Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced Subsidiary
Unit 2: Development, Plants and the Environment

Monday 2 June 2014 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI02/01

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 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.*
- 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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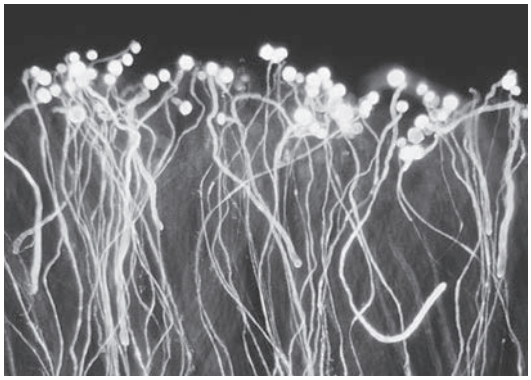
PEARSON

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 The photograph below shows pollen germinating on the stigma of a tomato flower.



Magnification ×100

(a) Explain how the pollen tubes grow through the style of the flower.

(2)

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(b) Place a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(i) The tip of the pollen tube breaks through the micropyle to enter the

(1)

☒ **A** egg cell

☒ **B** embryo sac

☒ **C** ovary

☒ **D** style

(ii) During fertilisation, nuclei from the pollen tube fuse with

(1)

☒ **A** the antipodal cells

☒ **B** the egg cell and the antipodal cells

☒ **C** the egg cell and the polar nuclei

☒ **D** the polar nuclei and the antipodal cells

(iii) During fertilisation, the following structures are produced

(1)

☒ **A** diploid zygote and diploid endosperm

☒ **B** diploid zygote and triploid endosperm

☒ **C** triploid zygote and diploid endosperm

☒ **D** triploid zygote and triploid endosperm

(c) Describe how the structure of a pollen grain differs from that of a sperm cell.

(2)

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(Total for Question 1 = 7 marks)

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2 In 1886, Sir Francis Galton claimed that the height of a child could be predicted by working out the mean height of its parents.

Scientists have since discovered that the inheritance of height is an example of polygenic inheritance.

(a) Explain what is meant by the term **polygenic inheritance**.

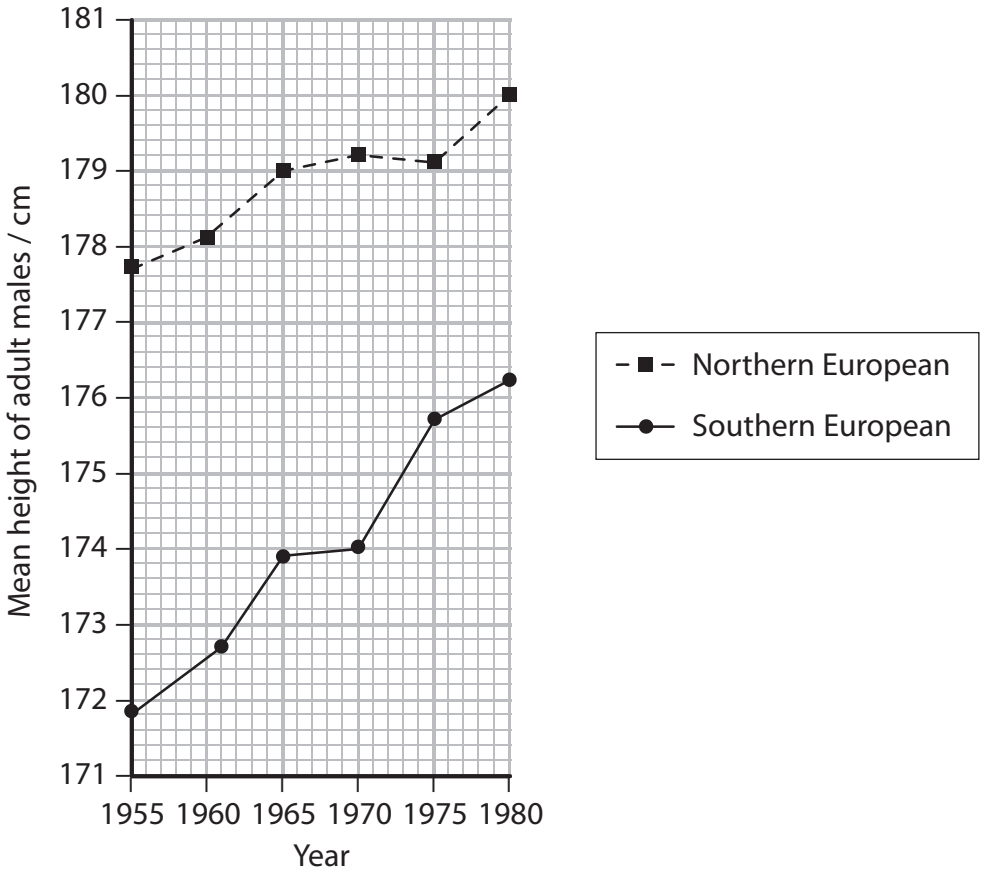
(2)

(b) Some scientists have suggested that diet may affect the growth of a child.

Explain how the height of an adult human demonstrates how environmental factors interact with genotype.

(3)

(c) The graph below shows the mean height of populations of adult males in Northern and Southern Europe from 1955 to 1980.



(i) Using the information in the graph, describe the changes in mean height for adult European males from 1955 to 1980.

(3)

(ii) Suggest an explanation for the changes in mean height of these two groups of adult males.

(2)

(Total for Question 2 = 10 marks)

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3 Prokaryotic and eukaryotic organisms can be classified depending on their cellular structure.

(a) Describe **three** structural differences between prokaryotic and eukaryotic cells.

(3)

(b) In 1977, Carl Woese suggested that there are three domains of living organisms: the Archaea, the Bacteria and the Eukaryota.

He used molecular phylogeny to classify organisms into different domains.

Explain what is meant by the term **molecular phylogeny**.

(3)

(c) The table below shows some of the cellular features of organisms belonging to the three different domains.

Feature	Archaea	Bacteria	Eukaryota
Cell membrane	Branched hydrocarbon chains attached to glycerol by ether bonds	Unbranched fatty acid chains attached to glycerol by ester bonds	Unbranched fatty acid chains attached to glycerol by ester bonds
Ribosome size	70S	70S	80S
Number of protein molecules in RNA polymerase	10	5	12
Peptidoglycan in cell wall	No	Yes	No
Type of chromosome	Circular	Circular	Linear

(i) Using information from this table, give evidence that supports Woese's conclusion that the Archaea are distinct from **both** the Bacteria and the Eukaryota.

(2)

(ii) Using information from the table, explain why the Archaea are thought to be more closely related to Eukaryota than to Bacteria.

(2)

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(Total for Question 3 = 10 marks)

4 The root tip squash procedure can be used to observe cells undergoing mitosis.

(a) Explain the role of mitosis in the development of roots.

(2)

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(b) (i) The flow chart below describes the stages involved in staining a root tip squash to show mitosis.

Complete the flow chart by writing the most appropriate word or words on the dotted lines.

(3)

Stage 1

Carefully remove the root tip from an onion that has been grown in water

↓

Stage 2

Place the root tip in ..... acid,

which will ..... the tissue

↓

Stage 3

Rinse in distilled water and then add a few drops

of a stain such as .....

↓

Stage 4

Place the stained root tip on a .....

and then place a ..... on top

(ii) Describe **one** safety precaution that should be taken when carrying out this procedure.

(1)

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*(c) Following mitosis, some cells undergo differentiation to become specialised tissues, such as xylem.

Explain how cells differentiate to become specialised tissues.

(4)

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(d) Similar staining techniques can be used to observe cells undergoing meiosis.

(i) Name a process that may be observed in cells undergoing meiosis but **not** mitosis.

(1)

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(ii) Explain how meiosis can give rise to genetic variation in the gametes produced.

(2)

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(Total for Question 4 = 13 marks)

5 The photograph below shows seed pods of a Canola plant (*Brassica napus*). Canola is a plant grown as a crop because the seeds are rich in oil. The extracted oil is used in cooking and as a sustainable fuel.

Magnification ×0.1

(a) Suggest why the production of oil from Canola seeds can be described as **sustainable**.

(2)

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(b) Farmers provide the plants with fertiliser containing nitrate ions.

Explain the importance of nitrate ions for the growth of plants.

(2)

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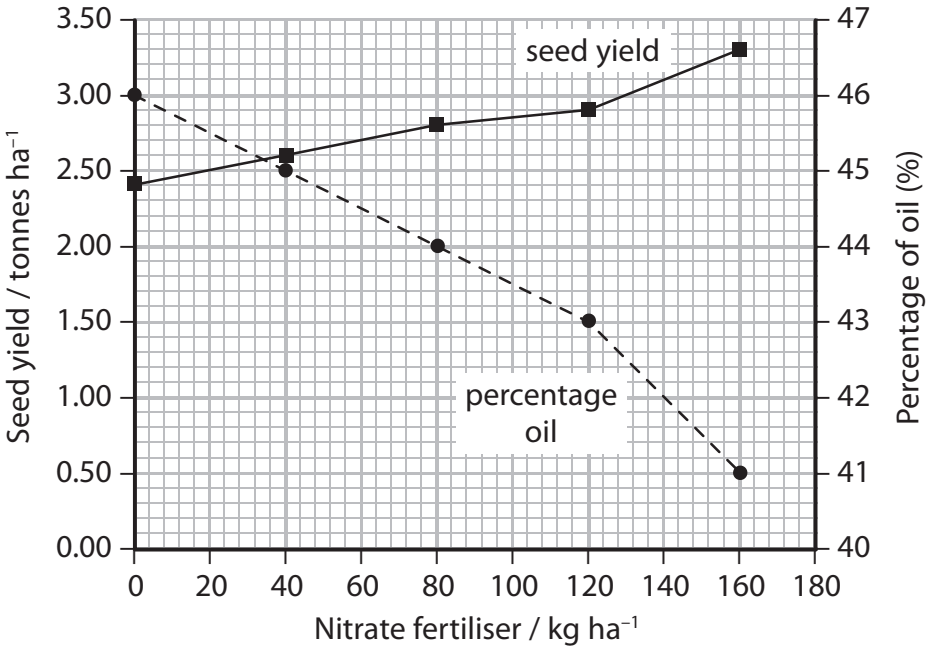
(c) Scientists carried out an investigation into the effect of nitrate fertiliser on the yield.

The graph below shows the results of this investigation.



(i) Place a cross ☒ in the box next to the correct word or words to complete the following statement.

The mass of nitrate fertiliser added and the percentage of oil produced show

(1)

☒ **A** a negative correlation

☒ **B** no relationship

☒ **C** a positive correlation

☒ **D** a proportional relationship

(ii) Using information in the graph, calculate the percentage change in seed yield when the level of nitrate fertiliser is increased from 0 to 160 kg ha^{-1}.

Show your working.

(3)

..... (%)

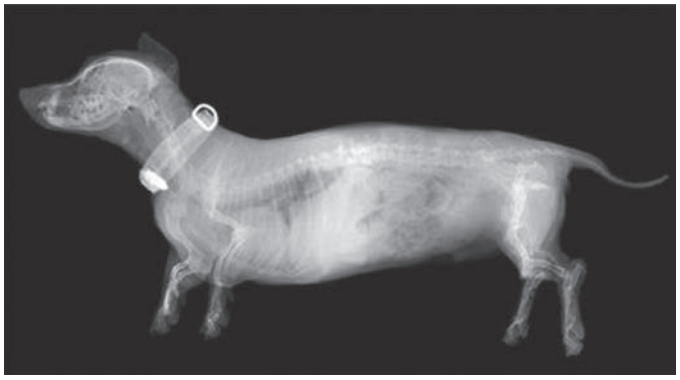
(iii) Suggest how the scientist could have ensured that this investigation was valid.

(4)

(Total for Question 5 = 12 marks)

6 The photograph below shows an X-ray of a dachshund. The dachshund is a breed of dog that is at higher risk of paralysis due to spinal injury.

Scientists have successfully used stem cells to reverse this paralysis.



Magnification ×0.02

(a) Suggest why stem cells can be used to reverse this paralysis.

(2)

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(b) The trial experiment was carried out on a dog that was paralysed due to a spinal injury and was unable to use its back legs.

The scientists extracted stem cells from the lining of the dog's nose. These cells were cultured for one month to increase their numbers. The stem cells were then injected into the injury site of this dog.

Suggest why stem cells were taken from this dog and not from another dog.

(2)

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(c) A further investigation was carried out on 34 dogs with spinal injuries. Some had stem cells injected into the site of the spinal injury. The others were injected with a fluid containing no stem cells. This fluid is called a neutral fluid.

Neither the scientists nor the owners knew which dogs had been given stem cells and which had been given the neutral fluid.

The dogs that were given stem cells recovered the use of their back legs.

(i) Explain the reason for giving some of the dogs a neutral fluid instead of stem cells.

(2)

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(ii) Suggest why neither the scientists nor the owners knew which dogs had been given stem cells and which had been given the neutral fluid.

(1)

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(Total for Question 6 = 7 marks)

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7 The photograph below shows a coconut palm tree. These trees often grow on beaches near the sea. They can grow to a height of 25 metres.

The seedpod produced by the coconut tree has a thick fibrous husk that protects the seed from damage when it falls. This husk contains two types of fibre, white coir fibres and brown coir fibres.

Magnification ×0.003

(a) A student determined the mean tensile strength of white and brown coir fibres. The table below shows the mean tensile strength for the fibres and the ranges of the data.

Type of fibre	Length of fibre / mm	Tensile strength / MPa
White coir	5	192 ± 37
White coir	35	162 ± 32
Brown coir	5	343 ± 36
Brown coir	35	186 ± 55

(i) Using the data in the table, identify which type of fibre shows the lowest percentage variability in tensile strength.

Place a cross ☒ in the box next to the correct conclusion that can be drawn from the results shown in this table

(1)

☒ **A** long brown fibre

☒ **B** long white fibre

☒ **C** short brown fibre

☒ **D** short white fibre

(ii) The student concluded that brown coir fibres are stronger than white coir fibres.

Use the information in the table to comment on the validity of her conclusion.

(4)

(b) Fibre cells in coir have a similar structure to sclerenchyma fibres.

(i) Suggest how the structure of the coir fibres makes them light, waterproof and strong.

(3)

(ii) White coir fibres are more flexible than brown coir fibres. Suggest how their structure may account for this difference in flexibility.

(1)

(Total for Question 7 = 9 marks)

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8 The photograph below shows Ethiopian wolves (*Canis simensis*). They live on isolated mountains at altitudes above 3000 metres. They are one of 19 endemic animal species living in the mountains of Ethiopia.

Magnification ×0.01

(a) Explain what is meant by the term **endemic species**.

(1)

(b) There are estimated to be only 500 Ethiopian wolves left in the wild, living in six separate populations. There are high levels of genetic diversity between these six populations.

The separate populations are geographically isolated. This prevents interbreeding between populations.

Suggest how this may affect the genetic diversity of each individual population.

(2)

(c) Ethiopian wolves are endangered in the wild.

Some scientists have suggested that moving male wolves from one population to another may help the species survive.

Suggest how this strategy of transferring individuals from one population to another could help the species survive.

(2)

(d) (i) The table below shows adaptations of the Ethiopian wolf that enable it to survive in its mountain habitat. Place a cross (✗) in the table that correctly describes whether the adaptation is behavioural, anatomical or physiological.

(3)

Adaptation	Behavioural	Anatomical	Physiological
Small sharp teeth widely-spaced to cope with small prey			
Narrow snout to fit into small gaps when hunting small prey			
Hunting alone, as prey are too small to share with other wolves			

*(ii) Suggest how natural selection has led to the evolution of this species of wolf, adapted for life in the mountains of Ethiopia.

(4)

(Total for Question 8 = 12 marks)

TOTAL FOR PAPER = 80 MARKS

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