



Neural signalling: practice questions

4 questions · 12 marks · mark scheme at the back

For IB Diploma Biology SL undefined. **HL only** is additional higher level content, for HL students only.

Name

Total / 12

1 PAPER 1A STYLE [1 mark]

How does the sodium-potassium pump contribute to the resting potential of a neuron?

- A. ☐ It pumps two Na^+ out and three K^+ in by facilitated diffusion
- B. ☐ It pumps three Na^+ out and two K^+ in using energy from ATP
- C. ☐ It pumps Na^+ and K^+ into the neuron using energy from ATP
- D. ☐ It opens voltage-gated channels so Na^+ diffuses out

2 PAPER 1A STYLE [1 mark]

Why can a signal pass in only one direction across a typical synapse?

- A. ☐ The synaptic cleft is too wide for ions to diffuse back
- B. ☐ The postsynaptic neuron has no sodium-potassium pumps
- C. ☐ Only the presynaptic neuron releases neurotransmitter and only the postsynaptic membrane has its receptors
- D. ☐ Voltage-gated calcium channels are found only in the postsynaptic membrane

3

[6 marks]

The table shows the diameter and conduction speed of six nerve fibres. The values are typical values for practice. (a) Compare the conduction speeds of fibre C and fibre D. [2] (b) Calculate how many times wider fibre C is than fibre D. [1] (c) A larger study of 50 myelinated fibres found a correlation coefficient of $r = 0.95$ between diameter and conduction speed. State the type of correlation and calculate the coefficient of determination, R^2 . [2] (d) Using the data, suggest one advantage of myelination in the nervous system of a vertebrate. [1]

Diameter and conduction speed of six nerve fibres			
Fibre	Myelinated	Diameter / μm	Conduction speed / m s^{-1}
A	No	0.5	0.6
B	No	1.0	1.2
C (squid giant axon)	No	500	25
D	Yes	4	24
E	Yes	10	60
F	Yes	20	120

Answer =

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4

[4 marks]

Describe how the arrival of an action potential at a presynaptic neuron leads to an excitatory postsynaptic potential at a synapse that uses acetylcholine.

[illegible]

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B [1]

2. [1]

C C [1]

3. [6]

- (a) speeds similar / C 25 m s^{-1} and D 24 m s^{-1} [1]
- (a) D achieves this with a much smaller diameter / C is non-myelinated and D is myelinated [1]
- (b) $500 \div 4 = 125$ times [1]
- (c) (strong) positive correlation [1]
- (c) $R^2 = 0.95^2 = 0.90$ [1] Accept 0.9025.
- (d) fast conduction with narrow fibres, so many fibres fit in a small space / nerve OWTTE [1]
- Accept: rapid responses without needing giant axons.

4. [4]

- depolarization of presynaptic membrane opens (voltage-gated) calcium channels [1]
- Ca^{2+} diffuses into presynaptic neuron [1]
- Ca^{2+} acts as a signal causing vesicles to fuse with presynaptic membrane / exocytosis [1]
- acetylcholine diffuses across the synaptic cleft [1]
- acetylcholine binds to (transmembrane) receptors on postsynaptic membrane [1]
- ion channels open and positive ions / Na^+ diffuse into the postsynaptic cell [1]
- postsynaptic membrane depolarized [1]
- max 4