

Question Number	Answer	Additional Guidance	Mark
1(a)	<ol style="list-style-type: none"> 1. idea that opsin uncouples from the (rod cell) cell surface membrane ; 2. trans retinal {converts / eq} to cis retinal ; 3. rhodopsin is (re)formed / eq ; 4. from opsin and retinal ; 5. idea that this results in dark adaptation ; 6. permeability of the cell surface membrane to Na⁺ increases / eq ; 7. hyperpolarisation of cell decreases / eq ; 8. (more) neurotransmitter is released / eq ; 	<p>NB IGNORE references to bipolar neurone responses IGNORE reference to retinol</p> <p>6. ACCEPT Na⁺ {enters /channels unblocked / channels open} 7. ACCEPT (partial) depolarisation / reduced potential difference 8. ACCEPT glutamate for neurotransmitter</p>	(5)

Question Number	Answer	Additional Guidance	Mark
1 (b)(i)	<ol style="list-style-type: none"> mean peak voltage increases as light intensity increases up to 9 AU / eq ; idea of {non linear increase / increase decreases} ; no further increase in change in mean peak voltage as light intensity increases from 9AU / eq ; 	<p>IGNORE speed references</p> <p>2. ACCEPT greatest change is mean peak voltage is when light intensity increases from 1 to 3</p>	(2)

Question Number	Answer	Additional Guidance	Mark
1 (b)(ii)	<p><i>As light intensity increases up to 9AU</i></p> <ol style="list-style-type: none"> idea that the greater the light intensity, the less {neurotransmitter/eq} there is binding to the neurone present ; idea that inhibition removed e.g. (more) Na⁺ channels open, (more) Na⁺ diffuses into neurone ; so peak voltage of depolarisation becomes more positive / eq ; <p><i>At high light intensities (from 9AU) :</i></p> <ol style="list-style-type: none"> idea of no {neurotransmitter/eq} binding ; sufficient Na⁺ enters / eq ; so action potential achieved ; 	<p>NB ACCEPT glutamate for neurotransmitter</p> <p>ACCEPT converse for decreasing light intensity</p> <p>3 ACCEPT increasing depolarisation</p> <p>5 ACCEPT threshold potential achieved</p>	(4)

Question Number	Answer	Additional Guidance	Mark
1(c)	<ol style="list-style-type: none"> idea of rats have rights ; rats made {blind/ eq } ; 15 samples may not be sufficient for a reliable investigation / eq ; idea that rat retina may not behave like human retina (so investigation has no (potential) medical application) ; 	<ol style="list-style-type: none"> ACCEPT lack of consent given ACCEPT harmed, causes pain, requires killing rats ACCEPT tissue culture available 	(2)

Question Number	Answer	Mark	
2(a)(i)	B ;	(1)	
2(a)(ii)	D ;	(1)	
2(a)(iii)	A ;	(1)	
2(a)(iv)	D ;	(1)	
2(a)(v)	A ;	(1)	
Question Number	Answer	Additional guidance	Mark
2(b)	<ol style="list-style-type: none"> 1. Ideas of (muscles) work antagonistically ; 2. circular muscle relaxes ; 3. radial muscle contracts; 	ACCEPT 2 stretched	(2)

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3(a)	<table border="1"> <thead> <tr> <th rowspan="2">Description</th> <th colspan="4">Area of the rod cell</th> </tr> <tr> <th>A</th> <th></th> <th>C</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>Nearest the pupil of the eye</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>Containing the photosensitive pigment</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>Has the pre-synaptic membrane</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </tbody> </table>	Description	Area of the rod cell				A		C	D	Nearest the pupil of the eye	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Containing the photosensitive pigment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Has the pre-synaptic membrane	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	(3)
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3(b) (i)	<ol style="list-style-type: none"> reference to light intensity required / eq ; light {absorbed / eq} by rhodopsin / eq ; rhodopsin changes shape / eq ; rhodopsin is converted to retinal AND opsin / eq ; opsin binds with cell surface membrane / eq ; idea of fewer {sodium ions /Na⁺} enter rod cell ; idea of sodium ions pumped out of rod cell ; hyperpolarisation occurs (leading to change in voltage) / eq ; 	<p>ACCEPT 3 - cis to trans retinal</p> <p>ACCEPT 6 - decreases permeability (of membrane) to {sodium ions /Na⁺}, channels close ;</p>	(4)

Question Number	Answer	Additional Comments	Mark
3(b) (ii)	<ol style="list-style-type: none"> idea of not enough {rhodopsin is converted /opsin binds to membrane} ; (so) change in voltage is insufficient / eq ; idea of { neurotransmitter / glutamate} still released (from rod cell) ; idea that depolarisation in bipolar neurone insufficient ; idea of bipolar neurone already depolarised ; 	ACCEPT 4 - for depolarisation- threshold level not achieved	(2)

Question Number	Answer	Mark
4 (a) (i)	{pigment / eq} at back of eye absorbs light / no light is reflected out (from the choroid) ;	(1)

Question Number	Answer	Mark
4 (a) (ii)	<ol style="list-style-type: none"> 1. circular muscles contract (and radial muscles relax) to {constrict / eq} pupil ; 2. radial muscles contract (and circular muscles relax) to {dilate / eq} pupil ; 3. need for fine control of aperture to allow pupil to be reset to a different size / allow changing to take account of varying light intensity ; 4. (these) muscles can only shorten / eq ; 5. antagonistic muscles have opposite effects / eq ; 6. idea that contraction of one muscle set stretches the other ; 	(3)

Question Number	Answer	Mark
4 (a) (iii)	<ol style="list-style-type: none"> 1. details of impulse e.g. depolarisation / eq ; 2. reference to bipolar {neurone / cell / eq} ; 3. reference to sensory neurone / eq ; 4. reference to optic nerve ; 5. reference to {motor / eq} neurone connected to (radial) muscles ; 6. reference to contraction of radial muscle ; 	(3)

Question Number	Answer	Mark
4 (b)	<ol style="list-style-type: none"> 1. has an effect on nervous system of iris / eq ; 2. radial muscles contract / eq ; 3. idea of prevention of pupil constriction ; 4. larger aperture / pupil dilates / eq ; 5. letting more light in / eq ; 6. (so) can see { more / all / eq } retina ; 	(3)

Question Number	Answer	Mark
4 (c)	<ol style="list-style-type: none"> 1. retinol and retinal are very similar in structure / eq ; 2. idea of retinol is needed to make retinal / eq ; 3. idea that shortage of retinol in diet leads to less retinal ; 4. in rods ; 5. idea that this leads to reduced vision in { low light / at night / eq } ; 	(3)

Question number	Answer	Mark
5(a)(i)	C	(1)

Question number	Answer	Mark
5(a)(ii)	A	(1)

Question number	Answer	Mark
5(a)(iii)	D	(1)

Question number	Answer	Mark
5(b)(i)	<ol style="list-style-type: none"> 1. Idea that lack of (visual) stimulation limits brain development ; 2. Idea that this due to of lack of connections ; 3. within the {visual cortex / eq} / eq ; 4. Idea that the brain cannot interpret this visual information correctly / eq ; 5. reference to critical {period / window} ; 6. idea that mice are different from humans ; 	(3)

Question number	Answer	Mark
5(b)(ii)	<ol style="list-style-type: none"> 1. Idea that embryo supplies cells ; 2. Idea that some people have {ethical / eq} objections to the use of embryonic cells / eq ; 3. Idea of objections to the use of animals ; 4. Idea of risk of stem cells becoming cancerous ; 	(2)

Question number	Answer	Mark
5(c)(i)	<ol style="list-style-type: none"> 1. Idea that (cerebral hemisphere) is the site of vision perception ; 2. reference to visual cortex / eq ; 3. idea that stem cells differentiate ; 4. this treatment will help to establish (neurone) connections / eq ; 5. Idea that can not get stem cells to this location any other way (than injection) ; 	(2)

Question number	Answer	Mark
5(c)(ii)	<ol style="list-style-type: none"> 1. reduce number of variables / to keep all variables constant / eq ; 2. so that only the effect of the {treatment / eq} is measured / eq ; 	(2)