

5.1.11: H⁺ and OH⁻ Ions - An Introduction to Acids and Bases

Learning Objectives

- To identify H⁺ as an acid and OH⁻ as a base.

You may have some idea, from your day-to-day experiences, of some chemical substances that are considered acids or bases. Generally, a compound that is sour is recognized as being an acid. Some familiar acids may include citric acid, which is a molecule found in citrus fruits such as lemons and limes, and acetic acid, the molecule that makes up vinegar. Bases, on the other hand, include chemicals such as sodium bicarbonate (baking soda), which is bitter-tasting, and sodium hydroxide, which is found in cleaning substances and is not recommended for ingestion.

More details about acids, bases, and the reactions they undergo will be discussed later in this text. However, because you have just learned about ions and ionic compounds, it is worth pointing out two important ions that are used to identify and distinguish if a substance is acidic or basic; hydrogen ions, H⁺, and hydroxide ions, OH⁻. In fact, one definition of acids and bases states that an **acid** will produce H⁺ when dissolved in water and a **base** will produce a OH⁻ when dissolved in water.

Ionic compounds that are basic are easily recognized because the hydroxide ion is part of the formula and name. Some common examples are sodium *hydroxide*, NaOH, and calcium *hydroxide*, Ca(OH)₂. When dissolved in water, sodium hydroxide will split into its constituent ions, sodium ions (Na⁺) and hydroxide ions (OH⁻) in a 1:1 ratio. However, according to its chemical formula, calcium hydroxide will produce two hydroxide ions for every one calcium ion, a 1:2 ratio.

Compounds that produce hydrogen ions in water contain one or more hydrogen ions in the chemical formula and usually have special names to help recognize them as acids. Hydrochloric acid (HCl), nitric acid (HNO₃), and carbonic acid (H₂CO₃) are all acids. HCl and HNO₃ each dissolve in water producing a H⁺ and an anion (chloride and nitrate respectively). As indicated by the formula for carbonic acid there are two H⁺ for every one carbonate ion. The below table lists some common acids. See if you can determine the ratio of H⁺ to anions produced when these compounds are dissolved in water.

Table 5.1.11.1 Common Acids and Their Anions

Acid Name	Acid Formula	Anion Name	Anion Formula
acetic acid	CH ₃ COOH	acetate ion	CH ₃ COO ⁻
carbonic acid	H ₂ CO ₃	bicarbonate ion	HCO ₃ ⁻
		carbonate ion	CO ₃ ²⁻
hydrobromic acid	HBr	bromide ion	Br ⁻
nitric acid	HNO ₃	nitrate ion	NO ₃ ⁻
nitrous acid	HNO ₂	nitrous ion	NO ₂ ⁻
phosphoric acid	H ₃ PO ₄	dihydrogen phosphate ion	H ₂ PO ₄ ⁻
		hydrogen phosphate ion	HPO ₄ ²⁻
		phosphate ion	PO ₄ ³⁻
sulfuric acid	H ₂ SO ₄	hydrogen sulfate ion	HSO ₄ ⁻
		sulfate ion	SO ₄ ²⁻
sulfurous acid	H ₂ SO ₃	hydrogen sulfite ion	HSO ₃ ⁻
		sulfite ion	SO ₃ ²⁻

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