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Student number

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Attempt/Time taken \_\_\_\_\_

# GCSE BIOLOGY

Topic Paper: Enzymes (2.2 The human digestive system, 6.1.5 DNA structure)  
Part 2

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Time allowed: 40 minutes

## Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

## Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

## Information

- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.



**35 Marks**

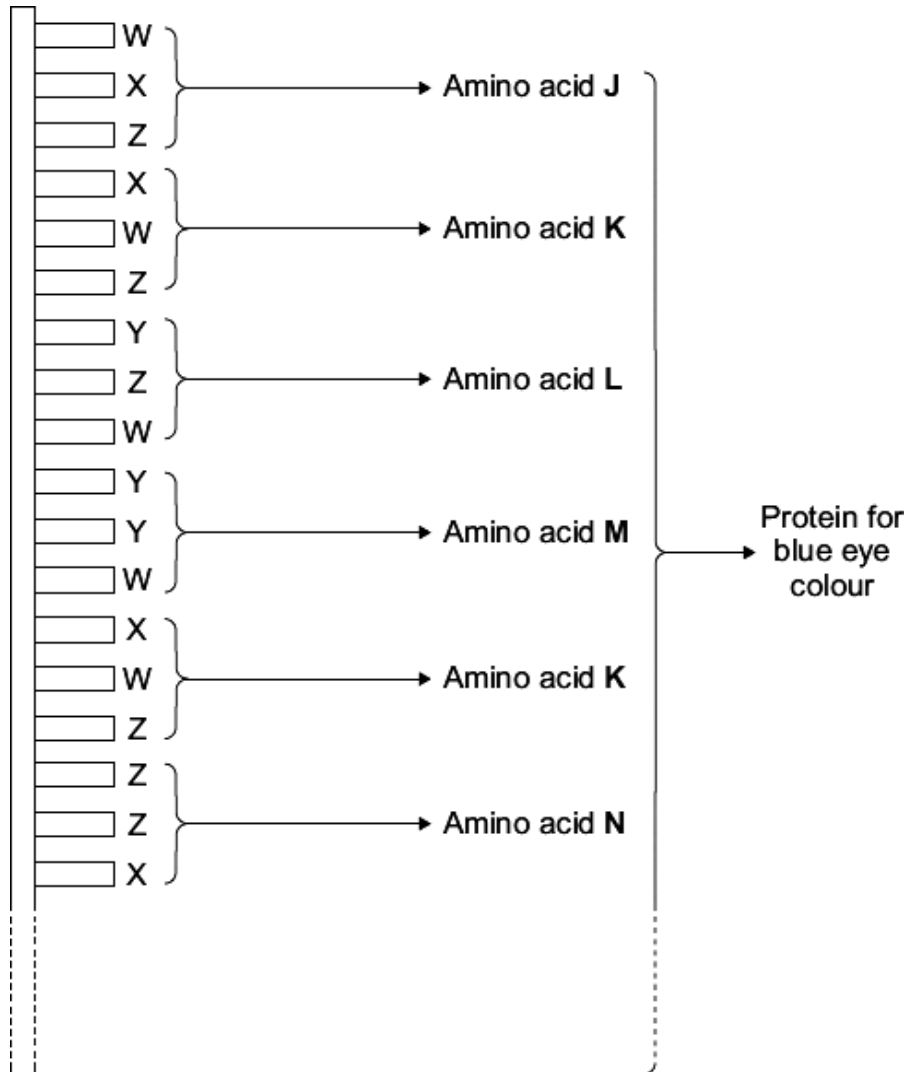
**Q8.** A molecule of DNA contains four different bases, **W, X, Y** and **Z**.

The four bases are arranged in a long chain.

The chain of bases controls the synthesis of a protein.

The diagram shows a small section of a DNA molecule.

This section is responsible for synthesising the protein for blue eye colour.



(a) What word is used to describe 'a small section of a DNA molecule that controls the synthesis of a protein'?

.....

(1)

(b) In the cell, where are proteins synthesised?

.....

(1)



(c) Describe how the protein for blue eye colour is synthesised.

To gain full marks you must use information from the diagram.

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(3)

(d) Mistakes sometimes occur when DNA molecules are copied during cell division.

Suppose that one of the **W** bases shown in the diagram was substituted by an **X** base.

(i) What would happen to the structure of the protein synthesised by this part of the DNA molecule?

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.....

(1)

(ii) What might be the effect of this change in structure of the protein?

.....  
.....

(1)

(Total 7 marks)

**Q9.** There are enzymes in biological washing powders. Biological washing powder has to be used at temperatures below 45 °C.

(a) The enzymes in biological washing powders do **not** work on the stains on clothes at temperatures above 45 °C.

Explain why.

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.....  
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(2)



- (b) Some bacteria, called thermophilic bacteria live in hot springs at temperatures of 80 °C.

Scientists have extracted enzymes from these thermophilic bacteria. These enzymes are being trialled in industrial laundries.

The laundries expect to increase the amount of clothes they can clean by using enzymes from thermophilic bacteria instead of using the biological washing powders the laundries use now.

- (i) The laundries expect to be able to increase the amount of clothes that they can clean each day.

Suggest why.

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(2)

- (ii) Using washing powders with enzymes from thermophilic bacteria may be more harmful to the environment than using the biological washing powders that laundries use now.

Suggest why.

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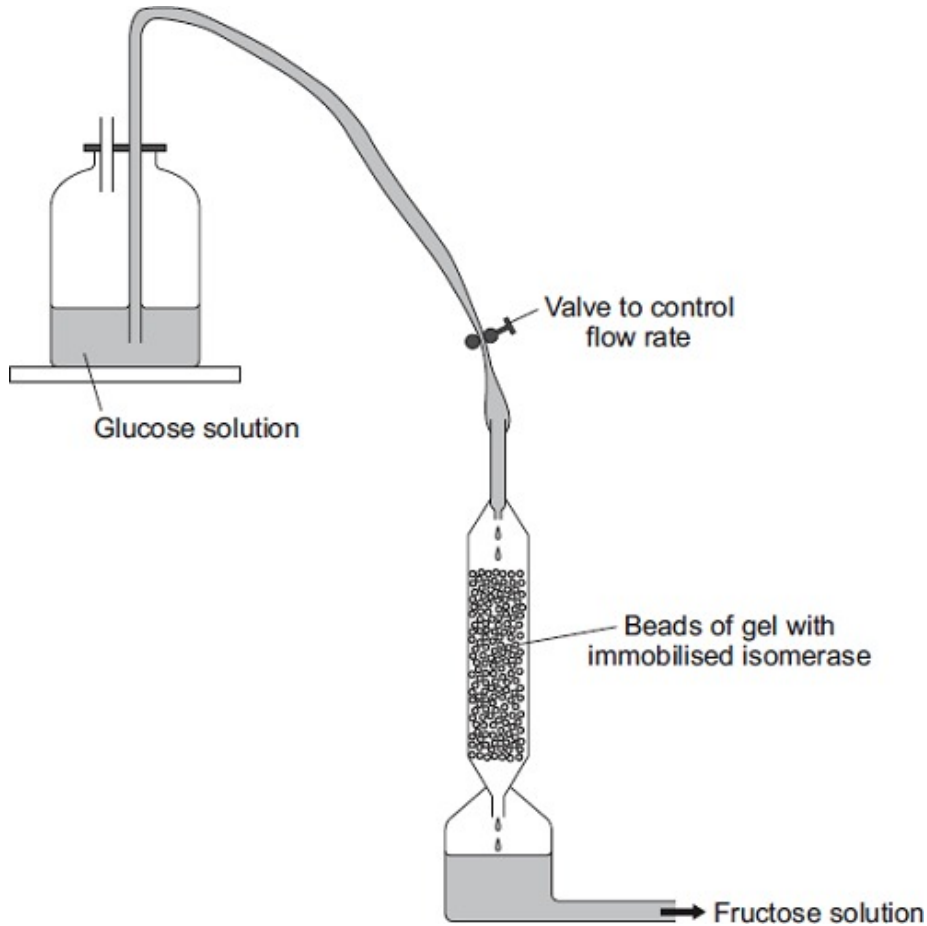
(2)

(Total 6 marks)

**Q10.** Isomerase is an enzyme which can change glucose into fructose. Fructose is often used instead of glucose in products like slimming foods.

In industry, isomerase is often 'immobilised' within beads of gel. The beads are placed in a glass column. The isomerase stays attached to the beads and a solution of glucose is allowed to flow between the beads in the column.

The diagram shows how immobilised isomerase is used.



(a) An alternative method of changing glucose into fructose would be to mix a solution of the isomerase with the glucose solution in a large container. Suggest **two** advantages of using isomerase immobilised in a column of beads.

- 1.....
- .....
- 2.....
- .....

(2)



- (b) A manufacturer investigated the effect of using different flow rates of glucose solution on the rate of fructose production.

The table shows the results.

Flow rate in dm <sup>3</sup> per minute	Rate of fructose production in mg per minute
1	150
2	325
3	480
4	608
5	650
6	650
7	650

The manufacturer decides to use a flow rate of 5 dm<sup>3</sup> per minute.

Suggest why the manufacturer chose this flow rate.

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.....

(2)

- (c) Fructose is a much sweeter sugar than glucose.

Explain why manufacturers of slimming foods may wish to use fructose as a sweetener instead of glucose.

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(2)  
(Total 6 marks)



**Q11.** A certain gene codes for the production of an enzyme called 'HEXA'.

One human genetic disorder causes damage to nerve cells in the brain.  
This disorder is caused by a small change in the DNA of the HEXA gene.  
People with this disorder make a changed HEXA enzyme that does not work.

(a) Explain how a change in the DNA of the HEXA gene can result in the production of a changed HEXA enzyme that does not work.

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(3)

(b) The gene coding for the HEXA enzyme is found on chromosome number 15.

(i) How many chromosomes are there in the nucleus of a human nerve cell? .....

(1)

(ii) A boy had the changed HEXA gene on the chromosome number 15 that he inherited from his father.

The changed HEXA gene coded for a HEXA enzyme that does not work.  
The boy did **not** develop the genetic disorder.

Explain why the boy did **not** develop the genetic disorder.

.....  
.....  
.....  
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(2)



(iii) The boy grew up and got married.

A blood test showed that his wife had also inherited the same changed HEXA gene.

There is a 1 in 4 chance that this couple's first child will have the genetic disorder.

Use a genetic diagram to explain why.

Use the following symbols in your explanation:

**H** = allele for making the normal HEXA enzyme

**h** = allele for making a HEXA enzyme that does not work.

(3)  
(Total 9 marks)





**Q12.** Fresh milk is a mixture of compounds including lipid, protein and about 5% lactose sugar.

Lactose must be digested by the enzyme lactase, before the products can be absorbed.

Lactase can be added to fresh milk to pre-digest the lactose. This makes 'lactose-free' milk, which is suitable for people who do not produce enough lactase of their own.

A student investigated the effect of changing pH and temperature on the digestion of lactose in milk.

The results are shown in **Tables 1** and **2**.

**Table 1**  
**Effect of pH**

pH	Time taken to digest lactose in minutes
4.0	20
5.0	18
6.0	13
7.0	7
8.0	5
9.0	6

**Table 2**  
**Effect of temperature**

Temperature in °C	Time taken to digest lactose in minutes
25	20
30	14
35	11
40	6
45	29
50	No digestion

(a) The label on a carton of lactose-free milk states:

'Lactase is normally produced in the stomach of mammals.'

The results in **Table 1** suggest that this statement is **not** true.

Explain how.

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(2)



(b) Explain, as fully as you can, the results shown in **Table 2** .

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(3)

(c) Bile is produced in the liver and is released into the small intestine.

Bile helps the digestion of lipid in the milk.

Describe how.

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(2)

(Total 7 marks)