AQA GCSE Biology | 8461

SPECIFICATION POINT 4.5.2.2

The brain (biology only)

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**22**
Available paper years	**2007–2021**

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.

4.5.2.2 The brain (biology only)

Answer 01 · Mark scheme March 2007 | BLY1A | Original Q2 | Legacy

Two	**A**	arthritis	**2**
	B	diabetes	**1**
	C	heart disease	**3**
	D	high blood pressure	**4**

Answer 02 · Mark scheme November 2007 | BLY1B | Original Q8 | Legacy

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

4.5.2.2 The brain (biology only)

Answer 03 · Mark scheme

Question 5

	answers	extra information	mark
(a)	any **three** from: • vaccine is inactive / dead form of (pathogen) • stimulates antibody production • stimulates antitoxin production • by white cells • antibodies kill (pathogen) • antitoxins neutralise poisons • antibodies quickly produced on reinfection • reference to ingestion by white cells	allow antigens ignore antibodies remain in blood	3
(b)(i)	(no) any **two** from • sample size small / only 12 • conclusion based on hearsay from parents • only 8 parents linked autism to MMR • no control used		2
(b)(ii)	(yes) being paid by parents / lawyers		1
total			6

4.5.2.2 The brain (biology only)

Answer 03 · Mark scheme January 2008 | BLY1H | Original Q5 | Legacy

BLY1H

Answer 04 · Mark scheme January 2009 | BLY1H | Original Q4 | Legacy

question	answers	extra information	mark
4(a)(i)	receptor	allow named receptor eg light receptor ignore sensory neurone allow sense organ / named sensory organ eg skin / eye	1
4(a)(ii)	sensory (neurone)	allow afferent	1
4(a)(iii)	motor (neurone)	allow efferent	1
4(a)(iv)	effector / muscle / gland / named		1
4(b)	any **two** from: • impulse / information passes from one neurone to another **or** impulse / information passes across gap • chemical / transmitter involved • diffusion (across gap)		2
4(c)	brain / person not aware of pain / stimulus / can't feel possibility of (permanent / serious) damage / eg burning	allow brain/ person doesn't know / realise / unable to coordinate ignore reflex ignore information ignore danger	1 1
Total			**8**

4.5.2.2 The brain (biology only)

Answer 04 · Mark scheme January 2009 | BLY1H | Original Q4 | Legacy

COMPONENT NUMBER: BLY1H

COMPONENT NAME: Science B / Biology

STATUS: Final

DATE: January 2009

Answer 05 · Mark scheme March 2010 | BLY1AP | Original Q2 | Legacy

Two	This question has been removed because of a problem with the answer sheet.			
	A	B	C	D

Answer 06 · Mark scheme June 2010 | BLY1BP | Original Q7 | Legacy

No matching mark scheme was available in the supplied archive for this question.

4.5.2.2 The brain (biology only)

Answer 07 · Mark scheme

June 2019 | BLY1H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	genetically identical / same DNA / same chromosomes	**gains 2 marks** accept identical without reference to genetic material for **1** mark	2
6(b)	remove nucleus from egg insert genetic material / nucleus / DNA / chromosomes from frozen mouse electric shock **or** allow to divide **or** insert into womb / uterus	allow use empty egg cell do **not** allow if reference to sperm	1 1 1
6(c)	ethical / religious / emotional reasons **or** not known if it is safe / long term effects not known	ignore playing God / unnatural / immoral	1
Total			**6**

4.5.2.2 The brain (biology only)

Answer 07 · Mark scheme June 2010 | BLY1H | Original Q6 | Legacy

BLY1H

4.5.2.2 The brain (biology only)

Answer 08 · Mark scheme

Question 7

question	answers	extra information	mark
7	a mutation occurs **or** variation in size / shape of pelvis	allow idea that walking upright needs larger pelvis to bear weight	1
	large / wide birth canal / pelvis allowed passage of wide skull / brain	do **not** allow pelvis became larger to enable birth of larger-skulled babies	1
	link between brain size and intelligence		1
	those with larger pelvis / brain more likely to survive / reproduce		1
Total			**4**

4.5.2.2 The brain (biology only)

Answer 08 · Mark scheme

January 2011 | BLY1H | Original Q7 | Legacy

BLY1H

4.5.2.2 The brain (biology only)

Answer 09 · 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**

4.5.2.2 The brain (biology only)

Answer 09 · Mark scheme

January 2011 | BLY3H | Original Q1 | Legacy

BLY3H

4.5.2.2 The brain (biology only)

Answer 10 · 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**

4.5.2.2 The brain (biology only)

Answer 10 · Mark scheme

June 2011 | BLY2H | Original Q7 | Legacy

BLY2H

4.5.2.2 The brain (biology only)

Answer 11 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)(i)	**A** – pituitary **B** – ovary / ovaries	allow hypothalamus	1 1
2(a)(ii)	in blood (stream)	accept in plasma ignore dissolved	1
2(b)(i)	FSH and Luteinising Hormone (LH)		1
2(b)(ii)	fertilised OR reference to sperm form embryos / ball of cells or cell division (embryo) inserted into mother's womb / uterus	 allow (fertilised egg) is inserted into mother's womb / uterus	1 1 1
2(b)(iii)	any **one** from: • multiple births lead to low birth weight • multiple births cause possible harm to mother / fetus / embryo / baby / miscarriages	 allow premature ignore reference to cost / ethics / population	1
2(c)(i)	any **one** from: • almost identical • both approximately 20%	 allow S (slightly) more successful	1
2(c)(ii)	larger numbers (in clinic R) (in 2007) results likely to be more repeatable (in 2008)	allow only 98 (in S) (compared to 1004 (in R)) allow more reliable do **not** accept more reproducible / accurate / precise	1 1
Total			**11**

4.5.2.2 The brain (biology only)

Answer 11 · Mark scheme

January 2013 | BL1HP | Original Q2 | Legacy

BL1HP

4.5.2.2 The brain (biology only)

Answer 12 · Mark scheme

January 2013 | BL2HP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	allele expressed even when other allele present **or** expressed if just one copy of allele is present **or** expressed if heterozygous	if present other allele not expressed	1
6(a)(ii)	2 affected parents have unaffected child **or 1** and **2** → **5** / **6** **or** if recessive all of **1** and **2**'s children would have CADASIL		1
6(a)(iii)	heterozygous – has unaffected children **or** because if homozygous all children would have CADASIL		1
6(b)	genetic diagram including: correct gametes: **D** and **d** **and** **d** (and **d**) derivation of offspring genotypes: **Dd** **Dd** **dd** **dd** identification of **Dd** as CADASIL **or dd** as unaffected correct probability: 0.5 / ½ / 1 in 2 / 50 % / 1 : 1	accept alternative symbols, if defined ignore 7 / 8 or male / female allow just **Dd** **dd** if ½-diagram allow ecf if correct for student's gametes allow ecf if correct for student's gametes	1 1 1 1
6(c)(i)	stem cells can differentiate **or** are undifferentiated / unspecialised can form blood vessel cells / brain cells **or** stem cells can divide		1 1

Question 6 continues on the next page . . .

4.5.2.2 The brain (biology only)

BL2HP

Question 6 continued . . .

question	answers	extra information	mark
6(c)(ii)	ethical argument – eg no risk of damage to embryo **or** adult can give consent for removal of cells **or** adult can re-grow skin **or** if from a relative then less chance of rejection **or** if from self then no chance of rejection **or** skin cells more accessible	more ethical qualified ignore religion unqualified	1
Total			**10**

4.5.2.2 The brain (biology only)

Answer 12 · Mark scheme

January 2013 | BL2HP | Original Q6 | Legacy

BL2HP

4.5.2.2 The brain (biology only)

Answer 13 · Mark scheme

June 2013 | BL1HP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	(substance / chemical) that affects body chemistry / chemical reactions in the body		1
6(b)	statin / aspirin / neither recommended any **five** from: • argued evaluation in favour of aspirin or statin or neither answers could include reference to for statins: • more people in studies • so data / findings more repeatable • reduces cholesterol but aspirin doesn't • aspirin (may) causes bleeding / poor clotting but statins do not • smaller (total) percentage suffer side-effects • monitored by doctor, aspirins not for aspirin: • cheaper • can be bought over the counter rather than prescribed • statins cause serious damage / muscle damage / kidney failure but aspirins do not similarities: • both have similar effect on reducing (non-fatal) heart attacks • incidence of side-effects low in both	no mark, may be implied. If no recommendation or implication, max 4 marks answers should be comparative accept converse for statins / aspirin but **not** as advantage of one **and** disadvantage of other accept reliable for repeatable ignore accurate / precise allow reduces cholesterol but no evidence about aspirin allow aspirin causes bleeding / poor clotting but no evidence about statins allow (for aspirin) higher reduction of risk of heart attack	5
Total			**6**

4.5.2.2 The brain (biology only)

Answer 14 · Mark scheme

June 2013 | BL1HP | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)		in this order only	
	A cytoplasm		1
	B (cell) membrane	do **not** accept (cell) wall	1
7(b)(i)	synapse		1
7(b)(ii)	(as) chemical	accept neurotransmitter or named ignore references to how the chemical is passed do **not** accept electrical	1
7(c)		ignore references to synapses accept 'nerve cell' for neuron(e) throughout penalise 'nerve' for neurone once only	
	(from light-sensitive cell to connecting neurone) to sensory neurone		1
	(sensory neurone) to brain / CNS	allow (sensory neurone) to relay neurone / spinal cord	1
	(brain / CNS) to motor neurone	allow (relay neurone / spinal cord) to motor neurone	1
	(motor neurone) to (eyelid) muscle	ignore effector	1
Total			**8**

4.5.2.2 The brain (biology only)

Answer 15 · Mark scheme

June 2013 | BL2HP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	changes code /sequences of bases **or** sequence of amino acids is different		1
	the enzyme has different / wrong shape / structure	allow the active site is changed	1
	so substrate will not fit into enzyme / will not join to enzyme		1
6(b)(i)	46	allow 23 pairs	1
6(b)(ii)	also inherited (from mother) normal chromosome 15 / normal allele / normal gene / boy is heterozygous / **Hh**	allow the boy is a carrier	1
	(allele for) this disorder is recessive **or** the normal allele would give a working enzyme	ignore converse	1
6(b)(iii)	genetic diagram including: Parental gametes: **H** and **h** from both parents	accept alternative symbols, if defined	1
	derivation of offspring genotypes: **HH Hh Hh hh**	allow alternative if correct for student's parental genotypes / gametes	1
	identification of **hh** (having the disorder) if 1 in 4		1
Total			**9**

4.5.2.2 The brain (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

4.5.2.2 The brain (biology only)

Answer 16 · Mark scheme

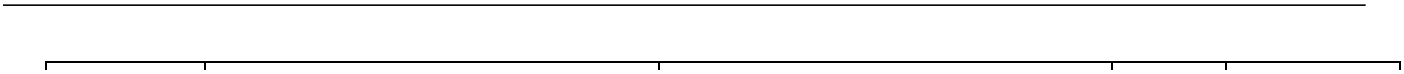
June 2015 | BL3HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(c)(i)	(sports drinks) contain a lot of glucose (a person with diabetes) does not produce insulin **or** does not produce enough insulin so <u>blood</u> glucose / sugar levels will rise too high **or** to a dangerous level	 allow (person with diabetes) has cells which do not respond to insulin do **not** allow insulin produced by liver	1 1 1	AO1 / AO2 333c
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**	

4.5.2.2 The brain (biology only)

Answer 16 · Mark scheme

June 2015 | BL3HP | Original Q5 | Legacy



4.5.2.2 The brain (biology only)

Answer 17 · Mark scheme

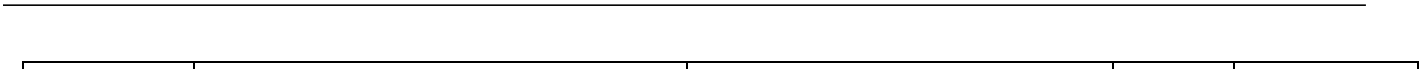
June 2016 | BL1HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	legal, recreational drugs		1	AO1 1.3.1e
1(a)(ii)	any **one** from: • dependence / addiction • withdrawal (symptoms) or described	 allow reliance eg headache / sickness / nausea ignore side effects alone	1	AO1 1.3.1h
1(b)(i)	idea of not part of the drug company **or** it is another company	not biased can be accepted for either part bi or bii, but not both	1	AO2 1.3.1a
1(b)(ii)	idea of so they will not be biased	allow results will be trustworthy	1	AO3 1.3.1a
1(b)(iii)	no / reduced feeling of pleasure (from alcohol) (so) less likely to drink alcohol	allow brain less sensitive to alcohol allow so easier to stop (drinking alcohol)	1 1	AO3 1.3.1
1(c)(i)	higher % **or** more boys (than girls) drink beer / lager / cider higher % **or** more girls (than boys) drink spirits / alcopops / wine	allow boys drink more beer / lager / cider allow girls drink more spirits / alcopops / wine allow valid descriptions using % figures	1 1	AO2 1.3.1
1(c)(ii)	any **one** from: • only 100 boys were surveyed • only done on 15-year-olds • no data on the table about boys that don't drink alcohol • data only about UK • boys may have lied about alcohol consumption	 allow small sample may not be representative allow not done on all ages allow none of the bars are 100% or highest bar is 88%	1	AO3 1.3.1
Total			9	

4.5.2.2 The brain (biology only)

Answer 17 · Mark scheme

June 2016 | BL1HP | Original Q1 | Legacy



4.5.2.2 The brain (biology only)

Answer 18 · Mark scheme June 2016 | BL1HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	receptors detect / sense stimuli / change in surroundings **or** convert stimulus into an impulse	ignore send impulses to brain / spinal cord	1	AO1 1.2.1b/d/e
	example of a receptor	allow any appropriate organ or part of an organ, eg eye / retina or named type of receptor eg light receptor	1	
	effectors allow / make response **or** convert an impulse to an action	ignore receive impulses from brain / spinal cord	1	
	(effector) muscle / gland	allow an example ignore eg arm / leg	1	
4(b)(i)	junction	allow idea of a (small) gap / space do **not** allow if implication is that the neurones move	1	AO1 1.2.1e
	between neuron(e)s	allow named types of neurones	1	
4(b)(ii)		allow answers in terms of specific types of neurone		AO1 1.2.1e
	chemical	allow neurotransmitter / named neurotransmitter released	1	
	any **one** from: • (chemical released) from one neurone • (chemical) passes (across synapse) to next neurone to stimulate / cause (electrical) impulse	ignore produced allow diffuses for passes (across)	1	

4.5.2.2 The brain (biology only)

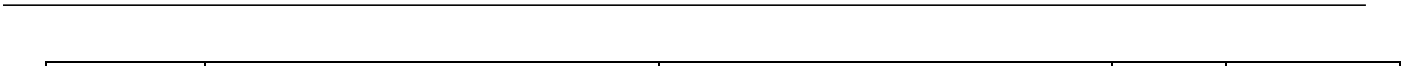
Answer 18 · Mark scheme June 2016 | BL1HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(c)(i)	skin	ignore hand / leg	1	AO2 1.2.1b
4(c)(ii)	1.6 (cm per millisecond)	allow 2 if evidence of rounding up of 1.6	1	AO2 1.2.1d/e
4(c)(iii)	any **two** from: • synapses slow down transmission / impulse • fewer synapses (via brain) • (therefore) fewer delays	ignore length of neurones allow idea of movement of chemical being slower than electrical impulse allow one synapse compared to two **or** only one synapse allow impulse travels more slowly in relay neurones	2	AO3 1.2.1d/e
Total			**12**	

4.5.2.2 The brain (biology only)

Answer 18 · Mark scheme

June 2016 | BL1HP | Original Q4 | Legacy



4.5.2.2 The brain (biology only)

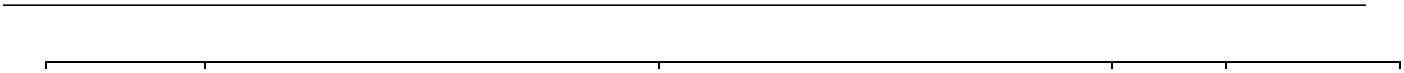
Answer 19 · Mark scheme June 2016 | BL3HP | Original Q7 | Legacy

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**	

4.5.2.2 The brain (biology only)

Answer 19 · Mark scheme

June 2016 | BL3HP | Original Q7 | Legacy



4.5.2.2 The brain (biology only)

Answer 20 · Mark scheme

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			

4.5.2.2 The brain (biology only)

Answer 20 · 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

4.5.2.2 The brain (biology only)

Answer 20 · Mark scheme

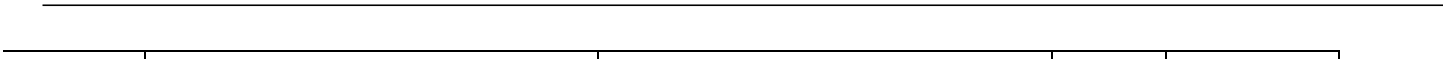
June 2019 | 8461/1H | Original Q5

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**	

4.5.2.2 The brain (biology only)

Answer 20 · Mark scheme

June 2019 | 8461/1H | Original Q5



4.5.2.2 The brain (biology only)

Answer 21 · Mark scheme

November 2020 | 8461/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	A		1	AO1 4.5.2.2
06.2	cerebral cortex	allow cerebrum allow cerebral hemisphere(s) ignore D	1	AO1 4.5.2.2
06.3	any **three** from: • can ask people to do different tasks (while taking scan) • to see which part of brain is active / inactive • to compare with a person without brain damage • to see (exactly) where the damage is • (traditional) MRI scanner cannot be used if people can't stay still	allow can ask person to do a (specific) task allow to see which part of the brain is working allow examples such as children **or** patients with Parkinson's disease allow may be better for people who are claustrophobic	3	AO3 4.5.2.2
06.4	(cells in) retina sensitive to light impulse passes along (sensory) neurone (along) optic nerve	allow retina detects light allow rods / cones detect light allow electrical signal **or** electrical message passes along (sensory) neurone allow chemical transmission across synapse	1 1 1	AO1 4.5.2.1 4.5.2.3

4.5.2.2 The brain (biology only)

Answer 21 · Mark scheme

November 2020 | 8461/2H | Original Q6

Question	Answers	Mark	AO / Spec.
06.5	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO2
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	4.5.2.3 4.6.2.1 4.6.2.2 4.6.3.1 4.6.3.4 4.7.1.3 4.7.1.4
	Indicative content • mutation (in gene / DNA) • randomly **or** due to chance • causes new / different protein / (visual) pigment to be made • in the retina of bird • (so more) variation in the wavelengths of light birds retinas could detect • birds with the mutation **or** birds able to detect UV are more likely to see fruits (that reflect UV) • birds with the mutation **or** birds able to detect UV are more likely to see where small mammals are or have been • therefore get more food (small mammals or fruit) • avoid being eaten (by small mammals) • out competing those birds without the mutation **or** birds not able to detect UV • so more likely to survive **and** reproduce **or** have offspring • by natural selection • passing on allele / gene / mutation to offspring • repeated over many generations For Level 3 a link to UV vision is required		
Total			**14**

4.5.2.2 The brain (biology only)

Answer 21 · Mark scheme

November 2020 | 8461/2H | Original Q6

4.5.2.2 The brain (biology only)

Answer 22 · 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**	

4.5.2.2 The brain (biology only)

Answer 22 · Mark scheme November 2021 | 8461/2H | Original Q3

Answer 21 · Examiner comments November 2020 | 8461/2H | Original Q6

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

This question was about the brain and vision, and applications to the use of MRI scanners and to the evolution of a sight adaptation in birds. Many students lacked precision in their explanations for **06.3**. In order to explain the advantage of the functional MRI (fMRI) scanner, using the given information, the majority of successful students stated that it would enable doctors to see which part of the brain was active / inactive in a certain situation in order to ascertain the location of any brain damage. Some were more explicit and explained that the context for this would be having the patient perform a particular task. Some suggested, correctly, that the scan could be compared with one from a person without brain damage, or that the fMRI scanner could be used on a person who had difficulty staying still such as a young child or a person with Parkinson's.

06.4 was not answered at all well by many students. The question asked for how the brain received information from the eye, *not* how the eye produced an image or made adjustments for different light intensities, *nor* for the coordination of any response, some or all of which were included in the answers of many. Several important details were also omitted in many answers – eg light is not just focused on 'the back of the eye' but on the *retina*, and the latter is actually *sensitive* to the light or contains *receptors* rather than just being the passive recipient of an image; *impulses* are then sent along *neurones* (not just 'messages' or 'signals' in 'nerves') in the *optic nerve*.

Given that some birds had an adaptation allowing them to detect UV light, and that some fruits and the urine of small mammals reflected UV light, students had to explain how this feature in the birds might have evolved in **06.5**. Many students suggested correctly that a mutation might have occurred in an ancestral bird, although very few went on to state that this would have been a random occurrence. Very few students related this to a possible structural change in the cells of the retina. However, many did realise that the mutation, or ability to detect UV, would enable the birds to see fruits and thus obtain more food than non-mutant birds and/or see where small mammals had been and hence either avoid predation or manage to catch these mammals as food. Many students then went on to explain that the birds with UV vision would be more likely to survive and reproduce, passing on their favourable allele (or 'the mutation') to their offspring, perhaps over many generations, and that this was an example of natural selection. Some students interpreted this as a 'speciation' question and hence gave an answer they had prepared previously. Students need to read the question carefully in order to assess what aspects of their knowledge may be applied *appropriately* in answering it. The question differentiated very well across the entire ability range of the students.

Answer 22 · 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.