Acid-Base Reactions

Explore Lab Science

What are Acid-Base reactions?

Acid-base reactions are the chemical reactions that occur when acids and bases are mixed together. The **Brønsted-Lowry** theory of acids and bases discusses them in terms of the exchange of hydrogen ions.

$$\underset{\textbf{acid}}{HA} + \underset{\textbf{base}}{B} \longrightarrow \underset{\textbf{conjugate base/acid}}{BH^+} + A^-$$

As a result of such a reaction, you end with a **conjugate acid** and a **conjugate base**.

Acids

An acid is a molecule or solution that contains a lot of hydrogen ions (H^+). Acids like to donate hydrogens to other compounds.

Acids usually taste sour, like lemon juice or vinegar.

HCl HNO_3 HBr

H_2SO_4 CH_3COOH

Bases

Bases are molecules or solutions that are low in hydrogen ions. They like to grab hydrogens off of other compounds.

Bases usually feel slippery, like soap.

$CaCO_3$

NH_3

$NaOH$

H_2O

Salts

Salts are neutral compounds, which means they have no charge, and they are the result of an acid-base **neutralization** reaction where acids and bases react to yield water and a salt.

NaCl is the type of salt that you use to season your food.

Acid-Base Reactions

Simple acid-base reactions involve the transfer of a hydrogen atom from the acid to the base.

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

acid base water salt

$$HCO_3^- + H_2O \rightarrow H_2CO_3 + OH^-$$

base acid conjugate acid conjugate base

Naked Egg Experiment

In the case of the vinegar and eggshell reaction – the acetic acid from the vinegar first donates a proton to the calcium carbonate of the eggshell to make another acid, carbonic acid, and a calcium salt:

$$2\ CH_3COOH + CaCO_3 \rightarrow H_2CO_3 + Ca(CH_3COO)_2$$

And then the carbonic acid breaks down into H_2O and CO_2 to make the net reaction:

$$\underset{\text{acid}}{2\ CH_3COOH} + \underset{\text{base}}{CaCO_3} \rightarrow \underset{\text{water}}{H_2O} + CO_2 + \underset{\text{salt}}{Ca(CH_3COO)_2}$$

Naked Egg Experiment

As the vinegar reacted with the egg shell, you may have noticed gas bubbles escaping. Those are the CO_2 gas from the final reaction in the previous slide. And the scum layer you see forming over your vinegar after the eggshell has dissolved is the calcium salt.

Antacids

Acid-base reactions occur often in your daily life!

For example, after eating certain foods sometimes the stomach creates more hydrochloric acid (HCl) than normal and you experience heartburn. You can treat that with an antacid, usually aluminum hydroxide ($Al[OH]_3$), which is a base.

This neutralizes the acid to form water and a salt.

Blood Buffering System

Additionally, your body uses a **buffering system** to keep the hydrogen ion concentration (or pH) of your blood in check. Your body coordinates the release hydrogen carbonate ions to reduce the acidity of your blood. Alternatively, your respiratory system controls how much CO_2 you exhale when the acidity of your blood is too low.

$$\underset{\text{acid}}{H^+} + \underset{\text{base}}{HCO_3^-} \rightarrow \underset{\text{conjugate acid}}{H_2CO_3} \rightarrow \underset{\text{water}}{H_2O} + CO_2$$

References

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