

Write your name here

Surname

Other names

Centre Number

Candidate Number

Edexcel GCE

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Friday 15 June 2012 – Morning

Time: 1 hour 30 minutes

Paper Reference

6BI04/01

You do not need any other materials.

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.

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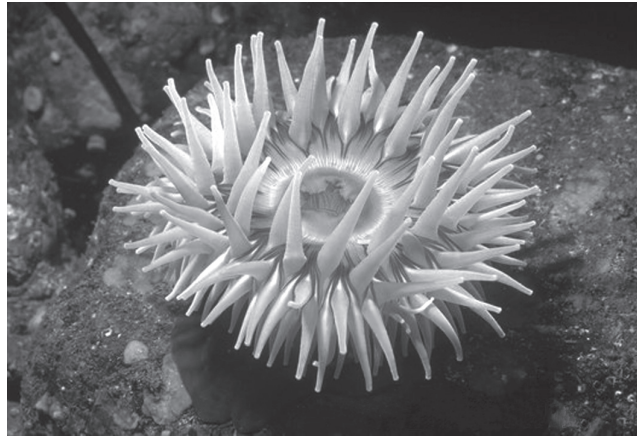


PEARSON

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 The sea anemone, *Anthopleura elegantissima*, occupies a niche at the secondary and tertiary consumer levels in a food web on the shores of North America.



Neil G. Mcdaniel / Science Photo Library

Sea anemone Magnification $\times 1$

At high tide, the sea anemone is active and feeds on a variety of small invertebrate animals and fish. It paralyses its prey using stinging cells on tentacles. The food is then passed into the gut of the sea anemone for digestion by enzymes. The anemones also form the food of various carnivores.

At low tide, the anemones are exposed on the rocks of the shore where they remain stationary until the water returns at high tide.

During this exposure, the tentacles and body of each anemone are contracted into a rounded mass.

- (a) Explain what is meant by the term **niche**, using the sea anemone *Anthopleura elegantissima* as an example.

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(b) Suggest and explain why the anemones contract when exposed at low tide.

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- (c) Line transects were used to study the effects of abiotic factors on the distribution of *A. elegantissima* on a rocky shore. In this study, line transects were taken from the upper shore to the low water mark.

The mean results from these line transects are shown in the table below.

Quadrat	Mean height above low water mark / m	Mean rock temperature / °C	Mean number of <i>A. elegantissima</i>
1	3.9	12	0
2	3.6	12	0
3	3.7	12	0
4	3.4	13	5
5	3.2	12	10
6	3.0	12	21
7	2.9	11	32
8	2.5	12	56
9	2.4	12	68
10	2.1	13	55
11	1.7	13	76
12	1.2	12	45
13	0.9	12	25
14	0.6	12	18
15	0.0	12	21

- (i) Place a cross ☒ in the box next to the term that describes the type of sampling that uses line transects to study the distribution of *A. elegantissima*.

(1)

- ☐ **A** controlled
- ☐ **B** random
- ☐ **C** systematic
- ☐ **D** trial and error



2 Certain herbivores, such as cows, contain bacteria in their stomachs.

These bacteria produce enzymes that can digest cellulose and other organic compounds in the plant material that the cows eat.

As a result of the bacterial activity, methane and carbon dioxide are released. These gases pass into the atmosphere as the cow burps or exhales.

- (a) (i) Place a cross ☐ in the box next to the term used to describe the type of chemical reaction involved in the digestion of cellulose by enzymes.

(1)

- ☐ **A** autolysis
- ☐ **B** haemolysis
- ☐ **C** hydrolysis
- ☐ **D** photolysis

- (ii) Place a cross ☐ in the box next to the most likely product of the digestion of cellulose by the bacteria.

(1)

- ☐ **A** amino acids
- ☐ **B** fatty acids
- ☐ **C** glucose
- ☐ **D** glycerol

- (b) Suggest why these bacteria need to have special adaptations to live in the stomach of a cow.

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- (c) On a farm in Wales, an investigation was carried out to assess the effect of diet on the milk yield and methane production of cows.

A herd of cows was divided into two groups, A and B. The cows in group A were fed a traditional diet and those in group B were fed the same diet with a mixture of chopped hay and straw added.

The table below shows the results of this investigation.

Group	Diet	Mean milk yield per cow / $\text{dm}^3 \text{ day}^{-1}$	Methane emission for each dm^3 milk produced / dm^3
A	Traditional with no added material	24.0	30.0
B	Traditional with added chopped hay and straw	27.6	24.0

- (i) Using the information in the table, calculate the rate of methane production per cow on each of the two diets.

(2)

Group A = ...

Group B = ...



- *(ii) Scientists have estimated that if all cattle in Britain were fed on a diet with added chopped hay and straw, there would also be an annual reduction of at least 1.6 million tonnes of carbon dioxide released into the atmosphere.

With reference to your answer in (c)(i) and the information on carbon dioxide release, suggest why the new diet may be supported by organisations that are concerned about global warming.

(5)

(Total for Question 2 = 12 marks)



3 Clear areas with no trees can be found within many forests. These areas usually have communities of animals and plants which are different from those found in the wooded parts of the forest. These clear areas are maintained by the grazing of animals such as rabbits and deer.

(a) Describe what might happen to the clear areas in forests, over a long period of time, if the numbers of rabbits and deer decreased.

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- (b) The butterfly *Boloria selene* (Small Pearl-bordered Fritillary) can be found in many of the clear areas of British forests.



Small Pearl-bordered Fritillary Magnification $\times 1.5$

This butterfly lays its eggs on low-growing plants such as *Viola riviniana* (Dog Violet), on which the caterpillars feed when they hatch.

The adult butterflies feed on nectar from plants such as *Ajuga reptans* (Bugle) and other low-growing species.

Since the plants on which the butterfly depends are able to grow only in forest clearings, small reproductively-isolated populations of *B. selene* can be identified in many forests.

- (i) The distribution of plants in a forest is affected by many abiotic factors.

Name **one** of these factors and suggest how this factor could affect the distribution of the low-growing plants within the clear areas of a forest.

(3)

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- (ii) Explain what is meant by the term **reproductively-isolated populations** of *B. selene*.

(3)

- (iii) Suggest why it is unlikely that any individuals within a population of *B. selene* would survive if the numbers of rabbits and deer decreased.

(3)

(Total for Question 3 = 12 marks)



4 Photosynthesis involves the fixation of carbon dioxide in chloroplasts.

- (a) Place a cross ☒ in the box next to the region of the chloroplast that would be involved in the fixation of carbon dioxide.

(1)

- ☒ **A** crista
☒ **B** granum
☒ **C** matrix
☒ **D** stroma

- (b) An investigation was carried out into the effect of reducing the carbon dioxide available for photosynthesis. Cells of a unicellular alga were suspended in a solution containing 1.0% carbon dioxide. After 250 seconds, the carbon dioxide in the solution was reduced to 0.003%.

The cells were illuminated with a bright light and some were removed at regular time intervals for 500 seconds. The concentrations of ribulose biphosphate (RuBP) and glycerate 3-phosphate (GP) in the cells were measured.

- (i) Suggest **two** reasons why a suspension of cells of a unicellular alga, in a solution, is more suitable for this investigation than using leaves.

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- (ii) Suggest why it would be advisable to illuminate the cells at a high light intensity during this investigation.

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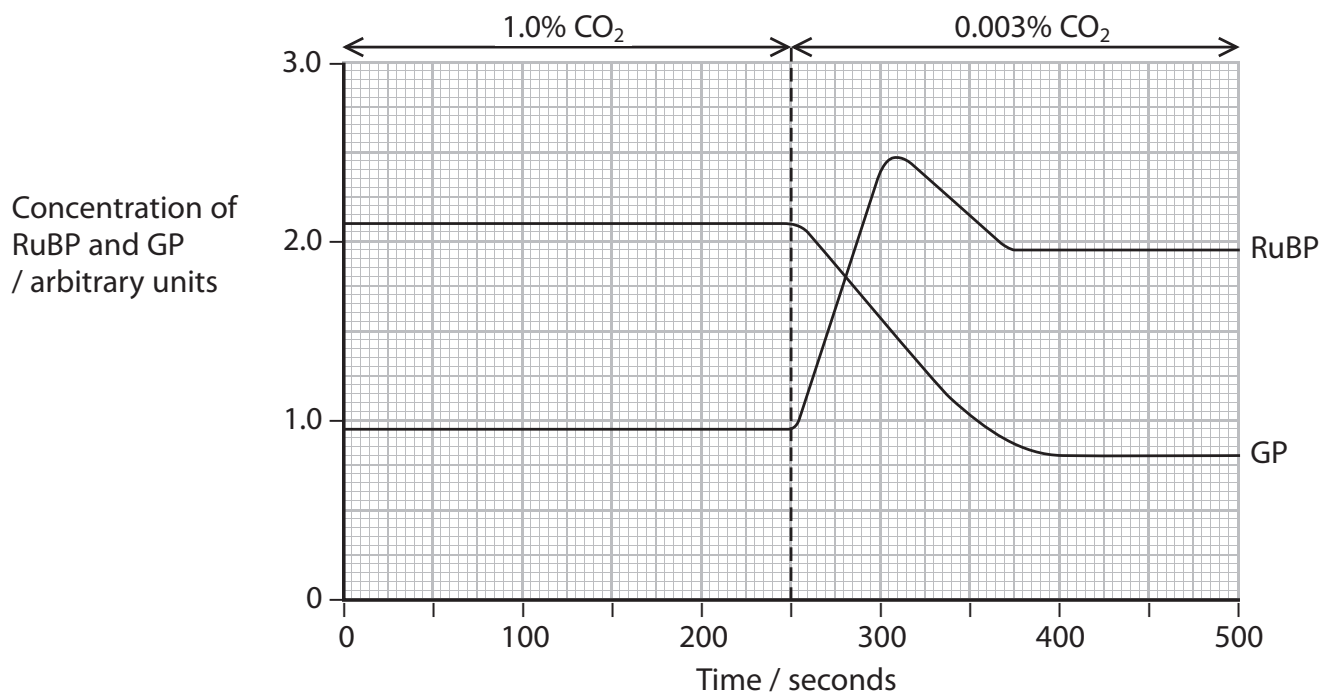
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*(iii) The graph below shows the results of the investigation.



Describe and suggest an explanation for the changes in the concentrations of RuBP and GP shown in the graph.

(6)

(Total for Question 4 = 12 marks)



- 5 A pathologist was called to examine the body of a young man found partly-buried in a shallow grave. The initial examination of the body provided evidence that could be used to estimate the time of death of the young man.

One source of evidence used for an estimation of the time of death was the remains of insects found on the body.

The table below describes some of the types of insect remains found and the pathologist's notes.

Type of insect	Life cycle stage	Pathologist's notes
<i>Chrysomya rufifacies</i> (blowflies)	Pupa cases	Pupa cases empty
<i>Dermestes maculates</i> (beetles)	Third stage larval skins	Good condition
<i>Necrobia rufipes</i> (beetles)	Adult	Active

- (a) Place a cross ☒ in the box next to the term that describes the use of evidence provided by insect remains on a dead body.

(1)

- ☐ A forensic bryology
- ☐ B forensic entomology
- ☐ C forensic mycology
- ☐ D forensic neurology



(b) The flow diagram below shows the main stages in the life cycle of blowflies and beetles.

EGG → LARVA → PUPA → ADULT

- (i) Place a cross ☒ in the box next to the factor that would have the most effect on the rate of development of each stage of the life cycle of insects on this dead body.

(1)

- ☐ **A** interspecific competition
- ☐ **B** light
- ☐ **C** predation by birds
- ☐ **D** temperature

- (ii) Suggest how the pathologist might use the information in the table and the flow diagram to estimate the time of death of the young man.

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(c) Suggest how useful each of the following additional sources of evidence would be for the pathologist in determining the time of death of this young man. Give an explanation for each of your answers.

(i) Body temperature

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(ii) State of decomposition

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(Total for Question 5 = 9 marks)



6 In the immune response, antibodies are produced that are specific to the antigens of the pathogen causing the infection.

(a) Place a cross ☒ in the box next to the type of cell that produces antibodies as part of the immune response.

(1)

- ☐ A erythrocyte
- ☐ B macrophage
- ☐ C plasma cell
- ☐ D thrombocyte

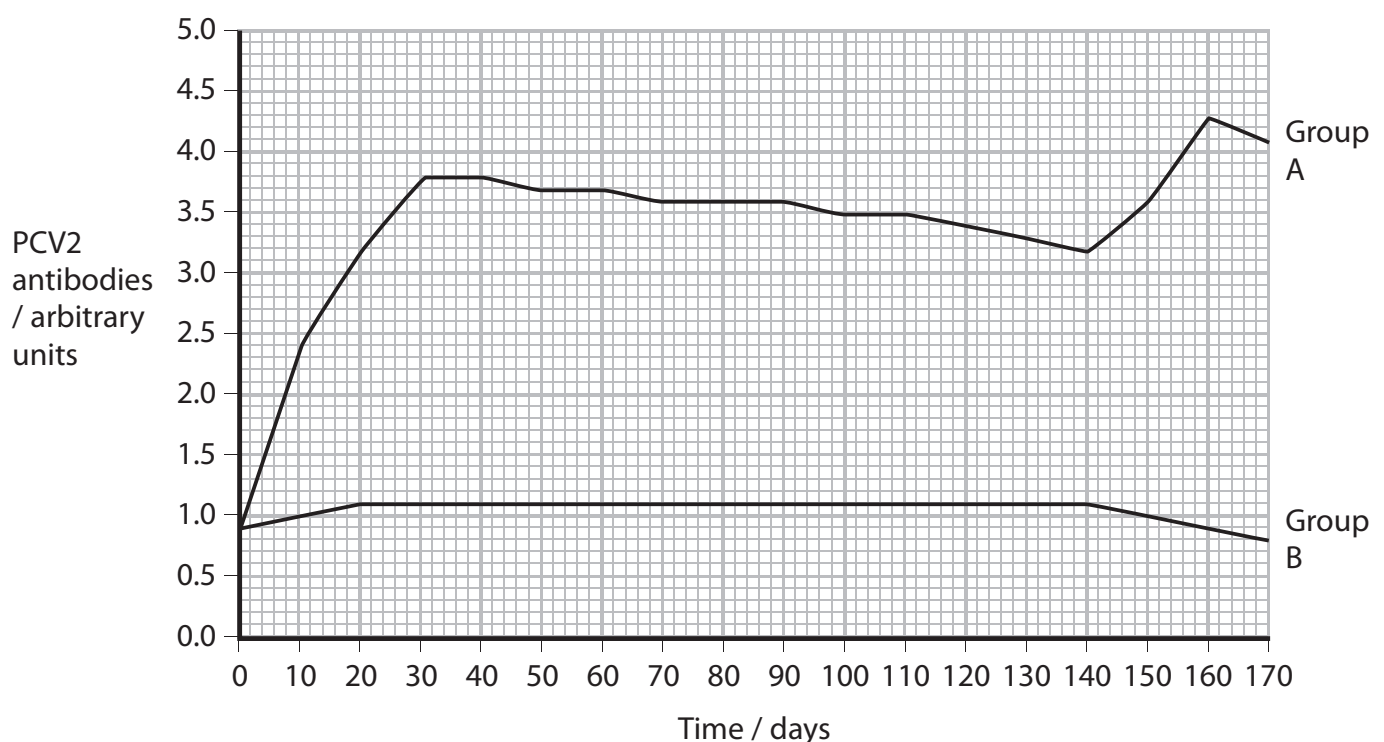
(b) In pigs, the disease known as post-weaning multisystemic syndrome (PWMS) is caused by the PCV2 virus. Common symptoms of PWMS include weight loss, breathing difficulties and enlargement of the lymph nodes. Most pigs diagnosed with PWMS will have to be destroyed.

A new vaccine has been developed to give gilts (female pigs having their first pregnancy) active immunity against PWMS. To test this vaccine, gilts were divided into two groups, A and B.

Group A gilts were vaccinated against PWMS on day 0, at the start of pregnancy. A second vaccination was given on day 20. A final vaccination was given on day 140, approximately 20 days before they were due to give birth.

Group B gilts were given no vaccine.

The graph below shows the results of blood tests to measure the concentration of PCV2 antibodies in these two groups.



(i) Describe how the vaccine gives **active immunity** against PWMS.

(3)

(ii) Apart from having no vaccine, suggest how group B should be treated during the test. Give reasons for your answer.

(3)



(iii) Compare the changes in concentrations of PCV2 antibodies in the blood of the two groups of gilts during pregnancy.

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- (iv) The table below shows the concentration of PCV2 antibodies detected in the piglets produced by the two groups of gilts, during the first 40 days after birth.

Age of piglets / days	Concentration of PCV2 antibodies / arbitrary units	
	Group A piglets	Group B piglets
0	3.9	0.7
10	3.2	0.8
20	3.0	2.6
40	2.9	2.9

Suggest reasons for the changes in the concentrations of PCV2 antibodies in group A and group B piglets.

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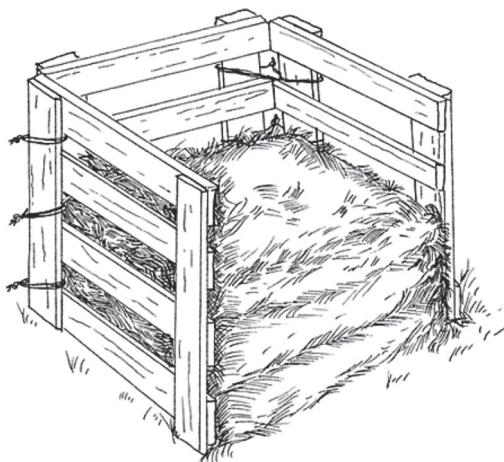
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(Total for Question 6 = 13 marks)



- 7 Waste plant material from gardens can be turned into a bulk organic fertiliser known as compost. Compost consists of semi-decomposed material which can add texture and mineral nutrients to the soil.

The diagram below shows a typical garden compost bin.



- (a) Place a cross ☒ in the boxes next to the **two** types of organism that would be able to decompose organic compounds in waste plant material.

(2)

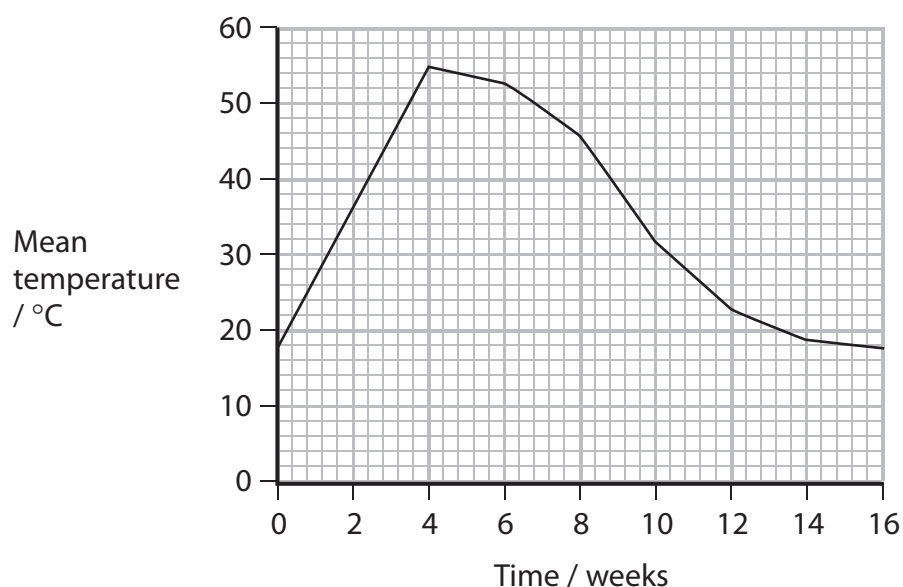
- ☐ A algae
- ☐ B bacteria
- ☐ C fungi
- ☐ D viruses



- (b) As part of a study of compost formation, a student monitored the temperature in a compost heap for several weeks. A compost heap was set up using a mixture of leaves, straw and other plant material.

The student added some nitrate fertiliser and watered the compost heap. The temperature was measured in the compost heap by inserting a long thermometer at several points. The temperature readings were repeated for a further 16 weeks.

The graph below shows the results of this part of the study.



The table below shows statements that the student wrote in her report on the study. Place a tick (✓) in each row to indicate whether the statement is true or false.

(3)

Statement	True	False
Compost formation involves respiration by microorganisms.		
I added nitrate fertiliser so that the microorganisms could synthesise nucleic acids.		
There is only one trophic level in my compost heap.		



(c) Describe the changes in temperature shown in the graph.
Suggest explanations for these changes.

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(d) Suggest why the student took temperature measurements by using **a long thermometer at several points**.

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(Total for Question 7 = 12 marks)



8 DNA is found in chromosomes and consists of double-stranded polynucleotide molecules. The sequence of bases in DNA forms the basis of what is known as the genetic code.

(a) Explain why a molecule of DNA can be described as a **double-stranded polynucleotide**.

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(5)

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