AQA GCSE Biology | 8461

SPECIFICATION POINT 4.4.2.1

Aerobic and anaerobic respiration

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**21**
Available paper years	**2009–2025**

Using this booklet

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

Name: _____ **Date:** _____

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

4.4.2.1 Aerobic and anaerobic respiration

Answer 01 · Mark scheme

January 2009 | BLY3H | Original Q5 | Legacy

question	answers	extra information	mark
5(a)(i)	glucose **and** galactose		1
5(a)(ii)	any **three** from: Evidence: • absorption reduced by cyanide • absorb faster (than other sugars) Explanation: • active transport needs <u>energy</u> • less / no <u>energy</u> available / released if cyanide is there **or** less / no <u>energy</u> if no / less respiration	allow converse allow <u>energy</u> produced ignore cyanide prevents respiration	3
5(b)	all / the sugars / they can be absorbed <u>when gut poisoned</u> / <u>with cyanide</u> **or** <u>when no respiration</u> (diffusion) does not need an <u>energy</u> supply		1 1
Total			**6**

4.4.2.1 Aerobic and anaerobic respiration

Answer 01 · Mark scheme January 2009 | BLY3H | Original Q5 | Legacy

COMPONENT NUMBER: BLY3H

COMPONENT NAME: Biology

STATUS: Final

DATE: January 2009

Answer 02 · Mark scheme March 2010 | BLY1BP | Original Q7 | Legacy

Seven	**2**	**3**	**4**	**3**

4.4.2.1 Aerobic and anaerobic respiration

Answer 03 · Mark scheme

June 2019 | BLY2H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	20		1
2(a)(ii)	one tenth / 0.1 / 10% / 1:9 / 1 in 10 / 1 out of 10 / $\frac{1}{10}$	for correct answer irrespective of working ignore any units accept equivalent fractions eg $\frac{4}{40}$ / $\frac{2}{20}$ do **not** allow eg 1:10 / 1 to 10 if answer is incorrect clear selection of 2 **and** 20, **or** equivalent **or** 1:4:5 / 1:5:4 gains **1** mark	2
2(b)	any **two f**rom: • (body) heat / maintaining body temperature • movement (max 2) • growth / cell division / repair / reproduction / building molecules • accept active transport	do **not** accept sweating / cooling / excretion allow keep warm allow **2 different** examples of movement, internally and / or externally eg breathing / exercise / eating / circulation allow muscle contraction if no other muscle action is credited movement + breathing = 1 mark allow examples eg making proteins (from amino acids) ignore 'chemical reactions' / digestion	2

Question 2 continues on the next page

4.4.2.1 Aerobic and anaerobic respiration

BLY 2H

Question 2 continued

question	answers	extra information	mark
2(c)	more movement / have to hunt / catch food	allow converse if stated for herbivore eg herbivores food is all around ignore reference to size **or** predator unqualified	1
2(d)	any **two** from • less movement • less heat loss • less respiration	ignore reference to food allow no movement allow less space to move ignore less space unqualified allow no heat loss **or** they are kept warm	2
Total			**8**

4.4.2.1 Aerobic and anaerobic respiration

Answer 03 · Mark scheme

June 2010 | BLY2H | Original Q2 | Legacy

BLY 2H

4.4.2.1 Aerobic and anaerobic respiration

Answer 04 · Mark scheme

June 2010 | BLY2H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	B and D	both required in any order	1
3(b)	any **two** from: • carbohydrate / named example • protein / enzyme • amino acid • hormone / named plant hormone • lipid / fat / oil / wax • chlorophyll • DNA • vitamin(s)	do **not** accept compounds restricted to animals allow **2** marks for 2 named examples do **not** allow a general name and a named example for **2** marks (eg award **1** mark only for carbohydrate and starch) allow **2** marks for 2 named examples	2
3(c)	contains minerals / salts / ions / nutrients / named (needed by plants) for health / better growth	ignore 'food' do **not** allow vitamins / glucose / energy etc for / help plant growth is insufficient ignore moisture retention / soil structure ignore more plants allow examples linked to mineral eg contains magnesium to make chlorophyll for **2** marks	1 1
Total			**5**

4.4.2.1 Aerobic and anaerobic respiration

Answer 04 · Mark scheme

June 2010 | BLY2H | Original Q3 | Legacy

BLY 2H

4.4.2.1 Aerobic and anaerobic respiration

Answer 05 · Mark scheme

June 2010 | BLY3H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	A = (cell) wall B = cytoplasm	ignore cellulose	1 1
1(a)(ii)	any **one** from • bacterial cell / it has no nucleus • DNA free in cytoplasm • has no vacuole / no vesicles	 accept has DNA instead of a nucleus but **not** just has DNA allow no mitochondria ignore size ignore strands of DNA	1
1(b)(i)	yeast grows best / better / well **or** optimum temperature for yeast / more yeast present CO_2 made(by yeast) **or** respires / respiration (by yeast)	allow yeast works best / better / well allow fermentation (ignore anaerobic/aerobic)	1 1
1(b)(ii)	bacterium grows best / better / well / more bacteria present **or** optimum temperature for bacterium (lactic) acid made (by bacterium)	ignore micro organism / microbes allow works / respires best / better / well (ignore anaerobic/aerobic) do **not** allow wrong acid	1 1
1(b)(iii)	bread still rises (in acid conditions) **or** no need to control / monitor pH		1
Total			**8**

4.4.2.1 Aerobic and anaerobic respiration

Answer 05 · Mark scheme

June 2010 | BLY3H | Original Q1 | Legacy

BLY 3H

4.4.2.1 Aerobic and anaerobic respiration

Answer 06 · Mark scheme June 2010 | BLY3H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	without <u>oxygen</u>	ignore reference to air	1
3(a)(ii)	otherwise difficult to stir / to pump / to transfer	allow prevent 'clogging' owtte	1
3(a)(iii)	need to stir / pump / heat		1
3(b)(i)	rises then falls then levels / slight rise quantitative descriptor eg to 80% / max. on day 4 / min. on day 16	 accept other valid quantitative descriptor allow accuracy ± $\frac{1}{2}$ small square	1 1 1
3(b)(ii)	16 (15.5 to 16.4)		1
3(c)	oxygen present (CO_2 produced) by <u>aerobic</u> respiration **or** not much <u>anaerobic</u> respiration **or** not much methane / CH_4 produced		1 1
Total			**9**

4.4.2.1 Aerobic and anaerobic respiration

Answer 06 · Mark scheme

June 2010 | BLY3H | Original Q3 | Legacy

BLY 3H

4.4.2.1 Aerobic and anaerobic respiration

Answer 07 · Mark scheme January 2011 | BLY3H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	carbohydrase	allow correct named example eg amylase / maltase	1
4(a)(ii)	fermentation / <u>an</u>aerobic respiration	accept alcoholic fermentation	1
4(b)	any **three** from: • ethanol renewable / can be re-made **or** petrol non-renewable / can't be re-made • maize / plants / photosynthesis takes in <u>CO_2</u> • (ethanol) causes less increase / no increase in CO_2 concentration in the atmosphere **or** (ethanol) is carbon neutral • (ethanol) has less effect / no effect on climate / on global warming	accept converse for petrol ignore ethanol gives off less CO_2 accept converse for petrol accept correct reference to named pollutant / effect from petrol	3
Total			**5**

4.4.2.1 Aerobic and anaerobic respiration

Answer 07 · Mark scheme

January 2011 | BLY3H | Original Q4 | Legacy

BLY3H

4.4.2.1 Aerobic and anaerobic respiration

Answer 08 · Mark scheme

June 2011 | BLY2H | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)	16	accept correct answer for **2** marks, irrespective of working if no answer **or** answer incorrect accept 0.64 x 100 / 4 (.0) **or** 0.16 for **1** mark	2
8(b)	insect cold-blooded / not warm blooded **or** does not control body temperature	accept mammal warm-blooded / constant (high) body temperature / controls body temperature	1
	reference to insect 0.96 (kJ) **and** mammal 12.25 (kJ) transferred by respiration **or** relevant calculation of this transfer	ignore references to other data	1
	(less respiration) so more energy / biomass / food available (for growth of insect)	(more respiration) so less energy / biomass / food available (for growth of mammal)	1
Total			**5**

The AQA UMS Conversion Calculator is available on the Results statistics page of the AQA Website

4.4.2.1 Aerobic and anaerobic respiration

Answer 09 · Mark scheme

June 2011 | BLY3H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5	D – many microvilli (1) Ex – provide large surface area (1) D – many capillaries / good blood supply (1) Ex – maintain concentration / diffusion gradient **or** quickly removes food (1) D – thin wall / one cell thick surface / capillaries near surface (1) Ex – short distance for food to travel (1) D – many mitochondria (1) Ex – provide energy / ATP for active uptake / transport (1)	**five** points made max **3** descriptions max **3** explanations allow villi are thin ignore villi are one cell thick	max 5
Total			**5**

4.4.2.1 Aerobic and anaerobic respiration

Answer 09 · Mark scheme

June 2011 | BLY3H | Original Q5 | Legacy

BLY3H

4.4.2.1 Aerobic and anaerobic respiration

Answer 10 · Mark scheme

January 2013 | BL2HP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	mitochondrion / mitochondria	must be phonetically correct	1
3(a)(ii)	carbon dioxide / CO_2 water / H_2O	in either order accept CO2 but **not** CO^2 accept H2O **or** HOH but not H^2O	1 1
3(a)(iii)	diffusion high to low concentration through (cell) membrane **or** through cytoplasm	 allow down a concentration gradient do **not** accept cell wall	1 1 1
3(b)	ribosomes make proteins / enzymes using amino acids part A / mitochondria provide the energy for the process	 allow ATP do **not** accept produce or make energy	1 1 1
Total			9

4.4.2.1 Aerobic and anaerobic respiration

Answer 10 · Mark scheme

January 2013 | BL2HP | Original Q3 | Legacy

BL2HP

4.4.2.1 Aerobic and anaerobic respiration

Answer 11 · Mark scheme

June 2013 | BL2HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	A = cytoplasm B = (cell) membrane		1 1
4(b)	in yeast: makes alcohol / makes CO_2 / does not make lactic acid	'it' equals yeast do not allow uses / involves alcohol / CO_2	 1
4(c)(i)	any **two** from: • volume of yeast / suspension • volume of sugar / solution • concentration of sugar • temperature	 allow amount of yeast amount of sugar = max 1 for sugar (total) volume = 1 mark if no other volume ignore concentration of yeast	2
4(c)(ii)	most / more CO_2 given off with fructose **or** faster CO_2 production **or** faster respiration so (rate of) alcohol production will be greatest / more (with fructose)	'it' equals fructose allow faster fermentation do **not** allow aerobic respiration	1 1
Total			**7**

4.4.2.1 Aerobic and anaerobic respiration

Answer 12 · Mark scheme June 2014 | BL2HP | Original Q3 | Legacy

3(a)	anaerobic respiration	allow phonetic spelling	1	AO1 2.6.2a, b,d
3(b)(i)	4.4	4.2, 4.3, 4.5 or 4.6 with figures in tolerance (6.7 to 6.9 and 2.3 to 2.5) and correct working gains 2 marks 4.2, 4.3, 4.5 or 4.6 with no working shown or correct working with one reading out of tolerance gains 1 mark correct readings from graph in the ranges of 6.7 to 6.9 **and** 2.3 to 2.5 but no answer / wrong answer gains 1 mark	2	AO2 2.6.2a, b,d
3(b)(ii)	more energy is needed / used / released (at 14 km per hour) not enough oxygen (can be taken in / can be supplied to muscles) so more anaerobic respiration (to supply the extra energy) **or** more glucose changed to lactic acid	do **not** allow energy production ignore work allow reference to oxygen debt do **not** allow less / no oxygen allow not enough aerobic respiration	1 1 1	AO1 / AO2 2.6.2a, b,d
Total			**6**	

4.4.2.1 Aerobic and anaerobic respiration

Answer 12 · Mark scheme

June 2014 | BL2HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / spec ref.

4.4.2.1 Aerobic and anaerobic respiration

Answer 13 · Mark scheme

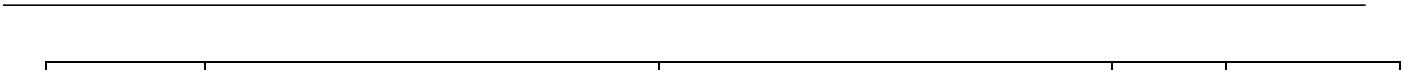
June 2015 | BL1HP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	photosynthesis		1	AO2 1.6.1a/1.6.2a
2(b)(i)	140		1	AO2 1.6.1d/ 1.6.2a
2(b)(ii)	(10 billion tonnes) more added (to atmosphere) than removed	allow ecf from part (b)(i)	1	AO2 1.6.1d/ 1.6.2a
Total			**3**	

4.4.2.1 Aerobic and anaerobic respiration

Answer 13 · Mark scheme

June 2015 | BL1HP | Original Q2 | Legacy



4.4.2.1 Aerobic and anaerobic respiration

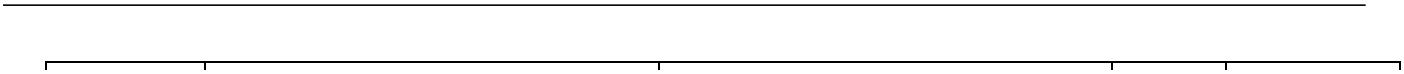
Answer 14 · Mark scheme June 2015 | BL3HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	fungus		1	AO1 344d
1(a)(ii)	oxygen / O_2	accept air accept O_2 do **not** allow O^2/ O / O2	1	AO2 344d
1(a)(iii)	glucose (syrup)	allow carbohydrate / sugar ignore food / starch allow oxygen if oxygen / air not given in (a)(ii)	1	AO1 344d
1(b)	any **two** from: • quicker • suitable for vegetarians • cheaper • more efficient **or** less land / methane	ignore high in protein ignore sustainability unqualified ignore less pollution unqualified allow less animals harmed / killed allow food chain is shorter **or** has less trophic levels allow less energy lost (from the food chain) do **not** allow no energy lost allow low(er) in calories (than some meat) allow low(er) in fat / healthier (than some meat) allow source of fibre / prevent constipation	2	AO3 344a/d
Total			**5**	

4.4.2.1 Aerobic and anaerobic respiration

Answer 14 · Mark scheme

June 2015 | BL3HP | Original Q1 | Legacy



4.4.2.1 Aerobic and anaerobic respiration

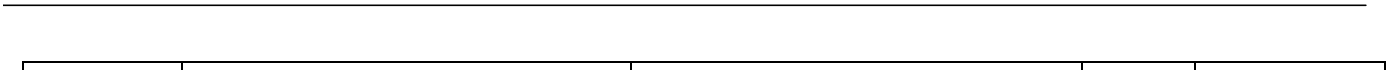
Answer 15 · Mark scheme June 2016 | BL2HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	without <u>oxygen</u>	allow not enough oxygen ignore air ignore production of CO_2 ignore energy	1	AO1 2.6, 2.6.2a
1(a)(ii)	more/high/increased lactic acid (at end)	allow approximate figures (to show increase) ignore reference to glucose	1	AO3 2.6, 2.6.2b
1(b)(i)	1.5	allow only 1.5 / 1½ / one and a half	1	AO3 2.6, 2.6.1g/h
1(b)(ii)	increases at first **and** levelling off suitable use of numbers eg rises to 10 / by 9 (dm^3 per min) **or** increases up to 1.5 (min) / levels off after 1.5 (min) (of x axis timescale) **or** after the first minute (of the run)	ignore subsequent decrease allow answer in range 1.4 to 1.5	1 1	AO2 2.6, 2.6.1g/h
1(b)(iii)	supplies (more) oxygen supplies (more) glucose for (more) respiration releases (more) energy (for muscle contraction)	need 'more/faster' once only for full marks allow removes (more) CO_2 /lactic acid / heat as an alternative for either marking point one **or** two, **once** only do **not** allow energy production or **for** respiration	1 1 1 1	AO1 2.6.1b/e/f/g/h 2.6.2d
Total			**9**	

4.4.2.1 Aerobic and anaerobic respiration

Answer 15 · Mark scheme

June 2016 | BL2HP | Original Q1 | Legacy



4.4.2.1 Aerobic and anaerobic respiration

Answer 16 · Mark scheme June 2017 | BL1HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	idea that sexual reproduction results in genetic variation	allow converse if clearly referring to asexual reproduction allow reference to natural selection / evolution (if conditions change)	1	AO1 1.7.2a
7(b)(i)	any **four** from: • nucleus taken from egg (cell) (of female) **A or** cytoplasm (and membrane) discarded • nucleus removed / discarded from egg (cell) (from female) **B or** only cytoplasm (and membrane) kept • nucleus from **A** inserted into (enucleated / empty cell / cytoplasm from) egg (cell) (of female) **B** • fertilised / fertilisation (of 'hybrid' cell) • electric shock (after fertilisation) **or** grown into embryo	accept throughout: female **A** = person with faulty mitochondria female **B** = person without faulty mitochondria allow egg and sperm fuse allow cell division / mitosis	4	AO1/3 1.7.2a/c
7(b)(ii)	idea of cytoplasm / mitochondria of 'hybrid' / fertilised cell / embryo comes from cell / female / B with 'normal' mitochondria **OR** only the nucleus is used from A (1) the nucleus does not contain mitochondria **or** these faulty genes (1)		1 1	AO2 1.7.2c

4.4.2.1 Aerobic and anaerobic respiration

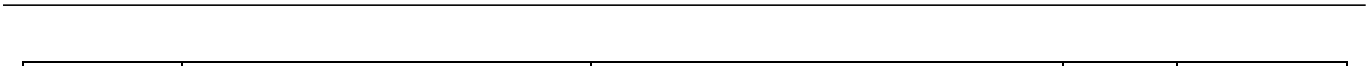
Answer 16 · Mark scheme

7(b)(iii)	any **one** from: • idea that child has unknown parentage **or** 3 parents • against religious beliefs / teachings • could cause (more) prejudice (against people with perceived imperfection)	ignore ref to unethical / immoral ignore ref to being against religion / God's will unqualified	1	AO3 1.7
Total			**8**	

4.4.2.1 Aerobic and anaerobic respiration

Answer 16 · Mark scheme

June 2017 | BL1HP | Original Q7 | Legacy



4.4.2.1 Aerobic and anaerobic respiration

Answer 17 · Mark scheme November 2021 | 8461/1H | Original Q4

04.1	$6O_2 + C_6H_{12}O_6 \rightarrow 6H_2O + 6CO_2$		1	AO1 4.4.2.1
04.2	mitochondria / mitochondrion		1	AO1 4.1.1.2
04.3	any **two** from: • movement / muscle contraction • keeping warm • active transport • building larger molecules	ignore reference to metabolism unqualified allow examples of movement allow examples of building larger molecules e.g. making (named) proteins / cellulose allow cell division ignore growth	2	AO1 4.4.2.1 4.4.2.3
04.4	any **two** from: • anaerobic produces lactic acid **and** aerobic does not • aerobic produces carbon dioxide **and** anaerobic does not • aerobic produces water **and** anaerobic does not • aerobic occurs (mainly) in the mitochondria **and** anaerobic does not • anaerobic releases less energy than aerobic	allow anaerobic creates an oxygen debt **and** aerobic does not allow anaerobic **only** occurs in the cytoplasm allow anaerobic releases less ATP (than anaerobic) do **not** accept anaerobic produces / makes / creates less energy	2	AO1 4.4.2.1
04.5	carbon dioxide ethanol		1 1	AO1 4.4.2.1

4.4.2.1 Aerobic and anaerobic respiration

Answer 17 · Mark scheme

04.6	pondweed takes in CO_2 for photosynthesis snail **and** pondweed are respiring producing CO_2	 if no other mark awarded allow rate of respiration = rate of photosynthesis for **1** mark	1 1	AO2 4.4.2.1 4.4.1.1
04.7	(no light so) no photosynthesis **or** plant is not taking in CO_2 **and** snail **and** plant are respiring and so are releasing CO_2		1	AO2 4.4.2.1 4.4.1.1
04.8	snail is being decayed / decomposed / broken down (by) decomposers / bacteria (in pond water / snail) (therefore) respiration (of decomposers / bacteria) releases CO_2	ignore being fed on allow fungi / microbes / microorganisms do **not** accept anaerobic respiration	1 1 1	AO3 AO2 AO3 4.7.2.2 4.4.2.1
Total			**14**	

4.4.2.1 Aerobic and anaerobic respiration

Answer 17 · Mark scheme

November 2021 | 8461/1H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.

4.4.2.1 Aerobic and anaerobic respiration

Answer 18 · Mark scheme

June 2023 | 8461/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.1	any **two** from: • *(effect)* muscle fatigue **or** oxygen debt occurs (1) *(reason)* caused by (build-up of) lactic acid (1) • *(effect)* (continued) heavy / deep / fast breathing (1) *(reason)* to provide the oxygen needed to break down (built-up) lactic acid (1) • *(effect)* (continued) increased heart rate (1) (*reason)* to provide the oxygen needed to break down (built-up) lactic acid (1) • *(effect)* fewer / weaker muscle contractions (1) *(reason)* (because) less energy is released / available (1)	mark as pairs allow muscle cramp ignore fatigue / cramp unqualified allow to repay the oxygen debt allow to repay the oxygen debt do **not** accept energy being produced / made / created	4	AO1 4.4.2.1 4.4.2.2

4.4.2.1 Aerobic and anaerobic respiration

Answer 18 · Mark scheme

June 2023 | 8461/1H | Original Q4

Question	Answers	Mark	AO / Spec Ref.
04.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5-6	AO3 4.4.2.2
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3-4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2	
	No relevant content.	0	
	Indicative content • test a group of athletes • use at least two different types / intensities of exercise • get each athlete to do all exercises **or** have a large (≥30) group doing each exercise • record heart rate for each athlete before and after exercise **or** calculate increase in heart rate for each athlete after exercise • calculate the mean increase in heart rates for each type / intensity of exercise • compare mean increase in heart rates for each type / intensity of exercise • control variables: o same (biological) sex **or** mix of sexes o same level of activity / exercise o same age o same caffeine / drug / medicine intake o same length of time for exercise o no health issues / illnesses o return to resting heart rate before each exercise		

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.3	(athlete is) faster / stronger	allow description of improved performance allow reference to increased stamina / endurance	1	AO2 4.4.2.1 4.4.2.2
	(because more muscle mass so) more / stronger muscle contractions		1	

4.4.2.1 Aerobic and anaerobic respiration

Answer 18 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.4	hybridoma		1	AO1 4.3.2.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.5	any **three** from: • (cell) is cloned • many (identical) cells are produced • all the cells make the same antibody • the antibody is (collected and) purified	 ignore name of cell allow many clones are produced	3	AO1 4.3.2.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.6	a monoclonal antibody only binds to the anabolic steroid		1	AO2 4.3.2.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.7	to show that the test is working	allow to prevent a false negative (result) ignore to show there are free / remaining monoclonal antibodies	1	AO3 4.3.2.1 4.3.2.2

4.4.2.1 Aerobic and anaerobic respiration

Answer 18 · Mark scheme

June 2023 | 8461/1H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.8	*evidence* no blue / visible dye (in control area) *reason* (because) no (free) monoclonal antibodies bound to control area **or** (because) there were no (free) monoclonal antibodies on the end of the (test) strip	allow no line(s) (in control area) allow no colour change (in control area) allow the (free) monoclonal antibodies did not move up the test strip allow urine did not move up the test strip	1 1	AO3 4.3.2.1 4.3.2.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.9	D		1	AO3 4.3.2.1 4.3.2.2

Total Question 4	21

4.4.2.1 Aerobic and anaerobic respiration

Answer 19 · Mark scheme

June 2023 | 8461/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.1	(0 to 6h): in the dark so (only) respiration occurs	ignore reference to animals allow no / limited light so (only) respiration occurs allow night(time) so (only) respiration occurs	1	AO2 4.7.1.2 4.7.2.2 4.4.1.2 4.4.2.1
	(respiration) produces carbon dioxide		1	
	(8 to 12h): in the light so photosynthesis (rate) is faster than respiration (rate)	allow in the light so more photosynthesis than respiration allow day(time) so more photosynthesis than respiration do **not** accept no respiration	1	
	idea of net / overall uptake of carbon dioxide	allow uptake of carbon dioxide by photosynthesis is greater / faster than output by respiration	1	

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.2	field of maize only takes in carbon dioxide for 6 months of the year (compared to all year)	answers must be comparative allow converse argument allow maize takes in carbon dioxide for a shorter amount of time	1	AO3 4.7.2.4 4.7.3.4 4.7.3.3
	(and) field of maize takes in less carbon dioxide per day than rainforest		1	

4.4.2.1 Aerobic and anaerobic respiration

Answer 19 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.3	for comparison		1	AO2
	(because) different areas started with different numbers (of species)	do **not** accept (because) different areas started with different numbers of trees	1	AO3 4.7.2.4 4.7.3.1 4.7.3.4 4.7.3.6 4.7.3.3

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.4	any **one** from: • number of tree species increased rapidly at first • the number of tree species increases more slowly later • rate of increase of number of tree species decreases with time • beyond about 50 years there were more tree species than in the original rainforest • there was (great) variability of number of tree species from one study area to another at the same time	ignore answers referring to numbers of trees unqualified allow it takes 45 to 55 years for the forest to recover (the number of species) ignore biodiversity increases	1	AO3 4.7.2.4 4.7.3.1 4.7.3.6 4.7.3.3

4.4.2.1 Aerobic and anaerobic respiration

Answer 19 · Mark scheme June 2023 | 8461/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.5	more / different types of food available more / different types of habitat / shelter **or** nest sites available	ignore more food available allow more / different habitats	1 1	AO2 4.7.2.4 4.7.3.1 4.7.3.6 4.7.3.3

Total Question 6	**11**

4.4.2.1 Aerobic and anaerobic respiration

Answer 20 · Mark scheme

June 2024 | 8461/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.1	46 000 **or** 16 400 **or** 12.8 **or** 0.8		1	AO2 4.7.2.1 4.7.4.3 4.7.5.2
	46 000 **and** 16 400 **or** 262 400		1	
	46 000 **and** 209 920 **or** 3593.75		1	
	2191.3 **or** $\frac{46\,000 \times 10\,000}{209\,920}$ **or** $\frac{3593.75 \times 10\,000}{16\,400}$		1	
	2190		1	

4.4.2.1 Aerobic and anaerobic respiration

Answer 20 · Mark scheme June 2024 | 8461/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.2	suitable scale, symmetrical around 0 labels for *x*-axis **and** for bars correct values plotted: chickens 2200 maize 4200	 (biomass in) kg (bars) maize and chickens allow a tolerance of ±½ small square ignore height of bars	1 1 1	AO2 4.7.4.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.3	2200 4200 = 0.5238… : 1 **or** 11 : 21 **or** 1 : 1.9	 allow rounded value	1 1	AO2 4.7.4.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.4	lost via egestion / faeces	ignore urine / excretion / waste ignore not digested do **not** accept respiration do **not** accept not eaten do **not** accept movement **or** as heat **or** for keeping warm	1	AO1 4.7.4.3

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.5	lysine and tryptophan		1	AO3 4.4.2.3 4.7.5.2

4.4.2.1 Aerobic and anaerobic respiration

Answer 20 · Mark scheme

June 2024 | 8461/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.6	any **one** from: • chickens need low amounts of leucine (for growth) • (chicken) proteins contain low amount / proportion of leucine	do **not** accept leucine is not needed (for growth)	1	AO3 4.4.2.3 4.7.5.2

Total Question 7	13

Question 5

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.1	(to) transport / carry hormones / antibodies / proteins / ions / enzymes / urea / glucose / carbon dioxide	allow (to) transport / carry other correctly named substances allow (to) transport / carry platelets ignore nutrients / waste / oxygen	1	AO1 4.2.2.3

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.2	*recall of equation* magnification = $\frac{\text{size of image}}{\text{size of real object}}$	allow magnification = $\frac{\text{diameter of image}}{\text{diameter of real object}}$ ignore use of equation triangle	1	AO1
	rearrangement of equation size of real object = $\frac{\text{size of image}}{\text{magnification}}$	allow diameter of real object = $\frac{\text{diameter of image}}{\text{magnification}}$	1	AO2
	substitution $\frac{6.3}{7200}$	allow substitution of incorrectly converted value	1	AO2
	0.000875 (cm)	allow answer using incorrectly converted value	1	AO2
	conversion 8.75 (µm)	allow 8.8 (µm) allow conversion to µm at any stage ignore further rounding	1	AO2 4.1.1.5

4.4.2.1 Aerobic and anaerobic respiration

Answer 21 · Mark scheme

<table>
<tr><th>Question</th><th>Answers</th><th>Mark</th><th>AO / Spec Ref.</th></tr>
<tr><td>05.3</td><td>
<table>
<tr><th>Pressure of blood travelling through vessel in arbitrary units</th><th>Blood vessel in Figure X</th></tr>
<tr><td></td><td></td></tr>
<tr><td>5</td><td>A</td></tr>
<tr><td>18</td><td>B</td></tr>
<tr><td>120</td><td>C</td></tr>
</table>
allow 1 mark for 1 or 2 correct answers

ignore names of blood vessels</td><td>2</td><td>AO3
4.2.2.2</td></tr>
</table>

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.4	pulmonary vein		1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.5	thick elastic / muscle (layer)	ignore thick wall unqualified do **not** accept reference to cell walls ignore has no valves	1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.6	less energy released / transferred (per molecule of glucose)	allow more molecules of glucose need to be broken down to release / transfer equivalent energy do **not** accept less energy produced / made / created do **not** accept no energy released do **not** accept less energy released for respiration	1	AO1 4.4.2.1
	(due to) incomplete breakdown / oxidation of glucose	allow glucose **only** broken down to lactic acid	1	

4.4.2.1 Aerobic and anaerobic respiration

Answer 21 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.7	(the athlete has an) oxygen debt	allow the lactic acid concentration is high	1	AO2 4.4.2.1 4.4.2.2
	(so more) oxygen is required to oxidise lactic acid	allow (so more) oxygen is required to remove lactic acid allow (so more) oxygen is required to break down lactic acid ignore reference to oxygen being used to convert lactic acid back to glucose (in the liver) ignore reference to liver as the site of lactic acid oxidation	1	

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.8	(there is) more haemoglobin so more oxygen (carried **/** bound)	allow more oxyhaemoglobin (is formed)	1	AO2 4.4.2.1 4.2.2.3
	(athlete can do) more aerobic respiration to transfer / release (more) energy **or** (athlete can do) more aerobic respiration so less muscle fatigue / cramp	allow (athlete will do) less anaerobic respiration which transfers / releases less energy allow (athlete will do) less anaerobic respiration which would (otherwise) result in muscle fatigue / cramp do **not** accept (athlete can do) more anaerobic respiration do **not** accept energy produced / made / created do **not** accept energy released for respiration	1	

Total Question 5	16

4.4.2.1 Aerobic and anaerobic respiration

Answer 17 · Examiner comments November 2021 | 8461/1H | Original Q4

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

As in previous years, many students continue to incorrectly refer to energy production and that respiration requires energy. Very few students scored full marks in **04.6** due to a lack of understanding that both the plant and the animal were respiring. Many students appeared to not read the question or graph correctly, and referred to there being card over the tube and hence, no photosynthesis. Many students thought that the carbon dioxide concentration stayed the same because the light intensity was changing. A number of students described the 'lid' of the tube as not being held on securely and therefore, allowing the escape of carbon dioxide.

An unusually high number of students referred to the black paper in the investigation as black pepper, causing some confusion when it came to answering associated questions.

In **04.8**, a common misconception seen was that cells continue to respire once an organism has died and that as a body decomposes, the body itself releases carbon dioxide, rather than the carbon dioxide being released from respiration of microorganisms.

Answer 18 · Examiner comments June 2023 | 8461/1H | Original Q4

Question 4 (Standard, standard/high and high demand)

04.1 Students were asked to explain two effects of anaerobic respiration on the body. Over 87% of students scored some marks on this question but only around 12% managed to score full marks. Many students mentioned lactic acid and were able to put this in the context of oxygen debt or muscle fatigue, though some answers were vague and referred to pain, aches or stitch which were not deemed sufficient to gain credit at this level. Lots of students gave increased breathing and heart rate as effects but less were able to relate this to the reason of needing the oxygen to break down lactic acid. Oxygen debt was frequently referred to but only gained credit as an explanation if reference was made to it being repaid in this context. While a significant number of students referred to 'less energy' being available, very few students correctly linked this idea to 'weaker muscle contractions'.

04.2 This levelled response question required students to design an investigation to show the effects of different exercise on heart rate. Most students attempted an answer, seemingly familiar with such an investigation. Over 16% of students were successful at entering level 3, with around 32% reaching level 2. The main barrier to students achieving higher marks seemed to be using just one athlete for the investigation which then limited the maximum mark achievable, as this would not lead to a valid outcome. Most understood the importance of measuring heart rate before and after exercise, although some students forgot about measuring the initial heart rate first, which again would not lead to a valid outcome. There were many references to technology such as heart rate monitors or watches to measure heart rate, which was creditworthy as long as heart rate was recorded before and after exercise. Students were generally very competent at describing control variables for their investigation.

4.4.2.1 Aerobic and anaerobic respiration

Answer 18 · Examiner comments

04.3 Nearly 58% of students managed to gain the first marking point about anabolic steroids making athletes faster or stronger, or gave specific descriptions of improved performance or enhanced stamina. Only 6% of students also gained the second marking point, and were able to develop this and explain that the increased muscle mass caused more or stronger muscle contractions. Students must take care not to repeat information in the question stem without adding value to this; thus, an answer stating that anabolic steroids improve performance was insufficient.

04.4 Over 92% of students correctly identified 'hybridoma' as the type of cell created when a mouse lymphocyte and tumour cell combine.

04.5 The process of creating monoclonal antibodies is clearly well known by some students, though others have varied misconceptions including that the lymphocyte or monoclonal antibodies are cloned, rather than the hybridoma. Just under 3% of students were able to get the full 3 marks as a result.
Many students spent a lot of their answer describing that a hybridoma is formed when a mouse lymphocyte and tumour cell combine, but this gained no credit as it had been assessed in the previous question, and so wasted time and answer space. Very few described that the hybridoma is cloned (simply dividing by mitosis was frequently stated but gained no credit). Additionally, very few were able to describe that all the cells produced made the same antibody. The most common point made that gained credit was that monoclonal antibodies need to be purified after collection. This question was set at high demand and required correct use of terminology, which very few students were able to do; consequently, almost 59% of students scored zero marks.

04.6 Almost 90% of students were able to correctly identify that a monoclonal antibody only binds to the anabolic steroid.

04.7 Around 47% of students were able to correctly suggest the purpose of the control area in a test strip, and suggested that it was to show that the test had worked. Some were distracted into giving other irrelevant details of the test process here and discussed the complementary nature of monoclonal antibodies, rather than focus on the question posed.

04.8 Many students were able to give correct evidence with 58% gaining 1 mark. Sadly, less were able to suggest a possible reason for the evidence they had selected and consequently, only around 26% of students successfully gained both available marks. Some students referred to other processes involved in the test when discussing the reason, rather than focussing on the idea of monoclonal antibodies not binding to, or reaching, the control area. Lots of students described the test not being used properly, or the urine not having any steroids in it as their reason, neither of which gained credit.

04.9 Just over 75% of students correctly identified athlete D as testing positive for anabolic steroids.

4.4.2.1 Aerobic and anaerobic respiration

Answer 19 · Examiner comments June 2023 | 8461/2H | Original Q6

Question 6

This question was about the combined effects of respiration and photosynthesis on the carbon dioxide concentration in the air and the recovery of a rainforest community following deforestation.

06.1 Most students only considered the effects of photosynthesis in this question about changing carbon dioxide concentrations in the air in a tropical rainforest over a 24-hour period. For the first 6 hours shown in Figure 9 there was no light – hence only respiration took place and this produced carbon dioxide, hence the high levels of carbon dioxide shown on the graph. Many students understood that photosynthesis would not occur in the dark but then attributed respiration solely to animals in the forest. Between 8 am and 12 noon, the graph showed that carbon dioxide levels decreased. While most understood that the plants would be photosynthesising at this time, few realised that respiration also took place but the rate of photosynthesis exceeded that of respiration – hence a net uptake of carbon dioxide. Fewer than one-quarter of students reached even half-marks and only 1 percent scored all 4 marks.

Answer 19 · Examiner comments June 2023 | 8461/2H | Original Q6

06.2 Many students missed the concept of the time factor in answering this question which asked for an explanation why replacing rainforest with a maize crop would increase the carbon dioxide concentration in the air over one year. Using information from Figure 9 and Figure 10 should have indicated that maize removed less carbon dioxide from the air over the course of one day (not simply that the carbon dioxide concentration in the air decreased less at midday). Although many commented on the maize crop growing for just 6 months of the year, few stressed that this would mean the maize was only taking in carbon dioxide for half the year compared to the rainforest doing the same throughout the year. Only 1 in 40 students fully demonstrated their understanding of this situation.

06.3 Figure 11 showed an increase in the number of tree species with time following deforestation. The data were presented as percentages compared with adjacent control areas. About half of the students appreciated that presenting the data as percentages enabled comparisons to be made, but hardly any made the point that the initial numbers of species would have varied from one study area to another thus making a comparison of absolute numbers invalid. Mistakenly referring to the number of trees rather than to the number of tree species was quite common.

06.4 The stem to this question gave the information that the biodiversity of trees increased in the regenerating forest, but many restated this as their conclusion from the data in Figure 11. Further details from the data were required – such as the number of tree species exceeding the original number after about 50 years, or the fact that for any point in time there was great variability from one area to another, or a description of the changing pattern of recovery with time. Only 10 percent were successful here.

06.5 Many attributed the given increase in animal diversity in the regenerating rainforest to there being more food or more habitat available rather than to more variety of food types and more types of habitat.

4.4.2.1 Aerobic and anaerobic respiration

Answer 20 · Examiner comments

June 2024 | 8461/2H | Original Q7

Question 7 (standard/high and high demand)

07.1 Students were provided with data regarding chickens and farmland, and were asked to calculate the area of land needed to provide enough energy from maize seeds for 1000 chickens to grow to full size. The mark scheme is designed to benefit the logical mathematical use of the numbers that were provided in the stem of the question.

Almost 35% of students were able to attain the maximum five marks by calculating the correct answer of 2190 m^2. Students with a final answer showing an error to the power of 10 (such as 2.19, 21.9, 21900 etc.) gained four marks in line with the marking procedure for calculations (section 3.3 of the mark scheme).

A small number of students did not convert their answer to 3 significant figures so could only be awarded four marks. Despite the high level of challenge provided by this calculation, 40% of students were able to gain 1 or 2 marks.

Students are encouraged to show their working out for all calculations.

07.2 Students were asked to complete a pyramid of biomass for maize seeds and chickens, and it was clear that many students had a weak understanding of this. 20% of students gained all three marks, with 40% of students not gaining any mark at all or not attempting the question.

Students used a vast range of different scales, but only those that were symmetrical and used over half the available grid were able to gain marking point 1. A number of students did not notice that they needed to calculate the value for chickens and not simply plot 2.2 kg. This went on to provide problems devising a suitable scale.

07.3 Over 50% of students correctly calculated the ratio of chicken biomass to maize seed biomass. Common errors were using the mean mass of 1 chicken, and not calculating the value for 1000 chickens, inverting the correct values and giving an answer of 21:11 or 1.9:1. Students are reminded to check their ratio reflects the order given in the question.

07.4 Just under a quarter of students correctly articulated what happened to the remaining 20% of the biomass in the maize seeds. It was clear a far greater number of students knew the correct answer but gave vague responses such as ‘waste’ or used colloquial terms which were insufficient for credit at this level.

07.5 85% of students correctly identified lysine and tryptophan as the amino acids found in significantly higher proportions in the QPM seeds.

07.6 Only 15% of students were able to correctly suggest why a diet containing less leucine does not slow down the growth of chickens. Many students did not appear to read all the information provided and incorrectly suggested that leucine was not an essential amino acid, or not essential to growth.

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Question 5 (standard/high demand and high demand)

05.1 This question was generally well answered with 63% of students achieving the mark. Some students gave vague answers such as 'nutrients', 'waste' or 'carbohydrates', which were not credited due to a lack of specificity. These responses suggested a partial understanding but missed the precision required by the mark scheme. It was surprising to see a large number of students describing blood clotting, possibly confusing the word 'plasma' with 'platelets.

05.2 This question required students to recall and apply the magnification formula, including rearranging it, substituting values and performing unit conversions. Most students were able to correctly recall the full magnification equation rather than relying on symbols or triangle methods, which were not creditworthy. However, a common source of error was an incorrect rearrangement of the equation when solving for actual size. Additionally, a significant number of students struggled with unit conversion. While many recognised that 1 mm = 1000 µm, they often overlooked the need to first convert from centimetres to millimetres, leading to errors in the final answer. Despite this, many students made a good attempt (59% gained full marks and a further 32% achieved 4 marks), and it was encouraging to see clear working and structure in students' responses. Students should be reminded not to round their answers to calculation questions too early on in their working; as a number of students did so in this question, leading to an incorrect final answer.

05.3 Students were presented with a diagram of the heart showing four labelled blood vessels and were required to match labels to a pressure value. Most students were able to correctly identify that blood leaves the heart at high pressure and returns at lower pressure. Some also recognised that pressure in the pulmonary circulation is lower than in the systemic circulation. Where students had a secure understanding of the circulatory system, they were able to apply this knowledge effectively to select the correct values, with 66% achieving full marks, and 22% achieving 1 mark.

4.4.2.1 Aerobic and anaerobic respiration

Answer 21 · Examiner comments June 2025 | 8461/1H | Original Q5

05.4 68% of students were able to identify vessel D as the pulmonary vein, suggesting a strong familiarity with the structure and function of the heart. Where errors occurred, they were often due to confusing the pulmonary vein with the aorta, with errors in both the side of the heart and the direction of blood flow.

05.5 This was a generally well-answered question, with 62% of students correctly describing artery walls as thick, muscular and / or elastic. A small number of students referred instead to the size of the lumen or the pressure of the blood, which did not gain credit as the question asked specifically about the structure of the wall.

05.6 63% of students scored no marks in this question, with the majority misunderstanding what was being asked of them, often describing the disadvantages of anaerobic respiration, rather than the efficiency. Therefore, those students who only referred to the production of lactic acid and its effects did not answer the question and so could not gain credit for this knowledge. Students who went into all the detail they knew regarding the comparison of aerobic and anaerobic respiration frequently gained the first mark (26%), as irrelevant information was ignored. Only 10% of students were able to access the second mark, realising that the word 'only', was critical to this approach. A number of students continue to refer to energy production or generation and some other common misconceptions seen included:

- aerobic respiration being quicker than anaerobic
- anaerobic respiration using more energy than aerobic
- removal of lactic acid requiring energy (and so anaerobic respiration being less efficient).

05.7 Most students who gained the first mark in this question did so by referring to 'oxygen debt'. 45% of students achieved 1 mark. Describing the presence of lactic acid in the blood was insufficient for this mark, as the figure shows there was always some lactic acid present. A number of students could link the concept of oxygen debt to this question but gave further explanatory detail showing that they did not understand what it meant, for example, incorrect ideas such as 'oxygen was used in the oxygen debt', 'the body needs an oxygen debt' and 'the oxygen debt is still required'. 34% of students scored full marks with the second marking point being more difficult to access for many, with some of these displaying a misunderstanding of the concepts described in the specification; in that oxygen is used to 'remove' or 'break down' lactic acid but is not used directly to rebuild lactic acid into glucose. A number of published texts only add to the confusion around this concept; the conversion of lactic acid back to glucose is an oxidation reaction (loss of electrons), but it does not require oxygen directly. Vague descriptions such as 'oxygen flushing out the lactic acid', 'limiting the effects of lactic acid' or 'neutralising the lactic acid' were insufficient. Some students thought that the body needed to aerobically respire in order to break down the lactic acid.

05.8 The answers from many students (58%) lacked the detail required to gain either mark, although it was clear that many of these students understood the overall advantage to some athletes of having a high number of red blood cells. Those students who did not gain credit often referred to the increased number of red blood cells being able to

4.4.2.1 Aerobic and anaerobic respiration

Answer 21 · Examiner comments June 2025 | 8461/1H | Original Q5

carry more oxygen to the muscles in order for more respiration to take place to release energy.
These students had omitted reference to haemoglobin (for MP1) or to 'aerobic' or 'anaerobic' respiration (for MP2) and should be reminded to include all the relevant detail they have learned when answering any question.
Fewer students than in the past, now refer incorrectly to energy being 'produced' or to energy being used 'for' respiration, although a significant minority still do. Some students also think that oxygen binds to red blood cells to form haemoglobin.