

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

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ~~☒~~ and then mark your new answer with a cross ☒.

- 1 Blood is filtered in the kidney to remove unwanted substances.

Figure 1 shows part of a nephron.

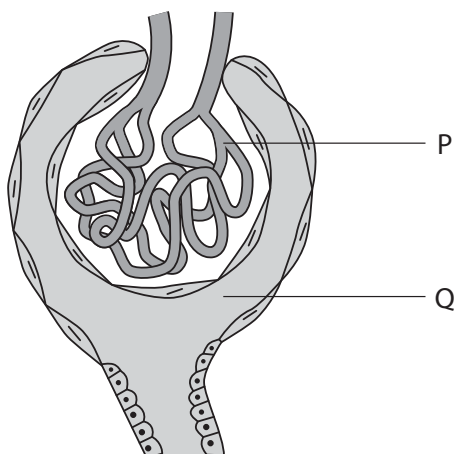


Figure 1

- (a) Name the structures labelled P and Q.

(2)

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- (b) Figure 2 shows information about some of the components in the blood and in the filtrate in this part of the nephron.

component	concentration in the blood	concentration in the filtrate in the nephron
glucose	1.0mg per cm ³	1.0mg per cm ³
protein	47.0g per dm ³	0.0g per dm ³
red blood cells	4.5×10^6 per cm ³	0.0 per cm ³
white blood cells	8.0×10^3 per cm ³	0.0 per cm ³

Figure 2

- (i) Calculate the difference in the number of red blood cells and the number of white blood cells in 1 cm³ blood.

Give your answer in standard form.

(2)

- (ii) Explain why there are differences in the concentrations of some components in the blood and some components in this part of the nephron.

(2)

- (c) State the name of the hormone that regulates the water content of the blood.

(1)

(Total for Question 1 = 7 marks)



P 5 2 4 6 5 A 0 3 3 2

- 2 (a) Figure 3 shows a diagram of a red blood cell from a turtle and a diagram of a red blood cell from a human.

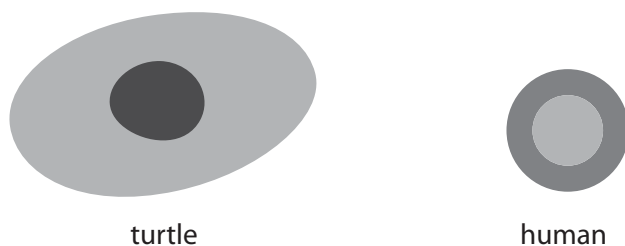


Figure 3

- (i) These cells are animal cells.

Animal cells do not have

(1)

- A** cytoplasm
- B** a cell membrane
- C** a cell wall
- D** mitochondria

- (ii) The actual length of the red blood cell from a turtle is $20.5 \mu\text{m}$.

Calculate the length of the magnified image of the red blood cell of the turtle when magnified $400\times$.

(2)

..... μm

- (iii) The width of the human red blood cell, when magnified $400\times$, is 3.08 mm .

Calculate the actual width of the cell and show your answer in standard form.

(2)

..... mm



(b) Red blood cells are carried in veins and arteries.

Figure 4 shows the equipment used to measure the elasticity of an artery.

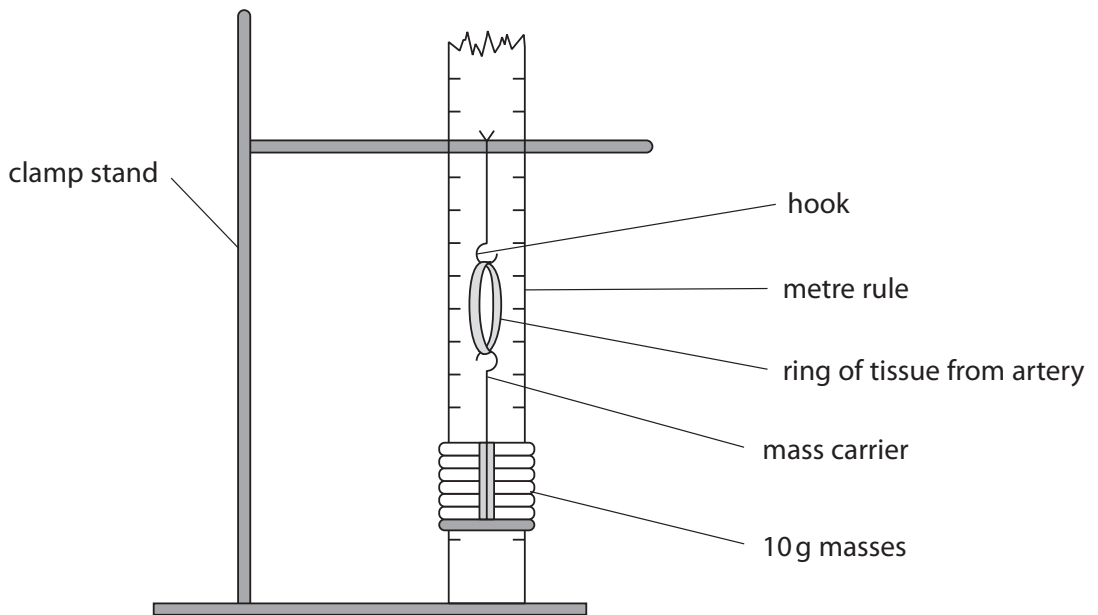


Figure 4

(i) Describe a method you could use to see how much the ring of tissue from an artery could stretch before it no longer returned to its original size.

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(ii) Give **one** safety precaution you need to take when handling animal tissue such as blood vessels.

(1)

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(Total for Question 2 = 9 marks)



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- 3 A student compared the number of stomata on the upper and lower surfaces of a leaf. She completed a leaf peel as shown in Figure 5.

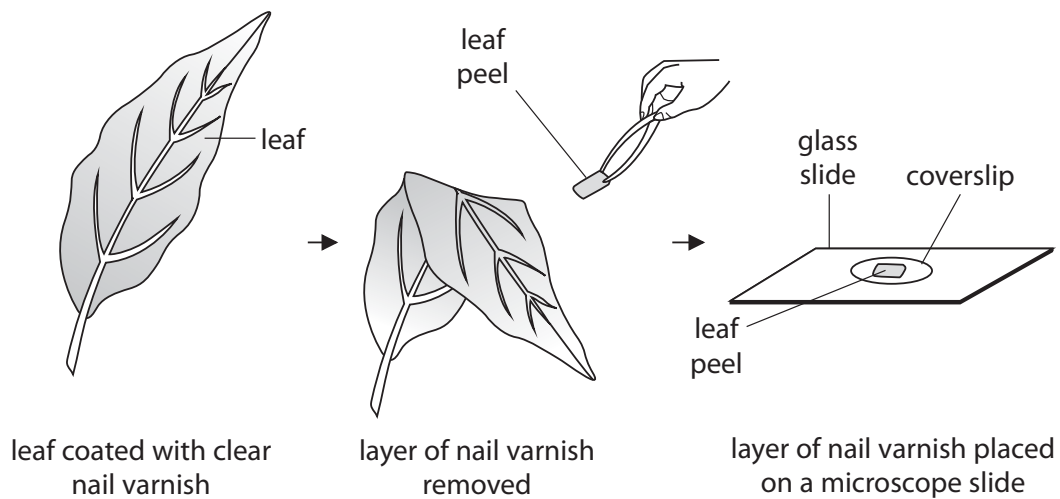


Figure 5

The layer of nail varnish shows an impression of the cells on the surface of the leaf.

- (a) (i) State why a coverslip is placed on top of the leaf peel.

(1)

- (ii) Explain why the leaf peel rather than the whole leaf was viewed with a microscope.

(2)

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- (b) The student drew a biological diagram of the leaf peel taken from the underside of the leaf.

Figure 6 shows this diagram.

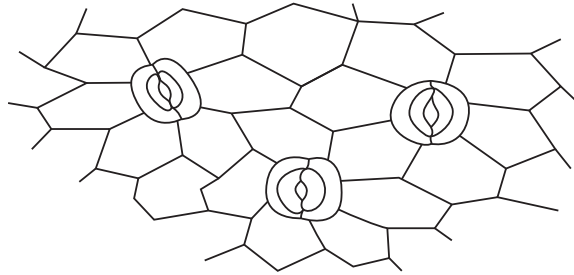


Figure 6

- (i) State the number of stomata visible on Figure 6.

(1)

- (ii) The student observed that the stomata were open.

Describe how stomata open.

(3)

- (iii) The leaf peel from the upper surface of this leaf showed no stomata.

Explain why it is an advantage to the plant to have this distribution of stomata in the upper and lower surfaces of the leaf.

(2)

(Total for Question 3 = 9 marks)



P 5 2 4 6 5 A 0 7 3 2

- 4 Since 2003, in France, people have been buying Siberian chipmunks as pets but then releasing them into the wild when they are no longer wanted.

They are now classified as an invasive species.

Figure 7 shows a Siberian chipmunk (*Tamias sibiricus*).



© 2011, Søren Brøndum Christensen

Figure 7

- (a) Siberian chipmunks eat acorns which, are the seeds of oak trees.

In Siberia, the natural predators of Siberian chipmunks are wild dogs.

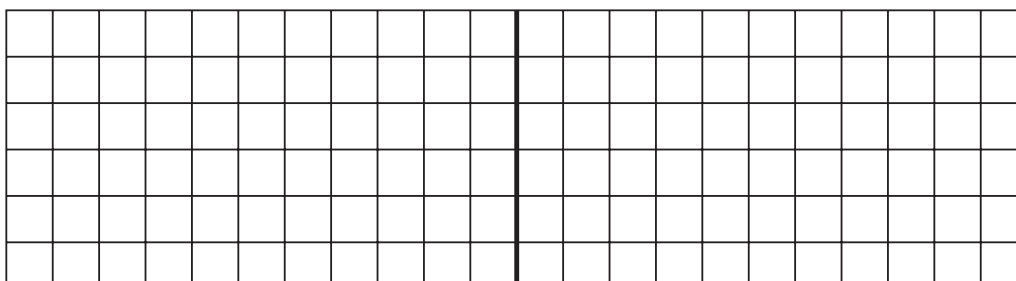
- (i) Figure 8 shows the biomass of three organisms in a food chain from one area of Siberia.

organisms	biomass in kg
acorns	20 650
chipmunks	2 200
wild dogs	230

Figure 8

Draw a pyramid of biomass for this food chain.

(2)



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(ii) In France, Siberian chipmunks have very few natural predators.

Describe how this affected the Siberian chipmunk population in France.

(2)

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(iii) The percentage of energy transferred from the acorns to the chipmunks is 9.5%.

The energy contained in the acorns is 97 500 kJ.

Calculate the amount of energy transferred to the chipmunks.

Give your answer to the nearest whole number.

(3)

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- (b) The black-legged tick (*Ixodes scapularis*) is a parasite that feeds on the blood of animals including Siberian chipmunks and humans.

The tick transmits the Lyme disease pathogen.

Figure 9 shows the number of cases of Lyme disease in humans in France in 2003 and 2015.

Number of cases of Lyme disease in humans in France	
2003	2015
9 500	27 000

Figure 9

- (i) Calculate the percentage increase in the number of cases of Lyme disease in humans in France from 2003 to 2015.

(2)

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- (ii) Explain why there has been an increase in the number of cases of Lyme disease in humans in France.

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(Total for Question 4 = 11 marks)

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- 5 Figure 10 shows the estimated blood flow through some parts of the body when a person is at rest and during exercise.

part of the body	estimated rate of blood flow in cm^3 per minute	
	at rest	during exercise
brain	750	748
heart muscle	350	1 150
digestive system	2 500	1 200
other muscles	1 200	14 500
all other organs (except lungs)	1 423	1 420

Figure 10

- (a) Compare the rate of blood flow through the body when this person is at rest and during exercise.

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- (b) Explain why there is a change in the rate of blood flow through the digestive system during exercise.

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- (c) The stroke volume is the amount of blood leaving one chamber of the heart per beat.

From which chamber of the heart does this volume of oxygenated blood flow?

(1)

- A left atrium
 B left ventricle
 C right atrium
 D right ventricle

- (d) A person has a cardiac output of 4.9 litres per minute. The stroke volume of each heart beat is 70 ml.

Calculate the heart rate.

(2)

..... beats per minute

(Total for Question 5 = 8 marks)

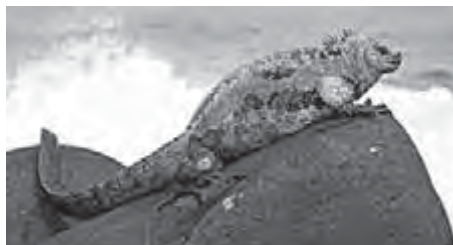


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6 (a) Iguanas are lizards.

Some species of iguana live on hot islands in the Pacific Ocean and use the environment to regulate their body temperature.

Figure 11 shows an iguana on a rock in the sunshine.



© benjamint444/Getty Images

Figure 11

A marine biologist measured the oxygen consumption of an iguana at different temperatures.

Figure 12 shows the results.

body temperature of the iguana in °C	oxygen consumption in cm ³ per gram per hour
20	0.4
25	0.8
30	1.1
35	1.4

Figure 12

- (i) Describe how the body temperature of the iguana affects its oxygen consumption. (1)

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(ii) Explain why the body temperature of the iguana affects its oxygen consumption. (3)

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(iii) Iguanas do not have sweat glands.
When an iguana is too hot, it pants by opening its mouth to cool down.
Explain how this behaviour helps to cool the iguana down. (2)

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(b) (i) Where in the human brain is the thermoregulatory centre?

(1)

- A cerebellum
- B cerebral cortex
- C hypothalamus
- D pituitary gland

(ii) Explain the role of vasodilation in thermoregulation.

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- 7 (a) A student investigated the effect of nitrate ion concentration on plant growth. She placed barley seedlings in three test tubes containing different concentrations of nitrate fertiliser.

Test tube 1 contained distilled water with 1 pellet of nitrate fertiliser.

Test tube 2 contained distilled water with 2 pellets of nitrate fertiliser.

Test tube 3 contained distilled water with 3 pellets of nitrate fertiliser.

After 7 days, the lengths of the seedlings were measured.

Figure 13 shows an example of the apparatus used.

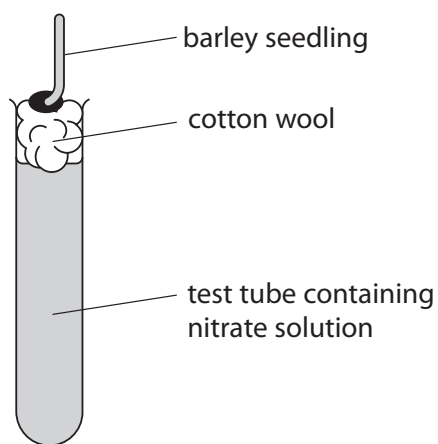


Figure 13

- (i) Describe a control for this investigation.

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- (ii) The nitrate fertiliser contains the chemical compound potassium nitrate. The hazard symbol on the bag of potassium nitrate fertiliser is shown in Figure 14.



Figure 14

Which hazard does this symbol represent?

(1)

- A flammable
- B oxidising
- C corrosive
- D explosive

- (iii) Give a method, other than measuring the change in length, that would show the growth of the seedlings.

(1)



(b) Figure 15 shows the results of this investigation.

seedling in test tube	length at the start in mm	length after 7 days in mm
1	4	11
2	6	17
3	5	26

Figure 15

(i) Explain why there are differences in the change in the lengths of the seedlings.

(2)

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(ii) Explain how nitrate ions were absorbed by the seedling in test tube 3.

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(c) Farmers use crop rotation to reduce the need to add nitrate fertilisers to the soil.
Plants such as peas and beans have a mutualistic relationship with nitrogen-fixing bacteria.
Explain why farmers use these plants in their crop rotation cycle.

(3)

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- 8 (a) Figure 16 shows the effect of light intensity and temperature on the rate of photosynthesis.

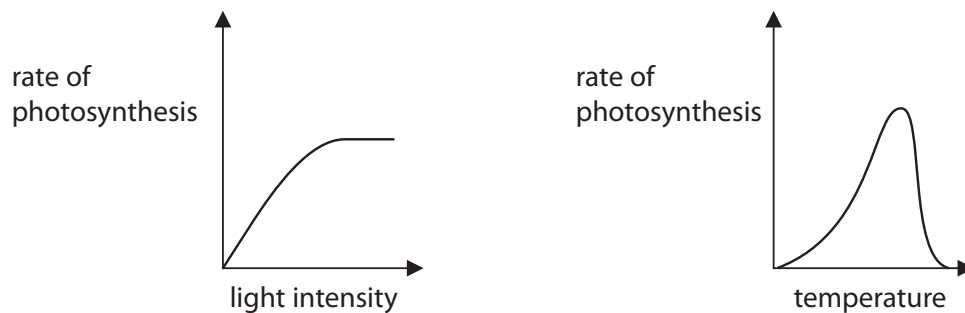


Figure 16

- (i) Describe the effect of light intensity on the rate of photosynthesis.

(2)

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- (ii) Explain the effect of temperature on the rate of photosynthesis.

(2)

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- (b) A student measured the rate of photosynthesis using algal balls in a laboratory. The tube of algal balls was kept at a temperature of 25°C and was moved to different distances from a light source.

The results of this investigation showed that the rate of photosynthesis is

(1)

- A directly proportional to the distance from a light source
- B inversely proportional to light intensity
- C directly proportional to temperature
- D inversely proportional to the distance from a light source



* (c) Explain how substances are moved through a plant by transpiration and translocation. (6)

Handwriting practice area consisting of multiple horizontal dotted lines for writing the answer.

(Total for Question 8 = 11 marks)

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- 9 (a) Figure 17 shows the concentration of the hormones oestrogen and progesterone in the blood of women of different ages.

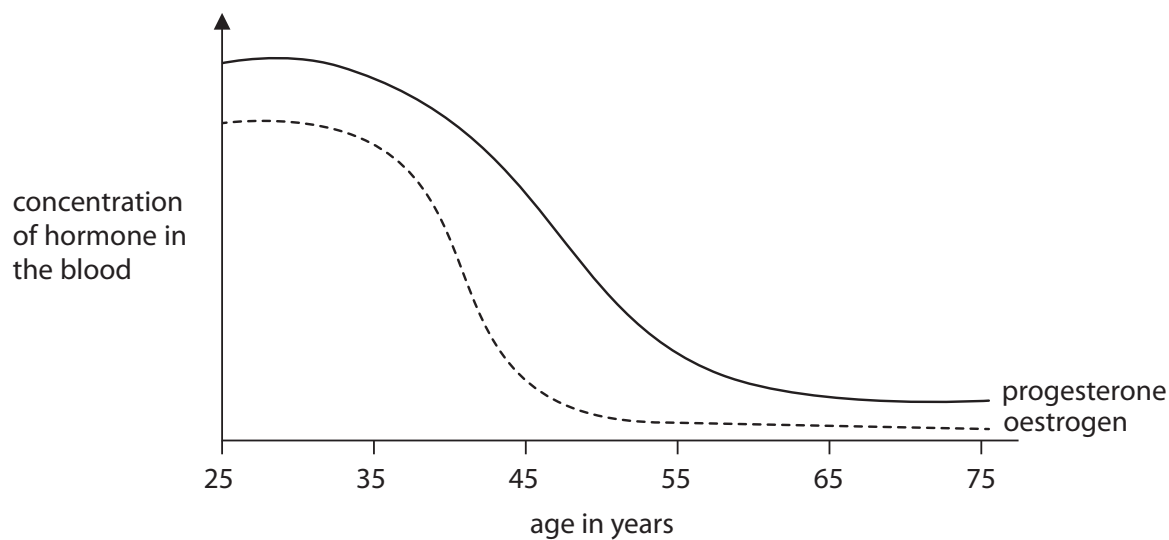


Figure 17

- (i) Use information from Figure 17 to explain why women over the age of 50 are less likely to ovulate.

(2)

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- (ii) Use information from Figure 17 to explain why women are less likely to menstruate after the age of 60.

(2)

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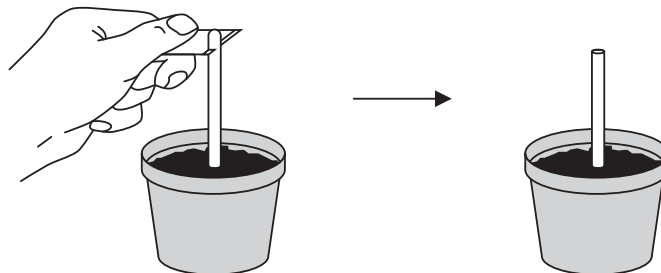


10 (a) Figure 18 shows an investigation into the growth of plant shoots.

Experiment 1:

The tip of a shoot was removed from the plant.

There was no growth in the shoot after 3 days.



Experiment 2:

The tip of a shoot was cut off and then placed back onto the shoot.

The shoot had grown 6 mm after 3 days.

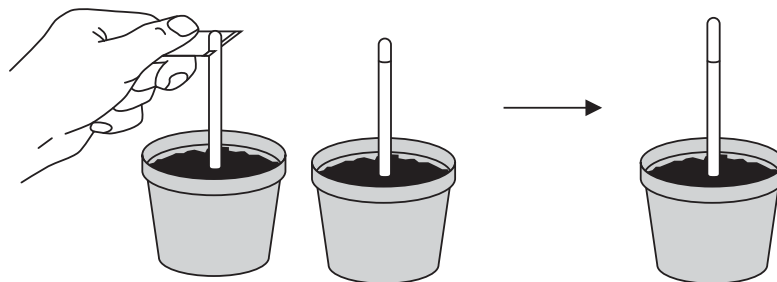


Figure 18

- (i) Give **one** variable that must have been controlled for the plant shoot to grow vertically, as shown in experiment 2.

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(ii) State **one** conclusion that could be made based on these two experiments. (1)

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(iii) Which plant hormone causes growth in the plant shoot? (1)

- A auxin
- B ethene
- C gibberellin
- D chlorophyll

(iv) Explain **one** way that this investigation could be improved. (2)

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*(b) Marram grass is a plant that grows on exposed areas of sand dunes.

Figure 19 shows marram grass growing and a cross section through a leaf of marram grass.

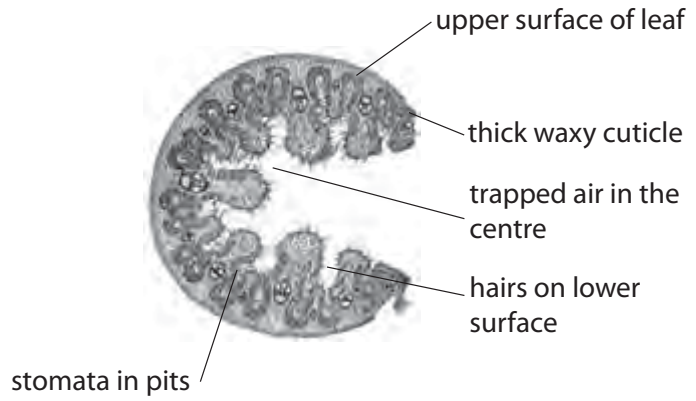


Figure 19

Explain how marram grass is adapted to survive in the hot, windy and dry conditions of a sand dune.

(6)

A series of horizontal dotted lines provided for the student to write their answer to the question.

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