Cambridge Assessment
International Education

Interactive

Interactive Example Candidate Responses
Paper 2 (May/June 2016), Question 1
Cambridge International AS & A Level
Biology 9700

Version 1.0

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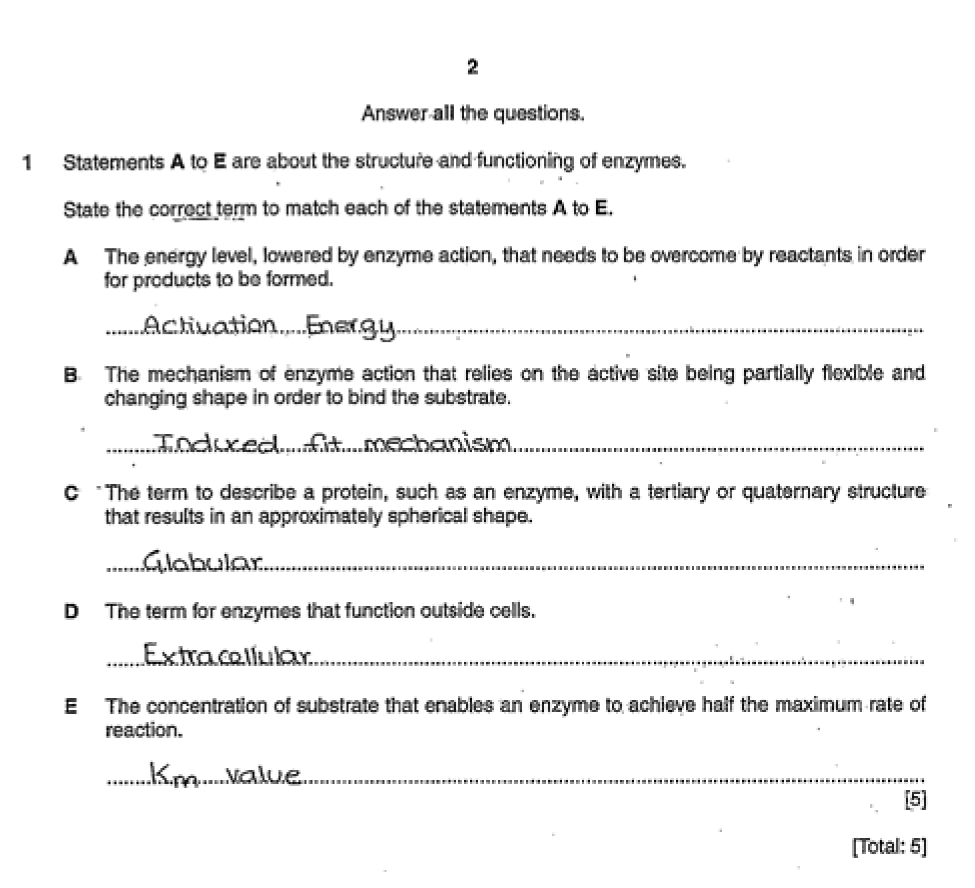


Answer **all** the questions.

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.

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.

K_m value

[5]

[Total: 5]

Your Mark

1(A) ☐

1(B) ☐

1(C) ☐

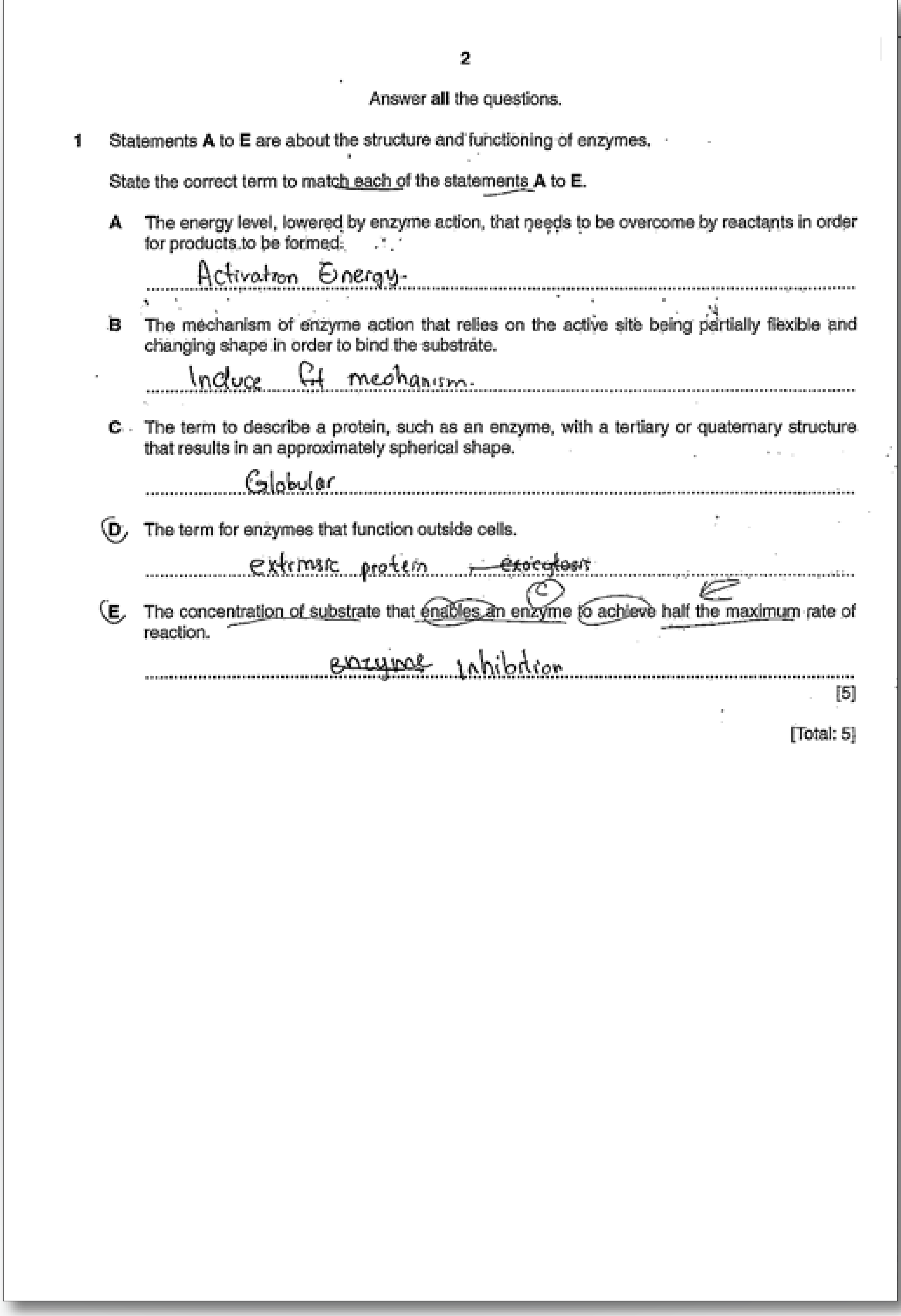
1(D) ☐

1(E) ☐

Q1	Mark scheme	
(a)A	A activation energy / energy of activation ;	**[1]**
(a)B	induced fit ; A induced fit, model / hypothesis / theory / mechanism	**[1]**
(a)C	globular ;	**[1]**
(a)D	extracellular ;	**[1]**
(a)E	E Michaelis-Menten constant ; A Km	**[1]** **[Total: 5]**

EXAMINER COMMENTS

MARK SCHEME



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Activatron 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.

extrinsic protein ~~exocytosis~~

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

enzyme inhibitor

[5]

[Total: 5]

Your Mark

1(A) ☐

1(B) ☐

1(C) ☐

1(D) ☐

1(E) ☐

Q1	Mark scheme
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(a)B	induced fit ; A induced fit, model / hypothesis / theory / mechanism **[1]**
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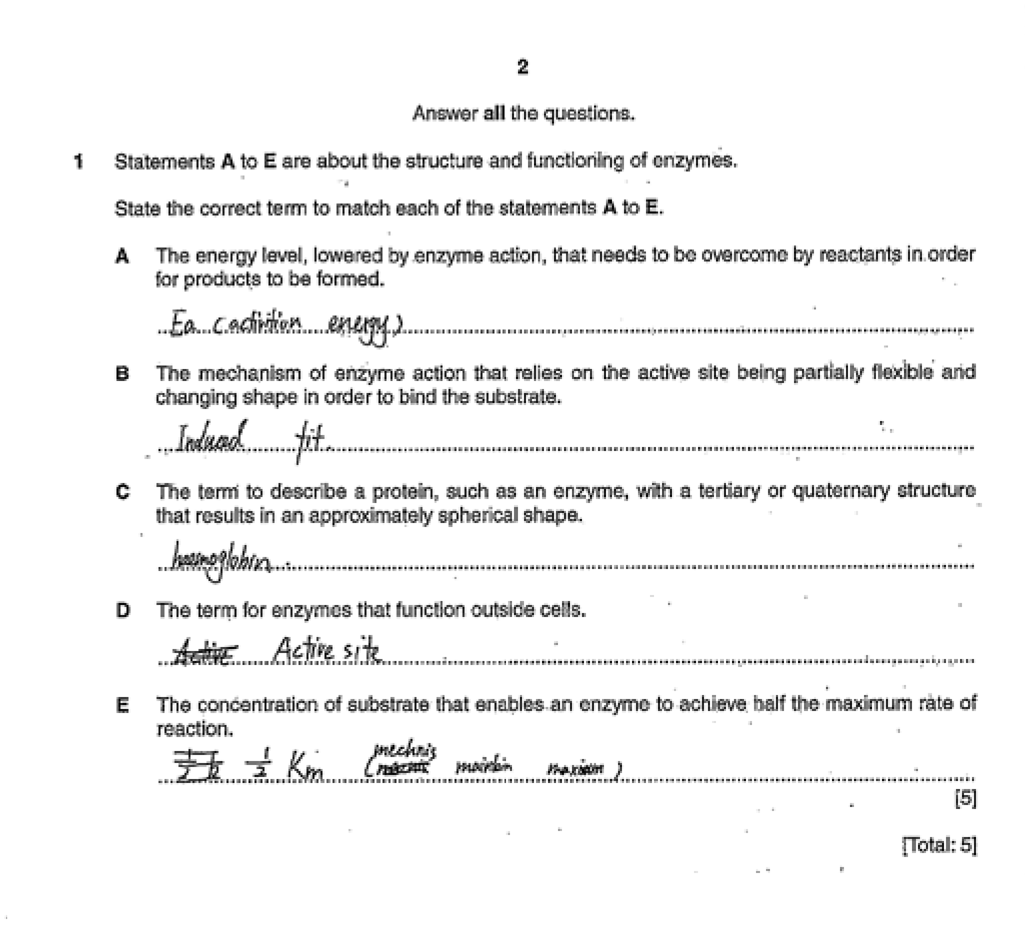

2

Answer **all** the questions.

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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)

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

Indued 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

D The term for enzymes that function outside cells.

~~Active~~ Active site

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

~~[illegible]~~ $\frac{1}{2}$ Km (mechnis ~~[illegible]~~ maixbin maxium)

[5]

[Total: 5]

Your Mark

1(A) ☐

1(B) ☐

1(C) ☐

1(D) ☐

1(E) ☐

Q1	Mark scheme	
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(a)B	induced fit ; A induced fit, model / hypothesis / theory / mechanism	**[1]**
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(a)E	E Michaelis-Menten constant ; A Km	**[1]** **[Total: 5]**

EXAMINER COMMENTS

MARK SCHEME

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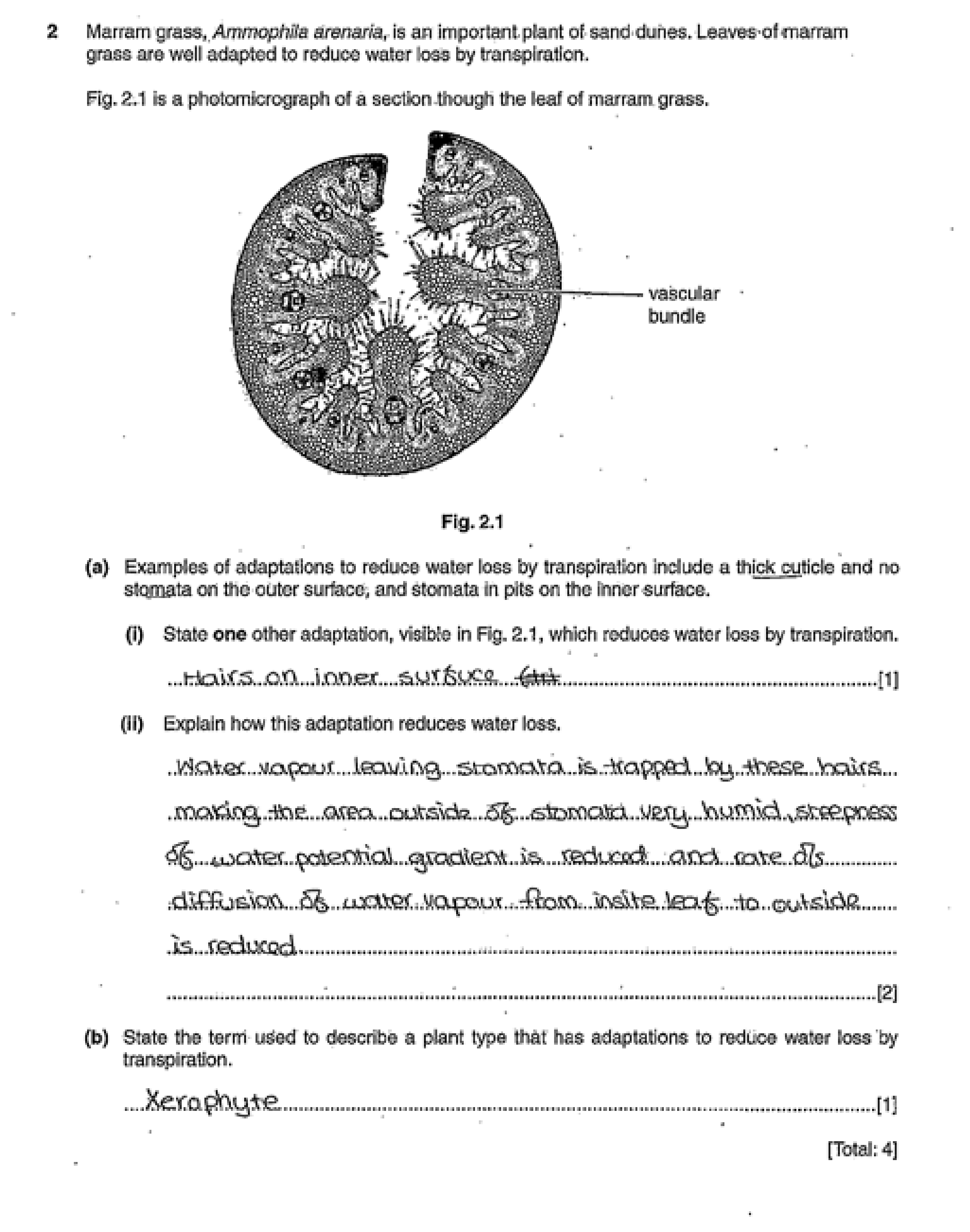

2 Marram grass, *Ammophila arenaria*, is an important plant of sand dunes. Leaves of marram grass are well adapted to reduce water loss by transpiration.

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 ~~thi~~ [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 diffusion of water vapour from insite leaf to outside is reduced [2]

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

Xerophyte [1]

[Total: 4]

Your Mark

(a)(i)

(a)(ii)

(b)

Q2	Mark scheme
(a)(i)	curled / rolled, leaf ; R curly / curved / folded or trichomes / hairs ; A hair / hairy,-like structures R cilia / spines / needles **[1]**
(a)(ii)	*allow explanations for stomata in pits, thick cuticle and no stomata on outer surface as ecf from (i)* *curled leaf / trichomes / stomata in pits* *ref. to* (creates) still / non-moving, air ; (in enclosed area) humid / moist ; AW, e.g. traps water vapour / maintains humidity <u>water potential gradient</u> less steep or decreased rate of <u>diffusion</u> of <u>water</u> <u>vapour</u> (out) ; **A** (water) *vapour pressure gradient* for water potential gradient I decreased concentration gradient of water vapour *assume in context of between substomatal air space and enclosed area unless stated otherwise* *thick cuticle* greater layer impermeable wax / AW ; A thicker waterproof layer increases distance for diffusion ; of water vapour ; *no stomata on outer surface* most water lost via (open) stomata ; cuticular transpiration only ; *ref. to* where most exposure to, light / air currents / wind ; **[max 2]**
((b)	xerophytic / xerophyte ; **[1]** **[Total: 4]**

EXAMINER COMMENTS

MARK SCHEME

Select page

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MIDDLE

LOW

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

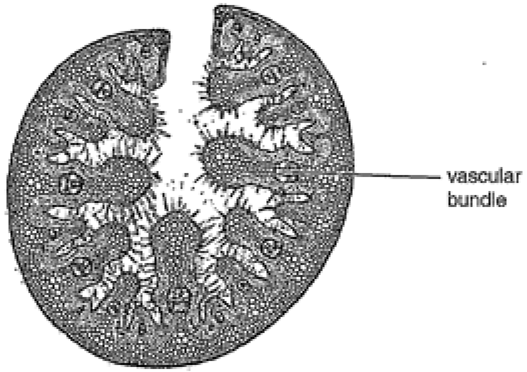

Fig. 2.1

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(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]

(ii) Explain how this adaptation reduces water loss.

The ~~Hairs~~ structures acts like a barrier between the leaf and outer s areas , they may trap the water there, thus lowering the water potential gradient between inside and outside , so ~~too~~ 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]

Your Mark

(a)(i) ☐

(a)(ii) ☐

(b) ☐

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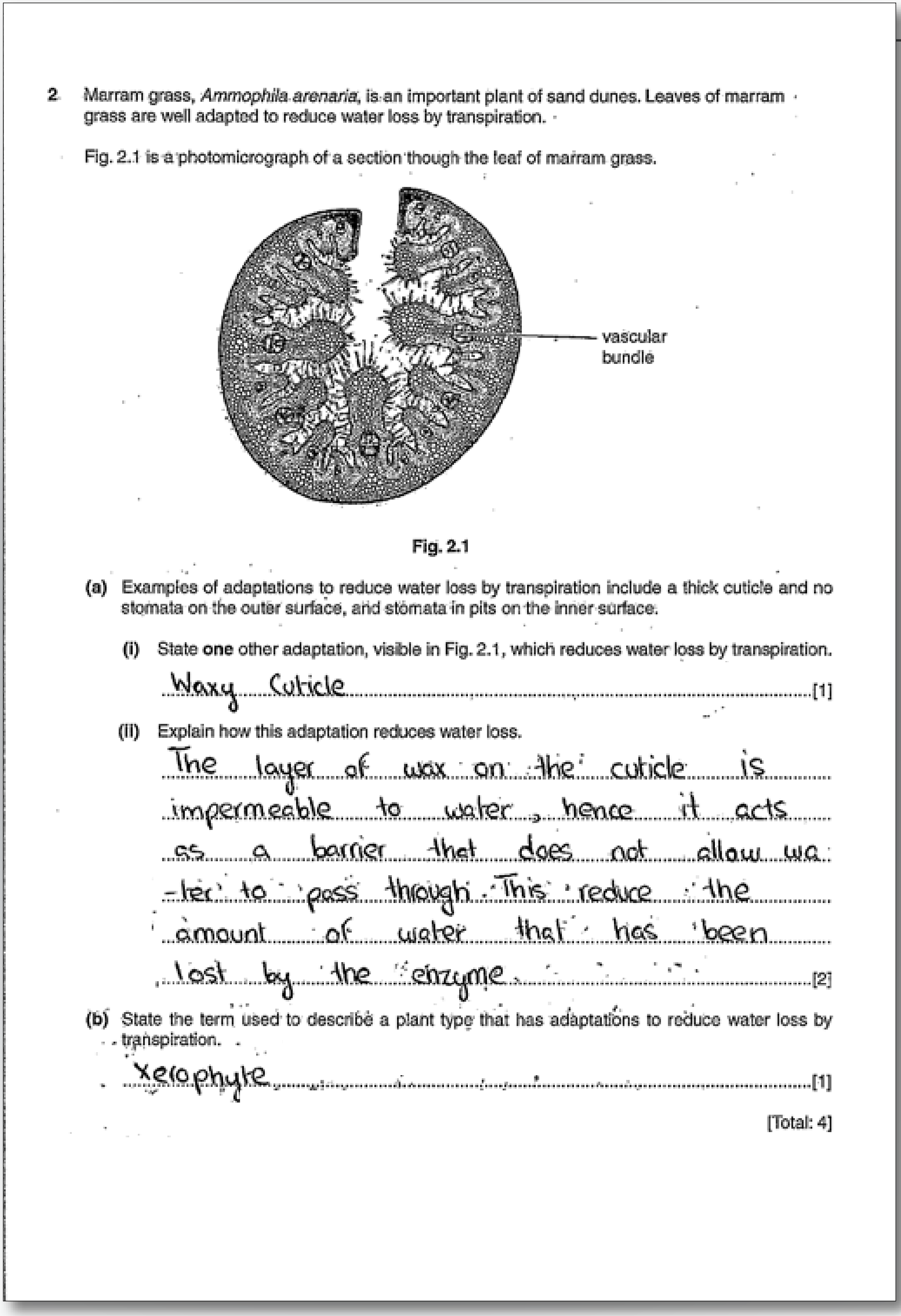

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(i) State **one** other adaptation, visible in Fig. 2.1, which reduces water loss by transpiration.

Waxy Cuticle [1]

(ii) Explain how this adaptation reduces water loss.

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

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

Xerophyte [1]

[Total: 4]

Your Mark

(a)(i) ☐

(a)(ii) ☐

(b) ☐

Q2	Mark scheme
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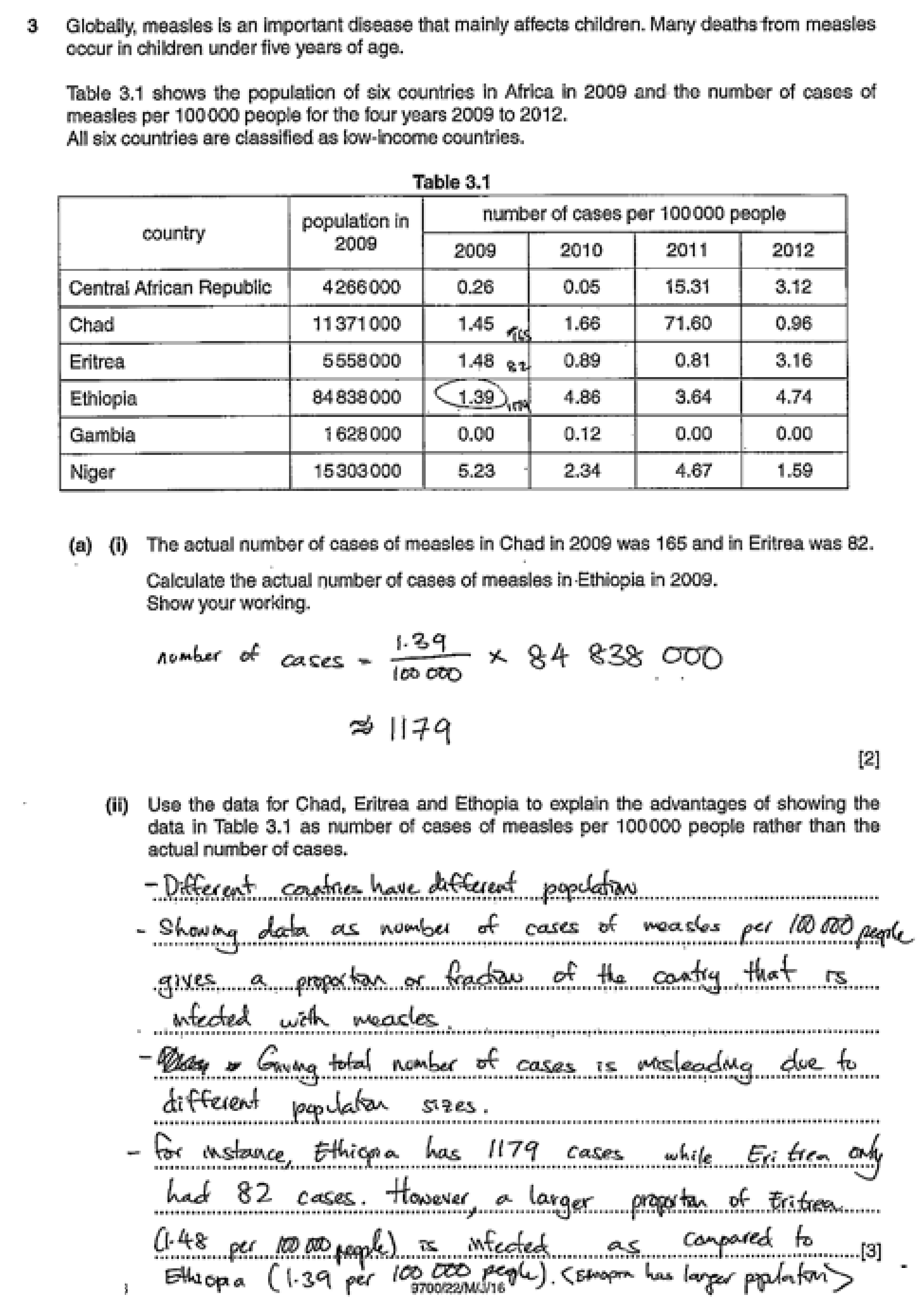

3 Globally, measles is an important disease that mainly affects children. Many deaths from measles occur in children under five years of age.

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.

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

$$\approx 1179$$

[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.

- Different countries have different population
- Showing data as number of cases of measles per 100 000 people gives a proportion or fraction of the contry that is infected with measles.
- ~~[illegible]~~ 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]

Your Mark

Examiner marks and comments

Your Mark	Mark	Comment
3(a)(i)	2/2	The correct calculated value is given and the working is also shown clearly.
3(a)(ii)	3/3	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.
3(b)	4/4	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. 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. The candidate makes it clear here that they are switching to provide evidence that does not support the statement.
3(c)	2/2	This is a very good description of the vaccine used in the successful campaign to eradicate smallpox. A very thorough answer displaying good understanding.
3(d)	1/1	
3(e)	2/2	There are actually two acceptable examples in this second answer; the cost of manufacturing viruses would have been enough to earn the mark.

EXAMINER COMMENTS

MARK SCHEME

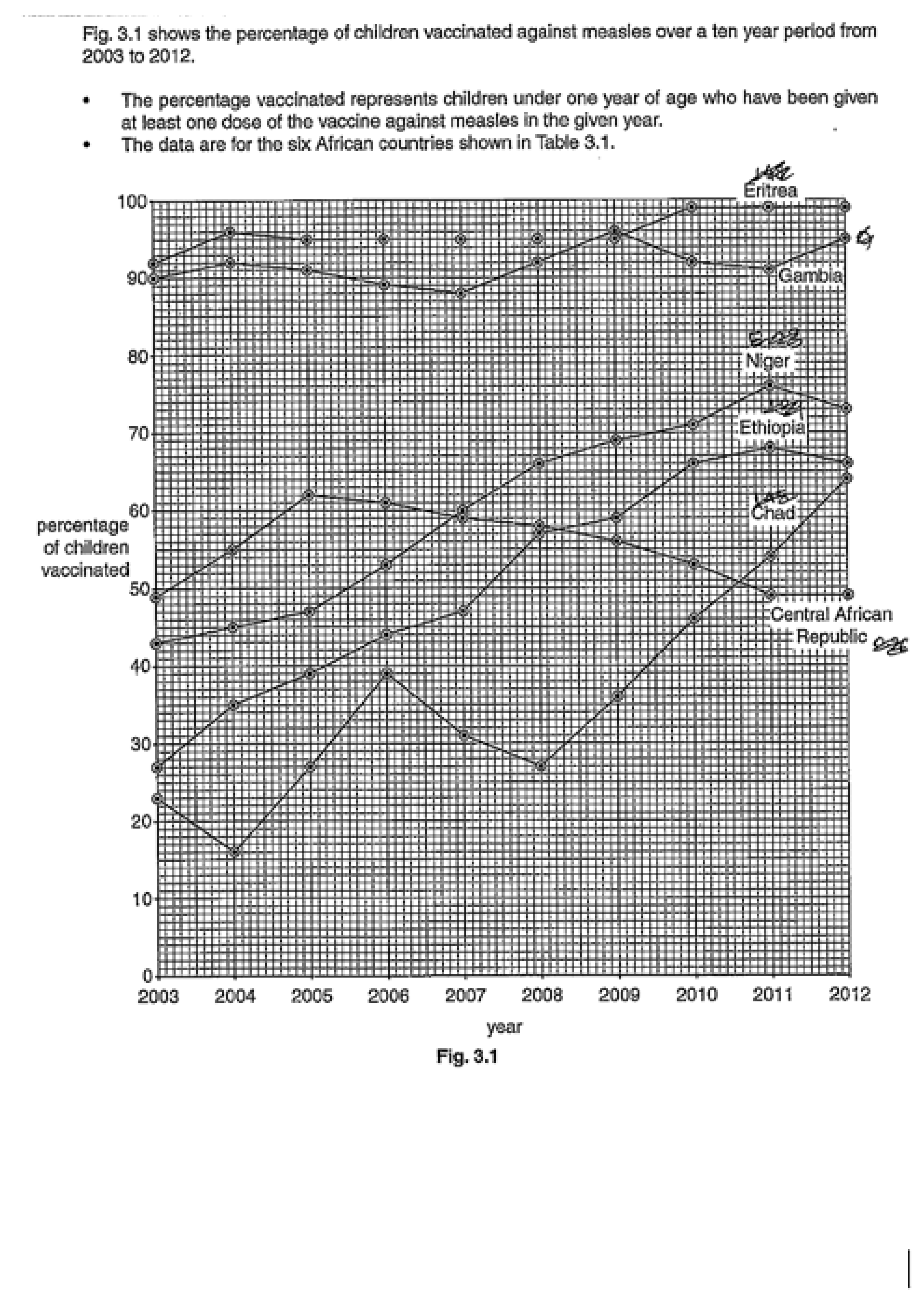

Fig. 3.1 shows the percentage of children vaccinated against measles over a ten year period from 2003 to 2012.

- 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

Examiner marks and comments

	Your Mark	Mark	Comment
3(a)(i)		2/2	The correct calculated value is given and the working is also shown clearly.
3(a)(ii)		3/3	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.
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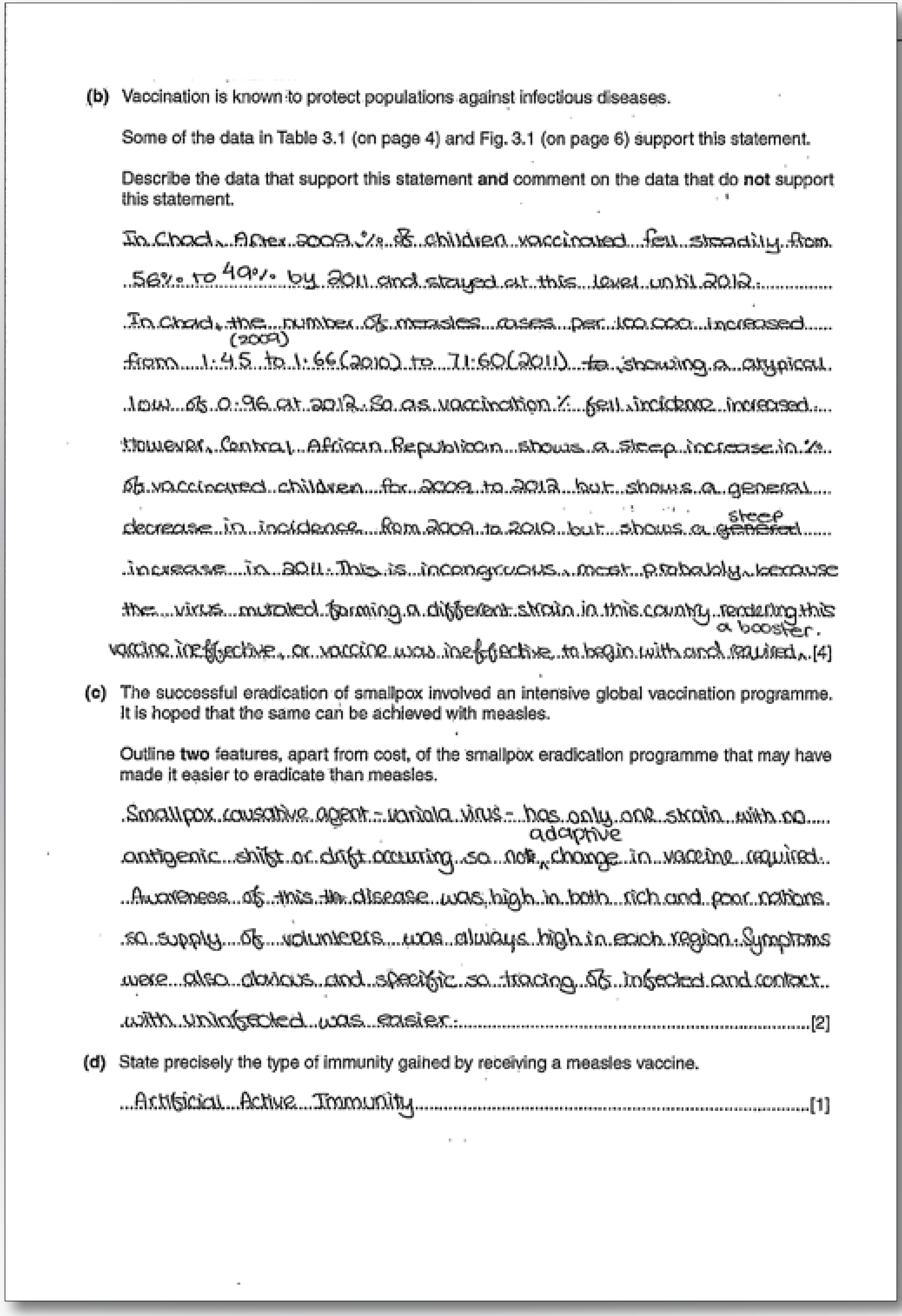
HIGH

MIDDLE

LOW



(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 Chad, After 2009 % of children vaccinated fell steadily from
56% to 49% by 2011 and stayed at this level until 2012.
In Chad, the number of measles cases per 100,000 increased
from (2009) 1:45 to 1:66 (2010) to 71:60 (2011) ~~to~~ showing a atypical
low of 0:96 at 2012. So as vaccination % fell, incidence increased.
However, Central African Republican shows a steep increase in %
of vaccinated children for 2009 to 2012 but shows a general
decrease in incidence from 2009 to 2010 but shows a ~~general~~ steep
increase in 2011. This is incongruous, most probably because
the virus mutated forming a different strain in this country rendering this
vaccine ineffective, or vaccine was ineffective to begin with and required a booster. [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.

Smallpox causative agent – variola virus – has only one strain with no
antigenic shift or drift occurring so not adaptive change in vaccine required.
Awareness of ~~this~~ ~~the~~ disease was high in both rich and poor nations.
so supply of volunteers was always high in each region. Symptoms
were also obvious and specific so tracing of infected and contact
with uninfected was easier. [2]

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

Artificial Active Immunity [1]

Examiner marks and comments

	Your Mark	Mark	Comment
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3(c)		2/2	This is a very good description of the vaccine used in the successful campaign to eradicate smallpox. A very thorough answer displaying good understanding.
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EXAMINER COMMENTS

MARK SCHEME

Select page

HIGH

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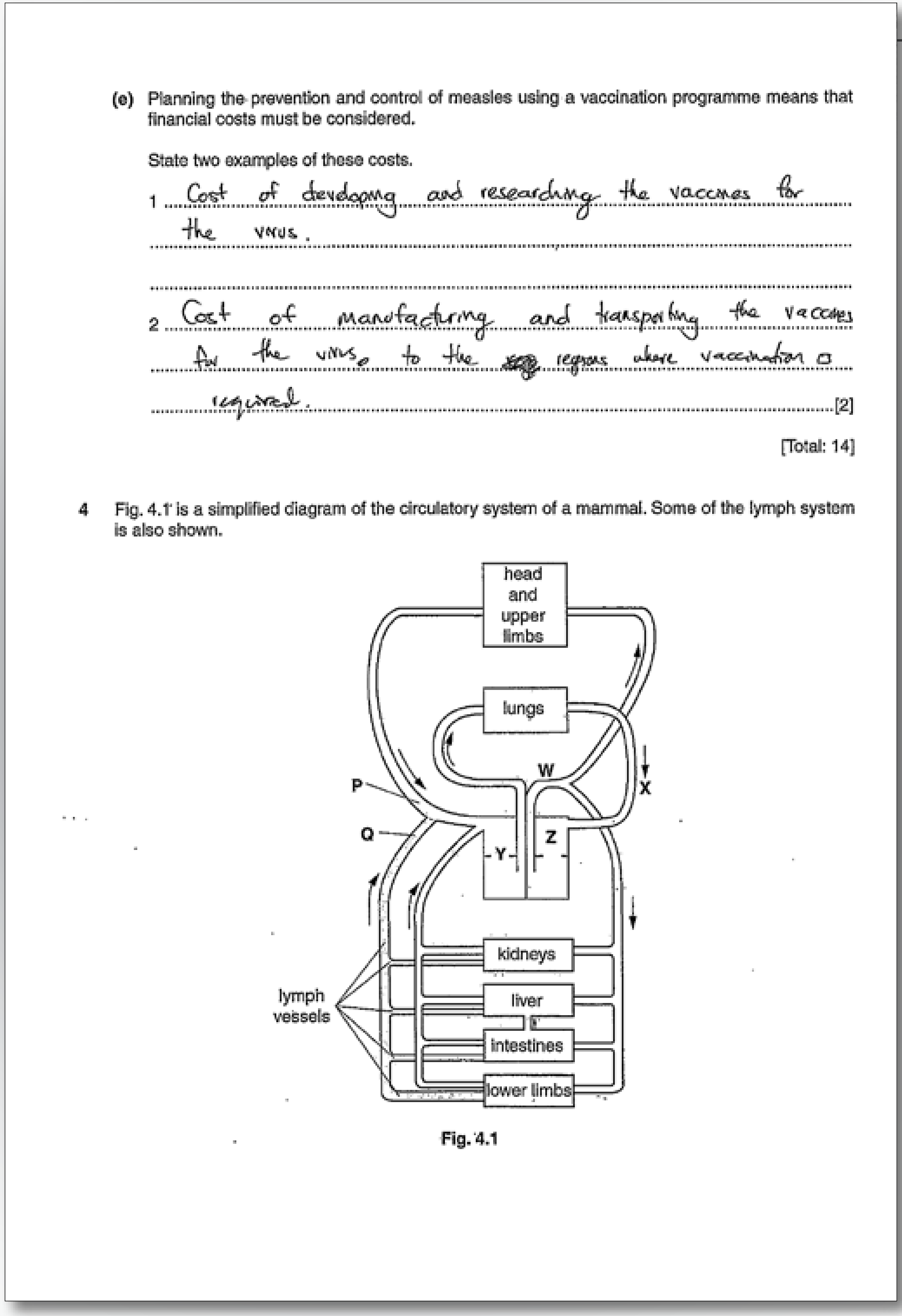

(e) Planning the prevention and control of measles using a vaccination programme means that financial costs must be considered.

State two examples of these costs.

1 Cost of developing and researching the vaccines for the virus.

2 Cost of manufacturing and transporting the vaccines for the virus, to the regions where vaccination is required.

[2]

[Total: 14]

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

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b) ☐

3(c) ☐

3(d) ☐

3(e) ☐

Examiner marks and comments

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2/2	This is a very good description of the vaccine used in the successful campaign to eradicate smallpox. A very thorough answer displaying good understanding.
1/1	
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MARK SCHEME

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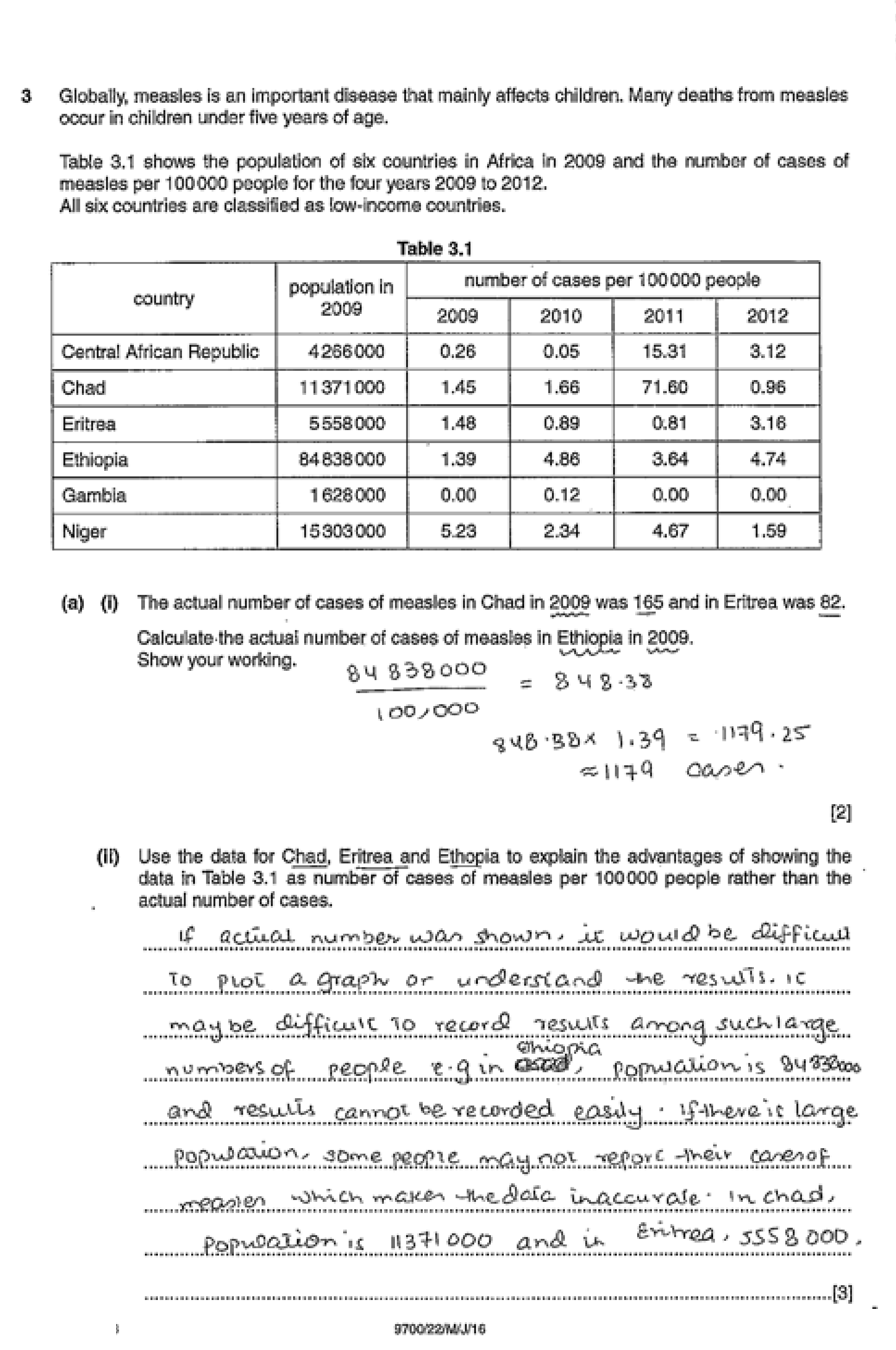

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(a) (i) The actual number of cases of measles in Chad in 2009 was 165 and in Eritrea was 82.

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

$$\frac{84\,838000}{100{,}000} = 848.38$$

$848.38 \times 1.39 = 1179.25$

≈ 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, 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.

[3]

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b) ☐

3(c) ☐

3(d) ☐

3(e) ☐

Q3	Mark scheme
(a)(i)	1179 ;; one mark if not to the whole person e.g. 1179.24 / 1179.2 or if calculation correct but answer incorrect e.g. 1.39 × 848.38 or 1.39 × (84 838 000/100 000) or if no calculation to check but answer given as 1180 [2] **[2]**
(a)(ii)	1 provides information about / AW, proportion / percentage, (of population) affected / AW ; 2 to, make (valid) comparisons / compare ; between countries / in one country over time 3 provides information about severity of disease ; AW 4 population size, taken into account / different for different countries / changes over time in a country ; do not need ‘size’ if ‘use of ‘population’ is in correct context 5 idea that countries with larger populations will usually have more cases / higher number of cases may just mean larger population of country; 6 AVP ; gives guidance about whether the disease is, spreading / becoming an epidemic / dying out (in one country) in context of over time idea that number of cases per 100 000 are, standardised / normalised, values 7 use of data to support ; only two of Chad, Eritrea or Ethiopia where comparisons between countries stated I ref. to other countries (2009) actual cases and standardised cases comparison (2009) to support mp 5 population size and actual cases stated values of similar number of cases per 100 000 and populations of different sizes countries compared, number of cases per 100 000 for any stated year, with comment about severity number of cases per 100 000 for one country over time, withcomment about severity / spreading / dying out / control / AW **[max 3]**

EXAMINER COMMENTS

MARK SCHEME

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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.

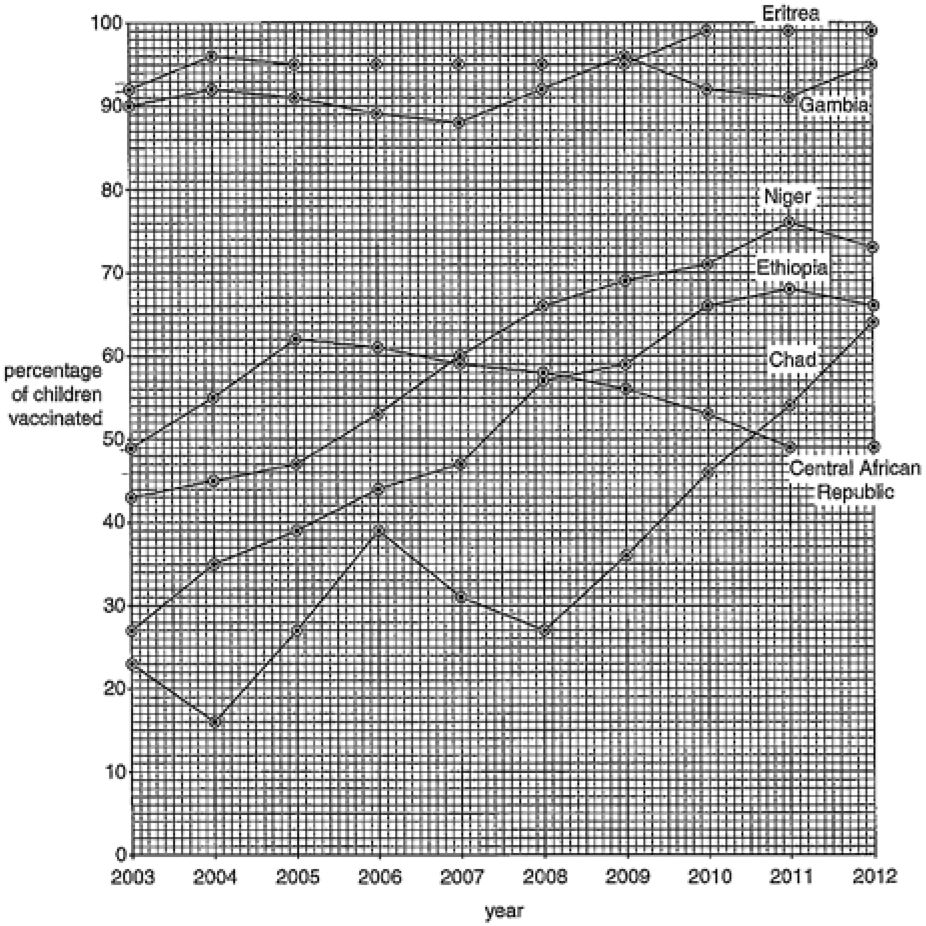

Fig. 3.1

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b) ☐

3(c) ☐

3(d) ☐

3(e) ☐

Q3	Mark scheme
(b)	can give values of percentage vaccinated to describe 'increasing / decreasing' percentage vaccination *support* 1 Gambia high percentage vaccinated (throughout) and low number of cases ; **A** Eritrea 2 data to support ; e.g. a percentage vaccination for a year and number of cases (same, or following, year after vaccination) or a range given for percentage vaccinations over the whole, or stated, number of years or a compilation of the two *partial / weak, support* 3 Central African Republic decreasing vaccination and number of cases in 2011, higher / 15.31 ; 4 Chad (from 2008) increasing percentage vaccination and, low / stated, number of cases, 2009 / 2010 / 2012 ; 1.45 1.66 0.96 *do not support* 5 Niger / Ethiopia / Chad, (generally) increasing percentage vaccinated and number of cases, fluctuates / increase and decrease (ora) / AW ; **A** stated correct data to show increase and decrease **A** for Chad if mp 4 given and ref. to increase / 71.6 in 2011 6 (generally) increasing percentage vaccinated and number of cases, increases / goes from 2.34–4.67, in 2011 in Niger or increases / goes from 1.39–4.86, in 2010 in Ethiopia or increases / goes from 1.66–71.6, in 2011 in Chad A 1.45–1.66 in 2010 ; 7 Central African Republic decreasing vaccination and low number of cases in, 2009 / 2010 / 2012 ; 8 / 9 AVP ;; e.g. • idea that most values for number of cases are low irrespective of vaccination percentage • ref.to needs, high / 90%, vaccination to be effective **A** < 80% / low, vaccination ineffective • idea that generally Gambia / Eritrea, have higher percentage vaccinated and have lower number of cases than, (three of) Ethiopia, Chad, Central African Republic, Niger / the other countries

EXAMINER COMMENTS

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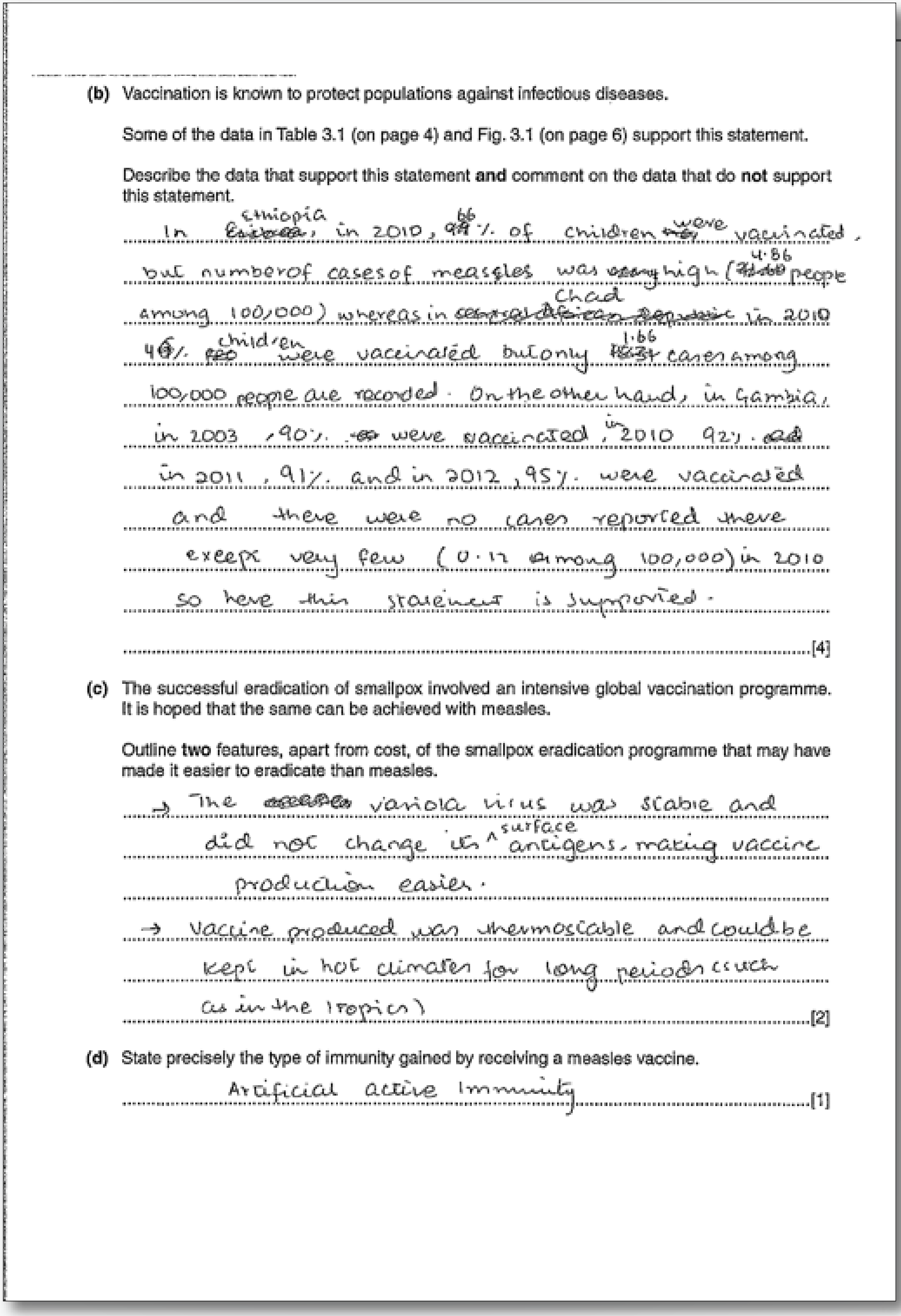

(b) Vaccination is known to protect populations against infectious diseases.

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 ~~they~~ were vaccinated, but numberof casesof measles was ~~very~~ high (~~[illegible]~~ 4.86 people among 100,000) whereas in ~~central African Republic~~ Chad in 2010 46% ~~[illegible]~~ children were vaccinated but only ~~[illegible]~~ 1.66 cases among 100,000 people are recorded. On the other hand, in Gambia, in 2003, 90% ~~[illegible]~~ were vaccinated, in 2010 92% ~~[illegible]~~ in 2011, 91% and in 2012, 95% were vaccinated and there were no cases reported there except very few (0.17 among 100,000) in 2010 so here this statement is supported.

[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 ~~[illegible]~~ 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)

[2]

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

Artificial active Immunity

[1]

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b) ☐

3(c) ☐

3(d) ☐

3(e) ☐

Q3	Mark scheme
(b) *cont.*	• ref. to Chad / Central African Republic, in 2011 and, epidemics / inability to keep number of cases down / ineffectiveness of vaccination programme I ref. to 71.6 (Chad) or 15.31 (Central African Republic) • Eritrea 2012 high vaccination but, increase in / 3.16, cases • ref. to increasing percentage of vaccination in Niger and decrease in cases, 2009–2010 from 5.23 to 2.34 / 2011–2012 from 4.67–1.59 **A** 2009–2012 from 5.23 to1.59 **[max 4]**
(c)	*points refer to smallpox, look for points written as ora any two from* 1 high, percentage / proportion, immunised / vaccinated ; AW **A** mass vaccination 2 no boosters required / one dose enough / immunity very long-lived; **A** idea of long-lasting effect of vaccine 3 same, vaccine / antigens, used (throughout) ; treat as neutral ref. to, low mutation rate / stability, of smallpox virus 4 heat stable / thermostable / freeze-dried / lyophilised, vaccine ; I frozen **A** no need to refrigerate / AW **A** idea of longer shelf-life 5 ease of, administering vaccine / training people to give vaccine ; 6 ring vaccination / described, e.g. contact tracing ; 7 easy to identify infected people / AW, (to begin ring vaccination) ; 8 lower percentage cover required for smallpox than measles / lower herd immunity required; 9 AVP ; smallpox less infectious (so lower percentage cover required) idea of less, civil unrest / war / movement of populations (so easier to implement) suggestion that smallpox live vaccine (and measles not live) **[max 2]**
(d)	active artificial / artificial active ; treat as neutral acquired **[1]**

(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. [2]

[Total: 14]

4 Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.

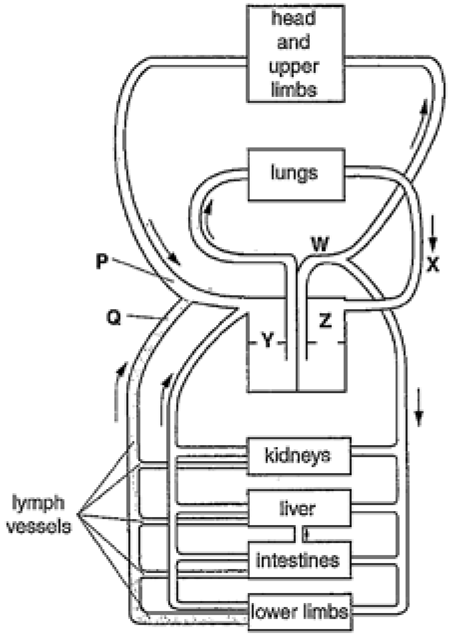

Fig. 4.1

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b) ☐

3(c) ☐

3(d) ☐

3(e) ☐

Q3	Mark scheme
(e)	*can be from point of view of country programme or WHO programme cost* 1 preparing / manufacturing / purchasing, vaccine ; A cost to provide vaccine free to developing countries 2 disposables / equipment to administer (vaccine) ; e.g. syringes / needles / (protective) gloves 3 storage ; e.g. space, security 4 refrigeration / maintaining cold chain ; 5 transport (of, vaccine / health care workers) ; 6 wages / training, of staff involved ; e.g. wages for, health care workers administering vaccine / staff involved in training health care workers 7 record keeping / contact tracing ; 8 advertising / informing / marketing / education ; 9 research / development ; 10 setting up vaccination / immunisation, camps (for remote / epidemic, areas) ; I building, hospitals / clinics **[max 2]**

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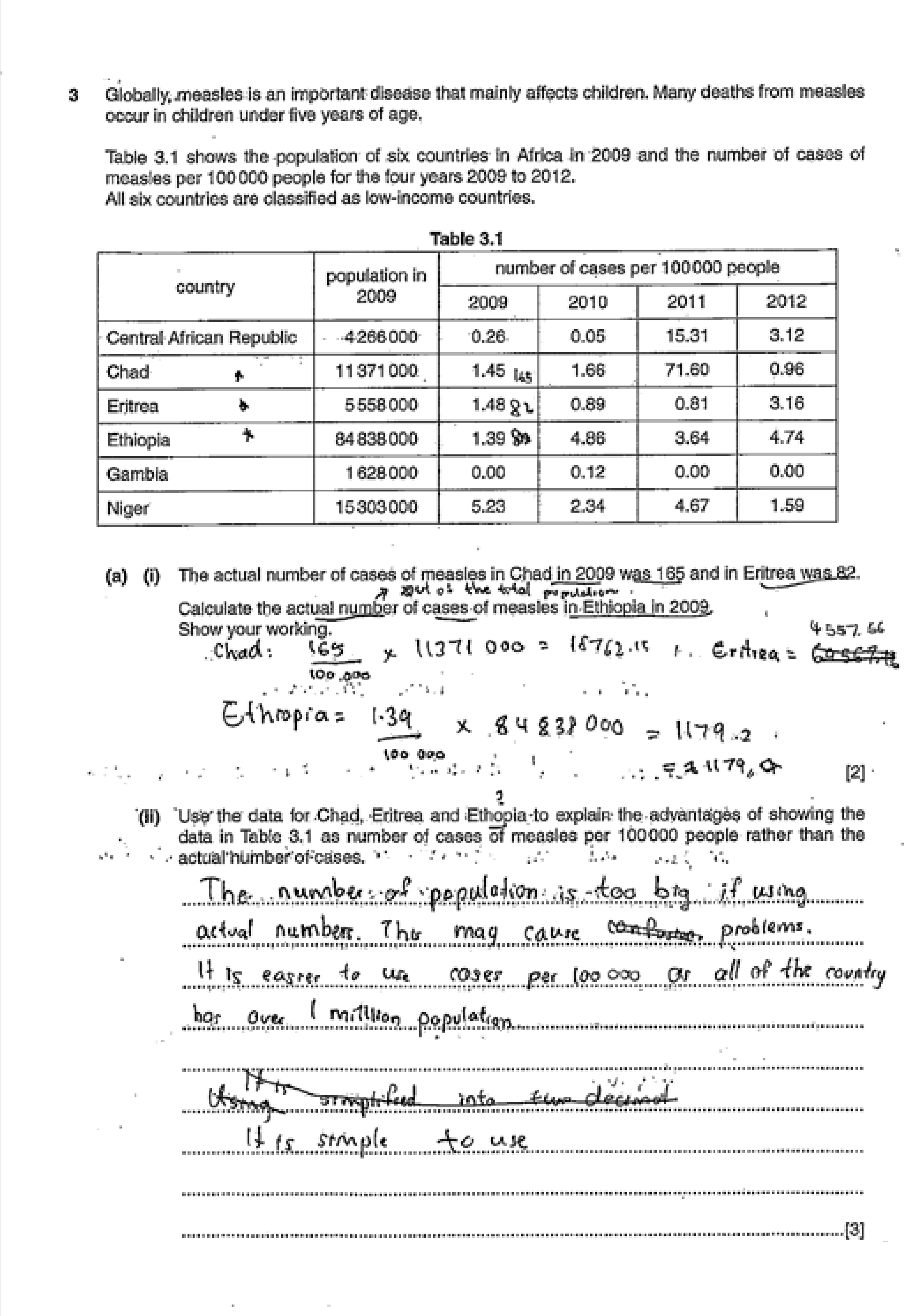

3 Globally, measles is an important disease that mainly affects children. Many deaths from measles occur in children under five years of age.

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 80	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.

out of the total population

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

Chad: $\frac{165}{100\,000}$ × 11371 000 = 18762.15 , Eritrea = 4557.66 ~~6056.7~~

Ethropia = $\frac{1.39}{100\,000}$ × 84 838 000 = 1179.2

≈ 1179.0

[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.

~~Using It is simplified into two decimal~~

It is simple to use

[3]

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b) ☐

3(c) ☐

3(d) ☐

3(e) ☐

Q3	Mark scheme
(a)(i)	1179 ;; one mark if not to the whole person e.g. 1179.24 / 1179.2 or if calculation correct but answer incorrect e.g. 1.39 × 848.38 or 1.39 × (84 838 000/100 000) or if no calculation to check but answer given as 1180 [2] **[2]**
(a)(ii)	1 provides information about / AW, proportion / percentage, (of population) affected / AW ; 2 to, make (valid) comparisons / compare ; between countries / in one country over time 3 provides information about severity of disease ; AW 4 population size, taken into account / different for different countries / changes over time in a country ; do not need 'size' if 'use of 'population' is in correct context 5 idea that countries with larger populations will usually have more cases / higher number of cases may just mean larger population of country; 6 AVP ; gives guidance about whether the disease is, spreading / becoming an epidemic / dying out (in one country) in context of over time idea that number of cases per 100 000 are, standardised / normalised, values 7 use of data to support ; only two of Chad, Eritrea or Ethiopia where comparisons between countries stated I ref. to other countries (2009) actual cases and standardised cases comparison (2009) to support mp 5 population size and actual cases stated values of similar number of cases per 100 000 and populations of different sizes countries compared, number of cases per 100 000 for any stated year, with comment about severity number of cases per 100 000 for one country over time, withcomment about severity / spreading / dying out / control / AW **[max 3]**

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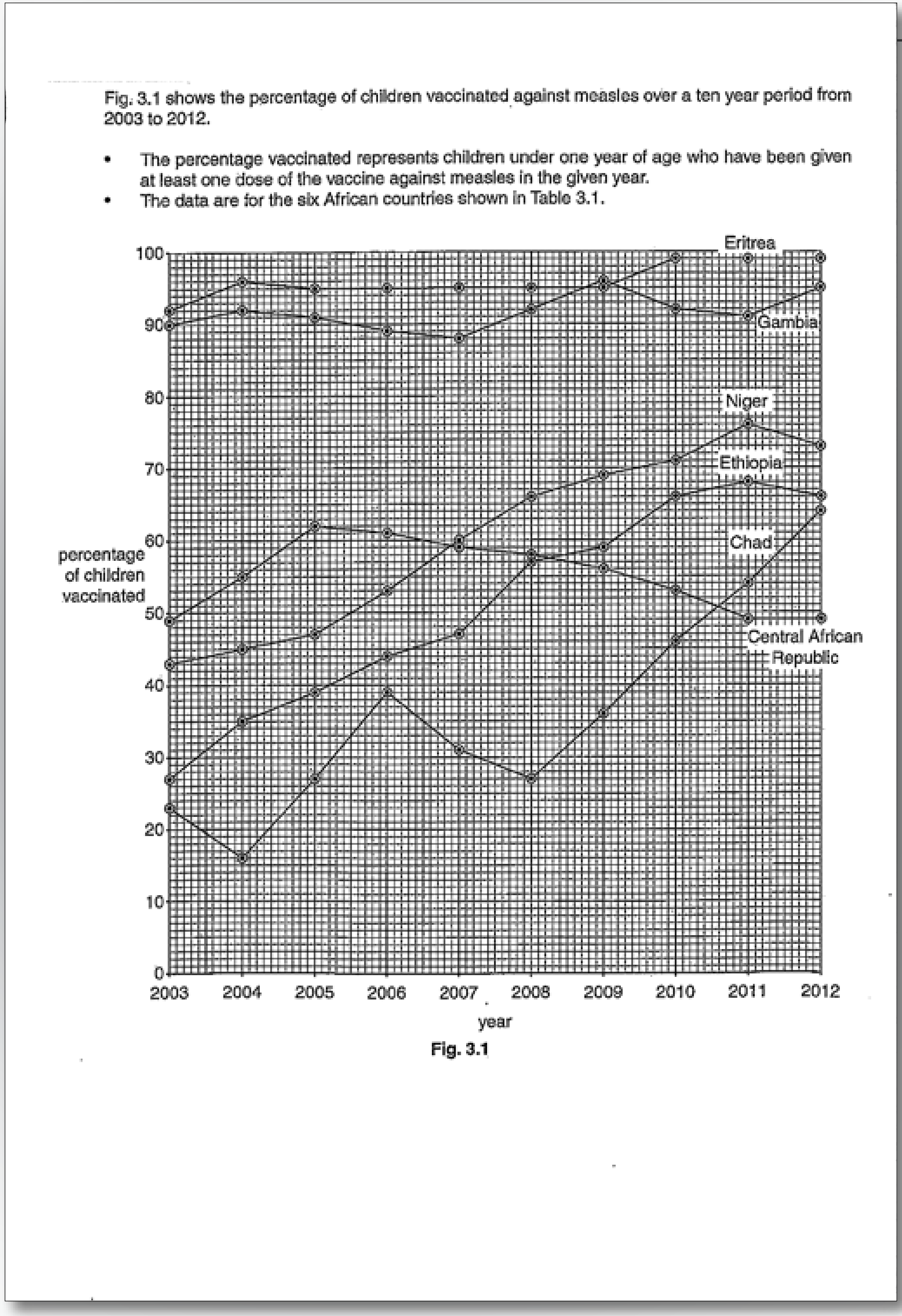

Fig. 3.1 shows the percentage of children vaccinated against measles over a ten year period from 2003 to 2012.

- 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

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b) ☐

3(c) ☐

3(d) ☐

3(e) ☐

Q3	**Mark scheme**
(b)	can give values of percentage vaccinated to describe 'increasing / decreasing' percentage vaccination *support* 1 Gambia high percentage vaccinated (throughout) and low number of cases ; **A** Eritrea 2 data to support ; e.g. a percentage vaccination for a year and number of cases (same, or following, year after vaccination) or a range given for percentage vaccinations over the whole, or stated, number of years or a compilation of the two *partial / weak, support* 3 Central African Republic decreasing vaccination and number of cases in 2011, higher / 15.31 ; 4 Chad (from 2008) increasing percentage vaccination and, low / stated, number of cases, 2009 / 2010 / 2012 ; 1.45 1.66 0.96 *do not support* 5 Niger / Ethiopia / Chad, (generally) increasing percentage vaccinated and number of cases, fluctuates / increase and decrease (ora) / AW ; **A** stated correct data to show increase and decrease **A** for Chad if mp 4 given and ref. to increase / 71.6 in 2011 6 (generally) increasing percentage vaccinated and number of cases, increases / goes from 2.34–4.67, in 2011 in Niger or increases / goes from 1.39–4.86, in 2010 in Ethiopia or increases / goes from 1.66–71.6, in 2011 in Chad A 1.45–1.66 in 2010 ; 7 Central African Republic decreasing vaccination and low number of cases in, 2009 / 2010 / 2012 ; 8 / 9 AVP ;; e.g. • idea that most values for number of cases are low irrespective of vaccination percentage • ref.to needs, high / 90%, vaccination to be effective **A** < 80% / low, vaccination ineffective • idea that generally Gambia / Eritrea, have higher percentage vaccinated and have lower number of cases than, (three of) Ethiopia, Chad, Central African Republic, Niger / the other countries

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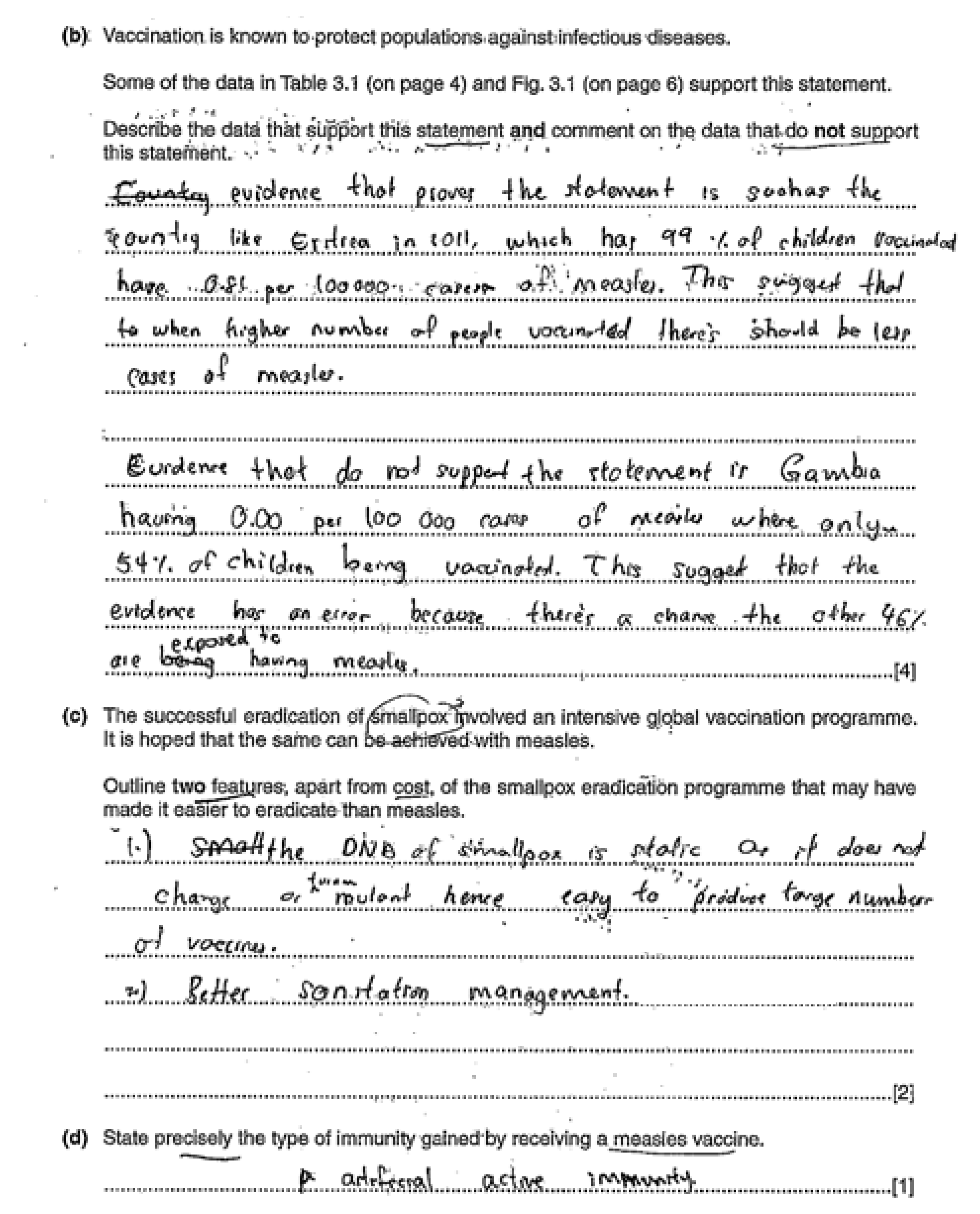

(b) Vaccination is known to protect populations against infectious diseases.

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 proves the statement is soohas 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 turn virulent 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]

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b) ☐

3(c) ☐

3(d) ☐

3(e) ☐

Q3	Mark scheme
(b) *cont.*	• ref. to Chad / Central African Republic, in 2011 and, epidemics / inability to keep number of cases down / ineffectiveness of vaccination programme I ref. to 71.6 (Chad) or 15.31 (Central African Republic) • Eritrea 2012 high vaccination but, increase in / 3.16, cases • ref. to increasing percentage of vaccination in Niger and decrease in cases, 2009–2010 from 5.23 to 2.34 / 2011–2012 from 4.67–1.59 **A** 2009–2012 from 5.23 to1.59 **[max 4]**
(c)	*points refer to smallpox, look for points written as ora any two from* 1 high, percentage / proportion, immunised / vaccinated ; AW **A** mass vaccination 2 no boosters required / one dose enough / immunity very long-lived; **A** idea of long-lasting effect of vaccine 3 same, vaccine / antigens, used (throughout) ; treat as neutral ref. to, low mutation rate / stability, of smallpox virus 4 heat stable / thermostable / freeze-dried / lyophilised, vaccine ; I frozen **A** no need to refrigerate / AW **A** idea of longer shelf-life 5 ease of, administering vaccine / training people to give vaccine ; 6 ring vaccination / described, e.g. contact tracing ; 7 easy to identify infected people / AW, (to begin ring vaccination) ; 8 lower percentage cover required for smallpox than measles / lower herd immunity required; 9 AVP ; smallpox less infectious (so lower percentage cover required) idea of less, civil unrest / war / movement of populations (so easier to implement) suggestion that smallpox live vaccine (and measles not live) **[max 2]**
(d)	active artificial / artificial active ; treat as neutral acquired **[1]**

EXAMINER COMMENTS

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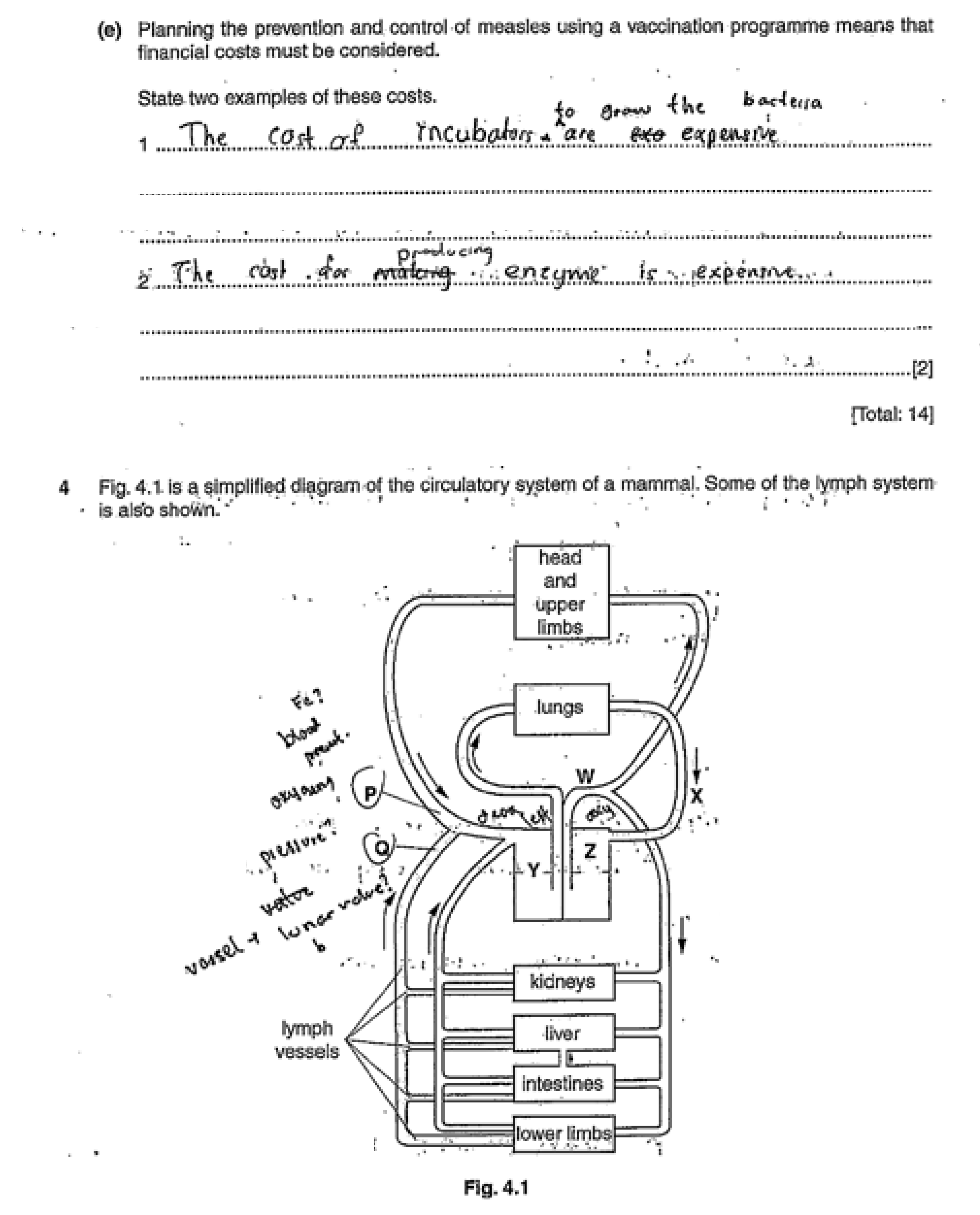

(e) Planning the prevention and control of measles using a vaccination programme means that financial costs must be considered.

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]

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

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b) ☐

3(c) ☐

3(d) ☐

3(e) ☐

Q3	Mark scheme
(e)	*can be from point of view of country programme or WHO programme cost* 1 preparing / manufacturing / purchasing, vaccine ; A cost to provide vaccine free to developing countries 2 disposables / equipment to administer (vaccine) ; e.g. syringes / needles / (protective) gloves 3 storage ; e.g. space, security 4 refrigeration / maintaining cold chain ; 5 transport (of, vaccine / health care workers) ; 6 wages / training, of staff involved ; e.g. wages for, health care workers administering vaccine / staff involved in training health care workers 7 record keeping / contact tracing ; 8 advertising / informing / marketing / education ; 9 research / development ; 10 setting up vaccination / immunisation, camps (for remote / epidemic, areas) ; I building, hospitals / clinics **[max 2]**

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Interactive Example Candidate Responses
Paper 2 (May/June 2016), Question 4

Cambridge International AS & A Level
Biology 9700

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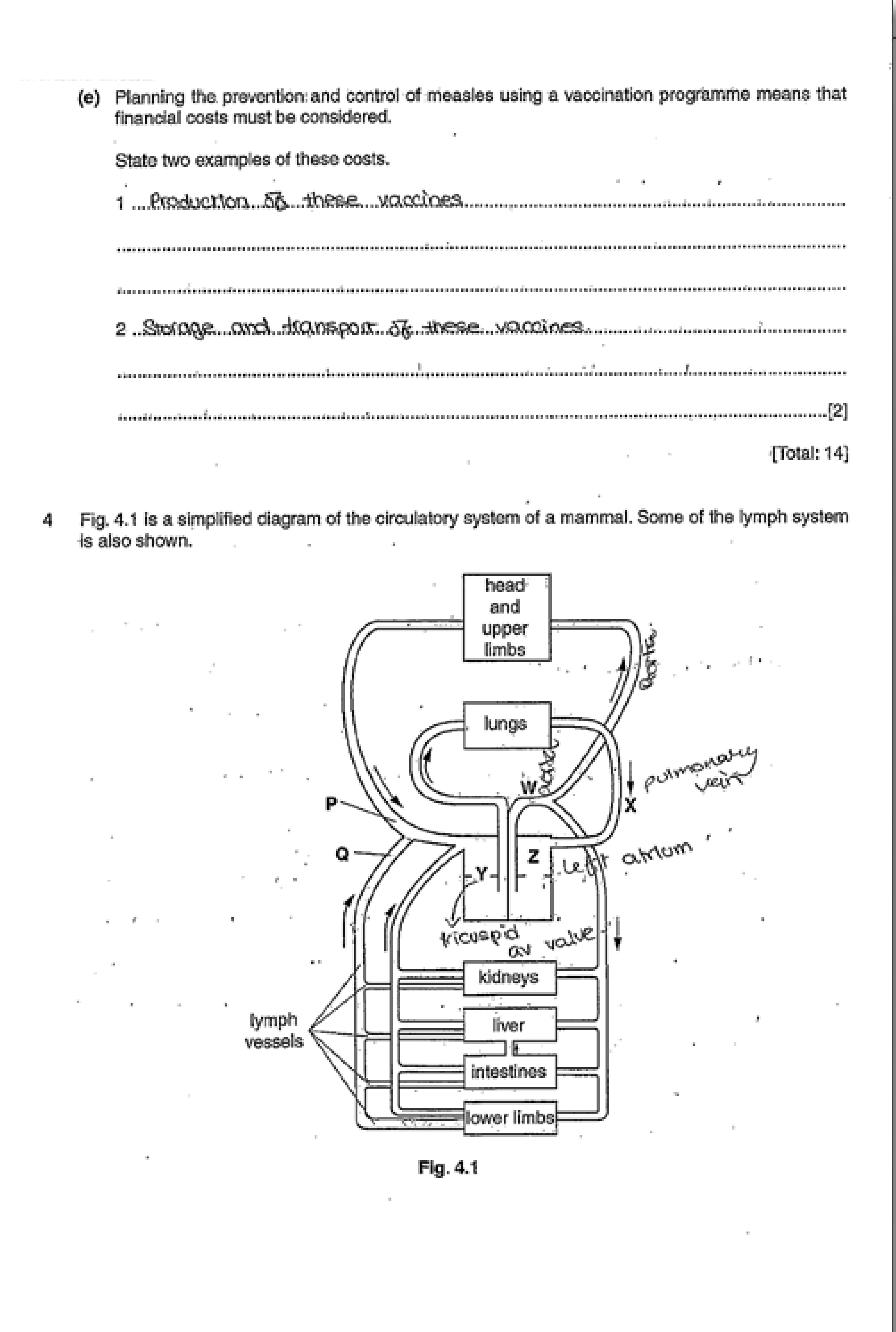


(e) Planning the prevention and control of measles using a vaccination programme means that financial costs must be considered.

State two examples of these costs.

1 Production of these vaccines

2 Storage and transport of these vaccines

[2]

[Total: 14]

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

Your Mark

4(a)

4(b)

4(c)

4(d)

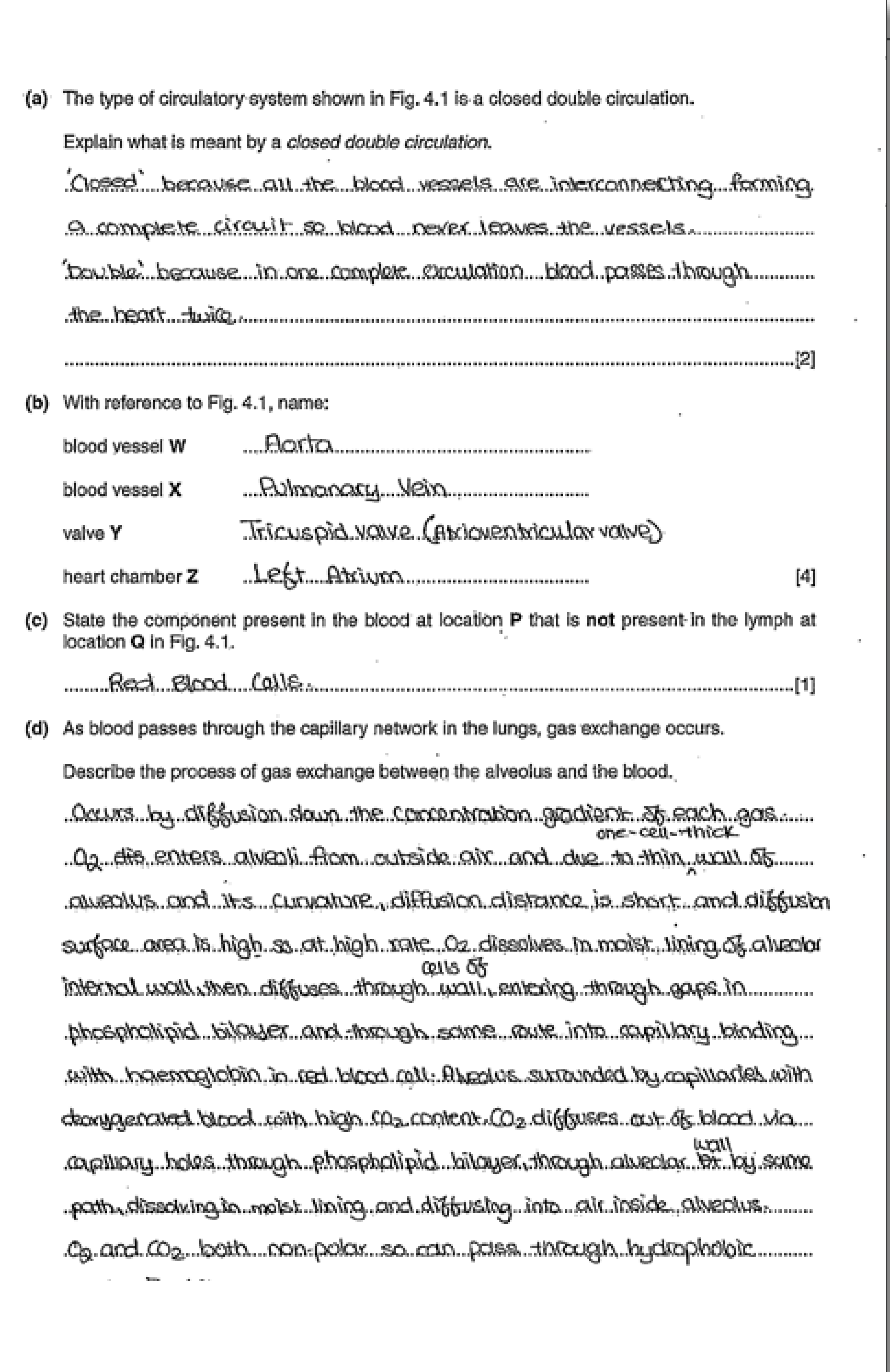
4(e)(i)

4(e)(ii)

Q4	Mark scheme
(a)	blood contained in (blood) vessels AW or blood contained in any three of heart, arteries, veins, capillaries ; systemic and pulmonary, systems / circulation ; **A** 'systematic' **A** described if *circulations not named* e.g. for each complete circuit (round the body) passes through heart twice from heart to lungs and back, then to (rest of) body and back **[2]**
(b)	W = aorta / aortic arch ; X = pulmonary vein ; Y = right atrioventricular / tricuspid, (valve) ; Z = left, atrium / auricle ; **[4]**
(c)	red blood cells ; **A** rbc **A** platelets **A** plasma proteins / named **[1]**
(d)	**1** idea of carbon dioxide out (of blood to alveolus) and oxygen in (to alveolus from blood) ; **2** diffusion / diffuses or (movement from) high concentration to low concentration / down a concentration gradient ; **A** diffusion / pressure, gradient **3** (across) squamous epithelium / squamous cells (of alveolar wall) ; **A** pavement cells **4** (and) endothelium / endothelial cells (of capillary wall) ; **A** squamous cells but must be clear that this is for capillary wall **5** oxygen, into / AW, red blood cells ; I oxygen binds to Hb **6** steep gradient maintained by, ventilation / uptake by haemoglobin / blood carries oxygen away / blood arrives with carbon dioxide / deoxygenated blood arriving low in oxygen **[max 4]**
(e)(i)	F = nucleolus ; A nucleus G = cell surface / plasma, membrane ; **[2]**
(e)(ii)	transport / transporter / carrier, protein ; R pump protein specific protein ; glucose, binding site / AW ; I glucose binds R glucose receptor *specific binding site (in protein) = 2 marks* (glucose binding causes) conformational change ; AW, e.g. changes shape passive / no energy required / no ATP required ; movement is, down the concentration gradient / from high to low concentration ; *must be in context of through the membrane protein* **[max 3] [Total: 16]**

EXAMINER COMMENTS

MARK SCHEME



(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.

'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

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 dis 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 cells of wall, entering through gaps in phospholipid bilayer and through some route into capillary binding with haemoglobin in red blood cell. 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 ~~Bt~~ wall by same path, dissolving in moist lining and diffusing into air inside alveolus. O_2 and CO_2 both non-polar so can pass through hydrophobic

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Your Mark

4(a) ☐

4(b) ☐

4(c) ☐

4(d) ☐

4(e)(i) ☐

4(e)(ii) ☐

Q4	Mark scheme
(a)	blood contained in (blood) vessels AW or blood contained in any three of heart, arteries, veins, capillaries ; systemic and pulmonary, systems / circulation ; **A** 'systematic' **A** described if *circulations not named* e.g. for each complete circuit (round the body) passes through heart twice from heart to lungs and back, then to (rest of) body and back **[2]**
(b)	W = aorta / aortic arch ; X = pulmonary vein ; Y = right atrioventricular / tricuspid, (valve) ; Z = left, atrium / auricle ; **[4]**
(c)	red blood cells ; **A** rbc **A** platelets **A** plasma proteins / named **[1]**
(d)	**1** idea of carbon dioxide out (of blood to alveolus) and oxygen in (to alveolus from blood) ; **2** diffusion / diffuses or (movement from) high concentration to low concentration / down a concentration gradient ; **A** diffusion / pressure, gradient **3** (across) squamous epithelium / squamous cells (of alveolar wall) ; **A** pavement cells **4** (and) endothelium / endothelial cells (of capillary wall) ; **A** squamous cells but must be clear that this is for capillary wall **5** oxygen, into / AW, red blood cells ; I oxygen binds to Hb **6** steep gradient maintained by, ventilation / uptake by haemoglobin / blood carries oxygen away / blood arrives with carbon dioxide / deoxygenated blood arriving low in oxygen **[max 4]**
(e)(i)	F = nucleolus ; A nucleus G = cell surface / plasma, membrane ; **[2]**
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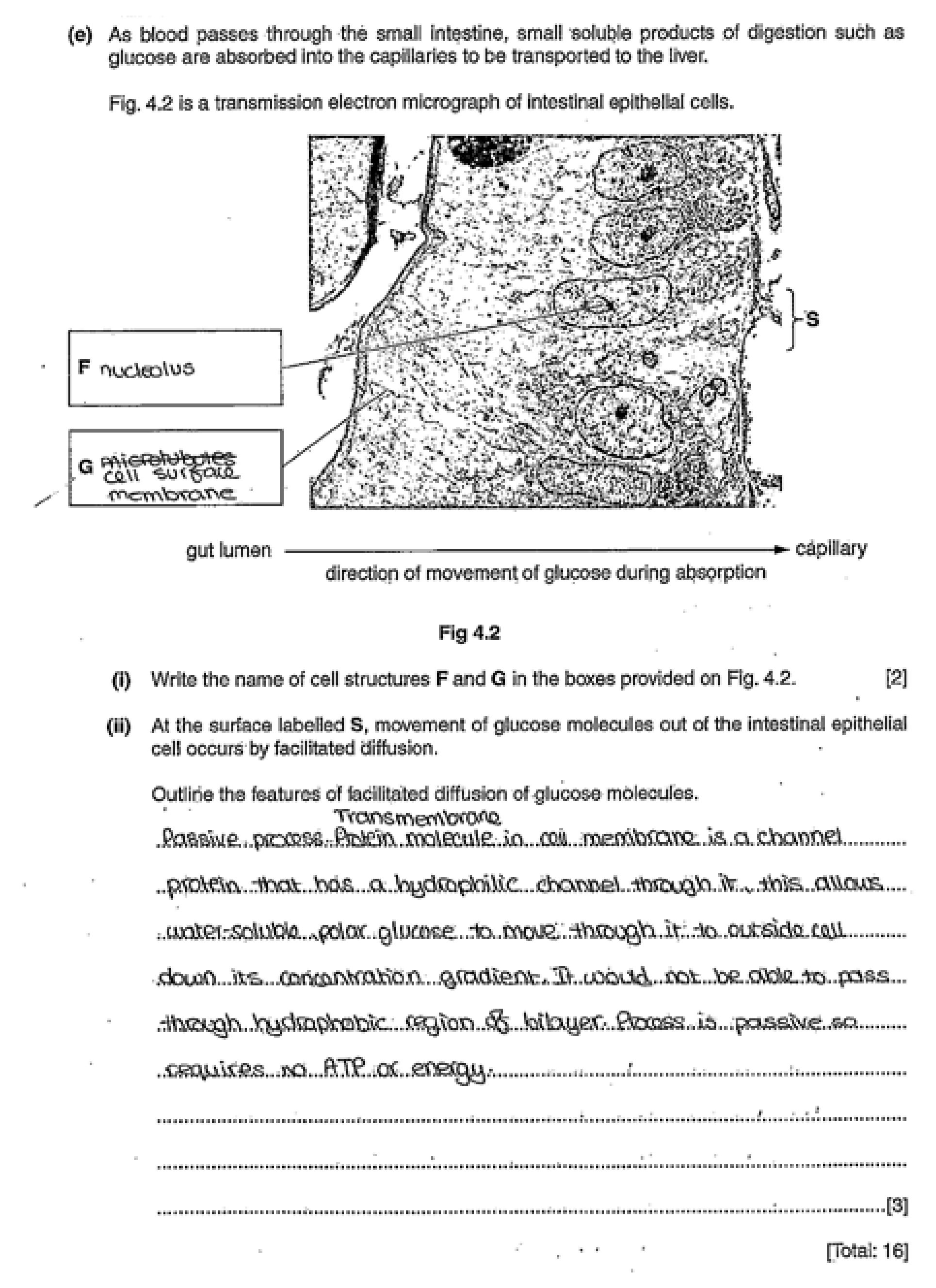

(e) As blood passes through the small intestine, small soluble products of digestion such as glucose are absorbed into the capillaries to be transported to the liver.

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.

[3]

[Total: 16]

Your Mark

4(a) ☐

4(b) ☐

4(c) ☐

4(d) ☐

4(e)(i) ☐

4(e)(ii) ☐

Q4	Mark scheme
(a)	blood contained in (blood) vessels AW or blood contained in any three of heart, arteries, veins, capillaries ; systemic and pulmonary, systems / circulation ; **A** 'systematic' **A** described if *circulations not named* e.g. for each complete circuit (round the body) passes through heart twice from heart to lungs and back, then to (rest of) body and back **[2]**
(b)	W = aorta / aortic arch ; X = pulmonary vein ; Y = right atrioventricular / tricuspid, (valve) ; Z = left, atrium / auricle ; **[4]**
(c)	red blood cells ; **A** rbc **A** platelets **A** plasma proteins / named **[1]**
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(e)(i)	F = nucleolus ; A nucleus G = cell surface / plasma, membrane ; **[2]**
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Select page

HIGH

MIDDLE

LOW

(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 ~~eco~~ expensive

2 The cost for ~~making~~ producing enzyme is expensive

[2]

[Total: 14]

4 Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.

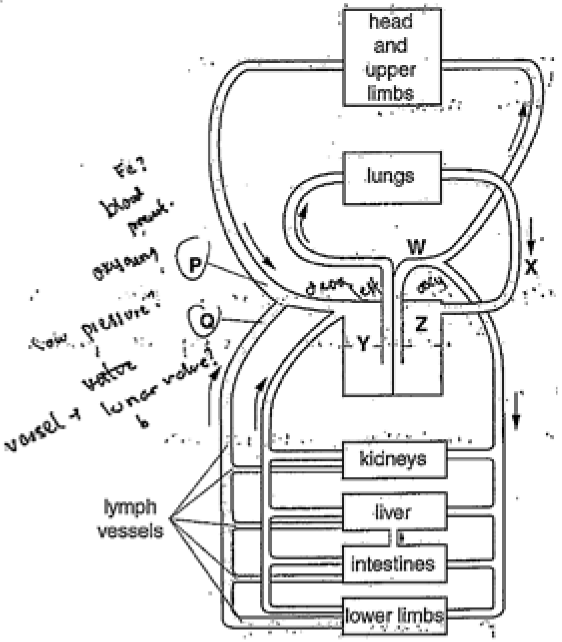

Fig. 4.1

Your Mark

4(a) ☐

4(b) ☐

4(c) ☐

4(d) ☐

4(e)(i) ☐

4(e)(ii) ☐

Q4	Mark scheme
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EXAMINER COMMENTS

MARK SCHEME

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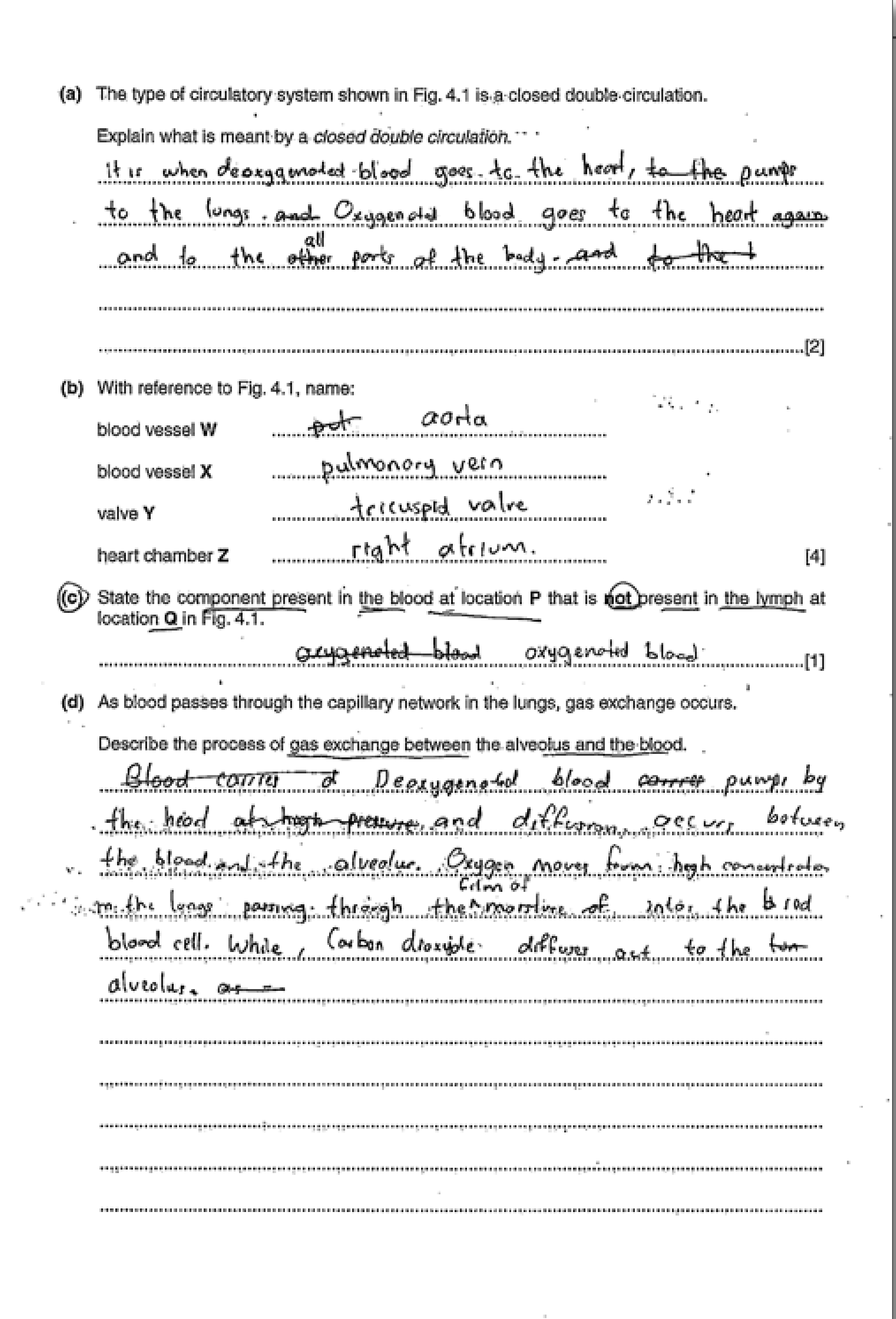

(a) The type of circulatory system shown in Fig. 4.1 is a closed double circulation.

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 +~~

[2]

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

blood vessel **W** ~~pot~~ aorta

blood vessel **X** pulmonory 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 [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 head ~~at high pressure~~ and diffusion occurs between the blood and the alveolus. Oxygen moves from high concentration in the lungs passing through the film of moisture of into the b red blood cell. While, Carbon dioxide diffuses out to the ~~ton~~ alveolus. ~~as —~~

Your Mark

4(a) ☐

4(b) ☐

4(c) ☐

4(d) ☐

4(e)(i) ☐

4(e)(ii) ☐

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EXAMINER COMMENTS

MARK SCHEME

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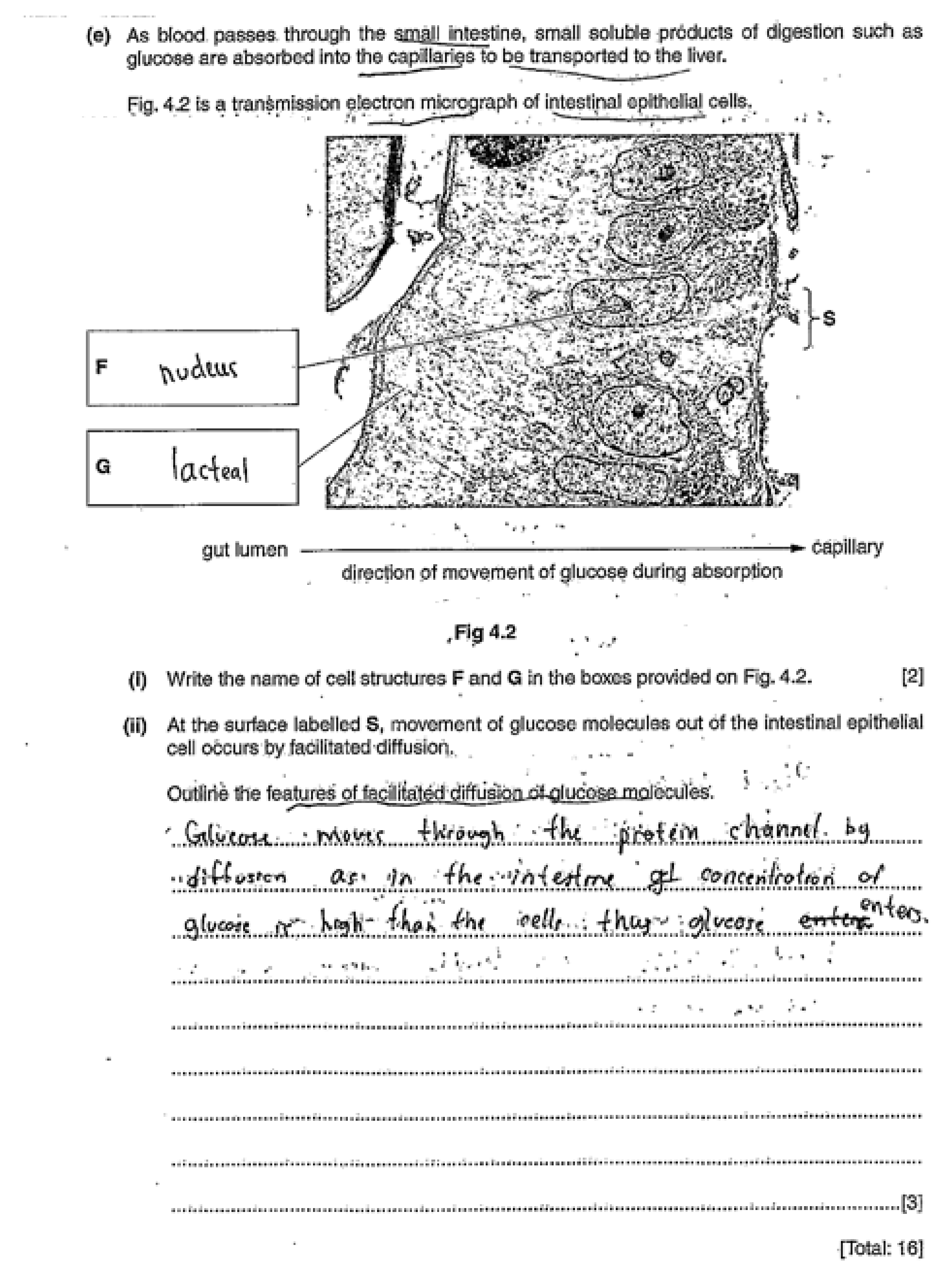

(e) As blood passes through the small intestine, small soluble products of digestion such as glucose are absorbed into the capillaries to be transported to the liver.

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.

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

[3]

[Total: 16]

Your Mark

4(a) ☐

4(b) ☐

4(c) ☐

4(d) ☐

4(e)(i) ☐

4(e)(ii) ☐

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EXAMINER COMMENTS MARK SCHEME

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HIGH MIDDLE LOW

(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 A large number of population need the vaccination for free.

2 The vaccination of measles also need booster which increase the cost.

[2]

[Total: 14]

4 Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.

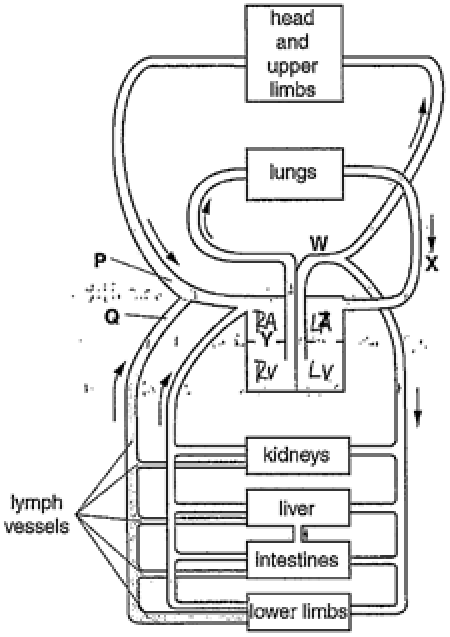

Fig. 4.1

Your Mark

4(a) ☐

4(b) ☐

4(c) ☐

4(d) ☐

4(e)(i) ☐

4(e)(ii) ☐

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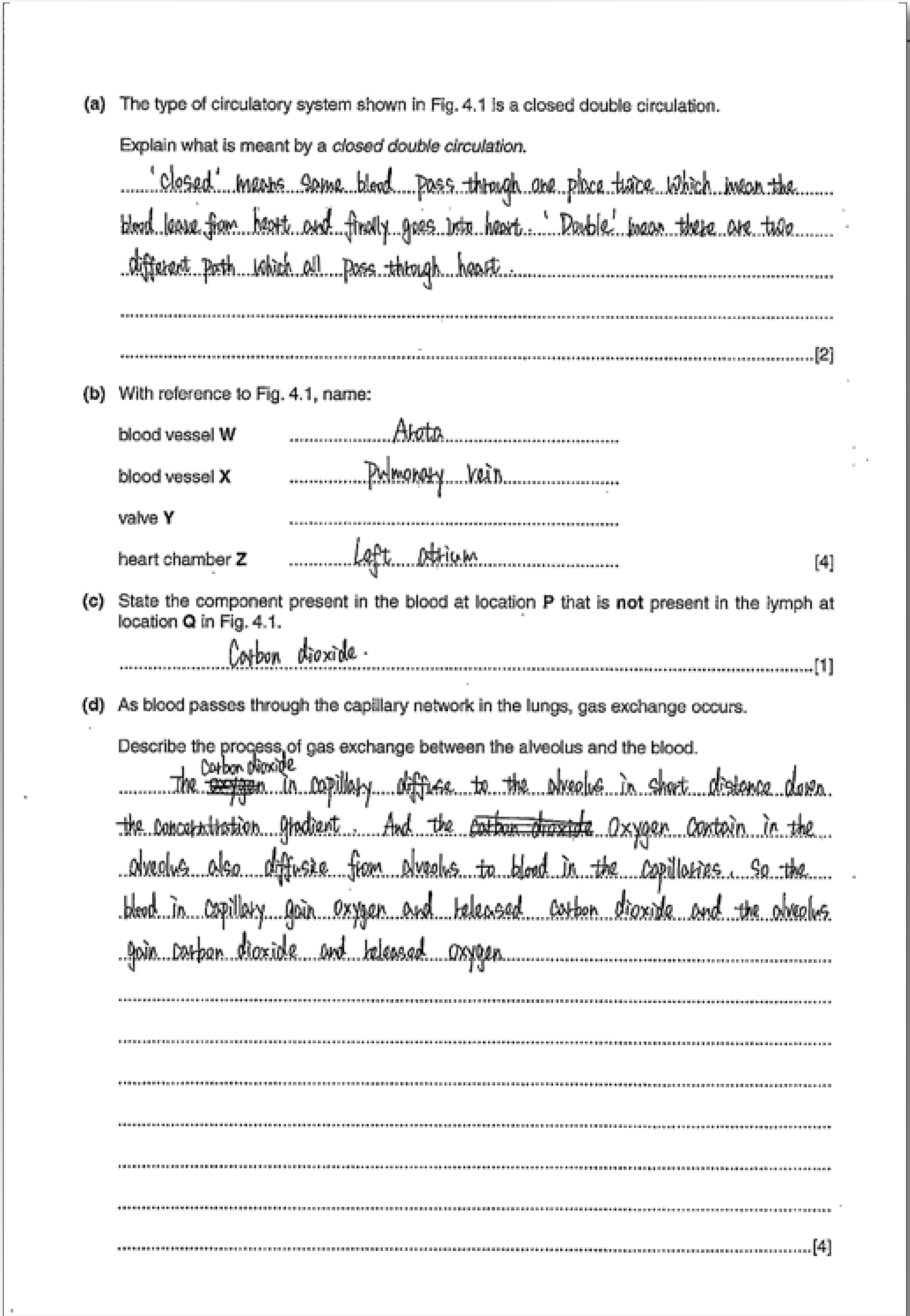

(a) The type of circulatory system shown in Fig. 4.1 is a closed double circulation.

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. [2]

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

blood vessel **W** Aroto

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 diffuske 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 [4]

Your Mark

4(a) ☐

4(b) ☐

4(c) ☐

4(d) ☐

4(e)(i) ☐

4(e)(ii) ☐

Q4	Mark scheme
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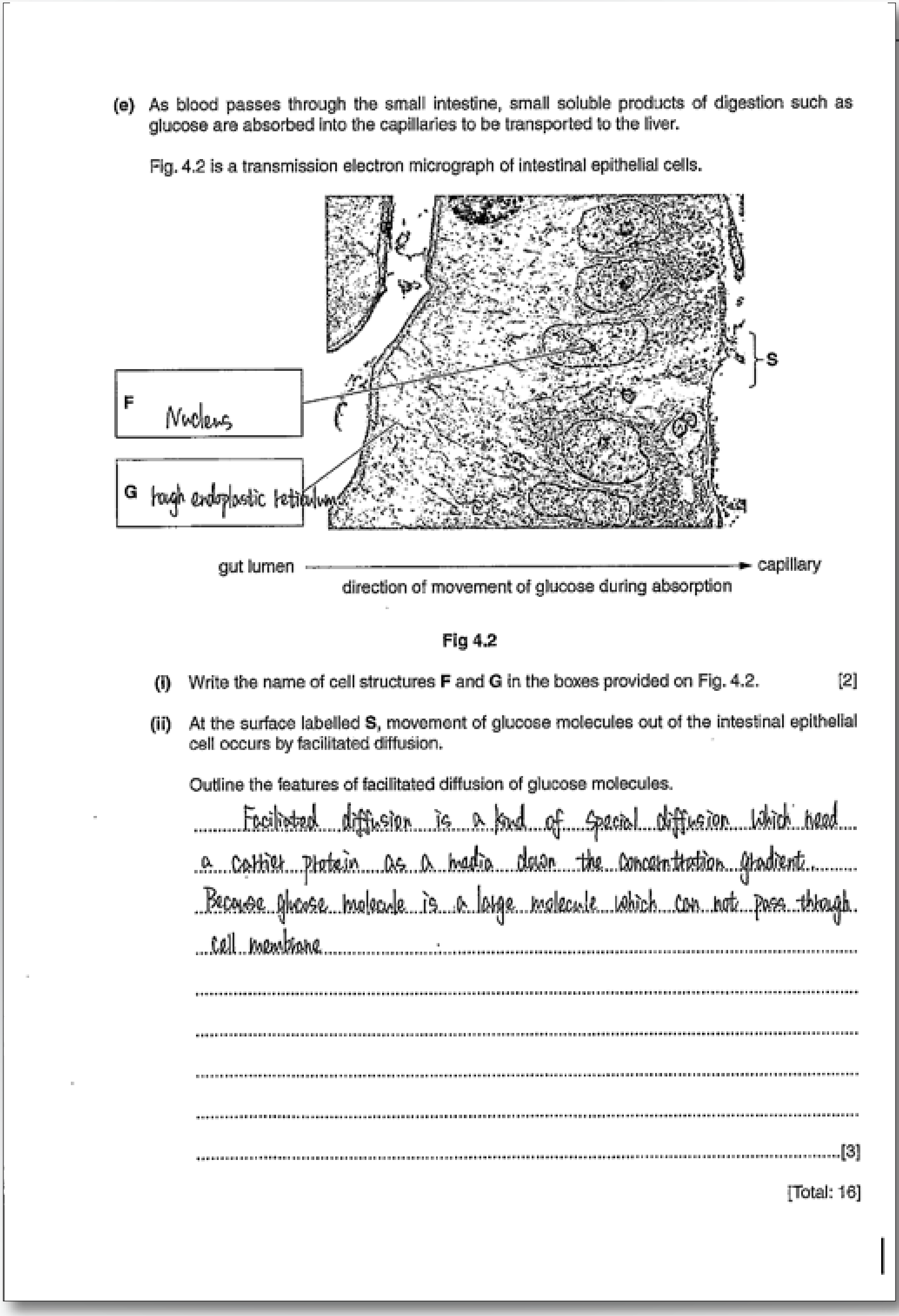
EXAMINER COMMENTS

MARK SCHEME



(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.

F Nucleus

G rough endoplastic reticulum

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 cattier 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]

Your Mark

4(a) ☐

4(b) ☐

4(c) ☐

4(d) ☐

4(e)(i) ☐

4(e)(ii) ☐

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Interactive Example Candidate Responses
Paper 2 (May/June 2016), Question 5

Cambridge International AS & A Level
Biology 9700

Version 1.0

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HIGH MIDDLE 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 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 to eachother at the centromere, ~~strands~~ ~~The chromosomes~~ ~~are like~~ 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]

Your Mark

5(a)(i) ☐

5(a)(ii) ☐

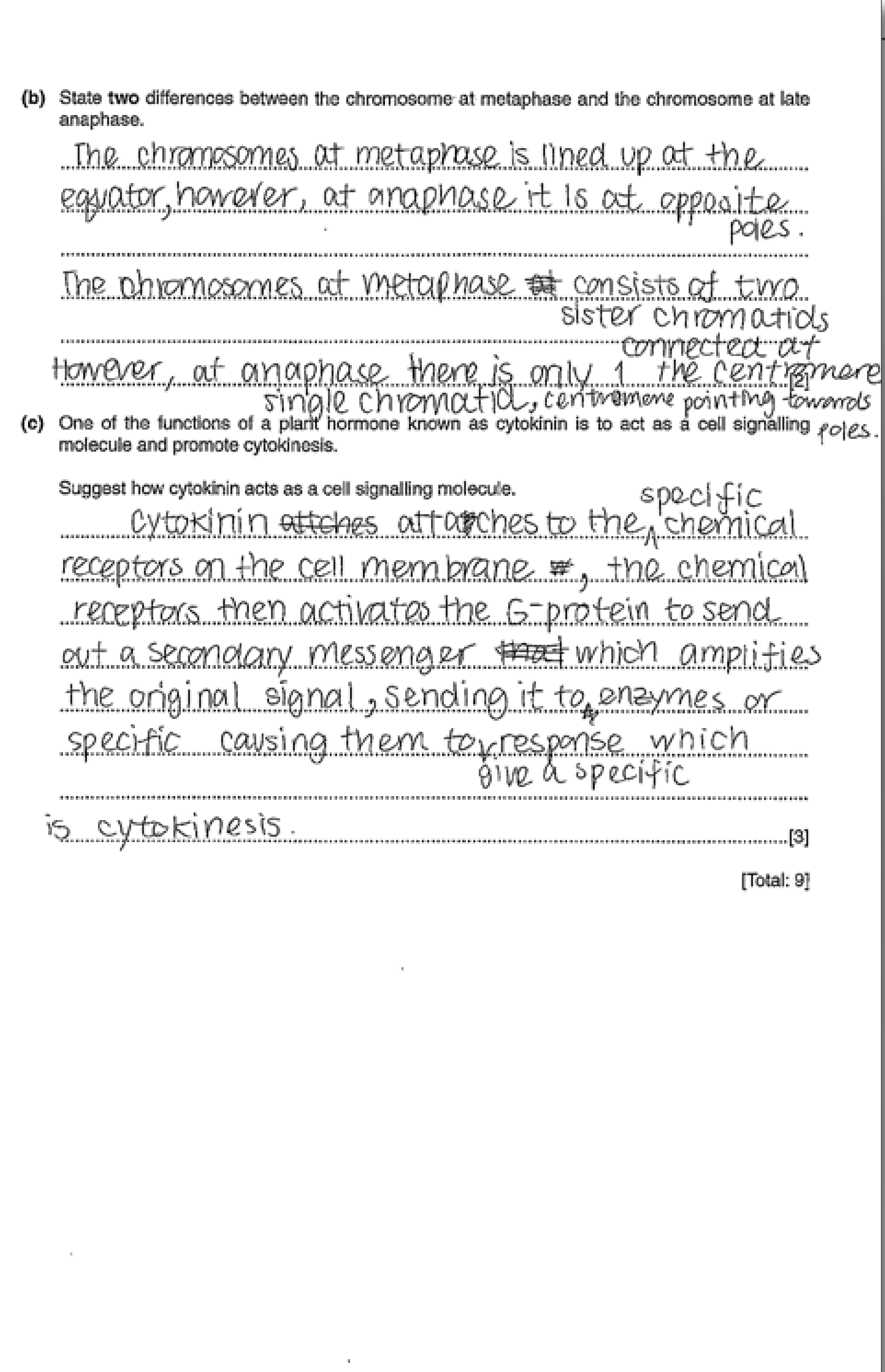
5(b) ☐

5(c) ☐

Q5	**Mark scheme**
(a)(i)	coiling / supercoiling / condenses / condensation ; **A** become shorter and thicker **R** contracts **[1]**
(a)(ii)	*accept from labelled diagram* two chromatids ; identical / sister, chromatids ; joined by a centromere ; **A** kinetochore *one from* (reach chromatid) DNA complexed with protein histone proteins / histones ; telomeres at end of chromatids **[max 3]**
(b)	*metaphase versus anaphase* idea of single chromosome of two chromatids versus two separated chromatids / daughter chromosomes e.g. two chromatids versus, one chromatid / one daughter chromosome ; sister chromatids joined at centromere versus chromatids separateddistance between sister chromatids zero versus increasing distance between chromatids share a centromere versus do not share a centromere / centromere divides two DNA molecules versus one DNA molecule ; at, equator / metaphase plate versus towards / at, poles ; **R** centre **R** ends linear / straight versus V shape / AW ; **[max 2]**
(c)	acts at <u>target</u> cell ; binds to receptor ; **R** receptor cells *allow ecf for other mps* **R** trapped / caught ref. specificity ; **A** receptor complementary (shape) for cytokinin **A** cytokinin fits into receptor this is also mp2 **A** recognition of cytokinin by receptor receptor (located) in, cell surface / plasma, membrane ; **A** cell membrane **A** phospholipid bilayer **A** transmembrane receptor sets off / AW, response in the cell / described response(s) ; e.g. triggers secondary messenger activates enzyme(s) I signals / causes / stimulates, cell to divide / cytokinesis (acts) <u>extracellularly / extracellular signal or (acts) intracellularly / intracellular signal</u> ; *must be in context of candidate's answer* **[max 3]** **[Total: 9]**

EXAMINER COMMENTS

MARK SCHEME



(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.

The chromosomes at metaphase [illegible] 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 [illegible], the chemical receptors then activates the G-protein to send out a secondary messenger [illegible] which amplifies the original signal, sending it to enzymes or specific causing them to give a specific response which is cytokinesis.

[3]

[Total: 9]

Select page

HIGH

MIDDLE

LOW

Your Mark

5(a)(i) ☐

5(a)(ii) ☐

5(b) ☐

5(c) ☐

Q5	Mark scheme
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(b)	*metaphase versus anaphase* idea of single chromosome of two chromatids versus two separated chromatids / daughter chromosomes e.g. two chromatids versus, one chromatid / one daughter chromosome ; sister chromatids joined at centromere versus chromatids separateddistance between sister chromatids zero versus increasing distance between chromatids share a centromere versus do not share a centromere / centromere divides two DNA molecules versus one DNA molecule ; at, equator / metaphase plate versus towards / at, poles ; **R** centre **R** ends linear / straight versus V shape / AW ; **[max 2]**
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EXAMINER COMMENTS

MARK SCHEME

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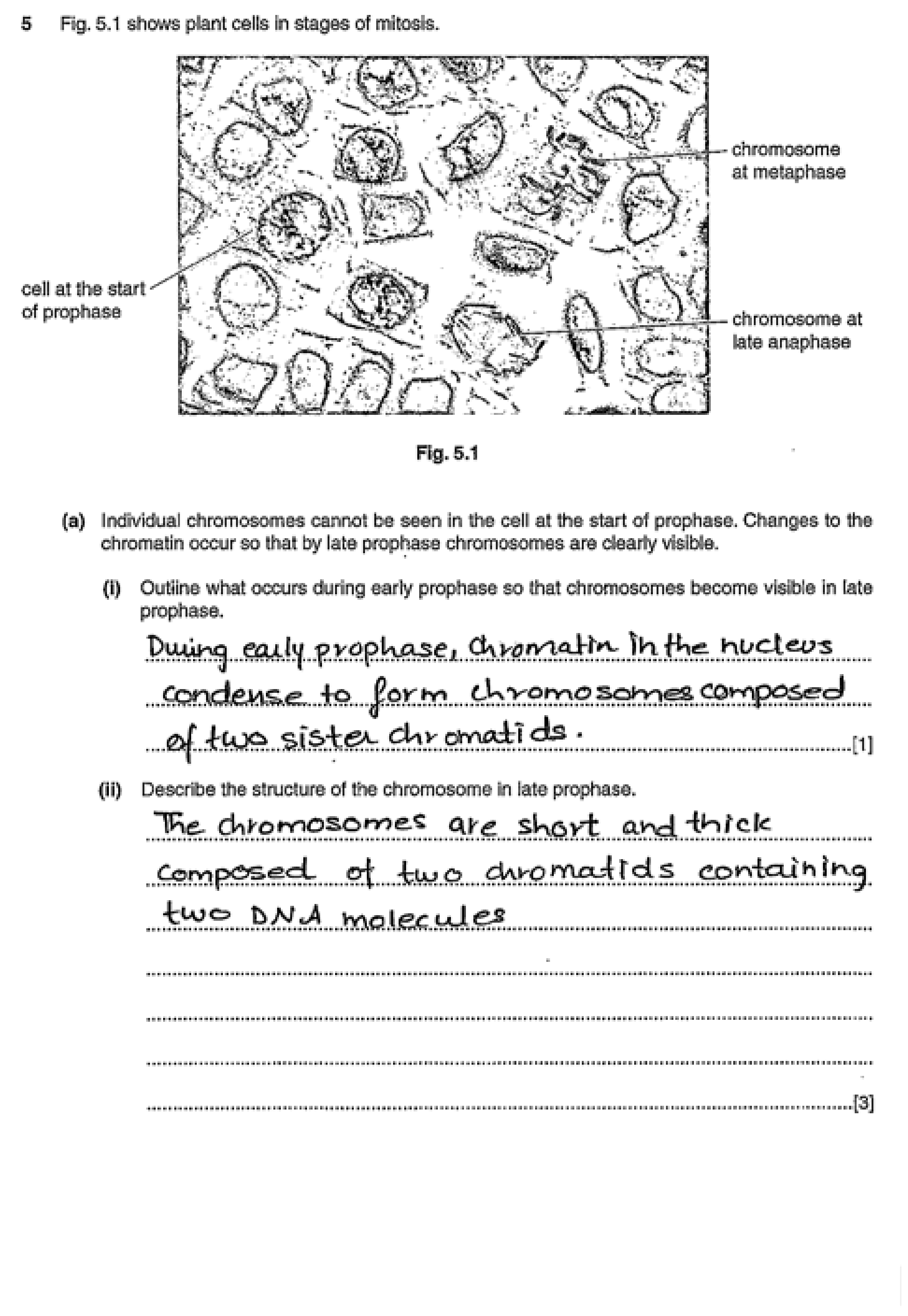

5 Fig. 5.1 shows plant cells in stages of mitosis.

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]

Your Mark

5(a)(i) ☐

5(a)(ii) ☐

5(b) ☐

5(c) ☐

Q5	Mark scheme
(a)(i)	coiling / supercoiling / condenses / condensation ; **A** become shorter and thicker **R** contracts **[1]**
(a)(ii)	*accept from labelled diagram* two chromatids ; identical / sister, chromatids ; joined by a centromere ; **A** kinetochore *one from* (reach chromatid) DNA complexed with protein histone proteins / histones ; telomeres at end of chromatids **[max 3]**
(b)	*metaphase versus anaphase* idea of single chromosome of two chromatids versus two separated chromatids / daughter chromosomes e.g. two chromatids versus, one chromatid / one daughter chromosome ; sister chromatids joined at centromere versus chromatids separateddistance between sister chromatids zero versus increasing distance between chromatids share a centromere versus do not share a centromere / centromere divides two DNA molecules versus one DNA molecule ; at, equator / metaphase plate versus towards / at, poles ; **R** centre **R** ends linear / straight versus V shape / AW ; **[max 2]**
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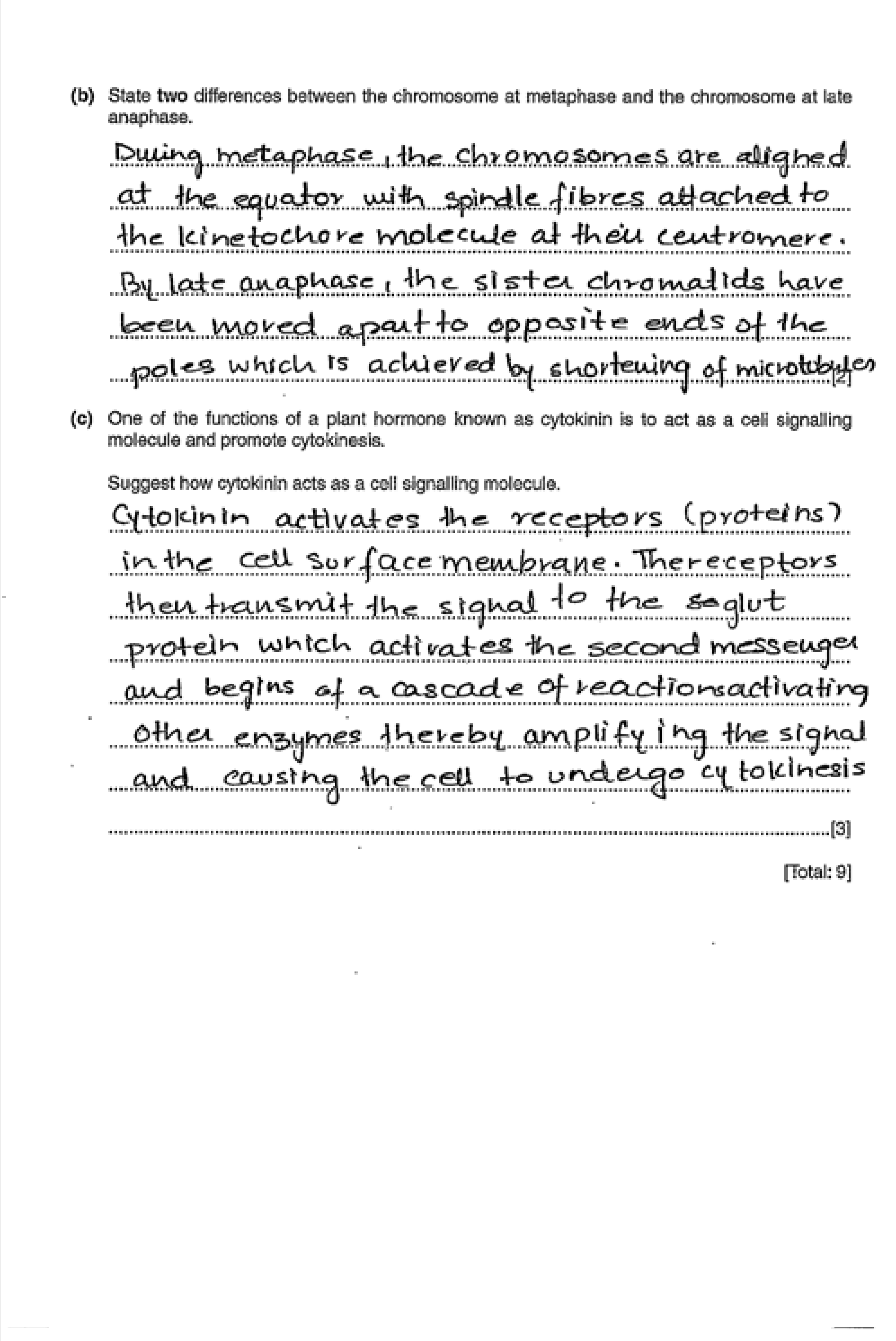
EXAMINER COMMENTS

MARK SCHEME



(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 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 ~~se~~ glut 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]

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Your Mark

5(a)(i) ☐

5(a)(ii) ☐

5(b) ☐

5(c) ☐

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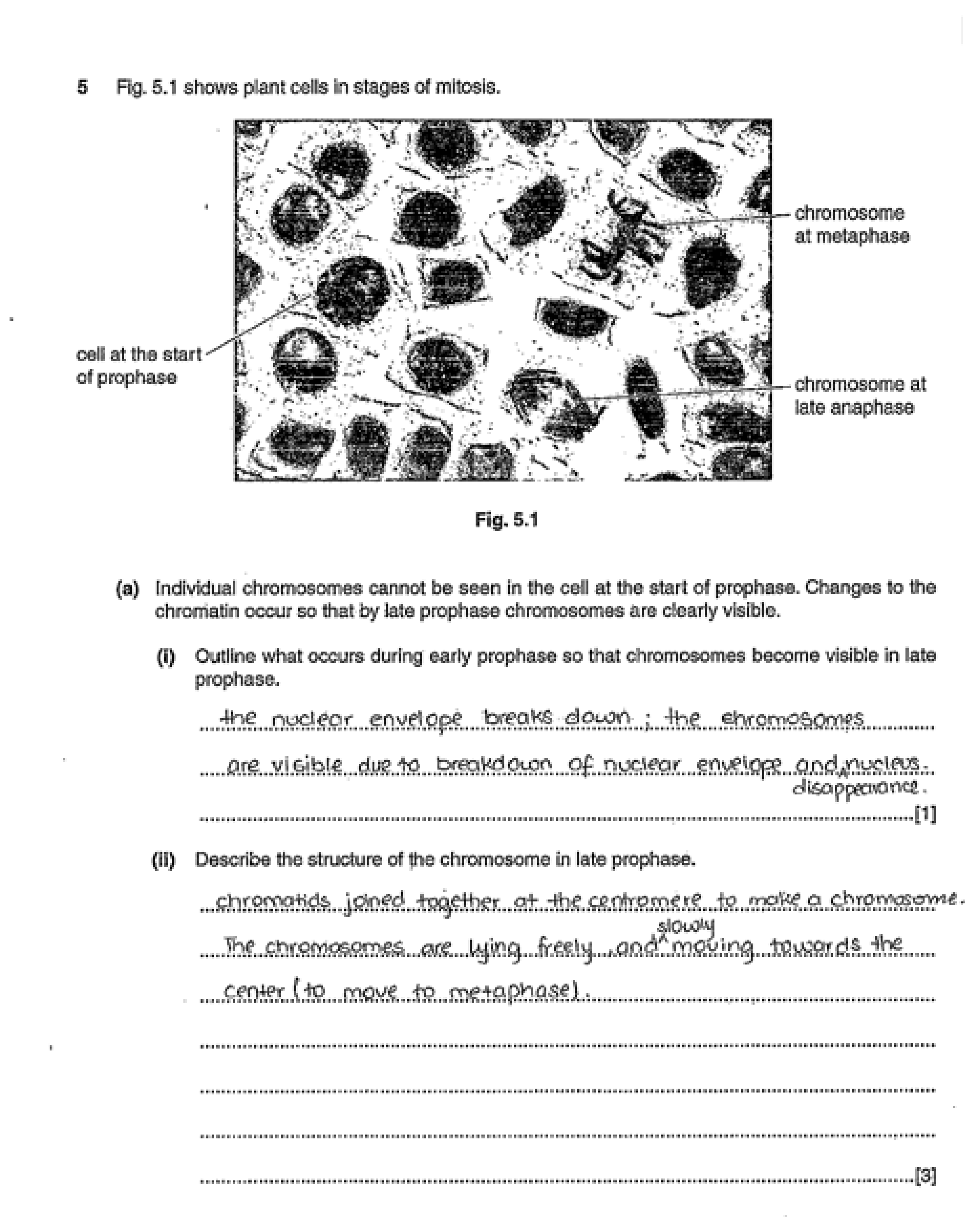

5 Fig. 5.1 shows plant cells in stages of mitosis.

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]

Your Mark

5(a)(i) ☐

5(a)(ii) ☐

5(b) ☐

5(c) ☐

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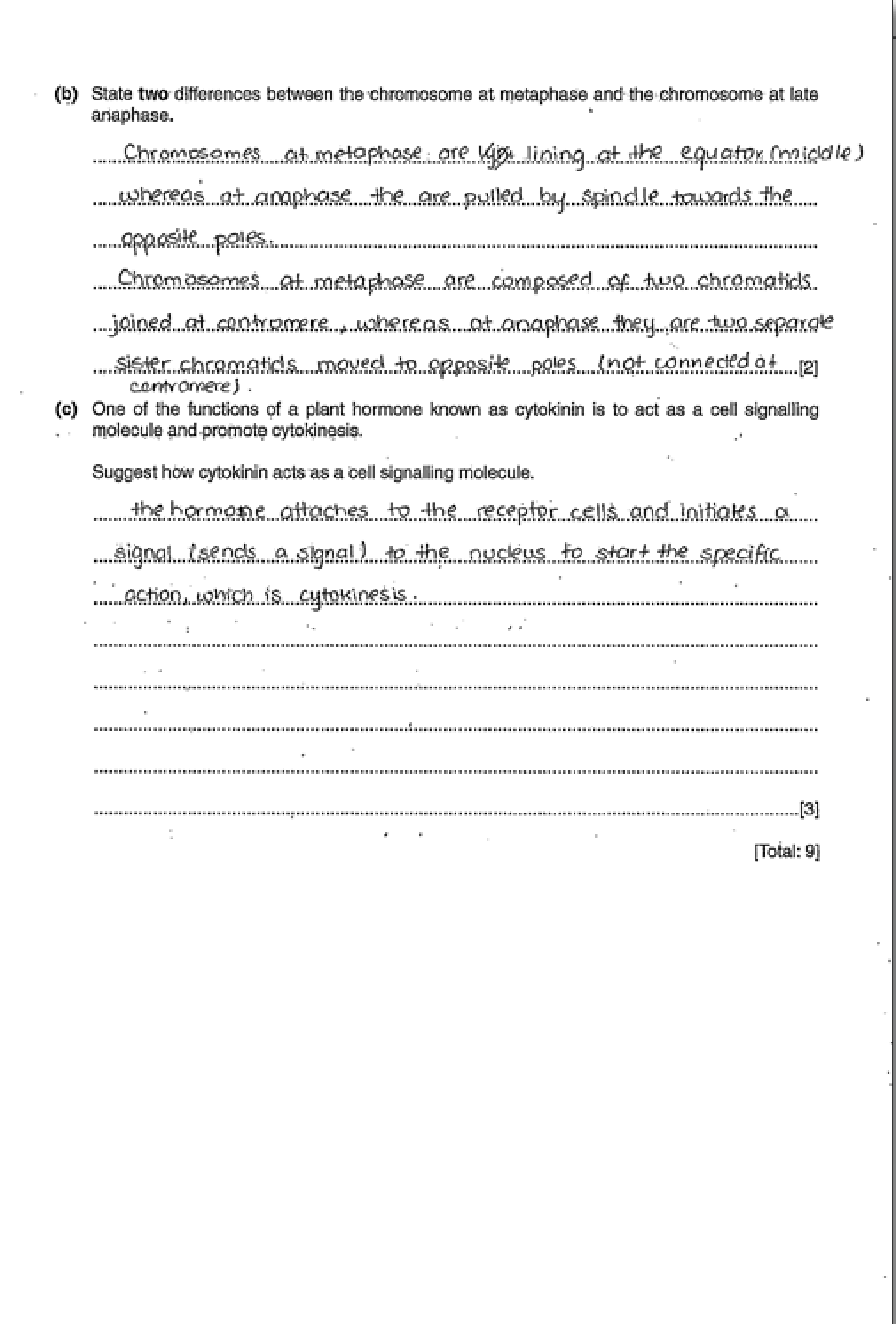

(b) State **two** differences between the chromosome at metaphase and the chromosome at late anaphase.

Chromosomes at metaphase are lining at the equator (middle) whereas at anaphase the are pulled by spindle towards the opposite poles.

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. [3]

[Total: 9]

Your Mark

5(a)(i) ☐

5(a)(ii) ☐

5(b) ☐

5(c) ☐

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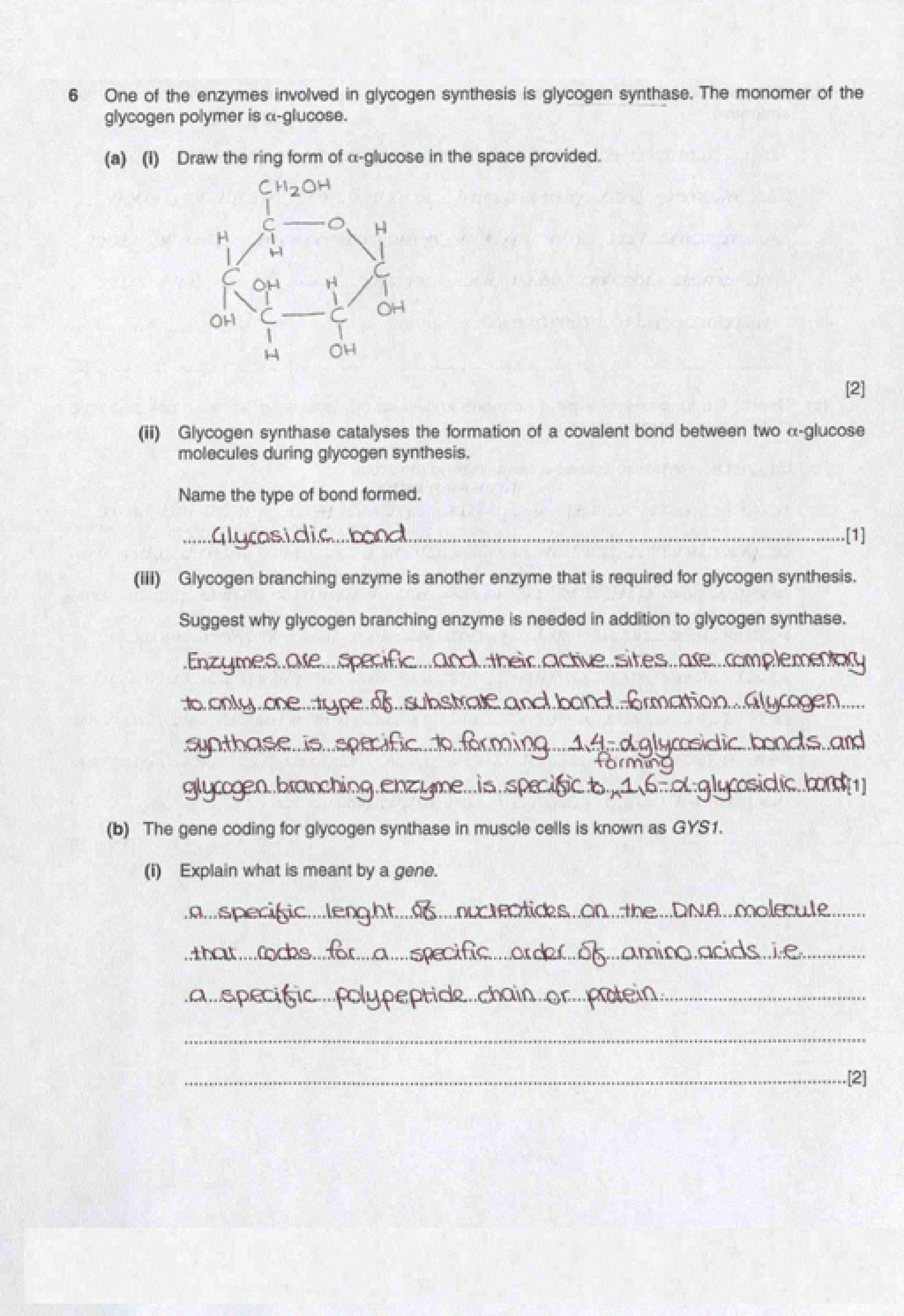
e: info@cambridgeinternational.org   www.cambridgeinternational.org

Interactive Example Candidate Responses
Paper 2 (May/June 2016), Question 6
Cambridge International AS & A Level
Biology 9700

Version 1.0



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.

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]

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

[2]

Your Mark

6(a)(i) ☐

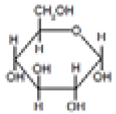
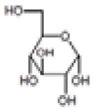
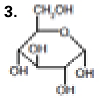
6(a)(ii) ☐

6(a)(iii) ☐

6(b)(i) ☐

6(b)(ii) ☐

6(c) ☐

Q6	Mark scheme
(a)(i)	1.  2.  3.  two marks for correct drawing of ring structure ;; *all atoms shown or one of diagrams 1–3 above* *one mark if, inconsistent / incomplete, drawing:* *diagram 1 – one missing H from any of carbons 2–6 (OH groups and rest of drawing must be correct)* *diagrams 2 and 3 – adding the H to one of carbons 1–5 (OH groups and rest of drawing must be correct)* **[2]**
(a)(ii)	glycosidic ; **A** glucosidic **[1]**
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(b)(i)	*treat as neutral unit of inheritance* sequence of, nucleotides / bases ; section / length / part, of DNA (molecule) ; codes for a polypeptide ; **A** protein *for polypeptide* **A** enzyme **A** information to produce a polypeptide **A** codes / information, for sequence of amino acids / primary structure (of a, polypeptide / protein) **R** genetic code for a polypeptide **[max 2]**
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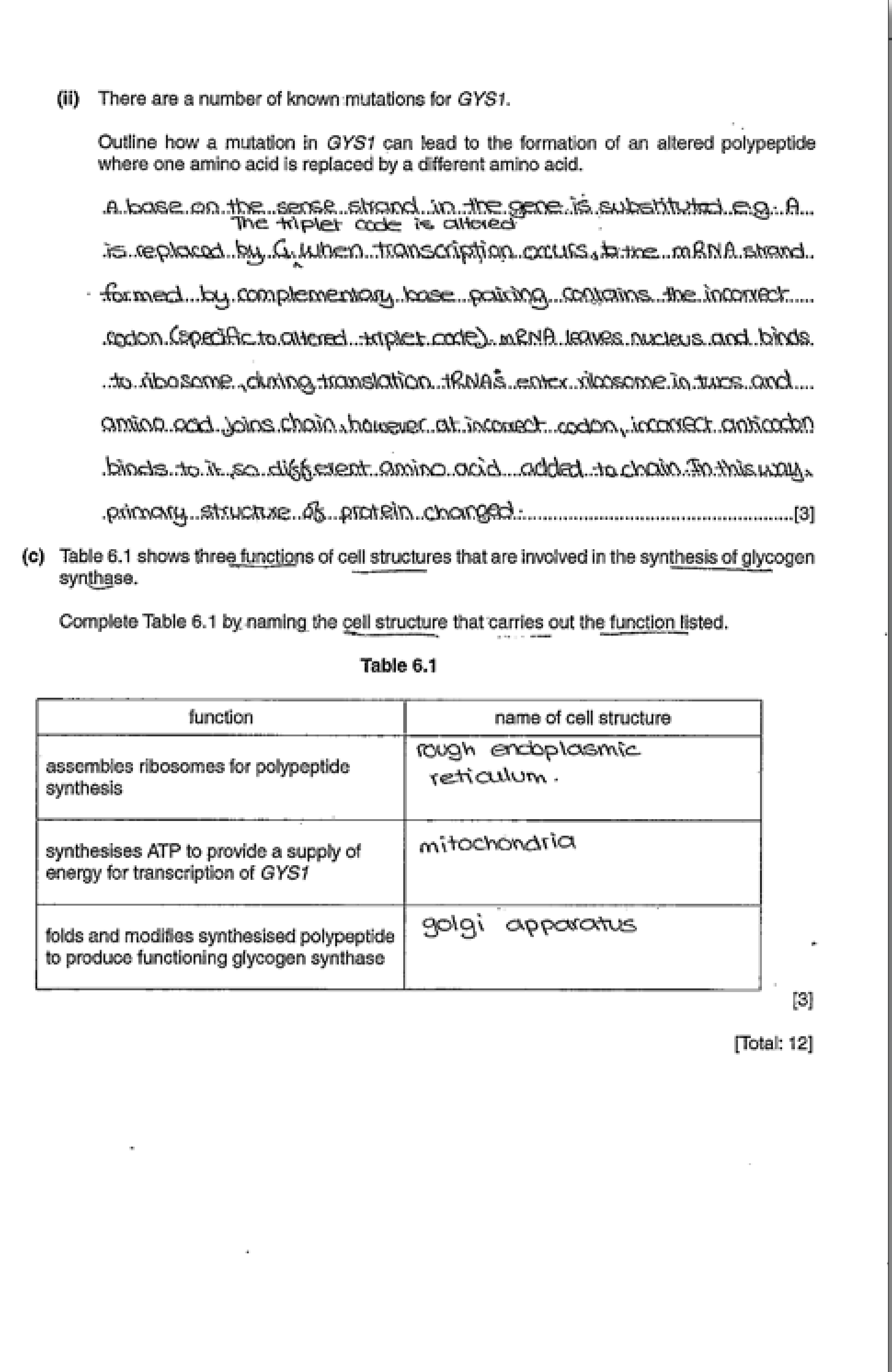
(c)	nucleolus ; **R** if other cell structures given mitochondrion ; **R** if other cell structures given rough endoplasmic reticulum or Golgi (body / apparatus / complex) ; **[3]** **[Total: 12]**



(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 when transcription occurs, the mRNA strand formed by complementary base pairing contains the incorrect codon (specific to altered triplet code). mRNA leaves nucleus and binds to ribosome, during translation tRNAs enter ribosome in twos 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. [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.
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]

Select page

HIGH MIDDLE LOW

Your Mark

6(a)(i) ☐

6(a)(ii) ☐

6(a)(iii) ☐

6(b)(i) ☐

6(b)(ii) ☐

6(c) ☐

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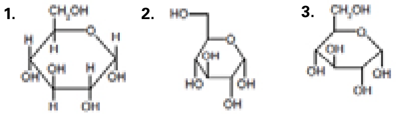
(a)(i)	 two marks for correct drawing of ring structure ;; *all atoms shown or one of diagrams 1–3 above* *one mark if, inconsistent / incomplete, drawing:* *diagram 1 – one missing H from any of carbons 2–6 (OH groups and rest of drawing must be correct)* *diagrams 2 and 3 – adding the H to one of carbons 1–5 (OH groups and rest of drawing must be correct)* **[2]**
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EXAMINER COMMENTS

MARK SCHEME

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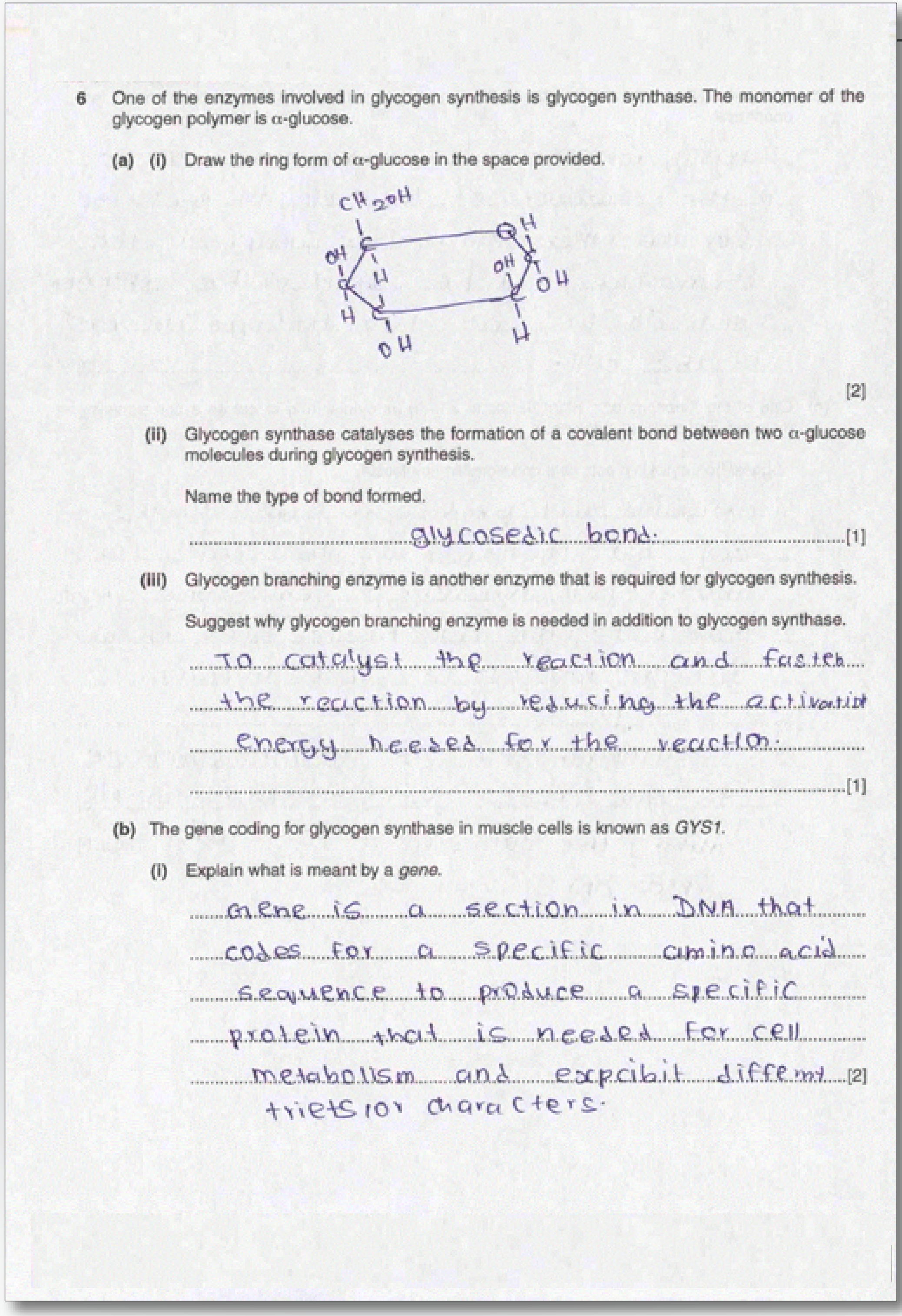

6 One of the enzymes involved in glycogen synthesis is glycogen synthase. The monomer of the glycogen polymer is α-glucose.

(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 redusing 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 excpibit differnt [2] triets or characters.

Your Mark

6(a)(i) ☐

6(a)(ii) ☐

6(a)(iii) ☐

6(b)(i) ☐

6(b)(ii) ☐

6(c) ☐

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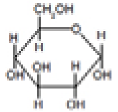
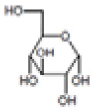
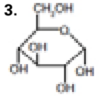
(a)(i)	1.  2.  3.  two marks for correct drawing of ring structure ;; *all atoms shown or one of diagrams 1–3 above* *one mark if, inconsistent / incomplete, drawing:* *diagram 1 – one missing H from any of carbons 2–6 (OH groups and rest of drawing must be correct)* *diagrams 2 and 3 – adding the H to one of carbons 1–5 (OH groups and rest of drawing must be correct)* **[2]**
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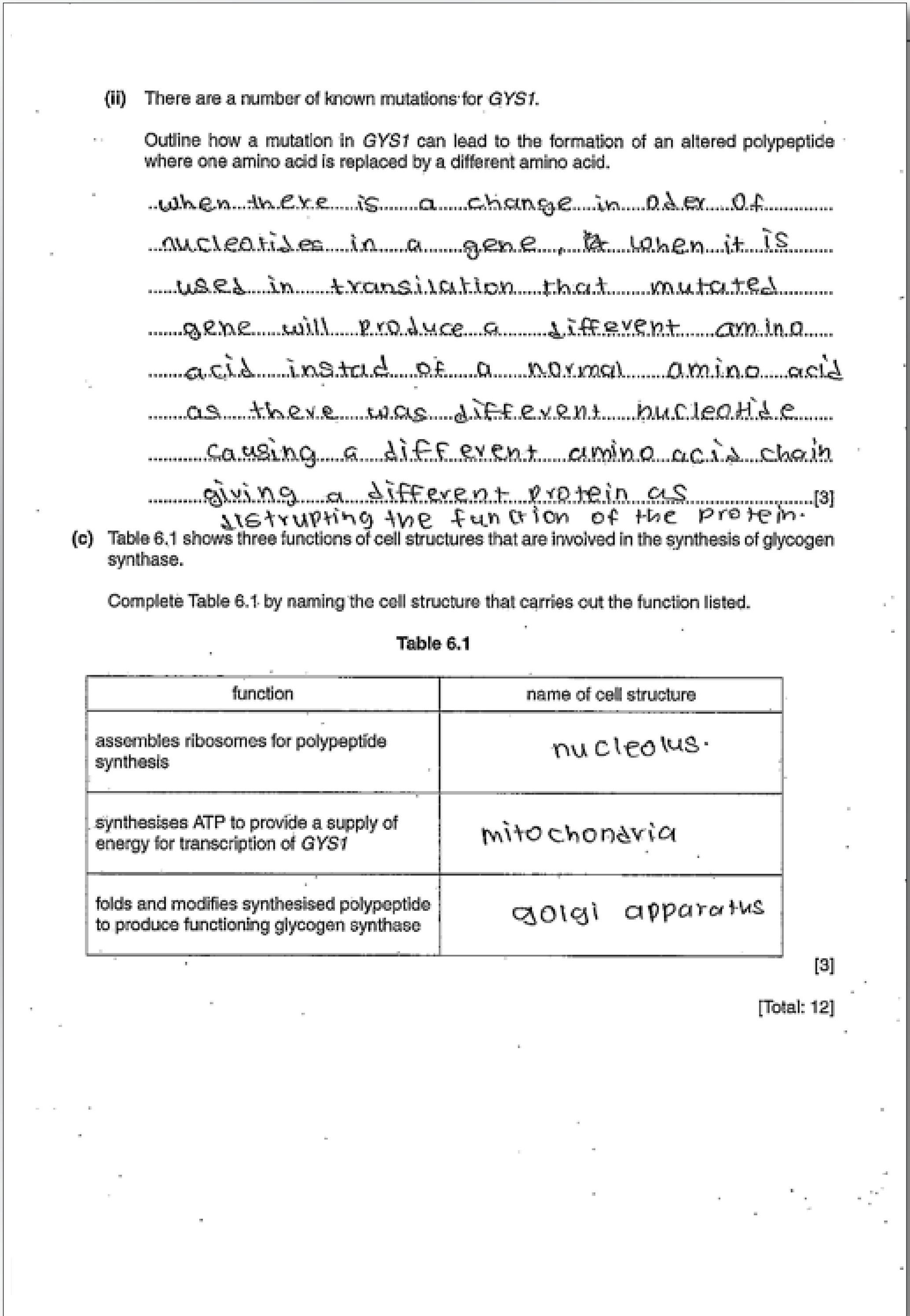

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Outline how a mutation in *GYS1* can lead to the formation of an altered polypeptide where one amino acid is replaced by a different amino acid.

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

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function	name of cell structure
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synthesises ATP to provide a supply of energy for transcription of *GYS1*	mitochondria
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[3]

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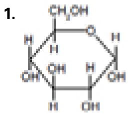
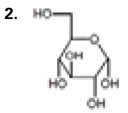
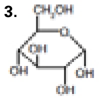
(a)(i)	1.  2.  3.  two marks for correct drawing of ring structure ;; *all atoms shown or one of diagrams 1–3 above* *one mark if, inconsistent / incomplete, drawing:* *diagram 1 – one missing H from any of carbons 2–6 (OH groups and rest of drawing must be correct)* *diagrams 2 and 3 – adding the H to one of carbons 1–5 (OH groups and rest of drawing must be correct)* **[2]**
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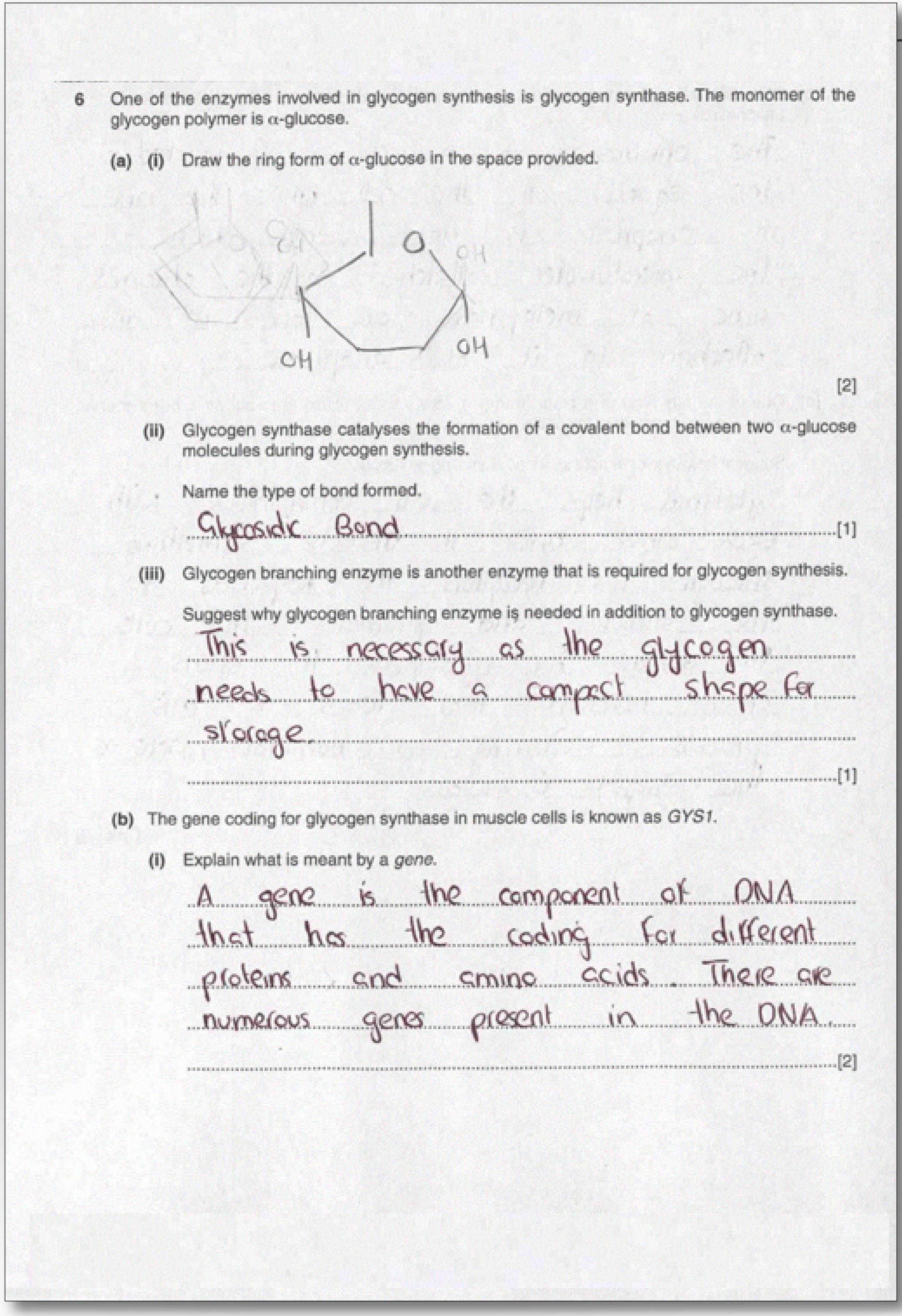


6 One of the enzymes involved in glycogen synthesis is glycogen synthase. The monomer of the glycogen polymer is α-glucose.

(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.

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.

..........[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 that has the coding for different proteins and amino acids. There are numerous genes present in the DNA.

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

Your Mark

6(a)(i) ☐

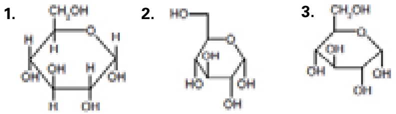
6(a)(ii) ☐

6(a)(iii) ☐

6(b)(i) ☐

6(b)(ii) ☐

6(c) ☐

Q6	Mark scheme
(a)(i)	 two marks for correct drawing of ring structure ;; *all atoms shown or one of diagrams 1–3 above* *one mark if, inconsistent / incomplete, drawing:* *diagram 1 – one missing H from any of carbons 2–6 (OH groups and rest of drawing must be correct)* *diagrams 2 and 3 – adding the H to one of carbons 1–5 (OH groups and rest of drawing must be correct)* **[2]**
(a)(ii)	glycosidic ; **A** glucosidic **[1]**
(a)(iii)	to form / has, (glycosidic α) 1–6, bonds / links (to make branches) ; ref. to different shaped / specific / complementary, active site required to form bonds (for branching) ; **[max 1]**
(b)(i)	*treat as neutral unit of inheritance* sequence of, nucleotides / bases ; section / length / part, of DNA (molecule) ; codes for a polypeptide ; **A** protein *for polypeptide* **A** enzyme **A** information to produce a polypeptide **A** codes / information, for sequence of amino acids / primary structure (of a, polypeptide / protein) **R** genetic code for a polypeptide **[max 2]**
(b)(ii)	**1** (in DNA / gene) altered, sequence / AW, of, nucleotides / bases ; I DNA sequence **2** base substitution or base / nucleotide, replaces another, base / nucleotide; **A** example must be in context of, *DNA / gene* **3** (mRNA synthesised) during transcription ; **4** (mutation leads to) altered / AW, mRNA / messenger RNA ; **5** (only) one (mRNA) codon changed / a different codon ; **A** one DNA, triplet / codon, changed I ref. to codons changed **6** tRNA, with / has, a different anticodon ; **7** (tRNA) brings, a different / a changed / the incorrect, amino acid, during translation / to the ribosome ; **8** codon-anticodon, binding / complementary / AW ; A matches **R** amino acid with anticodon
(c)	nucleolus ; **R** if other cell structures given mitochondrion ; **R** if other cell structures given rough endoplasmic reticulum or Golgi (body / apparatus / complex) ; **[3]** **[Total: 12]**

EXAMINER COMMENTS

MARK SCHEME

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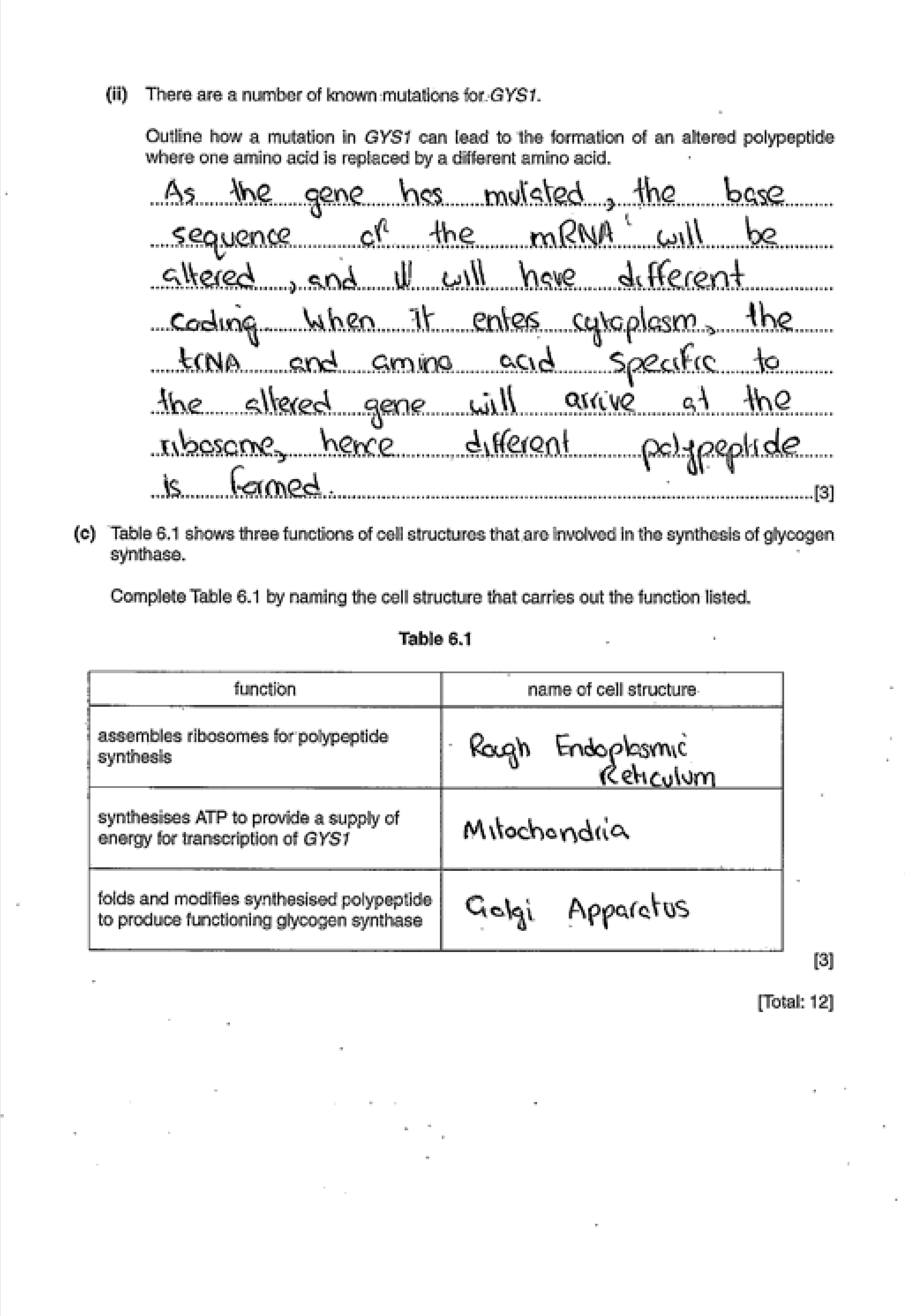


(ii) There are a number of known mutations for *GYS1*.

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 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
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]

Your Mark

6(a)(i) ☐

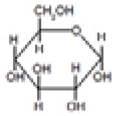
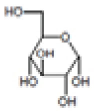
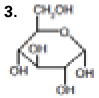
6(a)(ii) ☐

6(a)(iii) ☐

6(b)(i) ☐

6(b)(ii) ☐

6(c) ☐

Q6	Mark scheme
(a)(i)	1.  2.  3.  two marks for correct drawing of ring structure ;; *all atoms shown or one of diagrams 1–3 above* *one mark if, inconsistent / incomplete, drawing:* *diagram 1 – one missing H from any of carbons 2–6 (OH groups and rest of drawing must be correct)* *diagrams 2 and 3 – adding the H to one of carbons 1–5 (OH groups and rest of drawing must be correct)* **[2]**
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International Education

Interactive

Interactive Example Candidate Responses
Paper 3 (May/June 2016), Question 1

Cambridge International AS & A Level
Biology 9700

Version 1.0

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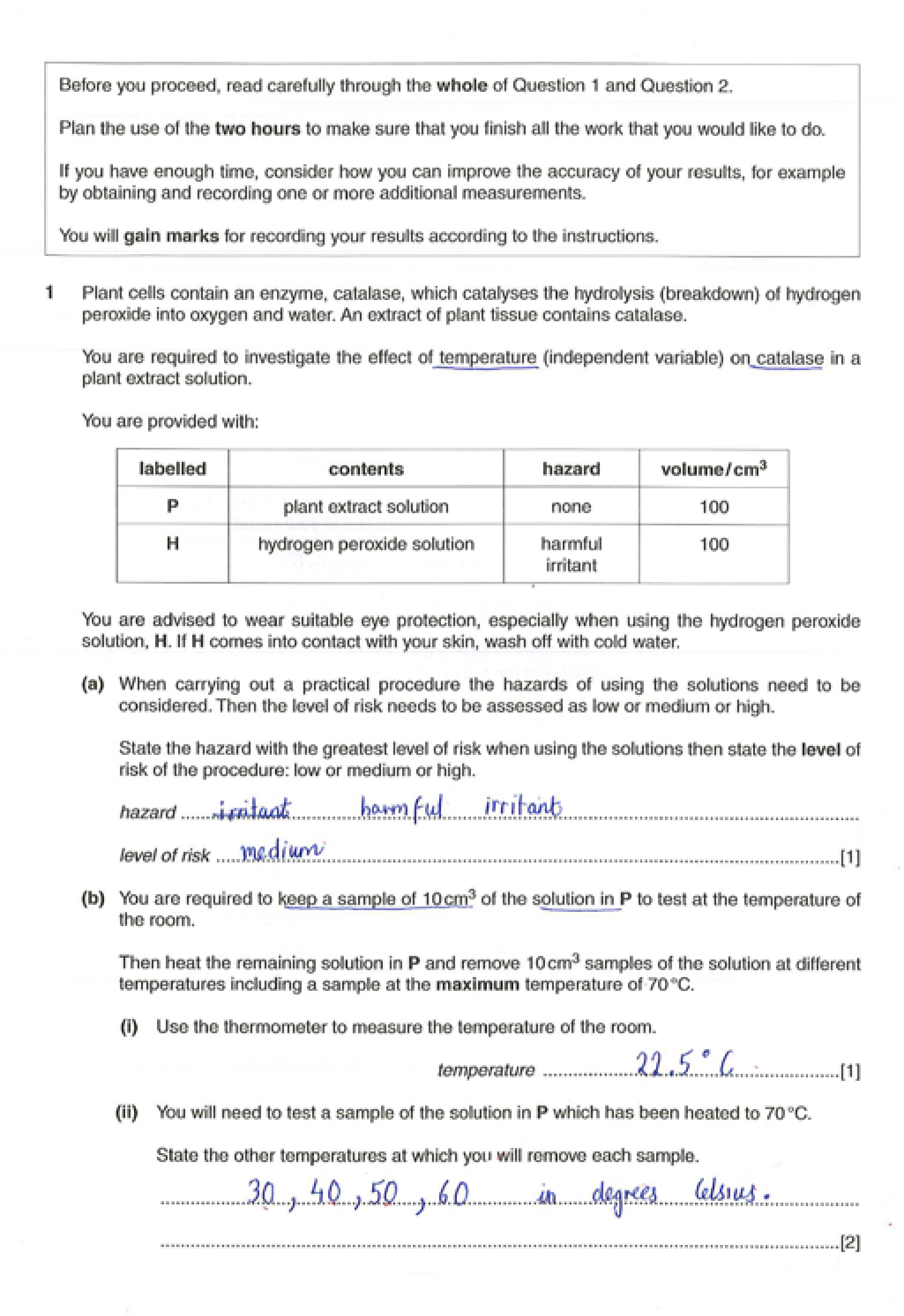

Before you proceed, read carefully through the **whole** of Question 1 and Question 2.

Plan the use of the **two hours** to make sure that you finish all the work that you would like to do.

If you have enough time, consider how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

You will **gain marks** for recording your results according to the instructions.

1 Plant cells contain an enzyme, catalase, which catalyses the hydrolysis (breakdown) of hydrogen peroxide into oxygen and water. An extract of plant tissue contains catalase.

You are required to investigate the effect of temperature (independent variable) on catalase in a plant extract solution.

You are provided with:

labelled	contents	hazard	volume/cm³
P	plant extract solution	none	100
H	hydrogen peroxide solution	harmful irritant	100

You are advised to wear suitable eye protection, especially when using the hydrogen peroxide solution, **H**. If **H** comes into contact with your skin, wash off with cold water.

(a) When carrying out a practical procedure the hazards of using the solutions need to be considered. Then the level of risk needs to be assessed as low or medium or high.

State the hazard with the greatest level of risk when using the solutions then state the **level** of risk of the procedure: low or medium or high.

hazard irritant harmful irritant

level of risk medium [1]

(b) You are required to keep a sample of 10cm³ of the solution in **P** to test at the temperature of the room.

Then heat the remaining solution in **P** and remove 10cm³ samples of the solution at different temperatures including a sample at the **maximum** temperature of 70 °C.

(i) Use the thermometer to measure the temperature of the room.

temperature 22.5 °C [1]

(ii) You will need to test a sample of the solution in **P** which has been heated to 70 °C.

State the other temperatures at which you will remove each sample.

30, 40, 50, 60 in degrees celsius.

[2]

Your Mark

- 1(a) ☐
- 1(b)(i) ☐
- 1(b)(ii) ☐
- 1(b)(iii) ☐
- 1(b)(iv) ☐
- 1(b)(v) ☐
- 1(b)(vi) ☐
- 1(c) ☐

Q1	Mark scheme
(a)(i)	*(risk assessment)* (hydrogen peroxide) harmful or irritant + medium or high ; **[1]**
(b)(i)	*(measures room temperature)* whole number or to half a degree + °C ; **[1]**
(b)(ii)	*(decides on interval for temperature)* at least three additional temperatures + whole numbers + even intervals ; °C ; **[2]**
(b)(iii)	*(recording results)* 1. table drawn + heading, temperature + °C ; 2. heading, time + seconds ; 3. records results for at least five temperatures ; 4. correct pattern of results ; 5. times recorded as whole seconds ; 6. records results for repeats + means calculated ; **[6]**
(b)(iv)	*(source of error with reason)* appropriate error with reason ; e.g. concentration of hydrogen peroxide decreases appropriate error with reason ; e.g. different volumes of extract on each square of filter paper **[2]**
(b)(v)	*(conclusions)* (as temperature increases, activity increases) more successful collisions or more enzyme-substrate-complexes / ESCs ; (decreased / no activity) denatures or changed shape of active site ; **[2]**
(b)(vi)	*(modification to investigate another variable)* 1. (to standardise temperature) stated temperature + thermostatically controlled water-bath ; 2. (independent variable) at least five concentrations of catalase ; 3. (method) simple dilution / proportional dilution / serial dilution ; **[3]**
(c)	*(chart)* 1. (x-axis) different plant species + (y-axis) initial rate of activity of catalase / s–1 ; 2. (scale on x-axis) even width of bars + (scale on y-axis) 0.05 to 2 cm, labelled at least each 2 cm ; 3. correct plotting of five bars ; 4. five bars labelled with each horizontal line drawn as a thin line + each column labelled ; **[4]** **[Total: 21]**

EXAMINER COMMENTS

MARK SCHEME

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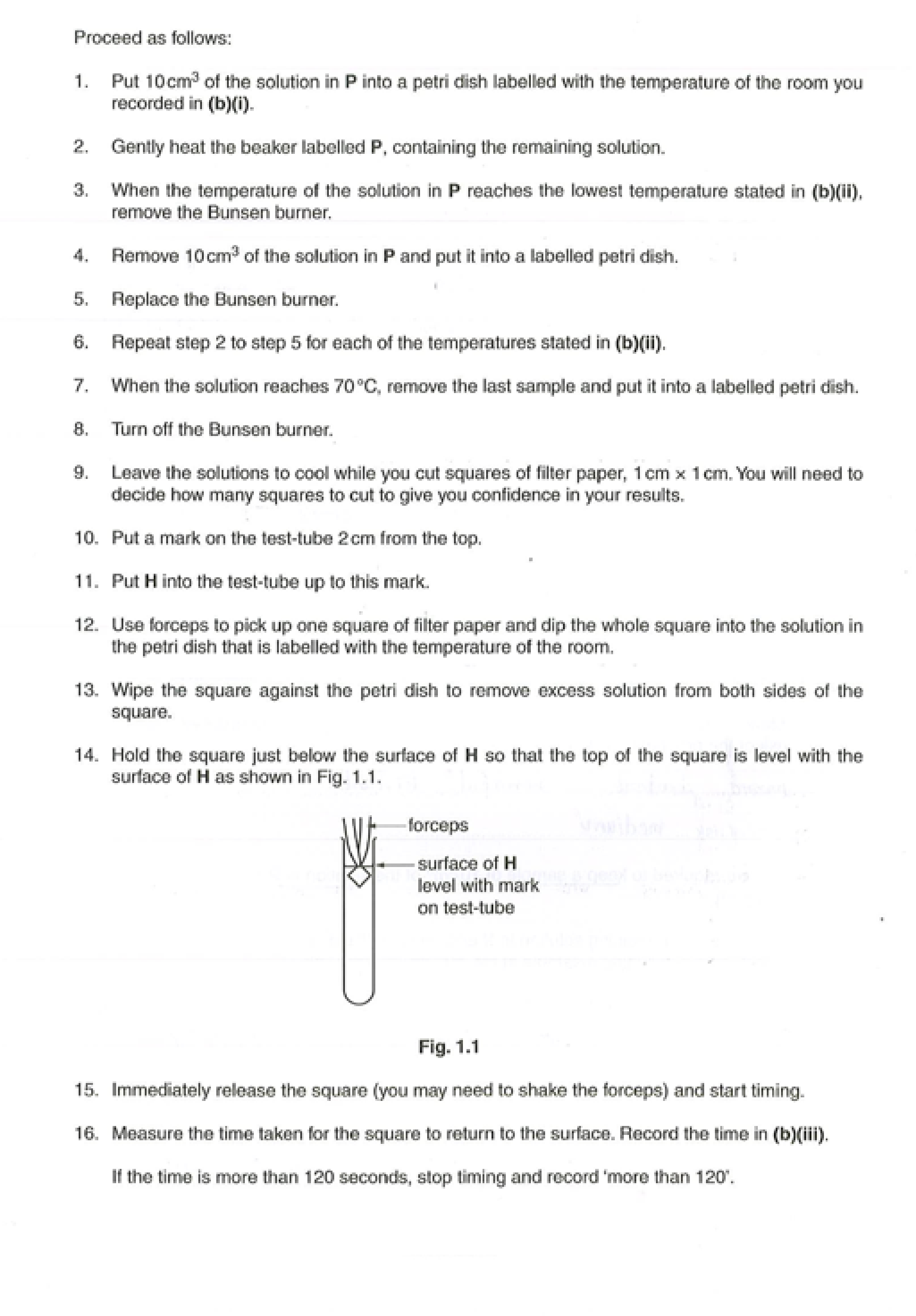

Proceed as follows:

1. Put 10 cm^3 of the solution in **P** into a petri dish labelled with the temperature of the room you recorded in **(b)(i)**.
2. Gently heat the beaker labelled **P**, containing the remaining solution.
3. When the temperature of the solution in **P** reaches the lowest temperature stated in **(b)(ii)**, remove the Bunsen burner.
4. Remove 10 cm^3 of the solution in **P** and put it into a labelled petri dish.
5. Replace the Bunsen burner.
6. Repeat step 2 to step 5 for each of the temperatures stated in **(b)(ii)**.
7. When the solution reaches 70 °C, remove the last sample and put it into a labelled petri dish.
8. Turn off the Bunsen burner.
9. Leave the solutions to cool while you cut squares of filter paper, 1 cm × 1 cm. You will need to decide how many squares to cut to give you confidence in your results.
10. Put a mark on the test-tube 2 cm from the top.
11. Put **H** into the test-tube up to this mark.
12. Use forceps to pick up one square of filter paper and dip the whole square into the solution in the petri dish that is labelled with the temperature of the room.
13. Wipe the square against the petri dish to remove excess solution from both sides of the square.
14. Hold the square just below the surface of **H** so that the top of the square is level with the surface of **H** as shown in Fig. 1.1.

Fig. 1.1

15. Immediately release the square (you may need to shake the forceps) and start timing.
16. Measure the time taken for the square to return to the surface. Record the time in **(b)(iii)**.

If the time is more than 120 seconds, stop timing and record 'more than 120'.

Your Mark

1(a) ☐
1(b)(i) ☐
1(b)(ii) ☐
1(b)(iii) ☐
1(b)(iv) ☐
1(b)(v) ☐
1(b)(vi) ☐
1(c) ☐

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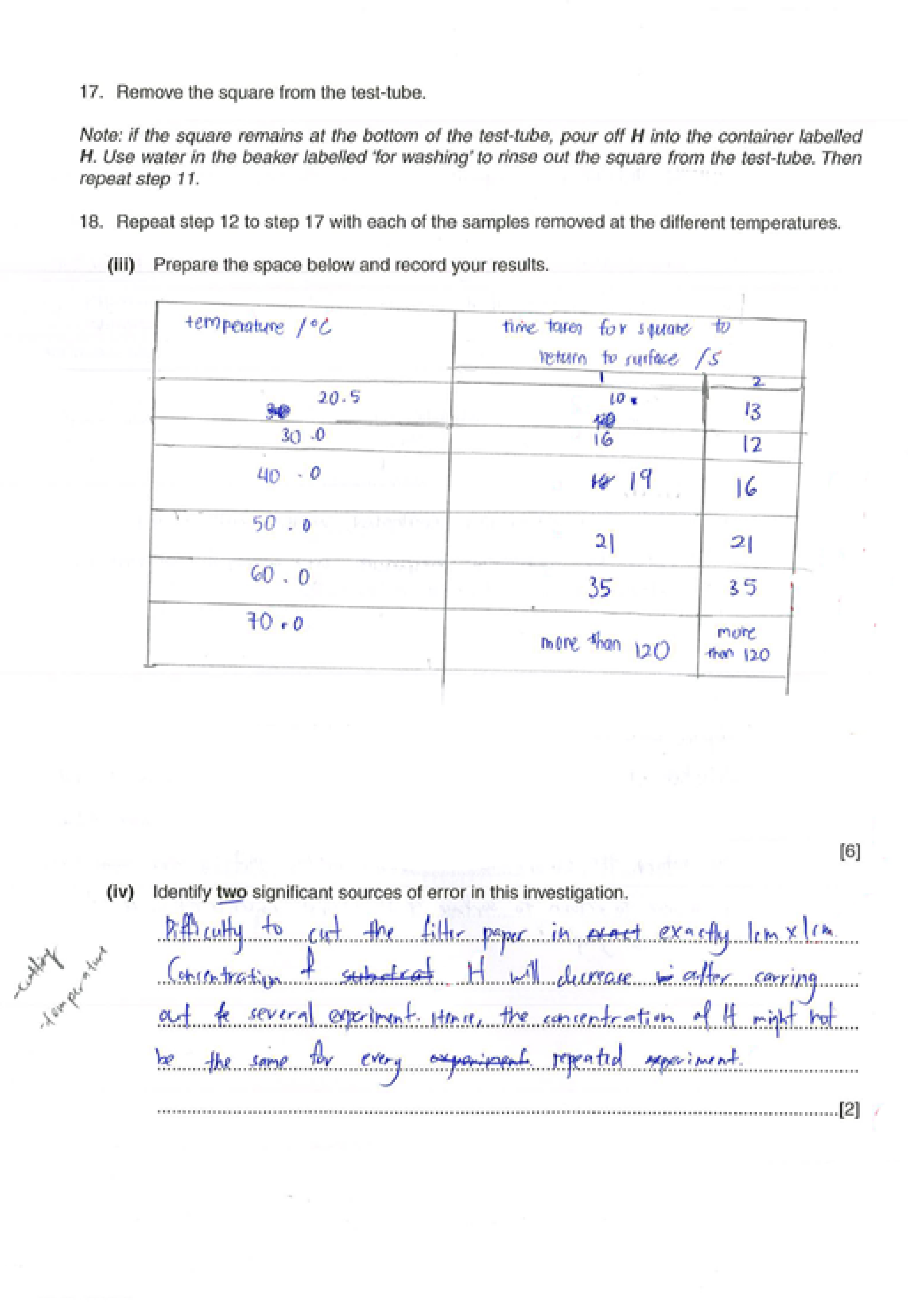

17. Remove the square from the test-tube.

*Note: if the square remains at the bottom of the test-tube, pour off **H** into the container labelled **H**. Use water in the beaker labelled 'for washing' to rinse out the square from the test-tube. Then repeat step 11.*

18. Repeat step 12 to step 17 with each of the samples removed at the different temperatures.

(iii) Prepare the space below and record your results.

temperature / °C	time taken for square to return to surface / s	
	1	2
~~30~~ 20.5	10 ~~10~~	13
30.0	16	12
40.0	~~16~~ 19	16
50.0	21	21
60.0	35	35
70.0	more than 120	more than 120

[6]

(iv) Identify two significant sources of error in this investigation.

-cutting

-temperature

Difficulty to cut the filter paper in ~~exact~~ exactly 1cm x 1cm

Concentration of ~~substrat~~ H will decrease ~~w~~ after carring out the several experiment. Hence, the concentration of H might not be the same for every ~~experiment~~ repeated experiment.

[2]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

1(c) ☐

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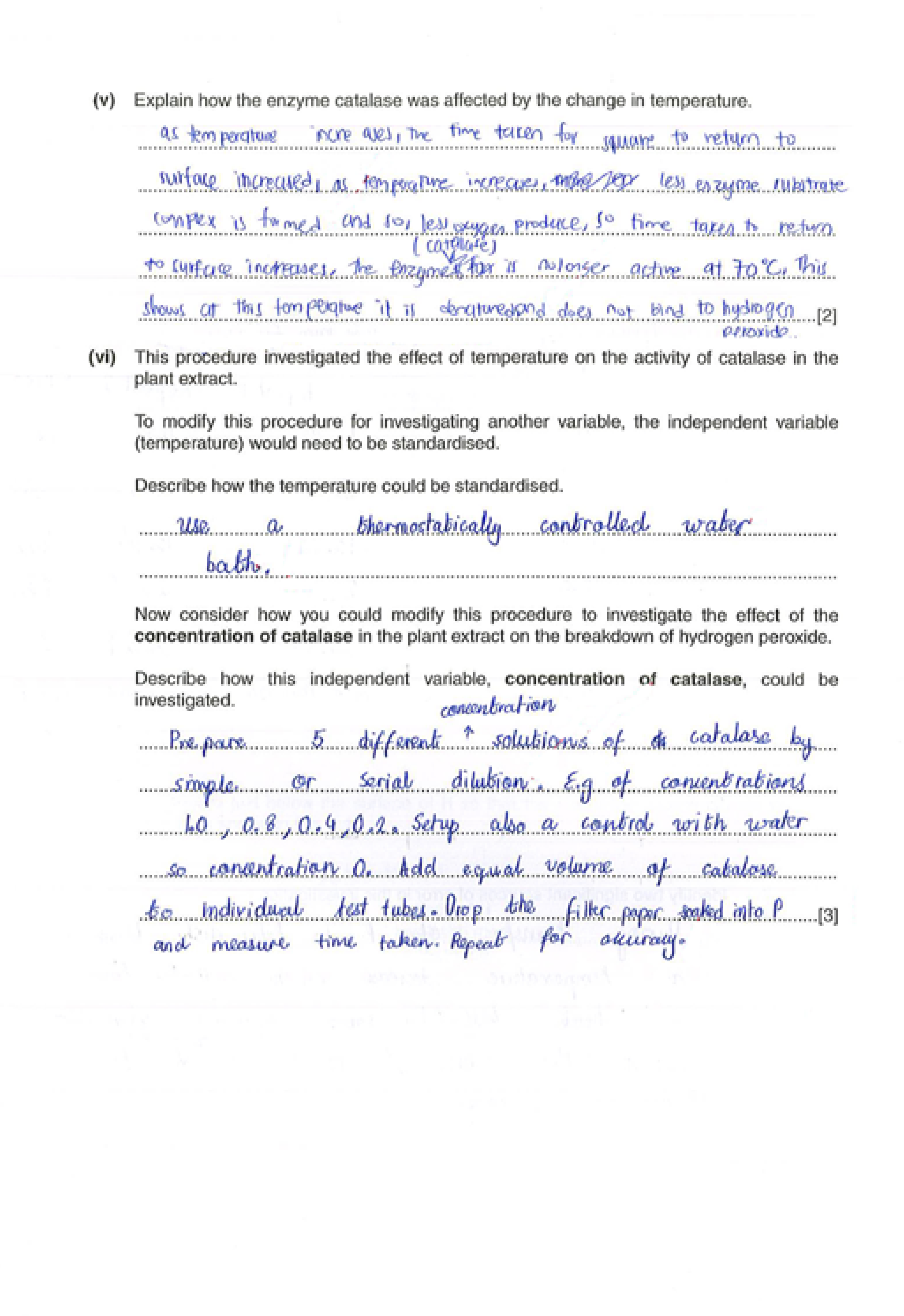

(v) Explain how the enzyme catalase was affected by the change in temperature.

as temperature increases, the time taken for square to return to surface increased, as temperature increases, ~~more/less~~ less enzyme substrate complex is formed and so, less oxygen produce, so time taken to return to surface increases. the enzyme (catalase) for is no longer active at 70°C, this shows at this temperature it is denatured and does not bind to hydrogen peroxide. [2]

(vi) This procedure investigated the effect of temperature on the activity of catalase in the plant extract.

To modify this procedure for investigating another variable, the independent variable (temperature) would need to be standardised.

Describe how the temperature could be standardised.

Use a thermostatically controlled water bath.

Now consider how you could modify this procedure to investigate the effect of the **concentration of catalase** in the plant extract on the breakdown of hydrogen peroxide.

Describe how this independent variable, **concentration of catalase**, could be investigated.

Prepare 5 different concentration solutions of ~~c~~ catalase by simple or serial dilution. E.g of concentrations 1.0, 0.8, 0.4, 0.2. Setup also a control with water so concentration 0. Add equal volume of catalase to individual test tubes. Drop the filter paper soaked into P and measure time taken. Repeat for accuracy. [3]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

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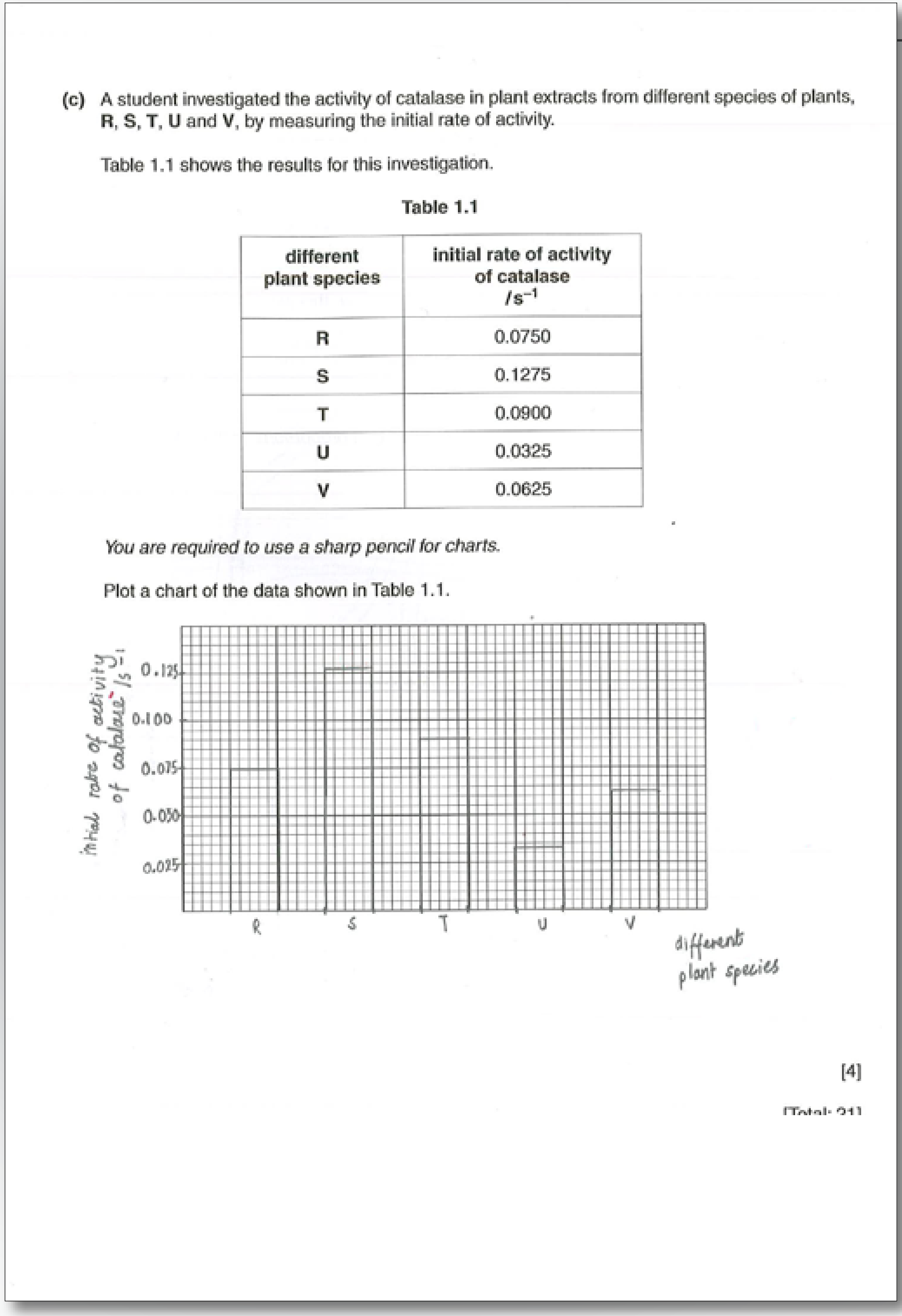

(c) A student investigated the activity of catalase in plant extracts from different species of plants, **R**, **S**, **T**, **U** and **V**, by measuring the initial rate of activity.

Table 1.1 shows the results for this investigation.

Table 1.1

different plant species	initial rate of activity of catalase /s^{-1}
R	0.0750
S	0.1275
T	0.0900
U	0.0325
V	0.0625

You are required to use a sharp pencil for charts.

Plot a chart of the data shown in Table 1.1.

[4]

[Total: 21]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

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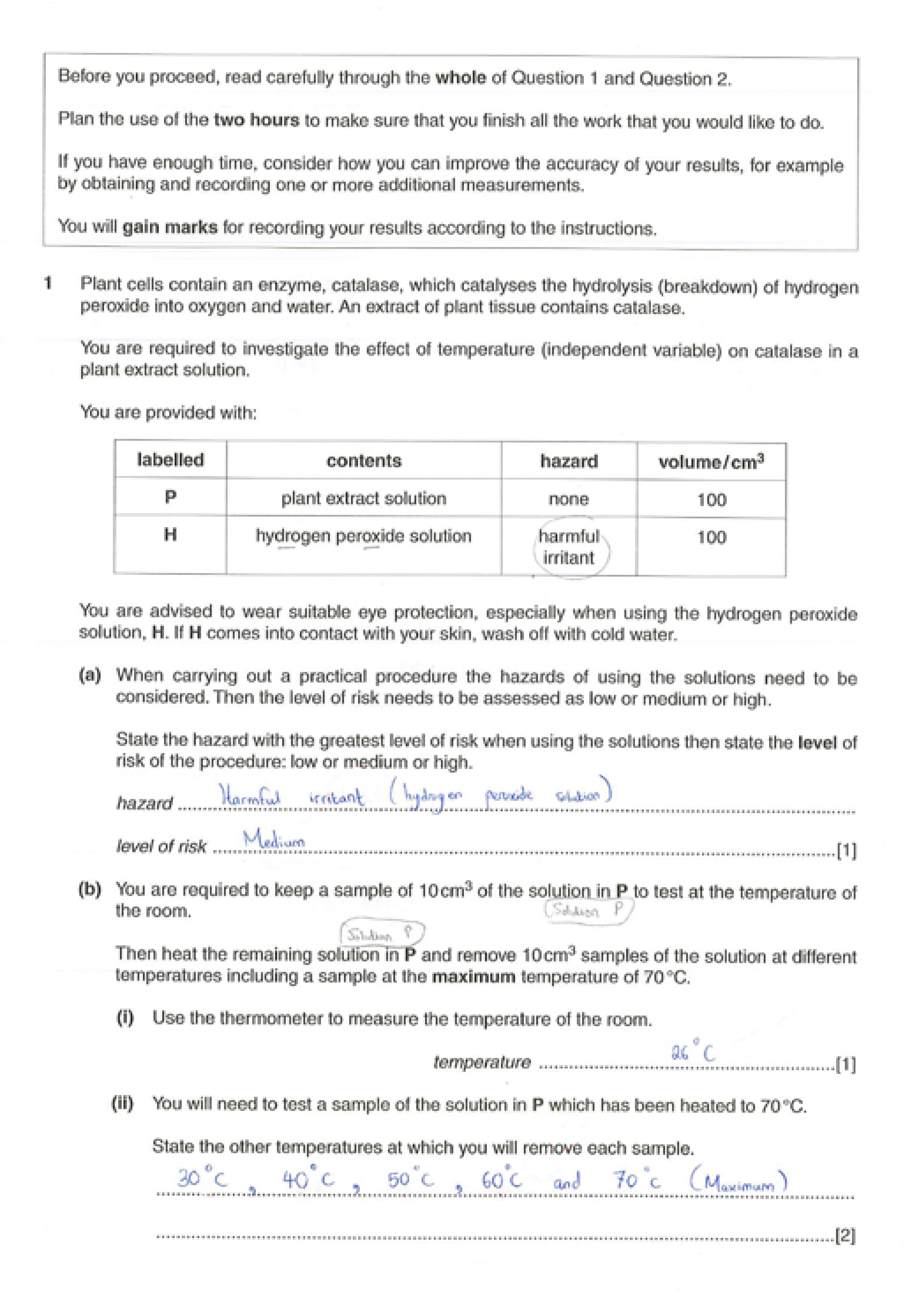

Before you proceed, read carefully through the **whole** of Question 1 and Question 2.

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If you have enough time, consider how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

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State the hazard with the greatest level of risk when using the solutions then state the **level** of risk of the procedure: low or medium or high.

hazard Harmful irritant (hydrogen peroxide solution)

level of risk Medium [1]

(b) You are required to keep a sample of 10 cm^3 of the solution in **P** to test at the temperature of the room. Solution P

Solution P

Then heat the remaining solution in **P** and remove 10 cm^3 samples of the solution at different temperatures including a sample at the **maximum** temperature of 70 °C.

(i) Use the thermometer to measure the temperature of the room.

temperature 26 °C [1]

(ii) You will need to test a sample of the solution in **P** which has been heated to 70 °C.

State the other temperatures at which you will remove each sample.

30 °C, 40 °C, 50 °C, 60 °C and 70 °C (Maximum)

[2]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

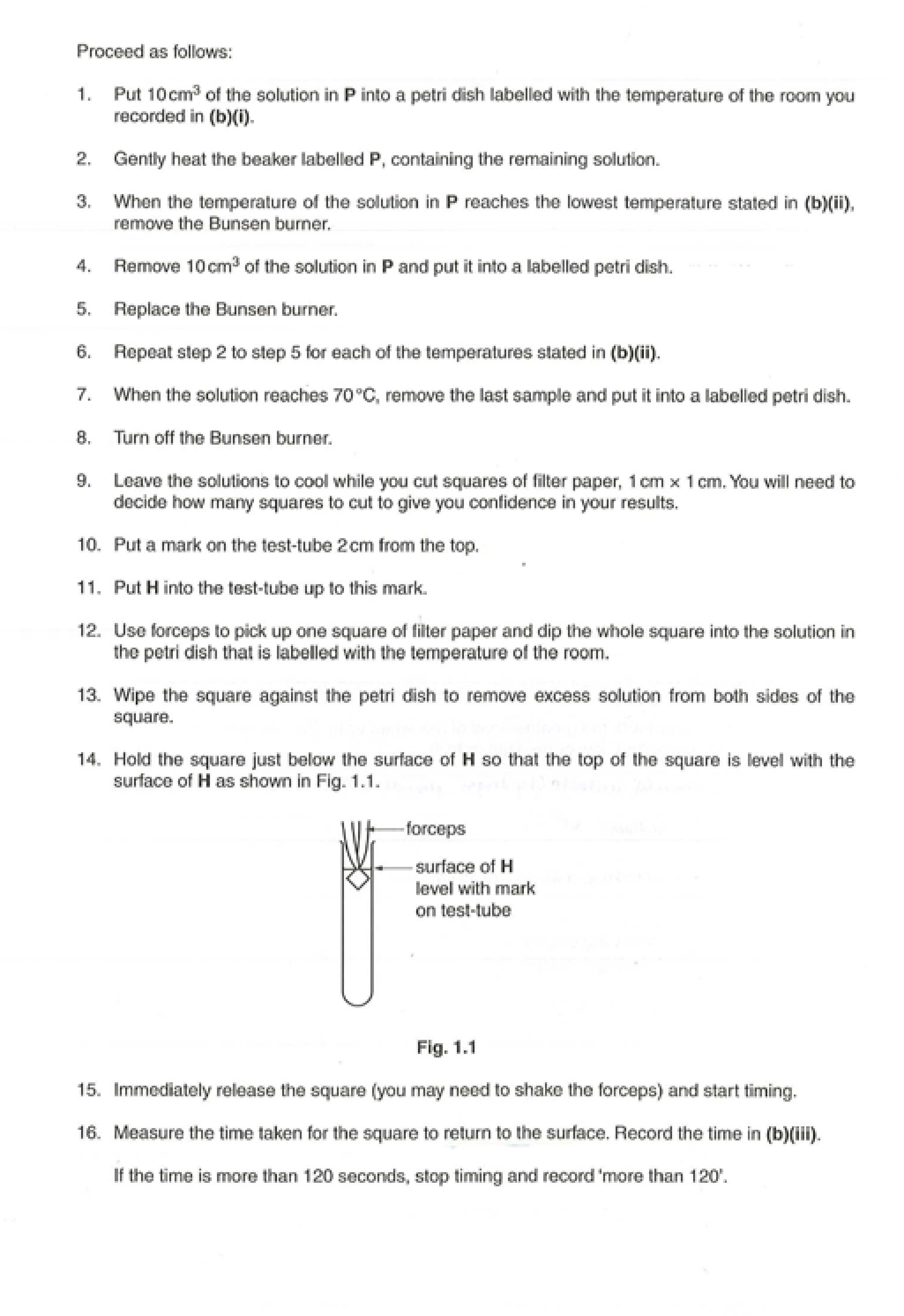
1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

1(c) ☐

Q1	Mark scheme
(a)(i)	*(risk assessment)* (hydrogen peroxide) harmful or irritant + medium or high ; **[1]**
(b)(i)	*(measures room temperature)* whole number or to half a degree + °C ; **[1]**
(b)(ii)	*(decides on interval for temperature)* at least three additional temperatures + whole numbers + even intervals ; °C ; **[2]**
(b)(iii)	*(recording results)* 1. table drawn + heading, temperature + °C ; 2. heading, time + seconds ; 3. records results for at least five temperatures ; 4. correct pattern of results ; 5. times recorded as whole seconds ; 6. records results for repeats + means calculated ; **[6]**
(b)(iv)	*(source of error with reason)* appropriate error with reason ; e.g. concentration of hydrogen peroxide decreases appropriate error with reason ; e.g. different volumes of extract on each square of filter paper **[2]**
(b)(v)	*(conclusions)* (as temperature increases, activity increases) more successful collisions or more enzyme-substrate-complexes / ESCs ; (decreased / no activity) denatures or changed shape of active site ; **[2]**
(b)(vi)	*(modification to investigate another variable)* 1. (to standardise temperature) stated temperature + thermostatically controlled water-bath ; 2. (independent variable) at least five concentrations of catalase ; 3. (method) simple dilution / proportional dilution / serial dilution ; **[3]**
(c)	*(chart)* 1. (x-axis) different plant species + (y-axis) initial rate of activity of catalase / s–1 ; 2. (scale on x-axis) even width of bars + (scale on y-axis) 0.05 to 2 cm, labelled at least each 2 cm ; 3. correct plotting of five bars ; 4. five bars labelled with each horizontal line drawn as a thin line + each column labelled ; **[4]** **[Total: 21]**



Proceed as follows:

1. Put 10 cm^3 of the solution in **P** into a petri dish labelled with the temperature of the room you recorded in **(b)(i)**.
2. Gently heat the beaker labelled **P**, containing the remaining solution.
3. When the temperature of the solution in **P** reaches the lowest temperature stated in **(b)(ii)**, remove the Bunsen burner.
4. Remove 10 cm^3 of the solution in **P** and put it into a labelled petri dish.
5. Replace the Bunsen burner.
6. Repeat step 2 to step 5 for each of the temperatures stated in **(b)(ii)**.
7. When the solution reaches 70 °C, remove the last sample and put it into a labelled petri dish.
8. Turn off the Bunsen burner.
9. Leave the solutions to cool while you cut squares of filter paper, 1 cm × 1 cm. You will need to decide how many squares to cut to give you confidence in your results.
10. Put a mark on the test-tube 2 cm from the top.
11. Put **H** into the test-tube up to this mark.
12. Use forceps to pick up one square of filter paper and dip the whole square into the solution in the petri dish that is labelled with the temperature of the room.
13. Wipe the square against the petri dish to remove excess solution from both sides of the square.
14. Hold the square just below the surface of **H** so that the top of the square is level with the surface of **H** as shown in Fig. 1.1.

Fig. 1.1

15. Immediately release the square (you may need to shake the forceps) and start timing.
16. Measure the time taken for the square to return to the surface. Record the time in **(b)(iii)**.

    If the time is more than 120 seconds, stop timing and record 'more than 120'.

Select page
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LOW

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

1(c) ☐

Q1	Mark scheme	
(a)(i)	*(risk assessment)* (hydrogen peroxide) harmful or irritant + medium or high ;	**[1]**
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(b)(v)	*(conclusions)* (as temperature increases, activity increases) more successful collisions or more enzyme-substrate-complexes / ESCs ; (decreased / no activity) denatures or changed shape of active site ;	**[2]**
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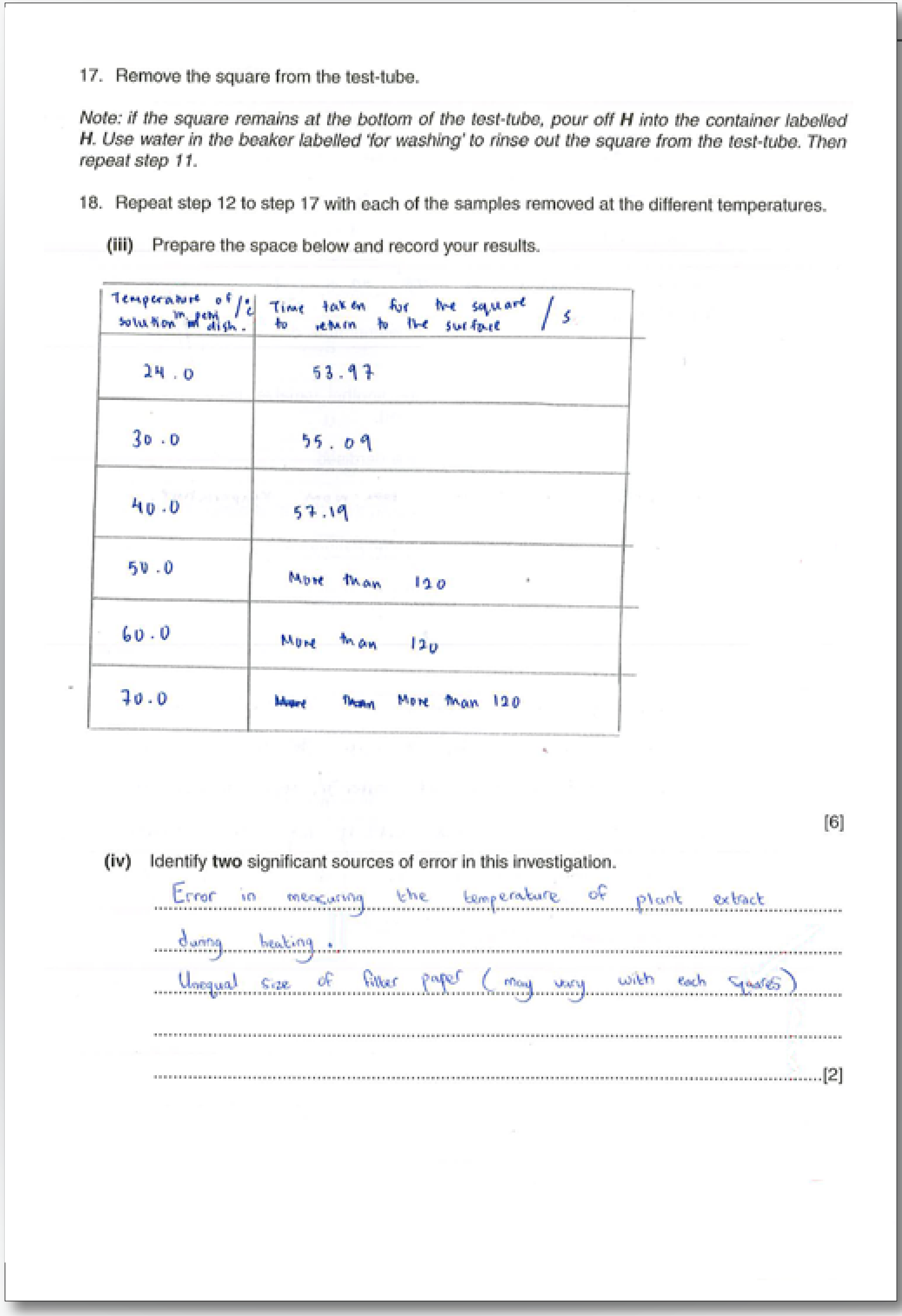
EXAMINER COMMENTS
MARK SCHEME



17. Remove the square from the test-tube.

*Note: if the square remains at the bottom of the test-tube, pour off **H** into the container labelled **H**. Use water in the beaker labelled 'for washing' to rinse out the square from the test-tube. Then repeat step 11.*

18. Repeat step 12 to step 17 with each of the samples removed at the different temperatures.

(iii) Prepare the space below and record your results.

Temperature of solution in petri dish. /°C	Time taken for the square to return to the surface / s
24.0	53.97
30.0	55.09
40.0	57.19
50.0	More than 120
60.0	More than 120
70.0	~~More than~~ More than 120

[6]

(iv) Identify **two** significant sources of error in this investigation.

Error in meacuring the temperature of plant extract during heating.

Unequal size of filter paper (may vary with each squares)

[2]

Your Mark

1(a)

1(b)(i)

1(b)(ii)

1(b)(iii)

1(b)(iv)

1(b)(v)

1(b)(vi)

1(c)

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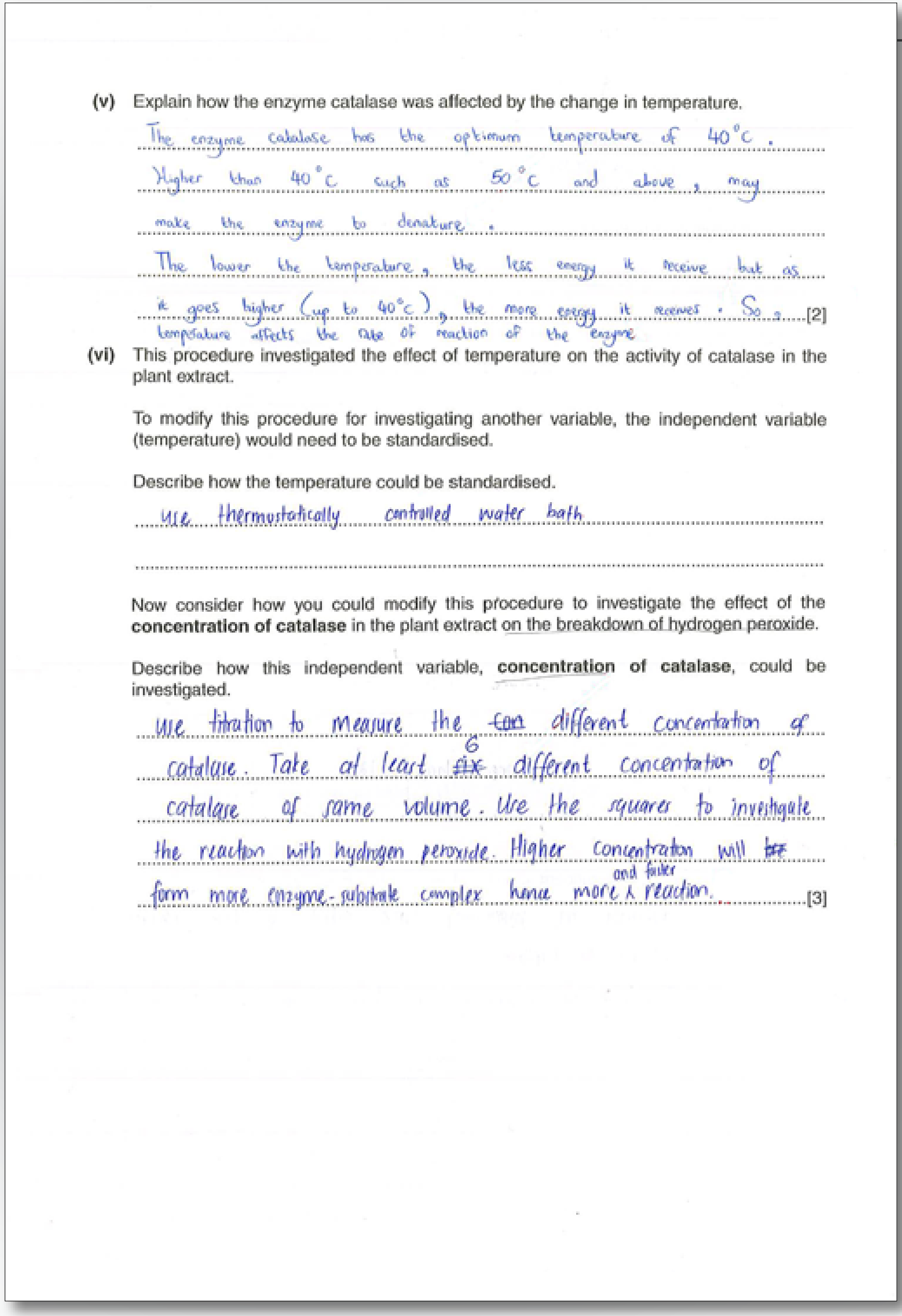

(v) Explain how the enzyme catalase was affected by the change in temperature.

The enzyme catalase has the optimum temperature of 40°C. Higher than 40°C such as 50°C and above, may make the enzyme to denature. The lower the temperature, the less energy it receive but as it goes higher (up to 40°C), the more energy it receives. So, temperature affects the rate of reaction of the enzyme [2]

(vi) This procedure investigated the effect of temperature on the activity of catalase in the plant extract.

To modify this procedure for investigating another variable, the independent variable (temperature) would need to be standardised.

Describe how the temperature could be standardised.

Use thermostatically controlled water bath

Now consider how you could modify this procedure to investigate the effect of the **concentration of catalase** in the plant extract on the breakdown of hydrogen peroxide.

Describe how this independent variable, **concentration of catalase**, could be investigated.

Use titration to measure the ~~con~~ different concentation of catalase. Take at least ~~six~~ 6 different concentation of catalase of same volume. Use the squares to investigate the reaction with hydrogen peroxide. Higher concentration will ~~be~~ form more enzyme-substrate complex hence more and faster reaction. [3]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

1(c) ☐

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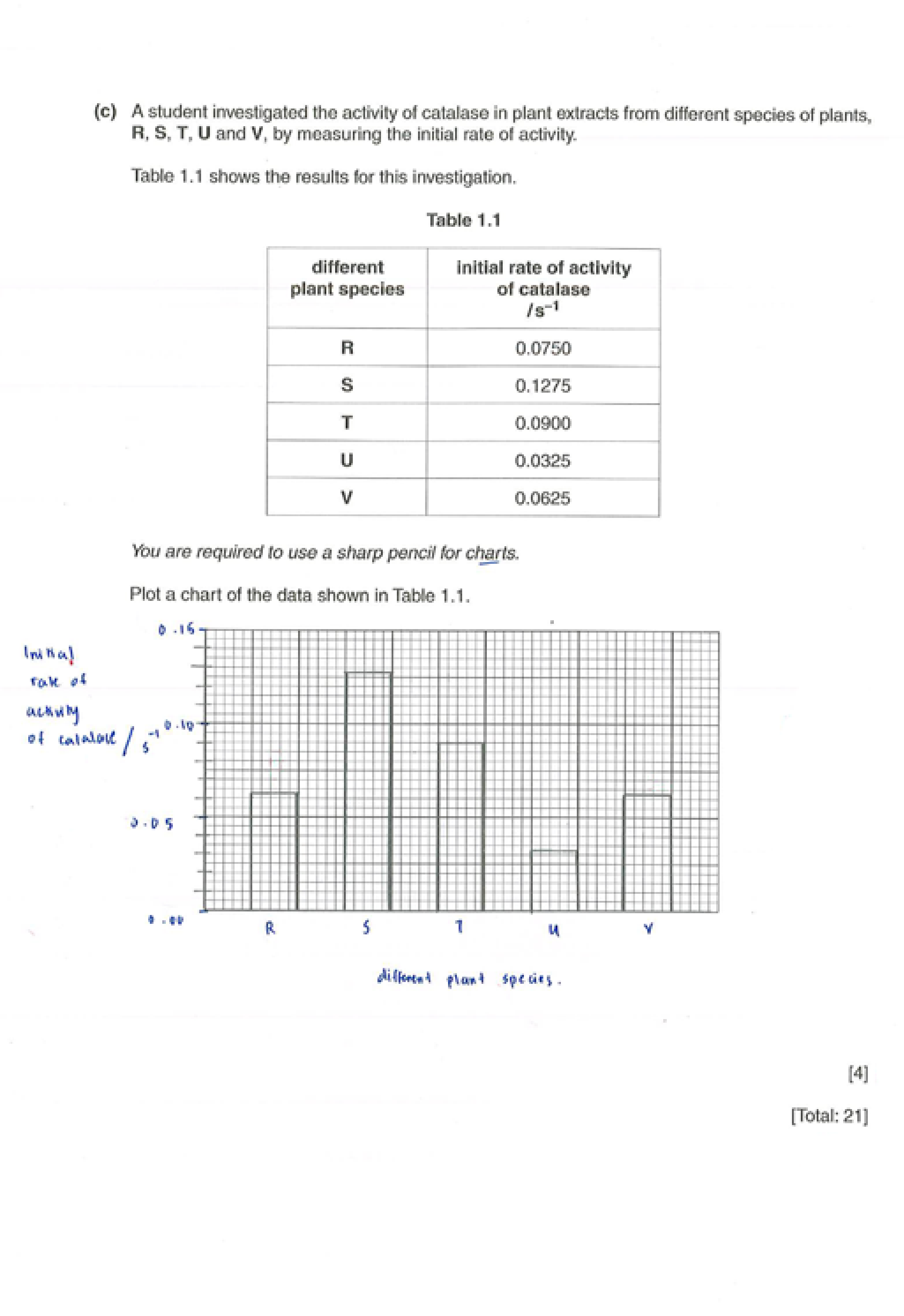
EXAMINER COMMENTS

MARK SCHEME



(c) A student investigated the activity of catalase in plant extracts from different species of plants, **R**, **S**, **T**, **U** and **V**, by measuring the initial rate of activity.

Table 1.1 shows the results for this investigation.

Table 1.1

different plant species	initial rate of activity of catalase /s^{-1}
R	0.0750
S	0.1275
T	0.0900
U	0.0325
V	0.0625

You are required to use a sharp pencil for charts.

Plot a chart of the data shown in Table 1.1.

[4]

[Total: 21]

Your Mark

- 1(a) ☐
- 1(b)(i) ☐
- 1(b)(ii) ☐
- 1(b)(iii) ☐
- 1(b)(iv) ☐
- 1(b)(v) ☐
- 1(b)(vi) ☐
- 1(c) ☐

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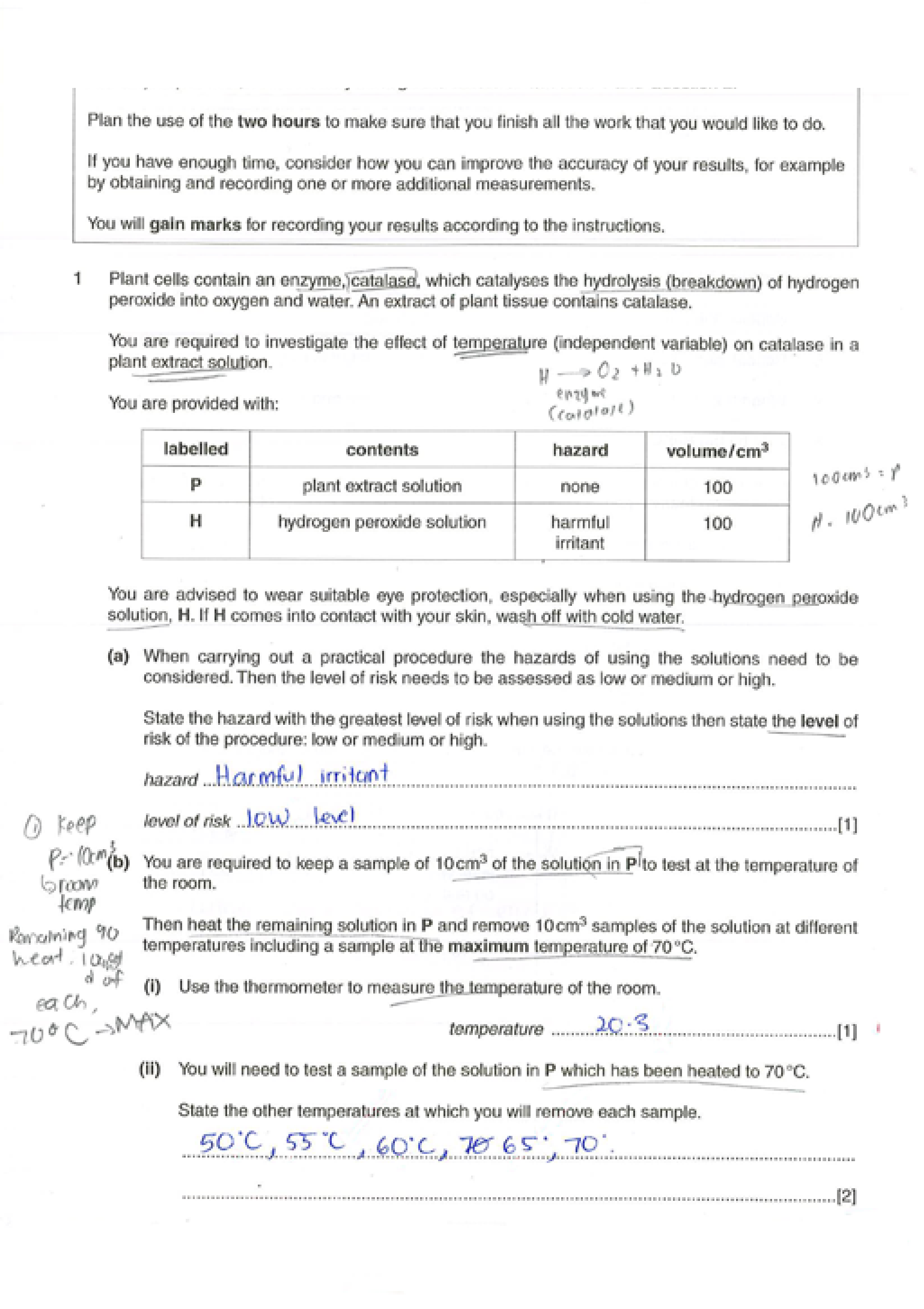

Plan the use of the **two hours** to make sure that you finish all the work that you would like to do.

If you have enough time, consider how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

You will **gain marks** for recording your results according to the instructions.

1 Plant cells contain an enzyme, catalase, which catalyses the hydrolysis (breakdown) of hydrogen peroxide into oxygen and water. An extract of plant tissue contains catalase.

You are required to investigate the effect of temperature (independent variable) on catalase in a plant extract solution.

$H \xrightarrow[\text{(catalase)}]{\text{enzyme}} O_2 + H_2O$

You are provided with:

labelled	contents	hazard	volume/cm³
P	plant extract solution	none	100
H	hydrogen peroxide solution	harmful irritant	100

100cm³ = P

H. 100cm³

You are advised to wear suitable eye protection, especially when using the hydrogen peroxide solution, **H**. If **H** comes into contact with your skin, wash off with cold water.

(a) When carrying out a practical procedure the hazards of using the solutions need to be considered. Then the level of risk needs to be assessed as low or medium or high.

State the hazard with the greatest level of risk when using the solutions then state the **level** of risk of the procedure: low or medium or high.

hazard Harmful irritant

level of risk low level [1]

① Keep P: 10cm³ room temp

(b) You are required to keep a sample of 10cm³ of the solution in **P** to test at the temperature of the room.

Then heat the remaining solution in **P** and remove 10cm³ samples of the solution at different temperatures including a sample at the **maximum** temperature of 70 °C.

Remaining 90 heat. 10cm³ of each, 70°C → MAX

(i) Use the thermometer to measure the temperature of the room.

temperature 20·3 [1]

(ii) You will need to test a sample of the solution in **P** which has been heated to 70 °C.

State the other temperatures at which you will remove each sample.

50°C, 55°C, 60°C, ~~70~~ 65°, 70°.

[2]

Your Mark

1(a)	
1(b)(i)	
1(b)(ii)	
1(b)(iii)	
1(b)(iv)	
1(b)(v)	
1(b)(vi)	
1(c)	

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EXAMINER COMMENTS

MARK SCHEME

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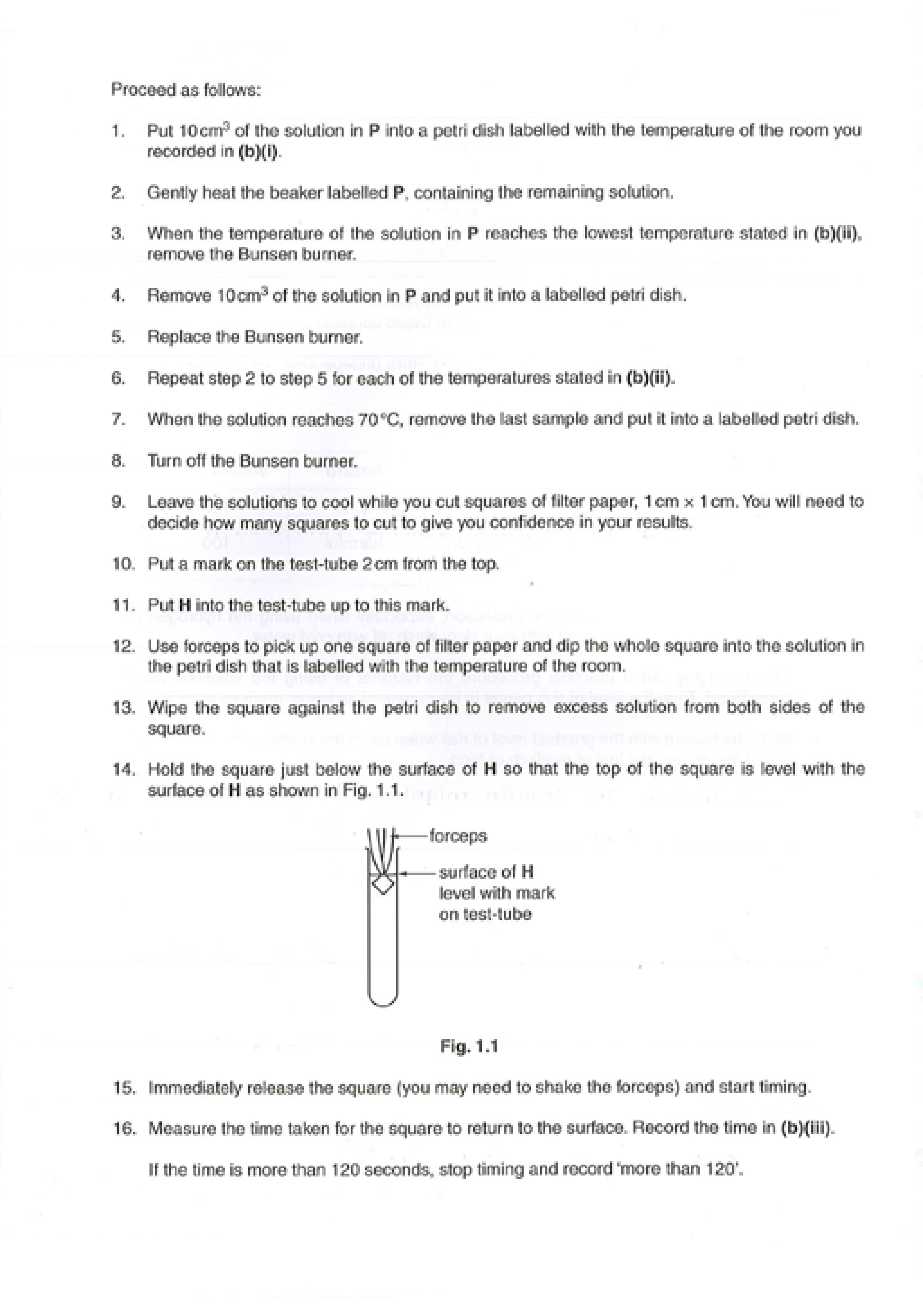

Proceed as follows:

1. Put 10 cm³ of the solution in **P** into a petri dish labelled with the temperature of the room you recorded in **(b)(i)**.
2. Gently heat the beaker labelled **P**, containing the remaining solution.
3. When the temperature of the solution in **P** reaches the lowest temperature stated in **(b)(ii)**, remove the Bunsen burner.
4. Remove 10 cm³ of the solution in **P** and put it into a labelled petri dish.
5. Replace the Bunsen burner.
6. Repeat step 2 to step 5 for each of the temperatures stated in **(b)(ii)**.
7. When the solution reaches 70 °C, remove the last sample and put it into a labelled petri dish.
8. Turn off the Bunsen burner.
9. Leave the solutions to cool while you cut squares of filter paper, 1 cm × 1 cm. You will need to decide how many squares to cut to give you confidence in your results.
10. Put a mark on the test-tube 2 cm from the top.
11. Put **H** into the test-tube up to this mark.
12. Use forceps to pick up one square of filter paper and dip the whole square into the solution in the petri dish that is labelled with the temperature of the room.
13. Wipe the square against the petri dish to remove excess solution from both sides of the square.
14. Hold the square just below the surface of **H** so that the top of the square is level with the surface of **H** as shown in Fig. 1.1.

Fig. 1.1

15. Immediately release the square (you may need to shake the forceps) and start timing.
16. Measure the time taken for the square to return to the surface. Record the time in **(b)(iii)**.

If the time is more than 120 seconds, stop timing and record 'more than 120'.

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

1(c) ☐

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EXAMINER COMMENTS

MARK SCHEME

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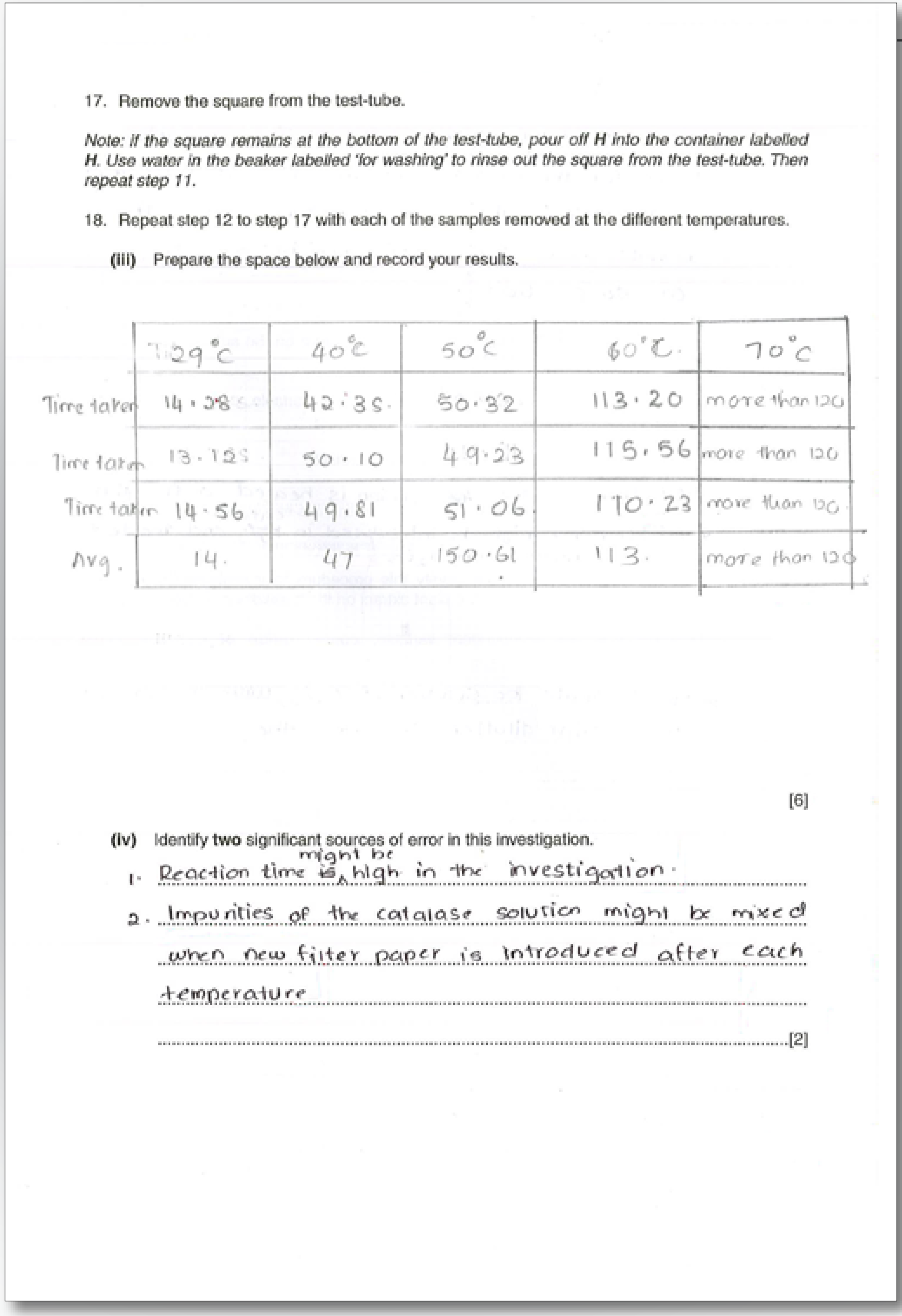

17. Remove the square from the test-tube.

*Note: if the square remains at the bottom of the test-tube, pour off **H** into the container labelled **H**. Use water in the beaker labelled 'for washing' to rinse out the square from the test-tube. Then repeat step 11.*

18. Repeat step 12 to step 17 with each of the samples removed at the different temperatures.

(iii) Prepare the space below and record your results.

	29 °C	40 °C	50 °C	60 °C.	70 °C
Time taken	14 · 38	42 · 35.	50 · 32	113 · 20	more than 120
Time taken	13 · 12S	50 · 10	49 · 23	115 · 56	more than 120
Time taken	14 · 56	49 · 81	51 · 06.	110 · 23	more than 120
Avg.	14.	47	150 · 61	113.	more than 120

[6]

(iv) Identify **two** significant sources of error in this investigation.

1. Reaction time ~~is~~ might be high in the investigation.

2. Impurities of the catalase solution might be mixed when new filter paper is introduced after each temperature

[2]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

1(c) ☐

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EXAMINER COMMENTS

MARK SCHEME

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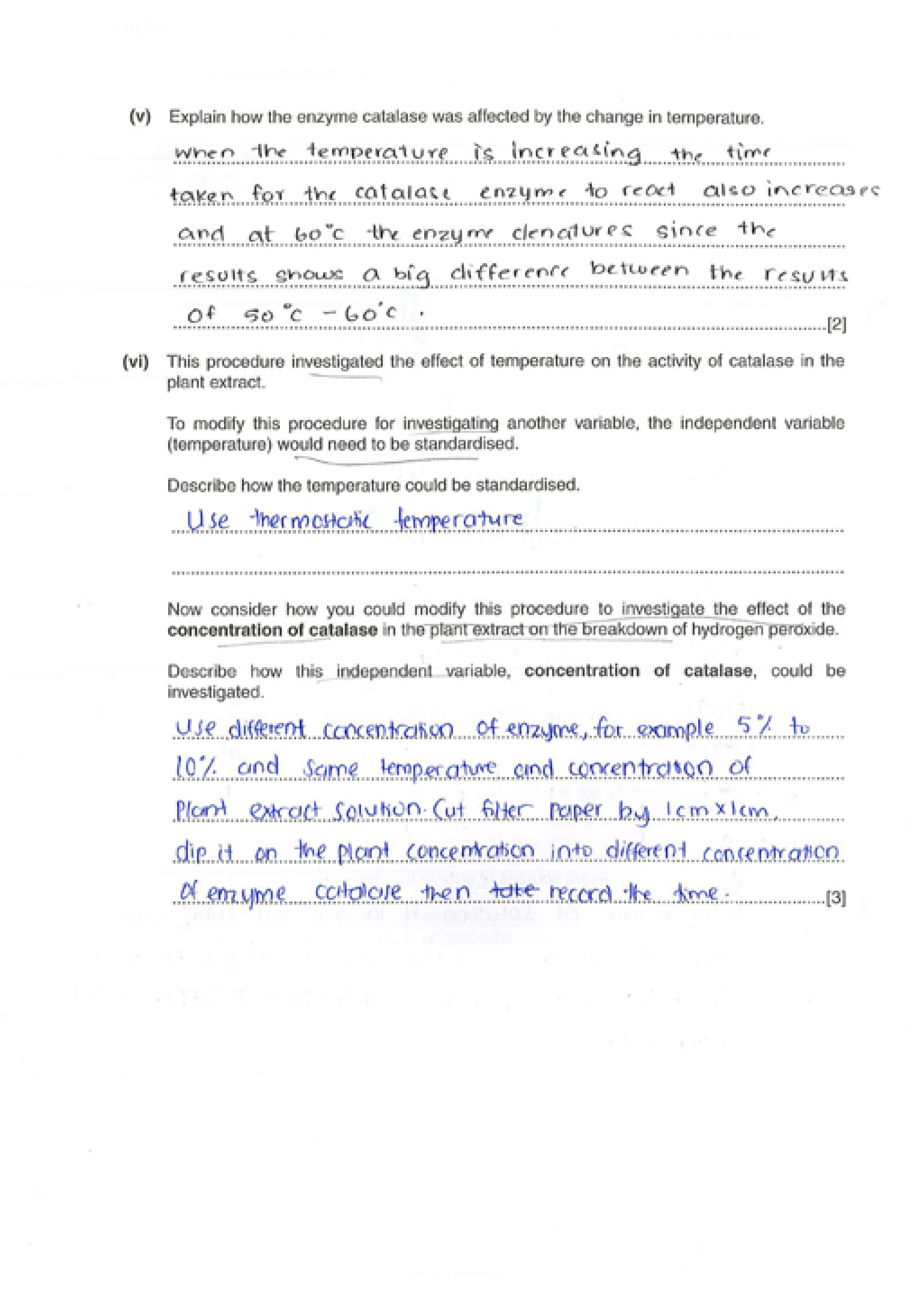

(v) Explain how the enzyme catalase was affected by the change in temperature.

when the temperature is increasing the time taken for the catalase enzyme to react also increases and at 60°c the enzyme denatures since the results shows a big difference between the results of 50°c - 60°c . [2]

(vi) This procedure investigated the effect of temperature on the activity of catalase in the plant extract.

To modify this procedure for investigating another variable, the independent variable (temperature) would need to be standardised.

Describe how the temperature could be standardised.

Use thermostatic temperature

Now consider how you could modify this procedure to investigate the effect of the **concentration of catalase** in the plant extract on the breakdown of hydrogen peroxide.

Describe how this independent variable, **concentration of catalase**, could be investigated.

Use different concentration of enzyme, for example 5% to 10% and Same temperature and concentration of Plant extract solution. Cut filter paper by 1cm x 1cm, dip it on the plant concentration into different concentration of enzyme catalase then ~~take~~ record the time. [3]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

1(c) ☐

Q1	Mark scheme	
(a)(i)	*(risk assessment)* (hydrogen peroxide) harmful or irritant + medium or high ;	**[1]**
(b)(i)	*(measures room temperature)* whole number or to half a degree + °C ;	**[1]**
(b)(ii)	*(decides on interval for temperature)* at least three additional temperatures + whole numbers + even intervals ; °C ;	**[2]**
(b)(iii)	*(recording results)* 1. table drawn + heading, temperature + °C ; 2. heading, time + seconds ; 3. records results for at least five temperatures ; 4. correct pattern of results ; 5. times recorded as whole seconds ; 6. records results for repeats + means calculated ;	**[6]**
(b)(iv)	*(source of error with reason)* appropriate error with reason ; e.g. concentration of hydrogen peroxide decreases appropriate error with reason ; e.g. different volumes of extract on each square of filter paper	**[2]**
(b)(v)	*(conclusions)* (as temperature increases, activity increases) more successful collisions or more enzyme-substrate-complexes / ESCs ; (decreased / no activity) denatures or changed shape of active site ;	**[2]**
(b)(vi)	*(modification to investigate another variable)* 1. (to standardise temperature) stated temperature + thermostatically controlled water-bath ; 2. (independent variable) at least five concentrations of catalase ; 3. (method) simple dilution / proportional dilution / serial dilution ;	**[3]**
(c)	*(chart)* 1. (x-axis) different plant species + (y-axis) initial rate of activity of catalase / s–1 ; 2. (scale on x-axis) even width of bars + (scale on y-axis) 0.05 to 2 cm, labelled at least each 2 cm ; 3. correct plotting of five bars ; 4. five bars labelled with each horizontal line drawn as a thin line + each column labelled ;	**[4]** **[Total: 21]**

EXAMINER COMMENTS

MARK SCHEME

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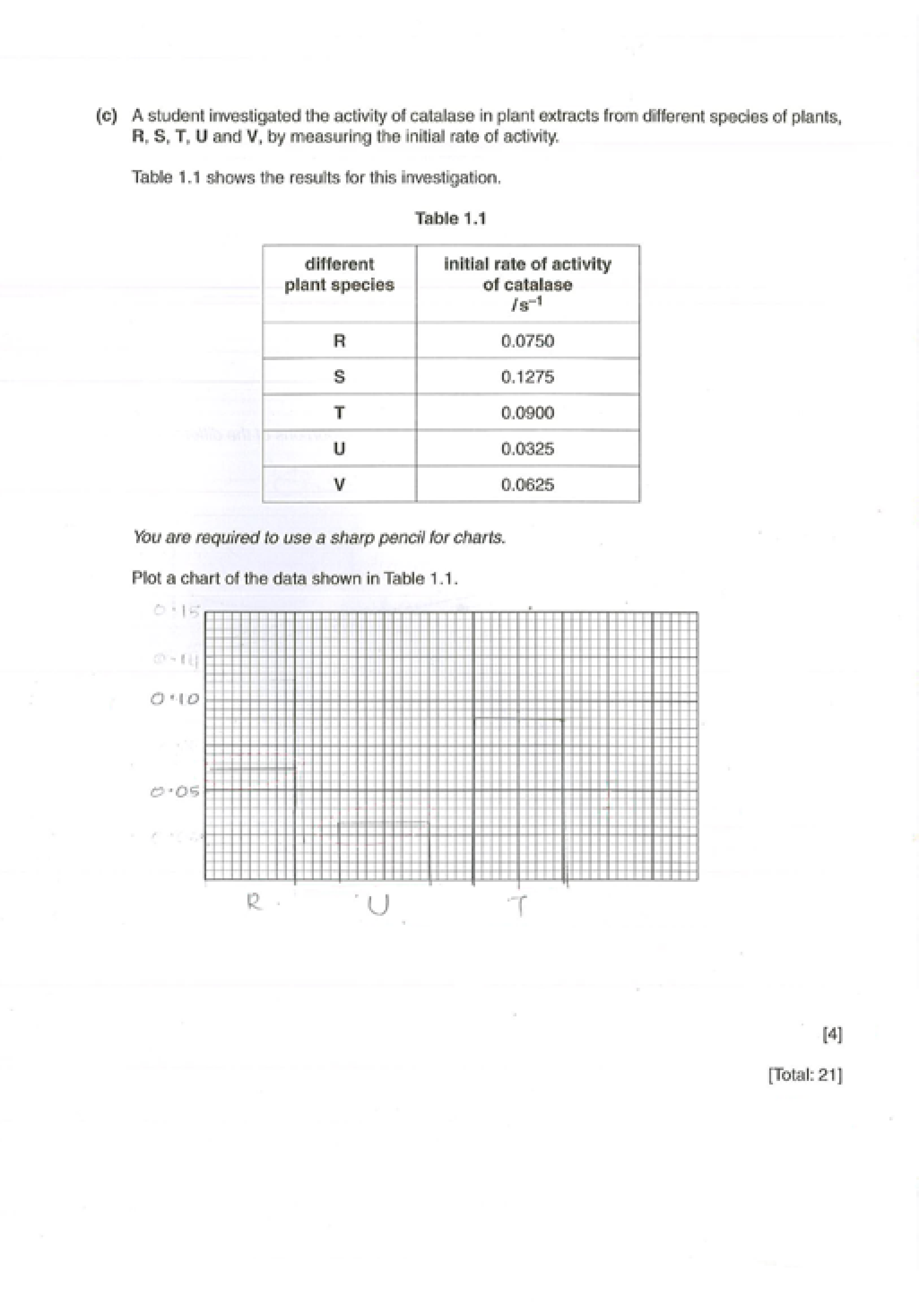

(c) A student investigated the activity of catalase in plant extracts from different species of plants, R, S, T, U and V, by measuring the initial rate of activity.

Table 1.1 shows the results for this investigation.

Table 1.1

different plant species	initial rate of activity of catalase / s^{-1}
R	0.0750
S	0.1275
T	0.0900
U	0.0325
V	0.0625

You are required to use a sharp pencil for charts.

Plot a chart of the data shown in Table 1.1.

[4]

[Total: 21]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(b)(iv) ☐

1(b)(v) ☐

1(b)(vi) ☐

1(c) ☐

Q1	**Mark scheme**
(a)(i)	*(risk assessment)* (hydrogen peroxide) harmful or irritant + medium or high ; **[1]**
(b)(i)	*(measures room temperature)* whole number or to half a degree + °C ; **[1]**
(b)(ii)	*(decides on interval for temperature)* at least three additional temperatures + whole numbers + even intervals ; °C ; **[2]**
(b)(iii)	*(recording results)* 1. table drawn + heading, temperature + °C ; 2. heading, time + seconds ; 3. records results for at least five temperatures ; 4. correct pattern of results ; 5. times recorded as whole seconds ; 6. records results for repeats + means calculated ; **[6]**
(b)(iv)	*(source of error with reason)* appropriate error with reason ; e.g. concentration of hydrogen peroxide decreases appropriate error with reason ; e.g. different volumes of extract on each square of filter paper **[2]**
(b)(v)	*(conclusions)* (as temperature increases, activity increases) more successful collisions or more enzyme-substrate-complexes / ESCs ; (decreased / no activity) denatures or changed shape of active site ; **[2]**
(b)(vi)	*(modification to investigate another variable)* 1. (to standardise temperature) stated temperature + thermostatically controlled water-bath ; 2. (independent variable) at least five concentrations of catalase ; 3. (method) simple dilution / proportional dilution / serial dilution ; **[3]**
(c)	*(chart)* 1. (x-axis) different plant species + (y-axis) initial rate of activity of catalase / s–1 ; 2. (scale on x-axis) even width of bars + (scale on y-axis) 0.05 to 2 cm, labelled at least each 2 cm ; 3. correct plotting of five bars ; 4. five bars labelled with each horizontal line drawn as a thin line + each column labelled ; **[4]** **[Total: 21]**

EXAMINER COMMENTS

MARK SCHEME

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Version 1.0

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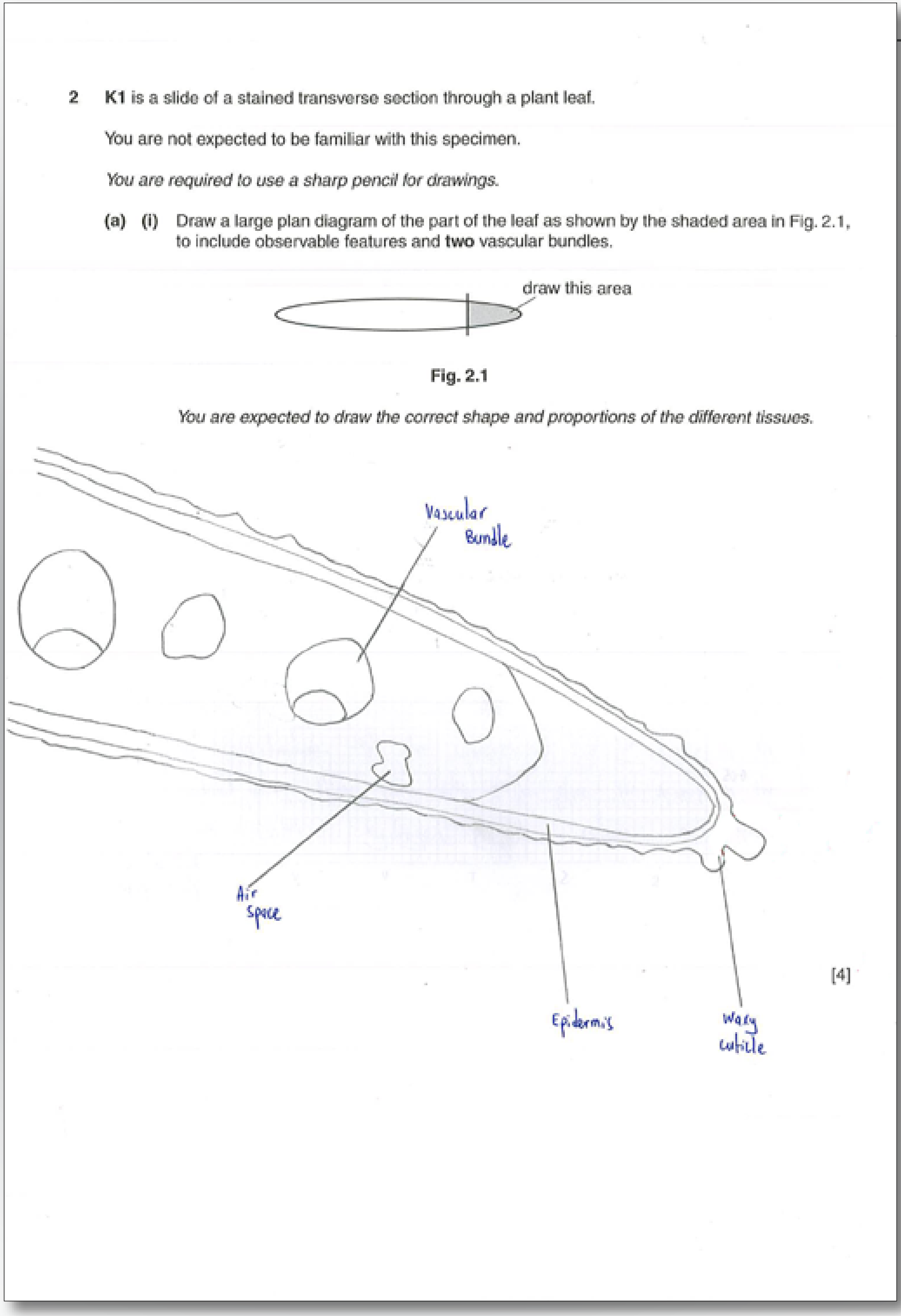

2 **K1** is a slide of a stained transverse section through a plant leaf.

You are not expected to be familiar with this specimen.

You are required to use a sharp pencil for drawings.

(a) (i) Draw a large plan diagram of the part of the leaf as shown by the shaded area in Fig. 2.1, to include observable features and **two** vascular bundles.

draw this area

Fig. 2.1

You are expected to draw the correct shape and proportions of the different tissues.

[4]

Your Mark

2(a)(i)

2(a)(ii)

2(b)(i)

2(b)(ii)

2(c)

Q2	Mark scheme
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
(a)(ii)	*(drawing)* 1. quality of line for outer wall of cells + size at least 50 mm across largest cell ; 2. only four cells drawn, each cell touching at least one other cell ; 3. cell walls drawn as two lines close together ; 4. one cell which shows a difference from other cells ; e.g. cell contains an inclusion 5. uses one label line + one label to cell wall ; **[5]**
(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
(b)(ii)	*(conclusion)* (habitat) water + (feature) large air spaces or more air spaces or AVP ; **[1]**
(c)	*(observable difference between leaf on* K1 *and leaf in* Fig. 2.2*)* organises comparisons into three columns with one column for features, one headed **K1** and one headed **Fig. 2.2** ; any three observable differences of comparison ;;; e.g. **K1** has more vascular bundles than **Fig. 2.2** **[4]** **[total: 19]**

EXAMINER COMMENTS

MARK SCHEME

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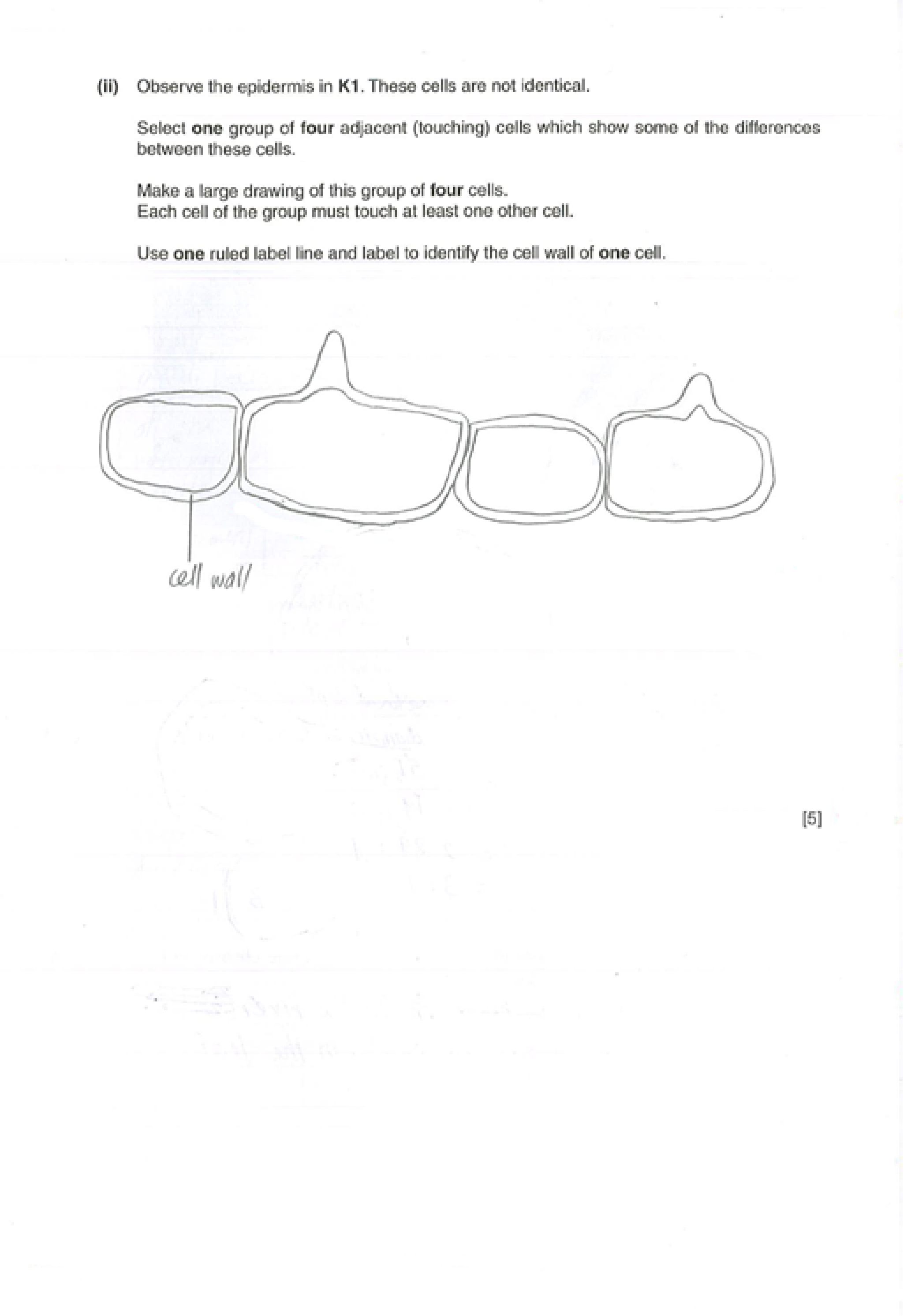

(ii) Observe the epidermis in **K1**. These cells are not identical.

Select **one** group of **four** adjacent (touching) cells which show some of the differences between these cells.

Make a large drawing of this group of **four** cells.
Each cell of the group must touch at least one other cell.

Use **one** ruled label line and label to identify the cell wall of **one** cell.

[5]

Your Mark

2(a)(i) ☐

2(a)(ii) ☐

2(b)(i) ☐

2(b)(ii) ☐

2(c) ☐

Q2	Mark scheme
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
(a)(ii)	*(drawing)* 1. quality of line for outer wall of cells + size at least 50 mm across largest cell ; 2. only four cells drawn, each cell touching at least one other cell ; 3. cell walls drawn as two lines close together ; 4. one cell which shows a difference from other cells ; e.g. cell contains an inclusion 5. uses one label line + one label to cell wall ; **[5]**
(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
(b)(ii)	*(conclusion)* (habitat) water + (feature) large air spaces or more air spaces or AVP ; **[1]**
(c)	*(observable difference between leaf on* K1 *and leaf in* Fig. 2.2*)* organises comparisons into three columns with one column for features, one headed **K1** and one headed **Fig. 2.2** ; any three observable differences of comparison ;;; e.g. **K1** has more vascular bundles than **Fig. 2.2** **[4]** **[total: 19]**

EXAMINER COMMENTS

MARK SCHEME

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(b) Fig. 2.2 is a photomicrograph of a stained transverse section through part of a leaf from a different type of plant.

You are not expected to be familiar with this specimen.

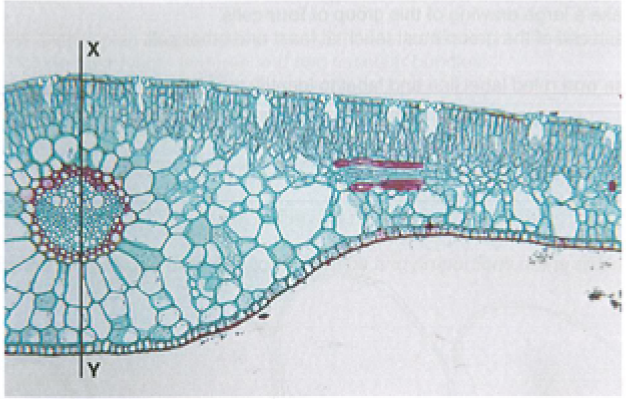


Fig. 2.2

(i) Use the line **X–Y** to determine the simplest ratio of the depth of the midrib to the diameter of the vascular bundle.

You may lose marks if you do not show your working.

X-Y : diameter of vascular bundle
54mm : 18mm
27 : 9
9 : 3
3 : 1

simplest ratio 3:1 [5]

(ii) Suggest a habitat where this plant might grow and **one** observable feature, shown in Fig. 2.2, which adapts it to this habitat.

habitat ~~Under a river~~ [illegible] In the river [illegible]

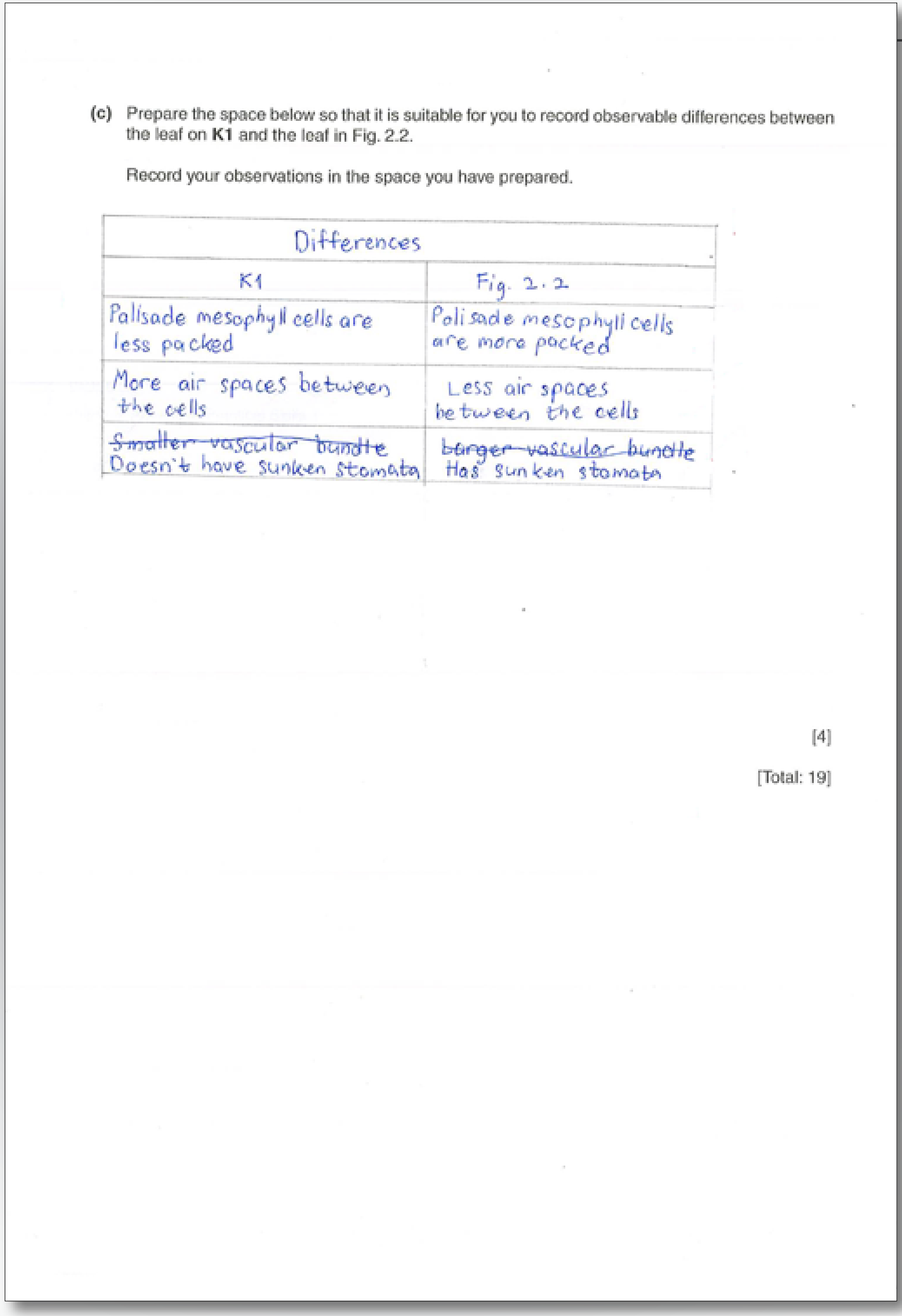
feature Has many air spaces in the leaf [1]

Your Mark

2(a)(i) ☐
2(a)(ii) ☐
2(b)(i) ☐
2(b)(ii) ☐
2(c) ☐

Q2	Mark scheme
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
(a)(ii)	*(drawing)* 1. quality of line for outer wall of cells + size at least 50 mm across largest cell ; 2. only four cells drawn, each cell touching at least one other cell ; 3. cell walls drawn as two lines close together ; 4. one cell which shows a difference from other cells ; e.g. cell contains an inclusion 5. uses one label line + one label to cell wall ; **[5]**
(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
(b)(ii)	*(conclusion)* (habitat) water + (feature) large air spaces or more air spaces or AVP ; **[1]**
(c)	*(observable difference between leaf on* K1 *and leaf in* Fig. 2.2*)* organises comparisons into three columns with one column for features, one headed K1 and one headed **Fig. 2.2** ; any three observable differences of comparison ;;; e.g. K1 has more vascular bundles than Fig. 2.2 **[4]** **[total: 19]**

EXAMINER COMMENTS
MARK SCHEME



(c) Prepare the space below so that it is suitable for you to record observable differences between the leaf on **K1** and the leaf in Fig. 2.2.

Record your observations in the space you have prepared.

Differences	
K1	Fig. 2.2
Palisade mesophyll cells are less packed	Palisade mesophyll cells are more packed
More air spaces between the cells	Less air spaces between the cells
~~Smaller vascular bundle~~ Doesn't have sunken stomata	~~Larger vascular bundle~~ Has sunken stomata

[4]

[Total: 19]

Your Mark

2(a)(i) ☐

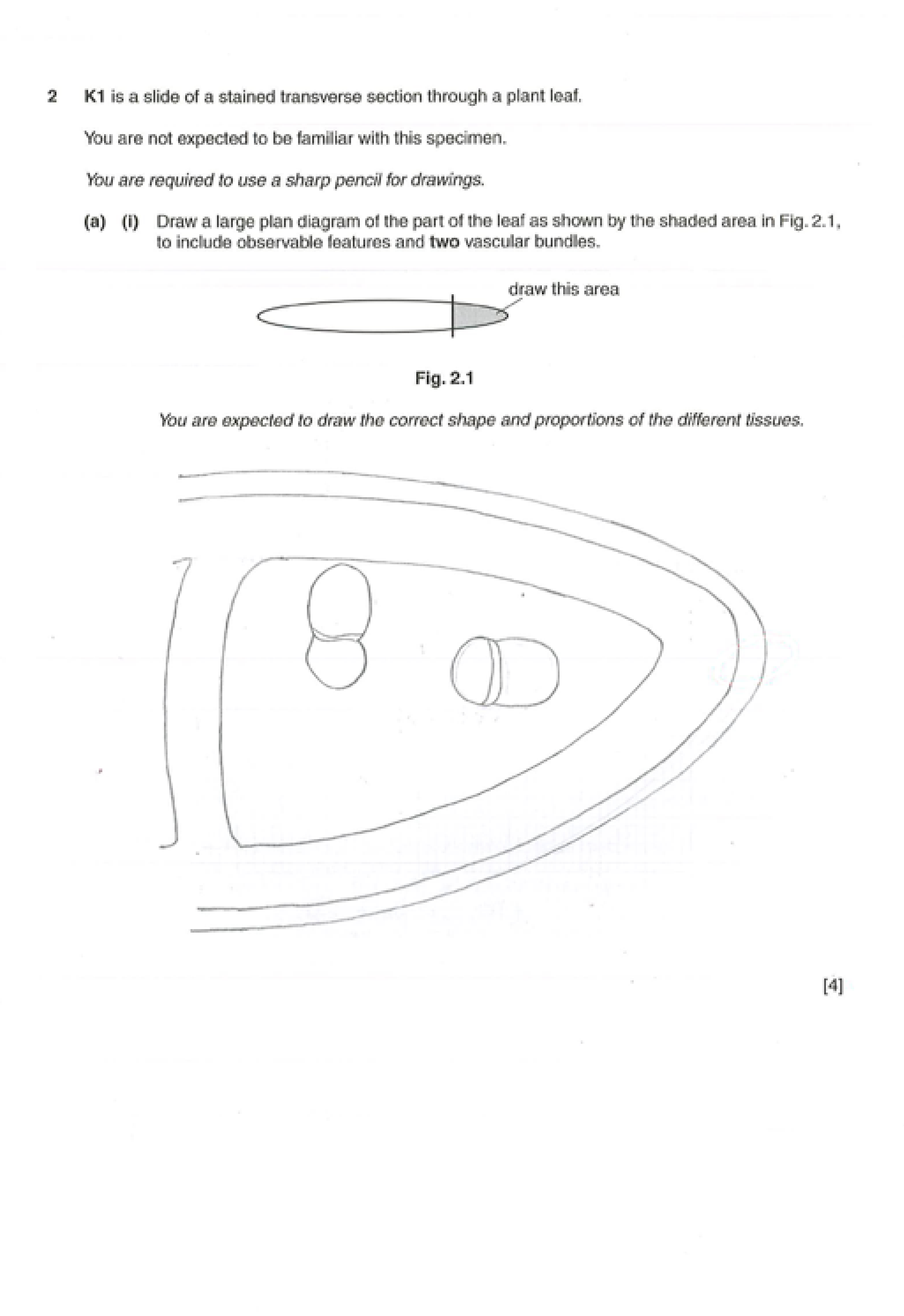
2(a)(ii) ☐

2(b)(i) ☐

2(b)(ii) ☐

2(c) ☐

Q2	Mark scheme
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
(a)(ii)	*(drawing)* 1. quality of line for outer wall of cells + size at least 50 mm across largest cell ; 2. only four cells drawn, each cell touching at least one other cell ; 3. cell walls drawn as two lines close together ; 4. one cell which shows a difference from other cells ; e.g. cell contains an inclusion 5. uses one label line + one label to cell wall ; **[5]**
(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
(b)(ii)	*(conclusion)* (habitat) water + (feature) large air spaces or more air spaces or AVP ; **[1]**
(c)	*(observable difference between leaf on* K1 *and leaf in* Fig. 2.2*)* organises comparisons into three columns with one column for features, one headed K1 and one headed Fig. 2.2 ; any three observable differences of comparison ;;; e.g. K1 has more vascular bundles than Fig. 2.2 **[4]** **[total: 19]**



2 **K1** is a slide of a stained transverse section through a plant leaf.

You are not expected to be familiar with this specimen.

You are required to use a sharp pencil for drawings.

(a) (i) Draw a large plan diagram of the part of the leaf as shown by the shaded area in Fig. 2.1, to include observable features and **two** vascular bundles.

draw this area

Fig. 2.1

You are expected to draw the correct shape and proportions of the different tissues.

[4]

Your Mark

2(a)(i)	
2(a)(ii)	
2(b)(i)	
2(b)(ii)	
2(c)	

Q2	Mark scheme
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
(a)(ii)	*(drawing)* 1. quality of line for outer wall of cells + size at least 50 mm across largest cell ; 2. only four cells drawn, each cell touching at least one other cell ; 3. cell walls drawn as two lines close together ; 4. one cell which shows a difference from other cells ; e.g. cell contains an inclusion 5. uses one label line + one label to cell wall ; **[5]**
(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
(b)(ii)	*(conclusion)* (habitat) water + (feature) large air spaces or more air spaces or AVP ; **[1]**
(c)	*(observable difference between leaf on* K1 *and leaf in* Fig. 2.2*)* organises comparisons into three columns with one column for features, one headed **K1** and one headed **Fig. 2.2** ; any three observable differences of comparison ;;; e.g. **K1** has more vascular bundles than **Fig. 2.2** **[4]** **[total: 19]**

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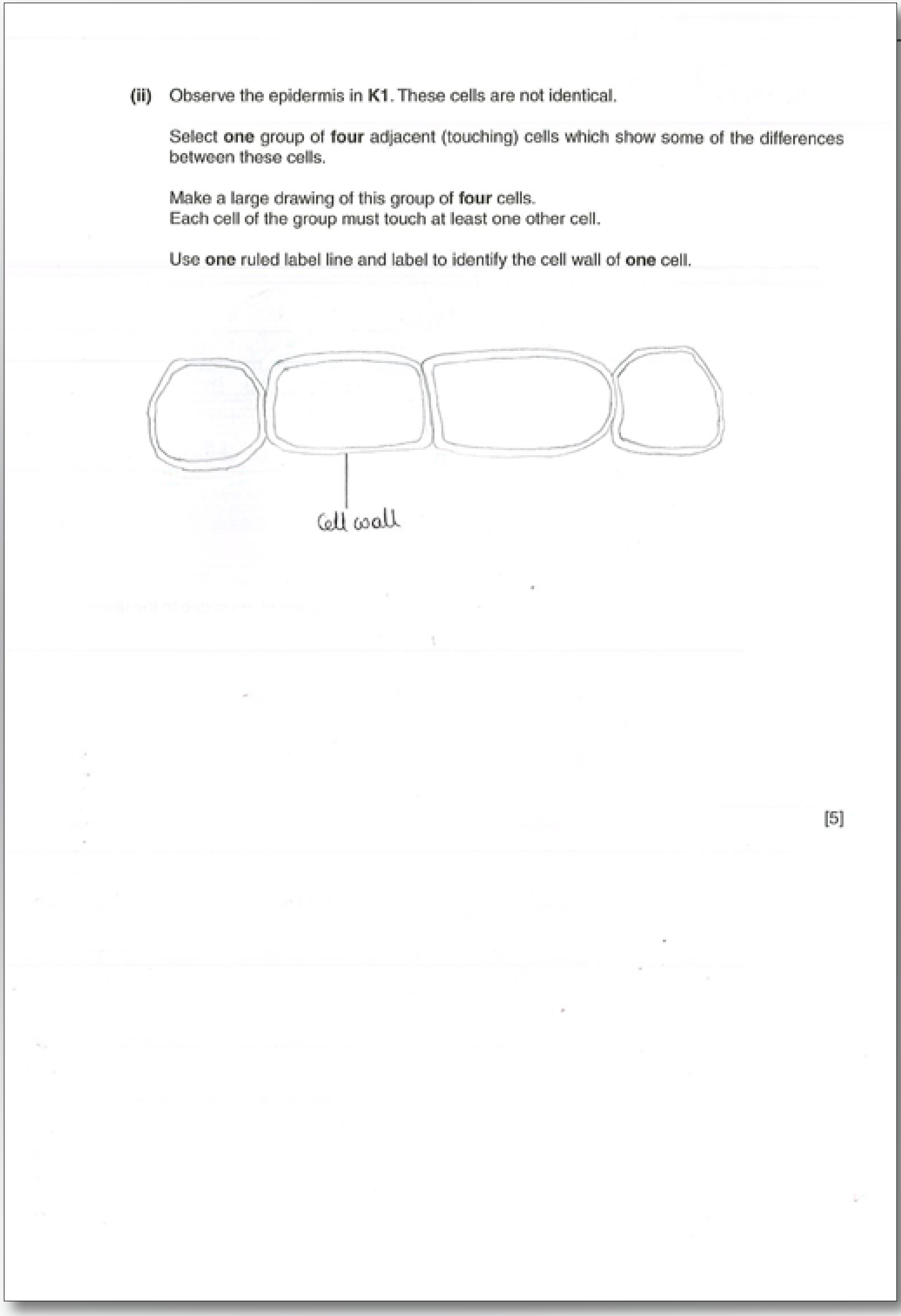

(ii) Observe the epidermis in **K1**. These cells are not identical.

Select **one** group of **four** adjacent (touching) cells which show some of the differences between these cells.

Make a large drawing of this group of **four** cells.
Each cell of the group must touch at least one other cell.

Use **one** ruled label line and label to identify the cell wall of **one** cell.

[5]

Your Mark

2(a)(i) ☐

2(a)(ii) ☐

2(b)(i) ☐

2(b)(ii) ☐

2(c) ☐

Q2	**Mark scheme**
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
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(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
(b)(ii)	*(conclusion)* (habitat) water + (feature) large air spaces or more air spaces or AVP ; **[1]**
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EXAMINER COMMENTS

MARK SCHEME

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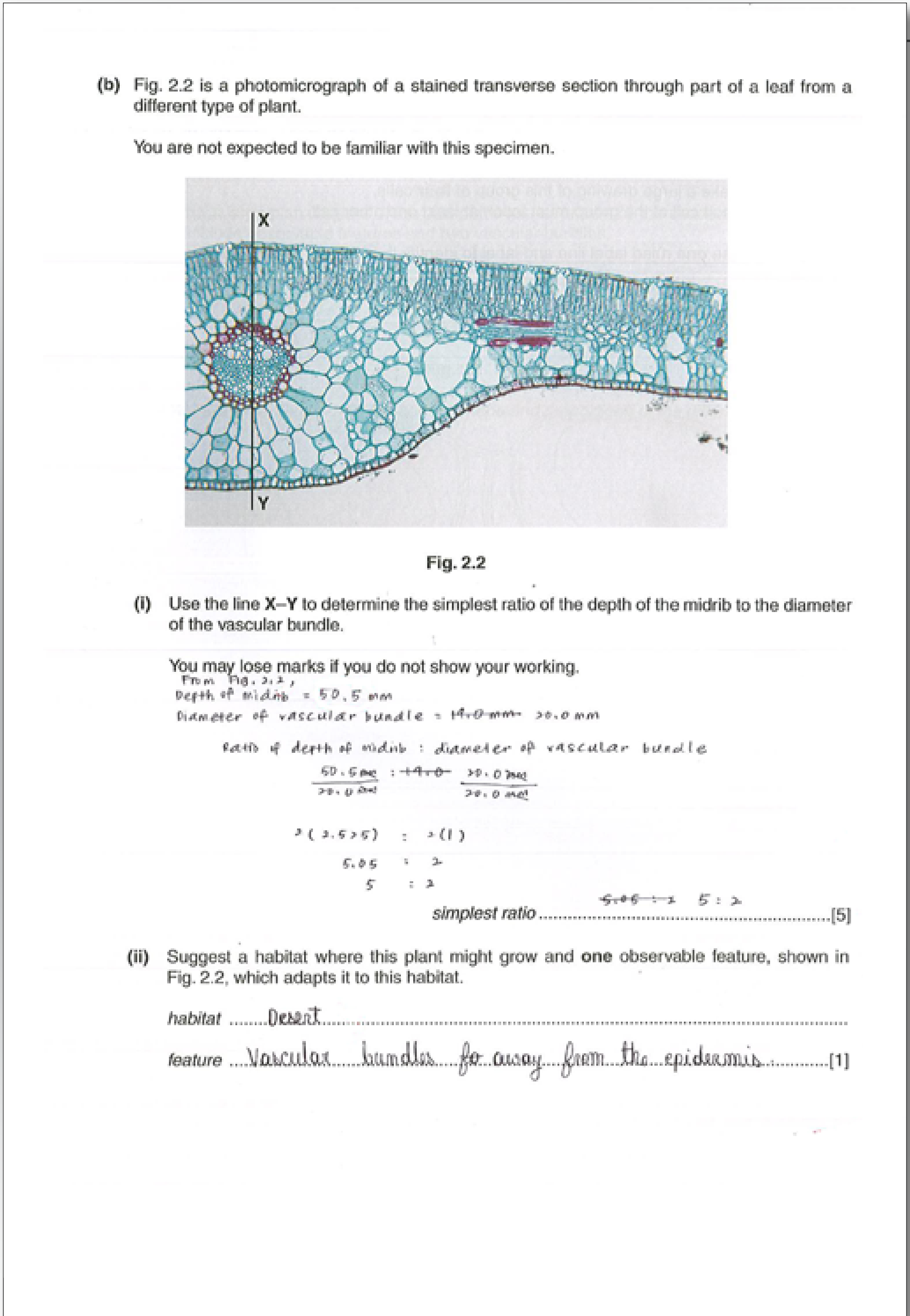

(b) Fig. 2.2 is a photomicrograph of a stained transverse section through part of a leaf from a different type of plant.

You are not expected to be familiar with this specimen.

Fig. 2.2

(i) Use the line **X–Y** to determine the simplest ratio of the depth of the midrib to the diameter of the vascular bundle.

You may lose marks if you do not show your working.

From Fig. 2.2,
Depth of midrib = 50.5 mm
Diameter of vascular bundle = ~~19.0 mm~~ 20.0 mm

Ratio of depth of midrib : diameter of vascular bundle

$\frac{50.5 mm}{20.0 mm}$: ~~19.0~~ $\frac{20.0 mm}{20.0 mm}$

2 (2.525) : 2 (1)
5.05 : 2
5 : 2

simplest ratio ~~5.05 : 2~~ 5 : 2 [5]

(ii) Suggest a habitat where this plant might grow and **one** observable feature, shown in Fig. 2.2, which adapts it to this habitat.

habitat Desert

feature Vascular bundles far away from the epidermis [1]

Your Mark

2(a)(i) ☐

2(a)(ii) ☐

2(b)(i) ☐

2(b)(ii) ☐

2(c) ☐

Q2	Mark scheme
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
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EXAMINER COMMENTS

MARK SCHEME

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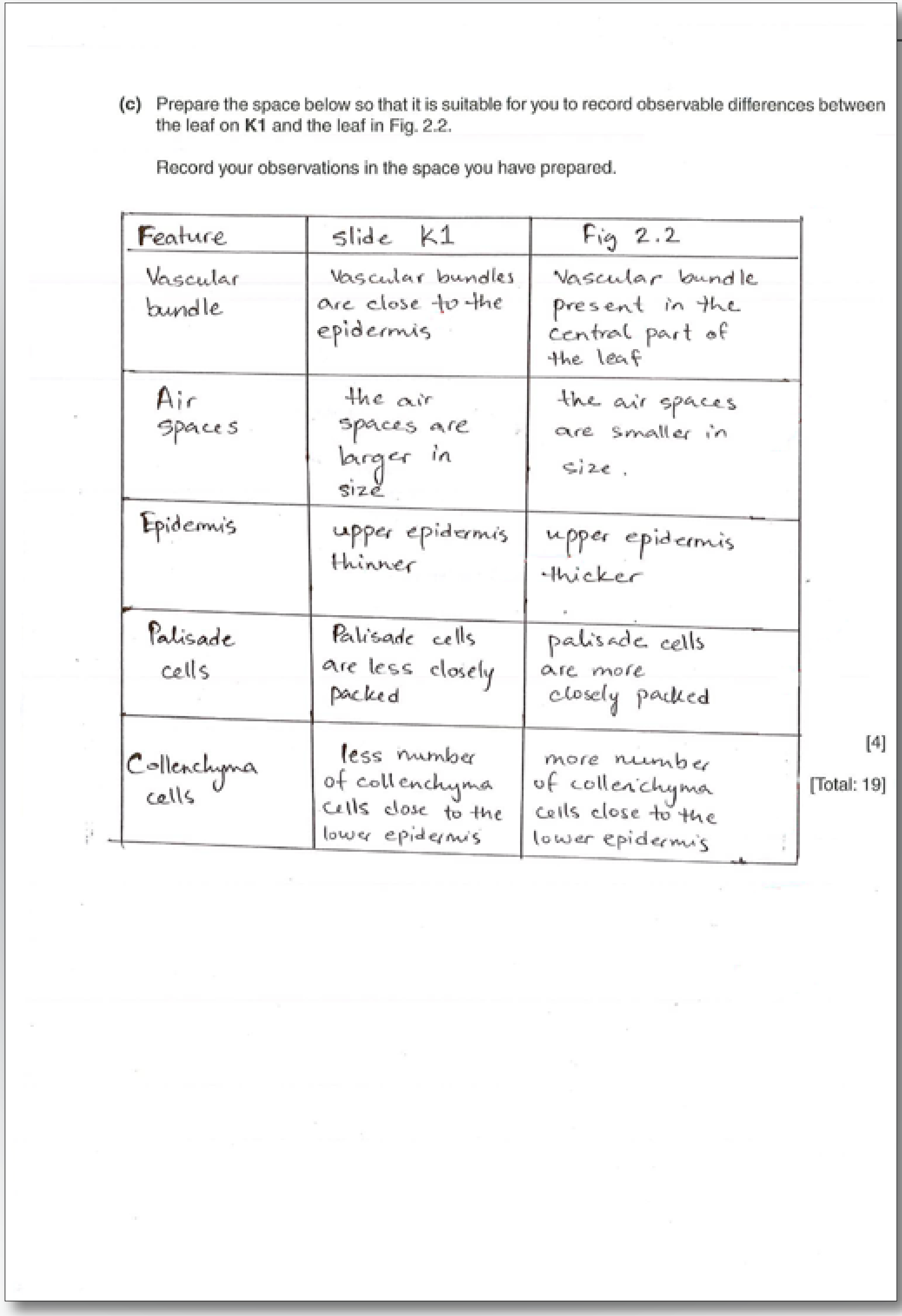

(c) Prepare the space below so that it is suitable for you to record observable differences between the leaf on **K1** and the leaf in Fig. 2.2.

Record your observations in the space you have prepared.

Feature	slide K1	Fig 2.2
Vascular bundle	Vascular bundles are close to the epidermis	Vascular bundle present in the central part of the leaf
Air spaces	the air spaces are larger in size	the air spaces are smaller in size.
Epidermis	upper epidermis thinner	upper epidermis thicker
Palisade cells	Palisade cells are less closely packed	palisade cells are more closely packed
Collenchyma cells	less number of collenchyma cells close to the lower epidermis	more number of collenchyma cells close to the lower epidermis

[4]

[Total: 19]

Your Mark

2(a)(i)	☐
2(a)(ii)	☐
2(b)(i)	☐
2(b)(ii)	☐
2(c)	☐

Q2	Mark scheme
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
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(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
(b)(ii)	*(conclusion)* (habitat) water + (feature) large air spaces or more air spaces or AVP ; **[1]**
(c)	*(observable difference between leaf on* K1 *and leaf in* Fig. 2.2) organises comparisons into three columns with one column for features, one headed **K1** and one headed **Fig. 2.2** ; any three observable differences of comparison ;;; e.g. **K1** has more vascular bundles than **Fig. 2.2** **[4]** **[total: 19]**

EXAMINER COMMENTS

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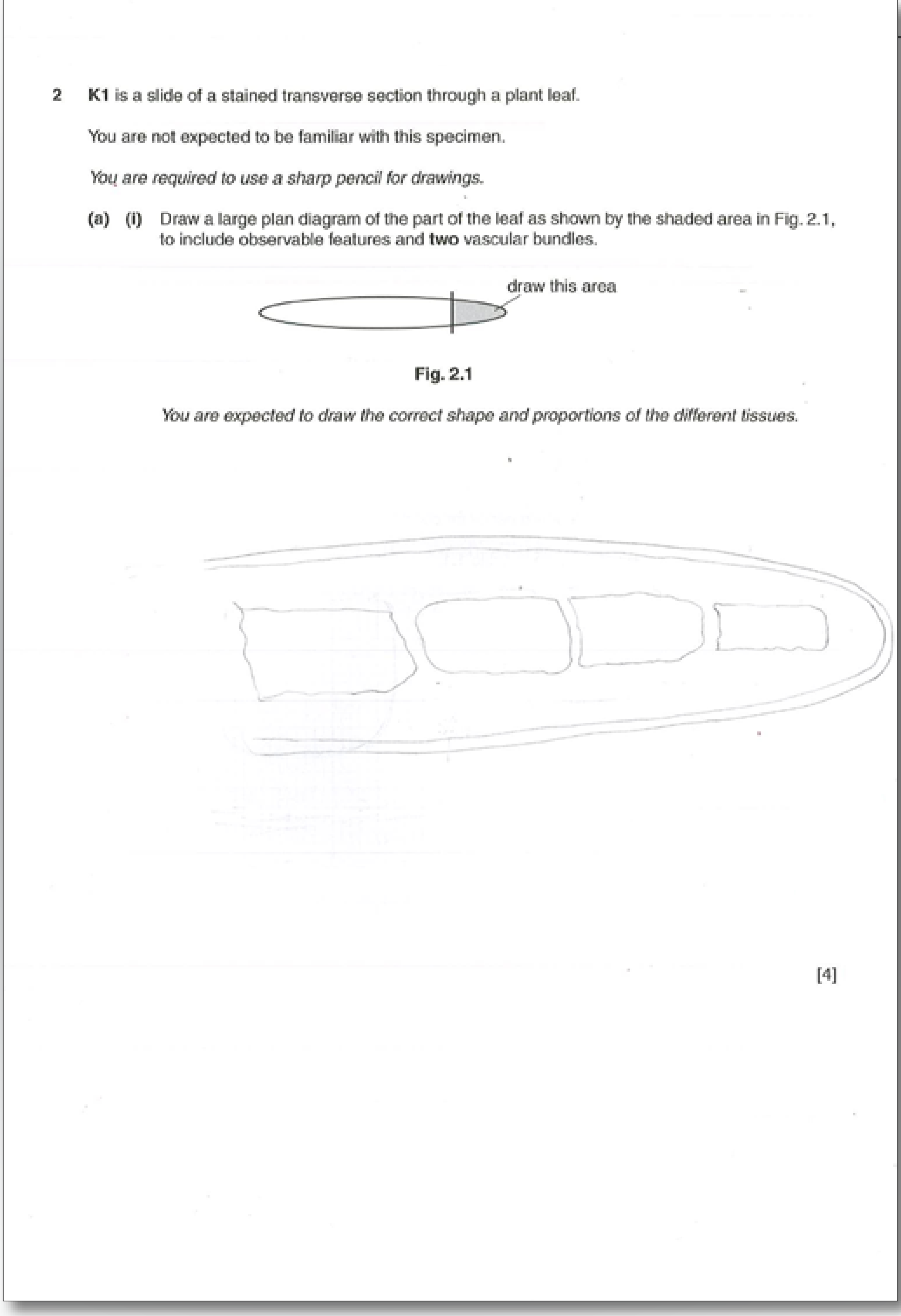

2 **K1** is a slide of a stained transverse section through a plant leaf.

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(a) (i) Draw a large plan diagram of the part of the leaf as shown by the shaded area in Fig. 2.1, to include observable features and **two** vascular bundles.

draw this area

Fig. 2.1

You are expected to draw the correct shape and proportions of the different tissues.

[4]

Your Mark

2(a)(i) ☐

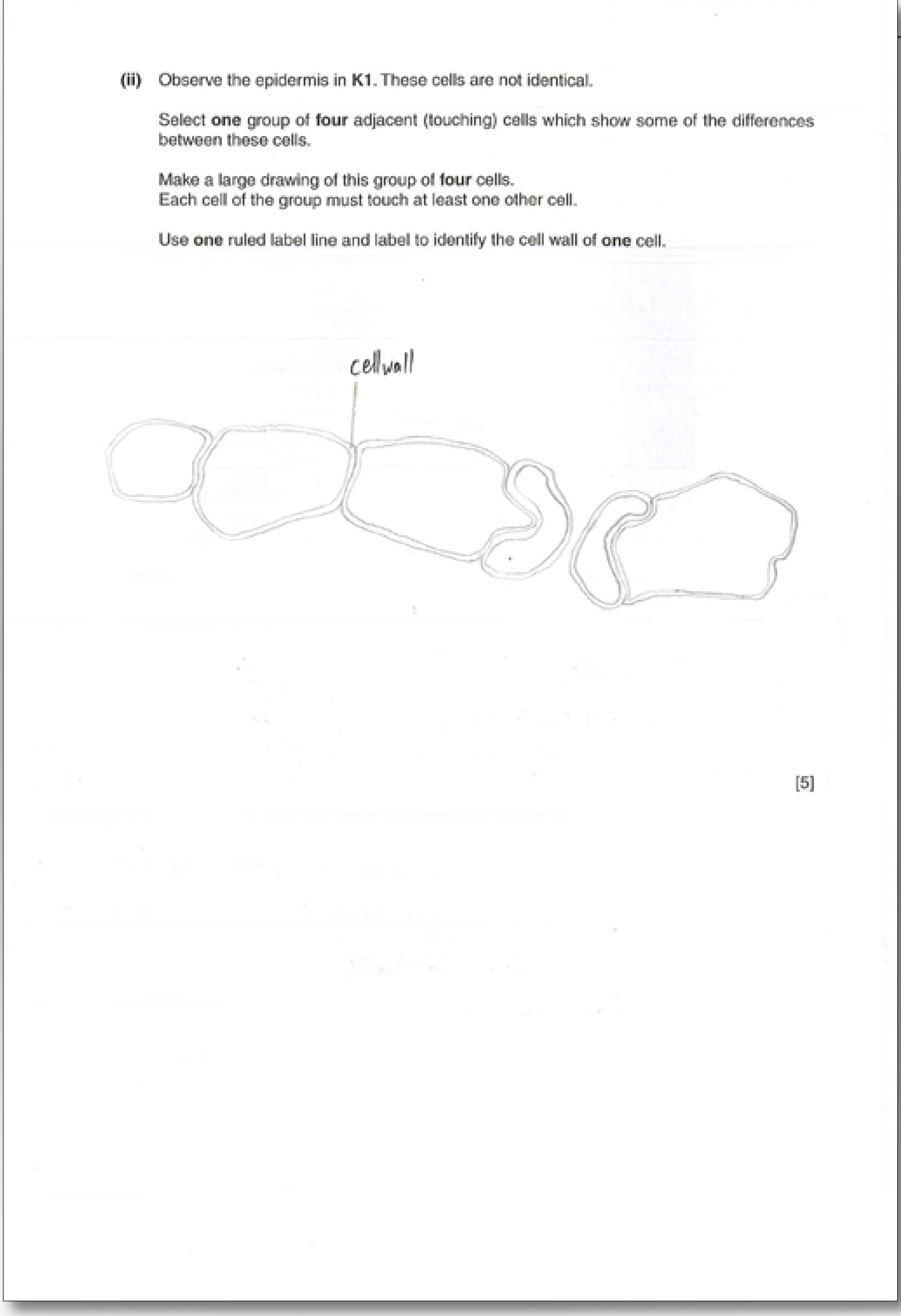
2(a)(ii) ☐

2(b)(i) ☐

2(b)(ii) ☐

2(c) ☐

Q2	Mark scheme
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
(a)(ii)	*(drawing)* 1. quality of line for outer wall of cells + size at least 50 mm across largest cell ; 2. only four cells drawn, each cell touching at least one other cell ; 3. cell walls drawn as two lines close together ; 4. one cell which shows a difference from other cells ; e.g. cell contains an inclusion 5. uses one label line + one label to cell wall ; **[5]**
(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
(b)(ii)	*(conclusion)* (habitat) water + (feature) large air spaces or more air spaces or AVP ; **[1]**
(c)	*(observable difference between leaf on* K1 *and leaf in* Fig. 2.2) organises comparisons into three columns with one column for features, one headed **K1** and one headed **Fig. 2.2** ; any three observable differences of comparison ;;; e.g. **K1** has more vascular bundles than **Fig. 2.2** **[4]** **[total: 19]**



(ii) Observe the epidermis in **K1**. These cells are not identical.

Select **one** group of **four** adjacent (touching) cells which show some of the differences between these cells.

Make a large drawing of this group of **four** cells.
Each cell of the group must touch at least one other cell.

Use **one** ruled label line and label to identify the cell wall of **one** cell.

[5]

Select page

HIGH

MIDDLE

LOW

Your Mark

2(a)(i) ☐

2(a)(ii) ☐

2(b)(i) ☐

2(b)(ii) ☐

2(c) ☐

Q2	Mark scheme
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
(a)(ii)	*(drawing)* 1. quality of line for outer wall of cells + size at least 50 mm across largest cell ; 2. only four cells drawn, each cell touching at least one other cell ; 3. cell walls drawn as two lines close together ; 4. one cell which shows a difference from other cells ; e.g. cell contains an inclusion 5. uses one label line + one label to cell wall ; **[5]**
(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
(b)(ii)	*(conclusion)* (habitat) water + (feature) large air spaces or more air spaces or AVP ; **[1]**
(c)	*(observable difference between leaf on* K1 *and leaf in* Fig. 2.2*)* organises comparisons into three columns with one column for features, one headed **K1** and one headed **Fig. 2.2** ; any three observable differences of comparison ;;; e.g. **K1** has more vascular bundles than **Fig. 2.2** **[4]** **[total: 19]**

EXAMINER COMMENTS

MARK SCHEME

(b) Fig. 2.2 is a photomicrograph of a stained transverse section through part of a leaf from a different type of plant.

You are not expected to be familiar with this specimen.

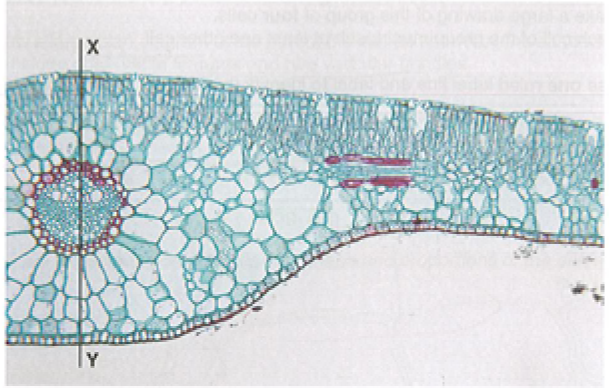


Fig. 2.2

(i) Use the line **X–Y** to determine the simplest ratio of the depth of the midrib to the diameter of the vascular bundle.

You may lose marks if you do not show your working.

Depth of midrib = 2.8 cm

Diameter of vasc. bundle = 1.9 cm

×10 (1.9 : 2.8) ×10

19 : 28

simplest ratio ~~19:28~~ 19:28 [5]

(ii) Suggest a habitat where this plant might grow and **one** observable feature, shown in Fig. 2.2, which adapts it to this habitat.

habitat ~~cold habitat hot h~~ hot climate.

feature ~~thick cuticle~~ thick cuticle [1]

Your Mark

2(a)(i) ☐

2(a)(ii) ☐

2(b)(i) ☐

2(b)(ii) ☐

2(c) ☐

Q2	Mark scheme
(a)(i)	*(plan diagram)* 1. plan diagram of appropriate size + no shading ; 2. no cells + at least two vascular bundles + correct section drawn ; 3. epidermis drawn as two lines drawn closely together ; 4. line drawn to show area of cells located at tip of leaf; **[4]**
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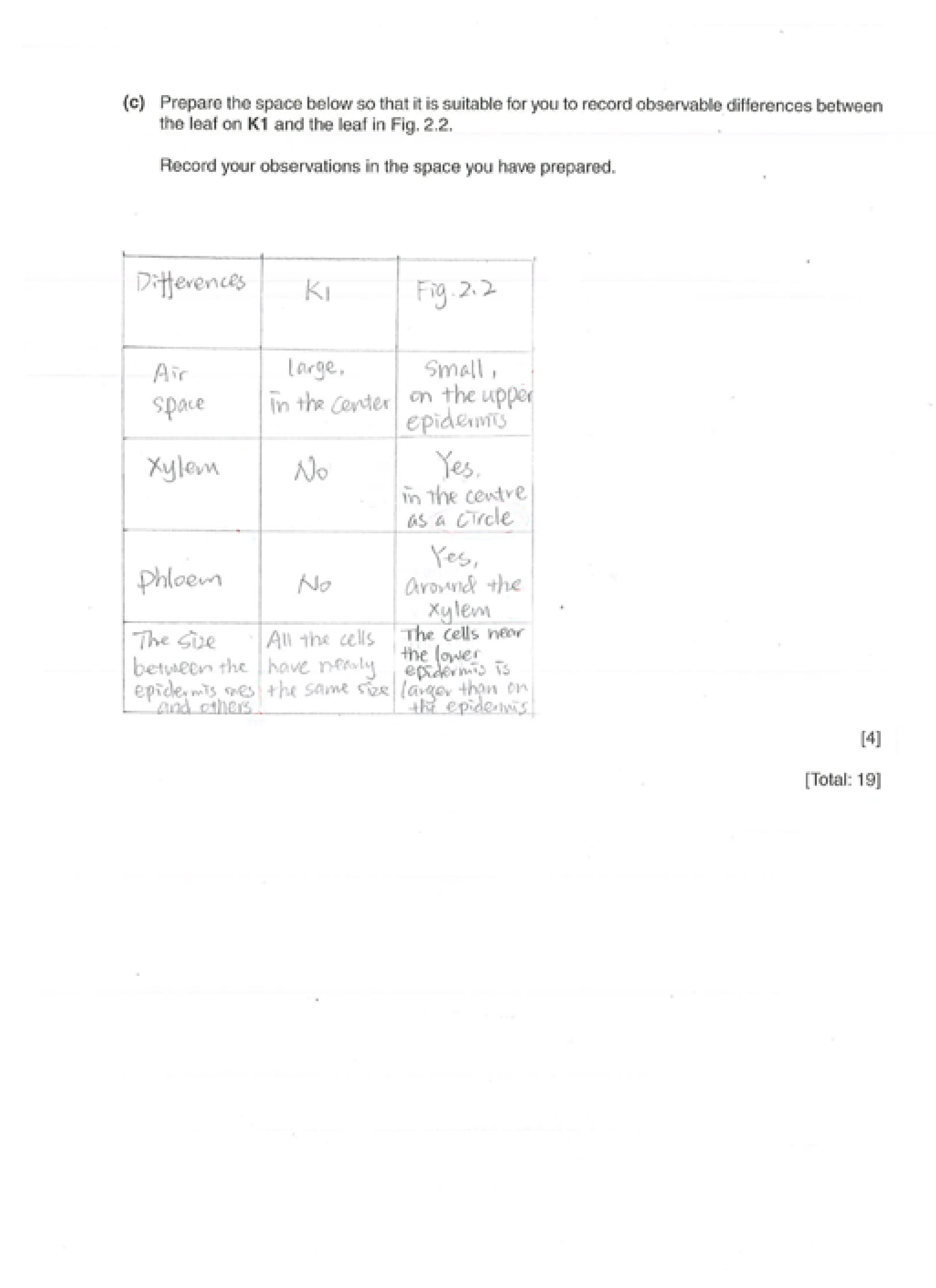
(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
(b)(ii)	*(conclusion)* (habitat) water + (feature) large air spaces or more air spaces or AVP ; **[1]**
(c)	*(observable difference between leaf on* K1 *and leaf in* Fig. 2.2*)* organises comparisons into three columns with one column for features, one headed **K1** and one headed **Fig. 2.2** ; any three observable differences of comparison ;;; e.g. **K1** has more vascular bundles than **Fig. 2.2** **[4]** **[total: 19]**

EXAMINER COMMENTS

MARK SCHEME



(c) Prepare the space below so that it is suitable for you to record observable differences between the leaf on **K1** and the leaf in Fig. 2.2.

Record your observations in the space you have prepared.

Differences	K1	Fig. 2.2
Air space	large, In the Center	Small, on the upper epidermis
Xylem	No	Yes. in the centre as a Circle
Phloem	No	Yes, Around the xylem
The size between the epidermis ones and others	All the cells have nearly the same size	The cells near the lower epidermis is larger than on the epidermis

[4]

[Total: 19]

Your Mark

2(a)(i) ☐

2(a)(ii) ☐

2(b)(i) ☐

2(b)(ii) ☐

2(c) ☐

Q2	Mark scheme
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(b)(i)	*(ratio)* 1. measures depth of midrib + diameter of the vascular bundle ; 2. records whole numbers or to 0.5 for both measurements ; 3. decides to use same units for both measurements ; 4. displays, in final ratio, larger number to smaller number ; 5. final answer as simplest ratio ; **[5]**
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Cambridge Assessment
International Education

Interactive

Interactive Example Candidate Responses
Paper 4 (May/June 2016), Question 1
Cambridge International AS & A Level
Biology 9700

Version 1.0

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1 **(a)** ATP and NAD both play important roles in respiration. Both compounds are nucleotides.

Fig. 1.1 represents the molecular structures of ATP and NAD.

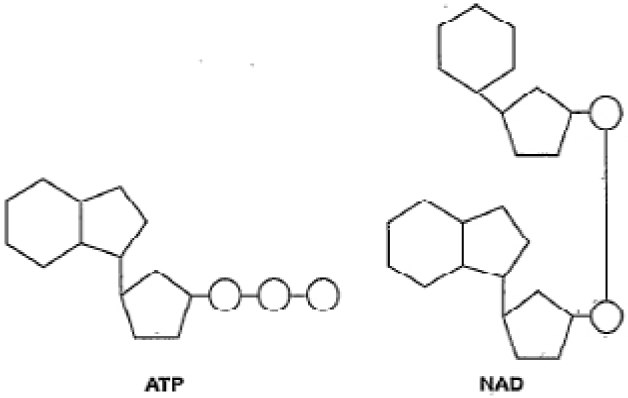

Fig. 1.1

Using Fig. 1.1, compare the structures of ATP and NAD.

ATP contains one nitrogenous base (adenine) while NAD has two nitrogenous bases, one purine and one pyrimidine. ATP has three phosphate groups while NAD has two. ~~ATP~~ ATP has one pentose sugar (ribose) while NAD has two pentose sugars.

[3]

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d) ☐

1(e) ☐

Q1	Mark scheme
(a)	both have <u>ribose</u> (sugars) ; **R** ribulose ATP has 1, ribose / pentose / sugar, NAD has 2 ; I ref. to additional hexose both have, adenine / purine (base) ; I adenosine NAD has, nicotinamide / pyrimidine (base) ; ATP has 3 phosphates, NAD has 2 ; **[max 3]**
(b)	*accept synthesise / produce / convert to, for 'make' for all mp* make (named), protein / polypeptide / peptides ; **A** protein synthesis / translation make (named), disaccharide / oligosaccharide / polysaccharide / glycogen ; **R** nonmammalian examples such as starch or cellulose make (named), triglycerides / lipids / phospholipids / steroids / cholesterol ; **A** glycogenesis make, nucleotide / polynucleotide / nucleic acid / DNA / RNA ; **A** transcription / DNA replication AVP ; e.g. named example of, polymerisation / condensation **A** phosphorylation example **[max 3]**
(c)	<u>substrate</u>-linked / <u>substrate</u>-level, <u>phosphorylation</u> ; **I** condensation reaction **[1]**
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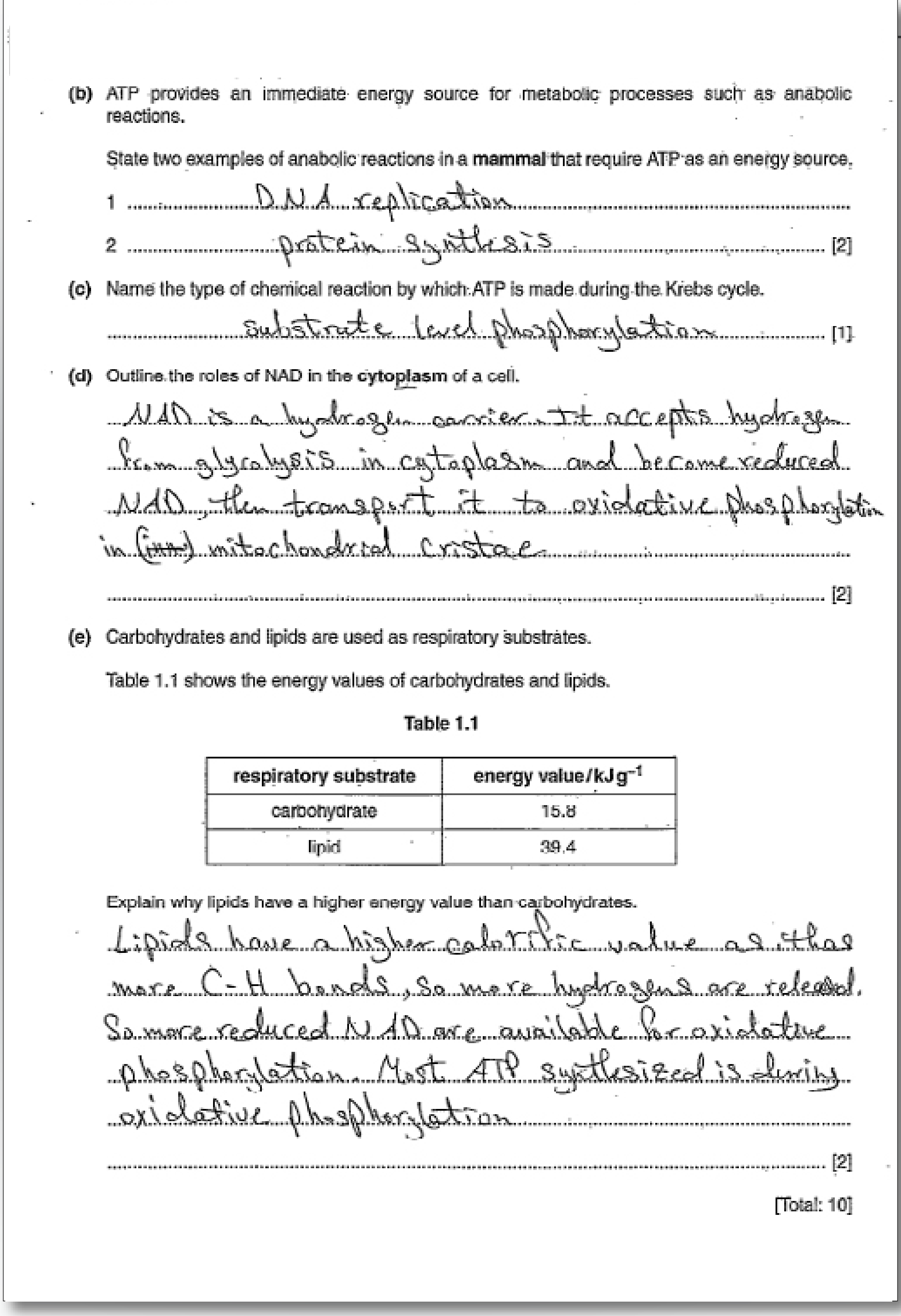

(b) ATP provides an immediate energy source for metabolic processes such as anabolic reactions.

State two examples of anabolic reactions in a **mammal** that require ATP as an energy source.

1 D.N.A replication

2 protein synthesis [2]

(c) Name the type of chemical reaction by which ATP is made during the Krebs cycle.

substrate level phosphorylation [1]

(d) Outline the roles of NAD in the **cytoplasm** of a cell.

NAD is a hydrogen carrier. It accepts hydrogen from glycolysis in cytoplasm and become reduced NAD, then transport it to oxidative phosphorylatin in ~~(mm)~~ mitochondrial cristae

[2]

(e) Carbohydrates and lipids are used as respiratory substrates.

Table 1.1 shows the energy values of carbohydrates and lipids.

Table 1.1

respiratory substrate	energy value/kJ g^{-1}
carbohydrate	15.8
lipid	39.4

Explain why lipids have a higher energy value than carbohydrates.

Lipids have a higher calorific value as it has more C-H bonds, So more hydrogens are released. So more reduced NAD are available for oxidative phosphorylation. Most ATP synthesized is during oxidative phosphorylation

[2]

[Total: 10]

Your Mark

1(a)

1(b)

1(c)

1(d)

1(e)

Q1	Mark scheme
(a)	both have <u>ribose</u> (sugars) ; **R** ribulose ATP has 1, ribose / pentose / sugar, NAD has 2 ; **I** ref. to additional hexose both have, adenine / purine (base) ; **I** adenosine NAD has, nicotinamide / pyrimidine (base) ; ATP has 3 phosphates, NAD has 2 ; **[max 3]**
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(c)	substrate-linked / substrate-level, phosphorylation ; **I** condensation reaction **[1]**
(d)	hydrogen, carrier / acceptor ; **A** gets reduced or gains H / H$^+$ and electrons **I** donates **R** H_2 / hydrogen molecules (acts as a) coenzyme ; **A** enables dehydrogenases to work *ref. to* glycolysis / respiration in anaerobic conditions ; **A** anaerobic respiration **I** aerobic **[max 2]**
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EXAMINER COMMENTS

MARK SCHEME

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1 (a) ATP and NAD both play important roles in respiration. Both compounds are nucleotides.

Fig. 1.1 represents the molecular structures of ATP and NAD.

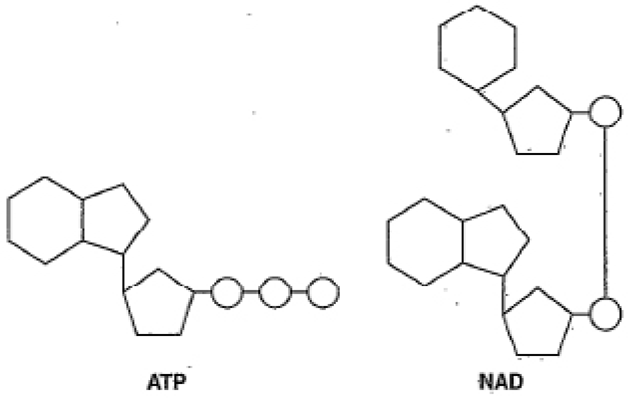

Fig. 1.1

Using Fig. 1.1, compare the structures of ATP and NAD.

ATP is made up of one ribose sugar, a nitrogenous base which is a purine. ~~and is also~~ ATP is also known as Adenosine triphosphate. The ribose sugar is bonded to three phosphate groups.

NAD is made up of two ribose sugars, ~~two~~ Nitrogenous bases; a purine and pyrimidine. The two ribose sugars are bonded to a single phosphate group, ~~each to~~ a single phosphate group. The two phosphate group are linked together.

[3]

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d) ☐

1(e) ☐

Q1	Mark scheme
(a)	both have <u>ribose</u> (sugars) ; **R** ribulose ATP has 1, ribose / pentose / sugar, NAD has 2 ; I ref. to additional hexose both have, adenine / purine (base) ; I adenosine NAD has, nicotinamide / pyrimidine (base) ; ATP has 3 phosphates, NAD has 2 ; **[max 3]**
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(c)	<u>substrate</u>-linked / <u>substrate</u>-level, <u>phosphorylation</u> ; **I** condensation reaction **[1]**
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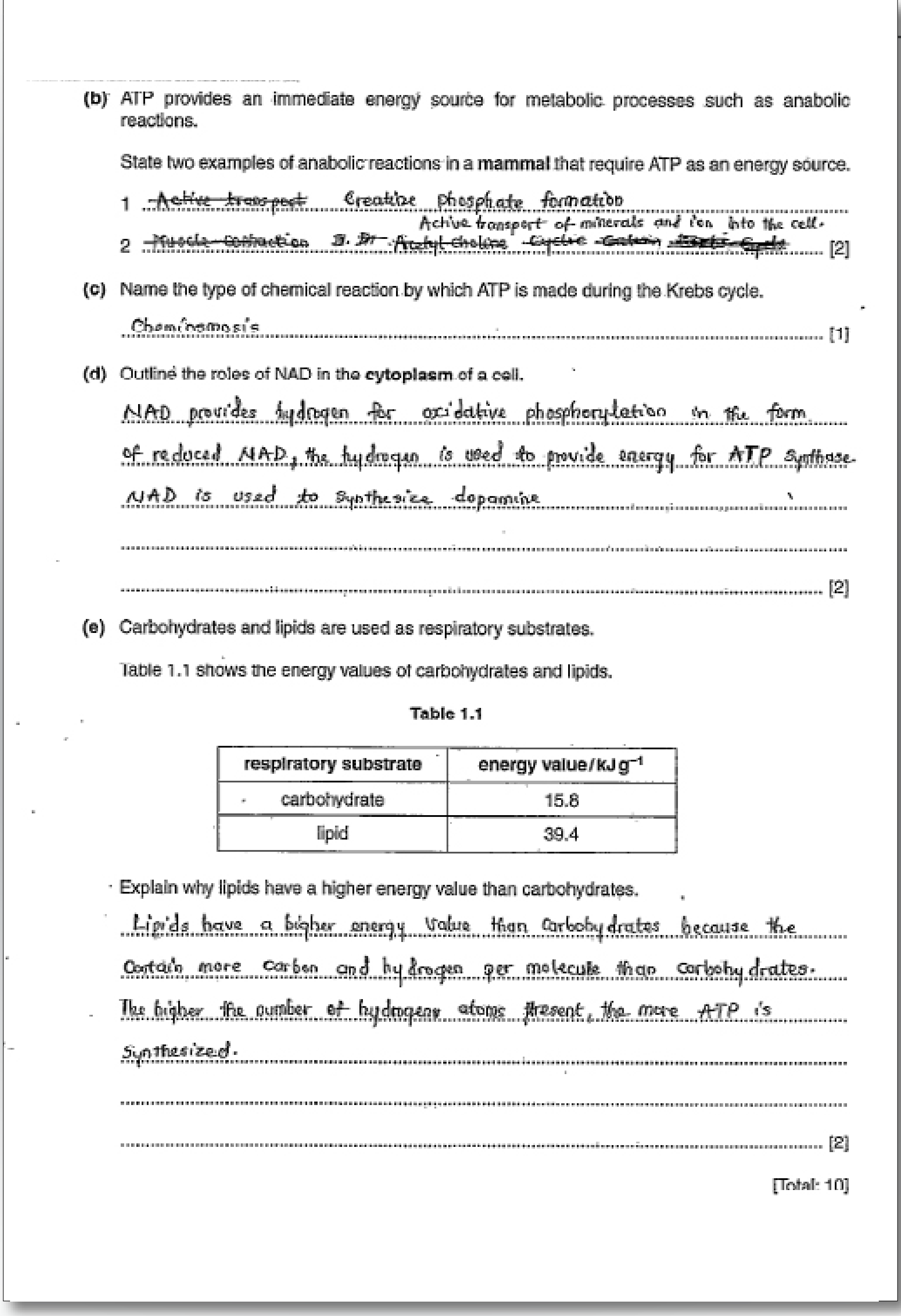
EXAMINER COMMENTS

MARK SCHEME



(b) ATP provides an immediate energy source for metabolic processes such as anabolic reactions.

State two examples of anabolic reactions in a **mammal** that require ATP as an energy source.

1 ~~Active transport~~ Creatine phosphate formation

2 ~~Muscle contraction~~ ~~3. Br~~ ~~Acetyl choline~~ ~~Cyclic Calcium~~ ~~[illegible] Cycle~~ Active transport of minerals and ion into the cell. [2]

(c) Name the type of chemical reaction by which ATP is made during the Krebs cycle.

Chemiosmosis [1]

(d) Outline the roles of NAD in the **cytoplasm** of a cell.

NAD provides hydrogen for oxidative phosphorylation in the form of reduced NAD, the hydrogen is used to provide energy for ATP synthase. NAD is used to synthesize dopamine

[2]

(e) Carbohydrates and lipids are used as respiratory substrates.

Table 1.1 shows the energy values of carbohydrates and lipids.

Table 1.1

respiratory substrate	energy value / kJ g^{-1}
carbohydrate	15.8
lipid	39.4

Explain why lipids have a higher energy value than carbohydrates.

Lipids have a higher energy value than carbohydrates because the contain more carbon and hydrogen per molecule than carbohydrates. The higher the number of hydrogens atoms present, the more ATP is synthesized.

[2]

[Total: 10]

Your Mark

1(a)

1(b)

1(c)

1(d)

1(e)

Q1	Mark scheme
(a)	both have <u>ribose</u> (sugars) ; **R** ribulose ATP has 1, ribose / pentose / sugar, NAD has 2 ; I ref. to additional hexose both have, adenine / purine (base) ; I adenosine NAD has, nicotinamide / pyrimidine (base) ; ATP has 3 phosphates, NAD has 2 ; **[max 3]**
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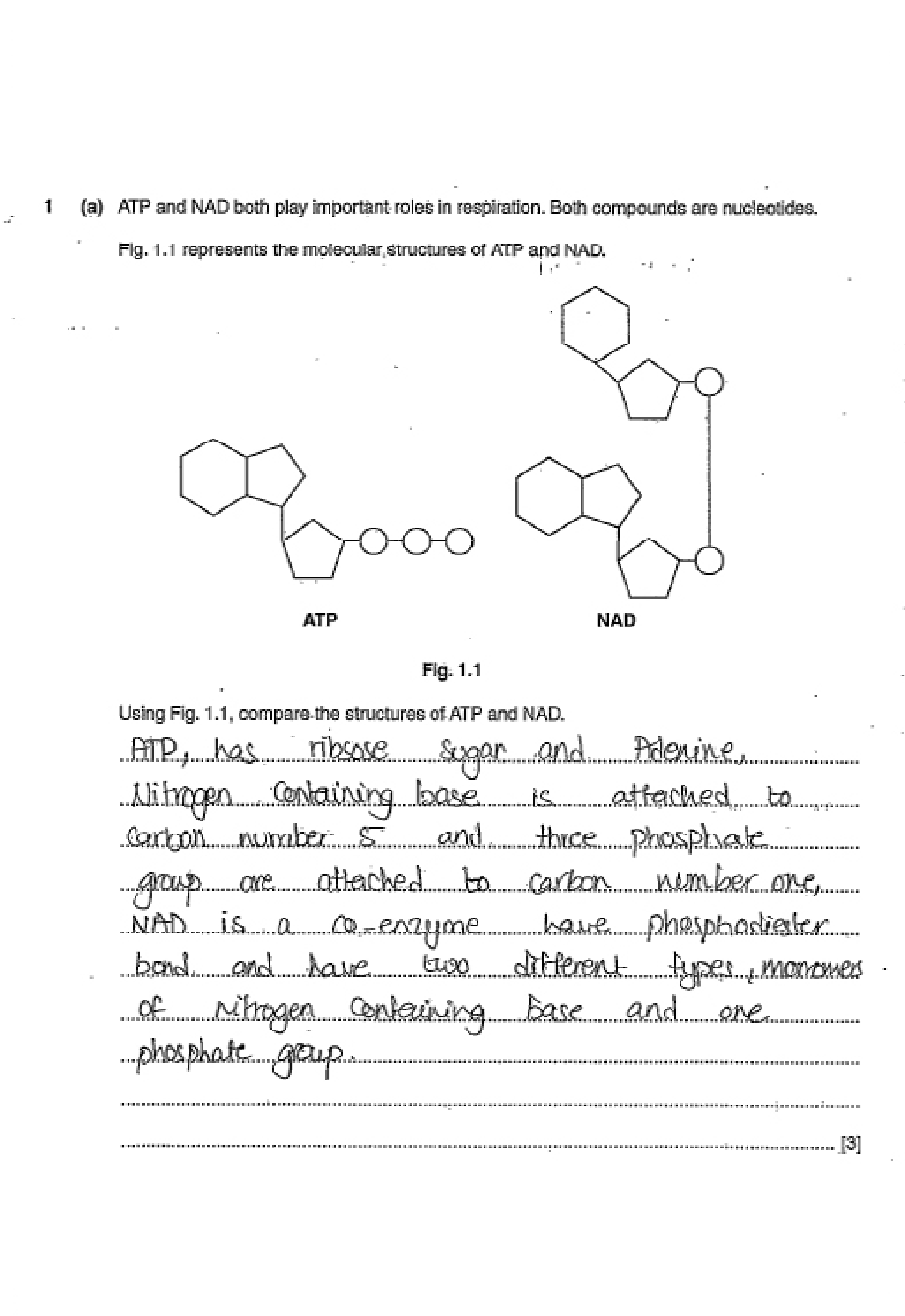

1 (a) ATP and NAD both play important roles in respiration. Both compounds are nucleotides.

Fig. 1.1 represents the molecular structures of ATP and NAD.

Fig. 1.1

Using Fig. 1.1, compare the structures of ATP and NAD.

ATP, has ribsose sugar and Adenine, Nitrogen containing base is attached to carbon number 5 and three phosphate group are attached to carbon number one, NAD is a co-enzyme have phosphodiester bond and have two different types, monomes of Nitrogen containing Base and one phosphate group.

[3]

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d) ☐

1(e) ☐

Q1	Mark scheme
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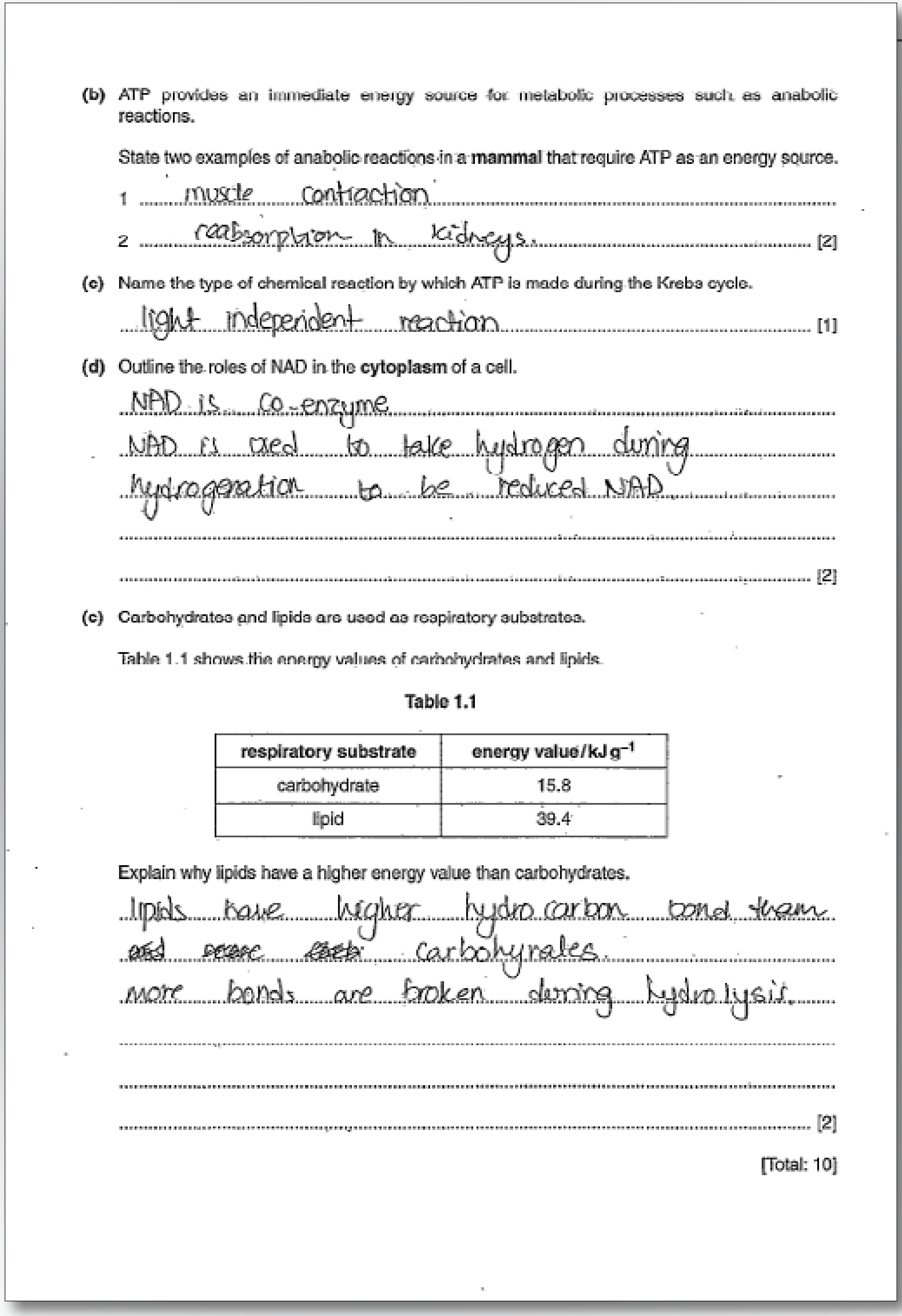

(b) ATP provides an immediate energy source for metabolic processes such as anabolic reactions.

State two examples of anabolic reactions in a **mammal** that require ATP as an energy source.

1 muscle contraction

2 reabsorption in kidneys. [2]

(c) Name the type of chemical reaction by which ATP is made during the Krebs cycle.

light independent reaction [1]

(d) Outline the roles of NAD in the **cytoplasm** of a cell.

NAD is co-enzyme
NAD is used to take hydrogen during hydrogenation to be reduced NAD

[2]

(e) Carbohydrates and lipids are used as respiratory substrates.

Table 1.1 shows the energy values of carbohydrates and lipids.

Table 1.1

respiratory substrate	energy value / kJ g^{-1}
carbohydrate	15.8
lipid	39.4

Explain why lipids have a higher energy value than carbohydrates.

lipids have higher hydro carbon bond than ~~and~~ ~~more~~ ~~[illegible]~~ carbohyrates.
more bonds are broken during hydrolysis.

[2]

[Total: 10]

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d) ☐

1(e) ☐

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EXAMINER COMMENTS

MARK SCHEME

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Cambridge Assessment
International Education

Interactive

Interactive Example Candidate Responses
Paper 4 (May/June 2016), Question 2
Cambridge International AS & A Level
Biology 9700

Version 1.0

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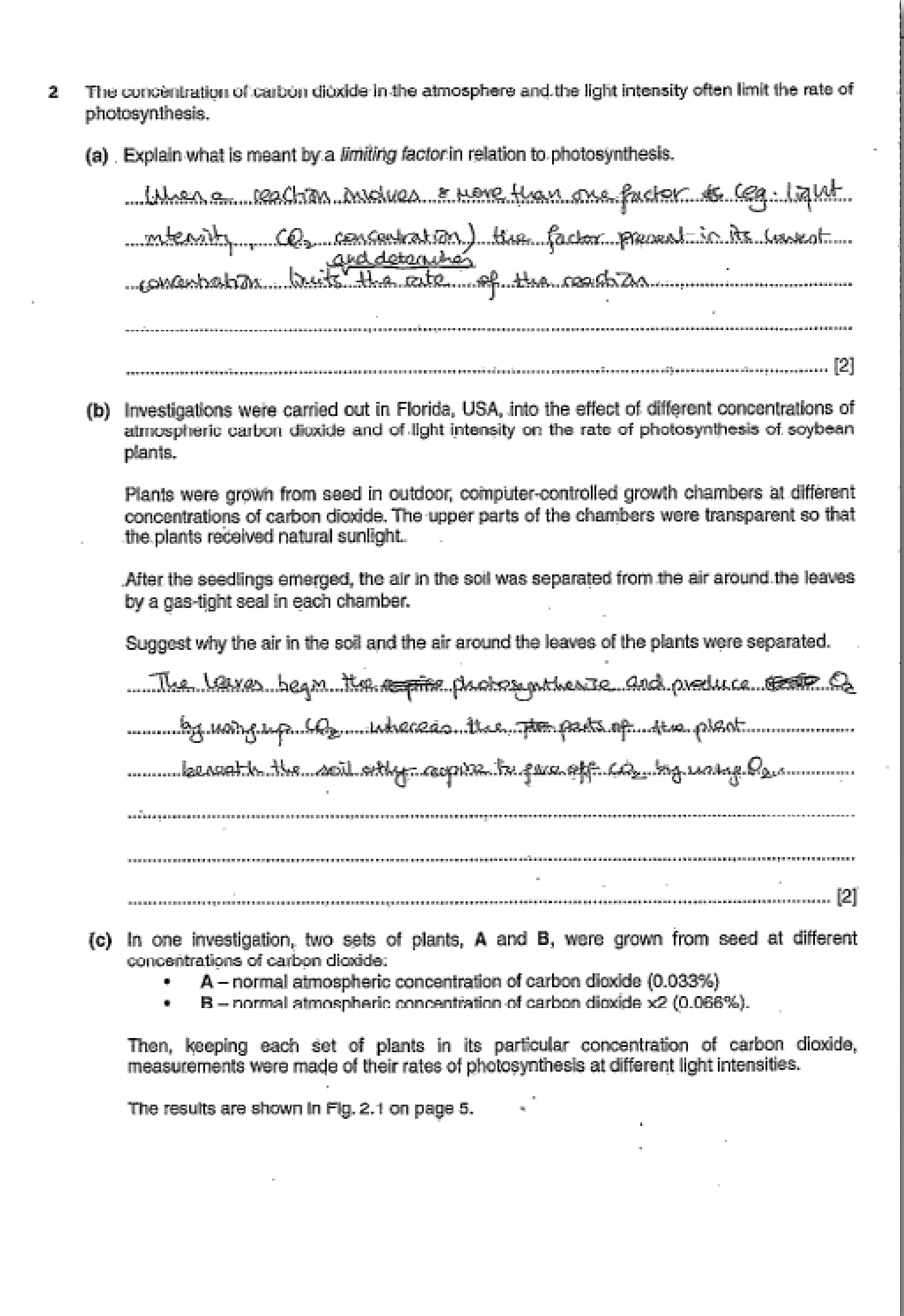

2 The concentration of carbon dioxide in the atmosphere and the light intensity often limit the rate of photosynthesis.

(a) Explain what is meant by a *limiting factor* in relation to photosynthesis.

When a reaction involves more than one factor (e.g. light intensity, CO_2 concentration) the factor present in its lowest concentration limits and determines the rate of the reaction

[2]

(b) Investigations were carried out in Florida, USA, into the effect of different concentrations of atmospheric carbon dioxide and of light intensity on the rate of photosynthesis of soybean plants.

Plants were grown from seed in outdoor, computer-controlled growth chambers at different concentrations of carbon dioxide. The upper parts of the chambers were transparent so that the plants received natural sunlight.

After the seedlings emerged, the air in the soil was separated from the air around the leaves by a gas-tight seal in each chamber.

Suggest why the air in the soil and the air around the leaves of the plants were separated.

The leaves begin to photosynthesize and produce O_2 by using up CO_2 whereas the parts of the plant beneath the soil only respire to give off CO_2 by using O_2.

[2]

(c) In one investigation, two sets of plants, **A** and **B**, were grown from seed at different concentrations of carbon dioxide:

- **A** – normal atmospheric concentration of carbon dioxide (0.033%)
- **B** – normal atmospheric concentration of carbon dioxide x2 (0.066%).

Then, keeping each set of plants in its particular concentration of carbon dioxide, measurements were made of their rates of photosynthesis at different light intensities.

The results are shown in Fig. 2.1 on page 5.

Select page

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Your Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

2(d)

Q2	Mark scheme
(a)	at lowest value / in shortest supply ; **I** insufficient supply / not enough (the) one factor of several that affects rate ; **A** one factor of several prevents increase in rate **[2]**
(b)	to keep out unwanted CO_2 (in air around leaves) ; **A** to stop CO_2 increasing / entering (upper chamber) *ref. to* respiration of soil organisms ; **A** respiration of bacteria / fungi / seeds *ref. to* respiration of plant roots ; **[max 2]**
(c)(i)	*I ref. to set* **B** *throughout I time references* *at low(er) light intensity / light intensity up to a figure in range 6 – 7 au* **1** rate increases as light intensity increases ; **2** light intensity is (main) limiting factor ; *mp1 and mp 2 need to be in correct context* *at high light intensity / light intensity above a figure in range 6 – 7 au* **3** rate, levels off / reaches plateau / remains constant ; **A** rate unaffected (by light intensity) **4** another (named) factor / not light intensity, is limiting ; **A** CO_2 concentration / temperature *mp3 and mp4 need to be in correct context* **[max 3]**
(c)(ii)	more CO_2 available in **B** / less CO_2 in **A** ; **A** CO_2 concentration in **B** is double that of **A** *ref. to* fixation / Calvin cycle / light independent reactions ; **A** description, e.g. CO_2 combines with RuBP CO_2 concentration is limiting factor in set **A** ; **A** CO_2 concentration is limiting at a higher light intensity in **B** **[max 2]**
(d)	*accept ora throughout* **1** **D**, adapted to high CO_2 / can use more CO_2 (per unit leaf area) ; **A** plants in D have, adjusted / accommodated, to high CO_2 **2** **D** have more, chloroplasts / chlorophyll ; **3** **D** have more, rubisco / RuBP ; **4** **D** have more stomata ; **5** **D** have thinner leaves ; **6** AVP ; e.g. ref. to diffusion of CO_2 **[max 4]** **[Total: 13]**

EXAMINER COMMENTS

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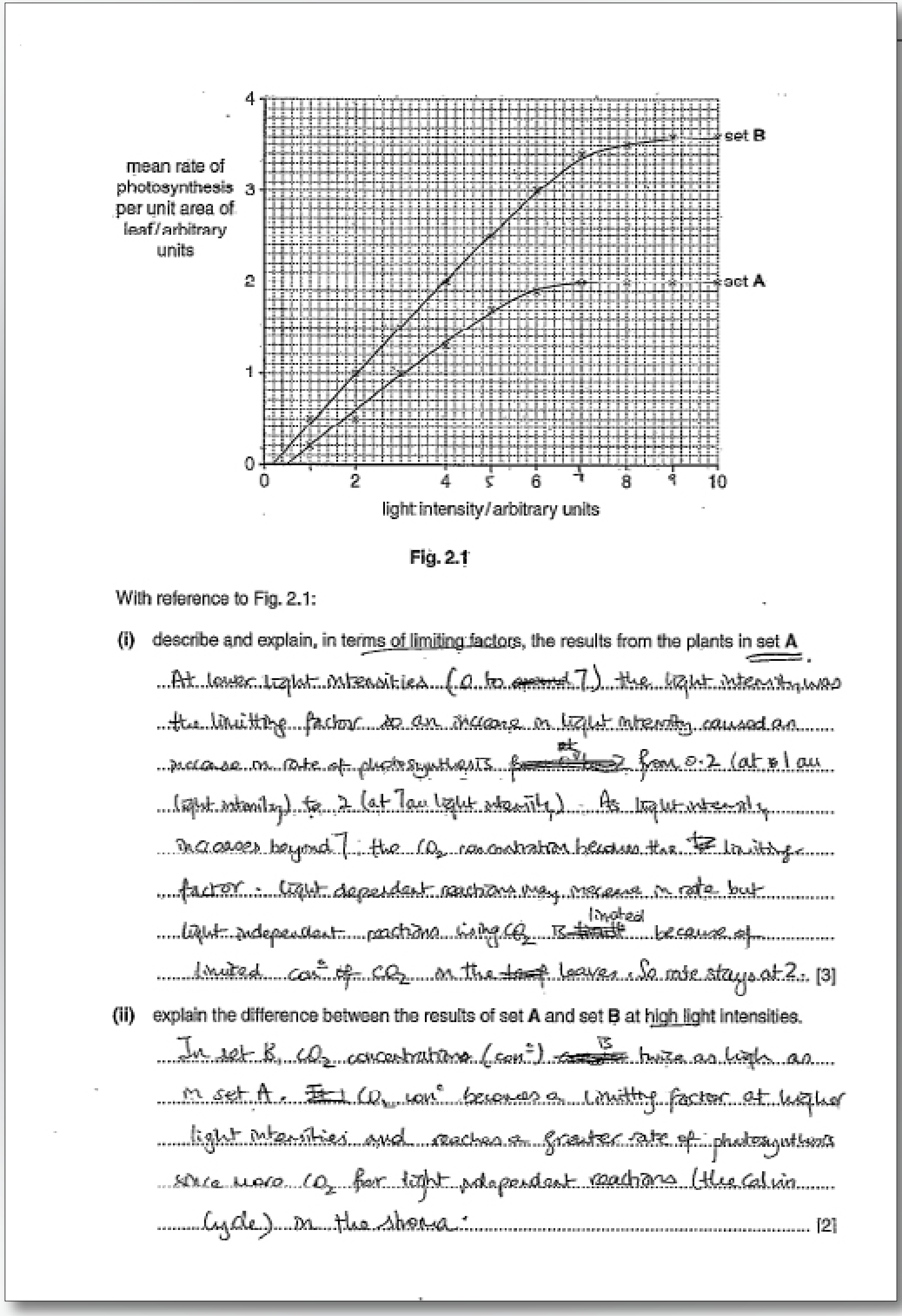

Fig. 2.1

With reference to Fig. 2.1:

(i) describe and explain, in terms of limiting factors, the results from the plants in set **A**.

At lower light intensities (0 to ~~around~~ 7) the light intensity was the limiting factor so an increase in light intensity caused an increase in rate of photosynthesis at ~~[illegible]~~ from 0.2 (at ~~0~~ 1 au (light intensity) to 2 (at 7au light intensity). As light intensity increases beyond 7, the CO_2 concentration becomes the ~~[illegible]~~ limiting factor. light dependent reactions may increase in rate but light independent reactions using CO_2 is ~~limited~~ limited because of limited conc of CO_2 in the ~~leaf~~ leaves. So rate stays at 2. [3]

(ii) explain the difference between the results of set **A** and set **B** at high light intensities.

In set B, CO_2 concentrations (conc) ~~[illegible]~~ is twice as high as in set A. ~~[illegible]~~ CO_2 conc becomes a limiting factor at higher light intensities and reaches a greater rate of photosynthesis since more CO_2 for light independent reactions (the Calvin cycle) in the stroma. [2]

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Your Mark

2(a) ☐

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2(c)(i) ☐

2(c)(ii) ☐

2(d) ☐

Q2	Mark scheme
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(c)(i)	*I ref. to set **B** throughout I time references* *at low(er) light intensity / light intensity up to a figure in range 6 – 7 au* **1** <u>rate</u> increases as light intensity increases ; **2** light intensity is (main) limiting factor ; *mp1 and mp 2 need to be in correct context* *at high light intensity / light intensity above a figure in range 6 – 7 au* **3** rate, levels off / reaches plateau / remains constant ; **A** rate unaffected (by light intensity) **4** another (named) factor / not light intensity, is limiting ; **A** CO_2 concentration / temperature *mp3 and mp4 need to be in correct context* **[max 3]**
(c)(ii)	more CO_2 available in **B** / less CO_2 in **A** ; **A** CO_2 concentration in **B** is double that of **A** *ref. to* fixation / Calvin cycle / light independent reactions ; **A** description, e.g. CO_2 combines with RuBP <u>CO_2 concentration</u> is limiting factor in set **A** ; **A** CO_2 concentration is limiting at a higher light intensity in **B** **[max 2]**
(d)	*accept ora throughout* **1** **D**, adapted to high CO_2 / can use more CO_2 (per unit leaf area) ; **A** plants in D have, adjusted / accommodated, to high CO_2 **2** **D** have more, chloroplasts / chlorophyll ; **3** **D** have more, rubisco / RuBP ; **4** **D** have more stomata ; **5** **D** have thinner leaves ; **6** AVP ; e.g. ref. to <u>diffusion</u> of CO_2 **[max 4]** **[Total: 13]**

EXAMINER COMMENTS

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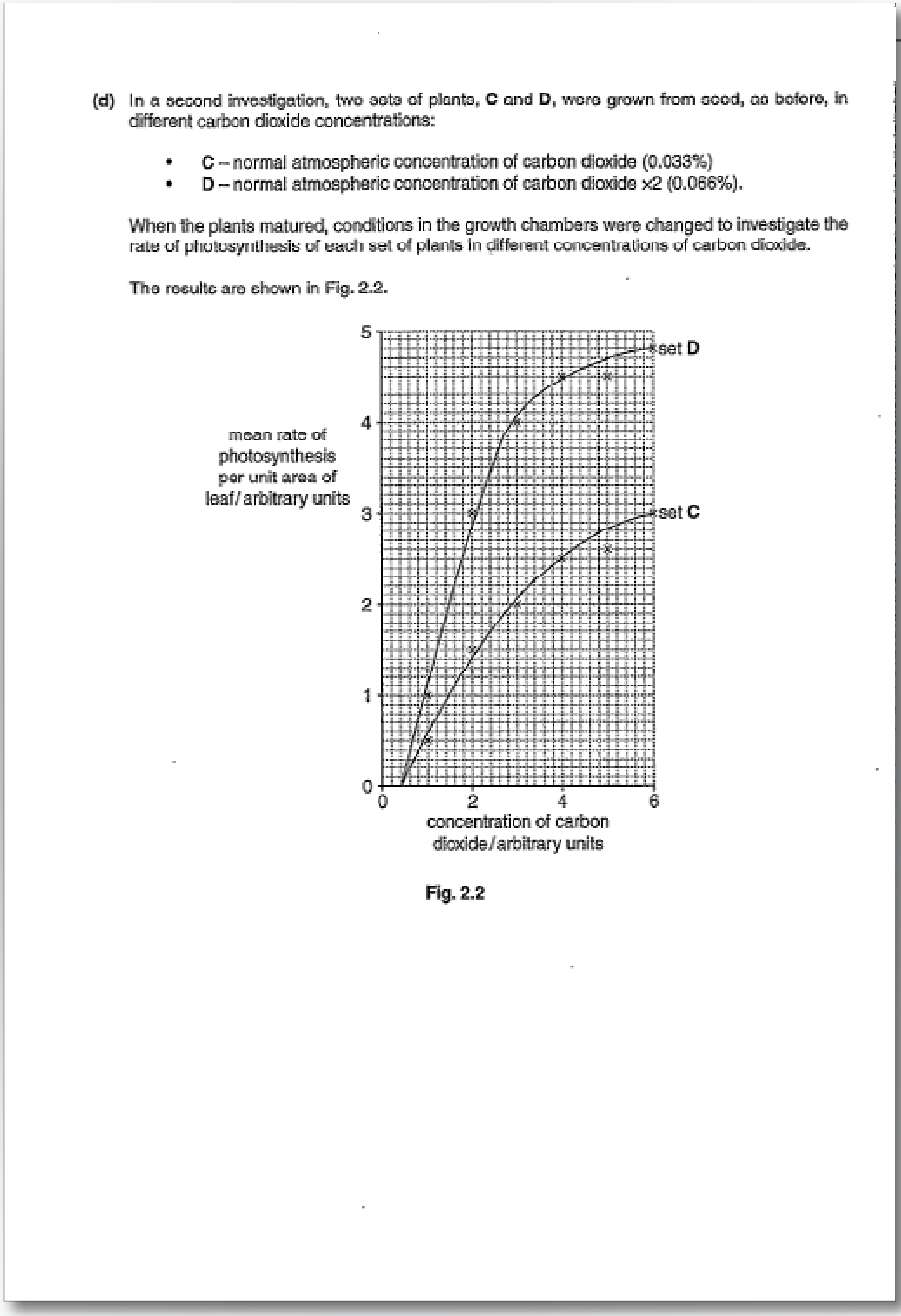

(d) In a second investigation, two sets of plants, **C** and **D**, were grown from seed, as before, in different carbon dioxide concentrations:

- **C** – normal atmospheric concentration of carbon dioxide (0.033%)
- **D** – normal atmospheric concentration of carbon dioxide ×2 (0.066%).

When the plants matured, conditions in the growth chambers were changed to investigate the rate of photosynthesis of each set of plants in different concentrations of carbon dioxide.

The results are shown in Fig. 2.2.

Fig. 2.2

Your Mark

2(a) ☐

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2(c)(ii) ☐

2(d) ☐

Q2	Mark scheme
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EXAMINER COMMENTS

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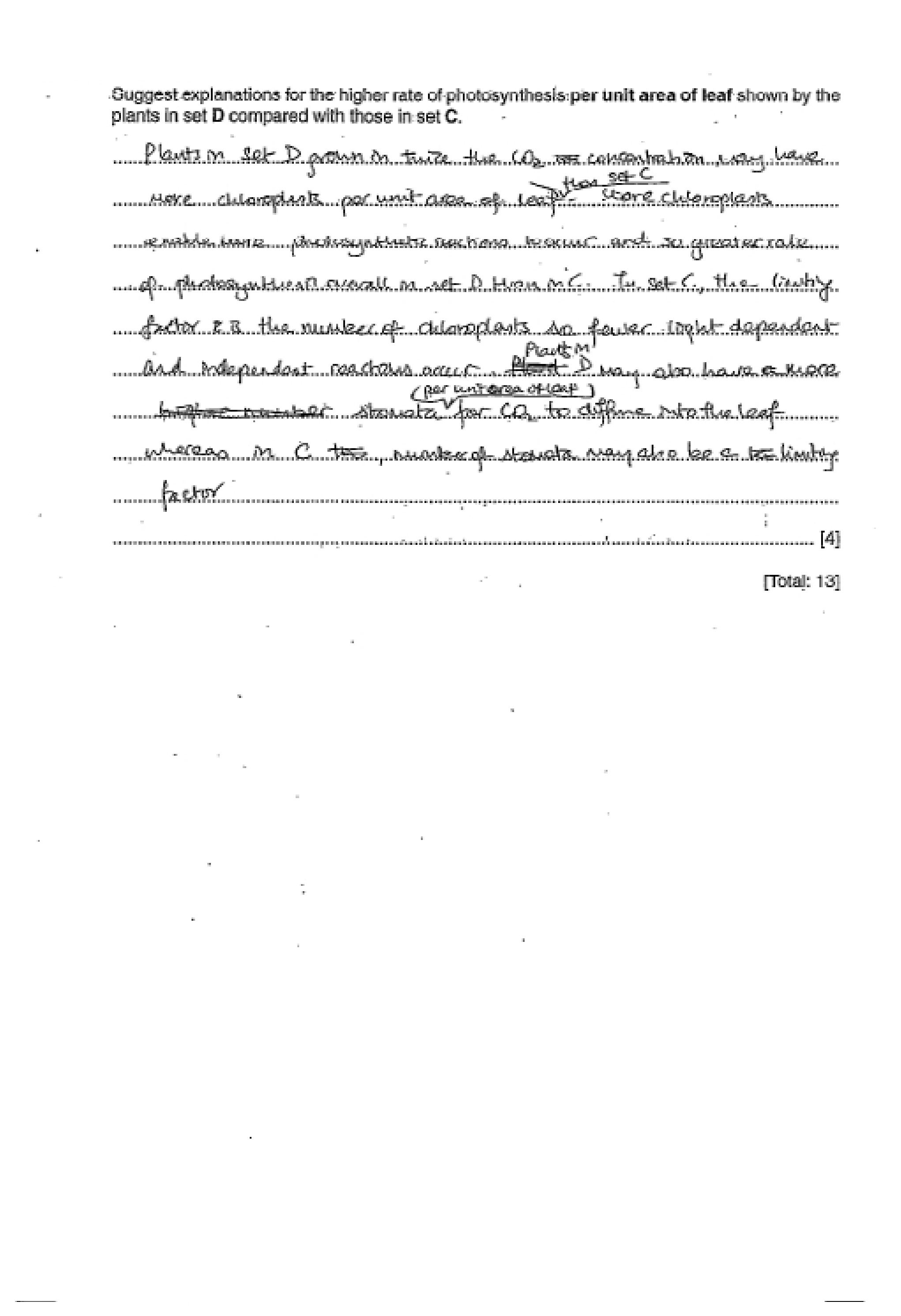

Suggest explanations for the higher rate of photosynthesis **per unit area of leaf** shown by the plants in set **D** compared with those in set **C**.

Plants in set D grown in twice the CO_2 ~~??~~ concentration may have more chloroplasts per unit area of leaf than set C. More chloroplasts enable more photosynthetic reactions to occur and so greater rate of photosynthesis overall in set D than in C. In set C, the limiting factor e.g. the number of chloroplasts so fewer light dependent and independent reactions occur. Plants in ~~Plant~~ D may also have a more ~~higher number~~ stomata (per unit area of leaf) for CO_2 to diffuse into the leaf whereas in C ~~the~~, number of stomata may also be a ~~the~~ limiting factor

[4]

[Total: 13]

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2(d) ☐

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EXAMINER COMMENTS | MARK SCHEME

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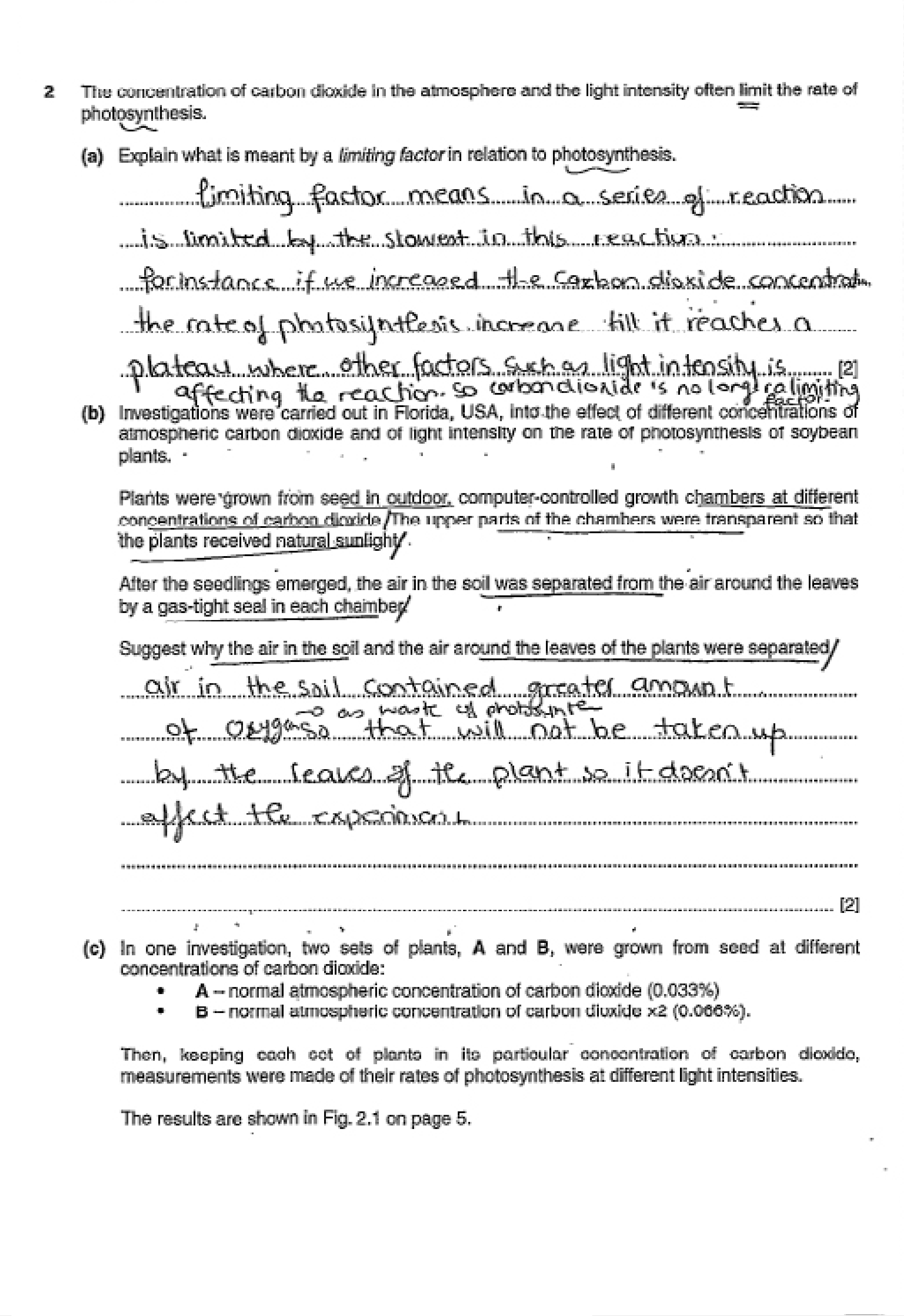

2 The concentration of carbon dioxide in the atmosphere and the light intensity often limit the rate of photosynthesis.

(a) Explain what is meant by a *limiting factor* in relation to photosynthesis.

limiting factor means in a series of reaction is limited by the slowest in this reaction: forinstance if we increased the carbon dioxide concentrat the rate of photosiynthesis increase till it reaches a plateau where other factors such as light intensity is affecting the reaction. so carbondioxide 's no longr a limiting factor. [2]

(b) Investigations were carried out in Florida, USA, into the effect of different concentrations of atmospheric carbon dioxide and of light intensity on the rate of photosynthesis of soybean plants.

Plants were grown from seed in outdoor, computer-controlled growth chambers at different concentrations of carbon dioxide. The upper parts of the chambers were transparent so that the plants received natural sunlight.

After the seedlings emerged, the air in the soil was separated from the air around the leaves by a gas-tight seal in each chamber.

Suggest why the air in the soil and the air around the leaves of the plants were separated.

air in the soil contained greater amount of oxygen → as waste of photosynte so that will not be taken up by the leaves of the plant so it doesn't affect the experiment. [2]

(c) In one investigation, two sets of plants, **A** and **B**, were grown from seed at different concentrations of carbon dioxide:

- **A** – normal atmospheric concentration of carbon dioxide (0.033%)
- **B** – normal atmospheric concentration of carbon dioxide x2 (0.066%).

Then, keeping each set of plants in its particular concentration of carbon dioxide, measurements were made of their rates of photosynthesis at different light intensities.

The results are shown in Fig. 2.1 on page 5.

Your Mark

2(a) ☐

2(b) ☐

2(c)(i) ☐

2(c)(ii) ☐

2(d) ☐

Q2	Mark scheme
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(c)(i)	***I*** *ref. to set* ***B*** *throughout* ***I*** *time references* *at low(er) light intensity / light intensity up to a figure in range 6 – 7 au* **1** rate increases as light intensity increases ; **2** light intensity is (main) limiting factor ; *mp1 and mp 2 need to be in correct context* *at high light intensity / light intensity above a figure in range 6 – 7 au* **3** rate, levels off / reaches plateau / remains constant ; **A** rate unaffected (by light intensity) **4** another (named) factor / not light intensity, is limiting ; **A** CO_2 concentration / temperature *mp3 and mp4 need to be in correct context* **[max 3]**
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(d)	*accept ora throughout* **1** **D**, adapted to high CO_2 / can use more CO_2 (per unit leaf area) ; **A** plants in D have, adjusted / accommodated, to high CO_2 **2** **D** have more, chloroplasts / chlorophyll ; **3** **D** have more, rubisco / RuBP ; **4** **D** have more stomata ; **5** **D** have thinner leaves ; **6** AVP ; e.g. ref. to diffusion of CO_2 **[max 4]** **[Total: 13]**

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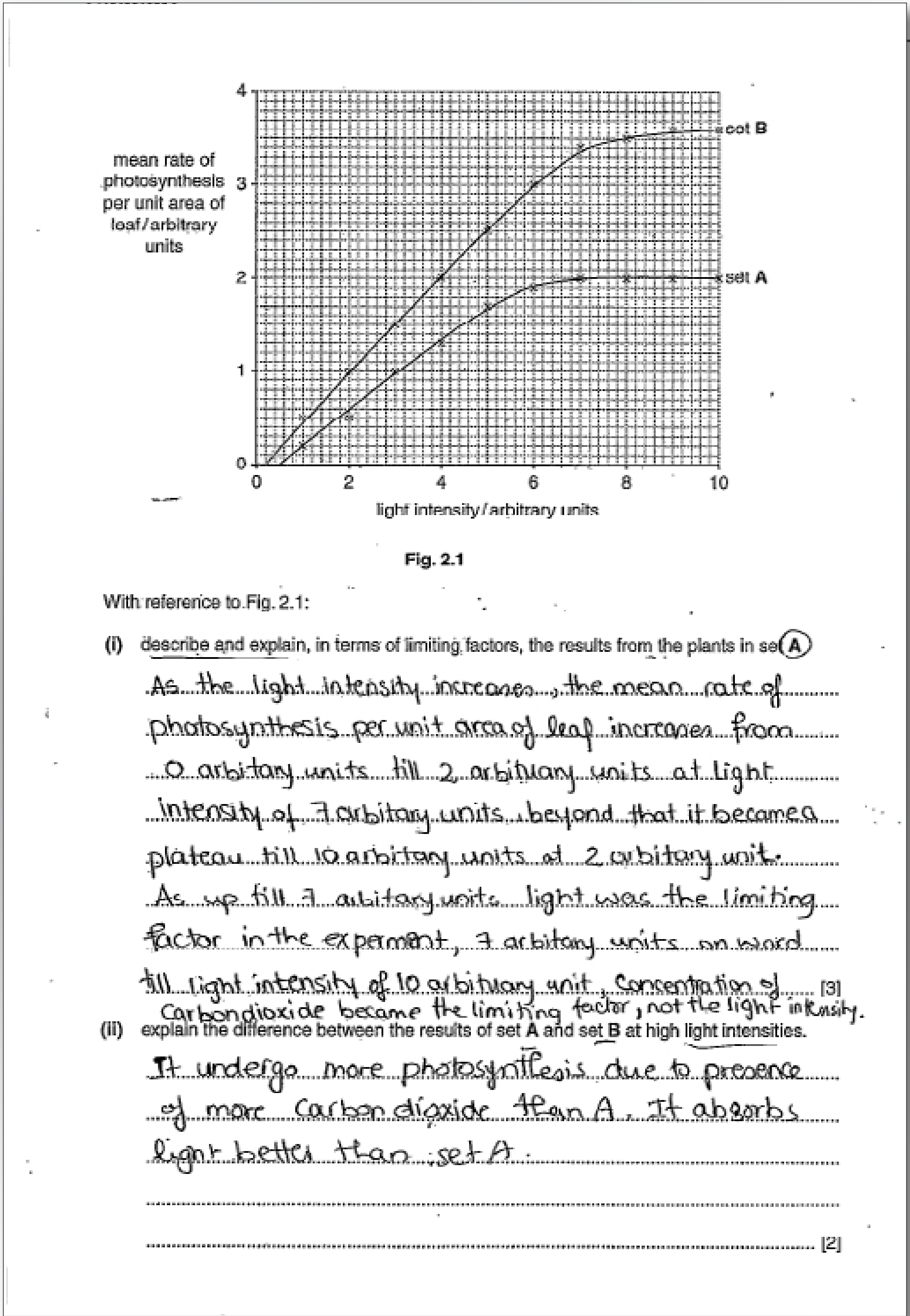

Fig. 2.1

With reference to Fig. 2.1:

(i) describe and explain, in terms of limiting factors, the results from the plants in set A

As the light intensity increases, the mean rate of photosynthesis per unit area of leaf increases from 0 arbitary units till 2 arbituary units at light intensity of 7 arbitary units beyond that it became plateau till 10 arbitary units at 2 arbitary unit. As up till 7 arbitary units light was the limiting factor in the experment, 7 arbitary units on word till light intensity of 10 arbituary unit, Concentration of Carbondioxide became the limiting factor, not the light intensity. [3]

(ii) explain the difference between the results of set A and set B at high light intensities.

It undergo more photosynthesis due to presence of more carbon dioxide than A. It absorbs light better than set A.

[2]

Your Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

2(d)

Q2	**Mark scheme**
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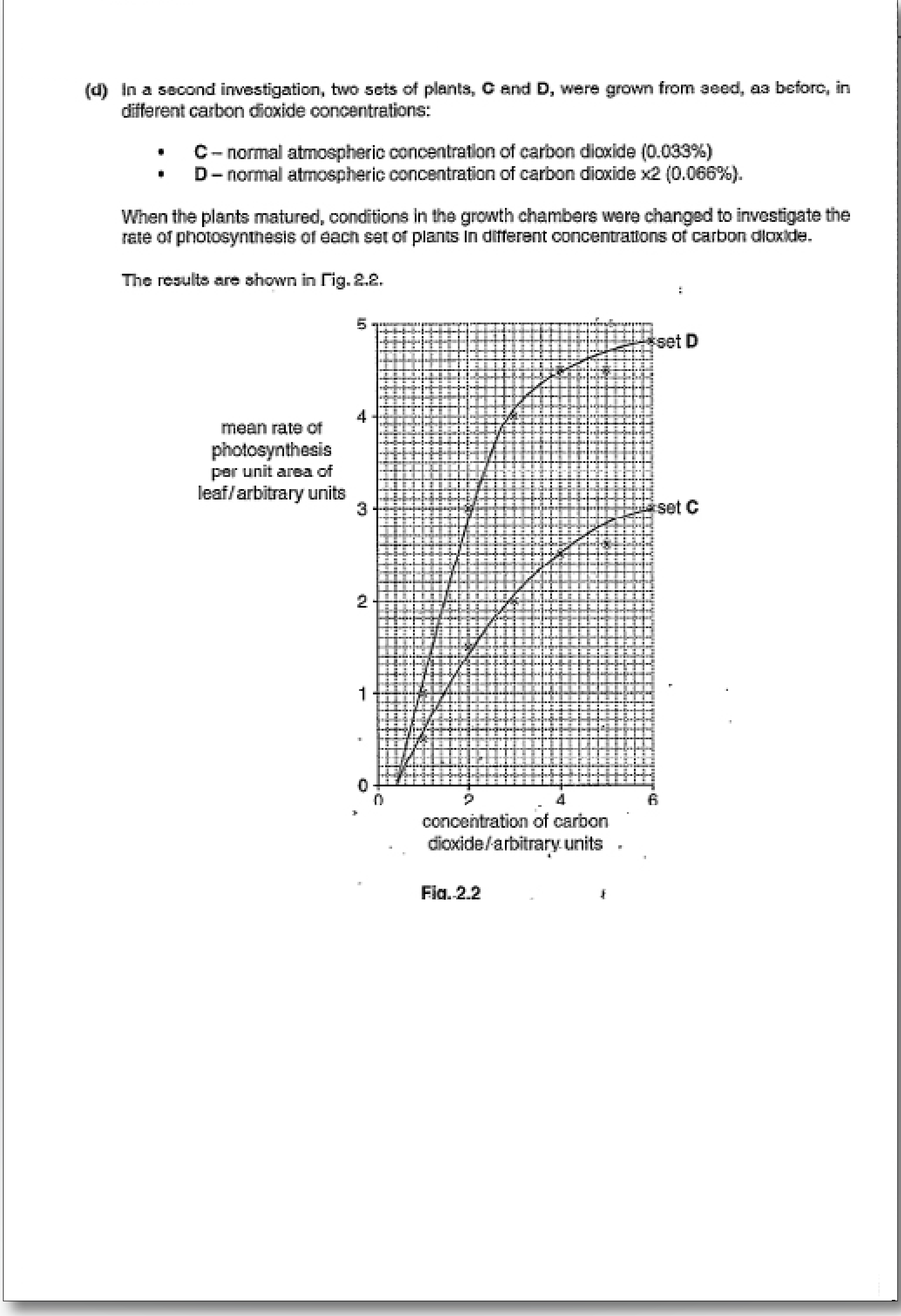

(d) In a second investigation, two sets of plants, C and D, were grown from seed, as before, in different carbon dioxide concentrations:

- C – normal atmospheric concentration of carbon dioxide (0.033%)
- D – normal atmospheric concentration of carbon dioxide x2 (0.066%).

When the plants matured, conditions in the growth chambers were changed to investigate the rate of photosynthesis of each set of plants in different concentrations of carbon dioxide.

The results are shown in Fig. 2.2.

Fig. 2.2

Your Mark

2(a) ☐

2(b) ☐

2(c)(i) ☐

2(c)(ii) ☐

2(d) ☐

Q2	Mark scheme
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EXAMINER COMMENTS
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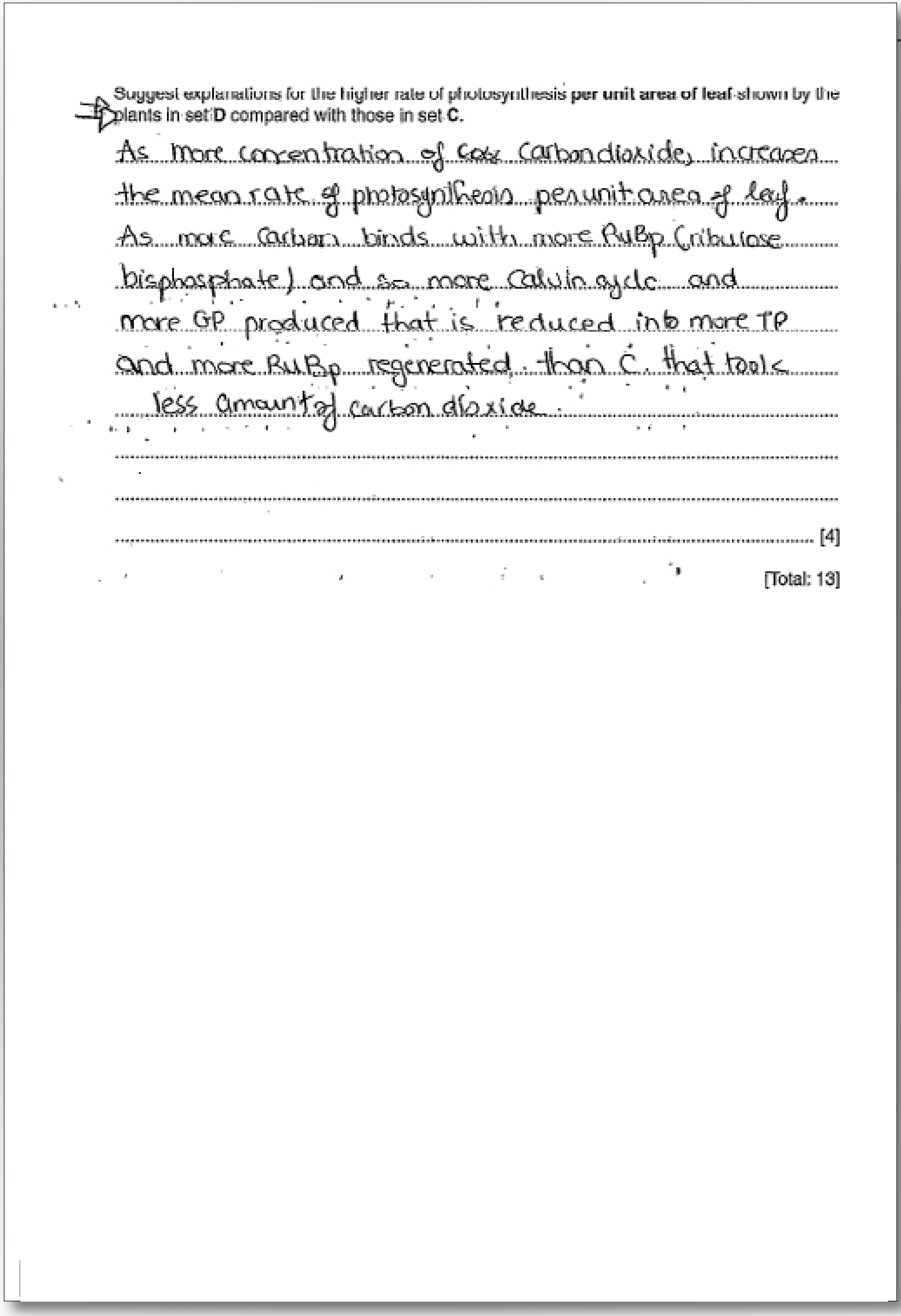

Suggest explanations for the higher rate of photosynthesis **per unit area of leaf** shown by the plants in set **D** compared with those in set **C**.

As more concentration of ~~Co2~~ carbondioxide, increases the mean rate of photosynthesis per unit area of leaf. As more carbon binds with more RuBp (ribulose bisphosphate) and so more Calvin cycle and more GP produced that is reduced into more TP and more RuBp regenerated than C that took less amount of carbon dioxide.

[4]

[Total: 13]

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2(a) ☐

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2(c)(ii) ☐

2(d) ☐

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EXAMINER COMMENTS

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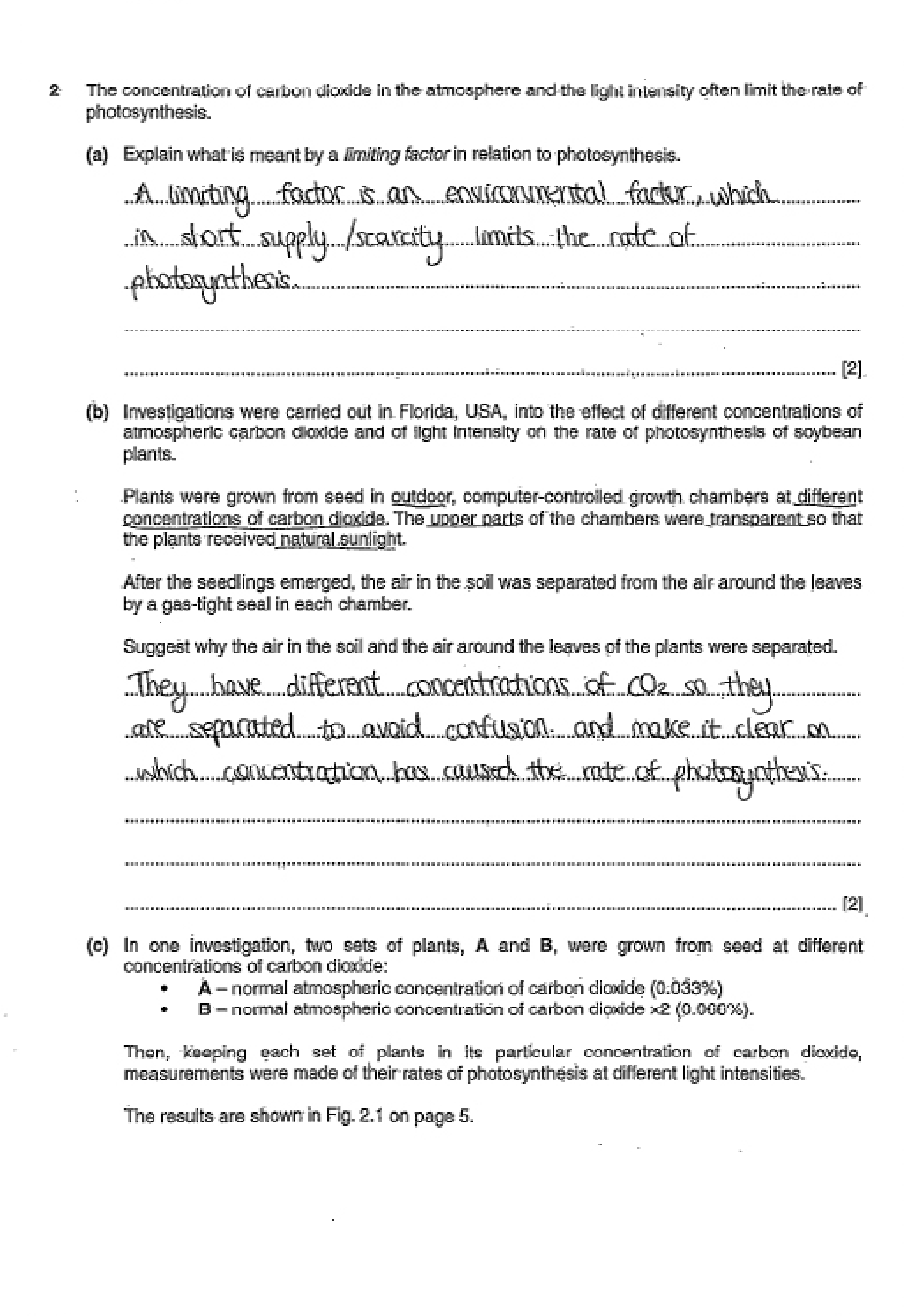

2 The concentration of carbon dioxide in the atmosphere and the light intensity often limit the rate of photosynthesis.

(a) Explain what is meant by a *limiting factor* in relation to photosynthesis.

A limiting factor is an environmental factor, which in short supply /scarcity limits the rate of photosynthesis. [2]

(b) Investigations were carried out in Florida, USA, into the effect of different concentrations of atmospheric carbon dioxide and of light intensity on the rate of photosynthesis of soybean plants.

Plants were grown from seed in outdoor, computer-controlled growth chambers at different concentrations of carbon dioxide. The upper parts of the chambers were transparent so that the plants received natural sunlight.

After the seedlings emerged, the air in the soil was separated from the air around the leaves by a gas-tight seal in each chamber.

Suggest why the air in the soil and the air around the leaves of the plants were separated.

They have different concentrations of CO_2 so they are separated to avoid confusion and make it clear on which concentration has caused the rate of photosynthesis. [2]

(c) In one investigation, two sets of plants, **A** and **B**, were grown from seed at different concentrations of carbon dioxide:

- **A** – normal atmospheric concentration of carbon dioxide (0.033%)
- **B** – normal atmospheric concentration of carbon dioxide ×2 (0.000%).

Then, keeping each set of plants in its particular concentration of carbon dioxide, measurements were made of their rates of photosynthesis at different light intensities.

The results are shown in Fig. 2.1 on page 5.

Your Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

2(d)

Q2	Mark scheme
(a)	at lowest value / in shortest supply ; **I** insufficient supply / not enough (the) one factor of several that affects rate ; **A** one factor of several prevents increase in rate **[2]**
(b)	to keep out unwanted CO_2 (in air around leaves) ; **A** to stop CO_2 increasing / entering (upper chamber) *ref. to* respiration of soil organisms ; **A** respiration of bacteria / fungi / seeds *ref. to* respiration of plant roots ; **[max 2]**
(c)(i)	***I** ref. to set **B** throughout **I** time references* *at low(er) light intensity / light intensity up to a figure in range 6 – 7 au* **1** <u>rate</u> increases as light intensity increases ; **2** light intensity is (main) limiting factor ; *mp1 and mp 2 need to be in correct context* *at high light intensity / light intensity above a figure in range 6 – 7 au* **3** rate, levels off / reaches plateau / remains constant ; **A** rate unaffected (by light intensity) **4** another (named) factor / not light intensity, is limiting ; **A** CO_2 concentration / temperature *mp3 and mp4 need to be in correct context* **[max 3]**
(c)(ii)	more CO_2 available in **B** / less CO_2 in **A** ; **A** CO_2 concentration in **B** is double that of **A** *ref. to* fixation / Calvin cycle / light independent reactions ; **A** description, e.g. CO_2 combines with RuBP <u>CO_2 concentration</u> is limiting factor in set **A** ; **A** CO_2 concentration is limiting at a higher light intensity in **B** **[max 2]**
(d)	*accept ora throughout* **1** **D**, adapted to high CO_2 / can use more CO_2 (per unit leaf area) ; **A** plants in D have, adjusted / accommodated, to high CO_2 **2** **D** have more, chloroplasts / chlorophyll ; **3** **D** have more, rubisco / RuBP ; **4** **D** have more stomata ; **5** **D** have thinner leaves ; **6** AVP ; e.g. ref. to <u>diffusion</u> of CO_2 **[max 4]** **[Total: 13]**

EXAMINER COMMENTS

MARK SCHEME

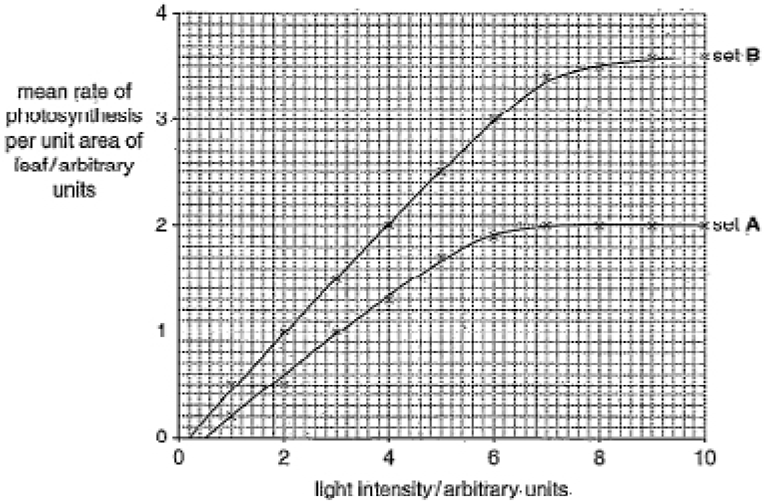

Fig. 2.1

With reference to Fig. 2.1:

(i) describe and explain, in terms of limiting factors, the results from the plants in set **A**

At low light intensity, CO_2 concentration is not the limiting factor, light intensity is. So as light intensity increases, the rate of photosynthesis also increases. Then, when light intensity is 7 arbitrary units, a plateau is reached. No matter how much light intensity increases, the rate of photosynthesis remains constant. This is due to light intensity not being the limiting factor any more, CO_2 is probably limiting now! [3]

(ii) explain the difference between the results of set **A** and set **B** at high light intensities.

At high light intensities, set B has a higher rate of photosynthesis because the concentration of CO_2 is higher (twice as much), so it takes longer for CO_2 concentrations to be limiting in set B.

Your Mark

2(a) ☐

2(b) ☐

2(c)(i) ☐

2(c)(ii) ☐

2(d) ☐

Q2	Mark scheme
(a)	at lowest value / in shortest supply ; **I** insufficient supply / not enough (the) one factor of several that affects rate ; **A** one factor of several prevents increase in rate **[2]**
(b)	to keep out unwanted CO_2 (in air around leaves) ; **A** to stop CO_2 increasing / entering (upper chamber) *ref. to* respiration of soil organisms ; **A** respiration of bacteria / fungi / seeds *ref. to* respiration of plant roots ; **[max 2]**
(c)(i)	***I** ref. to set **B** throughout **I** time references* *at low(er) light intensity / light intensity up to a figure in range 6 – 7 au* **1** rate increases as light intensity increases ; **2** light intensity is (main) limiting factor ; *mp1 and mp 2 need to be in correct context* *at high light intensity / light intensity above a figure in range 6 – 7 au* **3** rate, levels off / reaches plateau / remains constant ; **A** rate unaffected (by light intensity) **4** another (named) factor / not light intensity, is limiting ; **A** CO_2 concentration / temperature *mp3 and mp4 need to be in correct context* **[max 3]**
(c)(ii)	more CO_2 available in **B** / less CO_2 in **A** ; **A** CO_2 concentration in **B** is double that of **A** *ref. to* fixation / Calvin cycle / light independent reactions ; **A** description, e.g. CO_2 combines with RuBP CO_2 concentration is limiting factor in set **A** ; **A** CO_2 concentration is limiting at a higher light intensity in **B** **[max 2]**
(d)	*accept ora throughout* **1** **D**, adapted to high CO_2 / can use more CO_2 (per unit leaf area) ; **A** plants in D have, adjusted / accommodated, to high CO_2 **2** **D** have more, chloroplasts / chlorophyll ; **3** **D** have more, rubisco / RuBP ; **4** **D** have more stomata ; **5** **D** have thinner leaves ; **6** AVP ; e.g. ref. to diffusion of CO_2 **[max 4]** **[Total: 13]**

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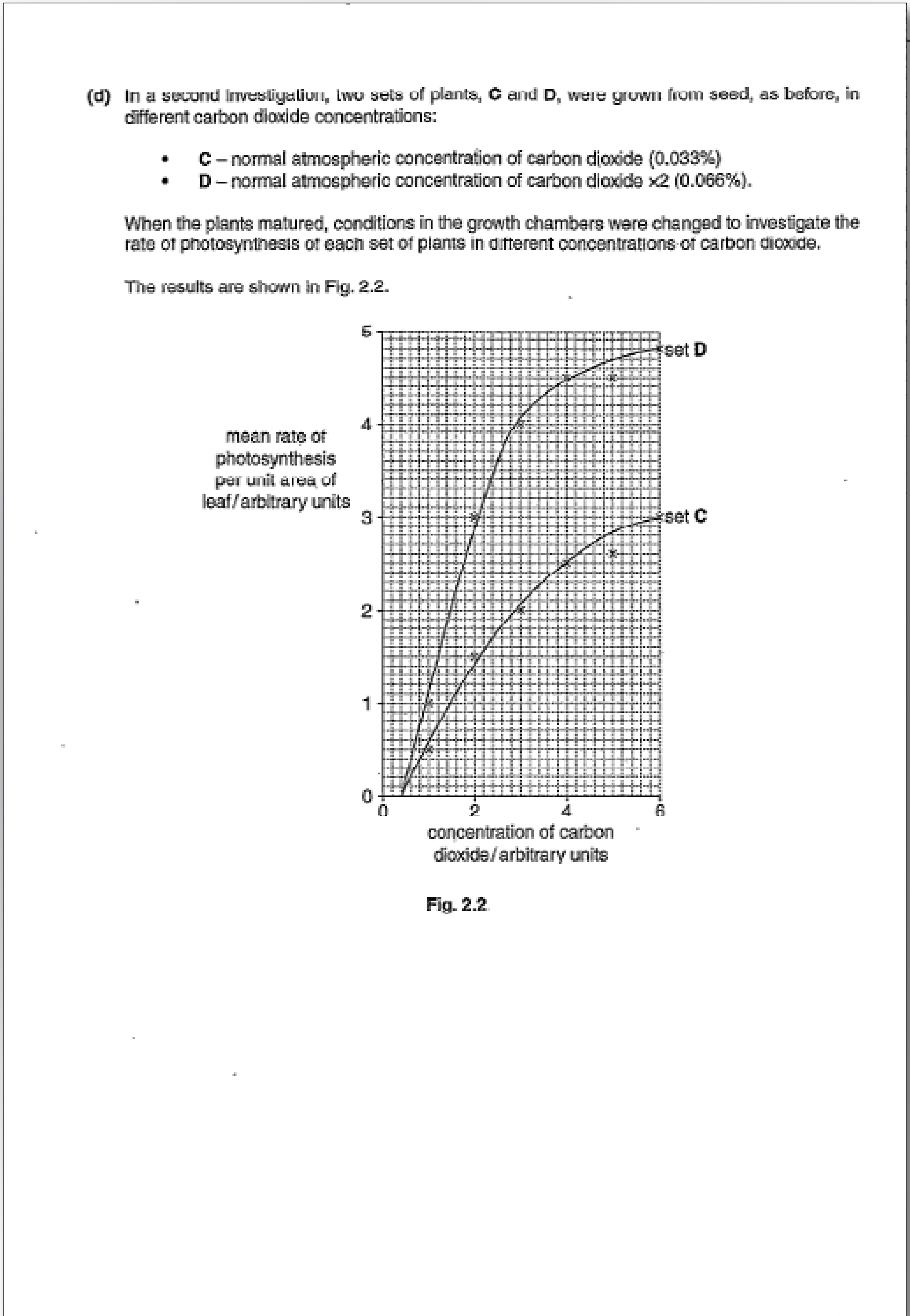
MIDDLE

LOW



(d) In a second investigation, two sets of plants, **C** and **D**, were grown from seed, as before, in different carbon dioxide concentrations:

- **C** – normal atmospheric concentration of carbon dioxide (0.033%)
- **D** – normal atmospheric concentration of carbon dioxide x2 (0.066%).

When the plants matured, conditions in the growth chambers were changed to investigate the rate of photosynthesis of each set of plants in different concentrations of carbon dioxide.

The results are shown in Fig. 2.2.

Fig. 2.2

Your Mark

2(a) ☐

2(b) ☐

2(c)(i) ☐

2(c)(ii) ☐

2(d) ☐

Q2	Mark scheme
(a)	at lowest value / in shortest supply ; **I** insufficient supply / not enough (the) one factor of several that affects rate ; **A** one factor of several prevents increase in rate **[2]**
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(c)(i)	***I** ref. to set **B** throughout **I** time references* *at low(er) light intensity / light intensity up to a figure in range 6 – 7 au* **1** <u>rate</u> increases as light intensity increases ; **2** light intensity is (main) limiting factor ; *mp1 and mp 2 need to be in correct context* *at high light intensity / light intensity above a figure in range 6 – 7 au* **3** rate, levels off / reaches plateau / remains constant ; **A** rate unaffected (by light intensity) **4** another (named) factor / not light intensity, is limiting ; **A** CO_2 concentration / temperature *mp3 and mp4 need to be in correct context* **[max 3]**
(c)(ii)	more CO_2 available in **B** / less CO_2 in **A** ; **A** CO_2 concentration in **B** is double that of **A** *ref. to* fixation / Calvin cycle / light independent reactions ; **A** description, e.g. CO_2 combines with RuBP <u>CO_2 concentration</u> is limiting factor in set **A** ; **A** CO_2 concentration is limiting at a higher light intensity in **B** **[max 2]**
(d)	*accept ora throughout* **1** **D**, adapted to high CO_2 / can use more CO_2 (per unit leaf area) ; **A** plants in D have, adjusted / accommodated, to high CO_2 **2** **D** have more, chloroplasts / chlorophyll ; **3** **D** have more, rubisco / RuBP ; **4** **D** have more stomata ; **5** **D** have thinner leaves ; **6** AVP ; e.g. ref. to <u>diffusion</u> of CO_2 **[max 4]** **[Total: 13]**

EXAMINER COMMENTS

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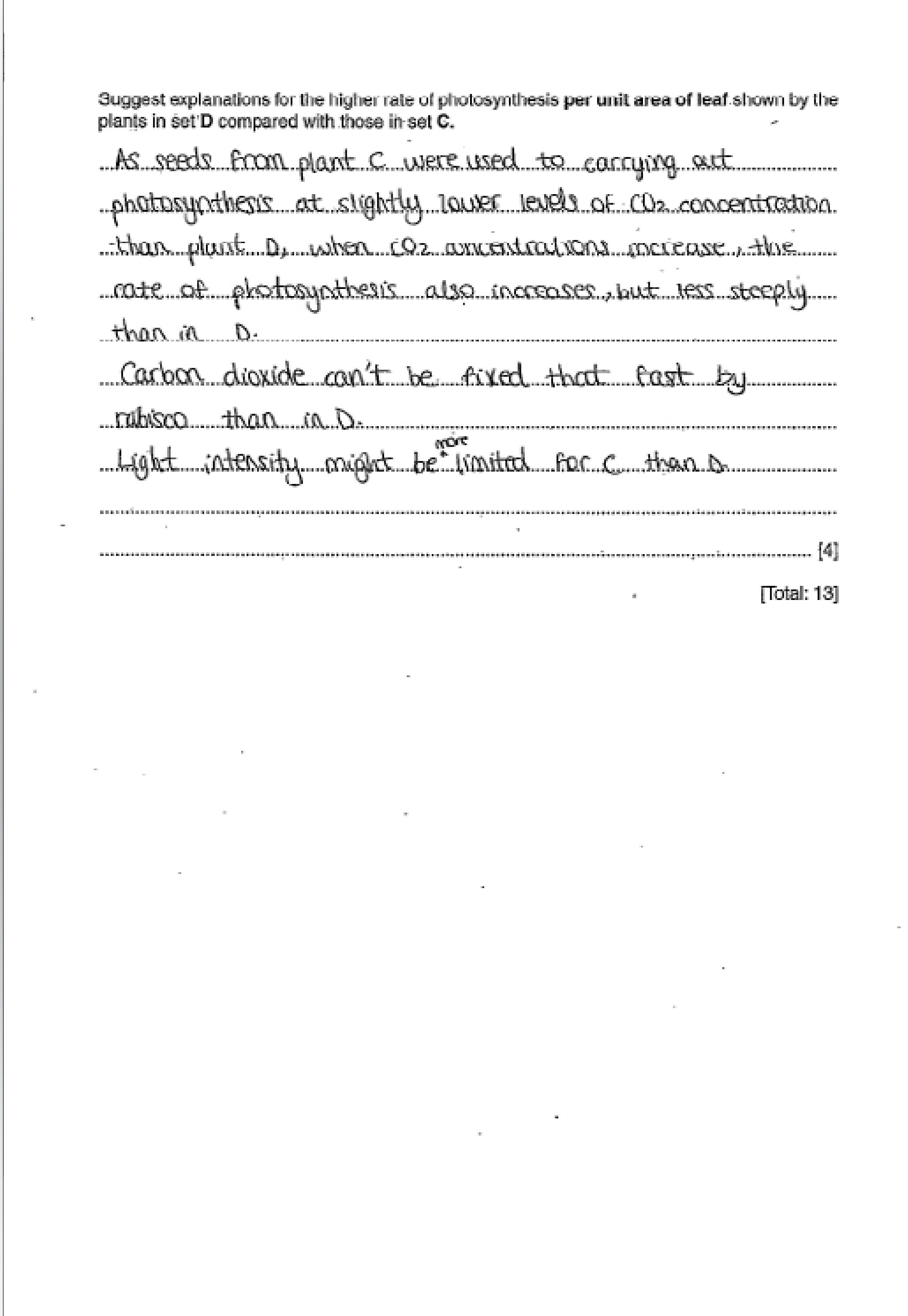

Suggest explanations for the higher rate of photosynthesis per unit area of leaf shown by the plants in set D compared with those in set C.

As seeds from plant C were used to carrying out photosynthesis at slightly lower levels of CO_2 concentration than plant D, when CO_2 concentrations increase, the rate of photosynthesis also increases, but less steeply than in D.

Carbon dioxide can't be fixed that fast by rubisco than in D.

Light intensity might be more limited for C than D.

[4]

[Total: 13]

Your Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

2(d)

Q2	**Mark scheme**
(a)	at lowest value / in shortest supply ; **I** insufficient supply / not enough (the) one factor of several that affects rate ; **A** one factor of several prevents increase in rate **[2]**
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(c)(i)	*I ref. to set **B** throughout I time references* *at low(er) light intensity / light intensity up to a figure in range 6 – 7 au* **1** <u>rate</u> increases as light intensity increases ; **2** light intensity is (main) limiting factor ; *mp1 and mp 2 need to be in correct context* *at high light intensity / light intensity above a figure in range 6 – 7 au* **3** rate, levels off / reaches plateau / remains constant ; **A** rate unaffected (by light intensity) **4** another (named) factor / not light intensity, is limiting ; **A** CO_2 concentration / temperature *mp3 and mp4 need to be in correct context* **[max 3]**
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EXAMINER COMMENTS

MARK SCHEME

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Interactive Example Candidate Responses
Paper 4 (May/June 2016), Question 3
Cambridge International AS & A Level
Biology 9700

Version 1.0

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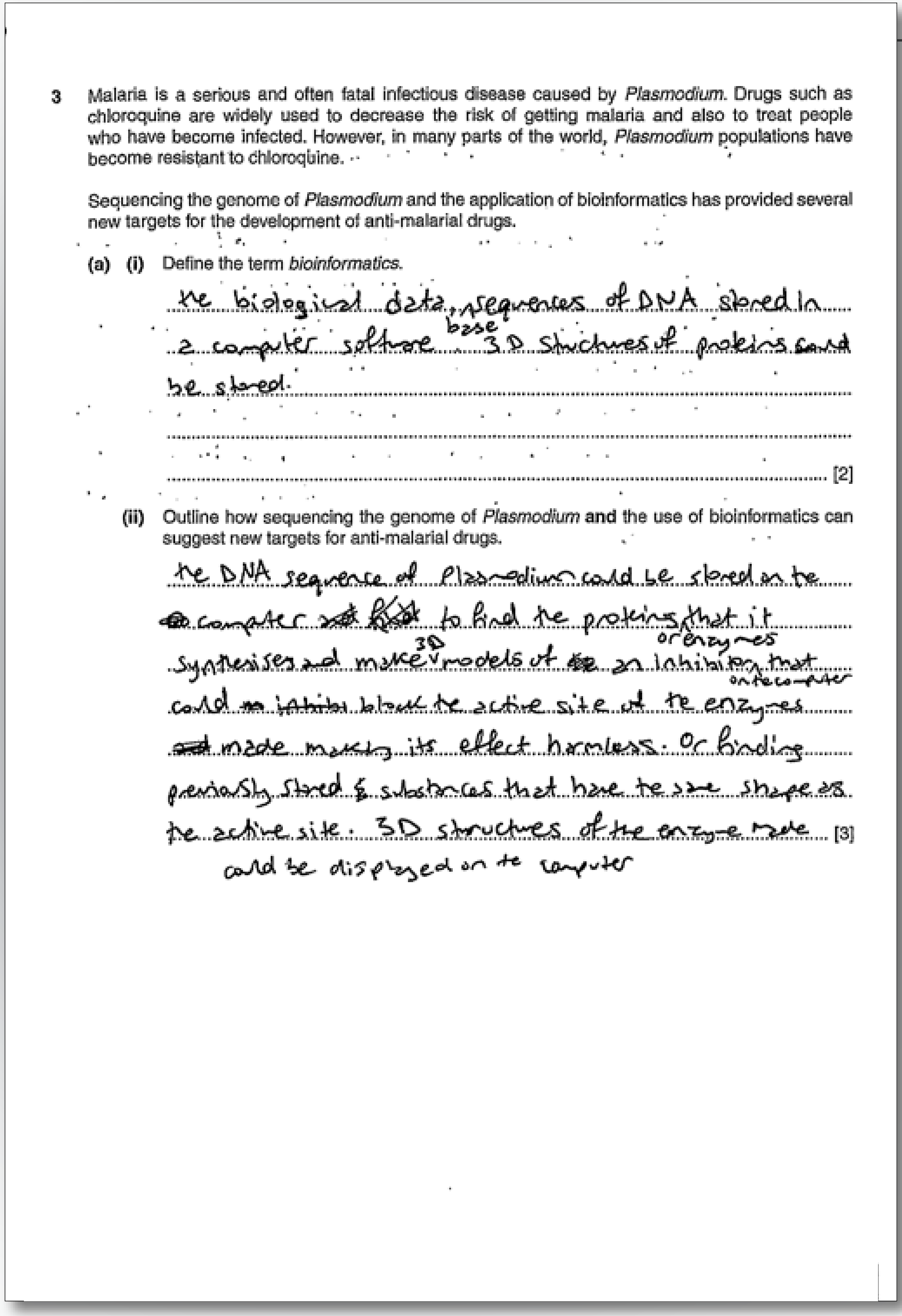

3 Malaria is a serious and often fatal infectious disease caused by *Plasmodium*. Drugs such as chloroquine are widely used to decrease the risk of getting malaria and also to treat people who have become infected. However, in many parts of the world, *Plasmodium* populations have become resistant to chloroquine.

Sequencing the genome of *Plasmodium* and the application of bioinformatics has provided several new targets for the development of anti-malarial drugs.

(a) (i) Define the term *bioinformatics*.

the biological data, sequences of DNA stored in a computer software base 3D structures of proteins ~~and~~ can be stored.

[2]

(ii) Outline how sequencing the genome of *Plasmodium* and the use of bioinformatics can suggest new targets for anti-malarial drugs.

the DNA sequence of Plasmodium could be stored on the computer ~~and~~ ~~[illegible]~~ to find the proteins or enzymes that it synthesises and make 3D models of ~~the~~ an inhibitor on the computer that could ~~inhibit~~ block the active site of the enzymes ~~and~~ made making its effect harmless. Or finding previously stored substances that have the same shape as the active site. 3D structures of the enzyme made [3]
could be displayed on the computer

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b)(i) ☐

3(b)(ii) ☐

Q3	Mark scheme
(a)(i)	<u>database</u>(s) ; computer (programs) / software ; analysis of, data / biological information / sequences ; **A** compare, genes / genomes **[max 1]**
(a)(ii)	**1** identify / recognise, gene(s) ; **A** find where genes are **2** predict, primary structure / amino acid sequences, of proteins ; **3** predict 3D structure of proteins ; **A** tertiary **4** identify / predict, functions of proteins (from 3D structure) ; **5** ref. to drug to, bind with / block activity of / disrupt structure of, protein / enzyme ; **A** drug specific to protein I denature, protein / enzyme **6** drug prevents, transcription / expression, (of gene) ; I gene editing **[max 3]**
(b)(i)	cheaper ; **A** more economic(al) faster / can try many different drugs in a short period of time ; **A** time-saving can try out changes to, model / drug structure, to see if more effective ; no need for, laboratories / equipment ; **I** uses less labour (initially) no need for tests on, animals / humans ; **A** fewer ethical issues **[max 3]**
(b)(ii)	functionality / to test that drug, actually works / is effective ; **A** cannot assume predictions are correct I efficiency safety ; **A** *ref. to* clinical trials / side effects dosage ; **A** theoretical modelling will not give information on doses **[max 2]** **[Total: 10]**

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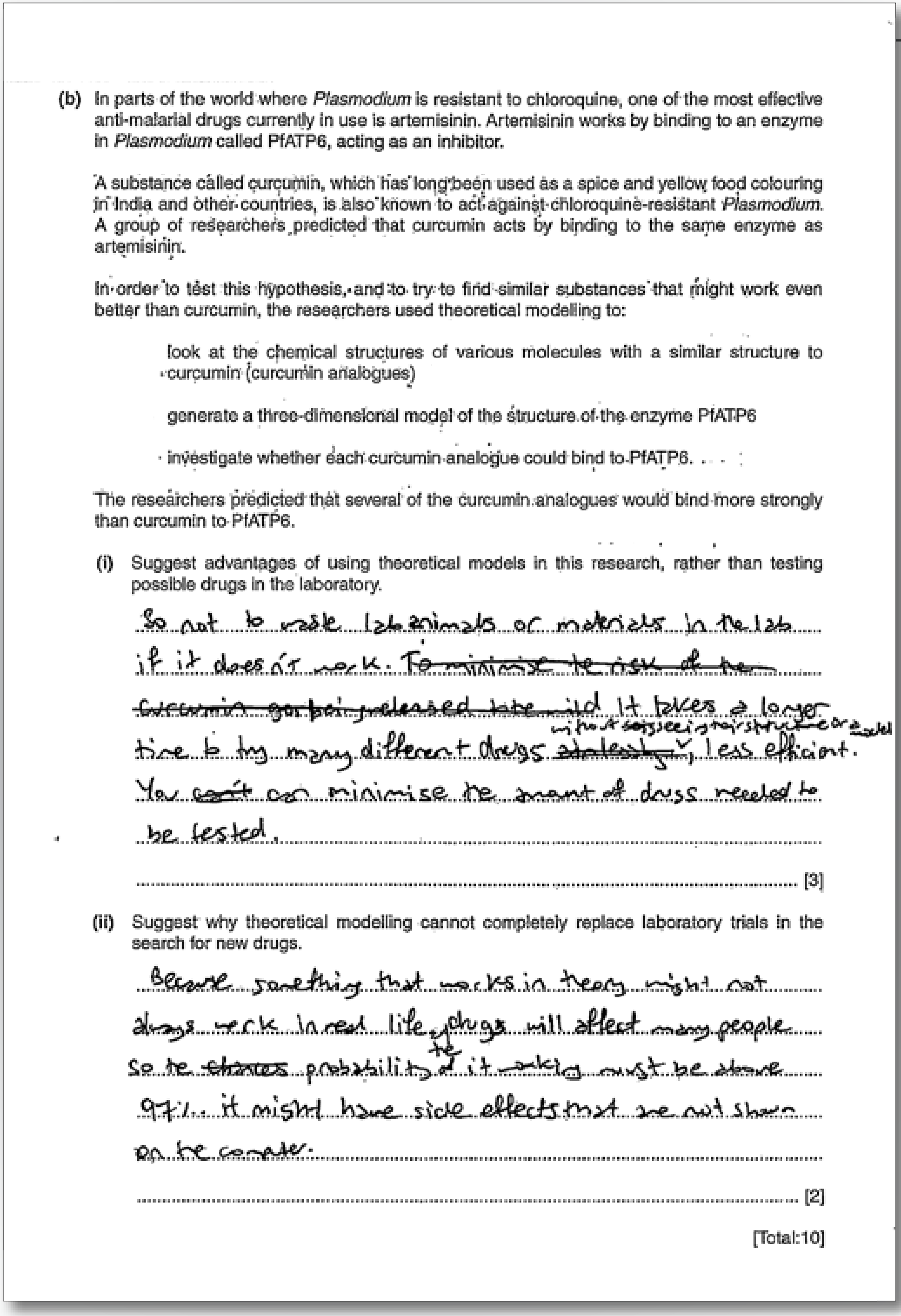

(b) In parts of the world where *Plasmodium* is resistant to chloroquine, one of the most effective anti-malarial drugs currently in use is artemisinin. Artemisinin works by binding to an enzyme in *Plasmodium* called PfATP6, acting as an inhibitor.

A substance called curcumin, which has long been used as a spice and yellow food colouring in India and other countries, is also known to act against chloroquine-resistant *Plasmodium*. A group of researchers predicted that curcumin acts by binding to the same enzyme as artemisinin.

In order to test this hypothesis, and to try to find similar substances that might work even better than curcumin, the researchers used theoretical modelling to:

- look at the chemical structures of various molecules with a similar structure to curcumin (curcumin analogues)
- generate a three-dimensional model of the structure of the enzyme PfATP6
- investigate whether each curcumin analogue could bind to PfATP6.

The researchers predicted that several of the curcumin analogues would bind more strongly than curcumin to PfATP6.

(i) Suggest advantages of using theoretical models in this research, rather than testing possible drugs in the laboratory.

So not to waste lab animals or materials in the lab if it doesn't work. ~~To minimise the risk of the curcumin go bei released into wild~~ It takes a longer time to try many different drugs ~~stateles~~ without seeing their structure or model, less efficient. You ~~can't~~ can minimise the amount of drugs needed to be tested.

[3]

(ii) Suggest why theoretical modelling cannot completely replace laboratory trials in the search for new drugs.

Because something that works in theory might not always work in real life, the drugs will affect many people so the ~~chances~~ probability of it working must be above 97%. it might have side effects that are not shown on the computer.

[2]

[Total:10]

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b)(i) ☐

3(b)(ii) ☐

Q3	Mark scheme
(a)(i)	database(s) ; computer (programs) / software ; analysis of, data / biological information / sequences ; **A** compare, genes / genomes **[max 1]**
(a)(ii)	**1** identify / recognise, gene(s) ; **A** find where genes are **2** predict, primary structure / amino acid sequences, of proteins ; **3** predict 3D structure of proteins ; **A** tertiary **4** identify / predict, functions of proteins (from 3D structure) ; **5** ref. to drug to, bind with / block activity of / disrupt structure of, protein / enzyme ; **A** drug specific to protein I denature, protein / enzyme **6** drug prevents, transcription / expression, (of gene) ; I gene editing **[max 3]**
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EXAMINER COMMENTS

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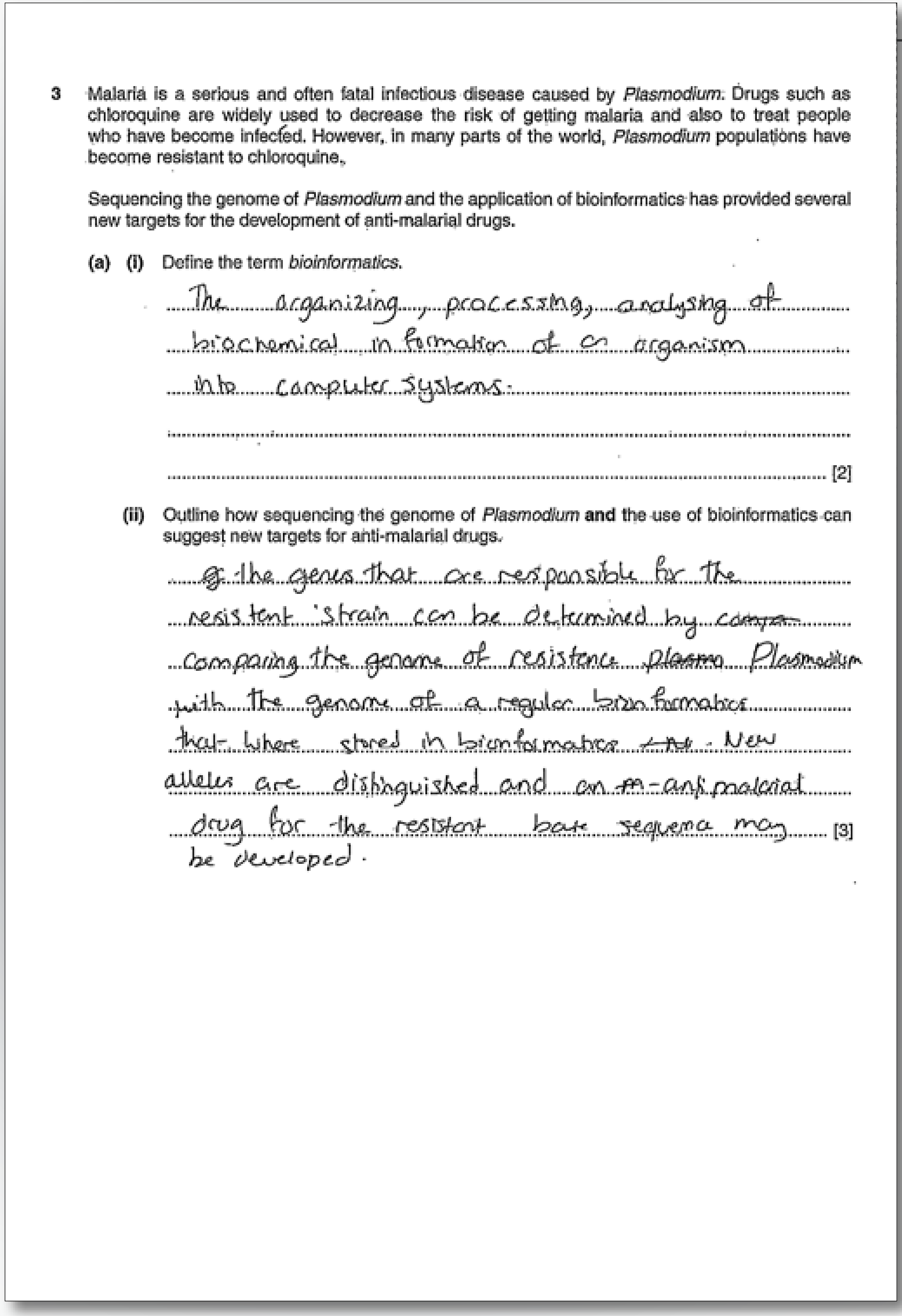

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Sequencing the genome of *Plasmodium* and the application of bioinformatics has provided several new targets for the development of anti-malarial drugs.

(a) (i) Define the term *bioinformatics*.

The organizing, processing, analysing of biochemical in formation of an organism into computer systems.

[2]

(ii) Outline how sequencing the genome of *Plasmodium* **and** the use of bioinformatics can suggest new targets for anti-malarial drugs.

~~g~~ the genes that are responsible for the resistent 'strain can be determined by ~~compa~~ comparing the genome of resistence ~~plasma~~ Plasmodium with the genome of a regular bioinformatics that where stored in bioinformatics ~~the~~. New alleles are distinguished and an ~~m~~-anti malarial drug for the resistant base sequence may be developed. [3]

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b)(i) ☐

3(b)(ii) ☐

Q3	**Mark scheme**
(a)(i)	database(s) ; computer (programs) / software ; analysis of, data / biological information / sequences ; **A** compare, genes / genomes **[max 1]**
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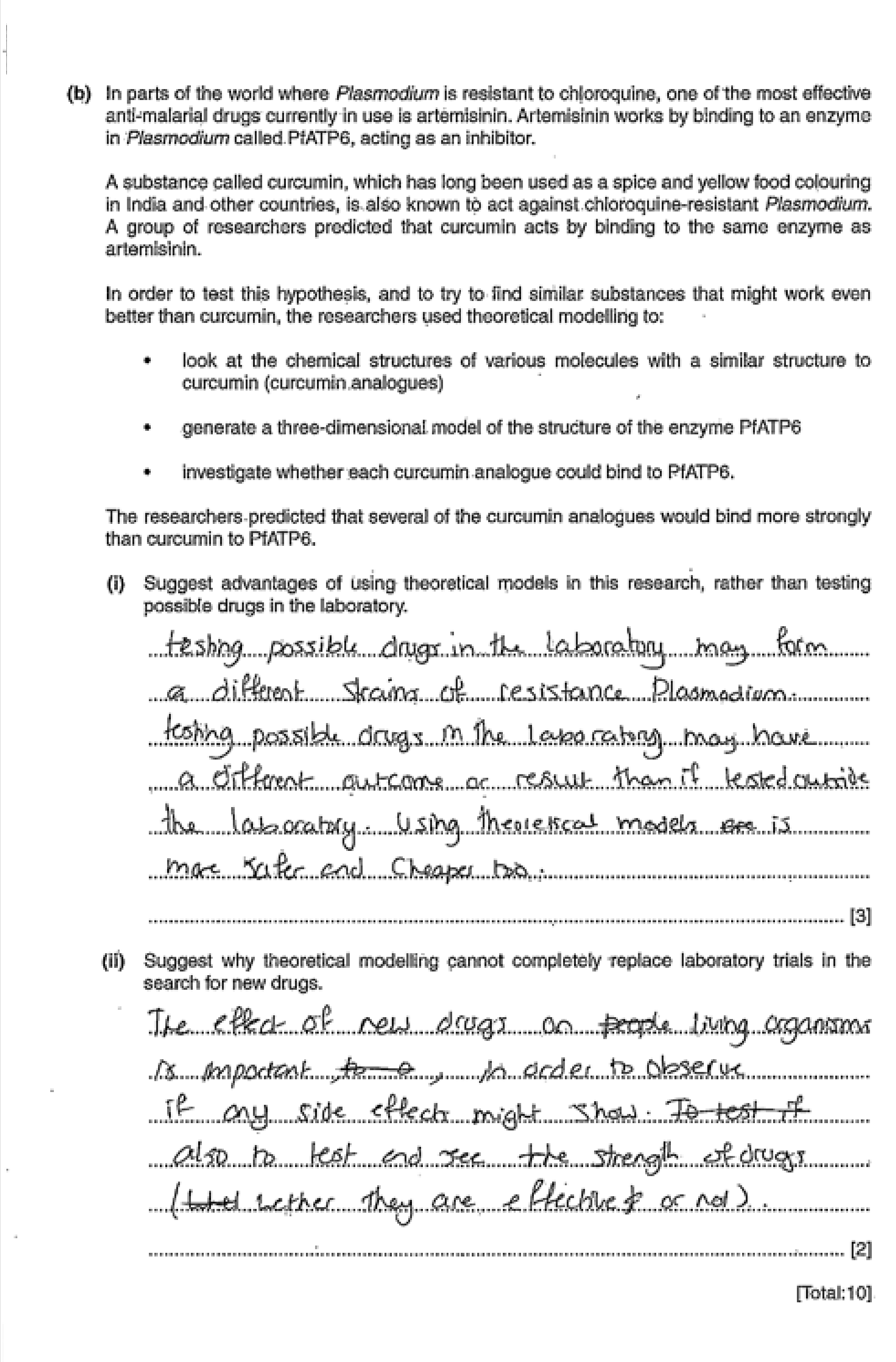

(b) In parts of the world where *Plasmodium* is resistant to chloroquine, one of the most effective anti-malarial drugs currently in use is artemisinin. Artemisinin works by binding to an enzyme in *Plasmodium* called PfATP6, acting as an inhibitor.

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The researchers predicted that several of the curcumin analogues would bind more strongly than curcumin to PfATP6.

(i) Suggest advantages of using theoretical models in this research, rather than testing possible drugs in the laboratory.

testing possible drugs in the laboratory may form a different Strains of resistance Plasmodium. testing possible drugs in the laboratory may have a different outcome or result than if tested outside the laboratory. Using theoretical models ~~are~~ is more safer and Cheaper too.

[3]

(ii) Suggest why theoretical modelling cannot completely replace laboratory trials in the search for new drugs.

The effect of new drugs on ~~people~~ living organisms is important ~~to e~~, in order to observe if any side effects might show. ~~To test if~~ also to test and see the strength of drugs (~~to test~~ wether they are effective ~~s~~ or not).

[2]

[Total:10]

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Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b)(i) ☐

3(b)(ii) ☐

Q3	Mark scheme
(a)(i)	<u>database</u>(s) ; computer (programs) / software ; analysis of, data / biological information / sequences ; **A** compare, genes / genomes **[max 1]**
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EXAMINER COMMENTS

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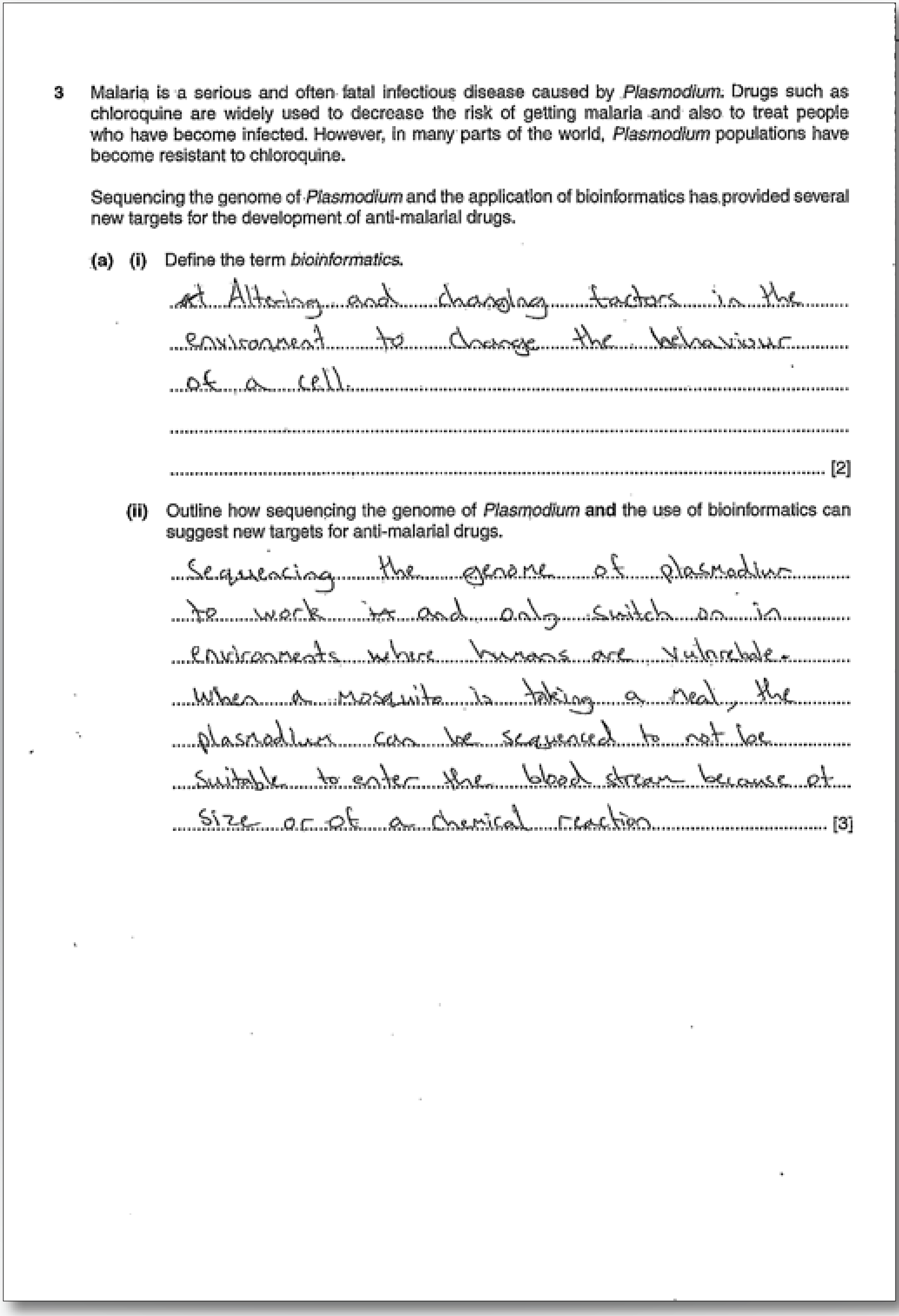

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Sequencing the genome of *Plasmodium* and the application of bioinformatics has provided several new targets for the development of anti-malarial drugs.

(a) (i) Define the term *bioinformatics*.

~~at~~ Altering and changing factors in the environment to change the behaviour of a cell. [2]

(ii) Outline how sequencing the genome of *Plasmodium* **and** the use of bioinformatics can suggest new targets for anti-malarial drugs.

Sequencing the genome of plasmodium to work ~~in~~ and only switch on in environments where humans are vulnerable. When a mosquito is taking a meal, the plasmodium can be sequenced to not be suitable to enter the blood stream because of size or of a chemical reaction [3]

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b)(i) ☐

3(b)(ii) ☐

Q3	**Mark scheme**
(a)(i)	<u>database</u>(s) ; computer (programs) / software ; analysis of, data / biological information / sequences ; **A** compare, genes / genomes **[max 1]**
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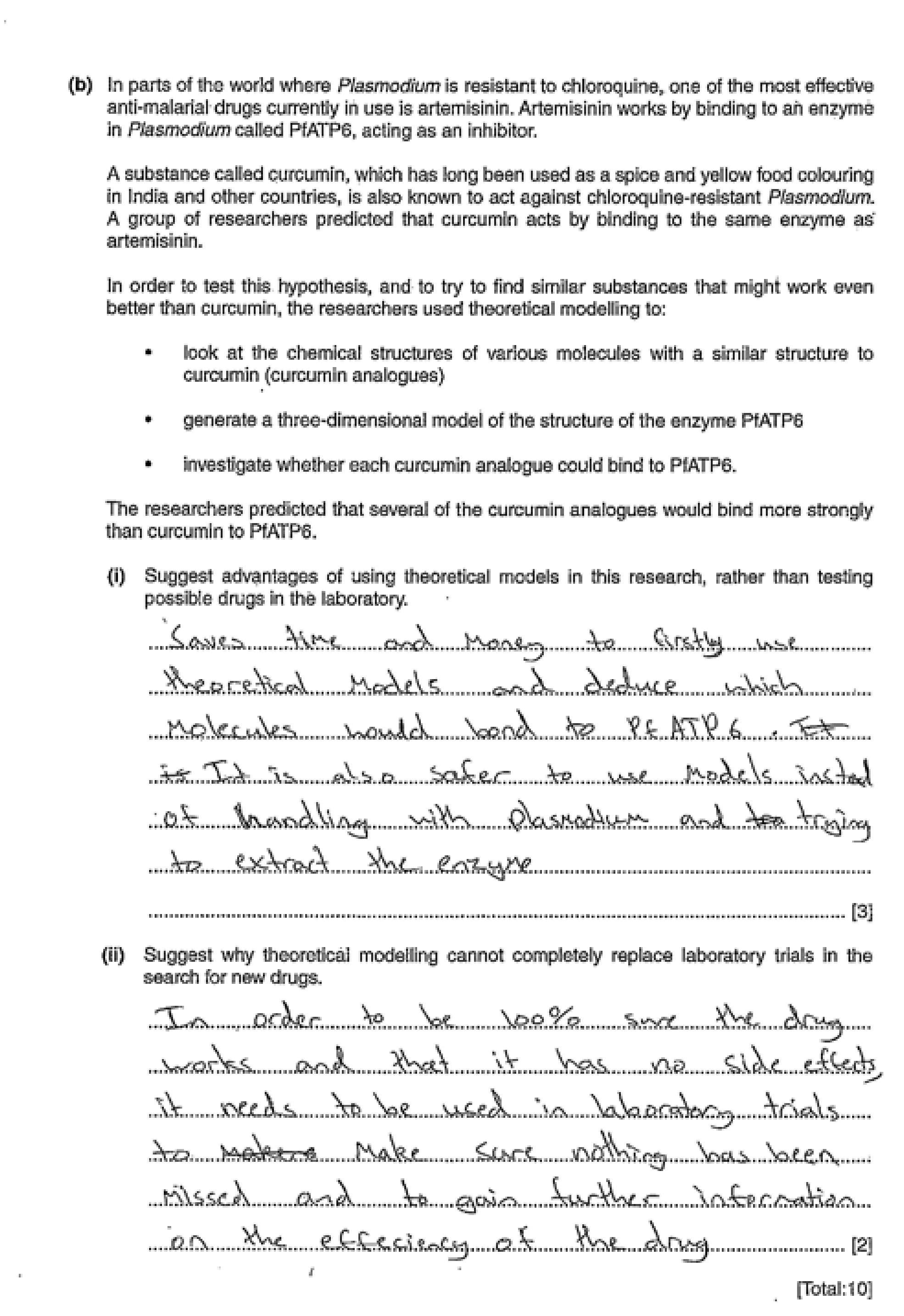
EXAMINER COMMENTS

MARK SCHEME



(b) In parts of the world where *Plasmodium* is resistant to chloroquine, one of the most effective anti-malarial drugs currently in use is artemisinin. Artemisinin works by binding to an enzyme in *Plasmodium* called PfATP6, acting as an inhibitor.

A substance called curcumin, which has long been used as a spice and yellow food colouring in India and other countries, is also known to act against chloroquine-resistant *Plasmodium*. A group of researchers predicted that curcumin acts by binding to the same enzyme as artemisinin.

In order to test this hypothesis, and to try to find similar substances that might work even better than curcumin, the researchers used theoretical modelling to:

- look at the chemical structures of various molecules with a similar structure to curcumin (curcumin analogues)
- generate a three-dimensional model of the structure of the enzyme PfATP6
- investigate whether each curcumin analogue could bind to PfATP6.

The researchers predicted that several of the curcumin analogues would bind more strongly than curcumin to PfATP6.

(i) Suggest advantages of using theoretical models in this research, rather than testing possible drugs in the laboratory.

Saves time and money to firstly use theoretical models and deduce which molecules would bond to PfATP6. ~~It~~ ~~is~~ It is also safer to use models instead of handling with Plasmodium and ~~ten~~ trying to extract the enzyme

[3]

(ii) Suggest why theoretical modelling cannot completely replace laboratory trials in the search for new drugs.

In order to be 100% sure the drug works and that it has no side effects, it needs to be used in laboratory trials to ~~makere~~ make sure nothing has been missed and to gain further information on the efficiency of the drug [2]

[Total:10]

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MIDDLE

LOW

Your Mark

3(a)(i) ☐

3(a)(ii) ☐

3(b)(i) ☐

3(b)(ii) ☐

Q3	Mark scheme
(a)(i)	database(s) ; computer (programs) / software ; analysis of, data / biological information / sequences ; **A** compare, genes / genomes **[max 1]**
(a)(ii)	**1** identify / recognise, gene(s) ; **A** find where genes are **2** predict, primary structure / amino acid sequences, of proteins ; **3** predict 3D structure of proteins ; **A** tertiary **4** identify / predict, functions of proteins (from 3D structure) ; **5** ref. to drug to, bind with / block activity of / disrupt structure of, protein / enzyme ; **A** drug specific to protein I denature, protein / enzyme **6** drug prevents, transcription / expression, (of gene) ; I gene editing **[max 3]**
(b)(i)	cheaper ; **A** more economic(al) faster / can try many different drugs in a short period of time ; **A** time-saving can try out changes to, model / drug structure, to see if more effective ; no need for, laboratories / equipment ; **I** uses less labour (initially) no need for tests on, animals / humans ; **A** fewer ethical issues **[max 3]**
(b)(ii)	functionality / to test that drug, actually works / is effective ; **A** cannot assume predictions are correct I efficiency safety ; **A** *ref. to* clinical trials / side effects dosage ; **A** theoretical modelling will not give information on doses **[max 2]** **[Total: 10]**

EXAMINER COMMENTS

MARK SCHEME

Cambridge Assessment International Education
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e: info@cambridgeinternational.org www.cambridgeinternational.org

Cambridge Assessment
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Interactive

Interactive Example Candidate Responses
Paper 4 (May/June 2016), Question 4
Cambridge International AS & A Level
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Version 1.0

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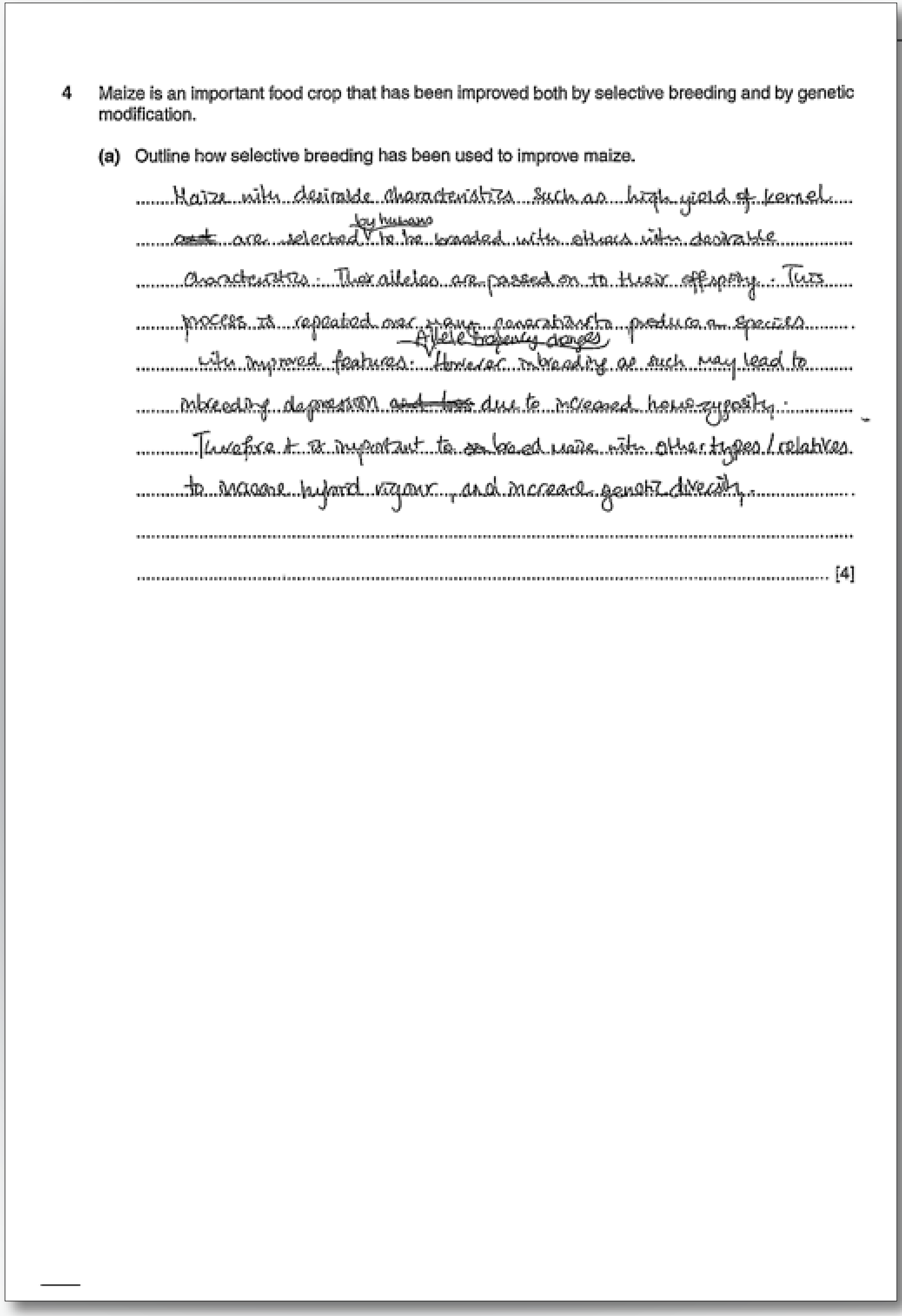

4 Maize is an important food crop that has been improved both by selective breeding and by genetic modification.

(a) Outline how selective breeding has been used to improve maize.

Maize with desirable characteristics such as high yield of kernel ~~and~~ are selected by humans to be breeded with others with desirable characteristics. Their alleles are passed on to their offspring. This process is repeated over many generations to produce a species with improved features. Allele frequency changes. However inbreeding as such may lead to inbreeding depression ~~and loss~~ due to increased homozygosity. Therefore it is important to ~~en~~ breed maize with other types / relatives to increase hybrid vigour, and increase genetic diversity.

[4]

Your Mark

4(a) ☐

4(b) ☐

4(c)(i) ☐

4(c)(ii) ☐

Q4	Mark scheme
(a)	**1** best / desirable, plants crossed ; **A** cross-pollinated **R** cross with other (maize) species **2** repeatedly / every generation ; **3** detail of cross-pollination ; e.g. ref. to male tassels and female silks **4** example of desirable characteristic ; **A** more kernels / big kernels / high yield / *ref. to* kernel colour / fast-growing / cold-tolerant **5** hybridisation / two inbred (named) lines crossed / F1 hybrids formed ; **A** description, e.g. cross two, homozygous parents / parents from two purebred lines **6** gives more, vigorous / uniform, plants ; **A** heterosis **7** *ref. to* dwarf maize / mutant alleles for gibberellin (synthesis) ; **[max 4]**
(b)	**1** discontinuous ; *max 2 for mp2–6* **2** one gene / single locus / monogenic, inheritance ; **A** monohybrid **3** two alleles ; **4** dominant and recessive ; **5** 1:1 ratio purple to yellow ; **A** 50% purple, 50% yellow **6** test cross / Aa × aa ; **[max 3]**
(c)(i)	**1** as, Bt crops / area, increases the number of resistant, pests / species, increases ; **A** the more (the area of) Bt crops grown, the more (the) resistant species **2** figures quote ; (2 years, area with units once) **3** figures quote ; (2 years, no. resistant pest species) **4** mutation(s) (in pest species) ; **5** chance / random / spontaneous (mutations) ; **6** pests evolve resistance / natural selection for resistant pests ; **7** AVP ; e.g. plateau in resistance, 2002–2005 / 2009–2011 first 6 years / 1996–2001, no resistant species **[max 4]**
(c)(ii)	*social* increased yield / more food / cheaper food / AW ; *environmental* decreased insecticide use / few hazards to humans / Bt only targets pest species ; **A** no / less pesticide used R herbicide **[2]** **[Total: 13]**

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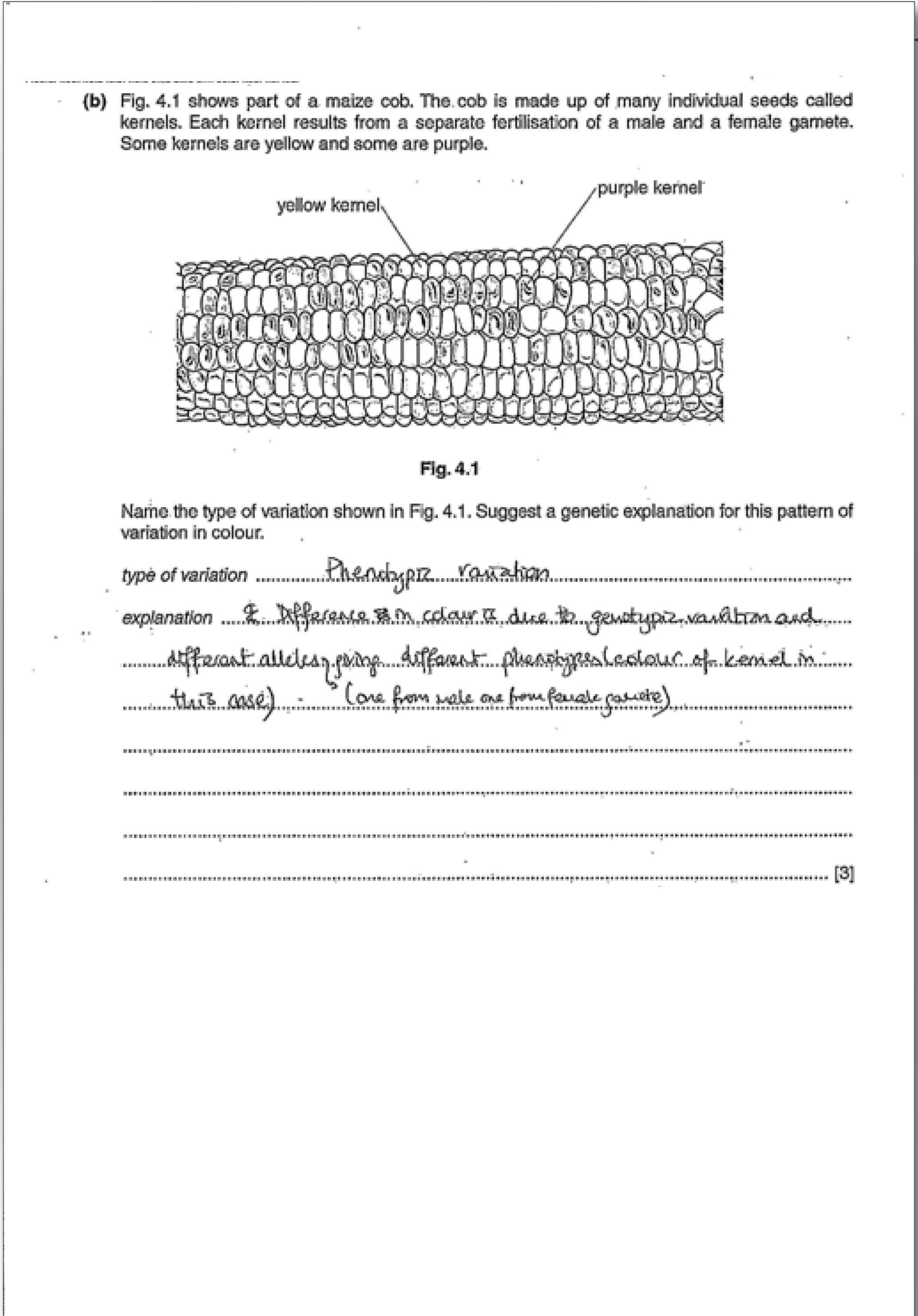

(b) Fig. 4.1 shows part of a maize cob. The cob is made up of many individual seeds called kernels. Each kernel results from a separate fertilisation of a male and a female gamete. Some kernels are yellow and some are purple.

Fig. 4.1

Name the type of variation shown in Fig. 4.1. Suggest a genetic explanation for this pattern of variation in colour.

type of variation Phenotypic variation

explanation Difference in colour is due to genotypic variation and different alleles (one from male one from female gamete) giving different phenotypes (colour of kernel in this case)

[3]

Your Mark

4(a)

4(b)

4(c)(i)

4(c)(ii)

Q4	Mark scheme
(a)	**1** best / desirable, plants crossed ; **A** cross-pollinated **R** cross with other (maize) species **2** repeatedly / every generation ; **3** detail of cross-pollination ; e.g. ref. to male tassels and female silks **4** example of desirable characteristic ; **A** more kernels / big kernels / high yield / *ref. to* kernel colour / fast-growing / cold-tolerant **5** hybridisation / two inbred (named) lines crossed / F1 hybrids formed ; **A** description, e.g. cross two, homozygous parents / parents from two purebred lines **6** gives more, vigorous / uniform, plants ; **A** heterosis **7** *ref. to* dwarf maize / mutant alleles for gibberellin (synthesis) ; **[max 4]**
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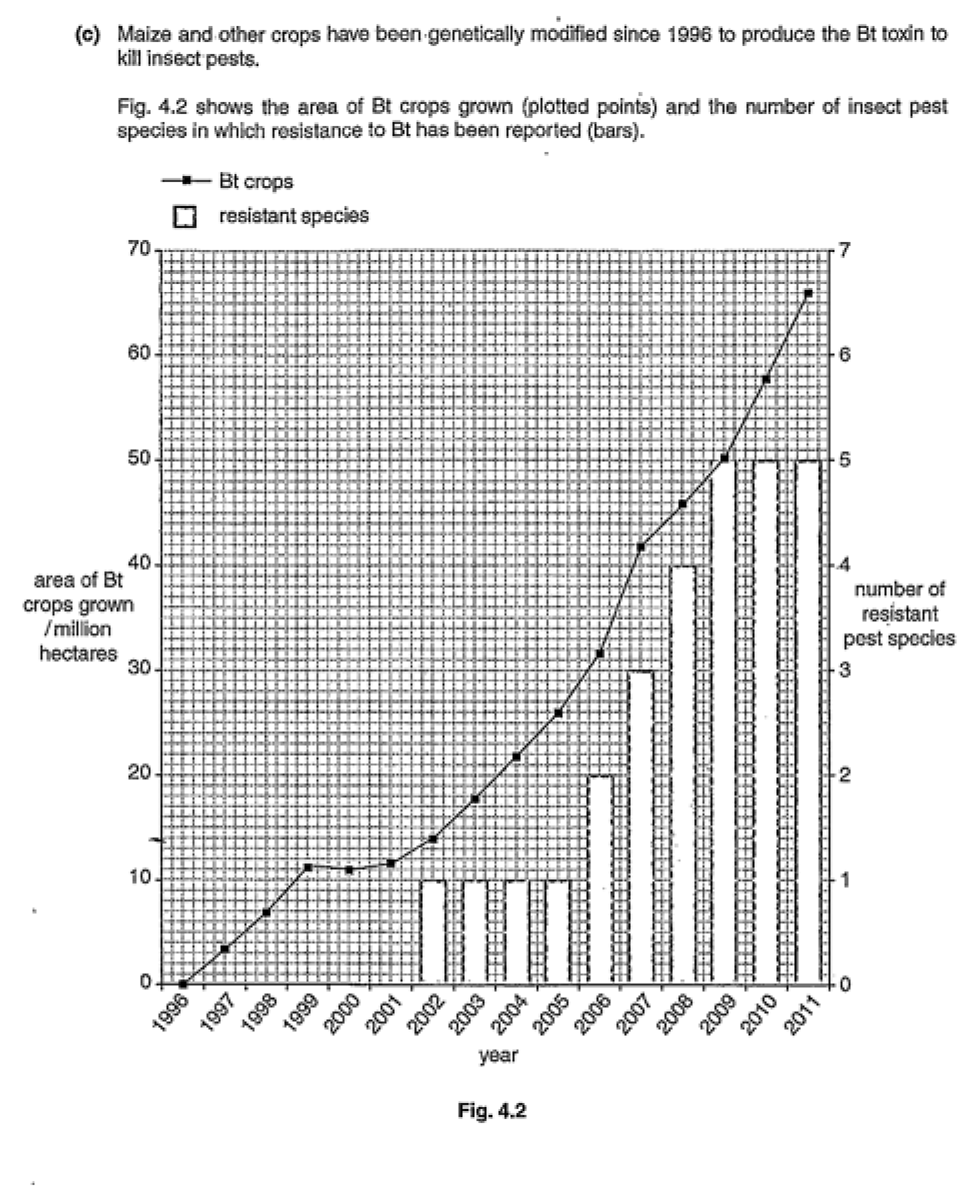

(c) Maize and other crops have been genetically modified since 1996 to produce the Bt toxin to kill insect pests.

Fig. 4.2 shows the area of Bt crops grown (plotted points) and the number of insect pest species in which resistance to Bt has been reported (bars).

Fig. 4.2

Your Mark

4(a) ☐

4(b) ☐

4(c)(i) ☐

4(c)(ii) ☐

Q4	Mark scheme
(a)	**1** best / desirable, plants crossed ; **A** cross-pollinated **R** cross with other (maize) species **2** repeatedly / every generation ; **3** detail of cross-pollination ; e.g. ref. to male tassels and female silks **4** example of desirable characteristic ; **A** more kernels / big kernels / high yield / *ref. to* kernel colour / fast-growing / cold-tolerant **5** hybridisation / two inbred (named) lines crossed / F1 hybrids formed ; **A** description, e.g. cross two, homozygous parents / parents from two purebred lines **6** gives more, vigorous / uniform, plants ; **A** heterosis **7** *ref. to* dwarf maize / mutant alleles for gibberellin (synthesis) ; **[max 4]**
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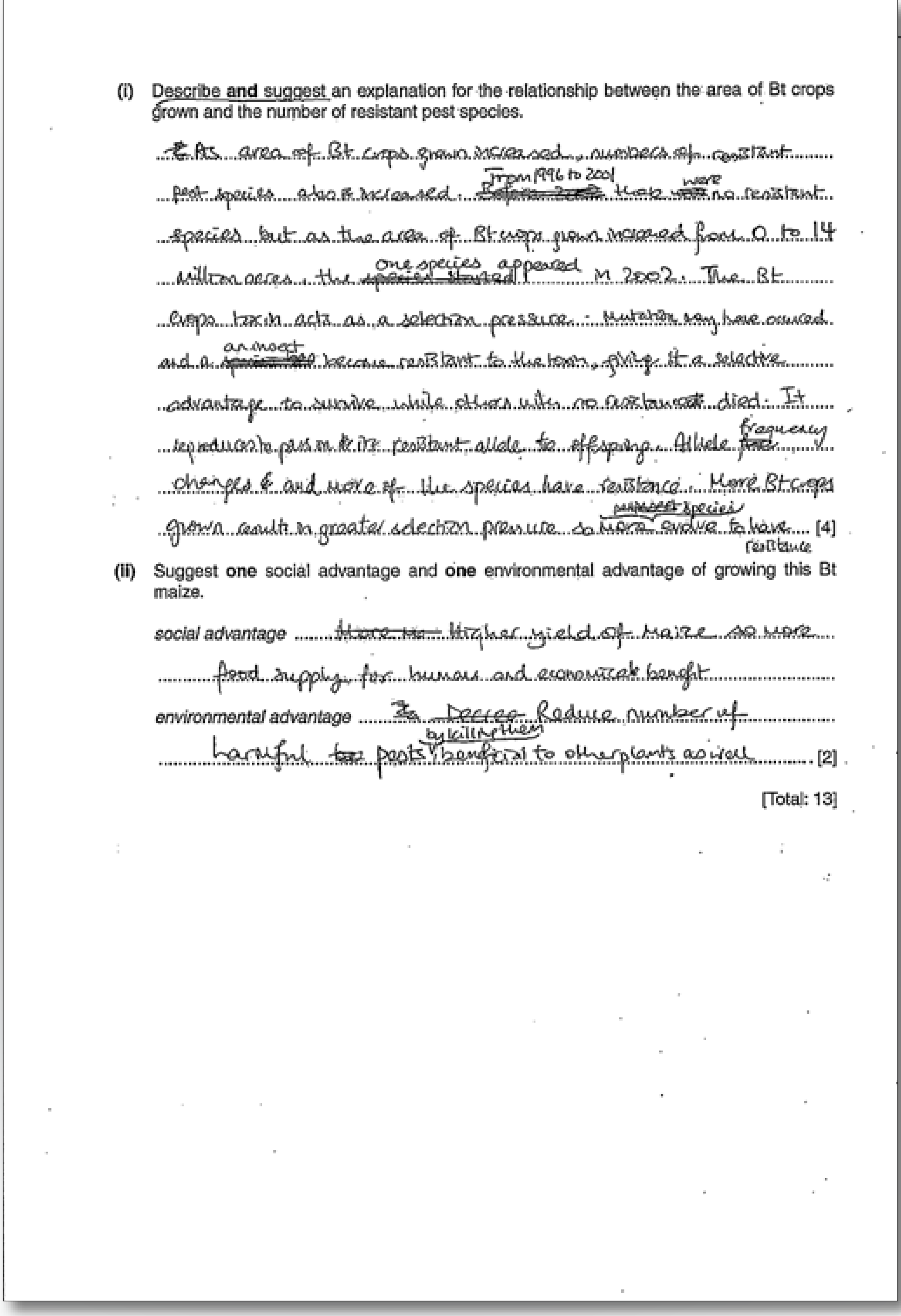

(i) Describe and suggest an explanation for the relationship between the area of Bt crops grown and the number of resistant pest species.

~~E~~ As area of Bt crops grown increased, numbers of resistant pest species also ~~B~~ increased. ~~Before 2002~~ From 1996 to 2001 there ~~was~~ were no resistant species but as the area of Bt crops grown increased from 0 to 14 million acres, the ~~species started~~ one species appeared in 2002. The Bt crops toxin acts as a selection pressure. ∴ Mutation may have caused and a ~~species~~ an insect become resistant to the toxin, giving it a selective advantage to survive while others with no resistance ~~allele~~ died. It reproduce to pass on it its resistant allele to offspring. Allele ~~freq~~ frequency changes ~~&~~ and more of the species have resistance. More Bt crops grown result in greater selection pressure so ~~more~~ more species evolve to have resistance ..... [4]

(ii) Suggest **one** social advantage and **one** environmental advantage of growing this Bt maize.

social advantage ~~More m~~ Higher yield of maize so more food supply for humans and economical benefit

environmental advantage ~~To~~ ~~Decrea~~ Reduce number of harmful ~~to~~ pests by killing them beneficial to other plants as well ..... [2]

[Total: 13]

Your Mark

4(a) ☐

4(b) ☐

4(c)(i) ☐

4(c)(ii) ☐

Q4	Mark scheme
(a)	**1** best / desirable, plants crossed ; **A** cross-pollinated **R** cross with other (maize) species **2** repeatedly / every generation ; **3** detail of cross-pollination ; e.g. ref. to male tassels and female silks **4** example of desirable characteristic ; **A** more kernels / big kernels / high yield / *ref. to* kernel colour / fast-growing / cold-tolerant **5** hybridisation / two inbred (named) lines crossed / F1 hybrids formed ; **A** description, e.g. cross two, homozygous parents / parents from two purebred lines **6** gives more, vigorous / uniform, plants ; **A** heterosis **7** *ref. to* dwarf maize / mutant alleles for gibberellin (synthesis) ; **[max 4]**
(b)	**1** <u>discontinuous</u> ; *max 2 for mp2–6* **2** one gene / single locus / monogenic, inheritance ; **A** monohybrid **3** two alleles ; **4** dominant and recessive ; **5** 1:1 ratio purple to yellow ; **A** 50% purple, 50% yellow **6** test cross / Aa × aa ; **[max 3]**
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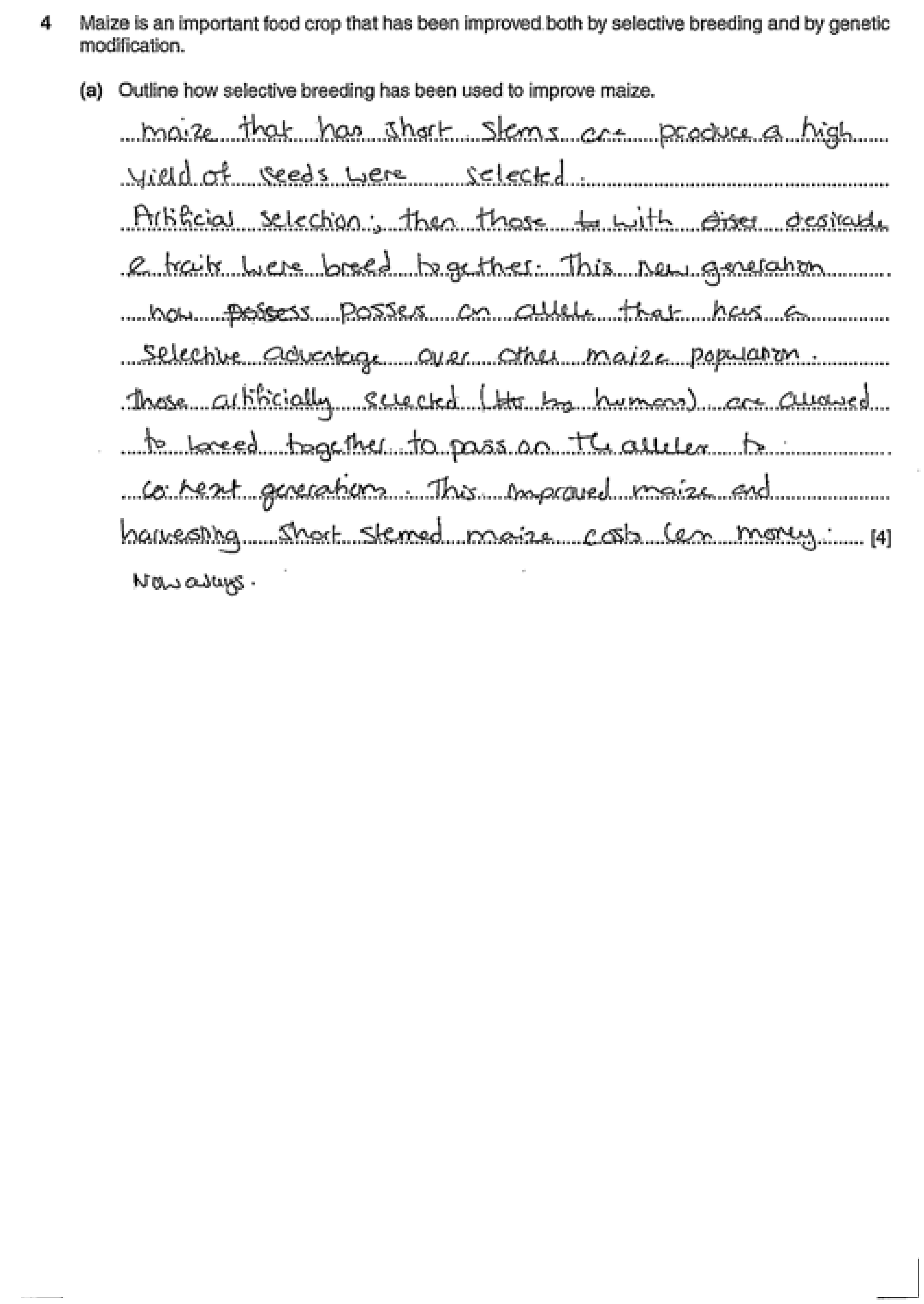

4 Maize is an important food crop that has been improved both by selective breeding and by genetic modification.

(a) Outline how selective breeding has been used to improve maize.

maize that has short stems are produce a high yield of seeds were selected.
Artificial selection; then those ~~to~~ with ~~either~~ desirable trait were breed together. This new generation now ~~possess~~ posses an allele that has a selective advantage over other maize population. Those artificially selected (~~ltte~~ by humans) are allowed to breed together to pass on the alleles to co: next generations. This improved maize and harvesting short stemed maize costs less money. [4]
Nowadays.

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Your Mark

4(a) ☐

4(b) ☐

4(c)(i) ☐

4(c)(ii) ☐

Q4	**Mark scheme**
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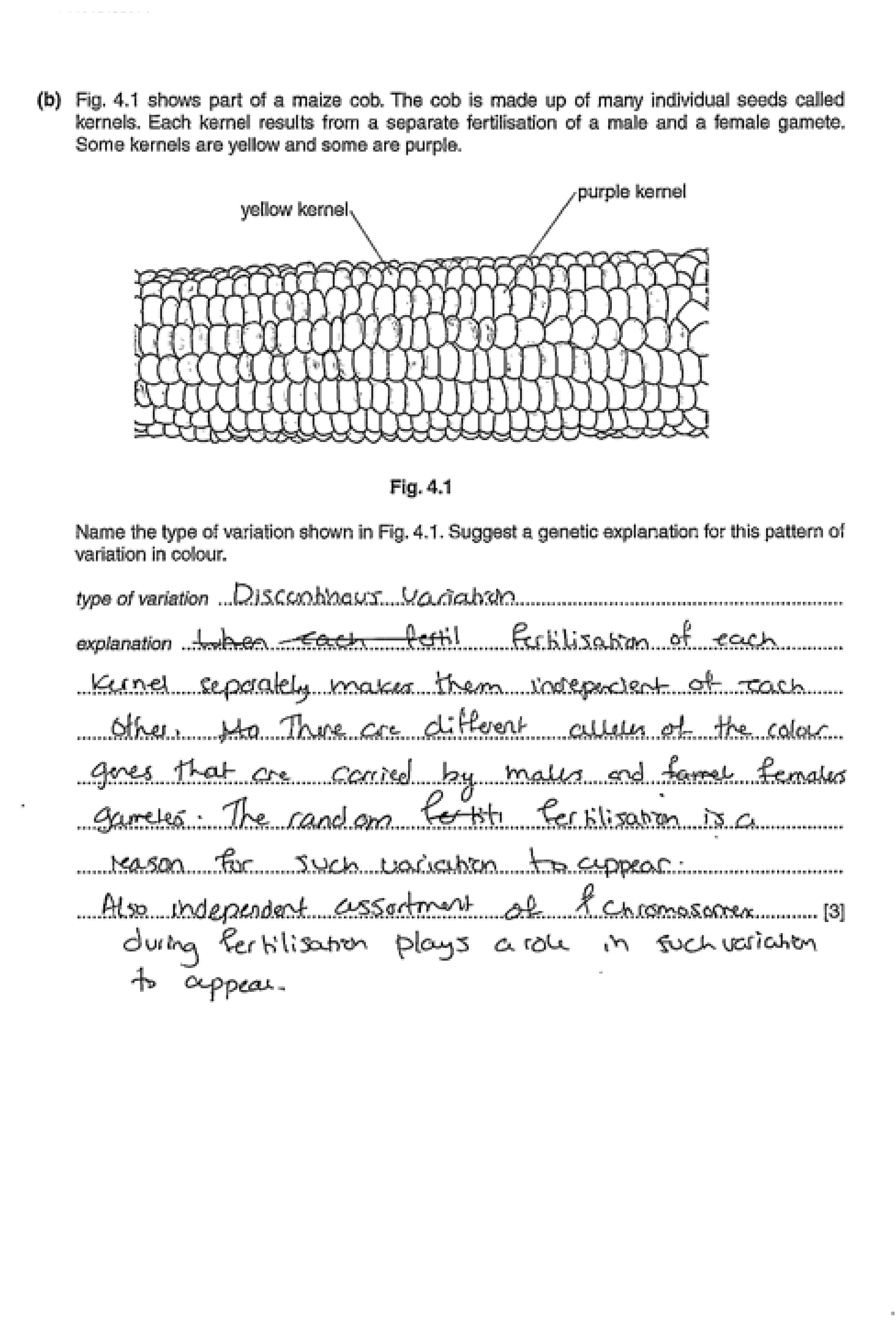

(b) Fig. 4.1 shows part of a maize cob. The cob is made up of many individual seeds called kernels. Each kernel results from a separate fertilisation of a male and a female gamete. Some kernels are yellow and some are purple.

Fig. 4.1

Name the type of variation shown in Fig. 4.1. Suggest a genetic explanation for this pattern of variation in colour.

type of variation Discontinous variation

explanation ~~when each fertil~~ fertilisation of each kernel separately makes them independent of each other. ~~Ha~~ There are different alleles of the colour genes that are carried by males and ~~famel~~ females gametes. The random ~~ferti~~ fertilisation is a reason for such variation to appear. Also independent assortment of ~~f~~ chromosomes during fertilisation plays a role in such variation to appear. [3]

Select page

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Your Mark

4(a) ☐

4(b) ☐

4(c)(i) ☐

4(c)(ii) ☐

Q4	Mark scheme
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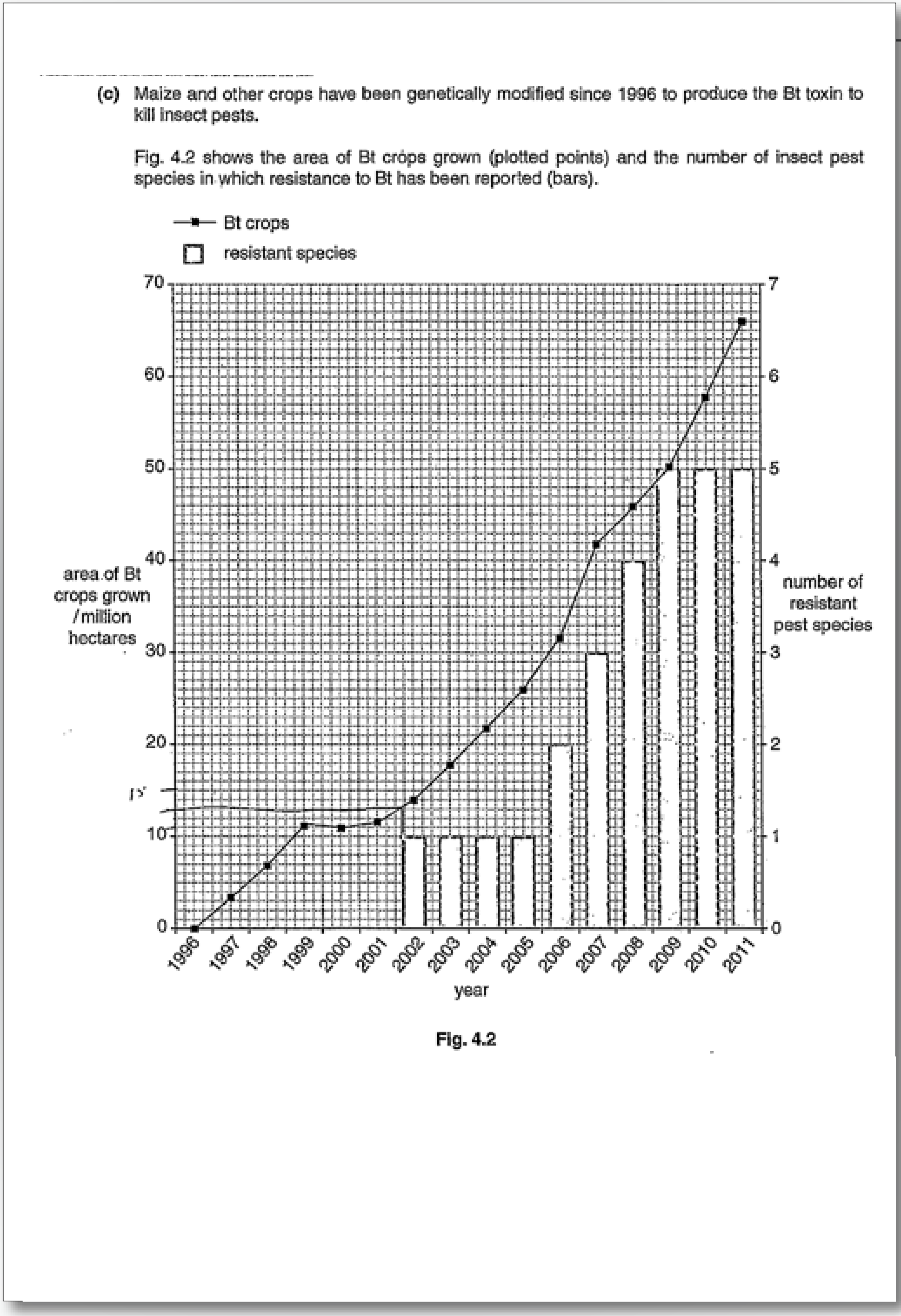

(c) Maize and other crops have been genetically modified since 1996 to produce the Bt toxin to kill insect pests.

Fig. 4.2 shows the area of Bt crops grown (plotted points) and the number of insect pest species in which resistance to Bt has been reported (bars).

Fig. 4.2

Your Mark

4(a) ☐

4(b) ☐

4(c)(i) ☐

4(c)(ii) ☐

Q4	Mark scheme
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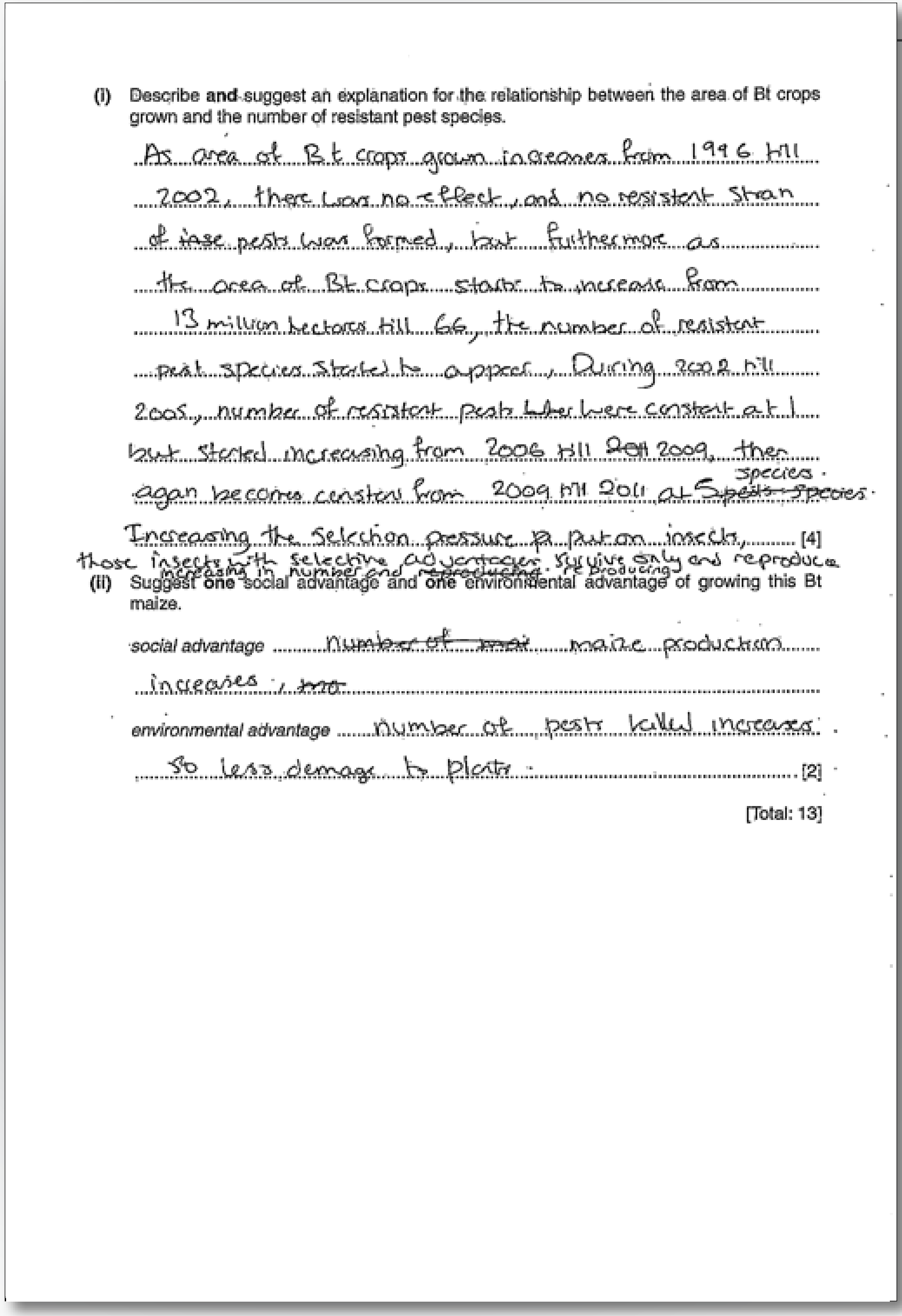

(i) Describe **and** suggest an explanation for the relationship between the area of Bt crops grown and the number of resistant pest species.

As area of Bt crops grown increases from 1996 till 2002, there was no effect, and no resistent stran of ~~iase~~ pests was formed, but futhermore as the area of Bt crops starts to increase from 13 million hectares till 66, the number of resistant pest species started to appear. During 2002 till 2005, number of resistent pests ~~wher~~ were constent at 1 but started increasing from 2006 till ~~2011~~ 2009, then again become constent from 2009 till 2011 at 5 ~~pests~~ ~~species~~ species.

Increasing the selection pressure ~~p~~ put on insects, those insects with selective advantages survive only and reproduce increasing in number and ~~reproducing~~. reproducing [4]

(ii) Suggest **one** social advantage and **one** environmental advantage of growing this Bt maize.

social advantage ~~number of mai~~ maize production increases ; ~~mo~~

environmental advantage number of pests killed increases so less demage to plants . [2]

[Total: 13]

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Your Mark

4(a)

4(b)

4(c)(i)

4(c)(ii)

Q4	Mark scheme
(a)	**1** best / desirable, plants crossed ; **A** cross-pollinated **R** cross with other (maize) species **2** repeatedly / every generation ; **3** detail of cross-pollination ; e.g. ref. to male tassels and female silks **4** example of desirable characteristic ; **A** more kernels / big kernels / high yield / *ref. to* kernel colour / fast-growing / cold-tolerant **5** hybridisation / two inbred (named) lines crossed / F1 hybrids formed ; **A** description, e.g. cross two, homozygous parents / parents from two purebred lines **6** gives more, vigorous / uniform, plants ; **A** heterosis **7** *ref. to* dwarf maize / mutant alleles for gibberellin (synthesis) ; **[max 4]**
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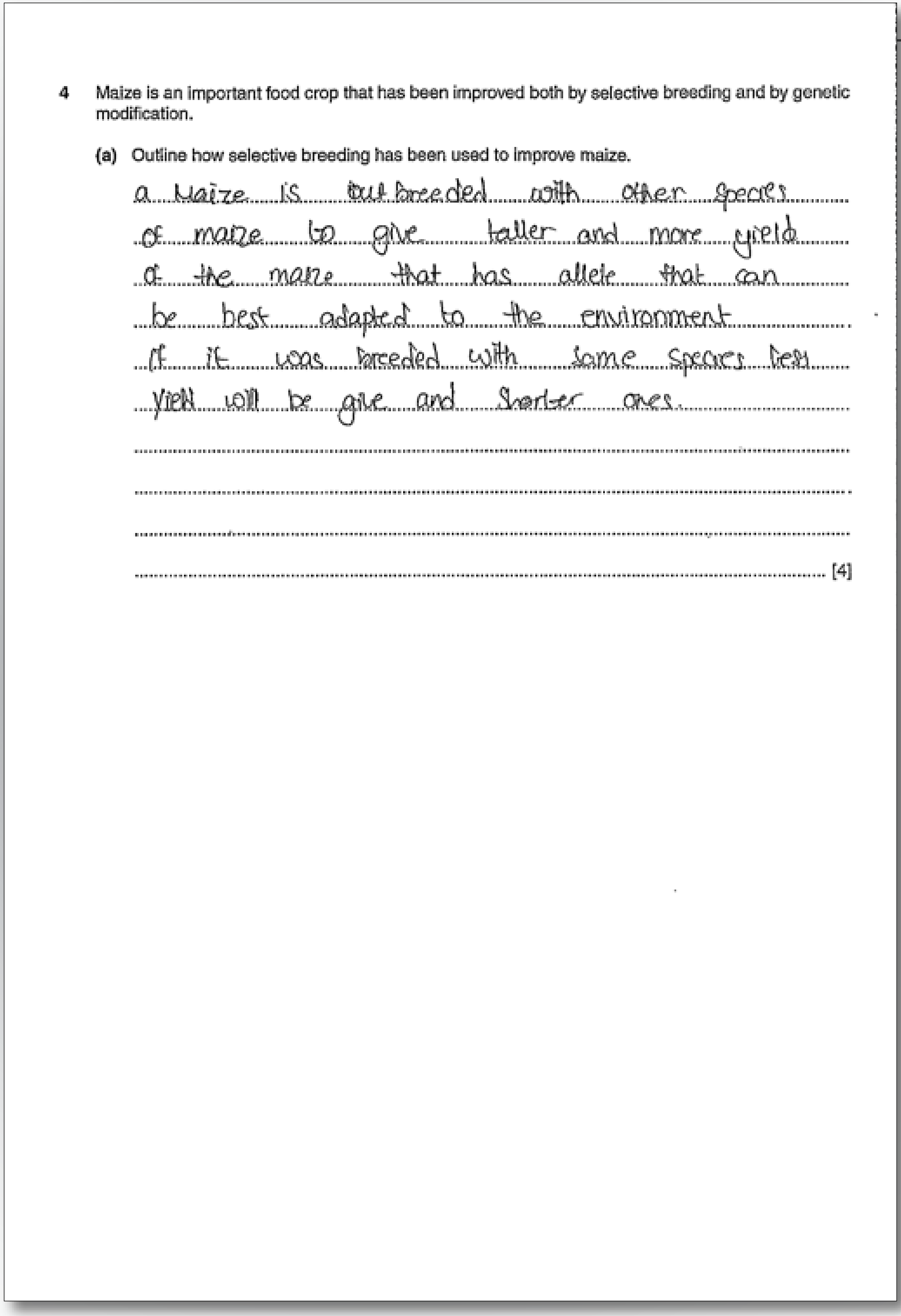
EXAMINER COMMENTS

MARK SCHEME



4 Maize is an important food crop that has been improved both by selective breeding and by genetic modification.

(a) Outline how selective breeding has been used to improve maize.

a Maize is out breeded with other species of maize to give taller and more yield of the maize that has allele that can be best adapted to the environment if it was breeded with same species less yield will be give and shorter ones.

[4]

Your Mark

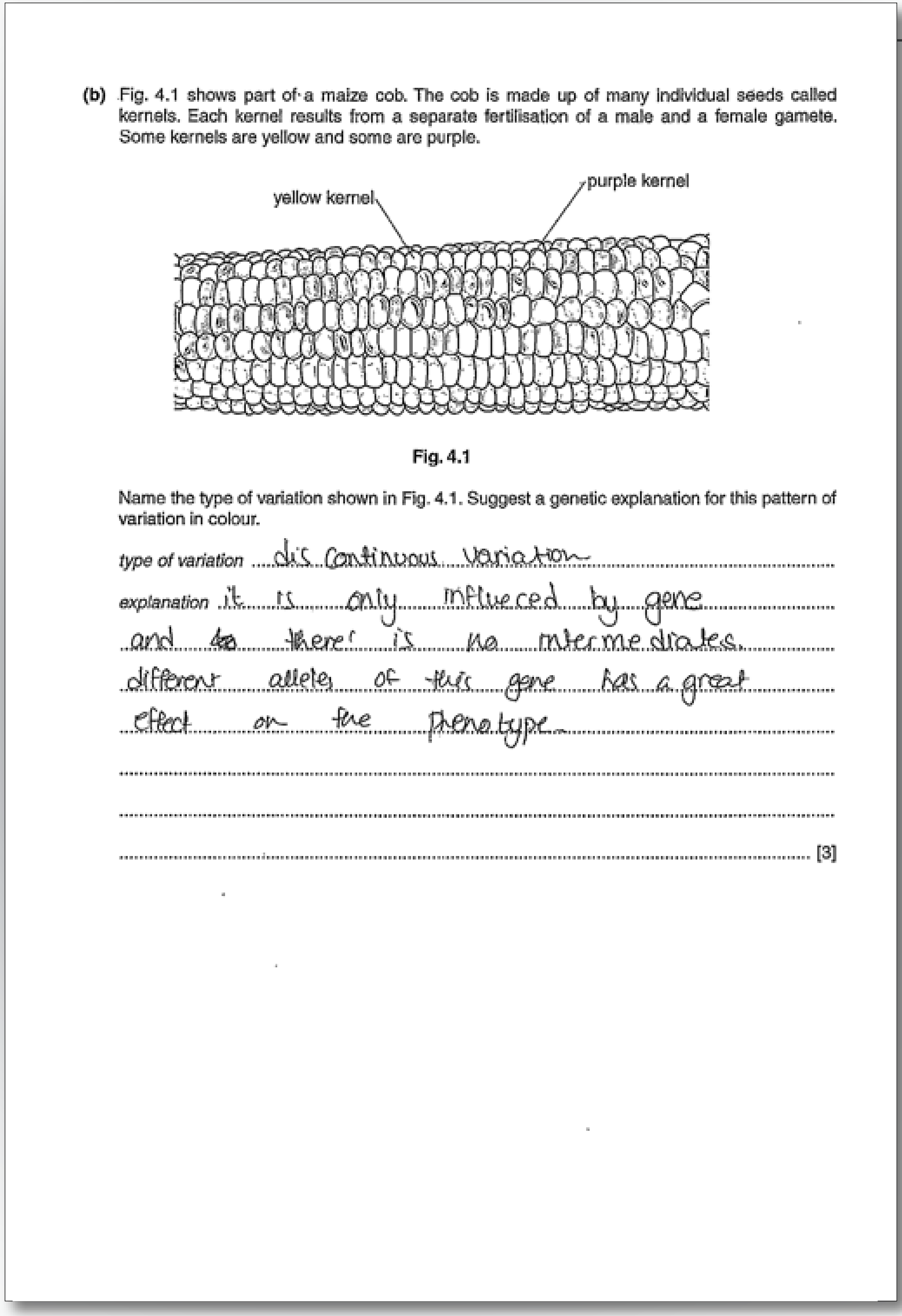
4(a) ☐

4(b) ☐

4(c)(i) ☐

4(c)(ii) ☐

Q4	Mark scheme
(a)	**1** best / desirable, plants crossed ; **A** cross-pollinated **R** cross with other (maize) species **2** repeatedly / every generation ; **3** detail of cross-pollination ; e.g. ref. to male tassels and female silks **4** example of desirable characteristic ; **A** more kernels / big kernels / high yield / *ref. to* kernel colour / fast-growing / cold-tolerant **5** hybridisation / two inbred (named) lines crossed / F1 hybrids formed ; **A** description, e.g. cross two, homozygous parents / parents from two purebred lines **6** gives more, vigorous / uniform, plants ; **A** heterosis **7** *ref. to* dwarf maize / mutant alleles for gibberellin (synthesis) ; **[max 4]**
(b)	**1** <u>discontinuous</u> ; *max 2 for mp2–6* **2** one gene / single locus / monogenic, inheritance ; **A** monohybrid **3** two alleles ; **4** dominant and recessive ; **5** 1:1 ratio purple to yellow ; **A** 50% purple, 50% yellow **6** test cross / Aa × aa ; **[max 3]**
(c)(i)	**1** as, Bt crops / area, increases the number of resistant, pests / species, increases ; **A** the more (the area of) Bt crops grown, the more (the) resistant species **2** figures quote ; (2 years, area with units once) **3** figures quote ; (2 years, no. resistant pest species) **4** mutation(s) (in pest species) ; **5** chance / random / spontaneous (mutations) ; **6** pests evolve resistance / natural selection for resistant pests ; **7** AVP ; e.g. plateau in resistance, 2002–2005 / 2009–2011 first 6 years / 1996–2001, no resistant species **[max 4]**
(c)(ii)	*social* increased yield / more food / cheaper food / AW ; *environmental* decreased insecticide use / few hazards to humans / Bt only targets pest species ; **A** no / less pesticide used R herbicide **[2]** **[Total: 13]**



(b) Fig. 4.1 shows part of a maize cob. The cob is made up of many individual seeds called kernels. Each kernel results from a separate fertilisation of a male and a female gamete. Some kernels are yellow and some are purple.

Fig. 4.1

Name the type of variation shown in Fig. 4.1. Suggest a genetic explanation for this pattern of variation in colour.

type of variation dis continuous variation

explanation it is only influeced by gene and ~~to~~ there' is no intermedrates. different allele of this gene has a great effect on the phenotype.

[3]

Your Mark

4(a) ☐

4(b) ☐

4(c)(i) ☐

4(c)(ii) ☐

Q4	Mark scheme
(a)	**1** best / desirable, plants crossed ; **A** cross-pollinated **R** cross with other (maize) species **2** repeatedly / every generation ; **3** detail of cross-pollination ; e.g. ref. to male tassels and female silks **4** example of desirable characteristic ; **A** more kernels / big kernels / high yield / *ref. to* kernel colour / fast-growing / cold-tolerant **5** hybridisation / two inbred (named) lines crossed / F1 hybrids formed ; **A** description, e.g. cross two, homozygous parents / parents from two purebred lines **6** gives more, vigorous / uniform, plants ; **A** heterosis **7** *ref. to* dwarf maize / mutant alleles for gibberellin (synthesis) ; **[max 4]**
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(c)(i)	**1** as, Bt crops / area, increases the number of resistant, pests / species, increases ; **A** the more (the area of) Bt crops grown, the more (the) resistant species **2** figures quote ; (2 years, area with units once) **3** figures quote ; (2 years, no. resistant pest species) **4** mutation(s) (in pest species) ; **5** chance / random / spontaneous (mutations) ; **6** pests evolve resistance / natural selection for resistant pests ; **7** AVP ; e.g. plateau in resistance, 2002–2005 / 2009–2011 first 6 years / 1996–2001, no resistant species **[max 4]**
(c)(ii)	*social* increased yield / more food / cheaper food / AW ; *environmental* decreased insecticide use / few hazards to humans / Bt only targets pest species ; **A** no / less pesticide used R herbicide **[2]** **[Total: 13]**

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MIDDLE

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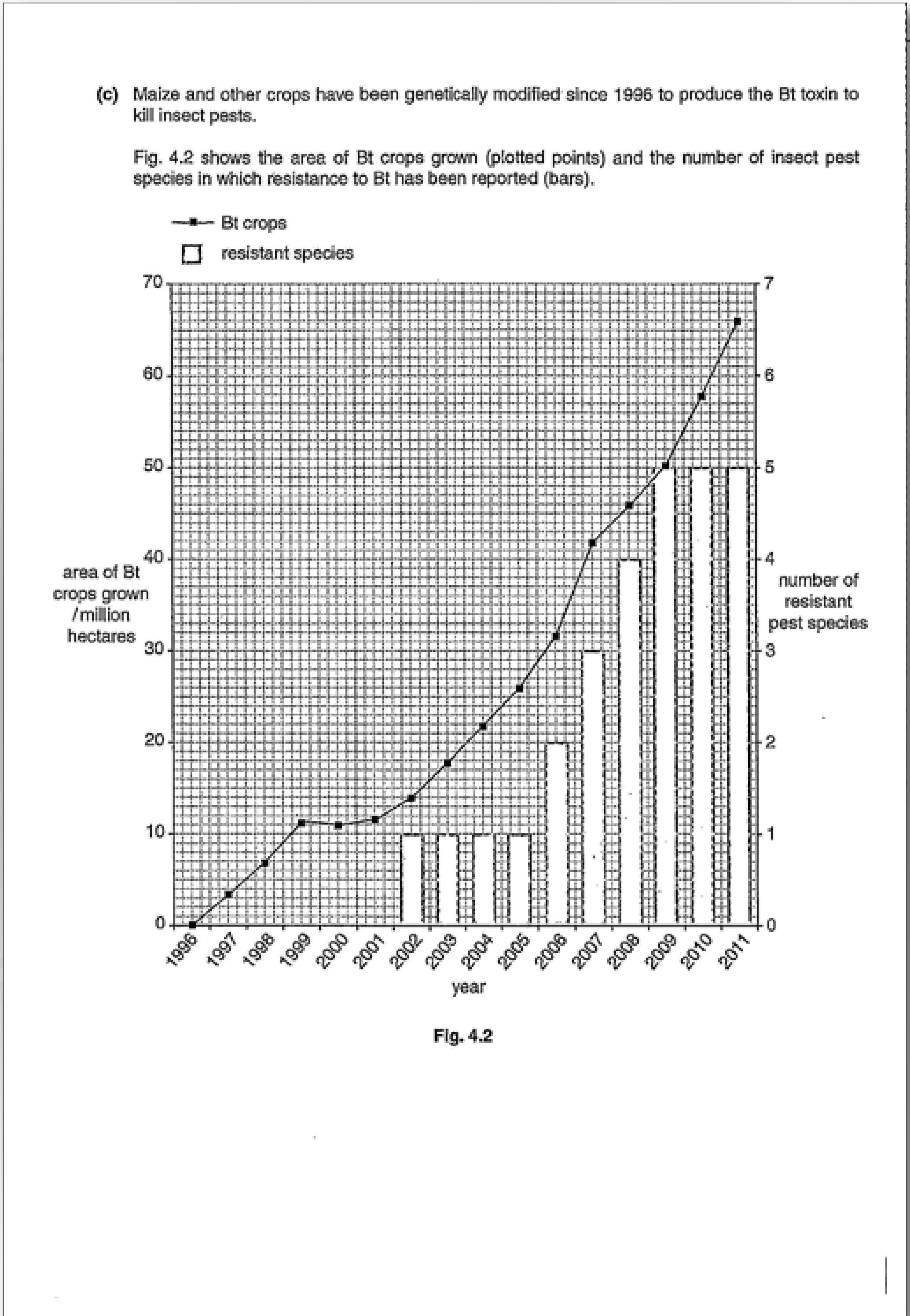

(c) Maize and other crops have been genetically modified since 1996 to produce the Bt toxin to kill insect pests.

Fig. 4.2 shows the area of Bt crops grown (plotted points) and the number of insect pest species in which resistance to Bt has been reported (bars).

Fig. 4.2

Your Mark

4(a) ☐

4(b) ☐

4(c)(i) ☐

4(c)(ii) ☐

Q4	Mark scheme
(a)	**1** best / desirable, plants crossed ; **A** cross-pollinated **R** cross with other (maize) species **2** repeatedly / every generation ; **3** detail of cross-pollination ; e.g. ref. to male tassels and female silks **4** example of desirable characteristic ; **A** more kernels / big kernels / high yield / *ref. to* kernel colour / fast-growing / cold-tolerant **5** hybridisation / two inbred (named) lines crossed / F1 hybrids formed ; **A** description, e.g. cross two, homozygous parents / parents from two purebred lines **6** gives more, vigorous / uniform, plants ; **A** heterosis **7** *ref. to* dwarf maize / mutant alleles for gibberellin (synthesis) ; **[max 4]**
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EXAMINER COMMENTS

MARK SCHEME

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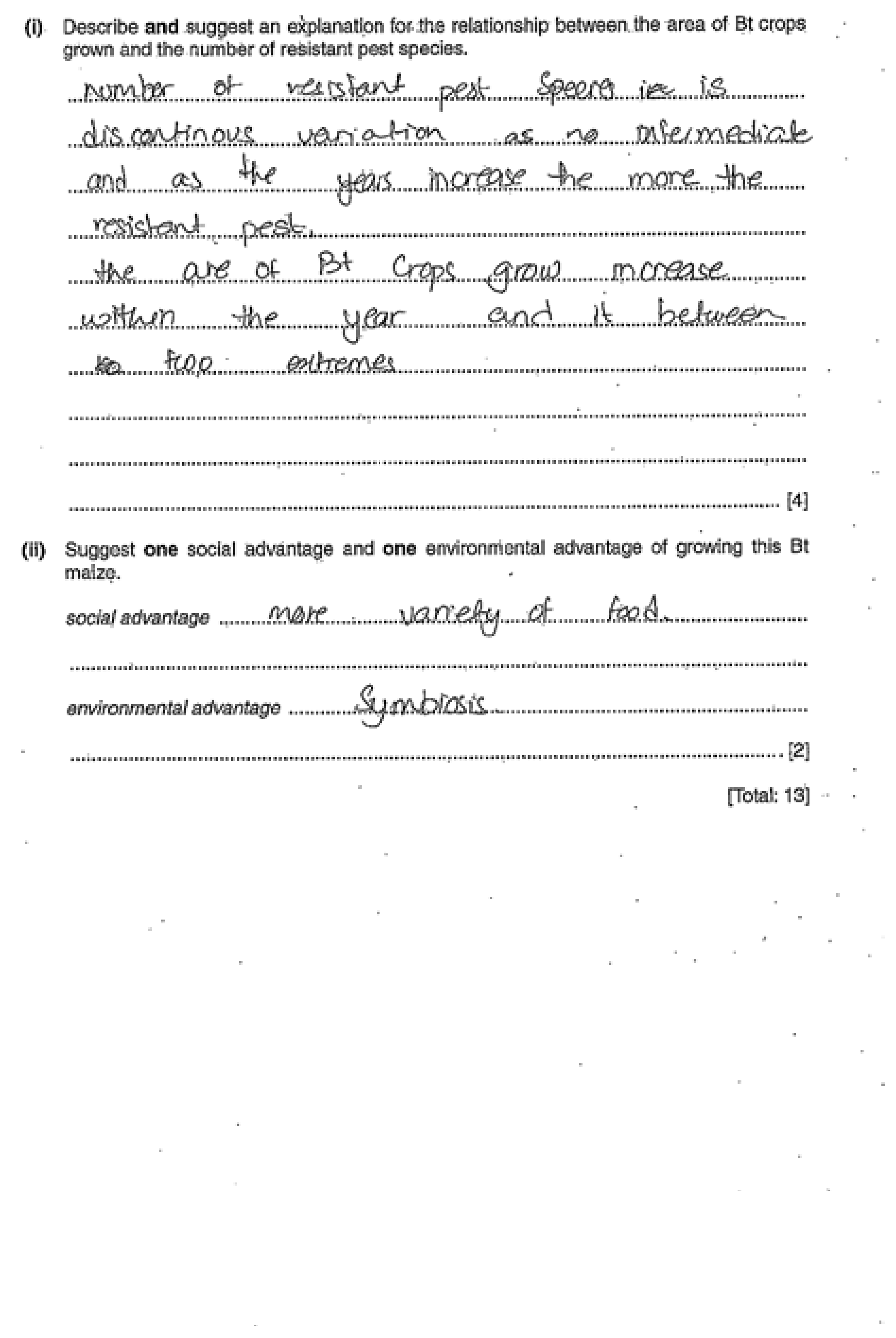

(i) Describe **and** suggest an explanation for the relationship between the area of Bt crops grown and the number of resistant pest species.

number of resistant pest Speens ~~ie~~ is dis continous variation as no infermediate and as the years increase the more the resistant pest.
the are of Bt Crops grow increase within the year and it between ~~to~~ two extremes
[4]

(ii) Suggest **one** social advantage and **one** environmental advantage of growing this Bt maize.

social advantage more variety of food.

environmental advantage Symbiosis.
[2]

[Total: 13]

Your Mark

4(a) ☐

4(b) ☐

4(c)(i) ☐

4(c)(ii) ☐

Q4	**Mark scheme**
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(c)(ii)	*social* increased yield / more food / cheaper food / AW ; *environmental* decreased insecticide use / few hazards to humans / Bt only targets pest species ; **A** no / less pesticide used R herbicide **[2]** **[Total: 13]**

EXAMINER COMMENTS

MARK SCHEME

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Interactive Example Candidate Responses
Paper 4 (May/June 2016), Question 5
Cambridge International AS & A Level
Biology 9700

Version 1.0

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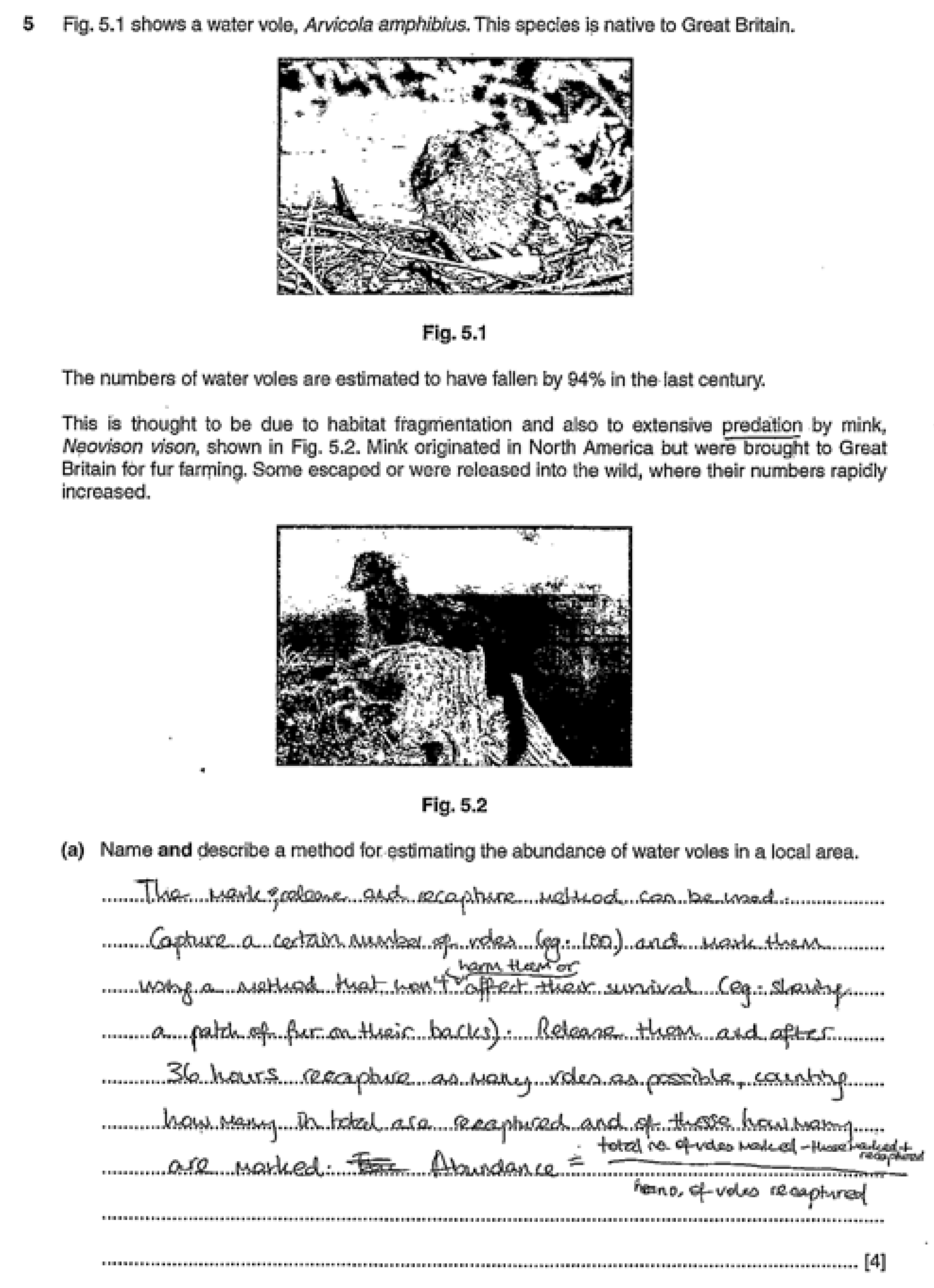


5 Fig. 5.1 shows a water vole, *Arvicola amphibius*. This species is native to Great Britain.

Fig. 5.1

The numbers of water voles are estimated to have fallen by 94% in the last century.

This is thought to be due to habitat fragmentation and also to extensive predation by mink, *Neovison vison*, shown in Fig. 5.2. Mink originated in North America but were brought to Great Britain for fur farming. Some escaped or were released into the wild, where their numbers rapidly increased.

Fig. 5.2

(a) Name and describe a method for estimating the abundance of water voles in a local area.

The mark, release and recapture method can be used. Capture a certain number of voles (eg: 100) and mark them using a method that won't harm them or affect their survival (eg: shaving a patch of fur on their backs). Release them and after 36 hours recapture as many voles as possible, counting how many in total are recaptured and of these how many are marked: ~~For~~ Abundance = $\frac{\text{total no. of voles marked} - \text{those marked + recaptured}}{\text{total no. of voles recaptured}}$

[4]

Select page

HIGH

MIDDLE

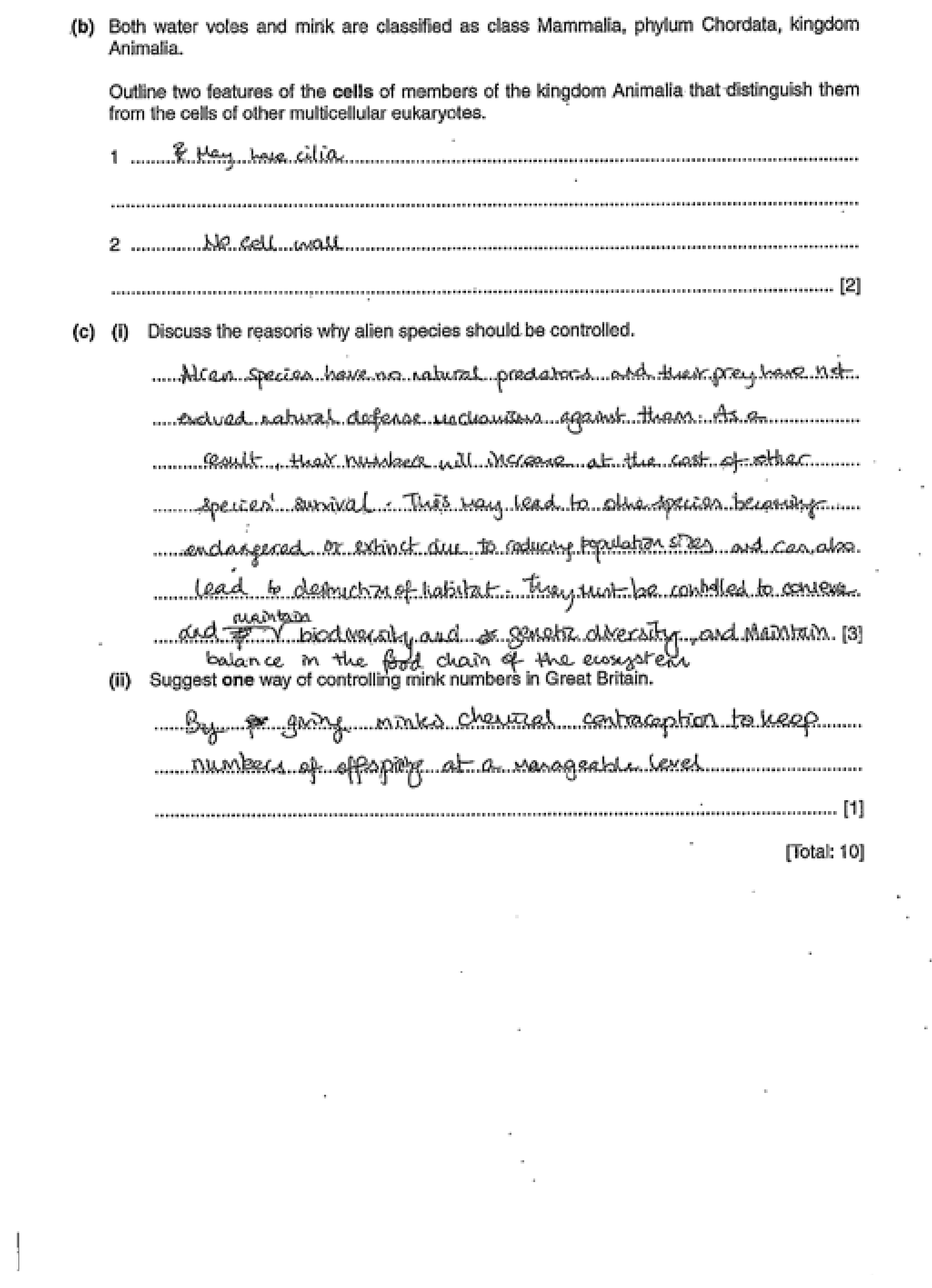
LOW

Examiner marks and comments

	Your Mark	Mark	Comment
5(a)		3/4	A mark is given for the name of the method. No detail of how the voles are trapped is given but there is a wealth of detail about the marking process. The length of time that elapses before the second round of trapping earns a mark. The formula provided finds the difference between the number of voles caught in the first and second samples whereas these two figures should be multiplied together on the top line of the calculation.
5(b)		2/2	The answer is overly brief, lacking a subject for the sentence, but we assume the answer refers to the object of the question (animal cells) so this gets a mark. Although this is a negative feature, something animal cells don not have, it is considered mark-worthy because other cells of multicellular eukaryotes, plants and fungi, do both have cell walls (on all cells).
5(c)(i)		3/3	A mark is given for the idea that the alien species may be a predator of another native species. 8. Reduction in another species' abundance scores here. 9. The effect of the alien species in changing or destroying the habitat scores a mark.
5(c)(ii)		1/1	Contraceptive measures are credited on the mark scheme along with hunting the mink or using a disease agent specific to mink.

EXAMINER COMMENTS

MARK SCHEME



(b) Both water voles and mink are classified as class Mammalia, phylum Chordata, kingdom Animalia.

Outline two features of the **cells** of members of the kingdom Animalia that distinguish them from the cells of other multicellular eukaryotes.

1 they have cilia

2 No cell wall [2]

(c) (i) Discuss the reasons why alien species should be controlled.

Alien species have no natural predators and their prey have not evolved natural defense mechanisms against them. As a result, their number will increase at the cost of other species' survival. This may lead to other species becoming endangered or extinct due to reducing population sizes and can also lead to destruction of habitat. They must be controlled to conserve and maintain biodiversity and ~~or~~ genetic diversity, and maintain balance in the food chain of the ecosystem [3]

(ii) Suggest **one** way of controlling mink numbers in Great Britain.

By giving minks chemical contraception to keep numbers of offspring at a manageable level [1]

[Total: 10]

◀ Select page ▶

HIGH | MIDDLE | LOW

Examiner marks and comments

	Your Mark	Mark	Comment
5(a)	☐	**3/4**	A mark is given for the name of the method. No detail of how the voles are trapped is given but there is a wealth of detail about the marking process. The length of time that elapses before the second round of trapping earns a mark. The formula provided finds the difference between the number of voles caught in the first and second samples whereas these two figures should be multiplied together on the top line of the calculation.
5(b)	☐	**2/2**	The answer is overly brief, lacking a subject for the sentence, but we assume the answer refers to the object of the question (animal cells) so this gets a mark. Although this is a negative feature, something animal cells don not have, it is considered mark-worthy because other cells of multicellular eukaryotes, plants and fungi, do both have cell walls (on all cells).
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5(c)(ii)	☐	**1/1**	Contraceptive measures are credited on the mark scheme along with hunting the mink or using a disease agent specific to mink.

EXAMINER COMMENTS

MARK SCHEME

Select page

HIGH

MIDDLE

LOW

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Fig. 5.1

The numbers of water voles are estimated to have fallen by 94% in the last century.

This is thought to be due to habitat fragmentation and also to extensive predation by mink, *Neovison vison*, shown in Fig. 5.2. Mink originated in North America but were brought to Great Britain for fur farming. Some escaped or were released into the wild, where their numbers rapidly increased.

Fig. 5.2

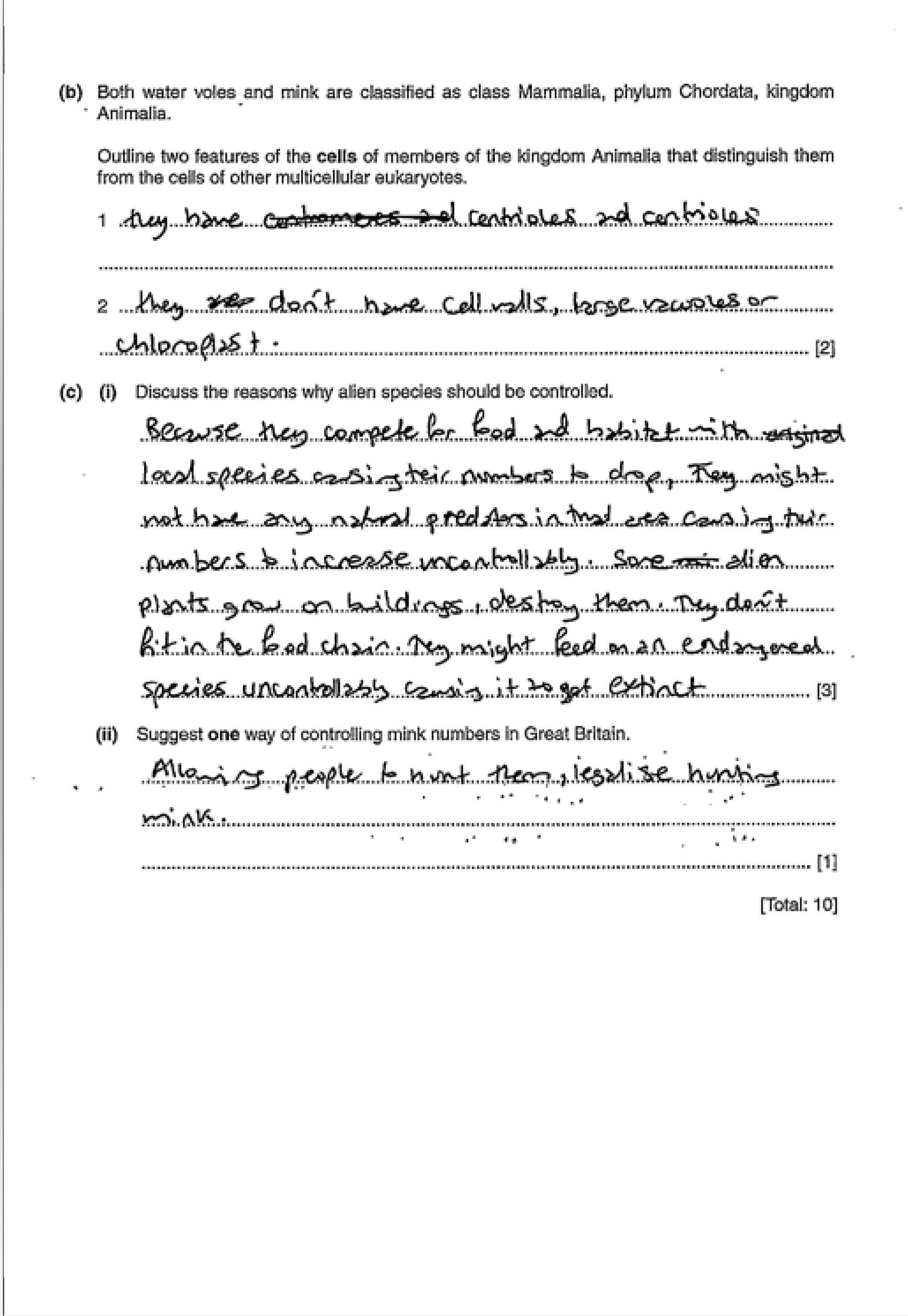
(a) Name **and** describe a method for estimating the abundance of water voles in a local area.

~~By random sampling a quadrat is used/1m x 1m and all water voles in that~~ Mark-release-recapture ~~because~~ method because it is a mobile animal. ~~[illegible]~~ The area of the surface local area is calculated. Some water voles are captured and marked and counted. Then they are released in the wild and allowed to mix, then ~~[illegible]~~ water voles are again captured, the marked water voles are counted and the ~~[illegible]~~ unmarked water voles are counted. The ratio of marked to unmarked is assumed to be the same for the whole population so that ratio is the same as the ratio of originally marked ~~spec~~ water voles to the ~~unmarked~~ rest of the water voles [4]

	Your Mark	Mark	Comment
5(a)		1/4	The correct name for the technique scores a mark. No details of capturing or marking are given. The time that elapses until 'then' is not specified.
5(b)		2/2	'They' is taken to mean animal cells so this scores a mark. Absence of a cell wall is considered an identifying feature of animal cells. Not having large vacuoles is potentially a third mark (but the answer is only out of two), while not having chloroplasts is ignored as a neutral point.
5(c)(i)		2/3	Identification of alien species as possible competitors scores a mark. This scores marking point 1, that numbers of other species could decrease. This is incorrect as in order to compete with others the alien species must eat the same food as a native species. However it was not a direct opposite of the mark point already given so was ignored. This is the same marking point as 'causing their numbers to drop', already given on line 2.
5(c)(ii)		1/1	This idea scores a mark.

EXAMINER COMMENTS

MARK SCHEME



(b) Both water voles and mink are classified as class Mammalia, phylum Chordata, kingdom Animalia.

Outline two features of the **cells** of members of the kingdom Animalia that distinguish them from the cells of other multicellular eukaryotes.

1 they have ~~centromeres and~~ centrioles and centrioles

2 they ~~are~~ don't have cell walls, large vacuoles or chloroplast. [2]

(c) (i) Discuss the reasons why alien species should be controlled.

Because they compete for food and habitet with ~~original~~ local species causing their numbers to drop. They might not have any natural predaters in that area causing their numbers to increase uncontrollably. Some ~~mi~~ alien plants grow on buildings, destroy them. They don't fit in the food chain. They might feed on an endangered species uncontollably causing it to get extinct [3]

(ii) Suggest **one** way of controlling mink numbers in Great Britain.

Allowing people to hunt them, legalise hunting mink. [1]

[Total: 10]

Examiner marks and comments

	Your Mark	Mark	Comment
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Select page

HIGH MIDDLE LOW

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This is thought to be due to habitat fragmentation and also to extensive predation by mink, *Neovison vison*, shown in Fig. 5.2. Mink originated in North America but were brought to Great Britain for fur farming. Some escaped or were released into the wild, where their numbers rapidly increased.

Fig. 5.2

(a) Name **and** describe a method for estimating the abundance of water voles in a local area.

By sumpling, ~~chem~~ choosing a certain area, counting how many water voles there are in that certain area and then multiplying by how large the Area is.

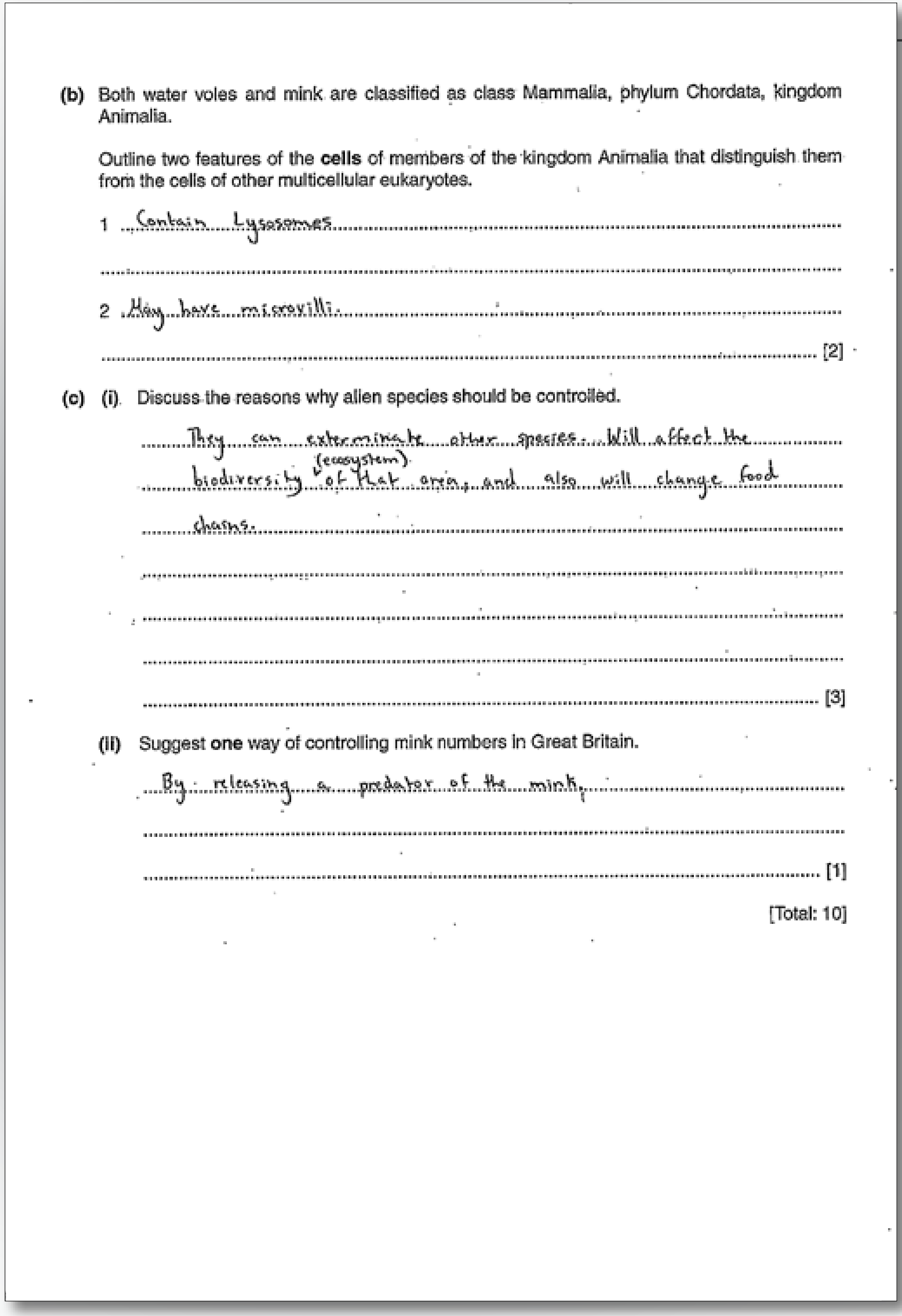
[4]

Examiner marks and comments

	Your Mark	Mark	Comment
5(a)		0/4	No reference to the mark-release-recapture method is given. The method described seems to assume the water voles will be easy to see and count in the same way that plants are.
5(b)		1/2	Cells of all multicellular eukaryotes contain lysosomes so this is not a unique animal cell feature. This scores although the candidate has left the examiner to guess the identity of the cells which may have microvilli.
5(c)(i)		2/3	This scores marking point 1 for reducing the number of another species. Altering food chains scores a mark.
5(c)(ii)		0/1	Since mink are medium-sized carnivores the predators that could catch and eat them are likely to be a danger to the health of humans and farm and domestic animals as well as mink. Releasing a new alien predator species like the lynx into the British countryside is not considered a feasible idea.

EXAMINER COMMENTS

MARK SCHEME



(b) Both water voles and mink are classified as class Mammalia, phylum Chordata, kingdom Animalia.

Outline two features of the **cells** of members of the kingdom Animalia that distinguish them from the cells of other multicellular eukaryotes.

1 Contain Lysosomes

2 They have microvilli.

[2]

(c) (i) Discuss the reasons why alien species should be controlled.

They can exterminate other species. Will affect the biodiversity (ecosystem) of that area, and also will change food chains.

[3]

(ii) Suggest **one** way of controlling mink numbers in Great Britain.

By releasing a predator of the mink.

[1]

[Total: 10]

Select page

HIGH

MIDDLE

LOW

Examiner marks and comments

	Your Mark	Mark	Comment
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EXAMINER COMMENTS

MARK SCHEME

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Interactive Example Candidate Responses
Paper 4 (May/June 2016), Question 6
Cambridge International AS & A Level
Biology 9700

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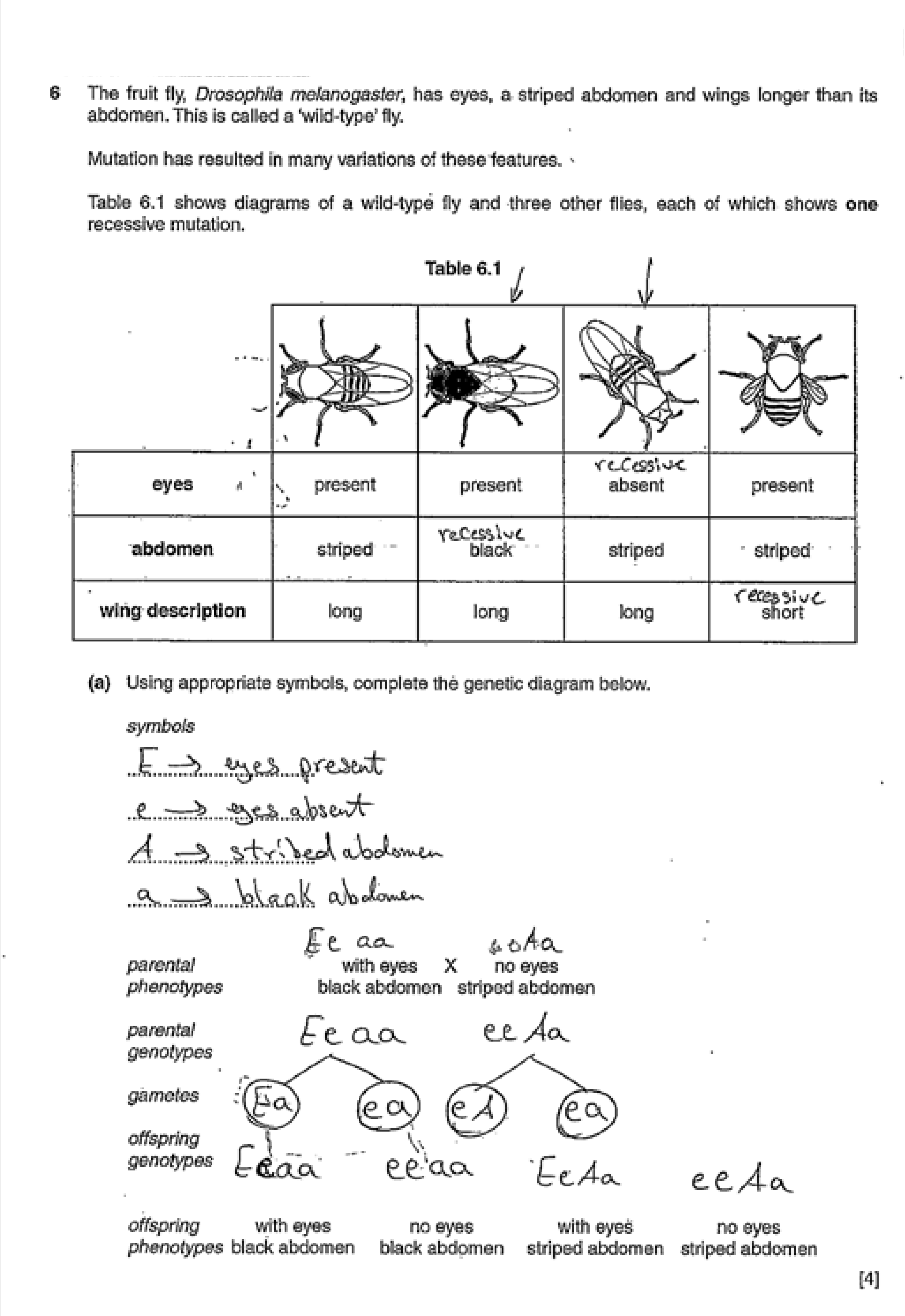

6 The fruit fly, *Drosophila melanogaster*, has eyes, a striped abdomen and wings longer than its abdomen. This is called a 'wild-type' fly.

Mutation has resulted in many variations of these features.

Table 6.1 shows diagrams of a wild-type fly and three other flies, each of which shows **one** recessive mutation.

Table 6.1

eyes	present	present	recessive absent	present
abdomen	striped	recessive black	striped	striped
wing description	long	long	long	recessive short

(a) Using appropriate symbols, complete the genetic diagram below.

symbols

E → eyes present

e → eyes absent

A → striped abdomen

a → black abdomen

parental phenotypes	Ee aa with eyes black abdomen	X	eeAa no eyes striped abdomen	
parental genotypes	Ee aa		ee Aa	
gametes	Ea	ea	eA	ea
offspring genotypes	Eeaa	eeaa	EeAa	eeAa
offspring phenotypes	with eyes black abdomen	no eyes black abdomen	with eyes striped abdomen	no eyes striped abdomen

[4]

Your Mark

6(a)

6(b)

6(c)

6(d)

Q6	Mark scheme
(a)	key to 4 chosen symbols ; **A** any two lettered pairs (e.g. E/e and A/a) identified I symbols for wing length *no eyes and black abdomen* must be lower case (e, a) *with eyes and striped abdomen* must be upper case (E, A) *allow ecf to max 3 if error in symbols* *parents genotypes* Eeaa × eeAa ; *gametes* Ea ea × eA ea ; A each gamete written twice *F2 genotypes* Eeaa eeaa EeAa eeAa ; **[4]**
(b)	cross with, homozygous recessive / black no-eyes, fly ; **A** double recessive / aaee (or own symbols) / organism showing recessive characters or phenotype **[4]**
(c)	see table below **A** fractions in last column **A** 3 s.f. in last column **[3]**
(d)	no significant deviation from expected / difference not significant ; **A** (95% probability that) difference is due to chance **A** data is a good fit / match **A** null hypothesis (no significant difference between O and E) **R** comment on significance of results **R** 'the value' is not significant probability (of this deviation) is over 0.05 / χ^2 is less than 7.82 ; **A** χ^2 / results (of χ^2 test), less than value at probability 0.05 *ref. to* critical value ; *ecf reverse arguments if answer from 6(c)is over 7.82* *ref. to* independent assortment / AW ; **[max 2]** **[Total: 10]**

observed number (O)	expected number (E)	O – E	(O – E) 2	(O – E)2 E
86	83	3	9	0.11
87	83	4	16	0.19
81	83	-2	4	0.05
78	83	-5	25	0.30
332	332	;; χ^2 = 0.65 ;		

EXAMINER COMMENTS

MARK SCHEME

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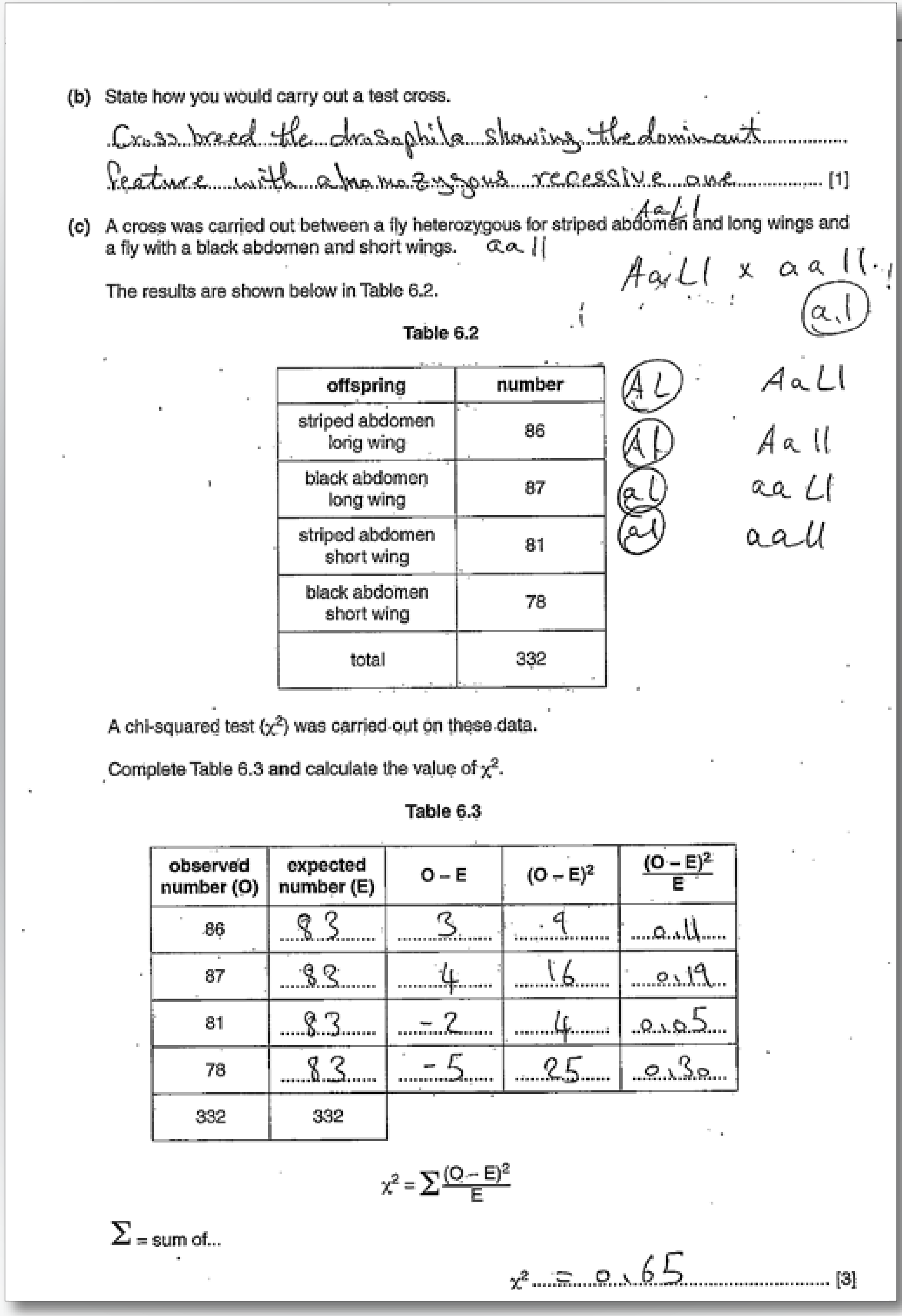

(b) State how you would carry out a test cross.

Cross breed the drosophila showing the dominant feature with a homozygous recessive one [1]

(c) A cross was carried out between a fly heterozygous for striped abdomen and long wings and a fly with a black abdomen and short wings. aa ll

AaLl

AaLl x aa ll

a,l

The results are shown below in Table 6.2.

Table 6.2

offspring	number		
striped abdomen long wing	86	AL	AaLl
black abdomen long wing	87	Al	Aall
striped abdomen short wing	81	aL	aaLl
black abdomen short wing	78	al	aall
total	332		

A chi-squared test (χ^2) was carried out on these data.

Complete Table 6.3 and calculate the value of χ^2.

Table 6.3

observed number (O)	expected number (E)	O – E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
86	83	3	9	0.11
87	83	4	16	0.19
81	83	-2	4	0.05
78	83	-5	25	0.30
332	332			

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

Σ = sum of...

χ^2 = 0.65 [3]

Your Mark

6(a) ☐

6(b) ☐

6(c) ☐

6(d) ☐

<table>
<tr><th>Q6</th><th>Mark scheme</th></tr>
<tr><td>(a)</td><td>key to 4 chosen symbols ;
A any two lettered pairs (e.g. E/e and A/a) identified I symbols for wing length
<i>no eyes and black abdomen</i> must be lower case (e, a)
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<i>allow ecf to max 3 if error in symbols</i>

<i>parents genotypes</i> Eeaa × eeAa ;
<i>gametes</i> Ea ea × eA ea ; A each gamete written twice
<i>F2 genotypes</i> Eeaa eeaa EeAa eeAa ; [4]</td></tr>
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A null hypothesis (no significant difference between O and E)
R comment on significance of results
R ‘the value’ is not significant

probability (of this deviation) is over 0.05 / χ2 is less than 7.82 ;
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<i>ref. to</i> <u>critical value</u> ; <i>ecf reverse arguments if answer from 6(c)is over 7.82</i>
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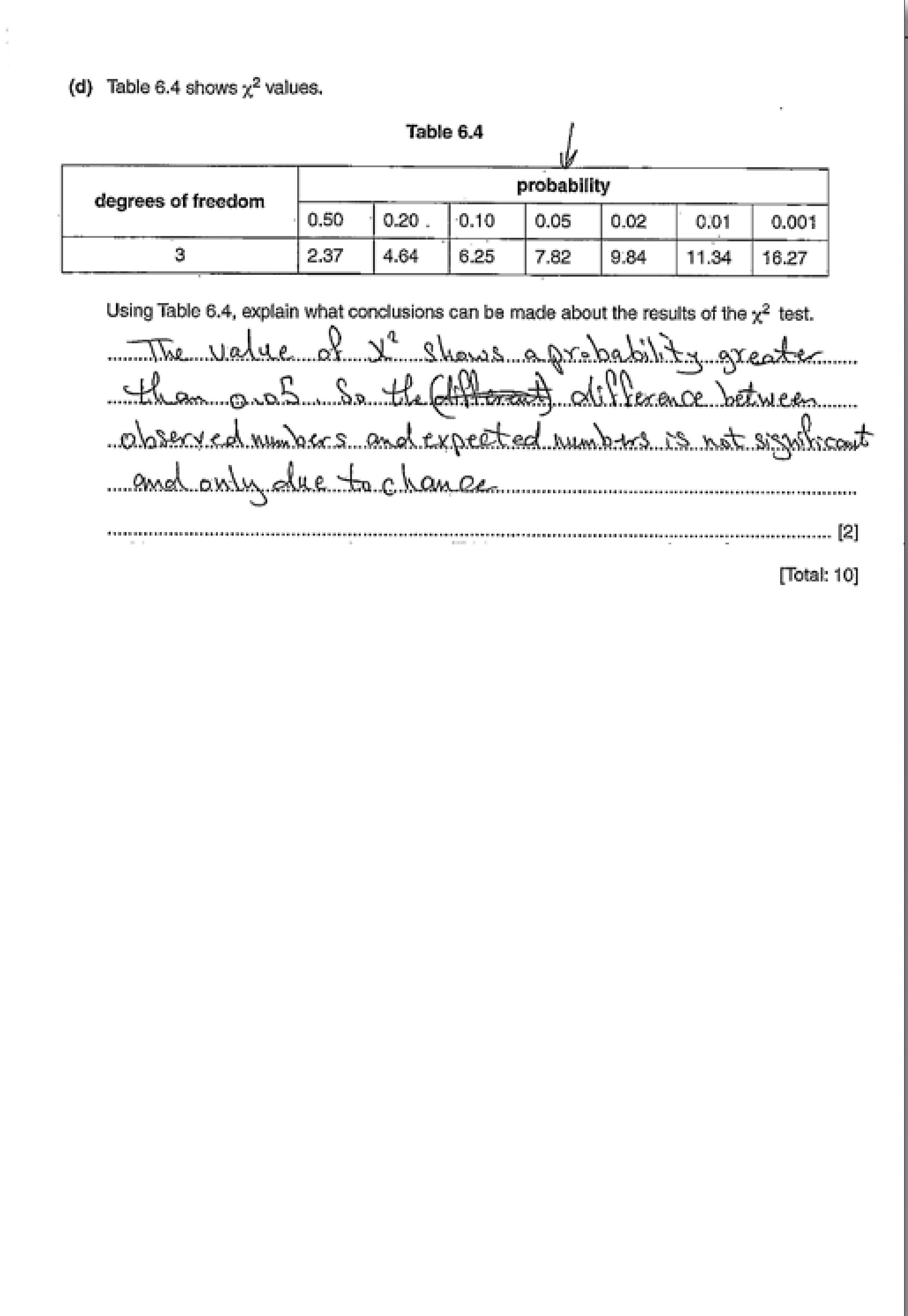
EXAMINER COMMENTS

MARK SCHEME



(d) Table 6.4 shows χ^2 values.

Table 6.4

degrees of freedom	probability						
	0.50	0.20	0.10	0.05	0.02	0.01	0.001
3	2.37	4.64	6.25	7.82	9.84	11.34	16.27

Using Table 6.4, explain what conclusions can be made about the results of the χ^2 test.

The value of χ^2 shows a probability greater than 0.05. So the ~~(different)~~ difference between observed numbers and expected numbers is not significant and only due to chance

[2]

[Total: 10]

Your Mark

6(a) ☐

6(b) ☐

6(c) ☐

6(d) ☐

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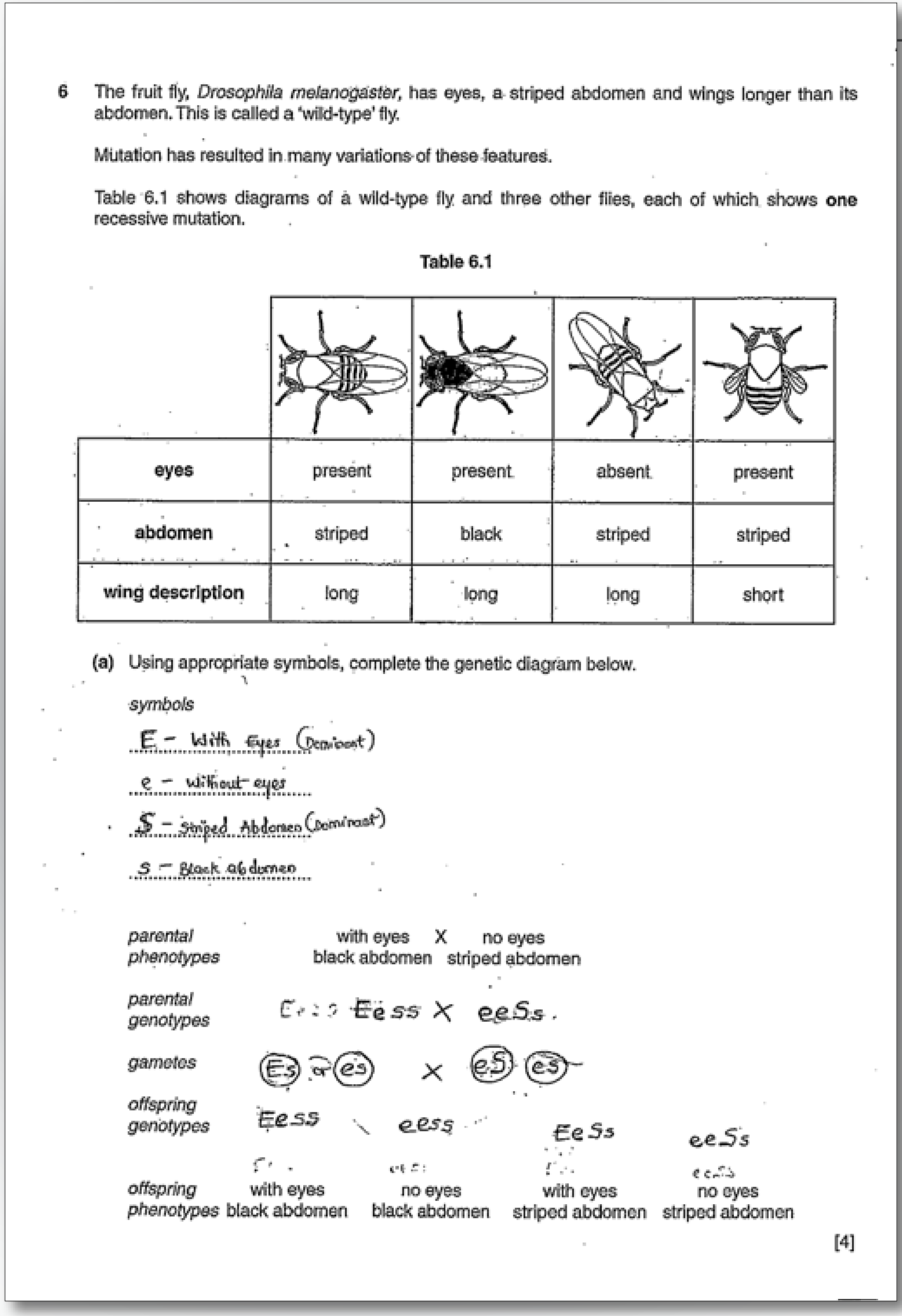

6 The fruit fly, *Drosophila melanogaster*, has eyes, a striped abdomen and wings longer than its abdomen. This is called a 'wild-type' fly.

Mutation has resulted in many variations of these features.

Table 6.1 shows diagrams of a wild-type fly and three other flies, each of which shows **one** recessive mutation.

Table 6.1

eyes	present	present	absent	present
abdomen	striped	black	striped	striped
wing description	long	long	long	short

(a) Using appropriate symbols, complete the genetic diagram below.

symbols

E – With Eyes (Dominant)

e – without eyes

S – striped Abdomen (Dominant)

s – Black abdomen

parental phenotypes with eyes black abdomen X no eyes striped abdomen

parental genotypes ~~Eess~~ Eess X eeSs.

gametes Es or es × eS es

offspring genotypes Eess eess EeSs eeSs

offspring phenotypes with eyes black abdomen | no eyes black abdomen | with eyes striped abdomen | no eyes striped abdomen

[4]

Your Mark

6(a) ☐

6(b) ☐

6(c) ☐

6(d) ☐

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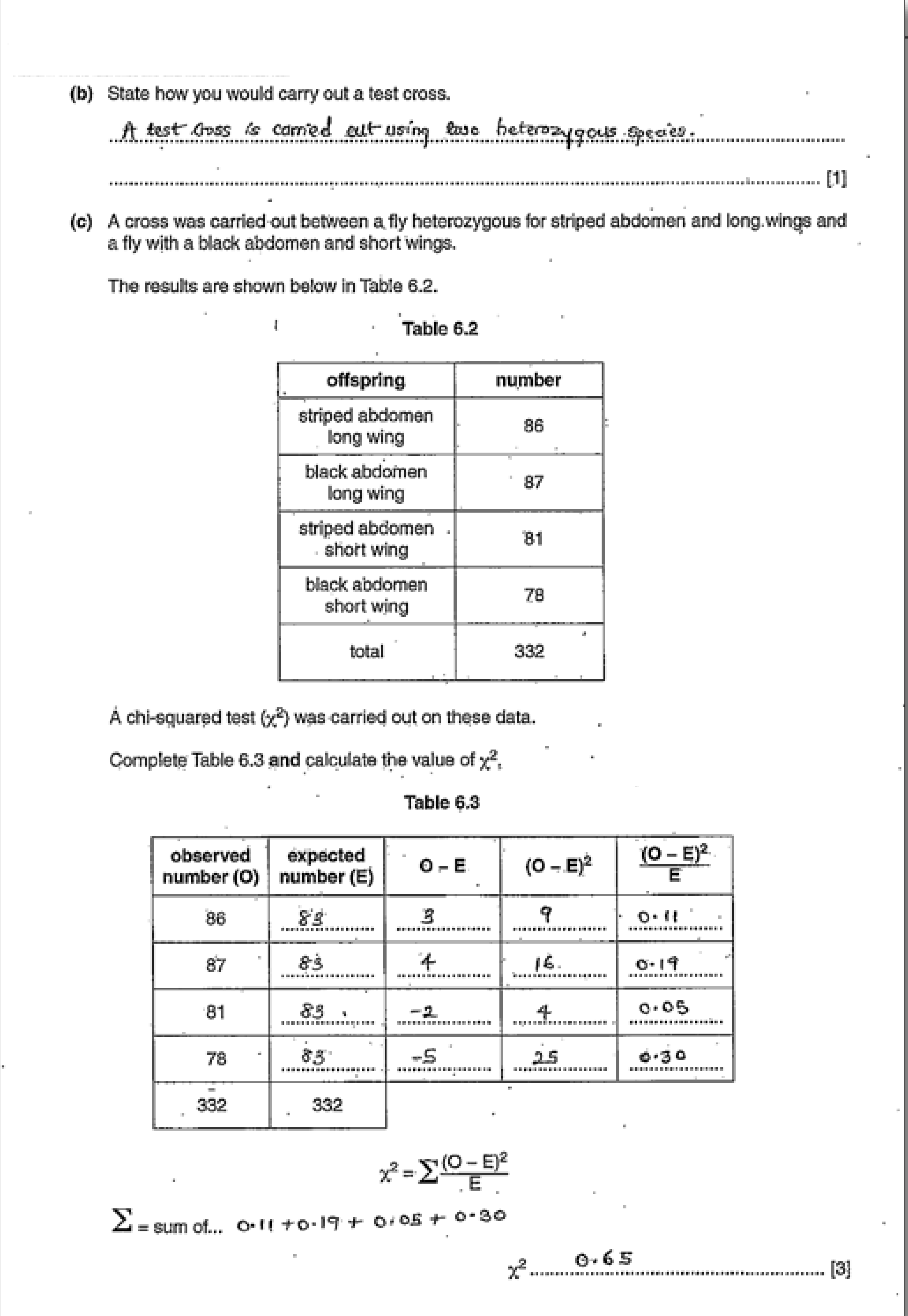
EXAMINER COMMENTS

MARK SCHEME



(b) State how you would carry out a test cross.

A test Cross is carried out using two heterozygous species.

[1]

(c) A cross was carried out between a fly heterozygous for striped abdomen and long wings and a fly with a black abdomen and short wings.

The results are shown below in Table 6.2.

Table 6.2

offspring	number
striped abdomen long wing	86
black abdomen long wing	87
striped abdomen short wing	81
black abdomen short wing	78
total	332

A chi-squared test (χ^2) was carried out on these data.

Complete Table 6.3 and calculate the value of χ^2.

Table 6.3

observed number (O)	expected number (E)	O – E	$(O - E)^2$	$\frac{(O-E)^2}{E}$
86	83	3	9	0·11
87	83	4	16	0·19
81	83	-2	4	0·05
78	83	-5	25	0·30
332	332			

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

$\sum$ = sum of... 0·11 + 0·19 + 0·05 + 0·30

χ^2 0·65 [3]

Your Mark

6(a) ☐

6(b) ☐

6(c) ☐

6(d) ☐

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<i>ref. to</i> <u>critical value</u> ; <i>ecf reverse arguments if answer from 6(c)is over 7.82</i>
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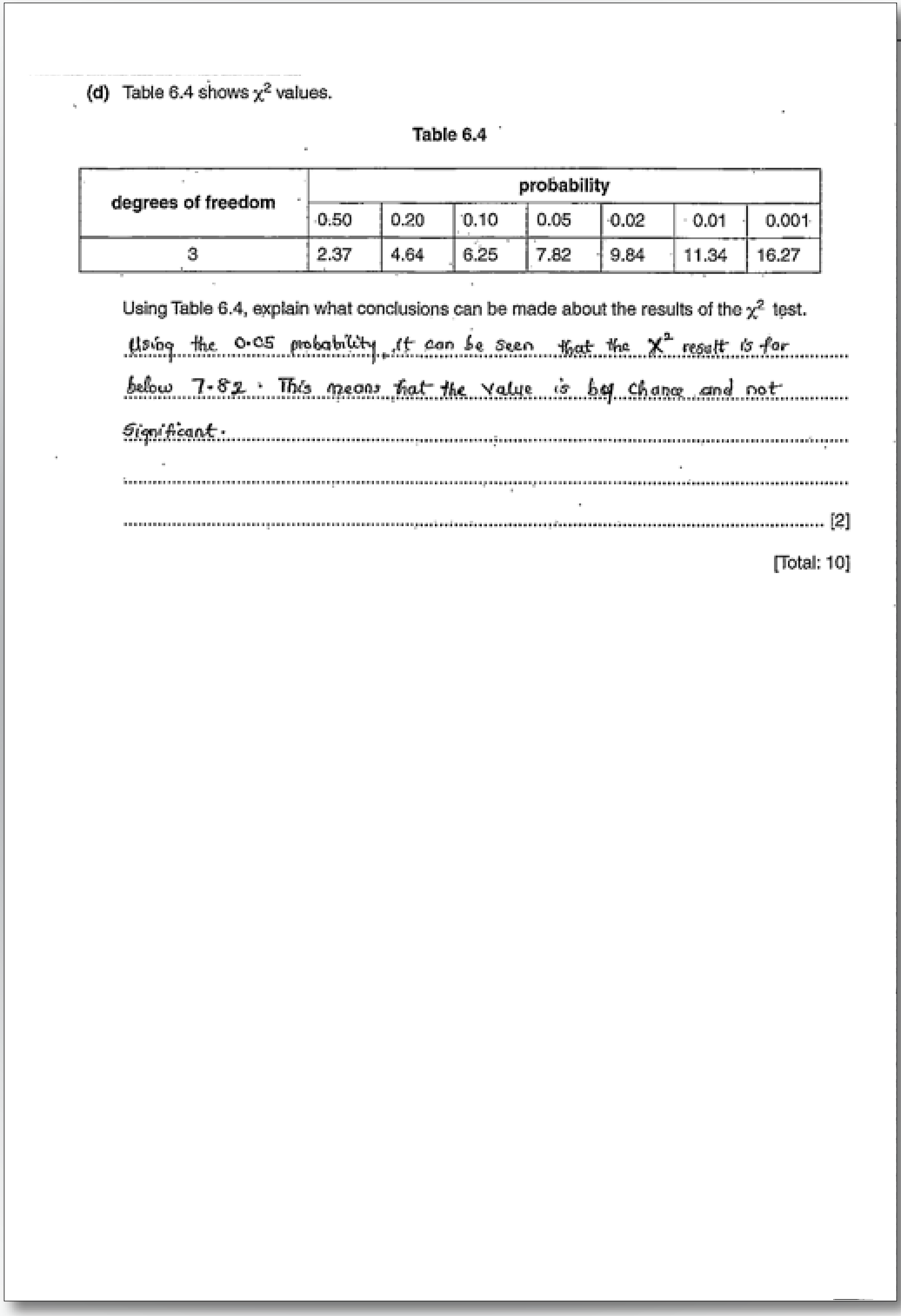

(d) Table 6.4 shows χ^2 values.

Table 6.4

degrees of freedom	probability						
	0.50	0.20	0.10	0.05	0.02	0.01	0.001
3	2.37	4.64	6.25	7.82	9.84	11.34	16.27

Using Table 6.4, explain what conclusions can be made about the results of the χ^2 test.

Using the 0·05 probability, it can be seen that the χ^2 result is for below 7·82. This means that the value is bey chance and not Significant.

[2]

[Total: 10]

Your Mark

6(a) ☐

6(b) ☐

6(c) ☐

6(d) ☐

Q6	**Mark scheme**
(a)	key to 4 chosen symbols ; **A** any two lettered pairs (e.g. E/e and A/a) identified I symbols for wing length *no eyes and black abdomen* must be lower case (e, a) *with eyes and striped abdomen* must be upper case (E, A) *allow ecf to max 3 if error in symbols* *parents genotypes* Eeaa × eeAa ; *gametes* Ea ea × eA ea ; A each gamete written twice *F2 genotypes* Eeaa eeaa EeAa eeAa ; **[4]**
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(c)

observed number (O)	expected number (E)	O – E	(O – E) 2	(O – E)2 E
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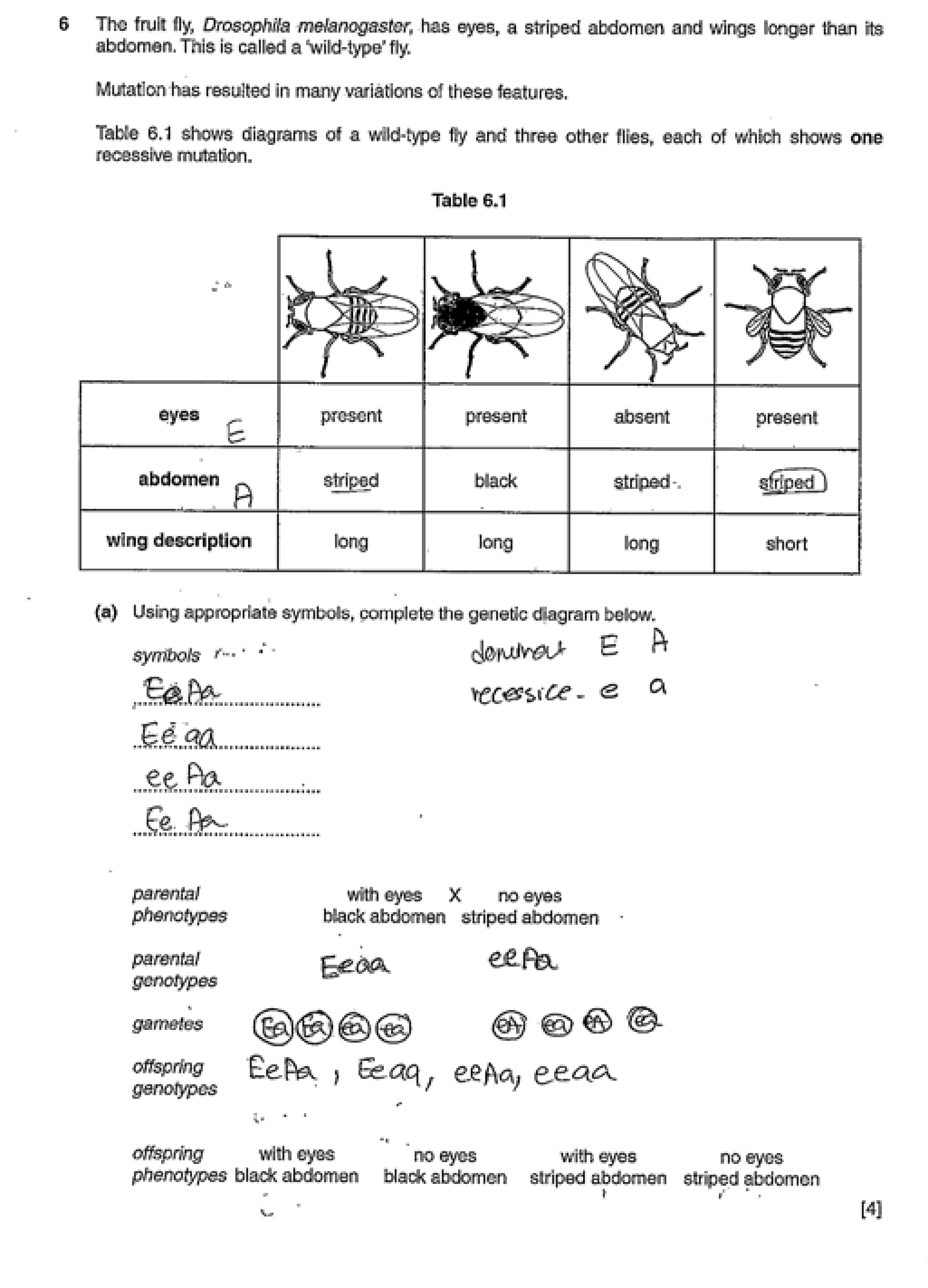
EXAMINER COMMENTS

MARK SCHEME



6 The fruit fly, *Drosophila melanogaster*, has eyes, a striped abdomen and wings longer than its abdomen. This is called a 'wild-type' fly.

Mutation has resulted in many variations of these features.

Table 6.1 shows diagrams of a wild-type fly and three other flies, each of which shows **one** recessive mutation.

Table 6.1

eyes E	present	present	absent	present
abdomen A	striped	black	striped	striped
wing description	long	long	long	short

(a) Using appropriate symbols, complete the genetic diagram below.

symbols

EeAa

Ee aa

ee Aa

Ee Aa

dominant E A

recessive - e a

parental phenotypes with eyes black abdomen X no eyes striped abdomen

parental genotypes Eeaa eeAa

gametes Ea Ea ea ea eA ea eA ea

offspring genotypes EeAa , Eeaa, eeAa, eeaa

offspring phenotypes with eyes black abdomen | no eyes black abdomen | with eyes striped abdomen | no eyes striped abdomen

[4]

Select page

HIGH MIDDLE LOW

Your Mark

6(a)

6(b)

6(c)

6(d)

Q6 Mark scheme

(a)

key to 4 chosen symbols ;
A any two lettered pairs (e.g. E/e and A/a) identified I symbols for wing length
no eyes and black abdomen must be lower case (e, a)
with eyes and striped abdomen must be upper case (E, A)
allow ecf to max 3 if error in symbols

parents genotypes Eeaa × eeAa ;
gametes Ea ea × eA ea ; A each gamete written twice
F2 genotypes Eeaa eeaa EeAa eeAa ; **[4]**

(b)

cross with, homozygous recessive / black no-eyes, fly ;
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(c)

observed number (O)	expected number (E)	O – E	(O – E) 2	(O – E)2 E
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;; χ^2 = 0.65 ;

A fractions in last column **A** 3 s.f. in last column **[3]**

(d)

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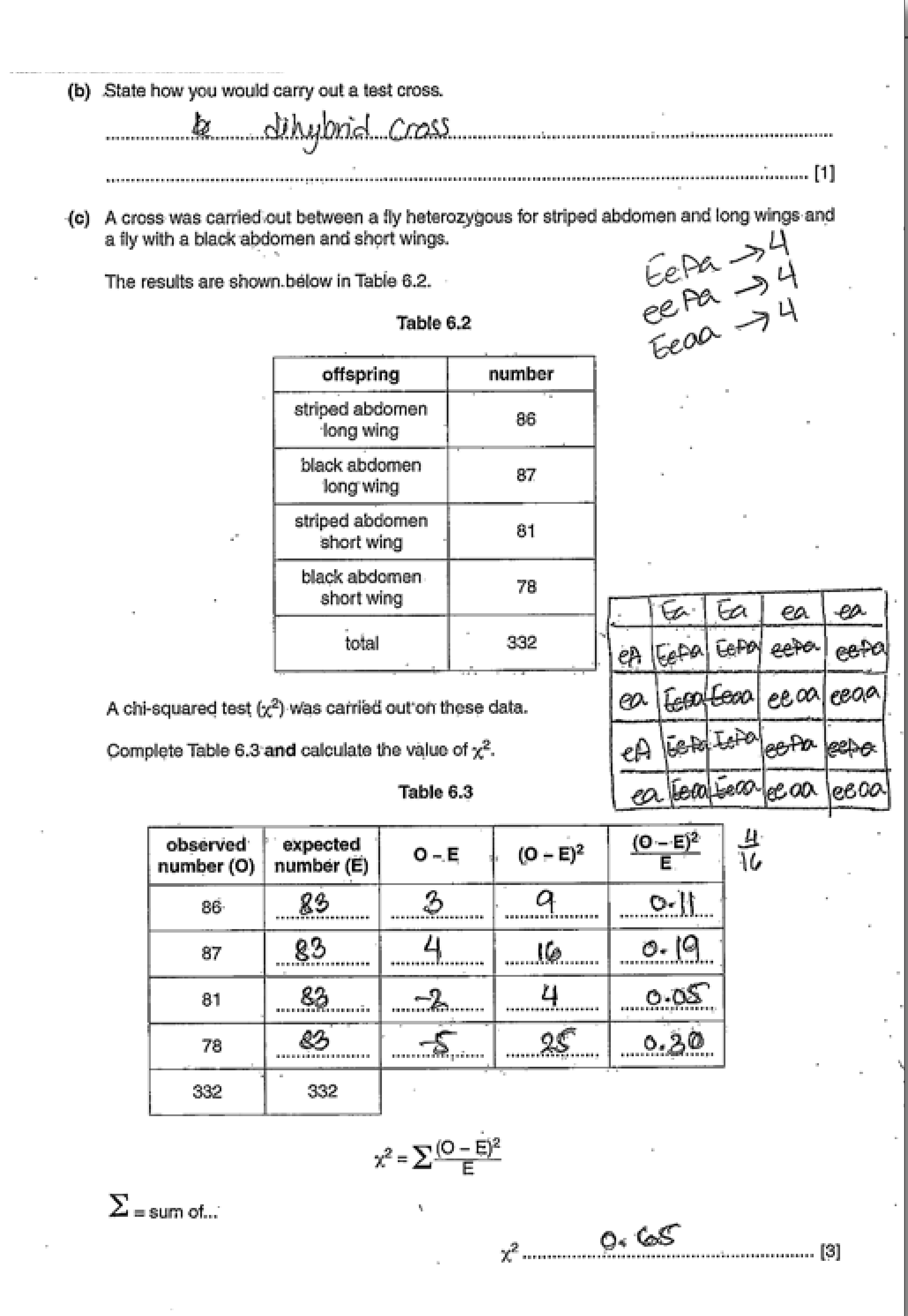
EXAMINER COMMENTS

MARK SCHEME



(b) State how you would carry out a test cross.

dihybrid cross [1]

(c) A cross was carried out between a fly heterozygous for striped abdomen and long wings and a fly with a black abdomen and short wings.

The results are shown below in Table 6.2.

EePa → 4
eePa → 4
Eeaa → 4

Table 6.2

offspring	number
striped abdomen long wing	86
black abdomen long wing	87
striped abdomen short wing	81
black abdomen short wing	78
total	332

	Ea	Ea	ea	ea
eA	EePa	EePa	eePa	eePa
ea	Eeaa	Eeaa	ee aa	eeaa
eA	EePa	EePa	eePa	eePa
ea	Eeaa	Eeaa	ee aa	ee aa

A chi-squared test (χ^2) was carried out on these data.

Complete Table 6.3 and calculate the value of χ^2.

Table 6.3

observed number (O)	expected number (E)	O – E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
86	83	3	9	0.11
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81	83	-2	4	0.05
78	83	-5	25	0.30
332	332			

4
16

$$\chi^2 = \Sigma \frac{(O-E)^2}{E}$$

Σ = sum of...

χ^2 0.65 [3]

Select page

HIGH

MIDDLE

LOW

Your Mark

6(a) ☐

6(b) ☐

6(c) ☐

6(d) ☐

Q6 Mark scheme

(a)

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parents genotypes	Eeaa	×	eeAa ;
gametes	Ea ea	×	eA ea ; A each gamete written twice
F2 genotypes	Eeaa eeaa		EeAa eeAa ; **[4]**

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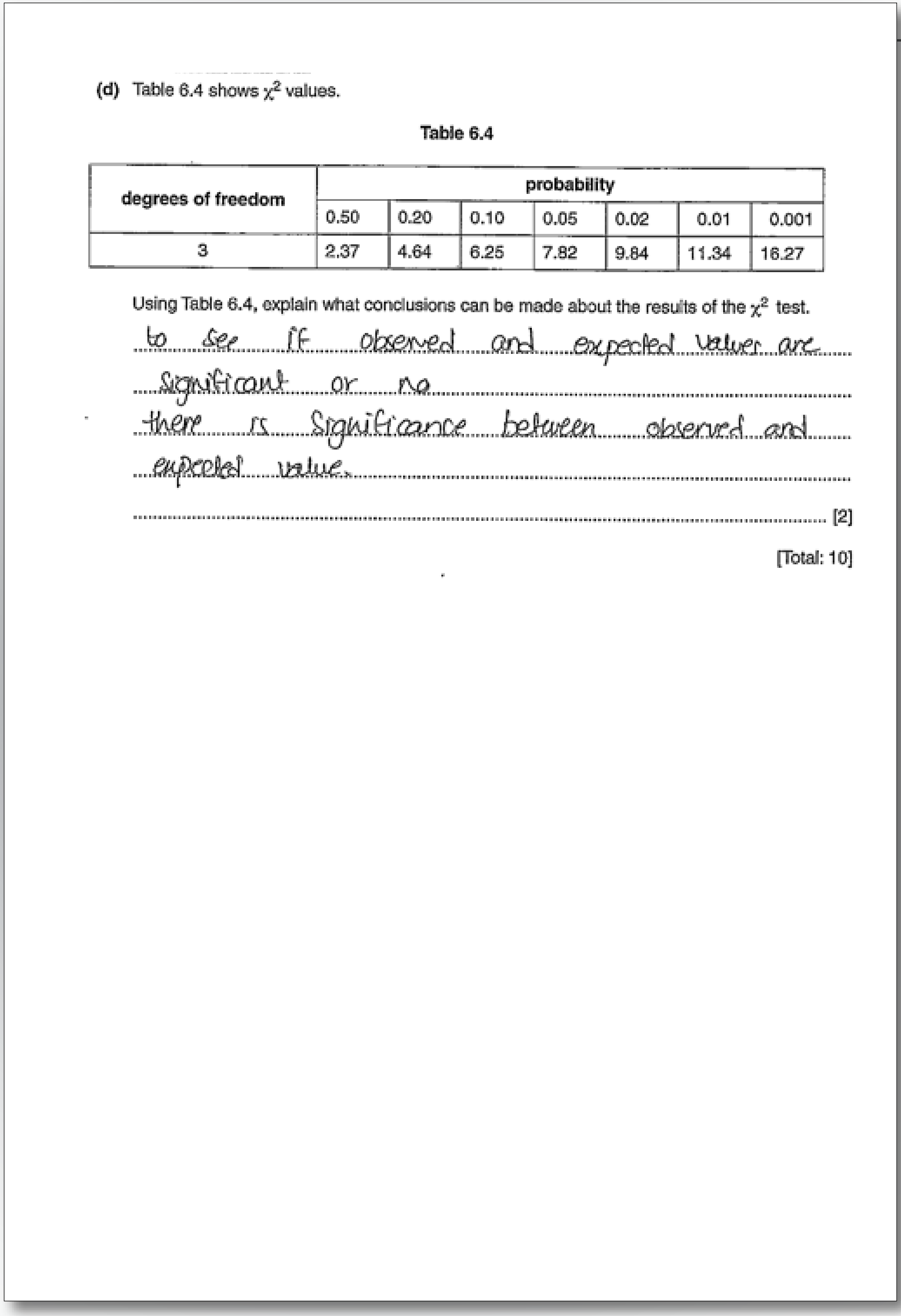
EXAMINER COMMENTS

MARK SCHEME



(d) Table 6.4 shows χ^2 values.

Table 6.4

degrees of freedom	**probability**						
	0.50	0.20	0.10	0.05	0.02	0.01	0.001
3	2.37	4.64	6.25	7.82	9.84	11.34	16.27

Using Table 6.4, explain what conclusions can be made about the results of the χ^2 test.

to see if observed and expected values are significant or no there is significance between observed and expected value.

[2]

[Total: 10]

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Your Mark

6(a)

6(b)

6(c)

6(d)

<table>
<tr><th>Q6</th><th>Mark scheme</th></tr>
<tr><td>(a)</td><td>key to 4 chosen symbols ;
A any two lettered pairs (e.g. E/e and A/a) identified I symbols for wing length
<i>no eyes and black abdomen</i> must be lower case (e, a)
<i>with eyes and striped abdomen</i> must be upper case (E, A)
<i>allow ecf to max 3 if error in symbols</i>
<i>parents genotypes</i> Eeaa × eeAa ;
<i>gametes</i> Ea ea × eA ea ; A each gamete written twice
<i>F2 genotypes</i> Eeaa eeaa EeAa eeAa ; [4]</td></tr>
<tr><td>(b)</td><td>cross with, homozygous recessive / black no-eyes, fly ;
A double recessive / aaee (or own symbols) / organism showing recessive characters or phenotype [4]</td></tr>
<tr><td>(c)</td><td>
<table>
<tr><th>observed number (O)</th><th>expected number (E)</th><th>O – E</th><th>(O – E)
2</th><th>(O – E)2
E</th></tr>
<tr><td>86</td><td>83</td><td>3</td><td>9</td><td>0.11</td></tr>
<tr><td>87</td><td>83</td><td>4</td><td>16</td><td>0.19</td></tr>
<tr><td>81</td><td>83</td><td>-2</td><td>4</td><td>0.05</td></tr>
<tr><td>78</td><td>83</td><td>-5</td><td>25</td><td>0.30</td></tr>
<tr><td>332</td><td>332</td><td></td><td colspan="2">;; χ2 = 0.65 ;</td></tr>
</table>
A fractions in last column A 3 s.f. in last column [3]</td></tr>
<tr><td>(d)</td><td>no significant <u>deviation</u> from expected / <u>difference</u> not significant ;
A (95% probability that) difference is due to chance
A data is a good fit / match
A null hypothesis (no significant difference between O and E)
R comment on significance of results
R ‘the value’ is not significant
probability (of this deviation) is over 0.05 / χ2 is less than 7.82 ;
A χ2 / results (of χ2 test), less than value at probability 0.05
<i>ref. to</i> <u>critical value</u> ; <i>ecf reverse arguments if answer from 6(c)is over 7.82</i>
<i>ref. to</i> independent assortment / AW ; [max 2]
[Total: 10]</td></tr>
</table>

EXAMINER COMMENTS

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Interactive Example Candidate Responses
Paper 4 (May/June 2016), Question 7
Cambridge International AS & A Level
Biology 9700

Version 1.0

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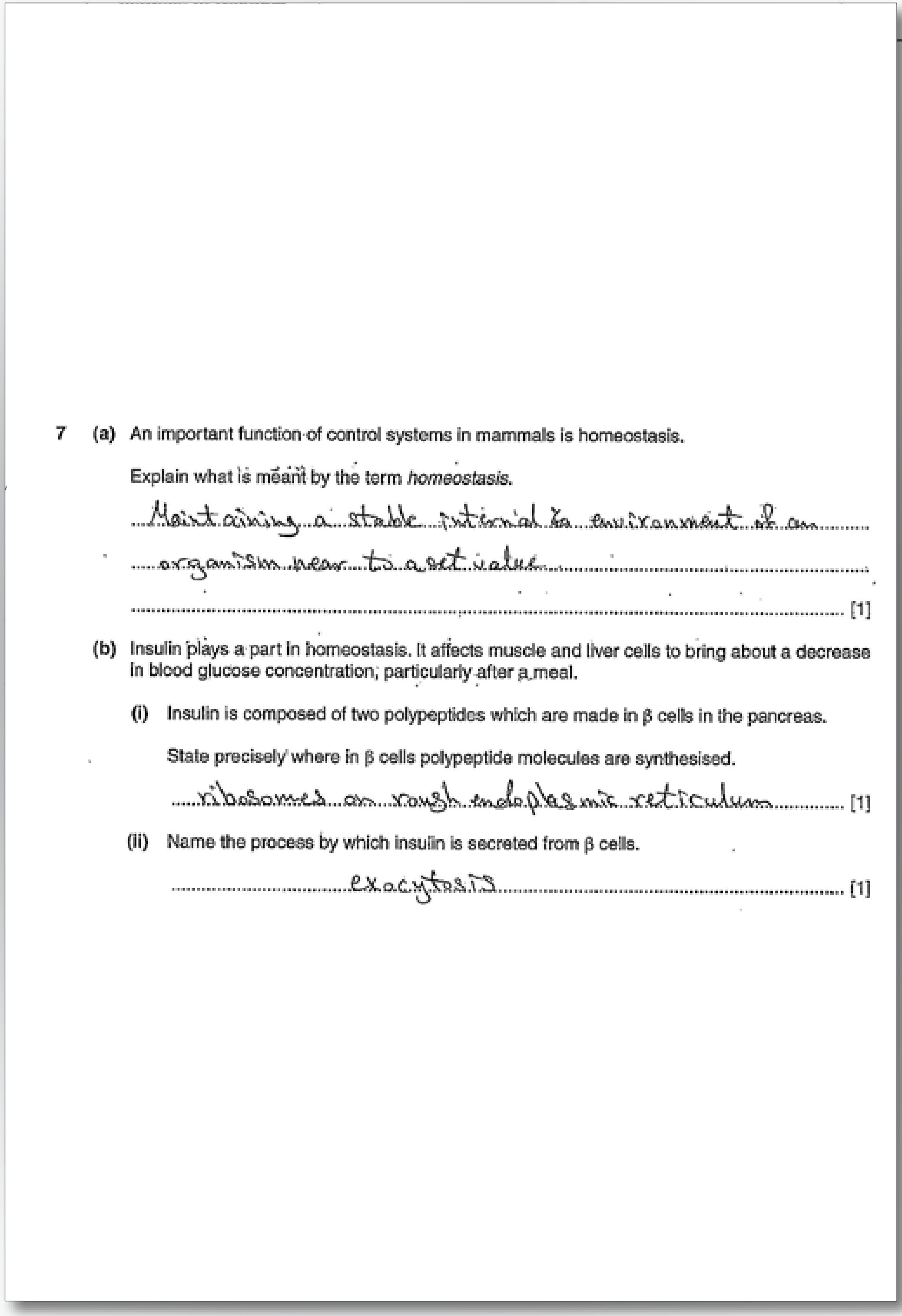


7 (a) An important function of control systems in mammals is homeostasis.

Explain what is meant by the term *homeostasis*.

Maintaining a stable internal to environment of an organism near to a set value [1]

(b) Insulin plays a part in homeostasis. It affects muscle and liver cells to bring about a decrease in blood glucose concentration, particularly after a meal.

(i) Insulin is composed of two polypeptides which are made in β cells in the pancreas.

State precisely where in β cells polypeptide molecules are synthesised.

ribosomes on rough endoplasmic reticulum [1]

(ii) Name the process by which insulin is secreted from β cells.

exocytosis [1]

Your Mark

7(a) ☐

5(b)(i) ☐

7(b)(ii) ☐

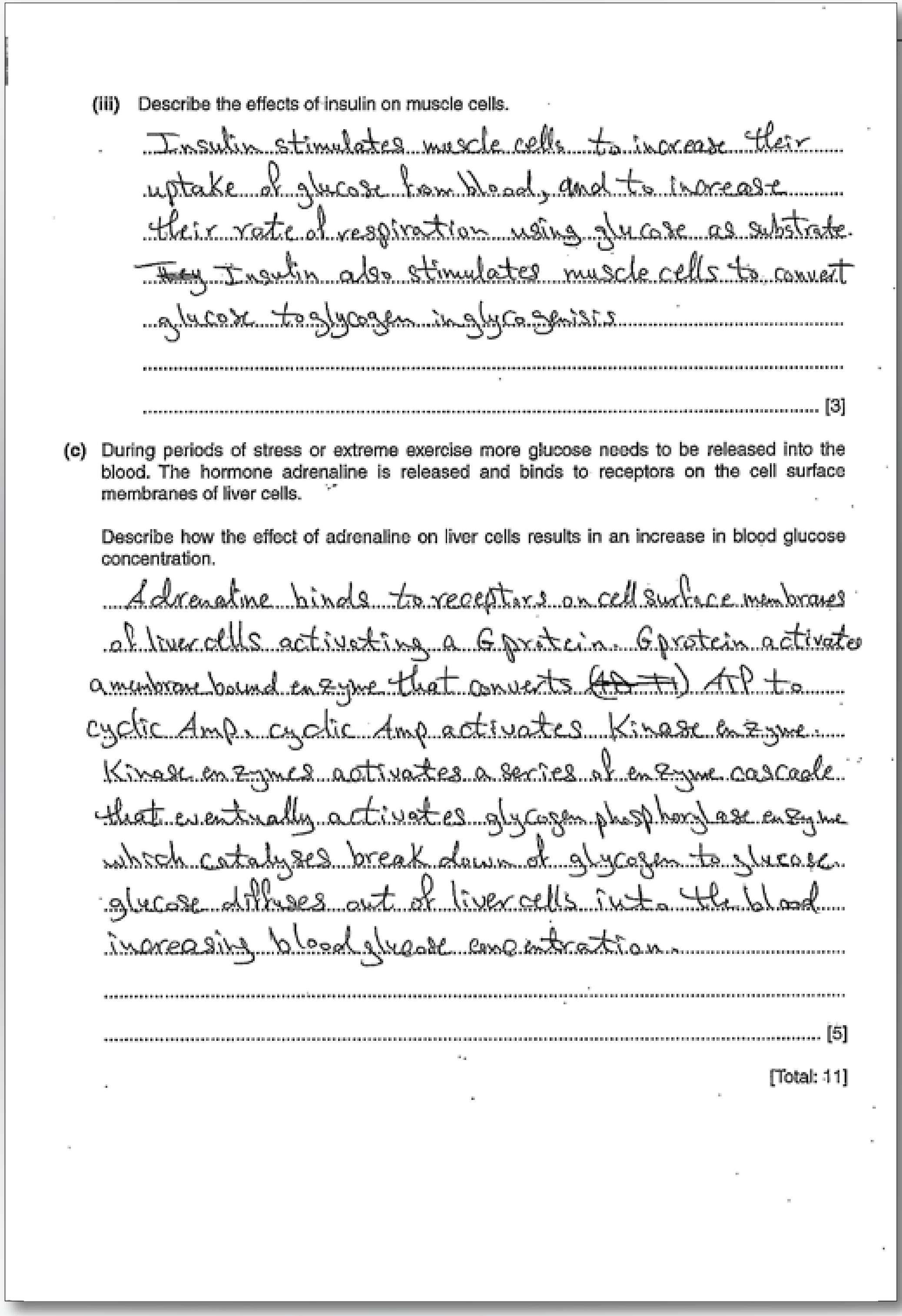
7(b)(iii) ☐

7(c) ☐

Q7	Mark scheme
(a)	maintaining a constant internal environment ; AW **R** external I body conditions **[1]**
(b)(i)	*ribosomes / rough endoplasmic reticulum / RER ;* **[1]**
(b)(ii)	*exocytosis ;* **[1]**
(b)(iii)	causes glucose uptake / increases permeability to glucose ; adds transport proteins to cell (surface) membrane ; **A** in sarcolemma **A** GLUT(4), proteins / channels / carriers more glucose respired / increase in respiration rate ; glucose converted to glycogen / glycogenesis ; **[max 3]**
(c)	*accept stimulates / stimulated, for activates / activated throughout* **1** (adrenaline) receptor shape change ; **2** G-proteins activated ; **A** description of G protein releases (α) subunit **3** adenylyl cyclase activated ; A adenyl(ate) cyclase **4** cyclic AMP made ; **5** (cAMP is) second messenger ; **6** activates / phosphorylates, kinase ; **7** *ref. to* enzyme cascade / cascade of reactions ; **8** glycogenolysis / hydrolysis of glycogen, stimulated / AW ; **A** break down glycogen **9** AVP ; gluconeogenesis / ref. to glucose transport proteins **A** description / glucose from, amino acids / lipids **A** GLUT(2) channels / carriers **[max 5]** **[Total: 11]**

EXAMINER COMMENTS

MARK SCHEME



(iii) Describe the effects of insulin on muscle cells.

Insulin stimulates muscle cells to increase their uptake of glucose from blood, and to increase their rate of respiration using glucose as substrate. ~~They~~ Insulin also stimulates muscle cells to convert glucose to glycogen in glycogenisis

[3]

(c) During periods of stress or extreme exercise more glucose needs to be released into the blood. The hormone adrenaline is released and binds to receptors on the cell surface membranes of liver cells.

Describe how the effect of adrenaline on liver cells results in an increase in blood glucose concentration.

Adrenaline binds to receptors on cell surface membranes of liver cells activating a G protein. G protein activates a membrane bound enzyme that converts (~~[illegible]~~) ATP to cyclic Amp. cyclic Amp activates Kinase enzyme. Kinase enzymes activates a series of enzyme cascade that eventually activates glycogen phosphorylase enzyme which catalyses break down of glycogen to glucose. glucose diffuses out of liver cells into the blood increasing blood glucose concentration.

[5]

[Total: 11]

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Your Mark

7(a) ☐

5(b)(i) ☐

7(b)(ii) ☐

7(b)(iii) ☐

7(c) ☐

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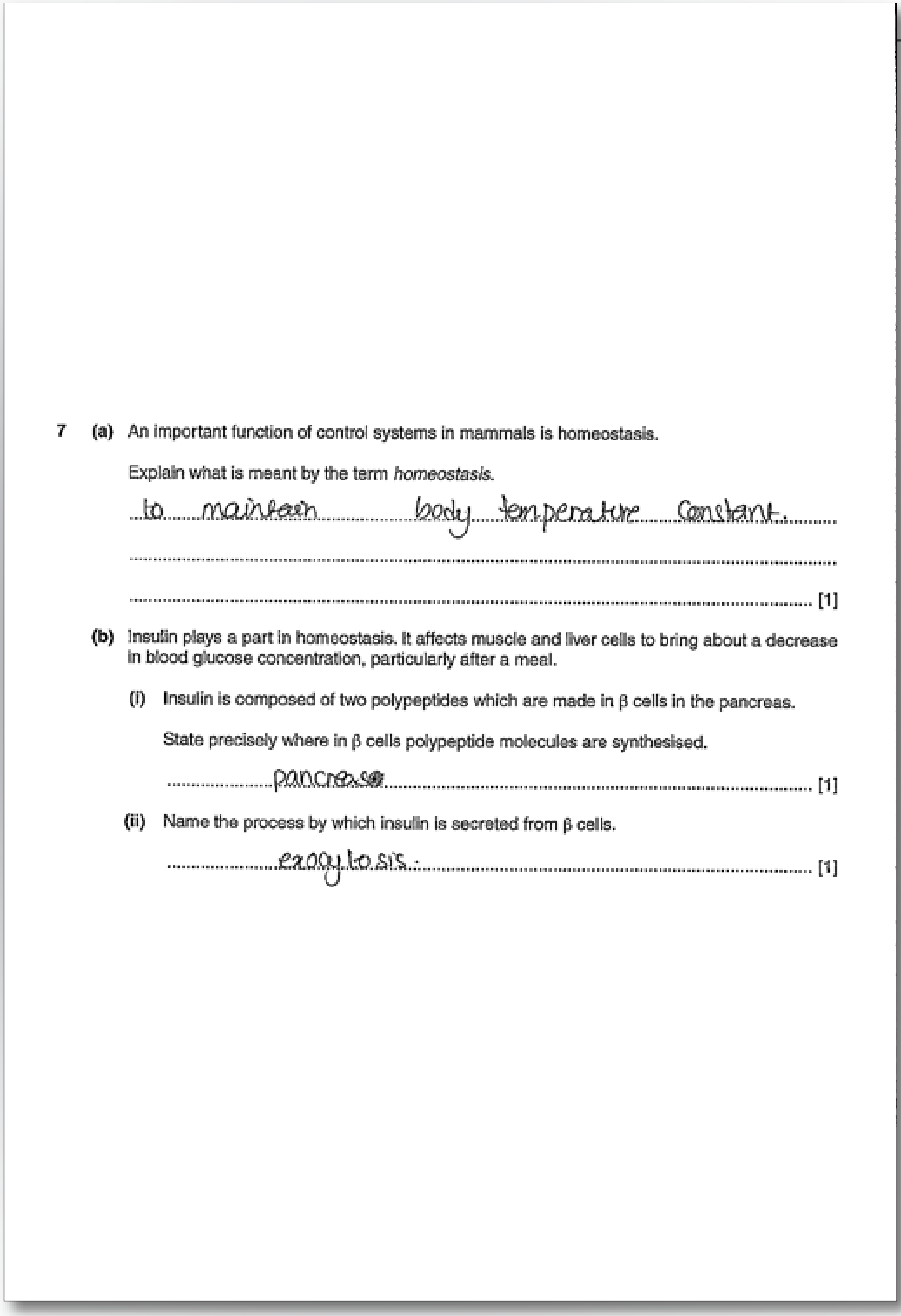

7 (a) An important function of control systems in mammals is homeostasis.

Explain what is meant by the term *homeostasis*.

to maintain body temperature constant.

[1]

(b) Insulin plays a part in homeostasis. It affects muscle and liver cells to bring about a decrease in blood glucose concentration, particularly after a meal.

(i) Insulin is composed of two polypeptides which are made in β cells in the pancreas.

State precisely where in β cells polypeptide molecules are synthesised.

pancreas [1]

(ii) Name the process by which insulin is secreted from β cells.

exocytosis. [1]

Your Mark

7(a) ☐

5(b)(i) ☐

7(b)(ii) ☐

7(b)(iii) ☐

7(c) ☐

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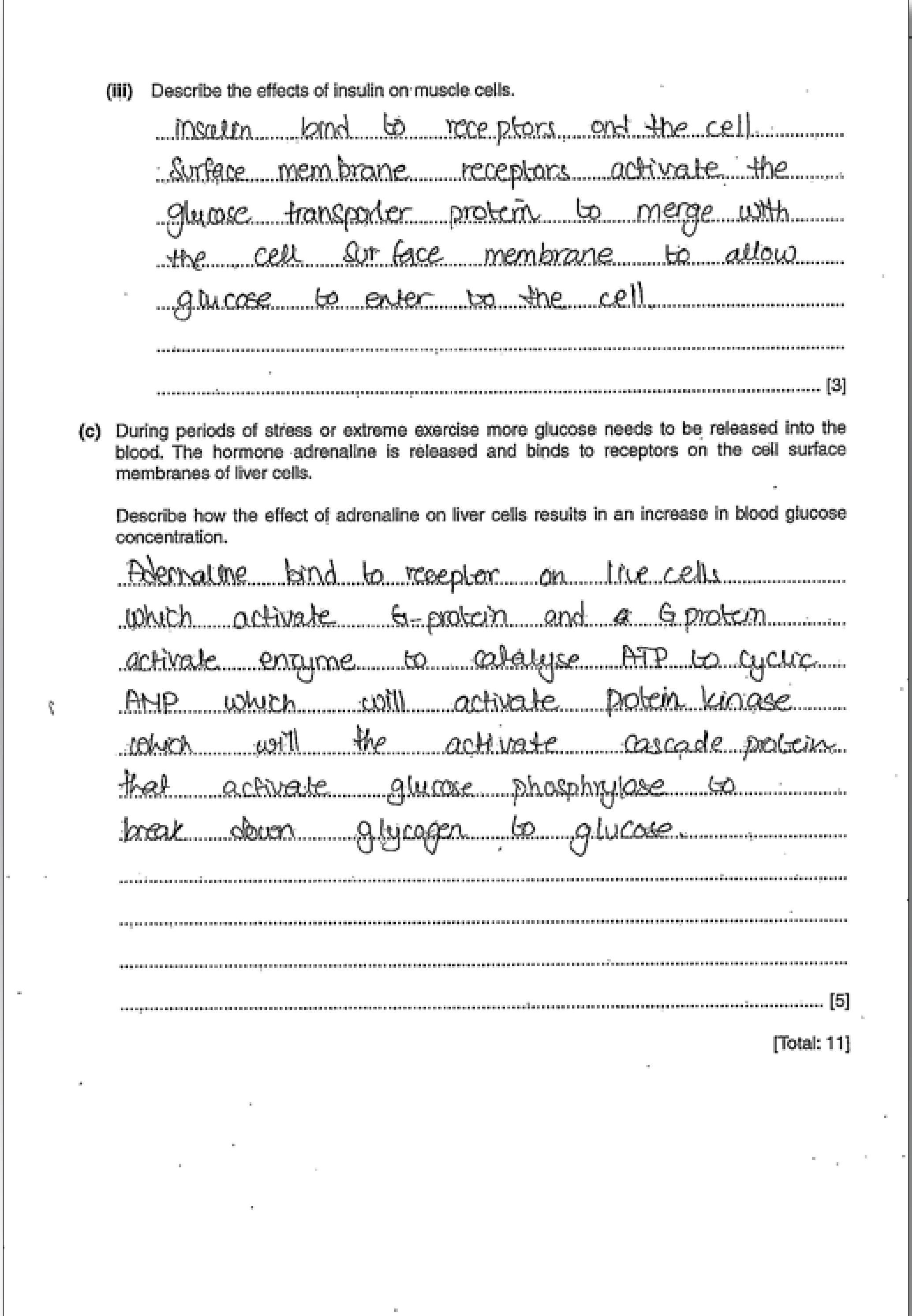

(iii) Describe the effects of insulin on muscle cells.

insulin bind to receptors ond the cell surface membrane receptors activate the glucose transporter protein to merge with the cell surface membrane to allow glucose to enter to the cell

[3]

(c) During periods of stress or extreme exercise more glucose needs to be released into the blood. The hormone adrenaline is released and binds to receptors on the cell surface membranes of liver cells.

Describe how the effect of adrenaline on liver cells results in an increase in blood glucose concentration.

Adernaline bind to receptor on live cells which activate G-protein and ~~a~~ G protein activate enzyme to catalyse ATP to cyclic AMP which will activate protein kinase which will the activate cascade protein that activate glucose phosphrylase to break down glycogen to glucose.

[5]

[Total: 11]

Your Mark

7(a) ☐

5(b)(i) ☐

7(b)(ii) ☐

7(b)(iii) ☐

7(c) ☐

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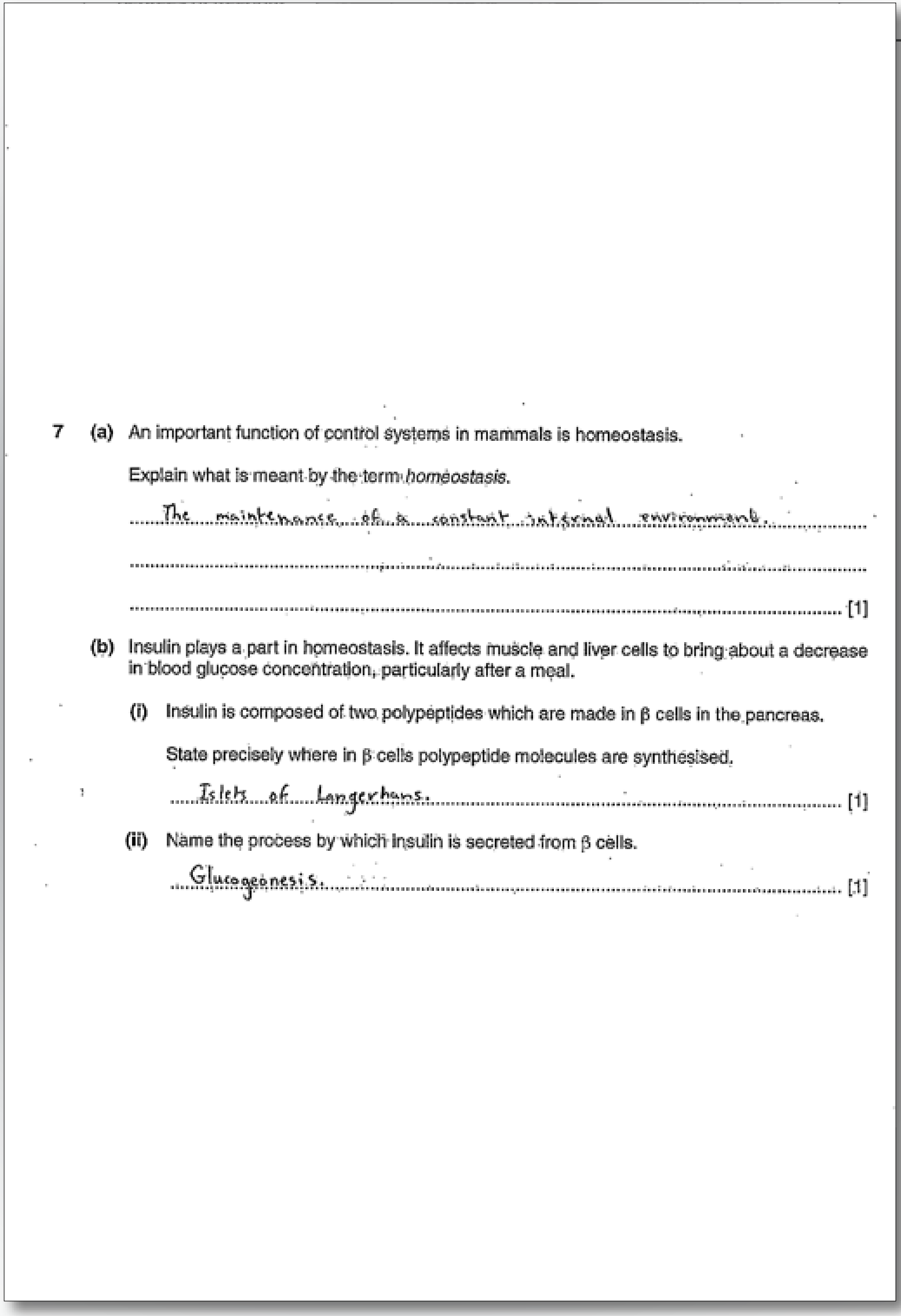

7 (a) An important function of control systems in mammals is homeostasis.

Explain what is meant by the term *homeostasis*.

The maintenance of a constant internal environment.

[1]

(b) Insulin plays a part in homeostasis. It affects muscle and liver cells to bring about a decrease in blood glucose concentration, particularly after a meal.

(i) Insulin is composed of two polypeptides which are made in β cells in the pancreas.

State precisely where in β cells polypeptide molecules are synthesised.

Islets of Langerhans. [1]

(ii) Name the process by which insulin is secreted from β cells.

Glucogeonesis. [1]

Your Mark

7(a)

7(b)(i)

7(b)(ii)

7(b)(iii)

7(c)

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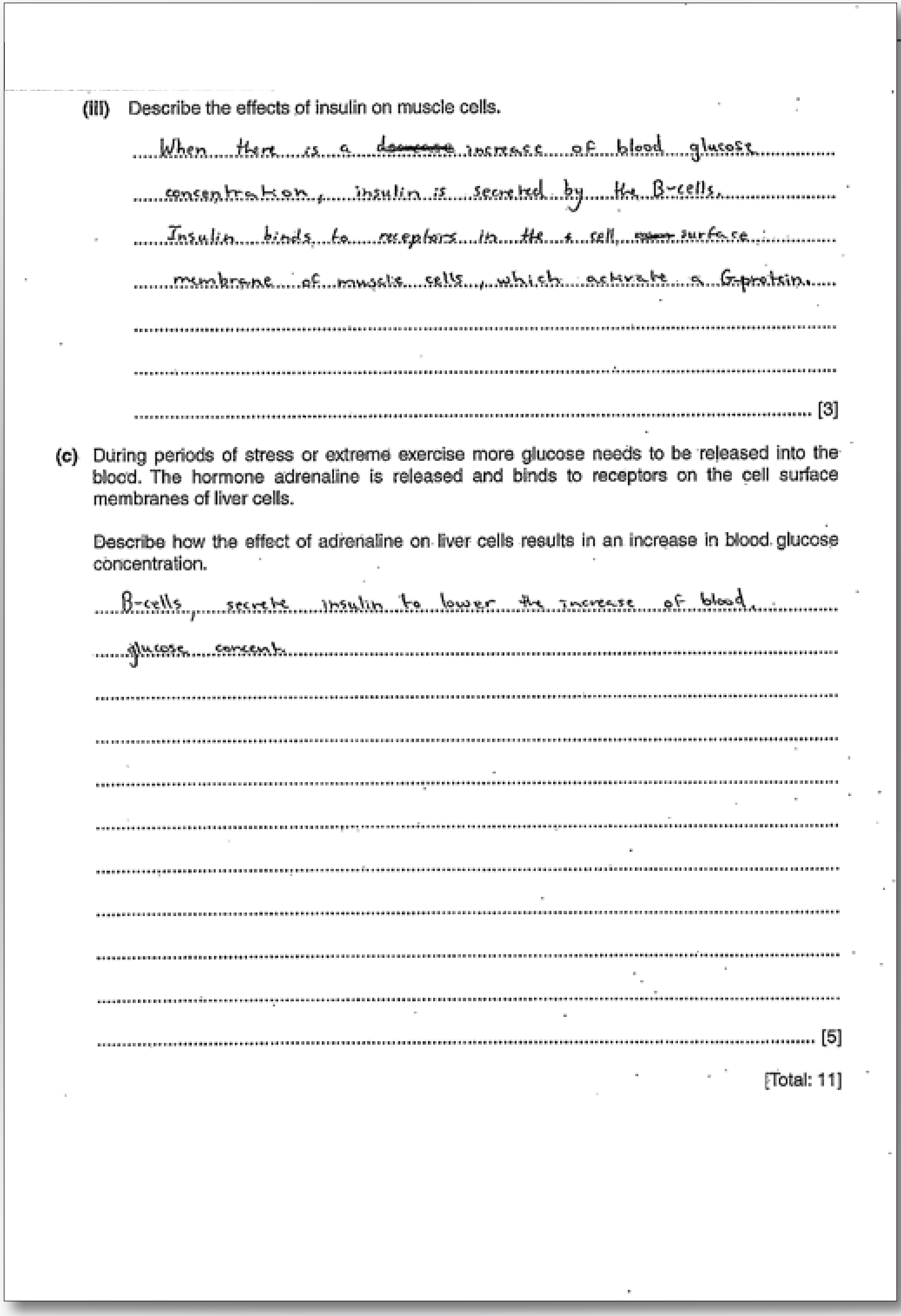

(iii) Describe the effects of insulin on muscle cells.

When there is a ~~decrease~~ increase of blood glucose concentration, insulin is secreted by the B-cells. Insulin binds to receptors in the cell ~~mem~~ surface membrane of muscle cells, which activate a G-protein.

[3]

(c) During periods of stress or extreme exercise more glucose needs to be released into the blood. The hormone adrenaline is released and binds to receptors on the cell surface membranes of liver cells.

Describe how the effect of adrenaline on liver cells results in an increase in blood glucose concentration.

B-cells, secrete insulin to lower the increase of blood, glucose concent.

[5]

[Total: 11]

Your Mark

7(a) ☐

7(b)(i) ☐

7(b)(ii) ☐

7(b)(iii) ☐

7(c) ☐

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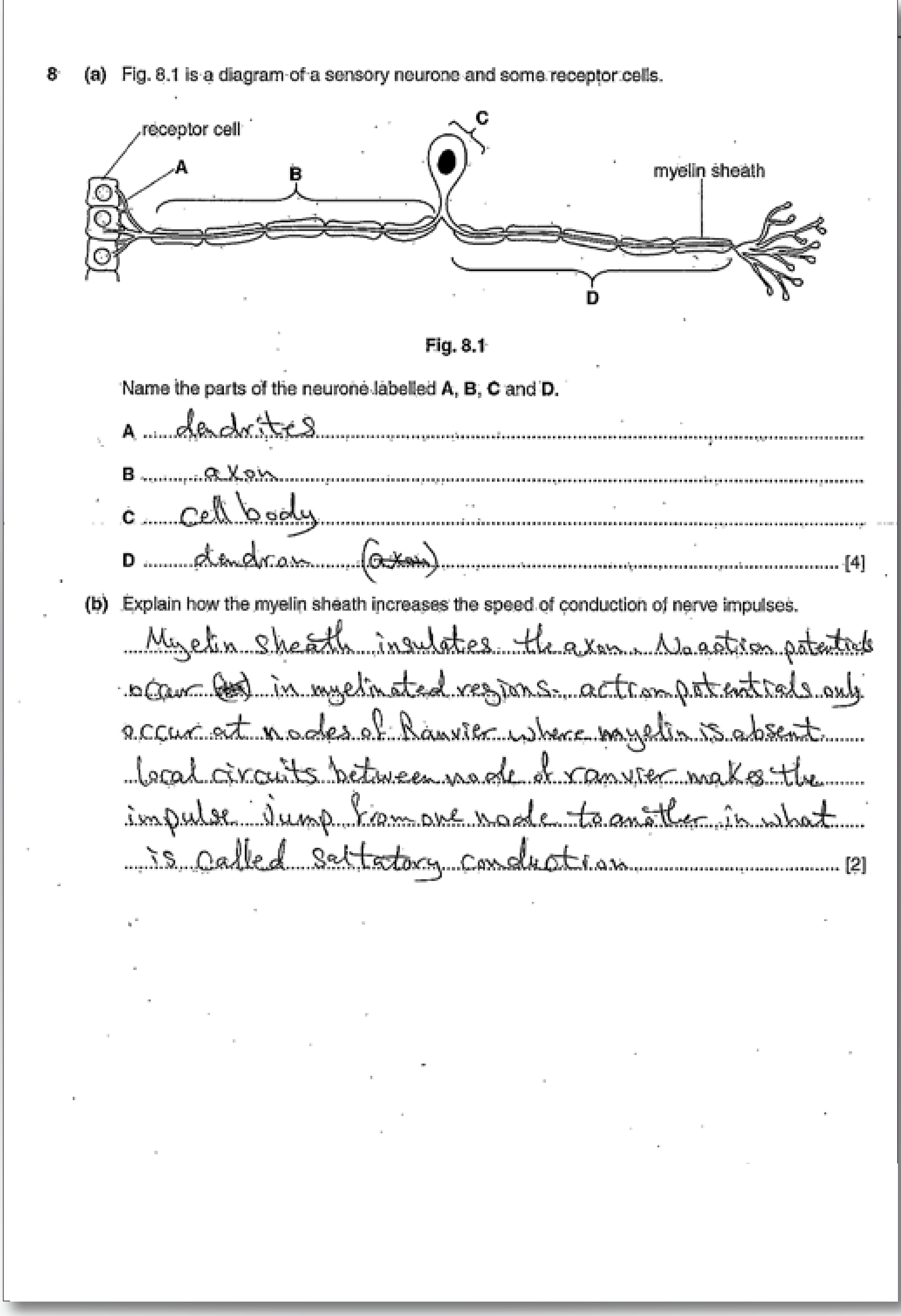


8 (a) Fig. 8.1 is a diagram of a sensory neurone and some receptor cells.

Fig. 8.1

Name the parts of the neurone labelled **A**, **B**, **C** and **D**.

A dendrites

B axon

C cell body

D dendron (~~axon~~) [4]

(b) Explain how the myelin sheath increases the speed of conduction of nerve impulses.

Myelin sheath insulates the axon. No action potentials occur in myelinated regions. action potentials only occur at nodes of Ranvier where myelin is absent. local circuits between node of ranvier makes the impulse jump from one node to another in what is called saltatory conduction [2]

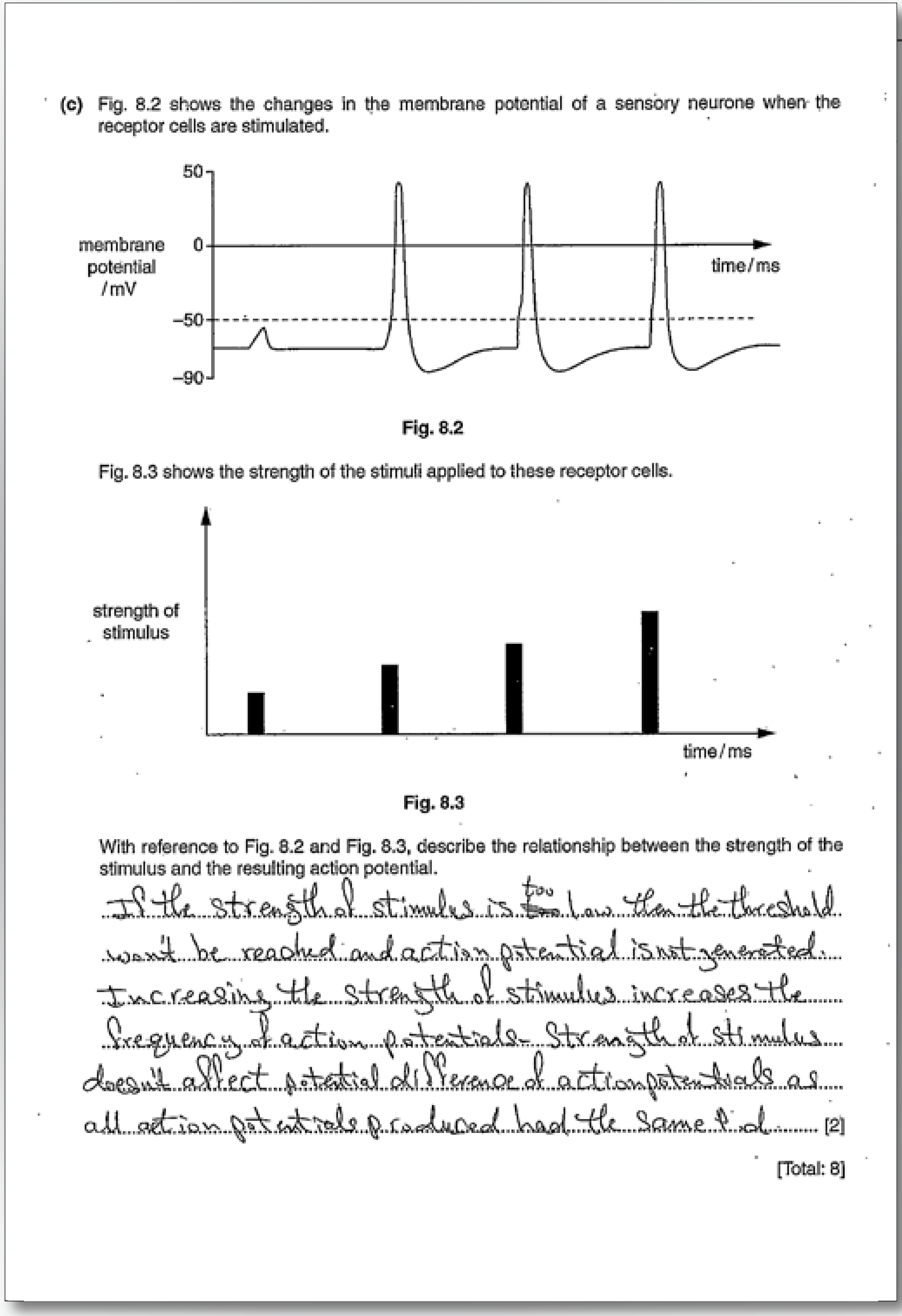
Your Mark

8(a) ☐

8(b) ☐

8(c) ☐

Q8	Mark scheme
(a)	**A** – dendrite(s) ; **B** – dendron / (sensory) axon ; **C** – cell body (of neurone) / soma / centron ; **D** – axon (membrane) ; **A** terminal axon **[4]**
(b)	myelin insulates (axon) ; action potentials / depolarisation, only at nodes (of Ranvier) ; local circuits set up between nodes ; I local circuits at nodes action potentials / impulses, 'jump' from node to node or saltatory conduction **[max 2]**
(c)	only, stimulus / depolarisation / receptor potential / potential difference, that reaches threshold produces an action potential ; ora **A** -50mV for threshold **A** generator for receptor *idea that* the action potential is the same size no matter how strong the stimulus ; *ref. to* all-or-nothing (law) ; I all-and-nothing **[max 2]** **[Total: 8]**



(c) Fig. 8.2 shows the changes in the membrane potential of a sensory neurone when the receptor cells are stimulated.

Fig. 8.2

Fig. 8.3 shows the strength of the stimuli applied to these receptor cells.

Fig. 8.3

With reference to Fig. 8.2 and Fig. 8.3, describe the relationship between the strength of the stimulus and the resulting action potential.

If the strength of stimulus is too low then the threshold won't be reached and action potential is not generated. Increasing the strength of stimulus increases the frequency of action potentials. Strength of stimulus doesn't affect potential difference of action potentials as all action potentials produced had the same p.d. [2]

[Total: 8]

Your Mark

8(a) ☐

8(b) ☐

8(c) ☐

Q8	Mark scheme
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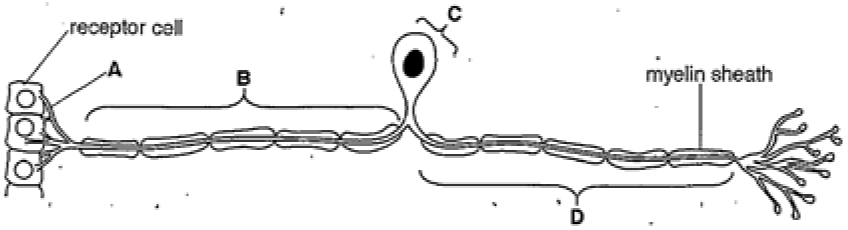

Fig. 8.1

Name the parts of the neurone labelled **A**, **B**, **C** and **D**.

A Dendrites

B axon

C cell body

D axon [4]

(b) Explain how the myelin sheath increases the speed of conduction of nerve impulses.

it makes the impulse ~~travel~~ jumps from node of ranvier to another by saltatory movement. Increasing speed of conduction 50 times It's impramble. [2]

Your Mark

8(a) ☐

8(b) ☐

8(c) ☐

Q8	Mark scheme
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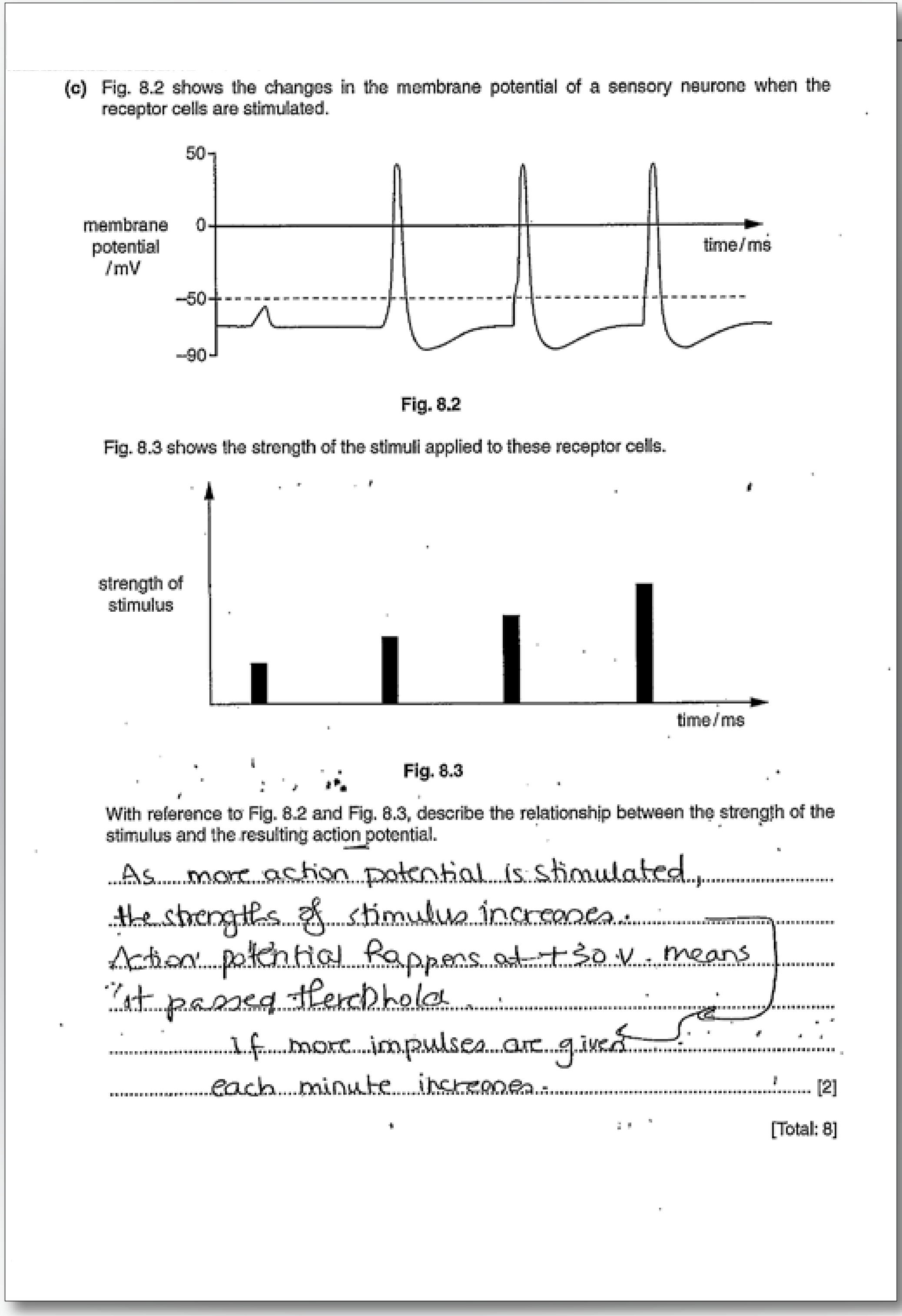

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Fig. 8.2

Fig. 8.3 shows the strength of the stimuli applied to these receptor cells.

Fig. 8.3

With reference to Fig. 8.2 and Fig. 8.3, describe the relationship between the strength of the stimulus and the resulting action potential.

As more action potential is stimulated, the strengths of stimulus increases. Action potential happens at +30 V. means it passed therdhold. If more impulses are given each minute increases. [2]

[Total: 8]

Your Mark

8(a) ☐

8(b) ☐

8(c) ☐

Q8	**Mark scheme**
(a)	**A** – dendrite(s) ; **B** – dendron / (sensory) axon ; **C** – cell body (of neurone) / soma / centron ; **D** – axon (membrane) ; **A** terminal axon **[4]**
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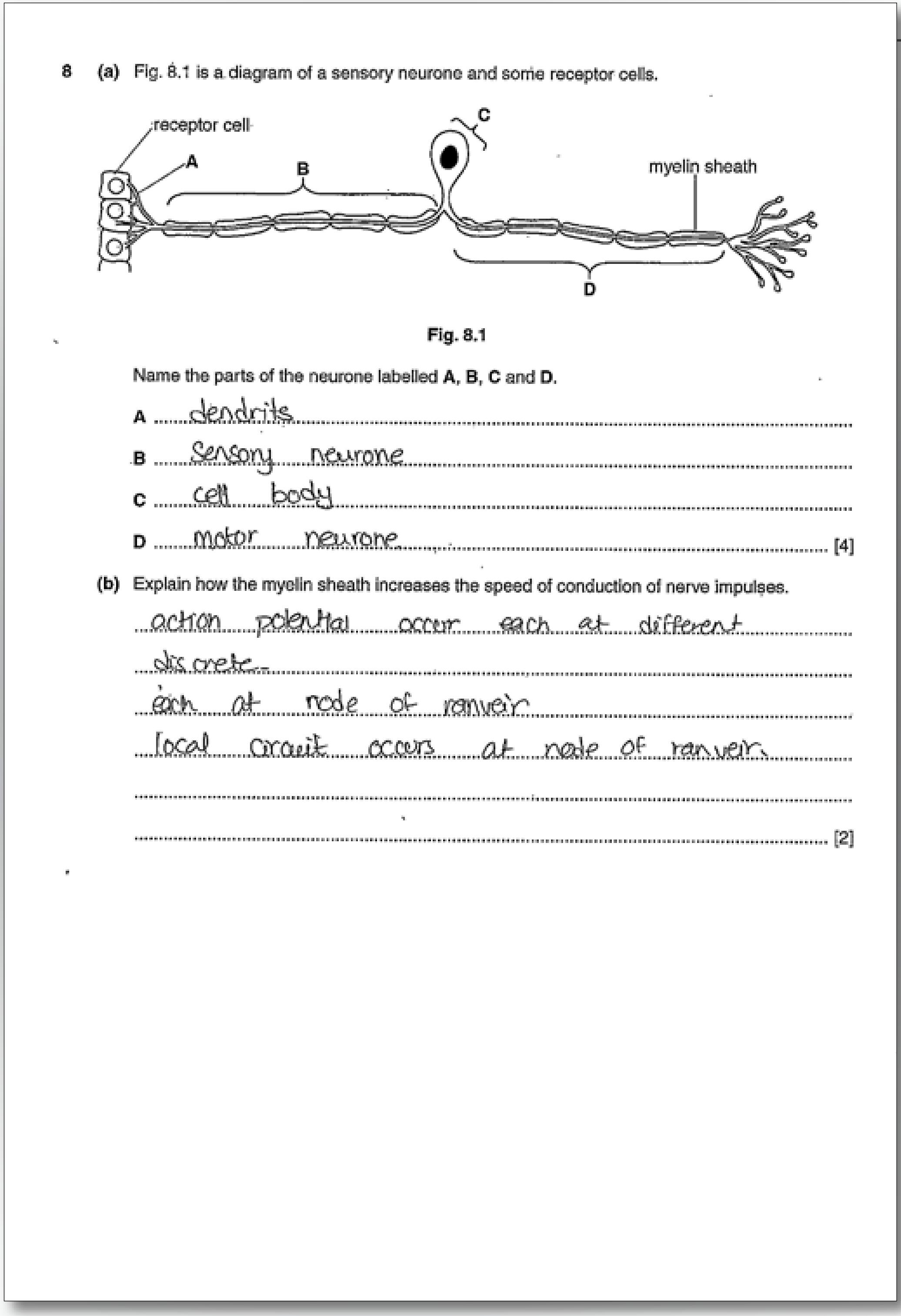

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Fig. 8.1

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A dendrits

B Sensory neurone

C cell body

D motor neurone [4]

(b) Explain how the myelin sheath increases the speed of conduction of nerve impulses.

action potential occur each at different

dis crete

each at node of ranveir

local circuit occurs at node of ranveir

[2]

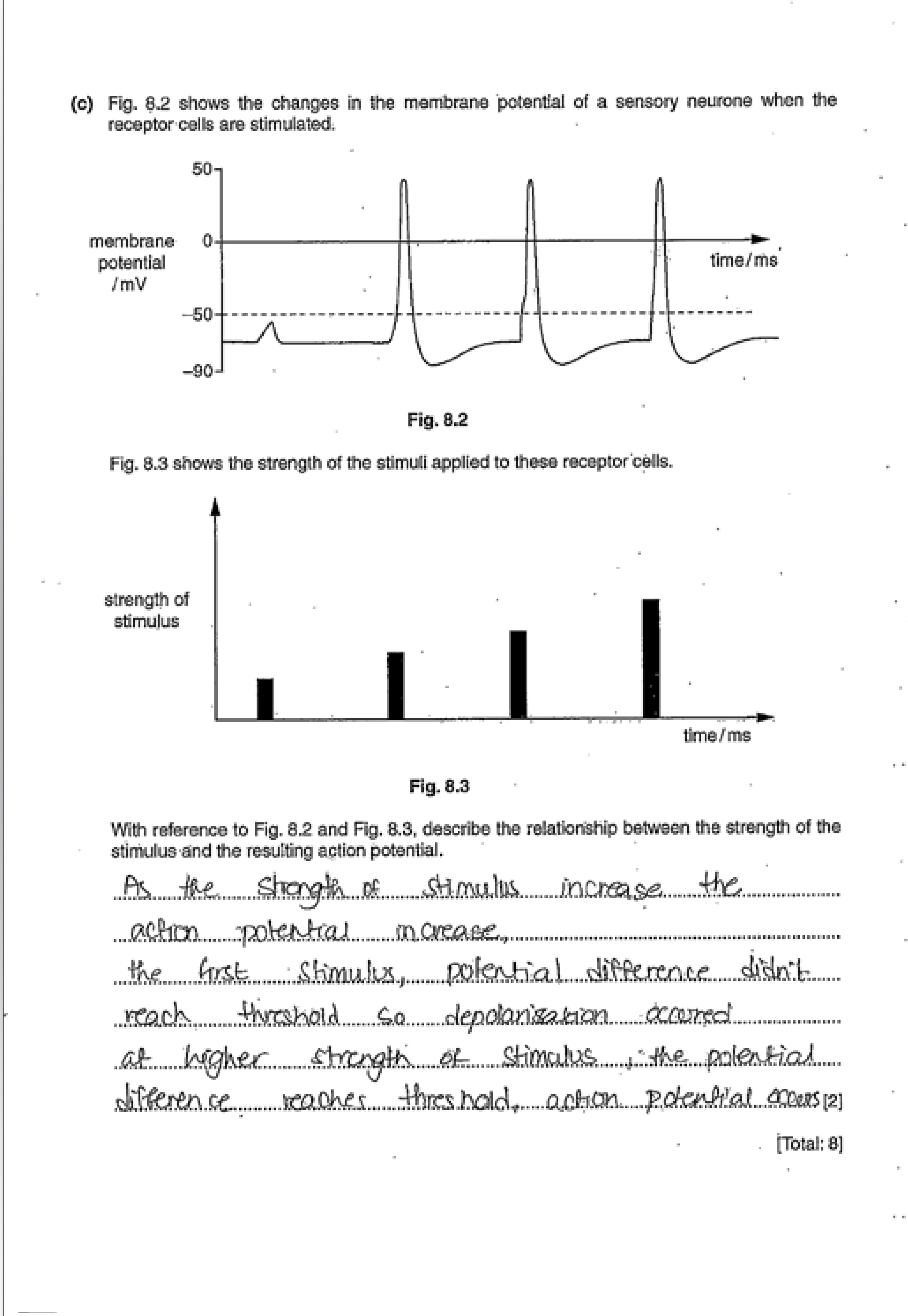
Your Mark

8(a) ☐

8(b) ☐

8(c) ☐

Q8	Mark scheme
(a)	**A** – dendrite(s) ; **B** – dendron / (sensory) axon ; **C** – cell body (of neurone) / soma / centron ; **D** – axon (membrane) ; **A** terminal axon **[4]**
(b)	myelin insulates (axon) ; action potentials / depolarisation, only at nodes (of Ranvier) ; local circuits set up between nodes ; I local circuits at nodes action potentials / impulses, 'jump' from node to node or saltatory conduction **[max 2]**
(c)	only, stimulus / depolarisation / receptor potential / potential difference, that reaches threshold produces an action potential ; ora **A** -50mV for threshold **A** generator for receptor *idea that* the action potential is the same size no matter how strong the stimulus ; *ref. to* all-or-nothing (law) ; I all-and-nothing **[max 2]** **[Total: 8]**



(c) Fig. 8.2 shows the changes in the membrane potential of a sensory neurone when the receptor cells are stimulated.

Fig. 8.2

Fig. 8.3 shows the strength of the stimuli applied to these receptor cells.

Fig. 8.3

With reference to Fig. 8.2 and Fig. 8.3, describe the relationship between the strength of the stimulus and the resulting action potential.

As the Strength of stimulus increase the action potential increase, the first Stimulus, potential difference didn't reach threshold so depolarization occured at higher strength of Stimulus , the potential difference reaches threshold, action potential occurs [2]

[Total: 8]

Your Mark

8(a) ☐

8(b) ☐

8(c) ☐

Q8	Mark scheme
(a)	**A** – dendrite(s) ; **B** – dendron / (sensory) axon ; **C** – cell body (of neurone) / soma / centron ; **D** – axon (membrane) ; **A** terminal axon **[4]**
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Interactive

Interactive Example Candidate Responses
Paper 4 (May/June 2016), Question 9
Cambridge International AS & A Level
Biology 9700

Version 1.0

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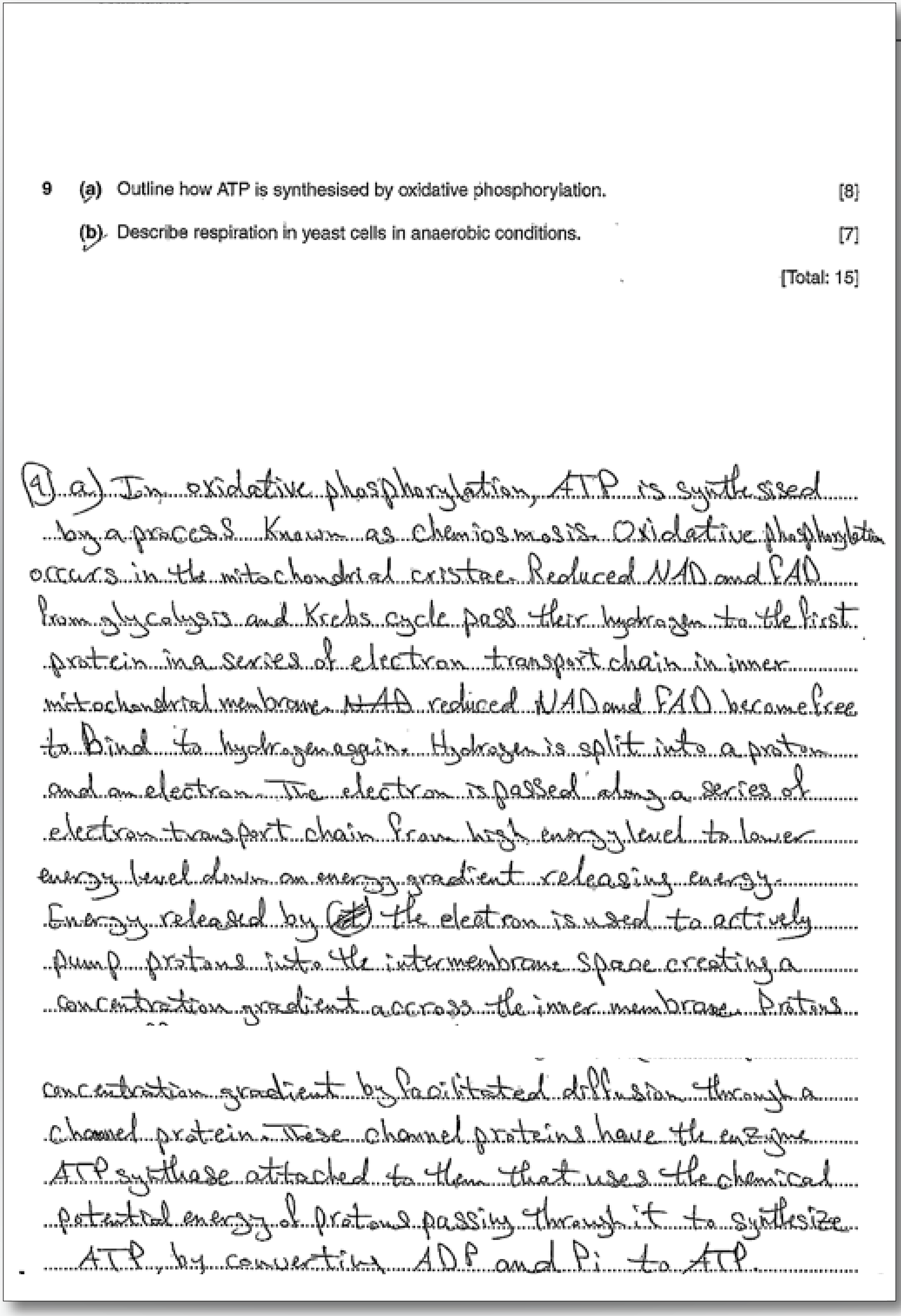

9 (a) Outline how ATP is synthesised by oxidative phosphorylation. [8]

(b) Describe respiration in yeast cells in anaerobic conditions. [7]

[Total: 15]

9 a) In oxidative phosphorylation, ATP is synthesised by a process Known as chemiosmosis. Oxidative phosphorylatn occurs in the mitochondrial cristae. Reduced NAD and FAD from glycolysis and Krebs cycle pass their hydrogen to the first protein in a series of electron transport chain in inner mitochondrial membrane. ~~NAD~~ reduced NAD and FAD become free to Bind to hydrogen again. Hydrogen is split into a proton and an electron. The electron is passed along a series of electron transport chain from high energy level to lower energy level down an energy gradient releasing energy. Energy released by the electron is used to actively pump protons into the intermembrane space creating a concentration gradient accross the inner membrane. Protons

concentration gradient by facilitated diffusion through a channel protein. These channel proteins have the enzyme ATP synthase attached to them that uses the chemical potential energy of protons passing through it to synthesize ATP by converting ADP and Pi to ATP.

Select page

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MIDDLE

LOW

Your Mark

9(a)

9(b)

Q9	**Mark scheme**
(a)	*accept proton / hydrogen ion / H^+ / H ion as equivalent throughout* **1** reduced, NAD / FAD ; A NADH / NADH2 / NADH + H+ for reduced NAD **2** passed to ETC ; **3** inner membrane / cristae ; **4** hydrogen released (from reduced, NAD / FAD) ; **R** H_2 **5** split into electrons and protons ; **A** released as electron and proton **6** electrons pass along, carriers / cytochromes ; **A** electrons pass along proteins of, ETC / carrier chain **7** energy released pumps protons into intermembrane space ; **8** proton gradient is set up ; **A** concentration gradient of protons is created **A** full description **9** protons diffuse, (back) through membrane / down gradient ; **A** protons diffuse into matrix **10** ATP synthase / stalked particles / protein channels ; **A** ATP synthetase R ATPase **11** (ATP produced from) ADP and (inorganic) phosphate ; **A** context for 'final' **12** idea of oxygen as final electron acceptor ; **13** addition of proton (to oxygen) to form water / (oxygen) reduced to water ; **[max 8]**
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EXAMINER COMMENTS

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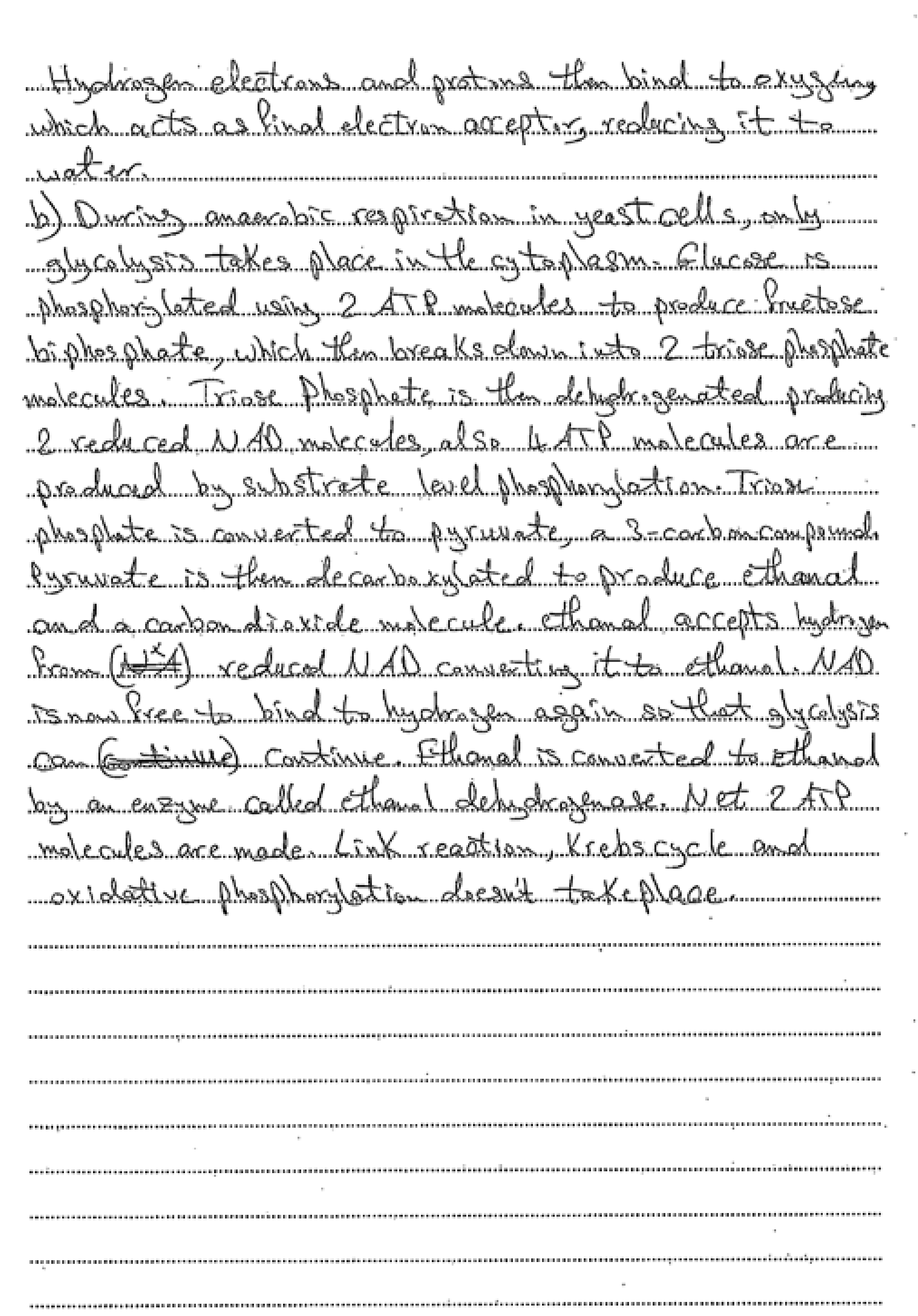

Hydrogen electrons and protons then bind to oxygen which acts as final electron acceptor, reducing it to water.

b) During anaerobic respiration in yeast cells, only glycolysis takes place in the cytoplasm. Glucose is phosphorylated using 2 ATP molecules to produce fructose biphosphate, which then breaks down into 2 triose phosphate molecules. Triose Phosphate is then dehydrogenated producing 2 reduced NAD molecules, also 4 ATP molecules are produced by substrate level phosphorylation. Triose phosphate is converted to pyruvate, a 3-carbon compound. Pyruvate is then decarboxylated to produce ethanal and a carbon dioxide molecule. ethanal accepts hydrogen from (~~NAD~~) reduced NAD converting it to ethanol. NAD is now free to bind to hydrogen again so that glycolysis can (~~continue~~) continue. Ethanal is converted to ethanol by an enzyme called ethanol dehydrogenase. Net 2 ATP molecules are made. Link reaction, Krebs cycle and oxidative phosphorylation doesn't take place.

Your Mark

9(a) ☐

9(b) ☐

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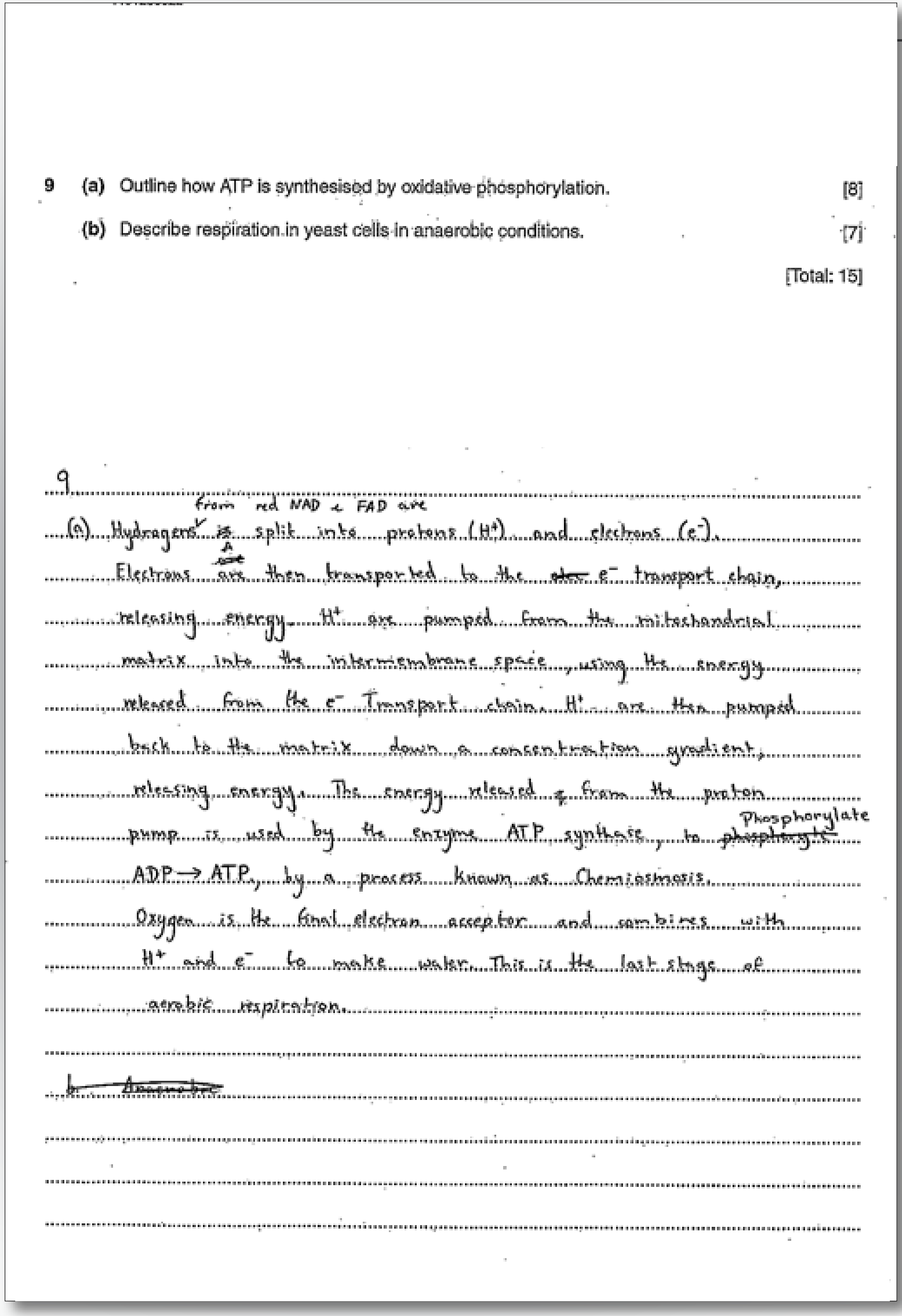

9 (a) Outline how ATP is synthesised by oxidative phosphorylation. [8]

(b) Describe respiration in yeast cells in anaerobic conditions. [7]

[Total: 15]

9

(a) Hydrogens ~~is~~ from red NAD & FAD are split into protons (H^+) and electrons (e^-).
Electrons are then transported to the ~~ele~~ e^- transport chain,
releasing energy. H^+ are pumped from the mitochondrial
matrix into the intermembrane space, using the energy
released from the e^- Transport chain. H^+ are then pumped
back to the matrix down a concentration gradient,
releasing energy. The energy released from the proton
pump is used by the enzyme ATP synthase, to ~~phosphoryate~~ Phosphorylate
ADP → ATP, by a process known as Chemiosmosis.
Oxygen is the final electron acceptor and combines with
H^+ and e^- to make water. This is the last stage of
aerobic respiration.

~~b Anaerobic~~

Your Mark

9(a) ☐

9(b) ☐

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EXAMINER COMMENTS

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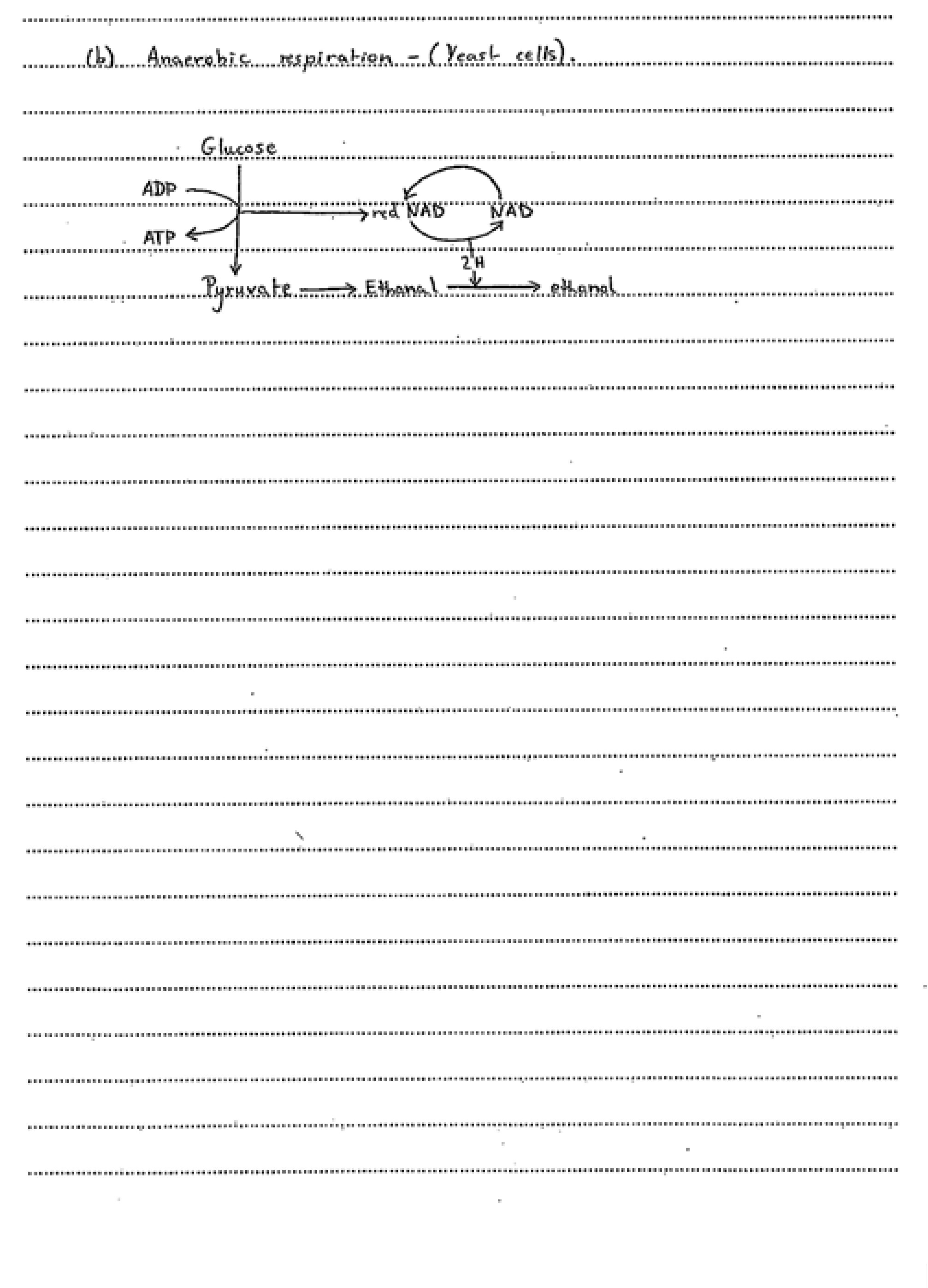

(b) Anaerobic respiration - (Yeast cells).

Your Mark

9(a) ☐

9(b) ☐

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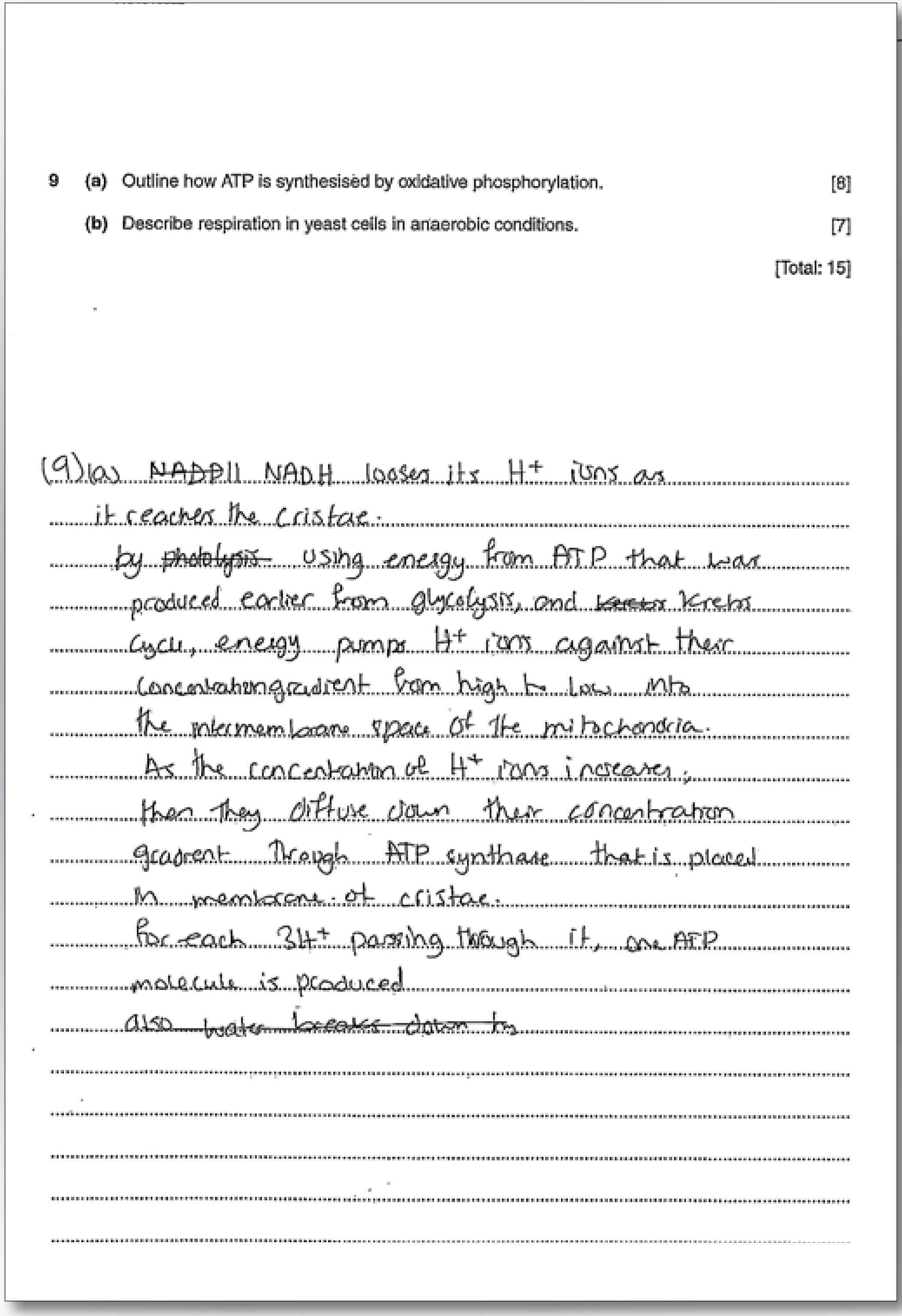

9 (a) Outline how ATP is synthesised by oxidative phosphorylation. [8]

(b) Describe respiration in yeast cells in anaerobic conditions. [7]

[Total: 15]

(9)(a) ~~NADPH~~ NADH looses its H^+ ions as it reaches the cristae.
by ~~photolysis~~ using energy from ATP that was produced earlier from glycolysis, and ~~Kerbs~~ Krebs cycle, energy pumps H^+ ions against their concentrationgradient from high to low into the intermembrane space of the mitochondria.
As the concentration of H^+ ions increases, then they diffuse down their concentration gradient through ATP synthase that is placed in membrane of cristae.
For each $3H^+$ passing through it, one ATP molecule is produced
also ~~water breaks down to~~

Your Mark

9(a) ☐

9(b) ☐

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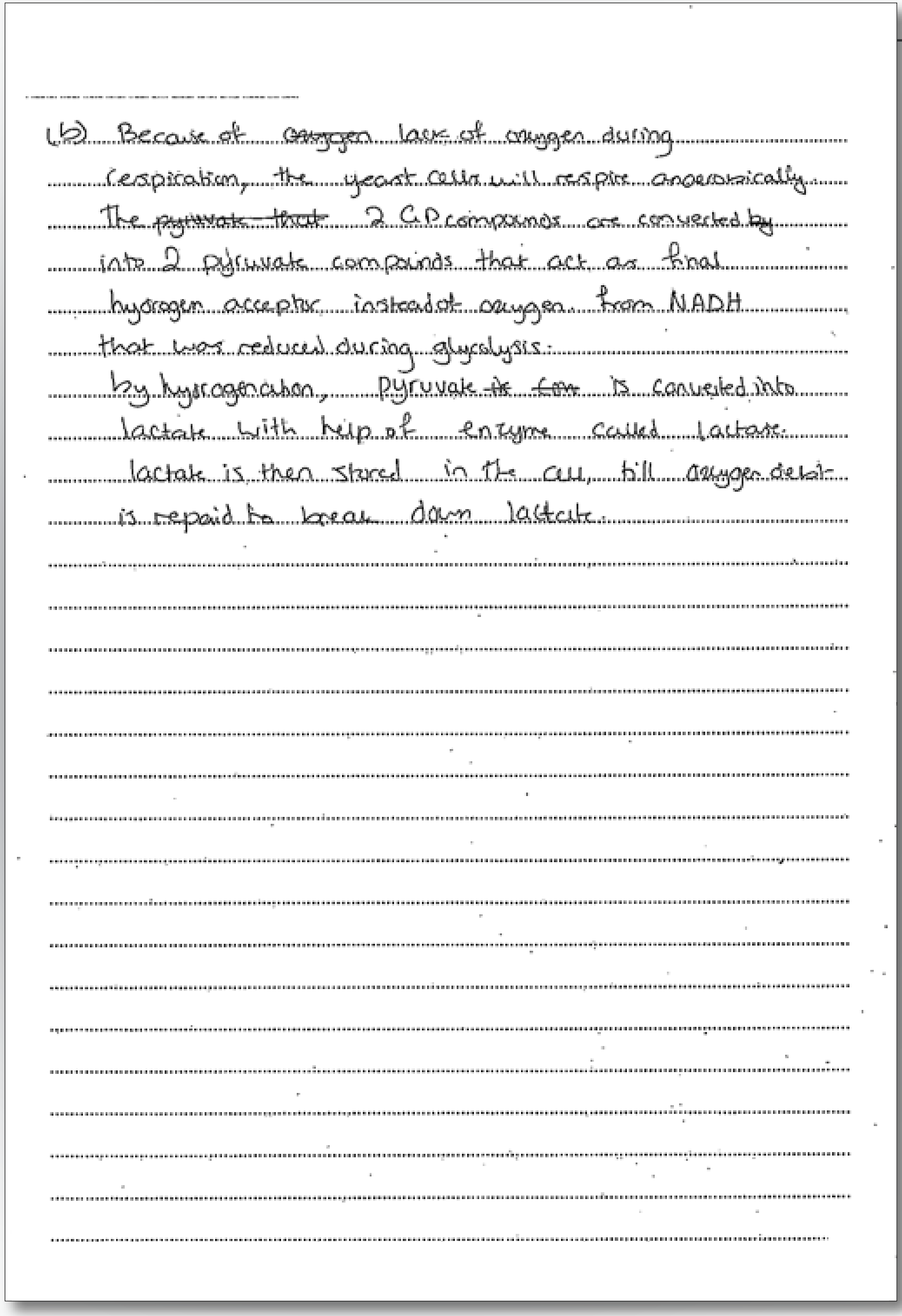

(b) Because of ~~oxygen~~ lack of oxygen during respiration, the yeast cells will respire anaerobically. The ~~pyruvate that~~ 2 C.P compounds are converted by into 2 pyruvate compounds that act as final hydrogen acceptor instead of oxygen from NADH that was reduced during glycolysis. by hydrogenation, pyruvate ~~is~~ ~~for~~ is converted into lactate with help of enzyme called lactase. lactate is then stored in the cell, till oxygen debt is repaid to break down lactate.

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LOW

Your Mark

9(a) ☐

9(b) ☐

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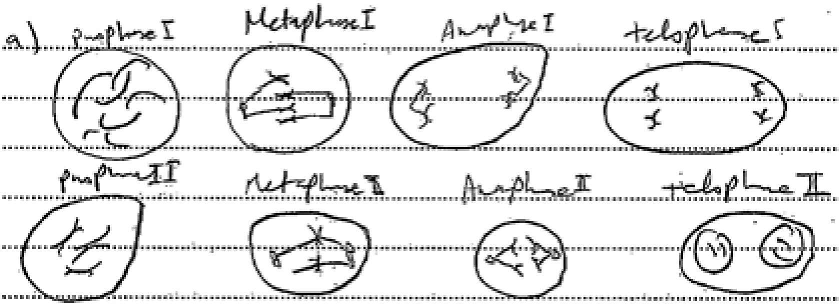
⑩ (a) Describe the behaviour of chromosomes during meiosis. [9]

(b) Outline the differences between structural and regulatory genes. [6]

[Total: 15]

10) a)



Meiosis is divided into meiosis I and Meiosis II. reduction in number of chromosomes occur during meiosis I. while meiosis II lead to like mitosis. This leads to formation of 4 daughter gametes having half number of chromosomes. prophase I, chromosomes began to condense, nuclear envelope and nucleolus degenerate and crossing over takes place. During Metaphase I, chromosomes that consist of double chromatids are lined at equator and joined to one spindle fibres. half number of chromosomes goes to other side and half also goes to opposite site leading to two groups of haploid number and all of them composed of double chromatids. During telophase I, some plant cells do not undergo telophase I, where nucleolus and nuclear envelope degenerate. Meiosis II began by

Your Mark

10(a) ☐

10(b) ☐

Q10	**Mark scheme**
(a)	**I** *ref. to* nuclear envelope **I** names of stages *meiosis I* **1** chromosomes, condense / thicken / spiralise ; **2** homologous chromosomes pair / bivalents form ; **3** crossing over / described ; **4** chiasma(ta) ; **5** spindle fibres / microtubules, attach to / pull, centromeres / kinetochores ; *allow once in mp5* **or** *in meiosis II* **6** bivalents line up on, equator / mid-line ; **A** pairs of homologous chromosomes **7** independent assortment (of homologous pairs) / described ; **A** random assortment **8** chromosomes move to, two ends of cell / poles ; A (pairs of) homologous chromosomes separate *meiosis II* **9** (individual) chromosomes / pairs of chromatids, line up on, equator / mid-line ; **10** at right angles to first equator ; **11** centromeres divide ; **12** chromatids separate ; A chromatids move to (opposite) poles **13** *ref. to* haploid / chromosome number halved / one set of chromosomes ; **A** n *for haploid* **[max 9]**
(b)	**I** polypeptide *throughout* *structural gene* **1** structural protein / enzyme / rRNA ; **A** any named protein other than a transcription factor (e.g. transporter / receptor / named hormone / immunoglobulin / haemoglobin / etc.) **R** *if any of these are identified as product of regulatory gene* **2** named, structural protein / other protein / enzyme, or tRNA ; **R** named protein if function wrongly described **3** *idea that* needed for, structure / function, of cell ; *regulatory gene* **4** (product) controls, gene expression / transcription ; **A** promote / prevent / start / stop, gene expression or transcription **5** (codes for) transcription factor / DNA-binding protein ; **6** binds to, promoter / operator / DNA response element ; **7** stops / allows, binding of RNA polymerase ; **8** ref. to repressor / repressible ; **A** silencer **9** ref. to inducer / inducible ; **A** activator / enhancer **10** named example of regulatory gene ; **A** lac repressor / DELLA repressor / homeobox or homeotic or *Hox* gene **[max 6]** **[Total: 15]**

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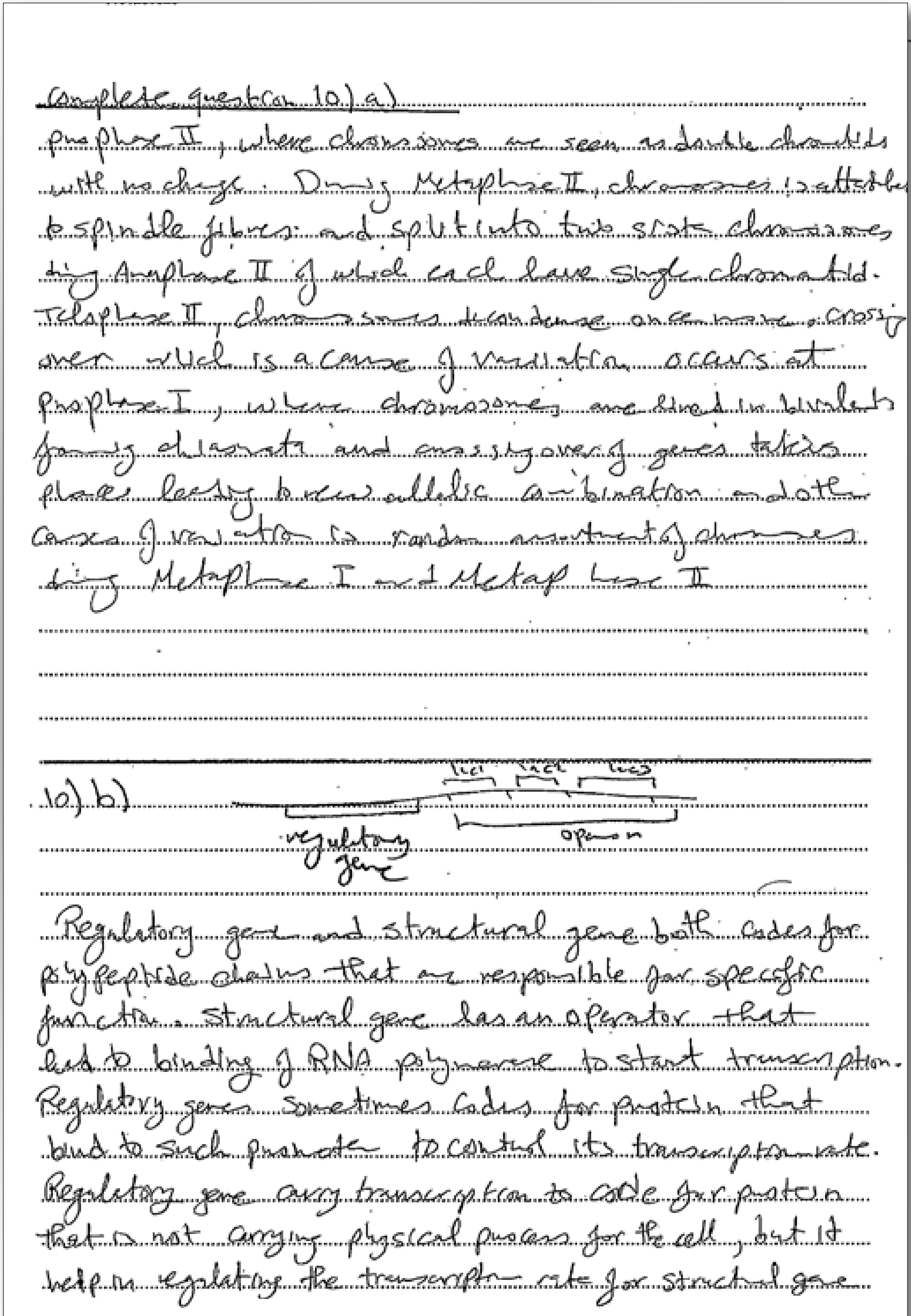

Complete question 10) a)

prophase II, where chromosomes are seen as double chromatids with no change. During Metaphase II, chromosomes is attached to spindle fibres and split into two sister chromosomes during Anaphase II of which each have single chromatid. Telophase II, chromosomes decondense once more. Crossing over which is a cause of variation occurs at prophase I, where chromosomes are lined in bivalents forming chiasmata and crossing over of genes taking place leading to new allelic combination and other causes of variation is random assortment of chromosomes during Metaphase I and Metaphase II

10) b)

Regulatory gene and structural gene both codes for polypeptide chains that are responsible for specific function. Structural gene has an operator that lead to binding of RNA polymerase to start transcription. Regulatory genes sometimes codes for protein that bind to such promoter to control its transcription rate. Regulatory gene carry transcription to code for protein that is not carrying physical process for the cell, but it help in regulating the transcription rate for structural gene

Your Mark

10(a) ☐

10(b) ☐

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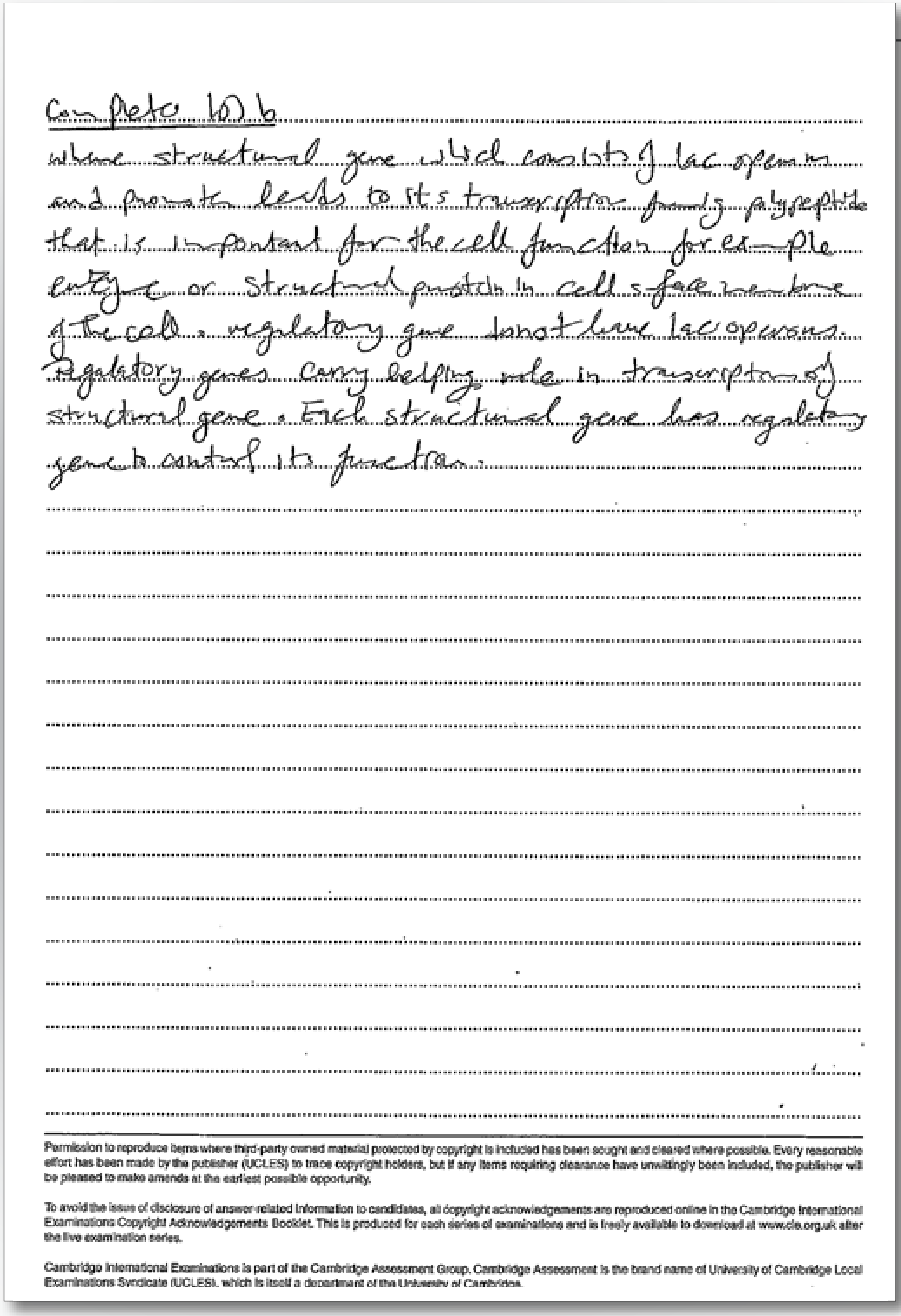

Complete 10) b

where structural gene which consists of lac operons and promoter leads to its transcription forming polypeptide that is important for the cell function for example enzyme or structural protein in cell surface membrane of the cell. regulatory gene donot have lac operons. Regulatory genes carry helping role in transcription of structural gene. Each structural gene has regulatory gene to control its function.

Your Mark

10(a) ☐

10(b) ☐

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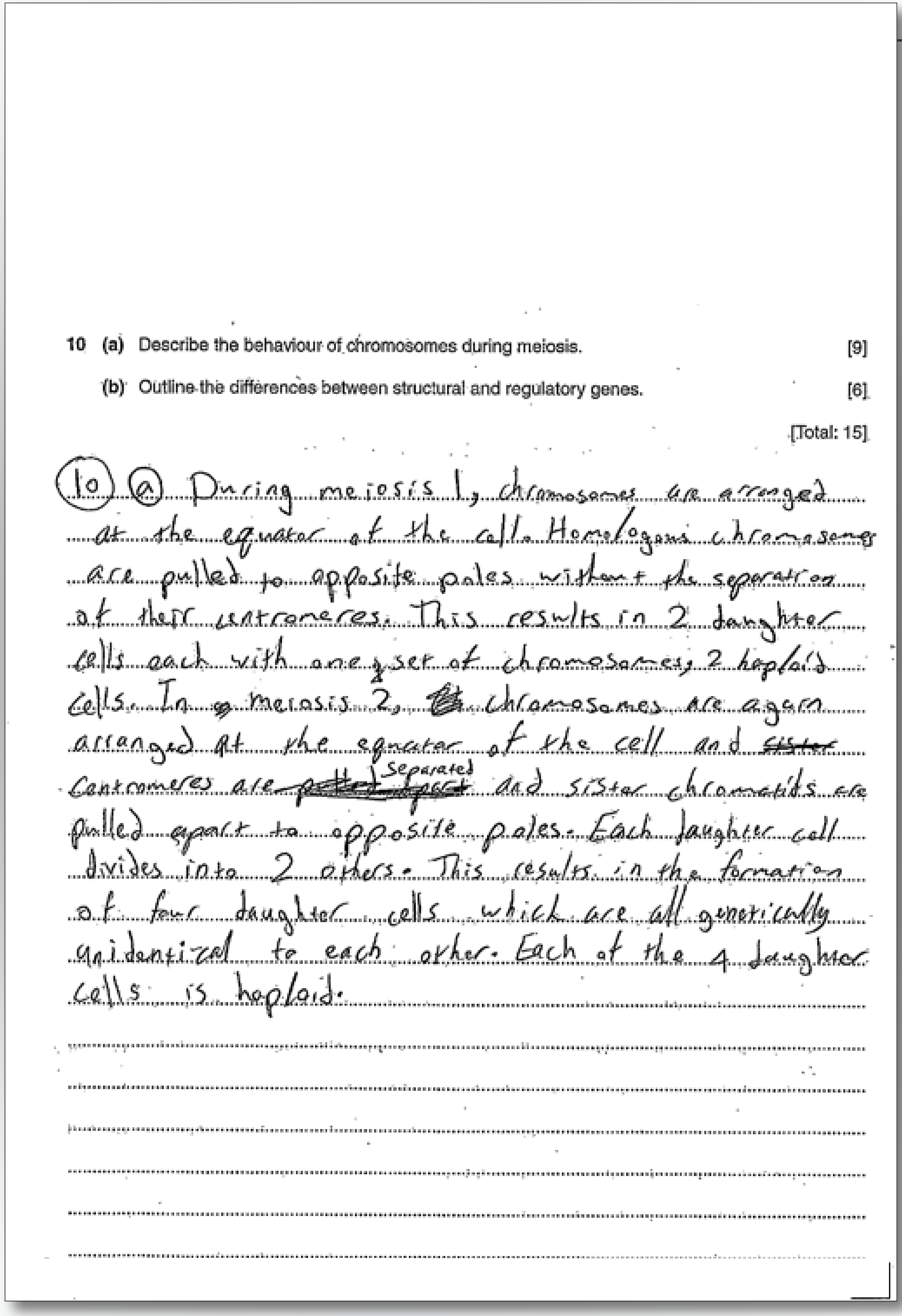
(b)	**I** polypeptide *throughout* *structural gene* **1** structural protein / enzyme / rRNA ; **A** any named protein other than a transcription factor (e.g. transporter / receptor / named hormone / immunoglobulin / haemoglobin / etc.) **R** *if any of these are identified as product of regulatory gene* **2** named, structural protein / other protein / enzyme, or tRNA ; **R** named protein if function wrongly described **3** *idea that* needed for, structure / function, of cell ; *regulatory gene* **4** (product) controls, gene expression / transcription ; **A** promote / prevent / start / stop, gene expression or transcription **5** (codes for) transcription factor / DNA-binding protein ; **6** binds to, promoter / operator / DNA response element ; **7** stops / allows, binding of RNA polymerase ; **8** ref. to repressor / repressible ; **A** silencer **9** ref. to inducer / inducible ; **A** activator / enhancer **10** named example of regulatory gene ; **A** lac repressor / DELLA repressor / homeobox or homeotic or *Hox* gene **[max 6]** **[Total: 15]**

EXAMINER COMMENTS

MARK SCHEME



10 (a) Describe the behaviour of chromosomes during meiosis. [9]

(b) Outline the differences between structural and regulatory genes. [6]

[Total: 15]

(10) (a) During meiosis 1, chromosomes are arranged at the equator of the cell. Homologous chromosomes are pulled to opposite poles without the separation of their centromeres. This results in 2 daughter cells each with one set of chromosomes, 2 haploid cells. In meiosis 2, chromosomes are again arranged at the equater of the cell and ~~sister~~ centromeres are ~~pulled apart~~ separated and sister chromatids are pulled apart to opposite poles. Each daughter cell divides into 2 others. This results in the formation of four daughter cells which are all genetically unidentical to each other. Each of the 4 daughter cells is haploid.

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MIDDLE

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Your Mark

10(a) ☐

10(b) ☐

Q10	Mark scheme
(a)	**I** *ref. to* nuclear envelope **I** names of stages *meiosis I* **1** chromosomes, condense / thicken / spiralise ; **2** homologous chromosomes pair / bivalents form ; **3** crossing over / described ; **4** chiasma(ta) ; **5** spindle fibres / microtubules, attach to / pull, centromeres / kinetochores ; *allow once in mp5* **or** *in meiosis II* **6** bivalents line up on, equator / mid-line ; **A** pairs of homologous chromosomes **7** independent assortment (of homologous pairs) / described ; **A** random assortment **8** chromosomes move to, two ends of cell / poles ; A (pairs of) homologous chromosomes separate *meiosis II* **9** (individual) chromosomes / pairs of chromatids, line up on, equator / mid-line ; **10** at right angles to first equator ; **11** centromeres divide ; **12** chromatids separate ; A chromatids move to (opposite) poles **13** *ref. to* haploid / chromosome number halved / one set of chromosomes ; **A** n *for haploid* **[max 9]**
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EXAMINER COMMENTS

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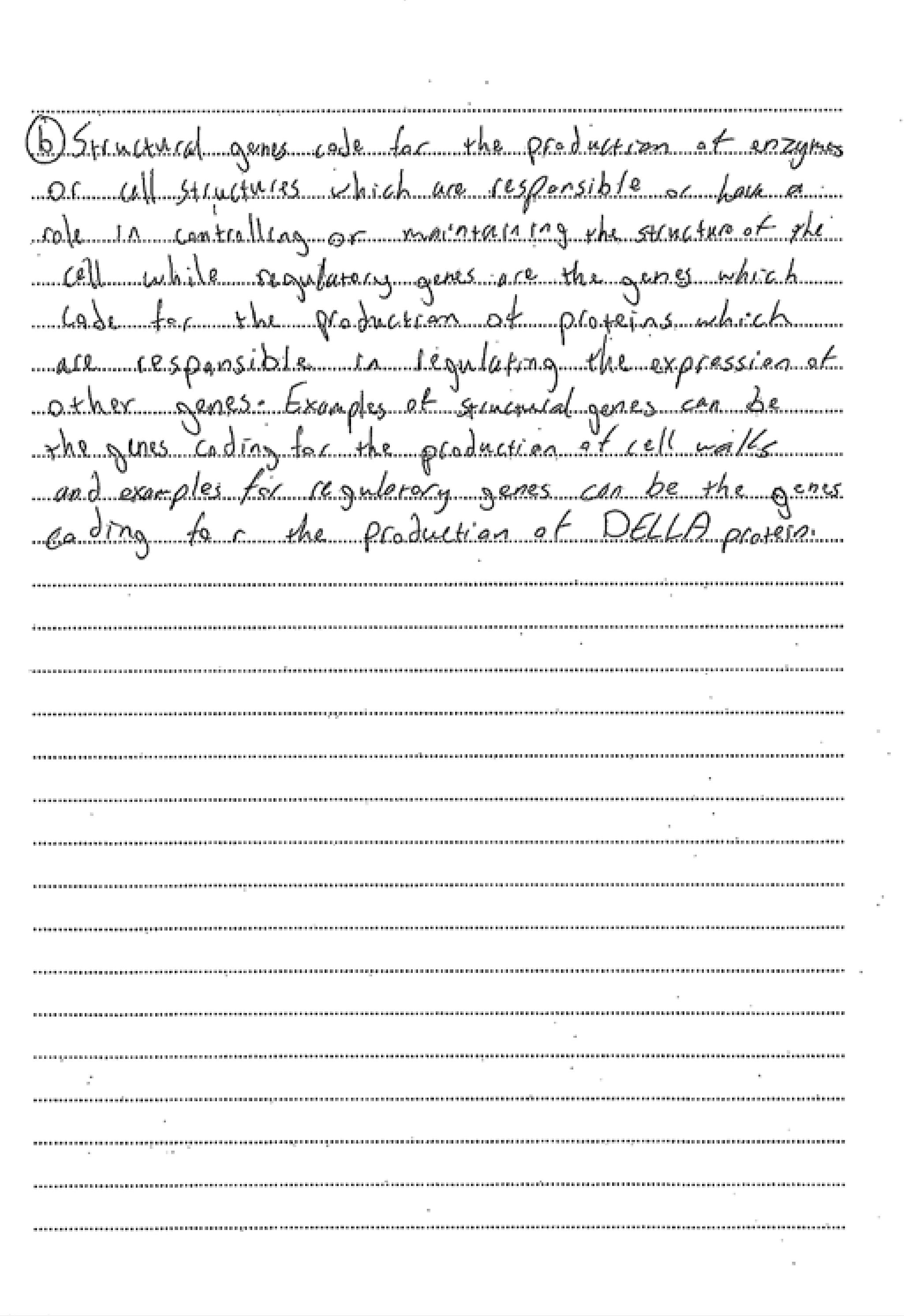
(b) Structural genes code for the production of enzymes or cell structures which are responsible or have a role in controlling or maintaining the structure of the cell while regulatory genes are the genes which code for the production of proteins which are responsible in regulating the expression of other genes. Examples of structural genes can be the genes coding for the production of cell walls and examples for regulerory genes can be the genes coding for the production of DELLA protein.

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MIDDLE

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Your Mark

10(a)

10(b)

Q10	Mark scheme
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EXAMINER COMMENTS

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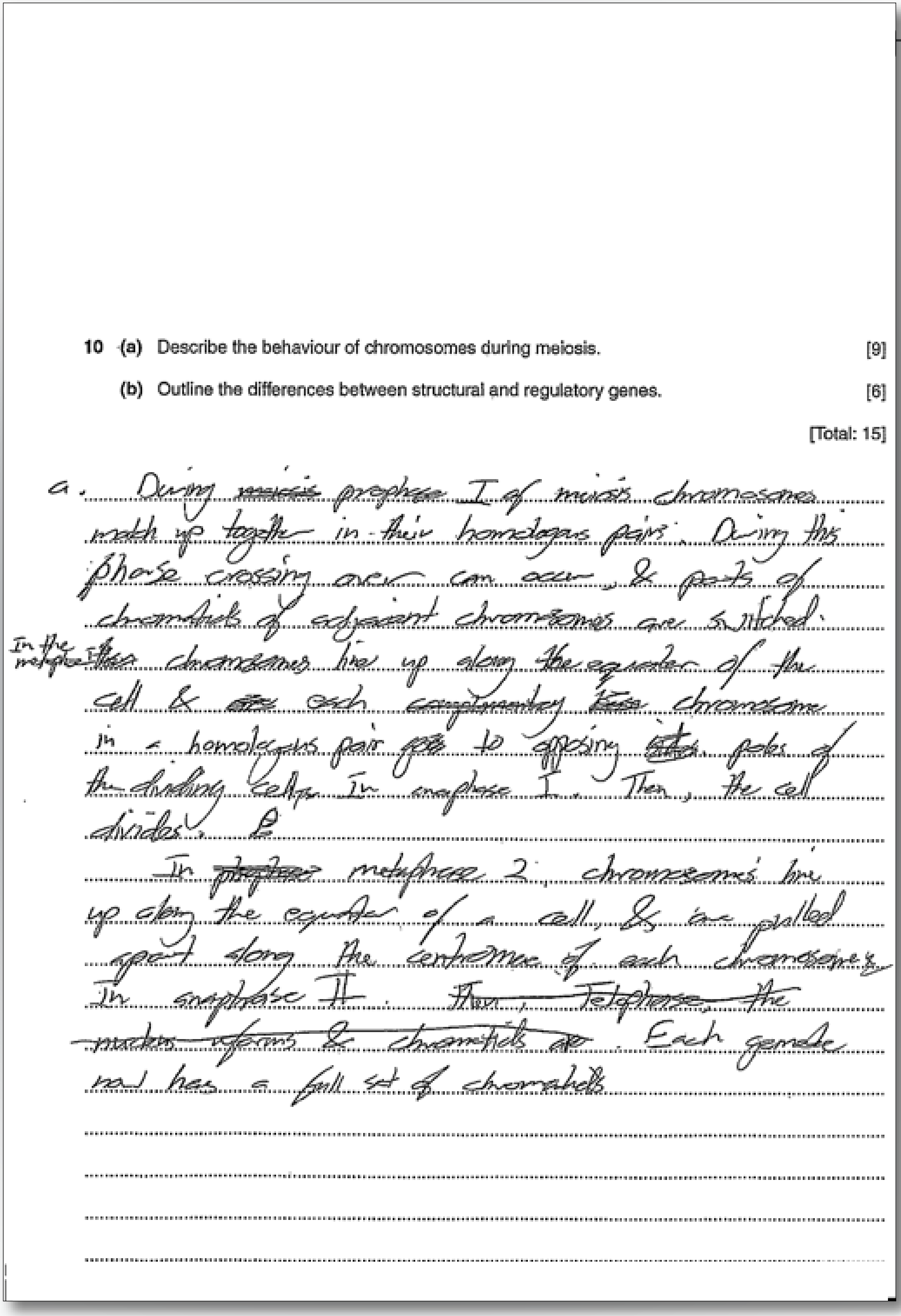

10 (a) Describe the behaviour of chromosomes during meiosis. [9]

(b) Outline the differences between structural and regulatory genes. [6]

[Total: 15]

a. During ~~meiosis~~ prophase I of meiosis chromosomes match up together in their homologous pairs. During this phase crossing over can occur, & parts of chromatids of adjacent chromosomes are switched. In the metaphase ~~the~~ chromosomes line up along the equator of the cell & ~~are~~ each ~~complementary~~ ~~base~~ chromosome in a homologous pair ~~goes~~ to opposing ~~sides~~ poles of the dividing cells. In anaphase I. Then, the cell divides. R

In ~~prophase~~ metaphase 2, chromosomes line up along the equator of a cell, & are pulled apart along the centromere of each chromosome. In anaphase II. ~~Then, Telophase, the nucleus reforms & chromatids are~~. Each gamete now has a full set of chromatids

Your Mark

10(a) ☐

10(b) ☐

Q10	Mark scheme
(a)	**I** *ref. to* nuclear envelope **I** names of stages *meiosis* I **1** chromosomes, condense / thicken / spiralise ; **2** homologous chromosomes pair / bivalents form ; **3** crossing over / described ; **4** chiasma(ta) ; **5** spindle fibres / microtubules, attach to / pull, centromeres / kinetochores ; *allow once in mp5* **or** *in meiosis II* **6** bivalents line up on, equator / mid-line ; **A** pairs of homologous chromosomes **7** independent assortment (of homologous pairs) / described ; **A** random assortment **8** chromosomes move to, two ends of cell / poles ; A (pairs of) homologous chromosomes separate *meiosis II* **9** (individual) chromosomes / pairs of chromatids, line up on, equator / mid-line ; **10** at right angles to first equator ; **11** centromeres divide ; **12** chromatids separate ; A chromatids move to (opposite) poles **13** *ref. to* haploid / chromosome number halved / one set of chromosomes ; **A** n *for haploid* **[max 9]**
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EXAMINER COMMENTS

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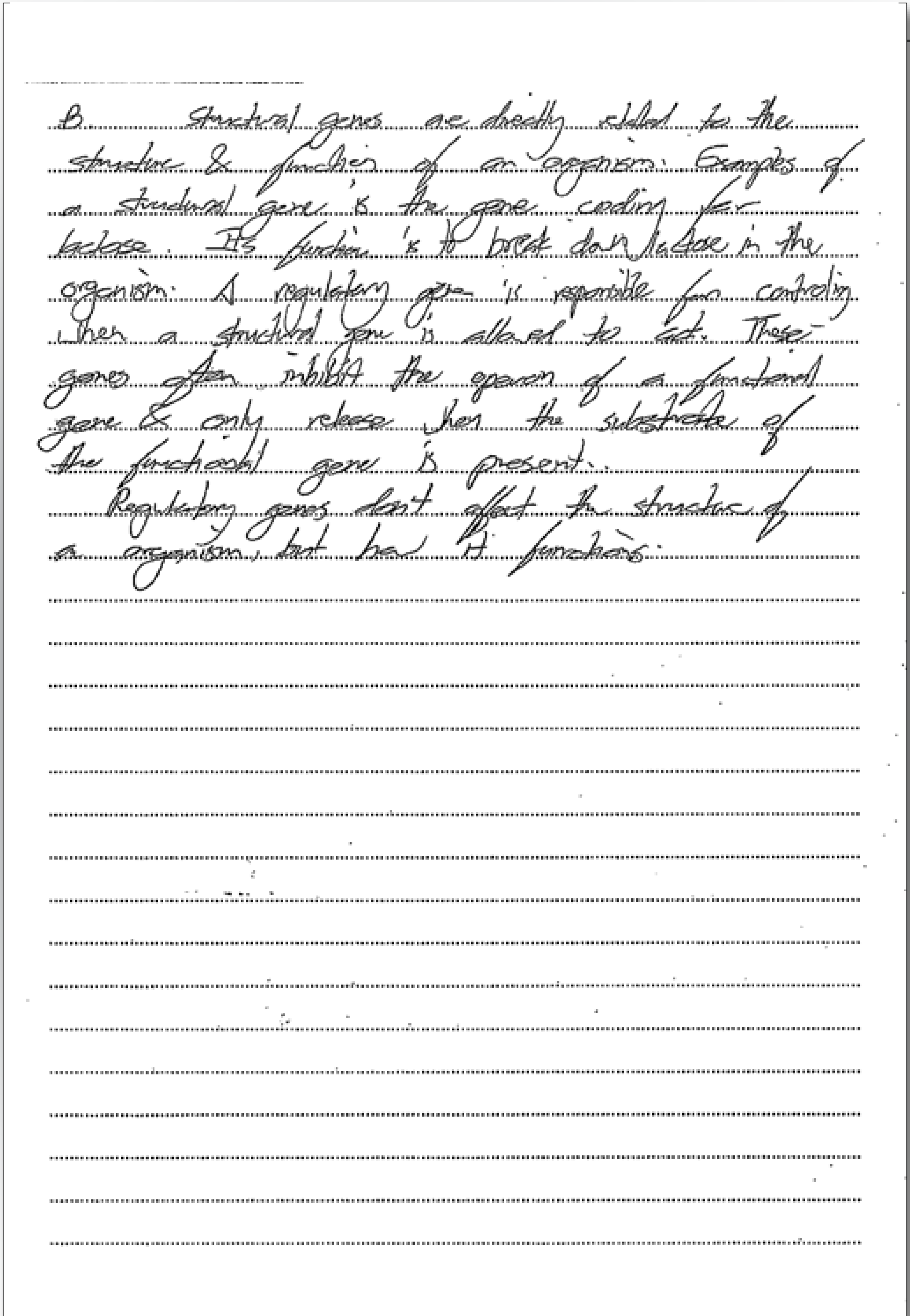

B Structural genes are directly related to the structure & function of an organism. Examples of a structural gene is the gene coding for lactase. Its function is to break down lactose in the organism. A regulatory gene is responsible for controlling when a structural gene is allowed to act. These genes often inhibit the operon of a functional gene & only release when the substrate of the functional gene is present.

Regulatory genes don't affect the structure of a organism, but how it functions.

Your Mark

10(a) ☐

10(b) ☐

Q10	Mark scheme
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EXAMINER COMMENTS

MARK SCHEME

Cambridge Assessment International Education
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Cambridge Assessment
International Education

Interactive

Interactive Example Candidate Responses
Paper 5 (May/June 2016), Question 1
Cambridge International AS & A Level
Biology 9700

Version 1.0

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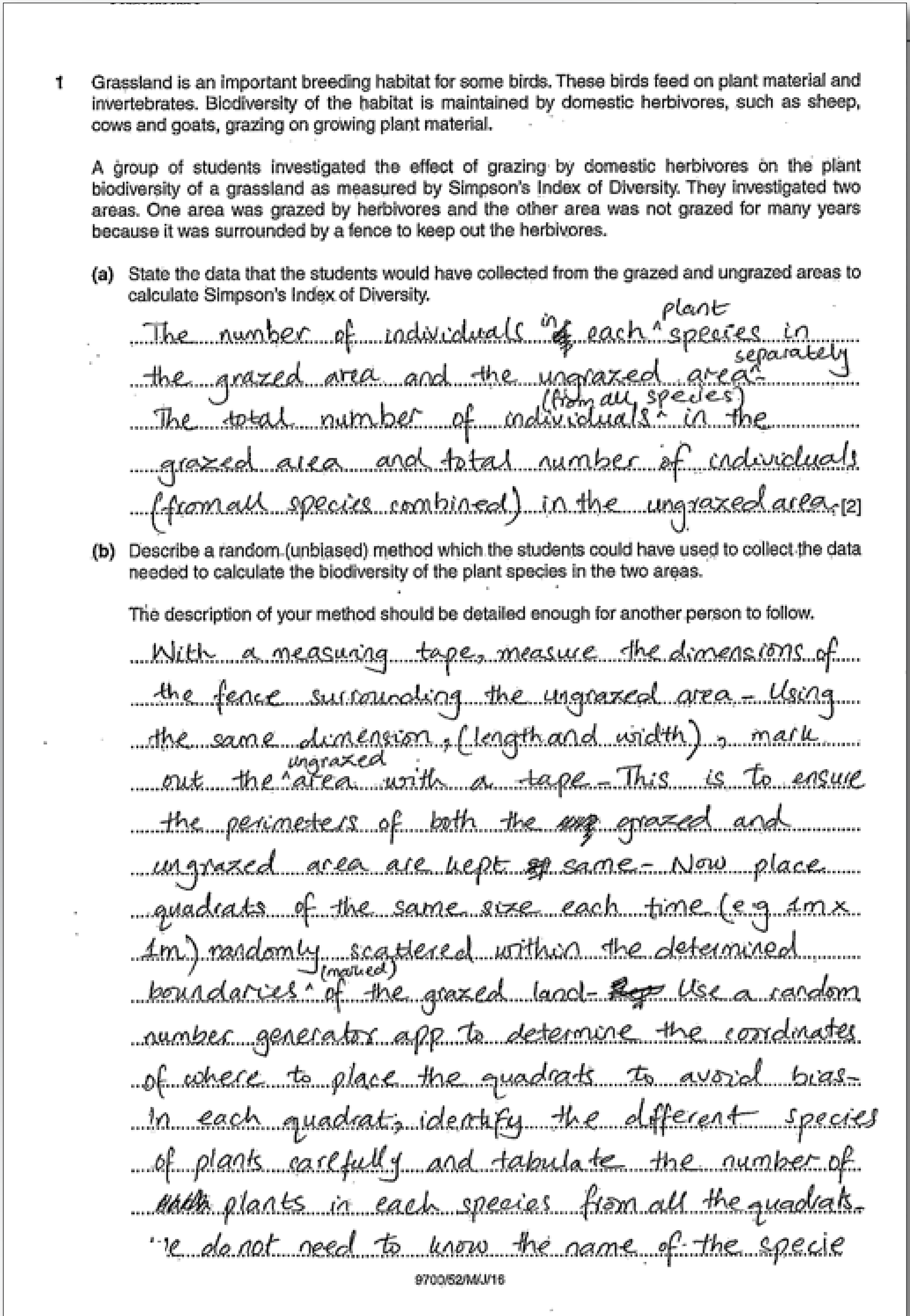


1 Grassland is an important breeding habitat for some birds. These birds feed on plant material and invertebrates. Biodiversity of the habitat is maintained by domestic herbivores, such as sheep, cows and goats, grazing on growing plant material.

A group of students investigated the effect of grazing by domestic herbivores on the plant biodiversity of a grassland as measured by Simpson's Index of Diversity. They investigated two areas. One area was grazed by herbivores and the other area was not grazed for many years because it was surrounded by a fence to keep out the herbivores.

(a) State the data that the students would have collected from the grazed and ungrazed areas to calculate Simpson's Index of Diversity.

The number of individuals in ~~of~~ each plant species in the grazed area and the ungrazed area separately. The total number of individuals (from all species) in the grazed area and total number of individuals (from all species combined) in the ungrazed area. [2]

(b) Describe a random (unbiased) method which the students could have used to collect the data needed to calculate the biodiversity of the plant species in the two areas.

The description of your method should be detailed enough for another person to follow.

With a measuring tape, measure the dimensions of the fence surrounding the ungrazed area. Using the same dimension, (length and width), mark out the ungrazed area with a tape. This is to ensure the perimeters of both the ~~ung~~ grazed and ungrazed area are kept [illegible] same. Now place quadrats of the same size each time (e.g 1m x 1m) randomly scattered within the determined (marked) boundaries of the grazed land. [illegible] Use a random number generator app to determine the coordinates of where to place the quadrats to avoid bias. In each quadrat, identify the different species of plants carefully and tabulate the number of ~~each~~ plants in each species from all the quadrats. ''le do not need to know the name of the specie

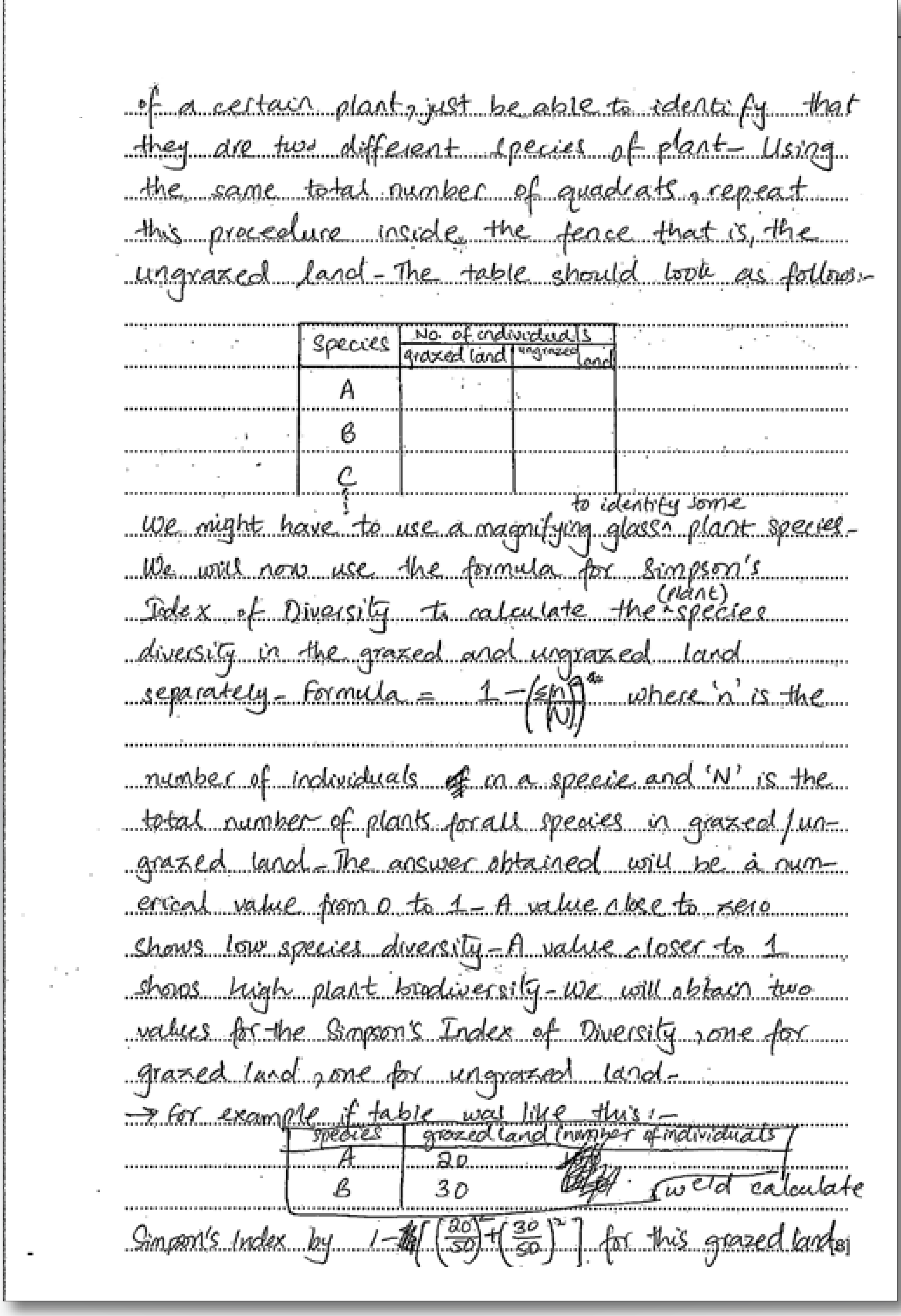
9700/52/M/J/16

Your Mark

1(a) ☐
1(b) ☐
1(c) ☐
1(d)(i) ☐
1(d)(ii) ☐
1(d)(iii) ☐
1(d)(iv) ☐
1(e) ☐
1(f) ☐

Q1	Mark scheme	
	Expected answer	**Extra guidance**
(a)	number of individuals or population of each type of / sort of / species present (in the sample) ; total number of individuals / all populations (of all species);	**A** count the number in different species **A** in context of any named organisms
(b)	*any 8 from*: 1 *ref.* to sampling in both areas / grazed and ungrazed ; 2 any idea of marking out the area to be sampled ; 3 use a method of generating random numbers (to use coordinates); 4 use a (frame or point) quadrat (for individual samples) ; 5 place (quadrat AW) at coordinates ; 6 ref. to method of identifying or distinguishing different species / types / sorts of plant ; 7 *ref. to counting* / recording of: number of individuals or the population of / each type / sort / species present (in quadrat / plot) or the total number of all the plants present (in quadrat / plot) ;	**I** *any ref. to standardising environmental factors.* **I** if listed as the independent **I** ref. to transects e.g. tape measures / use string and marker pole / make a grid of plot e.g. random number generator / app / select number from a hat **I** throwing of quadrat must be clear that the quadrat is the counting frame spelling of quadrat must be correct at least once **A** descriptions, e.g. frame placed on the ground e.g. photographs / key / app / expert / nature guide / AW **A** using letters or numbers for different species **I** percentage cover / abundance scale

EXAMINER COMMENTS
MARK SCHEME



of a certain plant, just be able to identify that they are two different species of plant. Using the same total number of quadrats, repeat this procedure inside the fence that is, the ungrazed land. The table should look as follows:-

Species	No. of individuals	
	grazed land	ungrazed land
A		
B		
C		

We might have to use a magnifying glass to identify some plant species. We will now use the formula for Simpson's Index of Diversity to calculate the (plant) species diversity in the grazed and ungrazed land separately. Formula = $1-\left(\frac{\Sigma n}{N}\right)^{2}$ where 'n' is the number of individuals ~~of~~ in a specie and 'N' is the total number of plants for all species in grazed/ungrazed land. The answer obtained will be a numerical value from 0 to 1. A value close to zero shows low species diversity. A value closer to 1 shows high plant biodiversity. We will obtain two values for the Simpson's Index of Diversity, one for grazed land, one for ungrazed land.

→ for example if table was like this:-

species	grazed land (number of individuals)
A	20
B	30

we'd calculate Simpson's Index by $1-\left[\left(\frac{20}{50}\right)^{2}+\left(\frac{30}{50}\right)^{2}\right]$ for this grazed land [8]

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

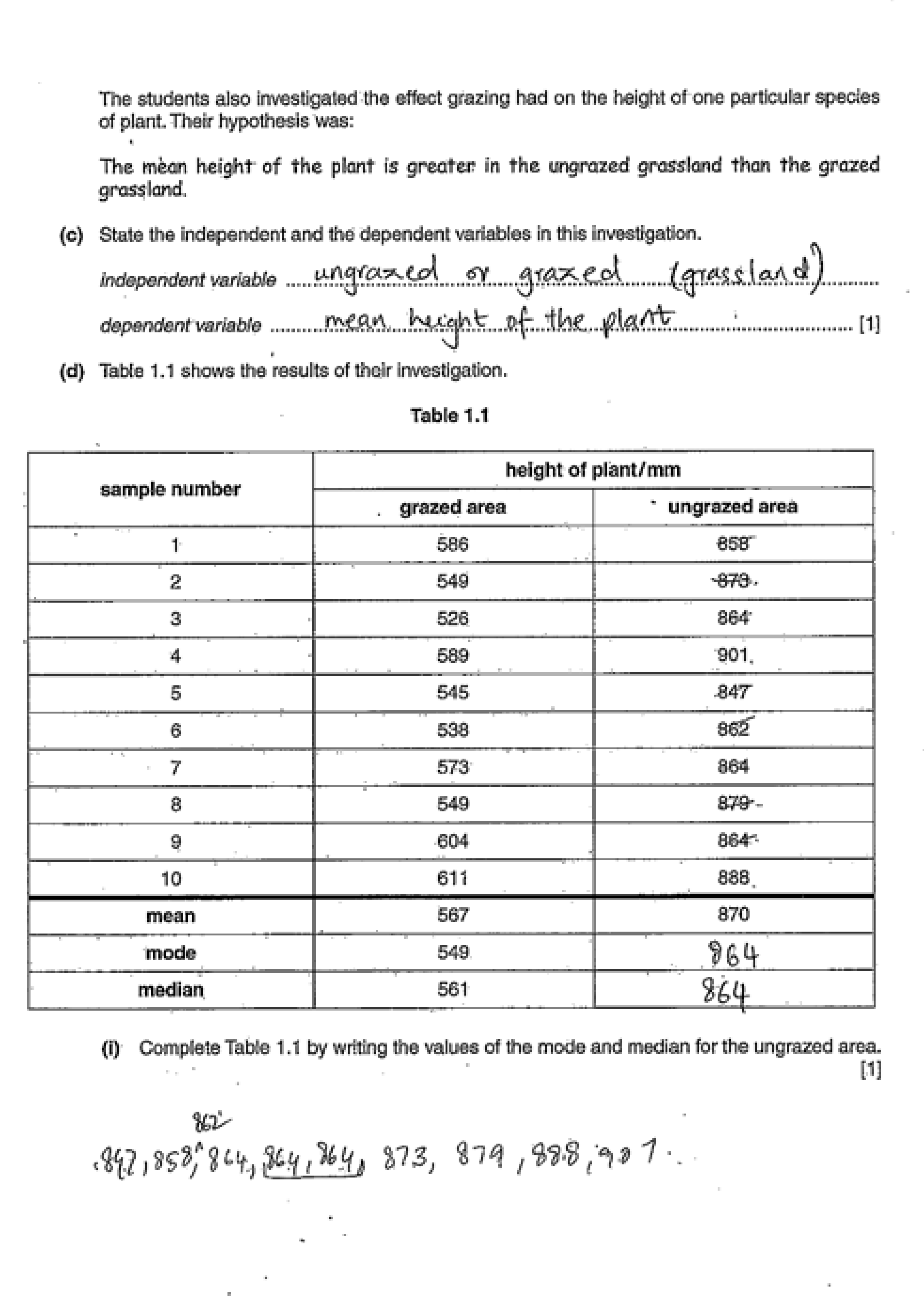
1(d)(iii) ☐

1(d)(iv) ☐

1(e) ☐

1(f) ☐

Q1	Mark scheme	
	Expected answer	**Extra guidance**
(b)	8 same size quadrat / same quadrat AW ; 9 same size plot in each area ; 10 same number of different quadrats / samples per plot ; 11 replicate the procedure with a different plot in a given area ; 12 sample at different times of year / seasons ; 13 safety any 1 from: • ref. to injury / getting lost and staying with group ; • allergy to plants and wearing gloves / protective clothing ; • allergy to pollen / hay fever and wearing mask or taking medication ; • ref. to uneven ground / hazardous plants or animals or environment and wearing suitable shoes / protective clothing ;	e.g. 10 quadrats in each plot **I** repeat 3 times and find a mean **A** if only replicate with different plots in one area **I** repeat 3 times and take a mean **I** sampling on same day / next week **I** low risk **A** any suitable example – thorny / stinging plants, insect bites / stings, snakes, belligerent grazing animals and a suitable precaution **[max8]**



The students also investigated the effect grazing had on the height of one particular species of plant. Their hypothesis was:

The mean height of the plant is greater in the ungrazed grassland than the grazed grassland.

(c) State the independent and the dependent variables in this investigation.

independent variable ungrazed or grazed (grassland)

dependent variable mean height of the plant [1]

(d) Table 1.1 shows the results of their investigation.

Table 1.1

sample number	**height of plant/mm**	
	grazed area	**ungrazed area**
1	586	858
2	549	873
3	526	864
4	589	901
5	545	847
6	538	862
7	573	864
8	549	879
9	604	864
10	611	888
mean	567	870
mode	549	864
median	561	864

(i) Complete Table 1.1 by writing the values of the mode and median for the ungrazed area. [1]

862

847, 858, 864, 864, 864, 873, 879, 888, 907.

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MIDDLE

LOW

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

1(d)(iii) ☐

1(d)(iv) ☐

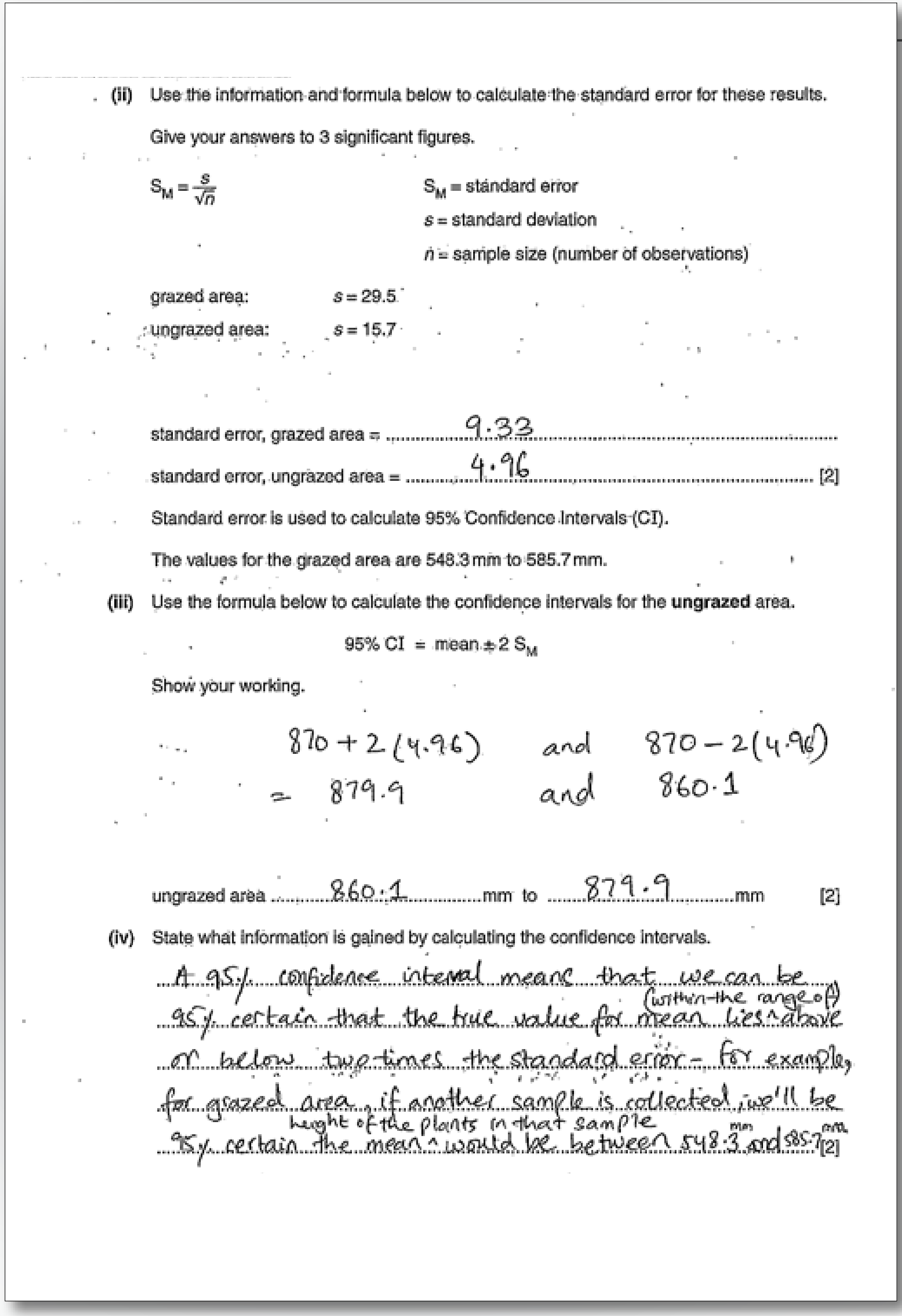
1(e) ☐

1(f) ☐

Q1	**Mark scheme**	
	Expected answer	**Extra guidance**
(c)	independent: grazed and / or ungrazed grassland and dependent: (mean) height (of plant) ;	**A** type of grass land **I** extent of grazing **[1]**
(d)(i)	mode = 864 and median = 864 ;	**[1]**

EXAMINER COMMENTS

MARK SCHEME



(ii) Use the information and formula below to calculate the standard error for these results.

Give your answers to 3 significant figures.

$S_M = \frac{s}{\sqrt{n}}$

S_M = standard error

s = standard deviation

n = sample size (number of observations)

grazed area: $s = 29.5$

ungrazed area: $s = 15.7$

standard error, grazed area = 9.33

standard error, ungrazed area = 4.96 [2]

Standard error is used to calculate 95% Confidence Intervals (CI).

The values for the grazed area are 548.3 mm to 585.7 mm.

(iii) Use the formula below to calculate the confidence intervals for the **ungrazed** area.

$$95\%\ \text{CI} = \text{mean} \pm 2\,S_M$$

Show your working.

$870 + 2(4.96)$ and $870 - 2(4.96)$

$= 879.9$ and 860.1

ungrazed area 860.1 mm to 879.9 mm [2]

(iv) State what information is gained by calculating the confidence intervals.

A 95% confidence interval means that we can be 95% certain that the true value for mean lies (within the range of) above or below two times the standard error – for example, for grazed area, if another sample is collected, we'll be 95% certain the mean height of the plants in that sample would be between 548.3 mm and 585.7 mm [2]

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

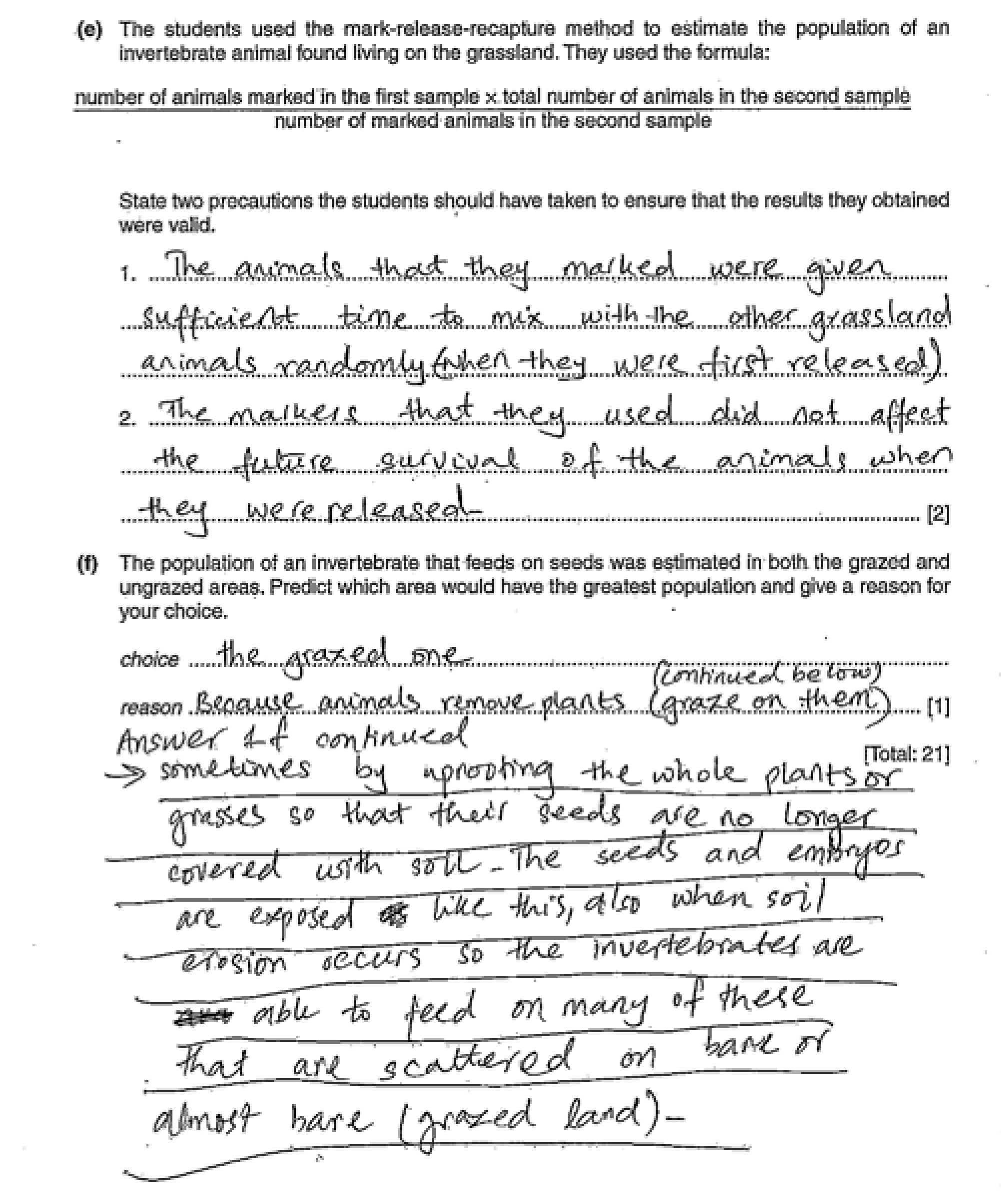
1(d)(iii) ☐

1(d)(iv) ☐

1(e) ☐

1(f) ☐

Q1	Mark scheme	
	Expected answer	**Extra guidance**
(d)(ii)	SM grazed = 9.33 ; SM ungrazed = 4.97 / 4.96 ;	*max 1 if answers are to 1 dp or 3 dp* (9.3 / 9.329, 5.0 / 4.965) **[2]**
(d)(iii)	860.1 ; to 879.9 ;	**A** ecf from 1(d)(ii)for correct calculation from incorrect S_M **[2]**
(d)(iv)	*any 2 from:* 95% confident / sure / certain that the mean lies within these limits ; shows the reliability of the mean ; the ungrazed mean is more reliable (because it's smaller) ; the difference between means is significant because there is no overlap between CI for ungrazed and grazed ;	*must be a clear statement* **R** if ref. to accuracy or results AW ora the grazed is less reliable (because it is bigger) **[max2]**



(e) The students used the mark-release-recapture method to estimate the population of an invertebrate animal found living on the grassland. They used the formula:

$$\frac{\text{number of animals marked in the first sample} \times \text{total number of animals in the second sample}}{\text{number of marked animals in the second sample}}$$

State two precautions the students should have taken to ensure that the results they obtained were valid.

1. The animals that they marked were given sufficient time to mix with the other grassland animals randomly (when they were first released)

2. The markers that they used did not affect the future survival of the animals when they were released. [2]

(f) The population of an invertebrate that feeds on seeds was estimated in both the grazed and ungrazed areas. Predict which area would have the greatest population and give a reason for your choice.

choice the grazed one

reason Because animals remove plants (graze on them) (continued below) [1]

[Total: 21]

Answer 1f continued

→ sometimes by uprooting the whole plants or grasses so that their seeds are no longer covered with soil. The seeds and embryos are exposed like this, also when soil erosion occurs so the invertebrates are able to feed on many of these that are scattered on bare or almost bare (grazed land).

Select page

HIGH **MIDDLE** **LOW**

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

1(d)(iii) ☐

1(d)(iv) ☐

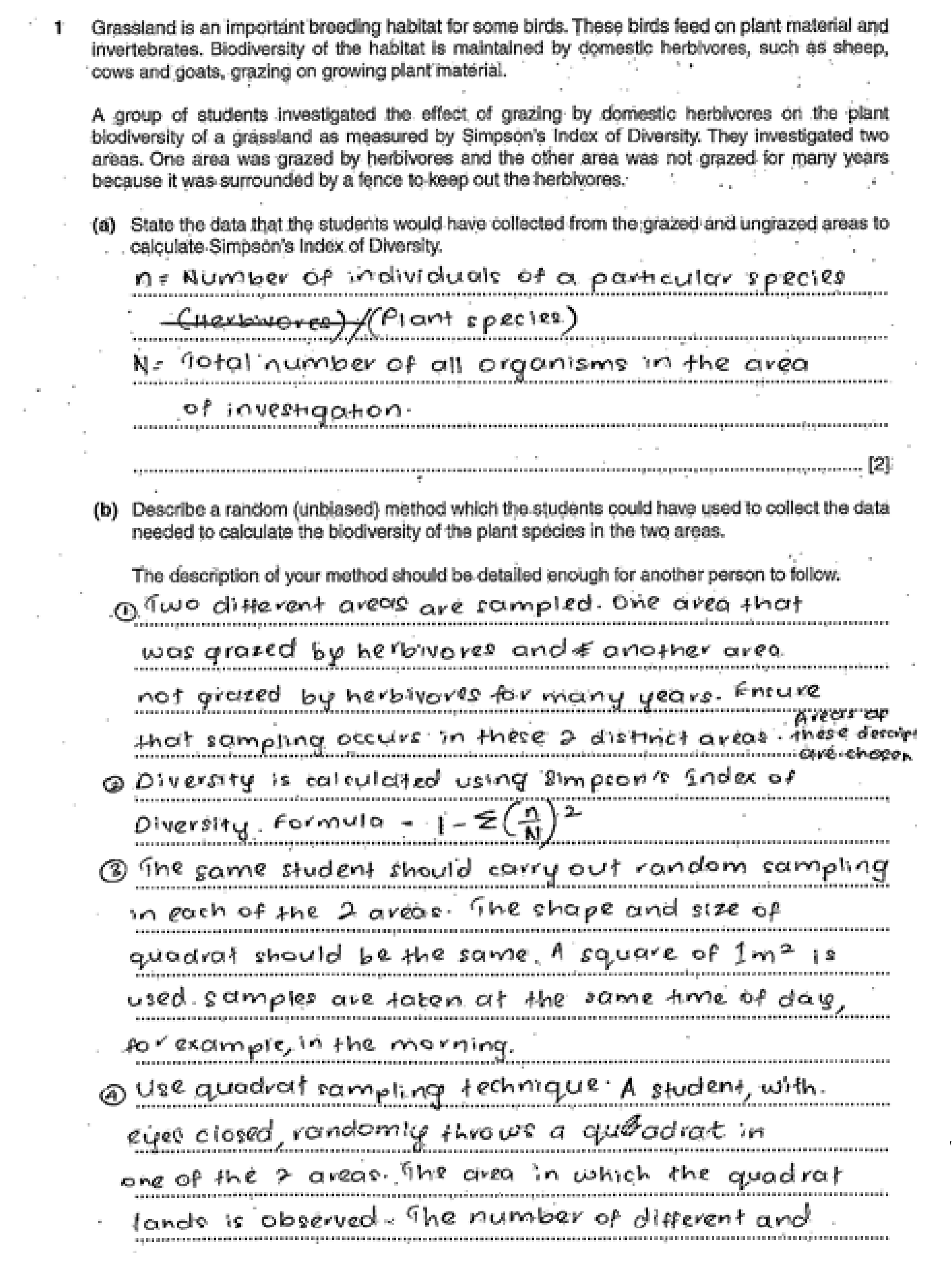
1(e) ☐

1(f) ☐

Q1	**Mark scheme**	
	Expected answer	**Extra guidance**
(e)	*any 2 from:* sample from a large area ; *idea that* there is a long enough time interval, for marked individuals to mix into the population / between capture and recapture ; *idea that* the marking technique must not be toxic AW ; *idea that* the marking technique must not increase / decrease chances of survival ; marking technique must not fall off / be rubbed off / washed off animal ; *idea that* time is not so long that migration / life cycle changes (of the species) have occurred ;	I sample size I any specified times need the idea of *long enough for dispersal* e.g. increases or decreases chance of predation **A** in terms of inhibiting / changing movement or behaviour **[max2]**
(f)	ungrazed and because there are more seeds (to eat) / AW ;	**A** ungrazed as there will be larger plants and more places for inverts to hide from predators / protection from predators. **[1]**
		Total [21]

EXAMINER COMMENTS

MARK SCHEME



1 Grassland is an important breeding habitat for some birds. These birds feed on plant material and invertebrates. Biodiversity of the habitat is maintained by domestic herbivores, such as sheep, cows and goats, grazing on growing plant material.

A group of students investigated the effect of grazing by domestic herbivores on the plant biodiversity of a grassland as measured by Simpson's Index of Diversity. They investigated two areas. One area was grazed by herbivores and the other area was not grazed for many years because it was surrounded by a fence to keep out the herbivores.

(a) State the data that the students would have collected from the grazed and ungrazed areas to calculate Simpson's Index of Diversity.

n = Number of individuals of a particular species ~~(Herbivores)~~/(Plant species)
N = Total number of all organisms in the area of investigation.

[2]

(b) Describe a random (unbiased) method which the students could have used to collect the data needed to calculate the biodiversity of the plant species in the two areas.

The description of your method should be detailed enough for another person to follow.

① Two different areas are sampled. One area that was grazed by herbivores and another area not grazed by herbivores for many years. Ensure that sampling occurs in these 2 distinct areas. Areas of these descript are chosen

② Diversity is calculated using Simpson's Index of Diversity. formula = $1 - \Sigma\left(\frac{n}{N}\right)^2$

③ The same student should carry out random sampling in each of the 2 areas. The shape and size of quadrat should be the same. A square of 1m² is used. samples are taken at the same time of day, for example, in the morning.

④ Use quadrat sampling technique. A student, with eyes closed, randomly throws a quadrat in one of the 2 areas. The area in which the quadrat lands is observed. The number of different and

Select page

HIGH MIDDLE LOW

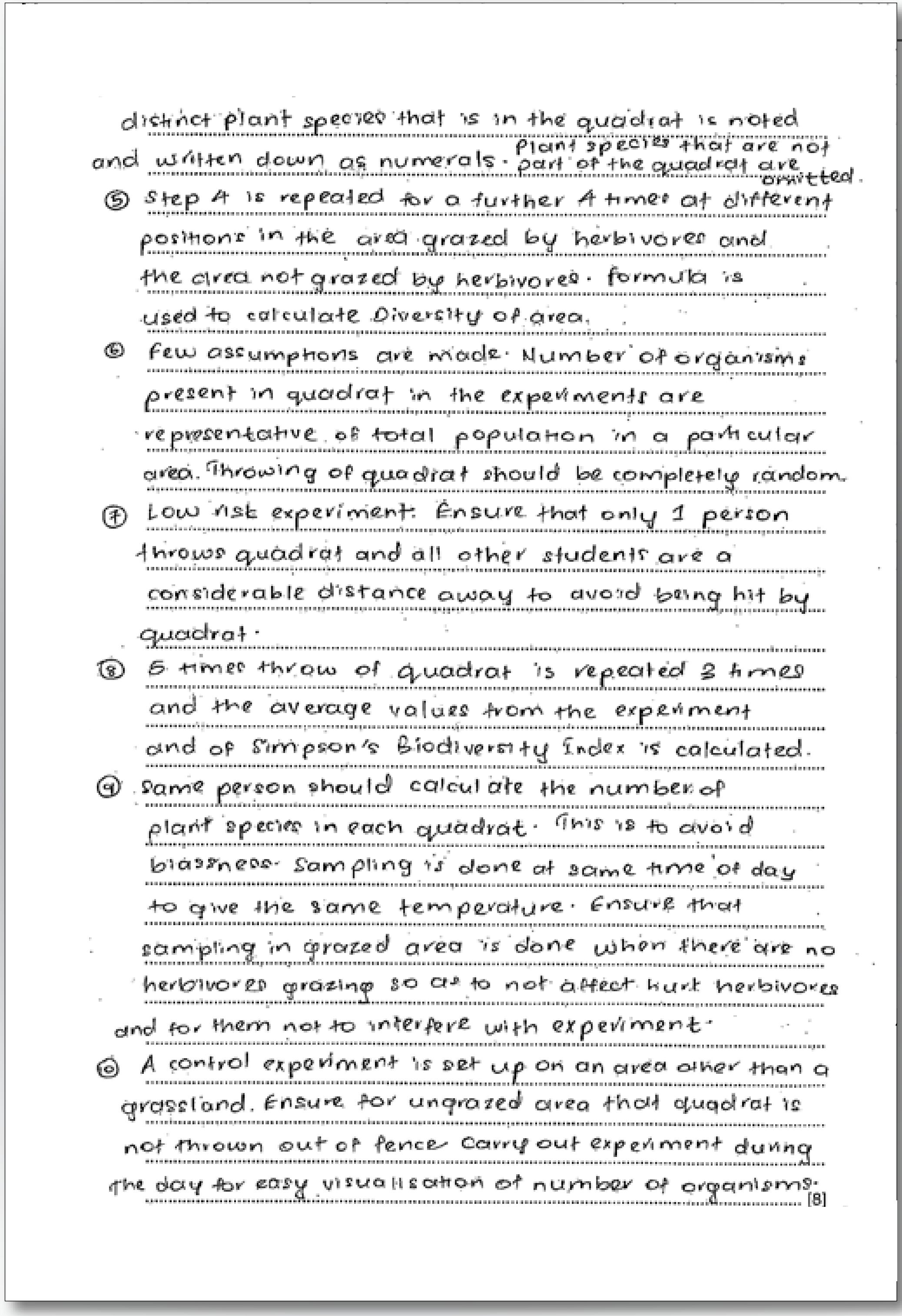
Your Mark

1(a) ☐
1(b) ☐
1(c) ☐
1(d)(i) ☐
1(d)(ii) ☐
1(d)(iii) ☐
1(d)(iv) ☐
1(e) ☐
1(f) ☐

Q1	Mark scheme	
	Expected answer	**Extra guidance**
(a)	number of individuals or population of each type of / sort of / species present (in the sample) ; total number of individuals / all populations (of all species);	**A** count the number in different species **A** in context of any named organisms
(b)	*any 8 from:* 1 *ref.* to sampling in both areas / grazed and ungrazed ; 2 any idea of marking out the area to be sampled ; 3 use a method of generating random numbers (to use coordinates); 4 use a (frame or point) <u>quadrat</u> (for individual samples) ; 5 place (quadrat AW) at coordinates ; 6 ref. to method of identifying or distinguishing different species / types / sorts of plant ; 7 *ref. to counting* / recording of: number of individuals or the population of / each type / sort / species present (in quadrat / plot) or the total number of all the plants present (in quadrat / plot) ;	**I** *any ref. to standardising environmental factors.* **I** if listed as the independent **I** ref. to transects e.g. tape measures / use string and marker pole / make a grid of plot e.g. random number generator / app / select number from a hat **I** throwing of quadrat must be clear that the quadrat is the counting frame spelling of quadrat must be correct at least once **A** descriptions, e.g. frame placed on the ground e.g. photographs / key / app / expert / nature guide / AW **A** using letters or numbers for different species **I** percentage cover / abundance scale

EXAMINER COMMENTS

MARK SCHEME



distinct plant species that is in the quadrat is noted and written down as numerals. plant species that are not part of the quadrat are omitted.

⑤ Step 4 is repeated for a further 4 times at different positions in the area grazed by herbivores and the area not grazed by herbivores. formula is used to calculate Diversity of area.

⑥ few assumptions are made. Number of organisms present in quadrat in the experiments are representative of total population in a particular area. Throwing of quadrat should be completely random.

⑦ Low risk experiment. Ensure that only 1 person throws quadrat and all other students are a considerable distance away to avoid being hit by quadrat.

⑧ 5 times throw of quadrat is repeated 3 times and the average values from the experiment and of Simpson's Biodiversity Index is calculated.

⑨ Same person should calculate the number of plant species in each quadrat. This is to avoid biasness. Sampling is done at same time of day to give the same temperature. Ensure that sampling in grazed area is done when there are no herbivores grazing so as to not affect hurt herbivores and for them not to interfere with experiment.

⑩ A control experiment is set up on an area other than a grassland. Ensure for ungrazed area that quadrat is not thrown out of fence. Carry out experiment during the day for easy visualisation of number of organisms. [8]

Select page

HIGH

MIDDLE

LOW

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

1(d)(iii) ☐

1(d)(iv) ☐

1(e) ☐

1(f) ☐

Q1	**Mark scheme**	
	Expected answer	**Extra guidance**
(b)	8 same size quadrat / same quadrat AW ; 9 same size plot in each area ; 10 same number of different quadrats / samples per plot ; 11 replicate the procedure with a different plot in a given area ; 12 sample at different times of year / seasons ; 13 safety any 1 from: • ref. to injury / getting lost and staying with group ; • allergy to plants and wearing gloves / protective clothing ; • allergy to pollen / hay fever and wearing mask or taking medication ; • ref. to uneven ground / hazardous plants or animals or environment and wearing suitable shoes / protective clothing ;	e.g. 10 quadrats in each plot **I** repeat 3 times and find a mean **A** if only replicate with different plots in one area **I** repeat 3 times and take a mean **I** sampling on same day / next week **I** low risk **A** any suitable example – thorny / stinging plants, insect bites / stings, snakes, belligerent grazing animals and a suitable precaution **[max8]**

EXAMINER COMMENTS

MARK SCHEME

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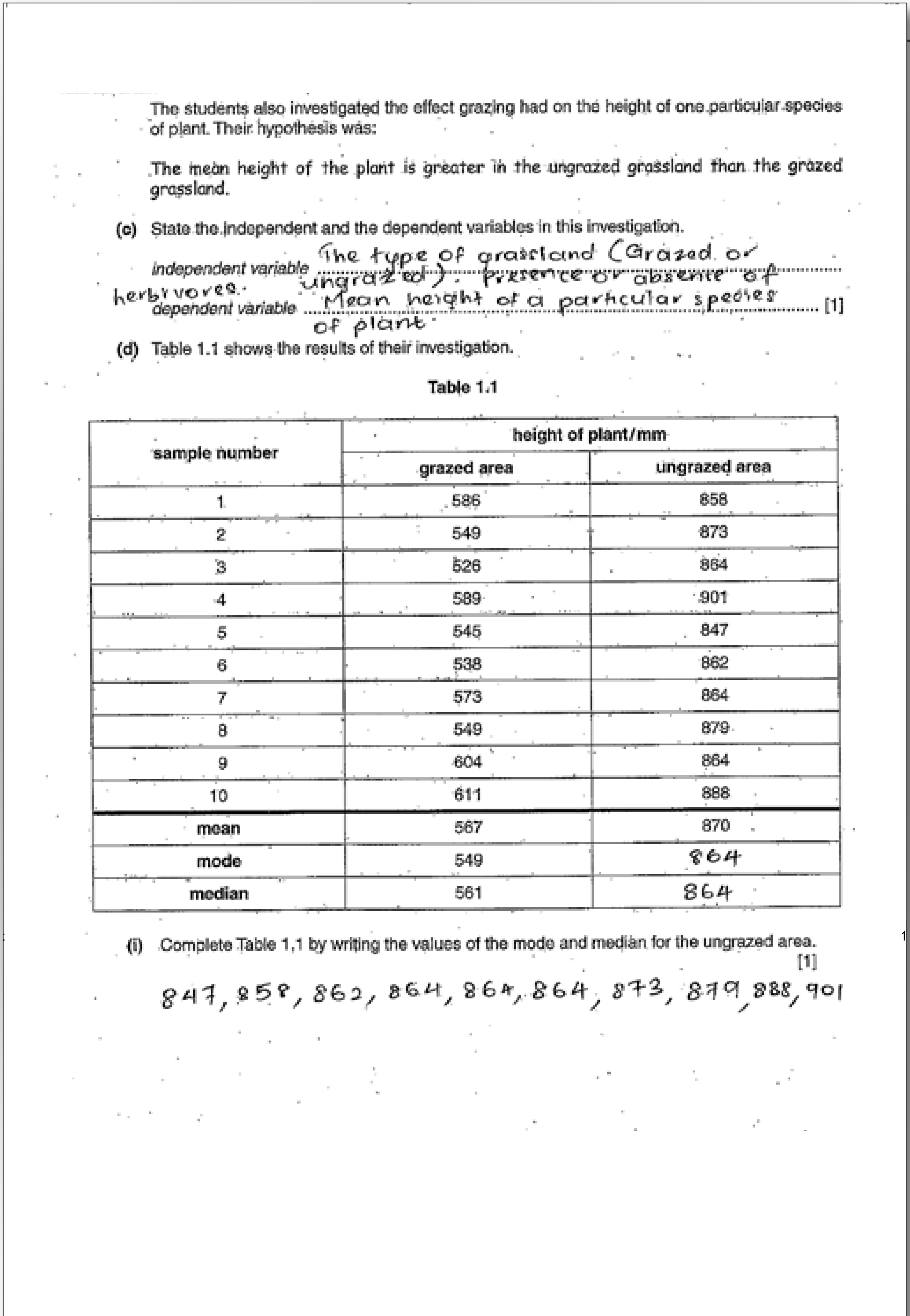
MIDDLE

LOW



The students also investigated the effect grazing had on the height of one particular species of plant. Their hypothesis was:

The mean height of the plant is greater in the ungrazed grassland than the grazed grassland.

(c) State the independent and the dependent variables in this investigation.

independent variable The type of grassland (Grazed or ungrazed). Presence or absence of herbivores.

dependent variable Mean height of a particular species of plant. [1]

(d) Table 1.1 shows the results of their investigation.

Table 1.1

sample number	height of plant/mm	
	grazed area	ungrazed area
1	586	858
2	549	873
3	526	864
4	589	901
5	545	847
6	538	862
7	573	864
8	549	879
9	604	864
10	611	888
mean	567	870
mode	549	864
median	561	864

(i) Complete Table 1.1 by writing the values of the mode and median for the ungrazed area. [1]

847, 858, 862, 864, 864, 864, 873, 879, 888, 901

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

1(d)(iii) ☐

1(d)(iv) ☐

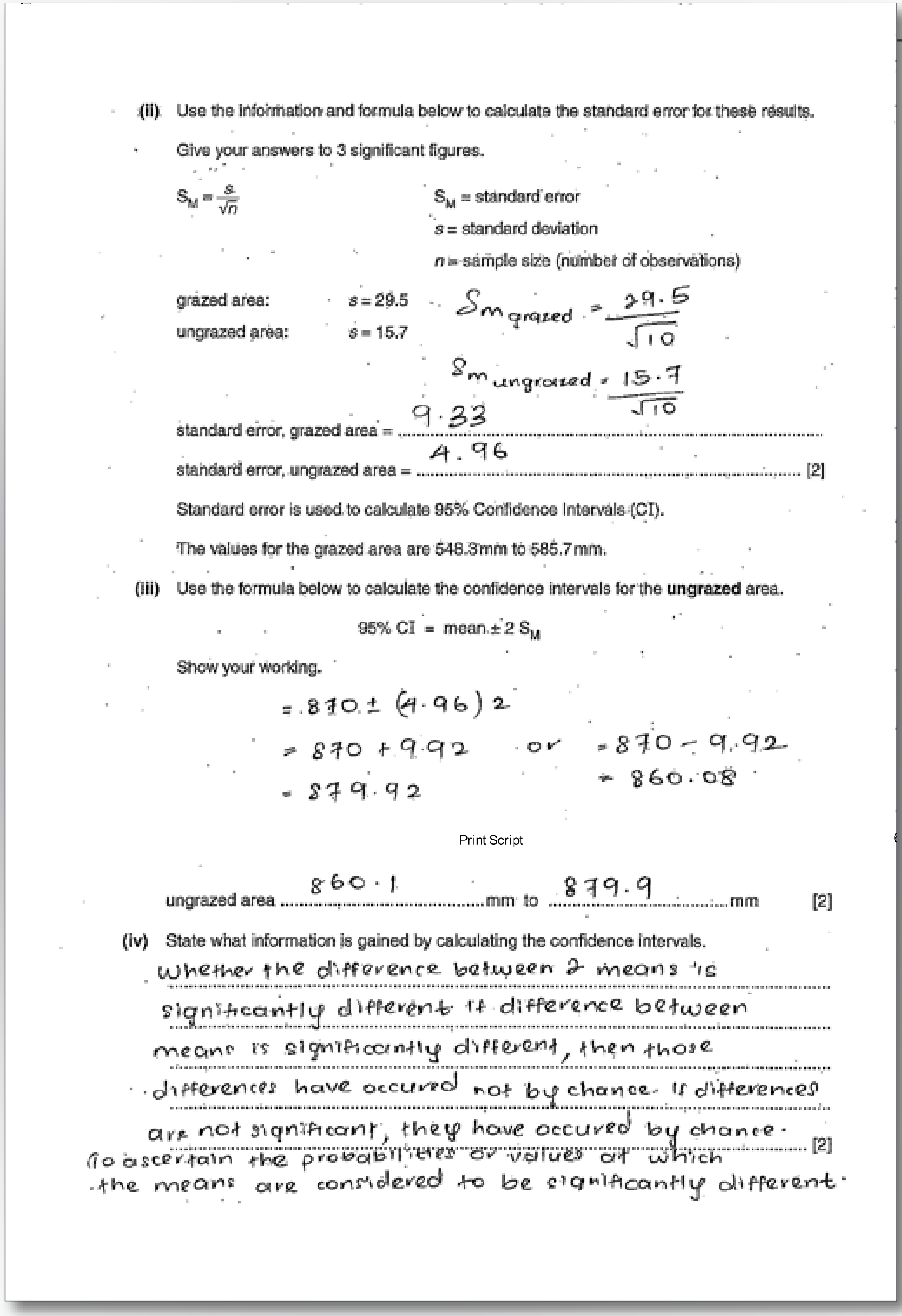
1(e) ☐

1(f) ☐

Q1	**Mark scheme**	
	Expected answer	**Extra guidance**
(c)	independent: grazed and / or ungrazed grassland and dependent: (mean) height (of plant) ;	**A** type of grass land **I** extent of grazing **[1]**
(d)(i)	mode = 864 and median = 864 ;	**[1]**

EXAMINER COMMENTS

MARK SCHEME



(ii) Use the information and formula below to calculate the standard error for these results.

Give your answers to 3 significant figures.

$S_M = \frac{s}{\sqrt{n}}$

S_M = standard error

s = standard deviation

n = sample size (number of observations)

grazed area: $s = 29.5$

ungrazed area: $s = 15.7$

$S_{m\ grazed} = \frac{29.5}{\sqrt{10}}$

$S_{m\ ungrazed} = \frac{15.7}{\sqrt{10}}$

standard error, grazed area = 9.33

standard error, ungrazed area = 4.96 [2]

Standard error is used to calculate 95% Confidence Intervals (CI).

The values for the grazed area are 548.3mm to 585.7mm.

(iii) Use the formula below to calculate the confidence intervals for the **ungrazed** area.

95% CI = mean ± 2 S_M

Show your working.

$= 870 \pm (4.96)2$

$= 870 + 9.92$ or $= 870 - 9.92$

$= 879.92$ $= 860.08$

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ungrazed area 860.1 mm to 879.9 mm [2]

(iv) State what information is gained by calculating the confidence intervals.

Whether the difference between 2 means is significantly different if difference between means is significantly different, then those differences have occured not by chance. If differences are not significant, they have occured by chance. [2]

(To ascertain the probabilities or values at which the means are considered to be significantly different.

Your Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

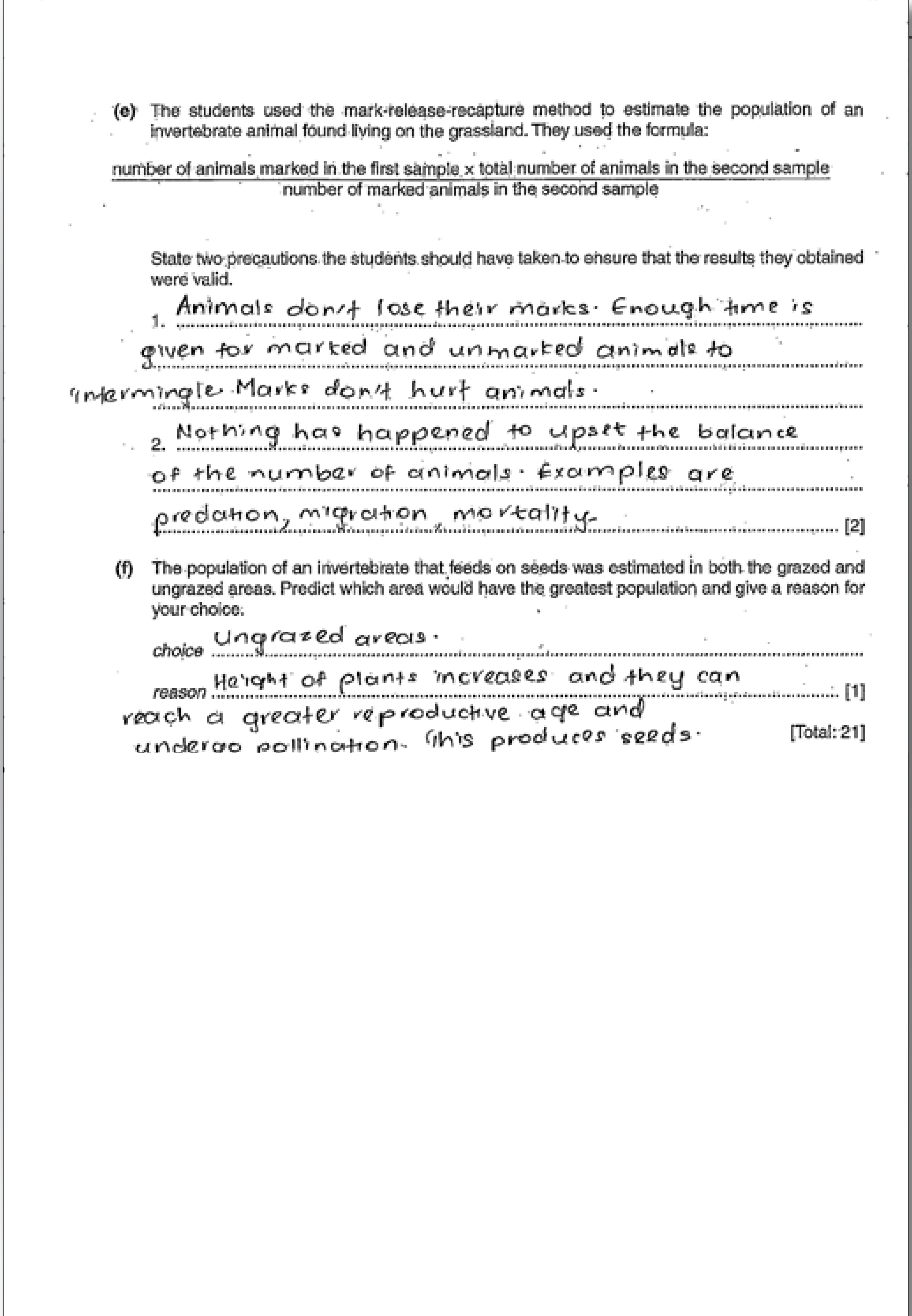
1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1	Mark scheme	
	Expected answer	**Extra guidance**
(d)(ii)	SM grazed = 9.33 ; SM ungrazed = 4.97 / 4.96 ;	*max 1 if answers are to 1 dp or 3 dp* (9.3 / 9.329, 5.0 / 4.965) **[2]**
(d)(iii)	860.1 ; to 879.9 ;	**A** ecf from 1(d)(ii)for correct calculation from incorrect S_M **[2]**
(d)(iv)	*any 2 from:* 95% confident / sure / certain that the mean lies within these limits ; shows the reliability of the mean ; the ungrazed mean is more reliable (because it's smaller) ; the difference between means is significant because there is no overlap between CI for ungrazed and grazed ;	*must be a clear statement* **R** if ref. to accuracy or results AW ora the grazed is less reliable (because it is bigger) **[max2]**



(e) The students used the mark-release-recapture method to estimate the population of an invertebrate animal found living on the grassland. They used the formula:

$$\frac{\text{number of animals marked in the first sample} \times \text{total number of animals in the second sample}}{\text{number of marked animals in the second sample}}$$

State two precautions the students should have taken to ensure that the results they obtained were valid.

1. Animals don't lose their marks. Enough time is given for marked and unmarked animals to intermingle. Marks don't hurt animals.

2. Nothing has happened to upset the balance of the number of animals. Examples are predation, migration, mortality. [2]

(f) The population of an invertebrate that feeds on seeds was estimated in both the grazed and ungrazed areas. Predict which area would have the greatest population and give a reason for your choice.

choice Ungrazed areas.

reason Height of plants increases and they can reach a greater reproductive age and undergo pollination. This produces seeds. [1]

[Total: 21]

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

1(d)(iii) ☐

1(d)(iv) ☐

1(e) ☐

1(f) ☐

Q1	**Mark scheme**	
	Expected answer	**Extra guidance**
(e)	*any 2 from:* sample from a large area ; *idea that* there is a long enough time interval, for marked individuals to mix into the population / between capture and recapture ; *idea that* the marking technique must not be toxic AW ; *idea that* the marking technique must not increase / decrease chances of survival ; marking technique must not fall off / be rubbed off / washed off animal ; *idea that* time is not so long that migration / life cycle changes (of the species) have occurred ;	I sample size I any specified times need the idea of *long enough for dispersal* e.g. increases or decreases chance of predation **A** in terms of inhibiting / changing movement or behaviour **[max2]**
(f)	ungrazed and because there are more seeds (to eat) / AW ;	**A** ungrazed as there will be larger plants and more places for inverts to hide from predators / protection from predators. **[1]**
		Total [21]

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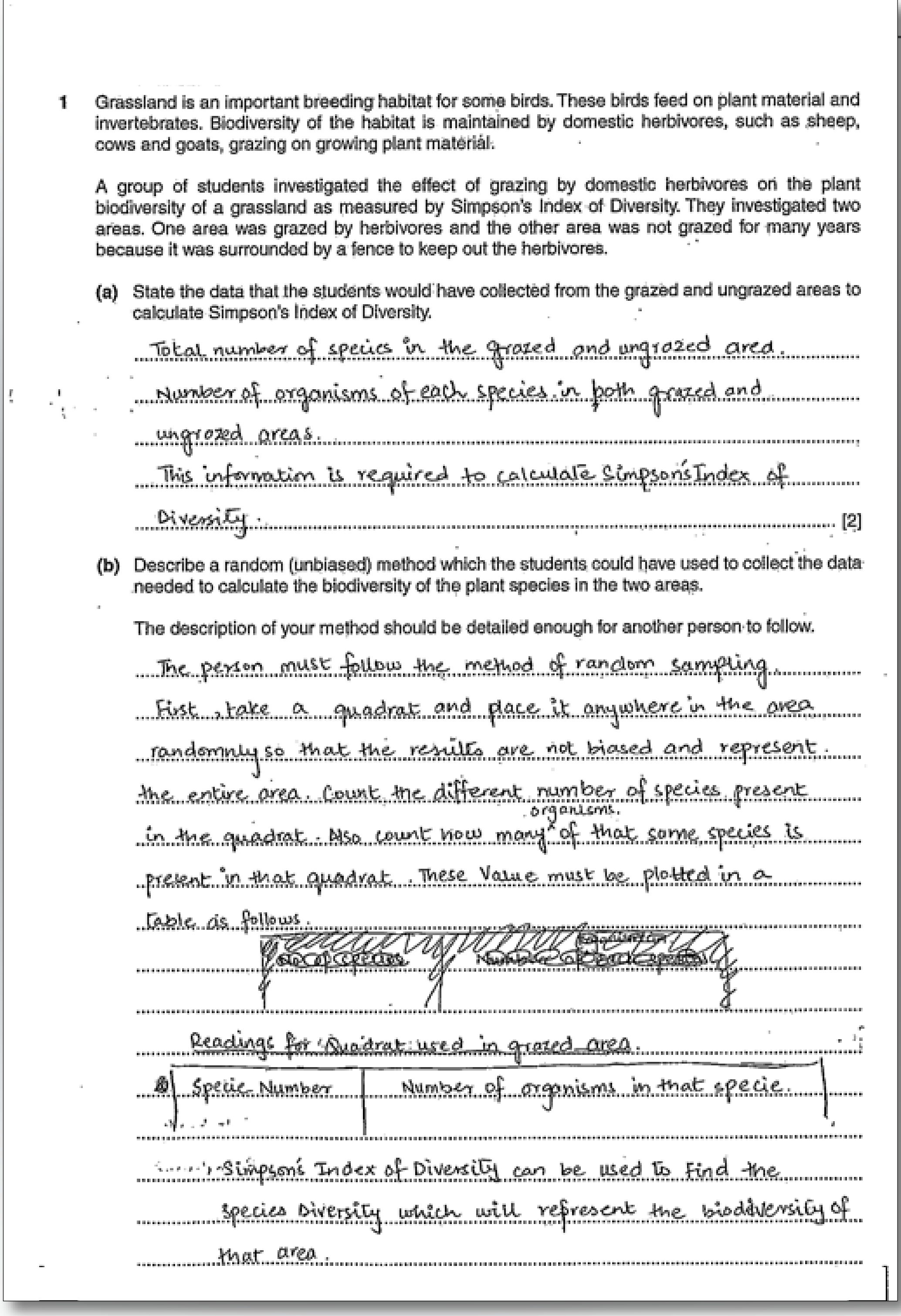


1 Grassland is an important breeding habitat for some birds. These birds feed on plant material and invertebrates. Biodiversity of the habitat is maintained by domestic herbivores, such as sheep, cows and goats, grazing on growing plant material.

A group of students investigated the effect of grazing by domestic herbivores on the plant biodiversity of a grassland as measured by Simpson's Index of Diversity. They investigated two areas. One area was grazed by herbivores and the other area was not grazed for many years because it was surrounded by a fence to keep out the herbivores.

(a) State the data that the students would have collected from the grazed and ungrazed areas to calculate Simpson's Index of Diversity.

Total number of species in the grazed and ungrazed area.
Number of organisms of each species in both grazed and ungrazed areas.
This information is required to calculate Simpson's Index of Diversity. [2]

(b) Describe a random (unbiased) method which the students could have used to collect the data needed to calculate the biodiversity of the plant species in the two areas.

The description of your method should be detailed enough for another person to follow.

The person must follow the method of random sampling. First, take a quadrat and place it anywhere in the area randomnly so that the results are not biased and represent the entire area. Count the different number of species present in the quadrat. Also count how many organisms of that same species is present in that quadrat. These Value must be plotted in a table as follows.

Readings for Quadrat used in grazed area.

Specie Number	Number of organisms in that specie.

Simpson's Index of Diversity can be used to find the species Diversity which will represent the biodiversity of that area.

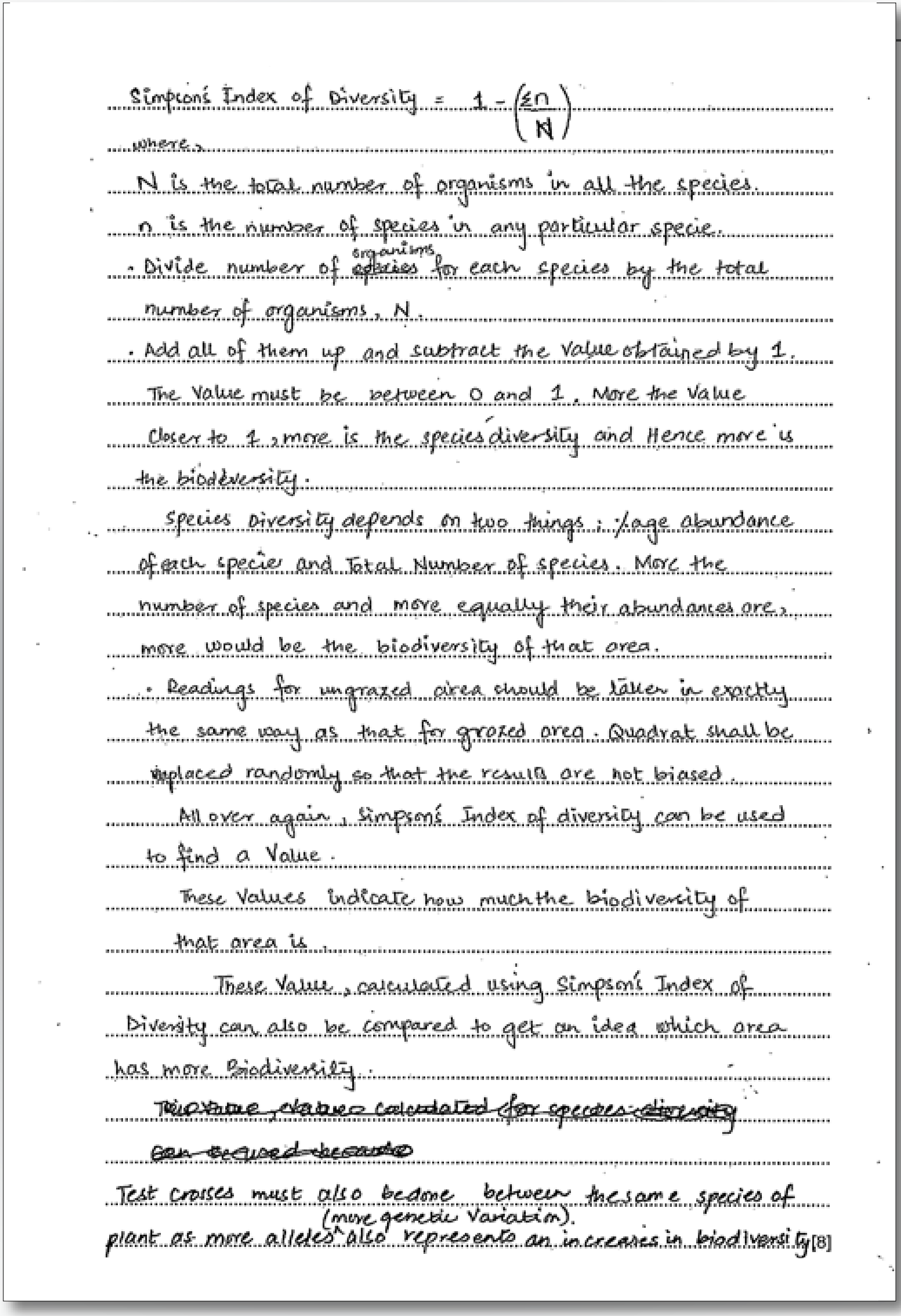
Your Mark

1(a) ☐
1(b) ☐
1(c) ☐
1(d)(i) ☐
1(d)(ii) ☐
1(d)(iii) ☐
1(d)(iv) ☐
1(e) ☐
1(f) ☐

Q1	Mark scheme	
	Expected answer	**Extra guidance**
(a)	number of individuals or population of each type of / sort of / species present (in the sample) ; total number of individuals / all populations (of all species);	**A** count the number in different species **A** in context of any named organisms
(b)	*any 8 from:* 1 *ref.* to sampling in both areas / grazed and ungrazed ; 2 any idea of marking out the area to be sampled ; 3 use a method of generating random numbers (to use coordinates); 4 use a (frame or point) quadrat (for individual samples) ; 5 place (quadrat AW) at coordinates ; 6 ref. to method of identifying or distinguishing different species / types / sorts of plant ; 7 *ref. to counting* / recording of: number of individuals or the population of / each type / sort / species present (in quadrat / plot) or the total number of all the plants present (in quadrat / plot) ;	**I** *any ref. to standardising environmental factors.* **I** if listed as the independent **I** ref. to transects e.g. tape measures / use string and marker pole / make a grid of plot e.g. random number generator / app / select number from a hat **I** throwing of quadrat must be clear that the quadrat is the counting frame spelling of quadrat must be correct at least once **A** descriptions, e.g. frame placed on the ground e.g. photographs / key / app / expert / nature guide / AW **A** using letters or numbers for different species **I** percentage cover / abundance scale

EXAMINER COMMENTS

MARK SCHEME



Simpcons Index of Diversity = $1 - \left(\frac{\Sigma n}{N}\right)$

where,

N is the total number of organisms in all the species.

n is the number of species in any particular specie.

- Divide number of ~~species~~ organisms for each species by the total number of organisms, N.
- Add all of them up and subtract the value obtained by 1.

The value must be between 0 and 1. More the value closer to 1, more is the species diversity and Hence more is the biodiversity.

Species Diversity depends on two things: %age abundance of each specie and Total Number of species. More the number of species and more equally their abundances are, more would be the biodiversity of that area.

- Readings for ungrazed area should be taken in exactly the same way as that for grazed area. Quadrat shall be placed randomly so that the results are not biased.

All over again, Simpson's Index of diversity can be used to find a Value.

These Values indicate how much the biodiversity of that area is.

These Value, calculated using Simpson's Index of Diversity can also be compared to get an idea which area has more Biodiversity.

~~The value, values calculated for species diversity~~
~~can be used because~~

Test crosses must also be done between the same species of plant as more alleles (more genetic Variation). also represents an increases in biodiversity [8]

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

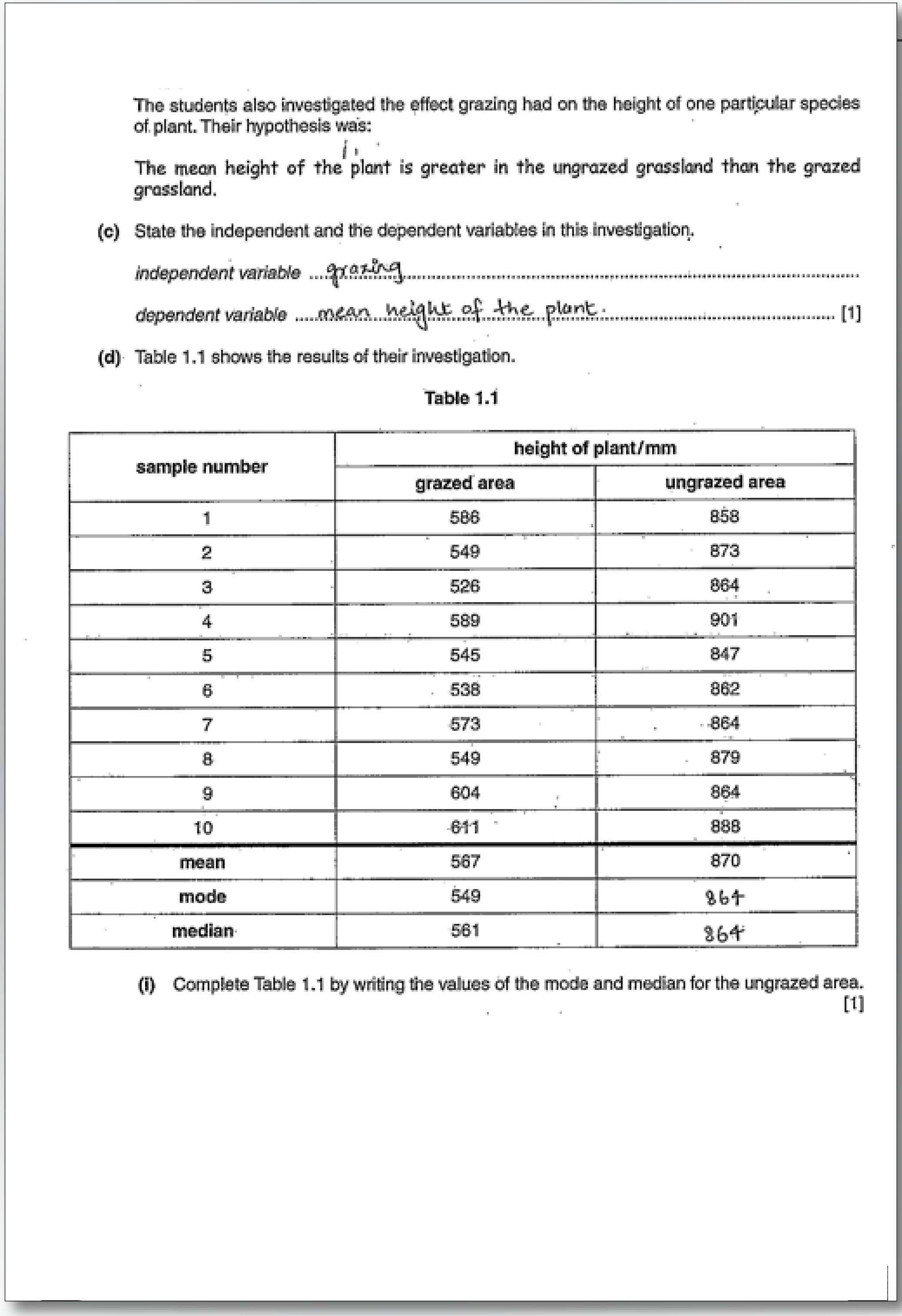
1(d)(iii) ☐

1(d)(iv) ☐

1(e) ☐

1(f) ☐

Q1	**Mark scheme**	
	Expected answer	**Extra guidance**
(b)	8 same size quadrat / same quadrat AW ; 9 same size plot in each area ; 10 same number of different quadrats / samples per plot ; 11 replicate the procedure with a different plot in a given area ; 12 sample at different times of year / seasons ; 13 safety any 1 from: • ref. to injury / getting lost and staying with group ; • allergy to plants and wearing gloves / protective clothing ; • allergy to pollen / hay fever and wearing mask or taking medication ; • ref. to uneven ground / hazardous plants or animals or environment and wearing suitable shoes / protective clothing ;	e.g. 10 quadrats in each plot **I** repeat 3 times and find a mean **A** if only replicate with different plots in one area **I** repeat 3 times and take a mean **I** sampling on same day / next week **I** low risk **A** any suitable example – thorny / stinging plants, insect bites / stings, snakes, belligerent grazing animals and a suitable precaution **[max8]**



The students also investigated the effect grazing had on the height of one particular species of plant. Their hypothesis was:

The mean height of the plant is greater in the ungrazed grassland than the grazed grassland.

(c) State the independent and the dependent variables in this investigation.

independent variable grazing

dependent variable mean height of the plant. [1]

(d) Table 1.1 shows the results of their investigation.

Table 1.1

sample number	**height of plant/mm**	
	grazed area	**ungrazed area**
1	586	858
2	549	873
3	526	864
4	589	901
5	545	847
6	538	862
7	573	864
8	549	879
9	604	864
10	611	888
mean	567	870
mode	549	864
median	561	864

(i) Complete Table 1.1 by writing the values of the mode and median for the ungrazed area. [1]

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

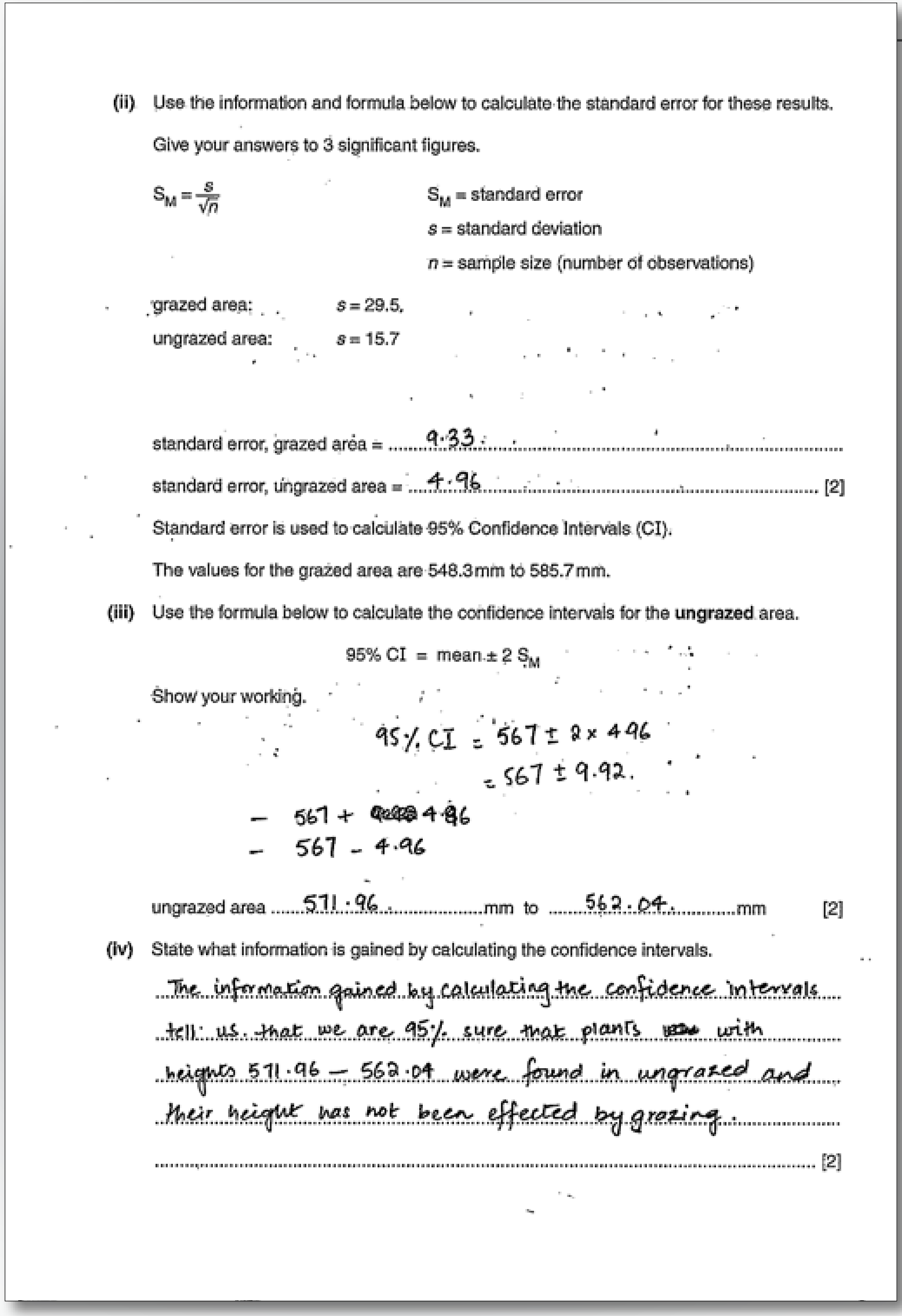
1(d)(iii) ☐

1(d)(iv) ☐

1(e) ☐

1(f) ☐

Q1	**Mark scheme**	
	Expected answer	**Extra guidance**
(c)	independent: grazed and / or ungrazed grassland and dependent: (mean) height (of plant) ;	**A** type of grass land **I** extent of grazing **[1]**
(d)(i)	mode = 864 and median = 864 ;	**[1]**



(ii) Use the information and formula below to calculate the standard error for these results.

Give your answers to 3 significant figures.

$S_M = \frac{s}{\sqrt{n}}$

S_M = standard error

s = standard deviation

n = sample size (number of observations)

grazed area: $s = 29.5$

ungrazed area: $s = 15.7$

standard error, grazed area = 9·33

standard error, ungrazed area = 4·96 [2]

Standard error is used to calculate 95% Confidence Intervals (CI).

The values for the grazed area are 548.3mm to 585.7mm.

(iii) Use the formula below to calculate the confidence intervals for the **ungrazed** area.

$$95\%\ CI = \text{mean} \pm 2\ S_M$$

Show your working.

$$95\%\ CI = 567 \pm 2 \times 4 \cdot 96$$
$$= 567 \pm 9 \cdot 92.$$

$- \quad 567 + 4 \cdot 96$

$- \quad 567 - 4 \cdot 96$

ungrazed area 571·96 mm to 562·04 mm [2]

(iv) State what information is gained by calculating the confidence intervals.

The information gained by calculating the confidence intervals tell us that we are 95% sure that plants with heights 571·96 – 562·04 were found in ungrazed and their height has not been effected by grazing.

[2]

Select page

HIGH | MIDDLE | LOW

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

1(d)(iii) ☐

1(d)(iv) ☐

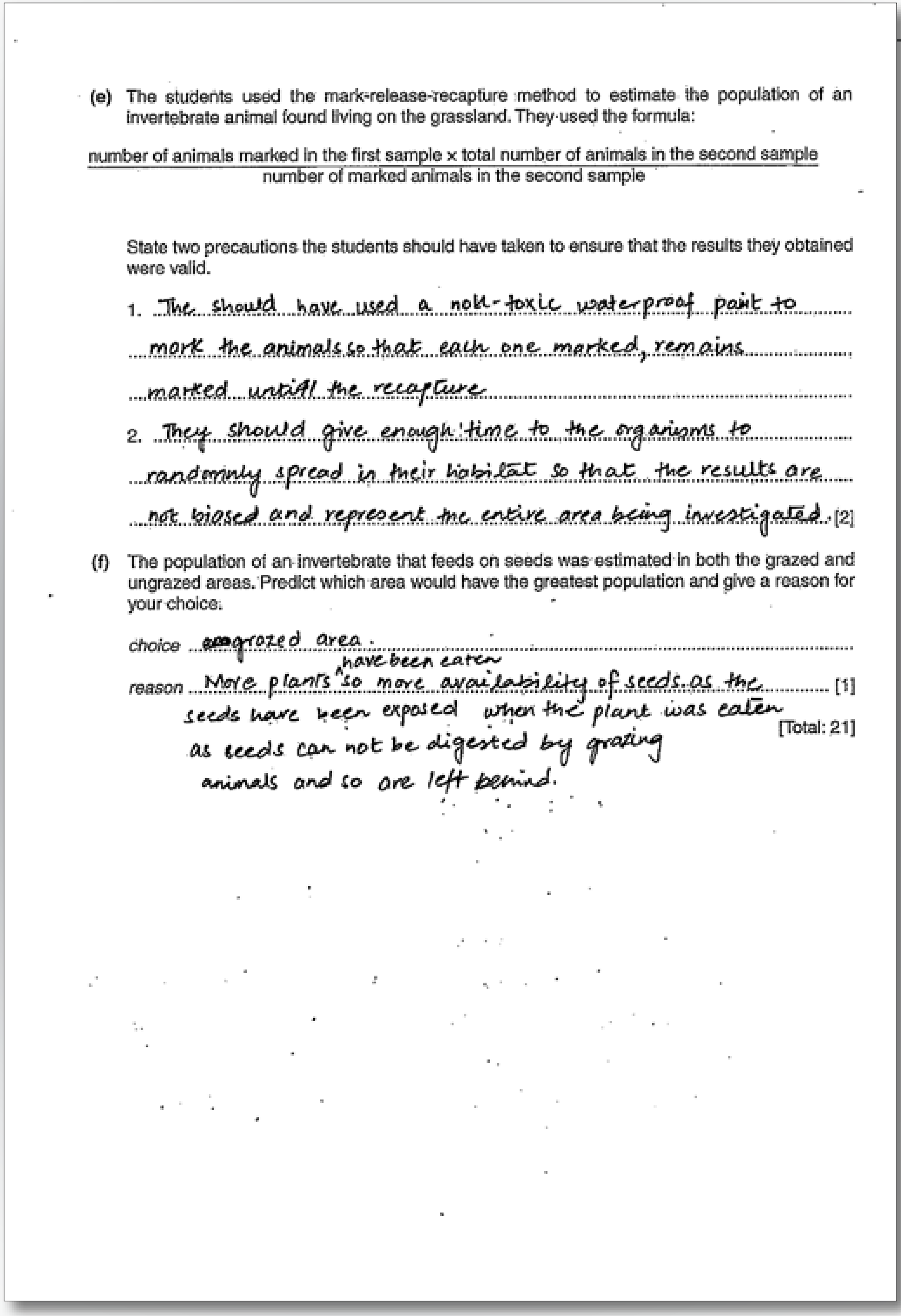
1(e) ☐

1(f) ☐

Q1	**Mark scheme**	
	Expected answer	**Extra guidance**
(d)(ii)	SM grazed = 9.33 ; SM ungrazed = 4.97 / 4.96 ;	*max 1 if answers are to 1 dp or 3 dp* (9.3 / 9.329, 5.0 / 4.965) **[2]**
(d)(iii)	860.1 ; to 879.9 ;	**A** ecf from 1(d)(ii)for correct calculation from incorrect S_M **[2]**
(d)(iv)	*any 2 from:* 95% confident / sure / certain that the mean lies within these limits ; shows the reliability of the mean ; the ungrazed mean is more reliable (because it's smaller) ; the difference between means is significant because there is no overlap between CI for ungrazed and grazed ;	*must be a clear statement* **R** if ref. to accuracy or results AW ora the grazed is less reliable (because it is bigger) **[max2]**

EXAMINER COMMENTS

MARK SCHEME



(e) The students used the mark-release-recapture method to estimate the population of an invertebrate animal found living on the grassland. They used the formula:

$$\frac{\text{number of animals marked in the first sample} \times \text{total number of animals in the second sample}}{\text{number of marked animals in the second sample}}$$

State two precautions the students should have taken to ensure that the results they obtained were valid.

1. The should have used a nott-toxic waterproof paint to mork the animals so that each one marked, remains marked until the recapture
2. They should give enough time to the organisms to randomly spread in their habitat so that the results are not biased and represent the entire area being investigated. [2]

(f) The population of an invertebrate that feeds on seeds was estimated in both the grazed and ungrazed areas. Predict which area would have the greatest population and give a reason for your choice.

choice grozed area.

reason More plants have been eaten so more availability of seeds as the seeds have been exposed when the plant was eaten as seeds can not be digested by grazing animals and so are left behind. [1]

[Total: 21]

Select page

HIGH

MIDDLE

LOW

Your Mark

1(a) ☐

1(b) ☐

1(c) ☐

1(d)(i) ☐

1(d)(ii) ☐

1(d)(iii) ☐

1(d)(iv) ☐

1(e) ☐

1(f) ☐

Q1	Mark scheme	
	Expected answer	**Extra guidance**
(e)	*any 2 from:* sample from a large area ; *idea that* there is a long enough time interval, for marked individuals to mix into the population / between capture and recapture ; *idea that* the marking technique must not be toxic AW ; *idea that* the marking technique must not increase / decrease chances of survival ; marking technique must not fall off / be rubbed off / washed off animal ; *idea that* time is not so long that migration / life cycle changes (of the species) have occurred ;	I sample size I any specified times need the idea of *long enough for dispersal* e.g. increases or decreases chance of predation **A** in terms of inhibiting / changing movement or behaviour **[max2]**
(f)	ungrazed and because there are more seeds (to eat) / AW ;	**A** ungrazed as there will be larger plants and more places for inverts to hide from predators / protection from predators. **[1]**
		Total [21]

EXAMINER COMMENTS

MARK SCHEME

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Interactive

Interactive Example Candidate Responses
Paper 5 (May/June 2016), Question 2
Cambridge International AS & A Level
Biology 9700

Version 1.0

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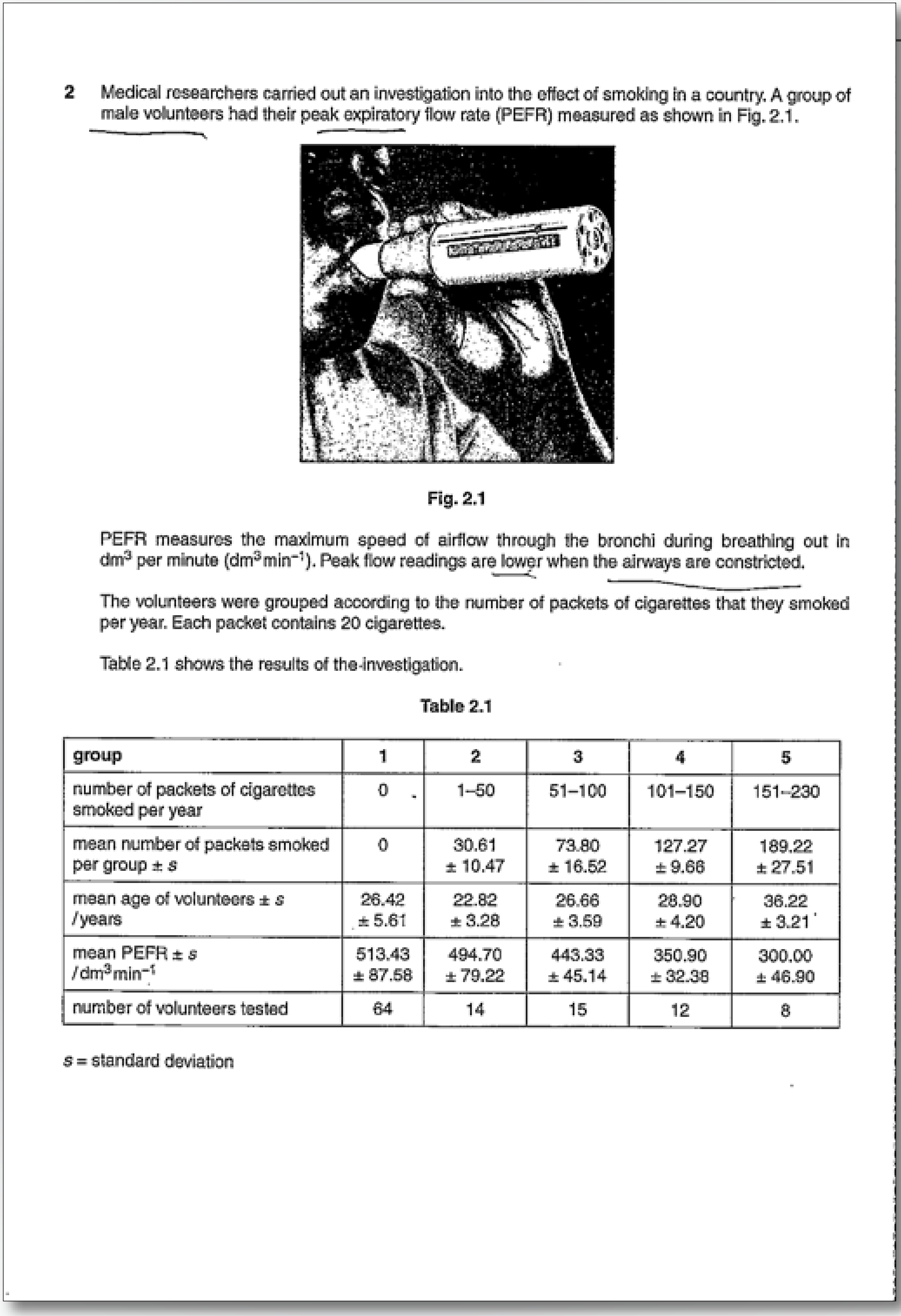

2 Medical researchers carried out an investigation into the effect of smoking in a country. A group of male volunteers had their peak expiratory flow rate (PEFR) measured as shown in Fig. 2.1.

Fig. 2.1

PEFR measures the maximum speed of airflow through the bronchi during breathing out in dm³ per minute ($dm^3 min^{-1}$). Peak flow readings are lower when the airways are constricted.

The volunteers were grouped according to the number of packets of cigarettes that they smoked per year. Each packet contains 20 cigarettes.

Table 2.1 shows the results of the investigation.

Table 2.1

group	1	2	3	4	5
number of packets of cigarettes smoked per year	0	1–50	51–100	101–150	151–230
mean number of packets smoked per group ± *s*	0	30.61 ± 10.47	73.80 ± 16.52	127.27 ± 9.66	189.22 ± 27.51
mean age of volunteers ± *s* /years	26.42 ± 5.61	22.82 ± 3.28	26.66 ± 3.59	28.90 ± 4.20	36.22 ± 3.21
mean PEFR ± *s* /$dm^3 min^{-1}$	513.43 ± 87.58	494.70 ± 79.22	443.33 ± 45.14	350.90 ± 32.38	300.00 ± 46.90
number of volunteers tested	64	14	15	12	8

s = standard deviation

Your Mark

2(a) ☐

2(b) ☐

2(c)(i) ☐

2(c)(ii) ☐

Q2	**Mark scheme**	
	Expected answer	**Extra guidance**
2(a)	*any 3 from:* 1 body mass / weight ; 2 number of volunteers in each group ; 3 age of volunteers ; 4 no factor affecting air flow / lung capacity ; 5 (physical) fitness of volunteers ; 6 (type of) cigarette smoked ; 7 PEFR device / apparatus used ; 8 PEFR test done when volunteers are sitting down / standing up ; 9 time of day the PEFR test performed ; 10 ethnicity / race ;	**I** diet / sex / alcohol consumption / medication / drugs / range of number of packets of cigarettes ; **A** same number in each age group **A** asthma, CF, COPD, TB, lung cancer **A** disease affecting the lungs / breathing **A** living at altitude **A** minimum time since last cigarette **I** passive smoking **A** in terms of nicotine / tar / filter / brand **A** not after exercise / at rest **[max3]**
2(b)	*any 3 from:* *support (max 2)* *conclusion 1 (an increase in the number of packets smoked decreases the PEFR measurement)* 1 the mean PFER decreases as the mean number of packets / cigarettes smoked increase ; 2 compare data from two PEFR and a trend on smoking **or** compare data from two number of packets smoked and a trend in PEFR ; 3 highest no. of packets / cigarettes smoked has the lowest mean PEFR ;	*answers must either include both 'means' or link relevant data for any two groups (age or PEFR and number of packets smoked) from Table 2.1 / comparisons of age with PEFR* *must link PEFR values to the amount smoked / number of packets (not just quote from the table)* e.g. (mean) PEFR decreases from 513.43 to 300.00 with increase in packets / cigarettes smoked e.g. (mean) PEFR decreases as the (mean) number packets increase from 0 to 189.22 **A** non-smokers / group 1 has the highest mean PEFR

EXAMINER COMMENTS

MARK SCHEME

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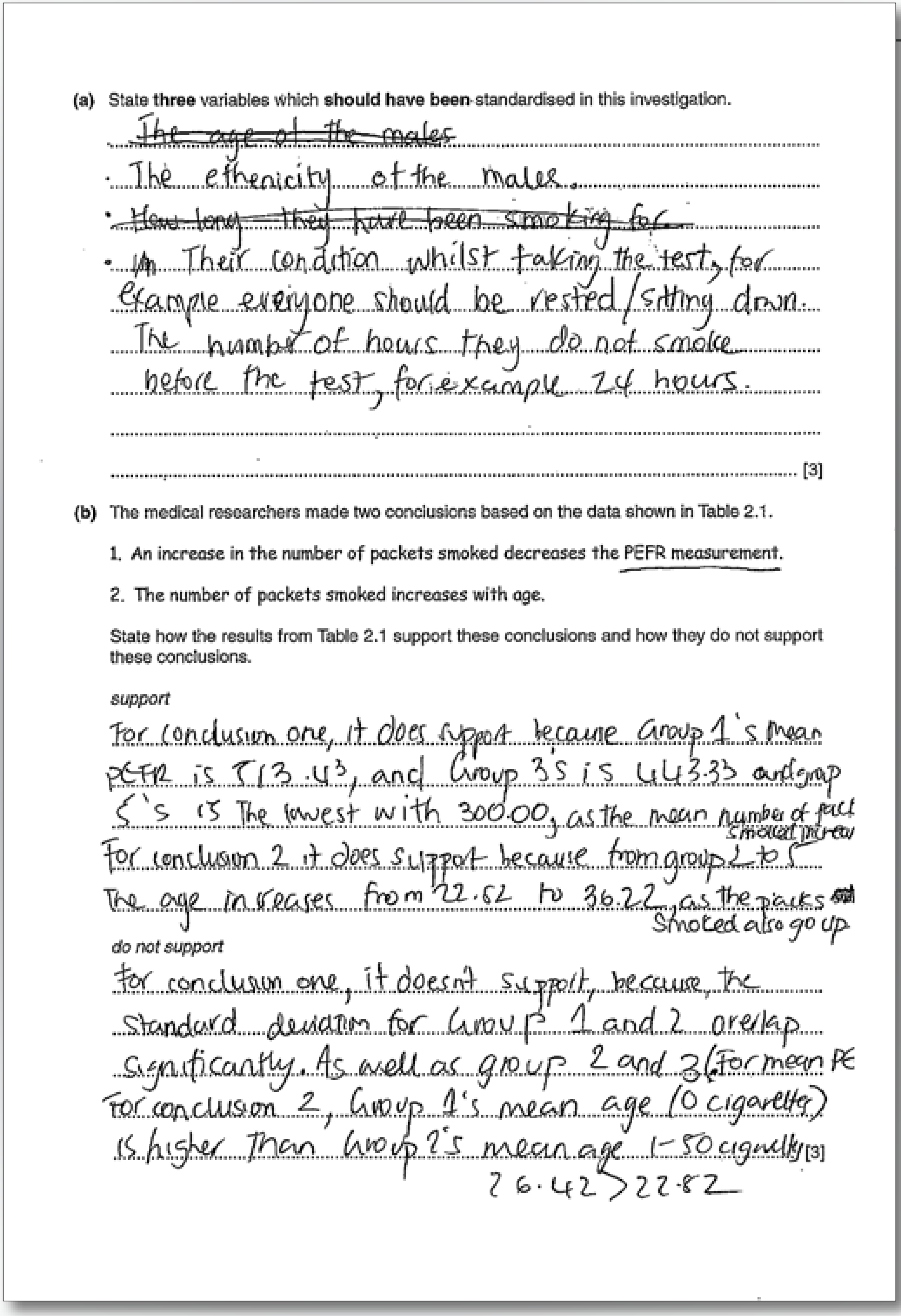


(a) State three variables which should have been standardised in this investigation.

~~The age of the males~~

• The ethenicity of the males.

• ~~How long they have been smoking for.~~

• ~~In~~ Their condition whilst taking the test, for example everyone should be rested / sitting down.

The number of hours they do not smoke before the test, for example 24 hours.

[3]

(b) The medical researchers made two conclusions based on the data shown in Table 2.1.

1. An increase in the number of packets smoked decreases the PEFR measurement.
2. The number of packets smoked increases with age.

State how the results from Table 2.1 support these conclusions and how they do not support these conclusions.

support

For conclusion one, it does support because Group 1's mean PEFR is 513.43, and Group 3's is 443.33 and group 5's is the lowest with 300.00, as the mean number of pack smoked increases

For conclusion 2 it does support because from group 2 to 5 The age increases from 22.62 to 36.22, as the packs smoked also go up

do not support

for conclusion one, it doesn't support, because the standard deviation for Group 1 and 2 overlap significantly. As well as group 2 and 3 (for mean PE

For conclusion 2, Group 1's mean age (0 cigarette) is higher Than Group 2's mean age 1-50 cigarette [3]

26.42 > 22.82

Your Mark

2(a) ☐

2(b) ☐

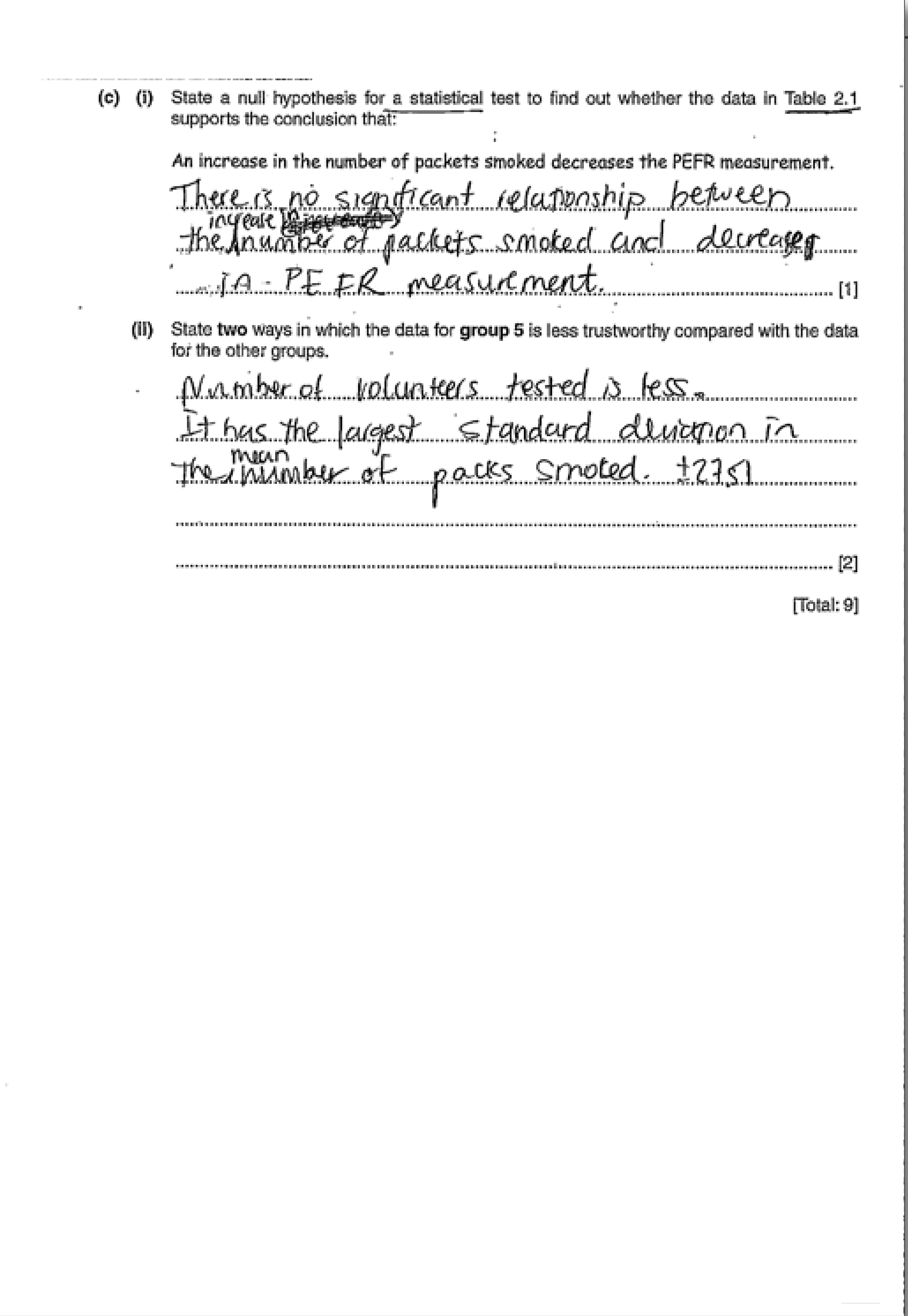
2(c)(i) ☐

2(c)(ii) ☐

Q2	Mark scheme	
	Expected answer	**Extra guidance**
2(b)	*conclusion 2 (the number of packets smoked increases with age)* 4 as <u>mean</u> age increases the mean number of packets increases ; 5 compare data from two age groups and a trend on smoking **or** compare data from two mean number of packets smoked and a trend on age ; 6 old<u>est</u> volunteers / group 5 smoked the high<u>est</u> mean number of packets ; does not support (max 2) conclusion 1 (an increase in the number of packets smoked decreases the PEFR measurement) 7 as the number packets increases **and** the values / range / standard deviation of PEFR of two of the groups overlap ; *conclusion 2 (the number of packets smoked increases with age)* 8 values / range/ standard deviation of the ages (for each group) overlap **or** there are no distinct age groups / age groups overlap ; 9 group 2 smoke more packets than group 1 but (mean) age is lower ;	must link age values to the amount smoked / number of packets (not just quote from the table) must not use group 1 data here (26.42 and 0) e.g. (mean) number of packets increases from 30.61 to 189.22 with an increase in age e.g. (mean) age increases from 22.82 to 36.22 as the (mean) number of packets smoked increases **A** the youngest smokers / group 2 smoked the least <u>mean</u> number of packets **A** the lar<u>gest mean</u> number of packets was smoked by the old<u>est</u> people e.g. overlap between: group 1 / non-smokers and group 2 group 1 / non-smokers and group 3 group 2 and group 3 group 4 and group 5 **A** individuals in groups 1, 2, 3 and 4 all have a similar / same age **[max3]**

EXAMINER COMMENTS

MARK SCHEME



(c) (i) State a null hypothesis for a statistical test to find out whether the data in Table 2.1 supports the conclusion that:

An increase in the number of packets smoked decreases the PEFR measurement.

There is no significant relationship between the increase in ~~[illegible]~~ number of packets smoked and decrease in PEFR measurement. [1]

(ii) State **two** ways in which the data for **group 5** is less trustworthy compared with the data for the other groups.

Number of volunteers tested is less.
It has the largest standard deviation in the mean number of packs smoked. ±27.51

[2]

[Total: 9]

Select page

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Your Mark

2(a) ☐

2(b) ☐

2(c)(i) ☐

2(c)(ii) ☐

Q2	Mark scheme	
	Expected answer	**Extra guidance**
2(c)(i)	there is no significant relationship / correlation between the decrease in the PEFR and the increase in the number of packets of cigarettes smoked **or** there is no significant decrease in the PEFR as the number of packets smoked increases **or** the increase in the number of packets smoked does not significantly decrease the PEFR ;	**A** there is no significant relationship / correlation between the increase in the number of packets of cigarettes smoked and the decrease in the PEFR **[max1]**
2(c)(ii)	*any 2 from:* number of volunteers small (est.); great(est) range in number of packets of cigarettes smoked (151–230) ; larg(est) standard deviation for number of packets of cigarettes ;	**A** has a range of 80 instead of 50 **[max2]** **Total: [9]**

EXAMINER COMMENTS

MARK SCHEME

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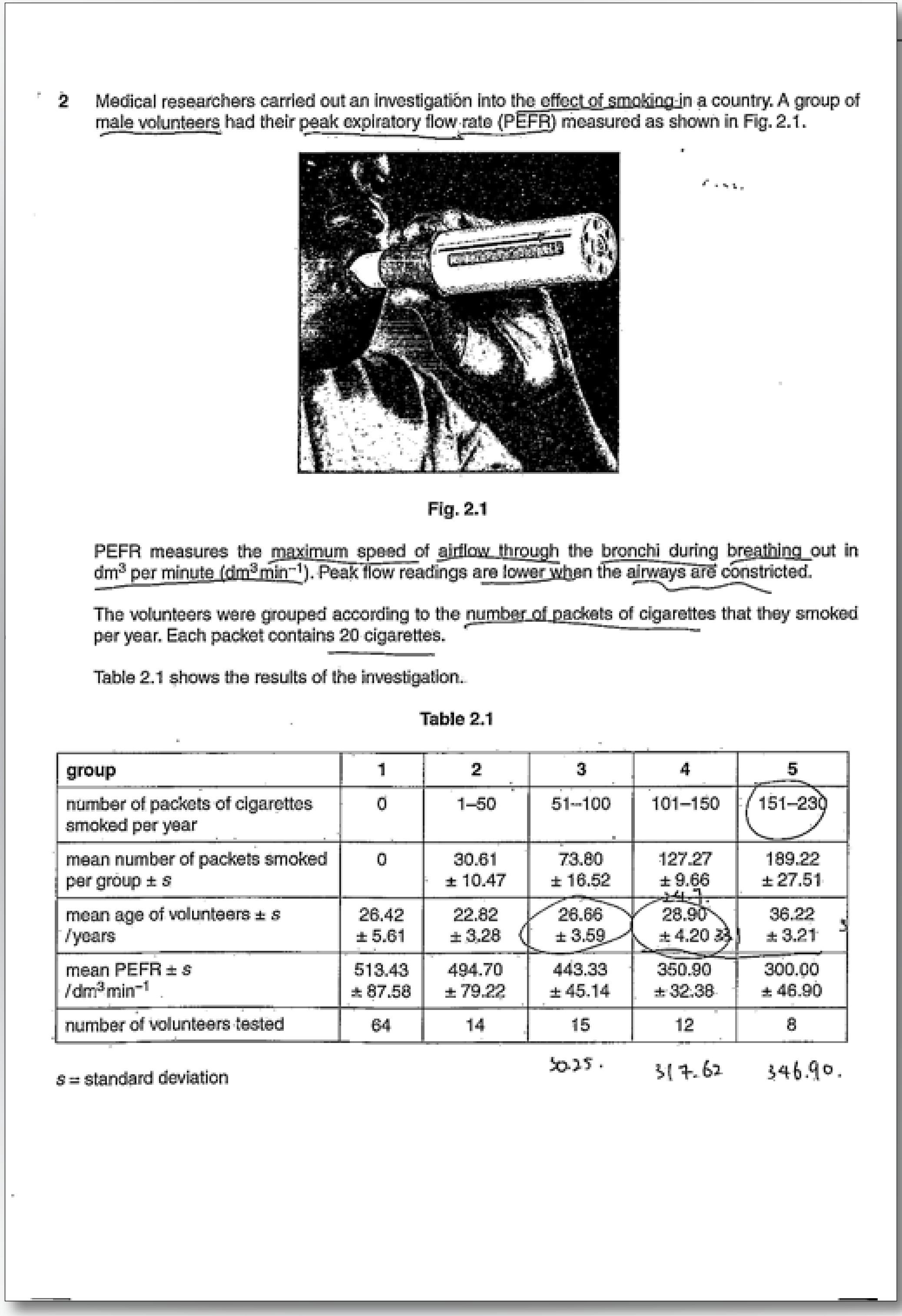

2 Medical researchers carried out an investigation into the effect of smoking in a country. A group of male volunteers had their peak expiratory flow rate (PEFR) measured as shown in Fig. 2.1.

Fig. 2.1

PEFR measures the maximum speed of airflow through the bronchi during breathing out in dm³ per minute ($dm^3 min^{-1}$). Peak flow readings are lower when the airways are constricted.

The volunteers were grouped according to the number of packets of cigarettes that they smoked per year. Each packet contains 20 cigarettes.

Table 2.1 shows the results of the investigation.

Table 2.1

group	1	2	3	4	5
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mean age of volunteers ± *s* /years	26.42 ± 5.61	22.82 ± 3.28	26.66 ± 3.59	24.7. 28.90 ± 4.20 33	36.22 ± 3.21
mean PEFR ± *s* /$dm^3 min^{-1}$	513.43 ± 87.58	494.70 ± 79.22	443.33 ± 45.14	350.90 ± 32.38	300.00 ± 46.90
number of volunteers tested	64	14	15	12	8
			50.25.	317.62	346.90.

s = standard deviation

Your Mark

2(a) ☐

2(b) ☐

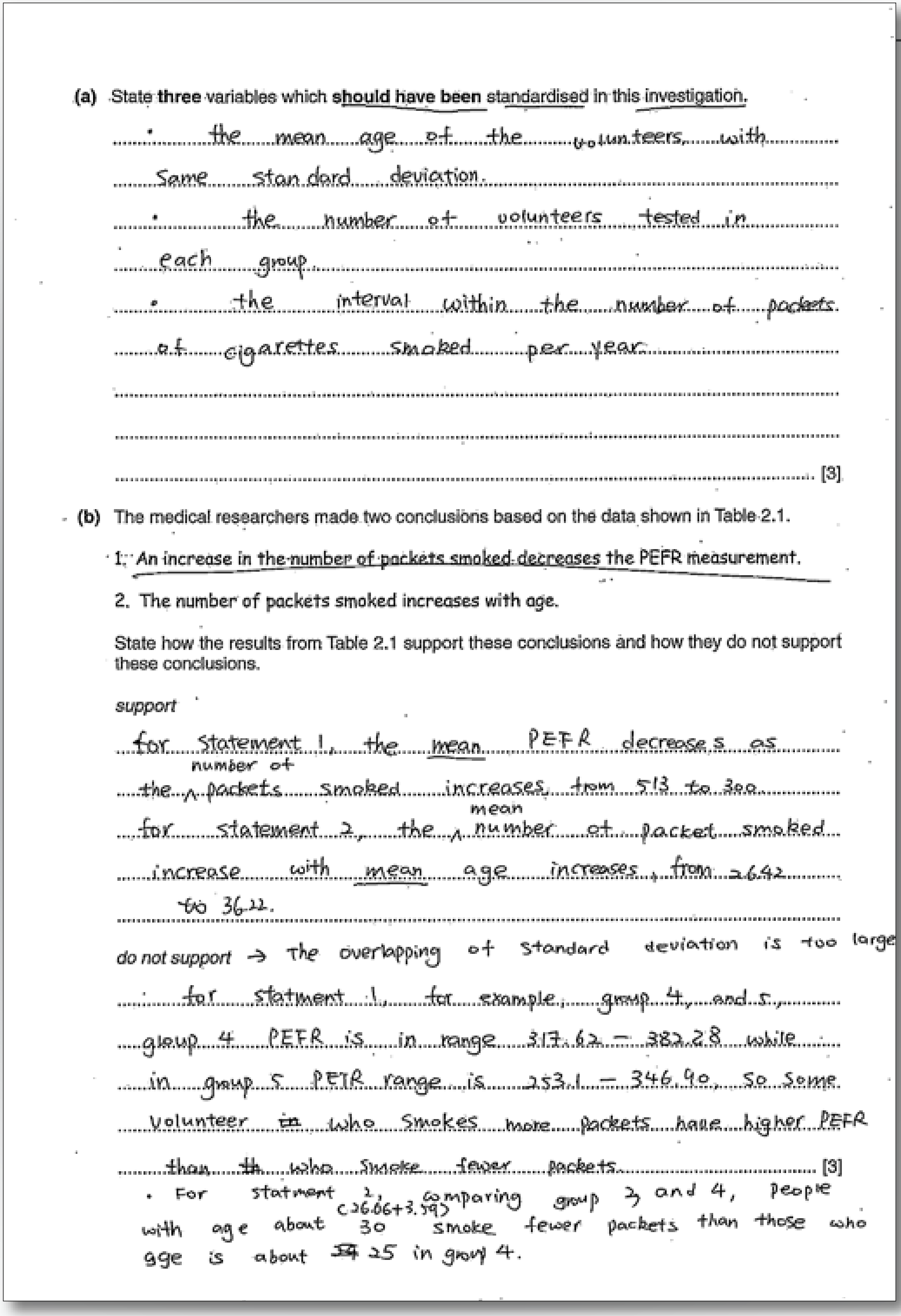
2(c)(i) ☐

2(c)(ii) ☐

Q2	Mark scheme	
	Expected answer	**Extra guidance**
2(a)	*any 3 from:* 1 body mass / weight ; 2 number of volunteers in each group ; 3 age of volunteers ; 4 no factor affecting air flow / lung capacity ; 5 (physical) fitness of volunteers ; 6 (type of) cigarette smoked ; 7 PEFR device / apparatus used ; 8 PEFR test done when volunteers are sitting down / standing up ; 9 time of day the PEFR test performed ; 10 ethnicity / race ;	**I** diet / sex / alcohol consumption / medication / drugs / range of number of packets of cigarettes ; **A** same number in each age group **A** asthma, CF, COPD, TB, lung cancer **A** disease affecting the lungs / breathing **A** living at altitude **A** minimum time since last cigarette **I** passive smoking **A** in terms of nicotine / tar / filter / brand **A** not after exercise / at rest **[max3]**
2(b)	*any 3 from:* *support (max 2)* *conclusion 1 (an increase in the number of packets smoked decreases the PEFR measurement)* 1 the <u>mean</u> PFER decreases as the <u>mean</u> number of packets / cigarettes smoked increase ; 2 compare data from two PEFR and a trend on smoking **or** compare data from two number of packets smoked and a trend in PEFR ; 3 highest no. of packets / cigarettes smoked has the lowest mean PEFR ;	*answers must either include both 'means' or link relevant data for any two groups (age or PEFR and number of packets smoked) from Table 2.1 / comparisons of age with PEFR* *must link PEFR values to the amount smoked / number of packets (not just quote from the table)* e.g. (mean) PEFR decreases from 513.43 to 300.00 with increase in packets / cigarettes smoked e.g. (mean) PEFR decreases as the (mean) number packets increase from 0 to 189.22 **A** non-smokers / group 1 has the highest <u>mean</u> PEFR

EXAMINER COMMENTS

MARK SCHEME



(a) State three variables which should have been standardised in this investigation.

• the mean age of the volunteers with Same stan dard deviation.

• the number of volunteers tested in each group.

• the interval within the number of packets of cigarettes smoked per year.

[3]

(b) The medical researchers made two conclusions based on the data shown in Table 2.1.

1. An increase in the number of packets smoked decreases the PEFR measurement.

2. The number of packets smoked increases with age.

State how the results from Table 2.1 support these conclusions and how they do not support these conclusions.

support

for statement 1, the mean PEFR decreases as the number of packets smoked increases from 513 to 300

for statement 2, the mean number of packet smoked increase with mean age increases, from 26.42 to 36.22.

do not support → The overlapping of standard deviation is too large

for statment 1, for example, group 4, and 5, group 4 PEFR is in range 317.62 – 382.28 while in group 5 PEFR range is 253.1 – 346.90, so some volunteer ~~in~~ who smokes more packets have higher PEFR than ~~th~~ who smoke fewer packets. [3]

• For statment 2, comparing group 3 and 4, people with age about 30 (26.66+3.59) smoke fewer packets than those who age is about ~~34~~ 25 in group 4.

Your Mark

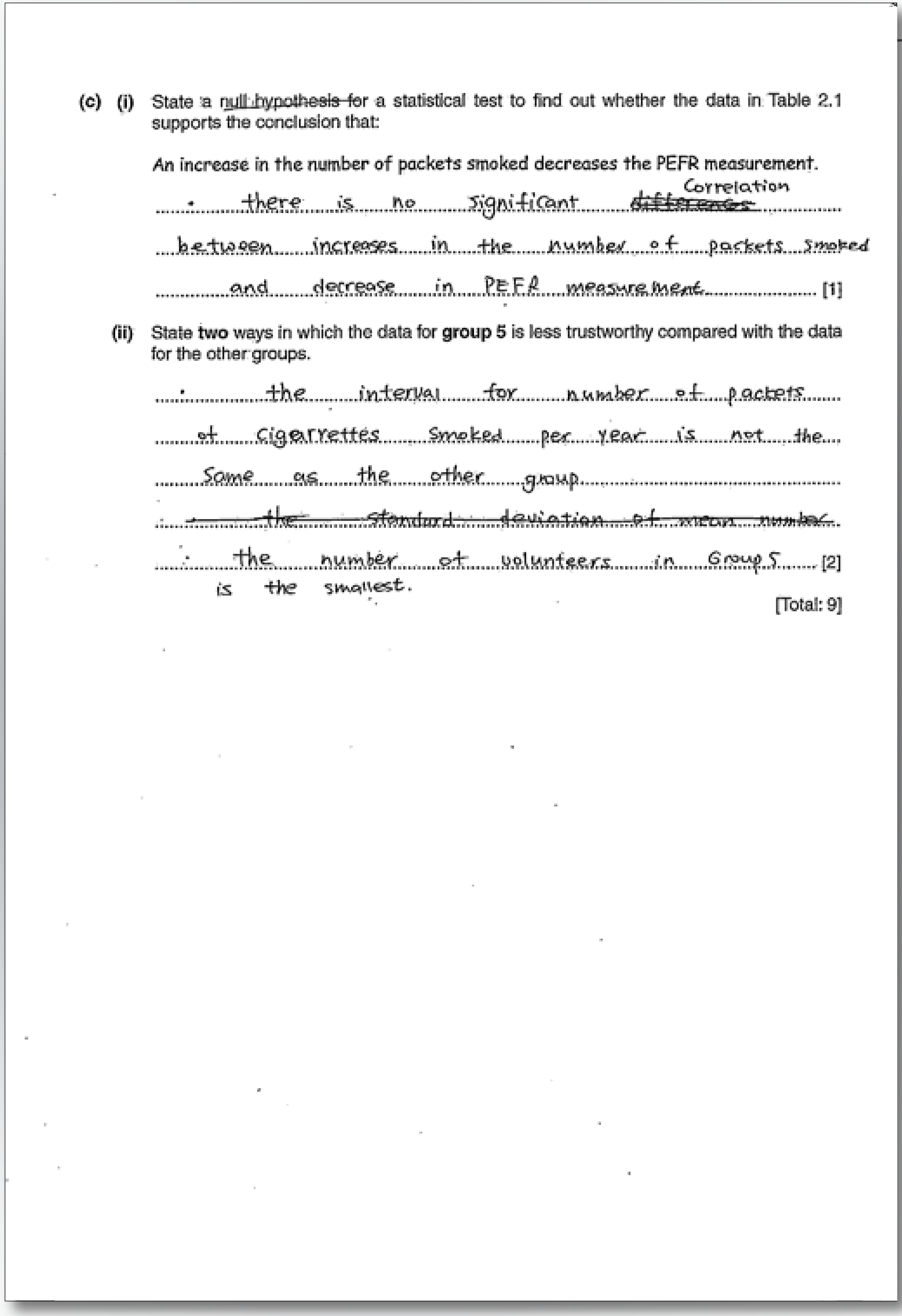
2(a)

2(b)

2(c)(i)

2(c)(ii)

Q2	Mark scheme	
	Expected answer	**Extra guidance**
2(b)	*conclusion 2 (the number of packets smoked increases with age)* 4 as mean age increases the mean number of packets increases ; 5 compare data from two age groups and a trend on smoking **or** compare data from two mean number of packets smoked and a trend on age ;	must link age values to the amount smoked / number of packets (not just quote from the table) must not use group 1 data here (26.42 and 0) e.g. (mean) number of packets increases from 30.61 to 189.22 with an increase in age e.g. (mean) age increases from 22.82 to 36.22 as the (mean) number of packets smoked increases
	6 oldest volunteers / group 5 smoked the highest mean number of packets ;	**A** the youngest smokers / group 2 smoked the least mean number of packets **A** the largest mean number of packets was smoked by the oldest people
	does not support (max 2) conclusion 1 (an increase in the number of packets smoked decreases the PEFR measurement) 7 as the number packets increases **and** the values / range / standard deviation of PEFR of two of the groups overlap ;	e.g. overlap between: group 1 / non-smokers and group 2 group 1 / non-smokers and group 3 group 2 and group 3 group 4 and group 5 **A** individuals in groups 1, 2, 3 and 4 all have a similar / same age
	conclusion 2 (the number of packets smoked increases with age) 8 values / range/ standard deviation of the ages (for each group) overlap **or** there are no distinct age groups / age groups overlap ; 9 group 2 smoke more packets than group 1 but (mean) age is lower ;	**[max3]**



(c) (i) State a null hypothesis for a statistical test to find out whether the data in Table 2.1 supports the conclusion that:

An increase in the number of packets smoked decreases the PEFR measurement.

• there is no significant ~~differences~~ Correlation between increases in the number of packets smoked and decrease in PEFR measurement. [1]

(ii) State **two** ways in which the data for **group 5** is less trustworthy compared with the data for the other groups.

• the interval for number of packets of cigarrettes smoked per year is not the same as the other group

~~• the standard deviation of mean number~~

• the number of volunteers in Group 5 is the smallest. [2]

[Total: 9]

Your Mark

2(a) ☐

2(b) ☐

2(c)(i) ☐

2(c)(ii) ☐

Q2	Mark scheme	
	Expected answer	**Extra guidance**
2(c)(i)	there is no significant relationship / correlation between the decrease in the PEFR and the increase in the number of packets of cigarettes smoked **or** there is no significant decrease in the PEFR as the number of packets smoked increases **or** the increase in the number of packets smoked does not significantly decrease the PEFR ;	**A** there is no significant relationship / correlation between the increase in the number of packets of cigarettes smoked and the decrease in the PEFR **[max1]**
2(c)(ii)	*any 2 from:* number of volunteers small (est.); great(est) range in number of packets of cigarettes smoked (151–230) ; larg(est) standard deviation for number of packets of cigarettes ;	**A** has a range of 80 instead of 50 **[max2]** **Total: [9]**

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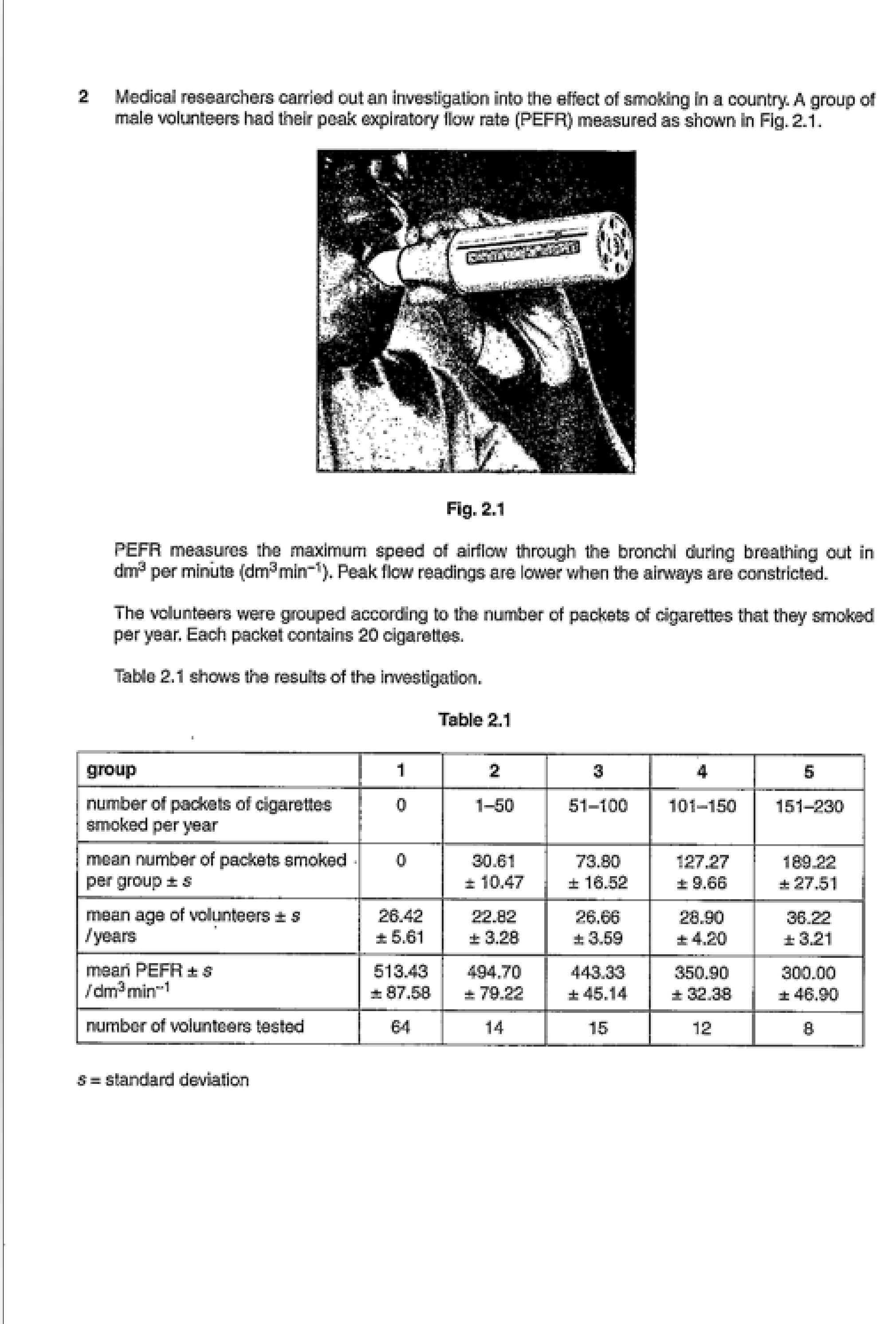

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number of volunteers tested	64	14	15	12	8

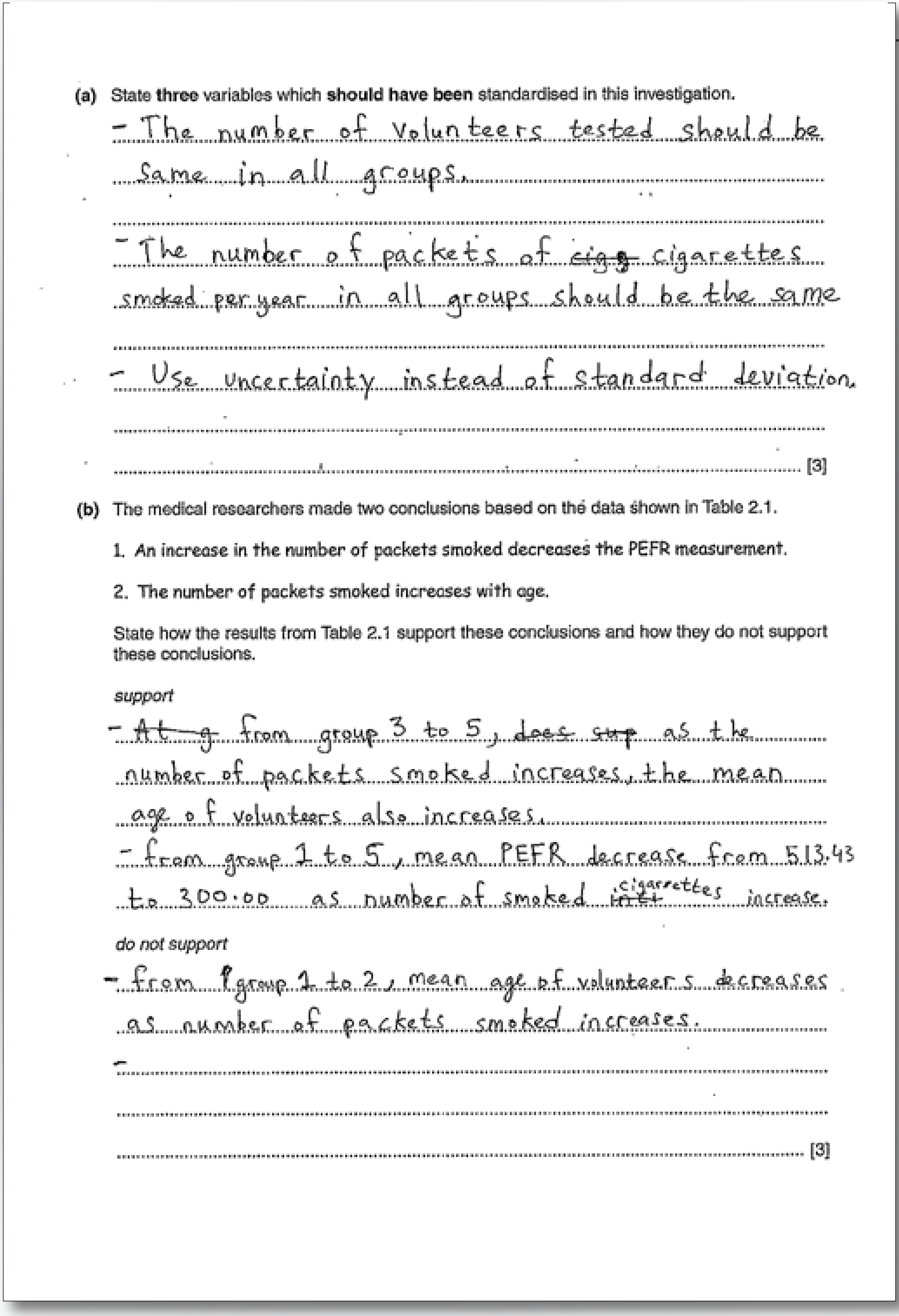
s = standard deviation

Examiner marks and comments

	Your Mark	Mark	Comment
2(a)	☐	1/3	The candidate gained credit for this answer. This answer did not gain credit as the investigation does include a way of standardising this variable. This statement is not relevant and suggests that this candidate does not understand that standard deviation is one way of showing uncertainty.
2(b)	☐	2/3	This statement could have gained mp4 or mp5, but did not gain credit as the candidate omitted 'mean' from the number of packets (mp4) and did not quote the figures to show the increase in the numbers of packets(mp5). The candidate gained mp2 as they have quoted relevant figures for the decrease n PEFR linked to an increase in the number of packets of cigarettes. This answer gained mp9 as the candidate has made a link between a decrease in mean age and and increase in number of cigarettes.
2(c)(i)	☐	0/1	This answer is a weak description of a negative correlation, which is true, but not a null hypothesis. A null hypothesis should state that there is no significant correlation between the changes in the two parameters being assessed, in this case, the decrease in PFER and the increase in smoking
2(c)(ii)	☐	1/2	This answer is not relevant. The differences in ages does not affect validity, which is more concerned with the reliability of the data for this group. The candidate gained credit for this answer.

EXAMINER COMMENTS

MARK SCHEME



(a) State **three** variables which **should have been** standardised in this investigation.

- The number of Volunteers tested should be Same in all groups.

- The number of packets of ~~cigg~~ cigarettes smoked per year in all groups should be the same

- Use uncertainty instead of standard deviation.

[3]

(b) The medical researchers made two conclusions based on the data shown in Table 2.1.

1. An increase in the number of packets smoked decreases the PEFR measurement.
2. The number of packets smoked increases with age.

State how the results from Table 2.1 support these conclusions and how they do not support these conclusions.

support

- ~~At g~~ from group 3 to 5, ~~does sup~~ as the number of packets smoked increases, the mean age of volunteers also increases.
- from group 1 to 5, mean PEFR decrease from 513.43 to 300.00 as number of smoked ~~ints~~ cigarettes increase.

do not support

- from group 1 to 2, mean age of volunteers decreases as number of packets smoked increases.
-

[3]

Examiner marks and comments

Your Mark	Mark	Comment
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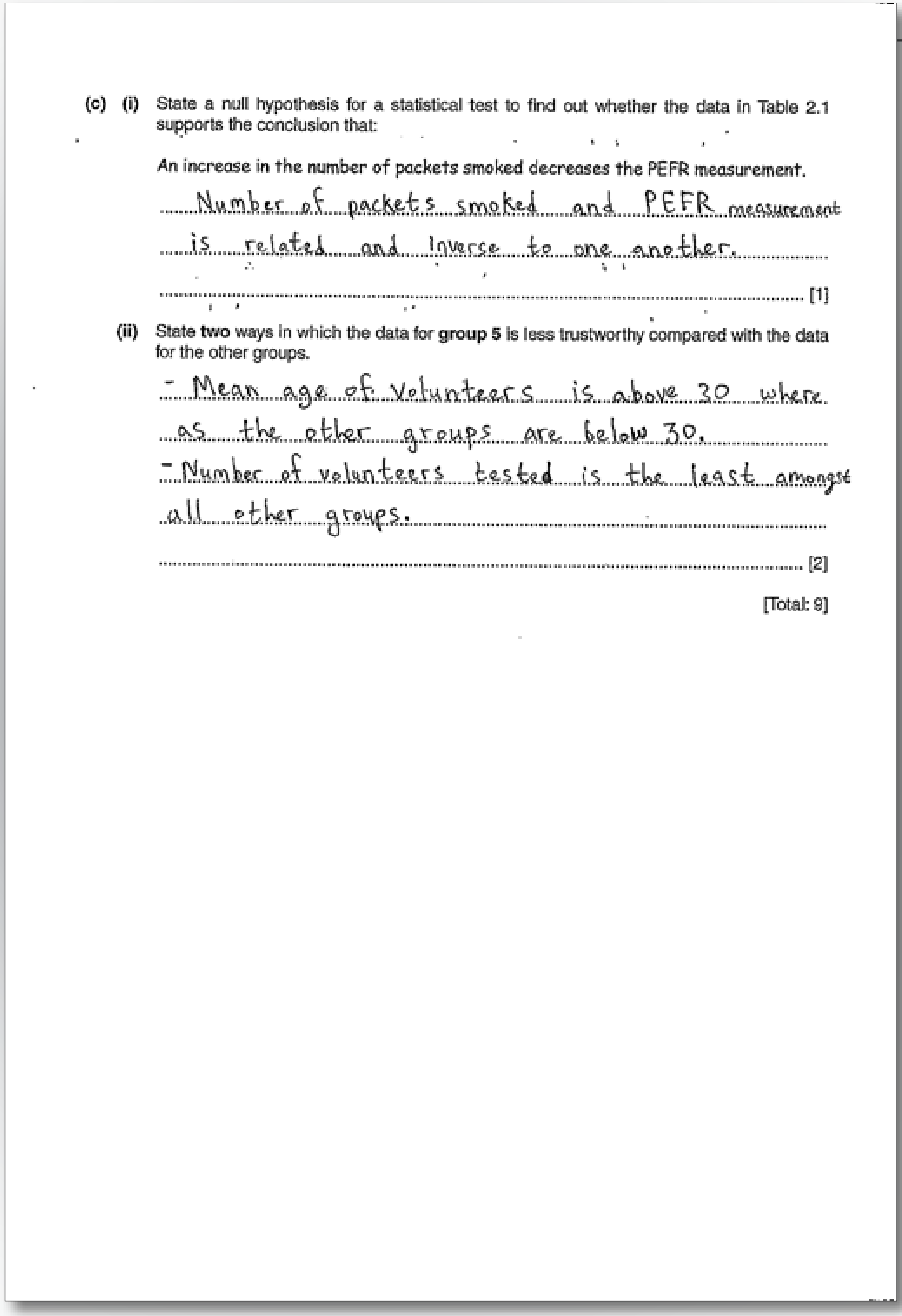
2(c)(i) ☐	0/1	This answer is a weak description of a negative correlation, which is true, but not a null hypothesis. A null hypothesis should state that there is no significant correlation between the changes in the two parameters being assessed, in this case, the decrease in PFER and the increase in smoking
2(c)(ii) ☐	1/2	This answer is not relevant. The differences in ages does not affect validity, which is more concerned with the reliability of the data for this group. The candidate gained credit for this answer.



(c) (i) State a null hypothesis for a statistical test to find out whether the data in Table 2.1 supports the conclusion that:

An increase in the number of packets smoked decreases the PEFR measurement.

Number of packets smoked and PEFR measurement is related and inverse to one another.

[1]

(ii) State **two** ways in which the data for **group 5** is less trustworthy compared with the data for the other groups.

- Mean age of volunteers is above 30 where as the other groups are below 30.

- Number of volunteers tested is the least amongst all other groups.

[2]

[Total: 9]

Select page

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Your Mark

2(a) ☐

2(b) ☐

2(c)(i) ☐

2(c)(ii) ☐

Examiner marks and comments

Mark	Comment
1/3	The candidate gained credit for this answer. This answer did not gain credit as the investigation does include a way of standardising this variable. This statement is not relevant and suggests that this candidate does not understand that standard deviation is one way of showing uncertainty.
2/3	This statement could have gained mp4 or mp5, but did not gain credit as the candidate omitted 'mean' from the number of packets (mp4) and did not quote the figures to show the increase in the numbers of packets(mp5). The candidate gained mp2 as they have quoted relevant figures for the decrease n PEFR linked to an increase in the number of packets of cigarettes. This answer gained mp9 as the candidate has made a link between a decrease in mean age and and increase in number of cigarettes.
0/1	This answer is a weak description of a negative correlation, which is true, but not a null hypothesis. A null hypothesis should state that there is no significant correlation between the changes in the two parameters being assessed, in this case, the decrease in PFER and the increase in smoking
1/2	This answer is not relevant. The differences in ages does not affect validity, which is more concerned with the reliability of the data for this group. The candidate gained credit for this answer.

EXAMINER COMMENTS

MARK SCHEME

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