Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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7	
8	
TOTAL	

General Certificate of Education
Advanced Level Examination
June 2012

Biology BIOL4

Unit 4 Populations and environment

Friday 15 June 2012 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.

Question 1 starts on the next page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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

1 The diagram shows the dominant plants in communities formed during a succession from bare soil to pine forest.

Time in years	1	2 – 4	5 – 24	25 – 100
	Bare field	Grassland	Shrub	Forest

Key

 Crabgrass

 Aster

 Broomsedge

 Dogwood

 Pine

1 (a) Name the pioneer species shown in the diagram.

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(1 mark)

1 (b) The species that are present change during succession. Explain why.

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(2 marks)

1 (c) The pine trees in the forest have leaves all year. Explain how this results in a low species diversity of plants in the forest.

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(1 mark)

4

Turn over ▶

2 In a species of snail, shell colour is controlled by a gene with three alleles. The shell may be brown, pink or yellow. The allele for brown, $\mathbf{C^B}$, is dominant to the other two alleles. The allele for pink, $\mathbf{C^P}$, is dominant to the allele for yellow, $\mathbf{C^Y}$.

2 (a) Explain what is meant by a *dominant* allele.

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(1 mark)

2 (b) Give **all** the genotypes which would result in a brown-shelled snail.

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(1 mark)

2 (c) A cross between two pink-shelled snails produced only pink-shelled and yellow-shelled snails. Use a genetic diagram to explain why.

(3 marks)

2 (d) The shells of this snail may be unbanded or banded. The absence or presence of bands is controlled by a single gene with two alleles. The allele for unbanded, **B**, is dominant to the allele for banded, **b**.

A population of snails contained 51 % unbanded snails. Use the Hardy-Weinberg equation to calculate the percentage of this population that you would expect to be heterozygous for this gene. Show your working.

Answer ..... %
(3 marks)

8

Turn over for the next question

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

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(1 mark)

3 (b) Scientists investigated the distribution of three species of fish in a lake. They recorded the range of depths where each species was found. The table shows their results.

Species of fish	Range of depths / m
White bass	0 to 8.4
Walleye	6.8 to 10.0
Sauger	7.2 to 14.6

3 (b) (i) Use information from the table to give the range of depths at which all three species of fish may be found living together.

Answer ..... m

(1 mark)

3 (b) (ii) Suggest and explain **one** advantage to the fish of occupying different depths in the lake.

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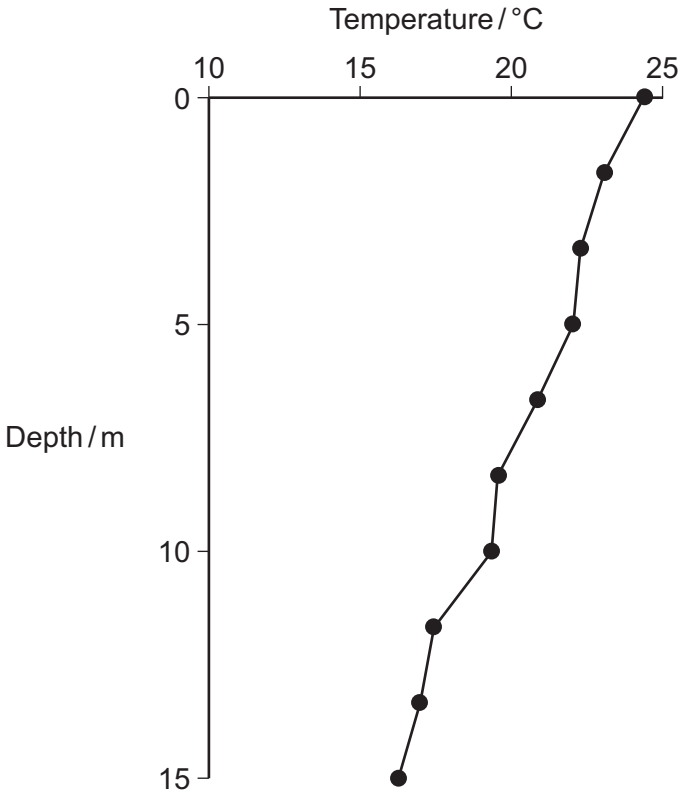
(2 marks)

3 (c) The graph shows the relationship between the depth and the temperature of the water in the lake.



A student concluded that the temperature of the water in the lake determined the depth at which the species of fish were found. Use the table and the graph to evaluate this conclusion.

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(3 marks)

(Extra space) .....

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7

4 A scientist investigated the uptake of radioactively labelled carbon dioxide in chloroplasts. She used three tubes, each containing different components of chloroplasts. She measured the uptake of carbon dioxide in each of these tubes. Her results are shown in the table.

Tube	Contents of tube	Uptake of radioactively labelled CO_2 / counts per minute
A	Stroma and grana	96 000
B	Stroma, ATP and reduced NADP	97 000
C	Stroma	4 000

4 (a) Name the substance which combines with carbon dioxide in a chloroplast.

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(1 mark)

4 (b) Explain why the results in tube **B** are similar to those in tube **A**.

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(1 mark)

4 (c) Use the information in the table to predict the uptake of radioactively labelled carbon dioxide if tube **A** was placed in the dark. Explain your answer.

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(2 marks)

4 (d) Use your knowledge of the light-independent reaction to explain why the uptake of carbon dioxide in tube **C** was less than the uptake in tube **B**.

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(2 marks)

4 (e) DCMU is used as a weed killer. It inhibits electron transfer during photosynthesis. The addition of DCMU to tube **A** decreased the uptake of carbon dioxide. Explain why.

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(2 marks)

8

Turn over for the next question

5 (a) Insect pests of crop plants can be controlled by chemical pesticides or biological agents.
Give **two** advantages of using biological agents.

1 .....

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2 .....

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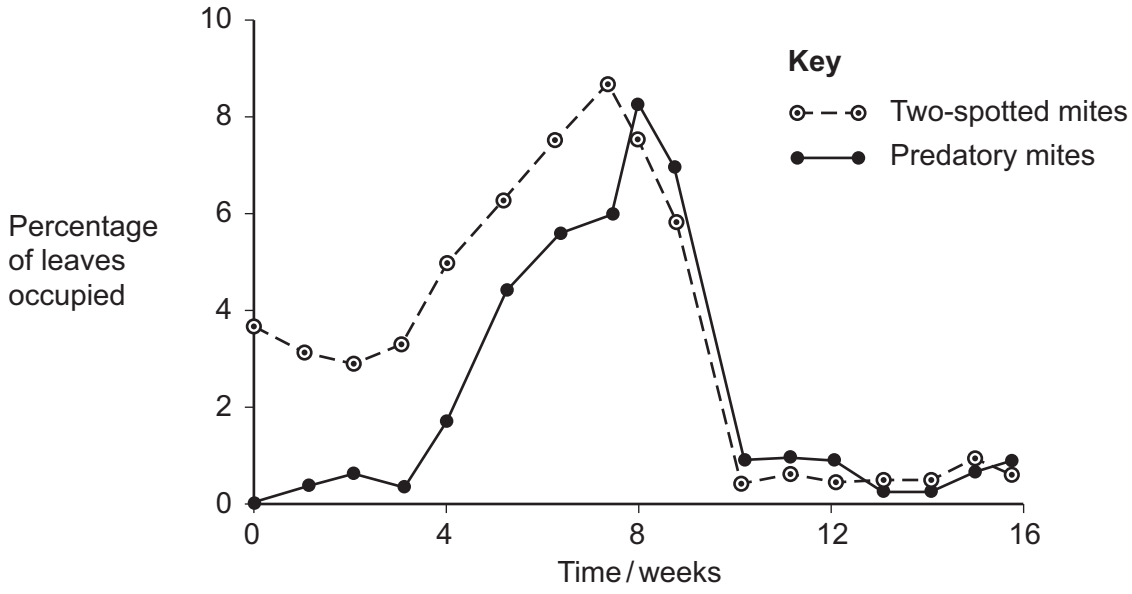
(2 marks)

Two-spotted mites are pests of strawberry plants. Ecologists investigated the use of predatory mites to control two-spotted mites. They released predatory mites on strawberry plants infested with two-spotted mites. They then recorded the percentage of strawberry leaves occupied by two-spotted mites and by predatory mites over a 16-week period. The results are shown on the graph.



5 (b) Describe how the percentage of leaves occupied by predatory mites changed during the period of this investigation.

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(2 marks)

5 (c) The ecologists concluded that in this investigation control of the two-spotted mite by a biological agent was effective. Explain how the results support this conclusion.

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(2 marks)

5 (d) Farmers who grow strawberry plants and read about this investigation might decide **not** to use these predatory mites. Suggest **two** reasons why.

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2 .....

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(2 marks)

5 (e) The ecologists repeated the investigation but sprayed chemical pesticide on the strawberry plants after 10 weeks. After 16 weeks no predatory mites were found but the population of two-spotted mites had risen significantly. Suggest an explanation for the rise in the two-spotted mite population.

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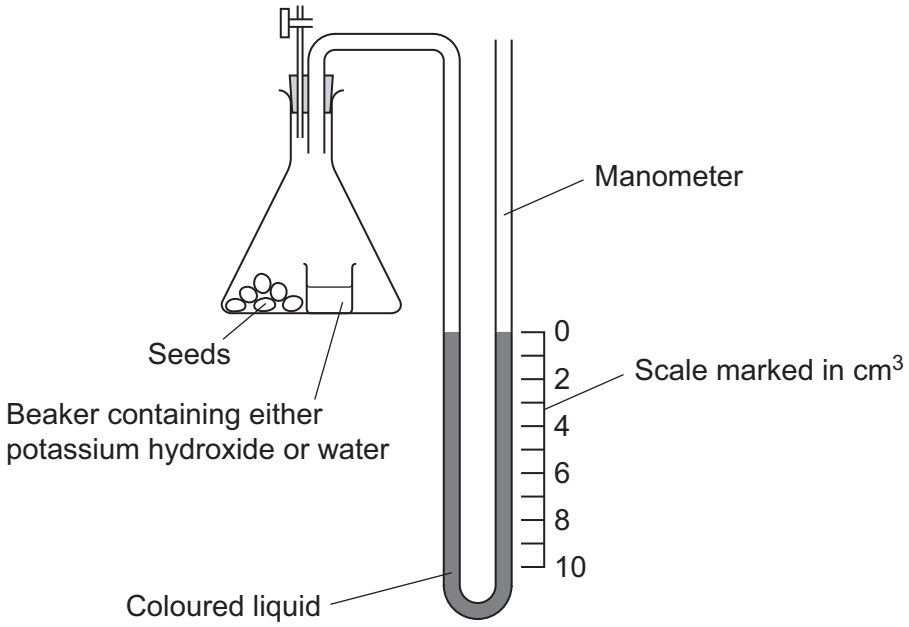
(2 marks)

10

6 A student investigated the rate of gas exchange in aerobically respiring seeds using the apparatus shown in the diagram. She carried out two experiments.

- In Experiment **1**, she put potassium hydroxide solution in the beaker. Potassium hydroxide solution absorbs carbon dioxide.
- In Experiment **2**, she put water in the beaker.



6 (a) Both experiments were carried out at the same temperature. Explain why.

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(2 marks)

6 (b) (i) The level of coloured liquid in the right-hand side of the manometer tube went down during Experiment **1**. Explain why.

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(3 marks)

(Extra space) .....

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The results from both experiments are shown in the table.

Experiment	Solution in beaker	Fall in volume of coloured liquid in right-hand side of manometer / cm^3
1	Potassium hydroxide	5
2	Water	1

6 (b) (ii) Use these results to calculate the volume of carbon dioxide produced during Experiment **1**.

Answer = ... cm^3

(1 mark)

6 (c) The student repeated Experiment **1** using seeds which were respiring anaerobically. What would happen to the level of coloured liquid in the right-hand side of the manometer tube? Explain your answer.

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(2 marks)

8

7 Biofuels are fuels which can be produced from plants. Scientists have developed a standard method called net life-cycle carbon dioxide production (NLP) to find the overall effect of producing and using particular biofuels on carbon dioxide production.

7 (a) Petroleum is used as a comparison when evaluating NLPs of biofuels. Suggest **two** reasons why.

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2 .....

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(2 marks)

7 (b) Biofuels are produced by a variety of different companies. The scientists who developed the method of calculating NLPs are funded by the government's environmental agency.
Suggest **two** advantages of this method being developed by these scientists.

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2 .....

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(2 marks)

Scientists compared the percentage change in carbon dioxide production if different biofuels replaced petroleum. Their results are shown in the table.

Biofuel	Percentage change in carbon dioxide production if this fuel replaced petroleum
Corn ethanol	–18
Soy-based biodiesel	+4
Switch-grass ethanol	–124
Sugar-cane ethanol	–26

7 (c) (i) The scientists suggested that using biofuels would have a great effect on limiting climate change. Use the data in the table to evaluate this suggestion.

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(4 marks)

(*Extra space)* .....

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Question 7 continues on the next page

7 (c) (ii) Producing and using biofuels from corn ethanol results in a negative percentage change in carbon dioxide production. Explain why.

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(2 marks)

7 (d) Ethanol can be produced from cellulose. It is produced by anaerobic respiration of cellulose-based biomass by microorganisms. The cellulose is pre-treated by adding cellulose-digesting enzymes before it is used in anaerobic respiration. Suggest why pre-treatment is necessary.

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(3 marks)

(Extra space) .....

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7 (e) Large areas of land have to be used to grow the plants to make biofuels. Ecologists have suggested that changes in land use could lead to a decrease in biodiversity. Suggest how changes in land use could lead to a decrease in biodiversity.

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(2 marks)

15

8 (a) Explain how farming practices increase the productivity of agricultural crops.

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(5 marks)

(Extra space) .....

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Question 8 continues on the next page

8 (b) Describe how the action of microorganisms in the soil produces a source of nitrates for crop plants.

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(5 marks)

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8 (c) Explain how the use of pesticides can result in resistant strains of insect pests.

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(5 marks)

(Extra space) .....

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15

END OF QUESTIONS

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