

- M1.** (a) 1. automatic (adjustments to changes in environment)/ involuntary;
 2. reducing/avoiding damage to tissues / prevents injury/named injury
 e.g. burning;
 3. role in homeostasis/example;
 4. posture/balance;
 5. finding/obtaining food/mate/suitable conditions;
 6. escape from predators;

(ignore 'danger' or 'harm' unless qualified)

3 max

- (b) (i) 1. (impulse causes) calcium ions/ Ca^{++} to enter axon;
 2. vesicles move to/fuse with (presynaptic) membrane;
 3. acetylcholine (released);
 4. (acetylcholine) diffuses across synaptic cleft/synapse;
 5. binds with receptors on (postsynaptic) membrane;
(reject active sites, disqualify point)
 6. sodium ions/ Na^+ enter (postsynaptic) neurone;
 7. depolarisation of (postsynaptic) membrane;
 8. if above threshold nerve impulse/action potential produced

6 max

- (ii) neurone to neurone and neurone to muscle;
 action potential in neurone and no action potential in muscle/
 sarcolemma;
 no summation in muscle;
 muscle response always excitatory (never inhibitory);
some neuromuscular junctions have different neurotransmitters;
(penalise 'nerve' once)

2 max

[11]

- M2.** (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 max

- (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]
- M3.** (a) (i) Motor;
- 1
- (ii) Gland / glandular;
Q Answers that name a specific gland may be awarded credit.
- 1
- (b) Hormones reach all cells (via blood);
Neurotransmitters secreted directly on to target cell;
Different hormones specific to different target cells;
- 3
- [5]
- M4.** (a) (i) Sodium ions move out of axon;
By diffusion/down concentration gradient;
Through sodium ion channels/sodium ion channels open;
- 2 max
- (ii) Potassium ions enter / potassium ion channels open;
- 1
- (b) Myelin insulates axon / ions can only pass through (plasma membrane of axon) at gaps in myelin sheath;
(Gaps in sheath are called) nodes of Ranvier;
Q The second marking point should be awarded only where answers include the correct scientific term.
- 2
- [5]

- M5.** (i) Binds to receptor/proteins; and opens Na⁺ channels;
Na⁺ enter and make membrane potential less negative/depolarised
 2
- (ii) (Vesicles containing) neurotransmitter only in presynaptic membrane/
 neurone;
 receptor/proteins only in postsynaptic membrane/neurone;
 so neurotransmitter diffuses down concentration gradient;
 max 2
- (iii) GABA opens K⁺ and Cl⁻ channels;
 K⁺ passes out and Cl⁻ passes in;
 Membrane potential more negative/hyperpolarised;
 Requires increased stimulation/must open more Na⁺ channels/allow
 more Na⁺ to enter;
 To reach threshold;
 max 4
- [8]**
- M6.** (a) membrane relatively impermeable / less permeable to sodium ions /
 gated channels are closed / fewer channels;
 sodium ions pumped / actively transported out;
 by sodium ion carrier / intrinsic proteins;
 higher concentration of sodium ions outside the neurone;
 inside negative compared to outside / 3 sodium ions out for two
 potassium ions in;
*(if sodium mentioned but not in context of ions,
 negate 1 mark)*
 4 max
- (b) (i) 1.6;
 1
- (ii) $18 \div 1.6 = 11.25$;
 multiply by 1000 to convert from ms to s / 11 250;
(correct method = 1 mark, i.e. $\frac{\text{distance}}{\text{time}}$ or $\times 1000$)
(correct answer based on (b)(i) = 2 marks)
 2
- (iii) time for transmission / diffusion across the neuromuscular
 junction / synapse;
 time for muscle (fibrils) to contract;
 1 max
- (c) movement by diffusion;
 binding to receptors on (post-synaptic) membrane;
 causing sodium channels to open / sodium ions to move in
 to muscle (cell);
 3

- (d) (i) toxin binds to/competes for / blocks the acetylcholine receptors;
acetylcholine can not depolarise the membrane /
the toxin does not cause depolarisation;
*(allow references to generating action potentials instead of
depolarisation, do not allow references to impulses in muscles)* 2
- (ii) acetylcholinesterase is unable to breakdown acetylcholine;
acetylcholine still available to depolarise the membrane /
generate action potentials in the membrane; 2

[15]

M7. (a) In table:

D
B
C

All 3 correct = 2 marks;;

2 correct = 1 mark;

0 or 1 correct = 0 marks

2

- (b) (i) myelin insulates / prevents ion movement; saltation / described
re leaping node to node; 2
- (ii) cat has higher body temperature;
ignore references to homeiothermy/warm-blooded
faster diffusion of ions / faster opening of ion pores/gates/channels; 2
- (c) 1 increasing stimulus (potential) causes decrease in potential
difference / rise in potential at P;
- 2 1 or 2 is sub-threshold / 1 or 2 does not give action potential;
- 3 3 or 4 is above threshold / 3 or 4 does give an action potential;
- 4 influx of Na⁺ ions; (*not just Na/sodium*)
- 5 voltage-gated channels (in axon membrane) opens / opens Na⁺
channels /membrane more permeable to Na⁺
(NOT just Na/sodium);
- 6 sufficient for stimulation of adjacent region of axon;
- 7 impulse propagated (from P to Q);
- 8 suitable ref. to 'all-or-nothing' law;

5 max

- (d) 1 X / Acetylcholine → opening of Na^+ channels / increases Na^+ permeability;
- 2 X / Acetylcholine → Na^+ ion entry into Z;
- 3 X / Na^+ entry - raises potential / reduces potential difference / makes potential less negative;
- 4 Y / Cl^- entry - lowers potential / increases potential difference / makes potential more negative;
- 5 X stimulates and Y inhibits (Z);
- 6 balance of impulses from X and Y determines whether Z fires action potential / determines whether potential rises above threshold;

4 max

[15]

- M8.** (a) Transports Na^+ and K^+ ;
By active transport / pump / against concentration gradient;
Restores ion balance after an action potential;
[reject K^+ out and Na^+ in]
- (b) (i) each protein has a specific tertiary structure/shape;
because the ions have different sizes/shape/charge;
[reject receptors binding]
- (ii) fewer protein B molecules, which transport sodium ions;
more protein A molecules, which transport potassium ions;

2

max 2

max 1

[5]

- M9.** (a) sodium gates or channels open / increase in permeability of axon membrane to sodium ion;
sodium ions enter axon;
- (c) non-myelinated – next section of membrane depolarised / whole membrane;
myelinated – depolarisation / ion movement only at nodes;
impulse jumps from node to node / saltatory conduction;

2

3

[5]

- M10.** (a) action potential arrives / depolarisation occurs;
calcium ions enter synaptic knob;
vesicles fuse with membrane;
acetylcholine diffuses (across synaptic cleft);
binds to receptors;
- 4 max
- (b) inside becomes more negatively charged / hyperpolarised; stimulation
does not reach threshold level / action potential not produced;
depolarisation does not occur / reduces effect of sodium ions entering;
- 3
- (c) (i) inhibits enzyme (which breaks down GABA);
more GABA available (to inhibit neurone);
- OR
- binds to (GABA) receptors;
inhibits neuronal activity / chloride ions enter (neurone);
- 2 max
- (ii) receptors have different tertiary/3D structure/shape not
complementary;
GABA cannot bind; inhibition of neuronal activity does not occur /
chloride ions do not enter;
- 3
- [12]
-
- M11.** (a) closed open closed;
closed closed open;
- 2
- (b) active transport / pump of Na⁺ out of axon;
diffusion of K⁺ out of axon / little diffusion of Na⁺ into the axon;
- 2
- (c) can not pass through phospholipid bilayer;
because water soluble / not lipid soluble / charged / hydrophilic /
hydrated;
- 2
- [6]

