PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 9: CONTROL SYSTEMS

NERVOUS TRANSMISSION

SCORE	PERCENTAGE
/148	%

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Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	B 0.75 ms A is incorrect because at 0.5s it is a resting potential C is incorrect because sodium channels are closed D is incorrect because sodium channels are closed		**1**

Q2.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • slows {transmission / impulse} (1) • because reduced {myelin sheath / Schwann cells} (1) • affects saltatory conduction / affects jumping between nodes of Ranvier (1) • (change to membrane) affects action potential / ion movement / ion channels (1)		**(3)**

Q3.

Question Number	Answer	Mark
(i)	The only correct answer is C sensory neurone and dorsal root *A is incorrect because X is a sensory neurone* *B is incorrect because X is a sensory neurone and Y is the dorsal root* *D is incorrect because Y is the dorsal root*	1

Question Number	Answer	Mark
(ii)	The only correct answer is D medulla oblongata *A is incorrect because the cerebellum does not control breathing and heart rate* *B is incorrect because the cerebrum does not control breathing and heart rate* *C is incorrect because the hypothalamus does not control breathing and heart rate*	1

Q4.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to four of the following: • change in {potential difference} in tetrodotoxin is small(er) / (1) • no action potential / less depolarisation (1) • (voltage gated) sodium channels {not open / closed / blocked} (1) • sodium (ions) cannot pass through membrane / sodium (ions) cannot enter neurone (1) • no nerve impulse to muscles / muscles not stimulated / muscles cannot contract (1)	**ACCEPT** no depolarisation **ACCEPT** less sodium ions enter **ACCEPT** effector for muscle	4

Q5.

Question Number	Correct Answer	Additional guidance	Mark
(i)	velocity of myelinated axon = 76 m s^{-1} (1) 0.8 ÷ 76 = 0.01 (1)	Accept answer derived from range 74 to 76 m s^{-1} Accept 0.011 or answers with more decimal places Correct answer gains full marks	**(2)**

Question Number	Indicative content	
***(ii)**	Answers will be credited according to the candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The Indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • Increase in diameter increases conduction velocity in both axon types • More surface area for ion movement and therefore depolarisation • Conduction velocity is greater in the myelinated axon compared to the unmyelinated axon • Myelinated axons have a much smaller diameter than unmyelinated • Greater efficiency of myelinated neurones compared to unmyelinated axons • Impulse jumps from node to node / saltatory conduction • The myelin insulates • The insulation is discontinuous at nodes of Ranvier • Depolarisation only at nodes	
Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.
Level 2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.
Level 3	5-6	An explanation is made, which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

Q6.

Question Number	Answer	Additional Guidance	Mark
	In sensory neurone: 1. dendron longer; 2. dendron myelinated ; 3. axon shorter ; 4. {cell body / eq} {not at the end / towards the middle / to the side / eq } ; 5. reference to no {motor end plate / eq} ;	ALLOW converse for motor neurone 4. **ACCEPT** centron / nucleus for cell body	**(3)**

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	**A** 1 and 2 *B is incorrect because lidocaine binds to voltage gated sodiumchannels* *C is incorrect because lidocaine binds to voltage gated sodiumchannels* *D is incorrect because lidocaine binds to voltage gated sodiumchannels*		**1**
(ii)	B parasympathetic neurone reduce *A is incorrect because acetylcholine reduces the heartrate* *C is incorrect because acetylcholine is released byparasympathetic neurones* *D is incorrect because acetylcholine is released byparasympathetic neurones*		**1**
(iii)	An answer that makes reference to three from: • action potential / impulse arrives at pre-synaptic {terminal / knob}(1) • calcium channels open and calcium ions diffuse in(1) • vesicles move to membrane (1) • vesicles fuse with membrane and release acetylcholine (1)	**Allow** action potential stimulatespresynaptic membrane **Allow** Ca^{2+} **Allow** exocytosis	**3**

Q8.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • neurone at resting potential (1) • because (voltage gated) sodium (ion) channels {closed / blocked} (1) • therefore no movement of sodium (ions) into neurone / into cell / into axon / across membrane (1) • therefore prevents {depolarisation / action potential} (1)	**ACCEPT** not open **DO NOT ACCEPT** nerve	**(4)**

Q9.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to four of the following: • arrival of {action potential / impulse} at presynaptic {knob / terminal} (1) • calcium channels open / calcium ions enter (presynaptic knob) (1) • vesicles {move to / fuse with} presynaptic membrane (1) • acetylcholine {diffuses across / released into} the {synapse / cleft} (1) • binding to receptors on postsynaptic membrane {opening sodium channels / allowing sodium ions to enter} (1)	**Accept** calcium ions pass through membrane **Do not accept** calcium ions enter membrane **Accept** neurotransmitters for acetylcholine	**(4)**

Question Number	Answer	Additional Guidance	Mark
(ii)	The only correct answer is **B** (excitatory, inhibitory, inhibitory) **A** is not correct because lidocaine is inhibitory affecting the Na^+/K^+ ATPase pump, and cobra venom is inhibitory, blocking acetylcholine receptors **C** is not correct because nicotine is excitatory, mimicking acetylcholine, lidocaine is inhibitory affecting the Na^+/K^+ ATPase pump, and cobra venom is inhibitory, blocking acetylcholine receptors **D** is not correct because nicotine is excitatory, mimicking acetylcholine		**(1)**

Q10.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to four of the following: • sodium potassium pump (1) • therefore sodium (ions) move out and potassium (ions) move in (1) • potassium (ions) move out through potassium channels (1) • sodium channels close / membrane is impermeable to sodium (ions) / sodium (ions) do not move in (1) • outside more positive than inside (1)	**ACCEPT** Na^+ for sodium ions and K^+ for potassium ions **DO NOT ACCEPT** potassium channels are open so potassium ions enter **ACCEPT** only a few sodium channels are open / only a few sodium ions move in **ACCEPT** outside becomes positive **AND** inside becomes negative	**4**

Q11.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to four of the following: • {action potential / impulse} arrives at (presynaptic) terminal / membrane / synaptic knob (1) • calcium channels open (1) • calcium ions diffuse into the neurone (1) • vesicles move towards the (presynaptic) membrane (1) • vesicles fuse with presynaptic membrane / exocytosis occurs (1)		**4**

Q12.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • an action potential only occurs {when stimulation of A is high and B is low / when threshold is reached} (1) • because the levels of acetylcholine are high and the levels of glutamate are low (1) • an action potential does not occur when levels of glutamate are high (1) • because movement of chloride ions causes {hyperpolarisation / reduces depolarisation} (1)	**Accept** EPSP is greater than IPSP **Accept** because enough sodium ions enter the neurone / enough sodium channels open **Accept** excitatory transmitter for acetylcholine **Accept** IPSP is greater than EPSP **Accept** inhibitory transmitter for glutamate **Accept** description of hyperpolarisation e.g. inside becomes more negative	**(3)**

Q13.

Question Number	Answer	Additional Guidance	Mark
	An answer that includes the following • there is no action potential until the stimulus is greater than 45 (mV) (1) • this is the threshold value (1)	Accept range between 45-55 mV / 46 -55mV Accept converse Accept this is where depolarisation occurs / Na channels open Ignore optimum voltage	**Exp (2)**

Q14.

Question Number	Answer	Additional Guidance	Mark
	The only correct answer is **C** (open, closed) **A** is not correct because Na^+ channels are open not closed **B** is not correct because Na^+ channels are open, not closed and K^+ channels are closed not open **D** is not correct because K^+ channels are closed not open		**(1)**

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to four from the following: similarity • same speed at 1 μm • speed increases for myelinated and unmyelinated axons (1) differences (max 3) • for axon diameters of more than 1 μm, myelinated are faster (1) • myelinated have a steeper / greater increase (1) • myelinated axons are slower below 1 μm in diameter (1) • myelinated is linear relationship	At least one similarity and one difference **Accept** converse **Accept** ref to numerical comparison **Accept** converse **Accept** proportional increase / **Accept** converse for non-myelinated	**4**

Question Number	Answer	Additional Guidance	Mark
(ii)	• correct extrapolation to y axis to calculate c (1) • correct calculation of gradient • correct calculation of speed at 5 μm diameter (1)	-0.5 (**Accept** -0.4 to -0.6) 2/0.8 = 2.5 12 m s^{-1} (**Accept** between 11.9 and 12.1) **Accept** 12 for two marks Correct answer gains full marks	**3**

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to three of the following: • saltatory transmission does not occur (1) • because there are {fewer / no} nodes of Ranvier (1) • so impulse does not jump (between nodes) (1) • and sodium channels have to stimulate local current flow along each section of membrane / sodium channels have to open in every part of membrane / depolarisation has to occur along the whole length (1)		**3**

Q16.

Question Number	Answer	Mark
(a)(i)	100 (mV) ;	**(1)**

Question Number	Answer	Mark
(a)(ii)		**(3)**

Description	**A**	**B**	**C**	**D**	**E**	**F**
Stage when the concentration of positive ions is greatest inside the axon			☒			
Stage when hyperpolarisation first occurs					☒	
Site showing the resting potential	☒					

Question Number	Answer	Mark
***(b)**	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence 1. diffuses across {gap /eq} ; 2. binds to (receptors on) post-synaptic membrane / eq ; 3. idea of gated-channels opening or Na^+ travels through post-synaptic membrane ; 4. causing a depolarisation / eq ; 5. (if sufficient present) an action potential is set up in {post-synaptic membrane/adjacent cell / eq} ; 6. details such as temporal or spatial summation ; 7. idea that allows coordination / one way flow of information ; 8. idea that it allows integration in post-synaptic cell ; 9. neurotransmitter broken down (by enzyme) / eq ; 10. so that do not get {prolonged /eq} action potential in post-synaptic membrane / make receptors available again ; 11. credit reference to fate of products e.g. reabsorbed through pre-synaptic membrane OR to be re-synthesised into neurotransmitter substance ;	**(5)**

Q17.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three from: • capsaicin binds to (TPV) receptors in membrane of receptors cells (1) • this causes neurotransmitter (from receptors) to bereleased onto sensory neurone {generating an epsp / opening sodium channels / causing sodium ions to flow in} (1) • high concentrations of capsaicin generate an epsp that) overcomes threshold to form an {action potential} (1) • action potential moves along the neurone by (opening sodium channels) (1)	**Allow** low concentrations does notovercome threshold **Allow** high concentrations opens voltage gated sodium channels	3

Question Number	Indicative content	
(ii)	Answers will be credited according to candidate's deployment of knowledge and understanding ofmaterial in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientificand relevant. **Descriptions** • 100 mg / 50 mg / higher doses / of capsaicin increase mass of sweat produced D • sweat production from 100 mg decreases after 5 days D • 10 mg has less effect D • 10 mg / 50mg have same effect for all seven days D • 100 mg effect decreases after 3/4/5 days D • 100 mg generates less sweat than 50 mg after 5/6 days D **Explanation / Optimal Dose** • increased sweating and evaporation of water E • evaporation of water requires heat energy E • latent heat of vaporisation is high for water so sweating removes a lot of heat energy E • 50 mg is optimal dose E • because there 100 mg begins to lose effect after 3/4/5 days E • and 100 mg produces more side effects / burning sensations / red rash E **Validity of data** • 50 mg dose has consistent sweat production as error bars all overlap V • 100 mg and 50 mg are significantly higher than 10 mg as error bars do not overlap V • 10 mg has a high variation between responses of volunteers V	**6**

	• no control experiment has been carried out V • sample size is small V • capsaicin may interfere with other medicines / may make illness worse / no tests done on illpeople V		
Level	**Marks**		
Level 0	Marks	No awardable content	
Level 1	1-2	Limited scientific judgement made with a focus on mainly just one method, with a fewstrengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledgeand understanding but with limited evidence to support the judgement being made. **Basic description of the effects of each dose** **one mark: any one from D, E, V** **two marks: 3D, 2D + 1E, 2D + 1V**	
Level 2	3-4	A scientific judgement is made through the application of relevant evidence, with strengthsand weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge andunderstanding, with occasional evidence to support the judgement being made. **Detailed description and either E or V** **three marks: at least four points from D + E or D + V** **four marks: at least five points from D + E or D + V**	
Level 3	5-6	A scientific judgement is made which is supported throughout by sustained application ofrelevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge andunderstanding with evidence to support the judgement being made. **Must have elements of D, E and V.** **five marks: at least six points from D, E and V** **six marks: at least seven points from D, E and V AND must refer to standard deviations**	

Q18.

Question Number	Correct Answer	Additional guidance	Mark
(a)	Measurement from diagram: 2.1 cm = 0.021 m (1) Actual distance: 0.021 m ÷ 226 = 9.2×10^{-4} m (1) Calculate speed: 0.02 ms = 2.0×10^{-5} s 9.2×10^{-4} m ÷ 2.0×10^{-5} s = 4.65 ms^{-1} (1)	e.c.f. at any stage penalise once only Correct answer gains full marks with no working	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
(b)	An explanation that makes reference to the following: • myelin may absorb / reflect light (1) • therefore less light passes to light sensitive cells (1) • hence some rod / light sensitive cells not stimulated / bleached (1)		**(3)**

Q19.

Question Number	Answer	Additional guidance	Mark
(a)	**A** - cell body ; **B** - axon ;		**(2)**

Question Number	Answer	Additional guidance	Mark
(b)(i)	1. increasing Eugenol concentration increases percentage inhibition / positive correlation ; 2. description of non linear correlation ; 3. credit correct manipulation of the data e.g. between 0.1 and 1.0 mmol dm^3 percentage inhibition to increase by 55% ;	ACCEPT 2 – e.g. greatest increase in inhibition is between eugenol concentration of 0.2 and 0.4 mmol dm^{-3}	**(2)**

Question Number	Answer	Additional guidance	Mark
* **(b)(ii)**	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence) 1. {reduced / eq} Ca^{2+} enters { *presynaptic membrane* / into *sensory neurone*} ; 2. due to Ca^{2+} channel not opening / decreased sensitivity of *membrane* to Ca^{2+} ; 3. fewer *vesicles* {move towards / fuse} with *presynaptic membrane* ; 4. less *neurotransmitter* {released into / less diffuses across} {*synaptic* gap / eq} ; 5. less *neurotransmitter* binds to receptors on {*post-synaptic membrane* / adjacent neurone} ; 6. idea of reduced depolarisation / less Na^+ or cation channels open ; 7. idea of { threshold intensity / *action potential* / *impulse*} less likely to occur ; 8. idea of pain not being sensed as impulse {stopped before entering CNS / leaving the *sensory neurone*} ;	ACCEPT 1 – into *synaptic* knob / pre-synaptic neurone ACCEPT 4 (& 5) - named neurotransmitter example ACCEPT 7 - not reached as alternative to less likely to be reached	**(6)**

Q20.

Question Number	Answer	Additional Comments	Mark
(a) (i)	(terminal) dendrite ;		**(1)**

Question Number	Answer	Additional Comments	Mark
(a) (ii)	B ;		**(1)**

Question Number	Answer	Additional Comments	Mark
(b) (i)	1. Increasing eugenol concentration increase percentage inhibition / positive correlation ; 2. Description of non linear correlation ; 3. Credit correct manipulation of the data e.g. 0.8 mmol dm^{-3} increase causes percentage inhibition to increase by {x2.7 / eq} ;	**2. Ignore** references to rate or speed **Accept** greatest increase is between 0.2 and 0.4	**(2)**

Question Number	Answer	Additional Comments	Mark
(b) (ii)	Correct answer gains 2 marks 72.5 / 73.0 / 75 (%) ; ;	**Accept** for 1 mark (65 + 80) ÷ 2 or 145 ÷ 2 if answer incorrect	**(2)**

Question Number	Answer	Additional Comments	Mark
* (c)	QWC – Spelling of technical terms (shown in italics) must be correct and the answer must be organised in a logical sequence 1. higher concentration of Na^+ outside of neurone / eq ; 2. sodium ions move in causing a depolarisation / eq ; 3. eugenol may affect { Na^+ / voltage-dependent} gates / eq ; 4. eugenol reduces influx of Na^+ / eq ; 5. (so) depolarisation less likely to occur / eq ; 6. no impulse transmitted along neurone / eq ; 7. idea of no transmission to next neurone ; 8. idea of pain not being sensed as impulse stopped before entering CNS ;	**QWC emphasis is logical sequencing in the context of how eugenol affects the movement** **6. Accept** no action potential **7. Accept** no release of neurotransmitter	**(6)**

Q21.

Question Number	Answer	Additional Guidance	Mark
(i)	<table><tr><th>Stage</th><th>Voltage-gated K^+ channel open</th><th>Voltage-gated K^+ channel closed</th><th>Voltage-gated Na^+ channel closed</th></tr><tr><td>Depolarisation</td><td></td><td>✓</td><td></td></tr><tr><td>Repolarisation</td><td>✓</td><td></td><td>✓</td></tr></table>	**3 columns correct = 2 marks** **2 columns correct = 1 mark**	**(2)**

Question Number	Answer	Mark
(ii)	A ;	**(1)**

Q22.

Question Number	Answer	Additional Comments	Mark
(a)	1. only (alpha) 1-4 glycosidic bonds in amylose / (alpha) 1-6 only found in amylopectin ; 2. only amylopectin has side branches / only amylose is {coiled / eq} ; 3. Amylopectin is a {larger / eq} molecule than amylose ;	**1. ACCEPT** 1-6 and 1-4 in amylopectin	**(2)**

Question Number	Answer	Additional Comments	Mark
(b)	1. Different individuals in the {colony / eq} take on specific {roles / jobs / eq} ; 2. Example given e.g. queen produces offspring ;	**1. Accept** division of labour **2. Accept** dominance by queen, {few of the males / kings} involved in breeding	**(2)**

Question Number	Answer	Additional Comments	Mark
(c) (i)	Idea that body temperature of animal mimics the ambient temperature ;	**Accept** body temp follows environmental temperature	**(1)**

Question Number	Answer	Additional Comments	Mark
(c) (ii)	1. Lack of insulating layer: Idea that does not impede transfer of heat energy / allows exchange of heat energy more easily ; 2. A marked reduction in sweat glands: Idea that they do not need to cool down OR less water lost ;	**1. Accept** enables heat transfer between environment and NMR	**(2)**

Question Number	Answer	Additional Comments	Mark
(d)	1. (Cancer causing) gene identified / eq ; 2. Gene {cut / isolated / eq} from DNA / eq ; 3. Using a {restriction / eq} enzyme / eq ; 4. Gene in {vector / named vector} ; 5. Mechanism for getting {gene/vector} into host cells (of mice) / eq ;	**1. Accept** screen for the gene **2. Accept** extracted **3. Accept** correctly named restriction enzyme e.g. EcoR1 **4. Accept** Named egs – retrovirus, virus, liposome, plasmid, bacteria **5. Accept** reference to (micro)injection, microprojectiles, electroporation, gene gun, inhaler, transduction	**(3)**

Question Number	Answer	Additional Comments	Mark
* (e)	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence 1. {*neurone* (cell) surface membrane exposed / no *myelination* / eq} at nodes of *Ranvier* ; 2. Nodes are the site of clusters of {*sodium-gated channel proteins / potassium channels*} ; 3. Which {open / close} when *impulse* arrives / eq ; 4. Allowing *depolarisation* at nodes / eq ; 5. idea that *myelin*/eq acts as an (electrical) *insulator* (on *neurone* surface between nodes) ; 6. reference to *Schwann* cell ; 7. idea that *impulse/depolarisation* 'jumps' to next node ; 8. Reference to this being *saltatory conduction* ; 9. idea that this happens between the *myelin* layers of the *Schwann* cell ;	**QWC emphasis on spelling** **3. Accept** influx of sodium ions	**(5)**

Question Number	Answer	Additional Comments	Mark
(f)	1. idea of heart working less efficiently ; 2. idea of less oxygen absorbed at lungs / eq ; 3. less blood pumped to brain ; 4. concentration gradient (for oxygen) at brain reduced / eq ; 5. less oxygen in blood (in brain) diffuses into brain tissue / eq ; 6. idea of less oxygen in brain tissue due to continual (aerobic) respiration ;		**(3)**

Question Number	Answer	Additional Comments	Mark
(g)	gonadotrophin-releasing (hormone) stimulates gonadotrophin release / gonadotrophin stimulates ovulation / testosterone stimulates {sperm production / (male) secondary sexual characteristics / other named example} ;		**(1)**

Question Number	Answer	Additional Comments	Mark
(h)	1. Idea of effect on mitochondria ; 2. (therefore) reduced {energy / ATP / eq} for flagellum movement ;	**1. Accept** less efficient / fewer / none **2. Accept** tail for flagellum	**(2)**

Question Number	Answer	Additional Comments	Mark
(i)	1. idea that fat is an energy store ; 2. reduces dependence on external food source / eq ; 3. enables disperser to travel / eq ; 4. (metabolic) water is released (on oxidation) / eq ; 5. acts as a thermal insulator / eq ;	**Accept** energy-rich	(3)

Question Number	Answer	Additional Comments	Mark
(j)	1. idea that unfamiliar males are likely to be genetically different ; 2. idea that this is outbreeding ; 3. idea that this increases genetic diversity ;	**3. Accept** producing offspring that are genetically different	(2)

Question Number	Answer	Additional Comments	Mark
(k)	the order of the {bases / genes and non-coding sequences / eq} in the DNA (of the naked mole rats) is found / eq ;	**Accept** exons and introns **Ignore** genes unqualified	(1)

Question Number	Answer	Additional Comments	Mark
(l)	Paired responses: 1. reduced sensitivity to chemical pain / disconnection of 'pain nerves' ; 2. Idea of pain relief e.g. dealing with post traumatic pain, post surgical pain, joint pain after a knee operation ; 3. haemoglobin has higher affinity for oxygen ; 4. Idea of dealing with reduced oxygen situations such as due to a heart attack or stroke ; 5. Naked mole rat {incisors / eq } grow through skin (of lip) without damage ; 6. Idea of better prosthesis e.g. new {coatings / permanent seal} at {skin / bone / metal} interface, soft tissue not damaged, avoid infection ; 7. High protein stability / does not (easily) lose 3D shape ; 8. (so) reduced effect of oxidative {damage / stress} / reduced effect of oxygen-containing free radicals / live healthily into old age ; 9. Cell overcrowding early warning gene / ref. to two tiered contact inhibition / presence of gene p16 ; 10.Idea of cancer prevention e.g. cancer resistance, future cancer therapy ; 11.Naked mole rat neurones display immature {characteristics / physiological properties} / brain cells that cope with {low oxygen / hypoxia} ; 12.To treat people with temporary loss of oxygen to brain e.g. heart attack, stroke, drowning / to prevent permanent brain damage ; 13.High levels of oxytocin receptors in {brain / nucleus accumbens}; 14.Idea of links to autism ; 15.Naked mole rats do not experience menopause ; 16.Ref to osteoporosis {treatment / prevention} (without side effects) ; 17.circadian rhythms / sleep patterns of naked mole rats ; 18.Idea that may help with sleep disorders ;	**9. Accept** anticancer mechanism	

Q23.

Question Number	Answer	Additional Guidance	Mark
	1. idea that it binds to wasp venom so it {is removed from / can no longer bind to} receptor ; 2. idea that breaks down wasp venom so it leaves receptor ; 3. idea that wasp venom binds more readily to it than to the receptor ; 4. idea of the nature of the compound e.g. enzyme ;		**(2)**

Q24.

Question Number	Answer	Additional Guidance	Mark
(i)	resting (potential) (1)		**Clerical (1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer including four of the following • {sodium / Na} channels open (1) • sodium **ions** flow into {axon / cell / neurone} (1) • this causes depolarisation (1) • {sodium / Na} channels close at {0.8ms / 30mV} (1) • {potassium / K} channels open at {0.8ms / 30mV} (1)	Ignore how they are moving Accept sodium gates open Ignore membrane	**Exp (4)**

Q25.

Question Number	Correct Answer	Additional guidance	Mark
	A description that makes reference to three of the following: • binds to active site of cholinesterase (1) • acetylcholine remains / not broken down (1) • depolarisation of post synaptic membrane continues (1) • nerve impulse continues / action potential continues (1)		**(3)**