AQA GCSE BIOLOGY (HIGHER) · 8461

BIOLOGY



MARK SCHEME

4.5.2 THE HUMAN NERVOUS SYSTEM (PACK 4)

SCORE	PERCENTAGE
/127	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

(a) A

1

(b) D

1

(c) A = synapse

1

B = motor (neurone)

1

in this order only

(d) a reflex action

1

(e) 12 (ms)

1

0.012 (s)

1

*an answer of 0.012 (s) scores **2** marks*

(f) A

1

(g) controls the release of an egg

1

(h) in the blood(stream)

allow in the plasma / blood vessels
*do **not** accept in blood cells / platelets*

1

(i) (person) C

1

any **one** from:

- the testosterone level is high(er)

  allow testosterone is the main male (sex) hormone

- 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 there is no menstrual cycle

1

no marks if A or B given

[12]

Q2.

STEMUP.CO.UK

(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

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

1

$0.013(33...)\,(\text{s})$ **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]

Q3.

(a) (715.1 − 238.8 = 476.3)

STEMUP.CO.UK

$\frac{476.3}{715.1}(\times 100)$

1

66.6 (%)

allow correct rounding of 66.60606908

1

*an answer of 66.6 (%) scores **2** marks*

(b) hold metre rule above hand of person to be tested so the bottom of the ruler is level with the top of the hand

allow description of any reasonable method that would give results

1

drop the rule and the other person catches it

1

record / measure the distance where the rule is caught

1

convert the distance into time using a standard (scale) chart **or** calculation

1

ignore electronic methods

(c) any **one** from:

- higher resolution

  allow measured in milliseconds

- times are too small (for humans) to measure

  ignore human error unqualified

- random

  allow not biased

- no calculation errors

  allow it is quicker
  ignore more precise

1

(d) any **two** from:

- used a different person in each test
  or
  different people need different amounts of sleep
  or
  no baseline established (for comparison)
- only one person was tested for each sleep time
  or
  sample size is too small
- only did the test on one night
- as reaction times in ms they need to do (more than three / five) repeats
  or
  there is wide variation in the results
  or
  result for Student C **or**
  4 hours' sleep shows a decrease in reaction time
- don't know if other factors were controlled

STEMUP.CO.UK

allow correct named example, such as caffeine consumed, sleep before investigation, age

- table only shows some of the data

2

(e) **reasons in support:**

- performance / accuracy decreases with increasing alcohol concentration **and** performance / accuracy decreases as lack of sleep increases
- reduction in performance at the legal alcohol limit / 0.08% (for driving) is the same as (more than) 24 hours without sleep

reasons against:

- idea that the statement is sensationalised and does not use (quantifiable) data
- the (performance) scales are different, so difficult to make comparison **or** the (performance) scales are different so the data is misleading
- being tired is subjective / different for everyone

allow idea that lack of sleep does not necessarily correlate with tiredness

- there is wide variation in the data
- (the graph shows that) some people have 16 / 18 hours without sleep and don't have a drop in performance
- at alcohol levels of 0.09% some people have a 14% drop in performance (which is much higher than lack of sleep)

allow other correct points of comparison

- (data contradicts the statement because) for some a small amount of alcohol improves performance

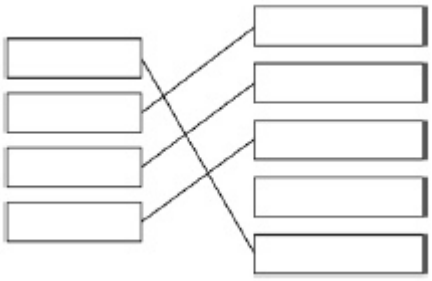
***max 3** marks if only reasons in support or reasons against given*
ignore study design

4

[13]

Q4.

(a)



*4 correct = **3** marks*
*3 correct = **2** marks*
*2 correct = **1** mark*
(4-5)

3

(b) time awake

1

STEMUP.CO.UK

(c) description of how to do a 'ruler drop'

1

how to measure length in cm

1

a control measure taken
or
how to use a conversion chart to get reaction time

1

(d) any **one** sensible reason:

for ruler drop test:
- have lots of equipment
- inexpensive equipment
- many students can do it at same time

for computer test:
- more accurate
- more repeatable
- students can cheat on ruler drop test

1

(e) 0.556….. or

(0.44+0.49+0.83+0.27+0.75)/5

1

0.56

*an answer of 0.56 scores **2** marks*

1

(f) at first stays same / has slight dip (until 12 hours)

12 hours only needed once

1

increases from 12 hours awake

ignore 'increases' alone

1

(g) **either:**
does support, because overall goes up
or
does not support, because it goes down / stays the same at first and only goes up after 12 hours

1

(h) any **two** from:
- use more volunteers
- make sure they all do the same activities at the same time
- give them the same food and coffee/tea at the same time
- control the age / gender of volunteers
- make sure they all had a good night's sleep the night before the investigation began

2

[15]

STEMUP.CO.UK

Q5.

(a) **A**

1

(b) **F**

1

(c) **B**

1

(d) **D**

1

(e) nucleus

1

(f) (makes reactions) faster

allow to reduce risk of damage / burns

allow for protection / safety

1

(g) alcohol

1

tiredness

1

[8]

Q6.

(a) fast reaction to reduce / protect from harm

allow named examples

1

(b) high<u>er</u> caffeine concentration causes short<u>er</u> reaction time.

allow converse

ignore 'faster / slower <u>reaction</u> <u>time</u>'

1

(c) **Level 3 (5–6 marks):**
A coherent method is described with relevant detail, which demonstrates a broad understanding of the relevant scientific techniques and procedures. The steps in the method are logically ordered. The method would lead to the collection of valid results.

Level 2 (3–4 marks):
The bulk of a method is described with mostly relevant detail, which demonstrates a reasonable understanding of the relevant techniques and procedures. The method may
not be in a completely logical sequence and may be missing some detail.

Level 1 (1–2 marks):
Discrete relevant points are made which demonstrate some understanding of the relevant scientific techniques and procedures. They may lack a logical structure and would not
lead to the production of valid results.

0 marks:

STEMUP.CO.UK

No relevant content.

Indicative content

- use decaffeinated coffee as control
- control volume of coffee
- blind trial or do not tell students which coffee they are drinking
- left for standard time between drink and test
- at least 10 minutes
- control start position of ruler
- control other factors such as light in the room
- same person for different concentrations
- repeat for each caffeine concentration
- use a range of caffeine concentrations
- start with lowest concentration of caffeine
- use caffeine solution instead of coffee to control for other ingredients
- repeat investigation with more people and calculate means

6

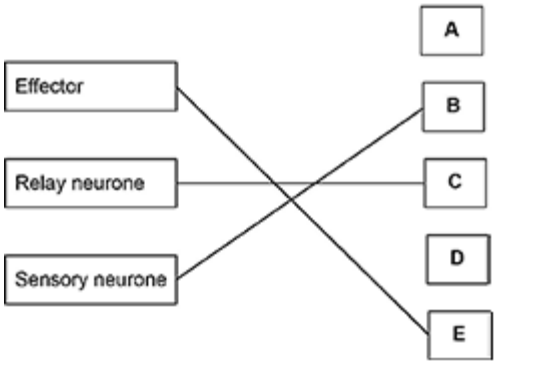
[8]

Q7.

(a) Reflex action

1

(b)



extra lines from the left negate the mark

3

(c) dependent

1

(d) 17.0

allow answers in range 17.0–17.3 cm

1

(e) 0.5 cm

1

(f) 23.5

1

does not fit the pattern **or** at least 5 cm higher than the other values

1

(g) The results are for the left and right hands of different people

1

[10]

STEMUP.CO.UK

Q8.

(a) 0.92 = 76.2 × time

1

time = 0.92 ÷ 76.2

1

= 0.012

*allow 0.012 with no working shown for **3** marks*

1

(b) pathway **B** has two synapses

*allow converse for pathway **A***

1

chemicals diffuse across each synapse

1

which slows down the impulse

1

(c) 140−203

1

(d) use the same person for each test

1

use left hand **and** right hand

1

use a bigger sample size **or** more people

allow take more readings with each person

1

(e) mean drop distance = (230 + 211 + 279 + 215 + 264) ÷ 5 = 239.8

1

239.8 mm = 0.2398 m

1

mean reaction time = $\sqrt[2]{\frac{2 \times 0.2398}{9.8}}$

1

= 0.221

*incorrect sig. figs max. **3** marks*

1

*allow 0.221 with no working shown for **4** marks*

[14]

Q50.

(a) (i) synapse

1

(ii) chemical

accept neurotransmitter or named neurotransmitter

1

STEMUP.CO.UK

(b) 3.175 **or** 3.18 (seconds)

*allow **2** marks for a time of 3.2 calculated for the pain impulse*

or

*allow **1** mark for a correct substitution or reorganisation:*

0.6 = 1.92 / t

or

t = 1.92 / 0.6

*allow **1** mark for an incorrect time for pain impulse − 0.025 correctly subtracted*

3

[5]

Q51.

(a) reduces / controls amount of light entering the eye

ignore stops light entering the eye

1

(so) less chance of damage

accept protects the retina allow

(so) can see better (in bright light)

1

(b) any **two** from:

allow converse statements

A reflex action is:

- fast(er)
- automatic / not thought about
- involves few(er) neurones
- involves few(er) synapses
- does not (always) involve the brain

allow nerves

*do **not** allow reference to hormones*

2

[4]

Q52.

(a) A – (cell) membrane

allow phonetic spelling

1

B – cytoplasm

1

C – nucleus

1

(b) any **two** from:

- to react / respond (to the surroundings)

STEMUP.CO.UK

ignore brain / nervous system reacts
ignore adapt

- avoid dangers / prevent harm to body
  allow examples eg to prevent body being burned by hot object

- to coordinate behaviour / process information
  ignore send messages

2

[5]

Q53.

(a) light

must be in correct order
allow light waves

1

sound

allow sound waves

1

touch

1

(b) (i) 0.35 in skin column circled

only look at figures in table more than one figure circled negates mark
ignore values written in table for mean reaction time for eyes

1

(ii) 0.25 (seconds)

allow 1 mark for $\frac{0.23 + 0.27 + 0.24 + 0.26}{4}$
or 1 / 4

2

(iii) any **one** from:

ignore figures / references to sensitivity

- the ears / sound had the shortest reaction time
  allow fastest

- the eyes / light had the longest reaction time
  allow slowest

- ears and skin had similar reaction times
  ignore references to anomalies or repeat values

1

[7]

Q54.

(a) (i) any **one** from:

STEMUP.CO.UK

- same test being repeated
- test number not a dependent variable / variable being tested
- test number is not a continuous variable
  allow test number is a categoric variable
  allow data is categoric

1

(ii) ignore / repeat anomalous result

1

calculate means (for each sense organ)
allow average

1

(b) any **one** from:
ignore figures

- eyes have longest reaction time
  allow slowest
- ears have shortest reaction time
  allow fastest
- ears and skin have similar reaction times
  ignore references to anomalies / repeat values / test numbers

1

[4]

Q55.

(a) X – relay (neurone)
Y – motor (neurone)
both required for mark
must be in correct order

1

(b) chemical (released from **X**)
*do **not** accept electrical impulse*
accept chemical messenger / transmitter
accept neurotransmitter
accept named transmitter substance eg acetylcholine

1

(crosses) synapse
*allow for **2** marks diffusion of the chemical across the synapse*

1

[3]

Q56.

A – receptor

STEMUP.CO.UK

ignore organ / nerve

1

B – sensory

allow sensor

1

C – CNS / central nervous system

accept spinal cord
allow coordinator
ignore brain
*do **not** accept spine*

1

D – motor

1

E – effector

1

[5]

Q57.

receptor detects stimulus / sharp object

1

impulse / information / message passes along sensory neurone to spinal cord

1

from spinal cord along motor neurone to muscle

1

muscle contracts

1

[4]

STEMUP.CO.UK

Q1.

(a) 98% of students were able to identify the cell nucleus from the sensory neurone

(b) 50% of students were able to identify the receptor.

(c) Students had to label the synapse and the motor neurone on the nerve pathway. On many scripts seen (13%) there was no attempt to label either part. Where a part was correctly identified it was occasionally the motor neurone. Synapse was very rarely seen. 9% of students achieved both marks.

(d) 91% of students were able to identify that the action described was a reflex action.

(e) Students were asked to read two values, in milliseconds, from a table and subtract them to give the difference in muscle contraction time between an old and a young person. An answer in seconds was required. 72% of students achieved one mark from an answer of '12'. 3% of students managed to successfully convert milliseconds into seconds, to arrive at a value of 0.012s.

(f) The position of the pituitary gland was correctly located by 35% of students.

(g) The most common misconception for the function of LH was to control blood glucose concentration. 32% of students knew that it controlled the release of an egg.

(h) This question was generally well answered with 57% of students identifying the bloodstream. However, many students thought that LH travelled via the nervous system, digestive system or in blood cells which was not creditworthy.

(i) Overall 80% of students were able to identify person C as the 18-year-old boy from three graphs showing the relative levels of sex hormones. Students usually gave the correct reason of there being a high level of testosterone, although some stated the low amounts of oestrogen / progesterone.

Often students failed to gain the mark because they made statements such as 'only males produce testosterone', or 'only females produce oestrogen'. Those who did not achieve the second mark often made vague statements referring to hormones rather than naming the specific hormones.

Q2.

(a) 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.

(b) 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.

STEMUP.CO.UK

- 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.

(c) 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.

(d) 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.

(e) 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.

Q3.

(a) 66% of students did not achieve any marks in this question. The most common error was to calculate the percentage remaining as opposed to calculating the percentage decrease.

Rounding of 66.60606908 was often incorrect, with 66.60 and 66 seen. A significant number of students were unable to round correctly or show working where ×100 was needed.

(b) Most students wrote about the 'ruler dropping method' as expected, as this is the

STEMUP.CO.UK

Required Practical Activity. The description given had to be a clear sequence of instructions that could be repeated to achieve full marks. Most students achieved marking points two and three, marking points one and four proved more difficult.

Marking point one required a description of exactly the reading where the ruler was held in relation to the finger and thumb of the catcher. Some students appear to have used a ruler calibrated with time, but this is not explicit in their account. Some students suggested the use of a stopwatch overlooking that the reaction time of the watch holder would also be involved. Marking point four required a description of how the ruler reading was converted into time.

The question discriminated well with 50% of students achieving at least two mars and 1% achieving all four marks.

(c) 24% of students achieved the mark in this question. Many students gave 'no human error' unspecified as the answer which was insufficient.

(d) 18% of students achieved both marks and 45% achieved one mark. A number of students did not appear to appreciate that 'increased reaction time' means slower.

(e) This question asks for an evaluation of the newspaper's statement using information from figures 1 and 2. This question was not answered well with zero students achieving three or four marks. Most students evaluated the data rather than the newspaper statement. 45% of students were able to achieve one or two marks.

The most common one-mark answer was to say that 'accuracy decreases as both lack of sleep and alcohol intake increases'. Many students did not use the data as instructed so that their answers were unclear. Very few students were able to analyse the data and clearly state their findings. Many students made statements which they did not justify from the evidence. Many did not refer to the statement in their answer.

Q50.

(a) (i) Just under two thirds of the students gained the mark by naming the synapse, although there were several unusual spellings. Incorrect responses included 'effector', 'receptor', 'relay neurone' and 'neurone junction'.

(ii) There were some very good descriptions of how information crosses a synapse as a chemical that diffuses across the gap. A few used the term 'neurotransmitter'. However, others got their terminology confused by talking about a chemical impulse or a chemical reaction.

(b) As for many calculations, 1 mark was allowed for a correct substitution into the equation. It is a good tip to encourage students to do this as a matter of course. Some attempted to reorganise the equation directly, without writing down the substitution step, and often made a mistake so gained 0 marks. Many gained 2 marks for calculating the time for the pain impulse.

Q51.

(a) Often students did not answer the question and explained the response of the eye to dim light instead of its response to bright light. Many students repeated information given in the question, and some described a reflex arc. Around half of the students gained 1 mark, usually for saying it reduced damage to the eye, but reducing damage to the body was too vague to gain a mark.

STEMUP.CO.UK

(b) The question asked for two differences between a reflex action and a voluntary action, but students often just rephrased one difference to gain 1 mark only, for example, a reflex action is automatic and a voluntary one is thought about. References to a reflex action being automatic or not involving the brain were the most common responses. Many students were confused as to what the CNS is. Several students did not make it clear whether they were referring to a reflex or voluntary action, and others thought a reflex action protected the body, whereas a voluntary action would cause damage to the body.

Q52.

(a) The most common correct response was nucleus. Many labelled the membrane as a cell wall.

(b) Many students gave examples of how the body detects stimuli, or listed different stimuli can be detected, but did not go on to explain why this is important. The most common correct response was 'to prevent harm to the body'. Few gained the third marking point for the idea of the nervous system co-ordinating behaviour or processing information. There were many vague responses about sending messages, which was not enough to gain the mark.

Q53.

(a) Most students scored 3 marks for this question. When errors were made they were usually for saying that the skin was sensitive to chemicals.

(b) (i) Almost three quarters of the students correctly identified the anomaly in the table.

(ii) The question was well attempted and almost two thirds of the students gained full marks, with only a small proportion gaining 1 mark for showing the correct working. A very common error was to write 0.23 + 0.27 + 0.24 + 0.26 ÷ 4. This was allowed 1 mark, even though it is mathematically incorrect as brackets are needed. Evidence that students did not know how to input this calculation into their calculator was shown by incorrect answers. Other students made the mistake of dividing by 5 instead of 4. There was some confusion between mean, median and range.

(iii) Many students did not understand the term conclusion and just quoted figures from the table. About half of the students incorrectly deduced that the eyes had the shortest reaction time, rather than the ears. There were many responses that were poorly phrased, so could not be credited. For example, the ears were the best; the ears were more responsive, sensitive or efficient. Responses which referred to reproducibility or the anomaly were insufficient.

Q54.

(a) (i) This was a high demand question, so it was not surprising that few students gained a mark. The most common correct answer was that the data was not continuous or that it was categoric. Most students said that a scatter graph was used because it was easier to read.

(ii) Less than half of the students gained 1 mark, which was usually for saying that an average would have to be calculated. Some described the axes that would be needed on the bar chart, which didn't answer the question that asked what would have to be done with the results before a bar chart could be drawn.

STEMUP.CO.UK

(b) Many students incorrectly deduced that the eyes had the shortest reaction time, rather than the ears. There were many responses that were poorly phrased, so could not be credited. For example, the ears were the best; the ears were more responsive, sensitive or efficient. Responses which referred to reproducibility or the anomaly were insufficient.

Q55.

(a) There was the usual confusion between the two types of neurone; these types should be familiar to students hoping to gain grades A and B.

(b) Knowledge and understanding of the word ‘synapse’ was seen far more frequently than the idea of a chemical being released from X. Many students stated that the impulse had to ‘jump the gap’. A surprisingly large number of students described a reflex arc in detail rather than answering the question.

Q56.

This question was common with the Higher Tier paper. Some students knew some of the words used to describe the structures involved in a reflex action, although they were often given in the wrong order. The receptor was often incorrect, with sensory neurone frequently being given as an incorrect response here. Sensory and motor neurones were sometimes named correctly. A range of responses were given for CNS. Spinal cord was allowed, but incorrect answers included relay, which was already given in the sentence, synapse and brain, demonstrating some knowledge but not sufficient to gain a mark. Spine and spinal column were not allowed as these are made of bone. For effector, several students gave reactor, contractor or gland. Unfortunately a lot of students did not know any of the words and wrote nerve in several of the spaces. Only half the students gained at least one mark for this question.

STEMUP.CO.UK