Cambridge Assessment International Education

# Example Candidate Responses – Paper 4

## Cambridge IGCSE™ / IGCSE (9–1)

## Biology 0610 / 0970

For examination from 2021

Cambridge Pathway

# Contents

# Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge IGCSE / IGCSE (9–1) Biology 0610 / 0970, and to show how different levels of candidates' performance (high, middle and low) relate to the subject's curriculum and assessment objectives.

In this booklet candidate responses have been chosen from the June 2021 exam series to exemplify a range of answers.

For each question, the response is annotated with a clear explanation of where and why marks were awarded or omitted. This is followed by examiner comments on how the answer could have been improved. In this way, it is possible for you to understand what candidates have done to gain their marks and what they could do to improve their answers. There is also a list of common mistakes candidates made in their answers for each question.

This document provides illustrative examples of candidate work with examiner commentary. These help teachers to assess the standard required to achieve marks beyond the guidance of the mark scheme. Therefore, in some circumstances, such as where exact answers are required, there will not be much comment.

The questions, mark schemes and inserts used here are available to download from the School Support Hub. These files are:

**0610 June 2021 Question Paper 41**

**0610 June 2021 Mark Scheme 41**

Past exam resources and other teaching and learning resources are available on the School Support Hub:

www.cambridgeinternational.org/support

## How to use this booklet

This booklet goes through the paper one question at a time, showing you the high-, middle- and low-level response for each question. The candidate answers are set in a table. In the left-hand column are the candidate answers, and in the right-hand column are the Examiner comments.

| Example Candidate Response – high | Examiner comments |
|---|---|
| 3 Bacteria are used in many biotechnological processes.<br>(a) Explain why bacteria are useful in biotechnology.<br>Bacteria are useful in biotechnology because there are no ethical issues associated with them. Bacteria contains 1<br>2 plasmids similar to DNA and can easily be manipulated. 3<br>Bacteria reproduce in large amounts and can form many 4<br>complex substances. 5<br>[3]<br>(b) Insulin is one of many human proteins that are made by genetically engineered bacteria.<br>troyed the cells<br>[1] | 1 The candidate gives a a correct answer which fulfils marking point 4.<br>2 This is marking point 6.<br>3 The candidate needs to further explain that the plasmid can be manipulated to be used in genetic engineering which would give marking point 7.<br>4 The candidate needs to say that the bacteria reproduce quickly which |

**Answers** are by real candidates in exam conditions. These show you the types of answers for each level. Discuss and analyse the answers with your learners in the classroom to improve their skills.

**Examiner comments** are alongside the answers. These explain where and why marks were awarded. This helps you to interpret the standard of Cambridge exams so you can help your learners to refine their exam technique.

## How the candidate could have improved their answer

**(a)** Although the candidate was awarded full marks for this question, they could have improved it by explaining how the manipulation of plasmids could be used for genetic engineering. They also needed to avoid the use of the word 'substances'. In this case, bacteria making complex 'molecules' would have been a better use of biological terminology.

This section explains how the candidate could have improved each answer. This helps you to interpret the standard of Cambridge exams and helps your learners to refine their exam technique.

## Common mistakes candidates made in this question

- **(b)(i)** The candidate needed to give the answer 'pancreas', rather than 'liver'. The pancreas produces insulin, but insulin has an effect on the cells of the liver.
- **(b)(iii)** The candidate needed to include further details to explain that insulin reduces the concentration of blood sugar.

Often candidates were not awarded marks because they misread or misinterpreted the questions.

Lists the common mistakes candidates made in answering each question. This will help your learners to avoid these mistakes and give them the best chance of achieving the available marks.

# Question 1

## Example Candidate Response – high

1 (a) Baker's yeast, *Saccharomyces cerevisiae*, is a single-celled organism that is classified in the kingdom Fungi.

Fig. 1.1 is a drawing of a section through a yeast cell.

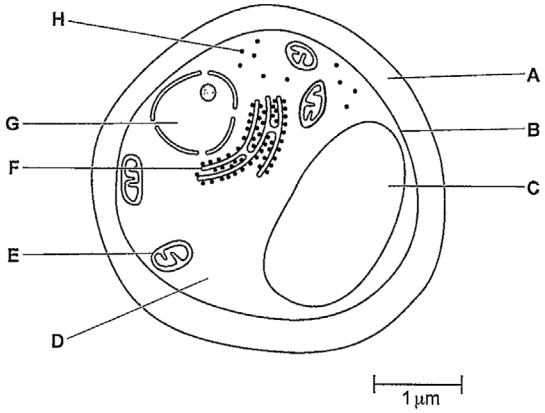



**Fig. 1.1**

(i) State **one other** kingdom that contains organisms that all have structure **A**.

Plant Kingdom 1 ..... [1]

(ii) Table 1.1 shows some cell functions.

Complete Table 1.1 by naming the cell structure responsible for each cell function and give the letter that identifies each cell structure in Fig. 1.1.

**Table 1.1**

| cell function | cell structure | letter from Fig. 1.1 |
|---|---|---|
| storage of genes | Nucleus | G |
| aerobic respiration | | E 2 |
| amino acids are assembled to make protein | Ribosome | H |

[3]

## Examiner comments

1 The candidate gives a correct answer. Either 'plant' or 'prokaryote' is acceptable.

Mark for (a)(i) = 1 out of 1

2 The candidate correctly identifies the nucleus and ribosome. They correctly identify the location where aerobic respiration takes place, but need to also name the cell structure (mitochondria).

Mark for (a)(ii) = 2 out of 3

## Example Candidate Response – high, continued

**(b)** A student made a drawing of one *Escherichia coli* bacterium. Fig. 1.2 shows the student's drawing.

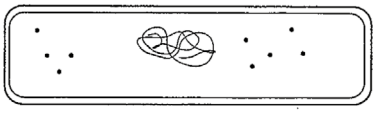



**Fig. 1.2**

The actual length of the bacterial cell is 2 µm.

**(i)** Convert the actual length of the cell to millimetres.

2000 3 mm [1]

**(ii)** State the other information that the student needs in order to calculate the magnification of the drawing in Fig. 1.2.

Image length. 4 [1]

**(c)** Describe the similarities **and** differences between the structure of the yeast cell and the structure of the bacterial cell.

Use the information in Fig. 1.1 and Fig. 1.2 in your answer.

Both bacterial cells and Yeast cells have a cell wall and contain ribosomes for protein synthesis. Both contain a cell membrane which is partially permeable to water. 5 However, the yeast contains a nucleus with organised DNA while the bacterial cells' DNA is spread around the cytoplasm. But, both structures contain a cytoplasm. 6 Bacterial cells', however, do not have a vacuole or and ~~endop~~ rough endoplasmatic reticulum in contrast to the yeast cell. 7

[6]

## Examiner comments

3 The candidate multiplies by 1000 instead of dividing by 1000 in their conversion to millimetres.

Mark for (b)(i) = 0 out of 1

4 The candidate gives a correct answer.

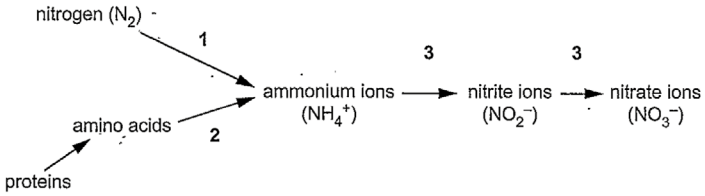
Mark for (b)(ii) = 1 out of 1

5 The candidate describes three similarities between the the yeast and bacterial cell.

6 The candidate moves on to the differences but then moves back to similarities. This is acceptable, but for clarity it would be better to list all the similarities followed by all the differences.

7 The candidate finishes their response by listing two more differences. All the similarities and differences are correct.

Mark for (c) = 6 out of 6

| Example Candidate Response – high, continued | Examiner comments |
|---|---|
| **(d)** Some bacteria are involved in the nitrogen cycle.<br><br>Fig. 1.3 shows part of the nitrogen cycle.<br><br>  <br><br><br>**Fig. 1.3**<br><br>State the processes that are represented by **1**, **2** and **3** on Fig. 1.3.<br><br>1 Nitrogen Fixation<br>2 (Deamination) Nitrification 8<br>3 Denitrificat ion 9<br><br>[3] | 8 'Deamination' is correct, although 'nitrification' is not. However, the first answer on the line is marked for this question, so the candidate is awarded the mark for process 2.<br><br>9 The candidate is able to identify process 1 but not process 3. This should be 'nitrification'.<br><br>Mark for (d) = 2 out of 3<br><br>**Total mark awarded = 12 out of 15** |

## How the candidate could have improved their answer

- **(a)(ii)** The candidate needed to name the cell structure which carries out aerobic respiration, although they identified it by letter in Fig. 1.1.
- **(b)(i)** The candidate multiplied 2 by 1000, but they needed to divide 2 by 1000 to convert it to millimetres.
- **(c)** The candidate was awarded the full 6 marks for this question. However, they could have described the similarities between the yeast and bacteria and then described the differences to improve the structure of their answer.
- **(d)** The candidate needed to correctly identify process C. The conversion of nitrite ions to nitrate ions is known as 'nitrification'.

## Example Candidate Response – middle

1 (a) Baker's yeast, *Saccharomyces cerevisiae*, is a single-celled organism that is classified in the kingdom Fungi.

Fig. 1.1 is a drawing of a section through a yeast cell.

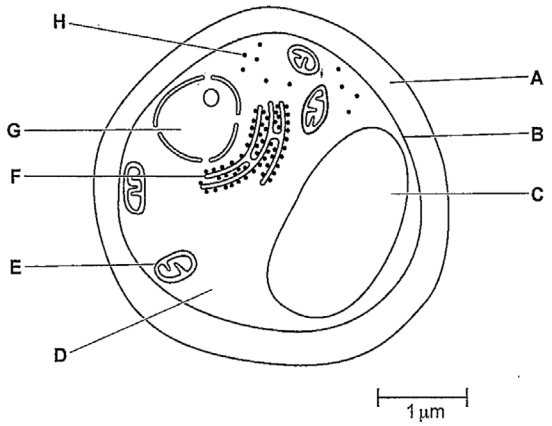



Fig. 1.1

(i) State **one other** kingdom that contains organisms that all have structure **A**.

Plant kingdom 1 [1]

(ii) Table 1.1 shows some cell functions.

Complete Table 1.1 by naming the cell structure responsible for each cell function and give the letter that identifies each cell structure in Fig. 1.1.

Table 1.1

| cell function | cell structure | letter from Fig. 1.1 |
|---|---|---|
| storage of genes | Nucleus | G |
| aerobic respiration | mitochondria | E |
| amino acids are assembled to make protein | ribosome | H |

2 [3]

## Examiner comments

1 The candidate gives the correct answer.

Mark for (a)(i) = 1 out of 1

2 The candidate correctly names and identifies all three cell structures from Fig. 1.1.

Mark for (a)(ii) = 3 out of 3

## Example Candidate Response – middle, continued

**(b)** A student made a drawing of one *Escherichia coli* bacterium. Fig. 1.2 shows the student's drawing.

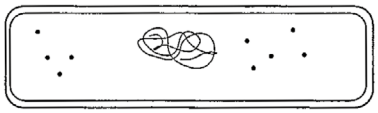


**Fig. 1.2**

The actual length of the bacterial cell is 2 μm.

**(i)** Convert the actual length of the cell to millimetres.

$\frac{1}{1000} \times 2$ ..... 0.002 ..... mm [1]

3

**(ii)** State the other information that the student needs in order to calculate the magnification of the drawing in Fig. 1.2.

length of the image ..... [1]

**(c)** Describe the similarities **and** differences between the structure of the yeast cell and the structure of the bacterial cell.

Use the information in Fig. 1.1 and Fig. 1.2 in your answer.

- The yeast cell has a circle shape while as the bacterial cell has a rectangle shape.
- The yeast cell is wider than the bacterial cell
- The bacterial cell is longer in length than the yeast cell.

4

- They both have cell walls

5

..... [6]

## Examiner comments

3 The candidate correctly converts micrometres to millimetres.

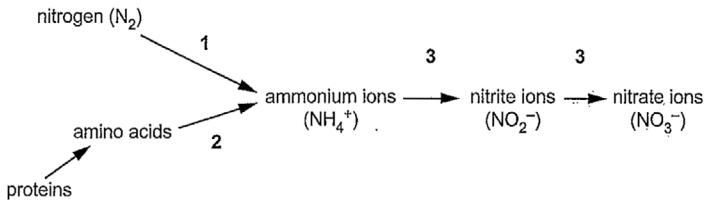
Mark for (b)(i) = 1 out of 1

Mark for (b)(ii) = 1 out of 1

4 The question asks about the structure of the yeast and bacterial cells. The candidate describes the differences between the shape and size of the cells, but these are not structural differences or similarities so they are not awarded any marks.

5 The candidate recognises one similarity between the structures of the cells: that they both have a cell wall.

Mark for (c) = 1 out of 6

| Example Candidate Response – middle, continued | Examiner comments |
|---|---|
| **(d)** Some bacteria are involved in the nitrogen cycle.<br><br>Fig. 1.3 shows part of the nitrogen cycle.<br><br>  <br><br><br>**Fig. 1.3**<br><br>State the processes that are represented by **1**, **2** and **3** on Fig. 1.3.<br><br>1 Nitrogen fixing<br>2 decay<br>3 Nitrofication<br><br>[3] | 6 Process 2 happens as the organism decays, but it is known as 'deamination' or 'ammonification'. The candidate's answer of 'decay' is ignored.<br><br>7 The candidate makes a spelling mistake here, but the answer is accepted because it is phonetically correct.<br><br>Mark for (d) = 2 out of 3<br><br>**Total mark awarded = 9 out of 15** |

## How the candidate could have improved their answer

- **(c)** The candidate needed to identify the similarities and differences in structure between the yeast and the bacterial cell. Their references to the differences in shape or size were ignored as they were not structures of the cells. The candidate was awarded one mark for stating that they both had a cell wall.
- **(d)** The candidate recognised that process 2 involved decay, but they needed to correctly name this process as 'deamination'.

## Example Candidate Response – low

1 (a) Baker's yeast, *Saccharomyces cerevisiae*, is a single-celled organism that is classified in the kingdom Fungi.

Fig. 1.1 is a drawing of a section through a yeast cell.

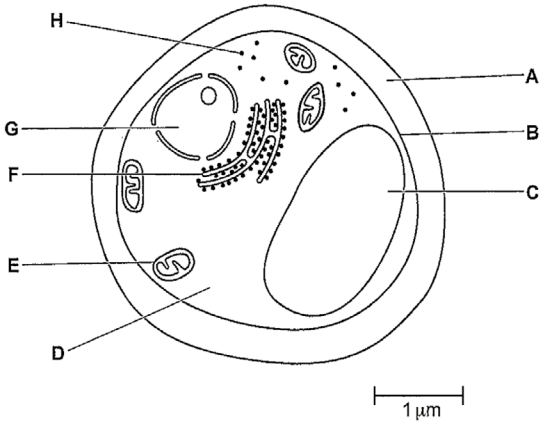



Fig. 1.1

(i) State **one other** kingdom that contains organisms that all have structure **A**.

Plantae 1 [1]

(ii) Table 1.1 shows some cell functions.

Complete Table 1.1 by naming the cell structure responsible for each cell function and give the letter that identifies each cell structure in Fig. 1.1.

Table 1.1

| cell function | cell structure | letter from Fig. 1.1 |
|---|---|---|
| storage of genes | | G |
| aerobic respiration | | E |
| amino acids are assembled to make protein | | F |

2 [3]

## Examiner comments

1 The candidate gives a correct answer.

Mark for (a)(i) = 1 out of 1

2 The candidate correctly identifies the letters from Fig. 1.1 which correspond to the cell functions. However they do not name any of the cell structures. This question is marked by row, so they are not awarded any marks for this.

Mark for (a)(ii) = 0 out of 3

## Example Candidate Response – low, continued

**(b)** A student made a drawing of one *Escherichia coli* bacterium. Fig. 1.2 shows the student's drawing.

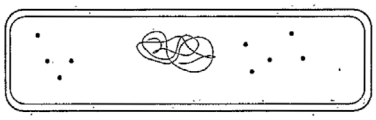


**Fig. 1.2**

The actual length of the bacterial cell is 2 µm.

**(i)** Convert the actual length of the cell to millimetres.

0.02 (3) ..... mm [1]

**(ii)** State the other information that the student needs in order to calculate the magnification of the drawing in Fig. 1.2.

Size of the drawing (4) ..... [1]

**(c)** Describe the similarities **and** differences between the structure of the yeast cell and the structure of the bacterial cell.

Use the information in Fig. 1.1 and Fig. 1.2 in your answer.

Both plant, bacterial and yeast cells have platelets (5)

Both bacterial and yeast cells have cell walls

Both bacterial and yeast cell have cytoplasm (6)

The bacterial cell has a fixed shape whilst the yeast cell does not (7)

The bacterial cell has rings of DNA inside of it (8)

The yeast cell has mitochondria (9)

..... [6]

## Examiner comments

3 The candidate divides 2 by 100, rather than 1000.

Mark for (b)(i) = 0 out of 1

4 The candidate recalls that the formula for magnification is magnification = image size divided by actual size. However, to be awarded the mark, the candidate needs to use this information to state the specific information needed to calculate the magnification. In this case it is length of the drawing, rather than size of the drawing.

Mark for (b)(ii) = 0 out of 1

5 The candidate gives an incorrect answer because platelets are a component of blood.

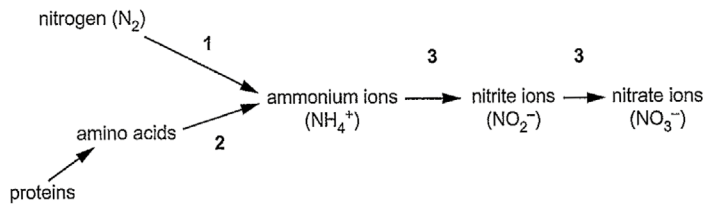
6 The candidate identifies two similarities in structure between the cells.

7 The candidate's references to shape are ignored because shape is not considered to be part of the cell structure.

8 The candidate knows that the bacterial cell contains rings of DNA, but they do not name these as plasmids so cannot be awarded a mark.

9 The candidate states that the yeast cell has mitochondria which implies that the bacterial cells do not have mitochondria.

Mark for (c) = 3 out of 6

| Example Candidate Response – low, continued | Examiner comments |
|---|---|
| **(d)** Some bacteria are involved in the nitrogen cycle.<br><br>Fig. 1.3 shows part of the nitrogen cycle.<br><br>  <br><br><br>**Fig. 1.3**<br><br>State the processes that are represented by **1**, **2** and **3** on Fig. 1.3.<br><br>1 denitrification<br>2 nitrification<br>3 nitrogen fixation<br><br>10<br>[3] | 10 The candidate misidentifies all three processes. They are able to name the processes in the nitrogen cycle, but is not able to match the names to the chemical reactions that occur in the nitrogen cycle.<br><br>Mark for (d) = 0 out of 3<br><br>**Total mark awarded = 4 out of 15** |

## How the candidate could have improved their answer

- **(a)(ii)** The candidate needed to name the cell structures identified from Fig. 1.1. This question was marked by row, so they were awarded no marks for this question.
- **(b)(i)** The candidate needed to divide 2 by 1000, rather than 100.
- **(b)(ii)** Although the candidate recalled that magnification should be calculated by image size divided by actual size, they needed to then incorporate the information given in the question. The question stated the actual length of the cell so the student needed to divide the image length by the actual length, so the information needed was the image length. The candidate's reference to the image size was ignored.
- **(c)** The candidate needed to use more exact biological terminology and refer to plasmids rather than rings of DNA. The question required candidates to describe structural similarities and differences and they mentioned some of these, however they also included differences in shape which were not considered part of the cell structure.
- **(d)** The candidate was able to name the processes in the nitrogen cycle, but they needed to be able to match these processes to the diagram.

## Common mistakes candidates made in this question

- **(a)(i)** 'Plants' or 'prokaryotes' was accepted as a correct answer. Some candidates stated 'bacteria', which is a group within the prokaryotes, but not the name of the kingdom.
- **(a)(ii)** The question was marked by row. If a candidate identified the letter from Fig. 1.1 matching the cell function, but did not name the cell structure, they could not be awarded the mark.
- **(b)(i)** Many candidates multiplied 2 by 1000, rather than divided by 1000. Some also divided by 100 rather than 1000.
- **(b)(ii)** Some answers such as 'image size' were not precise enough. 'Measured length' was also ignored.
- **(c)** Many candidates commented on differences in size and shape. These were not structural differences, so were ignored. Many candidates thought that yeast had ribosomes and bacteria do not.
- **(d)** Many candidates misidentified the processes in the nitrogen cycle. Most commonly, process 1 was misidentified as 'nitrification' or sometimes 'lightning'. Process 3 was commonly misidentified as denitrification. Answers of 'decay' and 'decomposition' were ignored for Process 2.

# Question 2

## Example Candidate Response – high

2 Large quantities of plastic waste are polluting the oceans.

(a) A survey published in March 2018 showed the increase in plastic waste in the Pacific Ocean. One area of the Pacific Ocean is known as the Great Pacific Garbage Patch (GPGP).

Data were collected from areas inside and outside the GPGP between 1965 and 2015 to estimate the quantity of plastic waste.

The results are shown in Fig. 2.1.

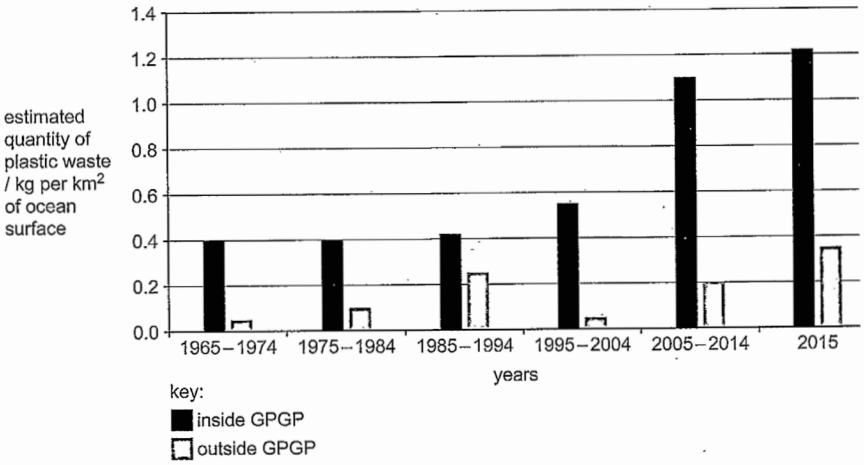



Fig. 2.1

1 Describe the results of the survey shown in Fig. 2.1.

Through the period of time from 1965 - 1984 the quantity of plastic inside GPGP was the same and the quantity outside GPGP 2 barely increased. Since then the quantity of plastic in the GPGP has always increased: In 1985 - 2004 it increased from 0·4 to 0·6 approximately inside GPGP 3 then in the 2004 the was a very rapid increase from 0·6 - 1:1 approximately up to 2014. And in one years time 2014 - 2015 it increased approximately from 1:1 to 1:2. On the other hand outside GPGP in 1994 - 2004 the amount decreased from 0·2 - 0·05 approximately. But it then began to rise rapidly as seen from 4 5 [4] outside GPGP 2004 - 2014 and then 2014 - 2015.

## Examiner comments

1 The candidate fulfills marking point 2.

2 The increase outside the GPGP is part of marking point 5.

3 The rapid increase is marking point 3.

4 The candidate offers a correct data quote, but the candidate has not included units so they are not awarded marking point 6.

5 The canddiate refers to the decrease followed by an increase, which is the final part of marking point 5, so together with their earlier point they can be awarded marking point 5.

Mark for (a) = 3 out of 4

## Example Candidate Response – high, continued

**(b)** The green turtle, *Chelonia mydas*, is a species of marine animal that is harmed by plastic waste.

Fig. 2.2 shows a green turtle swimming past a plastic bag in the Pacific Ocean.

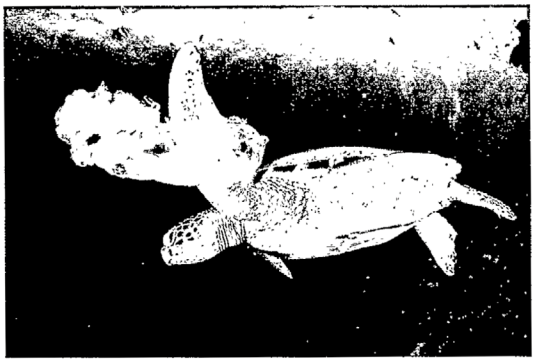


**Fig. 2.2**

**(i)** Turtles are classified as reptiles.

State **one** feature shown by all reptiles that is **not** found in amphibians.

have scales 6 [1]

**(ii)** Outline the dangers of non-biodegradable plastic waste to marine animals, such as green turtles.

these non-biodegradable plastic waste accumulate in landfills and also end up in seas. It can affect turtles in many ways like trapping them and not letting them swim 7 or see. Then turtles can also confuse them with food and they will ingest them, as they are non-biodegradable they fill up the turtle's stomach but don't really give them energy so they will eventually 8 die. 9

The plastic bags can accumulate on the surface stoppin light entering 10 or sink and cover their habitats or food they eat like (algea). 11 [4]

## Examiner comments

6 The candidate gives a correct answer. Scales are features of reptiles, but not amphibians.

Mark for (b)(i) = 1 out of 1

7 The candidate suggests that the turtles' movement is restricted, which is marking point 3.

8 The candidate expresses the idea well that the turtles' ability to gain nutrition is affected, so they are awarded marking point 4.

9 Plastic resulting in death of the marine animal is marking point 5.

10 The candidate almost achieves marking point 7, but they need to explain that if there is a lack of light, this will mean that producers cannot photosynthesise.

11 The candidate gives enough detail for marking point 9 as they suggest that there is a loss of habitat or feeding area.

Mark for (b)(ii) = 4 out of 4

| Example Candidate Response – high, continued | Examiner comments |
|---|---|
| (iii) Suggest ways to reduce the quantity of plastic waste.<br>Recycle which all the plastic that we use in the specific containers 12 Reuse these plastics for example plastic bags or bottles 13 And reducing plastics, this can be done by substitut replacing them with other alternative materials for example paper bags instead of plastic bags or glass bottles instead of plastic bottles 14 [2]<br>[Total: 11] | 12 The candidate makes a good suggestion that recycling is a way to reduce the quantity of plastic waste.<br>13 The candidate makes another good suggestion about reusing plastic products.<br>14 The candidate gives a very comprehensive answer. They use examples to fully explain their suggestions of ways to reduce the quantity of plastic waste.<br>Mark for (b)(iii) = 2 out of 2<br>**Total mark awarded = 10 out of 11** |

## How the candidate could have improved their answer

- **(a)** To improve their answer and be awarded full marks for this question, the candidate needed to include units in their data quote. This would have fulfilled marking point 6.
- **(b)(ii)** The candidate was awarded full marks for this question. However they could have fully explained the idea that if the plastic restricted the light that entered the water then this would lead to less photosynthesis by the producers in the water.

## Example Candidate Response – middle

**2** Large quantities of plastic waste are polluting the oceans.

**(a)** A survey published in March 2018 showed the increase in plastic waste in the Pacific Ocean. One area of the Pacific Ocean is known as the Great Pacific Garbage Patch (GPGP).

Data were collected from areas inside and outside the GPGP between 1965 and 2015 to estimate the quantity of plastic waste.

The results are shown in Fig. 2.1.

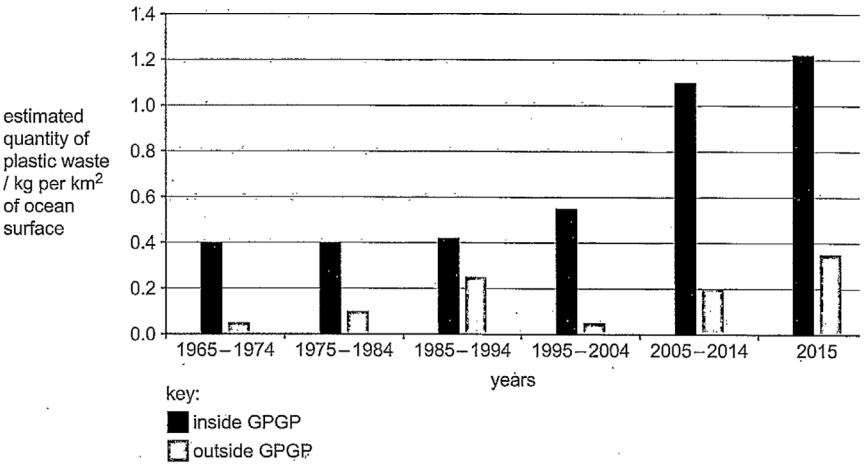



**Fig. 2.1**

Describe the results of the survey shown in Fig. 2.1.

There is an increase in plastic waste from 1965 to 2015. The wasting of plastic keeps increasing in the area inside GPGP so there is a direct proportional between increase in years and plastic waste in the area inside GPGP while for the area outside GPGP there is no specific pattern as the wastage keeps varying year to year.

[4]

## Examiner comments

1 The candidate does not quote any data so cannot be awarded any marks for this statement.

2 The candidate needs to mention that the quantity is constant at first and then increases steeply, inside the GPGP.

3 The candidate writes enough for marking point 5 which is the idea that the quantity of plastic waste outside the GPGP fluctuates.

Mark for (a) = 1 out of 4

## Example Candidate Response – middle, continued

**(b)** The green turtle, *Chelonia mydas*, is a species of marine animal that is harmed by plastic waste.

Fig. 2.2 shows a green turtle swimming past a plastic bag in the Pacific Ocean.

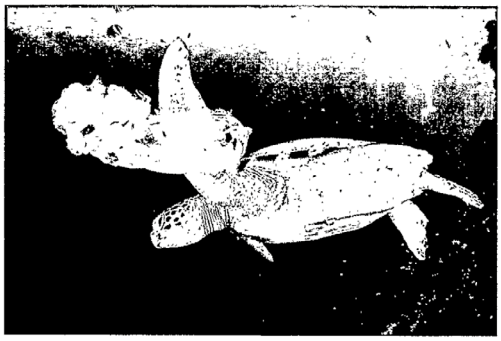


**Fig. 2.2**

**(i)** Turtles are classified as reptiles.

State **one** feature shown by all reptiles that is **not** found in amphibians.

reptile have scarly, rough skin 4 [1]

**(ii)** Outline the dangers of non-biodegradable plastic waste to marine animals, such as green turtles.

The plastics could cover the bodies making it hard for them to swim and feed 5 effectively. Moreover some plastic could be consumed by the green turtles sticking to the lungs and making it hard for them 6 to breathe. Not only that but also the consumed plastic could get in the way of their digestive system, making hard for 7 them to digest food and lead to death. [4] 8

## Examiner comments

4 Although the candidate makes a spelling mistake in the word 'scaly', they are awarded the mark. Reptiles do not have rough skin so this point is ignored.

Mark for (b)(i) = 1 out of 1

5 The candidate gives marking point 3, the idea that the turtles' ability to move is negatively affected by the plastic waste.

6 The candidate has the idea that the turtles' ability to breathe is negatively affected. However, they state that this is caused by consumption of the plastic which is not correct so they cannot be awarded marking point 2.

7 The candidate is awarded marking point 4 for the idea that the ability to gain nutrition is affected.

8 The candidate is awarded marking point 5 for suggesting that the presence of plastic in the marine environment can lead to the death of turtles.

Mark for (b)(ii) = 3 out of 4

| Example Candidate Response – middle, continued | Examiner comments |
|---|---|
| (iii) Suggest ways to reduce the quantity of plastic waste.<br>• Recycle the plastics 9<br>• deposit on land sites that it specifically designed to keep wastes 10<br>[2] | 9 The candidate offers a good suggestion that recycling is a way to reduce the quantity of plastic waste.<br>10 Disposing of plastic waste on land(fill) sites will not reduce the quantity of plastic waste.<br>Mark for (b)(iii) = 1 out of 2<br>**Total mark awarded = 6 out of 11** |

## How the candidate could have improved their answer

- **(a)** The candidate recognised the overall trend that there was an increase in plastic waste over time. However, they needed to compare the two, for example by saying that the quantity was always higher inside the GPGP than outside it and then give some data quotes. The candidate needed to describe the trend inside the GPGP, that the quantity remained constant and then increased steeply.
- **(b)(ii)** The candidate realised that the plastic could affect the ability of the turtle to breathe, however they incorrectly stated that this was due to consumption of the plastic which was not correct. They needed to include that the plastic might choke or strangle the turtle.
- **(b)(iii)** The question asked candidates to suggest ways to reduce the quantity of plastic waste. Recycling or reusing would be good suggestions, or using products made from other (biodegradable) materials. The candidate suggested depositing the waste on landfill sites. This may stop the plastic entering the marine environment, but would not reduce the overall quantity of plastic waste.

## Example Candidate Response – low

**2** Large quantities of plastic waste are polluting the oceans.

**(a)** A survey published in March 2018 showed the increase in plastic waste in the Pacific Ocean. One area of the Pacific Ocean is known as the Great Pacific Garbage Patch (GPGP).

Data were collected from areas inside and outside the GPGP between 1965 and 2015 to estimate the quantity of plastic waste.

The results are shown in Fig. 2.1.

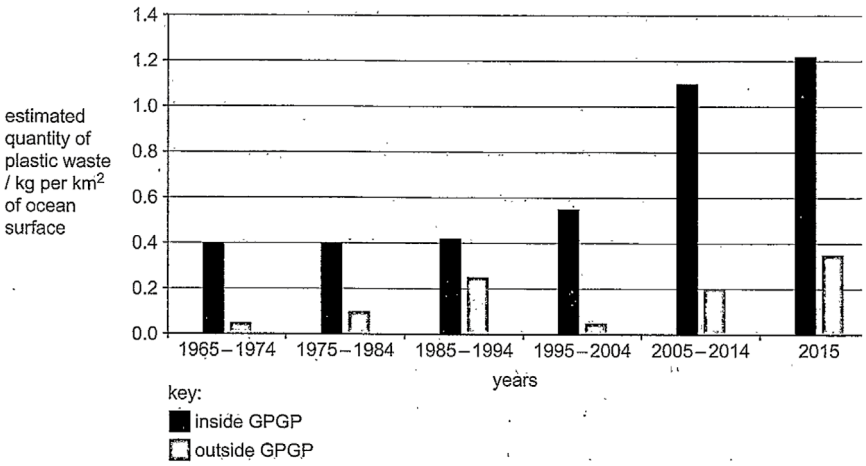



**Fig. 2.1**

Describe the results of the survey shown in Fig. 2.1.

The estimated quantity of plastic waste inside the GPGP was kept constant between 1965 to 1974 (0.4 kg/km²) and then started to rise gradually, it then rose drastically after 2004.

The estimated quantity outside the GPGP dropped in the years 1995 - 2004 but then rose again.

[4]

## Examiner comments

1 This is marking point 2.

2 The candidate gives a relevant data quote. They include years and units for quantity of plastic waste which fulfils marking point 6.

3 The steep increase in waste inside the GPGP after a period of being constant is marking point 3.

4 The candidate nearly fulfills marking point 5, but they need to include that the quantity outside the GPGP initially rose, before decreasing and then increasing again.

Mark for (a) = 3 out of 4

## Example Candidate Response – low, continued

**(b)** The green turtle, *Chelonia mydas*, is a species of marine animal that is harmed by plastic waste.

Fig. 2.2 shows a green turtle swimming past a plastic bag in the Pacific Ocean.

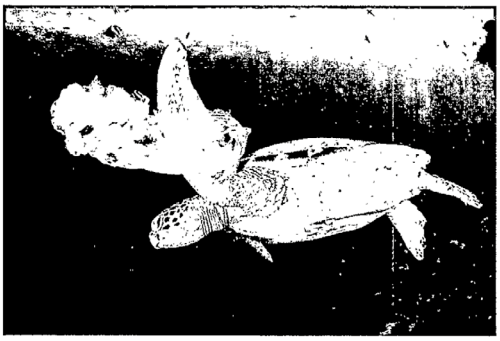


**Fig. 2.2**

**(i)** Turtles are classified as reptiles.

State **one** feature shown by all reptiles that is **not** found in amphibians.

Scaly skin 5 [1]

**(ii)** Outline the dangers of non-biodegradable plastic waste to marine animals, such as green turtles.

They cause pollution in the ocean. 6

They endanger the animals.

They make it hard for the animals to find oxygen. 7

They can make the animals extint 8

[4]

## Examiner comments

5 The candidate gives the correct answer.

Mark for (b)(i) = 1 out of 1

6 The candidate needs to give some details about how plastic waste could cause pollution by being toxic to the marine animals.

7 The candidate needs to explain why the animals may struggle to gain oxygen, for example, through strangulation by the plastic waste.

8 The plastic causing the animals to become endangered or extinct is not enough for the candidate to be awarded a mark. The question asks for a direct link between the plastic and how it may cause harm to the turtles.

Mark for (b)(ii) = 0 out of 4

| Example Candidate Response – low, continued | Examiner comments |
|---|---|
| (iii) Suggest ways to reduce the quantity of plastic waste.<br>Do not build companies next to the ocean because of the rate of pollution.<br>Do not trash refuse bins into the ocean. 9<br>[2] | 9 The candidate gives some suggestions to reduce the quantity of plastic waste in the ocean, but not how to reduce the quantity of plastic waste that exists in the first place.<br>Mark for (b)(iii) = 0 out of 2<br><br>**Total mark awarded = 4 out of 11** |

## How the candidate could have improved their answer

- **(a)** The candidate gave a good description of the data trend for the quantity of waste inside the GPGP and included a data quote. However, the trend for the quantity of waste outside the GPGP was incomplete. The candidate needed to include that the quantity of waste initially increased (before decreasing).
- **(b)(ii)** The candidate used some general terms to outline the dangers of plastic waste, for example, pollution and extinction. However, the candidate needed to explain precisely how plastic waste could harm marine animals. The candidate stated that the plastic waste might make it hard for the animals to find oxygen, but they needed to explain that this was because the plastic could cause choking or strangulation.
- **(b)(iii)** The candidate may have misread this question. They needed to discuss ways to reduce the amount of plastic waste that was created, rather than how to reduce the amount of plastic waste that reached the sea.

## Common mistakes candidates made in this question

- **(a)** Many candidates did not include units in their data quote. When answering a question such as this, candidates needed to look for trends in the data, rather than simply stating the quantities for each year. In addition, some candidates only described the data at each year, but did not identify any trends or compare between, inside, and outside the GPGP.
- **(b)(i)** Many candidates gave a suitable feature for this question, however, some described the skin of reptiles as dry or rough, both of which were ignored.
- **(b)(ii)** Many candidates described the direct effects of plastic waste on marine animals well. However, a common mistake they made was to suggest that eating the plastic affected the animals' ability to breathe. Many stated that the turtles could die, but did not explain why this could happen. The indirect effects of plastic waste often needed greater explanation. For example, some suggested that the plastic could block sunlight but did not go on to explain that this would prevent photosynthesis by the producers below. Some candidates did not give precise descriptions of the dangers and stated that the plastic would cause extinction, pollution or that it was harmful (which was given in the question stem). This was not enough to be awarded any marks.
- **(b)(iii)** Many candidates described ways to properly dispose of plastic waste. However, this does not answer the question as it would not reduce the quantity of plastic waste.

# Question 3

## Example Candidate Response – high

3 Bacteria are used in many biotechnological processes.

(a) Explain why bacteria are useful in biotechnology.

Bacteria are useful in biotechnology because there are no ethical issues associated with them. Bacteria contains 1
2 plasmids similar to DNA and can easily be manipulated. 3
Bacteria reproduce in large amounts and can form many 4
complex substances. 5

..... [3]

(b) Insulin is one of many human proteins that are made by genetically engineered bacteria.

Some people cannot produce insulin because their immune system has destroyed the cells that make insulin.

(i) State the organ that contains the cells that have been destroyed.

Pancreas 6 ..... [1]

(ii) State the name of the disease caused by the destruction of these cells.

Type 1 diabetes 7 ..... [1]

(iii) State the function of insulin in the body.

Increases the blood glucose concentration 8 ..... [1]

(c) Genetically engineered bacteria that are used to make insulin were grown in a fermenter for five days.

Samples were taken from the fermenter every six hours and the number of bacteria in 1.0 $mm^3$ of the nutrient solution were counted.

Changes in the numbers of living bacteria in the samples taken from the fermenter are shown in Fig. 3.1.

## Examiner comments

1 The candidate gives a a correct answer which fulfils marking point 4.

2 This is marking point 6.

3 The candidate needs to further explain that the plasmid can be manipulated to be used in genetic engineering which would give marking point 7.

4 The candidate needs to say that the bacteria reproduce quickly which would have fulfilled marking point 2.

5 The candidate gives enough detail for marking point 3, however the could improve their answer if they use the word ‘molecules’ rather than ‘substances’.

Mark for (a) = 3 out of 3

6 The candidate gives a correct answer.

Mark for (b)(i) = 1 out of 1

7 The candidate gives a correct answer.

Mark for (b)(ii) = 1 out of 1

8 The candidate gives the inverse of the correct answer. Insulin decreases blood glucose concentration.

Mark for (b)(iii) = 0 out of 1

## Example Candidate Response – high, continued

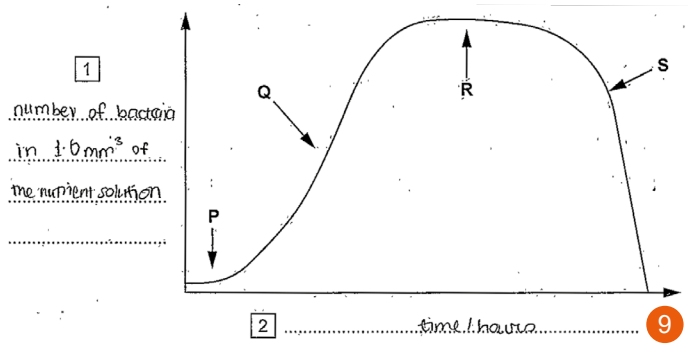



Fig. 3.1

(i) Complete Fig. 3.1 by adding labels for the axes at 1 and 2. [1]

(ii) State the names of the stages of population growth of the bacteria labelled P to S.

P Lag phase

Q Log phase

R Stationary phase

S Death phase 10

[2]

(iii) Explain, with reference to Fig. 3.1, why the bacteria did not grow in the fermenter for longer than five days.

At the beginning the bacteria was getting used to its environments and later started reproducing in the nutrient solution from P to Q. At R, reproduction halted as conditions were stable but the bacteria began 11
12 to ~~fight~~ compete for survival within the limited supply of nutrient in the solution. ~~*~~ So at S ~~more~~ bacteria began to die due to lack of nutrients. 13 [3]

## Examiner comments

9 The candidate gives the correct answer and labels both axes correctly.

Mark for (c)(i) = 1 out of 1

10 The candidate names the stages correctly.

Mark for (c)(ii) = 2 out of 2

11 The first part of the candidate's answer is not relevant. The question only asks about why the bacteria did not grow for longer than 5 days.

12 The candidate mentions the competition between the bacteria which is marking point 3.

13 The candidate makes a correct point and is awarded marking point 4.

Mark for (c)(iii) = 2 out of 3

## Example Candidate Response – high, continued

**(d)** Mineral salts are important in the human diet. One of the most important is iron.

Explain:
- the importance of iron in the human diet
- the effects of an iron deficiency.

Iron is crucial in the production of haemoglobin, the 14 pigment in red blood cells that is responsible for 15 16 transporting oxygen around the body. A lack of iron causes a reduction in the quantity and concentration of haemoglobin in the cells, causing less oxygen to be transported around the body for respiration, resulting in a deficiency called anaemia. 17 [3]

**(e)** Fig. 3.2 shows a field of cassava, *Manihot esculenta*, which is a crop plant grown in parts of Africa and Asia.

**Fig. 3.2**

The plants store starch in their roots, which form a large part of the diet for many people. Cassava does not provide many vitamins or mineral ions.

Genetic engineers have modified cassava to increase its iron content. They have done this by incorporating a gene for a membrane protein from the plant *Arabidopsis thaliana*.

**(i)** State the name of the enzyme that is used to cut out the gene from the DNA of *A. thaliana*.

Restriction enzymes 18 [1]

## Examiner comments

14 This is correct for marking point 1.

15 The candidate demonstrates knowledge that haemoglobin is found in red blood cells. This is marking point 2.

16 The candidate gives marking point 3, however, the mark scheme states that this question has a maximum of 2 marks for discussion of the importance of iron.

17 The candidate explains how a lack of iron can cause a deficiency known as anaemia which is marking point 5 but they do not give any symptoms of anaemia.

Mark for (d) = 3 out of 3

18 The candidate gives the correct answer.

Mark for (e)(i) = 1 out of 1

## Example Candidate Response – high, continued

(ii) Describe how the gene from *A. thaliana* and the DNA from cassava form recombinant DNA.

The restriction enzymes used to cut out the gene of DNA are used to isolate the DNA from the cassava. This causes 19 the DNA of the cassava to have complementary sticky ends to the sticky ends of the DNA from A. thaliana. These 20 combine together using DNA ligase to form recombinant DNA. 21 [2]

(iii) Scientists who develop genetically engineered varieties of crop plants often breed them for several generations before releasing them for farmers to use.

Suggest why the scientists do this.

This ensures that all the offspring at ~~any~~ older generations will have the required features as the primarily modified 22 crops. This also allows them to monitor any possible issues concerning the crop plants. 23

[2]

[Total: 20]

## Examiner comments

19 The candidate refers to the idea that the same restriction enzyme cuts the cassava DNA too which is marking point 1.

20 The formation of complementary sticky ends is both marking points 2 and 3.

21 The DNA being joined using ligase is marking point 4. The candidate mentions all marking points on the mark scheme to give a comprehensive answer.

Mark for (e)(ii) = 2 out of 2

22 This idea that the scientists check that all offspring have the required features is marking point 1.

23 This is almost marking point 3. However, the candidate refers to 'monitoring for possible issues' which does not clearly express the idea that the crops are monitored for potential adverse effects.

Mark for (e)(iii) = 1 out of 2

**Total mark awarded = 17 out of 20**

## How the candidate could have improved their answer

- **(a)** Although the candidate was awarded full marks for this question, they could have improved it by explaining how the manipulation of plasmids could be used for genetic engineering. They also needed to avoid the use of the word 'substances'. In this case, bacteria making complex 'molecules' would have been a better use of biological terminology.
- **(b)(iii)** The candidate needed to write about the function of insulin rather than glucagon. They should have included that insulin decreases blood glucose concentrations, rather than increases it.
- **(c)(iii)** The candidate only discussed the competition between the bacteria for nutrients and did not mention any other factors that might limit or cause the bacteria population to decrease, such as a lack of oxygen, or a build-up of waste products.
- **(e)(iii)** The candidate was almost awarded marking point 3, but they needed to express more clearly that the scientists would monitor for any adverse or side effects to make sure the crop was safe to eat.

## Example Candidate Response – middle

3 Bacteria are used in many biotechnological processes.

(a) Explain why bacteria are useful in biotechnology.

The ~~bact~~ Plasmid in a bacteria can be cut and put in a 1
different 2 gene for example a gene to produce insuline.
The bacteria can now reproduce insuline at a large scaled
because they reproduce rapidly. 3
there is no ethical issues. 4
[3]

(b) Insulin is one of many human proteins that are made by genetically engineered bacteria.

Some people cannot produce insulin because their immune system has destroyed the cells that make insulin.

(i) State the organ that contains the cells that have been destroyed.

liver 5 [1]

(ii) State the name of the disease caused by the destruction of these cells.

diabetes 1 6 [1]

(iii) State the function of insulin in the body.

control blood sugar level 7 [1]

(c) Genetically engineered bacteria that are used to make insulin were grown in a fermenter for five days.

Samples were taken from the fermenter every six hours and the number of bacteria in 1.0 $mm^3$ of the nutrient solution were counted.

Changes in the numbers of living bacteria in the samples taken from the fermenter are shown in Fig. 3.1.

## Examiner comments

1 This is marking point 6.

2 The candidate offers a description of the use of a plasmid in genetic engineering. This is marking point 7.

3 This is marking point 2.

4 This is marking point 4. The candidate expresses their ideas clearly and succinctly.

Mark for (a) = 3 out of 3

5 The correct answer should be pancreas. The liver is an organ that insulin acts on, but the pancreas produces insulin.

Mark for (b)(i) = 0 out of 1

6 The candidate gives the correct answer.

Mark for (b)(ii) = 1 out of 1

7 The candidate needs to include more detail here. Insulin controls blood sugar levels by decreasing the concentration of blood sugar.

Mark for (b)(iii) = 0 out of 1

| Example Candidate Response – middle, continued | Examiner comments |
|---|---|

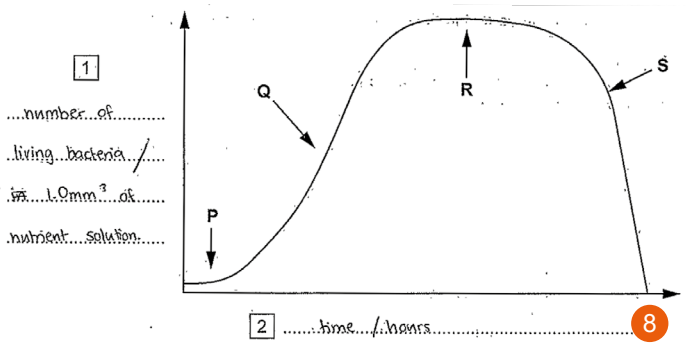



Fig. 3.1

(i) Complete Fig. 3.1 by adding labels for the axes at 1 and 2. [1]

(ii) State the names of the stages of population growth of the bacteria labelled **P** to **S**.

P .....

Q exponential growth 9 .....

R ~~stady~~ .....

S decrease 10 11 .....

[2]

(iii) Explain, with reference to Fig. 3.1, why the bacteria did not grow in the fermenter for longer than five days.

Because the limited factor 12 is the nutrient ~~with~~ which we can see at point S was used up and the bacteria could reproduce 13 anymore 14 .....

.....

.....

.....

.....

[3]

8 The candidate labels both axes correctly.

Mark for (c)(i) = 1 out of 1

9 The candidate correctly names stage Q as exponential growth.

10 The name of stage S is death or decline, so 'decrease' is not accepted.

11 The candidate only gives one correct answer so is not awarded any marks.

Mark for (c)(ii) = 0 out of 2

12 This is marking point 1.

13 The candidate offers 'nutrients' as a factor that could have limited the growth of the bacteria.

14 No further limiting factors are given, so the candidate gets two marks.

Mark for (c)(iii) = 2 out of 3

## Example Candidate Response – middle, continued

(d) Mineral salts are important in the human diet. One of the most important is iron.

Explain:
- the importance of iron in the human diet
- the effects of an iron deficiency

Iron is responsible for growth 15 and the production of red blood cells and 16 haemoglobin. 17

It causes anaemia and tiredness, 18 weakness. It can also cause the skin to turn yellow 19

[3]

(e) Fig. 3.2 shows a field of cassava, *Manihot esculenta*, which is a crop plant grown in parts of Africa and Asia.

Fig. 3.2

The plants store starch in their roots, which form a large part of the diet for many people. Cassava does not provide many vitamins or mineral ions.

Genetic engineers have modified cassava to increase its iron content. They have done this by incorporating a gene for a membrane protein from the plant *Arabidopsis thaliana*.

(i) State the name of the enzyme that is used to cut out the gene from the DNA of *A. thaliana*.

~~receptor cells~~ 20 [1]

## Examiner comments

15 This statement is ignored. Iron is not responsible for growth.

16 This is marking point 2.

17 This is marking point 1.

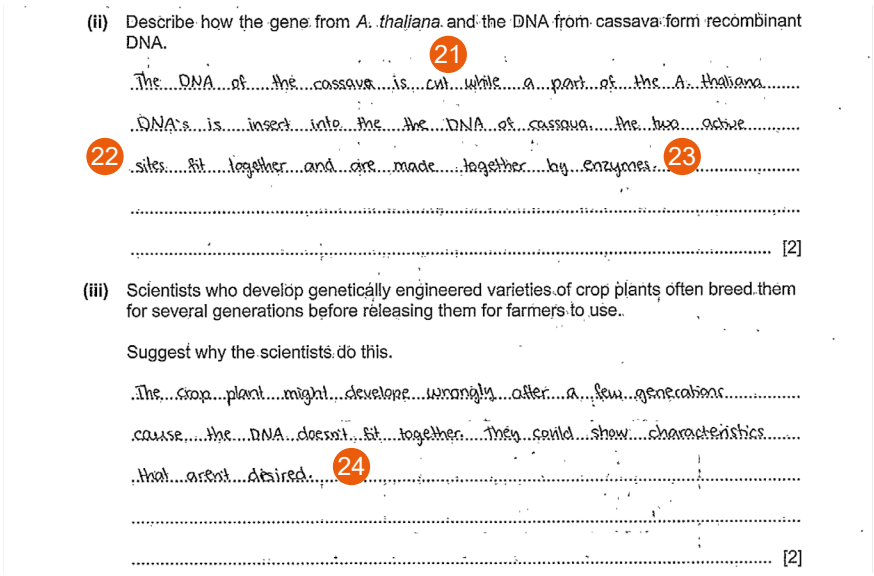
18 This is marking point 5 and 6. The candidate names the condition resulting from a lack of iron and describes some of the symptoms.

19 This part of the answer is ignored. Skin turning yellow is not a correct symptom of anaemia.

Mark for (d) = 3 out of 3

20 The candidate crosses out their answer, but they give no alternative so their crossed out answer can be marked. However, the crossed out answer is not correct.

Mark for (e)(i) = 0 out of 1

| Example Candidate Response – middle, continued | Examiner comments |
|---|---|
|  | 21 The candidate needs to include that the cassava DNA is cut using the same enzyme.<br><br>22 The candidate confuses the terminology relating to enzymes rather than recombinant DNA technology. They need to use the terms 'complementary sticky ends' rather than 'active sites'.<br><br>23 The candidate needs to name the enzyme that joins the DNA as 'ligase'.<br><br>Mark for (e)(ii) = 0 out of 2<br><br>24 The candidate almost has the idea that the scientists are checking for adverse side effects, but they need to express this idea more clearly.<br><br>Mark for (e)(iii) = 0 out of 2<br><br>**Total mark awarded = 10 out of 20** |



## How the candidate could have improved their answer

- **(b)(i)** The candidate needed to give the answer 'pancreas', rather than 'liver'. The pancreas produces insulin, but insulin has an effect on the cells of the liver.
- **(b)(iii)** The candidate needed to include further details to explain that insulin reduces the concentration of blood sugar.
- **(c)(ii)** The candidate needed to give four correct answers to be awarded the 2 marks for this question part. The candidate needed to give answers for the two stages they left blank. They named stage Q correctly. They named stage S as decrease. This was a description of what happened, but not the name of the stage, which is 'death' or 'decline'. The candidate needed to learn the names of a population growth curve as stated on the syllabus.
- **(c)(iii)** The candidate's answer started with a correct reference to limiting factors and names one of the factors as the lack of nutrients. However, this question was worth three marks, so the candidate needed to describe other factors that might have limited the population growth, such as a lack of space or build-up of toxins.
- **(e)(i)** The candidate needed to give the correct answer of restriction for the name of the enzyme, rather than 'recepting cells'.
- **(e)(ii)** The candidate needed to demonstrate their knowledge of terminology relating to recombinant DNA technology. They could have said that the same enzyme was used to cut the cassava DNA and that ligase was used to join the complementary sticky ends. They demonstrated some confusion with the terminology used to describe enzyme action. Cutting the DNA with restriction enzymes would result in complementary sticky ends rather than active sites.
- **(e)(iii)** The candidate said that the crop could show characteristics that weren't desired. However, they needed to add that these characteristics could be harmful, for example, they could have adverse side effects. They needed to offer a clearer suggestion. The candidate could also have said that the scientists needed to make sure that the desired characteristic was expressed.

## Example Candidate Response – low

3 Bacteria are used in many biotechnological processes.

(a) Explain why bacteria are useful in biotechnology.

Because they are ethical 1 and moral to use in experiments, for yeast and in bread making. They don't harm 2 and they are small to carry out in a laboratory. 3 [3]

(b) Insulin is one of many human proteins that are made by genetically engineered bacteria.

Some people cannot produce insulin because their immune system has destroyed the cells that make insulin.

(i) State the organ that contains the cells that have been destroyed.

liver 4 [1]

(ii) State the name of the disease caused by the destruction of these cells.

Obesity and Malnutrition 5 [1]

(iii) State the function of insulin in the body.

Give energy 6 [1]

(c) Genetically engineered bacteria that are used to make insulin were grown in a fermenter for five days.

Samples were taken from the fermenter every six hours and the number of bacteria in 1.0 $mm^3$ of the nutrient solution were counted.

Changes in the numbers of living bacteria in the samples taken from the fermenter are shown in Fig. 3.1.

## Examiner comments

1 The candidate gives marking point 4.

2 The candidate gives an example about yeast rather than bacteria, but examples are ignored in this answer.

3 The candidate correctly states that the bacteria are small, but they need to go further to explain that this means that they do not need much space, so therefore can be grown in a laboratory.

Mark for (a) = 1 out of 3

4 The correct answer is 'pancreas'.

Mark for (b)(i) = 0 out of 1

5 The answer is 'diabetes'.

Mark for (b)(ii) = 0 out of 1

6 The candidate gives an incorrect answer. Insulin does not give energy to the body.

Mark for (b)(iii) = 0 out of 1

## Example Candidate Response – low, continued

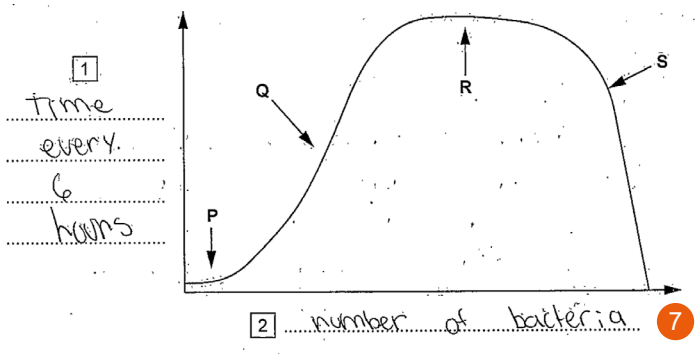



Fig. 3.1

(i) Complete Fig. 3.1 by adding labels for the axes at 1 and 2. [1]

(ii) State the names of the stages of population growth of the bacteria labelled **P** to **S**.

P lag Phase
Q exponential phase
R Stationary phase
S Death phase 8
[2]

(iii) Explain, with reference to Fig. 3.1, why the bacteria did not grow in the fermenter for longer than five days.

Because bacteria started getting low as enzymes became denatured and more than the optimum temperature 9 and the components and products finished or less concentration 10 [3]

## Examiner comments

7 The candidate labels the axes the wrong way round and does not give any units for the number of bacteria.

Mark for (c)(i) = 0 out of 1

8 The candidate correctly states the four stages of the population growth curve.

Mark for (c)(ii) = 2 out of 2

9 The candidate correctly describes an increase in temperature above the optimum which causes the bacteria to die.

10 The candidate states that products finish or decrease in concentration, but does not say what these products are. They need to name these products, for example, nutrients or oxygen.

Mark for (c)(iii) = 1 out of 3

## Example Candidate Response – low, continued

**(d)** Mineral salts are important in the human diet. One of the most important is iron.

Explain:
- the importance of iron in the human diet
- the effects of an iron deficiency.

Iron is important for the diet in order to have strong bones (11) and if there is an iron diffency then the bones will smooth and soft and no energy, feeling tired and unchcious. (12) [3]

**(e)** Fig. 3.2 shows a field of cassava, *Manihot esculenta*, which is a crop plant grown in parts of Africa and Asia.

**Fig. 3.2**

The plants store starch in their roots, which form a large part of the diet for many people. Cassava does not provide many vitamins or mineral ions.

Genetic engineers have modified cassava to increase its iron content. They have done this by incorporating a gene for a membrane protein from the plant *Arabidopsis thaliana*.

**(i)** State the name of the enzyme that is used to cut out the gene from the DNA of *A. thaliana*.

restriction (13) [1]

## Examiner comments

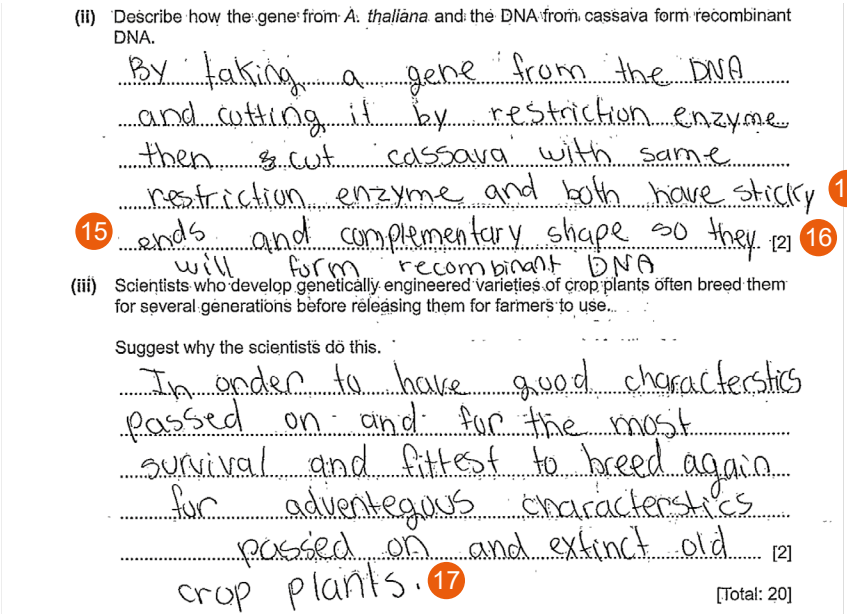
(11) The candidate confuses the function of iron with the function of calcium.

(12) Fatigue is a symptom of iron deficiency, which is marking point 6.

Mark for (d) = 1 out of 3

(13) The candidate gives a correct answer.

Mark for (e)(i) = 1 out of 1

| Example Candidate Response – low, continued | Examiner comments |
|---|---|
|  | 14 This is marking point 1.<br><br>15 The sticky ends are usually described as being complementary, rather than having complementary shapes, which is the terminology more commonly used with enzyme action.<br><br>16 This is marking point 2.<br><br>Mark for (e)(ii) = 2 out of 2<br><br>17 The candidate needs to express this answer clearly. They begin to describe the process of evolution and do not answer the question.<br><br>Mark for (e)(iii) = 0 out of 2<br><br>**Total mark awarded = 8 out of 20** |

(ii) Describe how the gene from *A. thaliana* and the DNA from cassava form recombinant DNA.

By taking a gene from the DNA and cutting it by restriction enzyme then cut cassava with same restriction enzyme and both have sticky ends and complementary shape so they will form recombinant DNA [2]

(iii) Scientists who develop genetically engineered varieties of crop plants often breed them for several generations before releasing them for farmers to use.

Suggest why the scientists do this.

In order to have good characterstics passed on and for the most survival and fittest to breed again for adventegous characterstics passed on and extinct old crop plants. [2]

[Total: 20]

## How the candidate could have improved their answer

- **(a)** The candidate needed to give more of an explanation that because the bacteria were small, they were useful in biotechnology because they don't take up much space. The candidate stated examples of yeast used in bread making. This was not relevant and did not answer the question, which was about bacteria and it did not ask for examples. They could also have given another reason: that bacteria have a rapid reproduction rate.
- **(b)(i)** The candidate needed to give the correct answer of 'pancreas'. Insulin acts on liver cells to reduce blood glucose concentrations, but does not make insulin.
- **(b)(ii)** The candidate needed to give the correct answer of 'diabetes'. Obesity and malnutrition are not caused by a lack of insulin.
- **(b)(iii)** The candidate needed to understand that insulin does not give energy to the body, it reduces the blood glucose concentration.
- **(c)(i)** The candidate labelled the axes the wrong way round: they needed to put time on the x-axis. Also, they needed to give units, such as number of bacteria / $mm^3$.
- **(c)(iii)** The candidate was awarded one mark for explaining that a rise in temperature above the optimum could denature the enzymes and cause the bacteria to die. They also stated that the bacteria die because some of the products had finished. However, they gave examples of factors that might be limiting, such as a lack of nutrients or oxygen.
- **(d)** The candidate confused an iron deficiency with a lack of calcium. They needed to state that iron is needed to make haemoglobin in red blood cells, rather than to make strong bones. The candidate could have named iron deficiency as 'anaemia' to be awarded an extra mark.
- **(e)(iii)** Rather than suggesting the scientists do this to 'in order to have good characteristics passed on', the candidate needed to state that it was to ensure the desired characteristics were inherited as this question was about genetically engineering crop plants to create crops with new, desired characteristics. The candidate tried to describe the process of evolution, which did not answer the question. They could have suggested that it would be helpful to ensure the new variety grew in field conditions.

## Common mistakes candidates made in this question

- **(a)** Many candidates gave examples of ways that bacteria were used in biotechnology, however, this did not answer the question. Some candidates stated that bacteria had the same DNA as humans but this was not correct and a better answer would be to say that bacteria have the same type of DNA as humans or that the genetic code was universal.
- **(b)(i)** Many candidates stated that the liver contained the cells that had been destroyed, rather than the pancreas. Insulin has an effect on the liver cells but is made by cells in the pancreas.
- **(b)(ii)** There were few mistakes with this question. However, those that did make a mistake usually gave a different disease such as 'anaemia' or 'sickle cell'.
- **(b)(iii)** Many candidates incorrectly stated that insulin controls or regulates blood sugar levels but this was not enough for an answer. The candidates needed to show how insulin controls blood sugar concentration.
- **(c)(i)** Many candidates made errors when labelling the y-axis. Some gave 'bacteria / $mm^3$' rather than 'number of bacteria / $mm^3$' and some did not include units.
- **(c)(ii)** Several candidates described what was happening at each stage of population growth, rather than giving the names stated on the syllabus, for example, they stated 'increasing' rather than 'exponential' or 'lag'.
- **(c)(iii)** Some candidates described what happened at all the stages in the growth curve, but, the question only asked about the final part of the growth curve when the population is decreasing. Others just described one factor that was limiting population growth, usually a lack of nutrients, but did not give other factors such as a lack of oxygen or build-up of waste.
- **(d)** Some candidates confused a lack of iron with a lack of calcium or vitamin D and thought that iron was needed for bone formation, rather than to make haemoglobin in red blood cells.
- **(e)(i)** The most common mistake in this question part was to name other enzymes rather than restriction enzyme. Candidates often gave an example of a digestive enzyme, for example, protease, amylase or pepsin. Sometimes, they gave 'ligase' which is the name of another enzyme used in genetic engineering.
- **(e)(ii)** Some candidates did not use correct technical language in this question so they were not awarded the marks. For example, they described how the DNA was joined, but with no mention of 'sticky ends' or 'ligase'.
- **(e)(iii)** Many candidates interpreted this question as asking about selective breeding by artificial selection and some did not express their ideas clearly enough. For example, they said that the scientists needed to test for problems with the crops, rather than for adverse side effects.

# Question 4

## Example Candidate Response – high

4 Two identical potted plants were used to investigate plant responses.

Plant **A** was placed on a clinostat that continually rotated. Plant **B** was not rotated.

Both plants were then placed on their sides and kept in the dark.

Fig. 4.1 shows the two plants at the start of the experiment and after seven days.

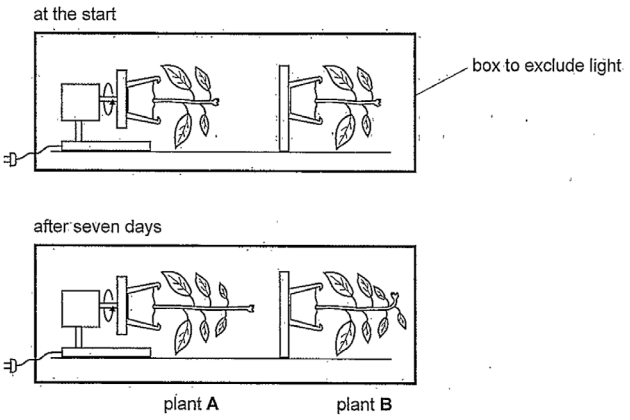



**Fig. 4.1**

**(a)** State the name of the response shown by the shoot of plant **B**.

gravitropism 1 ..... [1]

**(b)** Explain the reason for constantly rotating plant **A**.

So that gravity acts in all parts and so all parts respond to it. So that the plant auxin is evenly spread and 2 grows equally as all sides have responded to gravity in the same way, for the same time. There is no overall effect as all parts have grown equally. ..... [2]

**(c)** **(i)** State the name of the plant hormone that causes the response of the shoot of plant **B**.

(plant) auxin 3 ..... [1]

## Examiner comments

1 The candidate's answer, 'gravitropism', is correct.

Mark for (a) = 1 out of 1

2 The candidate explains the idea that gravity affects all sides of the plant equally, causing auxin to be equally distributed in the plant. However, they need to explain that plant A was constantly rotated to compare it with the response of plant B (which was not rotated).

Mark for (b) = 1 out of 2

3 The candidate gives the correct answer.

Mark for (c)(i) = 1 out of 1

## Example Candidate Response – high, continued

(ii) Explain how the plant hormone causes the response of plant **B**.

It is responding away from gravity and so auxin lies on
4 the bottom side of the shoot. The part with auxin grows at
5 a greater rate meaning that the bottom part will
grow faster causing the shoot to bend upwards
6 and grow upwards. The upper part doesn't have as
much auxin and so grows slower.

[3]

(d) Seeds germinate in the soil. The seedlings that grow from seeds show the same response as shown by plant **B** in Fig. 4.1.

Explain the advantages of this response to the survival of seedlings and mature plants.

It causes the shoot to grow upwards, and away from gravity,
towards the light, and the roots towards gravity, away from
the light. This causes the shoot to be in the air where it
recieves sunlight, being able to photosynthesis and make 7
carbohydrates, which allows the plant to live. The roots
8 grow downwards where it can absorb water
and ions from the soil. 9

[3]

## Examiner comments

4 Auxin collects on the lower side of the plant is marking point 2.

5 The lower side does not grow faster, but the cells elongate. It is this that causes the shoot to bend.

6 The candidate correctly identifies that the stem grows upwards and this fulfills marking point 4.

Mark for (c)(ii) = 2 out of 3

7 This is marking point 1.

8 This is marking point 5.

9 The candidate clearly expresses their answers. Roots growing downwards to absorb water and ions is marking point 6.

Mark for (d) = 3 out of 1

**Total mark awarded = 8 out of 10**

## How the candidate could have improved their answer

- **(b)** The candidate clearly explained the effect of rotating the plant and that this was needed to negate the effect of gravity. However, they needed to further explain that this was done so that in the investigation the scientist could compare the response of plant A with the response of plant B.
- **(c)(ii)** The candidate should have written that the auxin causes cell elongation, rather than causing the cells to grow faster.

## Example Candidate Response – middle

4 Two identical potted plants were used to investigate plant responses.

Plant **A** was placed on a clinostat that continually rotated. Plant **B** was not rotated.

Both plants were then placed on their sides and kept in the dark.

Fig. 4.1 shows the two plants at the start of the experiment and after seven days.

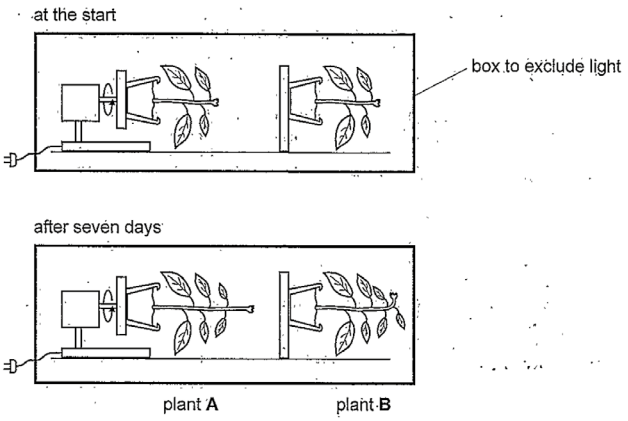



Fig. 4.1

(a) State the name of the response shown by the shoot of plant **B**.

Phototropism Geotropism 1 [1]

(b) Explain the reason for constantly rotating plant **A**.

To observe its response to gravity and to even the distribution of auxin to both sides of the 2 plant so not only one side elongnates

[2]

(c) (i) State the name of the plant hormone that causes the response of the shoot of plant **B**.

Auxin 3 [1]

## Examiner comments

1 The candidate's answer, 'geotropism', is correct.

Mark for (a) = 1 out of 1

2 The candidate has the right idea, that rotating causes an even distribution of auxin in the plant. However, they need to explain that this is done to compare the response in plant A to plant B.

Mark for (b) = 1 out of 2

3 The candidate gives a correct answer.

Mark for (c)(i) = 1 out of 1

## Example Candidate Response – middle, continued

(ii) Explain how the plant hormone causes the response of plant **B**.

The auxin is produced at the ~~roo~~ tip of the shoot and causes the cells at the darker side/~~to~~ gravity direction side to elong- 4 ate and move away from gravity and grow upwards. Or towards light. 5

[3]

(d) Seeds germinate in the soil. The seedlings that grow from seeds show the same response as shown by plant **B** in Fig. 4.1.

Explain the advantages of this response to the survival of seedlings and mature plants.

It causes the seedlings them to get as much light as possible 6 ~~thus~~ and the response is automatic. 7

[3]

## Examiner comments

4 The candidate writes part of their answer in the context of a response to light, but this is ignored. Marking point 3 is for auxin causing cell elongation.

5 The candidate interprets the diagram and states that the plant grows upwards. Although they state that the plant grows upwards, they say it grows towards the light so this is ignored.

Mark for (c)(ii) = 2 out of 3

6 The candidate needs to say that the plant needs the light for photosynthesis.

7 The candidate needs to discuss other advantages of the shoot growing upwards, or advantages of the roots growing downwards.

Mark for (d) = 0 out of 3

**Total mark awarded = 5 out of 10**

## How the candidate could have improved their answer

- **(b)** The candidate should have explained that plant A was rotated so that its response could be compared to plant B.
- **(c)(ii)** The candidate understood that auxin is produced in the shoot tip but did not explain that the auxin then moves to the lower side of the shoot. They wrote their answer in the context of both gravity and light. The plant was placed in a box, so that light would not play a part in the plant response. As the candidate was not awarded marks in questions **(a)** or **(b)** for writing about the response to light, in this question this reference to light was ignored.
- **(d)** The candidate needed to further explain that the plant needed light for photosynthesis. They also needed to explain the further advantages of a seed growing a shoot upwards and the roots downwards and the advantages of roots growing downwards such as to gain water.

## Example Candidate Response – low

4 Two identical potted plants were used to investigate plant responses.

Plant **A** was placed on a clinostat that continually rotated. Plant **B** was not rotated.

Both plants were then placed on their sides and kept in the dark.

Fig. 4.1 shows the two plants at the start of the experiment and after seven days.

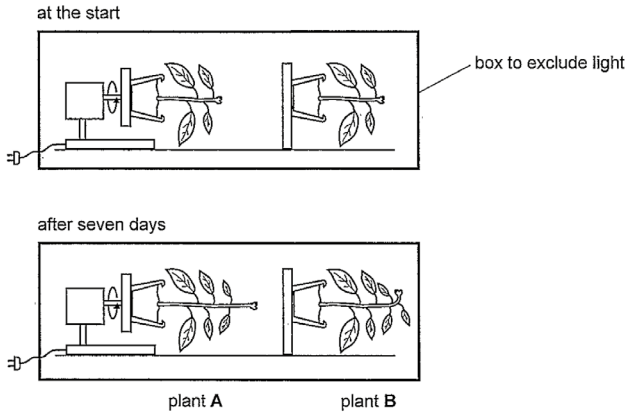



**Fig. 4.1**

**(a)** State the name of the response shown by the shoot of plant **B**.

Phototropism 1 ..... [1]

**(b)** Explain the reason for constantly rotating plant **A**.

• To ensure all parts of the plant didn't recieve ~~light~~ the same amount of light 2

• To compare it with plant B 3

..... [2]

**(c)** **(i)** State the name of the plant hormone that causes the response of the shoot of plant **B**.

Auxin 4 ..... [1]

## Examiner comments

1 The plant is placed in a box that excludes light. Therefore, the response is not due to light and is not phototropism.

Mark for (a) = 0 out of 1

2 The candidate's answer is in the context of light, so this is not correct.

Mark for (b) = 1 out of 2

3 This is marking point 2. Plant A is rotated so that it can be compared to plant B.

4 The candidate gives the correct answer

Mark for (c)(i) = 1 out of 1

## Example Candidate Response – low, continued

(ii) Explain how the plant hormone causes the response of plant **B**.

• Auxin is made found at the shoot of a plant

• Auxin react respond to light and moves toward the light source 5

• As auxin was in the shoot of plant B, the plant grew towards the light side where auxin is released. 6 [3]

(d) Seeds germinate in the soil. The seedlings that grow from seeds show the same response as shown by plant **B** in Fig. 4.1.

Explain the advantages of this response to the survival of seedlings and mature plants.

• The g response to light, will help the seedlings to grow towards the sun, where it can have a better photosynthesis reaction to make its food, unlike a plant in the dark, no less photosynthesis reaction will take place. 7

[3]

## Examiner comments

5 The candidate gives their answer in the context of light. As this has already been noted as incorrect in the previous question, this point is ignored.

Mark for (c)(ii) = 0 out of 3

6 The candidate needs to explain how auxin causes cell elongation which result in the shoot bending upwards.

7 The candidate writes one valid point in their answer; that light is needed for photosynthesis, which is marking point 1.

Mark for (d) = 1 out of 3

**Total mark awarded = 3 out of 10**

## How the candidate could have improved their answer

- **(a)** The candidate needed to give the correct answer 'gravitropism'. The plant was responding to gravity, but not to light as it was kept in the dark.
- **(b)** The candidate realised that plant A was a control and used to compare to plant B. However, they should have said that the plant was rotated to ensure all parts of the plant received the same amount of gravity, not light.
- **(c)(ii)** The candidate was unable to explain how auxin caused the response seen in plant B. They needed to have explain that the auxin moves to the lower side of the plant, causing cell elongation and the stem to bend upwards.
- **(d)** The candidate gave one advantage of the shoot growing upwards. This question was worth 3 marks, so they needed to discuss three advantages. For example, they could have stated that the shoot also needs to grow upwards to gain oxygen and the roots grow downwards to get water and ions.

## Common mistakes candidates made in this question

- **(a)** Many candidates confused 'gravitropism' with 'phototropism'. However, the plants were placed in a box to exclude light so that phototropism did not play a part in the response. References to 'trophisms' were ignored.
- **(b)** Few candidates explained that plant A was rotated so that the response could be compared to the response of plant B, i.e. it was the control. Some candidates explained the rotation in the context of light, for example, so that all sides receive equal light.
- **(c)(i)** Some candidates named other hormones such as 'glucagon' or 'adrenaline'.
- **(c)(ii)** A common misconception is to think that auxin causes faster cell growth but it does not, it stimulates cell elongation. It is this which causes the stem to bend. Few candidates stated that auxin produced in the tip moves down the stem (to the lower side). Those that thought this question was about phototropism may not have been awarded marking point 2 if they wrote that the auxin moves to the shaded side of the stem.
- **(d)** Many candidates did not fully explain the advantages of gravitropism to plants. Many described how plants need light for photosynthesis, but they couldn't name other advantages such as the shoot needing to grow upwards to gain carbon dioxide or the roots growing downwards to get water.

# Question 5

## Example Candidate Response – high

5 (a) Fig. 5.1 shows the female reproductive system.

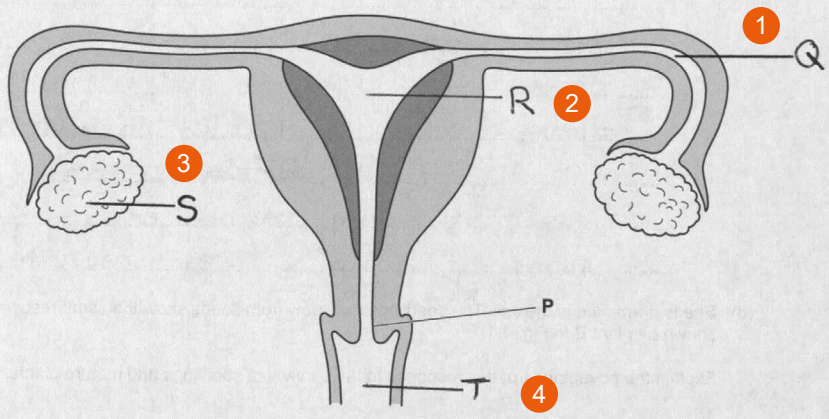



Fig. 5.1

Label Fig. 5.1 using the letters listed to show the position of the organs that are identified by their functions.

The first one (**P**) has been completed for you.

P site of secretion of mucus

Q site of fertilisation

R site of implantation

S site of oestrogen secretion

T site where sperm are deposited during sexual intercourse

[4]

(b) Fig. 5.2 shows a section through an egg cell at the time of ovulation.

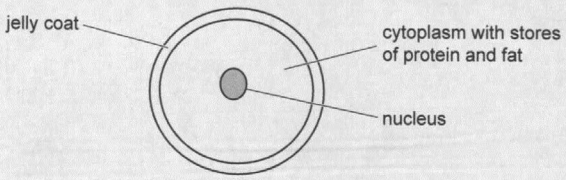



Fig. 5.2

## Examiner comments

1 The candidate correctly labels the oviduct as Q (the site of fertilisation).

2 The candidate incorrectly labels the inside of the uterus as R. The site of fertilisation should be on the endometrium.

3 The candidate correctly labels the ovary as S (the site of oestrogen secretion).

4 The candidate correctly labels the vagina as T (the site where sperm are deposited during sexual intercourse).

Mark for (a) = 3 out of 4

## Example Candidate Response – high, continued

(i) Explain why the egg cell contains stores of protein and fat.

*After fertilization, egg zygote can use these stores of energy 5 & nutrients for mitosis 6 * Also Once embryo develops, stores can be used to provide nutrients for growth and further mitosis 7 ↳Fat also provides insulation for embyro 8 [3]

(ii) Describe the function of the jelly coat.

-It lets one sperm cell in to fertilize the egg (digested by acroseme in sperm) -It then forms a protective coat that prevents other sperms from fertilizing the egg 9 [2]

(c) Fertilisation results in the formation of a zygote.

Describe how an embryo is formed from a zygote.

~~Zygote~~ -Zygote is formed by fertilization in oviduct -It then begins to divide 10 by mitosis 11 as it moves through oviduct - The bundle of cells 12 also use stem cells 13 for this mitosis - It finally becomes an embryo and implants itself in the uterus ↳ here it continues to grow and develop organs until it is a fetus 14 [4]

[Total: 13]

## Examiner comments

5 The candidate recognises that fat is a store of energy which is marking point 5.

6 The energy is used for mitosis which is marking point 6.

7 The question refers to why the egg cell contains stores of protein and fat. The candidate refers to the development of the embryo which answers the question.

8 The candidate refers to a use of fat in a fetus, not an egg cell which does not answer the question.

Mark for (b)(i) = 2 out of 3

9 This is marking point 2, however, the candidate does not include that the jelly coat changes or hardens to prevent more than one sperm entering the egg cell.

Mark for (b)(ii) = 1 out of 2

10 The zygote dividing is marking point 4.

11 The candidate's reference to mitosis is marking point 3.

12 The candidate's reference to a bundle of cells is marking point 6.

13 The candidate's reference to stem cells is marking point 8.

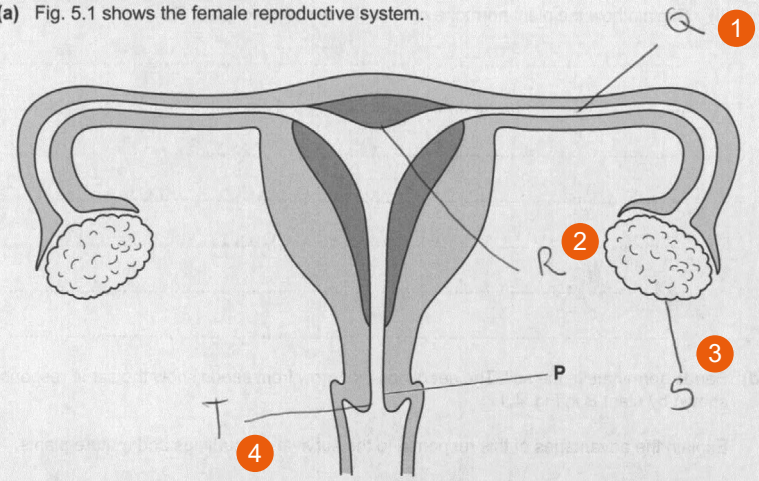
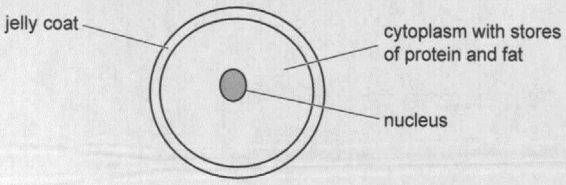
14 The candidate does not need to refer to the development of organs to become a fetus. This information does not answer the question.

Mark for (c) = 4 out of 4

**Total mark awarded = 10 out of 13**

## How the candidate could have improved their answer

- **(a)** The candidate needed to label the site of implantation (R) on the lining of the uterus (endometrium), rather than the centre of the uterus.
- **(b)(i)** The candidate referred to the use of proteins and fat in an embryo, rather than an egg cell but this did not answer the question. The candidate needed to explain one further cellular use of fat or protein, such as making membranes or enzymes.
- **(b)(ii)** The candidate stated that a protective coat forms after fertilisation. However, this was not enough detail to be awarded marking point 1. They needed to add that the jelly coat changes or hardens.
- **(c)** The candidate was awarded all four marks for this question. However, the final part of their answer referred to the development of organs which was irrelevant and did not answer the question so this was ignored.

| Example Candidate Response – middle | Examiner comments |
|---|---|
| 5 (a) Fig. 5.1 shows the female reproductive system.<br>  <br><br>Fig. 5.1<br>Label Fig. 5.1 using the letters listed to show the position of the organs that are identified by their functions.<br>The first one (**P**) has been completed for you.<br>**P** site of secretion of mucus<br>**Q** site of fertilisation<br>**R** site of implantation<br>**S** site of oestrogen secretion<br>**T** site where sperm are deposited during sexual intercourse<br>[4]<br>(b) Fig. 5.2 shows a section through an egg cell at the time of ovulation.<br>  <br><br>Fig. 5.2 | 1 The candidate correctly labels the oviduct as Q (site of fertilisation).<br>2 The canddiate correctly labels the endometrium as R (site of implantation).<br>3 The candidate correctly labels the ovary as S (site of oestrogen secretion).<br>4 The candidate incorrectly labels T (site where sperm are deposited). They need to label the vagina, not on the cervix.<br>Mark for (a) = 3 out of 4 |

## Example Candidate Response – middle, continued

(i) Explain why the egg cell contains stores of protein and fat.

Fats is a nutrient that will provide energy (5) and "insulation" to the egg cell as it will need it to "fight" against other Sperms that ~~the~~ try to enter the egg. Protein, (6) will allow the plant to grow, allows any cell tissue to be repaired and also (7) provides energy to the egg cell. [3]

(ii) Describe the function of the jelly coat.

The jelly coat provides a moist environment for the sperm cells to be able to swim into the the egg cell, it also protects the cell, apart from the zona pellucida, (from) and allows substances to dissolve. (8) [2]

(c) Fertilisation results in the formation of a zygote.

Describe how an embryo is formed from a zygote.

The fusion of a female gamete and a male gamete result in the zygote. Once the zygote is formed, the cell will start (9) multiplying by (mitosis) into eight balls of (10) (11) cells which will eventually form the embryo. During cell division the embryo will be growing (12) and developing, however, (after all) before all ~~the~~ this process, millions of sperm cells enter the cervix, go through the vagina, where some (of) die, and swim to the oviduct were fertilisation occurs. (13) [4]

[Total: 13]

## Examiner comments

(5) Fat as a source of energy is marking point 5.

(6) The candidate makes an incorrect point. Fat does not insulate the egg cell and it does not fight additional sperm cells that try to enter the egg.

(7) The candidate's point about protein for growth and repair is ignored because it is too vague. The question asks for specific uses of fat and protein in the cell, such as 'for making enzymes'.

Mark for (b)(i) = 1 out of 3

(8) The candidate does not give a correct function of the jelly coat.

Mark for (b)(ii) = 0 out of 2

(9) The candidate's point about the cell multiplying is ignored.

(10) The candidate's reference to mitosis is marking point 5.

(11) The candidate refers to balls of cells, which is marking point 6, but they incorrectly state that there are 8 balls of cells so they cannot be awarded marking point 6.

(12) The candidate's reference to cell division is marking point 4.

(13) The final part of the candidate's answer describes how fertilisation occurs. The question asks about events post fertilisation, so this does not answer the question.

Mark for (c) = 2 out of 4

**Total mark awarded = 6 out of 13**

## How the candidate could have improved their answer

- **(a)** The candidate needed to label 'T' correctly on the vagina, not on the cervix. The candidate's label was too high.
- **(b)(i)** The candidate recalled that fat is used as a source of energy and proteins are used for growth and repair, however, this did not answer the question. The candidate needed to use this knowledge to give examples of how the source of energy could be used (for example, in mitosis) or how the protein could be used for growth (for example, to make membrane structures or enzymes).
- **(b)(ii)** The candidate needed to write a correct function of the jelly coat. For example, they should have described how the jelly coat hardens after fertilisation to prevent other sperm entering.
- **(c)** The candidate gave some information which did not answer the question. They referred to the process of fertilisation which occurs before a zygote is formed but this was ignored. Instead, the candidate needed to give more detail to describe how the embryo was formed from the zygote, for example, they could have described how the chromosomes duplicate before separating.

| Example Candidate Response – low | Examiner comments |
|---|---|

5 (a) Fig. 5.1 shows the female reproductive system.

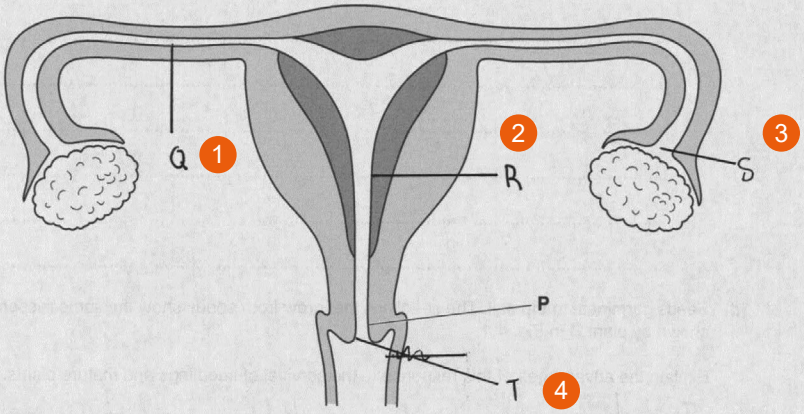



Fig. 5.1

Label Fig. 5.1 using the letters listed to show the position of the organs that are identified by their functions.

The first one (**P**) has been completed for you.

**P** site of secretion of mucus

**Q** site of fertilisation

**R** site of implantation

**S** site of oestrogen secretion

**T** site where sperm are deposited during sexual intercourse

[4]

(b) Fig. 5.2 shows a section through an egg cell at the time of ovulation.

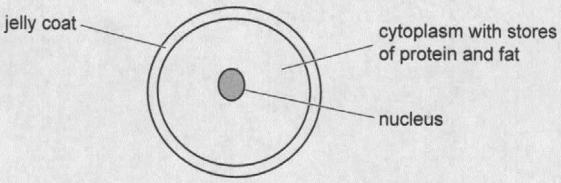



Fig. 5.2

1 The candidate correctly labels R on the endometrium.

2 The candidate correctly labels Q on the oviduct.

3 The candidate incorrectly labels S. It should be labelled on the ovary, not on the oviduct.

4 The candidate incorrectly labels T. It should be in the vagina below, not on the cervix.

Mark for (a) = 2 out of 4

| Example Candidate Response – low, continued | Examiner comments |
|---|---|
| (i) Explain why the egg cell contains stores of protein and fat.<br>The egg cell contains protein and fat so that the sperm cell fertilises the egg cell and begins to develop before implantation in the uterus it uses that protein and fat. 5<br>[3] | 5 The candidate needs to describe some uses of protein and fat. They refer to development after fertilisation but need to give specific detail on the uses of proteins or fats.<br>Mark for (b)(i) = 0 out of 3 |
| (ii) Describe the function of the jelly coat.<br>The jelly coat is to protect the egg cell and the cytoplasm 6<br>[2] | 6 The candidate describes an incorrect function. The jelly coat does not protect the egg cell.<br>Mark for (b)(ii) = 0 out of 2 |
| (c) Fertilisation results in the formation of a zygote.<br>Describe how an embryo is formed from a zygote.<br>As the zygote travels through the fallopian tube to the uterus the chromosomes from the egg cell nucleus and the sperm cell start to combine and the zygote then implants on the uterus lining and then starts to use that nutrients and the information from the the chromosome to develope the embryo 7<br>[4] | 7 The candidate describes how the zygote reaches the uterus, but needs to describe how the zygote becomes an embryo.<br>Mark for (c) = 0 out of 4<br><br>**Total mark awarded = 2 out of 13** |

## How the candidate could have improved their answer

- **(a)** The candidate needed to label S and T correctly. They needed to label S on the ovary, not on the oviduct and T on the vagina, not on the cervix.
- **(b)(i)** The candidate needed to describe some uses of protein and fat in the egg cell. They could have described how fats are a source of energy for cell division and proteins are used to make enzymes and how both are used to make cellular membranes.
- **(b)(ii)** The candidate needed to give a correct function of the jelly coat. They should have described how the jelly coat hardens after fertilisation to prevent other sperm from entering the cell.
- **(c)** The candidate should have described the cellular process that occur to develop a zygote into an embryo. This process begins with the duplication and then separation of chromosomes before mitosis occurs and the zygote divides repeatedly into a ball of genetically identical cells known as the embryo.

## Common mistakes candidates made in this question

- **(a)** Many candidates labelled T on the cervix, rather than in the vagina and some labelled the inside of the uterus as R, rather than the endometrium.
- **(b)(i)** Many candidates referred to the use of fat and protein in an embryo or fetus rather than an egg cell and gave answers such as fat being used for insulation but this did not answer the question. The most common answer was the idea that fat is a store of energy which can be used in mitosis. However, few described other uses of fat or protein. Some candidates mistakenly thought that energy is needed for the egg cell to move and some referred to protein being used for growth into a zygote but this was ignored.

- **(b)(ii)** Many candidates knew that the jelly coat only allows one sperm to enter the egg cell for fertilisation. However, few described how the jelly coat hardens after fertilisation to make the coat impenetrable to more sperm cells. A common mistake was to state that the jelly coat protects the egg cell but this was ignored.
- **(c)** Many candidates correctly referred to repeated cell division by mitosis resulting in the formation of a ball of cells. However, few gave a complete answer and also described how chromosomes duplicate and then separate during mitosis. Some candidates confused the terms zygote, embryo and fetus and others described events that occur after the embryo has formed and develops into a fetus, such as the development of organs and a placenta which did not answer the question. Many candidates simply referred to growth with no detail on the process of cell division.

# Question 6

## Example Candidate Response – high

6 (a) Antibodies are proteins that are produced by lymphocytes. Antitoxins are antibodies which neutralise the toxins released by some bacteria.

The transmissible disease diphtheria is caused by a bacterium that releases a toxin that can cause serious damage to the body.

A person is suspected of having caught diphtheria.

At a clinic, the person is given an injection of antitoxin antibodies that provide protection against the diphtheria toxin. She is also given an injection of the vaccine for diphtheria.

A few weeks later she is given a second injection of the diphtheria vaccine.

Fig. 6.1 shows the changes in concentration of the antitoxin antibodies and the antibodies produced in response to the vaccine.

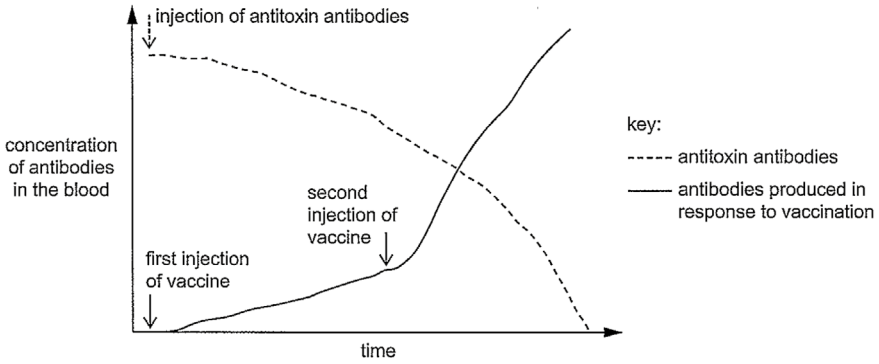



**Fig. 6.1**

(i) Explain the advantage of giving the person an injection of antitoxin antibodies.

The person immediately has antibodies and doesn't need to wait for the lymphocyte to recognise the pathogen, produce a big enough clone and antibodies. The injection of antibodies quickly stop the toxin ~~from~~ from spreading ~~for~~ and cause harm. 1 [2]

## Examiner comments

1 The idea that there is immediate protection is marking point 2.

Mark for (a)(i) = 1 out of 2

## Example Candidate Response – high, continued

**(ii)** Explain how the two injections of the vaccine result in better protection against diphtheria than the injection of antitoxin antibodies.

Vaccines are a weakened or dead virus or bacteria however they have the same antigens but can't cause harm. Lymphocytes have time to make antibodies and a big enough clone. Some are kept as memory cells so if the real infection comes, your body is waiting for it prepared and can kill it before it does any damage. This gives you active immunity. Injection of antibodies only gives you passive immunity and if you get that virus again, it will be acted upon as a first time one, causing damage. [3]

**(b)** Explain how antibodies protect the body against pathogens.

Antibodies release enzymes which kills it pathogens. Antibodies also attach onto the antigens of pathogens preventing them from moving and spreading, reproducing and causing harm, it kills the pathogen → which produce chemicals which harm the pathogen and eventually

[4]

**(c)** Antibodies can travel through the body in the lymphatic system.

State **two** functions of the lymphatic system **other than** defence against disease.

1 Carries tissue fluid and bring it back to the blood in the subclavian vein.

2 ~~Carries white blood cells and then (it is the immediate environment of all cells and helps to keep it constant.~~ Carries white blood cells and new ones are made in nodes in the lymphatic system

[2]

[Total: 11]

## Examiner comments

2 Production of memory cells is marking point 2.

3 The candidate describes how the two vaccinations reduce the chance of damage if the patient is infected, which is marking point 5.

4 The candidate recognises that this vaccination offers active immunity which fulfills marking point 1.

Mark for (a)(ii) = 3 out of 3

5 The candidate gives some incorrect information. Antibodies do not release enzymes.

6 The candidate correctly recalls that pathogens have antigens and that the antibodies attach onto the antigens. This is marking point 1 and 2.

7 The candidate describes how the antigens stop the pathogens from moving. This is a valid point and is marking point 7.

8 The antibody killing the pathogen is marking point 6.

Mark for (b) = 4 out of 4

9 The return of fluid to the blood is correct and the candidate is awarded one mark.

10 The question asks about functions other than defence against disease. The candidate's second function describes white blood cells, which is part of defence against disease so they cannot be awarded any marks for this answer.

Mark for (c) = 1 out of 2

**Total mark awarded = 9 out of 11**

## How the candidate could have improved their answer

- **(a)(i)** The candidate understood that there was immediate protection and a quick response. However, they also needed to name this type of response as 'passive immunity' to be awarded the second mark.
- **(b)** The candidate was awarded full marks for this question, however, they could have added further descriptions of how the antibody kills the pathogen. For example, by marking the pathogen for phagocytosis or directly causing the cell walls to burst. The antibodies do not have enzymes, so this statement was not awarded any marks.
- **(c)** The candidate gave one correct function of the lymphatic system. The second function did not answer the question, as the question asked candidates to state a function other than defence against disease. Another function of the lymphatic system that could have been given was transport of fat from the lacteals.

## Example Candidate Response – middle

**6 (a)** Antibodies are proteins that are produced by lymphocytes. Antitoxins are antibodies which neutralise the toxins released by some bacteria.

The transmissible disease diphtheria is caused by a bacterium that releases a toxin that can cause serious damage to the body.

A person is suspected of having caught diphtheria.

At a clinic, the person is given an injection of antitoxin antibodies that provide protection against the diphtheria toxin. She is also given an injection of the vaccine for diphtheria.

A few weeks later she is given a second injection of the diphtheria vaccine.

Fig. 6.1 shows the changes in concentration of the antitoxin antibodies and the antibodies produced in response to the vaccine.

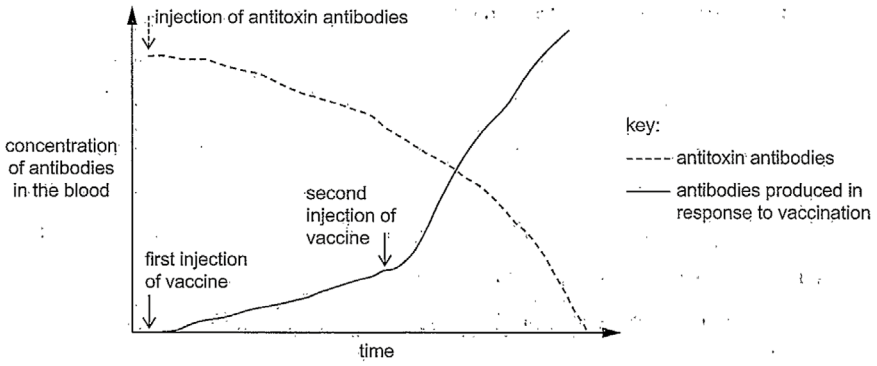



Fig. 6.1

**(i)** Explain the advantage of giving the person an injection of antitoxin antibodies.

It helps provide protection against the toxin whilst the body fights infection and begins making antibodies. 1

[2]

## Examiner comments

1 The candidate states that the injection of antibodies gives time for the immune system to produce its own antibodies. This is a valid point and is marking point 3.

Mark for (a)(i) = 1 out of 2

## Example Candidate Response – middle, continued

(ii) Explain how the two injections of the vaccine result in better protection against diphtheria than the injection of antitoxin antibodies.

It helps the bodie's immune system fight the disease and get rid of it 2 quicker. It increases the number/rate of production of antibodies which 3 fight against the disease and which remain in the blood after the disease is 4 gone therefore helping to defeat the ~~disease~~ disease once enters it again in the body. [3] 5

(b) Explain how antibodies protect the body against pathogens.

Pathogens have specific antigens on their surface 6 B & T cells work together in creating antibodies which is specific for each pathogen. Once they're made they bind to the antigens to dissable 7 8 the cells. Memory cells keep a 'memory' of the antibodies so if this pathogen enters again, it can produce the required antibodies quickly & easily. 9 [4]

(c) Antibodies can travel through the body in the lymphatic system.

State **two** functions of the lymphatic system **other than** defence against disease.

1 transportation of fats 10

2 helping maintain homestasis in the lacteal. 11 (transportation of waste & required substances in fluid) [2]

[Total: 11]

## Examiner comments

2 The immune system does not *fight* the disease so this statement is ignored.

3 The candidate recognises that the number of antibodies is increased with vaccination, however, they do not compare this to the injection of antibodies. For marking point 4, the candidate needs to say that the two vaccines result in a higher concentration of antibodies than the injection of antibodies.

4 The candidate states that the antibodies remain in the blood, rather than memory cells.

5 This is the idea that through vaccination the immune system is able to get rid of the pathogens if they enter the body. The candidate gives enough enough detail for marking point 5 here.

Mark for (a)(ii) = 1 out of 3

6 The candidate explains how the antigens on pathogens are specific which is marking point 1 and 3.

7 The binding of antibodies to antigens is marking point 2.

8 'Disabling the cells' is not enough for marking points 6 or 7. The candidate needs to say that the antibodies kill or immobilise the pathogen.

9 The candidate's description of memory cells and their action is correct, but this does not answer the question.

Mark for (b) = 3 out of 4

10 The candidate gives a correct answer.

11 The candidate's second function is not correct.

Mark for (c) = 1 out of 2

**Total mark awarded = 6 out of 11**

## How the candidate could have improved their answer

- **(a)(i)** To improve their answer, the candidate needed to include that the injected antibodies gave immediate protection and state that this was a type of passive immunity.
- **(a)(ii)** The candidate needed to compare the double vaccination to the injection of antitoxin antibodies. They stated that the antibodies were increased by vaccination, but needed to compare this to the lower rate from injections of antibodies. Another comparison could have been the production of memory cells and long-term immunity with vaccination, against no memory cells and short-term immunity through injection of antibodies. They also needed to recognise that vaccination provides active immunity (compared to passive immunity through antibody injections).
- **(b)** The candidate was nearly awarded full marks for this answer, but to improve it further, they could have explained how the antibody directly kills the pathogen, for example by lysis of the cells, or indirectly by marking the pathogen for phagocytosis. The candidate discussed the role of memory cells. However, this did not answer the question.
- **(c)** The candidate needed to give the drainage of tissue fluid as a second function of the lymphatic system.

## Example Candidate Response – low

**6 (a)** Antibodies are proteins that are produced by lymphocytes. Antitoxins are antibodies which neutralise the toxins released by some bacteria.

The transmissible disease diphtheria is caused by a bacterium that releases a toxin that can cause serious damage to the body.

A person is suspected of having caught diphtheria.

At a clinic, the person is given an injection of antitoxin antibodies that provide protection against the diphtheria toxin. She is also given an injection of the vaccine for diphtheria.

A few weeks later she is given a second injection of the diphtheria vaccine.

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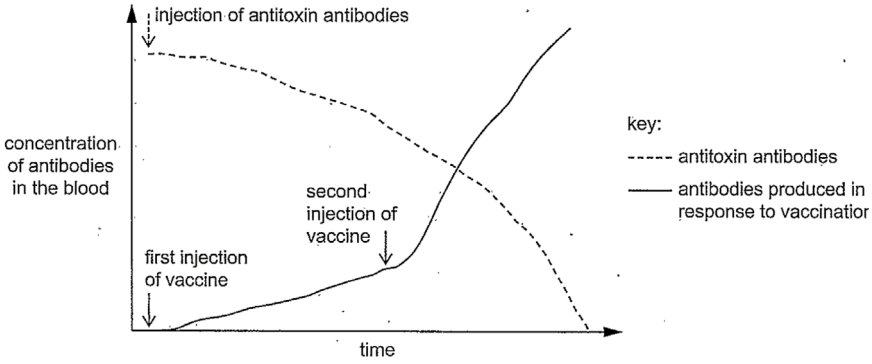


Fig. 6.1

**(i)** Explain the advantage of giving the person an injection of antitoxin antibodies.

o Serious demages to the body will be prevented. 1

o There will be more antibodes produced by the vaccine to prevent the diphtheria 2

o Active ~~immu~~ immunite will be created and memory cells. [2]

## Examiner comments

1 The candidate needs to explain that serious damage is prevented because the response is fast.

2 The candidate describes active immunity and creation of memory cells through vaccination, rather than passive immunity by antibody injection.

Mark for (a)(i) = 0 out of 2

## Example Candidate Response – low, continued

(ii) Explain how the two injections of the vaccine result in better protection against diphtheria than the injection of antitoxin antibodies.

The injection of antitoxin antibodies is effective at first but it's effect starts decreasing over time as well as the concentration of antibodies in the blood. However, by taking two injections of the vaccine, the concentration of antibodies in the blood is low at first but starts gradually increasing over time. 3 [3]

(b) Explain how antibodies protect the body against pathogens.

Lymocytes produce antibodies when a foreign antigen enters the body. 4 As the anti pathogens moie along the bloodstream, of lymphocytes multiply and produce several 5 antibodies. This antibodies will then attach themselves onto the antigens of the phatogen and destroy it. The phatogen will 6 then later be digested by enzymes in the phagocytes. 7 [4]

(c) Antibodies can travel through the body in the lymphatic system.

State **two** functions of the lymphatic system **other than** defence against disease.

1 Fluid balance 8

2 Absorption of fat 9

[2]

## Examiner comments

3 The candidate recognises that the antibodies from injection decrease over time and the antibodies from vaccination increase. However, they need to include that the antibodies through vaccination result in a higher concentration compared to the injection of antibodies.

Mark for (a)(ii) = 0 out of 3

4 This is stated in the question so does not need to be repeated.

5 The candidate repeats the same information.

6 This is marking points 1, 2 and 6. The candidate clearly explains antibody action.

7 This statement is true. However, the candidate also needs to include that the antibodies mark the pathogen (for destruction by phagocytes) so they do not give enough to fulfill marking point 5.

Mark for (b) = 3 out of 4

8 The candidate gives an incorrect answer.

9 The candidate is awarded one mark for this correct answer.

Mark for (c) = 1 out of 2

**Total mark awarded = 4 out of 11**

## How the candidate could have improved their answer

- **(a)(i)** The candidate confused passive and active immunity. To improve their answer, they should have recognised that the antitoxin antibody injection gives passive immunity, which gives immediate protection against the diphtheria toxins.
- **(a)(ii)** The candidate could have improved their answer through a better comparison of vaccination compared to antitoxin antibody injection. For example, they could have said that vaccination produces long-term, active immunity through production of memory cells, compared to short-term, passive immunity with no memory cells for antibody injection. The candidate compared the trend in antibodies but did not state that the antibodies after double vaccination are at a higher concentration compared to the antibodies from injection.
- **(b)** The candidate began their answer by restating information given in the question but this could not be awarded any marks. The candidate was able to describe antibody action and was awarded three marks for this. The candidate recalled that phagocytes destroy pathogens also but needed to link this to antibody action. To improve their answer, they needed to explain how the antibodies mark the pathogens for phagocytosis.
- **(c)** To improve their answer, the candidate could have given a second correct function of the lymphatic system, such as returning fluid to the blood.

## Common mistakes candidates made in this question

- **(a)(i)** Many candidates were not able to name this type of immunity as passive immunity. Some confused active and passive immunity and discussed the formation of memory cells. Other candidates state that the toxins were removed or neutralised, however, this information was already given in the question so they could not be awarded any marks for this.
- **(a)(ii)** Many candidates did not compare the two injections of vaccine to the injection of antitoxin antibodies. Candidates should have referred to the graph to answer this question. Some stated that high levels of antibodies were created through vaccination, but did not say that the concentration was greater than with antibody injection. Some candidates stated that memory cells were made from antibodies.
- **(b)** Many candidates confused antibody action with phagocytosis. Some candidates stated that antibodies engulf the pathogens, rather than the phagocytes and some candidates also confused the term antigen and thought that the antigens were on the antibody rather than the pathogen. Some candidates stated that antibodies produced enzymes to destroy the pathogen. Many candidates discussed the role of memory cells, however, this did not answer the question.
- **(c)** Many candidates could not recall the functions of the lymphatic system. A common mistake was to state a function relating to immunity. The question asked candidates to state two functions, other than defence against disease. Many candidates gave incorrect answers such as functions relating to the blood, digestion and homeostasis.

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