Write your name here

Surname	Other names

Pearson Edexcel GCE
Level 3 GCE

Centre Number	Candidate Number

Biology A (Salters Nuffield)

Advanced Subsidiary
Paper 2: Development, Plants and the Environment

Tuesday 7 June 2016 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
8BN0/02

You may need a ruler, a pencil and a calculator.

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.*
- 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.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

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 Gametes are specialised for their role in sexual reproduction.

(a) The purpose of the cortical reaction is to

(1)

☒ **A** allow the haploid nuclei to fuse

☒ **B** attract the sperm towards the egg cell

☒ **C** cause the sperm cell membrane to fuse with the egg cell membrane

☒ **D** ensure that only one sperm fertilises the egg

(b) (i) Which adaptation allows a sperm cell to digest the zona pellucida?

(1)

☒ **A** acrosome

☒ **B** flagellum

☒ **C** haploid nucleus

☒ **D** streamlined shape

(ii) Give a reason for the high density of mitochondria found in the midpiece of a sperm cell.

(1)

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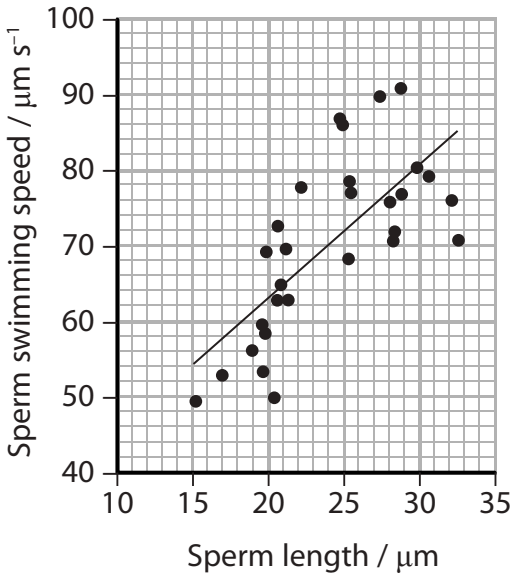
(c) The relationship between the length of a sperm cell and the speed at which it can swim was investigated.

The data collected are shown in the graph.



(i) Calculate the swimming speed of a sperm cell that is 40 μm long, as predicted by the line shown on the graph.

(2)

Answer .....

(ii) Explain the limitations of using the line on the graph to predict the swimming speed of sperm cells.

(2)

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(Total for Question 1 = 7 marks)

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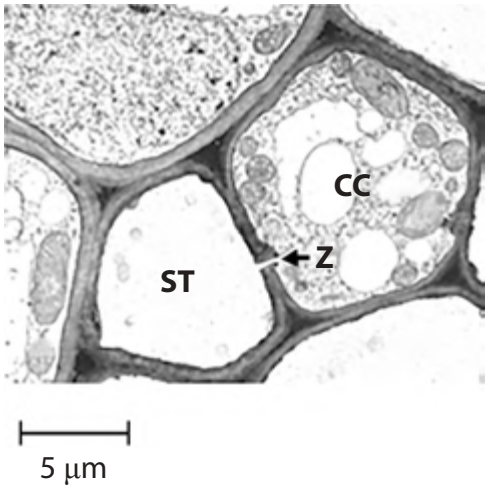
2 The electron micrograph shows a cross-section through part of a vascular bundle, containing phloem tissue.



A sieve tube element is labelled '**ST**'. A cell called a companion cell is labelled '**CC**'.

(a) Calculate the magnification of this image.

(1)

Answer: × .....

(b) The wall of the sieve tube element contains

(1)

☒ **A** cellulose, lamellae and lignin

☒ **B** cellulose, lignin and pectin

☒ **C** hemicellulose, microfibrils and pectin

☒ **D** hemicellulose, peptidoglycan and pectin

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(c) There is no nucleus in a mature sieve tube element.

Give **two** reasons why a sieve tube element does not require rough endoplasmic reticulum and ribosomes.

(2)

(d) Companion cells are found next to sieve tube elements.

(i) Describe the structure labelled **Z** that connects the cytoplasm of the companion cell to the sieve tube element.

(2)

(ii) The electron micrograph shows a difference in the number of mitochondria in the sieve tube element and in the companion cell.

Explain the difference in the number of mitochondria.

(3)

(Total for Question 2 = 9 marks)

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3 Soil contains inorganic ions essential for plant growth.

(a) Which compounds, found in plants, contain nitrogen from nitrate ions?

(1)

☒ **A** cellulose, amino acids and DNA

☒ **B** DNA, enzymes and amino acids

☒ **C** DNA, enzymes and starch

☒ **D** starch, proteins and cellulose

(b) The concentrations of some inorganic ions were measured in soil and in plants.

The table shows the concentration of nitrate ions in the soil and in different parts of a plant.

Site	Nitrate ion concentration / ppm
leaf	250
leaf stalk	990
stem	1200
root	2100
soil	29

(i) Calculate the percentage decrease in nitrate ion concentration from the root to the leaf.

(2)

Answer .....

(ii) Describe how nitrate ions are transported from the root to the leaves.

(2)

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(iii) The concentration of magnesium ions in the soil was found to be very low.

Explain the effects of a shortage of magnesium ions on a plant.

(3)

*(c) Lead ions can be toxic to plants.

Different plants are killed by different concentrations of lead ions.

The toxic concentrations for different plant categories are shown in the table.

Toxic lead ion concentration / ppm	Tolerance category of plant
<300	low
300–999	medium
1000–2000	high
>2000	very high

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Devise a laboratory investigation to determine the tolerance category of tomato plants to lead ions.

(6)

(Total for Question 3 = 14 marks)

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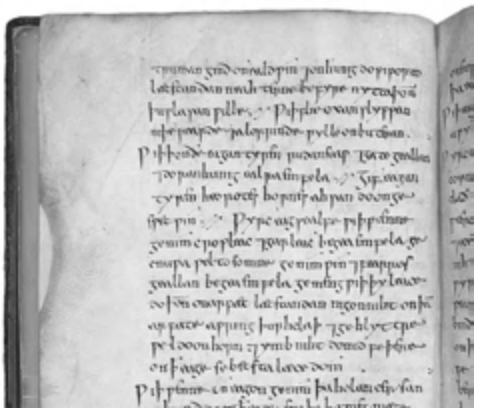
4 Bald's Leechbook was written in the 9th Century. This book contains details of medical treatments used over 1000 years ago.

The recipe for a 'salve', used to treat infections, is shown in the photograph.



Scientists followed the recipe to make this salve and tested it in the laboratory.

They found that the salve was very effective against *Staphylococcus aureus*. This bacterium commonly causes infections in humans.

(a) Describe **two** aseptic techniques that should be used when working safely with bacteria.

(2)

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(b) The salve was also tested on mice.

These mice had skin wounds infected with *S. aureus*. The salve was very effective in treating these infections.

(i) Explain why some bacteria can grow rapidly in skin wounds.

(3)

(ii) *S. aureus* can cause infections which are difficult to treat in humans.

Describe how scientists, after testing the salve on mice, could test whether the salve is an appropriate treatment for humans with wounds infected with *S. aureus*.

(4)

(Total for Question 4 = 9 marks)

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5 Egg cells vary in size between different species of animal.

Egg cells from different animals were measured and some further information about each species was recorded. The data are shown in the table.

Animal	Diameter of egg cell	Mass of adult / kg	Site of fertilisation	Site of offspring development
Domestic cow (mammal)	85 μm	540	inside the body	in the uterus
Human (mammal)	150 μm	62	inside the body	in the uterus
American eel (fish)	1.1 mm	6.8	in the sea	floating in the sea
Hermann's tortoise (reptile)	2.3 cm	3.4	inside the body	inside an egg shell, in a nest
Great spotted kiwi (bird)	7.8 cm	2.3	inside the body	inside an egg shell, in a nest

(a) The human egg cell and the eel egg cell are approximately spherical.
The formula for the volume of a sphere is

$$V = \frac{4}{3}\pi r^3$$

where V is the volume and r is the radius of the sphere.

The volume of the human egg cell is $1.8 \times 10^6\ \mu m^3$.

Calculate how many times larger the volume of the eel egg cell is than the volume of the human egg cell.

(3)

Answer ..... times larger

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(b) The eel egg cell is larger than the human egg cell, yet an adult eel is smaller than an adult human.

Analyse the data in the table to explain why it is advantageous for the eel to have a larger egg cell.

(2)

(c) (i) Deduce the relationship between egg cell diameter and the mass of the adult animal shown by the data.

(1)

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(ii) Criticise this data set as evidence for a relationship between egg cell diameter and the mass of the adult.

(4)

(Total for Question 5 = 10 marks)

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6 Svalbard Global Seed Vault (SGSV) is a seed bank. It keeps seeds from almost 4000 species of plants, focussing on food crops such as wheat, rice and maize.

(a) State suitable conditions for keeping seeds in a seed bank.

(2)

(b) Many seeds in SGSV store food in the form of starch.

(i) Why does the food store in seeds contain starch rather than cellulose?

(1)

☒ **A** starch can be stored for longer because it has 1–4 bonds

☒ **B** starch has more mineral ions than cellulose

☒ **C** starch is branched and supplies energy more quickly than cellulose

☒ **D** starch is more compact than cellulose because it has 1–6 bonds

(ii) Explain why starch must be broken down before it can be used by the cells of the growing plant.

(2)

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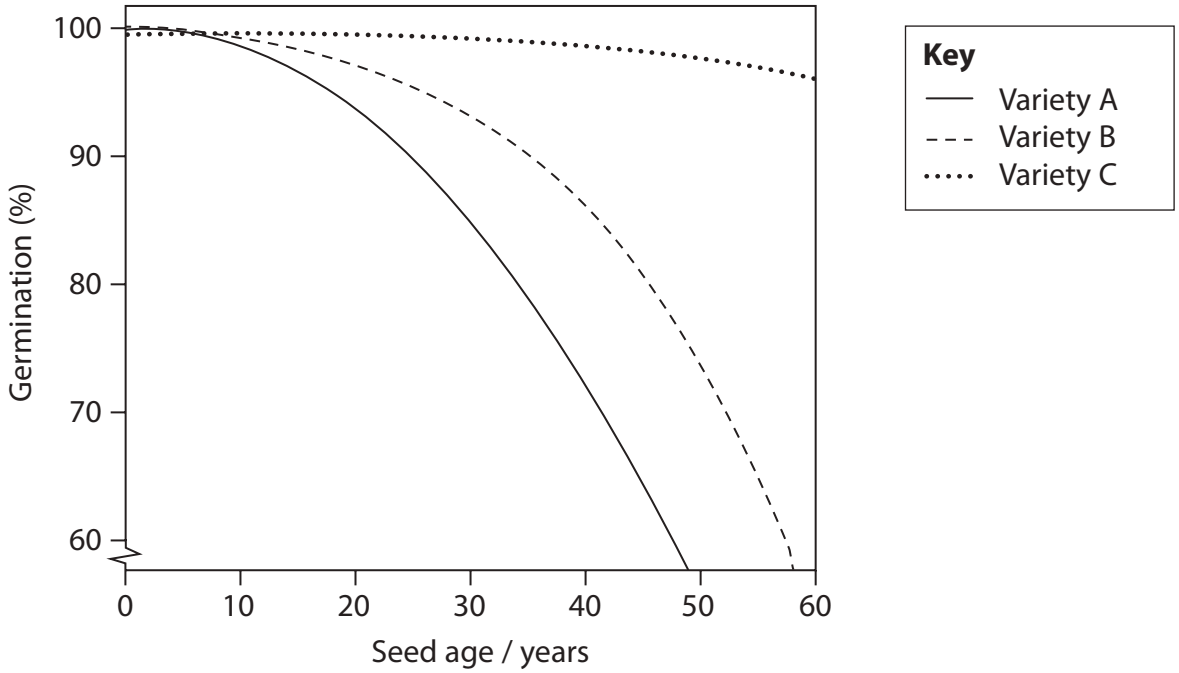
(c) The purpose of SGSV is to store seeds for use in the future, 50 or more years from now.

Seeds from three varieties of maize were tested to see the effects of long periods of storage. The results of these tests are shown in the graph.



Explain how SGSV could make use of these results.

(3)

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(d) SGSV keeps seeds from more than 865 000 varieties of plant, including 200 000 varieties of wheat and rice. Some of these varieties are rare or extinct in the wild.

Since 2004, more than 410 million dollars have been spent on SGSV and other seed banks around the world.

However, it is estimated that 75% of global crop diversity is not stored in international seed banks.

Critics argue that many crop varieties stored in SGSV are not actually used for food, and that the money would be better spent supporting farmers who are growing food crops.

Justify the continued funding of SGSV.

(3)

(Total for Question 6 = 11 marks)

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7 Some fish live in very cold parts of the sea where ice can form.

Many of these fish produce anti-freeze proteins, which help to stop ice forming inside the fish.

(a) The production of anti-freeze proteins is an example of

(1)

☒ **A** anatomical adaptation

☒ **B** change in allele frequency

☒ **C** physiological adaptation

☒ **D** reproductive isolation

(b) Anti-freeze glycoprotein (AFGP) is one type of anti-freeze protein.

Messenger RNA coding for AFGP is translated at a ribosome to produce a polypeptide.

Describe how this polypeptide is then processed to make AFGP.

(4)

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(c) Some fish produce another anti-freeze protein, called AFP II.

The tissues of these fish were tested for the presence of AFP II and the mRNA coding for AFP II.

The results are shown in the table.

Molecule	Present in
AFP II protein	all tissues
AFP II mRNA	liver tissue only

Explain the distribution of the AFP II protein and AFP II mRNA.

(4)

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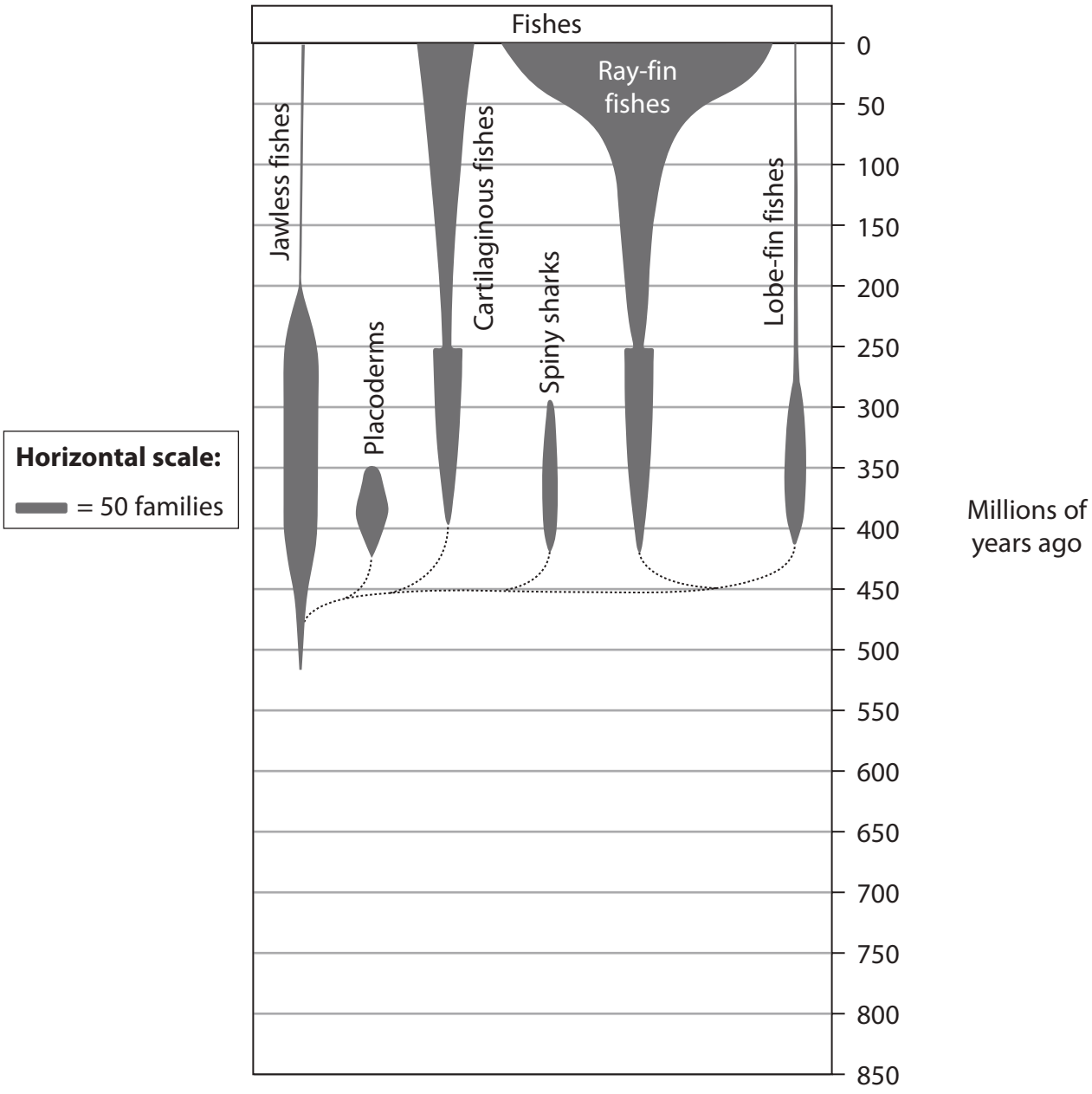
(d) Sea ice forms only during ice ages.

The table shows Earth's ice ages over the last 1000 million years.

Ice age	Time / millions of years ago
Quaternary	0 to 2.6
Karoo	260 to 360
Andean-Saharan	420 to 460
Cryogenian	630 to 850

The diagram shows how the number of families of fishes has changed over time.



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(i) At which time does the diagram show a major loss of biodiversity?

(1)

- ☒ **A** 65 million years ago
- ☒ **B** 252 million years ago
- ☒ **C** 359 million years ago
- ☒ **D** 419 million years ago

(ii) Many different types of anti-freeze protein are produced by ray-fin fishes.

Analyse the data to explain when these ray-fin fish are likely to have evolved the ability to produce anti-freeze proteins.

(3)

(Total for Question 7 = 13 marks)

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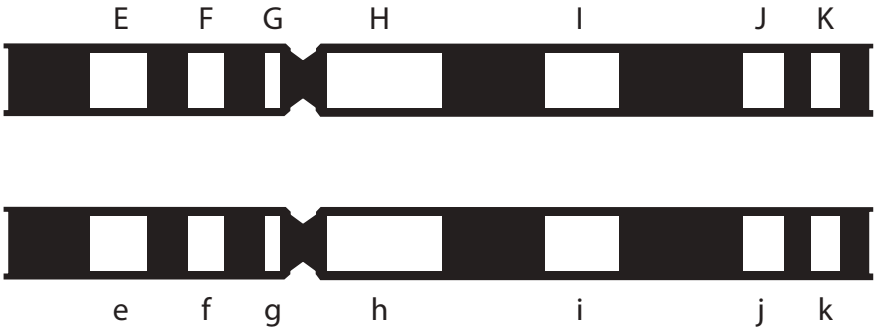
8 The diagram shows two homologous chromosomes from a man.



The white regions are the loci of seven genes involved in different phenotypic traits.
The letters E-K and e-k represent the alleles present at each locus.

(a) Alleles F and G are

(1)

☒ **A** autosomal and complementary

☒ **B** autosomal and linked

☒ **C** sex-linked and dominant

☒ **D** sex-linked and epigenetic

(b) This man produces gametes. Each gamete contains only one allele of each gene.

Describe how each gamete receives only one allele of each gene.

(2)

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(c) The gametes produced by this man may have different combinations of alleles.
Possible combinations of alleles are:

- E and K
- e and K
- h and i
- H and i

Assess the relative chances of this man's gametes containing these combinations of alleles.

(4)

(Total for Question 8 = 7 marks)

TOTAL FOR PAPER = 80 MARKS

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