AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.4.1.2

Rate of photosynthesis

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**7**
Available paper years	**2018–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.4.1.2 Rate of photosynthesis

Answer 01 · Mark scheme

June 2018 | 8464/B/1F | Original Q2

The full source mark scheme begins on page 21. Follow original question 2 in that document.

4.4.1.2 Rate of photosynthesis

Answer 02 · Mark scheme June 2018 | 8464/B/2F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	<table><tr><th>Factor</th><th>Biotic</th><th>Abiotic</th></tr><tr><td>Diseases</td><td>✓</td><td></td></tr><tr><td>Herbivores</td><td>✓</td><td></td></tr><tr><td>Temp</td><td></td><td>✓</td></tr><tr><td>Water</td><td></td><td>✓</td></tr></table>	allow **1** mark for 2 or 3 correct	2	AO1 4.7.1.3 4.7.1.2
06.2	(leaves block light near tree so) more light (as you move outwards)	allow low light intensity under tree ignore Sun	1	AO2 4.7.2.1
	for photosynthesis	allow less photosynthesis under the tree	1	AO1 4.7.2.1 4.4.1.1 4.4.1.3
	(which) produces (more) glucose / proteins (for growth)	ignore growth ignore food allow molecules, cell components or other correct substances instead of proteins if no other mark awarded allow less water / ions / minerals / nutrients under the tree	1	AO1 4.7.2.1 4.4.1.1 4.4.1.3
06.3		in this order		AO1 4.7.2.1
	quadrat	correct spelling only	1	
	light meter	allow lux meter allow light intensity meter allow light data logger	1	
06.4	1.5(0) (m^2)	allow 15 000 cm^2	1	AO2 4.7.2.1

4.4.1.2 Rate of photosynthesis

Answer 02 · Mark scheme

June 2018 | 8464/B/2F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	to keep light (intensity) as similar as possible	allow the light (intensity) might change ignore references to temperature ignore weather ignore Sun	1	AO3 4.7.2.1
06.6	any **one** from: • repeat (investigation) around the tree • repeat (investigation) for other trees / areas • sample every one metre • count the number of each species present (rather than percentage cover)	allow repeat in different directions ignore repeats unqualified ignore repeat at different times / days / seasons ignore different size quadrat ignore random sampling	1	AO3 4.7.2.1
06.7	daisy		1	AO3 4.7.2.1
06.8	as light (intensity) increased so did the percentage / cover of plants up to 100% / maximum at 175 (arbitrary units)	ignore directly proportional ignore positive correlation unqualified ignore distance	1 1	AO3 4.7.2.1

4.4.1.2 Rate of photosynthesis

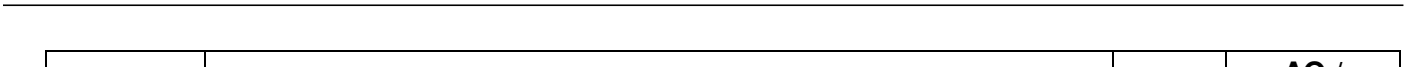
Answer 02 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.9	any pair from: • (lack of) water / rain (1) because the leaves are stopping the rain **or** because the roots of the tree are absorbing it (1) • (lack of) minerals / ions (1) because the tree (roots) have absorbed them (1) • temperature (1) because less thermal energy from the sun is reaching under the tree canopy (1)	ignore carbon dioxide do **not** accept oxygen allow soil moisture allow magnesium / nitrate / nutrients allow too cold / cooler allow 'heat' for thermal energy allow pH / acidity (1) because (some) fallen leaves are acidic (1)	2	AO2 4.7.2.1
Total			**15**	

4.4.1.2 Rate of photosynthesis

Answer 02 · Mark scheme

June 2018 | 8464/B/2F | Original Q6



4.4.1.2 Rate of photosynthesis

Answer 03 · Mark scheme June 2019 | 8464/B/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	oxygen	name takes precedence allow O_2 ignore O^2 / O / O2	1	AO1 4.4.1.1 4.4.1.2
01.2	(use) a lamp / light (source) (and) move away and / or towards pondweed	 allow use different power ratings **or** use a dimmer switch allow change the opacity of the beaker for **2** marks	1 1	AO1 4.4.1.2
01.3	count the number of bubbles in a given time	allow measure the volume of gas collected allow for **2** marks measure time taken to collect a specific number of bubbles	1 1	AO1 4.4.1.2 AO2/2 4-5 RPA5 WS2.3
01.4	34 (arbitrary units)	allow a value in the range 33.5 – 34.5 (arbitrary units)	1	AO2 4.4.1.2
01.5	200 lumens		1	AO3 4.4.1.2
01.6	any **one** from: • temperature • carbon dioxide (concentration) • amount of chlorophyll	ignore light (intensity) ignore heat ignore oxygen allow light colour / wavelength allow water ignore pH	1	AO1 4.4.1.2
Total			**8**	

4.4.1.2 Rate of photosynthesis

Answer 03 · Mark scheme

June 2019 | 8464/B/1F | Original Q1

4.4.1.2 Rate of photosynthesis

Answer 04 · Mark scheme November 2021 | 8464/B/1F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$6\,CO_2 + 6\,H_2O \rightarrow C_6H_{12}O_6 + 6\,O_2$		1	AO1 4.4.1.1
05.2	distance of the pondweed from the lamp		1	AO1 4.4.1.2 RPA5
05.3	bubbles (of gas) would be produced faster	allow more / bigger bubbles of gas would be produced (in a given time)	1	AO3 4.4.1.2 RPA5
	(because) enzymes work faster	allow (because) photosynthesis is controlled by enzymes allow (because) photosynthesis would be faster	1	AO2 4.2.2.1 4.4.1.2
05.4	any **one** from: • use an LED (lamp) • place a tank / beaker of water between the lamp and tube / pondweed • put the tube in a beaker of water • put the tube in a (thermostatically controlled) water bath • place a piece of glass between the lamp and tube / pondweed	allow use a light that does not emit (a lot of) infrared / thermal radiation allow place a heat shield between the lamp and tube / pondweed	1	AO3 4.4.1.2 RPA5

4.4.1.2 Rate of photosynthesis

05.5	any **two** from: • measure the volume of gas produced • allow the pondweed time to equilibrate • repeat **and** calculate a mean **or** repeat **and** remove anomalies • control the concentration of carbon dioxide (in the water) • use the same bulb / lamp	 allow amount for volume allow use a cylinder / gas syringe to collect the gas allow a description of this ignore repeat unqualified allow put the pondweed in sodium hydrogen carbonate (solution) **or** sodium bicarbonate (solution) allow use the same type / size / age / piece of pondweed allow record the number of bubbles of gas produced in a longer period of time	2	AO3 4.4.1.2 RPA5
05.6	3 (bubbles of gas produced per minute)	allow 3.2 (bubbles of gas produced per minute) do **not** accept 3.0 (bubbles of gas produced per minute)	1	AO2 4.4.1.2 RPA5
05.7	as light intensity decreases the rate of photosynthesis decreases	allow as distance from lamp increases rate of photosynthesis decreases allow as distance from lamp increases number of bubbles produced decreases	1	AO3 4.4.1.2 RPA5

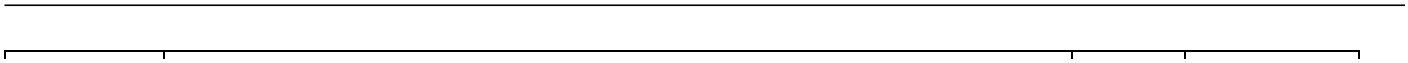
4.4.1.2 Rate of photosynthesis

05.8	all points plotted correctly line of best fit through their points	allow tolerance of ± ½ a small square allow **1** mark for four points plotted correctly do **not** accept line extended to 0, 0 ignore extrapolations of line	2 1	AO2 4.4.1.2 RPA5
05.9	8	allow correct value from their line ± ½ a small square allow value in range 6 to 9 if a curved line of best fit is not drawn	1	AO3 4.4.1.2 RPA5
Total			**13**	

4.4.1.2 Rate of photosynthesis

Answer 04 · Mark scheme

November 2021 | 8464/B/1F | Original Q5



4.4.1.2 Rate of photosynthesis

Answer 05 · Mark scheme

June 2022 | 8464/B/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	cells contain (many) chloroplasts	allow positioned nearest to the light **or** at the top of the leaf allow cells are closely packed **or** no gaps between cells allow chlorophyll for chloroplast	1	AO1 4.1.1.3 4.2.1 4.2.3.1 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	stomata		1	AO1 4.2.3.1 4.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	(real length) $= \frac{28}{400}$ (real length in mm =) 0.07 (real length in µm =) 70	 allow answer given for length in mm correctly multiplied by 1000	1 1 1	AO2 4.1.1.1 4.1.1.2 4.1.1.5 RPA1

4.4.1.2 Rate of photosynthesis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	diffusion		1	AO1 4.1.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	A Reason any **one** from: • steeper (diffusion) gradient • bigger difference in concentration of carbon dioxide inside and outside the cell	no marks if wrong cell chosen allow higher concentration of carbon dioxide outside the cell than inside the cell allow particles / molecules for carbon dioxide	1 1	AO3 AO2 4.1.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(number / amount of) bubbles time	allow volume of gas / oxygen allow suitable time eg 1 / 5 / 10 minutes	1 1	AO1 4.4.1.2 RPA5

4.4.1.2 Rate of photosynthesis

Answer 05 · Mark scheme

June 2022 | 8464/B/1F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	any **two** from: • temperature (of water) • light intensity **or** distance of light (from pondweed) • concentration of carbon dioxide (in water)	do **not** accept colour of light ignore time allow amount of light ignore light unqualified allow amount / mass of sodium hydrogen carbonate (in water) allow type / size of plant ignore volume of water / solution	2	AO3 4.4.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	y-axis labelled: rate of photosynthesis in arbitrary units		1	AO2 4.4.1.2 RPA5
	suitable scale		1	
	all **bars** plotted correctly	allow ± ½ a small square the bars can be in any order	1	
	all bars labelled correctly		1	

4.4.1.2 Rate of photosynthesis

Answer 05 · Mark scheme

June 2022 | 8464/B/1F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.9	blue		1	AO3 4.4.1.2 RPA5

Total Question 2		**17**

4.4.1.2 Rate of photosynthesis

Answer 06 · Mark scheme

June 2024 | 8464/B/1F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(reactants) water (products) oxygen	 allow H_2O allow O_2	 1 1	AO1 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	$C_6H_{12}O_6$		1	AO1 4.4.1.1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	any **two** from: • respiration • to convert to starch • to produce / store fat / oil • to produce cellulose • to produce amino acids **or** to produce protein	 allow energy (source) do **not** accept energy produced / made / created do **not** accept energy for respiration allow produce / store starch ignore used for growth of the plant	2	AO1 4.4.1.3 4.4.2.3

4.4.1.2 Rate of photosynthesis

Answer 06 · Mark scheme

June 2024 | 8464/B/1F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	higher / increase in temperature **or** more carbon dioxide	allow warmer allow combustion / burning releases carbon dioxide	1	AO3 AO2 4.4.1.2 4.4.1.3 4.4.2.3
	(so) more photosynthesis	allow faster photosynthesis	1	
	(so) more glucose / sugar made		1	
	(so) more protein / cellulose made		1	

Total Question 5	9

4.4.1.2 Rate of photosynthesis

Answer 07 · Mark scheme

June 2025 | 8464/B/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	the length of the pondweed the temperature of the water		1 1	AO1 4.4.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	as the distance increases the volume / oxygen decreases	allow as the light intensity decreases the volume / oxygen decreases ignore use of figures	1	AO2 4.4.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	3.6 (cm^3)		1	AO2 4.4.1.2 RPA 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	accuracy		1	AO2 4.4.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	greater (because) the rate of photosynthesis is higher	no marks if incorrect word chosen allow (because) photosynthesis would be faster / quicker allow (because) there is more photosynthesis allow (because) photosynthesis is controlled by enzymes allow (because) enzymes work faster allow (because) particles have more energy allow (because) the rate of reaction is faster / quicker	1 1	AO2 4.4.1.2

4.4.1.2 Rate of photosynthesis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	palisade mesophyll		1	AO1 4.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	chlorophyll		1	AO1 4.1.1.2 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	destroy the affected leaves		1	AO2 4.3.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.9	less / no light absorbed		1	AO2 4.3.1.4 4.4.1.2
	(so) less / no photosynthesis	allow (because) chloroplasts / chlorophyll is needed for photosynthesis	1	
	(so) less / no glucose / sugar (is made / produced)	allow (so) less / no protein / fat / starch / cellulose (is made / produced)	1	

Total Question 2	13

4.4.1.2 Rate of photosynthesis

AQA

GCSE
COMBINED SCIENCE: TRILOGY

8464/B/1F – BIOLOGY PAPER 1 FOUNDATION TIER

Mark scheme

8464

June 2018

Version/Stage: 1.0 Final

4.4.1.2 Rate of photosynthesis

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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4.4.1.2 Rate of photosynthesis

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

4.4.1.2 Rate of photosynthesis

MARK SCHEME – GCSE COMBINED SCIENCE: TRILOGY – 8464/B/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	cell membrane	extra ticks negates marks	1	AO1 4.1.1.2
01.2	engulf pathogens produce antibodies produce antitoxins	extra ticks negates marks	1 1 1	AO1 4.2.2.3 4.3.1.6
01.3	2050 − 100 = 1950	an answer of 1950 scores **2** marks allow **1** mark for a correct subtraction of incorrect values	1 1	AO2 4.3.1.2
01.4	any **one** from: • (more) people vaccinated • (more) people immune • no new measles strain	ignore injections / treatments / medicines unqualified allow vaccine produced allow (more people given) MMR (vaccine) do **not** allow antibiotics ignore less people infected	1	AO2 4.3.1.1 4.3.1.2 4.3.1.7
01.5	any **one** from: • measles is (caused by) a virus • viruses cannot be killed / destroyed by antibiotics	allow measles is not caused by a bacterium allow antibiotics **only** kill / destroy bacteria ignore harmed / treated	1	AO1 4.3.1.1 4.3.1.8 4.3.1.2
01.6	any **one** from: • use of a barrier method of contraception • use of a condom • vaccination / immunisation • avoid sexual intercourse / contact	ignore use of diaphragm ignore use protection / safe sex do **not** accept less sexual intercourse / contact	1	AO1 4.3.1.3

4.4.1.2 Rate of photosynthesis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	any **one** from: • size / shape/ type of paper disc • concentration of antibiotic • volume / amount of antibiotic • (incubation) time • (incubation) temperature	ignore paper disc unqualified allow strength / dosage of antibiotic allow 3 days ignore size of petri dish	1	AO2 4.3.1.8
01.8	to check that the disc / water did not have an effect **or** to make sure it was the antibiotic that had an effect	allow for comparison with the antibiotics allow as a (experimental) control do **not** accept as a control variable	1	AO3 4.3.1.8
01.9	(antibiotic) **A** any **one** from: • (antibiotic **A**) had the larg**est** clear area around it • (antibiotic **A**) killed the **most** bacteria	no marks if wrong antibiotic given	1 1	AO3 4.3.1.8
Total			**13**	

4.4.1.2 Rate of photosynthesis

MARK SCHEME – GCSE COMBINED SCIENCE: TRILOGY – 8464/B/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	glucose oxygen	extra ticks negates marks	1 1	AO1 4.4.1.1
02.2	count the number of bubbles produced in 1 minute measure the volume of gas produced in 30 seconds	extra ticks negates marks	1 1	AO3 4.4.1.2
02.3	any **one** from: • to control the temperature • temperature affects the rate of photosynthesis	ignore reference to 'it' allow so pondweed / solution did not warm up allow correct description of effect of temperature on rate allow high temperatures denature enzymes ignore references to limiting factors	1	AO3 4.4.1.2
02.4	52		1	AO2 4.4.1.2
02.5	all points plotted correctly smooth curve drawn through all points	(where a bar chart has been plotted) allow **1** mark for all bars plotted correctly if points are plotted as well as bars, ignore bars allow ± ½ a square allow **1** mark for three points correctly plotted ignore extensions of line / curve unless inconsistent with line / curve drawn	2 1	AO2 4.4.1.2

4.4.1.2 Rate of photosynthesis

MARK SCHEME – GCSE COMBINED SCIENCE: TRILOGY – 8464/B/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	any **one** from: • the nearer the light source to the pondweed the faster the rate of photosynthesis • the greater the light intensity the faster the rate of photosynthesis	allow converse statements for all marking points allow the nearer the light source to the pondweed the faster the bubbles produced allow the greater the light intensity the faster the bubbles produced allow the closer the light source the more the plant photosynthesises ignore more bubbles are produced with no reference to rate allow oxygen for bubbles do **not** accept carbon dioxide	1	AO3 4.4.1.2
Total			**10**	

4.4.1.2 Rate of photosynthesis

MARK SCHEME – GCSE COMBINED SCIENCE: TRILOGY – 8464/B/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	any **one** from: • water on potato would increase mass • to control amount of water on potato	allow so only the mass of the potato is measured allow to remove water from outside of potato allow liquid / solution / sugar solution for water allow so you get the correct (starting) mass of the potato do **not** accept so that all the pieces of potato weighed the same	1	AO3 4.1.3.2
03.2	increase in mass increase in length	extra ticks negate marks	1 1	AO2 4.1.3.2
03.3	osmosis into lower	in this order only allow diffusion allow inside do **not** accept through allow low / more dilute / dilute	1 1 1	AO1 4.1.3.2 AO2 4.1.3.2 AO2 4.1.3.2
03.4	any **one** from: • the concentration (of sugar solution) in the cells is 0.4 (mol/dm^3) • the concentration (of sugar solution) in the cells is the same as the solution (in the tube)	allow reference to potato instead of cells	1	AO3 4.1.3.2

4.4.1.2 Rate of photosynthesis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	any **two** from: • has (root) hairs • large surface / area • (root) hairs extend into soil • (root) hairs have thin walls	ignore references to active transport and mineral uptake allow root hair cells allow wide surface area allow (root) hairs are long / widespread	2	AO1 4.1.1.3 4.1.3.1 4.1.3.2
Total			**9**	

4.4.1.2 Rate of photosynthesis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1		**max 2** marks if written in terms of heart rate		AO2 4.4.2.2
	breathing rate when walking is twice that at rest	allow breathing rate when walking is 12 (breaths / minute) more than at rest	1	
	breathing rate when jogging is 5 times that at rest	allow breathing rate when jogging is 48 (breaths / minute) more than at rest	1	
	breathing rate when jogging is 2.5 times that when walking	allow breathing rate when jogging is 36 (breaths / minute) more than when walking	1	
		allow for **1** mark if no other marks gained: breathing rate at rest is 12 (breaths per minute), breathing rate when walking is 24 (breaths per minute) and breathing rate when jogging is 60 (breaths per minute) **or** breathing rate increases with increasing activity		

4.4.1.2 Rate of photosynthesis

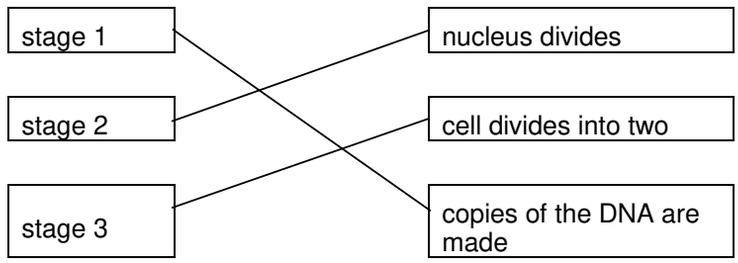
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(breathing rate increases)	reference to more / faster required at least once for full marks		AO1 4.4.2.2
	to supply more oxygen / O_2 **or** to supply oxygen / O_2 faster	allow to remove more carbon dioxide / CO_2 **or** to remove carbon dioxide / CO_2 faster do **not** accept incorrectly written formulae	1	
	for (aerobic) respiration **or** to reduce anaerobic respiration **or** to reduce lactic acid build up		1	
	(so) that more energy is transferred / released **or** (because) more energy is required	do **not** accept used / produced / created or energy made	1	
04.3	right ventricle / side of the heart pumps (blood) to the lungs		1	AO1 4.2.2.2
	left ventricle / side of the heart pumps (blood) to the body		1	
		if no other marks scored allow **1** mark for one side pumps blood to the lungs and the other side pumps blood to the body		

4.4.1.2 Rate of photosynthesis

MARK SCHEME – GCSE COMBINED SCIENCE: TRILOGY – 8464/B/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	any **one** from: • (the left ventricle) has to pump blood further (than the right ventricle) • (the left ventricle) has to pump blood with a greater force (than the right ventricle) • (the left ventricle) has to pump blood at a higher pressure (than the right ventricle)	there must be a comparative statement allow (the left ventricle) has to pump blood all around the body allow (left ventricle) has to pump blood harder	1	AO2 4.2.2.2
04.5	any **one** from: • strengthens heart (muscle) • reduces chance of another heart attack • reduces / controls weight • improves circulation	ignore prevents / no heart attacks allow decreases chance of fatty deposits **or** fat building up (in arteries / blood vessels) allow reduces resting heart rate	1	AO2 4.2.2.2 4.2.2.6
Total			**10**	

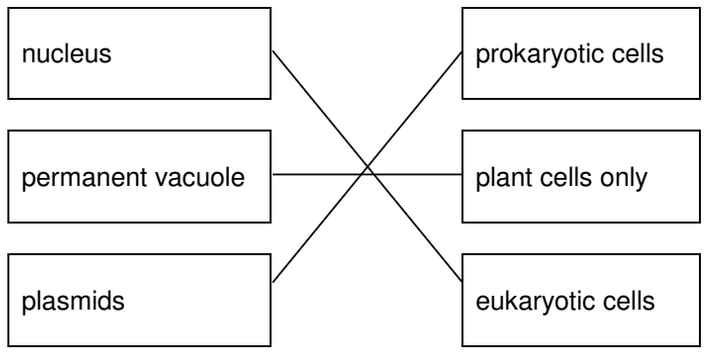
4.4.1.2 Rate of photosynthesis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	 allow **1** mark for 1 or 2 correct credit can be given where students have matched the boxes correctly, for example numbering the boxes		2	AO1 4.1.2.2
05.2	6 picograms		1	AO2 4.1.2.2
05.3	meristem cells in plants can differentiate throughout the life of the plant		1	AO1 4.1.2.3

4.4.1.2 Rate of photosynthesis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	any **two** from: • may cure / treat diseases **or** cure medical conditions **or** produce replacement cells / tissues / organs • cells unlikely to be **rejected** by patient • cells / tissues of any type can be produced • many cells produced • cells produced could be used for research • would reduce waiting time for transplants	ignore references to cost ignore all reference to producing babies / IVF allow example eg diabetes / paralysis allow cells can be stored for future use ignore used in medical treatments ignore patient makes / grows cells / tissues / organs ignore same genetic information ignore differentiated into most types of cells	2	AO3 4.1.2.3 4.1.1.4 4.6.2.4
05.5	any **two** from: • (potential) life is killed / destroyed • shortage of donors / eggs • egg donation / collection has risks • do not yet know risks / side effects of the procedure on the patient • may transfer (viral) infection • poor success rate	ignore references to cost ignore unethical unqualified Ignore reference to religion / beliefs allow embryo is killed ignore embryo is destroyed ignore embryo is a life / becomes a baby ignore long term effects are not well understood allow may cause tumours / cancer allow in terms of viable egg / embryo / cell / tissue / organ production	2	AO3 4.1.2.3 4.1.1.4 4.6.2.4
Total			**8**	

4.4.1.2 Rate of photosynthesis

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>06.1</td><td>

allow 1 mark for one or two correct links</td><td></td><td>2</td><td>AO1
4.1.1.1
4.1.1.2</td></tr>
<tr><td>06.2</td><td><table><tr><td>vacuole</td><td>ribosome</td><td>cell wall</td></tr></table>
tick box takes precedence
if no tick is given, look at both the figure and the circling of words in the table
if writing is seen on the figure and in the table both must be correct</td><td></td><td>1</td><td>AO1
4.1.1.2</td></tr>
<tr><td>06.3</td><td>turn the (fine focusing) knob until the cells are in focus</td><td>allow focus it

do not accept increase magnification

ignore decrease magnification
ignore clear
ignore references to resolution / illumination
ignore zoom in / out</td><td>1</td><td>AO2
4.1.1.2</td></tr>
</table>

4.4.1.2 Rate of photosynthesis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(rotate the) nosepiece / objective lens	allow change the (objective / eyepiece) lens	1	AO2 4.1.1.2
	to a higher power (lens)	allow (to) increase the magnification a comparator is required ignore change / adjust the magnification allow stronger or more powerful lens ignore references to resolution / illumination unqualified ignore zoom in / out ignore references to an electron microscope	1	

4.4.1.2 Rate of photosynthesis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5		an answer of 400 (×) scores **3** marks		AO2 4.1.1.2
	conversion of units: (112 mm →) 112 000 (µm) **or** (280 µm →) 0.28 (mm)		1	
	(magnification =) $\frac{112}{0.28}$ **or** (magnification =) $\frac{112\,000}{280}$	allow **1** mark for no conversion of units 112 / 280 **or** incorrect value from step 1 correctly substituted	1	
	400 (×)	do **not** accept if units are given	1	
		if no other mark scored allow **1** mark for: magnification = $\frac{\text{size of image}}{\text{size of real object}}$ a triangle with words or letters in is insufficient, as the correct rearrangement is needed		
Total			**9**	

4.4.1.2 Rate of photosynthesis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	is not caused by a pathogen / infective organism	allow not caused by a microorganism / microbe ignore not caused by infection ignore named pathogen unless bacteria, virus and fungus all mentioned	1	AO1 4.2.2.4 4.2.2.5 4.3.1.1 4.3
	(so) is not passed / spread (from person to person)	allow cannot be spread / caught allow is not infectious / contagious	1	AO2 4.2.2.4 4.2.2.5 4.3.1.1 4.3
07.2		allow 'it' for heart		AO1 4.2.2.4
	reduced / restricted / stopped blood flow	it does not matter where blood flow is restricted to – heart / body	1	
	(so) less oxygen reaches heart (muscle / cells)	must reference heart / it allow no oxygen reaches the heart (muscle / cells)	1	
	(so heart muscle / cells) cannot respire (enough) **or** (so heart muscle / cells) do not release (enough) energy	do **not** accept do not make / produce / create energy ignore references to breathing / suffocation ignore blood clots / blockages	1	

4.4.1.2 Rate of photosynthesis

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 3:** Relevant points (factors / effects) are identified, given in detail and logically linked to form a clear account.	5–6	AO2
	Level 2: Relevant points (factors / effects) are identified and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO2 AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content **medical risk factors:** • high blood pressure • high cholesterol • diabetes • genetic factors • medications **lifestyle risk factors:** • smoking • obesity • lack of exercise • high fat / energy diet • eating insufficient fruit / vegetables • alcohol • high salt intake • exposure to air pollution • certain drugs / correct named drug **examples of links:** • smoking – high bp / cholesterol / fatty deposition • obesity – lack of exercise / high bp / cholesterol / fatty deposition / diabetes • exercise – obesity / bp /diabetes • diet – obesity / cholesterol / diabetes • alcohol – bp / cholesterol • high salt intake - high blood pressure • genetic factors – bp / cholesterol / diabetes / obesity • medication – can affect blood / blood vessels / metabolism the main discriminator is the quality of linking both lifestyle and medical factors are required for **level 3**		4.2.2.2 4.2.2.4 4.2.2.5 4.2.2.6
Total		**11**	

4.4.1.2 Rate of photosynthesis

Answer 04 · Examiner comments November 2021 | 8464/B/1F | Original Q5

Question 5 (standard demand)

This question assessed knowledge and understanding of Required Practical Activity 5: investigating the effect of light intensity on the rate of photosynthesis. Two-fifths of students correctly identified the balanced equation for photosynthesis, with a similar proportion knowing that the distance of the pondweed from the lamp was the independent variable. Almost half of students stated a higher temperature would cause the pondweed to produce more bubbles, which was allowed. On the Foundation Tier students did not go on to explain why the rate would be faster at a higher temperature, nor did they suggest how the investigation could be improved so the temperature of the water did not increase. Many students did not understand what was being investigated, and suggested moving the lamp further away from the pondweed. A fifth of students scored one of the marks for **05.5**, usually for saying that using the same pondweed would make the results more valid. Quite a few students referred to carrying out repeats, but did not go on to say calculate a mean, or remove anomalies.

A third of students correctly calculated the rate of photosynthesis as 3 bubbles of gas per minute. The most common error was to divide the distance by the number of bubbles produced at that distance, or to multiply the distance by the number of bubbles. Over half of students made a correct conclusion describing the effect of light intensity on the rate of photosynthesis. Some students only described a pattern, such as ‘as distance increased the number of bubbles decreased’, which was insufficient. A reference to light intensity or distance from the lamp was needed, as well as a reference to the rate of photosynthesis, or to the number of bubbles produced. Cause and effect also had to be the correct way around, to link back to what the investigation was set up to find out.

Approximately two-thirds of students correctly plotted the results on the graph paper, using a small cross drawn with a sharp pencil. Only a few went on to join the points with a smooth curve. Most drew a ruled straight line. About a quarter of students extrapolated their line to predict the number of bubbles that would be produced if the lamp was 60 cm from the lamp.

4.4.1.2 Rate of photosynthesis

Answer 05 · Examiner comments

June 2022 | 8464/B/1F | Original Q2

Question 2 (low & standard demand)

02.1 This question was not answered well. Students did not seem to understand the word adaptation. Some students talked about a protective layer to stop water getting in or out. There were many references to a large surface area, or to the palisade layer being thick or thin. All of these were ignored. A tenth of students scored the mark, usually for saying the layer contained chlorophyll or chloroplasts.

02.2 40% of students thought the small pores on a leaf are called guard cells. A third of students selected the correct answer, stomata.

02.3 More than half of the students scored full marks for calculating the real length of the cell in micrometres. An additional quarter of students scored two marks. This was either for:

- a correct substitution and calculation in mm, or
- a correct substitution and correct conversion of an incorrectly calculated length in mm.

8% of the students scored one mark either for a correct substitution, or for a correct conversion of mm to micrometres.

02.4 39% of students thought carbon dioxide moved in and out of cells by active transport. Slightly fewer selected the correct response, diffusion.

02.5 Very few students scored two marks. A quarter of the students scored a mark for identifying cell A as the cell into which carbon dioxide would move at the fastest rate. For the reason, a definition of diffusion was insufficient; a comparison was required. This would ideally be a comparison between the different cells in Figure 3, although a comparison between the concentration inside and outside the cell was allowed.

02.6 Just under half the students gave the two measurements that would be required to calculate the rate of photosynthesis. 36% of students scored one mark, usually for the number of bubbles produced. References to the distance of the lamp from the pondweed were ignored.

02.7 17% of students scored two marks for two correct control variables. 61% of students scored at least one mark. The most common correct answers were amount of light and the size or type of pondweed.

02.8 Most students could draw a bar chart. 42% of students scored full marks, and an equal proportion scored three marks. A complete label, including units, was needed for the *y*-axis. A suitable scale was 1 cm for every arbitrary unit, although 2 units per cm was allowed. Bars had to be plotted and labelled with the colour of light, not with just a letter.

02.9 The vast majority of students correctly interpreted the results to conclude that blue light would be the best colour of light to grow plants in. The second most common response was green light, selected by less than a tenth of students.

Answer 06 · Examiner comments

June 2024 | 8464/B/1F | Original Q5

Question 5 (low and standard demand)

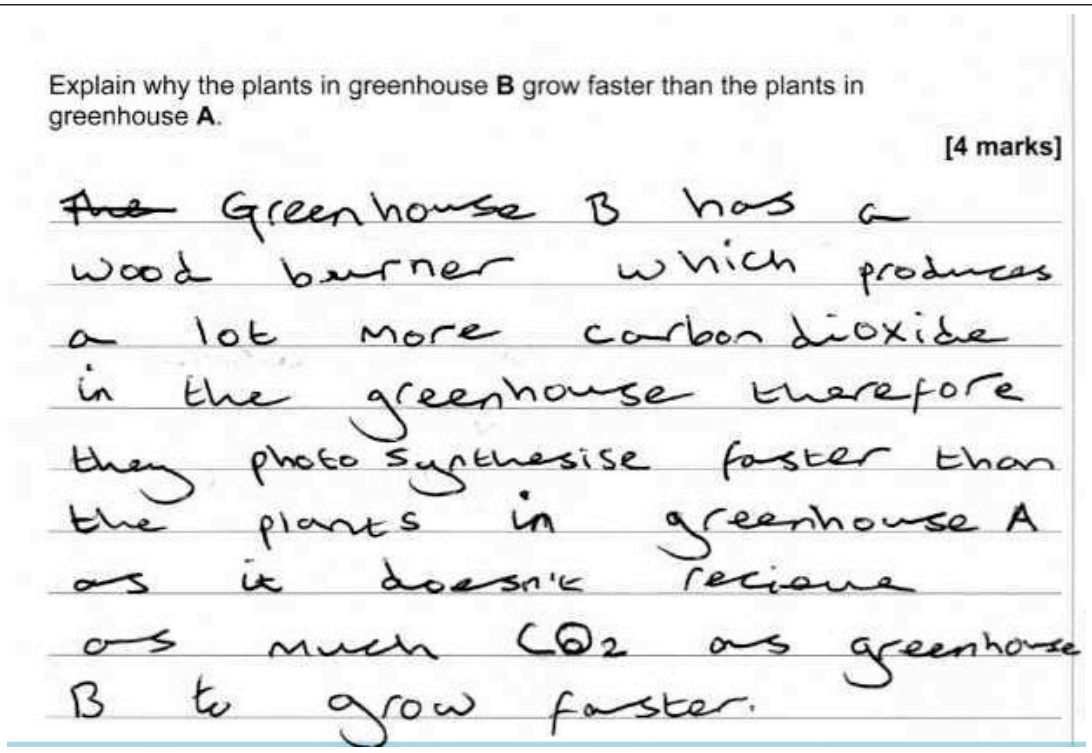
05.1 Just under two-thirds of students gave the correct reactant and product and very few (4%) gained only 1 mark. The most common reason for incorrect answers seems to be confusion between the reactants and products. Those students who correctly used formulae rather than the words were credited.

05.2 The vast majority (89%) of students identified the correct formula for glucose.

05.3 Students really struggled to gain credit in this question. Those who did gain credit usually met marking point 1 for respiration or energy: 'Used for energy' was the most common correct answer given. Convert/produce/make starch were also common responses which gained credit; however, many students simply wrote 'for storage', 'for food' or 'to store as food', which lacked the detail needed. Some students referenced fat and cellulose for marking point 3 and marking point 4, but very few students referenced amino acids or protein for marking point 5.

The most common incorrect answers were for growth and for repair.

05.4 Many students achieved a mark by stating that there is an increased temperature in greenhouse B, and that there is more carbon dioxide, or that combustion releases carbon dioxide. A reasonable number of students were then able to relate this to more photosynthesis or a faster rate of photosynthesis. A more limited number of students could relate this to an increase in glucose being made, but very few went on to relate this to more protein or cellulose being made.



Explain why the plants in greenhouse **B** grow faster than the plants in greenhouse **A**.

[4 marks]

~~The~~ Greenhouse B has a wood burner which produces a lot more carbon dioxide in the greenhouse therefore they photosynthesise faster than the plants in greenhouse A as it doesn't recieve as much CO_2 as greenhouse B to grow faster.

An example of a common 2-mark response, in which the student has given part of the answer but not gone on to relate the increase in photosynthesis to production of glucose, protein or cellulose.

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Answer 07 · Examiner comments

June 2025 | 8464/B/1F | Original Q2

Question 2 (Low and Standard demand)

02.1 82% of students gained at least one mark, with 24% achieving both marks.

02.2 This question was generally well answered, with many students correctly identifying that as the distance increased, the volume of oxygen decreased.

However, students who failed to gain credit often gave vague responses such as ‘it went down’ or ‘it decreased’, without specifying what changed or how the two variables were related.

Some students attempted to explain the trend instead of describing it—for example, by writing ‘as the distance increased, photosynthesis was slower’. While this demonstrated some understanding, it did not directly answer the question and could not be awarded credit.

02.3 The direction of the scale confused many students, most of whom incorrectly gave the value corresponding to the shaded area (representing water) instead. As a result, the most common incorrect responses fell within the range of 4.2 to 4.6, which reflected the volume of water rather than of oxygen.

02.4 78% of students gained the mark on this question.

02.5 This question was generally well attempted, with many students correctly selecting ‘greater’. However, some students were not awarded this mark by either not selecting a word from the list or by choosing their own term.

Despite many students recognising that the volume of oxygen collected would increase, few successfully linked this to photosynthesis as the underlying biological process. Instead, a common error was to rephrase the question stem with responses such as ‘the warmer it is, the more oxygen is produced’, which lacked scientific reasoning.

Some students attempted to explain the increase in oxygen production by referencing energy, but many incorrectly linked this energy increase to the lamp or plant rather than to the particles involved in the reaction.

02.6 49% of students gained the mark on this question. The most frequently chosen incorrect response was spongy mesophyll.

02.7 This question was generally well answered, with most students, 51%, able to provide a recognisable version of the correct answer such as 'chloraphyill’ or ‘chlorofill’.
However, ambiguous responses such as ‘chloroplasm’ were not awarded credit.

02.8 42% of students gained the mark on this question. The most frequently chosen incorrect response was the use of an antitoxin on the affected leaves.

02.9 Very few students, only 8%, gained two or more marks on this question. Some students misinterpreted the question, assuming that all leaves had been infected or removed. In these cases, responses that stated no light absorbed, no photosynthesis, or no glucose/protein production were accepted for each respective marking point, as this was a reasonable interpretation.

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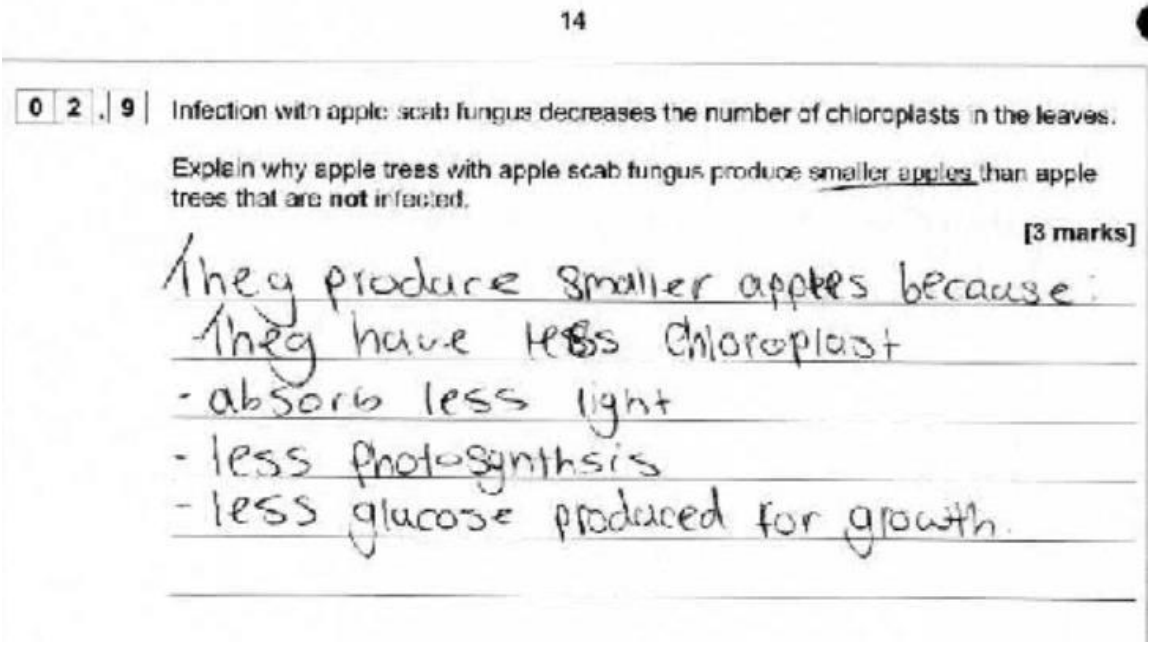
4.4.1.2 Rate of photosynthesis

Answer 07 · Examiner comments June 2025 | 8464/B/1F | Original Q2

Many students correctly identified that less photosynthesis would occur. Some students were credited for recognising that less light is absorbed. Acceptable alternatives included less light is taken in, but responses such as 'less light is attracted to the leaf' were not creditworthy.

A number of students made the connection between smaller apples and glucose production or referred to complex substances such as starch. cellulose, fat or protein, all of which were acceptable.

Answers that referred to less energy, but without qualifying this in terms of glucose or product synthesis, could not be credited.



14

0 2 . 9 Infection with apple scab fungus decreases the number of chloroplasts in the leaves.

Explain why apple trees with apple scab fungus produce smaller apples than apple trees that are **not** infected.

[3 marks]

They produce smaller apples because:
They have less chloroplast
- absorb less light
- less photosynthsis
- less glucose produced for growth.

In this example, all three required points are clearly communicated. Although the student presents their explanation using bullet points, the logical progression and linking of ideas are still evident.
The use of bullet points did not detract from the clarity or completeness of the response. As the key ideas were well expressed and appropriately connected, full credit was awarded with 3 marks.
This highlights that well-structured bullet point responses can still fully meet the marking criteria when the content is accurate and coherently linked.

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