AQA GCSE Biology | 8461

SPECIFICATION POINT 4.5.3.3

Maintaining water and nitrogen balance in the body (biology only)

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**31**
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.

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 01 · Mark scheme

March 2007 | BLY1A | Original Q9 | Legacy

Nine	**2**	**4**	**1**	**2**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 01 · Mark scheme

March 2007 | BLY1A | Original Q9 | Legacy

BLY1A (Human Biology) Higher Tier

Question	Key		
One	**A**	antibiotics	**1**
	B	natural selection	**3**
	C	pandemic	**4**
	D	resistance	**2**
Two	**A**	may cause damage to the liver and brain	**2**
	B	may cause less oxygen to be carried by the blood	**1**
	C	may cause withdrawal symptoms	**3**
	D	may lead to becoming addicted to a hard drug	**4**

	A	B	C	D
Three	**4**	**1**	**2**	**4**
Four	**2**	**4**	**1**	**2**
Five	**4**	**3**	**3**	**1**
Six	**2**	**3**	**3**	**3**
Seven	**3**	**3**	**4**	**2**
Eight	**2**	**4**	**2**	**1**
Nine	**2**	**2**	**2**	**2**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 02 · Mark scheme

January 2008 | BLY3H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
(a)	any **three** from: • glucose enters blood from gut / liver / glycogen • glucose is <u>filtered out</u> of the blood • glucose is (a) small (molecule) • taken / etc back into the blood / reabsorbed • by active transport	 ignore 'diffusion' allow absorbed into the blood but **not** absorbed unqualified ignore diffusion	3
(b)(i)	<u>in a healthy person</u> protein not present because proteins are large (molecules) **or** because cannot pass through (filter) <u>in person with disease</u> lets protein through (filter) owtte		1 1

continued…

BLY3H

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 5 continued…

question	answers	extra information	mark
(b)(ii)	advantages: up to any **three** from: • no build-up of toxins / keeps blood conc. ± constant • prevent high blood pressure • don't need restricted diet / restricted fluid intake **or** time wasted on dialysis • blood clots may result from dialysis • infection may result from dialysis • with dialysis, blood may not clot properly due to anti-clotting drugs • cost issues (ie transplant cheaper) disadvantages: **at least one** from: • rejection / problem finding tissue match • use of immuno-suppressant drugs → other infections • dangers during operation / example described	ignore 'kidney works all the time' must have at least one advantage and at least one disadvantage for full marks	3 1
total			9

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 02 · Mark scheme January 2008 | BLY3H | Original Q5 | Legacy

BLY3H

Answer 03 · Mark scheme June 2008 | BLY3H | Original Q5 | Legacy

question	answers	extra information	mark
5(a)(i)	protein is large (molecule) / too big to pass through filter		1
5(a)(ii)	glucose is present in the filtrate **or** 0.8 in filtrate no glucose is present in the urine **or** 0 in urine	ignore units	1 1
5(a)(iii)	active transport – up / against (concentration) gradient **or** from low to high (concentration) uses energy / ATP	it = active transport throughout accept needs specific carrier / specific protein (in cell membrane) for **1** mark	1 1
5(b)	<u>water</u> <u>re</u>absorption / taken out **or** water taken into blood / body	other substances cancel mark	1
Total			**6**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 03 · Mark scheme June 2008 | BLY3H | Original Q5 | Legacy

COMPONENT NUMBER: BLY3H

COMPONENT NAME: Biology

STATUS: Final

DATE: June 2008

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 04 · Mark scheme

January 2009 | BLY3H | Original Q7 | Legacy

question	answers	extra information	mark
7(a)(i)	**A**		1
7(a)(ii)	(protein) molecule is large cannot pass through filter	ignore letters (protein is) too big to get through the filter = **2** marks	1 1
7(b)	**B** is taken back into the blood **or B** is reabsorbed reabsorbed completely **or** reabsorbed after filtration		1 1
7(c)	RBC is too big to pass through filter Haemoglobin is inside red blood cells **or** haemoglobin released when red blood cell bursts Haemoglobin is small enough to pass through filter **or** haemoglobin diameter < pore diameter		1 1 1
Total			**8**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 04 · Mark scheme January 2009 | BLY3H | Original Q7 | Legacy

COMPONENT NUMBER: BLY3H

COMPONENT NAME: Biology

STATUS: Final

DATE: January 2009

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 05 · Mark scheme June 2009 | BLY3H | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	no effect / little effect		1
7(a)(ii)	reduced	ignore reference to later increase	1
7(b)(i)	more (re)absorption **or** more (material) taken into blood	do not allow if extra incorrect reference to filtration made	1
	of water	allow **only** if linked to reabsorption do **not** accept water if in a list of substances	1
7(b)(ii)	ions in blood diluted **or** concentration of ions decreases		1
	increased water reabsorption **or** more water present in blood	do not allow if extra incorrect reference to filtration made accept sensible alternative suggestion eg reabsorption of ions disrupted	1
Total			**6**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 06 · Mark scheme

November 2009 | BLY1AP | Original Q7 | Legacy

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

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 07 · Mark scheme January 2010 | BLY2H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	pancreas	allow phonetic spelling	1
3(a)(ii)	(increases movement of) glucose into cells / organs / named	allow (glucose) converted to glycogen / fat allow (glucose) used in (increased) respiration do **not** allow hybrid spellings of glycogen	1
3(b)	**Type of diabetes** / **Treatment** Type 1 → Careful attention to diet only Type 1 → Careful attention to diet **and** injection of insulin Type 2 → Careful attention to diet **and** injection of insulin Type 2 → Injection of insulin only	**1** mark per correct line extra line from a type of diabetes cancels the mark	2
3(c)(i)	protein		1
3(c)(ii)	gene / allele		1

Question 3 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

BLY2H

Question 3 continued

question	answers	extra information	mark
3(c)(iii)	any **three** from: • (amino acids) broken down / converted • (amino acids) form / into urea • (break down / convert / urea formed) in liver • (urea / broken down amino acids) removed / filtered by kidney • (urea / broken down amino acids) in urine • (urine / urea / broken down amino acids) stored / held in bladder	max **2** if any one process goes on in the wrong organ	3
Total			**9**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 07 · Mark scheme January 2010 | BLY2H | Original Q3 | Legacy

BLY2H

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 08 · Mark scheme

January 2010 | BLY3H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	protein		1
6(a)(ii)	(protein molecules too) large cannot pass through filter **or** can't leave blood **or** can't pass into kidney tubule / named part	 NB holes in the filter are too small = **2** marks	1 1
6(b)	any **four** from: • use of partially permeable membrane **or** only small molecules can pass through membrane • dialysis fluid has 'ideal' concentrations of solutes • diffusion of waste substances out of blood **or** waste passes from high to low concentration • reference to equilibrium (between plasma & dialysis fluid)	 allow correct named example accept named example – eg urea accept reference to counterflow to maintain concentration gradient	4
Total			**7**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 08 · Mark scheme January 2010 | BLY3H | Original Q6 | Legacy

BLY3H

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 09 · 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**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 09 · Mark scheme

June 2010 | BLY2H | Original Q5 | Legacy

BLY 2H

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 10 · Mark scheme

June 2010 | BLY3H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	movement of atoms / molecules / ions	accept particles allow dissolved substances ignore reference to membranes	1
	(substance) moves from high to low concentration	allow down the gradient ignore across / along / with a gradient	1
6(a)(ii)	any **two** from: • movement of molecules / ions	accept particles allow dissolved substances this point once only in (a)(i) and (a)(ii)	2
	• from low to high concentration	allow up / against the gradient ignore across / along / with a gradient	
	• requires energy / respiration	accept requires ATP	

Question 6 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

BLY 3H

Question 6 continues

question	answers	extra information	mark
6(b)	• **<u>filtration</u>** of blood **or** described re small (molecules) through / large not	ignore diffusion	1
	max **four** from:		4
	• **<u>reabsorption</u>** / substances taken back into blood		
	• (reabsorption) of <u>all</u> of the sugar / glucose		
	• (reabsorption) of <u>some</u> of ions / of ions <u>as needed</u> by body		
	• (reabsorption) *of* <u>some</u> *of* water / of water <u>as needed</u> by the body		
	• urea present in urine	accept urea not reabsorbed	
	• reabsorption of water by <u>osmosis</u> / <u>diffusion</u> ***or*** reabsorption of sugar / ions by <u>active transport</u>		
Total			**9**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 11 · 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**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 11 · Mark scheme January 2011 | BLY3H | Original Q1 | Legacy

BLY3H

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 12 · Mark scheme

January 2011 | BLY3H | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	A		1
7(a)(ii)	(protein molecule is) too large to pass through the filter / cannot pass through the filter		1
7(b)	RBC is too big to / cannot pass through filter haemoglobin released when RBC bursts **or** haemoglobin inside RBC in a healthy person haemoglobin is small enough to / can pass through filter **or** haemoglobin diameter < pore diameter **or** haemoglobin only 5.5 nanometres		1 1 1
Total			**5**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 13 · Mark scheme

March 2011 | BLY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	liver	**4**
	B	pituitary gland	**1**
	C	kidney	**3**
	D	skin	**2**

Answer 14 · Mark scheme

March 2011 | BLY1AP | Original Q2 | Legacy

Two	**A**	result **A**	**4**
	B	result **B**	**2**
	C	result **C**	**1**
	D	result **D**	**3**

	A	B	C	D

Answer 15 · Mark scheme

June 2011 | BLY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	kidney	4
	B	liver	1
	C	ovary	3
	D	pituitary gland	2

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 16 · Mark scheme

June 2011 | BLY3H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	(protein molecules too) big **or** larger than pore size	allow cannot fit through the pores / hole / gaps	1
2(b)(i)	diffusion		1
2(b)(ii)	high to low concentration **or** high concentration in blood, low concentration in dialysis fluid **or** down concentration gradient **or** correct use of numbers	ignore along gradient / across gradient allow there is none in dialysis fluid	1
2(c)	any value between 3.15 and 3.25 (inclusive)		1
2(d)(i)	any **two** from: • kidney works all the time **or** dialysis works for short time **or** dialysis needs regular trips to hospital / regular treatment / long term treatment • kidney maintains correct concentration all the time **or** no build-up as between dialysis sessions • no need to regulate diet **or** correct example – eg low salt / low protein / low fluid intake as with dialysis • cheaper in the long term	 ignore enables an active life accept kidney transplant is one off treatment	2

Question 2 continues on the next page

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Question 2 continued

question	answers	extra information	mark
2(d)(ii)	any **two** from: • rejection / described **or** need to use immunosuppressants **or** need to take drugs for life • susceptible to other infections • hazards of operation / anaesthetic • shortage of donors / match • high initial cost	allow may need later replacement	2
Total			**8**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 16 · Mark scheme

June 2011 | BLY3H | Original Q2 | Legacy

BLY3H

Question 6

question	answers	extra information	mark
6(a)(i)	any **one** from: • cells • tissues • (live) animals / named	 allow mammals	1
6(a)(ii)	any **three** from: (to test for) • toxicity / check not poisonous / not harmful • interaction with other drugs • efficacy **or** to see if they work **or** check if they treat the disease • dosage **or** how much is needed	 allow side-effect allow converse allow converse	3

Question 6 continues on the next page . . .

Question 6 continued

question	answers	extra information	mark
6(b)	**argued evaluation** any **six** from: • statin can damage / muscles / kidneys / organs but cholesterol blockers don't • statins can cause death but cholesterol blockers don't • cholesterol blockers can interfere with action of other drugs but statins don't • statins are for a life time but cholesterol blockers are not • statins (might) reduce cholesterol to zero but cholesterol blockers only reduce it **or** statins reduce cholesterol more • statins better for people with inherited high cholesterol • cholesterol blockers better for people with dietary cholesterol problems • taking/using statins/cholesterol blockers is better than dying from heart attack or build up of fat in blood vessels or reduced blood flow	comparison can be written anywhere in evaluation allow use of 'only' for implied comparison for each point eg **only** statins damage muscles / kidneys / organs ignore liver if neither of the first 2 points are given accept for **1** mark statins are more dangerous than cholesterol blockers **or** statins have more side effects allow statins (might) stop membrane / hormone production but cholesterol blockers don't	6
Total			**10**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 17 · Mark scheme

January 2012 | BL1HP | Original Q6 | Legacy

COMPONENT NUMBER: BL1HP

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 18 · 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**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 19 · Mark scheme June 2014 | BL3HP | Original Q4 | Legacy

4(a)(i)	defence against **or** destroy pathogens / bacteria / viruses / microorganisms	do **not** allow 'destroy disease' accept engulf pathogen / bacteria / viruses / microorganism accept phagocytosis accept produce antibodies / antitoxins allow immune response	1	AO1 3.2.2d
4(a)(ii)	they are small fragments of cells		1	AO1 3.2.2e
4(b)	liver kidney(s)	in this order only	1 1	AO1 3.2.2b
4(c)	any **two** from: • that it doesn't cause an immune response **or** isn't rejected / damaged by white blood cells • whether it is a long lasting material / doesn't decompose / corrode / inert • if it is strong (to withstand pressure) • it will open at the right pressure • that it doesn't cause clotting • that it doesn't leak **or** it prevents backflow • non toxic	ignore correct size	2	AO3 3.2
Total			6	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 19 · Mark scheme

June 2014 | BL3HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / spec ref.

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 20 · Mark scheme June 2015 | BL3HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	(the kidney) filters the blood	ignore refs to hormones and drugs	1	AO1 331a/c
	(and then) reabsorbs <u>all</u> of the glucose		1	
	reabsorbs some of the ions	allow salts ignore minerals	1	
	reabsorbs some of the water		1	
	releases urea (in urine)		1	
7(b)(i)	should fall from 28 (to the end of dialysis)	ignore any line drawn after end of dialysis allow + / - 0.5 square graph line must fall to / below below 15	1	AO2 331d/e
7(b)(ii)	should stay level at about 6 throughout	ignore slight variations allow + / - 1 square ignore any line drawn after end of dialysis	1	AO2 331d/f
7(c)(i)	immune system	allow white blood cells / lymphocytes	1	AO1 331g/h
	(produces) antibodies		1	
	(which) attack the antigens (on the transplanted kidney)	non-matching antigens insufficient	1	
7(c)(ii)	any **one** from: • tissue typing (to find match) • treating with drugs that suppress the immune system	accept treat with immunosuppressants	1	AO1 331i
Total			**11**	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 21 · Mark scheme June 2017 | BL2HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	46 **or** 23 pairs		1	AO1 2.7.2b
6(a)(ii)	(alternative / different) form(s) of a gene / of the same gene		1	AO1 2.7.2c
6(a)(iii)	only expressed if the dominant (allele) is not present / if the other (allele) is not present **or** only expressed if 2 (recessive alleles) are present	allow won't be expressed if the dominant allele is present	1	AO1 2.7.2e
6(b)(i)	having 2 different alleles	do **not** allow 2 different genes ignore carrier	1	AO1 2.7
6(b)(ii)	genetic diagram including: correct gametes **or** parental genotypes **N** and **n** and **N** and **n** **or** **Nn** and **Nn** offspring genotypes correctly derived: **NN** **Nn** **Nn** **nn** identification of **nn** as AKU correct probability only: 0.25 / ¼ / 1 in 4 / 25% / 1 : 3	allow alternative symbols if defined do **not** allow if alternative symbols used and not defined allow genotypes correct for student's parental gametes allow correct identification of student's offspring genotypes do **not** allow 3 : 1 / 1 : 4 do **not** allow if extra incorrect probabilities given	1 1 1 1	AO2/3 2.7 2.7.3a

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 21 · Mark scheme

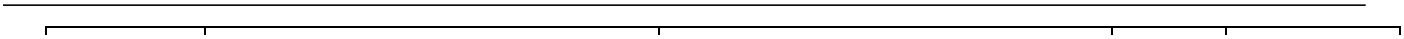
June 2017 | BL2HP | Original Q6 | Legacy

6(c)(i)	mitosis	correct spelling only	1	AO1 2.7.1a/d
6(c)(ii)	4		1	AO2 2.7.1a,d
6(d)(i)	any **one** from: • may lead to damage to embryo **or** may destroy embryos • embryo cannot give consent • ref to possible miscarriage (of implanted embryo) • idea of avoiding prejudice against disabled people • idea of not producing designer babies	allow emotive terms e.g. murder allow disposal of embryos allow embryos used in research ignore religion unqualified	1	AO3 2.7 2.7.3d
6(d)(ii)	any **one** from: • prevent having child with the disorder **or** reduce incidence of the disease / inherited / genetic diseases **or** prevent future suffering of child from the disease • embryo cells could be used in stem cell treatment • can have another child without need for IVF • provides embryos for research • ref to avoiding long term cost of treating a child (with a disorder) **or** avoid parental stress	ignore ref to having a healthy child ignore ref to selection of gender allow reference to parents being prepared in advance	1	AO3 2.7 2.7.3d
Total			**12**	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 21 · Mark scheme

June 2017 | BL2HP | Original Q6 | Legacy



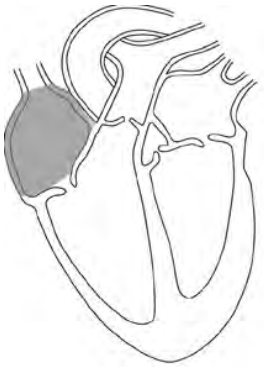
4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 22 · 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

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

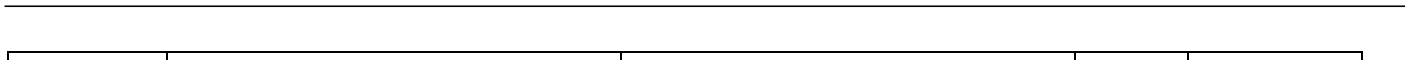
Answer 22 · Mark scheme

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**	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 22 · Mark scheme

June 2018 | 8461/1H | Original Q3



4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 23 · Mark scheme June 2019 | 8461/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	plasma		1	4.2.2.3 AO1
06.2	Benedict's (reagent / solution)	allow Fehling's (reagent / solution)	1	4.2.2.1 AO1
06.3	add chemical / Benedict's (reagent to urine) **and** boil / heat positive result – (colour changes from blue to brick) red	allow ecf from question **06.2** allow any temperature above 65 °C ignore water bath unqualified allow orange / yellow / green / brown if no other mark awarded, allow **1** mark for reference to glucose testing stick / strip	1 1	4.2.2.1 AO1
06.4	the blood is more concentrated **or** less dilute (than the solution in the cells) (so) water moves out of cells by osmosis water moves through a partially permeable membrane	allow the solution in the cells is less concentrated **or** more dilute than the blood allow correct references to water concentration **or** water potential **or** hypotonic / hypertonic ignore reference to amount of water or glucose allow (so) water moves into the blood by osmosis allow semi-permeable / selectively permeable membrane	1 1 1	4.1.3.2 AO2

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 23 · Mark scheme

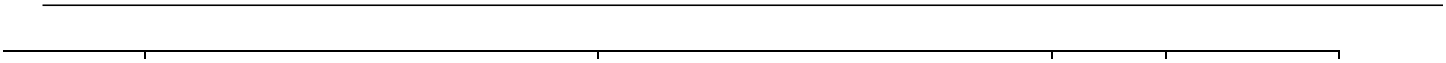
June 2019 | 8461/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	projections / folds / villi provide a large surface area	ignore small intestine has a large surface area do **not** allow cilia	1	4.1.3.1 4.1.3.3 4.2.2.1 4.1.1.2 AO1
	walls of projections / folds / villi / capillaries are thin / one cell thick for shorter absorption / diffusion distance		1	AO2
	(small intestine is) very long, increasing time (for absorption)		1	AO1
	good / efficient blood supply to maintain concentration gradient	allow many capillaries to maintain concentration gradient	1	AO2
	cells have many mitochondria for (aerobic) respiration for active transport **or** cells have many mitochondria for energy release for active transport	do **not** accept anaerobic do **not** accept producing energy	1	
Total			**12**	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 23 · Mark scheme

June 2019 | 8461/1H | Original Q6



4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 24 · Mark scheme June 2019 | 8461/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	pituitary		1	AO1 4.5.3.3
06.2	ADH		1	AO1 4.5.3.3
06.3		allow ecf for name of hormone from Question **06.2** ignore name of gland		4.5.3.3
	high(er) concentration of blood **causes** (more) ADH / hormone release	allow low(er) water potential of blood causes (more) ADH / hormone release allow alternative descriptions in terms of – eg low(er) water concentration / level **or** high(er) osmotic pressure **or** high(er) solute concentration / level	1	AO2
	(and hormone / ADH causes) increased permeability of kidney tubules (to water)	allow increased permeability of collecting duct / distal convoluted tubule	1	AO1
	(so) increased water reabsorption	allow more water taken back into blood ignore reference to urine	1	AO1

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

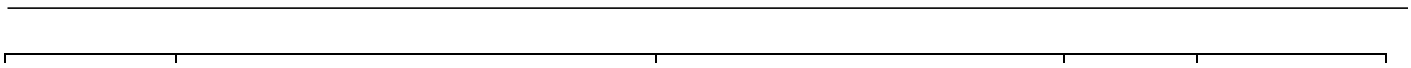
Answer 24 · Mark scheme June 2019 | 8461/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4		allow converse if clearly describing dialysis explanation must match reason		AO3 4.5.3.3
	changes in concentrations / levels of substances / urea are minimised	allow no change in concentration / level of substances / urea allow correctly named substances	1	
	(so) less / no chance of causing damage to body cells / tissues	allow eg less / no osmotic stress **or** not poisoned by urea	1	
	not repeatedly puncturing skin **or** blood not in contact with machine	allow blood does not leave the body	1	
	(so) less / no chance of infection **or** less / no chance of blood clots **or** no need to take anti-clotting drugs	allow less / no chance of microorganisms entering body allow only one operation so less chance of infection for **2** marks allow dialysis requires anti-clotting drugs and so may lose more blood if cut for **2** marks	1	
Total			**9**	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 24 · Mark scheme

June 2019 | 8461/2H | Original Q6



4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 25 · 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

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 25 · 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**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 25 · Mark scheme

November 2020 | 8461/2H | Original Q6

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 26 · Mark scheme November 2021 | 8461/1H | Original Q7

07.1	cells grow / divide abnormally / uncontrollably	ignore mutation	1	AO1 4.2.2.7

07.2	has spread to other parts / organs of the body **or** has spread to the liver / lung **or** has formed a secondary tumour	allow tumour has metastasised	1	AO2 4.2.2.7

07.3	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO2 4.2.2.3 4.3.1.6 4.4.2.1 4.4.2.2
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content.	0	
	Indicative content: *Tiredness* • fewer red blood cells • so less haemoglobin • so less oxygen transported around the body • so less (aerobic) respiration can take place • so more anaerobic respiration takes place • less energy released for metabolic processes **or** less energy released so organs cannot function as well • lactic acid produced (during anaerobic respiration) causes muscle fatigue *Frequent infections* • fewer white blood cells / phagocytes / lymphocytes • so fewer antibodies produced **or** less phagocytosis • so fewer pathogens / bacteria / viruses killed *Bleeding* • fewer platelets • so blood does not clot as easily For **Level 3**, reference to all three symptoms must be made.		

Answer 26 · Mark scheme

November 2021 | 8461/1H | Original Q7

07.4	anti-B antibodies in patient / receiver / recipient will bind to type B antigens on person's / donor's red blood cells		1	AO3
	(so) red blood cells clump together and are wider than capillaries **or** (so) red blood cells clump together and block capillaries	allow (so) red blood cells clump together and capillaries burst	1	AO3
	(so) cells have reduced supply of oxygen / glucose **or** (so) cells can't respire	ignore references to energy if no other mark awarded allow antibodies from patient and antigens from donor are matching / complementary shapes for **1** mark	1	AO2 4.2.2.3 4.3.1.6
07.5	no antigens (on type O red blood cells)		1	AO3 4.2.2.3 4.3.1.6
	(so) antibodies cannot bind (to the antigens / red blood cells)	allow no clumping (of red blood cells)	1	
07.6	hepatitis C infection		1	AO3 4.2.2.3 4.3.1.1
07.7	no / less bile reaches the small intestine	ignore less / no bile produced	1	AO3
	(so) less / no emulsification of fat	allow correct description of emulsification do **not** accept reference to chemical digestion	1	AO1
	(so) smaller surface area for lipase to break down fat		1	AO1
	pH of small intestine is not neutralised / alkaline	allow pH of small intestine is acid / low	1	AO2
	(so) lipase is not at its optimum pH to break down fat	pH (of small intestine) is not suitable for lipase to break down fat	1	AO2 4.2.2.1
Total			**19**	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 27 · Mark scheme

June 2022 | 8461/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	parents without MSUD have a child with MSUD	allow 1 and 2 (without MSUD) have child 5 (with MSUD) **or** 7 and 8 (without MSUD) have child 12 (with MSUD) ignore MSUD skips a generation	1	AO3 4.6.1.6 4.6.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	gametes correct: **N + n** and **N + n**		1	AO2
	correct derivation of offspring genotypes: **NN Nn Nn nn**	allow correct for gametes stated	1	AO2
	correct phenotype for each genotype	allow correct for offspring genotypes ignore carrier	1	AO2
	correct probability: 0.25 / ¼ / 25% / 1 in 4	allow correct answer only allow 1:3 do **not** accept 1 in 3 / 1:4	1	AO3 4.6.1.6 4.6.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	liver		1	AO2 4.5.3.3

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 27 · Mark scheme

June 2022 | 8461/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4		allow **P** for toxic substance throughout		AO2 4.2.2.1 4.1.3.1 4.6.1.5 4.6.1.6
	(no enzyme 2 made **so**) cannot break down the toxic substance	allow (no enzyme 2 made **so**) cannot change toxic substance into harmless products	1	
	the toxic substance is still made (from the amino acids)	allow toxic substance builds up over time ignore concentration of toxic substance is high(er)	1	
	toxic substance diffuses / moves (from cells) into the blood	ignore incorrect name of organ	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	the toxic substance passes through filter in kidney **or** **P** passes through filter in kidney		1	AO1 4.5.3.3
	(some / all) not reabsorbed	allow (some / all) not absorbed **back** into the blood **or** (some / all) not taken **back** into the blood ignore (some / all) not absorbed into the blood **or** (some / all) not taken into the blood	1	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 27 · Mark scheme

June 2022 | 8461/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	proteins contain amino acids **or** proteins are made of amino acids	allow proteins are broken down into amino acids	1	AO1
	must keep (certain) amino acids in low amount	allow (so) (certain) amino acids do not build up allow (so) less of (certain) amino acids are produced	1	AO2
	(so) toxic substance **or P** does not build up in the body **and** cause damage to cells / tissues / organs		1	AO2 4.6.1.5 4.6.1.7 4.4.2.3

Total Question 5		**14**

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 28 · 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

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 28 · 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	

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

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 28 · 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

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 29 · 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	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 29 · 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

Question 8

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.1	regulation / control / maintenance of internal conditions	allow keeping internal conditions the same	1	AO1 4.5.1
	for optimum conditions for cell(s) / enzyme(s) (activity)	allow a description of optimum functioning of cell / body	1	

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.2	glucose **and** urea are filtered (out of the blood)	allow a description of filtration of glucose **and** urea (out of the blood)	1	AO1 4.5.1 4.5.3.3
	protein is not filtered (out of the blood)		1	
	all glucose reabsorbed	allow all glucose absorbed back into the blood	1	
	urea (mostly) not reabsorbed **or** urea passes out in urine	allow urea not absorbed back into the blood	1	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 30 · Mark scheme

June 2024 | 8461/2H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.3	(increased / high) ADH increases water reabsorption **or** (increased / high) ADH increases permeability to water	allow converse for decreased / low / no ADH	1	AO1
	(water reabsorption) from kidney tubules		1	AO1
	(so) ADH increases the concentration (of urine)		1	AO1
	(so) ADH decreases the <u>volume</u> (of urine)		1	AO2 4.5.1 4.5.3.3

Total Question 8	10

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 31 · Mark scheme

June 2025 | 8461/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	ADH **or** antidiuretic hormone	allow other correct pituitary hormone eg FSH / LH / TSH ignore functions of hormones	1	AO1 4.5.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	any **one** from: • (it would) be digested to amino acids • (it would) be digested by protease • (it would) be digested (by enzymes) in the stomach • (it would) be digested (by enzymes) in the small intestine • (it would) be digested so (hGH is) not absorbed	allow 'broken down' for digested throughout	1	AO2 4.2.2.1 4.5.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	isolate (hGH) gene from human DNA / chromosome	allow cut (hGH) gene from human DNA / chromosome	1	AO1 4.6.2.4
	join (hGH) gene to (cut) <u>plasmid</u>		1	
	put plasmid (containing gene) into bacteria		1	
	enzyme used at a suitable stage: to cut (hGH) gene from human DNA **or** to insert / join (hGH) gene to plasmid	allow reference to named enzyme used in genetic engineering allow to insert / join (hGH) gene to bacterial DNA	1	

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 31 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	any **two** from: • (hGH) easier to isolate / purify / extract • made in larger quantities • no / less chance of immune reaction • no / less chance of passing on disease / pathogens (from animals to humans) **or** no / less chance of infection (of humans) • no / less chance of containing antibiotics / urea / drugs • it is the specific human hormone so may be more effective (in human body)	allow converse if clearly referring to GH ignore reference to speed of production allow no / less chance of rejection ignore reference to side effects allow named (animal) disease eg BSE allow animal GH may not be the correct shape ignore ethical / religious reasons ignore reference to cost	2	AO3 4.6.2.4

Total Question 4	8

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 22 · 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.

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.

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.

Question 7 (standard, standard/high & high demand)

In **07.4** and **07.5**, many students had not read the stem of the question in detail and therefore gave ideas about the donor transferring antibodies to the patient. In **07.5**, several students stated that the red blood cells do not have a specific antigen 'shape' so therefore all of the antibodies can fit and bind.

In **07.7**, most students were able to describe the function of bile as an emulsifier, and many students gave long explanations of how bile works, however, they did not link this to a lack of bile and why this would cause difficulty digesting fat.

This question highlighted several misconceptions in this area. Some students thought that fat, lipase or food molecules pass through the bile duct and that big molecules of fat would not fit past the blockage. Some students stated that bile is an enzyme and were confused over the difference between lipase and bile, often thinking that they are one in the same.

Concluding Remarks

The standard of responses seen in this paper was lower than in previous years. Students generally scored well on simple recall of knowledge questions (AO1) and questions on the topic of cell structure were generally well answered. Some students were able to apply their knowledge effectively in straightforward questions (AO2), but many found application of knowledge to new situations more difficult. There was indication that many students had not carried out the Required Practical Activities assessed throughout the paper. Many student's understanding of the structure and function of plant tissues was limited and a lack of clear knowledge meant that some students did not articulate themselves well throughout the paper. Generally, students scored well on the mathematical skills, however, a lack of precision when reading data from graphs was common.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 27 · Examiner comments June 2022 | 8461/2H | Original Q5

Question 5

The topic of this question was the inheritance of a human disease and the specific effects of this condition on the body.

05.1 Evidence from the pedigree diagram given in **Figure 4** that maple syrup urine disease (MSUD) was a recessive condition was provided by the fact that unaffected parents could produce a child with MSUD. Incorrect answers related to one of the parents having the condition but none of her children having it, or to the low frequency of MSUD in this family. Fewer than half of the students gave a correct answer.

05.2 Three-quarters of students were able to draw a correct Punnett square diagram to show that heterozygous parents had a 25 percent chance of producing a child with MSUD.

Answer 27 · Examiner comments

June 2022 | 8461/2H | Original Q5

However, fewer than half of these gained all 4 marks, mainly because they did not follow the instruction in the question to *identify the phenotype of each offspring genotype*.

Questions **05.3** to **05.6** were based on **Figure 5** which gave a metabolic pathway showing the breakdown of some types of amino acids and included the production and breakdown of a toxic substance, **P**.

05.3 The majority of students incorrectly selected the *kidney* as the organ in which the reactions were most likely to occur, with the correct answer, the *liver*, in second place.

05.4 Given that MSUD was caused by an inability to make the enzyme that broke down substance **P** into harmless products, students had to explain why the blood of a person with MSUD would contain a high concentration of substance **P**. Around three-quarters of students understood that substance **P** would not be broken down but only around 1 in 100 could fully explain that therefore the concentraton of **P** would build up in the cells that made it *and* that **P** would then move from the cells into the blood. Some thought, incorrectly, that **P** could not be excreted by the kidney and would therefore build up in the blood – although the subsequent question would have given evidence against this idea.

05.5 Some details of how the kidneys function were required to answer this question about why substance **P** would be found in the urine, namely that it would be filtered out of the blood by the kidneys and not reabsorbed. Despite urine being mentioned in the question, a surprisingly large proportion failed to mention the kidneys in their answers. Filtration was a better-understood concept than reabsorption. Fewer than one-third of students scored any marks for this question.

05.6 Since toxic substance **P** was derived from certain amino acids, the majority of students understood that a person with MSUD should have a low-protein diet because proteins were made of amino acids. However, fewer than one third of these could go on to explain that amino acids would need to be kept in small amounts to avoid a build-up of **P** which would harm the body cells / tissues / organs.

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 28 · 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.

Answer 28 · 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.

Answer 29 · 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.

Answer 30 · Examiner comments

June 2024 | 8461/2H | Original Q8

Question 8 (standard/high and high demand)

08.1 Almost 60% of students could give an appropriate definition for homeostasis and so gained the first marking point. However, many did not expand the definition to include providing optimum conditions for cellular/enzyme activity and so marking point 2 could not be awarded. Fewer than 10% of students scored full marks in this question.

08.2 Students were asked to describe what happens to glucose, protein and urea in the kidneys. There was confusion seen between the role of the liver and the kidney with a noticeable number of students stating that protein was deaminated or that glucose was stored as glycogen by the kidney. Many students struggled to articulate the filtering process and lacked clarity communicating absorption/reabsorption and what this meant in terms of where the substances ended up.

For marking point 1 many students rightly identified glucose and urea as being filtered from the blood by the kidneys. However, many also stated that protein was also filtered, which then made marking point 2 not accessible. Although a large number of students knew that glucose was reabsorbed, they did not make clear it was *all* the glucose being reabsorbed. Marking point 4 was the most common mark seen, with many using the second alternative 'urea passing out in the urine' to gain credit.

5% of students gained full marks, with the majority of students gaining 1 or 2 marks.

08.3 Students were asked to explain how ADH affects the production and concentration of urine by the kidneys. Over one third of students were not able to gain any marks on this question, with 5% of students not attempting it at all.

There appears to be a lot of confusion amongst students regarding the trigger for the production of ADH, with many students thinking ADH stops being released when blood is more concentrated. Students that did get marking point 1 correct however, often got muddled regarding the effect ADH had on the kidney tubules, and the consequences on urine production - often getting the ideas completely the wrong way around.

1 in 5 students gained a mark in this question which was most commonly for marking points 1 or 4. Marking point 2 was rarely seen, with many students simply referring to 'the kidney' rather than the tubules themselves.

Those that were clear that high ADH decreases the volume of urine, often did not communicate it clearly for credit in marking point 4 at this high level of demand. There was also some difficulty understanding the term 'concentration' with many students getting muddled between water concentration and urea concentration.

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Answer 31 · Examiner comments

Question 4 (Standard/high demand)

04.1

Almost all students attempted this question, with just over 80% of gaining the mark. ADH and FSH were the most common creditworthy answers seen. Common incorrect answers, although seen relatively rarely, included adrenaline, thyroxine, and progesterone.

04.2

Only a third of students gained credit in this question. Whilst many students were able to begin their answer to this question, a number did not give sufficient detail at this level of demand to gain the mark. Stronger responses often covered several marking points in one succinct sentence e.g. 'The hGH would be digested by protease into amino acids within the stomach and so would not be absorbed into the blood', whilst those that were less successful did not refer to either what would break down the hGH, or where this breakdown would occur.

A significant proportion of students cited the stomach acid as breaking down the protein, with many going on to refer to denaturation of enzymes. A number also referred incorrectly to the hGH 'dissolving', rather than being digested.

Some students misunderstood the question and wrote about the hormone taking longer to get into the blood stream if taken orally, rather than focussing on the hormone being digested as a protein. Other less successful responses correctly recognised that the hormone would be digested but implied that the products of this digestion would work in the same way as the undigested hormone when later absorbed into the bloodstream. The idea of lack of absorption because the hormone was 'too big' was also seen relatively frequently.

04.3

This question differentiated well, with the full range of marks awarded. While a quarter of students scored no marks, a third of students were able to gain 3 or 4 marks. High level responses often went beyond the scope of the specification, using terminology such as recombinant DNA, restriction enzymes / endonucleases and DNA ligase in the correct contexts. 'Sticky ends' also featured frequently with some good descriptions of how these were used within the process. Some students confused 'ligase' with 'lipase' which meant that they were unable to earn credit for mark point 4.

A very small minority of students answered the question in relation to production of insulin rather than hGH, but a number of responses detailed parts of the process of adult cell cloning, rather than genetic engineering.

Some students found explaining the process of genetic engineering difficult and used only the information provided in the question. Reference to plasmids as vectors for mark point 3 and the sweeping statement 'using enzymes and plasmids' were not creditworthy without further qualification as this information was given to them in the question.

Less successful responses often confused the role of the hormone and the enzymes in the process, with the enzyme occasionally being inserted into the plasmid, or the hGH hormone itself (rather than the gene) being cut out, or placed into the plasmid/bacteria.

04.4

50% of students scored no marks on this question. Students are reminded that when answering 'compare' style questions they should make it absolutely clear to what they are referring when writing in the converse and to be mindful when using the word 'it'. In the

4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)

Answer 31 · Examiner comments June 2025 | 8461/2H | Original Q4

context of this question, 'it' referred to the hormone produced by genetic engineering as this was the subject of the question and therefore, an answer of 'it might spread infection' is incorrect. There was a significant number of responses where marks could not be awarded due to this lack of clarity.

Bullet points 2, 3 and 4 were the most commonly awarded, although for bullet point 4, a lack of qualification relating to the disease being passed on or spreading to humans (rather than the disease just being present in urine) meant this bullet point could not be awarded.

A number of uncreditworthy responses referred to the difficulties in physically collecting the urine from the animal, as well as ideas that the recombinant hormone is simply 'cheaper', 'easier', 'safer' or 'quicker'. A significant proportion of students described recombinant production in purely hygienic terms (e.g. 'cleaner' or 'more sanitary') without recognising it is easier to purify.

Only a very small number of students were able to access bullet point 6, often due to a lack of precision with their wording; many students did state that it was a 'specific human hormone' but often neglected to go on to relate this to effectiveness.