Neuronal Communication

Question Paper 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Communication, homeostasis and energy
Topic	Neuronal communication
Booklet	Question Paper 1

Time allowed: **72 minutes**

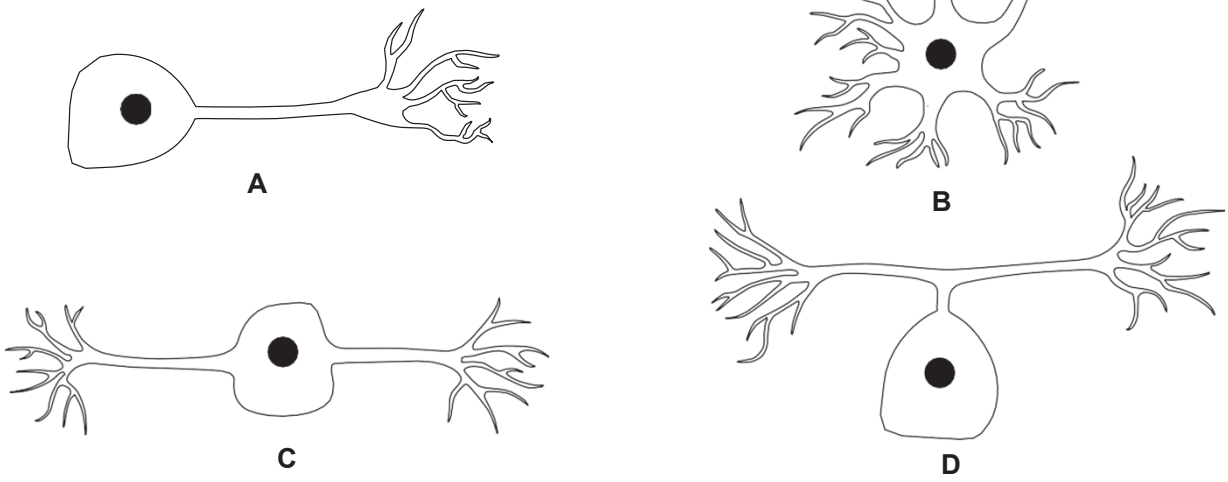
Score: **/53**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Which of the following diagrams, **A** to **D**, shows a sensory neurone?



[Total: 1]

The table below shows the membrane potentials of different neurones at a cholinergic synapse. The data were recorded on five separate occasions, as shown in the five rows.

	Membrane potential (mV)			
	Presynaptic neurone A	*Presynaptic neurone B*	*Presynaptic neurone C*	*Postsynaptic neurone*
1	+40	–70	–70	–70
2	–70	+40	–70	–70
3	–70	–70	+40	–70
4	+40	+40	–70	–70
5	+40	+40	+40	+40

Which of the following, **A** to **D**, explains these data?

A. divergence

B. hyperpolarisation

C. spatial summation

D. temporal summation

[Total: 1]

Animals receive different stimuli from their environment. Their synapses can manage multiple stimuli, often resulting in one response (such as a muscle twitching).

This action of the synapse is an example of

A spatial summation

B all or nothing response

C temporal summation

D cell signalling

[1]

Plasma membranes are very important for many processes involved in the functioning of cells, both in animals and plants.

(a) Fig. 4.1 represents part of the plasma (cell surface) membrane of an axon.

Structures labelled **A** to **D** represent the involvement of proteins in the movement of ions during **depolarisation** of the membrane.

D represents a voltage-gated protein.

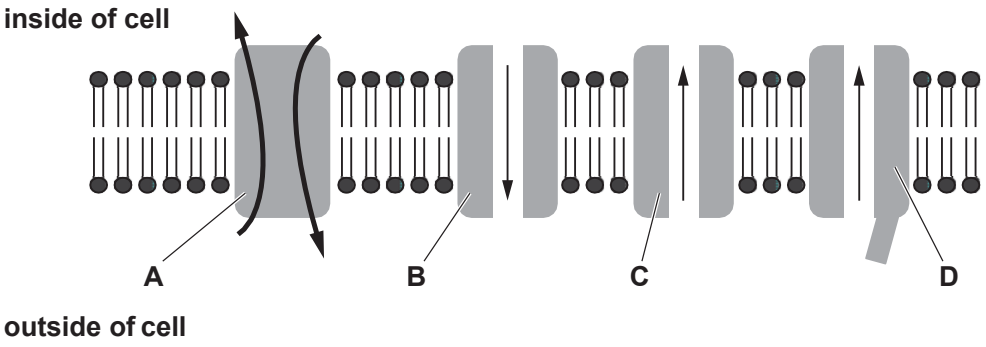


Fig. 4.1

Identify, using the appropriate letter(s), which of the proteins **A**, **B**, **C** or **D**:

(i) need(s) ATP to function **[1]**

(ii) transport(s) potassium ions (K^+) **into** the cell **[1]**

(iii) allow(s) potassium ions (K^+) **out of** the cell **[1]**

(iv) allow(s) or transport(s) sodium ions (Na^+) **into or out of** the cell. **[1]**

(b) Fig. 4.2 represents part of the plasma (cell surface) membrane of a cell that responds to adrenaline.

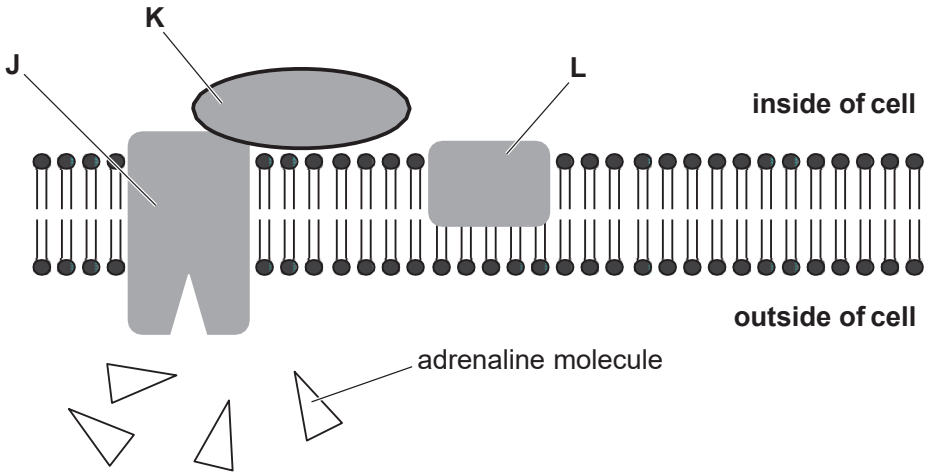


Fig. 4.2

Describe the involvement of **J**, **K** and **L** in the cell's response to adrenaline.

In your answer, you should use appropriate technical terms, spelled correctly. **[5]**

(c) Fig. 4.3 represents part of the **inner** membrane of a cell organelle. The letters represent substances involved in one stage of aerobic respiration.

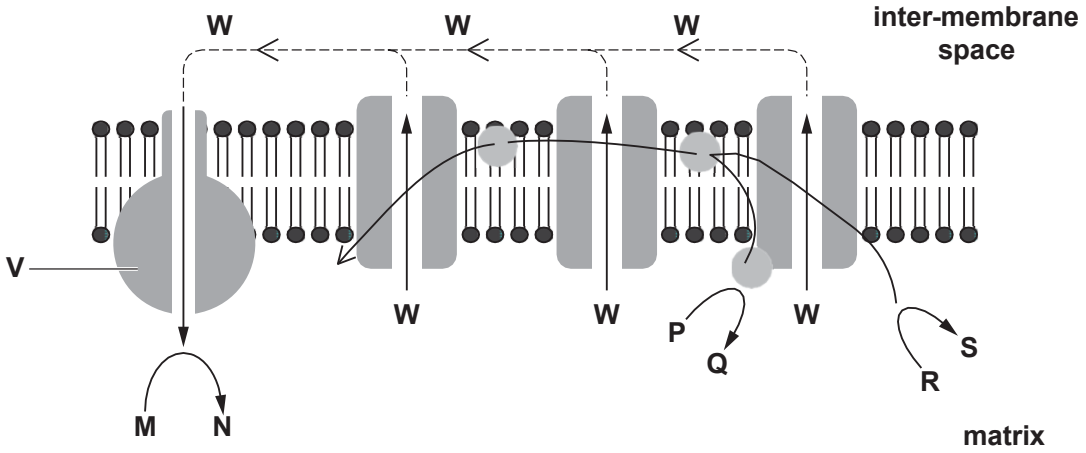


Fig. 4.3

(i) In which organelle would this inner membrane be found? **[1]**

(ii) Identify **V**. **[1]**

(iii) Identify **W**. **[1]**

(iv) Which letter **from Fig. 4.3** represents a reduced coenzyme? **[1]**

(v) Which letter **from Fig. 4.3** represents ATP? **[1]**

[Total: 14]

(a) Fig. 1.1 represents a cross section through a myelinated neurone.

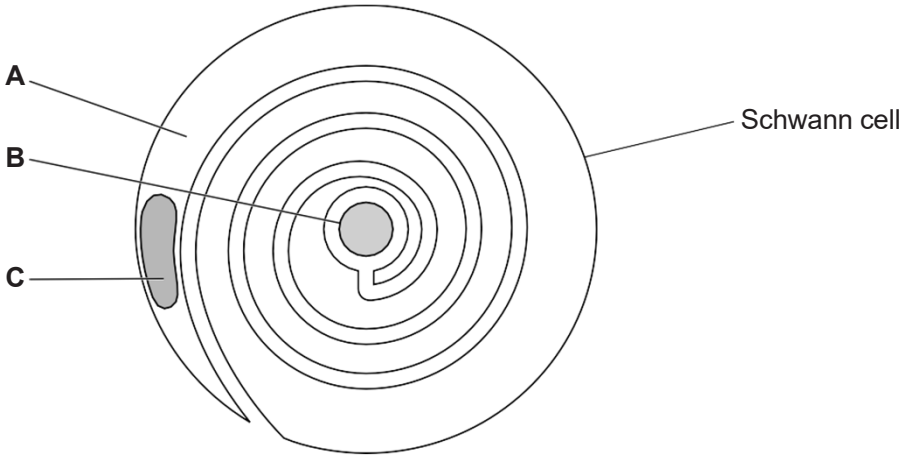


Fig. 1.1

(i) Identify **A** to **C**. **[3]**

(ii) Name the gap between two adjacent Schwann cells along the length of the neurone. **[1]**

(b) There are a number of differences between myelinated and non-myelinated neurones. One difference is the distribution of voltage-gated sodium ion channels in the membrane.

myelinated neurone

- voltage-gated sodium ion channels only occur at gaps between Schwann cells
- each gap is approximately 2 μm long
- gaps occur at approximately 1000 μm intervals

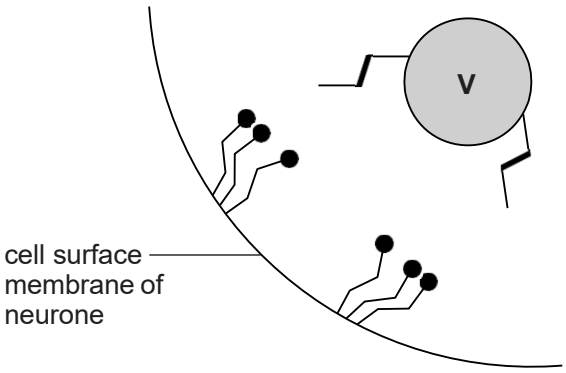
non-myelinated neurone

- voltage-gated sodium ion channels occur along the total length of the neurone

Use the information above to explain the difference in the speed of conduction of an action potential along the length of a myelinated neurone and a non-myelinated neurone. **[4]**

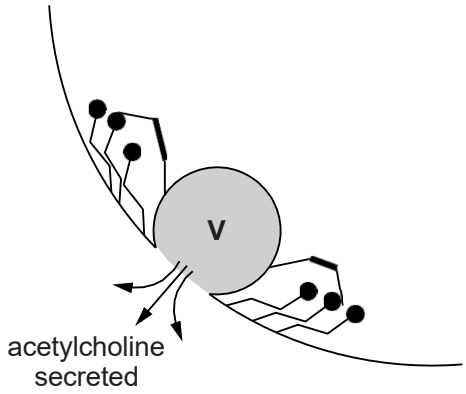
(c) A family of membrane proteins known as SNARE proteins are attached to vesicle membranes and cell surface membranes.

Fig. 1.2 summarises the mechanism by which vesicles secrete acetylcholine from a neurone.



Vesicle (**V**) has a type of SNARE protein attached to its membrane. This protein is known as vesicle associated membrane protein (VAMP).

The cell surface membrane of the neurone has a complex of SNARE proteins attached to it.



When the VAMP protein locks onto the SNARE complex, it enables the vesicle membrane to fuse with the cell surface membrane. This allows secretion of acetylcholine from the neurone.

Fig. 1.2

(i) Name the process by which the acetylcholine is secreted. **[1]**

(ii) Name the part of a neurone from which acetylcholine is secreted. **[1]**

Botulinum toxin is a protease that is produced by the bacterium, *Clostridium botulinum.*

(iii) If this toxin is present in the body, for example as a result of eating contaminated food, the toxin enters neurones.

With reference to Fig. 1.2, suggest, with reasons, the effects that botulinum toxin may have once it has entered a neurone. **[2]**

[Total: 12]

(a) Fig. 1.1 represents a sensory neurone connected to its associated receptor cells.

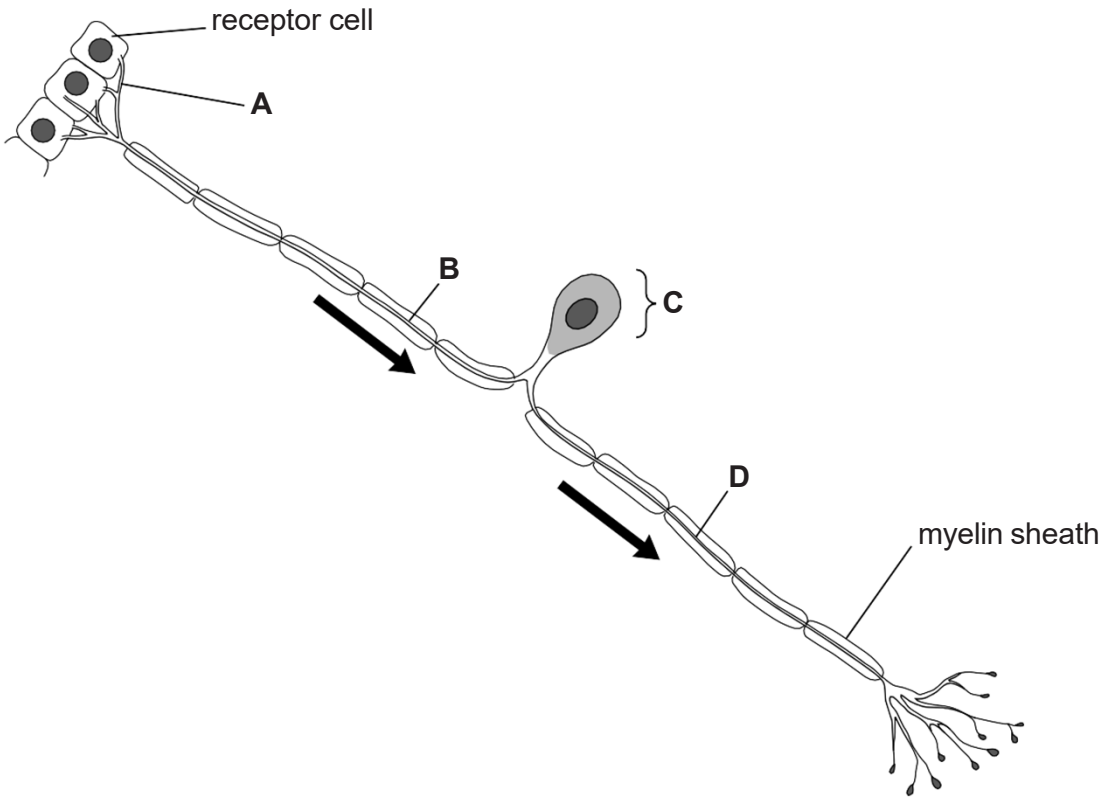


Fig. 1.1

(i) Identify the parts of the neurone labelled **A** to **D**. **[4]**

A .....

B .....

C .....

D .....

(ii) What is represented by the arrows on Fig. 1.1? **[1]**

(b) Describe and explain how the **resting potential** is established **and** how it is maintained in a sensory neurone.

In your answer, you should use appropriate technical terms, spelled correctly.

[4]

(c) Fig. 1.2 shows the changes in the membrane potential of a sensory neurone when the receptor cells are stimulated.

Fig. 1.3 indicates the strength of the stimuli that results in the corresponding changes in membrane potential.

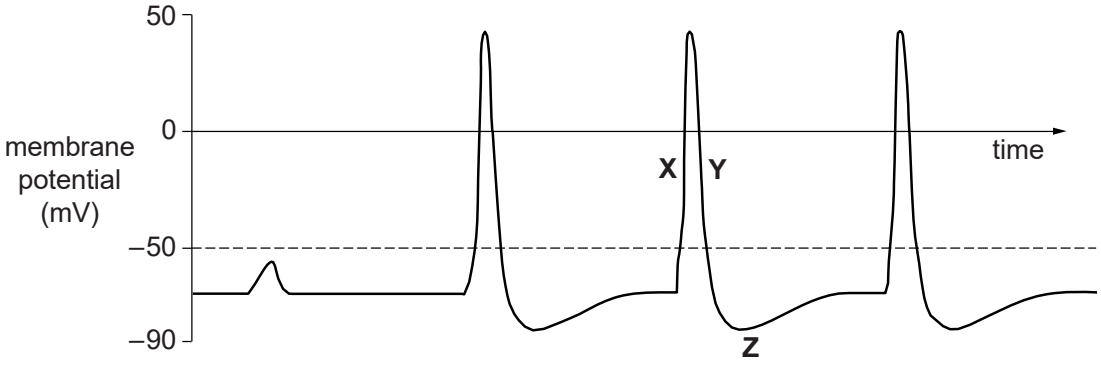


Fig. 1.2

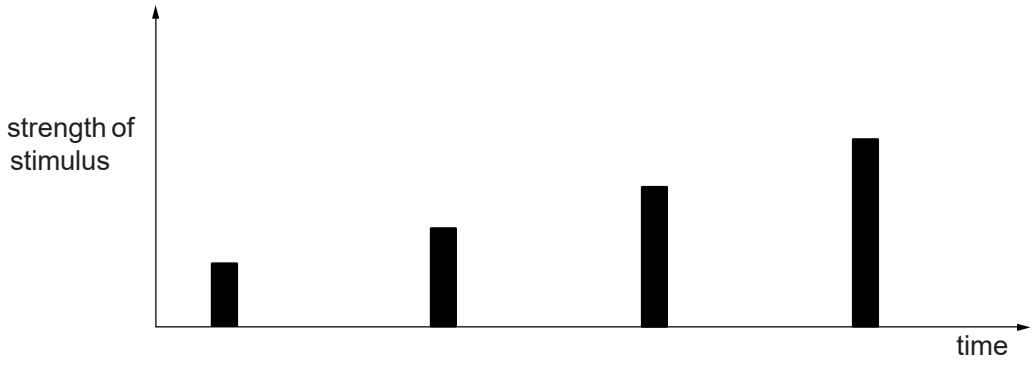


Fig. 1.3

(i) State the term used to describe what is happening at each of the points **X**, **Y** and **Z** on Fig. 1.2.

[3]

X .....

Y .....

Z .....

(ii) What term is used to refer to the value of −50 mV on Fig. 1.2? **[1]**

(iii) Comment on the relationship between the strength of a stimulus, as shown in Fig. 1.3, and the resulting action potential, as shown in Fig 1.2.

[2]

[Total: 15]

(a) The nervous system is made up of a number of different types of neurone, which transmit electrical impulses.

Complete the table below by stating **three** differences in the structure of motor and sensory neurones.

motor neurone	sensory neurone

[3]

(b) Complete the following passage, using the most appropriate term(s) in each case.

When an impulse is not passing along a neurone, a resting potential of .....mV is established. When the neurone is stimulated, it causes ..... of the cell surface membrane. This will not generate an action potential unless it is large enough to exceed the ....

A neurone will either conduct an action potential or not; this is described as the

..... - ..... - .....law.

Action potentials all have the same ..... . The only way in which the intensity of a stimulus can be interpreted is by the ..... of the action potential. **[6]**

[Total: 9]