Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Time 1 hour 30 minutes

Paper reference **8BI0/02**

Biology B

Advanced Subsidiary
PAPER 2: Core Physiology and Ecology

Candidates may use:
Calculator, HB pencil, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In question(s) marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

Answer ALL questions.

Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Biologists classify organisms based on characteristics and on evolutionary relationships.

(a) (i) Which of these groups contains the greatest variety of organisms?

(1)

☒ **A** genus

☒ **B** kingdom

☒ **C** phylum

☒ **D** species

(ii) Closely-related genera are grouped together in a

(1)

☒ **A** class

☒ **B** domain

☒ **C** family

☒ **D** order

(iii) Which of these is a kingdom?

(1)

☒ **A** Archaea

☒ **B** Bacteria

☒ **C** Eukarya

☒ **D** Protista

(b) (i) Explain the evidence that led to the three-domain model of classification replacing the five-kingdom model.

(3)

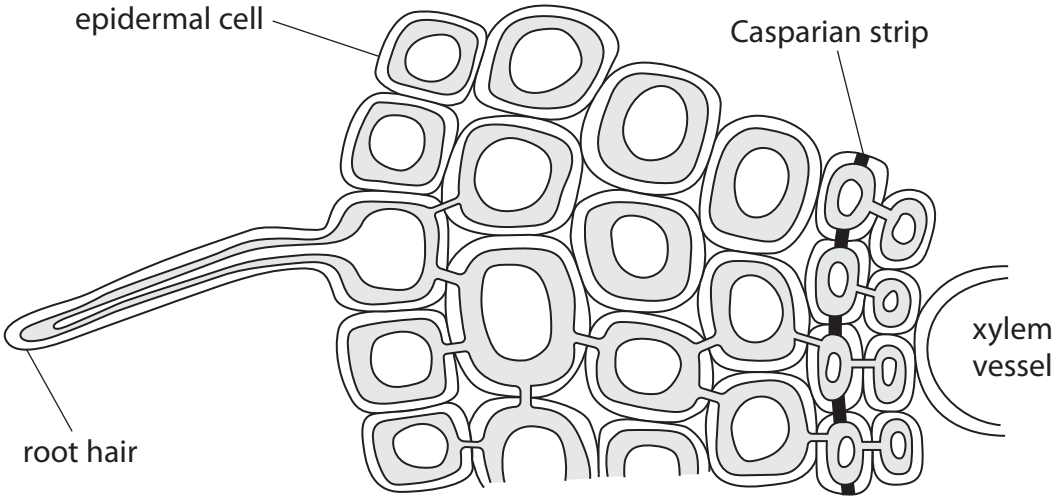
(ii) Give a method that a scientist, with a new theory based upon experimental results, could use to share this with others in the scientific community.

(1)

(Total for Question 1 = 7 marks)

2 Water can move through plant cells.

(a) The diagram shows the cells in a plant root.



(Source from: https://cronodon.com/BioTech/Plant_Transport.html)

(i) On the diagram, draw the symplastic pathway that water takes from the soil to the xylem vessel.

(2)

(ii) The length of the root hair cell in the diagram is 60 mm.

The magnification of the diagram is ×100.

Calculate the actual length of the root hair cell in micrometres.

(2)

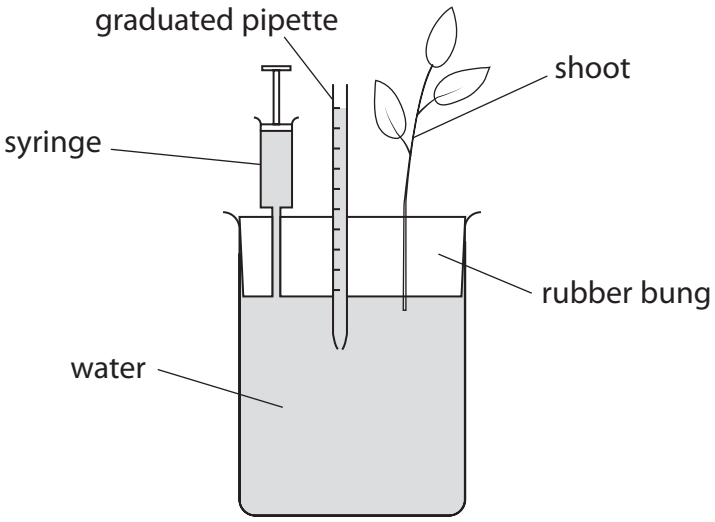
Answer ..... μm

(b) Explain how the cohesion-tension model accounts for the transport of water from plant roots to leaves.

(4)

(Total for Question 2 = 8 marks)

3 The diagram shows a type of potometer.



(Source from: Science and Plants for Schools: www.saps.org.uk)

The leaves of the shoot must be kept dry when assembling the potometer under water in a sink.

The syringe plunger is pushed down until the water level is raised to zero in the graduated pipette.

The water level in the graduated pipette is used to measure water uptake by the shoot.

(a) (i) Explain why the apparatus should be assembled under water.

(2)

(ii) Explain why the leaves must be kept dry whilst assembling the apparatus.

(2)

(b) (i) Explain how this potometer can be used to investigate the effect of light intensity on the rate of water uptake by this shoot.

(4)

(ii) This potometer measures the uptake of water by a plant shoot.

Give **two** reasons why the water lost by transpiration is less than the water taken up by the plant shoot.

(2)

(Total for Question 3 = 10 marks)

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4 Substances move into cells by several processes.

(a) (i) Which of these processes requires energy from respiration?

(1)

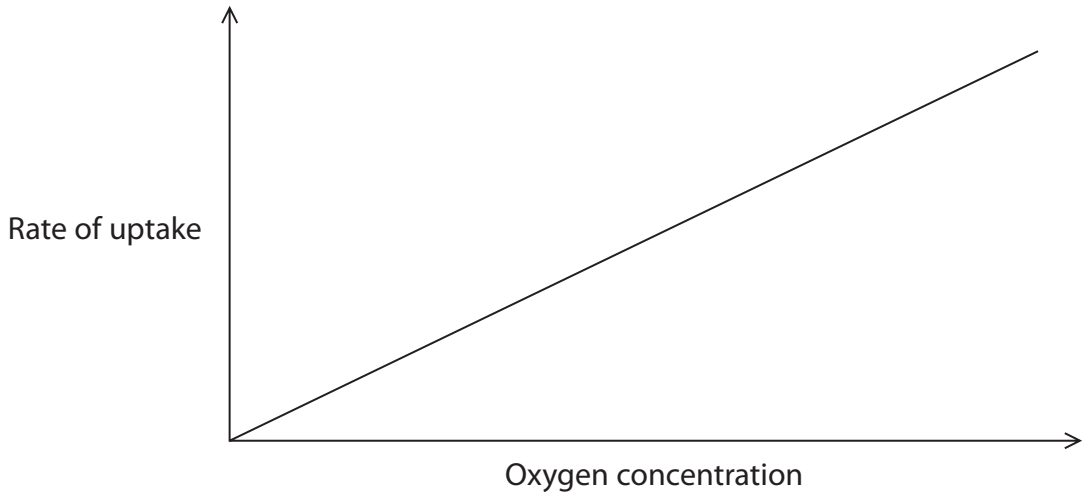
- ☒ **A** diffusion
- ☒ **B** endocytosis
- ☒ **C** facilitated diffusion
- ☒ **D** osmosis

(ii) Which of these processes can occur against a concentration gradient?

(1)

- ☒ **A** active transport
- ☒ **B** diffusion
- ☒ **C** facilitated diffusion
- ☒ **D** osmosis

(iii) The graph shows the effect of increasing oxygen concentration on the rate of uptake of a substance **other** than oxygen.



Which of these processes is shown by the graph?

(1)

- ☒ **A** active transport
- ☒ **B** diffusion
- ☒ **C** facilitated diffusion
- ☒ **D** osmosis

(iv) Which substance can enter a cell by diffusion?

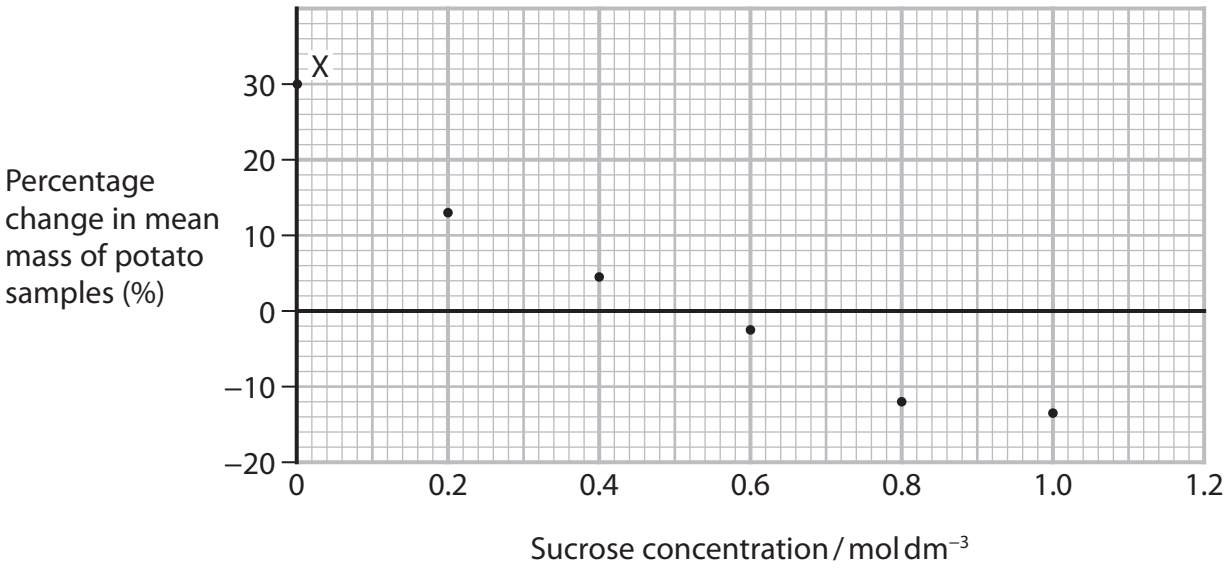
(1)

- ☒ **A** amino acid
- ☒ **B** carbon dioxide
- ☒ **C** glucose
- ☒ **D** protein

(b) When plant cells absorb water, the water potential of the cells changes.

The water potential of potato cells was investigated.

The graph shows the percentage change in mean mass of potato samples after immersion in sucrose solutions of different concentrations.



(i) Draw a suitable line on this graph.

(1)

(ii) Give the sucrose concentration that has the same water potential as the cells in these potato samples.

(1)

Answer ..... mol dm^{-3}

(iii) The water potential (ψ) of plant cells can be calculated using the equation:

$$\psi = P + \pi$$

Explain the changes in the water potential of cell (ψ), turgor pressure (P) and osmotic potential (π), at point X on the graph.

(4)

(iv) Explain why it is more difficult to determine the osmotic potential (π) than the water potential (ψ) of plant cells.

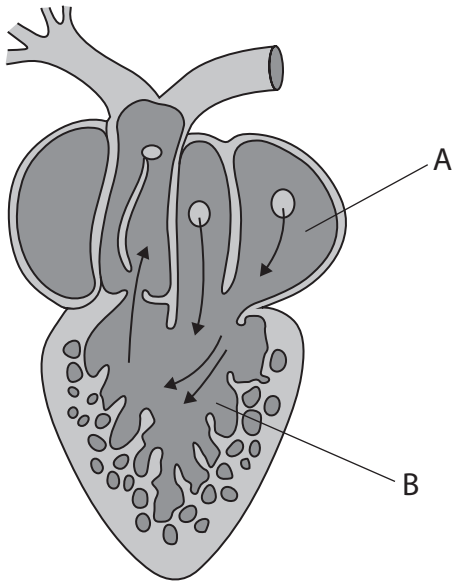
(2)

(Total for Question 4 = 12 marks)

5 The structure of a frog heart is different from those of mammals and fish.

The diagram shows the structure of a frog heart.

The arrows show the direction of blood flow.



(a) (i) Name the parts of the heart labelled A and B.

(2)

A .....

B .....

(ii) Compare and contrast the structure of the frog heart with the structure of the mammalian heart.

(3)

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(b) Amphibians, such as the frog:

- absorb oxygen through their lungs and through their moist skin
- have a lower metabolic rate than mammals
- have a double circulation system.

(i) State one difference between the double circulation system of the frog and that of the mammal.

(1)

(ii) Explain how the circulatory system of the frog is adapted for the metabolism and gas exchange of the frog.

(4)

(c) Describe the sequence of stimulation that occurs in a mammalian heart in one cardiac cycle.

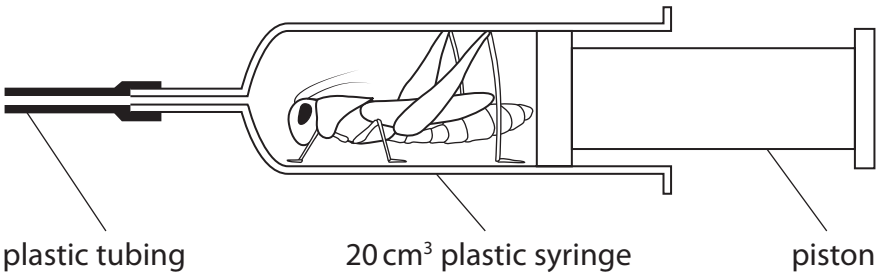
(4)

(Total for Question 5 = 14 marks)

6 The effect of gas composition on the breathing rate of locusts was investigated.

The method used was:

Step 1 A locust was placed in a 20 cm^3 clear plastic syringe, as shown in the diagram. The piston was inserted so it gently held the locust in place so that the locust had no room to move.



Step 2 The number of pumping movements of the abdomen which occurred in 30 seconds was counted. This was repeated three more times.

Step 3 Gases of different compositions were added to the syringe through the plastic tubing.

Step 4 For each different composition of gases, the number of pumping movements of the abdomen which occurred in 30 seconds was counted.

Step 5 Between each composition of gases used, the piston was moved in and out ten times to replace the exhaled air with laboratory air.

Step 6 The locust was then left for 5 minutes before the next composition of gases was added.

(a) (i) State the purpose of **Step 5**.

(1)

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(ii) State the purpose of **Step 6**.

(1)

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(b) The table shows the results of the investigation.

Gas composition (%)		Number of movements in 30 seconds				Mean	Range	SD
oxygen	carbon dioxide							
21	0.1	26	22	31	29	27	9	3.9
16	4.1	41	44	46	49	45	8	3.4
100	0.0	5	12	6	8	8	7	3.1
94	6.0	48	42	46	49	46	7	3.1
88	12.0	44	46	50	53	48	9	
83	17.0	54	51	53	49	52	5	2.2

(i) Calculate the standard deviation for the number of movements in 30 seconds when the gas has a composition of 88% oxygen and 12% carbon dioxide.

Use the formula

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

(3)

Answer .....

(ii) Explain the relationship between the range and the standard deviation.

(2)

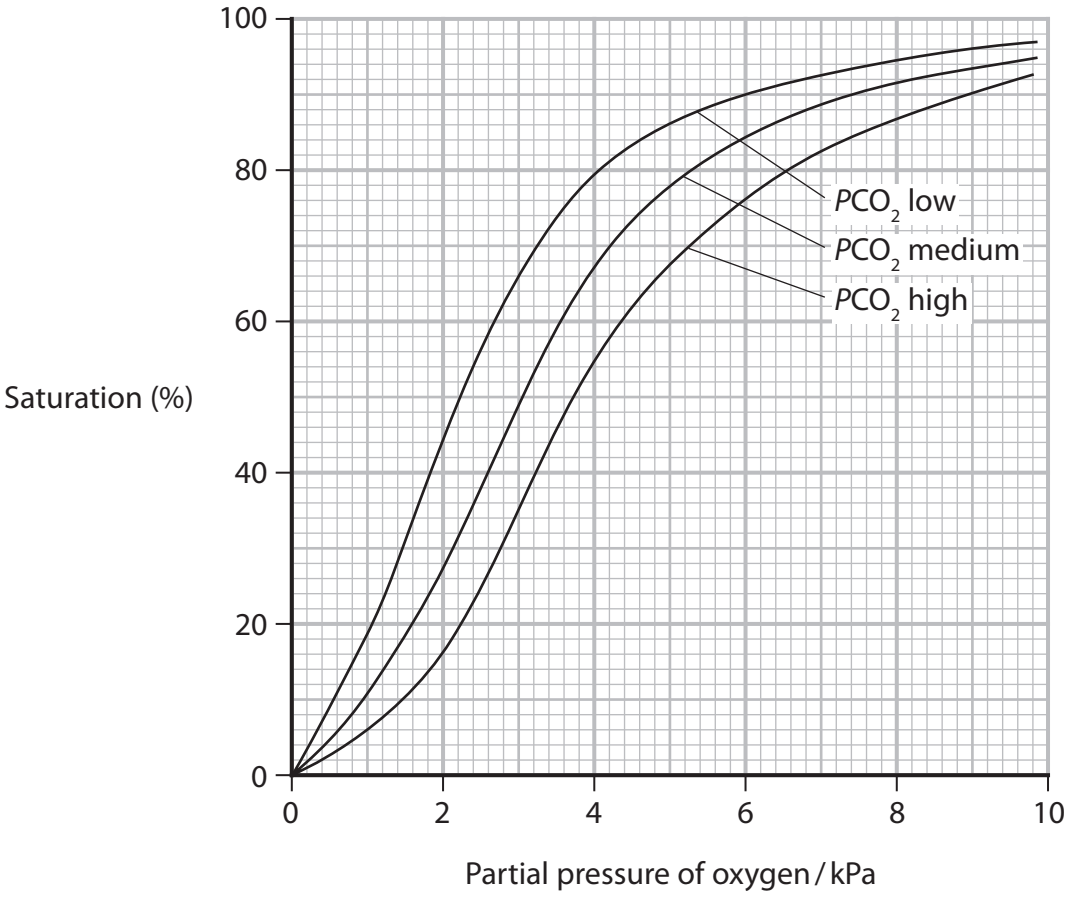
(c) Analyse the data to comment on the effect gas composition has on the breathing rate of this locust.

(4)

(Total for Question 6 = 11 marks)

7 Haemoglobin transports oxygen within the blood.

The graph shows the relationship between the partial pressure of oxygen and the saturation of haemoglobin with oxygen at three partial pressures of carbon dioxide.



(a) (i) The curve moves to the right when more carbon dioxide is present.

This move to the right is due to the

(1)

- ☒ **A** Bohr effect
- ☒ **B** chloride shift
- ☒ **C** dissociation curve
- ☒ **D** oxygen debt

(ii) Explain why the curves are S-shaped.

(2)

(iii) Calculate the difference between the percentage change in saturation of haemoglobin with oxygen as the partial pressure of oxygen changes from 8 kPa to 2 kPa for low carbon dioxide compared with high carbon dioxide.

(2)

Difference ..... %

(iv) Analyse the data to explain the advantage to the mammal of the curve moving to the right.

(3)

(b) Mammals that live at high altitudes are in an environment with a lower partial pressure of oxygen.

Explain the position of the haemoglobin dissociation curve for mammals that live at high altitude.

(2)

(Total for Question 7 = 10 marks)

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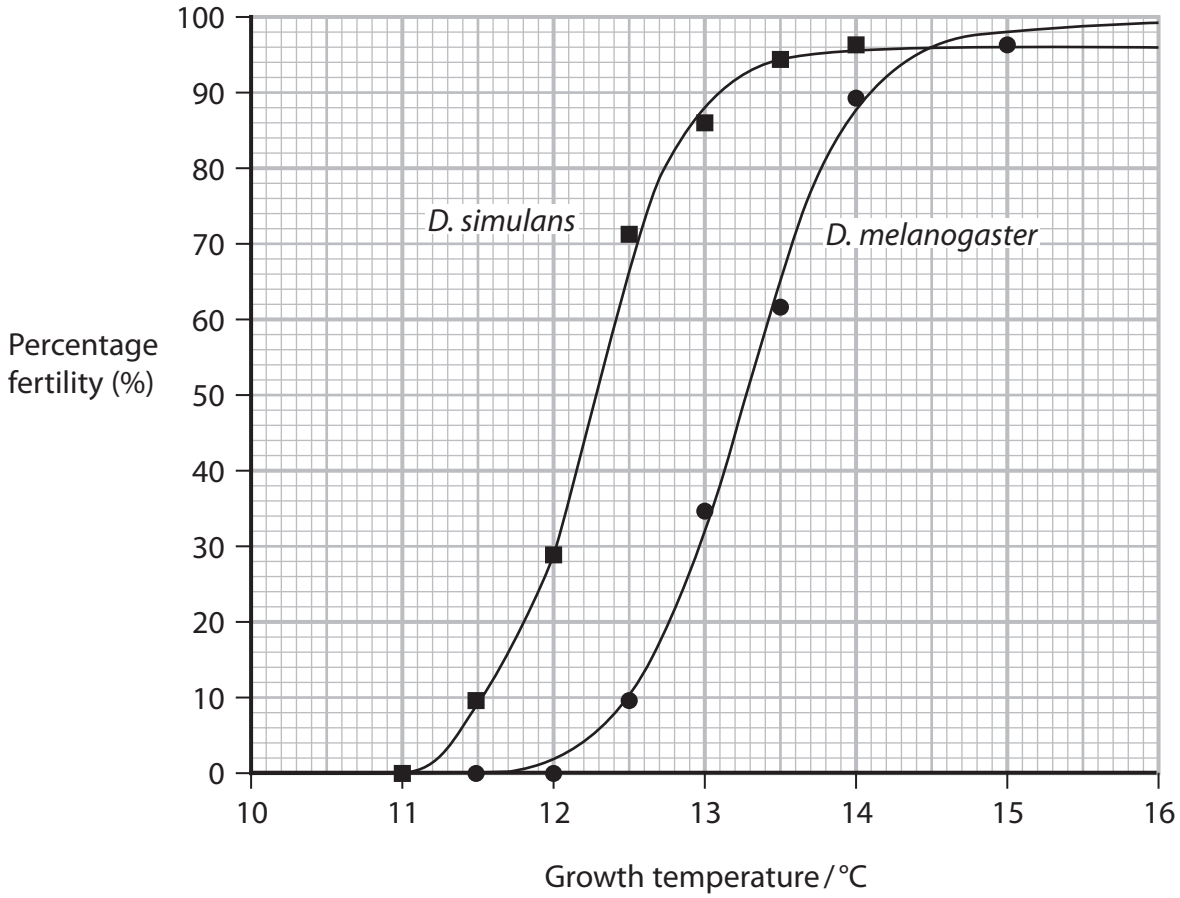
8 The photograph shows a fruit fly, *Drosophila*.

(Source: © Roblan/Shutterstock)

Species of *Drosophila* live in a range of habitats in different parts of the world.

The geographic distribution of these species ranges from regions with low temperatures to regions with high temperatures.

The graph shows the effect of temperature on the percentage fertility of male flies of two species of *Drosophila*, *D. simulans* and *D. melanogaster*.



(a) The effect of low temperature on fertility is often compared using the temperature that results in 50% fertility.

Determine the difference in these temperatures for the two species.

(1)

Temperature difference .....

(b) Scientists also collected data from the two species about the effect of both high and low temperature on the viability of eggs and fertility of male flies.

An egg is viable if it develops into an adult.

The table shows the effects of temperature on the viability of eggs and fertility of males, for the two species of *Drosophila*.

Species	Lowest temperature / °C		Highest temperature / °C	
	at which eggs are viable	at which males are fertile	at which eggs are viable	at which males are fertile
D. melanogaster	10	12	32	30
D. simulans	10	11	31	28

(i) Give the relationship between temperature and the viability of eggs and fertility of males.

(1)

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*(ii) Another group of scientists recorded the courtship song of male *D. melanogaster* and male *D. simulans*.

The male flies vibrate their wings producing a courtship song to attract females.

The courtship song is produced in pulses.

The interval between pulses and the duration of each pulse are shown in the table.

Species	Mean interval between pulses / ms	Duration of pulse / s
D. melanogaster	34.1	1.6
D. simulans	48.9	3.4

Discuss how the data provides evidence for the geographical distribution and type of speciation of the two species of *Drosophila*.

Use the data from tables for temperature and for courtship song.

(6)

(Total for Question 8 = 8 marks)

TOTAL FOR PAPER = 80 MARKS

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