Titration Curves Map

Edexcel International A Level Chemistry · Unit 4 · Topic 14C Titration Curves and Indicators

1 Measuring a curve

14.15

- 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

14.15

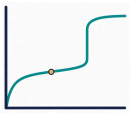
- Starts at pH 1.00
- Equivalence **pH 7.00**
- Jump about **3.7–10.3**
- Excess ÷ **total volume**
- Ends near 12.5

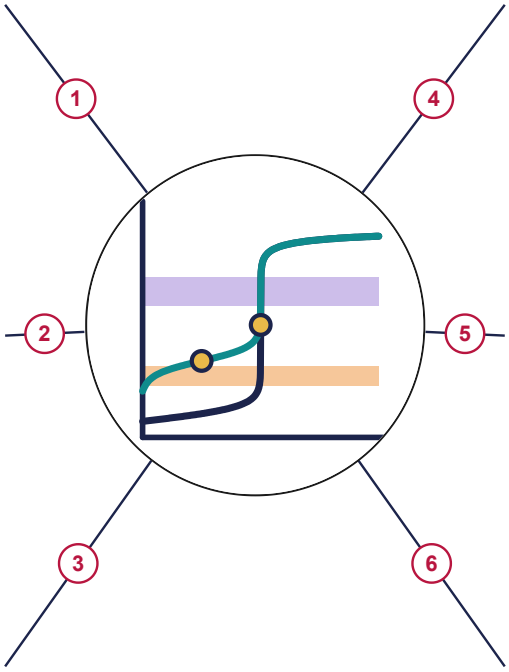


3 Weak acid

14.15, 14.21

- 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

14.15

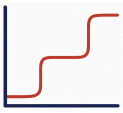
- Equivalence **below 7** (5.28)
- $NH_4^+ \rightleftharpoons NH_3 + H^+$
- Short jump: 3.7–6.9
- Weak + weak: **no jump**
- No sharp end point



5 Diprotic

14.15

- **Two** equivalence points
- $CO_3^{2-} \rightarrow HCO_3^- \rightarrow CO_2$
- $H_2C_2O_4 \rightarrow HC_2O_4^- \rightarrow C_2O_4^{2-}$
- Second at **twice** the first
- Overall 1 : 2



6 Indicators

14.16

- **HIn ⇌ 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**

Two steps

- 25.0 cm³ 0.100 Na_2CO_3
- with 0.100 mol dm⁻³ HCl
- **25.00 and 50.00 cm³**

K_a from the curve

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

Buffers, the flat region of the weak acid curve, follow in Topic 14D.

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