

Write your name here

Surname

Other names

Centre Number

Candidate Number

**Edexcel GCE**

**Biology**

**Advanced Subsidiary**

**Unit 2: Development, Plants and the Environment**

Wednesday 18 January 2012 – Afternoon

**Time: 1 hour 30 minutes**

Paper Reference

**6BI02/01**

**You do not need any other materials.**

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.*

### 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.*
- Questions labelled with an **asterisk** (\*) are ones where the quality of your written communication will be assessed  
– *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

### 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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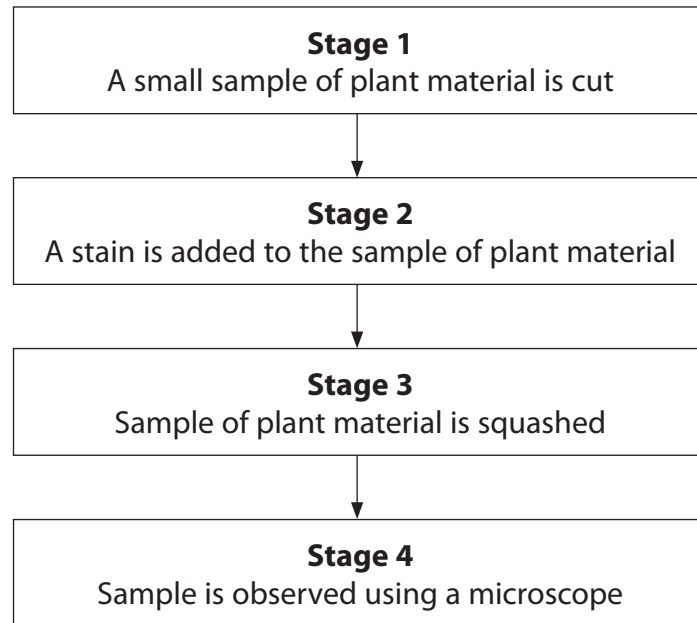
**PEARSON**

**Answer ALL questions.**

**Some questions must be answered with a cross ☐. 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 be studied using plant material.

(a) The diagram below shows some stages in a process that allows mitosis to be studied in plant material.



Place a cross ☐ in the box next to the correct word or words to complete each of the following statements.

(5)

(i) In stage 1, the small sample of plant material is cut from

- ☐ **A** a leaf edge
- ☐ **B** a root tip
- ☐ **C** sclerenchyma fibres
- ☐ **D** xylem vessels



(ii) In stage 1, the most sensible safety precaution is to

- ☐ **A** cut away from oneself
- ☐ **B** cut towards oneself
- ☐ **C** wear safety goggles
- ☐ **D** wear a lab coat

(iii) In stage 2, the most sensible precaution to protect clothes from the stain is to

- ☐ **A** keep the stain in a waterbath
- ☐ **B** wear a lab coat
- ☐ **C** wear gloves
- ☐ **D** wear safety goggles

(iv) The function of the stain in stage 2 is to

- ☐ **A** make the chromosomes visible
- ☐ **B** make the cytoplasm visible
- ☐ **C** separate the genes from the nucleus to make them more visible
- ☐ **D** separate the chromosomes from the nucleus to make them more visible

(v) In stage 3, the sample is squashed between

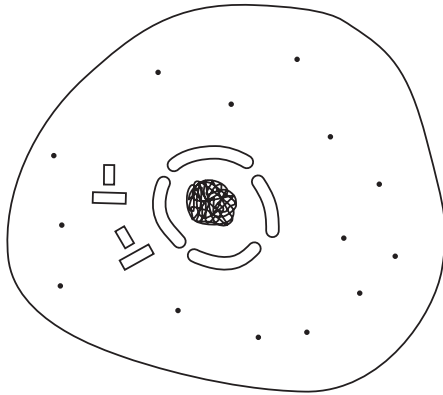
- ☐ **A** the objective lens of the microscope and the coverslip
- ☐ **B** the objective lens of the microscope and the slide
- ☐ **C** the slide and coverslip
- ☐ **D** two coverslips



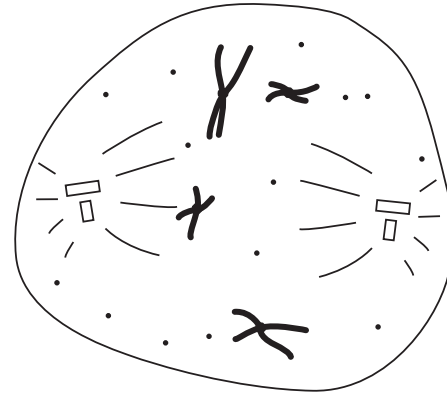
\*(b) Prophase is one of the stages of mitosis that could be seen using this process.

The two diagrams below show prophase in an animal cell.

Diagram 1 shows early prophase and diagram 2 shows late prophase.



**Diagram 1 (early prophase)**



**Diagram 2 (late prophase)**

Using the two diagrams, describe the changes that occur from early prophase to late prophase.

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**(Total for Question 1 = 10 marks)**



2 Organisms are adapted to their environment which increases their chances of survival.

- (a) Read through the following passage about adaptations to the environment. Write on the dotted lines the most appropriate word or words to complete the passage.

(3)

The process of ..... selection can lead to adaptation, survival and ..... .

There are three types of adaptations to the environment: physiological, anatomical and ..... .

- (b) The table below describes some adaptations in humans. Complete the table by stating whether the adaptation is physiological or anatomical.

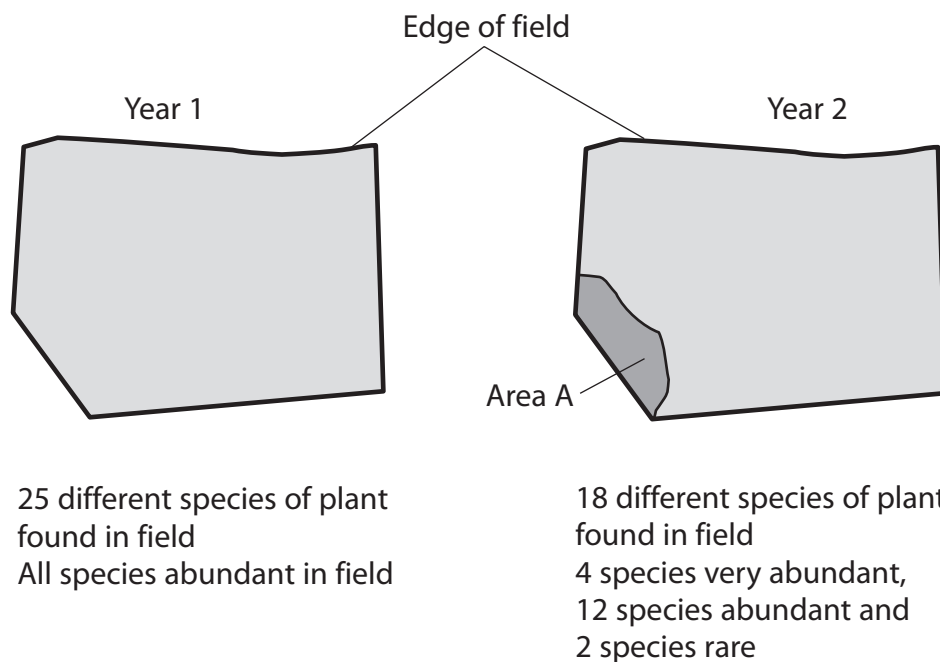
(3)

| Description                                                                                  | Adaptation |
|----------------------------------------------------------------------------------------------|------------|
| Hearing becoming temporarily less sensitive after listening to loud music for a few hours    |            |
| Heart beats faster when the hormone adrenaline is released                                   |            |
| People living in a cold climate have a shorter neck than people living in a hot, dry climate |            |

(Total for Question 2 = 6 marks)



- 3 A student studied one field in two different years.  
She recorded some information, shown in the diagram below.



- (a) Using the information in the diagram, suggest in which year the species richness was greater. Give a reason for your answer.

(2)

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- (b) Buttercup plants were found in this field in both years. Buttercup plants can produce new plants by asexual reproduction.

- (i) Name the type of cell division required for asexual reproduction.

(1)

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- (ii) The genetic diversity of buttercup plants in the field is low.  
Describe and explain why asexual reproduction results in low genetic diversity. (2)

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- \*(c) Another student noted that several species of plant did not grow as well in area A as they did in the rest of the field. He suggested this was due to a shortage of nitrate ions in the soil in this area.

The effect of varying nitrate ion concentration on the growth of one plant species can be investigated in a laboratory.

Describe how this investigation can be carried out to produce **reliable** results. (5)

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(Total for Question 3 = 10 marks)

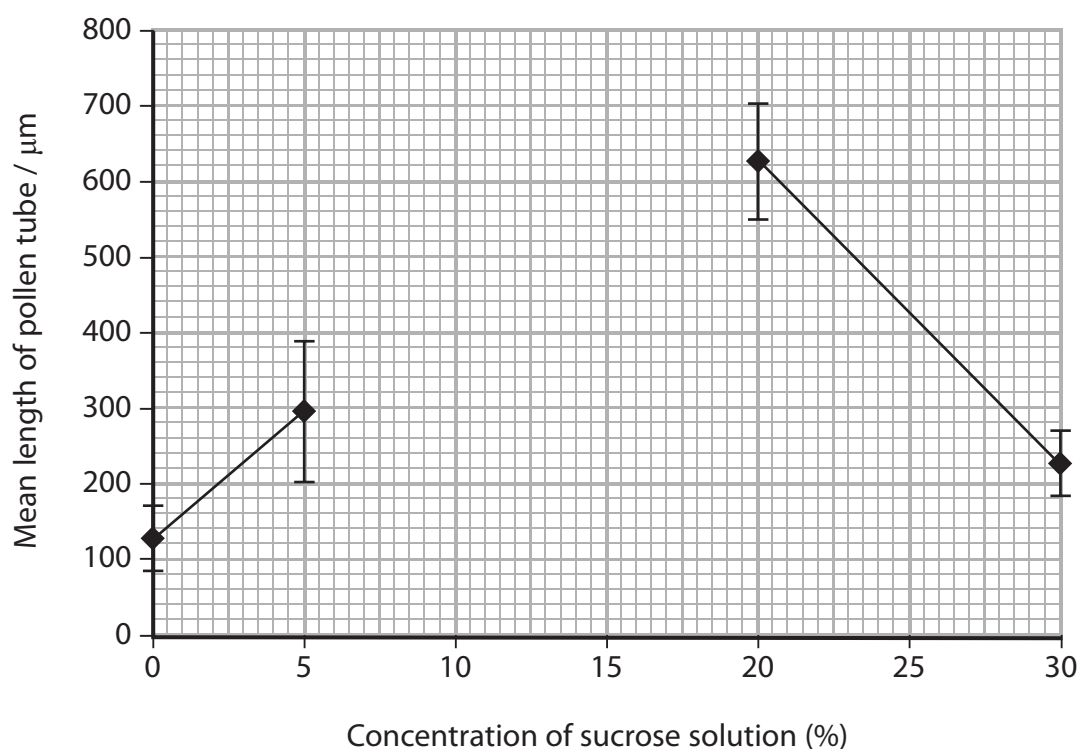


- 4 A student investigated the effect of sucrose concentration on the growth of pollen tubes.

Four pollen grains were placed in a small dish containing water. The pollen grains were left for two hours and the lengths of the pollen tubes produced were measured. The mean length was then calculated.

This procedure was repeated using dishes containing sucrose solutions at concentrations of 5%, 10%, 20% and 30%.

The graph below shows the mean lengths of the pollen tubes from four of the five sets of results. Error bars showing the range are also shown.



- (a) The table below shows the results for the pollen grains placed in the 10% sucrose solution.

| Grain number | Length of pollen tube / $\mu\text{m}$ |
|--------------|---------------------------------------|
| 1            | 690                                   |
| 2            | 680                                   |
| 3            | 720                                   |
| 4            | 710                                   |
| Mean         | 700                                   |



- (i) Using the information in the table, plot the mean length of pollen tubes and the error bar showing the range of data for the 10% sucrose solution and complete the graph.

(3)

- (ii) Using the completed graph, describe the effect of increasing sucrose concentration on the mean length of pollen tubes over the two-hour period.

(3)

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- (b) Explain the function of the pollen tube in fertilisation in flowering plants.

(3)

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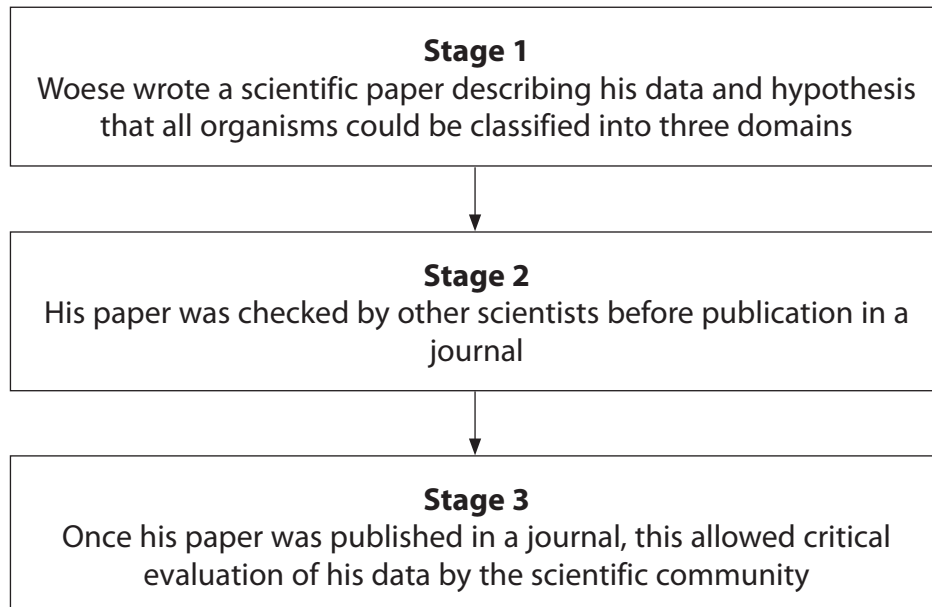
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**(Total for Question 4 = 9 marks)**



5 Woese, a scientist, collected data that allowed him to propose the hypothesis that all organisms could be classified into three domains.

(a) The diagram below shows some of the stages Woese used to publicise his new data and hypothesis.



(i) In stage 1, Woese suggested three domains, including the Bacteria and the Eukaryota (Eukarya). Name the third domain.

(1)

(ii) In stage 2, Woese's paper was checked by scientists before publication. Explain why his paper was checked by scientists at this stage.

(1)

(iii) Suggest **two** ways, other than publication in a journal, that scientists can use to present their data to the **scientific** community.

(2)

1 .....

2 .....



(iv) Explain what is meant by the phrase ‘allowed critical evaluation of his data by the scientific community’ in stage 3. (2)

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(b) The table below compares some features of two domains.  
Complete the table by placing a tick (✓) in the box, if the feature may be present in the domain or a cross (✗) if it is absent. (4)

| Feature                      | Domain   |           |
|------------------------------|----------|-----------|
|                              | Bacteria | Eukaryota |
| Ribosomes                    |          |           |
| Smooth endoplasmic reticulum |          |           |
| Cell (surface) membrane      |          |           |
| Slime capsule                |          |           |

(Total for Question 5 = 10 marks)



6 Plants produce a variety of material useful to humans, such as starch, cellulose and fibres.

(a) Starch can be used to form packaging.

Explain why it may be better to make packaging from starch rather than from oil-based products.

(2)

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(b) The table below gives three statements about starch and cellulose.

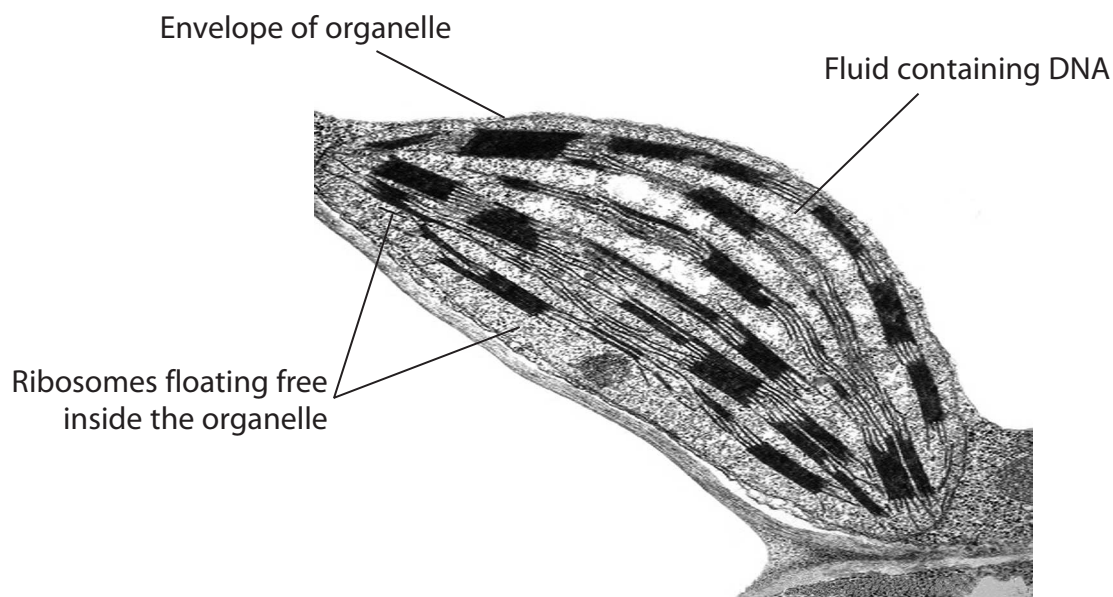
Complete the table by placing a tick (✓) in the box, if the statement is correct, and if the statement is incorrect, place a cross (✗) in the appropriate box.

(3)

| Statement                                                | Starch | Cellulose |
|----------------------------------------------------------|--------|-----------|
| Consists of microfibrils held together by hydrogen bonds |        |           |
| Found in amyloplasts                                     |        |           |
| Made up of $\beta$ -glucose monomers                     |        |           |



- (c) The organelle, shown in the electron microscope image below, contains the monomers of starch.



Magnification x10 000

Dr. Jeremy Burgess / Science Photo Library

A student incorrectly identified this organelle as rough endoplasmic reticulum because it had ribosomes inside it.

- (i) Name this organelle.

(1)

- (ii) Using the labels on the diagram and your own knowledge, give **two** reasons why it is **not** rough endoplasmic reticulum.

(2)

Reason 1 .....

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Reason 2 .....

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- (d) The stem of a plant contains xylem vessels and sclerenchyma fibres.  
Compare the functions of xylem vessels with the functions of sclerenchyma fibres.

(3)

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**(Total for Question 6 = 11 marks)**

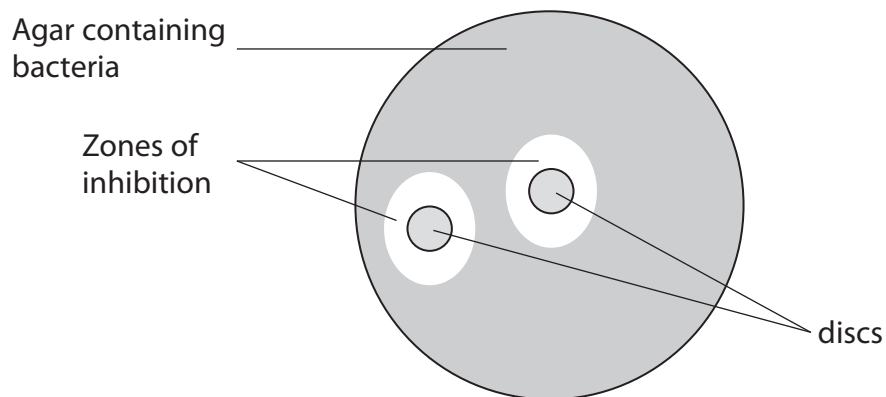


**7** An investigation was carried out to study the antimicrobial properties of garlic.

A piece of garlic was crushed with 5 cm<sup>3</sup> of sterile water to form a full-strength extract.

Two sterilised paper discs were each soaked in the full-strength extract. Both discs were placed on an agar plate covered in the bacterium *Micrococcus luteus*. This plate was incubated at 25 °C for 24 hours.

After this time, the diameter of the zone of inhibition around each disc was measured and the mean diameter was calculated.



This procedure was repeated using different dilutions of the full-strength extract.

The results of the investigation are shown in the table below.

| Concentration of extract as a percentage of the full-strength extract (%) | Mean diameter of zone of inhibition / mm |
|---------------------------------------------------------------------------|------------------------------------------|
| 100                                                                       | 18                                       |
| 80                                                                        | 17                                       |
| 60                                                                        | 16                                       |
| 40                                                                        | 12                                       |
| 20                                                                        | 8                                        |



(a) Using the information in the table, describe the effect of the concentration of garlic extract on the mean diameter of the zone of inhibition.

(3)

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(b) Suggest which concentration of garlic extract has the strongest antimicrobial properties. Give an explanation for your answer.

(3)

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(c) Suggest a suitable control for this investigation.

(1)

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- (d) The discs were sterilised by being placed in alcohol and then left to dry before being soaked in the extract.

Suggest why the discs should be sterilised before being soaked in the extract.

(2)

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- (e) Suggest how the results in the table might have been different if the discs had not been allowed to dry after being placed in alcohol. Explain your answer.

(2)

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**(Total for Question 7 = 11 marks)**



- 8 A series of studies on rats have shown that the phenotype of an organism is the result of an interaction between the genotype and the environment.

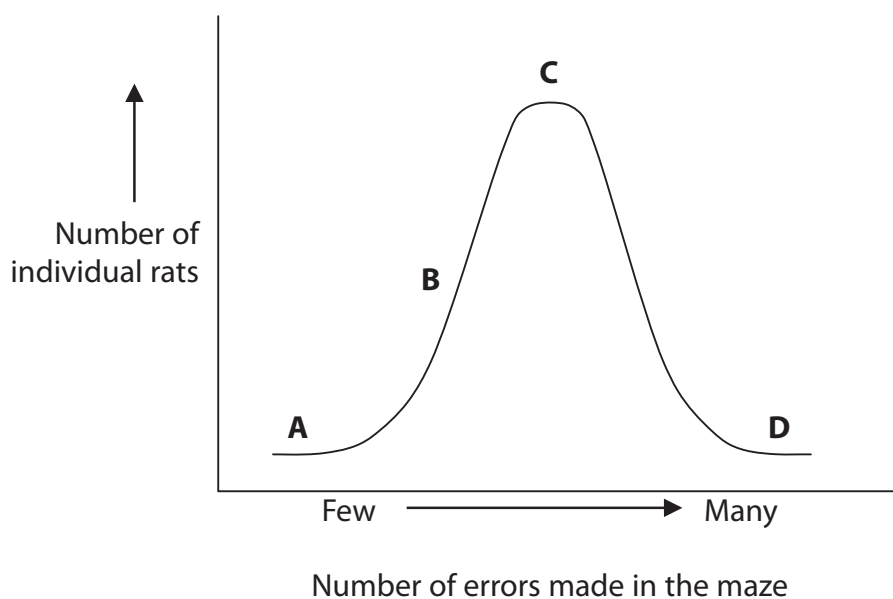
(a) An investigation was carried out to study the ability of rats to run through a maze.



Rat at start of maze

A rat was placed at the start of the maze and the number of errors it made was recorded as it ran through the maze.

This was repeated using many rats and the results are shown in the graph below.



- (i) Using the information in the graph, place a cross ☒ in the box that correctly identifies rats that are **least** good at running through a maze.

(1)

- ☒ A
- ☐ B
- ☐ C
- ☐ D



Place a cross ☒ in the box next to the correct word to complete each of the following statements.

(ii) The shape of this graph suggests that the type of variation shown is

(1)

- ☐ **A** categoric
- ☐ **B** continuous
- ☐ **C** discontinuous
- ☐ **D** discrete

(iii) The distribution of the data in this graph is

(1)

- ☐ **A** causal
- ☐ **B** irregular
- ☐ **C** normal
- ☐ **D** proportional



- (b) In another investigation, rats that were very good at running through mazes (maze-bright) were selected. These were allowed to breed amongst themselves for several generations to produce more maze-bright rats.

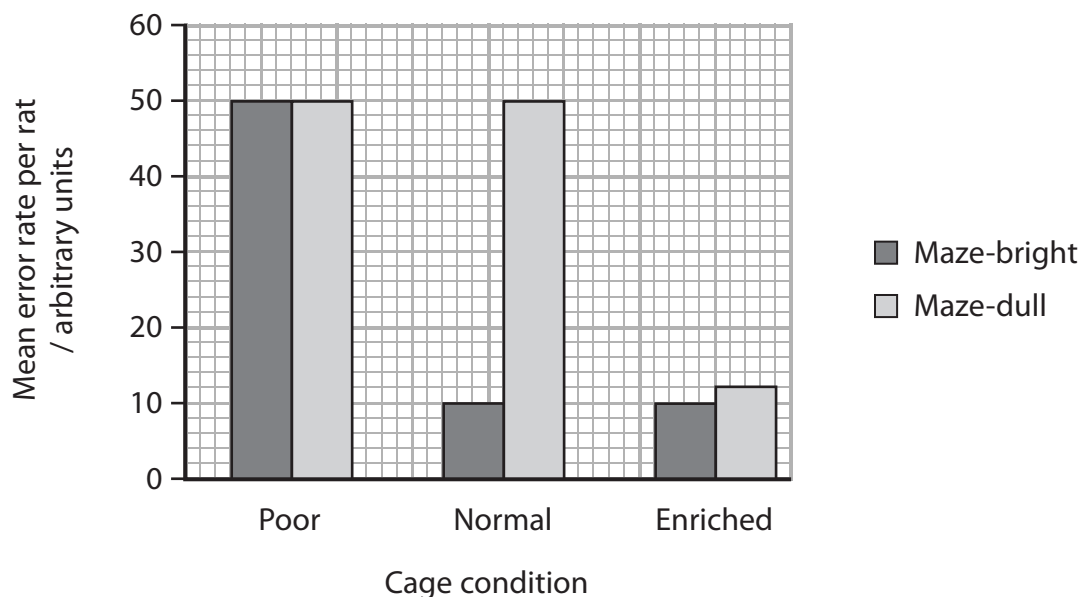
When these rats were young, they were split into three groups. Each group was raised in one of three cage conditions. These conditions are described in the table below.

| Cage condition | Description           |
|----------------|-----------------------|
| Poor           | Cages with no toys    |
| Normal         | Cages with a few toys |
| Enriched       | Cages with many toys  |

When adult, these rats then ran through a maze and the number of errors made was recorded. The mean error rate per rat was calculated.

This investigation was repeated with rats that were least good at running through mazes (maze-dull).

The results are shown in the graph below.



- (i) State the phenotype of the rats being studied in this investigation.

(1)



(ii) Suggest **two** factors that need to be controlled in this investigation.

(2)

1 .....

2 .....

(iii) Compare the mean error rate per rat for maze-bright rats and maze-dull rats in poor cage conditions and enriched cage conditions.

(3)

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(iv) Describe and explain the differences in the mean error rate per rat for maze-dull rats when they grew up in normal cage conditions and enriched cage conditions.

(2)

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- (v) Describe and explain the effect on the mean error rate per rat for maze-bright rats when they grew up in normal cage conditions and enriched cage conditions.

(2)

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**(Total for Question 8 = 13 marks)**

**TOTAL FOR PAPER = 80 MARKS**



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