Unit 5

Control in Cells & Organisms

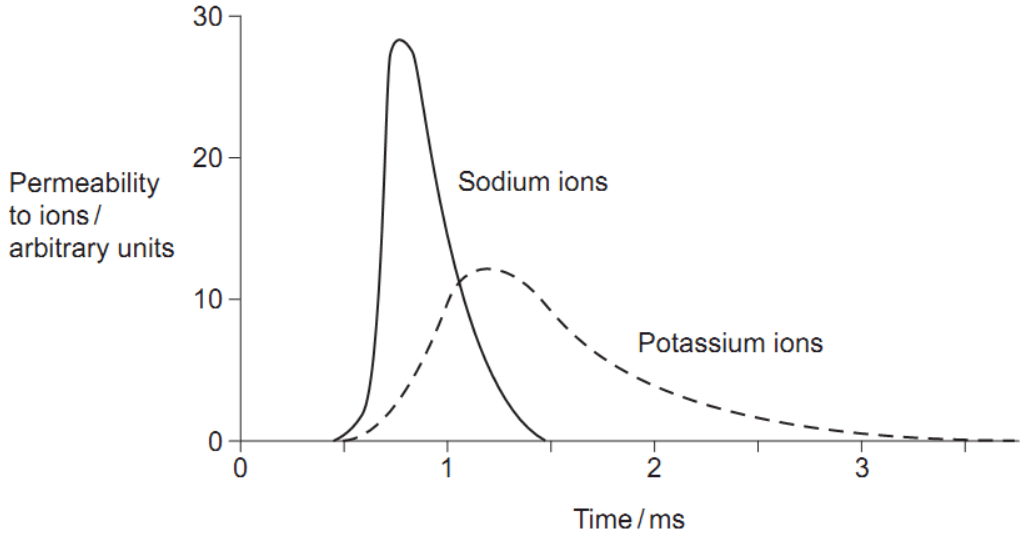
Coordination

Practice Exam Questions

3.5.2 Coordination may be chemical or electrical in nature.	
Principles	Nerve cells pass electrical impulses along their length. They stimulate their target cells by secreting chemical neurotransmitters directly on to them. This results in rapid, short-lived and localised responses. Mammalian hormones are substances that stimulate their target cells via the blood system. This results in slow, long-lasting and widespread responses. Histamine and prostaglandins are local chemical mediators released by some mammalian cells and affect only cells in their immediate vicinity. In flowering plants, specific growth factors diffuse from growing regions to other tissues. They regulate growth in response to directional stimuli. The role of indoleacetic acid (IAA) in controlling tropisms in flowering plants.
Nerve impulses	The structure of a myelinated motor neurone. The establishment of a resting potential in terms of differential membrane permeability, electrochemical gradients and the movement of sodium and potassium ions. Changes in membrane permeability lead to depolarisation and the generation of an action potential. The all-or-nothing principle. The passage of an action potential along non-myelinated and myelinated axons, resulting in nerve impulses. The nature and importance of the refractory period in producing discrete impulses. Factors affecting the speed of conductance: myelination and saltatory conduction; axon diameter; temperature.
Synaptic transmission	The detailed structure of a synapse and of a neuromuscular junction. **Candidates should be able to** explain • unidirectionality • temporal and spatial summation • inhibition. The sequence of events involved in transmission across a cholinergic synapse and across a neuromuscular junction. When provided with information, **candidates should be able to** predict and explain the effects of specific drugs on a synapse. Recall of the names and mode of action of individual drugs will **not** be required.

1

During an action potential, the permeability of the cell-surface membrane of an axon changes. The graph shows changes in permeability of the membrane to sodium ions (Na^+) and to potassium ions (K^+) during a single action potential.



(a) Explain the shape of the curve for sodium ions between 0.5 ms and 0.7 ms.

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(3 marks)

(b) During an action potential, the membrane potential rises to +40 mV and then falls. Use information from the graph to explain the fall in membrane potential.

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(3 marks)

(c) After exercise, some ATP is used to re-establish the resting potential in axons. Explain how the resting potential is re-established..

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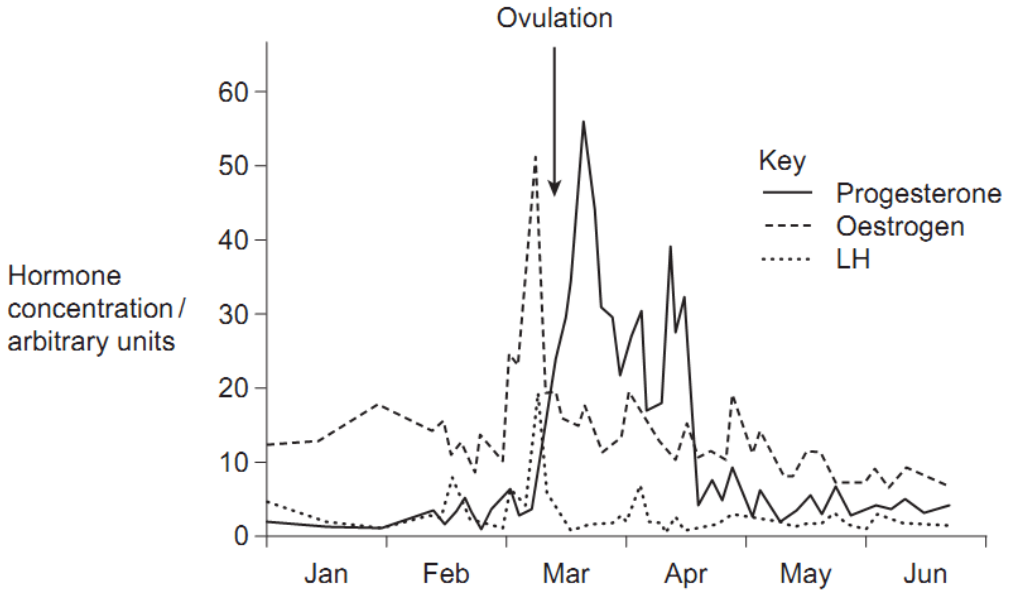
(2 marks)

Total 8 marks

2

Scientists investigated control of ovulation in a species of mammal. They measured the concentration of some hormones in the blood of females between January and June. The graph shows the results for one animal.



(a) The concentration of LH in the blood is controlled by negative feedback. Use the curves for progesterone and LH to explain how.

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(3 marks)

(b) (i) Explain how the change in progesterone concentration in March shows that ovulation took place at the time indicated.

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(2 marks)

(b) (ii) **Two** pieces of information from the graph, other than the change in progesterone concentration, show that ovulation took place at the time indicated. Explain how.

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(4 marks)

Total 9 marks

3

Different substances are involved in coordinating responses in animals.

(a) Hormones are different from local chemical mediators such as histamine in the cells they affect.

(a) (i) Describe how hormones are different in the cells they affect.

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(1 mark)

(a) (ii) Describe how hormones and local chemical mediators reach the cells they affect.

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(2 marks)

(b) Synapses are unidirectional. Explain how acetylcholine contributes to a synapse being unidirectional.

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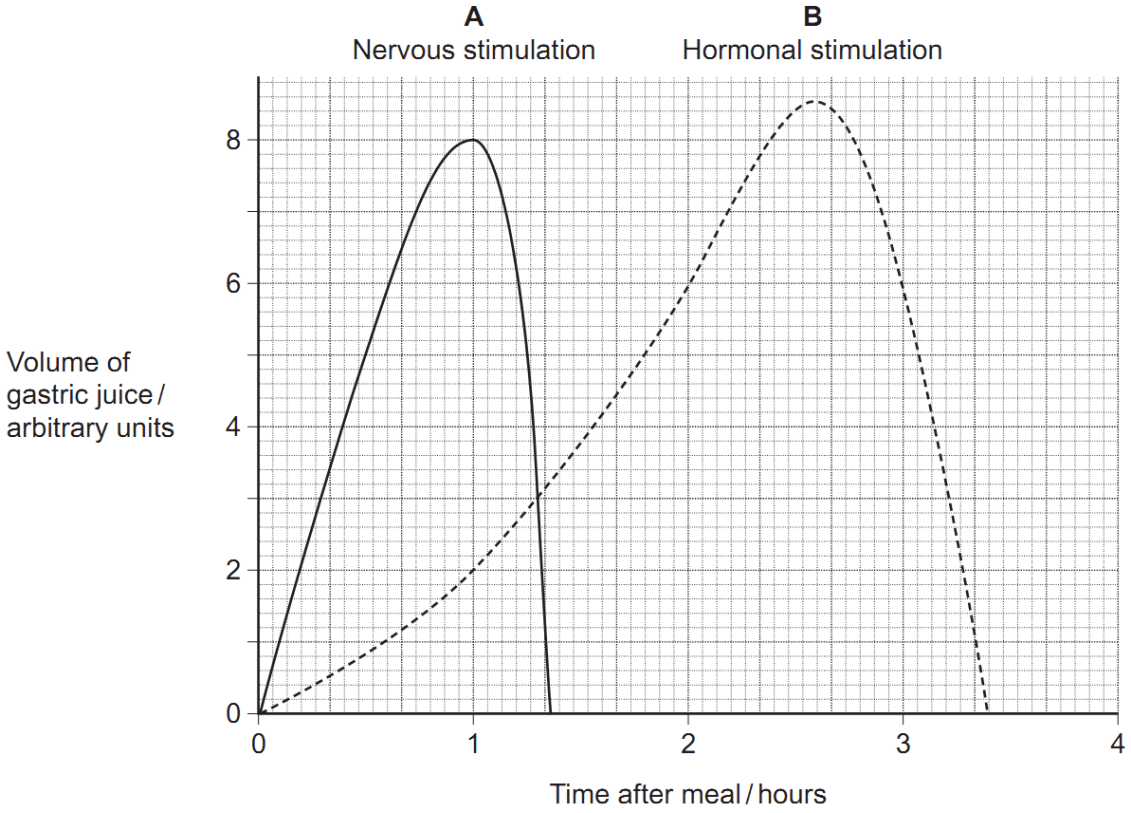
(2 marks)

(c) Cells in the stomach wall release gastric juice after a meal. The graph shows how the volumes of gastric juice produced by nervous stimulation and by hormonal stimulation change after a meal.



(c) (i) Describe the evidence from the graph that curve **A** represents the volume of gastric juice produced by nervous stimulation.

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(2 marks)

(c) (ii) Complete the table to show the percentage of gastric juice produced by nervous stimulation at the times shown.

	Time after meal / hours		
	1	**2**	**3**
Percentage of gastric juice produced by nervous stimulation			

(1 mark)

Total 8 marks

4

IAA is a specific growth factor.

(a) Name the process by which IAA moves from the growing regions of a plant shoot to other tissues.

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(1 mark)

(b) When a young shoot is illuminated from one side, IAA stimulates growth on the shaded side. Explain why growth on the shaded side helps to maintain the leaves in a favourable environment.

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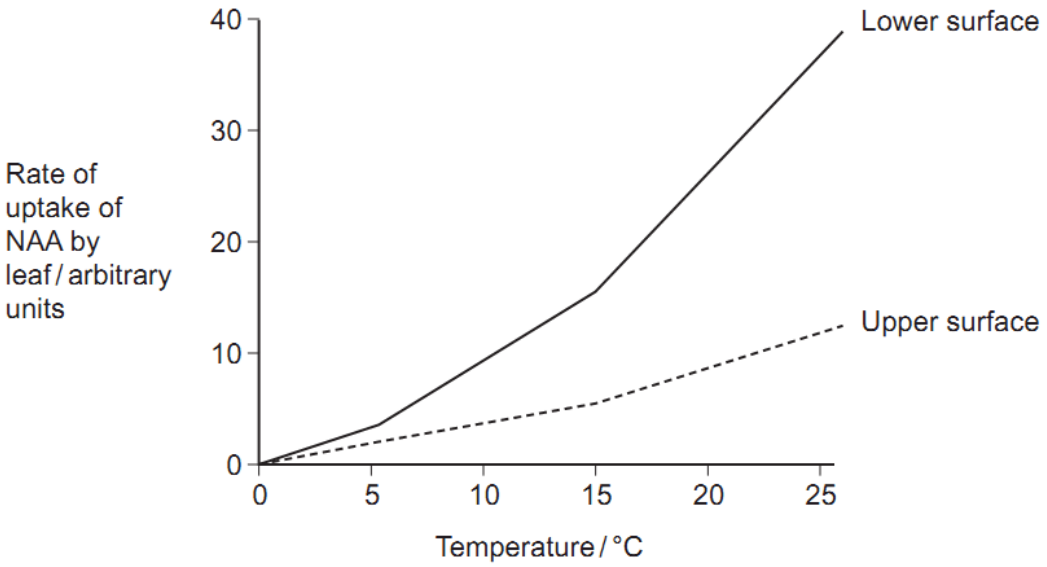
(2 marks)

NAA is a similar substance to IAA. It is used to control the growth of cultivated plants. Plant physiologists investigated the effect of temperature on the uptake of NAA by leaves. They sprayed a solution containing NAA on the upper and lower surfaces of a leaf. The graph shows their results.



(c) Explain the effect of temperature on the rate at which NAA is taken up by the lower surface of the leaf.

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(2 marks)

(d) There are differences in the properties of the cuticle on the upper and lower surfaces of leaves.

(d) (i) Suggest how these differences in the cuticle might explain the differences in rates of uptake of NAA by the two surfaces.

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(2 marks)

(d) (ii) In this investigation, the physiologists investigated the leaves of pear trees. Explain why the results might be different for other species.

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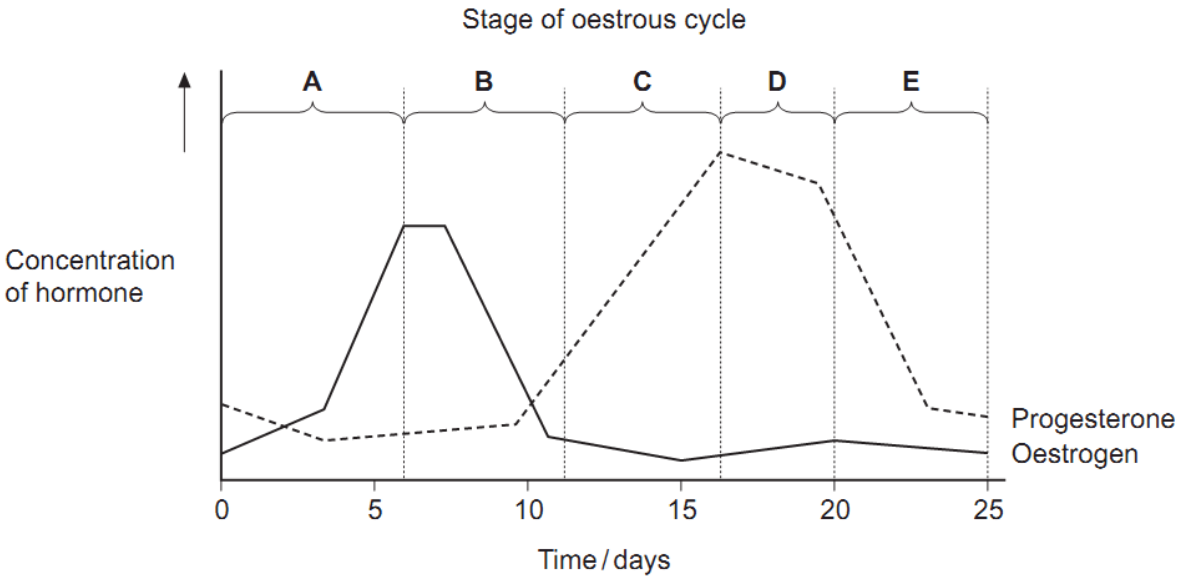
(1 mark)

Total 8 marks

5

The graph shows the concentrations of two hormones in the blood of an adult female pig over 25 days.



(a) (i) Use the graph to give the letter of the stage where ovulation occurred.

(1 mark)

(a) (ii) Give **one** piece of evidence from the graph that this pig was **not** pregnant at 25 days.

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(1 mark)

(b) The relationship between oestrogen and LH is an example of positive feedback. Explain how.

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(2 marks)

(c) Farmers sometimes give progesterone to sheep to prevent ovulation.
Explain how progesterone prevents ovulation.

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(2 marks)

Total 6 marks

6

(a) (i) Fig. 4.1 shows the major components of the mammalian nervous system.

Complete Fig. 4.1 using the terms from the list below.

autonomic nervous system
spinal cord
peripheral nervous system

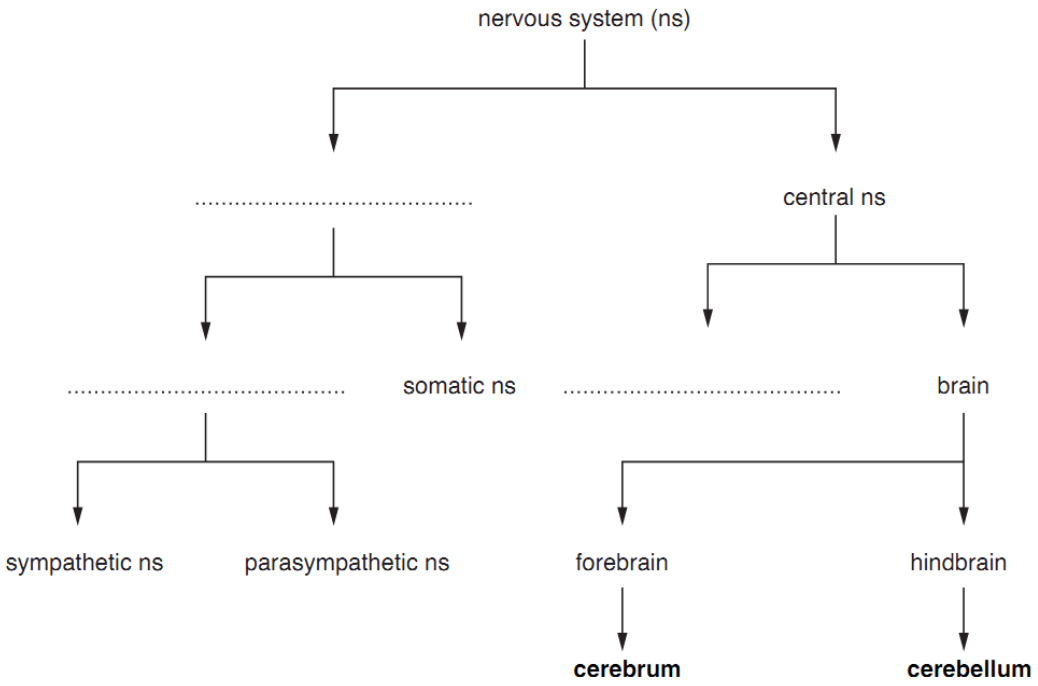

Fig. 4.1

[3]

(ii) Fig. 3.1 represents part of the axon of a neurone.

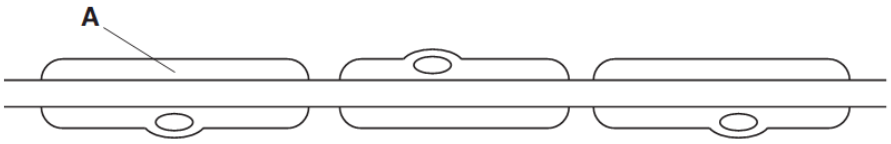

Fig. 3.1

Describe the **structure** of the feature labelled **A**.

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..... **[2]**

Table 3.1 shows details of the diameter and speed of conduction of impulse along the neurones of different animal taxa.

Table 3.1

type of neurone	axon diameter (μm)	speed of conduction ($m s^{-1}$)	animal taxon
myelinated	4	25	mammal
myelinated	10	30	amphibian
myelinated	14	35	amphibian
unmyelinated	15	3	mammal
unmyelinated	1000	30	mollusc

(b) Using **only the data in Table 3.1**, describe the effect of each of the following on the speed of conduction:

(i) myelination,

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..... **[2]**

(ii) axon diameter.

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..... **[2]**

(c) The speed of conduction of a nerve impulse is also affected by temperature.

(i) Suggest why an increase in temperature results in an increase in the speed of conduction.

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(ii) As the temperature continues to increase, it reaches a point at which the conduction of the impulse ceases. Suggest why.

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..... **[1]**

(d) Outline the events following the arrival of an action potential at the synaptic knob until the acetylcholine has been released into the synapse.

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

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[Total: 15]

7

Fig. 6.1 shows a neuromuscular junction.

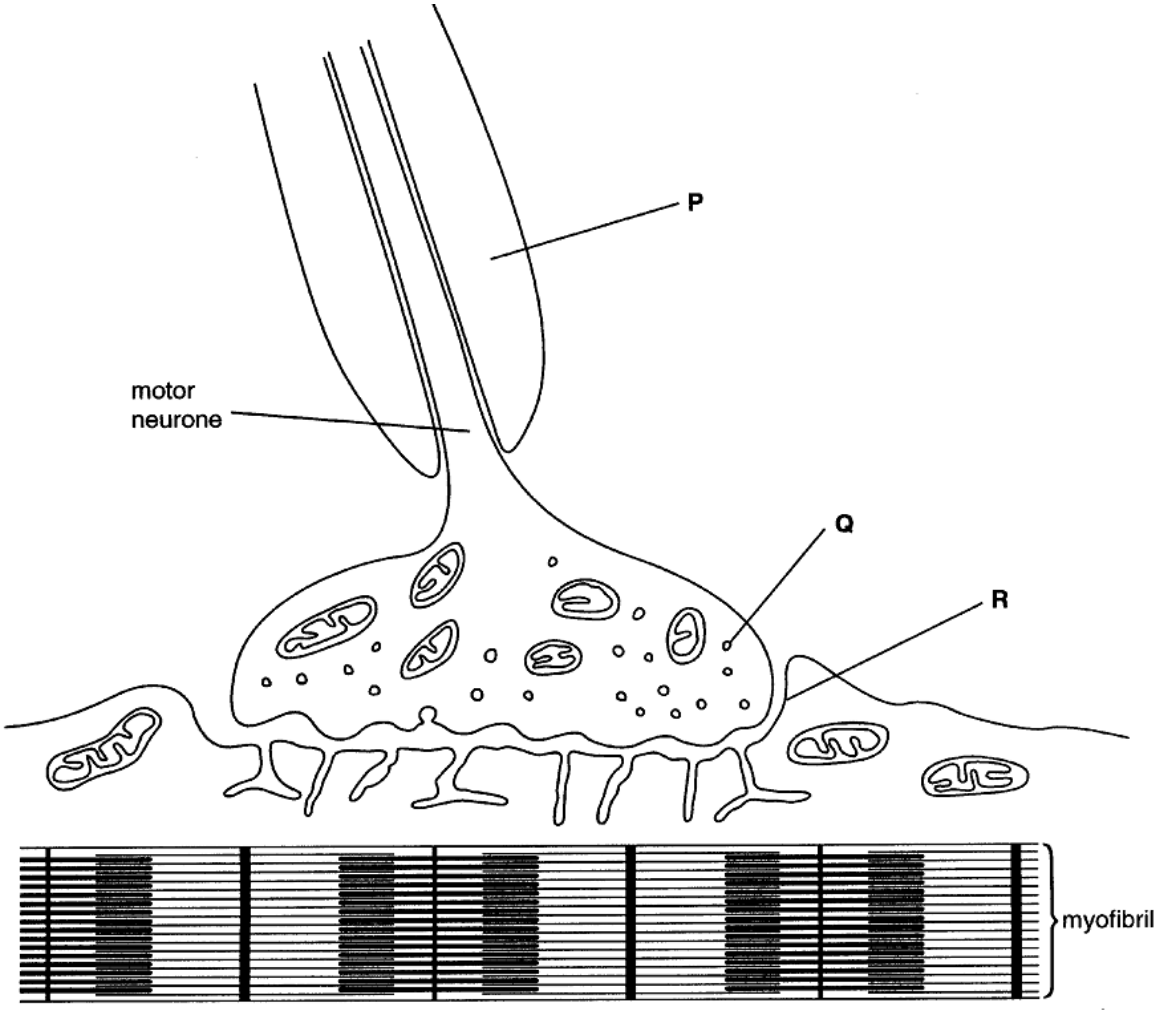

Fig. 6.1

(a) Name structures **P** to **R**.

P .....

Q .....

R .....[3]

(b) Using the information in Fig. 6.1, describe and explain how an impulse in the motor neurone stimulates contraction of the myofibril.

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Nicotine acts at some neuromuscular junctions to stimulate muscles to contract.

(c) Suggest a way in which nicotine may act at neuromuscular junctions to have this effect.

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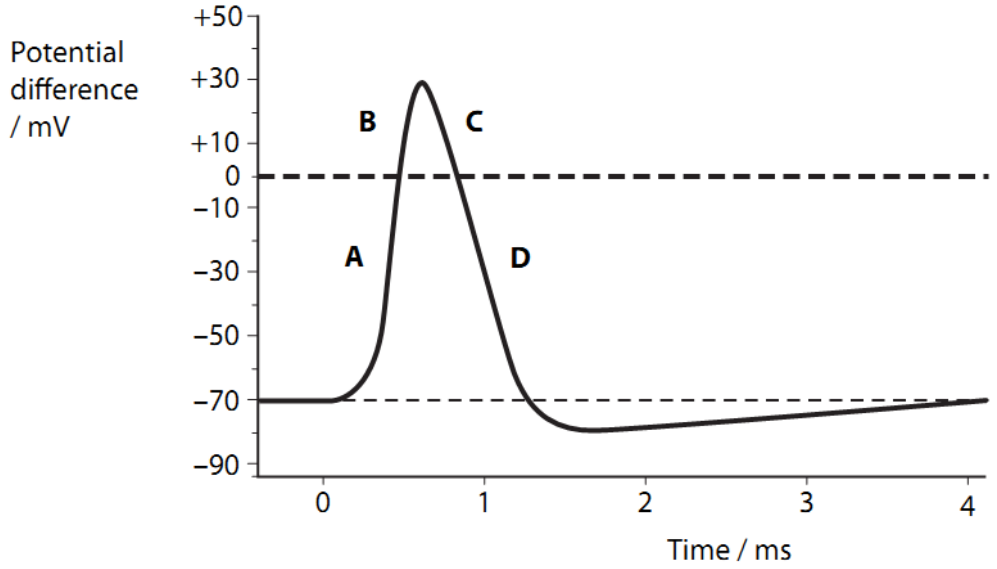
[Total : 12]

8.

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	☐	☐
D	☐	☐

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

(3)

(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)

Total 10 marks

9.

(a) Fig. 2.1 represents the end region of a neurone at a cholinergic synapse.

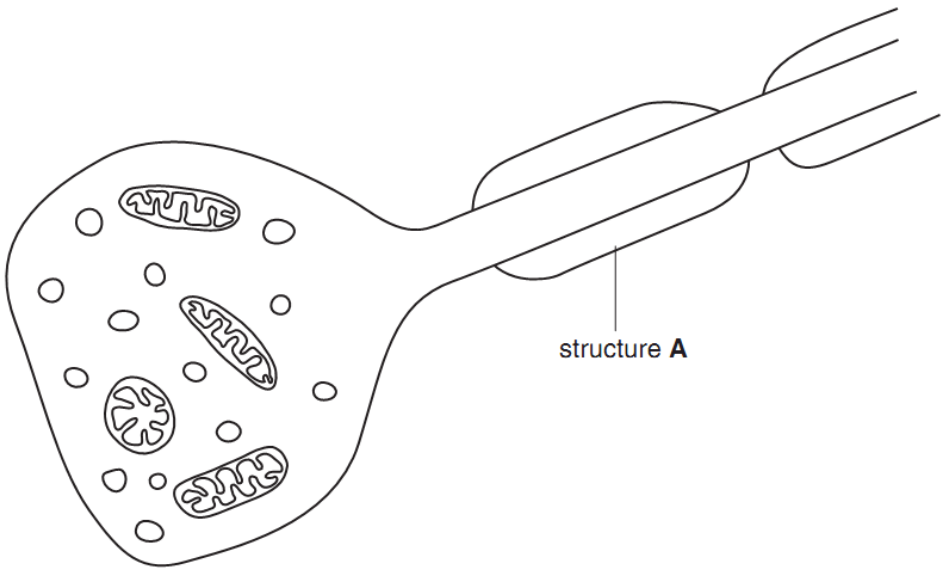

Fig. 2.1

(i) Describe the function of **structure A**.

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

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..... **[4]**

(ii) Name the process by which acetylcholine leaves the neurone shown in Fig. 2.1.

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(iii) Name the process by which acetylcholine travels across the synaptic cleft.

..... **[1]**

(iv) A feature of synapses is that they allow transmission in only one direction.

State how this is achieved.

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..... **[1]**

(b) The chemical nature of synaptic transmission makes it susceptible to disruption by toxins.

(i) Atropine is a toxin produced by the deadly nightshade plant, *Atropa belladonna*.

Atropine is a similar shape to acetylcholine. The presence of atropine prevents the initiation of an action potential in the post-synaptic neurone.

Explain how the presence of atropine in the synapse will prevent the initiation of an action potential.

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..... **[3]**

(ii) Nerve gases have been used as chemical weapons. Some nerve gases act by inhibiting acetylcholinesterase, prolonging the effect of acetylcholine.

Suggest how atropine could act as an antidote to nerve gas.

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..... **[2]**

Total 12 marks

10.

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]**

11

Compare, using named examples, the features of the chemical communication systems of flowering plants and mammals. *(In this question, 1 mark is available for the quality of written communication.)*

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QWC [1]

12 Table 2.1 shows the rate of nerve impulse transmission in neurones from different animals.

Table 2.1

animal	myelinated	diameter of neurone / μm	rate of nerve impulse transmission / $m\,s^{-1}$
crab	no	30	5
squid	no	500	25
frog	yes	16	32
cat	no	15	2
cat	yes	20	100

(a) (i) State **two** structural features of neurones that affect the rate of nerve impulse transmission.

1 .....

2 ..... **[2]**

(ii) Explain the differences in the rate of nerve impulse transmission for the two different types of neurone from the cat.

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..... **[3]**

(b) The rate of nerve impulse transmission in a human arm was investigated as follows:

- an electrical stimulus was applied to the ulnar nerve at the elbow
- this produced a twitch in the muscles of the thumb after a time interval of $\mathbf{t_0}$ seconds
- the electrical stimulus was then applied to the same nerve at the shoulder, a distance of 0.3 metres from the elbow
- the thumb twitch this time followed after a slightly longer time $\mathbf{t_1}$
- $\mathbf{t_1} - \mathbf{t_0}$ was found to be 6×10^{-3} seconds.

Calculate the rate of transmission of the nerve impulse along the ulnar nerve in metres per second.

Answer = ... $m\,s^{-1}$ **[2]**

(c) When a neurone is not transmitting an impulse it is polarised, with the inside of the neurone negatively charged relative to the outside. This is known as the resting potential. It is in the range of –50 to –90 mV but is usually –65 mV.

Fig. 2.2 shows the distribution of ions across the membrane of the neurone at the resting potential.

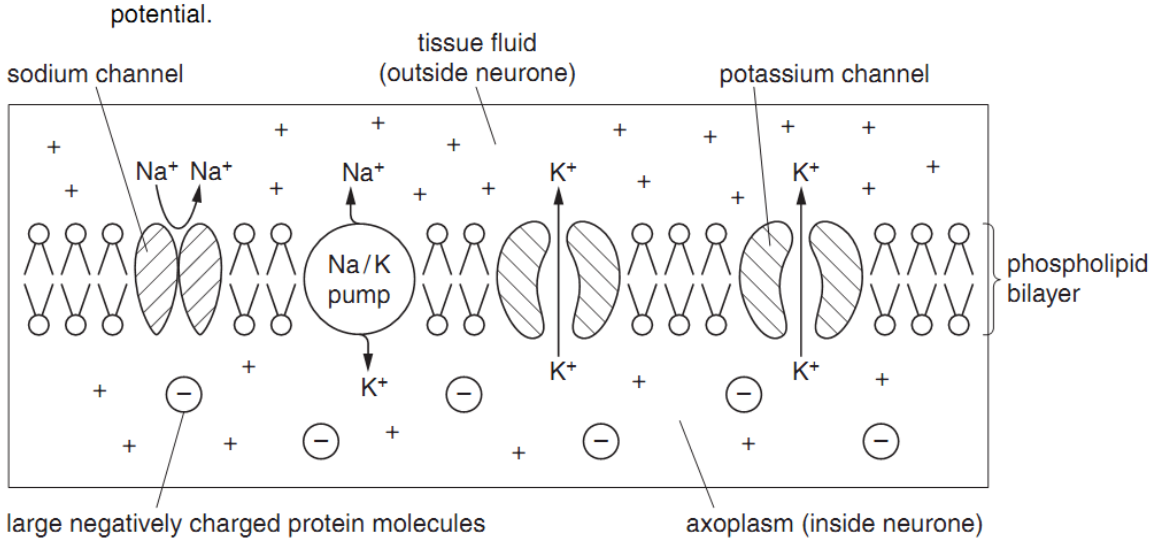

Fig. 2.2

In this question, one mark is available for the quality of spelling, punctuation and grammar.

Describe how the resting potential is maintained.

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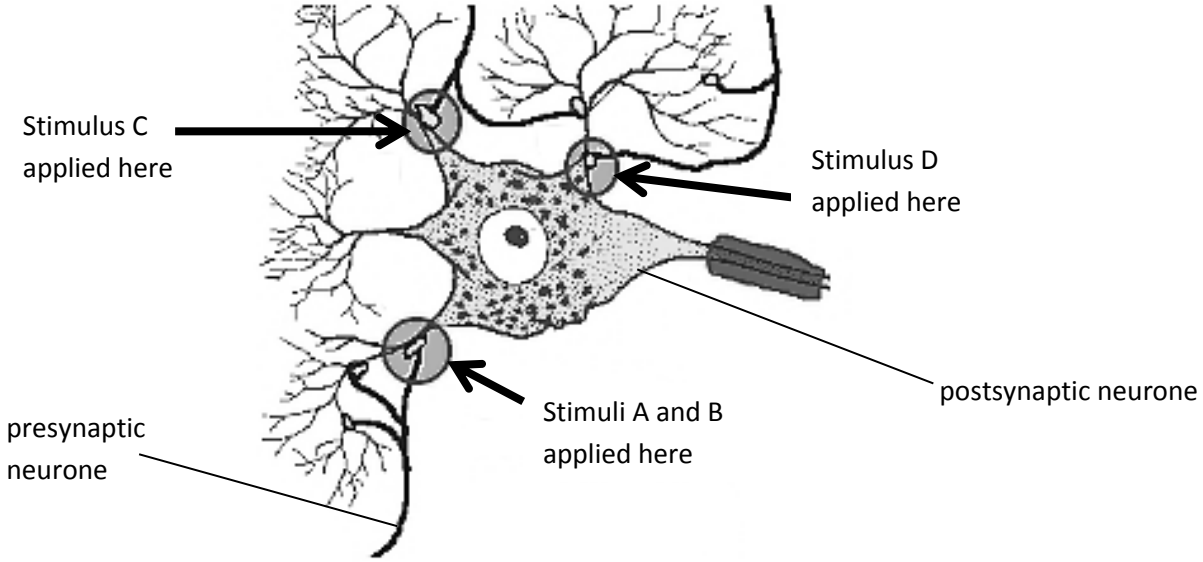
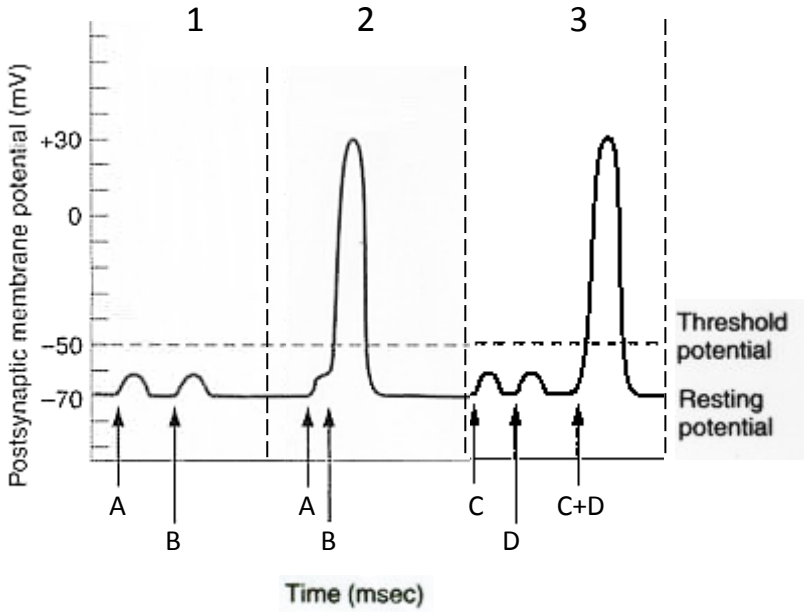
Quality of Written Communication **[1]**

13

In an investigation into synapses a number of stimuli were applied as shown in the diagram below. All stimuli were of the same intensity.



Measurements of any electrical changes in the postsynaptic neurone were recorded and are shown in the three graphs below:



[a] In graph 1 two stimuli, A and B, have been applied. Explain why no action potential is produced

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1 mark

[b] In graph 2 the same two stimuli have been applied. Explain why an action potential is produced

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2 marks

[c] In graph 3 two stimuli, C and D, have been applied separately and then together. Explain the observed results.

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4 marks

Total 7 marks

Answers and Markscheme

1

Question	Marking guidance	Mark	Comments
1(a)	(Ion) channel proteins open; Sodium in; Changes membrane potential/makes inside of axon less negative/positive/depolarisation/ reaches threshold; More channels open/positive feedback;	3 max	Accept other phrases for ion channel proteins providing that it is clear that it is something through which ions pass. Reject carrier. First marking point relates to opening. Third point must relate to more (channels) opening.
1(b)	Potassium channels open; Potassium out; Sodium channels close;	3	Do not penalise candidate who refers to sodium or potassium. Ions are mentioned in question. Reject pump
1(c)	Pump/active transport/transport against concentration gradient; Of sodium from axon/sodium out/of potassium in;	2	Do not penalise candidate who refers to sodium or potassium. Ions are mentioned in question

2

Question	Marking guidance	Mark	Comments
2 (a)	LH rises; Increase in progesterone; Progesterone inhibits LH; (Then) LH falls;	3 max	The question requires explanation of control of LH Answer must relate to progesterone and LH. General answers should not gain credit here. Points 1 and 2 must relate to graph so reject secretes, makes etc
2 (b)(i)	Corpus luteum; Progesterone produced;	2	Do not credit references to progesterone being needed.
2 (b)(ii)	A lot of/ rise in oestrogen; Associated with follicle growth/development/ LH surge; ***OR*** Fall in oestrogen; Follice breaks down; Surge in LH (before ovulation); (LH) stimulates ovulation/release of egg; ***OR*** Fall in LH (after ovulation); Inhibited by progesterone;	4	

3.

<table>
<tr><th>Question</th><th>Marking Guidelines</th><th>Mark</th><th>Comments</th></tr>
<tr><td>3 (a)(i)</td><td>Hormones have widespread effect / affect different organs / affect different parts of the body / affect distant organs / only affect cells with right receptor;</td><td>1</td><td>Assume “they” refers to hormones</td></tr>
<tr><td>3 (a)(ii)</td><td>1. Hormones in blood;
2. Local chemical mediators spread by diffusion / spread directly;</td><td>2</td><td>1. May be awarded where candidates refer to both as “they”.</td></tr>
<tr><td>3 (b)</td><td>1. (Acetylcholine) released from/in presynaptic side;
2. Diffusion from higher concentration/to lower concentration;
3. Receptors in postsynaptic (side) / binds on postsynaptic (side);</td><td>2 max</td><td>2. Mark for diffusion only awarded in context of unidirectional movement.</td></tr>
<tr><td>3 (c)(i)</td><td>1. Rapid response;
2. Short duration;</td><td>2</td><td>Specific wording is not important. It is the principles that matter here.
Points may be made by referring to figures.</td></tr>
<tr><td>3 (c)(ii)</td><td><table><tr><td></td><td>1</td><td>2</td><td>3</td></tr><tr><td>Percentage</td><td>80</td><td>0</td><td>0</td></tr></table></td><td>1</td><td>Ignore % sign</td></tr>
</table>

4

Question	Marking Guidelines	Mark	Comments
4(a)	Diffusion;	1	Ignore references to simple/facilitated Accept active transport
4(b)	1. Causes plant to bend/grow towards light / positive phototropism; 2. (Light) required for photosynthesis;	2	
4(c)	1. More kinetic energy; 2. Faster movement of molecules; 3. More diffusion;	2 max	Ignore references to opening stomata Answer should be in context of more but comparative statement only necessary once.
4(d)(i)	1. Thick cuticle on upper surface / thin cuticle on lower surface / few stomata on upper surface / no stomata on upper surface; 2. More diffusion / shorter diffusion pathway (on lower surface);	2	1. Ignore cuticle only on upper surface. Ignore references to more or less waxy. 2. If candidate writes about stomata accept ref to greater area for diffusion.
4(d)(ii)	Different species have different (qualified) properties;	1	Eg cuticle thickness Leaf size Number of stomata

5

Question	Marking Guidelines	Mark	Comments
5(a)(i)	B;	1	
5(a)(ii)	Fall in progesterone / progesterone same as at start / progesterone low at 25 days;	1	Ignore references to oestrogen
5(b)	Answer showing understanding of positive feedback i.e. more produces more / differs further; Answer showing understanding of positive feedback correctly linked to oestrogen and LH i.e. more oestrogen produces more LH;;	2	1 mark for basic idea 2 marks for idea illustrated correctly by example of oestrogen and LH Answer must relate to oestrogen increasing not just high oestrogen
5(c)	1. Progesterone has negative feedback effect / inhibits secretion of FSH/LH; 2. (FSH) stimulates follicle development / (LH) stimulates ovulation;	2	

6

Question				Expected Answers	Marks	Additional Guidance
6	(a)	(i)		peripheral (ns) ; autonomic (ns) ; spinal cord ;	3	
	(a)	(ii)	1 2 3	myelin / myelinated / lipid / fatty (sheath) ; (Schwann) <u>cell</u>, wrapped around / surrounds / AW, <u>axon</u> ; except at nodes of Ranvier / (sheath) not continuous / presence of gaps (in the sheath) ;	2 max	1 **DO NOT CREDIT** fatty acids 3 must be in the context of structure rather than function (as many refer to it in context of saltatory conduction)
	(b)	(i)	1 2 3	(myelination produces) greater speeds ; unmyelinated needs larger diameter to produce same speed ; comparative figs, **all** with units, to support either the general trend or the exception to the trend with the mollusc ;	2 max	1 **IGNORE** ref to axon diameter for this mp 3 1 speed for myelinated (25 / 30 / 35 , **m s^{-1}**) **and** 1 speed for unmyelinated (3 / 30 , **m s^{-1}**) (allow m/s) **or** calculated difference in speed between myelinated and unmyelinated (**with units unless** a multiple e.g. approx. x12)
	(b)	(ii)	1 2	larger axon diameter produces greater speeds ; **ora** comparative figs, **all** with units, to support ;	2 max	1 needs to be a general statement 2 2 diameters & speeds (**both with units**) for ***myelinated*** **or** calculated difference in diameter for 2 stated speeds (**both with units unless** diameter is a multiple e.g. around x 1.4 / around 140%)

type of neurone	diameter (µm)	speed (m s^{-1})	animal taxon
myelinated	4	25	mammal
myelinated	10	30	amphibian
myelinated	14	35	amphibian

or
2 diameters & speeds (**both with units**) for ***unmyelinated***
or
calculated difference in diameter for 2 stated speeds (**both with units unless** diameter is a multiple e.g. about x10)

type of neurone	diameter (µm)	speed (m s^{-1})	animal taxon
unmyelinated	15	3	mammal
unmyelinated	1 000	30	mollusc

6 continued

Question				Expected Answers	Marks	Additional Guidance
6	(c)	(i)	1	increased <u>kinetic energy</u> / <u>KE</u> so, • ions <u>diffuse</u>, across (axon) membrane / into neurone / into cell / between nodes / along neurone, more quickly ***or*** • faster movement of (neurotransmitter) vesicles / exocytosis (of neurotransmitter) ***or*** • neurotransmitter diffuses more quickly across, synapse / synaptic cleft ***or*** • neurotransmitter (ACh) broken down by enzyme (acetylcholinesterase) more quickly ;	**S & C** **1 max**	description of ion movement must be correct (e.g. Na^+ in for depolarisation / Ca^{2+} into presynaptic knob)
			2	faster <u>diffusion</u> of ions leads to, • faster depolarisation ***or*** • shorter duration of action potential ***or*** • shorter refractory period ***or*** • faster repolarisation ;		
	(c)	(ii)	1	ion, channels / pumps, disrupted / denatured / no longer function ;	**1 max**	**DO NOT CREDIT** general denaturation of proteins / enzymes
			2	fluidity of, membrane / phospholipid / bilayer, disrupted ;		**2** **IGNORE** leaky membrane unless qualified
			3	(named) synaptic enzymes denatured ;		

6 continued

Question			Expected Answers		Marks	Additional Guidance
6	(d)					**IGNORE** ref to influx of Na^+ and events when action potential arrives at the synaptic knob – start when the Ca^{2+} channels open
			1	calcium **channel**s open ;		
			2	Ca^{2+} / Ca^{++} / calcium ions **,** enter / diffuse into,		2 **DO NOT CREDIT** 'calcium' alone **DO NOT CREDIT** Ca^+ **DO NOT CREDIT** **'**enter membrane' – must cross it
			3	acetylcholine / ACh / **neurotransmitter**, in **vesicle**(s) ;		
			4	(synaptic) vesicles move towards **presynaptic** membrane ;		4 **CREDIT pre-synaptic**
			5	vesicles fuse with membrane **;**		5 **DO NOT CREDIT** attach / bind / join
			6	release acetylcholine, by **exocytosis ,** into synaptic **cleft ;**		'vesicles move and fuse with presynaptic membrane' = mps 4 & 5
					3 max	'vesicles move and fuse with membrane' = mp 5 only
			QWC – technical terms used appropriately and spelt correctly **;**		**1**	Use of **three** terms from: **channel**(s), **vesicle**(s), **neurotransmitter**, **presynaptic / pre-synaptic**, **exocytosis**, **cleft**,
				Total	**15**	

7

Question	Expected Answers	Marks
7 (a)	**P** myelin sheath / Schwann cell; **Q** vesicle; **R** post-synaptic membrane / sarcolemma;	**3**
(b)	entry of calcium ions or Ca^{2+} / calcium channels open; **A** gates for channels vesicles fuse with membrane / exocytosis; neurotransmitter / ACh, released (into gap) / diffuses (across gap); binds to receptor site (on sarcolemma / post-synaptic membrane); ref to large surface area; depolarisation / end plate potential / open sodium channels; depolarisation / action potential / impulse in, T / transverse (system) tubules; sarcoplasmic reticulum releases, calcium ions / Ca^{2+}; calcium ions / Ca^{2+}, bind to troponin; tropomyosin moves; reveals myosin binding sites on, actin / thin filaments; **A** myosin binding sites exposed movement of myosin heads / sliding filaments described / AW; mitochondria produce ATP; ref to ATP (either in neurone or muscle);	**7**
(c)	*question says 'a way' – mark first answer with further detail for maximum of two marks or treat first part of answer as neutral to allow the award of one mark* same shape as / mimics, ACh; **A** A/W causes sodium channels to open; binds / attaches, to receptor sites; ref to complementary shapes of nicotine and receptor; post-synaptic membrane / sarcolemma; stimulates release of ACh; inhibits, destruction of ACh / uptake of ACh by motor neurone; AVP; e.g. further detail of other alternative method ref acetycholinesterase	**2**
		[Total: 12]

8

Question Number	Correct Answer	Mark
(a)	1. depolarisation of adjacent {membrane / eq} / eq ; 2. changes PD across membrane / eq ; 3. opens sodium {gates / eq} ; 4. sodium ions move into (the neurone) ;	**max (2)**

Question Number	Correct Answer			Mark
(b)	**Position on diagram**	**Permeable to sodium ions**	**Permeable to potassium ions**	**(2)**
	A	☒	;	
	D		☒ ;	

Question Number	Correct Answer	Mark
(c)	1. correct {reference to / description of} diffusion gradient (of potassium ions) ; 2. correct {reference to / description of} electrochemical gradient ; 3. increased permeability (of membrane) to potassium ions / eq ; 4. reference to potassium {gates / eq} open / eq ; 5. reference to sodium {gates / eq} closed / eq ;	**max (3)**

2(d)	1. PD less negative / eq 2. idea that the membrane remains permeable to potassium ions ; 3. potassium ions {move because of charge difference / eq} ; 4. into {nerve cell / neurone / axon / eq} ; 5. idea that potassium ion is removing a positive charge (from the outside) ; 6. idea that equilibrium is established e.g. diffusion gradient balanced by potential difference ;	**max (3)**

9.

Question			Expected Answers		Marks	Additional Guidance
9	(a)	(i)	1	structure A / Schwann cell / it , produces **myelin** ;		*1* Needs the idea of production rather than simply stating 'it is a myelin sheath'
			2	(electrical) insulation / insulates ;		*2* **CREDIT** insulate or derived term. **IGNORE** impermeable **DO NOT CREDIT** *idea of* thermal insulation
			3	prevents movement of ions , into / out of , neurone / axon ***or*** prevents **depolarisation** ;		*3* **CREDIT** 'across membrane' instead of , in / out, of axon **IGNORE** ion exchange **IGNORE** impermeable **DO NOT CREDIT** ions moving , into / out of , membrane **DO NOT CREDIT** movement of ions without qualification
			4	speeds up , **conduction** / transmission / passage , of , **impulse** / action potential ;		*4* Statement must be comparative eg faster **DO NOT CREDIT** message / signal / wave of depolarisation
			5	**action potentials** / **local circuits** / depolarisation / only occur at , gaps / **nodes** (of Ranvier) ;		*5* **ACCEPT** longer local circuits **ACCEPT** 'local currents' instead of local circuits
			6	**saltatory** conduction / described ;	3 max	*6* eg • impulse jumps from , node to node / gap to gap **Note:** 'saltatory conduction' = 2 QWC terms
			QWC – technical terms used appropriately with correct spelling ;		1	Correct use and spelling of 3 terms from: **myelin, depolarisation (or other derived term),** **impulse, conduct (or other derived term),** **action potential, local circuit,** **node, saltatory** **You should use the GREEN DOT to identify the QWC terms that you are crediting.** **Please insert a QWC symbol next to the PENCIL ICON, followed by** **a tick (✓) if QWC has been awarded** **or a cross (×) if QWC has not been awarded**

9 continued

Question			Expected Answers	Marks	Additional Guidance
9	(a)	(ii)	<u>exocytosis</u> ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** bulk transport
9	(a)	(iii)	<u>diffusion</u> ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **DO NOT CREDIT** facilitated diffusion
9	(a)	(iv)	**1** *idea that only* the <u>presynaptic</u> neurone , produces / releases / contains , acetylcholine / ACh / (neuro)transmitter ; **2** only the <u>presynaptic</u> membrane has , $Ca^{(2+)}$ / calcium (ion) , channels ; **3** *idea that only* the <u>postsynaptic</u> , membrane / neurone , has (ACh) receptors ; **4** ACh broken down at <u>postsynaptic</u> membrane ;	1 max	**IGNORE** ref to refractory period (as not a feature of synapse) **ACCEPT** ACH / ach throughout ***1*** **CREDIT** knob / terminal bouton / bulb (instead of neurone) ***2*** ***3*** **DO NOT CREDIT** ref to bouton / bulb / etc ***4*** **IGNORE** ref to (acetyl)cholinesterase without ref to action at postsynaptic membrane

9 continued

Question			Expected Answers		Marks	Additional Guidance	
9	(b)	(i)				**IGNORE** ref to atropine and ACh having similar shapes (as given in Q) **ACCEPT** ACH / ach throughout **Only credit ORA for the mark points if candidate clearly states that these events do NOT take place with atropine.**	
			1	*idea that* atropine , binds to / occupies / competes for , (ACh) receptor on postsynaptic , membrane / neurone ;		***1***	**IGNORE** ref inhibition **DO NOT CREDIT** active site **DO NOT CREDIT** ref to bouton / bulb / etc
			2	*idea that* prevents ACh binding / blocks binding site / blocks receptor ;		***2***	
			3	ion gates / ion channels / sodium channels / protein channels , do not open / remain closed ;		***3***	**CREDIT** fewer ion channels open
			4	Na^+ cannot enter / K^+ cannot leave , neurone / (nerve) cell ;		***4***	**CREDIT** sodium ions / potassium ions **DO NOT CREDIT** Na / K **DO NOT CREDIT** ions entering the membrane
			5	no / insufficient , depolarisation / postsynaptic potential / excitatory postsynaptic potential / epsp / generator potential ;		***5***	**IGNORE** action potential (as given in Q)
			6	(so) does not reach threshold (value / potential) ;	**3 max**	***6***	

9 continued

Question			Expected Answers	Marks	Additional Guidance
9	(b)	(ii)			**ACCEPT** ACH / ach throughout
			1 *idea that* will , bind to / occupy / compete for / block , (some of ACh) receptors ;		*1* **DO NOT CREDIT** ref to active site
			2 *so* acetylcholine / ACh , cannot bind / less likely to bind (to receptor / to postsynaptic membrane) ;		*2* **ACCEPT** *idea that* ACh remains in synaptic cleft
			3 prevents / reduces , constant stimulation / overstimulation / constant depolarisation , of postsynaptic neurone **or** prevents / reduces , constant firing of action potentials / tetanus / (muscle) spasm ;		*3*
			4 AVP ;	2 max	*4* eg • effective if administered soon after exposure • cannot counteract inhibition of acetylcholinesterase
			TOTAL	**12**	

10.

Question		Expected Answer	Mark	Additional Guidance
10				**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
		1 - 60 to -70 ;		*1* **ACCEPT** any single figure or range (within this range) Must be a negative number
		2 depolarisation ;		
		3 threshold potential / threshold value ;		
		4 all or nothing ;		*4* **ALLOW** all or none
		5 size / magnitude ;		*5* **ALLOW** amplitude **DO NOT CREDIT** intensity / strength / value / potential difference / voltage
		6 frequency ;	6	
		Total	6	

11.

similarities

1 number of different chemicals involved;
2 transported to different part of organism;
3 act on specific cells/ tissues;
4 released from specific cells;

differences

5 greater number of hormones in mammals;
6 move more rapidly to target tissues in mammals;
7 in bloodstream;
8 mammalian hormones produced in endocrine glands;
9 name of gland with correct hormone;
10 many mammalian hormones proteins or steroids;
11 response to hormones faster in mammals / ora;
12 transported in xylem / phloem in plants;
13 can be diffusion / active transport in plants;
14 can act in cells where produced in plants;
15 in plants different concentrations has different effects;
16 example of above eg apical dominance, leaf abscission;
17 plant chemicals active at very low concentrations;
18 no negative feedback in plants;
19 plant chemicals produced in a variety of tissues;
20 often at meristems / dividing cells;
21 example of meristem and chemical; e.g. shoot apical meristem and auxin.
22 synergism often shown in plants / AW;
23 example of synergism; e.g. auxin and GA in stem growth.
24 plant chemicals are acids / terpenes;
25 AVP; e.g.pheromones in animals / scents in plants **7 max**

QWC – clear, well organised, using specialist terms **1**

Question			Expected Answers	Marks
12	(a)	(i)	diameter (of neurone) ; **A** thickness, width **R** diameter of nerve (presence / absence of) myelin (sheath) / Schwann cells / nodes of Ranvier ; **A** myelination, myelinated	**2**
		(ii)	*apply ora throughout* *greater diameter* (due to) less leakage of ions ; ref. to surface area to volume ratio ; *myelin sheath* myelin (sheath) / Schwann cells, impermeable to ions / gives (electrical) insulation ; nodes of Ranvier ; depolarisation occurs at nodes ; **A** description of depolarisation long local circuits ; saltatory conduction ; **A** description of saltatory conduction	**max 3**
	(b)		1/ 0.006 x 0.3 or 0.3 / 0.006 ; 50 ;; *2 marks for correct answer without working.*	**2**
	(c)	1	phospholipid / bilayer, impermeable to K / Na ions ;	
		2	negatively charged, organic ions / protein molecules unable to cross membrane ;	
		3	Na - K pump ;	
		4	active process / ATP used ;	
		5	3 Na ions out ;	
		6	2 K ions in ;	
		7	ions, diffuse / move down gradient ;	
		8	through protein channels ;	
		9	more K ion channels open than Na ion channels / AW ; **A** K ion channels open and Na ion channels closed	
		10	(membrane) more permeable to K ions than Na ions ; **A** relative rates of movement	
		11	(results in) electrical / electrochemical, gradient ; **A** description of gradient	
		12	no net movement of ions / balance between chemical and electrical gradient ;	
			reject sodium / potassium, atoms / molecules once then apply ecf. Allow sodium / potassium unqualified.	**max 7**
			QWC – legible text with accurate spelling, punctuation and grammar;	**1**
			[Total: 15]	

13

[a] **Neither stimulus has reached the threshold potential**

[b] **The stimuli have been applied close together (in time);**

there has been temporal summation

[c] **Neither stimulus is large enough to reach the threshold potential;**

When applied together there is summation;

this is spatial summation;

summation means the threshold potential is reached