## Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

**2.1**

- **volumetric pipette**

**2.2**

- the acid has **exactly neutralised** the alkali

**2.3**

- acid: **red**
- alkali: **yellow**

**2.4**

- 23.15 **cm**$^3$

**2.5**

- readings 1.20 and 24.10
- titre = 22.90 cm$^3$

**2.6**

- $0.100 \times \dfrac{25.0}{1000}$
- $= 0.00250$ mol

**2.7**

- water would **dilute** the acid, changing its concentration

**2.8**

- it can be **swirled** without the liquid spilling

**3.1**

**A**

**3.2**

**B**

**3.3**

(a)

- add a few drops of **indicator** to the alkali in the flask
- add acid from the burette, **swirling**, then **drop by drop** near the end
- stop when the indicator **just changes colour**; record the volume

(b) indicators are weak acids: more would **change the titre**

(c) to **mix** the solutions so the acid reacts fully

**3.4**

(a) 23.95, 22.95, 23.90

(b)

- use runs **1 and 3** (within 0.10)
- $(23.95 + 23.90) \div 2 = 23.93$ cm$^3$

**3.5**

- moles NaOH $= 0.100 \times 0.0250 = 0.00250$
- moles HCl $= 0.00250$ (1 : 1)
- $c = 0.00250 \div 0.02000 = 0.125$ mol/dm$^3$

**3.6**

(a)

- $n = c \times V = 0.100 \times \dfrac{22.50}{1000}$
- $=$ **0.00225** mol

(b)

- ratio $Na_2CO_3$ : HCl = 1 : 2
- $n = 0.00225 \div 2 =$ **0.001125** mol

(c)

- $c = \dfrac{n}{V} = \dfrac{0.001125}{0.0250}$
- $=$ **0.0450** mol/dm$^3$

(d) **orange** (from yellow; red when acid is in excess)

(e) **repeat** until two titres are **concordant** (within 0.10 cm$^3$) and average those

**3.7**

(a)

- $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

(b) **blue** to **colourless**

(c) $0.200 \times 0.0250 = 0.00500$ mol

(d) $0.00500 \div 2 = 0.00250$ mol

(e) $0.00250 \div 0.02000 = 0.125$ mol/dm$^3$

(f)

- $0.125 \times 98$
- $= 12.3$ g/dm$^3$

(g)

- repeat with the same volumes **without the indicator**
- **evaporate** and leave to **crystallise**