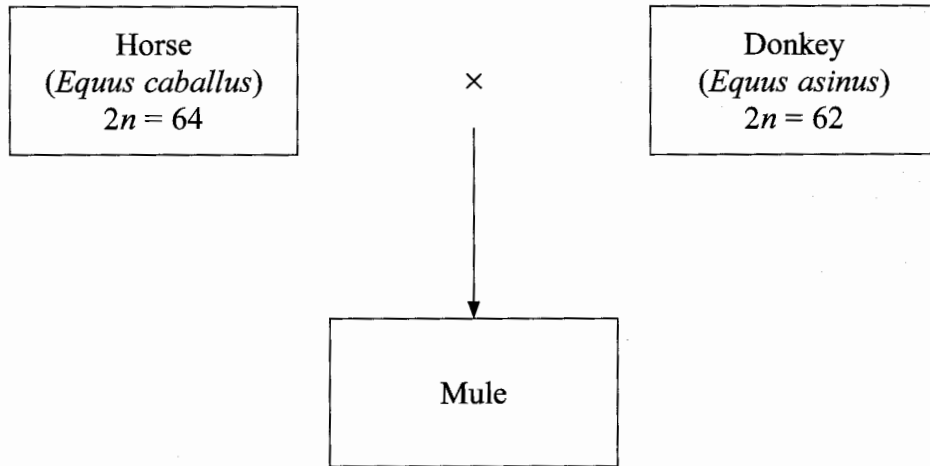


Answer ALL questions in the spaces provided.

1. If a horse, *Equus caballus*, is mated with a donkey, *Equus asinus*, a hybrid known as a mule is produced.



Mules are almost always sterile and produce no offspring. This phenomenon is an example of a post-zygotic isolating mechanism.

- (a) State the diploid number of chromosomes in a mule and suggest why mules are unable to produce offspring.

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(3)



(b) State what is meant by the term **isolating mechanism**. Suggest why the production of a mule by mating a horse with a donkey is described as a post-zygotic isolating mechanism.

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(c) It has been suggested that the mule should be named as a new species, *Equus mulus*. Suggest why this might not be acceptable to some biologists.

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(2)

(Total 8 marks)

Q1



2. Predators are animals that hunt and eat other animals. The numbers of predators in an area can have a serious effect on the breeding success of ground-nesting birds.

On the moors of Northumberland, a conservation project was undertaken to investigate whether the removal of predators improved the numbers and breeding success of ground-nesting birds, such as the curlew, golden plover, lapwing and red grouse. In one plot, predators were removed. In another similar plot, no predators were removed. The numbers of the four bird species in both plots were monitored between 2002 and 2005.

Numbers of pairs of breeding birds with no predators

Year	Curlew	Golden plover	Lapwing	Red grouse
2002	18	9	14	55
2003	22	8	18	92
2004	18	7	19	159
2005	17	7	17	165

Numbers of pairs of breeding birds with predators

Year	Curlew	Golden plover	Lapwing	Red grouse
2002	4	7	1	22
2003	3	4	1	16
2004	3	3	1	19
2005	3	4	0	16



(a) Using the information in the tables, suggest which species benefited most from the removal of predators. Give reasons for your answer.

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(b) Describe a method that you could carry out to enable you to estimate the population of an animal living in a specific area, using the Lincoln Index.

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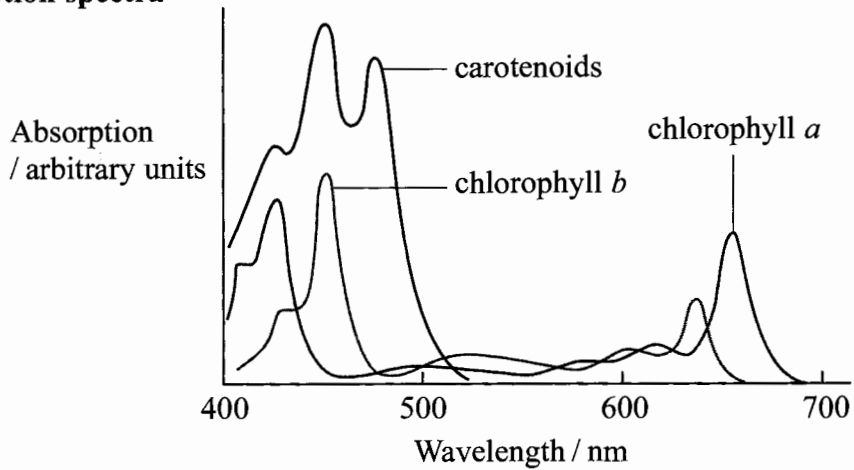
(Total 6 marks)

Q2

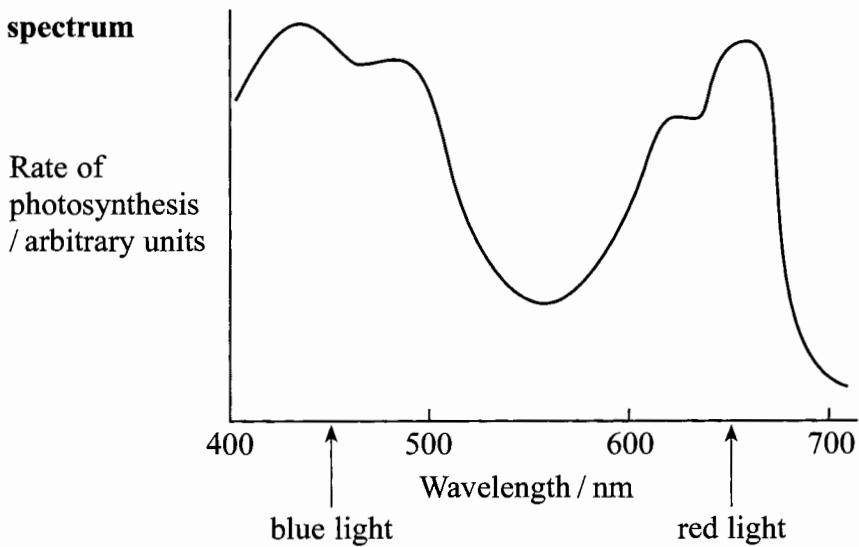


3. The diagrams below show the absorption spectra and the action spectrum that were produced in an investigation of photosynthesis in a flowering plant.

Absorption spectra



Action spectrum



(a) Using the information in the two graphs, explain the relationship between the absorption and action spectra for this flowering plant.

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(3)



(b) State precisely where the chlorophyll pigments would be found in a chloroplast of a flowering plant.

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(c) Describe how chromatography could be used to identify the chloroplast pigments from the leaves of a flowering plant.

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(d) Explain why flowering plants grown in soil which is deficient in magnesium ions often have leaves with pale yellow patches between the veins.

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(Total 10 marks)

Q3



Synoptic Section

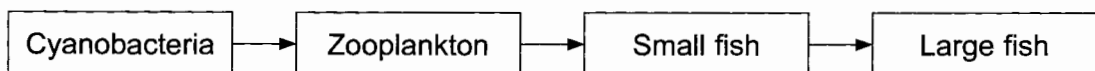
The questions in this section are designed to give you the opportunity to make connections between different areas of biology and to use skills and ideas developed throughout the course in new contexts. You should include in your answers any relevant information from the whole of your course.

4. In summer, algal blooms are a common sight on ponds and lakes. One type of algal bloom is caused by cyanobacteria. The cyanobacteria release poisonous chemicals that can kill animals that drink the water.

(a) Cyanobacteria are prokaryotes. In the space below, draw a diagram of a typical prokaryotic cell. On your drawing, label the following **four** structures: cell wall, cell surface (plasma) membrane, flagellum and plasmid.

(4)

(b) Under normal conditions, the numbers of cyanobacteria in a lake are controlled by zooplankton (microscopic animals) and fish. A typical food chain involving cyanobacteria is shown below.



Explain how a sudden increase in the level of nitrates in the lake could disrupt this food chain.

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(c) The numbers of cyanobacteria can be controlled by using mats of barley straw which float on the water. The barley straw releases growth inhibitors. Suggest how these inhibitors could interfere with the growth of the cyanobacteria.

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(2)

(d) It may be possible to reduce the numbers of cyanobacteria by introducing predators or parasites of the cyanobacteria. Suggest **one** reason why it would be preferable to use biological control, rather than chemical control, to reduce the cyanobacteria.

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(1)

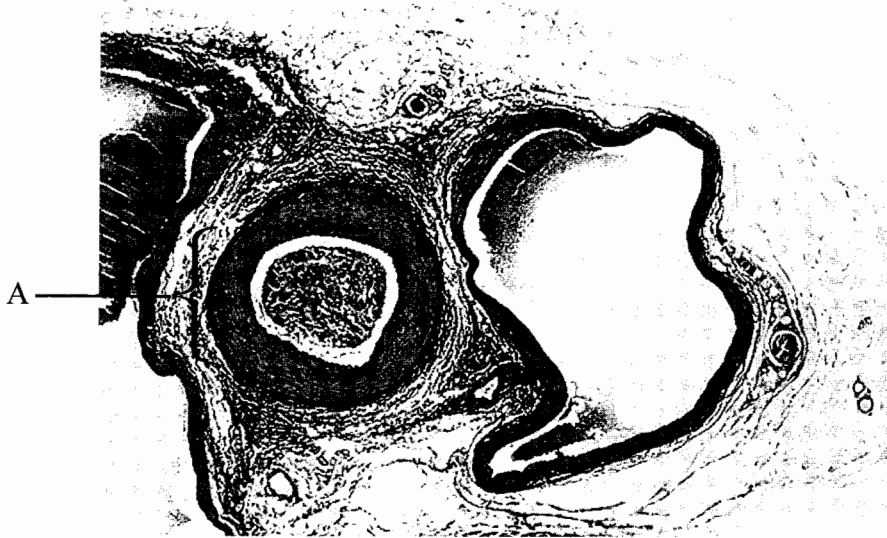
Q4

(Total 10 marks)

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5. The photograph below shows two blood vessels, as seen using a light microscope.



Magnification $\times 50$

(a) (i) Identify the type of blood vessel labelled A on the photograph.

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(ii) Describe **two** features of blood vessel A and explain the function of each feature.

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(b) People suffering from high blood pressure may be given Angiotensin Converting Enzyme (ACE) inhibitors. The ACE inhibitor stops the conversion of an inactive substance in the blood called angiotensin I to the active form, angiotensin II. Angiotensin II causes blood vessels to constrict.

Suggest how the ACE inhibitor could prevent the conversion of angiotensin I to angiotensin II.

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(Total 9 marks)

Q5

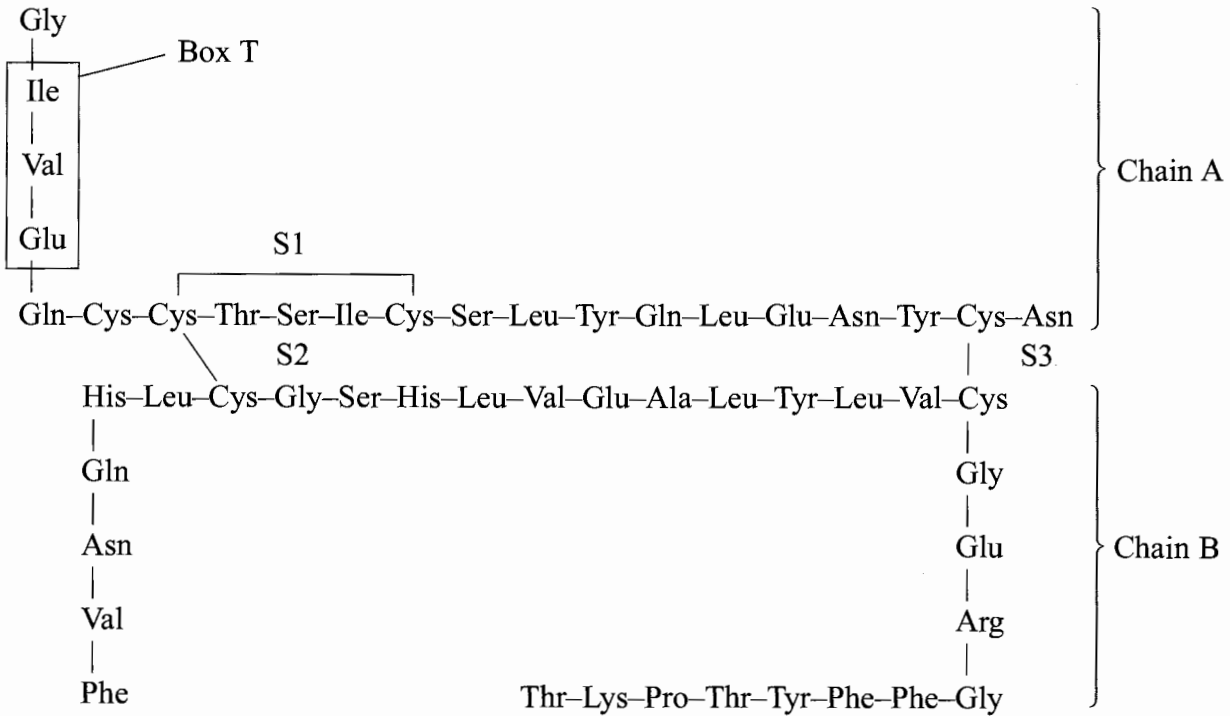


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6. The polypeptide hormone, insulin, is involved in the regulation of blood glucose levels in mammals. Human insulin is composed of two chains of amino acids. Chain A consists of 21 amino acids and Chain B of 30 amino acids. The chains are held together by two disulphide bridges (S2 and S3). A third disulphide bridge (S1) is present within the A chain.

The diagram below shows the structure of human insulin. Each three-letter code in Chain A and Chain B represents an amino acid. S1, S2 and S3 show the three disulphide bridges.



- (a) Explain how the amino acids, isoleucine (Ile), valine (Val) and glutamic acid (Glu), shown in Box T, are linked together.

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(2)



(b) Chain A and Chain B are held together by disulphide bridges, a type of covalent bond. Give examples of **two** other types of bond that may be found between polypeptide chains. State how the relative strength of these bonds compares with that of disulphide bridges.

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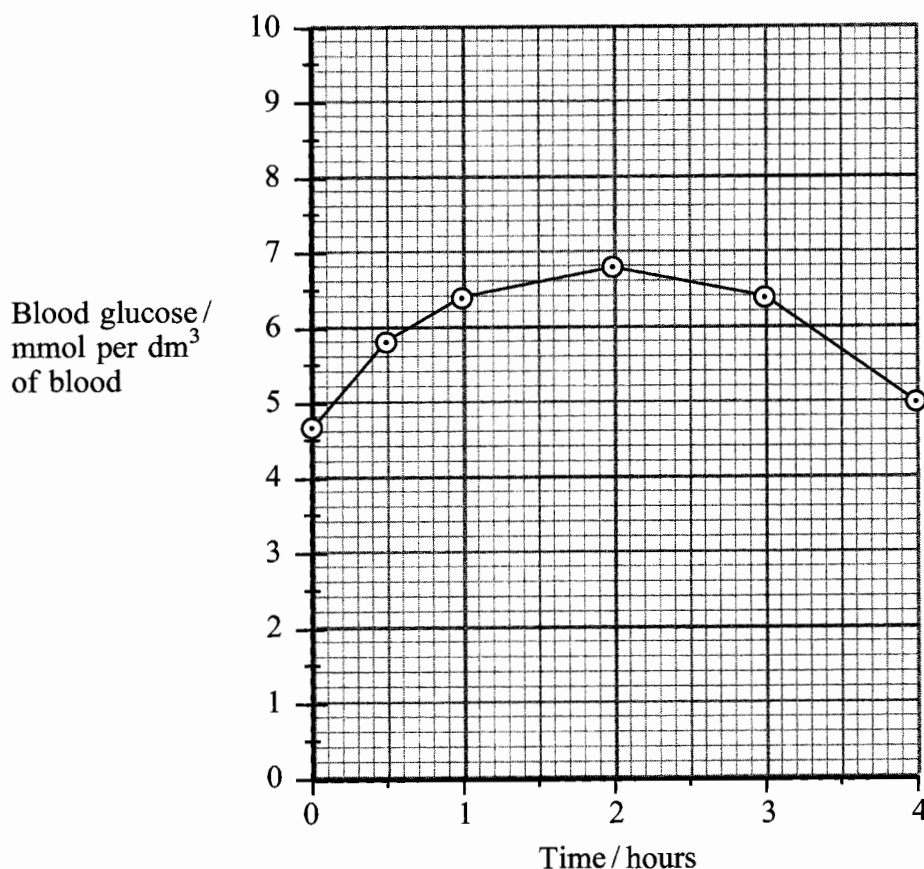
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(c) In an investigation a student, who had not eaten for 12 hours, drank a solution containing 100 g of glucose. The level of glucose in the blood of the student was then monitored for the next 4 hours. The graph below shows the results of the investigation.



Suggest why the level of glucose in the blood of the student started to rise within the first hour after drinking the solution.

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(1)

(d) A point mutation may lead to the replacing of the amino acid, cysteine (Cys), with another amino acid during the production of insulin. The resulting insulin would have a different structure. Suggest how the results of the investigation would have differed had the student used this insulin. Explain your answer.

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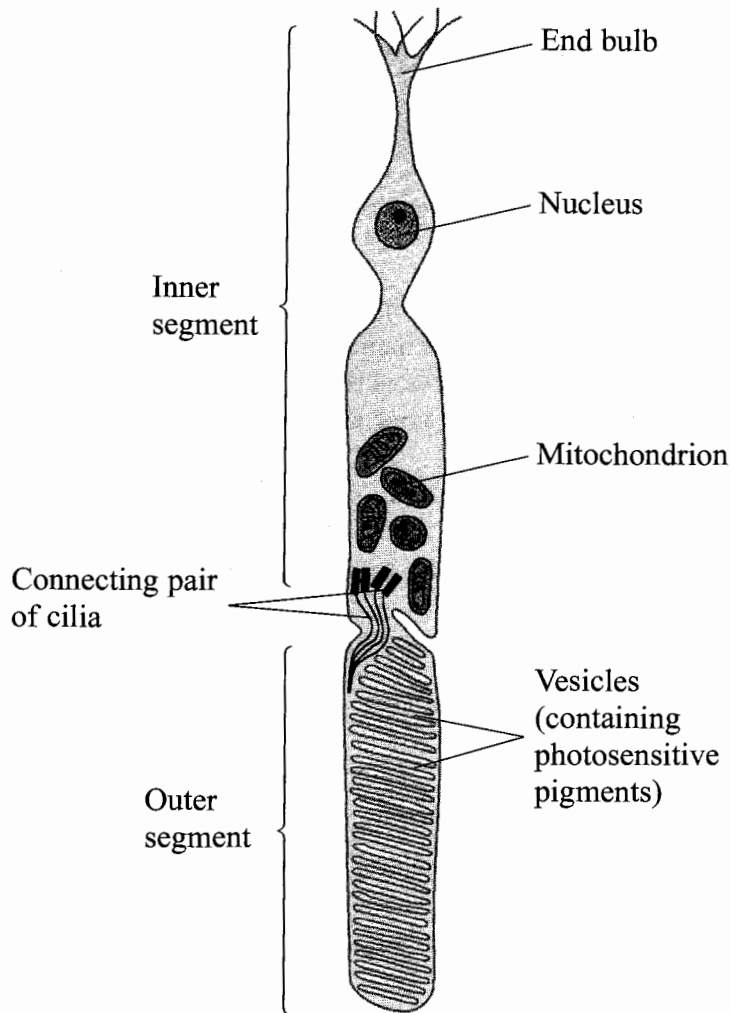
(6)

(Total 12 marks)

Q6



7. The diagram below shows a rod cell from the retina of the human eye.



The function of rod cells can be affected by the condition known as retinitis pigmentosa. Retinitis pigmentosa causes the gradual breakdown of photoreceptor cells in the retina. As these cells degenerate and die, patients experience progressive loss of vision.

One of the most common forms of retinitis pigmentosa can be caused by a recessive allele inherited from parents who have normal vision.



(a) With reference to the function of rod cells and rhodopsin as photoreceptors, explain why people with retinitis pigmentosa experience progressive loss of vision.

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(4)

(b) Two parents with normal vision have a child who develops retinitis pigmentosa. With the aid of a genetic diagram, explain the probability of the disorder developing in any future children they have.

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(5)

(Total 9 marks)

Q7



8. Describe **three** uses of lipids in plants and animals.

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Q8

(Total 6 marks)

TOTAL FOR PAPER: 70 MARKS

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