

LESSON SLIDES

Acids, Bases and the pH Scale

Chemistry · Measuring how acidic or alkaline a solution is

By the end of this lesson you can

- 🎯 Describe acids and alkalis with everyday examples
- 🎯 Tell a base apart from an alkali
- 🎯 Use the pH scale and indicators
- 🎯 Explain the tenfold steps of the pH scale
- 🎯 Describe neutralisation and name the salt

Acids and alkalis are everywhere

- Lemon and lime juice contain citric acid
- Vinegar contains ethanoic (acetic) acid
- Your stomach makes hydrochloric acid to help digest food
- Many household cleaners are alkaline
- Indigestion tablets contain bases that cancel out stomach acid

Acids and alkalis compared

Acids

- pH less than 7
- Turn blue litmus paper red
- Edible ones taste sour (never taste in the lab)
- React with many metals to give hydrogen gas
- Concentrated acids are corrosive

Alkalis

- pH more than 7
- Turn red litmus paper blue
- Are bases that dissolve in water
- Neutralise acids
- Concentrated alkalis are corrosive too

Base or alkali?

- A base is any substance that reacts with an acid to make a salt and water
- An alkali is a base that dissolves in water
- So every alkali is a base, but not every base is an alkali
- Sodium hydroxide is a base and an alkali
- Copper oxide is a base but does not dissolve, so it is not an alkali

The pH scale

- A number scale, usually shown from 0 to 14
- pH 7 is neutral, like pure water
- Below 7 is acidic: the lower the number, the more acidic
- Above 7 is alkaline: the higher the number, the more alkaline
- pH measures the concentration of hydrogen ions in a solution

Each step on the pH scale is ten times

×10

**A solution at pH 3 has ten times the
hydrogen ion concentration of one at pH 4**

Everyday substances on the pH scale

- From strong acid at pH 0 to strong alkali at pH 14, with pure water neutral at pH 7.



Indicators show acid or alkali

- An indicator changes colour depending on pH
- Litmus: red in acid, blue in alkali
- Universal indicator: red (strong acid), green (neutral), purple (strong alkali)
- Red cabbage juice is a natural indicator
- A pH meter gives a more precise number

Litmus or universal indicator?

Litmus

- Only two colours: red or blue
- Tells you acid or alkali
- Does not tell you how acidic
- Neutral: neither paper changes colour

Universal indicator

- A range of colours across the pH scale
- Gives an approximate pH number
- Shows strongly or weakly acidic or alkaline
- Compare the colour with a chart

 Example

Worked example: comparing two solutions

- 1 Lemon juice: about pH 2. Coffee: about pH 5
- 2 Difference: $5 - 2 = 3$ steps
- 3 Each step is $\times 10$, so $10 \times 10 \times 10$
- 4 Lemon juice is about 1,000 times more acidic
- 5 Coffee is still acidic, just much less so

Neutralisation

- Acid + base $\rightarrow$ salt + water
- Hydrogen ions from the acid react with hydroxide ions: $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$
- The pH moves towards 7
- Universal indicator changes towards green
- Too much alkali makes the mixture alkaline again

 Example

Naming the salt

- 1 Hydrochloric acid + sodium hydroxide → sodium chloride + water
- 2 First part of the name comes from the base (sodium)
- 3 Second part comes from the acid (chloride)
- 4 Hydrochloric gives chlorides; sulfuric gives sulfates; nitric gives nitrates
- 5 Antacid: magnesium hydroxide + hydrochloric acid → magnesium chloride + water

Working safely with acids and alkalis

- Wear eye protection throughout
- Use dilute solutions in small volumes
- Never taste or smell chemicals to identify them
- Rinse spills on skin with plenty of cold water and tell the teacher
- Alkalis are especially harmful to eyes

 Quick check

A solution turns universal indicator purple. What is its approximate pH?

A pH 1

B pH 7

C pH 5

D pH 13

Key takeaways

- ✓ Acids have pH below 7; alkalis have pH above 7; pH 7 is neutral
- ✓ An alkali is a base that dissolves in water
- ✓ Each pH step is a tenfold change
- ✓ Litmus shows acid or alkali; universal indicator shows the approximate pH
- ✓ $\text{Acid} + \text{base} \rightarrow \text{salt} + \text{water}$