Example Candidate Responses

Cambridge International AS & A Level

Cambridge International AS and A Level Biology

9700

Paper 2 – AS Level Structured Questions

Cambridge Advanced

CAMBRIDGE International Examinations

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Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge International AS and A Level Biology (9700), 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 to exemplify a range of answers. Each response is accompanied by a brief commentary explaining the strengths and weaknesses of the answers.

For each question, each response is annotated with a clear explanation of where and why marks were awarded or omitted. This, in turn, 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 will have to do to improve their answers. At the end there is a list of common mistakes candidates made in their answers for each question.

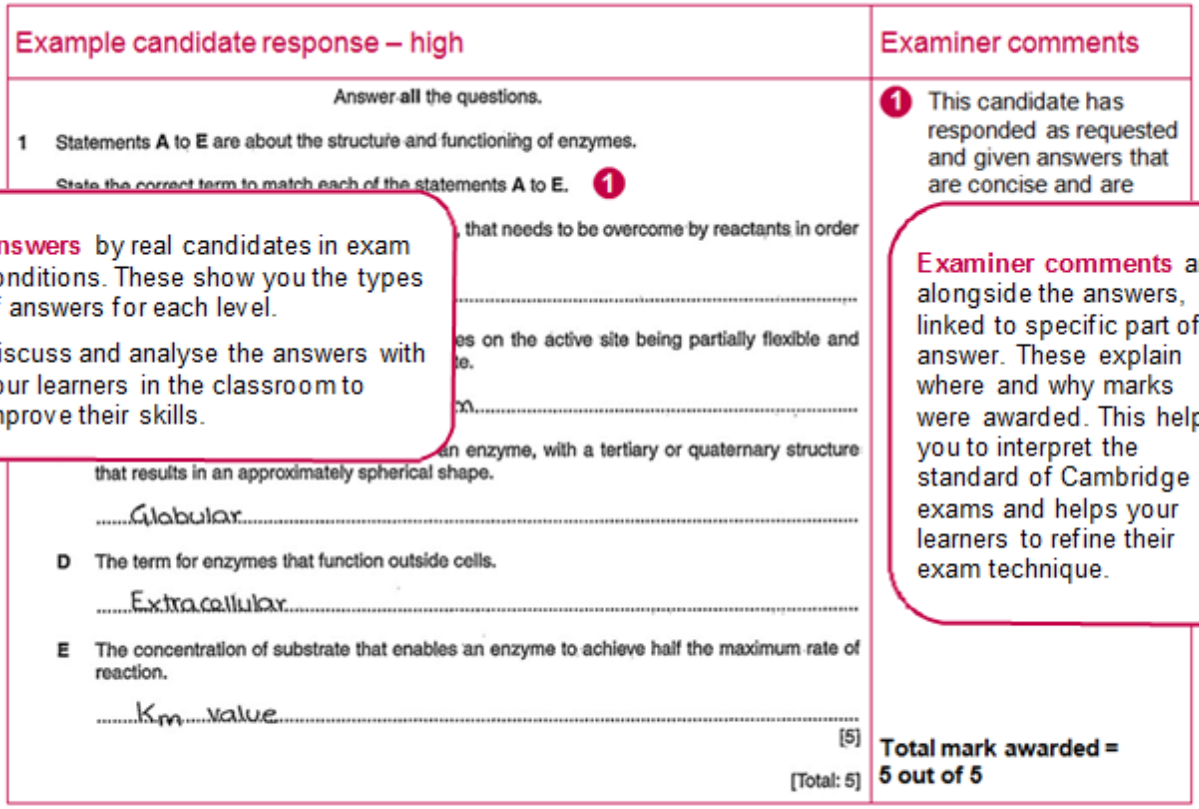
This document provides illustrative examples of candidate work. These help teachers to assess the standard required to achieve marks, beyond the guidance of the mark scheme. Some question types where the answer is clear from the mark scheme, such as short answers and multiple choice, have therefore been omitted.

The questions, mark schemes and pre-release material used here are available to download as a zip file from Teacher Support as the Example Candidate Responses Files. These files are:

Question Paper 22, June 2016	
Question paper	9700_s16_qp_22.pdf
Mark scheme	9700_s16_ms_22.pdf
Question Paper 33, June 2016	
Question paper	9700_s16_qp_33.pdf
Mark scheme	9700_s16_ms_33.pdf
Question Paper 41, June 2016	
Question paper	9700_s16_qp_41.pdf
Mark scheme	9700_s16_ms_41.pdf
Question Paper 52, June 2016	
Question paper	9700_s16_qp_52.pdf
Mark scheme	9700_s16_ms_52.pdf

Past papers, Examiner Reports and other teacher support materials are available on Teacher Support at **https://teachers.cie.org.uk**

How to use this booklet



Example candidate response – high	Examiner comments
Answer **all** the questions. 1 Statements **A** to **E** are about the structure and functioning of enzymes. State the correct term to match each of the statements **A** to **E**. 1 , that needs to be overcome by reactants in order ..... es on the active site being partially flexible and te. on..... an enzyme, with a tertiary or quaternary structure that results in an approximately spherical shape. .....Globular..... **D** The term for enzymes that function outside cells. .....Extracellular..... **E** The concentration of substrate that enables an enzyme to achieve half the maximum rate of reaction. .....Km value..... [5] [Total: 5]	1 This candidate has responded as requested and given answers that are concise and are **Total mark awarded = 5 out of 5**

Answers 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, linked to specific part of the answer. These explain where and why marks were awarded. This helps you to interpret the standard of Cambridge exams and helps your learners to refine their exam technique.

How the candidate could have improved their answer

Stating for **E** the 'Michaelis-Menten constant' wou
However, knowledge that this is also referred to a
was able to gain full marks.

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

Common mistakes candidates made in this question

A. Some candidates only gave the term 'activation'
strictly correct it was allowed.

B. Some candidates gave a mixture of terms, such
'induced substrate', 'lock and key fit'. The examiner

C. Named globular proteins were incorrectly given as a response. Of these, 'haemoglobin' was most commonly seen. The spellings of 'globular' were not always correct.

This lists the common mistakes candidates made in answering each question. This will help your learners to avoid these mistakes at the exam and give them the best chance of achieving a high mark.

Assessment at a glance

Candidates for Advanced Subsidiary (AS) certification take Papers 1, 2 and 3 (either Advanced Practical Skills 1 or Advanced Practical Skills 2) in a single examination series.

Candidates who, having received AS certification, wish to continue their studies to the full Advanced Level qualification may carry their AS marks forward and take Papers 4 and 5 in the examination series in which they require certification.

Candidates taking the full Advanced Level qualification at the end of the course take all five papers in a single examination series.

Candidates may only enter for the papers in the combinations indicated above.

Candidates may not enter for single papers either on the first occasion or for resit purposes.

All components will be externally assessed.

Component	Weighting	
	AS Level	A Level
Paper 1 Multiple Choice **1 hour** This paper consists of 40 multiple choice questions, all with four options. All questions will be based on the AS Level syllabus content. Candidates will answer all questions. Candidates will answer on an answer sheet. [40 marks]	31%	15.5%
Paper 2 AS Level Structured Questions **1 hour 15 minutes** This paper consists of a variable number of questions, of variable mark value. All questions will be based on the AS Level syllabus content. Candidates will answer all questions. Candidates will answer on the question paper. [60 marks]	46%	23%
Paper 3 Advanced Practical Skills **2 hours** This paper requires candidates to carry out practical work in timed conditions. This paper will consist of two or three experiments drawn from different areas of the AS Level syllabus. Candidates will answer all questions. Candidates will answer on the question paper. [40 marks]	23%	11.5%
Paper 4 A Level Structured Questions **2 hours** This paper consists of a variable number of structured questions each with a variable mark value (Section A) and a choice of one free response style question worth 15 marks (Section B). All questions will be based on the A Level syllabus but may require knowledge of material first encountered in the AS Level syllabus. Candidates will answer on the question paper. [100 marks]	–	38.5%
Paper 5 Planning, Analysis and Evaluation **1 hour 15 minutes** This paper consists of a variable number of questions of variable mark value based on the practical skills of planning, analysis and evaluation. Candidates will answer on the question paper. [30 marks]	–	11.5%

Teachers are reminded that the latest syllabus is available on our public website at **www.cie.org.uk** and Teacher Support at **https://teachers.cie.org.uk**

Paper 2 – AS Level structured questions

Question 1

Example candidate response – high	Examiner comments
Answer **all** the questions. 1 Statements **A** to **E** are about the structure and functioning of enzymes. State the correct term to match each of the statements **A** to **E.** 1 **A** The energy level, lowered by enzyme action, that needs to be overcome by reactants in order for products to be formed. .....Activation Energy..... **B** The mechanism of enzyme action that relies on the active site being partially flexible and changing shape in order to bind the substrate. .....Induced fit mechanism..... **C** The term to describe a protein, such as an enzyme, with a tertiary or quaternary structure that results in an approximately spherical shape. .....Globular..... **D** The term for enzymes that function outside cells. .....Extracellular..... **E** The concentration of substrate that enables an enzyme to achieve half the maximum rate of reaction. .....Km value..... [5] [Total: 5]	1 This candidate responds appropriately and gives answers that are concise and contain correct scientific terms. **Total marks awarded = 5 out of 5**

How the candidate could have improved their answer

E. Giving the 'Michaelis–Menten constant' would have demonstrated knowledge of the correct term to use here. However, knowledge that this is also referred to as the 'K_m value' was also creditworthy, so the candidate was able to gain full marks.

Example candidate response – middle	Examiner comments
Answer **all** the questions. 1 Statements **A** to **E** are about the structure and functioning of enzymes. State the correct term to match each of the statements **A** to **E**. **A** The energy level, lowered by enzyme action, that needs to be overcome by reactants in order for products to be formed. Activation Energy. **B** The mechanism of enzyme action that relies on the active site being partially flexible and changing shape in order to bind the substrate. Induce fit mechanism. **C** The term to describe a protein, such as an enzyme, with a tertiary or quaternary structure that results in an approximately spherical shape. Globular **D** The term for enzymes that function outside cells. 1 extrinsic protein ~~exocytosis~~ **E** The concentration of substrate that enables an enzyme to achieve half the maximum rate of reaction. enzyme inhibition [5] [Total: 5]	1 Although neither **D** nor **E** is correct here, it is good practice to cross out an incorrect answer clearly, leaving only the answer that should be marked. **Total marks awarded = 3 out of 5**

How the candidate could have improved their answer

A. The term ‘energy’ in ‘activation energy’ does not have an uppercase (capital) *E*. This is only a minor point.

B. The candidate wrote ‘induce fit’, which was accepted; however, the correct term is ‘induced fit (mechanism)’.

The correct terms required are stated in the syllabus: 'extracellular' (**D**) and 'Michaelis–Menten constant' (**E**), so greater familiarity with these terms would have helped this candidate.

Example candidate response – low

Answer **all** the questions.

1 Statements **A** to **E** are about the structure and functioning of enzymes.

State the correct term to match each of the statements **A** to **E**.

A The energy level, lowered by enzyme action, that needs to be overcome by reactants in order for products to be formed.

Ea activition energy) 1

B The mechanism of enzyme action that relies on the active site being partially flexible and changing shape in order to bind the substrate.

Induced fit.

C The term to describe a protein, such as an enzyme, with a tertiary or quaternary structure that results in an approximately spherical shape.

haemoglobin 2

D The term for enzymes that function outside cells.

~~Active~~ Active site 3

E The concentration of substrate that enables an enzyme to achieve half the maximum rate of reaction.

~~$\frac{1}{2}$~~ $\frac{1}{2}$ Km (mechnis ~~reactions~~ maintain maxium) 4

[5]

[Total: 5]

Examiner comments

1 It is good that the candidate qualifies 'Ea' with the full term, as it is that term, given in brackets, that gains credit here.

2 The candidate gives an example of a protein with tertiary and quaternary structure rather than the term to describe a protein that has an approximately spherical shape.

3 The 'active site' is a term used to describe a particular part of the enzyme molecule where catalysis occurs, so does not match the description.

4 The candidate has some recollection of this area of the syllabus but has confused terms. The first answer only was considered and is incorrect.

Total marks awarded = 2 out of 5

How the candidate could have improved their answer

A. Here 'activation energy' was incorrectly spelled as '*activition* energy'.

C. It would have helped if the difference between 'the term to describe' and 'the name of . . .' had been better understood. 'Globular' was the required answer but an example of a globular protein was given.

E. The term given in brackets by the candidate was too different from the 'Michaelis–Menten constant' to be creditworthy. Candidates should try to learn the correct spellings of scientific terms.

Common mistakes candidates made in this question

A. Some candidates only gave the term ‘activation’ instead of ‘activation energy’. Although this was not strictly correct, it was allowed.

B. Some candidates gave a mixture of terms, such as ‘induced key’, ‘induced fit key’, ‘induced lock and key’, ‘induced substrate’, ‘lock and key fit’. The examiners were looking only for ‘induced fit’.

C. Examples of globular proteins were incorrectly given in response to this question. Of these, ‘haemoglobin’ was most commonly seen. The spelling of ‘globular’ was not always correct.

D. Terms with the prefix ‘ex’ were given, such as ‘extrinsic’, ‘external cellular’, ‘exocellular’ and ‘exocytosis’. ‘Catalysts’ was also given as an incorrect response.

E. Some candidates were not able to get close enough to the correct spelling of ‘Michaelis–Menten’. ‘V_{max}’, which is a different term, was also given. Some candidates gave ½ V_{max}, but this is a stage in deriving K_m. Some candidates also misinterpreted the statement as inhibition, so this term along with ‘competitive inhibition’ and ‘non-competitive inhibition’ were given.

Question 2

Example candidate response – high

2 Marram grass, *Ammophila arenaria*, is an important plant of sand dunes. Leaves of marram grass are well adapted to reduce water loss by transpiration.

Fig. 2.1 is a photomicrograph of a section though the leaf of marram grass.

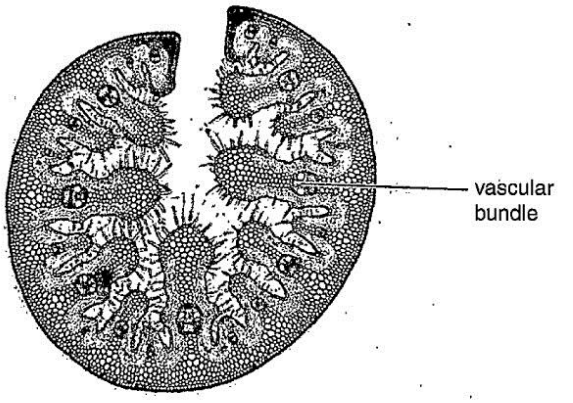


Fig. 2.1

(a) Examples of adaptations to reduce water loss by transpiration include a thick cuticle and no stomata on the outer surface, and stomata in pits on the inner surface.

(i) State **one** other adaptation, visible in Fig. 2.1, which reduces water loss by transpiration.

Hairs on inner surface (trichomes) 1 [1]

(ii) Explain how this adaptation reduces water loss.

Water vapour leaving stomata is trapped by these hairs making the area outside of stomata very humid, steepness of water potential gradient is reduced and rate of 2 diffusion of water vapour from insite leafs to outside is reduced

[2]

(b) State the term used to describe a plant type that has adaptations to reduce water loss by transpiration.

Xeraphyte 3 [1]

[Total: 4]

Examiner comments

1 An acceptable description of an adaptation that is visible.

Mark for (a)(i) = 1/1

21 The adaptation from (i) is used to explain correctly how water loss is reduced. The candidate gives a logical account that includes a reason for the reduced water potential gradient.

Mark for (a)(ii) = 2/2

3 The correct term is used and is spelt correctly.

Mark for (b) = 1/1

Total marks awarded = 4 out of 4

How the candidate could have improved their answer

(a) (i) and **(ii)** Although it is acceptable to use the term 'hairs', the more precise term is 'trichomes', so the candidate could have used this to improve their answer.

Mark awarded = **(a) (i) 1/1, (ii) 2/2**
Mark awarded = **(b) 1/1**

Total marks awarded = 4 out of 4

Example candidate response – middle

2 Marram grass, *Ammophila arenaria*, is an important plant of sand dunes. Leaves of marram grass are well adapted to reduce water loss by transpiration.

Fig. 2.1 is a photomicrograph of a section though the leaf of marram grass.

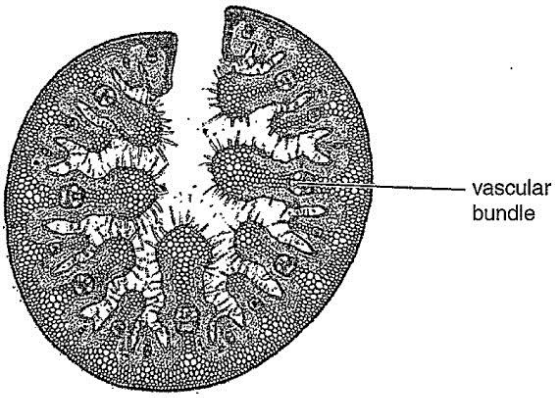


Fig. 2.1

(a) Examples of adaptations to reduce water loss by transpiration include a thick cuticle and no stomata on the outer surface, and stomata in pits on the inner surface.

(i) State **one** other adaptation, visible in Fig. 2.1, which reduces water loss by transpiration.

Hair like structures on the surfaces to reduce water loss. 1 ..... [1]

(ii) Explain how this adaptation reduces water loss.

The ~~hairs~~ structures acts like a barrier 2 between the leaf and outer s areas, they may trap the water there, thus lowering the water potential gradient between inside and outside, so ~~the~~ less water moves outwards.

..... [2]

(b) State the term used to describe a plant type that has adaptations to reduce water loss by transpiration.

Xerophyte ..... [1]

[Total: 4]

Examiner comments

1 The phrase 'to reduce water loss' is not necessary here as it repeats part of the question.

Mark for (a) (i) = 1/1

2 The candidate correctly uses the feature given in **(a) (i)** in their explanation. The term 'barrier' has been ignored as the explanation that follows is sufficient to show understanding of a humid region in the enclosed area. There is correct use of the term 'water potential gradient'.

Mark for (a) (ii) = 1/2

Mark for (b) = 1/1

Total marks awarded = 3 out of 4

How the candidate could have improved their answer

(a) (i) Credit was awarded here, but the trichomes could have been specifically named, instead of 'hair-like structures', and their location could have been more clearly defined as within the enclosed area of the leaf.

(a) (ii) The candidate should have referred to 'water vapour' instead of just 'water'.

Mark awarded = **(a) (i) 1/1, (ii) 1/2**
Mark awarded = **(b) 1/1**

Total marks awarded = 3 out of 4

Example candidate response – low

2 Marram grass, *Ammophila arenaria*, is an important plant of sand dunes. Leaves of marram grass are well adapted to reduce water loss by transpiration.

Fig. 2.1 is a photomicrograph of a section though the leaf of marram grass.

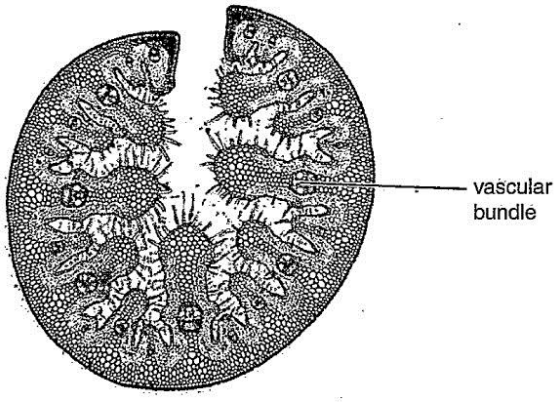


Fig. 2.1

(a) Examples of adaptations to reduce water loss by transpiration include a thick cuticle and no stomata on the outer surface, and stomata in pits on the inner surface.

(i) State **one** other adaptation, visible in Fig. 2.1, which reduces water loss by transpiration.

Waxy Cuticle 1 ..... [1]

(ii) Explain how this adaptation reduces water loss.

The layer of wax on the cuticle is impermeable to 2 water, hence it acts as a barrier that does not allow wa-ter to pass through. This reduce the amount of water that has been lost by the enzyme. 3 ..... [2]

(b) State the term used to describe a plant type that has adaptations to reduce water loss by transpiration.

Xerophyte ..... [1]

[Total: 4]

Examiner comments

1 This answer repeats information already given in the question, which asks for one *other* adaptation.

Mark for (a) (i) = 0/1

2 This explains a feature of leaves in general and is not specific to only this type of leaf, which has a number of adaptations to reduce water loss by transpiration.

3 The reference to 'the enzyme' is confusing and suggests that the candidate has not read through their answer to spot this error.

Mark for (a) (ii) = 0/2

Mark for (b) = 1/1

Total marks awarded = 1 out of 4

How the candidate could have improved their answer

(a) (i) The candidate could have looked at the obvious features of a rolled leaf and trichomes in Fig. 2.1 and observed that these were very different features to leaves that do not have adaptations which reduce water loss. The answer 'waxy cuticle' is a common feature of leaves and not an adaptation which reduces water loss.

(a) (ii) Candidates who had given 'waxy cuticle' as their answer to (a) (i) were allowed to carry the error forward as there were some creditworthy points that could have been made. Here, the candidate could have explained it was a 'thick*er* impermeable' layer and referred to an increased diffusion distance. Also, the term 'water vapour' rather than 'water' should have been used.

Mark awarded = **(a) (i) 0/1, (ii) 0/2**
Mark awarded = **(b) 1/1**

Total marks awarded = 1 out of 4

Common mistakes candidates made in this question

(a) (i) The trichomes were incorrectly termed 'root hairs', 'needles', 'spikes', 'spines' or 'cilia'.
Some candidates gave features that had already been given in the question or just stated 'smaller surface area'.

(a) (ii) The movement of water and water vapour should be explained in terms of water potential, but it was common to see an explanation in terms of concentration, which should be avoided. Some candidates considered differences in water potential, but instead of saying water moves from a higher to a lower water potential, stated that water moves from a high water potential gradient to a low water potential gradient, which is incorrect. Some forgot to state that it was water vapour that left via the stomata and only stated 'water'. Others thought that the trichomes absorbed water rather than being present to create a humid area. Some referred to 'inside the leaf' when in fact they meant the area enclosed by the rolled leaf, which is still external air.

(b) Here the most common mistakes were to term a xerophyte a 'xerotype', 'or 'xenophyte' or to state a type of xerophyte, so that 'cactus' was commonly seen.

Question 3

Example candidate response – high

3 Globally, measles is an important disease that mainly affects children. Many deaths from measles occur in children under five years of age.

Table 3.1 shows the population of six countries in Africa in 2009 and the number of cases of measles per 100 000 people for the four years 2009 to 2012.
All six countries are classified as low-income countries.

Table 3.1

country	population in 2009	number of cases per 100 000 people			
		2009	2010	2011	2012
Central African Republic	4 266 000	0.26	0.05	15.31	3.12
Chad	11 371 000	1.45 165	1.66	71.60	0.96
Eritrea	5 558 000	1.48 82	0.89	0.81	3.16
Ethiopia	84 838 000	1.39 1179	4.86	3.64	4.74
Gambia	1 628 000	0.00	0.12	0.00	0.00
Niger	15 303 000	5.23	2.34	4.67	1.59

(a) (i) The actual number of cases of measles in Chad in 2009 was 165 and in Eritrea was 82.

Calculate the actual number of cases of measles in Ethiopia in 2009.
Show your working.

number of cases = $\frac{1.39}{100\,000} \times 84\,838\,000$

≈ 1179 1

[2]

(ii) Use the data for Chad, Eritrea and Ethiopia to explain the advantages of showing the data in Table 3.1 as number of cases of measles per 100 000 people rather than the actual number of cases.

- Different countries have different population
- Showing data as number of cases of measles per 100 000 people gives a proportion or fraction of the country that is infected with measles. 2
- ~~Using~~ Giving total number of cases is misleading due to different population sizes.
- for instance, Ethiopia has 1179 cases while Eritrea only had 82 cases. However, a larger proportion of Eritrea (1.48 per 100 000 people) is infected as compared to Ethiopia (1.39 per 100 000 people). <Ethiopia has larger population> [3]

Examiner comments

1 The correct calculated value is given and the working is also shown clearly.

Mark for (a) (i) = 2/2

2 The idea of taking population size into account is implied by the statement that different countries have different population sizes. The candidate has supported this clearly with their calculated data from (a) (i) and some data extracted from Table 3.1. The values have been correctly transferred to their response.

Mark for (a) (ii) = 3/3

Example candidate response – high, continued	Examiner comments

Fig. 3.1 shows the percentage of children vaccinated against measles over a ten year period from 2003 to 2012.

- The percentage vaccinated represents children under one year of age who have been given at least one dose of the vaccine against measles in the given year.
- The data are for the six African countries shown in Table 3.1.

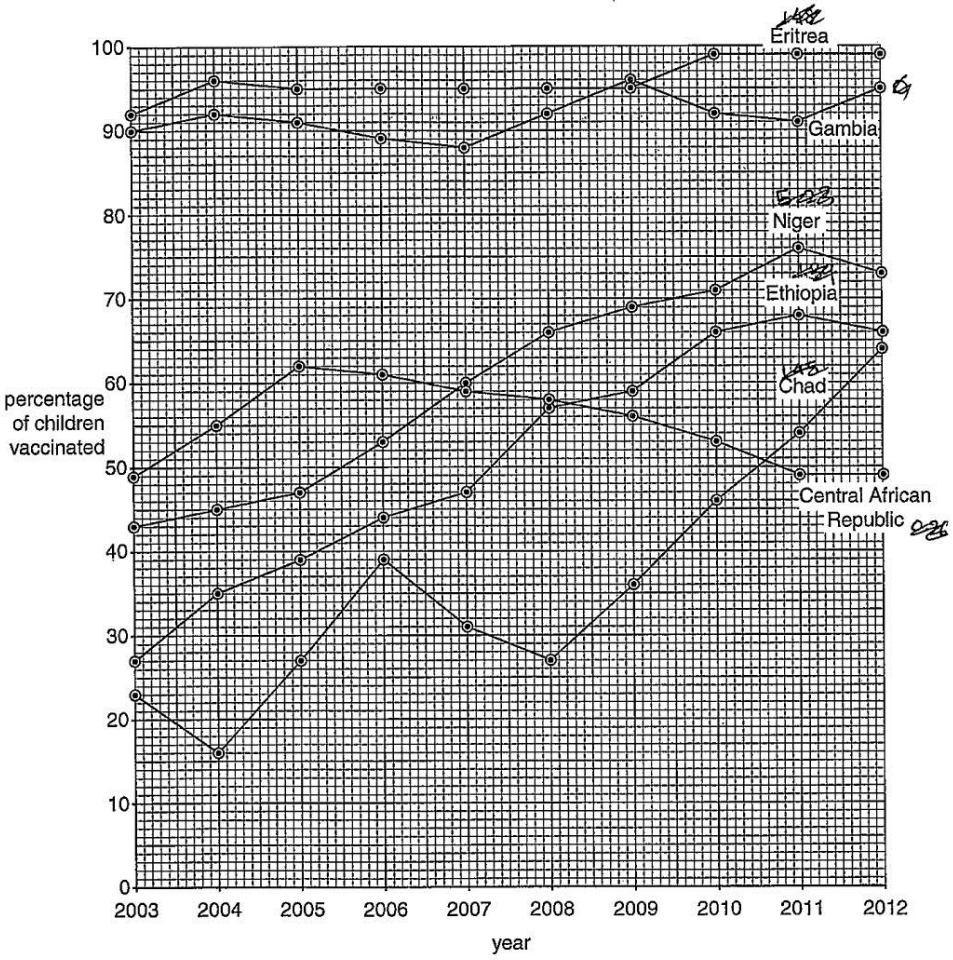


Fig. 3.1

Example candidate response – high, continued

(b) Vaccination is known to protect populations against infectious diseases.

Some of the data in Table 3.1 (on page 4) and Fig. 3.1 (on page 6) support this statement.

Describe the data that support this statement **and** comment on the data that do **not** support this statement.

Support: - Increasing percentage of children vaccinated leads to a decreased number of cases of measles per 100 000 people. 3

- For instance, in Niger, there is an increase in percentage of children vaccinated between 2009 (69%) and 2010 (71%), leading to a decrease from 5.23 cases per 100 000 people in 2009 to 2.34 cases per 100 000 in 2010.
- Countries with higher percentage of children vaccinated has lower number of cases of measles per 100 000 people. 4
- For instance, Gambia, with 95% of children vaccinated in 2012 has 0 cases per 100 000 people in 2012.

5 Does not support: - Graph only shows percentage of children vaccinated, not the percentage of population vaccinated.
- There is an outbreak of measles in 2011, leading to an increase in number of cases per 100 000 people in ~~Gambia~~, Chad and Niger, despite an increase in percentage of children vaccinated. [4]

(c) The successful eradication of smallpox involved an intensive global vaccination programme. It is hoped that the same can be achieved with measles.

Outline **two** features, apart from cost, of the smallpox eradication programme that may have made it easier to eradicate than measles.

1. A live vaccine was used for small pox, made from weakened/ mutated virus from a strand of similar virus closely related to small pox. 6 (larger immune response)

2. Smallpox vaccine could be freeze dried, causing it to be able to be stored in a wide range of temperatures, resulting in easy storage and transportation. [2] 7

(d) State precisely the type of immunity gained by receiving a measles vaccine.

Artificial active [1]

Examiner comments

3 The candidate has set out their response clearly, starting with a sentence that supports the statement. They then include information about Niger as an example. A trend is made clear and this is supported with correct data taken from the graph and the table.

4 The sentences about Gambia are strong pieces of evidence to support the statement – these are expressed well by the candidate. Again, correct data is given in support.

5 The candidate makes it clear here that they are switching to provide evidence that does not support the statement.

Mark for (b) = 4/4

6 This is a very good description of the vaccine used in the successful campaign to eradicate smallpox.

7 A very thorough answer displaying good understanding.

Mark for (c) = 2/2

Mark for (d) = 1/1

Example candidate response – high, continued	Examiner comments
(e) Planning the prevention and control of measles using a vaccination programme means that financial costs must be considered. State two examples of these costs. 1 Cost of developing and researching the vaccines for the virus. 8 2 Cost of manufacturing and transporting the vaccines for the virus, to the regions where vaccination is required. [2] [Total: 14]	8 There are actually two acceptable examples in this second answer; the cost of manufacturing viruses would have been enough to earn the mark. Mark for (e) = 2/2 **Total marks awarded = 14 out of 14**

How the candidate could have improved their answer

(a) (ii) The relevance of different population sizes for different countries is referred to at the start and halfway through the response. This point is made more clearly the second time, although it could have been qualified by stating that giving the cases per 100 000 takes into account the differences in population size. Although full marks were awarded here, another advantage would be that numbers per 100 000 provide information about the severity of the disease when different countries are compared, or in one country over time.

(b) The candidate used the term 'outbreak' to describe a large increase in cases of measles, but the very large increase in cases seen in the stated countries could have been described as an epidemic. In this case, the candidate had already written enough to be awarded the maximum number of marks.

Mark awarded = **(a) (i) 2/2, (ii) 3/3**
Mark awarded = **(b) 4/4**
Mark awarded = **(c) 2/2**
Mark awarded = **(d) 1/1**
Mark awarded = **(e) 2/2**

Total marks awarded = 14 out of 14

Example candidate response – middle

3 Globally, measles is an important disease that mainly affects children. Many deaths from measles occur in children under five years of age.

Table 3.1 shows the population of six countries in Africa in 2009 and the number of cases of measles per 100 000 people for the four years 2009 to 2012.
All six countries are classified as low-income countries.

Table 3.1

country	population in 2009	number of cases per 100 000 people			
		2009	2010	2011	2012
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Gambia	1 628 000	0.00	0.12	0.00	0.00
Niger	15 303 000	5.23	2.34	4.67	1.59

(a) (i) The actual number of cases of measles in Chad in 2009 was 165 and in Eritrea was 82.

Calculate the actual number of cases of measles in Ethiopia in 2009.
Show your working.

$\frac{84\,838\,000}{100\,000} = 848.38$ 1

$848.38 \times 1.39 = 1179.25$
≈ 1179 cases.

[2]

(ii) Use the data for Chad, Eritrea and Ethopia to explain the advantages of showing the data in Table 3.1 as number of cases of measles per 100 000 people rather than the actual number of cases.

If actual number was shown, it would be difficult to plot a graph or understand the results. It may be difficult to record results among such large numbers of people e.g in ~~Ethiopia~~ Ethiopia, population is 84838000 and results cannot be recorded easily. If there is large population, some people may not report their cases of measles which makes the data inaccurate. In chad, population is 11371000 and in Eritrea, 5558000, 2

[3]

Examiner comments

1 The steps in the calculation are set out clearly and the candidate has remembered to give the calculated value to the nearest whole person in order to match the values given in the question examples.

Mark for (a) (i) = 2/2

2 The candidate has done just enough to show their understanding that the different countries have different population sizes.

Mark for (a) (ii) = 1/3

Example candidate response – middle, continued	Examiner comments

Fig. 3.1 shows the percentage of children vaccinated against measles over a ten year period from 2003 to 2012.

- The percentage vaccinated represents children under one year of age who have been given at least one dose of the vaccine against measles in the given year.
- The data are for the six African countries shown in Table 3.1.

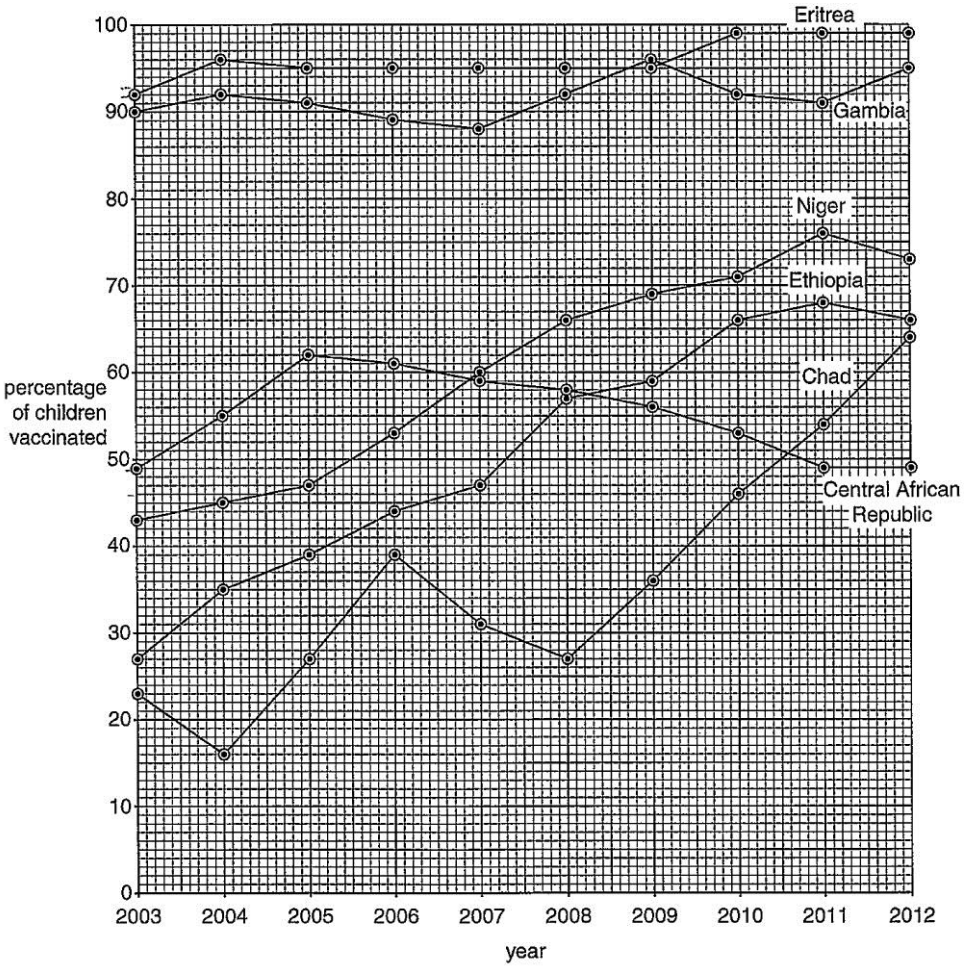


Fig. 3.1

Example candidate response – middle, continued	Examiner comments
(b) Vaccination is known to protect populations against infectious diseases. Some of the data in Table 3.1 (on page 4) and Fig. 3.1 (on page 6) support this statement. Describe the data that support this statement **and** comment on the data that do **not** support this statement. In ~~Eritrea~~ Ethiopia, in 2010, ~~99~~ 66 % of children ~~are~~ were vaccinated, but number of cases of measles was ~~very~~ high (~~72 000~~ 4.86 people among 100,000) whereas in ~~central African Republic~~ Chad in 2010 ~~46~~ % ~~of~~ children were vaccinated but only ~~1.27~~ 1.66 cases among 100,000 people are recorded. On the other hand, in Gambia, in 2003, 90% ~~of~~ were vaccinated, in 2010 92%, ~~and~~ in 2011, 91% and in 2012, 95% were vaccinated and there were no cases reported there except very few (0.12 among 100,000) in 2010 so here this statement is supported. [4]	**3** The candidate makes it clear which country is being described and states the year, the percentage of children vaccinated and the number of cases per 100 000 to support their statements. Mark for (b) = 2/4
(c) The successful eradication of smallpox involved an intensive global vaccination programme. It is hoped that the same can be achieved with measles. Outline **two** features, apart from cost, of the smallpox eradication programme that may have made it easier to eradicate than measles. → The ~~smallpox~~ variola virus was stable and did not change its ^surface antigens, making vaccine production easier. → Vaccine produced was thermostable and could be kept in hot climates for long periods (such as in the tropics) **4** [2]	**4** Two main features are outlined here. The outline of the second feature is directly linked to the vaccination programme and gains credit. Mark for (c) = 1/2
(d) State precisely the type of immunity gained by receiving a measles vaccine. Artificial active immunity **5** [1]	**5** The candidate knows that this is active immunity and qualifies this with the precise type of active immunity. Mark for (d) = 1/1

Example candidate response – middle, continued	Examiner comments
(e) Planning the prevention and control of measles using a vaccination programme means that financial costs must be considered. State two examples of these costs. 1 cost of infrastructure, to get to poor areas where roads etc have not been built and cases of measles are high in number. 2 cost of providing educational facilities to people in remote areas to educate them of the importance of getting vaccinated. 6 [2] [Total: 14]	6 The second example is well described. The first example implies transport costs and is given credit. Mark for (e) = 2/2 **Total marks awarded = 9 out of 14**

How the candidate could have improved their answer

(a) (ii) Here the candidate tried to point out the disadvantages of showing the actual number of cases when they should have focused on the *advantages* of using number of cases per 100 000 people, as the question asked. The idea that different countries have different population sizes is only weakly implied by quoting the population values; a worded statement would have been better here.

(b) The trends in vaccination should have been given for the different countries here. It was not sufficient to quote one year and give the value of the number of cases per 100 000, as this did not show whether or not the vaccination programme which takes place in a country over a number of years is successful in protecting the population. Trends for other countries (Eritrea, Niger and Central African Republic) could also have been described, using data to support the description. In terms of commenting on the success of the vaccination programme, it was necessary to look at the trend of vaccination in one country and compare this to the number of cases per 100 000 for the same country, rather than take one year and compare two different countries.

(c) The candidate could have qualified their correct statement about the Variola virus not changing its surface antigens by going on to state that this meant that only one type of vaccine was required.

Mark awarded = **(a) (i) 2/2, (ii) 1/3**
Mark awarded = **(b) 2/4**
Mark awarded = **(c) 1/2**
Mark awarded = **(d) 1/1**
Mark awarded = **(e) 2/2**

Total marks awarded = 9 out of 14

Example candidate response – low

3 Globally, measles is an important disease that mainly affects children. Many deaths from measles occur in children under five years of age.

Table 3.1 shows the population of six countries in Africa in 2009 and the number of cases of measles per 100 000 people for the four years 2009 to 2012.
All six countries are classified as low-income countries.

Table 3.1

country	population in 2009	number of cases per 100 000 people			
		2009	2010	2011	2012
Central African Republic	4 266 000	0.26	0.05	15.31	3.12
Chad	11 371 000	1.45 165	1.66	71.60	0.96
Eritrea	5 558 000	1.48 82	0.89	0.81	3.16
Ethiopia	84 838 000	1.39	4.86	3.64	4.74
Gambia	1 628 000	0.00	0.12	0.00	0.00
Niger	15 303 000	5.23	2.34	4.67	1.59

(a) (i) The actual number of cases of measles in Chad in 2009 was 165 and in Eritrea was 82.
Calculate the actual number of cases of measles in Ethiopia in 2009.
Show your working.

out of the total population

Chad: $\frac{165}{100\,000} \times 11\,371\,000 = 18762.15$ Eritrea = 4557.56

Ethiopia = $\frac{1.39}{100\,000} \times 84\,838\,000 = 1179.2$ = 1179 **1**

[2]

(ii) Use the data for Chad, Eritrea and Ethopia to explain the advantages of showing the data in Table 3.1 as number of cases of measles per 100 000 people rather than the actual number of cases.

The number of population is too big if using actual numbers. This may cause ~~confusion~~ problems. It is easier to use cases per 100 000 as all of the country has over 1 million population. **2**

~~It is simplified into five decimal~~ It is simple to use

[3]

Examiner comments

1 Although there are other calculations and values for Chad and Eritrea, the candidate has written 'Ethiopia' and on the same line given the correct calculation. The correct rounded-down answer is also given.

Mark for (a) (i) = 2/2

2 There is some hint of an understanding that different countries have different populations, but not enough to be awarded any marks.

Mark for (a) (ii) = 0/3

Example candidate response – low, continued	Examiner comments

Fig. 3.1 shows the percentage of children vaccinated against measles over a ten year period from 2003 to 2012.

- The percentage vaccinated represents children under one year of age who have been given at least one dose of the vaccine against measles in the given year.
- The data are for the six African countries shown in Table 3.1.

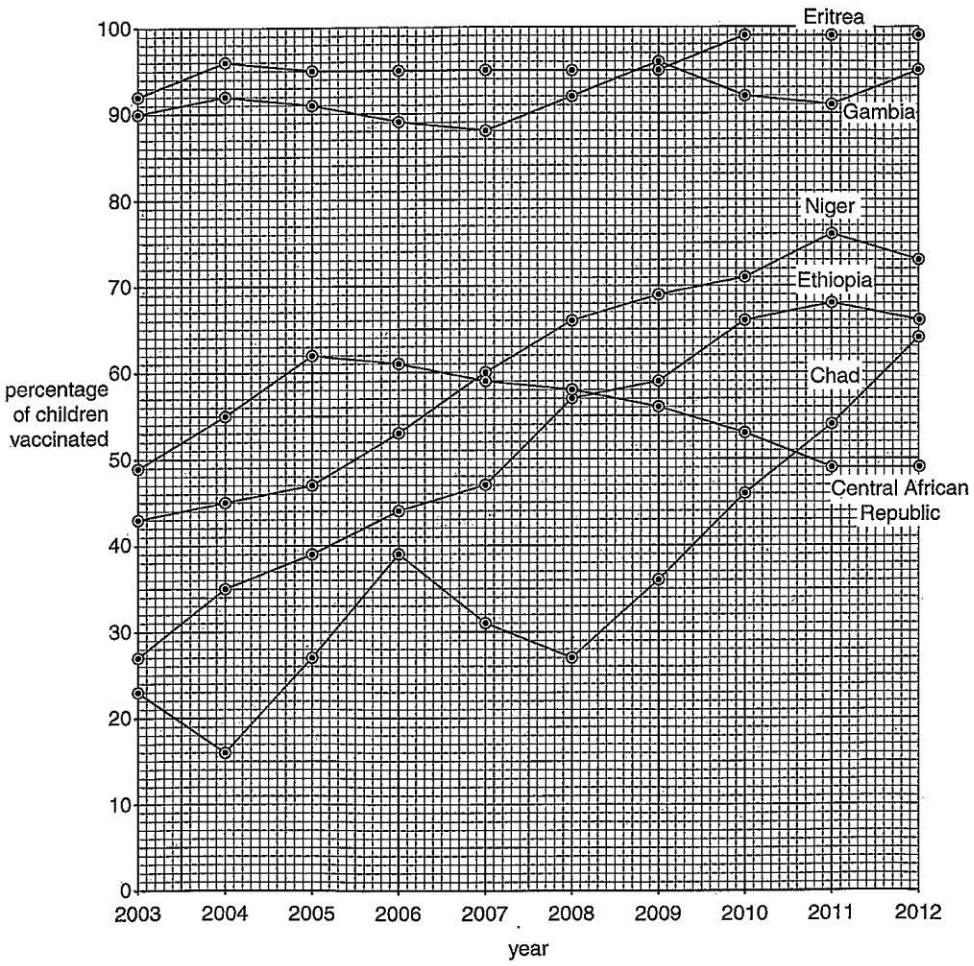


Fig. 3.1

Example candidate response – low, continued

(b) Vaccination is known to protect populations against infectious diseases.

Some of the data in Table 3.1 (on page 4) and Fig. 3.1 (on page 6) support this statement.

Describe the data that support this statement **and** comment on the data that do **not** support this statement.

Country evidence that prover the statement is suchas the country like Eritrea in 2011, which has 99 % of children vaccinated have 0.81 per 100 000 cases of measles. This suggest that to when higher number of people vaccinated there's should be less cases of measles.

Evidence that do not support the statement is Gambia having 0.00 per 100 000 cases of measles where only 54 % of children being vaccinated. This suggest that the evidence has an error because there's a chance the other 46 % are being exposed to having measles. [4]

(c) The successful eradication of smallpox involved an intensive global vaccination programme. It is hoped that the same can be achieved with measles.

Outline **two** features, apart from cost, of the smallpox eradication programme that may have made it easier to eradicate than measles.

1.) Small the DNA of smallpox is static or it does not change or mutant hence easy to produce large number of vaccines.

2.) Better sanitation management.

[2]

(d) State precisely the type of immunity gained by receiving a measles vaccine.

A artificial active immunity [1]

Examiner comments

3 The candidate includes the four items that are required to gain credit for data to support the statement: country; number of cases per 100 000; percentage vaccination value; and year. As these are all correctly extracted from the graph and the table, one mark can be given.

4 This is not quite the same as saying that a consistently high percentage vaccination will lead to a low number of cases. 'Higher' could mean 20% instead of 10% and 'less' could mean 11.5 instead of 12.0 cases per 100 000.

5 There is no year to accompany this value for cases per 100 000 and the percentage vaccination value is not correct for any of the years for Gambia.

Mark for (b) = 1/4

6 This is only part-way to gaining the mark as there is no precise statement about the vaccine: 'easy to produce ...' is too vague.

7 This is not directly related to the global vaccination programme.

Mark for (c) = 0/2

8 Good knowledge is shown and the precise type of immunity is correctly stated.

Mark for (d) = 1/1

Example candidate response – low, continued	Examiner comments
(e) Planning the prevention and control of measles using a vaccination programme means that financial costs must be considered. State two examples of these costs. 1 The cost of incubators to grow the bacteria are ~~exo~~ expensive 2 The cost for ~~making~~ producing enzyme is expensive [2] [Total: 14]	9 Measles is caused by a virus. 10 The question is about vaccines and not enzymes. Mark for (e) = 0/2 **Total marks awarded = 4 out of 14**

How the candidate could have improved their answer

(a) (i) There is some irrelevant information in the space available for the calculation and the correct calculated value. This should have been crossed out to ensure that the examiner only considered the correct calculation.

(a) (ii) A firm statement that different countries have different populations would have helped to gain credit here. More marks could also have been gained if the idea of 'easier to use' was explained by stating that cases per 100 000 shows the proportion of the population with the disease. Further detail on 'simple to use' should have been given. This could have included the idea that it allows comparison between countries or shows the severity of the disease between countries or over time within one country.

(b) The data for Eritrea should have been qualified by stating that a high percentage vaccination throughout the years shown also produces a low number of cases of measles per 100 000. The candidate did not give a trend, supported by extracted data, for any stated country to show that an increase in percentage of children vaccinated is linked to a decrease in cases per 100 000 of measles, or vice versa.

(c) The first feature could have been qualified by explaining that only one type of vaccine needed to be developed for use so that the same one could be used throughout the eradication programme. The outline of the second feature needed to include a statement about the global vaccination programme, such as a high proportion of the world being vaccinated, or about the vaccine, such as its heat stability owing to freeze-dried preparation.

(e) The candidate had a gap in their knowledge about the type of organism causing measles. The idea of the incubator to produce bacteria is about the preparation of the vaccine, but the causative organism is a virus. The second statement about production would have gained credit if the candidate had checked their response and noted the error of 'enzyme' instead of 'vaccine'. Other examples of costs could have been wages for the health workers to deliver the vaccine or the cost of transport of the vaccine.

Mark awarded = **(a) (i) 2/2, (ii) 0/3**
Mark awarded = **(b) 1/4**
Mark awarded = **(c) 0/2**
Mark awarded = **(d) 1/1**
Mark awarded = **(e) 0/2**

Total marks awarded = 4 out of 14

Common mistakes candidates made in this question

(a) (i) Not all candidates gave the answer to the nearest whole case here. Some included the correct working, but were a factor of ten or more out in their final answer, while others rounded to 1180.

(a) (ii) Some candidates stated that cases per 100 000 were averages, rather than a proportion (or ratio). Some did not realise that the cases per 100 000 were calculated from actual reported cases of measles and stated that it was quicker to use estimates. Some incorrectly thought that the values represented the number of deaths from measles.

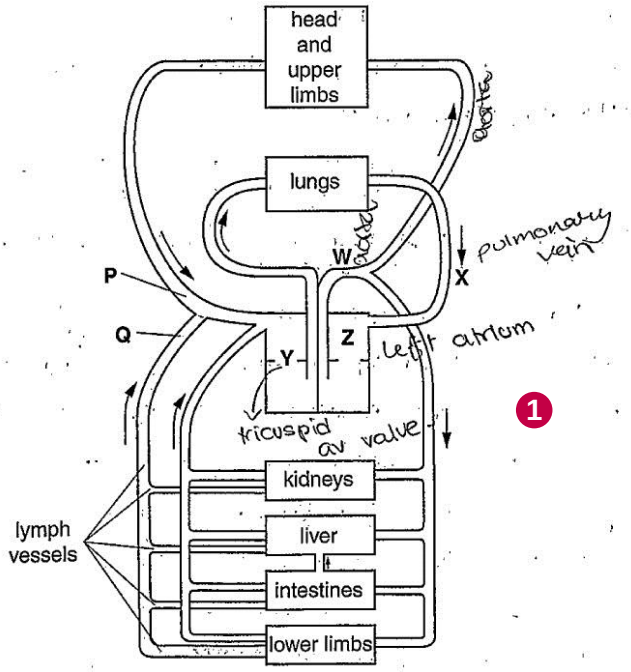
(b) Many candidates forgot to consider the time aspect of a vaccination programme or to realise that they should have been looking for trends over the years rather than quoting values for one year only. When quoting data extracted from the table and graph, many forgot to state one or more of: the country; whether the percentage vaccination was increasing or decreasing; the cases per 100 000. Some misread the curve for Chad and thought it represented Central African Republic. Some only used Fig. 3.1, which meant they could only comment on the percentage of children vaccinated over time. Some concentrated only on one or two countries and did not give any description or comments for the other countries.

(c) Many candidates correctly stated that the smallpox virus did not mutate, but did not go on to explain how this impacted on the vaccine and vaccination programme, namely that only one vaccine needed to be developed and could be used throughout the programme. Some mistakenly thought that the vaccine was frozen rather than being freeze-dried. A number wrote about how to improve a measles vaccination programme, but as they did not state that this was carried out for the smallpox vaccination programme, they could not gain credit for knowledge of the smallpox programme.

(d) Some candidates only stated that this was ‘active immunity’. This was not enough as active immunity can be either ‘artificial’, as in this case, or ‘natural’.

(e) Some candidates did not relate their answer to a vaccination programme and gave examples of how an individual would incur costs. Some did not make clear the difference between vaccine and vaccination, and ‘vaccination would cost’ is vague and not the same as ‘the cost of purchasing vaccines’.

Question 4

Example candidate response – high	Examiner comments
4 Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.  Fig. 4.1	1 To remind themselves of the structure of the heart and its associated blood vessels, the candidate has annotated Fig. 4.1 to help them formulate their response.

Example candidate response – high, continued

(a) The type of circulatory system shown in Fig. 4.1 is a closed double circulation.

Explain what is meant by a *closed double circulation*.

'Closed' because all the blood vessels are interconnecting forming a complete circuit so blood never leaves the vessels. (2)

'Double' because in one complete circulation blood passes through the heart twice.

[2]

(b) With reference to Fig. 4.1, name:

blood vessel **W** Aorta

blood vessel **X** Pulmonary Vein (3)

valve **Y** Tricuspid valve (Atrioventricular valve)

heart chamber **Z** Left Atrium [4]

(c) State the component present in the blood at location **P** that is **not** present in the lymph at location **Q** in Fig. 4.1.

Red Blood Cells. [1]

(d) As blood passes through the capillary network in the lungs, gas exchange occurs.

Describe the process of gas exchange between the alveolus and the blood.

Occurs by diffusion down the concentration gradient of each gas. O_2 diffuses enters alveoli from outside air and due to thin, one-cell-thick wall of alveolus and its curvature, diffusion distance is short and diffusion surface area is high so at high rate O_2 dissolves in moist lining of alveolar internal wall then diffuses through wall, entering through gaps in cells of phospholipid bilayer and through same route into capillary binding with haemoglobin in red blood cell. (4) (5) Alveolus surrounded by capillaries with deoxygenated blood with high CO_2 content. CO_2 diffuses out of blood via capillary holes through phospholipid bilayer, through alveolar wall by same path, dissolving in moist lining and diffusing into air inside alveolus. (6) (7) O_2 and CO_2 both non-polar so can pass through hydrophobic region of bilayer. [4]

Examiner comments

(2) The response has been set out so that it is clear that both 'closed' circulation and 'double' circulation are being explained.

Mark for (a) = 2/2

(3) The candidate gains credit for the correct name for valve Y. Note that stating 'atrioventricular valve' alone would not gain the mark; this needs to be the '*right* atrioventricular' valve.

Mark for (b) = 4/4

Mark for (c) = 1/1

(4) Adaptations of surfaces for gas exchange are not required as the question asks for a description of gas exchange.

(5) A sequential account is given, demonstrating good understanding of the process.

(6) The outside air, alveolus, capillary and red blood cell are all mentioned to show that the complete process has been considered.

(7) Both respiratory gases are mentioned.

Mark for (d) = 3/4

Example candidate response – high, continued	Examiner comments

(e) As blood passes through the small intestine, small soluble products of digestion such as glucose are absorbed into the capillaries to be transported to the liver.

Fig. 4.2 is a transmission electron micrograph of intestinal epithelial cells.

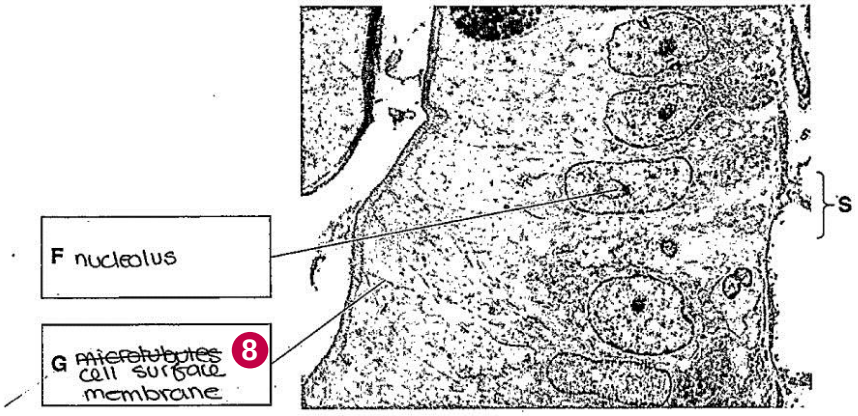


Fig 4.2

(i) Write the name of cell structures **F** and **G** in the boxes provided on Fig. 4.2. [2]

(ii) At the surface labelled **S**, movement of glucose molecules out of the intestinal epithelial cell occurs by facilitated diffusion.

Outline the features of facilitated diffusion of glucose molecules.

Passive process. Transmembrane protein molecule in cell membrane is a channel protein that has a hydrophilic channel through it, this allows water-soluble, polar glucose to move through it to outside cell down its concentration gradient. It would not be able to pass through hydrophobic region of bilayer. Process is passive so requires no ATP or energy. 9

[3]

[Total: 16]

8 The candidate has clearly crossed out an incorrect answer and given the correct response below.

Mark for (e) (i) = 2/2

9 The main features of facilitated diffusion are given clearly and the response is to the point. The focus is on the transport of glucose, as required by the question.

Mark for (e) (ii) = 3/3

Total marks awarded = 15 out of 16

How the candidate could have improved their answer

(a) When explaining a 'closed' circulation, a more complete response would be to name the three main types of blood vessels and the heart. However, this answer was enough to gain the marks.

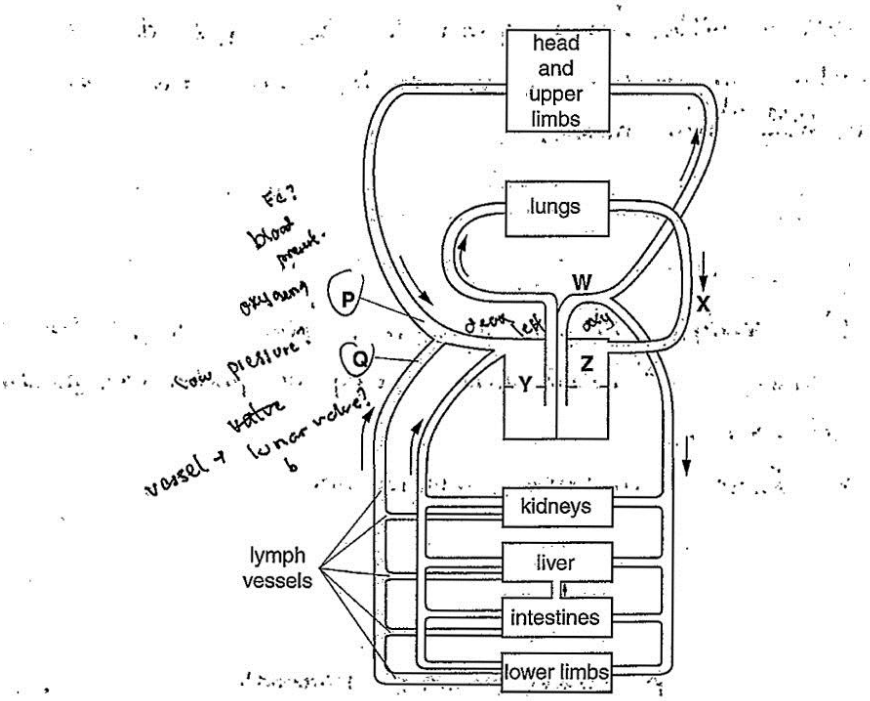
(c) Although the candidate had no problem gaining this mark, it is not correct to name a red blood cell as Red Blood Cell, with upper case (capital) initials.

(d) More detail on the passage of oxygen from the alveolus to the red blood cell and vice versa (of carbon dioxide) could have been included here. The thin wall of the alveolus should have been described as the 'squamous epithelium' and the capillary wall named as the 'endothelium'. More detail on the diffusion of the gases could have included reference to the diffusion down a steep gradient, with some qualification of how a steep gradient is maintained.

(e) (ii) Although 'channel protein' was accepted, the actual type of membrane protein for the facilitated diffusion of glucose is a 'carrier protein'. One of the main features of a carrier protein for glucose is a binding site specific for glucose. On binding there is a conformational (shape) change that allows the movement of glucose across the membrane.

Mark awarded = **(a) 2/2**
Mark awarded = **(b) 4/4**
Mark awarded = **(c) 1/1**
Mark awarded = **(d) 3/4**
Mark awarded = **(e) (i) 2/2, (ii) 3/3**

Total marks awarded = 15 out of 16

Example candidate response – middle	Examiner comments
4 Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.  Fig. 4.1	

Example candidate response – middle, continued

(a) The type of circulatory system shown in Fig. 4.1 is a closed double circulation.

Explain what is meant by a *closed double circulation*.

it is when deoxygenated blood goes to the heart, to the pumps to the lungs. and Oxygenated blood goes to the heart again and to the all other parts of the body. and to the ~~t~~ 1

.....

.....[2]

(b) With reference to Fig. 4.1, name:

blood vessel **W** ~~pul~~ aorta 2

blood vessel **X** pulmonary vein

valve **Y** tricuspid valve

heart chamber **Z** right atrium. [4]

(c) State the component present in the blood at location **P** that is not present in the lymph at location **Q** in Fig. 4.1.

~~oxygenated blood~~ oxygenated blood 3 [1]

(d) As blood passes through the capillary network in the lungs, gas exchange occurs.

Describe the process of gas exchange between the alveolus and the blood.

Blood carries ~~d~~ Deoxygenated blood ~~carries~~ pumps by the heart at ~~high pressure~~, and diffusion occurs between the blood and the alveolus. Oxygen moves from high concentration 4 in the lungs passing through the form of membrane of into the red blood cell. While, Carbon dioxide 5 diffuses out to the ~~lun~~ alveolus. as ~~=~~

.....[4]

Examiner comments

1 The candidate has written just enough to show an understanding that, for a full circulation around the body, the blood passes through the heart twice. There is no explanation of the term 'closed'.

Mark for (a) = 1/2

2 There are only three correct answers here. Although heart chamber **Z** is an 'atrium', the candidate has stated 'right' instead of 'left'.

Mark for (b) = 3/4

3 This is a description of blood rather than a component.

Mark for (c) = 0/1

4 Although there is little detail about the pathway taken and 'the lungs' is stated rather than 'the alveolus', the candidate shows an understanding that oxygen enters the red blood cell, so gains credit.

5 The candidate correctly identifies the mechanism of transport of the respiratory gases and knows the direction of movement of both oxygen and carbon dioxide.

Mark for (d) = 3/4

Example candidate response – middle, continued

(e) As blood passes through the small intestine, small soluble products of digestion such as glucose are absorbed into the capillaries to be transported to the liver.

Fig. 4.2 is a transmission electron micrograph of intestinal epithelial cells.

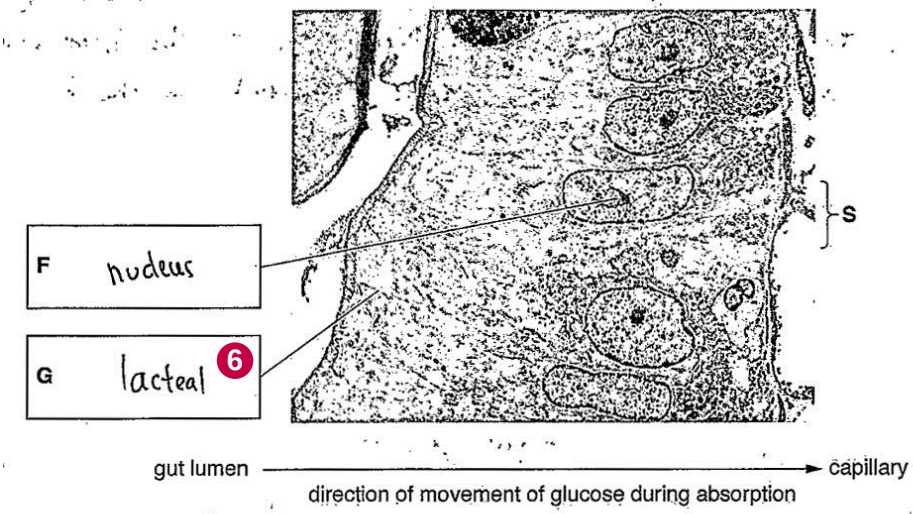


Fig 4.2

(i) Write the name of cell structures **F** and **G** in the boxes provided on Fig. 4.2. [2]

(ii) At the surface labelled **S**, movement of glucose molecules out of the intestinal epithelial cell occurs by facilitated diffusion.

Outline the features of facilitated diffusion of glucose molecules. 7

Glucose moves through the protein channel by diffusion as in the intestine gt concentration of glucose is high than the cells thus glucose enters enters.

[3]

[Total: 16]

6 'Nucleus' is acceptable for structure **F**, but 'lacteal' for **G** is incorrect as this is not a cell structure. A lacteal is a lymph vessel.

Mark for (e) (i) = 1/2

7 The candidate realises that glucose must pass through a membrane protein so gains credit. Movement of glucose down the concentration gradient from the intestinal epithelial cell towards the capillary is not clearly given in this response.

Mark for (e) (ii) = 1/3

Total marks awarded = 9 out of 16

How the candidate could have improved their answer

(a) The candidate could have stated the pulmonary and systemic circulations, to be sure of gaining credit here. They should also have included an explanation of 'closed circulation', either by mentioning that blood is contained in blood vessels or by naming the three main types of blood vessels and the heart.

(b) The candidate needed to remember that the sides of the heart and the heart chambers are named as if one is facing a person and so the right-hand side of the diagram is actually the left side of the heart.

(c) The candidate should have followed through on the idea of oxygen and remembered that oxygen is carried in red blood cells. Oxygen is not considered a component of blood, as it is carried by haemoglobin within red blood cells.

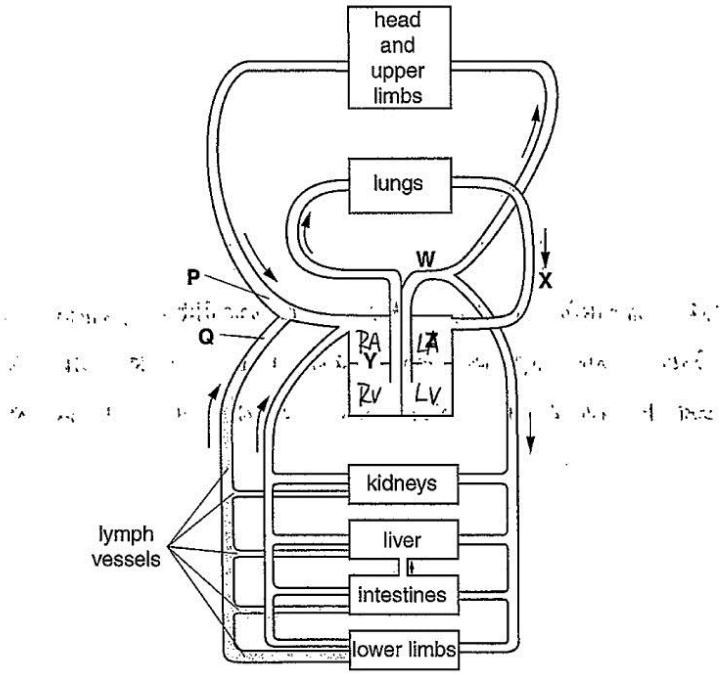
(d) The oxygen should have been described as diffusing from the alveolus, rather than from the lung. The candidate could have included detail of the pathway, the squamous epithelium of the alveolus and the endothelium of the capillary.

(e) (i) The information provided stated that Fig. 4.2 showed intestinal epithelial cells. As the nuclei are obvious, with further study of Fig. 4.2 the candidate might have realised that the thin line between one cell and the next was the cell surface membrane.

(e) (ii) The 'channel protein' was acceptable here, as the candidate understood that glucose cannot cross the cell surface membrane unaided. However, 'carrier protein' would have been more correct. The movement down the concentration gradient could have been expressed as going from a high to a low concentration (a high concentration within the epithelial cell to a lower concentration outside the cell). To gain full marks, a statement that the movement is passive should have been included.

Mark awarded = **(a) 1/2**
Mark awarded = **(b) 3/4**
Mark awarded = **(c) 0/1**
Mark awarded = **(d) 3/4**
Mark awarded = **(e) (i) 1/2, (ii) 1/3**

Total marks awarded = 9 out of 16

Example candidate response – low	Examiner comments
4 Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.  Fig. 4.1	

Example candidate response – low

(a) The type of circulatory system shown in Fig. 4.1 is a closed double circulation.

Explain what is meant by a *closed double circulation.*

'closed' means same blood pass through one place twice which mean the blood leave from heart and finally goes into heart. 'Double' mean there are two different path which all pass through heart. 1

[2]

(b) With reference to Fig. 4.1, name:

blood vessel **W** Aorta 2

blood vessel **X** Pulmonary vein

valve **Y**

heart chamber **Z** Left atrium [4]

(c) State the component present in the blood at location **P** that is **not** present in the lymph at location **Q** in Fig. 4.1.

Carbon dioxide.

[1]

(d) As blood passes through the capillary network in the lungs, gas exchange occurs.

Describe the process of gas exchange between the alveolus and the blood.

The ~~oxygen~~ carbon dioxide in capillary diffuse to the alveolus in short distance down the concentration gradient. And the ~~carbon dioxide~~ oxygen contain in the alveolus also diffusse from alveolus to blood in the capillaries. So the blood in capillary gain oxygen and released carbon dioxide and the alveolus gain carbon dioxide and released oxygen 3

[4]

Examiner comments

1 The candidate attempts to explain both 'closed circulation' and 'double circulation'. Neither explanation is close enough to the required answers to gain credit.

Mark for (a) = 0/2

2 This was accepted for 'aorta'.

Mark for (b) = 3/2

Mark for (c) = 0/1

3 The candidate demonstrates knowledge of the direction of movement of each of the respiratory gases and their mechanism of movement.

Mark for (d) = 2/4

Example candidate response – low

(e) As blood passes through the small intestine, small soluble products of digestion such as glucose are absorbed into the capillaries to be transported to the liver.

Fig. 4.2 is a transmission electron micrograph of intestinal epithelial cells.

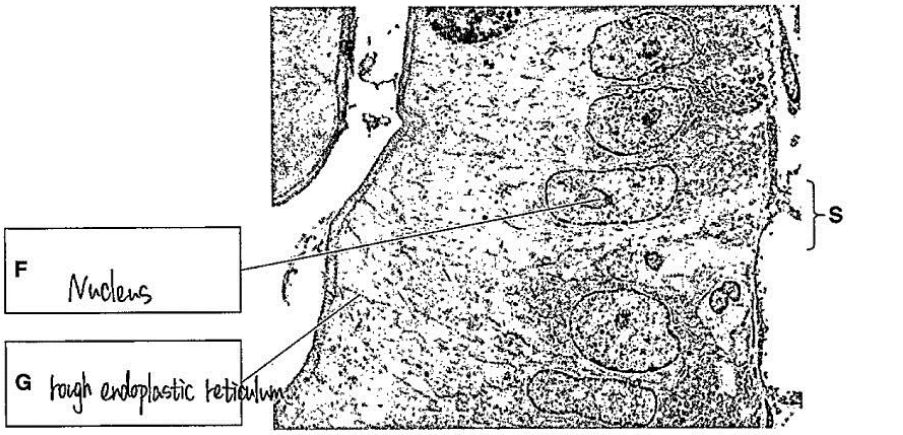


Fig 4.2

(i) Write the name of cell structures **F** and **G** in the boxes provided on Fig. 4.2. [2]

(ii) At the surface labelled **S**, movement of glucose molecules out of the intestinal epithelial cell occurs by facilitated diffusion.

Outline the features of facilitated diffusion of glucose molecules.

Facilitated diffusion is a kind of special diffusion which need a carrier protein as a media down the concentration gradient. Because glucose molecule is a large molecule which can not pass through cell membrane

.....[3]

[Total: 16]

Examiner comments

Mark for (e) (i) = 1/2

4 The candidate correctly realises that a carrier protein is involved, so is credited for this. Although 'down the concentration gradient' is given here, there is no mention of glucose moving down this gradient from the cell to the outside. The final sentence states that glucose cannot cross the membrane so appears to be a contradiction. As this is not qualified further, no more marks are given.

Mark for (e) (ii) = 1/3

Total marks awarded = 7 out of 16

How the candidate could have improved their answer

(a) The explanation of closed circulation needed to show understanding that blood is contained in blood vessels. The statement for double circulation should have been more precise about the 'two different paths'. Either the pulmonary and systemic circulations could have been named, or a more precise answer should have been given stating that the full circulation of blood means passage through the heart twice.

(b) The candidate could have attempted to name all the structures and not leave valve Y blank. The aorta, blood vessel W, could have been spelled correctly.

(c) A greater familiarity with the difference between blood and lymph would have helped this candidate to suggest either red blood cells or plasma proteins here. These two components are unable to pass from the blood into the tissue fluid so will not be collected by the lymph system.

(d) The candidate could have stated that oxygen enters the red blood cell and given detail on the pathway via the squamous epithelium of the alveolus and the endothelium of the capillary.

(e) (i) In Fig. 4.2 the rough endoplasmic reticulum (written as 'endoplastic' by the candidate) would not look like a single dark line separating the two cells. The best response would have been 'cell surface membrane', but if the candidate had given just 'cell membrane', this would have been accepted.

(e) (ii) The final sentence should have been completed with 'so the glucose moves through the carrier protein', or similar. The candidate could also have stated that no energy is required for the glucose to cross the membrane, and should have made clear that glucose molecules move down the concentration gradient from the cell to the outside.

Mark awarded = **(a) 0/2**
Mark awarded = **(b) 3/4**
Mark awarded = **(c) 0/1**
Mark awarded = **(d) 2/4**
Mark awarded = **(e) (i) 1/2, (ii) 1/3**

Total marks awarded = 7 out of 16

Common mistakes candidates made in this question

In **(a)**, it was common for candidates to only describe double circulation and ignore 'closed circulation'. It was also common for candidates to describe closed as 'blood is unable to leave' without any mention of blood vessels. For double circulation, it was not correct to write about the passage of blood through the heart as going 'across' or 'around' the heart. Some described one complete circuit around the body as one cardiac cycle, which is incorrect. A cardiac cycle refers to the heartbeat. Another common error was to state that for one heartbeat, the blood passes into two circulations.

(b) A common error here was to spell 'aorta' incorrectly, usually as 'arota'. The other common error was to name the atrioventricular valve but forget to state that it was the *right* atrioventricular valve.

(c) Many incorrectly gave a respiratory gas, carbon dioxide or oxygen, instead of considering a larger component of blood, such as a red blood cell or plasma protein. A number also gave 'white blood cell', forgetting that these can be found in the lymph system.

(d) There was often a lack of precision in describing the movement of oxygen or carbon dioxide: oxygen was described as moving from the lung to the capillary, or carbon dioxide from the capillary to the lung, rather than giving the correct structure, 'the alveolus'. It was also common for candidates to list the adaptive features of a gas exchange surface, which did not answer the question.

(e) (i) Some candidates did not notice the faint line separating the intestinal epithelial cells and gave 'cytoplasm' as their answer.

(e) (ii) The most common mistake in outlining features of facilitated diffusion was to state that it was an active energy-requiring process. Another common mistake was to state that glucose is transported across by both channel and carrier proteins, whereas glucose is transported only by a carrier protein. Candidates who gave 'channel protein' were not penalised, but this is not strictly correct.

Question 5

Example candidate response – high

5 Fig. 5.1 shows plant cells in stages of mitosis.

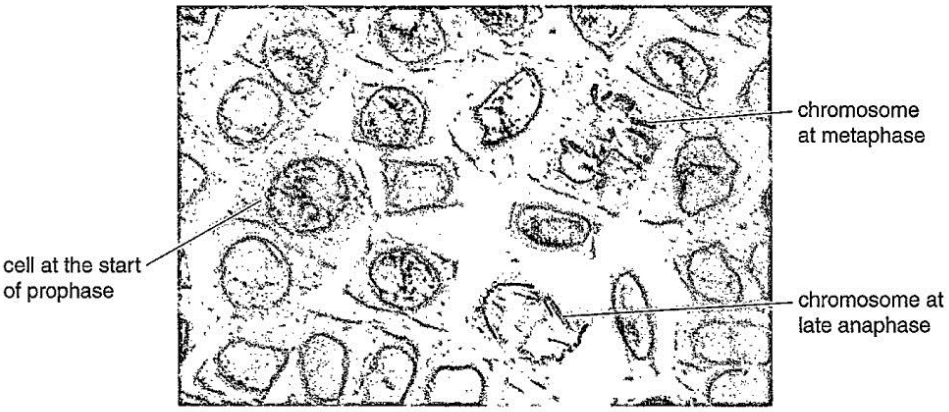


Fig. 5.1

(a) Individual chromosomes cannot be seen in the cell at the start of prophase. Changes to the chromatin occur so that by late prophase chromosomes are clearly visible.

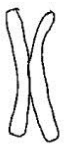
(i) Outline what occurs during early prophase so that chromosomes become visible in late prophase.

The chromatin condenses and coils during early prophase.

.....[1]

(ii) Describe the structure of the chromosome in late prophase.

Two identical ~~Two~~ sister chromatids are attached 1 to each other at the centromere, ~~strands~~ ~~The chromosomes are~~ The have a cap at the end called telomere. Coiled, so it looks like two identicale strands ~~with the~~ attached at the centre which has the same length.



.....[3]

Examiner comments

Mark for (a) (i) = 1/1

1 The main features of the structure of a chromosome are given first. Later in the response, more detail is given when telomeres are mentioned.

Mark for (a) (ii) = 3/3

Example candidate response – high, continued	Examiner comments

(b) State **two** differences between the chromosome at metaphase and the chromosome at late anaphase.

The chromosomes at metaphase is lined up at the equator, however, at anaphase it is at opposite poles. (2)

The chromosomes at metaphase ~~is~~ consists of two sister chromatids connected at the centromere however, at anaphase there is only 1 single chromatid, centromere pointing towards poles. [2]

(c) One of the functions of a plant hormone known as cytokinin is to act as a cell signalling molecule and promote cytokinesis.

Suggest how cytokinin acts as a cell signalling molecule.

Cytokinin ~~attches~~ attaches to the specific chemical receptors on the cell membrane #, the chemical receptors then activates the G-protein to send out a secondary messenger ~~that~~ which amplifies the original signal, sending it to enzymes or specific causing them to response which give a specific is cytokinesis. (3) [3]

[Total: 9]

(2) The candidate deals with one feature at a time and the two stages are compared to highlight the differences. The candidate names each stage to avoid confusion and uses the connector 'however' to introduce a difference.

Mark for (b) = 2/2

(3) The candidate has applied their knowledge of the main features of cell signalling to this example of the plant hormone cytokinin and its involvement in cytokinesis at the end of mitosis. The response is written to give a sequential account.

Mark for (c) = 3/3

Total marks awarded = 9 out of 9

How the candidate could have improved their answer

(a) (ii) The candidate drew a diagram to accompany their response. The diagram should have been labelled to support the written text.

(b) To make their response easier to mark, the candidate could have set out the comparison of the second feature a little more clearly. There is space to finish the statement about the chromosomes at metaphase consisting of two sister chromatids. The candidate could have drawn a line to separate the end of this sentence from the sentence about the chromatid at late anaphase.

(c) The location of the receptors could have been described more accurately as being in the cell surface membrane of the cell.

Mark awarded = **(a) (i) 1/1, (ii) 3/3**
Mark awarded = **(b) 2/2**
Mark awarded = **(c) 3/3**

Total marks awarded = 9 out of 9

Example candidate response – middle	Examiner comments

5 Fig. 5.1 shows plant cells in stages of mitosis.

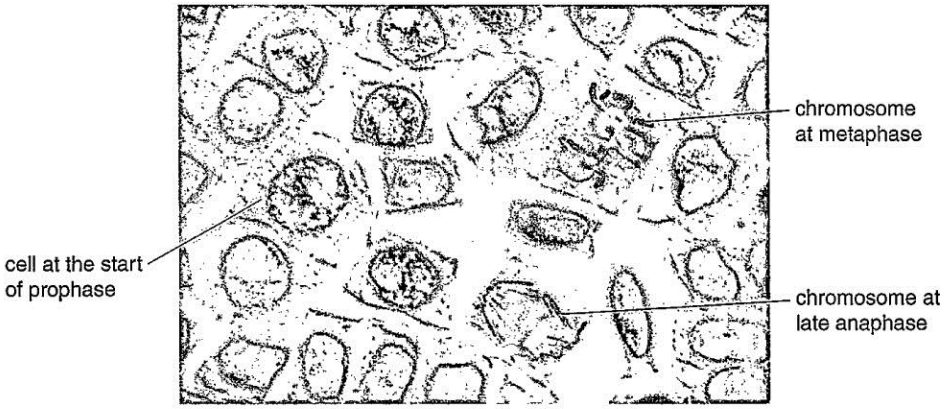


Fig. 5.1

(a) Individual chromosomes cannot be seen in the cell at the start of prophase. Changes to the chromatin occur so that by late prophase chromosomes are clearly visible.

(i) Outline what occurs during early prophase so that chromosomes become visible in late prophase.

During early prophase, chromatin in the nucleus condense to form chromosomes composed of two sister chromatids. [1]

(ii) Describe the structure of the chromosome in late prophase.

The chromosomes are short and thick composed of two chromatids containing two DNA molecules [3]

1 This first part is fine as an answer. The rest of the answer, '…two sister chromatids' is not necessary here, but would be useful in **(a) (ii)**.

Mark for (a) (i) = 1/1

2 Although the candidate uses the plural 'chromosomes', a mark is awarded for the idea of two chromatids per single chromosome.

Mark for (a) (ii) = 1/3

Example candidate response – middle, continued	Examiner comments
(b) State **two** differences between the chromosome at metaphase and the chromosome at late anaphase. During metaphase, the chromosomes are aligned at the equator with spindle fibres attached to the kinetochore molecule at their centromere. By late anaphase, the sister chromatids 3 have been moved apart to opposite ends of the poles which is achieved by shortening of microtubules [2] **(c)** One of the functions of a plant hormone known as cytokinin is to act as a cell signalling molecule and promote cytokinesis. Suggest how cytokinin acts as a cell signalling molecule. Cytokinin activates the receptors (proteins) in the cell surface membrane. The receptors then transmit the signal to the seglut 4 protein which activates the second messenger and begins of a cascade of reactions activating other enzymes thereby amplifying the signal and causing the cell to undergo cytokinesis [3] [Total: 9]	3 The stages are named to avoid confusion. There is just enough here to show understanding of a single chromosome at metaphase composed of two chromatids and separated chromatids at anaphase. The fact that the equator at metaphase and the poles at anaphase are noted is enough to gain the second mark, although 'ends of the poles' has been given the benefit of the doubt. Mark for (b) = 2/2 4 The reference to 'glut' was ignored here (this is specific to glucose). The candidate demonstrates understanding that the presence of cytokinin causes a cascade of reactions that leads to cytokinesis. The location of the receptor is also given correctly. Mark for (c) = 2/3 **Total marks awarded = 6 out of 9**

How the candidate could have improved their answer

(a) (ii) The information that the candidate provided in **(a) (i)** about two sister chromatids should have been included here to gain an additional mark. The reference to ‘chromosomes’ and not ‘a single chromosome’ is also confusing. If the candidate had noted that the chromatids were joined at the centromere, or drawn a labelled diagram, this would have helped to gain maximum marks.

(b) There were a few minor errors here, though not sufficient to withhold credit. If these had been corrected, the answer would have been of better quality. The kinetochore should not have been called ‘a molecule’. In addition, ‘opposite ends of the poles’ should have been written more simply and more correctly as ‘opposite poles’. The chromosome at metaphase could have been qualified by stating that it was comprised of the two chromatids joined at the centromere.

(c) The candidate could have gained the final mark by explaining that cytokinin binds to the receptor located in the cell surface membrane. The reference to ‘glut’ should not have been given as glut proteins are membrane transport proteins for glucose.

Mark awarded = **(a) (i) 1/1, (ii) 1/3**
Mark awarded = **(b) 2/2**
Mark awarded = **(c) 2/3**

Total marks awarded = 6 out of 9

Example candidate response – low

5 Fig. 5.1 shows plant cells in stages of mitosis.

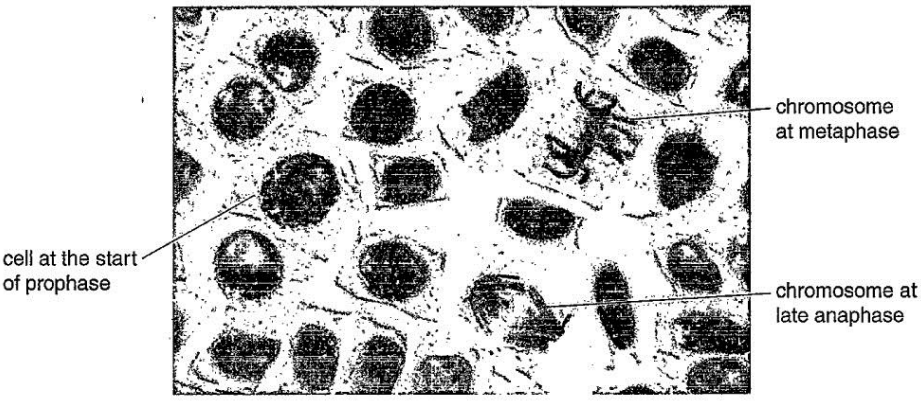


Fig. 5.1

(a) Individual chromosomes cannot be seen in the cell at the start of prophase. Changes to the chromatin occur so that by late prophase chromosomes are clearly visible.

(i) Outline what occurs during early prophase so that chromosomes become visible in late prophase.

the nuclear envelope breaks down ; the chromosomes are visible due to breakdown of nuclear envelope and nucleus disappearance.

[1]

(ii) Describe the structure of the chromosome in late prophase.

chromatids joined together at the centromere to make a chromosome.

The chromosomes are lying freely and slowly moving towards the center (to move to metaphase).

[3]

Examiner comments

1 The candidate describes events occurring in the cell during early prophase, which is not required by the question.

Mark for (a) (i) = 0/1

2 This is correct information so gains a mark. There is no reference to two chromatids or to sister/identical chromatids.

3 The candidate moves away from the aim of the question here and attempts to describe the behaviour of the chromosomes at late prophase.

Mark for (a) (ii) = 1/3

Example candidate response – low, continued	Examiner comments
(b) State **two** differences between the chromosome at metaphase and the chromosome at late anaphase. Chromosomes at metaphase are lying at the equator (middle) whereas at anaphase the are pulled by spindle towards the opposite poles. 4 Chromosomes at metaphase are composed of two chromatids joined at centromere, whereas at anaphase they are two separate sister chromatids moved to opposite poles (not connected at centromere). [2] **(c)** One of the functions of a plant hormone known as cytokinin is to act as a cell signalling molecule and promote cytokinesis. Suggest how cytokinin acts as a cell signalling molecule. the hormone attaches to the receptor cells and initiates a signal (sends a signal) to the nucleus to start the specific action, which is cytokinesis. 5 [3] [Total: 9]	4 This is an excellent answer that is clearly laid out to show the differences. Notice that the candidate mentions two sister chromatids: this is information that could have been included in **(a) (ii)**. Mark for (b) = 2/2 5 The reference to receptor cells is too ambiguous to award either a mark for target cells or a mark for binding to receptors. There is therefore not enough to show understanding that binding to receptors results in a cascade of reactions leading to cytokinesis. Mark for (c) = 0/3 **Total marks awarded = 3 out of 9**

How the candidate could have improved their answer

(a) (i) The candidate should have focused on the changes occurring to the DNA/chromatin to make it more visible, rather than describing events occurring at early prophase.

(a) (ii) More detail about the chromosome was required here. Using the term 'chromatids' is not sufficient to imply two chromatids, nor does it show understanding that the two chromatids are identical.

(c) The hormone should have been described as attaching to the receptors of the target cells, rather than stating 'receptor cells', which is wrong. It was not clear if the candidate was describing receptors in the target cells as receptor cells or describing the target cells as receptor cells. The location of the receptors should have been given. There should have been a clear reference to the binding of the hormone to a receptor, which then triggers a sequence of events ending with cytokinesis.

Mark awarded = **(a) (i) 0/1, (ii) 1/3**
Mark awarded = **(b) 2/2**
Mark awarded = **(c) 0/3**

Total marks awarded = 3 out of 9

Common mistakes candidates made in this question

(a) (i) and (ii) This question was misread by some candidates, who described early and then late prophase rather than the behaviour of the chromosome at prophase, as requested. There were also some who were confused about a single chromosome comprised of two sister chromatids and a homologous pair of chromosomes. An incorrect term, 'homologous chromatids', was frequently seen in **(a) (i)**, and chromosomes were sometimes incorrectly described as 'uncoiling'.

(b) The equator was stated to be the centre or middle of the cell, which was not creditworthy. Similarly, the poles were given as the 'ends'.

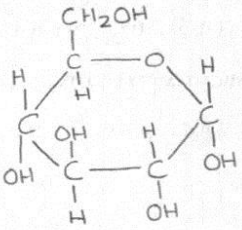
(c) A common mistake was to describe cytokinin as having a receptor, rather than the receptor being on the target cell. Some misread 'cytokinin' as 'cytokine' and described stages in the immune response.

Question 6

Example candidate response – high

6 One of the enzymes involved in glycogen synthesis is glycogen synthase. The monomer of the glycogen polymer is α-glucose.

(a) (i) Draw the ring form of α-glucose in the space provided.



1

[2]

(ii) Glycogen synthase catalyses the formation of a covalent bond between two α-glucose molecules during glycogen synthesis.

Name the type of bond formed.

Glycosidic bond [1]

(iii) Glycogen branching enzyme is another enzyme that is required for glycogen synthesis.

Suggest why glycogen branching enzyme is needed in addition to glycogen synthase.

Enzymes are specific and their active sites are complementary to only one type of substrate and bond formation. Glycogen synthase is specific to forming 1,4-α glycosidic bonds and glycogen branching enzyme is specific to forming 1,6-α glycosidic bond [1]

2

(b) The gene coding for glycogen synthase in muscle cells is known as *GYS1*.

(i) Explain what is meant by a *gene*.

a specific lenght of nuclectides on the DNA molecule that codes for a specific order of amino acids i.e. a specific polypeptide chain or protein

3

[2]

Examiner comments

1 The diagram is set out clearly so that it is easy for the examiner to check knowledge of the structure of α-glucose.

Mark for (a) (i) = 2/2

Mark for (a) (ii) = 1/1

2 An excellent response showing knowledge of α,1-6 bond formation between glucose monomers and an understanding of the specificity of enzymes.

Mark for (a) (iii) = 1/1

3 A comprehensive response.

Mark for (b) (i) = 2/2

Example candidate response – high, continued

(ii) There are a number of known mutations for *GYS1*.

Outline how a mutation in *GYS1* can lead to the formation of an altered polypeptide where one amino acid is replaced by a different amino acid.

A base on the sense strand in the gene is substituted e.g. A is replaced by G. The triplet code is altered (4) when transcription occurs, in the mRNA strand formed by complementary base pairing contains the incorrect codon (specific to altered triplet code). (5) mRNA leaves nucleus and binds to ribosome, during translation tRNA's enter ribosome in turns and amino acid joins chain, however at incorrect codon, incorrect anticodon binds to it, so different amino acid added to chain. In this way, primary structure of protein changed. (6) [3]

(c) Table 6.1 shows three functions of cell structures that are involved in the synthesis of glycogen synthase.

Complete Table 6.1 by naming the cell structure that carries out the function listed.

Table 6.1

function	name of cell structure
assembles ribosomes for polypeptide synthesis	rough endoplasmic reticulum. (7)
synthesises ATP to provide a supply of energy for transcription of *GYS1*	mitochondria
folds and modifies synthesised polypeptide to produce functioning glycogen synthase	golgi apparatus

[3]

[Total: 12]

Examiner comments

4 The 'sense strand' was ignored in this response. The DNA strand that is copied to form the mRNA can be termed the template strand.

5 It is made clear that only one codon is altered, which would lead to a single amino acid change

6 This is a flowing, sequential account. The candidate knows the difference between transcription and translation and knows the main events that occur in each process.

Mark for (b) (ii) = 3/3

7 The second and third cell structures match the descriptions of the function. However, the first cell structure should be the nucleolus.

Mark for (c) = 2/3

Total marks awarded = 11 out of 12

How the candidate could have improved their answer

(a) (i) The candidate could have made sure that the bonds between the carbon atoms and the hydroxyl groups showed bonding between C and O. The candidate's diagram has the bond leading from the carbon atom to a location between the O and the H. This was not penalised.

(b) (i) The only error here was the misspelling: 'lenght', instead of 'length'.

(c) Careful rereading of the function and reflection on the meaning of the phrase 'assembles ribosomes' might have reminded the candidate of the role of the nucleolus.

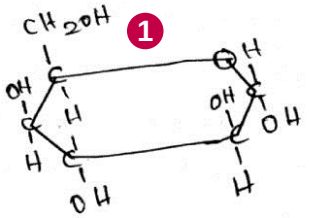
Mark awarded = **(a) (i) 2/2, (ii) 1/1, (iii) 1/1**
Mark awarded = **(b) (i) 2/2, (ii) 3/3**
Mark awarded = **(c) 2/3**

Total marks awarded = 11 out of 12

Example candidate response – middle

6 One of the enzymes involved in glycogen synthesis is glycogen synthase. The monomer of the glycogen polymer is α-glucose.

(a) (i) Draw the ring form of α-glucose in the space provided.



[2]

(ii) Glycogen synthase catalyses the formation of a covalent bond between two α-glucose molecules during glycogen synthesis.

Name the type of bond formed.

glycosedic bond. [1]

(iii) Glycogen branching enzyme is another enzyme that is required for glycogen synthesis.

Suggest why glycogen branching enzyme is needed in addition to glycogen synthase.

To catalyst the reaction and fasten the reaction by reducing the activation energy needed for the reaction. [1]

(b) The gene coding for glycogen synthase in muscle cells is known as *GYS1*.

(i) Explain what is meant by a *gene*.

Gene is a section in DNA that codes for a specific amino acid sequence to produce a specific protein that is needed for cell metabolism and expcibit different characters. [2]

Examiner comments

1 Even if the method of writing over the corners of the ring structure with C and O is ignored, the candidate only shows 11 and not 12 hydrogen atoms. Three of the carbons, the hydroxyl groups, are not drawn in the correct position.

Mark for (a) (i) = 0/2

2 This is not the correct spelling, but the candidate is awarded the mark.

Mark for (a) (ii) = 1/1

3 This describes the action of an enzyme in general rather than focusing on the action of the glycogen branching enzyme.

Mark for (a) (iii) = 0/1

4 The information provided about a gene is a correct explanation and gains full marks.

Mark for (b) = 2/2

Example candidate response – middle

(ii) There are a number of known mutations for *GYS1*.

Outline how a mutation in *GYS1* can lead to the formation of an altered polypeptide where one amino acid is replaced by a different amino acid.

when there is a change in oder of nucleotides in a gene, it when it is uses in transiation that mutated gene will produce a diffevent amino acid instad of a normal amino acid as theve was diffevent nucleotide causing a diffevent amino acid chain giving a different protein as distrupting the function of the protein. [3]

5

(c) Table 6.1 shows three functions of cell structures that are involved in the synthesis of glycogen synthase.

Complete Table 6.1 by naming the cell structure that carries out the function listed.

Table 6.1

function	name of cell structure
assembles ribosomes for polypeptide synthesis	nucleolus.
synthesises ATP to provide a supply of energy for transcription of *GYS1*	mitochondria
folds and modifies synthesised polypeptide to produce functioning glycogen synthase	golgi apparatus

6

[3]

[Total: 12]

Examiner comments

5 The word 'oder' is taken to mean 'order' and so a mark can be awarded. There is no other creditworthy material in the response. The candidate more or less repeats the idea that an altered polypeptide is formed.

Mark for (b) (ii) = 1/3

6 Full marks are awarded here. The candidate has read the first function statement carefully and correctly deduces that the structure is the nucleolus.

Mark for (c) = 3/3

Total marks awarded = 7 out of 12

How the candidate could have improved their answer

(a) (i) The candidate could have practised drawing the correct ring structure of α-glucose as part of their revision.

(a) (ii) The candidate's spelling of 'glycosedic' for 'glycosidic' should have been corrected.

(a) (iii) The candidate should have used knowledge of the structure of glycogen to consider the precise function of the glycogen branching enzyme, or should have applied knowledge of enzyme specificity to explain why the formation of the different bonds requires a different enzyme.

(b) (ii) The candidate needed to continue a sequential account and give the next steps in the formation of the polypeptide chain, having begun correctly with the altered nucleotide sequence.

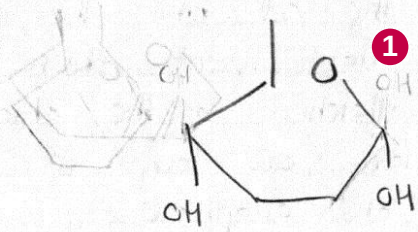
Mark awarded = **(a) (i) 0/2, (ii) 1/1, (iii) 0/1**
Mark awarded = **(b) (i) 2/2, (ii) 1/3**
Mark awarded = **(c) 3/3**

Total marks awarded = 7 out of 12

Example candidate response – low

6 One of the enzymes involved in glycogen synthesis is glycogen synthase. The monomer of the glycogen polymer is α-glucose.

(a) (i) Draw the ring form of α-glucose in the space provided.



1

[2]

(ii) Glycogen synthase catalyses the formation of a covalent bond between two α-glucose molecules during glycogen synthesis.

Name the type of bond formed.

Glycosidic Bond .....[1]

(iii) Glycogen branching enzyme is another enzyme that is required for glycogen synthesis.

Suggest why glycogen branching enzyme is needed in addition to glycogen synthase.

This is necessary as the glycogen needs to have a compact shape for storage. 2

.....[1]

(b) The gene coding for glycogen synthase in muscle cells is known as *GYS1*.

(i) Explain what is meant by a *gene*.

A gene is the component of DNA 3 that has the coding for different proteins and amino acids 4. There are numerous genes present in the DNA

.....[2]

Examiner comments

1 The diagram is not complete and there is too much guesswork left to the examiner to be able to award any marks.

Mark for (a) (i) = 0/2

Mark for (a) (ii) = 1/1

2 This answer is too general because the candidate has explained why a branched molecule will help in the overall compact shape. There is no comment about the role of the glycogen branching enzyme or enzyme specificity in the synthesis of glycogen.

Mark for (a) (iii)= 0/1

3 A component of DNA would be a nucleotide.

4 This reads as if one gene has the information to produce a number of different proteins as well as produce amino acids, which is not correct.

Mark for (b) (i) = 0/2

Example candidate response – low, continued

(ii) There are a number of known mutations for *GYS1*.

Outline how a mutation in *GYS1* can lead to the formation of an altered polypeptide where one amino acid is replaced by a different amino acid.

As the gene has mutated, the base sequence of the mRNA (5) will be altered, and it will have different coding when it enters cytoplasm, the tRNA and amino acid specific to the altered gene will arrive at the ribosome, hence different polypeptide is formed. [3]

(c) Table 6.1 shows three functions of cell structures that are involved in the synthesis of glycogen synthase.

Complete Table 6.1 by naming the cell structure that carries out the function listed.

Table 6.1

function	name of cell structure
assembles ribosomes for polypeptide synthesis	Rough Endoplasmic Reticulum (6)
synthesises ATP to provide a supply of energy for transcription of *GYS1*	Mitochandria
folds and modifies synthesised polypeptide to produce functioning glycogen synthase	Golgi Apparatus

[3]

[Total: 12]

Examiner comments

(5) The candidate shows understanding that a different mRNA would be formed here. The idea that a tRNA would bring a different amino acid to the ribosome is implied and is awarded a mark.

Mark for (b) (ii) = 2/3

(6) The first structure is incorrect, but the second and third are awarded marks.

Mark for (c) = 2/3

Total marks awarded = 5 out of 12

How the candidate could have improved their answer

(a) (i) The candidate needed to learn this structure and produce a more complete diagram so that the relative positions of the H and OH groups for each carbon and the position of the CH_2OH group were shown.

(a) (iii) The candidate needed to consider the synthesis of glycogen here. They understood that glycogen is a branched molecule, so stating the function of the glycogen branching enzyme in forming α-1,6 glycosidic bonds would have gained credit.

(b) (i) The gene should have been described as a length or section of DNA and it should have been made clear that the gene codes for a polypeptide.

(b) (ii) The candidate should have begun their account with the idea that the sequence of nucleotides on the DNA would be altered, and/or stated that a base substitution had occurred. The statements about tRNA could have been more precise. The idea that a tRNA with a different anticodon would bring a different amino acid to the ribosome for translation was not clearly stated.

(c) The candidate should have given 'nucleolus' as the structure responsible for assembling ribosomes.

Mark awarded = **(a) (i) 0/2, (ii) 1/1, (iii) 0/1**
Mark awarded = **(b) (i) 0/2, (ii) 2/3**
Mark awarded = **(c) 2/3**

Total marks awarded = 5 out of 12

Common mistakes candidates made in this question

(a) (i) The CH_2OH group was frequently incorrect, for example C_2H_5OH or CH_2O. Many forgot to draw in the hydrogen for carbon 5, while a number inverted the H and OH groups for carbons 2 and 3.

(a) (ii) The spelling of 'glycosidic' was frequently incorrect. Some gave 'peptide' or 'hydrogen bond' in error.

(a) (iii) The most common mistake was to be too general and state that the enzyme was needed to form branches, or that the enzyme lowered activation energy, rather than stating precisely the type of bond catalysed by glycogen branching enzyme or showing an understanding of active sites and specificity in bond formation.

(b) (i) Many responses to this were too vague, referring to genes producing characteristics and not giving molecular detail as stated in the relevant syllabus learning outcome. Quite a few candidates confused the idea of a gene coding for a polypeptide with the genetic code and incorrectly stated that a gene had a genetic code. Some thought that a gene was only a triplet of bases. Others stated that a gene coded for an amino acid rather than a polypeptide.

(b) (ii) A change of one amino acid means that only one codon is altered. However, many candidates suggested that insertion or deletion mutations could have occurred. Some candidates did not outline any of the events in transcription and translation and wrote instead about how changes in a polypeptide would lead to a non-functioning protein.

(c) The most common mistake here was to give 'rough endoplasmic reticulum' instead of 'nucleolus' for the first function.

Cambridge International Examinations
1 Hills Road, Cambridge, CB1 2EU, United Kingdom
t: +44 1223 553554 f: +44 1223 553558
e: **info@cie.org.uk** **www.cie.org.uk**

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