

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel International Advanced Level

Thursday 12 October 2023

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 questions labelled 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.
- 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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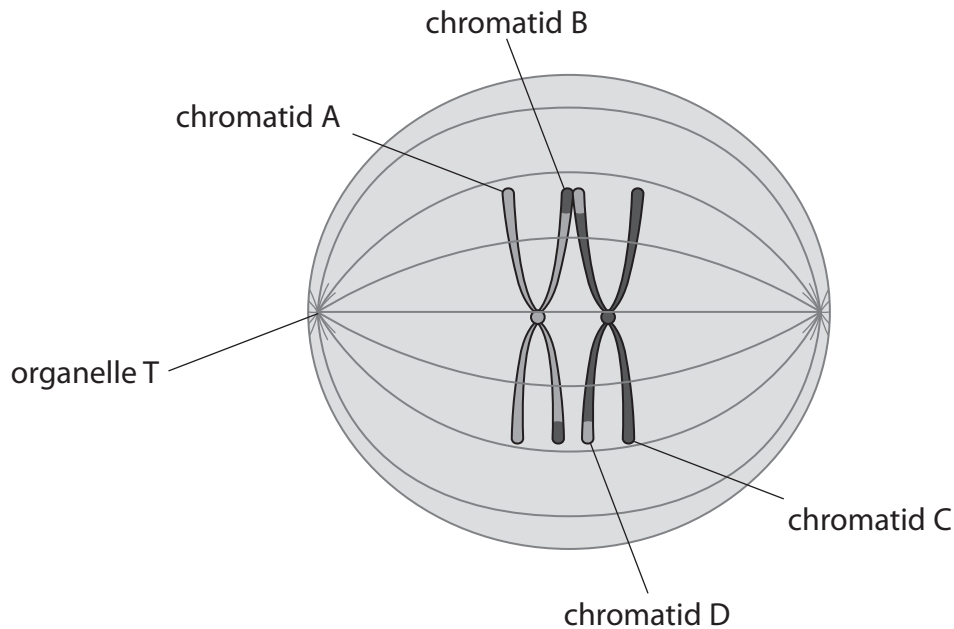

Pearson

Answer ALL questions.

Write your answers in the space 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** The diagram shows part of a cell at the start of metaphase I of meiosis.



- (a) Which is organelle T?

(1)

- ☐ **A** centriole
☐ **B** lysosome
☐ **C** nucleolus
☐ **D** ribosome

- (b) Explain why it is possible for chromatid A to be genetically different from chromatid B.

(2)

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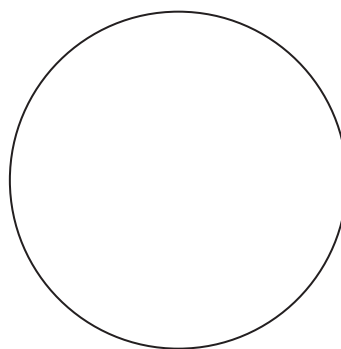
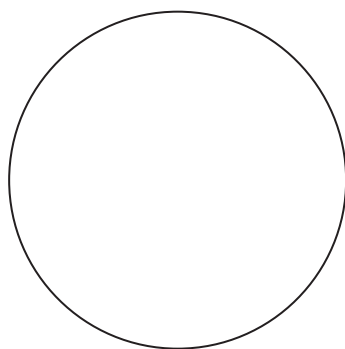
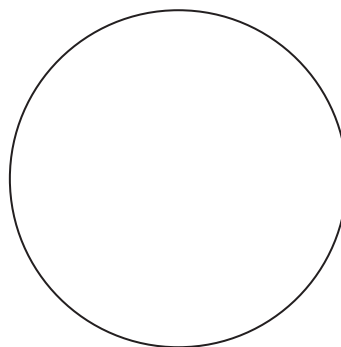
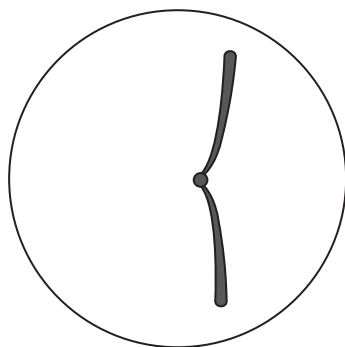
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- (c) A student was asked to draw the four haploid cells produced by this cell in metaphase I of meiosis.

The diagram shows the incomplete drawings produced by this student.

Complete the drawings to show the **four haploid** cells produced.

(2)



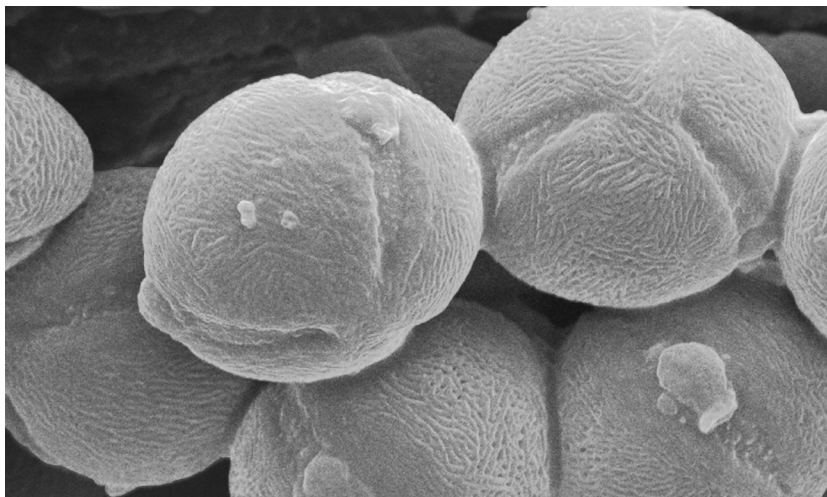
(Total for Question 1 = 5 marks)

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- 2 The photograph shows some pollen grains, as seen using an electron microscope.



(Source: BSIP SA / Alamy Stock Photo)

Scale bar |—————|
20 μm

- (a) Calculate the magnification of this photograph.

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

(2)

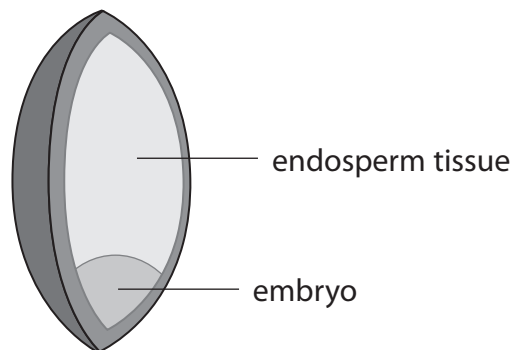
Answer



(b) A pollen grain can produce a pollen tube that contains a generative nucleus.

Plant fertilisation results in the production of an embryo and endosperm tissue.

The diagram shows the location of an embryo and endosperm tissue in a seed.



Describe how the generative nucleus results in the production of an embryo and endosperm tissue in a seed.

(3)

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(c) Flower colour and pollen grain size are genetically determined in foxglove plants.

The linkage of the genes for flower colour and pollen grain size has been investigated.

(i) State what is meant by the term **linkage** with reference to these two genes.

(1)

(ii) A statistical test can be used to analyse observed phenotype frequencies and expected phenotype frequencies for the foxglove plants.

Which of the following statistical tests would be used?

(1)

- ☐ **A** Chi squared
- ☐ **B** correlation coefficient
- ☐ **C** standard deviation
- ☐ **D** Student's t-test

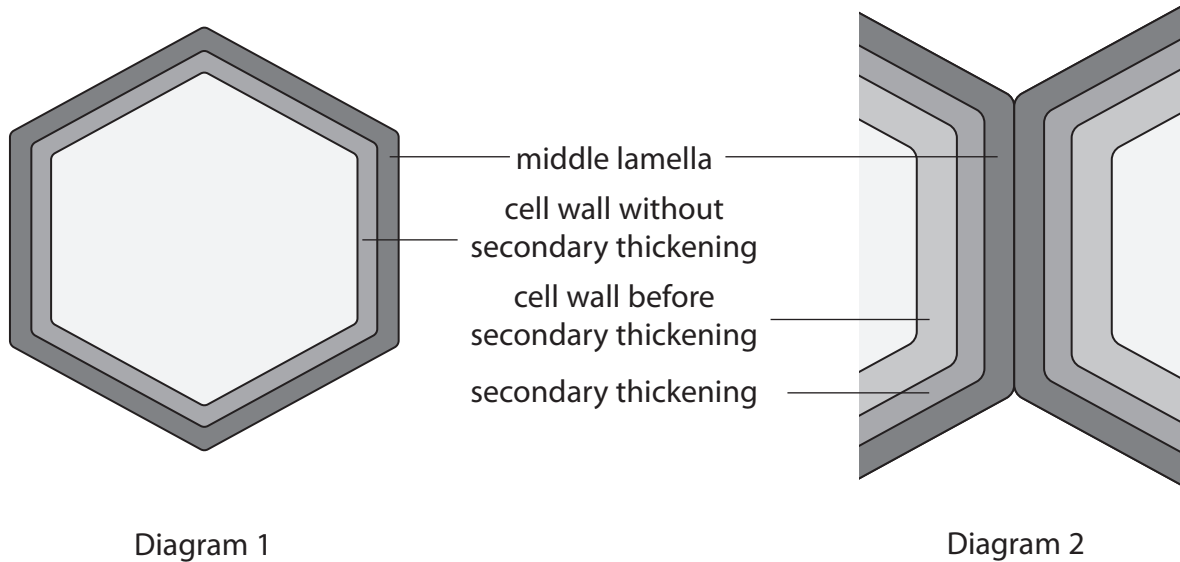
(Total for Question 2 = 7 marks)



3 (a) Some plant cell walls develop secondary thickening.

Diagram 1 shows a cell without secondary thickening.

Diagram 2 shows part of the cell walls of two adjacent cells with secondary thickening.



Give **three** differences between a cell wall with secondary thickening and a cell wall without secondary thickening.

Use the information in the diagrams to support your answer.

(3)

- 1
- 2
- 3



(b) (i) Plant cell walls contain cellulose.

How many of the following statements about cellulose molecules are correct?

- contain α -glucose molecules
- contain 1,4 and 1,6 glycosidic bonds
- form microfibrils

(1)

☐ **A** none

☐ **B** one

☐ **C** two

☐ **D** three

(ii) Secondary thickening occurs in sclerenchyma fibres.

Explain how secondary thickening contributes to the physical properties of sclerenchyma fibres.

(2)

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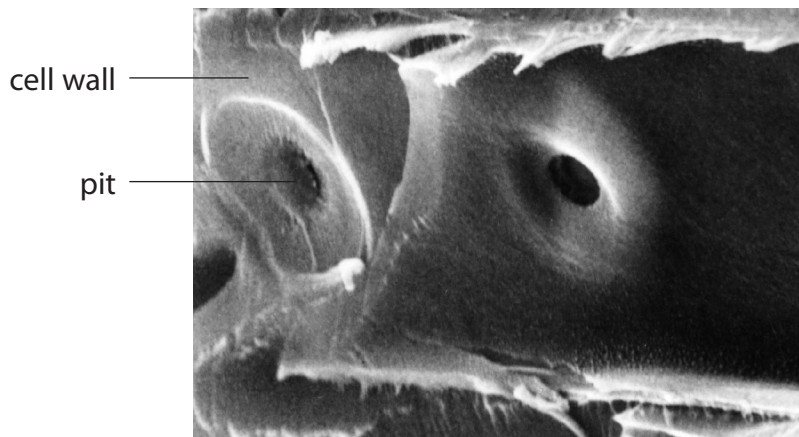
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(c) Some cells in xylem vessels have secondary thickening.

The photograph shows pits in the wall of part of a xylem vessel, as seen using an electron microscope.



(Source: G.F. Gennaro / Science Photo Library)

Describe the function of pits in the xylem vessel.

(2)

(Total for Question 3 = 8 marks)



- 4 The photograph shows mangroves in the Caribbean.



(Source: Stefania Barbier / Alamy Stock Photo)

A new type of bacteria was discovered living in these mangroves.

Scientists called this new type of bacteria *Thiomargarita magnifica*.

One cell of these bacteria is 20 mm in length.

The smallest known type of bacteria, *Mycoplasma genitalium*, is 300 nm in length.

- (a) (i) Both of these are found in the domain Bacteria.

Give the names of the other **two** domains.

(1)

1

2

- (ii) Calculate how many times larger *T. magnifica* is than *M. genitalium*.

Give your answer in standard form.

(2)

Answer



(b) The cytoplasm of *T. magnifica* contains structures called pepins.

The function of pepins is protein synthesis.

Pepins contain circular DNA and ribosomes and are surrounded by a membrane.

Explain how these **three** structures contribute to the function of pepins.

(3)

DNA

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Ribosomes

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Membrane

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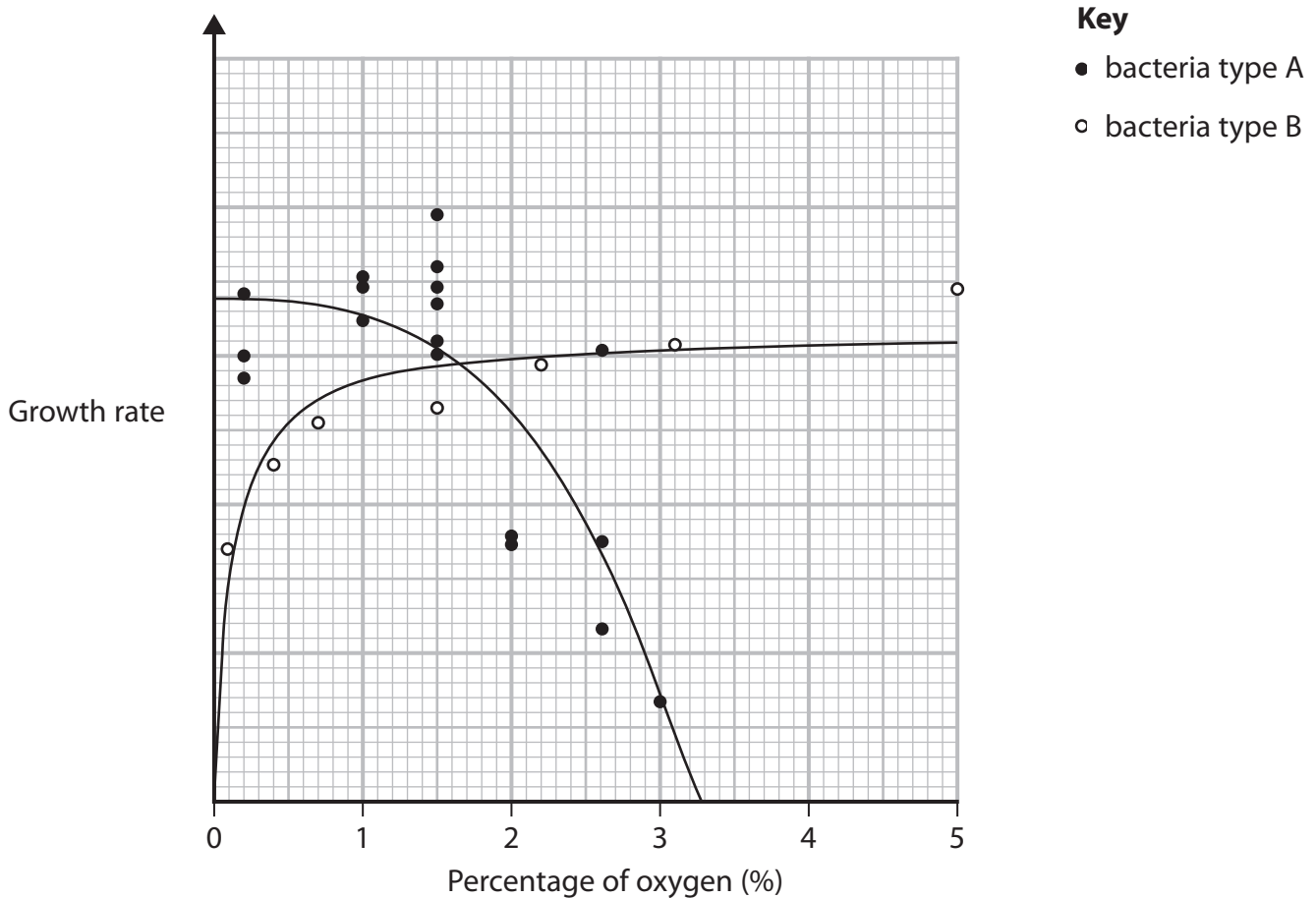
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- (c) Some bacteria require oxygen in their surroundings whereas other bacteria do not.

The graph shows the growth rate of two types of bacteria, A and B, which were grown in different concentrations of oxygen.

The bacteria were supplied with water and grown at their optimum temperatures.



- (i) Explain why an optimum temperature and water are needed for bacterial growth.

(2)

Optimum temperature

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Water

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- (ii) Explain the results for these two types of bacteria shown in the graph.

(3)

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(Total for Question 4 = 11 marks)

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5 The lack of some inorganic ions in soil can affect the yield of fruit from crop plants.

- (a) The photograph shows part of a vine plant growing in soil lacking magnesium ions.

The vine plant shown has yellow leaves and reduced growth.



(Source: Nigel Cattlin / Alamy Stock Photo)

- (i) Which tissue is involved in the transport of magnesium ions in a plant?

(1)

- ☐ **A** amyloplast
- ☐ **B** plasmodesmata
- ☐ **C** sclerenchyma
- ☐ **D** xylem

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- (ii) Explain how a lack of magnesium ions could result in yellow leaves and reduced growth.

(3)

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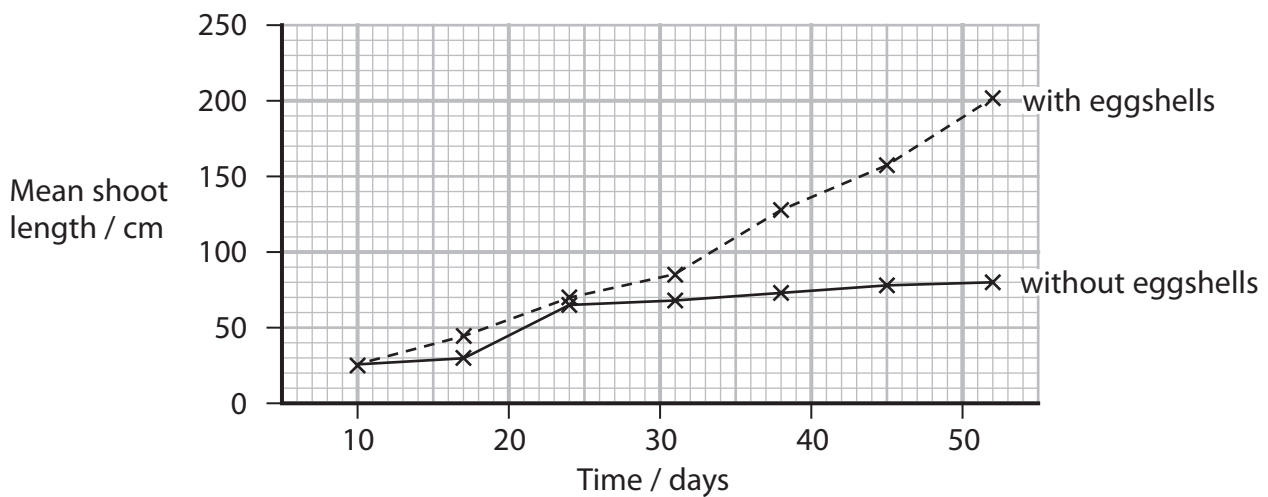
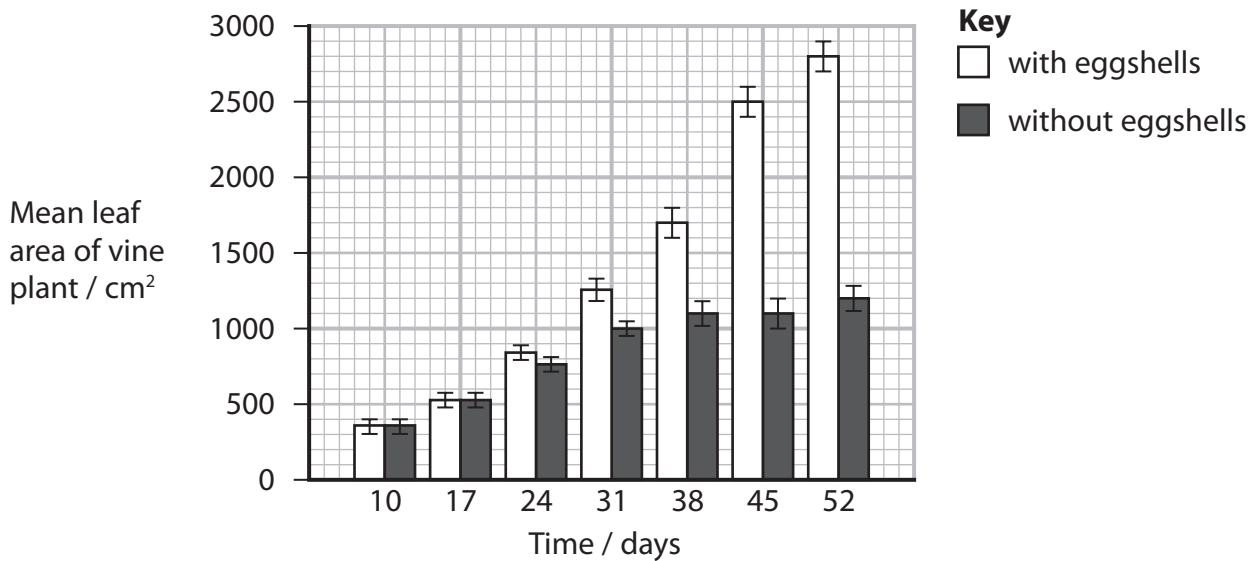
*(b) Calcium ions are also needed for the growth of vine plants and fruit production.

Chicken eggshells contain calcium ions. Some farmers add crushed eggshells to the soil surrounding vine plants.

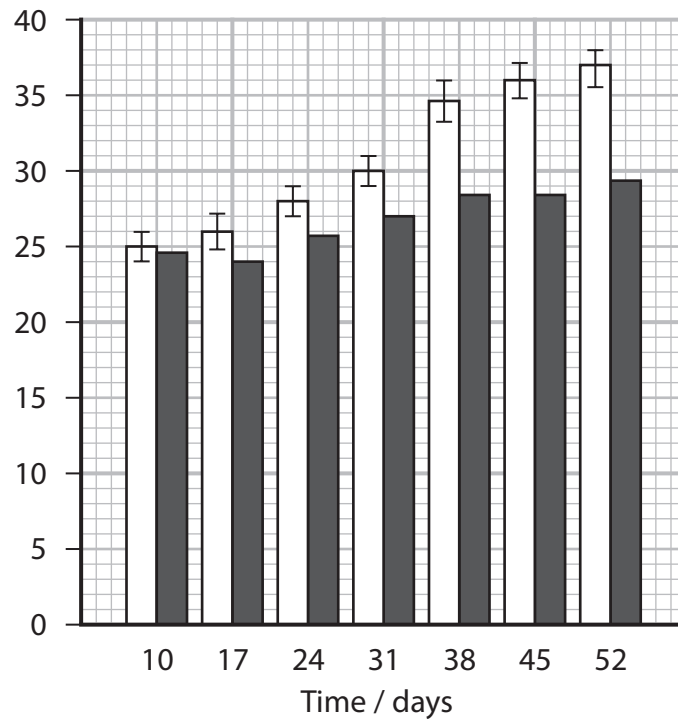
The effect of adding crushed eggshells to the soil surrounding vine plants was investigated.

The mean leaf area, mean shoot length and mean chlorophyll content were calculated over 52 days.

The graphs show the results of this investigation.



Mean chlorophyll
content / a.u.



Key

□ with eggshells

■ without eggshells

Discuss the benefits of adding crushed eggshells to the soil surrounding vine plants.

Use the information in the question to support your answer.

(6)

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(Total for Question 5 = 10 marks)



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6 A mimic octopus can change shape to look like other organisms.

The photographs show a venomous sea snake, a mimic octopus looking like a venomous sea snake and a mimic octopus looking like a flat fish.



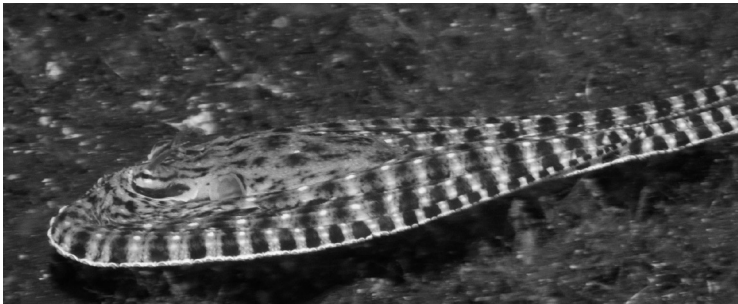
venomous sea snake

(Source: Reinhard Dirscherl / Alamy Stock Photo)



mimic octopus looking like a venomous sea snake

(Source: David Fleetham / Alamy Stock Photo)



mimic octopus looking like a flat fish

(Source: Hal Beral / VWPics / Alamy Stock Photo)

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(a) This octopus is adapted to its niche.

(i) State what is meant by the term **niche**.

(1)

(ii) The mimic octopus has the same banding pattern as the venomous sea snake.

Name this type of adaptation.

(1)

(iii) Suggest why the mimic octopus would change its appearance to look like a flat fish and a venomous sea snake.

(2)

Flat fish

Venomous sea snake

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(b) The photograph shows a blue-ringed octopus.



(Source: Oksana Golubeva / Alamy Stock Photo)

This octopus produces a toxin called tetrodotoxin. This toxin affects neurones by blocking sodium channels.

The pain-relieving properties of this toxin were investigated in a drug trial.

Stage II of this drug trial compared the tetrodotoxin with the current pain-relieving drug in a group of cancer patients.

(i) Which of the following describes the purpose of the current pain-relieving drug in stage II of the drug trial?

(1)

- ☐ **A** control
- ☐ **B** digitalis
- ☐ **C** placebo
- ☐ **D** solvent



- (ii) Describe the processes that would have occurred before and after stage II in this tetrodotoxin drug trial.

(4)

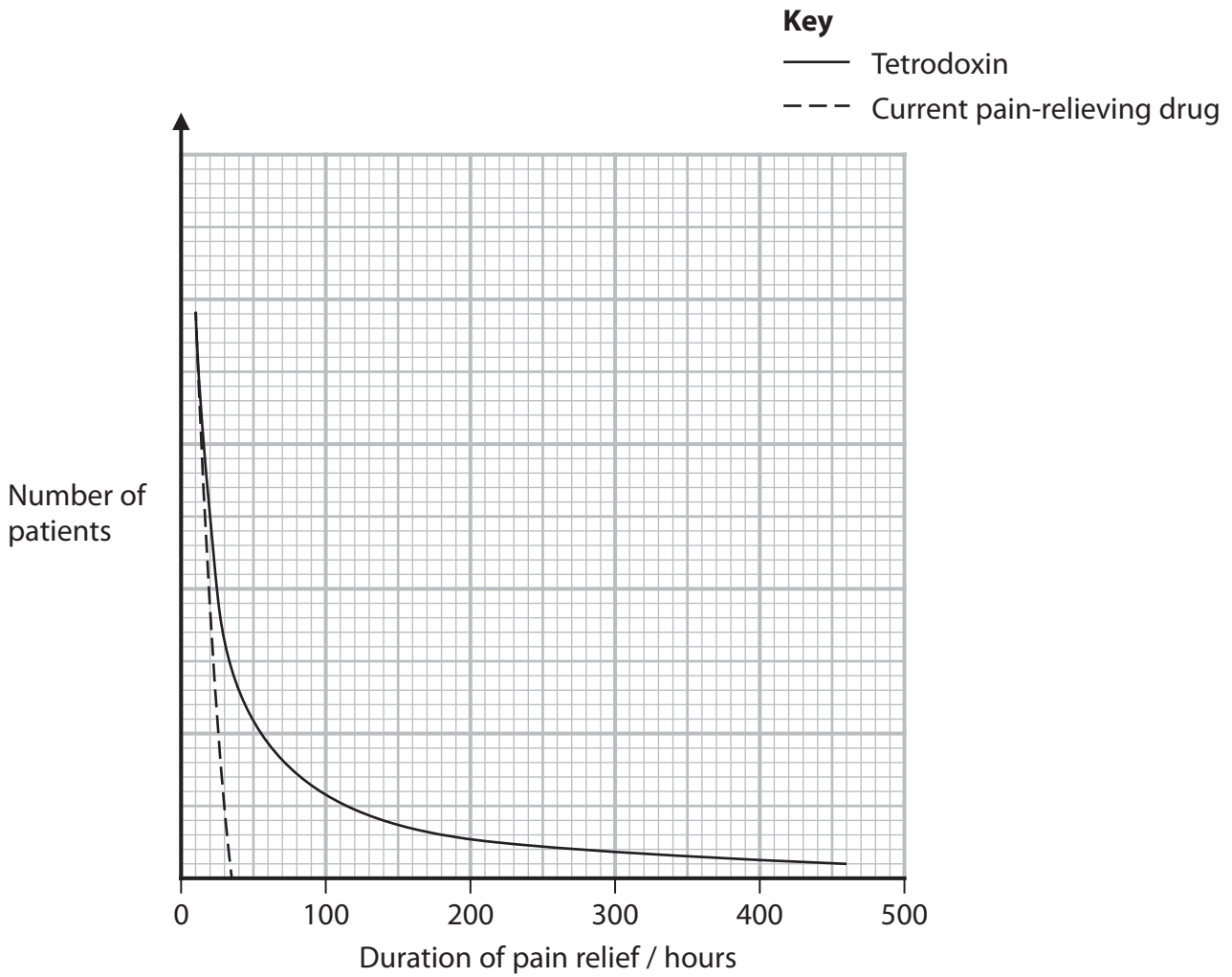
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- (c) The graph shows the duration of pain relief using both tetrodotoxin and the current pain-relieving drug in stage II of this drug trial.



Comment on the results of this investigation.

(4)

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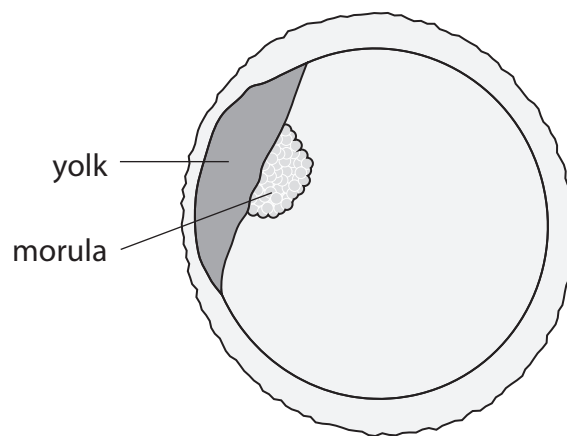
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(Total for Question 6 = 13 marks)



7 Cells can divide by mitosis.

The diagram shows a morula beginning to develop on the yolk of a fertilised fish egg cell.



(a) (i) Which of the following describes a morula?

(1)

- ☐ **A** a hollow ball of pluripotent stem cells
- ☐ **B** a hollow ball of totipotent stem cells
- ☐ **C** a solid ball of pluripotent cells
- ☐ **D** a solid ball of totipotent cells

(ii) Suggest **one** function of the yolk in the fertilised fish egg cell.

(1)

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- (b) As the fish embryo develops, different types of body cells and tissues are formed.
One type of tissue that develops is skeletal muscle tissue.

All the cells in the skeletal muscle tissue contain the same genes as the morula cells.

Explain how these skeletal muscle cells can contain the same genes as the morula cells but be different in structure and function.

(5)

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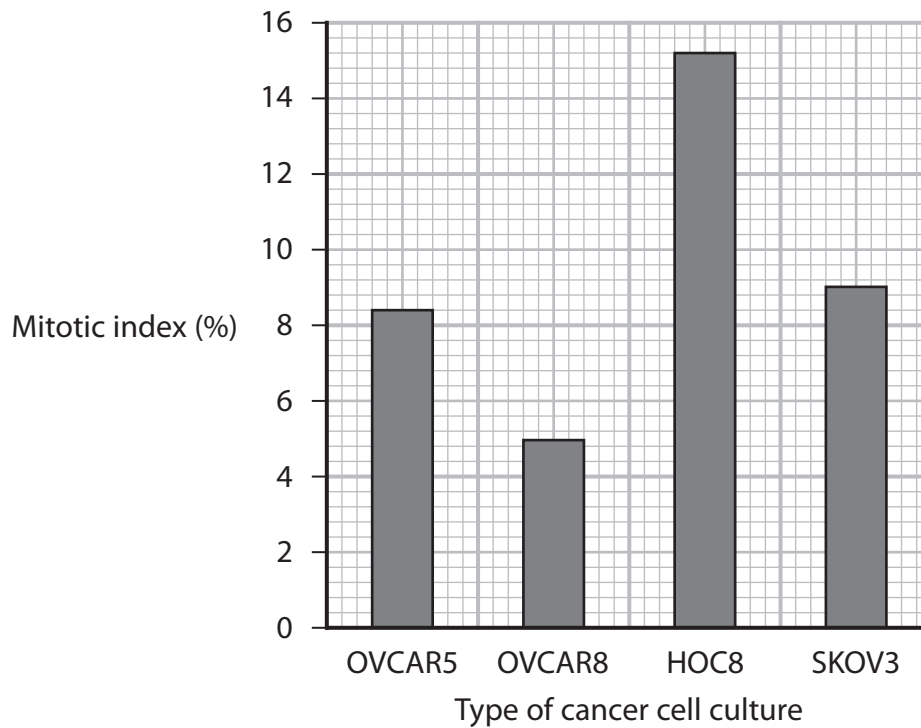
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(c) The mitotic index of four types of cancer cell culture was investigated.

The graph shows the results of this investigation.



(i) Two thousand OVCAR8 cells were studied.

Calculate how many OVCAR8 cells were in interphase.

(2)

Answer



- (ii) Which cancer cell culture has the highest proportion of cells undergoing nuclear division?

(1)

- ☐ **A** HOC8
☐ **B** OVCAR5
☐ **C** OVCAR8
☐ **D** SKOV3

- (iii) Explain why some people think that research into cancer treatments should not use embryonic stem cells.

(2)

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(Total for Question 7 = 12 marks)

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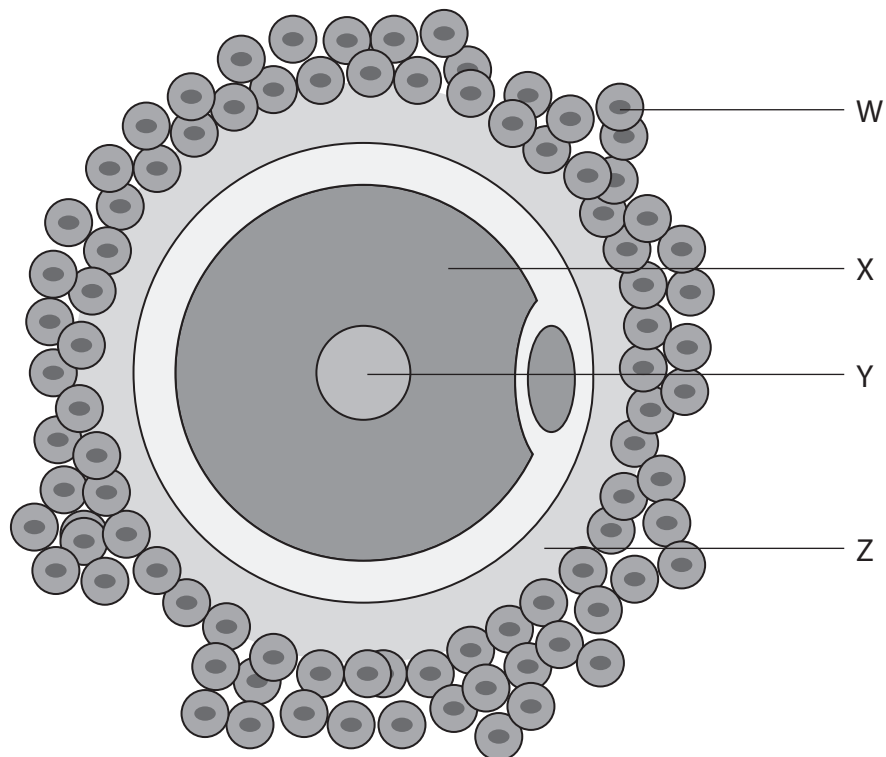
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8 Some organisms can produce gametes for sexual reproduction.

(a) The diagram shows an incomplete drawing of a human egg cell, drawn by a student.



(i) State the letter which shows the zona pellucida.

(1)

(ii) The student did not include the structures that contain enzymes involved in hardening the zona pellucida.

Name these structures.

(1)

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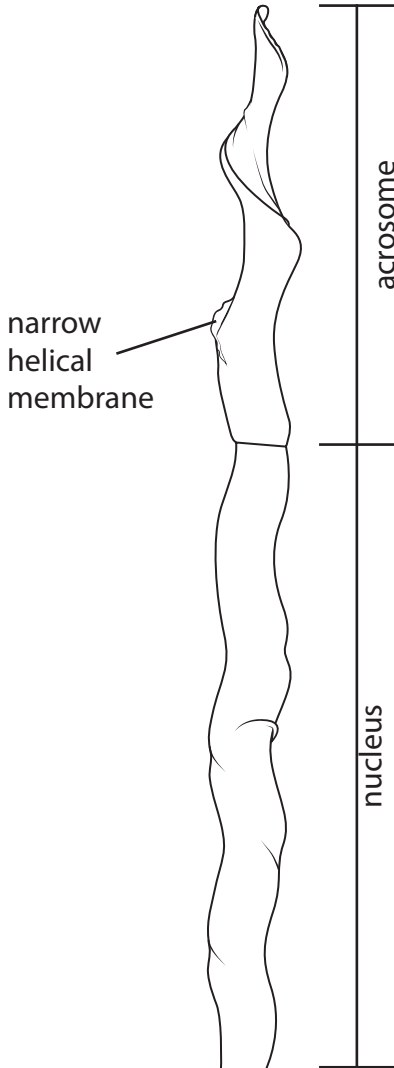
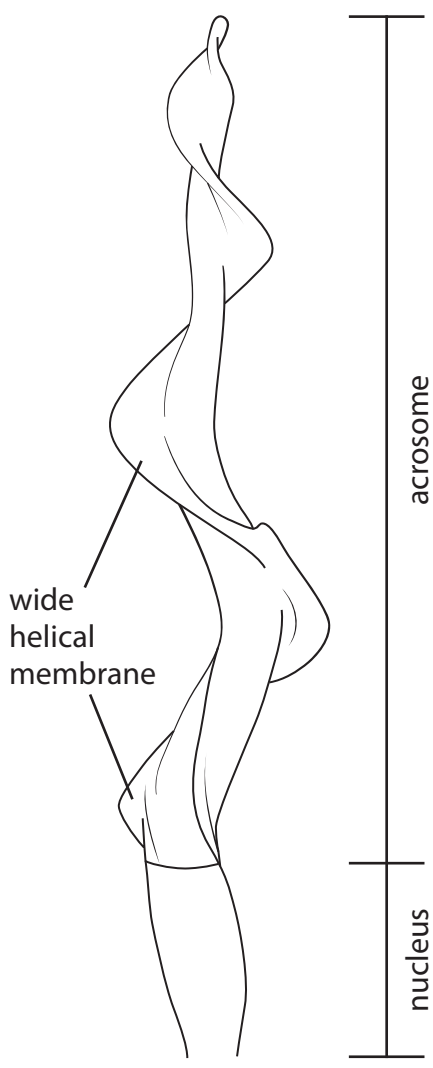
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(b) The table shows some information about two birds.

Both birds have a helical membrane around part of their sperm cells.

Information	Nuthatch	Reed bunting
Photograph	 (Source: Drew Buckley / Alamy Stock Photo)	 (Source: Angela Yates / Alamy Stock Photo)
Reproductive behaviour	Female has one male partner	Female mates with several males in a short period of time.
Drawing of head of sperm cell		



(i) How many of the following statements about sperm cells are correct?

- The mid-piece of the sperm cell contains many mitochondria for anaerobic respiration.
- The acrosome is a membrane bound sac containing digestive enzymes.
- The nucleus contains circular DNA.

(1)

☐ **A** none

☐ **B** one

☐ **C** two

☐ **D** three

(ii) Sperm cells with a larger acrosome to nucleus ratio have an increased swimming speed.

Calculate the acrosome to nucleus ratio for the reed bunting sperm cell shown in the table.

(1)

Answer

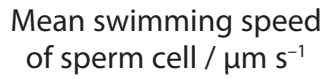
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- The graph shows the results of this investigation.



Explain how these adaptations are related to the reproductive behaviour of these birds.

(4)

[illegible]

- (c) An individual organism that can produce both egg cells and sperm cells is said to be a hermaphrodite.

Blue dragons (*Glaucus atlanticus*) are sea slugs that are hermaphrodites and can be found in the Indian Ocean.

The photograph shows a blue dragon.



(Source: BIOSPHOTO / Alamy Stock Photo)

Each individual can produce both egg cells and sperm cells for sexual reproduction with another blue dragon.

Their sperm cells cannot fertilise their own egg cells.

Suggest reasons why it may be advantageous for blue dragons to be hermaphrodites.

(3)

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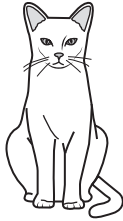
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(d) The table shows some information about a population of 100 cats.

Colour of cat			
	Black	Black	White
Genotype	BB	Bb	bb
Part of Hardy–Weinberg equation	p^2	$2pq$	q^2
Number of cats			16

Complete the table to show how many cats would have the homozygous dominant genotype and how many cats would have a heterozygous genotype.

Use the equation

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

(3)

(Total for Question 8 = 14 marks)

TOTAL FOR PAPER = 80 MARKS



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