Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Biology

Advanced Subsidiary
Unit 2: Development, Plants and the Environment

Thursday 26 May 2011 – 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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P 3 8 1 7 2 A 0 1 2 8

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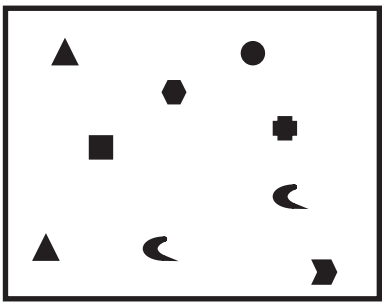
Answer ALL questions.

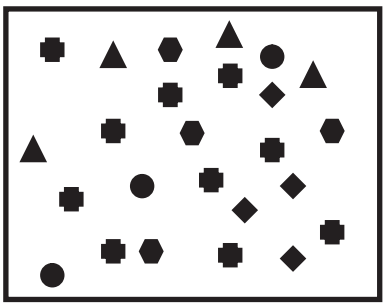
Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Biodiversity is an important concept in conservation.

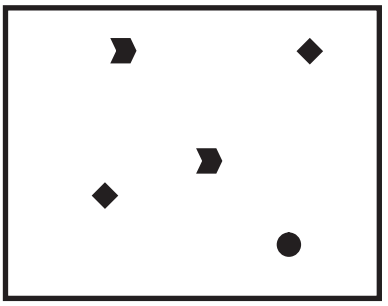
(a) The diagrams below show four identically sized areas A, B, C and D.
Different shapes represent different species.



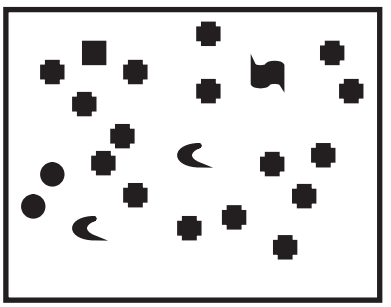
Area A



Area B



Area C



Area D

Place a cross ☒ in the box next to the correct letter to complete each of the following statements.

(i) The area with the highest species richness is

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D**

(ii) The area with the lowest species richness is

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D**

(iii) State which area contains an endemic species, giving reasons for your answer.

(3)

Area.....

Reasons.....

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(b) Zoos help to conserve rare endemic species through captive breeding programmes and reintroduction programmes.

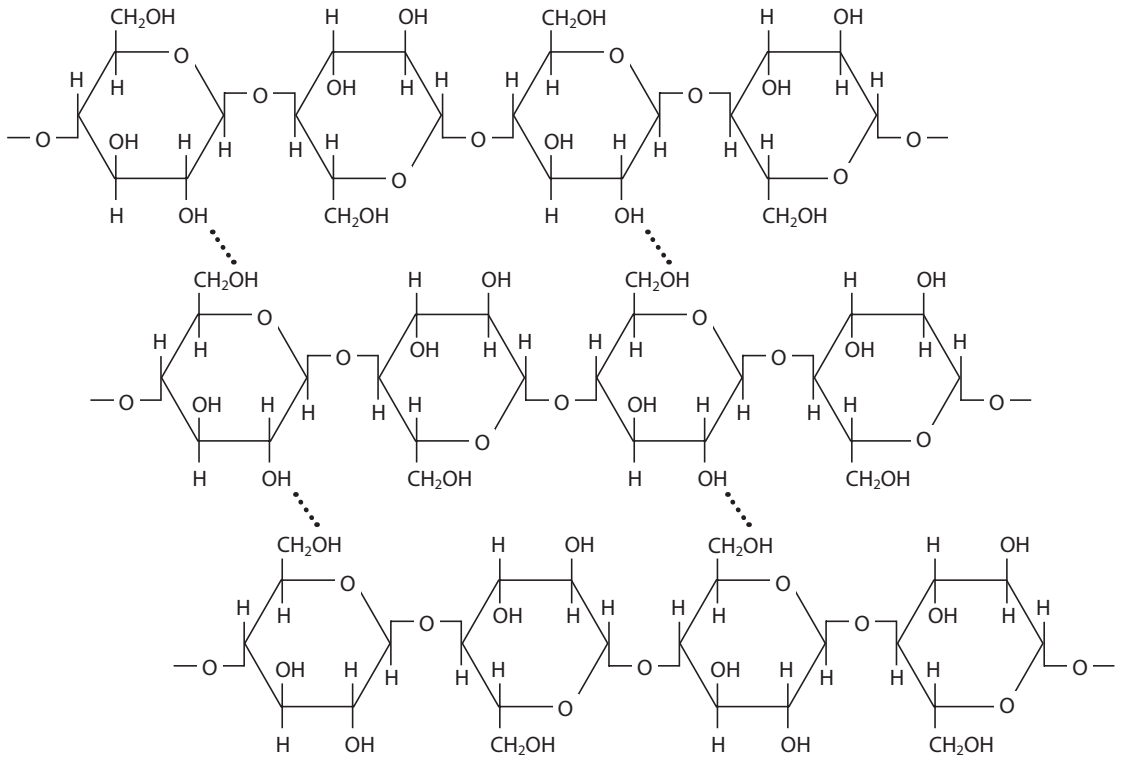
* Describe how zoos use these programmes to help conserve rare species.

(5)

(Total for Question 1 = 10 marks)

2 Cellulose and mineral ions are important components of a plant.

(a) The diagram below shows part of a cellulose microfibril.



(i) On the diagram above, draw a circle labelled **G** round **one** of the glycosidic bonds.

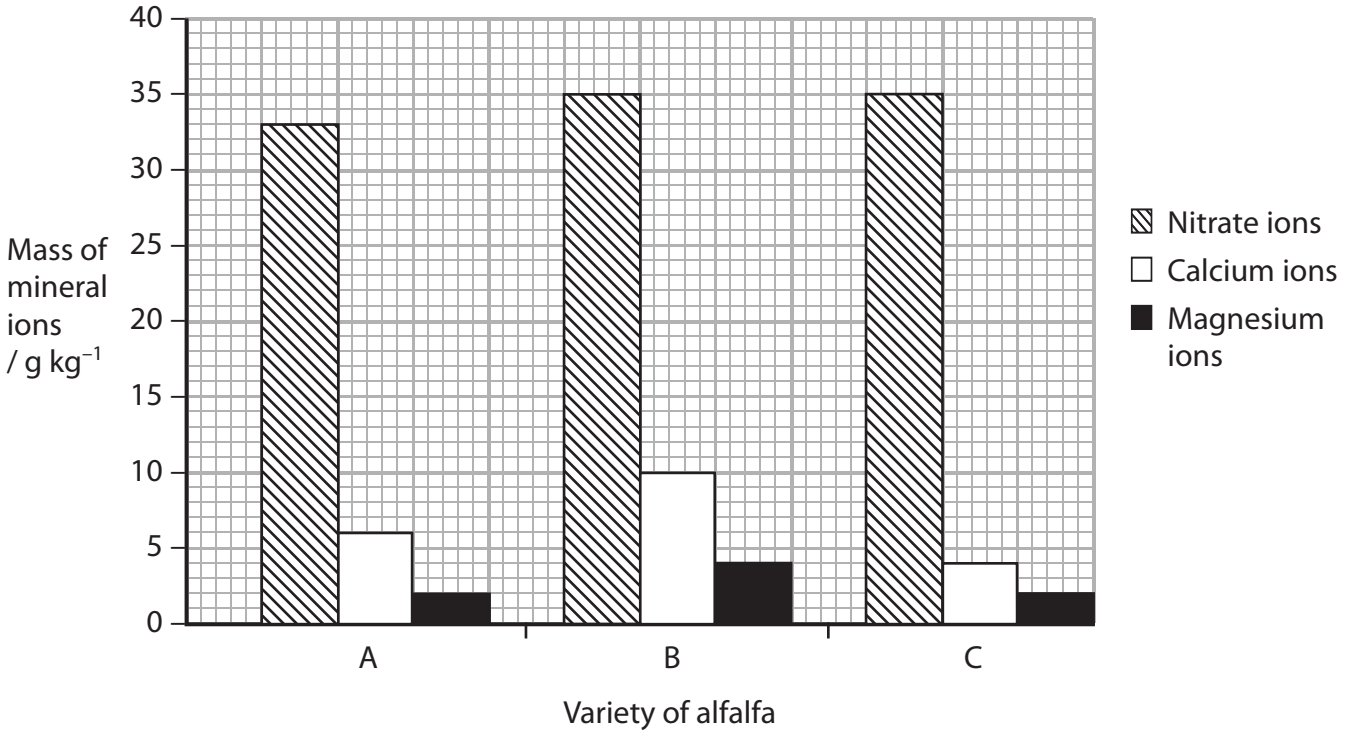
(1)

(ii) On the diagram above, draw a circle labelled **H** round **one** of the hydrogen bonds.

(1)

(b) An investigation was carried out to find the mass of mineral ions in three varieties (A, B and C) of the alfalfa plant.

The results of this investigation are shown in the graph below.



(i) Using the information in the graph, suggest which variety of alfalfa could have the highest concentration of chlorophyll. Give a reason for your answer.

(2)

Variety .....

Reason .....

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.....

(ii) Using the information in the graph, suggest which variety of alfalfa could have the strongest cell walls. Give an explanation for your answer.

(3)

Variety .....

Explanation .....

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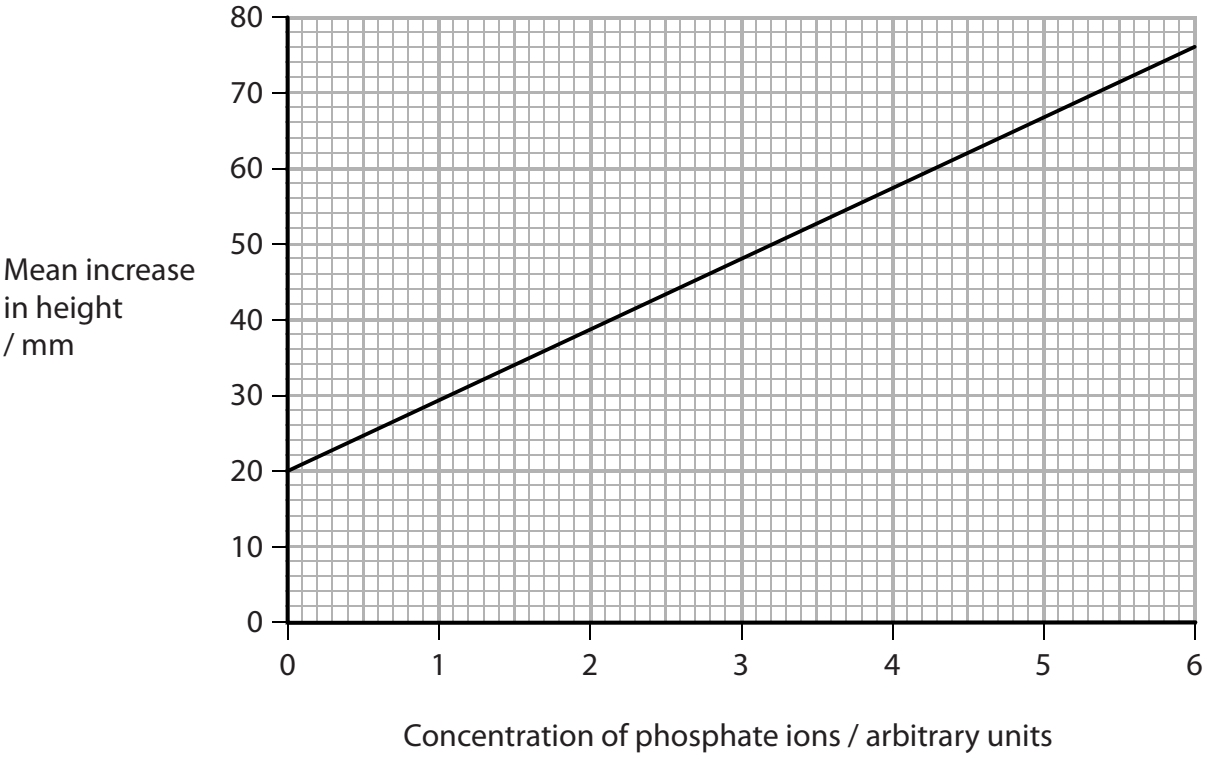
(c) An investigation was carried out to find the concentration of phosphate ions in a soil sample.

Five wheat seedlings were grown in a solution containing all necessary mineral ions, except for phosphate ions. After three weeks, the increase in height of each seedling was measured and the mean increase in height was calculated.

This procedure was repeated for solutions containing different concentrations of phosphate ions.

The results are shown in the graph below.



(i) Another five wheat seedlings were grown in a sample of soil for three weeks and their mean increase in height was found to be 45 mm.

Use the graph to estimate the concentration of phosphate ions in this sample of soil.

(1)

Answer ..... arbitrary units

(ii) In this investigation, all the seedlings were grown from seeds from the same wheat plant. Suggest why this would improve the validity of the results.

(1)

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(iii) Suggest **two** factors, other than the time for growth and the source of the seeds, that should have been kept constant in this investigation.

(2)

1 .....

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2 .....

.....

(Total for Question 2 = 11 marks)

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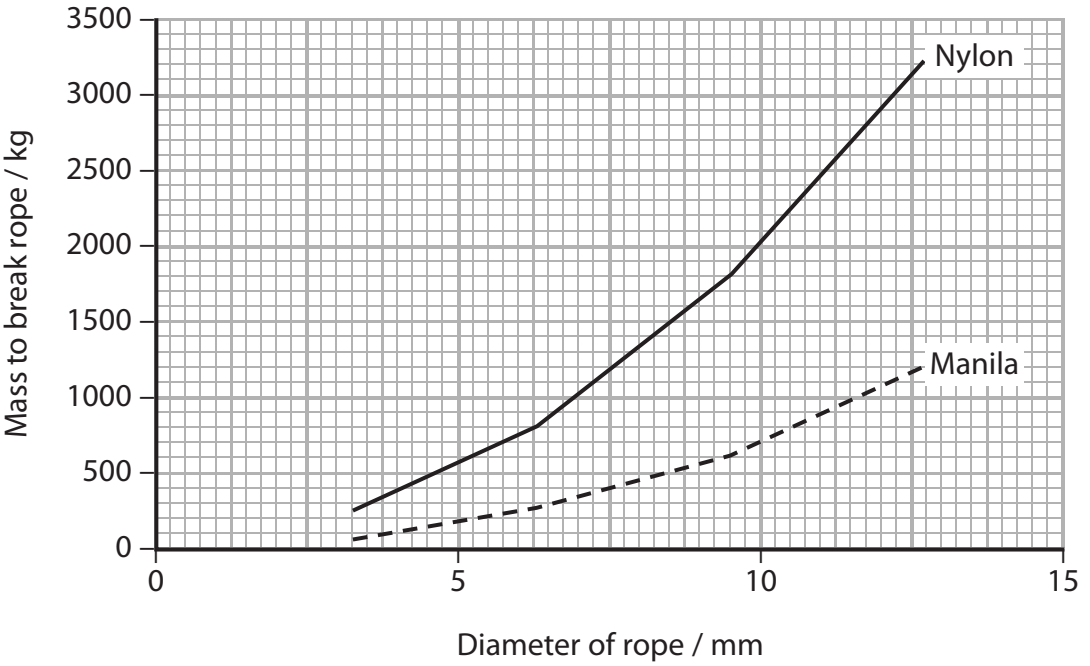
3 Ropes can be made from many substances including nylon and manila.
Nylon is a synthetic fibre. Manila is made of fibres from the *Musa textilis* plant, shown in the photograph below.

Malkolm Warrington / Science Photo Library

(a) The mass required to break ropes, of different diameters, made from nylon and manila was investigated.
The results of this investigation are shown in the graph below.

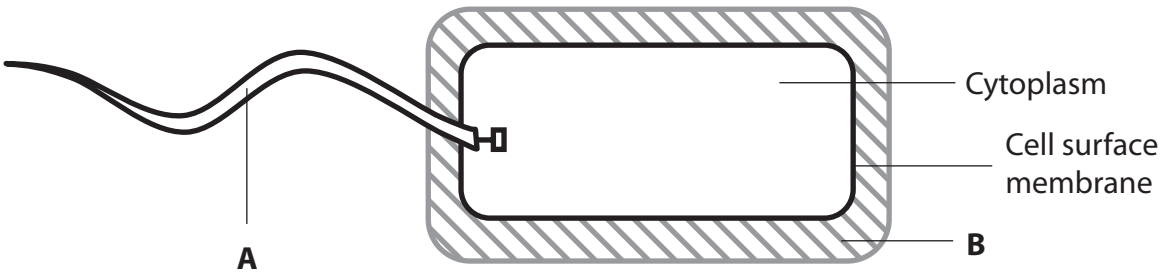


Compare the effect of increasing the diameter on the mass needed to break nylon rope rather than manila rope.

(3)

(b) In the process of making rope, waste material is produced. Some of these waste materials can be broken down by prokaryotic cells such as bacteria.

The diagram below shows the structure of a prokaryotic cell.



(i) Name the parts labelled **A** and **B** on the diagram.

(2)

A .....

B .....

(ii) On the diagram, draw and label **two** structures present in the cytoplasm.

(2)

(Total for Question 3 = 7 marks)

4 Mitosis and meiosis are both forms of nuclear division. Mitosis can be observed in root tip squashes from a plant such as garlic.

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

(i) The stain used in a root tip squash can be intensified by

(1)

☒ **A** adding acid

☒ **B** adding alkali

☒ **C** gently heating

☒ **D** squashing the tip

(ii) Mitosis occurs in

(1)

☒ **A** plant fibres

☒ **B** sclerenchyma fibres

☒ **C** stem cells

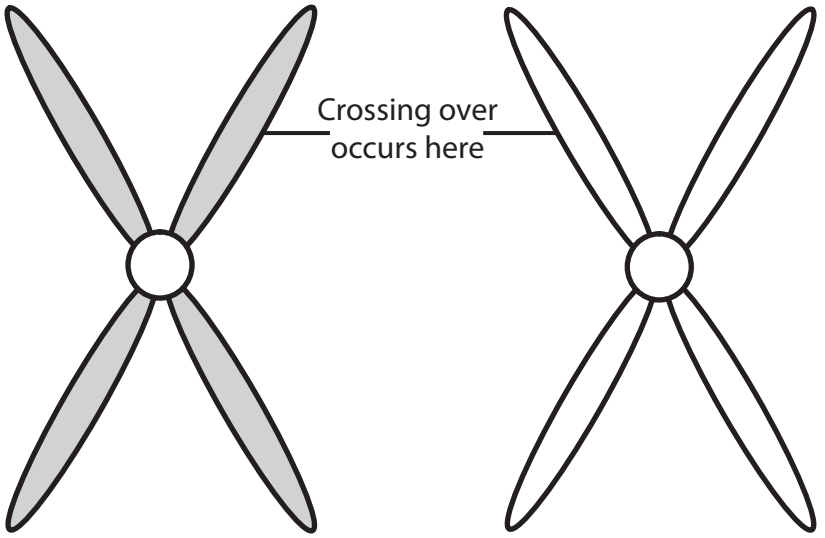
☒ **D** xylem vessels

(b) Describe the appearance of a cell in telophase of mitosis as seen in a root tip squash.

(3)

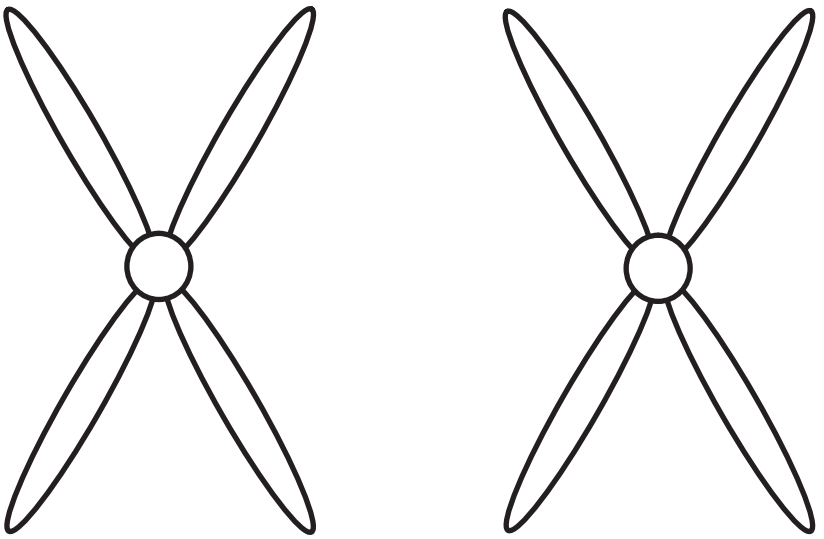
(c) One way in which meiosis increases genetic variation is through crossing over.

(i) The diagram below shows a pair of homologous chromosomes during meiosis. They are positioned next to each other but crossing over has not yet occurred.



Complete the diagram below to show these chromosomes after crossing over has occurred.

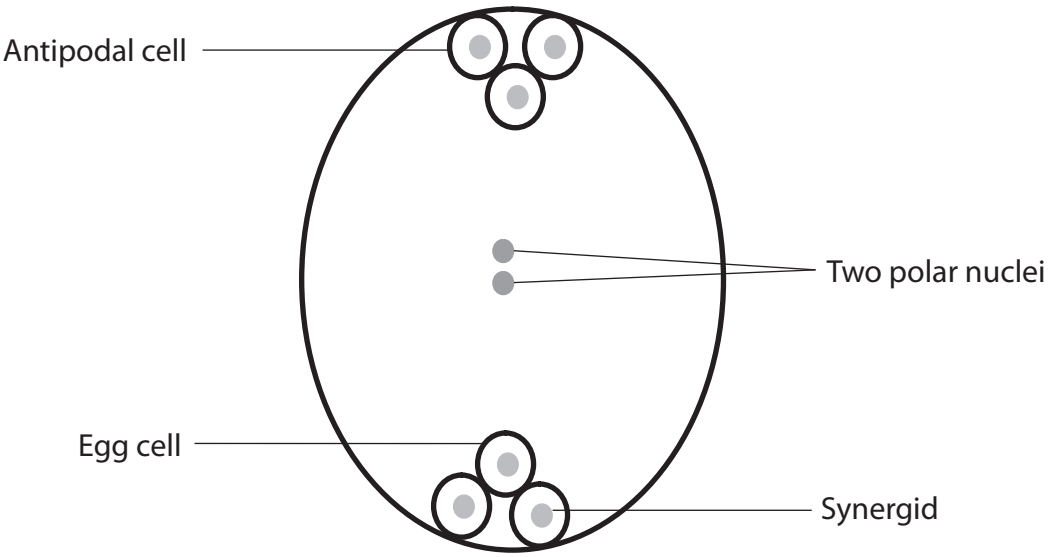
(1)



(ii) Meiosis produces haploid structures in the plant.

The diagram below shows an embryosac.
Draw a circle round each of the labels of **two** haploid structures that are fertilised in the embryosac.

(2)



(iii) Explain what is meant by the term **haploid number** of chromosomes.

(1)

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(Total for Question 4 = 9 marks)

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5 Genetic diversity is important for the long term survival, adaptation and evolution of organisms. Genetic diversity can be considered as the number of different alleles found at each gene locus in a population of organisms.

(a) Explain what is meant by the term **gene locus**.

(2)

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(b) The genetic diversity of two breeds of dog, P and Q, was investigated.
The total number of different alleles found at 31 gene loci was recorded for each breed.

The results are shown in the table below.

Breed of dog	Total number of different alleles at 31 gene loci
P	239
Q	144

(i) The mean number of different alleles per gene locus for both breeds was calculated.
Place a cross ☒ in the box next to the mean for breed P.

(1)

☒ **A** 5.7

☒ **B** 7.2

☒ **C** 7.7

☒ **D** 31.0

(ii) Breed Q has a mean of 4.6 different alleles per gene locus.
If their environment changed, breed P would be more likely to survive and evolve than breed Q.

Using information on mean number of different alleles per gene locus and your own knowledge, explain why breed P is more likely to survive and evolve than breed Q.

(5)

(c) Two groups of dogs, of breed P, were taken from the same population.
The total number of different alleles at the same 31 gene loci was recorded for each of these two groups.

The results are shown in the table below.

Group	Number of dogs of breed P	Total number of different alleles at 31 gene loci
1	40	239
2	20	215

Suggest why the total number of different alleles in group 1 was greater than in group 2.

(2)

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(d) Adaptation can be behavioural, physiological or anatomical.
Place a cross ☒ in the box that correctly identifies a **behavioural adaptation** in humans.

(1)

☒ **A** Long necks are more common in people living in hot dry conditions

☒ **B** More red blood cells in people living high up a mountain

☒ **C** More white blood cells in people with an infection

☒ **D** Taking a rest in the heat of the day

(Total for Question 5 = 11 marks)

6 Woese was the scientist who proposed a classification of organisms into three domains called the Archaea, Bacteria and Eukaryota (Eucarya).

(a) The table below shows some of the characteristics of the three domains.

Characteristic	Domain		
	A	**B**	**C**
Mitochondria	Absent	Absent	Present
Cell wall containing peptidoglycan	Yes	No	No
Amino acid carried on tRNA that starts protein synthesis	Formylmethionine	Methionine	Methionine
Sensitive to antibiotics	Yes	No	No
May contain chlorophyll	Yes	No	Yes

(i) Using the information in the table, suggest which of A, B and C represents the Eukaryota domain. Give a reason for your answer.

(2)

Domain .....

Reason .....

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(ii) Many scientists believe that the Eukaryota domain is more closely related to the Archaea domain than to the Bacteria domain.

Using the information in the table, suggest which of A, B and C represents the Archaea domain. Give a reason for your answer.

(2)

Domain .....

Reason .....

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.....

(b) Cells of the Eukaryota domain contain rough endoplasmic reticulum and Golgi apparatus.
Both the rough endoplasmic reticulum and the Golgi apparatus are made up of membrane-bound sacs.

(i) Describe how you would recognise the Golgi apparatus as seen using an electron microscope.

(3)

*(ii) Explain the roles of rough endoplasmic reticulum and the Golgi apparatus in a cell.

(6)

(Total for Question 6 = 13 marks)

7 Stem cells can differentiate into specialised cells and tissues.

(a) There are about 23 000 genes in a human body cell. The table below shows the number of genes that have not been switched off, in three different cells, A, B and C.

Cell	Number of genes that have not been switched off
A	11 000
B	18 000
C	23 000

Suggest which of these cells is a totipotent stem cell.
Give reasons for your answer.

(3)

Cell .....

Reasons .....

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(b) A fertilised egg can be used as a source of human pluripotent stem cells.

(i) Explain what is meant by the term **pluripotent stem cell**.

(2)

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(ii) Describe how a fertilised egg can be used as a source of human pluripotent stem cells.

(3)

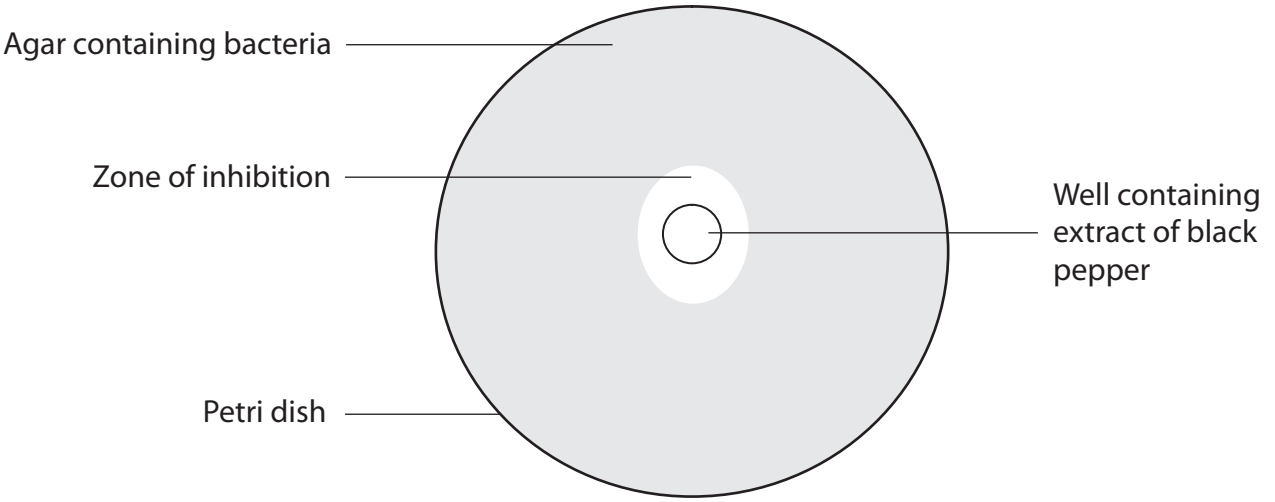
(Total for Question 7 = 8 marks)

8 An investigation was carried out to extract antimicrobial substances from black pepper.

One extraction method used ethanol. The black pepper was crushed and soaked in the ethanol for 24 hours. The crushed pepper was then removed, leaving an ethanol extract.

A Petri dish containing agar and one species of bacterium (B1) had a cylinder of agar removed to produce a well.
The ethanol extract was then placed in the well.

The Petri dish was incubated at 37 °C for 24 hours. After incubation, the diameter of the zone of inhibition around the well was measured. This was repeated using Petri dishes with different species of bacteria (B2, B3, B4 and B5).



The investigation was repeated using an extract prepared with hot water in place of ethanol.

(a) (i) Describe how the bacteria should be added to the Petri dish.

(2)

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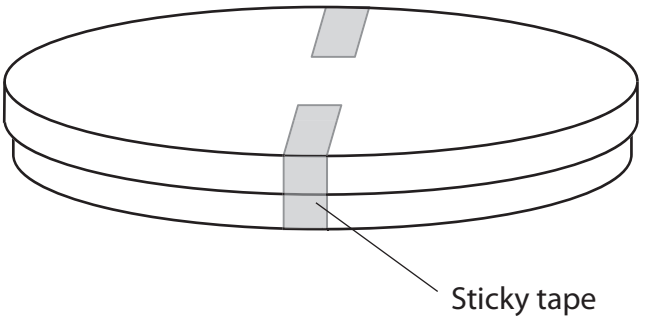
(ii) Before incubation, the lid was secured to the base of the Petri dish as shown in the diagram below.



Explain why the lid was secured in this way.

(2)

(iii) Suggest why an incubation temperature of 37 °C should not be used in a school or college laboratory.

(1)

(b) The results of this investigation are shown in the table below.

Species of bacterium	Mean diameter of zone of inhibition / mm	
	Ethanol extract	Hot water extract
B1	27.4	18.2
B2	26.2	16.8
B3	15.0	29.6
B4	25.0	16.4
B5	15.0	29.8
Mean	21.7	22.2

(i) One student used the data in the table to form the hypothesis that using ethanol was more effective than hot water at extracting antimicrobial substances from crushed black pepper.

Give evidence from the table that supports this hypothesis.

(1)

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(ii) A second student formed the hypothesis that using hot water to extract the antimicrobial substances was more effective than using ethanol.

Give evidence from the table that supports this hypothesis.

(1)

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(c) Another investigation was carried out using cold water to extract the antimicrobial substances. The same method was used but only bacterium species B1 was tested.
The table below shows the mean diameter of the zones of inhibition and the ranges of the data.

Mean diameter of zone of inhibition / mm	
Hot water extract	**Cold water extract**
18.2 ± 1.4	16.4 ± 0.6

(i) A third student stated that some of the results for the hot water extract overlapped with some of the results for the cold water extract.

Suggest what evidence from the table above the student could have used to support this statement.

(2)

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(ii) Using the table above, suggest whether the data for the hot or cold water extract were more reliable. Give a reason for your answer.

(2)

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(Total for Question 8 = 11 marks)

TOTAL FOR PAPER = 80 MARKS

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