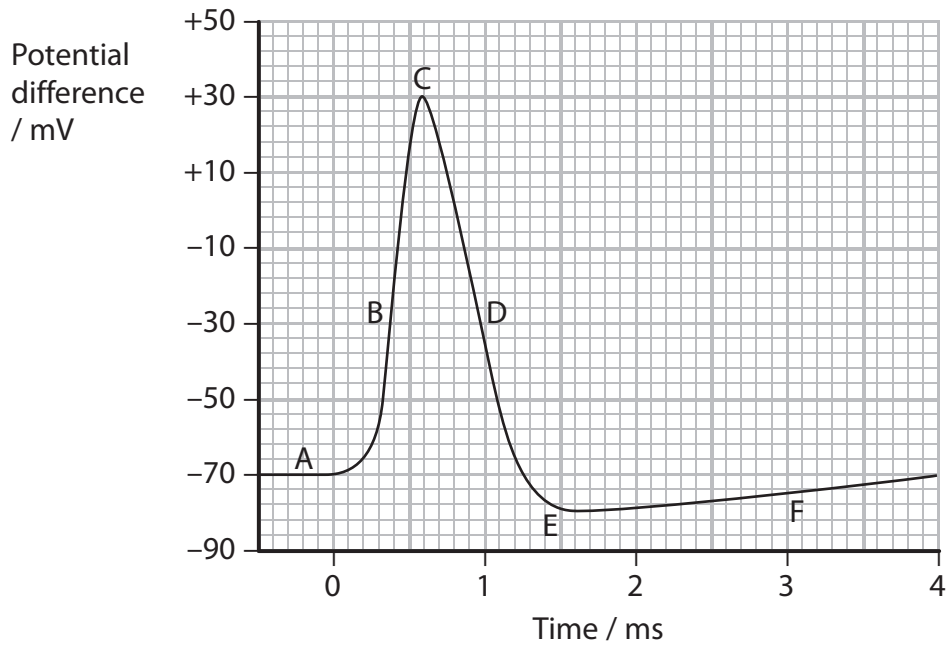


- 1 (a) The graph below shows the changes in potential difference across the membrane of a neurone after stimulation.



- (i) Using the information in the graph, state the maximum change in potential difference across the membrane of this neurone during depolarisation.

(1)

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- (ii) The table below describes three of the stages shown in the graph.

Place a cross in the box (☒) below the letter that correctly links the description to one of the labels on the graph above.

(3)

Description	A	B	C	D	E	F
Stage when the concentration of positive ions is greatest inside the axon	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Stage when hyperpolarisation first occurs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Stage showing the resting potential	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

*(b) When a nerve impulse reaches a synapse, calcium ions enter the neurone through the pre-synaptic membrane. This causes a neurotransmitter, such as acetylcholine, to be released.

Describe and explain the sequence of events that occurs at the synapse, after a neurotransmitter has been released.

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(Total for Question 1 = 9 marks)

2 L-Dopa can be used to treat people with Parkinson's disease. Using L-Dopa for a long period of time can have side effects that include uncontrolled movement of limbs.

It is possible that increasing the levels of serotonin in the brain could be an effective treatment for these side effects. It has been suggested that MDMA (ecstasy) could be used to increase levels of serotonin.

(a) Explain why L-Dopa is used to treat people with Parkinson's disease.

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(b) Explain how MDMA could affect levels of serotonin in the brain.

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(c) In trials of this treatment, marmosets (small monkeys) were given a drug to reduce dopamine production. They were then treated with L-Dopa until they showed the side effects observed in the treatment of people with Parkinson's disease.

(i) Suggest a reason why the marmosets were treated with a drug to reduce dopamine production.

(1)

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(ii) Describe the ethical issues involved in the use of animals in a trial of this kind.

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(d) The results of the study showed that MDMA did reduce the side effects in the marmosets.

Describe the steps that would need to be taken before a similar treatment could be used in humans.

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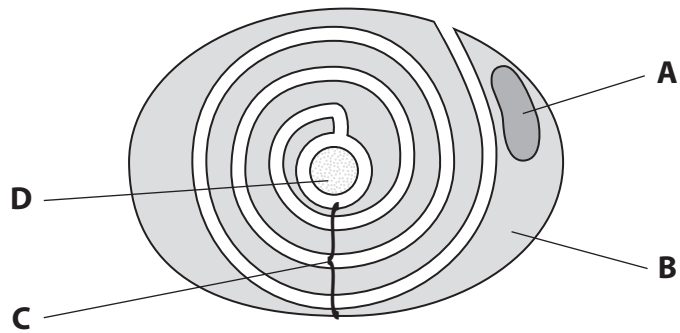
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(Total for Question 2 = 12 marks)

3 The diagram below shows a section through a motor neurone.



(a) Identify structures A, B, C and D by placing a cross ☒ in the correct box in the table below.

(4)

Structure	A	B	C	D
Axon	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cytoplasm of Schwann cell	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Myelin sheath	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Nucleus of Schwann cell	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

(b) Describe the role of the structure labelled **C** in the conduction of nerve impulses.

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(c) Explain how the structure of the axon cell membrane is related to the conduction of nerve impulses.

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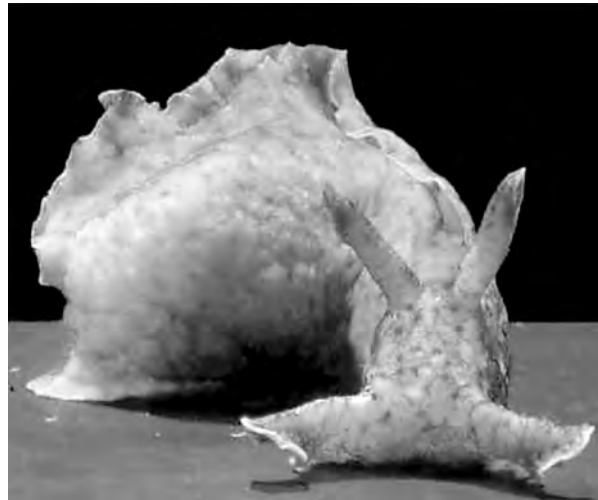
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(Total for Question 3 = 11 marks)

- 4 In some organisms, the nervous response to a stimulus can reduce as a result of repetition. This is known as habituation.

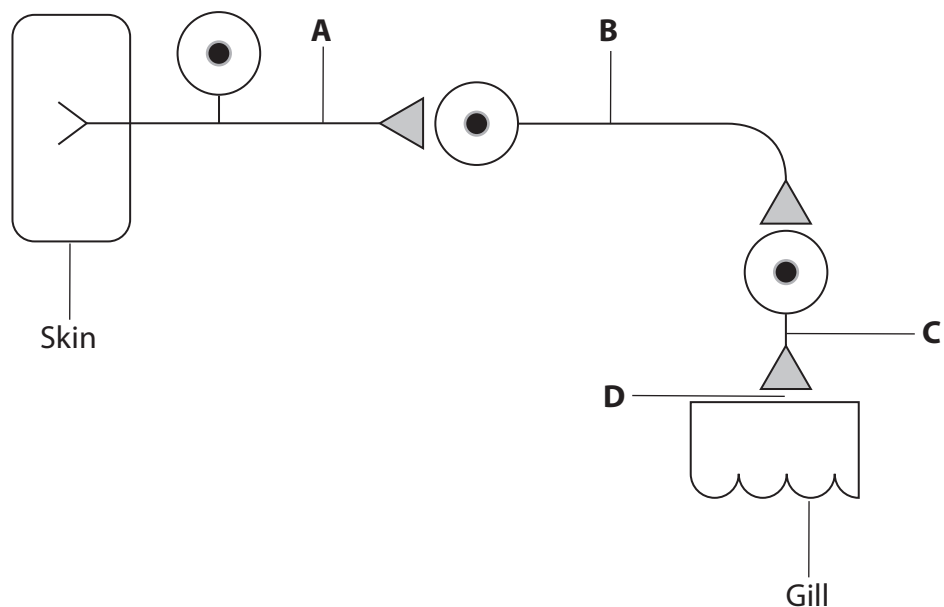
Sea slugs are marine animals which have gills for the uptake of oxygen from seawater.



Sea slug
Magnification $\times 1$

A sea slug withdraws its gill when its skin is touched. After some time, the gill is exposed again. With repeated touches, the time taken for it to expose the gill decreases. When the skin is touched frequently, the gill is not withdrawn.

The diagram below shows some of the neurones (nerve cells) involved in this response.



(a) Place a cross ☒ in the correct box in the table below to identify where structures **A**, **B**, **C** and **D**, listed in the table, are shown on the diagram.

(3)

Structure	A	B	C	D
Motor neurone	☒	☒	☒	☒
Sensory neurone	☒	☒	☒	☒
Synapse	☒	☒	☒	☒

(b) (i) Suggest how a repeated stimulus could result in less response from the gill.

(3)

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(ii) Suggest how this habituation may be of benefit to a sea slug.

(2)

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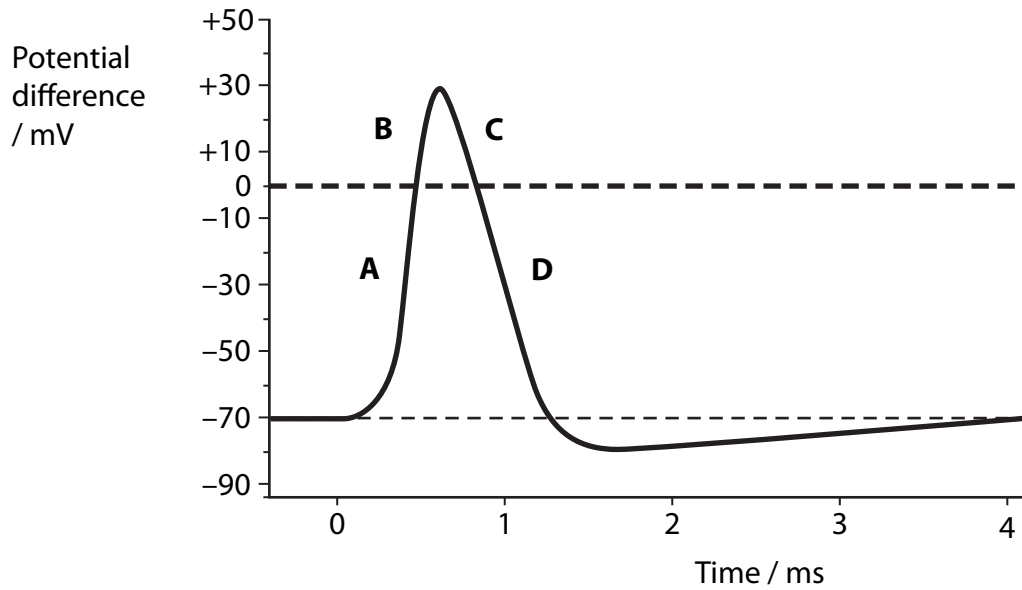
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(Total for Question 4 = 8 marks)

5 The diagram below shows changes in potential difference across the membrane of a neurone during an action potential.



(a) Describe the events that begin the depolarisation of the membrane of a neurone.

(2)

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(b) Complete the table below to show which ions are able to move across the membrane at positions **A** and **D** shown in the diagram.

Put a cross in the box if the membrane is permeable to the ion.

(2)

Position on diagram	Permeable to sodium ions	Permeable to potassium ions
A	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
D	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

(c) Give an explanation for the movement of ions at position **C** on the diagram.

(3)

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(d) Explain how the potential difference across the membrane is returned to the resting level in the time between 1.5 ms and 4.0 ms on the diagram.

(3)

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(Total for Question 5 = 10 marks)