OCR GCSE GATEWAY BIOLOGY A · J247

BIOLOGY



MARK SCHEME

B3.1 COORDINATION AND CONTROL: THE NERVOUS SYSTEM

SCORE	PERCENTAGE
/141	%

STEMUP

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Question			Answer/Indicative content	Marks	Guidance
1			B	1	
			Total	**1**	
2			B	1	
			Total	**1**	
3	a		detected by receptors in skin (1)	1	To gain marks these need to be in correct sequence
			impulse sent along sensory neurone (1)	1	
			to spinal cord / CNS (1)	1	
			impulse sent along motor neurone (1)	1	**ignore** brain
			to (hand / arm) muscles / effectors (1)	1	
	b		to avoid (further) damage (1)	1	**allow** ora
			the reaction needs to be rapid (1)	1	
			the brain would slow down the reaction time (1)	1	
			Total	**8**	
4			D	1	
			Total	**1**	
5			D	1	
			Total	**1**	
6	a		detected by receptors in skin (1)	1	to gain marks these need to be in the correct sequence
			impulse sent along sensory neurone (1)	1	
			to spinal cord / CNS (1)	1	
			impulse sent along motor neurone (1)	1	**ignore** brain
			to (hand / arm) muscles / effectors (1)	1	
	b	i	conclusion: as diameter increases so does speed of impulse (1)	1	
		i	but there are exceptions e.g. all speeds for B are greater than for C even though the diameters overlap (1)	1	must include example, but **allow** other valid examples from data

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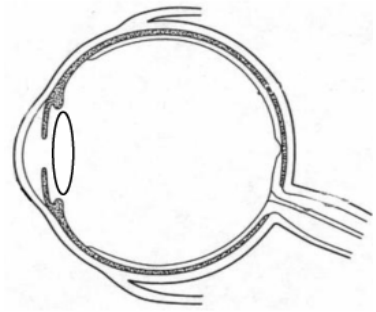
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Question			Answer/Indicative content	Marks	Guidance
		ii	cannot make a (valid) conclusion (1)	1	
		ii	although D has lowest speeds it also has the smallest diameter (and the results might be due to this) (1)	1	
			Total	9	
7			smell (of person) (1) wings / wing muscles (1)	2	**allow** scent **ignore** muscles unless correctly qualified **Examiner's Comments** Generally well answered. Where candidates gave generic muscle / gland responses they didn't score. These needed to be linked to the wings to gain credit. The stimulus was more often correct, but common errors were nose, humans and blood.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
8			fast (1) automatic (1)	2	**allow** quick / rapid **allow** unlearned **allow** you do it without thinking / unconsciously **ignore** 'it just happens' **allow** the response is always the same (1) **Examiner's Comments** Some candidates misread the question and described examples of other reflexes or explained the benefits of reflexes. Those who did correctly explain that reflexes are fast and automatic usually only gave one of these ideas, the former being the most common.
			Total	2	
9			<table><tr><td>peripheral nervous system</td><td></td></tr><tr><td>sense organs</td><td></td></tr><tr><td>central nervous system</td><td>✓</td></tr><tr><td>circulatory system</td><td></td></tr></table>	1	more than one answer =0
			Total	1	
10				1	Needs to be in the correct position but not necessarily an ovoid shape
			Total	1	

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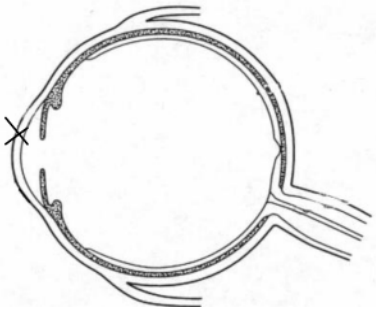
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Question			Answer/Indicative content	Marks	Guidance
11	a	i	bat (1)	1	
		ii	hippopotamus (1)	1	
		iii	(yes – no mark) **any two from** the line does show the trend / the line does show that as body mass increases, brain mass increases (1) the trend does seem to go in a straight line (1) there are the same number of points / four points above and below the line (1)	2	no = award no marks for answer
	b	i	8 (g) (2) But $\frac{2.5 \times 320}{100}$ (1)	2	correct answer but no working = 2
		ii	**any two from** as body mass increases, brain mass increases / ORA (1) as body mass increases, **relative** brain mass decreases / ORA (1)	2	**ignore** high or low must be comparative **ignore** references to 'larger' body mass and brain mass increases as **relative** brain mass decreases = 2

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Question			Answer/Indicative content	Marks	Guidance
		iii	(no) idea that brain mass is higher than expected (1) idea that **relative** brain mass is higher than expected (1)	2	if yes answer then award zero marks **allow** have an abnormally high brain mass (1) **allow** comparison e.g. have a lower body mass than gorilla / elephant but higher brain mass (1) **allow** ratio of brain mass to body mass is higher (1) **allow** ratio of body mass to brain mass is lower (1) **ignore** just 'humans have a high(er) brain mass' **allow have an abnormally high relative** brain mass (1) **allow** comparison e.g. have a lower body mass than gorilla / elephant but higher **relative** brain mass (1) **ignore just 'humans have a high(er) relative** brain mass' **ignore** just 'they don't fit the pattern'
			Total	10	
12		i		1	The centre of the X must be on the cornea **allow** label line that touches cornea
		ii	a person can see / focus on objects that are distant to them (1) but cannot see / focus on close objects (1)	2	**allow a person can only** see / focus on objects that are distant to them = (2) **ignore** see things in longer distance
			Total	3	

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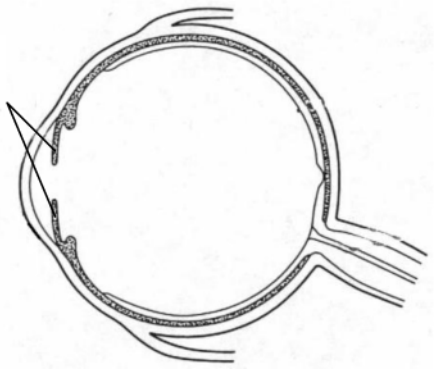
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Question			Answer/Indicative content	Marks	Guidance
13	a	i	**any two from** as body mass increases, brain mass increases / ORA (1) as body mass increases, **relative** brain mass decreases / ORA (1)	2	**ignore** high or low must be comparative **ignore** references to 'larger' body mass and brain mass increases as **relative** brain mass decreases = 2
		ii	(no) idea that brain mass is higher than expected (1) idea that **relative** brain mass is higher than expected (1)	2	if yes answer then award zero marks **allow** have an abnormally high brain mass (1) **allow** comparison e.g. have a lower body mass than gorilla / elephant but higher brain mass (1) **allow** ratio of brain mass to body mass is higher (1) **allow** ratio of body mass to brain mass is lower (1) **ignore** just 'humans have a high(er) brain mass' **allow** have an abnormally high **relative** brain mass (1) **allow** comparison e.g. has a higher body mass than chimpanzee but higher **relative** brain mass (1) **ignore** just 'humans have a high(er) **relative** brain mass' **ignore** just 'they don't fit the pattern'

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Question			Answer/Indicative content	Marks	Guidance
	b		(no) the points are scattered (1) (no) at any particular brain size there are people with a range of IQs / ora (1) (yes) lots of anomalies (1)	2	**allow** (no) as no pattern / no correlation (1) **allow** (yes) there is a (slight) positive correlation (1) **allow** (yes) the higher the brain size the higher the IQ / ora (1) **allow** (no) some people with small brains have higher IQ (than those with large brains) (1) **allow** (no) some brains are larger but IQ isn't as high (as expected) (1) **allow** the higher the brain size the higher the IQ for large brain sizes only (2)
			Total	6	
14	a		X 	1	**allow** X drawn over part of iris, centre of X must be on the iris **allow** only one side correctly labelled
	b		it bends / refracts / focuses the light less (1) light focused behind the retina / only light from distant objects is focused on the retina (1)	2	**allow** can't focus on near objects as this requires more refraction
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
15	a	i	mode = 0.26 (seconds) ✓	1 (AO 2.2)	Examiner's Comments This question assessed AO2.2. Most had the correct response to this question. Occasionally candidates would forget the decimal point and put 26 or 0.25 as their answer.
		ii	(means are identical so) no difference between reaction time in each hand ✓ (mode shows) non–dominant hand most often faster reaction✓	2 (AO 2 x 3.2b)	ALLOW they are very similar to each other ALLOW left side quicker/better to catch ruler Examiner's Comments This question assessed AO2.2. Most had the correct response to this question. Occasionally candidates would forget the decimal point and put 26 or 0.25 as their answer.
	b		include the units✓ record results in rank order✓	2 (AO 2 x 3.3b)	ALLOW put seconds in headings ALLOW sort the order Examiner's Comments This question set out to assess AO3, analyse information to improve experimental procedures, specifically related to recording data. Few candidates responded to the question in terms of improving the recording of their results. Most included experimental design elements to increase reliability or accuracy but not the actual recording of the data. Some candidates correctly identified that recording raw data of distance would be valuable (for peer review) and higher ability candidates did recognise that rank ordering the data would have improved the recording to help the mode calculation.

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Question			Answer/Indicative content	Marks	Guidance
	c		use ten left (dominant) hand students / ten right (dominant) hand students✓ opposite non–dominant hand tested for left/right handedness✓ Any one from: similar sample sizes / similar aged groups✓ compare means for each group✓	3 (AO 3 x 3.3a)	ALLOW add another table where student is left handed ALLOW same reaction room ALLOW compare reaction times for each group ALLOW set amount of left/right handed people <u>Examiner's Comments</u> This question assessed AO3, analysis of information to improve experimental procedures. Very few candidates identified the need to keep the number of left/right (dominant) handed the same as in the experiment. Even fewer suggested testing the non-dominant hand. However, many candidates did gain marks for comparing the means.
	d		sight✓	1 (AO 2.2)	ALLOW visual ALLOW to see when it's coming ALLOW light IGNORE eyes <u>Examiner's Comments</u> The question assessed AO2.2. Very few candidates identified that sight/light was the stimulus, many referring to the distance the ruler dropped. This indicates a lack of understanding of what a stimulus is, linked to the receptors involved.
	e		receptor✓ motor neurone✓	2 (AO 2 x 1.1)	correct order needed <u>Examiner's Comments</u> The question assessed recall AO1.1 for the structure of a reflex arc. Where candidates gained marks, it was usually for the motor nerve. Some also got the receptor but, there were instances where candidates couldn't quite recall the correct name and words like reaction and reactor were seen.
			Total	11	

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Question			Answer/Indicative content	Marks	Guidance
16			brain✓ egg✓ oestrogen✓ progesterone✓	4 (AO 4 x 1.1)	ALLOW estrogen Examiner's Comments Here AO1.1 recall was assessed for the role of hormones in the menstrual cycle. Most candidates gained one mark for the egg. Some also identified the brain and some got all four marks. However, occasionally candidates unfortunately got the two hormones the wrong way around.
			Total	4	

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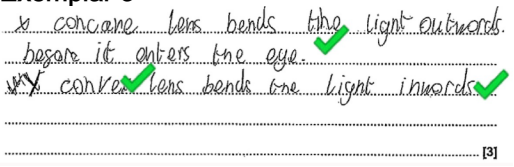
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Question			Answer/Indicative content	Marks	Guidance
17	a		pupil has dilated (in diagram B)✓ radial muscles contracted✓ to allow more light into the eye✓	3 (AO 2.1) (AO 1.1) (AO 1.1)	ALLOW pupil is larger IGNORE eyes / iris dilated ALLOW reflex action has occurred <u>Examiner's Comments</u> Candidates needed to recall details of how light entering the eye is controlled and apply this to the situation described in the question to be successful. Candidates often got mixed up in describing changes moving from the beach to the café. Although many could describe the change in size of the pupil few could explain how it happens. Radial muscles were not mentioned and where muscles were mentioned this was usually incorrect as they referred to ciliary muscles and suspensory ligaments. The understanding that this was a reflex action was rarely seen.
	b	i	person **X** is short–sighted✓ person **Y** is long–sighted✓	2 (AO 2 x 2.1)	ALLOW person X is myopic / has myopia ALLOW person Y is hypermetropic / has hypermetropia (hyperopia) <u>Examiner's Comments</u> The question assessed application of knowledge of eye defects. Most candidates referred to short sighted and long sighted with many identifying the correct person. However, some identified the defects but made the incorrect choice of person.

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Question			Answer/Indicative content	Marks	Guidance
		ii	person X concave/divergent lens **and** person Y convex/convergent lens✓ idea that concave lenses diverge light rays / person X needs a lens to diverge light rays (before they enter the eye)✓ idea that convex lenses converge light rays / person Y needs a lens to converge light rays (before they enter the eye)✓	3 (AO 1.1) (AO 2 x 2.1)	**ALLOW** minus powered lens **ALLOW** plus powered lens **Allow** diagram showing lens diverging light  **Allow** diagram showing lens converging light  Must be stated which diagram refers to which lens or person. <u>Examiner's Comments</u> Candidates needed to recall the appropriate lenses required to correct the eye defects and explain how these lenses work to gain maximum marks. The identification of the corrective lenses was achieved by higher ability candidates, but it was very rare to see anyone demonstrate an understanding of how these corrective lenses work. Both corrective lenses needed to be correctly identified to score the first marking point and some candidates only managed to identify one. **Exemplar 3**  This exemplar indicates that the candidate clearly understands what is happening to light rays after passing through the corrective lens. Although they have not used the correct terminology of diverging and converging, credit has been given to the descriptions of what is happening to the light rays. The marks awarded for an

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Question			Answer/Indicative content	Marks	Guidance
					explanation of how the lenses work could have been gained from a diagram, but this type of response was not seen.  This could be an area for candidates to develop their examination technique to recognise when diagrams could support an answer, if they find difficulty in writing down their ideas.
			Total	8	
18		i	(the allele) is recessive ✓	1 (AO 2.1)	ALLOW neither dominant Examiner's Comments Candidates need to apply their knowledge and understanding of genetics to achieve this mark. It differentiated well with the higher ability candidates' understanding that the allele is recessive. The majority of candidates referred to the number of eyes, and that they need two to become stronger / dominant, which did not gain credit.
		ii	The retina is damaged/doesn't function ✓	1 (AO 1.1)	ALLOW retina detects light / focuses the image / contains light receptors Examiner's Comments This was a well differentiated question. The majority of lower ability candidates did not gain the mark as common answers were too generalised such as 'it affects the eyes'.
			Total	2	

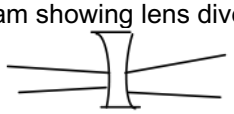
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Question			Answer/Indicative content	Marks	Guidance
19	a		pupil has dilated (in diagram B) ✓ radial muscles contracted ✓ to allow more light into the eye ✓	3 (AO 2.1) (AO 1.1) (AO 1.1)	ALLOW pupil is larger IGNORE eyes / iris dilated ALLOW reflex action has occurred <u>Examiner's Comments</u> Many candidates gained two marks here for the dilation of the pupil and the need to increase the ability of light to enter the eye. There were a significant number of candidates that tried to link this to the action of the ciliary muscles, rather than the radial muscles of the iris.
	b	i	person **X** is short-sighted ✓ person **Y** is long-sighted ✓	2 (AO 2 × 2.1)	ALLOW person X is myopic / has myopia ALLOW person Y is hypermetropic / has hypermetropia (hyperopia)

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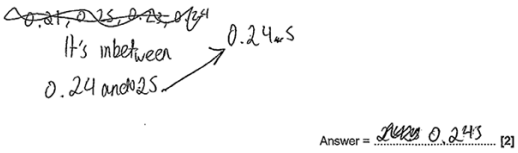
Question			Answer/Indicative content	Marks	Guidance
		ii	person X concave/divergent lens **and** person Y convex/convergent lens ✓ idea that concave lenses diverge light rays / person X needs a lens to diverge light rays (before they enter the eye) ✓ idea that convex lenses converge light rays / person Y needs a lens to converge light rays (before they enter the eye) ✓	3 (AO 1.1) (AO 2 × 2.1)	**ALLOW** minus powered lens **ALLOW** plus powered lens **Allow** diagram showing lens diverging light  **Allow** diagram showing lens converging light  Must be stated which diagram refers to which lens or person. <u>Examiner's Comments</u> Many candidates could correctly state the type of lens needed to correct each eye defect. For 'explain how the lens works', the most common error was to refer to the extent of bending or refraction of the light rather that the direction of the refraction. This is seen in exemplar 3, which would gain 1 mark. Exemplar 3 X, needs concave lenses, because the focus is before the retina. concave lenses partially refract the light less, letting the focus be on the retina. Y, needs convex, because the focus is after the retina, so it refracts the light more. [3]
			Total	8	

Question			Answer/Indicative content	Marks	Guidance
20	a	i	**Any two from:** idea that ruler release height is not standardised ✓ idea that release of ruler may cause uneven fall ✓ It (is the distance measured but time recorded) requires a calculation / may lead to conversion errors ✓ distance apart of fingers is not standardised ✓ fingers cover a range of different readings ✓ anticipation is possible / may learn to expect when it will be dropped ✓	2 (AO 2 × 3.3a)	 eg may fall sideways IGNORE simply readings taken incorrectly ALLOW does not specify which part of finger is measured
		ii	stimulus is randomised ✓ **time** rather than distance measured / no calculation needed ✓ **and any two from:** improvements could include: randomising left and right hand ✓ making each target number same distance to move to / same distance from the start button ✓ randomising the delay time before the number flashes ✓ use a touch screen to avoid moving the mouse ✓	3 (AO 3.2a) (AO 2× 3.3b)	IGNORE it uses a computer so its accurate <u>Examiner's Comments</u> A number of candidates could identify a reason why method two was better than method one. They often went on to state a problem with method two but did not suggest an improvement.

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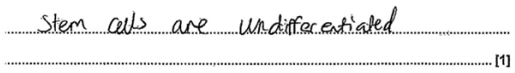
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Question			Answer/Indicative content	Marks	Guidance
	b	i	First check answer on answer line If answer = 0.25 award 2 marks list in rank order / selects correct 5th and 6th values ✓ $\frac{0.25+0.25}{2} = 0.25$ ✓	2 (AO 2 × 2.1)	IGNORE decimal place for the list in rank order Examiner's Comments Most candidates appreciated that the median is the middle value but then a significant number did not put the figures in order first and so therefore calculated a value between 0.24 and 0.25. This error is seen in exemplar 5. Exemplar 5 
		ii	Any two from: there is no difference in reaction times between left (non-dominant) hand and right (dominant) hand✓ mean and the median are the same for both hands / the same for the right (dominant) hand ✓ results from right (dominant) hand have a wider range (than left (non-dominant) hand) ✓	2 (AO 2 × 3.1a)	ALLOW ECF from b) ALLOW ORA Do not credit marks for reference to right and left handed students in each marking point. Examiner's Comments A small number of candidates incorrectly thought that the experiment was comparing right-handed and left-handed people and so lost marks here.

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Question			Answer/Indicative content	Marks	Guidance
	c	i	(skin stem cell) differentiates into (motor) neurone ✓	1 (AO 2.2)	ALLOW differentiates into MN (taken from abbreviation of motor neurone disease to MND in stem of question) Examiner's Comments This question was referring to the ability of stem cells to be able to produce nerve cells that could be used to measure the speed of impulses. Most candidates did not refer to nerve cells in their answers. This is shown in exemplar 6, which gained 1 mark. Exemplar 6  [1]
		ii	cerebru ✓ idea that area of brain controlling motor function / movement / conscious activities ✓	2 (AO 1.1) (AO 2.1)	ALLOW cerebral cortex / motor cortex IGNORE it is the area that coordinates reactions. DO NOT ALLOW a list of correct functions of the cerebrum without the importance of movement being highlighted Examiner's Comments The region labelled Y was correctly identified by many candidates, although there was some confusion with the cerebellum. The explanation did not always gain marks, as many candidates simply listed all the functions of the cerebrum.
		iii	Any two from: difficult to access brain (due to skull) ✓ large number of neurones / large number of nerve impulses in the brain/ difficult to follow a single neurone ✓ ethical issues of researching on brain / risk of damage ✓	1 (AO 2 × 2.2)	IGNORE difficult to take measurements in brain unless qualified Examiner's Comments There were many correct references to the difficulty of access to the brain and the risk of damage. Some candidates incorrectly referred to differences in conduction velocities in the two types of cell.
			Total	14	

Question			Answer/Indicative content	Marks	Guidance
21		i	<table><tr><td></td><td>R</td><td>r</td></tr><tr><td>R</td><td>RR</td><td>Rr</td></tr><tr><td>r</td><td>Rr</td><td>rr</td></tr></table> correct gametes ✓ correct genotypes of offspring ✓ probability = 0.25 / ¼ / 25% / 1 in 4 / 1:3	4 (AO 2.2) (AO 2.2) (AO 3.2b)	ALLOW other forms of diagrams other than Punnett square <u>Examiner's Comments</u> This question assessed AO2.2 with the application of practical techniques in completing a genetic cross. This was particularly well done by most candidates, except some candidates did not choose the symbols recommended in the question and this caused them confusion in interpretation. The question also included an AO3 mark for interpreting and drawing a conclusion from the Punnett square. The most common error was to give 75% as the response. Some candidates also made an error by describing the ratio as 1 in 3 when they should have written 1 in 4 or 1:3. These errors could be minimised by improving examination technique, where candidates are made aware of common errors in interpreting genetic diagrams.
		ii	rod cells are do not work / damaged ✓ rod cells can work in dim light ✓ but cannot detect colour ✓	3 (AO 2.1) (AO 2.1) (AO 1.1)	ALLOW rods cells broken down / cones are not broken down IGNORErod cells broken down (as in stem of question) ALLOW converse for cones ALLOW converse for cones ALLOW rods only see in black and white <u>Examiner's Comments</u> This question covered AO1.1 and AO2.1. Candidates often did not identify that rod cells were damaged. They frequently just put rod cells break down, missing out it was 'only' the rod cells, and hence were just repeating what was in the stem of the question. Good responses also discussed cones cells so got the reverse argument.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
22			D	1 (AO 1.1)	
			Total	1	
23			B	1 (AO 1.1)	
			Total	1	
24			D	1 (AO 1.1)	
			Total	1	
25			A	1 (AO 1.1)	Examiner's Comments  Misconception This is an AO1.1 question testing recall of the structure of the eye and its functions. Many candidates chose either C or B. Only candidates who performed well overall chose the correct answer A. Candidates seem to have the misconception that light enters the eye first through either the pupil or lens and very few were aware of the function of the cornea.
			Total	1	
26			C	1 (AO 1.1)	
			Total	1	
27			D	1 (AO 1.1)	
			Total	1	
28			C	1 (AO 2.1)	Examiner's Comments This proved to be a difficult question with no real pattern to the choices for incorrect answers.
			Total	1	

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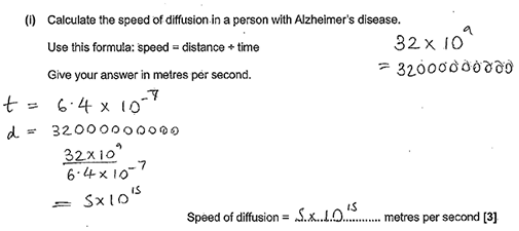
Question			Answer/Indicative content	Marks	Guidance
29	a	i	<u>understanding has increased because:</u> wider range of recording/scanning techniques / technology has developed ✓ improved accuracy of measurement ✓ **maximum three from:** <u>problems existing:</u> difficulties in getting individuals for case studies ✓ may cause harm to patients ✓ interpreting data from case studies is very complex ✓ ethical issues with experimenting on (live) animals / killing/harming animals for experimentation ✓	4 (AO 3.1b)	**ALLOW** named examples eg CAT, EEG / description of the techniques **ALLOW** map brain function with more accuracy **ALLOW** people reluctant to give consent / need many cases to draw reliable conclusions **IGNORE** consent is needed **ALLOW** may cause cancer in patients **ALLOW** Interpreting brain function/information is difficult / several areas may be involved in a specific function. **IGNORE** unethical to study the brain <u>Examiner's Comments</u> Many answers referred to improvements in technology leading to advancements. The most common problem stated was ethical issues with animal experimentation. Some candidates understood that human subjects may be reluctant to give consent but many simply stated that they were incapable of giving consent.

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Question			Answer/Indicative content	Marks	Guidance
		ii	**Any two from:** to inform other **scientists** (who might be working on the topic) ✓ to see if other scientists can replicate the work/ to have it peer reviewed✓ to allow recognition for their work✓	2 (AO 1.1)	**ALLOW** communicate scientific rationale/methodology for investigations / share ideas with other scientists / allow other scientists to develop work **ALLOW** check/prove/reproduce results **IGNORE** to let people know / to spread it more widely / to make it be accepted as fact Examiner's Comments Peer review, other scientists using the results in their research and publishing to gain recognition were often given as correct reasons. There were a number of vague references to 'letting other people know', which did not gain credit.

Question			Answer/Indicative content	Marks	Guidance
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 0.05 (metres per second) award 3 marks** Conversion of 32(nm) to 3.2×10^{-8} (metres) ✓ $3.2 \times 10^{-8} \div 6.4 \times 10^{-7}$ ✓ = 0.05 (metres per second) ✓	3 (AO 1.2) (AO 2.2 x2)	**ALLOW** ECF from first making point **ALLOW** 5×10^{-2} <u>Examiner's Comments</u> Many candidates could handle the conversion from nanometres to metres, divide by the time and give the correct answer in standard form. Credit was given for dividing by the time even if the initial conversion was incorrect. Exemplar 7 shows an example of this. It only scores one mark because the conversion is incorrect and the final calculation also contains an error. **Exemplar 7**  (i) Calculate the speed of diffusion in a person with Alzheimer's disease. Use this formula: speed = distance ÷ time Give your answer in metres per second. 32×10^{9} $= 32000000000$ $t = 6.4 \times 10^{-7}$ $d = 32000000000$ $\frac{32 \times 10^{9}}{6.4 \times 10^{-7}}$ $= 5 \times 10^{15}$ Speed of diffusion = 5×10^{15} metres per second [3]
		ii	(in Alzheimer's,) neurotransmitter/it takes longer to diffuse/move (across the synaptic gap) ✓ communication between areas of the brain takes longer / idea that brain function less co-ordinated / idea that making decisions takes longer / idea that reactions are slower / takes longer to comprehend / lack of concentration ✓	2 (AO 2.1) (AO 3.2a)	**ALLOW** in healthy people the speed (of diffusion) is faster / in Alzheimer's the speed (of diffusion) is slower need to score first marking point to score this marking point <u>Examiner's Comments</u> Most answers commented on the reduced speed of diffusion in people with Alzheimer's disease, but some did not follow this up by relating this to the symptoms.
			Total	**11**	

Question			Answer/Indicative content	Marks	Guidance
30			B ✓	1 (AO1.1)	
			Total	**1**	
31			C ✓	1 (AO2.1)	
			Total	**1**	
32		i	(sensory) receptor ✓	1 (AO2.1)	**IGNORE** neurone
		ii	brain ✓ motor ✓	2 (AO1.1)	**ALLOW** CNS **IGNORE** relay
			Total	**3**	
33			C ✓	1 (AO2.1)	
			Total	**1**	
34			A ✓	1 (AO2.1)	
			Total	**1**	
35			B ✓	1 (AO2.1)	
			Total	**1**	
36			B ✓	1 (AO2.1)	
			Total	**1**	

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Question			Answer/Indicative content	Marks	Guidance
37	a		cerebral cortex / cerebrum ✓	1 (AO1.1)	ALLOW motor cortex
	b	i	can send impulses along a different number of neurones ✓ the more neurones that are stimulated then the greater the force of contraction ✓ Or could stimulate motor neurone 1 or motor neurone 2 ✓ motor neurone 2 gives a stronger contraction / because motor neurone 2 supplies more muscle fibres ✓	2 (AO2.1)	answer must specifically refer to changes in the number of motor neurones stimulated to score marks (not just the order of motor neurones)
		ii	idea that the neurone supplying the leg muscle connects to many muscle fibres ORA ✓ this means that the contraction of the leg muscles can be less finely controlled ORA ✓ idea leg does not need such fine control for its function ORA ✓	3 (AO2.1) (AO3.2a) (AO3.2a)	

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Question			Answer/Indicative content	Marks	Guidance
	c		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed explanation of how the body coordinates this specific response, including a detailed outline of the correct pathway, in the correct order. **AND** Explains why coordination in **B** is more complicated. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Attempts to explain how the body coordinates this specific response, including an outline of the correct pathway, in the correct order. **AND** Gives a reason why coordination in **B** is more complicated. **OR** Detailed explanation of how the body coordinates this specific response, including a detailed outline of the correct pathway, in the correct order. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Attempts to explain how the body coordinates a response. **OR** Gives a reason why coordination in **B** is more complicated. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	6 (AO2 x 1.1) (AO2 x 2.1) (AO2 x 3.2a)	**AO1.1 Demonstrates knowledge and understanding of scientific ideas to identify the correct pathway** • receptors detect the stimulus and send impulse via a sensory neurone • CNS coordinates the response • CNS sends impulse to motor neurone • motor neurone causes muscles or effectors to respond **AO2.1 Applies knowledge and understanding of scientific ideas to explain how the body coordinates the response** • image dart board detected by retina/eye • cerebrum coordinates the response by sending impulses down spinal cord • motor neurone takes impulse from spinal cord to the muscles of the arm/hand • muscles in the arm/hand bring about the throwing response **AO3.2a Analyse information and ideas to make judgements about the differences between A and B** • coordination in **B** is more complicated because darts have different flight paths/ different positions of release • therefore, **B** needs to adjust the speed of the hand/force of the throw to match the throw angle

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Question			Answer/Indicative content	Marks	Guidance
			0 marks *No response or no response worthy of credit.*		
			Total	12	

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