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Catalase is an enzyme.

Catalase controls the following reaction:



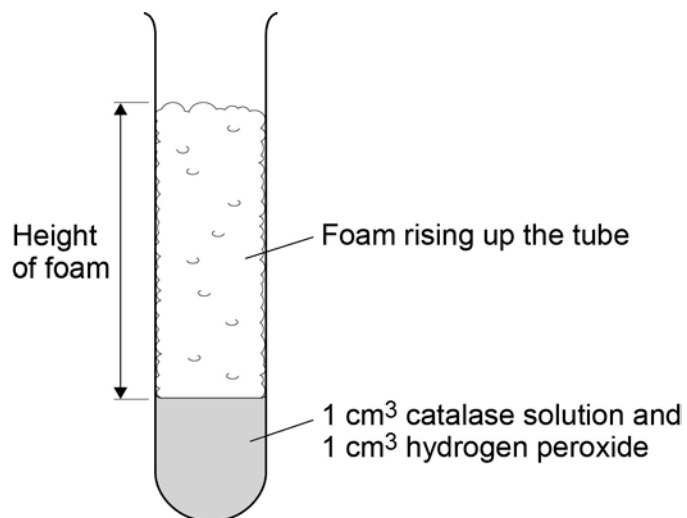
A student did an investigation on catalase activity.

This is the method used.

1. Put 1 cm³ hydrogen peroxide solution in a test tube.
2. Add 1 cm³ of catalase solution.
 - Bubbles of oxygen are produced.
 - Bubbles cause foam to rise up the tube.
3. Measure the maximum height of the foam.

Figure 4 shows the experiment.

Figure 4



The experiment is carried out at 20 °C.

Table 1 shows some results from the investigation.

Table 1

Temperature in °C	Maximum height of foam in cm			
	Test 1	Test 2	Test 3	Mean
10	1.3	1.1	0.9	1.1
20	0.0	3.3	3.1	3.2
30	5.2	5.0	5.3	5.2
40	4.2	3.5	4.4	4.0
50	2.1	1.9	2.3	2.1
60	0.0	0.0	0.0	0.0

0 2 . **1** Why did the student carry out the experiment three times at each temperature? **[1 mark]**

Tick **one** box.

To make the experiment more accurate

To prove the experiment was correct

To show the experiment was more repeatable

0 2 . **2** The student thought one result was an anomaly.

Circle the anomaly in **Table 1**.

[1 mark]

0 2 . **3** What did the student do with the anomalous result?

[1 mark]

Question 2 continues on the next page

0 2 . **4** Look at **Table 1** on **page 9**.

What conclusion can be made as the temperature increases?

[1 mark]

Tick **one** box.

Decreases the rate of reaction up to 30 °C

Decreases the rate of reaction up to 40 °C

Increases the rate of reaction up to 30 °C

Increases the rate of reaction up to 40 °C

0 2 . **5** At which temperature was catalase denatured?

[1 mark]

Tick **one** box.

10 °C

30 °C

40 °C

60 °C

0 2 . **6** The student thought the optimum temperature for catalase activity was between 30 °C and 40 °C.

How could the investigation be improved to find a more precise value for the optimum temperature?

Tick **one** box.

[1 mark]

Do the experiment at 70 °C and 80 °C

Do the experiment at 30 °C, 35 °C and 40 °C

Use less hydrogen peroxide solution

Use more catalase solution

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	to show the experiment was more repeatable		1	AO1/2 4.2.2.1
02.2	(circle) 0.0 at 20 °C		1	AO3/1a 4.2.2.1
02.3	ignored it / did not use it	ignore repeated it	1	AO3/2b 4.2.2.1
02.4	increases the rate of reaction up to 30 °C		1	AO3/3a 4.2.2.1
02.5	60 °C		1	AO2/1 4.2.2.1
02.6	do the experiment at 30 °C, 35 °C and 40 °C		1	AO3/3b 4.2.2.1

Question 2 continues on the next page

Question 2 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	<p>Level 2: A detailed and coherent plan covering all the major steps is provided. The method is set out logically taking into account control variable and appropriate measurements. The plan could be repeated by another person to determine the effect of pH on breakdown of starch by amylase.</p>		3–4	AO1/1 4.2.2.1
	<p>Level 1: Simple statements relating to relevant apparatus or steps are made but they may not be in a logical order. The plan would not allow another person to determine the effect of pH on breakdown of starch by amylase.</p>		1–2	
	No relevant content		0	
	<p>Indicative content</p> <ul style="list-style-type: none"> • range of at least 3 pH values / use of buffer solutions • control variables / keep amount or concentration of starch and amylase the same • keep temperature the same using water bath / electric heater • use iodine test to make qualitative observations • observe colour changes at different temperatures • do repeats at each pH 			
Total			10	