WJEC EDUQAS A-LEVEL BIOLOGY · COMPONENT 3

BIOLOGY



EXAM QUESTION PACK

3.5 THE NERVOUS SYSTEM

SCORE	PERCENTAGE
/129	%

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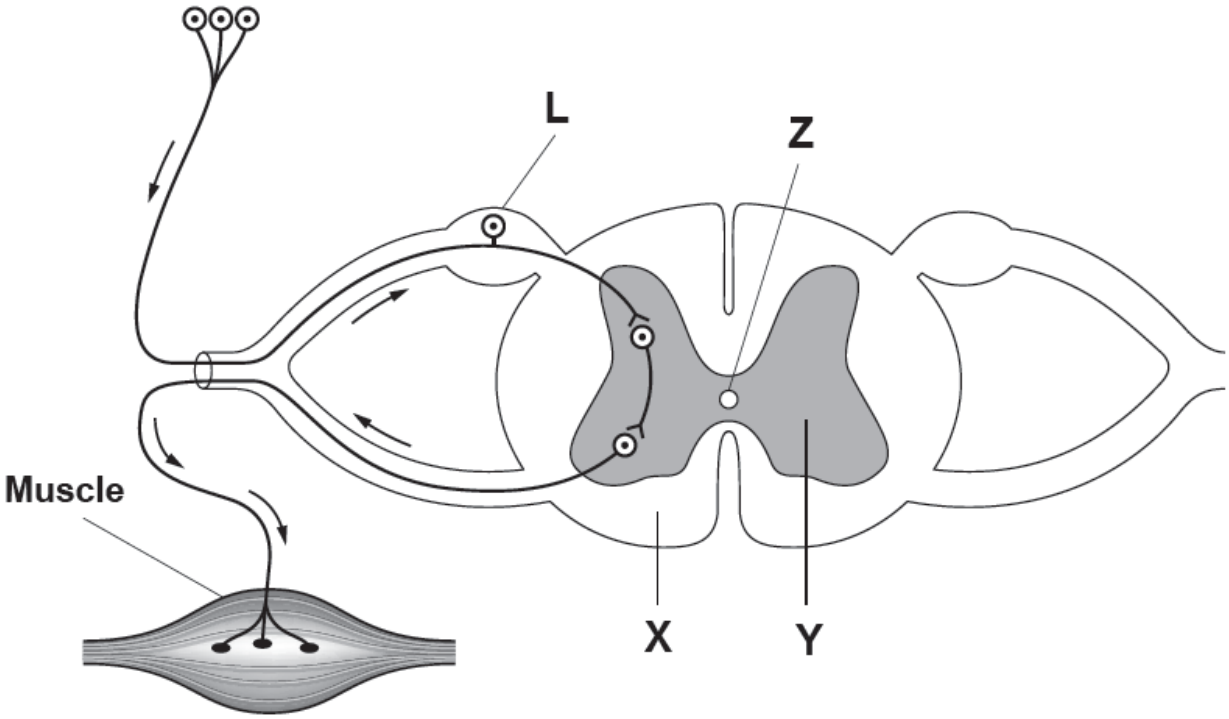
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1. The diagram below shows a transverse section of spinal cord and an associated reflex arc.



(a) (i) Identify **X** and **Y** shown on the diagram above and explain why there is a difference in colour in these two areas.

[2]

X . . . . . .

.

Y . . . . . .

.

Explanation

.....

.....

(ii) Identify L and Z shown on the diagram above.

[2]

L . . . . . .

.

Z . . . . . .

.

(b) (i) What is the name given to:

[2]

I the cells which partially cover neurons

.....

II the material which the cells produce to cover the axon

.....

(ii) What is the function of this material in the conduction of an action potential?

[2]

.....

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(iii) Multiple sclerosis is a progressive, degenerative disease of the nervous system in which the material referred to in (b)(i) is destroyed. Symptoms include increasing muscle weakness and loss of vision. Suggest an explanation for these symptoms.

[2]

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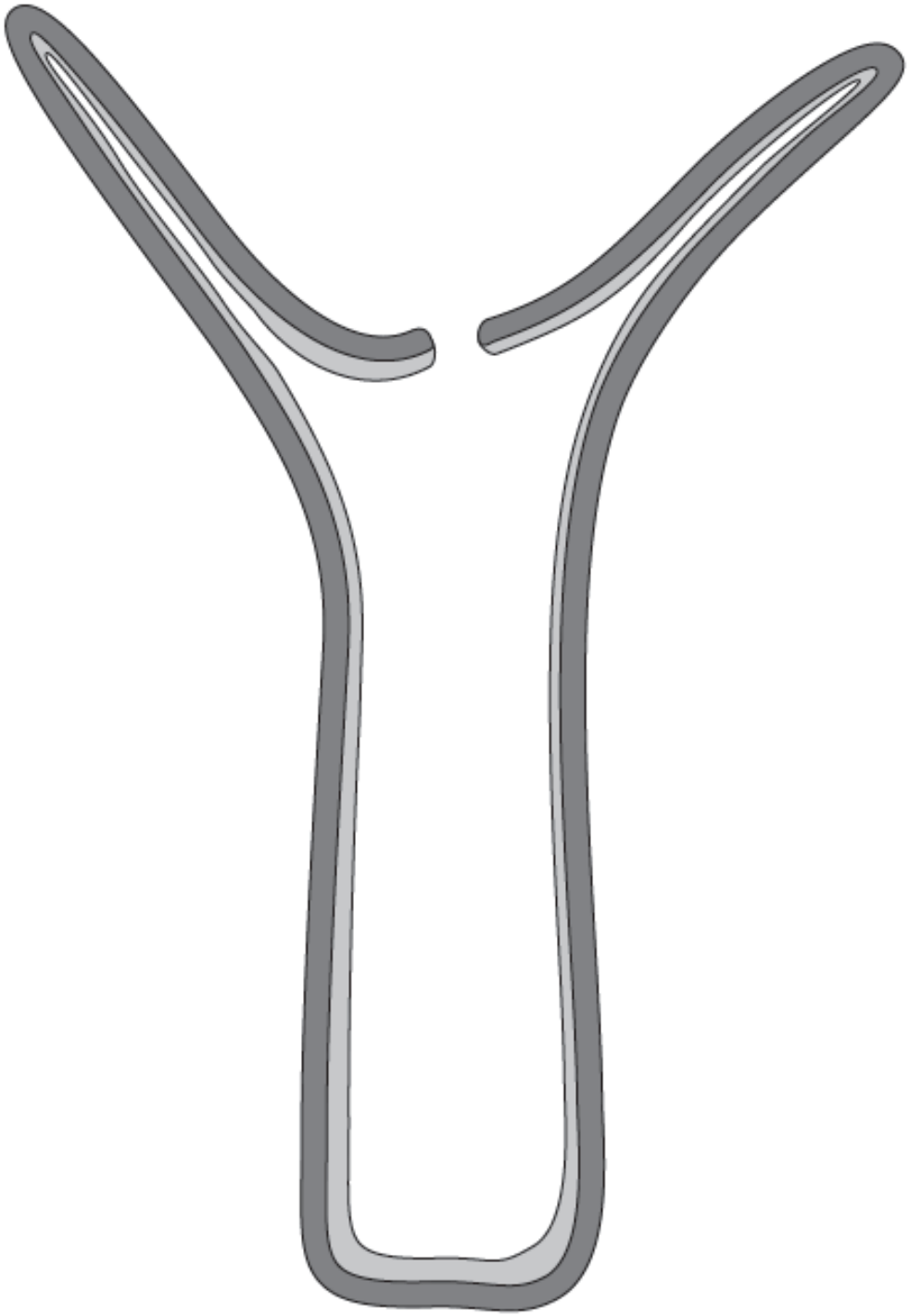
(iv) Suggest a possible medical treatment for multiple sclerosis.

[1]

(c) Nerve nets are common in some animal groups.

(i) Complete the diagram below to show a nerve net as would be seen in Hydra.

[1]



(ii) Give **two** ways in which the nerve net, as seen in Hydra, differs from that of the nervous system of a vertebrate.

[2]

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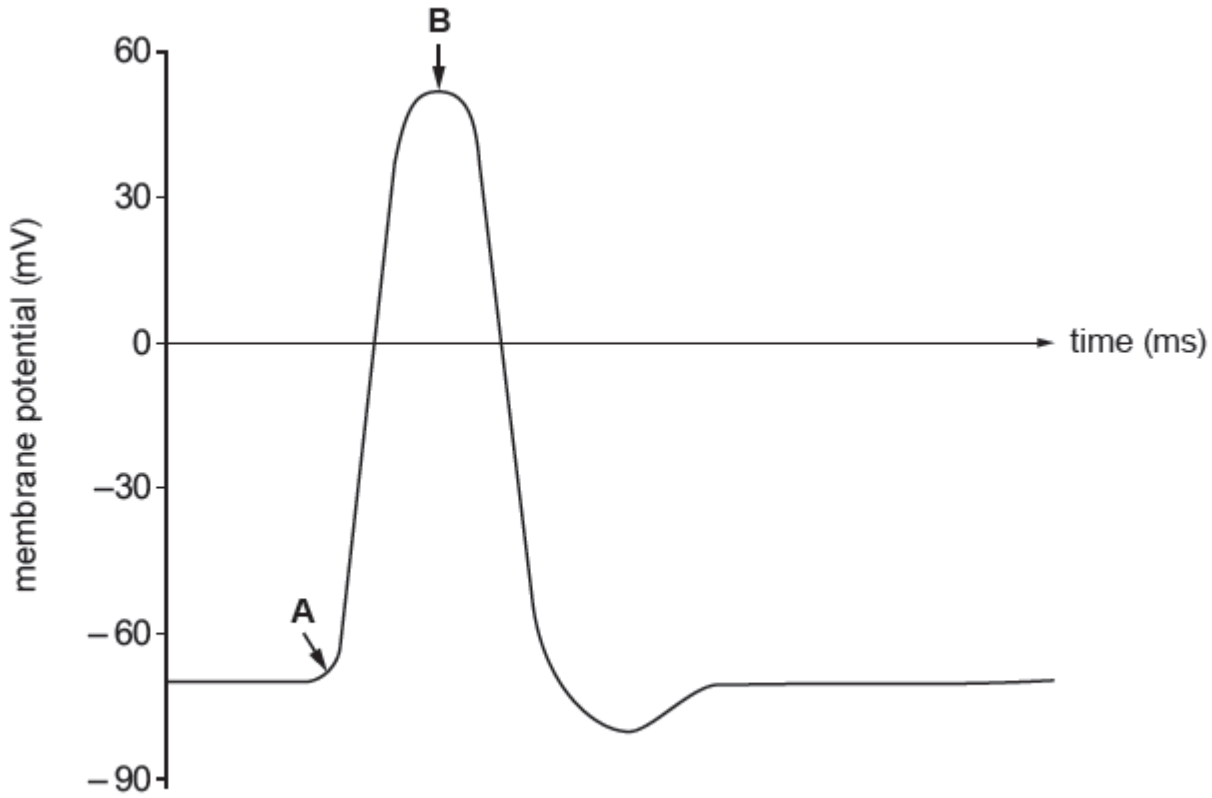
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2. The diagram shows the changes in the potential difference across the membrane of a neurone during the passage of

an action potential.



(a) Describe how the resting potential is maintained in the neurone.

[3]

(b) Describe the changes which are taking place in the membrane at points **A** and **B**.

[5]

A

B

(c) Multiple sclerosis is caused by the immune system destroying the myelin sheath of neurones. Explain why this condition leads to a slowing down of the transmission of a nerve impulse.

[3]

(d) Some chemicals such as organophosphorous insecticides increase the activity of the nervous system and others such as Beta-blockers reduce the activity of the nervous system.

Suggest two ways in which the chemicals could **increase** the activity of the nervous system and two ways in which the activity could be **decreased**.

[4]

(i) Increase in activity.

I . . . . . .

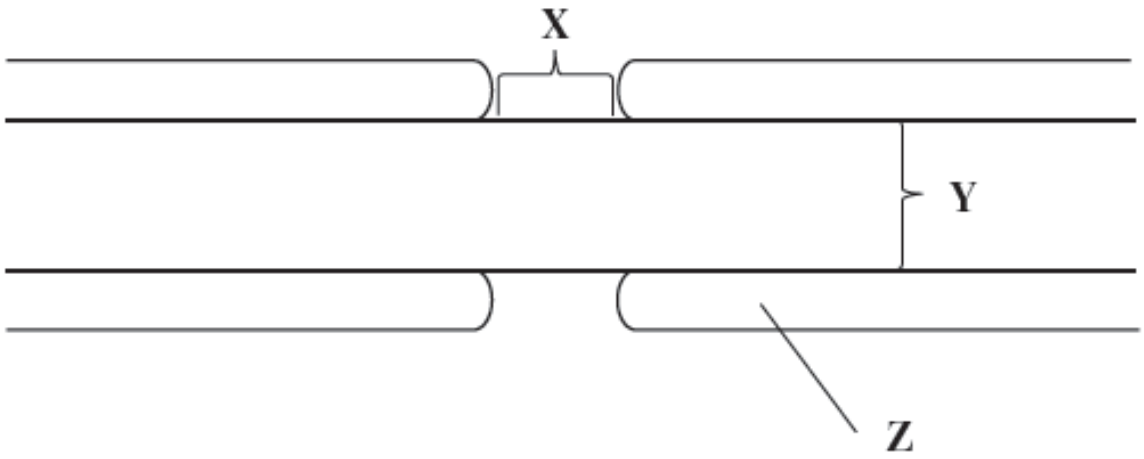
II . . . . . .
.

(ii) Decrease in activity.

I . . . . . .

II . . . . . .

3. The diagram below represents part of a myelinated neurone.



(a) Name **X** and **Y** shown on the diagram above.

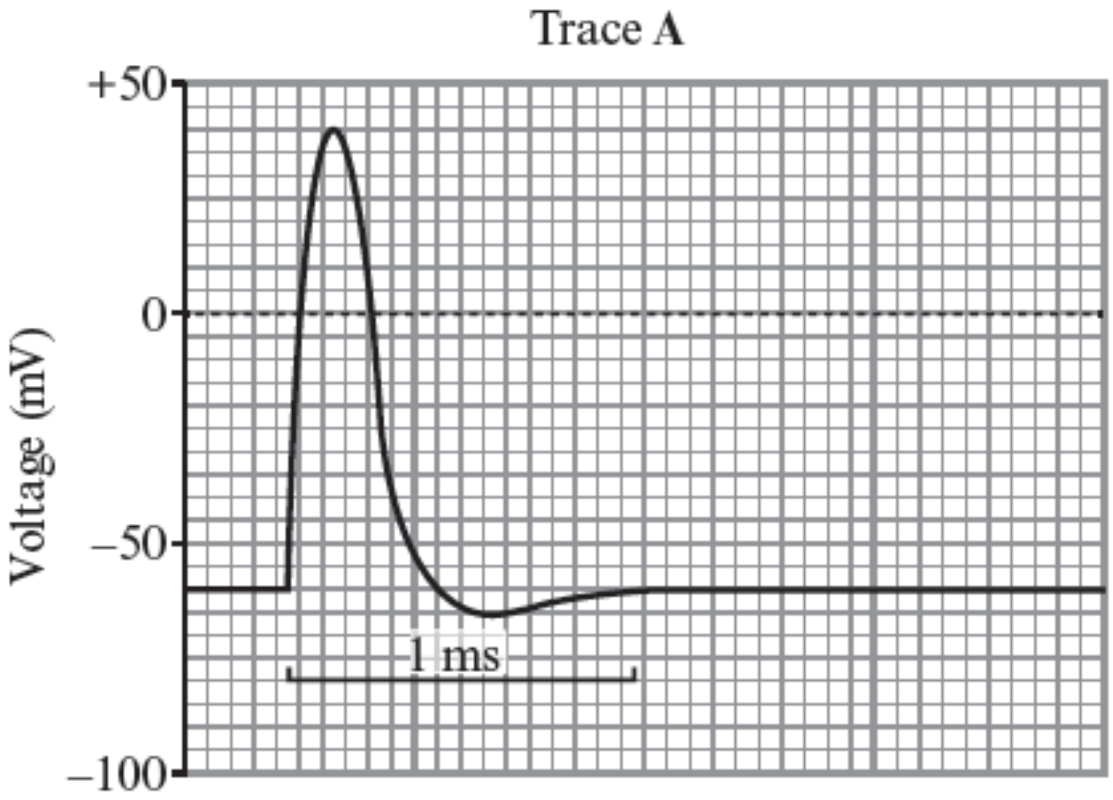
[2]

X ..... **Y** .....

(b) Name the cell type that forms layer **Z**.

[1]

Trace **A** below is an oscilloscope recording of changes in voltage across the membrane of a myelinated neurone during an action potential.



(c) Use Trace **A** to estimate the resting potential of **this neuron.**

[1]

(d) (i) Explain, in terms of movement of ions, what causes the rise in membrane potential seen in Trace **A** opposite.

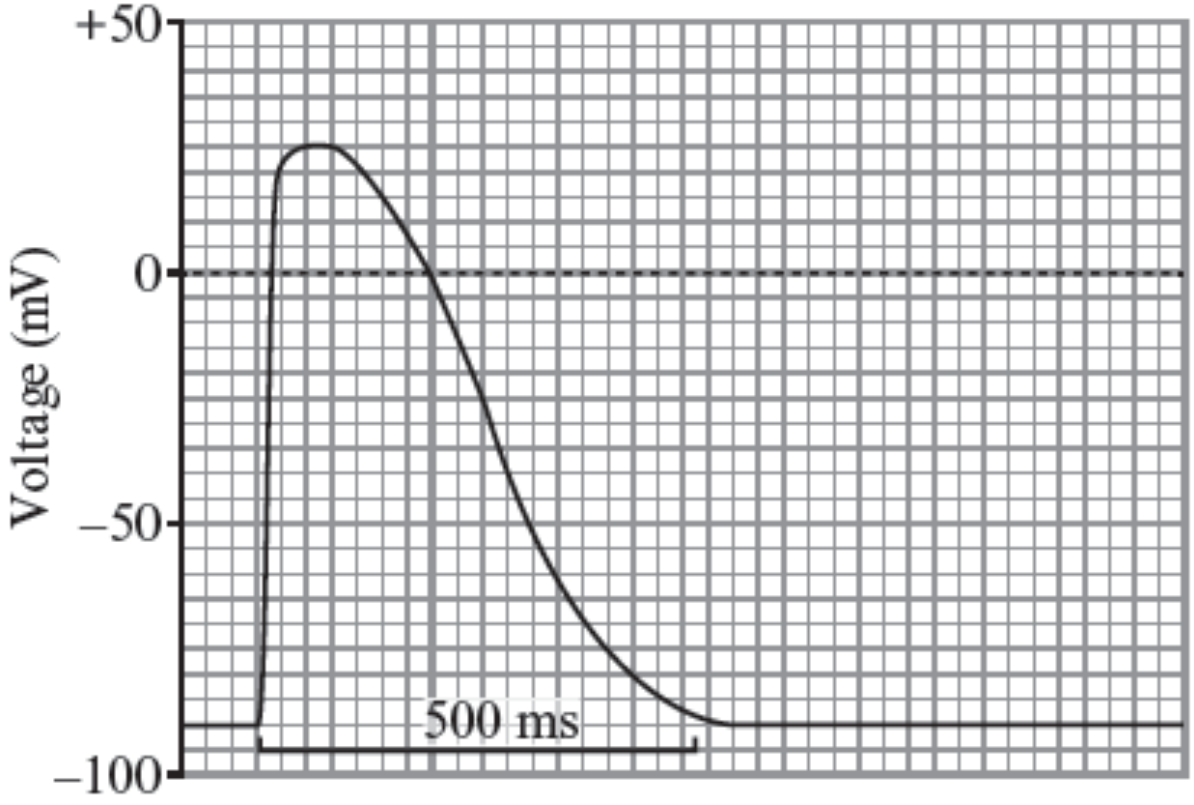
[2]

(ii) State the name given to the rapid fall in membrane potential seen in Trace **A**.

[1]

Trace **B** is another oscilloscope recording, showing changes in voltage across the membrane of a cardiac muscle fibre.

Trace B



(e) Compare Trace **A** and Trace **B** by giving two differences between them.

[2]

1.

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2.

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(f) Suggest how cardiac muscle fibres would respond when the voltage across the membrane rises.

[1]

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(g) The cardiac muscle fibres used to obtain the oscilloscope trace were obtained from a frog's heart. Consider the

ethics of killing a frog to obtain cardiac muscle fibres by giving **one** argument in favour and **one** against.

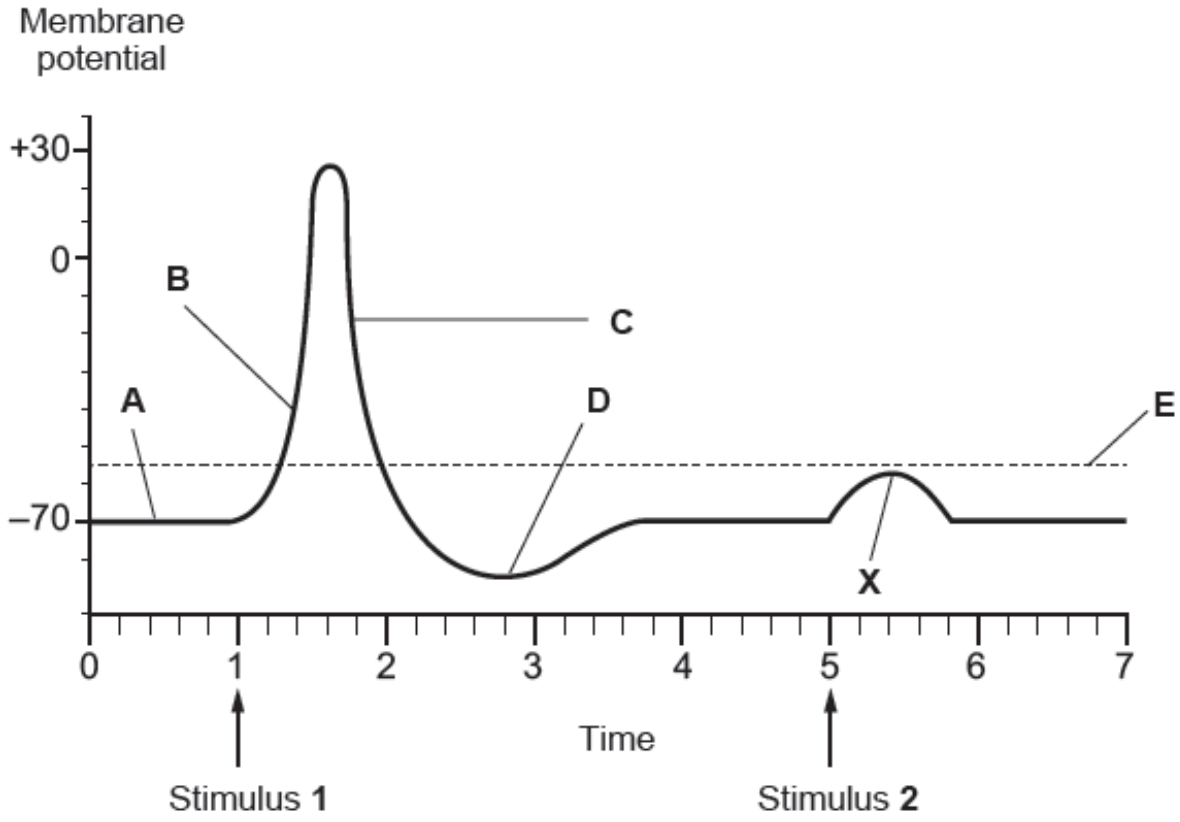
[2]

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4. An action potential is illustrated in the following graph



(a) What units should be used on the two axes of the graph shown above?

[2]

Membrane potential . . . . . .

Time . . . . . .

(b) Identify the stages of the action potential indicated by **A**, **B**, **C** and **D**.

[4]

A . . . . . .

B . . . . . .

C . . . . . .

D . . . . . .

(c) (i) What is represented by line E on the graph above? [1]

. . . . . .

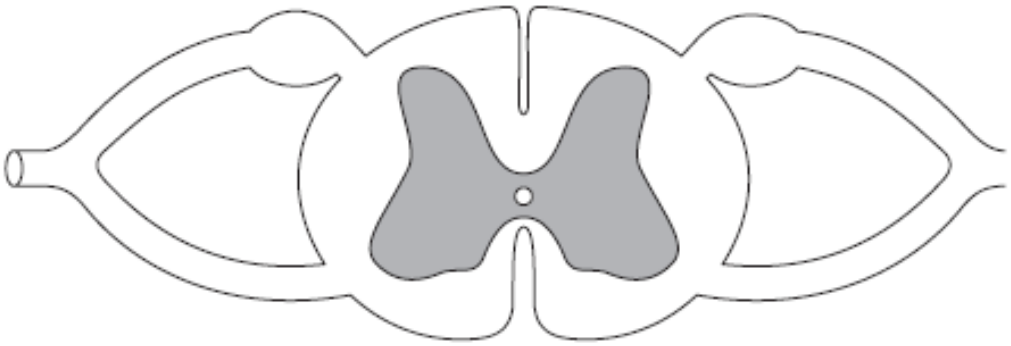
(ii) Explain why stimulus 2 failed to initiate an action potential as seen at point X. [2]

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5. The diagram shows a transverse section of the spinal cord.



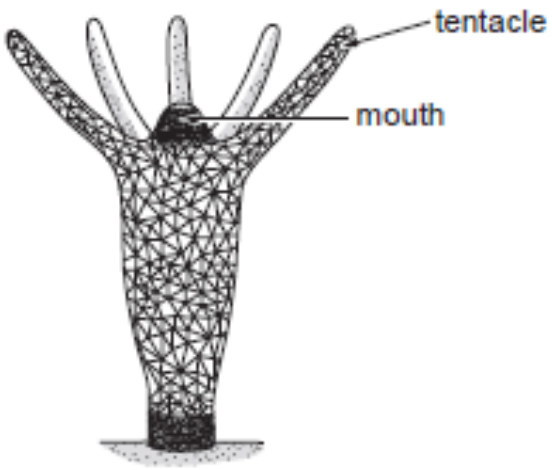
(a) (i) **Draw and label the position** of a sensory neurone and a motor neurone and label the cell bodies. [3]

(ii) When a person touches a hot object with their finger they will move away from the heat. State the advantage to humans of having this type of response to an external stimulus. [1]

. . . . . .

(b) Cnidaria is a phylum of invertebrate animals that are found in aquatic habitats. Their bodies consist of a jelly like substance sandwiched between two epithelial layers.

The diagram below shows the nervous system of a Cnidarian.



(i) State the name given to this type of nervous system. [1]

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(ii) Explain why the non-myelinated neurones of Cnidarians result in slower nerve impulses than in mammals. [2]

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6. Acetyl cholinesterase is one of many enzymes needed for the functioning of the nervous systems of vertebrates and insects. Certain chemical classes of pesticides, such as organophosphates, work against pests by inhibiting cholinesterase. While the effects of cholinesterase-inhibiting products are intended for insect pests, these chemicals can also be toxic to humans.
In severe cases of exposure to organophosphates, symptoms include uncontrollable muscular tremors, breathing difficulty and possible death.

(a) Explain the toxic effects of the organophosphates. [5]

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(b) Psychoactive drugs can affect synaptic transmission in a number of different ways.
Suggest some different mechanisms by which psychoactive drugs could decrease the rate of synaptic transmission. [4]

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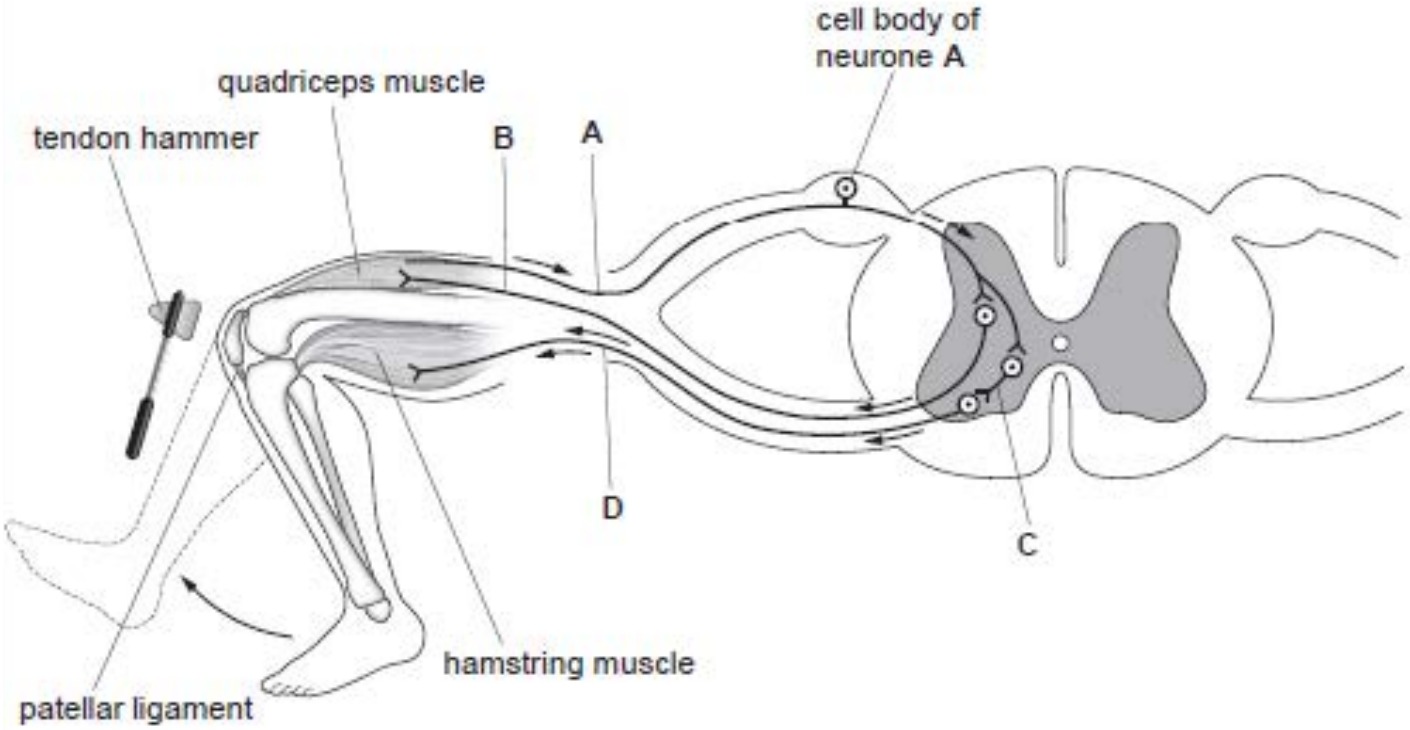
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7. The patellar reflex (commonly known as the knee-jerk reflex) can be used to identify problems in neural communication between the quadriceps muscle and the spinal cord. The patellar ligament joins the quadriceps muscle to the lower leg bone. Normally, when the leg is tapped sharply on the patellar ligament (just below the knee cap) the quadriceps muscle contracts involuntarily. Contraction of the hamstring then returns the lower leg to its original position.



(a) Four neurones, A, B, C and D, are labelled on the diagram above.

(i) Using the letters A to D, identify the neurones involved in the reflex arcs involving: [1]

I. the quadriceps muscle .....

II. the hamstring muscle .....

(ii) With reference to the neurones involved, explain why the contraction of the hamstring muscle occurs after the quadriceps muscle, in response to the same stimulus. [2]

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(b) Impulses are transmitted through the neurones as a wave of action potentials. Explain how the movement of ions results in the **generation** of an action potential. [4]

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(c) An experiment was carried out to determine the time taken for a person to kick their leg in response to the following stimuli:

Stimulus **1**. direct stimulus of the patellar ligament by the tendon hammer

Stimulus **2**. hearing the tendon hammer hitting the table

The reaction times to both stimuli were collected for a group of ten people. Mean reaction times were calculated and used to calculate the standard deviations for each stimulus. A t-test value was calculated to assess whether any difference in the results was significant. The results are summarised in the table below.

	STIMULUS 1	**STIMULUS 2**
mean reaction time / s	0.026	0.236
number of measurements	$n_1 = 10$	$n_2 = 10$
standard deviation	0.006	0.108
t-test value	2.41	

(i) Explain why a t-test was used to assess the significance of the differences in the results and not a Chi-squared test. [2]

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(ii) The null hypothesis for this experiment was that *'there was no significant difference between the results for Stimulus 1 and Stimulus 2'*. The degrees of freedom for this t-test were 18.

Use the t-test value and the information given in the table below to decide whether to accept or reject the null hypothesis at a suitable probability level. Explain your answer. [4]

degrees of freedom	probability			
	0.1	0.05	0.01	0.005
1	6.31	12.71	63.66	127.32
5	2.02	2.57	4.03	4.77
8	1.86	2.31	3.36	3.83
10	1.81	2.23	3.17	3.58
18	1.73	2.10	2.88	3.20
20	1.73	2.09	2.85	3.15

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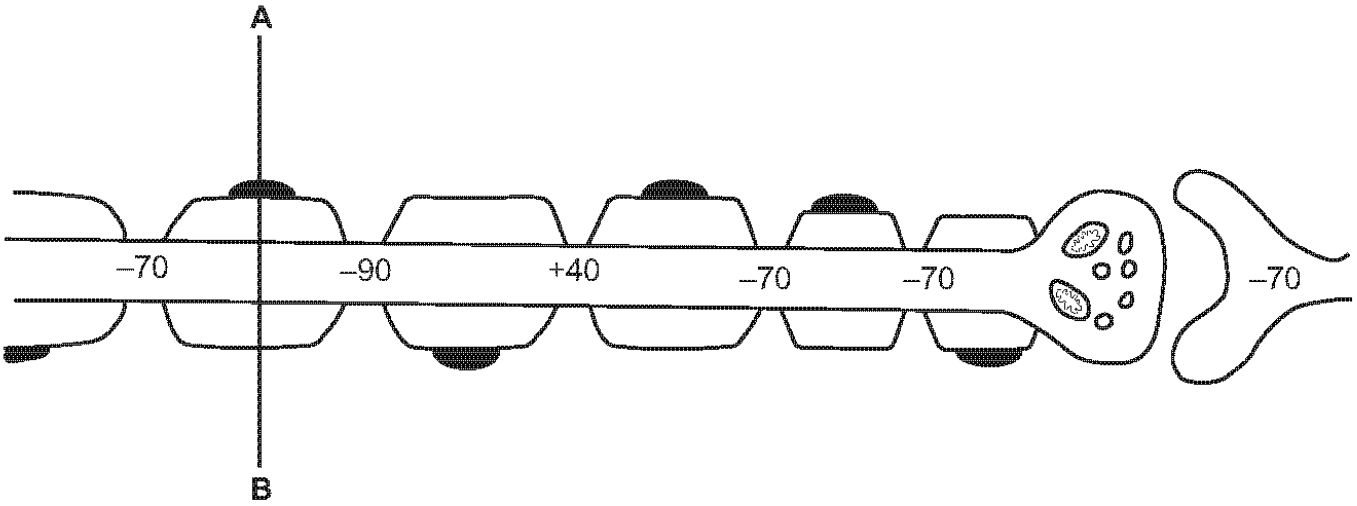
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8. The diagram shows part of two nerve fibres and a synapse. The figures indicate the potential difference across the membrane between the cytoplasm of each fibre and the extracellular fluid at intervals along the fibre.



Figures represent potential difference across membrane in mV

(a) Draw a circle around **one** region of the diagram where an action potential exists. Explain your choice. [2]

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(b) Give **two** reasons shown on the diagram which would prevent the nerve impulse travelling in the opposite direction. [2]

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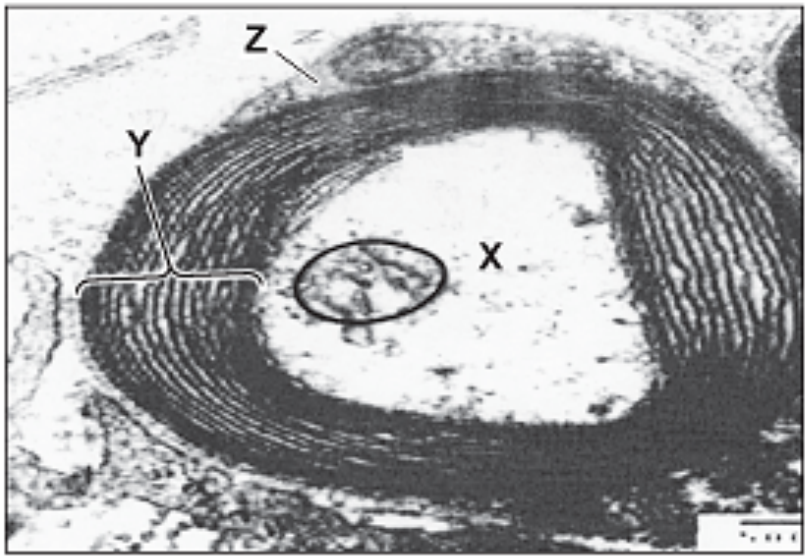
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(c) The electron micrograph below shows a transverse section of the nerve fibre through **A – B** on the diagram on page 8.



(i) Identify cell **Z** and structures **X** and **Y**. [3]

cell **Z** .....

structure **X** .....

structure **Y** .....

(ii) Explain what would happen to the rate of transmission of the nerve impulse if structure **Y** was damaged. [2]

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(d) Curare is a poisonous plant extract used by South American Indians on the tips of blowpipe arrows. It causes muscle paralysis in the victim by acting on the post synaptic membrane, preventing the transmission of the nerve impulse across a neuromuscular junction.

(i) Suggest and explain how curare may prevent the transmission of the impulse across the neuromuscular junction. [3]

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(ii) Suggest why curare has no effect on the contraction of the muscles of the heart. [1]

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13

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9. Complete the following table indicating whether the statement is true or false by placing a tick (✓) in the correct box. [4]

Statement	True	False
Motor neurones have only a single dendrite.		
Motor neurones have many axons.		
Dendrites receive and integrate impulses.		
Dendrites of motor neurones are rarely myelinated.		

4

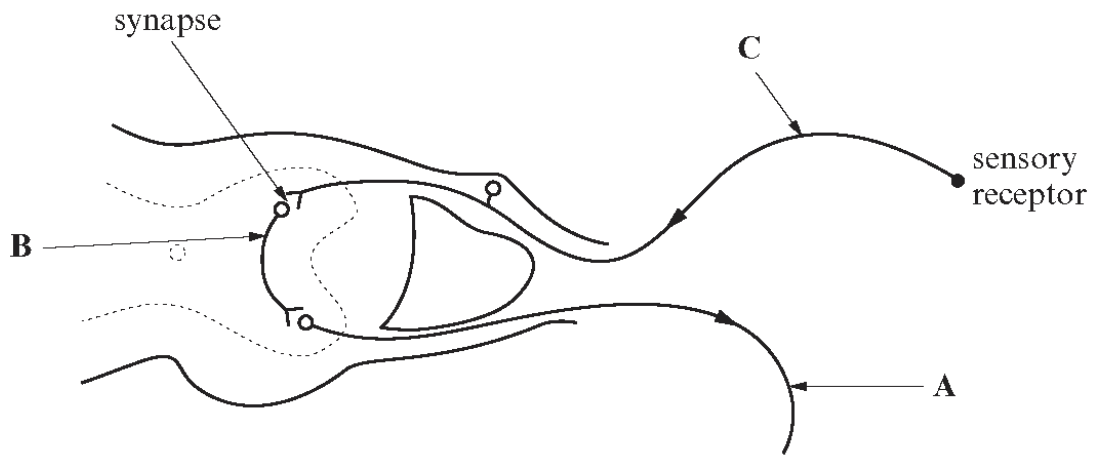
10.

(a) What is a reflex action? [2]

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(b) The diagram shows the neurones in a reflex arc.



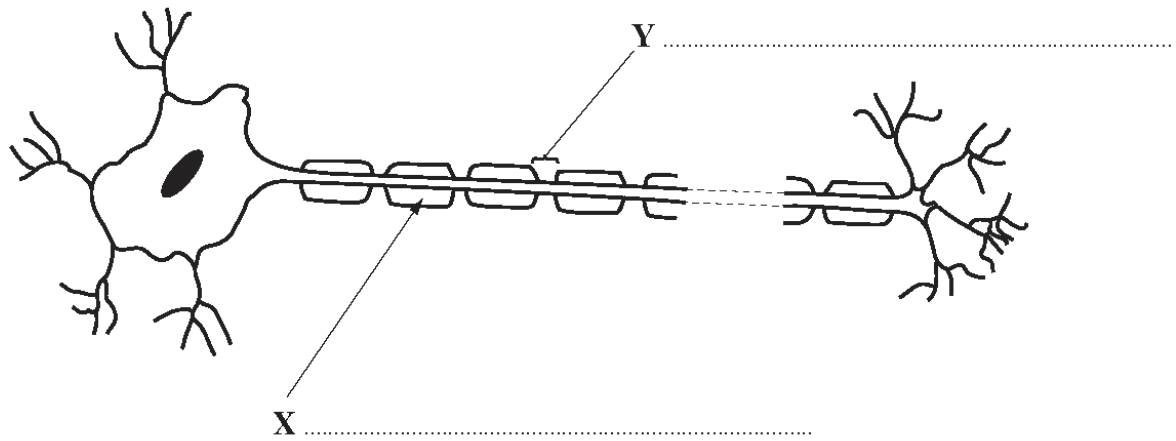
Name the types of neurone labelled **A, B** and **C**. [1]

A .....

B .....

C .....

(c) The diagram below represents a neurone.
On the diagram, label the structures **X** and **Y**. [2]



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(d) (i) Describe how a resting potential is maintained in a neurone. [2]

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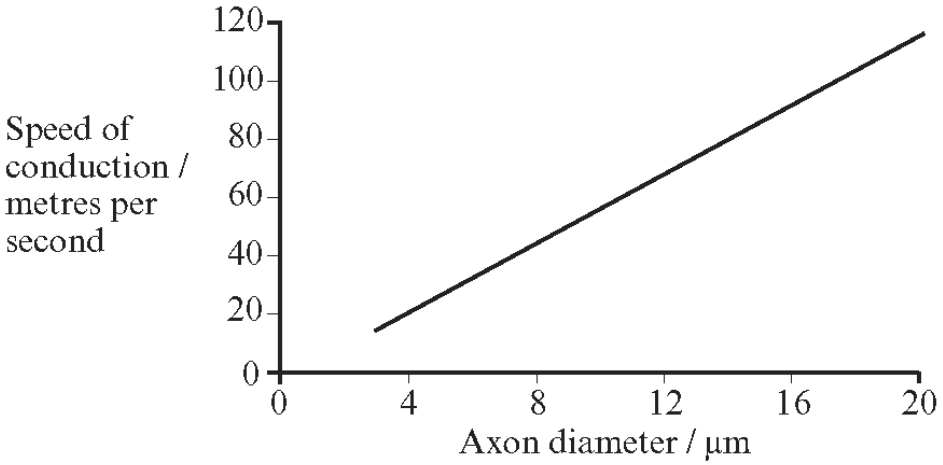
(ii) Describe how the potential across the membrane is reversed when an action potential is produced. [2]

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(e) The graph shows the relationship between the diameter of the axon and the speed of conduction of nerve impulses in myelinated axons of a cat.



(i) Describe the relationship between the diameter of the axon and the speed of conduction. [1]

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.....

(ii) Suggest an explanation for this increase in speed of conduction. [2]

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(iii) Explain why a myelinated axon uses less ATP to transmit a nerve impulse than a non-myelinated axon of the same diameter. [2]

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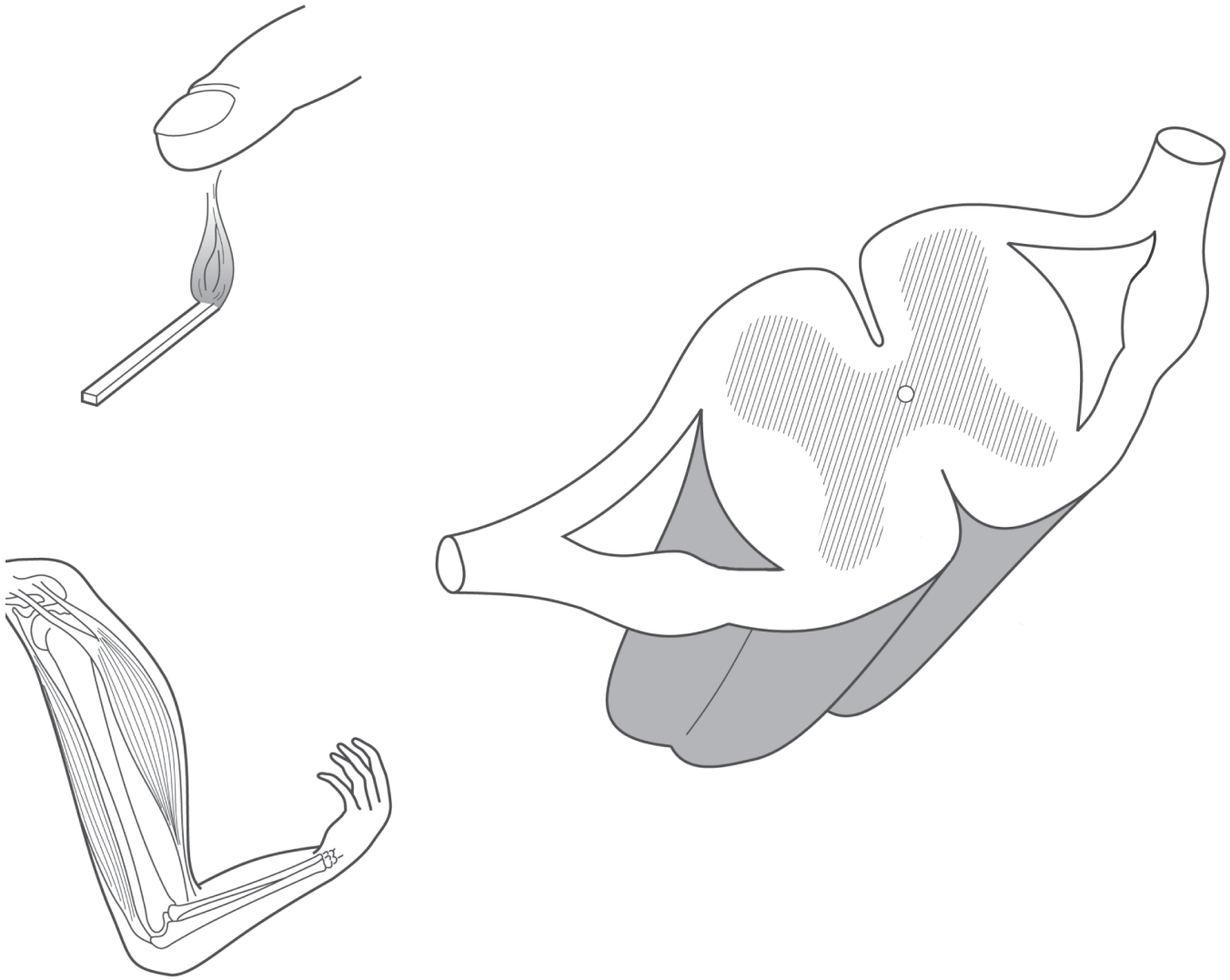
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(Total 14 marks)

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11. The diagram represents the spinal cord and structures involved in the hand withdrawal reflex. (Not drawn to scale).



(a) Draw and **label** on the diagram a sensory, relay and motor neurone involved in the reflex action when a hand is withdrawn from a hot object. [3]

(b) Explain giving **two** reasons, why nerve impulses can only travel in one direction. [2]

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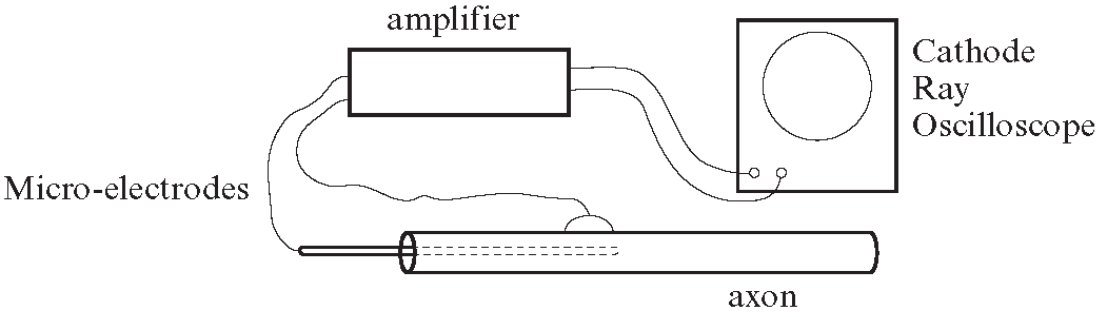
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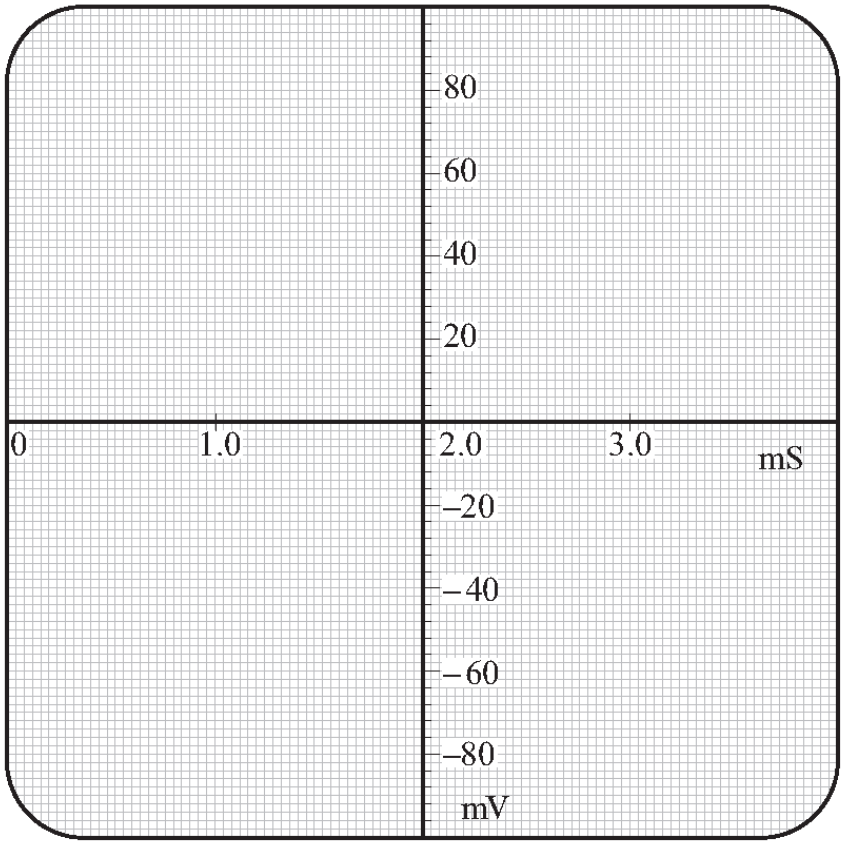
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(c) The equipment shown in the diagram below is used to measure electrical potential across the membrane of squid giant axons.

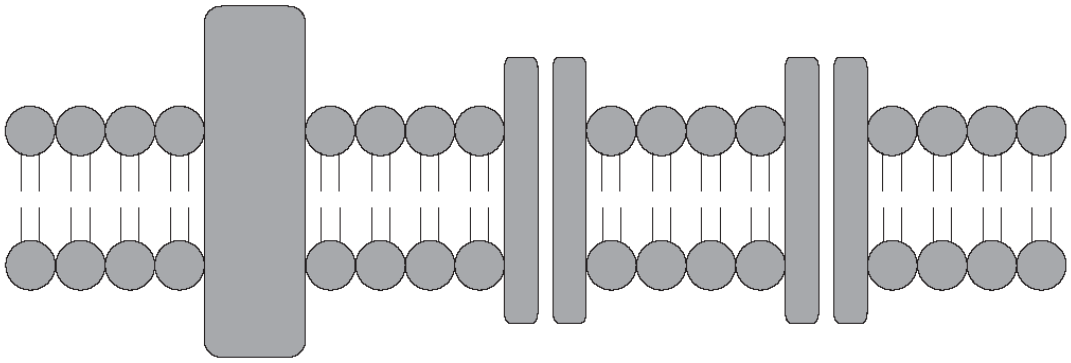


(i) Use the grid below to draw a typical action as it would appear on the screen of the cathode ray oscilloscope. [2]



(ii) Label your Action Potential to show, depolarisation and repolarisation. [1]

(d) The diagram below shows the structural components of the axon membrane that are responsible for the potentials measured in part *(c)*.



Na^+/K^+ pump Na^+ channel K^+ channel

(i) From which type of biological molecules are the following made?

pumps and channels ..... [1]

the bilayer ..... [1]

(ii) With reference to the diagram, describe how the following events are brought about. [4]

Resting Potential .....

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Depolarisation .....

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(e) Explain how impulses are transmitted across a synapse. [3]

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(Total 17 marks)

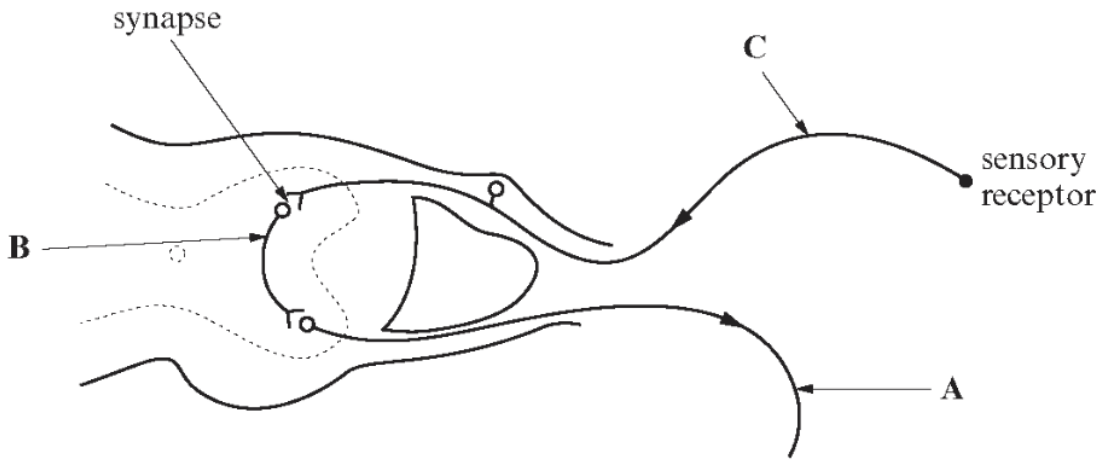
12.

(a) What is a reflex action? [2]

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(b) The diagram shows the neurones in a reflex arc.



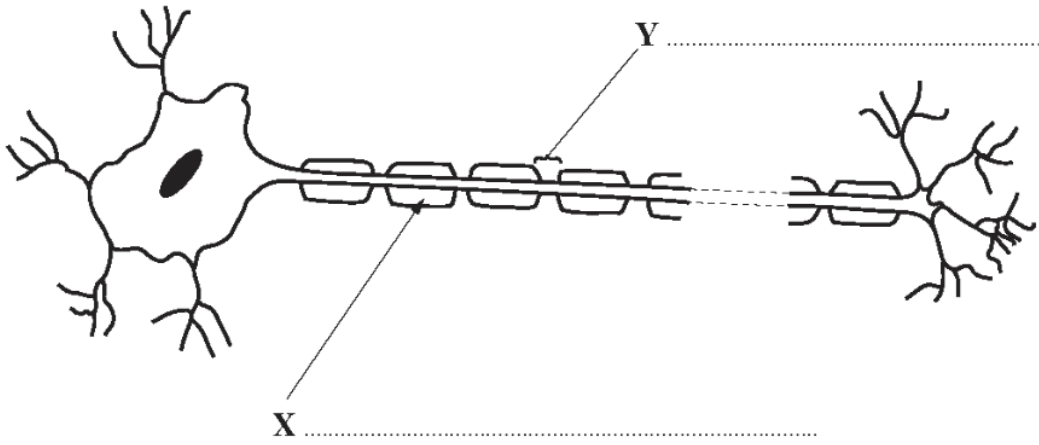
Name the types of neurone labelled **A, B** and **C**. [1]

A .....

B .....

C .....

(c) The diagram below represents a neurone.
On the diagram, label the structures **X** and **Y**. [2]



(d) (i) Describe how a resting potential is maintained in a neurone. [2]

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(ii) Describe how the potential across the membrane is reversed when an action potential is produced. [2]

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(e) One symptom of Altzheimer's disease is a reduction in the level of an enzyme in the brain that synthesises acetylcholine.

(i) Describe the function of acetylcholine at a synapse. [5]

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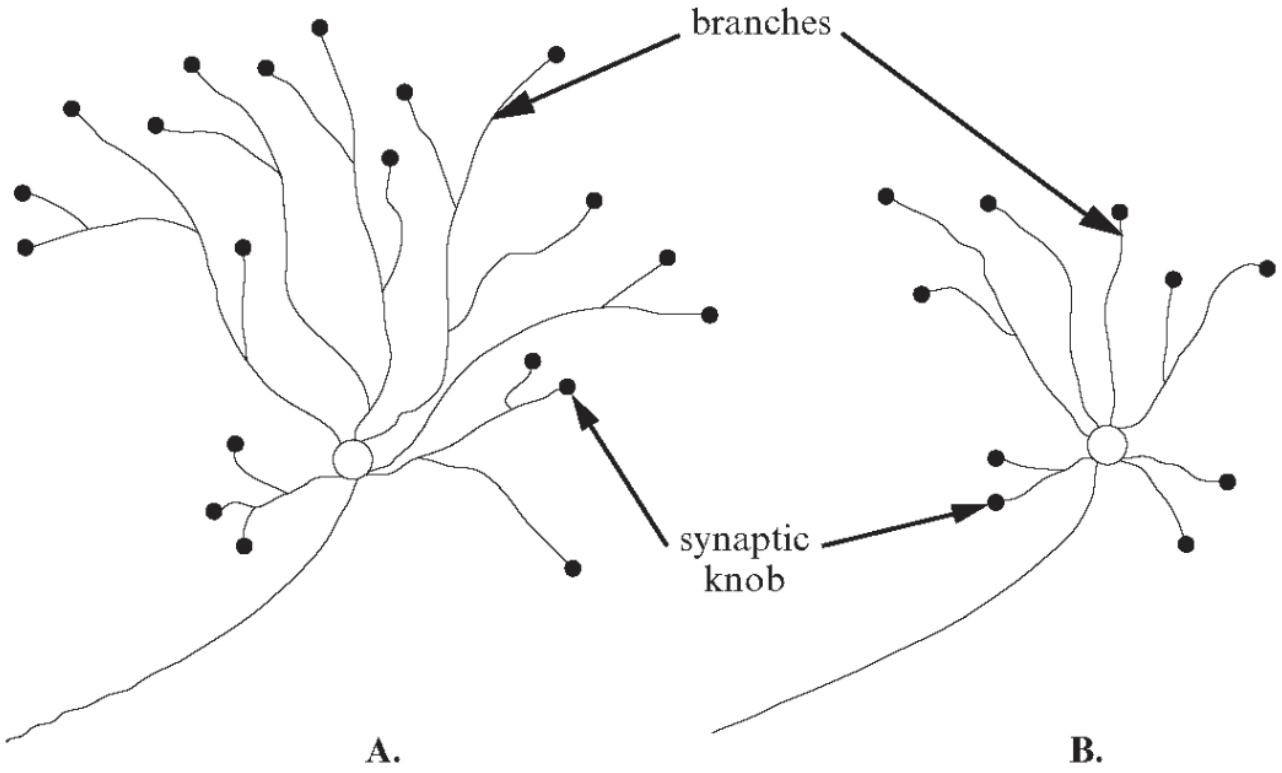
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The diagram below shows neurones from the brains of a healthy 70 year old, **A**, and a 70 year old with Altzheimer's disease, **B**.



(ii) State **two** differences between the neurones shown in the diagram. [2]

1. .....

.....

2. .....

.....

(iii) Suggest how **one** of the differences could account for the reduction in acetylcholine in a patient with Altzheimer's disease. [1]

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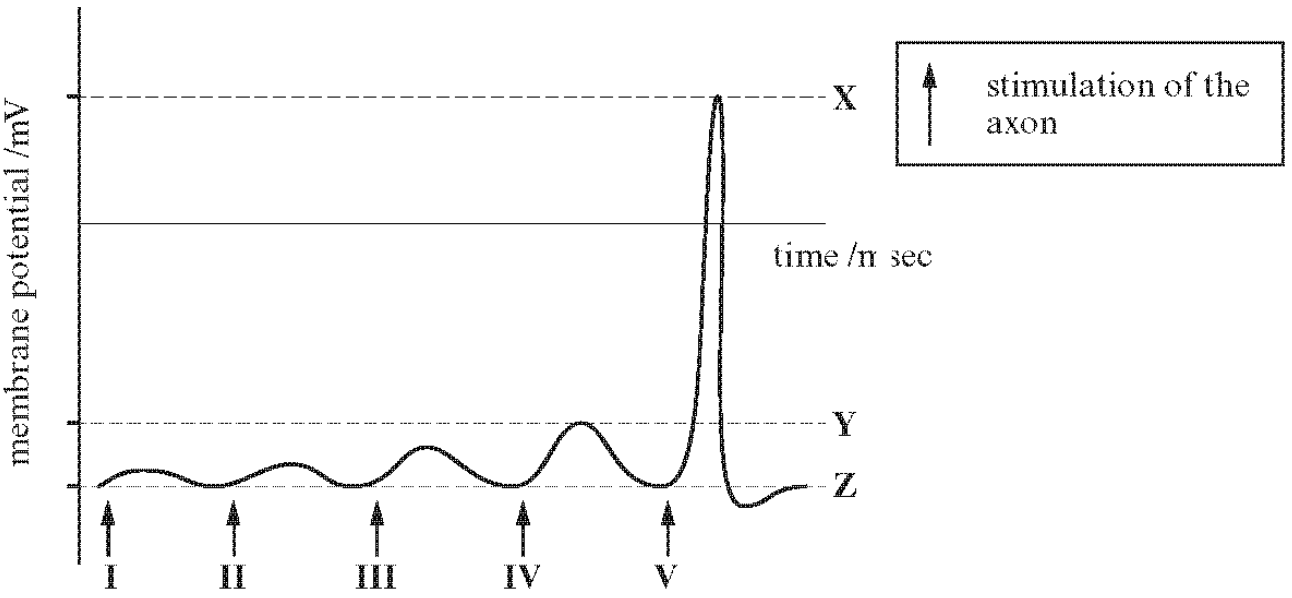
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(Total 17 marks)

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13. *(a)* The axon of a motor neurone was stimulated using an intracellular electrode. The strength of each stimulus was increased by the same amount each time and the potential difference across the cell membrane was monitored using an oscilloscope.

The results of the experiment are shown in the graph below.



(i) Suggest values for the membrane potential at: [1]

X ..... mV and Z ..... mV

(ii) Generation of an action potential involves ion-channels.

Explain how opening and closing of ion channels results in the depolarisation and repolarisation of the axon membrane shown at point **V** on the graph.

I. Depolarisation; [2]

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II. Repolarisation. [2]

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(iii) Explain why an action potential was not generated by stimuli **I** to **IV**. [2]

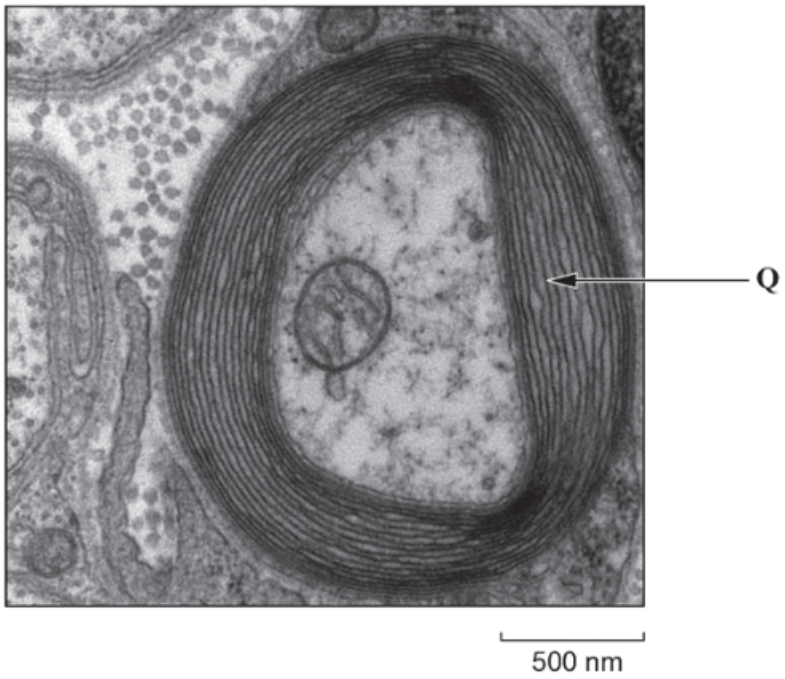
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(b) The transmission electron micrograph below shows a cross section of the axon of a motor neurone.



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(i) Name the substance you would expect to find at **Q** shown on the diagram above. [1]

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(ii) Name the cell that produces this substance. [1]

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(iii) Explain how the substance secreted by these cells and their arrangement along the neurone affect the speed of transmission of a nerve impulse. [4]

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1.	Question		Marking details	Marks Available
1	(a)	(i)	**Both X and Y correct for one mark** X White matter Y Grey matter; Explanation: Grey matter contains the (darkly staining) cell bodies/nuclei of neurones whilst the white matter is mainly {axons/myelin};	**1 for both** 1
		(ii)	L Dorsal Root ganglion; Z Central canal;	2
	(b)	(i)	Schwann cell; Myelin/ phospholipid; NOT lipid	2
		(ii)	Insulates the axon; Allows saltatory conduction/ impulse jumps from node to node; So speeding up the transmission of the action potential/ increase speed of conduction;	Max 2
		(iii)	Impulses cannot jump node to node/ saltatory conduction is stopped/ local circuits {too short/insufficient}/ {Few/no} voltage gated Na+ channels (between Nodes of Ranvier); So action potential cannot be generated/ speed of conduction is reduced/ action potential does not reach destination;	2
		(iv)	Remyelinate the axon/use of stem cells/make the membrane add Na^+ channels in bare areas/prevent further demyelination/ immune {suppressants/ inhibitory} drugs; Accept physiotherapy	1
	(c)	(i)	Nerve net drawn	1
		(ii)	Respond to a limited number of stimuli; Cannot detect source of stimulus/ impulses pass in all directions; Number of effectors is small; No CNS; Accept no brain Action potential can be carried in more than one direction along a neurone; Only one type of cell/ unmyelinated/ facilitation - qualified/ slower response;	Max 2
			Question 1 Total	**[14]**

2.

Question		Marking details	Marks Available
2	*(a)*	Any three from	max 3
		Sodium/ potassium pumps;	
		ATP / active transport;	
		3 Na^+ out 2 K^+ in;	
		Organic anions, -ve charged molecules/proteins;	
		Pd across membrane -60mV / -70mv;	
		Membrane leakage, more permeable to K^+ than Na^+;	
	(b)	A. Threshold reached;	max 5
		Sodium voltage gated channels open;	
		Sodium ions diffuse into {cytoplasm/ cell};	
		Depolarised;	
		B. Sodium voltage gated channels close;	
		Potassium voltage gated channels open;	
		Potassium diffuses out;	
		Ref. to Sodium/potassium pumps;	
		Repolarised;	
		Max 3 for A or B.	
	(c)	Any three from	max 3
		Myelin sheath electrical insulation;	
		Ion exchange only at nodes of Ranvier/ depolarisation only at nodes;	
		Action potential jumps from one node of Ranvier to next;	
		Saltatory conduction;	
		If no myelin sheath local circuits;	
		Saltatory conduction much faster than local circuits;	
	(d)	Increase:	max 2
		Mimic action of normal transmitters / bind to receptors;	
		Prevent breakdown of transmitter;	
		Stimulate release of transmitters;	
		Reduce threshold for excitation of post synaptic membranes;	
		Accept; more calcium ions diffuse in	
		Decrease:	max 2
		Block receptors on post synaptic membrane;	
		Prevent Ca^{2+} being released;	
		Prevents exocytosis;	
		Prevents recycling of neurotransmitter/ active transport back across presynaptic membrane;	
		Raises threshold;	
		changes shape of neurotransmitter;	
		Question 2 Total	**[15]**

3.

Question			Marking details	Marks Available
3	*(a)*		X is the node of Ranvier; Y is axon /axoplasm;	2
	(b)		Schwann (cell);	1
	(c)		-60mV;	1
	(d)	(i)	(voltage-gated) sodium channels open/ increase in sodium ion permeability; {sodium ions / Na^+} {diffuse/ flood/ rush/ sudden influx} in;	2
		(ii)	repolarisation;	1
	(e)		resting potential is lower / more negative in {B/ the cardiac muscle fibre}/ ORA; slower repolarisation / time taken to get back to resting potential is longer in {B/ the cardiac muscle fibre}/ ORA; higher peak of depolarisation /more positive potential reached in {A/ neurone}/ ORA; {no hyperpolarisation/ refractory period/ undershoot} in Trace B;	2 max
	(f)		contraction; NOT contract faster	1
	(g)		Frog has right to life / {suffering/ pain/ distress/ harm} of frog / frogs scarce in the wild; NOT cruel benefits to medicine/ health of heart research;	2
			Question 3 Total	**[12]**

4.

Question			Marking details	Marks Available
3	*(a)*		milliVolts/mV; NOT microvolts milliseconds/msec/ ms;	2
	(b)		A Resting potential; B Depolarisation C Repolarisation; D Hyperpolarisation/ refractory ;	4
	(c)	(i)	Threshold (potential);	1
		(ii)	Failed to reach threshold potential; All or nothing response; -55; So (too few) sodium gates opened/not enough depolarisation;	max 2
			Question 3 Total	**[9]**

5.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		Labelled Motor Neurone on ventral side and labelled sensory neurone on dorsal side (1) Labelled Cell body of sensory nerve in ganglion (1) Labelled cell Body of motor nerve in grey matter (1)	3			3		
		(ii)		Protective/prevents {damage/injury/harm} NOT defence mechanism	1			1		
	(b)	(i)		Nerve net	1			1		
		(ii)		Impulse must pass along whole length of {neurone/membrane/axon} (1) Mammals have {myelin/nodes} which cause {saltatory conduction/or description of} (1) ORA for non myelinated		2		2		
				Question 5 total	**5**	**2**	**0**	**7**	**0**	**0**

6.

Question			Marking details	Marks Available
6	(a)		Any **5** from: 1. Acetylcholine is normally hydrolysed / broken down by Acetyl Cholinesterase; 2. Organophosphates prevent the breakdown of acetylcholine; 3. So Acetylcholine remains bound to receptors on post-synaptic membrane; 4. So {synaptic transmission / action potentials} continue to be generated; 5. Sustained contraction of muscle; 6. Uncontrolled contractions of {diaphragm / intercostal muscles} interferes with breathing / OWTTE;	5
	(b)		Any **4** from: 1. Some drugs prevent {synthesis / resynthesis} of neurotransmitter; 2. Blocking of {calcium ions / Ca^{2+}} uptake; 3. Some drugs inhibit {release / exocytosis} of neurotransmitters; 4. Some drugs block receptors in post-synaptic membrane preventing neurotransmitters binding to them; 5. Sodium ion channels change shape; 6. Faster reabsorption of neurotransmitter; 7. Hyperpolarisation of post-synaptic membrane; 8. Named example: Valium / Temazepam / benzodiazepines / beta-blockers / cannabis / alcohol;	4
			Question 6 Total	**[9]**

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7.

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		**Both answers correct for 1 mark:** I A and B II A, C and D	1			1		
		(ii)		hamstring has more synapses/ ORA (1) hamstring has more neurones/ ORA(1) Accept use of data if comparative/ or descriptions of neurones involved in both reflex arcs		2		2		
	(b)			A. Sodium ion (gated) channels open (1) B. Sodium ions {rush in/influx} (1) NOT into membrane C. Threshold {reached/exceeded} (1) D. Charge changes to become positive inside axon and negative outside axon/ correct references to suitable values (-70 and + 40 mV) (with units)/ depolarisation (1) MPs A and B in context of ions (does not need to appear in both)	4			4		
	(c)	(i)		**Any two (x1) from:** testing (significance_of) differences between {means/ sets of {continuous / normally distributed/ interval }}data(1) Chi squared used to test significance of differences in {discontinuous / nominal} data /can calculate expected value (1) T test there are no expected values/ chi squared has expected values (1)		2		2	2	
		(ii)		A. Critical value is 2.10 (1) NOT circled in table alone B. because t value is greater than critical value (at p=0.05)(1) C. reject null hypothesis (1) D. {results/ means } are significantly different(1) ECF MP b,c,d if incorrect critical value chosen			4	4	4	
				Question 7 total	**5**	**4**	**4**	**13**	**6**	**0**

8.

Question			Marking details	Marks Available
8	*(a)*		circle on diagram at +40; Action potential membrane depolarised / inside becomes +ve;	2
	(b)		Synaptic vesicles only on presynaptic membrane side of synapse; Refractory period / hyperpolarisation;	2
	(c)	(i)	**Z** = *Schwann cell* ; X = Axon / axoplasm; **Y** = myelin sheath / coiled membrane of Schwann cell;	3
		(ii)	Slow down; saltatory conduction would not take place / local circuit shortened;	2
	(d)	(i)	Any **3** from: Curare has a complementary shape binds to receptors on post synaptic membrane; prevents transmitter substance / acetylcholine binding; *post synaptic membrane* not depolarised / Na+ ions do not move in / Na+ gated channels remain closed / no action potential;	3
		(ii)	Different transmitter used to trigger contraction in heart / adrenalin used / heart is myogenic / AVP;	1
			Question 8 Total	**[13]**

9.

Question			Marking details	Marks Available
9				[4]

Statement	*True*	*False*
Motor neurones have only a single dendrite.		✓
Motor neurones have many axons.		✓
Dendrites receive and integrate impulses.	✓	
Dendrites of motor neurones are rarely myelinated.	✓	

Question 9 total **[4]**

10.

(a) (rapid) reaction/ response to a stimulus; **[1]**
automatic / involuntary / not under conscious control /
brain not involved (not: cannot be controlled / automated without thinking) **[1]**

(b) A – motor;
B – relay / intermediate / connector;
C – sensory
(all three) **[1]**

(c) (i) X – myelin sheath / Schwann cell

Y – node of Ranvier **[2]**

(d) (i) Na+ or sodium ions are actively removed / pumped out /
faster than K^+ ions are moved in; **[1]**

K^+ or potassium ions diffuse out more rapidly than Na^+ /
membrane has a higher permeability to K^+ than Na^+. **[1]**

or Na / K pumps $3Na^+$ out and $2K^+$ in = 2 marks
(Ref. to ions needed at least once;1 mark if no number)

(ii) Sudden change /increase in the permeability of the membrane to Na^+/
sodium gates / channels open;
sodium ions diffuse in or ref. concentration gradient
(not: move in) **[2]**

(e) (i) As the axon diameter increases the speed of conduction increases
(ref. linear/proportional needs direction allow: positive correlation) **[1]**

(ii) Speed of transmission (of the action potential) depends on **[1]**
resistance (of axoplasm)
(This resistance is related to the diameter of the axon). The greater /
larger the diameter of the axon the less the resistance. **[1]**

Or increased diameter means increased surface area (of axon)
over which exchange of ions can take place.

(iii) ATP is required for active transport / ref Na/ K pumps;
Na^+ ions (actively) moved out only at nodes in myelinated;
Na^+ ions (actively) moved out along whole length of
axon in non-myelinated. (Any 2) **[2]**

[Total 14 marks]

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11.	(a)	sensory neurone from finger tip, cell body in root ganglion;	1
		relay neurone in grey matter;	1
		motor neurone same side of arc through ventral root to muscle.	1
	(b)	sensitivity of nerve membrane lost during depolarisation/refractory period; in synapses transmitter substances diffuse from knob to post synaptic membrane	1 1
	(c) (i)	general shape of spike including overshoot dip. accurate values -70 to +40 or +50 mV (width c.3ms) (allow: 68-80 + 30-60)	2
	(ii)	correct labelling of depolarisation on upward and repolarisation on downward side of graph	1
	(d) (i)	I proteins	1
		II phospholipids	1
	(ii)	Ref. to pumps e.g. resting potential – Na+/K+ pump pumps Na+ out and K+ in; Ref. why difference between two sides e.g. organic anions inside create pd/K+ channels open; less permeable to Na+ (not: ref. concentration gradient)	1 1
		depolarisation - impulse opens Na+ channel/voltage gated channel; Na ions rush in/sudden increase in permeability to Na+	1 1
	(e)	transmitter substances synthesised in synaptic knob; impulse causes secretory vesicle to migrate to (presynaptic) membrane/Ca ions to rush in; vesicle fuses with membrane discharges transmitter substance/exocytosis; diffusion of transmitter substance across cleft; transmitter binds to post-synaptic membrane/stimulates depolarisation/reference to receptors. (Any 3 in correct sequence; no mention of transmitter substance=2 max)	3

12. (a) (rapid) response to a stimulus;

automatic / involuntary / not under conscious control /

brain not involved. [2]

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(b) A – motor;

B – relay / intermediate / connector;

C – sensory. (all three) [1]

(c) (i) X – myelin sheath

Y – node of Ranvier [2]

(d) (i) Na+ or sodium ions are actively removed / pumped out / faster than K^+ ions are moved in;

K^+ or potassium ions diffuse out more rapidly than Na^+ / membrane has a higher permeability to K^+ than Na^+.

Na / K pump pumps $3Na^+$ out and $2K^+$ in = 2 marks

(1 mark if no number)

(ii) Sudden increase in the permeability of the membrane to Na^+ / sodium channels open; sodium diffuses in. [2]

(e) (i) acts as a neurotransmitter / transmits impulse across synapse;

synaptic vesicles fuse with pre-synaptic membrane;

released acetylcholine diffuses across synaptic cleft;

attaches to receptor site on post-synaptic membrane;

sodium channels open and Na^+ diffuse in;

membrane is depolarised;

action potential is generated. (any 5 points) [5]

(ii) fewer branches in Altzhiemer's patient / B;

shorter branches in Altzheimer's patient / B;

fewer synaptic knobs in Altzheimer's patient / B; [2]

(iii) fewer knobs less enzyme (less acetylcholine synthesised) [1]

[Total 17 marks]

13.	Question		Marking details	Marks Available
	13 *(a)*	(i)	**A** + 40mV **C** - 70mV [both needed for 1 mark] (accept suitable alternatives eg., -60 / + 30)	1
		(ii)	**depolarisation** Sodium / Na^+ (ion) channels open; Na^+ {flood / diffuse rapidly} into axon; (pd) inside axon becomes {positive/ +40}; **repolarisation** Na^+ (ion) channels close and K^+(ion) channels open; K^+ {flood / diffuse rapidly} out of axon ; Must infer sudden movement out (pd) inside axon becomes {negative/ returns to-70};	max 2 max 2
		(iii)	threshold potential not reached / all sub-threshold stimuli; stimulus / depolarisation not enough to open Na^+ (ion) channels; ref. to action potential being 'All or Nothing';	max 2
	(b)	(i)	Myelin; Accept phosphopilid	1
		(ii)	Schwann cell;	1
		(iii)	Accept annotation on diagram myelin inhibits{loss of charge/ movement of ions} (from axon) / insulates (axon)/ prevemts depolarisation; {gaps/ spaces} (between Schwann cells) called nodes of Ranvier; no myelin present in {nodes/ gaps/ spaces}; depolarisation only possible at Nodes of Ranvier / action potential can only form {at the nodes/ where there is no myelin}/ channels can only {open/close} in the nodes; action potential jumps from one node to the next / saltatory conduction/ lengthens local circuits/ OWTTE; nerve impulse transmission faster;	max 4

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