Qualification Accredited

OCR
Oxford Cambridge and RSA

Examiners' report

GCSE

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

OCR Level 1/Level 2 GCSE (9-1) in Biology B (Twenty First Century Science)

J257

For first teaching in 2016

J257/03 Summer 2025 series

Version 1

Contents

Introduction 4
Paper 3 series overview 5
Question 1 (a) 6
Question 1 (b) 6
Question 1 (c) (i) 7
Question 1 (c) (ii) 7
Question 1 (c) (iii) 8
Question 1 (d) 9
Question 1 (e) 10
Question 1 (f) 10
Question 2 (a) (i) 11
Question 2 (a) (ii) 12
Question 2 (b) 12
Question 2 (c) 12
Question 2 (d) 13
Question 3 (a) 14
Question 3 (b) 15
Question 3 (c) 15
Question 3 (d) 16
Question 3 (e) 17
Question 4 (a) 18
Question 4 (b) 19
Question 4 (c) 20
Question 4 (d) (i) 21
Question 4 (d) (ii) 22
Question 4 (e) 22
Question 5 (a) 23
Question 5 (b) (i) 23
Question 5 (b) (ii) 24
Question 5 (b) (iii) 24
Question 5 (c) 25
Question 6 (a) 26
Question 6 (b) 26
Question 6 (c) (i) 27

Question 6 (c) (ii) 28
Question 6 (d) 28
Question 7 (a) (i) 30
Question 7 (a) (ii) 31
Question 7 (b) (i) 31
Question 7 (b) (ii) 32
Question 7 (b) (iii) 32
Question 7 (b) (iv) 33
Question 7 (c) 33
Question 7 (d) 34
Question 8 (a) 34
Question 8 (b) 34
Question 8 (c) 35
Question 8 (d) 36
Question 8 (e) (i) 37
Question 8 (e) (ii) 38
Question 9 (a) (i) 39
Question 9 (a) (ii) 40
Question 9 (b) (i) 41
Question 9 (b) (ii) 41
Question 9 (c) (i) 41
Question 9 (c) (ii) 42
Question 9 (c) (iii) 42

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate responses is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from Teach Cambridge.

Paper 3 series overview

J257/03 is the first of two higher tier papers assessing biology in the Biology B suite. This paper is a breadth paper which aims to assess a wide range of content from the specification. To do well on this paper candidates need to have a well-rounded understanding of the whole specification and need to be comfortable applying their knowledge to unfamiliar contexts. One question may bring in multiple elements of the specification in the sub sections of the question and candidates need to be well practised and comfortable with this style of question to yield the best results.

Candidates were clearly well prepared for this examination and rose to the challenge of the unfamiliar contexts. Omit rates were very low suggesting that candidates felt confident tackling the questions. For the most part candidates did appear to understand the command words used, providing descriptions and explanations as appropriate and candidates showed competence in applying their mathematical techniques to this paper. The practical element continues to improve, candidates understanding of aseptic techniques was good, however there still remains some difficulty in determining variables and candidates appeared to be less familiar with the use of a potometer to investigate transpiration rates.

In questions where explanations are required, candidates should be encouraged to use the number of marks as a guide to the level of detail required in the answer.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• could identify dependent, independent and control variables (Question 2 (d)) • could identify the components of biological molecules (Question 5 (b) (ii)) • could interpret a family tree and clearly communicate the evidence to support the statement (Question 3 (d)) • understood how mutations in non-coding DNA affect an organism's phenotype (Question 9 (c) (iii)) • could apply their knowledge successfully to unfamiliar contexts (Question 3 (d), 7 (b) (i), 7 (b) (ii)) • could analyse data presented in a scatter graph (Question 3 (e)).	• were unable to apply knowledge to unfamiliar contexts (Question 4 (b), 5 (c), 9 (a) (ii)) • found the mathematical components of the paper difficult. Many candidates were unable to determine fractions, complete multi staged calculations • found it difficult to interpret data (Question 2 (b), 3 (e)) • seemed unfamiliar with the practical's assessed in the paper (aseptic techniques, measuring transpiration)

Question 1 (a)

1 There are approximately 350 000 African savannah elephants.

(a) 130 000 of these elephants live in Botswana, a country in southern Africa.

Which of these is the closest approximation to the fraction of African savannah elephants that live in Botswana?

Tick (✓) **one** box.

- $\frac{1}{2}$ ☐
- $\frac{1}{3}$ ☐
- $\frac{1}{4}$ ☐
- $\frac{1}{5}$ ☐

[1]

Candidates performed well on this question and seemed familiar with determining fractions.

Question 1 (b)

(b) The African savannah elephant is an endangered species.

Conservation efforts have been successful in increasing the number of elephants.

Suggest **one** method that may have been used to help conserve this species.

.....

..... **[1]**

Candidates engaged well with this part of the question, offering some good suggestions of methods that would undoubtably be used to conserve elephants. Preventing and poaching and hunting of elephants the creation of protected areas and breeding programmes were the most common responses observed.

Question 1 (c) (i)

(c) In May 2020, many elephants were found dead in a region of Botswana.

Scientists discovered that their death was caused by a bacterium that only causes disease once in the blood of an elephant.

The bacterium usually lives in the nose of some elephants where it does **not** cause disease.

Scientists think a rise in environmental temperature caused the bacteria to enter the blood of these elephants.

(i) Suggest why the scientists may be concerned about this bacterium.

.....

..... **[1]**

Most candidates noted the link between the rise in environmental temperature and this being the cause of the bacteria entering the blood of the elephants. They successfully linked this to rising global temperatures to consider how this would impact the population of elephants. Some candidates simply stated global warming without linking this to the effect on the population and did therefore not gain credit.

Question 1 (c) (ii)

(ii) Which of these will ingest and digest the bacterium?

Tick (✓) **one** box.

- Antibodies ☐
- Platelets ☐
- Red blood cells ☐
- White blood cells ☐

[1]

The majority of candidates correctly identified white blood cells as being responsible for the ingestion and digestion of the bacterium. The most common incorrect response was antibodies, suggesting perhaps a slight misunderstanding of the role of antibodies.

Question 1 (c) (iii)

(iii) Which of these will tag the bacterium for attack?

Tick (✓) **one** box.

- Antibodies ☐
- Platelets ☐
- Red blood cells ☐
- White blood cells ☐

[1]

The majority of candidates correctly identified antibodies as being responsible for tagging the bacterium for attack. The most common incorrect response was white blood cells.

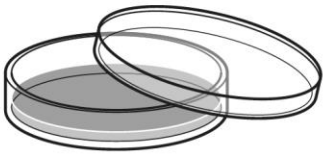
Question 1 (d)

(d) To identify the type of bacterium responsible for the death of the elephants, the scientists cultured the bacteria.

They poured some of the bacteria onto agar jelly in a Petri dish and spread it with a glass spreader.
Then they incubated the Petri dish.

The diagram shows the equipment they used.

Glass bottle containing the sample of bacteria



Petri dish containing agar jelly

Glass spreader

Suggest **two** ways the scientists could improve their method to make sure the technique was aseptic.

1 .....

.....

2 .....

.....

[2]

Candidates also performed well on this part of the question, most seemed familiar with the aseptic techniques that would be used when culturing bacteria and were able to describe these clearly. The most common responses seen included: working near a Bunsen burner, sterilising the equipment used to prevent contamination and only opening the petri dish lid slightly. Stating that upon incubation the petri dish should be stored upside down, or taping the lid shut were the most common incorrect responses, and this may perhaps have been a result of candidates not reading the rubric carefully and focussing on the steps of this common biology practical.

Question 1 (e)

(e) Some bacteria have evolved to become resistant to antibiotics.

The statements describe the steps in this process.

They are **not** in the correct order.

A Bacterium survives.

B Bacterium has a selective advantage.

C Bacterium passes resistance gene to offspring.

D Bacterium reproduces.

E Mutation occurs in the DNA of a bacterium creating a gene for antibiotic resistance.

Write the letters in the boxes to show the correct order of the steps.

One of the steps has been done for you.

		A		

[2]

Candidates were clearly familiar with the steps involved in the process of natural selection with the majority being given at both marks.

Question 1 (f)

(f) Bacteria evolve by natural selection.

Darwin was one of the scientists who originally developed the theory of natural selection.

Who was the **other** scientist?

..... **[1]**

This continues to be a scientist that candidates appear to be less familiar with, although it was noted that compared to previous series there did appear to be a slight improvement in the number that correctly named Alfred Russel Wallace as the scientist who was also responsible for developing the theory of natural selection. Common incorrect responses included Mendel and Linnaeus, although many of the names suggested were often not scientists working in the field of biology or indeed even the name of a scientist.

Question 2 (a) (i)

2 Yeast produce ethanol during fermentation.
A scientist investigated how temperature affects ethanol production.

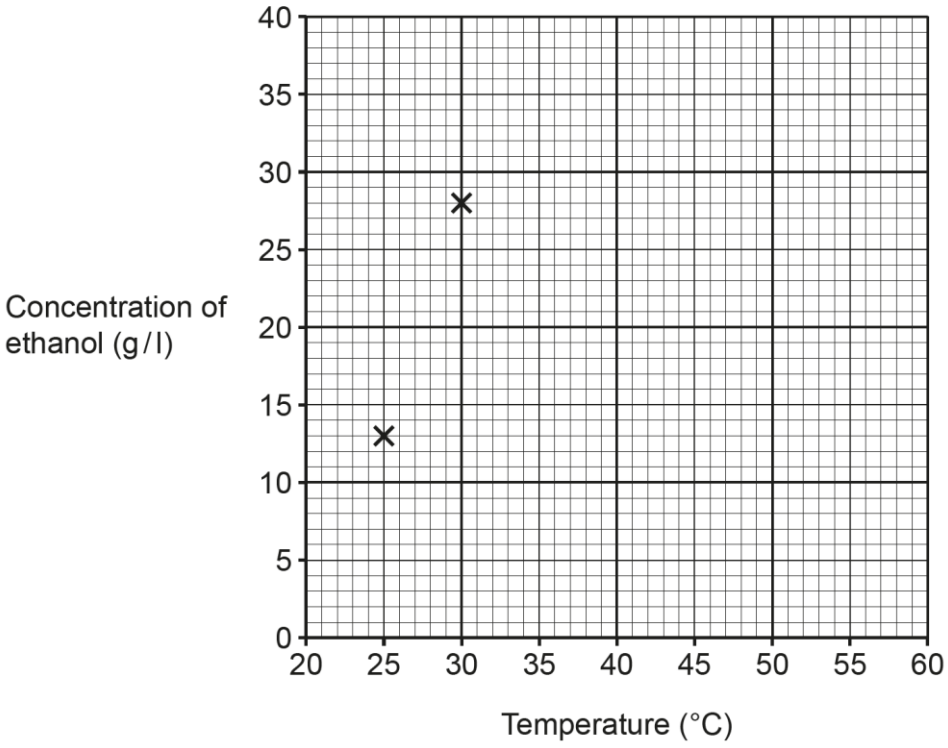
The scientist measured the concentration of ethanol in a yeast solution at six different temperatures.

The table shows their results.

Temperature (°C)	Concentration of ethanol (g/l)
25	13
30	28
35	**30**
40	**35**
45	**33**
50	**30**

(a)
(i) Plot the results from the table on the graph.

Two points have been plotted for you.



[1]

Most candidates plotted all 4 plots accurately – when mistakes were made it was more likely to be made for plotting the third data point (33). Centres should remind candidates that a cross should be used when plotting points, as modelled in the two plotted for them.

Question 2 (a) (ii)

(ii) Draw a curve of best fit on the graph. **[1]**

Candidates found drawing the curve of best fit difficult. Candidates appeared to be unfamiliar with the criteria that should be used to determine where this line should be placed, and this is a skill are encouraged to practise with candidates. The most common error observed was for extrapolation of the curve to temperatures outside the data range. The majority of candidates that made this mistake extrapolated to the origin but many also extended it beyond the final data plot. Candidates should be reminded that a line or curve can only be drawn for the data the has been determined. Those that did realise that this was the case often went on to draw excellent curves.

Question 2 (b)

(b) State **two** conclusions that can be made from these data.

1 .....

.....

2 .....

.....

[2]

Candidates demonstrated their ability to interpret data and to draw relevant conclusions from data given with the majority being given at least one mark for this question. The most common correct response observed was the determination of 40°C as the optimum temperature for this fermentation process. A noticeable number of candidates incorrectly concluded that the yeast (rather than its enzymes) had denatured beyond 40°C.

Question 2 (c)

(c) Fermentation is another name for anaerobic respiration in yeast.

Complete the equation for **anaerobic** respiration in yeast.

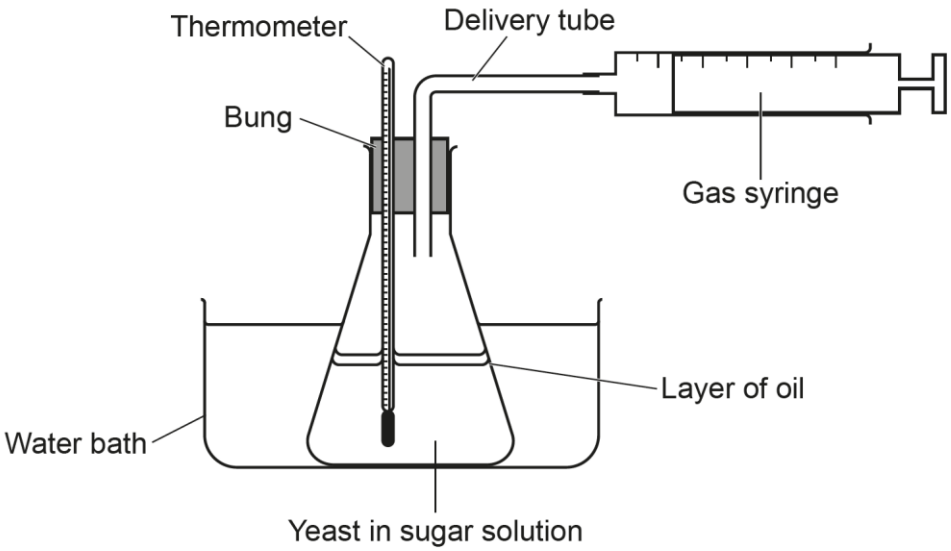
sugar ⟶ ethanol + ...

[1]

Many candidates correctly identified carbon dioxide as the missing product. Common incorrect responses included lactic acid and water. Glucose, ATP and energy were also seen.

Question 2 (d)

(d) The diagram shows the equipment used to investigate the effect of different sugars (sucrose, glucose and galactose) on the rate of respiration in yeast.



For this investigation, describe:

- the dependent variable
- the independent variable
- a control variable that should be kept constant.

Dependent variable .....

.....

Independent variable .....

.....

Control variable .....

.....

[3]

Variables remain an area for development for centres and candidates. Those candidates who knew the meaning of these key scientific words went on to score at least two marks, but some candidates still appear to be confused as to which variable is the one which is measured (dependent), and which is changed (independent). Candidates that were only given two marks often used the word amount to mean volume when describing that the gas produced was the dependent variable. Candidates should be encouraged to use correct scientific terminology such as volume, concentration and mass rather than amount. The most common correct control variable that was described was maintaining the temperature of the water bath. Candidates that did not gain credit for the control variable were often too general in their description, for example, simply stating the oil layer, rather than the thickness of the oil layer, or the yeast, rather that the mass of yeast.

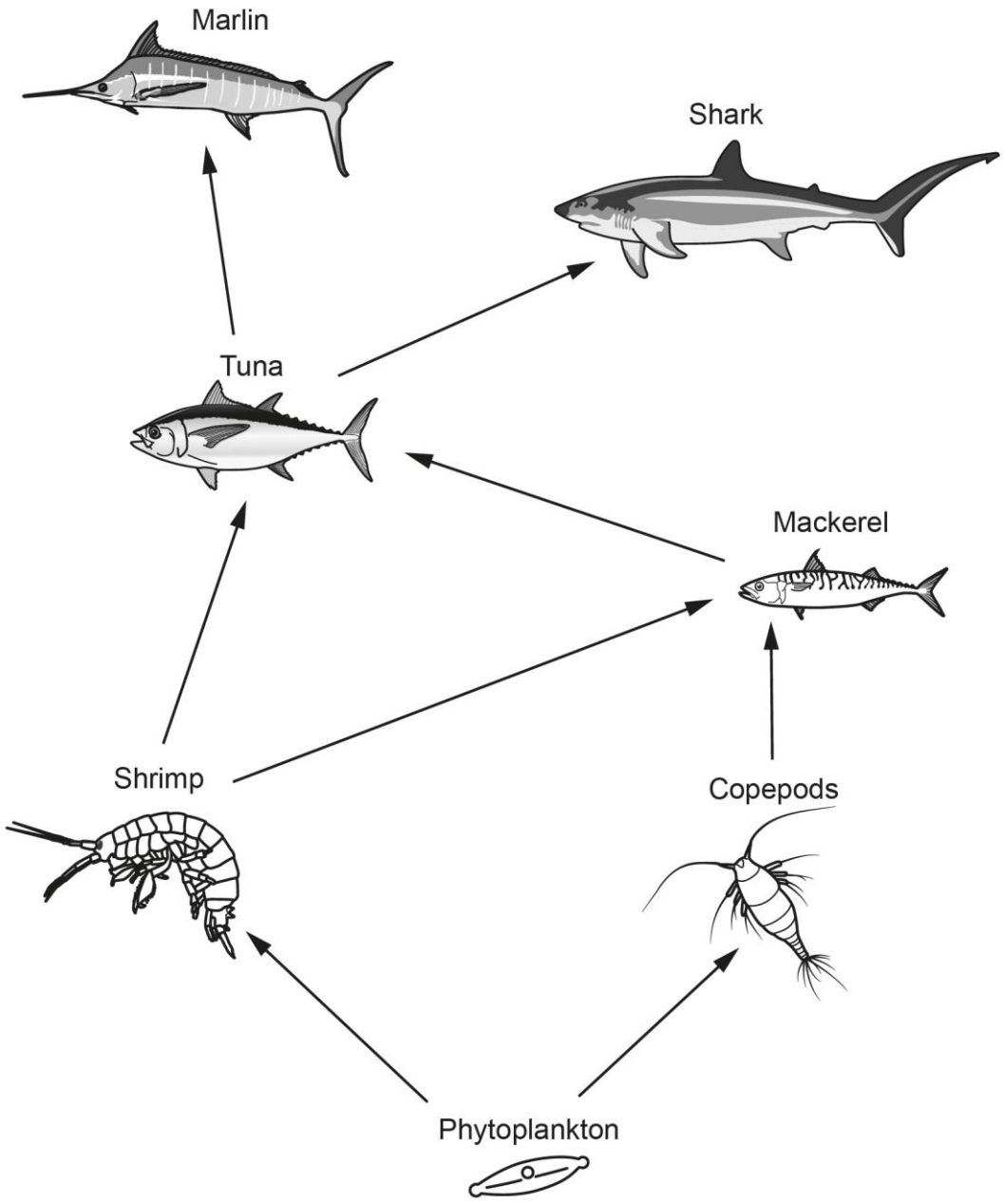
OCR support

The Language of measurement in context defines key scientific terms used in practicals. It also demonstrates the use of the terms in the context of a specific practical.

Question 3 (a)

3 **Fig. 3.1** shows part of a food web for a marine ecosystem.

Fig. 3.1



(a) Name an organism in **Fig. 3.1** that feeds at two different trophic levels.

..... **[1]**

Most candidates recognised that the tuna feeds at more than one trophic level. While shark and marlin were also acceptable responses, these were rarely seen. The most common incorrect response was shrimp.

Question 3 (b)

(b) Explain the possible impact on the population of **copepods** if the population of **shrimp decreased**.

.....

.....

.....

..... **[2]**

Candidates engaged well with the food web presented and seemed to be well versed in interpreting the population dynamics that could be determined. The most common route taken by candidates was for describing that a reduction in the shrimp population would result in a decrease in the copepod population as there would be less competition for phytoplankton. Some candidates simply stated the change they would expect to see in the copepod population rather than explaining the change and a small number of candidates did not state whether they would expect to see the copepod population increase or decrease.

Question 3 (c)

(c) There is plenty of water and oxygen in the ocean so the shrimp do **not** need to compete for these.
The shrimp do need to compete for food.

State **one other** factor the shrimp need to compete for.

..... **[1]**

The most common correct factor that was given credit was for identifying that the shrimp would also compete for mates. The majority of candidates were given this mark. When it was not given this was often for stating sunlight or food (which was in the stem of the question).

Question 3 (d)

(d) Mercury is a heavy metal that can enter the water.

People are advised **not** to eat large amounts of tuna due to the quantity of mercury found in these fish.

Explain why people are advised to limit the amount of tuna eaten, but **not** the amount of mackerel.

.....

.....

.....

.....

.....

..... **[3]**

Some candidates performed very well on this question, identifying that the mercury in the water would enter organisms lower down the food chain and would be passed up the food chain through feeding, resulting in organisms higher up the food chain containing larger quantities of the metal which would then be harmful to human health if eaten. Many scored some marks on this question with the most common correct response being the identification that the mercury was passed on during feeding. A common misunderstanding was that humans were more at risk from eating tuna because they were larger fish and that humans eat more tuna, basing their response on mass of tuna rather than concentration of mercury in the tissues.

Question 3 (e)

(e) Scientists think that an increase in mercury consumption is linked to increased risk of cardiovascular disease in humans.

To investigate this, they conducted a study of 251 people.

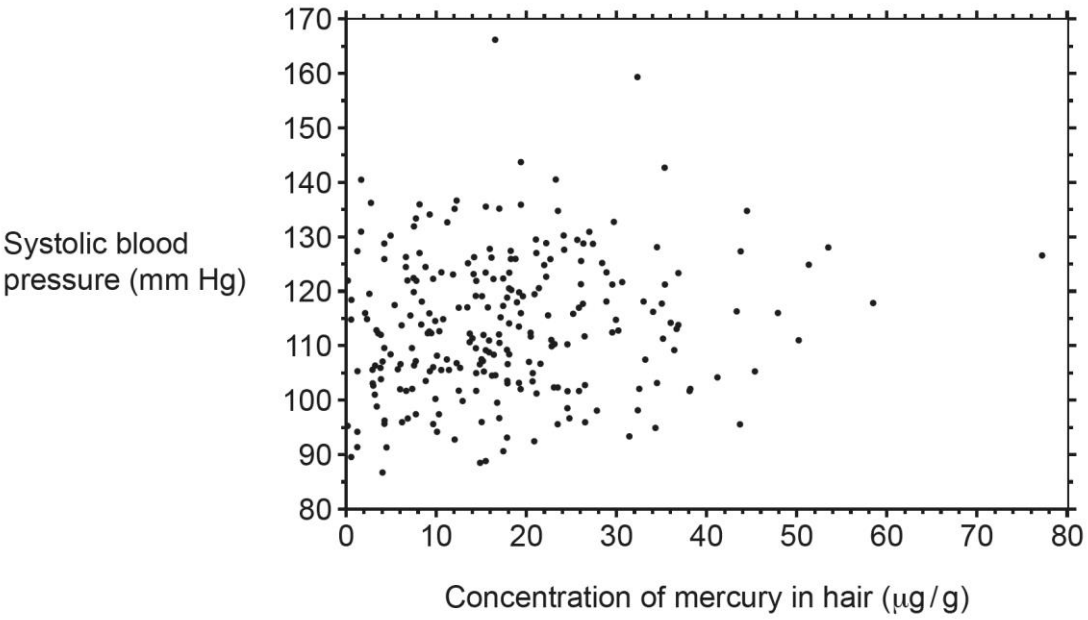
For each person they measured:
- the concentration of mercury in a strand of hair
- their systolic blood pressure.

Fig. 3.2 shows their results.

Normal systolic blood pressure is 120–129 mm Hg.

A high systolic blood pressure can be an indication of increased risk of cardiovascular disease.

Fig. 3.2



Explain why the data in **Fig. 3.2** does **not** support the link between mercury consumption and increased risk of cardiovascular disease.

.....

.....

.....

..... **[2]**

This question proved more challenging to candidates with relatively few candidates being given both marks. Many correctly identified that there was a weak correlation but found it difficult to then elaborate on this. Often candidates selected one plot to try to emphasise their point rather than delving into the data set as a whole and carefully analysing why it could not support the link. Some candidates did correctly note that the concentration of mercury in the hair may not be equivalent to the mercury in their diet.

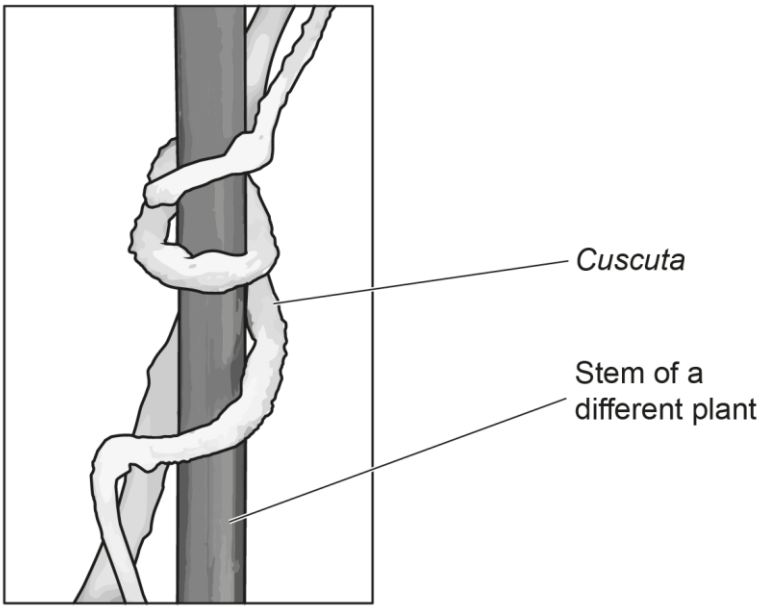
Question 4 (a)

4 *Cuscuta* is a plant that does **not** have any roots or leaves. It is usually orange or yellow in colour and does **not** have chlorophyll.

Cuscuta is a parasitic plant. It wraps itself around other plants to obtain nutrients.

Fig. 4.1 shows a *Cuscuta* wrapped around the stem of a different plant.

Fig. 4.1



(a) Explain why *Cuscuta* attaches to the xylem of the plant it wraps around.

.....

..... **[1]**

A large proportion of candidates correctly identified that the xylem transports water and mineral ions with some explaining that without roots this would be the only source of these items for the plant. For those candidates that were not given the mark this was often for stating incorrectly that the xylem is responsible for transport of sugars. Some candidates used everyday language such as 'nutrients' and should be reminded to give specific examples of named substances.

Question 4 (b)

(b) Explain why *Cuscuta* tries to attach to the phloem of the plant it wraps around.

.....

.....

.....

.....

.....

..... **[3]**

Candidates seemed less familiar with the role of the phloem in the plant as the vessel which transports sugars. Those that did know this and used the information provided in the stem, that the plant lacks leaves, produced clear logical responses relating a lack of chlorophyll to a lack of photosynthesis, identifying that the plant would be unable to produce its own glucose and would therefore obtain this from the stem of the plant it was wrapped around. Many candidates simply stated the function of the phloem and did not link this to the context provided and were therefore only given one mark. Some candidates again used everyday language such as 'nutrients' and should be reminded to give specific examples of named substances.

Exemplar 1

The phloem transports good molecules like glucose and amino acids. The Cuscuta cannot make its own glucose because it has no chloroplyll for photosynthesis. Cuscuta cannot take in amino acids through active transport as it has no roots. Cuscuta attaches to the phloem to provide these biological molecules. **[3]**

This is an example of a candidate that has processed the question well, carefully considered the importance of the information presented and brought that together with their knowledge to produce a thought-out response which is logical. They have identified that without chlorophyll the *Cuscuta* cannot photosynthesise and produce glucose, and that the phloem will provide these. This response was given full marks.

Question 4 (c)

(c) Plants with leaves lose water from their leaves by transpiration.

Name the structure that allows water to move out of leaves, into the air.

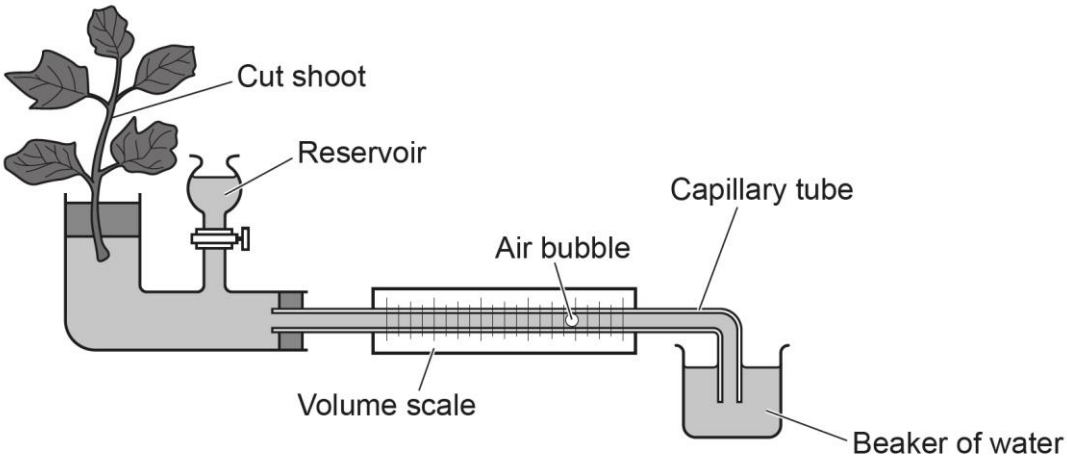
..... **[1]**

The majority of candidates correctly identified the stoma as the structure through which water moves out of the leaf.

Question 4 (d) (i)

(d) **Fig. 4.2** shows the apparatus used to measure the rate of water uptake from a cut shoot.

Fig. 4.2



(i) Name the apparatus shown in **Fig. 4.2**.

..... **[1]**

A large proportion of candidates knew that the name of the piece of apparatus in the diagram was a potometer. Some candidates did state a photometer, which was not given credit as this is a different piece of equipment. Those candidates that seemed unfamiliar with this apparatus occasionally stated 'volume scale' as their response, but there was evidence of some guessing in this question, perhaps suggesting that while they may have seen the apparatus, they do not know or perhaps remember its name.

Question 4 (d) (ii)

(ii) Which **two** measurements need to be taken to determine the rate of water uptake from the cut shoot?

1 .....

2 .....

[2]

Candidates found this question more challenging and did not appear to be familiar with the measurements that would need to be taken to determine the rate of transpiration with very few candidates being given both marks. Common incorrect responses included counting the number of bubbles, perhaps confusing this procedure with one to determine the rate of photosynthesis or measuring the volume of water in the reservoir or beaker.

OCR support

The Purposeful practical instructions for investigating transpiration guides candidates through the practical set up, method and extension questions. There are questions alongside the method that encourage candidates to consider the purpose behind steps being taken in the method.

Question 4 (e)

(e) Which of these environmental factors will result in a **low transpiration rate** and which will result in a **high transpiration rate**?

Tick (✓) **one** box in each row.

	Low transpiration rate	**High transpiration rate**
High light intensity		
High windspeed		
Low temperature		

[2]

Most candidates correctly attributed two environmental factors that would result in either a low or high transpiration rate.

Question 5 (a)

5 Farmers use chemicals such as fertilisers and pesticides on their land.

These chemicals can affect the biodiversity of the soil and the fields.

(a) State **two** reasons why it is important to conserve biodiversity.

1 .....

.....

2 .....

.....

[2]

There was an abundance of excellent responses to this question. Some responses were focused on reasons biodiversity is important for humans but many also considered why biodiversity is important for ecosystems. Answers included for food chain stability, to preserve genetic stability, with some candidates explaining the importance of genetic variation.

Question 5 (b) (i)

(b) Some farmers choose to use natural fertilisers such as animal waste.
The animal waste is broken down by decomposers which releases products such as nitrates and phosphates into the soil.

(i) Which of these describes how a plant absorbs the nitrates from the soil?

Tick (✓) **one** box.

Active transport ☐

Diffusion ☐

Osmosis ☐

Translocation ☐

[1]

Many candidates correctly identified active transport as the method by which nitrates are absorbed by a plant from the soil. There was no pattern observed in incorrect responses.

Question 5 (b) (ii)

(ii) Tick (✓) **one** box in each row to show whether each of these molecules are made using **nitrogen**, **phosphates**, **both** or **neither**.

	Only nitrogen	**Only phosphates**	**Both nitrogen and phosphates**	**Neither**
Glucose				
DNA				
Protein				

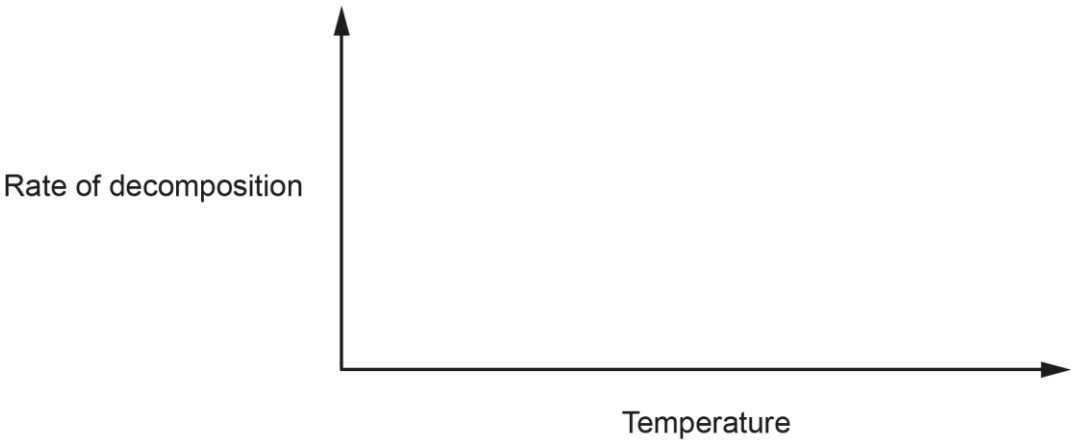
[2]

This question proved more challenging for candidates. Some candidates did not appear to know the formula for glucose or did not use it to determine that neither nitrogen nor phosphates are present in this molecule. Identifying the elements in DNA and protein also proved challenging with candidates perhaps not considering that they know the structure of DNA to enable them to determine the response.

Question 5 (b) (iii)

(iii) Temperature affects the rate of decomposition.

Sketch a line on the graph to show how temperature affects the rate of decomposition.



[2]

Most candidates correctly identified that an increase in temperature would increase the rate of reaction, many however drew a line that levelled and did not consider the effect of higher temperatures on the rate of an enzyme-controlled reaction such as decomposition.

Question 5 (c)

(c) An organism was found preserved in some wetlands.
The organism stopped living over 2000 years ago but had not been decomposed by microorganisms.

The wetlands the organism was found in are acidic, and the oxygen content is low.

Explain why the organism was preserved and was **not** decomposed.

.....

.....

.....

.....

.....

..... **[3]**

Candidates found this question more challenging. Those that made the link between enzymes and decomposition seemed to tackle this question better and identified that an acidic pH could denature the enzymes involved. Those that did discuss enzymes on occasion referred to the substrate no longer fitting the enzyme rather than the active site, but this was a mark point that was not given often. Some candidates did recognise that oxygen would be required for aerobic respiration. The most common response given credit was for identifying that the low pH and low oxygen content prevented microorganisms surviving. Several responses did refer to waterlogging and osmosis. Centres should remind candidates that the rubric at the start of the question is there to guide them to the appropriate biological content that is linked. Very few candidates were given full marks for this question.

Question 6 (a)

6 The female menstrual cycle is controlled by hormones.

As a female human gets older, the levels of hormones in their body decrease.

(a) Draw lines to connect each **hormone** with its correct **function**.

Hormone	Function
FSH	Causes an egg to mature in an ovary and stimulates the ovaries to release oestrogen.
LH	Prepares the lining of the uterus for implantation of a fertilised egg.
Progesterone	Triggers ovulation.

[2]

A very high proportion of candidates correctly identified the correct function for all hormones. When only one mark was given, it was most commonly for connecting LH to triggers ovulation.

Question 6 (b)

(b) One symptom of decreasing hormone levels in female humans is hot flushes. This is a sudden increase in the temperature of the skin.

Suggest how the body tries to cool down during one of these hot flushes.

.....

.....

.....

..... **[2]**

Candidates engaged well with this question and very few did not gain credit for this question. Identifying that sweat would be the main thermoregulatory mechanism that would assist cooling was the most common response.

Misconception

Many candidates appear to think that vasodilation is the movement of the blood vessels so that they are closer to the skins surface. This was a common incorrect response observed by the marking panel. Centres could tackle this misconception by showing two diagrams of a cross section of the skin – one before vasodilation and the second during, to highlight the widening of the arteries supplying the skins surface with blood and describing how an increase in diameter will increase the flow of blood to the skins surface.

Question 6 (c) (i)

(c) To reduce the symptoms of decreasing hormone levels, hormone replacement therapy can be used.

Hormone replacement therapy is a medication that contains oestrogen and progesterone.

The medication can be administered by a patch which is worn on the lower part of the body. The body slowly absorbs the hormones through the skin from the patch.

(i) The patch contains 3.2 mg of an oestrogen replacement.

The absorption rate is approximately 0.5 mg in 24 hours.

Calculate the maximum number of **complete** days that the patch would release this hormone for.

Number of days = ... **[1]**

Most candidates correctly evaluated the calculation to determine the value 6.4 and then rounded this figure to the nearest whole number. The most common error was for not rounding the number and to present 6.4 as the final response or incorrectly rounding to 6 or 7.

Question 6 (c) (ii)

(ii) It is recommended that the patch is changed twice a week.

Suggest why this recommendation is different to the number you calculated in **(c)(i)**.

.....

..... **[1]**

There were some excellent suggestions for this question, demonstrating that candidates had really engaged with the context. The best responses appreciated that the absorption rate of the hormones was an approximate and that changing the patch meant that if the absorption rate was greater than that given the female would not be without or have fewer hormones. Other good responses considered that changing a patch on the same days would help the female remember to do this or considered that over time the patch may lift and this would affect delivery.

Question 6 (d)

(d) Before hormone replacement therapy was available as a medicine it was tested in drug trials. The first stage of this was pre-clinical trials in which the medicine was tested on cultured cells.

Describe the stages of the drug trials for hormone replacement therapy that will have happened **after** pre-clinical trials.

Explain the importance of these stages.

.....

.....

.....

.....

.....

..... **[3]**

This question identified that for some candidates, although they are aware of the different stages of drug trials, cannot attribute these events to the pre-clinical and post clinical trials. This was demonstrated by the number of candidates that chose to write about the use of animals in their response (which form part of the pre-clinical trials). There were some excellent responses seen, where candidates clearly expressed their understanding of why different groups of people would be used in trials and which elements, safety, efficacy and dosage, they were used to identify. Those that chose to write about double blind trials and placebos generally demonstrated a good understanding of the purpose of these trials, but some did simply just refer to the term without explaining its use. The best responses linked their response to the need to test on women who had lower hormone levels.

Exemplar 2

→ Test on animals (see if there are harmful side effects on living organisms).

→ Test on healthy patients (see if there are side effects on healthy, normal people).

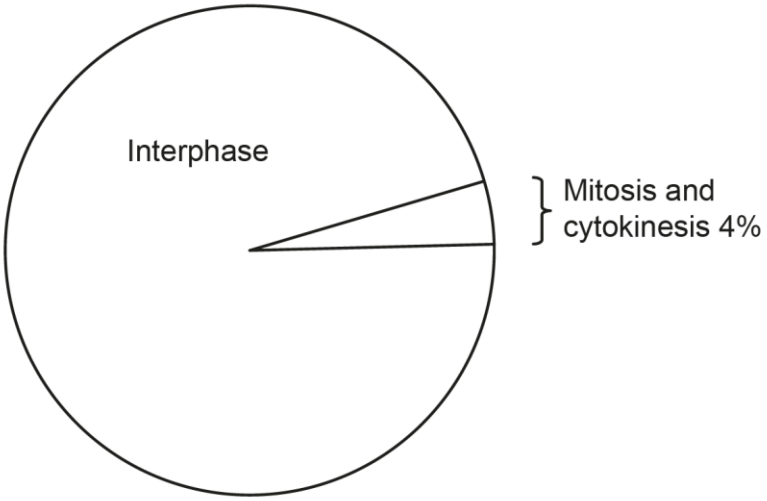
→ Test on those who need hormone replacement (see if the drug works to treat the problem) (effectiveness) [3]

A common error made by candidates can be seen in this response, with the inclusion of animal testing. The response does go on to describe the testing that will occur in pre-clinical trials, the information is well structured, detailed and clear, resulting in two marks being given.

Question 7 (a) (i)

7 **Fig. 7.1** shows the cell cycle for one cell.

Fig. 7.1



(a)

(i) An intestinal cell takes 11 hours to complete the cell cycle.

Calculate the length of time that this cell is in interphase.

Give your answer:

- in **minutes**
- to the nearest **whole minute**.

Length of time the cell is in interphase = ... minutes **[3]**

Candidates generally performed well on this question, with a large proportion being given full marks. The most common error was not rounding the number to a whole number. The most common route observed when only one mark was given was for converting 11 hours into 660 minutes.

Question 7 (a) (ii)

(ii) Describe what happens in a cell that is in interphase.

.....

..... **[1]**

Identifying what happens in a cell in interphase proved quite challenging to candidates. The most common incorrect responses included, referring to copying of genetic material rather than DNA, identifying that subcellular structures would copy without detailing which structures or for identifying events that take place in mitosis. Centres should be encouraged to discuss with candidates why each of these would prevent a mark being given.

Question 7 (b) (i)

(b) The mitotic index is a measure of the proportion of cells in a sample that are undergoing mitosis.

Table 7.2 shows data from four tissue samples analysed in a laboratory.

Table 7.2

Tissue sample	Total number of cells	Number of cells in mitosis	Mitotic index
A	750	200	0.267
B	180	110	0.611
C	188	44	0.234
D	192	28	

(i) Calculate the mitotic index for tissue sample **D**.

Use the equation: mitotic index = number of cells in mitosis ÷ total number of cells

Give your answer to **3** decimal places.

Mitotic index for tissue sample **D** = ... **[2]**

The majority of candidates were given both marks for this calculation. The most common error was not presenting the response to the correct three decimal places.

Question 7 (b) (ii)

(ii) Mitotic index can be used to identify tumours. Tissue samples with a high mitotic index are more likely to be tumours.

Explain why mitotic index is used to identify tumours.

.....

.....

.....

..... **[2]**

This question was found challenging by candidates. Many candidates did not identify that tumours will be the result of uncontrolled cell division, instead only referring to uncontrolled growth. Only a small proportion identified that a high mitotic index would indicate that many cells were indeed dividing and instead stated that they would be dividing rapidly.

Question 7 (b) (iii)

(iii) Which tissue sample in **Table 7.2**, **A**, **B**, **C** or **D** is **most** likely to be a tumour?

..... **[1]**

Very few candidates did not identify B as the tissue sample likely to be a tumour.

Question 7 (b) (iv)

(iv) Samples taken from the centre of tumours sometimes have a lower mitotic index, whereas samples taken from the outside of tumours have a higher mitotic index.

A scientist is analysing some tumours.

Suggest how the scientist should collect and use samples from the tumours to find the mitotic index which is representative of a tumour.

.....

.....

.....

..... **[2]**

Candidates found this question a little challenging and often seemed to find it difficult to express their ideas. Those that were only given one mark often referred to calculating an average rather than a mean; centres should spend time discussing that mode and median are also measures of average and when they would be most appropriate to use. The higher scoring responses clearly described the need to obtain multiple samples from different parts of a tumour and then use this to generate a mean.

Question 7 (c)

(c) Some tumours are harmful but some are **not**.

Harmful tumours usually have a higher mitotic index.

A scientist took a large number of samples from harmful tumours.
The mean mitotic index of these samples was 0.8.

A sample is taken from another tumour.
The mitotic index calculated for this tumour is 0.8.

Explain why this does **not** confirm the tumour is harmful.

.....

.....

.....

..... **[1]**

This question also proved challenging and again candidates struggled to express their ideas clearly. The most common correct responses discussed the idea that not all harmful tumours would have a low mitotic index or that some non-harmful tumours can have a higher mitotic index.

Question 7 (d)

(d) Cancer is described as a non-communicable disease.

Explain why.

.....

..... **[1]**

Most candidates clearly knew the difference between communicable and non-communicable disease, and this was expressed in many different ways by candidates. Occasionally candidates stated that cancer could not be spread without qualification and therefore were not given the mark.

Question 8 (a)

8 Genetic engineering is a technique used by scientists to insert a gene from the DNA of one organism or species into the DNA of another organism or species.

(a) What is a gene?

.....

..... **[1]**

Many candidates gave excellent descriptions of what a gene is. Common responses that did not gain credit simply stated that they were sections of DNA without clarifying this further, or for stating that they coded for a particular characteristic, phenotype or amino acids, rather than proteins.

Question 8 (b)

(b) Scientists have genetically engineered bacteria to produce insulin.

What would the insulin produced by the bacteria be used to treat?

..... **[1]**

The majority of candidates correctly identified that diabetes could be treated using insulin.

Question 8 (c)

(c) At the beginning of the genetic engineering process, scientists insert the insulin gene into a plasmid.

Which word describes the plasmid's role in this process?

Tick (✓) **one** box.

- Chromosome ☐
- Genome ☐
- Variant ☐
- Vector ☐

[1]

Most candidates correctly identified that the role of a plasmid in genetic engineering was as a vector. The most common incorrect response was genome, followed by variant.

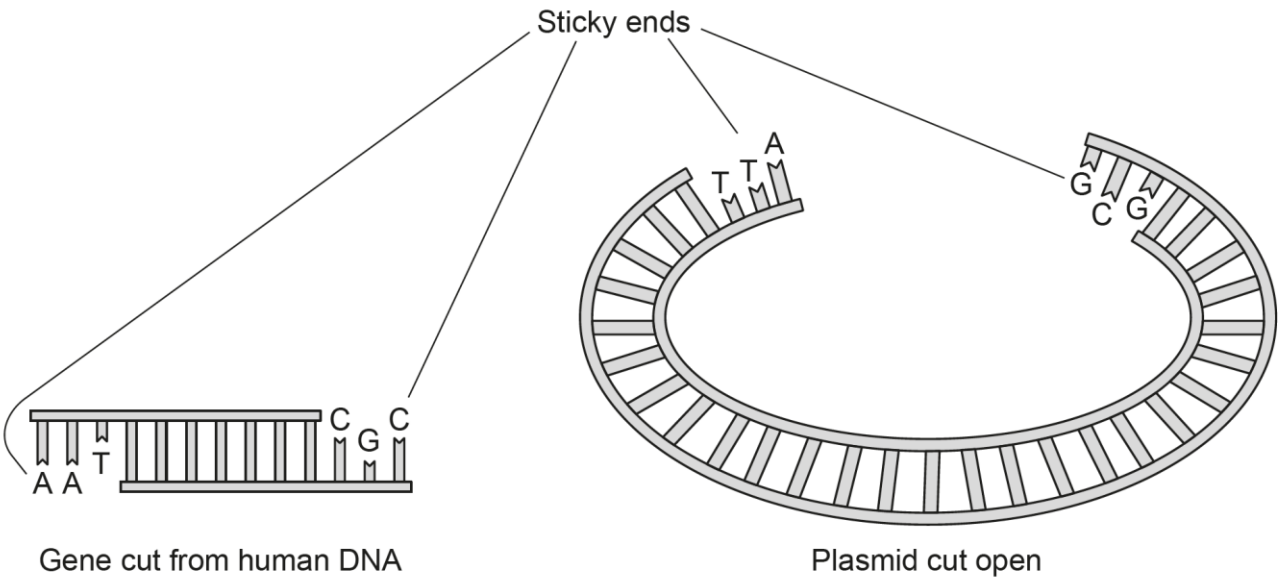
Question 8 (d)

(d) The insulin gene is removed from a section of human DNA using enzymes called restriction enzymes. These enzymes cut the DNA at specific base sequences.

The plasmid is also cut open using the same restriction enzymes.

When the human DNA and the plasmid are cut, the ends have some unpaired bases. They are called 'sticky ends'. This is shown in **Fig. 8.1**.

Fig. 8.1



Explain how the creation of sticky ends enables the two sections of DNA to join.

.....

..... **[1]**

Many candidates had the right idea about how the sticky ends created by the restriction enzymes enabled the two sections of DNA to be joined together but found it difficult to articulate this using the correct scientific terminology and did not refer to complementary base pairing. Many candidates did use the idea of base pairing to help explain their understanding by stating the base pairs that formed, A-T and C-G and this was given credit.

Question 8 (e) (i)

(e) The plasmid containing the gene is inserted into the bacteria.
The bacteria divide and start producing insulin.

The bacteria are grown in large fermenters where they are provided with nutrients.

(i) The number of bacteria doubles every 20 minutes.

Calculate how many bacteria there will be after 2 hours if there are 120 at time zero.

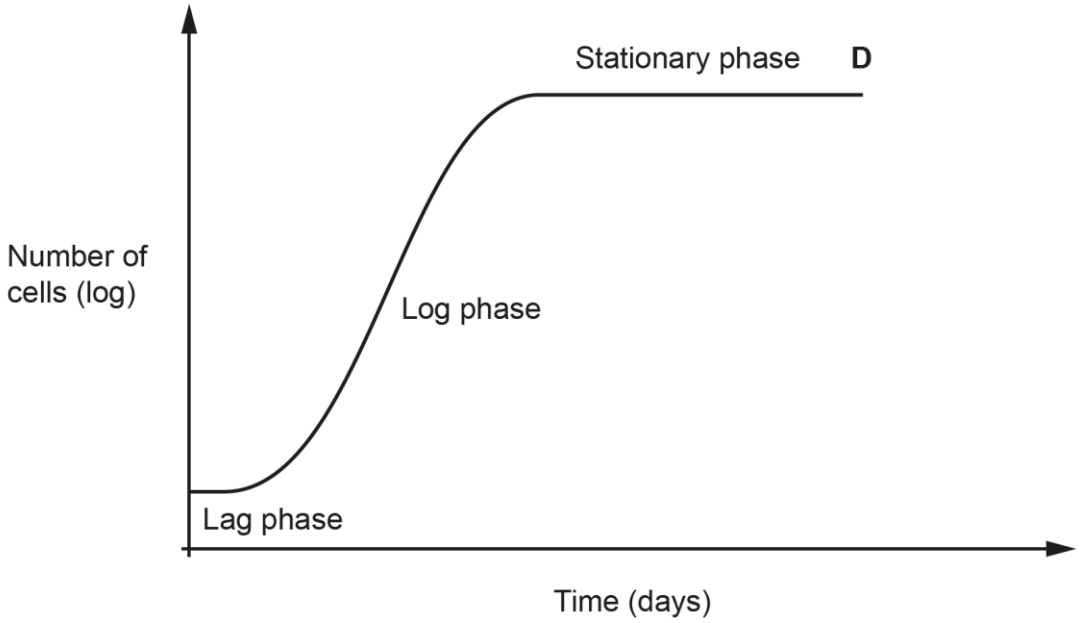
Number of bacteria after 2 hours = ... **[2]**

Most candidates correctly calculated the number of bacteria that would be present after 2 hours. The most common errors made were not realising that there were 120 bacteria present at the start, or for including a seventh division. Often candidates did not seem to appreciate the idea of exponential growth and even though the determined there were six rounds of division they simply added 120 each time.

Question 8 (e) (ii)

(ii) **Fig. 8.2** shows the bacterial growth curve for the bacteria grown in the fermenter.

Fig. 8.2



Suggest what would happen at point **D** if the bacteria were **not** supplied with a constant supply of nutrients.

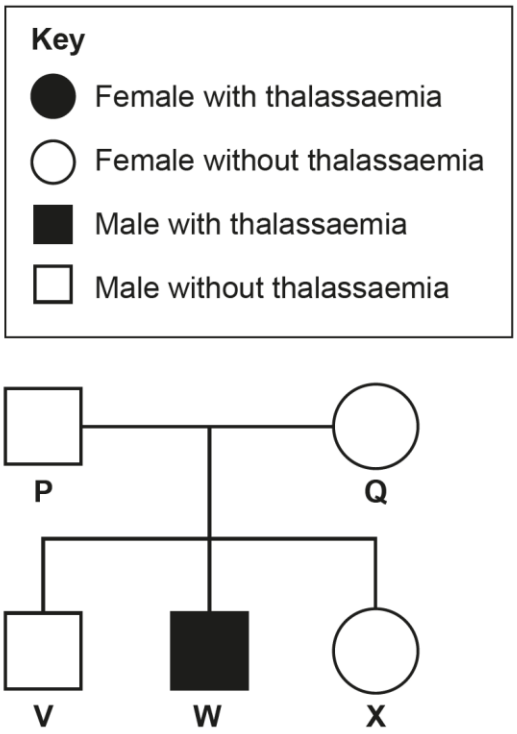
..... **[1]**

The most common error made by candidates on this question was to simply suggest that the bacteria would die. These candidates had not appreciated that bacteria will be dying in all stages of this growth curve, and that at point D more bacteria would die and therefore the population would in fact decrease.

Question 9 (a) (i)

9 Thalassaemia is an inherited genetic disorder caused by a recessive allele.

(a) The diagram shows a family tree.
It includes two parents and their three children.



(i) Describe the evidence from the family tree that supports this statement:

'Thalassaemia is caused by a recessive allele.'

.....

.....

.....

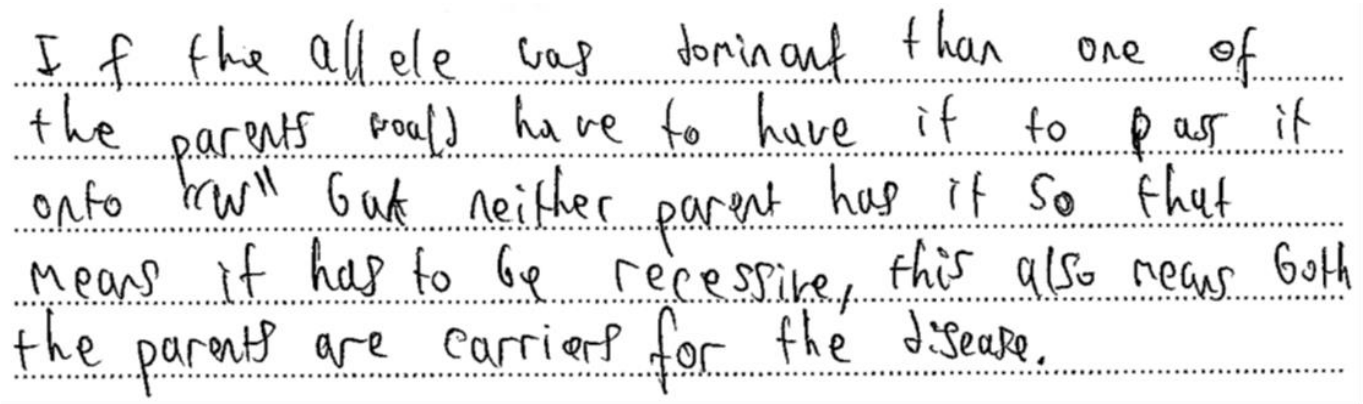
.....

.....

..... **[3]**

Candidates engaged well with this context and had clearly been shown how to interpret family trees. Some candidates found it difficult to express the evidence clearly and succinctly, but there were some excellent examples of well-thought-out reasoning. The most common mark given was for stating that child W had thalassaemia, but neither of the parents did. Many also went on to describe that the parents would therefore be carriers. Interestingly it is worthy of note that few candidates used the terms homozygous recessive when describing child W or heterozygous when describing the parents genotype.

Exemplar 3


If the allele was dominant than one of the parents would have to have it to pass it onto W" but neither parent has it so that means it has to be recessive, this also means both the parents are carriers for the disease.

In this exemplar we see an alternative approach to explain why the allele that causes thalassemia is recessive was taken by this candidate. Rather than describing the evidence for why it was recessive instead they chose to explain why it could not be dominant, which was an acceptable alternative approach. The response then details that both parents must therefore be carriers. This response was given two marks. To be given full marks it would need to explain that child W, was therefore homozygous recessive.

Question 9 (a) (ii)

(ii) Individual **W** has a child with a female who is **homozygous dominant** for this genetic disorder.

Calculate the probability that this child has thalassaemia.

Probability that the child has thalassaemia = ... **[3]**

Candidates are clearly comfortable with determining genetic probabilities as was demonstrated by their ability to tackle this question and reflected by the proportion that were given full marks. An important point for centres to relay to candidates relates to the display of workings. A number of candidates drew a Punnett square using W/w making it difficult to tell the difference between uppercase (dominant) and lowercase (recessive) alleles. This made it difficult to award partial credit for working shown in the Punnett square when the final response was incorrect.

Assessment for learning

Reminding candidates of the importance of representing alleles in Punnett squares using letters for which there is a clear difference between uppercase (dominant) and lowercase (recessive), e.g. A/a or D/d can help them score marks. Try to avoid using C, F K, M O, P, S U, V, W, X and Z.

Question 9 (b) (i)

(b) Thalassaemia results in red blood cells that contain low levels of haemoglobin.

(i) What is the role of haemoglobin?

..... **[1]**

Most candidates correctly identified the role of haemoglobin in the carriage of oxygen. This was expressed in different ways, with some candidates even referring to oxyhaemoglobin.

Question 9 (b) (ii)

(ii) Suggest **one** symptom experienced by people with thalassaemia.

..... **[1]**

Candidates used the information provided and their knowledge to suggest an impressive range of possible symptoms. The most common responses were fatigue/tiredness and breathlessness.

Question 9 (c) (i)

(c) Genetic disorders are caused by DNA mutations.

(i) Complete the sentences to describe how a mutation in a gene can change the activity of an enzyme.

Use words from the list.

active site	**amino acids**	**bases**
proteins	**ribosomes**	**substrate**

The mutation changes the order of the ..... in the gene.

This changes the order of the ..... in the enzyme.

This changes the shape of the enzyme's ..... .

[3]

Most candidates scored two or three marks for this question. The most common incorrect response observed was selecting proteins in the place of amino acids in the second sentence.

Question 9 (c) (ii)

(ii) A mutation can also happen in non-coding DNA.

What is non-coding DNA?

Tick (✓) **one** box.

DNA that does **not** cause a genetic disorder. ☐

DNA that does **not** store instructions for making a protein. ☐

DNA that does **not** store instructions for making an enzyme. ☐

DNA that is **not** made from nucleotides. ☐

[1]

Many candidates correctly identified that the role of non-coding DNA. Those that did not generally selected the third option – DNA that does not store instructions for making an enzyme.

Question 9 (c) (iii)

(iii) Describe how a mutation in non-coding DNA can affect an organism's phenotype.

.....

.....

.....

.....

.....

..... **[2]**

This final question proved to be the most challenging question on the paper and demonstrated that very few candidates fully understand the role of non-coding DNA and the effect that a mutation in this region would cause. Those that were given both marks however did express their understanding very clearly. The most common incorrect response observed was relating the change in a base sequence to the change in the order of the amino acids and subsequent issues relating to protein structure.

Supporting you

Teach Cambridge

Make sure you visit our secure website **Teach Cambridge** to find the full range of resources and support for the subjects you teach. This includes secure materials such as set assignments and exemplars, online and on-demand training.

Don't have access? If your school or college teaches any OCR qualifications, please contact your exams officer. You can forward them this link to help get you started.

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Access to Scripts

We've made it easier for Exams Officers to download copies of your candidates' completed papers or 'scripts'. Your centre can use these scripts to decide whether to request a review of marking and to support teaching and learning.

Our free, on-demand service, Access to Scripts is available via our single sign-on service, My Cambridge. Step-by-step instructions are on our website.

Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular professional development courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses for your subject on **Teach Cambridge**. You'll also find links to our online courses on NEA marking and support.

Signed up for ExamBuilder?

ExamBuilder is the exam paper builder platform for a range of our qualifications. Find out more.

Free for all OCR centres with an Interchange account, it allows unlimited users per centre. We require an Interchange username to verify your centre's users for ExamBuilder.

If you do not have an Interchange account, please contact your centre administrator (usually the Exams Officer) to request a username.

Once you have an Interchange username, use the form on this page to sign up for ExamBuilder, or ask an existing user at your centre to create an ExamBuilder account for you.

Active Results

Review students' exam performance with our free online results analysis tool. It is available for all GCSEs, AS and A Levels and Cambridge Nationals (examined units only).

Find out more.

Tell us what you think

Your feedback plays an important role in how we develop, market, support and resource qualifications now and into the future. We want you and your students to enjoy and get the best out of our qualifications and resources, but to do that we need your honest opinions to tell us whether we're on the right track or not.

You can email your thoughts to resources.feedback@ocr.org.uk or visit our feedback page to learn more about how you can help us improve our resources.

Designing and testing in collaboration with you and your students

Helping young people develop an ethical view of the world

Equality, diversity, inclusion and belonging (EDIB) are part of everything we do

---

Contact the team at:

01223 553998

ocr.org.uk

To stay up to date with all the relevant news about our qualifications, register for email updates at ocr.org.uk/updates

Visit our Online Support Centre at support.ocr.org.uk

CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT