OXFORD AQA
INTERNATIONAL QUALIFICATIONS

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____
I declare this is my own work.

INTERNATIONAL A-LEVEL
BIOLOGY (9610)

Unit 5 Synoptic paper

Thursday 6 June 2024 07:00 GMT Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- a pencil
- 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.
- In Question 6, 2 marks will be awarded for the quality of your written communication. You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

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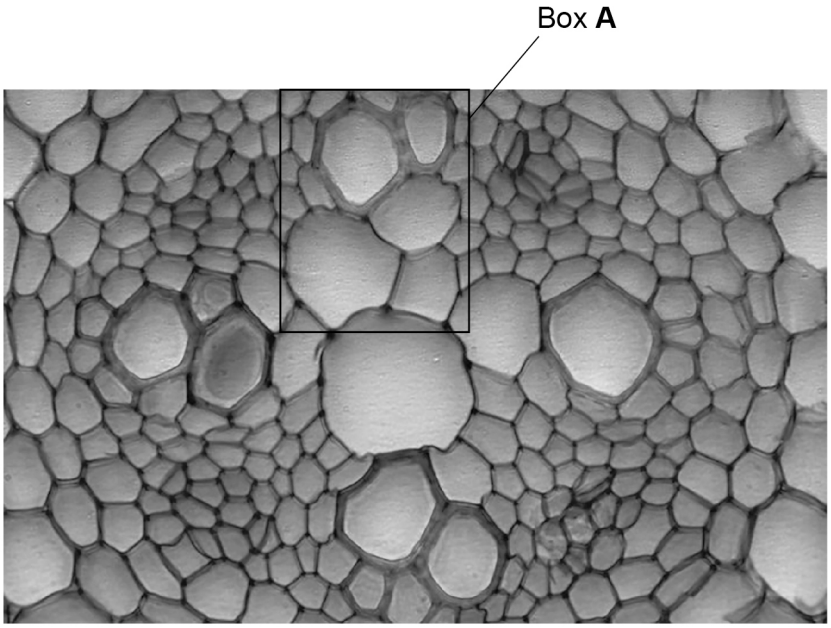
Answer **all** questions in the spaces provided.

0 1 Xylem tissue transports water in plants.

Figure 1 shows a transverse section through part of a root of a dicotyledonous plant.

Figure 1



Magnification = ×500

0 1 . 1 Draw a diagram of the **five** xylem vessels shown in box **A** in **Figure 1**.

Draw your diagram in the box shown in **Figure 2**.

Make sure your drawing fits the box in **Figure 2** in the same way that the five xylem vessels fit box **A** in **Figure 1**.

Include the connections of the xylem vessels to the adjacent cells.

[3 marks]

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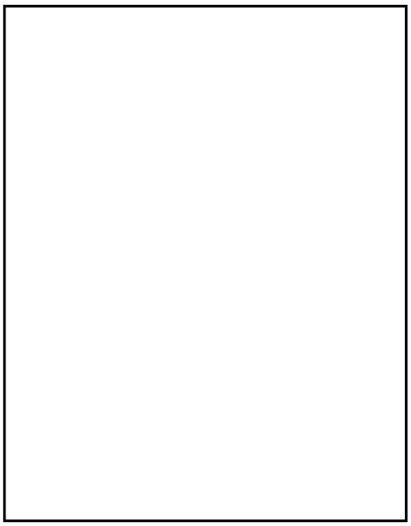
Figure 2



0 1 . 2 The magnification of **Figure 1** is ×500

Calculate the magnification of your drawing in **Figure 2**.

Give your answer to **3** significant figures.

[3 marks]

Magnification = _____

Question 1 continues on the next page

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0 1 . 3 Explain how transpiration causes water movement through the xylem vessels.

[4 marks]

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Question 1 continues on the next page

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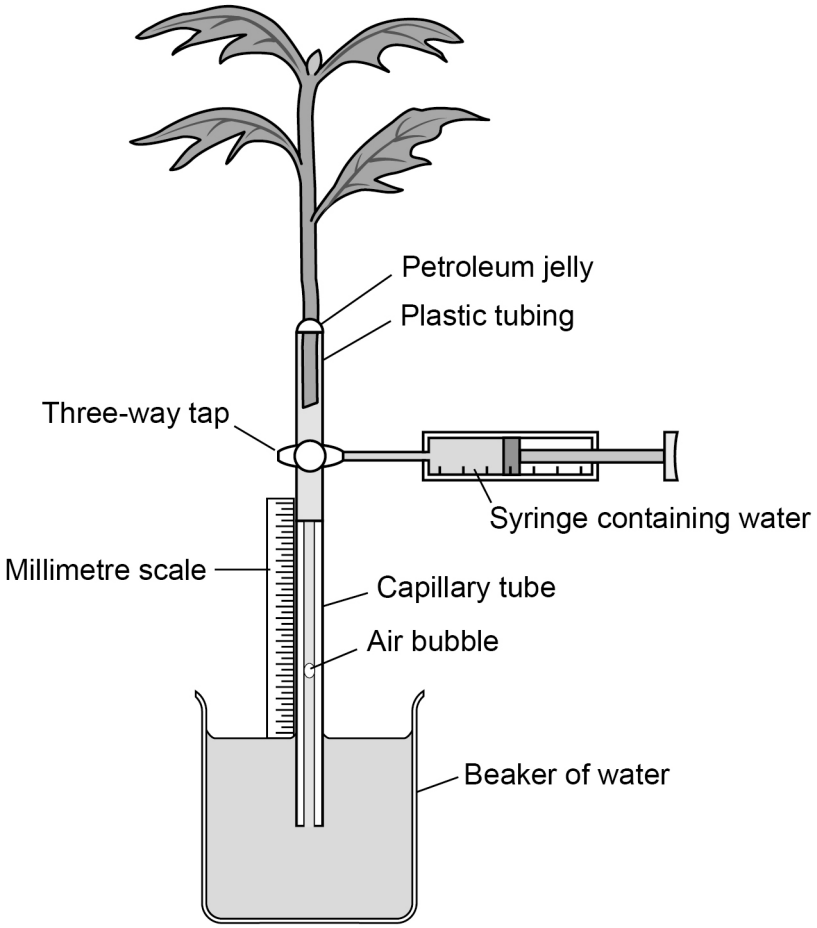
Figure 3 shows a simple potometer.

Figure 3



0 1 . 4 Describe how you would use the potometer shown in **Figure 3** to estimate the rate of transpiration from the plant shoot in mm^3 per hour.

[5 marks]

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0 1 . 5 Explain why the method you described in Question **01.4** gives only an **approximate** value for the rate of transpiration from the plant shoot.

[2 marks]

17

Turn over for the next question

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0 2 A student investigates the effect of temperature on the activity of the enzyme amylase.

This is the method the student uses.

1. Put a test tube containing 1% amylase solution in a water bath at 10 °C
2. Keep a beaker of starch solution at room temperature.
3. Put 5 cm^3 of the starch solution into an empty test tube and add a few drops of the amylase solution.
4. Put the test tube containing the starch and amylase in the water bath at 10 °C
5. Remove a small volume of the starch–amylase mixture after 2 minutes and add it to a drop of iodine solution.
6. Repeat step 5 every 2 minutes with separate drops of iodine until the iodine no longer turns blue-black.
7. Repeat steps 1 to 6 with the water bath at 20 °C, 40 °C, 60 °C and 80 °C

0 2 . 1 The student's method contains several errors.

Identify **two** errors and state how the student could correct them.

[2 marks]

Error _____

_____

Correction _____

_____

_____

_____

Error _____

_____

Correction _____

_____

_____

_____

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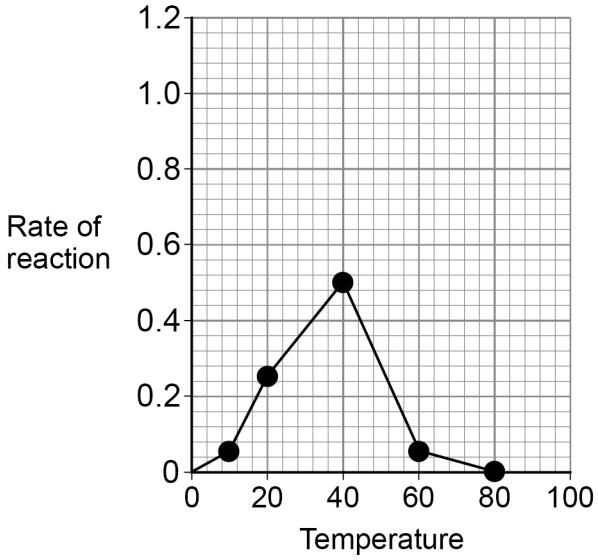
The student draws a graph of the results of the investigation.

Figure 4 shows the student's graph.

Figure 4



0 2 . 2 Describe **two** ways the student could improve the graph in **Figure 4**.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 3 The student states:

'The optimum temperature for amylase activity is 40 °C.'

Describe how the student could find a more accurate value for the optimum temperature.

[2 marks]

_____

_____

_____

_____

_____

6

Turn over ►

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0 3 Huntington's disease (HD) is an inherited condition that causes gradual damage to nerve cells in the brain.

HD is caused by a dominant allele.

0 3 . 1 Give **all** the possible genotypes of a person with HD.

Use the symbols:

H = allele for HD
h = allele for **not** having HD.

[1 mark]

_____

HD is very rare in most populations but in one isolated area of Venezuela in South America, 48% of the population possess a genotype which causes HD.

0 3 . 2 Estimate the percentage of people who are heterozygous for HD in this population in Venezuela.

Use the Hardy–Weinberg equation.

[3 marks]

Percentage of heterozygous people = _____ %

Do not write outside the box

The allele for HD has a harmful effect on those people who have it in their genotype.

A person who has the allele for HD usually has no symptoms of the disease until the person is at least 30 years old.

0 3 . 3 Many people in the isolated population in Venezuela can trace their origins back to a common ancestor 200 years ago.

The allele for HD has **not** been lost from this population in Venezuela by natural selection.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 3 . 4 HD causes the death of neurones in the brain.

People with HD produce a substance called huntingtin.

Huntingtin prevents the formation of a protein that transfers electrons and protons from reduced NAD in the mitochondrion.

Suggest how huntingtin may lead to the death of neurones.

[2 marks]

_____

_____

_____

_____

_____

_____

8

Turn over for the next question

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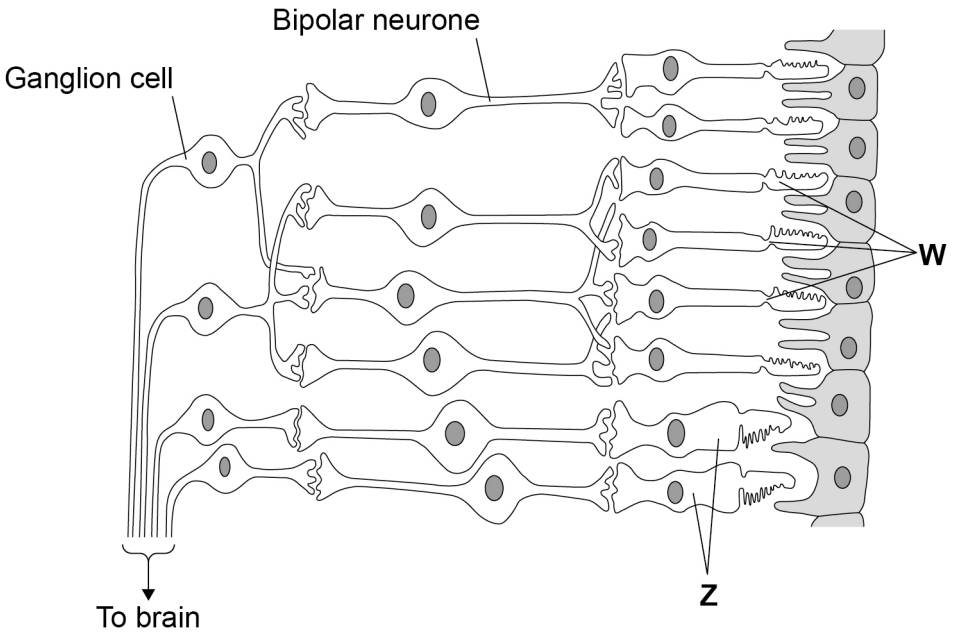
0 4 **Figure 5** shows part of the retina in a human eye.

Figure 5



0 4 . 1 In **Figure 5**, **W** and **Z** are two types of light receptor cell.

Name the cell types labelled **W** and **Z**.

[1 mark]

Cell type **W** _____

Cell type **Z** _____

0 4 . 2 Explain how the connections of cells of type **W** allow vision in low light intensities.

Use information from **Figure 5**.

[3 marks]

_____

_____

_____

_____

_____

_____

_____

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Cells of type **Z** allow high visual acuity in colour.

0 4 . 3 Explain how the connections of cells of type **Z** allow high visual acuity.

Use information from **Figure 5**.

[2 marks]

0 4 . 4 Explain how cells of type **Z** allow colour vision.

[3 marks]

9

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0 5 Cystic fibrosis (CF) is an inherited condition caused by a mutation in the CFTR gene. In CF, the tertiary structure of the CFTR protein is altered. This causes thick, sticky mucus to build up in the bronchioles and causes breathing difficulties.

Scientists have developed a test to find out whether a fetus has CF, is a carrier of CF or does not have CF.

The test uses DNA probes. The probes are short lengths of single-stranded DNA with a fluorescent substance attached. A probe will bind to a specific part of the fetal DNA being tested.

During the test, the fetal DNA is:

- heated to 95 °C for 5 minutes
- then cooled to 50 °C and mixed with the probe.

0 5 . 1 Explain why the scientists heat the fetal DNA to 95 °C

[2 marks]

0 5 . 2 Explain why the scientists cool the DNA to 50 °C, and **not** to 20 °C, before mixing the DNA with the probe.

[2 marks]

Question 5 continues on the next page

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The scientists make two different fluorescent DNA probes, **Probe 1** and **Probe 2**.

- **Probe 1** is only able to bind to the normal CFTR allele (**N**).
- **Probe 2** is only able to bind to the CF allele (**n**).

0 5 . 3 Explain why each probe binds to a different allele.

[2 marks]

0 5 . 4 Give the reason why the scientists use **fluorescent** probes.

[1 mark]

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0 5 . 5 Once the DNA probes have each bound to an allele, the DNA-probe complexes are isolated and analysed, as follows:

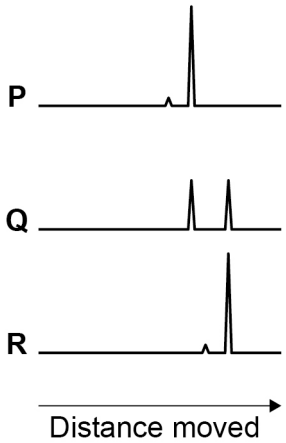
Step 1: The DNA-probe complexes are heated to separate the probes from the alleles.

Step 2: The separated probes are analysed by electrophoresis.

In this analysis, the shorter probes move faster than the longer probes through the electrophoresis gel.

Figure 6 shows results of electrophoresis for three fetuses, **P**, **Q** and **R**.

Figure 6



In **Figure 6**, the peaks show the position of each probe.

The size of the peak shows the amount of the probe.

Probe 2 is two nucleotides longer than **Probe 1**.

What is the genotype (**NN**, **Nn** or **nn**) of each fetus?

[2 marks]

Fetus **P** _____

Fetus **Q** _____

Fetus **R** _____

Question 5 continues on the next page

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Scientists investigate the use of gene therapy to treat people with CF.

They genetically engineer a virus to contain the normal CFTR allele.

The virus is then breathed into the lungs from an inhaler.

The scientists recruit 37 volunteers with CF.

- 20 inhale the virus with the CFTR allele.
- 17 inhale a placebo (does **not** contain the CFTR allele).

The volunteers use their inhalers at regular intervals for 90 days.

The scientists measure how fast each volunteer can breathe out at the start and at intervals of 30 days.

Table 1 shows the results.

Table 1

Time / days	**Mean speed of breathing out minus speed at start ± SD / dm^3 s^{-1}**	
	With CFTR allele	With placebo
0	0	0
30	+ 0.10 ± 0.05	– 0.04 ± 0.04
60	+ 0.02 ± 0.07	– 0.03 ± 0.06
90	0.00 ± 0.08	– 0.07 ± 0.05

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0 5 . 6 The investigation is 'double-blind'. This means that neither the scientists nor the patients know which patients are given the CFTR allele and which are given the placebo.

Why is it important to have a double-blind investigation?

[2 marks]

0 5 . 7 Evaluate the effectiveness of treating CF patients using virus particles containing the CFTR allele.

Use information from the scientists' method and from **Table 1**.

[4 marks]

15

Turn over for the next question

Do not write outside the box

You are reminded that **2** marks will be awarded
for the quality of your written communication in **Question 6**.

0 6 All living organisms need water to survive.

0 6 . 1 Describe the processes in plants that **use** water.

[6 marks]

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0 6 . 2 Plan an experiment to measure the water potential of a plant tissue.

[6 marks]

Question 6 continues on the next page

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0 6 . 3 Xerophytic plants are adapted to live in areas with low water availability.

Describe the adaptations of xerophytic plants.

[6 marks]

20

Quality of written communication [2 marks]

END OF QUESTIONS

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