Unit 3 and 4 Biology

Revision Booklet

Extra EPI Analysis Questions

Question 6

Salivary amylase is secreted into the mouth from cells in the salivary glands. Starch is converted to maltose in the presence of salivary amylase.

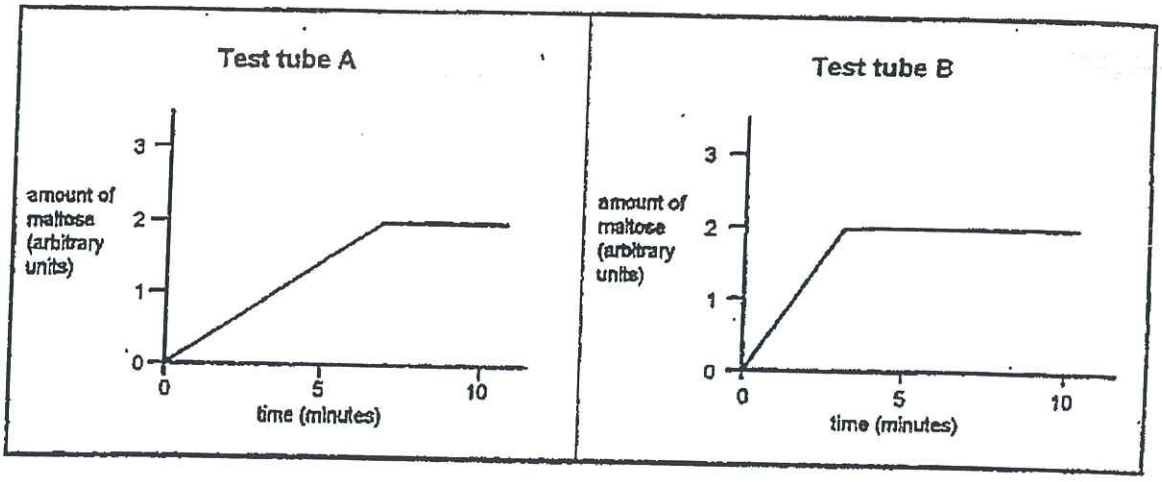
$$\text{starch} \xrightarrow{\text{salivary amylase}} \text{maltose}$$

a. Where within the cells of the salivary glands is salivary amylase packaged for secretion ?

Golgi

1 mark

In an experiment tubes A and B, each containing the same amount of starch and salivary amylase, were incubated at 15 °C and 30 °C respectively. The pH of the mixtures in both tubes was 7. At regular intervals the amount of maltose in each tube was measured and the results graphed, as shown below.



b. What is the variable in this experiment ?

Temperature (IV)

1 mark

c. i. What similarity is there between the results for tube A and tube B ?

2 units of product (maltose) formed.

1 mark

ii. Provide a reason to explain this similarity.

Same amount of substrate used.

1 mark

d. i. What difference is there between the results for tube A and tube B ?

It took (about) twice as long in tube A to form the same amount of product.

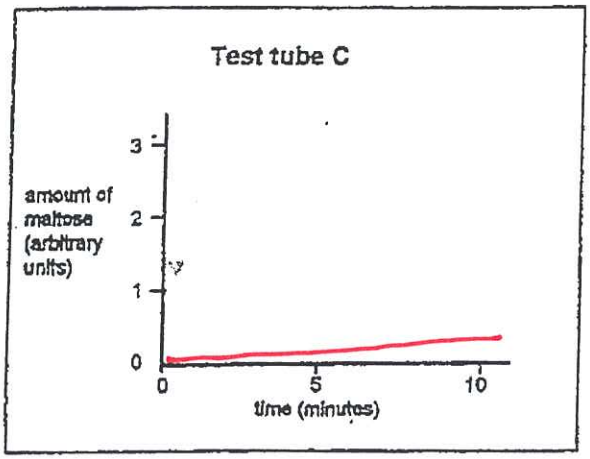
1 mark

ii. Provide a reason to explain this difference.

Tube B was 30°C and A 15°C meaning less collisions b/w substrate + product in A.

1 mark

Another tube (tube C) was set up containing the same amount of starch and salivary amylase as in tubes A and B. The pH of this third tube was also 7. The tube was incubated at 60 °C.



e. i. Complete the graph by drawing a line to show how much maltose would be produced in tube C after ten minutes. 1 mark

ii. Explain your answer.

Enzyme denatured — (1)

3D shape changed so substrate can no longer bind — (1)

2 marks

Approximately 5% of dietary starch is converted to maltose by salivary amylase in the mouth. Although swallowed food normally spends enough time in the stomach for all the starch to be broken down by the enzyme, only a further 30 - 40 % of the starch is actually converted to maltose while it is in the stomach.

f. Suggest a reason why all the starch is not converted to maltose by the time it leaves the stomach.

Food ↓ surface area.

Time of reaction too short

Any reasonable explanation

1 mark

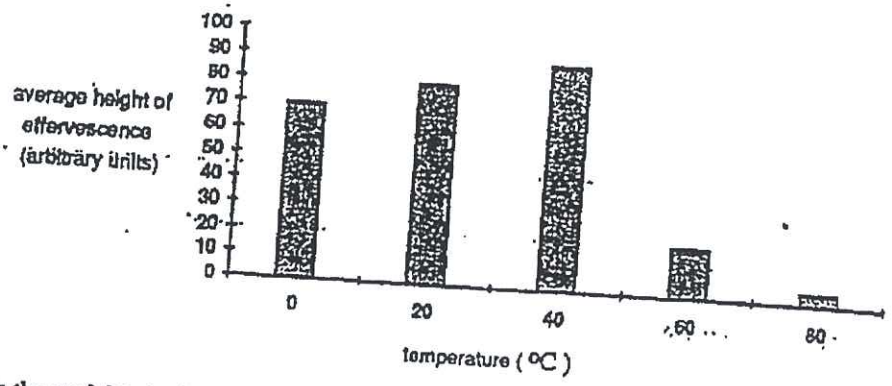
Total 10 marks

Question 4

Hydrogen peroxide is converted into water and carbon dioxide gas in the presence of the enzyme catalase. Catalase is an intracellular enzyme found in living tissues, for example liver.

$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water} + \text{carbon dioxide}$$

Students set up five identical test-tubes. Into each test-tube they placed an equal amount of ground-up liver. Then the students raised or lowered the temperature of each test-tube for five minutes. They marked on each test-tube the level of ground-up tissue and then added an equivalent volume of hydrogen peroxide into each of the five test-tubes. They recorded the height of the effervescence that resulted as an indication of the amount of carbon dioxide that was released from the resulting reaction. They repeated this procedure a number of times at each temperature. The average height of the effervescence in each test-tube was then calculated. The results are shown below.



a. What is the variable in this experiment?

Temperature (°C)

1 mark

b. Consider the graph.

i. What do the results indicate about the effect of different temperatures on the production of carbon dioxide gas by liver cells?

Optimum of 40°C – maximum enzyme productivity (height 60-40). – (1)

Below 40°C – less effervescence ($\downarrow CO_2$) → ↓ collisions – (1)

Above 40°C – less effervescence ($\downarrow CO_2$) → denatured – (1)

3 marks

ii. Suggest a reason for the results obtained at temperatures above 40°C.

Enzyme denatured.

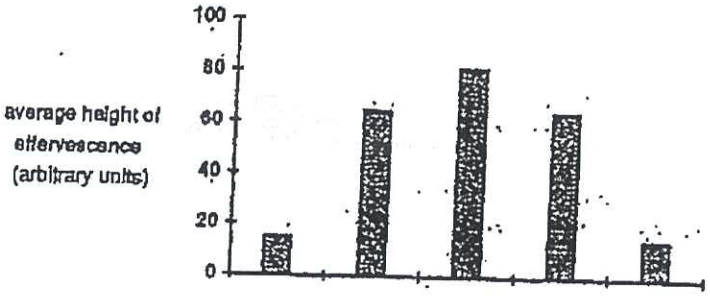
1 mark

c. Explain why the students ground the liver before placing it in the test-tube.

↑ SA of substrate (1)

1 mark

To investigate the effect of another variable, the students carried out a similar experiment but kept the temperature constant at 20°C. Each test-tube contained the same amount of ground liver and hydrogen peroxide as in the first experiment. The height of the effervescence was measured and the results graphed.



d. What similarity is there between the results from the first experiment and the second experiment ?.

Optimum height and on either side height decreases (1)

1 mark

e. What difference is there between the results from the first experiment and the second experiment ?

decrease on either side of optimum is equal compared to unequal decrease with earlier result (1)

1 mark

f. Suggest a variable which may result in such a plot.

pH (1)

1 mark

g. Explain one strength in the students' experimental design.

Same amount of liver used
or Same amount of H_2O_2 used. (1)

1 mark

Total 10 marks

Question 2

Enzymes are sometimes described as organic catalysts.

a. What does the term 'organic catalyst' mean?

Speeds up reactions — (1)

* lowers Ea.

Specific — (1)

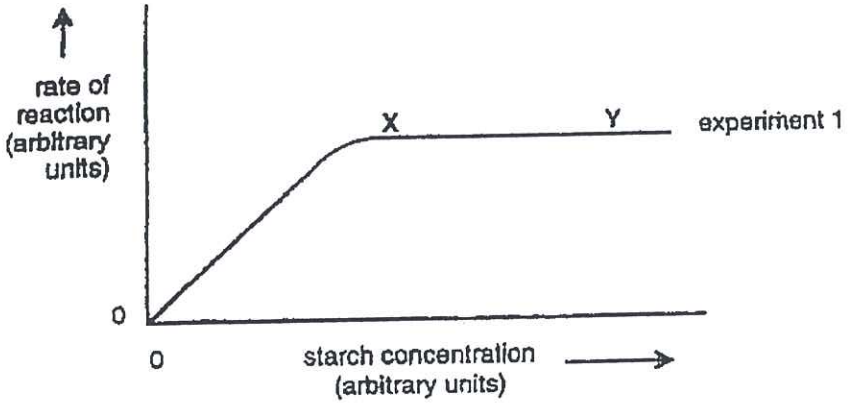
2 marks

The enzyme amylase catalyses the breakdown of starch into maltose as follows.

$$\text{starch} \xrightarrow{\text{amylase}} \text{maltose + water}$$

An experiment (experiment 1) was carried out to investigate how varying the concentration of starch affected the rate of the reaction. The concentration of enzyme, pH and temperature were kept constant throughout the experiment. The results are shown in Figure 3.

Figure 3



b. i. Explain why the reaction rate increases until starch concentration reaches point X.

More substrate more collisions between enzyme + substrate causing rate to ↑ — (1)

1 mark

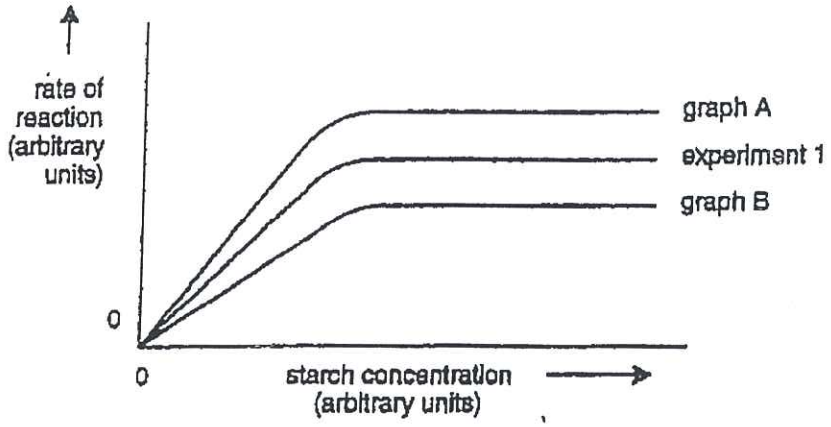
ii. Explain why the reaction rate is constant between points X and Y.

Enzyme active sites are all occupied — (1)

1 mark

Another experiment (experiment 2) was conducted with an increased amount of enzyme and the results plotted on the same graph as those of experiment 1. The graph is as follows.

Figure 4



c. Explain which graph, graph A or graph B, represents the results of experiment 2.

Graph A (1)

More enzyme, more active sites, more conversion of substrate per unit time (rate) (1)

2 marks

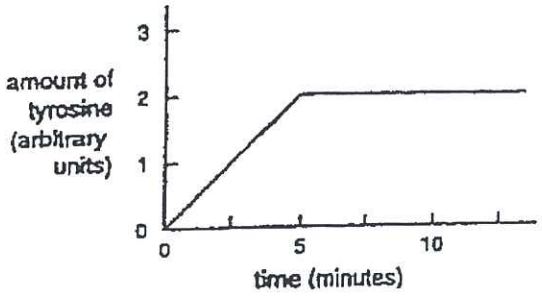
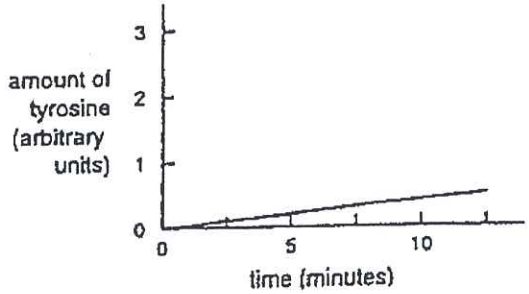
Total 6 marks

Question 4

Phenylalanine is converted to tyrosine in the presence of the enzyme phenylalanine hydroxylase.

$$\text{Phenylalanine} \xrightarrow{\text{Phenylalanine hydroxylase}} \text{Tyrosine}$$

Two tubes were prepared as shown in the table below and incubated. At regular intervals the amount of tyrosine in each tube was measured and the results graphed. The results are also included in the following table.

Test tube A	Test tube B
phenylalanine phenylalanine hydroxylase incubated at 37°C pH 7.4	phenylalanine (same amount as in A) water (same volume as enzyme in A) incubated at 37°C pH 7.4
	

a. What is the variable in this experiment?

Presence of phenylalanine hydroxylase — (1)

1 mark

b. Consider the graph for tube A.

i. What does the graph indicate about the production of tyrosine between the 5 and 10 minute marks of the experiment?

Constant — (1)

1 mark

ii. Suggest a reason for the result obtained from the 5 minute mark onwards.

Same amount of phenylalanine — (1)

1 mark

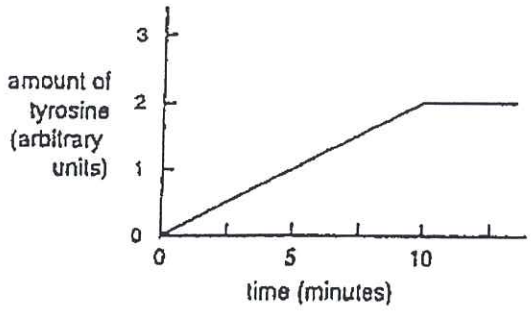
c. Describe what has happened in tube B during the incubation period.

Slow production of tyrosine — (1)

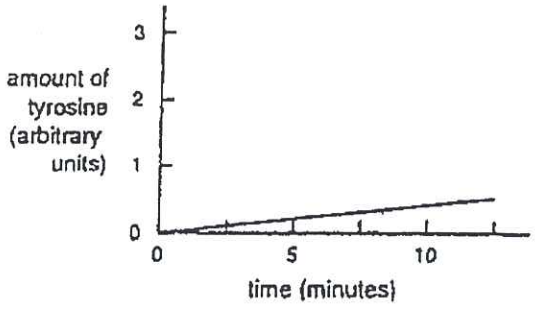
1 mark

Two more tubes were set up. Both contained the same amount of phenylalanine and the same enzyme as in tube A. The amount of tyrosine was measured over a period and the results graphed.

Graph for tube C



Graph for tube D



d. What similarity is there between the results for tube A and tube C?

2 units of product produced — (1)

1 mark

e. What difference is there between the results for tube A and tube C?

Took twice as long for tube C to form product (1)

1 mark

f. Describe one difference between the experimental set-up of tube A and tube C which would cause the difference in results.

tube C lower temp than A. — (1)

1 mark

g. The results for tube B and tube D appear similar when graphed. However, in tube B there was no enzyme, whereas enzyme was present in tube D. Explain one difference between the experimental set-up for tubes B and D that would lead to the result in tube D.

tube D high temp → enzyme denatured (1)

1 mark

Total 8 marks

M 2

Question 6

Experiments with North American rattlesnakes have revealed that they can detect infra-red radiation using specialized pit organs located between the nose openings and the eyes. By means of these organs the snakes can detect small prey from a distance of 1 or 2 metres and accurately attack it.
Biologists studying the Australian carpet snake, *Morelia spilotes*, hypothesised that these snakes detect infra-red radiation in the same way as the North American rattlesnakes.
Assume that you have been asked to test this hypothesis. You are provided with a supply of adult carpet snakes.

Consider an experiment you would perform to determine whether the Australian carpet snake can detect infra-red radiation. List nine essential features which would be required to make the experiment a valid scientific investigation.

1 Background research into type of prey snakes eat.
2 Divide snakes into several groups and place them into an enclosed environment.
3 Ensure each environment has the same size, temperature (CV)
4 Place prey at different distances from snakes in each enclosed environment (IV)
5 Distances range from 1 ⟶ 5 m.
6 Measure the accuracy of the attack on the prey (DV).
7 Repeat the experiment several times.
8 Quantify and average the data gained
9 Present the data as a graph for easy interpretation.

(9 marks)
Time: approx 11 mins