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## **2.4 Enzymes**

Hard



# **BIOLOGY**

## **IB HL**

## 2.4 Enzymes

### Question Paper

Course	DP IB Biology
Section	2. Molecular Biology
Topic	2.4 Enzymes
Difficulty	Hard

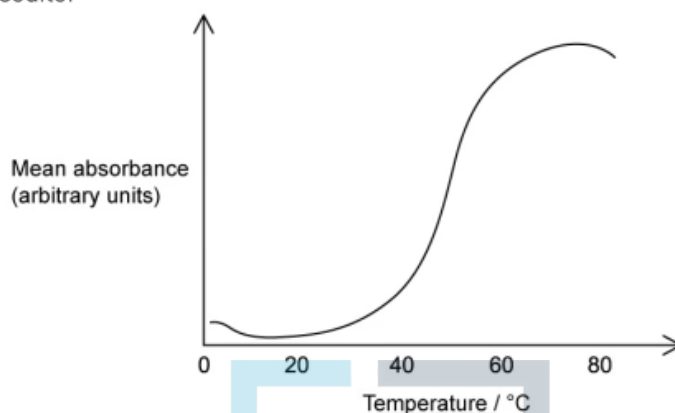
Time allowed: 10  
Score: /5  
Percentage: /100

## Question 1

Beetroot (*Beta vulgaris*) is a root vegetable with a characteristic red colour that is due to the pigment betanin found within the vacuoles of beetroot cells.

Scientists investigated the effect of temperature on the release of betanin from the beetroot cells. This was recorded as the mean absorbance when using a colorimeter, with a higher absorbance indicating more pigment released. The scientists deduced that the pigment is released when the membrane proteins of the tonoplast surrounding the vacuole denature.

The graph below shows their results.



Which of the following descriptions would best explain the point where enzymes start to denature inside the beetroot cells?

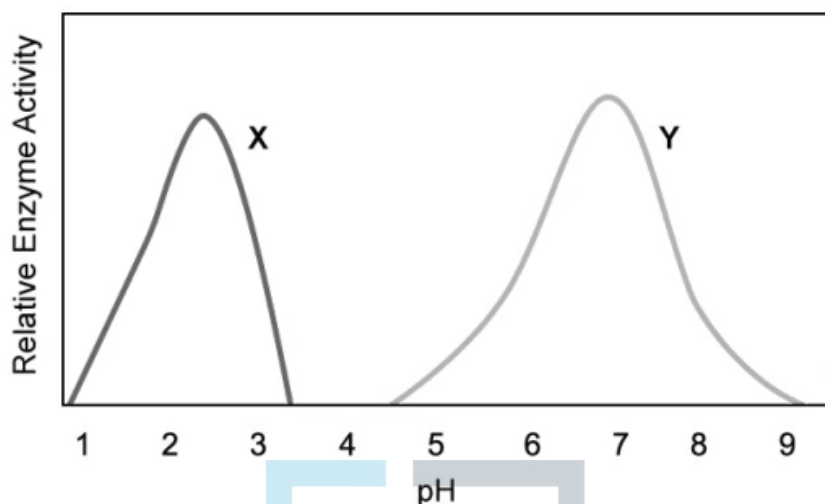
- A. Enzymes would denature at 30°C. At this point, the amount of pigment released from the beetroot cells is increasing and this indicates denaturing of the membrane proteins of the vacuole
- B. Enzymes would denature when the temperature inside the beetroot cells increase to above 40°C. This is the point when membrane proteins begin to denature and release more pigment
- C. The enzymes inside the beetroot cells would start to denature at 50°C. The greatest amount of pigment is released from the cells at this point which indicates that the membrane proteins of the vacuole are fully denatured
- D. At temperatures above 60°C, the enzymes inside the beetroot cells will be denatured. Most of the pigment has been released at this point, indicating that the membrane proteins of the vacuole are denatured

[1 mark]

## Question 2

Scientists extracted enzymes from different parts of the digestive tract of a mammal. The containers of enzyme samples got mixed up with each other before the scientists could label them. In order to identify the enzymes, they monitored the enzyme activity of each sample at different pH levels to determine the optimum pH for each.

The graph below shows the results for two of the samples (X and Y).



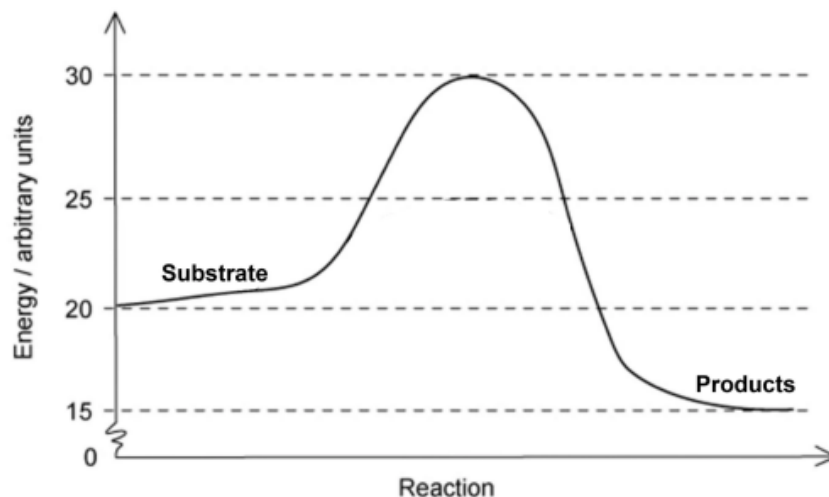
Which of the following would be the most valid conclusion that the scientists can draw from these results?

- A. Enzyme X is from the stomach of the mammal since it performs at an optimum when conditions are acidic, while enzyme Y is most likely from the mouth of the mammal where conditions are more neutral
- B. Enzyme X is from the stomach of the mammal since it performs at an optimum when conditions are acidic, while enzyme Y is most likely from the small intestine of the mammal where conditions are more alkaline
- C. Enzyme Y is from the stomach of the mammal since it performs at an optimum when conditions are acidic, while enzyme X is most likely from the small intestine of the mammal where conditions are more alkaline
- D. Enzyme Y is from the mouth of the mammal since it performs at an optimum when conditions are neutral, while enzyme X is most likely from the small intestine of the mammal where conditions are more alkaline

[1 mark]

### Question 3

The following graph shows the change in energy that occurs during an enzyme catalysed reaction.



Which of the following would be the most accurate description of this graph?

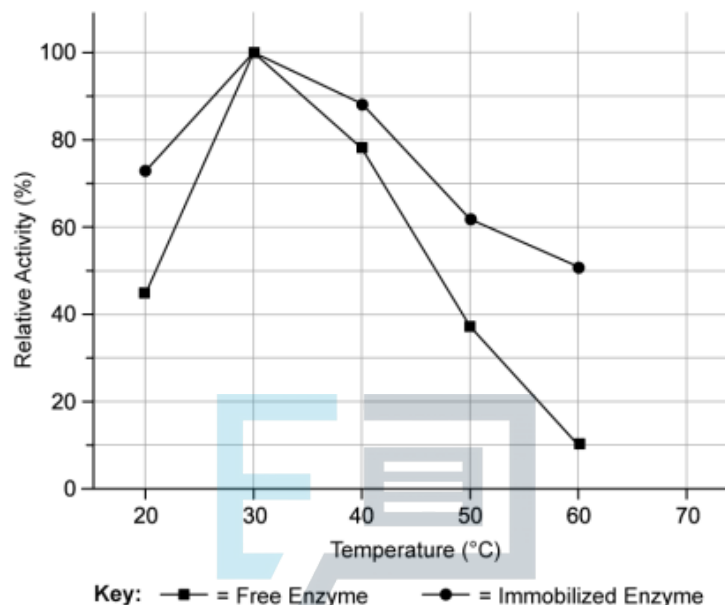
- A. This is an anabolic reaction that releases energy. Large, complex molecules are broken down into smaller, simpler ones during hydrolysis reactions.
- B. This is a catabolic reaction that releases energy. Large, complex molecules are broken down into smaller, simpler ones during hydrolysis reactions.
- C. This is an anabolic reaction that requires an input of energy. Large, complex molecules are formed from smaller, simpler ones during condensation reactions.
- D. This is an catabolic reaction that requires an input of energy. Large, complex molecules are formed from smaller, simpler ones during condensation reactions.

[1 mark]

### Question 4

$\beta$ -glucosidases are a diverse group of enzymes which hydrolyse glycosidic bonds and are present in a wide variety of organisms. One of their uses in the food industry is the hydrolysis of bitter compounds during juice extraction to increase the sweetness of the final product. These enzymes are often immobilised when used in the food industry to increase production and save on costs.

Scientists compared the activity of free  $\beta$ -glucosidase to that of immobilised  $\beta$ -glucosidase over a range of different temperatures. Their results are shown in the graph below.



Which of the following would be the most valid comparison between free and immobilised  $\beta$ -glucosidase?

- A. Immobilised  $\beta$ -glucosidase activity increases at a faster rate, compared to the free enzyme, for temperatures below the optimum, however, activity decreases at a slower rate for temperatures above the optimum temperature
- B. The activity of free  $\beta$ -glucosidase decreases at a lower rate for temperatures above the optimum, compared to the immobilised enzyme. At 60°C there is a 400% increase in rate of activity
- C. The activity of immobilised  $\beta$ -glucosidase decreases at a lower rate for temperatures above the optimum, compared to the free enzyme. At 60°C there is a 400% higher rate of activity
- D. The activity of free  $\beta$ -glucosidase increases at a faster rate for temperatures below optimum compared to the immobilised enzyme, however, activity decreases at a slower rate above the optimum temperature

[1 mark]



### Question 5

Students investigated the effect of starch concentration on the activity of amylase.

1. They used a 1% starch solution and made two dilutions of 0.1% and 0.01%
2. They added 10 cm<sup>3</sup> of amylase to each of the three test tubes
3. They took samples of each solution at 10 second intervals for 30 seconds in total
4. Iodine solution was added to each sample to test for the presence of starch
5. They came to the conclusion that the amylase did not properly break down the starch

Their teacher suggested that the students could achieve some more useful results by making some simple improvements to their experimental design.

Which of the following would represent the best improvements to their experimental design?

- A. More dilutions should have been done over a smaller range of concentrations, there should have been multiple test tubes for each concentration and the experiment should have been conducted for at least 2 minutes
- B. More dilutions should have been done over a greater range of concentrations, there should have been multiple test tubes for each concentration and the experiment should have been conducted for at least 30 minutes
- C. More dilutions should have been done over a greater range of concentrations, there should have been multiple test tubes for each concentration and the experiment should have been conducted for at least 2 minutes
- D. More dilutions should have been done over a smaller range of concentrations, there should have been multiple test tubes for each concentration and the experiment should have been conducted for at least 30 minutes

[1 mark]