Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Monday 23 October 2017 – Morning
Time: 1 hour 30 minutes

Paper Reference
WBI04/01

You must have:
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 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

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

Turn over ▶

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P 5 0 7 8 3 A 0 1 2 8

Pearson

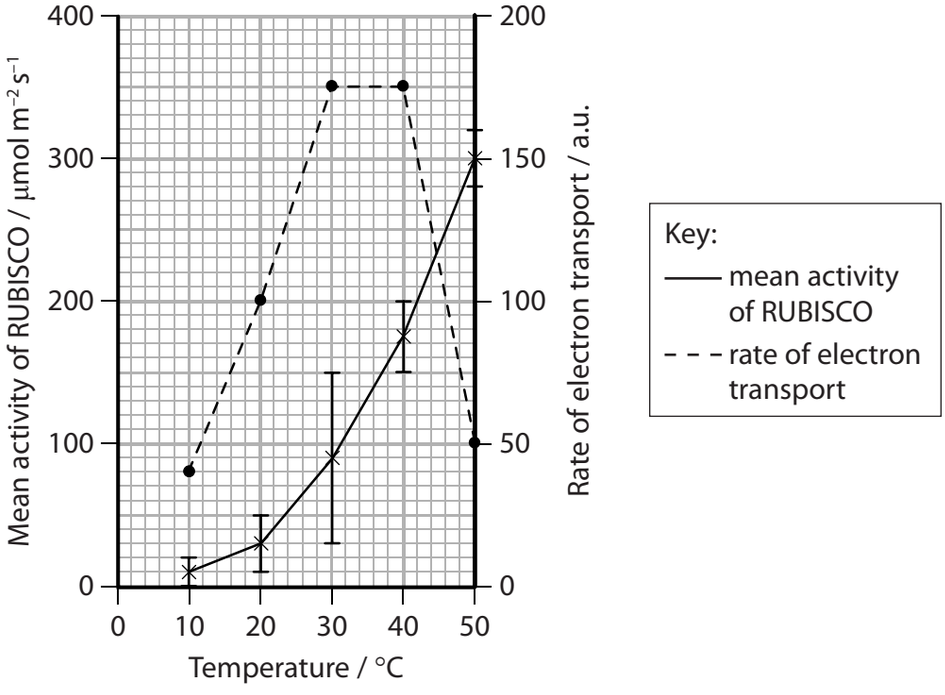
Answer ALL questions.

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 Temperature is one factor that affects the rate of photosynthesis.

A student investigated the effect of temperature on the rate of electron transport and the mean activity of the enzyme RUBISCO in the chloroplasts of a leaf.

The graph below shows the results of this investigation.



(a) (i) Put a cross ☒ in the box next to the location of electron transport in the chloroplast.

(1)

☒ **A** matrix

☒ **B** outer membrane

☒ **C** stroma

☒ **D** thylakoid membrane

(ii) Explain the role of electron transport in photosynthesis.

(2)

(iii) The student extended the investigation to find the optimum temperature for electron transport.

Put a cross ☒ in the box next to the temperature range that should be used to find the optimum temperature for electron transport.

(1)

☒ **A** 10 °C to 20 °C

☒ **B** 20 °C to 30 °C

☒ **C** 30 °C to 40 °C

☒ **D** 40 °C to 50 °C

(b) (i) Explain the role of RUBISCO in photosynthesis.

(3)

(ii) The student expressed the activity of RUBISCO as $\mu mol\ m^{-2}\ s^{-1}$.

Suggest what the student measured in this investigation to find the activity of RUBISCO.

(3)

(c) Using the information in the graph, discuss the reliability of the results obtained in this investigation.

(3)

(Total for Question 1 = 13 marks)

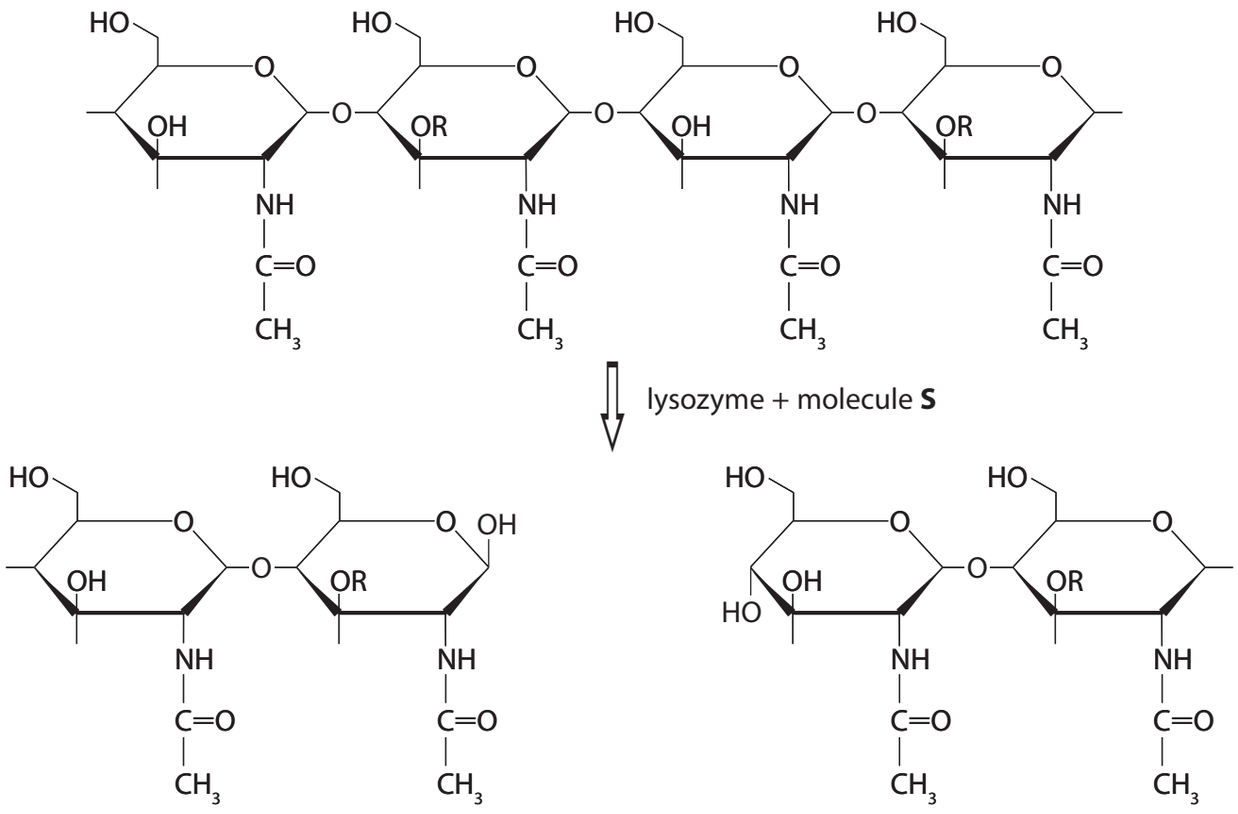
2 The non-specific responses of the body to infection include inflammation, interferon production and phagocytosis.

*(a) Describe the roles of inflammation, interferon production and phagocytosis in the non-specific response of the body to infection.

(6)

(b) The non-specific responses to infection also involve lysozyme. Lysozyme is an enzyme that damages the cell walls of some bacteria.

The diagram below shows the action of lysozyme on part of a molecule present in the cell walls of some bacteria.



(i) Put a cross ☒ in the box next to the name of the bond broken by lysozyme.

(1)

☒ **A** ester

☒ **B** glycosidic

☒ **C** peptide

☒ **D** phosphodiester

(ii) Name molecule **S**.

(1)

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(iii) Explain why lysozyme does not destroy viruses.

(2)

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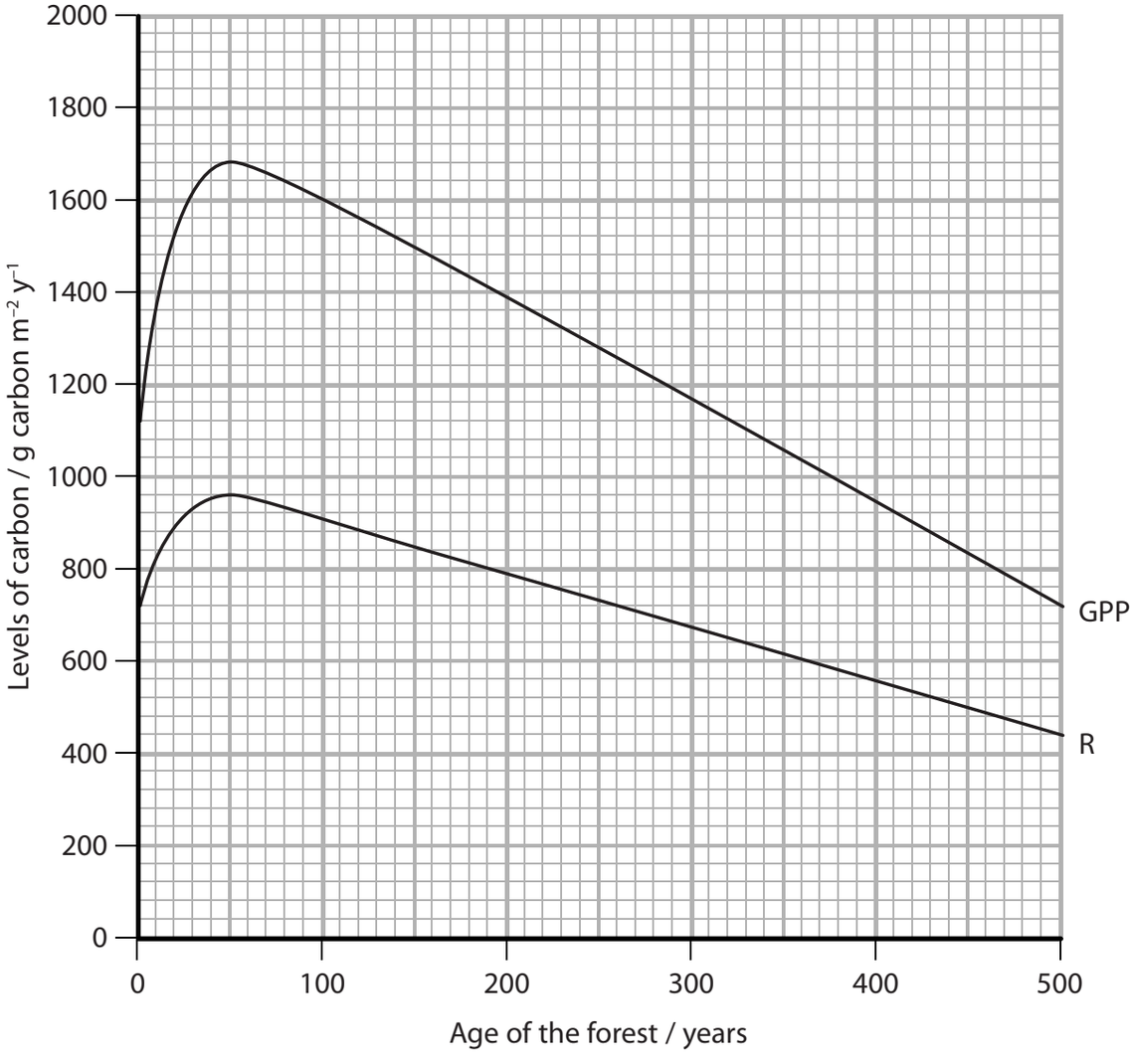
(Total for Question 2 = 10 marks)

3 The growth of trees in a forest depends on a number of factors, including the age of the forest.

The graph below shows the gross primary productivity (GPP) and respiration (R) in a forest as it ages.



(a) The GPP and R shown in the graph are for the parts of the trees above ground.

The graph can be used to calculate the NPP for the parts of the trees above ground.

(i) Use the graph to find the maximum values for GPP, R and NPP.

(2)

GPP .....

R .....

NPP .....

(ii) The NPP for the parts of the trees below ground is difficult to determine. It is estimated to be 65% of the NPP value for the parts of the trees above ground.

Calculate the maximum NPP for all parts of the trees in this forest.

(2)

Answer ..... g carbon m^{-2} y^{-1}

(b) Using the information in the graph and your own knowledge, explain why NPP decreases with the age of the forest.

(4)

(c) Reforestation can be used to reduce atmospheric levels of carbon dioxide.

One car may generate approximately 2.3 tonnes of carbon in one year.

Using this information and the graph, discuss the use of reforestation to reduce atmospheric levels of carbon dioxide.

(4)

(Total for Question 3 = 12 marks)

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***4** The photograph below shows a green iguana.

Magnification ×0.25

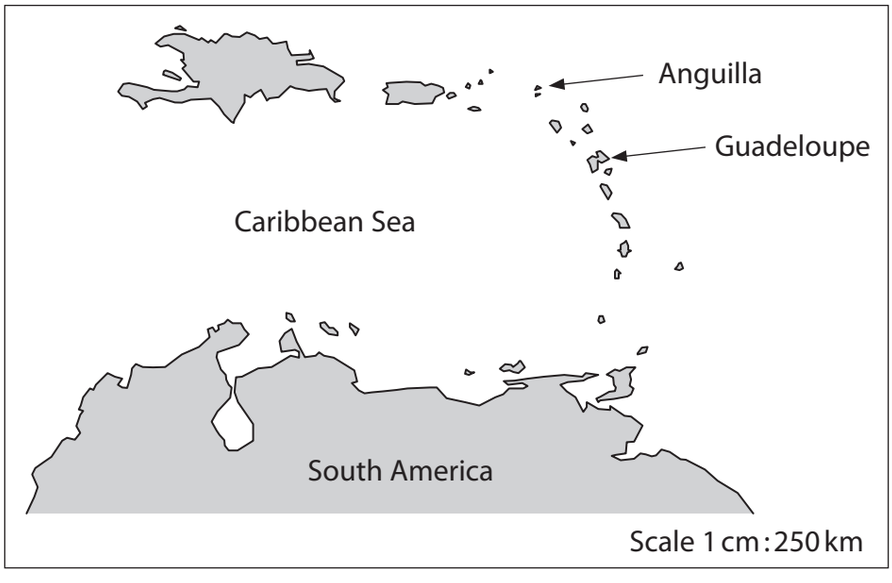
The green iguana is a species of lizard that eats plants and is native to Central South America and the Caribbean.

Areas in the Caribbean were damaged by hurricane Marilyn in 1995.

Fifteen green iguanas drifted on a raft of uprooted trees to the island Anguilla. Green iguanas did not live on Anguilla before these fifteen green iguanas arrived.

It is thought that these green iguanas drifted from another island, Guadeloupe.

The map below shows part of the Caribbean where these islands are located.



When these green iguanas were discovered on Anguilla, scientists were excited about studying changes in this population over a long period of time.

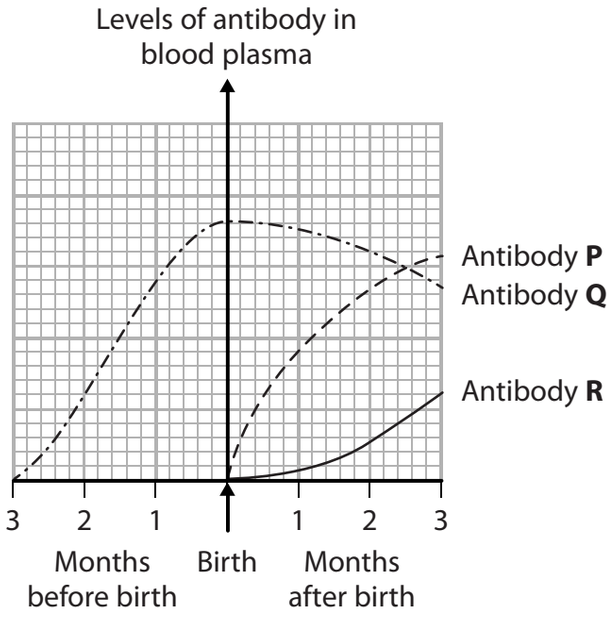
Explain what could happen to this population of green iguanas.

(6)

(Total for Question 4 = 6 marks)

5 When a person develops immunity to a pathogen, the concentration of antibodies in their blood plasma changes.

(a) The graph below shows changes in the concentration of three antibodies, **P**, **Q** and **R**, in the blood plasma of a baby in the months before and after its birth.



(i) Antibody **P** is a maternal antibody.
Explain the importance of maternal antibodies to a newborn baby.

(2)

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(ii) Put a cross ☒ in the box next to the type of immunity that involves antibody **Q**.

(1)

☒ **A** artificial active

☒ **B** artificial passive

☒ **C** natural active

☒ **D** natural passive

(iii) Explain the role of B cells in the production of antibody **R**.

(4)

(b) Immunity in a child can be increased by vaccines. Vaccines contain antigens.

(i) Explain the meaning of the term **antigen**.

(2)

(ii) Vaccines may not be effective if the concentration of maternal antibodies in the blood plasma is too high.

Suggest why the concentration of maternal antibodies may stop a vaccine being effective.

(3)

(Total for Question 5 = 12 marks)

6 Calcitonin is a protein hormone produced by the thyroid gland.

(a) Synthesis of a protein involves a number of processes.

The diagram below shows some of these processes.

(i) Put a cross ☒ in the box next to the row in the table that correctly identifies the four processes **P**, **Q**, **R** and **S**.

(1)

	Process P	Process Q	Process R	Process S
☒ **A**	transcription	post-transcription	translation	post-translation
☒ **B**	transcription	translation	post-transcription	post-translation
☒ **C**	translation	post-translation	transcription	post-transcription
☒ **D**	translation	transcription	post-transcription	post-translation

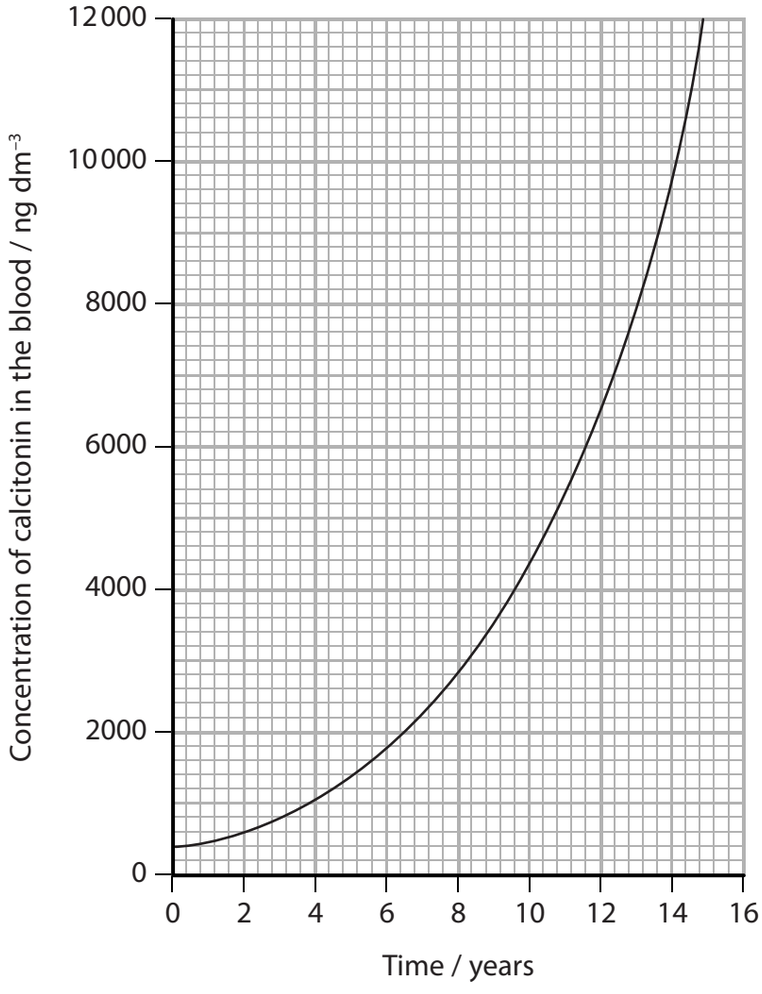
(ii) Put a cross ☒ in the box next to the row in the table that correctly identifies the location of each of these four processes **P**, **Q**, **R** and **S**.

(1)

	Process P	Process Q	Process R	Process S
☒ **A**	cytoplasm	nucleus	Golgi apparatus	secretory vesicle
☒ **B**	cytoplasm	ribosomes	secretory vesicle	Golgi apparatus
☒ **C**	nucleus	nucleus	ribosomes	Golgi apparatus
☒ **D**	nucleus	ribosomes	Golgi apparatus	secretory vesicle

(b) Medullary thyroid cancer (MTC) results in a high concentration of calcitonin in the blood. MTC can be treated by surgery and radiotherapy.

The graph below shows the changes in the concentration of calcitonin in the blood of a patient with MTC following this treatment.



The doubling time for the concentration of calcitonin in the blood is correlated with the severity of the cancer.

(i) Using MTC as an example, explain the meaning of the term **correlation**.

(2)

(ii) If the concentration of calcitonin doubles in less than 24 months, this indicates that the treatment is ineffective.

Using the information in the graph, explain whether the treatment is effective for this patient.

(3)

(iii) A blood sample has to be taken from the patient to test for calcitonin.

Antibodies are used to test the blood for calcitonin.

Explain why antibodies can be used in this test.

(3)

(c) Calcitonin gene-related peptide (CGRP) is produced by the hypothalamus.

The gene used to synthesise CGRP in the hypothalamus is the same as the gene that is used to synthesise calcitonin in the thyroid gland.

Explain how the same gene can be used to produce both CGRP and calcitonin.

(3)

(Total for Question 6 = 13 marks)

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7 Locusts are swarming insects. One swarm may contain thousands of locusts.

A swarm of locusts can be a huge economic threat to agriculture. Locusts can cause famine as they eat most of the vegetation wherever they land.

The photograph below shows a locust.

Magnification ×0.5

(a) Swarming locusts are able to fly for long periods of time without landing. They can fly for longer periods of time than other insects, such as honey bees and flies.

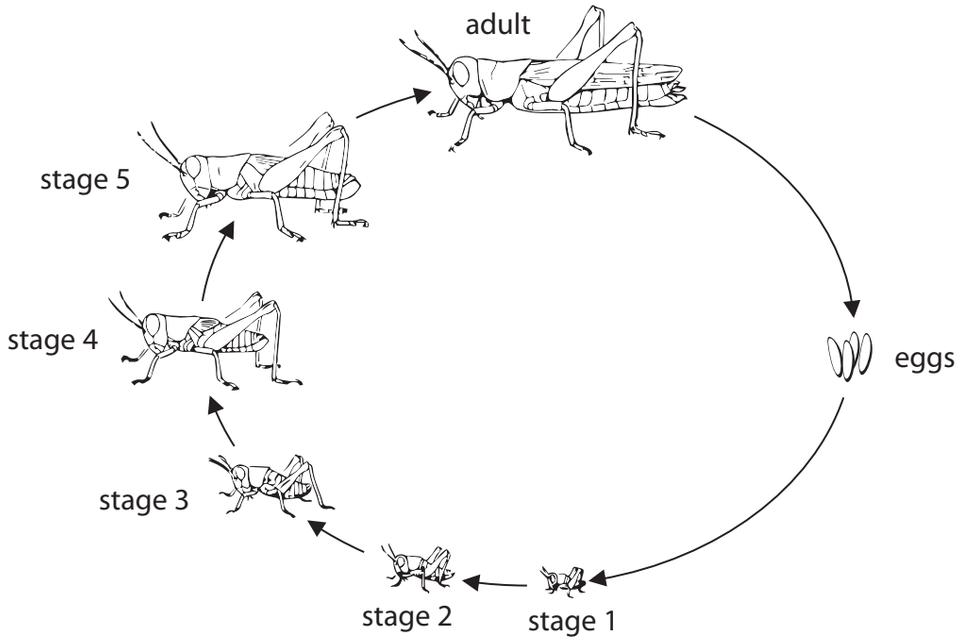
The table below shows some information about locusts, honey bees and flies.

Insect	Main food store	Energy content of food store / kJ g^{-1}	Metabolic rate / kJ g^{-1} h^{-1}	Hourly consumption of food store as a percentage of body mass (%)
locust	lipid	39.3	0.27	0.7
honey bee	carbohydrate	17.6	1.23	20.0
fly	carbohydrate	17.6	0.50	10.0

Using the information in the table, explain why locusts are able to fly for long periods of time.

(3)

(b) The diagram below shows the life cycle of a locust.



(i) Describe an investigation that could be carried out, in an incubator at 25 °C, to determine the growth rate of the locust at each of the five development stages.

(4)

(ii) Explain why different results would be obtained if this investigation is carried out at 30 °C.

(2)

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(c) Locusts are used as food for humans in a number of countries.

The raising of animals as a source of food produces greenhouse gases. Raising locusts, rather than chickens, as a source of food produces fewer greenhouse gases.

(i) Put a cross ☒ in the box next to the greenhouse gases.

(1)

☒ **A** carbon dioxide, methane and water vapour

☒ **B** carbon dioxide, oxygen and water vapour

☒ **C** carbon dioxide, methane and oxygen

☒ **D** methane, oxygen and water vapour

(ii) Explain how raising locusts for food could affect global warming.

(3)

(Total for Question 7 = 13 marks)

8 Genetic relationships can be identified using DNA profiling.

The DNA used can be either nuclear DNA or mitochondrial DNA (mtDNA).

(a) Suggest **one** function of the proteins coded for by genes in the mtDNA.

(1)

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(b) Analysis of DNA from the nucleus requires the DNA to be amplified using the polymerase chain reaction (PCR). The DNA fragments are then separated by gel electrophoresis.

(i) The PCR imitates semi-conservative replication of DNA in a cell.

Compare PCR and semi-conservative replication.

(4)

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(ii) Gel electrophoresis uses an electric current to separate the DNA fragments.

Put a cross ☒ in the box next to the correct statement about gel electrophoresis.

(1)

☒ **A** larger DNA fragments move further because they can push the molecules in the gel out of the way better than smaller fragments

☒ **B** larger DNA fragments move further because they have more negative charges than smaller fragments

☒ **C** smaller DNA fragments move further because they travel faster than the larger fragments

☒ **D** smaller DNA fragments move further because they are more negatively charged than larger fragments

(c) A skeleton can be identified by analysing mtDNA.

Suggest why mtDNA can be analysed when it is not possible to analyse nuclear DNA from a skeleton.

(2)

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(d) Explain why the mtDNA of a child will be identical to the mtDNA of its mother.

(3)

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(Total for Question 8 = 11 marks)

TOTAL FOR PAPER = 90 MARKS

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