PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 9: CONTROL SYSTEMS

DETECTION OF LIGHT BY MAMMALS

SCORE	PERCENTAGE
/49	%

STEMUP

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Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	The only correct answer is: **A** bipolar neurone *B is incorrect because ganglion neurones are after bipolar neurones* *C is incorrect because motor neurones are not found in the retina* *D is incorrect because optic neurone is an incorrect term*		**1 comp**

Q2.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following points: • rhodopsin breaks down into opsin and (trans) retinal (1) • causing sodium channels (on the rod cell) to close / to be blocked (1) • leading to the (rod cell) hyperpolarising (1) • so that less { (inhibitory) transmitter / glutamate} is released (1)	**Accept** cis retinal is converted to trans retinal **Do not accept** voltage gated sodium channels **Accept** sodium ions stop moving into the cell **Accept** blocks cation channels **Accept** membrane becomes more positive outside / more negative inside **Accept** correct descriptions of hyperpolarising	**3 exp**

Q3.

Question Number	Indicative Content
*	Answers will be credited according to candidate's deployment of knowledge and understanding of 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. • spending longer in the dark reduces the minimum intensity at which light is seen / increases sensitivity D • retina is less sensitive to 620 nm light / more sensitive to 500 nm light / D • sensitivity continues to increase over time with 500 nm light / levels off with 620 nm light D • 620 nm light stimulates cones but not rods D • 500 nm light stimulates rod cells and cones D • exposure to light bleaches / breaks down rhodopsin / iodopsin B • trans retinal is converted back to cis retinal in the dark B • rhodopsin / iodopsin is (re)synthesised in the dark B • (cis) retinal binds to opsin (in dark) B • cone cells / iodopsin dark adapt faster than rod cells B • rhodopsin takes longer to be reconverted from opsin and retinal than iodopsin B • rhodopsin is more sensitive than iodopsin B • rod cells are more sensitive / stimulate at lower minimum light R • due to spatial summation / (retinal) convergence of rods R • so that several rod cells are stimulated to overcome a threshold / generate action potential in bipolar cells R • levelling off with 620 nm light shows that cone cells are less sensitive than rod cells R

Level 0	Marks	No awardable content
Level 1	1-2 (1-3)	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. **1 mark : one point from D, R or B** **2 marks : one from D and one from D, R or B**
Level 2	3-4 (4-6)	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. **D with some of R or B** **3 marks: 1D and 2 from R or B OR 2 D and 1 from R or B** **4 marks: 2 D and at least 2 from R or B OR 1 D and at least 2 from R or B**
Level 3	5-6 (7-9)	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. **D, B and R** **5 marks : at least two descriptions of data and one R and one of B** **6 marks : at least two descriptions of data and at least two of R and two of B**

Q4.

Question Number	Correct Answer	Additional guidance	Mark
(a)	A		**(1)**

Question Number	Correct Answer	Additional guidance	Mark
(b)(i)	• 55% of 12 million = 6,600,000 (1) 91.4% of men have normal vision so: • 100 – 91.4 = 8.6% population with CB (1) • 8.6% of 6,600,000 = 567, 600 (1)	Correct answer gains full marks	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
(b)(ii)	An explanation that makes reference to one of the following: • males inherit one X chromosome (1) • recessive allele will always be expressed in males (1) **or** • females inherit 2 X chromosomes (1) • so if they inherit one recessive and one dominant allele, the recessive allele will not be expressed (1)		**(2)**

Question Number	Correct Answer	Additional guidance	Mark
(b)(iii)	An explanation that makes reference to the following: • the highest percentage of defects in cones are in the L and M cones (1) • L cone is sensitive to long wavelengths of light in the red part of the visible spectrum (1) • M cone is sensitive to medium wavelengths of light in the green/ red part of the visible spectrum (1) • therefore a defect in these cones will lead to a person not being able to see light in the red/green spectrum (1)	Accept manipulation of data regarding percentage of cone defects	**(4)**

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	1. mean peak voltage increases as light intensity increases up to 9 AU / eq ; 2. idea of {non linear increase / increase decreases} ; 3. no further increase in change in mean peak voltage as light intensity increases from 9AU / eq ;	**IGNORE** speed references **2. ACCEPT** greatest change is mean peak voltage is when light intensity increases from 1 to 3	**(2)**

Question Number	Answer		Mark
(ii)	*As light intensity increases up to 9AU* 1. idea that the greater the light intensity, the less {neurotransmitter/eq} there is binding to the neurone present ; 2. idea that inhibition removed e.g. (more) Na^+ channels open, (more) Na^+ diffuses into neurone ; 3. so peak voltage of depolarisation becomes more positive / eq ; *At high light intensities (from 9AU) :* 4. idea of no {neurotransmitter/eq} binding ; 5. sufficient Na^+ enters / eq ; 6. so action potential achieved ;	**NB ACCEPT** glutamate for neurotransmitter **ACCEPT** converse for decreasing light intensity **3 ACCEPT** increasing depolarisation **5 ACCEPT** threshold potential achieved	**(4)**

Q6.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to five of the following: • rhodopsin bleached / rhodopsin forms opsin and retinal (1) • closing of sodium (ion) / Na^+ channels (1) / sodium (ion) / Na^+ cannot enter cell / membrane less permeable to sodium (ion) / Na^+ (1) • sodium pump continues (1) • inside more negative / hyperpolarisation / generator potential (1) • release of {neurotransmitter / glutamate} stops (1) • {depolarisation / action potential} in {bipolar cell / ganglion cell / sensory neurone} (1)	**DO NOT ACCEPT** optic nerve	**(5)**

Q7.

Question Number	Acceptable Answer	Additional Guidance	Mark
	A description that makes reference to the following: • description of appropriate method for varying light intensity (1) • quantification of light intensity (1) • description of appropriate method for measuring reading accuracy (1) • description of method for controlling two relevant variables (1)	E.g. use of filters, dimmer switch, different distances of lamp from experimental setup E.g. use of light meter E.g. number of errors, number of pauses, time taken, different text needed for each measurement E.g. subject at same distance from text, same time to adapt to each new light intensity, text same { size / font },	**(4)**

Q8.

Question Number	Indicative content
*	Answers will be credited according to candidate's deployment of knowledge and understanding of 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. • no light is seen at 15 degrees (D) • as there are no rods or cones at the blind spot (D) • cones are less sensitive than rods / can only detect bright light (R) • because they do not have spatial summation /rods have spatial summation (R) • cones are only found in the fovea / between 5° and 5° (R) • rods are not found in the fovea / between 5° and 5° / found everywhere except fovea / between 5° and 5° (R) • rods are stimulated by green light / 525 nm light (R) • rods are not stimulated by red light / 670 nm light (R) • dim red light /670 nm light is not seen at any angle because rods cells are not sensitive to red light / light of 670nm (S) • and cone cells are not sensitive enough (S) • bright red light / 670 nm light is only seen when on the fovea / between 5° and 5° because red cones are only on the fovea / not found outside the fovea (S) • and rod cells can not detect red light (S)

	• bright green light / 525nm light is seen everywhere apart from the blind spot / 15° because cone cells detect it in the fovea (S) • and rod cells detect green light / 525 nm light away from the fovea (S) • dim green light / 525 nm light is seen at angles greater than 10° because rod cells are sensitive to green light / 525 nm light (S) **Level 1: Only description (any 1 or 2 from B or R)** **Level 2: Elements of description of data and explanation but not fully linked (any 3 or 4 from B, R or S)** **Level 3: Description and explanations and linked well and no major errors (any 5 or 6 from B, R, S)**

Level	Marks	
Level	Marks	
0	0	No awardable content
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.
2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of all pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.
3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of all pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

Q9.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to four of the following: • rhodopsin involved (1) • retinal changes from cis to trans form / opsin and retinal formed (1) • {Na^+ / cation} channels close / Na^+ stop diffusing into rod cell (1) • Na^+ still moves out / inside cell becomes more negative / hyperpolarisation (1) • stops {glutamate / neurotransmitter} release (1)	**ACCEPT** blocks sodium channels	**(4)**

Q10.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • at a light intensity of 2 lux, monochrome vision is possible but colour vision is not (1) • because cones require higher light intensity to function (1) • at very low light intensities, vision is less accurate because insufficient rhodopsin broken down into retinal and opsin (1) • therefore action potential not generated in {bipolar / ganglion } cell (1)		**(4)**