CIE Chemistry A-Level

Practicals for Papers 3 and 5

Titrations

Example Method for an acid-base titration

Method	Accuracy	Explanation
1. Pour approximately 100cm^3 of the standard solution of known concentration into a beaker.	• Use a **clean**, **dry** beaker.	
2. Fill the burette with the standard solution of **known** concentration.	• **Rinse** the burette before using a small volume of the solution. • Make sure the **jet space** in the burette is **filled** and doesn't contain air bubbles.	If the jet space is not filled it will lead to errors if it then fills during the titration, leading to a larger than expected titre reading.
3. Pour approximately 100cm^3 of the solution with unknown concentration into a second beaker.	• Use a clean, dry beaker.	
4. Using a pipette filler and pipette to transfer exactly 25cm^3 of solution into a 250cm^3 conical flask.	• Rinse the 25cm^3 pipette with the solution of **unknown** concentration. • The conical flask should been rinsed with deionised water.	A conical flask is used in preference to a beaker because it is easier to swirl the mixture in a conical flask without spilling the contents.
5. Add two to three drops of phenolphthalein indicator to the solution in the conical flask and note the initial colour of the indicator.		Only **a few** drops of indicator is required. If too much is added it will affect the titration result.
6. Record the initial burette reading.	• Make sure that all your burette readings are to the appropriate precision and are read from the bottom of the **meniscus**.	
7. Titrate the contents of the conical flask by adding solution to it from the burette until the indicator undergoes a definite, permanent **colour change**. Record the final burette reading in your table of results. Calculate the titre volume (change in volume in the burette).	• Add the solution slowly, **swirling** the flask gently to mix the solution. • Add the solution dropwise near the **end-point**. • Use a white tile underneath the flask to help observe the colour change.	Distilled water can be used during a titration to wash the sides of the flask so that all reactants are washed into the mixture. This water does not affect the titration as it doesn't change the number of moles of each reactant.

8. **Repeat**, calculate and record the volume of solution used in the titration in a table (titre volume). Repeat until two concordant results are obtained. Record all of the results that you obtain.	• You should normally carry out at least **three** titrations.	

Conical flask/burette:

- If solution A is titrated **against** solution B, it means that solution A is in the conical flask and solution B is in the burette.
- The alkali usually in conical flask.

Titration Tables (Results):

- If 2 or 3 values are within 0.10cm^3 and are therefore **concordant**, then the results are accurate and reproducible and the titration technique is good or consistent.
- Results should be clearly recorded in a **table**.
- Rows on the table should be: initial burette reading, final burette reading and titre, all in cm^3.
- Columns on the table should be the different trials labelled numerically.
- Tick the two concordant titres.
- Record titre volumes to **2dp** (0.05 cm^3).
- Only make an average titre volume using the concordant titre results.

Safety precautions:

- Acids and alkalis are corrosive (at low concentrations acids are irritants).
- Wear **eye protection and gloves**.
- If spilled immediately wash affected parts after spillage.
- If a substance is unknown, treat it as potentially toxic and wear gloves.

Titrating mixtures:

- If titrating a mixture to work out the concentration of an active ingredient, it is necessary to consider if the mixture contains other substances that have acid-base properties and could affect the reaction.
- If they don't have acid-base properties we can titrate with confidence.

Testing batches:

- In quality control it will be necessary to do titrations or testing on several samples as the concentration and amount of the chemical being tested may vary between samples.

Uncertainties:

- Uncertainty of a measurement using a burette.
- If the burette used in the titration had an uncertainty for each reading of +/– 0.05 cm^3 then during a titration, two readings are taken making the **overall** uncertainty on the titre volume **+/– 0.10 cm^3**.
- Often, another 0.05 cm^3 is added on because of uncertainty identifying the end point colour change.

Reducing uncertainties in a titration:

- Replacing measuring cylinders with pipettes or burettes which have lower apparatus uncertainty will lower the overall error.
- To **reduce the uncertainty** in a burette reading the titre volume needs to be made **larger**. This could be done by: increasing the volume and concentration of the substance in the conical flask or by decreasing the concentration of the substance in the burette.
- Leaving NaOH in the burette will cause damage to the apparatus which could lead to errors.