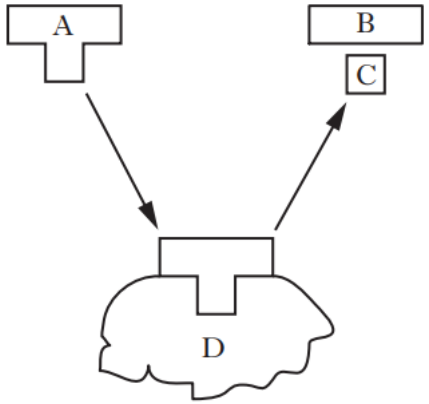
Enzymes

1. The diagram represents three stages in an enzyme-controlled reaction.

Which row in the table identifies the labelled structures?

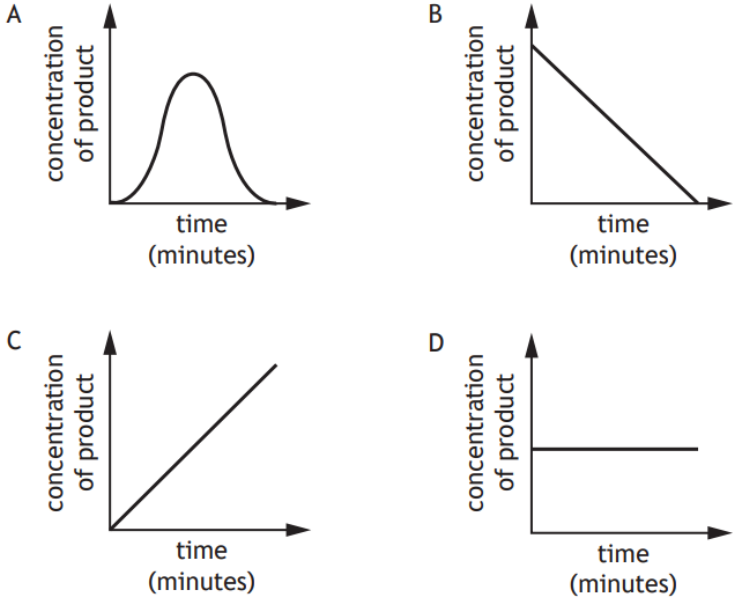
	Substrate	Enzyme	Product
A	L	N	K
B	N	K	M
C	K	L	N
D	M	K	N

2. The diagram below represents a degradation reaction involving an enzyme.



Which letter identifies the substrate?

3. Which diagram shows the concentration of product during a degradation reaction?



4. Which term refers to the process by which complex molecules are formed from simple molecules?

A Digestion

B Synthesis

C Degradation

D Respiration

5. The active site of an enzyme is complementary to

A one type of substrate molecule

B all types of substrate molecules

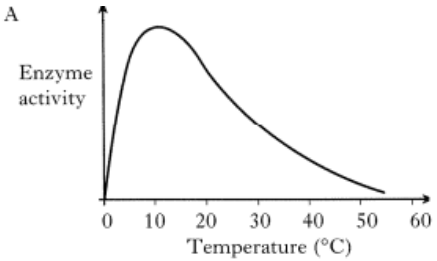
C one type of product molecule

D all types of product molecules.

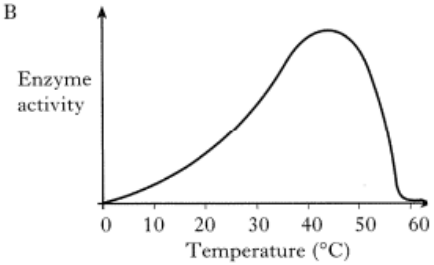
Enzymes

6. Which of the following graphs best shows the change in enzyme activity with temperature.

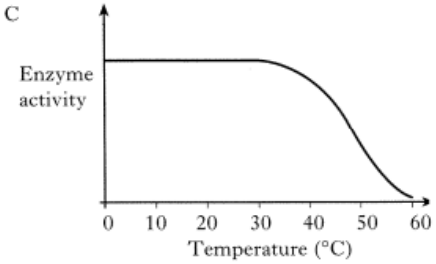
A



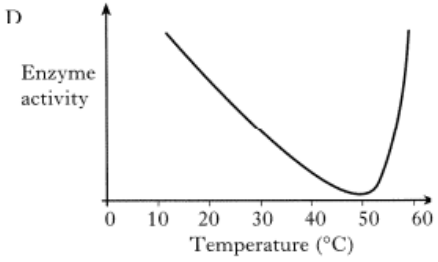
B



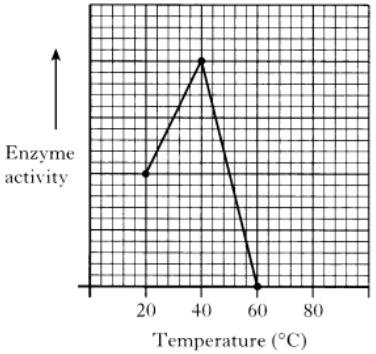
C

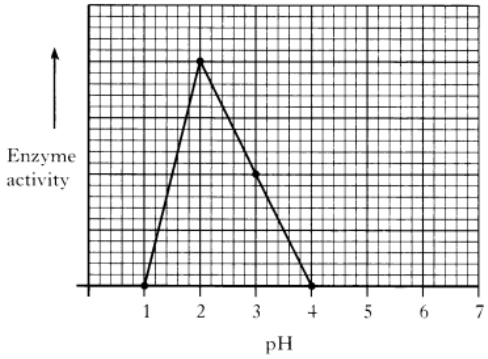


D



7. The graphs below show the effects of temperature and pH on the activity of an enzyme.

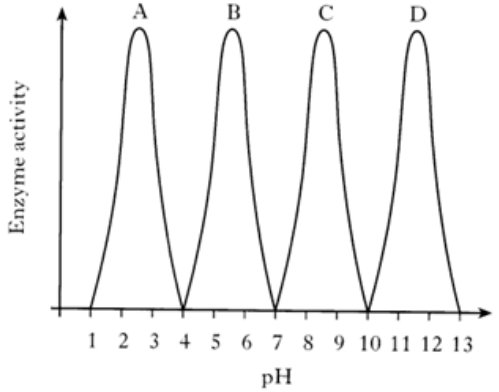




Which line in the table identifies correctly the conditions at which the enzyme is most active?

	Temperature	*pH*
A	40	2
B	40	4
C	50	2
D	60	4

8 Which of the following enzymes would be denatured at pH 11.



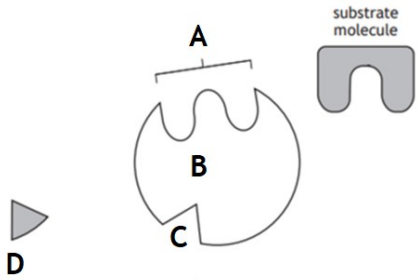
A Enzyme D only

B Enzyme A & B only

C Enzyme C & D only

D Enzyme A, B & C only

9. The active site of an enzyme can be found at:

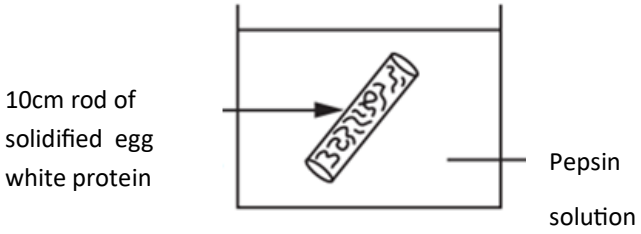


Enzymes

10. Pepsin is an enzyme that breaks down protein into amino acids.

An investigation was carried out into the effect of pH on pepsin activity.

Four experiments were set up as shown below at pH2, 5, 7 & 10.



The table below shows the length of the solidified egg white protein rod after one hour at each pH.

pH	*length* (cm)
2	6
5	8
7	9
10	10

What is the optimum pH for pepsin.

A pH 2

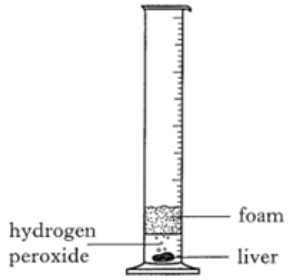
B pH 5

C pH 7

D pH 10

11. Catalase is an enzyme found in liver tissue that breaks down hydrogen peroxide into oxygen and water.

An investigation was carried out into the effect of pH on catalase activity. Four experiments were set up as shown below at pH 5, 7, 9 & 11.



The time taken to collect 10cm^3 of oxygen foam was noted or each pH.

pH of hydrogen peroxide solution	*Time to collect 10 cm^3 of oxygen foam* (s)
5	120
7	30
9	50
11	85

At pH 7 catalase is

A at its minimum activity

B at its optimum activity

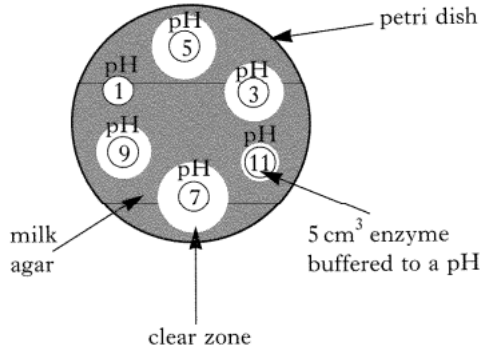
C denatured

D not specific to hydrogen peroxide

12. An investigation into the effect of pH on the digestion of milk by an enzyme was carried out.

Five identical dishes were set up with wells cut out of the agar.

To each well was added 5 cm^3 of the enzyme kept at a different pH as shown in the diagram below.



The dishes were kept at 35 °C.

The diameter of the area cleared by the action of the enzyme was measured.

	Diameter of clear zone (mm)				
pH	*Dish 1*	*Dish 2*	*Dish 3*	*Dish 4*	*Dish 5*
1	0	0	0	0	0
3	2	1	1	2	1
5	3	4	2	3	3
7	6	5	5	5	4
9	2	2	3	1	2
11	1	0	0	1	0

The pH at which the enzyme was most active was

A 3

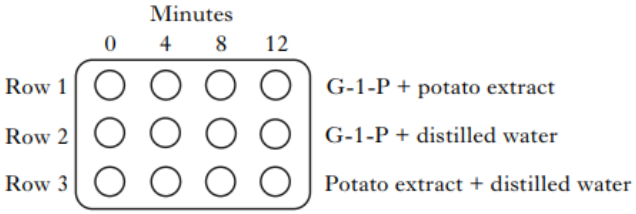
B 5

C 7

D 9.

Enzymes

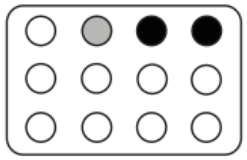
13. In an investigation into the synthesis of starch from glucose-1-phosphate (G-1-P) by the enzyme phosphorylase, a tile was set up as shown below. Starch-free potato extract was used as the source of phosphorylase.



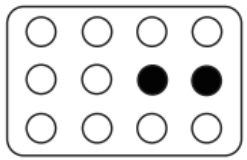
Iodine solution was added to the columns at the time intervals shown.

Which of the following tiles shows the expected result of this investigation?

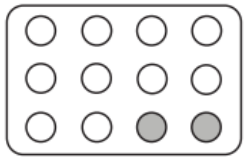
A



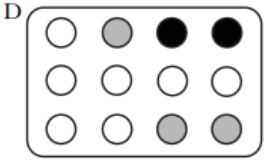
B



C

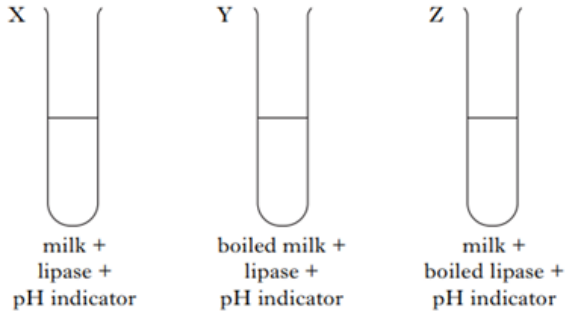


D



14. Lipase is an enzyme found in the small intestine that speeds up the breaks down of fat into fatty acids and glycerol. Full fat milk contains a high proportion of fat.

Three test tubes were set up as shown in the diagram below.



The pH of the content of each test tube was recorded at the start and again 15 minutes later.

What change in pH took place.

A The pH decreased in each test tube

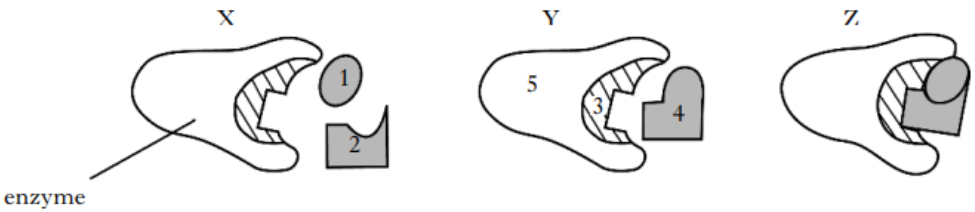
B The pH increased in each test tube

C The pH decreased in test tube X and Y but did not change in test tube Z.

D The pH increased in test tube Y and Z but did not change in test tube X.

Enzymes

1. (*a*) The diagram below shows three stages X, Y and Z that occur when an enzyme converts its substrate into a product.



(i) This enzyme promotes the breakdown of a complex molecule into simpler molecules.

Put the stages into the correct order to show this degradation reaction.

_____ → _____ → _____ **1**

(ii) Which number in the diagram shows the active site?

_____ **1**

(*b*) Complete the following sentence by underlining the correct word from the choice in brackets.

Enzymes are made of { carbohydrate / fat / protein }. **1**

(*c*) Describe what happens to an enzyme when it is denatured.

_____

_____ **1**

2

Mark

(*a*) All living cells require enzymes. What would happen to chemical reactions in a cell if enzymes were not present?

_____ **1**

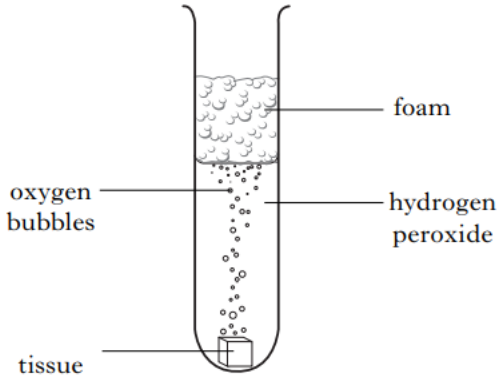
(*b*) Give **one** example of an enzyme responsible for the synthesis of a substance.

_____ **1**

(*c*) Catalase enzyme releases oxygen from hydrogen peroxide.

Different tissues were tested for catalase activity by adding equal masses of tissue to hydrogen peroxide at pH 7.

The height of the foam produced was used as a measure of the volume of oxygen released.



The investigation was carried out at pH7.

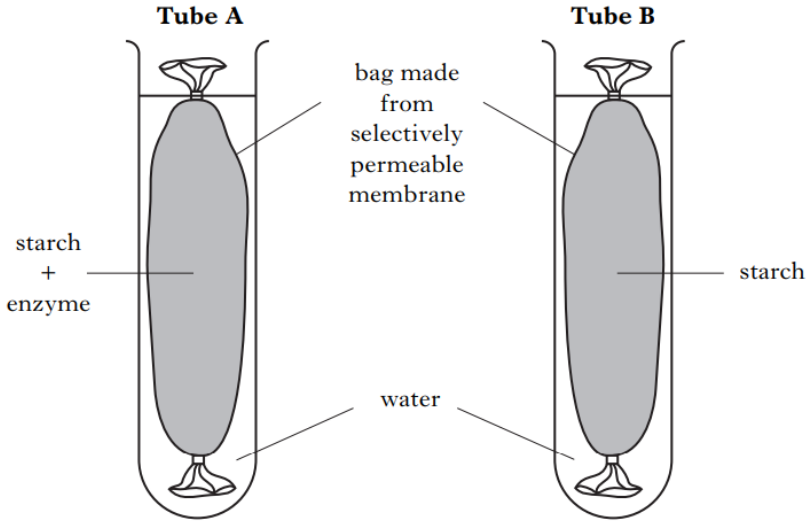
Use the words **increase**, **decrease** or **stay the same** to complete the following sentence correctly.

At pH 4 oxygen production would _____

at pH 11 oxygen production would _____

Enzymes

3. An investigation into the effect of a digestive enzyme on starch was set up as shown below.



Explain why sugar was present in the water in Tube A.

_____

_____

4. (i) The process of cell division is controlled by many specific enzymes. Explain the term *specific* as used in this context.

_____

_____

1

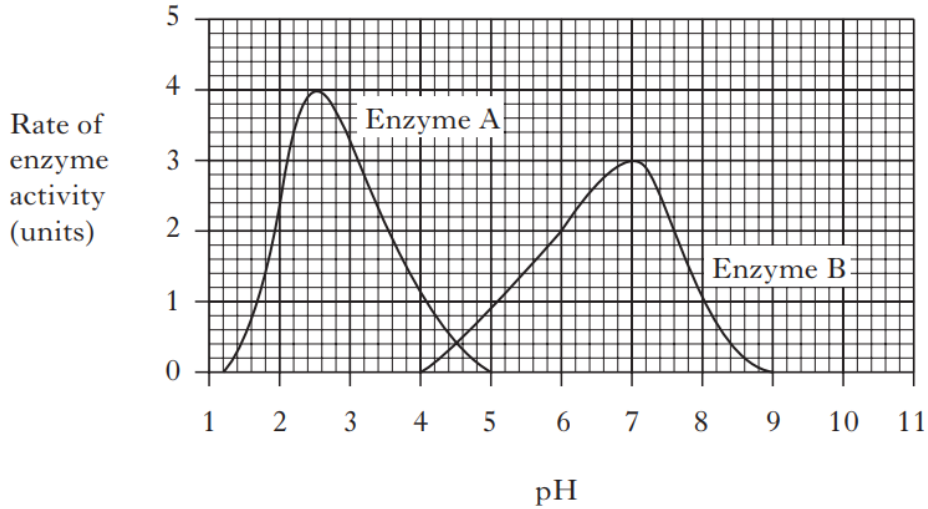
(ii) Enzymes have an optimum temperature and pH. Explain the meaning of the word *optimum*.

_____

_____

1

5. The following graph shows the relationship between pH and the rate of activity of two different enzymes.



Use information from the graph to answer the following questions.

(i) Between which pH values are both enzymes active?

Between _____ and _____ **1**

(ii) Enzymes are biological catalysts. Describe what is meant by the term *catalyst*.

_____

_____

_____ **1**

(iii) Name the type of chemical substance from which enzymes are made.

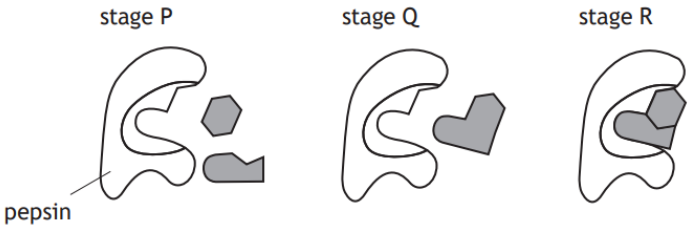
_____ **1**

6

Enzymes

6 Pepsin is an enzyme involved in the digestion of proteins, which is a degradation reaction.

The diagram represents three stages that occur in this reaction.



(i) Using letters from the diagram, put the stages into the correct order to show this degradation reaction. **1**

stage _____ → stage _____ → stage _____

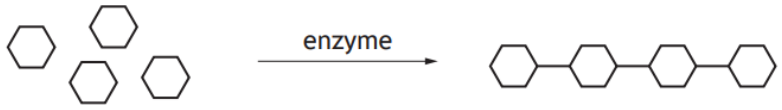
(ii) Describe the feature of pepsin that allows it to bind to only one substrate. **1**

_____

_____

7. Potatoes store sugar in the form of starch. Glucose-1-phosphate (G-1-P) molecules are converted to starch in an enzyme-controlled reaction.

This enzyme can be found in potato extract.



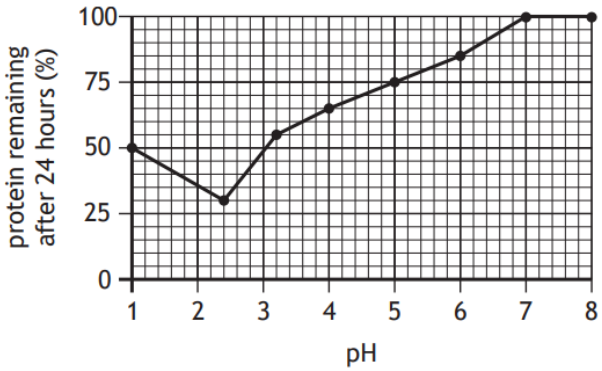
(a) (i) Identify the type of reaction carried out by this enzyme.

_____

(ii) Identify the substrate in this reaction.

_____

8. The graph shows the results of an experiment to investigate the effect of pH on pepsin activity.



a) Use the graph to identify the optimum pH of pepsin. **1**

pH _____

b) Enzymes can be denatured by changes in pH.

Give a reason why the rate of reaction will be affected. **1**

_____

_____

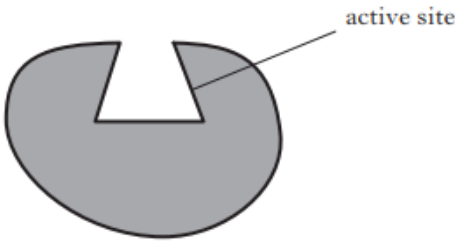
9. Decide if each of the following statements about enzymes is **True** or **False**, and tick (✓) the appropriate box.

If the statement is **False**, write the correct word(s) in the **Correction** box to replace the word underlined in the statement.

Statement	*True*	*False*	*Correction*
During denaturation, the substrate changes shape.			
Amylase is a synthesis enzyme.			

Enzymes

10. The diagram below represents an enzyme which carries out a synthesis reaction.



(*a*) The sentences below describe some of the properties of enzymes.

Underline **one** option in each set of brackets to make the sentences correct.

Enzyme {slow down / speed up} the rate of chemical reactions.

The shape of an enzyme molecule is {complementary to / the same as} its substrate.

(*b*) Describe what is meant by the term "synthesis reaction".

_____

_____

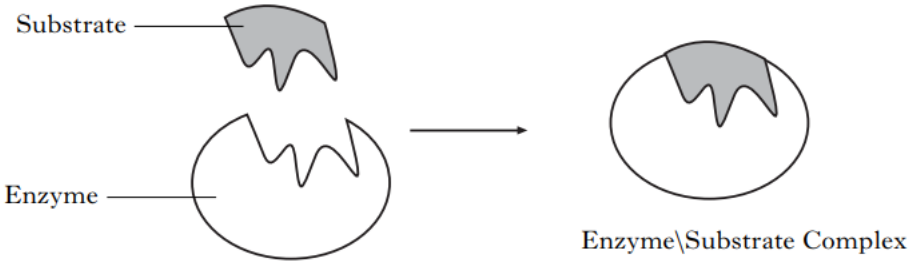
(*c*) Explain why a denatured enzyme no longer works.

_____

_____

_____ **2**

11. Enzymes are biological catalysts. The diagram below shows part of an enzyme controlled reaction.



(*a*) Describe the features of an enzyme which allow it to combine with only one substrate.

_____

_____

_____ **2**

(*b*) What happens to an enzyme when it is boiled?

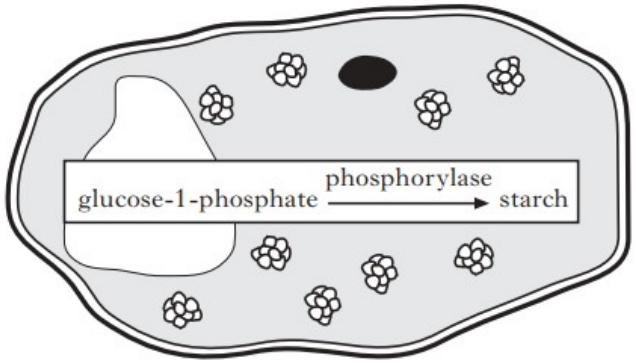
_____ **1**

(*c*) Name a factor, other than temperature, which affects enzyme activity.

_____ **1**

Enzymes

12. The diagram below shows the action of the enzyme phosphorylase in a potato cell.



(i) Underline the option in the bracket to make the sentence correct.

The action of the enzyme phosphorylase catalyses the { synthesis / degradation } of starch. **1**

(ii) State the effect of phosphorylase on the rate of this reaction.

_____ **1**

(iii) Explain why lipase could not produce starch in this reaction.

_____

_____ **1**

13. Predict the catalase activity in beef at 100 °C. Give a reason for your answer.

Prediction _____ units

Reason _____

_____ **1**

14 Amylase is produced in the salivary glands. The substrate of amylase is starch. Amylase was added to a starch suspension and a sugar was produced.

(a) State the optimum temperature for the action of amylase.

_____ °C **1**

(b) An enzyme has a shape which is complementary to its substrate.

(i) What term describes this property of an enzyme?

_____ **1**

(ii) Name the part of the enzyme that is complementary to its substrate.

_____ **1**

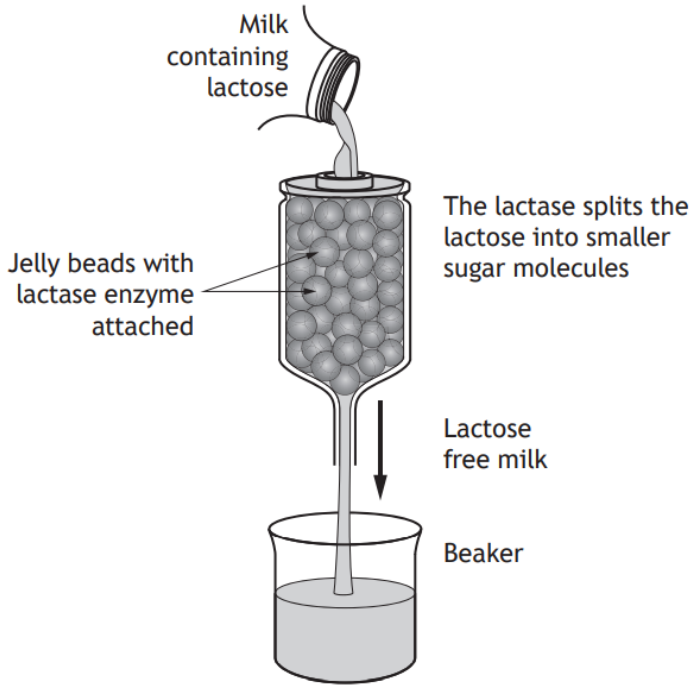
15 Underline **one** word in each group to make the sentences correct.

Enzymes are found in { *some* / *most* / *all* } cells and are made of { *protein* / *carbohydrate* / *fat* }.

Enzymes are { *substrates* / *reagents* / *catalysts* } and work best in { *hot* / *warm* / *cold* } conditions. **2**

Enzymes

16 The diagram below shows how the enzyme lactase is used in the production of lactose-free milk.



(a) (i) Underline **one** option in each of the brackets to make the following sentences correct.

This process is an example of a {degradation / synthesis} reaction.

In this reaction, lactose is the {product / substrate} of lactase.

(ii) A fault in the production resulted in boiling water running over the lactase enzyme.

Using your knowledge of enzymes, predict how the milk produced would differ from the expected product.

Explain your answer. **2**

Prediction _____

_____

Explanation _____

_____

(b) Enzymes such as lactase are biological catalysts.

Explain the role of enzymes in living cells. **1**

_____

_____

(c) Name the substance of which enzymes are made. **1**

_____

17 (i) The samples were left in a warm place to provide optimum conditions for the enzyme.

Explain what is meant by the term *optimum conditions*.

_____

_____ **1**

(ii) Cellulase enzyme is specific for cellulose.

Explain what is meant by the term *specific*.

_____

_____ **1**

Enzymes

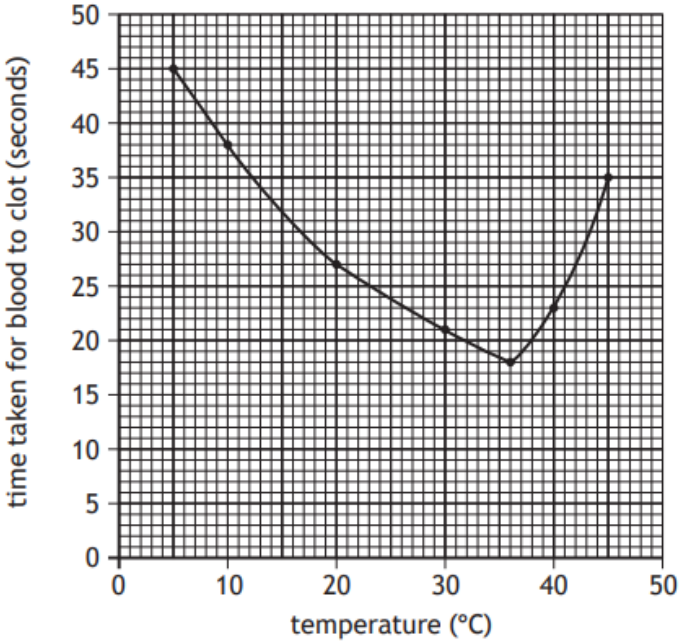
18 When a person cuts their finger, a blood clot forms at the wound. To form the clot, an enzyme converts a soluble protein into an insoluble protein.

(a) The soluble protein is the substrate for the enzyme.

Name the part of the enzyme that binds to its substrate.

_____

(b) The graph shows the time taken for the enzyme to clot samples of blood at different temperatures.



(i) Identify the optimum temperature for this enzyme.

_____ °C

(ii) An enzyme can be completely denatured at very high temperatures, meaning that it can no longer catalyse its reaction.

Describe what has happened to the enzyme **and** explain why the reaction no longer occurs. **2**

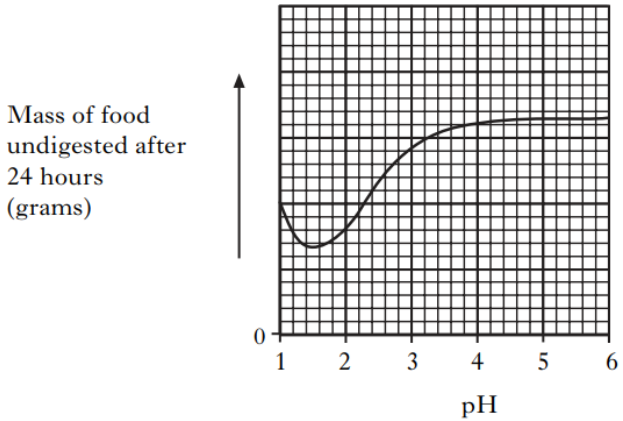
_____

_____

_____

_____

19 The graph below shows the results of an experiment into the activity of a stomach enzyme at various pH levels.

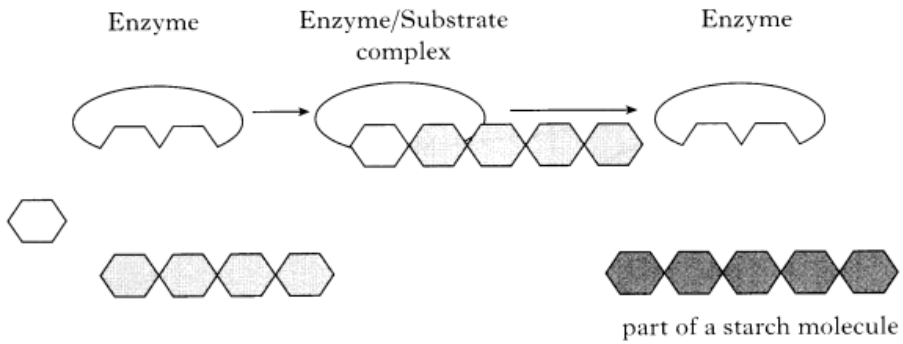


1 From the graph, what is the optimum pH of this enzyme?

pH _____ **1**

Enzymes

20 (*a*) Enzymes are involved in synthesis or degradation chemical reactions. The diagram below represents an example of one of these types of reactions.



(i) Name the type of chemical reaction and the enzyme shown in the diagram.

Type of chemical reaction _____

The enzyme _____

(ii) Place an X on the diagram to show the position of an active site. **1**

(*b*) What type of molecule are all enzymes made of?

_____ **1**

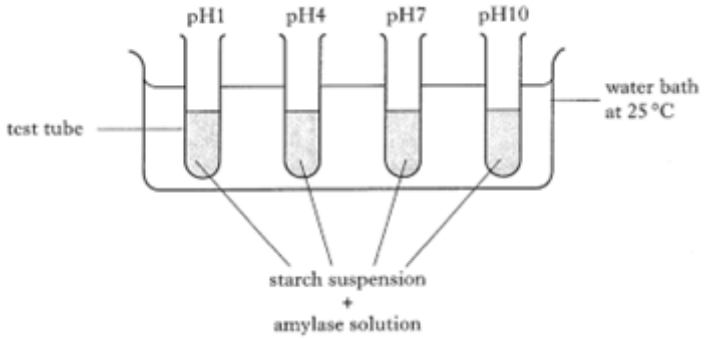
(*c*) What happens to the active site when an enzyme is denatured?

_____ **1**

21 Name the enzyme which catalyses the synthesis of starch in potato cells.

_____ **1**

22 An experiment was set up to investigate the effect of pH of the action of an enzyme amylase that break down starch into simple sugars.



After 30 minutes, a sample from each test tube was tested for the presence of simple sugars using Benedict's solution which turns brick red when sugar is present.

a) Predict the results if the enzyme had been boiled before use. Give an explanation for your answer.

Prediction _____

Explanation _____

_____ **2**

b) Name **one** factor, other than pH, which can affect the activity of an enzyme.

_____ **1**

Enzymes

23 Catalase, an enzyme found in living tissues, is involved in the breakdown of hydrogen peroxide into water and oxygen.

In an investigation, catalase was extracted in solution from a variety of tissues and used to soak paper discs. These discs were then dropped into beakers of hydrogen peroxide, as shown in Diagram 1. As the oxygen was released the discs returned to the surface, as shown in Diagram 2.

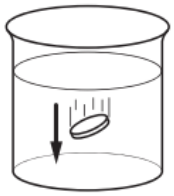


Diagram 1

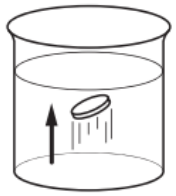


Diagram 2

The time taken for these discs to return to the surface was recorded and shown in the table.

Type of tissue	*Time for disc to return to the surface* (s)
Apple	108
Banana	44
Carrot	68
Liver	8
Onion	70
Potato	72

The experiment was carried out at pH 7, the optimum pH for catalase.

Complete the following sentence, using the words **increase, decrease** or **stay the same**, to predict what would happen if the experiment was repeated at pH 4. **1**

At pH 4, the rate of oxygen production would _____

in each tissue.

MARKS

24 (a) Hydrogen peroxide can damage cells and lead to cell death. Catalase is an enzyme which breaks down hydrogen peroxide into oxygen and water.

Scientists in New Zealand investigated the link between the level of catalase in sheep livers and the fat in their meat. The hypothesis was that the higher the level of liver catalase, the greater the fat content of the meat.

In the investigation, they examined 9 sheep with a high percentage of fat and 15 sheep with a low percentage of fat. The sheep with the high percentage of fat had an average catalase level of 4800 K/g and those with the lower percentage of fat had an average catalase level of 3600 K/g.

The scientists concluded that their hypothesis was correct.

Name the substrate of catalase. **1**

_____

(b) The optimum temperature for the activity of catalase is 37°C.

Predict what would happen to the activity of catalase if the temperature was lowered to 34°C. **1**

_____

Mark

25 (*a*) Enzymes are described as "biological catalysts".

What is the meaning of the term "catalyst"?

_____

_____ **1**

(*b*) Name the substance from which enzymes are made.

_____ **1**

(*c*) Name an enzyme involved in a synthesis reaction.

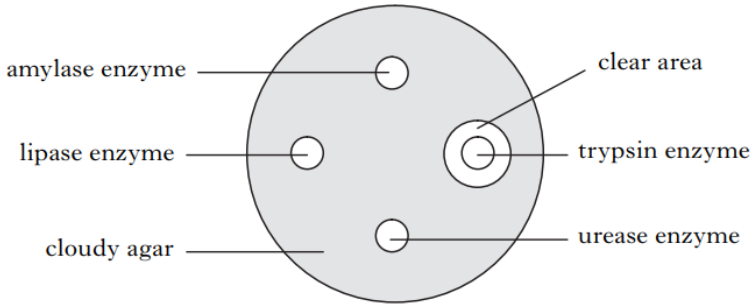
_____ **1**

Enzymes

26 An investigation was carried out into digestion of a protein.

The protein was mixed with agar gel in a petri dish. Four holes were cut in the gel and a different enzyme was placed in each hole. The dish was left for two days. Where digestion of the protein had taken place, a clear area developed in the gel around the hole. The diameter of the clear area was measured. The experiment was carried out four times.

The diagram below represents the appearance of one of the petri dishes after two days.



Explain why trypsin digested the protein but no other enzyme did.

_____

_____ 1

27 Catalase will only work on one substrate.

What word is used to describe this feature of an enzyme?

_____

28 The trout eggs would not hatch if it were not for the presence of enzymes to act as catalysts.

Explain the meaning of the term "catalyst".

_____

_____ 1

29 The diagrams represent stages in an enzyme-controlled reaction.

(a) Enzymes are involved in two types of reaction.

Identify the type of reaction shown in the diagrams above. 1

_____

(b) Describe the events occurring in the enzyme reaction shown. 3

_____

_____

_____

_____

_____

_____ 1

_____

_____

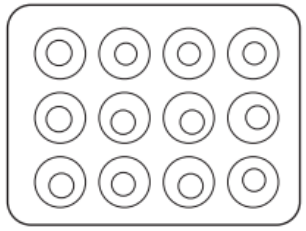
_____

_____

Enzymes

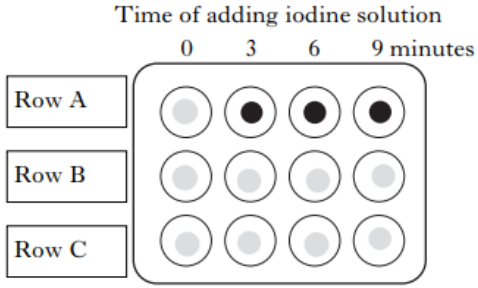
30 Phosphorylase is an enzyme extracted from potatoes. Drops of phosphorylase, glucose-1-phosphate and water were added to a dimple tile as shown.

Row A	phosphorylase + glucose-1-phosphate
Row B	phosphorylase + water
Row C	glucose-1-phosphate + water



A drop of iodine solution was added to one dimple in each row at three-minute intervals. If starch is present, a black colour forms.

The results are shown below.



(*a*) In which row has starch been synthesised?

Row _____ **1**

(*b*) The experiment was carried out at 25 °C. How would the results in Row A differ if the experiment had been carried out at a lower temperature?

_____

(*b*) Of what type of substance are enzymes made?

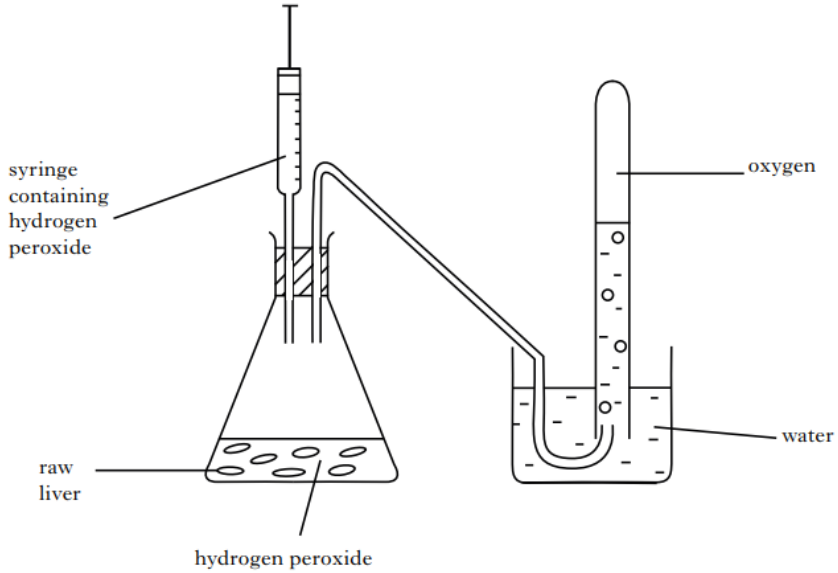
_____ **1**

31 Liver contains the enzyme catalase which carries out the following reaction.

hydrogen peroxide ⟶ water + oxygen

The investigation shown below was carried out to demonstrate the effect of pH on catalase activity in liver.

Hydrogen peroxide of different pH values was added to 1 g of roughly chopped raw liver.



The time taken to collect 1cm³ of oxygen was recorded and the results are shown in the table below.

pH of hydrogen peroxide solution	*Time to collect 1 cm³ of oxygen* (seconds)			*Average time to collect 1cm³ of oxygen* (seconds)
	Trial 1	*Trial 2*	*Trial 3*	
7	76	77	81	78
8	56	58	57	57
9	50	45	40	45
10	53	50	53	52
11	59	69	70	66

(*a*) From the table, state the optimum pH for catalase in liver.

_____ **1**

Enzymes

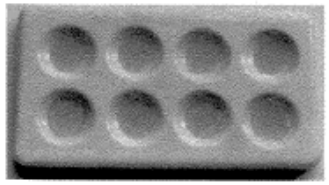
32 Potatoes store carbohydrate in the form of starch.
An enzyme found in potato cells converts glucose-1-phosphate into starch.

glucose-1-phosphate $\xrightarrow{\text{Enzyme}}$ starch

The following description outlines how an investigation into the time taken for the synthesis of starch to occur was carried out.

1 A starch-free potato extract was prepared.
This potato extract contained the enzyme.

2 Two rows of a spotting tile were set up as shown in the diagram.



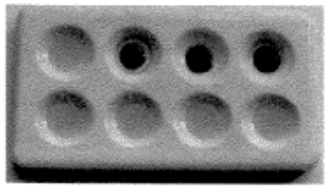
A glucose-1-phosphate + potato extract

B glucose-1-phosphate + water

3 A stop clock was started.

4 Iodine was added to each column at 5 minute intervals.
Iodine turns black when starch is present.

The results are shown below.



A

B

5 10 15 20

Time (minutes)

(*a*) Name the enzyme present in the potato extract.

_____ **1**

(*b*) Explain why all the starch was removed from the potato extract before it was used in the investigation.

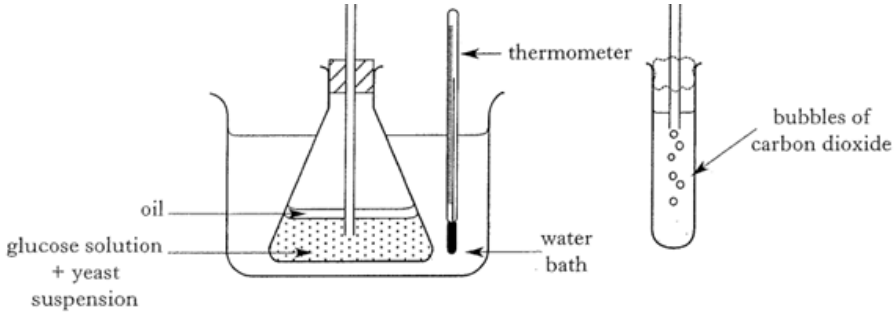
_____

_____ **1**

(*c*) What evidence is there to show that the enzyme is necessary for the synthesis of starch?

_____ **1**

33 An investigation was carried out into the effect of temperature on rate of fermentation in yeast.



Explain why no carbon dioxide is produced when the temperature is 70 °C.

_____

_____

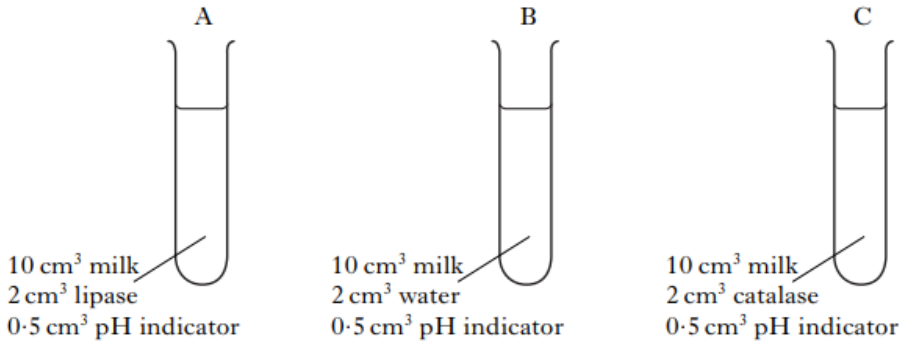
_____

_____ **2**

Enzymes

34 The activity of the enzymes lipase and catalase was investigated.

Three test tubes were set up.



The colour of the pH indicator was noted at the start and after 20 minutes.

The results are shown in the table below.

	Colour of pH indicator	
Test tube	*At start*	*After 20 minutes*
A	green	orange
B	green	green
C	green	green

In tube A, the pH indicator colour change was due to the production of fatty acids as the lipase reacted with the fat in the milk.

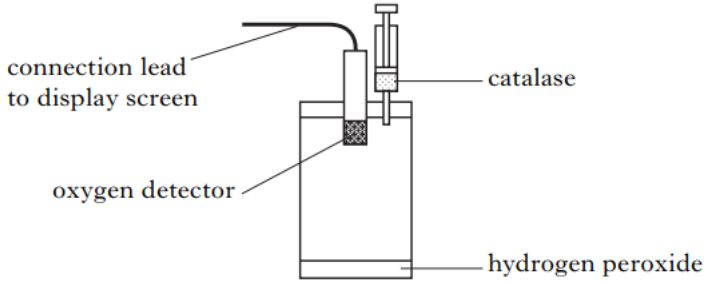
Explain why there was no change in tube C.

_____

_____

_____

35 The apparatus shown below was used to study the effect of different temperatures on the activity of the enzyme catalase.



The catalase was added and reacted with the hydrogen peroxide to release oxygen. The increase in oxygen compared to the starting value was recorded as a percentage.

This was carried out at five different temperatures and the results are shown below.

Temperature (°C)	*Increase in oxygen* (%)
4	0·55
21	0·80
34	1·45
40	1·05
50	0·05

a) At which temperature was the catalase most active?

_____ °C

b) Explain why there was no oxygen released when the experiments were repeated with different enzymes.

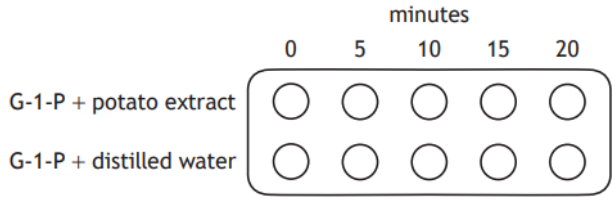
_____

_____

Enzymes

36. An experiment was set up to investigate the time taken for starch to be produced. All previously made starch was removed from the potato extract.

Two rows of a dimple tile were set up as shown in the diagram.



At 5-minute intervals the content of the dimples in each column was tested for the presence of starch.

The results are shown in the table.

	Starch present	
Time (minutes)	**G-1-P + potato extract**	**G-1-P + distilled water**
0	no	no
5	no	no
10	yes	no
15	yes	no
20	yes	no

a) Suggest a reason for any previously made starch being removed from the potato extract. **1**

_____

_____

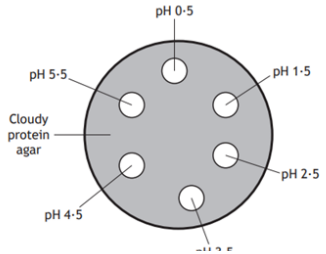
b) Explain how the results show that the enzyme is required for the reaction to occur. **1**

_____

_____

37 An investigation was carried out into the effect of pH on the activity of the enzyme pepsin.

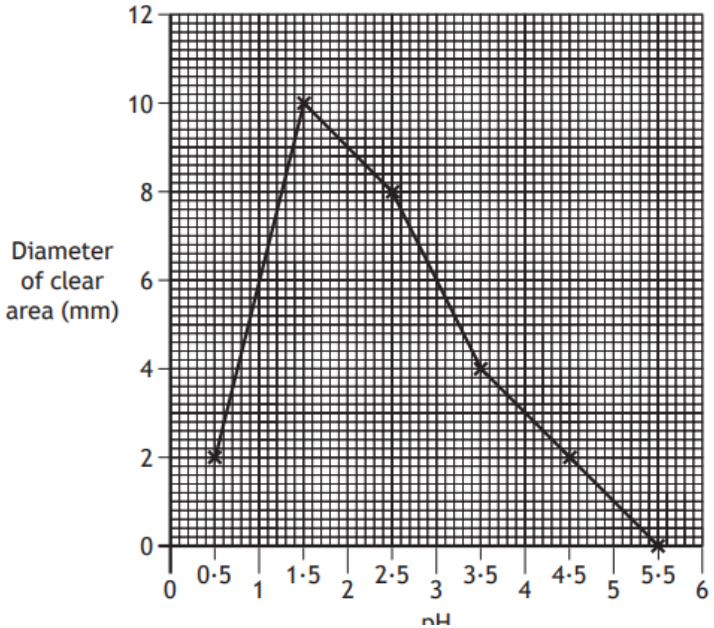
A Petri dish was filled with cloudy protein agar. Six holes were made in the agar and each was filled with pepsin solution at the pH values shown.



When the protein is broken down, cloudy agar becomes clear.

The dish was examined after 24 hours and the diameter of the clear area around each hole was measured. The larger the clear area, the more active the enzyme.

The results are shown in the graph.



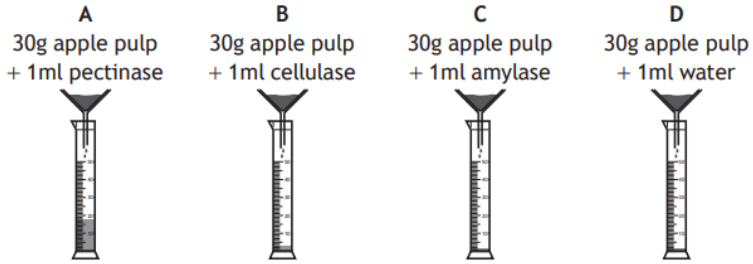
Identify the optimum pH for pepsin in this experiment. **1**

pH _____

Enzymes

38 Enzymes are used to help extract juice from fruit pulp.

The diagrams show a student's investigation into the effectiveness of different enzymes on the volume of juice produced.



After 30 minutes, the volume of apple juice collected was measured and the procedure was then repeated.

The average for each cylinder was calculated and the results are shown in the table.

Cylinder	Liquid added to apple pulp	Average volume of apple juice collected (ml)
A	pectinase	17·6
B	cellulase	3·2
C	amylase	1·8
D	water	1·6

(a) Name the enzyme which was the least effective at extracting juice from the apple pulp. **1**

_____

(b) Enzymes can be involved in two types of reaction. The extraction of juice from apple pulp is an example of a degradation reaction.

Name the other type of reaction. **1**

_____

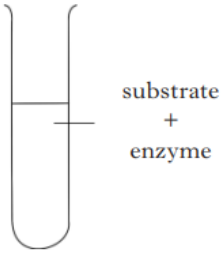
(c) All of the enzymes broke down at least some part of the apple pulp to produce apple juice.

What name is given to the substance that an enzyme breaks down? **1**

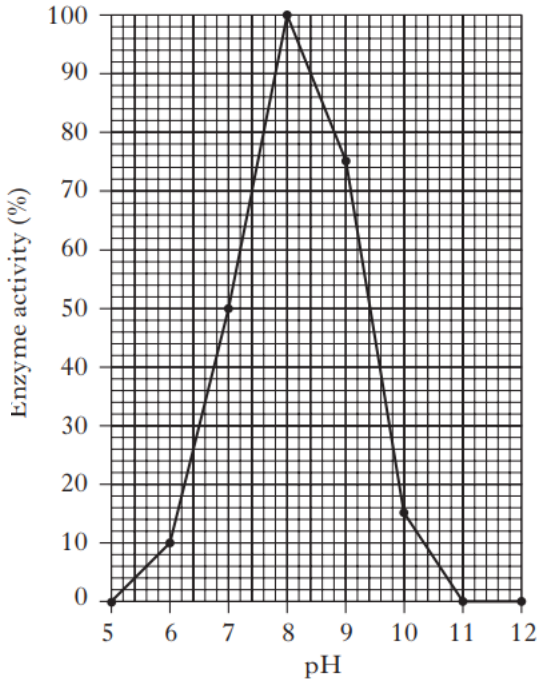
_____

39 An investigation was carried out to find the effect of pH on the activity of an enzyme.

Substrate at different pH values was added to the enzyme in different test tubes.



The results of this investigation are shown in the graph below.



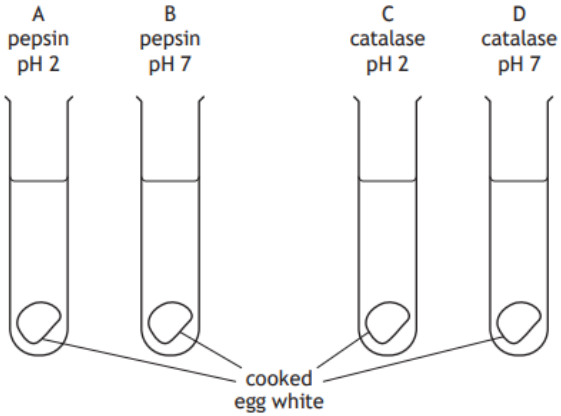
What is the optimum pH for this enzyme?

_____ **1**

Enzymes

40. An investigation was carried out into the breakdown of cooked egg white by enzymes.

2 g of cooked egg white was placed in each of four test tubes containing different enzyme solutions at different pH levels as shown.



The test tubes were placed in a water bath at 37 °C for 2 hours.

The cooked egg white was then removed and weighed.

The results are shown in the table.

Test tube	Mass after 2 hours (g)	Change in mass (g)	% change in mass
A	0.3		85.0
B	1.9	0.1	5.0
C	2.0	0	0
D	2.0	0	0

a) (i) Explain why the change in mass in test tube B was less than in test tube A. **1**

_____

_____

(ii) Explain why there was no change in mass in test tubes C and D. **1**

_____

_____

b) If the investigation was repeated at 70 °C, describe the change in the:

(i) structure of the active site of the enzymes **1**

_____

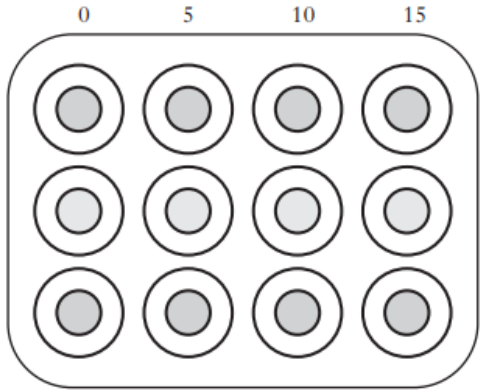
(ii) rate of the reaction in test tubes A and B. **1**

_____

41 The diagram below shows an investigation into the activity of the phosphorylase enzyme. *Mark*

A spotting tile was set up as shown below. Each column was then tested at the times shown.

Time (minutes)



(i) State whether phosphorylase is a synthesising or degrading enzyme.

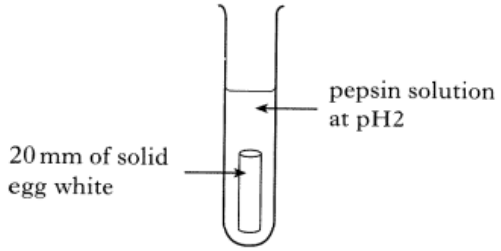
_____ **1**

(ii) Name the product produced in row A. **1**

_____

Enzymes

42 To investigate the effect of temperature on the activity of the enzyme pepsin, five test tubes were set up as shown below.



Each tube was placed in a water bath at a different temperature.
After 12 hours, the following results were obtained.

Test tube	*Temperature* (°C)	*Length of egg white after 12 hours* (mm)
A	5	19
B	20	17
C	35	13
D	45	15
E	60	20

(*a*) At which temperature did the greatest digestion of egg white take place?

_____ °C

1

b) Pepsin is found in the stomach which has a very acidic optimum pH. If the experiment had been repeated at pH 7, predict the most likely result for the length of egg white in test tube B above.

Tick the correct box.

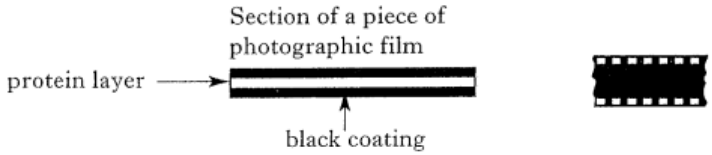
19 mm ☐ 17 mm ☐

15 mm ☐ 13 mm ☐

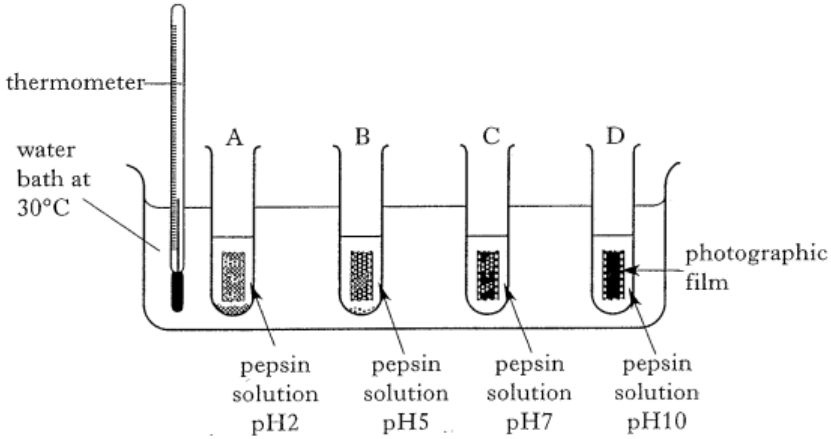
1

43. (*a*) Pepsin is an enzyme that breaks down protein.

Photographic film that has been exposed and developed has a black coating that is held on by a protein layer.



The diagram below shows the results of an investigation into the activity of the enzyme pepsin.



a) Name the variable investigated in this experiment.

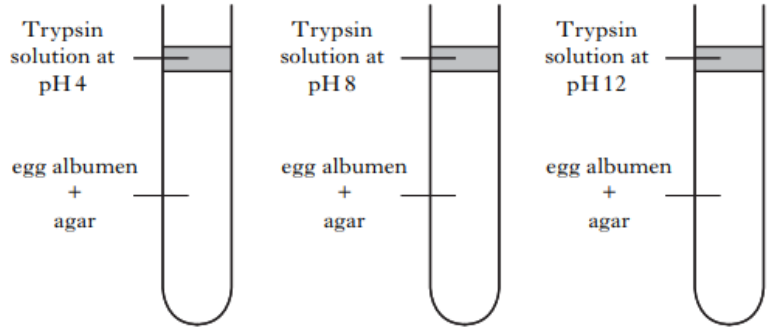
_____.

b) Name the substrate in the photographic film that pepsin breaks down.

_____

Enzymes

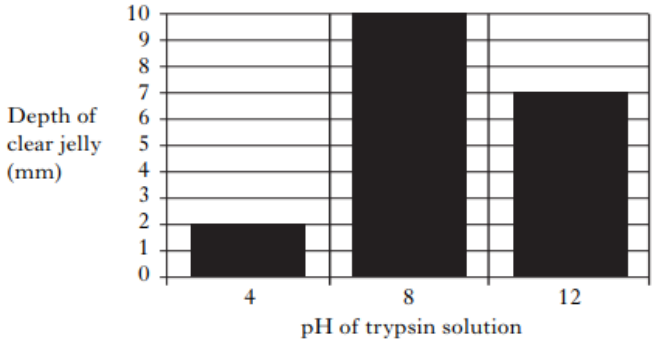
44. The diagram below shows an investigation into the effect of pH on the digestion of protein by trypsin.



Egg albumen is the source of protein. It is added to agar to give a cloudy, white jelly. When the egg albumen is digested the jelly turns clear.

The test tubes were left in a warm place for 24 hours. At the end of this time the depth of the clear jelly was measured.

The graph below shows results from this investigation.



a) State the optimum pH for the enzyme.

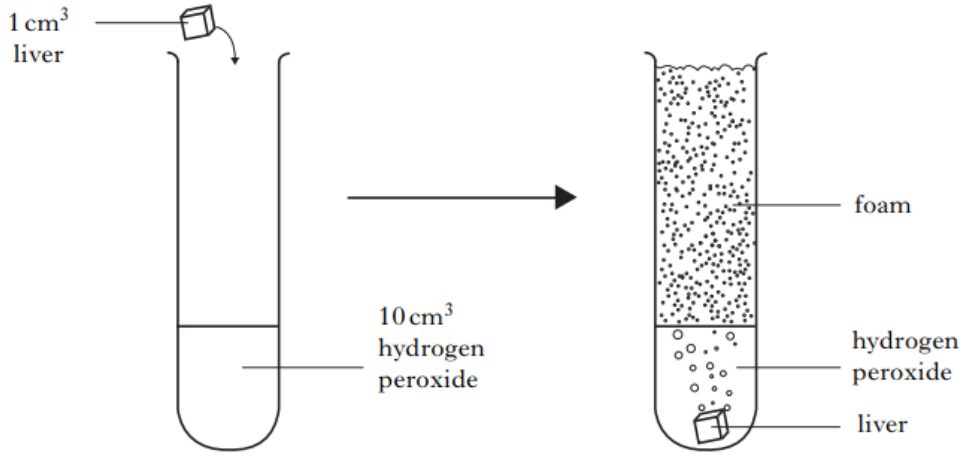
_____

B) Name the enzyme & substrate from the information above.

Enzyme _____

Trypsin _____

45. Liver contains the enzyme catalase. Catalase breaks hydrogen peroxide into oxygen and water as shown below.



a) (i) Name the gas in the foam.

_____ **1**

(ii) Which other product was formed during this reaction?

_____ **1**

(iii) How could the activity of catalase be measured in this experiment?

_____

_____ **1**

b) Explain why enzyme activity decreases at temperatures above the optimum.

_____

_____ **1**

Enzyme Marking Scheme

1 D

2 A

3 C

4. B

5. A

6. B

7. A

8. D

9. A

10. A

11. B

12. C

13. A

14. C

1. (i) Y Z X (ii) 3 b) protein c) active site changes shapes, lowering enzyme activity.

2. a) slow down/stop b) phosphorylase c) decrease decrease

3. Enzyme broke down starch into sugar.

4. (i) shape of the active site is complementary to only 1 substrate.

   (ii) conditions an enzyme has the highest activity/ is most active.

5 (i) 4 to 5 (ii) speeds up the reaction but not used up. (iii) protein

6 (i) Q R P (ii) shape of the active site is complementary to only 1 substrate

7 (i) synthesising (ii) glucose 1 phosphate

8 a) (i) 2.5 (ii) active site changes shape

9.

Statement	*True*	*False*	*Correction*
During denaturation, the substrate changes shape.		x	enzyme
Amylase is a synthesis enzyme.		x	degrading

10. a) Enzyme {slow down / speed up} the rate of chemical reactions.

The shape of an enzyme molecule is {complementary to / the same as} its substrate.

b) smaller substrate join together to make a larger product.

c) When the active site changes shapes, the enzyme activity is lowered.

11 a) shape of the active site is complementary to only 1 substrate.

b) enzyme is denatured OR active site changes shape.

c) pH

12 (i) synthesising (ii) increase

(iii) shape of the active site is complementary to only 1 substrate.

13. 0 units

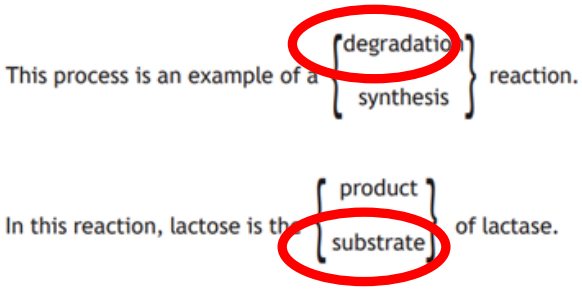
Enzyme denatured OR active site changes shape.

14 a) 37 b) (i) specificity (ii) active site

15. Enzymes are found in {*some* / *most* / *all*} cells and are made of {*protein* / *carbohydrate* / *fat*}.

Enzymes are {*substrates* / *reagents* / *catalysts*} and work best in {*hot* / *warm* / *cold*} conditions.

Enzymes

16.(i) 

(ii) milk contains lactose

Enzyme denatured

b) speed up reactions but not used up.

c) Proteins

17. (i) Conditions enzyme has the highest activity.

(ii) shape of the active site is complementary to only one substrate.

18 a) active site

b (i) 36 (ii) active site changes shape (1 mark)

No longer complementary to its substrate (1 mark)

19 1.5

20 A (i) synthesising phosphorylase b) protein c) changes shape

21 Phosphorylase

22 a) No sugar present in water

Enzyme denatured so can't break down starch to sugar.

b) pH

23. decrease

24. a) Hydrogen peroxide b) decrease

25. s) speeds up a reaction but not used up. B) protein c) phosphorylase

26. Shape of the active site is complementary to only one substrate.

27. Specific/specificity

28. Speeds up a reaction but not used up.

29. a) degrading

b)

1. substrate binds to enzyme's active site OR enzyme substrate oomplex forms

OR active site of enzyme is complementary to one substrate.

2. Enzyme has an active site OR reaction occurs at active site of enzyme

3. Product made/released

30 a) row A b) slower reaction/no reaction c) protein

31 9 (lowest time = fastest reaction)

32 a) phosphorylase b) To ensure only starch PRODUCED in experiment was measured.

C) In the row without the enzyme no starch is produced.

33. Enzymes are needed for fermentation (1 mark)

Enzymes are denatured at high temperatures.

34. Shape of the active site is complementary to only one substrate

35. a) 34 b) Shape of the active site is complementary to only one substrate.

36 a) To ensure only starch PRODUCED in experiment was measured.

b) Without the enzyme no starch is PRODUCED.

37 1.5

Enzymes

37 a) amylase b) synthesising c) substrate

39. 8

40 a (i) pepsin is more active at pH 2/less active at pH 7 OR pepsin's optimum pH is 2 in test tube A (ii) egg white is not the substrate for catalase

B (i) shape would change (ii) decrease/no reaction

41 (i) synthesising (ii) starch

42 a) 35 b)

19 mm [X]	17 mm [ ]
15 mm [ ]	13 mm [ ]

43 a)pH b) protein

44 a) 8 b) enzyme = trypsin substrate = egg albumin/protein (NOT clear jelly/agar)

45a (i) oxygen (ii) water b) height of foam/volume of foam/collecting oxygen in a syringe/upturned measuring cylinder

b) active site changes shape