

Ionic Equations for the Reactions of Acids and Metals

Answer the questions below.

1. Define a 'redox' reaction.

A redox reaction is one in which oxidation and reduction occur at the same time.

2. How is an electron represented in a half equation?

e^-

3. What state symbol should be written next to the formula 'Mg' in an equation?

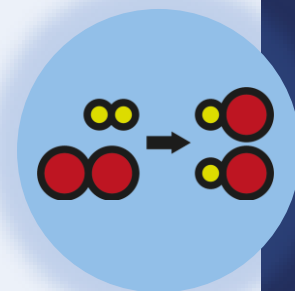
(s)

4. What state symbol should be written next to the ion ' Mg^{2+} ' in an equation?

(aq)

5. State the ions that make up $AgNO_3$.

Ag^+ NO_3^-



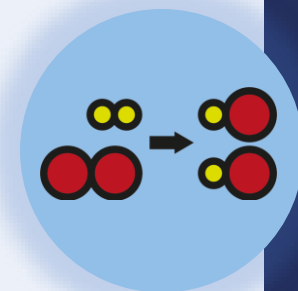
Ionic Equations for the Reactions of Acids and Metals

Do Now:

1. Define a 'redox' reaction.
2. How is an electron represented in a half equation?
3. What state symbol should be written next to the formula 'Mg' in an equation?
4. What state symbol should be written next to the ion 'Mg²⁺' in an equation?
5. State the ions that make up AgNO₃.

Drill:

1. State the ions present in sodium hydroxide.
2. Write the word equation for the reaction of sodium metal with water.
3. Write a balanced ionic equation for the same reaction.

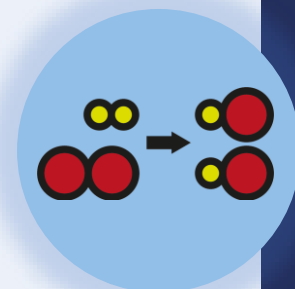


Ionic Equations for the Reactions of Acids and Metals

Read Now:

The main component of stomach acid is hydrochloric acid (HCl). Sometimes acid in the stomach is called 'gastric acid'. This acid plays an important role in digestion and immunity. It helps to break down protein in your diet, absorb essential nutrients, and control viruses and bacteria that might otherwise infect your stomach. Gastric acid is produced by parietal cells in the stomach. A complex process results in both hydrogen ions (H^+) and chloride ions (Cl^-) being present in the stomach. These ions together form hydrochloric acid.

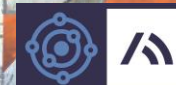
1. Name the main acid in the human stomach.
2. What is another name for acid in the stomach?
3. What are the functions of acid in the stomach?
4. Where is the acid in stomach produced?
5. What ions in the stomach join together to form hydrochloric acid?



(HT) Ionic Equations for the Reactions of Acids and Metals

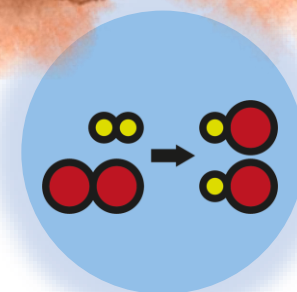
C4.2.6

Science
Mastery



- C4.2.1 PKR: Reactions of Metals
- C4.2.2 Extracting Less Reactive Metals
- C4.2.3 PKR: Ions, Ionic Bonding and Deducing Ionic Formulae
- C4.2.4 (HT) Ionic Equations and Displacement Reactions
- C4.2.5 (HT) Writing Half Equations
- **C4.2.6 (HT) Ionic Equations for the Reactions of Acids and Metals**

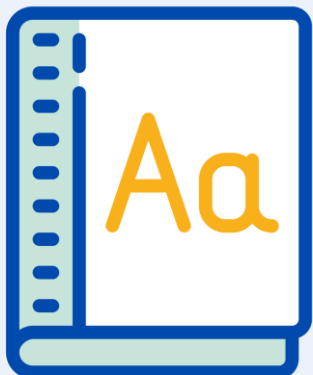
- C4.2.7 Introduction to Electrolysis
- C4.2.8 Extracting Metals by Electrolysis
- C4.2.9 Electrolysis of Molten Ionic Compounds
- C4.2.10 Electrolysis in Solutions
- C4.2.11 RP: Electrolysis of Aqueous Solutions 1
- C4.1.12 RP: Electrolysis of Aqueous Solutions 2
- C4.1.13 TIF: Corrosion and its Prevention
- C4.2.14 (HT) Obtaining Raw Materials
- C4.2.15 Recycling Metals
- C4.2.16 Feedback Lesson



Following this lesson, students will be able to:

- Describe the reactions of acids and metals with chemical equations
- Write ionic equations for the reactions of acids and metals
- Write half equations for the reactions of acids and metals

Key Words:



hydrochloric acid

ionic equation

sulfuric acid

nitric acid

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the previous lesson's exit ticket.

- The teacher should customise this slide as needed, to facilitate
 - **reteach, explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
 - **practise** answering specific questions or of key skills.
 - **redrafting** or **improving** previous work.

Answer the question below.

3. Complete the half equation to show the oxidation of a potassium atom.

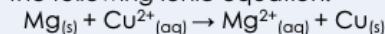


- ☐ A. $\text{K}^{2+}_{(aq)} + 2\bar{e}$
☐ B. $\text{K}^{+}_{(s)} + \bar{e}$
☒ C. $\text{K}^{+}_{(aq)} + \bar{e}$

Exit ticket

Answer the questions below.

1. The reaction between magnesium and copper (II) sulfate can be represented by the following ionic equation:



Which answer correctly splits this ionic equation into two half equations?

- ☒ A. $\text{Mg}_{(s)} \rightarrow \text{Mg}^{2+}_{(aq)} + 2\bar{e}$ $\text{Cu}^{2+}_{(aq)} + 2\bar{e} \rightarrow \text{Cu}_{(s)}$
☐ B. $\text{Mg}_{(s)} + 2\bar{e} \rightarrow \text{Mg}^{2+}_{(aq)}$ $\text{Cu}^{2+}_{(aq)} \rightarrow \text{Cu}_{(s)} + 2\bar{e}$
☐ C. $\text{Mg}_{(s)} \rightarrow \text{Mg}^{2+}_{(aq)}$ $\text{Cu}^{2+}_{(aq)} \rightarrow \text{Cu}_{(s)}$

2. [What is a redox reaction?

- ☐ A. A redox reaction is one which oxidation or reduction take place
☐ B. A redox reaction is one in which oxidation and reduction take place
☒ C. A redox reaction is one in which oxidation and reduction take place at the same time

Exit ticket

Metals and acids react

When a **metal** reacts with an **acid**, a **salt** and **hydrogen** are made.



There are three acids that you should know. Can you remember their chemical formulae? (Hint: all acids contain H)

- Hydrochloric acid $\text{HCl}_{(\text{aq})}$ $\text{H}^+ \text{Cl}^-$
- Nitric acid $\text{HNO}_3_{(\text{aq})}$ $\text{H}^+ \text{NO}_3^-$
- Sulfuric acid $\text{H}_2\text{SO}_4_{(\text{aq})}$ $2\text{H}^+ \text{SO}_4^{2-}$

When acids are added to water, they split up into their ions.

Can you state the ions that are in each of these acids?

We can use the metal and the acid names to predict the salt that will form.

- Hydro**chloric** acid forms salts ending in '**chloride**'
 $\text{zinc} + \text{hydrochloric acid} \rightarrow \text{zinc chloride} + \text{hydrogen}$
- Nitric** acid forms salts ending in '**nitrate**'
 $\text{calcium} + \text{nitric acid} \rightarrow \text{calcium nitrate} + \text{hydrogen}$
- Sulfuric** acid forms salts ending in '**sulfate**'
 $\text{aluminium} + \text{sulfuric acid} \rightarrow \text{aluminium sulfate} + \text{hydrogen}$

Use the general formula to predict the products of each reaction.



Metal	Acid	Product 1	Product 2
iron	hydrochloric acid	iron chloride	hydrogen
magnesium	sulfuric acid	magnesium sulfate	hydrogen
sodium	nitric acid	sodium nitrate	hydrogen
lead	nitric acid	lead nitrate	hydrogen

The reactions of acids with metals are redox reactions

Let's look at an example.

The reaction between magnesium and hydrochloric acid can be represented by the word equation:



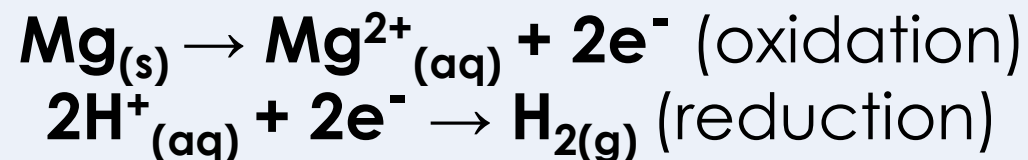
The *chemical* equation for this reaction is



The *ionic* equation for this reaction is



The two *half* equations for this reaction are



The reactions of acids with metals are redox reactions

The reaction between zinc and hydrochloric acid can be represented by the word equation:



Show that this is a redox reaction.

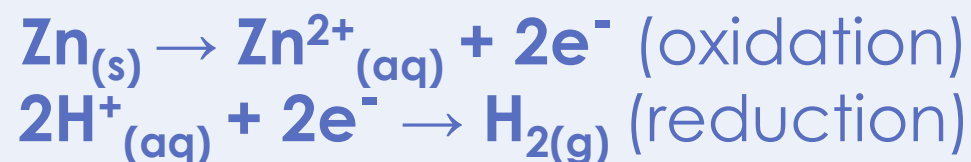
The *chemical* equation for this reaction is



The *ionic* equation for this reaction is



The two *half* equations for this reaction are



This is a redox reaction because both oxidation and reduction are occurring at the same time.

Spot the error

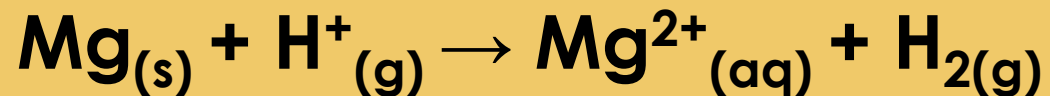
The reaction between magnesium and sulfuric acid can be represented by the word equation:



The chemical equation for this reaction is:



The ionic equation for this reaction is:



Drill

1. Write a general equation for the reaction of an acid and a metal.
2. What gas is produced when acids react with metals?
3. State the formula for hydrochloric acid.
4. State the formula for nitric acid.
5. State the formula for sulfuric acid.
6. State the ions that make up hydrochloric acid.
7. Predict the products of a reaction between aluminium and nitric acid.
8. Define 'redox reaction'.
9. Define oxidation in terms of electrons.
10. Define reduction in terms of electrons.

Drill answers

1. acid + metal \rightarrow salt + hydrogen
2. Hydrogen gas is produced when acids react with metals
3. HCl is the formula for hydrochloric acid
4. HNO_3 is the formula for nitric acid
5. H_2SO_4 is the formula for sulfuric acid
6. The ions in hydrochloric acid are H^+ and Cl^-
7. Aluminium and nitric acid would produce aluminium nitrate and hydrogen
8. A redox reaction is one in which oxidation and reduction occur at the same time
9. Oxidation is the loss of electrons
10. Reduction is the gain of electrons

I: Writing half equations for acid and metal reactions

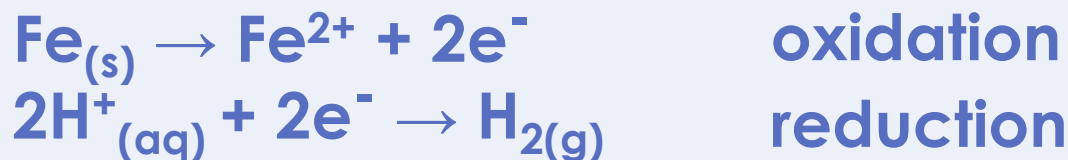
The chemical equation for a reaction between iron and sulfuric acid is:



1. Write an ionic equation for this reaction.



2. Write two half equations for this reaction.



3. State which half equation demonstrates oxidation, and which demonstrates reduction.

We: Writing half equations for acid and metal reactions

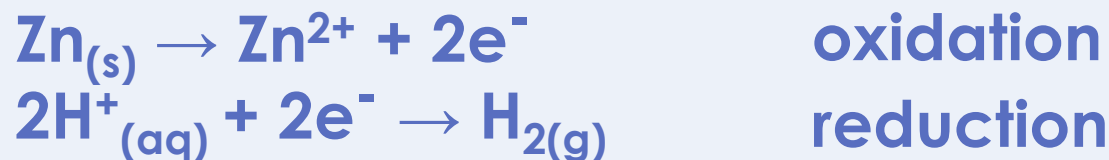
The chemical equation for a reaction between zinc and sulfuric acid is:



1. Write an ionic equation for this reaction.



2. Write two half equations for this reaction.



3. State which half equation demonstrates oxidation, and which demonstrates reduction.

You: Writing half equations for acid and metal reactions

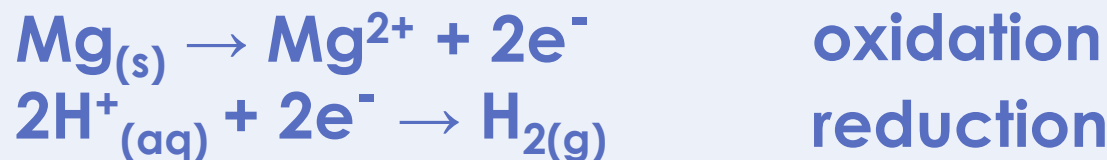
The chemical equation for a reaction between magnesium and sulfuric acid is:



1. Write an ionic equation for this reaction.



2. Write two half equations for this reaction.



3. State which half equation demonstrates oxidation, and which demonstrates reduction.

Answer the questions below.

1. Complete the half equation to show the electrons involved.



- ☐ A. $+ e^-$
- ☒ B. $+ 3e^-$
- ☐ C. $- e^-$

2. What is the formula for a zinc ion?

- ☐ A. Zn
- ☐ B. Zn^+
- ☒ C. Zn^{2+}
- ☐ D. Zn^-

Answer the question below.

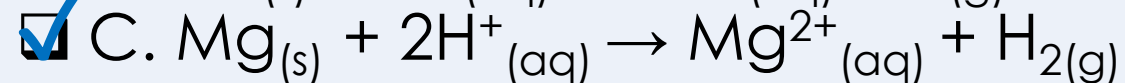
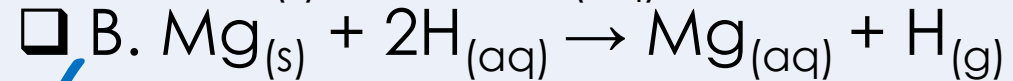
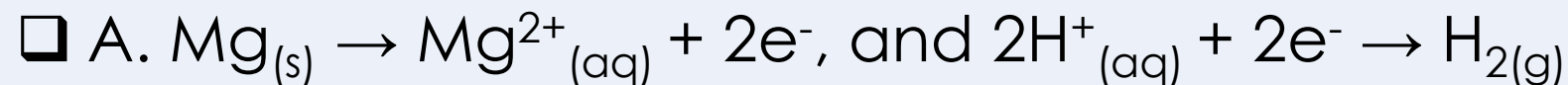
3. The reaction between magnesium and sulfuric acid can be represented by the word equation:

magnesium + sulfuric acid \rightarrow magnesium sulfate + hydrogen.

The chemical equation for this reaction is:



What is the ionic equation for this reaction?



Lesson C4.2.6

What was good about this lesson?

What can we do to improve this lesson?

[Send us your feedback by clicking this link](#)
or by emailing sciencemastery@arkonline.org
Thank you!