CIE Chemistry A Level

4.3.2 Practical Skills for Paper 5 - Planning

Notes

Planning

When planning an experiment, it is important to choose a **safe** and **efficient** procedure. A safe procedure ensures that no risks are posed to the person carrying out the experiment. It may also ensure that the results are **valid** as results may be affected if the experiment is not being carried out safely. Choosing the most efficient procedure achieves **maximum productivity** meaning there is as little waste and as few processes as possible so the procedure is quicker.

Devising a hypothesis

Before you can start to devise an experimental method, you must create a **hypothesis**. A hypothesis is a **suggested explanation** based on previously observed results that is used as a starting point for an investigation. A hypothesis is often written as an if/then statement. For example:

- 'If I drink more water, then I will lose weight faster.'
- 'If you drink coffee before bed, then it will take you longer to get to sleep.'

A hypothesis states a relationship between two variables - the **independent** and **dependent** variables. The hypothesis **cannot be proven as true** but it can be supported by scientific data.

A **prediction** is a guess of what might happen during an experiment. It offers no explanation and it may or may not be based on evidence. In a prediction, the correlation between two variables is not stated.

Devising a method

Before devising a method, several variables must be considered:

- Independent variable - the factor that you change during an experiment
- Dependent variable - the factor that changes/ is measured during an experiment
- Control variable - factors that must be kept constant to ensure results are valid.

When devising a method you must include:

- What your **independent, dependent** and **control variables** are
- How to **control** the **control variables** to ensure the test is valid
- The **range** and **intervals** of your independent variable you will test
- If the experiment should be **repeated**
- Whether a **control experiment** is possible for comparison
- The required **apparatus** and how to **set up** the apparatus **safely**
- The **techniques** required
- A method that enables you to **test the predictions** you have made

Ultimately, the method must be **clear, easy to follow** and enable you to collect **precise and accurate data.**

<u>Control variables</u>

Control variables are the variables which must be kept the same throughout the experiment to ensure they do not affect the results.

Example:

If the rate of reaction between hydrochloric acid and sodium is being investigated at different temperatures, the control variables would be:

- Concentration of acid
- Volume of acid
- Surface area of sodium
- Mass of sodium

Choosing apparatus

When choosing experimental apparatus, you should consider the **required precision** and the **practicality** of the apparatus. For example, exact volumes are required in a titration so a burette and pipette would be used to measure the volumes of solution. In comparison, when observing the reaction between sodium hydroxide solution and a solution of copper ions, a measuring cylinder can be used to measure the volumes as they do not need to be exact.

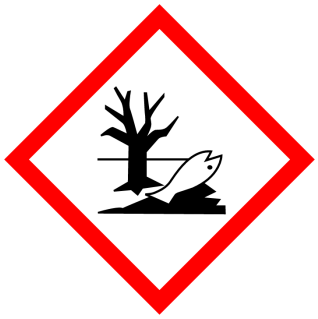
Risk Assessments

There are a lot of **hazards** related to experimental apparatus. These must be considered in a risk assessment when devising an experimental procedure. Apparatus must be used carefully and treated well to **prevent damage**. As well as damaged apparatus causing an expense, it also **corrupts data**. If damaged apparatus is used for an experiment then the data produced must be discarded as **invalid** because it is not known whether the **equipment has affected the results**.

Examples of safety precautions to take when using apparatus:

- **Bunsen burners** - these must be left on the orange safety flame when not in use and the gas tap must be turned off when the flame is not lit. All hair must be tied back and safety goggles must be worn. Flammable substances must be kept away from the flame and the room should be kept well ventilated to encourage complete combustion.
- **Glassware** - fragile glassware is used in the laboratory. This must be handled with care to prevent breakages. If glassware smashes, there are two possible dangers: broken glass and chemical spillages.

Materials used in experiments often have a **hazard symbol** to indicate what precautions must be taken. Common hazards seen in the laboratory are **'irritant'**, **'corrosive'** and **'hazardous to the environment'**. The hazard symbols are often on the chemical bottle in a red diamond, similar to the two below. It is important that the hazards of the materials are included in a **risk assessment** when devising an experiment and within this, there should be a record of suitable actions to take.



For example:
Corrosive and/or irritant - these chemicals must be handled carefully to avoid contact with the skin. Safety glasses must be worn and the skin should be washed immediately if it comes into contact.

Control Experiments

A control experiment is when all factors are the same as the experiment but the value of the independent variable is zero. A control experiment is done to verify that it is the independent variable (rather than another factor) affecting the dependent variable.