OXFORD AQA

INTERNATIONAL QUALIFICATIONS

Please write clearly in block capitals.

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Candidate signature _____

I declare this is my own work.

INTERNATIONAL AS

BIOLOGY (9610)

Unit 1 The Diversity of Living Organisms

Thursday 4 January 2024 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	

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

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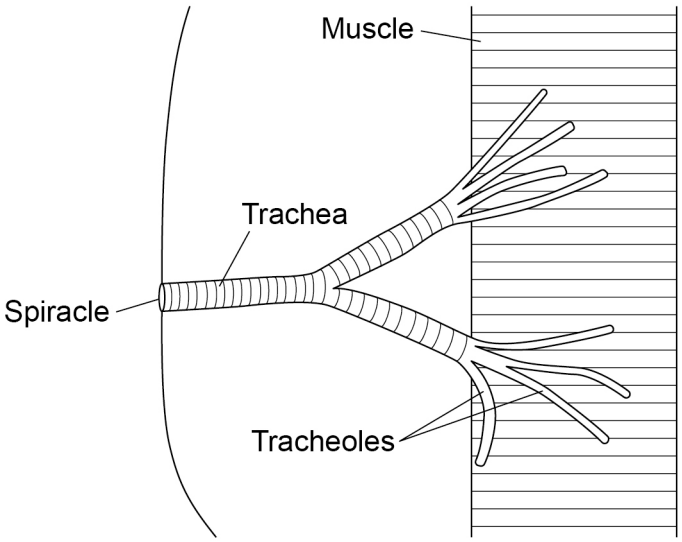
0 1 **Figure 1** shows part of the gas exchange system of an insect.

Figure 1

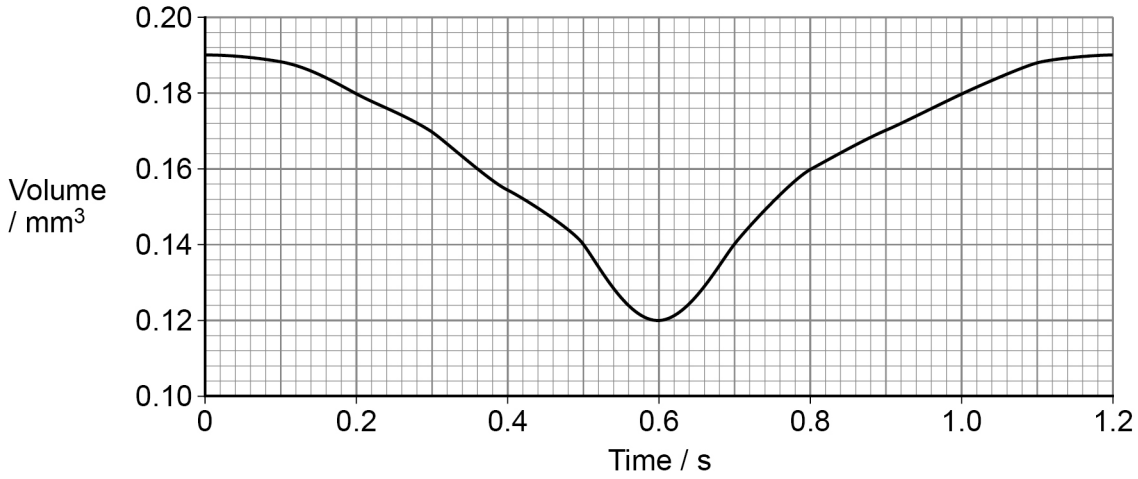


0 1 . 1 Draw **one** arrow on **Figure 1** and label it **G** to show where gas exchange occurs.

[1 mark]

Figure 2 shows the change in the volume of air in one trachea of an insect during one ventilation cycle.

Figure 2



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0 1 . 2 Calculate the volume of air that leaves the trachea in one minute.

Use data from **Figure 2**.

[2 marks]

Volume _____ mm^3

0 1 . 3 Give **three** differences between the structure of the gas exchange systems of insects and mammals.

[3 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

0 1 . 4 State **one** advantage and **one** disadvantage of the gas exchange system of an insect when compared to a mammalian gas exchange system.

[2 marks]

Advantage _____

_____

_____

Disadvantage _____

_____

_____

Question 1 continues on the next page

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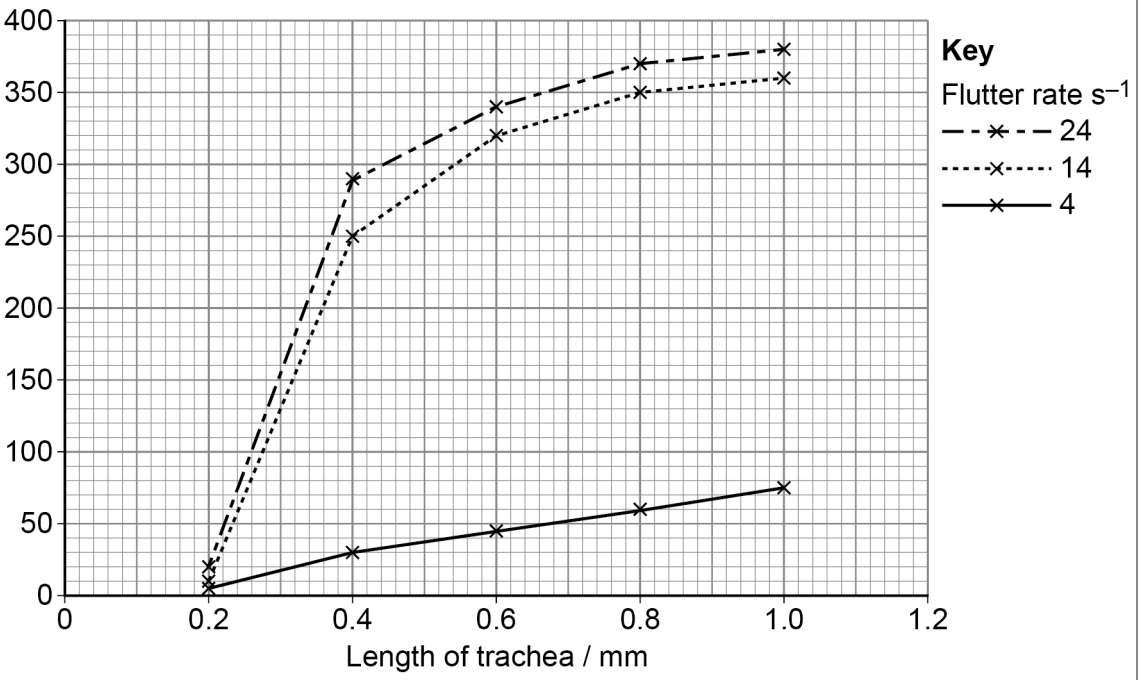
Insects can close their spiracles to reduce water loss.

They can open them to allow for ventilation.

Some insects are able to repeatedly open and close their spiracles very quickly. This is known as fluttering.

Figure 3 shows the percentage respiratory increase for insects with different trachea lengths at three different flutter rates.

Figure 3



0 1 . 5 Describe how flutter rate and trachea length affect the percentage respiratory increase.

Use information from **Figure 3**.

[3 marks]

11

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0 2 Mitochondria contain a protein called cytochrome c consisting of over 100 amino acids.

0 2 . 1 Draw the general structure of an amino acid.

[1 mark]

0 2 . 2 When **two** amino acids are joined together, two products are formed.

Name these products.

[2 marks]

1 _____

2 _____

Question 2 continues on the next page

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The amino acid sequences of cytochrome c in 7 species were compared.

The information in **Table 1** can be used to work out the evolutionary relationship between species.

Table 1 shows the number of differences in amino acids between pairs of species.

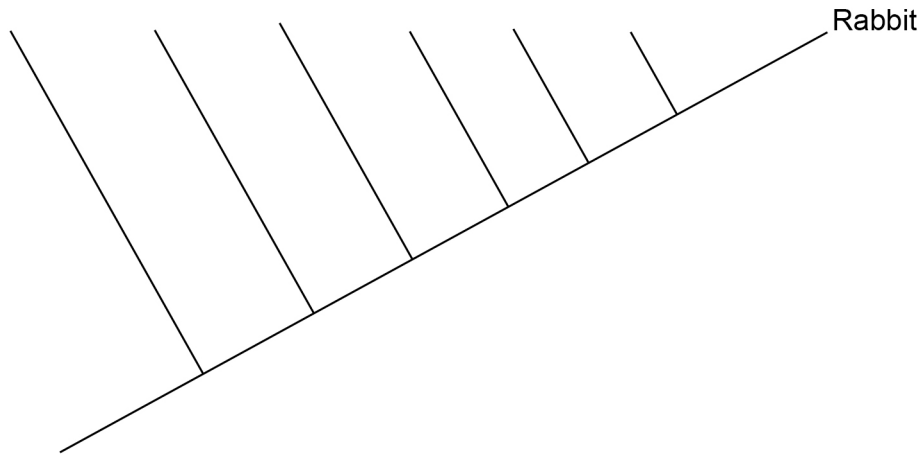
Table 1

	Yeast	**Frog**	**Rabbit**	**Turtle**	**Penguin**	**Kangaroo**	**Donkey**
Yeast	0	47	45	49	45	46	45
Frog	47	0	11	10	12	13	13
Rabbit	45	11	0	9	8	6	5
Turtle	49	10	9	0	11	11	10
Penguin	45	12	8	11	0	10	11
Kangaroo	46	13	6	11	10	0	8
Donkey	45	13	5	10	11	8	0

0 2 . 3 Complete **Figure 4** to show the evolutionary relationship between the species. Use information from **Table 1**.

[2 marks]

Figure 4



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0 2 . 4 Suggest **one** advantage and **one** disadvantage of using the sequence of amino acids in cytochrome c to classify species.

[2 marks]

Advantage _____

_____

_____

Disadvantage _____

_____

_____

7

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 3 A student investigates the effect of different concentrations of sucrose solution on tissue from melon fruit.

The student:

- produces 5 sucrose solutions of concentrations 0.0625, 0.125, 0.25, 0.50 and 1.00 mol dm^{-3}
- puts 10 cm^3 of each sucrose solution into separate test tubes
- puts all 5 test tubes into a water bath at 30 °C
- cuts 5 cylinders of melon to 30 mm in length using a scalpel and ruler
- measures the starting mass of each cylinder of melon
- puts a cylinder of melon into each test tube and seals with a bung
- removes the cylinders of melon from the sucrose solution after 24 hours
- removes the excess sucrose solution from the surface of the cylinders using absorbent paper
- measures the final mass of each cylinder of melon
- calculates the percentage change in mass of each cylinder of melon.

0 3 . 1 Suggest **two** improvements the student can make to the method **and** explain how these changes improve the accuracy of the investigation.

[4 marks]

Improvement 1 _____

Explanation 1 _____

_____

_____

_____

Improvement 2 _____

Explanation 2 _____

_____

_____

_____

Question 3 continues on the next page

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0 3 . 2 Describe how the risk of injury from **one** potential hazard in the investigation can be reduced.

[1 mark]

Table 2 shows the student's results.

Table 2

Concentration of sucrose / mol dm^{-3}	Start mass / g	Final mass / g	Percentage change in mass
0.0625	2.79	2.94	+5.38
0.125	2.73	2.81	+2.93
0.25	2.74	2.71	−1.09
0.50	2.88	2.44	−15.28
1.00	2.65	1.96	

0 3 . 3 Calculate the percentage change in mass for the cylinder of melon in 1.00 mol dm^{-3} sucrose concentration.

[2 marks]

Percentage change in mass = _____ %

0 3 . 4 Give a reason why the student calculated the **percentage** change in mass for each concentration.

[1 mark]

Do not write outside the box

0 3 . 5 The student leaves the cylinders of melon in the sucrose solutions for 24 hours. State why.

[1 mark]

0 3 . 6 Explain why the student seals each test tube with a bung.

[2 marks]

0 3 . 7 Explain the results obtained with 0.0625 mol dm^{-3} sucrose concentration.

[2 marks]

Question 3 continues on the next page

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0 3 . 8 Explain how the student can use the results to estimate the water potential of melon tissue.

[3 marks]

16

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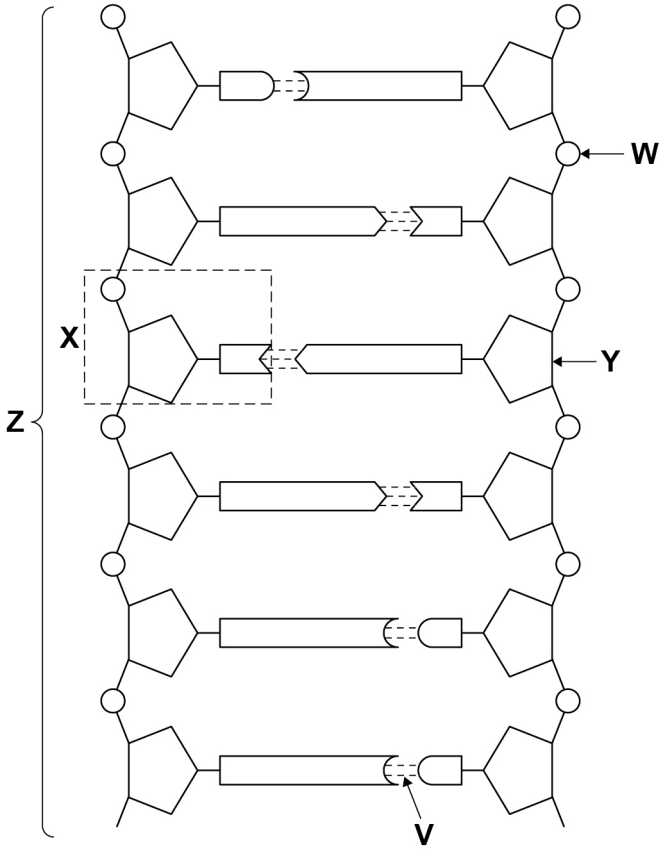
0 4 **Figure 5** shows part of a biological molecule.

Figure 5



0 4 . 1 Name parts **W**, **X** and **Y** in **Figure 5**.

[3 marks]

W _____

X _____

Y _____

0 4 . 2 Name bond **V**.

[1 mark]

_____

0 4 . 3 Give the letter that represents a monomer.

[1 mark]

_____

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Table 3 shows the percentages of different DNA bases in four different organisms.

Table 3

	Percentage of each base in DNA			
Source of DNA	**Adenine**	**Guanine**	**Thymine**	**Cytosine**
Human	30.9	19.9	29.4	19.8
Actinobacteria	15.1	35.1	14.4	35.4
Wheat	27.3	22.7	27.1	22.8
Yeast	31.3	18.7	32.9	17.1

0 4 . 4 Describe patterns in the data in **Table 3**.

[2 marks]

0 4 . 5 Explain what the patterns in **Table 3** indicate about the structure of DNA.

[2 marks]

Question 4 continues on the next page

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0 4 . 6 The DNA of a species contains 24% adenine bases.

A section of a DNA molecule from this species has 500 base pairs.

Calculate the total number of cytosine bases present in this section of DNA.

You do **not** need to use any data from **Table 3** in your answer.

[2 marks]

Number of bases = _____

11

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0 5 Aromatase is an enzyme needed for reproduction in many animals.

0 5 . 1 Describe how mRNA is synthesised from the aromatase gene.

[5 marks]

Question 5 continues on the next page

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Carp are freshwater fish.

Scientists are using gene technology to stop the carp population in a lake from increasing.

The scientists have inserted a section of DNA into the DNA of carp embryos to prevent the synthesis of aromatase.

The inserted DNA is transcribed into mRNA with a base sequence complementary to the normal mRNA synthesised from the aromatase gene.

Table 4 shows the sequence of bases on different polynucleotides found in the genetically-modified carp.

Table 4

	Sequence of bases					
Aromatase gene	A	T	T	C	G	C
mRNA produced from aromatase gene						
Inserted DNA						
mRNA produced from inserted DNA	A	U	U	C	G	C

0 5 . 2 Complete **Table 4**.

[2 marks]

0 5 . 3 Suggest how the inserted DNA prevents aromatase production.

[3 marks]

Do not write outside the box

Scientists want to compare the aromatase activity in:

- the genetically-modified carp
- carp found in the lake.

The scientists take tissue samples from a large number of each type of carp.

They measure the aromatase activity in the tissues in the laboratory.

0 5 . 4 Suggest **three** variables the scientists should control in their laboratory investigation.

[3 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

0 5 . 5 The scientists release the genetically-modified carp into the lake.

The scientists count the carp population 2 years later and find that the carp numbers have decreased.

Suggest **one** reason for this decrease.

[1 mark]

_____

_____

_____

14

Turn over for the next question

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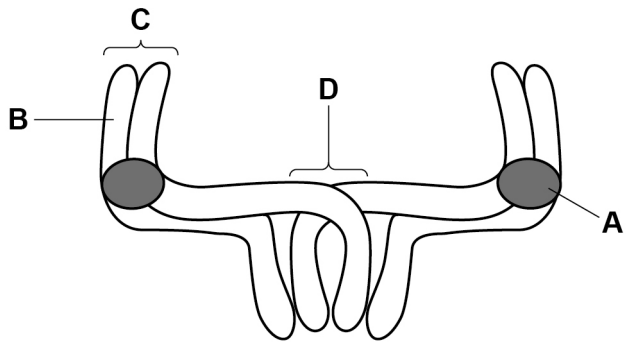
0 6 A bivalent is a pair of homologous chromosomes.

Figure 6 shows a bivalent.

Figure 6



0 6 . 1 Name structures **A**, **B** and **C** in **Figure 6**.

[3 marks]

A _____

B _____

C _____

0 6 . 2 Name the type of cell division during which homologous chromosomes come together in pairs.

[1 mark]

_____

Do not write outside the box

0 6 . 3 Describe what is happening at **D** in **Figure 6**.

[2 marks]

6

Turn over for the next question

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0 7 Read the following passage:

Inside our body cells there is an approximately equal mix of DNA from our parents. Most of this parental DNA is in the nucleus of the cell. However, not all the DNA is in the nucleus, the mitochondria also contain DNA.

Mitochondrial DNA has a different evolutionary origin than nuclear DNA. It is thought that mitochondria were originally formed when a special type of bacterium was engulfed by a different, bigger prokaryotic cell. This is called the endosymbiotic theory.

All of the DNA inside mitochondria comes from our mothers. Mitochondrial DNA contains only 37 genes in contrast to the nucleus, which contains approximately 20 000 genes. However, there are between 2 and 10 mitochondrial DNA genome copies in each mitochondrion and hundreds of mitochondria in every cell. This means there are many thousands of copies of each mitochondrial gene in each cell.

Scientists have worked out the genetic code of mitochondrial DNA and are investigating its ancestry. There is a clear record of distant maternal evolution in mitochondrial DNA because it only originates from the mother, and its DNA code changes less frequently than in nuclear DNA.

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

0 7 . 1 The main evidence for the endosymbiotic theory is the similarities between mitochondria and prokaryotic cells, compared with nuclei (lines 4–7).

Table 5 lists features of nuclei, mitochondria and prokaryotic cells.

Table 5

Feature	Nuclei	Mitochondria	Prokaryotic cells
Can divide by meiosis			
Have circular DNA			
DNA associated with histone proteins			
May have flagella			
Surrounded by two membranes			
DNA found in the cytoplasm or matrix			

Do not write outside the box

Put a tick (✓) in **Table 5** if the feature is found in nuclei, mitochondria or prokaryotic cells.

You may put more than one tick (✓) in each row.

[3 marks]

0 7 . 2 Scientists compare the number of copies of two different genes in a cell. One gene is from the mitochondria and one gene is from the nucleus.

The cell contains 2750 mitochondria and one nucleus.

Calculate the ratio of the total number of copies of the gene from the mitochondria compared to the total number of copies of the gene from the nucleus.

Assume there are 10 copies of the gene in each mitochondrion.

[2 marks]

Ratio of copies in mitochondria : copies in nucleus = _____ : 1

Question 7 continues on the next page

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0 7 . 3 A small number of human cells may be left at the scene of a crime.

When examining cells from the scene of a crime, scientists often examine mitochondrial DNA instead of nuclear DNA.

Suggest why.

[1 mark]

0 7 . 4 The DNA code changes less frequently in mitochondrial DNA compared to nuclear DNA (lines 15–17).

Explain why.

[2 marks]

0 7 . 5 DNA sequencing and amino acid sequencing are two methods used to classify organisms.

State **two** other methods that can be used to classify organisms.

[2 marks]

1

2

10

END OF QUESTIONS

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