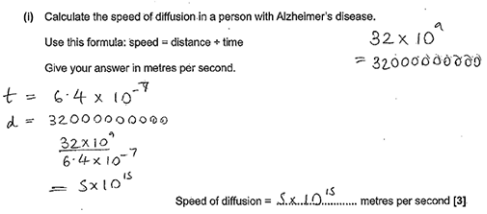
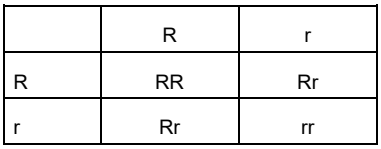
Mark scheme – The Nervous System (H)

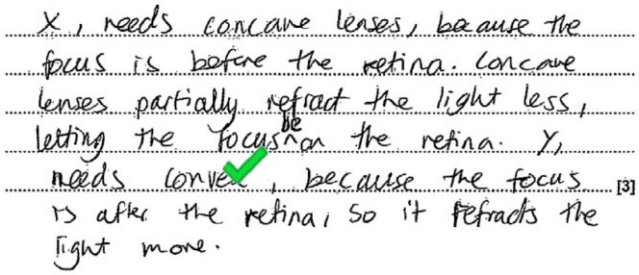
Question			Answer/Indicative content	Marks	Guidance
1			B ✓	1 (AO2.1)	
			Total	**1**	
2			A ✓	1 (AO2.1)	
			Total	**1**	
3			B ✓	1 (AO2.1)	
			Total	**1**	
4			C ✓	1 (AO2.1)	
			Total	**1**	
5			D	1 (AO 1.1)	
			Total	**1**	
6			C	1 (AO 2.1)	**Examiner's Comments** This proved to be a difficult question with no real pattern to the choices for incorrect answers.
			Total	**1**	
7	a	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 ✓	3 (AO2.1) (AO3.2a) (AO3.2a)	

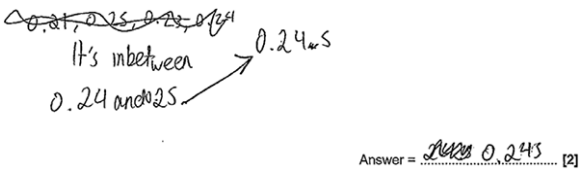
			idea leg does not need such fine control for its function ORA ✓		
	b		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed explanation of how the body coordinates this specific response, including a detailed 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*	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

			relevant. **0 marks** *No response or no response worthy of credit.*		
	c		cerebral cortex / cerebrum ✓	1 (AO1.1)	**ALLOW** motor cortex
			Total	**12**	
8	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.
		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 **<u>Examiner's Comments</u>** 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.
	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} **Examiner's Comments** 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 x 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 **Examiner's Comments** 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**	
9		i	 |	R	r | | R | RR | Rr | | r | Rr | rr |	**4**	**ALLOW** other forms of diagrams other than Punnett square **Examiner's Comments** This question assessed AO2.2 with the application of

			correct gametes ✓ correct genotypes of offspring ✓ probability = 0.25 / ¼ / 25% / 1 in 4 / 1:3	**(AO 2.2)** **(AO 2.2)** **(AO 3.2b)**	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 **IGNORE**rod cells broken down (as in stem of question) **ALLOW** converse for cones **ALLOW** converse for cones **ALLOW** rods only see in black and white **Examiner's Comments** 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**	
10	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 **Examiner's Comments** 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)
		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) ✓	**3** **(AO 1.1)** **(AO 2 × 2.1)**	**ALLOW** minus powered lens **ALLOW** plus powered lens **Allow** diagram showing lens diverging light 

			idea that convex lenses converge light rays / person Y needs a lens to converge light rays (before they enter the eye) ✓		**Allow** diagram showing lens converging light  Must be stated which diagram refers to which lens or person. **Examiner's Comments** 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**	
11	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:	**3 (AO 3.2a) (AO 2× 3.3b)**	**IGNORE** it uses a computer so its accurate **Examiner's Comments**

			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 ✓		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.
	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.
	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** Stem cells are undifferentiated [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**	