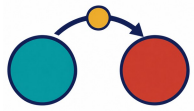
Acids, Bases and pH Map

AQA A-level Chemistry · 3.1.12.1–3.1.12.3 Acids, bases and pH

1 Brønsted–Lowry

3.1.12.1

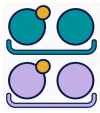
- **Acid**: proton (H^+) donor
- **Base**: proton acceptor
- The base uses a **lone pair**
- $H^+ + H_2O \rightarrow \mathbf{H_3O^+}$
- Water can be either: amphoteric



2 Conjugate pairs

3.1.12.1

- Differ by **one H^+**
- Acid → conjugate base
- Base → conjugate acid
- Two pairs in every reaction
- Pairs sit **across** the arrow

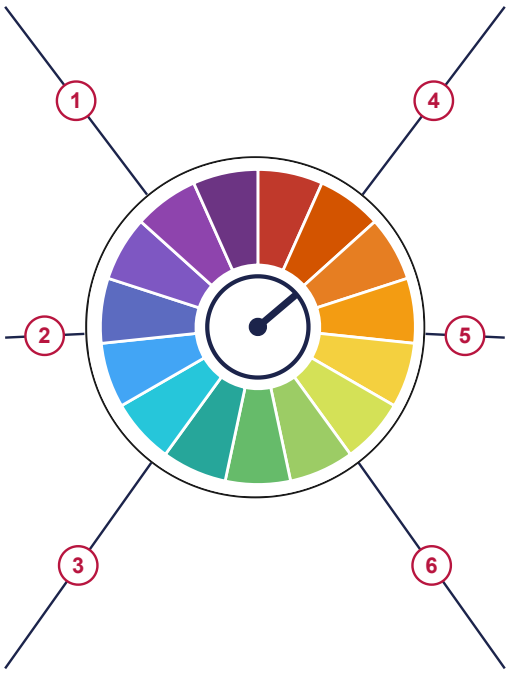


3 pH

3.1.12.2

- **$pH = -\log_{10}[H^+]$**
- **$[H^+] = 10^{-pH}$**
- pH to **2 d.p.**, no unit
- One unit = **×10** in $[H^+]$
- Can be below 0





4 Strong acids

3.1.12.2

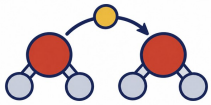
- **Fully dissociated**
- HCl, HNO_3: $[H^+]$ = [acid]
- $pH = -\log_{10}$[acid]
- Dilute ×10: pH **+1**
- Strong ≠ concentrated



5 Ionic product of water

3.1.12.3

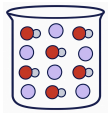
- $H_2O \rightleftharpoons H^+ + OH^-$
- **$K_w = [H^+][OH^-]$**
- 1.00×10^{-14} mol² dm⁻⁶ (298 K)
- From K_c: $[H_2O]$ is constant
- Heating raises K_w (endothermic)



6 Strong bases

3.1.12.3

- **Fully dissociated**: NaOH, KOH
- $Ba(OH)_2$: **two** OH^-
- **$[H^+] = K_w \div [OH^-]$**
- Then $pH = -\log_{10}[H^+]$
- Neutral: **$[H^+] = [OH^-]$**



pH at 298 K

every value from $[H^+]$ or from $K_w = 1.00 \times 10^{-14}$ mol² dm⁻⁶

Solution	$[H^+]$ or $[OH^-]$ / mol dm⁻³	Working	pH
0.0250 mol dm⁻³ HNO_3	$[H^+] = 0.0250$	$-\log_{10} 0.0250$	1.60
pure water	$[H^+] = 1.00 \times 10^{-7}$	$\sqrt{K_w}$	7.00
0.0500 mol dm⁻³ NaOH	$[OH^-] = 0.0500$	$[H^+] = K_w \div 0.0500 = 2.00 \times 10^{-13}$	12.70
0.0150 mol dm⁻³ $Ba(OH)_2$	$[OH^-] = 0.0300$	$[H^+] = 3.33 \times 10^{-13}$	12.48
pure water at 50 °C	$K_w = 5.48 \times 10^{-14}$	$[H^+] = \sqrt{K_w} = 2.34 \times 10^{-7}$	6.63

Worked examples

Find the pairs

- $HNO_3 + H_2O \rightarrow H_3O^+ + NO_3^-$
- HNO_3 / NO_3^-
- **H_3O^+ / H_2O**

Dilute it

- 25.0 cm³ 0.100 HCl
- made up to 250 cm³
- **pH 2.00**

Neutral when hot

- 100 °C: $K_w = 5.13 \times 10^{-13}$
- pH of pure water 6.14
- **$[H^+] = [OH^-]$: neutral**

Weak acids, K_a and pK_a follow in 3.1.12.4; pH curves in 3.1.12.5; buffers in 3.1.12.6.

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