The effect of substrate concentration on the rate of an enzyme-controlled reaction

Introduction

Catalase is an enzyme found in many tissues. It catalyses the reaction in which hydrogen peroxide breaks down into water and oxygen. The oxygen is given off as a gas.

\[
\text{catalase} \quad \text{hydrogen peroxide} \rightarrow \ \text{water} + \text{oxygen}
\]

In this task you will investigate the effect of different concentrations of hydrogen peroxide on the rate of this reaction.

You will put pieces of card into an extract containing catalase. The card will soak up the extract containing the enzyme. You will then transfer each piece of card to a test tube containing a different concentration of hydrogen peroxide and measure the time for the card to rise to the surface.

Materials

You are provided with

- solution of hydrogen peroxide
- an extract of plant material containing the enzyme catalase
- water
- pipettes or measuring cylinders
- boiling tubes and a rack in which to stand them
- pieces of absorbent card
- forceps
- stopwatch or timer
- marker pen
- glass rod
- Petri dish or lid for waste card

You may ask your teacher for any other apparatus you require.
Method

Read these instructions carefully before you start your investigation.

Setting up the apparatus

1. Make up five boiling tubes each containing 40 cm³ of a different concentration of hydrogen peroxide. Use the hydrogen peroxide and the water to make up the different concentrations. The table shows the volume of hydrogen peroxide and the volume of water to add to each tube.

<table>
<thead>
<tr>
<th>Percentage concentration of hydrogen peroxide</th>
<th>Volume of hydrogen peroxide/cm³</th>
<th>Volume of water/cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>80</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>60</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>40</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>20</td>
<td>8</td>
<td>32</td>
</tr>
</tbody>
</table>

Label your tubes with the concentration.

2. Use the forceps to dip a piece of card into the extract containing the enzyme. You should be able to see the extract soaking into the card, causing it to go darker.

3. Remove the card from the extract and shake off any surplus liquid.

4. Drop the card into the boiling tube containing 100% hydrogen peroxide. It should fall to the bottom of the tube. If it does not, push it to the bottom with the glass rod.

5. As soon as the card is at the bottom of the boiling tube start your stopwatch or timer. Record the time taken for the card to rise to the surface of the hydrogen peroxide on your Candidate Results Sheet: Stage 1.

6. Remove the card and put it in an empty Petri dish.

7. Repeat steps 2 to 6 in the boiling tube containing 100% hydrogen peroxide as many times as you think necessary.

8. Repeat steps 2 to 7 for each of the other four concentrations of hydrogen peroxide.

You must decide for yourself

- how many times to repeat the experiment at each concentration of hydrogen peroxide.
ISA BIO3T/Q12 Candidate Results Sheet: Stage 1

The effect of substrate concentration on the rate of an enzyme-controlled reaction

Centre Number .......................... Candidate Number ..........................

Candidate Name .................................................................

Record your raw data in a table in the space below. (3 marks)

Hand in this sheet at the end of each practical session.
ISA BIO3T/Q12 Candidate Results Sheet: Stage 2

The effect of substrate concentration on the rate of an enzyme-controlled reaction.

Centre Number □□□□ Candidate Number □□□□

Candidate Name.................................................................................................................................

Calculate the mean time taken for the card to rise to the surface at each concentration of hydrogen peroxide. Use the space below to process your data. (1 mark)
Use the graph paper provided to plot a graph of your processed data. Write a suitable title for your graph. *(6 marks)*

Title ..................................................................................................................................................
..................................................................................................................................................

Hand in this sheet at the end of each practical session.