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# BIOLOGY

## ORGANISMS RESPOND TO CHANGES IN ENVIRONMENTS

Level & Board	AQA (A-LEVEL)
TOPIC:	NERVE IMPULSES
PAPER TYPE:	SOLUTION - 1
TOTAL QUESTIONS	6
TOTAL MARKS	44

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## Nerve Impulses - 1

1.

(a) Damaged myelin sheaths means that the nerve impulse will propagate across the axon at a slower rate (as it will take longer for action potentials to be reached).

**OR**

Action potentials travel more slowly/ no salutatory conduction

Muscles contract slower

(b) **Lipid soluble.** Pass through the phospholipid bilayer

(c) The cannabinoids bind to a receptor that closes the calcium ion channels. This means that the calcium ions cannot enter the pre-synaptic neuron and so can't stimulate the movement of vesicles (containing neurotransmitters such as acetylcholine) to the pre-synaptic membrane. This means that the neurotransmitters are not released into the synaptic cleft and so do not bind to receptors on the post-synaptic membrane and so sodium ion channels on the post-synaptic membrane do not open, and so sodium ions cannot diffuse across the post-synaptic membrane and enter the post-synaptic neuron and so cannot continue the nerve impulse (the sodium ions diffuse across the post synaptic membrane by facilitated diffusion).

Prevents influx of calcium ions (into pre-synaptic membrane);

- Synaptic vesicles don't fuse with membrane/vesicles don't release neurotransmitter
- Neurotransmitter does not diffuse across synapse/does not bind to receptors on post-synaptic membrane
- No action potential/depolarization of post-synaptic membrane/sodium ion channels do not open/prevents influx of sodium ions

**OR**

Prevents influx of calcium ions.

Vesicles don't fuse with membrane

Neurotransmitter does not diffuse across synapse

Non-action potential

**(d)**

They won't affect synapses in the brain

They won't cause problems with the brain's functions

so only the neuromuscular junctions affected

**2.**

**(a)** In addition, three sodium ions move out of the membrane for every two potassium ions that move into the membrane via the sodium potassium pump. The combination of the sodium-potassium pump and the leaky channels results in the cell maintaining a stable, negative, resting membrane potential.

**OR**

membrane more permeable to potassium ions and less permeable to sodium ions

**(b)** When pressure is applied to a Pacinian corpuscle the membrane is distorted, opening the stretch-mediated  $\text{Na}^+$  channels. This then allows  $\text{Na}^+$  ions to move in down their concentration gradient which increases the membrane potential.

**OR**

Pressure causes membrane to become stretched

Sodium ion channels in membrane open and sodium ions move in

Greater pressure more channels open

**(c)**

Threshold has been reached

Causes all or nothing response

**(d)**

Less saltatory conduction

More depolarization over length

**3.**

**(a)**

P = Minus

Q = Plus

$P + Q = 1$

$P^2 + 2PQ + Q^2 = 1$

$P = 0.2$

Therefore  $Q = 1 - 0.2$

$Q = 0.8$

Therefore  $2PQ = 2 \times (0.2 \times 0.8)$

$2PQ = 0.32$

Answer = 0.32

**(b)**

Mutation produced KDR minus / resistance allele;

DDT use provides selection pressure;

Mosquitoes with KDR minus allele more likely (to survive) to reproduce;

Leading to increase in KDR minus allele in population.

**(c)**

Neurons remain depolarized

So, no action potentials

**(d)**

Mutation changes shape of sodium ion channels

DDT no longer complementary/able to bind

**4.**

**(a)** A myelinated neuron is insulated by a layer of Schwann cells that make up the myelin sheath. This aids in the faster conduction of an action potential down the neuronal axon.

**OR**

In non-myelinated, adjoining regions of membrane depolarized across entire length of axon

In myelinated, depolarization occurs only at nodes of Ranvier

Saltatory conduction

**5.**

**(a)**

Probability of obtaining this difference by chance

is less than 0.05

Difference is significant

**(b)**

All dementia results lower than control group / non-dementia result higher

Error bars do not overlap so differences are (possibly) significant

Dementia may be due to other factors / not only due to a lack of myelin

Because big / significant differences in myelin in different dementia

Only small sample sizes / only one study / more data required

**6.**

**(a)** Sodium ion channels open. Sodium ions enter

**(b)** If it's not removed it will keep binding to receptors and keep causing depolarization.

**(c)**

Movement in all groups about same before MDMA

MDMA increases movement in Group L

Group K shows MDMA causes movement

No / little increase in mice without receptor / Group M

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