

## Mark schemes

- 1**
- (a) 1. Membrane more permeable to potassium ions and less permeable to sodium ions;  
2. Sodium ions actively transported / pumped out and potassium ions in. 2
- (b) 1. (Pressure causes) membrane / lamellae to become deformed / stretched; 2. Sodium ion channels in membrane open and sodium ions move in; 3. Greater pressure more channels open / sodium ions enter. 3
- (c) 1. Threshold has been reached;  
2. (Threshold or above) causes maximal response / all or nothing principle. 2
- (d) 1. Less / no saltatory conduction / action potential / impulse unable to 'jump' from node to node;  
2. More depolarisation over length / area of membranes. 2
- [9]** (a) The colour of the square has no effect on the duration of the afterimage / there is no

**2** difference in the duration of the afterimage **with** squares of different colours;  
*Accept other ways of expressing the null hypothesis but reference must be made to colour of square and the duration of the afterimage*  
*Reject 'there is no difference in the duration of the afterimage and the colour of the square'*

- (b) Standard error (with 95% confidence limits)/t test because looking for differences between means / measurements (from different samples);  
*Test and reason required for the marking point*

- (c) 1. (When staring at purple) red (sensitive) and blue (sensitive) cones are stimulated / green (sensitive) cones are not stimulated;  
2. Red and blue cone cells become exhausted / stop working;  
3. (Afterimage due to) green (sensitive) cone cells working;  
*Allow 1 extra mark up to the maximum of 3 for additional detail to marking point 2 e.g. exhaustion of pigment, exhaustion of neurotransmitter, exhaustion of ATP*

- (d) 25% = 2 marks;  
15-12/12 × 100 = 1 mark;

1

1

3

2

[7]

3

- (a) 1. Three peaks / three maximum values / three maxima;  
2. At different wavelengths / different colours / blue, green and red;  
*Accept 'at 430nm, 515nm, 585nm' ( $\pm 5$ nm for all)* 2
- (b) Overlap between different types of cone cells / some wavelengths /colours are detected by more than one type of cone cell; 1
- (c) 1. Birds have four peaks, humans have three peaks;  
2. Birds and humans have types (that peak) at 515 nm/greenand 585 nm/red;  
3. (Similar type) but (peak) at 430 nm in humans and 450 nm in birds;  
4. Birds have a peak / can see at 370 nm / shorter wavelength / UV range;  
*1. Birds have four different types of cone, humans have three*  
*Accept all numbers read from the graph within  $\pm 5$  nm.*  
*3. Do not accept 'both humans and birds absorb blue'*

3 max

- (d) 1. (Each cone cell has) separate neurone to brain / separate bipolar neurone / separate ganglion cell;  
2. (So) no retinal convergence / impulses from each cone kept separate / no summation of impulses;  
*Allow converse for rod cells*  
*2. Accept idea that each cone only represents a small area of the retina* 2
- (e) Between 230 790 to 231 000 = 2 marks;  
Area of fovea =  $1.54 \text{ mm}^2$  = 1 mark;  
*Using  $\pi$  as 3.14 or 22/7 or  $\pi$  on the calculator*  
*No credit can be awarded if the area has been incorrectly calculated* 2

[10]

4

- (a) Any **two** from:
- light
  - pressure

- touch
- temperature
- chemicals
- (loud) noise
- smell;

*Two required for 1 mark*

*Do not accept unqualified reference to dust / particles / objects*

*Accept (rapid) movement (of particles / air) towards the eye*

*Accept humidity / moisture / tears*

1

- (b) 1. Standard deviations / standard errors;
2. (So) likely to overlap;

2

- (c) 1. Would not know the patient's / human's normal blink rate so unable to make a comparison;
2. Blink rate could be affected by stress of seeing a doctor;
3. Many factors could affect blink rate so it would be difficult to tell if blink rate was due to illness

2 max

- (d) 1. Not possible to predict intermediate values;
2. Only one result for each time period / not mean values;

2

- (e) Collected paired data;

1

- (f) 1. No / low influx of sodium ions;
2. So no depolarisation / action potential;
2. *'so no impulses' insufficient*

2

- (g) 1. Allows calcium ions in;
2. At end of presynaptic neurone;
3. Causing release of neurotransmitter;

*1. Accept Ca<sup>2+</sup>/Ca ions but not Ca/Ca+*

*2. The idea of the end of the presynaptic neurone must be given e.g. presynaptic knob*

3

- (h) 1. Reference to large group size;
2. Reference to matching a specific, named variable;
3. Applying a statistical test to the data;
1. Accept  $\geq 20$  / many / lots' but not 'several / less than 20'
  2. Accept any named variable other than age.
  3. Accept 'use SE / 95% confidence limits'

3

[16]

5

- (a) 1. (Increased pressure) deforms / changes stretch-mediated sodium (ion) channel;
2. (Sodium channels open and) sodium ions flow in; Accept  $\text{Na}^+$
3. Depolarisation (leading to generator potential). Accept correct description of depolarisation

3

- (b) Value between 2.17:1 and 2.29:1;
- Accept rounding up to 2.2 or 2.3
- Accept: number without : 1
- Correct working showing answer but incorrect rounding in answer line = 1

Values between 117 to 119 and between 52 to 54 found but ratio wrong way round = 1 mark.

Wrong way round gives answer between 0.35:1 and 0.46:1

2

- (c) 1. Parasympathetic greater effect than sympathetic; Ignore: descriptions of graph
2. Parasympathetic keeps heart rate down / lower / decreases heart rate (as bloodpressure increases);
3. Sympathetic keeps heart rate up / higher / increases heart rate (as bloodpressure increases);
2. and 3. Accept converse for blood pressure decreases
4. Parasympathetic greatest / greater effect at high blood pressure / sympathetic greatest effect at low blood pressure.

3 max

[8]

6

- (a) (i) 1 and 2 share neurone but 2 and 3 have separate neurones (to brain);

Ignore wrong names of neurones

1

- (ii) 1 unit is sub-threshold / 3 units are above threshold / give sufficient depolarisation;  
 (1 unit) No impulses / no action potential / in (sensory) neurone / does not stimulate (sensory) neurone / 3 units → impulses;  
 (Spatial) summation / sufficient neurotransmitter released / from 3 receptors / insufficient N-T from one;  
*Reject 'temporal'*

3

- (b) (i) (Three) different types of (cone) cells / types 6 and 7 sensitive to different wavelengths / different frequencies / different colours;
- (ii) Impulses along separate neurone from each receptor cell / each receptor cell connects to separate neurone;

2

[6] (i) no (photo)receptor cells at Y / no rods and cones;

7

1

- (ii) X has many / only cones / more cones than Z; which each synapse to a single neurone / bipolar cell / no retinal convergence;  
 OR  
 Z has mainly rods / more rods than cones; which share / converge on neurones / bipolar cells;

2

[3] (a) no rods at blind spot or fovea;

8

g  
r  
e  
a  
t  
e  
r  
d  
i  
s  
t  
r  
i  
b  
u  
t  
i  
o  
n  
o  
f  
r

(b) more rods and no / fewer cones present; rods  
at the fovea / rods not mainly at periphery;

rods have high sensitivity / show retinal convergence /  
converse for cones;

rhodopsin 'bleached' at low light intensities / iodopsin  
'bleached'; at high light intensities;

3 max

[5] (i) rhodopsin bleached / broken down by light;

9

(ii) rhodopsin / pigment absorbs green light more readily than red / is more  
sensitive to green light;  
(after resynthesis) less (intense) green light needed to break down  
rhodopsin (than red);

- (iii) white has (high proportion of) wavelengths to which rhodopsin not sensitive;

1

[5] (a) (epithelial cell) of tubule cells carry out active transport;

10

transport chloride / sodium ions out (of filtrate); against concentration gradient; into surrounding tissue / tissue fluid; creates / maintains water potential gradient for water reabsorption; countercurrent multiplier;

5 max

- (b) if water potential of blood falls, detected by receptors in hypothalamus; leads to ADH released from pituitary gland; ADH makes cells of collecting duct / distal convoluted tubule permeable to water;  
*(accept DCT)*

water leaves filtrate by osmosis; smaller volume of urine produced;

*(accept converse if water potential of blood rises)*

4 max

- (c) (autonomic reflex), autonomic ganglion involved; extra synapse outside the spinal cord; inhibitory rather than excitatory neurone; more neurones involved;

2 max

[11] (a) Colour detected by cone cells;

11

Fovea contains (only / mainly) cone cells;  
Three types of cone / cells described / each sensitive to different wavelength / to red or green or blue;

*Max 2 if 'rods' and 'cones' confused consistently*

3

- (b) (i) Each receptor (in fovea)/each cone connected to separate neurone / rods/cells in other parts share a neurone;

*Accept nerve cell / nerve fibre*

1

- (ii) Many rods in other parts of retina;  
Rhodopsin / pigment in receptors / rod cells very sensitive to light/ works in low light;  
Receptors / rods connected in groups to ganglion cell / neurone;  
Summation;  
Description of summation, eg if enough light above threshold hits any cells in the group, then get nerve impulses to brain/along optic nerve;

3 max

[7]