Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Education
Advanced Level Examination
June 2013

Biology BIOL4

Unit 4 Populations and environment

Tuesday 11 June 2013 9.00 am to 10.30 am

For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Time allowed
- 1 hour 30 minutes

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.
- You may ask for extra paper. Extra paper must be secured to this booklet.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 75.
- You are expected to use a calculator, where appropriate.
- The marks for questions are shown in brackets.
- Quality of Written Communication will be assessed in all answers.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use scientific terminology accurately.

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

1 (a) What information is required in order to calculate the growth rate of a population?

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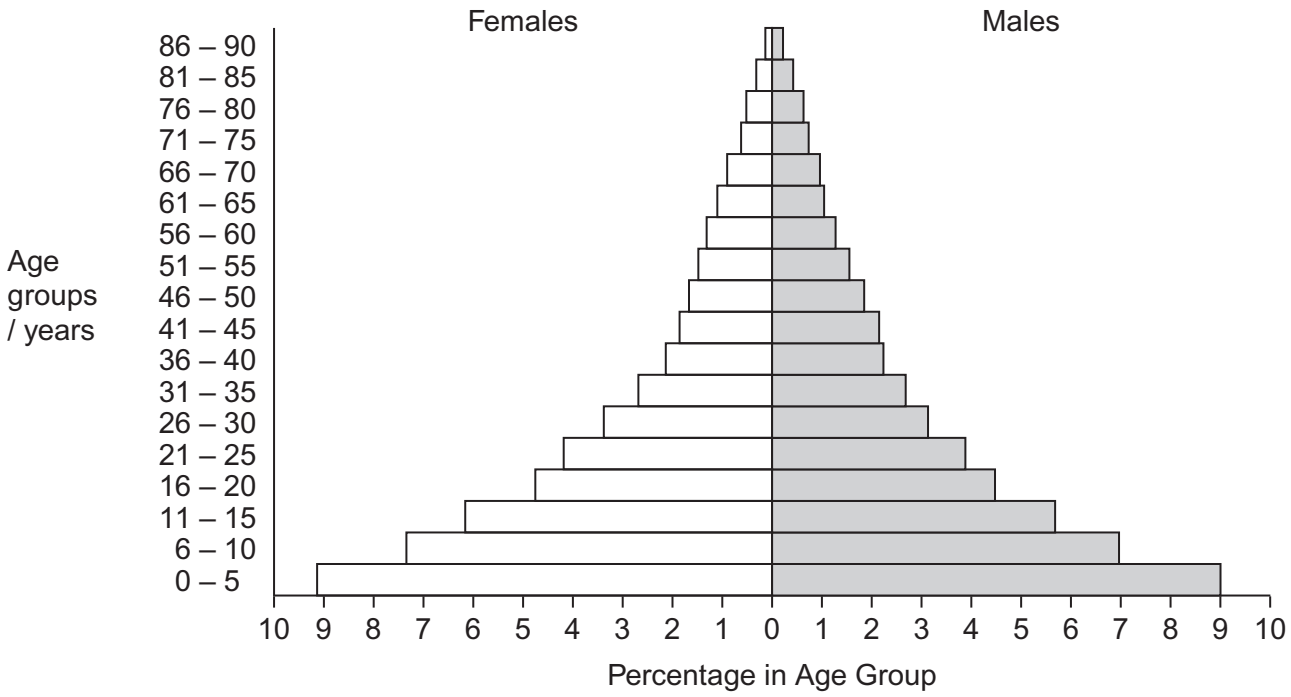
(2 marks)

1 (b) The diagram shows an age population pyramid for humans in a country.



This country is at an early stage of demographic transition. Describe the evidence for this.

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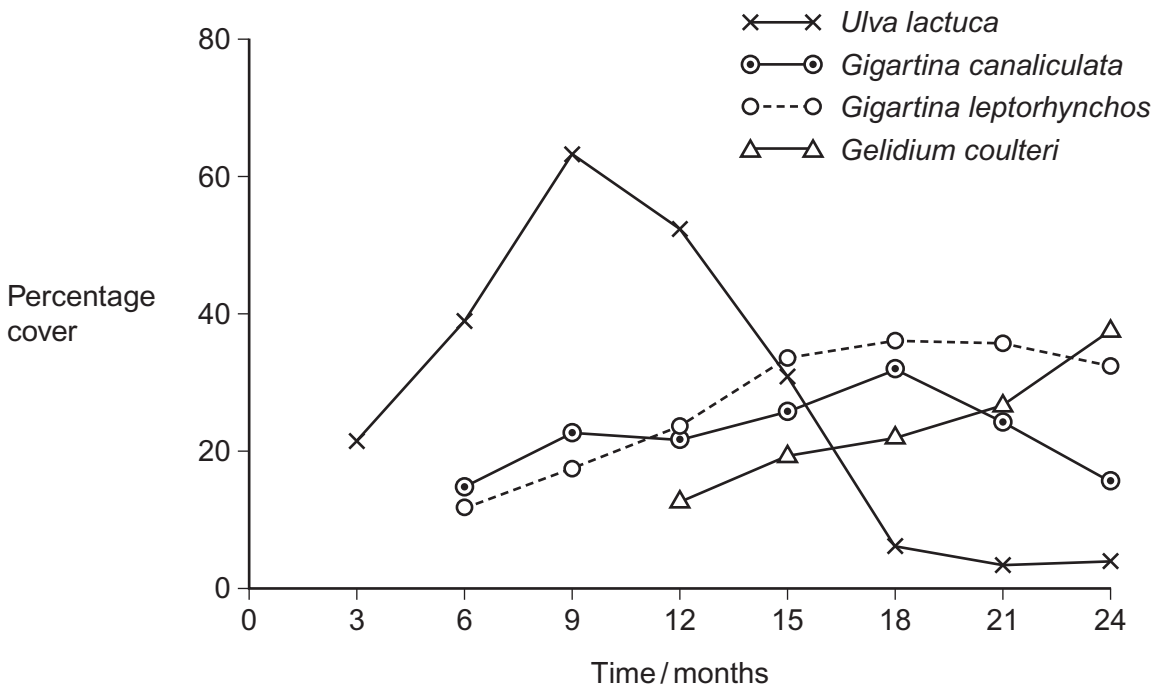
(2 marks)

4

2 Algae are photosynthesising organisms. Some algae grow on rocky shores.
A scientist investigated succession involving different species of algae. He placed concrete blocks on a rocky shore. At regular intervals over 2 years, he recorded the percentage cover of algal species on the blocks. His results are shown in the graph.



2 (a) Name the pioneer species.

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(1 mark)

2 (b) (i) The scientist used percentage cover rather than frequency to record the abundance of algae present. Suggest why.

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(1 mark)

2 (b) (ii) Some scientists reviewing this investigation were concerned about the validity of the results because of the use of concrete blocks.
Suggest **one** reason why these scientists were concerned about using concrete blocks for the growth of algae.

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(1 mark)

2 (c) Use the results of this investigation to describe and explain the process of succession.

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(4 marks)

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7

3 (a) Explain what is meant by the term phenotype.

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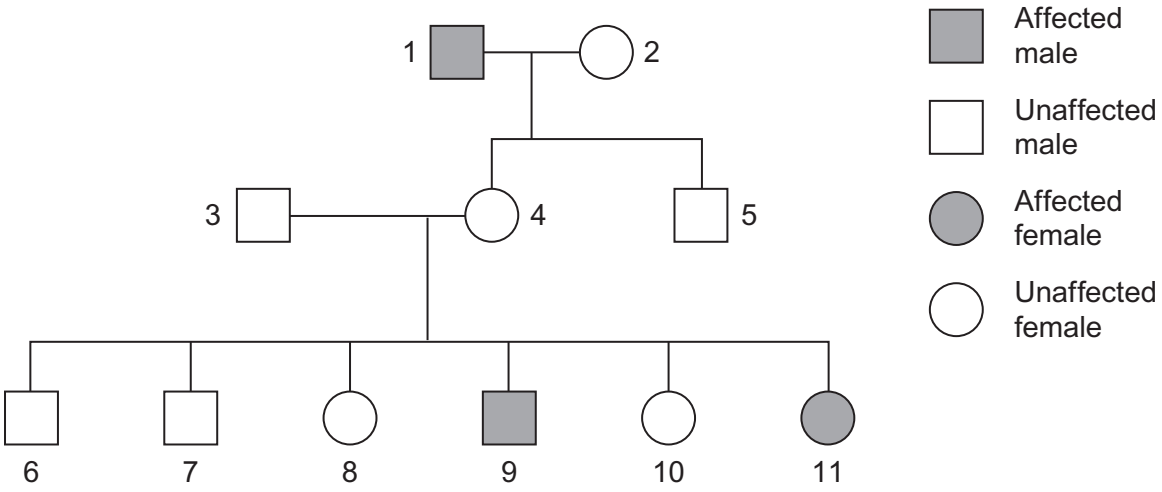
(2 marks)

3 (b) Tay-Sachs disease is a human inherited disorder. Sufferers of this disease often die during childhood. The allele for Tay-Sachs disease **t**, is recessive to allele **T**, present in unaffected individuals. The diagram shows the inheritance of Tay-Sachs in one family.



3 (b) (i) Explain **one** piece of evidence from the diagram which proves that the allele for Tay-Sachs disease is recessive.

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(2 marks)

3 (b) (ii) Explain **one** piece of evidence from the diagram which proves that the allele for Tay-Sachs disease is **not** on the X chromosome.

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(2 marks)

3 (c) (i) In a human population, one in every 1000 children born had Tay-Sachs disease. Use the Hardy-Weinberg equation to calculate the percentage of this population you would expect to be heterozygous for this gene. Show your working.

Answer = ... %

(3 marks)

3 (c) (ii) The actual percentage of heterozygotes is likely to be lower in future generations than the answer to part **(c)(i)**. Explain why.

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(1 mark)

10

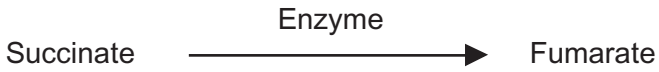
4 (a) The table contains statements about three stages of respiration.

Complete the table with a tick if the statement in the first column is true for each stage of respiration in an animal.

	Glycolysis	**Link reaction**	**Krebs cycle**
Occurs in mitochondria			
Carbon dioxide produced			
NAD is reduced			

(3 marks)

4 (b) The following reaction occurs in the Krebs cycle.



A scientist investigated the effect of the enzyme inhibitor malonate on this reaction. The structure of malonate is very similar to the structure of succinate. The scientist added malonate and the respiratory substrate, pyruvate, to a suspension of isolated mitochondria. She also bubbled oxygen through the suspension.

4 (b) (i) Explain why the scientist did not use glucose as the respiratory substrate for these isolated mitochondria.

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(2 marks)

4 (b) (ii) Explain how malonate inhibits the formation of fumarate from succinate.

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(2 marks)

4 (b) (iii) The scientist measured the uptake of oxygen by the mitochondria during the investigation. The uptake of oxygen decreased when malonate was added. Explain why.

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(2 marks)

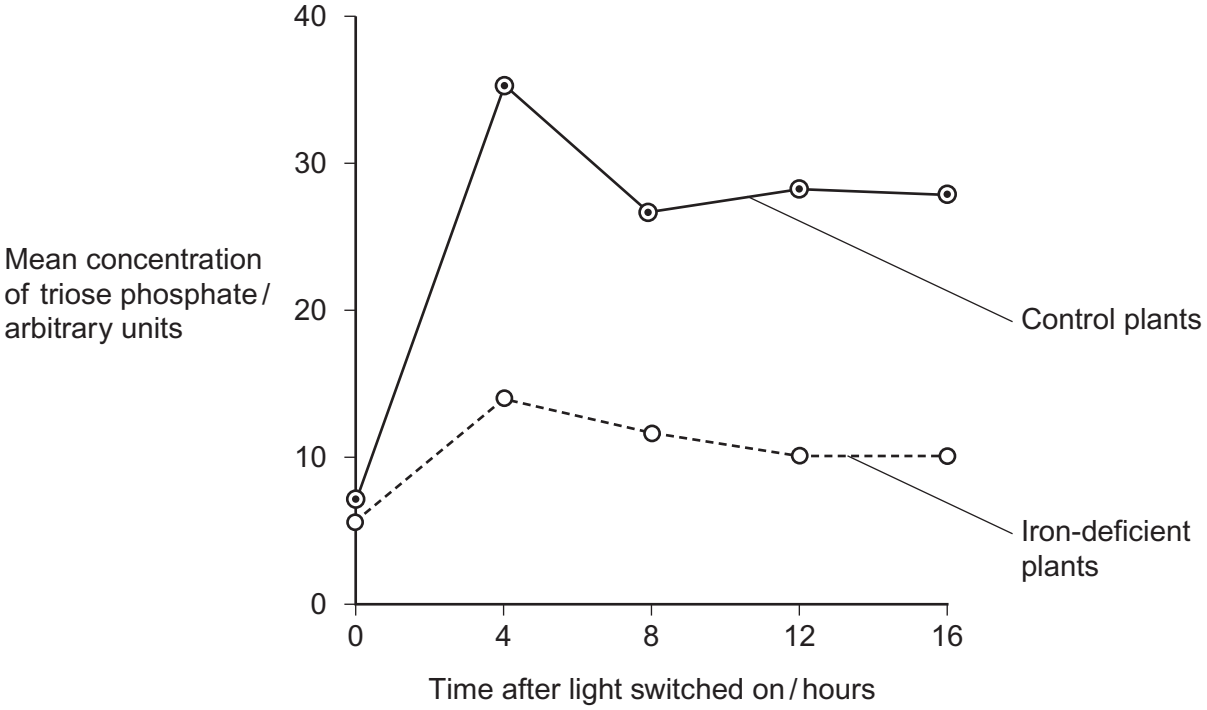
9

Turn over for the next question

5 Scientists investigated the effect of iron deficiency on the production of triose phosphate in sugar beet plants. They grew the plants under the same conditions with their roots in a liquid growth medium containing all the necessary nutrients. Ten days before the experiments, they transferred half the plants to a liquid growth medium containing no iron. The scientists measured the concentration of triose phosphate produced in these plants and in the control plants:

- at the end of 6 hours in the dark
- then for 16 hours in the light.

Their results are shown in the graph.



5 (a) (i) The experiments were carried out at a high carbon dioxide concentration. Explain why.

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(1 mark)

5 (a) (ii) Explain why it was important to grow the plants under the same conditions up to ten days before the experiment.

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(1 mark)

5 (a) (iii) The plants were left in the dark for 6 hours before the experiment. Explain why.

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(1 mark)

5 (b) Iron deficiency reduces electron transport. Use this information and your knowledge of photosynthesis to explain the decrease in production of triose phosphate in the iron-deficient plants.

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(4 marks)

(Extra space) .....

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5 (c) Iron deficiency results in a decrease in the uptake of carbon dioxide. Explain why.

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(2 marks)

9

6 The Amazonian forest today contains a very high diversity of bird species.

- Over the last 2 000 000 years, long periods of dry climate caused this forest to separate into a number of smaller forests.
- Different plant communities developed in each of these smaller forests.
- Each time the climate became wetter again, the smaller forests grew in size and merged to reform the Amazonian forest.

6 (a) Use the information provided to explain how a very high diversity of bird species has developed in the Amazonian forest.

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(5 marks)

(Extra space) .....

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6 (b) Speciation is far less frequent in the reformed Amazonian forest. Suggest **one** reason for this.

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(1 mark)

6

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

7 Malaria is a disease caused by a parasite. Scientists investigated the effect of malaria on competition between two species of *Anolis* lizard on a small Caribbean island. They sampled both populations by collecting lizards from a large number of sites on the island.

7 (a) (i) Explain the importance of collecting lizards from a large number of sites.

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(1 mark)

7 (a) (ii) Describe **one** method the scientists could have used to ensure that the sites were chosen without bias.

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(2 marks)

7 (a) (iii) The population number of both species of lizard varied at different times of the year. Suggest **two** reasons why.

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(2 marks)

Question 7 continues on the next page

The scientists investigated the percentage of lizards of both species that were infected with malaria at different sites on the island. They collected samples of both lizards at intervals of 3 months for 1 year. They also recorded the elevation (height above sea level) of each site. Some of their results are shown in the table.

Site	Elevation of collection site / metres	Total number of *A. gingivinus* collected in one year	Percentage of *A. gingivinus* infected with malaria	Total number of *A. wattsi* collected in one year	Percentage of *A. wattsi* infected with malaria
1	10	13	0	0	0
2	80	30	0	0	0
3	120	35	23	3	0
4	200	40	30	7	0
5	300	52	46	12	0
6	315	35	31	13	1
7	370	155	37	79	2
8	414	124	44	68	4

7 (b) When analysing their results, the scientists used the percentage of lizards infected at each site, rather than the number of lizards infected. Explain why.

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(2 marks)

7 (c) A preliminary study suggested that malarial infections were more common at higher elevations. Use the information provided to evaluate this suggestion.

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(2 marks)

7 (d) (i) As a result of this investigation, the scientists concluded that the presence of malaria provided a competitive advantage to *A. wattsi*. Use the information provided to explain how they reached this conclusion.

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(2 marks)

7 (d) (ii) The malarial parasite of *Anolis* lizards destroys both red and white blood cells. Suggest how an increase in the percentage of *A. gingivinus* infected with malaria could result in *A. wattsi* having a competitive advantage.

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(2 marks)

7 (d) (iii) The scientists carried out a statistical test to determine whether the correlation between the number of *A. wattsi* collected and the percentage of *A. gingivinus* infected was significant. They obtained a value for P of < 0.01.

Use the terms **probability** and **chance** to help explain what this means.

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(2 marks)

15

8 (a) Rather than use chemical pesticides or biological agents, farmers often use an integrated system of chemical pesticides and biological agents to control agricultural pests. Explain the advantages of using an integrated system to control agricultural pests.

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(6 marks)

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8 (b) Nitrate from fertiliser applied to crops may enter ponds and lakes. Explain how nitrate may cause the death of fish in fresh water.

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(5 marks)

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Question 8 continues on the next page

8 (c) Explain how the intensive rearing of domestic livestock increases net productivity.

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(4 marks)

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END OF QUESTIONS