OCR GCSE 21ST CENTURY BIOLOGY B · J257

BIOLOGY



MARK SCHEME

B5.2 HOW DOES THE NERVOUS SYSTEM HELP US RESPOND TO CHANGES? (HIGHER)

SCORE	PERCENTAGE
/59	%

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					answer **Examiner's Comments** Amy was the answer given by over half of candidates. If incorrect, Orla and Cillan were the most frequent incorrect responses. Simon's explanation was recognised by almost all candidates as being incorrect.
	c		stepping / grasping / sucking	1	**accept** any **newborn** reflex e.g. Babinski's reflex/ tonic neck reflex/ rooting/ startle/ moro/ gasping/ suckling/ crying/ bradycardic response (swimming under water without breathing)/ curling feet **Examiner's Comments** Many responses were acceptable for this item. The majority of candidates obtained the mark and concluded the paper with a positive outcome. A minority of candidates had not read the question carefully enough, and did not realise they were to give new-born responses.
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
2			**Level 3 (5-6 marks)** Correctly identifies point(s) from four areas. Quality of written communication does not impede communication of the science at this level **Level 2 (3-4 marks)** Correctly identifies point(s) from two areas Quality of written communication partly impedes communication of the science at this level **Level 1 (1-2marks)** Correctly identifies point(s) from one area. Quality of written communication impedes communication of the science at this level **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of	6	**This question is targeted at grades up to A*** **Identifies part of the neuron affected** • myelin / fatty sheath **Identifies role of the part of the neuron affected** • **insulation / insulating** (from neighbouring cells) • (presence) increases speed of transmission of **electrical/nerve impulse** • (idea of) prevents **electrical/nerve impulse** being lost/interference **Impact on transmission** • (idea of) (less sheath so) less insulation • (idea of) slower/reduced/weakened/no transmission of **electrical/nerve impulse** **Possible effect on individual** • (idea that) motor neuron leads to a muscle / effector • could affect movement/reactions/ coordination • could affect walking, grip, facial expressions, involuntary movement • Accept any sensible effect **ignore** reference to damaged neurons **Examiner's Comments** Most candidates answered this question well. This question enabled candidates to demonstrate their knowledge of neuron structure and function, with many identifying the fatty/myelin sheath, although fewer understanding its role in insulation, with the impact on transmission awarded less frequently than the other areas. Many

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Question			Answer/Indicative content	Marks	Guidance
					were able to identify the visible effect of multiple sclerosis on this structure. However, some struggled to explain the normal functioning of the neuron, often without the correct use of terminology such as *electrical*/*nervous* impulse, with many candidates mentioning signals, messages or just impulses, which did not allow them to gain credit. This was unfortunate since it prevented these candidates from obtaining marks for two out of the four areas upon which the mark scheme was based. Many candidates showed a good understanding of the overall impact of multiple sclerosis on the control of body movement, providing most candidates with the opportunity to gain marks.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
3	a	i	Cerebral cortex	1	**Accept** cerebrum / cerebral hemispheres / pre – frontal cortex Examiner's Comments Most candidates correctly managed to name the cerebral cortex. There were some candidates however that did not attempt it at all and cerebellum was probably the most common incorrect response. A few candidates struggled to find the correct terminology and resorted to 'speech centre'.
		ii	*any one from* idea of some children (are found when they) are too old to learn language skills / Idea that language develops at an early age: idea of neurone pathways (for language) form earlier in life / neurone pathways (for language) less likely to form later in life / neurone pathways (for language) not formed	1	**Ignore** memory **Accept** up to 10 years Examiner's Comments ??The most common misconceptions related to neural pathways dying or not being used, failing to link language skills to age, saying they were too old to learn but not linking it to language or vague statements along the lines of there being 'no one around to teach them'. The lack of specific details cost many candidates marks as many were at least partway there with their responses. A few candidates used connections rather than neurone pathways.

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Question			Answer/Indicative content	Marks	Guidance
	b		*any two from* electrical stimulation is invasive / MRI scans are not invasive; electrical stimulation has risk / MRI has less risk; electrical stimulation could harm / damage (named) parts of the brain / cause infection / death / pain OR MRI causes less or no damage etc;	2	**ignore** references to ethics / religion **accept** description of invasive, such as need to cut the skull / inserts electrodes into the brain **Accept** dangerous **Ignore** not safe / no risk **Ignore** side effects Examiner's Comments Often students repeated the reverse of their primary statement, usually related to 'damage the brain' or 'harmful' and therefore only scored one mark. Some candidates failed to score because they simply referred to damage without specifying the brain. Surprisingly, not many candidates got the mark for electrical stimulation being invasive, and many did not know what a MRI scan actually was as they sometimes linked it to using radiation. There were also some comments about MRI being safe, more trusted and ethical arguments about consent.
			Total	4	

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Question			Answer/Indicative content	Marks	Guidance
4			[Level 3] Some detail of nervous pathway involved and may include description of squirrel behaviour Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Ref. to sense organ / receptor / brain / nerves / muscles and may include some description of squirrel behaviour Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Description of squirrel behaviour OR why it does it Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	• receptors • sensory neuron • processing centre • coordination • motor neuron • effector / muscle / gland • (epinephrine) Indicative scientific points may include: • impulses are electrical • impulses are fast • impulses are short lived • reference to synapses • relevant suggestion of what squirrel does • explanation of why squirrel does it / idea of increased survival. Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments In this question candidates were asked to suggest why a predator appearing causes a rapid response in a squirrel and to describe the processes that occur to allow the response to happen. Most pupils answered this very well, with many scoring 6/6 marks. Clear knowledge of the neuron pathways from receptor through to effector was demonstrated by many. Very strong answers included references to muscles as effectors as well as glands producing adrenaline. Few candidates referred to the properties of impulses (electrical, fast, short-lived) or to synapses. Weaker answers simply stated that the squirrel would 'run away' or 'see the predator and run'. Some responses referred to the 'eyes' or 'ears' of the squirrel and to the brain, but details of the pathway were either not given or were incorrect. Common mistakes included students referring to conditioning in the response and association of the

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Question			Answer/Indicative content	Marks	Guidance
					predator with previous confrontations.
			Total	6	
5			Nerve impulse sent from brain; (impulse) to motor neurone / muscle / effector (in arm);	2	Ignore messages / signals Examiner's Comments Candidates were asked for an explanation as to how the brain can over-ride a reflex to drop a hot plate. This was answered poorly by most candidates. Some suggested that the brain could stop the pain receptors from detecting the pain, others simply stated that the brain 'chose to keep hold of the plate', others said that the brain could modify the reflex arc / stop the motor neuron from sending a message. A small number of pupils were able to state that the brain sent a message to the muscles in the hand to keep hold of the plate. Very few candidates were able to state that the brain sent an impulse to the effector. Signal and messages were the imprecise terms used by candidates. Candidates also answered along the lines that the impulses would arrive at the brain and be either rerouted, stopped altogether or modified to make the impulse far less intense as a result, and so the effector would not respond. Others thought that through repetition you would gradually be able to get used to the pain and hence keep hold of the plate.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
6	a		Any two from: A / flashing lights OR C / hearing music, is sensory; B / movement / muscle / effector is motor; C is not lower back / B is not upper front ora; Not enough information to be certain / AW;	2	Examiner's Comments This question asked candidates to comment on two conclusions a student made regarding the results of an experiment where different areas of the brain were stimulated. Not many candidates were able to gain full marks for this question but the question was answered well by the stronger candidates who were able to link 'flashing lights' and 'sounds' to a sensory response and movement to a motor response. Weaker candidates found this difficult to express, with some simply rephrasing parts of the question and some simply stating that they agreed. Some candidates related the conclusions to their own knowledge of the functions of parts of the brain but didn't comment on the results that the conclusions were based on. Others gave confused answers that tried to relate the conclusions to the reflex arc and not the results. Some candidates linked to motor and sensory neurons. Some students did reference the fact that there were not enough results / information to make accurate conclusions. Very few commented on the positions of the letters but those that did mostly linked this to the 'not enough information' marking point.

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Question			Answer/Indicative content	Marks	Guidance
	b		<table><tr><td>SSRIs break down serotonin molecules.</td><td></td></tr><tr><td>SSRIs stop serotonin from being produced.</td><td></td></tr><tr><td>SSRIs block sites where serotonin is removed from the synapse.</td><td>✓</td></tr><tr><td>SSRIs stimulate the serotonin receptor sites on the second neuron.</td><td>✓</td></tr><tr><td>SSRIs slow down the production of serotonin.</td><td></td></tr><tr><td>SSRIs have a similar effect to serotonin.</td><td>✓</td></tr><tr><td>SSRIs are rapidly broken down in the synapse.</td><td></td></tr><tr><td>SSRIs effects are due to an increased serotonin concentration in the synapse.</td><td>✓</td></tr></table>	3	4 correct = 3 marks 3 correct = 2 marks 2 correct = 1 mark Each extra tick negates one correct tick **Examiner's Comments** This question asked candidates to tick boxes about statements linking to SSRIs. The question was generally well answered with many scoring 2 or 3 marks. Nearly all picked up at least 1 mark for this with some ticking more than 4 boxes and losing a mark. Common mistakes were incorrectly ticking the 1st and 5th boxes showing a misunderstanding of how SSRI's affect serotonin.
	c		*Any two from:*Idea that patient may not benefit directly; Patient may be harmed; Idea of informed consent / patient cannot give consent;	2	**Examiner's Comments** In this question candidates were asked to discuss ethical issues associated with using brain damaged patients for research. This was answered well in the main, with the majority of pupils either mentioning the idea of informed consent (some expressing this as the patient not being aware or understanding) and / or harming the patient further. Few candidates were able to express the idea that the patient may not benefit directly from the research. Some candidates clearly didn't understand the concept of 'ethical issues' with some mentioning problems with obtaining reliable results. Others simply stated that it was 'disrespectful' or that people would object due to 'religious reasons'.
			Total	7	

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Question			Answer/Indicative content	Marks	Guidance
7	a		effector ? produces / creates the **response** processing centre ? receive information / coordinate responses receptor ? to detect stimuli	2	**3 correct responses = 2 marks** **1 or 2 correct responses = 1 mark** **accept** named example ? muscle contraction / gland secretion / creates action **reject** reference to stimulus **ignore** causes a change **ignore** spinal cord / CNS but **reject** brain / decides **accept** 'tells effector what to do' **ignore** processing **accept** reacts to stimulus **Examiner's Comments** Many candidates struggled to complete the three features listed in this question. Some candidates correctly described the function of the receptor but many were challenged with the function of both the effector and processing centre.
	b	i	**any three from** neuron B has highest (mean) value / neuron B has two highest values (104 & 91)/neuron C has lowest result and so it is not C ; idea of outlier / value 104/ 4th result in data for neuron B ; outlier increased mean for neuron B / correct recalculation of the mean for neuron B (79) ; range of B is large / much more variation in data for B (compared to A) ; the value of B is only slightly above A / the two ranges overlap / idea of no real difference ; a number of values in A are greater than some in B	3	if arguments **only** in support of **neuron A** = 2 marks **accept** reverse argument **Examiner's Comments** Most candidates presented a good analysis of the data, with particular reference to the higher mean value for neuron B. It was encouraging to note the level of analysis by candidates with regards to outliers and the consistency of data values within each range.

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Question			Answer/Indicative content	Marks	Guidance
		ii	prevents **impulses leaving** the neuron (1) prevent **impulses entering** from an adjacent neuron (1)	2	**reject** messages / electricity / signals **ignore** mixed up / speeding up **accept** 'interfering' with other neuron = 1 max. **Examiner's Comments** This question was challenging for many candidates. Many candidates had difficulty in articulating the problem of impulses leaving and/or entering neurons without the myelination. Some candidates referred generally to the mixing of impulses without further description.
	c		**Level 3 (5–6 marks)** Good suggested **explanation** of why impulse is one-directional AND **linked** to description of events at the synapse. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Good **detailed description** of events at the synapse. Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** Good **basic description** of events at the synapse. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to A*** **Indicative scientific points may include:** **Explanation of one-way transmission** • only the sensory neuron (not the relay neuron) can produce / release the chemicals / transmitter substances • only the relay neuron (not the sensory neuron) membrane contains the receptor molecules needed to trigger an impulse. • only the sensory / first neuron has reuptake channels / sites for (breakdown products of) chemicals / transmitter substances **Description of events at synapse** *Detailed* • impulse causes release of chemicals / transmitter substances • chemicals / transmitter substances diffuse across the gap • chemicals / transmitter substances bind to receptor molecules on the membrane of the relay neuron • only specific chemicals can bind to the receptor molecules

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Question	Answer/Indicative content	Marks	Guidance
			• when bound to the receptor molecules the chemicals trigger / initiate a nerve impulse at the membrane of the relay neuron • chemicals / transmitter substances broken down / reabsorbed (into sensory / first neuron) *Basic* • synapse is a gap between adjacent neurons / between the sensory and relay neuron • sensory / first neuron releases chemicals into gap • impulse carried across the synapse / gap • chemicals cause an impulse at relay / second neuron Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments Some excellent responses were given for this question with good descriptions of neurotransmitter/chemical release, diffusion and recognition at the receptor sites. However, most candidates struggled to describe the basis of the one-way direction of the impulse at the synapse. Many candidates were unable to identify the basic feature of synaptic operation but did recognise that synapses represent a gap and that chemicals were involved in transmission at this site.
	Total	13	

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Question			Answer/Indicative content	Marks	Guidance
8	a		only one / the first neuron releases the chemical / transmitter substance (1) only one / the second / next neuron has the receptor (sites / molecules) (1)	2	must be clear that there are two separate neurons – one releasing the chemical and one with receptors **allow** pre-synaptic neuron **allow** one side of the synapse releases the chemical **allow** post-synaptic neuron **allow** one side of the synapse has receptors **ignore** nerve **ignore** sensory / motor **ignore** ref to reuptake Examiner's Comments This question either seemed to gain two marks or zero marks. Some candidates clearly described the process of neurotransmitter release from the first neurone and the presence of receptors on the second. Other responses were very confused and it was often unclear as to how many neurones candidates were talking about. Some candidates gave detailed and correct information about nerve impulses and neurones but failed to answer the question and focus on how the neurones and synapses ensure that the impulse only moves in one direction. A few candidates even described neurones travelling.
	b		cerebral cortex / cerebral hemisphere / ~~cerebrum / frontal lobe (1)~~	1	
			Total	3	Examiner's Comments The majority of candidates correctly named the ‘cerebral cortex’ as the part of the brain most likely to be affected by the early stages of Alzheimer's disease.

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Question			Answer/Indicative content	Marks	Guidance
9	a		*any two from:* involuntary / automatic / without thinking; rapid / fast / quick / immediate; short-lived / doesn't last long;	1	two answers required for one mark Examiner's Comments It was perhaps surprising to see many candidates perform quite badly on this question. Very few seemed able to give two features of a reflex action, with many giving examples of a reflex, e.g. blinking, sneezing, or describing the same feature in two ways, e.g. 'involuntary' and 'without thinking'.
	b	i	A – receptor; B – sensory neuron; D – motor neuron; E – effector / muscle;	3	5 correct responses = 3 marks 3 or 4 correct responses = 2 mark 2 correct responses = 1 marks 0 or 1 correct responses = 0 marks if 'neuron' is missing throughout, deduct one mark **allow** nerve / nerve cell for neuron throughout ignore CNS **allow** effector neuro Examiner's Comments
			… no processing of information is required. ✓ [ ] [ ] [ ]	1	if more than one box is ticked = 0 marks Examiner's Comments The majority of candidates correctly ticked the top box, identifying the advantage of the fixed pathway as 'no processing is required'.
			Total	**5**	

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>10</td><td>a</td><td>i</td><td><table><tr><th>Area of brain</th><th>Function</th></tr><tr><td>A</td><td>Responsible for conscious movement.</td></tr><tr><td>B</td><td>Responsible for intelligence, memory, consciousness and language.</td></tr><tr><td>C</td><td>Responsible for regulation or heart rate and breathing rate.</td></tr></table></td><td>2 (AO 1.1 x 2)</td><td>3 correct answers = 2 marks
2 or 1 correct answers = 1 mark
If candidate gives the same answer for all three areas award 0

ALLOW correct names e.g.
A – Cerebellum
B – Cerebral cortex
C – Brain stem</td></tr>
<tr><td></td><td></td><td>ii</td><td>Any one from:

they may not be able to give (informed) consent ✓

may cause further damage✓</td><td>1 (AO 1.1)

1 (AO 1.1)</td><td>ALLOW ethical considerations

DO NOT ALLOW imaging techniques

ALLOW MRI , CT/CAT scan, PET and EEG</td></tr>
<tr><td></td><td></td><td>iii</td><td>Any one from:use fMRI ✓use electrical stimulation ✓</td><td></td><td>Examiner's Comments

Questions 3 (a) (i), (ii) and (iii) were all focussed on the functions of the brain and how we are able to study these functions. Part (a) (i) should have been relatively straightforward but did cause candidates some difficulty with many only scoring 1 mark, often for correctly identifying B (cerebral cortex) as being responsible for intelligence, memory, consciousness and language. In part (a) (ii) most candidates scored a mark for either stating informed consent may not be possible or further damage could be caused. Ideally for Part (a) (iii) we were looking for the role of fMRI in imaging or electrical stimulation, however this was not seen as frequently as we would have liked. Centres should be encouraged to discuss the role of MRI in studying the brain. Candidates that did not gain credit on this question often suggested the use of animal brains or dissection of human brains.</td></tr>
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Question			Answer/Indicative content	Marks	Guidance
	b		(Quickly) axon has fatty sheath / is insulated/myelinated ✓ (Long distances) Long **axon** ✓	2 (AO 1.1 x 2)	IGNORE reference to dendrites and synapses Examiner's Comments Few candidates gained both marks for this question. The fatty sheath was the answer that was seen most frequently. Many candidates did not to score the second mark for stating the neuron was long rather than the axon, this was unfortunate as the clearly did have an understanding of the structure of a neuron, but their answer lacked precision. Synapses and dendrites were often referred to, suggesting candidates did not read the question carefully.
	c	i	Relay and motor neurons ✓	1 (AO 2.1)	
		ii	Diffusion ✓	1 (AO 1.1)	Examiner's Comments When answered incorrectly, active transport was a common error.
		iii	Unspecialised/undifferentiated cells / can differentiate/specialise into neurons/other types of cell✓	1 (AO 1.1)	Examiner's Comments This question was answered very well. Those that lost the mark did so for a description of an unspecialised cell, for example it can become any type of cell, or it can become a nerve cell rather than using the correct term(s), (unspecialised/undifferentiated or can specialise/differentiate).
			Total	9	

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