

section 1 Acids and Bases

What You'll Learn

- how acids and bases are similar and different
- formulas and uses of common acids and bases

Mark the Text

Underline As you read, underline any words or sentences you think might be important to remember. When you finish reading, look back at what you underlined to make sure you understand it.

FOLDABLES™

A Compare and Contrast

Make the following Foldable to help you understand acids and bases.

Describe	Properties	Common Examples
Acids		
Bases		

Before You Read

Think of a food or drink you like that tastes sour. What do you think gives it a sour taste?

Read to Learn

Acids

What do you think about when you hear the word *acid*? Do you think of a substance that can burn your skin or put a hole in metal? Many sour foods contain acids. Some acids are dangerous to handle. Others are safe, and some are good to eat.

What are the properties of acids?

An **acid** is a substance that produces hydrogen ions, H^+ , in a water solution. When an acid dissolves in water, some of the hydrogen atoms are released as hydrogen ions, H^+ . It is the ability to produce these H^+ ions that gives acids their characteristic properties. When an acid dissolves in water, H^+ ions interact with water molecules to form hydronium ions. A **hydronium ion** (hi DROH nee um • I ahn), H_3O^+ , is a combination of an H^+ ion and a water molecule.

Acids have some common properties. All acids taste sour. But you should never taste a substance to see if it is acidic. Some acids can burn you. Acids are corrosive, which means they seem to eat away some metals. When an acid reacts with a metal, hydrogen gas and metallic compounds form. Acids also cause indicators to change color. An **indicator** is an organic compound that changes color in acid and base. Litmus paper is an indicator that turns red in acids.

What are some common acids?

Many foods contain acids. Citrus fruits contain citric acid. Lactic acid is found in yogurt and buttermilk. Pickled foods contain vinegar, also known as acetic acid. Your stomach uses hydrochloric acid to help it digest food.

Common Acids and Their Uses

Name, Formula	Use (example)	Other Information
Acetic acid, CH_3COOH	Food preservation and preparation	When in solution with water, it is known as vinegar.
Acetylsalicylic acid, $\text{HOOC}-\text{C}_6\text{H}_4-\text{OOCCH}_3$	Pain relief, fever relief, inflammation reduction	Known as aspirin
Ascorbic acid, $\text{H}_2\text{C}_6\text{H}_6\text{O}_6$	Antioxidant, vitamin	Called vitamin C
Carbonic acid, H_2CO_3	Carbonated drinks	Involved in cave, stalactite, and stalagmite formation and acid rain
Hydrochloric acid, HCl	Digestion as gastric juice in stomach, to clean steel in a process called pickling	Commonly called muriatic acid
Nitric acid, HNO_3	To make fertilizers	Colorless, yet yellows when exposed to light
Phosphoric acid, H_3PO_4	To make detergents, fertilizers and soft drinks	Slightly sour but pleasant taste, detergents containing phosphates cause water pollution
Sulfuric acid, H_2SO_4	Car batteries, to manufacture fertilizers and other chemicals	Dehydrating agent, causes burns by removing water from cells

Some common acids and their uses are listed in the table. Many of these acids are important in making products, such as fertilizer. Remember that many acids can burn your skin.

Bases

A **base** is any substance that forms **hydroxide ions**, OH^- , in a water solution. A base is also any substance that accepts H^+ ions from acids.

Unlike acids, not many foods are bases. Egg whites and baking powder are two foods that are basic. Some medicines, such as antacids, are basic. A common base is soap. A characteristic of bases is that they feel slippery, like soapy water. Many cleaning products contain bases. Bases are important in industry, also. For example, sodium hydroxide is a base that is used to separate cellulose fibers from wood pulp to make paper.

Picture This

- Identify** Look at the acids listed in the table above. What is the first element in the chemical formula of most acids?

Picture This

2. **Identify** Look at the bases listed in the table. What molecule do most of the bases have in their chemical formulas?
-

What are the properties of bases?

Bases are the opposites of acids. While bases and acids do share some features, bases also have their own properties. When they are not dissolved in water, many bases are solids in the form of crystals. In solution, bases feel slippery and taste bitter. Like strong acids, strong bases are corrosive. Bases can burn you. Never taste or touch a substance to see if it is basic. Bases also cause indicators to change color. Litmus paper is an indicator that turns blue in bases.

What are some common bases?

The table below lists some common bases and their uses. You may have used many common bases found in cleaning products and not even known it.


Common Bases and Their Uses

Name, Formula	Uses	Other Information
Aluminum hydroxide, $\text{Al}(\text{OH})_3$	Color-fast fabrics, antacid, water purification	Sticky gel that collects suspended clay and dirt particles on its surface
Calcium hydroxide, $\text{Ca}(\text{OH})_2$	Leather-making, mortar and plaster, lessen acidity of soil	Called caustic lime
Magnesium hydroxide, $\text{Mg}(\text{OH})_2$	Laxative, antacid	Called milk of magnesia when in water
Sodium hydroxide, NaOH	To make soap, oven cleaner, drain cleaner, textiles, and paper	Called lye and caustic soda; generates heat (exothermic) when combined with water, reacts with metals to form hydrogen
Ammonia, NH_3	Cleaners, fertilizer, to make rayon and nylon	Irritating odor that is damaging to nasal passages and lungs

Reading Check

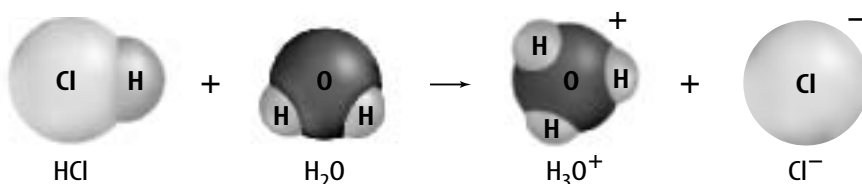
3. **Explain** Why is water the main solvent for acidic and basic solutions?
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-
-
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Solutions of Acids and Bases

Many products that contain acids and bases are solutions. Water is the main solvent for these solutions because water molecules have polarity. Remember, polarity means a molecule has a slight positive charge on one end and a slight negative charge on the other end. 

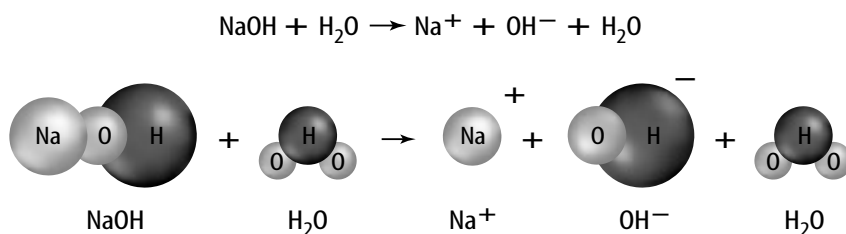
What happens when acids dissolve in water?

Remember that an acid produces hydrogen ions (H^+) in water. When an acid dissolves in water, the negative ends of nearby water molecules attract the positive hydrogen in the acid. The acid separates into ions, which is called dissociation. What is left after dissociation are negative ions and positive H^+ ions. The H^+ ions combine with water molecules to form hydronium ions (H_3O^+). Therefore, an acid compound produces hydronium ions when dissolved in water. The figure shows the dissociation of hydrogen chloride (HCl) into hydronium and chloride ions.



What happens when bases dissolve in water?

Bases form hydroxide ions (OH^-) in water. In the table of bases on the previous page, you can see that most bases have $-OH$ in their formulas. When bases dissolve in water, the positive ends of nearby water molecules attract the OH^- ions in the base. The base dissociates. What is left after dissociation are positive ions and negative OH^- ions. Unlike acid dissociation, the OH^- ions do not combine with water molecules. The figure shows the dissociation of sodium hydroxide (NaOH).



How is ammonia different from other bases?

Ammonia, NH_3 , is a base that does not contain $-OH$. In water, ammonia actually dissociates water molecules. An ammonia molecule attracts a hydrogen ion from a water molecule to form an ammonium ion, NH_4^+ . The rest of the water molecule is a hydroxide ion, OH^- . Ammonia is found in many household cleaners. You should never use products containing ammonia with other cleaners that contain chlorine (sodium hypochlorite), such as bathroom bowl cleaners and bleach. Ammonia reacts with sodium hypochlorite and produces toxic gases that can severely damage lung tissue and cause death.

Picture This

4. **Identify** When HCl dissociates, what ions does it produce?

Picture This

5. **Identify** When NaOH dissociates, it produces a molecule of water, H_2O and two ions. What ions does it produce?

● After You Read

Mini Glossary

acid: a substance that produces hydrogen ions, H^+ , in a water solution

base: any substance that forms hydroxide ions, OH^- , in a water solution or a substance that accepts H^+ ions from acids

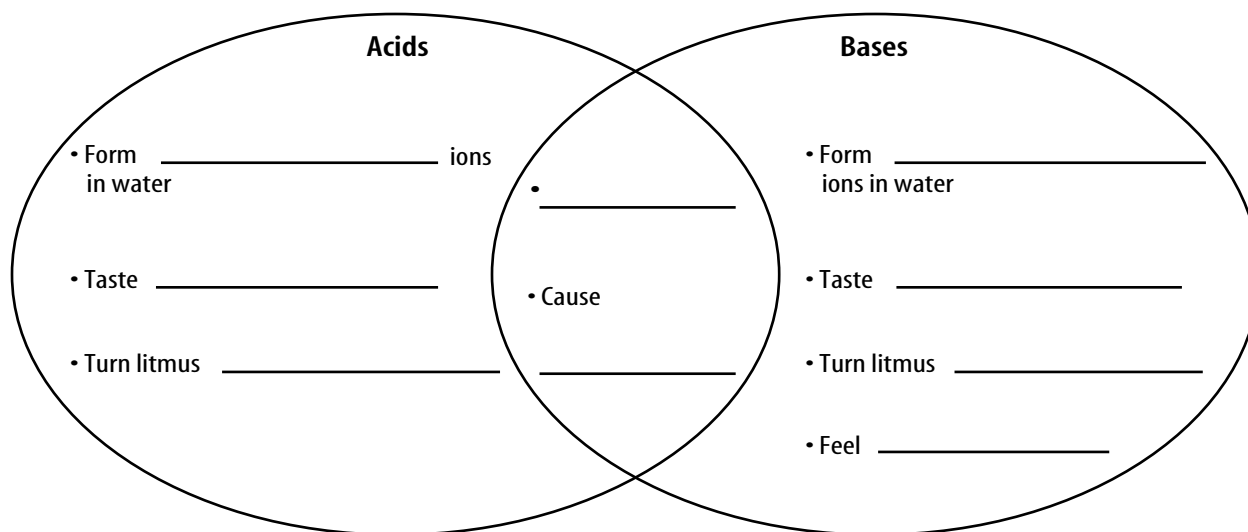
hydronium ion: a combination of a water molecule and a hydrogen ion


hydroxide ion: OH^- ion formed when bases dissolve in water

indicator: an organic compound that changes color in acid and base

1. Review the terms and their definitions in the Mini Glossary. Write a sentence using the term for the substance that makes many foods taste sour.

2. Fill in the Venn diagram with properties of acids and bases. Be sure to put any properties that acids and bases have in common in the part where the ovals overlap.



3.  You underlined words and sentences in this section that you thought would be important to remember. How did this help you learn about the topics in the section?

