EXAM PAPERS PRACTICE

Proteins and enzymes 2

Level: OCR A Level H420
Subject: Biology
Exam Board: Suitable for all boards
Topic: Proteins and enzymes 2
Type: Questionnaire

To be used by all students preparing for OCR A Level Biology H420 foundation or higher tier but also suitable for students of other boards.

1 Trypsin is a protease. It is produced in an inactive form inside some of the cells of the pancreas.

(a) Name the part of a pancreatic cell that produces the inactive form of trypsin.

_____

(1)

(b) Suggest the advantage of producing trypsin in an inactive form inside cells in the pancreas.

_____

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(2)

(c) After the inactive form of trypsin enters the small intestine, another enzyme removes a short chain of amino acids from the end of the inactive trypsin molecules. This leads to the formation of the active form of trypsin.

(i) Name the type of bond hydrolysed when the short chain of amino acids is removed.

_____

(1)

(ii) Sometimes trypsin can become activated inside a pancreatic cell. A competitive inhibitor in the cell then binds to the trypsin and stops it working.
Explain how the competitive inhibitor stops trypsin working.

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(3)

(Total 7 marks)

2 Haemoglobin is a protein. It is made of two alpha polypeptides and two beta polypeptides. Each alpha polypeptide has 141 amino acids and each beta polypeptide has 146 amino acids.

(a) What term is used to describe the structure of a protein made of two or more polypeptides?

_____

(1)

(b) Calculate the minimum number of DNA bases needed to code for the number of amino acids in one alpha polypeptide.

Answer = _____

(1)

(c) Describe the role of haemoglobin in supplying oxygen to the tissues of the body.

_____

_____

_____

_____

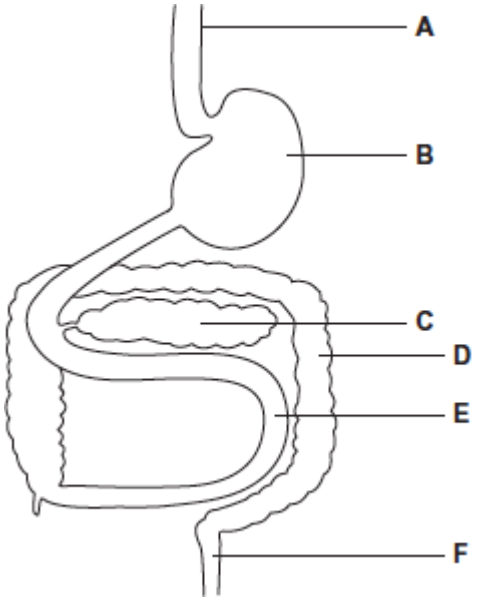
(2)

(ii) Explain the advantage to a person with anaemia of the change shown in the oxygen dissociation curve.

(3)

(Total 8 marks)

3 The diagram represents part of the human digestive system. The organs are labelled **A–F**.



(a) Give the letter of the organ that produces amylase.

(1)

(b) Give the letter of the organ that produces maltase.

(1)

(c) Maltose is hydrolysed by the enzyme maltase.

Explain why maltase catalyses only this reaction.

[Extra space]

(3)

(Total 5 marks)

4 Doctors investigated babies who were bottle-fed with baby-formula milk and suffered from colic. Colic is a condition that affects the gut and makes babies cry.

Each mother was given two solutions to add to her baby's milk. One solution contained the enzyme lactase, the other did not. The mother did not know which solution contained lactase. The mother added one of the solutions to her baby's milk for a week and recorded how long it cried each day. The mother then used the other solution for the second week.

The table shows the results.

	Mean crying time / hours day^{-1}
Milk with lactase	1.43
Milk without lactase	2.57

(a) Suggest an explanation for the results.

_____

_____

_____

_____

(2)

(b) The mothers were not told which solution contained lactase.

Suggest **one** reason why.

_____

_____

(1)

(c) Suggest **one** variable the doctors would have to control in this study to make it a fair test. Explain your answer.

Variable _____

Explanation _____

_____

_____

(2)

(d) The doctors concluded that adding lactase to milk was, '*A major breakthrough for babies with colic*.'

Evaluate the evidence for this conclusion.

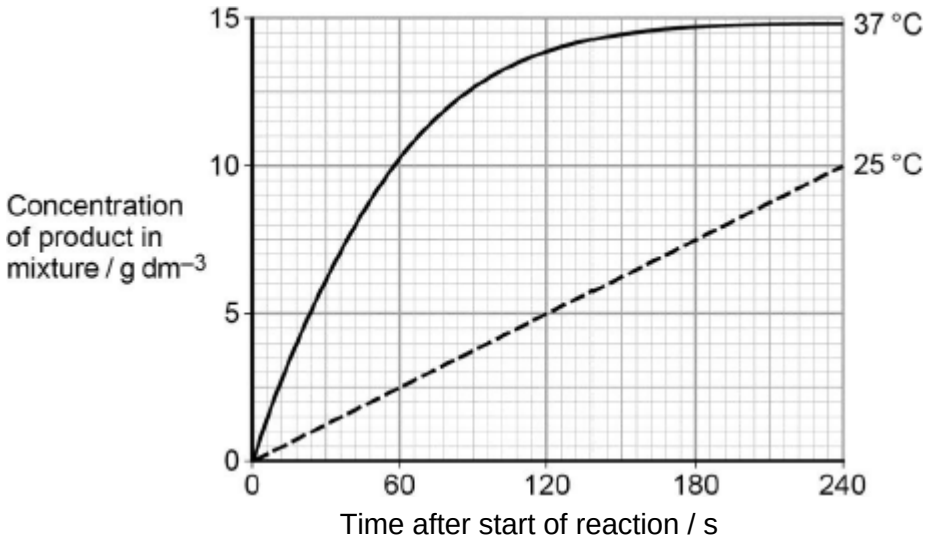
(Extra space)

(3)

(Total 8 marks)

5 A technician investigated the effect of temperature on the rate of an enzyme-controlled reaction. At each temperature, he started the reaction using the same volume of substrate solution and the same volume of enzyme solution.

The figure below shows his results.



(a) Give **one** other factor the technician would have controlled.

(1)

(b) Calculate the rate of reaction at 25 °C.

Answer _____

(2)

(c) Describe and explain the differences between the two curves.

_____

_____

_____

_____

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(Extra space) _____

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(5)

(Total 8 marks)

6 (a) Messenger RNA (mRNA) is used during translation to form polypeptides.
Describe how mRNA is produced in the nucleus of a cell.

(6)

(b) Describe the structure of proteins.

(5)

(c) Describe how proteins are digested in the human gut.

(4)

(Total 15 marks)

7 (a) In humans, the enzyme maltase breaks down maltose to glucose.
This takes place at normal body temperature.

Explain why maltase:

- only breaks down maltose
- allows this reaction to take place at normal body temperature.

(Extra space)

(5)

(b) Scientists have investigated the effects of competitive and non-competitive inhibitors of the enzyme maltase.

Describe competitive and non-competitive inhibition of an enzyme.

(Extra space) _____

(5)

(Total 10 marks)

8 (a) Describe the role of the enzymes of the digestive system in the complete breakdown of starch.

(5)

(b) Describe the processes involved in the absorption of the products of starch digestion.

(5)

(Total 10 marks)

9 Read the following passage.

Job's Tears is a cereal plant which grows in the tropics. An unusual protein has been found in its grains. This protein is unusual because it has two functions. It acts as both an enzyme inhibitor and as an enzyme. As an inhibitor, the protein reduces the activity of starch-digesting enzymes. The protein acts as an enzyme by breaking down chitin, a polysaccharide found in the walls of many fungi, to its monomers. Because of the resulting more negative water potential in the cytoplasm of the fungus, this effectively leads to "death by osmosis" of any fungus attacking the grain.

Our knowledge of the relationship between protein structure and function has led to the development of the new technology of protein engineering. This involves changing the amino acid sequence of a protein and altering its tertiary structure. Altering the tertiary structure changes the protein's properties. So far, we have been unable to produce a protein with more than one function such as that found in Job's Tears. We have had success, though, in making some enzymes more stable and less prone to heat denaturation. We have done this by substituting amino acids and allowing the formation of additional chemical bonds.

Use information from the passage and your own knowledge to answer the following questions.

(a) (i) The protein found in Job's Tears breaks down chitin (line 4). What type of chemical reaction is involved in breaking down chitin?

_____

(1)

(ii) Breakdown of chitin leads to "death by osmosis" of fungi attacking the grain (lines 6 - 7). Explain how.

_____

_____

_____

_____

(2)

(iii) This protein does not break down the cell walls of the Job's Tears plant. Explain why.

_____

_____

(1)

(b) Explain what is meant by the tertiary structure of a protein (line 10).

_____

_____

(1)

(c) (i) Explain how heating an enzyme leads to it being denatured.

(2)

(ii) How can protein engineering make enzymes more stable and less prone to heat denaturation (line 13)?

(2)

(d) Describe how the sequence of amino acids in part of the protein from Job's Tears could enable this protein to act as an enzyme inhibitor.

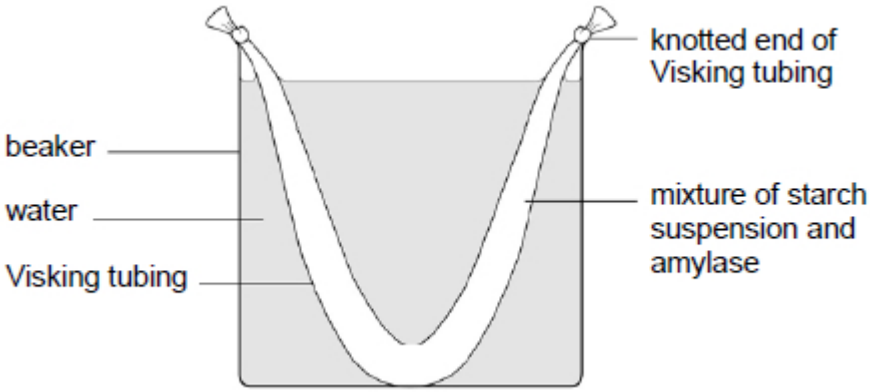
(6)

(Total 15 marks)

10 (a) Cells lining the ileum of mammals absorb the monosaccharide glucose by co-transport with sodium ions. Explain how.

(3)

A student set up the experiment shown in the diagram below.



The material from which Visking tubing is made is partially permeable.

After 15 minutes, the student removed samples from the liquid in the beaker and from the liquid inside the Visking tubing. She carried out biochemical tests on these samples. She drew the table below to record her results.

(b) Complete the table by placing a tick (✓) in each box that you expect to have shown a positive result.

Biochemical test	**Liquid from beaker**	**Liquid inside Visking tubing**
Biuret reagent		
Iodine in potassium iodide		
Benedict's solution		

(3)

(c) Justify your answers to part **(b)**.

(3)

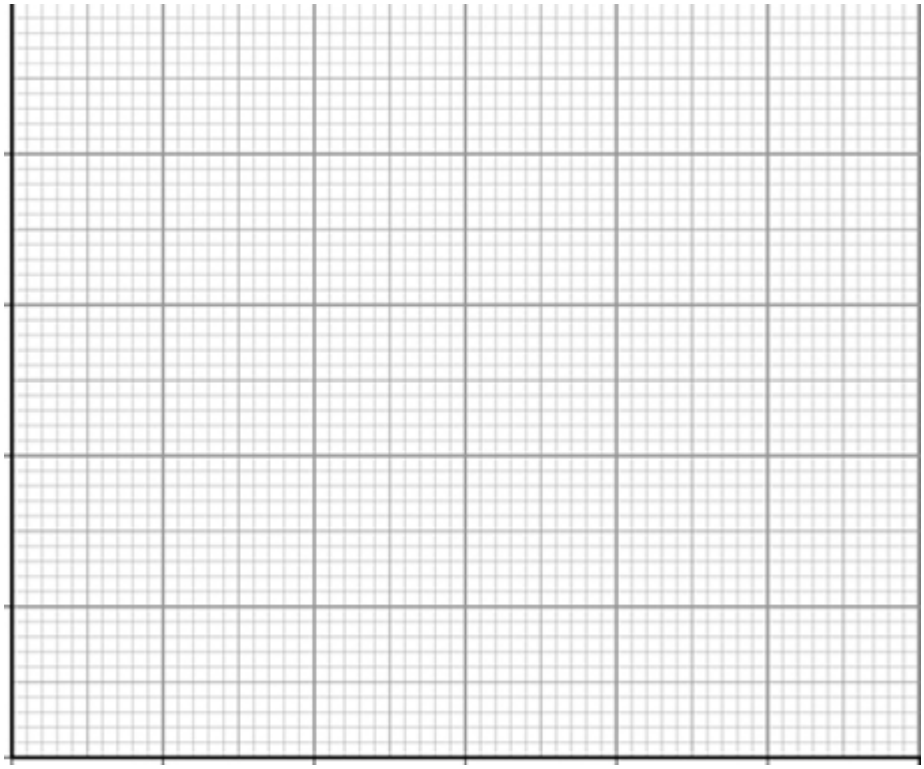
(Total 9 marks)

11 A biochemist isolated a protease from a bacterium. He investigated the effect of temperature on the rate of hydrolysis of a protein by this protease. He measured the mass of protein hydrolysed in **5 minutes** at each temperature.

The results are shown in the table below.

Temperature / °C	Mass of protein hydrolysed / g	Rate of hydrolysis / $\frac{\text{}}{\text{}}$
5	0.48	
10	1.11	
15	1.23	
20	1.05	
30	0.78	
45	0.12	

(a) Process the data in the table. Plot the processed data on the graph paper.



(4)

(b) A student concluded from a graph of the data in the table that the bacterium lives at 15 °C.

Does the data support the student's conclusion? Give reasons for your answer.

(4)

(c) Suggest **two** variables the biochemist controlled when investigating the effect of temperature on the rate of breakdown of a protein by the protease.

1. _____

2. _____

(1)

(Total 9 marks)

12 (a) Describe the induced-fit model of enzyme action.

_____

_____

_____

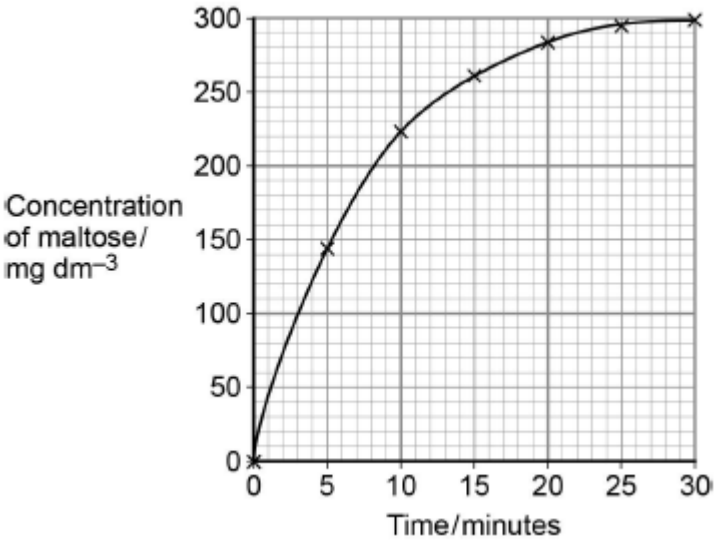
_____

_____

(2)

(b) A scientist investigated the hydrolysis of starch.
He added amylase to a suspension of starch and measured the concentration of maltose in the reaction mixture at regular intervals.

His results are shown in the graph below.



Determine the rate of the reaction **at** 10 minutes.
Show how you obtained your answer.

Rate of reaction _____ mg dm^{-3} min^{-1}

(2)

(c) Explain the results shown in the graph.

_____

_____

_____

_____

_____

(2)

(d) A quantitative Benedict's test produces a colour whose intensity depends on the concentration of reducing sugar in a solution. A colorimeter can be used to measure the intensity of this colour.

The scientist used quantitative Benedict's tests to produce a calibration curve of colorimeter reading against concentration of maltose.

Describe how the scientist would have produced the calibration curve and used it to obtain the results in the graph.

Do **not** include details of how to perform a Benedict's test in your answer.

(3)

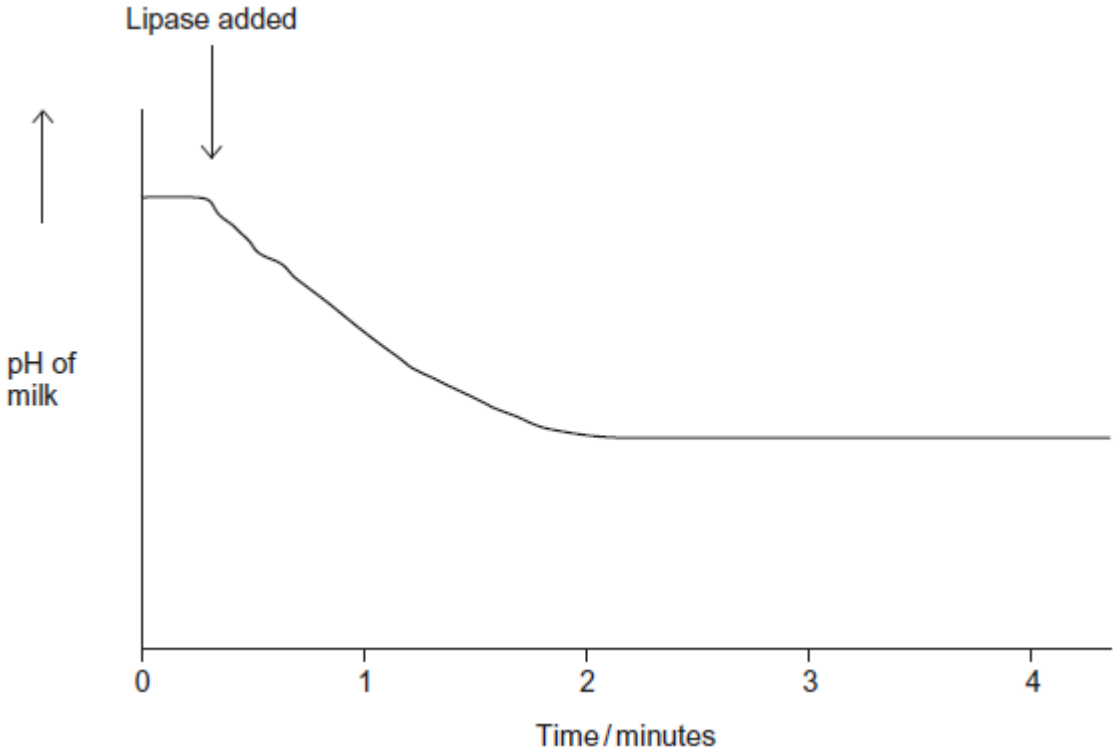
(Total 9 marks)

13 Lipase is an enzyme that hydrolyses triglycerides.

A student investigated the hydrolysis of triglycerides in milk by human lipase at 20 °C.

He recorded the pH of a sample of milk before and after adding lipase. He used a pH meter to record pH.

His results are shown in the graph.



(a) Suggest **one** advantage of using a pH meter rather than a pH indicator in this experiment.

_____

_____

_____

(1)

(b) Explain why the pH decreases when the lipase is added to the milk.

_____

_____

_____

(1)

(c) Suggest why the pH remained constant after 2 minutes.

_____

_____

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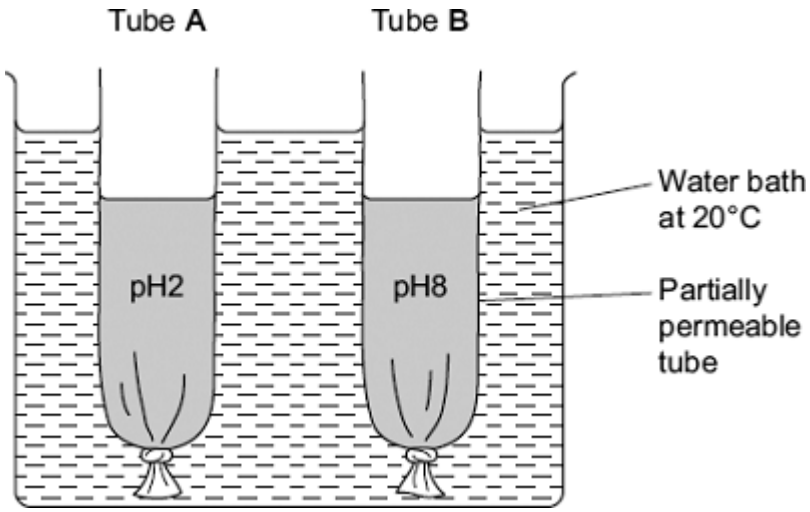
(2)

(d) The student carried out his experiment at 20 °C. He then repeated the experiment at 15 °C. Draw a line on the graph to show the results you would expect at 15 °C.

(2)

(Total 6 marks)

14 (a) A student investigated the effect of pH on the activity of the enzyme amylase.
She set up the apparatus shown in the diagram.



The tubes were made from Visking tubing. Visking tubing is partially permeable.
She added an equal volume of amylase solution and starch to each tube.

- She added a buffer solution at pH2 to tube **A**.
- She added an equal volume of buffer solution at pH8 to tube **B**.

After 30 minutes, she measured the height of the solutions in both tubes.
She then tested the solutions in tubes **A** and **B** for the presence of reducing sugars.

Describe how the student would show that reducing sugars were present in a solution.

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*(Extra space)*_____

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(3)

(b) After 30 minutes, the solution in tube **B** was higher than the solution in tube **A**.

(i) Explain why the solution in tube **B** was higher.

_____

_____

_____

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_____

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*(Extra space)*_____

_____

_____

(3)

(ii) The student concluded from her investigation that the optimum pH of amylase was pH8. Is this conclusion valid? Explain your answer

_____

_____

_____

(1)

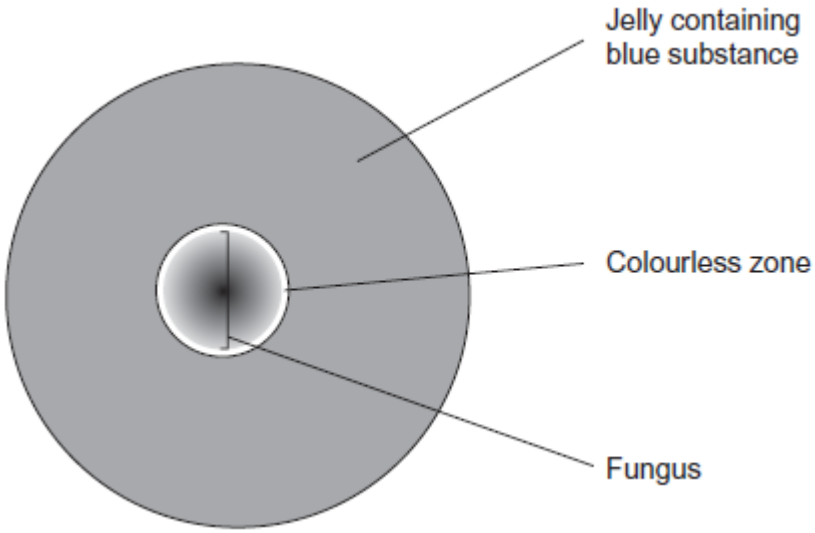
(Total 7 marks)

15 Catalase is used in a number of industrial processes. It is normally obtained from a fungus called *Aspergillus niger*. Scientists produced a mutant strain of *A*. *niger* called K30. They wanted to know if this mutant strain produced more catalase than the normal strain of *A*. *niger*.

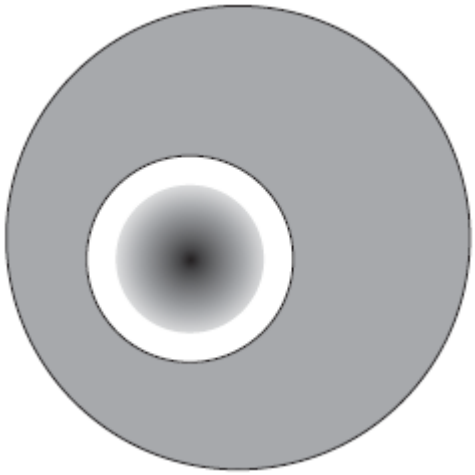
- The scientists grew samples of the normal strain of the fungus and of the K30 strain on jelly in separate Petri dishes. The jelly contained a blue substance which is turned colourless by catalase.
- They incubated the dishes for 3 days then measured the diameter of the colourless zone around the fungus.
- They calculated the ratio of the diameter of the colourless zone to the diameter of the fungus.

The diagram shows the dishes after incubation.

Normal strain



K30 strain



(a) The scientists grew both strains of fungi on dishes kept at 30 °C. Keeping the dishes at a temperature of 15 °C would affect the results. Use your knowledge of kinetic energy to explain why.

(2)

(b) (i) The scientists gave their results as ratios. Explain the advantage of giving the results of this investigation as a ratio.

_____

_____

_____

_____

_____

(2)

(ii) For the normal strain the ratio of the diameter of the colourless zone to the diameter of the fungus was 1.1 : 1.

Calculate the ratio of the diameter of the colourless zone to the diameter of the fungus for the K30 strain. Show your working.

Ratio = _____

(2)

(c) The catalase produced by the K30 strain of the fungus is mainly an extracellular enzyme. This means that the fungus secretes catalase from its cells into the jelly in the Petri dish.

Describe and explain the evidence from the investigation which shows that the catalase is an extracellular enzyme.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

16 Bromelain is a protein-digesting enzyme found in pineapples. Some people claim that bromelain tablets have benefitial effect on health. These effects include reducing swelling and pain after surgery and reducing growth of cancers.

Bromelain is absorbed from the gut into the blood. Scientists gave a group of volunteers 3 g of bromelain in tablets each day for three days. They then measured the maximum mass of bromelain in the blood of each volunteer. The mean value for the maximum mass of bromelain in the blood of the volunteers was 0.025 mg.

(a) There is a difference between the mass of bromelain that the volunteers were given and the maximum mass of bromelain in their blood. Suggest **one** explanation for this difference.

_____

_____

(1)

(b) The scientists measured the concentration of bromelain in the blood. What else did they need to measure to calculate the total mass of the bromelain in the blood of a volunteer?

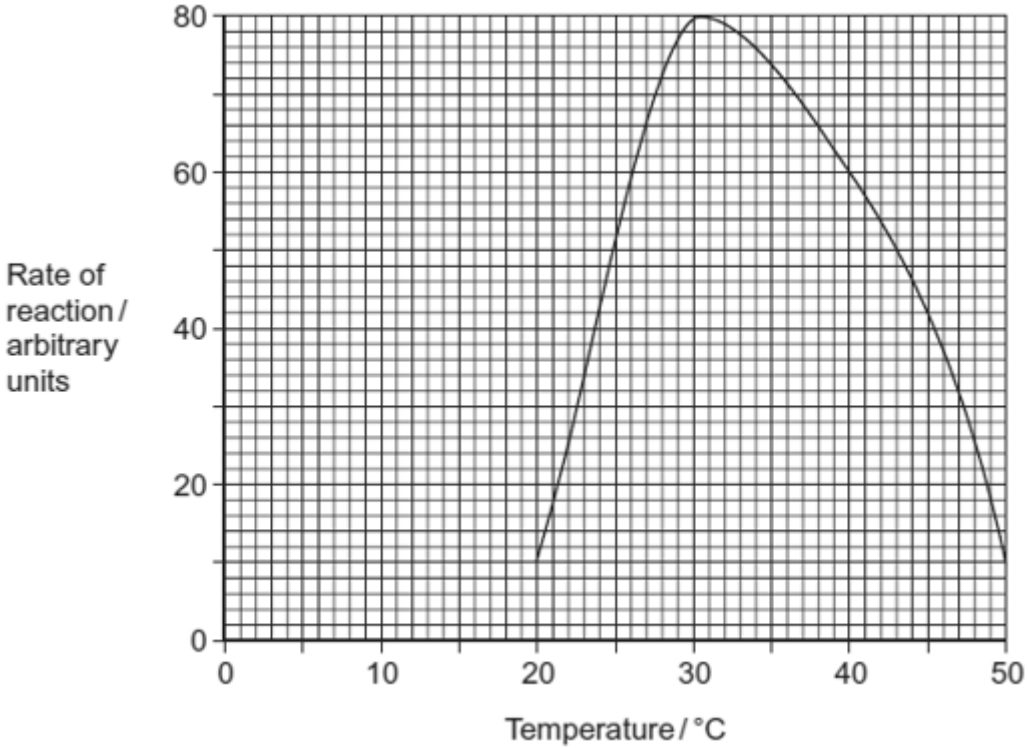
_____

_____

(1)

(Total 2 marks)

17 A protease is an enzyme that digests protein. The graph shows how the activity of a protease varies with temperature.



(a) (i) Describe what the graph shows about the effect of temperature on the rate of reaction.

_____

_____

_____

(1)

(ii) Explain the shape of the curve between 30 °C and 50 °C.

_____

_____

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_____

_____

_____

*(Extra space)*_____

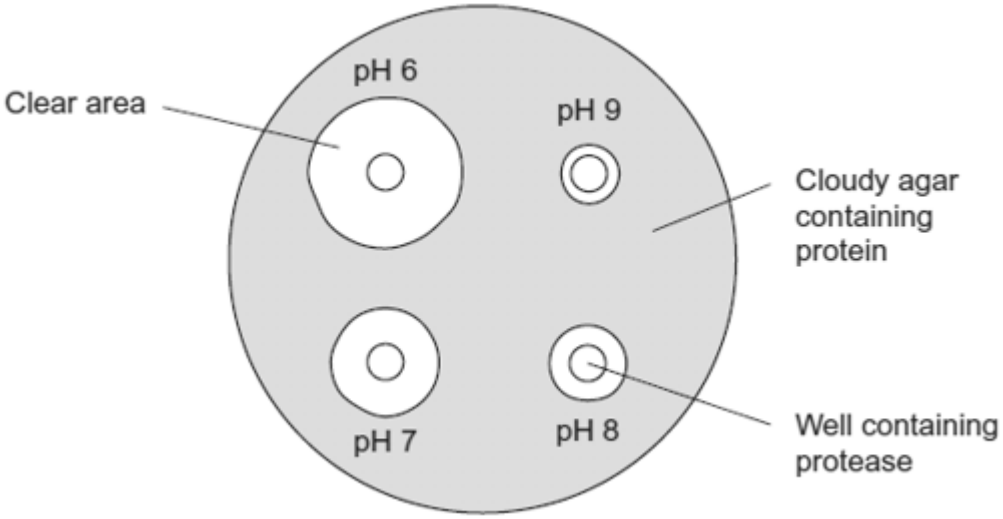
_____

(3)

(b) Students investigated the effect of pH on the activity of the protease.

- The students used agar plates containing protein. The protein made the agar cloudy.
- They made four wells of equal size in the agar of each plate.
- They added a drop of protease solution to each of the wells. The protease solution in each well was at a different pH.
- The students incubated the agar plates for 4 hours at a constant temperature.

The diagram shows the agar plates after they were incubated and the pH of the protease solution in each well.



(i) How should the students make sure that the pH of the protease solution did **not** change?

_____

(1)

(ii) Use the graph to suggest a suitable temperature for incubating the agar plates.

Explain your answer.

_____

_____

_____

(1)

(iii) Use the diagram to describe the effect of pH on the activity of this protease.

_____

_____

_____

(1)

(Total 7 marks)

18 Catalase is an enzyme. It catalyses the breakdown of hydrogen peroxide in the reaction:

$$\underset{\text{hydrogen peroxide}}{2H_2O_2} \rightarrow \underset{\text{water}}{2H_2O} + \underset{\text{oxygen}}{O_2}$$

In an investigation, samples of different substances were added to hydrogen peroxide in a series of test tubes. The rate of reaction was measured by recording the rate at which bubbles of oxygen were produced. A scale going from 0 for no bubbles to 5 for the maximum rate of bubbling was used to measure this. The results are shown in the table.

Tube	Substance added	Rate at which bubbles of oxygen were produced
A	Piece of liver	4
B	Ground liver and sand	5
C	Sand	0
D	Piece of cooled, boiled liver	0

(a) Explain the difference between the rate at which bubbles were produced in.

(i) tubes **A** and **B**;

_____

_____

_____

_____

(2)

(ii) tubes **A** and **D**.

_____

_____

_____

_____

_____

_____

(3)

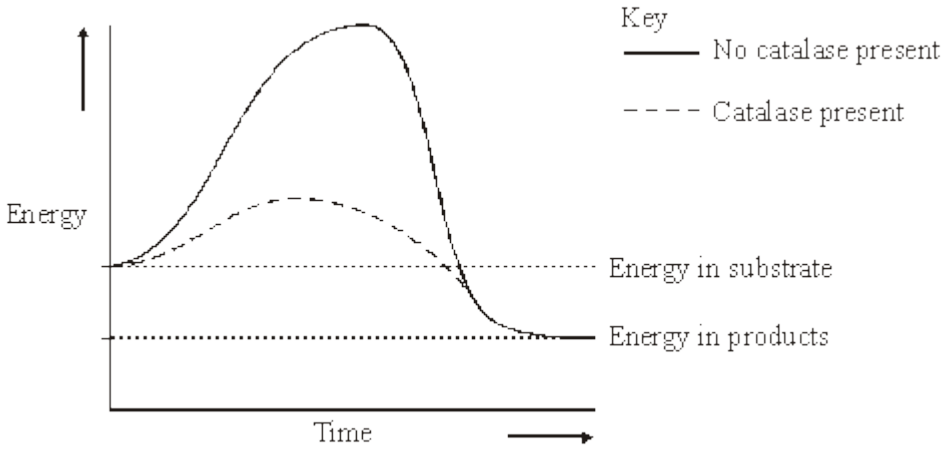
(b) Explain the purpose of tube **C**.

_____

_____

(1)

(c) The graph shows the energy changes which take place during the reaction in which hydrogen peroxide is converted to water and oxygen.



Use the graph to explain why

(i) hydrogen peroxide breaks down at a lower temperature when catalase is present than when it is not present;

_____

_____

(1)

(ii) test tubes **A** and **B** became warmer when the reaction was taking place.

_____

_____

_____

_____

(2)

(Total 9 marks)

19 (a) Starch and protein are biologically important polymers.

(i) Explain what is meant by a polymer.

_____

_____

(1)

(ii) Give **one** example of a biologically important polymer other than starch or protein.

_____

(1)

(b) In an investigation, the enzyme amylase was mixed in a test tube with a buffer solution and a suspension of starch. The amylase broke down the starch to maltose. When all the starch had been broken down, a sample was removed from the test tube and tested with biuret reagent.

(i) Explain why a buffer solution was added to the amylase-starch mixture.

_____

_____

_____

(2)

(ii) What colour would you expect the sample to go when tested with biuret reagent?

_____

(1)

(iii) Give an explanation for your answer to part (ii)

_____

_____

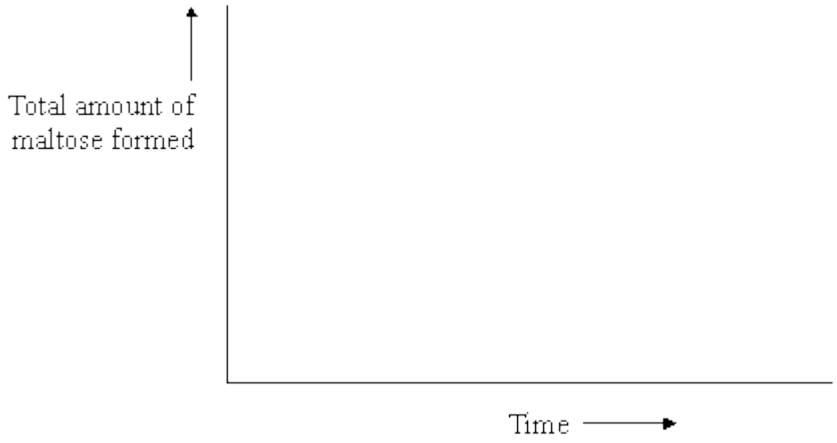
_____

(2)

(Total 7 marks)

20 (a) Amylase is an enzyme which hydrolyses starch to maltose. Some amylase and starch were mixed and the mixture incubated at 37 °C until the reaction was complete.

(i) Sketch a curve on the axes below to show the progress of this reaction.



(1)

(ii) Explain why the rate of the reaction decreases as the reaction progresses.

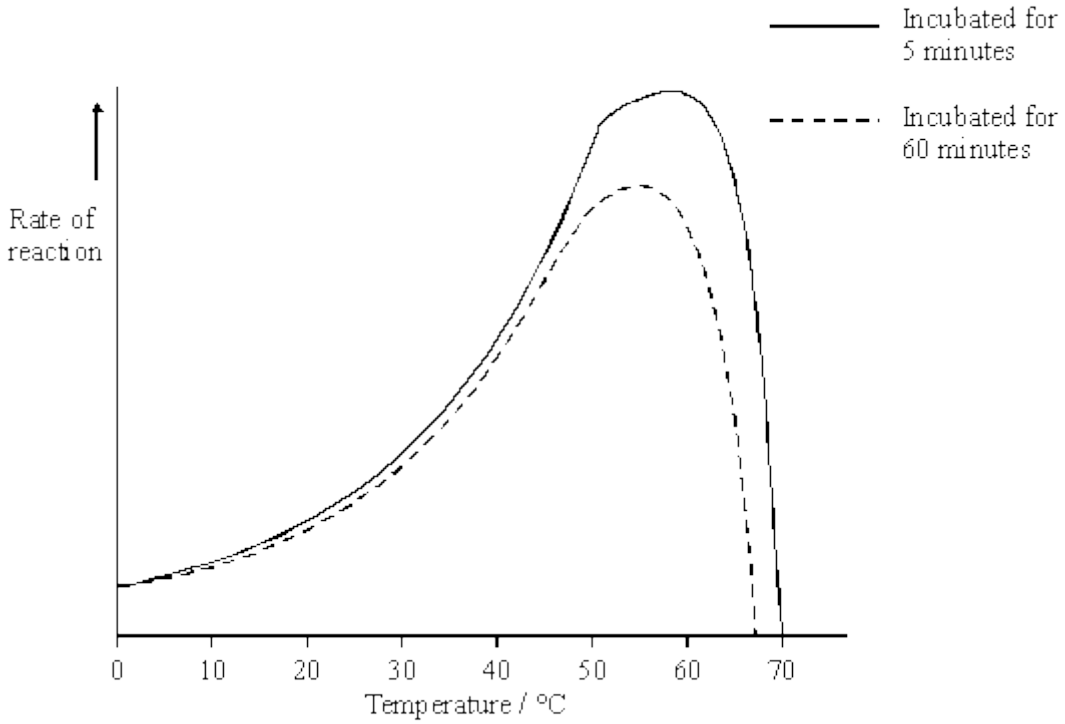
_____

_____

_____

(2)

The effect of temperature on the rate of reaction of an enzyme was investigated. A test tube containing the enzyme and a test tube containing the substrate were incubated separately at each of the temperatures being investigated. After 5 minutes, they were mixed and the rate of reaction was determined. The experiment was repeated but, this time, the enzyme and the substrate were left for 60 minutes before they were mixed. The results of the investigation are shown in the graph.



(b) The enzyme solution used in this investigation was made by dissolving a known mass of enzyme in a buffer solution. Explain why a buffer solution was used.

_____

_____

(1)

(c) (i) Use the graph to describe how incubation time affects the rate of the reaction.

(2)

(ii) The maximum rate of reaction with an incubation time of 60 minutes is less than the maximum rate of reaction with an incubation time of 5 minutes. Explain why.

(3)

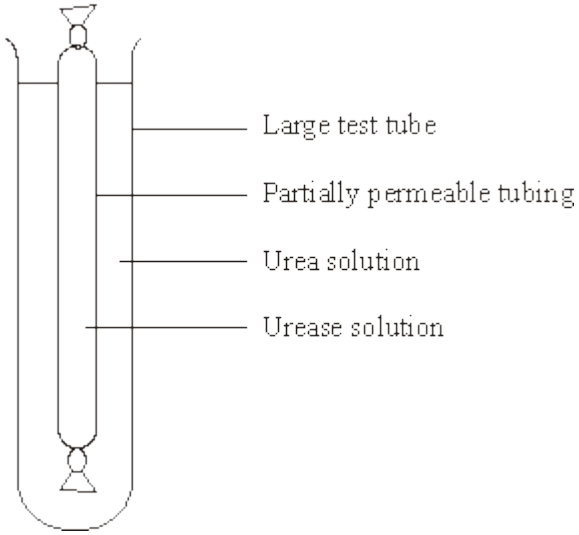
(d) Explain how inhibitors affect the rate of enzyme-controlled reactions.

(6)

(Total 15 marks)

21 **S** Urease is an enzyme which hydrolyses urea to ammonia and carbon dioxide. The ammonia produces an alkaline solution.

In an experiment, a solution of urease was placed in tubing made from a partially permeable membrane. This tubing was put into a large test tube containing urea solution, as shown in the diagram. A control was set up with urease solution in the tubing and water outside.



After 5 minutes, samples were taken from inside and outside the tubing in each of the test tubes. The samples were tested with an indicator that is yellow below pH 8.0 and blue above pH 8.0. The results are shown in the table.

Tube	Contents		Colour with indicator after 5 minutes	
	Inside tubing	**Outside tubing**	**Inside tubing**	**Outside tubing**
A	Urease solution	Urea solution	Blue	Yellow
B	Urease solution	Water	Yellow	Yellow

(a) Explain the result for tube **A**.

(3)

(b) The solutions inside and outside the tubing in tube **B** were tested after 30 minutes for the presence of protein.

(i) Describe how the presence of protein in a sample of a solution could be detected.

(2)

(ii) What results of the tests for protein would you expect for tube **B**? In each case explain your answer.

Inside the tubing

Outside the tubing

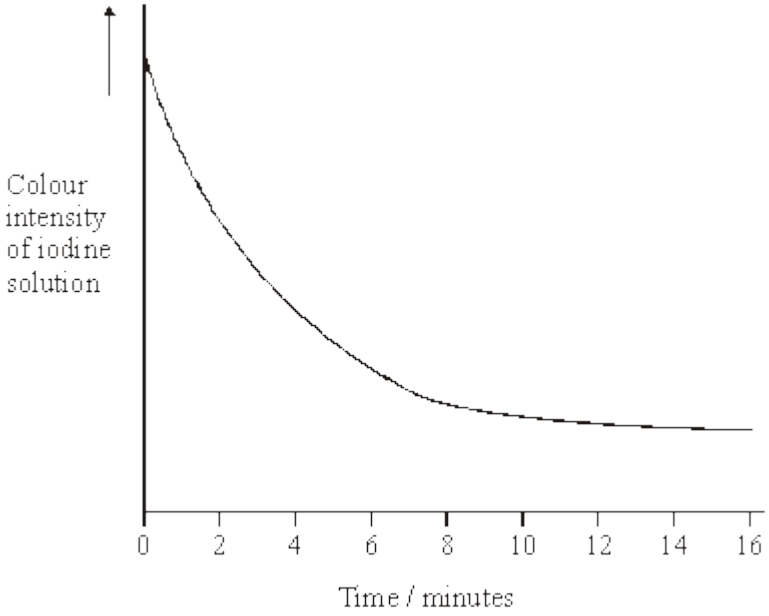
(2)

(c) Describe how you would carry out an investigation to find the optimum temperature for the activity of urease.

(3)

(Total 10 marks)

22 In an investigation into carbohydrase activity, the contents from part of the gut of a small animal were collected. The contents were added to starch solution at pH 7 and kept in a water bath at 25°C. At one-minute intervals, samples were removed and added to different test tubes containing dilute iodine solution. The colour intensity of each sample was determined. The graph shows the results.



(a) Explain the change in colour intensity.

_____

_____

_____

_____

(2)

(b) Draw clearly labelled curves on the graph to show the expected result if the experiment was repeated

(i) at 35 °C;

(ii) at pH 2.

(2)

(c) Explain how

(i) raising the temperature to 35 °C affects carbohydrase activity;

(ii) decreasing the pH affects carbohydrase activity.

(7)

(Total 11 marks)

23 Lactose is a disaccharide sugar which can be broken down by the enzyme lactase into two monosaccharides, glucose and galactose.

$$\text{lactose + water} \xrightarrow{\text{lactase}} \text{glucose + galactose}$$

(a) The formula for galactose is $C_6H_{12}O_6$. What is the formula for lactose?

(2)

(b) A solution containing the enzyme lactase was added to a lactose solution. The solution was incubated at 40 °C for one hour. Sample **A** was removed from the tube before incubation. Sample **B** was removed after one hour.

(i) Describe a chemical test you could carry out on sample **A** to show that lactose is a reducing sugar.

_____

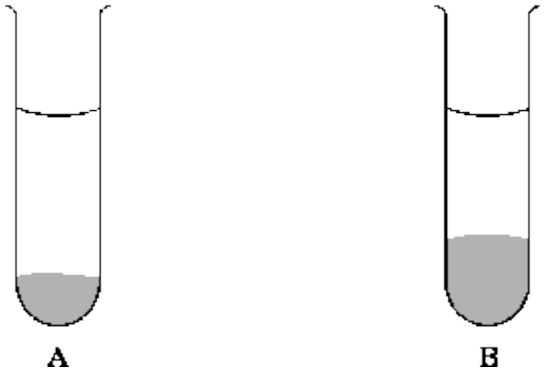
_____

_____

_____

(2)

(ii) This chemical test was carried out on samples **A** and **B**. All experimental variables were the same in the testing of the two samples. Both tubes were left for ten minutes to allow the precipitate to settle. The diagram shows the result.



Is galactose a reducing sugar? _____

Explain how the results in the diagram support your answer.

_____

_____

_____

_____

(2)

(Total 6 marks)

24 Antimicrobial proteins (AMPs), found in the skin of the African clawed frog, can kill bacteria. When AMPs are injected into humans, they are broken down by protease enzymes. Scientists have produced a number of AMPs that are not broken down by proteases. They did this by making these AMPs from man-made amino acids containing fluorine. The AMPs containing fluorine were found to be more effective in killing bacteria than AMPs without fluorine.

(a) Name the type of reaction involved when a protease enzyme breaks down an AMP.

_____

(1)

(b) Suggest why protease enzymes cannot break down AMPs made from amino acids containing fluorine.

_____

_____

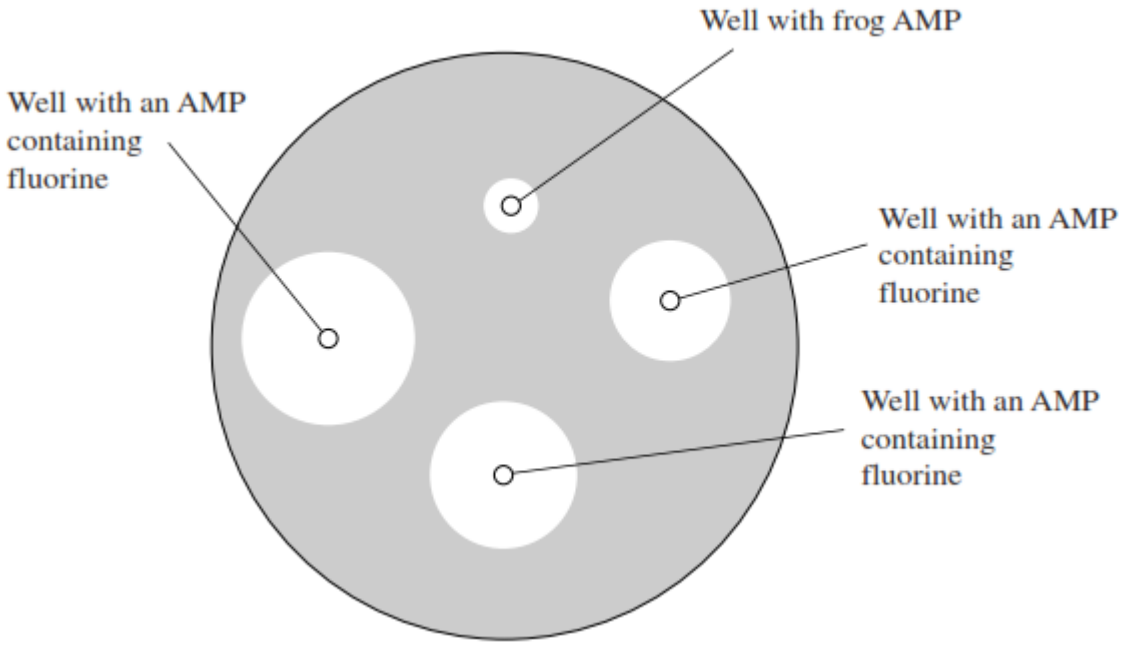
_____

_____

(2)

(c) Scientists carried out an investigation to compare the effectiveness of AMPs containing fluorine and a frog AMP. They inoculated an agar plate with a culture of one species of bacterium. They cut four wells in the agar. They placed a frog AMP in one well. They put three different man-made AMPs containing fluorine in the other three wells. They incubated the plate for 48 hours. After incubation, there were clear areas around each well where the bacteria had not grown.

The appearance of the plate after incubation is shown below.



(i) Give **one** example of aseptic technique that the scientists would have used during this investigation.

_____

_____

(1)

(ii) What conclusions could the scientists draw from these results?

_____

_____

_____

_____

_____

_____

(Extra space) _____

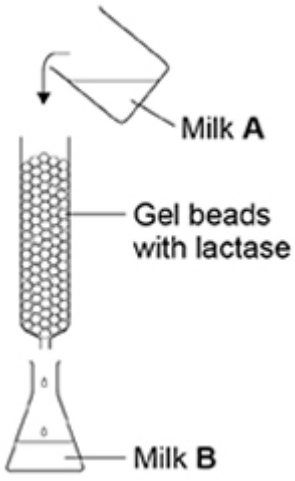
_____

_____

(3)

(Total 7 marks)

25 Many humans are unable to digest lactose. A scientist investigated the production of lactose-free milk. He produced gel beads containing the enzyme lactase and placed the beads in a column. He poured milk (Milk **A**) into the column and collected the milk (Milk **B**) after it had moved through the column over the beads. This is shown in the diagram below.



(a) Milk **A** contains no glucose. Milk **B** contains glucose. Explain why Milk **B** contains glucose.

_____

_____

_____

(1)

(b) The enzyme was trapped within the gel beads. Suggest **one** advantage of trapping the enzyme within the gel beads.

_____

_____

_____

(1)

The scientist varied the flow rate of the milk through the column. The effect of flow rate on the concentration of glucose in Milk **B** is shown in the table below.

Flow rate of milk through the column / cm^3 $minute^{-1}$	**Concentration of glucose in Milk B / arbitrary units**
50	45
100	6

(c) Explain the difference in the results in the table.

_____

_____

_____

(1)

(d) The gel beads were all similar sizes. Use the formula below to calculate the volume of one of the beads with a 3.0 mm diameter.

Volume of sphere = $\frac{4}{3}\pi r^3$

Volume = _____ mm^3

(1)

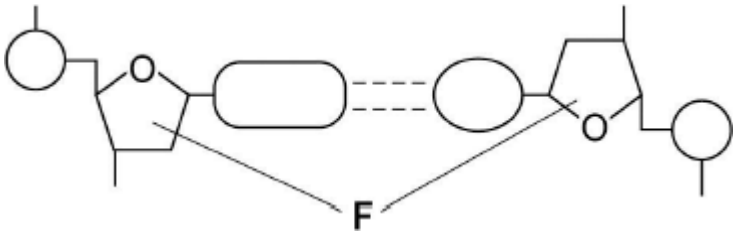
(e) Galactose has a similar structure to part of the lactose molecule.
Explain how galactose inhibits lactase.

(2)

(Total 6 marks)

26 **Figure 1** shows one base pair of a DNA molecule.

Figure 1



(a) Name part **F** of each nucleotide.

(1)

(b) Scientists determined that a sample of DNA contained 18% adenine.

What were the percentages of thymine and guanine in this sample of DNA?

Percentage of thymine ☐

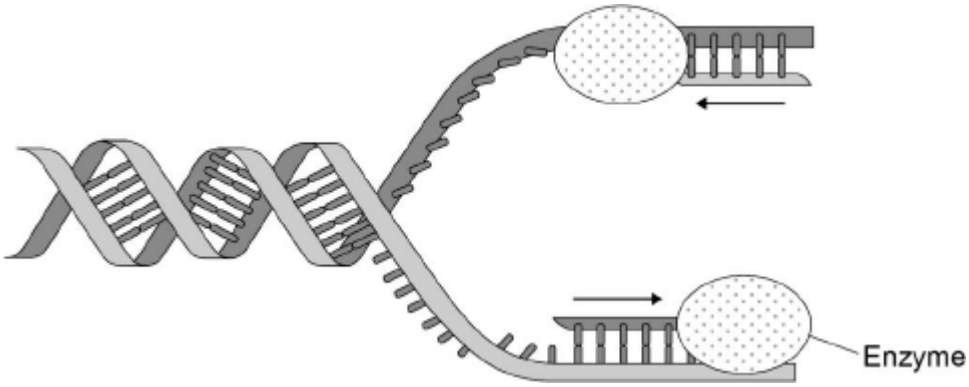
Percentage of guanine ☐

(2)

During replication, the two strands of a DNA molecule separate and each acts as a template for the production of a new strand.

Figure 2 represents DNA replication.

Figure 2



(c) Name the enzyme shown in **Figure 2**.

_____

(1)

The arrows in **Figure 2** show the directions in which each new DNA strand is being produced.

(d) Use **Figure 1, Figure 2** and your knowledge of enzyme action to explain why the arrows point in opposite directions.

_____

_____

_____

_____

_____

_____

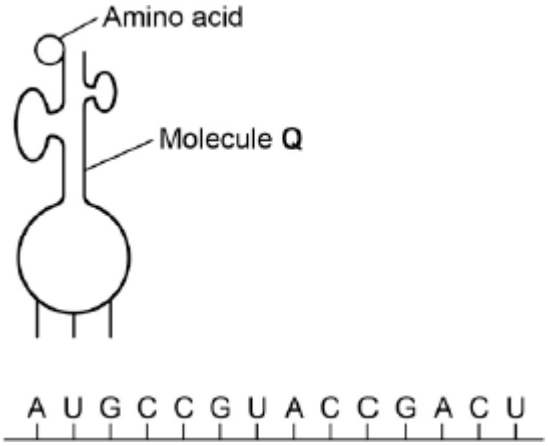
_____

_____

(4)

(Total 8 marks)

27 The diagram below represents one process that occurs during protein synthesis.



(a) Name the process shown.

_____

(1)

(b) Identify the molecule labelled **Q**.

_____

(1)

(c) In the diagram above, the first codon is AUG. Give the base sequence of:

the complementary DNA base sequence _____

the missing anticodon _____

(2)

The table below shows the base triplets that code for two amino acids.

Amino acid	**Encoding base triplet**
Aspartic acid	GAC, GAU
Proline	CCA, CCG, CCC, CCU

(d) Aspartic acid and proline are both amino acids. Describe how two amino acids differ from one another. You may use a diagram to help your description.

(1)

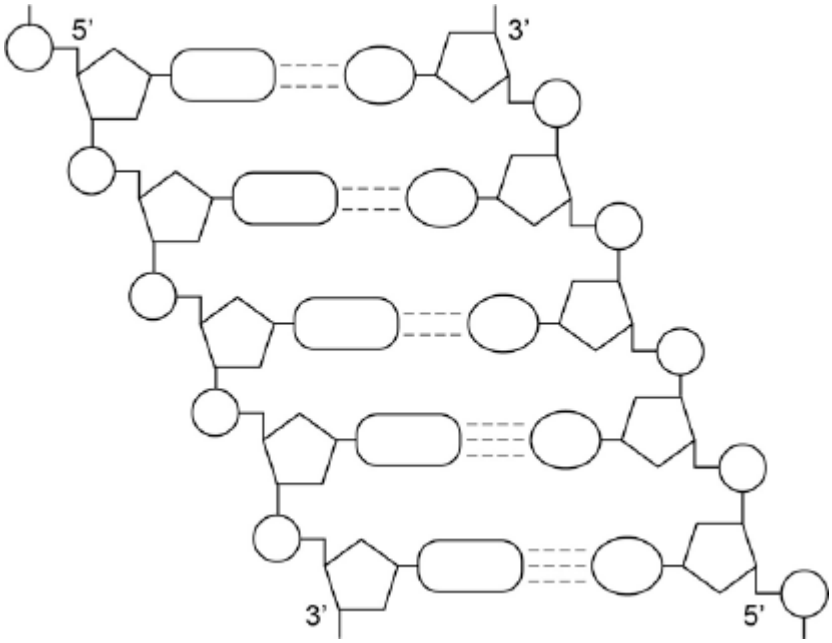
(e) Deletion of the sixth base (G) in the sequence shown in the diagram above would change the nature of the protein produced but substitution of the same base would not. Use the information in the table and your own knowledge to explain why.

(Extra space)

(3)

(Total 8 marks)

28 The following figure represents part of a DNA molecule.



(a) Draw a box around a single nucleotide.

(1)

The table below shows the percentage of bases in each of the strands of a DNA molecule.

DNA strand	**Percentage of each base**			
	A	**C**	**G**	**T**
Strand **1**	16			
Strand **2**		21	34	

(b) Complete the table by adding the missing values.

(2)

(c) During replication, the two DNA strands separate and each acts as a template for the production of a new strand. As new DNA strands are produced, nucleotides can only be added in the 5' to 3' direction.

Use the figure in part **(a)** and your knowledge of enzyme action and DNA replication to explain why new nucleotides can only be added in a 5' to 3' direction.

(Extra space)

(4)

(Total 7 marks)

29 (a) Describe the difference between the structure of a triglyceride molecule and the structure of a phospholipid molecule.

(1)

(b) Describe how you would test for the presence of a lipid in a sample of food.

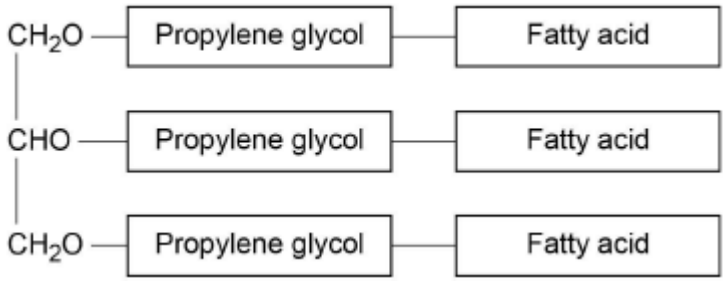
(2)

(c) Animal fats contain triglycerides with a high proportion of saturated fatty acids. If people have too much fat in their diet, absorption of the products of fat digestion can increase the risk of obesity. To help people lose weight, fat substitutes can be used to replace triglycerides in food.

Describe how a saturated fatty acid is different from an unsaturated fatty acid.

(1)

The diagram shows the structure of a fat substitute.



(d) This fat substitute **cannot** be digested in the gut by lipase.

Suggest why.

(2)

(e) This fat substitute is a lipid. Despite being a lipid, it cannot cross the cell-surface membranes of cells lining the gut.

Suggest why it **cannot** cross cell-surface membranes.

(1)

(Total 7 marks)

30 (a) HIV attaches to a specific protein receptor on helper T cells. A low percentage of people have a mutation of the *CCR5* gene which codes for this protein receptor. This mutation results in a non-functional protein receptor.

Explain how this mutation can result in the production of a non-functional protein receptor.

(4)

(b) People with the *CCR5* mutation show a greater resistance to developing AIDS.

Explain why.

(2)

(c) The frequency of the *CCR5* mutation is highest in Europe. Scientists have collected data on the history and number of HIV infections in Europe. Using these data, scientists have concluded that the high frequency of the *CCR5* mutation is not due to natural selection in response to HIV.

Suggest **two** reasons why scientists reached this conclusion.

1. _____

_____

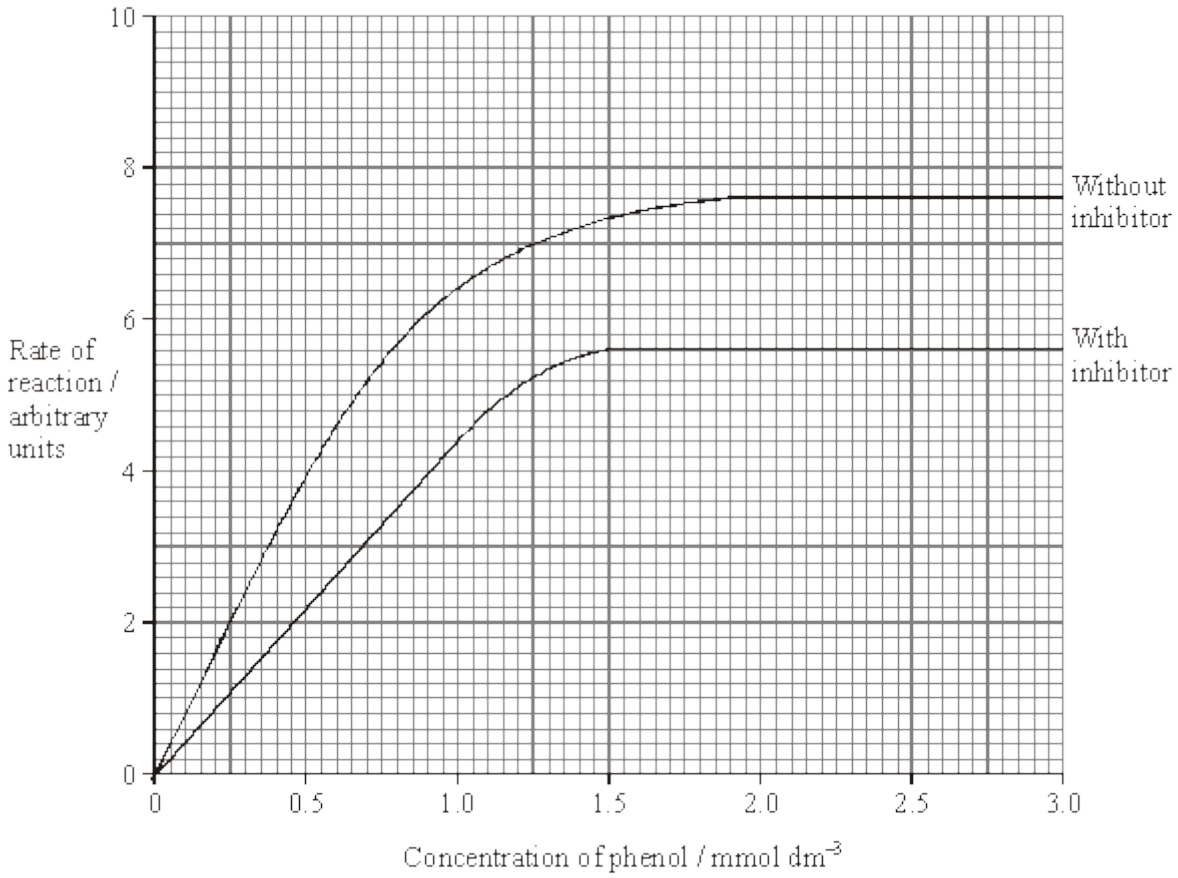
2. _____

_____

(2)

(Total 8 marks)

31 In an investigation, the rate at which phenol was broken down by the enzyme phenol oxidase was measured in solutions with different concentrations of phenol. The experiment was then repeated with a non-competitive inhibitor added to the phenol solutions. The graph shows the results.



(a) Explain why an increase in concentration of phenol solution from 2.0 to 2.5 mmol dm^{-3} has no effect on the rate of the reaction without inhibitor.

(2)

(b) Explain the effect of the non-competitive inhibitor.

(2)

(c) Calculate the percentage decrease in the maximum rate of the reaction when the inhibitor was added. Show your working.

Percentage decrease _____

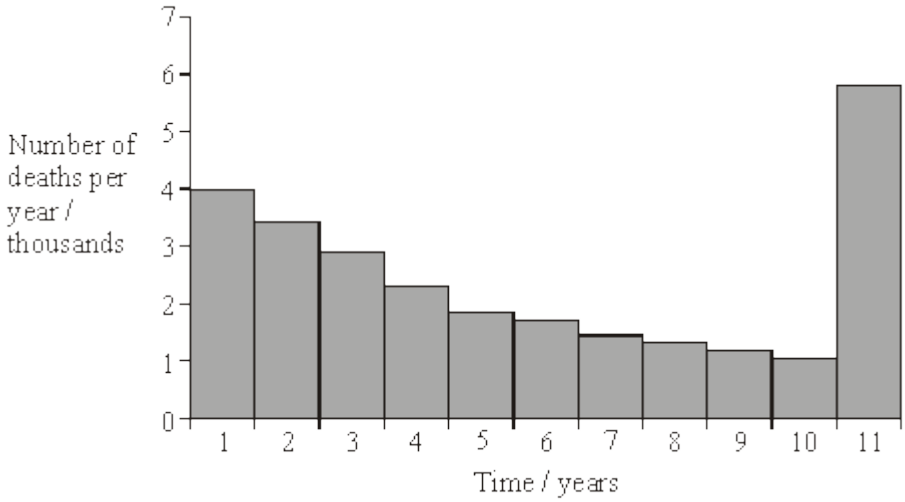
(2)

(d) Draw a curve on the graph to show the results expected if a competitive inhibitor instead of a non-competitive inhibitor had been used.

(1)

(Total 7 marks)

32 (a) The graph shows the number of deaths from influenza per year in a developed country.



(i) Suggest an explanation for the change in the number of deaths from influenza during the first 10 years.

_____

_____

(1)

(ii) Suggest an explanation for the large increase in the number of deaths from influenza in year 11.

_____

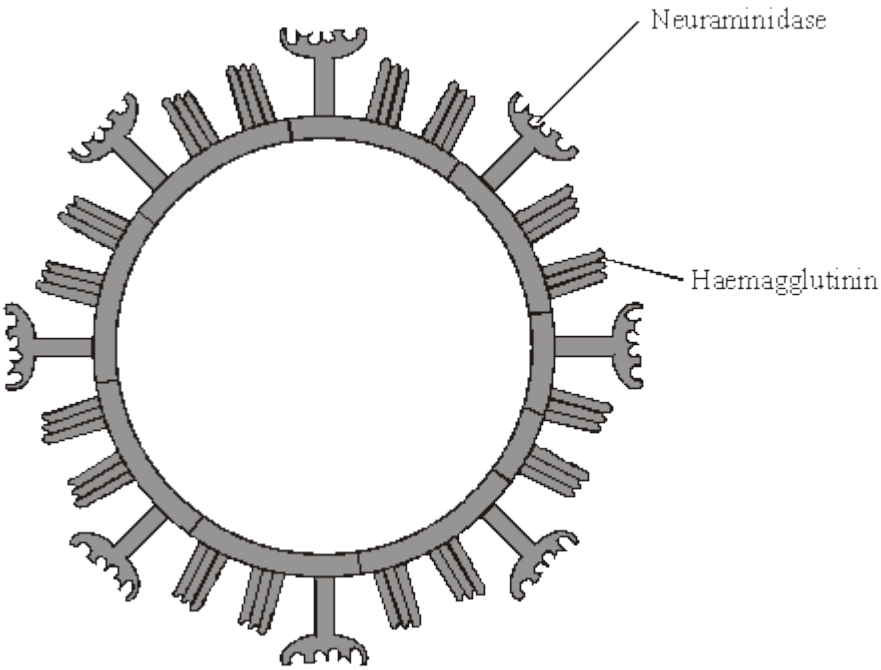
_____

_____

_____

(2)

(b) The diagram shows some of the structures on the outside of an influenza virus.



Haemagglutinin and neuraminidase are protein molecules. Haemagglutinin binds to receptor molecules on the surface of epithelial cells in the breathing system. Neuraminidase is an enzyme which breaks down molecules in the surface membrane of epithelial cells and allows the viruses to be released from the cells.

(i) Describe how T lymphocytes recognise and respond to the influenza virus.

_____

_____

_____

_____

(2)

(ii) Describe how B lymphocytes respond to the influenza virus.

(2)

(c) New drugs have recently become available for treating influenza. One type is a neuraminidase inhibitor. Explain how this type of drug would act as a treatment for influenza.

(2)

(Total 9 marks)

33 Gelatine is a protein. When a warm gelatine solution cools, it sets to form a jelly.
Fresh pineapple juice contains an enzyme that digests protein.
A student investigated the effect of pineapple juice on the setting of jelly.
He set up three different tubes of warm gelatine solution and recorded which had set after three hours. The contents of each tube and his results are shown in the table.

(a) Explain why 2 cm^3 of water was added to tubes **A** and **C**.

(2)

(b) Explain the results of

tube **A** _____

_____

_____

_____

tube **B** _____

_____

_____

_____

(4)

(c) What was the purpose of tube **C**?

_____

_____

_____

_____

_____

_____

(Extra space) _____

_____

_____

(3)

(Total 9 marks)