

Acids, bases and pH

What does pH tell us, and what happens during neutralisation?

By the end of this topic

- Use pH to identify acidic, neutral and alkaline solutions.
- Describe how indicators work.
- Distinguish a base from an alkali.
- Write simple word equations for neutralisation.

Key terms & definitions

Acid – A substance that produces hydrogen ions in water and forms a solution with pH below 7 at room temperature.

Base – A substance that reacts with and neutralises an acid.

Alkali – A base that dissolves in water.

Indicator – A substance that changes colour in acidic or alkaline solutions.

pH – A scale showing how acidic or alkaline a solution is.

Neutralisation – A reaction between an acid and a base.

Understand the idea

Acids and bases

Acids and bases have different chemical properties. Lemon juice and vinegar are acidic; soap solution is alkaline.

- An acid produces hydrogen ions in water. An ion is a charged particle.
- A base reacts with and neutralises an acid.
- An alkali is a base that dissolves in water.

The pH scale

The pH scale tells us how acidic or alkaline a solution is. The usual school chart runs from 0 to 14. At room temperature, pH 7 is neutral.

pH	Type of solution	Example
Below 7	Acidic	Vinegar.
7	Neutral	Pure water.
Above 7	Alkaline	Soap solution.

Reading pH values

At room temperature, pH 7 is neutral. Values can include decimals.

- Lower pH means more acidic: pH 6.5 is acidic.
- Higher pH means more alkaline: pH 7.5 is alkaline.
- A pH meter gives a numerical reading; an indicator chart usually gives an approximate value or range.

Indicators change colour

An indicator changes colour in acidic or alkaline solutions.

- Litmus: red in acid; blue in alkali.
- Universal indicator: a range of colours matched to a pH chart.
- Typical colours: red/orange in strongly acidic solutions; green at neutral pH; blue/purple in alkaline solutions.
- Always use the chart supplied with the indicator.

Neutralisation

Neutralisation is a reaction between an acid and a base.

- Acid + metal hydroxide $\rightarrow$ salt + water.
- Hydrochloric acid + sodium hydroxide $\rightarrow$ sodium chloride + water.
- "Salt" names a group of compounds, not just table salt. Its name depends on the reactants.

Acids reacting with carbonates

An acid reacting with a carbonate also produces carbon dioxide.

- Acid + carbonate $\rightarrow$ salt + water + carbon dioxide.
- Hydrochloric acid + calcium carbonate $\rightarrow$ calcium chloride + water + carbon dioxide.
- The carbon dioxide turns limewater milky.

How much acid and alkali should react?

Adding alkali to acid moves the pH towards neutral. Too much alkali makes the mixture alkaline.

- Equal volumes do not always neutralise exactly: concentrations and reacting amounts matter.
- Use measured amounts and an indicator to follow the change.
- Everyday examples: antacids react with excess stomach acid; lime can reduce soil acidity.

Worked examples

Write a word equation for the reaction between hydrochloric acid and sodium hydroxide.

Work through it

1. Write the two reactants on the left: hydrochloric acid + sodium hydroxide.

2. The products are sodium chloride and water.

3. Complete the equation: hydrochloric acid + sodium hydroxide → sodium chloride + water.

Common mistakes

Common mistake: Every base is an alkali.

Remember: An alkali is a base that dissolves in water. Some bases are insoluble.

Common mistake: Equal volumes of acid and alkali always give a neutral mixture.

Remember: The amounts that react depend on concentration and the substances used, not volume alone.

Answering questions

- When interpreting pH, give both the value and classification: for example, pH 4 means acidic.
- Check the reaction type before writing products: acid + hydroxide gives salt and water; acid + carbonate also gives carbon dioxide.

Try an investigation

Use indicator to test labelled, dilute solutions chosen by your teacher. Compare each colour with the supplied chart. Wear eye protection, use separate droppers and never taste solutions or mix cleaning products.

Do practical work with your teacher and follow the laboratory safety instructions.

Open [this topic online](#) for videos, reference diagrams and practice.

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ACIDS, ALKALIS & pH

The pH scale describes solutions in water.

ACIDIC:
below 7



$\text{pH} < 7$

NEUTRAL:
7



$\text{pH} = 7$

ALKALINE:
above 7



$\text{pH} > 7$

At room temperature, pure water is neutral.

Universal indicator changes colour. Use its colour chart.



pH 2



pH 7



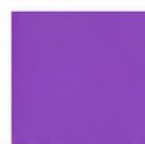
pH 12



Example:
pH 2



Example:
pH 7



Example:
pH 12

Other pH values give other colours.

NEUTRALISATION

Acid + metal hydroxide $\rightarrow$ salt + water

Example: hydrochloric acid + sodium hydroxide $\rightarrow$ sodium chloride + water



Never taste laboratory solutions.