AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.5.2

The human nervous system

Past-paper questions

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

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.2 The human nervous system

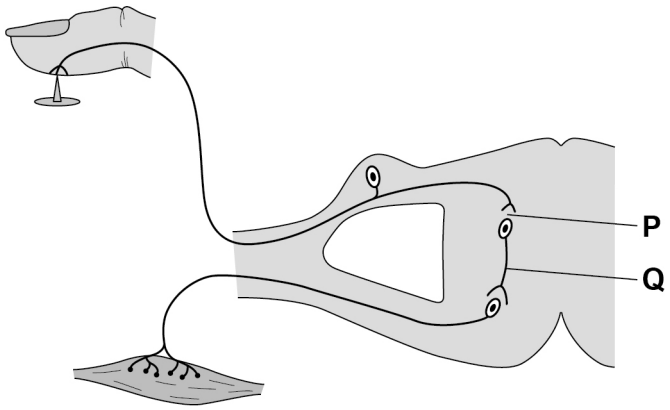
Question 01

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

0 4 This question is about the nervous system.

Figure 3 shows a reflex arc.

Figure 3



0 4 . 1 Name parts **P** and **Q** shown on **Figure 3**

[2 marks]

P _____

Q _____

0 4 . 2 Compare how information is transferred along a neurone with how information is transferred across gap **P**.

[2 marks]

_____

_____

_____

_____

0 4 . 3 Why does a conscious action take longer than a reflex action?

[1 mark]

_____

_____

4.5.2 The human nervous system

Question 01 · continued

0 4 . 4 Information travels at 120 metres per second in neurones.

Calculate the time it would take for the information to travel 1.6 m along a neurone.

Give your answer in milliseconds.

[3 marks]

Time = _____ ms

0 4 . 5 Doctors tested people of different ages to time how long it took between touching a sharp pin and the arm muscle contracting.

Table 3 shows the results.

Table 3

Age in years	Time for muscle to contract in milliseconds
30	18.9
40	20.2
50	23.1
60	26.7
70	31.3
80	37.0

Describe the relationship between age in years and time for the muscle to contract.

[2 marks]

10

4.5.2 The human nervous system

Question 02

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

0 1 Some students investigated the effect of drinking caffeine on reaction time.

They used a drink containing 32.25 mg of caffeine per 100 cm^3

This is the method used.

1. Divide the students into four groups, **A**, **B**, **C** and **D**.
2. Measure and record the reaction time of each student using the ruler-drop test.
3. Students in:
   - group **A** drink 200 cm^3 of water
   - group **B** drink 200 cm^3 of the caffeine drink
   - group **C** drink 400 cm^3 of the caffeine drink
   - group **D** drink 600 cm^3 of the caffeine drink.
4. Repeat step 2 after 15 minutes.

0 1 . 1 Describe how to do the ruler-drop test.

[3 marks]

Question 1 continues on the next page

Question 02 · continued

0 1 . 2 **Table 1** shows the mass of caffeine taken in by each student.

Table 1

Group	Mass of caffeine in mg
A	0
B	64.5
C	129.0
D	**X**

Calculate value **X**.

[1 mark]

X = _____ mg

0 1 . 3 Why did group **A** drink water instead of the caffeine drink?

[1 mark]

Question 02 · continued

Table 2 was used to convert the results of the ruler-drop test into reaction times.

Table 2

Distance in cm	Reaction time in s	Distance in cm	Reaction time in s
2	0.064	28	0.239
4	0.090	30	0.247
6	0.111	32	0.256
8	0.128	34	0.263
10	0.143	36	0.271
12	0.156	38	0.278
14	0.169	40	0.286
16	0.181	42	0.293
18	0.192	44	0.300
20	0.202	46	0.306
22	0.212	48	0.313
24	0.221	50	0.319
26	0.230	52	0.326

0 1 . 4 Estimate the reaction time for a student who recorded a distance of 23 cm

[1 mark]

Reaction time = _____ s

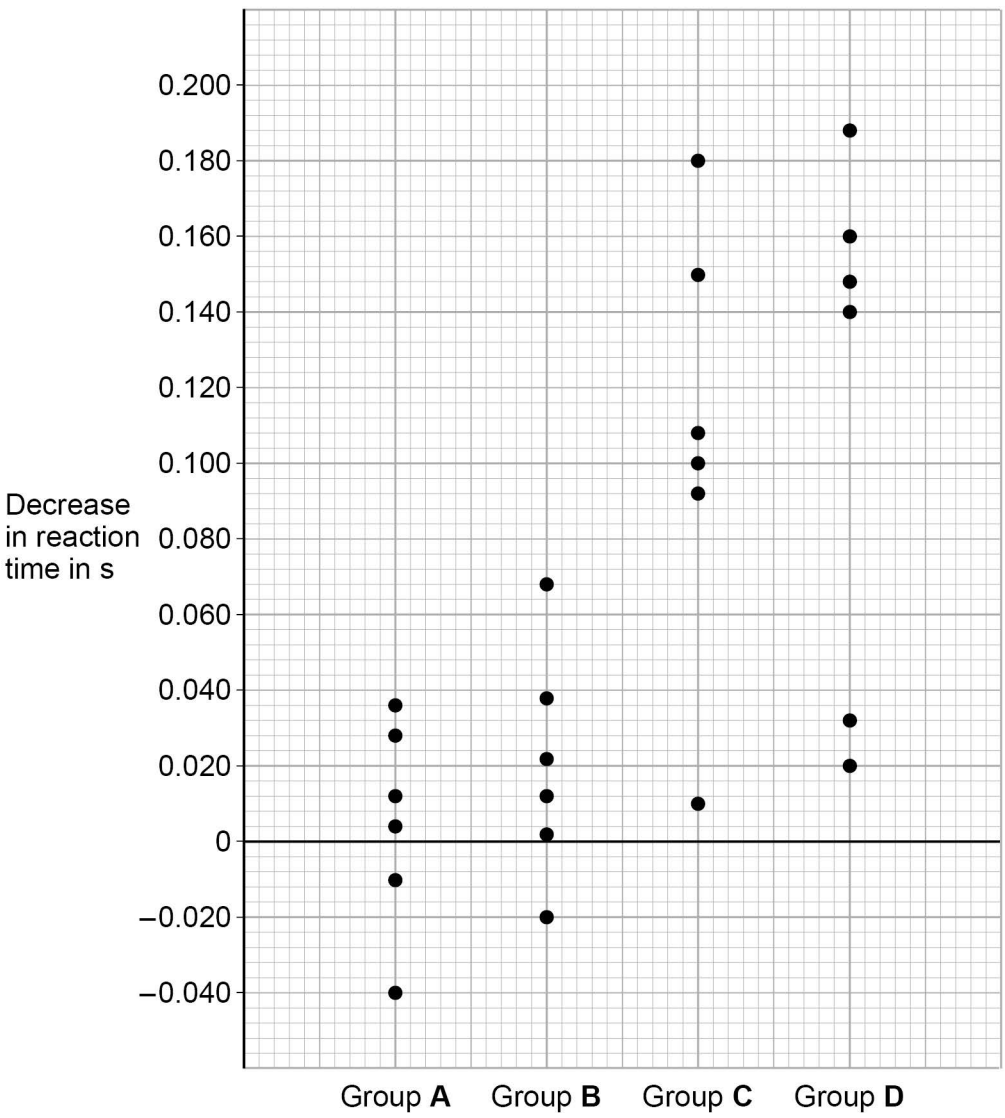
Question 1 continues on the next page

Question 02 · continued

Students calculated the decrease in their reaction time after the drink compared with before the drink.

Figure 1 shows the results for each student.

Figure 1



0 1 . 5 Describe the effect of the mass of caffeine taken in on the decrease in reaction time.

[1 mark]

4.5.2 The human nervous system

Question 02 · continued

0 1 . 6 For three students the decrease in reaction time was negative.

Give the reason why the value was negative.

[1 mark]

0 1 . 7 What is the range of results for group **C**?

[1 mark]

0 1 . 8 Suggest **two** variables that should have been controlled in this investigation.

[2 marks]

1

2

0 1 . 9 Explain why the ruler-drop test does **not** involve a reflex action.

[2 marks]

13

4.5.2 The human nervous system

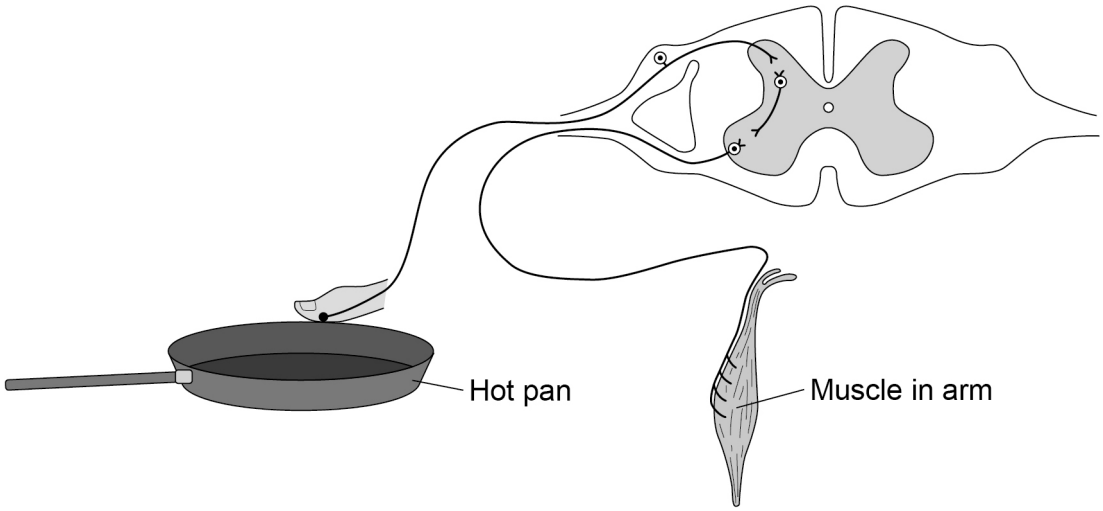
Question 03

0 2 Human reactions are a response to an external change.

0 2 . 1 Reflex actions help to protect the body against damage.

Figure 2 shows the nervous pathway for a reflex action.

Figure 2



A stimulus from the hot pan will cause the muscle in the arm to contract and move the finger away.

Describe how the stimulus from the hot pan reaches the muscle in the arm.

[4 marks]

4.5.2 The human nervous system

Question 03 · continued

0 2 . 2 A student investigated whether using the right hand or the left hand had an effect on reaction time.

The student only tested right-handed people.

Describe a method for the student's investigation.

Include details of the test you would use for reaction time.

[4 marks]

Question 2 continues on the next page

Question 03 · continued

A different student carried out an investigation to see if playing tennis improved reaction time.

The student used two groups of six people.

Table 1 shows the results.

Table 1

Person	Reaction time in seconds	
	People who play tennis	People who do not play tennis
1	0.2	0.3
2	0.4	0.4
3	0.3	0.6
4	0.4	0.5
5	0.2	0.3
6	0.3	0.2
Mean	**X**	0.4

0 2 . 3 Calculate mean value **X** in **Table 1**.

[2 marks]

X = _____ seconds

0 2 . 4 What is the dependent variable in the student's investigation?

[1 mark]

_____

4.5.2 The human nervous system

Question 03 · continued

The student concluded:

'Playing tennis improves reaction time.'

0 2 . 5 Give **one** piece of evidence which supports the conclusion.

[1 mark]

0 2 . 6 Give **one** piece of evidence which does **not** support the conclusion.

[1 mark]

13

4.5.2 The human nervous system

Question 04

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

0 5 Caffeine is a drug that decreases reaction time.

A group of sixteen students investigated the effect of caffeine on reaction time.

The students were all 15-year-old girls.

The group was divided into 8 pairs of students.

This is the method used.

1. Student **A** starts two stopwatches at the same time.
2. Student **A** then gives one of the stopwatches to Student **B**.
3. Student **A** says "stop" at the same time as stopping her stopwatch. Student **B** stops her stopwatch as quickly as possible after Student **A** says "stop".
4. The difference in time shown on the two stopwatches is recorded. This is the reaction time of Student **B**.
5. Student **B** drinks a caffeinated drink.
6. The students wait 15 minutes and then repeat steps 1 to 4.

0 5 . 1 Suggest **one** control variable the students should have used in the investigation.

Do **not** refer to age or sex in your answer.

[1 mark]

Question 04 · continued

0 5 . 2 Suggest **two** sources of random error when using this method to measure a person's reaction time.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

Question 5 continues on the next page

Table 1 shows the results.

Table 1

Student pair	Decrease in reaction time after drinking the caffeinated drink in seconds
1	0.039
2	0.021
3	0.027
4	0.041
5	0.022
6	0.036
7	0.024
8	0.097

0 5 . 3 Why can a mode **not** be determined for the data in **Table 1**?

[1 mark]

0 5 . 4 The students decided the result from pair **8** was anomalous.

The students calculated that the mean decrease in reaction time was 0.030 seconds.

Describe how the students calculated the mean decrease in reaction time.

[1 mark]

0 5 . 5 Caffeine causes the release of adrenaline.

Adrenaline affects heart rate.

Explain how the effect of adrenaline on heart rate might cause reaction time to decrease.

[4 marks]

Question 5 continues on the next page

Adenosine is a different chemical made by the body.

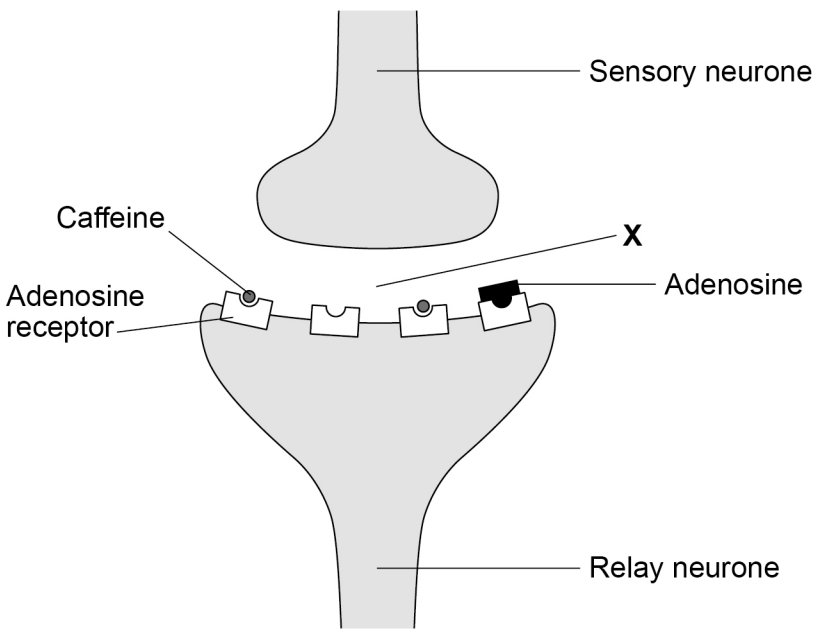
Adenosine binds to receptors on relay neurones.

Adenosine decreases the number of impulses in relay neurones.

Figure 5 shows how caffeine binds to adenosine receptors on a relay neurone.

When caffeine binds to adenosine receptors it blocks the receptor so adenosine cannot bind.

Figure 5



0 5 . 6 Label **X** shows the gap between the sensory neurone and the relay neurone.

What is the name of the gap labelled **X**?

[1 mark]

4.5.2 The human nervous system

Question 04 · continued

0 5 . 7 Suggest why reaction time decreases when caffeine binds to adenosine receptors.

[2 marks]

12

Turn over for the next question

4.5.2 The human nervous system

Question 05

0 6 Hormones are released from endocrine glands.

0 6 . 1 Which gland releases hormones to control other glands?

[1 mark]

Tick (✓) **one** box.

- Adrenal ☐
- Pituitary ☐
- Thyroid ☐

Several hormones can affect blood glucose concentration.

0 6 . 2 Adrenaline can increase blood glucose concentration.

What is **one** other effect of adrenaline?

[1 mark]

Tick (✓) **one** box.

- Decreased breathing rate ☐
- Decreased metabolic rate ☐
- Increased blood flow to muscles ☐
- Increased FSH production ☐

0 6 . 3 Cells in the pancreas detect changes in blood glucose concentration.

What type of cell in the body detects changes?

[1 mark]

_____

Question 6 continues on the next page

Question 05 · continued

Scientists investigated whether blood glucose concentration affects reaction time.

The reaction times of ten people with Type 1 diabetes were measured.

This is the method used.

1. Tell one person to drink a glucose solution.
2. Monitor the person's blood glucose concentration.
3. Record the person's reaction time when the person's blood glucose concentration is:
   - 16 mmol/dm^3
   - 6 mmol/dm^3
   - 3 mmol/dm^3
4. Repeat steps 1 to 3 for the nine other people.

0 6 . 4 People with Type 1 diabetes were selected for the investigation instead of people who did **not** have diabetes.

Explain why.

[2 marks]

0 6 . 5 Control variables between the different people in the investigation included:

- age
- sex
- food and drink consumed before and during the test.

Suggest **two other** control variables that should be used in the investigation.

[2 marks]

1 _____

_____

2 _____

_____

0 6 . 6 It was important for the scientists to monitor the health of each person during the investigation.

Suggest **one** reason why.

[1 mark]

_____

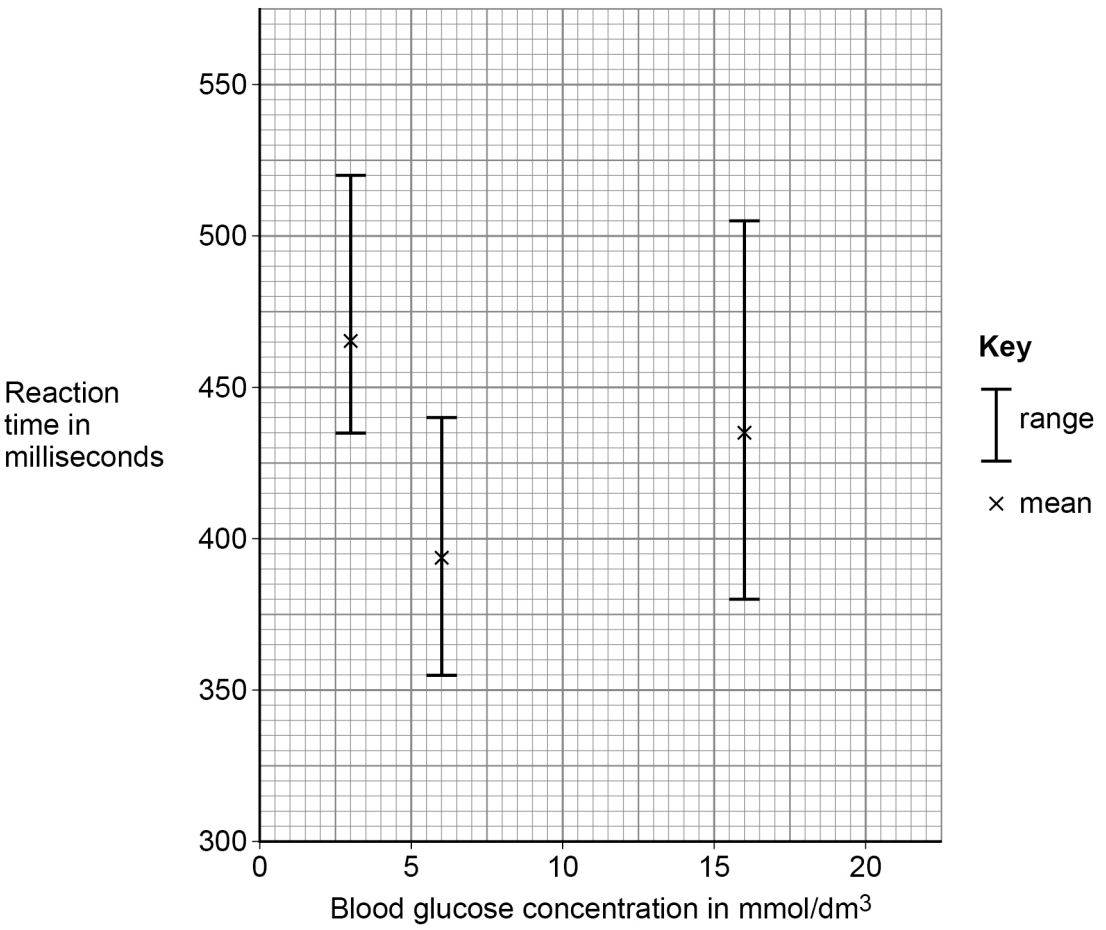
_____

Question 6 continues on the next page

Question 05 · continued

Figure 6 shows the results.

Figure 6



0 6 . 7 People who do **not** have diabetes usually have a blood glucose concentration in the range of 4.0 mmol/dm^3 to 7.8 mmol/dm^3.

Describe how the results in **Figure 6** show the importance of homeostasis.

[2 marks]

4.5.2 The human nervous system

Question 05 · continued

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

[5 marks]

0 6 . 9 The scientists gave the hypothesis:

‘Optimum blood glucose concentration increases the production of chemicals that diffuse across synapses.’

Describe how an increase in the chemicals could decrease reaction time.

[2 marks]

17