Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Friday 17 May 2024

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 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 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.
- 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 the 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 plant contains several types of cells, tissues and organs.

(a) State what is meant by the term **organ**.

(1)

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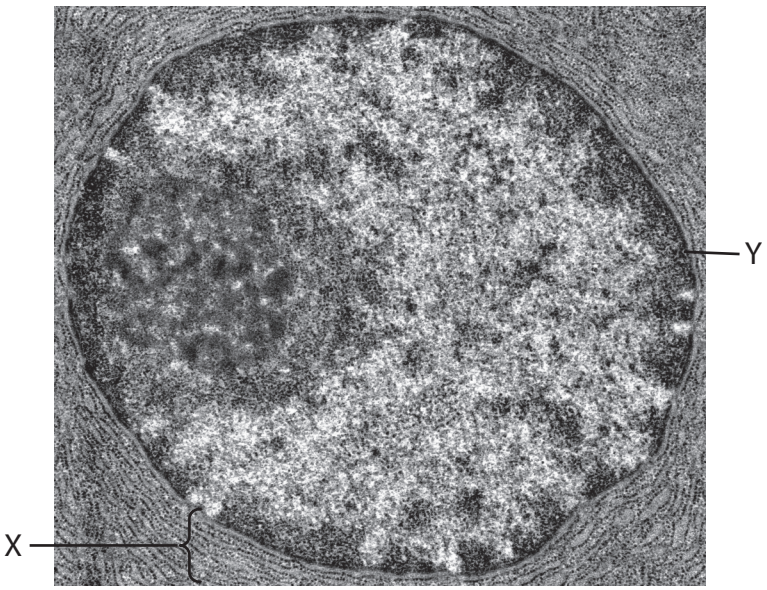
(b) The photograph shows part of a cell.



(i) Which organelle is labelled X?

(1)

☒ **A** chloroplast

☒ **B** endoplasmic reticulum

☒ **C** Golgi apparatus

☒ **D** plasmodesmata

(ii) The organelle surrounded by the membrane labelled Y contains the nucleolus.

Give the name and function of the organelle that contains the nucleolus.

(1)

Name .....

Function .....

.....

.....

(iii) Which of the following are functions of the nucleolus?

1. production of ribosomes
2. synthesis of DNA
3. synthesis of RNA

(1)

☒ **A** 1 and 2 only

☒ **B** 1 and 3 only

☒ **C** 2 and 3 only

☒ **D** 1, 2 and 3

(iv) Organisms can be classified into three domains.

State which of the three domains would contain an organism with the organelles X and Y.

(1)

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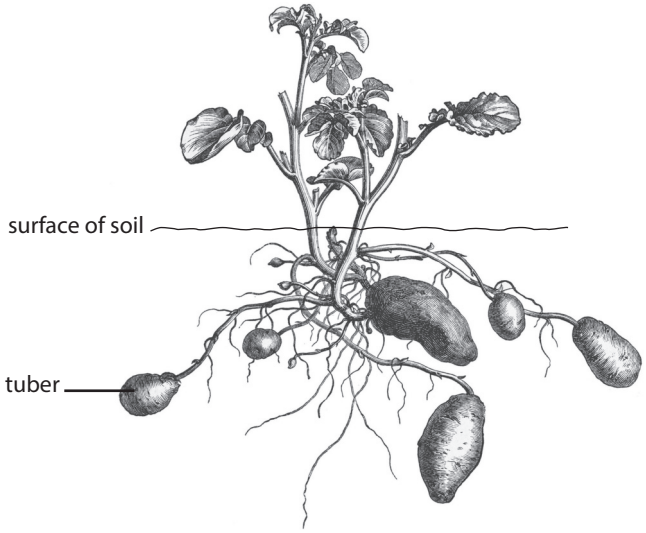
(c) The drawing shows tubers of a potato plant developing below the surface of the soil.



Organic molecules are transported through the potato plant to the developing tubers.

These molecules can be used to form starch molecules.

(i) Which structure in the cells of these tubers would store starch molecules?

(1)

☒ **A** amyloplast

☒ **B** chloroplast

☒ **C** middle lamella

☒ **D** vacuole

(ii) Explain how the **structure** of starch enables the potato tubers to have a high energy content.

(2)

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(Total for Question 1 = 8 marks)

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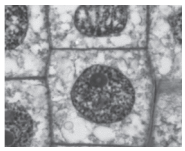
2 Interphase and mitosis are parts of the cell cycle.

(a) The photograph shows a plant cell in interphase.



(i) Interphase is the part of the cell cycle when mitosis is not taking place.

Which of the following processes occur during interphase?

1. cell growth
2. genetic material is replicated
3. organelles are synthesised

(1)

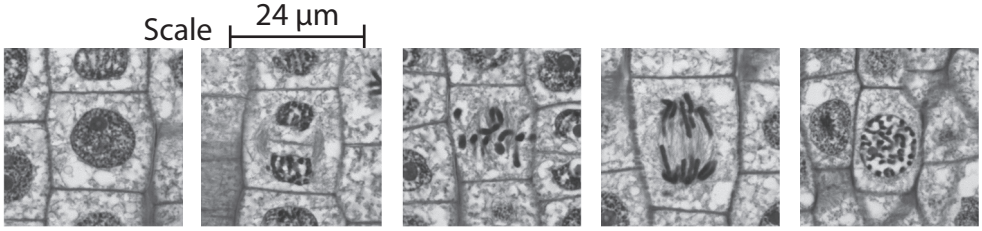
☒ **A** 1 only

☒ **B** 1 and 2 only

☒ **C** 2 and 3 only

☒ **D** 1, 2 and 3

(ii) The photographs show some stages in the cell cycle.



Which row shows the correct sequence of these stages in the cell cycle?

(1)

		Sequence of stages				
☒	**A**	V	X	W	Y	Z
☒	**B**	V	X	Y	Z	W
☒	**C**	V	Z	X	Y	W
☒	**D**	V	Z	W	X	Y

(iii) Calculate the magnification of photograph **W**.

Use the scale bar to help you.

(1)

Answer .....

(b) The mitotic index of a tissue was calculated.

The tissue had 450 cells in mitosis and the mitotic index was 37.5%.

Calculate the number of cells in this tissue that were in **interphase**.

(2)

Answer .....

(c) Describe the events that occur during prophase of mitosis.

(2)

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(d) Some new cells produced by mitosis are used for repairing damaged tissues.

Some new cells produced by mitosis are used for growth of tissues.

(i) Give an example of a tissue that could be produced in a plant.

(1)

.....

(ii) Give **one role**, other than for growth or repair, for new cells produced by mitosis.

(1)

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(Total for Question 2 = 9 marks)

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3 The photograph shows a gentoo penguin from Antarctica.

© robertharding / Alamy Stock Photo

These penguins swim in the very cold Antarctic waters in search of food.

They feed on fish, squid and shrimp.

(a) Explain **two** anatomical adaptations of these penguins that enable them to survive in this environment.

Use the information in the question to support your answer.

(2)

Adaptation 1 .....

Reason .....

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Adaptation 2 .....

Reason .....

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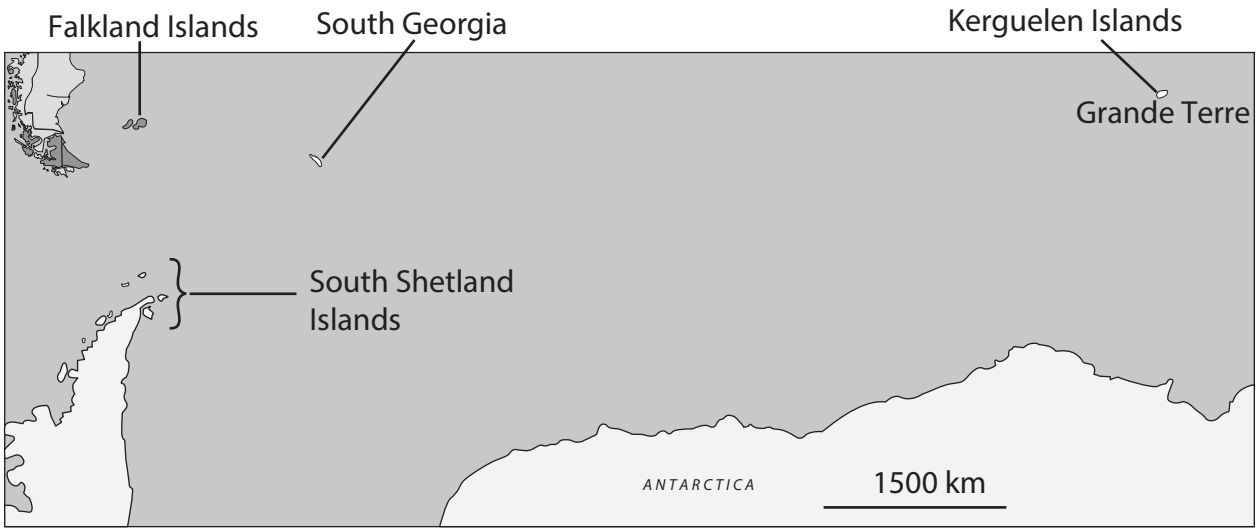
(b) The map shows four groups of islands that have gentoo penguin populations.



It has been proposed that the gentoo penguins on these four groups of islands are **different** species.

(i) Suggest **one** way that these penguins can be shown to belong to different species.

(1)

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.....

(ii) Explain how different species of gentoo penguin could have formed.

Use the map to support your answer.

(5)

(Total for Question 3 = 8 marks)

4 All living organisms are made of cells.

Some cells are specialised for their function.

(a) One specialised cell is the sperm cell.

Draw a mammalian sperm cell showing the acrosome, the nucleus and a mitochondrion.

Label the acrosome, nucleus and mitochondrion.

(3)

(b) A human egg cell is another example of a specialised cell.

(i) A human egg cell has a radius of 50 µm.

Calculate the **volume** of this human egg cell.

Use the formula:

$$V = \frac{4}{3}\pi r^3$$

(1)

Answer ..... µm^3

(ii) The surface area of this egg cell is 31 416 µm^2.

Give the surface area to volume ratio of this egg cell.

(1)

Answer ..... : 1

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(iii) Explain **three** ways in which a mammalian egg cell is specialised for its functions.

(3)

(c) A fertilised egg cell develops into a morula and then a blastocyst.

Which of the following are correct statements?

1. A blastocyst contains pluripotent stem cells.
2. A blastocyst is a hollow ball of cells whereas a morula is not.
3. Both of these structures contain cells which divide by meiosis.

(1)

☒ **A** 1 and 2 only

☒ **B** 1 and 3 only

☒ **C** 2 and 3 only

☒ **D** 1, 2 and 3

(Total for Question 4 = 9 marks)

5 The photograph shows a fruit fly.

© Nature Picture Library / Alamy Stock Photo

(a) The gene for eye colour in this species of fruit fly has multiple alleles.

Homozygous fruit flies have two identical alleles for eye colour.

The table gives some information about these alleles.

Allele	Eye colour of homozygous fruit fly	Depth of colour
+	red	darkest colour
w^{ch}	cherry	
w^{b}	blood	
w^{e}	eosin	
w^{apr}	apricot	
w^{iv}	ivory	
w^{cr}	cream	
w	white	lightest colour

(i) These alleles are found at the same locus.

State what is meant by the term **locus**.

(1)

(ii) Explain how these alleles can produce fruit flies with different coloured eyes.

(2)

(b) The development of an embryo into either a female or a male fruit fly is determined by two different proteins.

The female specific Dsx-F protein leads to the development of a female fly and the male specific Dsx-M protein results in a male fly.

Both proteins are the product of the same gene.

Explain how this gene can give rise to either a female or a male fly.

(4)

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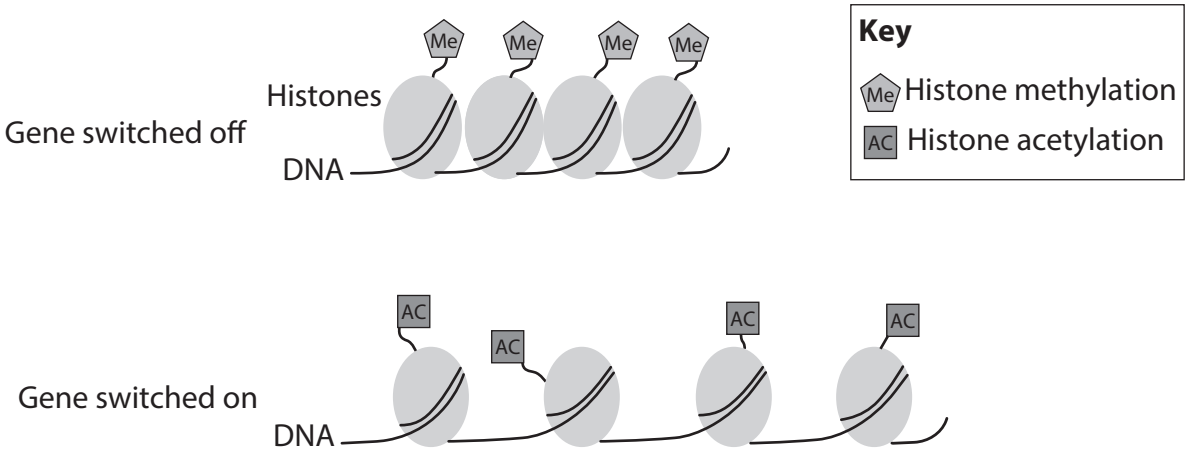
(c) Histone modification can affect gene expression, as shown in the diagram.



Explain how histone modification can affect gene expression.
Use the diagram to support your answer.

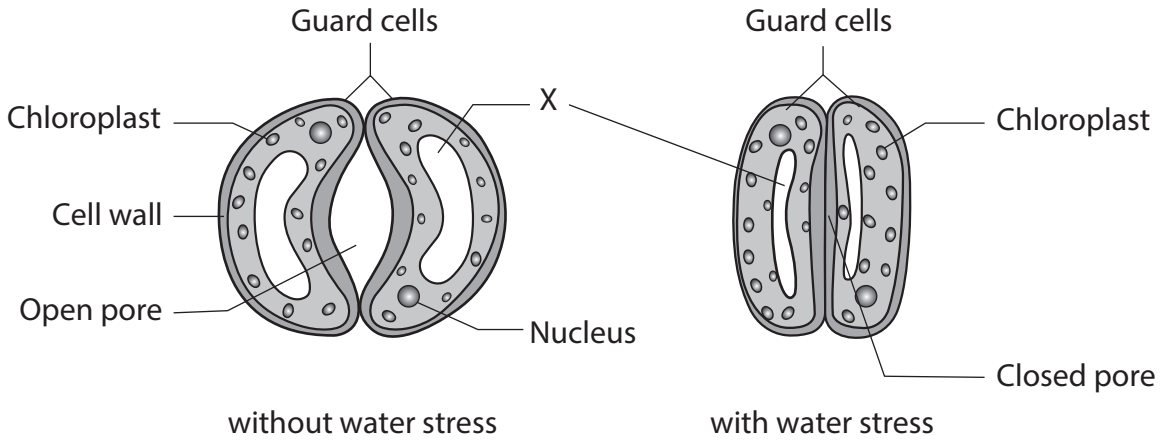
(5)

(Total for Question 5 = 12 marks)

6 Water is important for plants.

There are pores in the surface of the leaf, which are formed by guard cells. Changes to the guard cells cause the pores to open or close.

The diagram shows guard cells, at the same time of day, from a wheat plant without water stress and from a wheat plant that has water stress.



When a plant is not given sufficient water, for a period of time, it develops water stress.

This can have several effects on the plant.

(a) One effect is to close the pores in the leaves. This occurs due to changes in the guard cells.

(i) Name the structure labelled X.

(1)

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(ii) Suggest why the closing of the pores reduces water stress in the plant.

(1)

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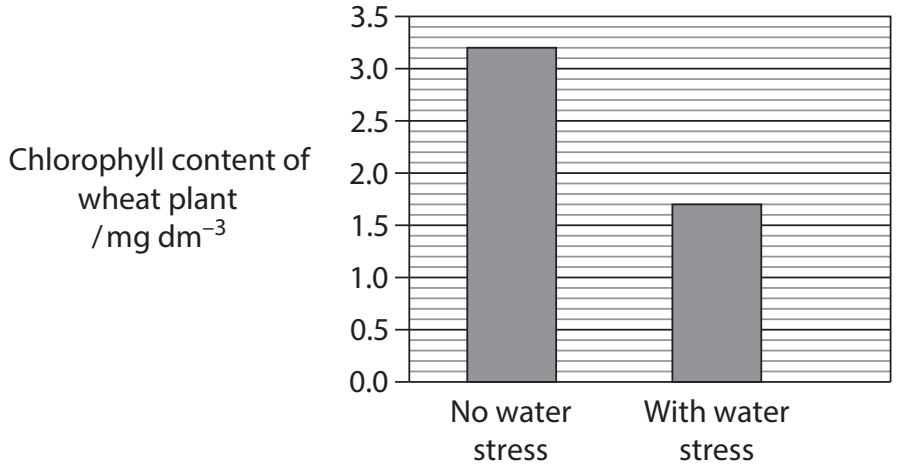
(b) Another effect is the reduction in the absorption of mineral ions, for example magnesium ions.

Magnesium ions are needed in the formation of chlorophyll.

The effect of water stress on the chlorophyll content of a wheat plant was investigated.

The results are shown in the graph.



Which is the percentage change in chlorophyll content when the wheat plant has water stress?

(1)

☒ **A** +46.9%

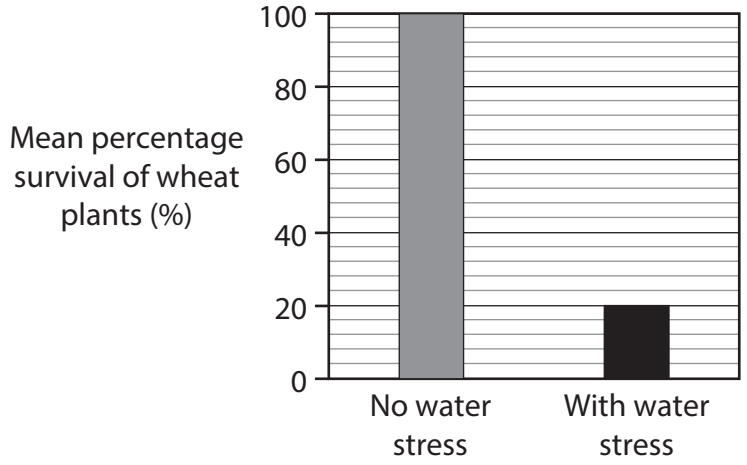
☒ **B** –46.9%

☒ **C** –88.2%

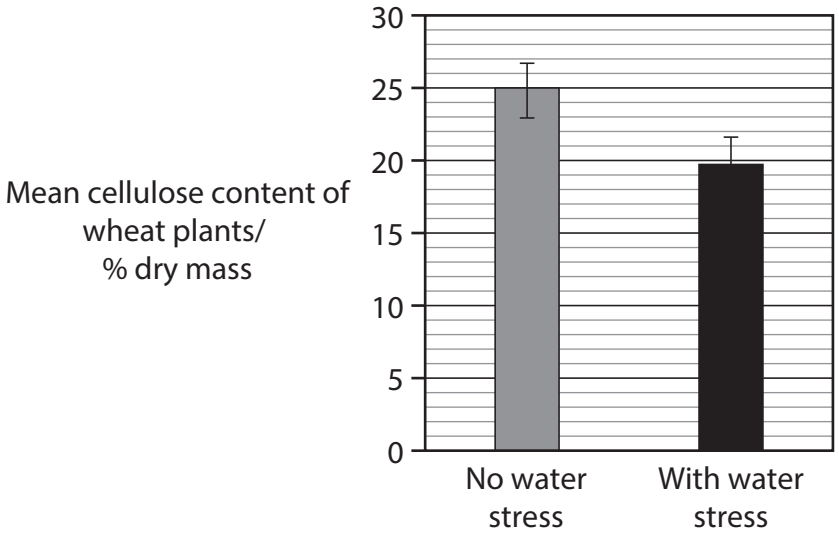
☒ **D** +88.2%

*(c) The graphs show three more effects of water stress on wheat plants.

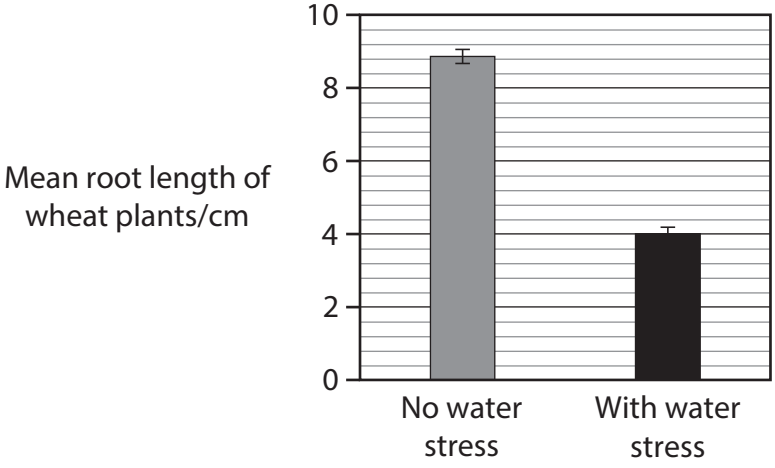
Graph A shows the effect of water stress on percentage survival rate.



Graph B shows the effect of water stress on cellulose content.



Graph C shows the effect of water stress on root length.



Deduce how water stress could affect the growth of wheat plants.

Use information from the whole of Question 6 and your own knowledge to support your answer.

(6)

(Total for Question 6 = 9 marks)

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7 The photograph shows a mother and baby Malayan tapir (*Tapirus indicus*). They live in the rainforests of southeast Asia.

Each gamete of a Malayan tapir contains 26 chromosomes.

(a) The body cells of the mother Malayan tapir have some genetic similarities to and differences from the cells of her baby.

Explain why the body cells of the mother and baby have genetic similarities **and** differences.

(3)

(b) Biodiversity within a species can be measured using genetic diversity.

Three melanistic Malayan tapirs have been discovered that have black fur all over their bodies.

Melanistic tapirs have two copies of the recessive allele for fur colour and are homozygous.

(i) Scientists wanted to determine the heterozygosity index of the Malayan tapir species.

Which equation can be used to calculate the heterozygosity index?

(1)

	Equation
☒ **A**	$\text{heterozygosity index} = \frac{\text{number of heterozygotes}}{\text{number of individuals in the population}}$
☒ **B**	$\text{heterozygosity index} = \frac{\text{number of heterozygotes}}{\text{number of species in the habitat}}$
☒ **C**	$\text{heterozygosity index} = \frac{\text{number of individuals in the population}}{\text{number of heterozygotes}}$
☒ **D**	$\text{heterozygosity index} = \frac{\text{number of species in the habitat}}{\text{number of heterozygotes}}$

(ii) Explain how scientists could determine if a **change** in the frequency of the recessive allele was occurring over time.

(2)

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(c) The map shows the change in distribution of the Malayan tapir over the past 20 years.

Key
- Current distribution
- Earlier distribution

(i) Give **one similarity** between the current and earlier distribution of the Malayan tapir.

(1)

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(ii) One difference is that the distribution has reduced due to human activity.

Suggest **one** reason why human activity has caused this change in distribution.

(1)

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(iii) A study suggested that the genetic diversity of the Malayan tapirs has decreased due to populations being separated from each other.

Explain how a captive breeding programme could maintain the genetic diversity of Malayan tapir populations.

(3)

(Total for Question 7 = 11 marks)

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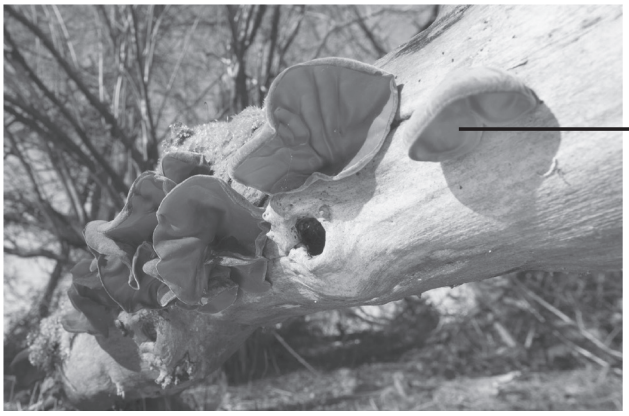
8 The photograph shows a species of fungus growing on a dead tree in a woodland habitat.



Wood contains a high proportion of lignin and cellulose.

Fungi can break down molecules in wood by releasing extracellular enzymes.

(a) Describe the role of the rough endoplasmic reticulum in the formation of extracellular enzymes.

(3)

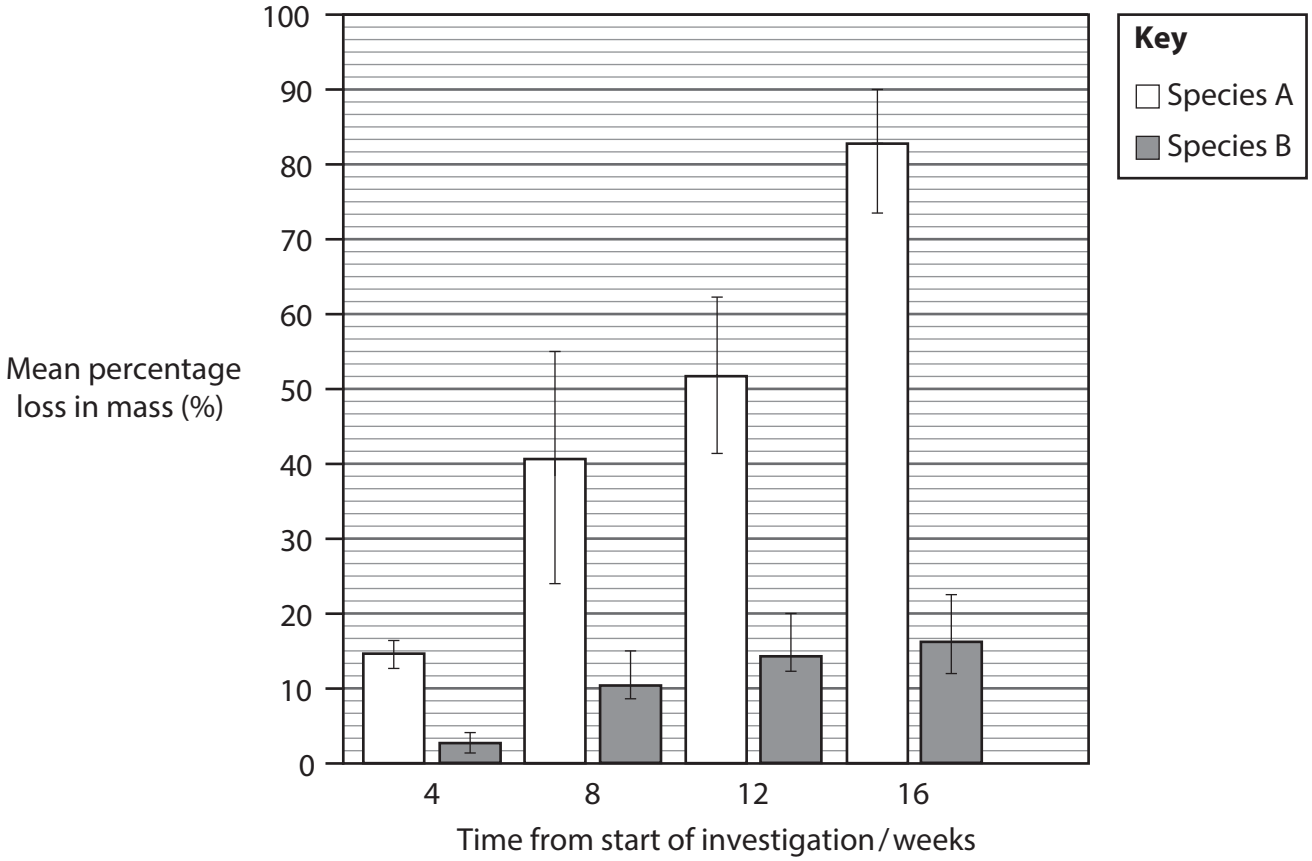
(b) Different species of fungus can break down different molecules in wood.

The effect of two species of fungus on the percentage loss in mass of wooden blocks was investigated.

Species A was grown on one set of wood blocks and species B was grown on another set of wood blocks.

The percentage loss in mass of the blocks was recorded every four weeks.

The graph shows the results of the investigation.



(i) Comment on the results of this investigation.

(3)

(ii) Suggest **one** reason for the difference in breakdown of the wood by species A and species B.

(1)

(c) A study compared the biodiversity of two woodland habitats.

The index of diversity for habitat one was 4.2.

The table shows the data obtained from habitat two.

Species	Number of individuals (n)	n(n–1)
A	34	1122
B	6	30
C	27	
D	4	12
E	9	72
F	31	930
G	120	14280

(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 two.

Use the table and the formula to help you.

(3)

Answer .....

(ii) State which habitat has the higher biodiversity.

Give a reason for your answer.

(1)

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(iii) Species D is an endangered plant species.

Explain the processes that could be used by a seed bank to conserve this plant species.

(3)

(Total for Question 8 = 14 marks)

TOTAL FOR PAPER = 80 MARKS

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