

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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I declare this is my own work.

INTERNATIONAL AS BIOLOGY (9610)

Unit 1 The Diversity of Living Organisms

Wednesday 6 May 2026

08:00 UK Time

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	
TOTAL	

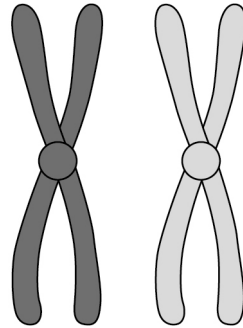


Answer **all** questions in the spaces provided.

0 1

Figure 1 shows homologous chromosomes.

Figure 1



0 1 . 1

Give the meaning of homologous chromosomes.

[2 marks]

0 1 . 2

Crossing over between homologous chromosomes in meiosis results in genetic variation.

Give **two** other causes of genetic variation.

[2 marks]

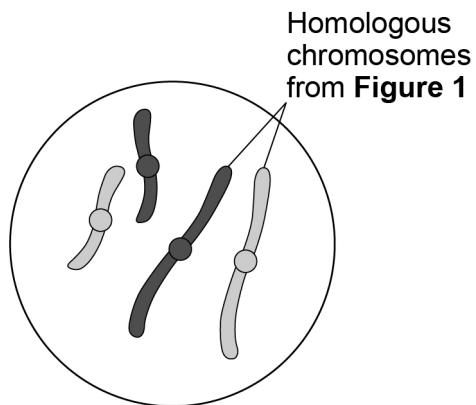
1

2



Figure 2 shows the pair of homologous chromosomes from **Figure 1** and another pair of homologous chromosomes.

Figure 2



0 1 . 3

State why the chromosomes in **Figure 1** look different from those in **Figure 2**.

[1 mark]

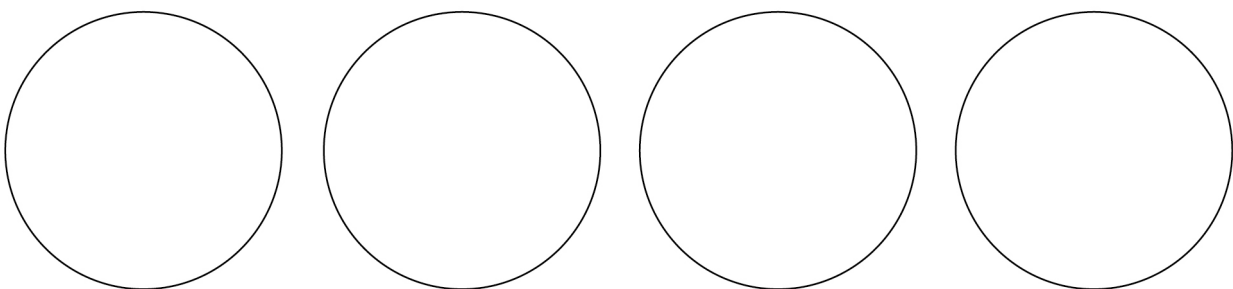
0 1 . 4

There are four possible combinations of the chromosomes shown in **Figure 2**, in the gametes resulting from meiosis.

Complete **Figure 3** to show the possible combinations.

[2 marks]

Figure 3



Question 1 continues on the next page

Turn over ►



0	1	.	5
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Explain the importance of meiosis in organisms that reproduce sexually.

[2 marks]

9



In transcription, pre-mRNA is synthesised in the nucleus of a cell.

[5 marks]

[illegible]

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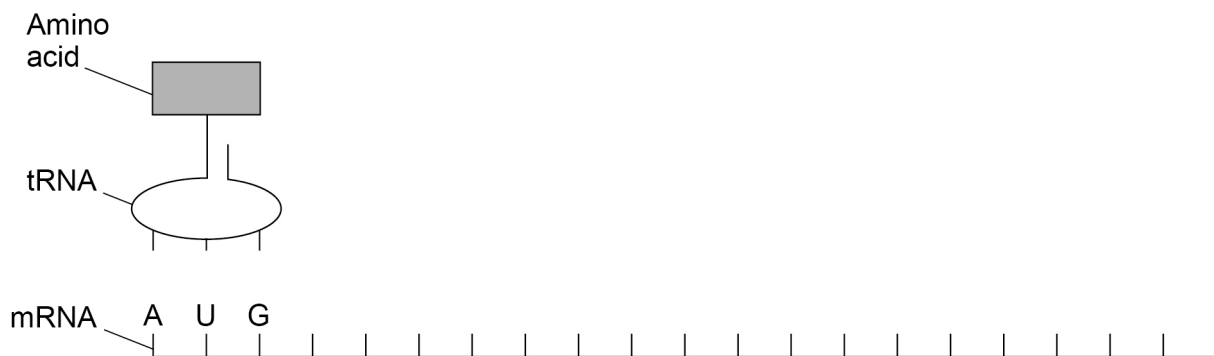
0 2 . 2 Pre-mRNA is spliced to form mRNA.

Explain why splicing of pre-mRNA is necessary.

[2 marks]

Figure 4 shows the RNA molecules involved in translation.

Figure 4



0 2 . 3 **Figure 4** shows the first codon on the mRNA molecule.

Give the complementary triplet on DNA and the anticodon of the tRNA molecule.

[2 marks]

DNA triplet _____

tRNA anticodon _____



0 2 . 4 Each nucleotide in the mRNA molecule contains three types of substance.

One substance is a nitrogenous base.

Name the other two substances.

[2 marks]

1 _____

2 _____

Question 2 continues on the next page

Turn over ►



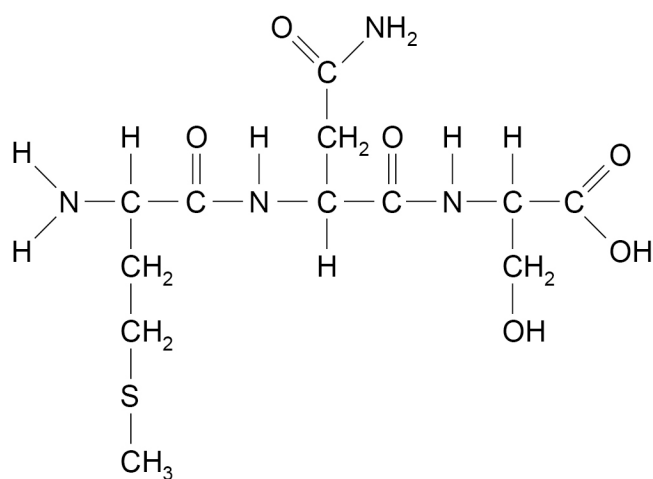
Table 1 shows the R-groups of some amino acids.

Table 1

Amino acid	R-group
Alanine	CH ₃
Asparagine	CH ₂ CONH ₂
Aspartic acid	CH ₂ COOH
Glutamic acid	CH ₂ CH ₂ COOH
Glycine	H
Methionine	CH ₂ CH ₂ SCH ₃
Serine	CH ₂ OH
Valine	CHCH ₃ CH ₃

Figure 5 shows a polypeptide.

Figure 5



0 2 . 5

Use **Table 1** to identify the amino acids in the polypeptide in **Figure 5**.

Name the amino acids.

[2 marks]



0 3

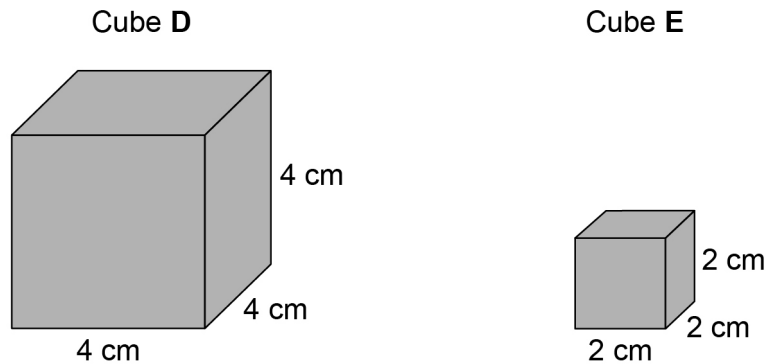
Three students investigate the effect of changing surface area on the time taken for the diffusion of acid into cubes of different sizes.

The students use cubes made from a thick, clear substance called agar.

Each student cuts two agar cubes, **D** and **E**.

Figure 6 shows the agar cubes.

Figure 6

**0 3****1**

State how the students should cut the agar cubes to reduce the risk of injury.

[1 mark]

0 3**2**

The surface area to volume ratio of Cube **E** is 3 : 1

Calculate the surface area to volume ratio of Cube **D**.

[2 marks]

Surface area to volume ratio = _____ : 1

Question 3 continues on the next page

Turn over ►



0 3 . 3

The agar contains a pH indicator called phenolphthalein.

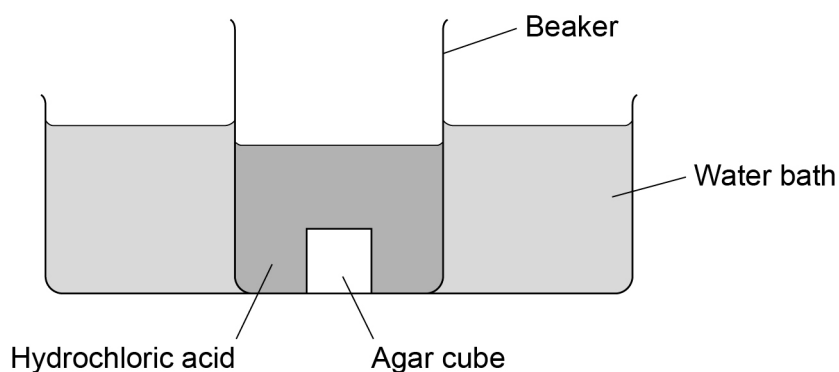
Phenolphthalein is pink at pH 8 and turns colourless (has no colour) below pH 8.

Each student:

- puts 200 cm³ of hydrochloric acid in a beaker in a water bath
- puts one Cube **D** into the beaker
- measures the time taken for the pink colour in the agar to disappear completely.

Figure 7 shows the equipment.

Figure 7



Each student repeats the experiment using one Cube **E**.

The students control the volume of hydrochloric acid.

State **three** other variables that should be controlled to allow a valid comparison.

[3 marks]

- 1 _____
- 2 _____
- 3 _____



The three students record their results and calculate the mean time taken.

Table 2 shows the students' results.

Table 2

Student	Time	
	Cube D	Cube E
1	1537s	780.9s
2	1621s	769.1s
3	1633s	790s
Mean		780s

0 3 . 4 The students' teacher says that **Table 2** is not presented correctly.

Give **two** ways **Table 2** can be improved.

[2 marks]

1 _____

2 _____

0 3 . 5 Calculate the mean time taken for Cube **D** to turn colourless.

[1 mark]

Mean time = _____ s

Question 3 continues on the next page

Turn over ►



0	3	.	6
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The value of the time taken for Cube **D** to turn colourless is different for each student.

Give **one** reason why.

Suggest **one** improvement to increase the accuracy of measuring the time taken.

[2 marks]

Reason _____

Improvement _____

11



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0 4

Many insects look very similar. This means it is difficult to classify them into the correct genus. Scientists use molecular comparisons to classify organisms more accurately.

0 4 . 1

Cytochrome c is a protein involved in aerobic respiration.

The amino acid sequence of cytochrome c is often used to classify insects.

Explain **one** reason why.

[2 marks]

0 4 . 2

Scientists also compare the DNA base sequence of the gene that codes for cytochrome c.

This leads to more accurate classification of insects than comparing amino acid sequences of the protein.

Explain why.

[2 marks]



Many species of insect live in rivers.

Factories sometimes release heavy metal ions into rivers. Heavy metal ions can be toxic even at low concentrations.

Scientists investigate the effect of heavy metal ions on the populations of insects in a river.

The scientists:

- measure the concentration of heavy metal ions at the site of release and at different distances along the river
- estimate the number of each species of insect at 0 m, 300 m and 600 m from the site of release.

0 4 . 3

Suggest why the scientists can only **estimate** the population sizes of the insects in a river.

Do **not** include problems identifying the insects in your answer.

[1 mark]

Question 4 continues on the next page

Turn over ►



Table 3 shows the estimated number of each species of insect at the three sites along the river.

Table 3

Species of insect	Estimated number of insects at each distance		
	0 m	300 m	600 m
<i>Belostoma flumineum</i>	3	15	20
<i>Enallagma cyathigerum</i>	0	12	25
<i>Ephemera danica</i>	0	5	8
<i>Hermetia illucens</i>	7	8	10
<i>Hesperocorixa castanea</i>	5	5	6
<i>Nectopsyche candida</i>	2	4	19
<i>Nectopsyche exquisita</i>	2	5	25
<i>Tabanus sulcifrons</i>	20	60	57
<i>Tipula exquisita</i>	0	10	20

0 4 . 4 State the **two** species that are the most closely related.

Use **Table 3**.

[1 mark]



0 4 . 5 Calculate the index of diversity (d) for the samples taken at 0 m.

Use the formula:

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

N = total number of organisms of all species

n = total number of organisms of each species.

[2 marks]

d = _____

The index of diversity for the insects at 300 m and at 600 m are given below.

The index of diversity at 300 m = 3.72

The index of diversity at 600 m = 6.33

0 4 . 6 The insect populations at 300 m and 600 m have the same species richness, but the index of diversity at 300 m is lower.

Use the information in **Table 3** to explain why.

[3 marks]

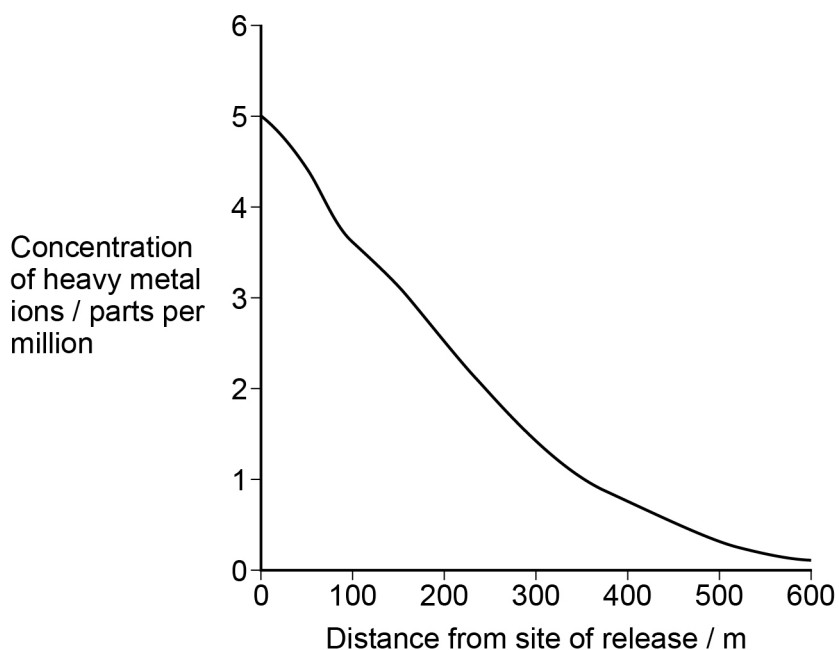
Question 4 continues on the next page

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Figure 8 shows the concentration of heavy metal ions at different distances from the site of release.

Figure 8



0 4 . 7

Describe the relationship between heavy metal ion concentration and the index of diversity for insects.

Use **Figure 8** and the index of diversity values at 300 m and 600 m.

[1 mark]

0 4 . 8 Heavy metal ions can bind to enzymes.

Suggest how heavy metal ions can change the index of diversity of the river.

[2 marks]

0 4 . 9 Give **two** other human activities that could reduce biodiversity in rivers.

Do **not** include the effects of climate change in your answer.

[2 marks]

1

2

16

Turn over for the next question

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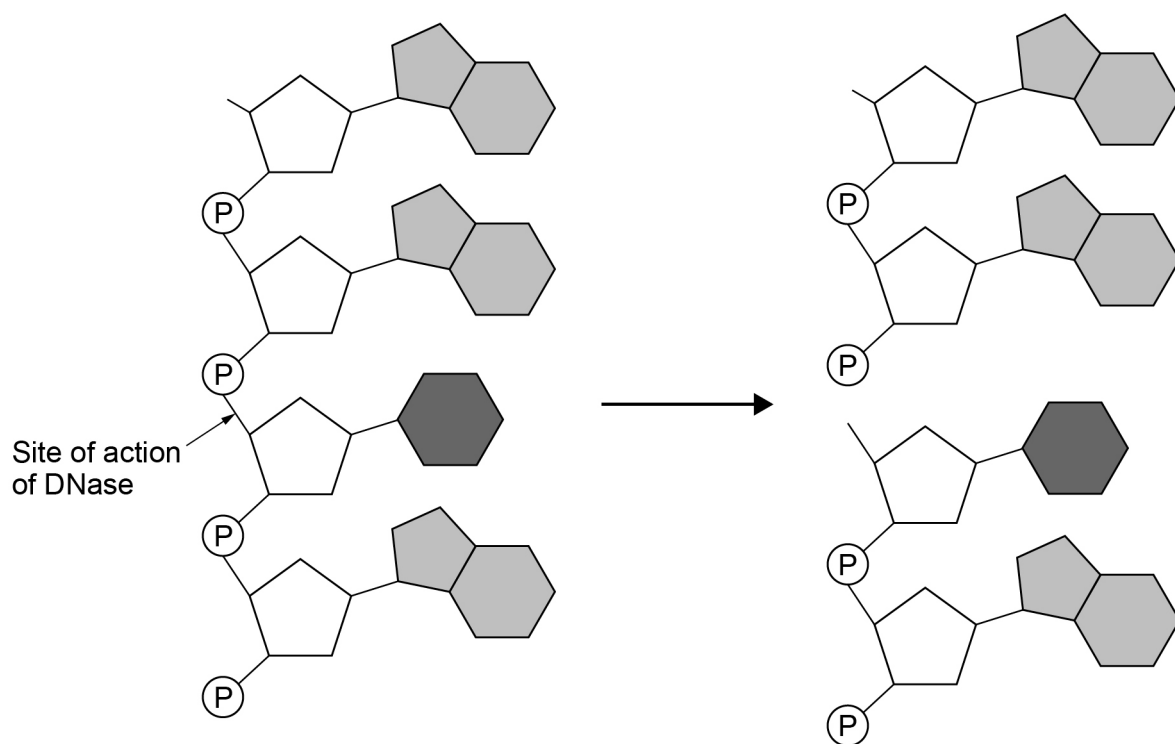
0 5

Scientists make short lengths of single-stranded DNA.

Deoxyribonuclease (DNase) hydrolyses some of the phosphodiester bonds in this DNA.

Figure 9 shows DNase hydrolysing one of the phosphodiester bonds found in the DNA.

Figure 9



0 5

1

Define **hydrolysis**.

[1 mark]



0 5 . 2

DNase hydrolyses a single-stranded DNA molecule 440 bases long. This creates fragments 1–4 bases in length.

Give the range for the possible number of fragments produced.

[1 mark]

Range = _____

Scientists investigate the effect of DNA concentration on the rate of reaction of DNase.

A solution of DNA absorbs light. As the DNA is hydrolysed, the absorption of light increases.

This is the method the scientists use.

1. Take 1.8 cm³ of a 200 µg cm⁻³ solution of single stranded DNA.
2. Add 1% DNase solution.
3. Record the absorbance of light by the solution for 5 minutes.
4. Repeat steps 1–3 ten times and calculate a mean.
5. Repeat steps 1–4 for four other DNA concentrations.

0 5 . 3

The scientists use the same concentration of enzyme for each concentration of DNA.

Give **two other** variables and describe how they can be controlled.

[2 marks]

1 _____

2 _____

Question 5 continues on the next page

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0 5 . 4

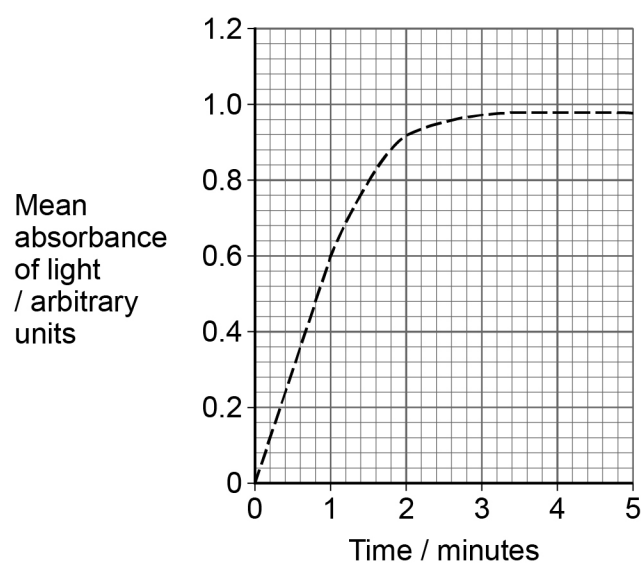
The experiment is repeated ten times at each DNA concentration.

Explain why.

[2 marks]

Figure 10 shows the results for one DNA concentration.

Figure 10



0 5 . 5

Use Figure 10 to find the initial rate of reaction per minute.

[1 mark]

Initial rate = _____ arbitrary units minute⁻¹



0 5 . 6

Calculating the initial rate of reaction is a more useful measure of rate than calculating a mean rate between 0 and 5 minutes.

Explain why.

[2 marks]

0 5 . 7

The scientists find the initial rate of reaction at each concentration of DNA.

For each concentration of DNA, the concentration of DNase is kept constant at 1%.

A graph of initial rate of reaction against concentration of DNA is plotted.

Explain why the shape of the curve is similar to the shape of the curve in **Figure 10**.

[2 marks]

Question 5 continues on the next page

Turn over ►



0 5 . 8 DNase **cannot** hydrolyse RNA.

Suggest why.

[2 marks]

0 5 . 9 The initial rate of hydrolysis in **Figure 10** is faster than the initial rate of hydrolysis of DNA inside living cells.

Suggest why.

[3 marks]



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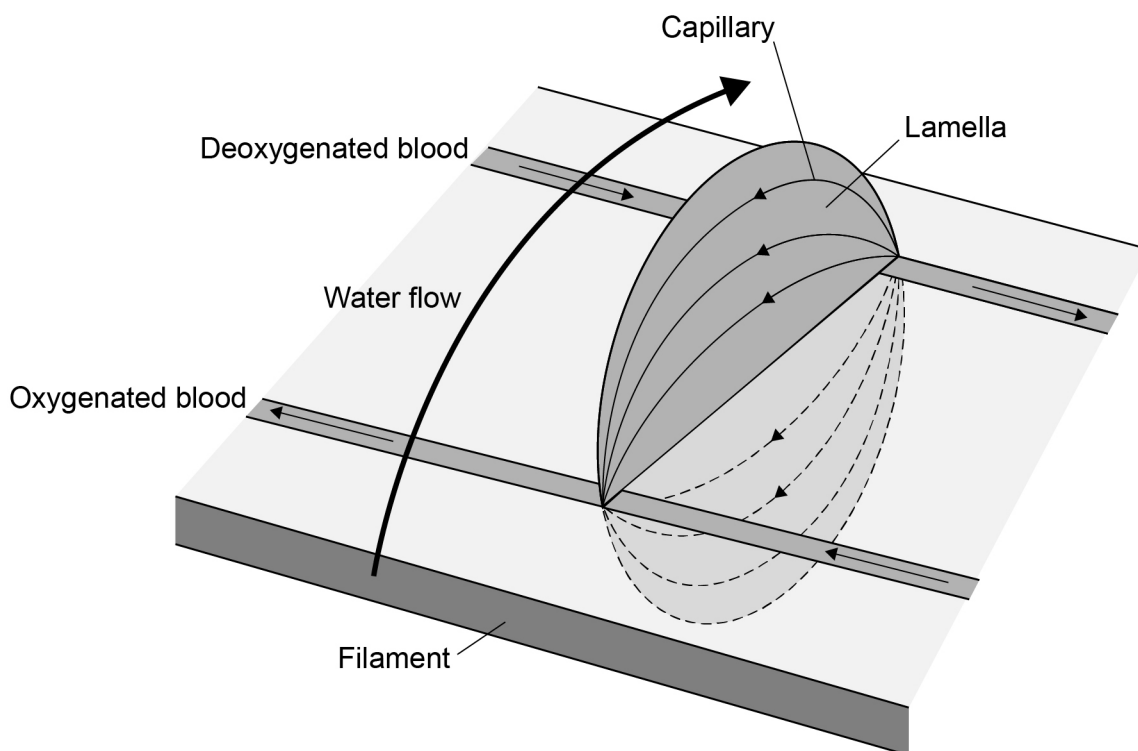


2 5

0 6

Figure 11 shows part of the gill of a fish.

Figure 11



Read the following passage:

Fish have a specialised gas exchange system consisting of gills. Each gill is made of many layers called filaments and each filament has many raised parts on the top and bottom, called lamellae. The walls of the lamellae are very thin and each lamella contains many blood capillaries. Gas exchange occurs between the blood that flows through the capillaries and the water that flows over the gills. Each species of fish has a maximum gill size, limiting the amount of oxygen that can be exchanged.

5

In recent years, there has been an increase in water temperatures due to climate change and a decrease in the mean size of fish. A possible explanation for the decrease in the size of fish is that as water temperature rises the concentration of oxygen in the water decreases. This means that the fish cannot grow as large, even though there is an increase in the rate of enzyme-catalysed reactions.

10

A smaller mean size in fish is linked to a reduced reproduction rate and reduced populations. Humans can find it difficult to catch enough fish when the population size is small, and so often decrease the size of the holes in their nets. This affects the whole ecosystem.

15

Use the information from the passage and your own knowledge to answer the questions.



[3 marks]

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Explain why.

[2 marks]

Question 6 continues on the next page

Turn over ►



0 6 . 3

A decrease in oxygen concentration of the water could lead to less growth (lines 9–13).

Suggest why.

[2 marks]

0 6 . 4

Humans catch fish with nets.

Suggest how a decrease in the size of the holes in fishing nets could affect the whole ecosystem (lines 14–17).

[2 marks]

0 6 . 5

Suggest **one** change that can be made to fishing to stop fish populations from decreasing.

Do **not** include net hole size in your answer.

[1 mark]

END OF QUESTIONS

10


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Question number	Additional page, if required. Write the question numbers in the left-hand margin.
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