

Enzymes

Question Paper 6

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Enzymes
Sub Topic	Enzymes
Booklet	Theory
Paper Type	Question Paper 6

Time Allowed : 53 minutes

Score : / 44

Percentage : /100

Grade Boundaries:

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

- 1 Sucrase is the enzyme that catalyses the hydrolysis of sucrose. A student investigated the effect of substrate concentration on the activity of this enzyme.

Six test-tubes were set up each containing 10 cm^3 of different concentrations of sucrose solutions. The test-tubes were left in a water bath at 30°C for ten minutes.

After ten minutes, 5 cm^3 of a sucrase solution at 30°C was added to each test-tube and the reaction mixtures were stirred.

After a further five minutes, the temperature of the water-bath was raised to above 85°C and the same volume of Benedict's solution added to each test-tube in turn. The student recorded the time when a green colour first became visible in each test-tube.

The concentrations used and the student's results are shown in Table 2.1.

Table 2.1

concentration of sucrose / g dm^{-3}	time taken for green colour to appear / s
5	278
10	145
15	95
20	75
50	47
100	45

- (a) Explain why the temperature of the water-bath was raised to above 85°C .

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(c) With reference to the student's results, describe **and** explain the effect of increasing substrate concentration on the rate of hydrolysis of sucrose by sucrase.



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- 2 Pompe disease is a rare neuromuscular disease caused by an autosomal recessive allele. This allele prevents the production of an enzyme called acid alpha-glucosidase (AG), which breaks down glycogen in muscle cells. Glycogen can build up in muscle cells causing damage to the cells. This damage leads to muscle weakness which gets worse with time.

- (a) Explain how two parents, both of whom produce normal amounts of AG, can produce a child with Pompe disease.

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- (b) One form of treatment is enzyme replacement therapy where AG is given through regular injections.

- (i) Suggest how AG may be manufactured.

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- (ii) Name the hormone that stimulates the breakdown of glycogen in **liver** cells.

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- (iii) State under what conditions glycogen would need to be broken down in liver or muscle cells.

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- (c) The MN blood group system is based on the presence of glycoproteins M and N, on the surface membrane of red blood cells, which act as *antigens*.

State what is meant by the term *antigen*.

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- (d) The type of MN antigen on the surface membrane of red blood cells is controlled by a single gene with two alleles, L^M and L^N . The phenotypes of the MN blood group system are MM, MN and NN.

Complete the genetic diagram to show how the MN blood group is inherited.

parental phenotypes MN x MN

parental genotypes

gametes

offspring genotypes

offspring phenotypes [3]

- (e) Allele frequencies for L^M and L^N vary in different human populations throughout the world.

Table 7.1 shows the L^M and L^N allele frequencies from five populations.

Table 7.1

population	allele frequency / %	
	L^M	L^N
Canadian Inuit	91	9
Egyptian	52	48
German	55	45
Chinese	57	43
Nigerian	55	45

Discuss the data shown in Table 7.1.

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3 Enzymes catalyse reactions in which substrate molecules are converted to products.

(a) There are two main approaches to investigation of the activity of an enzyme. State the two ways in which the activity of an enzyme can be found.

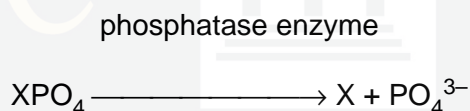
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Phosphatase enzymes remove phosphate groups from a wide range of organic compounds that contain phosphate. This makes available a supply of phosphate ions within cells. The reaction catalysed by phosphatase enzymes is as follows:



X = an organic compound

The activity of phosphatase was measured at different values of pH by using nine different buffer solutions. The temperature was kept constant at 30 °C. The results are shown in Fig. 5.1.

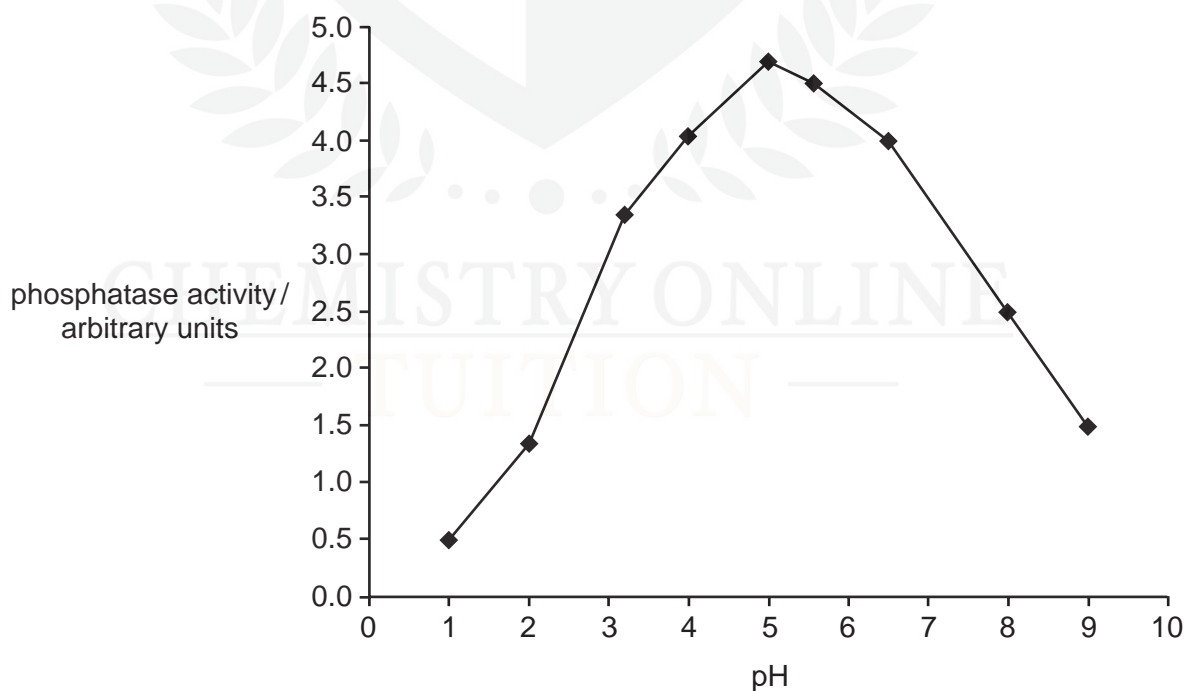


Fig. 5.1

(b) Using the data in Fig. 5.1, describe the effect of pH on the activity of phosphatase.

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(c) Explain why the activity of phosphatase is very low at pH 1.

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(d) Draw a curve on Fig. 5.1 to show the results you would expect if the experiment was repeated in exactly the same way but at a temperature of 20 °C. [2]

(e) Explain how competitive inhibitors affect the activity of enzymes, such as phosphatase.

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[Total : 14]

4 Enzymes are globular proteins that catalyse specific reactions.

(a) Explain how enzymes catalyse specific reactions.

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(b) Restriction enzymes cut DNA into fragments. They cut at specific sites determined by the sequence of bases. Fig. 4.1 shows the base sequences cut by three restriction enzymes and a section of DNA cut by one of these enzymes.

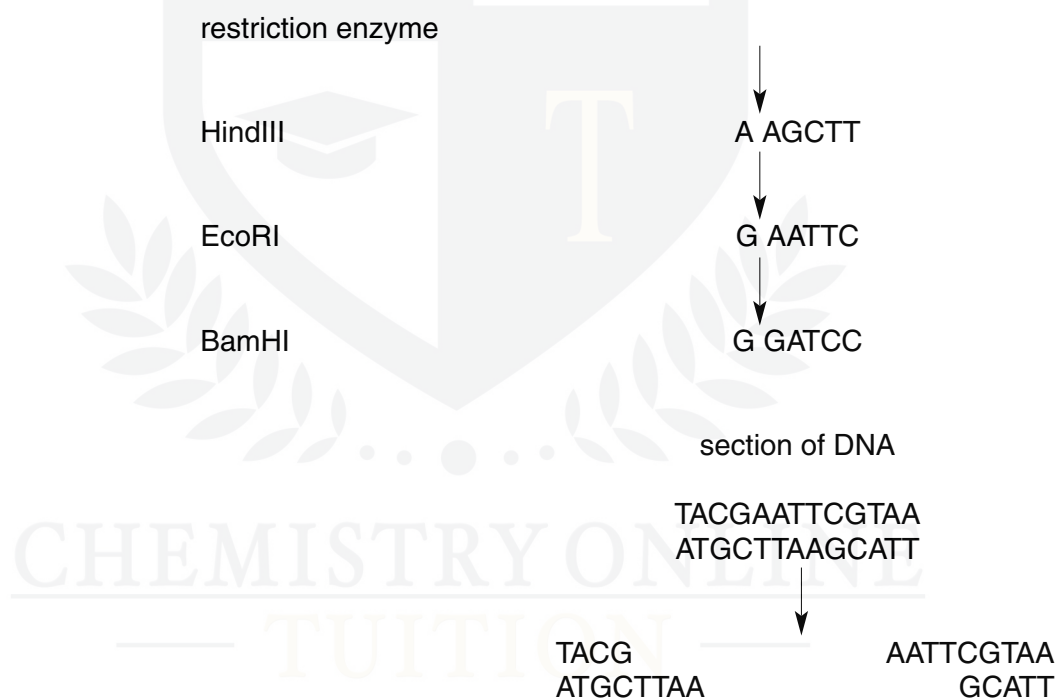


Fig. 4.1

(i) Identify the restriction enzyme that has cut the section of DNA shown in Fig. 4.1.

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(ii) State the name given to the unpaired base sequences that remain after DNA has been cut by the three restriction enzymes shown in Fig. 4.1.

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- (c) Human genes may be cloned by inserting lengths of DNA into bacteria. This may be carried out by inserting the DNA into a plasmid.

Explain how lengths of DNA, cut by restriction enzymes, are inserted into plasmids.

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[Total : 8]

