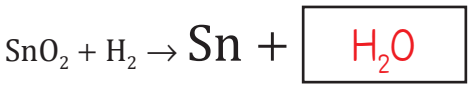
Edgenuity

Warm-Up | Neutralization Reactions

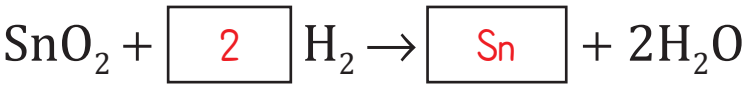
Writing Balanced Chemical Equations

1. Write the [unbalanced] equation.



2. Count [atoms] of both sides.

3. Balance the equation.



Lesson Objectives

By the end of this lesson, you should be able to:

- Predict the [products] of acid-base neutralization reactions.
- Define salt and describe the observable properties of salts and [salt] solutions.
- Write equations and net ionic equations for neutralization reactions.

Science Practice: Use domain-specific symbols to correctly write net ionic equations.

Warm-Up | Neutralization Reactions

Words to Know

Fill in this table as you work through the lesson. You may also use the glossary to help you.

total ionic equation	the chemical equation for a reaction in an aqueous solution that represents all ions present
neutralization	the reaction of an acid and a base to produce a salt and water
net ionic equation	the chemical equation for a reaction in an aqueous solution that represents only those species that participate in the reaction
nonelectrolyte	a compound that does not form ions in aqueous solution
salt	an ionic compound formed from the reaction of an acid and a base
conductivity	the ability to transfer heat or electric current
hydrolysis	the dissociation of a salt in water
electrolyte	a compound that forms ions in an aqueous solution
spectator ion	an ion that is present in both reactants and products in a chemical equation, and that appears in a total ionic equation but not a net ionic equation

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Lesson Question How is a neutralization reaction expressed?

Slide 2

Salt

- A **salt** is a compound formed from the reaction of an [acid] with a base.
- Most salts are [ionic] and soluble in water.
- [Hydrolysis] is the dissociation of salts in water.
- Examples are [KCl], $NaNO_3$.

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Neutralization Reactions

- The [neutralization] reaction is acid + base → salt + water.
- These are some examples.

$HCl + NaOH \rightarrow NaCl +$ [H_2O]

$H_2SO_4 + Mg(OH)_2 \rightarrow$ [$MgSO_4$] $+ 2H_2O$

$HNO_3 + KOH \rightarrow KNO_3 + H_2O$

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

- The pH of the combined solution is ~ [7].

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Neutralization Reactions in Everyday Life

- Antacids neutralize excess stomach acid.

$$NaHCO_3 + HCl \rightarrow H_2O + \boxed{NaCl} + CO_2$$

$$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$$

- Toothpaste contains antacids to cancel acids that would damage teeth.
- Lime (calcium hydroxide) is used to neutralize acidic soil.

Salt Solutions

- Salts form ions in the solution

$$NaCl \rightarrow \boxed{Na^+} + Cl^-.$$

- Conductivity is the ability to conduct electricity.
- Electrolytes form ions in aqueous solution and have high conductivity.
- Nonelectrolytes do not form ions in aqueous solution and do not conduct electricity.

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Total Ionic Equations

Acid-base neutralization reaction:

$$HCl + \boxed{NaOH} \rightarrow NaCl + H_2O$$

A **total ionic equation** shows all the ions involved in the reaction.

$$H^+ + Cl^- + Na^+ + \boxed{OH^-} \rightarrow Na^+ + Cl^- + H_2O$$

Spectator Ions

Total ionic equation:

$$H^+ + Cl^- + Na^+ + OH^- \rightarrow Na^+ + Cl^- + H_2O$$

Spectator ions are ions that do not participate directly in the reaction.

$$H^+ + Cl^- + Na^+ + OH^- \rightarrow Na^+ + \boxed{Cl^-} + H_2O$$

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Net Ionic Equations

Total ionic equation:

$$H^+ + Cl^- + Na^+ + OH^- \rightarrow Na^+ + Cl^- + H_2O$$

Spectator ions

A **net ionic equation** shows only the ions involved in the reaction. The spectator ions are removed.

$H^+ + OH^- \rightarrow H_2O$

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Acidic, Basic, and Neutral Salts

- Strong acids and bases dissociate completely in solution.

  Examples: HCl, HNO_3, NaOH

- Weak acids and bases partially dissociate.

  Examples: HCN, HF, NH_3

  $HCN \rightleftharpoons H^+ + CN^-$

- Salts can be acidic, basic, or neutral.

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Strong and Weak Acids and Bases

- Strong acid combined with weak base (example: $HCl + NH_3 \rightarrow NH_4Cl$):
  - Water not formed as product; no [hydroxide] ions
  - Solution pH < [7]; ammonium salt dissociates to form some H^+
- Weak acid combined with strong base

  (example: [CH_3COOH] $+ NaOH \rightarrow Na^+CH_3COO^- + H_2O$):
  - Solution pH > 7; [acetic] acid not completely ionized

Summary | Neutralization Reactions

Lesson Question

How is a neutralization reaction expressed?

Answer

(Sample answer) A neutralization reaction results from combining an acid with a base and forms salt and water. When a salt is dissolved in water, it dissociates into ions. Salt solutions can be acidic, basic, or neutral. Spectator ions appear on both sides of the equation, but do not appear in a net ionic equation.

Slide 2

Neutralization Reactions and Equations

- Neutralization reactions result from acid + base → [salt] + water.
- Salts are products of reactions between acids and bases.
  - When a salt is dissolved in water, it dissociates into [ions].
  - Salts are [electrolytes] and will conduct electricity in a solution.
  - Salt solutions can be acidic, basic, or neutral.
- Spectator ions appear on both sides of the equation, but do not appear in [net] ionic equations.

Summary | Neutralization Reactions

Use this space to write any questions or thoughts about this lesson.