Enzymes

Question Paper 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Foundations in Biology
Topic	Enzymes
Booklet	Question Paper 1

Time allowed: **66 minutes**

Score: **/49**

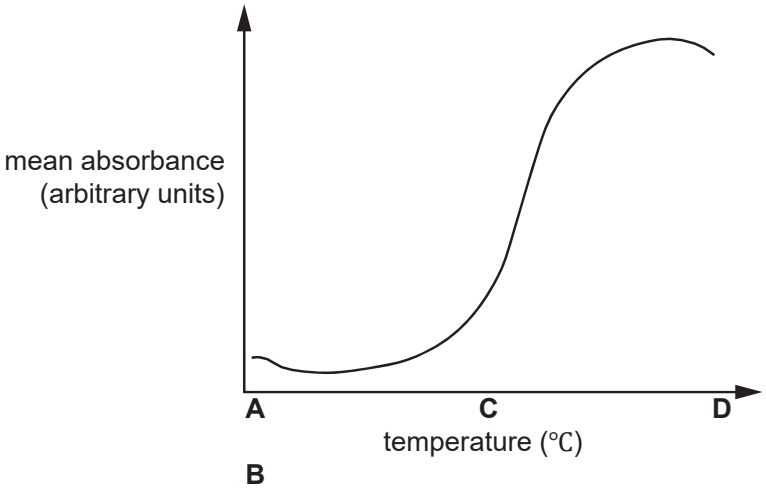
Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Swiss chard is a leafy green vegetable related to spinach. Some varieties have yellow stalks that have vacuoles containing yellow betaxanthin pigments.

The graph below shows the effect of temperature on the release of these pigments recorded as mean absorbance, when measured with a colorimeter.

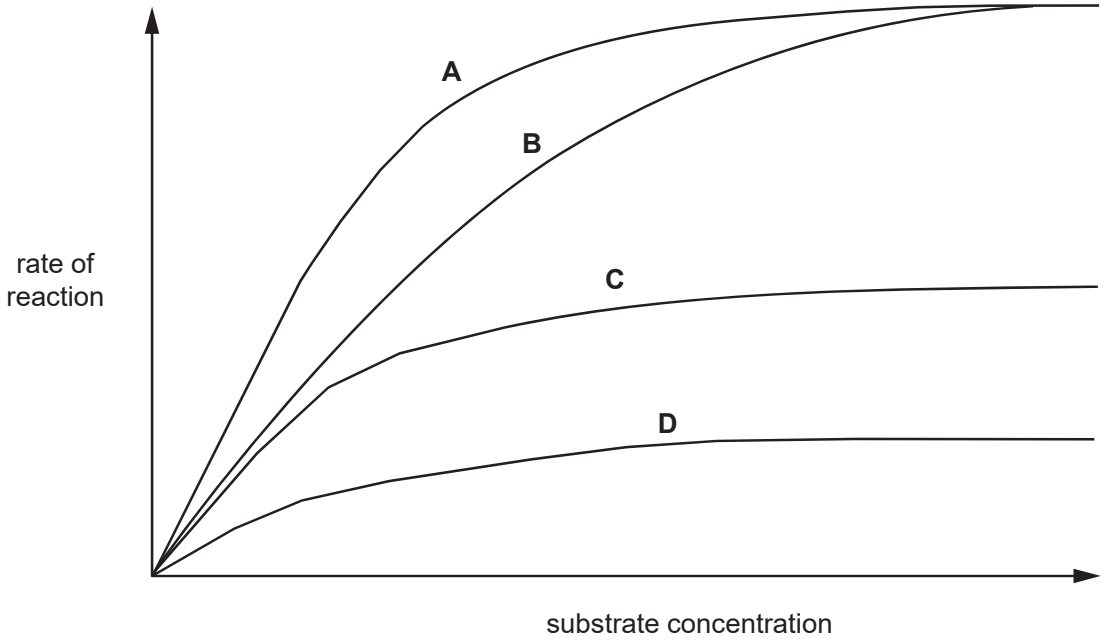


It was deduced that the betaxanthins were released from the vacuole due to the denaturing of proteins in the tonoplast (vacuolar membrane).

Which letter, **A** to **D**, shows the temperature at which the proteins denature?

[1]

The following graph shows the rate of reaction of an enzyme in different substrate concentrations.

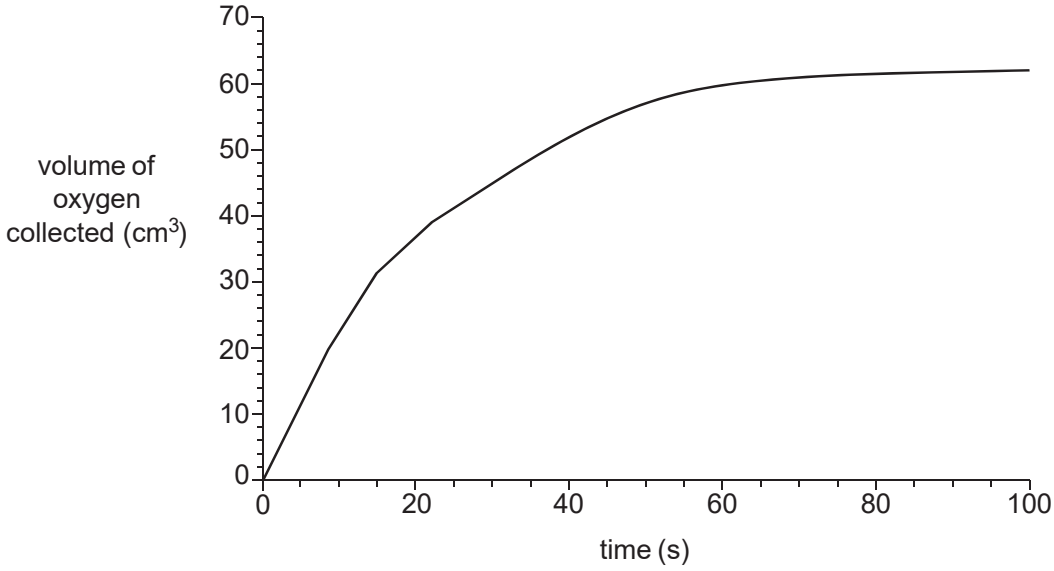


Which letter, **A** to **D**, shows the rate of reaction with a fixed quantity of competitive inhibitor?

[1]

Celery contains the enzyme catalase, which breaks down hydrogen peroxide into oxygen and water.

A student added liquidised celery to a solution of hydrogen peroxide and collected the oxygen given off by the reaction. The results are shown in the graph below.



Which of the following shows the rate of reaction **at** 30s?

A 0.85 cm^3 s^{-1}

B 1.00 cm^3 s^{-1}

C 1.15 cm^3 s^{-1}

D 1.50 cm^3 s^{-1}

[1]

The protease enzyme bromelain can be extracted from pineapples. A student investigated the effect of changing the concentration of the enzyme and measured the time taken to break down the protein gelatine.

(a) State **three** variables that the student would need to control in order to make the results of this investigation **valid**. **[3]**

(b) The data from the student's experiment is shown in Table 26.

Concentration of bromelain (%)	Rate of protein digestion (s^{-1})	Standard deviation
0.010	0.0037	0.00014
0.025	0.0090	0.00034
0.050	0.0155	0.00260
0.075	0.0184	0.00371
0.100	0.0198	0.00340

Table 26

(i) Describe how the rate of reaction was calculated. **[1]**

(ii) Explain what the standard deviation shows in Table 26. **[2]**

(c) Fig. 26 shows the results plotted on a graph with the standard deviations as error bars.

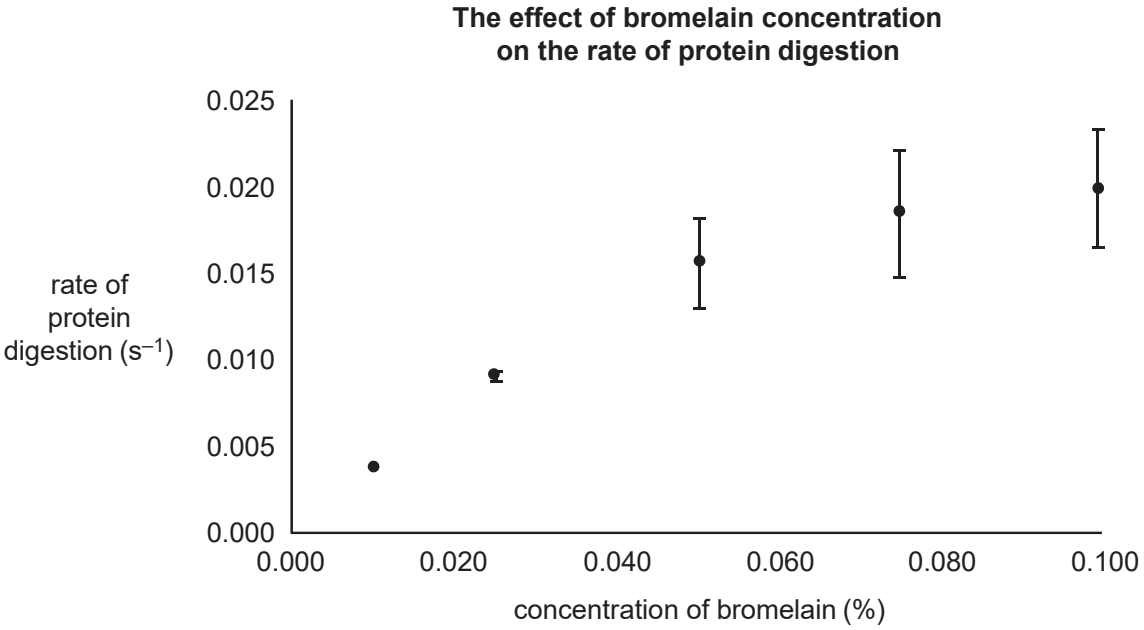


Fig. 26

Explain the pattern shown in the data using Table 26 and Fig. 26. **[3]**

[Total: 9]

(a) Fungi produce enzymes to digest complex food substances. Amylase is an enzyme that catalyses the conversion of starch to maltose.

- A sample of the fungus *Amanita citrina* was placed on agar in a petri dish.
- The agar contained starch.
- The dish was incubated until the thread-like hyphae had grown a few centimetres.
- Iodine solution was then poured onto the surface of the agar.

A diagram representing the results is shown in Fig. 4.

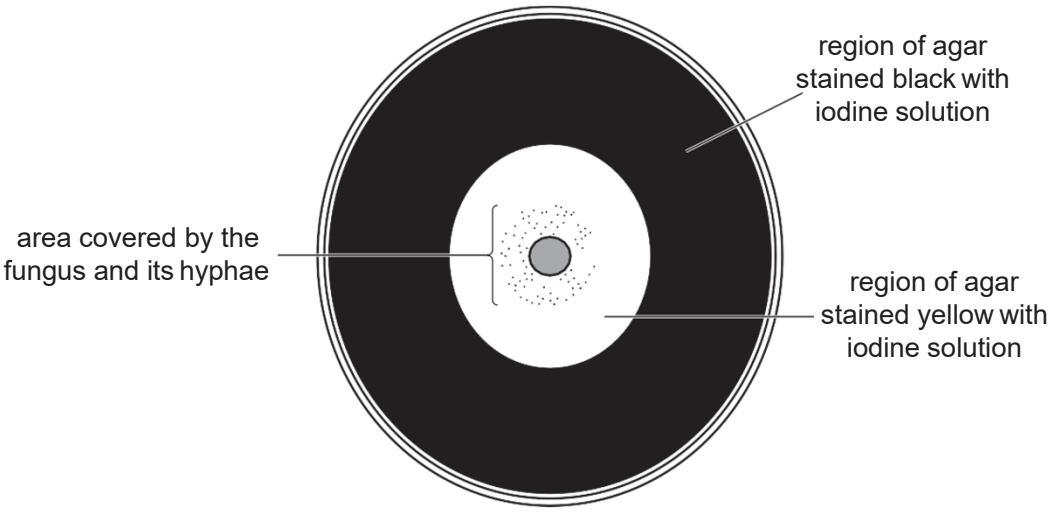


Fig. 4

(i) To which genus does this fungus belong? **[1]**

(ii) The region of yellow staining shown in Fig. 4 includes part of the agar where the fungus had not yet grown.

What does this pattern indicate about the action of the fungal enzymes? **[1]**

(b) Lipase is an enzyme that catalyses the breakdown of lipids.

An investigation was carried out to see the effect of temperature on the activity of a lipase.

- 5 cm^3 of an alkaline solution of lipid was poured into a test tube.
- The test tube was placed into a water bath maintained at 20 °C and left to equilibrate.
- A few drops of an indicator were added to the wells of a white spotting tile. The indicator is pink above pH values of 8.3 and turns colourless at pH values below 8.3.
- Once the lipid solution had equilibrated, 1 cm^3 of 0.5% lipase solution at the same temperature was then added to the test tube.
- For five minutes, at 30 second intervals, the solution was stirred and a few drops were removed from the test tube and placed in a well on the white spotting tile.
- The time was recorded when the solution and indicator did not remain pink.
- The procedure was repeated four more times at 20 °C and then again at a further six temperatures.

The results are shown in Table 4.1 below.

Temperature (°C)	Time when solution did not remain pink				
	Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5
20	210	270	240	300	270
25	90	120	210	180	120
30	60	60	90	90	60
35	60	60	60	90	60
40	210	120	210	180	210
45	240	300	300	–	270
50	–	–	–	–	–

Table 4.1

(i) Why is pH **not** a controlled variable in this investigation? **[1]**

(ii) Identify **one** variable that has been controlled in this procedure. **[1]**

(iii) Identify **one** variable, other than pH, that has **not** been controlled in this procedure. **[1]**

(iv) The procedure required the solution to be stirred and then drops of solution to be placed on a white spotting tile.

Suggest why this procedure was followed rather than simply adding indicator to the test tube, stirring the solution and looking for the colour change in the test tube. **[1]**

(v) What can be concluded from the results in Table 4.1 about the optimum temperature for lipase activity? **[1]**

(vi) Describe **two different** ways in which the procedure could be modified to obtain a more accurate value for the optimum temperature for lipase activity.

[4]

(c)* There are two models for the mechanism of enzyme action. Outline how changes in temperature can affect these mechanisms of lipase action. **[6]**

[Total: 17]

Amylase is an enzyme that breaks down starch into maltose.

(a) A student investigated the breakdown of starch into maltose. The results are shown in **Fig. 2.1**.

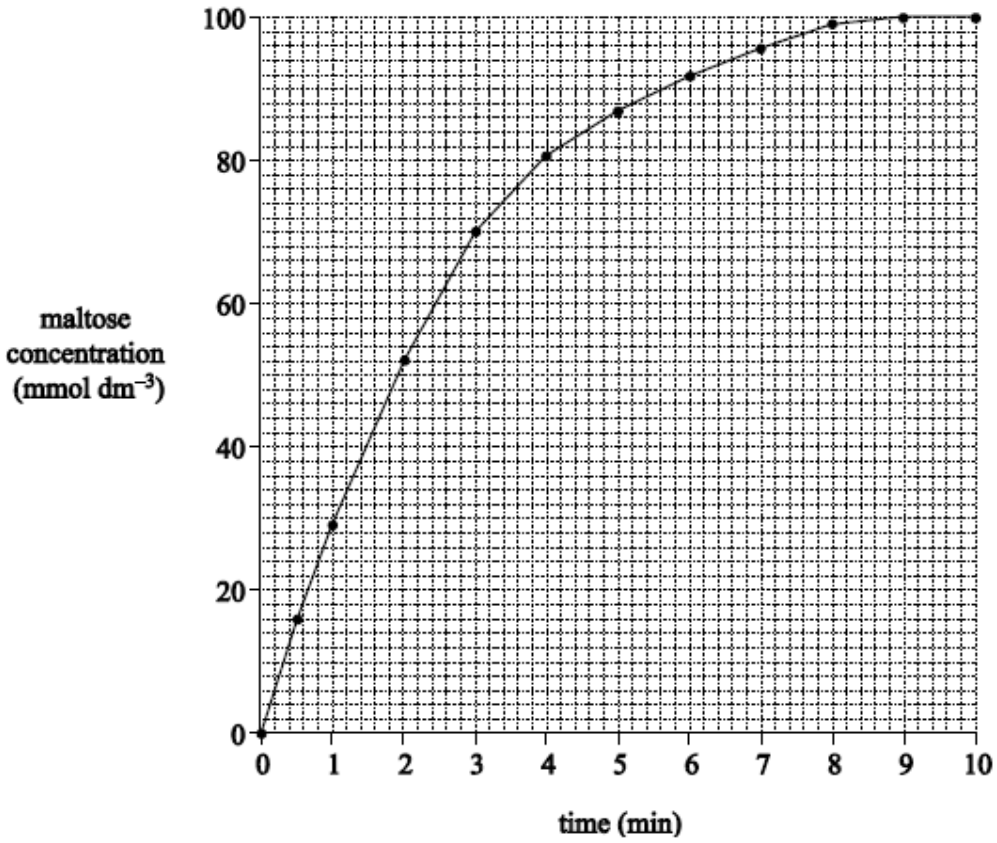


Fig. 2.1

(i) Calculate the rate of maltose production over the first 30 s.

Use appropriate units. **[2]**

(ii) How would this calculated rate differ from the 'true' initial rate of reaction? Explain your answer. **[3]**

(b) The student conducted a further investigation using the same enzyme and substrate.

- A range of substrate concentrations was used.
- The investigation was repeated in the presence of an inhibitor of amylase activity extracted from kidney beans.

Fig. 2.2 shows a sketch of the student's results.

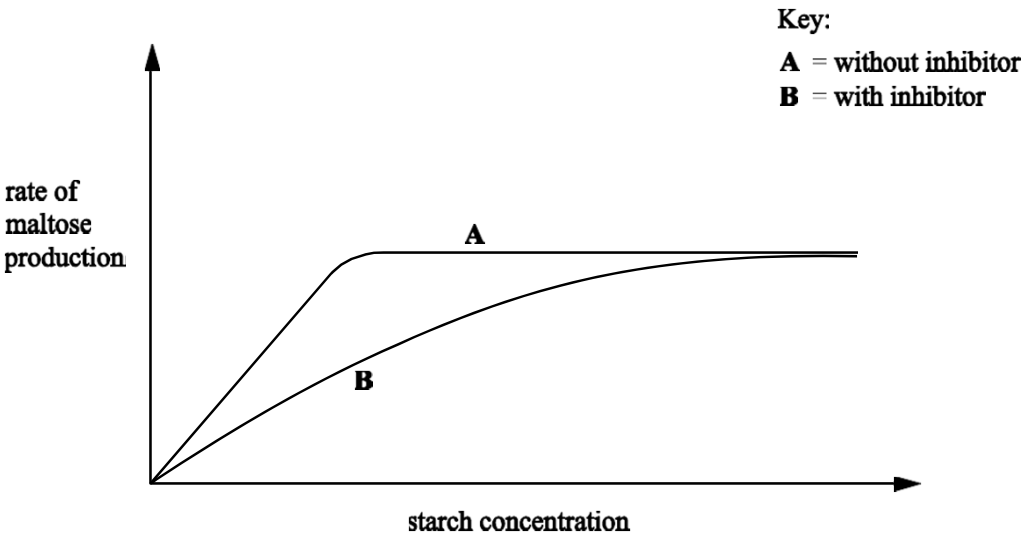


Fig. 2.2

(i) Explain the mechanism by which the extract from the kidney bean inhibited the amylase.

[3]

(ii) What evidence from the graph supports your answer to part **(i)**? **[1]**

(c) The student then investigated the effect of pH on the activity of the amylase.

This was the method used,

- Tubes containing starch and amylase were set up in a range of pH buffer solutions.
- The same concentration of starch and amylase were used each time.
- A small sample of the solution was removed and tested for the presence of starch at 20 s intervals.
- The procedure was repeated three times and a mean was calculated for each pH.

The student presented the results in **Table 2.1**.

pH	4	5	6	7	8	9
Mean amylase activity (% of maximum)	27	68	96	100	50	29

Table 2.1

(i) Another student wanted to replicate the investigation.

Refine the method, by giving additional information, so that reproducible results would be obtained. **[3]**

(ii) Explain, with reference to bonding, why amylase activity is low at pH 4. **[4]**

(iii) The student concluded that the optimum pH for amylase was pH 7.

A teacher made the following statement:

*'The results in **Table 2.1** provide only weak support for the conclusion that the optimum pH for amylase is pH 7.0'*

Evaluate the statement **and** suggest an improvement to the student's procedure that would support the conclusion more strongly.

Evaluation **[3]**

Improvement

(d) Amylase activity is increased in the presence of chloride ions.

State the name given to any inorganic ion that increases the activity of an enzyme. **[1]**

[Total: 20]