OXFORD
INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

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

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Candidate signature _____

INTERNATIONAL A-LEVEL
BIOLOGY (9610)

Unit 3 Populations and genes

Monday 14 January 2019 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	
TOTAL	

Do not write outside the box

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

0 1 . 1 A species occupies a niche within a habitat.

Explain why it is an advantage for different species to occupy different niches.

[2 marks]

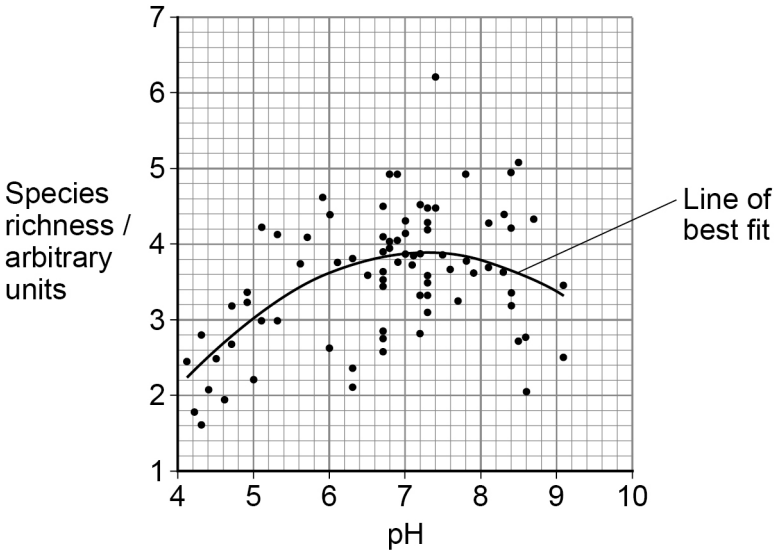
0 1 . 2 Fish occupying different niches have differently-shaped mouths.

Suggest **one** reason why mouth shape is an adaptation to their niche.

[1 mark]

Species richness is the number of different species in a given area.
Figure 1 shows the effect of pH on species richness of fish in a large number of lakes in one area.

Figure 1



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0 1 . 3 A student concludes that pH 7.3 gives the highest species richness.

Evaluate the student's conclusion.

Use data from **Figure 1**.

[4 marks]

0 1 . 4 pH is one abiotic factor that affects species richness.

Explain how **two** other abiotic factors could affect the species richness of fish.

[2 marks]

1

2

9

Turn over for the next question

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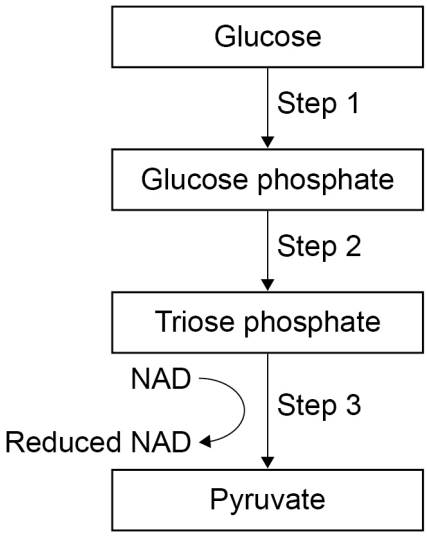
0 2 **Figure 2** shows some of the steps in glycolysis.

Figure 2



0 2 . 1 Describe what happens to the reduced NAD produced during Step 3 in aerobic respiration.

[3 marks]

0 2 . 2 In anaerobic conditions, some bacteria use reduced NAD to convert pyruvate to ethanol.

Explain why this is an advantage to the bacteria.

[2 marks]

Do not write outside the box

0 2 . 3 Pyruvate enters mitochondria through mitochondrial pyruvate carriers (MPCs).

Suggest why an MPC inhibitor would decrease the rate of oxygen uptake by a mammalian cell.

[3 marks]

0 2 . 4 Scientists can calculate the maximum theoretical yield of ATP from the aerobic respiration of one molecule of glucose.

Suggest how an increase in membrane permeability would reduce this yield of ATP. Use your knowledge of the passage of protons across mitochondrial membranes.

[2 marks]

10

Turn over for the next question

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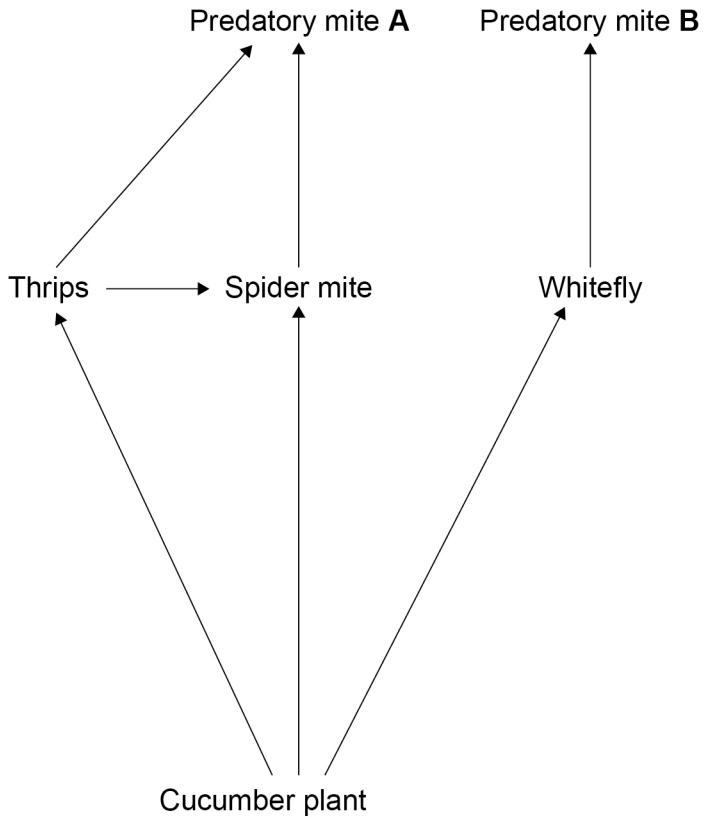
0 3 Cucumbers are crop plants. In some countries, cucumbers are grown in glasshouses. **Figure 3** shows part of a food web in a glasshouse.

Figure 3



0 3 . 1 Thrips are insects that feed using their mouthparts to pierce plant cells and suck the cell contents.
The damage to cells causes white patches to develop on the plant leaves.

Explain how thrips decrease the productivity of a cucumber crop growing in a glasshouse.

[2 marks]

Do not write outside the box

0 3 . 2 Biological pest control can be used to reduce the numbers of thrips.

Describe **two** advantages of using biological pest control rather than chemical pesticides.

[2 marks]

1 _____

_____

2 _____

_____

0 3 . 3 Suggest **one** disadvantage of using only predatory mite **B** for biological pest control. Use information from **Figure 3**.

[2 marks]

_____

_____

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Question 3 continues on the next page

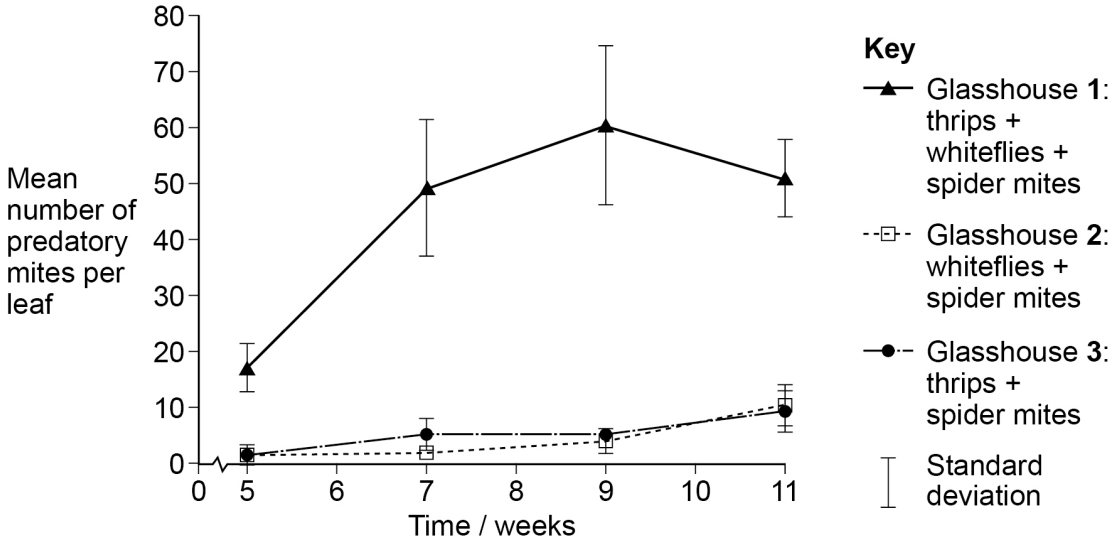
Do not write outside the box

A scientist investigates the effect of pest species on the mean number of predatory mites per leaf.

The scientist:
- grows cucumber plants in three identical glasshouses for 5 weeks
- adds thrips, whiteflies and spider mites to glasshouse **1**, whiteflies and spider mites to glasshouse **2**, and thrips and spider mites to glasshouse **3**
- adds predatory mites **A** and **B** to all three glasshouses
- counts the mean number of predatory mites every 2 weeks.

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

Figure 4



0 3 . 4 A student concludes that the mean number of predatory mites per leaf peaks at 9 weeks and then decreases.

Evaluate this conclusion.

Use only the data from glasshouse **1**.

[3 marks]

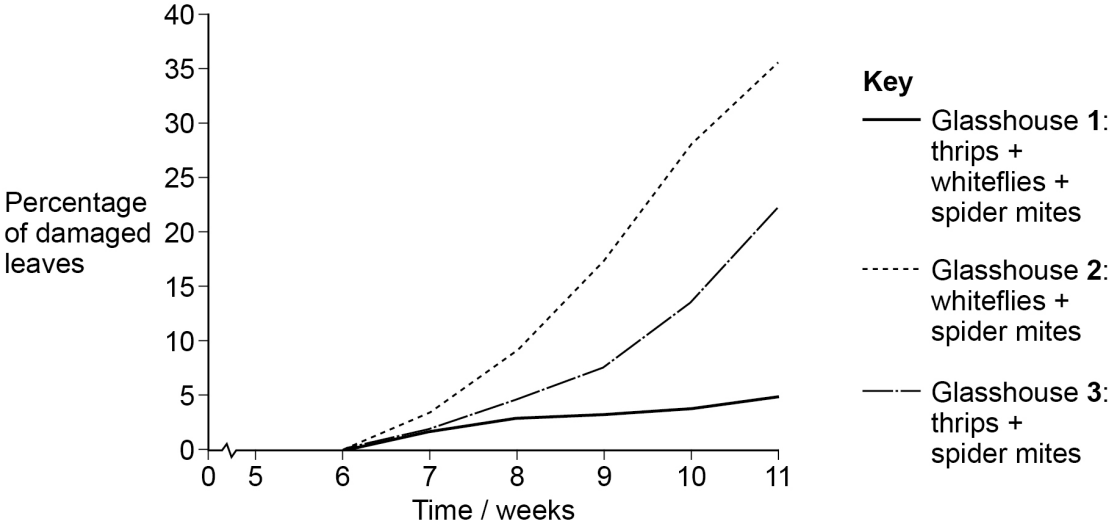
Do not write outside the box

0 3 . 5 The scientist also investigates the effect of pest species on the leaf damage caused by spider mites.

The scientist:
- counts the number of damaged and undamaged leaves every week
- calculates the percentage of damaged leaves.

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

Figure 5



The scientist concludes that increased diversity of pest species improves biological pest control.

Explain how the data in **Figure 4** and **Figure 5** support this conclusion.

[4 marks]

13

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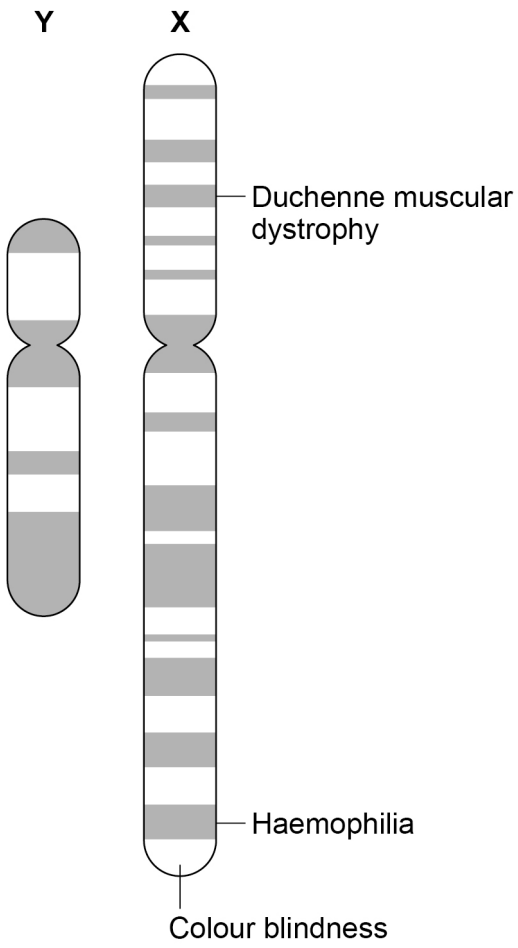
0 4 Duchenne muscular dystrophy, haemophilia and colour blindness are sex-linked conditions.

Figure 6 shows a Y chromosome and an X chromosome.

Figure 6



0 4 . 1 Explain why sex-linked conditions are more common in males than in females. Use information from **Figure 6**.

[3 marks]

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Question 4 continues on the next page

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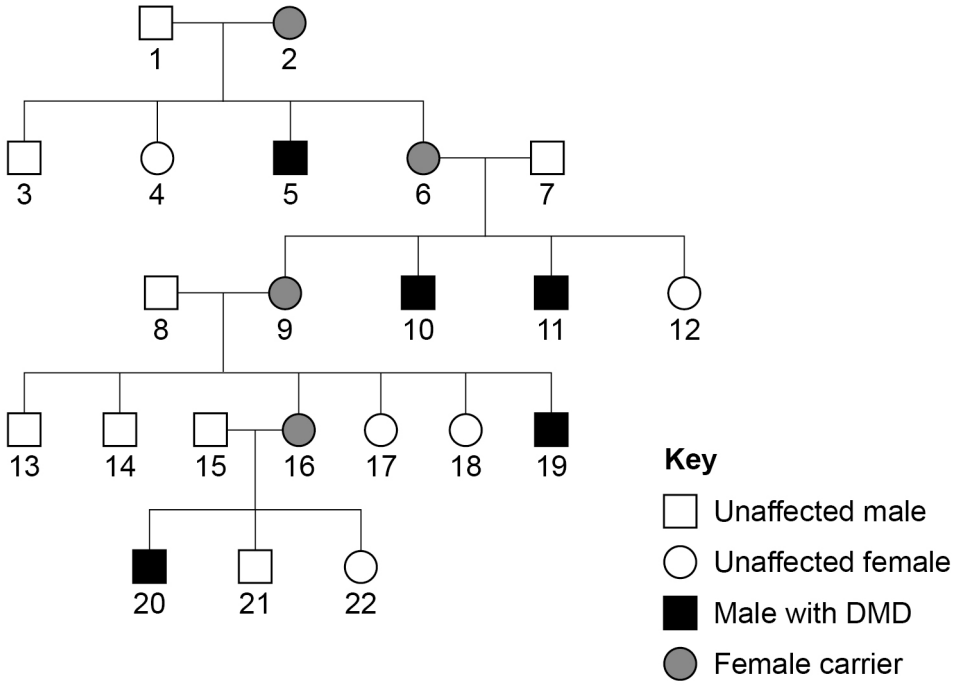
Duchenne muscular dystrophy (DMD) is an inherited condition that causes muscles to become progressively weaker.

A recessive allele (d) on the X chromosome causes DMD.

Figure 7 is a pedigree chart showing the inheritance of DMD in one family.

Figure 7



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0 4 . 2 Identify the genotypes of individuals **15** and **16**.

Tick (✓) **one** box.

[1 mark]

Individual 15	Individual 16	
X^dX	XY^d	
X^DX	X^dY	
X^dY	X^DX^d	
X^DY	X^DX^d	

0 4 . 3 Individuals **15** and **16** have another child.

State the probability of their child being a boy with DMD.

[1 mark]

_____

0 4 . 4 Explain why individual **22** could never have a son with DMD.

[2 marks]

_____

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Question 4 continues on the next page

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0 4 . 5 Cystic fibrosis (CF) is another inherited condition.

A recessive allele causes CF. The CF allele is **not** carried on the sex chromosomes.

The frequency of the CF allele in a population is 0.025

Calculate the percentage of the population who are carriers of CF.

Use the Hardy-Weinberg equation.

[3 marks]

Percentage of population who are carriers _____

0 4 . 6 Suggest **one** reason why the actual percentage of carriers of CF is different from the value you calculated in question **04.5**.

[1 mark]

_____

_____

_____

11

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Turn over for the next question

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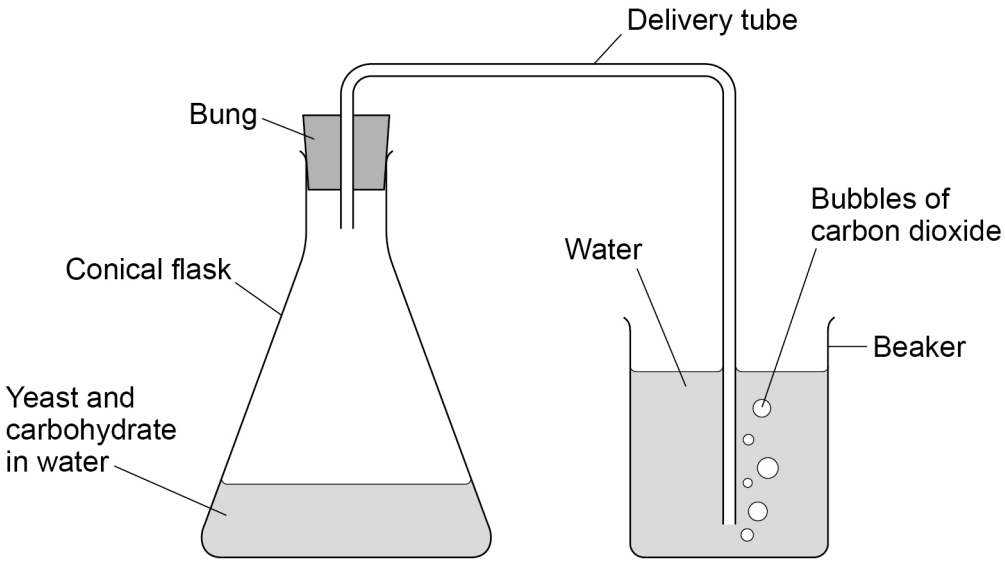
0 5 A student investigates the effect of different carbohydrates on the number of bubbles of carbon dioxide produced by yeast.

The student uses the apparatus shown in **Figure 8**.

Figure 8



The student:

- adds 5 g yeast to 100 cm^3 water in a 250 cm^3 conical flask
- adds 1 g glucose to the conical flask and mixes thoroughly
- seals the conical flask using the bung and delivery tube
- waits for 5 minutes
- counts the number of bubbles of carbon dioxide released in 1 minute
- repeats the investigation using sucrose instead of glucose in step 2
- repeats the investigation again using starch instead of glucose in step 2.

0 5 . 1 The student keeps the mass of yeast, the mass of carbohydrate, and the volume of water constant when repeating the investigation.

State **two** other variables that the student should control.

Describe how each variable could be controlled.

[2 marks]

1 _____

_____

2 _____

_____

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0 5 . 2 One source of error in the student's investigation is that the bubbles vary in size.

Describe how the student could reduce this error.

[1 mark]

The student's results are shown in **Table 1**.

Table 1

Source of carbohydrate	Number of bubbles released in 1 minute
Glucose	52
Sucrose	7
Starch	12

0 5 . 3 Plot a suitable graph of the results.

[2 marks]

Question 5 continues on the next page

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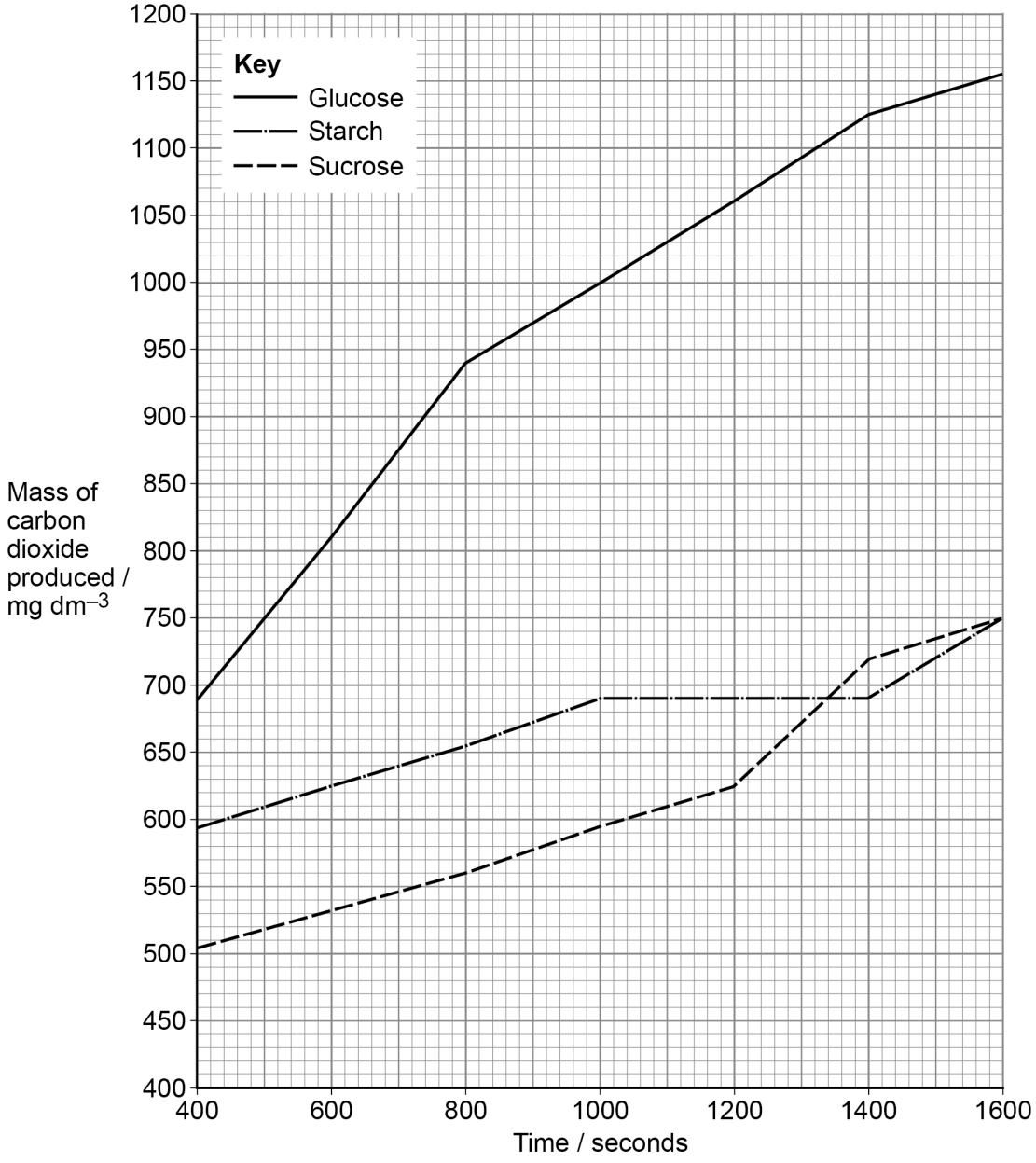
A scientist measures the change in carbon dioxide production in yeast over time. The only variable the scientist changes is the type of carbohydrate.

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

Figure 9



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0 5 . 4 Calculate the rate of carbon dioxide production at 500 seconds using glucose.

Give your answer in mg dm^{-3} min^{-1} correct to 2 significant figures.

[3 marks]

_____ mg dm^{-3} min^{-1}

0 5 . 5 Explain the differences in the rate of carbon dioxide production for the different carbohydrates from 400 to 800 seconds.

[3 marks]

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0 5 . 6 The scientist continues the investigation and finds the production of carbon dioxide from the glucose solution decreases after 2000 seconds.

Suggest **one** reason why carbon dioxide production decreases.

[1 mark]

_____

_____

12

Turn over for the next question

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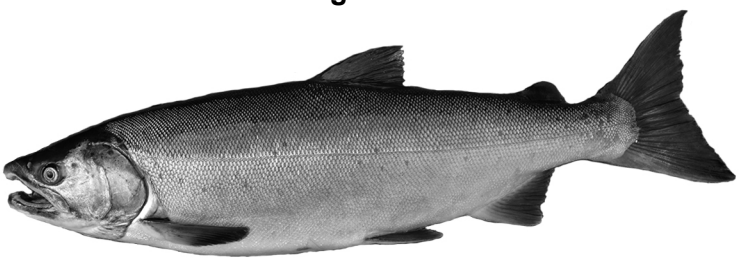
0 6 **Figure 10** shows a female salmon. Female salmon lay their eggs in nests.
A scientist investigates the effect of the size of females on behaviour, nest depth and egg diameter.

Figure 10



An adult female:

- arrives at the place where she will lay her eggs
- digs a nest in her territory
- releases eggs into the nest for the male to fertilise
- covers the fertilised eggs with stones
- guards her territory.

Females cover their eggs to protect them from predators and physical damage.

The scientist measures the lengths of 13 female salmon, the depth of the nest for each fish and the mean diameter of the eggs in the nest.

The results are shown in **Table 2**.

Table 2

Length of female salmon / cm	Depth of nest / cm	Mean egg diameter / mm
46.5	8.9	6.2
50.0	14.0	6.4
53.0	11.4	6.3
53.5	12.7	6.6
56.0	12.7	6.6
56.0	9.0	7.0
58.0	10.5	7.2
61.5	14.0	7.1
65.5	22.8	7.8
67.0	15.2	8.1
68.0	17.8	8.5
69.0	20.3	8.4
74.0	26.7	8.5

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0 6 . 1 The scientist plots a graph of the length of female salmon and the depth of nest. State the type of graph the scientist should use.

Give **one** reason for your choice.

[1 mark]

0 6 . 2 The scientist wants to use a statistical test to determine if there is a link between the length of female salmon and the depth of their nests.

Name a test that the scientist could use and describe how he would interpret the value obtained.

[2 marks]

Question 6 continues on the next page

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There is competition between female salmon for nesting territory.

Female salmon spend almost all of their breeding life defending their territory to prevent other female salmon from digging up the eggs to use the nesting site.

The scientist monitors the behaviour of the female salmon during the time they are breeding.

The scientist records the lengths of the female salmon and the outcome of fights between female salmon.

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

Table 3

Length of female salmon defending territory (D) / cm	Length of female salmon attacking territory (A) / cm	Winner of fight (D or A)
59.0	67.0	A
61.0	70.0	A
61.5	72.5	A
62.0	68.5	A
65.0	69.0	A
67.5	68.5	A
68.0	71.0	D
68.0	69.0	D

0 6 . 3 The scientist concludes that larger female salmon have a selective advantage.

Evaluate this conclusion.

Use data from **Table 2** (on page 20) and **Table 3**.

[4 marks]

7

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Turn over for the next question

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0 7 **Table 4** shows the changes in atmospheric carbon dioxide concentration, atmospheric methane concentration and temperature over 20 years.

Table 4

	Year		
	1990	**2000**	**2010**
Global mean atmospheric CO_2 concentration / parts per million	354	370	389
Global mean atmospheric methane concentration / parts per million	1.67	1.73	1.75
Global mean temperature difference compared with the mean for the 20th century / °C	+ 0.43	+ 0.44	+ 0.70

0 7 . 1 Explain how changes in levels of carbon dioxide and methane in the atmosphere can cause climate change.

[4 marks]

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0 7 . 2 Explain how the change in global mean temperature in **Table 4** could increase or decrease the yield of crop plants.

[6 marks]

Increased yield _____

_____

_____

_____

_____

_____

Decreased yield _____

_____

_____

_____

_____

_____

0 7 . 3 Humans have been selectively breeding crop plants for thousands of years.

Explain how selective breeding has reduced the ability of crop plants to adapt to climate change.

[3 marks]

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13

END OF QUESTIONS

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