A Level OCR Biology

16 Neuronal communication – answers

Question	Answers	Extra information	Mark	AO Spec reference
1(a)	converts stimulus / light energy to action potential / electrical energy ✓	Accept 'chemical energy' instead of 'electrical energy' (because light detection stimulates several events in a cone cell, including a change in retinal's shape, that involve changes in chemical energy)	1	AO2 5.1.3(a)
1(b)	Any three from: sodium ion channels are stretch-mediated / open when (receptor) membrane is stretched ✓ sodium ions diffuse into sensory neurone ✓ (receptor membrane is) depolarised ✓ generator potential ✓ threshold potential reached ✓ action potential passes along sensory neurone ✓	Accept 'Na' for 'sodium' and 'Na^+' for 'sodium ions' throughout	3 max	AO1 5.1.3(a)
1(c)(i)	Any two from: molecule binds to (olfactory) receptor ✓ receptor molecule changes shape ✓ sodium ion channel opens ✓ sodium ions diffuse into sensory neurone / neurone ✓	Accept 'Na' for 'sodium' and 'Na^+' for 'sodium ions' throughout[	2 max	AO2 5.1.3(a)
1(c)(ii)	receptors have different binding sites / shapes / conformations / structures ✓ *idea of* each binding site is specific / complementary to a particular molecule ✓		2	AO2 5.1.3(a)
1(d)	Na^+ ions diffuse into receptor / depolarisation of receptor membrane / generator potential / receptor potential ✓ action potential passes along sensory neurone ✓ *idea of* brain interprets nerve impulses as pain ✓		3	AO2 5.1.3(a)

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Question	Answers	Extra information	Mark	AO Spec reference
2(a)	Any two from: cell body at the end of axon ✓ dendrites on cell body ✓ no dendron ✓	Accept alternative wording	2 max	AO1 5.1.3(b)
2(b)(i)	Any three from: myelination increases conduction speed ✓ *idea that* conduction speed is positively correlated with axon diameter ✓ (increase in) axon diameter has greater effect in myelinated neurones ✓ *idea that* relationship between axon diameter and conduction speed is (almost / approximately) directly proportional in myelinated neurones ✓	Accept reverse argument	3 max	AO3 5.1.3(c)
2(b)(ii)	'conduction speed (m s^{-1} or m/s)' on y axis **AND** 'diameter of axon (μm)' on x axis ✓ appropriate scale ✓ all data points accurate to within half a grid unit **AND** suitable line of best fit ✓		3	AO2 5.1.3(c)
2(b)(iii)	Any two from: (myelin provides) electrical insulation ✓ saltatory conduction ✓ *idea that* depolarisation only occurs at nodes of Ranvier ✓ *idea of* longer local currents ✓		2 max	AO1 5.1.3(b) 5.1.3(c)
2(b)(iv)	increased kinetic energy / diffusion rate of ions ✓		1	AO1 5.1.3(c)
3(a)(i)	Any three from: sodium–potassium pump ✓ 3 Na^+ ions pumped out (of neurone) for every 2 K^+ ions pumped in ✓ (some) K^+ ion channels remain open / (some) K^+ ions leak back out of the neurone ✓ potential difference of −70 mv ✓	Accept - 60 – 75 mv	3 max	AO1 5.1.3(c)

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Question	Answers	Extra information	Mark	AO Spec reference
3(a)(ii)	*idea of* different activity or amount of sodium–potassium pumps ✓ *idea of* different amount of K^+ ion channels ✓		1 max	AO2 5.1.3(c)
3(b)	Any three from: *Purkyne neurone has* lower / less positive action potential peak ✓ shorter duration of action potential / faster repolarisation ✓ more frequent action potentials ✓ Purkyne neurone has hyperpolarisation **AND** CA1 has no clear hyperpolarisation ✓	Accept reverse arguments for the CA1 neurone throughout Accept 'refractory period' for 'hyperpolarisation'	3 max	AO2 5.1.3(c)
3(c)	*idea that* stimulus must be above threshold value to produce action potential ✓ action potential always the same magnitude / shape (in a particular type of neurone) ✓		2	AO1 5.1.3(c)
4(a)	Any three from: *idea of* ensuring impulses travel in one direction ✓ *idea of* (multiple postsynaptic neurones allows) signals to be passed to many effectors ✓ spatial summation / described ✓ temporal summation / described ✓ *idea of* (summation) allows indication of stimulus strength ✓		3 max	AO1 5.1.3(d)
4(b)	3 marks for correct order of **1** **3** **6** **4** **2** **5** ✓ ✓ ✓	If 3 marks are not awarded, allow one mark for 1 and 2 being in the correct boxes and one mark for 5 and 6 being in the correct boxes.	3	AO1 5.1.3(d)

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Question	Answers	Extra information	Mark	AO Spec reference
4(c)	Any three from: acetylcholinesterase ✓ hydrolyses / breaks down acetylcholine ✓ (forming) choline and ethanoic acid ✓ (which) diffuse back into presynaptic neurone ✓		3 max	AO1 5.1.3(d)
5(a)	Any two from: no / fewer nerve impulses ✓ stops sodium ions diffusing into neurones / depolarisation of neurones ✓ no action potentials ✓		2 max	AO2 5.1.3(c)
5(b)	Any two from: more exocytosis of dopamine into synaptic clefts ✓ more dopamine binds to receptors on postsynaptic membranes ✓ more action potentials in postsynaptic neurones ✓		2 max	AO2 5.1.3(d)
5(c)	Any two from: (more) dopamine remains in synaptic clefts ✓ (dopamine) (re)binds to postsynaptic receptors ✓ more action potentials in postsynaptic neurones ✓		2 max	AO2 5.1.3(d)
5(d)	fewer acetylcholine molecules can bind to postsynaptic receptors ✓ fewer action potentials in postsynaptic neurones ✓		2	AO2 5.1.3(d)
6	**Level 3 (5–6 marks)** Outlines the role of receptors in several areas of homeostasis with few or no errors. *There is a well-developed line of reasoning, which is clear and logically-structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.*	**Indicative content**: • An understanding of the interaction between stimuli, sensory receptors and the brain's autonomic areas (e.g., medulla oblongata and hypothalamus).	6	AO1 3.1.2(g) 5.1.1(c) 5.1.1(d) 5.1.2(d) 5.1.3(a)

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Question	Answers	Extra information	Mark	AO Spec reference
	Level 2 (3–4 marks) Outlines the role of receptors in homeostasis with some omissions or errors. *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.* **Level 1 (1–2 marks)** Outlines a role of a receptor in homeostasis. *The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.* **0 marks** No response or no response worthy of credit.	• An outline of the role of the medulla oblongata and receptors in the control of heart and breathing rate (very few details are expected to be known). • The roles of thermoreceptors and the hypothalamus in thermoregulation. • The roles of osmoreceptors and the hypothalamus in the control of water potential.		
7	**Level 3 (5–6 marks)** Describes similarities **and** differences with few or no errors. *There is a well-developed line of reasoning, which is clear and logically-structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.* **Level 2 (3–4 marks)** Describes similarities **and** differences with some omissions or errors. *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.* **Level 1 (1–2 marks)** Describes similarities **or** differences with several omissions or errors. *The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.* **0 marks** No response or no response worthy of credit.	**Indicative content**: *Similarities:* • Both examples of cell signalling • Respond to stimuli • Rely on sensory receptors • Have target cells / effectors *Differences*: • Transmission in blood vs neurones • Neuronal communication is quicker • More widespread response to hormones / more localised response to nerve impulses • Hormonal effects are longer lasting	6	AO1 5.1.3 5.1.4

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Skills box answers

Question	Answer
1	Drawn in pen – should be pencil Lines too thick Lines too rough Lines uneven
2