Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 3 GCE

Thursday 5 June 2025

Afternoon (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 all your working** out in calculations and **include units** 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.

Turn over ▶

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Answer ALL questions. Write your answers in the spaces provided.

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 A sequence of changes takes place in the body of a mammal after death.
Forensic scientists can use this to help determine the time of death.

(a) State three changes that take place in the body of a mammal in the **first 24 hours** after death.

(3)

(b) Insects lay eggs on the body and their larvae feed on the dead tissue.

(i) Which of the following describes the sequence of organisms that colonise a body after death?

(1)

☒ **A** bacteria, beetles, flies

☒ **B** bacteria, flies, beetles

☒ **C** fungi, flies, bacteria

☒ **D** beetles, flies, fungi

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(ii) Explain the effect of an increase in temperature on the rate of decomposition.

(3)

(Total for Question 1 = 7 marks)

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2 Most of the starch consumed by humans comes from the cereal crops: wheat, maize and rice.

Growth of cereal crops is reduced by drought and high temperatures.

(a) Which of the following describes the structure of starch?

(1)

- ☒ **A** amino acids joined by glycosidic bonds
- ☒ **B** amino acids joined by peptide bonds
- ☒ **C** glucose molecules joined by ester bonds
- ☒ **D** glucose molecules joined by glycosidic bonds

(b) Enset is a plant related to the banana plant. It is grown in Ethiopia in Africa, where there is little rainfall and frequent droughts.



(Source: © Silarock/Shutterstock)

The fruit of the enset plant is the main source of starch for many people.

Enset plants are resistant to drought and high temperatures.

Explain why these plants may be a sustainable food source as global warming brings about climate change.

(2)

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(c) Leaves of enset plants can be used to make fibres for weaving.

Describe how the tensile strength of fibres from enset plants can be determined.

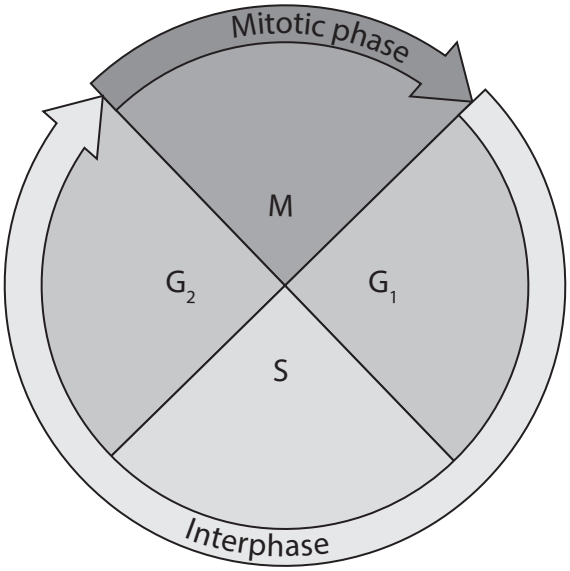
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(Total for Question 2 = 7 marks)

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3 The cell cycle allows cells to divide and produce new cells for growth and repair.

(a) The diagram shows the stages of the cell cycle.

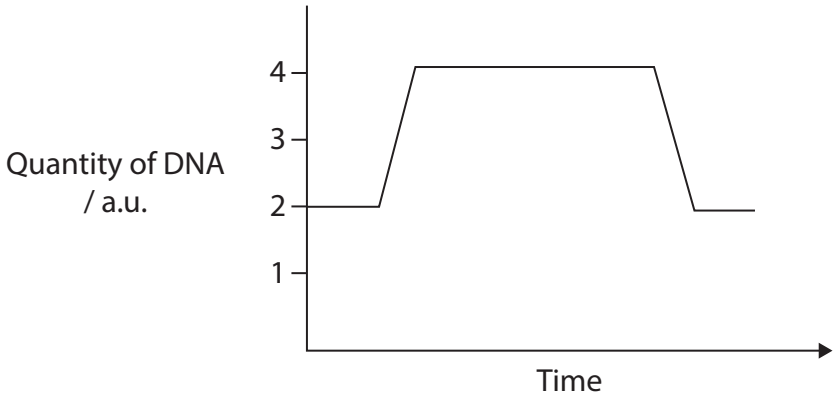


(i) Describe what happens in the G_1 phase of the cell cycle.

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(ii) The graph shows the change in DNA content of a cell during the cell cycle.

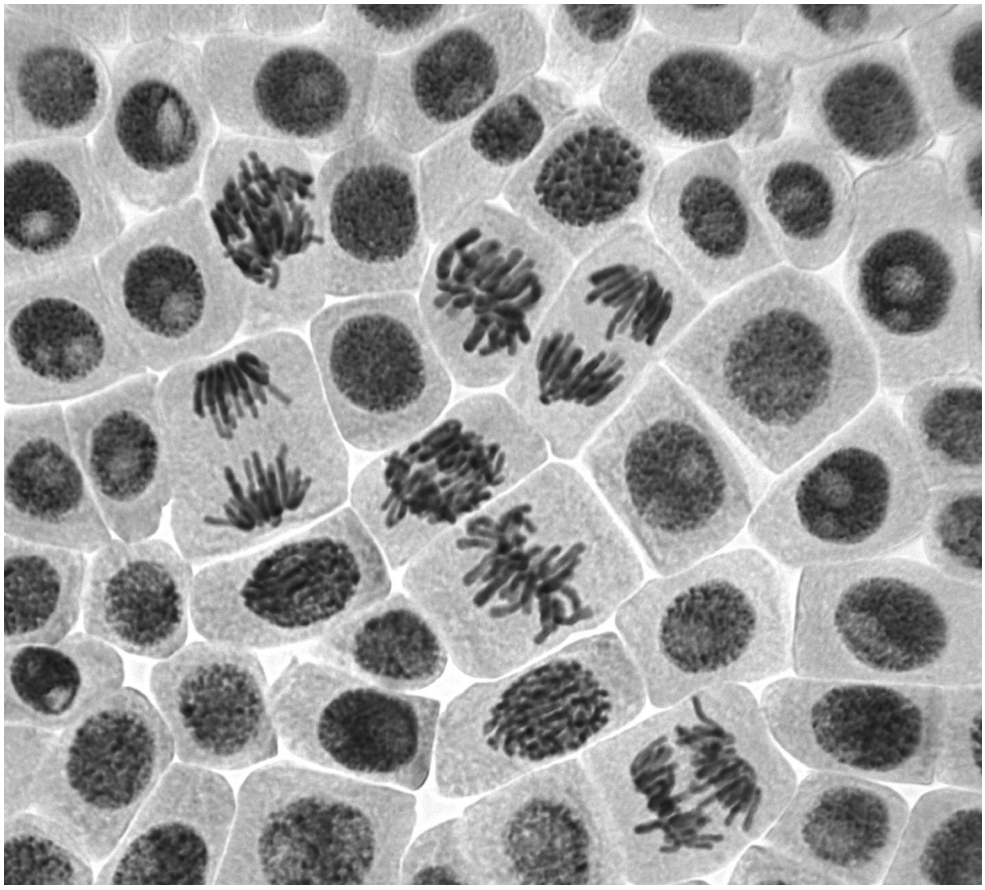


Explain the changes in the quantity of DNA in a cell during the cell cycle.

(3)

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(b) The photograph shows cells from a root tip undergoing mitosis, as seen using a light microscope.



(Source: © Dimarion/Shutterstock)

What is the total number of cells undergoing metaphase and anaphase?

(1)

- ☒ **A** 7
- ☒ **B** 10
- ☒ **C** 21
- ☒ **D** 28

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(c) Stem cells in bone marrow divide continuously. The cells produced can differentiate into all types of blood cell.

(i) Which of the following describes stem cells in **bone marrow**?

(1)

- ☒ **A** differentiated stem cells that produce only red blood cells
- ☒ **B** pluripotent stem cells that can differentiate into all cell types
- ☒ **C** stem cells that can differentiate into some, but not all, cell types
- ☒ **D** totipotent stem cells that can differentiate into blood cells

(ii) Red blood cells contain haemoglobin, a globular protein.

Describe the structure of a **globular protein**.

(2)

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(Total for Question 3 = 9 marks)

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4 The photograph shows a cheetah.



(Source : © Bildagentur Zoonar GmbH/Shutterstock)

The number of cheetahs has been reduced by human activities such as hunting.

Cheetahs are now extinct in India.

(a) All cheetahs belong to the same species.

(i) Which of the following defines the term **species**?

(1)

☒ **A** a group of different organisms that live in the same habitat

☒ **B** a group of organisms that live in the same habitat and do not interbreed

☒ **C** a group of similar organisms that interbreed to produce fertile offspring

☒ **D** a group of similar organisms that interbreed to produce infertile offspring

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(ii) There are two populations of cheetah: the Asian cheetah and the African cheetah.

Describe how gel electrophoresis can be used to determine that these two populations of cheetah are closely related.

(3)

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(b) Cheetahs from Africa are being reintroduced into a national park in India.

They are being taken from game reserves in Namibia and South Africa.

(i) Explain the advantages of introducing cheetahs from these two populations.

(3)

(ii) The animals chosen were all born in the wild alongside other predators.

Deduce why this may increase the survival chances of the cheetahs when they are relocated to the national park in India.

(2)

(Total for Question 4 = 9 marks)

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5 All cells are surrounded by a cell surface membrane.

This membrane controls the movement of substances in and out of the cell.

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

(3)

(b) Water and mineral ions enter a plant through the root hair cells.

(i) Explain how water enters these cells.

(2)

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(ii) Some mineral ions are at a lower concentration in the soil than in the root hair cells.

Which of the following describes how these mineral ions enter the cells of the root?

(1)

☒ **A** active transport through carrier proteins using energy from ATP

☒ **B** active transport through channel proteins using energy from ATP

☒ **C** endocytosis using energy from ATP

☒ **D** facilitated diffusion using energy from ATP

(c) Explain how the structure of tissues in the stem enables water to be transported from the roots to the leaves.

(4)

(Total for Question 5 = 10 marks)

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6 Pathogens can cause disease if they enter the body.

(a) The following are aspects of the non-specific immune response.

1. Acidic conditions on the skin that are the optimum for bacterial enzymes
2. Lysozymes in tears that break down bacterial cell walls
3. Skin flora that compete with pathogens

Which of these defence mechanisms prevent the entry of pathogens?

(1)

☒ **A** 1 and 2

☒ **B** 1, 2 and 3

☒ **C** 1 and 3

☒ **D** 2 and 3

(b) Describe **two** practices used in hospitals to prevent the spread of infection.

(2)

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2 .....

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(c) Antibiotics are used to control bacterial infections.

Many organisms produce substances with antibiotic properties.

The table shows some information about two of these substances.

Antibiotic substance	Potential use
Seraticin	Effective against MRSA, *C. difficile*, *E. coli*
Reutericyclin	Effective against MRSA

Some of these antibiotics may be effective against resistant bacteria such as MRSA.

(i) Devise an investigation to compare the effectiveness of these two antibiotic substances.

(4)

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(ii) Some antibiotics destroy the bacterial cell wall.

Bacteria have cell walls made of peptidoglycan.

Peptidoglycan is a polymer of sugars with amino acids attached. The sugars are joined by glycosidic bonds. Cross links form between the amino acids in adjacent chains.

Compare and contrast the structures of peptidoglycan and cellulose.

(3)

(Total for Question 6 = 10 marks)

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7 The photograph shows a stoat, a small mammal living in the UK.



(Source: © Bildagentur Zoonar GmbH/Shutterstock)

Stoats mate once a year and can produce, on average, 12 offspring.

(a) Before fertilisation, the cell membrane of a sperm cell fuses with the egg cell membrane.

(i) Describe the events **after** the fusion of these membranes.

(3)

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(ii) After fertilisation, cell division leads to the formation of a blastocyst.

Cells of the blastocyst differentiate to form an embryo.

Describe how cells of the blastocyst differentiate.

(2)

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(b) Female stoats can produce offspring in the first year of life.

The table shows the predicted increase in population, assuming 12 offspring are produced each year and that half the offspring are female and all of the offspring survive.

Year	Number of breeding females	Number of female offspring	Total number of offspring
1	1	6	12
2	1 + 6 = 7	42	84
3	7 + 42 = 49	294	588
4			

(i) Complete the table to show the number of breeding females, number of female offspring and total number of offspring produced in year 4.

(2)

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(ii) A mutation causing females to mature rapidly allows stoats to reproduce in their first year.

Explain how the frequency of an allele leading to early maturity may change over time.

(4)

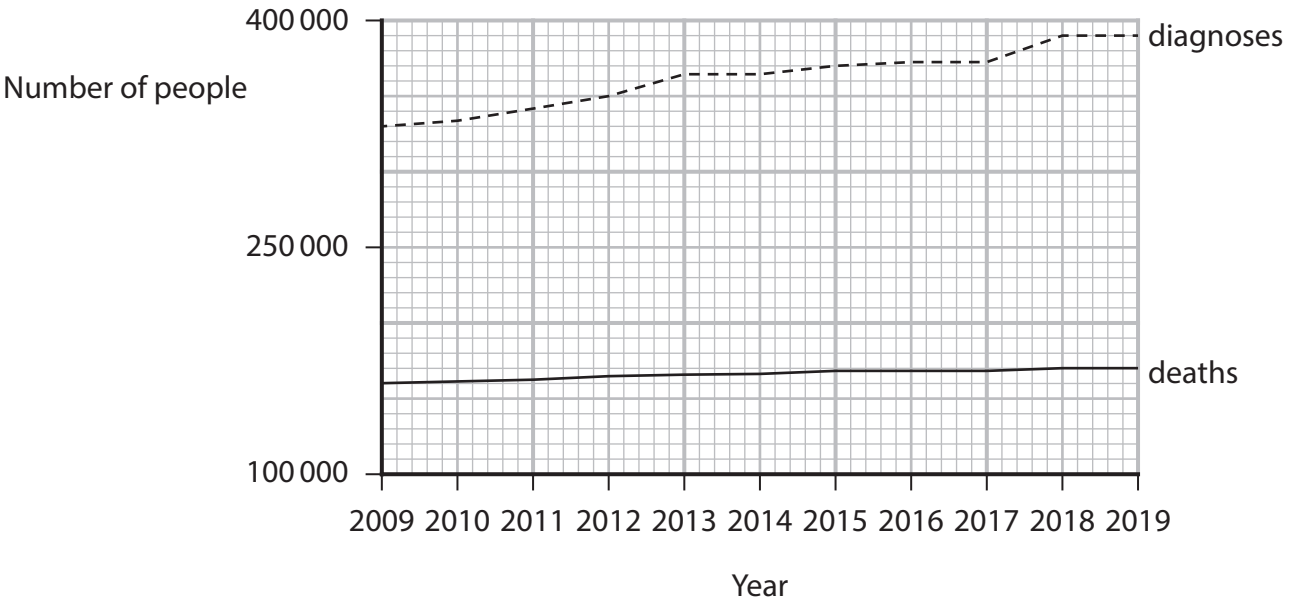
(Total for Question 7 = 11 marks)

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8 Cancer affects many people in the UK.

Current treatments mean that many more people survive.

The graph shows the number of people diagnosed and dying from cancer within 10 years of diagnosis.



(a) (i) Calculate the percentage increase in cancer diagnoses from 2009 to 2019.

Give your answer to three significant figures.

(2)

.....%

(ii) Predict the number of deaths within ten years of diagnosis in 2029.

(1)

Answer .....

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(b) Most cancers are treated with surgery, radiotherapy or chemotherapy, often in combination.

New treatments are constantly developed and have to undergo clinical trials.

Which of the following describes phase III of a clinical trial?

(1)

- ☒ **A** a double blind trial on a large number of healthy individuals
- ☒ **B** a double blind trial on a large number of people with the condition
- ☒ **C** a trial on a small number of healthy individuals to test for side effects
- ☒ **D** trials on animals

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(c) New treatments for cancer involve types of immunotherapy.

The table shows examples of immunotherapy and the method of action.

Type of immunotherapy	Method of action
Monoclonal antibodies	The antibody attaches to the specific protein antigen on cancer cells
Checkpoint blockers	Blocks T cell inhibitors produced by cancer cells
mRNA vaccine	Engulfed by macrophages and used to synthesise the specific protein antigen

(i) Explain how mRNA can be used to produce a specific protein to act as an antigen.

(3)

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*(ii) Discuss how these types of immunotherapy can lead to the destruction of cancer cells.

Use your own knowledge and the information given in this question.

(6)

(Total for Question 8 = 13 marks)

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9 An increasing concentration of carbon dioxide in the atmosphere has been linked to climate change.

(a) Cells in the leaves of trees contain chloroplasts that absorb carbon dioxide.

Describe what happens to carbon dioxide when it enters a chloroplast.

(4)

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(b) Trees are important carbon sinks.

A formula can be used to calculate the mass of carbon in the trunk of a tree:

Biomass = volume of trunk × density of the species

The mass of carbon stored in the trunk is 50% of the biomass.

Calculate the mass of carbon stored in the trunk of an oak tree with a height of 3.0 m and a diameter of 1.2 m.

The density of oak is 720 kg m^{-3}.

Volume of a cylinder = $\pi r^2 h$

Give your answer to one decimal place.

(3)

Answer ..... kg

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(c) Scots pine is a species of conifer tree with a density of 420 kg m^{-3}.

Conifers have fewer species of plant growing underneath them than oak trees.

Deduce why planting oak trees may have more environmental benefits than planting Scots pine.

(3)

(d) Soil also stores large quantities of carbon.

Discuss the role of microorganisms in carbon storage in forest soils.

(2)

(Total for Question 9 = 12 marks)

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10 Climate change affects germination of seeds and location of plant species.

(a) Seeds need a source of energy for germination.

Many seeds contain a store of starch.

Water absorbed by the seed activates the enzyme amylase that breaks down the starch.

(i) Which statement describes the role of amylase in the germination of a seed?

(1)

☒ **A** starch is broken down by condensation reactions to release glucose for respiration

☒ **B** starch is broken down by hydrolysis reactions to release amino acids for respiration

☒ **C** starch is broken down by hydrolysis reactions to release glucose for photosynthesis

☒ **D** starch is broken down by hydrolysis reactions to release glucose for respiration

(ii) As seeds germinate, they synthesise polypeptides to produce proteins for growth.

Which of the following describes a polypeptide?

(1)

☒ **A** a sequence of amino acids joined by ester bonds

☒ **B** a sequence of amino acids joined by peptide bonds

☒ **C** a sequence of fatty acids joined by ester bonds

☒ **D** a sequence of mononucleotides joined by phosphodiester bonds

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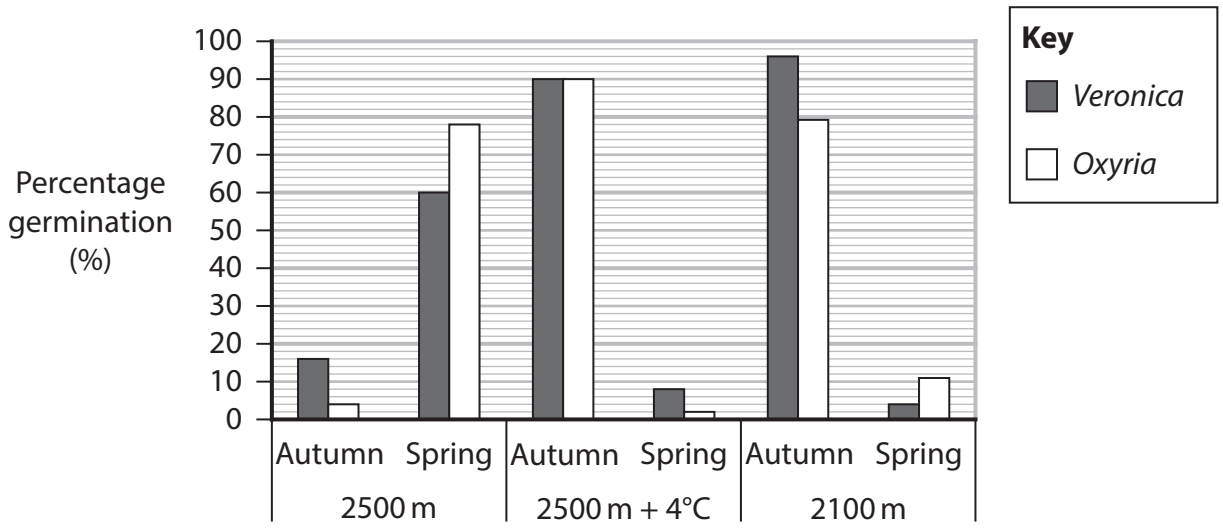
(b) An investigation was carried out to determine the effect of an increase in temperature on the timing of germination of alpine plants.

Two species of alpine plant that grow at an altitude of 2500 m are *Oxyria* and *Veronica*.

Seeds from these two species were placed in agar and kept for one year in the following conditions:

- a cycle of seasonal temperatures found at 2500 m
- a cycle of seasonal temperatures 4°C higher than those found at 2500 m
- a cycle of seasonal temperatures found at 2100 m.

The graph shows the results of this investigation.



(i) The ratio of spring to autumn germination for *Oxyria* grown in conditions found at 2500 m decreased from 19.5 : 1 to 0.02 : 1 when temperatures were increased by 4°C.

Calculate the ratios of spring to autumn germination for *Veronica*.

(2)

Ratio of spring to autumn germination for 2500 m ..... : 1

Ratio of spring to autumn germination for 2500 m plus 4°C ..... : 1

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(ii) During the winter months, the air and soil temperatures fall.

Deduce the effect of climate change on the survival of alpine plant species such as *Oxyria* and *Veronica*.

(2)

*(c) The effect of temperature on germinating seeds can be demonstrated by measuring the Q_{10} value for enzyme activity.

When seeds germinate, amylase is produced.

This enzyme can be extracted from the seeds and used to break down starch.

Devise an experiment to compare the Q_{10} of amylase from germinating seeds of *Veronica* and *Oxyria*.

(6)

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(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS

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