PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 9: CONTROL SYSTEMS

NERVOUS TRANSMISSION

SCORE	PERCENTAGE
/148	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions and mark schemes in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question or mark scheme material in this pack. Pearson has not endorsed, approved or been involved in the production of it. Pearson, Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

Pearson publishes its past papers and mark schemes free of charge. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

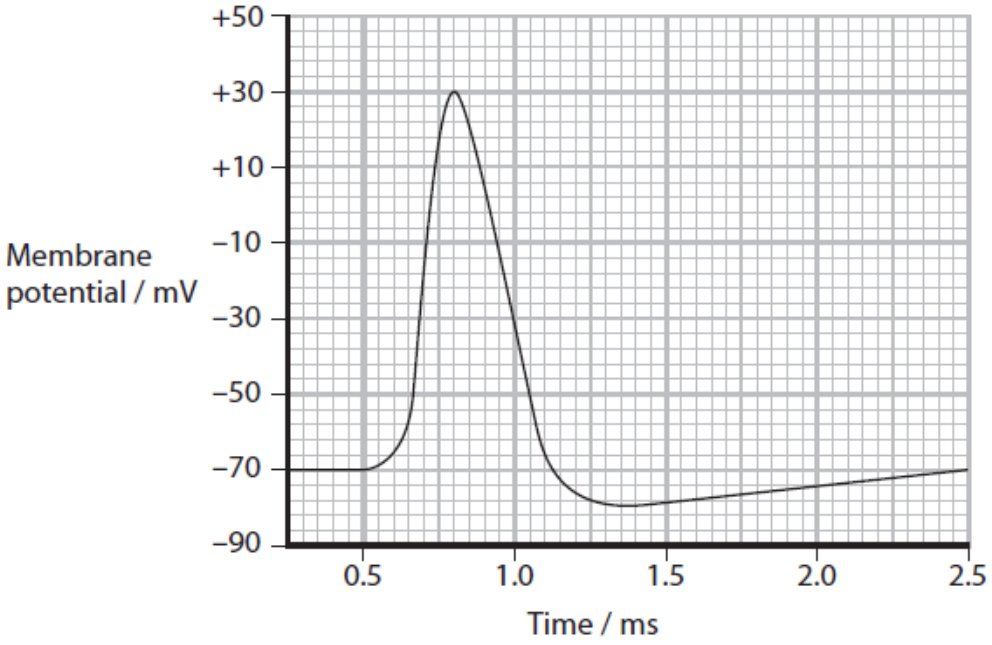
If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The speed of a nerve impulse along a neurone depends on the diameter and the presence or absence of myelin.

The graph shows an action potential in a neurone.



When are voltage-gated sodium channels open?

(1)

☒ **A** 0.25 ms

☒ **B** 0.75 ms

☒ **C** 1.00 ms

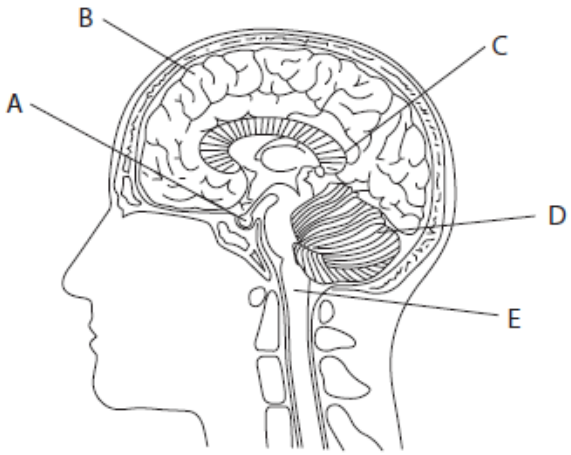
☒ **D** 1.25 ms

(Total for question = 1 mark)

Q2.

The human brain controls many functions.

The diagram shows a section through a human brain with parts labelled A to E.



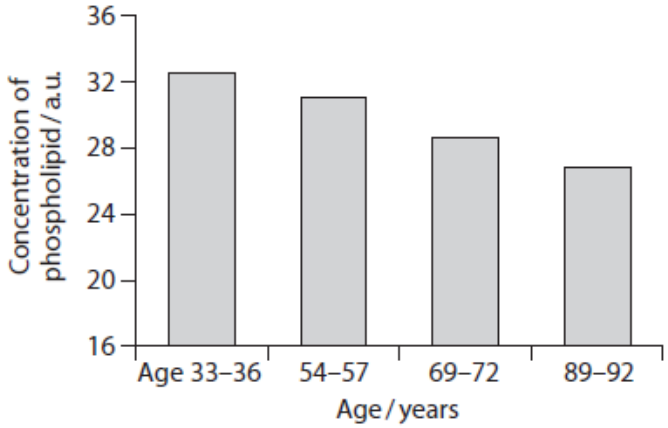
The human brain consists of 100 billion neurones.

The function of these neurones is affected by many factors.

The concentration of phospholipid in neurones from one part of the brain was measured.

This was carried out in people from different age ranges.

The graph shows the results.



Explain how age might affect the structure of a neurone and the speed of transmission of an impulse.

(3)

.....

.....

.....

.....

.....

.....

.....

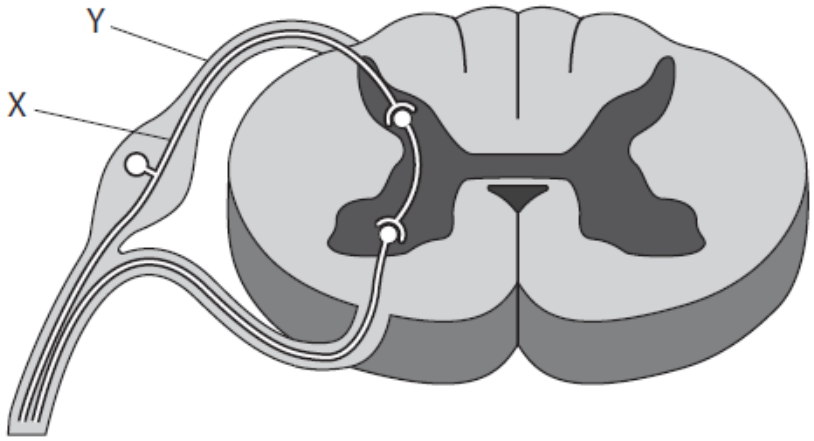
.....

(Total for question = 3 marks)

Q3.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(i) The diagram shows a section through the spinal cord.



Which row correctly names the structures labelled X and Y?

(1)

	X	Y
☒ **A**	motor neurone	dorsal root
☒ **B**	motor neurone	ventral root
☒ **C**	sensory neurone	dorsal root
☒ **D**	sensory neurone	ventral root

(ii) Which region of the brain only controls breathing and heart rate?

(1)

☒ **A** cerebellum

☒ **B** cerebrum

☒ **C** hypothalamus

☒ **D** medulla oblongata

(Total for question = 2 marks)

Q4.

The photograph shows a blue-ringed octopus.

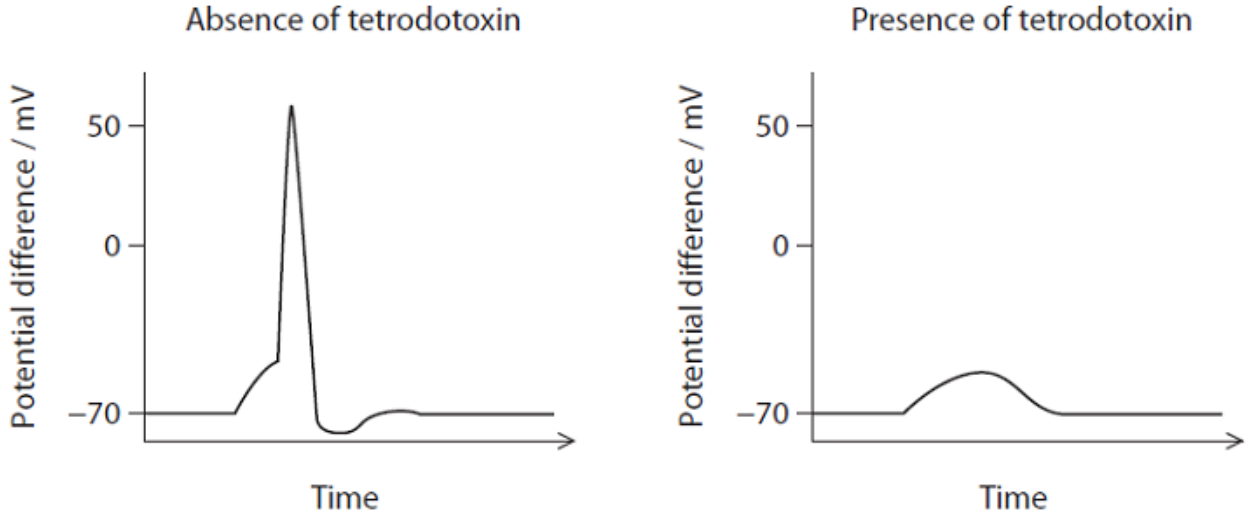


This octopus produces tetrodotoxin that it uses to paralyse its prey.

The effects of tetrodotoxin on a neurone were investigated.

A neurone was stimulated in the absence of and in the presence of tetrodotoxin.

The graphs show the results of this investigation.



Comment on how tetrodotoxin affects the potential difference of a neurone when the prey of the octopus is paralysed.

(4)

.....

.....

.....

.....

.....

.....

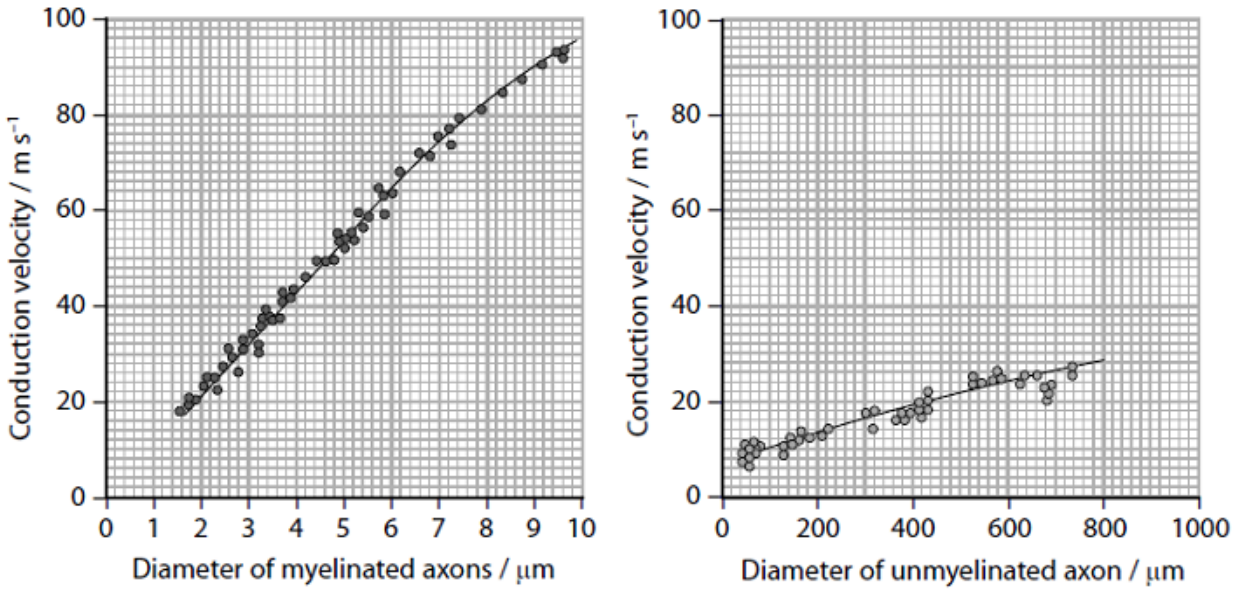
.....

.....

(Total for question = 4 marks)

Q5.

The graphs below show the conduction velocity and diameter of myelinated and unmyelinated axons.



(Source: http://blp6.atw.hu/BLP6/HTML/C0059780323045827.htm)

(i) Calculate the time it would take for a nerve impulse to travel 80 cm in a myelinated axon with a diameter of 7 μm.

(2)

Answer ..... s

*(ii) Analyse the data to explain the conduction velocity in the myelinated and the unmyelinated axons.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 8 marks)

Q6.

Voltage-gated K^+ and Na^+ channels are involved in the transmission of impulses in sensory and motor neurones.

Describe the differences in the structure of a myelinated sensory neurone and a myelinated motor neurone.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

Q7.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Acetylcholine is a neurotransmitter released by neurones in the autonomic nervous system.

(i) Which of the following substances bind to acetylcholine receptors?

(1)

1. cobra venom

2. nicotine

3. lidocaine

☒ **A** 1 and 2

☒ **B** 1 and 3

☒ **C** 1, 2 and 3

☒ **D** 2 and 3

(ii) Which row is correct for acetylcholine?

(1)

	Type of neurone that releases acetylcholine	Effect of acetylcholine
☒ **A**	parasympathetic neurone	increases heart rate
☒ **B**	parasympathetic neurone	decreases heart rate
☒ **C**	sympathetic neurone	increases heart rate
☒ **D**	sympathetic neurone	decreases heart rate

(iii) Describe the events that lead to the release of acetylcholine at a synapse.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

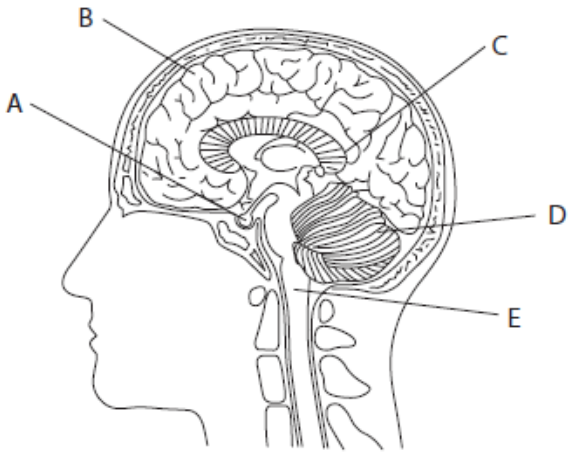
.....

(Total for question = 5 marks)

Q8.

The human brain controls many functions.

The diagram shows a section through a human brain with parts labelled A to E.



Poisons can also affect the function of neurones in the brain.

The photograph shows a pufferfish, a traditional food delicacy in Japan.



Pufferfish have to be carefully prepared by a chef to remove a poison called tetrodotoxin. This poison causes muscle paralysis.

Neurones were placed in a solution containing tetrodotoxin and in a control solution.

The neurones were stimulated and the potential difference across the axon membrane was measured.

The table shows the results.

Solution	Potential difference after stimulation / mV
tetrodotoxin	−70
control	+40

Analyse the data to explain the effect of tetrodotoxin on the neurone.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

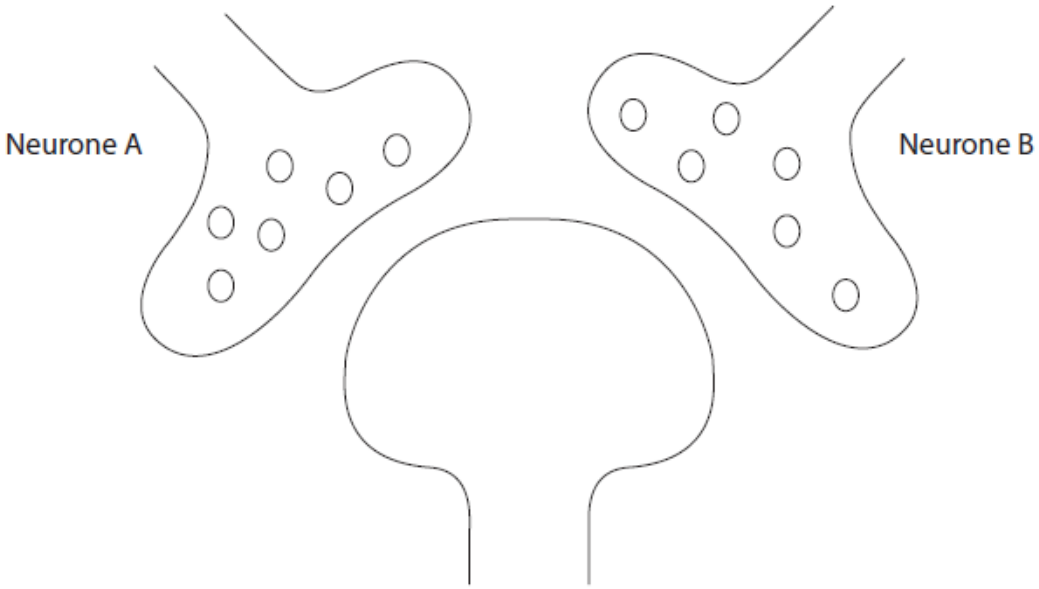
Q9.

The diagram shows the structure of a synaptic junction between three neurones.

Neurone A releases the excitatory neurotransmitter acetylcholine.

Neurone B releases the inhibitory neurotransmitter glutamate.

Glutamate causes chloride ions to move into the postsynaptic neurone.



(i) Describe the sequence of events that leads to an excitatory postsynaptic potential (EPSP) in the postsynaptic neurone after stimulation of neurone A.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Which of the following rows correctly describes the action of each substance on this postsynaptic neurone?

(1)

	Nicotine	Lidocaine	Cobra venom
☒ **A**	excitatory	excitatory	excitatory
☒ **B**	excitatory	inhibitory	inhibitory
☒ **C**	inhibitory	excitatory	excitatory
☒ **D**	inhibitory	inhibitory	inhibitory

(Total for question = 5 marks)

Q10.

Explain how the resting potential is maintained in a neurone.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q11.

Acetylcholine is a neurotransmitter produced by the parasympathetic nervous system.

Describe the process by which acetylcholine is released from a synapse.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

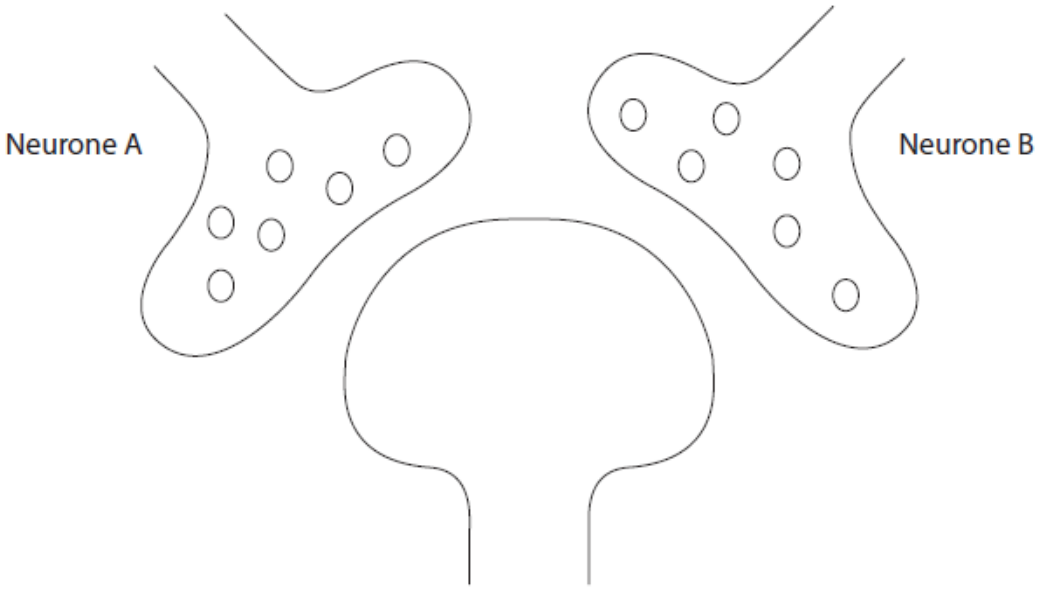
Q12.

The diagram shows the structure of a synaptic junction between three neurones.

Neurone A releases the excitatory neurotransmitter acetylcholine.

Neurone B releases the inhibitory neurotransmitter glutamate.

Glutamate causes chloride ions to move into the postsynaptic neurone.



A scientist investigated the effect of the intensity of stimulation of neurones A and B on the production of an action potential in the postsynaptic neurone.

High intensity stimulation of neurones A and B causes a high frequency of impulses to arrive at the presynaptic terminals.

The results are shown in the table.

Intensity of stimulation		Production of action potential in postsynaptic neurone
Neurone A	Neurone B	
low	low	no
low	high	no
high	low	yes
high	high	yes

Explain the effect of the intensity of stimulation on the production of an action potential in the postsynaptic neurone.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q13.

Scientists investigated the effect of stimulating an axon with different voltages and measured the response.

The table shows the results of this investigation.

Stimulus voltage / mV	Response
25	No action potential
35	No action potential
45	No action potential
55	Action potential
65	Action potential
75	Action potential

Analyse the data to describe the conclusions which can be drawn.

(2)

.....

.....

.....

.....

.....

.....

(Total for question = 2 marks)

Q14.

The brain is involved in many homeostatic mechanisms.

An action potential results from the depolarisation of the membrane of a neurone.

Which row of the table shows the correct state of the ion channels during this depolarisation?

(1)

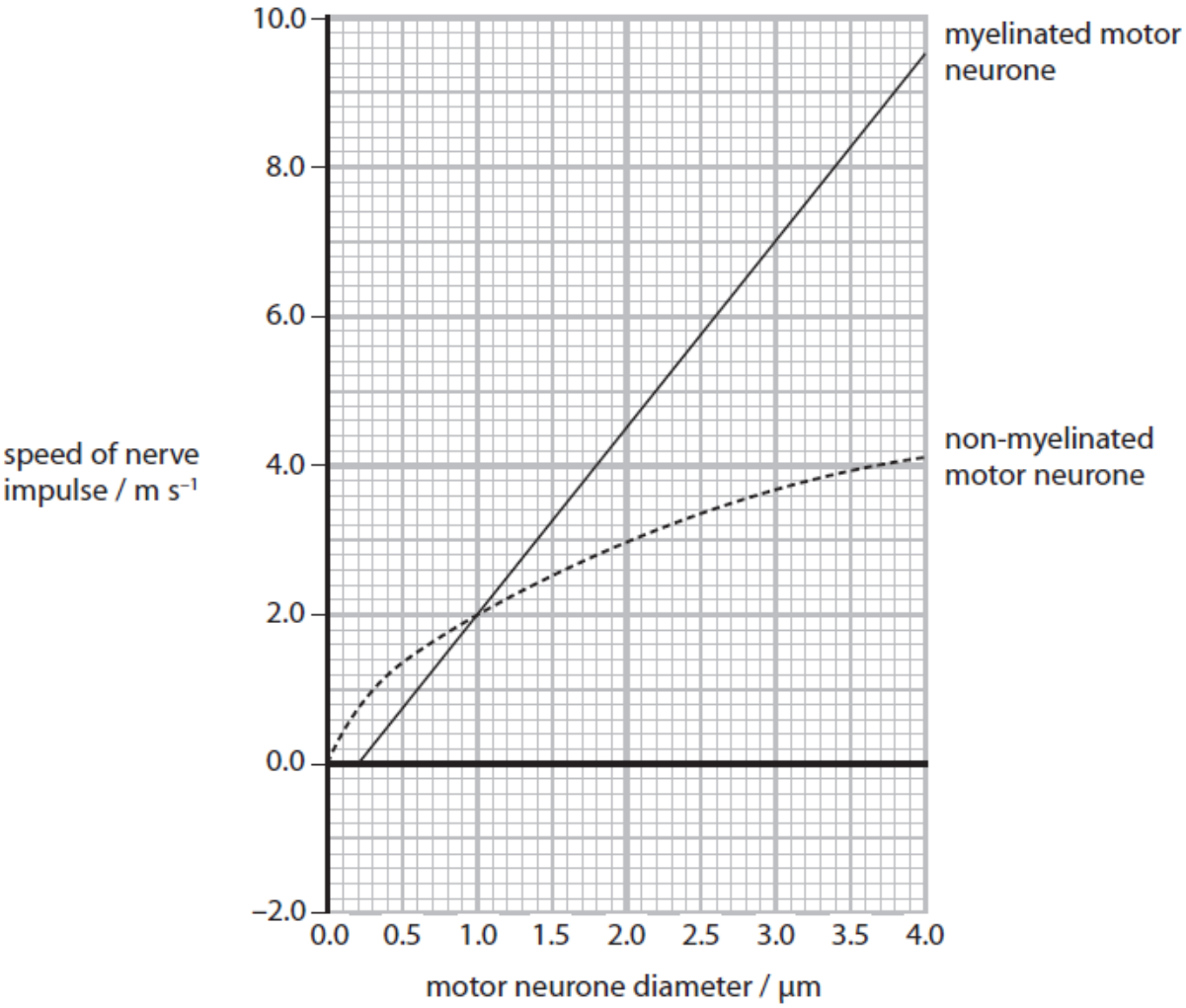
	Na^+ channels	K^+ channels
☒ **A**	closed	closed
☒ **B**	closed	open
☒ **C**	open	closed
☒ **D**	open	open

(Total for question = 1 mark)

Q15.

The speed of a nerve impulse along a neurone depends on the diameter and the presence or absence of myelin.

The graph shows the relationship between the diameter of the neurone and the speed of nerve impulses along myelinated and non-myelinated motor neurones.



(i) Compare and contrast the effect of diameter on the speed of an impulse in myelinated and non-myelinated motor neurones.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Determine the speed of a nerve impulse along a myelinated motor neurone with a diameter of 5 µm.

The equation for a linear relationship is $y = mx + c$

(3)

Answer .....

(iii) Multiple sclerosis (MS) is a disease that results in the loss of myelin around motor neurones.

Explain why the speed of nerve impulses along axons is slower in people with MS.

(3)

.....

.....

.....

.....

.....

.....

.....

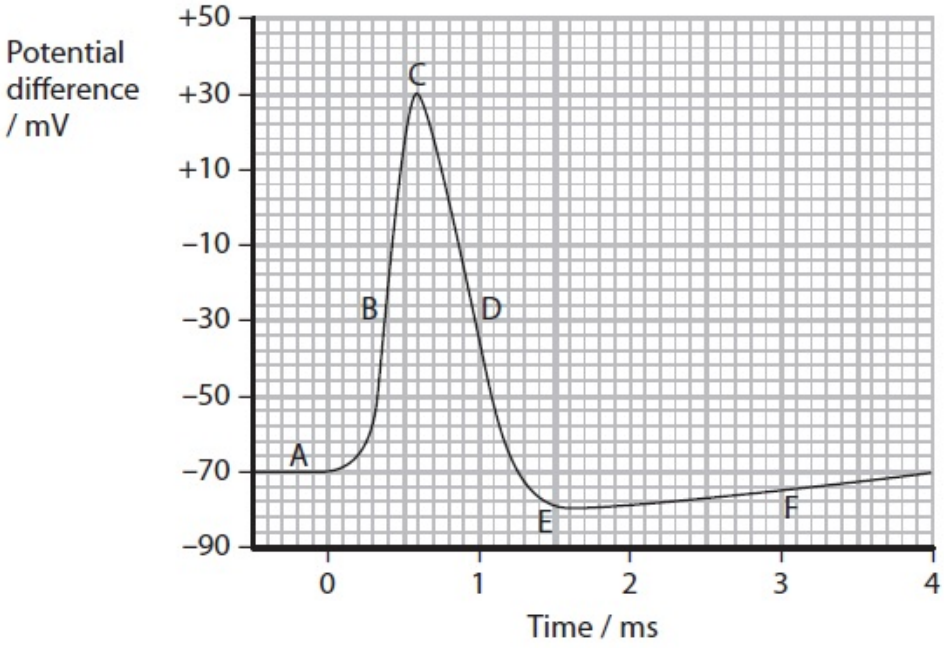
.....

.....

(Total for question = 10 marks)

Q16.

(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)

..... mV

(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	☐	☐	☐	☐	☐	☐
Stage when hyperpolarisation first occurs	☐	☐	☐	☐	☐	☐
Stage showing the resting potential	☐	☐	☐	☐	☐	☐

*(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.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 9 marks)

Q17.

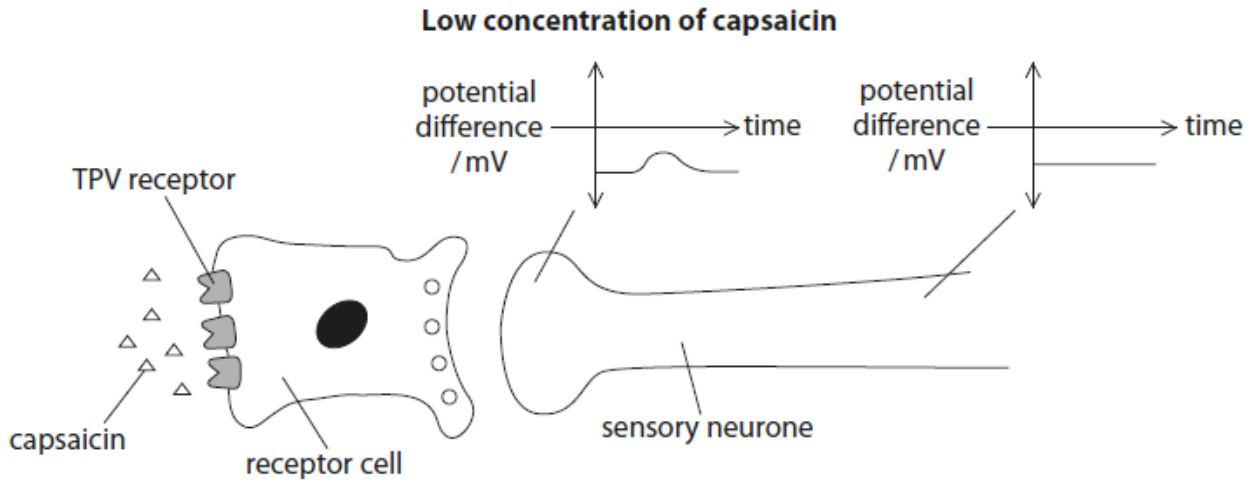
Acetylcholine is a neurotransmitter released by neurones in the autonomic nervous system.

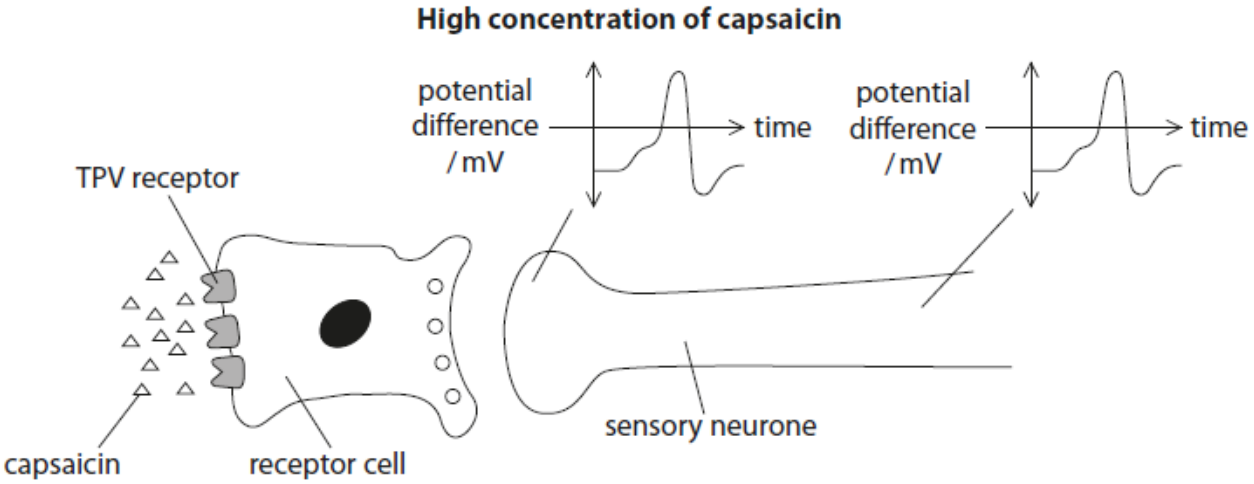
Capsaicin is a substance found in chilli plants that makes them taste 'hot.'

Capsaicin binds to temperature receptor proteins called TPV receptors. This stimulates impulses along sensory neurones that send impulses to the brain.

The effect of capsaicin on the depolarisation of the membrane of a sensory neurone was investigated. The potential difference across the membrane was measured at two places on the sensory neurone after adding capsaicin.

The results for a high concentration and a low concentration of capsaicin are shown in the diagram.





(i) Explain the effect of capsaicin on the depolarisation of the sensory neurone.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

*(ii) Capsaicin affects sweat production. It has been suggested that capsaicin could be used to lower the temperature of people with fevers.

The effect of three different doses of capsaicin on sweat production was investigated.

Five students took one 10 mg tablet of capsaicin each day, for one week.

The mass of sweat produced from a 10 cm^2 area of skin was measured one hour after taking each tablet of capsaicin.

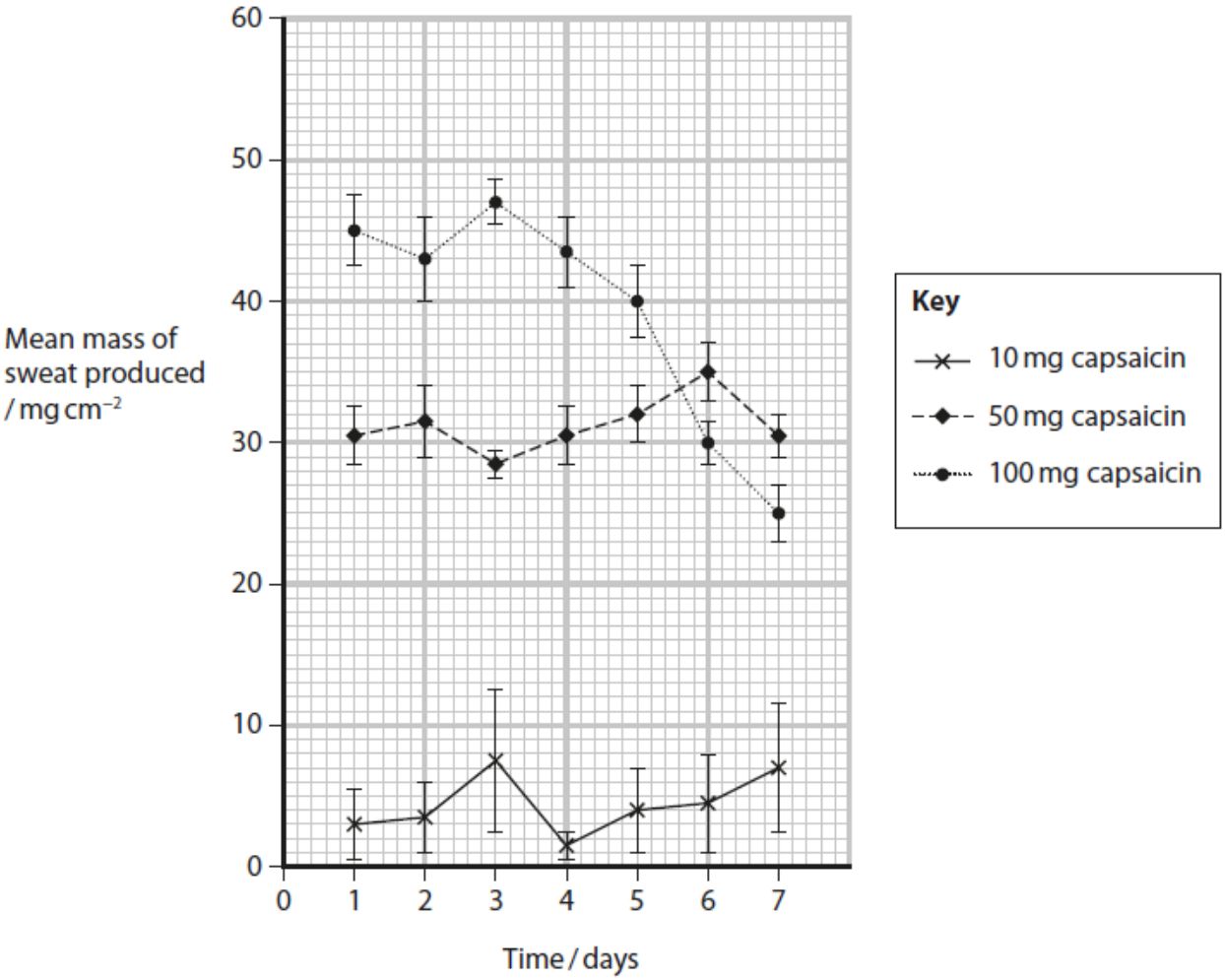
The mean mass of sweat per square centimetre of skin for the group of students was calculated for each day.

This was repeated with different groups of students taking 50 mg of capsaicin and taking 100 mg of capsaicin.

Most of the students who were given 100 mg of capsaicin reported a burning sensation and redness of the skin.

The results are shown in the graph.

Error bars represent standard deviations.



Analyse the data to discuss the use of capsaicin to lower the temperature of people with fevers.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

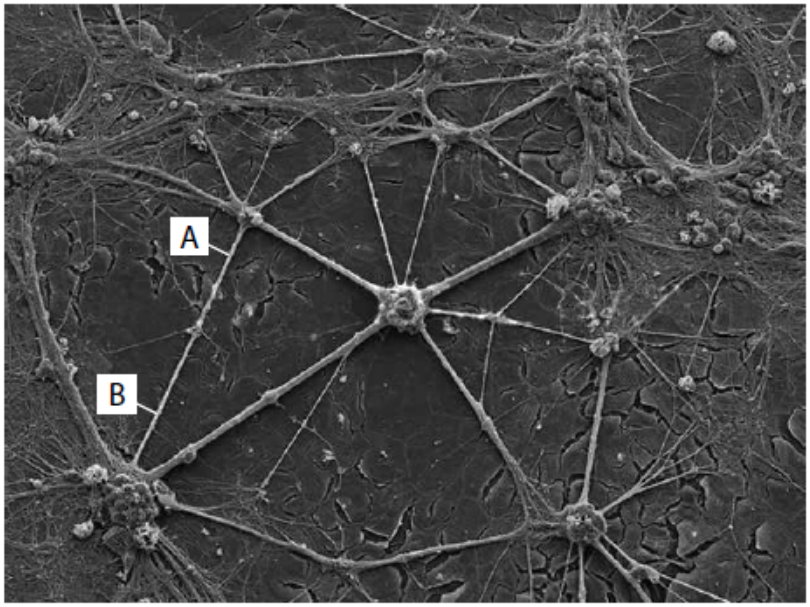
.....

.....

(Total for question = 9 marks)

Q18.

The photomicrograph below shows myelinated neurones.



© C016/7131 David Scharf/Science Photo Library

Magnification ×226

(a) The time taken for an impulse to travel between two electrodes placed at the points labelled **A** and **B** was measured as 0.02 milliseconds.

Calculate the speed of the impulse.

(3)

Answer ..... ms^{-1}

(b) The neurones of the retina are not usually myelinated. However in some eye conditions, myelination does occur.

Explain why the presence of myelinated neurones in the retina might mean that a clear image will not be formed.

(3)

.....

.....

.....

.....

.....

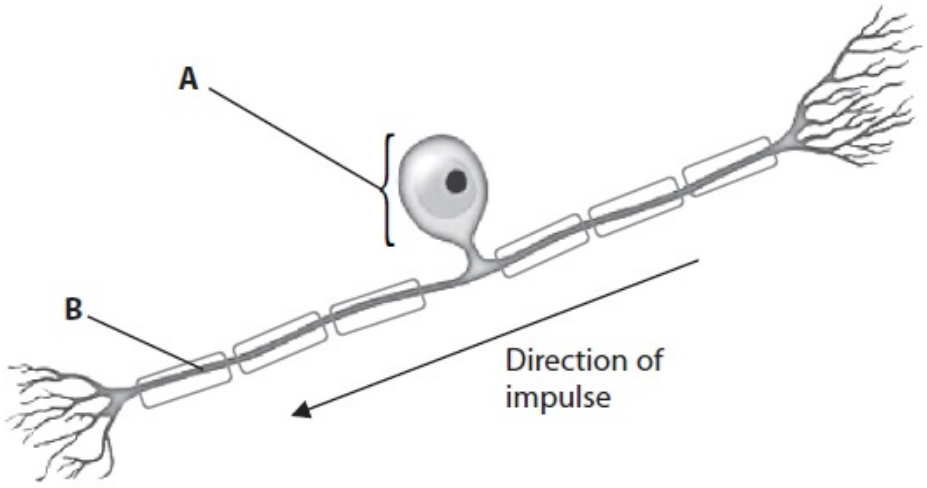
.....

.....

.....

(Total for question = 6 marks)

Q19. The diagram below shows a sensory neurone.



(a) Name the structures labelled **A** and **B**.

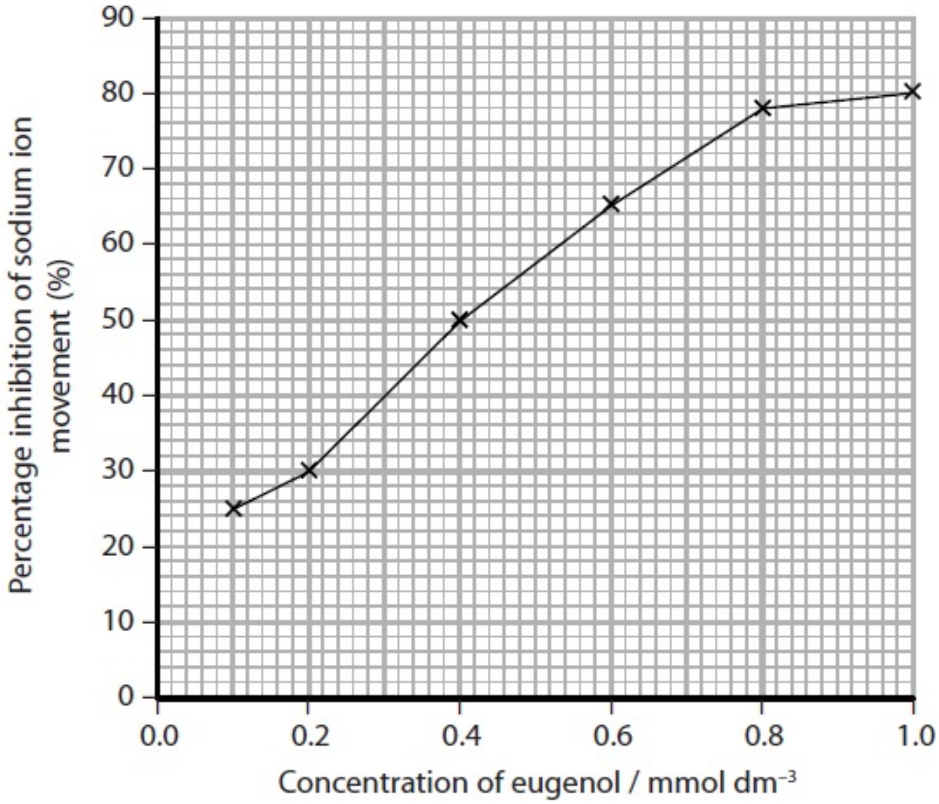
(2)

A.....

B.....

(b) Eugenol is a drug that inhibits the movement of sodium ions and calcium ions through the cell surface membranes of sensory neurones.

The graph below shows the effect of eugenol concentration on the percentage inhibition of sodium ion movement.



(i) Describe the relationship between the concentration of eugenol and the percentage inhibition of sodium ion movement.

(2)

.....

.....

.....

.....

.....

.....

*(ii) Eugenol can be used to reduce pain.

Suggest an explanation for how eugenol affects the movement of calcium ions and reduces pain.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

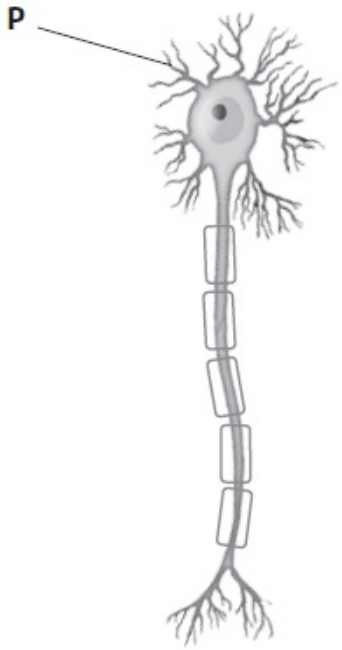
.....

.....

.....

(Total for Question = 10 marks)

Q20. (a) The diagram below shows a motor neurone.



(i) Name the structure labelled **P**.

(1)

.....

(ii) Place a cross ☒ in the box to identify the direction of the nerve impulse in the axon of this motor neurone.

(1)

☒ A →

☒ B ↓

☒ C ←

☒ D ↑

(b) Eugenol is a drug that inhibits the movement of sodium ions through the cell surface membranes of sensory neurones.

The table below shows the effect of eugenol concentration on the percentage inhibition of sodium ion movement.

Concentration of eugenol / mmol dm^{-3}	Percentage inhibition of sodium ion movement (%)
0.2	30
0.4	50
0.6	65
1.0	80

(i) Describe the effect of eugenol on the percentage inhibition of sodium ion movement.

(2)

.....

.....

.....

.....

.....

.....

(ii) Using information from the table, calculate the percentage inhibition of sodium ion movement at a concentration of eugenol of 0.8 mmol $dm^{-}3$.

Show your working.

(2)

Answer.....%

*(c) Eugenol can be used to reduce pain.

Suggest an explanation for how eugenol affects the movement of sodium ions and reduces pain.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question = 12 marks)

Q21.

Voltage-gated K^+ and Na^+ channels are involved in the transmission of impulses in sensory and motor neurones.

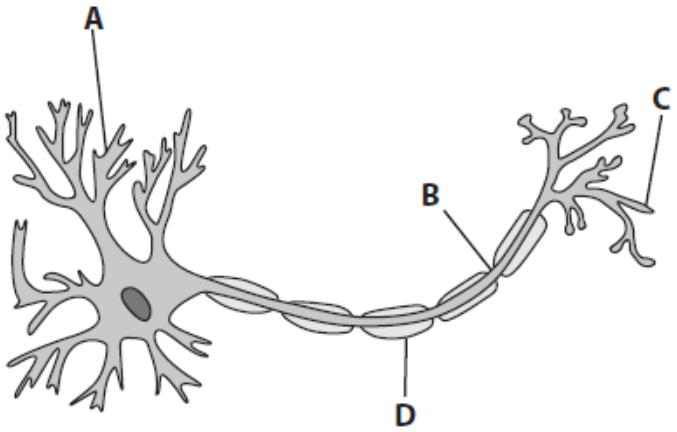
(i) The table below identifies two stages in the transmission of an impulse in a sensory neurone.

Place a tick (✓) in each box that correctly identifies whether the channels are open or closed during these two stages.

(2)

Stage	Voltage-gated K^+ channels open	Voltage-gated K^+ channels closed	Voltage-gated Na^+ channels closed
Depolarisation			
Repolarisation			

(ii) The diagram below shows a myelinated motor neurone.



Place a cross in the box ☒ that labels the site where neurotransmitters bind and initiate depolarisation.

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

Q22. The scientific article you have studied is adapted from several sources.

Use the information from the article and your own knowledge to answer the following questions.

(a) The sweet potato eaten by naked mole rats (paragraph 3) is very rich in starch. Starch can be a combination of amylose and amylopectin.

Give **two** structural differences between amylose and amylopectin.

(2)

.....

.....

.....

.....

.....

(b) Explain why a colony of naked mole rats is considered 'a eusocial society' (paragraph 4).

(2)

.....

.....

.....

.....

.....

(c) Naked mole rats show evidence of poikilothermy (paragraph 5).

(i) Explain what is meant by the term **poikilothermic**.

(1)

.....

.....

.....

(ii) Suggest how each of the following 'contribute to poikilothermic responses to changing temperature of this mammal'.

(2)

'Lack of an insulating layer'

.....

.....

.....

'A marked reduction in sweat glands'

.....

.....

.....

(d) Suggest a mechanism that could have been used to genetically modify cells from mice with cancer-causing genes (paragraph 13).

(2)

.....

.....

.....

.....

.....

*(e) Whilst naked mole rats are 'impervious to chemical pain' they do feel 'acute pain such as cuts and burns' (paragraph 31).

Touching something hot, which could lead to a burn, can cause nerve impulses to travel along myelinated sensory neurones very rapidly.

Explain how myelination increases the speed of transmission of nerve impulses in a sensory neurone.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(f) Explain how a heart attack can temporarily reduce the oxygen concentration in brain tissue (paragraph 36).

(3)

.....

.....

.....

.....

.....

.....

.....

(g) Using the information in paragraph 48, name **one** hormone **and** state its function.

(1)

Hormone:

.....

Function:

.....

.....

.....

(h) Suggest how a change in the mid region of the sperm may make it non-motile (paragraph 48).

(2)

.....

.....

.....

.....

.....

.....

(i) Disperser naked mole rats 'are laden with fat' (paragraph 50).

Suggest why it may be advantageous for disperser naked mole rats to have high levels of fat.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

(j) Explain the statement that 'a preference by reproductively active females for unfamiliar males is interpreted as inbreeding avoidance' (paragraph 52).

(2)

.....

.....

.....

.....

(k) 'The naked mole rat hasn't yet had its genome sequenced' (paragraph 53).

Explain what is meant by the term **genome sequenced**.

(1)

.....

.....

.....

(l) 'With so much to offer science, it is no surprise that naked mole rats are becoming more common in labs' (paragraph 53).

Using information from the article, describe **two** adaptations of naked mole rats. For each adaptation, explain why it could be of interest in a medical research laboratory.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question = 30 marks)

Q23.

The scientific article you have studied is adapted from articles in *Nature* and *Scientific American*.

Use the information from the article and your own knowledge to answer the question.

Octopamine is a neurotransmitter (paragraph 24). Libersat and his team believe that wasp venom probably blocks octopamine receptors in the central nervous system of the cockroach.

Suggest **two** ways that the 'compound that reactivates octopamine receptors' (paragraph 25) could work.

(2)

.....

.....

.....

.....

.....

.....

.....

.....

Q24.

Nerve impulses are transmitted along neurones.

(i) In the time period between two nerve impulses, the potential difference across the membrane is –70 mV.

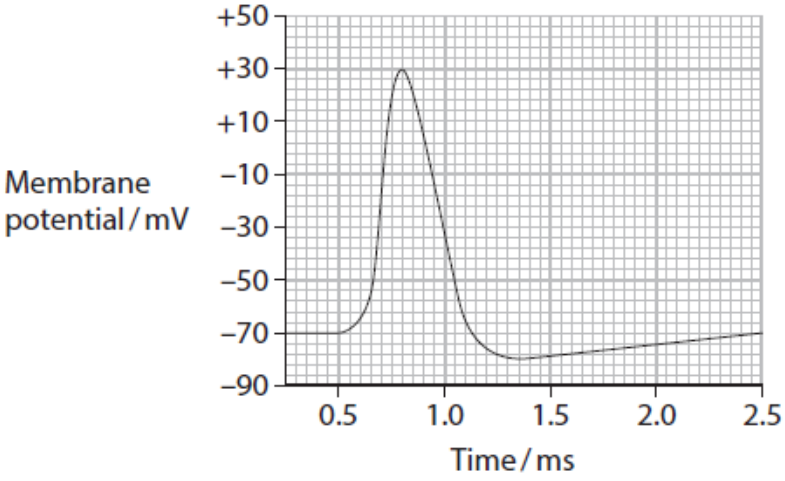
State the term given to this potential difference.

(1)

.....

(ii) When the neurone is stimulated, an action potential may occur in the axon, due to the change in permeability of the membrane to ions.

The graph shows an action potential.



Describe what happens in the axon membrane to cause the change in potential difference between 0.55 ms and 0.80 ms.

(4)

.....

.....

.....

.....

.....

.....

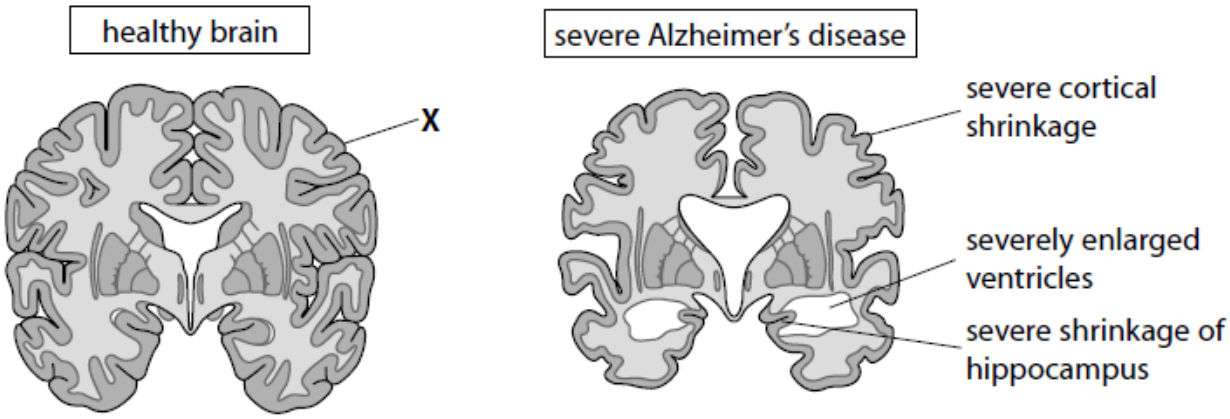
.....

.....

(Total for question = 5 marks)

Q25.

The diagrams below show a horizontal cross section of a healthy human brain and a brain from a person with severe Alzheimer's disease.



© Copyright 2000 – 2014 BrightFocus Foundation. All rights reserved

Drug treatments are available to reduce the symptoms of Alzheimer's disease.

One of the drugs available works as a non-competitive inhibitor of cholinesterase, the enzyme that breaks down acetylcholine in the synapse.

Describe how the action of this drug helps reduce the symptoms of Alzheimer's disease.

(3)

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)