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INTERNATIONAL AS
BIOLOGY (9610)

Unit 2 Biological Systems and Disease

Thursday 16 January 2020 07:00 GMT Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- a ruler with millimetre measurements
- a scientific 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.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- 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 marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

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Answer **all** questions in the spaces provided.

0 1 Melanin is a pigment that gives colour to fur.

Production of melanin requires an enzyme called tyrosinase.

Albino cats have a genetic mutation that causes the production of a non-functional tyrosinase enzyme.

Albino cats have white fur.

Figure 1 shows part of the DNA base sequence for the tyrosinase gene.

Figure 1

DNA triplet number	26	27	28	29	30	31	32	33	34	35	36	37
Base sequence of cat with coloured fur	CTC	CCC	TCC	TCT	GCT	GAT	GTG	GAA	TTT	TGC	CTA	AGT
Base sequence of albino cat	CTC	CCT	CCT	CTG	CTG	ATG	TGG	AAT	TTT	GCC	TAA	GTC

0 1 . 1 Name the type of mutation in the albino cat.

Circle a possible position of the mutation in **Figure 1**.

[2 marks]

Table 1 shows some DNA triplets and the amino acids they code for.

Table 1

First letter of DNA triplet			
A	**C**	**G**	**T**
AAA – lys	CCA – pro	GAA – glu	TAA – stop
AAC – asn	CCC – pro	GAT – asp	TCC – ser
AAT – asn	CCT – pro	GCC – ala	TCT – ser
AGG – arg	CTA – leu	GCT – ala	TGA – stop
AGT – ser	CTC – leu	GGG – gly	TGC – cys
ATG – met	CTG – leu	GTC – val	TGG – trp
ATT – ile	CTT – leu	GTG – val	TTT – phe

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0 1 . 2 **Figure 2** shows the amino acid sequence for the cat with coloured fur.

Determine the amino acid sequence for the albino cat.

Use information from **Table 1** to complete **Figure 2**.

[1 mark]

Figure 2

DNA triplet number	26	27	28	29	30	31	32	33	34	35	36	37
Base sequence of cat with coloured fur	CTC	CCC	TCC	TCT	GCT	GAT	GTG	GAA	TTT	TGC	CTA	AGT
Amino acid sequence of cat with coloured fur	leu	pro	ser	ser	ala	asp	val	glu	phe	cys	leu	ser
Base sequence of albino cat	CTC	CCT	CCT	CTG	CTG	ATG	TGG	AAT	TTT	GCC	TAA	GTC
Amino acid sequence of albino cat												

0 1 . 3 Explain how the mutation shown in **Figure 1** would cause the tyrosinase enzyme to be non-functional.

[3 marks]

Question 1 continues on the next page

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0 1 . 4 Some mutations are called silent mutations.

Explain why a silent mutation does not change the function of a protein.

Use an example from **Table 1** (on page 2).

[3 marks]

0 1 . 5 Mutations provide a more significant source of variation in a population of prokaryotes than in a population of eukaryotes.

Give reasons why.

[3 marks]

12

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0 2 Cholera causes diarrhoea.

Diarrhoea can cause dehydration.

Oral rehydration solution (ORS) is used to treat dehydration.

An oral rehydration solution is made by mixing a powder with boiled water.

Table 2 shows the basic components of the powder used to make an ORS.

Table 2

Component of the powder used to make an ORS	**Mass in ORS / g dm^{-3}**	**Mass in sachet to make 200 cm^3 of ORS / g**
Sodium chloride	2.6	0.5
Potassium chloride	1.5	0.3
Sodium citrate	2.9	0.6
	13.5	

0 2 . 1 Complete **Table 2** to show:

- the missing component and
- the mass of the missing component in the sachet used to make 200 cm^3 of ORS.

[2 marks]

0 2 . 2 A 1-year-old girl weighs 8.9 kg

She needs 15 cm^3 kg^{-1} h^{-1} ORS to treat dehydration caused by cholera.

She is treated for 4 hours.

Calculate how much solution she will need.

Give your answer in dm^3 to 2 decimal places.

[2 marks]

_____ dm^3

4

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0 3 Vaccinations protect people against serious diseases.

0 3 . 1 Which type of immunity is produced by a vaccination?

[1 mark]

Tick (✓) **one** box.

Artificial, active ☐

Artificial, passive ☐

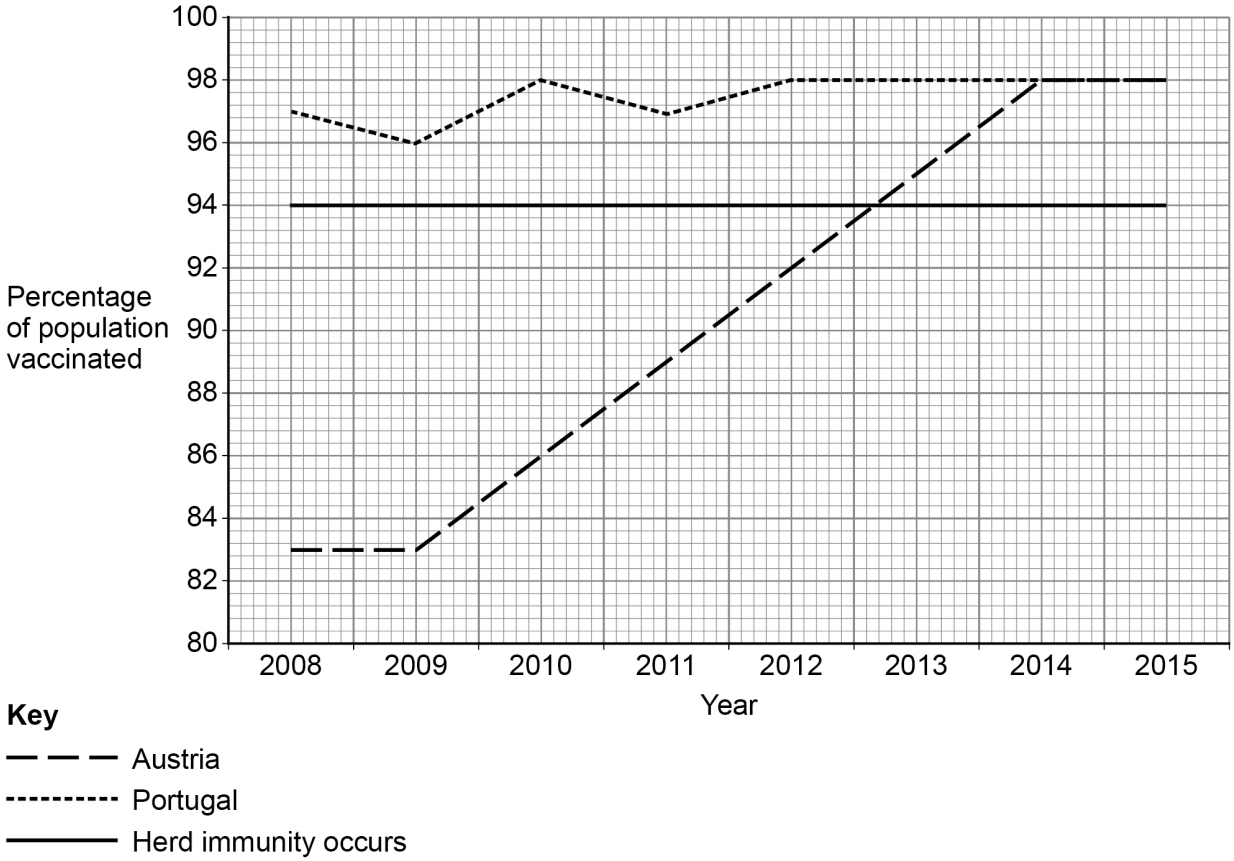
Natural, active ☐

Natural, passive ☐

The DTP vaccine protects people against the diseases diphtheria, tetanus and pertussis.

Figure 3 shows the percentage of the population in Austria and Portugal that had the DTP vaccine in the years 2008 to 2015.

Figure 3



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0 3 . 2 In 2011, a person who had not had the DTP vaccine was advised to visit Portugal rather than Austria.

Suggest why.

Use the data in **Figure 3** and your own knowledge.

[3 marks]

0 3 . 3 Some people think that all childhood vaccinations should be compulsory.

Give reasons for **and** reasons against this idea.

[3 marks]

7

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0 4 One feature of coronary heart disease (CHD) is the formation of atheroma.

0 4 . 1 Describe how atheromas form and cause CHD.

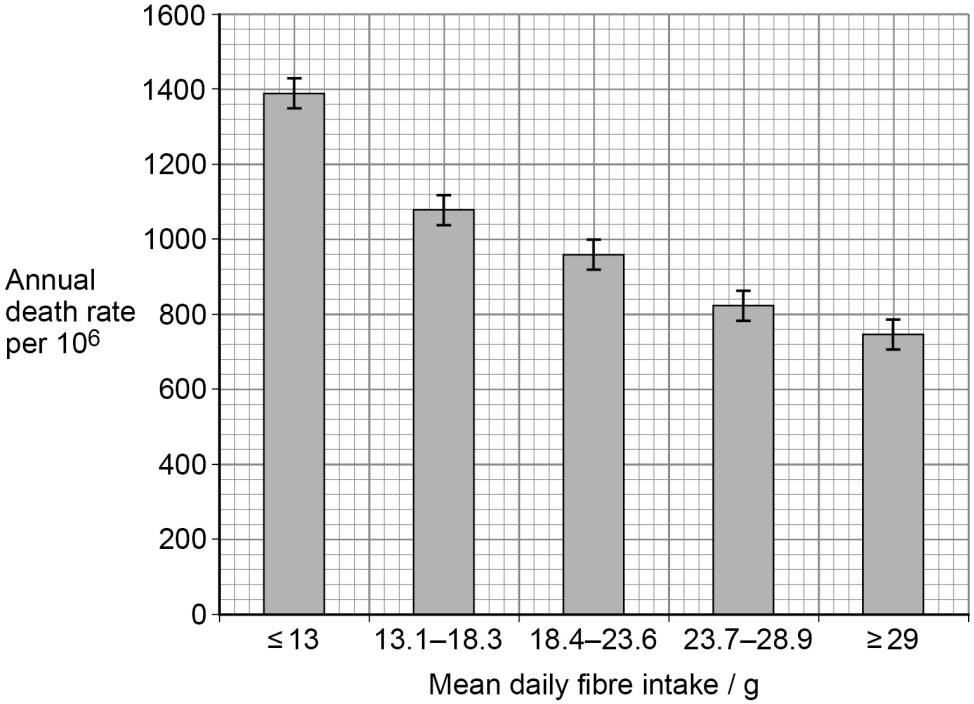
[3 marks]

Many scientists think that a diet high in fibre reduces the risk of CHD.
In a study, the mean daily fibre intake of 500 000 people was recorded.
Over the next 9 years, the number of those people that died each year was recorded.

Figure 4 shows the relationship between the mean daily fibre intake and the annual death rate.

The graph shows standard deviation bars.

Figure 4



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0 4 . 2 The scientists concluded that the more fibre a person eats, the less likely they are to die from CHD.

Evaluate this statement.

Use information from **Figure 4**.

[3 marks]

Question 4 continues on the next page

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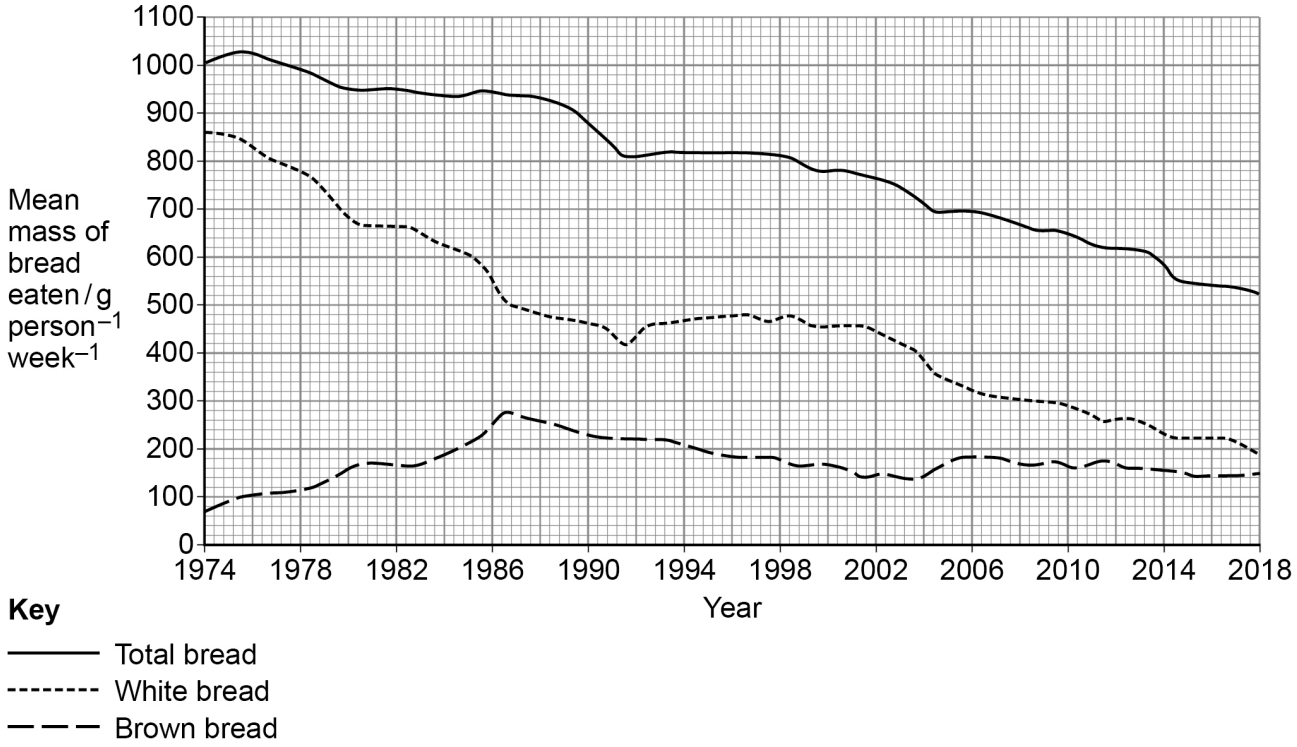
Bread is a source of fibre.

Figure 5 shows the average mass of bread eaten per person each week in the UK from 1974 to 2018.

Figure 5



0 4 . 3 Describe the patterns shown in **Figure 5**.

Use data in your answer.

[3 marks]

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15 students investigate the mass of fibre they obtain from their daily lunches.

Table 3 shows the fibre content of each student's lunch.

Table 3

Student	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
Fibre content of lunch / g	11	5	14	5	2	10	5	7	10	5	3	10	8	3	6

0 4 . 4 Give the **modal** fibre content of the students' lunches.

[1 mark]

0 4 . 5 Give the **median** fibre content of the students' lunches.

[1 mark]

0 4 . 6 Recent research recommends that everyone should eat between 25 and 30 g of fibre per day.

The students each get 18.4 g of fibre from their other meals during the day.

A student eats the median amount of fibre given in your answer to Question **04.5**.

Would this student get the recommended daily amount of fibre?

Show how you arrived at your answer.

[1 mark]

12

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0 5 A farmer grows wheat.

One year, as the wheat plants are growing, the leaves have yellow patches. The plants are shorter than normal and produce fewer seeds.

0 5 . 1 Suggest why wheat plants with yellow patches on their leaves produce fewer seeds.

[2 marks]

A group of agricultural students investigate the cause of the reduced yield of seeds.

They think the yellow patches are caused by a plant virus spread by aphids.

The students:
- select two fields where wheat has not been grown (fresh soil)
- select two fields where wheat has been grown (used soil)
- plant new wheat seeds in one 10 m^2 area in each of the four different fields
- collect aphids from the plants with reduced yield
- release the aphids onto **one** field with fresh soil and **one** field with used soil.

0 5 . 2 Suggest **two** factors the students should control in their investigation.

[2 marks]

1 _____

2 _____

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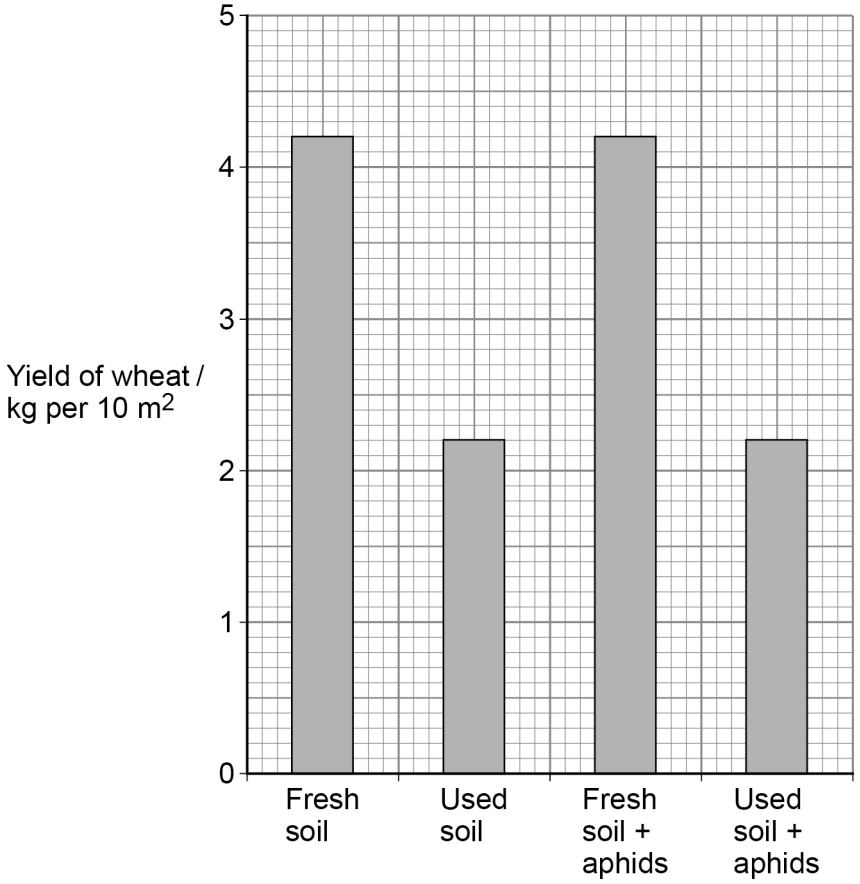
Figure 6 shows the yield of wheat harvested from each 10 m^2 area of the four different fields.

Figure 6



0 5 . 3 The data do **not** support the hypothesis that the virus is spread by aphids.

Explain why.

Use information from **Figure 6**.

[2 marks]

Question 5 continues on the next page

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0 5 . 4 The students conclude that the reduced yield is not caused by aphids.

Suggest a possible cause of the reduced yield.

[1 mark]

_____

_____

_____

7

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0 6 A teacher asks some students to prepare a root tip squash from a plant.

The students:

- collect root tips from a plant
- place the root tips in hydrochloric acid for 15 minutes
- rinse the root tips in distilled water in a watch glass
- cut off the end of the root tip (1 mm) and place it on a microscope slide
- cover the section with toluidine blue stain and mash with a mounted needle to separate the cells
- add a cover slip and squash to spread out the cells
- observe under a microscope.

The students draw some of the cells they can see with the microscope.

Figure 7 shows the drawings produced by student **A** and student **B**; these drawings look different from each other.

Figure 7

A **B**

0 6 . 1 The teacher states that student **B** has **not** prepared the slide correctly.

Suggest how the teacher knows from the drawings in **Figure 7** that student **B** has **not** prepared the slide correctly.

[1 mark]

_____

_____

_____

Question 6 continues on the next page

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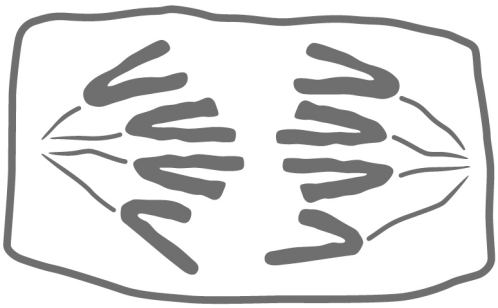
0 6 . 2 Give a possible explanation about what student **B** has done wrong.

[2 marks]

Another student draws one of the cells visible under the microscope.

Figure 8 shows the student's drawing.

Figure 8



0 6 . 3 Name the stage of mitosis shown in the drawing.

[1 mark]

Do not write outside the box

0 6 . 4 At the start of mitosis, chromosomes become visible and the nuclear membrane disintegrates.

Describe what happens after this to allow the chromatids to reach the position shown in **Figure 8**.

[3 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

0 6 . 5 A student calculates the mitotic index of the tissue as 4.7%

The student counts a total of 236 cells.

Calculate how many cells were in mitosis.

Give your answer to the nearest whole number.

[2 marks]

Number of cells in mitosis = _____

9

Turn over ►

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0 7 Stress can increase heart rate.

Doctors want to know if stress causes a greater increase in heart rate in people with high blood glucose levels than in people with normal blood glucose levels.

A group of young men are involved in a medical trial.

0 7 . 1 Before starting the medical trial, all the men are asked to walk up and down a set of stairs.

Anyone with a heart rate above 150 bpm is excluded from the medical trial.

Suggest a reason why.

[1 mark]

The young men are split into two groups of 12.

Each man in **Group 1** is given a drink containing 1 g of sucrose per kg body mass.

Each man in **Group 2** is given the same drink containing 1 g of sucralose per kg body mass instead of sucrose.

None of the men know which drink they have.

Sucralose is a substance with a similar structure to sucrose.

0 7 . 2 Describe how drinking sucrose raises blood glucose levels.

[3 marks]

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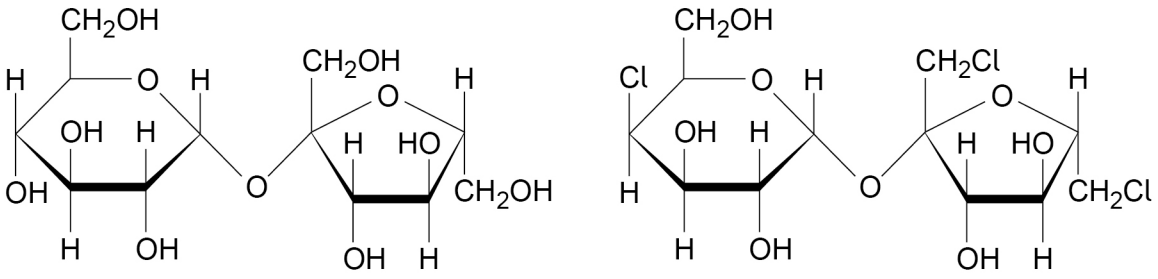
Figure 9 shows the structural formulae of sucrose and sucralose.

Figure 9



Sucrose Sucralose

0 7 . 3 Explain why sucralose does not increase blood glucose levels.

Use information from **Figure 9**.

[3 marks]

0 7 . 4 Sucralose is used as an artificial sweetener in food and drinks.

Suggest why the men in **Group 2** have a drink sweetened with sucralose rather than just drinking water.

[1 mark]

Question 7 continues on the next page

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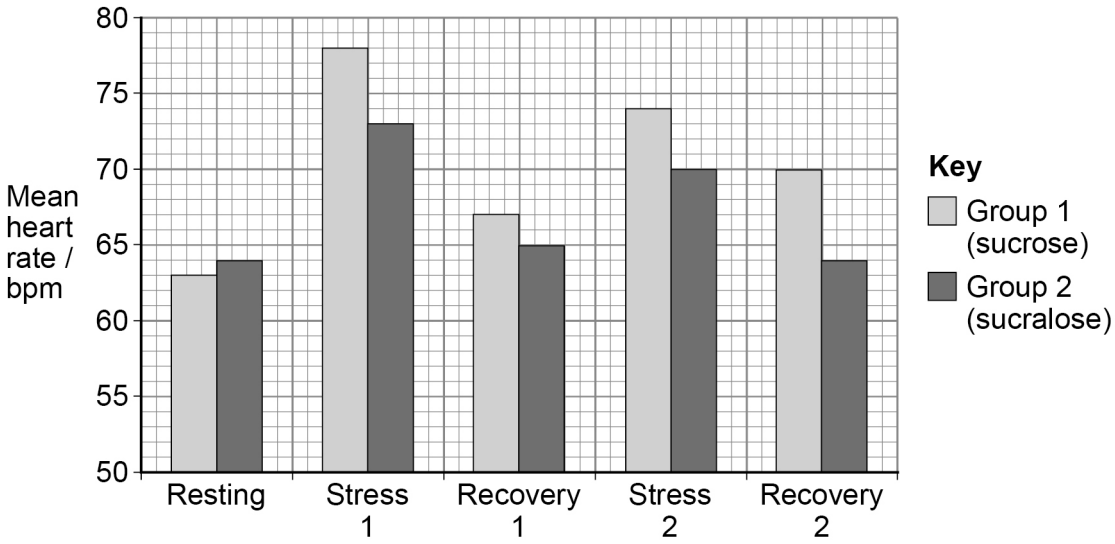
In the medical trial, the men's heart rates are measured at rest.

The men's heart rates are then measured straight after a stressful event and again after a 30-minute recovery.

The measurements are repeated after a second stressful event and after another 30-minute recovery.

Figure 10 shows the results.

Figure 10



0 7 . 5 Compare how the mean heart rates of the men in the two different groups were affected by the stressful events.

[3 marks]

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0 7 . 6 People with untreated Type 2 diabetes have high blood glucose levels.

Based on the trial, a student thinks that the heart rates of people with Type 2 diabetes would be more affected by stress than the heart rates of people without Type 2 diabetes.

Evaluate the student's statement.

[3 marks]

14

Turn over for the next question

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0 8 Multicellular organisms like plants and animals need specialised transport systems to move fluids around their bodies.

0 8 . 1 Describe how water moves from the soil into the xylem of a plant root.

[5 marks]

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0 8 . 2 Describe how blood is moved from the left ventricle of the heart to the body and back to the heart.

[5 marks]

10

END OF QUESTIONS

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