Candidate Name	Centre Number					Candidate Number				

AS BIOLOGY

COMPONENT 1

Basic Biochemistry and Cell Organisation

SPECIMEN PAPER

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**14**	
3.	**10**	
4.	**18**	
5.	**16**	
6.	**9**	
Total	**75**	

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

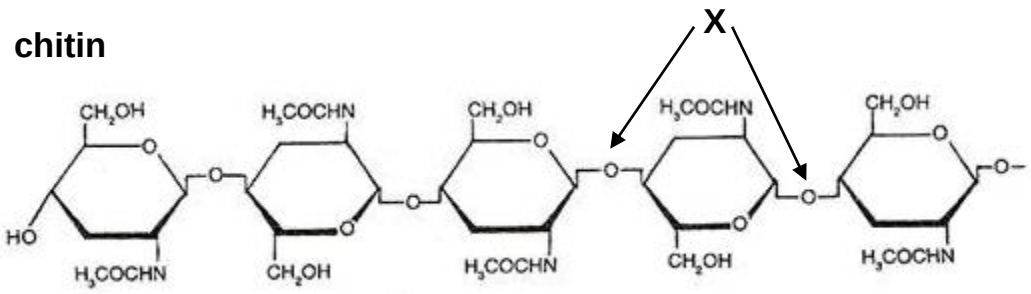
INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
The assessment of the quality of extended response (QER) will take place in question 6.

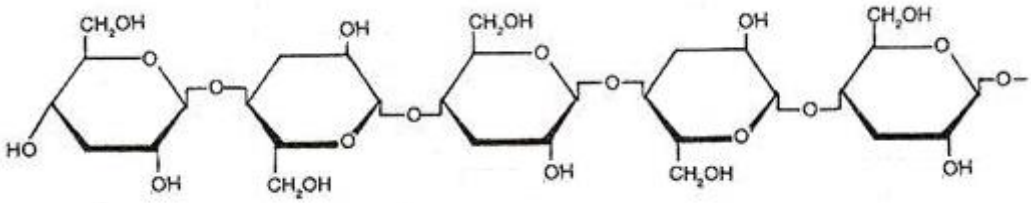
*Answer **all** questions.*

1. Chitin and cellulose are polysaccharides found in the cell walls of some organisms. The structures of these polysaccharides are shown in the diagrams below.

chitin



cellulose



(a) Identify the type of bond labelled **X** on the diagram. [1]

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(b) Describe **one** similarity and **one** difference between the structures of chitin and cellulose. [2]

Similarity: .....

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Difference: .....

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(c) Explain how the structures of these molecules are different to that of starch. [2]

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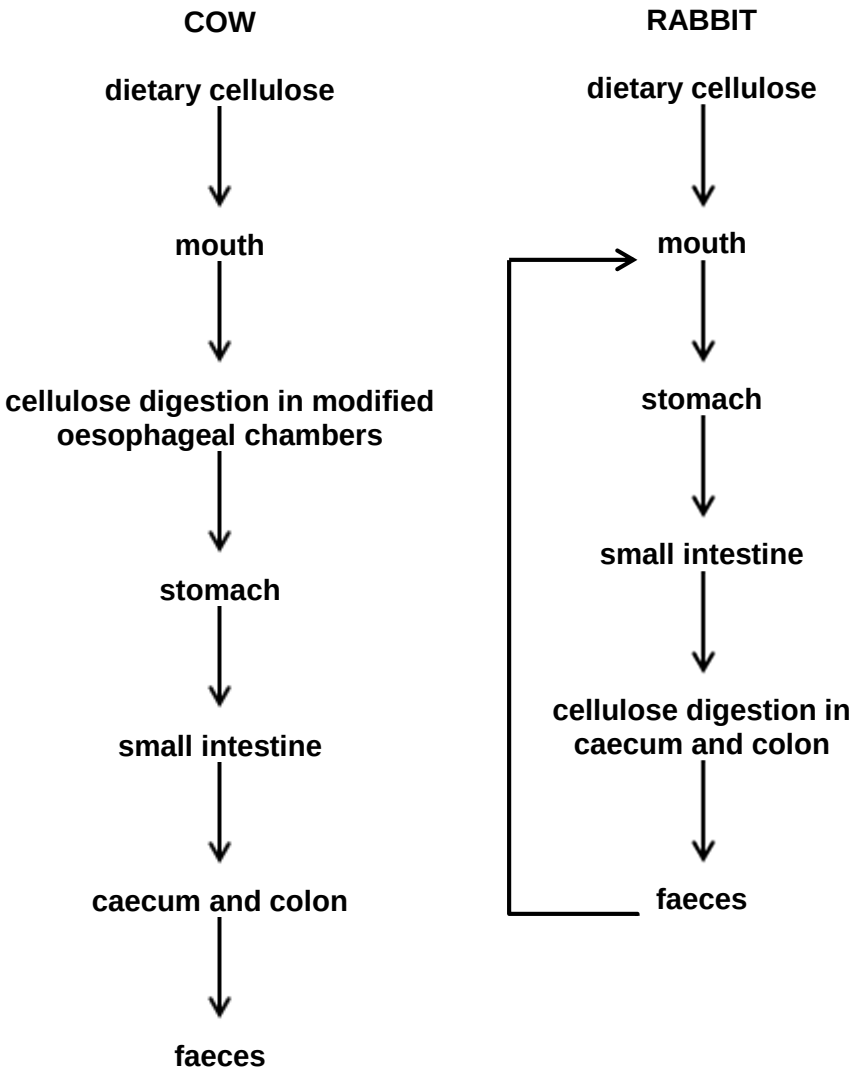
(d) In herbivores, cellulose is digested by cellulase enzymes secreted by bacteria living in the gut. The diagrams below show the site of cellulose digestion in cow and in a rabbit.



Explain why it is necessary for the rabbit to ingest its faeces but not for the cow. [3]

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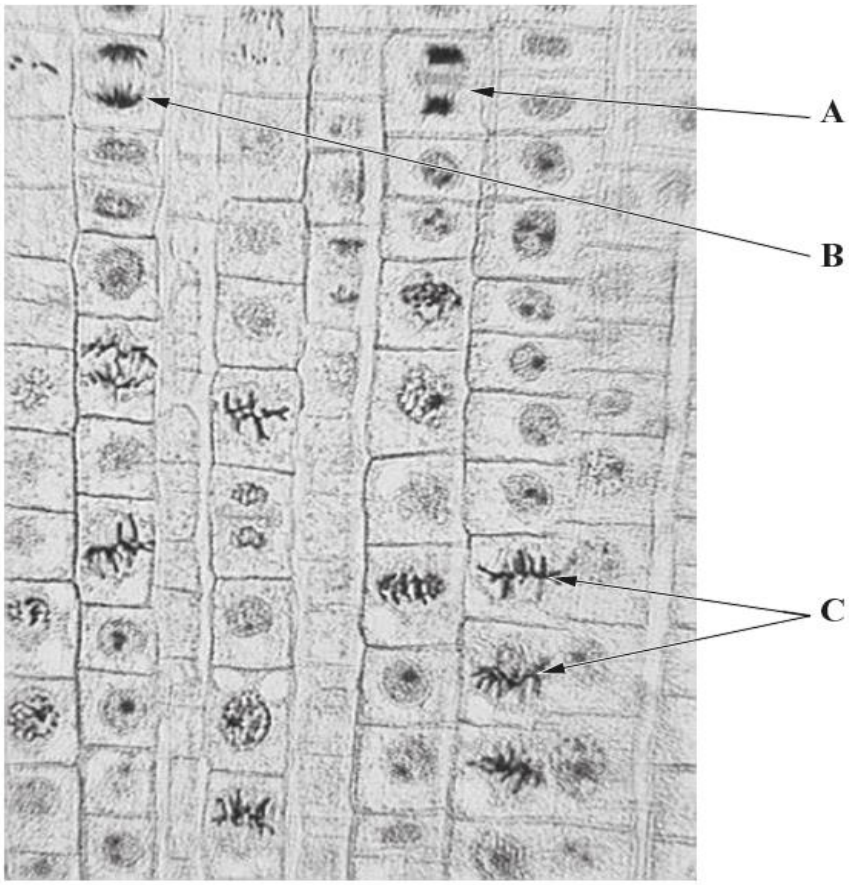
2. Colchicine is an alkaloid compound derived from the corm and other parts of the autumn crocus, *Colchicum autumnale*. Colchicine induces the disassembly of microtubule fibres and thus stops the mitotic process so that chromosome morphology and number can be studied.

The photograph below shows a preparation of garlic (*Allium sativum*) root tip using colchicine to show different stages of the mitotic cell cycle.



(a) (i) Name the stages shown in **A** and **C.** [1]

Stage **A**……

Stage **C**……

(ii) Explain why the disassembly of microtubules would stop mitosis at the different stages that can be observed. [2]

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(iii) Explain the purpose of the process occurring during the stage labelled **B**. [2]

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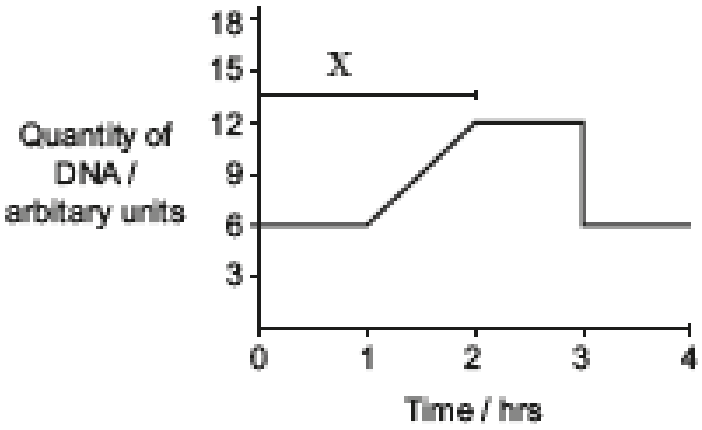
(b) The quantity of DNA in the nucleus of an animal cell was monitored for a period of four hours as shown in the graph below.



(i) Name the stage in the cell cycle which is represented by the time period labelled **X** on the graph above. [1]

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(ii) Using evidence from the graph give a reason for your answer in part (b)(i). [1]

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(iii) What additional evidence would be needed to conclude if the cell is undergoing mitosis or meiosis? Explain your answer. [1]

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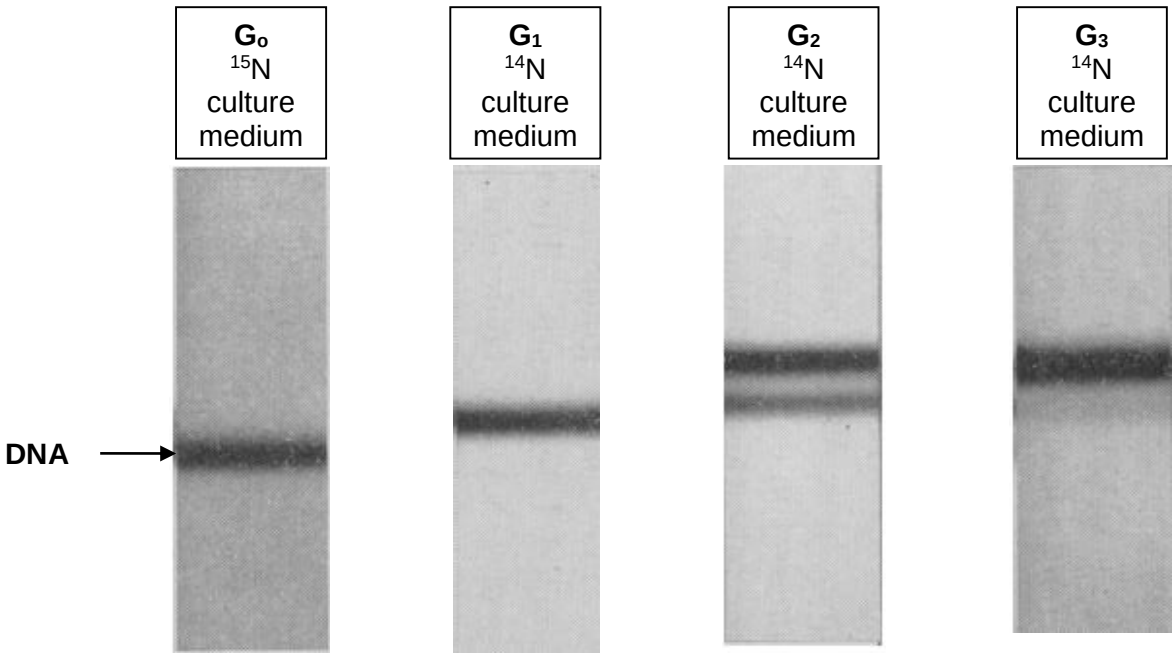
(c) Experiments conducted in the 1950s proved that DNA replication is semi-conservative. The experimental procedure involved growing bacteria with the heavy ^{15}N isotope of nitrogen until the entire DNA contained ^{15}N. The bacteria were then grown for several generations (**G**) in culture medium containing the ^{14}N isotope of nitrogen. At each stage samples of DNA were extracted and separated using ultracentrifugation. The results from one of these experiments are shown in the image below.



(i) Name the part of the DNA molecule which contained the ^{15}N. [1]

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(ii) State what is meant by **semi-conservative** replication and explain how the results shown above support this theory. [5]

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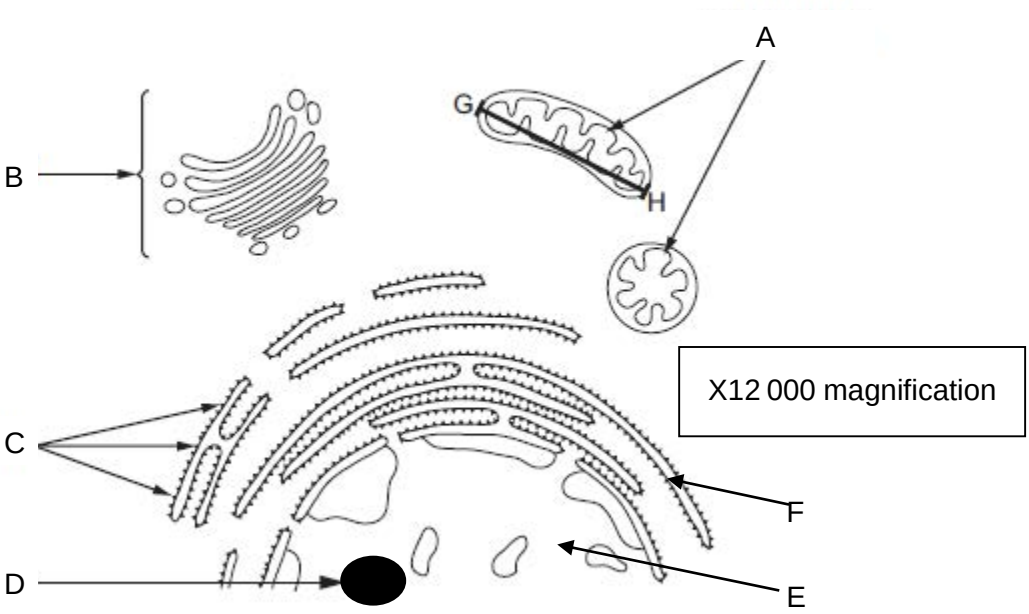
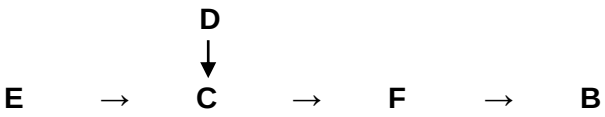
3. The production and secretion of functional proteins from a cell involves a number of cell organelles. The drawing shows part of a generalised animal cell.



(a) Some of these organelles shown above are involved in the production of a functional protein as shown in the flow chart below:



(i) State how organelles **B** to **F** work together in this particular sequence. [5]

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(ii) Suggest the role of organelle A in the production of functional protein. [1]

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(b) (i) Calculate the actual size of organelle **A** between **G** and **H**. [2]
Express your answer using the most appropriate unit.

Answer .....

(ii) Organelle A is similar in size to prokaryotic cells and has structures in common with them. This led the biologist, Lynn Margulis, to conclude that this organelle evolved from ancient prokaryotes. The theory of endosymbiosis proposes that these ancient prokaryotes were engulfed by other bacterial cells and both benefited from the relationship. This association is thought to have led to the evolution of eukaryotic cells.

Using your knowledge of cell structures and processes described, justify this conclusion. [2]

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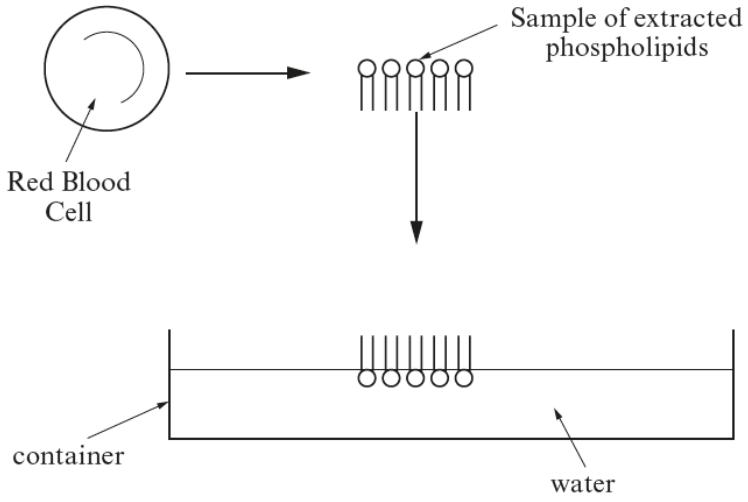
4. (a) In 1925, two scientists, Gorter and Grendel investigated the arrangement of phospholipids in the plasma membrane. Their investigation involved the removal of the phospholipids from the surface membrane of red blood cells in 10 cm^3 of blood. The phospholipids were then placed on the surface of water and allowed to spread out to form a single layer called a monofilm.



(i) Explain fully why the phospholipid molecules are arranged as shown in the container in the diagram above. [2]

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(ii) The area covered by all of the phospholipids in the monofilm was found to be 12.2 m^2. It was concluded that the total surface area of the intact red blood cells was 6.1m^2. Justify how Gorter and Grendel reached this conclusion. [2]

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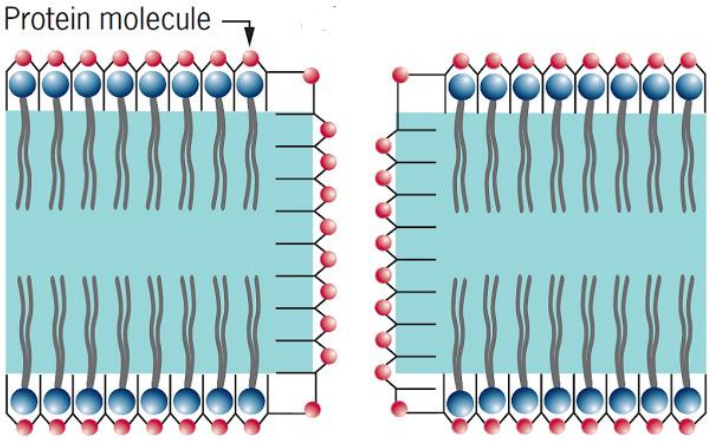
(b) In 1935, Davson and Danielli, proposed a model for the structure of the plasma membrane that built on the findings of Gorter and Grendel together with the discovery that the plasma membrane contained proteins. A diagram to show their proposed structure is shown below.



(i) Describe how this model differs from the currently accepted model of the plasma membrane structure. [3]

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(ii) The currently accepted model is called the fluid-mosaic model. Explain why it has been given this name. [2]

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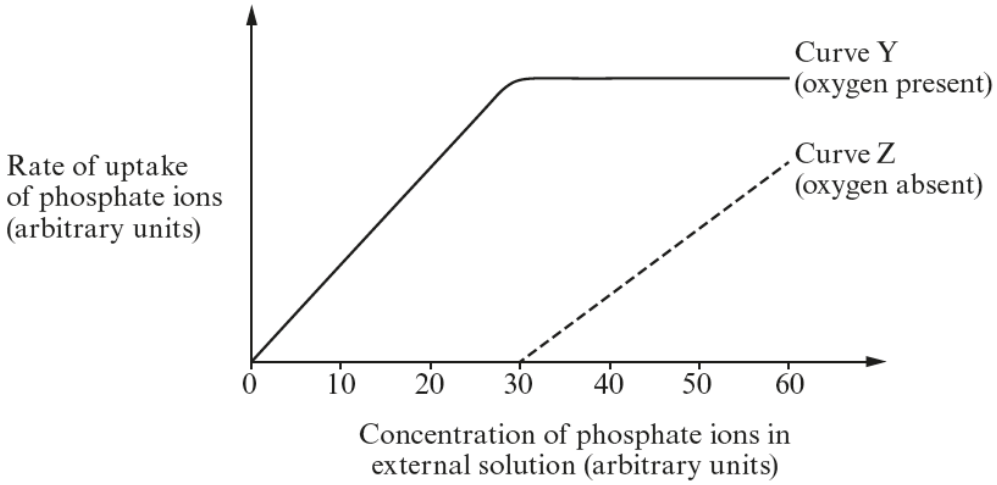
(c) An investigation was carried out on the uptake of phosphate ions in root tissue. The root tissue was cut into discs of uniform size and each disc was added to an equal volume of solution containing phosphate ions of varying concentrations. The experiment was first carried out with oxygen present and then repeated with oxygen absent. The results are shown in the graph below.



(i) Explain why pH and temperature would have to be kept constant in this experiment. [3]

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(ii) Using the results shown on the graph, what conclusions can be drawn about the uptake of phosphate ions by the cells. Justify your conclusions. [6]

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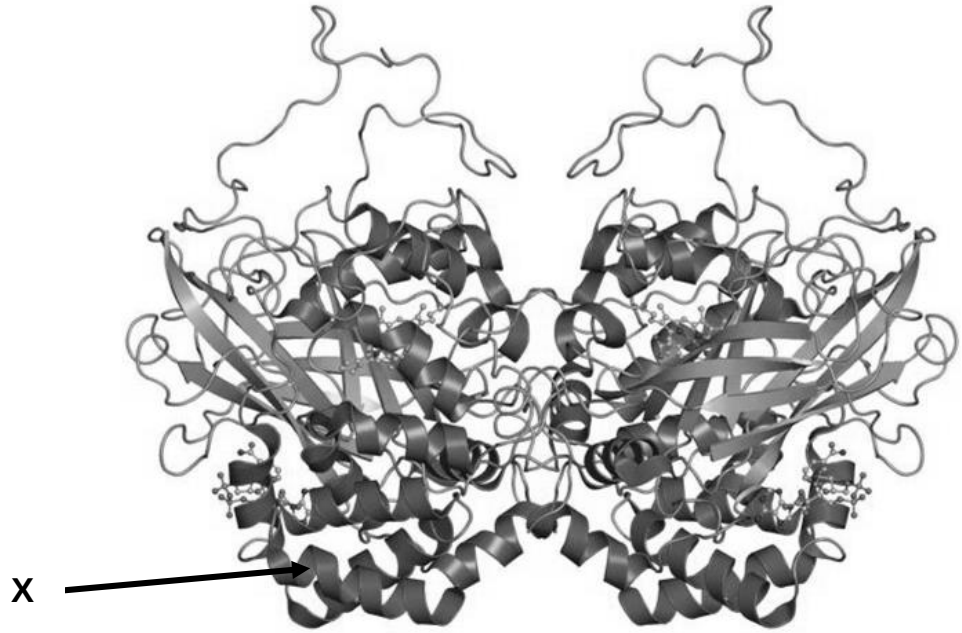
5. Catalase is an enzyme which is found in high concentrations in many tissues including potato tissue. This enzyme catalyses the breakdown of hydrogen peroxide into oxygen and water.

Catalase is composed of a tetramer of four polypeptide chains each bonded to a haem group containing an atom of iron. A diagram of the structure of catalase is shown in the diagram below.



(a) (i) Explain why this protein is said to have a quaternary structure. [1]

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(ii) Identify the name of the type of protein structure labelled **X** on the diagram and explain how this structure is formed. [1]

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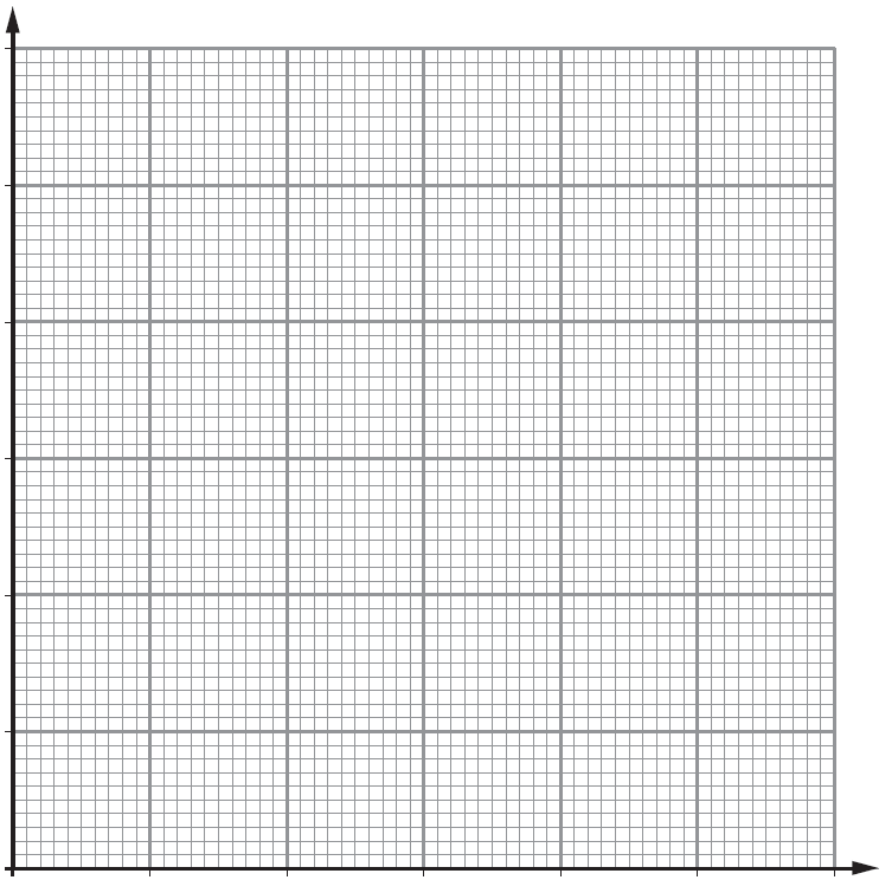
A student investigated the action of the enzyme catalase. The student homogenised 1g of potato tissue in $5cm^3$ of water and soaked discs of filter paper of 5mm diameter in the potato extract. The filter paper was then pushed to the bottom of a test tube containing a fixed height of hydrogen peroxide solution and the time taken for the filter paper to reach the surface of the liquid was recorded. Using the same hydrogen peroxide solution, the experiment was repeated twice to obtain three results for a range of hydrogen peroxide concentrations.

The results of the student's investigation are shown below.

Concentration of hydrogen peroxide solution (% of stock solution)	Time taken for filter paper disc to reach the surface (s)				Mean rate of reaction ($s^{-1}10^2$)
	Trial 1	Trial 2	Trial 3	mean	
0.75	20	21	23	21.3	
1.50	19	15	12	15.3	6.5
3.00	13	13	12	12.7	7.9
4.50	11	12	12	11.7	8.5
6.00	12	10	13	11.7	8.5

(b) (i) Calculate the mean rate of reaction for the 0.75% hydrogen peroxide solution and write your answer in the table. [1]

(ii) Plot the data on the graph below. [3]



(iii) Explain the shape of the graph. [6]

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(c) Apart from human error, suggest two sources of error which could have led to inaccuracies occurring within this experiment and two ways in which these could have been minimised. [4]

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6. Some scientists have claimed that without liquid water, life could not exist on Earth. With reference to the properties of water, explain why water is claimed to be essential for life on this planet.
(The quality of extended response will be assessed in this question.) [9QER]

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