AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.5.2

The human nervous system

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**5**
Available paper years	**2018–2024**

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 The human nervous system

Answer 01 · Mark scheme June 2018 | 8464/B/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(P) synapse	allow phonetic spelling	1	AO1 4.5.2
	(Q) relay neuron(e)	allow intermediate neuron(e)	1	
04.2	(in neurone) as electrical impulse	allow electrical potential ignore signal / message	1	AO1 4.5.2
	(across synapse / gap P) as diffusion / movement of chemical / neurotransmitter		1	
		if no mark awarded allow **1** mark for mention of electrical and chemical in that order		
04.3	the impulse has to travel to the brain (and back)	allow it needs time to be processed by the brain allow the pathway is (a lot) longer allow more synapses	1	AO3 4.5.2
04.4	$120 = \frac{1.6}{\text{time}}$	an answer of 13(.33…) (ms) scores **3** marks an answer 0.013(33…) **or** 1/75 scores **2** marks	1	AO2 4.5.2
	or evidence of: $\text{speed} = \frac{\text{distance}}{\text{time}}$			
	0.013(33…) (s) **or** $\frac{1}{75}$		1	
	13(.33…) (ms)	an incorrect answer correctly converted to ms scores **1** mark	1	

4.5.2 The human nervous system

Answer 01 · Mark scheme

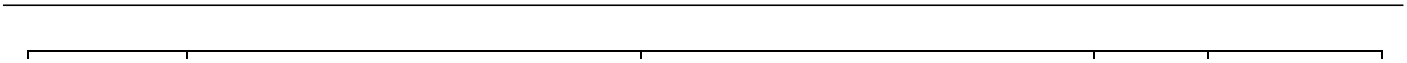
June 2018 | 8464/B/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	as age (in years) increases the time for the muscle to contract increases at an increasing rate	do **not** accept directly proportional allow correct description of 'at an increasing rate'	1 1	AO2 4.5.2
Total			**10**	

4.5.2 The human nervous system

Answer 01 · Mark scheme

June 2018 | 8464/B/2H | Original Q4



4.5.2 The human nervous system

Answer 02 · Mark scheme

June 2019 | 8464/B/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	hold a ruler (just) above the (open) hand of the other student drop the ruler and other student catches it record where the ruler is caught	ignore near the hand do **not** accept give verbal signal ignore timing	1 1 1	AO1 4.5.2
01.2	193.5		1	AO2 4.5.2
01.3	to compare the effect of no caffeine	allow as a control (group) allow to show the effect of caffeine do **not** accept control variable	1	AO3 4.5.2
01.4	0.217 (s)	allow any value in the range 0.2150 to 0.2180	1	AO2 4.5.2
01.5	as mass of caffeine increases the decrease / change in reaction time increases	allow converse ignore caffeine decreases reaction time do **not** accept the greater the increase in reaction time the greater the mass of caffeine	1	AO3 4.5.2
01.6	their reaction time was greater (after the drink)	allow converse allow slower / longer for greater do **not** accept anomalous result	1	AO3 4.5.2

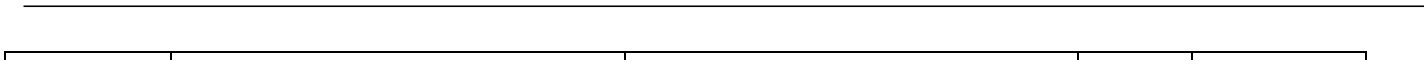
Answer 02 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	0.01(0) to 0.18(0) **or** 0.18(0) to 0.01(0) **or** 0.17(0)	allow values in range 0.008 to 0.012 **and** 0.178 to 0.182 allow correct calculation from values in range if no values are given, allow answers in the range 0.166 to 0.174 allow 0.01 ≤ C ≤ 0.18 ignore units	1	AO2 4.5.2
01.8	any **two** from: • (same range of) age • (same) sex / gender • (same) height / weight / BMI • all had no caffeine / medication / drugs earlier that day • equally tired or (same) amount of sleep • practice of the ruler drop test • starting point of ruler / hand • same point to take measurement above / below the thumb / finger • using the same hand • (same) number of students in each group	allow height ruler dropped from do **not** accept volume / concentration of caffeine	2	AO3 4.5.2
01.9	not automatic (because) it involves the (conscious part of the) brain	allow it is a voluntary action allow because it involves thinking / decision **or** conscious action	1 1	AO2 4.5.2
Total			**13**	

4.5.2 The human nervous system

Answer 02 · Mark scheme

June 2019 | 8464/B/2H | Original Q1



4.5.2 The human nervous system

Answer 03 · Mark scheme

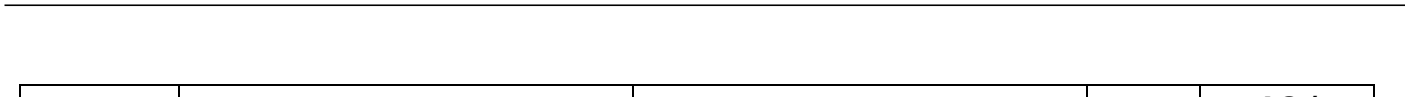
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any **four** from: • (stimulus is) detected by the receptor • (initiates) an electrical impulse • (impulse) travels via the neurones • sensory, relay and motor • crosses synapses • (crosses synapses) as a chemical	allow in this order only	4	AO1 AO2 4.5.2
02.2	**Level 2:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		3–4	AO2
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.		1–2	AO1
	No relevant content		0	4.5.2 RPA 6
	Indicative content • select at least 3 people • do reaction time test at least 3 times using right hand • details on how to do test in valid manner • find a mean • remove anomalous readings • repeat for each person for left hand • select people of same age • select people of same gender • same time of day • other control such as amount of coffee, sleep. To access level 2 the right hand and left hand of each person must be compared			
02.3	$\frac{(0.2 + 0.4 + 0.3 + 0.4 + 0.2 + 0.3)}{6}$ **or** $\frac{1.8}{6}$ 0.3		1 1	AO2 4.5.2 RPA 6

02.4	reaction time	allow time	1	AO2 4.5.2 RPA 6
02.5	students who play tennis (regularly) had shorter / faster (mean) reaction time(s)		1	AO3 4.5.2 RPA 6
02.6	any **one** from: • overlap in times between two groups • small difference in (mean) times • small sample used	allow correctly described as comparative data allow students who did not play tennis may have played other (ball) games	1	AO3 4.5.2 RPA 6
Total			**13**	

4.5.2 The human nervous system

Answer 03 · Mark scheme

November 2020 | 8464/B/2H | Original Q2



4.5.2 The human nervous system

Answer 04 · Mark scheme

November 2021 | 8464/B/2H | Original Q5

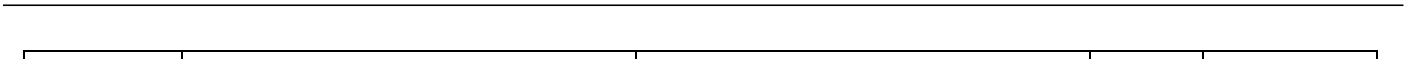
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **one** from: • previous intake of caffeine that day • usual intake of caffeine (on previous days) • concentration of caffeine • volume of caffeine • time of day • amount of sleep • body mass • previous experience of the test • which hand (of student **B**) holds the stopwatch	allow named caffeinated drink for caffeine allow amount / mass / type of caffeine for **1** mark allow fatigue allow (body) weight / BMI	1	AO1 4.5.2 RPA6
05.2	any **two** from: • (student **A**) does not press both start buttons simultaneously • (student **A**) may not say stop and press button simultaneously • student **B** could be distracted • idea that student **B** anticipated student **A** stopping the stopwatch • stopwatch malfunction	allow (stop)watches may not be <u>accurate</u>	2	AO3 4.5.2 RPA6
05.3	no value / result / number occurs more than once **or** all the values / results / numbers are different		1	AO2 4.5.2 RPA6

05.4	add(ed) the other (7) results and divide(d) by 7	allow correctly shown calculation ignore leave out the result for pair 8	1	AO2 4.5.2 RPA6
05.5	(adrenaline) increases heart rate (which) increases oxygen / glucose to brain / muscle (cells) (which) increases rate of respiration (so) releasing more energy for (faster / more) muscle <u>contraction</u>	allow increases blood flow allow (so) releasing more ATP for (faster / more) muscle <u>contraction</u> do **not** accept energy produced / made / created	1 1 1 1	AO1 AO1 AO2 AO2 4.5.3.6 4.5.2
05.6	synapse	allow synaptic cleft	1	AO1 4.5.2
05.7	fewer adenosine (molecules) can bind to the receptors **or** adenosine has no / less effect on the (relay) neurone therefore impulses in relay neurone are more frequent	 allow impulses in relay neurone are faster allow there are more impulses in relay neurone allow impulses in relay neurone not delayed / reduced (in number) ignore caffeine binds to adenosine receptors	1 1	AO2 AO3 4.5.2
Total			**12**	

4.5.2 The human nervous system

Answer 04 · Mark scheme

November 2021 | 8464/B/2H | Original Q5



Answer 05 · Mark scheme

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	pituitary		1	AO1 4.5.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	increased blood flow to muscles		1	AO1 4.5.3.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	receptor(s) (cells / neurones)	allow sensory (cells / neurones)	1	AO1 4.5.1

4.5.2 The human nervous system

Answer 05 · Mark scheme

June 2024 | 8464/B/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4		allow converse if clearly describing people who do not have diabetes		
	blood glucose (concentration) varies more (than in people who do not have diabetes)	allow blood glucose (concentration) increases / decreases more allow blood glucose (concentration) goes very high allow to get a sufficient range of blood glucose (concentrations)	1	AO2 4.5.3.2
	(because) less / no insulin produced when blood glucose (concentration) increases **or** (because) less / no insulin produced to decrease blood glucose (concentration)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	any **two** from: • prior familiarity with reaction time test • type of (reaction time) test • insulin (injections) • example of named drug (that would affect reaction time) • amount of sleep • distractions	ignore health unqualified allow practice allow description of part of a reaction time test to control eg which hand is used to catch the ruler ignore caffeine / alcohol allow tiredness / sleep	2	AO1 4.5.3.2 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	low / high blood glucose (concentration) is dangerous / unsafe	allow (to monitor for) unconsciousness / coma / headache / dizziness ignore hypoglycaemia / hyperglycaemia unqualified	1	AO3 4.5.3.2

4.5.2 The human nervous system

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	lowest reaction times recorded in (range of) blood glucose (concentration) found in people who do not have diabetes	allow high **and** low blood glucose (concentration) increase (mean) reaction time allow lowest reaction times recorded in range 4.0 to 7.8 ($mmol/dm^3$)	1	AO3
	homeostasis keeps blood glucose (concentration) in a narrow / small range **or** low(er) reaction times are a survival advantage		1	AO2 4.5.1 4.5.3.2

4.5.2 The human nervous system

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.8	when blood glucose (concentration) increases the pancreas releases insulin	allow when blood glucose (concentration) is / nears 7.8 ($mmol/dm^3$) the pancreas releases insulin allow when blood glucose (concentration) is high the pancreas releases insulin	1	AO1 4.5.1 4.5.3.2
	(insulin causes) glucose to move (from the blood) into the liver / muscle (cells)	if neither mark awarded allow **1** mark for glucose moves into cells	1	
	in (liver / muscle) (excess) glucose is converted to glycogen		1	
	when blood glucose (concentration) decreases the pancreas releases glucagon	allow when blood glucose (concentration) is / nears 4.0 ($mmol/dm^3$) the pancreas releases glucagon allow when blood glucose (concentration) is low the pancreas releases glucagon	1	
	(glucagon causes) glycogen to be converted into glucose and released into the blood	allow (glucagon causes) glycogen to be converted into glucose which increases blood glucose (concentration)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.9	any **two** from: (if more chemical produced / present) • diffusion of chemical (across synapse) is faster • an impulse in relay / motor / next neurone is more likely • an impulse is more likely to reach muscle	allow electrical signal for impulse throughout ignore signal / message allow an impulse in relay / motor / next neurone is faster / stronger / bigger allow there will be more impulses in relay / motor / next neurone(s) allow an impulse reaches muscle in less time allow an impulse reaches muscle faster allow bigger impulse causes faster muscle contraction	2	AO2 AO3 4.5.2

Total Question 6	17

Answer 01 · Examiner comments

June 2018 | 8464/B/2H | Original Q4

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

04.1 Of the 63% of students who achieved at least one mark, this was mark was usually for identifying gap P as a synapse. Far less were able to correctly label the relay neurone. Many students labelled Q as a motor neurone.

04.2 Most commonly students achieved one mark for describing electrical impulses or the diffusion of chemicals across the synapse, so the compensation mark was not often awarded.

Common errors referred to electrical messages, pulses or signals, instead of electrical impulses. Impulses alone was also insufficient to gain credit.

- Some students who knew that a synapse involved chemicals then did not mention that the chemical had to move or diffuse.
- Some students correctly used the term neurotransmitter but did not say it diffused or moved across the gap / synapse.
- Other students confused chemical and electrical impulses with answers such as chemicals diffusing along the neurone or electrical impulses diffusing across the gap often seen.
- Some students misinterpreted the question and compared the speed at which the information travels in a neurone and across a synapse.
- A few students referred to hormones travelling across the synapse rather than chemicals and a few students mentioned blood travelling down a neurone as if it were a blood vessel.

Answer 01 · Examiner comments June 2018 | 8464/B/2H | Original Q4

04.3 Few correct answers were seen on this question with 17% of students achieving the mark. Many simple answers related to one going to the brain and the other to the spinal cord or answers such as it being automatic or there is no thinking involved were commonly seen and were insufficient.

Lots of students wrote about the 'conscious action' or 'it' moving to the brain without being clear that it is the 'impulse' that is actually travelling to the brain. Some students seemed confused about the central nervous system and thought that both the brain and spinal cord are part of the CNS, and therefore suggested that the reflex didn't have to go the CNS. Many stated that you simply needed more time to think about it but made no mention of the brain.

Finally, many students simply said that reflexes were automatic or for our protection which is why they were faster.

04.4 Most students understood that in order to answer the question they needed to use the speed = distance ÷ time equation. But often did not rearrange it correctly and therefore divided 120 by 16.

The vast majority of students were unable to convert their answer into milliseconds to achieve marking point three and many did not attempt to. Those that did often multiplied their answer by 100 or 10 but rarely by 1000 and other students divided by 10 or 100.

When students did correctly gain the first marking point they usually also achieved the second (28%). It was very rare to award the compensation mark.

04.5 74% of students were awarded the first marking point. Some students described the pattern as directly proportional which is clearly wrong and therefore they could not gain this mark.

The second mark was only seen by 2% of students. Lots of attempts were made to include data in the answer but they often just quoted data from the table or did simple subtractions of two numbers from the table.

Answer 02 · Examiner comments

June 2019 | 8464/B/2H | Original Q1

Question 1 (standard demand)

01.1 Almost all students gained some credit for describing the ruler drop test. Most described the dropping and catching of the ruler but this mark point was not awarded if there was a countdown or warning given, or if the student was dropping and catching the ruler themselves.

Many students were able to describe exactly where the ruler should be positioned above the hand, but if a large height was indicated this was not awarded. The measurement on the ruler where it was caught was the third mark and any references to timing were ignored although many measured both.

01.2 88% of students correctly calculated the dose of caffeine for group D.

01.3 70% of students realised that a drink with no caffeine was needed to be able to see the effect of caffeine on reaction time. This could be expressed in various ways including ‘as a control group’, however ‘a control variable’ was not given credit as caffeine is in fact the independent variable. References to a ‘placebo’ were ignored.

01.4 79% of students were able to estimate the reaction time for a drop of 23 cm.

4.5.2 The human nervous system

Answer 02 · Examiner comments

June 2019 | 8464/B/2H | Original Q1

01.5 Many students didn't appear to read this question carefully and answered a different question giving that reaction time either increased or decreased. Half the students correctly expressed the relationship as 'as the mass of caffeine increases so does the decrease in reaction time' which is directly from the graph.

Some students just quoted data from the graph which did not gain credit. 'A positive correlation' did not gain credit but was ignored if the correct relationship was also given. Likewise the statement that reaction time was quicker was also ignored if the correct answer was present.

01.6 A 'mathematical' reason was required as to why these points were negative, so ideas related to errors or the method were not relevant. Some students surmised that the ruler was not caught at all or that they were distracted. 38% of students realised it was because the reaction time increased rather than decreased after the drink and so gained the mark.

01.7 Three-quarters of students were able to give the correct range of results for group C.

01.8 47% of students were able to give one or two variables that should have been controlled. The most common correct variables were related to the position of the hand and ruler before the test or using the same hand each test.

Most incorrect responses referred to some aspect of the caffeine drink which was in fact the independent variable and already very well controlled.

01.9 Over half of students were able to gain one mark for realising that either a reflex action is automatic or that the ruler drop test requires a conscious action or involves the brain. 9% of students gave the full answer for two marks Some students only referred to the absence or presence of danger as distinguishing the two actions or said that the ruler drop test only needed 'hand to eye coordination' or 'did not involve the brain'.

Many answers were based on the erroneous belief that the ruler drop test did not involve a stimulus or receptors like a reflex action, or that it could not be a reflex action as it was not to avoid danger or pain.

4.5.2 The human nervous system

Answer 04 · Examiner comments November 2021 | 8464/B/2H | Original Q5

Question 5 (standard, standard/high and high demand)

Some students read and understood the reaction time method provided. Some however, made assumptions that this was a 'ruler drop' method and then struggled to answer questions relating to control variables and possible sources of random error in the method.

In **05.4** students had to link their knowledge of the effect of adrenaline on the body to reaction time. A common misconception seen was that reaction time decreasing must mean slower reactions. Few students referred to oxygen or glucose supply to muscles or the brain, and fewer referred to the rate of respiration or energy released for muscle contraction. The common errors referring to energy being 'produced' were seen.

Students could generally recall the term 'synapse'. Few could apply their knowledge to the scenario given in **05.7**. Many students simply repeated the information provided, which is never awarded credit.

Answer 05 · Examiner comments

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

06.1 Nearly all students could identify that the pituitary gland releases hormones to control other glands.

06.2 Most students knew that adrenaline increases blood flow to muscles.

06.3 Most students could give the correct answer of receptor or sensory neurone/cell.

Some students were unaware that receptors that respond to stimulus are types of cells. Common incorrect answers were red blood cells, white blood cells, effector, muscle, named organs and nerve cells or neurones unqualified.

06.4 Very few students gained 2 marks. Many students stated that blood glucose goes up or is high in people with diabetes, but this is also true of people without diabetes, so the mark could not be awarded. The answer needed to be comparative.

Many students simply stated that people with diabetes do not produce enough insulin. This did not go far enough for either mark to be awarded.

Some students demonstrated confusion between Type 1 and Type 2 diabetes. Other students tried to answer in terms of how reaction time would be affected rather than blood glucose concentration.

Confusion was evident in terms of incorrect responses stating that 'insulin breaks down into glucose', or 'people with diabetes don't produce enough glucose'.

The answers to this question highlighted that many students did not understand the biological basis of diabetes. Common misconceptions included:

- people with Type 1 diabetes cannot make their own glucose (and this was sometimes followed by comments implying it is therefore safer for people with diabetes to drink glucose)
- glucose is the same as insulin
- insulin is converted to glucose
- insulin is converted to glycogen
- a lack of insulin means blood glucose concentration is lower.

© 2024 AQA and its licensors. All rights reserved.

4.5.2 The human nervous system

Answer 05 · Examiner comments

06.5 The most frequent correct responses related to amount of sleep or minimising distractions.

Common misinterpretations of the question referred to controlling the volume or concentration of glucose solution. Students should take care to read all the information provided. Different volumes or concentrations of glucose solutions would be necessary to change the independent variable. Food and drink were controlled, so references to controlling caffeine and alcohol intake could not be credited.

Many students assumed the reaction time test was the ruler drop test. If they described a suitable control variable, such as 'using dominant hand to catch the ruler' this was credited, but often these attempts at control variables were incorrect, such as 'same ruler' or 'same person dropping the ruler'.

06.6 Some students incorrectly interpreted the question as being an issue with recording accurate results. Many responses did not go far enough to be awarded the mark, such as 'blood glucose goes too high' without giving a reason why this is problematic. Common incorrect responses were too vague, such as 'in case they fell ill' or 'to give insulin injections'.

Some students suggested the health of the patient would affect the results/reaction times in the experiment, rather than considering the risk to the person with diabetes. These were not awarded the mark.

There were some good answers in which the students understood that both low and high blood glucose concentration are dangerous.

06.7 Students found this question challenging. Many simply defined homeostasis rather than answering the question. Some students approached the right idea but were imprecise with their language, such as 'faster/slower reaction times' indicating confusion between reactions, reaction times and the time recorded. Students need to be careful they are not describing time as speeding up or slowing down, which is not possible. Reactions can be faster but not reaction times.

Some students did identify that reaction times in the range for people without diabetes were lower but did not go far enough to state lowest. Similarly, some identified high blood glucose concentration increased reaction time but did not refer to low blood glucose concentration.

06.8 Many students are confused between glucose, glycogen, glucagon. Glycerol was also seen. Hybrid spellings between these terms was common and whilst phonetic spelling is acceptable, marks cannot be credited where there is ambiguity between technical terms.

Common misconceptions were that insulin or glucagon are broken down into glucose. For marking point 1, students often missed mention of the pancreas, in which case the mark would not be awarded. Few students gave marking point 2.

Some students misunderstood the question and described how people with diabetes control their blood sugar levels through diet and exercise.

Students sometimes spend time starting this style of question by re-writing the question. This is not necessary.

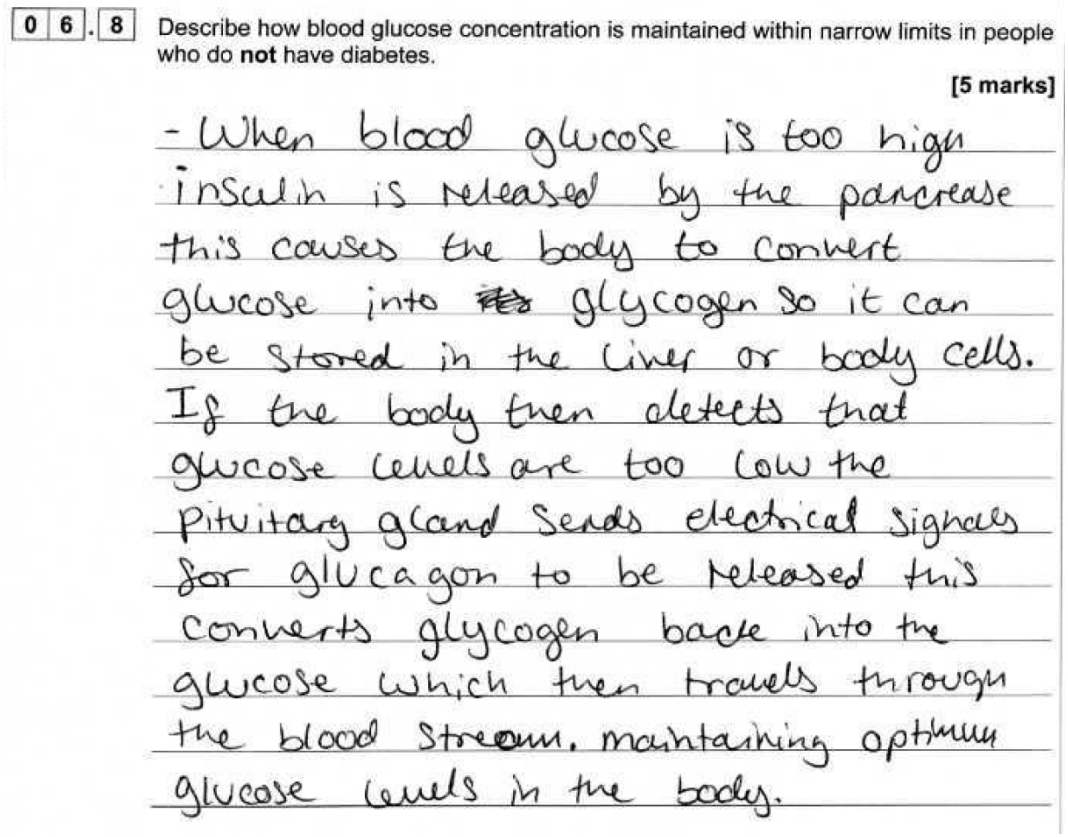
© 2024 AQA and its licensors. All rights reserved.

4.5.2 The human nervous system

Answer 05 · Examiner comments June 2024 | 8464/B/2H | Original Q6

0 6 . 8 Describe how blood glucose concentration is maintained within narrow limits in people who do **not** have diabetes.

[5 marks]


- When blood glucose is too high insulin is released by the pancrease this causes the body to convert glucose into ~~FES~~ glycogen so it can be stored in the liver or body cells. If the body then detects that glucose levels are too low the Pituitary gland sends electrical signals for glucagon to be released this converts glycogen back into the glucose which then travels through the blood stream, maintaining optimum glucose levels in the body.

The student has given marking points 1 and 3. 'Pancrease' is given benefit of the doubt as a phonetic spelling of pancreas.

The student is not clear whether glucose or glycogen is entering liver cells, therefore marking point 2 cannot be awarded.

The student has not referred to where glucagon is released from when blood glucose concentration decreases, therefore marking point 4 cannot be given.

Marking point 5 is given, so the student gains 3 marks for this question.

06.9 Many students answered as if the reaction time has increased, despite the question. For the first marking point, many stated that the increase in chemical would decrease the rate of diffusion, or 'overwhelm' the body. Few students made appropriate mention of impulses. Very few students could link the role of the diffusion of chemicals to impulses in the next/motor/relay neurone.

There was frequent use of incorrect terminology, such as:

- electrical impulses travelling across a synapse
- chemical impulses travelling across a synapse
- chemicals diffusing down neurones
- neurones moving from receptors to effectors.

Although it's beyond the specification, the term 'neurotransmitters' was seen and could be used.

© 2024 AQA and its licensors. All rights reserved.

Contact us

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

Tel: 01483 477756
Email: gcsescience@aqa.org.uk

aqa.org.uk

© 2024 AQA and its licensors. All rights reserved.