AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname ____________________

Forename(s) ____________________

Candidate signature ____________________

A-level
BIOLOGY
Paper 1

Thursday 6 June 2019 Morning Time allowed: 2 hours

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.
- 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 91.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

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

0 1 . 1 Describe how a **non-competitive** inhibitor can reduce the rate of an enzyme-controlled reaction.

[3 marks]

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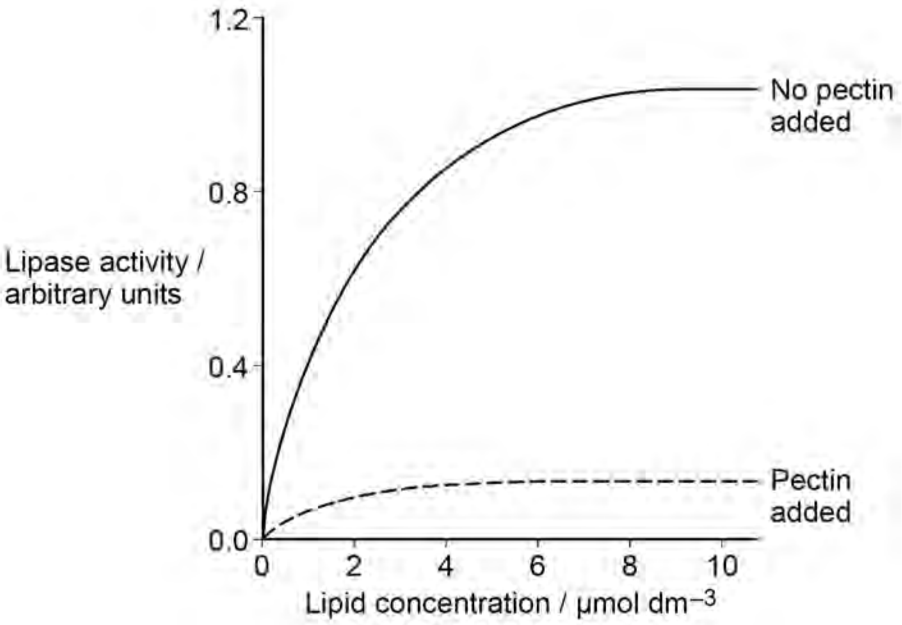
Pectin is a substance found in some fruit and vegetables.

A scientist investigated the effect of pectin on the hydrolysis of lipids by a lipase enzyme.

His results are shown in **Figure 1**.

Figure 1



0 1 . 2 The scientist concluded that pectin is a non-competitive inhibitor of the lipase enzyme.

Use **Figure 1** to explain why the scientist concluded that pectin is a **non-competitive** inhibitor.

[1 mark]

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Question 1 continues on the next page

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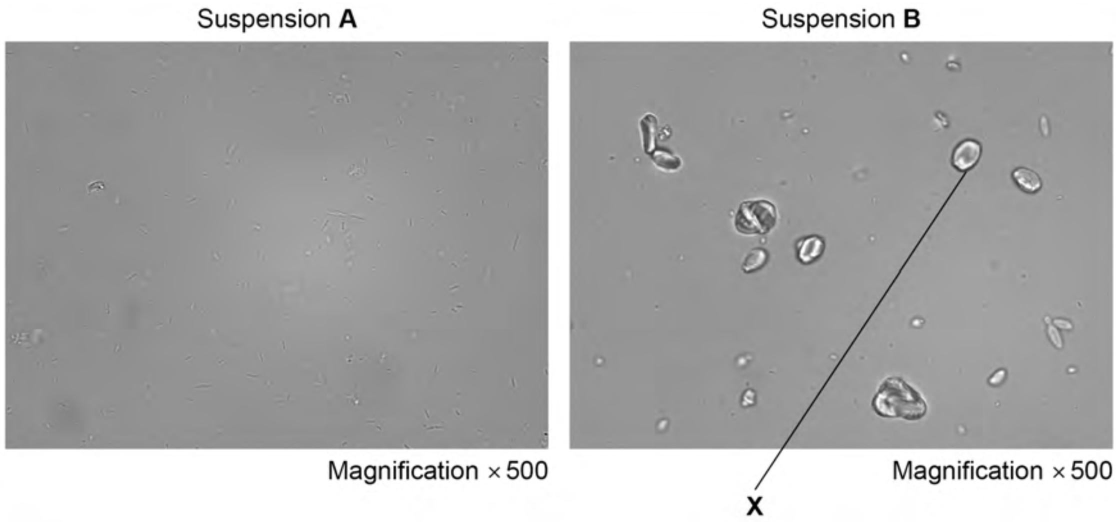
The scientist also found that pectin stops the action of bile salts. He prepared two suspensions:

- suspension **A** – lipid and bile salts
- suspension **B** – lipid, bile salts and pectin.

He did **not** add lipase to either suspension.

He observed samples from the suspensions using an optical microscope.
Figure 2 shows what he saw in a typical sample from each suspension.

Figure 2



0 1 . 3 Calculate the maximum length of the large lipid droplet marked **X** in **Figure 2**.

Using a ruler with millimetre intervals always includes an uncertainty in the measurement. Use the uncertainty in your measurement to determine the uncertainty of your calculated maximum length.

You can assume there is no uncertainty in the magnification.

[2 marks]

Maximum length = ____________________ µm

Uncertainty of your calculated maximum length = ____________________ µm

Do not write outside the box

0 1 . 4 No large lipid droplets are visible with the optical microscope in the samples from suspension **A**.

Explain why.

[2 marks]

8

Turn over for the next question

0 2 . 1 **Table 1** shows cell wall components in plants, algae, fungi and prokaryotes.
Complete **Table 1** by putting a tick (✓) where a cell wall component is present.

[3 marks]

Table 1

Cell wall component	**Plants**	**Algae**	**Fungi**	**Prokaryotes**
Cellulose				
Murein				
Chitin				

Cell walls make up much of the fibre that people eat.

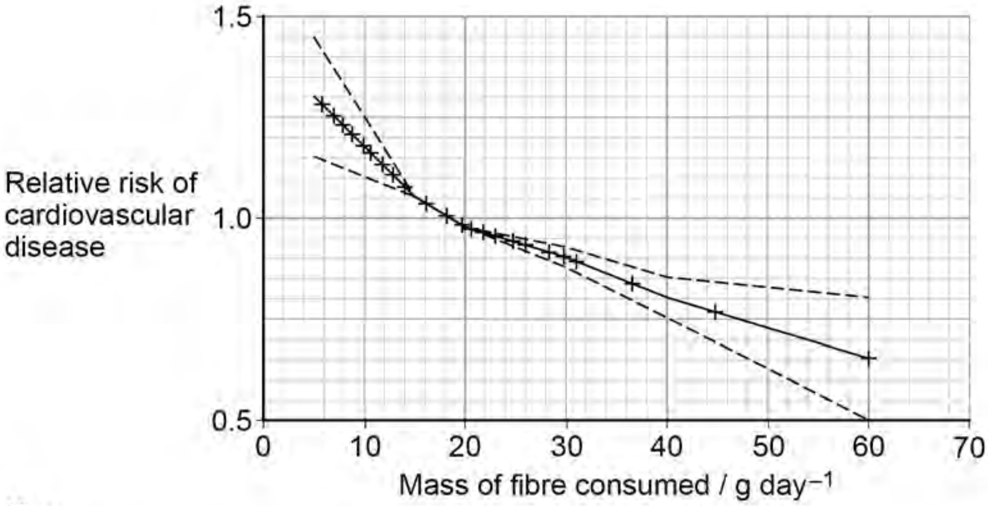
Scientists investigated the relationship between the mass of fibre people ate each day and their risk of cardiovascular disease (CVD).

They gathered data from a large sample of people and used this to calculate a relative risk.

- A relative risk of 1 means there is no difference in risk between the sample and the whole population.
- A relative risk of < 1 means CVD is less likely to occur in the sample than in the whole population.
- A relative risk of > 1 means CVD is more likely to occur in the sample than in the whole population.

Their results are shown in **Figure 3**. A value of ± 2 standard deviations from the mean includes over 95% of the data.

Figure 3



Key

—— Mean relative risk

- - - Line of best fit showing ± 2 standard deviations from the mean

Each '+' plotted point represents 1000 people

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0 2 . 2 A student concluded from **Figure 3** that eating an extra 10 g of fibre per day would significantly lower his risk of cardiovascular disease.

Evaluate his conclusion.

[4 marks]

[Extra space]

Question 2 continues on the next page

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0 2 . 3 The scientists estimated the mean mass of fibre eaten per day using a food frequency questionnaire (FFQ).

The FFQ asks each person how often they have eaten many types of food over the past year.

An alternative method to calculate fibre eaten is for a nurse to ask each person detailed questions about what they have eaten in the last 24 hours.

Suggest **one** advantage of using the FFQ method and **one** disadvantage of using the FFQ method compared with the alternative method.

[2 marks]

Advantage ____

____

____

____

____

Disadvantage ____

____

____

____

____

9

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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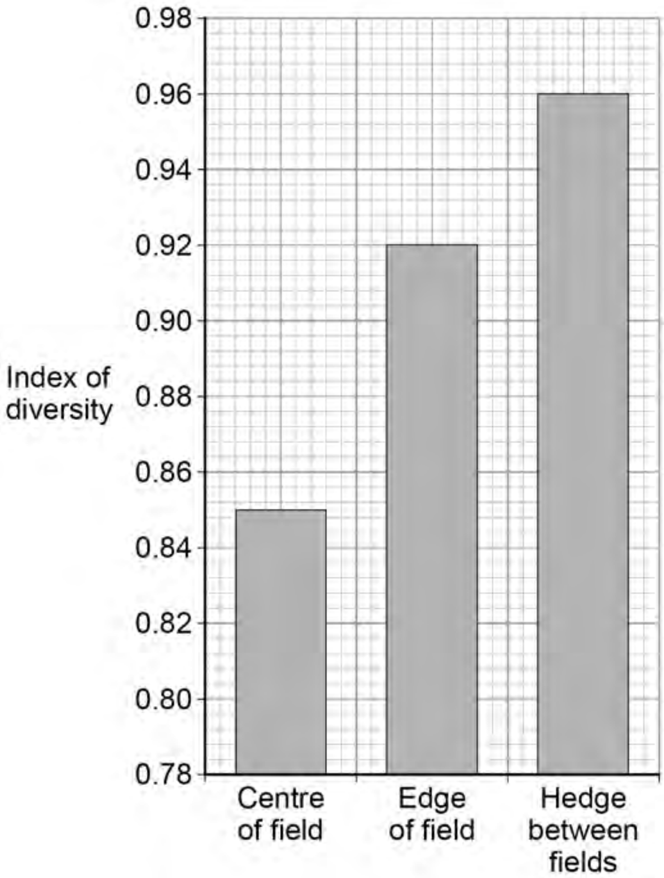
0 3 A group of students investigated biodiversity of different areas of farmland. They collected data in each of these habitats:

- the centre of a field
- the edge of a field
- a hedge between fields.

Their results are shown in **Figure 4**.

Figure 4



0 3 . 1 What data would the students need to collect to calculate their index of diversity in each habitat?

Do **not** include apparatus used for species sampling in your answer.

[1 mark]

Do not write outside the box

0 3 . 2 Give **two** ways the students would have ensured their index of diversity was representative of each habitat.

[2 marks]

1 ____

____

____

2 ____

____

____

0 3 . 3 Modern farming techniques have led to larger fields and the removal of hedges between fields.

Use **Figure 4** to suggest why biodiversity decreases when farmers use larger fields.

[1 mark]

____

____

____

____

Question 3 continues on the next page

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0 3 . 4 Farmers are now being encouraged to replant hedges on their land.

Suggest and explain **one** advantage and **one** disadvantage to a farmer of replanting hedges on her farmland.

[2 marks]

Advantage

Disadvantage

6

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Turn over for the next question

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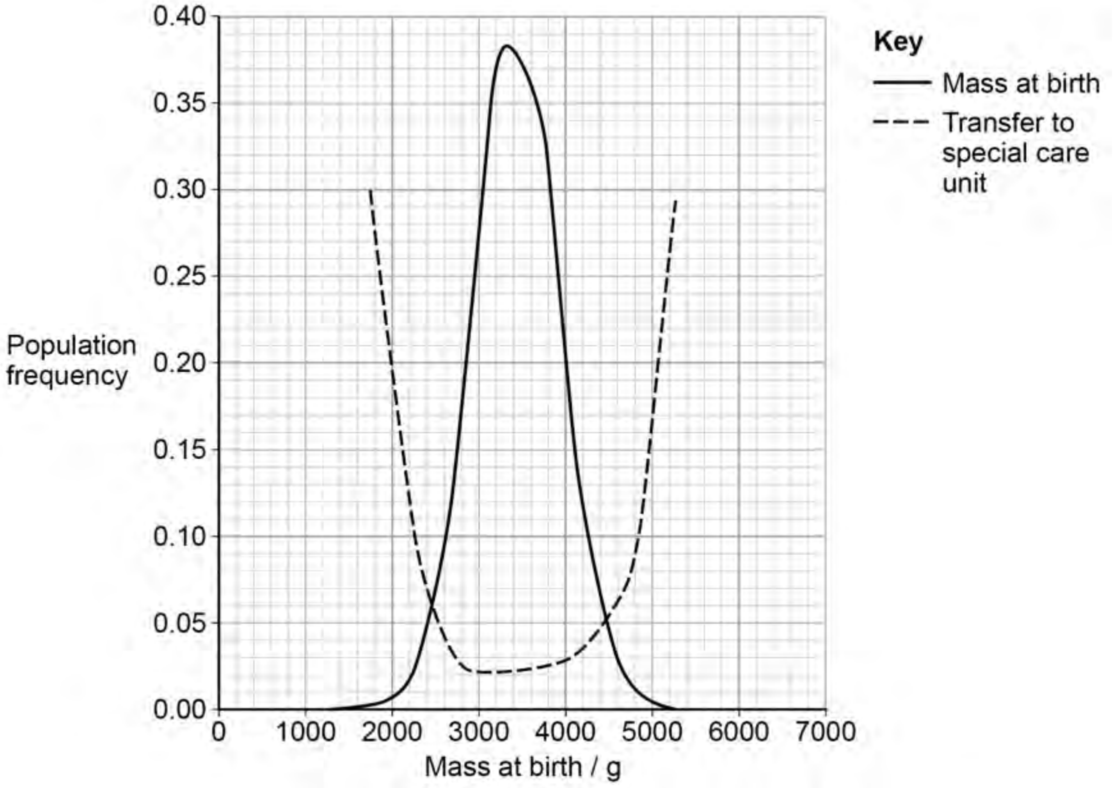
0 4 Scientists collected data on 800 000 human births. The data showed the mass of each baby at birth and whether the baby needed to be transferred to a special care unit for very ill babies.

Their results are shown in **Figure 5**.

Figure 5



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0 4 . 1 Use **Figure 5** to explain how human mass at birth is affected by stabilising selection.
[3 marks]

[Extra space]

Question 4 continues on the next page

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0 4 . 2 The scientists studied the effect of one form, *KIR2DS1*, of the human *KIR* gene on mass at birth.

In the following passage the numbered spaces can be filled with biological terms.

KIR2DS1 is an ____(1)____ of the *KIR* gene, found at a ____(2)____ on chromosome 19. *KIR2DS1* is 14 021 bases long and is ____(3)____ into mRNA that is 1101 bases long. This mRNA is then ____(4)____ into a polypeptide 304 amino acids long. The polypeptide is then modified in the organelle, ____(5)____, before forming its functional ____(6)____ protein structure.

Write the correct biological term beside each number below, that matches the space in the passage.

[3 marks]

(1) ____________________

(2) ____________________

(3) ____________________

(4) ____________________

(5) ____________________

(6) ____________________

Do not write outside the box

0 4 . 3 The scientists studied 1500 more births. They recorded the mass at birth of each baby and the nature of the *KIR* gene in the mother's genome.

Some of their results are shown in **Table 2**.

Table 2

Presence or absence of *KIR2DS1* in mother's genome	**Number of babies with mass at birth:**	
	between 2500 g and 4500 g	**above 4500 g**
Present	389	148
Absent	606	173

The scientists used a statistical test to test the following null hypothesis:

'The presence of *KIR2DS1* in the mother's genome does **not** affect the frequency of births above 4500 g'

Tick (✓) **one** box that gives the name of the statistical test that the scientists should use with the data in **Table 2** to test this null hypothesis.

[1 mark]

Chi-squared ☐

Correlation coefficient ☐

Student's t-test ☐

Question 4 continues on the next page

0 4 . 4 The scientists calculated a P value of 0.03 when testing their null hypothesis.

What can you conclude from this result? Explain your answer.

[3 marks]

10

0 5 . 1 Describe the structure of the human immunodeficiency virus (HIV).

[4 marks]

Question 5 continues on the next page

Do not write outside the box

Some people infected with HIV do not develop AIDS. These people are called HIV controllers.

Scientists measured the number of HIV particles (the viral load) and the number of one type of T helper cell (CD4 cells) in the blood of a group of HIV controllers and also in a group of HIV positive patients who had symptoms of AIDS.

The median values and the range of their results are shown in **Table 3**.

Table 3

HIV status of people	**Median viral load / virus particles per cm^3 of blood (range)**	**Median number of CD4 cells per mm^3 of blood (range)**
HIV controllers	212 (<50 to 609)	693 (529 to 887)
HIV positive people with AIDS symptoms	66 274 (30 206 to 306 163)	248 (107 to 365)

0 5 . 2 A test sample of 500 mm^3 of blood is taken from an HIV controller to determine the viral load.

Tick (✓) **one** box that shows the number of virus particles that would be present in a test sample of blood taken from an HIV controller with the median viral load.

[1 mark]

106 000 ☐

10 600 ☐

1060 ☐

106 ☐

Do not write outside the box

0 5 . 3 Use the data in **Table 3** and your knowledge of the immune response to suggest why HIV controllers do not develop symptoms of AIDS.

[3 marks]

[Extra space]

8

Turn over for the next question

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0 6 Scientists investigated the cell cycle in heart cells taken from mice 6 days before their birth and then at 4, 14 and 21 days after their birth.

Their results are shown in **Table 4**. Age 0 days = day of birth.

Table 4

Age / days	Percentage of heart cells undergoing mitosis	Percentage of heart cells undergoing DNA replication
–6	13.9	8.5
4	8.5	2.6
14	1.6	0.2
21	0.6	0.0

0 6 . 1 Describe and explain the data in **Table 4**.

[2 marks]

[Extra space]

Do not write outside the box

The scientists determined the percentage of heart cells undergoing DNA replication by using a chemical called BrdU. Cells use BrdU instead of nucleotides containing thymine during DNA replication.

0 6 . 2 Describe how BrdU would be incorporated into new DNA during semi-conservative replication.

[5 marks]

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 Cells with BrdU in their DNA are detected using an anti-BrdU antibody with an enzyme attached.

Use your knowledge of the ELISA test to suggest and explain how the scientists identified the cells that have BrdU in their DNA.

[3 marks]

[Extra space]

10

Turn over for the next question

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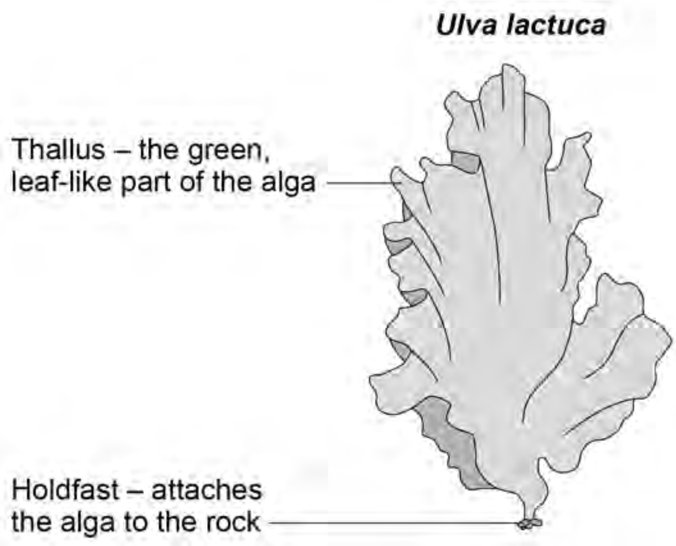
0 7 *Ulva lactuca* is an alga that lives on rocks on the seashore. It is regularly covered by seawater.

Figure 6 shows a diagram of one *Ulva lactuca* alga.

Figure 6



0 7 . 1 Unlike plants, *Ulva lactuca* does not have xylem tissue.

Suggest how *Ulva lactuca* is able to survive without xylem tissue.

[1 mark]

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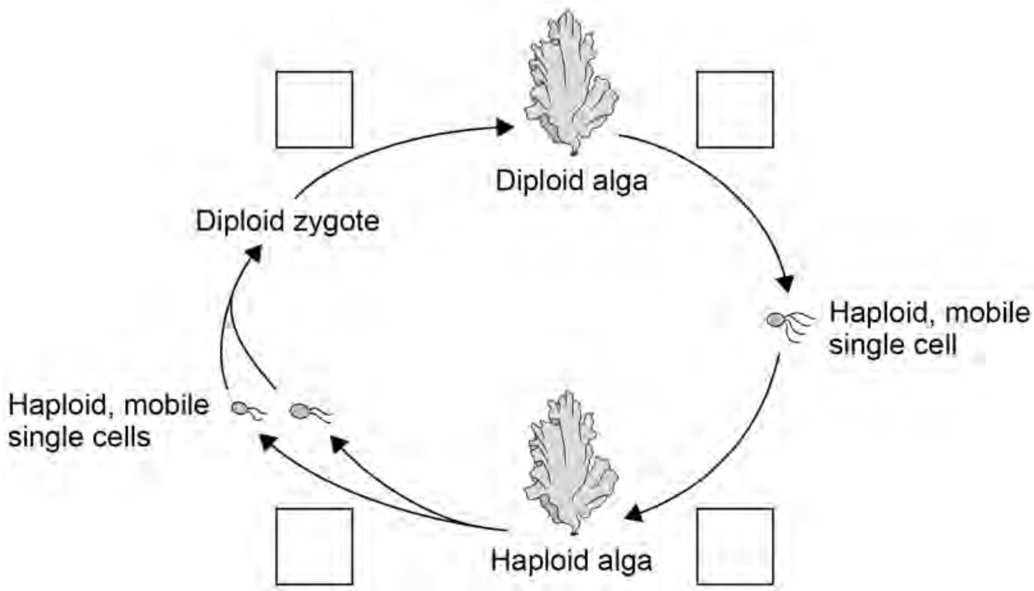
Ulva lactuca has a haploid and a diploid form.

Figure 7 shows the life cycle of *Ulva lactuca*.

Figure 7



0 7 . 2 On **Figure 7** complete each box with an appropriate letter to show the type of cell division happening between each stage in the life cycle. Use '**T**' to represent mitosis and '**E**' to represent meiosis.

[2 marks]

0 7 . 3 *Ulva prolifera* also produces haploid, mobile single cells that can fuse to form a zygote.

Suggest and explain **one** reason why successful reproduction between *Ulva prolifera* and *Ulva lactuca* does **not** happen.

[2 marks]

5

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0 8 The water potential of leaf cells is affected by the water content of the soil.

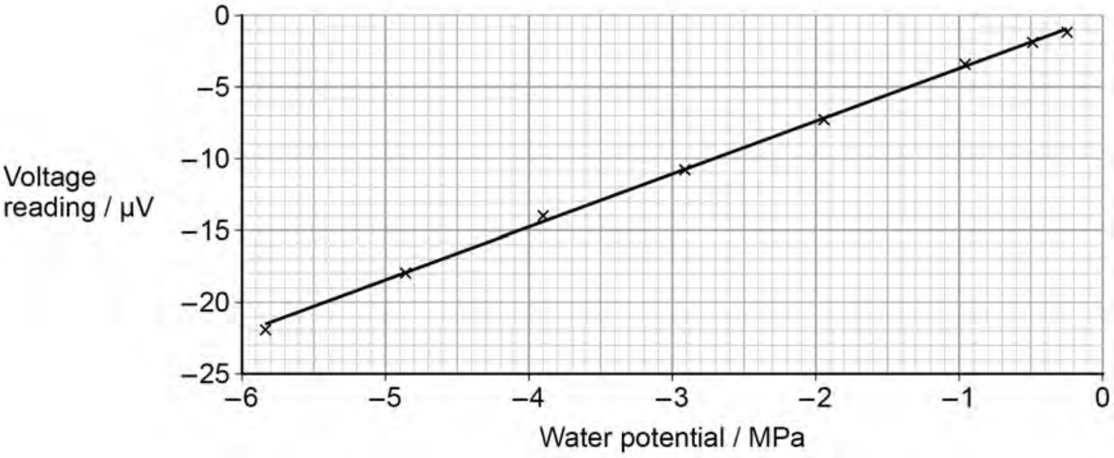
Scientists grew sunflower plants. They supplied different plants with different volumes of water.

After two days, they determined the water potential in the leaf cells by using an instrument that gave a voltage reading.

The scientists generated a calibration curve to convert the voltage readings to water potential.

Figure 8 shows their calibration curve.

Figure 8



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0 8 . 1 The scientists needed solutions of known water potential to generate their calibration curve.

Table 5 shows how to make a sodium chloride solution with a water potential of −1.95 MPa

Complete **Table 5** by giving all headings, units and volumes required to make 20 cm^3 of this sodium chloride solution.

[2 marks]

Table 5

Water potential / MPa	**Concentration of sodium chloride solution / $mol\ dm^{-3}$**	**Volume of 1 $mol\ dm^{-3}$ sodium chloride solution / ____**	____ / ____
−1.95	0.04	____	____

Table 6 shows some of the concentrations of sodium chloride solution the scientists used and the water potential of each solution.

Table 6

Concentration of sodium chloride solution / $mol\ dm^{-3}$	**Water potential / MPa**
0.04	−1.95
0.10	−4.87
0.12	−5.84

0 8 . 2 There is a linear relationship between the water potential and the concentration of sodium chloride solution.

Use the data in **Table 6** to calculate the concentration of sodium chloride solution with a water potential of −3.41 MPa

[2 marks]

Answer = ____________________ $mol\ dm^{-3}$

Turn over ►

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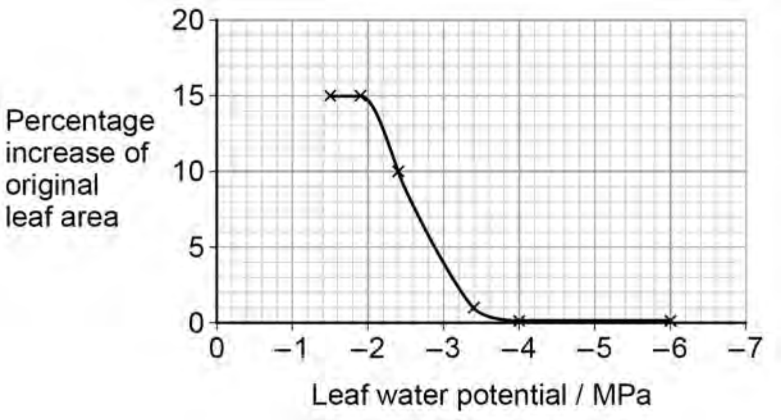
In addition to determining the water potential in the leaf cells, the scientists measured the growth of the leaves.

They recorded leaf growth as a percentage increase of the original leaf area.

Their results are shown in **Figure 9**.

Figure 9



0 8 . 3 One leaf with an original area of 60 cm^2 gave a voltage reading of $-7\,\mu V$

Use **Figure 8** (on page 28) and **Figure 9** to calculate by how much this leaf increased in area.
Give your answer in cm^2

[2 marks]

Answer = ____________________ cm^2

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0 8 . 4 Sunflowers are not xerophytic plants. The scientists repeated the experiment with xerophytic plants.

Suggest and explain **one** way the leaf growth of xerophytic plants would be different from the leaf growth of sunflowers in **Figure 9**.

[2 marks]

0 8 . 5 Use your knowledge of gas exchange in leaves to explain why plants grown in soil with very little water grow only slowly.

[2 marks]

10

Turn over for the next question

Do not write outside the box

0 9 A scientist investigated the affinity for oxygen of horse haemoglobin and mouse haemoglobin.

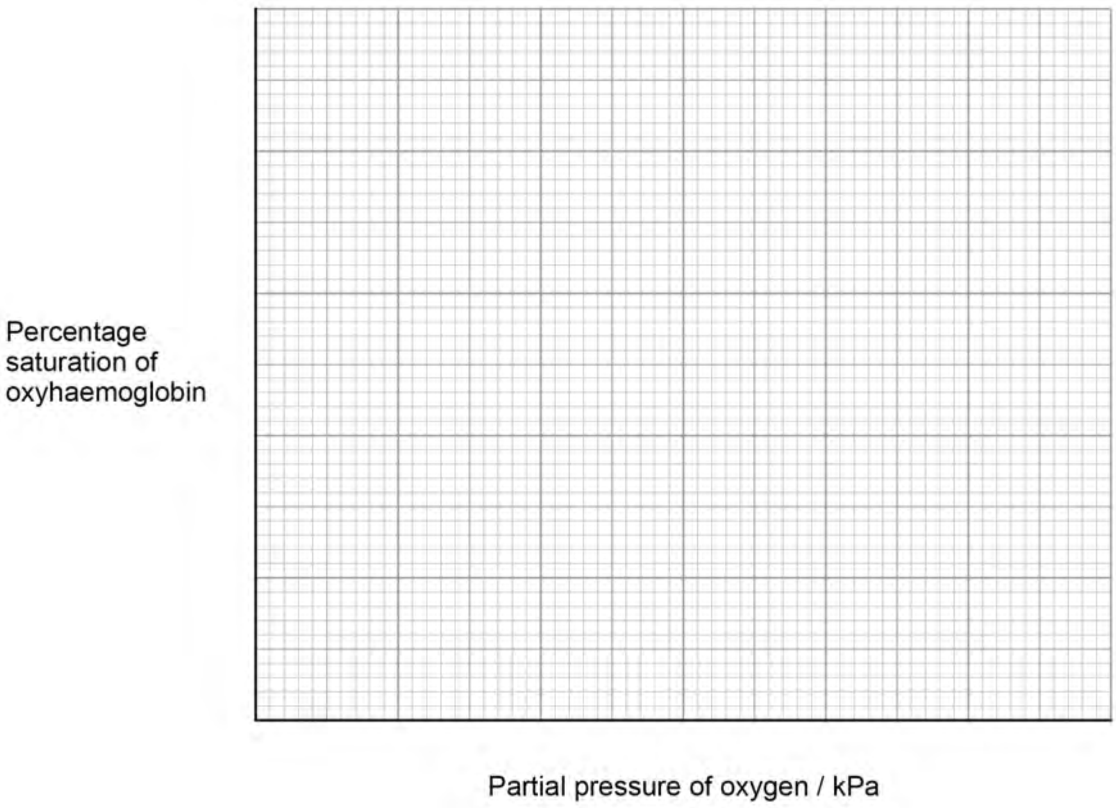
Some of their results are shown in **Table 7**.

Table 7

Animal	Partial pressure of oxygen when haemoglobin is 50% saturated / kPa	Partial pressure of oxygen when haemoglobin is 25% saturated / kPa	Body mass of one animal / g
Horse	3.2	1.9	550 000
Mouse	6.5	3.3	23

0 9 . 1 Plot the haemoglobin saturation data from **Table 7** and use these points to sketch the full oxyhaemoglobin dissociation curves for a horse and a mouse.

[3 marks]



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0 9 . 2 The following equation can be used to estimate the metabolic rate of an animal.

$$\text{Metabolic rate} = 63 \times \text{BM}^{-0.27}$$

BM = body mass in grams

Use this equation to calculate how many times faster the metabolic rate of a mouse is than the metabolic rate of a horse.

[2 marks]

Answer = ____________________ times faster

0 9 . 3 The data in **Table 7** show differences between the oxyhaemoglobin dissociation curve for a mouse and the oxyhaemoglobin dissociation curve for a horse.

Suggest how these differences allow the mouse to have a higher metabolic rate than the horse.

[2 marks]

[Extra space]

Question 9 continues on the next page

0 9 . 4 Mammals such as a mouse and a horse are able to maintain a constant body temperature.

Use your knowledge of surface area to volume ratio to explain the higher metabolic rate of a mouse compared to a horse.

[3 marks]

[Extra space]

10

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1 0 . 1 Explain **five** properties that make water important for organisms.

[5 marks]

[Extra space]

Question 10 continues on the next page

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1 0 . 2 Describe the biochemical tests you would use to confirm the presence of lipid, non-reducing sugar and amylase in a sample.

[5 marks]

[Extra space]

Do not write outside the box

1 0 . 3 Describe the chemical reactions involved in the conversion of polymers to monomers and monomers to polymers.

Give **two** named examples of polymers and their associated monomers to illustrate your answer.

[5 marks]

[Extra space]

15

END OF QUESTIONS

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