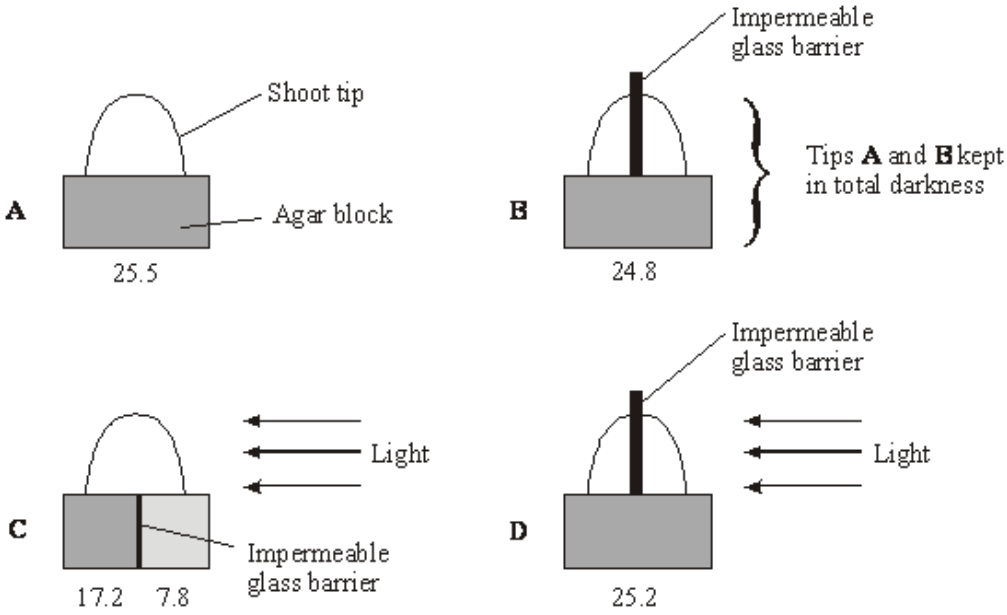
Q1. IAA is a substance that affects the growth of plants. It is produced in the tips of shoots and moves downwards in the stem to the rest of the plant. A series of experiments was performed to investigate the effect of the IAA on the growth of cucumber seedlings.

(a) **Figure 1** shows the results of an investigation into the effect of unidirectional light on IAA.

Figure 1



(i) Give **one** reason for the use of the impermeable glass barriers.

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(1)

(ii) What do the results of this experiment show about the effect of unilateral light on IAA? Use evidence from **Figure 1** to support your answer.

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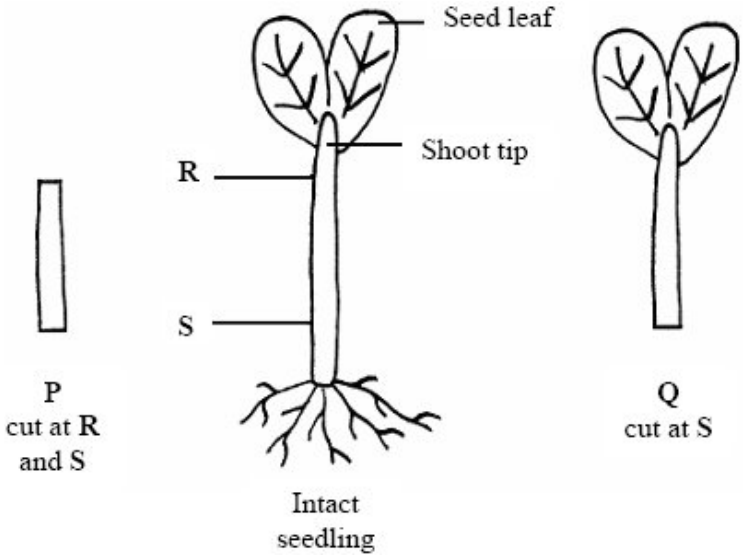
(3)

(b) **Figure 2** shows the ways in which two groups of cucumber seedlings were cut before being used in a second investigation

Figure 2



The two types of cut seedlings, **P** and **Q**, were grown in different growth media over a four-hour period. The table shows the results.

Group of cut seedlings used	Growth medium	Mean increase in length/mm	
		Grown in the dark	Grown in blue light
P	1% sucrose solution	1.2	0.8
P	Solution of 1% sucrose and 6 mg dm^{-3} IAA	3.9	5.2
Q	1% sucrose solution	4.1	3.3
Q	Solution of 1% sucrose and 6 mg dm^{-3} IAA	4.9	5.7

(i) The cut seedlings were grown in sucrose solution, rather than in distilled water. Give **one** reason why.

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(1)

(ii) When they were both grown in the dark, the two groups of seedlings responded differently to the inclusion of IAA in their growth media. Suggest **one** explanation for this different response.

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(2)

(iii) Describe the effect of blue light on the growth of seedlings **P** and **Q**.

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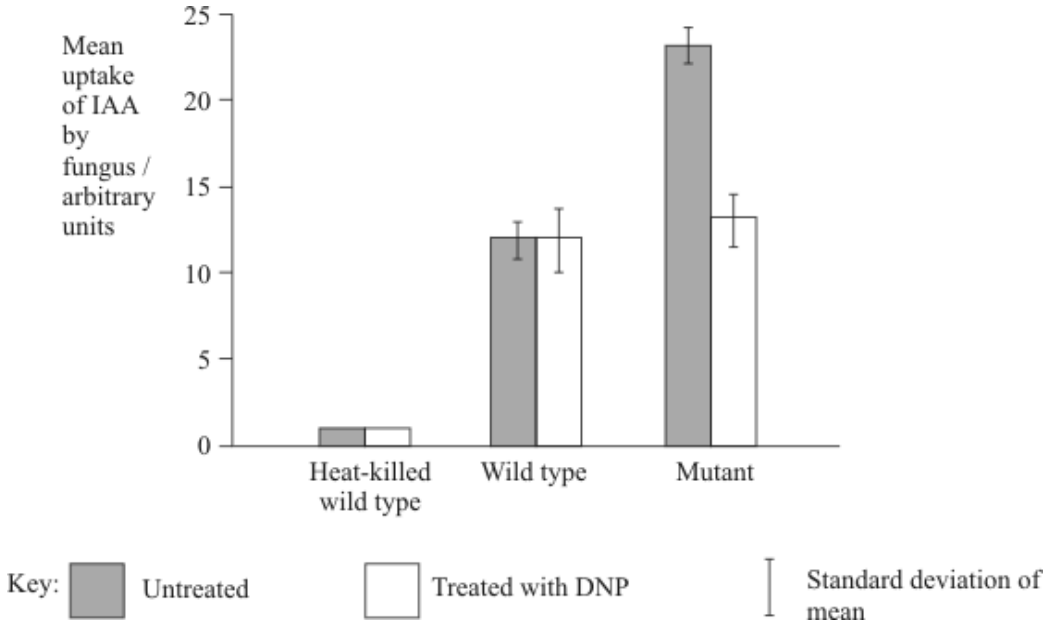
(3)

(c) Many fungi are parasites on plants. Uptake of IAA from the host plant affects the ability of these parasitic fungi to invade their plant host.

The uptake of IAA by a particular fungus was investigated. Two phenotypes of the fungus were used, the wild type and a particular mutant.

The bar chart shows the effect of DNP on the uptake of IAA by this fungus. DNP is a drug that affects the gradient of hydrogen ions across mitochondrial membranes.



Using evidence from the information given above and your own knowledge,

(i) explain how IAA is taken up by the cells of this fungus

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(2)

(ii) suggest how the mutation affected the cells of this fungus.

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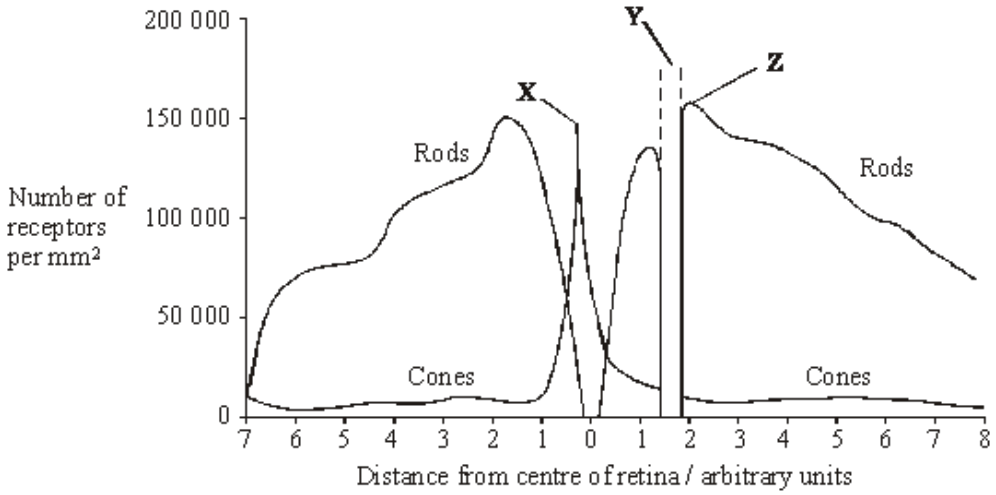
(3)
(Total 15 marks)

Q2. The graph shows the distribution of rod cells and cone cells across the retina of a human eye.



Use the diagram to explain why

(i) no image is perceived when light is focused on the retina at **Y**;

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(1)

(ii) an image formed at **X** is perceived in more detail than an image formed at **Z**.

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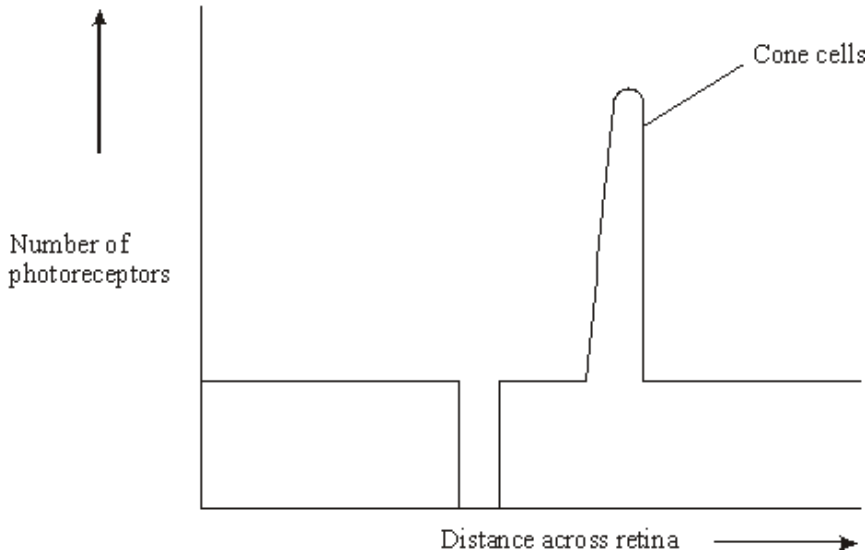
(2)
(Total 3 marks)

Q3. The diagram shows the distribution of cone cells across the retina of a human eye.



(a) On the diagram draw a line to show the distribution of rod cells across the retina.

(2)

(b) Nocturnal mammals are active at night. Describe how the number and distribution of rods and cones across the retina would differ in a nocturnal mammal from the number and distribution in a human. Explain your answer.

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(3)
(Total 5 marks)

Q4. After moving from bright light into darkness, it takes several minutes for the rod cells to recover their sensitivity. Researchers measured the ability of the rod cells to detect small spots of light of different colours and intensity after a person moved into darkness. The results are shown in **Figure 1**.

Figure 2 shows the amount of light of different wavelengths that rhodopsin absorbs.

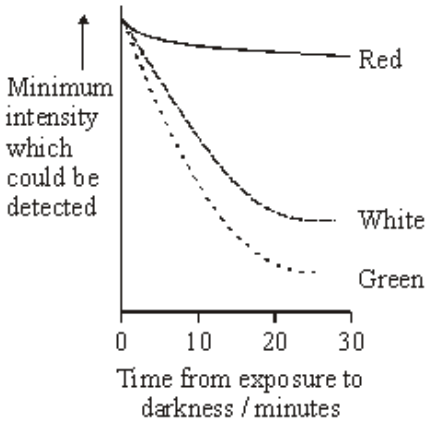

Figure 1

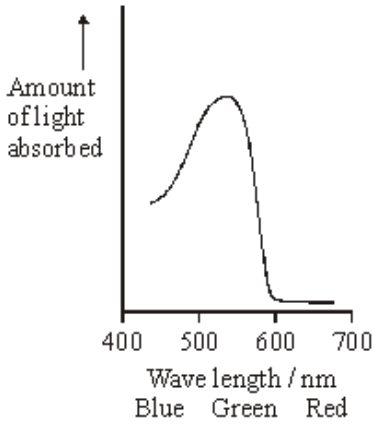

Figure 2

(i) Explain why it takes time for the rod cells to recover their sensitivity to light after moving into darkness.

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(2)

(ii) Use information in **Figures 1** and **2** to explain the differences in sensitivity of rod cells to red and green light.

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(2)

(iii) Suggest an explanation for the difference in sensitivity of rod cells to the white and green spots after 30 minutes.

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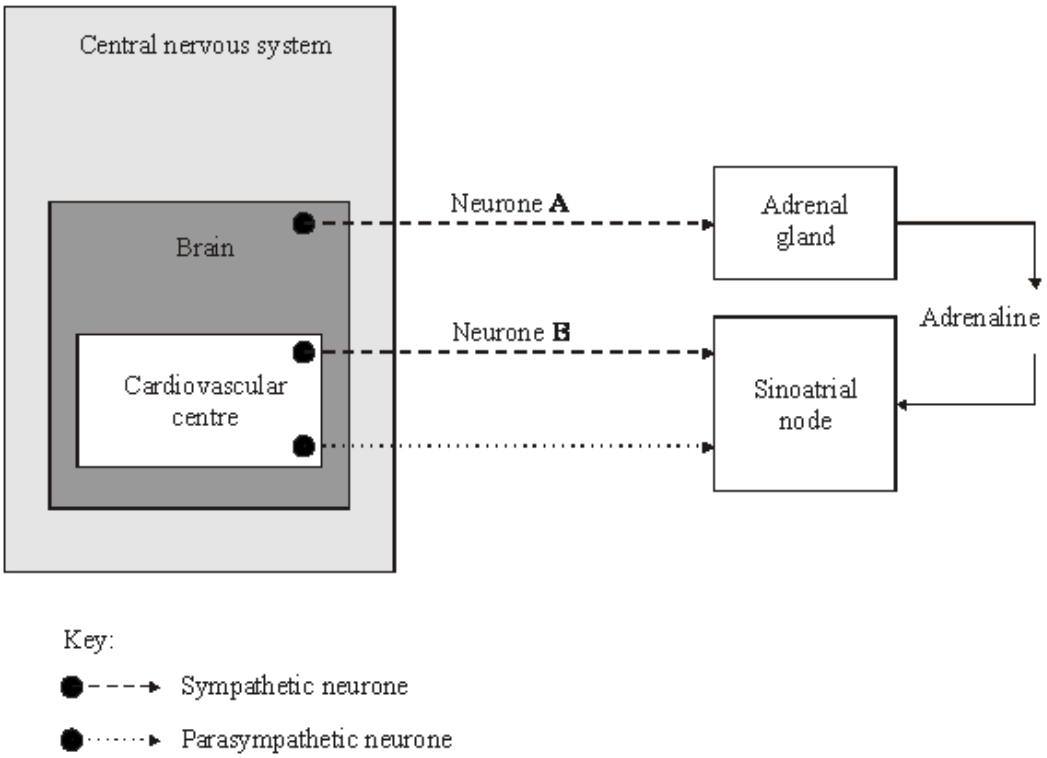
(1)

(Total 5 marks)

Q5. The diagram shows the control of the heart rate by the autonomic nervous system.



(a) In which part of the brain is the cardiovascular centre located?

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(1)

(b) What would be the effect on heart rate of stimulating

neurone **A**;

.....

neurone **B**?

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(1)

S (c) Describe how an impulse reaches the base of the ventricles of the heart from the sinoatrial node.

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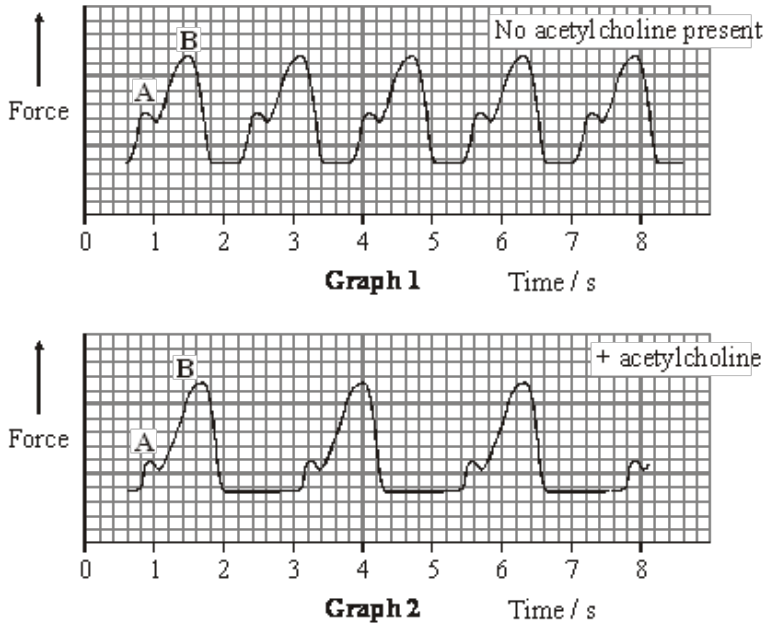
(3)
(Total 5 marks)

Q6. A frog's heart was attached to an instrument which measured the force produced as the heart contracted. **Graph 1** shows the changes in force when the heart was bathed in a solution of salts at 20 °C. **Graph 2** shows the results when the heart was bathed in the same solution at the same temperature, but including acetylcholine.



(a) Points **A** and **B** show when the atria and ventricle were contracting. Which point, **A** or **B**, shows contraction of the ventricle? Give **two** reasons for your answer.

Point .....

Reason 1 .....

.....

Reason 2 .....

.....

(2)

(b) Calculate the frog's heart rate when acetylcholine was **not** present. Show your working.

Heart rate = ... beats per minute.

(2)

(c) (i) From the graphs, what can you conclude about the effect of acetylcholine on

heart rate;

.....

stroke volume?

.....

(2)

(ii) Use your answer to part (i) to explain the effect of acetylcholine on cardiac output.

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(1)

(iii) Addition of acetylcholine in the experiment mimics the effect of one branch of the autonomic nervous system. Which branch is this?

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(1)

(d) (i) Explain how nervous control in a human can cause increased cardiac output during exercise.

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(4)

(ii) Explain why increased cardiac output is an advantage during exercise.

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(3)
(Total 15 marks)

Q7. (a) Increased intensity of exercise leads to an increased heart rate. Explain how.

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(Extra space) .....

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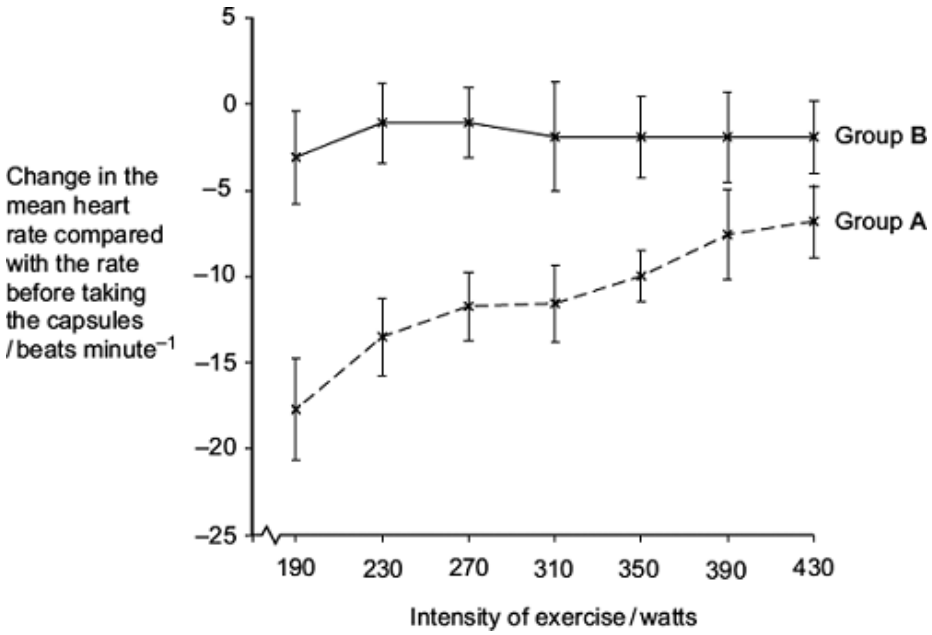
(3)

(b) Scientists investigated the effect of taking omega- fatty acids in fish oil on heart rate during exercise. They recruited two large groups of volunteers, **A** and **B**. For each group, they measured the mean heart rates at different intensities of exercise. The volunteers were then given capsules to take for 8 weeks.

- Group **A** was given capsules containing omega-3 fatty acids in fish oil.
- Group **B** was given capsules containing olive oil.

After 8 weeks, they repeated the measurements of mean heart rates at different intensities of exercise. The graph shows their results. The bars represent the standard deviations.



(i) Group **B** was given capsules containing olive oil. Explain why.

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(1)

(ii) The scientists concluded that omega-3 fatty acids lower the heart rate during exercise.
Explain how the information in the graph supports this conclusion.

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(Extra space) .....

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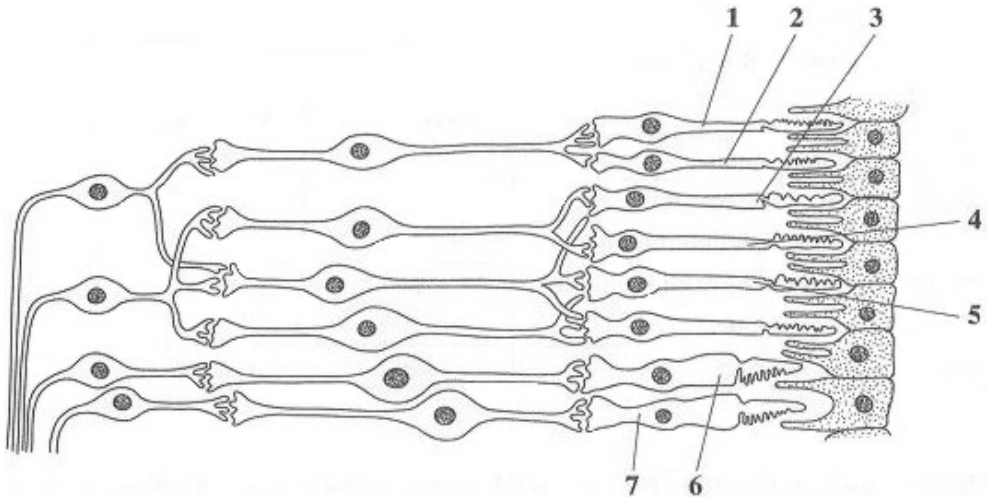
(3)
(Total 7 marks)

Q8. The diagram shows part of the retina in a human eye.



(a) Explain each of the following observations.

(i) When light falls on cells **1** and **2**, only one spot of light is seen. But, when light falls on cells **2** and **3**, two spots of light are seen.

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(1)

(ii) When one unit of light energy falls on cell **3**, no light is seen. But, when one unit of light energy falls on cell **3**, one unit falls on cell **4** and one unit falls on cell **5**, light is seen.

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(3)

(b) Cells of the same type as cells **6** and **7** are found in large numbers at the fovea. This results in colour vision with high visual acuity.

Explain what causes vision using the fovea.

(i) to be in colour;

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.....

(1)

(ii) to have high visual acuity.

.....

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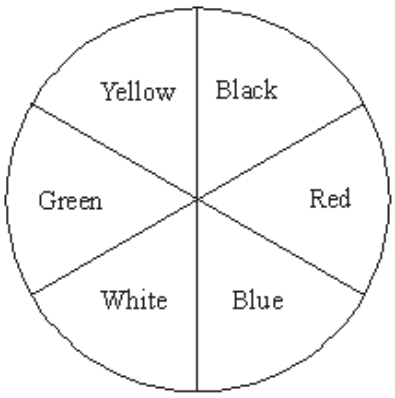
(1)
(Total 6 marks)

Q9. **S** In an investigation by a student into the responses of maggots, the bottom of a large box was marked with six coloured segments, as shown in the diagram.



30 maggots were placed on each segment in the box. A transparent cover was put on the box and light bulbs were positioned so that the segments were evenly illuminated. The positions of the maggots were recorded after one hour. The intensity of the light reflected by each segment was measured.

The experiment was repeated three more times. The total number of maggots in each segment from the four experiments is shown in the table.

Colour of segment	Intensity of reflected light / arbitrary units	Total number of maggots
Black	4	154
Red	25	229
Blue	10	178
White	44	47
Green	25	48
Yellow	40	64

(a) Give **one** conclusion about the responses of maggots which is supported by these results.

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Give the evidence from the table for your conclusion.

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(2)

(b) The chi-squared test was used to analyse the data. For the results obtained, suggest **one** null hypothesis which might be analysed by a chi-squared test.

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(1)

(c) It was suggested that the movement of the maggots might have been influenced by the Earth's magnetic field. Suggest **one** simple way of repeating the investigation which would avoid this possibility.

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(1)

(Total 4 marks)