

Paper Reference(s) 9BN0/01

Pearson Edexcel Level 3 GCE

Biology A (Salters Nuffield)

Advanced

Total Marks

PAPER 1: The Natural Environment and Species Survival

Thursday 5 June 2025 – Afternoon

Time: 2 hours

Question Paper

THIS DOCUMENT MUST BE RETURNED TO PEARSON AT THE END OF THE EXAMINATION
--

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Calculator, writing and drawing equipment

YOU WILL BE GIVEN

Diagram Booklet

INSTRUCTIONS

Answer ALL questions.

Show all your working out in calculations and include units where appropriate.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – 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.

There may be spare copies of some diagrams.

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.

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 marks)**

Answer space continues on the next page.

1(a) continued.

(continued on the next page)

1 continued.

(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 mark)

☐ **A bacteria, beetles, flies**

☐ **B bacteria, flies, beetles**

☐ **C fungi, flies, bacteria**

☐ **D beetles, flies, fungi**

(continued on the next page)

1(b) continued.

- (ii) Explain the effect of an increase in temperature on the rate of decomposition.
(3 marks)**

Answer space continues on the next page.

1(b)(ii) continued.

(Total for Question 1 = 7 marks)

- 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 mark)**

- ☐ **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**

(continued on the next page)

2 continued.

(b) Look at the image for Question 2(b) in the Diagram Booklet. Enset is a plant related to the banana plant. It is grown in Ethiopia in Africa, where there is little rainfall and frequent droughts.

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 marks)

Answer space continues on the next page.

2(b) continued.

(continued on the next page)

2 continued.

(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.

(4 marks)

Answer space continues on the next page.

2(c) continued.

(Total for Question 2 = 7 marks)

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

(a) Look at the diagram for Question 3(a) in the Diagram Booklet. It shows the stages of the cell cycle.

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

(2 marks)

Answer space continues on the next page.

3(a)(i) continued.

(continued on the next page)

3(a) continued.

- (ii) Look at the graph for Question 3(a)(ii) in the Diagram Booklet. It 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 marks)

Answer space continues on the next page.

3(a)(ii) continued.

(continued on the next page)

3 continued.

(b) Look at the image for Question 3(b) in the Diagram Booklet. It shows cells from a root tip undergoing mitosis, as seen using a light microscope.

**What is the total number of cells undergoing metaphase and anaphase?
(1 mark)**

☐ **A 7**

☐ **B 10**

☐ **C 21**

☐ **D 28**

(continued on the next page)

3 continued.

(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 mark)

- ☐ **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**

(continued on the next page)

3(c) continued.

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

**Describe the structure of a
GLOBULAR PROTEIN.**

(2 marks)

Answer space continues on the next page.

3(c)(ii) continued.

(Total for Question 3 = 9 marks)

- 4 Look at the image for Question 4 in the Diagram Booklet. It shows a cheetah.**

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 mark)

- ☐ **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**

4(a) continued.

- (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 marks)

Answer space continues on the next page.

4(a)(ii) continued.

(continued on the next page)

4 continued.

(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 marks)**

Answer space continues on the next page.

4(b)(i) continued.

(continued on the next page)

4(b) continued.

- (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 marks)

Answer space continues on the next page.

4(b)(ii) continued.

(Total for Question 4 = 9 marks)

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 marks)

Answer space continues on the next page.

5(a) continued.

(continued on the next page)

5 continued.

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

**(i) Explain how water enters these cells.
(2 marks)**

5(b) continued.

- (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 mark)**

- ☐ **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**

(continued on the next page)

5 continued.

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

Answer space continues on the next page.

5(c) continued.

(Total for Question 5 = 10 marks)

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 mark)

- ☐ **A 1 and 2**
- ☐ **B 1, 2 and 3**
- ☐ **C 1 and 3**
- ☐ **D 2 and 3**

(continued on the next page)

6 continued.

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

(2 marks)

1 _____

2 _____

6 continued.

(c) Antibiotics are used to control bacterial infections.

Many organisms produce substances with antibiotic properties.

Look at the table for Question 6(c) in the Diagram Booklet. It shows some information about two of these substances.

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 marks)

Answer space continues on the next 2 pages.

Turn over

6(c)(i) continued.

[illegible]

Turn over

6(c)(i) continued.

(continued on the next page)

6(c) continued.

- (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 marks)

Answer space continues on the next page.

6(c)(ii) continued.

(Total for Question 6 = 10 marks)

- 7 Look at the image for Question 7 in the Diagram Booklet. It shows a stoat, a small mammal living in the UK.**

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 marks)

Answer space continues on the next page.

7(a)(i) continued.

(continued on the next page)

7(a) continued.

- (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 marks)

Answer space continues on the next page.

7(a)(ii) continued.

(continued on the next page)

7 continued.

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

Look at the table for Question 7(b)(i) in the Diagram Booklet. It 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.

- (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 marks)**

(continued on the next page)

7(b) continued.

- (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 marks)

Answer space continues on the next page.

Turn over

7(b)(ii) continued.

(Total for Question 7 = 11 marks)

8 Cancer affects many people in the UK.

Current treatments mean that many more people survive.

Look at the graph for Question 8 in the Diagram Booklet. It 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 marks)**

_____ %

(continued on the next page)

Turn over

8(a) continued.

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

(1 mark)

Answer _____

(continued on the next page)

8 continued.

- (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 mark)

- ☐ **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**

(continued on the next page)

8 continued.

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

Look at the table for Question 8(c) in the Diagram Booklet. It shows examples of immunotherapy and the method of action.

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

Answer space continues on the next page.

Turn over

8(c)(i) continued.

(continued on the next page)

8(c) continued.

- *(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 marks)

Answer space continues on the next 2 pages.

8(c)(ii) continued.

[illegible]

Turn over

8(c)(ii) continued.

(Total for Question 8 = 13 marks)

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 marks)

Answer space continues on the next page.

9(a) continued.

(continued on the next page)

Turn over

9 continued.

(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 $\times$ 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 marks)

Answer space begins on the next page.

9(b) continued.

Answer _____ kg

(continued on the next page)

9 continued.

- (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 marks)**

Answer space continues on the next page.

Turn over

9(c) continued.

(continued on the next page)

9 continued.

(d) Soil also stores large quantities of carbon.

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

(2 marks)

Answer space continues on the next page.

Turn over

9(d) continued.

(Total for Question 9 = 12 marks)

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.

(continued on the next page)

10(a) continued.

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

- ☐ **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**

(continued on the next page)

10(a) continued.

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

Which of the following describes a polypeptide?

(1 mark)

- ☐ **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**

(continued on the next page)

10 continued.

- (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**

Look at the graph for Question 10(b) in the Diagram Booklet. It shows the results of this investigation.

(continued on the next page)

10(b) continued.

- (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 marks)

Ratio of spring to autumn germination

for 2500 m _____ : 1

Ratio of spring to autumn germination for

2500 m plus 4°C _____ : 1

10(b) continued.

- (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 marks)

Answer space continues on the next page.

10(b)(ii) continued.

(continued on the next page)

10 continued.

- *(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 marks)

Answer space continues on the next 4 pages.

10(c) continued.

[illegible]

Turn over

10(c) continued.

[illegible]

Turn over

10(c) continued.

[illegible]

Turn over

10(c) continued.

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS

END OF PAPER