

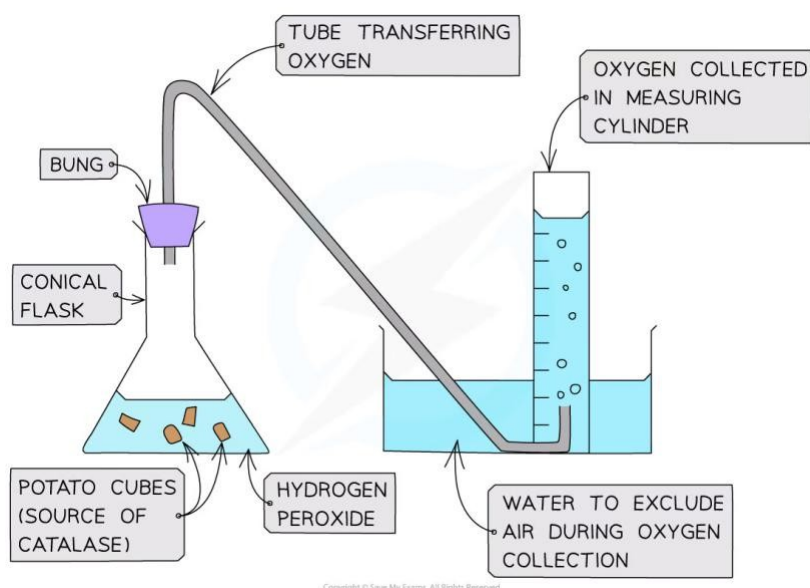


## MYP 4 CRITERIA B AND C SUMMATIVE ASSESSMENT

Subject	Grade	Points	Duration	Start time.
Biology	MYP 4	<div>B 20</div> <div>C 10</div>	60 mins	May 25, 01:40 pm
May 25, 01:40 pm (School TZ)				

### Section 1

There are many factors that affect the rate of decomposition of hydrogen peroxide by enzyme catalase. These include Substrate Concentration: Enzyme Concentration, Temperature, pH Level, Presence of Inhibitors, Presence of Co-factors, Substrate surface area. Varying the above factors may be used to speed up the rate of decomposition of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) to form oxygen gas and water, as illustrated below.



MYP 4 Biology students argued over the effect of surface area on the rate of decomposition of Hydrogen peroxide. Therefore, they decided to find out which surface area would decompose the hydrogen peroxide faster and produce large volumes of oxygen gas quickly. You are provided with:

- 250cm<sup>3</sup> of 0.1mol/dm<sup>3</sup> of hydrogen peroxide.
- 250ml conical flasks
- Delivery tubes
- Irish potatoes
- Scalpel
- Mortar and pestle.

Q 1.1 **Write** a research question for the above investigation.

B 2

How does the surface area of a substrate affect the rate of decomposition of hydrogen peroxide as measured by the time taken for a large volume of oxygen gas to be produced?

Q 1.2 **Formulate** a hypothesis to identify which substrate surface area will decompose hydrogen peroxide quickly.

B 3

If the surface area of the hydrogen peroxide is increased, then the rate of decomposition of hydrogen peroxide as measured by the time taken for large volume of oxygen gas to be produced will increase because there will be a larger surface area over which hydrogen peroxide will be acted in by the catalase enzyme and thus more oxygen and water will be produced faster.

Q 1.3 **Design** an investigation to find out which of the substrate surface area would decompose hydrogen peroxide quickly.

B 15

- In your answer you should include:
  - The independent, dependent and two control variables.
  - Details on how to manipulate, measure or monitor all of the variables
  - A list of any additional equipment you will need
  - Details of your method to allow you to collect sufficient data
  - how you will ensure the method is safe.

**Independent Variable**-Surface area of hydrogen peroxide. Using a ruler measure 30cm ruler, measure 5cm potato and crush them using a mortar and pestle at the same speed and pace for the times of 1 minute, 2 minutes, 3 minutes, 4 minutes and 5 minutes.

**Dependent Variable**-Time taken for large volume of hydrogen peroxide to be produced. Using a stopwatch measure the time taken for the oxygen gas to occupy 10 cubic cm in the measuring cylinder.

**Control Variable:**

1. Temperature. Using a water bath ensure that each set up uses 50 degrees Celsius.
2. Substrate concentration. Using a 30cm ruler ensure that each set up uses 5cm potato strips.

Additional equipment:

1. Water bath
2. 30 cm transparent ruler
3. Scalpel

**DETAILS OF HOW THE METHOD WILL COLLECT SUFFICIENT DATA:**

1. 5 increments of the Independent Variable to be obtained including 5cm potato strip crushed at the times of 1 minute, 2 minutes, 3 minutes, 4 minutes and 5 minutes in order to increase the number of data points obtained in a range and thus allowing a more concrete and certain relationship between the variables to be built.
2. Ensure that for the 5 increments of the Independent Variable, there will be three trials in order to ensure the calculation of an average, the getting rid of any random errors made during the experiment, the collection of more accurate and reliable data and to enable the identification of outliers.

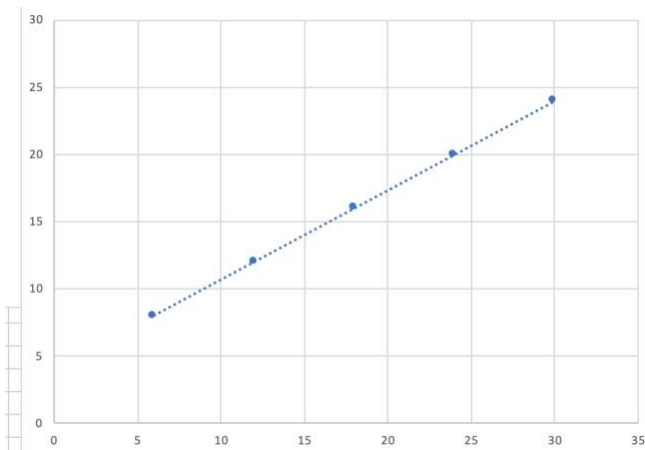
**Risk Assessment:**

1. Hot water from the water bath may lead to scalding. When carrying out the experiment the experimenters should wear protective gear that include gloves and goggles.
2. The scalpel might lead to cuts. When cutting the potato, ensure that you cut it away from your skin in order to prevent cuts and injuries.



## Section 2

The graph below shows how surface area affects the volume of oxygen gas produced as a result of decomposition of hydrogen peroxide by enzyme catalase.



Q 2.1 **Suggest** a title for the above graph.

C 1

A graph showing the relationship between surface area of hydrogen peroxide and volume of oxygen gas produced as a result of decomposition of the hydrogen peroxide.

Q 2.2 Correctly **label** the X and Y axes

C 2

X-Surface area of hydrogen peroxide in square cm.

Y-Volume of oxygen gas produced is cubic cm.

Q 2.3 Using the graph above, **suggest** which surface area produces more volume of oxygen gas.

C 1

The crushed surface area into smaller pieces.



Q 2.4 Use scientific reasoning to **explain** the trend presented in the graph above.

C 3

As the surface area of hydrogen peroxide is increased more volume of oxygen gas is produced. This is because there is a larger surface area over which the catalase enzymes work on the hydrogen peroxide is increased and thus the hydrogen peroxide is decomposed faster to form water and oxygen.

Q 2.5 Based on the graph above, **discuss** if the data presented supports your hypothesis.

C 3

The hypothesis is valid. Based on the data trend present on the graph it is evident that as you increase the surface area of hydrogen peroxide then a larger volume of oxygen gas is produced. This is because there is a larger surface area over which the catalase enzyme is working on the hydrogen peroxide thus the hydrogen peroxide decomposes faster and lots of oxygen and water is produced faster. Because the data trend in the graph correctly matches the hypothesis, the hypothesis is supported by the data trend and thus is valid.

