AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.7.3.3

Land use

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**20**
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.

4.7.3.3 Land use

Answer 01 · Mark scheme

June 2018 | 8464/B/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$		1	AO2 4.4.1.1
03.2	endothermic		1	AO1 4.4.1.1
03.3	measure the volume of gas released increase length of time	allow use a measuring cylinder / capillary tube / (gas) syringe allow sensible length of time allow video the investigation so you could re-count the bubbles later allow repeat the measurement at each distance several times **and** calculate a mean ignore references to using other distances	1 1	AO3 4.4.1.2
03.4	temperature affects **rate** of photosynthesis **or** temperature affects **rate** of bubble production (because) reaction / photosynthesis is controlled by **enzymes**	allow correct description of effect of temperature on rate allow high temperatures denature enzymes enzymes being denatured must be linked to high temperature	1 1	AO3 4.4.1.2

4.7.3.3 Land use

Answer 01 · Mark scheme

June 2018 | 8464/B/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	evidence of squaring for **two** distances that double: 25 **and** 100 **or** 100 **and** 400		1	AO2 4.4.1.2
	calculate $1/d^2$ for **two** distances that double: 0.04 **and** 0.01 **or** 1/25 **and** 1/100 **or** 0.01 **and** 0.0025 **or** 1/100 **and** 1/400	allow **2** marks for these calculations without working ignore calculations for a third distance as long as two where the distance doubles are correct	1	AO2 4.4.1.2
	(therefore as distance doubles) light intensity is quartered		1	AO3 4.4.1.2
03.6	2 (bubbles would be produced)		1	AO3 4.4.1.2
	(as) very little light / energy for **photosynthesis** to occur	do **not** accept no light allow **2** marks for a quarter of the bubbles are produced as light distance doubles so 2 bubbles would be expected	1	AO2 4.4.1.2

4.7.3.3 Land use

Answer 01 · Mark scheme

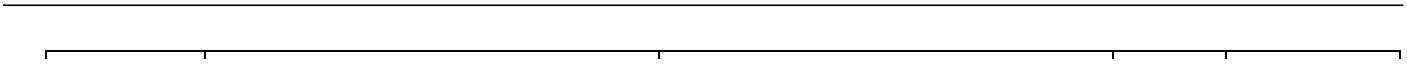
June 2018 | 8464/B/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	(independent variable) use different concentrations of sodium hydrogencarbonate solution	allow three concentration values ignore different concentrations of carbon dioxide ignore different amounts of sodium hydrogen carbonate solution	1	AO3 4.4.1.2
	(control variables) any **two** from: • distance from light source • temperature of solution • same plant • time for plant to equilibrate	**max 2** marks for control variables allow light intensity ignore light unqualified ignore same lamp allow type / size of plant allow time for plant to adjust to different solution ignore time unqualified	2	
Total			**14**	

4.7.3.3 Land use

Answer 01 · Mark scheme

June 2018 | 8464/B/1H | Original Q3



4.7.3.3 Land use

Answer 02 · Mark scheme

June 2018 | 8464/B/1H | Original Q4

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>04.1</td><td>to control for the starting mass (of the pieces of carrot)</td><td>allow because the pieces of carrot were not all the same mass at the start

do not accept were not all the same size
do not accept as a control variable</td><td>1</td><td>AO3
4.1.3.2</td></tr>
<tr><td>04.2</td><td>suitable scale and label for y-axis

all points plotted correctly

line of best fit</td><td>allow 5 or 6 per 2 cm

do not accept 5 per 1 cm

allow ± ½ a square
allow 1 mark for 4 correct points

<table><tr><th>conc. …</th><th>percentage (%) change…</th></tr><tr><td>0.0</td><td>+ 24</td></tr><tr><td>0.2</td><td>+ 12</td></tr><tr><td>0.4</td><td>+ 1</td></tr><tr><td>0.6</td><td>- 8</td></tr><tr><td>0.8</td><td>- 15</td></tr></table></td><td>1

2

1</td><td>AO2
4.1.3.2</td></tr>
<tr><td>04.3</td><td>value from student’s line of best fit</td><td>allow ± ½ a square</td><td>1</td><td>AO3
4.1.3.2</td></tr>
</table>

4.7.3.3 Land use

Answer 02 · Mark scheme

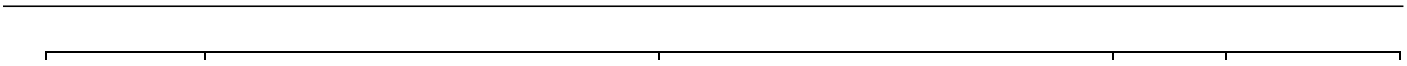
June 2018 | 8464/B/1H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	mass decreased		1	AO2 4.1.3.2
	(due to) **loss of water** by **osmosis**	ignore diffusion	1	AO1 4.1.3.2
	through a partially / selectively / semi permeable membrane		1	AO1 4.1.3.2
		a clear reference to concentration of water or concentration of sugar is required for the fourth mark		
	(as) concentration of sugar solution is greater than concentration of sugar (solution) inside cells / carrot **or** (as) the concentration of water is less outside the cells / carrot than the concentration inside the cells / carrot	allow (as) concentration of sugar solution inside cells / carrot is lower than the concentration of sugar solution (in the tube or around the carrot) allow answers in terms of dilute and concentrated solutions	1	AO2 4.1.3.2
04.5	the (partially permeable / cell) membrane was damaged	allow idea that cell membrane is no longer intact **or** is **more** permeable / leaky allow the membrane is denatured ignore cells are dead	1	AO3 4.1.3.2
Total			**11**	

4.7.3.3 Land use

Answer 02 · Mark scheme

June 2018 | 8464/B/1H | Original Q4



4.7.3.3 Land use

Answer 03 · Mark scheme

June 2018 | 8464/B/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	<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
01.2	(leaves block light near tree so) more light (as you move outwards) for photosynthesis (which) produces (more) glucose / proteins (for growth)	allow low light intensity under tree ignore Sun allow less photosynthesis under the tree 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 1 1	AO2 4.7.2.1 AO1 4.7.2.1 4.4.1.1 4.4.1.3 AO1 4.7.2.1 4.4.1.1 4.4.1.3
01.3	 quadrat light meter	in this order correct spelling only allow lux meter allow light intensity meter allow light data logger	 1 1	AO1 4.7.2.1
01.4	1.5(0) (m^2)	allow 15 000 cm^2	1	AO2 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	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
01.6	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
01.7	daisy		1	AO3 4.7.2.1
01.8	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

4.7.3.3 Land use

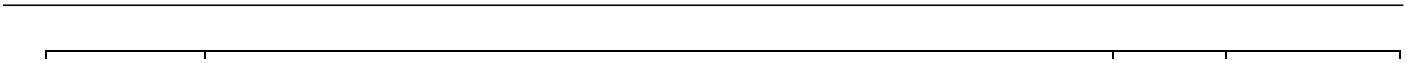
Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.9	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**	

4.7.3.3 Land use

Answer 03 · Mark scheme

June 2018 | 8464/B/2H | Original Q1



4.7.3.3 Land use

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	opened and closed the tap (so water enters from reservoir)	allow opened the tap (carefully / gently)	1	AO3 4.2.3.2
03.2	air bubble moves further (in a given time) (so) resolution is improved	allow air bubble moves faster allow it is easier to see a small change (in volume) ignore is easier to measure unqualified allow measurements are more accurate ignore to make test more accurate ignore references to precision or validity	1 1	AO3 4.2.3.2
03.3	$\frac{66}{5}$ **or** 13.2 (mm/min) 13.2 × 0.8 10.56 (mm^3/min)	an answer of 10.56 (mm^3/min) scores 3 marks allow tolerance of ± ½ square allow full marks from calculation from other **correct** pairs of readings allow value in range 13 to 13.4 for $\frac{66}{5}$ only ignore $\frac{63}{5}$ or 12.6 allow their calculated value in the range from 12 to 14 x 0.8 allow 10.6 or 11	1 1 1	AO2 4.2.3.2

4.7.3.3 Land use

Answer 04 · Mark scheme

June 2019 | 8464/B/1H | Original Q3

03.4	points plotted correctly suitable line of best fit	allow +/- ½ a square allow 1 mark for 4/5 correct plots	2 1	AO2 4.2.3.2
03.5	straight line starting at 0,0 with a steeper gradient than A		1	AO3 4.2.3.2
03.6	no photosynthesis (so) stomata closed (as no carbon dioxide needed) (so) no transpiration	allow plants need light for photosynthesis allow very little transpiration **or** little water lost	1 1 1	AO1 AO2 AO2 4.2.3.2 4.4.1.2
Total			**13**	

4.7.3.3 Land use

Answer 04 · Mark scheme

June 2019 | 8464/B/1H | Original Q3

4.7.3.3 Land use

Answer 05 · Mark scheme

June 2019 | 8464/B/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	hold a ruler (just) above the (open) hand of the other student drop the ruler and other student catches it record where the ruler is caught	ignore near the hand do **not** accept give verbal signal ignore timing	1 1 1	AO1 4.5.2
01.2	193.5		1	AO2 4.5.2
01.3	to compare the effect of no caffeine	allow as a control (group) allow to show the effect of caffeine do **not** accept control variable	1	AO3 4.5.2
01.4	0.217 (s)	allow any value in the range 0.2150 to 0.2180	1	AO2 4.5.2
01.5	as mass of caffeine increases the decrease / change in reaction time increases	allow converse ignore caffeine decreases reaction time do **not** accept the greater the increase in reaction time the greater the mass of caffeine	1	AO3 4.5.2
01.6	their reaction time was greater (after the drink)	allow converse allow slower / longer for greater do **not** accept anomalous result	1	AO3 4.5.2

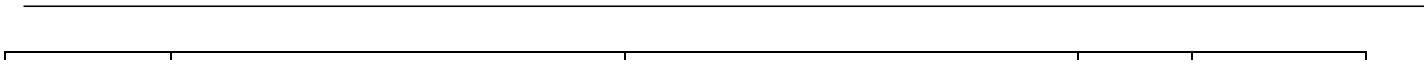
Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	0.01(0) to 0.18(0) **or** 0.18(0) to 0.01(0) **or** 0.17(0)	allow values in range 0.008 to 0.012 **and** 0.178 to 0.182 allow correct calculation from values in range if no values are given, allow answers in the range 0.166 to 0.174 allow 0.01 ≤ C ≤ 0.18 ignore units	1	AO2 4.5.2
01.8	any **two** from: • (same range of) age • (same) sex / gender • (same) height / weight / BMI • all had no caffeine / medication / drugs earlier that day • equally tired or (same) amount of sleep • practice of the ruler drop test • starting point of ruler / hand • same point to take measurement above / below the thumb / finger • using the same hand • (same) number of students in each group	allow height ruler dropped from do **not** accept volume / concentration of caffeine	2	AO3 4.5.2
01.9	not automatic (because) it involves the (conscious part of the) brain	allow it is a voluntary action allow because it involves thinking / decision **or** conscious action	1 1	AO2 4.5.2
Total			**13**	

4.7.3.3 Land use

Answer 05 · Mark scheme

June 2019 | 8464/B/2H | Original Q1



4.7.3.3 Land use

Answer 06 · Mark scheme

June 2019 | 8464/B/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	repeat for another ten quadrats		1	AO3 4.7.2.1
	use a random method to place the quadrats		1	
05.2		an answer of 4.8 x 10^5 scores **5** marks an answer of 481 766.4 **or** 481 766 **or** 480 000 scores **4** marks an answer of 15 744 × 4 × 7.65 scores **3** marks an answer of 15 744 (m^2) scores **2** marks		AO2 4.7.2.1
	(area of field =) 62 × 164 + 164 × 68 ÷ 2 **or** equivalent		1	
	15 744 (m^2)		1	
	15 744 × 4 × 7.65	allow use of incorrect area allow $\frac{7.65}{0.25} \times 15744$	1	
	481 766.4	allow 481 766 **or** 480 000	1	
	4.8 × 10^5	allow incorrect calculation expressed correctly	1	

Answer 06 · Mark scheme

Question	Answers	Mark	AO/ Spec. Ref
05.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3-4	AO2
	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 • trees over / in field • (which) reduce light for photosynthesis • (so) fewer daisies there • trees over / in field • (which) take water / nitrates / ions from the soil • (so) fewer daisies there • trampling on sports pitches • (will) kill plants • (so) fewer daisies there • competition from plants / grasses on field • (will) use up water / nitrates / ions / space • (so) fewer daisies there • gardener may water / fertilise / mow field • (which provides) more water / nitrates / ions • (so) more / fewer daises grow there • more insects / disease / animals in some areas • (may) eat / kill plants • (so) fewer daisies there • school buildings • (which) reduce light for photosynthesis • (so) fewer daisies near school • pollution / toxins from vehicles on roads • (which will) reduce growth • (so) fewer daisies near roads • wrong pH **or** lack of ions **or** poor drainage **or** poor / wet / dry soil in some areas • (which will) slow growth • (so) fewer daisies there Level 3 answers must refer to several factors in accurate detail		4.7.1.1 4.7.1.2 4.7.1.3 4.4.1.1
Total		**13**	

4.7.3.3 Land use

Answer 06 · Mark scheme

June 2019 | 8464/B/2H | Original Q5



4.7.3.3 Land use

Answer 07 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	concentration of the sugar solution		1	AO1 4.1.3.2 RPA 2
01.2	gained <u>water</u> (water moves) by osmosis **or** (because) concentration of water outside the potato is greater than inside the cells / potato	 allow converse statements (because) concentration (of sugar solution) inside the potato is greater than outside the potato / cells	1 1	AO2 AO1 4.1.3.2 RPA 2
01.3	all points correctly plotted line of best fit drawn as a curve through all the points	allow ± ½ a square ignore extrapolation of curve	1 1	AO2 4.1.3.2 RPA 2
01.4	correct reading from their graph	allow ± ½ a square allow answer in range 0.23 to 0.24 (mol/dm^3) if no line drawn	1	AO3 4.1.3.2 RPA 2

4.7.3.3 Land use

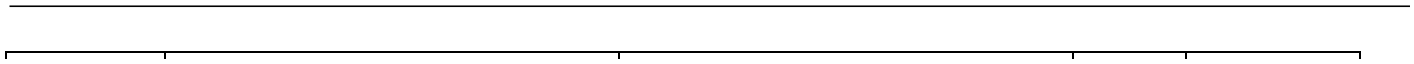
Answer 07 · Mark scheme

01.5	$\frac{0.25 \times 100}{7.96}$ = 3.14(070352) 3.14 (%)	allow $\frac{(8.21-7.96) \times 100}{7.96}$ allow correct rounding to 3 sig figs of an incorrectly calculated percentage change	1 1 1	AO2 4.1.3.2 RPA 2
Total			**9**	

4.7.3.3 Land use

Answer 07 · Mark scheme

November 2020 | 8464/B/1H | Original Q1



4.7.3.3 Land use

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	amylase	allow phonetic spelling allow carbohydrase do **not** accept amylose	1	AO1 4.2.2.1
02.2	small intestine		1	AO1 4.2.1 4.2.2.1
02.3	any **one** from: • greater magnification • higher resolving power	allow can see (smaller) sub-cellular structures / parts allow can see more detail (inside cells) allow reference to 3-D images	1	AO1 4.1.1.5
02.4	capillary		1	AO2 4.2.2.1 4.2.2.2
02.5	$20 = \frac{\text{image length}}{0.8}$ image length = 0.8 x 20 image length = 16 (mm)		1 1 1	AO2 4.1.1.5 RPA 1
02.6	diffusion		1	AO3 4.1.3.1
02.7	active transport	allow active uptake	1	AO3 4.1.3.3

4.7.3.3 Land use

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	any **one** from: • respiration • to form glycogen • to make amino acids / proteins	allow as an energy source do **not** accept to make / use / create / produce energy allow to make lipid / fat	1	AO1 4.4.2.1 4.4.2.3
02.9	**Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.		3–4	AO2 4.1.1.3 4.1.3.1 4.1.3.3 4.2.2.1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.		1–2	
	No relevant content		0	
	Indicative content • have (many) microvilli • (to) increase surface area • wall of villus only one cell thick **or** is thin • capillaries are close to surface • (so) short pathway • good blood supply • (to) transport food molecules away **or** to the body • (and) maintain a diffusion gradient • cells have many mitochondria • (where) respiration takes place • (where) energy is transferred • (as) active transport requires energy • energy is needed to absorb sugar / food / molecules For Level 2 must make links between structure and it's function			
Total			14	

4.7.3.3 Land use

Answer 08 · Mark scheme

November 2020 | 8464/B/1H | Original Q2

4.7.3.3 Land use

Answer 09 · Mark scheme

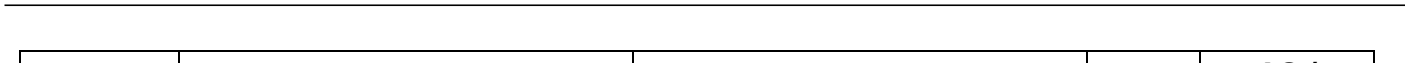
Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	the variety of all the different <u>species</u> (of organisms) on Earth **or** the variety of all the different <u>species</u> (of organisms) in a habitat / area / ecosystem		1	AO1 4.7.3.1
03.2	any **one** from: • compost • burning **or** as a fuel	allow to improve soil (texture / drainage / quality) allow to grow food / crops / plants ignore farming unqualified ignore as fertiliser	1	AO1 4.7.3.3
03.3	decay / burning of peat releases carbon dioxide (into the atmosphere) which is increasing global warming	do **not** accept peat bogs release carbon dioxide into the atmosphere allow a description of global warming or consequences if no other mark awarded allow removal of a carbon sink / store for 1 mark	1 1	AO1 4.7.3.3 4.7.3.5

03.4	any **two** from: • takes minerals from the soil as crops are harvested / removed • leads to soil erosion • farmers have to use fertilisers which pollute water / streams / lakes • burning crop waste produces carbon dioxide • using large farm machinery causes soil compaction	ignore nutrients allow burning crop waste causes global warming allow using large farm machinery releases carbon dioxide	2	AO3 4.7.3.2 4.7.3.3 4.7.3.5 4.7.3.6
03.5	antibiotic passed into the environment in animal faeces / urine / sewage **or** antibiotic in animal faeces / urine / sewage flows into rivers		1	AO2
	bacteria in water / land become antibiotic resistant	allow named water or land pathogen such as typhoid / cholera / E coli	1	AO2
	some of these bacteria are human pathogens		1	AO3
	(so) cause (human) diseases which now cannot be cured because they are antibiotic resistant	If no other marks awarded allow 1 mark for mention of antibiotics in milk / meat being consumed by humans.	1	AO3 4.6.3.4 4.7.3.2
Total			**10**	

4.7.3.3 Land use

Answer 09 · Mark scheme

November 2020 | 8464/B/2H | Original Q3



4.7.3.3 Land use

Answer 10 · Mark scheme

November 2021 | 8464/B/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$6\,CO_2 + 6\,H_2O \rightarrow C_6H_{12}O_6 + 6\,O_2$		1	AO1 4.4.1.1
01.2	distance of the pondweed from the lamp		1	AO1 4.4.1.2 RPA5
01.3	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
01.4	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

Answer 10 · Mark scheme

01.5	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
01.6	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
01.7	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

4.7.3.3 Land use

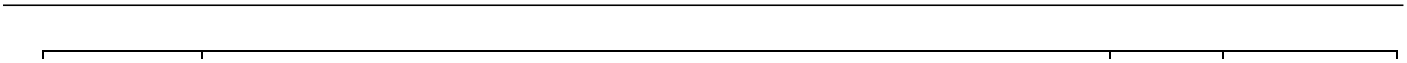
Answer 10 · Mark scheme

01.8	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
01.9	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**	

4.7.3.3 Land use

Answer 10 · Mark scheme

November 2021 | 8464/B/1H | Original Q1



4.7.3.3 Land use

Answer 11 · Mark scheme

November 2021 | 8464/B/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	releases energy (to the surroundings)	allow transfers (thermal) energy to the surroundings ignore transfers energy unqualified	1	AO1 4.4.2.1
03.2	to keep oxygen out	allow to keep air out allow (because) fermentation is an anaerobic reaction allow to prevent aerobic respiration	1	AO3 4.4.2.1
03.3	to allow the mixture / yeast / cells to reach the temperature	allow to reach 2 °C allow so yeast can equilibrate allow idea that contraction of gas (on cooling) would hinder results collection	1	AO3 4.4.2.1
03.4	(2 °C is) too cold for enzymes / yeast to work (so) no carbon dioxide / gas produced **or** (so) fermentation did not occur **or** fermentation was very slow enzymes become active at 35 °C so carbon dioxide / gas was produced	allow (at 2 °C) few / no collisions (between sugar and enzymes) do **not** accept an incorrect gas allow at 35 °C the enzymes started to work so carbon dioxide / gas was produced	1 1 1	AO2 4.2.2.1 4.4.2.1

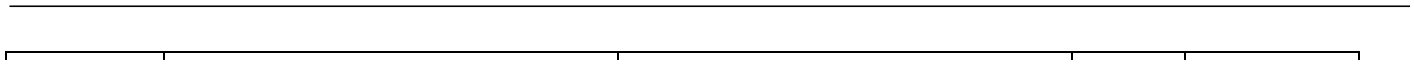
4.7.3.3 Land use

03.5	ideal / suitable temperature for enzymes / yeast to work (so) carbon dioxide / gas produced (rapidly) (after time / ≥ 15 minutes) rate / fermentation slowed (because) sugar / glucose / food began to run out **or** (because) increased concentration of ethanol / alcohol started to kill the cells	 do **not** accept an incorrect gas allow (after time / ≥ 15 minutes) less gas produced per minute	1 1 1 1	AO1 AO2 AO2 AO2 4.2.2.1 4.4.2.1
Total			**10**	

4.7.3.3 Land use

Answer 11 · Mark scheme

November 2021 | 8464/B/1H | Original Q3



4.7.3.3 Land use

Answer 12 · Mark scheme

November 2021 | 8464/B/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	increases (from 2005) to 690 million **or** increases to 2008	allow peak in 2008 allow peak at 690 million	1	AO2 4.7.3.1 4.7.3.6
	decreases (from 2008) to 630 million		1	
		if no other mark awarded, allow overall increase from 470 million **or** overall increase to 630 million **or** (overall) increase of 160 million **or** increases to 690 and decreases to 630 (without units) for **1** mark		
02.2	$\frac{690(\text{million}) - 460(\text{million})}{690(\text{million})} \times 100$	allow $\frac{230(\text{million})}{690(\text{million})} \times 100$	1	AO2 4.7.3.1 4.7.3.6
	33.3 (%)	ignore number of decimal places allow calculated value from incorrect graph readings	1	
	33 (%)	allow calculated answer correctly given to 2 significant figures	1	
02.3	compost	allow improving soil (texture / drainage / quality) ignore farming unqualified ignore as fertiliser	1	AO1 4.7.3.3
	burning **or** as a fuel		1	

4.7.3.3 Land use

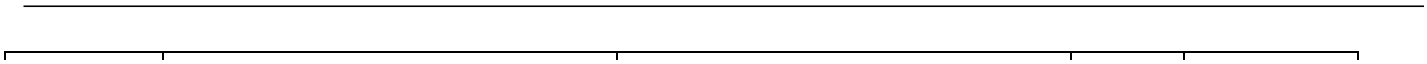
Answer 12 · Mark scheme

02.4	any **two** from: • reduce pollution • plant trees • breeding programmes (for endangered species) • rewilding / regeneration of habitats / hedgerows / meadows • (reintroducing) wider field margins • plant a variety of crops • reduce use of pesticide / herbicide / insecticide	ignore references to carbon dioxide, greenhouse gases or global warming allow reduce named example of pollution, eg smoke **or** acidic gases **or** sewage **or** fertiliser allow reduce toxic waste dumping allow afforestation allow reforestation ignore reduce / stop deforestation allow planting wild flower seeds allow reduce monoculture ignore recycling ignore protect / conserve habitat(s) / areas	2	AO1 4.7.3.1 4.7.3.2 4.7.3.4 4.7.3.6
Total			**9**	

4.7.3.3 Land use

Answer 12 · Mark scheme

November 2021 | 8464/B/2H | Original Q2



4.7.3.3 Land use

Answer 13 · Mark scheme

November 2021 | 8464/B/2H | Original Q5

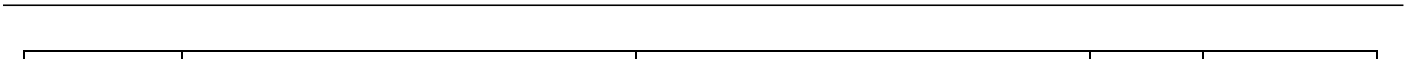
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **one** from: • previous intake of caffeine that day • usual intake of caffeine (on previous days) • concentration of caffeine • volume of caffeine • time of day • amount of sleep • body mass • previous experience of the test • which hand (of student **B**) holds the stopwatch	allow named caffeinated drink for caffeine allow amount / mass / type of caffeine for **1** mark allow fatigue allow (body) weight / BMI	1	AO1 4.5.2 RPA6
05.2	any **two** from: • (student **A**) does not press both start buttons simultaneously • (student **A**) may not say stop and press button simultaneously • student **B** could be distracted • idea that student **B** anticipated student **A** stopping the stopwatch • stopwatch malfunction	allow (stop)watches may not be <u>accurate</u>	2	AO3 4.5.2 RPA6
05.3	no value / result / number occurs more than once **or** all the values / results / numbers are different		1	AO2 4.5.2 RPA6

05.4	add(ed) the other (7) results and divide(d) by 7	allow correctly shown calculation ignore leave out the result for pair 8	1	AO2 4.5.2 RPA6
05.5	(adrenaline) increases heart rate (which) increases oxygen / glucose to brain / muscle (cells) (which) increases rate of respiration (so) releasing more energy for (faster / more) muscle <u>contraction</u>	allow increases blood flow allow (so) releasing more ATP for (faster / more) muscle <u>contraction</u> do **not** accept energy produced / made / created	1 1 1 1	AO1 AO1 AO2 AO2 4.5.3.6 4.5.2
05.6	synapse	allow synaptic cleft	1	AO1 4.5.2
05.7	fewer adenosine (molecules) can bind to the receptors **or** adenosine has no / less effect on the (relay) neurone therefore impulses in relay neurone are more frequent	 allow impulses in relay neurone are faster allow there are more impulses in relay neurone allow impulses in relay neurone not delayed / reduced (in number) ignore caffeine binds to adenosine receptors	1 1	AO2 AO3 4.5.2
Total			**12**	

4.7.3.3 Land use

Answer 13 · Mark scheme

November 2021 | 8464/B/2H | Original Q5



Answer 14 · Mark scheme

June 2022 | 8464/B/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **four** from: **Similarities:** • result from changes in the cell / DNA / genes • uncontrolled cell growth / division • can form a lump of cells • made up of abnormal cells **Differences:** Malignant tumours: • are made of cancer cells, benign tumours are not **or** benign tumours are made up of cells that are more similar to normal cells • (usually) grow faster than benign tumours • invade neighbouring tissues, but benign tumours do not • can spread (to other parts of the body) but benign tumours stay in one place **or** cells can travel in the blood, but benign tumours do not • can form secondary tumours, benign tumours do not	max **three** marks if only similarities or differences given allow result from mutations allow benign tumours (often) have a layer of covering cells, malignant tumours (usually) do not ignore references to level of harm	4	AO1 4.2.2.7

4.7.3.3 Land use

Answer 14 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	little exposure to ionising radiation **or** little exposure to carcinogens	allow little exposure to UV (light) allow little exposure to sunlight ignore little exposure Sun unqualified allow use sunscreen allow do not use sunbeds allow named carcinogen e.g. smoking	1	AO3
	(so) less cell / DNA / gene damage	allow (so) fewer mutations allow older people's (skin) cells are more susceptible to DNA damage if no other marks awarded allow **1** mark for skin cancer takes a long time to develop	1	AO2 4.2.2.6 4.2.2.7

4.7.3.3 Land use

Answer 14 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	any **two** from: • more females than males diagnosed each year up to age 59 (years) • more new cases in males than in females from 60 (years) • greatest number of people / males / females diagnosed in age group 65-69 (years) • number of new cases increases in **males** up to age group 65−69 (years) after which they decrease / fall	ignore the number of cases of skin cancer increases with age	2	AO3 4.2.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	to account for the different group sizes	allow there are different numbers of people / males / females of different ages allow so the different group sizes can be compared allow so it can be compared to populations in other countries ignore to compare unqualified	1	AO3 4.2.2.7

Answer 14 · Mark scheme

June 2022 | 8464/B/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	any **two** from: • number (of males / female per 100 000 population) increases with age • in females the number (per 100 000 population) increases at a steady rate • number (per 100 000 population) in males increases at a similar **or** at a slightly lower rate as in females up to age 55 • number (per 100 000 population) increases at a much higher rate in males than females above age 59	do **not** accept if referring to number of new cases allow number (per 100 000 population) in males increases at a steady rate up to 55−59 (years) allow number (per 100 000 population) in males increases more rapidly above age 59	2	AO2 4.2.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	$\frac{116 \times 694\,000}{100\,000}$ = 805.04 = 805	allow values in the range 114 to 118 allow an incorrectly calculated number of males correctly rounded to 3 significant figures if no other marks awarded allow **1** mark only for an answer of 5270	1 1 1	AO2 4.2.2.7

Total Question 5		14

Answer 15 · Mark scheme

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	any **two** from: • light (intensity) • water • temperature • mass / volume of soil • soil type **or** (soil) pH • other mineral content of the soil • number of plants (in a box) • starting mass / height / age of corn • type / variety of corn • harvested at the same time	do **not** accept nitrate ion concentration allow size of box allow depth of soil ignore fertiliser allow planting density allow species of corn allow harvested when mature	2	AO2 4.7.2.1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	suitable scale **and** axis labelled (mean <u>mass</u> (of corn) per plant in <u>grams / g</u>)	max **3** marks for bar chart	1	AO2 4.7.2.1 4.7.1.2
	all points plotted correctly	allow a tolerance of ± ½ a small square allow **1** mark for 4 or 5 correct plots	2	
	suitable line of best fit	ignore line extended beyond 50ppm ignore line joined point to point with straight lines	1	

4.7.3.3 Land use

Answer 15 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	as (soil) nitrate / concentration increases, (mean) mass (of corn) increases **and** then decreases		1	AO2 4.7.1.2 4.7.2.1
	with a maximum (mean mass of corn) at 30 (ppm)	allow a maximum consistent with graph in question **04.2** if no other mark awarded, allow **1** mark for (mean mass of corn) increases to 30 (ppm) **or** (mean mass of corn) decreases above 30 (ppm)	1	

Answer 15 · Mark scheme

June 2022 | 8464/B/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	any **four** from: (economic) • increasing nitrate / ion (concentration) up to 30 ppm will give high(er) yield / income / sales • greater than 30 ppm will decrease yield / mass / income / sales **and** therefore waste money / fertiliser • any increase in yield / mass / income / sales must be balanced with cost (of fertiliser) • quantity to add will depend on original nitrate (ion concentration) of soil (environmental) • (when it rains) fertiliser / nitrate will enter rivers / lakes / sea / ocean causing pollution	max **3** marks if no reference to environmental implication ignore mass for this marking point only allow greater than 30 ppm, the yield / mass / income / sales / will not increase (as much) **and** therefore waste money / fertiliser allow profit / benefit will depend on yield / mass / income / sales **and** cost (of fertiliser) allow fertiliser / nitrate run-off causes pollution allow eutrophication or description of eutrophication allow description of effect of fertiliser / nitrate pollution eg health impact of fertiliser in drinking water allow environmental implication of (significant) energy use in fertiliser production / transport	4	AO3 4.7.3.2 4.7.2.2 4.1.3.3 4.4.2.3

Total Question 4		**12**

4.7.3.3 Land use

Answer 16 · Mark scheme

June 2023 | 8464/B/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	starch (molecules) are large / insoluble (so) cannot be absorbed (into the blood)	 allow (so) cannot pass through the wall of the (small) intestine / gut allow (so) cannot diffuse into the blood allow sugar (molecules) are small / soluble (1) (so) can be absorbed into the blood **or** (so) can pass through the wall of the (small) intestine / gut (1)	1 1	AO1 4.2.2.1 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(10 cm^3 dilute) iodine solution and (1 cm^3 of) water	allow (10 cm^3 dilute) iodine solution allow water ignore iodine unqualified	1	AO3 4.2.2.1 RPA3

4.7.3.3 Land use

Answer 16 · Mark scheme

June 2023 | 8464/B/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	percentage of light passing through the liquid decreased with increasing starch concentration	allow the more concentrated the starch (suspension) the less light could pass through	1	AO2 4.2.2.1 RPA3
	(because iodine) solution was darker (in colour)	allow (iodine) solution was blacker allow the more (insoluble) starch the more cloudy the mixture	1	
	(so) absorbed more light	ignore less light passes through	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	any **one** from: • to allow them to reach 37 °C • so they would be at the optimum / same temperature	allow to allow them to reach body temperature allow to equilibrate	1	AO3 4.2.2.1 RPA4

Answer 16 · Mark scheme

June 2023 | 8464/B/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	6.6 (g/dm^3)	allow answer in range 6.5 to 6.7 (g/dm^3)	1	AO2 4.2.2.1 RPA3
	6.6 – 0.3 **or** 6.3 (g/dm^3)	allow correctly calculated value consistent with range allowed in step 1	1	RPA4
	$\frac{6.3}{3}$	allow correct subtraction of answer to step 1 minus 0.3 for 6.3 in this equation	1	
	2.1 (g/dm^3 per minute)	allow correctly calculated rate using incorrectly calculated value for 6.3 if no other marks awarded allow **1** mark for the concentrations 1.8 **and** 0.8 (g/dm^3)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	(at pH 1) shape of active site would be altered	allow (at pH 1) enzyme / amylase would be denatured	1	AO2
	(so) starch would not be digested	allow (so) enzyme / amylase would not work allow (so) no reaction would occur allow (so) reaction would be (a lot) slower	1	AO2
	(so) percentage of light passing through liquid would stay at 10	allow (so) percentage of light passing through liquid would not change / increase	1	AO3 4.2.2.1 RPA3 RPA4

Total Question 6	14

4.7.3.3 Land use

Answer 17 · Mark scheme

June 2024 | 8464/B/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	pituitary		1	AO1 4.5.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	increased blood flow to muscles		1	AO1 4.5.3.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	receptor(s) (cells / neurones)	allow sensory (cells / neurones)	1	AO1 4.5.1

4.7.3.3 Land use

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4		allow converse if clearly describing people who do not have diabetes		
	blood glucose (concentration) varies more (than in people who do not have diabetes)	allow blood glucose (concentration) increases / decreases more allow blood glucose (concentration) goes very high allow to get a sufficient range of blood glucose (concentrations)	1	AO2 4.5.3.2
	(because) less / no insulin produced when blood glucose (concentration) increases **or** (because) less / no insulin produced to decrease blood glucose (concentration)		1	

4.7.3.3 Land use

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	any **two** from: • prior familiarity with reaction time test • type of (reaction time) test • insulin (injections) • example of named drug (that would affect reaction time) • amount of sleep • distractions	ignore health unqualified allow practice allow description of part of a reaction time test to control eg which hand is used to catch the ruler ignore caffeine / alcohol allow tiredness / sleep	2	AO1 4.5.3.2 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	low / high blood glucose (concentration) is dangerous / unsafe	allow (to monitor for) unconsciousness / coma / headache / dizziness ignore hypoglycaemia / hyperglycaemia unqualified	1	AO3 4.5.3.2

4.7.3.3 Land use

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	lowest reaction times recorded in (range of) blood glucose (concentration) found in people who do not have diabetes	allow high **and** low blood glucose (concentration) increase (mean) reaction time allow lowest reaction times recorded in range 4.0 to 7.8 ($mmol/dm^3$)	1	AO3
	homeostasis keeps blood glucose (concentration) in a narrow / small range **or** low(er) reaction times are a survival advantage		1	AO2 4.5.1 4.5.3.2

4.7.3.3 Land use

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.8	when blood glucose (concentration) increases the pancreas releases insulin	allow when blood glucose (concentration) is / nears 7.8 ($mmol/dm^3$) the pancreas releases insulin allow when blood glucose (concentration) is high the pancreas releases insulin	1	AO1 4.5.1 4.5.3.2
	(insulin causes) glucose to move (from the blood) into the liver / muscle (cells)	if neither mark awarded allow **1** mark for glucose moves into cells	1	
	in (liver / muscle) (excess) glucose is converted to glycogen		1	
	when blood glucose (concentration) decreases the pancreas releases glucagon	allow when blood glucose (concentration) is / nears 4.0 ($mmol/dm^3$) the pancreas releases glucagon allow when blood glucose (concentration) is low the pancreas releases glucagon	1	
	(glucagon causes) glycogen to be converted into glucose and released into the blood	allow (glucagon causes) glycogen to be converted into glucose which increases blood glucose (concentration)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.9		allow electrical signal for impulse throughout ignore signal / message		
	any **two** from: (if more chemical produced / present) • diffusion of chemical (across synapse) is faster		2	AO2 AO3 4.5.2
	• an impulse in relay / motor / next neurone is more likely	allow an impulse in relay / motor / next neurone is faster / stronger / bigger allow there will be more impulses in relay / motor / next neurone(s)		
	• an impulse is more likely to reach muscle	allow an impulse reaches muscle in less time allow an impulse reaches muscle faster allow bigger impulse causes faster muscle contraction		

Total Question 6	17

4.7.3.3 Land use

Answer 18 · Mark scheme

June 2025 | 8464/B/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	10 cm^3 measuring cylinder with intervals of 0.1 ± 0.01 cm^3		1	AO1 4.4.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	*evidence of squaring for **two** distances that double:* (10 cm and 20 cm) 100 **and** 400 **or** (20 cm and 40 cm) 400 **and** 1600 **or** (30 cm and 60 cm) 900 **and** 3600	allow other appropriate values throughout	1	AO2 4.4.1.2 RPA5
	*calculate $1/d^2$ for **two** distances that double:* (10 cm and 20 cm) 0.01 / $\frac{1}{100}$ **and** 0.0025 / $\frac{1}{400}$ **or** (20 cm and 40 cm) 0.0025 / $\frac{1}{400}$ **and** 0.000625 / $\frac{1}{1600}$ **or** (30 cm and 60 cm) 0.001(11…) / $\frac{1}{900}$ **and** 0.00027(77…) / $\frac{1}{3600}$	allow **2** marks for these values without working	1	
	(therefore as distance doubles) light intensity is quartered		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	the rate of oxygen production increases	allow rate of photosynthesis increases ignore the volume of oxygen production increases unqualified	1	AO3
	(because) reactants / particles / molecules / enzymes have greater (kinetic) energy	allow reactants / particles / molecules / enzymes move faster	1	AO2
	(so) collisions are more frequent	allow (so) more collisions in a given time allow (so) more successful collisions	1	AO2 4.2.2.1 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	no / less oxygen (is produced)	allow photosynthesis is stopped / reduced allow the rate of oxygen production is 0 (cm^3/hour)	1	AO3
	(because) enzymes are destroyed	allow the enzymes are denatured allow active site has changed shape do **not** accept the cells / plant / pondweed is denatured do **not** accept the enzymes are killed	1	AO2 4.2.2.1 4.4.1.2

Total Question 3	**9**

Answer 19 · Mark scheme

June 2025 | 8464/B/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(takes account of) different starting masses	ignore were not all the same size do **not** accept as a control variable	1	AO2 4.1.3.2 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	as (total) surface area increases percentage increase in mass increases	allow as one increases, so does the other allow there is a positive correlation	1	AO2 4.1.3.2
	by a decreasing amount	allow description of decreasing amount of increase do **not** accept they are directly proportional	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	water moved in by osmosis	allow water moved in by diffusion do **not** accept (water moves) by active transport	1	AO1 4.1.3.2 RPA2
	(because water moves) from a dilute solution to a concentrated solution (inside the cell / potato)	allow (because water moves) from a high(er) concentration of water to a low(er) concentration of water (inside the cell / potato) allow (because water moves) from a high(er) water potential to a low(er) water potential (inside the cell / potato) allow (because water moves) from a lower concentration (of solute) to a higher concentration (of solute inside the cell / potato) allow (because water moves) down its concentration gradient do **not** accept water moves along / across a concentration gradient	1	

Answer 19 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	all the (groups of) potato pieces had the same percentage change in mass		1	AO2
	(because the) cell walls are completely stretched	allow cells are turgid	1	AO3
	(so) the cells cannot absorb any more water		1	AO3
				4.1.3.2 RPA 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(change the independent variable to) different concentrations of salt solution		1	AO3 4.1.3.2 RPA2
	do not cut the potato into pieces	allow control the surface area of the potato allow cut into the same number of pieces ignore use the same shape / size	1	

Total Question 4	10

Answer 20 · Mark scheme

June 2025 | 8464/B/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	herbicide is added / sprayed (on soil / land / field / crop / maize)		1	AO1
	(so) weeds killed **and** (GM) maize / crop not killed	allow (so) unwanted plants killed **and** (GM) maize / crop not killed allow **only** the weeds are killed	1	AO2
	(so) (GM) maize / crop has less competition for light / water / minerals / ions / space	allow (so) (GM) maize / crop has more light / water / minerals / ions / space ignore reference to nutrients ignore (GM) maize / crop has less competition unqualified	1	AO2
	(so more) photosynthesis to produce glucose which produces protein / cellulose / starch / fat (for growth)	allow (so more) photosynthesis to produce glucose which produces amino acids (for growth)	1	AO2 4.4.1.1 4.6.2.4 4.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	use of herbicide kills weeds / wildflowers / plants (that are not the crop)	allow increased use of herbicide / weedkiller ignore (more) use of pesticides ignore herbicide kills animals / insects	1	AO3 4.6.2.4 4.7.3.1
	(causes) fewer weeds **or** fewer other plants therefore less food for animals / insects	allow fewer wildflowers therefore less food for animals / insects allow less variety of food therefore lower number of species of animals / insects allow fewer weeds / wildflowers **or** fewer other plants therefore more competition for food	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	crops / plants may be insect / bee pollinated insects may be predators of (crop) pests	allow for pollination allow a description eg insects eat crop pests allow bees may be predators of (crop) pests	1 1	AO2 4.7.1.1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	provides source of food / shelter (for insects / bees / pollinators)	allow protection / hiding from predators	1	AO2 4.7.3.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(as oxygen level increases decay increases due to aerobic) respiration of microorganisms (which) releases carbon dioxide causing global warming	allow (aerobic) respiration of bacteria / fungi / decomposers allow (which) releases carbon dioxide which is a greenhouse gas allow (which) releases carbon dioxide causing the greenhouse effect ignore (which) releases carbon dioxide causing climate change	1 1	AO2 AO1 4.7.3.3 4.7.3.5 4.7.2.2 4.4.2.1

Total Question 4	11

4.7.3.3 Land use

Answer 01 · Examiner comments

June 2018 | 8464/B/1H | Original Q3

Question 3 (standard, standard / high & high demand)

03.1 85% of students selected the correct balanced equation for photosynthesis. The most common incorrect equation selected was that which represented respiration.

03.2 This question tested a new part of the specification. 49% students identified photosynthesis as an endothermic reaction. 25% of students thought photosynthesis was an aerobic reaction, and fewer said it was an exothermic reaction.

4.7.3.3 Land use

Answer 01 · Examiner comments

03.3 The question asked for two ways to measure the rate of photosynthesis more accurately. 8% of students achieved both marks, with 46% achieving one mark. This was usually for measuring the volume of gas released. Quite a lot of students suggested ways to do this, such as using a gas syringe, which was awarded a mark.

Relatively few students suggested increasing the length of time to collect the bubbles and some thought reducing the time would make the results more accurate.

Alternative ideas that gained credit included:

- using a video so the bubbles could be recounted afterwards
- repeating the measurements and calculating a mean (the whole of this statement was required for a mark).

Many students suggested carrying out the investigation using different distances, light intensities or sodium hydrogen carbonate concentrations, all of which were ignored.

03.4 The question asked why the pondweed had to remain at a constant temperature. 3% of students achieved both marks, and 54% were awarded one mark.

For the first marking point a reference to the effect of temperature on the rate of photosynthesis was required. Statements such as 'temperature affects photosynthesis' were ignored.

The second marking point was for stating that photosynthesis is controlled by enzymes, or that high temperatures denature enzymes.

03.5 62% of students achieved two marks for the correct calculation of $1 \div d^2$ for two distances that doubled. Calculations for all three distances were often given. Although the question said calculations **must** be included, quite a lot of students did not attempt any.

Students found the final mark, for explaining that as distance doubled the light intensity was quartered, the most difficult to express. For example, reduces by a quarter or decreases by four were incorrect. Many did not give a quantitative description, and said as distance increased light intensity decreased. This was insufficient.

03.6 50% of students were awarded the first marking point for predicting that two bubbles would be produced. This was the only answer allowed. Common incorrect responses were zero, one or four bubbles. 195 of students achieved both marks, as students found it difficult to give a reason for their prediction.

4.7.3.3 Land use

Answer 01 · Examiner comments

June 2018 | 8464/B/1H | Original Q3

03.7 Many students did not understand the term independent variable. Many of those who did, gave insufficient information to achieve the mark. They often said change the concentration of carbon dioxide, but did not describe how this could be done. Some suggested using different volumes of sodium hydrogen carbonate solution, but a reference to changing the concentration was needed.

The term control variable was better understood, but students did not always gain credit because their descriptions were too vague. For example, keep the light or lamp the same was insufficient. A reference to light intensity or the distance from the light source was needed. Temperature unqualified was ignored. It had to be clear that it was the temperature of the solution that should be controlled.

Answer 02 · Examiner comments

Question 4 (standard, standard / high & high demand)

04.1 9% of students understood why the percentage change in mass was calculated. A clear reference to the starting mass of the carrots being controlled, or that the carrots were not all the same mass at the start, was needed.

Quite a lot of students referred to being able to compare the carrots, which was insufficient. Some restated the title of the investigation, and said so that the effect of different concentrations of sugar solution on the carrot could be seen.

04.2 When plotting graphs, it is advisable to use a pencil so errors can be erased.

93% of students achieved a minimum of two marks, with 22% achieving full marks. Common mistakes included:

- forgetting to label the *x*-axis
- using an inappropriate scale, which made plotting very difficult
- plotting dots instead of crosses; dots cannot always be seen
- drawing a line of best fit which did not average out the data.

Most students chose a scale of 2 cm to 5% which was the most sensible option. Those choosing 1 cm to 5% did not gain the scale mark as less than half of the available space was used. Some students used a scale of 1 cm to 3 % which was acceptable.

Students should be aware that a line of best fit can be a curve or a straight, ruled line. The data provided formed a gentle curve. Approximately 10% of students drew a curve through all the points, which was correct. Those who drew a straight line could still be awarded the mark, as long as it averaged out the data. Very thick lines or sketchy, double or broken lines were insufficient.

4.7.3.3 Land use

Answer 02 · Examiner comments

04.3 Students had to read the value from their line where the percentage change in mass was 0. A tolerance of ± ½ a square was allowed.

33% of students correctly estimated the sugar concentration from their graph. A number of students gave an answer of 0.4 mol/dm^3 despite their line passing through a concentration greater than this. Other common incorrect answers included 0.2 and 0.8 mol/dm^3. Some students incorrectly read the scale, reading 0.46 as 0.43 or 0.42 as 4.2

04.4 55% of students achieved at least one mark, but only 27% achieved two or more marks. There were a few very good responses which demonstrated that the definition for osmosis had been learnt. Quite a lot of good answers only scored three marks because they did not mention that the mass decreased. Others did not mention the partially permeable membrane.

For the second marking point diffusion was ignored, as at high demand students are expected to know that water moves by osmosis. A few thought that water moves by active transport. Some thought that it was sugar that moved by osmosis.

Some responses included confused references to concentration. It was not clear whether students were talking about water or sugar concentration. Some switched between water concentration and sugar concentration. Those who expressed concentration in terms of dilute and concentrated solutions generally gave clearer responses.

Incorrect ideas that were seen included:

- the carrot filling up with sugar and bursting
- gas being given off
- bits falling off the carrot as it dissolved
- enzymes breaking down the starch.

04.5 3% of students achieved this mark for this question targeted at grades 8–9. Many students appreciated that the high temperature would damage something in the cell. In order to gain the mark they had to refer to the membrane.

Damage to the cell or to enzymes was often stated. Saying osmosis could not happen or the cells were dead were both insufficient. Some thought that water would not be able to enter or leave the cell, which was incorrect.

4.7.3.3 Land use

Answer 03 · Examiner comments

June 2018 | 8464/B/2H | Original Q1

Question 1 (standard demand)

01.1 86% of students were able to identify two or three factors that were biotic or abiotic, with about 64% identifying all four correctly.

01.2 Most students noted that light increased as you moved away from the tree. However, a much lower number related light to photosynthesis and fewer still could link to glucose for growth, although some answered with 'providing food'. There were students who mixed up photosynthesis and respiration.

01.3 Many students identified a quadrat and most of these could spell it correctly. Much fewer identified the light meter, with solar panel and light dependent resistor (LDR) as the most common wrong answers. 'Lightometer' was seen but unless this was qualified as a mobile phone app it did not gain credit. Similarly a 'light sensor' was only correct if linked to a data logger.

01.4 Most students attempted a calculation, with 15% answering correctly. Some students were able to correctly calculate the area of one quadrat as 0.25 m^2 but then multiplied by either ten or five instead of the six sites sampled.

01.5 A wide variety of answers were seen suggesting that students understood that light intensity could change during the day. Provided the idea was clear credit was awarded.

01.6 The many students who just wrote 'repeat the investigation' did not gain credit. However 38% of students knew that this would only improve validity if it was in a different direction or for a different tree. Sampling every metre was also a correct common response.

01.7 74% of students identified 'daisy'. A number of students wrote more than one answer and so lost the mark under the list rule. Clover was a common incorrect answer, possibly because that was the species with the highest percentage cover at high light intensity rather than the species which **only** grew at high light intensity.

01.8 The first straightforward mark point for increasing light intensity showing an increased percentage cover of plants was stated by 62% of students although some incorrectly inferred that it was the percentage cover of plants causing the increased light intensity.

Only the most mathematically astute students were able to note that a maximum of 100% cover was seen from 175au of light for the second mark. A number of students did not read the question carefully enough and gave detailed descriptions of what was happening for each species instead.

4.7.3.3 Land use

Answer 03 · Examiner comments June 2018 | 8464/B/2H | Original Q1

01.9 While 69% of students were able to identify a factor for one mark, often seen and credited within the reason section, very few were able to explain this in terms of the tree. Instead students gave very general reasons for why the factor was needed by plants. Many students wrote about the carbon dioxide level under a tree changing which is not the case.

Answer 04 · Examiner comments June 2019 | 8464/B/1H | Original Q3

Question 3 (standard, standard/high & high demand)

03.1 Around 44% of students scored this mark by referring to use of the tap or a description of releasing water from the reservoir. Some said add more water, but did not go on to say how this could be done.

Quite a lot of students said remove the shoot from the apparatus, whilst others said remove the water. There were quite a lot who suggested changing the temperature or humidity.

03.2 This was a challenging question and about 19% of students achieved a mark, although both marking points were seen in responses. For the second marking point, quite a lot of students said that the readings or results would be more accurate, which was allowed. Saying that the test was more accurate was ignored as the marking point related to the measurement on the scale. Vague descriptions, such as the bubble would be easier to see or to measure, were ignored.

03.3 Around 22% of students scored all three marks and around 30% scored one mark. This was usually for the first marking point. This mark could be gained from a variety of readings. The most common way was to divide 66 by 5. Other students chose other pairs of readings, for example 13 divided by 1 or 26 divided by 2. Any correct pairs of readings were creditworthy for marking point 1. The most common error on this first marking point was to divide 63 by 5, due to an incorrect graph reading. This did not gain a mark, but the student could go on to gain marking points 2 and 3.

The second mark was for multiplying their answer for marking point 1 by 0.8. A common error was to divide by 0.8. The final mark was for the correct calculation, which did not need to be rounded as the question did not request this. If it was rounded, the rounding had to be correct.

4.7.3.3 Land use

Answer 04 · Examiner comments June 2019 | 8464/B/1H | Original Q3

03.4 Almost a quarter of students gained all three marks with 64% of students scoring two marks. For those achieving two marks, these were usually for plotting the points. Errors in plotting were mainly made for the zero point, or the 3 minute point.

A line of best fit should average out the points. In this case the line should have been straight and drawn with a ruler. Incorrect lines tended to be drawn either too far below, or too close to the final point.

03.5 A fifth of the students scored this mark. Investigation C was carried out in dry air and at a high temperature, so water loss from the shoot would have been faster than in the other two investigations. Therefore the line would be steeper than the others, but still pass through the origin.

03.6 Around 70% of students scored one mark for saying the shoot would not photosynthesise in the dark. Very few students could give a full explanation relating water uptake to stomata and to transpiration from the leaves.

Many students thought the potometer measured the rate of photosynthesis, or that the air bubble was a gas produced by the plant.

Answer 05 · Examiner comments June 2019 | 8464/B/2H | Original Q1

Question 1 (standard demand)

01.1 Almost all students gained some credit for describing the ruler drop test. Most described the dropping and catching of the ruler but this mark point was not awarded if there was a countdown or warning given, or if the student was dropping and catching the ruler themselves.

Many students were able to describe exactly where the ruler should be positioned above the hand, but if a large height was indicated this was not awarded. The measurement on the ruler where it was caught was the third mark and any references to timing were ignored although many measured both.

01.2 88% of students correctly calculated the dose of caffeine for group D.

01.3 70% of students realised that a drink with no caffeine was needed to be able to see the effect of caffeine on reaction time. This could be expressed in various ways including ‘as a control group’, however ‘a control variable’ was not given credit as caffeine is in fact the independent variable. References to a ‘placebo’ were ignored.

01.4 79% of students were able to estimate the reaction time for a drop of 23 cm.

4.7.3.3 Land use

Answer 05 · Examiner comments

01.5 Many students didn't appear to read this question carefully and answered a different question giving that reaction time either increased or decreased. Half the students correctly expressed the relationship as 'as the mass of caffeine increases so does the decrease in reaction time' which is directly from the graph.

Some students just quoted data from the graph which did not gain credit. 'A positive correlation' did not gain credit but was ignored if the correct relationship was also given. Likewise the statement that reaction time was quicker was also ignored if the correct answer was present.

01.6 A 'mathematical' reason was required as to why these points were negative, so ideas related to errors or the method were not relevant. Some students surmised that the ruler was not caught at all or that they were distracted. 38% of students realised it was because the reaction time increased rather than decreased after the drink and so gained the mark.

01.7 Three-quarters of students were able to give the correct range of results for group C.

01.8 47% of students were able to give one or two variables that should have been controlled. The most common correct variables were related to the position of the hand and ruler before the test or using the same hand each test.

Most incorrect responses referred to some aspect of the caffeine drink which was in fact the independent variable and already very well controlled.

01.9 Over half of students were able to gain one mark for realising that either a reflex action is automatic or that the ruler drop test requires a conscious action or involves the brain. 9% of students gave the full answer for two marks Some students only referred to the absence or presence of danger as distinguishing the two actions or said that the ruler drop test only needed 'hand to eye coordination' or 'did not involve the brain'.

Many answers were based on the erroneous belief that the ruler drop test did not involve a stimulus or receptors like a reflex action, or that it could not be a reflex action as it was not to avoid danger or pain.

4.7.3.3 Land use

Answer 06 · Examiner comments

June 2019 | 8464/B/2H | Original Q5

Question 5 (standard, standard/high & high demand)

05.1 Most students were able to identify one way to improve the method given for the RPA of measuring a population of organisms; in this case, daisies in a school field. 57% of students gave both improvements correctly.

05.2 Most students made a good attempt at this tough multistep calculation. A third gained two marks for correctly calculating the area of the school field. A further 12% of students gained a further one mark, most usually for converting the incorrect answer they derived into standard form with two significant figures. 10% correctly calculated the result but failed to express it in the required format, while 7% calculated a totally correct answer.

05.3 This extended response question asking about factors which would affect the distribution of daisy plants on the school field was intended to be challenging. To give answers reaching Level 2 or 3 the student needed to include a high degree of accurate detail to explain each factor. Students who identified only factors, or who discussed only one factor, would be unlikely to get a mark awarded above Level 1. To gain a mark in Level 3 quite a lot of strong linking with accurate detail was needed for several factors and a clear understanding of how each one affected the distribution. It was not required to label each factor as biotic or abiotic but if the student chose to do so it needed to be correct.

11% of students gave enough accurate detail to be awarded five or six marks (Level 3). 57% of students gained three or four marks (Level 2) and 26% achieved one or two marks (Level 1). Very few students gained no credit or did not attempt a response. This question differentiated well throughout the ability range of students.

Answer 10 · Examiner comments

November 2021 | 8464/B/1H | Original Q1

Question 1 (standard demand)

This question assessed knowledge and understanding of Required Practical Activity 5: investigating the effect of light intensity on the rate of photosynthesis. Almost three-quarters of students correctly identified the balanced equation for photosynthesis. Just over half correctly identified the distance of the pondweed from the lamp as the independent variable.

More than two-thirds of students described how a higher temperature would increase the rate that the bubbles of oxygen were produced by the pondweed. A a quarter of students could explain why the rate would be faster at a higher temperature. A third of students suggested how the investigation could be improved so the temperature of the water did not increase, usually saying use an LED bulb. Many students did not understand what was being investigated and suggested moving the lamp further away from the pondweed. A third of students scored one of the marks for **01.5**, usually for saying that using the same pondweed would make the results more valid. Quite a lot of answers referred to carrying out repeats, but did not go on to say calculate a mean, or remove anomalies.

Half of the students correctly calculated the rate of photosynthesis as 3 bubbles of gas per minute. Common errors included dividing the distance by the number of bubbles produced at that distance, dividing a distance by 5 minutes, or dividing an incorrect number of bubbles by 5 minutes. **01.7** was answered well on the Higher Tier. Almost three-quarters of students made a correct conclusion describing the effect of light intensity on the rate of photosynthesis. Cause and effect had to be the correct way around, to link back to what the investigation was set up to find out.

4.7.3.3 Land use

Answer 10 · Examiner comments November 2021 | 8464/B/1H | Original Q1

Most students correctly plotted the points on the graph, using a small cross drawn with a sharp pencil. Fewer than a third of students went on to join the points with a smooth curve. Most drew a ruled straight line. Fewer than half correctly extrapolated their line to predict the number of bubbles that would be produced if the lamp was 60 cm from the lamp.

Answer 11 · Examiner comments November 2021 | 8464/B/1H | Original Q3

Question 3 (standard, standard/high and high demand)

This question assessed the application of knowledge related to fermentation, and analysis of an investigation into the effect of temperature on fermentation. Over half the students gained the mark for describing what exothermic means. Common errors included saying an exothermic reaction produces energy, or 'it gets warmer'. Reference to energy being released or emitted was required.

Very few students realised that the layer of oil was needed to keep oxygen out of the mixture. Incorrect suggestions included to prevent the liquid evaporating, to prevent gas escaping or to stop the yeast rising. Very few students knew that the mixture was left for 20 minutes to allow it to reach the correct temperature. Some had the correct idea, but thought the mixture had to warm up, rather than cool to 2 ºC. When explaining the results for the flask at 2 ºC half the students scored any marks, which was usually for saying that no gas was produced. There were confused references to a small amount of gas being produced, but this was not clearly related to when, or at which temperature. Very few references to enzymes were seen.

In **03.5** half the students acheived 1 mark for saying that gas was produced. A quarter of students scored 2 marks for also stating that 35 ºC was a suitable temperature for yeast to work. The third and fourth marking points were set at a higher level of demand and were rarely given.

4.7.3.3 Land use

Answer 12 · Examiner comments

November 2021 | 8464/B/2H | Original Q2

Question 2 (standard demand)

Generally, students could interpret the graph and describe the trends between 2008 and 2011 in terms of years, such as 'it increases to 2008'. However, fewer could correctly extract relevant data, such as the money spent in millions of pounds in 2008 or 2011. References to trends beyond 2011 were ignored. Some students tried to give economic or levels of concern reasons for the trends which did not answer the question. When 'describe' is used as a command word the answer does not require an explanation.

In **02.2** students were given the equation and asked to calculate the percentage change. Some students could not read the appropriate figures from the graph. The most common error was not giving the answer to two significant figures. This is prompted in the question and on the answer line. There were indications that some students are confused between decimal places and significant figures.

Knowledge of uses of peat was very weak, with most students not being able to give one use of peat taken from peat bogs. The most common correct answer related to peat in compost. Misconceptions of the term biodiversity were frequently seen in **02.4**, with answers referring to diversity in the human population or vague answers relating to recycling or climate change that would not directly increase biodiversity. Suggestions that would maintain, or decrease the rate of biodiversity decline, such as 'stop hunting' may maintain, but not increase biodiversity, and therefore were considered to be insufficient at this level.

Answer 13 · Examiner comments

November 2021 | 8464/B/2H | Original Q5

Question 5 (standard, standard/high and high demand)

Some students read and understood the reaction time method provided. Some however, made assumptions that this was a 'ruler drop' method and then struggled to answer questions relating to control variables and possible sources of random error in the method.

In **05.4** students had to link their knowledge of the effect of adrenaline on the body to reaction time. A common misconception seen was that reaction time decreasing must mean slower reactions. Few students referred to oxygen or glucose supply to muscles or the brain, and fewer referred to the rate of respiration or energy released for muscle contraction. The common errors referring to energy being 'produced' were seen.

Students could generally recall the term 'synapse'. Few could apply their knowledge to the scenario given in **05.7**. Many students simply repeated the information provided, which is never awarded credit.

4.7.3.3 Land use

Answer 14 · Examiner comments

June 2022 | 8464/B/1H | Original Q5

Question 5 (standard, standard/high & high demand)

05.1 This question was set at a high level of demand. Two-thirds of students scored one or more marks, with 41% of all students achieving two or more marks. Similarities and differences between benign and malignant tumours were needed for full marks. Where differences were given the statements had to be comparative. Many students compared how harmful the tumours are, or how they can be treated, neither of which was creditworthy.

05.2 39% of students scored one mark, usually for saying younger people wear sunscreen, or have had little exposure to sunlight. Little exposure to the Sun was ignored. Few referred to ionising radiation, and just said radiation, which was insufficient. The second marking point, about less cell or DNA damage in younger people, was rarely seen.

05.3 Two conclusions about the number of new cases were needed. Many students made conclusions from the lines on the graph, rather than from the bars. A common error was to say the number of cases increases with age, but this is not true above age 69. Students often referred to the wrong age ranges. For example, saying that there were more new cases in males than females above age 55 was incorrect, it was above age 60. The most common correct answer was that most people were diagnosed between the ages of 65 and 69.

Answer 14 · Examiner comments

June 2022 | 8464/B/1H | Original Q5

05.4 The question was set at the highest level of demand with 3% of students achieving the mark. Incorrect responses included ideas about accuracy and that there would be too many people to count, or too much data to plot.

05.5 Two trends in the number of people with skin cancer were needed. Many students did not describe trends, but instead gave information using the bars on the graph about the number of new cases. The simplest trend to identify was that the number of people with skin cancer increases with age. Half the students scored at least one mark.

05.6 18% of students scored three marks, and 10% scored one mark. This was usually for the compensation mark using a reading from the bar at age 80 to 84, rather than from the line.

4.7.3.3 Land use

Answer 15 · Examiner comments

Question 4 (standard/high & high demand)

04.1 The most common correct answers referred to temperature, light intensity and number of plants/seeds in each box.

Incorrect answers frequently referred to the nitrate ion concentration or the mass of corn, showing a lack of comprehension of the method given. 82% of students achieved at least one mark.

04.2 Students selected a wide range of scales for the *y*-axis of their graph. The most common scales were 20 grams per 1 cm or 25 grams per 1 cm. Some students compressed the *y*-axis, which was acceptable provided an indication of a compressed or broken axis was shown. Point plotting was generally accurate, even when unusual scales were chosen.

For the line of best fit, many students drew a straight line or joined points with straight lines which were both inappropriate.

4.7.3.3 Land use

Answer 15 · Examiner comments

04.3 Students were asked to describe the relationship between nitrate ion concentration and mean mass of corn, referring to data from the table. Some students very succinctly stated that mass increased up to 30 ppm and then decreased which scored both marking points. However, many students missed out the fact that there was a maximum mass at 30ppm, failing to use data from the table when describing the relationship. Sometimes, it was stated that the decrease was from 40 ppm which was incorrect.

A small number of students said the relationship was directly proportional which was incorrect.

04.4 Students were asked to evaluate both economic and environmental implications, therefore giving economic implications only could not gain all four marks.

For the first bullet point, increasing mass was ignored. This would overlap with **04.3** and is describing the relationship rather than evaluating. Failure to refer to a numerical value of fertiliser concentration when describing economic implications meant that many students did not gain marking points one or two.

For the third bullet point, 'worth the cost/money' was often part of a suitable explanation that also referred to profit or benefit depending on yield/mass/income/sales.

There were up to three marks available for the environmental implications. The statements in the extra information column relating to run-off and eutrophication are both equivalent to the fifth bullet point. However, the penultimate and final statements in this column are separate marking ideas that could both gain marks in the same response. They are beyond the specification but were credited if seen.

The most common mark awarded was for the environmental implication of fertilisers running off into water courses causing pollution. There were many vague answers such as 'fertiliser poisoning the soil' or 'killing wildlife in the fields' which did not gain any credit.

There were many misconceptions such as:

- fertiliser is a type of pesticide or herbicide
- fertiliser stops bees pollinating plants
- farmers must buy 0 ppm fertiliser
- fertiliser is made from peat bogs
- fertiliser makes food unfit to eat
- the plants over 40 ppm need more fertiliser because they aren't growing as well
- fertilisers release toxic gases.

4.7.3.3 Land use

Answer 16 · Examiner comments

June 2023 | 8464/B/1H | Original Q6

Question 6

06.1 Quite a lot of students simply stated that starch has to be digested to form sugar. Some went on to give uses of sugar, for example for respiration. These ideas were not creditworthy. A reference to the size of starch molecules, or that starch is insoluble, was needed for the first mark. A third of students scored at least 1 mark, usually for saying that starch molecules are big. Just over a tenth of students also gave a correct explanation in terms of absorption or diffusion into the blood. Some thought starch had to be digested because it is harmful.

06.2 Four fifths of students scored this mark for saying the control liquid for the investigation was water, which was allowed. A few gave the better answer of iodine solution.

06.3 Most students scored at least 1 mark for describing the pattern that the percentage of light passing through the liquid decreased with increasing starch concentration. Simply giving data was ignored, a clear pattern had to be described. Just over a quarter of students scored the second mark as well by explaining that this was because the iodine solution would be darker. The final mark which was set at the highest level of demand was rarely seen. A clear statement that a darker liquid would absorb more light was needed.

06.4 Half of the students scored the mark for explaining why the starch suspension and amylase solution were kept in the warm water bath for 10 minutes before being mixed together. Most said so they would be at the same temperature. Others gave a better answer saying that 37 °C was the optimum temperature for enzymes to work, or that it was body temperature.

06.5 The calculation of the mean rate of digestion was set at the highest level of demand, and involved the use of two graphs. Many students did not realise this, and only just over a tenth of students scored 1 mark. This was either for giving the concentration at zero time as being 6.6 g/dm^3 or for giving the concentrations 1.8 g/dm^3 and 0.8 g/dm^3 for the concentrations at 1 and 2 minutes. These three values all required use of both graphs. Quite a lot of students gave the percentage of light passing through the mixture at 1, 2 and 3 minutes. This only involved the use of one graph, so was not creditworthy at the level of demand at which the question was set.

06.6 Almost two fifths of students scored at least 1 mark for saying that the enzyme would be denatured at pH1. Half of these went on to say that therefore the starch would not be digested, or that the reaction would be much slower, to score 2 marks. The final mark was set at the highest level of demand. Very few could explain how this would affect the percentage of light passing through the liquid.

Answer 17 · Examiner comments

Question 6 (standard, standard/high & high demand)

06.1 Nearly all students could identify that the pituitary gland releases hormones to control other glands.

06.2 Most students knew that adrenaline increases blood flow to muscles.

06.3 Most students could give the correct answer of receptor or sensory neurone/cell.

Some students were unaware that receptors that respond to stimulus are types of cells. Common incorrect answers were red blood cells, white blood cells, effector, muscle, named organs and nerve cells or neurones unqualified.

06.4 Very few students gained 2 marks. Many students stated that blood glucose goes up or is high in people with diabetes, but this is also true of people without diabetes, so the mark could not be awarded. The answer needed to be comparative.

Many students simply stated that people with diabetes do not produce enough insulin. This did not go far enough for either mark to be awarded.

Some students demonstrated confusion between Type 1 and Type 2 diabetes. Other students tried to answer in terms of how reaction time would be affected rather than blood glucose concentration.

Confusion was evident in terms of incorrect responses stating that 'insulin breaks down into glucose', or 'people with diabetes don't produce enough glucose'.

The answers to this question highlighted that many students did not understand the biological basis of diabetes. Common misconceptions included:

- people with Type 1 diabetes cannot make their own glucose (and this was sometimes followed by comments implying it is therefore safer for people with diabetes to drink glucose)
- glucose is the same as insulin
- insulin is converted to glucose
- insulin is converted to glycogen
- a lack of insulin means blood glucose concentration is lower.

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4.7.3.3 Land use

Answer 17 · Examiner comments

06.5 The most frequent correct responses related to amount of sleep or minimising distractions.

Common misinterpretations of the question referred to controlling the volume or concentration of glucose solution. Students should take care to read all the information provided. Different volumes or concentrations of glucose solutions would be necessary to change the independent variable. Food and drink were controlled, so references to controlling caffeine and alcohol intake could not be credited.

Many students assumed the reaction time test was the ruler drop test. If they described a suitable control variable, such as 'using dominant hand to catch the ruler' this was credited, but often these attempts at control variables were incorrect, such as 'same ruler' or 'same person dropping the ruler'.

06.6 Some students incorrectly interpreted the question as being an issue with recording accurate results. Many responses did not go far enough to be awarded the mark, such as 'blood glucose goes too high' without giving a reason why this is problematic. Common incorrect responses were too vague, such as 'in case they fell ill' or 'to give insulin injections'.

Some students suggested the health of the patient would affect the results/reaction times in the experiment, rather than considering the risk to the person with diabetes. These were not awarded the mark.

There were some good answers in which the students understood that both low and high blood glucose concentration are dangerous.

06.7 Students found this question challenging. Many simply defined homeostasis rather than answering the question. Some students approached the right idea but were imprecise with their language, such as 'faster/slower reaction times' indicating confusion between reactions, reaction times and the time recorded. Students need to be careful they are not describing time as speeding up or slowing down, which is not possible. Reactions can be faster but not reaction times.

Some students did identify that reaction times in the range for people without diabetes were lower but did not go far enough to state lowest. Similarly, some identified high blood glucose concentration increased reaction time but did not refer to low blood glucose concentration.

06.8 Many students are confused between glucose, glycogen, glucagon. Glycerol was also seen. Hybrid spellings between these terms was common and whilst phonetic spelling is acceptable, marks cannot be credited where there is ambiguity between technical terms.

Common misconceptions were that insulin or glucagon are broken down into glucose. For marking point 1, students often missed mention of the pancreas, in which case the mark would not be awarded. Few students gave marking point 2.

Some students misunderstood the question and described how people with diabetes control their blood sugar levels through diet and exercise.

Students sometimes spend time starting this style of question by re-writing the question. This is not necessary.

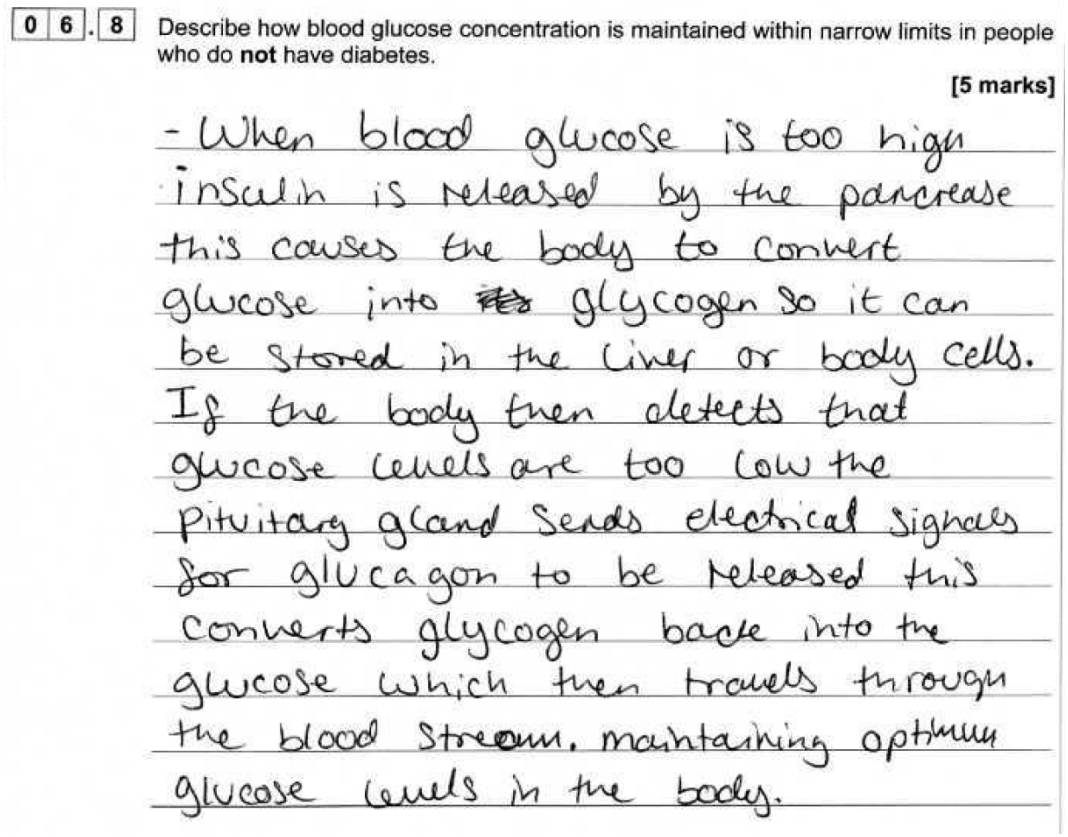
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4.7.3.3 Land use

Answer 17 · Examiner comments June 2024 | 8464/B/2H | Original Q6

0 6 . 8 Describe how blood glucose concentration is maintained within narrow limits in people who do **not** have diabetes.

[5 marks]


- When blood glucose is too high insulin is released by the pancrease this causes the body to convert glucose into ~~fats~~ glycogen so it can be stored in the liver or body cells. If the body then detects that glucose levels are too low the Pituitary gland sends electrical signals for glucagon to be released this converts glycogen back into the glucose which then travels through the blood stream, maintaining optimum glucose levels in the body.

The student has given marking points 1 and 3. 'Pancrease' is given benefit of the doubt as a phonetic spelling of pancreas.

The student is not clear whether glucose or glycogen is entering liver cells, therefore marking point 2 cannot be awarded.

The student has not referred to where glucagon is released from when blood glucose concentration decreases, therefore marking point 4 cannot be given.

Marking point 5 is given, so the student gains 3 marks for this question.

06.9 Many students answered as if the reaction time has increased, despite the question. For the first marking point, many stated that the increase in chemical would decrease the rate of diffusion, or 'overwhelm' the body. Few students made appropriate mention of impulses. Very few students could link the role of the diffusion of chemicals to impulses in the next/motor/relay neurone.

There was frequent use of incorrect terminology, such as:

- electrical impulses travelling across a synapse
- chemical impulses travelling across a synapse
- chemicals diffusing down neurones
- neurones moving from receptors to effectors.

Although it's beyond the specification, the term 'neurotransmitters' was seen and could be used.

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4.7.3.3 Land use

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Answer 20 · Examiner comments

June 2025 | 8464/B/2H | Original Q4

Question 4 (Standard/high and High demand)

04.1 Many students understood the term 'resistant'. However, it was clear that some students did not understand the term 'herbicide'. Some students confused herbicides with herbivores. Misconceptions surrounding herbicides were evident in statements such as 'herbicides can no longer eat the crops' and 'GM crops that are herbicide resistant cannot be eaten by herbivores' and some students confused herbicides with pesticides. Very few students were awarded marking point 1 as they often overlooked the idea that herbicide would be applied (to the crops).

For marking point 2, many students were seen to write that 'GM crops are less likely to be killed by herbicides' but did not then go on to state that the other plants / weeds would be killed. Many students incorrectly believed that maize and GM maize are grown simultaneously in the same field by the same farmer. This demonstrates a fundamental misunderstanding of how GM crops are used. Students need to be careful in their use of the word 'affected' as this was too vague for this marking point. For example, 'weeds are affected'.

Where students described the idea of competition in marking point 3, most were able to name a factor that would be competed for. However, it was very rare to see marking point 4.

Accounts of the steps involved in the process of producing GM plants were not relevant in this question but were seen in answers. In these instances, the students filled the answer space with their description before concluding with a short statement such as GM crops won't be killed. A small number of students went down the route of describing selective breeding instead of answering the question.

0 4 . 1 Maize is a crop plant.

A variety of maize has been genetically modified (GM) to be resistant to a herbicide.

Explain how growing GM herbicide-resistant maize can produce a larger yield than growing non-GM maize.

[4 marks]

as the genetically modified (GM) maize is resistant to a herbicide, it means that the maize can be sprayed by the herbicide, causing no damage to the plant but making it so no insects or bugs that will damage the maize, so more maize survives and will continue to produce a larger yei yield than growing non-GM maize.

This student gains marking point 1 but then continues to incorrectly describe function of the herbicide with a common misconception, so only marking point 1 was awarded.

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4.7.3.3 Land use

Answer 20 · Examiner comments June 2025 | 8464/B/2H | Original Q4

04.2 This question asked students how growing GM crops decreases the biodiversity of animals. Some students made no reference to animals in their answers at all. Either they did not read the question properly or did not understand what they were being asked. A commonly seen insufficient response was 'the GM crops are genetically identical' and some students wrote about monoculture.

Many students failed to use the word herbicide correctly in this answer and as in question **04.1**, a lack of understanding of the word herbicide proved problematic. It was common for students to state that animals would not be able to eat the GM herbicide resistant crop after herbicide had been applied or that if animals ate the crop they would die. A frequently seen insufficient idea was that growing GM crops would take up more land leaving less habitat space for animals. The most frequent marking point here was marking point 2 with the idea of fewer other plants meaning less food for animals.

04.3 Very few students were awarded 2 marks for this question. Some students did not understand the term yield in the question. The most commonly awarded mark was for marking point 1, for the idea of insects as pollinators. However, there were a lot of misconceptions surrounding pollen and pollination. Commonly seen misconceptions regarding pollination included:

- bees making pollen or being a source of pollen
- bees collecting pollen for nectar
- pollination being where seeds get stuck to a bee's body
- pollen being needed by crops for photosynthesis / respiration
- the idea that bees themselves fertilise the plants, rather than facilitating pollination as a step leading to fertilisation.

Where insufficient attempts at marking point 2 was seen, some students were not clear about insects eating or destroying pests, instead suggesting insects simply deter or scare crop pests.

The idea of insects dying and decomposing and therefore providing minerals for the crops was insufficient. Some students repeated information from the question, giving answers such as 'insects increase crop yields'.

04.4 The most common correct answer for this question was 'hedgerows provide places for insects to reproduce / breed'. 'Hedgerows provide a source of food' or 'hedgerows provide a source of shelter' were also commonly seen correct answers.

The most common insufficient response was 'more hedgerows provide more habitats / places to live' as this was repeating the information given. Students must take care not to simply repeat information given to them in the question stem. Many students made vague references to increased biodiversity without linking this to the context of the question or wrote about the hedgerow providing 'ideal living conditions' for the insects without specifying what those conditions are.

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4.7.3.3 Land use

Answer 20 · Examiner comments June 2025 | 8464/B/2H | Original Q4

04.5 This was a challenging question for many students as they failed to link microorganisms with respiration, instead writing answers implying the peat itself respired. It also appeared to be quite challenging to keep to the topic of the question, instead students frequently mentioned combustion rather than decay. There was a lot of repetition from the wording of the question, which didn't gain any marks. Very few students attained both marks available on this question, with marking point 1 rarely seen. Students who gained 1 mark, commonly gained the mark for stating that the released carbon dioxide is a greenhouse gas or that the release of carbon dioxide leads to global warming. Some students had the correct idea for marking point 2 but wrote the symbol for carbon dioxide incorrectly (e.g. 'CO2' or 'Co2', or with the 2 written superscript to the letters) and so were not awarded the mark. Refer to page 4 of the mark scheme for guidance on the use of formulae.

Most of the students achieving marking point 2 had not made the link to the source of the carbon dioxide being decomposers or respiration, with many stating that oxygen reacted with the peat to form carbon dioxide. There were not many students who could link the idea to increase oxygen enabling the microbes to respire, which produces carbon dioxide. Of the students who were not awarded marking point 2 it was frequently because the students identified that carbon dioxide would be released but did not go on to state the effect of this or simply reiterated the phrasing from the question stem (i.e. that carbon dioxide causes climate change). Several students made irrelevant references to methane or the ozone layer or stated that the process of cutting the peat released stored carbon dioxide. Another common error was stating that carbon is released into the atmosphere as opposed to carbon dioxide.

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4.7.3.3 Land use

GCSE

Combined Science: Trilogy

8464/B/1H Combined Science: Trilogy Biology Paper 1H

Report on the exam

Published: August 2025

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Overview

This paper is one of the six examined components for Combined Science: Trilogy. All of these papers follow a similar structure and test the same assessment objectives.

This paper has 70 marks available to students and is made up of six questions.

- Approximately 40% of marks assess AO1; 40% of marks assess AO2; and 20% of marks assess AO3.
- Approximately 40% of marks target Standard demand, 40% of marks target Standard/High demand and 20% of marks target High demand.

Questions 1 and 2 on this paper and questions 5 and 6 on the Foundation Tier paper are common. These questions are identical and are targeted at Standard demand.

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/High demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade is based on their attainment across all six papers.

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Summary of overall performance

Overall, students performed well on factual recall questions and straightforward mathematical calculations, whereas extended responses and the application of knowledge to unfamiliar contexts proved more challenging.

Strongest performance was observed in questions that tested basic recall or calculations. This was most noticeable in Questions **01.1**, **02.1** and **02.2**.
Students also performed well in the mathematical elements of the paper, particularly in **06.3** and **06.5**, where they demonstrated confidence in calculations involving standard form and percentages.

Moderate performance was seen in questions requiring straightforward application of knowledge, such as in **02.4**, and in **03.2**. Questions **05.2** and **06.1**, were also quite well answered by a significant proportion of students.

In contrast, a number of questions revealed significant difficulties for students, such as in **01.3**.
The extended response in **02.5** proved particularly challenging, as many students could describe the primary immune response but struggled to explain the secondary response in sufficient detail. Similarly, in **03.4** and **04.1**, students often gave imprecise answers which often lacked explanatory detail.

It is vital that students read all the information in each question and use it appropriately in their answers. Understanding the meaning of command words is particularly important. For example, ‘explain’ and ‘evaluate’ were often interpreted as ‘state’ or ‘describe’, leading to students missing out on marks. Question **06.6** was a notable example of this.

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Question 1 (Standard demand)

01.1 This question was generally well answered. A significant proportion of students (48%) achieved both marking points, demonstrating strong understanding of the topic. Many responses showed accurate labelling and good recall of the key blood vessels associated with the heart.

Where only one mark was awarded, this was most commonly for the correct identification of the vena cava.

01.2 61% of students gained the mark for this question.

01.3 This question was generally well answered, with most students recognising the involvement of respiration. However, many did not explain that more energy was required, and the misconception that energy is 'produced' rather than 'released' in the mitochondria was common.

Only a small proportion demonstrated understanding that the heart muscle needs to contract, with few using this precise term. Confusion between the processes of respiration and breathing was common.

Overall, 35% of students achieved two or more marks, while only 7% gained full marks. Most gained partial credit for identifying respiration but struggled to explain how energy is used by the heart.

01.4 This question was well answered, with 71% of students gaining at least one mark. Tiredness and chest pain were the most frequently identified symptoms.

Some responses repeated the same idea using different wording, for example 'heart attack' and 'blood clot'. Terms such as 'heart murmur' or 'palpitations' were credited as irregular heartbeat, while 'heartburn' was not.
Descriptions of increased breathing rate were often too vague, and few students mentioned pale skin.

01.5 This question was generally well answered, with over 80% of students gaining at least one mark. Many correctly identified infection or rejection as valid risks, while fewer mentioned the risk from anaesthetic.

Weaker responses often rephrased the question, giving vague statements such as 'there is a risk from surgery', which were not creditworthy. Some students speculated about long-term outcomes, for example 'the heart tissue not growing' or 'the patch being too small'. These were outside the scope of the question and not accepted.

Answers referring to bleeding had to make clear that it resulted from the operation and involved a significant loss of blood, with terms such as 'heavy blood loss' being credited. General references to 'risk of disease' were also not sufficient.

Descriptions such as the heart being punctured or stopping were credited as examples of damage to the heart, but unqualified terms like 'harming the heart' or 'death' were not.

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Question 2 (Standard demand)

02.1 This question was very well answered, with 95% of students correctly identifying touch or direct contact as a method of transmission. Many also referred accurately to coughing, sneezing, or droplets, which were credited.

Vague examples like hugging or playing together were not creditworthy, as they did not clearly imply skin-to-skin contact. In contrast, examples such as kissing, high fives, or transmission via contaminated surfaces like shared towels were accepted.

02.2 This question was very accessible, with many students correctly stating that antibiotics are used to treat bacterial infections.

A common misconception was the claim that chickenpox is not a virus, revealing a misunderstanding of the nature of the disease. References to 'it' were interpreted as referring to chickenpox and were credited where appropriate.

02.3 Many students correctly referred to dead pathogens, which was creditworthy. However, vague answers such as 'dead cells', 'dead disease', or 'dead chickenpox' were not accepted, as students needed to identify that it was the pathogen, not the disease itself, used in the vaccine.

Unqualified statements such as 'a small amount' were insufficient unless clearly linked to the dead pathogen or the antigen. Terms such as 'inert' or 'dormant' were accepted as synonymous with inactive when applied correctly to the pathogen.

02.4 This question was generally well answered, with 87% of students gaining at least two marks. Many demonstrated a clear understanding of the concepts being assessed.

Errors most often arose from repeating the same idea using different wording, for example stating that the drug was tested 'to check for toxicity' and 'to check for side effects'. These were treated as equivalent and not credited twice. References to allergic reactions were also accepted as side effects, and statements such as 'to check it doesn't kill the person' were credited as showing awareness of the ultimate risk.

Terms such as 'efficient' and 'effective' were accepted as equivalent to efficacy. However, references to 'reliability' or 'accuracy' were not sufficient, as they do not directly address whether the drug works as intended. Overall, this was an accessible question, though more precise language would have improved some responses.

02.5 This extended response question was assessed holistically. Many students demonstrated a clear understanding of the primary immune response, often describing in detail how white blood cells produce specific antibodies. These responses typically met the criteria for Level 2, with 50% of students achieving this level.

Fewer students were able to describe the secondary immune response in sufficient detail to reach Level 3, with only 10% achieving this. Stronger answers successfully linked features such as the faster production of antibodies and the role of memory cells in enabling a quicker, more effective response. High-level responses also referred to the production of complementary antibodies and explained how this led to a rapid destruction of pathogens. Statements such as antibodies being 'produced sooner' were creditworthy, while vague phrases such as pathogens being 'fought off quickly' were not.

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4.7.3.3 Land use

The function of white blood cells was generally well understood, and many students correctly described antibody production. However, credit for specificity required clarity that the antibodies produced were complementary or specific to the pathogen or its antigens. Simply stating that antibodies were produced was insufficient.

Confusion between antigens and antibodies was common and often affected the accuracy of responses. Overall, while the primary response was well described by most students, a lack of detail about the secondary immune response prevented many from progressing beyond Level 2. This question highlighted that the secondary immune response remains an area of weakness for many.

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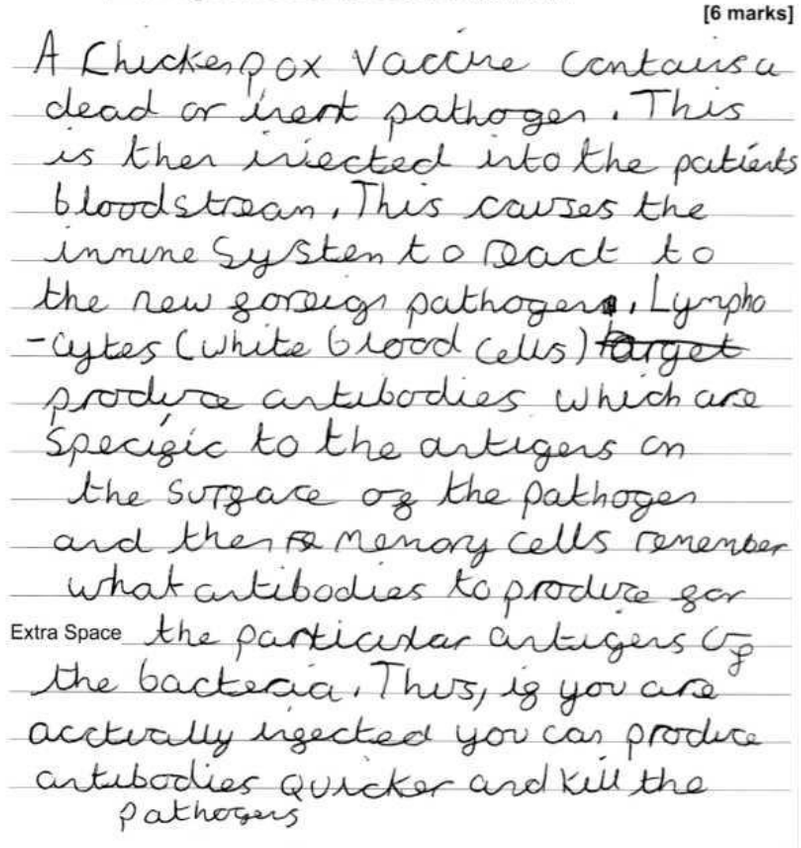
4.7.3.3 Land use

0 2 . 5 Explain how a vaccine for chickenpox gives immunity against the disease.

You should refer to how the body responds to:

- the vaccine
- chickenpox pathogens that enter the body after vaccination.

[6 marks]


A Chickenpox Vaccine contains a dead or inert pathogen. This is then injected into the patients bloodstream. This causes the immune System to react to the new foreign pathogens. Lympho -cytes (White blood cells) ~~target~~ produce antibodies which are Specific to the antigens on the surface of the pathogen and then memory cells remember what antibodies to produce for the particular antigens of the bacteria. Thus, if you are actually injected you can produce antibodies quicker and kill the pathogens

Extra Space

This response was awarded 4 marks but had the potential to reach 6 with slightly more detail. The initial explanation of what a vaccine is was ignored, as this was assessed in a previous question.
The student correctly states that white blood cells produce antibodies, which satisfies the requirements for Level 2 and earns 3 marks. They further add that the antibodies are specific to the antigens—this additional piece of indicative content increases the mark within Level 2.

Credit is given for the mention of memory cells, and the student continues by stating that antibodies are produced more quickly upon infection. While this begins to reference the secondary response, it lacks a second linked idea, such as explaining that pathogens are destroyed more rapidly. Had this been included, the response could have progressed into Level 3, with up to 6 marks awarded.

This example reflects a common pattern seen on the Higher Tier, students providing accurate information but not developing it fully enough to access the Level 3 marks.

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Question 3 (High demand)

03.1 58% of students were awarded the mark for this question.

03.2 This question differentiated well between students of varying ability. Most were able to gain the first two marks by correctly selecting two distances from the graph that doubled and applying the inverse square law. A small number of students selected distances that did not double, such as 10 cm and 60 cm, which prevented them from achieving the calculation marks.

A few students used the incorrect formula 1/d rather than $1/d^2$, resulting in no credit. Others referred to the rate of oxygen production rather than calculating light intensity, which was also not credited. However, the majority used the correct formula and expressed their answers in an acceptable form.

Stronger answers correctly stated that light intensity 'decreases by a factor of four' or an equivalent phrase. Many, however, gave only vague statements such as 'light intensity decreases as distance increases', which were insufficient. A small number incorrectly stated that intensity 'reduced by 25%'.

03.3 This question was generally well answered, with 54% of students achieving at least one mark. Many correctly described that an increase in temperature leads to a higher rate of photosynthesis or faster oxygen production. Responses referring to the 'rate of bubble production' were credited, as the bubbles were identified as oxygen in the figure. However, answers that only mentioned an increase in oxygen volume or used vague terms such as 'rate of reaction' without linking this to photosynthesis were not sufficient.

Although many students described an 'increase of energy', It was often unclear what had more energy and vague statements about an energy increase for 'the plant' were not creditworthy. The idea of *more frequent* collisions was generally not well described. Responses that referred only to collisions, without further qualification did not gain credit.

Overall, most students gained at least one mark. However, only a minority demonstrated the particle-level understanding required to achieve full marks.

03.4 This question was challenging, with only 37% of students gaining at least one mark. References to other limiting factors, such as carbon dioxide, were not credited.

Many students correctly stated that high temperatures lead to less oxygen production, but only those who linked this to enzyme denaturation gained full marks. Responses that referred vaguely to cells or pondweed being denatured were not accepted.

Incorrect answers often suggested that oxygen production would increase or remain unchanged. Some students gave irrelevant points about experiment accuracy, which were not creditworthy.

Overall, while many achieved partial marks, few used precise biological terminology or explained the cause-and-effect relationship needed for full credit.

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Question 4 (Standard and High demand)

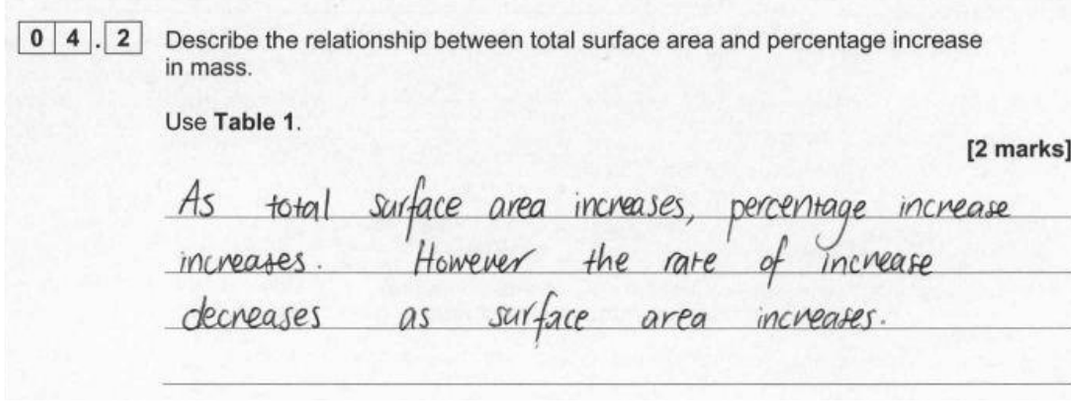
04.1 To gain credit, students needed to state that the potato pieces had different *starting* masses, making answers such as 'they have different mass', insufficient.

References to precision, accuracy, or comparability were not credited unless clearly linked to the variation in starting mass. Few students fully explained why using percentage change is more valid, with many giving vague responses such as 'more accurate' or 'more reliable'.

Some incorrectly attributed the use of percentage change to differences in surface area, which was not relevant. Others noted that it made results 'easier to compare', but did not go on to explain why.

04.2 This question was well answered, with 86% of students correctly identifying a positive correlation, stating that as surface area increases, the percentage increase in mass also increases.

A common error was the incorrect use of the term 'directly proportional', which was not credited as the relationship was not linear. Only 3% of students demonstrated higher-level understanding by noting that the rate of increase slowed, showing awareness of the diminishing trend in the data.


0 4 . 2 Describe the relationship between total surface area and percentage increase in mass.

Use **Table 1**.

[2 marks]

As total surface area increases, percentage increase increases. However the rate of increase decreases as surface area increases.

This is a rare response that was awarded 2 marks. The student successfully describes a decreasing rate, which meets the criteria for marking point 2. This level of detail and understanding was not commonly seen, as many students did not refer to the full pattern shown in the table.

04.3 To gain credit, students needed to state both the direction of water movement and name the process as osmosis. While most correctly identified osmosis, many omitted the direction of movement.

Explanations were credited if they described water moving from a high to low concentration of water, although this less precise wording often caused confusion. The preferred description was water moving from a dilute solution to a more concentrated solution across a partially permeable membrane. Statements referring to movement from low to high solute concentration were also accepted.

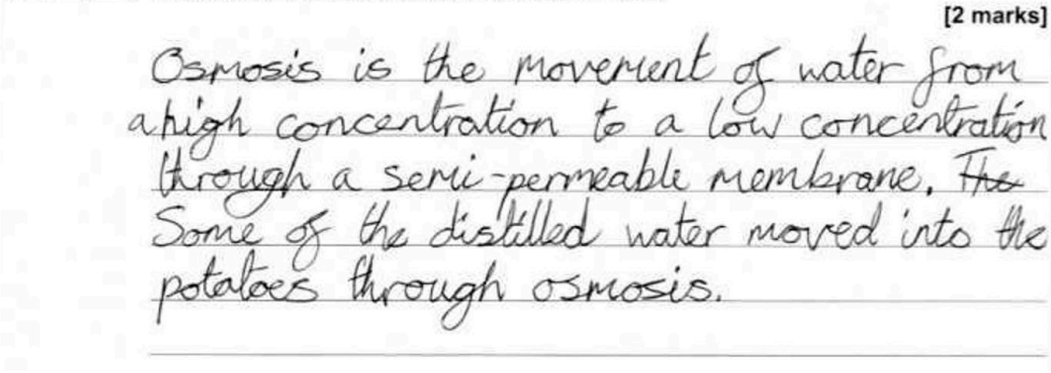
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4.7.3.3 Land use

Confusion about concentration remained common, with many students not distinguishing between water and solute concentration. Although most could name osmosis, unclear explanations of the gradient and movement direction often prevented full marks.

0 4 . 3 Explain why the potato pieces increased in mass.

[2 marks]


Osmosis is the movement of water from a high concentration to a low concentration through a semi-permeable membrane. ~~The~~ Some of the distilled water moved into the potatoes through osmosis.

This response was awarded 1 mark for a correct description of the movement of water into the potato by osmosis.
However, a common misconception is evident in the explanation that 'water moves from a high concentration to a low concentration.' While this is frequently seen, it lacks precision. The addition of 'water' before both references to concentration would have been acceptable, though not ideal.
This error highlights a widespread misunderstanding of the principles of osmosis, particularly in relation to concentration terminology.

04.4 This question was particularly challenging, with only 4% of students gaining any marks. It required application of knowledge about osmosis in a broader context.

Few students recognised that all potato pieces would eventually reach the same percentage change in mass after 24 hours. Many incorrectly stated that the pieces would have the same mass, showing misunderstanding of what percentage change represents.

Credit was also given for identifying that it is the potato *cells*, not the whole pieces or the potato, that becomes turgid.

Common misconceptions included the belief that concentrations would equalise, and osmosis would stop, that percentage change would increase indefinitely, or that cells would burst. The role of the cell wall in preventing bursting was rarely acknowledged.

Overall, this question highlighted significant gaps in students' understanding of osmosis, particularly in distinguishing between plant tissues and plant cells.

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4.7.3.3 Land use

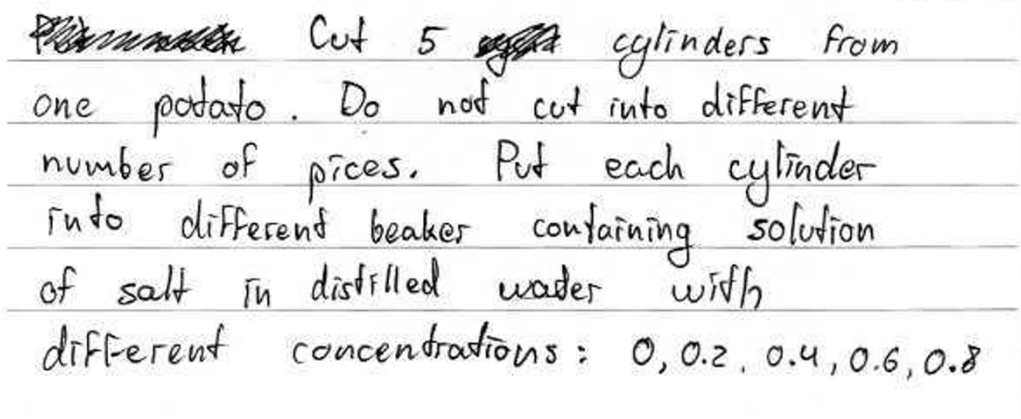
04.5 This question was poorly answered, with only 8% of students meeting both criteria. Many responses lacked precision and failed to clearly describe how the method should be adapted. Few students stated that the independent variable should be different concentrations of salt solution. References to at least three concentrations and the use of units such as g/dm^3 clarified that solutions, not masses of salt, were being tested. Vague statements such as 'add some salt to water' were not credited. Many students also failed to recognise that surface area needed to be replaced as the independent variable, often attempting to include both variables in the same method.

For controlling surface area, responses needed to state that all potato pieces should have the same surface area and not just the 'same size' or 'same shape' which were too vague. Students could also gain credit by stating that the cylinders should not be cut further or should be cut into the same number of pieces, as this implied control of surface area. Very few students addressed this point at all.

Overall, most responses demonstrated confusion around the concept of concentration and lacked the clarity required to access the marks.

Describe how the student could change the method to investigate the effect of salt concentration on potato tissue.

[2 marks]



This is a rare example of a 2-mark response. The student correctly refers to not cutting the pieces of potato, which demonstrates an understanding of the need to control the size and surface area of the samples. They also clearly state that different concentrations of salt solution were used, which shows an awareness of how to create the range of conditions needed to observe a pattern in mass change.

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Question 5 (Standard and High demand)

05.1 49% of students gained 1 mark on this question. 34% gained full marks for this question.

05.2 This question proved challenging, with 63% of students failing to achieve the mark. While many correctly identified the palisade layer, a wide range of incorrect responses was seen.

Common errors included confusing the palisade tissue with the upper epidermis, spongy mesophyll, or simply writing 'mesophyll', which was too vague to credit. Other incorrect answers suggested other plant tissues and sub-cellular structures.

Overall, the question highlighted that while some students had a good grasp of leaf anatomy, many lacked precise knowledge of the location and function of palisade tissue.

05.3 This question was challenging, with 62% of students failing to achieve any marks. It required understanding of the adaptations of palisade mesophyll tissue and how these relate to its role in photosynthesis. While some students identified one appropriate adaptation or function, few provided the full explanation needed for both marks.

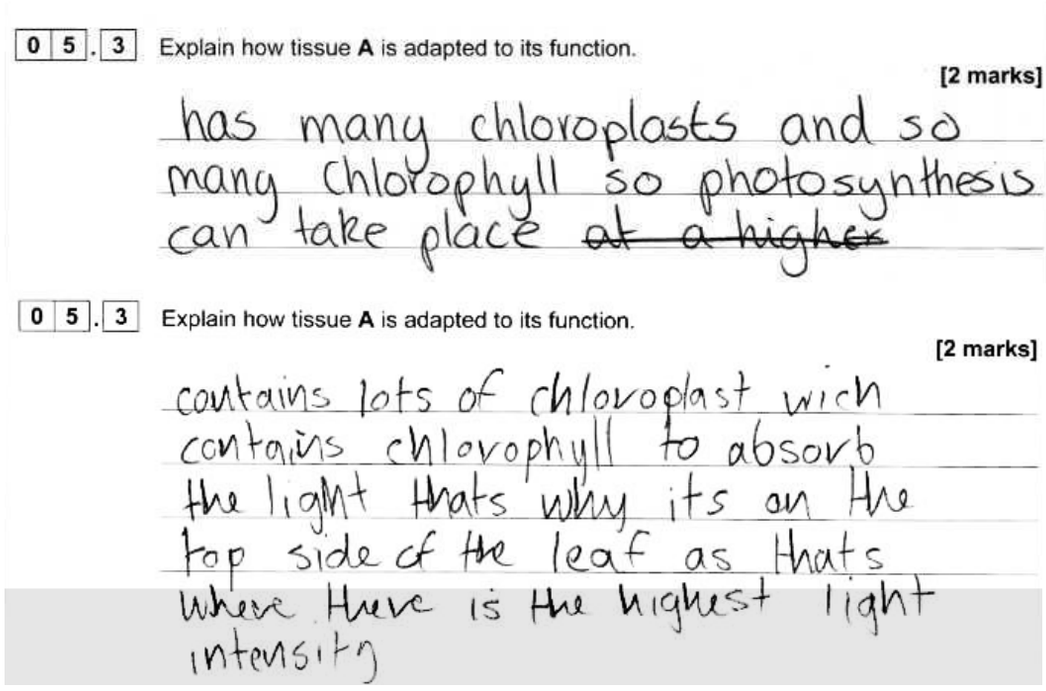
Many students correctly stated that the cells contain many chloroplasts or a large amount of chlorophyll. However, common errors included mentioning a 'large surface area', omitting the quantifier 'many', or failing to link the adaptation to its function. Responses such as 'contains chloroplasts for photosynthesis' were too vague, whereas answers specifying that the many chloroplasts absorb light for photosynthesis were awarded full credit.

Some students incorrectly described the position of the palisade cells at the top of the leaf or referred to unrelated processes such as water absorption or gas exchange. Confusion between palisade and spongy mesophyll tissues was also frequent.

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4.7.3.3 Land use

Source appendix · Full source examiner report



0 5 . 3 Explain how tissue **A** is adapted to its function.

[2 marks]

has many chloroplasts and so many chlorophyll so photosynthesis can take place ~~at a higher~~

0 5 . 3 Explain how tissue **A** is adapted to its function.

[2 marks]

contains lots of chloroplast wich contains chlorophyll to absorb the light thats why its on the top side of the leaf as thats where there is the highest light intensity

Two examples of responses that were both limited to 1 mark.

In the first example, the student is awarded for correctly stating that the cell contains many chloroplasts. However, further credit is not gained, as the response only references photosynthesis and does not specifically mention the absorption of light—an essential part of that marking point.

In the second example, the student is again awarded marking point 1 for correctly identifying the presence of many chloroplasts. This time, the student does mention light absorption but does not go on to link this to the process of photosynthesis.

In both cases, the students demonstrated partial understanding but did not provide enough detail to access full marks. This pattern was common across responses, where students often gave either the function (photosynthesis) or the mechanism (light absorption), but not both.

05.4 This question was challenging, with many students demonstrating only partial understanding. While 77% gained at least one mark, only 26% achieved three or more. Few were able to provide a full, coherent sequence of the pathway of water.

Most students gained credit for stating that water enters the root hair cells from the soil. However, answers that referred only to ‘roots’ or incorrectly described the process as active transport were not credited.

Fewer students successfully described water moving up the xylem, as many omitted the direction of flow or confused the xylem with the phloem, sometimes incorrectly referring to translocation instead of transpiration.

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References to water moving to the leaves were rare, with many responses diverting into discussions of photosynthesis, which was not relevant to the mark scheme.

Only a small number of students mentioned stomata or described their role in water leaving the leaf. Evaporation or transpiration as the final stage of water loss was more commonly stated, although it had to be correctly located to gain credit.

Overall, while the early and final stages of the process were better understood, students often lacked the precision and sequencing needed for full marks. This question highlighted persistent misconceptions about water transport and the role of specific plant structures.

Question 6 (High demand)

06.1 61% of students gained the mark for this question.

06.2 This question required students to apply their knowledge of ciliated cells in a new context. To gain credit, answers needed to describe the movement caused by the cilia (e.g. push, sweep, waft, pass through) and correctly identify what was being moved (e.g. egg, ovum, fertilised egg, or embryo). Phrases such as 'pass the egg through' were accepted, and incorrect references to the egg's destination were ignored. References to sperm were not credited.

Many students struggled, often confusing the roles of cilia and mucus. A common error was stating that cilia trap bacteria or pathogens, a function associated with mucus in the respiratory system rather than the oviduct.

06.3 Students generally performed well on this question, with 47% achieving full marks. Most were able to recall and correctly rearrange the equation, demonstrating strong mathematical skills.

The most common error was incorrect conversion from millimetres to micrometres, which prevented many from gaining the conversion mark. Some students also substituted values incorrectly, leading to an incorrect final answer.

Overall, performance was good, and many students showed confidence with both standard form and the calculation process. Clear working remains important, as it allows credit to be given for correct steps even when the final answer is incorrect. Students should also cross out incorrect attempts to make their reasoning clear.

06.4 This question proved difficult for many students, as it required clear application of knowledge about oxygen transport and respiration.

Many recognised that anaemia reduces oxygen transport but often used vague phrasing such as 'less oxygen is taken to the body', which was not credited. To gain the mark, answers needed to specify that oxygen was not reaching cells, muscles, or another specific destination. Irrelevant organs, such as the liver, and absolute statements like '*no* oxygen is taken to the cells' were not accepted.

Fewer students successfully identified the shift to anaerobic respiration and the associated production of lactic acid. Responses that referred only to 'less energy' or 'less aerobic respiration' were insufficient, and mentioning anaerobic respiration without lactic acid was also insufficient.

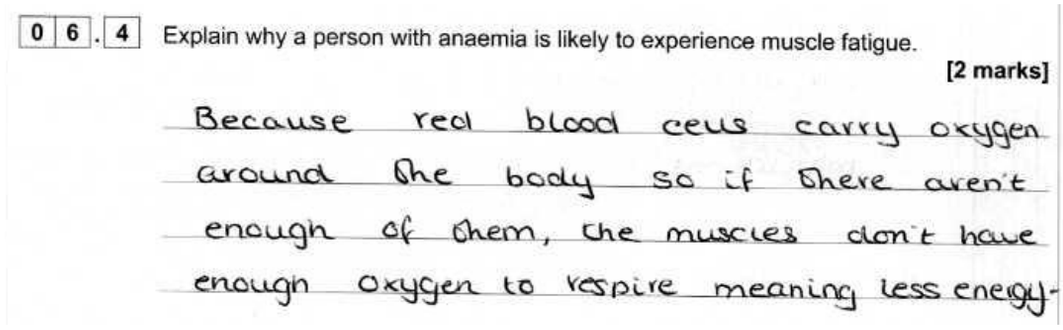
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4.7.3.3 Land use

Overall, while many students understood the initial effect of reduced oxygen transport, few linked this to the physiological consequences of anaerobic respiration, revealing gaps in applying respiration knowledge in unfamiliar contexts.

0 6 . 4 Explain why a person with anaemia is likely to experience muscle fatigue.

[2 marks]



This response was awarded 1 mark. The student correctly identifies that less oxygen reaches the muscles. A more general statement such as 'less oxygen to the body' would not have been sufficient at this level.
However, the student does not mention anaerobic respiration or the production of lactic acid, both of which were required to achieve further credit. This reflects a common issue where students recognise the reduction in oxygen delivery but do not link it to the consequences on respiration.

06.5 This question was generally well answered, with 67% of students gaining full marks. Many demonstrated strong mathematical skills and successfully applied standard form.

The most common errors were in the percentage calculation, which led to incorrect final answers despite correct method or structure. Magnitude errors, often caused by misplacing zeros, were also frequent.
Students who made calculation errors but correctly expressed their answer in standard form were often able to gain partial credit.

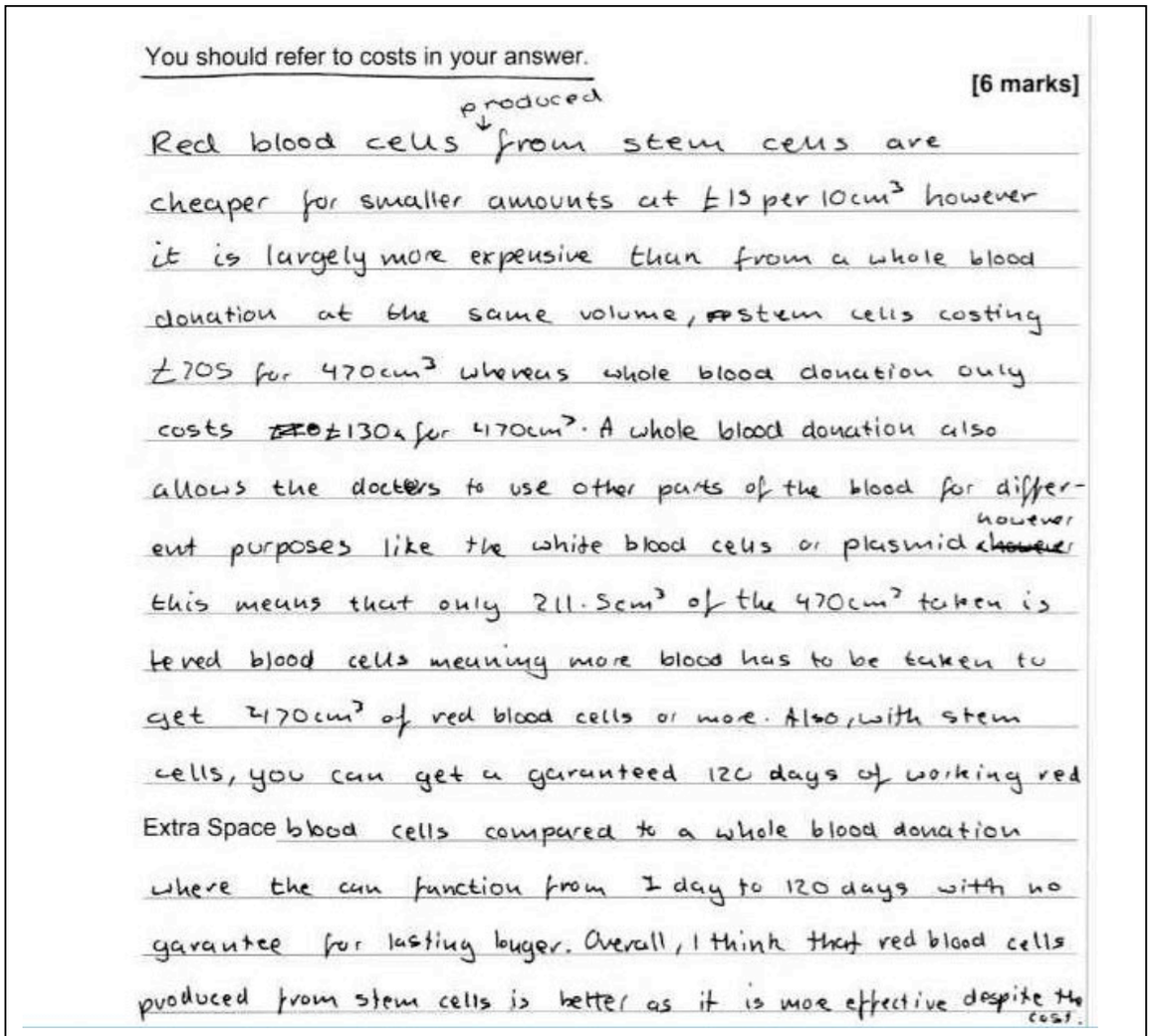
06.6 Most students (83%) accessed Level 1 by identifying relevant points, 47% reached Level 2, but only 1% achieved Level 3. The question highlighted weaknesses in data interpretation, comparative reasoning, and structuring evaluations.

Many students correctly identified advantages of stem cell-derived red blood cells, including longer shelf life, smaller sample requirements, and lower risk of infection. Some gained credit by framing these as disadvantages of whole blood donation. However, many answers simply re-stated information from the table without comparison or explanation.

Disadvantages of stem cells were rarely mentioned. While cost was often noted, few students developed this point or compared it effectively with the lower cost of whole blood donation. Misconceptions were common, particularly references to ethical concerns about embryonic stem cells, which were not relevant in this context. Few students recognised benefits such as reduced risk of rejection or potential advantages for patients with rare blood types.

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4.7.3.3 Land use



You should refer to costs in your answer.

[6 marks]

Red blood cells produced from stem cells are cheaper for smaller amounts at £15 per 10cm³ however it is largely more expensive than from a whole blood donation at the same volume, ~~#~~stem cells costing £705 for 470cm³ whereas whole blood donation only costs ~~£0~~£130 for 470cm³. A whole blood donation also allows the doctors to use other parts of the blood for different purposes like the white blood cells or plasmid ~~however~~ however this means that only 211.5cm³ of the 470cm³ taken is red blood cells meaning more blood has to be taken to get 470cm³ of red blood cells or more. Also, with stem cells, you can get a garanteed 120 days of working red blood cells compared to a whole blood donation where the can function from 1 day to 120 days with no garantee for lasting longer. Overall, I think that red blood cells produced from stem cells is better as it is more effective despite the cost.

Extra Space

This is a rare example of a response that was awarded 5 marks.

The student correctly states that red blood cells produced from stem cells are more expensive and identifies the specific cost as £705, meeting two of the cost-related points.

They then note that whole blood donation includes other components, such as white blood cells, and despite the incorrect reference to plasma, this is accepted as being in line with the indicative content principles. The student also explains that these additional components can be used for different purposes. This was sufficient to award credit relating to the advantages of whole blood donation.

The response continues with an extended discussion about the lifespan of different types of blood cells. Although somewhat lengthy, the student eventually makes the point that red blood cells derived from stem cells last longer—earning credit for an advantage of stem cell blood.

In total, this response gained credit for cost-related points, advantages of whole blood donation, and an advantage of stem cell blood. Had the student included a further distinct advantage of stem cell blood, they would have been awarded the full 6 marks.

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4.7.3.3 Land use

Cost evaluation was key to higher marks. Many students performed calculations correctly, allowing progression beyond Level 1, but errors occurred when comparing unequal volumes. Correct intermediary calculations were still credited.

Overall, while most students identified some valid points, only a very small proportion produced well-developed evaluations supported by data analysis.

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4.7.3.3 Land use

Contact us

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

Tel: 01483 477756
Email: gcsescience@aqa.org.uk

aqa.org.uk

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