



A-Level Biology

Nervous Impulses

Mark Scheme

Time available: 61 minutes

Marks available: 48 marks

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Mark schemes

1.

- (a) 1. Higher concentration of potassium ions inside **and** higher concentration of sodium ions outside (the neurone)

OR

potassium ions diffuse out

OR

sodium ions diffuse in;

Accept 'more' for 'higher concentration'.

Accept 'sodium ions can't diffuse in (due to alternative explanation).'

2. (Membrane) more permeable to potassium ions (leaving than sodium ions entering)

OR

(Membrane) less permeable to sodium ions (entering than potassium ions leaving);

Accept for 'less permeable to sodium ions' is 'impermeable to sodium ions' or 'sodium gates/channels are closed' (alternative explanation).

3. Sodium ions (actively) transported out and potassium ions in;

reference to ions or Na^+ and K^+ is required. If mentioned once allow for all mark points.

*If an answer provides two or three of these mark points **without** any reference to ions – award **one** maximum mark.*

Accept 3 Na^+ out and 2 K^+ in but reject if numbers used are incorrect.

3

- (b) 1. Myelination provides (electrical) insulation;

Reject thermal insulation.

Accept description of (electrical) insulation.

2. (In myelinated) saltatory (conduction)

OR

(In myelinated) depolarisation at nodes (of Ranvier);

3. In non-myelinated depolarisation occurs along whole/length (of axon);

Accept action potentials for depolarisation.

'Messages' or 'signals' disqualifies first of these marks credited.

3

- (c) 1. No/less ATP produced;
2. No/less active transport

OR

Sodium/potassium pump inhibited;

*Accept Na⁺ not/fewer moved out **and** K⁺ not/fewer moved in.*

3. Electrochemical gradient not maintained

OR

(Facilitated) diffusion of ions causes change to 0 mV

OR

(Results in) same concentration of (sodium and potassium) ions (either side of membrane)

OR

No net movement of (sodium and potassium) ions;

Accept reaches electrical equilibrium/balance.

Accept concentration gradient of sodium and potassium ions not maintained.

3

[9]

2.

- (a) 1. (Refers to) saltatory conduction

OR

(Nerve) impulses/depolarisation/ions pass to other neurones

OR

Depolarisation occurs along whole length (of axon);

Accept suitable description that refers to (transmission) from node to node (of Ranvier).

Accept action potential for depolarisation.

1 and 2. Accept action potentials for impulses.

1, 2 and 3. Reject first mark awarded if answer refers to messages/signals for impulses. Reject even if impulse/s also referred to.

2. (Nerve) impulses slowed/stopped;

3. (Refers to) neuromuscular junction

OR

(Refers to) sarcolemma;

3

- (b) 1. Slower/fewer impulse(s) along sympathetic/parasympathetic (pathway/neurones);
Accept action potentials for impulses.
Reject no impulses.
1, 2 and 3. Ignore 'information' but reject first mark awarded if answer refers to messages/signals for impulses. Reject even if impulse/s also referred to.

2. (Impulses) from cardiac centre
OR
(Impulses) from medulla;

3. To SAN;

3

- (c) 1. It/DNA is complementary to (m)RNA;
Accept (transcription) results in complementary (m)RNA.
Ignore miRNA/siRNA/transcriptional factors.

2. Binds to mRNA (for huntingtin);

3. Prevents translation;
Ignore transcription.

3

- (d) 1. Small sample size
OR
Only 46;

2. Only four-months
OR
short period (of trial);

3. Huntingtin/protein reduced
OR
Huntingtin/protein still produced
OR
Huntingtin/protein not removed;

Accept huntingtin for huntingtin.
Ignore miRNA/siRNA/transcriptional factors.

4. Allele/gene/mutation/mRNA (for Huntington's) still present
OR
(May be) temporary
OR
Drug treatment repeated;

5. Brain already damaged
OR
Brain damage may continue;

2 max

- (e) 1. (Drug/DNA) will directly/quickly reach brain
OR
(Cerebrospinal) fluid bathes the brain;
2. (Drug/DNA) not destroyed by acid
OR
(Drug/DNA) not digested (by enzymes);
Reject protein is digested.
Ignore location of enzymes.
Accept Drug/DNA denatured.

2

(f)

Mark in pairs but if no mark credited allow one mark for any reference to transcription or gene expression being affected.

1. (Increased) methylation of DNA/gene/allele;
Reject acetylation of DNA.
Accept gene expression for transcription but ignore gene switched on/off.
Ignore methylation of histones.
Accept DNA-histone complex as equivalent to histone(s).
2. Inhibits/prevents transcription;
OR
3. Decreased methylation of DNA/gene/allele;
4. Stimulates/allows transcription;
OR
5. Decreased acetylation of histone(s);
6. Inhibits transcription;
OR
7. Increased acetylation of histone(s);
8. Stimulates/allows transcription;

2 max

[15]

- 3.** (a) Only 3 neurones / nerve cells (in reflex arc) 1
- (b) 1. Rapid;
 2. Protect against damage to body tissues;
 3. Do not have to be learnt;
 4. Help escape from predators;
 5. Enable homeostatic control. 2 max
- (c) 1. Neurotransmitter only made in / stored in / released from pre-synaptic neurone;
 2. (Neuro)receptors only on the post-synaptic membrane; 2
- (d) 1. Axon **P** is myelinated;
 2. So shows saltatory conduction / impulses jump between nodes of Ranvier
- OR**
3. Axon **P** has a larger diameter;
 4. So less resistance to flow of ions.
- Mark as 1 & 2 OR 3 & 4*
- 2 **[7]**
- 4.** (a) One suitable suggestion; explained;
 E.g.
 1. Action potentials travel more slowly / don't travel;
Accept: fewer / no saltatory movement of potentials
2. So delay in muscle contraction / muscles don't contract / muscles contract slow(er);
- OR**
3. Action potentials / depolarisation 'leaks' to adjacent neurones;
Accept: neurones not insulated
4. So wrong muscle (fibres) contract. 2 max
- (b) Lipid-soluble / pass through phospholipid bilayer.
Not just 'pass through membranes' 1

- (c) 1. Prevents influx of calcium ions (into pre-synaptic membrane);
Need idea of moving into pre-synaptic membrane / synaptic knob
Accept Ca^{++} / Ca^{2+}
2. (Synaptic) vesicles don't fuse with membrane / vesicles don't release neurotransmitter;
Accept vesicles don't release acetylcholine
3. Neurotransmitter does not diffuse across synapse / does not bind to receptors (on post-synaptic membrane);
Accept: sarcolemma / muscle membrane for post-synaptic membrane
4. No action potential / depolarisation (of post-synaptic membrane) / sodium (ion) channels do not open / prevents influx of sodium ions.
Accept Na^+
Accept prevents depolarisation of muscle cell
Ignore: descriptions of events at post-synaptic membrane involving calcium ions and muscle contraction

4

- (d) 1. They won't affect synapses in brain;
 2. They won't cause problems with the brain's function / won't damage brain;
Accept: suitable named problem e.g. hallucination
Ignore: unqualified references to 'side effects'
Accept: reference to addiction / harm of smoking (cannabis)
3. (So only the) muscle / neuromuscular junctions treated / affected.

2 max

[9]

5.

- (a) (Ion) channel proteins open, sodium in;

Changes membrane potential / makes inside of axon less negative / positive / depolarisation / reaches threshold;

More channels open / positive feedback;

Accept other phrases for ion channel proteins providing that it is clear that it is something through which ions pass.

Reject carrier.

First marking point relates to opening.

Third point must relate to more (channels) opening.

3

(b) Potassium channels open;

Potassium out;

Sodium channels close;

Do not penalise candidate who refers to sodium or potassium. Ions are mentioned in question.

Reject pump

3

(c) Pump / active transport / transport against concentration gradient;

Of sodium from axon / sodium out / of potassium in;

Do not penalise candidate who refers to sodium or potassium. Ions are mentioned in question

2

[8]