Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

A: **Na^+ flows in**

B: **K^+ flows out**

C: K^+ keeps flowing out while K^+ channels close slowly (undershoot)

2.2

$0.6 \div 0.012$

$=$ **50 m/s**

2.3

the action potential opens voltage-gated Ca^{2+} channels and Ca^{2+} enters

vesicles fuse with the membrane and release transmitter

the transmitter binds receptors on the next cell and opens ion channels

2.4

$-70 + 8 + 8 = -54$ mV

this is above -55 mV, so **yes**, it fires

3.1

(a) a fatty insulating sheath around axons, made by **oligodendrocytes**

(b) the action potential jumps from one node of Ranvier to the next, which is faster and uses less energy

(c) current leaks out across the bare membrane; there are few Na^+ channels there, so the next part may not reach threshold

(d) heat makes conduction in damaged nerves fail more easily

3.2

(a) **acetylcholinesterase**

(b) acetylcholine builds up at synapses; too much at muscarinic receptors gives secretions, a slow heart and small pupils, and at the neuromuscular junction gives twitching then weakness

(c) it blocks muscarinic receptors, drying secretions and raising the heart rate; it does not act at the nicotinic receptors of muscle, so weakness remains

3.3

(a) **glutamate**; **GABA**

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(b) it binds the GABA-A receptor and makes GABA open its Cl^- channel more; Cl^- enters, making the cell more negative and less likely to fire

(c) it blocks the reuptake of serotonin into the nerve ending, so more serotonin stays in the synapse

(d) **dopamine**, from the **substantia nigra**