Enzymes

Question Paper 5

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Enzymes
Sub Topic	Enzymes
Booklet	Theory
Paper Type	Question Paper 5

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 Fig. 1.1 is an electron micrograph of three cells of the same species of bacterium, *Erwinia carotovora*.

Fig. 1.1

(a) Calculate the magnification of the electron micrograph in Fig. 1.1.

Show your working and give your answer to the nearest 10 000.

magnification × ..... [2]

(b) Name three structures, present in animal cells, which are **not** present in the cells shown in Fig. 1.1.

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3. .....

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(c) *E. carotovora* is a rod-shaped bacterium.

Explain why two of the bacterial cells in Fig. 1.1 do **not** appear rod-shaped.

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(d) *E. carotovora* causes a disease in carrot and potato plants.

The bacteria release an enzyme called pectinase which hydrolyses the polysaccharide pectin. Pectin helps plant cells to attach to each other.

(i) Name the type of chemical bond which will be hydrolysed by pectinase.

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(ii) Suggest what effect this disease will have on vegetables, such as carrots and potatoes.

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[Total: 9]

2 **(a)** In the small intestine, the enzyme lactase hydrolyses the disaccharide lactose into the monosaccharides glucose and galactose. A deficiency of lactase can lead to a condition known as lactose intolerance. The lactose passes undigested into the large intestine resulting in diarrhoea. Some babies are born with congenital lactase deficiency, which is an inherited condition, and require lactose-free milk from birth.

Suggest how two parents, who can digest lactose, can have a child with congenital lactase deficiency.

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(b) The enzyme lactase can be produced by biotechnology and then used to produce lactose-free dairy products. Lactase is frequently used immobilised in alginate beads.

Fig. 2.1 shows a comparison between the activity of lactase free in solution and lactase immobilised in alginate beads, over a range of temperatures. Equal concentrations of free lactase and immobilised lactase were used.

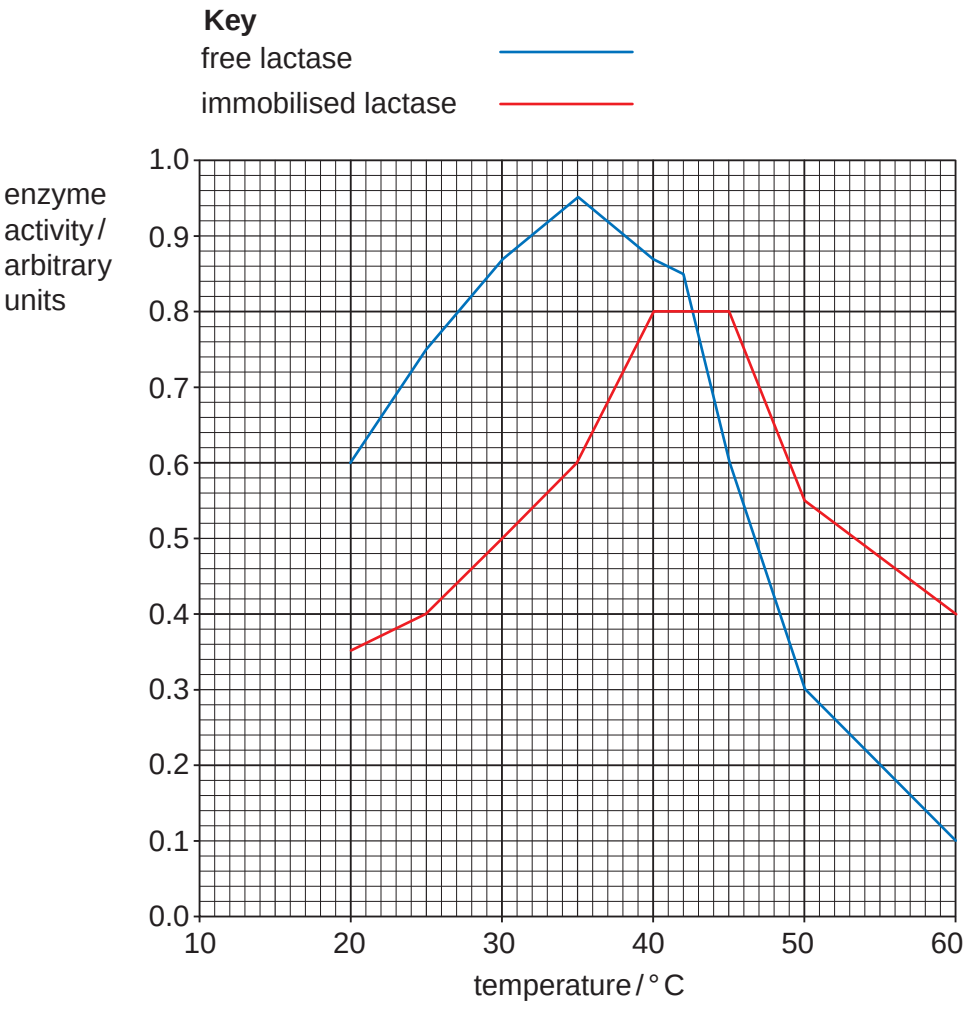

Fig. 2.1

With reference to Fig. 2.1:

(i) describe the effect of immobilisation on the activity of lactase

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(ii) suggest explanations for the differences between the activity of immobilised lactase and free lactase up to 40 °C.

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(c) State the advantages of using immobilised enzymes instead of free enzymes.

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[Total: 10]

3 **(a)** Enzymes are globular proteins that catalyse metabolic reactions.

Describe the features of globular proteins.

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(b) Enzymes can be used to remove cell walls from plant and fungal cells. The cells are incubated in a solution that contains a mixture of enzymes.

(i) Suggest an explanation for the fact that a different mixture of enzymes is required to remove the walls of plant cells compared to the walls of fungal cells.

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(ii) Explain why, when plant cells are incubated with enzymes to remove their cell walls, it is important to maintain an optimum pH.

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(c) A student carried out an investigation into osmosis using red blood cells.

Red blood cells were placed in sodium chloride (salt) solutions at five different concentrations. For each concentration, a sample was added immediately to a microscope slide and the cells were viewed using a light microscope for a period of time. The observations recorded are shown in Table 3.1.

Table 3.1

concentration of salt solution / %	observation of red blood cells
0.0	swell and burst, numbers decrease
0.4	increase in size
0.9	remain the same size
1.5	decrease in size
3.0	smaller and shrivelled

Explain, in terms of **water potential** and osmosis, the results that the student obtained.

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(d) The student also carried out a similar investigation using plant cells with cell walls removed. These cells were suspended in a 12% mannitol solution so that the water potential inside and outside of the cells was equal.

Fig. 3.1 is a photomicrograph of these cells.

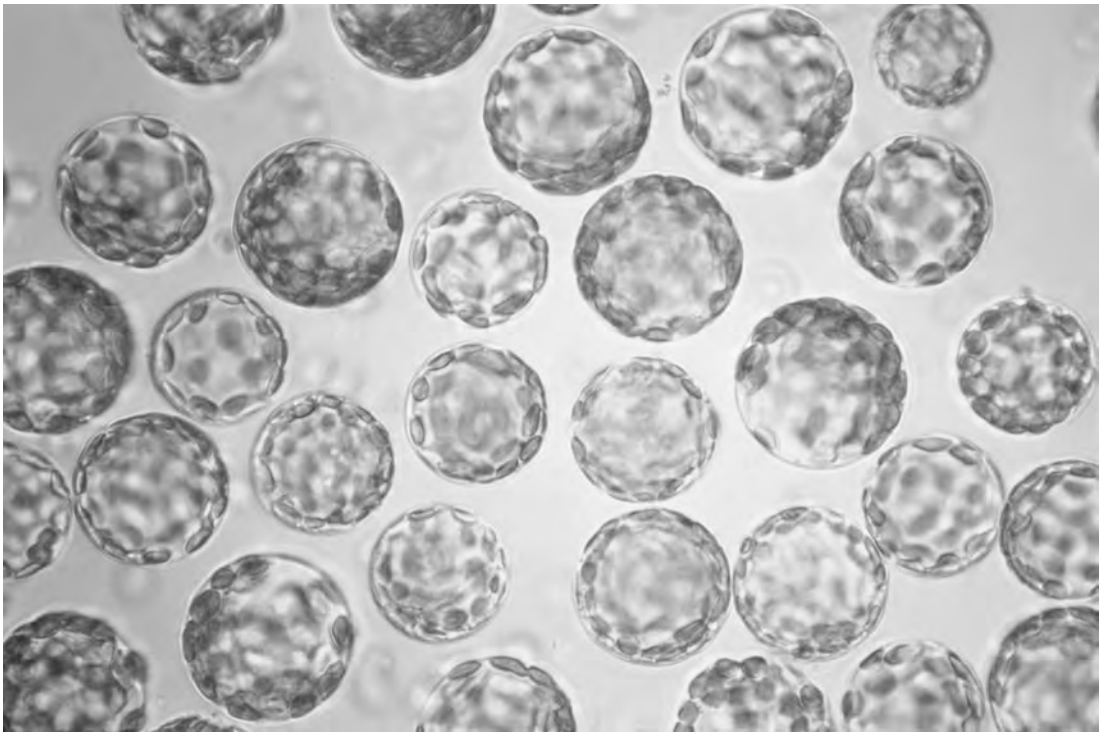

Fig. 3.1

The student removed a sample of these cells. The sample was placed into distilled water and was viewed using a light microscope.

Describe what you would expect the student to observe and explain why this would not occur with normal plant cells.

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[Total: 14]

4 The enzyme sucrase is used by many organisms for the hydrolysis of sucrose. Fig. 3.1 shows a diagram of the enzyme and its substrate.

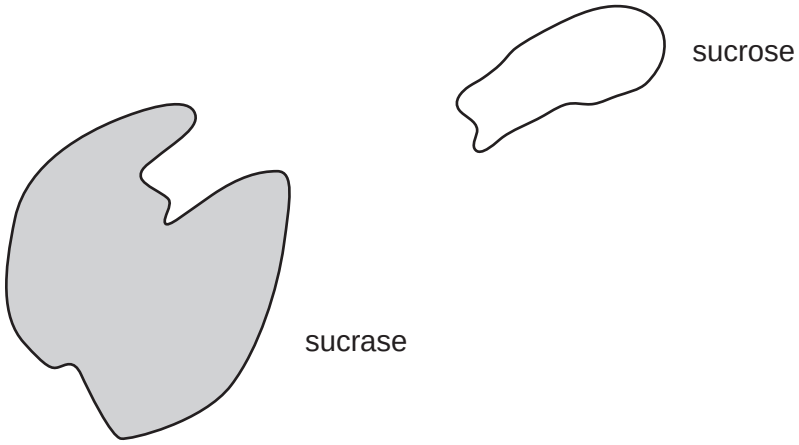

Fig. 3.1

(a) (i) State the names of the products of the hydrolysis of sucrose.

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(ii) With reference to Fig. 3.1, describe the mechanism of action of the enzyme in converting the substrate to products.

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(iii) Copper ions (Cu^{2+}) will inhibit the enzyme sucrase.
Suggest which type of inhibition occurs.

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(b) Sucrose is one of the assimilates transported in the phloem sieve tubes of plants from source to sink. Sucrase is found in sinks.

(i) Suggest the role played by sucrase in the process of unloading of sucrose at sinks.

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(ii) Plant sink organs convert excess products of sucrose hydrolysis to storage molecules, such as starch.

Explain why these products of hydrolysis themselves cannot be stored in plant tissue.

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[Total: 11]

5 Rice, *Oryza sativa*, is a staple food in many parts of the world. Rice is often grown in fields that are flooded with water for part of the growing season.

(a) The roots of young rice plants are highly tolerant of ethanol. Explain how this helps them to survive when the fields are flooded.

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(b) Rice grains have a similar structure to those of maize. The endosperm makes up most of the rice grain. The endosperm is surrounded by an aleurone layer, which contains hydrolytic enzymes. Outside the aleurone layer is the fused pericarp and testa, containing large amounts of cellulose.

(i) Describe the function of the endosperm.

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Brown rice includes the pericarp and testa, whereas in white rice these have been removed during milling, along with most of the aleurone layer.

Table 5.1 shows the nutrient content of samples of white and brown rice.

Table 5.1

	nutrient content per 100 g	
	white rice	brown rice
lipid / g	0.8	2.4
dietary fibre / g	0.6	2.8
calcium / mg	8	12
vitamin B_1 / mg	0.07	0.26
protein / g	6.0	7.4
carbohydrate / g	82.0	77.7

(ii) With reference to the structure of rice grains, suggest why brown rice contains more protein than white rice.

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(iii) Explain why brown rice contains less carbohydrate per gram than white rice.

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(iv) Explain why the grains of cereals such as rice are staple foods in many parts of the world.

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[Total: 9]