Reactions of Acids and Bases

Unit 3 Lesson 11

Reactions of Acids and Bases

Learning Objectives:

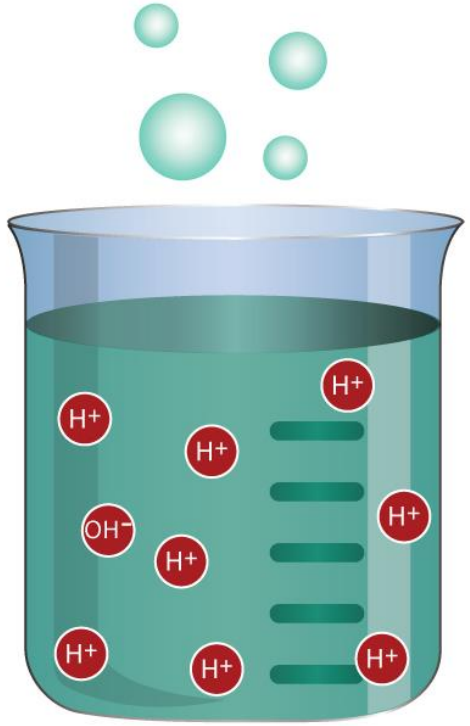
- Predict the products of the reaction between acids and metals.
- Predict the products of the reaction between acids and metal oxides or metal hydroxides.
- Predict the products of the reaction between acids and metal carbonates.

Key Vocabulary:

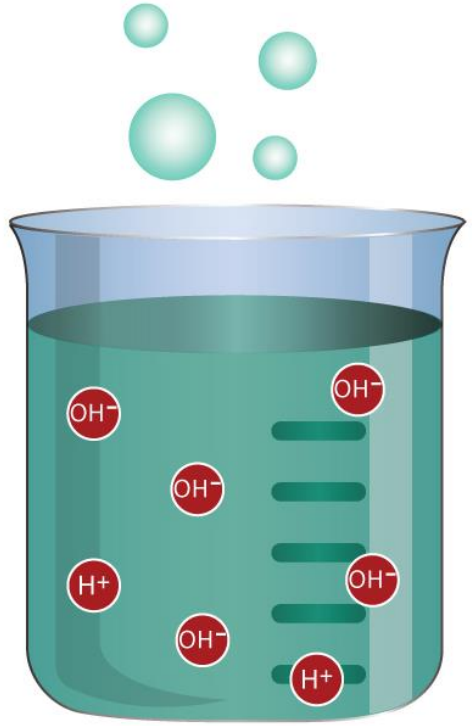
Carbonate, Metal oxide, Metal hydroxide, Neutralization, Salt

Reactions of Acids and Bases

- Acids are a group of chemicals which release hydrogen ions when they dissolve in water.
- Bases have the opposite property and can remove acid particles from a solution.
- Acids and bases show very predictable reactions.



Acids release hydrogen ions in solution.



Bases remove hydrogen ions from solution.

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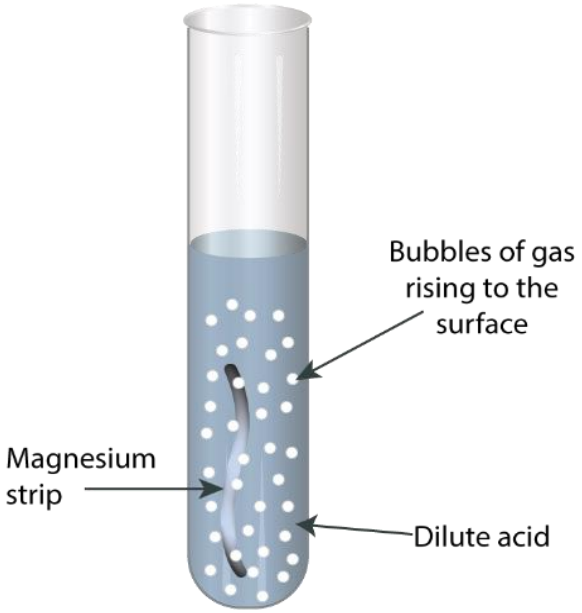
Reactions of Acids with Metals

Acid + Metal → Salt + Hydrogen gas

Reactions of Acids and Bases



1. **Acid reacting with metals.**

- Some metals such as magnesium and zinc react rapidly when placed in acid. This can be observed by bubbles and fizzing which occurs in the test tube.
- When the reaction occurs the hydrogen ions from the acid pull electrons off the metal to form the bubbles of hydrogen gas (H_2).
- This leaves the remainder of the acid molecule to join with the metal producing a new product called a metal salt.

Reactions of Acids and Bases

- Different acid and metal combinations produce different types of salts.
- The table to the right shows the ones that you should know for this unit.

Type of Acid	Salt formed
Hydrochloric acid	Chloride salt
Sulfuric acid	Sulfate salt
Nitric acid	Nitrate salt

Reactions of Acids and Bases

Acids and Metals

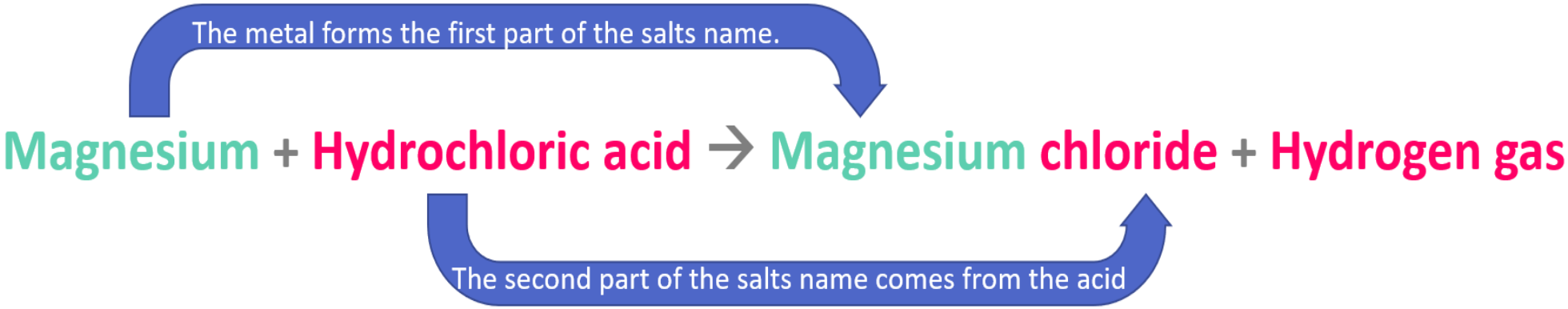
- The general reaction between an acid and a metal can be summarized by the following word equation:

Acid + Metal → Salt + Hydrogen gas

Reactions of Acids and Bases

Acids and Metals

- For example, magnesium ribbon reacts vigorously in hydrochloric acid and will fizz and bubble until it disappears.
- The reaction of magnesium and hydrochloric acid can be summarized as follows:



Reactions of Acids and Bases

Activity 1: Metal and Acid Reactions

Complete the following word for the reactions between metals and acids.

1. Zinc + Sulfuric acid →
2. Sodium + Hydrochloric acid →
3. Lithium + Nitric acid →
4. Calcium + hydrochloric acid →
5. Magnesium + Sulfuric acid →

Reactions of Acids and Bases

Activity 1: Answers

Complete the following word for the reactions between metals and acids.

1. Zinc + Sulfuric acid → Zinc sulfate + hydrogen
2. Sodium + Hydrochloric acid → Sodium chloride + hydrogen
3. Lithium + Nitric acid → Lithium nitrate + hydrogen
4. Calcium + hydrochloric acid → Calcium chloride + hydrogen
5. Magnesium + Sulfuric acid → Magnesium sulfate + hydrogen

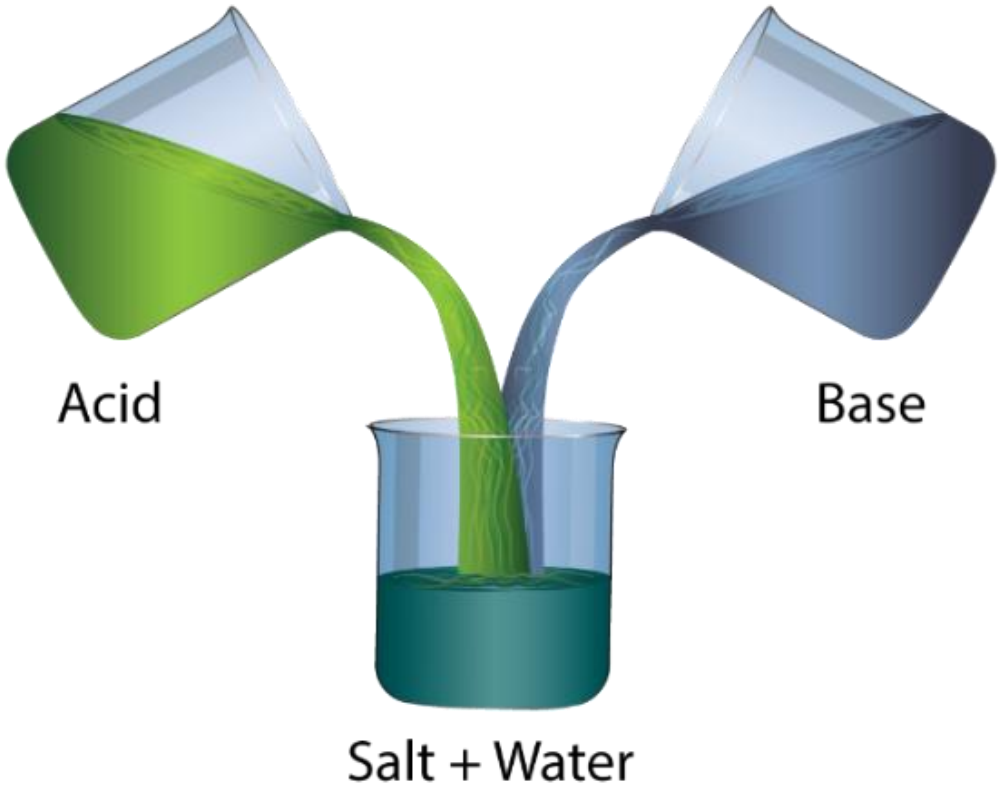
Reactions of Acids with Bases

Acid + Base → Salt + Water

Reactions of Acids and Bases

2. Acids reacting with Bases.

- Acids and bases (metal oxides and hydroxides) react with each other to form neutral water molecules and a metal salt.
- This type of reaction is called neutralization because the products have a pH of 7 and remove hydrogen ions from solution.



Neutral product

pH = 7

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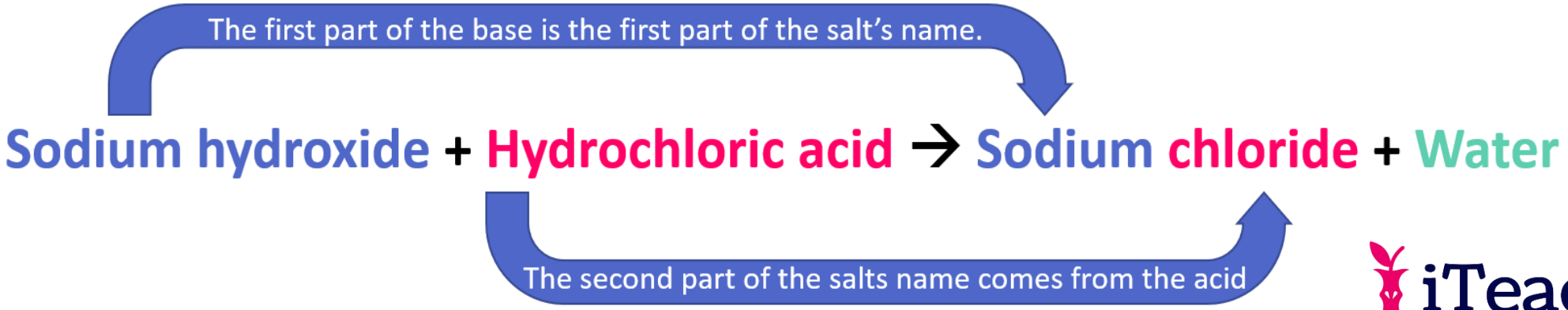
Reactions of Acids and Bases

Acids reacting with Bases.

- The solid salt compound from this reaction can be recovered by evaporating the water.
- The general word equation for the reaction of an acid and a base is:

Acid + Base → Salt + Water

- For example, sodium hydroxide reacts with hydrochloric acid:



Reactions of Acids and Bases

Activity 2: Acid and Base Reactions

Complete the following acid and base reactions

1. Zinc oxide + sulfuric acid →
2. Nitric acid + magnesium hydroxide →
3. Hydrochloric acid + barium oxide →
4. Calcium hydroxide + Sulfuric acid →
5. Copper oxide + sulfuric acid →

Reactions of Acids and Bases

Activity 2: Answers

Complete the following acid and base reactions

1. Zinc oxide + sulfuric acid → Zinc sulfate + water
2. Nitric acid + magnesium hydroxide → Magnesium nitrate + water
3. Hydrochloric acid + barium oxide → Barium chloride + water
4. Calcium hydroxide + Sulfuric acid → Calcium sulfate + water
5. Copper oxide + sulfuric acid → Copper sulfate + water

Reactions of Acids with Carbonates

Acid + Carbonate → Salt + Water + Carbon dioxide

Reactions of Acids and Bases

3. **Acids reacting with metal carbonates and metal hydrogen carbonates.**

   - Metal carbonates and hydrogen carbonates (also called bicarbonates) are also basic compounds which react with acids.
   - Acids can be neutralized by metal carbonates and bicarbonates and so these reactions are also classed as neutralization reactions because they remove hydrogen ions from the solution.

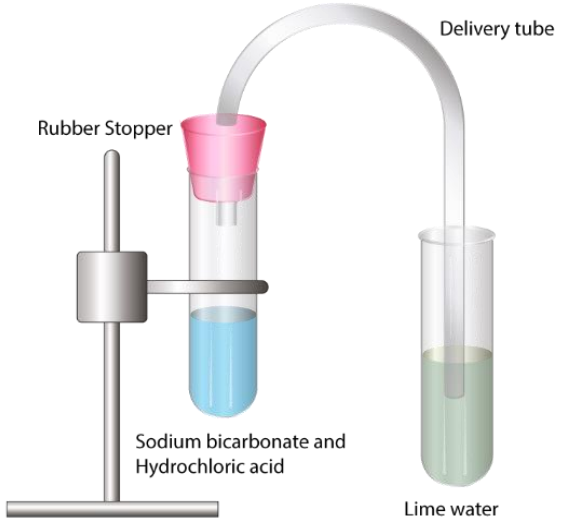
Reactions of Acids and Bases

Acids reacting with metal carbonates and metal hydrogen carbonates.

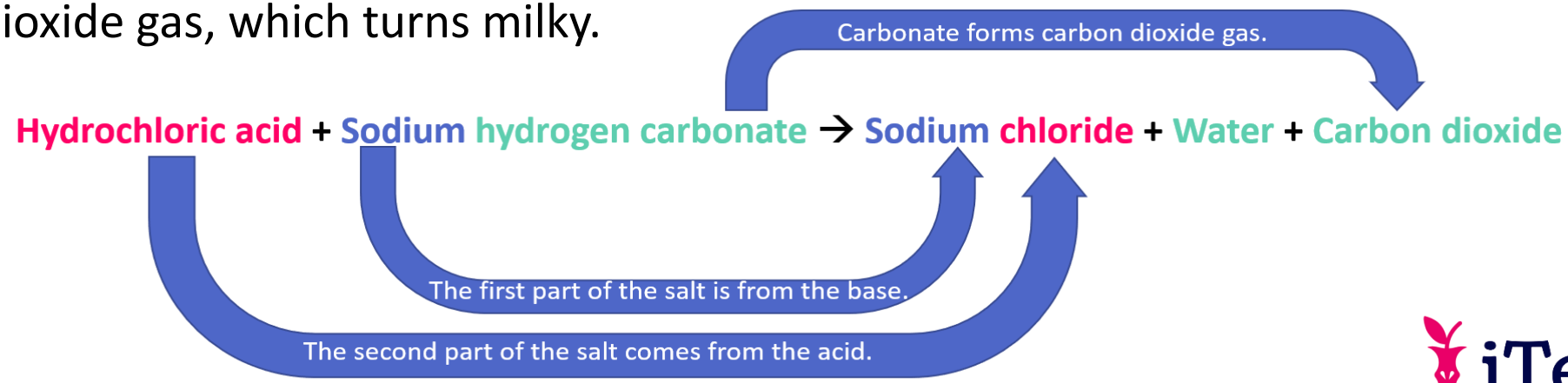
- However, unlike metal oxides and hydroxides, the carbonate or hydrogen carbonate means that carbon dioxide gas is also produced along with water.
- The general word equation for the reaction of an acid and a base is:

Acid + Metal Carbonate → Salt + Water + Carbon dioxide

Reactions of Acids and Bases



- An example of this type of reaction is sodium hydrogen carbonate (bicarbonate) and hydrochloric acid. The sodium hydrogen carbonate will fizz and bubble.
- Collecting the gas using a delivery tube placed in limewater will confirm the presence of carbon dioxide gas, which turns milky.



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Reactions of Acids and Bases

Activity 3: Acid and Metal (Hydrogen) Carbonates Reactions

Complete the following acid and metal carbonate/ metal hydrogen carbonate reactions:

1. Magnesium hydrogen carbonate + hydrochloric acid →
2. Nitric acid + sodium carbonate →
3. Sulfuric acid + Sodium hydrogen carbonate →
4. Calcium carbonate + hydrochloric acid →
5. Zinc carbonate + Sulfuric acid →

Reactions of Acids and Bases

Activity 3: Answers

Complete the following acid and metal carbonate/ metal hydrogen carbonate reactions:

1. Magnesium hydrogen carbonate + hydrochloric acid → Magnesium chloride + water + carbon dioxide
2. Nitric acid + sodium carbonate → Sodium nitrate + water + carbon dioxide
3. Sulfuric acid + Sodium hydrogen carbonate → Sodium sulfate + water + carbon dioxide
4. Calcium carbonate + hydrochloric acid → Calcium chloride + water + carbon dioxide
5. Zinc carbonate + Sulfuric acid → Zinc sulfate + water + carbon dioxide