Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|

Centre Number | Candidate Number

# Pearson Edexcel International Advanced Level

## Tuesday 14 October 2025

Afternoon (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 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.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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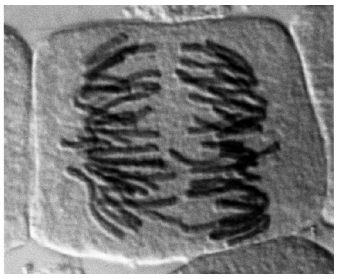
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**Answer ALL questions.**

**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** Mitosis can occur in some plant cells.
The photograph shows a plant cell as seen using a light microscope.



(Source: © DR. JUAN F. GIMENEZ-ABIAN/SCIENCE PHOTO LIBRARY)

(a) (i) Name the stage of mitosis shown in this photograph.

**(1)**

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(ii) Describe what happens during the **telophase** stage of mitosis in a plant cell.

**(2)**

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(b) A student used a light microscope to look at mitosis in cells in a root tip.

(i) The student prepared two root tip slides, each with a different stain, as shown in the table.

| Slide | Stain | Molecules stained |
|---|---|---|
| A | safranin | lignin and nucleic acids |
| B | nile red | lipids |

Identify which slide would provide the student with the information needed to observe cells in mitosis.

Give a reason for your answer.

**(1)**

Slide

.....

Reason

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.....

.....

(ii) The student recorded the number of cells in each stage of the cell cycle.

The table shows the results.

| Stage of cell cycle | Number of cells |
|---|---|
| interphase | 100 |
| prophase | 12 |
| metaphase | 5 |
| anaphase | 3 |
| telophase | 8 |

Which is the mitotic index that can be determined from these results?

**(1)**

☒ **A** 3.6%

☒ **B** 21.9%

☒ **C** 28.0%

☒ **D** 35.7%

**(Total for Question 1 = 5 marks)**

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**2** Plants and animals are made of cells.

(a) Starch can be stored in different parts of a plant cell.

(i) Which of these parts of a plant cell store starch?

**(1)**

☒ **A** amyloplast only

☒ **B** amyloplast and chloroplast only

☒ **C** amyloplast and vacuole only

☒ **D** amyloplast, chloroplast and vacuole

(ii) Describe the structure of starch.

**(3)**

(b) Lysosomes and ribosomes are structures found in an animal cell.

(i) State the function of a lysosome.

**(1)**

.....

.....

.....

(ii) Some ribosomes can be 20 nm in diameter and some lysosomes can be 0.2 μm in diameter.

Which is the ratio of these diameters of ribosomes to lysosomes?

**(1)**

☒ **A** 0.01 : 1

☒ **B** 0.1 : 1

☒ **C** 10 : 1

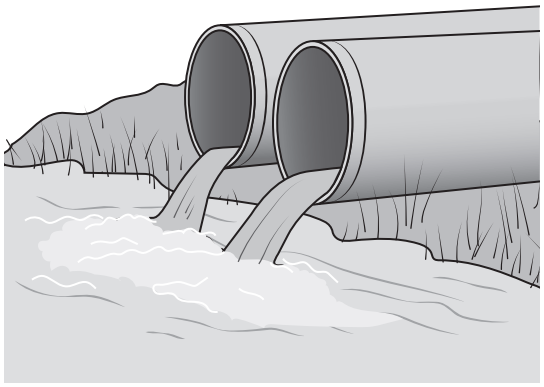
☒ **D** 100 : 1

**(Total for Question 2 = 6 marks)**

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**3** The diagram shows water with sewage entering a river.



(a) Some of the bacteria in the river will digest the sewage.

These bacteria will reduce the oxygen content of the river water.

Suggest why the oxygen content of the river water is reduced by the bacteria.

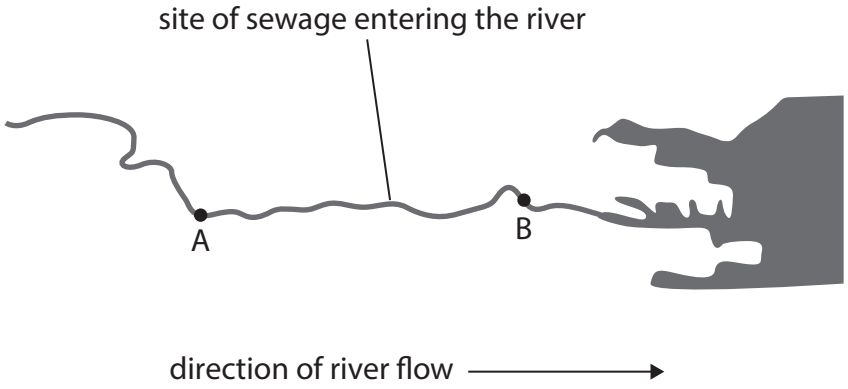
**(1)**

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(b) The diagram shows a river with two sampling sites, A and B.




The effect of the sewage on the species diversity in this river was investigated.

The number of individuals of each species present at sites A and B was recorded.

The table shows the results from sampling site A.

| Species | Number of individuals (n) | n(n – 1) |
|---|---|---|
| Bloodworm | 10 | 90 |
| Crayfish | 2 | 2 |
| Freshwater shrimp | 70 | 4830 |
| Mayfly nymph | 34 | 1122 |
| Sludgeworm | 2 | 2 |
| Total | 118 | 6046 |

(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 sampling site A.

Use the table and formula to help you.

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

**(2)**

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(ii) Suggest what effect the sewage entering the river will have on the biodiversity at sampling site **B**.

Give a reason for your answer.

**(2)**

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**(Total for Question 3 = 5 marks)**

**4** The photograph shows a tiger.



(Source: © robertharding/Alamy Stock Photo)

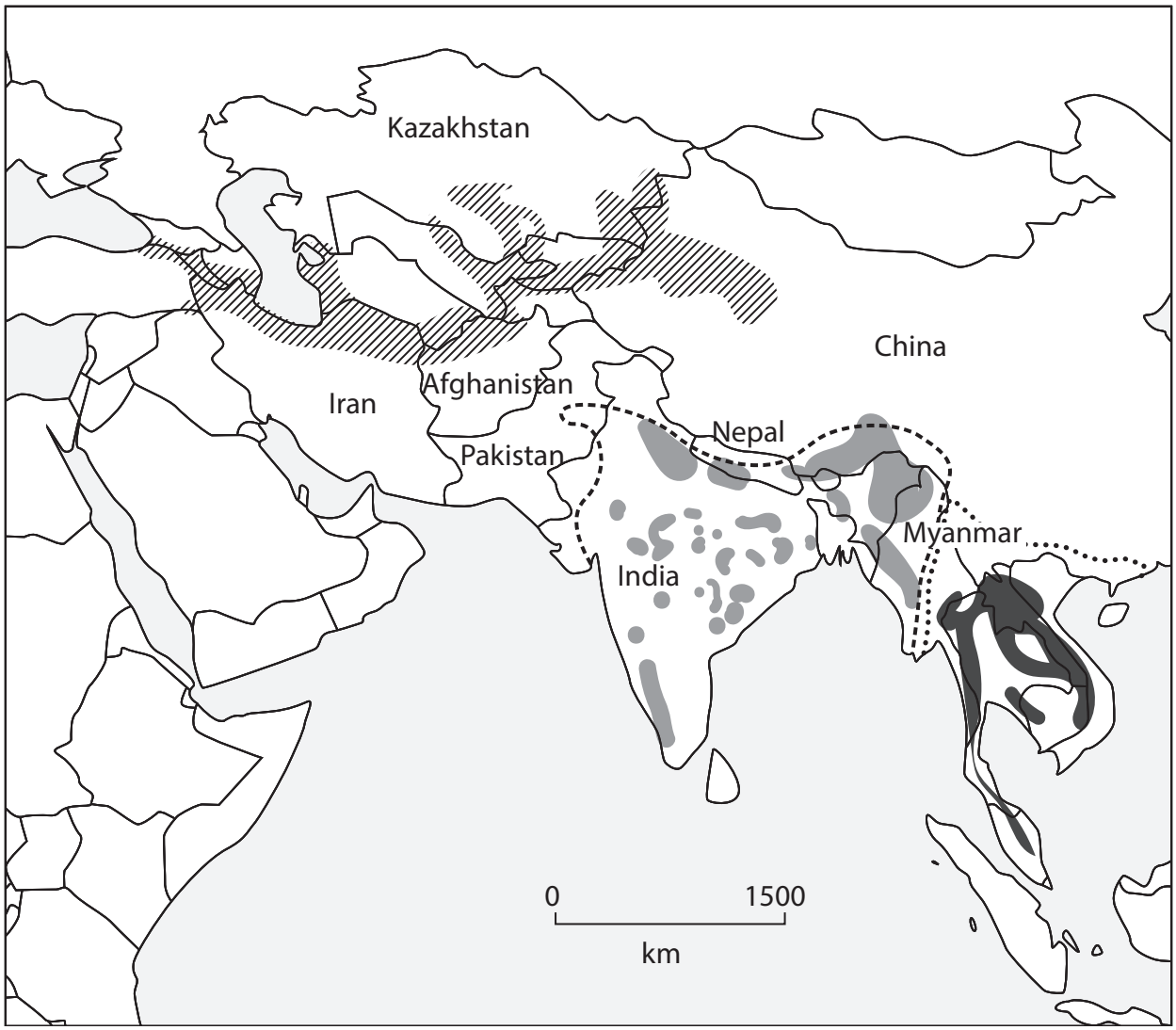
Scientists have classified all tigers as a single species.
However, tigers show so much variation that they are placed in several subspecies.

The map opposite shows the current and historical ranges for two endangered subspecies of tiger, the Bengal and the Indo-Chinese.

The historical range for the extinct Caspian tiger subspecies is also shown.

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(a) (i) Calculate the **maximum** width of the historical range of the extinct Caspian tiger.

**(1)**

Answer ..... km

(ii) Give **two** reasons why the Caspian tiger subspecies is now extinct.

**(2)**

1 .....

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2 .....

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(iii) Suggest why scientists have placed these tigers into different **subspecies** of the same species.

**(2)**

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(b) Scientists have suggested that creating links between populations of Bengal tiger would help maintain their genetic diversity.

Explain why this suggestion would help maintain the genetic diversity of the Bengal tiger.

Use the information on the map to support your answer.

**(3)**

(c) Describe how education could help conserve these endangered tiger subspecies.

**(3)**

**(Total for Question 4 = 11 marks)**

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**5** The photograph shows jute plants growing in a field in Bangladesh.



(Source: © WASIM MOLLA/Alamy Stock Photo)

(a) Fibres from jute plants are used to make bags and string as shown in the photograph.



(Source: © Dinodia Photos/Alamy Stock Photo)

(i) Give the name of a tissue that would be a source of jute fibres.

**(1)**

.....

(ii) Bags made from jute fibres have a high tensile strength.

Give **one** reason why these fibres have a high tensile strength.

**(1)**

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(iii) Bags made from jute are more sustainable than bags made from oil-based plastics as they are renewable.

Give **one other** reason why they are more sustainable than bags made from oil-based plastics.

**(1)**

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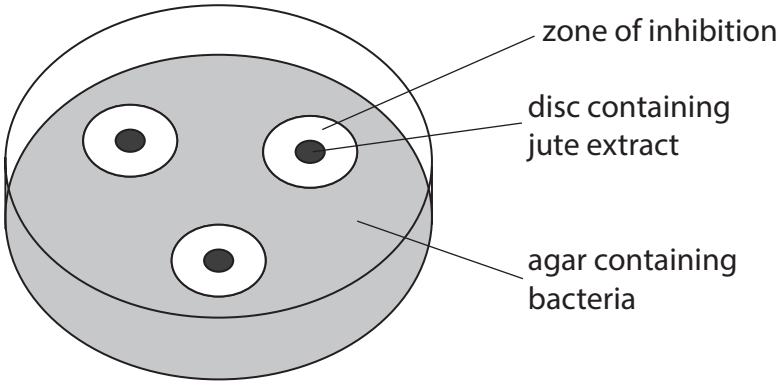
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(b) Extracts made from the leaves and seeds of jute plants have antimicrobial properties.

The effectiveness of these two extracts was investigated.

The diagram shows three discs soaked in one of the extracts placed on an agar plate containing one type of bacteria.




This was repeated for agar plates containing two other types of bacteria.

The plates were incubated at 25 °C for 24 hours.

The investigation was repeated with the second extract.

The table shows the results of this investigation.

| Type of bacteria | Mean diameter of zone of inhibition ± SD / mm | |
|---|---|---|
| | Extract made from jute leaves | Extract made from jute seeds |
| *B. pumilus* | 8.3 ± 0.3 | 11.8 ± 0.5 |
| *E. faecalis* | 9.3 ± 0.5 | 12.8 ± 0.6 |
| *L. monocytogenes* | 13.3 ± 0.5 | 12.5 ± 0.3 |

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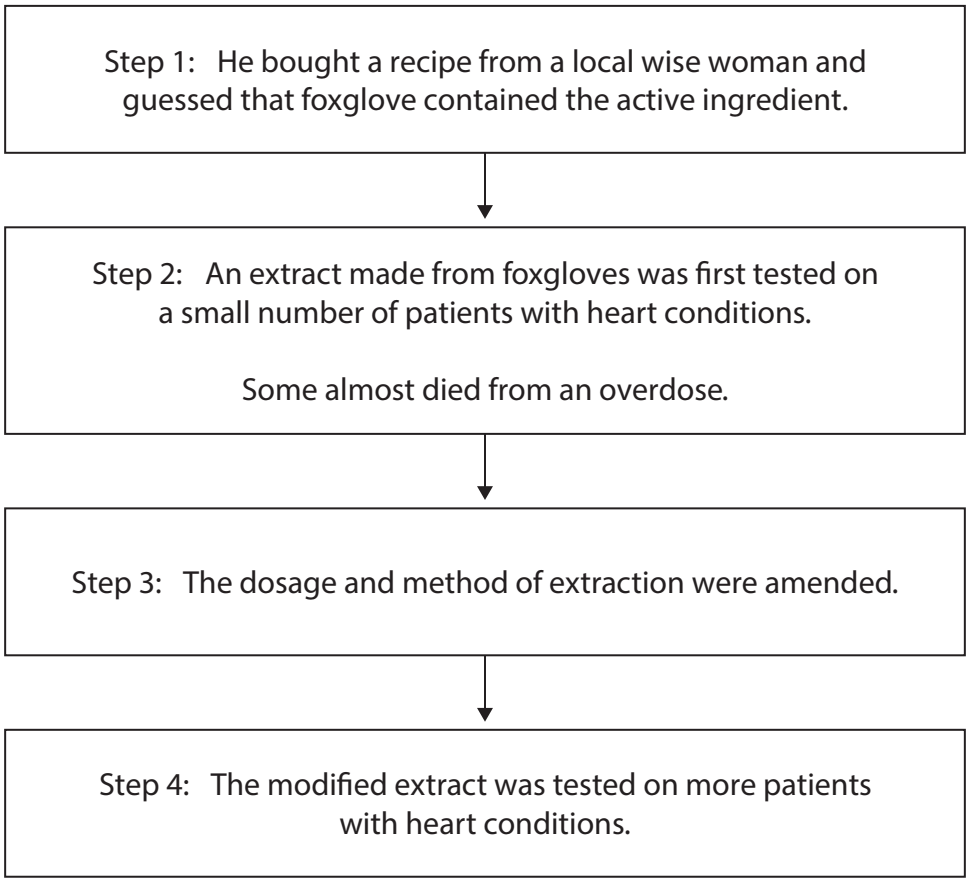
Deduce the effectiveness of the jute leaf and seed extracts.

**(3)**

(c) Plant extracts can also have therapeutic properties.

In the 18th century, William Withering tested various extracts made from foxglove plants to treat patients with heart conditions.

The diagram shows the steps in the method he used.




(i) Name the active ingredient in the extract that William Withering tested.

**(1)**

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(ii) Describe how each step in William Withering's method of drug testing compares with contemporary drug testing.

**(4)**

Step 1: He **guessed** that foxglove contained the active ingredient.

Step 2: An extract made from foxgloves was **first** tested on a small number of patients with heart conditions.

Step 3: The dosage and method of extraction were amended **after** some patients almost died from an overdose.

Step 4: The modified extract was tested on more patients with heart conditions.

**(Total for Question 5 = 11 marks)**

**6** Seed banks store seeds.
The photograph shows dried seeds stored in dry conditions in a seed bank.



(Source: © Imaginechina Limited / AlamyStock Photo)

(a) Explain why seeds are dried and then kept in dry conditions.

**(2)**

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(b) Seeds from some endangered plant species do not survive the drying process.

Cryopreservation is an alternative storage method.

This method involves removing the embryo tissue from a seed and placing it into liquid nitrogen at –196 °C.

(i) Which occurs during fertilisation to produce an embryo?

**(1)**

☒ **A** generative nucleus fuses with an egg cell nucleus

☒ **B** generative nucleus fuses with polar nuclei

☒ **C** male nucleus fuses with an egg cell nucleus

☒ **D** male nucleus fuses with polar nuclei

(ii) Explain why some seed banks would choose to use cryopreservation.

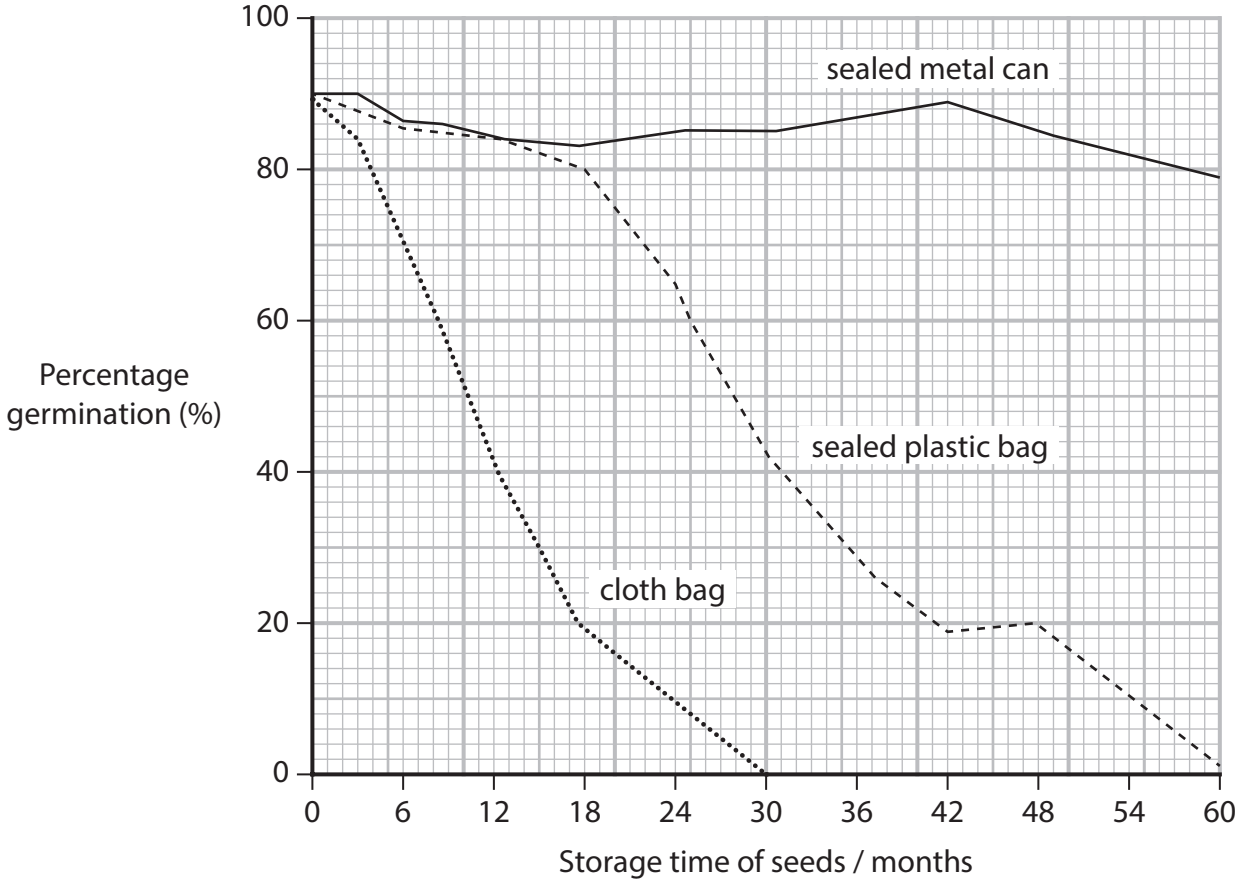
**(2)**

(c) Samples of seeds are removed from storage at intervals and tested to see if they will still germinate.

The type of container used to store seeds can affect the percentage germination of seeds in a seed bank.

This was investigated at a temperature of –20 °C.

The graph shows the percentage germination of seeds kept in three containers: a cloth bag, a sealed plastic bag and a sealed metal can.




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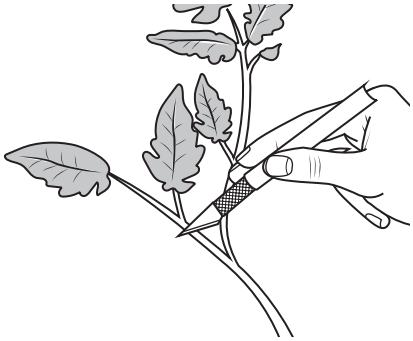
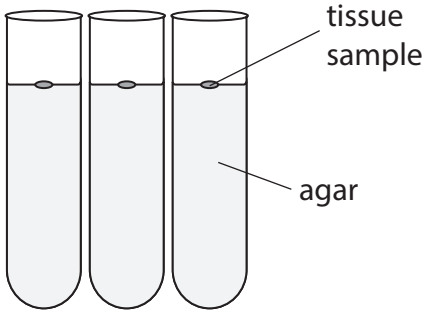
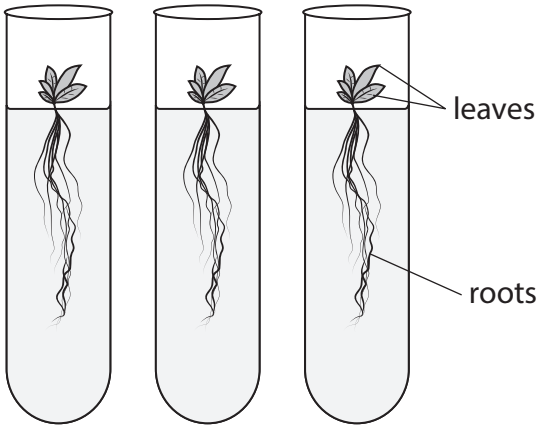
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Comment on the results of this investigation.

Use the data in the graph to support your answer.

**(4)**

(d) The diagram shows how new genetically identical plants can be grown using tissue samples from an endangered plant species.

| Stage of cloning process | Diagram | Process |
|---|---|---|
| 1 |  | Tissue samples are taken from a parent plant. |
| 2 |  | Tissue samples are placed in separate tubes containing nutrient agar.<br>The agar contains chemicals to stimulate growth and development. |
| 3 |  | Each tissue sample develops into a new genetically identical plant that has roots and leaves. |

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Explain **how** tissue samples taken from a parent plant can develop into whole plants that are genetically identical.

Use the information in the diagram and your own knowledge to support your answer.

**(4)**

**(Total for Question 6 = 13 marks)**

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**7** Gametes are specialised for their function.

(a) Explain **two** ways in which the head of a human **sperm cell** is specialised for its function.

**(2)**

1 .....

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2 .....

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(b) A student used a microscope and a graticule to view a human egg cell.

The actual diameter of the egg cell was calculated to be 0.10 mm.

Calculate the **volume** of this egg cell in $\mu m^3$.

Use the formula:

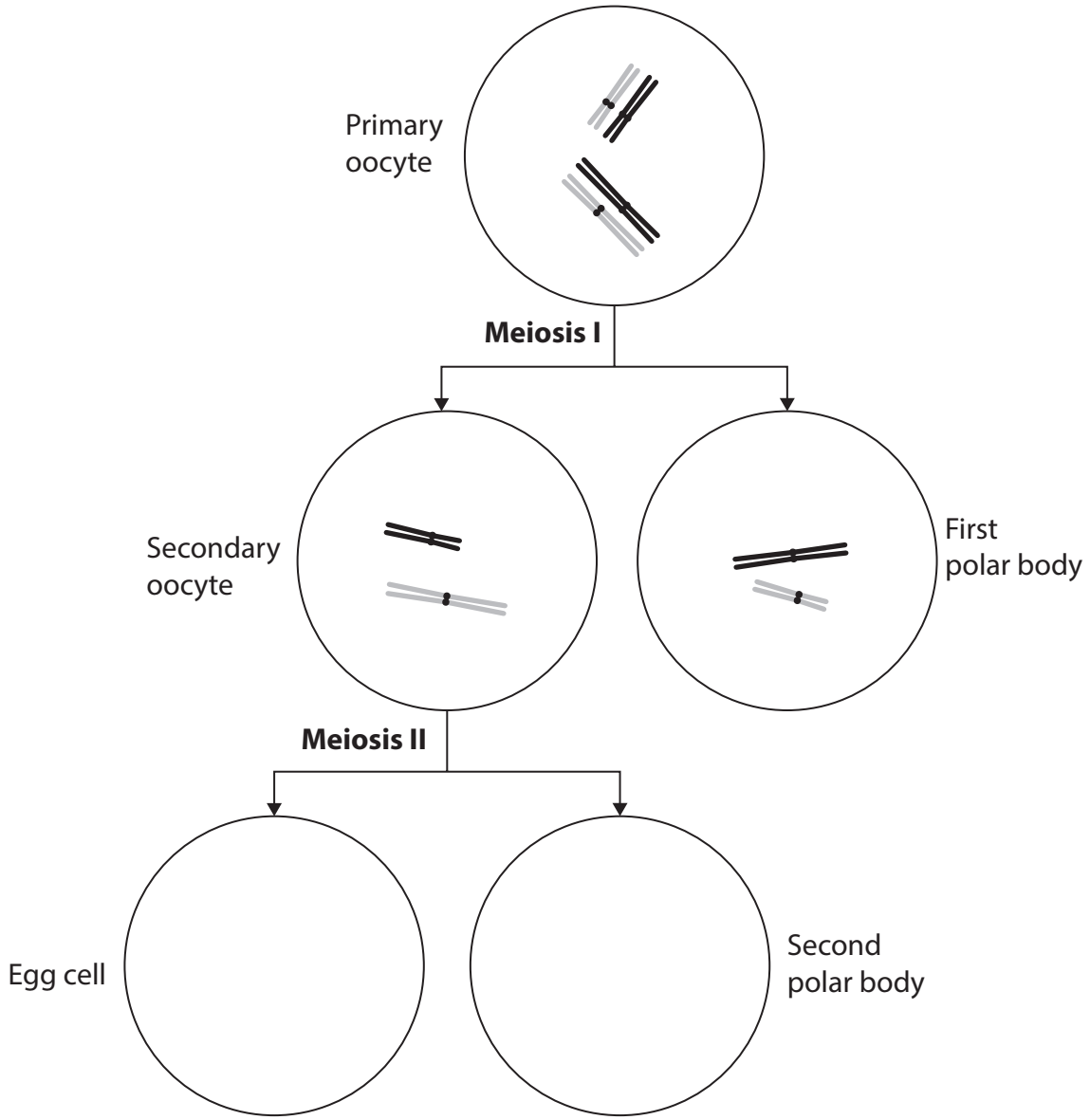
$$V = \frac{4}{3}\pi r^3$$

Give your answer in standard form.

**(2)**

Answer ..... $\mu m^3$

(c) The diagram shows some cells produced during meiosis in a female organism.




(Source: adapted from https://socratic.org/questions/591c7f4911ef6b5ff5ba72a0)

(i) The primary oocyte contains 2 pairs of chromosomes.

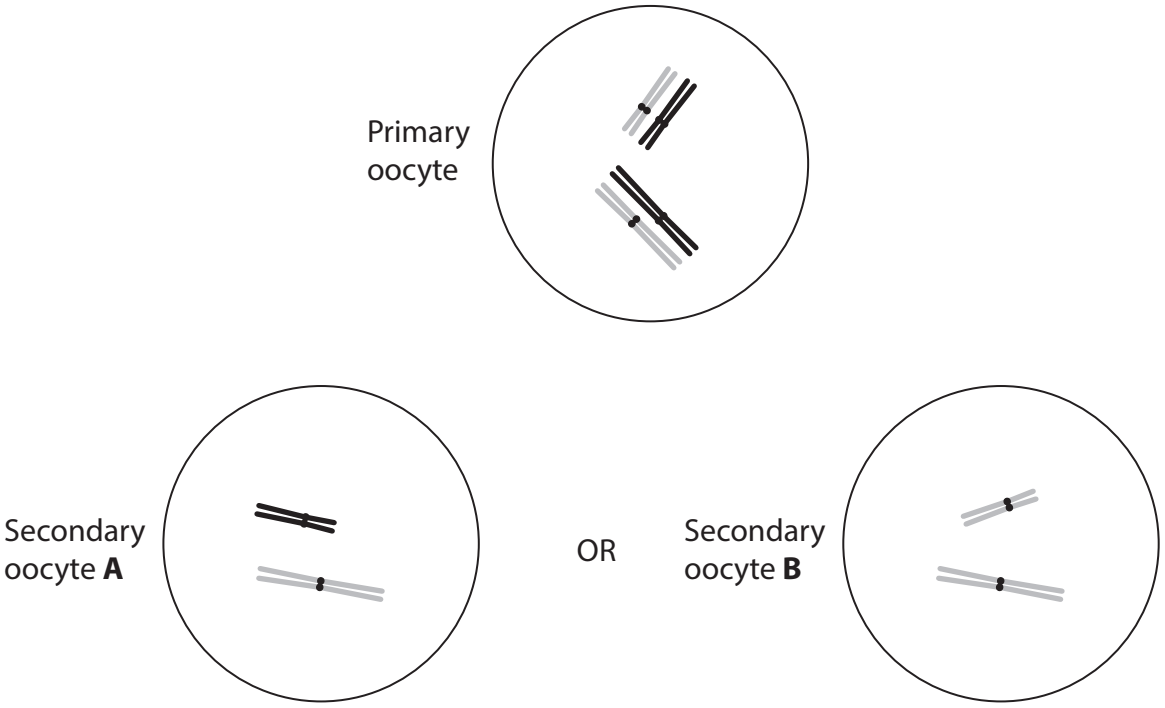
Complete the **diagram** to show the chromosomes that would be found in the **egg cell** and the **second polar body**.

**(2)**

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(ii) The diagram shows two secondary oocytes, A and B, that could have been produced from this primary oocyte as a result of meiosis I.




(Source: adapted from https://socratic.org/questions/591c7f4911ef6b5ff5ba72a0)

Explain why these secondary oocytes, A and B, are genetically different from each other.

**(2)**

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(d) Egg cells contain cortical granules that are transported to the cell surface membrane by protein fibres.

The gene Rab27a contains the genetic information for the production of these protein fibres.

The effect of deactivating the gene Rab27a was investigated.

Two hundred egg cells were split equally into two groups, as shown in the table.

| Group | Rab27a gene |
|---|---|
| A | active |
| B | deactivated |

(i) Describe how the activity of a gene, such as Rab27a, could be altered.

**(2)**

(ii) The egg cells of group A were placed in a Petri dish and a solution containing 1000 sperm cells was added.

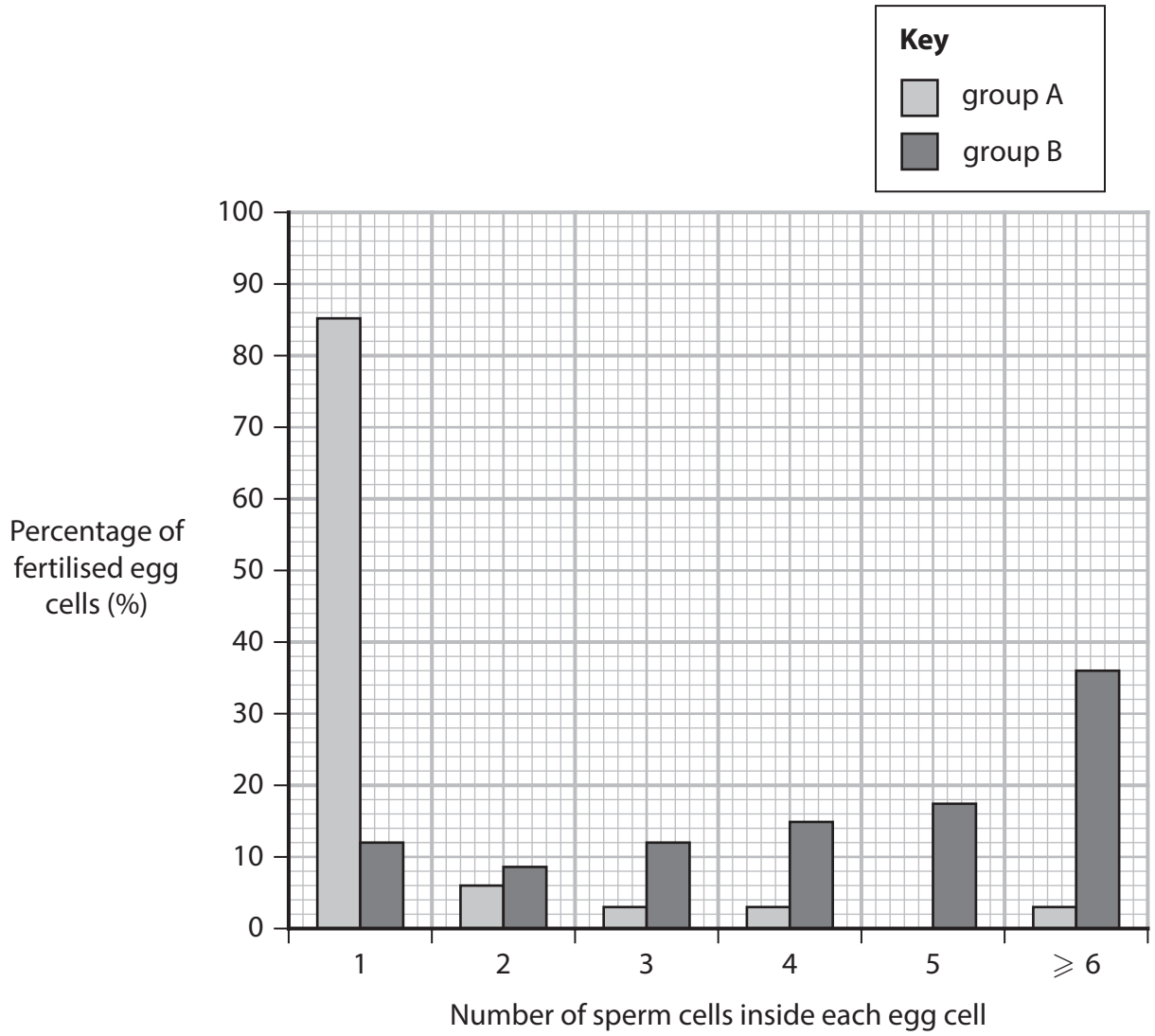
This was repeated for group B.

The Petri dishes were incubated at 37 °C.

After 24 hours, the percentage of egg cells that had been fertilised was determined.

The number of sperm cells in each egg cell was counted.

The graph shows the results of this investigation.




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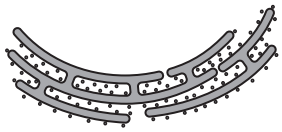
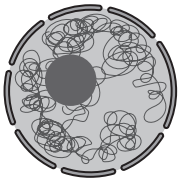
Explain the results of this investigation.

**(5)**

**(Total for Question 7 = 15 marks)**

**8** Cells in the small intestine produce the extracellular enzyme maltase.

(a) The diagrams show some organelles found in these cells.

| | |
|---|---|
| **P** |  |
| **Q** |  |
| **R** |  |
| **S** |  |

(i) Which organelle can form secretory vesicles containing extracellular enzymes that fuse with the cell membrane?

**(1)**

☒ **A** organelle **P**

☒ **B** organelle **Q**

☒ **C** organelle **R**

☒ **D** organelle **S**

(ii) Which row shows the organelles that have or produce ribosomes?

**(1)**

| | | Organelle | | | |
|---|---|---|---|---|---|
| | | **P** | **Q** | **R** | **S** |
| ☒ | **A** | ✓ | × | ✓ | × |
| ☒ | **B** | ✓ | × | × | ✓ |
| ☒ | **C** | × | ✓ | ✓ | × |
| ☒ | **D** | × | ✓ | × | ✓ |

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(iii) Maltase breaks down maltose into α-glucose.

The α-glucose is used in respiration.

Which part of a cell would be involved in respiration?

**(1)**

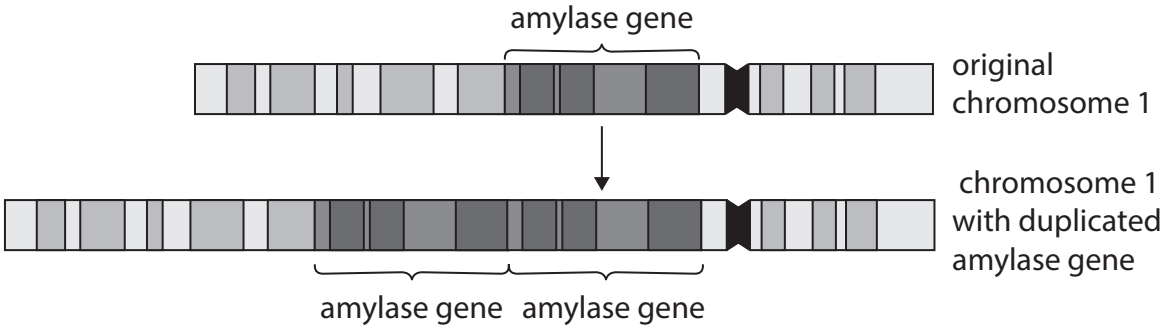
- ☒ **A** centriole
- ☒ **B** chloroplast
- ☒ **C** endoplasmic reticulum
- ☒ **D** mitochondria

(b) Salivary gland cells produce the extracellular enzyme amylase.

Amylase breaks down starch into smaller carbohydrates, such as maltose.

Errors in DNA replication and crossing over can result in gene duplication.

The diagram shows an original chromosome and a chromosome where gene duplication has occurred.




(i) Name the stage in meiosis in which crossing over would begin.

**(1)**

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(ii) Describe the process of crossing over.

**(2)**

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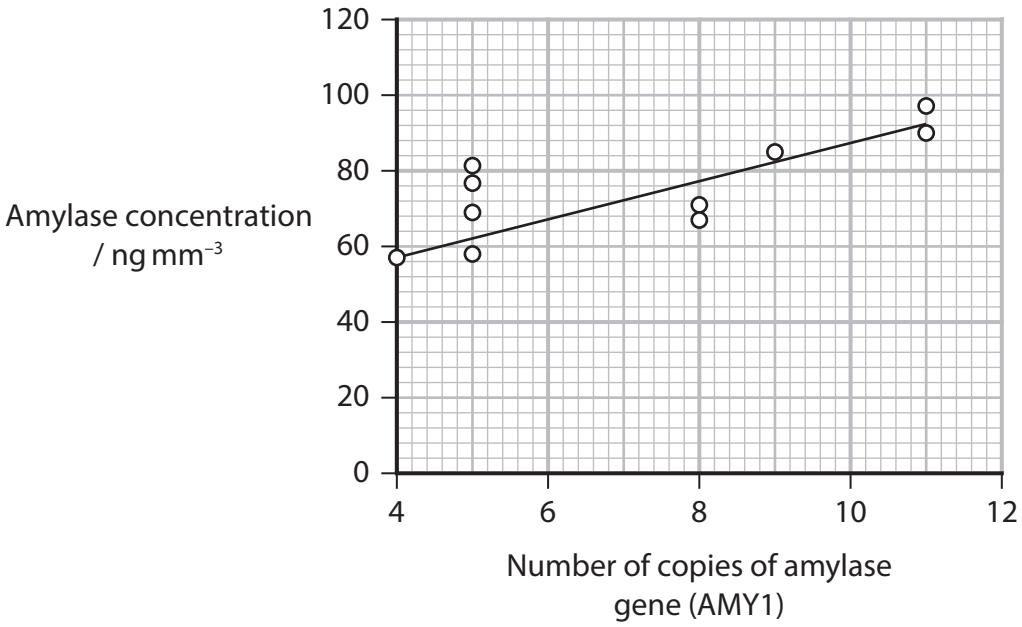
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(c) The effect of the number of copies of the amylase gene AMY1 on the amylase concentration produced was investigated.

The graph shows the result of this investigation.




The correlation coefficient for these data is 0.77.

What does this value mean?

**(1)**

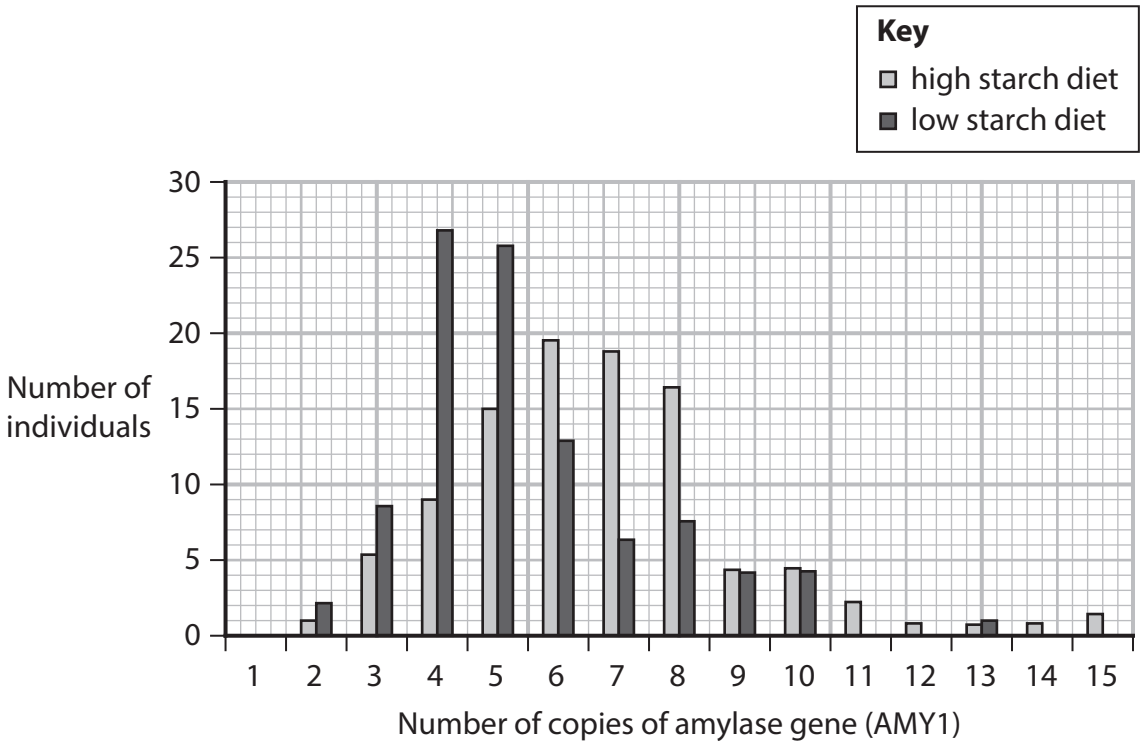
- ☒ **A** there is a strong negative correlation
- ☒ **B** there is a strong positive correlation
- ☒ **C** there is a weak negative correlation
- ☒ **D** there is a weak positive correlation

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(d) The relationship between the starch content of a normal diet and the number of copies of the amylase gene AMY1 in different human populations was investigated.

The graph shows the results of the investigation.




(i) State the mode for the number of copies of AMY1 in individuals with a high starch diet.

**(1)**

.....

*(ii) Scientists stated that the number of copies of the amylase gene AMY1 could be an **adaptation** of an organism to its diet.

Discuss this statement.

Give reasons to support your answer that use information from **all parts of Question 8** and your own knowledge.

**(6)**

**(Total for Question 8 = 14 marks)**

**TOTAL FOR PAPER = 80 MARKS**

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