

B10- The human nervous system Exam Practice 1

Name:

Score:

Q1.

Caffeine is a drug that affects reaction time.

Coffee is a drink that contains caffeine.

Five students investigated the effect of drinking coffee on their reaction time.

Each student sat in front of a computer screen showing a reaction timer.

This is the method used.

1. Press any key on the keyboard when the colour of the screen changes to green.
2. Record the reaction time shown on the computer screen.
3. Drink coffee containing caffeine.
4. Wait 15 minutes then repeat steps 1 and 2.

(a) What is the dependent variable in the investigation?

Tick (✓) **one** box.

The coffee containing caffeine

The number of students

The reaction time

(1)

(b) Give **two** control variables the students should have used.

1 _____

2 _____

(2)

(c) Why did the students wait 15 minutes after drinking the coffee before repeating the test?

(1)

(d) Responding to the colour change of the screen involves a receptor in the student.

Where is the receptor in the student?

Tick (✓) **one** box.

Ear

Eye

Skin

(1)

(e) Responding to the colour change of the screen involves an effector in the student.

What is the effector in the student?

Tick (✓) **one** box.

Brain

Gland

Muscle

Spinal cord

(1)

The table below shows the results.

Student	Reaction time in milliseconds	
	Before drinking coffee	After drinking coffee
1	385	255
2	420	291
3	285	265
4	871	259
5	463	247

(f) What is the effect of drinking coffee on reaction time?

Use the table above.

(1)

(g) Which student had the smallest change in reaction time after drinking coffee?

Tick (✓) **one** box.

Student 1

Student 2

Student 3

Student 4

Student 5

(1)

(h) The students decided that one of the results was anomalous.

What should the students do with the anomalous result when calculating the mean change in reaction time?

(1)

(Total 9 marks)

Q2.

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

They used a drink containing 32.25 mg of caffeine per 100 cm³

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 cm³ of water
 - group **B** drink 200 cm³ of the caffeine drink
 - group **C** drink 400 cm³ of the caffeine drink
 - group **D** drink 600 cm³ of the caffeine drink.
4. Repeat step 2 after 15 minutes.

(a) Describe how to do the ruler-drop test.

(3)

(b) **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**.

X = _____ mg

(1)

(c) Why did group **A** drink water instead of the caffeine drink?

(1)

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

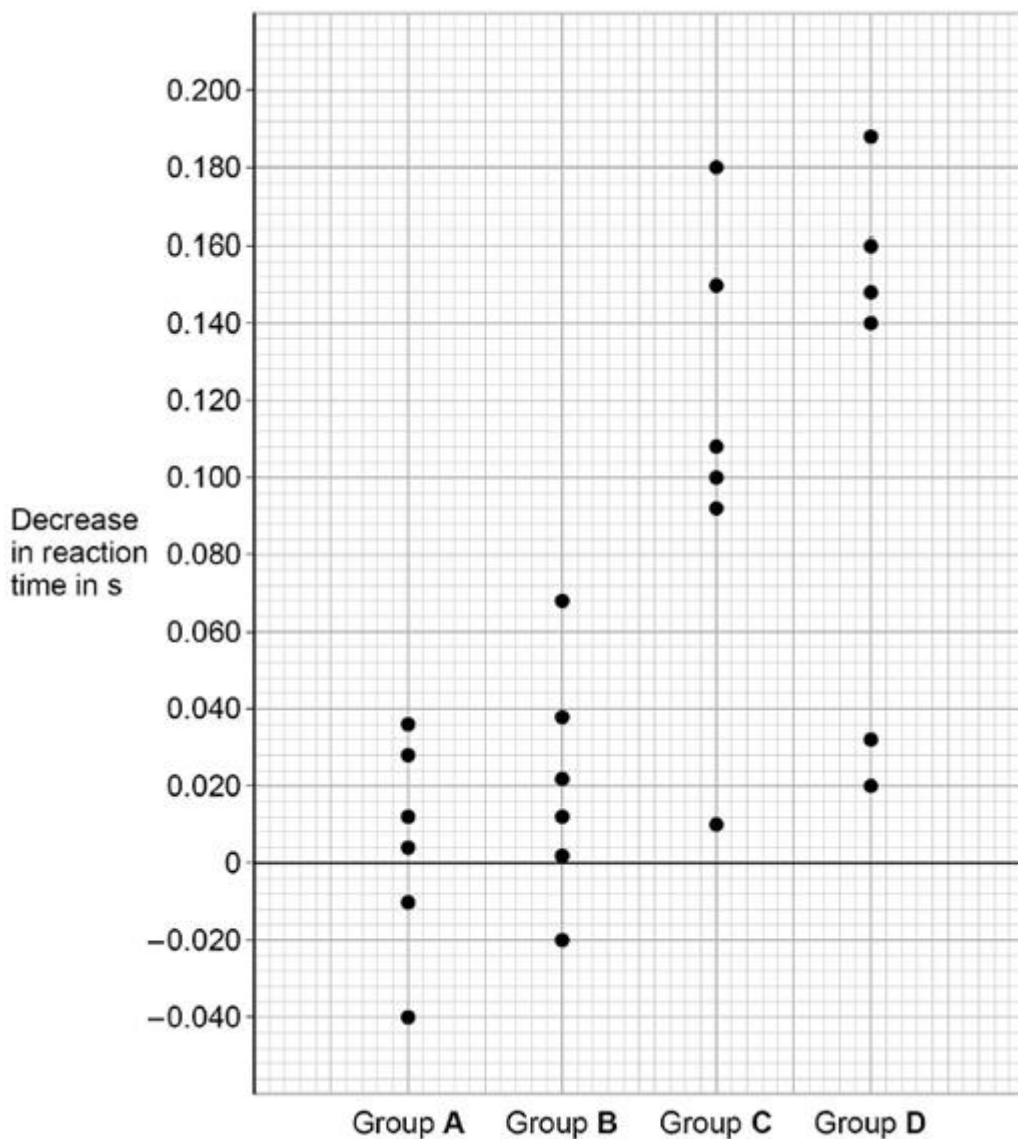
(d) Estimate the reaction time for a student who recorded a distance of 23 cm

Reaction time = _____ s

(1)

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

The graph shows the results for each student.



(e) Describe the effect of the mass of caffeine taken in on the decrease in reaction time.

(1)

(f) For three students the decrease in reaction time was negative.

Give the reason why the value was negative.

(1)

(g) What is the range of results for group **C**?

_____ (1)

(h) Suggest **two** variables that should have been controlled in this investigation.

1 _____

2 _____

_____ (2)

(i) Explain why the ruler-drop test does **not** involve a reflex action.

_____ (2)

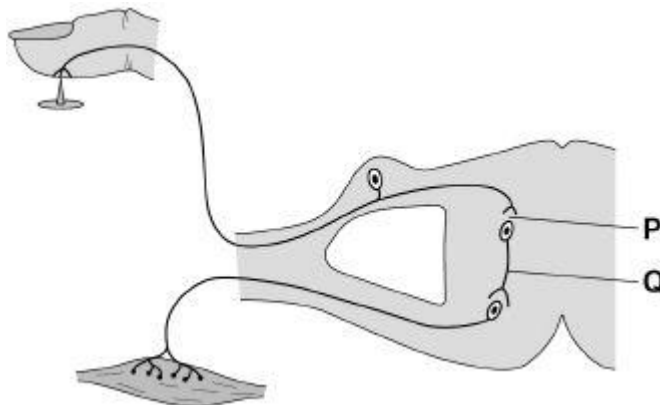
(Total 13 marks)

Higher Tier Questions

Q3.

This question is about the nervous system.

The diagram below shows a reflex arc.



- (a) Name parts **P** and **Q** shown on the diagram above.

P _____

Q _____

(2)

- (b) Compare how information is transferred along a neurone with how information is transferred across gap **P**.

(2)

- (c) Why does a conscious action take longer than a reflex action?

(1)

(d) 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.

Time = _____ ms

(3)

(e) Doctors tested people of different ages to time how long it took between touching a sharp pin and the arm muscle contracting.

The table below shows the results.

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)

(Total 10 marks)

Q4.

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.

- (a) Suggest **one** control variable the students should have used in the investigation.

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

(1)

- (b) Suggest **two** sources of random error when using this method to measure a person’s reaction time.

1 _____

2 _____

(2)

The table below shows the results.

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

(c) Why can a mode **not** be determined for the data in the table above?

(1)

(d) 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)

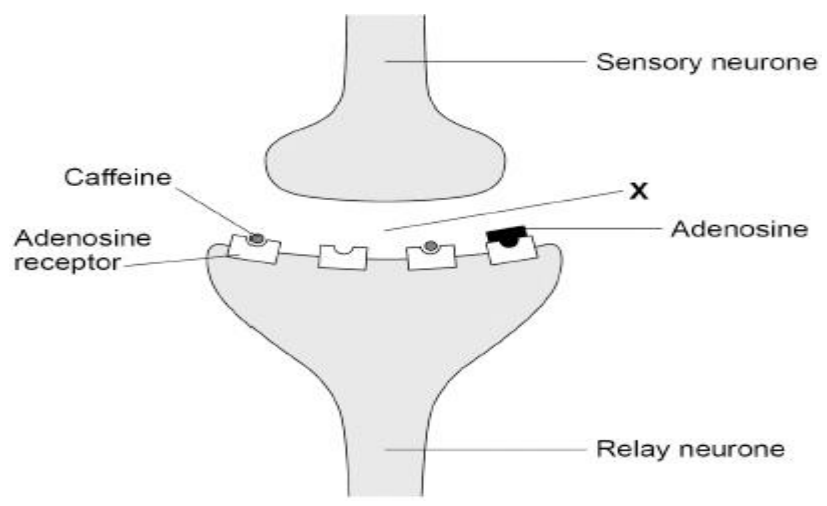
(e) Caffeine causes the release of adrenaline.

Adrenaline affects heart rate.

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

(4)

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.
The figure below 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.



(f) Label X shows the gap between the sensory neurone and the relay neurone.
What is the name of the gap labelled X?

(1)

(g) Suggest why reaction time decreases when caffeine binds to adenosine receptors.

(2)

(Total 12 marks)

Mark schemes

Q1.

- (a) the reaction time 1
- (b) any **two** from:
- age
 - sex
- allow gender*
- previous intake of caffeine / coffee that day
 - usual intake of caffeine / coffee (on previous days)
 - concentration of caffeine / coffee
 - volume of caffeine / coffee
- if neither given allow amount / mass of caffeine / drink **or** type / brand of coffee for 1 mark*
- time of day
 - amount / length of sleep
- allow fatigue*
- health
- allow other drugs taken*
- body mass
- allow (body) weight*
- same / type of reaction time program / software
 - same keyboard
 - prior experience with the reaction timer
- 2
- (c) any **one** from:
- (time) for the coffee / caffeine to work
 - (time) for coffee / caffeine to be absorbed
- allow (time) for the coffee / caffeine to be digested*
- (time) for caffeine to reach the brain
- allow (time) for coffee to reach the brain*
- (time) for coffee / caffeine to get round the body
- 1
- (d) eye 1
- (e) muscle 1
- (f) (reaction time is) decreased
- allow reaction time is shorter*
- allow reactions are faster*
- allow (reaction) time is quicker*
- 1
- (g) student 3 1
- (h) 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

[9]

Q2.

(a) hold a ruler (just) above the (open) hand of the other student
ignore near the hand

1

drop the ruler and other student catches it
*do **not** accept give verbal signal*

1

record where the ruler is caught
ignore timing

1

(b) 193.5

1

(c) to compare the effect of no caffeine
allow as a control (group)
allow to show the effect of caffeine

1

*do **not** accept control variable*

(d) 0.217 (s)

allow any value in the range 0.2150 to 0.2180

1

(e) 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

(f) their reaction time was greater (after the drink)

allow converse

allow slower / longer for greater

*do **not** accept anomalous result*

1

(g) 0.01(0) to 0.18(0)

or

0.18(0) to 0.01(0)

allow values in range 0.008 to 0.012

and

0.178 to 0.182

or

0.17(0)

*allow correct calculation from values in range
if no values are given, allow answers in the range 0.166 to 0.174*

allow $0.01 \leq C \leq 0.18$

ignore units

1

(h) 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

allow height ruler dropped from

- same point to take measurement above / below the thumb / finger
- using the same hand
- (same) number of students in each group

*do **not** accept volume / concentration of caffeine*

2

(i) not automatic

allow it is a voluntary action

1

(because) it involves the (conscious part of the) brain

allow because it involves thinking / decision or conscious action

1

[13]

Higher Tier Questions

Q3.

(a) (P) synapse

1

(Q) relay neuron(e)

allow intermediate neuron(e)

1

allow phonetic spelling

(b) (in neurone) as electrical impulse

*allow electrical potential
ignore signal / message*

1

(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

- (c) 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

(d) $120 = \frac{1.6}{\text{time}}$

or

evidence of: $\text{speed} = \frac{\text{distance}}{\text{time}}$

1

0.013(33...)(s) **or** $\frac{1}{75}$

1

13(.33...) (ms)

an incorrect answer correctly converted to ms scores 1 mark

1

- (e) as age (in years) increases the time for the muscle to contract increases
*do **not** accept directly proportional*

1

at an increasing rate

allow correct description of 'at an increasing rate'

1

[10]

Q4.

- (a) any **one** from:
- previous intake of caffeine that day
 - usual intake of caffeine (on previous days)
 - concentration of caffeine
 - volume of caffeine
- allow named caffeinated drink for caffeine*
allow amount / mass / type of caffeine for 1 mark
- time of day
 - amount of sleep
 - body mass
 - previous experience of the test
 - which hand (of student **B**) holds the stopwatch
- allow fatigue*
allow (body) weight / BMI

1

- (b) 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 accurate*
- 2
- (c) no value / result / number occurs more than once
or
all the values / results / numbers are different
- 1
- (d) add(ed) the other (7) results and divide(d) by 7
allow correctly shown calculation
ignore leave out the result for pair 8
- 1
- (e) (adrenaline) increases heart rate
allow increases blood flow
- 1
- (which) increases oxygen / glucose to brain / muscle (cells)
- 1
- (which) increases rate of respiration
- 1
- (so) releasing more energy for (faster / more) muscle contraction
allow (so) releasing more ATP for (faster / more) muscle contraction
*do **not** accept energy produced / made / created*
- 1
- (f) synapse
allow synaptic cleft
- 1
- (g) fewer adenosine (molecules) can bind to the receptors
or
adenosine has no / less effect on the (relay) neurone
- 1
- 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

[12]