

Methods of monitoring

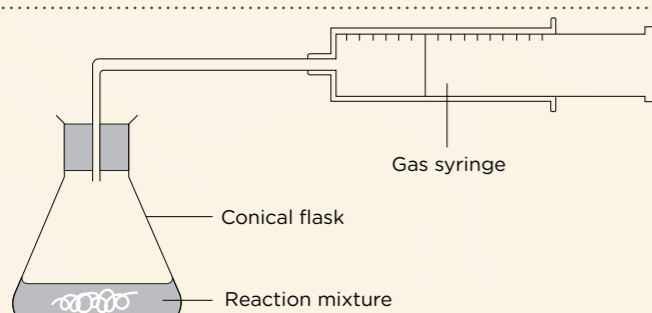
Key idea

The progress of a reaction can be followed by measuring how it changes over time. From this, we can work out the rate of the reaction – how quickly reactants are used up or how quickly products are formed.

1. Measuring the volume of gas produced over time

For reactions that produce a gas, the rate can be measured by collecting and measuring the volume of gas produced over time. There are two common methods for gas collection – gas syringe and inverted measuring cylinder.

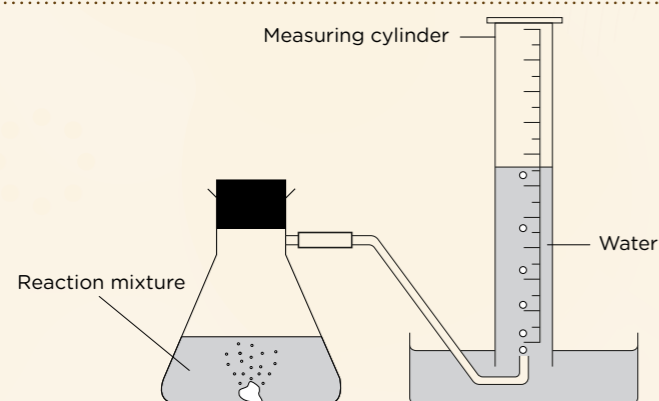
Gas syringe



How it works: The gas produced pushes the plunger in the syringe. The volume is read directly from the syringe.

- ✓ **Advantages:** Accurate measurement, closed system, easy to use.
- ✗ **Drawbacks:** Gas loss before connecting bung, friction and sticking, limited volume, not suitable for high-pressure gases.

Inverted measuring cylinder – gas displaces water



How it works: The gas produced displaces water in an upside-down cylinder and collects at the top. The volume of gas produced is read from the scale.

- ✓ **Advantages:** Simple and inexpensive, easy to see gas collected.
- ✗ **Drawbacks:** Gas loss before cylinder is turned, fragile setup, difficult to read scale to measure.

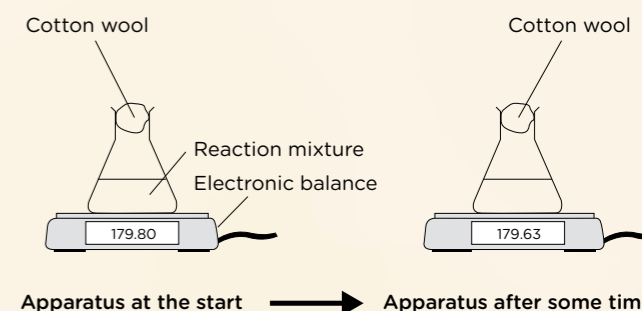
2. Measuring the loss in mass over time

For reactions that produce a gas, the rate can also be measured by recording the decrease in the mass of the reaction mixture over time.

Note: The mass decreases during the reaction because the gas that is produced leaves the reaction mixture.

How it works: The reaction mixture is contained in a flask which is placed on a balance and the mass is recorded at regular time intervals. As the gas is produced and escapes, the mass of the reaction mixture decreases.

- ✓ **Advantages:** Continuous measurement, simple equipment, direct and accurate measurement.
- ✗ **Drawbacks:** Gas must escape, not suitable for very fast reactions.



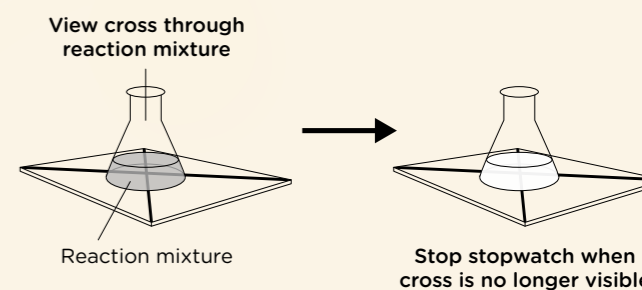
3. Measuring the formation of a precipitate over time

For reactions that produce a solid precipitate, the rate can be measured by monitoring how quickly the mixture turns cloudy. There are two methods – disappearing cross and light sensor.

Disappearing cross method

How it works: The reaction flask is placed over a piece of paper with a black 'X' marked on it. As the reaction produces a precipitate, the mixture becomes cloudy. The time taken for the 'X' to disappear from view is recorded.

- ✓ **Advantages:** Simple method, easy measurements.
- ✗ **Drawbacks:** Human judgement required, only one measurement taken.



Light sensor (connected to data logger) method

How it works: A light sensor is placed opposite a light source with the reaction container in between both. As the precipitate forms, the mixture becomes cloudier and blocks more light. The data logger records how light intensity decreases over time.

- ✓ **Advantages:** Continuous recording, better accuracy than using human eyesight.
- ✗ **Drawbacks:** Expensive, background light may affect readings.

