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Write your name here

Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Wednesday 25 January 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.

Turn over ▶

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P 3 9 5 0 5 R A 0 1 2 4

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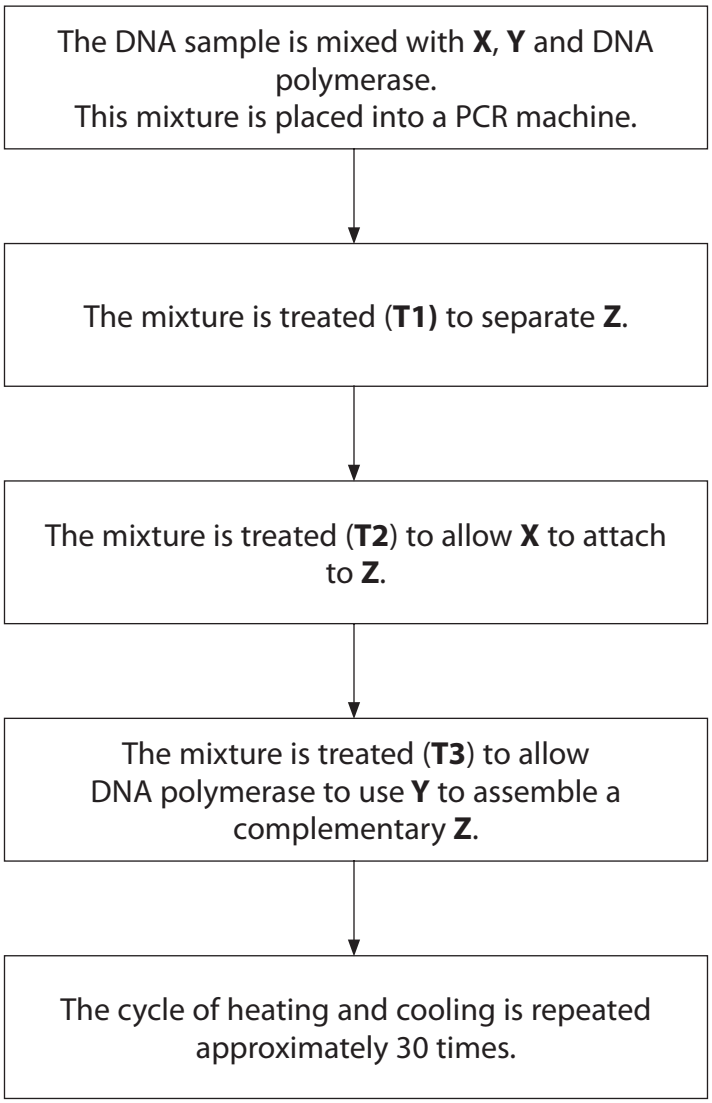
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Answer ALL questions.

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 During DNA profiling, the polymerase chain reaction (PCR) can be used to amplify a sample of DNA.

The diagram below shows how substances **X**, **Y** and **Z** are involved in the PCR.
It also gives the temperature treatments **T1**, **T2** and **T3** at various stages.



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(a) Name substances **X**, **Y** and **Z**.

(3)

Substance **X** .....

Substance **Y** .....

Substance **Z** .....

(b) Place a cross ☒ in the box next to the correct statements for treatments **T1**, **T2** and **T3**.

(3)

(i) Treatment **T1**

☒ **A** heated to 90–95 °C

☒ **B** heated to 75 °C

☒ **C** cooled to 55–60 °C

☒ **D** cooled to 4 °C

(ii) Treatment **T2**

☒ **A** heated to 90–95 °C

☒ **B** heated to 75 °C

☒ **C** cooled to 55–60 °C

☒ **D** cooled to 4 °C

(iii) Treatment **T3**

☒ **A** heated to 90–95 °C

☒ **B** heated to 75 °C

☒ **C** cooled to 55–60 °C

☒ **D** cooled to 4 °C

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(c) Suggest reasons for each of the following.

(i) DNA polymerase from human sources is not suitable for use in a PCR machine.

(2)

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(ii) Species of plants cannot be identified from woody (xylem) material using PCR and DNA profiling.

(2)

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(Total for Question 1 = 10 marks)

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2 The diagram below summarises the interconversion of ATP and ADP.



(a) Place a cross ☒ in the box that identifies each of the following.

(3)

(i) Substance **W**

☒ **A** carbon dioxide

☒ **B** an electron

☒ **C** inorganic phosphate

☒ **D** a proton

(ii) Reaction **S**

☒ **A** carboxylation

☒ **B** hydrolysis

☒ **C** phosphorylation

☒ **D** photolysis

(iii) Reaction **T**

☒ **A** carboxylation

☒ **B** hydrolysis

☒ **C** phosphorylation

☒ **D** photolysis

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(b) Reaction **T** occurs in a chloroplast.
Describe the structures in a chloroplast that are involved in this reaction.

(3)

(c) The energy released by reaction **S** is used to form GALP (glyceraldehyde 3-phosphate) during the Calvin cycle.
Plant cell walls contain cellulose molecules.

Suggest how GALP may be used to synthesise cellulose.

(5)

(Total for Question 2 = 11 marks)

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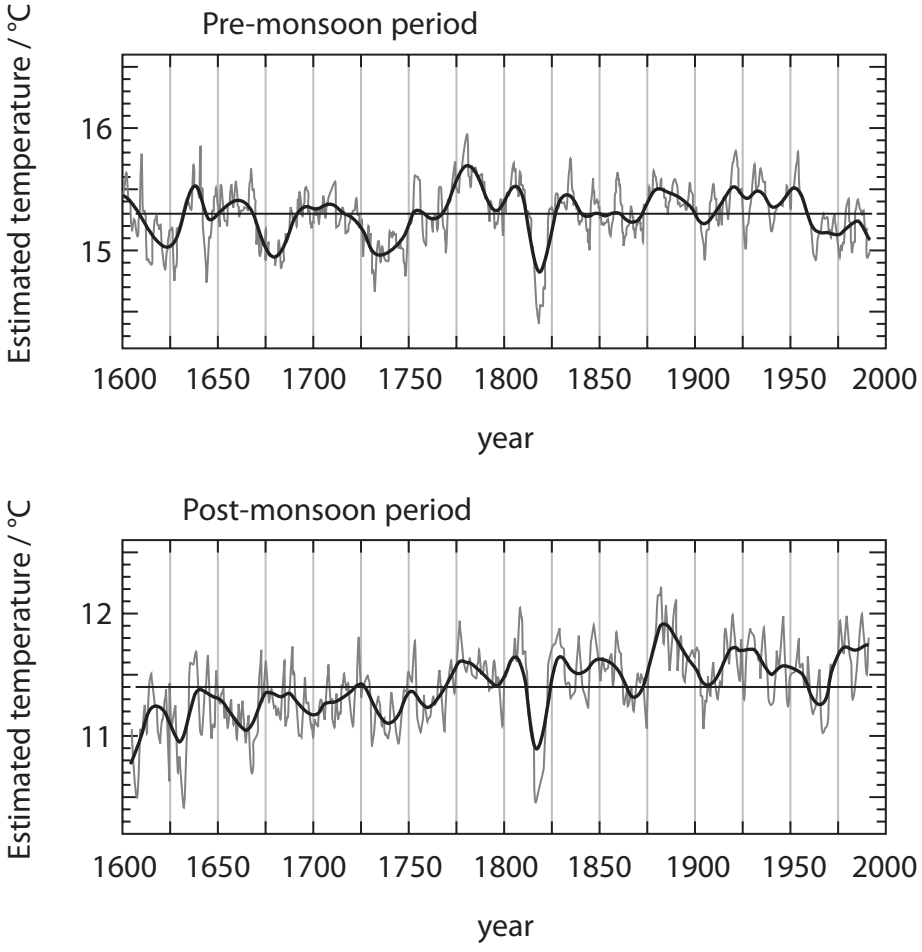
3 If a tree trunk is cut across horizontally, growth rings can be seen in the cut surface. The most significant factor that affects the formation of growth rings is environmental temperature. In regions where there is an annual cycle of seasonal temperature changes, it is possible to estimate the year in which a particular ring was formed.

In Nepal, there is an annual seasonal cycle of three distinct periods that is shown in the table below.

Period	Months	Description
Pre-monsoon	February to June	Relatively warm temperature, greater than 15 °C
Monsoon	July to September	Heavy rainfall
Post-monsoon	October to January	Relatively cool, usually less than 12 °C

Data from growth ring studies and other sources have been used to estimate the changes in environmental temperature in Nepal during the past 400 years.

The estimated temperatures for the pre-monsoon and post-monsoon periods are shown in the graphs below.



P 3 9 5 0 5 R A 0 8 2 4

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(a) Place a cross ☒ in the box next to the term used to describe the scientific study of tree growth rings.

(1)

☒ **A** climatology

☒ **B** dendrochronology

☒ **C** ecology

☒ **D** ethnobiology

(b) Compare the changes in mean environmental temperature between the pre-monsoon and the post-monsoon periods from 1600 to 2000.

(3)

(c) (i) Suggest how scientists could use these data to predict future climate change.

(3)

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(ii) Suggest why some scientists may not be convinced that these data can be used to predict future climate change.

(3)

(d) Suggest **one** source of evidence, apart from growth ring studies, that could be used to estimate changes in mean environmental temperature in Nepal during the past 400 years.

(1)

(Total for Question 3 = 11 marks)

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4 Nuthatches are small, colourful birds belonging to the genus, *Sitta*.
Many varieties of the species *Sitta europaea* (European nuthatch) can be found throughout mainland Europe.
These varieties form overlapping populations in different regions. These birds eat small invertebrates, living in tree bark, throughout the year.



European nuthatch. Magnification x0.5
Leslie J Borg/Science Photo Library

However, in the colder mountain forests on the island of Corsica, a small population of approximately 2500 pairs of nuthatches can be found. These birds are classified as the species *Sitta whiteheadi* (Corsican nuthatch). For most of the year, they feed on pine seeds. During the summer breeding season they also feed on small invertebrates.

Members of the two species, *S. europaea* and *S. whiteheadi*, are so similar in appearance and behaviour that they can usually only be distinguished by expert observation and research.

(a) Place a cross ☒ in the box next to the best definition of a species.

(1)

- ☒ **A** individuals can interbreed to produce fertile offspring
- ☒ **B** individuals can interbreed to produce hybrid offspring
- ☒ **C** individuals can interbreed to produce sterile offspring
- ☒ **D** individuals can interbreed to produce viable offspring

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*(b) In mountainous regions of mainland Europe, only *S. europaea* is found. Suggest how a distinct species of nuthatch, *S. whiteheadi*, has evolved in the mountainous regions of the island of Corsica.

(5)

(c) (i) Suggest how environmental changes, such as those caused by global warming, are more likely to cause extinction of *S. whiteheadi* than *S.europaea*.

(3)

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(ii) Suggest why *S. whiteheadi* might be able to survive an environmental change such as global warming.

(2)

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(d) Explain how the work of zoos could be important to the survival of *S. whiteheadi*.

(2)

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(Total for Question 4 = 13 marks)

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5 (a) The table below gives some of the features of bacteria and viruses.

Place **one** tick (✓) in each row to indicate whether the feature is found in bacteria only, viruses only or both bacteria and viruses.

(3)

Feature	Found in		
	Bacteria only	**Viruses only**	**Both bacteria and viruses**
Nucleic acid			
Cytoplasm			
Protein capsid			

(b) In human populations, the bacterium, *Helicobacter pylori*, is associated with the development of severe chronic atrophic gastritis (SCAG) in the stomach. SCAG is the first step that can lead to the most common form of stomach cancer.

The table below shows the reported new cases of stomach cancer in 2006 in the UK.

The mean rate of stomach acid secretion for each age group is also shown.

Age group / years	**Mean acid secretion / mg hour^{-1}**	**New cases of stomach cancer**
11–15	170	0
16–20	160	0
21–25	150	0
26–30	120	0
31–35	100	4
36–40	90	10
41–45	60	55
46–50	60	95
51–55	60	183
56–60	50	263
61–65	40	424
66–70	40	633

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(i) Suggest why patients with SCAG may be given antibiotics as part of their treatment.

(2)

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*(ii) Using the information about SCAG and the data, describe and suggest explanations for the trends shown in the table.

(5)

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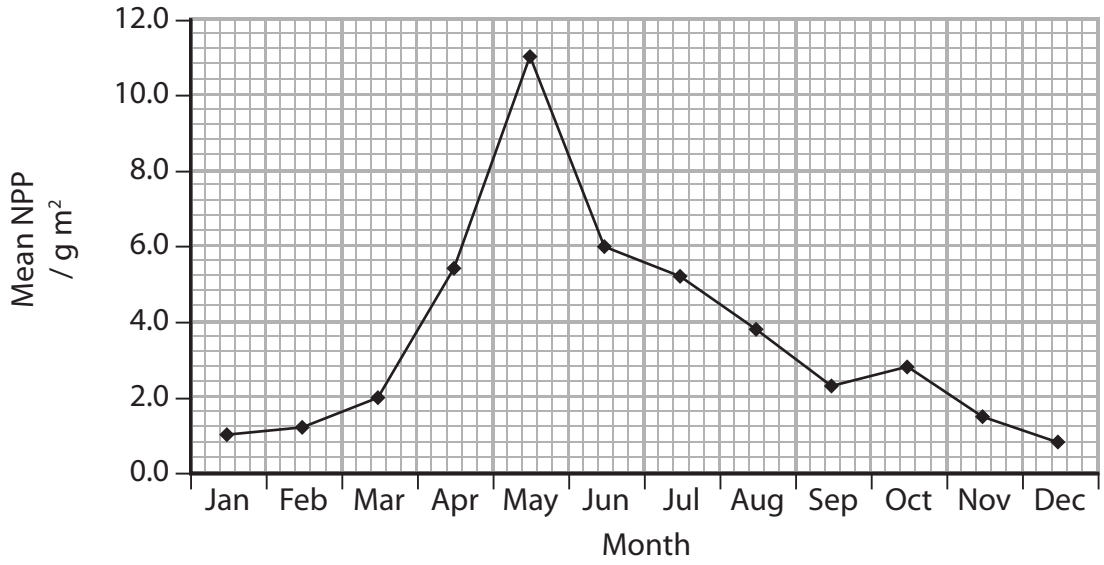
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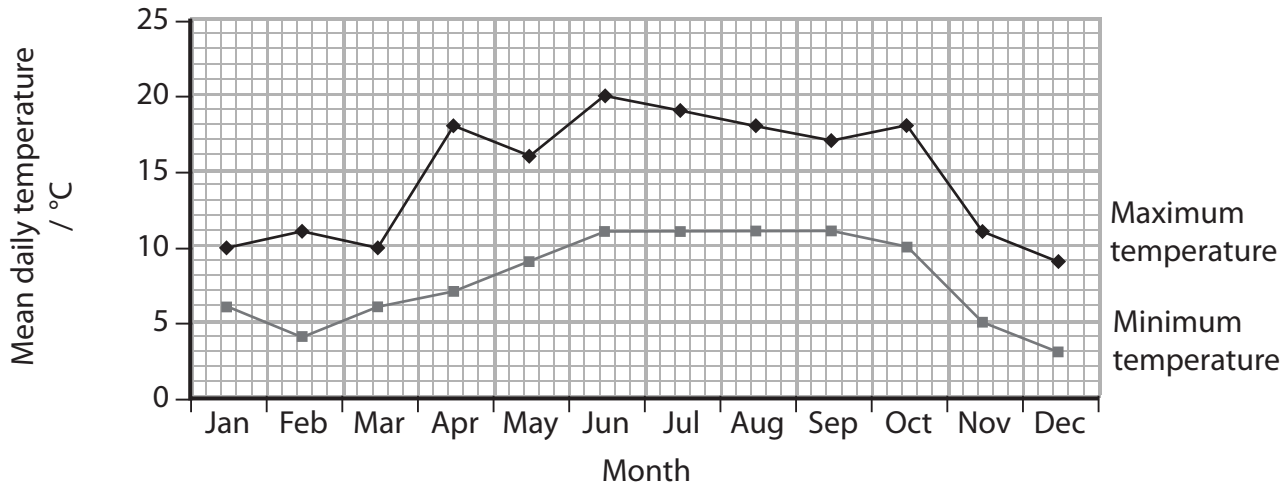
(Total for Question 5 = 10 marks)

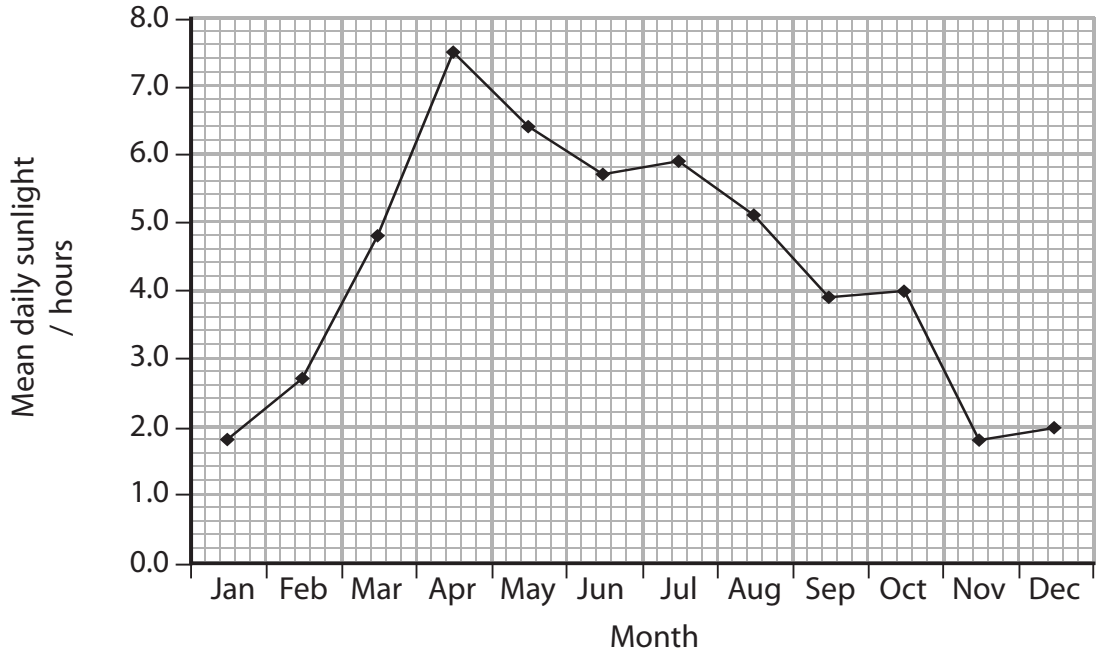
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6 The graphs below show data collected at a weather station in North Wales during 2007.

The monthly means of net primary productivity (NPP), daily maximum and minimum temperatures and sunlight hours are shown for grassland at this weather station.







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(a) (i) Explain what is meant by the term **net primary productivity**.

(2)

(ii) Calculate the overall percentage increase in the mean NPP from January to May.

(3)

Answer ..... %

(b) Suggest why an increase in temperature may cause an increase in NPP.

(2)

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(c) Using information from the graphs, describe and explain the relative effects of temperature and hours of sunlight on NPP in this grassland.

(4)

(d) Temperature and hours of sunlight are abiotic factors.
Suggest **two** biotic factors that may influence NPP in this grassland.

(2)

(Total for Question 6 = 13 marks)

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7 Infection with human immunodeficiency virus (HIV) can lead to the condition known as AIDS. In this condition, part of the immune system is destroyed.

(a) The genetic material in HIV consists of two strands of RNA.

Place a cross ☒ in the box next to the term used to describe each of the sub-units in a molecule of RNA.

(1)

☒ **A** amino acid

☒ **B** inorganic phosphate

☒ **C** nucleotide

☒ **D** saccharide

(b) (i) Name **two** types of cell that HIV enters in the immune system.

(2)

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(ii) Explain how HIV is able to enter these cells.

(3)

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(iii) Describe the sequence of events following infection of these cells by HIV, that may lead to the death of the patient.

(6)

(Total for Question 7 = 12 marks)

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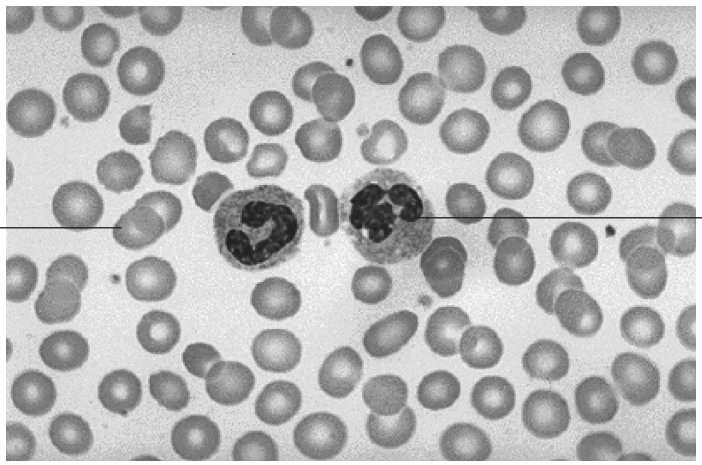
8 (a) The table below describes some features of the lymphocytes that are involved in the immune system.

Place a tick (✓) in the appropriate column to indicate whether the description is true or false.

(4)

Description	True	False
B and T cells are formed in the bone marrow		
B cells stimulate T cells to produce clones of memory cells		
T helper cells produce chemicals that destroy pathogens		
B and T cells are able to form clones by mitosis		

(b) A sample of blood was taken from a person with a bacterial infection.
The photograph below shows some of the cells in this blood sample.



Suggest **two** reasons why the bacteria that caused the infection are not visible in the photograph.

(2)

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(c) Suggest how a further sample of blood, taken a few days later, might differ from the one shown in the photograph, in each of the following circumstances. Give a reason for each answer.

(i) If the person is treated with antibiotic drugs.

(2)

(ii) If the person is given a placebo.

(2)

(Total for Question 8 = 10 marks)

TOTAL FOR PAPER = 90 MARKS

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