A-Level Biology

Receptors

Mark Scheme

Time available: 64 minutes
Marks available: 44 marks

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1.

(a) 1. Circular muscle contracts;

2. Radial muscle relaxes;

Accept, for one mark 'both muscles contract' or 'both muscles relax' as names of muscles are in the diagram.

Reject muscles constrict.

2

(b) 1. High (visual) acuity;

2. (Each) cone is connected to a single neurone;

Accept no retinal convergence.

Accept 'bipolar/nerve cell' for neurone.

3. (Cones send) separate (sets of) impulses to brain;

Accept 'optic nerve' for brain.

Reject 'signals', 'messages' for 'impulses'.

Accept 'action potential'.

3

(c) 1. Correct answer of 0.6 (%) = **2 marks**;;

Ignore any numbers after 0.6, 2.58, 2.6 and after 0.43.

2. Incorrect answer but shows number sequence 7065 / 7068 / 7069 / (ignore position of decimal point) = **1 mark**

OR

Final answer number sequence has 64 / 65 (ignore preceding zeros, numbers that follow and position of decimal point) **= 1 mark**

OR

Final answer is 2.58 / 2.6 (%) = **1 mark**

OR

Final answer of 0.43 (%) = **1 mark**;

2

(d) 1. High (visual) sensitivity;

Accept retinal convergence.

2. Several rods connected to a single neurone;

Accept 'bipolar/nerve cell' for neurone

Accept 2, 'many' or

3. Enough (neuro)transmitter to reach/overcome threshold

OR

Spatial summation to reach/overcome threshold; more for 'several'

Reject 'signals', 'messages' for 'impulses'.

Accept named neurotransmitter.

Accept depolarisation, 'action potential' or 'generator potential' for 'to reach threshold'.

Generator potentials combine to reach threshold/ depolarisation/action potential/generator potential.

3

[10]

2. (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]

3.

(a) The colour of the square has no effect on the duration of the afterimage / there is no 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'*

1

(b) Standard error (with 95% confidence limits)/t test because looking for differences between means / measurements (from different samples);

Test <u>and</u> reason required for the marking point

1

(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

3

(d) 25% = 2 marks;

15-12/12 × 100 = 1 mark;

2

[7]

4.

(i) no (photo)receptor cells at **Y** / no rods and cones;

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]

5.

(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) <u>different types</u> of (cone) cells / types 6 and 7 sensitive to <u>different</u> wavelengths / <u>different</u> frequencies / <u>different</u> colours;

(ii) Impulses along separate neurone from each receptor cell / each receptor cell connects to separate neurone;

2

[6]

6.

(a) **Two** marks for **three** correct structures,

one mark for **two** correct structures;;

P = capsule/lamella(e)

P – accept connective tissue (with layers of viscous gel)

Q = Sensory neurone

Q – accept axon

R = Myelin (sheath)

R – accept Schwann cell(s)

2

(b) 1.27% (second box) ticked;

1

(c) 1. The student started to move her hand before the ruler was released;

Accept any descriptions of a pre-emptive strike

2. The ruler did not fall vertically/was not placed vertically;

3. The ruler stuck to her skin (a little);

1 max

(d) 12.9 (m s^{-1});;

Accept 1 mark

For use of reaction time of 136 ms/0.136 s in answer

OR

$14.58\dot{3}$ (answer including Trial 3)

2

(e) 1. Time for synaptic transmission/transmission at neuromuscular junction;

2. Time taken for muscles to contract;

3. Time taken for (stretch-mediated) sodium ion channels to open (in the Pacinian corpuscle);

4. Student may have been distracted;

5. Time taken for coordination/comprehension (by the brain);

3 max

[9]