AQA

Please write clearly in block capitals.

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Forename(s) _____

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I declare this is my own work.

A-level BIOLOGY

Paper 1

Thursday 5 June 2025 Afternoon Time allowed: 2 hours

Materials

For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for the questions are shown in brackets.
- The maximum mark for this paper is 91.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

Answer **all** questions in the spaces provided.

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0 1 . 1 The digestion and absorption of lipids involves:

- emulsification by bile salts
- micelles.

Explain each of the following.

[4 marks]

The importance of emulsification in the digestion of lipids

The role of micelles in the absorption of lipids

0 1 . 2 Describe and explain the arrangement of phospholipid molecules in the cell-surface membrane.

[2 marks]

6

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0 2 . 1 Describe how mRNA is obtained from pre-mRNA.

[1 mark]

0 2 . 2 Describe how RNA polymerase joins RNA nucleotides.

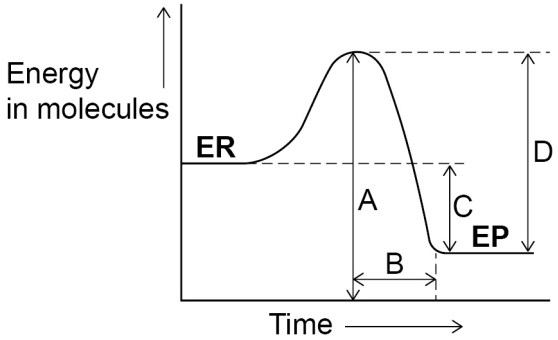
[2 marks]

Question 2 continues on the next page

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0 2 . 3 **Figure 1** shows the energy contained in molecules during an enzyme-controlled reaction.

Figure 1



Key

ER – Energy in reactants

EP – Energy in products

Which expression represents the activation energy (E_a) of this reaction?

Tick (✓) **one** box.

[1 mark]

A – C ☐

D – C ☐

$\frac{D - C}{B}$ ☐

D ☐

Do not write outside the box

0 2 . 4 In 1914, a group of scientists investigated enzyme action.

After studying their results, the scientists reached the following conclusions:

> An enzyme is a substance which causes a reaction to occur at "ordinary" temperatures by being present, but **not** by its ability to combine with another substance. An enzyme changes the rate of a reaction without itself being changed by that reaction.

Our current understanding of enzyme action is based on the induced-fit model.

Describe similarities **and** differences between the conclusions from 1914 and our current understanding of enzyme action.

[4 marks]

Similarities

Differences

8

Turn over for the next question

Do not write outside the box

0 3 . 1 Complete **Table 1** by adding a tick (✓) if the feature is present in the biological molecules.

Table 1

	Biological molecule		
Feature	**Glycogen**	**Sucrose**	**DNA**
Contains glucose			
Contains galactose			
Contains fructose			
Contains phosphate			
Formed by condensation reaction(s)			
Is a polymer			

[3 marks]

0 3 . 2 Lactase catalyses the hydrolysis of lactose.

A student investigated the effect of galactose on lactase activity.

The student used the following method.

1. Mix together (in tube **X**) solutions of lactose, galactose and lactase in a 15 : 3 : 1 volume ratio so that the total volume is 90 cm^3
2. Leave the mixture at 30 °C for 10 minutes.
3. Measure the glucose concentration in the mixture.
4. Repeat steps 1 to 3 with two different mixtures.

Calculate the volume of **galactose** solution used in tube **X**.

[1 mark]

Volume of galactose = _____ cm^3

Do not write outside the box

Table 2 shows the student's results.

Table 2

Tube	Mixture	Glucose concentration after 10 minutes / mg dm^{-3}
X	Lactose, galactose, lactase	100
Y	Lactose, water, lactase	180
Z	Galactose, water, lactase	0

0 3 . 3 Galactose is a competitive inhibitor of lactase.

Use this information and your knowledge of enzymes to explain the results obtained in **Table 2**.

[4 marks]

Tube **X** _____

_____

_____

_____

Tube **Y** _____

_____

_____

_____

Tube **Z** _____

_____

_____

_____

Question 3 continues on the next page

Do not write outside the box

0 3 . 4 Give:

- **one** change the student could make in tube **X** to confirm that galactose is a **competitive** inhibitor
- the result you would expect.

[2 marks]

Change _____

_____

_____

Result _____

_____

_____

10

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 4 . 1 Name **three** structures that are found in **some** prokaryotic cells but are **not** found in **all** prokaryotic cells.

[2 marks]

1 _____

2 _____

3 _____

0 4 . 2 **Table 3** shows the resolution of three types of microscope.

Table 3

Microscope	**Resolution / μm**
Optical	0.25
Scanning electron (SEM)	0.02
Transmission electron (TEM)	0.0002

Table 4 shows information about yeast cells and mitochondria.

Table 4

	Mean diameter / μm
Yeast cells	3.0
Mitochondria	0.22

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Identify the correct microscope to use in each of the following investigations.

Use your knowledge of microscopes and information in **Table 3** and **Table 4**.

Give **two** reasons for each choice of microscope.

[4 marks]

Investigation 1 – to study the living cells in a yeast culture that contains both living cells and dead cells. The living cells remain colourless and the dead cells are stained blue when a dye is added.

Type of microscope _____

Reason 1 _____

_____

_____

Reason 2 _____

_____

_____

Investigation 2 – to observe the three-dimensional structure of mitochondria.

Type of microscope _____

Reason 1 _____

_____

_____

Reason 2 _____

_____

_____

6

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0 5 . 1 Pears are a type of fruit.

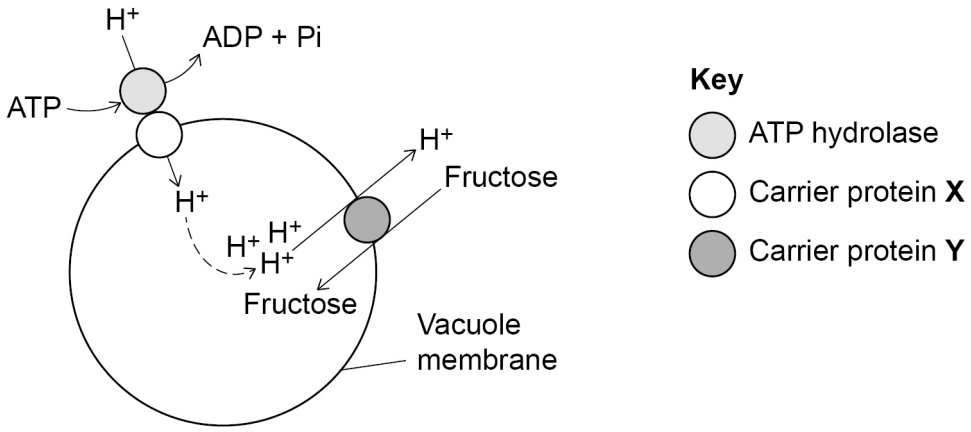
When pears ripen, the:

- fructose concentration increases in cell vacuoles
- volume of cell vacuoles increases.

Figure 2 shows information about a pear cell's vacuole membrane.

- Carrier protein **X** is linked to an ATP hydrolase enzyme.
- Carrier protein **Y** co-transports H^+ ions and fructose molecules in opposite directions.

Figure 2



Explain why the volume of the vacuoles in pear cells increases when pears ripen.

Your answer should refer to the role of:

- ATP hydrolase
- carrier protein **X** and carrier protein **Y**.

[4 marks]

Do not write outside the box

0 5 . 2 A respiratory inhibitor caused a change in pH of the solution within the vacuole.

Use information in **Figure 2** to explain how.

[3 marks]

0 5 . 3 Explain how a change in the expression of the genes coding for the carrier proteins can increase the rate of ripening of pears.

[2 marks]

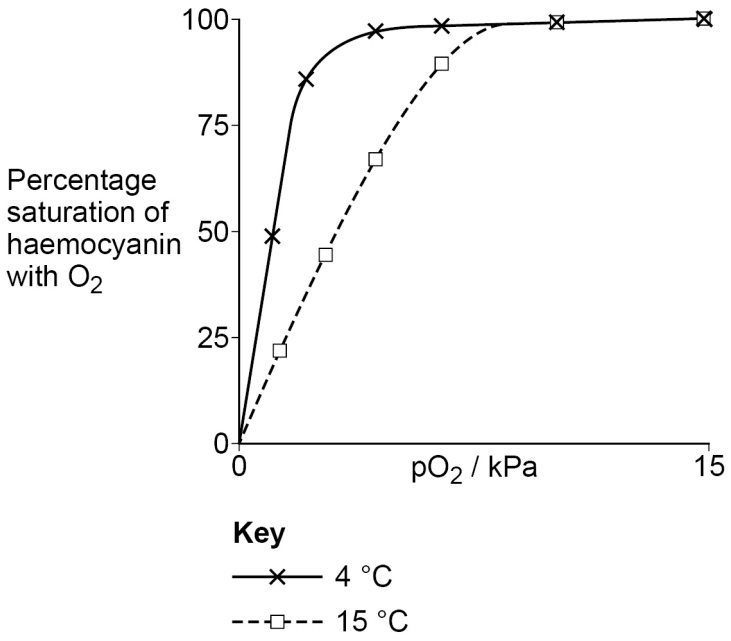
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0 6 . 1 Crab blood contains the respiratory pigment haemocyanin.

Figure 3 shows the dissociation curve for oxyhaemocyanin in a species of crab at two temperatures.

Figure 3



Crabs use gills for gas exchange.

Use **Figure 3** to explain how the increase in temperature affects the ability of haemocyanin to load or unload oxygen at the gills **and** in tissues.

Refer to high pO_2 and low pO_2 in your answer.

[2 marks]

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0 6 . 2 **Figure 4** shows the colour of haemocyanin with increasing concentrations of oxygen.

Figure 4

Deoxygenated haemocyanin	→	Increasingly oxygenated haemocyanin	→	Fully oxygenated haemocyanin
colourless		increasingly blue		dark blue

A calibration curve can be used to determine the percentage oxygen saturation of haemocyanin in a sample of crab blood.

You are given samples of crab blood in which the percentage oxygen saturation of haemocyanin is known.

Use all the information provided to:

- describe how you could produce a calibration curve for the percentage oxygen saturation of haemocyanin in crab blood
- identify **one** control variable used in the procedure to obtain data for the calibration curve.

[3 marks]

Description _____

_____

_____

_____

_____

_____

One control variable _____

_____

_____

Question 6 continues on the next page

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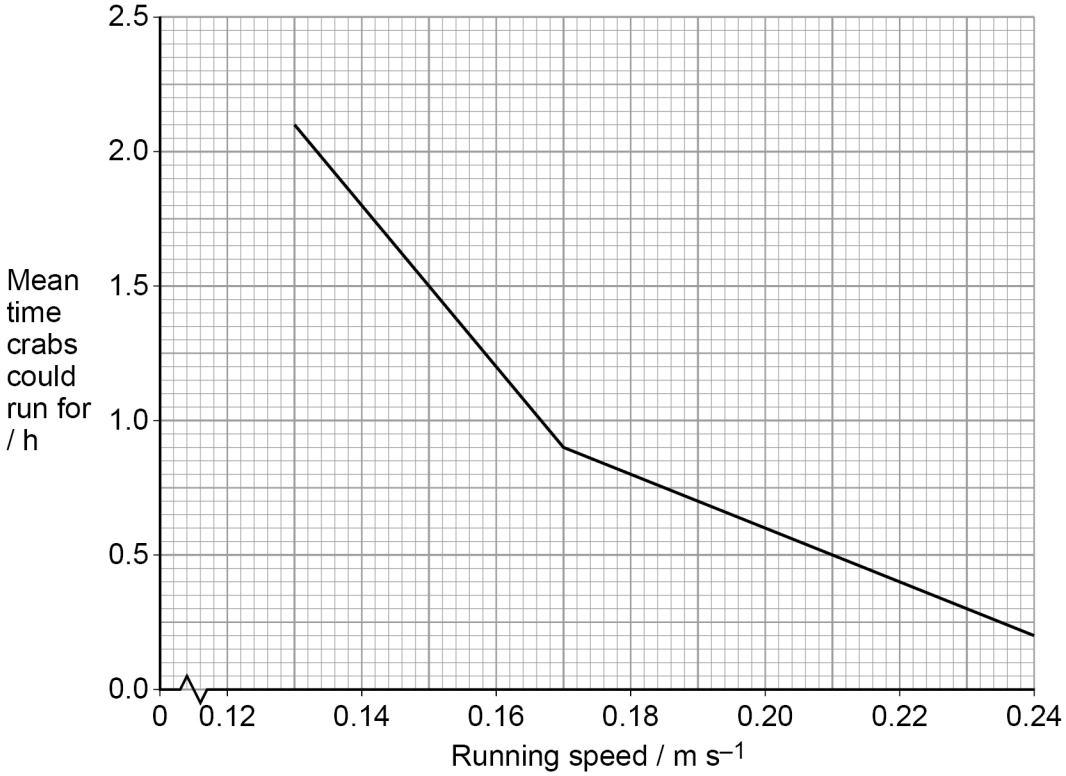
0 6 . 3 Ghost crabs live on sandy beaches.

Ghost crabs can run for a long time before they get tired and have to stop.

A scientist calculated the mean time ghost crabs could run for at different speeds before they stopped.

Figure 5 summarises the scientist's results.

Figure 5



A ghost crab running at 0.14 m s^{-1} covered a distance of 504 m in 1 hour.

Use **Figure 5** to calculate the extra distance this crab could cover if it continued running at 0.14 m s^{-1} before it stopped running.

Show your working.

[2 marks]

Extra distance _____ m

Do not write outside the box

0 6 . 4 **Figure 6** shows the data points from individual crabs that were used to plot the curve in **Figure 5**.

Figure 6

Figure 6 not reproduced here due to third-party copyright restrictions.

The figure is adapted from Figure 1 in https://journals.co.za/doi/pdf/10.10520/AJA00445096_586

The scientist selected the crabs at random from one sandy beach. Before the investigation, the crabs were equally rested and fed identical diets.

Use information in **Figure 6** to suggest why the line of best fit in **Figure 5** is **not** a good indicator of the time ghost crabs can run for.

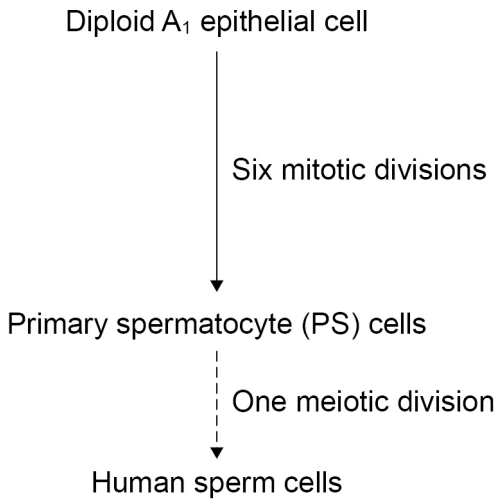
[3 marks]

10

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0 7 . 1 **Figure 7** shows how human sperm cells are produced in the testes from diploid A_1 epithelial cells.

Figure 7



Use **Figure 7** to calculate the minimum number of A_1 cells needed to produce 1.5×10^7 sperm cells.

Give your answer in standard form.

Show your working.

[2 marks]

Answer _____ A_1 cells

Do not write outside the box

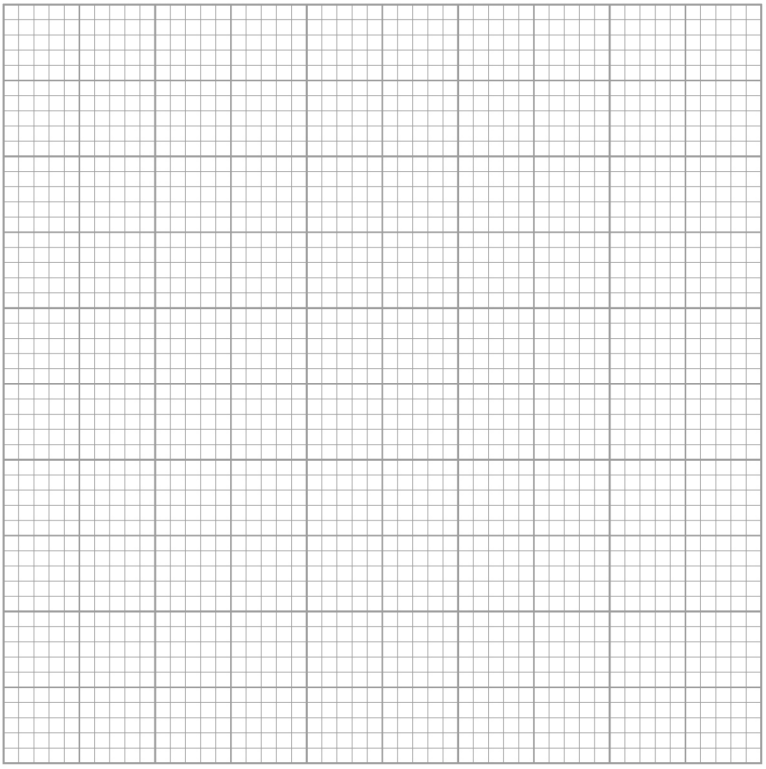
0 7 . 2 A PS cell goes through interphase before a meiotic division.

A scientist determined that the mass of DNA in **one** PS cell at the start of interphase is 8 arbitrary units.

Draw a bar chart in **Figure 8** showing the mass of DNA in **one** cell in each of these phases:

- at the start of interphase
- at the end of interphase
- at the end of the first meiotic division
- at the end of the second meiotic division.

Figure 8



[3 marks]

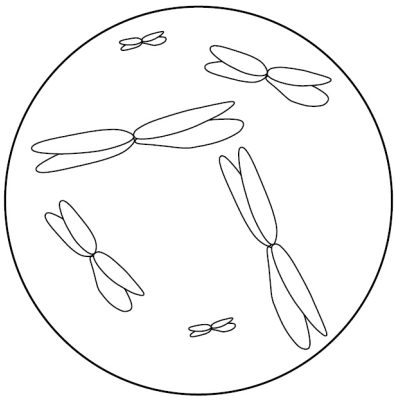
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0 7 . 3 A PS cell contains 46 chromosomes.

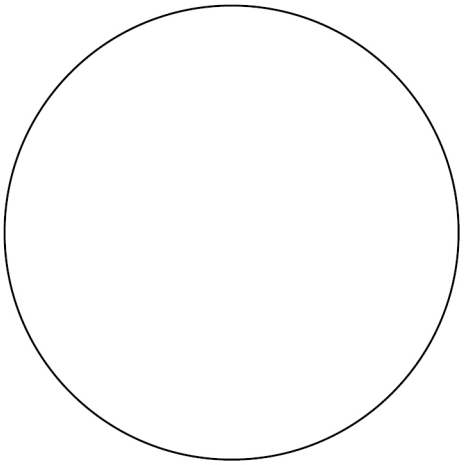
Figure 9 shows the appearance of six of those chromosomes just as a PS cell enters meiosis.

Figure 9



Using the information in **Figure 9**, draw chromosomes in **Figure 10** as they would appear in **one** cell at the end of the first meiotic division.

Figure 10



[1 mark]

Do not write outside the box

0 7 . 4 A mutation can produce a gamete with **one** extra chromosome.

Name the type of mutation that produces a gamete with one extra chromosome.

Explain how meiosis can produce a gamete with one extra chromosome.

[3 marks]

Type of mutation _____

Explanation _____

_____

_____

_____

_____

_____

9

Turn over for the next question

Do not write outside the box

0 8 . 1 Strains of bacteria with antibiotic resistance are common in hospitals.

Use your knowledge of selection to explain why.

[3 marks]

0 8 . 2 Antibiotic resistance alleles are located in plasmids.

There are 11 different types of plasmid inside cells of the bacterium *Bacillus thuringiensis*.

A scientist determined the:

- length of each type of plasmid in kilobase pairs (kbp)
- mean plasmid copy number (mean number of each type of plasmid per cell).

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Table 5 shows the scientist's results for 5 of these plasmids.

Table 5

Plasmid identity	Plasmid length / kbp	Mean plasmid copy number	Rank of plasmid length	Rank of mean plasmid copy number	Squared difference between ranks (d^2)
A	8	172	2	5	9
B	95	6	4	2	4
C	12	35	3	3	0
D	2	139	1	4	9
E	294	3	5	1	16

The Spearman rank correlation coefficient (r_s) between plasmid length and mean plasmid copy number is determined using this equation.

$$r_s = 1 - \frac{6 \sum d^2}{n (n^2 - 1)}$$

where

$\sum d^2$ = the sum of all d^2 figures

n = 5 (the highest rank number)

Use information in **Table 5** and the formula to calculate the r_s value for this set of data.

Show your working.

[2 marks]

r_s = _____

Turn over ►

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0 8 . 3 The scientist determined that the r_s value between plasmid length and mean plasmid copy number for all 11 types of plasmid is –0.94

What can you conclude from this r_s value?

[1 mark]

0 8 . 4 The length of the single circular (non-plasmid) DNA molecule in a *B. thuringiensis* cell is 5400 kbp

The total length of all plasmid DNA molecules in a *B. thuringiensis* cell is 65% greater than the length of the single circular DNA molecule.

Calculate the total number of kbp in all the plasmid molecules in a *B. thuringiensis* cell.

Show your working.

[2 marks]

Answer _____ kbp

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Question 8 continues on the next page

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0 8 . 5 A growing population of *B. thuringiensis* cells includes a:

- germination phase
- growth phase
- dormant phase.

A scientist incubated a culture of *B. thuringiensis* cells at 20 °C

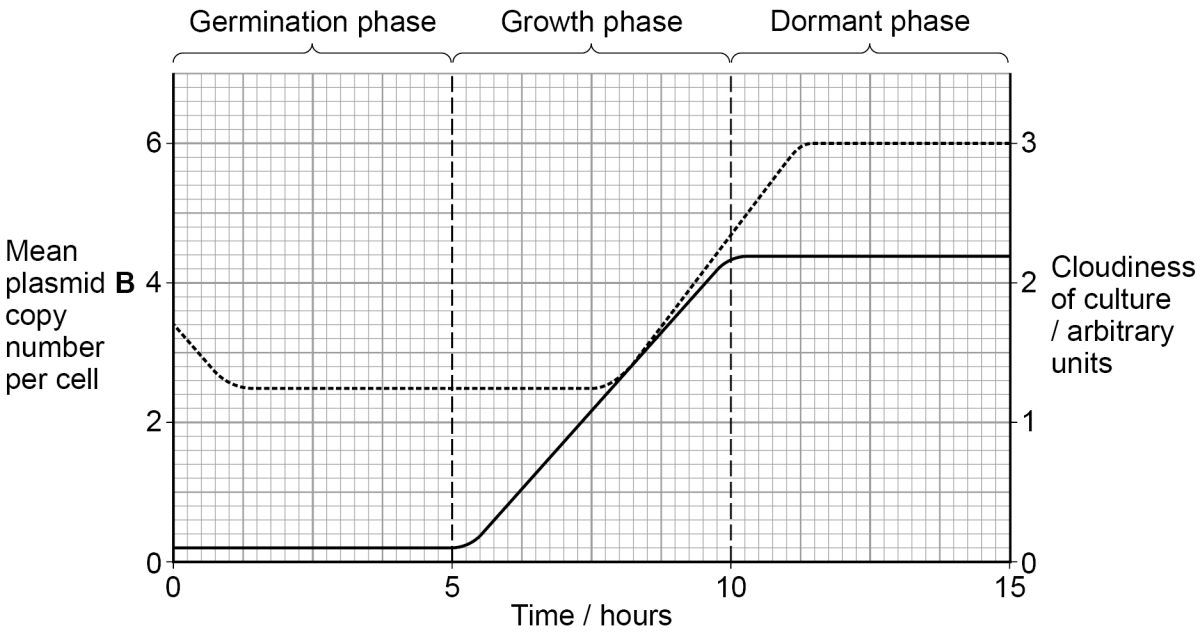
At intervals, the scientist:

- measured the cloudiness of the culture
- determined the mean plasmid **B** copy number per cell.

Cloudiness is a measure of the number of cells in a culture.

Figure 11 shows the scientist's results.

Figure 11



Key

---------- Mean plasmid **B** copy number

——— Cloudiness of culture

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Using information in **Figure 11**, what can you conclude about binary fission and the replication of plasmid **B** in the different phases of a growing population of *B. thuringiensis*?

[3 marks]

11

Turn over for the next question

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0 9 . 1 Scientists investigated chloroplasts taken from leaf cells of the species *Nicotiana tabacum*.

The scientists took chloroplasts from leaf cells of a healthy plant and from leaf cells of a mutant plant.

Chloroplasts are contained in several different types of specialised cells in *N. tabacum* leaves.

What terms are used to describe an organisation of specialised cells in an organism when:

- all the cells are of one type
- the cells are of more than one type?

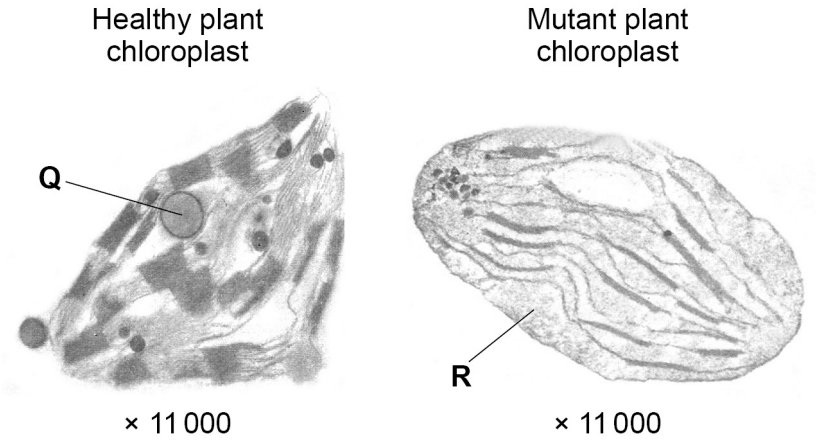
[1 mark]

Cells of one type _____

Cells of more than one type _____

0 9 . 2 **Figure 12** shows images of chloroplasts from *N. tabacum* cells observed with an electron microscope.

Figure 12



Identify the parts labelled **Q** and **R**.

[1 mark]

Q _____

R _____

Do not write outside the box

0 9 . 3 Use the images in **Figure 12** to predict how photosynthesis could be affected in the mutant plants.

Justify your answer.

[2 marks]

Question 9 continues on the next page

Do not write outside the box

0 9 . 4 Scientists investigated the rate of photosynthesis in healthy plants and in mutant plants.

Table 6 shows the scientists' results.

Chlorophyll a and chlorophyll b are two types of chlorophyll molecules used in photosynthesis.

Table 6

	Chlorophyll concentration / µg cm^{-3}	**Chlorophyll a : chlorophyll b ratio**	**Rate of photosynthesis / arbitrary units**
Healthy plant	45	2 : 1	1
Mutant plant	9	6 : 1	5

The scientists' results did not support what they predicted from **Figure 12** (on page 28) would be the effect of the mutation on photosynthesis.

Use information in **Table 6** to describe **and** explain the effect of the mutation.

[3 marks]

7

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1 0 . 1 Describe the roles of ribosomes, tRNA and ATP in the process of translation.

[6 marks]

Question 10 continues on the next page

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1 0 . 2 Describe **and** explain the adaptations of leaves that maximise gas exchange.

Do **not** refer to organelles in your answer.

[4 marks]

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1 0 . 3 Describe the pathway taken by blood between a kidney and the coronary arteries.

Include names of the major blood vessels (arteries and veins) **and** heart valves involved.

[5 marks]

15

END OF QUESTIONS

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