

Chapter 5 Reactions

Acidic, Basic, and Neutral Solutions

5. e. *Students know* how to determine whether a solution is acidic, basic, or neutral.

Acids and Bases

Some types of matter have special properties when dissolved in water. These substances can be classified as acids or bases. When an **acid** is mixed with water, it produces hydrogen ions (H^+) and a negative ion. An **ion** is an atom that has become electrically charged because it has lost or gained electrons. A **hydrogen ion (H^+)** is an atom of hydrogen that has lost its electron. In the case of hydrochloric acid, hydrogen ions and chloride ions form: $\text{HCl} \xrightarrow{\text{water}} \text{H}^+ + \text{Cl}^-$.

In contrast, when a **base** is mixed with water, it produces hydroxide ions (OH^-). A **hydroxide ion (OH^-)** is a negative ion, made of oxygen and hydrogen. When sodium hydroxide is mixed with water, the sodium ions separate from the hydroxide ions: $\text{NaOH} \xrightarrow{\text{water}} \text{Na}^+ + \text{OH}^-$.

Properties of Acids and Bases

Acids have specific properties that are caused by their hydrogen ions. Acids wear away certain metals. Acids in foods give them a sour or tart taste. Common acids include hydrochloric acid, citric acid (lemon juice), and acetic acid (vinegar). Acids are used in fertilizers and batteries and are found in many foods such as tomatoes, oranges, and spinach.

The properties of bases are caused by their hydroxide ions. Bases have a bitter taste and feel slippery. Common bases are sodium hydroxide, calcium hydroxide, and ammonia. Bases are used in shampoos and household cleaning products, and in baking to make cakes and breads light and fluffy.

Identifying Acids and Bases

One way to identify whether a substance is an acid or a base is to use an indicator. An **indicator** is a compound that changes color when in contact with an acid or a base. Litmus paper is a common indicator. Acids turn litmus paper red. Bases turn litmus paper blue.

Other kinds of indicators turn different colors at different pHs. pH tells the concentration of hydrogen ions in a solution. The **pH scale** is a range of values from 0 to 14. The lower the pH value, the higher the concentration of hydrogen ions. A pH lower than 7 is acidic. A pH greater than 7 is basic. If the pH of a solution is 7, the solution is neutral. A neutral solution is neither an acid nor a base. Pure water has a pH of 7.

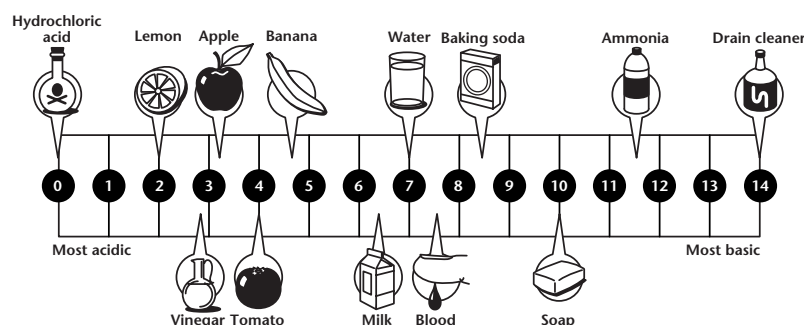
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Figure 5-6 The pH scale Strong acids have the lowest pH values. Strong bases have the highest pH values.

Chemistry labs often use a pH meter to measure pH. A pH meter is an electronic instrument that directly measures pH with an electrode. pH paper turns a different color for each pH value. Other indicators only change colors within a range of about two pH units.

Standard 5. e. Check

- 18** Which of the following is a characteristic of a base?
- A sour taste
 - B turns litmus paper red
 - C pH equal to 7
 - D pH higher than 7
- 19** When an acid is mixed with water,
- A hydrogen ions form.
 - B litmus paper turns blue.
 - C hydroxide ions form.
 - D the pH is 7.
- 20** Which pH value indicates the solution with the *lowest* concentration of hydrogen ions?
- A pH = 1
 - B pH = 5
 - C pH = 7
 - D pH = 9
- 21** Use Figure 5-6 to determine which of the following substances has the *highest* concentration of hydrogen ions.
- A milk
 - B water
 - C lemon juice
 - D ammonia