OXFORD

INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

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

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INTERNATIONAL AS
BIOLOGY (9610)

Unit 1 The diversity of living organisms

Wednesday 9 May 2018 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.
- 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.
- All working must be shown.

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

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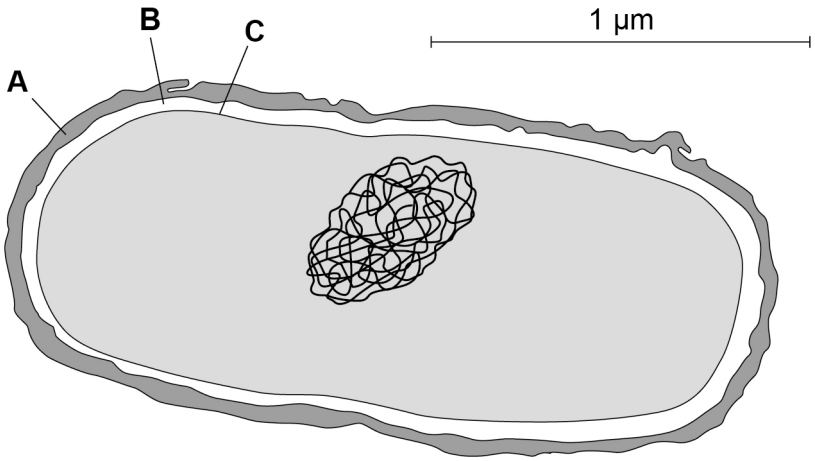
Answer **all** questions in the spaces provided.

0 1 **Figure 1** is a drawing of a transmission electron micrograph of an *E. coli* bacterium.

Figure 1



0 1 . 1 Name the three layers labelled **A**, **B** and **C** in **Figure 1**.

[3 marks]

A _____

B _____

C _____

0 1 . 2 Calculate the magnification of the image of the bacterium in **Figure 1**.

[1 mark]

Answer _____

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0 1 . 3 Some types of cell contain special proteins called chaperones.
Chaperone proteins are mostly found on the endoplasmic reticulum.

Describe the role of chaperone proteins.

[2 marks]

0 1 . 4 A protein in a eukaryotic cell may have a different shape from a protein in a bacterium even though they are coded for by an identical gene.

Suggest **one** reason why.

[1 mark]

7

Turn over for the next question

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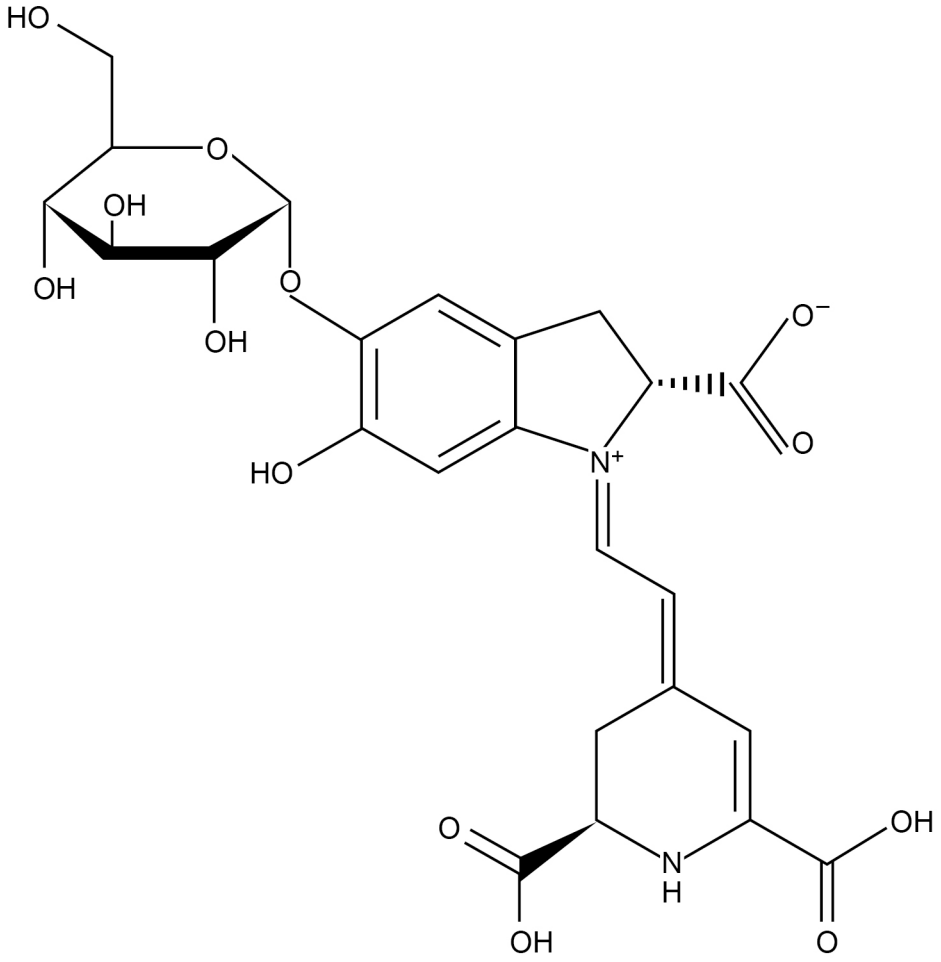
0 2 Beetroots are the swollen roots of some species of beet plant.

The vacuoles in the cells of beetroots contain a red, water-soluble pigment called betanin.

Figure 2 shows the structure of betanin.

Figure 2



0 2 . 1 Betanin does not usually cross the membrane of the vacuole.

Suggest **two** possible reasons why.
Use information from **Figure 2**.

[2 marks]

1 _____

_____

2 _____

_____

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A student carries out an experiment to investigate the effect of temperature on the permeability of membranes in beetroot cells.

The student uses the following method:

- cuts a cube of beetroot
- puts the cube into a test tube containing 10 cm^3 of water
- leaves the test tube for 20 minutes at 5 °C
- removes the cube of beetroot from the tube
- records the colour of the liquid in the tube.

The method is repeated at four other temperatures, using cubes from the same root.

The results are shown in **Table 1**.

Table 1

Temperature / °C	Colour of liquid
5	Pale pink
25	Pale pink
45	Pink
65	Dark pink
85	Red

0 2 . 2 Explain the results of the experiment shown in **Table 1**.

[4 marks]

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0 2 . 3 The student used an electric water bath for each temperature.

Give **one** reason why.

[1 mark]

0 2 . 4 The student repeated the experiment at 100 °C and found that the colour of the liquid was the same as the colour at 85 °C.

Explain why.

[2 marks]

0 2 . 5 Suggest **one** suitable control for this experiment.

[1 mark]

0 2 . 6 All of the beetroot pieces were cut to the same shape and size.

Explain why.

[2 marks]

12

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0 3 Schistosomiasis is a serious disease affecting millions of people each year.

It is caused by infection with a parasitic flatworm.

Scientists studied the genetic diversity of the three species of flatworm known to cause the disease.

Samples of the flatworms were collected at random from different locations.

0 3 . 1 Why was it important that the samples were collected at random?

[1 mark]

_____

_____

0 3 . 2 The scientists isolated the DNA from the mitochondria of the flatworms.
The mitochondrial DNA was used to measure the genetic diversity between the three species.

State **two** ways in which the structure of mitochondrial DNA is different from the structure of DNA inside the nucleus.

[2 marks]

1 _____

_____

2 _____

_____

0 3 . 3 In this study, scientists used DNA to determine the genetic diversity between the species of flatworms.

Explain **one** additional way in which genetic diversity could be measured.

[2 marks]

_____

_____

_____

_____

Question 3 continues on the next page

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0 3 . 4 Studying the genetic diversity of these parasitic flatworms is important in reducing the number of deaths caused by schistosomiasis.

Suggest why.

[1 mark]

_____

_____

_____

6

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 4 Emphysema is a disease that affects the alveoli and elastic tissue in the human lungs. It can be caused by the inhalation of irritants including chemicals found in cigarette smoke.

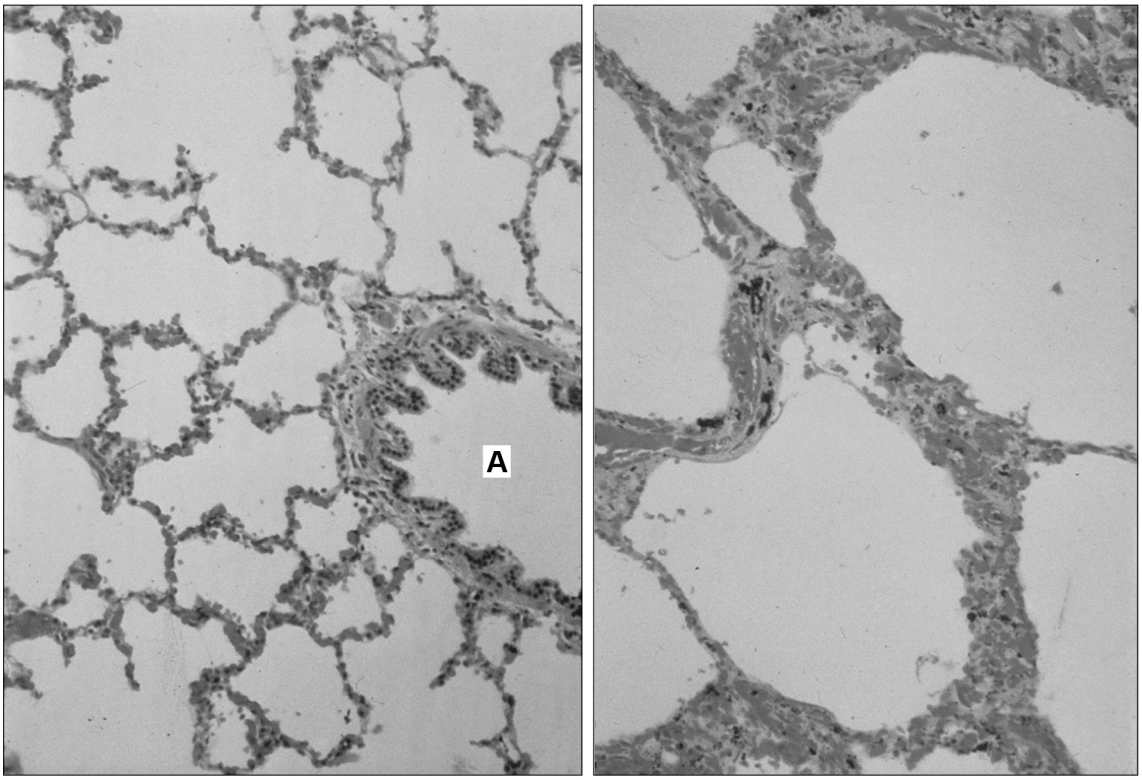
One effect of these chemicals is that they stimulate neutrophils (a type of white blood cell) to release an enzyme called elastase that breaks down elastic tissue.

Elastase is a protease enzyme. It breaks down elastic tissue through the hydrolysis of peptide bonds in the target proteins. The specific peptide bonds broken are those on the carboxyl side of hydrophobic amino acids such as alanine and valine.

Figure 3 shows a section of lung tissue from a healthy person and a section of lung tissue from a person with emphysema.

Figure 3

Section of lung tissue from a healthy person | **Section of lung tissue from a person with emphysema**



0 4 . 1 Name the structure labelled **A** in **Figure 3**.

[1 mark]

_____

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0 4 . 2 Explain why people suffering from emphysema have less efficient gas exchange than healthy people.

Use information from the passage and **Figure 3**.

[3 marks]

0 4 . 3 Elastic tissue contains a structural protein. What type of tertiary structure does this protein have?

[1 mark]

Tick (✓) **one** box.

Conjugated ☐

Fibrous ☐

Globular ☐

Prosthetic ☐

0 4 . 4 Elastase only catalyses the breakdown of the structural protein in the elastic tissue.

Explain why elastase does **not** break down other molecules.

[2 marks]

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0 4 . 5 Elastase breaks the peptide bonds on the carboxyl side of hydrophobic amino acids such as alanine and valine (Page 10, lines 7–8).

The R group in alanine is CH_3.

Draw the structure of alanine.

[1 mark]

8

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0 5 Scientists investigated the hydrolysis of cellulose from samples taken from recycled paper.

They measured the concentration of the products formed in the reaction.

0 5 . 1 Name the monomer that forms a cellulose molecule.

[1 mark]

_____

0 5 . 2 Describe a biochemical test for the monomer you named in your answer to question **05.1**.

[2 marks]

_____

_____

_____

_____

_____

_____

Question 5 continues on the next page

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0 5 . 3 In the investigation, the scientists mix the enzyme cellulase with the paper and a buffer solution in an incubated flask.

To measure the progress of the hydrolysis reaction, samples are taken from the flask every twelve hours.

The concentration of the products in each sample is measured.

Table 2 shows the scientists' results.

Table 2

Hours	**Concentration of products / g dm^{-3}**	**Rate of hydrolysis of cellulose / g dm^{-3} minutes^{-1}**
12	28.2	39.2×10^{-3}
24	42.9	20.4×10^{-3}
36	55.7	17.8×10^{-3}
48	59.2	4.9×10^{-3}
60	61.8	3.6×10^{-3}
72	62.5	

Calculate the missing rate of hydrolysis in **Table 2**. Write your answer in **Table 2**.

[1 mark]

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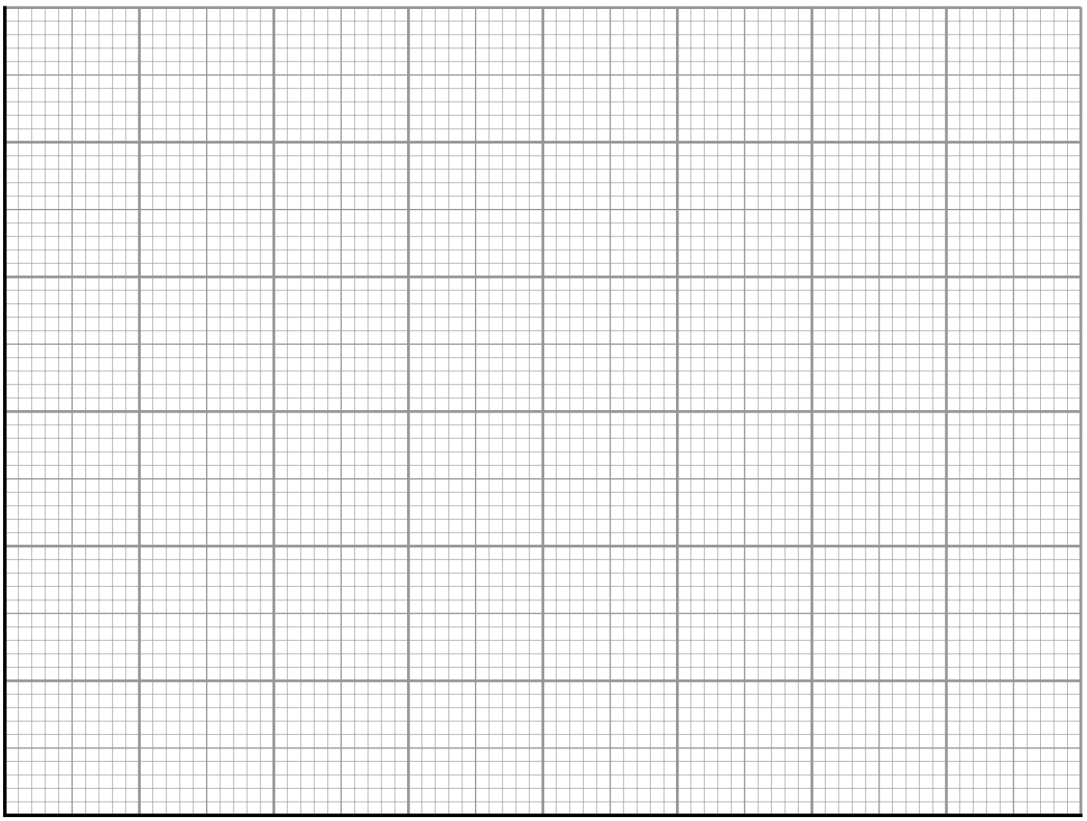
0 5 . 4 Plot a suitable graph of the rates of hydrolysis as shown in **Table 2**.

[3 marks]



0 5 . 5 Describe and explain the results of this investigation.

[3 marks]

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0 5 . 6 Explain how the structure of cellulose is related to its role in plant cell walls.

[3 marks]

13

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0 6 When apples are cut, their flesh turns brown as a result of an enzyme controlled reaction. The enzyme polyphenol oxidase (PPO) converts colourless phenols on the exposed surface of the apple into a brown pigment called melanin.

The reaction can be summarised as:

$$\text{phenols (colourless)} + \text{oxygen} \xrightarrow{\text{PPO}} \text{melanin (brown)}$$

A group of students investigate the effect of pH on the rate of browning of apples.

The students use the following method:

- cut a piece of apple and dip it into a pH4 buffer solution
- remove the apple slice and drain the excess solution
- record the time taken for the slice of apple to turn brown
- repeat the above steps with a range of different pH buffer solutions.

0 6 . 1 The size of the apple slices is constant.

State **one** other variable that should be controlled.

[1 mark]

_____

Another group of students conducting the same investigation decide to set up a colour standard before starting the experiment.

In order to do this, the students leave a freshly cut slice of apple exposed to air for it to turn brown.

This slice of apple is then sealed in plastic film.

0 6 . 2 Suggest why the students seal this piece of apple in plastic film.

[1 mark]

_____

_____

Do not write outside the box

0 6 . 3 Explain why having a colour standard is an improvement to the experiment.

[2 marks]

The results recorded by one student are shown in **Table 3**.

Table 3

pH buffer solution	Time taken for apple piece to turn brown / seconds
4	1200
5	959
6	675
7	482
8	994

0 6 . 4 Describe the results shown in **Table 3**.

[1 mark]

Do not write outside the box

Sodium chlorite (SC) is an inhibitor of the enzyme PPO.

Scientists working in the food industry investigated how SC could be used to reduce browning in apples.

0 6 . 5 Suggest how SC reduces the rate of browning in fruit such as apples.

[3 marks]

8

Turn over for the next question

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0 7 A scientific magazine recently produced an article with the headline

'At least 75% of the DNA in our genome is useless junk after all.'

0 7 . 1 Define the term 'genome'.

[1 mark]

0 7 . 2 Use your knowledge of DNA to suggest what the author of the article meant by 'useless junk'.

In your answer you should clearly describe where this junk DNA is located within the human genome.

[2 marks]

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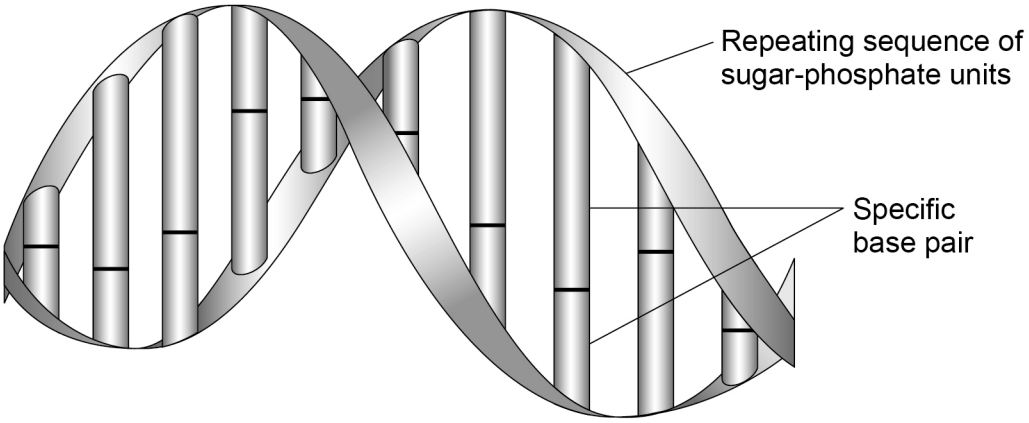
Figure 4 shows one complete turn of a DNA helix. Within the complete turn of the helix, each strand of DNA contains ten nucleotides.

Figure 4



0 7 . 3 A particular human chromosome is 1 metre long and contains 124 500 000 complete turns in its DNA helix.

Use this information to calculate the length of one nucleotide in nanometres.

[2 marks]

Answer _____ nm

Question 7 continues on the next page

Do not write outside the box

E. coli bacteria were allowed to grow and divide in a solution that contained the four DNA nucleotides. These were called **group A bacteria**.

Some of the group A bacteria were then transferred to a second solution, where they were allowed to grow and divide once. These were called **group B bacteria**.

The second solution was the same as the first, except that the nucleotides containing thymine were radioactive.

DNA from each group was tested for radioactivity.

Table 4 shows these results.

Table 4

Group A bacteria	No radioactivity
Group B bacteria	All DNA molecules were radioactive

0 7 . 4 Explain why **all** the DNA molecules in **group B bacteria** were radioactive.

Use your knowledge of DNA replication.

[4 marks]

9

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0 8 . 1 **Table 5** shows the classification of a species of firefly called ***Phosphaenus hemipterus***.

Complete **Table 5** by filling in the gaps.

[2 marks]

Table 5

Classification taxon	***Phosphaenus hemipterus***
Kingdom	*Animalia*
Phylum	*Anthropoda*
Class	*Insecta*
	Coleoptera
	Lampyridae
Genus	
Species	

Question 8 continues on the next page

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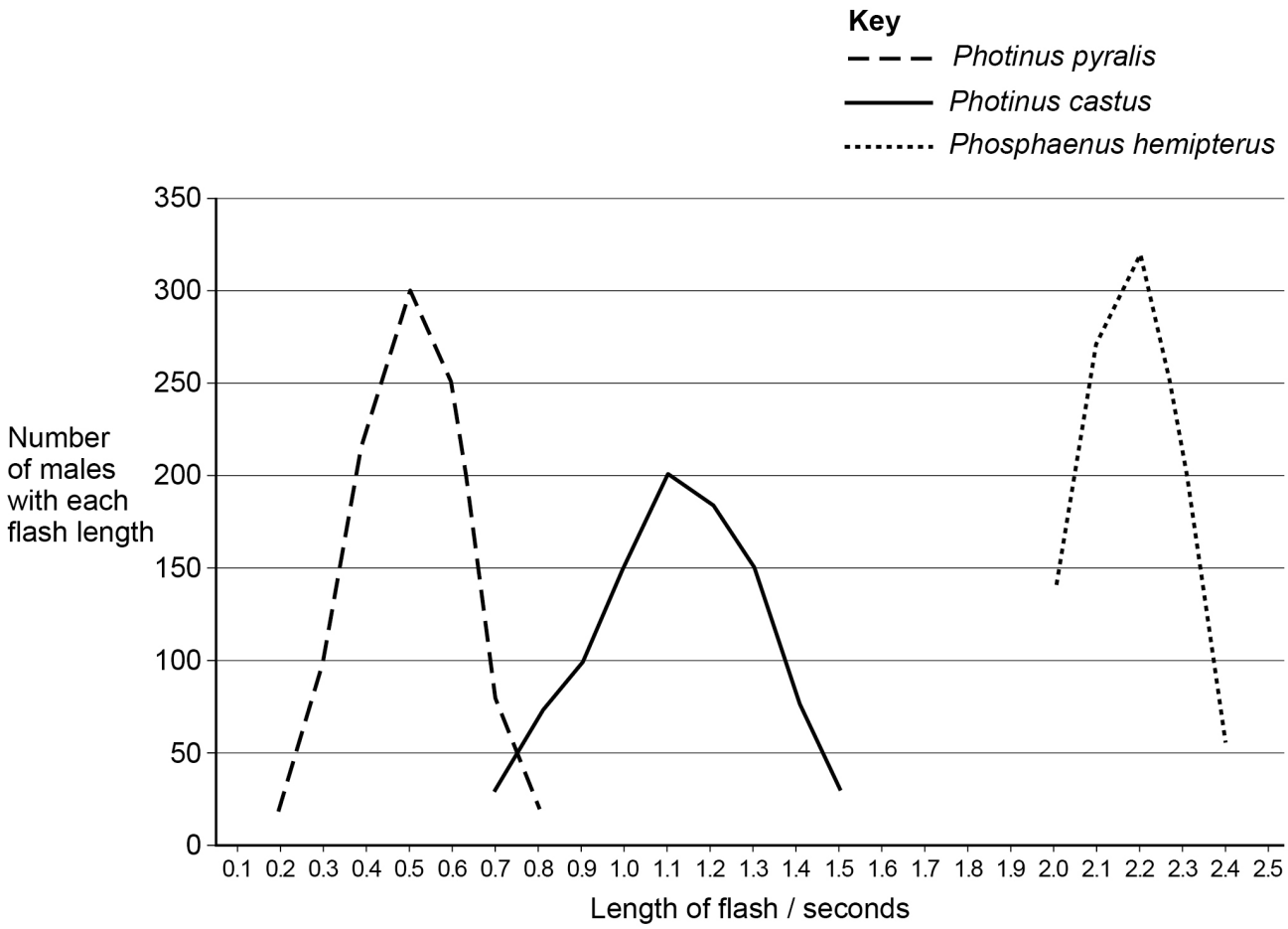
Male fireflies emit flashes of light as part of their courtship behaviour to attract females of the same species. Different species of firefly emit flashes lasting different lengths of time.

Scientists studied three different species of firefly living in the same community. They recorded the length of the flashes of 1000 males from each species.

Figure 5 shows the results they obtained.

Figure 5



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0 8 . 2 Describe the results shown in **Figure 5**.

[2 marks]

0 8 . 3 Calculate the percentage of males in the *Photinus castus* sample shown in **Figure 5** that have a flash length of 0.75 seconds.

[1 mark]

Answer _____ %

0 8 . 4 Fireflies that have a flash length between 0.7 and 0.8 seconds are less likely to pass their alleles on to the next generation.

Suggest why.

[2 marks]

Do not write outside the box

0 8 . 5 Classification is based on a hierarchy of groupings.

What is meant by the term 'hierarchy'?

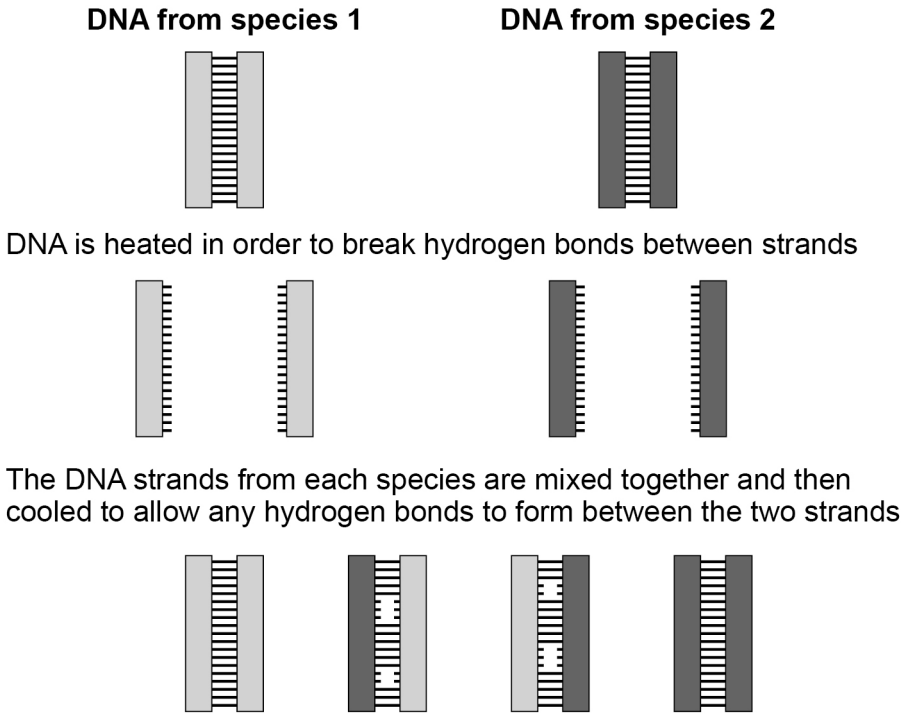
[2 marks]

DNA hybridisation is a technique used for determining the degree of relatedness between two different species.

DNA from the same part of a chromosome is removed from each species, separated into two strands using heat, and then cooled and allowed to recombine together.

Figure 6 shows this process.

Figure 6



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0 8 . 6 DNA taken from *Photinus pyralis* and *Photinus castus* was hybridised and then reheated. The hybrid strands separated at 80 °C.

DNA from *Photinus pyralis* and *Phosphaenus hemipterus* was also hybridised and then reheated. The hybrid strands separated at 75 °C.

Use these results to conclude which two species are most likely to share the most recent common ancestor.

[3 marks]

Two species sharing the most recent common ancestor are

_____ and _____

Explain how you reached this conclusion.

_____

_____

_____

_____

_____

_____

12

END OF QUESTIONS

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