Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 3 GCE

Thursday 23 May 2024

Morning (Time: 1 hour 30 minutes)

Paper reference **8BN0/02**

Biology A (Salters Nuffield)

Advanced Subsidiary

PAPER 2: Development, Plants and the Environment

You must have:
Calculator, HB pencil, ruler

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.*

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.*
- 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.

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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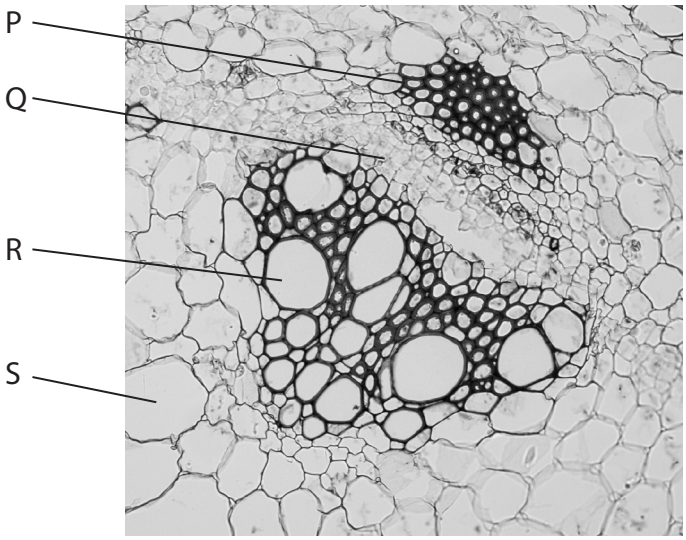
Answer ALL questions. Write your answers in the spaces provided.

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 Plant tissues can be observed using a light microscope.

(a) The photograph shows a cross section through part of a plant stem.



(Source: Sinhyu / Getty Images)

(i) Which of the following letters labels a xylem vessel?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(ii) Which of the following is the main function of xylem vessels?

(1)

☒ **A** transport of mineral ions and organic solutes

☒ **B** transport of water and mineral ions

☒ **C** transport of water and organic solutes

☒ **D** transport of water, mineral ions and organic solutes

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(iii) Which of the following tissues contains sieve tubes?

(1)

☒ **A** epidermal

☒ **B** phloem

☒ **C** sclerenchyma

☒ **D** xylem

(b) Calcium ions are transported through plant tissues.

Explain the importance of calcium ions to plants.

(3)

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(Total for Question 1 = 6 marks)

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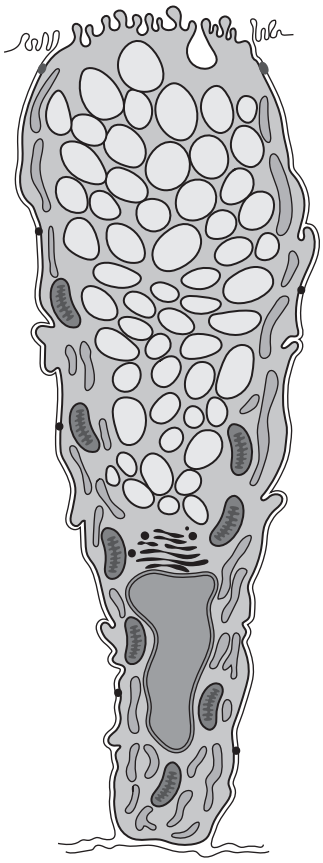
2 Prokaryotic and eukaryotic cells contain genetic material.

These cells also contain structures involved in protein synthesis.

(a) The diagram shows a goblet cell found in animals.



(i) Draw and label a nucleolus on the diagram.

(1)

(ii) Name an organelle, other than the nucleus, that contains DNA.

(1)

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(iii) Describe the organisation of DNA in the nucleus of a eukaryotic cell.

(2)

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(b) The ribosomes in both prokaryotic and eukaryotic cells are involved in protein synthesis.

The photograph shows a Golgi apparatus found in eukaryotic cells.

(Source: Aldona Griskeviciene / Shutterstock)

(i) Compare and contrast the structure of the Golgi apparatus with the structure of the rough endoplasmic reticulum (rER).

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(ii) Describe the roles of the rER and the Golgi apparatus in the processing of proteins.

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(Total for Question 2 = 10 marks)

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3 Colour vision deficiency can be inherited.

This deficiency occurs because some of the cells in the eyes, called cone cells, are either missing or do not work properly.

(a) State the name given to the position of a gene on a chromosome.

(1)

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(b) The gene for red-green colour deficiency is found on the X chromosome.

The allele for normal colour vision is dominant (B).

(i) Explain the ways that a mother with normal colour vision could have a child with red-green colour deficiency.

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(ii) Explain why a mother with the genotype $X^B X^b$ has functioning cone cells.

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(iii) What is the probability of parents with genotypes $X^B X^b$ and $X^B Y$ having a child who is both male and colour blind?

(1)

☒ **A** 0.00

☒ **B** 0.25

☒ **C** 0.50

☒ **D** 0.75

(Total for Question 3 = 7 marks)

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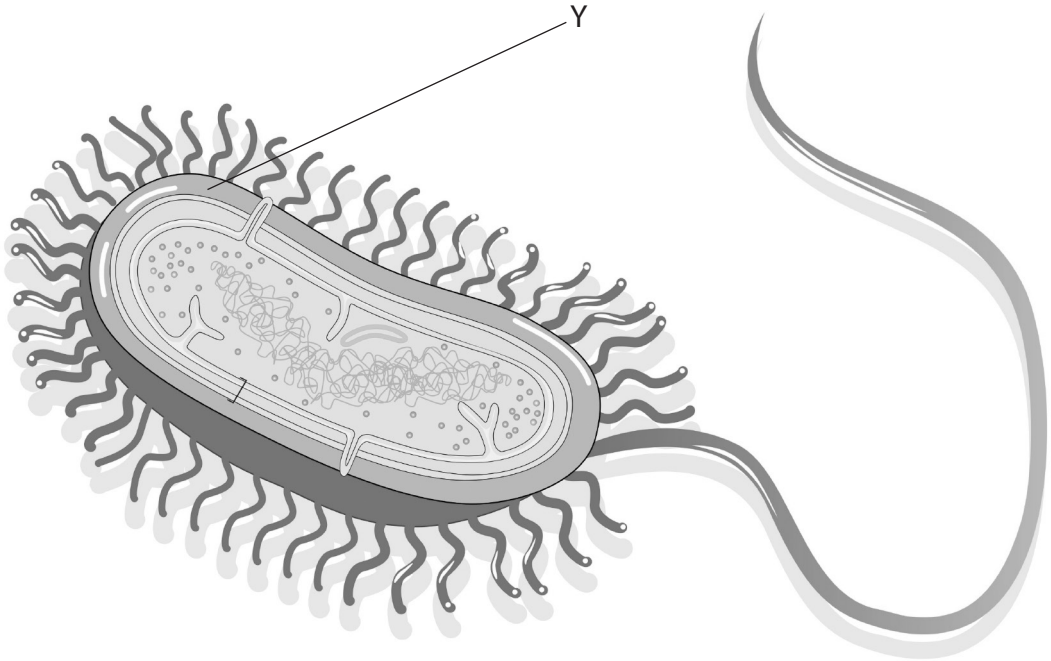
4 (a) Eukaryotic and prokaryotic cells share some common features, although there are differences in the structures of the two types of cell.

Bacteria are prokaryotic cells.

The diagram shows the structure of a bacterium.



(Source: Soleil Nordic / Shutterstock)

(i) Which one of the following is the structure labelled Y?

(1)

☒ **A** capsule

☒ **B** mesosome

☒ **C** plasmid

☒ **D** ribosome

(ii) Which one of the following describes the size of ribosomes found in bacteria?

(1)

☒ **A** larger than in eukaryotes

☒ **B** smaller than in eukaryotes

☒ **C** the same size as in eukaryotes

☒ **D** variable in size

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(b) Eukaryotic organisms can be multicellular.

They contain stem cells that can give rise to specialised cells.

(i) State what is meant by the term **totipotent stem cell**.

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(ii) Explain how totipotent stem cells can give rise to specialised cells.

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(Total for Question 4 = 8 marks)

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5 In 1832, the great bustard became extinct in the UK.

A reintroduction project released 20 of these birds into the wild.

(a) The Hardy–Weinberg equation can be used to calculate allele frequencies in populations.

This was used to determine the genetic diversity of this group of birds.

Two alleles were identified for one gene. The frequency of the dominant allele for this gene was found to be 0.8

(i) Use the Hardy–Weinberg equation to calculate the number of birds in this group that would have the dominant phenotype.

(3)

$$p^2 + 2pq + q^2 = 1$$

Answer .....

(ii) If only 20 birds were released, the Hardy–Weinberg equilibrium would change over time.

How many of the following statements could cause a change in this equilibrium?

- alleles will mutate due to selection pressure
- some alleles may be lost over generations
- some alleles may be introduced by migration of birds

(1)

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

(b) Reintroduction programmes must ensure that the proposed site is a suitable environment.

(i) State the term used to describe the role of an organism in its environment.

(1)

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(ii) Explain the genetic benefits of reintroducing birds collected from different regions.

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(c) Explain how breeding programmes in zoos can maximise genetic variation in populations before reintroduction to their natural habitat.

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(Total for Question 5 = 11 marks)

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6 Fibres can be extracted from tissues of some plants. There is often variation in the composition of these fibres.

(a) Plant fibres contain cellulose. There are similarities and differences between the structures of cellulose and starch.

Compare and contrast the structures of molecules of cellulose and starch.

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(b) Jute fibres can be used on their own or mixed with other materials to form a composite.

An investigation determined the tensile strength of jute fibres and two composite fibres containing jute.

The table shows the results of this investigation.

Fibre	Tensile strength / MPa
Jute	563
Jute-epoxy	513
Jute-polypropylene	44

Determine the effect on tensile strength of mixing jute with other materials.

(3)

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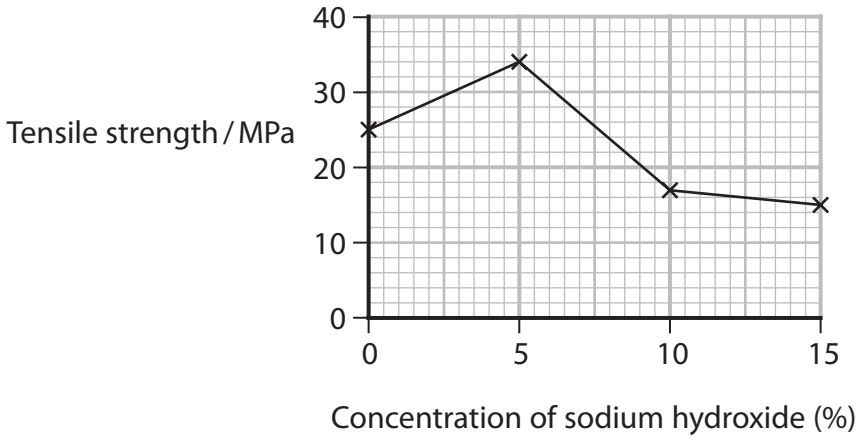
(c) In another investigation, the tensile strength of plant fibres treated with sodium hydroxide was measured.

The results of this investigation are shown in the graph.



Devise an investigation to determine the concentration of sodium hydroxide that produces the highest tensile strength in plant fibres.

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(Total for Question 6 = 12 marks)

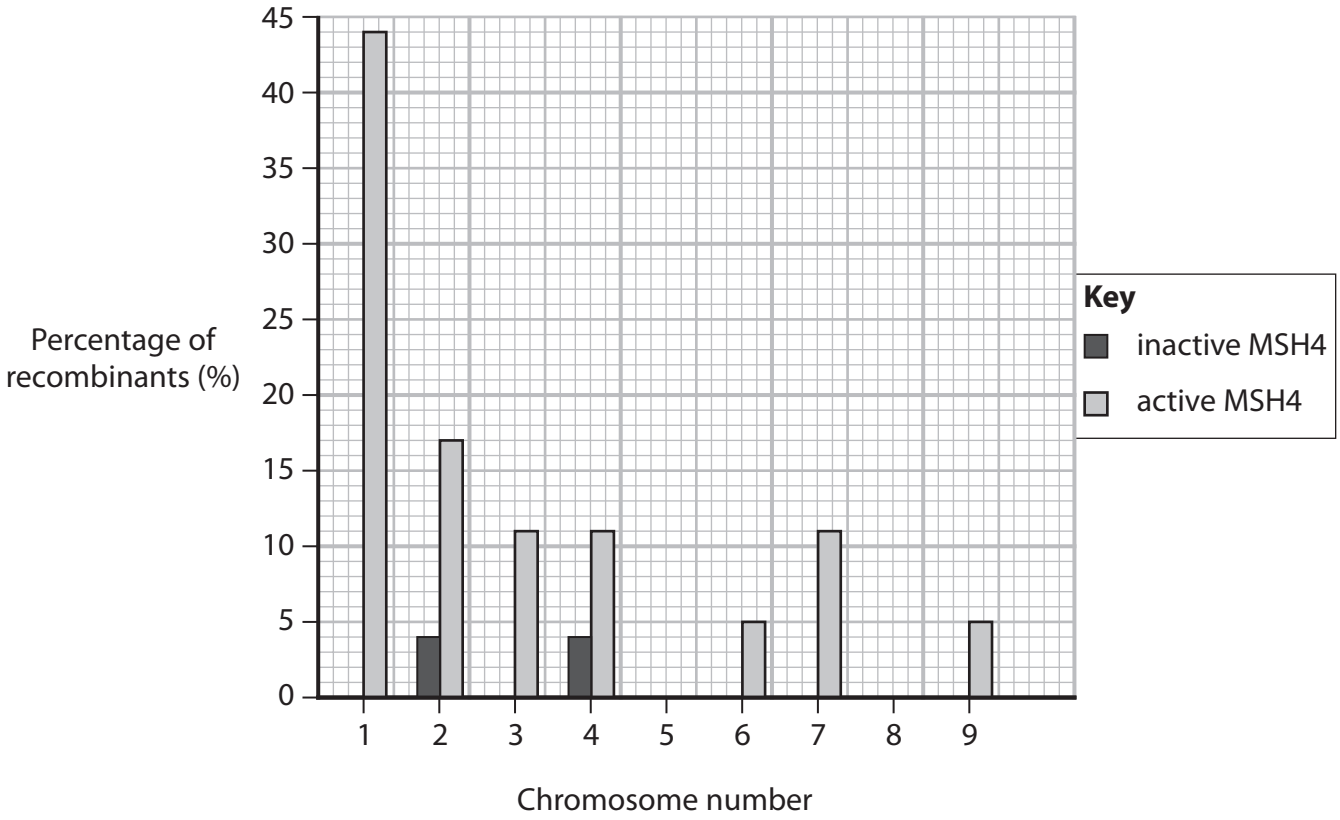
7 Chromosomes are able to transfer sections of DNA between homologous pairs during meiosis.

This forms recombinant chromosomes.

(a) The MSH4 gene affects crossing over during cell division.

The graph shows the effect of MSH4 gene activity on the percentage of recombinant chromosomes formed during meiosis.

Chromosomes are numbered according to length, with chromosome number 1 being the longest.



(i) Calculate the ratio of the percentage of the recombinants for chromosome 2 when the MSH4 gene is inactive and active.

(1)

Answer .....

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(ii) Deduce the effect of the MSH4 gene on the gametes produced.

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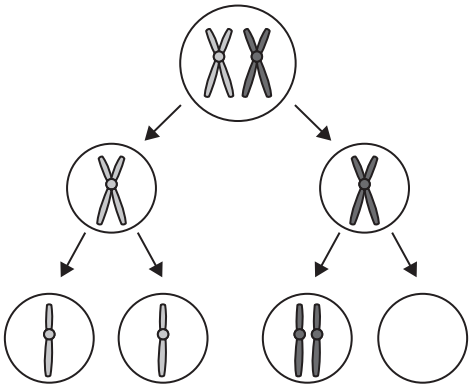
(b) During the process of meiosis, chromatids may not separate properly.

The diagram shows this effect.



Deduce how this can cause problems at fertilisation.

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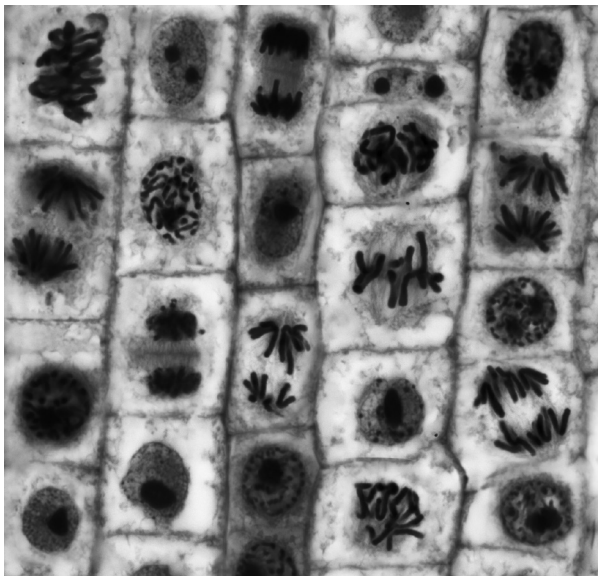
(c) A mitotic index can be calculated to show the proportion of cells in a tissue undergoing mitosis.

The photograph shows a selection of cells in a tissue.



(Source: STEVE GSCHMEISSNER / SCIENCE PHOTO LIBRARY)

Calculate the mitotic index for the intact cells in the photograph using this formula.

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}} \times 100$$

(2)

Answer .....

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(d) Some plants grown for fruit have extra sets of chromosomes.

The table shows the chromosome number for three different species of strawberry plant.

Species	Chromosome number
Fragaria moschata	42
Fragaria orientalis	28
Fragaria chiloensis	56

Describe how root tip squashes can be used to find out if chromosome number affected mitosis in these species of strawberry plant.

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8 Biodiversity is affected by agricultural methods such as the practice of monoculture.

Monoculture involves growing a single crop with no other species of plant.

(a) State **two** methods for measuring biodiversity in a habitat.

(2)

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(b) Monoculture can result in an increase in pest species that damage crops.

The photograph shows aphids, a pest species that damages plants grown for pasture and as crops.

(Source: HEATH MCDONALD / SCIENCE PHOTO LIBRARY)

Which one of the following adaptations of aphids is a physiological adaptation?

(1)

☒ **A** dropping from plant stems when approached by predator species

☒ **B** long, thin mouthparts that are pushed into the phloem of the plant

☒ **C** mature individuals are green in colour

☒ **D** they can reproduce sexually or asexually

(c) Cotton is an example of a crop grown as a monoculture.

Explain why the production of cotton fibres from cotton plants is sustainable.

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(d) Cattle farming in Brazil has made use of monoculture pasture.

The native grassland ecosystem has been replaced with pastures sown with grass plants not native to Brazil.

This has resulted in a loss of biodiversity.

Agroforests have been introduced to enhance biodiversity. These aim to provide food for cattle and restore biodiversity.

Agroforest involves growing a mixture of trees, shrubs and grasses.

Scientists monitored the biodiversity of insect species in an area of monocultural pasture and an area of agroforest.

Some of their results are shown in the table.

Group of insects	Total number of insects		Number of species	
	Agroforest	Monocultural pasture	Agroforest	Monocultural pasture
Hemiptera (bugs)	23 133	18 571	111	89
Hymenoptera (bees and wasps)	12 503	7 075	348	270
Diptera (flies)	8 184	15 470	219	203
Coleoptera (beetles)	2 772	171	348	306
Mantodea (mantids)	13	10	3	1

(i) Calculate the percentage change in the total number of Diptera insects found in agroforest compared with the monocultural pasture.

Give your answer to 3 significant figures.

(2)

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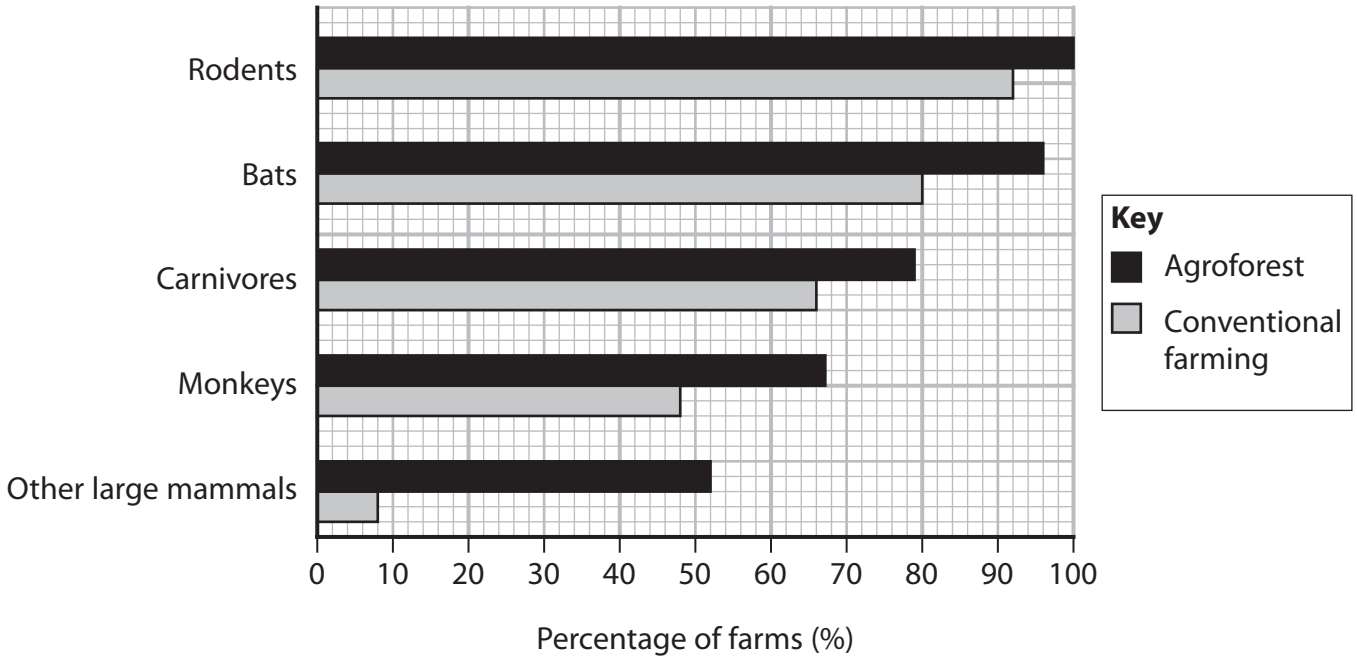
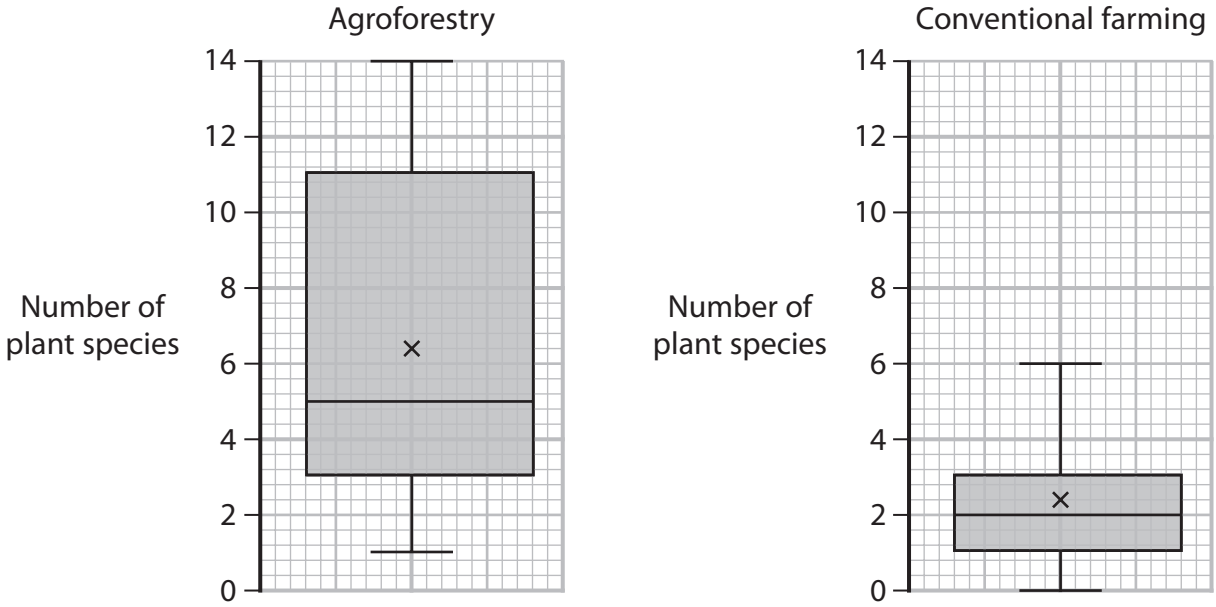
*(ii) Another study in Brazil recorded which mammal species farmers had observed.

The study involved 75 farms using agroforestry and 64 farms using conventional farming methods such as monoculture pasture.

The graph shows the percentages of farms recording the presence of the different types of mammal.



The boxplot graphs show the number of plant species found in these two types of farm. The x represents the mean, the line inside the box shows the median.



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Explain how a change from monocultural pasture to agroforestry can increase biodiversity.

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(Total for Question 8 = 13 marks)

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