Write your name here

Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced Subsidiary
Unit 4: The Natural Environment and Species Survival

Wednesday 16 June 2010 – 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.

Turn over ▶

1/1/1/1/1/
N 3 7 0 9 5 A 0 1 2 4

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 Forensic scientists use several different types of evidence to estimate the time of death of a body.

(a) Place a cross ☒ in the boxes next to the **two** types of evidence that could be used by a forensic scientist to estimate the time of death of a body.

(2)

☐ Degree of muscle contraction

☐ Length of fingernails

☐ Signs of decomposition

☐ Skin pigmentation

(b) The core temperature of a body can also be used to estimate the time of death. This can be recorded by measuring the temperature of the rectum.

The table below shows the mean core temperature, measured at 2-hour intervals after death, using data from a large number of bodies. The standard deviation from each of the means is also shown.

Time after death / hours	Mean core temperature / °C	Standard deviation from the mean / °C
2	36.7	0.9
4	36.0	1.1
6	35.3	1.3
8	31.3	1.5
10	29.6	1.7
12	28.1	2.0
14	26.7	2.3
16	25.5	2.6
18	25.0	2.9
20	23.6	3.1
22	22.8	3.3
24	22.3	3.4
26	21.8	3.4

Explain what the data indicates about the reliability of using core temperature to estimate the time of death.

(4)

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(c) Suggest **three** factors that could influence the rate at which a body cools after death.

(3)

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2 ....

3 ....

(Total for Question 1 = 9 marks)

2 It has been estimated that only 5% of the light energy hitting the surface of a leaf reaches the chloroplasts to be used in the synthesis of organic material. The total energy used in this synthesis is known as the gross primary productivity (GPP).

(a) Suggest **two** reasons why 95% of the light hitting the surface of a leaf is not used by the chloroplasts.

(2)

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(b) The mean GPP for plants on Earth is 24.4×10^6 J m^{-2} year^{-1}.

The plants use 3.7×10^6 J m^{-2} year^{-1} of this energy in metabolic processes. The energy in the remaining organic material is known as net primary productivity (NPP).

(i) Explain what is meant by the unit **J m^{-2} year^{-1}**.

(1)

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(ii) Calculate the percentage of the mean GPP that remains as NPP within plants on Earth.
Show your working.

(2)

Answer .... %

(iii) Place a cross ☒ in the box next to the metabolic process that best describes the process that accounts for most of the difference between GPP and NPP in plants.

(1)

☒ **A** Chemosynthesis

☒ **B** Respiration

☒ **C** Photosynthesis

☒ **D** Protein synthesis

*(c) With reference to the structures in a chloroplast, explain how the energy from light is made available in ATP molecules for the synthesis of organic materials.

(6)

(Total for Question 2 = 12 marks)

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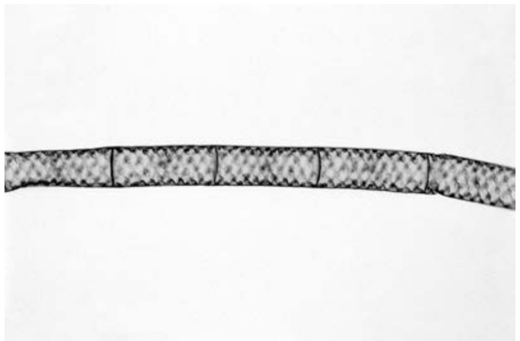
3 Filamentous algae are simple photosynthetic organisms that consist of long strands of very similar eukaryotic cells. Each of the cells in the strand is enclosed within a cellulose cell wall. The strand increases in length as the cells divide and elongate.

The photographs below show some cells in strands of a filamentous alga, as seen using a light microscope.



Magnification ×200

Magnification ×200

(a) (i) Put a cross ☒ in the box next to the term that describes the process involved in the cell divisions in a filamentous alga.

(1)

☒ **A** exocytosis

☒ **B** meiosis

☒ **C** mitosis

☒ **D** osmosis

(ii) Put a cross ☒ in the box next to the structure that would **not** be found in a cell from the strand of a filamentous alga.

(1)

☒ **A** lysosome

☒ **B** mitochondrion

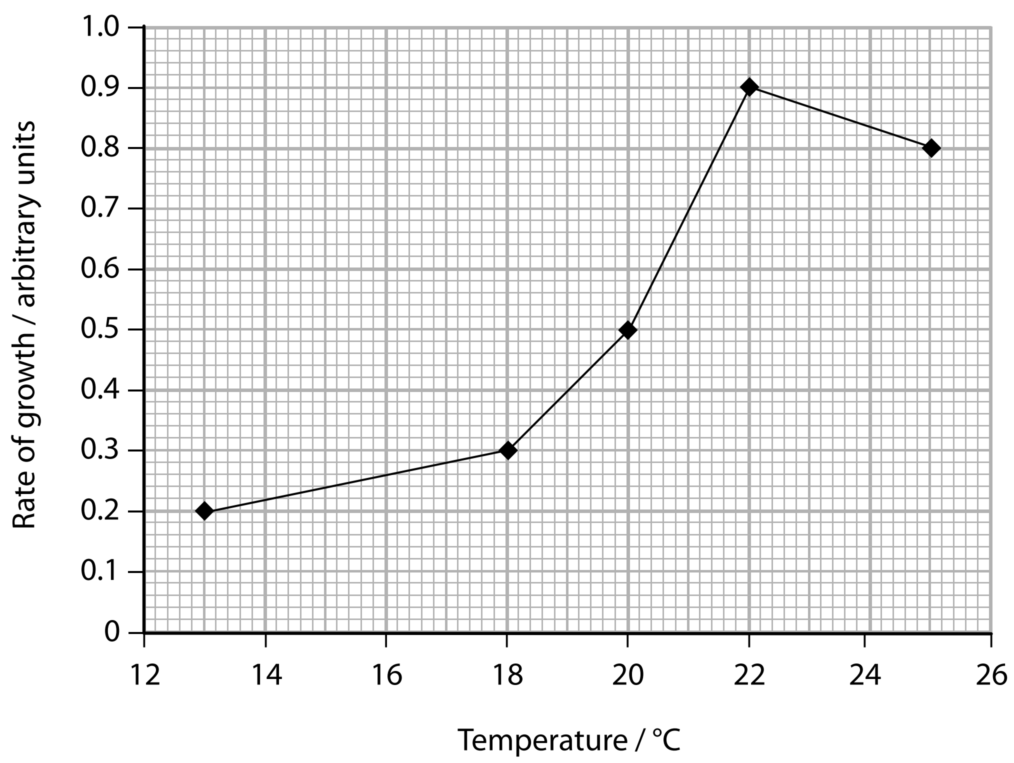
☒ **C** plasmid

☒ **D** ribosome

(b) An investigation was carried out into the effect of temperature on the rate of growth of a filamentous alga. Several short strands of the alga were placed into culture solutions which were kept at five different temperatures and at a high light intensity.

The number of cells in the strands, in each culture solution, was counted at the beginning of the time period and again after 18 days.
The rate of growth was then calculated.

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



(i) Name the **independent** variable in this investigation.

(1)

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(ii) Using the information in the graph, describe and suggest explanations for the effect of temperature on the rate of growth of the filamentous alga.

(4)

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N 3 7 0 9 5 A 0 8 2 4

(iii) Suggest why it was important that this investigation was carried out at a high light intensity.

(3)

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(iv) Suggest **two** abiotic factors, other than light intensity, that would need to be controlled in this investigation.

(2)

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(Total for Question 3 = 12 marks)

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4 Various non-specific responses of the body are involved in resistance to bacterial infections.

(a) Histamine, interferon and lysozyme are three substances involved in non-specific responses to infection.

For each of the following statements, put a cross ☒ in the box next to the name of the substance involved.

(i) Enzyme released in secretions that break down the cell walls of bacteria.
(1)

☒ **A** Histamine

☒ **B** Interferon

☒ **C** Lysozyme

(ii) Inflammation caused by a chemical released by white cells in connective tissue.
(1)

☒ **A** Histamine

☒ **B** Interferon

☒ **C** Lysozyme

(b) The flow diagram below summarises some of the stages of phagocytosis, a non-specific response to a bacterial infection.

Bacteria with **D** on surface enter blood

↓

E produce **F** which bind to **D** and label bacteria

↓

Labelled bacteria attach to **F** receptors on **G**

↓

G engulfs labelled bacteria by forming vacuoles

↓

H is released into the vacuoles to destroy the bacteria

(i) Identify **D**, **E**, **F**, **G** and **H** by writing appropriate terms in the spaces below.

(5)

D ....

E ....

F ....

G ....

H ....

(ii) Explain why the processes shown in the flow diagram will only happen in response to some types of bacteria.

(3)

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(Total for Question 4 = 10 marks)

5 Protein synthesis in cells involves molecules of DNA and RNA.

(a) The table below describes some features of the molecular structure of DNA and RNA. Place a tick (✓) in the box next to each statement to show whether it applies to DNA only, RNA only or to both DNA and RNA.

(2)

Description	**DNA only**	**RNA only**	**Both DNA and RNA**
Polymer formed from a single strand of nucleotides			
Pentose present in the nucleotides			
Adenine, cytosine, guanine and thymine present			
Nucleotides linked by phosphodiester bonds			

(b) The diagram below shows the sequence of the **last** six amino acids in a protein molecule.

The tRNA anticodon that corresponds to each amino acid is also shown.

amino acids	Alanine—	Glutamine—	Glycine—	Asparagine—	Proline—	Valine
tRNA anticodon	CGA	GUU	CCA	UUA	GGA	CAA

Using this information, explain how each of the following processes leads to the synthesis of this sequence of amino acids.

(i) The formation of mRNA during transcription in the nucleus

(3)

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(ii) The translation of mRNA into the sequence of amino acids in a ribosome

(3)

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(c) Suggest why the final triplet of nucleotides, on the strand of mRNA involved in the synthesis of this sequence of amino acids, did not correspond with any anticodon on tRNA.

(2)

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(Total for Question 5 = 10 marks)

6 Rhododendrons are shrubby plants that are widely distributed throughout the northern hemisphere.
The flowering periods and habitats of two species of rhododendron, found on Yakushima Island in Japan, are shown in the table below.

Species	Flowering period	Main flowering period	Habitat
Rhododendron eriocarpum	April to July	May	Rocky areas in lowland regions
Rhododendron indicum	May to July	June	High mountainous regions

Where these populations overlap, hybrid plants are found that have arisen as a result of cross-fertilisation between these two species. These hybrid plants are capable of flowering and producing viable seeds.

(a) Suggest why some scientists might prefer to classify *Rhododendron eriocarpum* and *Rhododendron indicum* as varieties within the same species rather than as two separate species.
(3)

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(b) (i) Explain what is meant by the term **genetic diversity** in a species.
(2)

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(ii) Explain why there is likely to be a greater genetic diversity in the hybrid plants than in either of the two separate species.

(2)

*(c) Explain how the two different species of Rhododendron on Yakushima Island may have evolved from a single population of an ancestral species.

(6)

(Total for Question 6 = 13 marks)

7 Several species of woodlice can be found in most gardens in Britain. Woodlice have bacteria in their digestive system that secrete enzymes required for the digestion of plant cell walls. Woodlice are decomposers of dead plants.

The photograph below shows one of the common species of woodlouse found in gardens in Britain.

Magnification x10
Amateur Entomologists Society / Kieren Pitts

(a) Suggest how woodlice are involved in the recycling of carbon.

(3)

(b) A student was watching woodlice in her garden. She noticed that woodlice on an area of paving slabs were fairly active and running about. When she lifted some of the stones near the slabs, the woodlice under these stones were relatively inactive at first. However, within a very short time these woodlice started to run about. After a few minutes, almost all of the woodlice that were under the stones had disappeared from view.

(i) The student thought that the behaviour and distribution of the woodlice were being influenced by an abiotic factor in her garden.

Place a cross ☒ in the box next to the term that describes this type of idea.

(1)

☒ **A** Hypothesis

☒ **B** Observation

☒ **C** Prediction

☒ **D** Theory

(ii) Suggest **two** examples of abiotic factors that might influence the behaviour and distribution of the woodlice in her garden.

(2)

1 ....

2 ....

(c) She decided to investigate the behaviour of the woodlice. She collected ten woodlice and released them into the centre of the area of paving slabs. She took photographs immediately after the woodlice were released (time 0) and each minute for ten minutes. This was repeated twice. Using the photographs, she recorded the number of woodlice on the paving slabs at one-minute intervals.

Her results are shown in the table below.

Time after release / minutes	**Number of woodlice on paved area**			
	1st release	**2nd release**	**3rd release**	**Mean**
0	10	10	10	10
1	10	9	9	9
2	9	8	9	9
3	7	7	7	7
4	7	6	5	6
5	6	6	6	6
6	4	5	4	4
7	4	3	4	4
8	3	3	2	
9	0	2	1	
10	1	1	0	

(i) Complete the table by calculating the mean for each of the final three minutes.

(1)

(ii) Suggest why taking photographs is a suitable method to count the woodlice.
(2)

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(iii) Explain why it would be difficult to determine which abiotic factor is influencing the behaviour and distribution of the woodlice in a garden environment.
(3)

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(Total for Question 7 = 12 marks)

8 Antibiotics are used to treat bacterial infections in eukaryotic organisms.

(a) The table below describes some of the structures that are found in cells. Complete the table by writing the name of each of the structures described and stating whether it is found in prokaryotic cells only **(P)**, eukaryotic cells only **(E)** or both types of cell **(B)**.

(3)

Description	Name of structure	P, E or B
Enclosed by outer smooth membrane; inner membrane folded forming cristae		
Long strand-like structure extending out from the cell; used for locomotion		
Small, circular loop of double-stranded DNA		

(b) Vancomycin is an antibiotic that kills bacterial cells by preventing the synthesis of peptidoglycan, a component of bacterial cell walls.

(i) State the term used to describe antibiotics, such as vancomycin, that kill bacterial cells.

(1)

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(ii) Suggest how bacterial cells are killed by vancomycin.

(2)

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(iii) Explain why doctors have been advised to limit the prescription of antibiotics.
(2)

(c) Describe how you could investigate the effect of different antibiotics on bacteria.
(4)

(Total for Question 8 = 12 marks)

TOTAL FOR PAPER = 90 MARKS

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