AQA GCSE Biology | 8461

SPECIFICATION POINT 4.5.2.4

Control of body temperature (biology only)

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**23**
Available paper years	**2008–2025**

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.

4.5.2.4 Control of body temperature (biology only)

Answer 01 · Mark scheme

June 2008 | BLY1AP | Original Q5 | Legacy

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

Answer 02 · Mark scheme

June 2008 | BLY1BP | Original Q6 | Legacy

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

4.5.2.4 Control of body temperature (biology only)

Answer 03 · 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…

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**

4.5.2.4 Control of body temperature (biology only)

Answer 03 · Mark scheme January 2009 | BLY2H | Original Q5 | Legacy

COMPONENT NUMBER: BLY2H

COMPONENT NAME: Additional Science / Biology

STATUS: Final

DATE: January 2009

Answer 04 · Mark scheme March 2010 | BLY1AP | Original Q1 | Legacy

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

4.5.2.4 Control of body temperature (biology only)

Answer 05 · Mark scheme

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**

4.5.2.4 Control of body temperature (biology only)

Answer 05 · Mark scheme

June 2010 | BLY1H | Original Q5 | Legacy

BLY1H

4.5.2.4 Control of body temperature (biology only)

Answer 06 · Mark scheme

June 2010 | BLY2H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	liver		1
5(a)(ii)	kidney	allow urethra / bladder ignore ureter	1
5(a)(iii)	(excess) protein / named / amino acids	accept amino / ammonia	1
5(b)	less / no sweating less heat lost / evaporation	allow ideas of how sweat glands change in order to reduce sweating	1 1
5(c)(i)	become narrower / constrict	allow contract / get smaller etc allow less blood flows through vessels do **not** allow capillaries become narrower **or** reference to movement of vessels	1
5(c)(ii)	reduced / no heat loss	allow heat gained from room	1
Total			**7**

4.5.2.4 Control of body temperature (biology only)

Answer 06 · Mark scheme

June 2010 | BLY2H | Original Q5 | Legacy

BLY 2H

Answer 07 · Mark scheme

November 2010 | BLY1AP | Original Q8 | Legacy

Eight	**3**	**4**	**3**	**1**

Answer 08 · Mark scheme

November 2010 | BLY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	the wind blows sand around	**3**
	B	very cold nights	**4**
	C	soft ground	**2**
	D	dry conditions	**1**

4.5.2.4 Control of body temperature (biology only)

Answer 09 · Mark scheme

January 2011 | BLY2H | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)	any **two** from • reference to role of thermoregulatory centre detecting rise in temperature (of blood or skin) **or** / causing increase in sweating • more evaporation • more cooling / heat loss	need to refer to more at least once to gain **both** marks without reference to more only award max **1** mark if both ideas given, eg cooling alone gets no marks	2
8(b)	blood vessels supplying (skin) capillaries **or** arteries **or** arterioles dilate / widen	do **not** accept capillaries / veins allow vasodilation do not accept idea of blood vessels moving note: marks are awarded independently accept shunt vessels close for **2** marks	1 1 1
8(c)(i)	muscle contraction	ignore relaxing do **not** allow vasoconstriction	1
8(c)(ii)	respiration (respiration) releases / produces heat	 reference to respiration is required for this mark	1 1
Total			**7**

4.5.2.4 Control of body temperature (biology only)

Answer 10 · Mark scheme

June 2011 | BLY1AP | Original Q6 | Legacy

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

4.5.2.4 Control of body temperature (biology only)

Answer 11 · Mark scheme

June 2011 | BLY2H | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	thermoregulatory centre	allow thermoregulation centre allow hypothalamus	1
7(a)(ii)	it has receptors reference to temperature of blood	ignore receptors in skin allow plasma for blood	1 1
7(b)	muscles contract increased respiration **or** more heat released	ignore relax / expand allow more heat produced if more not given allow respiration releases / produces heat	1 1
7(c)(i)	(blood vessels / arteries / arterioles) dilate / widen	do **not** accept capillaries dilate ignore blood vessels get bigger / expand do **not** accept idea of blood vessels moving	1
7(c)(ii)	more blood close to / near surface more heat lost **or** heat lost faster **or** cools faster	allow blood is closer to the surface do **not** accept idea of blood vessels moving do **not** allow for idea of evaporation	1 1
Total			**8**

4.5.2.4 Control of body temperature (biology only)

Answer 11 · Mark scheme

June 2011 | BLY2H | Original Q7 | Legacy

BLY2H

4.5.2.4 Control of body temperature (biology only)

Answer 12 · 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**

4.5.2.4 Control of body temperature (biology only)

Answer 12 · Mark scheme

June 2011 | BLY3H | Original Q4 | Legacy

BLY3H

4.5.2.4 Control of body temperature (biology only)

Answer 13 · 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'	1
		if no reference to skin allow blood vessels dilate and blood vessels constrict for one mark	
	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**

4.5.2.4 Control of body temperature (biology only)

Answer 14 · Mark scheme June 2014 | BL3HP | Original Q6 | Legacy

6(a)(i)	1 hour 15 mins / 1.25 hours / 75 mins	allow 1:15 ignore 1.15 hours	1	AO3 3.3.2
6(a)(ii)	increase in (core / body) temperature (due to an) increase in <u>respiration</u> **or** more <u>muscle</u> contraction releasing energy (as a waste product) skin temperature decreases (because there is) sweating (which) evaporates and cools the skin	ignore numbers allow produces 'heat' do **not** allow making energy ignore references to vasodilation or vasoconstriction	1 1 1 1 1 1	AO1 / AO2 / AO3 3.3.2a
6(a)(iii)	(there is) dilation of vessels (supplying skin capillaries) (so) more blood flows (near skin) (surface) **or** blood is closer (to the skin)	allow vasodilation allow blood vessels widen ignore expand do **not** accept dilating capillaries or moving vessels ignore ref to heat	1 1	AO1 / AO2 3.3.2d
6(b)	pancreas detects (low) blood glucose produces glucagon (so) glycogen is converted to glucose	 do **not** allow glucagon made in the liver allow adrenaline released which increases conversion of glycogen to glucose **or** reduced insulin production so less glucose into cells / less glucose converted to glycogen for 1 mark	1 1 1	AO1 3.3.3b
Total			12	

4.5.2.4 Control of body temperature (biology only)

Answer 14 · Mark scheme

June 2014 | BL3HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / spec ref.

4.5.2.4 Control of body temperature (biology only)

Answer 15 · Mark scheme June 2015 | BL1HP | Original Q7 | Legacy

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>7(a)</td><td>detect changes in surroundings or detect stimuli

convert information to impulse</td><td>allow any named stimulus for skin

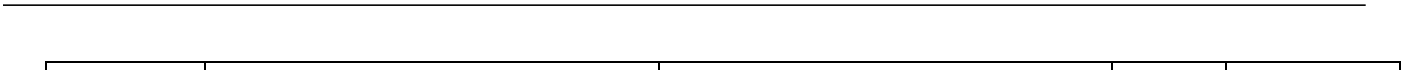
allow send impulse to sensory neurones / brain</td><td>1

1</td><td>AO1
1.2.1a/b</td></tr>
<tr><td>7(b)(i)</td><td><table><tr><td>muscle</td><td>contract(ion)</td></tr><tr><td>gland</td><td>release / secrete / produce chemical / hormone / enzyme</td></tr></table></td><td>1 mark for each effector
1 mark for each response
response must match type of effector (if given)
ignore examples
ignore relax(ation) / movement for contraction
do not allow expansion for muscles</td><td>4</td><td>AO1
1.2.1e</td></tr>
<tr><td>7(b)(ii)</td><td>any one from:
• (maintain temperature at which) enzymes work best
• so chemical reactions are fast(est)
• prevent damage to cells / enzymes</td><td>allow prevent enzymes being denatured (by temperature being too high)</td><td>1</td><td>AO1
1.2.2a</td></tr>
<tr><td>Total</td><td></td><td></td><td>7</td><td></td></tr>
</table>

4.5.2.4 Control of body temperature (biology only)

Answer 15 · Mark scheme

June 2015 | BL1HP | Original Q7 | Legacy



4.5.2.4 Control of body temperature (biology only)

Answer 16 · Mark scheme June 2015 | BL3HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	has the least amount of glucose (to) transfer energy (for the run)	allow least amount of fat **or** no fat allow (to) release energy (for the run) do **not** allow produces energy do **not** allow 'energy for respiration'	1 1	AO2 311d/e
5(a)(ii)	any **one** from: • cells will work inefficiently • absorb too much water / swell / overhydrate • lose too much water / shrink / dehydrate	ignore turgid / flaccid cells burst is insufficient allow cramp in muscle	1	AO2 311c/f
5(b)	any **three** from: • thermoregulatory centre • (has temperature) receptors • (which) monitor blood temperature (as it flows through the brain) • (temperature) receptors in the skin • (receptors) send impulses to the brain	ignore vasoconstriction / vasodilation / sweating allow hypothalamus impulses sent to the thermoregulatory centre = 2 marks	3	AO1 332b/c

4.5.2.4 Control of body temperature (biology only)

Answer 16 · Mark scheme

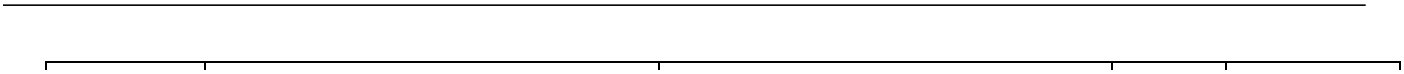
June 2015 | BL3HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(c)(i)	(sports drinks) contain a lot of glucose		1	AO1 / AO2 333c
	(a person with diabetes) does not produce insulin **or** does not produce enough insulin	allow (person with diabetes) has cells which do not respond to insulin do **not** allow insulin produced by liver	1	
	so blood glucose / sugar levels will rise too high **or** to a dangerous level		1	
5(c)(ii)	inject insulin **or** have an insulin pump (fitted)	do **not** allow swallow insulin accept exercise accept inhale insulin accept take metformin **or** other correctly named drug allow pancreatic transplant	1	AO1 333d
Total			**10**	

4.5.2.4 Control of body temperature (biology only)

Answer 16 · Mark scheme

June 2015 | BL3HP | Original Q5 | Legacy



4.5.2.4 Control of body temperature (biology only)

Answer 17 · Mark scheme

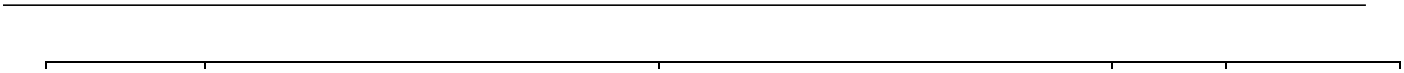
June 2016 | BL3HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7		ignore hair erection		AO1
	blood vessels supplying skin		1	3.3.2e
	constrict	allow vasoconstriction do **not** allow capillaries /veins constricting do **not** allow moving blood vessel	1	
	less blood flow (to / through capillaries / to skin)	allow blood flows further away from skin surface	1	
	so less energy is lost (to the surroundings)	allow less heat is lost	1	
	‘shivering’ by <u>muscle</u> (contraction)	allow <u>muscles</u> contract (and relax) rapidly	1	
	releasing energy **or** respiring (more)	allow ‘heat produced’ do **not** allow energy produced / made do **not** allow energy **for** respiration allow sweating stops / reduces	1	
Total			**6**	

4.5.2.4 Control of body temperature (biology only)

Answer 17 · Mark scheme

June 2016 | BL3HP | Original Q7 | Legacy



4.5.2.4 Control of body temperature (biology only)

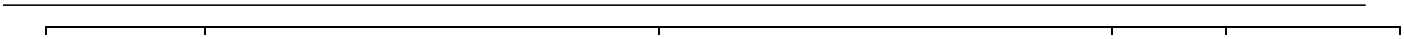
Answer 18 · Mark scheme June 2017 | BL3HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	(detected by) thermoregulatory centre	allow thermoregulatory part of brain allow detected by receptors in the brain	1	AO1 3.3.2b
7(b)	muscles contract (rapidly) this requires respiration (which) releases energy	 do **not** allow making energy allow making / releasing 'heat' ignore warms you up	1 1 1	AO1 3.3.2e
7(c)	blood vessels supplying the skin constrict (so) less blood flows to the skin / surface (of skin) (and) less energy is transferred (to the environment)	'skin' must be mentioned once for full marks allow vasoconstriction do **not** allow capillaries / veins constrict do **not** allow capillaries moving allow less heat is lost (to the environment) if no other marks awarded allow reduce sweating for 1 mark	 1 1 1	AO1 3.3.2e
Total			**7**	

4.5.2.4 Control of body temperature (biology only)

Answer 18 · Mark scheme

June 2017 | BL3HP | Original Q7 | Legacy



4.5.2.4 Control of body temperature (biology only)

Answer 19 · Mark scheme

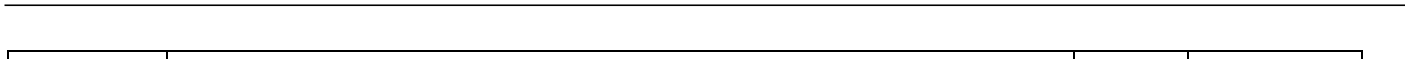
November 2021 | 8461/2H | Original Q3

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**	

4.5.2.4 Control of body temperature (biology only)

Answer 19 · Mark scheme

November 2021 | 8461/2H | Original Q3



4.5.2.4 Control of body temperature (biology only)

Answer 20 · Mark scheme

June 2022 | 8461/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$\frac{9.96 \times 10^{-3}}{1.35 \times 10^{-4}}$ 73.77… 74 (:1)	if no answer in answer space allow answer in **Table 6** allow $\frac{0.00996}{0.000135}$ allow a correctly derived whole number from an incorrect calculation do **not** accept if unit is given	1 1 1	AO2 4.1.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	as size increases, (surface area to volume) ratio decreases	allow they are inversely proportional **or** they are negatively correlated allow as one increases, the other decreases allow as size decreases, (surface area to volume) ratio increases	1	AO2 4.1.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	**D** has a smaller surface area to volume ratio (than **B**) (so) diffusion distance is too large (to meet demands of cells / organism)	allow converse for **B** throughout allow (so) diffusion takes too long (to meet demands of cells / organism)	1 1	AO3 AO2 4.1.3.1

4.5.2.4 Control of body temperature (biology only)

Answer 20 · Mark scheme

June 2022 | 8461/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4		allow converse for **E** throughout		AO3
	D has a larger surface area to volume ratio **and** so will lose heat more quickly (per unit volume than **E**)	allow **D** has a larger surface area to volume ratio **and** so temperature of **D** will drop more quickly ignore **E** loses more heat (overall)	1	AO2
	(**D**) requires greater rate of respiration		1	AO2
	(as) respiration is a (large) part of metabolism		1	AO2
	(so) need to generate more <u>heat</u> (to keep itself warm)	allow (so) needs to release more <u>heat</u> (to keep itself warm) do **not** accept energy produced / made / created	1	4.1.3.1 4.4.2.1 4.4.2.3

4.5.2.4 Control of body temperature (biology only)

Answer 20 · Mark scheme

June 2022 | 8461/1H | Original Q6

Question	Answers	Mark	AO / Spec. Ref.
06.5	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3–4	AO1 4.1.3.1 4.1.3.3 4.2.2.2
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	
	No relevant content	0	
	Indicative content • **both** have a large surface area o to maximise diffusion • **both** have thin walls **or** have walls that are one cell thick o to reduce diffusion distance / time • **both** are in close proximity to blood supply o to reduce diffusion distance / time • **both** have a good blood supply **or** both have a capillary network o to maintain concentration gradient • villi have microvilli o to (further) increase surface area • cells of villi contain many mitochondria o for active transport For **Level 2** reference to functions of structural details of **both** alveoli and villi is required.		

Total Question 6		**14**

4.5.2.4 Control of body temperature (biology only)

Answer 21 · 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	

4.5.2.4 Control of body temperature (biology only)

Answer 21 · 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		

4.5.2.4 Control of body temperature (biology only)

Answer 21 · 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

4.5.2.4 Control of body temperature (biology only)

Answer 21 · Mark scheme

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**

4.5.2.4 Control of body temperature (biology only)

Answer 22 · Mark scheme

June 2023 | 8461/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.1		allow answers in terms of insulin for hormone **A** and / or glucagon for hormone **B** allow answers in terms of blood glucose (concentration) for substance **Q**		AO3 4.5.3.7 4.5.3.2 4.5.3.1
	if (concentration of substance) **Q** becomes high (hormone) **A** is released / used		1	
	if (concentration of substance) **Q** becomes low (hormone) **B** is released / used		1	
	hormone(s) / **A** / **B** brings (concentration of) substance **Q** back to ideal / normal		1	

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.2	(thyroxine) increases (basal) metabolic rate	allow (thyroxine) increases metabolism allow (thyroxine) increases respiration allow (thyroxine) increases reactions in cells	1	AO1 4.5.3.7 4.4.2.1 4.4.2.3
	<u>respiration</u> releases energy	allow <u>respiration</u> releases heat do **not** accept energy being produced / made / created allow <u>respiration</u> is exothermic	1	

4.5.2.4 Control of body temperature (biology only)

Answer 22 · Mark scheme

June 2023 | 8461/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec Ref.
05.3	(kidney) tubules less permeable to water		1	AO1
	(so) less water is reabsorbed	allow (so) less water taken back into the blood	1	AO1
	(so) more water in urine causing increased rate of production (of urine)	allow (so) more water in urine causing increased volume (of urine)	1	AO2
	(so) more water in urine causing lower concentration of dissolved substances (in urine)	(so) more water in urine causing more dilute urine	1	AO2 4.5.3.3

Total Question 5	9

4.5.2.4 Control of body temperature (biology only)

Answer 23 · Mark scheme

June 2025 | 8461/2H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	*genotype* **HH** *reason* all offspring have (at least one) **H** **or** female **A** gives **H** to every offspring **or** none of the offspring are white so female **A** does not have a **h**	allow homozygous dominant MP2 is dependent on MP1	1 1	AO3 AO2 4.6.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	gametes correct for both parents: **H** + **h** correct derivation of offspring genotypes: **HH** + **Hh** + **Hh** + **hh** correct phenotype for each genotype: **HH** + **Hh** = Himalayan **and hh** = white probability correct for offspring genotypes, eg 0.25 / ¼ / 25% / 1 in 4	 allow correct derivation from incorrect gametes allow correct phenotypes for stated genotypes allow 1:3 do **not** accept 1 in 3 / 1:4 / 3:1 do **not** accept 0 / 100%	1 1 1 1	AO2 AO2 AO2 AO3 4.6.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	gives different set of 3 bases	allow gives a different triplet ignore codon	1	AO1
	codes for a different amino acid		1	AO1
	(which) alters shape of the (enzyme's) active site	allow the (enzyme's) active site is no longer complementary (to tyrosine / substrate)	1	AO2
	(so) tyrosine / substrate no longer fits	allow cannot form enzyme-substrate complexes	1	AO2 4.6.1.5 4.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	temperature inside mother's body is greater than 35 °C **or** temperature inside nest is greater than 35 °C	allow mother's body temperature is 39 °C	1	AO2
	(so) tyrosinase / enzyme does not work	allow tyrosinase / enzyme is inactive do **not** accept tyrosinase / enzyme is denatured	1	AO3 4.2.2.1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	outside environment is cooler	allow outside environment is less than 35 °C	1	AO2 4.5.2.4
	rabbit loses heat from ears / nose / feet / extremities **or** temperature of ears / nose / feet / extremities drops (more than rest of body)		1	
	(so) tyrosinase is (more) active		1	

4.5.2.4 Control of body temperature (biology only)

Answer 23 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	stops (UV / ionising) radiation causing mutation (in skin cells) (which can) lead to (skin) cancer	allow UV / ionising radiation can cause mutation (in skin cells) allow description of cancer eg tumours **or** uncontrolled cell division	1 1	AO2 4.2.2.6 4.2.2.7 4.6.1.5

Total Question 8	**17**

4.5.2.4 Control of body temperature (biology only)

Answer 19 · 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.

Answer 20 · Examiner comments — June 2022 | 8461/1H | Original Q6

Question 6 (Standard/high and high demand)

06.1 Over three quarters of students scored full marks in this question, selecting the correct numbers for surface area and volume from the table, dividing surface area by volume and then correctly rounding their answer of 73.77... to 74, the nearest whole number. Some students simply selected the correct numbers and wrote them as a ratio, but didn't progress to simplify this by dividing, so scored no marks. Another relatively common mistake that was seen was when students converted the standard form numbers to 'normal' numbers, but in doing so missed out one of the nines from 0.00996.

Answer 20 · Examiner comments June 2022 | 8461/1H | Original Q6

06.2 60% of students answered correctly, stating that as the size of the organism increased, the ratio decreased. The converse of this was also commonly seen and credited. A few noted the creditworthy relationship of inverse proportionality also. Students were asked for a relationship between two factors, but some did not refer to these factors in their response. This was the most obvious reason for students not achieving the mark. Some students got the relationship the wrong way round and others appeared to compare surface area to volume for each organism i.e. volume increasing as surface area increases, for example, stating that surface area is always bigger than volume.

06.3 Over 60% of students scored zero marks in this question. Just over 35% of students gained the first marking point, for the idea that organism **D** has a smaller surface area to volume ratio than organism **B**. Those that didn't achieve the mark failed to make their answer comparative. The converse was also credited. Very few students achieved the second mark point, which was for the idea that either the diffusion distance is **too** large or that diffusion would take **too** long. Many students just repeated the question stem and didn't mention the word diffusion.

06.4 This high demand question was not accessible to most students, with nearly 85% scoring zero marks. Most students recognised that **D** had a larger surface area to volume ratio, however failed to link this to losing heat more quickly. Some, but not many, realised that more respiration would be needed. Many students realised that metabolism is the sum of the chemical reactions in the body, but few made the link that respiration was a key part of it. Consequently, very few scored the final two marking points, with many students just stating that the rate of metabolism had increased, using information from the table in the question.

06.5 This levelled response question required students to make links between the adaptations of both villi and alveoli, which many students found difficult. The most common mark on this question was 1. Some students very competently described how the alveoli and villi are adapted to increase absorption. Some students, however, knew lots of detailed and correct information, but did not answer the question and refer to features of both alveoli and villi in their answer. Some answers lacked precision; many students lost marks referring to absorption rather than diffusion. There was also a number of references to thin membranes as opposed to thin walls. Other common mistakes were: the villi being one cell thick, reference to cell walls and the villi containing mitochondria, rather than the cells of the villi. Students who talked about both alveoli and villi and linked the adaptation to the correct consequence scored well.

Answer 21 · 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 21 · 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.

4.5.2.4 Control of body temperature (biology only)

Answer 22 · Examiner comments

June 2023 | 8461/2H | Original Q5

Question 5

This question was about homeostasis controlled by hormones.

05.1 Most students understood the simple representation of negative feedback shown in Figure 8 for the regulation of the concentration of a substance dissolved in the blood. The main omission, by one-quarter of students, was in not pointing out that the action of each hormone would return the concentration back to the ideal, or normal, concentration. Just under one-half of students gained full marks.

05.2 Understanding of the action of thyroxine, in the context of raising body temperature, was very limited. Many invoked temperature-regulation mechanisms such as vasoconstriction. Only 1 in 9 fully appreciated that thyroxine raised the metabolic rate and that one aspect of this – respiration – would release energy, or heat.

05.3 Table 2 showed the effects of different concentrations of ADH in the blood on the concentration of dissolved substances in urine and on the rate of urine production. Students had to explain the effects of a decrease in ADH between two of the values in the table. Hardly any mentioned that a lowering of ADH would decrease the permeability of the kidney tubules to water. Many understood that the change would decrease the reabsorption of water by the kidneys but the consequential effect on the urine was often poorly explained – few could relate the volume increase and the concentration decrease to more water being in the urine. Only 1 in 40 scored all 4 marks and only one-quarter scored half-marks. Some students just described the function of ADH without relating their answer to the decrease given in the question. Others used the inadequate term ‘absorption’ rather than reabsorption. Others thought that absorption related to water entering the kidney tubule rather than leaving it.

4.5.2.4 Control of body temperature (biology only)

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Question 8 (Standard/high and High demand)

08.1

A third of students gained both available marks for this question. Many students were able to correctly identify HH as the genotype. The alternative correct response of 'homozygous dominant' was also used by some students. A significant number gave incorrect answers of H, Hh and hh, whilst a few simply wrote heterozygous or homozygous. It was also clear that a significant number of students did not know what 'genotype' meant and wrote answers such as black or Himalayan. Some students used different letters to the required HH and did not include a key to indicate what their letters represented, so could receive no credit.
Some students were able to write very clear explanations for their selection of the HH genotype that matched one the three alternatives on the mark scheme. Some students wrote answers that successfully explained their answer of HH using a reverse logic.

08.2

A pleasing 40% of students were able to successfully draw a fully annotated Punnett square diagram and use it to give the probability of offspring being white – achieving full marks.
Many students were able to use the correct gametes for both parents, gaining mark point 1.
Students demonstrated good skills in deriving offspring genotypes in their Punnett squares even when their selected parental genotypes were incorrect and so gained mark point 2.
The commonest error for this question was the omission to clearly identify the phenotypes for each of the given offspring genotypes for mark point 3. The terms 'homozygous' and 'heterozygous' were used frequently to describe each phenotype, so did not gain credit.
Many students were able to give the correct probability from their Punnett square for mark point 4 to be awarded. Those students who chose incorrect parental genotypes of Hh and hh often subsequently gave 50% as their probability from correctly derived offspring, so could gain credit. A small number of students who ended up with HH, HH, Hh and Hh as their four offspring genotypes thought that the Hh genotypes were white.

08.3

Only 1% of students achieved full marks for this question, with 60% gaining no marks or not attempting the question. Many had an idea of how protein synthesis works but there was much confusion evident, for example amino acids coding for a gene or a protein, rather than the base triplet coding for an amino acid. The first mark point was not achieved by the vast

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majority of students, with some referencing codons or bases but few referred to a triplet or 3 bases. Many students then incorrectly stated that 'a different amino acid or protein was *made*', rather than 'a different amino acid was coded for'.
The final two marking points were most commonly seen among the 15% of students that scored 2 marks in this question. Several students were familiar with and could explain the idea of the active site changing shape and the consequences of that change in that the substrate would no longer fit to it.

08.4
Nearly 60% of students could give a partial explanation as to why the fur was white in the first four weeks of life – gaining at least 1 mark. Responses needed to specifically refer to either the temperature of the nest or the mother's body temperature – rather than the body temperature of the young rabbit.
Many students were able to explain the idea of the tyrosinase/enzyme not working above 35 °C, but a significant number went on to state that the enzyme was denatured which therefore precluded them from the second marking point.

08.5
Three quarters of students were able to score at least 1 mark in this question, with less than 5% of those gaining all 3 available marks. Some students correctly mentioned the outside environment being colder, but many referred to the young rabbit's body temperature falling, rather than just its extremities. A considerable number of students incorrectly stated that the body temperature of the young rabbits was between 15°C and 25°C. Correct ideas for mark point 2 were rarely awarded.
Many students were able to correctly state that the tyrosinase was now active for mark point 3. Some students showed confusion between tyrosine and tyrosinase here – missing out on mark point 3 if they did so.

08.6
Over 70% of students gained at least one mark for their partial explanation of the advantage of producing melanin when exposed to bright sunlight. Most students were able to correctly explain that UV radiation causes skin cancer (or just cancer) with the vast majority achieving this mark point. The idea of UV radiation causes mutation or DNA damage (which then led to cancer) was much less commonly seen.