AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.5.2

The human nervous system

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**6**
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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	A		1	AO1 4.5.2 4.1.1.3
03.2	D		1	AO2 4.5.2 4.1.1.3
03.3	A = synapse B = motor (neurone)	in this order only	1 1	AO1 4.5.2
03.4	a reflex action		1	AO1 4.5.2
03.5	 12 (ms) 0.012 (s)	an answer of 0.012 (s) scores **2** marks	 1 1	AO2 4.5.2
03.6	A		1	AO1 4.5.3.1
03.7	controls the release of an egg		1	AO1 4.5.3.3
03.8	in the blood(stream)	allow in the plasma / blood vessels do **not** accept in blood cells / platelets	1	AO1 4.5.3.1

4.5.2 The human nervous system

Answer 01 · Mark scheme

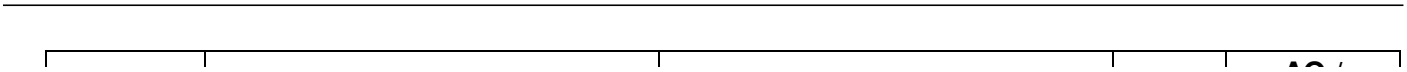
June 2018 | 8464/B/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.9	(person) C	no marks if A or B given	1	AO3 4.5.3.3
	any **one** from: • the testosterone level is high(er) • the oestrogen **and** / **or** progesterone levels are low • the oestrogen and progesterone levels do not rise and fall as they do in a menstrual cycle	allow testosterone is the main male (sex) hormone allow there is no menstrual cycle	1	
Total			**12**	

4.5.2 The human nervous system

Answer 01 · Mark scheme

June 2018 | 8464/B/2F | Original Q3



4.5.2 The human nervous system

Answer 02 · Mark scheme June 2019 | 8464/B/2F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	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
06.2	193.5		1	AO2 4.5.2
06.3	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
06.4	0.217 (s)	allow any value in the range 0.2150 to 0.2180	1	AO2 4.5.2
06.5	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
06.6	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

4.5.2 The human nervous system

Answer 02 · Mark scheme

June 2019 | 8464/B/2F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	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
06.8	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
06.9	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/2F | Original Q6

4.5.2 The human nervous system

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	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
07.2	**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			
07.3	$\frac{(0.2 + 0.4 + 0.3 + 0.4 + 0.2 + 0.3)}{6}$ **or** $\frac{1.8}{6}$ 0.3		1 1	AO2 4.5.2 RPA 6

07.4	reaction time	allow time	1	AO2 4.5.2 RPA 6
07.5	students who play tennis (regularly) had shorter / faster (mean) reaction time(s)		1	AO3 4.5.2 RPA 6
07.6	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 04 · Mark scheme

November 2021 | 8464/B/2F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	the reaction time		1	AO1 4.5.2 RPA6
02.2	any **two** from: • age • sex • previous intake of caffeine / coffee that day • usual intake of caffeine / coffee (on previous days) • concentration of caffeine / coffee • volume of caffeine / coffee • time of day • amount / length of sleep • health • body mass • same / type of reaction time program / software • same keyboard • prior experience with the reaction timer	allow gender if neither given allow amount / mass of caffeine / drink **or** type / brand of coffee for **1** mark allow fatigue allow other drugs taken allow (body) weight	2	AO1 4.5.2 RPA6
02.3	any **one** from: • (time) for the coffee / caffeine to work • (time) for coffee / caffeine to be absorbed • (time) for caffeine to reach the brain • (time) for coffee / caffeine to get round the body	allow (time) for the coffee / caffeine to be digested allow (time) for coffee to reach the brain	1	AO3 4.5.2 RPA6

4.5.2 The human nervous system

Answer 04 · Mark scheme

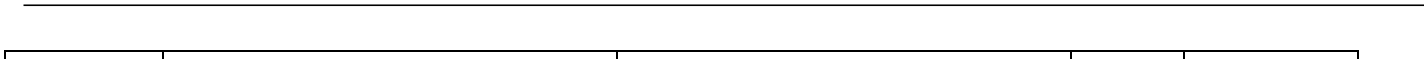
November 2021 | 8464/B/2F | Original Q2

02.4	eye		1	AO2 4.5.2 RPA6
02.5	muscle		1	AO2 4.5.2 RPA6
02.6	(reaction time is) decreased	allow reaction time is shorter allow reactions are faster allow (reaction) time is quicker	1	AO2 4.5.2 RPA6
02.7	student 3		1	AO3 4.5.2 RPA6
02.8	leave it out (and divide sum of the others by 4) **or** divide the sum of the others by 4	ignore repeat the test	1	AO3 4.5.2 RPA6
Total			**9**	

4.5.2 The human nervous system

Answer 04 · Mark scheme

November 2021 | 8464/B/2F | Original Q2



Answer 05 · Mark scheme

June 2023 | 8464/B/2F | Original Q2

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02.1	<table><tr><th>Variable</th><th>Independent variable</th><th>Dependent variable</th><th>Control variable</th></tr><tr><td>Distractions from background sounds</td><td></td><td></td><td>✓</td></tr><tr><td>Reaction time</td><td></td><td>✓</td><td></td></tr><tr><td>Type of stimulus</td><td>✓</td><td></td><td></td></tr></table> do **not** accept more than one tick in any row	1 1 1	AO1 4.5.2 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	repeat both methods 10 times		1	AO3 4.5.2 4.5.1 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	any **one** from: • practice • fewer distractions • familiarity (with test)	ignore repeating allow reference to effect of caffeine allow answers referring to competitiveness eg the student wanted to beat a previous time	1	AO3 4.5.2 4.5.1 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	2 bars correctly plotted **and** 2 bars correctly labelled as seeing (the stimulus) and hearing (the stimulus) (y axis label) (mean reaction) time in milliseconds / ms	allow a tolerance of ± ½ a small square allow any width bars touching or not allow bars in either order	1 1	AO2 4.5.2 4.5.1 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	(when seeing stimulus reaction time is) longer / greater / higher	allow converse for hearing stimulus if clearly stated allow bigger / larger allow slower (reaction time) allow slower (reactions) allow 130 milliseconds more ignore 130 milliseconds unqualified	1	AO3 4.5.2 4.5.1 RPA6

Total Question 2	**8**

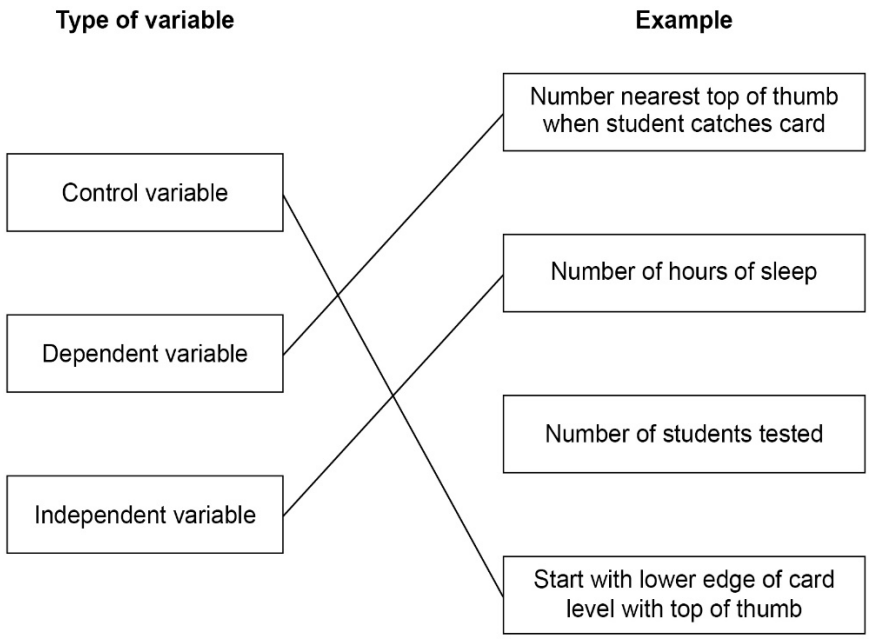
4.5.2 The human nervous system

Answer 06 · Mark scheme

June 2024 | 8464/B/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	any **one** from: • (react in order) to brake / steer • avoid accidents / collision / people / cars / objects	allow for safety	1	AO2 4.5.2

Question	Answers	Mark	AO / Spec. Ref.
03.2	 do **not** accept more than one line from a box on the left	1 1 1	AO1 4.5.2 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	students may catch the card between scores		1	AO3 4.5.2 RPA6

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	plot at 8.5 hours and reaction score 3	allow a tolerance of ±½ small square	1	AO2 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	7.5 (hours)	allow 7 ½ (hours) allow 7 hours and 30 minutes allow 7:30 allow answer on **Figure 6** if no answer on line do **not** accept 7.3	1	AO2 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	reaction time stayed the same		1	AO3 4.5.2 RPA6

4.5.2 The human nervous system

Answer 06 · Mark scheme

June 2024 | 8464/B/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	any **two** from: • repeat (card drop) for each student • repeat on different days • repeat on larger number of students • repeat with wider range of sleep times • control / same age • control / same sex • control / same food / drink / caffeine / drugs (before test) • control distance between thumb and forefinger • control / same practice • remove distractions • use computer / phone reaction timer • have more divisions on the card • record sleep time in smaller intervals	if none of these awarded allow **1** mark for repeat unqualified allow control / same gender allow remove gaps between (reaction) scores for **2** marks allow repeat for each student and calculate a mean for **2** marks allow repeat on different days and calculate a mean	2	AO3 4.5.2 RPA6

4.5.2 The human nervous system

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	long (cell)		1	AO1 4.5.2
	to transport / carry the information / impulse(s) / signal	allow to transport / carry electrical messages ignore to carry messages unqualified	1	
	from CNS / coordinator / spinal cord / brain to muscle(s) / effector		1	
	alternative approach 1: (many) branches (1)	allow (many) dendrites		
	to transport / carry the information / impulse(s) / signal (1)	allow to transport / carry electrical messages ignore to carry messages unqualified		
	to many / several muscle cells (1)			
	alternative approach 2: attach to muscle cells (1)			
	to transport / carry the information / impulse(s) / signal (to muscle) (1)			
	for muscle contraction (1)			
	alternative approach 3: many mitochondria (1)			
	to respire (1)	allow to release energy do **not** accept energy produced / made / created		
	to assist / allow the information / impulse / signal to travel (1)	allow to assist / allow the transport / carriage of electrical messages		

	alternative approach 4: insulation **or** fatty sheath (1) to transport / carry the information / impulse(s) / signal (1) (along the neurone) faster (1)	 allow to transport / carry electrical messages ignore to carry messages unqualified **alternative approach 5:** allow narrow (1) so many (neurones) can fit in a small space (1)		

Total Question 3	**13**

Answer 04 · Examiner comments November 2021 | 8464/B/2F | Original Q2

Question 2 (low & standard demand)

This was based on Required Practical Activity 6. It was clear that many students did not appear to understand the method given. When asked for two control variables, many students copied steps from the method that were not applicable.

Most students could identify the receptor and effector in this situation. It was more challenging to describe the effect of drinking coffee on reaction time, with many students stating reaction time increased. **02.7** required students to identify the smallest change in reaction time. A common incorrect answer was student 5, who showed the lowest reaction time, but not the smallest change. Most students knew that the anomalous result should not be included when calculating the mean. Common incorrect responses referred to rounding the anomaly up or down.

Answer 05 · Examiner comments June 2023 | 8464/B/2F | Original Q2

Question 2 (Low demand)

02.1 20% of students could correctly identify which variable was a control, independent or dependent variable for 3 marks. A further 40% gained 1 mark. The most common correct answer was for the control variable.

02.2 50% of students could correctly identify an improvement to the method.

02.3 Although the context of the investigation was a novel application of the required practical activity, many students had no difficulty applying their knowledge of the effects or practice and familiarity to answer the question. Few students mentioned distractions. References to simply repeating were insufficient (and just repeated part of the question). Being focused / alert / prepared were considered insufficient because these ideas could equally apply the first time the student undertook the test.

02.4 Students were asked to label the *y*-axis. Axes labels should enable anyone viewing the graph to make sense of the results. Therefore, simply labelling the *y*-axis 'y-axis' is insufficient. The label should include the unit. The brackets on the mark scheme indicate what was considered essential for the label, therefore 'Time / ms' was the minimum requirement.

The bars could be in either order. Some students confused the labels on the two bars. Students should be encouraged to use a ruler to draw bar charts. Those who drew the bars freehand were sometimes out of tolerance on the height of the bars.

4.5.2 The human nervous system

Answer 05 · Examiner comments

June 2023 | 8464/B/2F | Original Q2

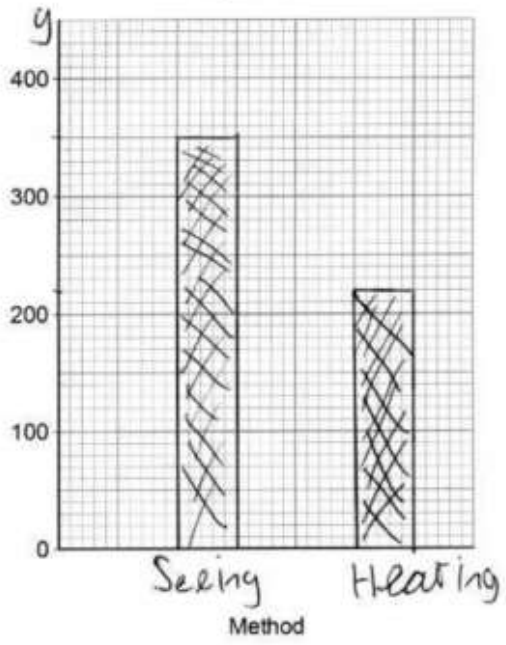
0 2 . 4 Complete **Figure 2**.

You should:

- plot the data from **Table 2** as a bar chart
- label each bar
- label the y-axis.

[2 marks]

Figure 2



The student has simply labelled the axis 'y' therefore marking point 2 cannot be awarded. The labels for the bars and the height of the bars allow marking point 1 to be awarded.

02.5 There are many ways that students could make a correct comparative statement about the two reaction times. Some students incorrectly stated that the reaction time when seeing was faster. This continues to be an issue, with students equating a larger number with 'faster'.

Unless stated otherwise by the student, we assumed the answer referred to reaction time when seeing the stimulus. This is due to the way the question is phrased. Therefore, 'it' was taken as the reaction time when seeing the stimulus, unless otherwise stated.

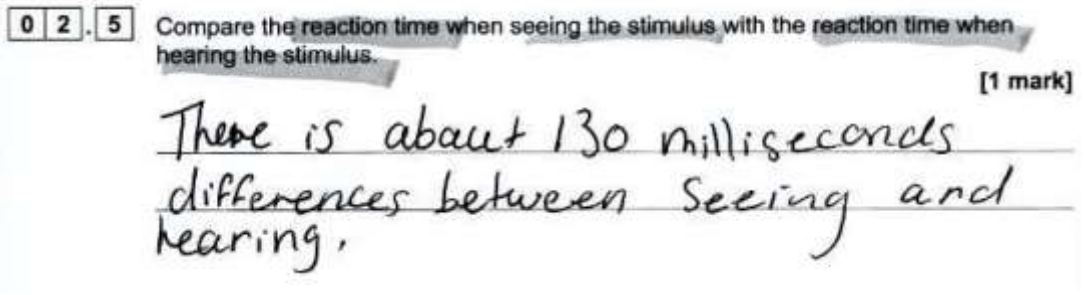
It is equally valid for students to give the converse argument, but only if clearly relating that argument to hearing. Therefore, 'They heard it quicker than they saw it' was acceptable.

4.5.2 The human nervous system

Answer 05 · Examiner comments June 2023 | 8464/B/2F | Original Q2

0 2 . 5 Compare the reaction time when seeing the stimulus with the reaction time when hearing the stimulus.

[1 mark]



The student has calculated the difference in reaction time, but the mark is not awarded because they have not stated which reaction time is greater / smaller.

Answer 06 · Examiner comments

June 2024 | 8464/B/2F | Original Q3

Question 3 (low & standard demand)

03.1 Most students could suggest why fast reactions are important for car drivers.

Responses that restated the question, such as 'fast reactions are important', or 'to be alert' were not sufficient. Some students misinterpreted the question and explained how they could get to where they were going faster by driving quickly, which was incorrect.

03.2 The most common error was to confuse the independent and dependent variable.

03.3 Most students could identify that it was a problem that the student may catch the card between scores.

03.4 Most students could plot the point correctly.

03.5 Many students could give the mode. Some students attempted calculations in the answer space, which were not needed to answer the question. In most cases, these students were attempting to calculate the mean or median.

03.6 Approximately half of the students selected the correct response that reaction time stayed the same.

03.7 Many students gave the idea of repeats, or using a wider range of different sleep times.

In most cases, incorrect responses were suggesting other independent variables that could be changed, such a drinking different caffeine drinks before the test. Other students incorrectly stated that all the students should sleep for the same length of time or that a stopwatch should be used.

03.8 Few students could state an adaptation of the motor neurone cell. The most common correct answers were 'long' or 'attached to muscle cells'. Explanations of the adaptation were very rare.

A frequently seen misconception was that the muscle contracts and then a signal is passed to the motor neurone. Few students referred correctly to an impulse.

Misconceptions that were frequently seen included:

- neurones transport energy
- the motor neurone tells muscle/brain what to do
- the motor neurone sends messages
- the cell can move
- the cell has a large surface area
- the cell pulls the muscle
- the cell has a tail/arm/leg/stem.

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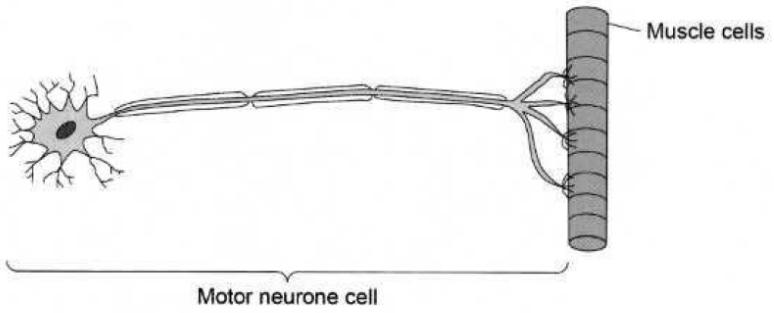
4.5.2 The human nervous system

Answer 06 · Examiner comments June 2024 | 8464/B/2F | Original Q3

0 3 . 8 Motor neurones are involved in reactions.

Figure 7 shows a motor neurone.

Figure 7



Explain **one** way the motor neurone cell is adapted for its function.

[3 marks]

Motor neurone cells are long in length so that messages being sent around the body can happen quickly and efficiently. There length means they can travel longer distances so messages to the CNS can happen as fast as possible.

The student gained 1 mark for 'long'. The misconception here, that the motor neurone is sending impulses, was frequently seen. In this instance, the student also refers to 'impulses' as 'messages', which is insufficient. The misconception that the impulse is travelling from the muscle, as demonstrated here, was also common.

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