OXFORD

INTERNATIONAL
AQA EXAMINATIONS

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 13 January 2021 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 . 1 The aorta is a large artery carrying blood away from the heart.

Describe how the structure of the aorta makes it suitable for this role.

[3 marks]

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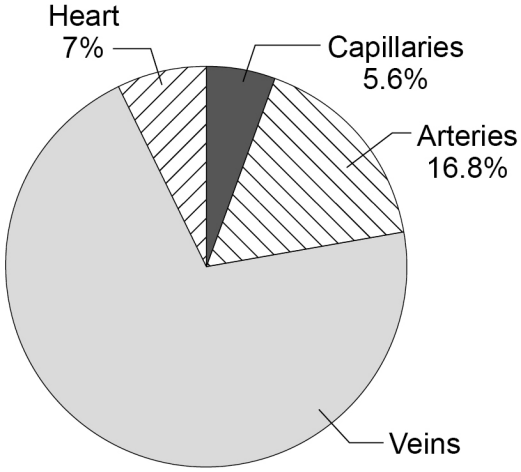
0 1 . 2 **Figure 1** shows the percentage of total blood volume in each of the different types of blood vessel in the human body.

Figure 1



Calculate the volume of blood in the veins if the total blood volume is 6000 cm^3

Give the volume to 2 significant figures.

[2 marks]

Volume of blood in the veins _____ cm^3

0 1 . 3 Suggest how the structure of veins allows them to carry the largest proportion of the total blood volume in the human body.

[1 mark]

_____

_____

_____

_____

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0 1 . 4 State the function of capillaries.

[1 mark]

_____

_____

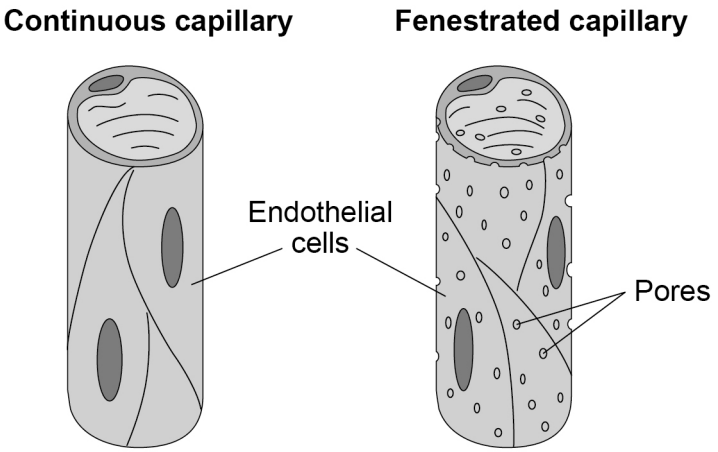
_____

0 1 . 5 **Figure 2** shows two different types of capillary, a continuous capillary and a fenestrated capillary.

The walls of both types of capillary are made of endothelial cells.

The membranes of the endothelial cells of fenestrated capillaries contain many pores.

Figure 2



Suggest an organ that might contain fenestrated capillaries.

Explain your choice.

[2 marks]

Organ _____

Explanation _____

_____

_____

9

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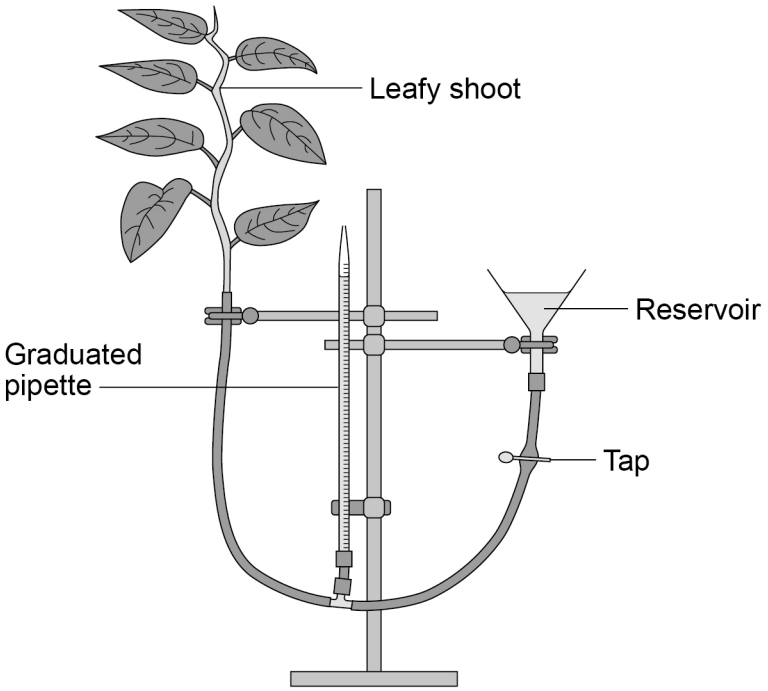
0 2 A student wants to know how much water a plant needs each week to prevent wilting (drooping leaves).

The student makes a potometer to estimate the rate of water uptake by a leafy shoot from the plant.

The potometer is set up as in **Figure 3** in a laboratory with a constant temperature of 15°C

Figure 3



0 2 . 1 The student controls the temperature.

Give **two** other environmental factors the student would need to control.

[2 marks]

1 _____

2 _____

0 2 . 2 Give the function of the reservoir.

[1 mark]

_____

_____

_____

Turn over ►

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The student uses the potometer to measure the volume of water taken up by the leafy shoot in 45 minutes.

Table 1 shows the student's results.

0 2 . 3 Complete **Table 1** to show the rate of water uptake per minute in each 15-minute period.

[2 marks]

Table 1

Time / min	**Reading on pipette / mm^3**	**Volume of water taken up / mm^3**	**Rate of water uptake / mm^3 min^{-1}**
0	0.5	0.0	0.00
15	4.4	3.9	
30	8.1	7.6	
45	11.8	11.3	

0 2 . 4 The student uses the data from **Table 1** and the number of minutes in a week to estimate the total volume of water the **whole** plant will need for 1 week.

Give **one** more measurement the student will need to make the estimation.

[1 mark]

_____

_____

_____

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0 2 . 5 The student waters the plant with the total estimated volume of water needed for 1 week.

After 4 days, the leaves of the plant have wilted.

Suggest why.

[2 marks]

0 2 . 6 Root pressure is a force that helps to move water through the xylem.

Describe how.

[3 marks]

11

Turn over for the next question

Do not write outside the box

0 3 . 1 Aphids feed on plants by inserting their mouthparts into the phloem.

Give the name of an aphid's mouthparts.

[1 mark]

_____

0 3 . 2 After an aphid has pierced the phloem with its mouthparts, the phloem sap is forced into the aphid's gut under high pressure.

Explain how this high pressure is generated in the phloem.

[3 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

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Question 3 continues on the next page

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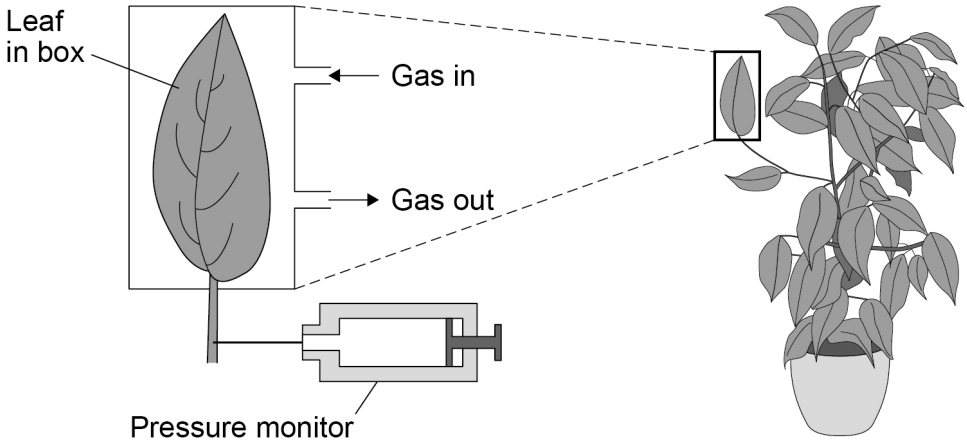
The mass flow hypothesis is one explanation of how sucrose moves through the phloem.

Scientists investigate the need for active transport in mass flow.

The scientists use a leaf that is still attached to a plant.

Figure 4 shows how the experiment is set up.

Figure 4



The scientists:

- insert a pressure monitor into the phloem in the leaf stalk of a leaf
- measure the pressure in the phloem at regular intervals using three different external conditions

These conditions are:

- leaf in air 0–6 min
- leaf in pure nitrogen gas 6–30 min
- leaf in air 30–40 min.

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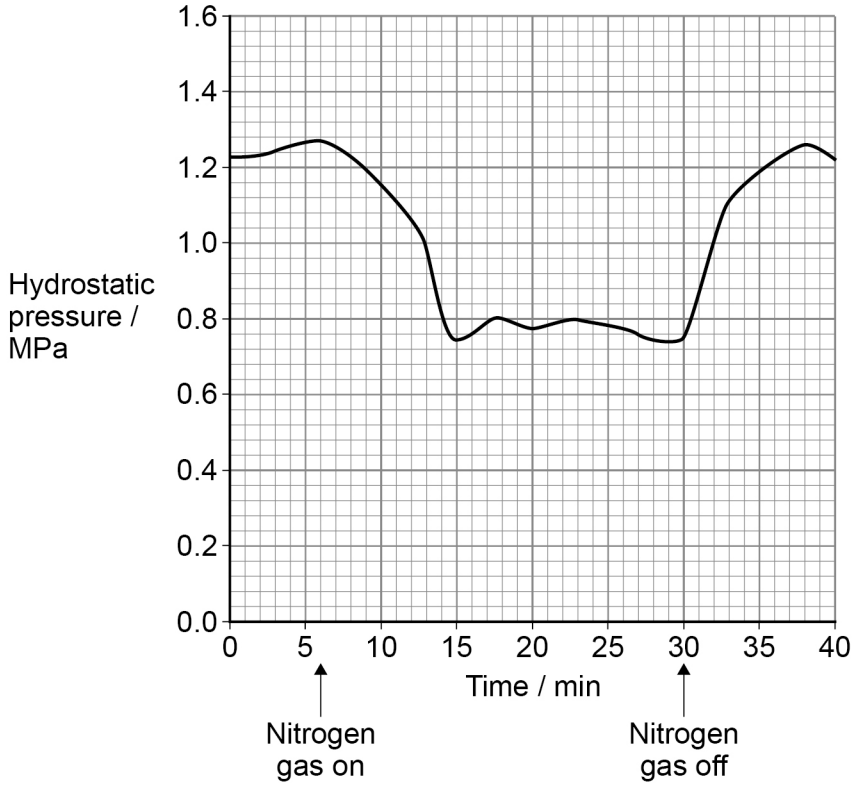
Figure 5 shows the changes in the hydrostatic pressure in the phloem when the leaf was in air (0–6 min and 30–40 min) and when the leaf was in pure nitrogen gas (6–30 min).

Figure 5



0 3 . 3 Suggest why nitrogen gas was used in this experiment.

[2 marks]

Question 3 continues on the next page

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0 3 . 4 The scientists think this experiment confirms that sucrose moves through the phloem by mass flow.

Evaluate how well the scientific procedures used in this experiment confirm the mass flow hypothesis.

[4 marks]

10

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0 4 Carbohydrates are an important part of the human diet.

0 4 . 1 Which statement is true for the digestion of the carbohydrate starch?

Tick (✓) **one** box.

[1 mark]

Digestion of starch involves:

condensation in the large intestine. ☐

condensation in the small intestine. ☐

hydrolysis in the large intestine. ☐

hydrolysis in the small intestine. ☐

0 4 . 2 Name the **two** enzymes needed for the complete digestion of starch to glucose.

[1 mark]

1 _____

2 _____

Question 4 continues on the next page

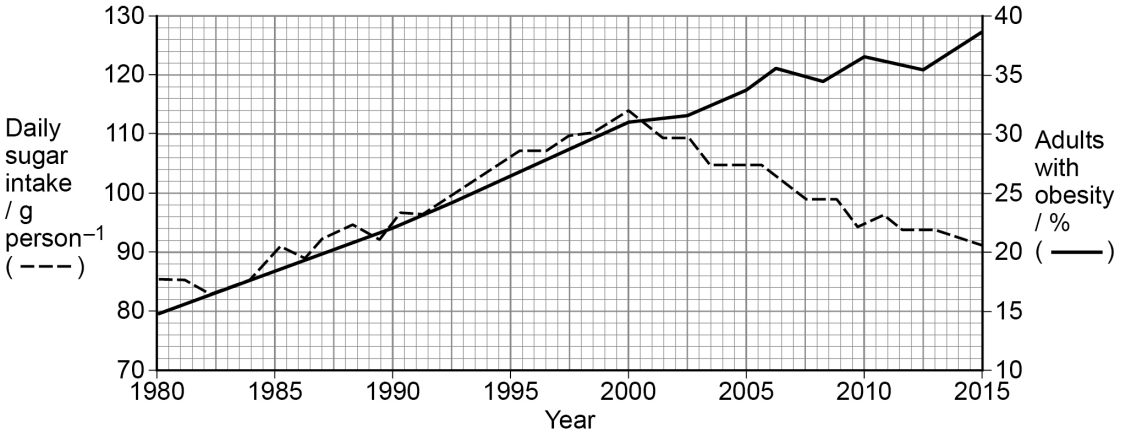
Do not write outside the box

When energy intake is much greater than energy use, a person can become obese. **Figure 6** shows:

- the daily sugar intake per person
- the percentage of adults with obesity

in the USA between 1980 and 2015.

Figure 6



0 4 . 3 A journalist uses **Figure 6** to write an article stating:

'A diet high in sugar will cause obesity and coronary heart disease.'

Evaluate this statement.

Use data from **Figure 6**.

[3 marks]

Do not write outside the box

0 4 . 4 The recommended total daily energy intake for an adult is 8700 kJ

1 g of sugar provides 16.8 kJ of energy.

Calculate the daily energy intake per person from sugar in the year 2000 as a percentage of the recommended total daily energy intake.

Use data from **Figure 6**.

[2 marks]

Percentage of energy intake from sugar = _____ %

0 4 . 5 Dietary factors can cause obesity.

Obesity is a risk factor for coronary heart disease.

Give one **non-dietary** risk factor for coronary heart disease.

[1 mark]

_____

8

Turn over for the next question

Do not write outside the box

0 5 Environmental risk factors may increase the number of cases of some types of cancer.

The use of fertilisers containing nitrates could be a risk factor if the nitrates enter drinking water.

Table 2 shows the number of cases of thyroid cancer in 20 651 women living in farming areas of the USA over 18 years.

Table 2

Nitrate intake / mg day^{-1}	**Number of cases of thyroid cancer during the 18-year study**
≤17.4	6
17.5–27.7	10
27.8–41.1	10
>41.1	14

0 5 . 1 A student states:

"High levels of nitrates in drinking water increase the risk of developing thyroid cancer."

Discuss why this conclusion might **not** be valid.

Use information from **Table 2**.

[3 marks]

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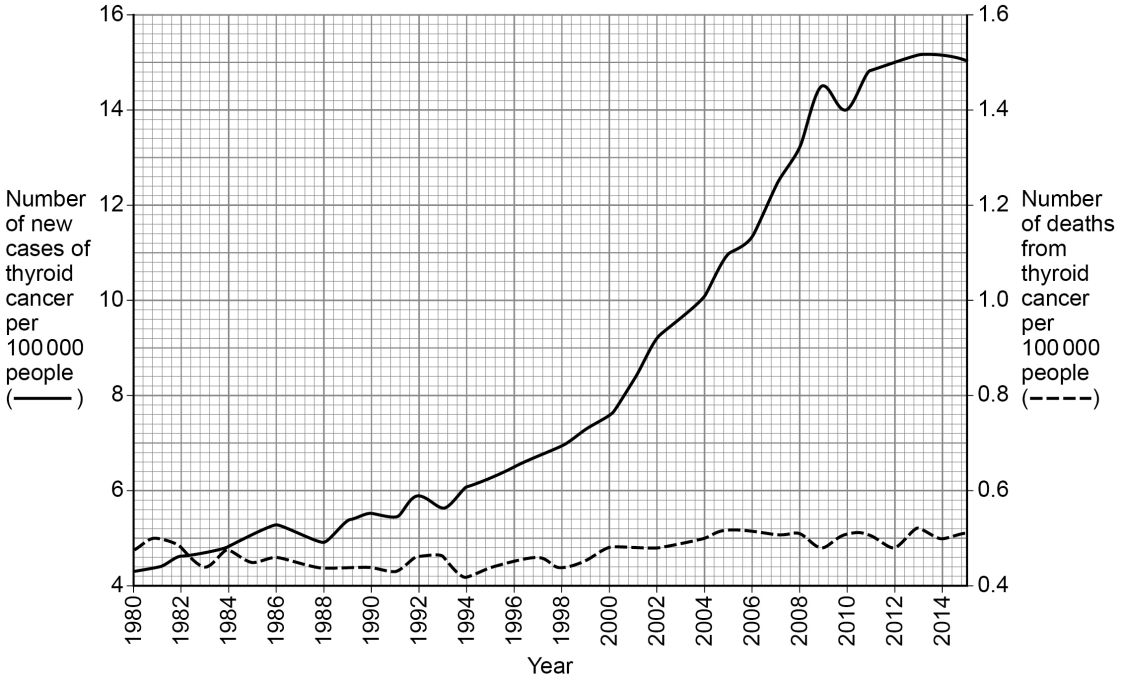
A different study considered the number of new cases of thyroid cancer and the death rate from thyroid cancer in the USA between 1980 and 2015.

Figure 7 shows the results.

Figure 7



0 5 . 2 Describe the patterns in the number of cases and the number of deaths shown in **Figure 7**.

Use data in your answer.

[3 marks]

Do not write outside the box

0 5 . 3 More people were diagnosed with thyroid cancer in 2015 than in 1980.

However, more people survived thyroid cancer in 2015 than in 1980.

Suggest how **both** of these statements could be true.

[1 mark]

0 5 . 4 Vincristine is a drug used for the treatment of thyroid cancer.

Vincristine prevents the formation of the spindle during mitosis.

Explain the effect vincristine would have on cell division.

You should refer to stages of mitosis in your answer.

[3 marks]

10

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0 6 Cardiac output is an important indicator of cardiovascular health.

0 6 . 1 Give the equation used to calculate cardiac output.

[1 mark]

_____

0 6 . 2 Cardiac output depends on a person's size.

Cardiac index is a measure that uses a person's size and cardiac output.

A patient has:

- a cardiac output of 7150 cm^3 min^{-1}
- a cardiac index of 3765 cm^3 min^{-1} m^{-2}

Calculate this patient's surface area.

Give your answer to 1 decimal place and include appropriate units.

[2 marks]

Patient's surface area = _____

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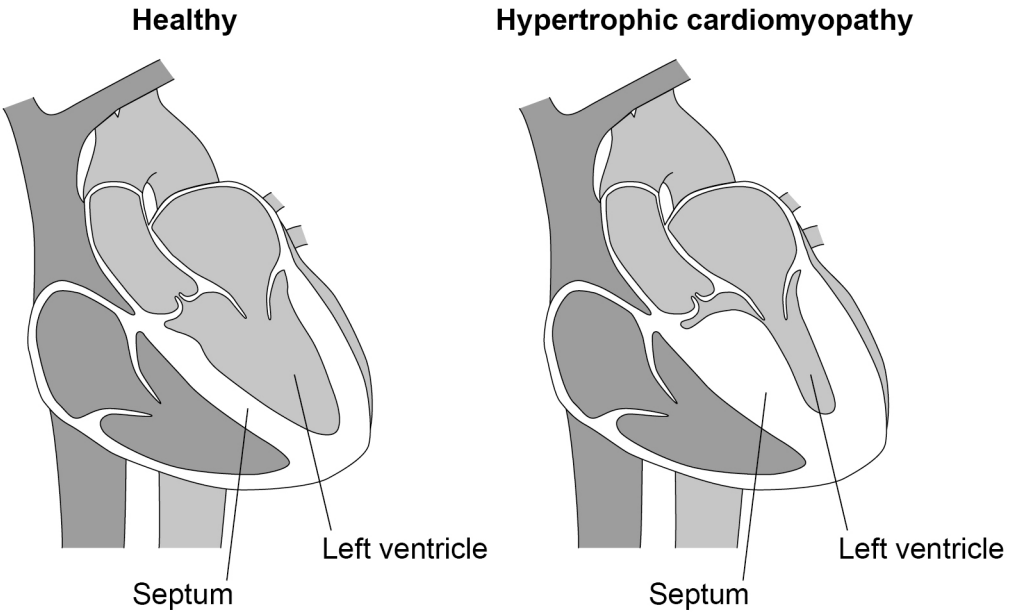
Some people are born with a heart condition called hypertrophic cardiomyopathy (HCM).

Figure 8 shows a diagram of a healthy heart and a diagram of a heart from a person with HCM.

Figure 8



Doctors study the differences in the structure and function of the hearts in 100 healthy volunteers and 100 patients with HCM.

Table 3 shows the doctors' results. All the values are means.

Table 3

	Healthy volunteers	**People with HCM**
Stroke volume / cm^3	102	85
Maximum thickness of outer wall of left ventricle / mm	76	175
Thickness of septum / mm	75	142
Ability of ventricle walls to relax	Walls can relax fully	Walls too stiff to relax fully

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Some of the symptoms of HCM include:

- sensation of rapid or pounding heartbeats
- feeling breathless during exercise
- fainting, especially during or just after exercise.

0 6 . 3 Suggest what causes each of these symptoms.

Use information from **Figure 8** and **Table 3**.

[3 marks]

6

Turn over for the next question

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0 7 Eukaryotic cells have a cell cycle.

Students prepare root tip squashes from two different species of plants, **A** and **B**, to compare their cell cycles.

0 7 . 1 During the preparation of the squashes, the root tips are soaked in acid.

Suggest **one** reason why this step is needed.

[1 mark]

0 7 . 2 The students observe the cells using a light microscope and a high-power lens. The students count several fields of view and calculate the mitotic index as 0.13 for plant **A** and 0.25 for plant **B**.

Explain what the difference in mitotic index indicates about the different plants.

[2 marks]

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Question 7 continues on the next page

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0 7 . 3 Some of the root tip cells are in interphase.

Interphase is made up of three phases, G1, S and G2.

Complete **Table 4** to show **one** process that occurs in each of the phases S and G2.

[2 marks]

Table 4

Phase	**Process**
G1	Replication of organelles
S	
G2	

The time that cells spend in DNA replication might be related to the size of the organism's genome.

Table 5 shows the time spent in DNA replication in minutes and the genome size (number of base pairs) in a variety of different species.

Table 5

Domain	**Phylum**	**Species**	**Time for DNA replication / min**	**Genome size / base pairs**
Eukaryote	Nematoda	*Caenorhabditis elegans*	360	9.7×10^7
Bacteria	Proteobacteria	*Caulobacter crescentus*	80	4.0×10^6
Bacteria	Proteobacteria	*Escherichia coli*	60	4.6×10^6
Eukaryote	Chordata	*Homo sapiens*	530	2.9×10^9
Eukaryote	Chordata	*Mus musculus*	420	2.6×10^9
Eukaryote	Arthropoda	*Oncopeltus fasciatus*	289	9.8×10^8
Eukaryote	Chordata	*Rattus rattus*	480	2.8×10^9

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0 7 . 4 Identify the most appropriate statistical test to show if there is a relationship between the time spent in DNA replication and the size of the genome.

[1 mark]

_____

0 7 . 5 The scientists chose a suitable statistical test.

The statistical test produced a value of 0.93, with a P value of 0.02.

Describe what these values show.

[2 marks]

Test value of 0.93 _____

_____

P value of 0.02 _____

_____

_____

_____

Question 7 continues on the next page

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0 7 . 6 Base pairing occurs during DNA replication.

Calculate the rate of base pairing per second for the species in the phylum Arthropoda.

Use data from **Table 5** (page 24).

[2 marks]

Rate = _____ base pairs s^{-1}

0 7 . 7 Other experiments on eukaryotic cells show that base pairing occurs at a rate of 50 bases per second. At this rate, DNA replication of all the chromosomes from end to end could not be completed in the times given in **Table 5**.

Suggest how DNA replication might be possible in the shorter times given in **Table 5**.

Use your knowledge of DNA structure and assume all experimental values are correct.

[1 mark]

_____

_____

_____

11

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0 8 . 1 Cholera is a disease caused by drinking water contaminated with bacteria.
One symptom of cholera is severe diarrhoea.

Describe how the bacteria cause this symptom.

[4 marks]

Question 8 continues on the next page

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0 8 . 2 Describe the primary immune response to the bacteria that cause cholera.

[6 marks]

10

END OF QUESTIONS

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