

# 15.1 Titration and a defensible concentration

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 10 marks

**KEY WORDS** titre • equivalence point

## Objective

Titration and a defensible concentration. Supported SL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

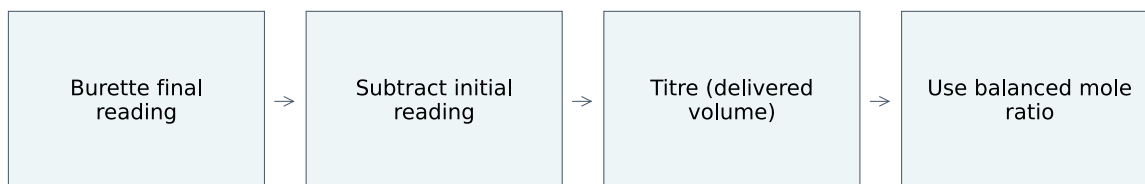
## 1 Key knowledge and worked examples

### ■ What would explain this observation?

- A burette reading is not the delivered volume. The **titre** is the difference between final and initial readings, and both readings have uncertainty.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

### ■ Build the model

- A titration measures the amount of one solution needed to react with a known amount of another. The equation gives the mole ratio. An indicator endpoint approximates the **equivalence point** when a suitable indicator is used.
- titre: The volume delivered between two burette readings; equivalence point: The point of stoichiometric reaction completion.



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■ **Choose evidence that can test it**

- Calculate the known amount first, apply the stoichiometric ratio, then divide by the unknown solution volume in cubic decimetres. Use concordant titres as required by the school method and report the accepted values.
- Rinse the burette with its solution and the pipette with the solution it transfers. Rinse the flask with distilled water. Add titrant slowly near the endpoint, swirl, and read the meniscus at eye level. Use a white tile and appropriate eye protection.

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■ **Work from known quantities**

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: 25.0 cubic centimetres of acid reacts 1:1 with 20.0 cubic centimetres of 0.100 mol per cubic decimetre alkali.  $n = cV = 0.100 \times 0.0200 = 0.00200$  mol. Acid amount is 0.00200 mol.  $c = n/V = 0.00200/0.0250 = 0.0800$  mol per cubic decimetre.

**Example:**

Burette readings are 1.40 and 23.65 cubic centimetres. Calculate titre. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

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■ **Check the conclusion and its limits**

- Adding distilled water to the flask changes volume but not the transferred amount of analyte. Do not average a rough titre with carefully measured concordant values.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

**Warn:**

A flask must be rinsed with analyte to avoid dilution of its mole amount. This claim is false: Adding distilled water to the flask changes volume but not the transferred amount of analyte. Do not average a rough titre with carefully measured concordant values.

**Key:**

Titration and a defensible concentration: Calculate the known amount first, apply the stoichiometric ratio, then divide by the unknown solution volume in cubic decimetres. Use concordant titres as required by the school method and report the accepted values.

## 2 Practice

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**2.1** Why rinse the pipette with the solution it will transfer? Choose one answer.

- **A** To avoid dilution by residual water
- **B** To create more moles of analyte
- **C** To make the solution neutral

[1]

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**2.2** Burette readings are 1.40 and 23.65 cubic centimetres. Calculate titre. Show the relation, substitution and units. [2]

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**2.3** Decide whether this claim is true and justify: A flask must be rinsed with analyte to avoid dilution of its mole amount. [2]

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**2.4** The volume delivered between two burette readings: write the technical term. [1]

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### 3 Exam-style questions

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**3.1** Fictional 1:1 titration: 25.0 cm<sup>3</sup> acid needs 18.0 cm<sup>3</sup> 0.100 mol/dm<sup>3</sup> alkali. Find acid concentration and explain how an overshoot endpoint biases it. [4]

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## Solutions

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**2.1 A** Calculate the known amount first, apply the stoichiometric ratio, then divide by the unknown solution volume in cubic decimetres. Use concordant titres as required by the school method and report the accepted values.

**2.2** titre=final–initial=23.65–1.40=22.25 cm<sup>3</sup>.

**2.3** False. Adding distilled water to the flask changes volume but not the transferred amount of analyte. Do not average a rough titre with carefully measured concordant values.

**2.4** titre. titre means The volume delivered between two burette readings.

**3.1**  $n=0.100 \times 0.0180=0.00180$  mol;  $c=0.00180/0.0250=0.0720$  mol/dm<sup>3</sup>. Overshoot increases recorded volume and inferred concentration in this model. Use concordant runs.