5. Enzymes

5.1 Enzymes

Paper 3 and 4

Question Paper

Paper 3

Questions are applicable for both core and extended candidates

1 **(b)** Amylase is an enzyme.

(i) Describe the function of amylase.

.....

.....

..... [2]

(ii) Define the term enzyme.

.....

.....

..... [2]

2 **(a)** Tick **(✓) all** the boxes that describe enzymes.

they are permanently changed by the reaction	
they are involved in all metabolic reactions	
they are proteins	
they are solvents	
they slow down all chemical reactions	

[2]

(b) Fig. 2.1 shows the effect of pH on the activity of three different digestive enzymes, **X**, **Y** and **Z**.

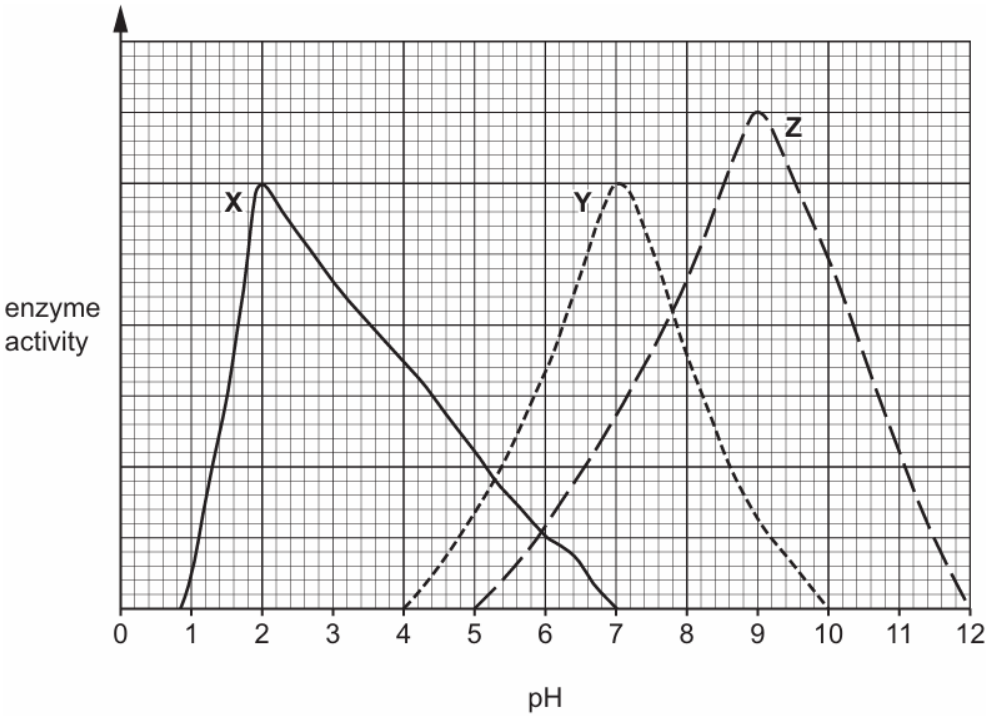

Fig. 2.1

Using the information in Fig. 2.1:

(i) State the optimum pH of enzyme **Z**.

..... [1]

(ii) State a pH value at which both enzymes **X** and **Y** are active.

..... [1]

(iii) State a pH value at which enzyme **Y** is completely denatured.

..... [1]

(iv) Enzyme **X** is a protease.

Describe its location and action in the digestive system.

location .....

action .....

[2]

(v) Enzyme **Y** is produced by the salivary glands.

State the substrate and product of enzyme **Y**.

substrate .....

product .....

[2]

(c) State the type of digestion that uses enzymes.

..... [1]

(d) State **one** factor, other than pH, that affects enzyme activity.

..... [1]

[Total: 11]

3 Enzymes are biological catalysts.

(a) Describe what is meant by a catalyst.

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.....

.....

.....

..... [2]

(b) State the type of biological molecule enzymes are made of.

..... [1]

(c) The rates of enzyme activity of two different enzymes, **A** and **B**, were recorded at different temperatures.

Fig. 2.1 shows the results.

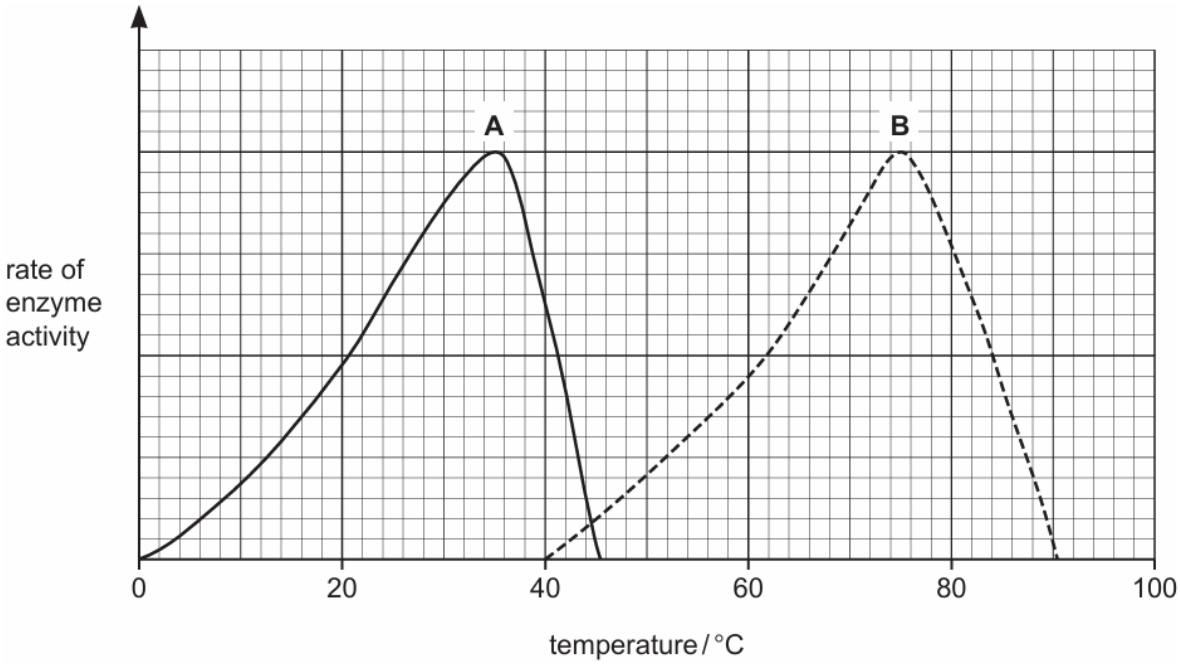

Fig. 2.1

(i) Compare the effect of temperature on the rate of enzyme activity for enzymes **A** and **B**.

Use data from Fig. 2.1 to support your answer.

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..... [4]

(ii) State the part of an enzyme that has a complementary shape to a substrate.

..... [1]

(iii) State **one** factor, **other than** temperature, that would affect the rate of enzyme activity.

..... [1]

(d) The box on the left contains the word 'Enzymes'.

The boxes on the right contain some sentence endings.

Draw **three** lines from the box on the left to make three correct sentences.

Enzymes	are involved in all metabolic reactions.
	are only made of the elements carbon and hydrogen.
	are necessary to sustain life.
	are needed for the loss of water vapour from leaves.
	are a type of hormone.
	are used to make fruit juice.

[3]

[Total: 12]

4 **(a)** Fig. 3.1 shows the action of an enzyme.

Fig. 3.1

On Fig. 3.1 use label lines and labels to identify:
- an enzyme
- a product
- a substrate.

[3]

(b) Describe what is meant by the term enzyme.

.....

.....

..... [2]

(c) The enzymes in biological washing powders speed up the removal of stains from clothing.

Some of these stains may contain fats.

(i) Circle the name of the enzyme that will remove fat stains.

amylase **lipase** **pectinase** **protease**

[1]

(ii) Explain why removing fat stains and protein stains from clothing requires a washing powder that contains more than one type of enzyme.

.....

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.....

..... [2]

(d) An investigation was carried out to compare how fast a biological washing powder removed stains at different temperatures.

Fig. 3.2 shows the results of the investigation.

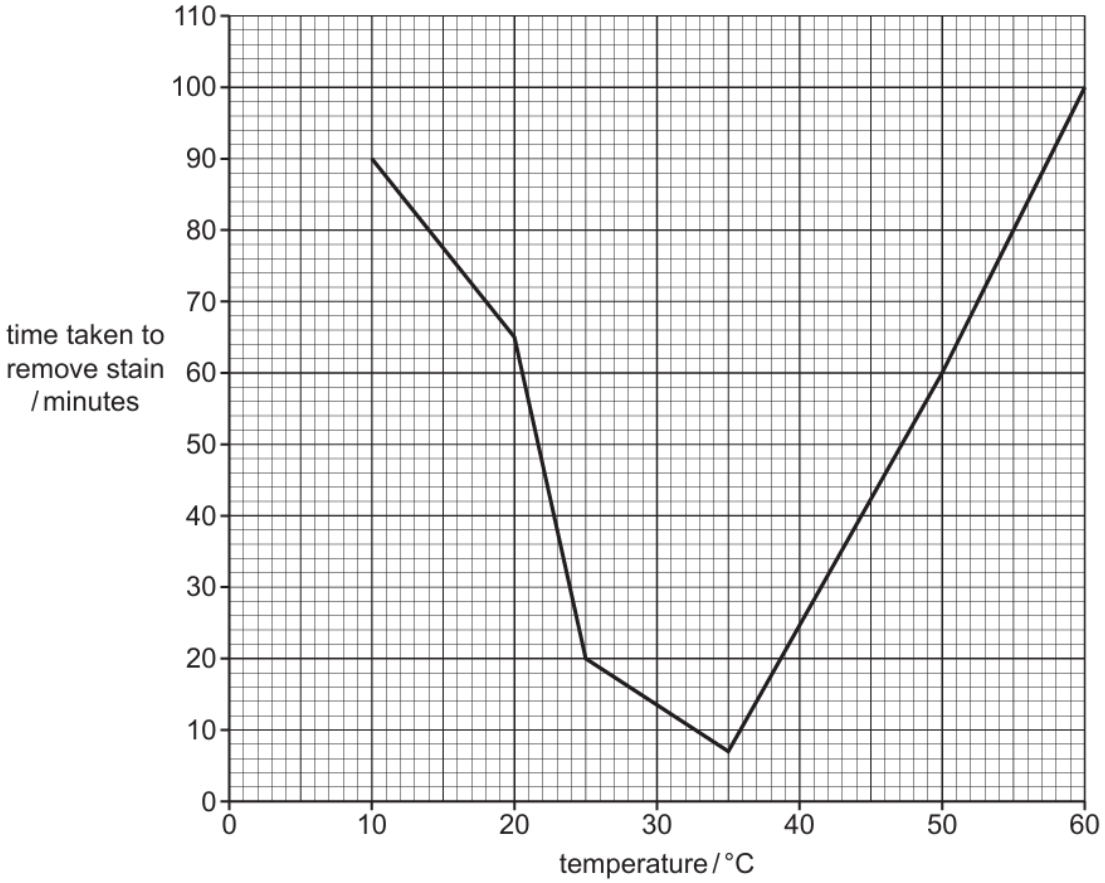

Fig. 3.2

Using the information in Fig. 3.2:

(i) State the optimum temperature for the washing powder.

..... °C [1]

(ii) State the time taken for the washing powder to remove the stain at 20 °C.

..... minutes [1]

(iii) Describe what happens to the enzymes in the biological washing powder between 40 °C and 60 °C.

.....

.....

.....

..... [2]

5 Enzymes help to digest food in humans and are produced by different parts of the alimentary canal.

(a) The box on the left contains a sentence beginning.

The boxes on the right contain some sentence endings.

Draw **two** lines to make two correct sentences about enzymes.

Enzymes	are carbohydrates.
	are catalysts that slow down reactions and remain unchanged.
	are catalysts that speed up reactions and are changed.
	are catalysts that speed up reactions and remain unchanged.
	are lipids.
	are proteins.

[2]

(b) Fig. 3.1 is a diagram showing an enzyme and several different substrate molecules.

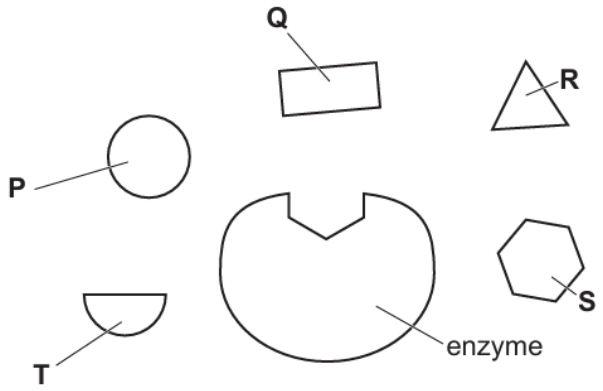

Fig. 3.1

State the letter of the molecule that is most likely to be the substrate for this enzyme.

..... [1]

(d) Fig. 3.2 is a graph showing the effect of changes in pH on the activity of four different enzymes, **U** to **X**.

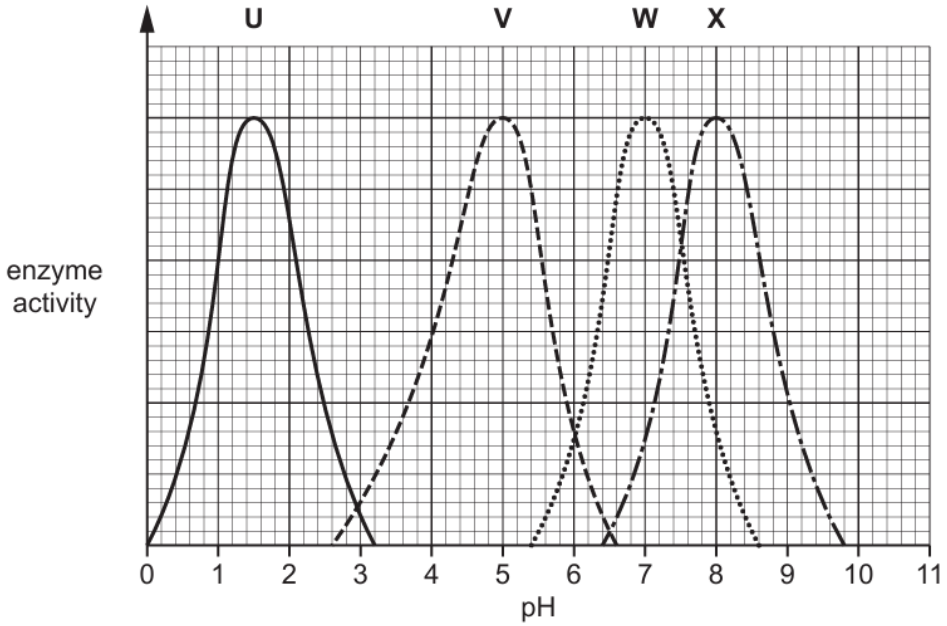

Fig. 3.2

The pH values in different parts of the alimentary canal were measured.

Table 3.1 shows the pH values found in the different parts of the alimentary canal.

(i) Use the information in Fig. 3.2 to state the letter of the enzyme that would be **most** active in each part of the alimentary canal.

Table 3.1

part of the alimentary canal	pH values	enzyme letter
duodenum	5.5	
ileum	8.0	
mouth	6.7	
stomach	1.5	

[2]

(ii) The duodenum and ileum are part of the small intestine.

State the name of **one** part of the large intestine.

..... [1]

6 **(d)** Alcohol dehydrogenase is an enzyme that breaks down alcohol in the body.

Fig. 3.2 shows the activity of alcohol dehydrogenase at different pH values.

Fig. 3.2

(i) State the pH value with the highest enzyme activity in Fig. 3.2.

..... [1]

(ii) State the pH value with the lowest enzyme activity in Fig. 3.2.

..... [1]

(iii) Suggest **one other** factor that could affect the activity of the enzyme alcohol dehydrogenase.

..... [1]

(e) Enzymes are biological catalysts.

Define the term catalyst.

.....

.....

..... [2]

(f) Enzymes are proteins.

Circle the elements that all enzymes contain.

calcium	**carbon**	**hydrogen**	**iodine**
iron	**magnesium**	**nitrogen**	**oxygen**

[2]

7 **(a)** Pectinase is an enzyme that is used in the production of apple juice.

A student investigated how pH affected the volume of apple juice produced when using pectinase.

The student chopped an apple into small pieces.

The pieces of apple were put into solutions with different pH values.

Pectinase was added to each solution.

After two hours the mixture was filtered and the volume of apple juice obtained was recorded.

Table 6.1 shows the results.

Table 6.1

pH	volume of apple juice obtained / cm^3
1.0	23.2
2.0	24.2
3.0	23.5
4.0	25.7
5.0	27.6
6.0	27.4
7.0	24.0
8.0	22.0

(i) State the pH at which pectinase is most active.

Give a reason for your answer.

pH .....

reason .....

.....

.....

[2]

(ii) State **one** factor, other than pH, that would affect the activity of pectinase.

..... [1]

(b) Pectinase is an enzyme.

The box on the left shows the beginning of a sentence.

The boxes on the right show some endings of sentences.

Draw **three** lines from the word 'Enzymes' to make three correct sentences.

Enzymes	are living organisms.
	are proteins.
	can only be used once.
	have a complementary shape to their substrate.
	increase the rate of chemical reactions.
	in the stomach are most active at pH 8.

[3]

8 **(a)** Catalase is an enzyme that catalyses the breakdown of hydrogen peroxide into water and oxygen.

The effect of temperature on catalase activity was investigated.

The results are shown in Fig. 8.1

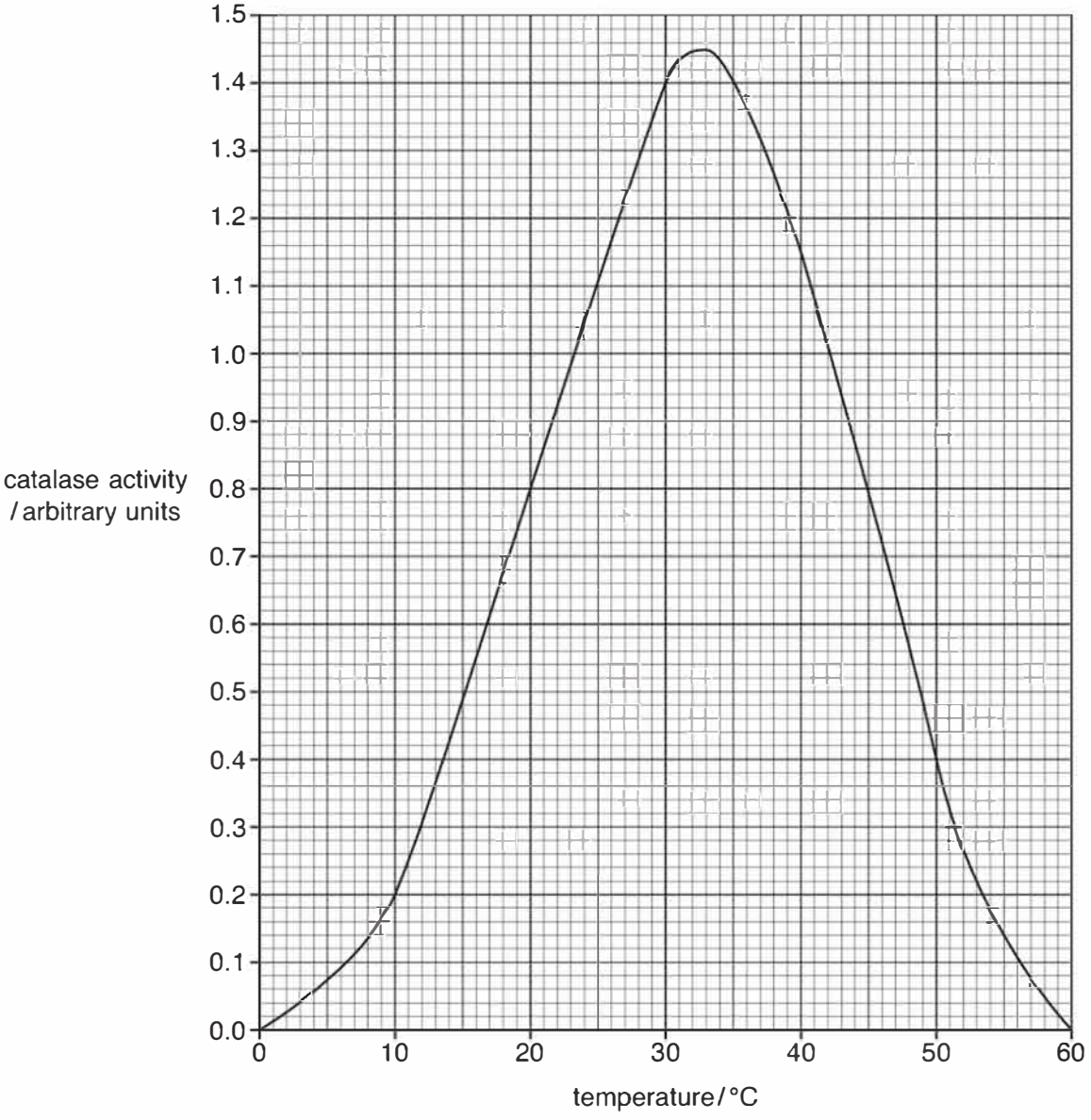

Fig. 8.1

(i) State the temperature at which catalase is most active in Fig. 8.1.

.....°C [1]

(ii) Explain why there is no enzyme activity at 60 °C.

.....

.....

.....[1]

(b) State **one** factor other than temperature that affects enzyme activity.

.....[1]

9 **(c)** Fig. 5.2 shows how the rate of reaction of a digestive enzyme changes with pH.

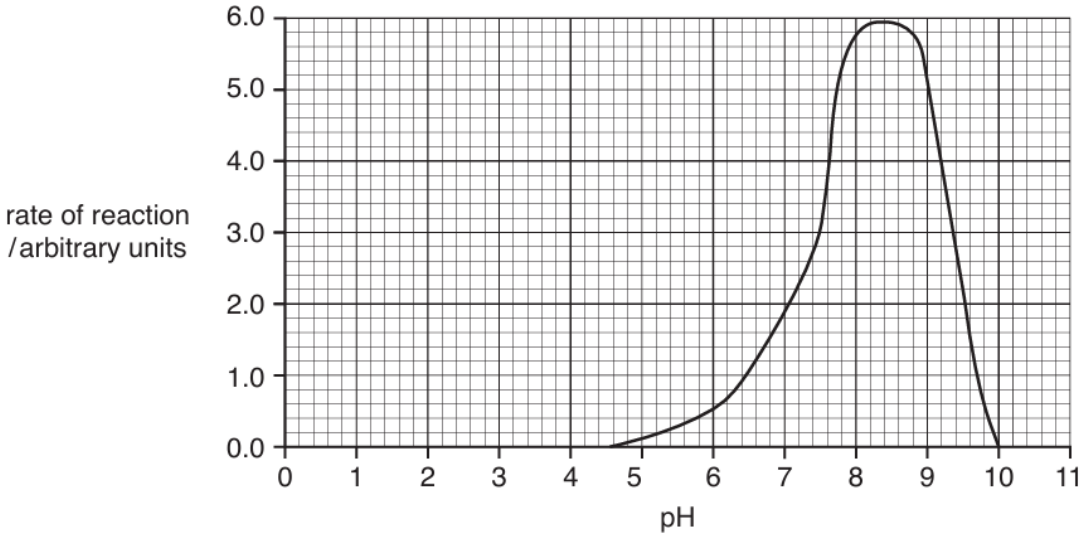

Fig. 5.2

(i) Describe the effect of the increase in pH on the rate of reaction shown in Fig. 5.2.

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.....[2]

(ii) State **one** factor other than pH that will affect enzyme activity.

.....[1]

Paper 4

Questions are applicable for both core and extended

candidates unless indicated in the question

10 **(a)** A student investigated the effect of lactase on three different liquids:

- milk
- lactose-free milk
- sucrose solution.

The student used an indicator to test for the presence of glucose. A sample of each liquid was tested before and after treatment with lactase.

The indicator turned brown in the presence of glucose. The indicator remained blue in the absence of glucose.

Table 4.1 shows the results of the tests.

Table 4.1

liquid	colour before treatment with lactase	colour after treatment with lactase
milk	blue	brown
lactose-free milk	brown	brown
sucrose solution	blue	blue

(i) Explain the results for the three liquids shown in Table 4.1. **(extended only)**

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..... [3]

(ii) The student kept the solutions at a temperature that was close to the optimum during the investigation.

Using your knowledge of the effect of temperature on enzyme activity, explain why this was important. **(extended only)**

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..... [4]

11 **(c)** The action of lipase is affected by temperature.

Fig. 1.2 shows the axes for a graph of the effect of temperature on the activity of lipase.

Complete the graph by:

- drawing a line to show the expected effect of temperature on the activity of lipase
- adding a label line and a label to show the point at which all the lipase has been denatured.

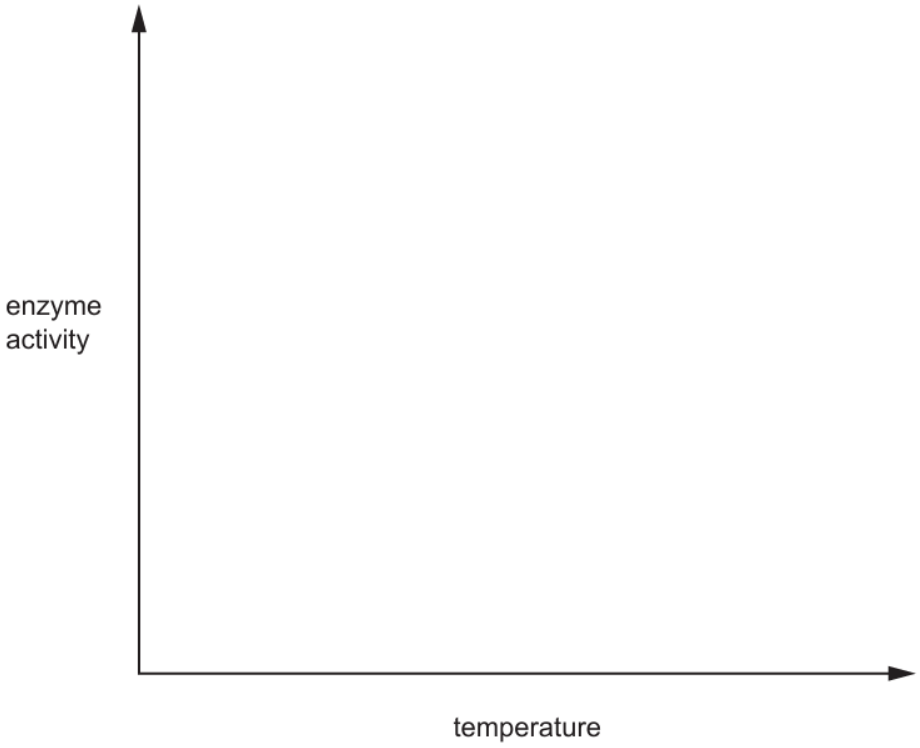

Fig. 1.2

[2]

(d) Explain why lipase cannot be used to catalyse the breakdown of proteins. **(extended only)**

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..... [3]

12 **(b)** Yeast cells make the enzyme sucrase. Sucrase catalyses the breakdown of sucrose to glucose and fructose.

Enzymes are made of protein.

Explain how the shape of a sucrase molecule is related to its function. **(extended only)**

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..... [2]

(c) The students made an extract of sucrase from yeast cells.

They investigated the activity of the sucrase extract at different pH values. They determined the rate of reaction at each pH.

They then calculated the rate of each reaction as a percentage of the fastest reaction, to give the percentage activity of sucrase.

The results of this investigation are shown in Fig. 1.2.

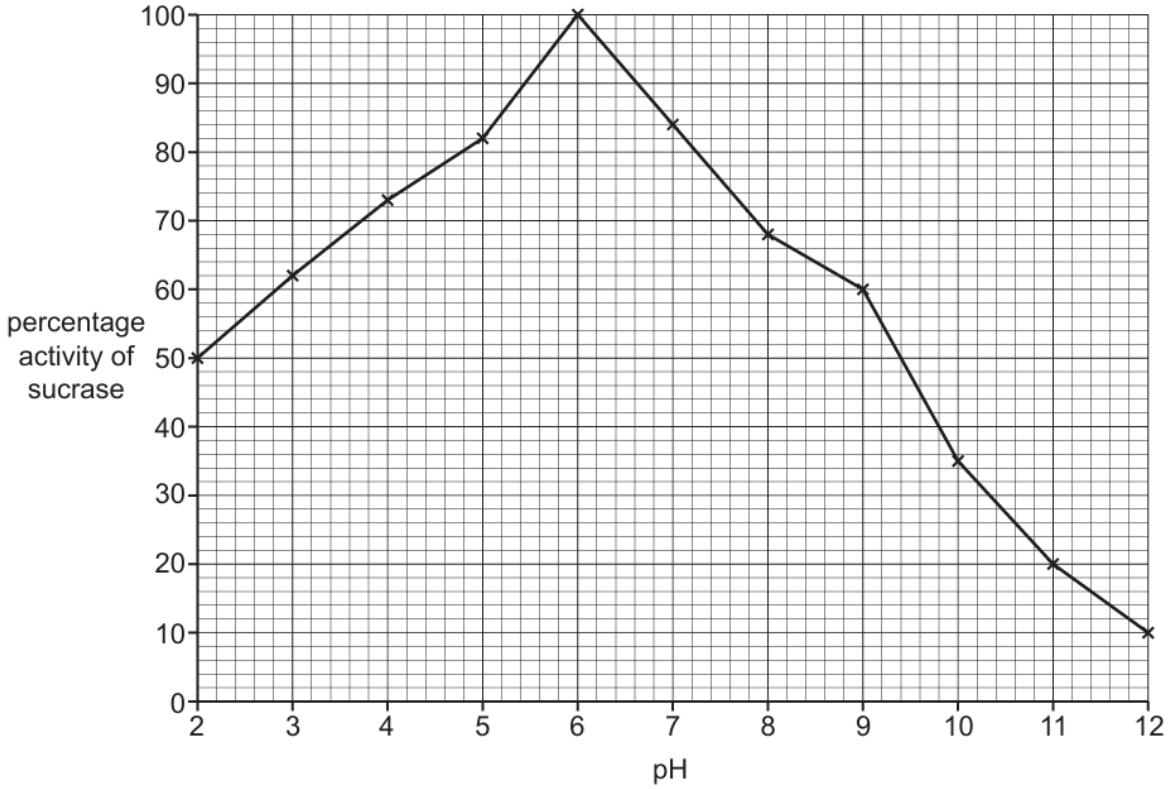

Fig. 1.2

Describe **and** explain the effect of pH on the activity of sucrase shown in Fig. 1.2. **(extended only)**

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..... [6]

13 Some washing powders contain enzymes.

(a) Fig. 3.1 shows a box of biological washing powder containing enzymes.

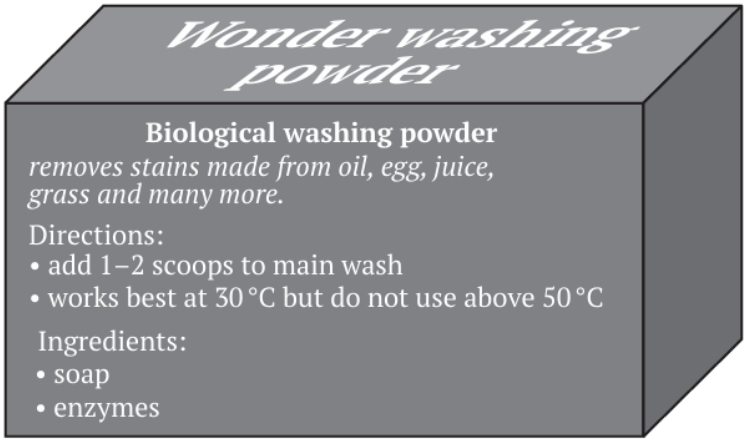

Fig. 3.1

(i) Eggs contain protein.

Describe how the biological washing powder removes egg stains.

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..... [3]

(ii) Explain why the manufacturer states that the washing powder works best at 30 °C and should **not** be used above 50 °C. **(extended only)**

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..... [4]

14 **(f)** Many fungi are decomposers that feed on dead plants. The fungi secrete enzymes to digest large molecules.

Students made an extract from a species of fungus. The extract contained digestive enzymes.

The students carried out an investigation to find out if amylase and pectinase were present in the fungal extract.

They made agar plates by filling Petri dishes with agar jelly containing either starch or pectin. They cut four holes of the same size in the agar jelly in each Petri dish.

The holes in each Petri dish contained the same volume of:
A – 1% amylase solution
B – 1% pectinase solution
C – distilled water
D – fungal extract.

The Petri dishes were kept at 27 °C for four days. After this time a dye was poured into each dish to stain the areas where starch and pectin remained.

Fig. 1.3 shows drawings of the stained agar in the Petri dishes. The clear zones indicate the areas where no starch or pectin remained.

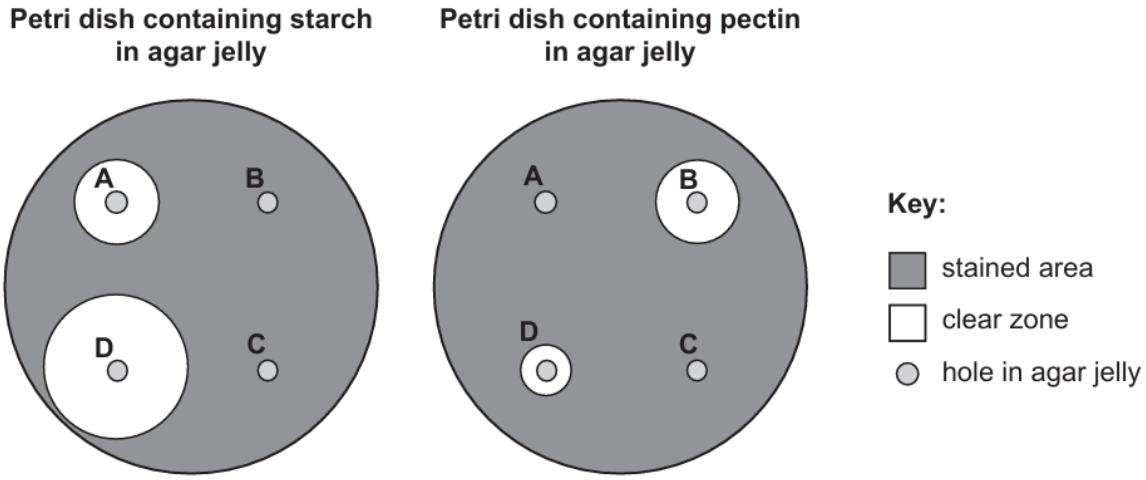

Fig. 1.3

(i) State what conclusions can be made about the enzymes in the fungal extract **and** give evidence from Fig. 1.3 to support your conclusions.

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..... [5]

(ii) The investigation was repeated but at 5 °C instead of at 27 °C.

Predict the effect of the lower temperature on the results.

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..... [1]

15 Enzymes are catalysts.

(a) Define the term catalyst.

.....

.....

..... [2]

(b) Fig. 6.1 shows diagrams of three enzymes and eight different substrates.

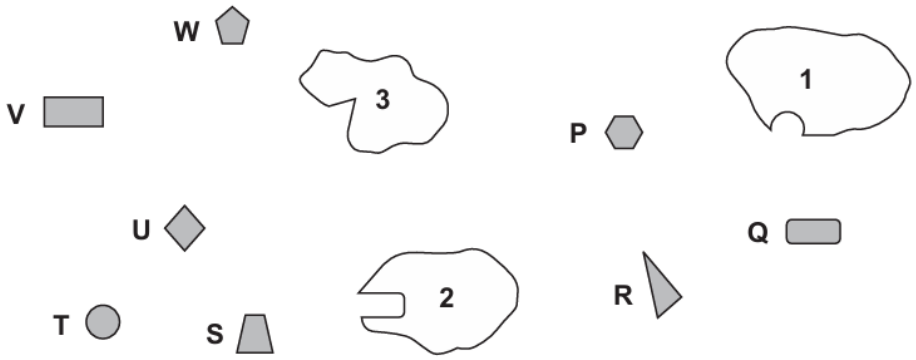

Fig. 6.1

(i) State the letter of the substrate that will be broken down by enzyme 1.

..... [1]

(ii) Explain, in terms of enzyme structure, the reason for your choice in **6(b)(i)**. **(extended only)**

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..... [2]

16 **(a)** The reactions of chemical digestion are catalysed by enzymes.

Fig. 1.1 shows the stages of an enzyme-catalysed reaction.

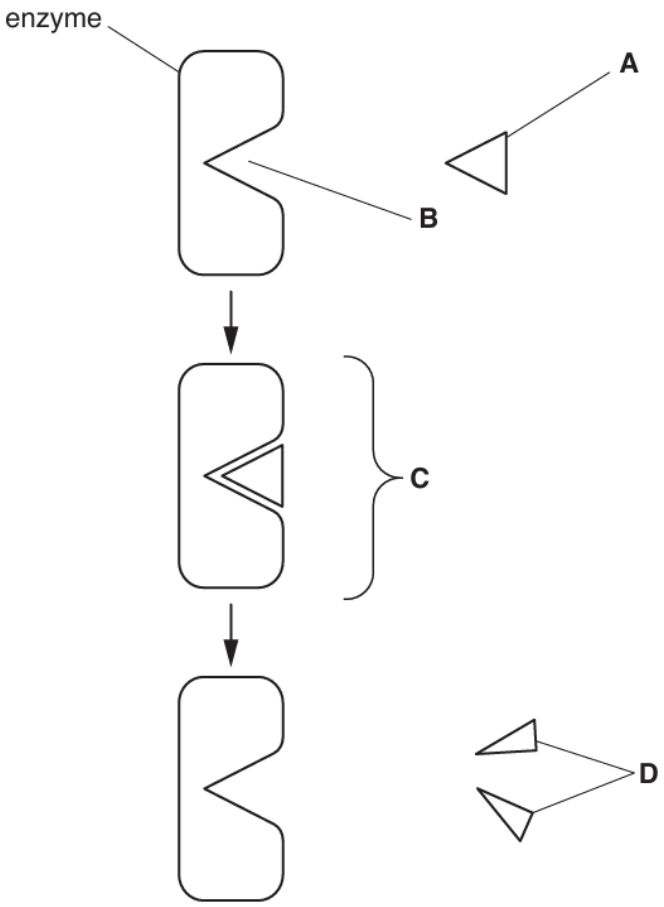

Fig. 1.1

State the names of **A** to **D** in Fig. 1.1. **(extended only)**

A .....

B .....

C .....

D .....

[4]