Titration Curves Map

OCR A Level Chemistry A · 5.1.3 pH titration curves and indicators

1 Measuring a curve

5.1.3(n)

- pH meter in the flask
- Alkali from a **burette**
- **Small portions** near the end
- pH (y) v volume added (x)
- Equivalence: mid-jump



2 Strong + strong

5.1.3(n)

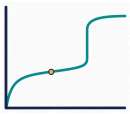
- Starts at pH 1.00
- Equivalence **pH 7.00**
- Jump about **3.7–10.3**
- Excess ÷ **total volume**
- Ends near 12.5

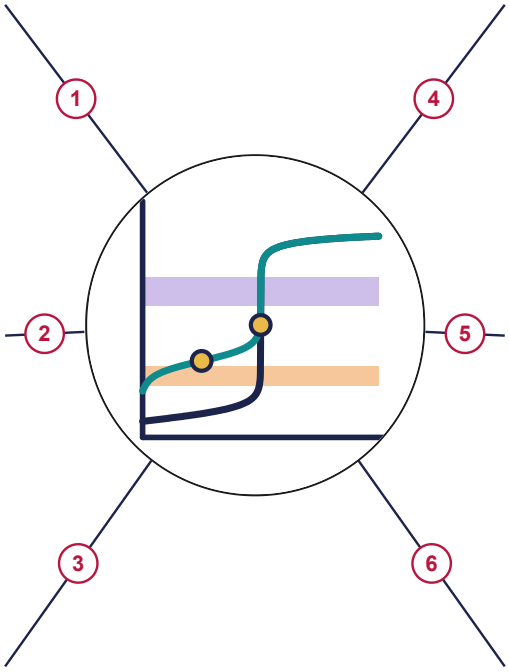


3 Weak acid

5.1.3(n)

- Starts higher: pH 2.88
- **Buffer region**: gentle rise
- Half-way: **pH = pK_a**
- Equivalence **above 7** (8.73)
- $A^- + H_2O \rightleftharpoons HA + OH^-$





4 Weak base

5.1.3(n)

- Equivalence **below 7** (5.28)
- $NH_4^+ \rightleftharpoons NH_3 + H^+$
- Short jump: 3.7–6.9
- Weak + weak: **no jump**
- No sharp end point



5 Titration calculations

5.1.3(n)

- Mean of **concordant** titres
- $n = c \times V \div 1000$
- Use the **mole ratio**
- Excess ÷ **total volume**
- Then pH of the excess



6 Indicators

5.1.3(n)

- **$HIn \rightleftharpoons H^+ + In^-$**
- Two colours; range ≈ pK_{in} ± 1
- Range **inside the jump**
- Methyl orange: strong acids
- Phenolphthalein: strong bases



The four curves at 298 K

25.0 cm³ of 0.100 mol dm⁻³ acid, 0.100 mol dm⁻³ base; equivalence at 25.00 cm³

Acid + base	Start pH	Equivalence pH	Vertical section	Indicator
HCl + NaOH	1.00	7.00	3.7–10.3	either
CH_3COOH + NaOH	2.88	8.73	7.2–10.3	phenolphthalein
HCl + NH_3	1.00	5.28	3.7–6.9	methyl orange
CH_3COOH + NH_3	2.88	7.00	none	none

Worked examples

Before equivalence

- 20.0 cm³ NaOH into 25.0 cm³ HCl
- H^+ left 5.00 × 10^{-4} mol in 45.0 cm³
- **pH 1.95**

From a titre

- 25.0 cm³ HCl needs 22.50 cm³
- of 0.100 mol dm⁻³ NaOH
- **[HCl] = 0.0900 mol dm⁻³**

K_a from the curve

- equivalence 24.60 cm³
- pH at 12.30 cm³: 3.75
- **K_a = 1.78 × 10^{-4}**

Buffer solutions, the flat region of the weak acid curve, follow in 5.1.3.

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