

Titrations

4.4.2.5 · Chemical changes · revision notes

GCSE Chemistry only (not in Combined Science). How to carry out a titration to find the exact volumes of a strong acid and a strong alkali that react (required practical 2).

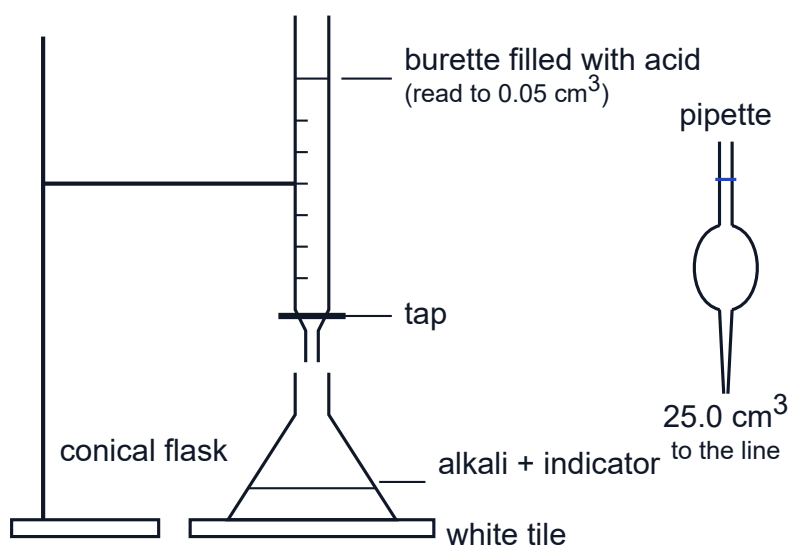
Key facts

- Titre = final burette reading – initial burette reading
- Concordant titres: within 0.10 cm^3 of each other
- $\text{cm}^3 \div 1000 = \text{dm}^3$
- $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Notes

Method (required practical 2)

- A titration finds the exact volumes of acid and alkali that react with each other.
- 1. Use a **pipette** and pipette filler to put exactly 25.0 cm^3 of alkali (e.g. sodium hydroxide solution) into a **conical flask**.
- 2. Add a few drops of **indicator** (e.g. phenolphthalein or methyl orange) and stand the flask on a white tile.
- 3. Fill a **burette** with the acid and record the starting reading.
- 4. Add the acid while swirling the flask. Near the end point, add it **drop by drop** until the indicator **just** changes colour.
- 5. Record the final reading. Titre = final reading – initial reading.
- 6. Do a rough titration first, then repeat until you have **concordant** results (within 0.10 cm^3 of each other).



Pipette the alkali into the flask; run the acid in from the burette until the indicator just changes colour.

Getting accurate results

- Read the burette at eye level, at the bottom of the meniscus, to the nearest 0.05 cm^3 .
- Use an indicator with a sharp colour change. Universal indicator is not used because its colour changes gradually.
- The white tile makes the colour change easier to see.
- Calculate the mean titre from the concordant results only, not the rough titre.

How to answer each type of question

6-mark: describe how to carry out a titration

4 to 6 marks

Grade 5

1. Measure a fixed volume of alkali with a pipette into a conical flask and add indicator.
2. Fill the burette with acid and record the initial reading.
3. Add acid while swirling, dropwise near the end point, until the colour just changes.
4. Record the final reading, repeat to get concordant results and calculate the mean.

Example. Describe how you would use a titration to find the volume of dilute hydrochloric acid that reacts exactly with 25.0 cm^3 of potassium hydroxide solution. [6 marks]

Model answer. Marked in levels. A top-level answer is a complete method in a logical order, such as:

Use a pipette (and filler) to measure 25.0 cm^3 of potassium hydroxide solution into a conical flask (1)

Add a few drops of indicator, e.g. phenolphthalein, and stand the flask on a white tile (1)

Fill a burette with hydrochloric acid and record the reading (1)

Add the acid while swirling, drop by drop near the end point (1)

Stop when the indicator changes colour (pink to colourless) and record the final reading (1)

Repeat until results are concordant (within 0.10 cm^3) and calculate the mean (1)

Calculate a mean titre

2 marks

Grade 5

1. Pick the concordant titres (within 0.10 cm^3 of each other).
2. Leave out the rough titre and any result that is not concordant.
3. Add the concordant titres and divide by how many there are; give 2 decimal places.

Example. A student recorded these titres.

Titration	Rough	1	2	3	4
Titre in cm^3	24.60	23.95	24.30	24.00	23.90

Calculate the mean titre using only the concordant results.

Model answer. Concordant titres are 23.95, 24.00 and 23.90 cm^3 (1)

Mean = $(23.95 + 24.00 + 23.90) \div 3 = 71.85 \div 3 = 23.95 \text{ cm}^3$ (1)

Don't lose marks

- ✗ Including the rough titre in the mean.
- ✗ Reading the burette from the top of the meniscus, or not at eye level.
- ✗ Writing burette readings to 1 decimal place, e.g. 23.5 instead of 23.50.

More tips

Memory tricks

- Burette readings are written to 2 decimal places, ending in 0 or 5, e.g. 23.45 cm³.

Exam technique

- Show every step of a calculation with units: you can still get marks for correct working if the final answer is wrong.
- Give answers to a sensible number of significant figures, usually the same as the data (often 3).
- Use the technical words: pipette, burette, conical flask, end point, titre, concordant.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 4

Name the equipment used in a titration

Burette, pipette with pipette filler, conical flask, indicator and white tile.

Grade 5

Describe how to carry out a titration

Add acid from a burette to a measured volume of alkali with indicator until the colour just changes.

Grade 5

Choose concordant results and find the mean

Use titres within 0.10 cm³ of each other and leave out the rough titre.

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