

## Neuronal Communication

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

Your answer

[1]

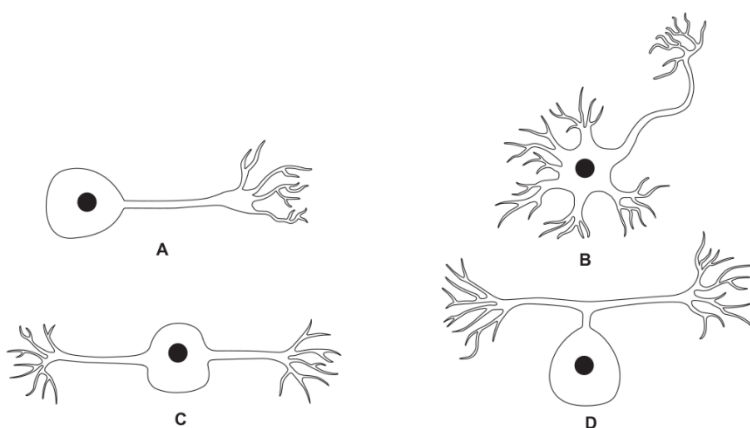
2. Which of the following describes the process that happens during **repolarisation** of a neurone during the action potential?

	Sodium channels	Potassium channels	Membrane potential
A	closed	open	decreasing
B	open	closed	decreasing
C	open	closed	increasing
D	closed	open	increasing

Your answer

[1]

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



Your answer

[1]

4. 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

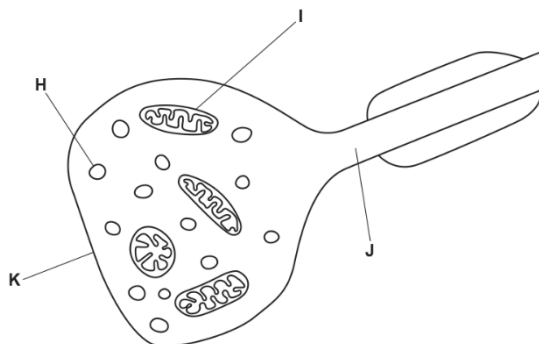
Which of the following, **A** to **D**, explains these data?

- A divergence
- B hyperpolarisation
- C spatial summation
- D temporal summation

Your answer

[1]

5. The image below shows a synaptic bulb.



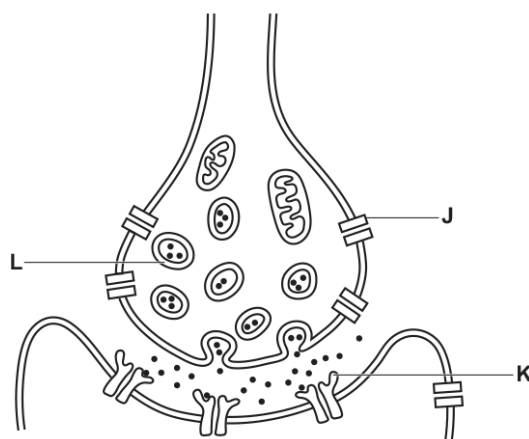
Which of the following rows, **A** to **D**, correctly names the parts labelled **H** to **J** in the image?

	H	I	J	K
A	vesicle containing neurotransmitter	mitochondrion	dendron	postsynaptic membrane
B	vesicle containing $Ca^{2+}$	mitochondrion	axon	presynaptic membrane
C	vesicle containing $Ca^{2+}$	myelin	dendron	postsynaptic membrane
D	vesicle containing neurotransmitter	mitochondrion	axon	presynaptic membrane

Your answer

[1]

6. The diagram below shows a synapse.



GABA is a neurotransmitter.

GABA reduces the number of action potentials in the postsynaptic neurone by opening chloride ion channels in the post-synaptic membrane.

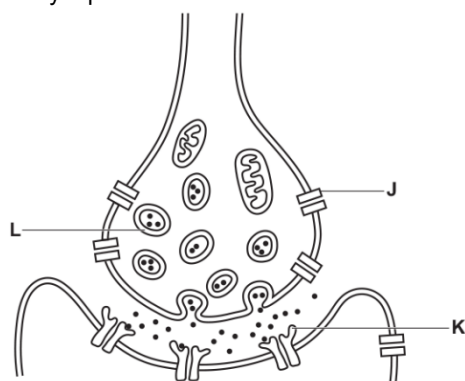
Which of the following statements, **A** to **D**, describes the action of GABA?

- A** GABA binds to structure **K** in competition with acetylcholine.
- B** GABA causes hyperpolarisation of the post-synaptic membrane.
- C** GABA causes depolarisation of the post-synaptic membrane.
- D** GABA inhibits release of neurotransmitter from structure **L**.

Your answer

[1]

7. The diagram below shows a synapse.



Which of the following statements, **A** to **D**, describes events occurring at a synapse?

- A** Acetylcholine is broken down by enzymes so that it can bind to structure **K**.
- B** An action potential causes structure **J** to close.
- C** Structure **J** is a voltage gated  $\text{Ca}^{2+}$  channel.
- D** Structure **L** is released by exocytosis.

Your answer

[1]



(b). Lobsters and sea cucumbers also have statocysts. From this information, the student concluded:

'I think this means squids, lobsters and sea cucumbers evolved from a recent common ancestor and are probably classified in the same phylum.'

Evaluate the extent to which the information about lobsters and sea cucumbers supports the student's conclusion.

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[2]

9. Fig. 2.1 shows a naked mole rat, *Heterocephalus glaber*.



**Fig. 2.1**

The naked mole rat is a mammal. However, it has several features that are unusual for mammals.

An unusual characteristic of naked mole rats is their tolerance of pain.

Acid causes pain responses in most mammals. Naked mole rats are tolerant of the pain caused by acid.

This tolerance can be explained by the type of pain receptor found in naked mole rats.

Fig. 2.2 shows a representation of the ion channels present in the pain receptors of naked mole rats and other mammals.

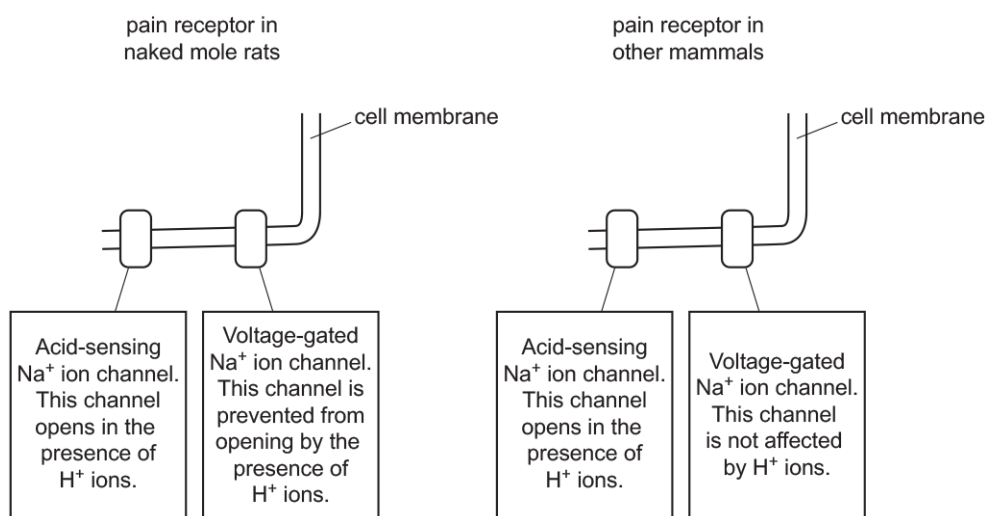


Fig. 2.2

i. Use the information in Fig. 2.2 to suggest why naked mole rats do not feel pain when exposed to acid.

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**[2]**

ii. Explain how a pain receptor is an example of a transducer.

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**[1]**

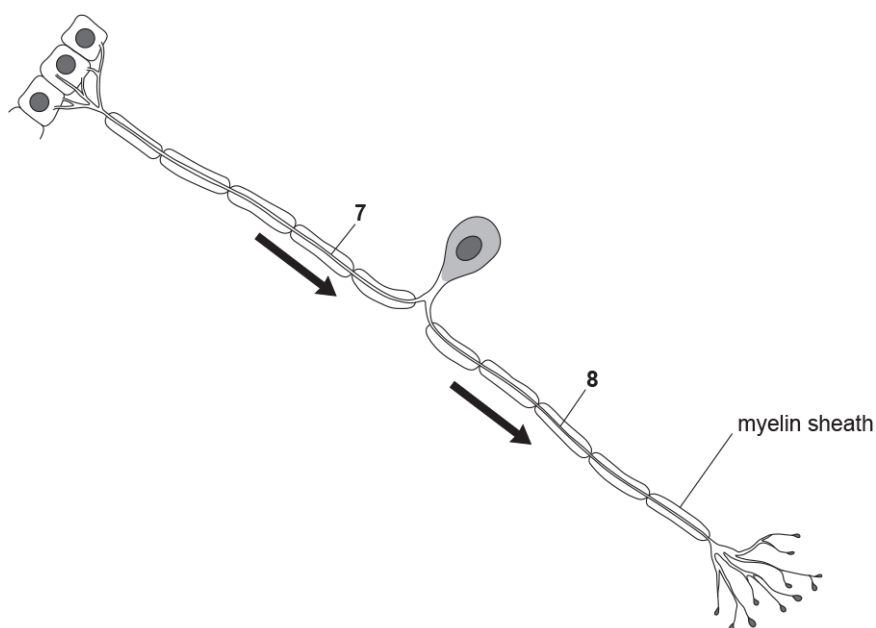
10. Which of the following statements about nervous transmission is **not** correct?

- A Breakdown of the myelin sheath can lead to uncoordinated movement.
- B Saltatory conduction increases the rate of propagation of a nerve impulse.
- C The myelin sheath is formed from Schwann cells.
- D The nodes of Ranvier act as electrical insulators.

Your answer

[1]

11. Below is a diagram of a neurone.



The arrows show the direction of the nerve impulse.

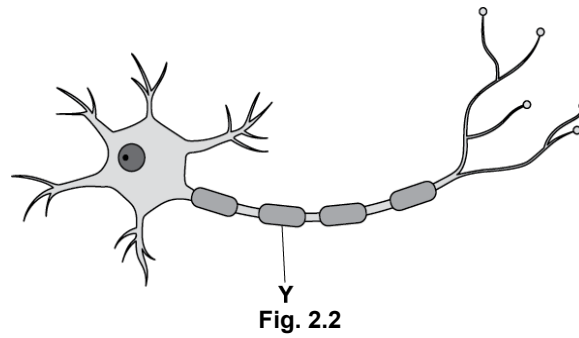
Which row in the table correctly identifies structures **7** and **8** and the type of neurone shown in the diagram?

	Structure 7	Structure 8	Type of neurone
<b>A</b>	axon	dendron	sensory
<b>B</b>	axon	dendron	motor
<b>C</b>	dendron	axon	sensory
<b>D</b>	dendron	axon	motor

Your answer

[1]

12. Fig. 2.2 shows a representation of a human neurone.



i. Name the type of neurone shown in Fig. 2.2.

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ii. State the function of Y in Fig. 2.2.

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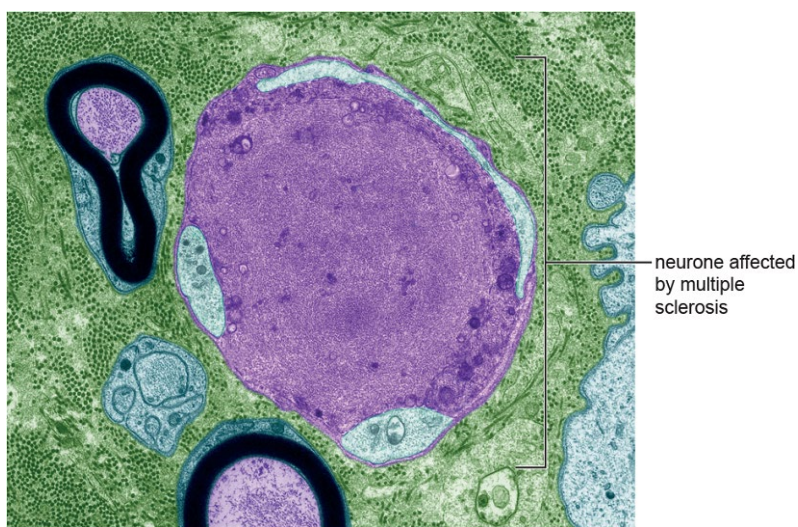
13. Multiple sclerosis (MS) is an autoimmune disease that damages the nervous system.

i. Suggest how the immune system causes damage to the nervous system.

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----- [2]



- ii. Fig. 5 (below and **on the insert**) shows three neurones of different sizes from a person with MS.



**Key**  
 purple = axon  
 light blue = Schwann cells  
 black = myelin sheath

**Fig. 5**

One of the neurones has been affected by MS

MS causes changes to neurones, which reduce the speed at which nervous impulses are conducted.

Using information from Fig. 5, what can you conclude about how MS causes a reduction in the speed of nervous impulses?

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**[2]**

**14.** Molluscs such as *H. lunulata* have unmyelinated neurones. Saltatory conduction cannot occur in these neurones.

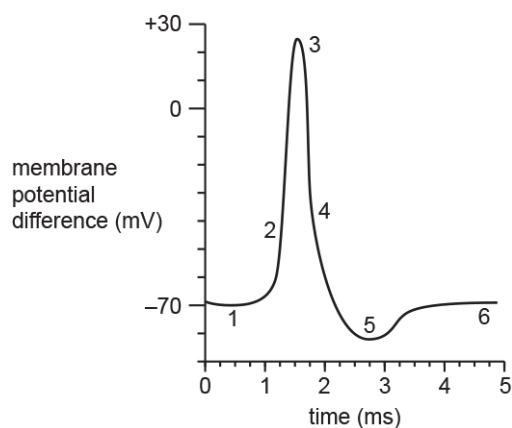
Why is transmission of action potentials along the axon slower in the absence of saltatory conduction?

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**[1]**

15. The graph represents the potential difference across the membrane of an axon during an action potential.



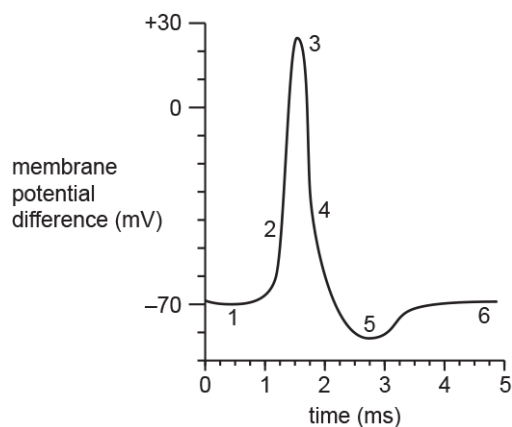
Which of the statements about the graph is correct?

- A Depolarisation is occurring at 4 and hyperpolarisation is occurring at 6.
- B Depolarisation is occurring at 2 and hyperpolarisation is occurring at 5.
- C Hyperpolarisation is occurring at 5 and repolarisation is occurring at 6.
- D Repolarisation is occurring at 4 and hyperpolarisation is occurring at 6.

Your answer

[1]

16. The graph represents the potential difference across the membrane of an axon during an action potential.



Which row in the table correctly describes the events occurring during the action potential?

	Position on graph	Na <sup>+</sup> /K <sup>+</sup> -pump is operating	Voltage-gated Na <sup>+</sup> channels are open	Voltage-gated K <sup>+</sup> channels are open
A	1	yes	no	yes
B	2	yes	yes	no
C	3	no	no	yes
D	4	no	yes	no

Your answer

[1]





19. FURA-2 is a fluorescent dye that can be used to measure the concentration of  $\text{Ca}^{2+}$  ions inside cells.

Scientists have used FURA-2 to study the role of  $\text{Ca}^{2+}$  ions in the synapses of living nerve tissue.

FURA-2 was injected into a single sensory neurone that was connected by a synapse to a relay neurone.

FURA-2 fluorescence inside the neurone was observed using a confocal microscope.

- i. Explain **one** advantage of using a confocal microscope in this study.

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- ii. The sensory neurone was stimulated electrically and the FURA-2 fluorescence in the synaptic bulb was measured. At the same time, an electrode recorded the membrane potential in a postsynaptic neurone.

The results of this study are shown in the table.

Strength of electrical stimulation	FURA-2 fluorescence in synaptic bulb	Highest membrane potential in postsynaptic neurone (mV)
Low	Low	-60
Medium	Medium	+40
High	High	+40

The intensity of FURA-2 fluorescence is proportional to the concentration of  $\text{Ca}^{2+}$  ions.

The scientists concluded that changes in the concentration of  $\text{Ca}^{2+}$  ions in the presynaptic neurone caused an action potential in the postsynaptic neurone.

Evaluate and explain the scientists' conclusion.

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