# Write Out The Net Ionic Equation Of The Acid-base Reaction That Dissolves The Solid With The Magnesium

**Write Out The Net Ionic Equation Of The Acid-base Reaction That Dissolves The Solid With The Magnesium** is a fundamental concept in chemistry that illustrates the interaction between acids and metals, leading to the formation of soluble ions and the dissolution of solid metal compounds. Understanding this reaction not only helps in grasping the principles of acid-base chemistry but also provides insights into practical applications such as metal cleaning, corrosion, and even biological processes. In this comprehensive guide, we will explore the detailed mechanisms behind this reaction, how to derive the net ionic equation, and its significance in various chemical contexts.

## Understanding Acid-Base Reactions Involving Magnesium and Solids

### What is Magnesium and Its Reactivity?

Magnesium (Mg) is a lightweight, alkaline earth metal known for its high reactivity, especially with acids. In its solid form, magnesium typically exists as a metal or as magnesium compounds like magnesium oxide (MgO), magnesium hydroxide ($Mg(OH)_2$), or magnesium carbonate ($MgCO_3$). When magnesium metal reacts with acids, it often produces hydrogen gas and corresponding magnesium salts.

### Common Acids That React With Magnesium

Several acids can react with magnesium, including:

- Hydrochloric acid (HCl)
- Sulfuric acid ($H_2SO_4$)
- Nitric acid ($HNO_3$)
- Acetic acid ($CH_3COOH$)
  (less vigorous reaction)

Among these, hydrochloric acid is most commonly used in laboratory demonstrations because of its simplicity and vigorous reaction with magnesium.

# General Reaction of Magnesium with Acid

## Typical Reaction Pattern

When magnesium metal reacts with an acid, the general reaction is:
$$\text{Mg (s)} + 2 \text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{H}_2 (g)$$
This reaction involves magnesium donating electrons to hydrogen ions, resulting in the formation of magnesium ions and hydrogen gas.

## Reaction with Solid Magnesium Compounds

If the solid is a magnesium compound like magnesium hydroxide or magnesium carbonate, the acid reacts with these compounds, dissolving the solid and forming soluble magnesium salts:
- Magnesium hydroxide reacts with acid to produce magnesium salt and water:
$$\text{Mg(OH)}_2 (s) + 2 \text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + 2 \text{H}_2\text{O}$$
- Magnesium carbonate reacts with acid to produce magnesium salt, water, and carbon dioxide:
$$\text{MgCO}_3 (s) + 2 \text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{CO}_2 (g) + \text{H}_2\text{O}$$

# Deriving the Net Ionic Equation for the Reaction

## Step-by-Step Process

To write the net ionic equation, follow these steps:
1. Write the balanced molecular equation for the acid reacting with the solid magnesium or magnesium compound.
2. Break down all soluble compounds into their constituent ions (ionic form).
3. Cancel out the spectator ions—ions that appear unchanged on both sides of the equation.
4. Write the remaining ions as the net ionic equation.

## Example: Reaction of Hydrochloric Acid with Solid Magnesium

Let's consider the reaction of magnesium metal with hydrochloric acid.

Balanced Molecular Equation:
$$\text{Mg (s)} + 2 \text{HCl (aq)} \rightarrow \text{MgCl}_2 (aq) + \text{H}_2 (g)$$

Step 1: Write Ionic Forms of Soluble Compounds

- Hydrochloric acid dissociates completely:
$$\text{HCl (aq)} \rightarrow \text{H}^+ (aq) + \text{Cl}^- (aq)$$
- Magnesium chloride dissociates:
$$\text{MgCl}_2 (aq) \rightarrow \text{Mg}^{2+} (aq) + 2 \text{Cl}^- (aq)$$

Step 2: Write the complete ionic equation

$$\text{Mg (s)} + 2 \text{H}^+ (aq) + 2 \text{Cl}^- (aq) \rightarrow \text{Mg}^{2+} (aq) + 2 \text{Cl}^- (aq) + \text{H}_2 (g)$$

Step 3: Cancel spectator ions

Spectator ions are those that appear unchanged on both sides—here, $\text{Cl}^-$.

Remaining ions:
$$\text{Mg (s)} + 2 \text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{H}_2 (g)$$

Net Ionic Equation:
$$\text{Mg (s)} + 2 \text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{H}_2 (g)$$

This is the net ionic equation for the acid-base reaction where magnesium dissolves by reacting with hydrogen ions from the acid, producing magnesium ions and hydrogen gas.

# Reactions with Other Magnesium Compounds

## Magnesium Hydroxide and Acid

Magnesium hydroxide reacts with acids as follows:

Balanced Molecular Equation:
$$\text{Mg(OH)}_2 (s) + 2 \text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + 2 \text{H}_2\text{O}$$

Net Ionic Equation:
$$\text{Mg(OH)}_2 (s) + 2 \text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + 2 \text{H}_2\text{O}$$

Here, the solid magnesium hydroxide dissolves as it reacts with hydrogen ions, forming magnesium ions and water.

## Magnesium Carbonate and Acid

Magnesium carbonate reacts with acids producing magnesium salt, water, and carbon dioxide:

Balanced Molecular Equation:
$$\text{MgCO}_3 (s) + 2 \text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{CO}_2 (g) + \text{H}_2\text{O}$$

Net Ionic Equation:
$$\text{MgCO}_3 (s) + 2 \text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{CO}_2 (g) + \text{H}_2\text{O}$$

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Practical Applications of These Reactions

1. Metal Cleaning and Passivation
Magnesium reacts with acids to remove oxide layers or to clean surfaces, utilizing the dissolution process represented by the net ionic equations.

2. Acid Neutralization and Buffer Solutions
Understanding how magnesium compounds react with acids helps in designing buffer solutions and neutralization processes in industrial settings.

3. Laboratory Demonstrations
Showing the evolution of hydrogen gas when magnesium reacts with acids is a common chemistry demonstration illustrating gas evolution and reaction mechanisms.

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Summary and Key Takeaways

- The net ionic equation for the acid-base reaction dissolving magnesium solid involves the reaction of magnesium metal or magnesium compounds with hydrogen ions.
- For magnesium metal reacting with hydrochloric acid:

$$\text{Mg (s)} + 2 \text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{H}_2 (g)$$

- Reactions vary depending on the magnesium compound involved but generally involve dissolution of the solid and formation of magnesium ions along with hydrogen gas or water.
- Recognizing spectator ions and balancing equations are critical steps in deriving accurate net ionic equations.

Final Thoughts

Mastering the net ionic equations of acid-base reactions involving magnesium and solids enhances your understanding of fundamental chemical principles. These reactions exemplify how metals dissolve in acids, releasing gases and forming soluble salts, which are key concepts in inorganic chemistry. Whether for academic purposes, industrial applications, or laboratory experiments, grasping these equations provides a solid foundation for exploring more complex chemical behaviors.

# Frequently Asked Questions

## What is the net ionic equation for the acid-base reaction that dissolves solid magnesium?

The net ionic equation is $Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$.

## Which acids can react with solid magnesium to produce a net

## ionic equation involving hydrogen gas?

Common acids like hydrochloric acid (HCl), sulfuric acid ($H_2SO_4$), or nitric acid ($HNO_3$) react with magnesium to produce hydrogen gas, with the net ionic equation: $Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$.

## How do you write the net ionic equation for magnesium reacting with an acid to produce magnesium ions and hydrogen gas?

First, write the balanced molecular equation, then eliminate spectator ions. For acids reacting with magnesium, the net ionic equation is $Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$.

## Why does magnesium dissolve in acid solutions but not in pure water?

Magnesium dissolves in acid because the acid provides $H^+$ ions that react with magnesium to produce magnesium ions and hydrogen gas, whereas pure water lacks sufficient $H^+$ ions for this reaction to occur.

## What role does the acid play in the dissolution of solid magnesium in aqueous solution?

The acid supplies $H^+$ ions that react with solid magnesium, facilitating its dissolution and producing magnesium ions and hydrogen gas, as represented by the net ionic equation $Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$.

# Additional Resources

Write Out The Net Ionic Equation Of The Acid-Base Reaction That Dissolves The Solid With The Magnesium

Understanding the dissolution of magnesium in acidic solutions is fundamental in chemistry, especially in acid-base reactions involving metals. The process involves complex interactions at the molecular level, resulting in the formation of soluble ions and the release of hydrogen gas. In this detailed review, we will explore the step-by-step derivation of the net ionic equation for the acid-base reaction that dissolves magnesium, emphasizing the underlying principles, detailed mechanisms, and practical implications.

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# Introduction to Magnesium and Acid-Base Reactions

Magnesium (Mg) is an alkaline earth metal characterized by its relatively high reactivity, especially with acids. When magnesium interacts with acids, it typically undergoes a redox reaction where

magnesium is oxidized, and hydrogen ions are reduced to hydrogen gas. These reactions are crucial in various industrial processes, laboratory demonstrations, and understanding corrosion mechanisms.

Key points:
- Magnesium's position in the periodic table (Group 2) makes it a reactive metal.
- Acidic solutions contain hydrogen ions ($H^+$) that can react with metals.
- The reaction results in the formation of magnesium salts and hydrogen gas.

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# Fundamental Principles of Acid-Base Reactions Involving Metals

Before delving into the specific net ionic equation, it is essential to understand the underlying principles:

1. Redox Nature of Metal-Acid Reactions
- Metals like magnesium tend to lose electrons (oxidation).
- Acids provide hydrogen ions ($H^+$), which gain electrons (reduction).

2. Dissociation of Acids
- Acid molecules dissociate in water to produce $H^+$ and anions (e.g., $Cl^-$ for HCl).
- For example: $HCl \rightarrow H^+ + Cl^-$

3. Reaction Pathway
- The metal reacts with free $H^+$ ions, resulting in the formation of hydrogen gas ($H_2$).
- The metal itself is converted into its ionic form ($Mg^{2+}$).

4. Formation of Salt
- The metal cation ($Mg^{2+}$) combines with the anion from the acid to form a soluble salt (e.g., $MgCl_2$).

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# Step-by-Step Derivation of the Acid-Base Reaction

Let's consider a common example: magnesium reacting with hydrochloric acid (HCl).

1. Initial Reactants
- Magnesium metal (Mg) in solid form.
- Hydrochloric acid (HCl), which dissociates in water.

2. Dissociation of HCl in Water
$$ \text{HCl (aq)} \rightarrow \text{H}^+ (aq) + \text{Cl}^- (aq) $$

3. Oxidation-Reduction Process
- Magnesium donates electrons to hydrogen ions:

$$ \text{Mg (s)} \rightarrow \text{Mg}^{2+} (aq) + 2e^- $$

- Hydrogen ions accept electrons and are reduced to hydrogen gas:

$$ 2\text{H}^+ (aq) + 2e^- \rightarrow \text{H}_2 (g) $$

4. Overall Reaction
Combining these steps, the overall balanced chemical reaction is:

$$ \text{Mg (s)} + 2\text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{H}_2 (g) $$

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# Writing the Complete Ionic Equation

The complete ionic equation showcases all ions involved explicitly:

$$ \text{Mg (s)} + 2\text{H}^+ (aq) + 2\text{Cl}^- (aq) \rightarrow \text{Mg}^{2+} (aq) + 2\text{Cl}^- (aq) + \text{H}_2 (g) $$

Notice that chloride ions ($Cl^-$) appear on both sides, indicating they are spectator ions in this particular reaction.

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# Deriving the Net Ionic Equation

The net ionic equation simplifies the complete ionic reaction by removing spectator ions—ions that do not directly participate in the formation of the precipitate, gas, or water.

1. Identify Spectator Ions
- In this case, $Cl^-$ ions are present on both sides and do not participate directly in the reaction.
- Removing these, the net ionic equation becomes:

$$ \text{Mg (s)} + 2\text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{H}_2 (g) $$

2. Final Net Ionic Equation
$$
\boxed{
\text{Mg (s)} + 2\text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{H}_2 (g)
}
$$

This concise equation captures the essence of the acid-base reaction involving magnesium dissolving via hydrogen ion reduction.

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# Mechanistic Insights and Practical Implications

1. Reaction Mechanism
- The process begins with magnesium metal surface interaction with $H^+$ ions.
- Electron transfer occurs at the metal surface:

$$\text{Mg (s)} \rightarrow \text{Mg}^{2+} + 2e^-$$

- The electrons reduce hydrogen ions:

$$2\text{H}^+ + 2e^- \rightarrow \text{H}_2 (g)$$

- The magnesium ions remain solvated in the solution, forming magnesium salts.

2. Reaction Conditions Affecting the Process
- Acid concentration: Higher $H^+$ concentration speeds up the reaction.
- Surface area of magnesium: Increased surface area (e.g., powdered magnesium) accelerates dissolution.
- Temperature: Elevated temperatures increase reaction rates.
- Presence of inhibitors: Certain ions or molecules can inhibit or promote the reaction.

3. Industrial and Laboratory Applications
- Hydrogen generation: Magnesium reacting with acids can produce hydrogen gas for fuel or chemical synthesis.
- Corrosion studies: Understanding magnesium corrosion in acidic environments.
- Preparation of magnesium salts: For use in pharmaceuticals, metallurgy, or chemical manufacturing.

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# Other Acid-Base Reactions Involving Magnesium

While the reaction with hydrochloric acid is most common, magnesium also reacts with other acids.

1. Reaction with Sulfuric Acid ($H_2SO_4$)
$$\text{Mg (s)} + \text{H}_2\text{SO}_4 (aq) \rightarrow \text{MgSO}_4 (aq) + \text{H}_2 (g)$$

- Net ionic:

$$\text{Mg (s)} + 2\text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{H}_2 (g)$$

2. Reaction with Acetic Acid ($CH_3COOH$)
- The reaction proceeds more slowly due to weaker acidity:

$$\text{Mg (s)} + 2\text{CH}_3\text{COOH} (aq) \rightarrow \text{Mg(CH}_3\text{COO)}_2 (aq) +$$

\text{H}_2 (g) \]

- Net ionic:

\[ \text{Mg (s)} + 2\text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{H}_2 (g) \]

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# Additional Considerations and Troubleshooting

1. Reaction Rate Variability
- Surface oxidation of magnesium can slow down the reaction.
- Protective oxide layers need to be removed (e.g., by abrasion) for optimal reaction.

2. Safety Aspects
- Hydrogen gas is flammable; reactions should be conducted in well-ventilated areas.
- Acid handling requires appropriate safety measures.

3. Limitations of the Reaction
- In the presence of passive layers or inhibitors, the reaction may be sluggish.
- The reaction may not proceed to completion if the acid is weak or exhausted.

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# Summary and Final Thoughts

The acid-base reaction involving magnesium and acids such as hydrochloric acid exemplifies fundamental principles of redox chemistry, ionization, and solubility. The net ionic equation:

\[
\boxed{
\text{Mg (s)} + 2\text{H}^+ (aq) \rightarrow \text{Mg}^{2+} (aq) + \text{H}_2 (g)
}
\]

captures the core transformation: solid magnesium metal reacts with hydrogen ions to produce magnesium ions in solution and liberate hydrogen gas. This reaction showcases the metal’s reactivity, the importance of ionic interactions, and the practical applications in hydrogen production, metallurgy, and corrosion studies.

Understanding this reaction in depth provides insight into broader topics such as electrochemistry, solvent effects, and industrial chemical processes. Whether used in laboratory demonstrations or large-scale manufacturing, the principles governing magnesium’s dissolution in acids remain central to inorganic chemistry and materials science.

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In conclusion, mastering the derivation and implications of the net ionic equation for magnesium's reaction with acids not only deepens chemical comprehension but

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