

# Edexcel A Biology A-Level

## Core Practical 12

Investigate the effect of temperature on the rate of an enzyme-catalysed reaction, to include  $Q_{10}$ .





The rate of reaction of an enzyme-controlled reaction is influenced by different factors: **the temperature, pH, concentration of the substrate, and the concentration of the enzyme**. The effect of each of these can be determined by **changing a single variable** and measuring its effect on the rate of reaction. It is important to **keep all other variables constant** so that they do not influence the results. Initial rate of reaction is measured because **rate of an enzyme-controlled reaction is high**, because enzymes act as **biological catalysts**, so concentration of reactants changes rapidly. The initial rate is the only point during the reaction when **concentration of reactants and products is known**.

The effect of changing temperature on rate can be quantified up to optimum temperature via calculating the **temperature coefficient** (Q10) for the reaction. This indicates the **change in rate of reaction caused by a 10 degree increase in temperature**, and is calculated via dividing rate of reaction at temperature T + 10 degrees by rate of reaction at temperature T.

Note: there are other ways to measure rate of reaction than the one outlined below. This method works because the enzyme **catalase** breaks down **hydrogen peroxide into water and oxygen** so rate can be calculated by measuring the volume of oxygen gas produced.

## Equipment

- Water bath
- Boiling tube
- Bung
- Soaked peas
- Hydrogen peroxide solution
- Delivery tube
- Gas syringe
- Stop clock
- Mortar and pestle

## Method

1. Grind a **known mass of peas in distilled water** and place in a boiling tube.
2. Add 5cm of **hydrogen peroxide solution** to the peas.
3. Fit the syringe into a delivery tube and the delivery tube into the boiling tube with a bung.
4. Place the boiling tube into a water bath at a **known temperature**.



5. Time for a set length of time e.g. 5 minutes. Measure the **volume of gas** produced at regular intervals e.g. 30 seconds.
6. Repeat the experiment at different temperatures.

## Risk Assessment

Hazard	Risk	Safety Precaution	In emergency	Risk Level
Biohazard	Contamination	Use disinfectant; wash hands with soap after handling	Seek assistance	Low
Broken glass	Cuts from sharp object	Take care when handling glassware; keep away from edge of desk	Elevate cuts; apply pressure; do not remove glass from wound; seek medical assistance	Low
Hot liquids	Scalding	Handle with care; use tongs to remove boiling tubes from water bath; wear eye protection, keep away from edge of desk	Run burn under cold water; seek medical assistance	Low
Hydrogen peroxide	May cause harm/irritation to eyes or in cuts	Wear eye protection; avoid contact with skin	Wash off skin immediately; flood eye/cuts with cold water	Low

## Graph

- Plot a graph of **temperature against ethanol concentration/temperature**.

## Conclusion

- Rate can be calculated by dividing **volume of gas** produced by **time**.
- Q10 can be calculated by dividing **rate at T+10 degrees** by rate at **T degrees**.
- Q10 for catalase is about 2; **the rate doubles for every 10 degree increase**.

Note: Q10 can be only be used **up to optimum temperature**.

