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Answer ALL the questions. Write your answers in the spaces provided.

1. (a) A student was asked to write a list of the characteristics shared by all living organisms. The list is shown below but it is not complete. Complete the list by writing the names of the missing characteristics in the empty boxes.

Characteristic
excretion
growth
movement
respiration
sensitivity

(2)

- (b) Suggest why excretion is important to living organisms.

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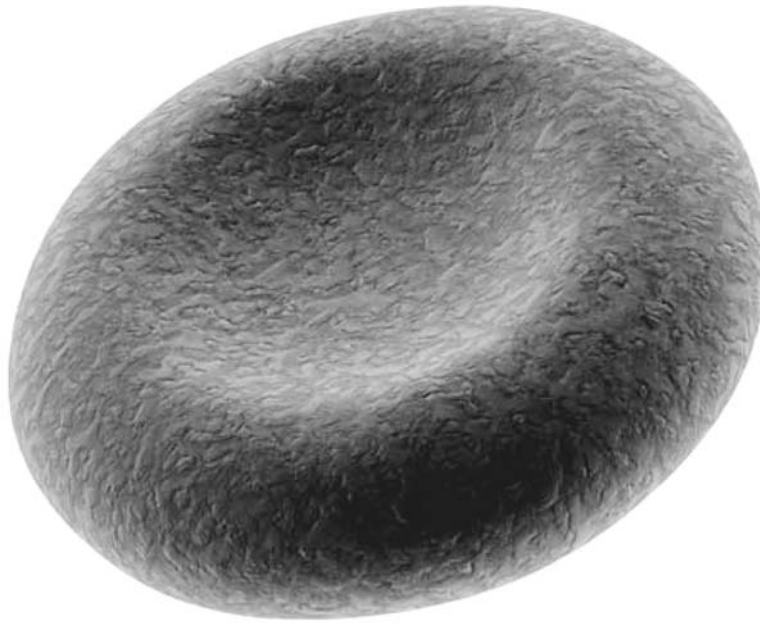
(2)

(Total 4 marks)

Q1



2. The diagram shows a red blood cell.



(a) (i) What is the name of the pigment in the cell that helps it to absorb oxygen?

..... (1)

(ii) Explain how the shape of the cell helps it to absorb oxygen.

.....  
.....  
.....  
..... (2)



(b) There are two types of white blood cell. One type is called a lymphocyte and produces antibodies. The other type is called a phagocyte.

(i) In the space below, draw and label a phagocyte.

(3)

(ii) Describe how a phagocyte helps to destroy pathogens.

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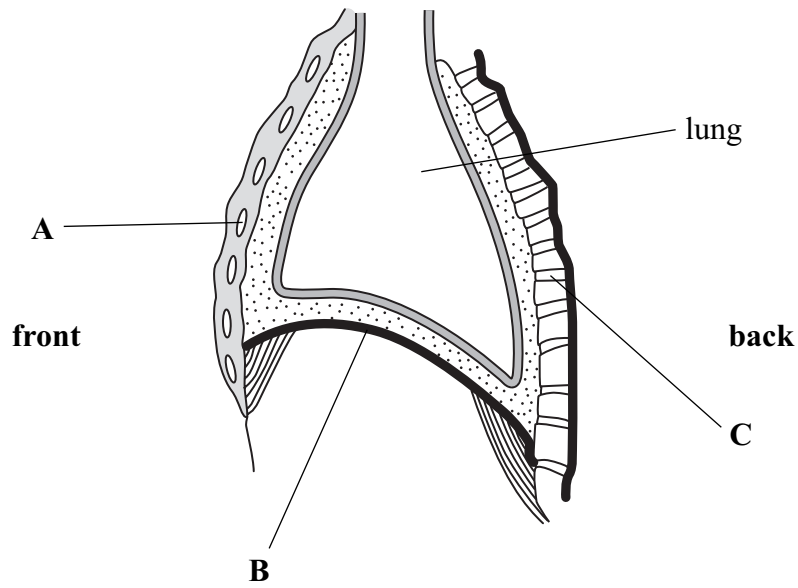
(2)

(Total 8 marks)

Q2



3. The diagram shows a section through a human thorax viewed from the side.



(a) Name the parts **A**, **B** and **C**.

**A** .....

**B** .....

**C** .....

**(3)**

(b) Describe what happens to **B** to help a person breathe in.

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.....

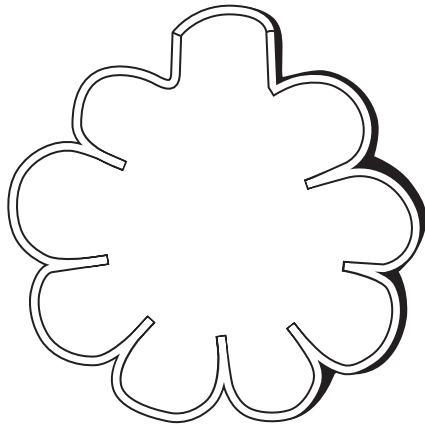
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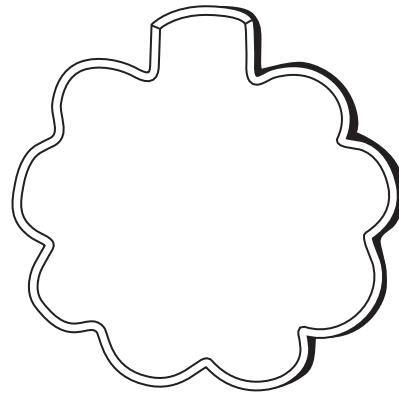
**(2)**



(c) Emphysema is a condition that affects alveoli. The diagram below shows an alveolus from a normal person and from a person who has emphysema.



**normal person**



**person with emphysema**

Suggest why the person with emphysema would find it difficult to walk upstairs.

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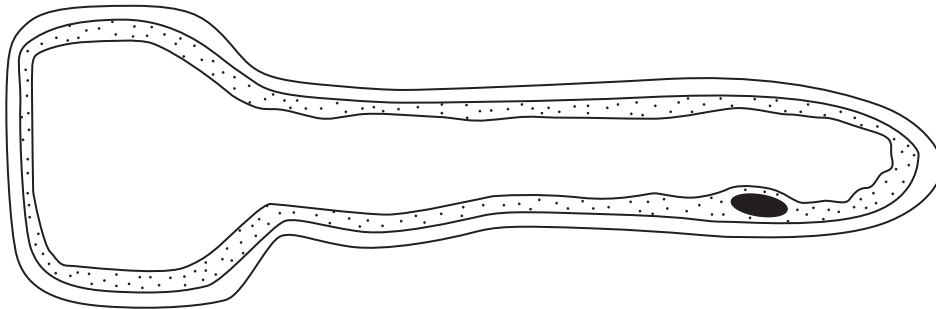
**(3)**

**(Total 8 marks)**

**Q3**



4. The diagram shows a root hair cell.



(a) Draw a line to the part that contains DNA. Label this part **P**. (1)

(b) Draw a line to the part that controls what enters the cell. Label this part **Q**. (1)

(c) Root hair cells absorb water and mineral ions.

(i) Name the process by which root hair cells absorb water.  
..... (1)

(ii) Mineral ions enter root hair cells by active transport.  
Explain why they enter by this method.  
.....  
.....  
.....  
..... (2)





(iii) Plants need mineral ions to make useful molecules.  
 The table names two mineral ions.  
 Complete the table by naming a molecule each mineral ion is used to make.

Mineral ion	Molecule made using the mineral ion
magnesium	
nitrate	

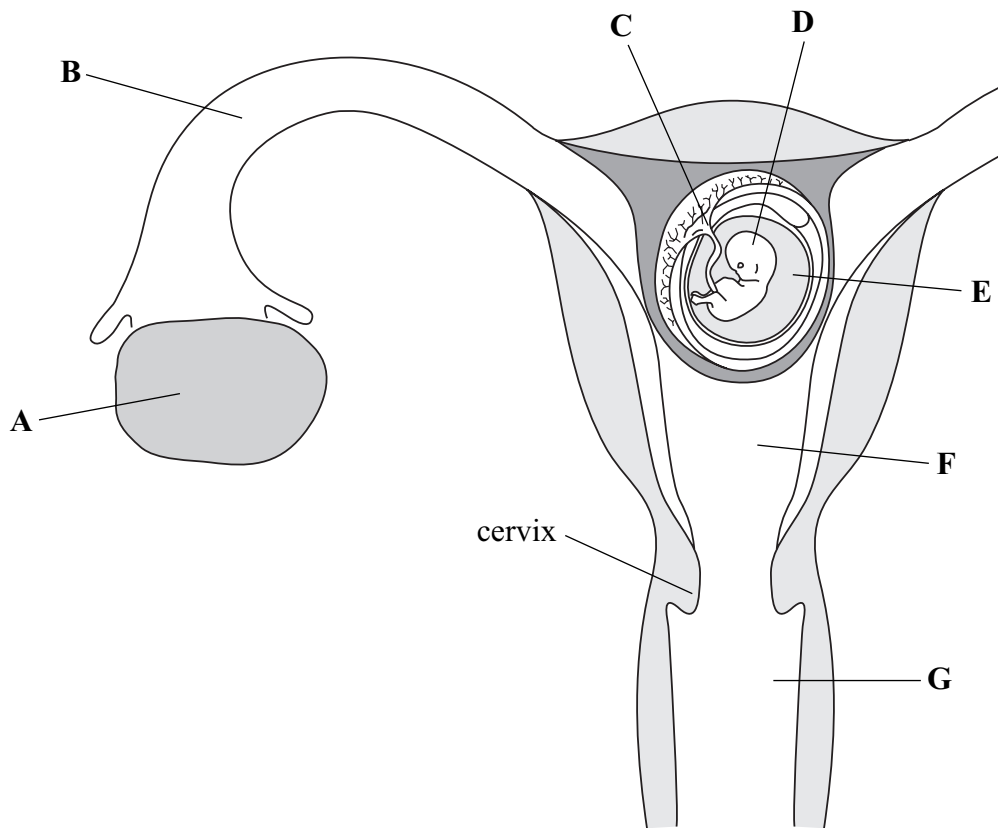
(2)

Q4

(Total 7 marks)



5. The diagram shows part of the reproductive system of a pregnant woman.



(a) Name the parts labelled **A** and **B**.

**A** .....

**B** .....

**(2)**

(b) (i) Which letter shows a part that releases progesterone?

.....

**(1)**

(ii) Why is it important that progesterone is released during pregnancy?

.....

.....

**(1)**



(c) (i) Which letter shows the placenta?

..... (1)

(ii) Give **two** functions of the placenta.

1 .....  
2 ..... (2)

(iii) Cells can be removed from the placenta to test for abnormalities.  
How many chromosomes would you expect to find in a cell from the placenta?

..... (1)

**(Total 8 marks)**

Q5



6. Carbon on Earth is found in four main sources. The table shows the amount of carbon, in relative units, in these sources.

Source	Relative units of carbon
air	1
plant vegetation	4
fossil fuels	14
limestone (fossil shells of sea animals)	100 000

(a) (i) Name **two** molecules in plants that contain carbon.

1 .....

2 .....

**(2)**

(ii) The carbon in plants can be released into the air as carbon dioxide. Give **two** ways by which this can happen.

1 .....

2 .....

**(2)**

(iii) Increasing the amount of carbon dioxide in the air can lead to global warming. Give **three** different harmful consequences of global warming.

1 .....

2 .....

3 .....

**(3)**



(b) Burning some fossil fuels releases sulphur dioxide.  
Explain the biological consequences of pollution of air by sulphur dioxide.

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(3)

Q6

(Total 10 marks)

7. Describe how glasshouses can be used to increase the yield of a named crop.

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Q7

(Total 5 marks)



8. Wolves are at risk of extinction because their numbers are decreasing. Scientists hope that cloning might help to increase the numbers of wolves and prevent their possible extinction.

Scientists from North Korea have claimed to have produced the first cloned wolves. The two wolves produced were female and were named Snuwolf and Snuwolffy.



- (a) Suggest **three** different reasons why the number of wolves is decreasing.

1 .....

.....

2 .....

.....

3 .....

.....

(3)



(b) To obtain Snuwolf and Snuwolffy, scientists transferred embryos into surrogate mothers.

(i) Describe how the cloned embryos may have been produced.

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.....  
.....  
.....  
.....  
.....

**(3)**

(ii) What is the purpose of the surrogate mothers?

.....  
.....  
.....  
.....

**(2)**

(iii) In total the scientists transferred 251 embryos into surrogate mothers in order to obtain Snuwolf and Snuwolffy.

Calculate the percentage success rate of this procedure.  
Show your working.

Answer ..... %  
**(2)**

(iv) How many male wolves were involved in producing the females Snuwolf and Snuwolffy?

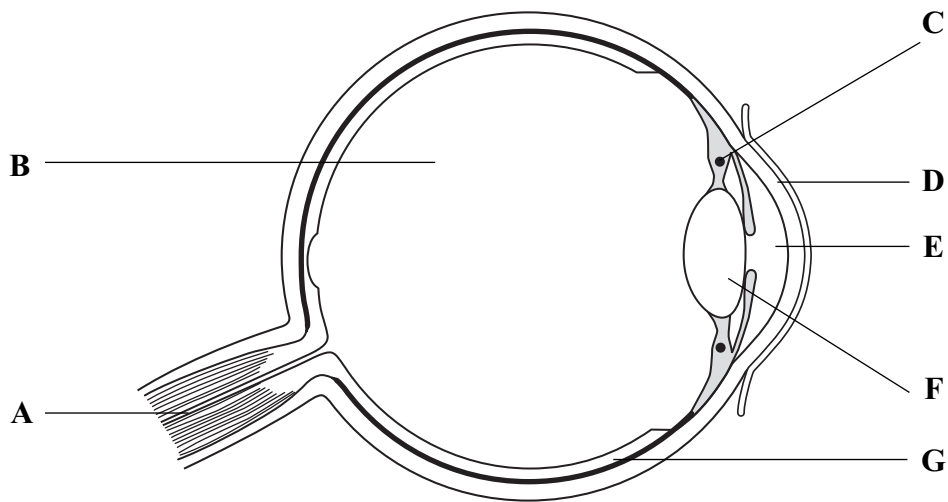
.....  
**(1)**

**Q8**

**(Total 11 marks)**



9. The diagram shows a section through the human eye.



(a) Which letter labels the cornea?

..... (1)

(b) Some people inherit a dominant allele that makes their cornea go cloudy.

The words below are used to describe the genotypes of characteristics controlled by genes. Which **two** words would be used to describe the genotype of someone with a cornea that does **not** go cloudy?

**heterozygous      homozygous      dominant      recessive**

..... (1)

(c) A cloudy cornea can be replaced by one transplanted from a donor. However, the transplanted cornea is sometimes rejected by the immune system. Despite the availability of immunosuppressive drugs, the rejection rate for transplanted corneas remains between 5 and 30%.

(i) Suggest why a transplanted cornea may be rejected.

.....  
 .....  
 .....  
 .....  
 .....  
 ..... (3)





(ii) Suggest what is meant by the term immunosuppressive.

.....

.....

**(1)**

(iii) A thousand people had a cornea transplant. What is the highest number of these people expected to have a successful cornea transplant?

.....

**(1)**

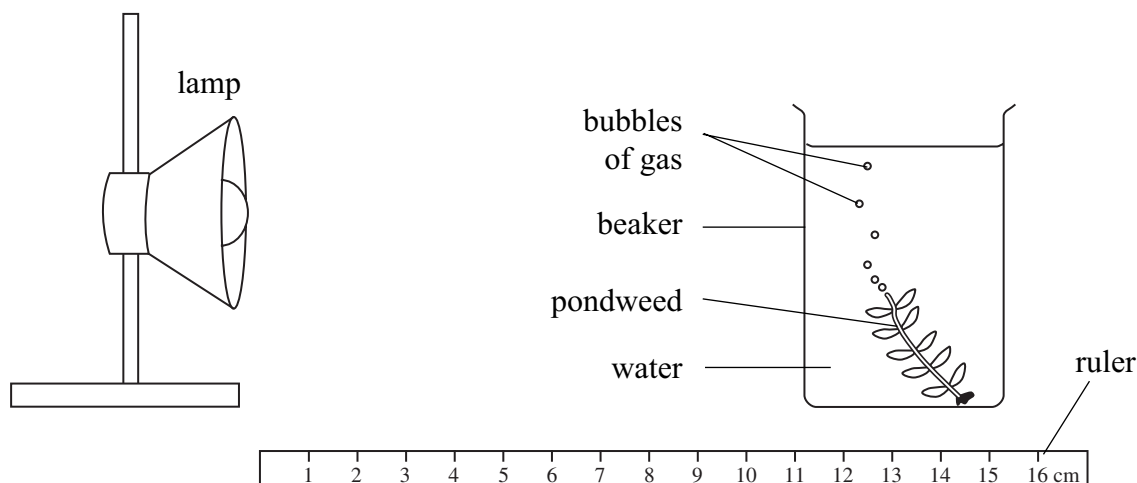
**Q9**

**(Total 7 marks)**

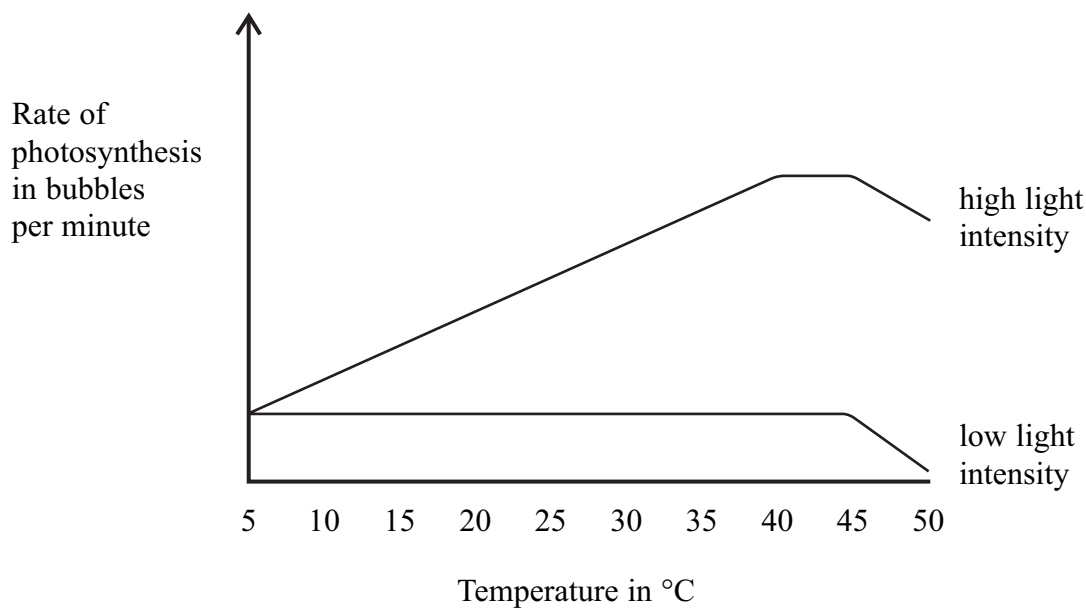


10. An investigation was carried out to find out how temperature affected the rate of photosynthesis in a water plant kept at high and low light intensity.

The apparatus shown below was used. The temperature of the water was changed gradually from 5 °C to 50 °C at low light intensity. The experiment was then repeated at high light intensity.



The graph shows the results of the investigation.



- (a) (i) Look at the results for low light intensity.  
What effect does changing the temperature from 5 °C to 45 °C have on the rate of photosynthesis?  
Explain this effect.

Effect .....

.....

Explanation .....

.....

(2)

- (ii) Look at the results for high light intensity.  
What effect does changing the temperature from 35 °C to 50 °C have on the rate of photosynthesis?  
Explain these effects.

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(4)

- (b) Name **two** factors that need to be kept the same for any comparison of the results of the investigation to be valid.

1 .....

2 .....

(2)

(Total 8 marks)

Q10



11. The food chain below is from a pond.

microscopic plants → microscopic animals → insects → fish

(a) (i) How many trophic levels are there in this food chain?

..... (1)

(ii) The microscopic plants are called producers. What term is used to describe the fish?

..... (1)

(b) The energy being transferred along this food chain was measured. The energy entering into the biomass of each type of organism was measured as was the energy then lost by respiration of these organisms. The results are shown in the table.

Organism	Energy entering biomass in kJ per m <sup>2</sup> per year	Energy lost by respiration in kJ per m <sup>2</sup> per year
microscopic plants	87 000	50 000
microscopic animals	14 000	8 000
insects	1 600	1 300
fish	500	300

(i) The energy entering the biomass of the insects was 1 600 kJ per m<sup>2</sup> per year. The energy entering the microscopic animals was 14 000 kJ per m<sup>2</sup> per year, but 8000 kJ per m<sup>2</sup> per year of this was lost by respiration. Give **two** other reasons why the remaining 4 400 kJ per m<sup>2</sup> per year were not available for the insects.

1 .....

2 .....

(2)



(ii) The efficiency with which energy is transferred from the microscopic plants to the microscopic animals can be calculated using the formula:

$$\text{energy transfer efficiency (\%)} = \frac{\text{total energy entering microscopic animals}}{\text{total energy entering microscopic plants}} \times 100$$

Use this formula to calculate the energy transfer efficiency between microscopic plants and microscopic animals. Show your working.

Answer ..... %  
(2)

(iii) What evidence suggests that the fish need to feed on other organisms in addition to insects?

.....  
.....  
.....

(1)

(Total 7 marks)

Q11



12. The bark (outer covering) of a cherry tree found in some African countries contains a chemical that is used to reduce the pain of prostate cancer. Removing the bark has killed many cherry trees. This has caused the cherry tree to become endangered.

(a) (i) Suggest what is meant by the term endangered.

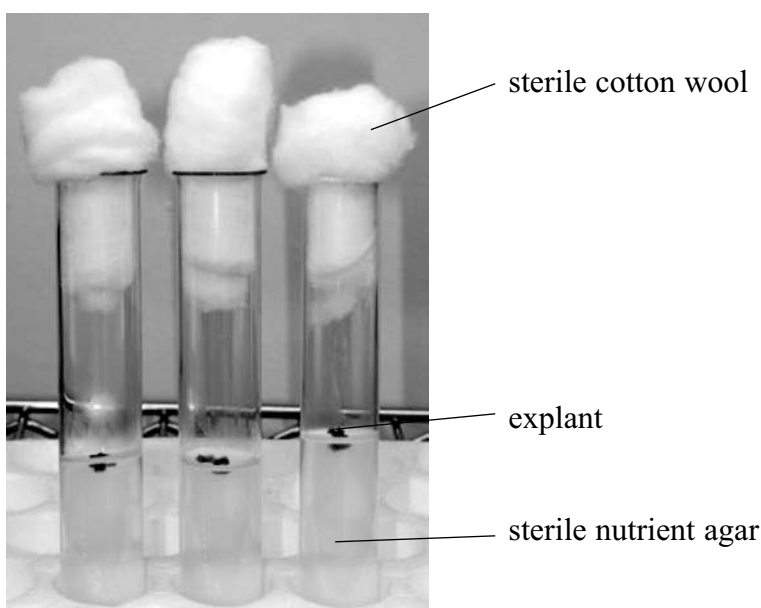
.....  
.....  
**(1)**

(ii) The bark of the tree contains phloem. Explain why removing the phloem is killing the trees.

.....  
.....  
.....  
.....  
**(2)**

(b) Micropropagation (tissue culture) is now being used to reduce the need to damage cherry trees in their natural habitat.

Small pieces of tissue (explants) are taken from a parent tree and placed on sterile nutrient agar in test tubes. The explants grow into small trees which are then grown into bigger trees that can be used to extract the painkilling chemical from their bark. The photograph shows some of the test tubes.



(i) Suggest why sterile cotton wool is placed in the mouth of each test tube.

.....  
.....  
.....  
.....

(2)

(ii) Name one substance in the sterile nutrient agar needed to provide energy for the explant to grow.

.....

(1)

(c) Give **two** reasons why micropropagation is an effective method to produce these plants.

1 .....

2 .....

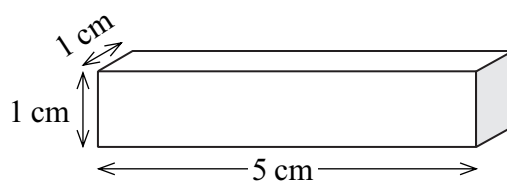
(2)

(Total 8 marks)

Q12



13. The diagram shows a raw potato chip.



(a) Calculate the surface area to volume ratio of this potato chip. Show your working.

Answer .....  
(2)

(b) A student took four chips A, B, C and D. The original mass of the chips was the same. The chips were then treated differently. After one hour the new mass of each chip was measured. The results are shown below.

Chip	Treatment	Original mass in g	New mass in g
A	Placed in water at 20 °C	10	12
B	Placed in strong sucrose solution at 20 °C	10	8
C	Placed in water at 10 °C	10	11
D	Cut in half and placed in water at 20 °C	10	13

(i) Explain why chip A had gained mass.

.....

.....

.....

.....

.....

(2)





(ii) Explain the difference in the results between the following chips.

chip A and chip B .....

.....

.....

chip A and chip C .....

.....

.....

chip A and chip D .....

.....

.....

(5)

Q13

(Total 9 marks)



14. Some people cannot control the level of glucose in their blood because they cannot make a hormone called insulin.

Fortunately, genetic modification of bacteria has been used to make human insulin. The passage below describes the process. Complete the passage by writing **one** suitable word on each dotted line.

The gene for insulin production is obtained from a human cell by cutting its DNA at specific sites by using an enzyme called ..... endonuclease. A plasmid is obtained from a bacterium and the same endonuclease enzyme is used to cut the plasmid open. This leaves sticky ends. The gene for insulin is put into the plasmid using an enzyme called ..... . The altered plasmid is then used as a ..... because it is used to transfer the recombinant ..... back into the bacterium. The genetically modified bacterium is then grown in a container called a ..... Large quantities of human insulin can then be obtained.

Q14

(Total 5 marks)



15. The photograph shows a shrew, a very small mammal.



Different types of shrew have different body masses. The table below gives the mass and the oxygen used, in cm<sup>3</sup> per g per hour, for five different types of shrew.

Type of shrew	Body mass of shrew in g	Oxygen used in cm <sup>3</sup> per g per hour
Masked	2.5	10.8
Wandering	4.5	8.6
Monterey	6.5	7.2
Sonoma	11.5	5.2
Short-tailed	20.0	4.0

(a) (i) All shrews need to keep their body temperature constant.  
Use this information to explain the relationship between the body mass of the shrews and the volume of oxygen used per hour.

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.....

.....

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.....

.....

**(3)**



(ii) Calculate the volume of oxygen used in one day by the largest shrew.  
Show your working.

Answer ..... cm<sup>3</sup>  
(2)

(b) Suggest **two** changes in the skin of a shrew that would take place if it moved into a cold area.

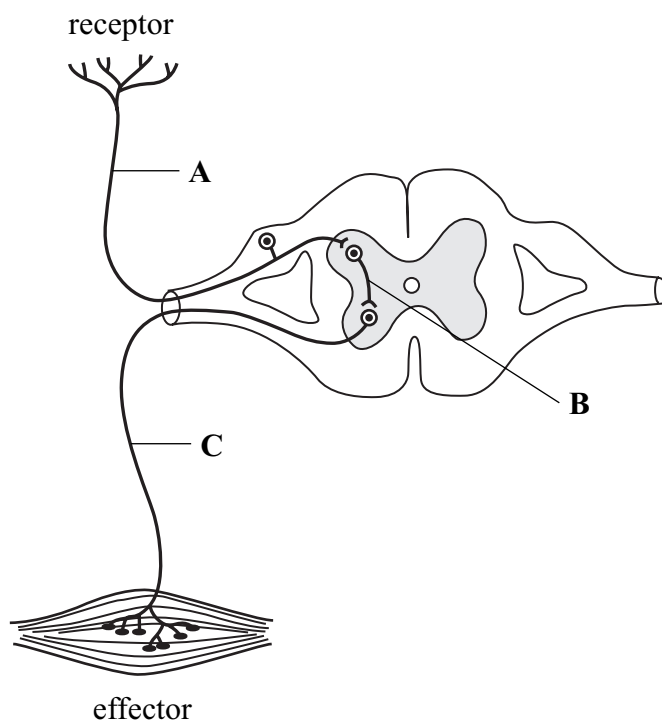
1 .....

2 .....

(2)



- (c) It is important that shrews respond quickly to any dangerous stimulus. The diagram shows the neurones involved in a reflex response of a shrew to a dangerous stimulus.



- (i) What is the name of neurone **A**?

..... (1)

- (ii) What is the name of the microscopic gap between neurone **B** and **C**?

..... (1)

- (iii) On the diagram, draw an arrow to show the direction of the impulse in neurone **C**.

(1)

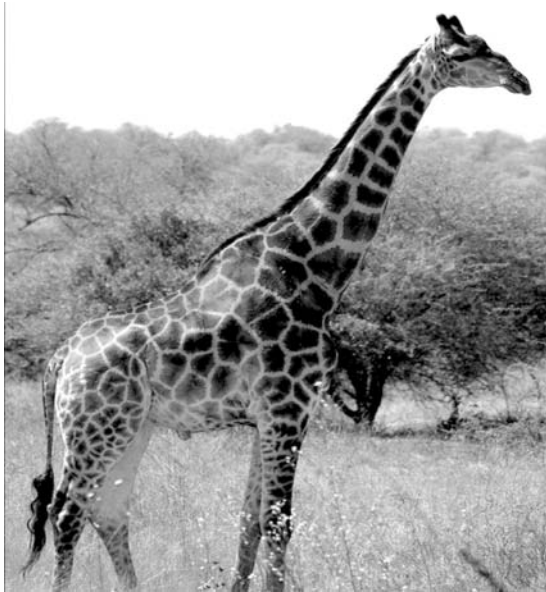
Q15

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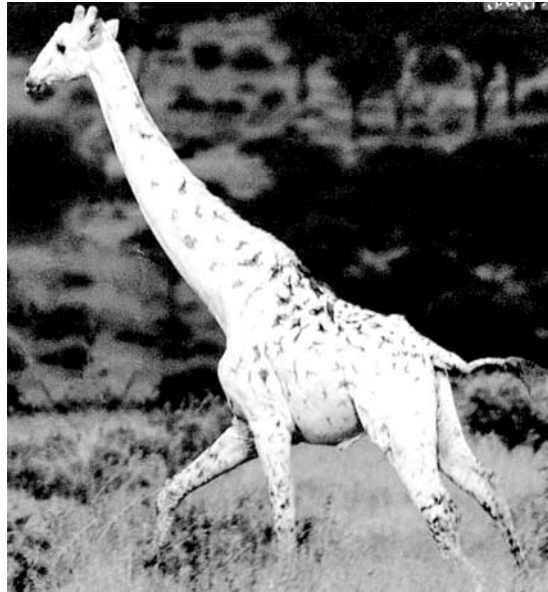


16. Albino giraffes have white hair. There are very few albino giraffes in the wild. The photographs show a normal giraffe and an albino giraffe.

Normal giraffe



Albino giraffe



Use your understanding of natural selection to explain why there are very few albino giraffes in the wild.

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(Total 5 marks)

Q16

**TOTAL FOR PAPER: 120 MARKS**

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