

AQA AS BIOLOGY

TOPIC 1

BIOLOGICAL MOLECULES



1

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?

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(1)

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

Answer =

(1)

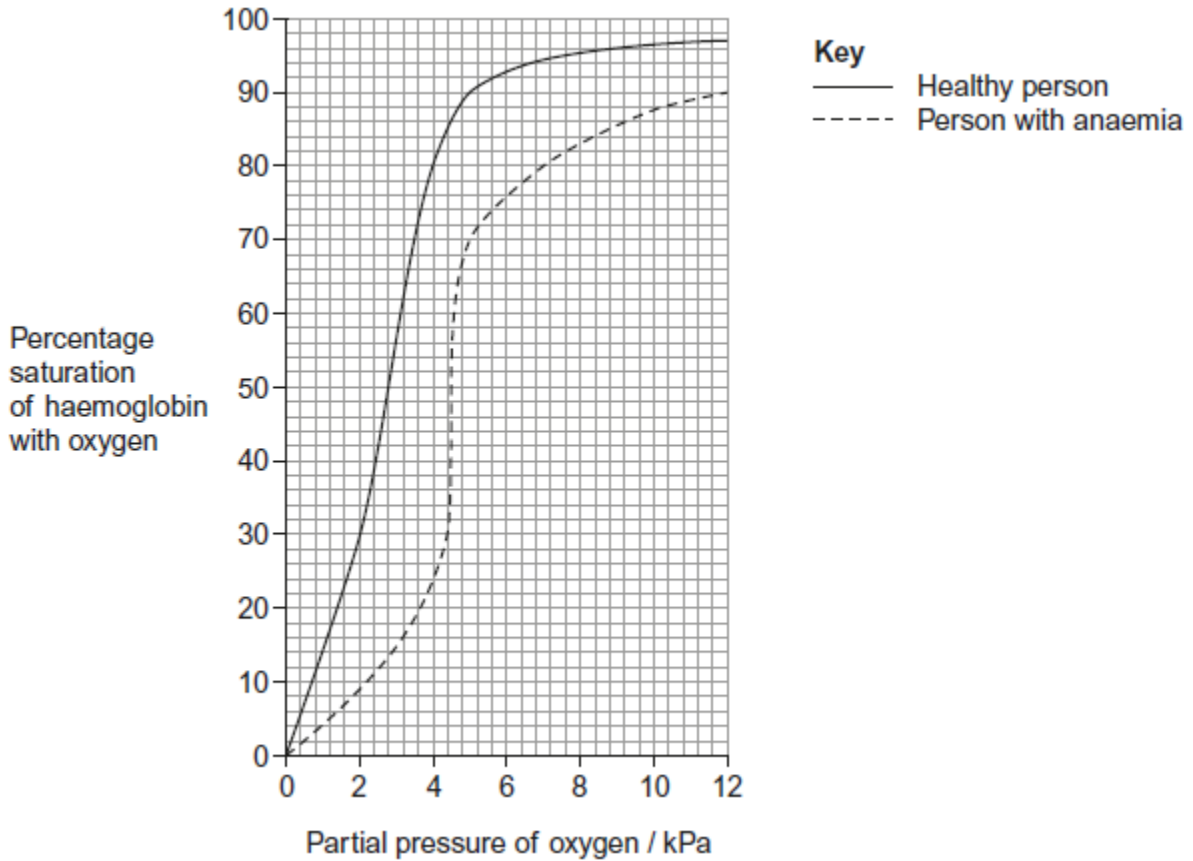
(c) Describe the role of haemoglobin in supplying oxygen to the tissues of the body.

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(2)

Anaemia is a condition in which there is a decrease in the concentration of haemoglobin in blood. In some people with anaemia, substances are produced which change the oxygen dissociation curve of haemoglobin.

The graph shows the effect of these substances on the oxygen dissociation curve of haemoglobin.



- (d) (i) Use information in the graph to find the difference in the percentage saturation of haemoglobin with oxygen between a healthy person and a person with anaemia at a partial pressure of oxygen of 4 kPa.

Answer =

(1)

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

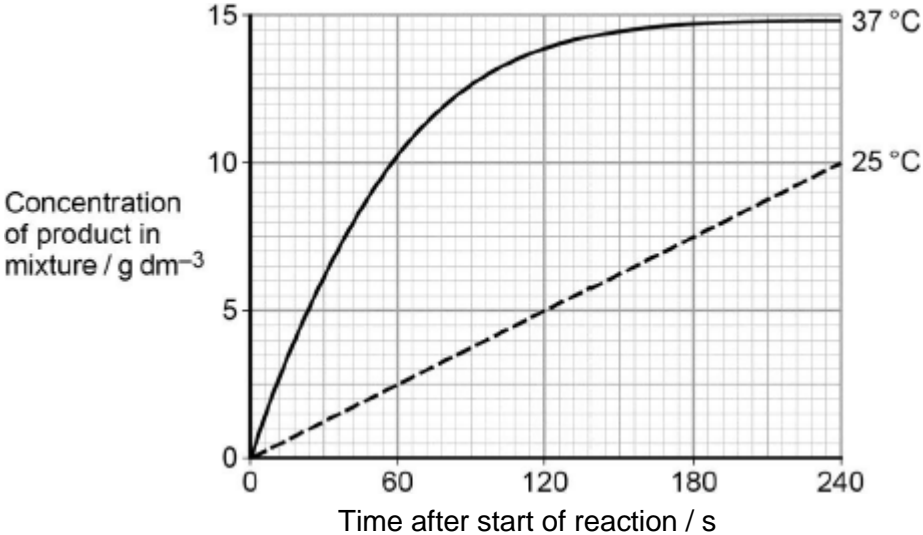
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(3)
 (Total 8 marks)

2 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.

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(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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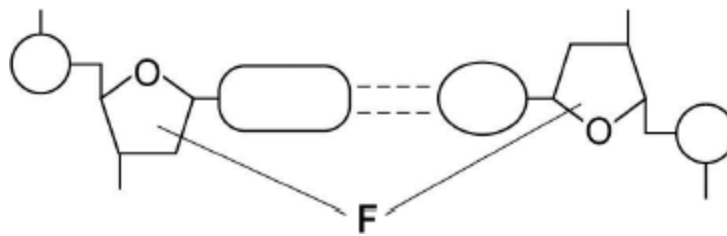
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(5)
(Total 8 marks)

3 Figure 1 shows one base pair of a DNA molecule.

Figure 1



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

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(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?

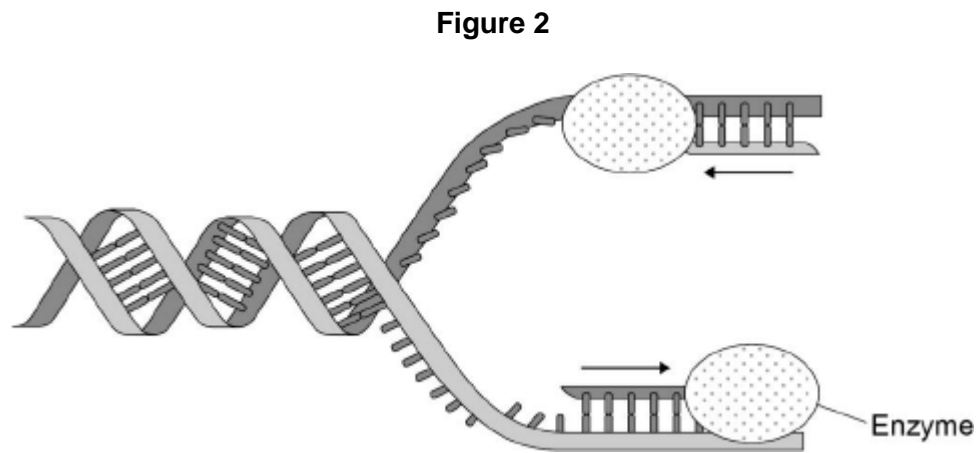
Percentage of thymine

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.



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

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(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.

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(4)
(Total 8 marks)

4

- (a) Describe how you would test a piece of food for the presence of lipid.

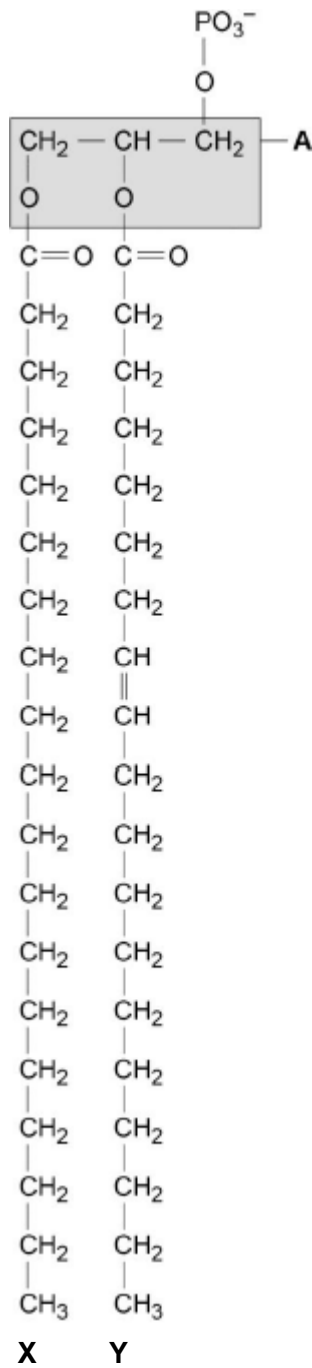
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(2)

The figure below shows a phospholipid.



- (b) The part of the phospholipid labelled **A** is formed from a particular molecule. Name this molecule.

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(1)

- (c) Name the type of bond between **A** and fatty acid **X**.

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(1)

(d) Which of the fatty acids, X or Y, in the figure above is unsaturated? Explain your answer.

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(1)

Scientists investigated the percentages of different types of lipid in plasma membranes from different types of cell. The table shows some of their results.

Type of lipid	Percentage of lipid in plasma membrane by mass		
	Cell lining ileum of mammal	Red blood cell of mammal	The bacterium <i>Escherichia coli</i>
Cholesterol	17	23	0
Glycolipid	7	3	0
Phospholipid	54	60	70
Others	22	14	30

(e) The scientists expressed their results as **Percentage of lipid in plasma membrane by mass**. Explain how they would find these values.

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(2)

Cholesterol increases the stability of plasma membranes. Cholesterol does this by making membranes less flexible.

(f) Suggest **one** advantage of the different percentage of cholesterol in red blood cells compared with cells lining the ileum.

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(1)

(g) *E. coli* has no cholesterol in its cell-surface membrane. Despite this, the cell maintains a constant shape. Explain why.

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(2)
(Total 10 marks)

5

Read the following passage.

Herpes simplex virus (HSV) infects nerve cells in the face, including some near the lips. Like many other viruses, HSV can remain inactive inside the body for years. When HSV becomes active, it causes cold sores around the mouth.

Human cells infected with a virus may undergo programmed cell death. While HSV is inactive inside the body, only one of its genes is transcribed. This gene is the latency-associated transcript (*LAT*) gene that prevents programmed cell death of an infected nerve cell.

5

Scientists have found that transcription of the *LAT* gene produces a microRNA. This microRNA binds to some of the nerve cell's own mRNA molecules. These mRNA molecules are involved in programmed cell death of nerve cells. The scientists concluded that production of this microRNA allows HSV to remain in the body for years.

10

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

(a) HSV infects nerve cells in the face (line 1). Explain why it infects **only** nerve cells.

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(3)

(b) HSV can remain inactive inside the body for years (lines 2–3). Explain why this virus can be described as **inactive**.

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(2)

(c) Suggest **one** advantage of programmed cell death (line 4).

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(1)

(d) The scientists concluded that production of this microRNA allows HSV to remain in the body for years (lines 10–12).

Explain how this microRNA allows HSV to remain in the body for years.

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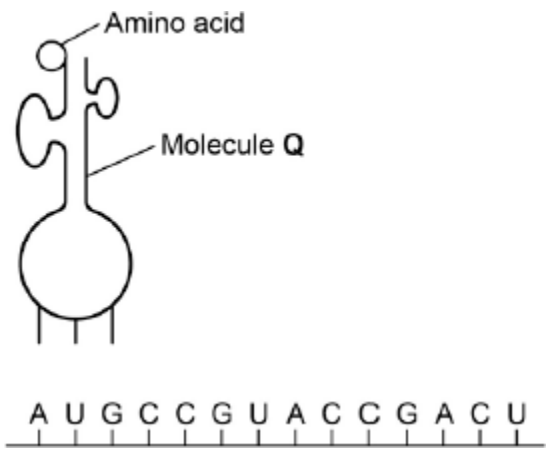
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(4)
(Total 10 marks)

6

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.

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(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.

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(3)
(Total 8 marks)

7

Newborn babies can be fed with breast milk or with formula milk. Both types of milk contain carbohydrates, lipids and proteins.

- Human breast milk also contains a bile-activated lipase. This enzyme is thought to be inactive in milk but activated by bile in the small intestine of the newborn baby.
- Formula milk does not contain a bile-activated lipase.

Scientists investigated the benefits of breast milk compared with formula milk.

- (a) The scientists used kittens (newborn cats) as model organisms in their laboratory investigation.

Other than ethical reasons, suggest **two** reasons why they chose to use cats as model organisms.

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(2)

- (b) Before starting their experiments, the scientists confirmed that, like human breast milk, cat's milk also contained bile-activated lipase.

To do this, they added bile to cat's milk and monitored the pH of the mixture.

Explain why monitoring the pH of the mixture could show whether the cat's milk contained lipase.

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(2)

The scientists then took 18 kittens. Each kitten had been breastfed by its mother for the previous 48 hours.

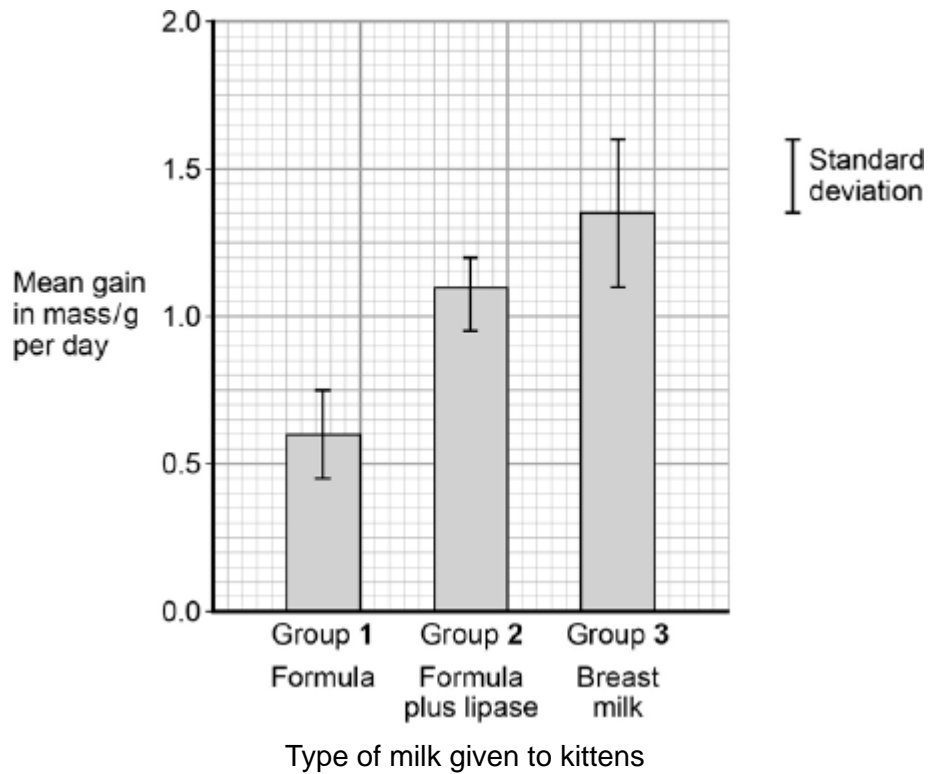
The scientists divided the kittens randomly into three groups of six.

- The kittens in group 1 were fed formula milk.
- The kittens in group 2 were fed formula milk plus a supplement containing bile-activated lipase.
- The kittens in group 3 were fed breast milk taken from their mothers.

Each kitten was fed 2 cm³ of milk each hour for 5 days.

The scientists weighed the kittens at the start of the investigation and on each day for 5 days.

The figure below shows the scientists' results.



(c) What can you conclude from the figure about the importance of bile-activated lipase in breast milk?

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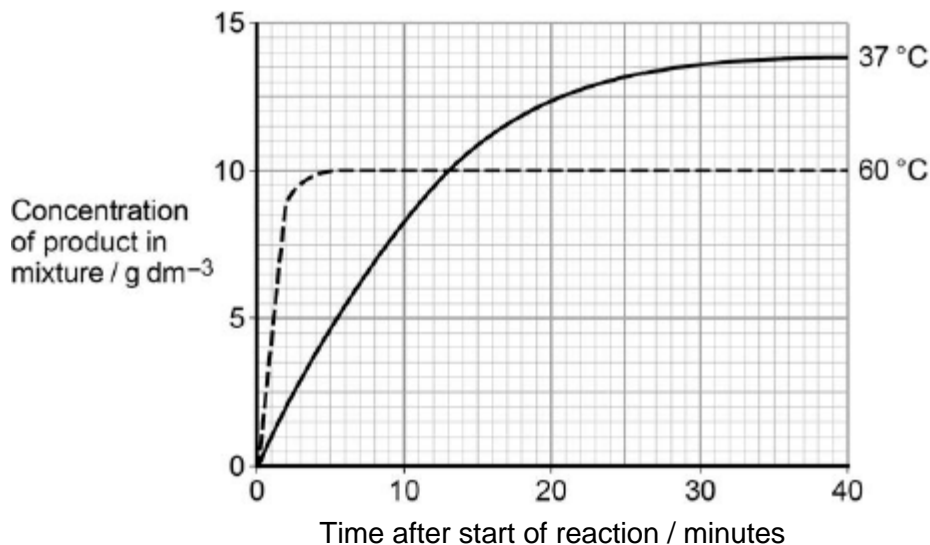
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(3)
(Total 7 marks)

8

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 concentration of substrate.

The following graph shows his results.



(a) Give **two** other factors the technician would have controlled.

1

2

(1)

(b) Draw a tangent on each curve to find the initial rates of reaction. Use these values to calculate the ratio of the initial rates of reaction at 60 °C : 37 °C. Show your working.

Ratio = :1

(2)

(c) Explain the difference in the initial rate of reaction at 60 °C and 37 °C.

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(2)

(d) Explain the difference in the rates of reaction at 60 °C and 37 °C between 20 and 40 minutes.

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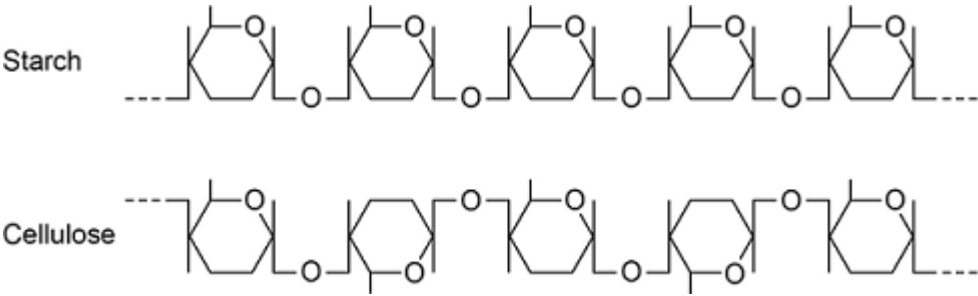
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(4)
(Total 9 marks)

9

Starch and cellulose are two important plant polysaccharides.

The following diagram shows part of a starch molecule and part of a cellulose molecule.



(a) Explain the difference in the structure of the starch molecule and the cellulose molecule shown in the diagram above.

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(2)

(b) Starch molecules and cellulose molecules have different functions in plant cells. Each molecule is adapted for its function.

Explain **one** way in which starch molecules are adapted for their function in plant cells.

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(2)

(c) Explain how cellulose molecules are adapted for their function in plant cells.

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(3)
(Total 7 marks)