

CIE Chemistry IGCSE

AO3 Practical Skills 5: Evaluate methods
and suggest possible improvements

Notes



Evaluation and analysis of experimental methods

Introduction

An important skill in chemistry is being able to **describe, explain** and **comment** on **experimental techniques** and **methods**. This includes:

How a proposed method could be improved

Examples:

- Carrying out **repeats** to identify **anomalies** and calculate a **mean**.
- When observing a **colour change** in solution, does the method suggest placing a white tile underneath the beaker to better observe the colour change?

How the apparatus used could be improved

Using apparatus with a **higher resolution** improves the **precision** of your readings.

Examples:

- Using a pH probe instead of universal indicator.
- Using a 25 cm³ measuring cylinder instead of a 50 cm³ flask to measure out 20 cm³.

Identifying any steps that could cause error

As well as identifying areas that could **cause error** you may also have to suggest how this error could be **minimised**.

Examples:

- An experiment used to investigate the water potential of potatoes requires wet potatoes to be dried, in this example, drying should be done by the same person for the same length of time with each potato piece.
- An experiment which investigates rates of reaction uses the reaction between hydrochloric acid and sodium thiosulfate which produces a white precipitate, causing the solution to turn cloudy. A white cross is placed under the beaker and the time taken for the black cross to disappear is measured. The exact point when the cross disappears is **subjective** and the time would vary from person to person, so the same one person should say when the cross disappears each time.

If you were to repeat an experiment, what changes you would make and why

This can include changes to the **method, apparatus** or the **range** and **intervals** of the **independent variable**.

Examples:

- If a trend was difficult to see then more values of the independent variable should be tested, such as instead of taking measurements at pH 6, pH 7, pH 8 and pH 9, next time you would test every 0.5 pH units from 5.5 to 9.5.
 - Testing over a **larger range** and at **smaller intervals**

Explaining why certain techniques / apparatus are used over others

Examples:

- A good **technique** for measuring mass is the **'weighing by difference' method** and is more **accurate** than taking a single mass measurement. The method - first weigh the



container with the solid in it, then add the solid to the reaction and reweigh the container, the difference between these two values would be the mass of solid added.

- This comes back to the **resolution** and **precision** of the apparatus
 - High resolution isn't always best though - it would be better to measure 100 cm^3 of a liquid using a 100 cm^3 beaker that had divisions every 10 cm^3 instead of measuring out 10 cm^3 in a 10 cm^3 beaker with divisions every 1 cm^3 - but having to do that 10 times to reach 100 cm^3 !

Identifying variables that need to be controlled and how you would control them

- These variables are called **control variables** and they are needed in order to carry out a **'fair test'**. If the variables are not controlled, the data produced is **invalid**.
 - It enables the effects of changing the independent variable alone to be observed and recorded.
- A fair test is one that **controls all of the variables in an experiment except one** - the one that you, the experimenter, changes. This is the **independent variable** and the thing that changes as a result of changing the independent variable is the **dependent variable**.
 - Because it is *dependent* on the other variable.
- Examples:
 - **Controlling temperature** - place the required flask/beaker etc. in which the experiment is taking place in into a **water bath**. The temperature in the water changes much more slowly and is much more constant than the temperature in the air.
 - Using the **same volumes / concentrations / masses** of chemicals used besides the independent variable in repeats. If the rate of reaction of two solutions is being measured at different temperatures, the concentration and volumes of the solutions must be kept exactly the same.
 - **Controlling pH** - a **pH buffer** can be used to limit the changes in pH during a reaction

