Write your name here

Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Tuesday 11 June 2013 – 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.*

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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P 3 9 8 8 6 A 0 1 2 0

PEARSON

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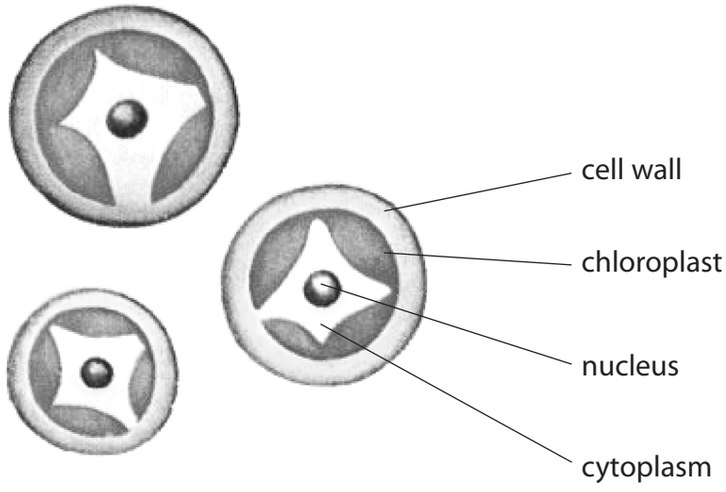
Answer ALL questions.

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 *Pleurococcus* is a unicellular organism that can be found on the bark of trees. Where *Pleurococcus* is growing, it appears as green patches on the bark. Each of the patches is a colony of genetically-identical cells of *Pleurococcus,* formed from a single original cell.

The diagram below shows some of the individual cells of *Pleurococcus* as they might appear using a light microscope.



(a) Place a cross ☒ in the box next to the names of the two structures that show that *Pleurococcus* would be classified as a eukaryotic organism.

(1)

☒ **A** cell wall and chloroplast

☒ **B** cell wall and cytoplasm

☒ **C** chloroplast and nucleus

☒ **D** cytoplasm and nucleus

(b) Explain how a colony of genetically-identical *Pleurococcus* cells could develop from a single original cell.

(2)

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(c) The distribution of *Pleurococcus* on 20 trees was investigated. The percentage cover of *Pleurococcus* was measured using a quadrat measuring 10 cm × 10 cm, divided into 100 small squares.

This quadrat was placed at eight points around the trunk of each tree. Each point on the tree faced a different direction. At each point, light intensity and moisture content were measured at mid-day.

The mean results are shown in the table below.

Point	Direction	Mean percentage cover (%)	Mean light intensity / arbitrary units	Mean moisture content / arbitrary units
1	North	89	6.6	8.8
2	North-east	86	6.4	8.6
3	East	84	6.9	8.7
4	South-east	67	7.3	7.5
5	South	46	8.7	5.2
6	South-west	51	8.4	5.1
7	West	60	8.1	7.0
8	North-west	78	7.6	8.2

(i) Suggest how this 10 cm × 10 cm quadrat was used to obtain the percentage cover of *Pleurococcus* at each point.

(2)

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(ii) Place a cross ☒ in the box next to the best conclusion that can be drawn from these results, about the distribution of *Pleurococcus*.

(1)

☒ **A** it is affected by both light intensity and moisture content

☒ **B** it is affected by light intensity more than moisture content

☒ **C** it is affected by moisture content more than light intensity

☒ **D** it is not affected by either light intensity or moisture content

(iii) Suggest how more evidence for the relationship between light intensity and the distribution of *Pleurococcus* could be obtained.

(3)

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(iv) Name **one** biotic factor and suggest how this factor might affect the distribution of *Pleurococcus* on the trees.

(2)

Biotic factor .....

Effect .....

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(Total for Question 1 = 11 marks)

2 The photograph below shows part of a leaf, as seen using a hand lens.

Magnification $\times 20$

(a) Suggest why each of the following is important for the production of carbohydrates in the photosynthetic cells.

(i) The thin lamina

(2)

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(ii) Vessels in the midrib

(2)

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(b) The photosynthetic cells contain many chloroplasts.

(i) Complete the table below by naming the part of the chloroplast where each of the reactions, **R**, **S** and **T**, takes place.

(3)

Reaction	Details	Part of the chloroplast
R	ADP + inorganic phosphate → ATP	
S	RuBP + CO_2 → 2 × GP	
T	2 × GP → 2 × GALP	

(ii) Place a cross ☒ in the box next to the name of reaction **R**.

(1)

☒ **A** carbon fixation

☒ **B** hydrolysis

☒ **C** phosphorylation

☒ **D** photolysis

(iii) Place a cross ☒ in the box next to the name of the enzyme involved in reaction **S**.

(1)

☒ **A** endonuclease

☒ **B** phosphorylase

☒ **C** RUBISCO

☒ **D** transcriptase

(iv) Suggest how GALP, formed by reaction **T**, can be used to synthesise the cellulose in plant cell walls.

(4)

(Total for Question 2 = 13 marks)

3 The carbon cycle describes the movement of carbon within an ecosystem.

In this cycle, carbon neutral processes do not change the concentration of carbon dioxide in the atmosphere.

The table below shows the main sources and combustion products of some fuels.

Fuel	Main sources	Main combustion products
Biodiesel	Oils from crops such as soya beans, rape seeds, palm seeds	Carbon dioxide and water vapour
Ethanol	Fermented sugars from crops such as sugar cane, sugar beet	Carbon dioxide and water vapour
Hydrogen	Catalysis of methane from fossil deposits or biogas generation using waste biomass	Water vapour
Methane	Extracted from fossil deposits or biogas generation using waste biomass	Carbon dioxide and water vapour
Propane	Refining of crude oil from fossil deposits	Carbon dioxide and water vapour

(a) Place a cross ☒ in the box next to the names of the four fuels, shown in the table, that could be considered to be biofuels.

(1)

☒ **A** biodiesel, ethanol, hydrogen, methane

☒ **B** biodiesel, ethanol, hydrogen, propane

☒ **C** biodiesel, ethanol, methane, propane

☒ **D** biodiesel, hydrogen, methane, propane

*(b) Large areas of land may need to be cleared in order to produce biofuels. This might involve deforestation.

Discuss why the production of biofuels may not be carbon neutral.

(5)

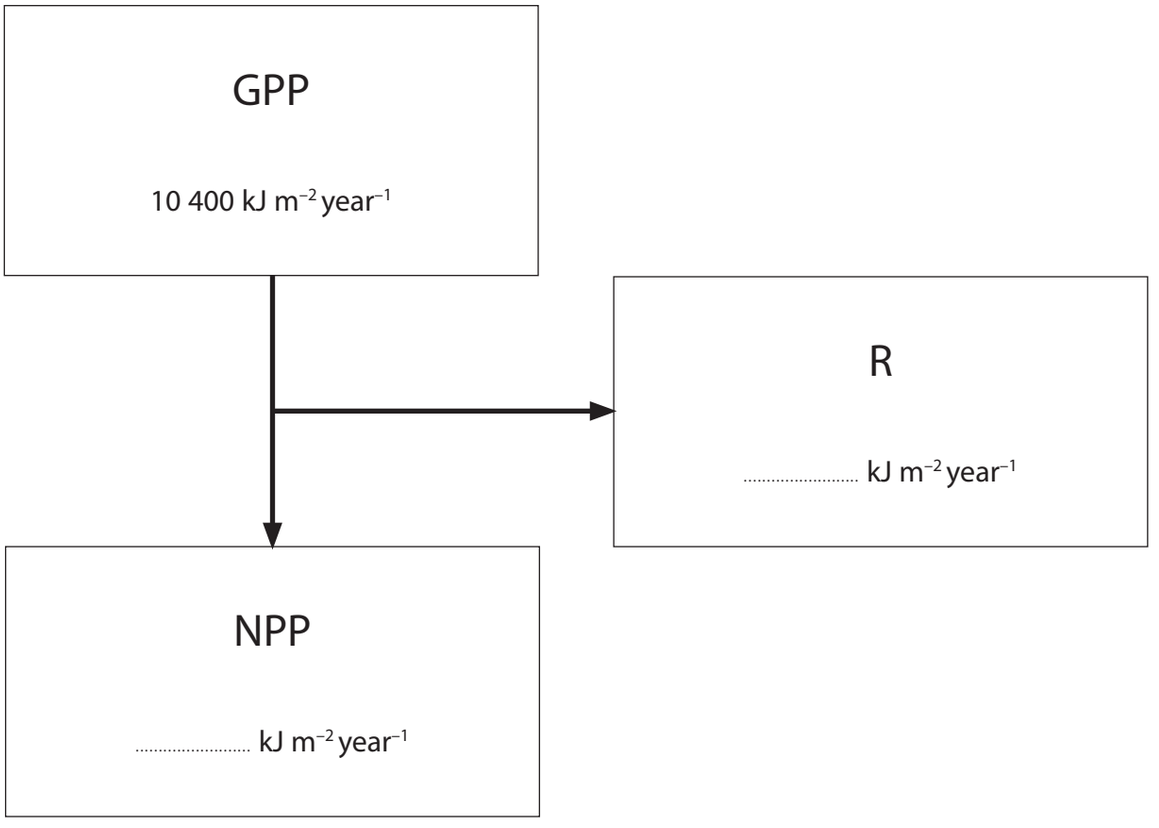
(c) Explain how the combustion products, from the burning of fuels, may lead to global warming.

(4)

(Total for Question 3 = 10 marks)

4 Farmers find it helpful to know the productivity of their land.

The diagram below shows the relationship between GPP (gross primary productivity), NPP (net primary productivity) and R (plant respiration) for an area of grassland.



(a) The efficiency of the transfer of energy from GPP to NPP for this grassland is 45%.

(i) Calculate the values for NPP and R. Write your answers in the diagram above.

(2)

(ii) Using the information given, explain the relationship between GPP and NPP.

(3)

(b) Suggest why NPP values would be of use to a farmer who wanted to use this land for cattle.

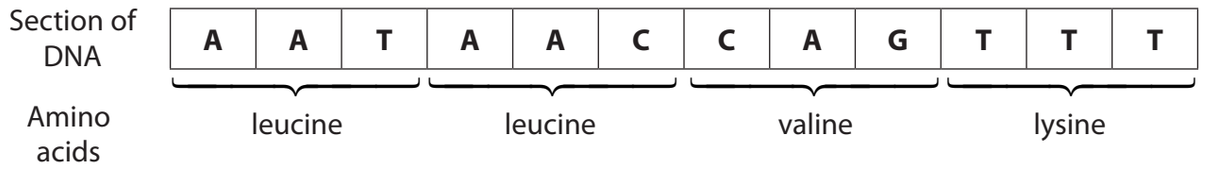
(3)

(c) The units (kJ m^{-2} $year^{-1}$) used in the diagram show a rate of energy production. Suggest why this is more useful than measurements of biomass in the grassland on a particular day.

(2)

(Total for Question 4 = 10 marks)

5 The diagram below shows the base sequence on a short section of DNA consisting of 12 mononucleotides. This base sequence contains the genetic code for a short section in the primary structure of a polypeptide.



(a) Name each of the bases represented by the letters, **A**, **C**, **G** and **T** in the diagram.

(1)

A .....

C .....

G .....

T .....

(b) Using the sequence shown in the diagram, explain the meaning of each of the following terms.

(i) Triplet code

(2)

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(ii) Non-overlapping

(2)

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(iii) Degenerate

(2)

(c) Place a cross ☒ in the box next to the names of the two components, other than the bases, that form part of each mononucleotide in this sequence.

(1)

☒ **A** deoxyribose and nitrate

☒ **B** deoxyribose and phosphate

☒ **C** ribose and nitrate

☒ **D** ribose and phosphate

*(d) Transcription of this section of DNA forms a complementary strand of mRNA.

Describe how translation of this mRNA synthesises part of a polypeptide molecule.

(5)

(Total for Question 5 = 13 marks)

6 Human diseases can be caused by many different types of organism, such as bacteria and viruses.

(a) Give **two** differences between the genetic material of bacteria and viruses.

(2)

(b) Tuberculosis (TB) is caused when droplets, containing the bacterium *Mycobacterium tuberculosis,* are inhaled into the lungs.

In the lungs, large numbers of the bacterium are formed rapidly. These can be ingested by macrophages. Eventually, tubercles (tissue masses), containing dormant bacteria inside macrophages, may form.

(i) Describe how macrophages ingest the bacteria.

(2)

(ii) Suggest why treatment with antibiotics may not be effective against the dormant bacteria in the tubercles.

(2)

(iii) TB can be prevented by vaccination. Explain how a person can develop artificial active immunity following vaccination.

(3)

(c) In a person with TB, the dormant bacteria in tubercles may be activated after several years. The bacteria multiply rapidly, resulting in severe lung damage.

The bacteria are released from the tubercles. These bacteria can inhibit the activity of T cells and infect other organs.

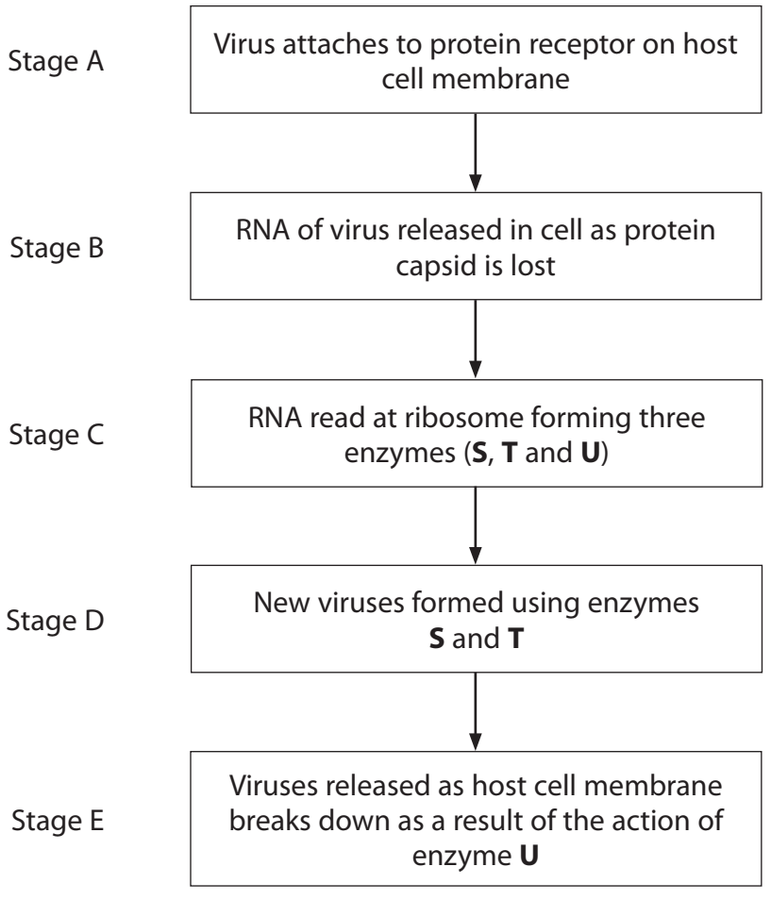
Explain why the activity of these bacteria and the inhibition of T cells means that a person may quickly develop severe symptoms leading to death.

(4)

(Total for Question 6 = 13 marks)

7 The common cold is a disease caused by a variety of viruses.

The flow diagram below describes how common cold viruses attack the cells on the inside of the nose.



(a) Common cold viruses infect only the cells inside the nose.

(i) Suggest why common cold viruses cannot infect cells if they land on unbroken skin.

(2)

(ii) Suggest why common cold viruses cannot infect cells if they enter the blood through a cut in the skin.

(2)

(b) Compare the action of the RNA in the common cold virus with that found in HIV.

(2)

(c) At Stage C, three enzymes are formed.

(i) Suggest why two of these enzymes, **S** and **T**, are needed at Stage D.

(2)

(ii) Suggest how enzyme **U** might catalyse the breakdown of the host cell membrane at Stage E.

(3)

(Total for Question 7 = 11 marks)

8 The group of birds, known as warblers, contains many species which are very similar in external appearance.

Two of these species, the chiffchaff, *Phylloscopus collybita*, and the willow warbler, *Phylloscopus trochilus*, are so similar that many experts can identify them only by listening to their individually-characteristic songs.
These songs are used during breeding to mark territory and attract mates.

The photographs below show these two warblers.

Chiffchaff

Willow warbler

Magnification × 0.75

(a) Although chiffchaffs and willow warblers are often found at the same time in the same woodlands, they do not interbreed.

(i) Suggest why successful interbreeding between chiffchaffs and willow warblers would make some scientists doubt their classification as separate species.

(3)

(ii) Suggest reasons why the two species do not interbreed.

(3)

(b) Records show that very little change in the appearance of chiffchaffs and willow warblers has occurred during the last two hundred years.

Suggest why the rate of change in the appearance of these two species is relatively slow.

(3)

(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 90 MARKS