Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Time 2 hours

Paper reference **9BN0/01**

Biology A (Salters Nuffield)

Advanced

PAPER 1: The Natural Environment and Species Survival

You must have:
Calculator, HB pencil, ruler

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.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- You may use a scientific calculator.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- Good luck with your examination.

Turn over ▶

P65458A

©2021 Pearson Education Ltd.

1/1/1/1/1/1/

P 6 5 4 5 8 A 0 1 3 2

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 Climate change has been linked to the release of carbon dioxide from some power stations.

(a) The main reason that carbon dioxide acts as a greenhouse gas is because it

(1)

☒ **A** absorbs infrared radiation reflected by the surface of the Earth

☒ **B** absorbs ultraviolet radiation reflected by the surface of the Earth

☒ **C** reflects infrared radiation absorbed by the surface of the Earth

☒ **D** reflects ultraviolet radiation absorbed by the Earth's atmosphere

(b) Name the plant organelle that fixes carbon dioxide from the atmosphere.

(1)

.....

(c) Net primary productivity (NPP) is a measure of the increase in biomass of a plant.

Explain why respiration affects the production of biomass.

(2)

.....

.....

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(d) Some power stations burn wood chips instead of fossil fuels to produce electricity.

The photograph shows wood chips at a power station.



© Mr. Amarin Jitnathum/Shutterstock

It is thought that burning wood chips is more beneficial to the environment because in the long term it does not add carbon dioxide to the atmosphere.

Explain why burning wood chips does not increase carbon dioxide to the atmosphere in the long term.

(4)

(Total for Question 1 = 8 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

2 Skulls can be used as evidence for human evolution.

The only type of human present today is the modern human. In the past, another type of human, called Neanderthal, occupied the same geographical area.

The photograph shows the skulls of both types of human.



Modern human skull Neanderthal skull

© hairymuseummatt/DrMikeBaxter

Genetic studies now show that these two types of human have interbred.

(a) Only small quantities of DNA can be extracted from the remains of Neanderthal humans.

The quantity of extracted DNA is amplified using

(1)

☒ **A** DNA profiling

☒ **B** polymerase chain reaction

☒ **C** RNA profiling

☒ **D** translation chain reaction

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) Devise a procedure, using electrophoresis, to compare the amplified DNA from these two types of human.

(4)

(c) Explain how the results of electrophoresis could provide evidence for interbreeding between the two types of human.

(2)

(Total for Question 2 = 7 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

3 During the civil war in Mozambique, from 1977 to 1992, 90% of the African elephants were killed for the ivory in their tusks.

Since 1992, the elephant population in Mozambique has increased.

The photograph shows a group of elephants in Mozambique.



© ALEXANDER JOE/Staff/Getty Images

A study of an elephant population in Mozambique was carried out in 2017.

The elephants studied were all born before 1992.

The table shows the number of elephants with and without tusks.

Elephants	Number of elephants
with tusks	98
without tusks	102

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(a) The presence of tusks is controlled by a single gene. The allele for tusks is known to be dominant.

The frequency of alleles in a population can be determined using the Hardy-Weinberg equation.

Calculate the frequency of the dominant and recessive alleles in this population. Give your answer to 2 decimal places.

(3)

Frequency of the dominant allele .....

Frequency of the recessive allele .....

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) In most African elephant populations, 2% to 4% of elephants do not grow tusks.

(i) Explain why the percentage of elephants without tusks in Mozambique will probably increase in the future.

(3)

(ii) Describe how the Hardy-Weinberg equation can be used to provide evidence for changes in the elephant population in Mozambique.

(2)

(Total for Question 3 = 8 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

4 Fertilisation in humans involves the fusion of a sperm cell with an egg cell.

(a) (i) After the sperm cell nucleus fuses with the egg cell nucleus, the single fertilised cell is described as a

(1)

☒ **A** diploid gamete

☒ **B** diploid zygote

☒ **C** haploid gamete

☒ **D** haploid zygote

(ii) The fertilised cell then divides by

(1)

☒ **A** meiosis to produce genetically different cells

☒ **B** meiosis to produce genetically identical cells

☒ **C** mitosis to produce genetically different cells

☒ **D** mitosis to produce genetically identical cells

(b) Cell division of the fertilised cell produces a ball of totipotent cells.

(i) Give the meaning of the term totipotent cell.

(2)

.....

.....

.....

.....

.....

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(ii) This ball of cells continues to divide to form the embryo. The cells of the embryo become specialised to form tissues and organs.

Describe how cells become specialised.

(3)

(c) Factors such as the diet of the mother during pregnancy can cause epigenetic changes in the embryo.

Explain how epigenetic changes affect the development of tissues in the embryo.

(3)

(Total for Question 4 = 10 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

5 Wildlife conservation can involve keeping animals in zoos as well as protecting habitats.

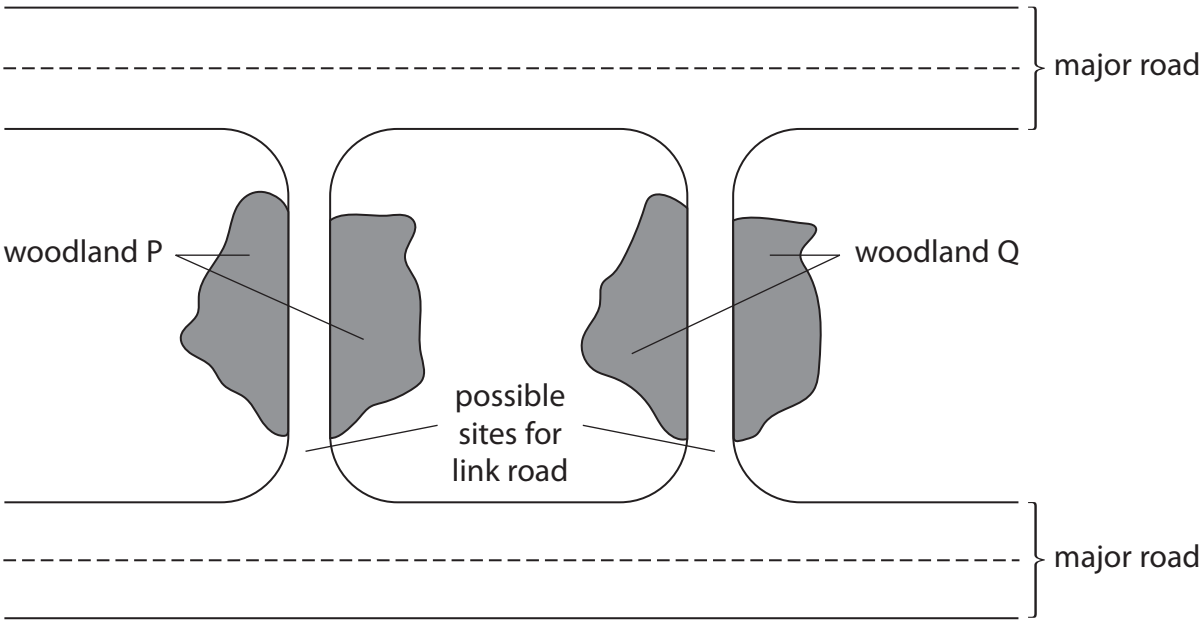
(a) Describe the roles that zoos play in animal conservation.

(3)

(b) Habitats can be destroyed by road building.

A link road is planned to connect two major roads.

The diagram shows the two possible sites for the link road and two woodland habitats.



DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(i) State what is meant by the term habitat.

(1)

(ii) To decide which of the two link roads should be built, studies of the biodiversity of woodlands P and Q need to be carried out.

Discuss what information needs to be collected from the two woodlands to make a decision about the site of the link road.

(4)

(Total for Question 5 = 8 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

6 Hereditary spherocytosis is a condition that affects red blood cells.

This inherited condition is caused by a gene mutation that affects the shape of the cell surface membrane.

(a) Describe the structure of the cell surface membrane.

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) The red blood cells of individuals with spherocytosis are spherical instead of having a biconcave disc shape.

Explain the effect of spherocytosis on the uptake of oxygen by red blood cells.

(3)

(c) Most cases of hereditary spherocytosis are caused by a dominant allele.

Use a genetic diagram to determine the probability of a child inheriting this condition if one parent is heterozygous and the other parent does not have the condition.

(2)

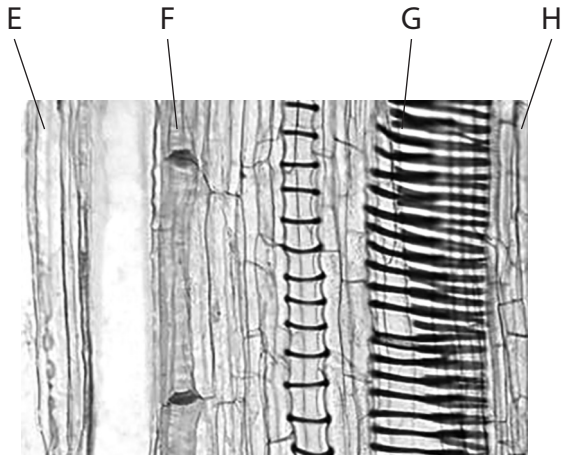
Answer .....

(Total for Question 6 = 8 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

7 The stems of plants contain tissues involved in transport and in support.

(a) The photograph shows a longitudinal section through one plant stem.



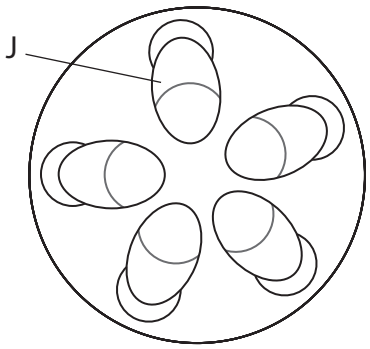
Cell image library - image ID 38928

(i) Which labelled structure in the photograph contains lignin?

(1)

- ☒ **A** E
- ☒ **B** F
- ☒ **C** G
- ☒ **D** H

(ii) The diagram shows a transverse section through a plant stem.



Which of the labelled structures in the photograph is located in the area labelled J in the diagram?

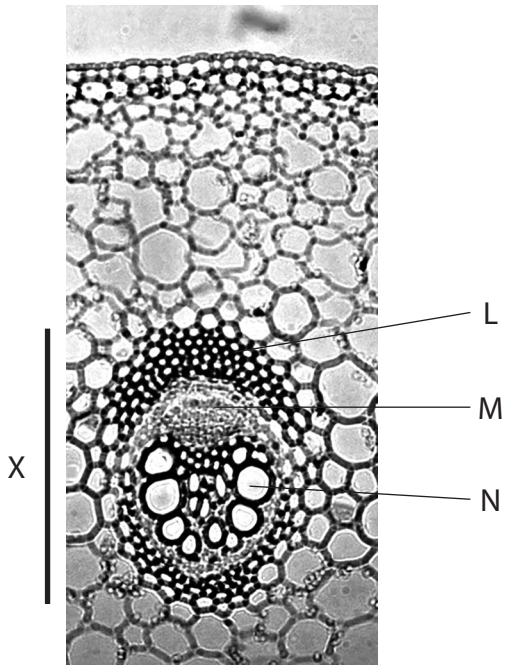
(1)

- ☒ **A** E
- ☒ **B** F
- ☒ **C** G
- ☒ **D** H

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) The photograph shows a cross section of part of the stem of a plant.

Fibres can be extracted from stems similar to this one and used instead of fibres produced from oil-based plastics.



John Bebbington FRPS Science and Plants for schools – https://www.saps.org.uk

(i) The part of the stem labelled L contains

(1)

☒ **A** phloem that transports organic solutes

☒ **B** sclerenchyma fibres that provide support

☒ **C** sieve tubes that transport water

☒ **D** xylem vessels that transport water and mineral ions

(ii) The part of the stem labelled M contains

(1)

☒ **A** phloem that transports organic solutes

☒ **B** sclerenchyma fibres that transport water

☒ **C** sieve tubes that synthesise organic solutes

☒ **D** xylem vessels that transport water and mineral ions

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(iii) The structure labelled N is a

(1)

- ☒ **A** part of the phloem that transports water
- ☒ **B** sclerenchyma fibre that provides support
- ☒ **C** sieve tube that transports organic solutes
- ☒ **D** xylem vessel that transports water and mineral ions

(iv) The line labelled X on the photograph represents the width of the vascular bundle.

The actual width of the vascular bundle is 320 µm.

Calculate the magnification of the image.

(3)

Answer .....

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(c) Fibres can be extracted from the stems of nettle plants and used to make clothing.

Explain why the production of fibres from nettles is more sustainable than fibres produced from crude oil.

(3)

(Total for Question 7 = 11 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

8 Penicillin is an antibiotic. It was discovered in 1928. Since then many antibiotics have been identified and are widely used in the treatment of bacterial infections.

(a) State what is meant by the term bacteriostatic antibiotic.

(1)

(b) Scientists have recently discovered a new class of antibiotics that bind to ribosomes.

(i) Explain why these antibiotics could affect the production of proteins in bacteria.

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(ii) These new antibiotics attach to a site on the ribosome not affected by any known antibiotics.

Deduce why these new antibiotics might be used to treat bacteria that are resistant to other antibiotics.

(2)

*(iii) Scientists have isolated these new antibiotics and tested their effectiveness against bacteria that are resistant to other types of antibiotic.

Devise a laboratory procedure to compare the effectiveness of penicillin with one of the new antibiotics.

(6)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 8 = 12 marks)

DO NOT WRITE IN THIS AREA

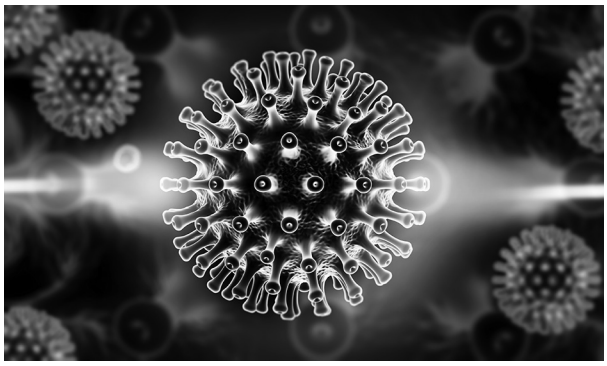
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

BLANK PAGE

9 The human immunodeficiency virus (HIV), shown in the image, causes acquired immunodeficiency syndrome (AIDS).



© Liya Graphics/Shutterstock

(a) HIV particles contain

(1)

- ☒ **A** DNA and DNA polymerase
- ☒ **B** DNA and reverse transcriptase
- ☒ **C** RNA and DNA polymerase
- ☒ **D** RNA and reverse transcriptase

(b) HIV enters and destroys T helper cells. This can cause AIDS.

(i) Describe how HIV particles are able to enter T helper cells.

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(ii) Explain why the destruction of T helper cells causes the symptoms of AIDS.

(4)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(c) A small number of people have been identified who are resistant to HIV.

They have a mutation in a gene coding for a protein in the cell membrane.

(i) Deduce why this mutation makes these people resistant to HIV infection.

(2)

(ii) Stem cell therapy can be used to treat patients infected with HIV.

The bone marrow of these patients can be destroyed using radiotherapy.

The patients can then be given stem cells from the bone marrow of a donor who has this mutation.

Explain why these stem cells may prevent HIV causing AIDS.

(4)

(Total for Question 9 = 14 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

BLANK PAGE

10 Anthropogenic climate change is linked to an increase in carbon dioxide in the atmosphere.

(a) The World Meteorological Association recorded carbon dioxide levels of 405 ppm in 2017.

This is an increase of 46% since 1817.

Calculate the level of carbon dioxide in 1817.

(2)

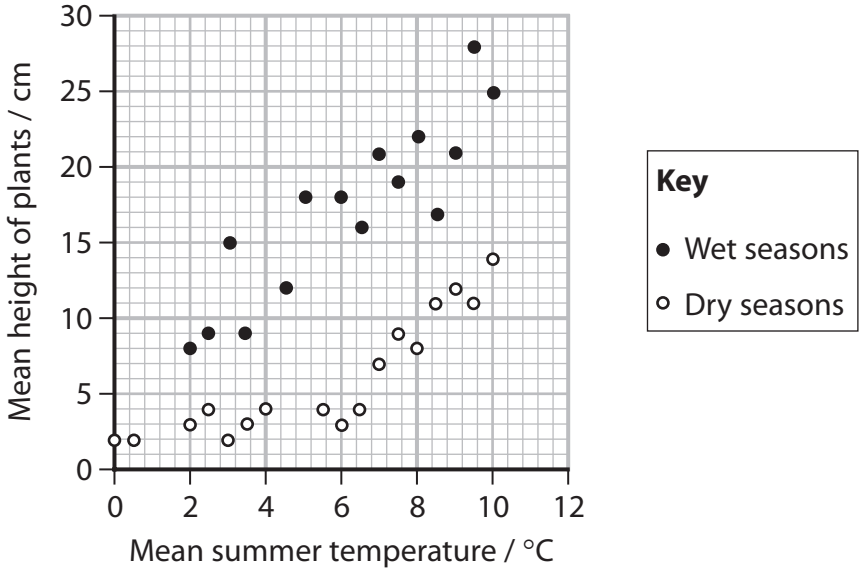
..... ppm

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) A study has investigated the effect of temperature changes on plants growing in the Arctic. This is an area with cold and short growing seasons.

Warming in the Arctic is leading to a change in the community of plants. The mean height of plants in the area was studied in both dry and wet growing seasons over a 30-year period. The summer temperatures over this period were recorded.

The results are shown in the graph.



Explain the effect of these environmental factors on the mean height of the plants.

(2)

.....

.....

.....

.....

.....

.....

.....

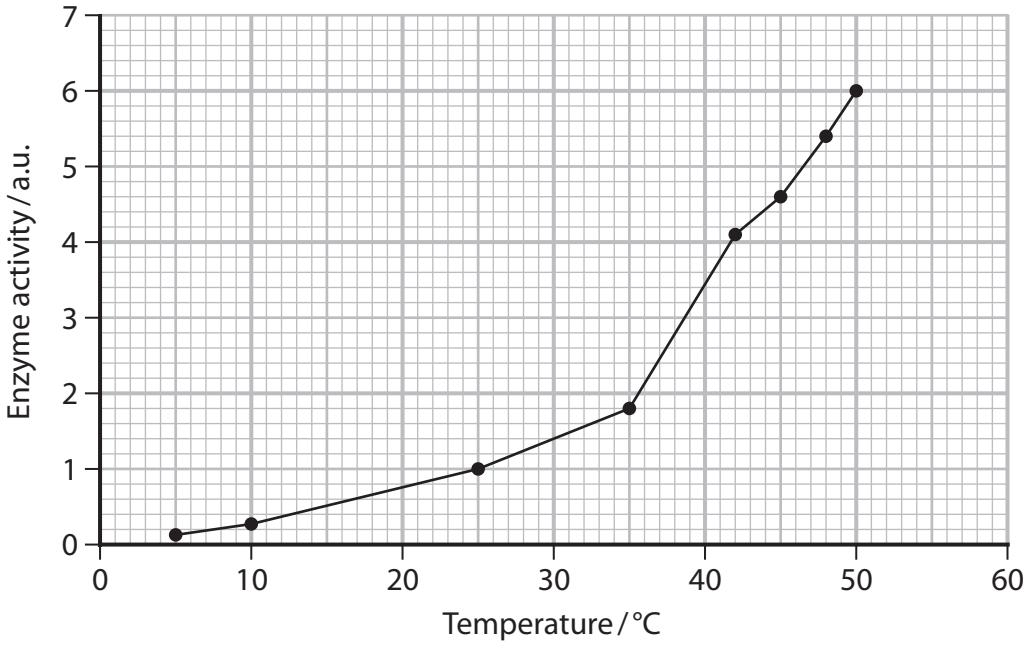
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(c) The effect of temperature on the activity of RUBISCO was studied.

The results are shown in the graph.



Analyse the data to explain why temperature affects the growth of plants.

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

*(d) The world is divided into climate zones based on temperature and rainfall.

Details of some of the climate zones are shown in the table.

Climate zone	Mean temperature	Mean precipitation (rain or snow) / mm year^{-1}
Polar (e.g. Arctic)	Warmest month below 10 °C	150 to 250
Temperate	Coolest month above 0 °C but below 18 °C Warmest month above 10 °C	500 to 2000

Results from the two studies described in this question can be used to explain how climate affects plant growth.

Discuss how anthropogenic climate change can affect the growth of plants in polar and temperate climate zones.

(6)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 10 = 14 marks)

TOTAL FOR PAPER = 100 MARKS

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Every effort has been made to contact copyright holders to obtain their permission for the use of copyright material. Pearson Education Ltd. will, if notified, be happy to rectify any errors or omissions and include any such rectifications in future editions