Please write clearly in block capitals.

Centre number						Candidate number				

Surname ______________________

Forename(s) ______________________

Candidate signature ______________________
I declare this is my own work.

AS
BIOLOGY
Paper 2

Friday 22 May 2020 Morning Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator.

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).
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for the 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	
9	
TOTAL	

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

0 1 . 1 *Littorina littorea* is a species of snail found on rocky sea shores.

A student investigated variation in snail shell height in two populations of snails.

Give **two** ways in which the student could ensure his samples would provide a reliable measure of the variation between individuals in each population.

[2 marks]

1 ____________________

____

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2 ____________________

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0 1 . 2 The student could determine the median, mode and range from his measurement of shell heights in these populations.

Give **two** other statistical values the student could calculate from his measurement of shell heights in these populations.

[1 mark]

1 ____________________

2 ____________________

0 1 . 3 Name the taxon in the hierarchy of classification represented by:

[1 mark]

1 *Littorina* ____________________

2 *littorea* ____________________

0 1 . 4 The student noticed there was a difference in shell height between these populations of snails. He wanted to investigate if the difference was significant.

Give a suitable null hypothesis to use in his investigation and name the statistical test to use with these data.

[2 marks]

Null hypothesis ____

____

____

Statistical test ____

____

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6

Turn over for the next question

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0 2 . 1 Describe how a phosphodiester bond is formed between two nucleotides within a DNA molecule.

[2 marks]

0 2 . 2 The two DNA strands of a particular gene contain 168 guanine bases between them. The relationship between the numbers of guanine bases (G), adenine bases (A), thymine bases (T) and cytosine bases (C) in these two strands of DNA is shown in the following equation.

$$G = 4(A + T) - C$$

Use this information and your understanding of DNA structure to calculate the maximum number of amino acids coded by this gene.

Show your working.

[2 marks]

Answer ____________________

0 2 . 3 Name the protein associated with DNA in a chromosome.

[1 mark]

Do not write outside the box

0 2 . 4 In the process of semi-conservative DNA replication, the two strands within a DNA molecule are separated. Each then acts as a template for the formation of a new complementary strand.

Describe how the separation of strands occurs.

[2 marks]

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7

Turn over for the next question

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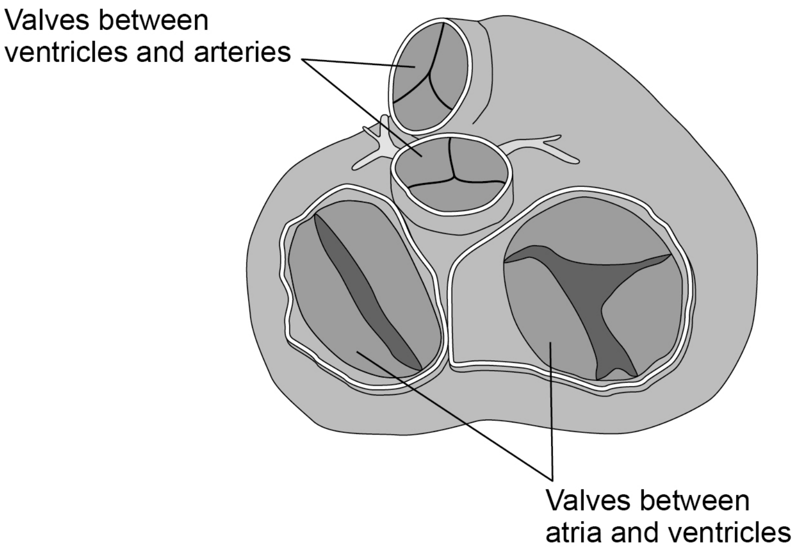
0 3 . 1 Explain how an arteriole can reduce the blood flow into capillaries.

[2 marks]

Figure 1 shows heart valves during one stage of a cardiac cycle.

Ventricles are visible through the open valves.

Figure 1



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0 3 . 2 What can you conclude from the appearance of valves in **Figure 1** about heart muscle activity and blood movement between:

1. ventricles and arteries?

[2 marks]

2. atria and ventricles?

[2 marks]

Question 3 continues on the next page

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0 3 . 3 Tick (✓) **one** box next to the blood vessel carrying blood at the lowest blood pressure.

[1 mark]

Capillary ☐

Pulmonary vein ☐

Renal vein ☐

Vena cava ☐

0 3 . 4 A scientist measured the heart rate and the volume of blood pumped in a single heart beat (stroke volume) of an athlete before exercise and calculated the cardiac output.

Cardiac output is calculated using this equation.

$$\text{cardiac output} = \text{heart rate} \times \text{stroke volume}$$

Her results are shown in **Table 1**.

Table 1

Heart rate / beats minute^{-1}	**Stroke volume / cm^3**	**Cardiac output / cm^3 minute^{-1}**
62	80	4960

After exercise, the athlete's stroke volume increased by 30% and the cardiac output was 13 832 cm^3 minute^{-1}

Calculate the athlete's heart rate after exercise.

Give the answer to 2 significant figures. Show your working.

[2 marks]

Heart rate ____________________ beats minute^{-1}

9

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0 4 A student investigated the effect of ethanol, hydrochloric acid and temperature on the loss of red pigment from beetroot cells.

During the procedure, the student:

- added 10 cm^3 water into one test tube
- added 10 cm^3 ethanol into a second test tube
- added 10 cm^3 hydrochloric acid into a third test tube
- put the three tubes into a 25 °C water bath
- cut four cylinders of tissue from a beetroot
- put a cylinder into each tube and fitted bungs
- added 10 cm^3 water into a fourth test tube and put this tube into a 70 °C water bath
- placed the fourth cylinder into this tube and fitted a bung
- later removed the cylinders from the tubes
- estimated the intensity of red pigment in each solution by eyesight.

0 4 . 1 Give **one** way in which the student could ensure the first three beetroot cylinders were kept at 25 °C throughout her experiment.

[1 mark]

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0 4 . 2 Give **two** variables that the student did **not** control in her procedure.

[2 marks]

1 ____

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2 ____

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Question 4 continues on the next page

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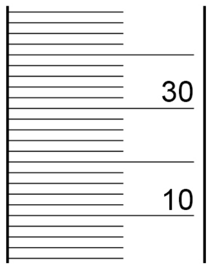
0 4 . 3 The student used a measuring cylinder to obtain 10 cm^3 of each solution.

Figure 2 shows some of the scale graduations on the side of this measuring cylinder.

Figure 2



What is the uncertainty of taking a reading of 10 cm^3 with this measuring cylinder?

Suggest how you could reduce the uncertainty calculated.

[2 marks]

Uncertainty ± ____________________ cm^3

Reducing uncertainty ____________________

____

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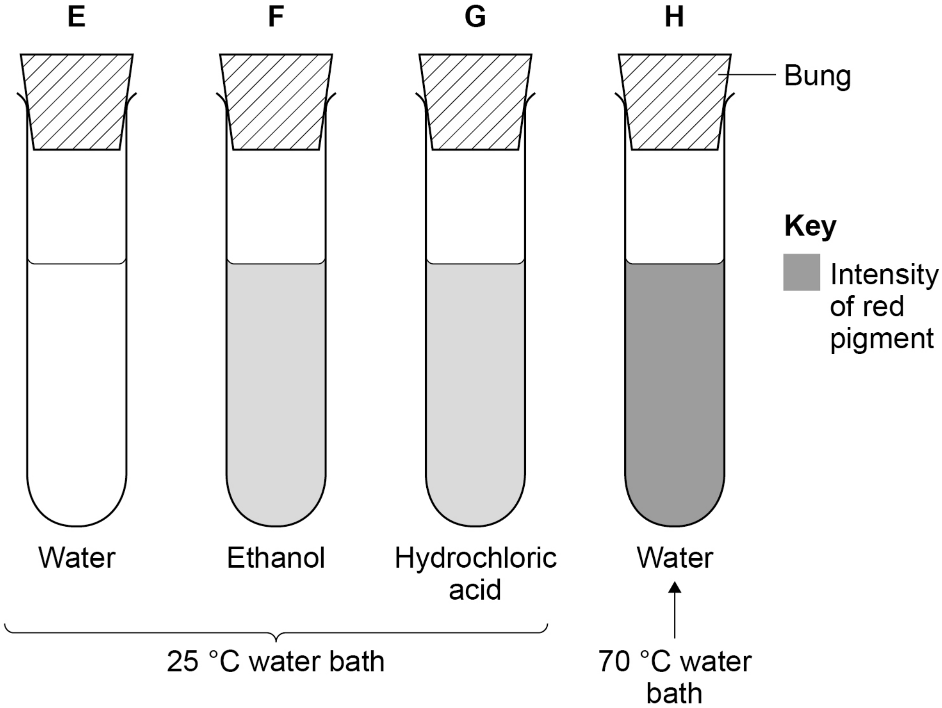
____

A different student used the same procedure and she controlled **all** variables appropriately. Her results are shown in **Figure 3**.

Figure 3



0 4 . 4 Using **Figure 3**, what can you conclude about the damage caused to beetroot cells by water, ethanol, hydrochloric acid and different temperatures?

Provide explanations for your conclusions.

[4 marks]

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Turn over for the next question

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0 5 . 1 A student investigated starch hydrolysis using the enzyme amylase.

During the procedure, the student:

- treated the starch to make it soluble
- prepared 10 cm^3 of different concentrations ($mg\ dm^{-3}$) of starch solution
- added an identical concentration of amylase to each starch solution
- measured the time in minutes to completely hydrolyse starch.

He repeated the procedure and calculated the mean time to completely hydrolyse starch in each concentration of starch solution.

Draw a table the student could use to record all of his results.

You only need to show completed column headings.

[2 marks]

0 5 . 2 Describe the results you would expect the student to obtain.

[1 mark]

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0 5 . 3 A competitive inhibitor decreases the rate of an enzyme-controlled reaction. Explain how.

[3 marks]

0 5 . 4 When bread becomes stale, the structure of some of the starch is changed. This changed starch is called retrograded starch.

Scientists have suggested retrograded starch is a competitive inhibitor of amylase in the small intestine.

Assuming the scientists are correct, suggest how eating stale bread could help to reduce weight gain.

[3 marks]

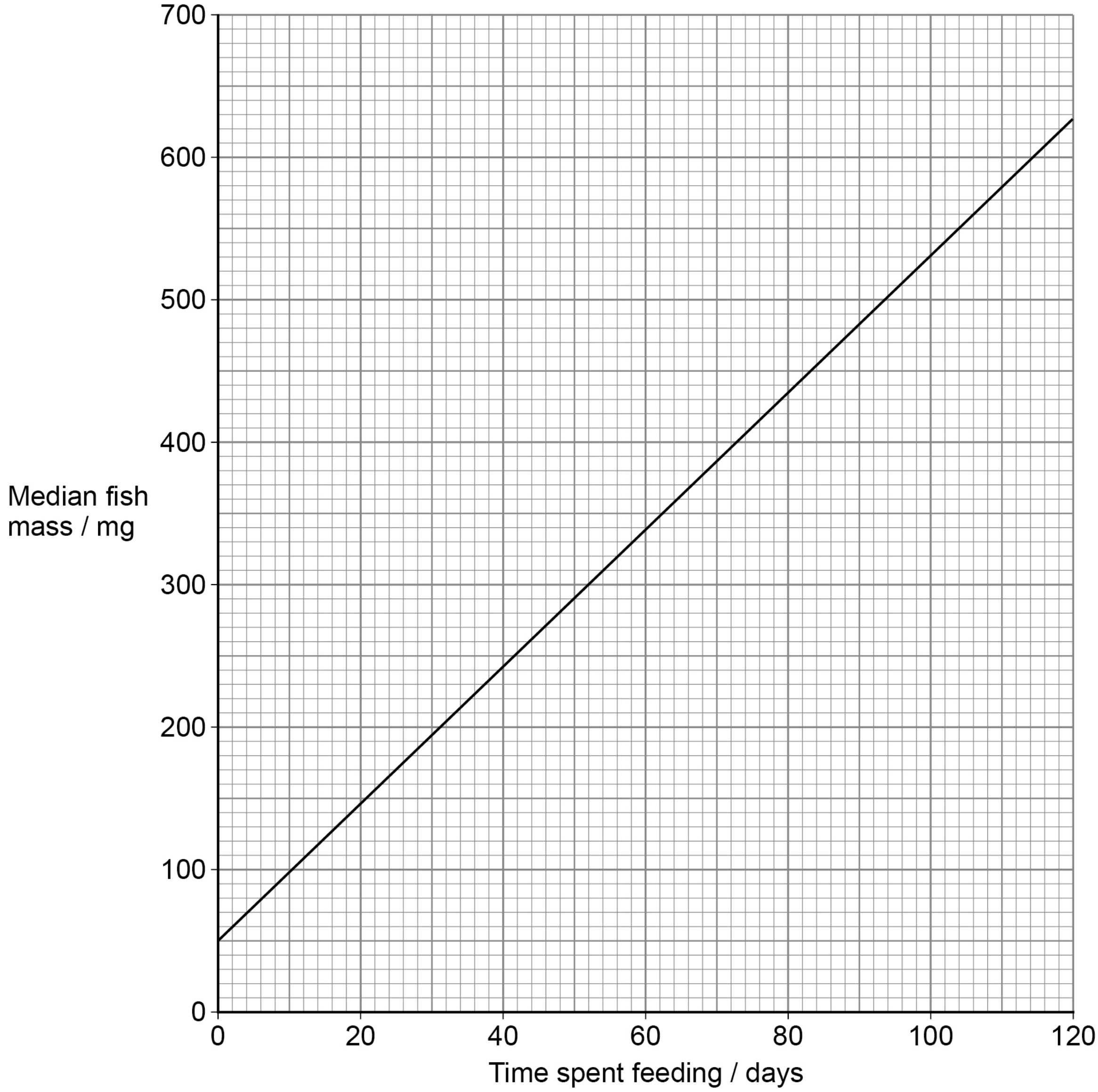
9

Turn over ►

0 6 Trout is a type of fish, often produced commercially in trout farms.

A scientist investigated the growth of farmed trout. She determined the median mass of a large population of trout at intervals. She started measuring on the day the newly hatched fish began feeding. Her results are shown in **Figure 4**.

Figure 4



The best fit line shown in **Figure 4** is represented using this equation.

$$\text{median fish mass} = (m \times \text{days feeding}) + 50$$

where m is the gradient of the best fit line.

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0 6 . 1 Use **Figure 4** and the equation to calculate the median mass of fish after 195 days' feeding.

Show your working.

[2 marks]

Answer ________________________ mg

0 6 . 2 A trout body cell contains 80 chromosomes.

Table 2 shows the number of chromosomes and the mass of DNA in different nuclei. All the nuclei are from the same trout.

Complete **Table 2**.

[2 marks]

Table 2

Nucleus	Number of chromosomes	Mass of DNA / arbitrary units
At prophase of mitosis	80	
At telophase of mitosis		25
From an egg cell		

0 6 . 3 Give **one** reason why trout eggs produced by meiosis are genetically different.

[1 mark]

____

____

____

Question 6 continues on the next page

A trout body cell contains 80 chromosomes.

Farmed female trout are treated so that they produce diploid egg cells.

0 6 . 4 Give the number of chromosomes in body cells of the offspring produced from treated farmed female trout and untreated farmed male trout.

[1 mark]

Number of chromosomes ____________________

0 6 . 5 The offspring produced from farmed trout are sterile. Suggest and explain why.

[2 marks]

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8

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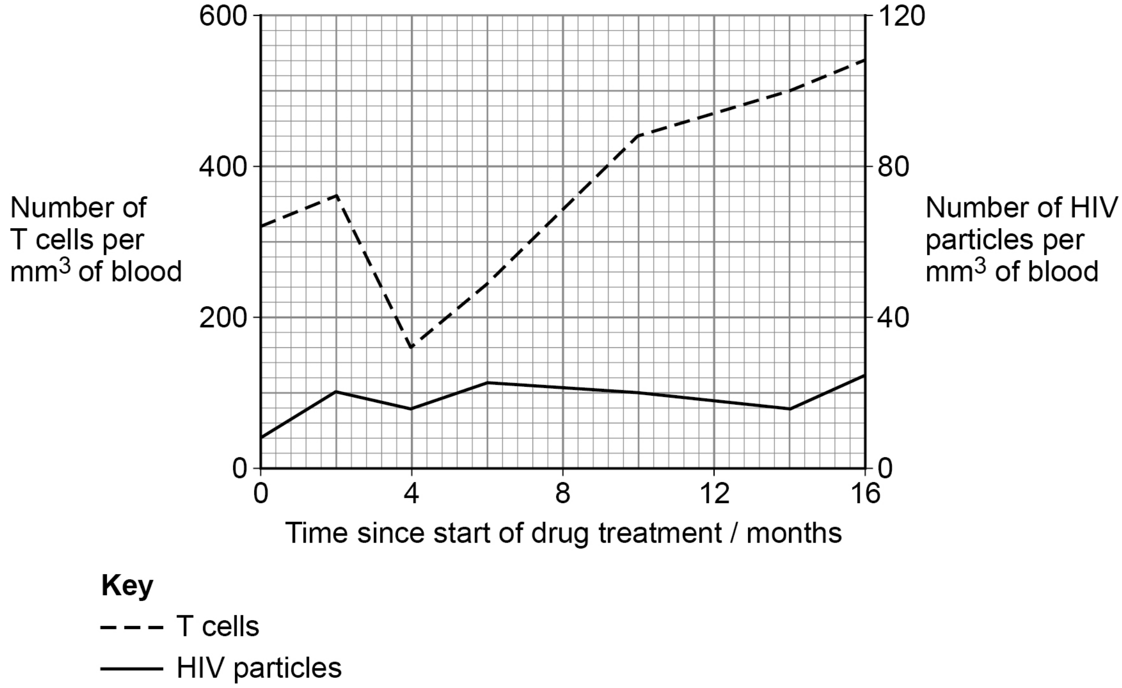
0 7 . 1 Explain how HIV affects the production of antibodies when AIDS develops in a person. **[3 marks]**

Question 7 continues on the next page

0 7 . 2 A scientist measured the effect of a drug on the number of T cells and the number of HIV particles in blood taken from a person with AIDS. The results are shown in **Figure 5**.

Figure 5



Symptoms of AIDS occur when the number of T cells is below 200 cells mm^{-3}

Use all of this information to evaluate the effectiveness of the drug in treating AIDS.

[5 marks]

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8

Turn over for the next question

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0 8 . 1 A scientist measured the pressure in a phloem tube in a willow plant stem.
He repeated his measurements to obtain nine readings.

His results are shown in **Table 3**.

Table 3

Phloem pressure / arbitrary units								
7.4	8.0	7.0	8.6	8.2	9.3	7.4	9.1	8.8

The percentage error of the mean phloem pressure in this phloem tube is calculated using this equation.

$$\text{Percentage error} = \frac{\text{uncertainty in measurement}}{\text{mean}} \times 100$$

The uncertainty in measurement is half the range of the measured values.

Calculate the percentage error of the mean phloem pressure in this phloem tube.

Show your working.

[2 marks]

Percentage error ____________________ %

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0 8 . 2 The mass flow hypothesis is used to explain the movement of substances through phloem.

Use your understanding of the mass flow hypothesis to explain how pressure is generated inside this phloem tube.

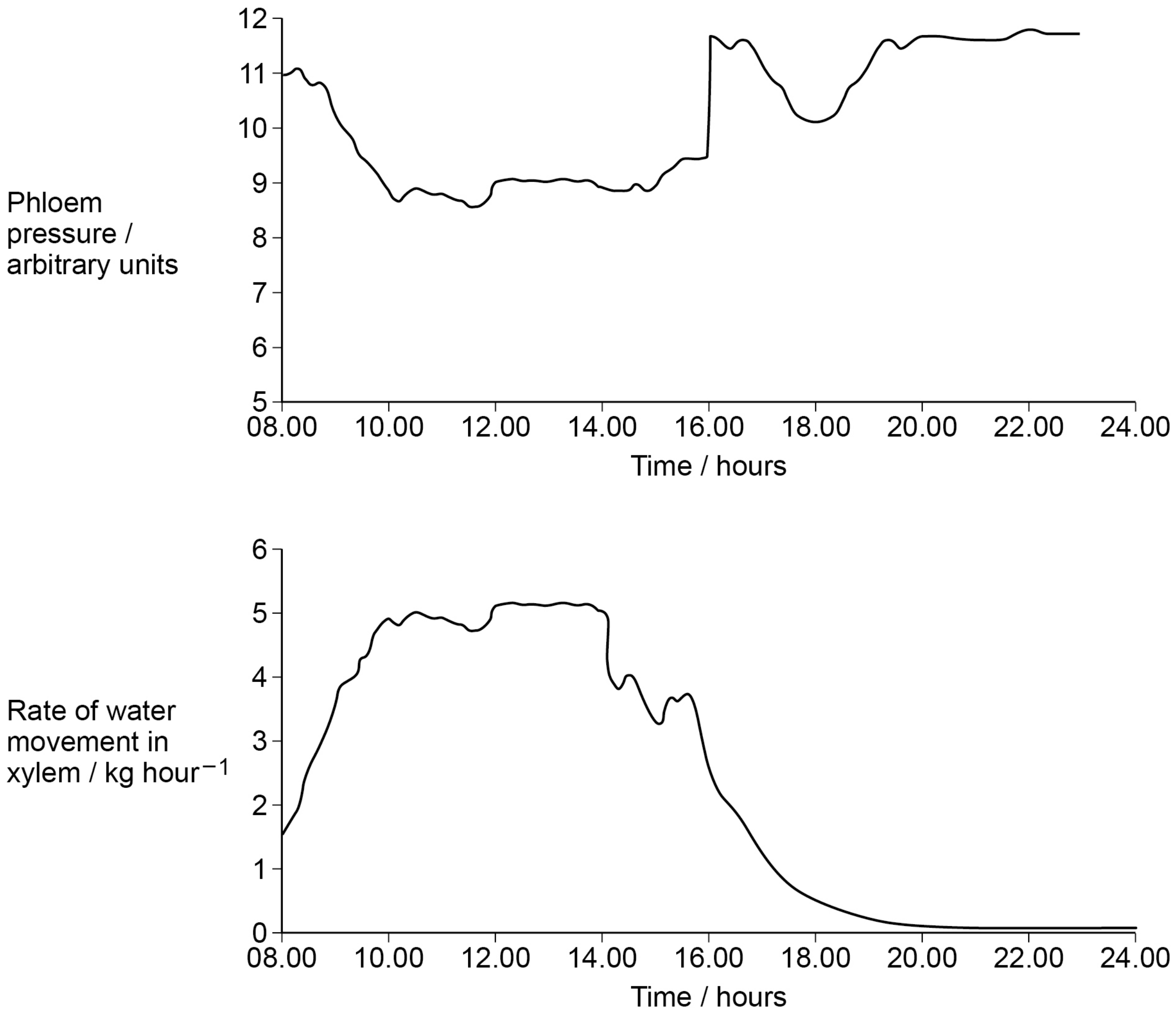
[3 marks]

Question 8 continues on the next page

0 8 . 3 The scientist also measured changes in the phloem pressure and changes in the rate of water movement in the xylem of a willow plant at intervals during a day.

His results are shown in **Figure 6**.

Figure 6



Describe the relationship between phloem pressure and the rate of water movement in xylem in this plant.

[1 mark]

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0 8 . 4 Phloem pressure is reduced during the hottest part of the day. Use information in **Figure 6** along with your understanding of transpiration and mass flow to explain why.
[3 marks]

9

Turn over for the next question

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0 9 . 1 Describe the processes involved in the absorption and transport of digested lipid molecules from the ileum into lymph vessels.

[5 marks]

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0 9 . 2 Describe how the structure of a protein depends on the amino acids it contains.

[5 marks]

10

END OF QUESTIONS

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