Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Biology

Advanced Subsidiary

Unit 2: Development, Plants and the Environment

Tuesday 8 June 2010 – Morning
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 on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.*
- 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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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 phenotype of an individual is dependent on a variety of factors.

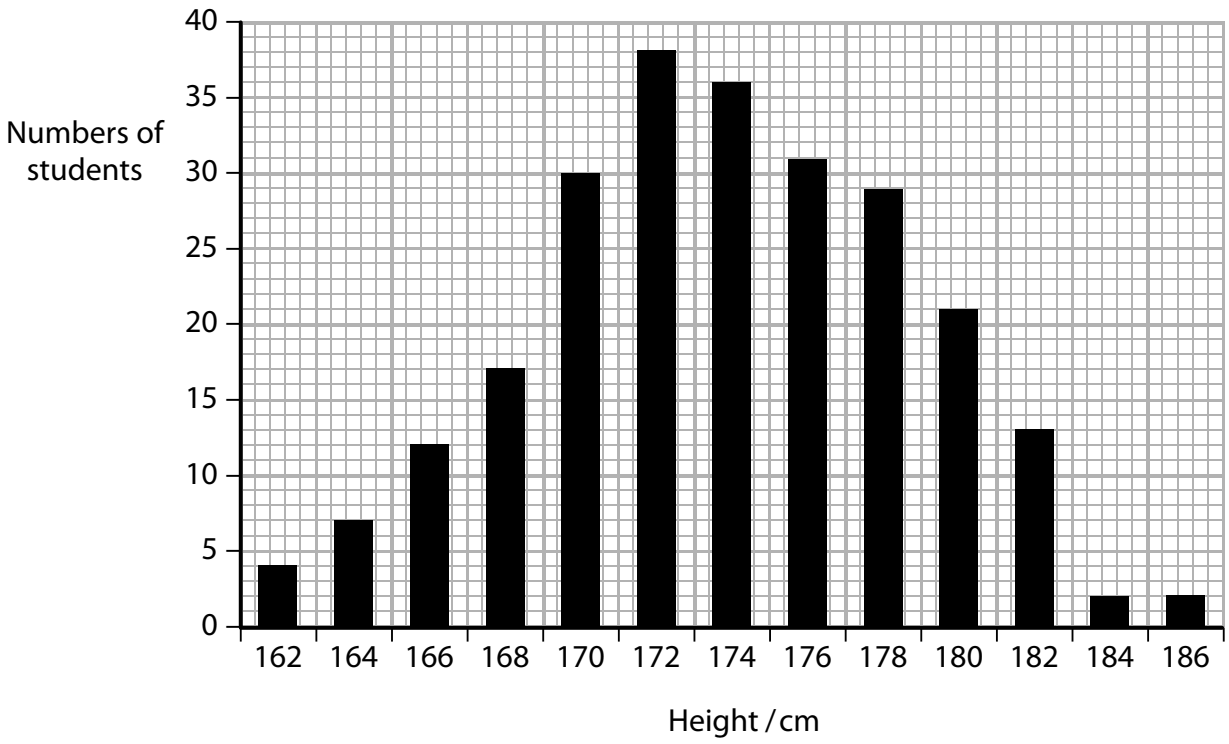
(a) (i) Complete the following sentence by writing the most appropriate word or words on the dotted lines.

(2)

In polygenic inheritance, the phenotypes are affected by forms of genes called ..... found at many ..... on chromosomes.

(ii) The graph below shows some data on the numbers of students of different heights.

Height is an example of polygenic inheritance.



State the heights that represents the median and the mode for this group of students.

(2)

Median height ..... cm

Mode height ..... cm

(b) (i) Complete the following short passage by writing the most appropriate word or words on the dotted lines.

(2)

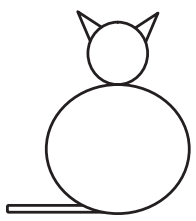
Animal fur colour is an example of a phenotype. The phenotype of an animal can be the result of an interaction between the ..... and the ..... .

(ii) The enzyme tyrosinase is involved in producing dark coloured fur in cats. Tyrosinase is active at the cat's body temperature.

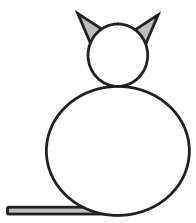
Some cats have a defective form of tyrosinase. The defective tyrosinase is inactive at normal body temperature, but becomes active in the cooler extremities of cats living in a cold environment.

The diagrams below show four cats with different fur colour distributions. Shaded areas represent dark coloured fur and non-shaded areas represent light coloured fur.

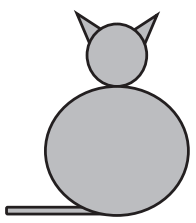
Cat A



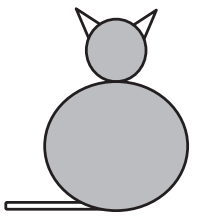
Cat B



Cat C



Cat D



Place a cross ☒ in the most appropriate box to select the diagram which represents:

(3)

a cat with normal tyrosinase	☒ A	☒ B	☒ C	☒ D
a cat with defective tyrosinase, in a hot country	☒ A	☒ B	☒ C	☒ D
a cat in a cold country with defective tyrosinase	☒ A	☒ B	☒ C	☒ D

(Total for Question 1 = 9 marks)

2 Stem cells are considered to be a potential treatment for many conditions. However, research on stem cells needs to be regulated.

*(a) Explain the meaning of the term **stem cell**.

(2)

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(b) State **three** potential sources of human stem cells.

(3)

1 .....

2 .....

3 .....

(c) (i) Suggest **two** reasons why there are regulating authorities for human embryo research.

(2)

1 .....

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2 .....

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(ii) Suggest why these regulating authorities should include people involved in human embryo research and people not involved in embryo research.

(2)

People involved in embryo research .....

.....

.....

People not involved in embryo research .....

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(Total for Question 2 = 9 marks)

3 In the 1990s, a scientist called Woese suggested a new way of grouping organisms into domains.

(a) The table below shows Woese's three domains and gives some of the characteristics of each domain.

Domain	Some characteristics of each domain
P	True nucleus absent Small (70S) ribosomes present Smooth endoplasmic reticulum absent RNA polymerase made up of 14 subunits
Q	True nucleus present Large (80S) ribosomes present Smooth endoplasmic reticulum present RNA polymerase made up of 14 subunits
R	True nucleus absent Small (70S) ribosomes present Smooth endoplasmic reticulum absent RNA polymerase made up of 4 subunits

(i) Place a cross ☒ in the box which shows the two domains which are most **distantly related**.

(1)

☒ **A** P and Q

☒ **B** P and R

☒ **C** Q and R

(ii) Place a cross ☒ in the box which shows the domain that represents eukaryotic organisms.

(1)

☒ **A** P

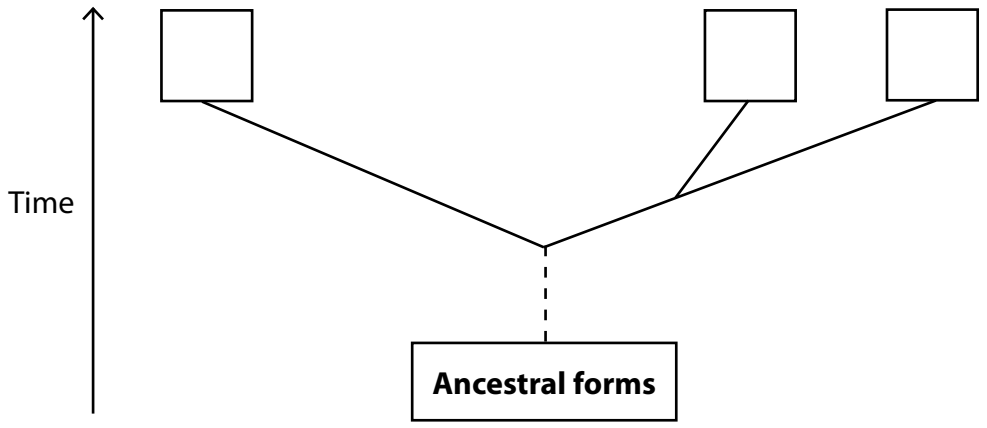
☒ **B** Q

☒ **C** R

(iii) The diagram below represents the phylogenetic tree for the three domains.

Place a cross (×) in the box on the diagram that correctly identifies the eukaryotic domain.

(1)



(iv) Give the name of **one** of the other two domains.

(1)

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(b) One domain includes the plants and these have cells with a cell wall.

*(i) Describe the structure of a plant cell wall.

(4)

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(ii) A student studied the cell wall arrangement between two adjacent plant cells. He noticed several features which he could not name. Two of these are described in the table below.

Complete the table by writing in the name of each feature described.

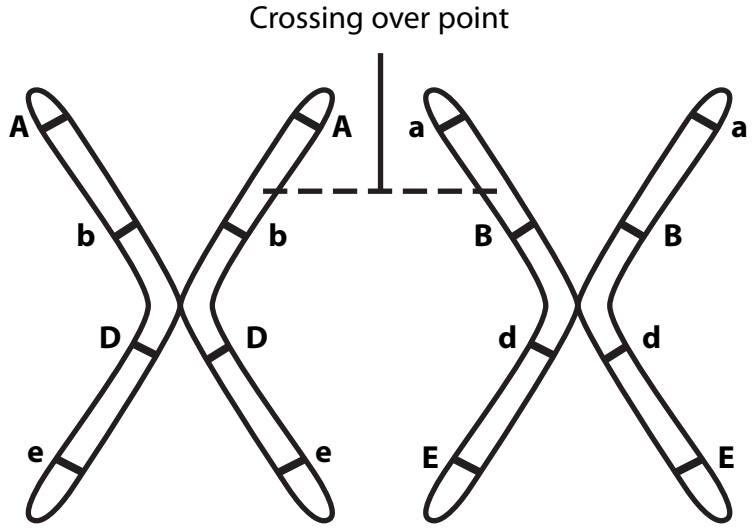
(2)

Feature described	Name of feature
Site where there was no cell wall and the cytoplasm linked the two adjacent cells	
Dark line that is the boundary between one cell and the next cell	

(Total for Question 3 = 10 marks)

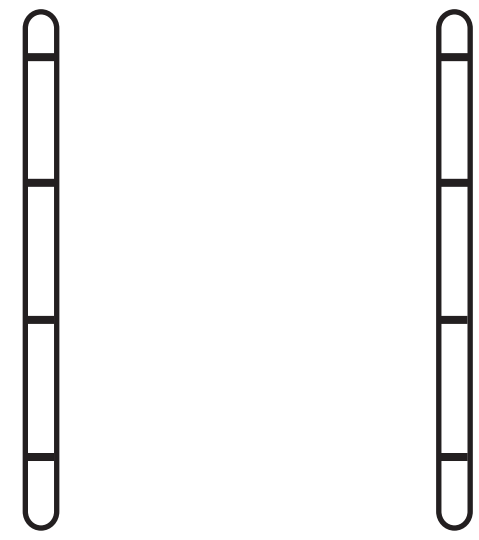
4 Meiosis leads to the production of gametes and is important in allowing genetic variation to occur.

(a) The diagram below shows one homologous pair of chromosomes during early meiosis.
Four genes (A, B, D and E) and the crossing over point have been labelled.



At the end of meiosis, four gametes will have been produced, each with a different combination of alleles.
Complete the diagram below to show the combination of alleles for the two recombinant chromosomes.

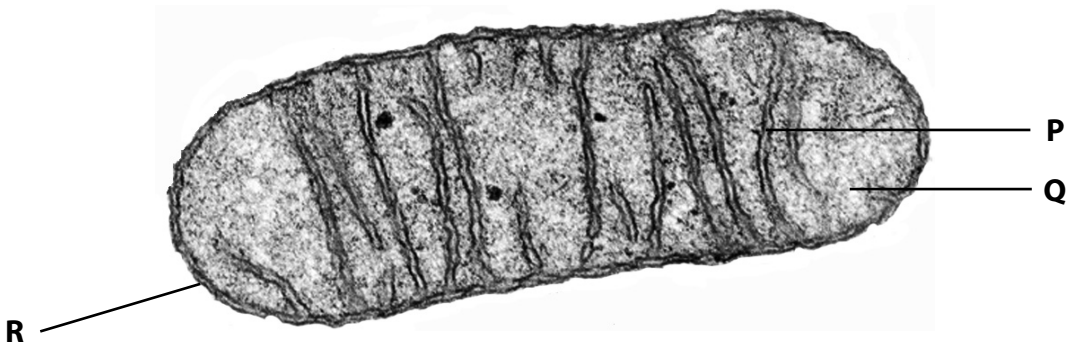
(1)



(b) Sperm cells are gametes. They contain mitochondria in their mid region.

(i) The photograph below shows a mitochondrion as seen using an electron microscope.

(3)



CNRI / Science Photo Library
Magnification x 90 000

Name the labelled structures shown in the photograph above.

P .....

Q .....

R .....

(ii) Explain the function of mitochondria in sperm cells.

(3)

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(c) In some species of mammal, at fertilisation most of the sperm cell enters the egg cell. The fertilised cell then divides by mitosis.

(i) A sperm cell containing 65 mitochondria fertilises an egg cell containing 100 000 mitochondria.
Calculate the percentage of the total mitochondria in this fertilised cell that come from the sperm cell. Show your working.

(2)

Answer ..... %

(ii) State how many cells there would be after the fertilised egg has divided, by mitosis, **four** times.

(1)

.....

(Total for Question 4 = 10 marks)

5 The rice plant is a type of grass and reproduces by producing grains.

Tom Myers / Agstockusa / Science Photo Library

(a) The rice grains are full of starch.

(i) Starch is a polymer of one monosaccharide.
Name this monosaccharide.

(1)

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*(ii) Describe **two** ways in which the structure of starch is related to its function.

(4)

Structure .....

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Function .....

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Structure .....

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Function .....

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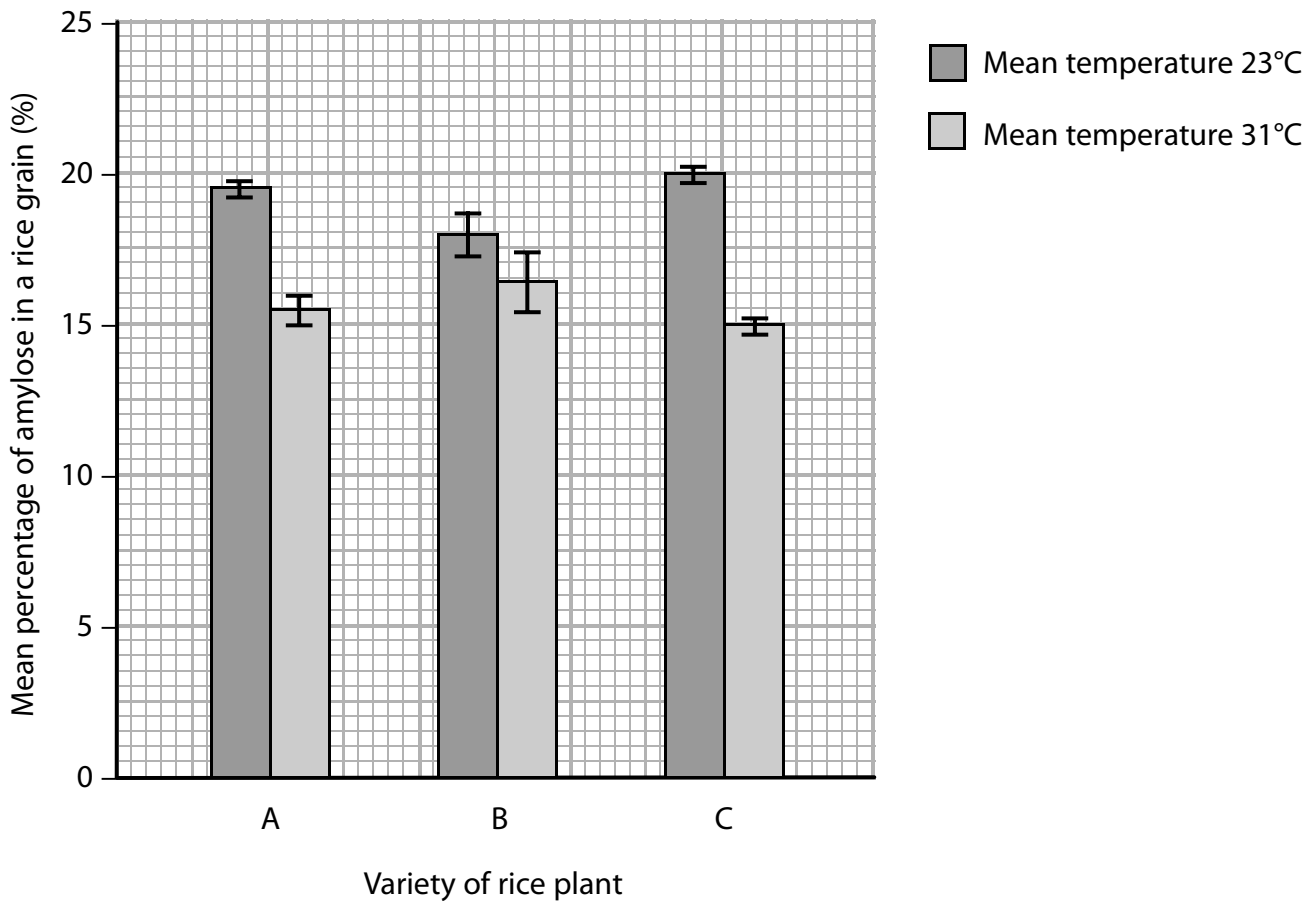
(b) Starch is made up of amylose and amylopectin. An investigation was undertaken to study the effect of temperature on amylose production in rice grains. Three different varieties of rice plant, A, B and C, were grown at a mean temperature of 23°C until they had produced mature rice grains. All other variables were kept constant.

Fifty rice grains were then collected from each variety and the mean percentage of amylose in a rice grain was determined.

This investigation was repeated at a mean temperature of 31°C.

The results are shown in the graph below.



(i) Describe the effect of temperature on the mean percentage of amylose in the rice grains of all three varieties of rice plant.

(2)

(ii) Using the information in the graph, suggest which set of data is least supportive of the statement that 'temperature has an effect on the percentage of amylose present in rice grains'. Explain your answer.

(3)

(Total for Question 5 = 10 marks)

6 Biodiversity, including both species richness and genetic diversity, is an important concept to be considered when organising captive breeding programmes.

(a) Explain what is meant by each of the following terms.

(3)

Niche .....

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Species richness .....

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(b) One way to measure genetic diversity is to find the percentage of genes that have different alleles.

The table below shows the percentage of genes that have different alleles in four types of cat.

Type of cat	Percentage of genes with different alleles (%)
Cheetah	4
Domestic cat	23
Lion	12
Ocelot	21

*(i) Using the information in the table above and your own knowledge, suggest why the cheetah is the cat at most risk if the environment changes.

(3)

(ii) Cheetahs are unusual amongst the big cats.

Cheetah and cub

Dr P. Marazzi / Science Photo Library

A female cheetah often mates with several different males and gives birth to two or three cubs at a time, each having a different father.

Suggest why this may be advantageous to cheetahs.

(2)

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(c) Rafa was a male cheetah involved in breeding programmes in several zoos.
The table below shows some data from Rafa's studbook.

Name of zoo housing Rafa	Event	Date of event
WINSTON	Birth of Rafa	24 Dec 1974
SD-WAP	Transfer	26 Nov 1980
LAGUNA HI	Transfer	9 Apr 1982
SD-WAP	Transfer	5 Dec 1984
BATON ROUGE	Transfer	11 Feb 1986

Suggest what effect transferring Rafa from one zoo to another had on genetic diversity in this species.

(2)

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(d) Place a cross ☒ in the box to the right of the statement that correctly describes an endemic animal.

(1)

Statement	
Ducks that migrate from one continent to another	☒
House fly that is found in all continents except Antarctica	☒
Cheetahs that are exclusive to one continent	☒

(Total for Question 6 = 11 marks)

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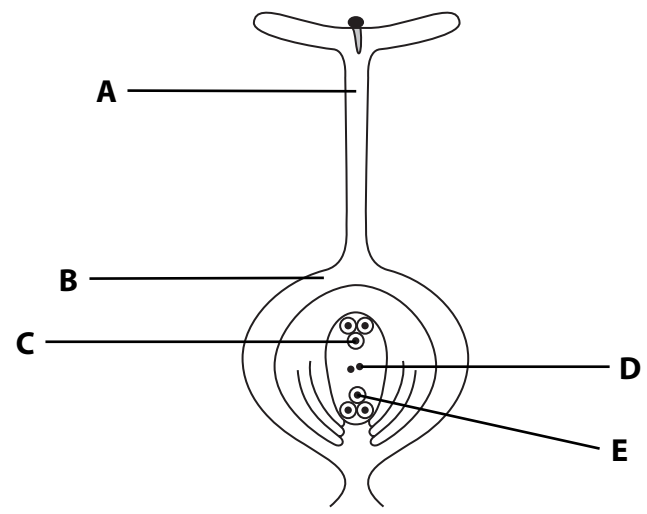
7 Pollen germination and pollen tube growth are important stages in plant sexual reproduction.

(a) The diagram below shows a pollen grain on the stigma of a flower.



(i) On the diagram above, draw a line to show the route taken by the pollen tube, from the pollen grain to the micropyle.

(2)

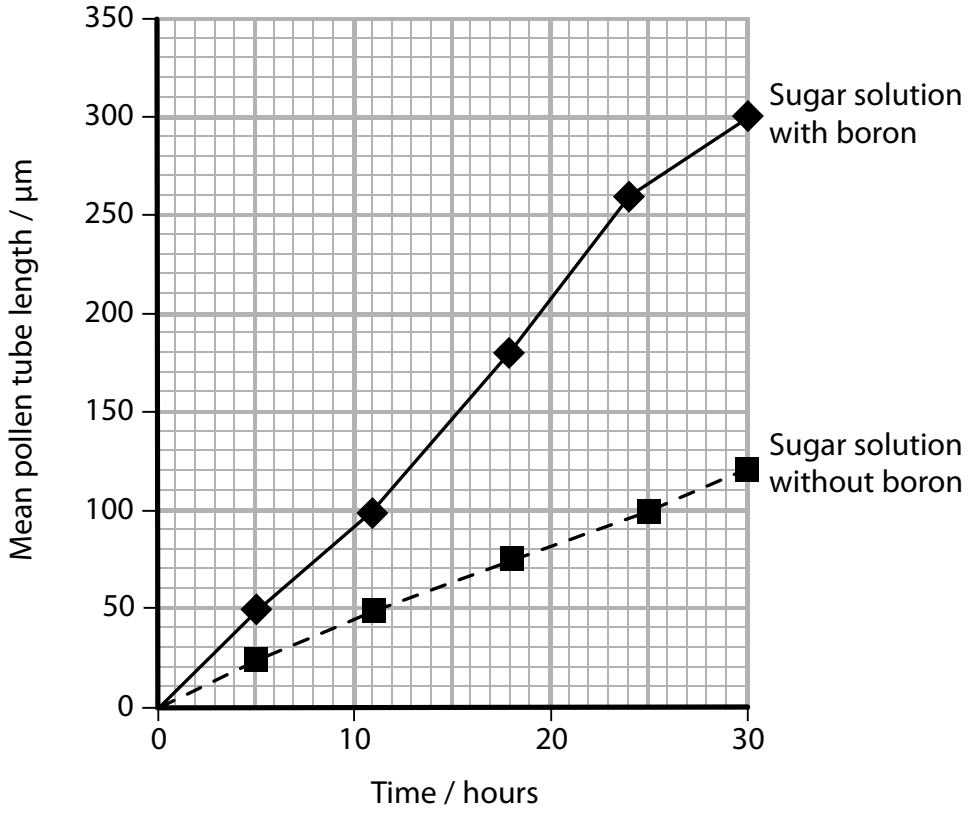
(ii) The table below shows the structures labelled on the diagram. Place a tick (✓) in the box next to each one in which the chromosome number increases at fertilisation.

(2)

Labelled structure	Tick (✓) if chromosome number increases at fertilisation
A	
B	
C	
D	
E	

(b) An investigation was undertaken to study the effect of the element boron on the growth of pollen tubes.
A large number of pollen grains was placed in a dilute sugar solution. Every six hours, for 30 hours, 500 pollen grains were removed and the length of the pollen tube of each was measured. The mean length of the pollen tubes was then calculated.
This was repeated with boron added to the dilute sugar solution.

The results are shown in the graph below.



(i) Using the information in the graph, compare the mean pollen tube length in these two sugar solutions, over this 30-hour period.

(3)

(ii) Using the result of this investigation, a student concluded that boron was necessary for pollen tube growth.
Suggest why another student disagreed with this conclusion.

(1)

(iii) Using the information in the graph, suggest an appropriate conclusion for the effect of boron on the rate of growth of pollen tubes.

(1)

(iv) Suggest the advantages to flowering plants of increased pollen tube growth.

(2)

(Total for Question 7 = 11 marks)

8 Plants usually take up nitrogen as nitrate ions for use in growth.

(a) An investigation was undertaken to study the effect of nitrate ion concentration on mitosis in the root tip of wheat seedlings.

Wheat seedlings were grown in a mineral solution containing a nitrate ion concentration of 3.3 mmol dm^{-3}. Root tip samples were taken and the number of cells undergoing mitosis per 500 cells was counted.
This was repeated using a nitrate ion concentration of 6.6 mmol dm^{-3}.
The results are shown in the table below.

Nitrate ion concentration / mmol dm^{-3}	Number of cells undergoing mitosis per 500 cells
3.3	25
6.6	19

(i) Using the information in the table, describe the effect of nitrate ion concentration on mitosis in root tips.

(2)

(ii) Suggest why a prediction of the number of cells undergoing mitosis, if the nitrate ion concentration used were 9.9 mmol dm^{-3}, would be unreliable.

(2)

(iii) To count the number of cells undergoing mitosis, a root tip squash was carried out.

Give **two** potential safety risks associated with the root tip squash technique. For one of the risks you have given, suggest a precaution to reduce the risk.

(3)

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QUESTION 8 CONTINUES ON THE NEXT PAGE

(b) Describe an experiment to find the optimum nitrate ion concentration for the growth of wheat seedling roots.

(3)

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(Total for Question 8 = 10 marks)

TOTAL FOR PAPER = 80 MARKS