Moles of HCl Needed:
 - Since 2 mol HCl react with 1 mol Mg,

Moles of HCl required: $(2 \times 0.0329) \approx 0.0658 \text{ mol}$
 - HCl's Contribution:
 - With a 1.28 N solution, the volume of HCl required to supply 0.0658 mol HCl is:

Volume = $\left(\frac{0.0658 \text{ mol}}{1.28 \text{ mol/L}} \right) \approx 0.0514 \text{ L}$ or 51.4 mL.
- Since in the experiment, the acid volume is 100 mL, which exceeds the minimum requirement, the excess ensures complete dissolution and reaction.

Step 2: Ensuring Complete Reaction and Dissolution

The excess HCl ensures that all the metal reacts, forming soluble metal chlorides and releasing hydrogen gas:



- Observation:
- The evolution of hydrogen gas during the process indicates the reaction's progress.
- Factors Influencing Completeness:
- Metal particle size (smaller particles react faster).
- Temperature (higher temperatures increase reaction rates).
- Acid concentration (sufficient to react fully).

Step 3: Dilution to 200 cc

After the metal has dissolved completely, the solution is diluted from 100 mL to 200 mL. This step is crucial for preparing a solution of known concentration for further analysis.

- Concentration Calculation:
- Moles of metal (or metal chloride) in the original 100 mL are now spread over 200 mL, halving the concentration.
- The molarity of the final solution (assuming all metal is converted into solution) is:

$$\begin{aligned} \text{Initial moles} &= 0.0329 \text{ mol} \\ \text{Final molarity} &= \frac{0.0329 \text{ mol}}{0.2 \text{ L}} = 0.1645 \text{ M} \end{aligned}$$

- Implication:
- This diluted solution can be used for various analytical procedures, such as titrations or spectrophotometric measurements, where precise concentration knowledge is vital.

Calculating the Concentration and Its Significance

Normality and Molarity of the Final Solution

The final concentration depends on the amount of metal dissolved and the total volume after dilution.

- Normality:
- Since the metal forms divalent ions, the solution's normality (equivalent per liter) relates directly to molarity:

$$\backslash \text{Normality} = 2 \times \text{Molarity} = 2 \times 0.1645 = 0.329 \text{ N} \backslash$$

- Significance:
- The normality indicates the reactive capacity of the solution, useful in titrations where the amount of reactive H⁺ or metal equivalents is crucial.

Applications of Such Diluted Solutions

The prepared solution can serve multiple purposes in analytical chemistry:

- Standard Solutions:
- Used for calibration curves in spectrophotometry or titrimetric analysis.
- Quantitative Analysis:
- Determining metal content in unknown samples via titration.
- Chemical Reactions:
- Studying reaction kinetics or metal reactivity.

Implications and Practical Considerations

Accuracy and Precision in Laboratory Procedures

The described process underscores the importance of meticulous measurement and control:

- Precise Weighing:
- Ensures accurate knowledge of the metal amount dissolved.
- Exact Volumes:
- Using calibrated volumetric flasks and pipettes guarantees concentration reproducibility.
- Reaction Completeness:
- Adequate reaction time and conditions prevent partial dissolution.

Safety and Handling

- Hydrogen Gas:
- Flammable and explosive; reactions should be conducted in well-ventilated areas.
- Acid Handling:

- HCl is corrosive; appropriate PPE and safety protocols are mandatory.

Environmental Considerations

- Waste Disposal:
 - Metal salts and acids should be disposed of following environmental regulations.
- Recycling and Reuse:
 - Solutions can often be neutral

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