

Enzymes

Question Paper 2

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Enzymes
Sub Topic	Enzymes
Booklet	Theory
Paper Type	Question Paper 2

Time Allowed : 64 minutes

Score : / 53

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

- 1 Canavan disease is a non sex-linked inherited condition that causes progressive damage to neurones of the brain. Symptoms of the condition include a loss of motor skills and mental retardation. The symptoms appear in early infancy and many children with this condition die by the age of four years.

People with Canavan disease lack an enzyme called aspartoacylase which breaks down N-acetyl aspartate. The build up of N-acetyl aspartate can interfere with the formation of the myelin sheath, particularly in neurones of the brain.

- (a) Enzymes such as aspartoacylase display specificity.

Outline what is meant by *specificity* of an enzyme.

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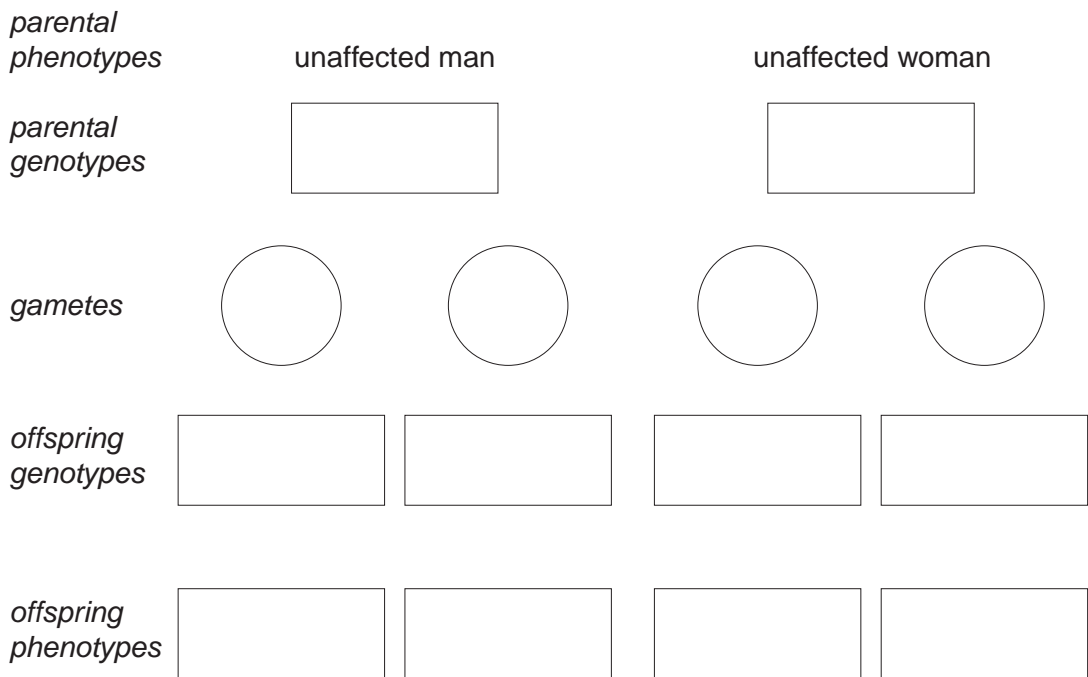
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- (b) Complete the genetic diagram below to show how an unaffected man and an unaffected woman could produce a child with Canavan disease.

key to symbols

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(c) Explain the importance of the myelin sheath in the functioning of a neurone.

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[Total: 8]

2 (a) Outline how an enzyme can be immobilised in alginate.

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(b) State two advantages, other than stability, of using an immobilised enzyme in an industrial process compared with the same enzyme that has not been immobilised.

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(c) Papain is a protease enzyme. Its activity at different temperatures, when immobilised onto an inert support, was compared with its activity in solution.

The results are shown in Fig. 2.1.

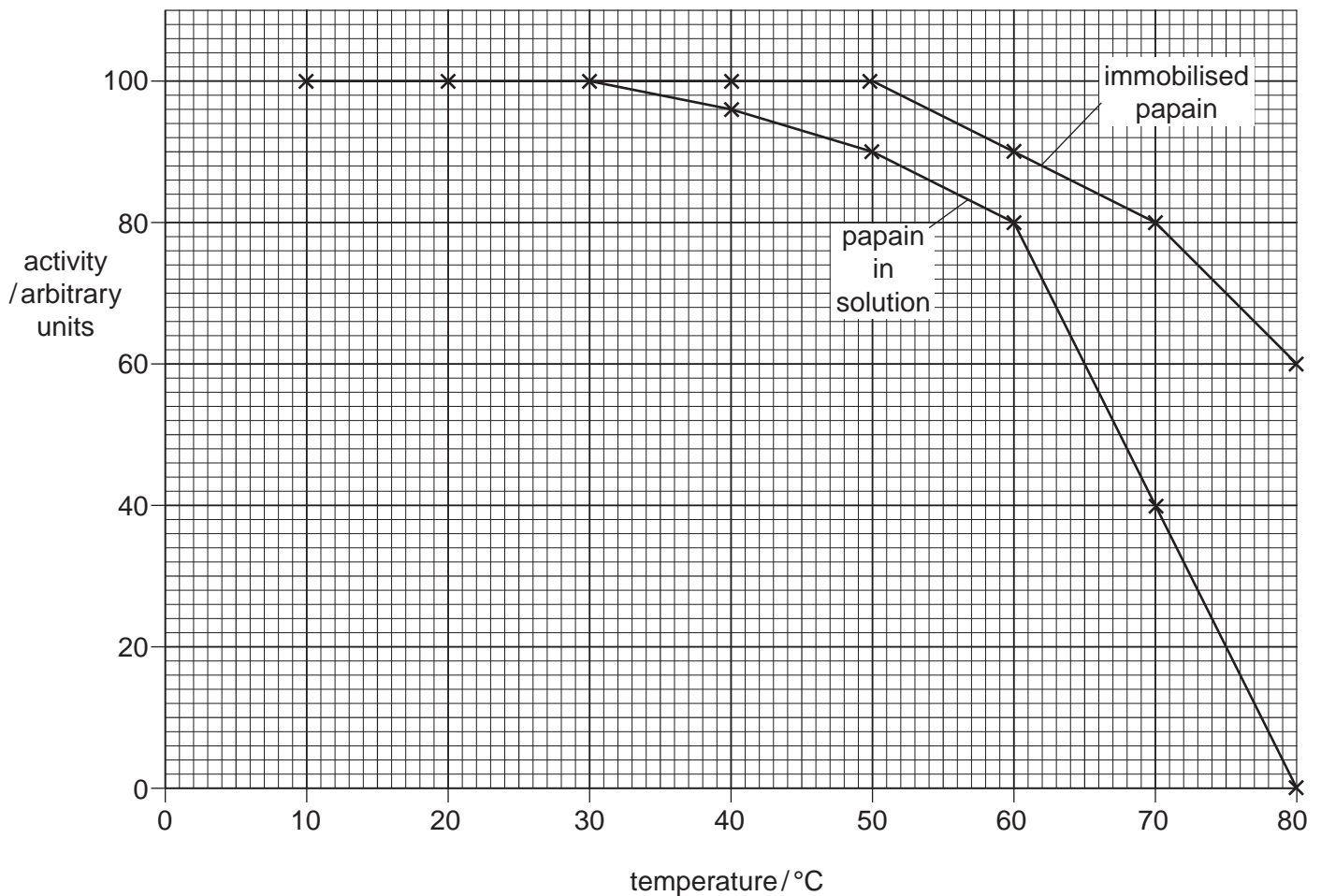


Fig. 2.1

With reference to Fig. 2.1, describe **and** explain the differences in activity of immobilised papain and papain in solution.

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[Total: 8]

- 3 (a) Some bacteria, such as *Rhizobium*, carry out nitrogen fixation, which is an important process in the nitrogen cycle.

Explain what is meant by the term *nitrogen fixation*.

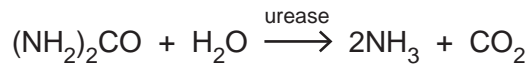
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- (b) An important enzyme in the nitrogen cycle is urease, which catalyses the hydrolysis of urea to ammonia. This reaction is shown below:



- (i) State the name of this process in the nitrogen cycle.

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- (ii) Explain the importance of this process in making nitrogen from animals available for uptake by plants.

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(c) The enzyme urease is known to be affected by competitive inhibitors. A student carried out an investigation to determine the percentage of urea hydrolysed by urease at various time intervals

- without any inhibitor
- with a competitive inhibitor.

The experiment was carried out in test tubes set up as follows:

Tube **A** – 1 cm³ of urease solution, 10 cm³ pH 7.5 buffer solution, 1 cm³ urea solution.

Tube **B** – 1 cm³ urease solution, 9 cm³ pH 7.5 buffer solution, 1 cm³ inhibitor, 1 cm³ urea solution.

Tube **C** – 1 cm³ water, 10 cm³ pH 7.5 buffer solution, 1 cm³ urea solution.

The results are shown in the table below.

time/min	percentage of urea remaining		
	Tube A	Tube B	Tube C
0	100	100	100
5	55	99	100
10	29	98	100
15	14	96	100
20	8	95	100
25	5	92	100
30	3	90	100

(i) State how Tube **C** acts as a control for this investigation.

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 [1]

(ii) Explain the difference in results between Tube **A** and Tube **B**.

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4 Cereal crops, such as sorghum and rice, are a major source of nutrients all over the world.

(a) Explain why cereal crops are important components of many people's diets.

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(b) Alpha amylase is an enzyme produced in germinating seeds, where it hydrolyses starch. Fig. 4.1 shows the effect of temperature on alpha amylase in germinating seeds of sorghum and rice.

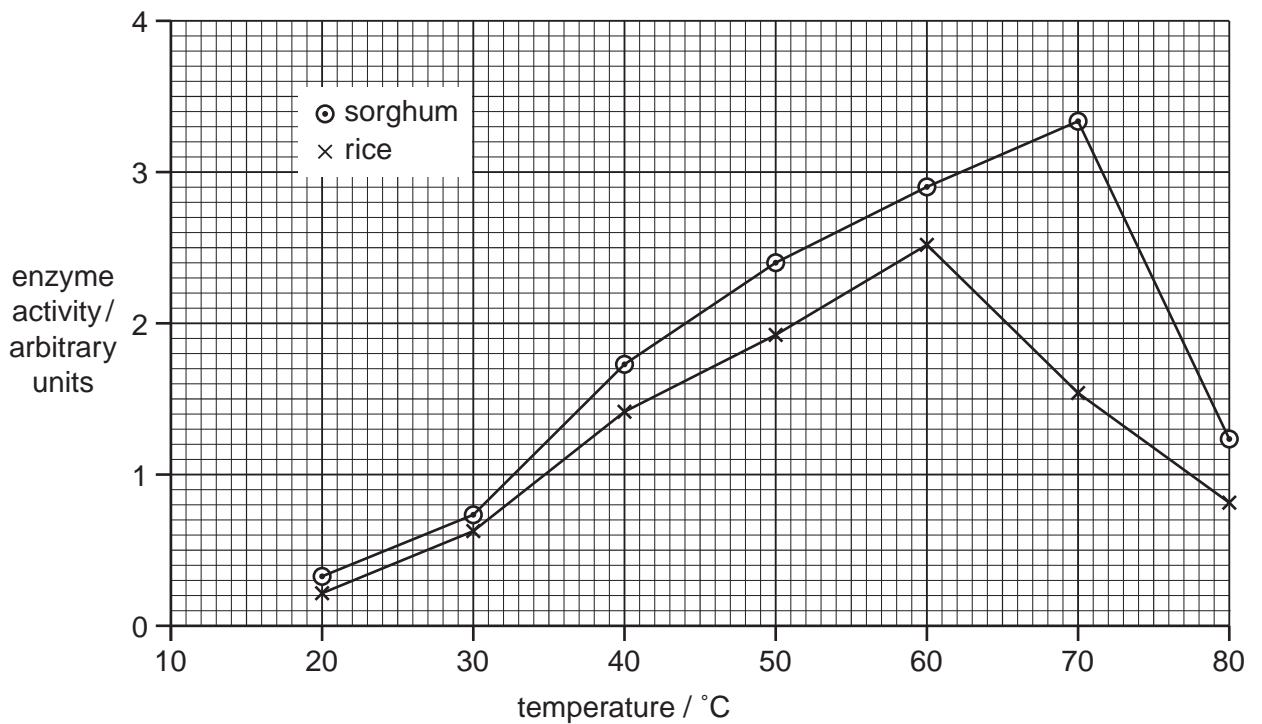


Fig. 4.1

(i) Name the part of the seed that contains starch.

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- (ii) With reference to Fig. 4.1, compare the effects of temperature on alpha amylase in sorghum and rice.

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- (iii) With reference to the types of bonding in proteins, suggest how differences in the tertiary structure of alpha amylase in rice and sorghum could explain the differences in their activities shown in Fig. 4.1.

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(c) Sorghum does not grow well at low temperatures. An investigation was carried out into the response of sorghum to low temperatures at different light intensities.

- Sorghum plants were kept at 25 °C in a light intensity of 215W m⁻² for several weeks, and then at 10 °C for three days.
- The temperature was then increased to 25 °C again for seven days.
- The investigation was repeated at light intensities of 170W m⁻² and 50W m⁻².
- Day length and carbon dioxide concentration were kept constant throughout.

The uptake of carbon dioxide, as mg CO₂ absorbed per gram of leaf dry mass, was measured

- at 25 °C before cooling
- at on each of the three days at 10 °C
- for seven days at 25 °C.

The results are shown in Table 4.1.

Table 4.1

light intensity / W m ⁻²	carbon dioxide uptake / mg CO ₂ g ⁻¹				
	at 25 °C, before cooling	during cooling at 10 °C			at 25 °C (mean over days 4 to 10)
		day 1	day 2	day 3	
215	50.1	3.0	0.4	0.2	0.2
170	48.2	5.5	2.9	1.2	1.5
50	22.4	3.0	1.2	0.7	9.2

With reference to Table 4.1

(i) describe **and** explain the effect of light intensity on the rate of carbon dioxide uptake **before cooling**

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- (ii) describe the effect of light intensity on the ability of sorghum plants to survive cooling.

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[Total: 15]

5 (a) Describe how enzymes take part in chemical reactions.

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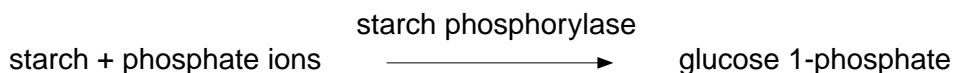
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Starch phosphorylase is an enzyme found in plant cells. In potato tuber cells, the enzyme takes part in the breakdown of starch when the tuber begins to grow.



A student investigated the effect of pH on this reaction using two buffer solutions.

The student prepared four test-tubes, **A** to **D**, as shown in Table 2.1 and described below.

The student made an extract of potato tissue that contained the enzyme. Some of this extract was boiled.

A solution of potassium dihydrogen phosphate was added to some tubes as a source of phosphate ions.

The test-tubes were left for ten minutes in a water bath at 30 °C and then samples were tested with iodine solution.

Table 2.1

test-tube	contents					results with iodine solution after ten minutes
	volume of starch solution / cm ³	volume of glucose 1-phospha solution / cm ³	volume of potassium dihydrogen phosphate solution / cm ³	pH of buffer solution	enzyme extract	
A	2		0.5	6.5	unboiled	negative
B	2		0.5	2.0	unboiled	positive
C	2		0.5	6.5	boiled	positive
D		2		6.5	boiled	negative

(b) (i) State what the student would conclude from a positive result with iodine solution.

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(ii) Explain why the student boiled some of the extract in this investigation.

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[2]

(c) Explain the results shown in Table 2.1.

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