PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 9: CONTROL SYSTEMS

DETECTION OF LIGHT BY MAMMALS

SCORE	PERCENTAGE
/49	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions and mark schemes in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question or mark scheme material in this pack. Pearson has not endorsed, approved or been involved in the production of it. Pearson, Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

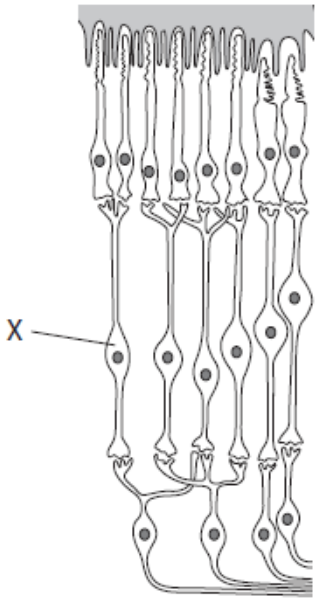
Pearson publishes its past papers and mark schemes free of charge. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The diagram shows a section of a human retina.



Which of the following is the name of the cell labelled X?

(1)

☒ **A** bipolar neurone

☒ **B** ganglion neurone

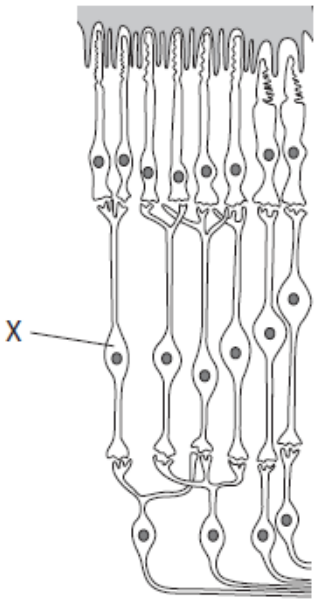
☒ **C** motor neurone

☒ **D** optic neurone

(Total for question = 1 mark)

Q2.

The diagram shows a section of a human retina.



Explain the role of rhodopsin in the generation of a nerve impulse in cell X when light falls on the retina.

(3)

.....

.....

.....

.....

.....

.....

.....

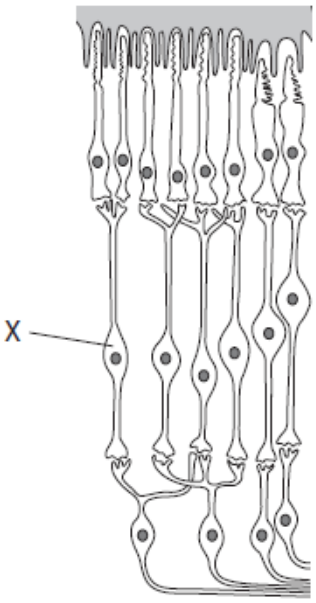
.....

.....

(Total for question = 3 marks)

Q3.

* The diagram shows a section of a human retina.

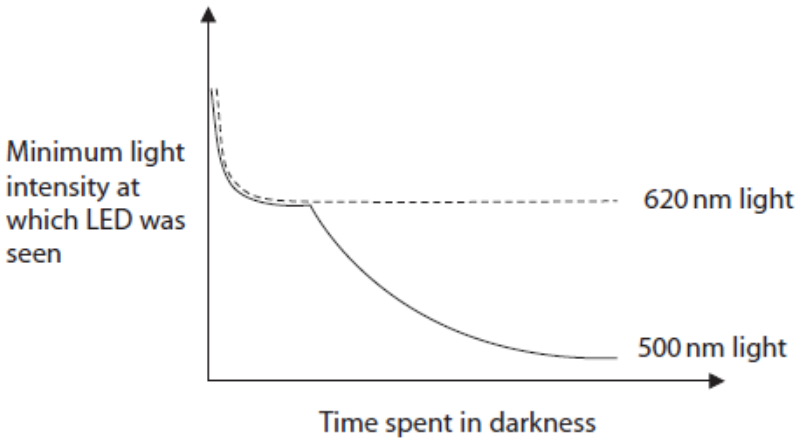


A scientist investigated the effect of how the length of time a volunteer spent in darkness affected the sensitivity of their retina to light.

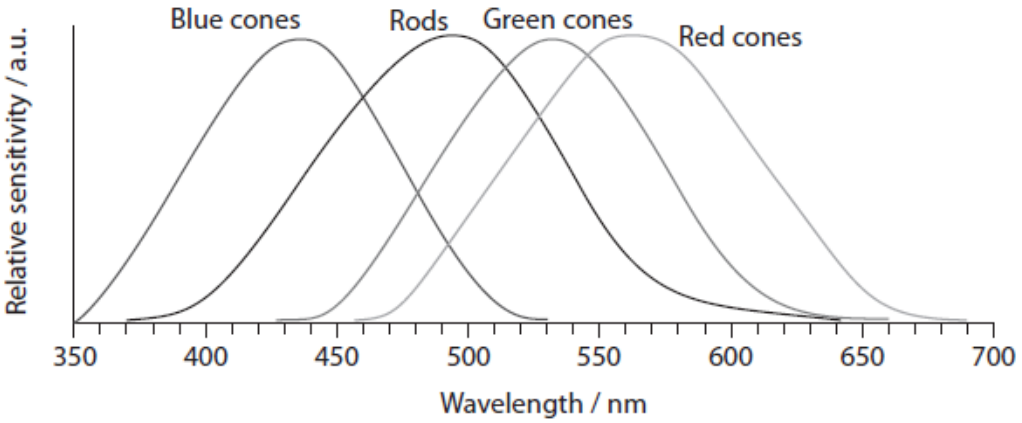
This is the method used:

- the volunteer sat in a room illuminated with white light for twenty minutes
- the lights were switched off and the room was placed into total darkness for one minute
- an LED emitting light of wavelength 500 nm at low light intensity was switched on
- the light intensity was gradually increased until the volunteer was able to see the LED and this minimum light intensity was recorded
- this was repeated with increasing lengths of time that the volunteer was kept in total darkness
- the investigation was then repeated with an LED that emitted red light with a wavelength of 620 nm.

The graph shows the results of this investigation.



The graph shows the relative sensitivity of rods and three types of cone to light of different wavelengths.



Analyse the graphs to explain the results of this investigation.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q4.

A defect in the cone cells of the retina can result in colour blindness.

(a) Which is the visual pigment found in cone cells?

(1)

☒ **A** iodopsin

☒ **B** opsin

☒ **C** retinol

☒ **D** rhodopsin

(b) The table below shows the distribution of different cones involved in colour blindness.

Population	Distribution of different cones / percentage of population (%)			
	Normal cones	L-cone defect	M-cone defect	S-cone defect
Men	91.40	2.45	6.14	0.01
Women	99.52	0.04	0.36	0.04

(i) The population of London is 12 million, of which 55% are men.

Calculate the number of men in London who are colour blind.

(3)

Answer .....

(ii) The allele for one defect in cone cells is recessive and carried on the X chromosome.

Explain why more men than women are colour blind.

(2)

.....

.....

.....

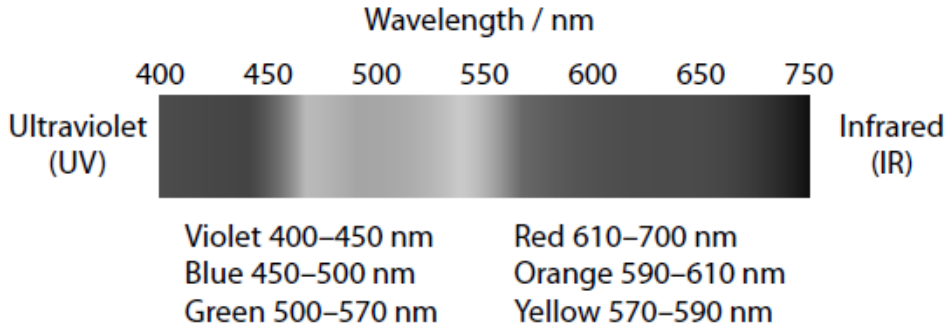
.....

(iii) L-cones respond to long wavelengths of light.

M-cones respond to medium wavelengths of light.

S-cones respond to short wavelengths of light.

The visible light spectrum is shown below.



Analyse the data to explain why red/green colour blindness is the most common throughout the population.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 10 marks)

Q5.

An investigation was carried out to study the effect of light on the mammalian retina.

Part of the retina of a young rat was removed and kept in the dark for two hours. This allowed the pigment in the rod cells to recover from bleaching caused by exposure to light.

When the retina had recovered from bleaching, the resting potential of the bipolar neurones in the retina was found to be -43 mV.

The retina was then exposed to a range of light intensities. Each light intensity caused the bipolar neurones to depolarise. The peak voltage of the depolarisation for each light intensity was recorded.

All other variables were kept constant.

The investigation used retinas from an additional 14 rats.

The mean results are shown in the table below.

Light intensity / arbitrary units	Mean peak voltage of depolarisation / mV
1	11
3	18
6	19
9	20
12	20

(i) Using the information in the table, describe the effect of light intensity on the mean peak voltage of depolarisation.

(2)

.....

.....

.....

.....

.....

.....

.....

(ii) Suggest an explanation for the effect of light intensity on the mean peak voltage of depolarisation in these neurones.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Q6.

When a mouse is put in a new environment, it will move around to find a safe place to live.

This is called exploratory behaviour.

A student investigated exploratory behaviour by putting a mouse into a large box.

The bottom of the box was marked into squares. There were four corner squares (C), two middle squares (M) and six side squares (S).

The marked bottom of the box is shown in the diagram.

C	S	S	C
S	M	M	S
C	S	S	C

The mouse moved about on the bottom of the box. The square occupied by the mouse was recorded every 10 seconds for 10 minutes.

The table shows the results of this investigation.

Total number of times square occupied by the mouse		
Corner square	Middle square	Side square
42	6	12

The student tested the null hypothesis that mice show no significant preference for corner, middle or side squares.

The mouse uses its eyes when exploring in the box.

Describe the role of rod cells in initiating action potentials to the brain of the mouse.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

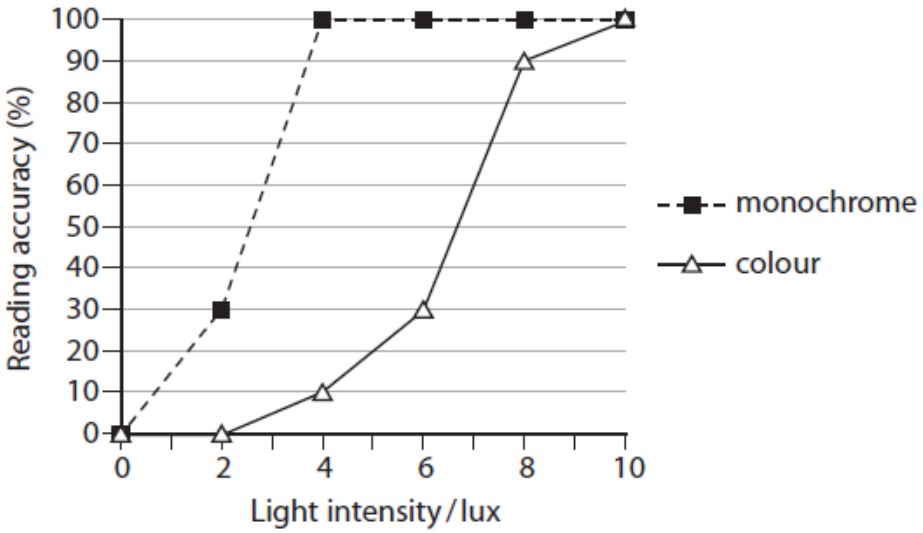
.....

(Total for question = 5 marks)

Q7.

A student investigated the effect of light intensity on reading accuracy in humans.

The graph shows the student's results for both monochrome (black and white) and colour vision.



Devise a method that the student could use to obtain these results.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

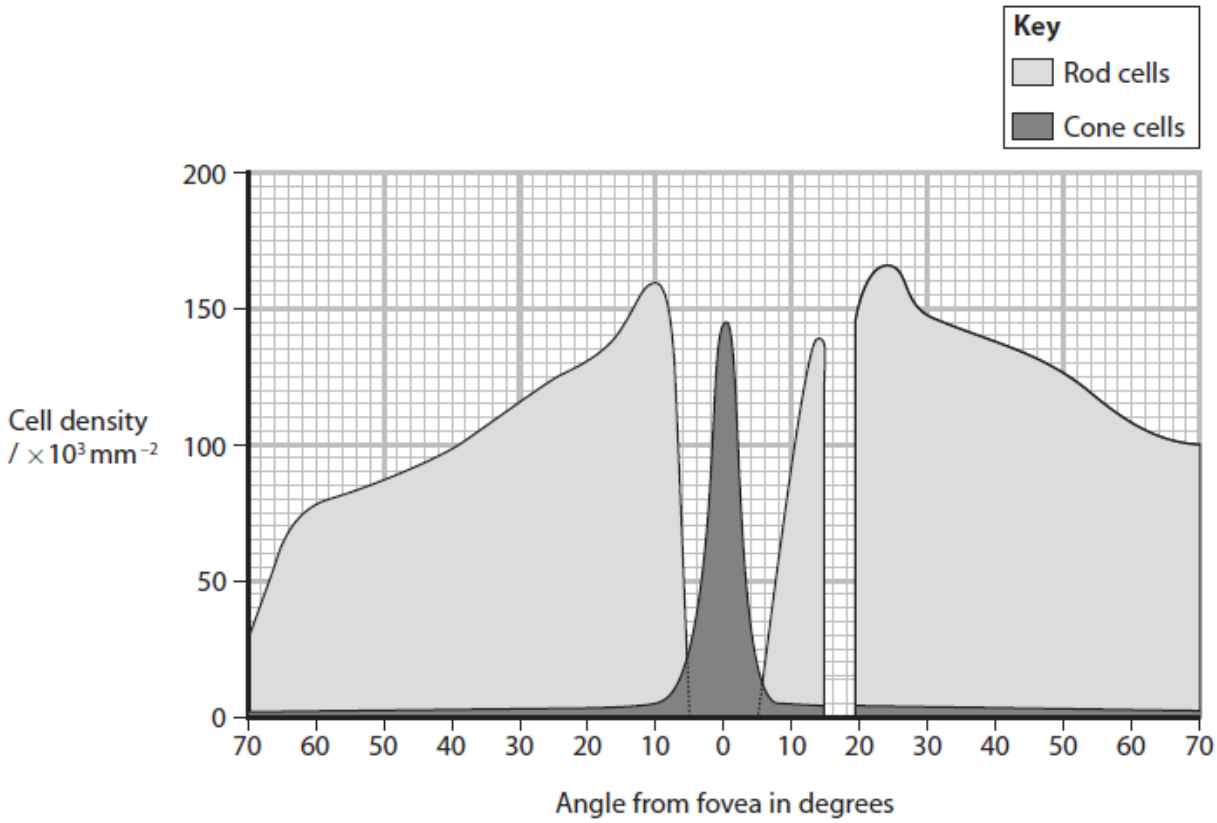
.....

.....

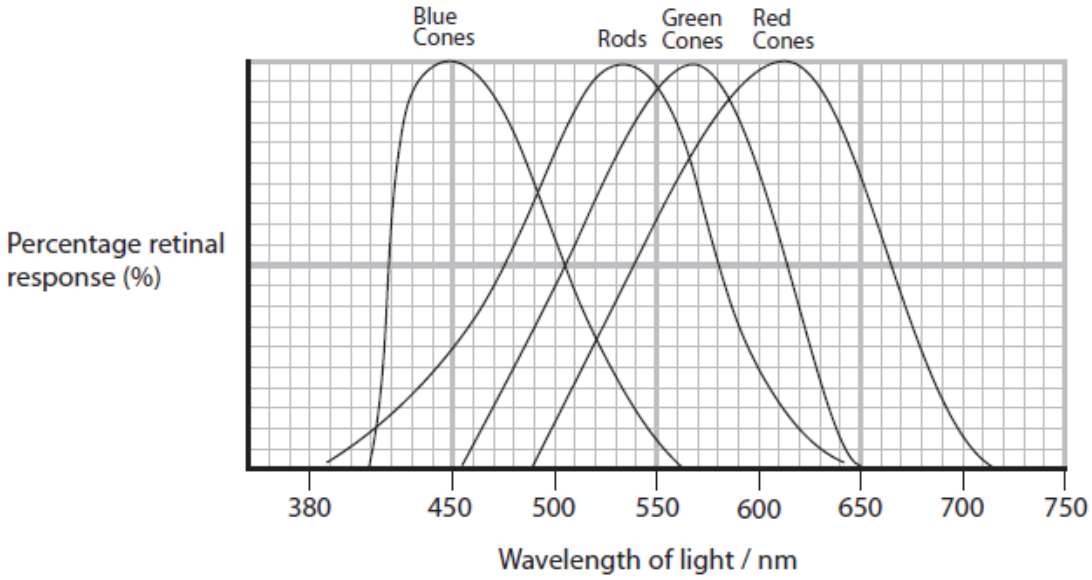
Q8.

*Graph 1 shows the distribution of photoreceptors across the retina.

Graph 2 shows the sensitivity of rod cells and cone cells to light of different wavelengths.



Graph 1



Graph 2

Students investigated the ability to detect beams of light of different colours and intensities.

A student covered one eye and a bright red light (wavelength 670 nm) was placed at different angles in the field of vision of the other eye. The student stated if they could detect the red light.

This was repeated with a dim red light.

This was then repeated with a bright green light and a dim green light (wavelength 525 nm).

The table shows the results of this investigation.

Angle from fovea in degrees	Light detected (Yes/No)			
	Bright light Red	Dim light Red	Bright light Green	Dim light Green
60	N	N	Y	Y
30	N	N	Y	Y
15	N	N	Y	Y
10	N	N	Y	Y
5	Y	N	Y	N
0	Y	N	Y	N
5	Y	N	Y	N
10	N	N	Y	Y
15	N	N	N	N
30	N	N	Y	Y
60	N	N	Y	Y

Analyse the data to explain the results of this investigation.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q9.

The retina contains rod cells and bipolar neurones.

Rod cells contain large numbers of mitochondria.

Rod cells release glutamate, an inhibitory neurotransmitter.

Describe how light causes a change in the release of glutamate from rod cells.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

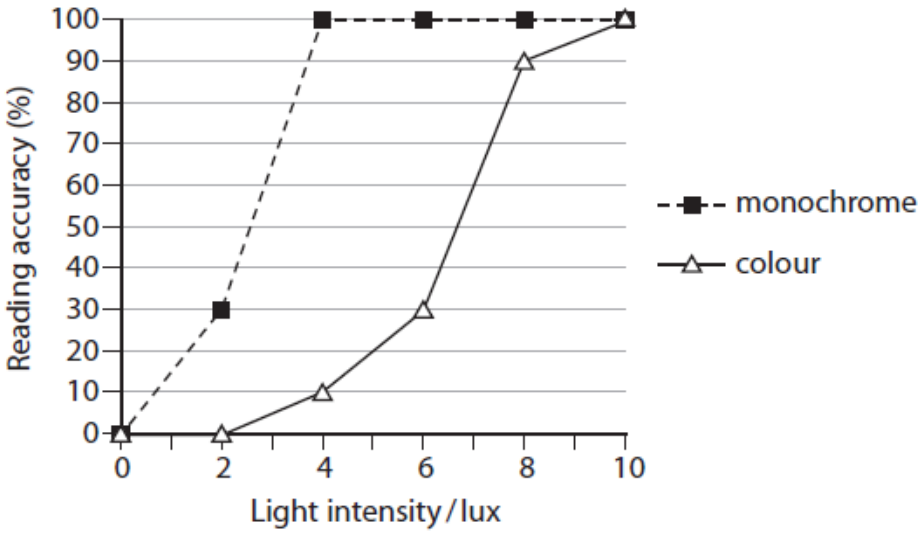
.....

(Total for question = 4 marks)

Q10.

A student investigated the effect of light intensity on reading accuracy in humans.

The graph shows the student's results for both monochrome (black and white) and colour vision.



Explain the student's results using your knowledge of the light-sensitive cells in the human eye.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....