AQA GCSE Biology | 8461

SPECIFICATION POINT 4.4.2.2

Response to exercise

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**42**
Available paper years	**2007–2025**

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.

4.4.2.2 Response to exercise

Answer 01 · Mark scheme January 2007 | BLY1H | Original Q3 | Legacy

Question 3

	answers	extra information	mark
(a)	any **two** from: • birth mass / growth reduced • smoke contains carbon monoxide • blood carries less oxygen / fetus receives less oxygen	ignore references to poison do **not** accept harder for fetus to breathe	2
(b)(i)	it may cause mental illness it may be a 'gateway' drug to more harmful substances	three answers max 1 four answers max 0	1 1
(ii)	it is less addictive than amphetamines, tobacco or alcohol it is not associated with major sociological problems	three answers max 1 four answers max 0	1 1
total			6

4.4.2.2 Response to exercise

Answer 02 · Mark scheme January 2007 | BLY1H | Original Q4 | Legacy

Question 4

	answers	extra information	mark
(a)(i)	liver		1
(ii)	heart	accept brain / blood vessels	1
(iii)	heredity / genes / exercise / metabolism / HDL LDL balance / ratio	stress is neutral	1
(b)	any **two** from: • increases metabolic rate or increased respiration • decreases blood pressure • decreases obesity / decreased cholesterol / burns off fat • lowers risk of heart disease • lowers risk of arthritis or worn joints • lowers risk of diabetes	references to stress are neutral allow keeps heart healthy	2
total			5

4.4.2.2 Response to exercise

Answer 03 · Mark scheme

November 2007 | BLY1A | Original Q4 | Legacy

Four	**1**	**1**	**4**	**2**

4.4.2.2 Response to exercise

Answer 04 · Mark scheme January 2008 | BLY3H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
(a)	any **three** from: • rose <u>rapidly</u> (during exercise) / use of approximate figures • then more slowly (during exercise) • to max 126 / at 5 minutes / end of exercise • <u>rapid</u> fall (during recovery) **or** use of approximate numbers • then less rapid fall / use of approximate numbers • returned to resting rate (60 bpm) by 11 minutes	accept rate (of increase) slows down	3
(b)	arteries dilate / widen	accept muscle in wall relaxes	1
(c)	any **four** from: • muscles using more energy **or** more energy released • muscles <u>respire</u> faster • supply more oxygen • supply more glucose / sugar • remove more CO_2 • remove lactic acid • remove heat / to cool	do **not** accept energy produced allow for aerobic respiration **or** to prevent anaerobic respiration 'more' needed ONCE only for full marks	4
total			8

4.4.2.2 Response to exercise

Answer 04 · Mark scheme January 2008 | BLY3H | Original Q4 | Legacy

BLY3H

Answer 05 · Mark scheme June 2008 | BLY1AP | Original Q5 | Legacy

Five	**3**	**2**	**3**	**3**

4.4.2.2 Response to exercise

Answer 06 · Mark scheme June 2008 | BLY1H | Original Q3 | Legacy

question	answers	extra information	mark
3(a)	diet **or** description		1
3(b)	exercise **or** group meetings **or** same number of kilocalories per day **or** time **or** group size		1
3(c)	any **two** from: eg • scientists didn't observe amount of exercise **or** volunteers cheated on exercise • scientists didn't observe the amount of food **or** volunteers cheated on food • mass of subjects not controlled • age of subjects not controlled • gender of subjects not controlled • occupation of subjects not controlled • different proportions of subjects completed course • low number of subjects	if no marks awarded for first 2 bullet points allow don't stick to plan **or** cheated for **1** mark allow not all completed course ignore not repeated	2
3(d)	any **two** from: (yes) • low carbohydrate / Group 1 / people / they lost more mass • low carbohydrate / Group 1 / people / they lost more body fat • low carbohydrate diet / Group 1 / people / they resulted in more HDL	ignore more people lost weight allow greater change in mass ignore more people lost body fat allow greater change in body fat allow better HDL to LDL balance allow greater change in HDL	2
Total			**6**

4.4.2.2 Response to exercise

Answer 06 · Mark scheme June 2008 | BLY1H | Original Q3 | Legacy

COMPONENT NUMBER: BLY1H

COMPONENT NAME: Science B / Biology

STATUS: Final

DATE: June 2008

4.4.2.2 Response to exercise

Answer 07 · Mark scheme

January 2009 | BLY2H | Original Q5 | Legacy

question	answers	extra information	mark
5(a)	respiration	allow muscle contraction **or** muscle movement **or** exercise of muscles allow metabolism / chemical reactions	1
5(b)(i)	any **two** from: • less / no water (available) for sweat • less / no heat lost / less / no cooling • less / no evaporation (of sweat)	 allow dehydrated so less sweat allow converse if evident that response refers to athletes who have drunk liquid only need to refer to less / no once	2
5(b)(ii)	**either** blood vessels supplying the skin **or** blood vessels in skin dilate / widen / muscles relax	 do **not** allow first mark if implied that skin capillaries dilate ignore enlarge / open vasodilation in skin = **2** marks allow hairs lie flat for **1** mark allow less insulation for **1** mark if linked to hairs allow more blood in skin for **1** mark if no other marks awarded	1 1
5(c)(i)	cold / 15°C cools the body / blood (more)	**or** reverse argument ignore reference to values for body temperature derived from graph	1

Question 5 continued on the next page…

4.4.2.2 Response to exercise

COMPONENT NUMBER: BLY2H

COMPONENT NAME: Additional Science / Biology

STATUS: Final

DATE: January 2009

Question 5 continued…

question	answers	extra information	mark
5(c)(ii)	any **two** from: • cools slower at 15°C cold / 15°C • cold / 15°C causes reduced blood flow to surface / skin • blood not cooled as much / as quickly • cold / 15°C causes shivering • muscles contract / more respiration / heat made	allow converse arguments ignore reference to capillaries	2
Total			**8**

4.4.2.2 Response to exercise

Answer 07 · Mark scheme January 2009 | BLY2H | Original Q5 | Legacy

COMPONENT NUMBER: BLY2H

COMPONENT NAME: Additional Science / Biology

STATUS: Final

DATE: January 2009

4.4.2.2 Response to exercise

Answer 08 · Mark scheme

question	answers	extra information	mark
1(a)(i)	19 800	for correct answer ignore working or lack of working 165 × 120 but no answer / wrong answer = **1** mark (ignore extras)	2
1(a)(ii)	any **two** from: • for respiration • energy released • prevents anaerobic respiration • prevents build-up of lactic acid	 ignore oxygen debt allow energy produced	2
1(b)	any **two** from: • increased breathing rate • increased depth of breathing **or** deep breathing • dilation of arteries / vasodilation • blood diverted from elsewhere	} more breathing is max **1** mark ignore increase in heart rate allow heavier breathing do **not** allow harder breathing allow blood vessels dilate do **not** allow veins / capillaries dilate ignore name of organ	2
Total			**6**

4.4.2.2 Response to exercise

Answer 08 · Mark scheme January 2009 | BLY3H | Original Q1 | Legacy

COMPONENT NUMBER: BLY3H

COMPONENT NAME: Biology

STATUS: Final

DATE: January 2009

Answer 09 · Mark scheme March 2009 | BLY1AP | Original Q2 | Legacy

Two	**A** constant	**3**	
	B greater	**4**	
	C insufficient	**2**	
	D irregular	**1**	

	A	B	C	D

Answer 10 · Mark scheme March 2009 | BLY1AP | Original Q6 | Legacy

Six	**1**	**3**	**1**	**1**

Answer 11 · Mark scheme June 2009 | BLY1AP | Original Q3 | Legacy

Three	**4**	**3**	**3**	**1**

4.4.2.2 Response to exercise

Answer 12 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)	A	no mark – can be specified in reason part if B given = no marks throughout if unspecified plus two good reasons = 1 mark	
	high(er) pressure in A	allow opposite for B do not accept 'zero pressure' for B	1
	pulse / described in A	accept fluctuates / 'changes' allow reference to beats / beating ignore reference to artery pumping	1
1(b)(i)	17		1
1(b)(ii)	68	accept correct answer from candidate's (b)(i) x 4	1
1(c)(i)	oxygen / oxygenated blood	allow adrenaline ignore air	1
	glucose / sugar	extra wrong answer cancels eg sucrose / starch / glycogen / glucagon / water allow fructose as an alternative to glucose ignore energy ignore food	1

Question 1 continues on the next page…

4.4.2.2 Response to exercise

Answer 12 · Mark scheme

BLY3H

Question 1 Continued

question	answers	extra information	mark
1(c)(ii)	carbon dioxide / CO_2 / lactic acid	allow CO2 / CO^2 ignore water	1
Total			**7**

4.4.2.2 Response to exercise

Answer 12 · Mark scheme

June 2009 | BLY3H | Original Q1 | Legacy

BLY3H

4.4.2.2 Response to exercise

Answer 13 · Mark scheme January 2010 | BLY3H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	B **or** D		1
1(a)(ii)	A **or** B		1
1(b)	any **four** from: • increased blood (flow) • (more) oxygen supplied **or** aerobic respiration • (more) glucose / sugar / food supplied • (higher rate of) respiration • (more) energy needed / released • (more) carbon dioxide <u>removed</u> • (muscles) doing (more) work **or** muscles contracting • remove heat / cooling • remove lactic acid **or** less lactic acid formed	more / faster must be implied at least once for full marks ignore reference to breathing allow less anaerobic (respiration) **or** and prevents oxygen debt ignore feeding allow made	4
Total			**6**

4.4.2.2 Response to exercise

Answer 13 · Mark scheme January 2010 | BLY3H | Original Q1 | Legacy

BLY3H

Answer 14 · Mark scheme March 2010 | BLY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	energy	**2**
	B	enzymes	**3**
	C	mass	**4**
	D	sweat	**1**

Answer 15 · Mark scheme March 2010 | BLY1AP | Original Q5 | Legacy

Five	**4**	**4**	**3**	**2**

Answer 16 · Mark scheme June 2010 | BLY1AP | Original Q4 | Legacy

Four	**4**	**2**	**4**	**3**

4.4.2.2 Response to exercise

Answer 17 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)	any **two** from: • arthritis • diabetes • high blood pressure • strokes • allow breathing difficulties	 allow damaged joints accept high blood sugar allow blocked blood vessels / thrombosis ignore cancer ignore high cholesterol	2
4(b)(i)	any **two** from: • lower number of women deaths up to age of 75-80 • higher number of women deaths after 80 • men's peak higher • men's peak at an earlier age • men's death start earlier than women • more men than women die of heart disease	to gain marks there must be a comparison ignore comparison at single age ignore women die older **or** men die younger	2

Question 4 continues on the next page

4.4.2.2 Response to exercise

Answer 17 · Mark scheme

BLY1H

Question 4 continued

question	answers	extra information	mark
4(b)(ii)	any **two** from: • men smoke more (cigarettes) • more men smoke • men under more stress • men less active • more men overweight / eat more / less diet conscious **or** different fat distribution • genetic factors • men might have lower metabolic rate • men less likely to visit doctor even though they have symptoms	ignore alcohol ignore reference to body size ignore references to hormones	2
4(c)	laboratory tests / tests on tissues **or** tests on animals **or** tests for toxicity tests for side effects on volunteers / healthy people / small numbers widespread testing **or** testing for optimum dose ***or*** test on patients / sick people ***or*** test to see if it is effective	points can be in any order ignore computer simulations accept use of placebo	1 1 1
Total			**9**

4.4.2.2 Response to exercise

Answer 17 · Mark scheme

June 2010 | BLY1H | Original Q4 | Legacy

BLY1H

4.4.2.2 Response to exercise

Answer 18 · Mark scheme

June 2010 | BLY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5	only 24 students tested **or** only one test **or** reference to lack of controls eg gender / age		1
	students could drink as much water as they wanted **or** some students drank more water than others **or** some students drank water and beer		1
	differences only slight	ignore effects of beer or promotion of beer drinking	1
Total			**3**

4.4.2.2 Response to exercise

Answer 18 · Mark scheme June 2010 | BLY1H | Original Q5 | Legacy

BLY1H

4.4.2.2 Response to exercise

Answer 19 · Mark scheme June 2010 | BLY3H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	120		1
4(a)(ii)	11 760 **or** correct answer from candidate's answer to (a)(i)	correct answer with or without working if answer incorrect 120 × 98 **or** candidate's answer to (a)(i) × corresponding SV gains **1** mark if candidate uses dotted line / might have used dotted line(bod) in (a)(i) **and** (a)(ii) no marks for (a)(i) but allow full ecf in (a)(ii) eg 140 x 88 = 12320 gains **2** marks	2
4(b)	trained athlete has higher stroke volume / more blood per beat same volume blood expelled with fewer beats **or** for same heart rate more blood is expelled		1 1

Question 4 continues on the next page

4.4.2.2 Response to exercise

BLY 3H

Question 4 continues

question	answers	extra information	mark
4(c)	increased <u>aerobic</u> <u>respiration**</u> **or** decreased <u>anaerobic</u> <u>respiration</u>	allow correct equation for aerobic respiration accept don't have to respire anaerobically	1
	increased <u>energy</u> supply / need		1
	less lactic acid formed **or** to breakdown lactic acid **or** *l*ess O_2-debt		1
	can do <u>more</u> work **or** can work harder / faster / longer **or** <u>less</u> fatigue / cramp / pain	accept muscle contraction for work	1
Total			**9**

4.4.2.2 Response to exercise

Answer 19 · Mark scheme June 2010 | BLY3H | Original Q4 | Legacy

BLY 3H

Answer 20 · Mark scheme November 2010 | BLY1AP | Original Q6 | Legacy

Six	**2**	**4**	**1**	**2**

Answer 21 · Mark scheme November 2010 | BLY1AP | Original Q9 | Legacy

Nine	**3**	**3**	**3**	**1**

4.4.2.2 Response to exercise

Answer 22 · Mark scheme

January 2011 | BLY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	any **two** from: • arthritis • diabetes • high blood pressure • heart / blood vessel disease	ignore descriptions ignore cholesterol	2
5(b)	(No) any **two** from: • patterns for cancer and obesity not identical • data only shows a link • some other factor(s) involved	allow descriptions of differences from graph	2
5(c)	any **two** from: • increases metabolic rate • exercise needs energy **or** exercise increases energy used by body • fat (stores) used / broken down **or** less food / energy converted into body mass / fat	accept increase BMR ignore increased respiration allow fat burned ignore burns energy / calories	2
Total			**6**

4.4.2.2 Response to exercise

Answer 22 · Mark scheme

January 2011 | BLY1H | Original Q5 | Legacy

BLY1H

4.4.2.2 Response to exercise

Answer 23 · Mark scheme January 2011 | BLY3H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	brain		1
1(a)(ii)	skin		1
1(a)(iii)	1/25 **or** 4% **or** 0.04 **or** 1 in 25 **or** 1:25 **or** 1 out of 25	allow $\frac{1000}{25000}$	1
1(b)	any **two** from: • increased / high heart rate / pulse rate • dilation / widening of <u>arteries / arterioles</u> (to skeletal muscles) **or** less blood flow to other organs • increased stroke volume / described	do **not** allow pumps more blood unqualified accept vasodilation unqualified do **not** accept reference to veins / capillaries	2
1(c)	<u>more</u> respiration / description **or** <u>more</u> energy required **or** to provide <u>more</u> energy respiration / process described → CO_2 CO_2 <u>diffuses</u> into blood	ignore references to breathing do **not** accept anaerobic respiration	1 1 1
Total			**8**

4.4.2.2 Response to exercise

Answer 23 · Mark scheme January 2011 | BLY3H | Original Q1 | Legacy

BLY3H

Answer 24 · Mark scheme June 2011 | BLY1AP | Original Q6 | Legacy

Six	**2**	**3**	**1**	**4**

4.4.2.2 Response to exercise

Answer 25 · Mark scheme June 2011 | BLY3H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	blood has red (blood) cells / haemoglobin		1
	haemoglobin combines with / carries oxygen	ignore 'mix' **NB** Blood can form oxyhaemoglobin = **2** marks	1
4(b)	blood gains oxygen / becomes oxygenated (in the lungs)	idea of acquiring oxygen must be unambiguous	1
	blood loses oxygen to the muscles / cells		1
	because muscles are respiring (aerobically)		1
	to provide energy (for exercise)		1
Total			**6**

4.4.2.2 Response to exercise

Answer 25 · Mark scheme June 2011 | BLY3H | Original Q4 | Legacy

BLY3H

Answer 26 · Mark scheme November 2011 | BLY1AP | Original Q2 | Legacy

Two	**A**	higher muscle to fat ratio	**2**
	B	obesity	**4**
	C	reduced cholesterol levels, decreases in weight	**1**
	D	very low metabolic rate, muscle loss	**3**

	A	B	C	D

Answer 27 · Mark scheme November 2011 | BLY1AP | Original Q6 | Legacy

Six	**3**	**4**	**3**	**3**

4.4.2.2 Response to exercise

Answer 28 · Mark scheme

June 2012 | BL2HP | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	any **three** from: • age (of athlete) • gender (of athlete) • starting concentration of glycogen • type / intensity of exercise • length of exercise period • number of training sessions • time interval between exercise sessions • exercise at same time of day	if diet given as answer = max **2** if none of these points gained amount of exercise = **1** mark if last four points not awarded allow time (for exercise) for **1** mark ignore references to amount of energy ignore they are both athletes	3
1(a)(ii)	any **two** from: • intensity of exercise • amount of exercise between sessions • starting concentration of glycogen • fitness / health • metabolic rate / respiration rate • amount / mass of muscle / physique • aspects of diet qualified, eg amount of food eaten	do **not** accept amount of carbohydrate if no other marks awarded allow height / mass / weight for **1** mark	2

4.4.2.2 Response to exercise

Answer 28 · Mark scheme

1(a)(iii)	(B has) less glycogen **or** (B's glycogen) fell more **or** (B's glycogen) built up less	he = B accept use of approximate figures allow other correct observations from graph eg A is lower at end of first session ignore rate of fall	1
1(b)	athlete **A** (no mark) athlete **A** had more glycogen / **B** has less (only if A chosen to complete marathon) (glycogen / glucose) used in respiration (more) energy released / available in athlete **A** **and either** energy used for movement / muscle action / to run **or** (extra) glycogen → (more) glucose	to gain full marks 'more' must be given at least once accept converse argument for **B** ignore anaerobic allow 'energy made'	 1 1 1 1
Total			**10**

4.4.2.2 Response to exercise

Answer 28 · Mark scheme

June 2012 | BL2HP | Original Q1 | Legacy

BL2HP

4.4.2.2 Response to exercise

Answer 29 · Mark scheme

June 2013 | BL3HP | Original Q6 | Legacy

Question 6

question	Answers	extra information	mark
6(a)	if body temperature too high blood vessels supplying skin (capillaries) dilate / widen	do **not** accept capillaries / veins dilate/constrict	1
	if body temperature is too low blood vessels supplying skin (capillaries) constrict / narrow	do **not** accept idea of blood vessels moving (through skin) ignore expand accept arteries / arterioles for 'blood vessels' if no reference to skin allow blood vessels dilate and blood vessels constrict for one mark	1
	so more / less blood flows through skin (capillaries) or nearer the surface of the skin	must correctly relate to dilation or constriction	1
	so more / less heat is lost (from the skin by radiation)	must correctly relate to dilation or constriction	1
6(b)	sweat released		1
	cannot evaporate because of high humidity / all the water vapour in the air		1
	so less heat lost / less cooling **or** it is evaporation of sweat that cools the body		1
Total			**7**

4.4.2.2 Response to exercise

Answer 30 · 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**	

4.4.2.2 Response to exercise

Answer 30 · Mark scheme

June 2014 | BL2HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / spec ref.

4.4.2.2 Response to exercise

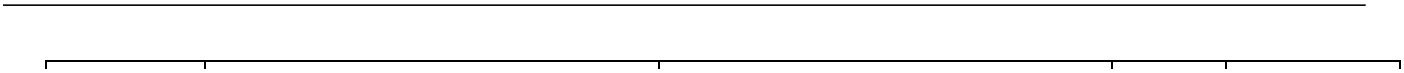
Answer 31 · Mark scheme June 2015 | BL2HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	5624	**allow 2 marks** for: • correct HR = 148 **and** correct SV = 38 plus wrong answer / no answer **or** • only one value correct **and** ecf for answer **allow 1 mark** for: • incorrect values **and** ecf for answer **or** • only one value correct	3	AO2 2.6, 2.6.1g
5(b)(i)	**Person 2** has low(er) stroke volume / SV / described	eg **Person 2** pumps out smaller volume each beat do **not** allow **Person 2** has lower heart rate	1	AO3 2.6, 2.6.1g
5(b)(ii)	**Person 1** sends <u>more blood</u> (to muscles / body / lungs) (which) supplies (more) oxygen (and) supplies (more) glucose (faster rate of) respiration **or** transfers (more) energy for use removes (more) CO_2 / lactic acid / heat **or** less lactic acid made **or** (more) muscle contraction / less muscle fatigue	 ignore aerobic / anaerobic allow (more) energy release allow aerobic respiration transfers / releases more energy (than anaerobic) do **not** allow makes (more) energy allow less oxygen debt if no other mark awarded, allow person 1 is fitter (than person 2) for max 1 mark	1 1 1 1 1	AO1 / AO2 2.6.1b,e,f, g,h, 2.6.2c,d
Total			**9**	

4.4.2.2 Response to exercise

Answer 31 · Mark scheme

June 2015 | BL2HP | Original Q5 | Legacy



4.4.2.2 Response to exercise

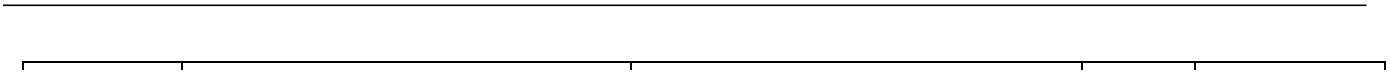
Answer 32 · Mark scheme June 2016 | BL2HP | Original Q1 | Legacy

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**	

4.4.2.2 Response to exercise

Answer 32 · Mark scheme

June 2016 | BL2HP | Original Q1 | Legacy



4.4.2.2 Response to exercise

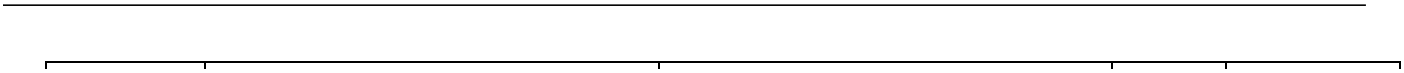
Answer 33 · Mark scheme June 2016 | BL3HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	(diaphragm) down **or** (becomes) flattened	do **not** allow up / in / expands ignore out ignore reference to contraction	1	AO1 3.1.2c
	(volume) increases		1	
5(b)(i)	(healthy alveolus has a) larger surface area	allow larger SA:Volume ratio accept converse for alveoli from person with emphesema allow walls between alveoli disintegrate **or** fluid accumulation in alveoli	1	AO2 3.1.1h/k
5(b)(ii)	less oxygen into the blood / muscles	less only needed once	1	AO2 3.1.1h/k 3.1.2b
	(so) less respiration	ignore ref. to anaerobic respiration	1	
	(and therefore) less energy is released (for exercise)	do **not** allow energy is produced / made do **not** allow energy **for** respiration	1	
Total			**6**	

4.4.2.2 Response to exercise

Answer 33 · Mark scheme

June 2016 | BL3HP | Original Q5 | Legacy



4.4.2.2 Response to exercise

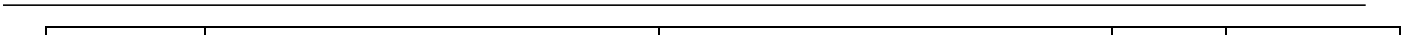
Answer 34 · Mark scheme June 2017 | BL3HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	sugar / glucose / carbohydrate	allow correctly named sugars	1	AO1 3.1.1d/e
6(b)(i)	3:1	do **not** allow 1:3 ignore 112:38 / 56:19 allow 2.95:1 allow 2.9:1	1	AO2 3.1.1e
6(b)(ii)	concentration is (slightly) lower than the blood **or** concentration is 20 units less (than blood) the ratio of sodium (ions) to potassium (ions) is close to 2:1	 allow has high levels of sugar / substance X to keep blood sugar levels stable **or** for (more) energy	1 1	AO3 3.1.1e
6(b)(iii)	cells shrivel **/** shrink (because) cells lose water due to osmosis (of water) **or** diffusion (of water)	ignore reference to flaccid / plasmolysed allow crenated allow because there is a higher concentration <u>of water</u> in cells (compared to the sports drink)	1 1 1	AO2/3 3.1.1b
Total			**7**	

4.4.2.2 Response to exercise

Answer 34 · Mark scheme

June 2017 | BL3HP | Original Q6 | Legacy



4.4.2.2 Response to exercise

Answer 35 · Mark scheme June 2017 | BL3HP | Original Q9 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(a)	pancreas releases <u>insulin</u> glucose moves into the cells **or** pancreas stops releasing glucagon glycogen stops being converted to glucose	do **not** allow liver releasing / producing insulin allow glucose is converted to glycogen	1 1	AO1 3.3.3a
9(b)	(exercise) uses up <u>glucose</u> idea of no <u>glucose</u> released into the blood(stream) (because) no available glycogen **or** glycogen cannot be broken down **or** no glycogen stored (and) <u>blood</u> sugar levels fall too low **or** (and) blood sugar levels remain low	 allow glucagon has no effect (on faulty glycogen) **or** glucagon doesn't break down glycogen ignore glycogen does not form properly	1 1 1 1	AO2 3.3.3b
Total			**6**	

4.4.2.2 Response to exercise

Answer 36 · Mark scheme June 2018 | 8461/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any **one** from: • respiration • formation of proteins • formation / breakdown of glycogen • breakdown of (excess) protein **or** formation of urea • photosynthesis **or** formation of glucose / starch (in plants)	allow other correct reference to metabolic reactions in cells ignore reference to digestion ignore formation of carbohydrates	1	AO1 4.4.2.3
02.2	males have a higher metabolic rate than females after five years of age the mean metabolic rate of females decreases faster than males up to 25 years of age	each additional tick negates a mark	1 1	AO3 4.4.2.3
02.3	$\frac{17}{53} \times 100$ 32.075472… 32.1	an answer of 32.1 scores **3** marks allow correct rounding of this to at least 4 significant figures allow a correct reduction to 3 significant figures from an incorrect calculation for marking point 2	1 1 1	AO2 4.4.2.3

4.4.2.2 Response to exercise

Answer 36 · Mark scheme

June 2018 | 8461/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **two** from: • (person) R heart rate rose / increased more slowly than (person) S • (person) R heart rate levelled off whereas (person) S continued to increase • (person) R heart rate rose less (overall / after 5 minutes of exercise) than S	allow converse allow correct use of figures eg R increased (overall) by 39 bpm / 65% and S by 54 bpm / 69% ignore lack of units	2	AO3 4.4.2.2
02.5	correct scale and axis labelled all points plotted correctly (to within ± ½ square) line joined point to point or correct curved line of best fit	allow min(s) do **not** accept 'm' the zero is not required on the *x*-axis allow 4 or 5 correct plots for **1** mark	1 2 1	AO2 4.4.2.2
02.6	$\frac{132 - 78}{12}$ 4.5 (minutes) / 4½ minutes / 4 minutes 30 seconds / 4:30	an answer of 4.5 minutes scores **2** marks allow $\frac{54}{12}$ allow sequential deductions of 12 four or five times do **not** accept 4:50 **or** 4 minutes 50 seconds	1 1	AO2 4.4.2.2

4.4.2.2 Response to exercise

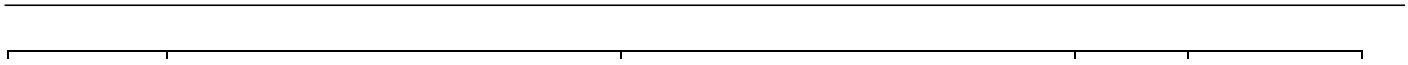
Answer 36 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
02.7	**Level 3:** The method would lead to the production of a valid outcome. All 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 • two groups of people - non-smokers and smokers • have at least five people in each group or large groups • get each person to do (named) exercise • controlled variables: - same number of people in each group or large groups - same gender - same level of activity / exercise - same age - no health issues / illnesses - same type of exercise - same time for exercise • record heart rate for each person before and after exercise • calculate increase in heart rate for each person after exercise • compare results for each group for **level 3**, students should refer to at least 5 smokers and 5 non-smokers, carrying out exercise with control variables and a means of determining an increase in heart rate for **level 2**, students should refer to 'groups' of smokers and non-smokers exercising		
Total			**20**

4.4.2.2 Response to exercise

Answer 36 · Mark scheme

June 2018 | 8461/1H | Original Q2



4.4.2.2 Response to exercise

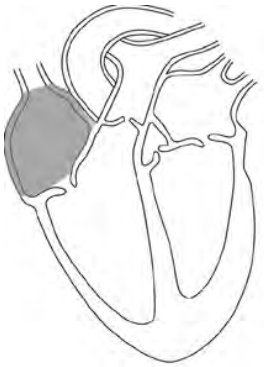
Answer 37 · Mark scheme June 2018 | 8461/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	any **two** from: • carbon dioxide • water • glucose • amino acids • lactic acid	allow proteins / hormones / antibodies / vitamins / minerals / ions / fatty acids / glycerol ignore sugar / enzymes / nutrients / waste	2	AO1 4.2.2.3
03.2	more haemoglobin (therefore) more oxygen can be carried / transported (for) more (aerobic) respiration of muscle (cells) **or** more energy released for muscle (cells)	**max 2** marks if 'more' is not given allow less anaerobic respiration / lactic acid / oxygen debt / fatigue in muscle (cells) ie addition of 'debt do **not** accept energy produced	1 1 1	AO1 4.2.2.3 4.4.2.2 AO2 4.2.2.3 4.4.2.2 AO1 4.2.2.3 4.4.2.2
03.3	pulmonary artery vena cava		1 1	AO1 4.2.2.2
03.4	B		1	AO1 4.2.2.2

4.4.2.2 Response to exercise

Answer 37 · Mark scheme

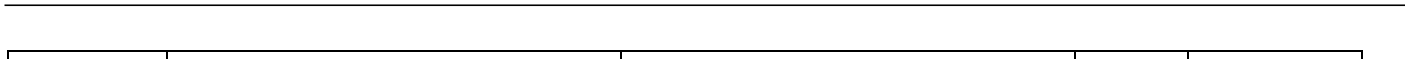
June 2018 | 8461/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	any **three** from: • arteries have a thick**er** layer of muscle (tissue) **or** veins have a thinn**er** layer of muscle (tissue) • arteries have a thick**er** layer of elastic tissue **or** veins have a thinn**er** layer of elastic tissue • arteries have a narrow**er** lumen **or** veins have a wid**er** lumen • arteries do not have valves **and** veins have valves	if neither marking points 1 or 2 awarded, allow arteries have a thick wall **and** veins have a thin wall **or** arteries have a thick**er** wall **or** veins have a thinn**er** wall for **1** mark do **not** accept 'cell wall' allow descriptions of 'lumen' allow **only** veins have valves	3	AO1 4.2.2.2
03.6	allow an X drawn anywhere in grey shaded area below: 	if a large X is drawn, award the mark if the intersection touches the grey area if a label line is used, award marks if the end of the label line touches the grey area allow label 'pacemaker' ignore label 'right atrium'	1	AO1 4.2.2.2
03.7	an irregular heart beat	allow arrhythmia allow fibrillation ignore heart failure do **not** accept cardiovascular disease / heart murmur	1	AO1 4.2.2.2
Total			**13**	

4.4.2.2 Response to exercise

Answer 37 · Mark scheme

June 2018 | 8461/1H | Original Q3



4.4.2.2 Response to exercise

Answer 38 · Mark scheme

June 2019 | 8461/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	**Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.		3–4	4.2.2.4 4.2.2.2 4.1.3.1 AO2
	Level 1: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.		1–2	
	No relevant content		0	
	Indicative content: • backflow can occur **or** some blood flows backwards • less blood leaves the heart **or** less blood is pumped around the body **or** some blood stays in the heart (instead of being pumped out) **or** reduced blood pressure **or** reduced flow rate • less oxygen supplied to muscles / cells • (so) less aerobic respiration • (so) less energy released • (so) less (efficient) muscle contraction • anaerobic respiration takes place • less (efficient) removal of lactic acid **or** lactic acid builds up **or** oxygen debt occurs • (lactic acid building up) causes muscle fatigue • less (efficient) removal of carbon dioxide (from blood) a **level 2** response should refer to both respiration **and** the effects on exercise			

4.4.2.2 Response to exercise

Answer 38 · Mark scheme June 2019 | 8461/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2		ignore raw numbers from **Table 4**		4.2.2.4 AO3
	(deaths mechanical valve =) 6% / 6.31136%	allow correctly rounded value	1	
	(deaths biological valve =) 10% / 10.14823%	allow correctly rounded value	1	
	(therefore a) higher proportion / percentage of patients die with biological valve **or** patients are more likely to die with biological valve	do **not** accept more patients die with a biological valve allow **2** marks for ratio mechanical : biological = 1:1.6 **or** 1:1.7 **or** correctly calculated value allow **3** marks for deaths with biological valves = 4% / 3.83687% higher **or** correctly rounded value **or** patients are 1.6 / 1.7 times more likely to die with biological valves if **no** other marks awarded, allow for **1** mark chance of death after a valve replacement is 8% / 7.77247% **or** correctly rounded value	1	AO2

4.4.2.2 Response to exercise

Answer 38 · Mark scheme

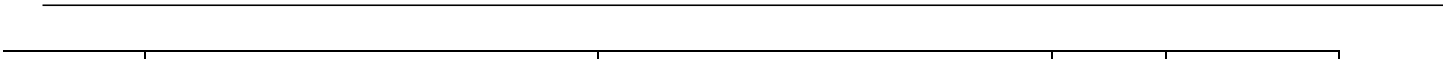
June 2019 | 8461/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	platelets	allow thrombocytes	1	4.2.2.3 AO1
05.4	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.		5–6	4.2.2.4 AO2 AO3
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.		3–4	
	Level 1: Relevant points are made. They are not logically linked.		1–2	
	No relevant content		0	
	Indicative content: **mechanical valves** • longer lasting **or** more durable **or** don't wear out as easily **or** less likely to need replacing (within 6 years) • blood clots (on the brain) are more likely (after surgery) • patient has to take anti-clotting medication (for the rest of their lives) • if medication not taken (correctly), clots can lead to blood clots on brain / heart attack • medication can lead to excessive bleeding (after injury) • some patients say they can hear the valves opening and closing • survival rate at 5 years is slightly higher for mechanical valve • lower percentage of deaths due to heart-related problems **biological valves** • no additional medication required • ethical issues surrounding use of animal tissue • valve may harden • more likely to need further operation **or** another new valve • more likely to be rejected • more likely to need (immuno-suppressant) medication **both valves** • both are readily available • little wait time a **level 2** response should contain comparisons of both valves **and** some reference to own knowledge			
Total			**14**	

4.4.2.2 Response to exercise

Answer 38 · Mark scheme

June 2019 | 8461/1H | Original Q5



4.4.2.2 Response to exercise

Answer 39 · Mark scheme

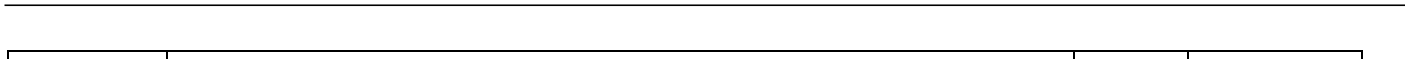
November 2021 | 8461/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3.1	any **one** from: • movement would release (extra) heat • movement would increase body temperature • movement would increase sweating		1	AO2 4.5.1 4.5.2.4
3.2	37.4 °C		1	AO2 4.5.1 4.5.2.4
3.3	<u>blood</u> is cooled at stomach / mouth (cooled) blood flows to the brain		1 1	AO2 4.5.1 4.5.2.4
3.4	via nerve(s) / neurones **or** via (nerve) impulse(s)	ignore type of neurone allow electrical signals allow via the nervous system	1	AO2 4.5.1 4.5.2.4
3.5	less sweating occurs so less heat is lost **or** less cooling	allow less sweat evaporates do **not** accept no sweating allow less heat used for evaporation of sweat / water	1 1	AO3 AO2 4.5.1 4.5.2.4
3.6	dilation of blood vessels in the skin		1	AO2 4.5.1 4.5.2.4
Total			**8**	

4.4.2.2 Response to exercise

Answer 39 · Mark scheme

November 2021 | 8461/2H | Original Q3



4.4.2.2 Response to exercise

Answer 40 · Mark scheme

June 2022 | 8461/2H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	echidna: 27 to 35 **or** by 8 (°C) **and** human: 36.2 to 37.2 **or** by 1 (°C)	allow a tolerance of ± 0.5 (°C) allow a tolerance of ± 0.1 (°C)	1	AO3 4.5.1 4.5.2.4
	echidna is more variable **or** human fluctuates less	allow echidna is 7 (°C) more variable for **2** marks allow echidna is 8 times more variable for **2** marks	1	

4.4.2.2 Response to exercise

Answer 40 · Mark scheme

June 2022 | 8461/2H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2		do **not** accept energy produced / made / created do **not** accept energy used for respiration		AO2 4.5.2.4 4.5.3.2 4.4.2.1
	loses less energy (from its body)	allow loses / wastes less heat	1	4.4.2.3
	(so) body energy store lasts longer	allow glycogen / fat lasts longer allow stored food lasts longer	1	
	OR			
	lower temperature gradient (between echidna and air) (1)			
	(so) loses less energy (1)	allow loses less heat		
	OR			
	less energy transferred maintaining (higher) body temperature (1)	allow less energy transferred for keeping warm		
	(so) more energy available for processes vital for life (1)	allow more energy for eg heart / brain function ignore metabolism		

4.4.2.2 Response to exercise

Answer 40 · Mark scheme June 2022 | 8461/2H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	activity / movement requires energy from respiration (and) respiration / metabolism releases heat (which increases body temperature) **OR** respiration / metabolism releases heat (which increases body temperature) (1) (which) increases the rate of chemical reactions **or** increases enzyme activity (1)	do **not** accept energy produced / made / created **once** only	1 1	AO2 4.5.2.4 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	more blood flow near surface (of skin) **or** more blood flow to the skin (so) more heat / energy is lost (from the blood) cools blood which cools the body	do **not** accept blood vessels move nearer to surface of skin ignore cools blood / body unqualified	1 1 1	AO1 4.5.2.4

4.4.2.2 Response to exercise

Answer 40 · Mark scheme

June 2022 | 8461/2H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	$\frac{20\,000 \times 40}{100 \times 2.5}$ **or** $\frac{8000}{2.5}$		1	AO2 4.5.2.4
	3 200 (cm^3)		1	
	3.2 (dm^3)	allow an incorrectly calculated value correctly divided by 1000	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	to replace ions / salt lost (in sweat)	allow named example such as Na^+ allow because ions / salt lost in sweat allow to prevent (muscle) cramp	1	AO2 4.5.2.4 4.5.3.3

Total Question 8		13

4.4.2.2 Response to exercise

Answer 41 · 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

4.4.2.2 Response to exercise

Answer 41 · 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	

4.4.2.2 Response to exercise

Answer 41 · 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

4.4.2.2 Response to exercise

Answer 41 · 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**

4.4.2.2 Response to exercise

Answer 42 · Mark scheme June 2025 | 8461/1H | Original Q5

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

4.4.2.2 Response to exercise

Answer 42 · Mark scheme

Question	Answers	Mark	AO / Spec Ref.
05.3	<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	2	AO3 4.2.2.2

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	

4.4.2.2 Response to exercise

Answer 42 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.7	(the athlete has an) <u>oxygen debt</u>	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 <u>aerobic</u> respiration to transfer / release (more) energy **or** (athlete can do) more <u>aerobic</u> respiration so less muscle fatigue / cramp	allow (athlete will do) less <u>anaerobic</u> respiration which transfers / releases less energy allow (athlete will do) less <u>anaerobic</u> 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

4.4.2.2 Response to exercise

Answer 36 · Examiner comments

June 2018 | 8461/1H | Original Q2

Question 2 (standard demand)

02.1 By far the most common correct responses referred to either respiration or protein synthesis. Metabolic reactions in plants were rarely given. Students who did not gain this mark often referred to digestion in the alimentary canal, which is extra-cellular, or gave a description of metabolic rate.

02.2 Almost all students managed to identify at least one correct conclusion, from those given in the question, with 85% of students identifying both correct conclusions.

02.3 62% of students achieved all three marks here, often rounding to three significant figures directly from their calculator displays. Incorrect rounding at some point in the calculation occasionally lost a mark. In addition, not recognising that the first 0 after the decimal point counted as a significant figure (giving an answer of 32.08), also cost some students a mark.

02.4 27% of students did not achieve marks because they either didn't describe changes in the heart rates in response to exercise or didn't compare the two people, both of which the question demands. Of these, some students simply compared resting heart rates, or overall heart rates with no reference to the impact the exercise had on the heart rate.

The most common answer given by students satisfied the first marking point. The second marking point was rarely awarded as students did not make the comparison between the two people. They were often able to correctly say that the heart rate for person R levelled off, but did not go on to compare this to the continued increase for person S.

If students calculated the overall increase the figures given were usually correct. A few students calculated the percentage increase, also usually correctly.

A few students attempted to explain the differences in terms of fitness, rather than simply describe the differences.

02.5 Completion of the graph was generally well done with 69% of students achieving all four marks. Where marks were lost it was often due to incomplete labelling of the *x*-axis, such as omission of part, or all, of the label, or giving the unit as 'm', rather than an appropriate unit.

Incorrect plotting was rare; although some appeared to have plotted the values at 3 and 4 minutes on 118 and 128 this was accepted as in tolerance.

A significant minority of students did not draw a graph at all and simply added a scale and label, achieving only one mark.

4.4.2.2 Response to exercise

Answer 36 · Examiner comments June 2018 | 8461/1H | Original Q2

02.6 This calculation was worked out either by subtracting the two heart rates and dividing by 12 or by sequential deductions of 12 from the higher heart rate.

A substantial number of students arrived at the correct answer by one of these methods, but the most common mistake was to arrive at 4 or 5 minutes (rather than 4.5) by the deductions method and not factor in the correct subtraction of half a minute's heart rate decrease. Some students rounded up to 5 minutes having reached the correct answer initially despite not being told to give the answer as a whole number.

Some students divided 132 by 12 without accounting for the fact that the heart rate only had to fall to 78, not to 0.

02.7 It is important that students understand the need for investigation designs to provide **valid** outcomes. In this case, the use of only one or two individuals of each type will not do this and those students who went down this route could not reach level 3. Furthermore, repetition with the same individuals is not equivalent to having large numbers of participants.

There were many good answers with students identifying several control variables, other than those involved directly with the exercise. Most students recognised the need to measure heart rate before and after exercise (and often all the way through as well) but then did not make it clear how they would use that data to calculate the increase in the heart rate. Many simply suggested calculating a mean without specifying what they would be taking a mean of.

Some suggested plotting the data on a graph and comparing the gradient from a smoker with a non-smoker which is a valid way of comparing an increase without subtracting starting rate from end rate.

4.4.2.2 Response to exercise

Answer 37 · Examiner comments

June 2018 | 8461/1H | Original Q3

Question 3 (standard & standard / high demand)

03.1 72% of students achieved at least one of these marks and many gained both, commonly giving two out of carbon dioxide, water and glucose. However, many students did not distinguish between substances, as required by the question, and various blood cell types were given, which were not acceptable.

03.2 There were two common omissions in answers. Firstly, many students omitted any reference to haemoglobin. Secondly many students did not link the increased oxygen supply to muscle cells, which would be needed by the athlete; and instead just indicated increased oxygen in the body, generally.

A significant minority of students referred to energy being made, created or produced, which will always disqualify otherwise correct answers.

4.4.2.2 Response to exercise

Answer 37 · Examiner comments June 2018 | 8461/1H | Original Q3

03.3 The most common error was to identify the pulmonary vein, rather than the pulmonary artery as carrying deoxygenated blood. Most students achieved at least one mark by identifying vena cava.

03.4 The correct answer 'B' was most commonly given, but the other two alternatives were occasionally seen.

03.5 This question asked for a comparison between an artery and a vein. Many students wrote about arteries and veins but did not make clear comparisons between them. Most marks were awarded for the alternate answer describing the walls of arteries as being thick(er) and the thin(ner) walls of veins. Very few students referred to the relative thicknesses of the elastic or muscle layers of the vessels.

Students who did not achieve marks often correctly stated that veins contain valves but made no further comparative statement about the lack of them in arteries. The difference in the size of the respective lumens was expressed in numerous ways; however thick or thin were terms not accepted as they don't describe the relative size of the lumens themselves.

This question would lend itself to a tabulated response thus ensuring a comparison for all answers was given but very few students took this route. Some students lost marks by referring to the cell walls of blood vessels which is clearly incorrect.

03.6 Most students added an X to the figure, but relatively few students (34%) achieved the mark. It appeared that despite efforts to clearly indicate where questions are being asked or instructions given, some students only respond when there are lines to write answers on.

03.7 There were many references to indeterminate cardiovascular diseases, with relatively few students (34%) knowing what a pacemaker is used to treat.

4.4.2.2 Response to exercise

Answer 39 · Examiner comments

November 2021 | 8461/2H | Original Q3

Question 3 (standard demand)

This question was about the maintenance of human body temperature. Although most students understood that the person whose temperature and rate of sweating were being monitored in the investigation should remain still to avoid an increase in these quantities, many gave the vague and inadequate answer that movement would have 'affected' them.

The vast majority of students were able to read the required body temperature (37.4°C) from the graph but approximately one-fifth presumably did not refer to the graph and chose one of the other options (36.8°C or 37°C) from their general knowledge.

03.3 revealed a lack of understanding in the vast majority of students (1 in 9 scored any marks). Very few appreciated that, upon drinking some ice-cold water, the *blood* would be cooled at the mouth or stomach and that this cooled *blood* would lead to a decrease in temperature near the brain. Most assumed it was the proximity of the mouth to the brain that caused the temperature decrease in the latter.

Around half of the students knew that the thermoregulatory centre in the brain communicated with the sweat glands via the nervous system, although the use of hormones was a common misconception.

In **03.5**, students were given a specific time period to consider in Figures 5 and 6 (graphs showing changes in body temperature and in the rate of sweating, respectively) but very few were able to explain that there was *less* sweating (as opposed to 'no sweating') and that consequently *less* heat would have been lost. Many students did not give an answer that related to the data in the graphs or did not refer to the time period specified in the question. Many also included irrelevant information about vasodilation, vasoconstriction or shivering.

In **03.6**, a common misconception was revealed: although half the students correctly selected dilation of blood vessels in the skin as the reason for reddening of the skin, almost as many, thought that the blood vessels would have moved closer to the skin surface.

4.4.2.2 Response to exercise

Answer 40 · Examiner comments — June 2022 | 8461/2H | Original Q8

Question 8

This question compared temperature regulation in a primitive mammal, the echidna, with that of a human.

08.1 Since a comparison of temperature variation in the echidna and the human was required, using data from the graphs in **Figures 11** and **12**, it was essential to quote or manipulate numbers from the graphs and to state which variation was the greater. Fewer than a quarter of students were completely successful. Some misread the figures on one or both graphs, others selected the cold-weather data for the echidna whereas warm weather had been asked for, and others did not state which organism's variation was the greater.

08.2 Many students struggled to understand why a low body temperature for hibernation in cold weather would benefit the echidna. Although just over half appreciated the animal would lose less energy, or heat, from its body, few could go on to explain that this was because of the lower temperature gradient between the echidna and its environment or explain that its body energy stores would last longer as a result.

08.3 Two different approaches to answering this question were given credit: to explain how activity could cause an increase in body temperature or to explain why an increase in body temperature would enable the animal to be more active. Either of these hinged on the vital point that energy was released by *respiration*, which was not mentioned by many students and thus only one-third scored any marks.

08.4 Explanations of how dilation of blood vessels in the skin could result in a decrease in body temperature were generally deficient in two respects: a misunderstanding of vasodilation and the omission of how cooling the blood in the skin resulted in a lowering of the temperature of the rest of the body. Some just stated that more blood flowed through dilated vessels or stated incorrectly that the vessels rose up through the skin. Hardly any students could explain that blood cooled at the skin would flow round the rest of the body

Answer 40 · Examiner comments — June 2022 | 8461/2H | Original Q8

and so remove heat from the other parts of the body. The one point generally scored was that more heat would be lost from the blood through the skin.

08.5 This proved to be a straightforward calculation for three-quarters of students, who scored full marks. A common error was the failure to convert correctly an answer in cm^3 to dm^3, even with the fact, given in the question, that 1000 cm^3 equalled 1 dm^3. Some left their answers as 3200 cm^3 of sweat lost by the athlete per day, others incorrectly coverted this to the somewhat improbable answer of 3 200 000 dm^3 per day.

08.6 The need to take salt tablets was related to replenishment of the salt lost in sweat by fewer than half of the students. Many thought that the extra salt in the blood would help to retain water in the body.

4.4.2.2 Response to exercise

Answer 41 · 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.

4.4.2.2 Response to exercise

Answer 41 · 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.

4.4.2.2 Response to exercise

Answer 42 · Examiner comments

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.

4.4.2.2 Response to exercise

Answer 42 · 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

4.4.2.2 Response to exercise

Answer 42 · 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.