

June 2010

Quality of written communication is awarded a maximum of 2 marks in this question. [2]

- | |
|---|
| <p>9 Give an account of the generation of an action potential, impulse transmission along an axon and subsequent transmission to a post-synaptic neurone. [16]</p> |
|---|

Sixteen points, minimum of six points from each part.

Generation of an action potential and transmission of the nerve impulse:

- at rest the membrane of an neurone is polarised/has a resting potential
- has a potential difference of about -70mV / is negative on the inside
- stimulation must be strong enough to reach a threshold potential
- this causes an action potential in which the inside becomes positive / potential difference is reversed / membrane is depolarised / influx of Na⁺ ions
- which results in sequential depolarisation of the neighbouring part of the axon membrane / local circuits
- the action potential is 'all or nothing' in its generation / below the threshold the action potential (impulse) does not fire / above the threshold there is no increase in magnitude of action potential
- after which the membrane becomes repolarised / recovers its resting potential
- causing a refractory period during which no further stimulation of the axon is possible / which ensures a one-way movement of the action potential
- this propagation of action potentials along a neurone is the transmission of the impulse
- speed of transmission is faster in axons with a wider diameter
- speed is also faster along myelinated neurones (with nodes of Ranvier)
- as there is saltatory conduction / the action potential "jumps" from node to node

Transmission across a synapse:

- when an action potential reaches the synaptic knob it causes an influx of Ca²⁺ ions
- this causes synaptic vesicles to move towards the pre-synaptic membrane
- and fuse with it, resulting in exocytosis of the transmitter substance
- which is generally acetylcholine (ACh) in peripheral nerves
- the acetylcholine diffuses across the cleft / travels across the 20nm wide cleft
- and attaches to receptors on the post-synaptic membrane
- this causes an influx of Na⁺ ions / depolarises the post-synaptic membrane
- causing an excitatory post-synaptic potential (EPSP)
- an action potential is evoked if the EPSP reaches threshold level / if enough receptors are stimulated / if enough transmitter is received
- summation (spatial/temporal) of neurotransmitter from several synaptic knobs may be needed to promote an action potential
- the acetylcholine is broken down by acetylcholinesterase (AChE)
- which prevents continued stimulation of the post-synaptic membrane
- the choline and acetyl components diffuse back towards the pre-synaptic membrane where they are reabsorbed and used in the synthesis of acetylcholine

For each point award equivalent descriptions. [16]