

1 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)

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

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(Total for Question 1 = 13 marks)

2 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

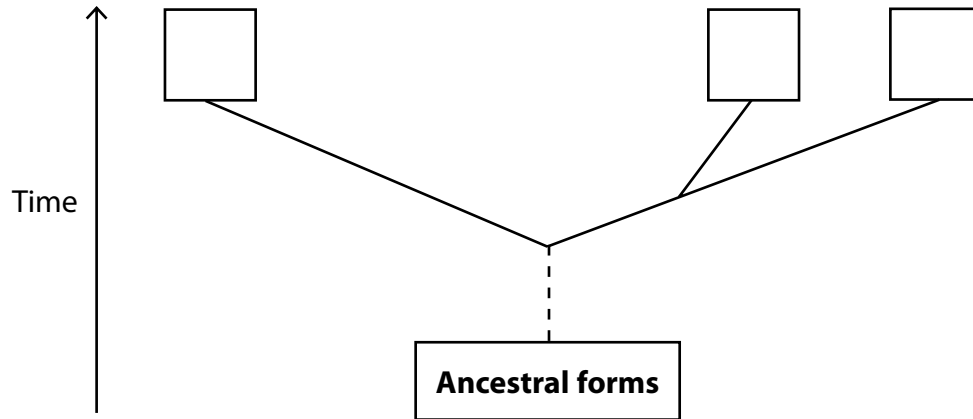
B Q

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)

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

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

(4)

- (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)

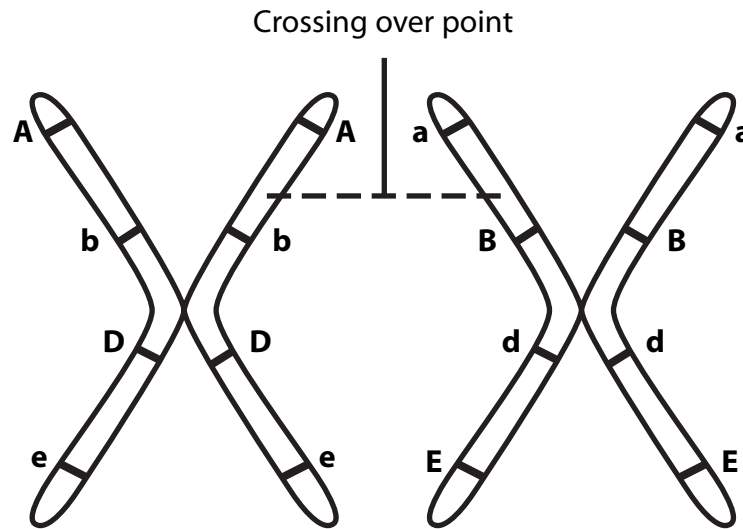
Feature described	Name of feature
Site where there was no cell wall and the cytoplasm linked the two adjacent cells	
Dark line that is the boundary between one cell and the next cell	

(Total for Question 2 = 10 marks)

3 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.

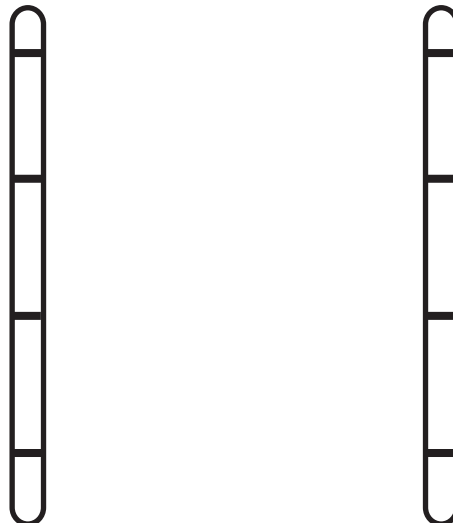
Four genes (A, B, D and E) and the crossing over point have been labelled.



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 3 = 10 marks)

4 Meiosis and mitosis are involved in cell division.

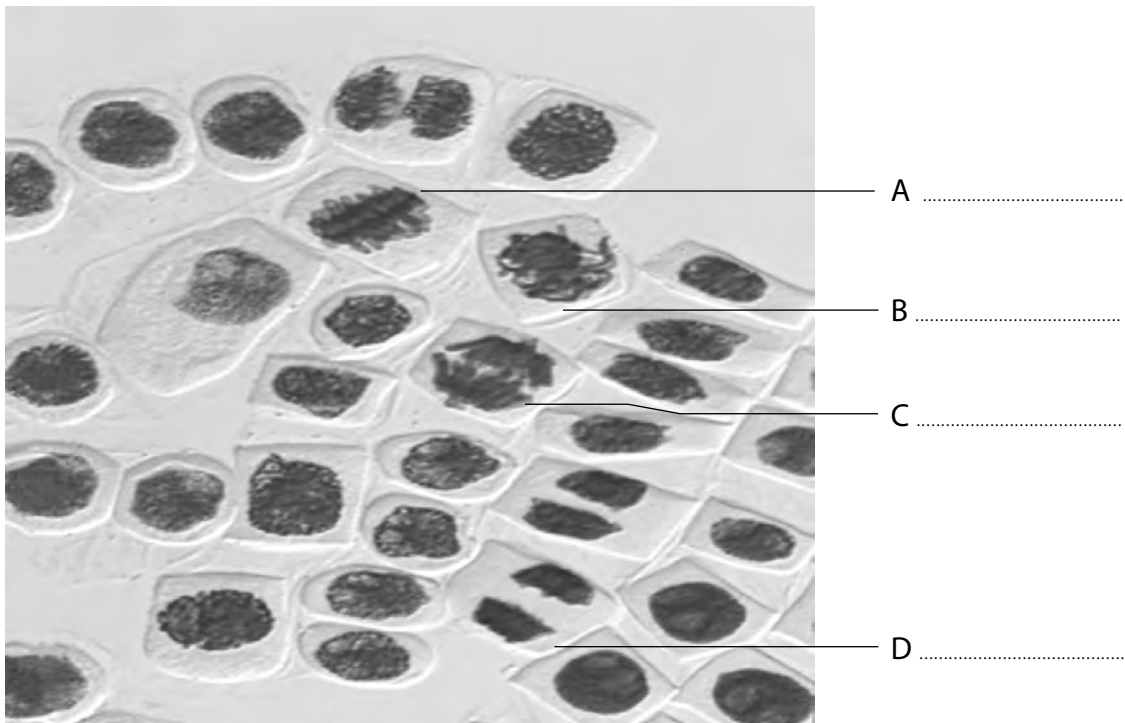
(a) The table below gives some statements about cell division. Place a tick (✓) in the box if **meiosis** is involved.

(2)

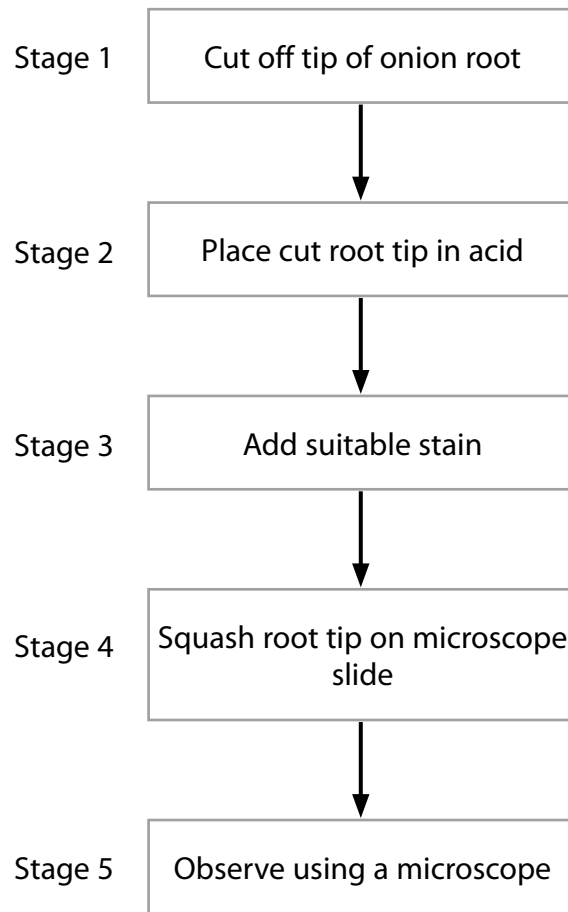
Statements about cell division	Meiosis is involved
Required for both sexual and asexual reproduction	
Produces gametes	
Crossing over can occur	
Occurs in mammals but not flowering plants	

(b) The photograph below shows some cells undergoing **mitosis**. Each of the cells A, B, C and D is in a different stage of mitosis. Write the name of the stage next to the appropriate letter.

(4)



(c) The diagram below shows some stages in the production of a root tip squash to observe mitosis.



(i) Suggest why the **tip** of the onion root is used.

(1)

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(ii) Suggest why acid is used in stage 2.

(1)

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(iii) Name a suitable stain for the root tip squash.

(1)

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(iv) There are various risks associated with the production of a root tip squash.
Suggest **two** risks and the precautions you would take to minimise each risk.

(2)

1

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2

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(Total for Question 4 = 11 marks)
