

Write your name here

Surname

Other names

Centre Number

Candidate Number

Edexcel GCE

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Friday 11 January 2013 – Afternoon

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.

Turn over ►

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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 Antibiotics are used in the treatment of bacterial infections.

- (a) (i) Cephalosporins are antibiotics that inhibit the production of bacterial cell walls.

Suggest why cephalosporins are **bactericidal** antibiotics.

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- (ii) Quinolones are antibiotics that inhibit the synthesis of DNA in bacterial cells.

Suggest why quinolones are **bacteriostatic** antibiotics.

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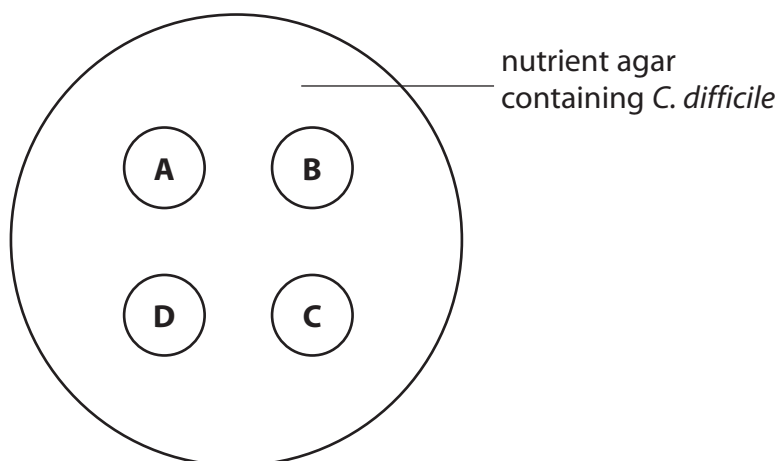


- (b) An investigation of the effectiveness of different antibiotics on *Clostridium difficile* was carried out by a hospital laboratory.

Several nutrient agar plates, containing *C. difficile*, were prepared.

Four discs, A, B, C and D, were placed on the surface of each plate. Each disc contained the same concentration of a different antibiotic.

The diagram below shows the position of the four discs on each agar plate, before being incubated.



After incubation, the scientists in the laboratory concluded that *C. difficile* was completely resistant to antibiotics A and C.

They also concluded that antibiotic D was more effective against *C. difficile* than antibiotic B.

- (i) Explain how the appearance of the nutrient agar plates, after incubation, would have enabled the scientists to reach these conclusions.

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For each of the statements below, put a cross (☒) in the box next to the term that completes each statement.

(ii) In this investigation, several nutrient agar plates were used for

(1)

- ☐ **A** accuracy
- ☐ **B** precision
- ☐ **C** reliability
- ☐ **D** validity

(iii) In this investigation, each disc had the same concentration of antibiotic for

(1)

- ☐ **A** accuracy
- ☐ **B** precision
- ☐ **C** reliability
- ☐ **D** validity

(c) Hospital-acquired infections caused by bacteria can be a major problem for patients.

In a study in a London hospital, it was found that pillows contaminated with bacteria could spread infections between patients.

Suggest how this hospital could improve the prevention and control of the spread of infections.

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(Total for Question 1 = 12 marks)



2 The Human Immunodeficiency Virus (HIV) infects cells of the human immune system.

(a) (i) Place a cross (☒) in the box next to the name of the type of cell in the human immune system that is infected by HIV.

(1)

☐ A B effector cell

☐ B B memory cell

☐ C T helper cell

☐ D T killer cell

(ii) Place a cross (☒) in the box next to the name of the enzyme used to produce DNA from viral RNA in an infected cell.

(1)

☐ A DNA polymerase

☐ B RNA polymerase

☐ C restriction endonuclease

☐ D reverse transcriptase

(b) An antibody, known as 2G12, has been isolated from the blood of an HIV patient.

(i) State **two** characteristic features of antibodies.

(2)

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- * (ii) The antibody 2G12 is produced in response to part of a glycoprotein found on the surface of HIV. Synthetic molecules have been made that resemble this part of the glycoprotein. The antibody 2G12 binds to these synthetic molecules.

Using the information, suggest how this may enable scientists to develop a means of producing **active** immunity to HIV infection.

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- (c) The table below shows some data about groups of people with HIV infection, in the United Kingdom in 2010.

Group	Numbers in the United Kingdom
People newly-diagnosed with HIV infection	6 630
People unaware of their HIV infection	21 625
People receiving treatment for HIV infection	65 000

Some of the figures shown in the table are estimates.

Suggest why data about HIV infections are often estimates.

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(Total for Question 2 = 11 marks)



- 3 The polar bear, *Ursus maritimus*, preys on seals and fish.
Polar bears are adapted to live in cold Arctic regions.



Polar bear
Magnification $\times 0.04$

A recent study has shown that all polar bears are descended from populations that diverged from the Irish brown bear, *Ursus arctos*, approximately 120 000 years ago.

In this study, DNA from modern polar bears, the remains of historic polar bears and the remains of Irish brown bears was analysed.

- (a) The first part of the study involved the amplification of DNA to give large enough samples for analysis.
- (i) Describe how small samples of DNA can be amplified.

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(ii) Name **one** technique that could be used to analyse the amplified DNA samples.

(1)

(b) Suggest how the scientists who conducted the study had their results accepted by other scientists.

(2)

(c) Suggest how each of the following may have contributed towards the divergence of polar bears and Irish brown bears into two separate species.

(i) Separation of the Arctic and Irish regions by sea

(2)

(ii) Genetic mutation

(2)

(Total for Question 3 = 11 marks)



4 Frogs are ectothermic animals. This means that their body temperature will vary as the environmental temperature varies.

(a) Explain why body temperature affects the rate of development of animals.

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- (b) Several species of the frog genus, *Rana*, can be found in North America. Many of these species inhabit areas within a range of latitudes from the colder north to the warmer south.

The table below shows data for four of these species, *R. clamitans*, *R. palustris*, *R. pipiens* and *R. sylvatica*.

Species	Body temperature of frog / °C			
	Lower lethal, below which frog dies	Minimum to start development	Maximum to complete development	Upper lethal, above which frog dies
<i>R. clamitans</i>	10.0	11.0	35.0	37.0
<i>R. palustris</i>	5.0	7.0	30.0	31.0
<i>R. pipiens</i>	3.0	6.0	28.0	30.0
<i>R. sylvatica</i>	0.0	2.0	24.0	25.0

Using the information, suggest why the lower and upper lethal temperatures limit the range of latitudes inhabited by each species of frog.

(2)

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- (c) Complete the species names in the diagram below to show the most likely distribution of *Rana* from north to south.

(2)

North



South

Rana

Rana

Rana

Rana

- (d) Populations of the different species overlap on the boundaries of each latitude range.

Suggest why interbreeding does not take place between these populations.

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(e) Suggest how global warming may affect the distribution of these species of *Rana* in North America.

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(Total for Question 4 = 13 marks)



5 Photosynthesis can be divided into two main stages, the light-dependent stage and the light-independent stage.

(a) Explain why the light-independent stage cannot take place without the light-dependent stage.

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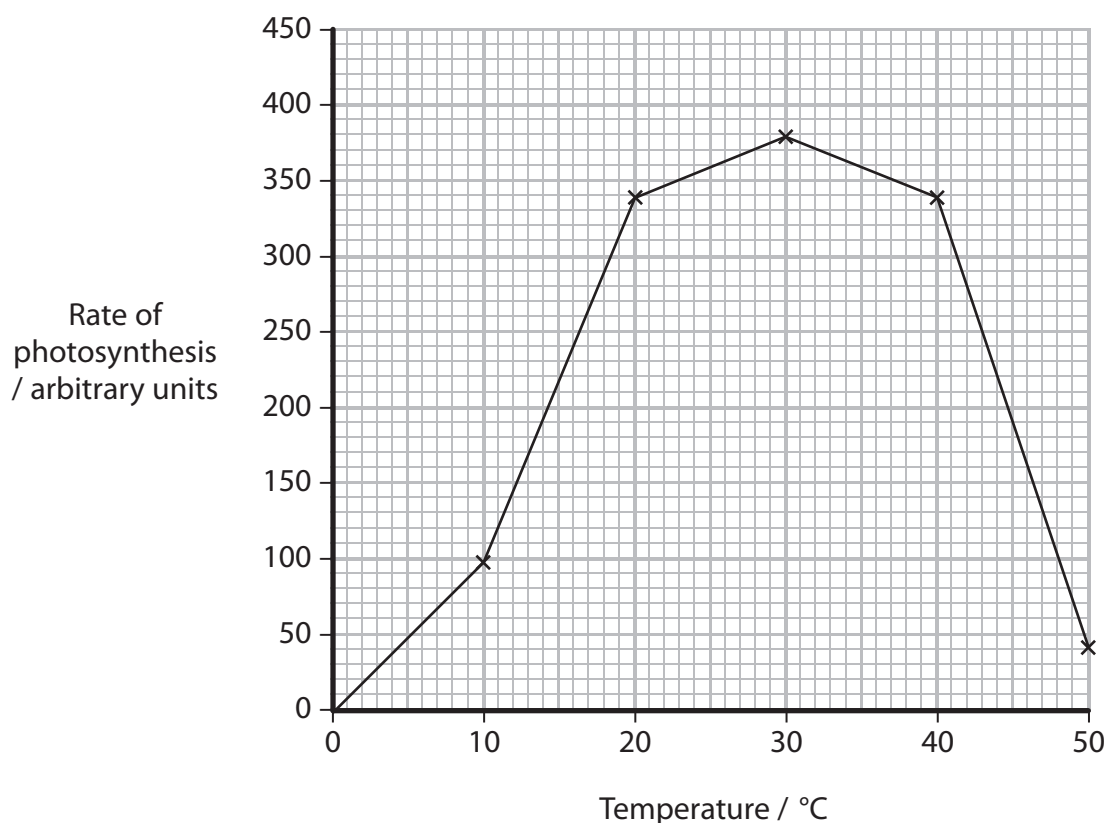


- (b) An investigation was carried out by a student, to find the effect of temperature on the rate of photosynthesis in *Elodea canadensis* (Canadian pondweed).

The rate of photosynthesis was measured over a period of two hours at a fixed temperature. This was repeated at different temperatures.

All other abiotic factors were controlled.

The results of this investigation are shown in the graph below.



- (i) Place a cross (☒) in the box next to the statement that describes what could be measured to find the rate of photosynthesis in this investigation.

(1)

- ☐ **A** increase in mass of *Elodea*
- ☐ **B** mass of nitrate absorbed
- ☐ **C** volume of carbon dioxide produced
- ☐ **D** volume of oxygen produced



- (ii) The temperatures used in this investigation were 0°C, 10°C, 20°C, 30°C, 40°C and 50°C.

Suggest what the results of the investigation show about the minimum temperature required for photosynthesis in *Elodea*.
Give a reason for your answer.

(2)

- (iii) Explain the meaning of the following statement.

"All other abiotic factors were controlled."

(2)



(iv) The student, who carried out this investigation, wrote the following as part of her conclusion.

Enzymes control the rate of photosynthesis in *Elodea*.

Discuss how far the results of this investigation support her conclusion.

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(Total for Question 5 = 12 marks)



- 6 During the construction of a motorway in the 1970s, an area of Hampshire heathland, previously used for grazing, was abandoned. With the loss of the grazing animals, succession towards a climax community took place on this heathland.

By the 1990s, a scrubland community had developed. A characteristic of this scrubland is the presence of young trees, such as the Birch (*Betula pendula*).

(a) Explain what is meant by each of the following terms.

(i) Succession

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(ii) Climax community

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(b) In the 1990s, a management strategy was put in place to conserve the rare and endangered heathland plants.

(i) Suggest why it is important to conserve rare and endangered plants.

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(ii) Using the information given on page 18, suggest **one** management strategy that could have been used to conserve the heathland.

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(c) A survey of the occurrence of one rare and endangered plant species, Petty Whin (*Genista anglica*) was carried out.

In this study, a line of 8 people at 2 m intervals walked across the study area. They recorded the position, height and width of each specimen of Petty Whin. The direction of the line was changed several times to ensure that the whole area was covered.

(i) Place a cross (☒) in the box next to the term that describes the method used to collect data in this survey.

(1)

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



- (ii) A statistical analysis of the data obtained gave a correlation value of 0.565 between height and width of Petty Whin. This correlation was not statistically significant.

Suggest reasons why the correlation was not statistically significant.

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(Total for Question 6 = 10 marks)



- 7 As a result of the destruction of many habitats, the numbers of some species of animals are now so low that they may not be able to survive.

The white rhinoceros, *Ceratotherium simum*, is an example of a mammal that is threatened with extinction.



White rhino
Magnification $\times 0.02$

In southern Africa, many reserves have been set up to protect habitats and animals. These areas are governed by special legislation and monitored by wardens.

- (a) Suggest why many scientists consider that the use of protected reserves is likely to be more successful for the conservation of some animals than captive breeding programmes in zoos.

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*(b) The illegal killing of white rhinoceros (poaching), to obtain their horns, is a serious problem in many of the reserves in southern Africa. When the body of a white rhinoceros is discovered, determination of the time of death is an important part of the police investigation to catch the poachers.

After several days, body temperature and rigor mortis cannot be used to determine the time of death.

Suggest how the time of death of a white rhinoceros could be determined if it is discovered several days after being killed.

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(Total for Question 7 = 8 marks)



8 Histamine and the proteins interferon and lysozyme are involved in the non-specific responses to infection.

(a) (i) Describe how the production and action of interferon differs from the production and action of lysozyme.

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(ii) Suggest why the protein structure of lysozyme is important to the way in which it acts against pathogens.

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(b) Following a bite by an insect, the area around the bite may show signs of inflammation as histamine is released.

- (i) Explain why an insect bite, which breaks the surface of the skin, may lead to inflammation around the injury.

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- (ii) In order to reduce inflammation, a cream containing antihistamines might be applied to the skin, around an insect bite.

Suggest why applying this cream might be better than taking tablets containing antihistamines.

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(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 90 MARKS

