OXFORD AQA
INTERNATIONAL QUALIFICATIONS

Please write clearly in block capitals.

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I declare this is my own work.

INTERNATIONAL AS
BIOLOGY (9610)

Unit 2 Biological Systems and Disease

Wednesday 10 January 2024 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.

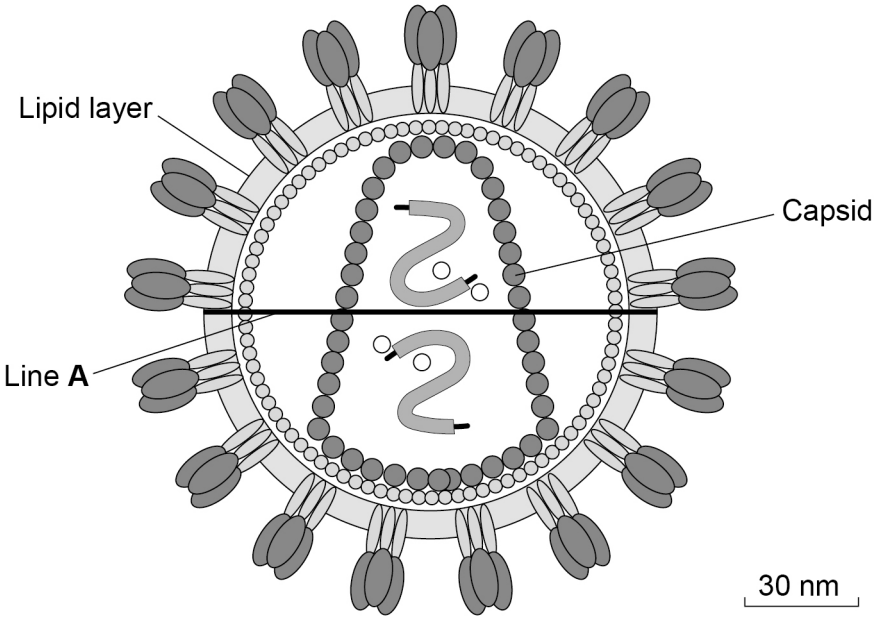
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

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

0 1 Human immunodeficiency virus (HIV) causes acquired immune deficiency syndrome (AIDS).

Figure 1 shows the structure of HIV.

Figure 1



0 1 . 1 Name the type of nucleic acid and an enzyme found inside the capsid.

[2 marks]

Type of nucleic acid _____

Name of enzyme _____

Do not write outside the box

0 1 . 2 HIV binds to receptors on helper T cells. The mean diameter of helper T cells is 8 μm and is many times larger than the HIV shown in **Figure 1**.

Calculate how many times larger.

Use the line labelled **A** to measure the diameter of the HIV.

Give your answer to 2 significant figures.

[2 marks]

Answer = _____ times larger

0 1 . 3 Describe how viral proteins are produced inside an infected helper T cell.

[4 marks]

_____

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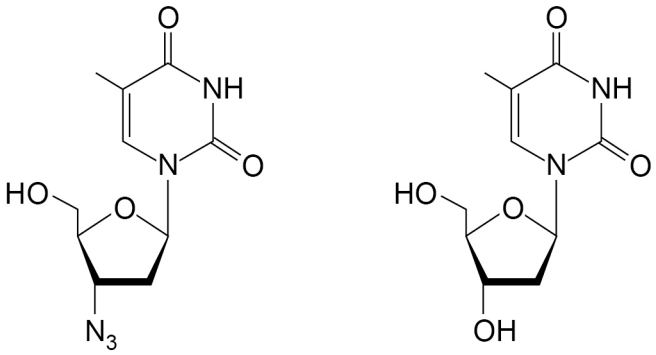
Question 1 continues on the next page

Azidothymidine (AZT) is a drug used for treating infection with HIV.

Figure 2 shows the structure of AZT and thymidine. Thymidine is part of a DNA nucleotide and consists of thymine joined to deoxyribose.

Figure 2



AZT **Thymidine**

0 1 . 4 Suggest how AZT could prevent the onset of AIDS.

[3 marks]

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11

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 2 . 1 Human heart rate varies depending on the needs of the body.

Some students plan to investigate the effect of exercise on heart rate.

Describe an investigation the students could do in school.

In your answer, include **one** safety precaution.

[4 marks]

0 2 . 2 Draw a suitable table for the results of the investigation you described in your answer to Question **02.1**.

[2 marks]

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A statistical test can be used to determine if the effect of exercise on the heart rate is significant.

0 2 . 3 State a suitable statistical test, the reason for choosing this test and the result you would expect if the effect of exercise on heart rate was significant.

[3 marks]

Name of statistical test _____

_____

Reason for choosing this test _____

_____

_____

_____

_____

_____

Result of test if exercise has a significant effect _____

_____

_____

_____

0 2 . 4 Give **two** factors, other than exercise, that may affect the heart rate of the students.

[2 marks]

1 _____

_____

2 _____

_____

11

Turn over for the next question

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0 3 Scientists investigate the effects of a fungal pathogen and aphids on the growth of a crop plant.

This is the method the scientists use:

1. Grow 20 plants from seeds that are infected with the fungal pathogen and 20 plants from seeds that are not infected.
2. Set up 4 groups of plants as follows:
   - **A** – infected plants with aphids added
   - **B** – non-infected plants with aphids added
   - **C** – infected plants with no aphids added
   - **D** – non-infected plants with no aphids added.
3. Grow the plants for 4 weeks in a light-controlled and temperature-controlled room.
4. Remove the aphids from the plants in groups **A** and **B**.
5. Put all the plants from each group in an oven at 90 °C to evaporate water from the plant tissue.
6. Calculate the mean dry mass per plant for each group.

0 3 . 1 During the investigation, the scientists control light and temperature.

Give **two** other variables the scientists should control.

[2 marks]

1 _____

2 _____

0 3 . 2 Suggest how the scientists can make sure that all the water in the plant samples has evaporated at step 5.

[2 marks]

_____

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Table 1 shows the scientists' results.

Table 1

Treatment	Mean dry mass of plants / g (±SD)
A	1.09 ± 0.12
B	2.21 ± 0.14
C	1.43 ± 0.24
D	4.34 ± 0.56

0 3 . 3 Describe what the results in **Table 1** show about the effects of the fungal pathogen and the aphids on the growth of the crop plant.

[4 marks]

Question 3 continues on the next page

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0 3 . 4 Explain how aphids feed on crops and how this would reduce crop production.

In your answer, use the results from **Table 1** (on page 9) and your own knowledge.

[3 marks]

11

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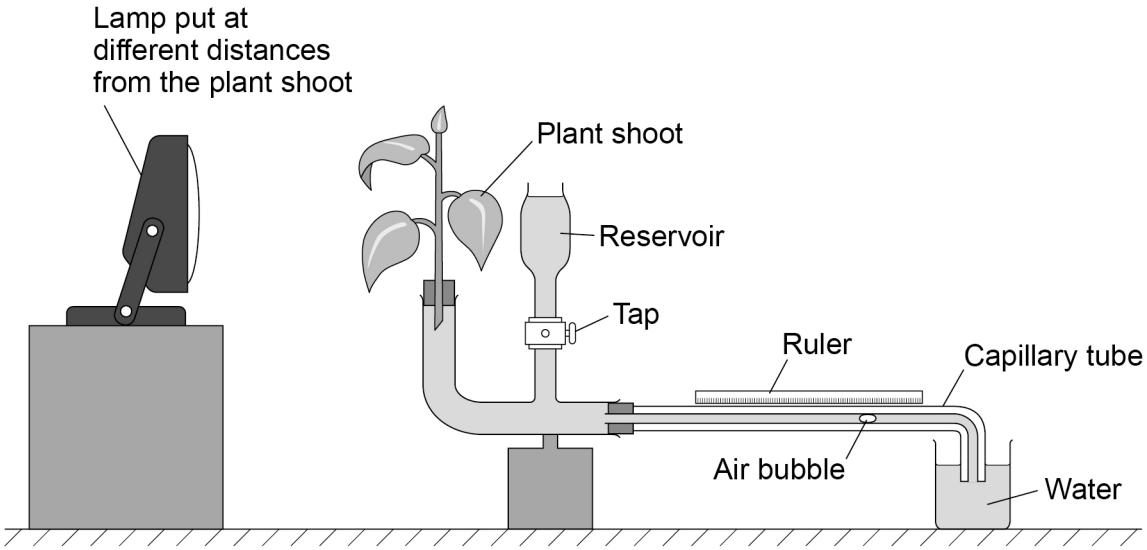
0 4 Students investigate the effect of light intensity on the rate of water uptake by a plant shoot.

The students put a lamp at different distances from a potometer to change the light intensity.

Figure 3 shows the equipment the students use.

Figure 3



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0 4 . 1 Describe how the students could:

- prevent air entering the xylem of the plant shoot when setting up the equipment
- prevent leaks from the potometer
- prevent the air bubble in the capillary tube moving off the scale.

[3 marks]

Prevent air entering the xylem of the plant shoot when setting up the equipment

Prevent leaks from the potometer

Prevent the air bubble in the capillary tube moving off the scale

Question 4 continues on the next page

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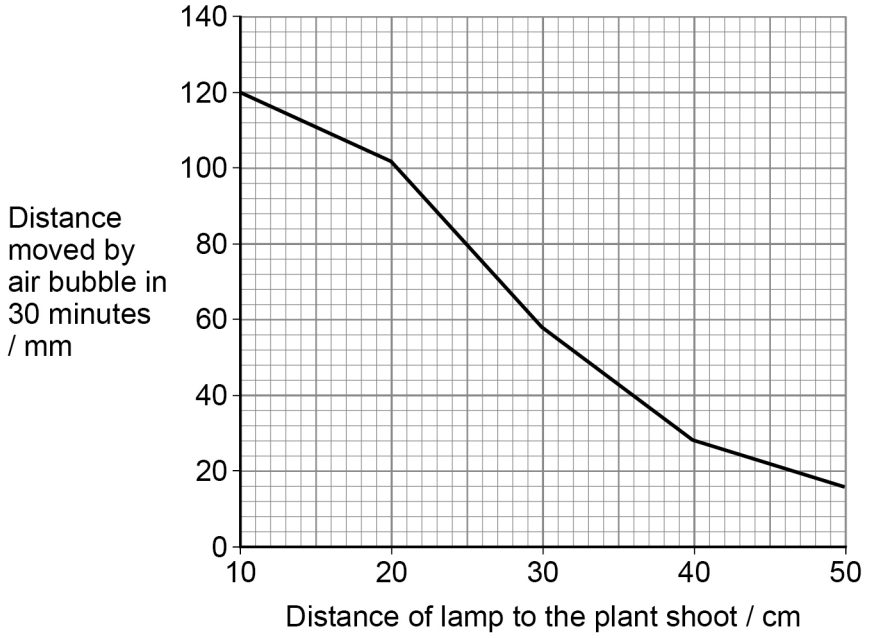
Figure 4 shows the students' results from this experiment.

Figure 4



The rate of water uptake is calculated using the distance moved by the air bubble inside the capillary tube.

The internal diameter of the capillary tube shown in **Figure 3** (on page 12) is 1.0 mm

0 4 . 2 Calculate the difference in rate of water uptake when the plant shoot was 10 cm from the lamp and when it was 50 cm away from the lamp.

Give your answer in $mm^3\ min^{-1}$

Use π = 3.14

[3 marks]

Difference in rate of water uptake = _____ $mm^3\ min^{-1}$

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0 4 . 3 One student thinks that increasing light intensity causes more potassium ions to move into guard cells.

Suggest how the movement of potassium ions into guard cells would explain the results shown in **Figure 4**.

[3 marks]

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9

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0 5 The transport systems of animals contain different types of blood vessel. **Figure 5** shows a photograph of a section through an artery and a vein.

Figure 5

0 5 . 1 Suggest why the artery appears circular in **Figure 5**, but the vein does not.

[1 mark]

_____

_____

_____

Question 5 continues on the next page

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Table 2 gives data for different types of blood vessel.

Table 2

Blood vessel	Mean length / cm	Mean diameter / cm	Total cross-sectional area / cm^2	Total blood volume / cm^3	Rate of blood flow ($cm^3\ s^{-1}$)
Aorta	40	1.0	0.8	30	28
Other large arteries	20	0.3	3	60	7.8
Arterioles	0.2	0.002	125	25	1.18
Capillaries	0.1	0.0008	600	60	0.036
Venules	0.2	0.0003	570	110	0.04
Large veins other than vena cava	20	0.6	11	220	1.9
Vena cava	40	1.3	1.2	50	1.8

0 5 . 2 Column 5 of **Table 2** shows the total blood volume for each type of blood vessel.

Give a word equation for calculating the total blood volume of a type of blood vessel.

Use information from **Table 2**.

[1 mark]

_____

0 5 . 3 Calculate the ratio of the rate of blood flow in the aorta to the rate of blood flow in the capillaries.

Give your answer to the nearest whole number.

[1 mark]

Answer = _____ : 1

Do not write outside the box

0 5 . 4 The rate of blood flow in capillaries is slow.

Suggest why this is an advantage to an organism.

[1 mark]

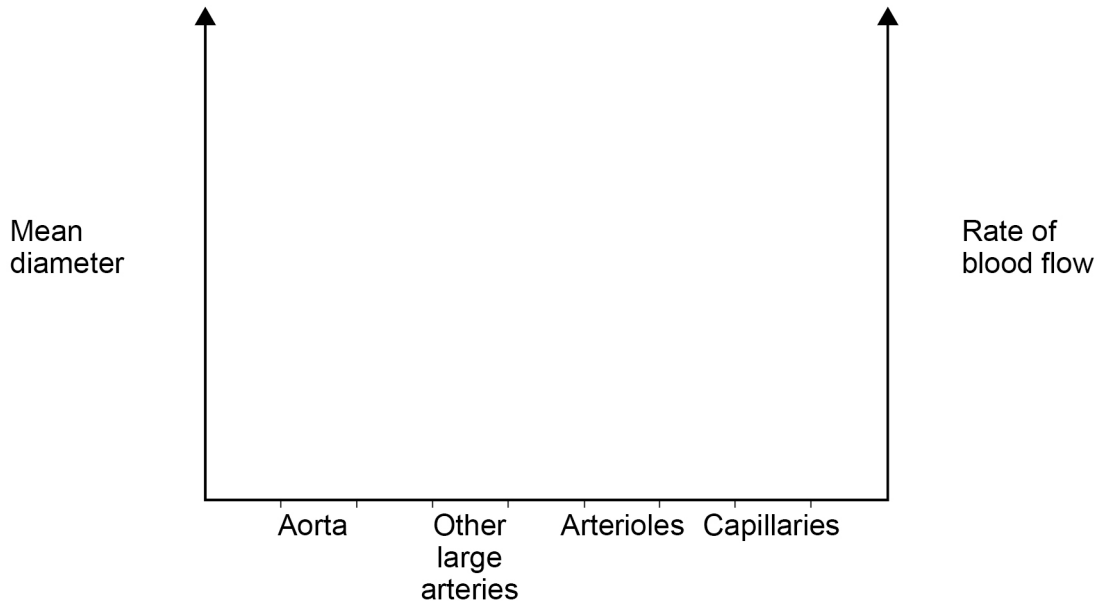
0 5 . 5 Sketch a graph to show the mean diameter and rate of blood flow for the:

- aorta
- other large arteries
- arterioles
- capillaries.

Use bars to show the mean diameters and a line to show rates of flow.

Do **not** include scales on your graph.

[2 marks]



0 5 . 6 Describe the relationship between mean diameter and rate of blood flow.

[1 mark]

7

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0 6 The human immune system responds to antigens by stimulating specific lymphocytes called T cells and B cells.

0 6 . 1 Define the term **antigen**.

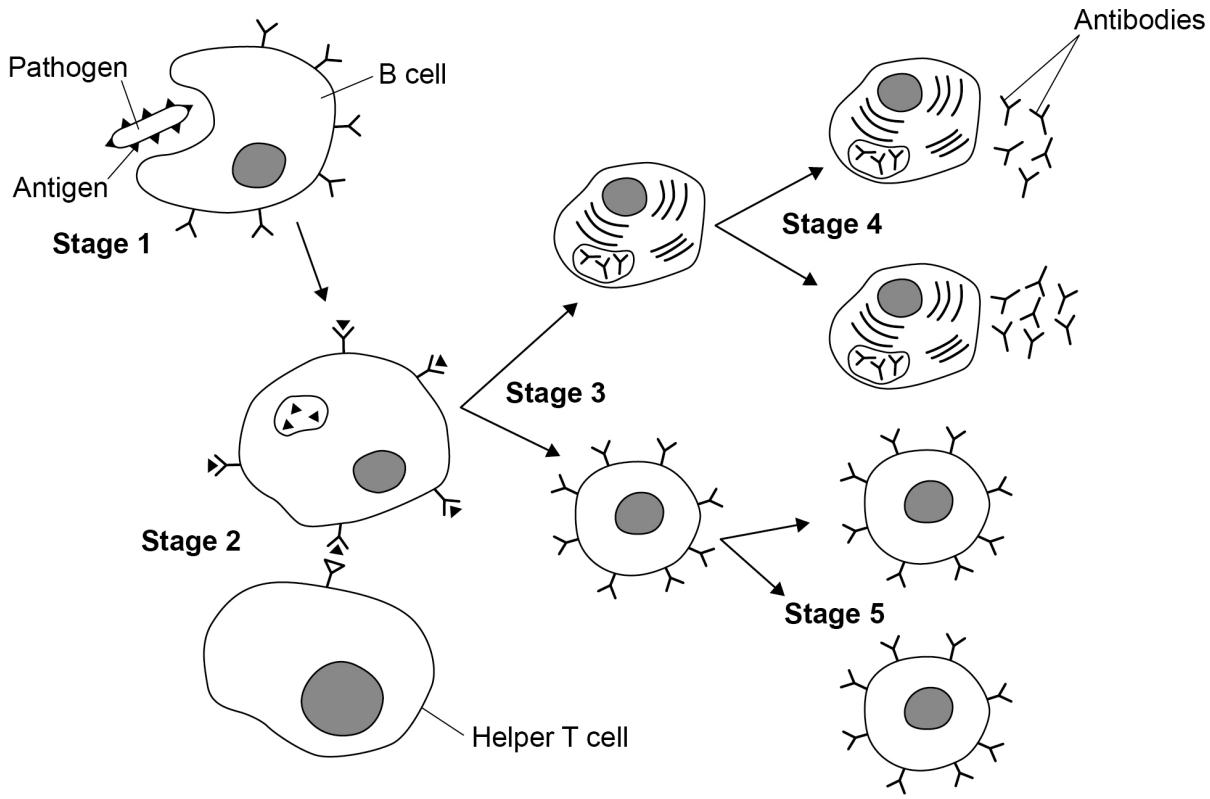
[1 mark]

_____

_____

Figure 6 shows the sequence of events during B cell activation.

Figure 6



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0 6 . 2 Describe what is happening in **Stage 1** and **Stage 2**.

[3 marks]

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0 6 . 3 An activated B cell divides into two different types of cells as shown in **Stage 3** on **Figure 6**.

Plasma cells produce large quantities of antibody molecules (**Stage 4**).

Name the type of cells shown in **Stage 5** and state their function.

[2 marks]

Name of cells _____

Function _____

_____

0 6 . 4 **Figure 6** shows antibody molecules as 'Y' shapes.

Draw a diagram to show the **detailed** structure of an antibody molecule.

Label your diagram.

[4 marks]

Question 6 continues on the next page

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A plasma cell can produce 2000 antibody molecules every second.

0 6 . 5 Calculate the number of antibody molecules **one** plasma cell could produce in 48 hours.

Give your answer in standard form to 2 significant figures.

[2 marks]

Number of antibody molecules = _____

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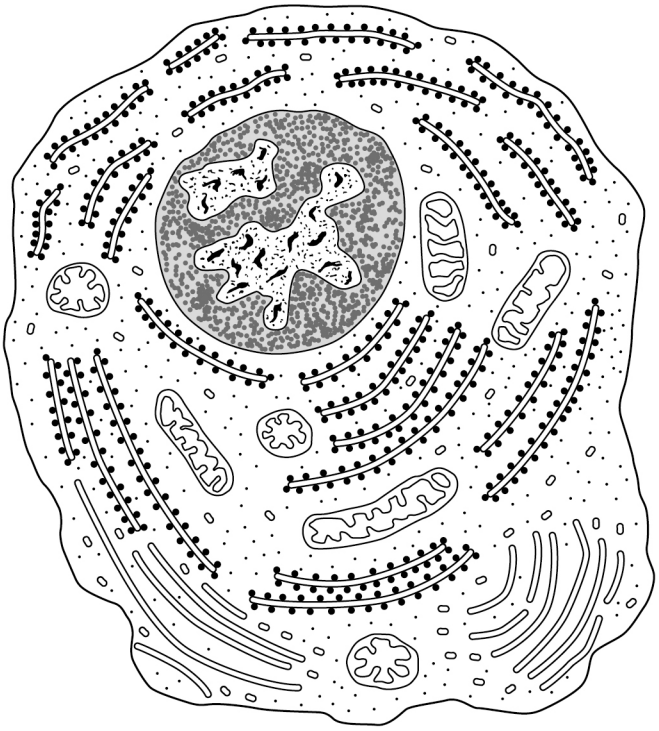
Figure 7 shows a plasma cell viewed with an electron microscope.

Figure 7



0 6 . 6 Identify **two** features shown in **Figure 7** that allow plasma cells to produce antibody molecules.

Explain how each feature allows plasma cells to produce very large numbers of antibody molecules very quickly.

[4 marks]

Feature 1 _____

Explanation _____

_____

_____

_____

Feature 2 _____

Explanation _____

_____

_____

_____

16

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0 7 Fats are digested in the human digestive system by lipases.

0 7 . 1 Describe how the products of fat digestion are absorbed.

[5 marks]

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0 7 . 2 A diet with a high fat content may increase the risk of developing coronary heart disease.

Describe how.

[5 marks]

10

END OF QUESTIONS

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