

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel International Advanced Level

Wednesday 15 January 2025

Morning (Time: 1 hour 30 minutes)

Paper reference **WBI12/01**

Biology

International Advanced Subsidiary/Advanced Level

UNIT 2: Cells, Development, Biodiversity and Conservation

You must have:
Scientific calculator, ruler, HB pencil

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.*
- **Show all your working out** in calculations and **include units** where appropriate.

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.*
- In the question 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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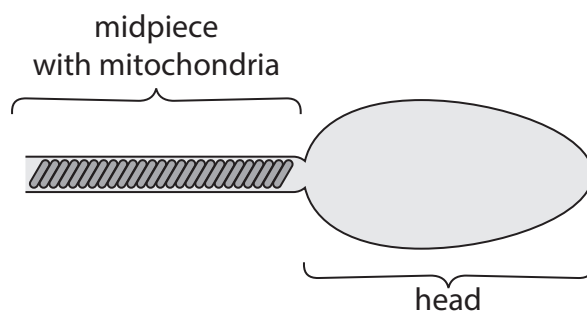


Answer ALL questions.

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 A sperm cell is specialised for its function.

(a) The diagram shows part of a labelled sperm cell.



(i) Complete the diagram by drawing and labelling a flagellum and an acrosome.

(1)

(ii) Give the function of the mitochondria in the midpiece of the sperm.

(1)

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(b) Some male mice will mate with only one female and some will mate with more than one female.

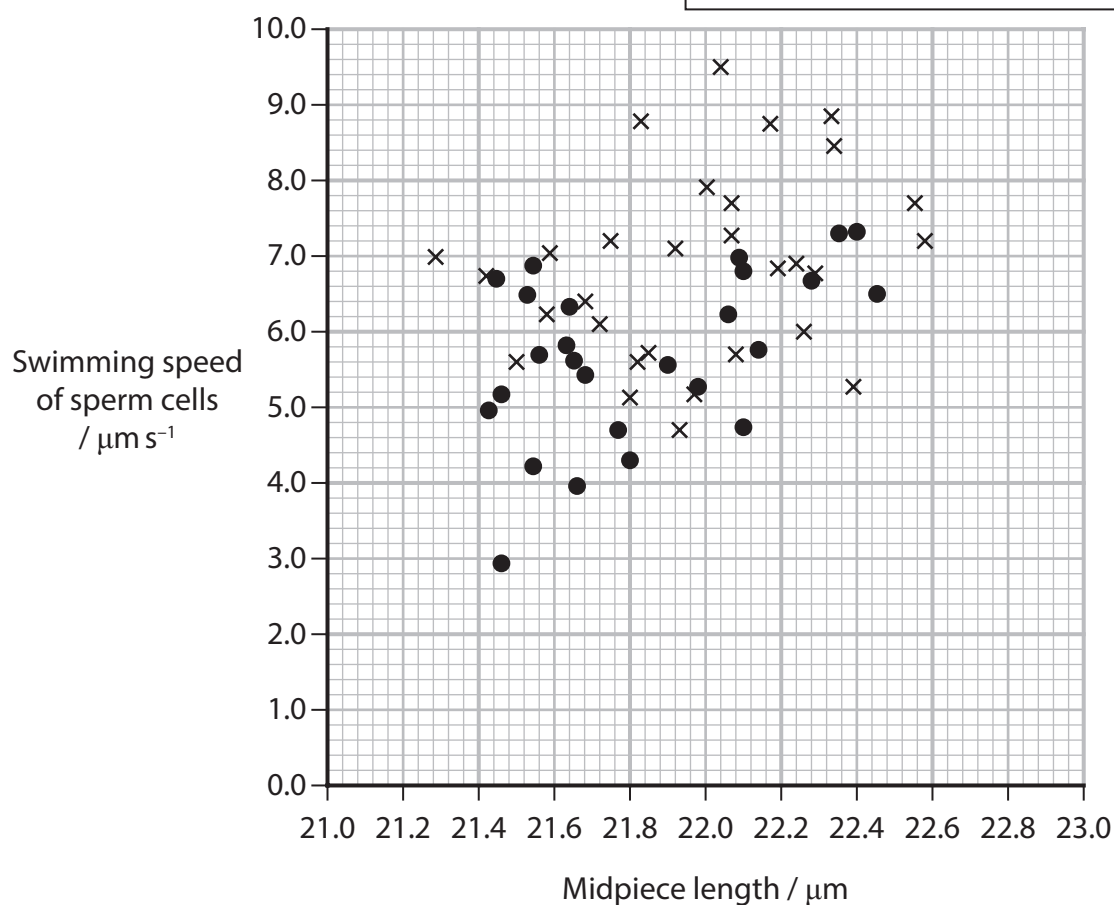
The swimming speed of sperm cells of mice has been investigated.

The graph shows the relationship between midpiece length and swimming speed of sperm cells of mice.



Key:

- male mates with only one female
- × male mates with more than one female



- (i) Give **two** conclusions that can be drawn from these data.

(2)

1

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- (ii) Give the name of a statistical test that could be used to assess the strength of the relationship between length of midpiece and swimming speed of sperm cells.

(1)

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(Total for Question 1 = 5 marks)



- 2 The photograph shows a rabbit with brown fur from Lokrum Island near Croatia.



(Source: © Peter Shaw / Alamy Stock Photo)

- (a) The Hardy-Weinberg equation can be used to determine changes in allele frequencies over time.

The equation can be written as $p^2 + 2pq + q^2 = 1$

Rabbits that inherit a dominant B allele have brown fur.

The proportion of homozygous dominant (BB) rabbits in the island population is represented by p^2 .

- (i) Which is the value for $2pq$ if $p^2 = 0.36$?

(1)

- ☐ **A** 0.06
- ☐ **B** 0.16
- ☐ **C** 0.48
- ☐ **D** 0.64

- (ii) Albino rabbits in this population have the genotype bb.

State the part of the equation that represents this genotype.

(1)

(b) A viral disease has killed many of the rabbits on Lokrum Island.

Several genes are involved in protecting rabbits from this virus.

Explain how this viral disease could result in a change in allele frequencies of **these** genes in the rabbit population on Lokrum Island.

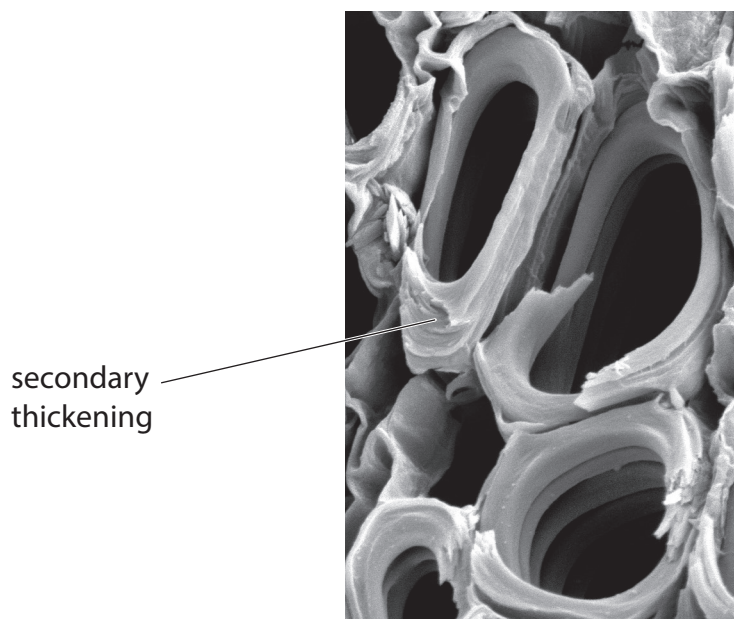
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(Total for Question 2 = 6 marks)



3 The cells in xylem vessels have cellulose cell walls and secondary thickening.

(a) The photograph shows xylem vessels and walls with secondary thickening, as seen using an electron microscope.



(Source: © Steve Gschmeissner / Science Photo Library)

Xylem vessels have cell walls containing cellulose microfibrils.

Describe how the structure and arrangement of cellulose **microfibrils** contribute to their functions in the cell walls of xylem vessels.

(3)

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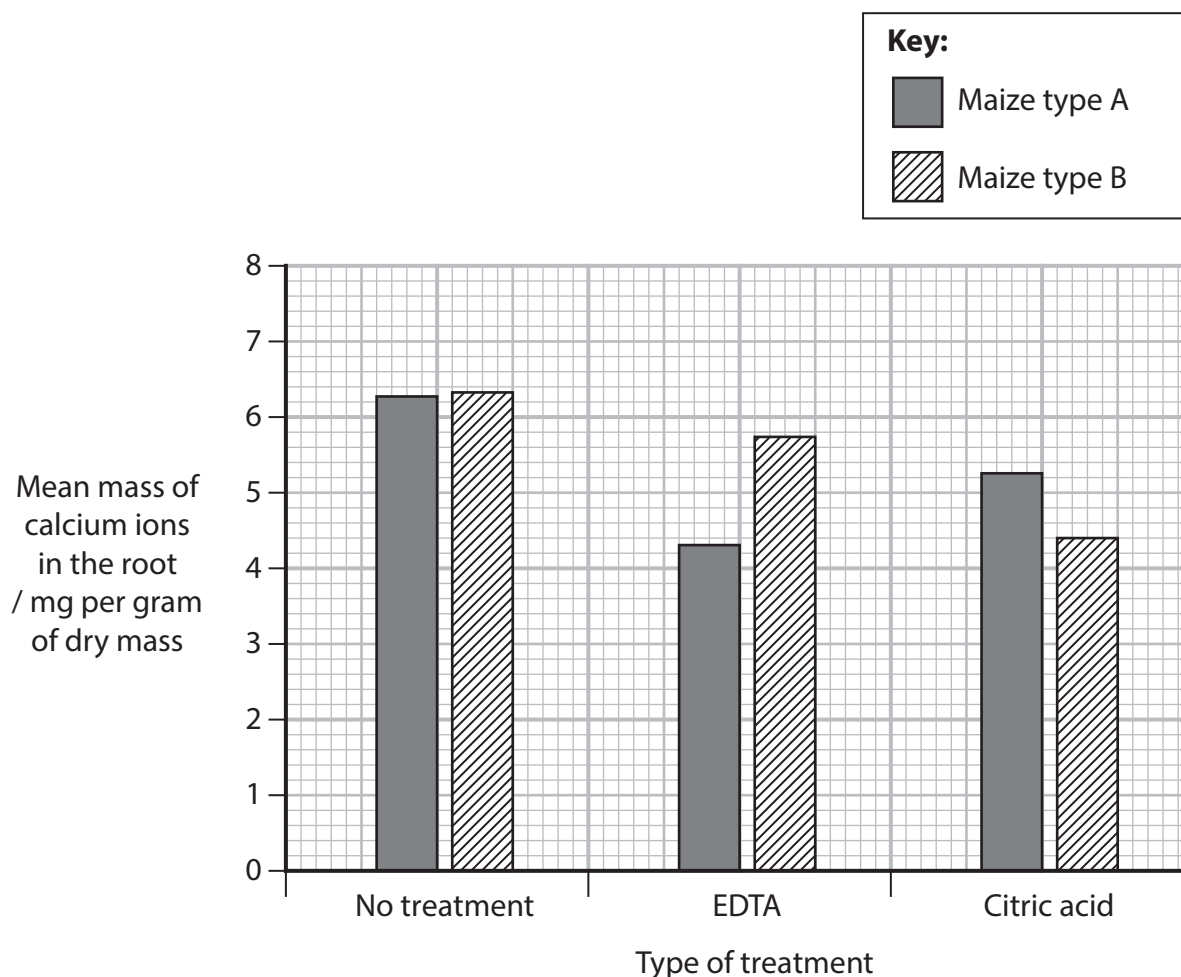
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(b) Chemicals in the soil can affect the absorption of inorganic ions.

Xylem vessels transport calcium ions from roots to other parts of a plant.

The effect of adding two chemicals, EDTA and citric acid, to the soil was investigated.

The graph shows the mean mass of calcium ions in the roots of two types of maize used in this investigation.



(i) Give **two** conclusions for the effect of these treatments on the calcium ion content in the roots of these two types of maize.

(2)

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(ii) Explain the effect EDTA would have on new cell walls in the roots of type A maize plants.

(2)

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(Total for Question 3 = 7 marks)

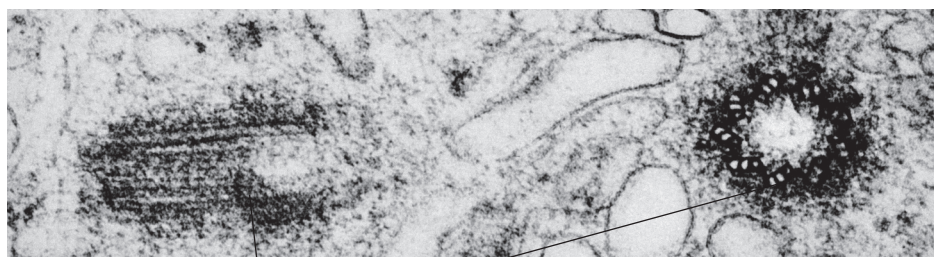
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- 4 The photograph shows two views of an organelle, observed using an electron microscope.



organelle

(Source: © Biology Pics / Science Photo Library)

- (a) (i) Which is the correct function of this organelle?

(1)

- ☐ A formation of lysosomes
- ☐ B formation of microtubules
- ☐ C formation of ribosomal RNA
- ☐ D formation of vesicles

- (ii) Suggest why the two views of this organelle look different.

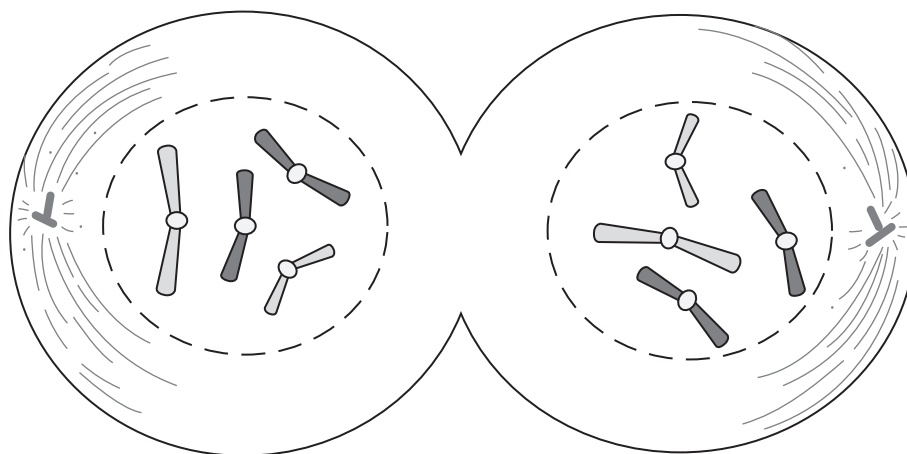
(1)

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(b) The diagram shows a cell in telophase of mitosis.



(Source adapted from: <https://www.shutterstock.com/image-vector/telophase-phase-cell-cycle-1678454008>)

(i) Draw **this** cell to show it in **metaphase** of mitosis.

(3)

(ii) Describe what happens in **anaphase** of mitosis.

(2)

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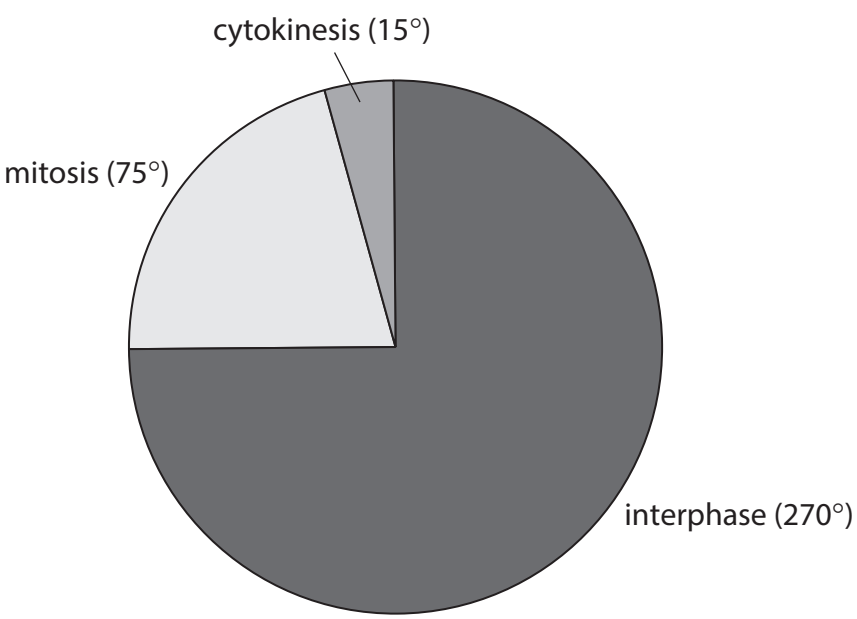
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(c) The diagram shows the relative proportions of the time spent in each stage of the cell cycle.

In these cells, cytokinesis takes 20 minutes.



Calculate how long interphase would take in these cells.

Give your answer in **hours**.

(1)

..... hours

(d) State how the mitotic index of a tissue could be calculated.

(1)

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(Total for Question 4 = 9 marks)

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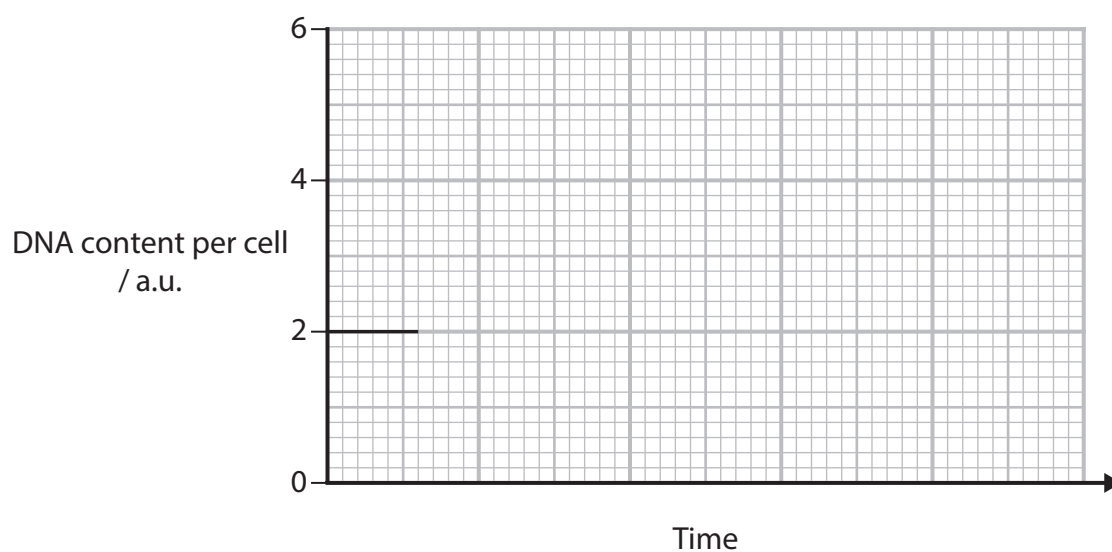
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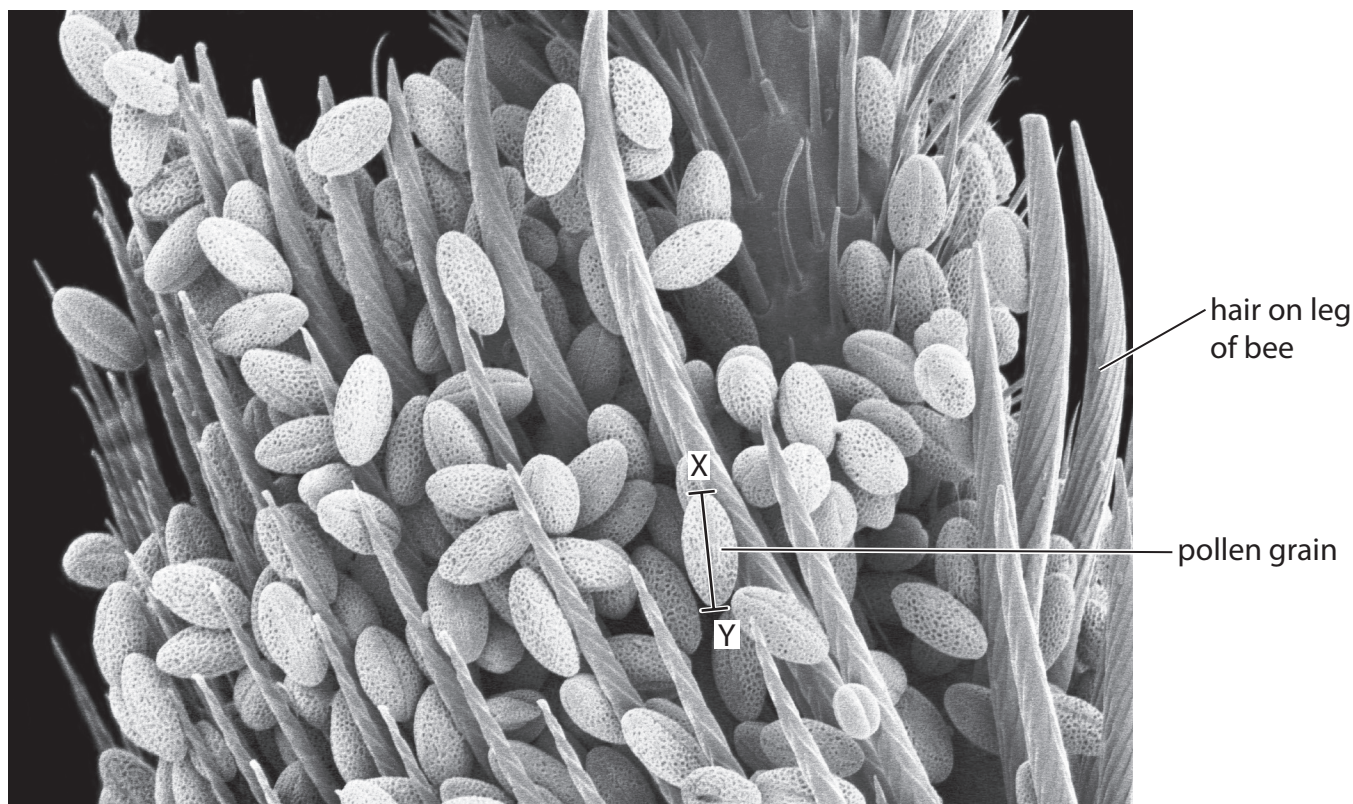
5 Some cells divide by meiosis to form gametes.

- (a) Complete this graph to show how the DNA content per cell would change when a cell, with 2 a.u. of DNA, undergoes meiosis to produce gametes.

(3)



(b) The photograph shows pollen grains on part of a leg of a bee.



(Source: © Susumu Nishinaga / Science Photo Library)

The actual length of the pollen grain between X and Y is $24\text{ }\mu\text{m}$.

Calculate the magnification of this photograph.

Give your answer to **two** significant figures.

(2)

Answer

(c) The photograph shows a bee on a peony flower.



(Source: © Boris Zhitkov / Alamy Stock Photo)

Pollen grains from the leg of the bee are transferred onto this flower.

The pollen grains will germinate and the pollen tubes will start to grow.

Describe the growth of a pollen tube and the process of fertilisation.

(5)

(d) The genetic diversity in a population of one species of peony was investigated.

There were 418 peony plants in this population.

Some of the genes of peony have several alleles.

The table shows the number of different alleles and the heterozygosity index for each of four genes in this population.

Gene	Number of different alleles of the gene	Heterozygosity index
PS43	10	0.422
PS103	10	0.810
PS105	4	0.036
PS147	16	0.834

- (i) How many of the peony plants in this population are heterozygous for gene PS105?

(1)

- ☐ **A** 15
- ☐ **B** 60
- ☐ **C** 340
- ☐ **D** 350

- (ii) The width of peony leaves is an example of polygenic inheritance.

Which row is correct for the width of peony leaves?

(1)

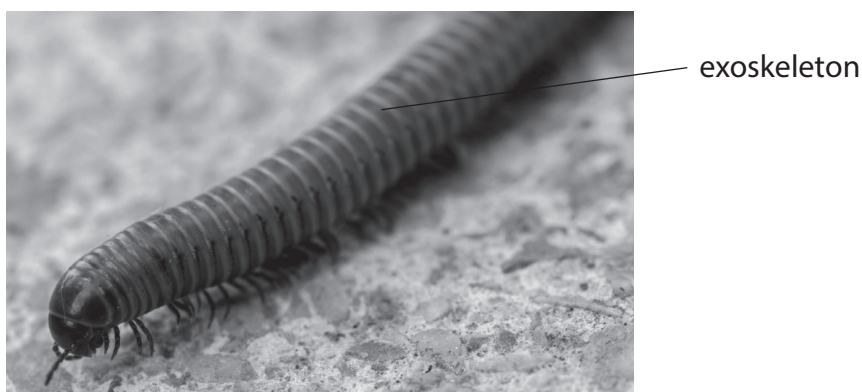
	One gene determines leaf width	Leaf width is determined by multiple alleles for several genes	Leaf width shows continuous variation
☐ A	✓	✓	✗
☐ B	✓	✗	✓
☐ C	✗	✓	✓
☐ D	✗	✗	✗

(Total for Question 5 = 12 marks)

6 Different species of millipede have different adaptations.

One shared adaptation is a hard outer layer called an exoskeleton.

The photograph shows a millipede.

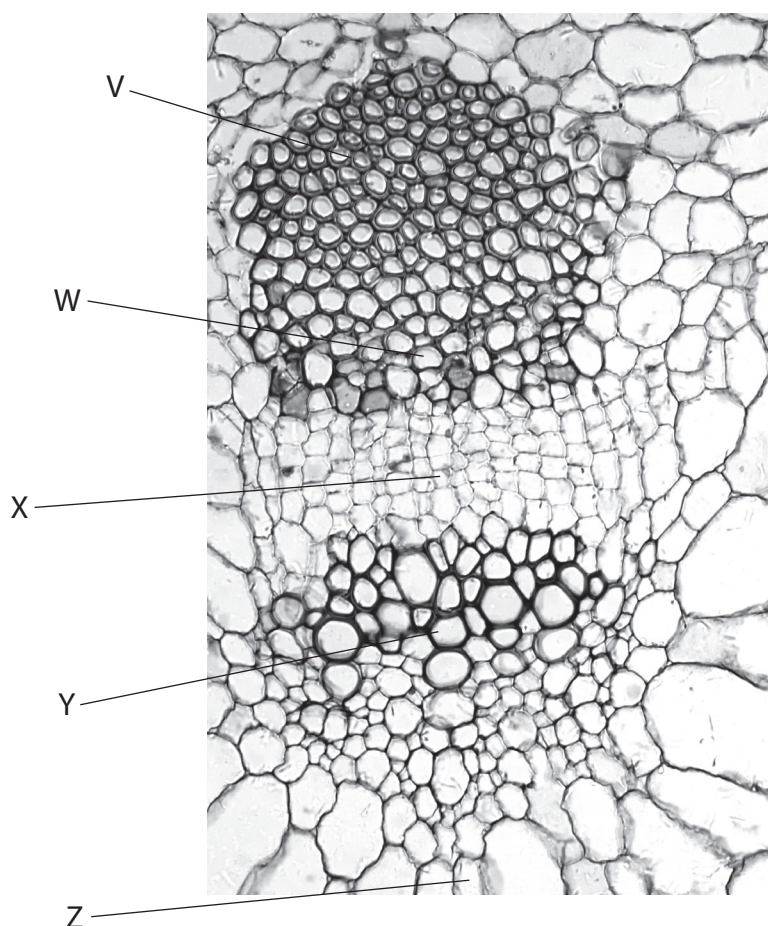


(Source: © Marina Kovacevic / Alamy Stock Photo)

- (a) *Illacme plenipes* is a species of millipede that is endemic to California. It was thought to be extinct but was rediscovered in 2005.

The mouth of this millipede is adapted to make holes in xylem and phloem tissues of living plants.

The photograph shows some plant tissues, as seen using a microscope.



(Source: © Choksawatdikorn / Shutterstock)

(i) Which of the labelled structures is a xylem vessel?

(1)

- ☐ **A** W
- ☐ **B** X
- ☐ **C** Y
- ☐ **D** Z

(ii) Which of the labelled structures contains sieve plates?

(1)

- ☐ **A** V
- ☐ **B** W
- ☐ **C** X
- ☐ **D** Y

(iii) Explain the advantages for this millipede of being able to make holes in xylem and phloem.

(3)

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(b) The *Illacme tobini* species of millipede is also endemic to California.

(i) It has an exoskeleton and 200 poison glands.

Suggest why this millipede has these adaptations.

(2)

Hard exoskeleton

Poison glands

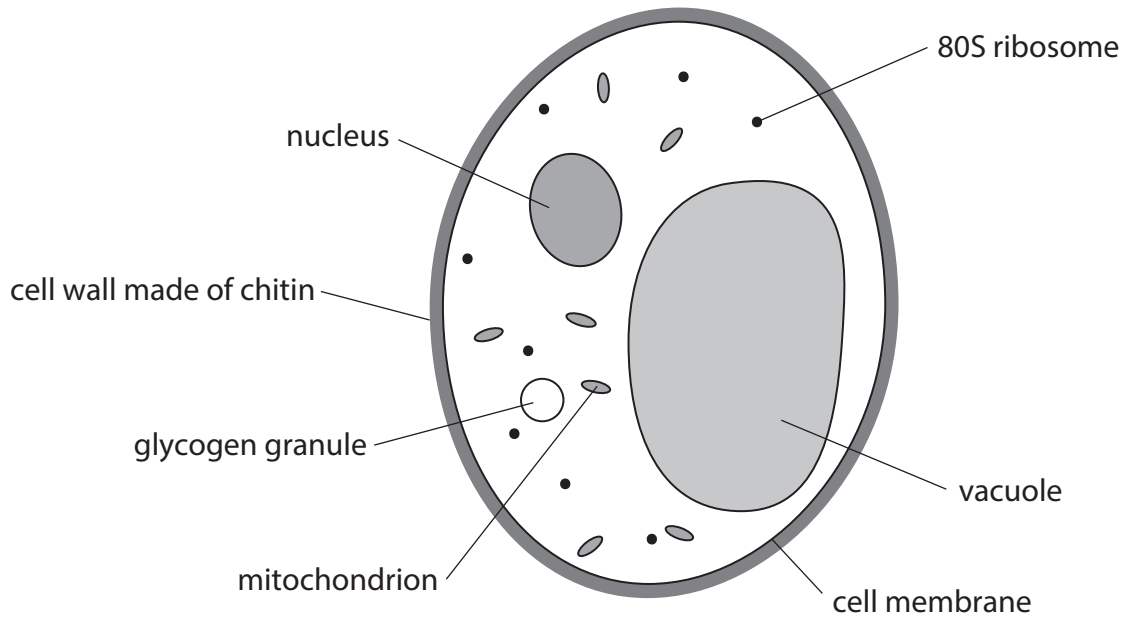
(ii) Explain how scientists could determine how closely related *I. plenipes* is to *I. tobini*.

(2)



(c) Some millipedes have bacteria in their gut that can break down fungal cells.

The diagram shows a fungal cell.



Compare and contrast the structure of this fungal cell and a bacterial cell.

(3)

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(Total for Question 6 = 12 marks)

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7 Proteins can control cell processes and determine cell structure.

- (a) Molecules of pre-mRNA are produced by transcription of active genes.

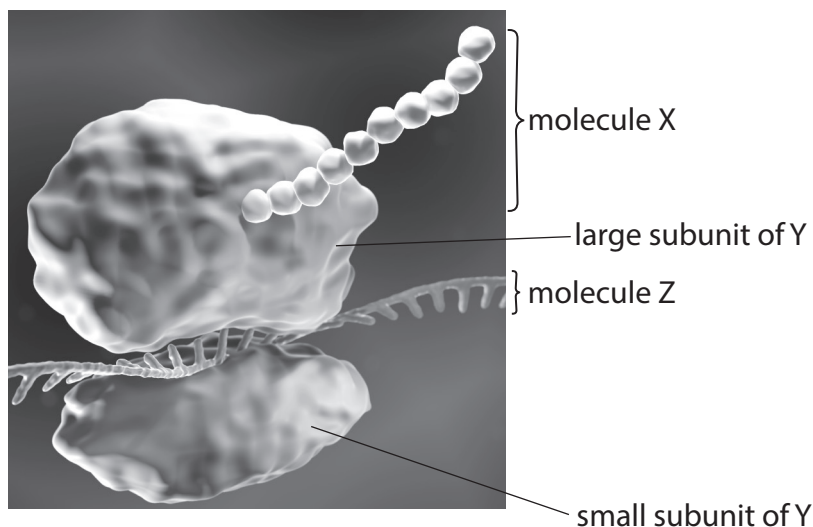
These molecules undergo post-transcriptional changes to form active mRNA.

Describe how post-transcriptional changes of pre-mRNA can produce active mRNA.

(3)



(b) The diagram shows a process taking place on structure Y in a eukaryotic cell.



(Source: © Artur Plawgo / Science Photo Library)

- (i) Structure Y can be found in the cytoplasm or on the surface of an organelle in a eukaryotic cell.

Which organelle would have structure Y on its surface?

(1)

- ☐ **A** Golgi apparatus
- ☐ **B** mitochondria
- ☐ **C** rough endoplasmic reticulum
- ☐ **D** smooth endoplasmic reticulum

- (ii) Give the function of structure Y.

(1)

- (iii) Which row gives the names of the molecules labelled X and Z?

(1)

	Molecule X	Molecule Z
☐ A	polypeptide	DNA strand
☐ B	polypeptide	RNA strand
☐ C	polysaccharide	DNA strand
☐ D	polysaccharide	RNA strand

(c) DNA methylation can alter the activation of a gene.

- (i) Suggest the role of the enzyme DNA methyltransferase (DNMT) in the process of DNA methylation.

(2)



- *(ii) Some cancers can be caused by the methylation of a tumour suppressor gene called *RASSF1*.

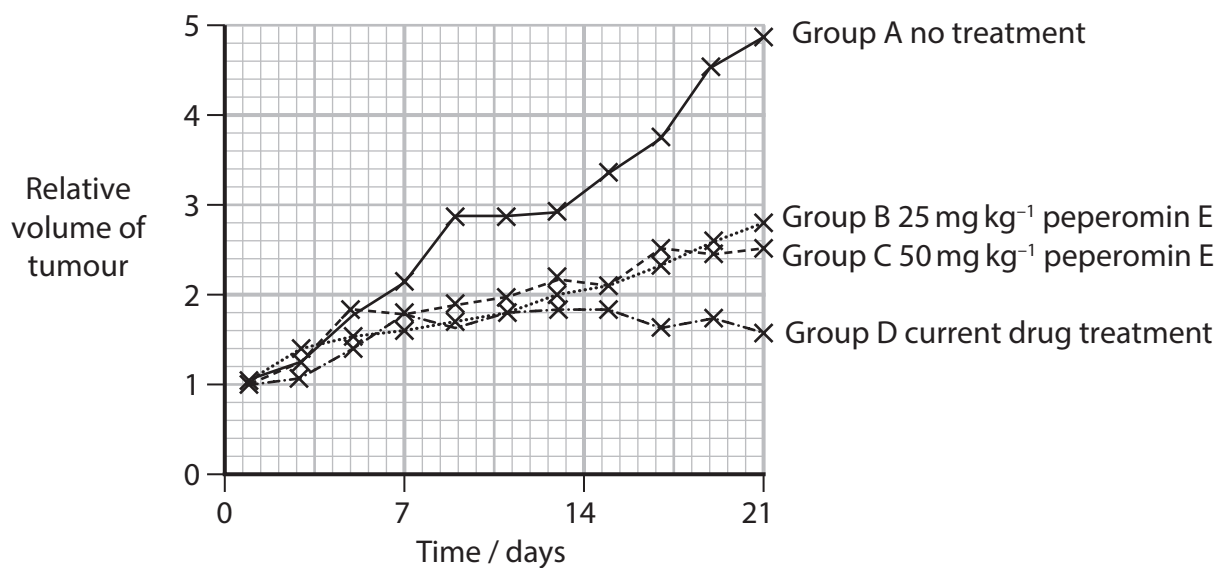
Tumour suppressor genes can slow down cell division or cause cell death.

Peperomin E is a drug that can cause the demethylation of the gene *RASSF1*.

In an investigation different treatments were given to groups of 10 mice.

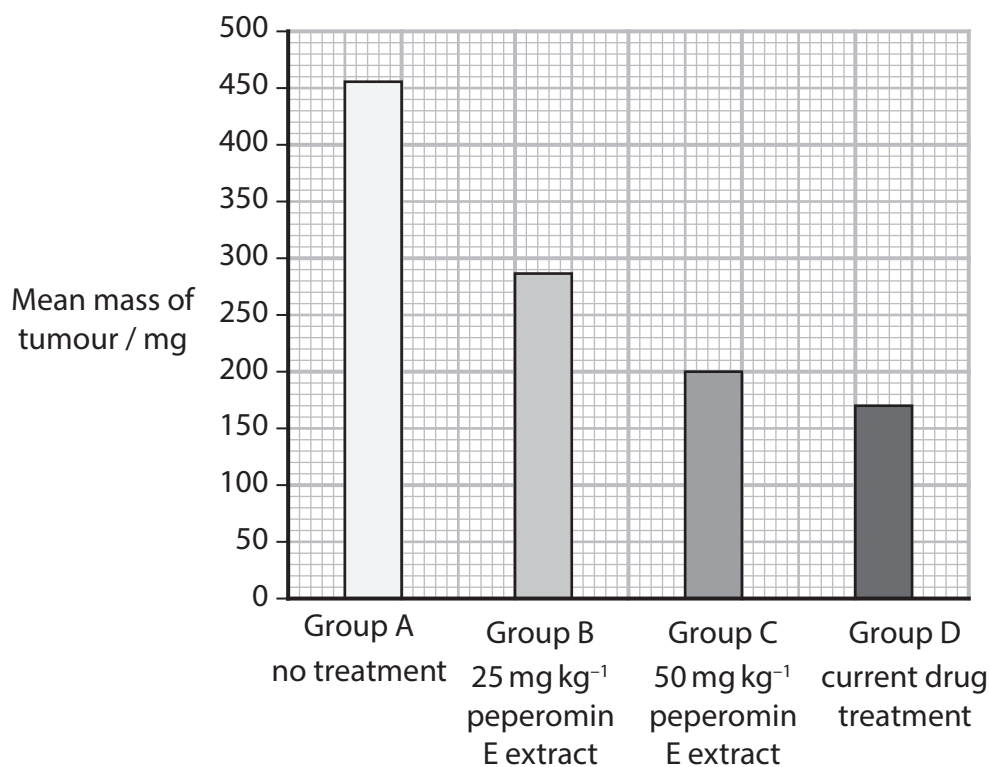
These mice had identical lung cancer tumours at the start of the investigation.

Graph A shows the changes in tumour volume for each group, over 21 days.



Graph A

Graph B shows the mean mass of tumours at 21 days.



Graph B



Explain how treatment with these two drugs affects the activity of the *RASSF1* gene and the changes in tumours.

Use **all** of the information in part (c) and your own knowledge to support your answer.

(6)

(Total for Question 7 = 14 marks)



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8 Humans have introduced new species to the island of St Helena.

Some of these species have become invasive and have reduced the biodiversity on this island.

These invasive species include cats, rabbits and rats.

- (a) The St Helena plover is a bird endemic to this island. It lays its eggs in a nest on the ground.

The photographs show a nest and offspring of a St Helena plover.



(Source: © Snapper Nick / Alamy Stock Photo)

Nest of a St Helena plover



(Source: © Buiten-Beeld / Alamy Stock Photo)

St Helena plover chick

- (i) Suggest why the population of the St Helena plover decreased after the introduction of cats and rats to the island.

(2)

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- (ii) Conservation programmes resulted in the population of the St Helena plover increasing from 200 adult birds in 2006 to 560 adults in 2016.

Calculate the mean rate of increase in this population.

(1)

..... number of birds per year

- (b) The St Helena gumwood tree is native to the island of Saint Helena.

The photograph shows part of a St Helena gumwood tree.



(Source: © Prisma by Dukas Presseagentur GmbH / Alamy Stock Photo)

The St Helena gumwood tree is critically endangered.

Rabbits have contributed to this situation by eating the shoots of young trees.

A breeding programme increased the population of the gumwood trees from two trees in 2009 to 6000 in 2019.

- (i) Describe how this St Helena breeding programme could have been carried out.

(2)

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(ii) Explain **one** way that young trees could be protected from rabbits.

(2)

(iii) Scientists have proposed storing seeds from St Helena gumwood trees in seed banks to aid the conservation of this endangered species.

Describe how a seed bank would successfully select, prepare **and** store seeds from these trees to aid the conservation of this endangered species.

(4)

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(c) A study compared the biodiversity of two habitats on the island of St Helena.

The table shows the data obtained from habitat 1.

Species	Number of individuals (n)	$n(n-1)$
A	747	557 262
B	8	56
C	75	5 550
D	12	132
E	63	
	$N = 905$	$\sum n(n-1) =$



(i) An index of diversity (D) is calculated using the formula:

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

Calculate the index of diversity for habitat 1.

Use the table and formula to help you.

Give your answer to **two** decimal places.

(3)

Answer

(ii) Habitat 2 has an index of diversity (D) of 2.80

A student concluded that the second habitat had a higher biodiversity.

State whether you agree or disagree with this conclusion. Give a reason for your answer.

(1)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

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