



Cells (Interaction and interdependence) 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

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

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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