AQA A-LEVEL · 7402

BIOLOGY



EXAM QUESTION PACK

3.3.4.2 MASS TRANSPORT IN PLANTS

SCORE	PERCENTAGE
/273	%

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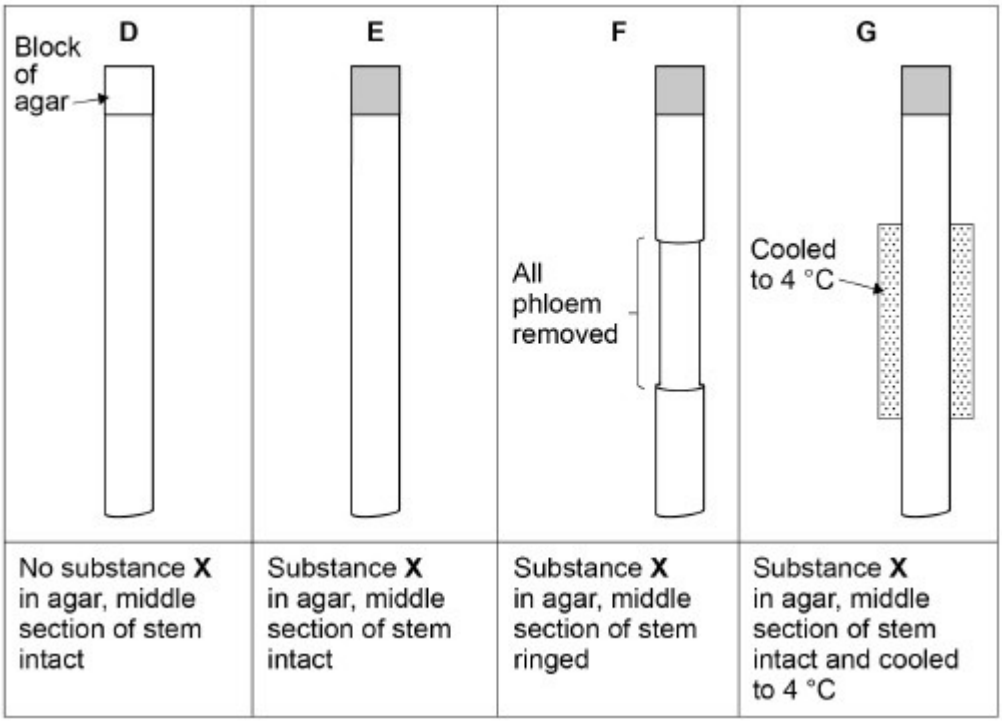
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Q1.

Under the correct conditions, new roots grow from the cut end of a plant stem. A scientist investigated the effect of substance X on the growth of new roots.

She used a ringing experiment to investigate the movement of substance X in stems taken from lemon plants. She cut out a length of stem from each plant. She then put a small block of agar on the top of each length of stem. Some agar blocks contained substance X.

The diagram below shows how she treated each length of stem.



She grew the lengths of stem in the same environmental conditions for 6 weeks, and then found the number of roots per length of stem. Roots grew at the other end of the stem from where the agar blocks were placed.

The table below shows the scientist's results.

Treatment	Mean number of roots per length of stem
D	5
E	11
F	4
G	3

(a) Treatment **D** is a control. Explain how the measurement obtained from this control is used by the scientist.

_____

(2)

(b) Using the diagram and the table above, what can you conclude from treatments **D** and **E** about root growth?

(3)

(c) The mass flow hypothesis is used to explain the movement of substances through phloem.

Evaluate whether the information from this investigation supports this hypothesis. Do **not** consider statistical analysis in the answer.

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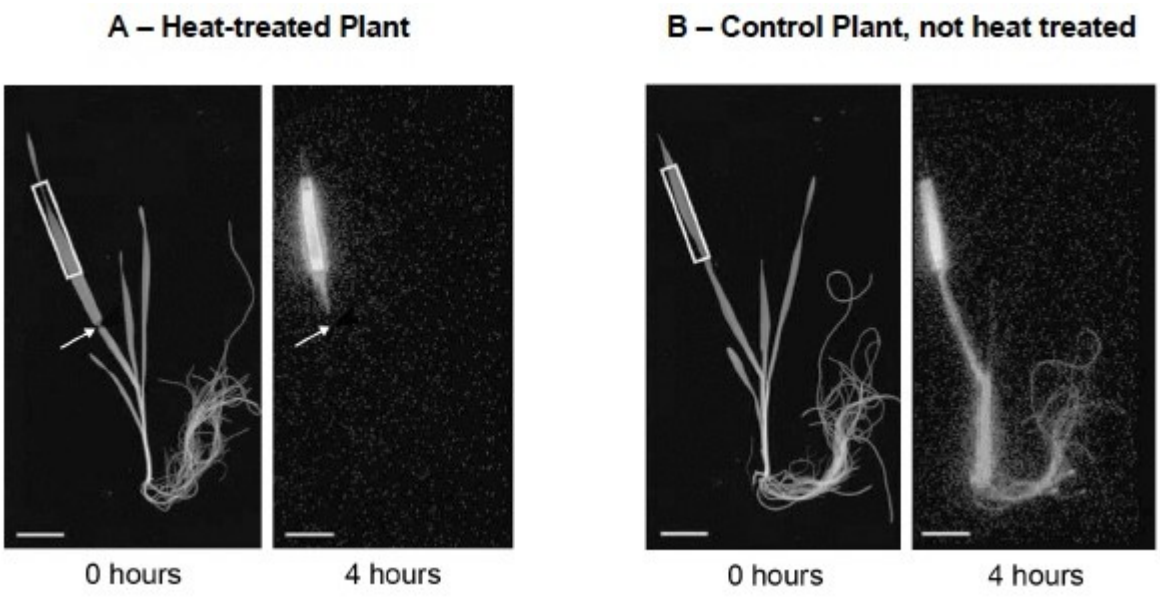
(Total 9 marks)

Q2.

Scientists investigated the effect of a heat treatment on mass transport in barley plants.

- They applied steam to one short section of a leaf of the heat-treated plants. This area is shown by the arrows in **Figure 1**.
- They did not apply steam to the leaves of control plants.
- They then supplied carbon dioxide containing radioactively-labelled carbon to each plant in the area shown by the rectangular boxes in **Figure 1**.
- After 4 hours, they:
  - found the position of the radioactively-labelled carbon in each plant. These results are shown in **Figure 1**.
  - recorded the water content of the parts of the leaf that were supplied with radioactively-labelled carbon dioxide. These results are shown in the table.

Figure 1



Plant from which the leaf was taken	Water content of leaf / % of maximum (± 2 standard deviations)
Heat-treated Plant A	84.6 (±11.3)
Control Plant, not heat treated B	92.8 (±8.6)

(a) The scientists concluded that this heat treatment damaged the phloem.

Explain how the results in **Figure 1** support this conclusion.

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(2)

(b) The scientists also concluded that this heat treatment did not affect the xylem.

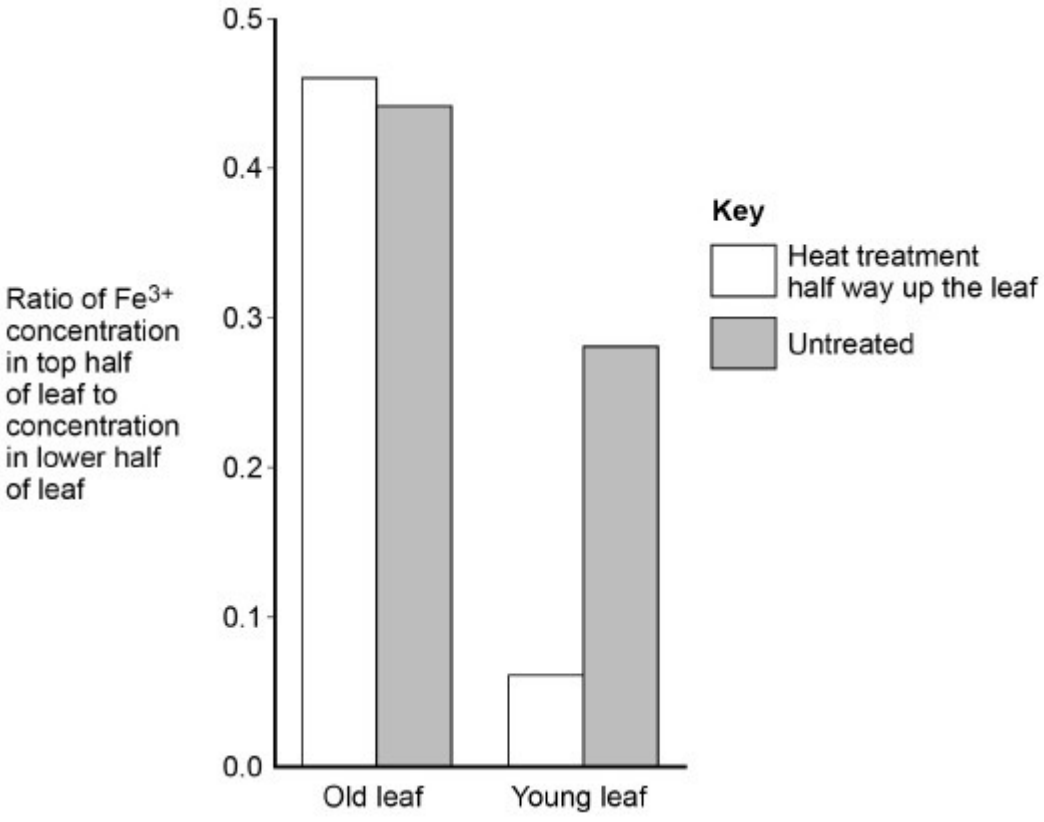
Explain how the results in the table support this conclusion.

(2)

(c) The scientists then investigated the movement of iron ions (Fe^{3+}) from the soil to old and young leaves of heat-treated barley plants and to leaves of plants that were not heat treated. Heat treatment was applied half way up the leaves. The scientists determined the concentration of Fe^{3+} in the top and lower halves of the leaves of each plant.

Their results are shown in **Figure 2**.

Figure 2



What can you conclude about the movement of Fe^{3+} in barley plants?

Use all the information provided.

(4)
(Total 8 marks)

Q3.

(a) Describe the cohesion-tension theory of water transport in the xylem.

(5)

(b) Describe how mRNA is produced in a plant cell.

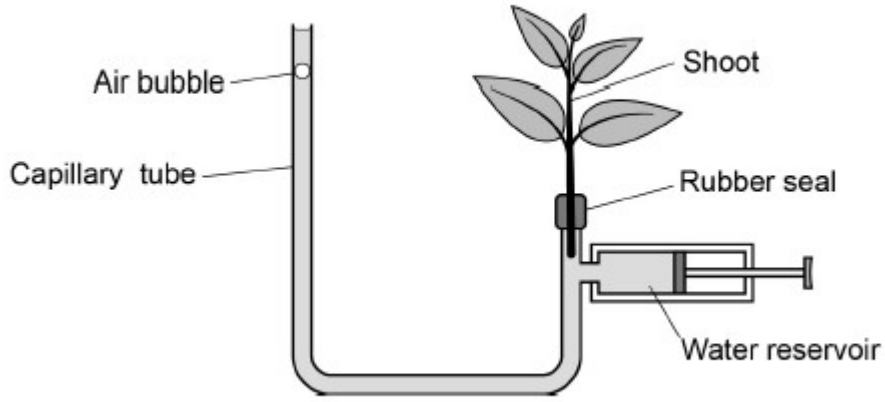
(5)

(Total 10 marks)

Q4.

A student used a potometer to measure the movement of water through the shoot of a plant. The potometer is shown in **Figure 1**. As water is lost from the shoot, it is replaced by water from the capillary tube.

Figure 1



(a) In one experiment, the air bubble moved 7.5 mm in 15 minutes. The diameter of the capillary tube was 1.0 mm.

Calculate the rate of water uptake by the shoot in this experiment.

Give your answer in mm^3 per hour. Show your working. (The area of a circle is found using the formula, area = πr^2)

_____ $mm^3\,hour^{-1}$

(2)

(b) The student wanted to determine the rate of water loss per mm^2 of surface area of the leaves of the shoot in **Figure 1**.

Outline a method she could have used to find this rate. You should assume that all water loss from the shoot is from the leaves.

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(3)

(c) The rate of water movement through a shoot in a potometer may not be the same as the rate of water movement through the shoot of a whole plant.

Suggest **one** reason why.

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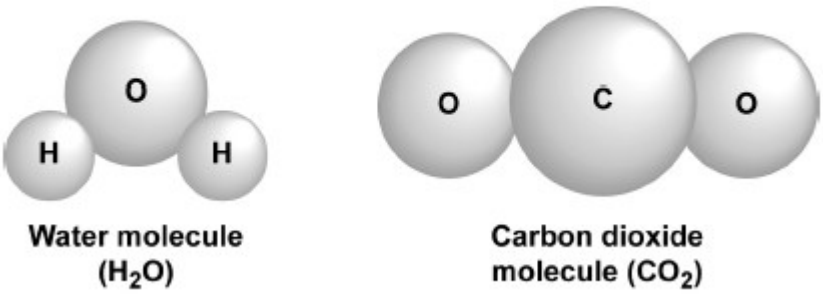
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(1)

(d) Aquaporins are channel proteins that allow the diffusion of water across membranes. One type of aquaporin, called PIP1, can also transport carbon dioxide molecules across membranes.

Figure 2 shows the structure of a water molecule and of a carbon dioxide molecule. They are drawn to the same scale.

Figure 2



Water molecule (H_2O)

Carbon dioxide molecule (CO_2)

Suggest **two** reasons why water molecules **and** carbon dioxide molecules can both pass through PIP1.

1. _____

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2. _____

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(2)

(e) The scientists first produced transgenic poplar trees. These trees all had a length of foreign DNA inserted into them. This DNA led to the production of single-stranded RNA that specifically inhibited expression of the gene for PIP1.

The scientists then measured the difference in the amount of PIP1 in leaves of transgenic poplars and in leaves of wild type poplars without the foreign DNA. The amount of PIP1 in the transgenic poplars was approximately 15% of that in the wild type poplars.

Using this information, what can you conclude about the effect of the foreign DNA in the transgenic poplar trees?

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(3)

(f) The transgenic poplars still produced some PIP1.

Suggest why.

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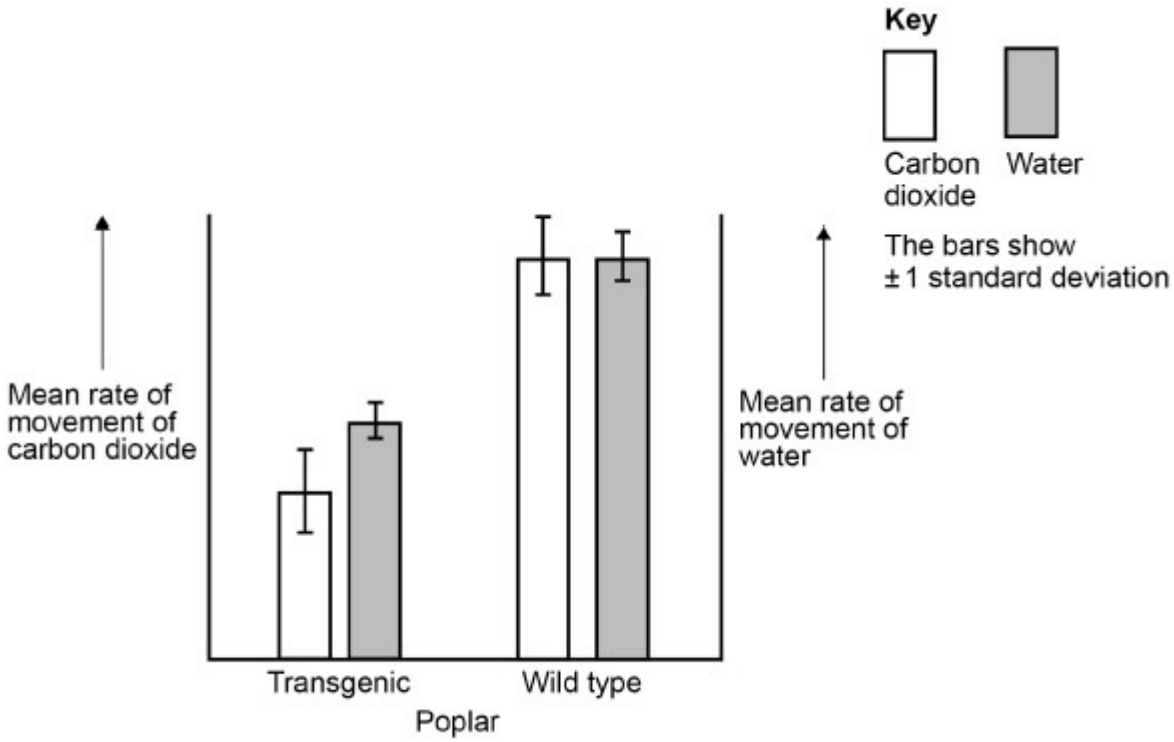
(1)

(g) The scientists investigated the importance of PIP1 in the movement of water and carbon dioxide through the tissues of leaves of poplar trees.

They measured the mean rates of movement of carbon dioxide and water through the tissues of leaves of transgenic poplars and through the tissues of leaves of wild

type poplars.

Their results are shown in the graph below.



Using only the graph above, evaluate the importance of PIP1 in the movement of carbon dioxide and water through leaves of poplar trees.

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(3)

(Total 15 marks)

Q5.

Read the following passage.

Some insect species feed on the leaves of plants. These leaf-chewers bite off pieces of leaves. Other insect species feed on sap from phloem or xylem. These sap-feeders have sharp, piercing mouthparts that they insert directly into either xylem or phloem. Leaf-chewers and insects

that feed on xylem sap are active feeders; this means they use their jaw muscles to obtain their food. In contrast, insects that feed on phloem sap are passive feeders; this means they do not use their jaw muscles to take up sap from phloem.

Feeding on phloem sap presents two problems. Firstly, phloem sap has sa high sugar concentration. This could lead to a high pressure of liquid in the insect's gut because of water entering the gut from the insect's body tissues. A phloem-sap-feeder polymerises some of these sugars into polysaccharides which are passed out of its anus as 'honey dew'. The secondproblem is that phloem sap has a low concentration of amino acids. Phloem-sap-feeding insects rely on bacteria in their guts to produce amino acids. Each phloem-sap-feeding insect receives a few of these bacteria from its parent. This has resulted in a reduction in the genetic diversity of the bacteria found within these insects.

A scientist investigated the effect of three different insects on the growth of a plant called the goldenrod. He found that leaf-chewing insects and xylem-sap-feeding insects caused a much greater reduction in total leaf area than did phloem-sap-feeding insects.

Use the information from the passage and your own knowledge to answer the following questions.

(a) Phloem-sap-feeders are passive feeders (lines 6–7).
Phloem-sap-feeders do not use their jaw muscles to take up sap from phloem.

Explain why they can take up sap without using their jaw muscles.

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(3)

(b) A phloem-sap-feeder polymerises some of these sugars into polysaccharides (line 12-13).
Suggest the advantage of this.

_____

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(2)

(c) Each phloem-sap-feeding insect receives a few of these bacteria from its parent. (lines 16–17).

Suggest how this has caused a reduction in genetic diversity of the bacteria.

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(2)

(d) A scientist found that leaf-chewers and xylem-sap-feeders had a greater effect on plant growth than phloem-sap-feeders (lines 20–22).

Other than environmental factors, give **two** features the scientist would have controlled in his experiment to ensure this conclusion was valid.

1. _____

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2. _____

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(2)

(e) The scientist used the reduction in total leaf area of the experimental plants as an indicator of plant growth.

Outline a method by which you could find the area of a plant leaf.

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(1)

(Total 10 marks)

Q6.

Boron is an element that is needed in very small amounts for normal plant growth.

One group of scientists tested a hypothesis that boron combines with sucrose to produce a sucrose-borate complex that is translocated more effectively than sucrose molecules.

They grew tomato plants in nutrient-poor sand. Prior to starting their experiment, they left the mature plants in a dark room for 48 hours.

For each plant, the scientists put one of its leaves into a solution of sucrose that was

radioactively labelled. These leaves were left attached to the plants. They used two radioactively labelled sucrose solutions:

- solution **A** contained boron at a concentration of 10 parts per million.
- solution **B** contained no boron.

After a period of time, the scientists removed samples from parts of the plants, dried them in an oven and ground each into a powder. They then measured the radioactivity in each powdered sample. The scientists' results are shown in the table.

Part of plant	**Mean radioactivity / counts minute^{-1} g^{-1}**	
	Plants with leaf immersed in solution A (with boron)	**Plants with leaf immersed in solution B (no boron)**
Stem tip	14.2	1.7
First leaf above treated leaf	3.3	0.0
Upper stem	31.2	8.3
Lower stem	28.3	13.3
First leaf below treated leaf	21.7	0.0
Roots	3.5	1.7

(a) Explain the following steps in the scientists' method.

They grew tomato plants in nutrient-poor sand.

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They left the mature plants in the dark for 48 hours before starting their experiment.

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(2)

(b) The scientists dried the plant samples in an oven at 100 °C.

Give **two** reasons why they used this temperature.

1. _____

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2. _____

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(2)

(c) Do the scientists' results support their hypothesis?

Use evidence from the table to support your answer.

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(4)

(d) Suggest how the scientists could adapt their method to determine which tissue carried the radioactively labelled sucrose.

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(2)

(Total 10 marks)

Q7.

Organic compounds synthesised in the leaves of a plant can be transported to the plant's roots.
This transport is called translocation and occurs in the phloem tissue of the plant.

(a) One theory of translocation states that organic substances are pushed from a high pressure in the leaves to a lower pressure in the roots.

Describe how a high pressure is produced in the leaves.

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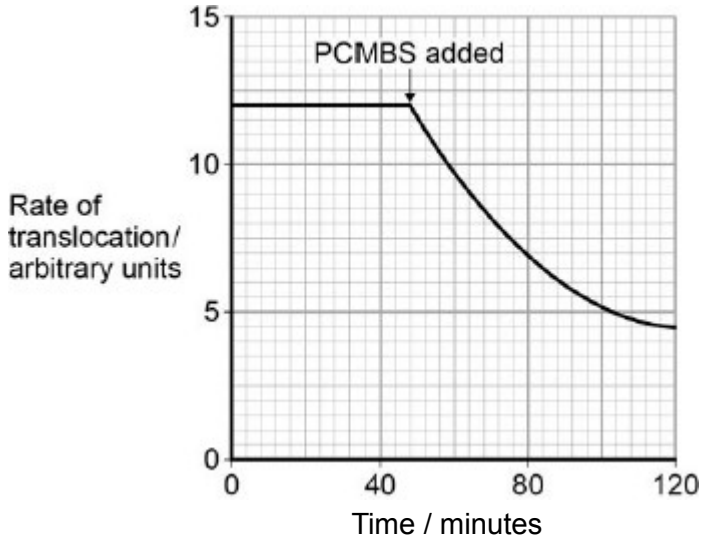
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(3)

PCMBS is a substance that inhibits the uptake of sucrose by plant cells.

Scientists investigated the effect of PCMBS on the rate of translocation in sugar beet. The figure below shows their results.



(b) During their experiment, the scientists ensured that the rate of photosynthesis of their plants remained constant.
Explain why this was important.

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_____

(2)

(c) The scientists concluded that some translocation must occur in the spaces in the cell walls.
Explain how the information in the figure above supports this conclusion.

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(2)

(Total 7 marks)

Q8.

(a) Contrast the processes of facilitated diffusion and active transport.

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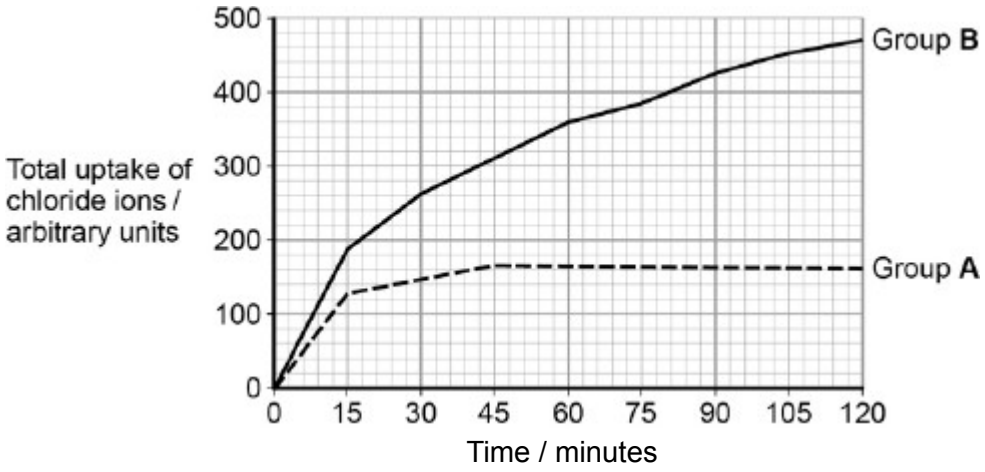
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(3)

Students investigated the uptake of chloride ions in barley plants. They divided the plants into two groups and placed their roots in solutions containing radioactive chloride ions.

- Group **A** plants had a substance that inhibited respiration added to the solution.
- Group **B** plants did not have the substance added to the solution.

The students calculated the total amount of chloride ions absorbed by the plants every 15 minutes. Their results are shown in the figure below.



(b) Calculate the ratio of the mean **rate** of uptake of chloride ions in the first hour to the **rate** of uptake of chloride ions in the second hour for group **B** plants.

Ratio = _____ :1

(2)

(c) Explain the results shown in the figure above.

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(4)

(Total 9 marks)

Q9.

(a) Describe the mass flow hypothesis for the mechanism of translocation in plants.

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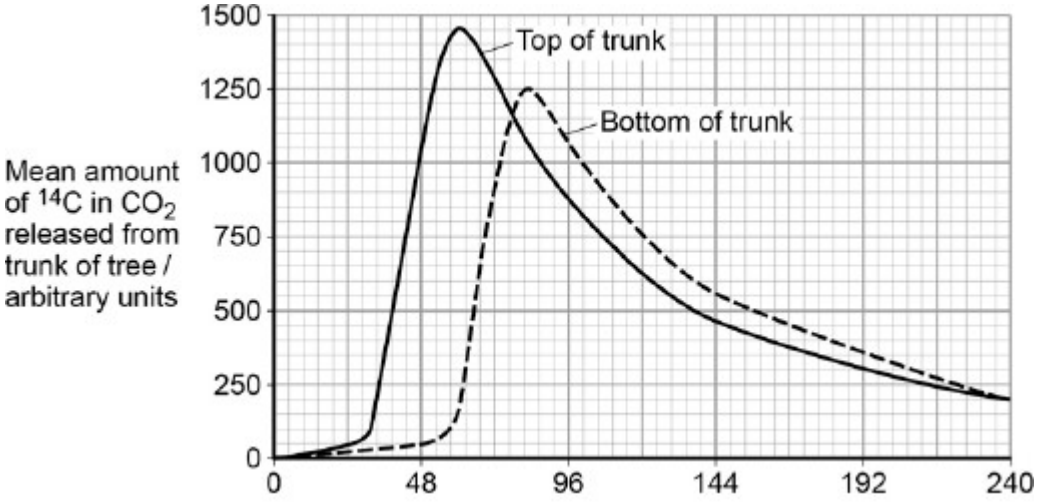
(4)

Scientists measured translocation in the phloem of trees. They used carbon dioxide labelled with radioactive ^{14}C.

They put a large, clear plastic bag over the leaves and branches of each tree and added $^{14}CO_2$. The main trunk of the tree was not in the plastic bag.

At regular intervals after adding the $^{14}CO_2$ to the bag, the scientists measured the amount of $^{14}CO_2$ released from the top and bottom of the main trunk of the tree. On the surface of the trunk of these trees, there are pores for gas exchange.

The following figure shows the scientists' results.



(b) Name the process that produced the $^{14}CO_2$ released from the trunk.

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(1)

(c) How long did it take the ^{14}C label to get from the top of the trunk to the bottom of the trunk? Explain how you reached your answer.

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(2)

(d) What other information is required in order to calculate the mean rate of movement of the ^{14}C down the trunk?

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_____

(1)

(Total 8 marks)

Q10.

A student investigated the distribution of stomata on leaves from two species of plant. She removed small pieces from the lower surface of the leaves of each plant species. She mounted these pieces on separate microscope slides. She then counted the number of stomata in several parts of the epidermis on each piece of leaf tissue using an optical microscope.

(a) Suggest appropriate units the student should use to compare the distribution of stomata on leaves.

_____

(1)

(b) The pieces of leaf tissue examined were very thin.

Explain why this was important.

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(2)

(c) Give **two** reasons why it was important that the student counted the number of stomata in several parts of each piece of leaf tissue.

1. _____

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2. _____

_____

(2)

(d) One of the two plant species used by the student in this investigation was a xerophyte.

Other than the distribution of stomata, suggest and explain **two** xerophytic features the leaves of this plant might have.

1. _____

_____

2. _____

_____

(2)

(e) The student then compared the rate of transpiration (evaporation of water) from the two species of plant. She did this by measuring the rate of water uptake by each plant species.

Suggest **two** reasons why the rate of water uptake by a plant might not be the same as the rate of transpiration.

1. _____

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2. _____

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(2)

(Total 9 marks)

Q11.

(a) Describe how the structures of starch and cellulose molecules are related to their functions.

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(5)

(b) Describe the processes involved in the transport of sugars in plant stems.

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(5)

(Total 10 marks)

Q12.

(a) (i) Give **two** ways in which the structure of starch is **similar** to cellulose.

1. _____

2. _____

(2)

(ii) Give **two** ways in which the structure of starch is **different** from cellulose.

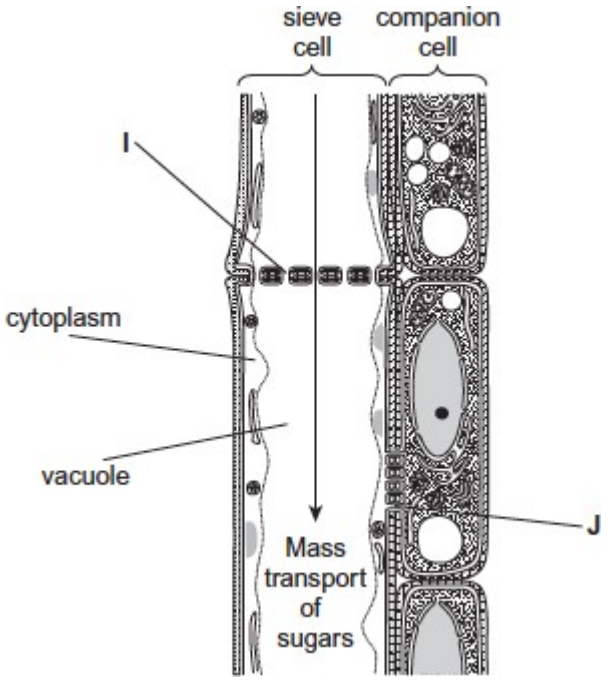
1. _____

2. _____

(2)

(b) In plants, mass transport of sugars takes place through columns of sieve cells in the phloem. Other cells, called companion cells, transport sugars into, and out of, the sieve cells.

The diagram shows the structure of phloem.



Structures **I** and **J** allow the transport of sugars between cells.

(i) Using the diagram, suggest and explain **one** other way in which sieve cells are adapted for mass transport.

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(2)

(ii) Using the diagram, suggest and explain **one** other way in which companion cells are adapted for the transport of sugars between cells.

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(2)

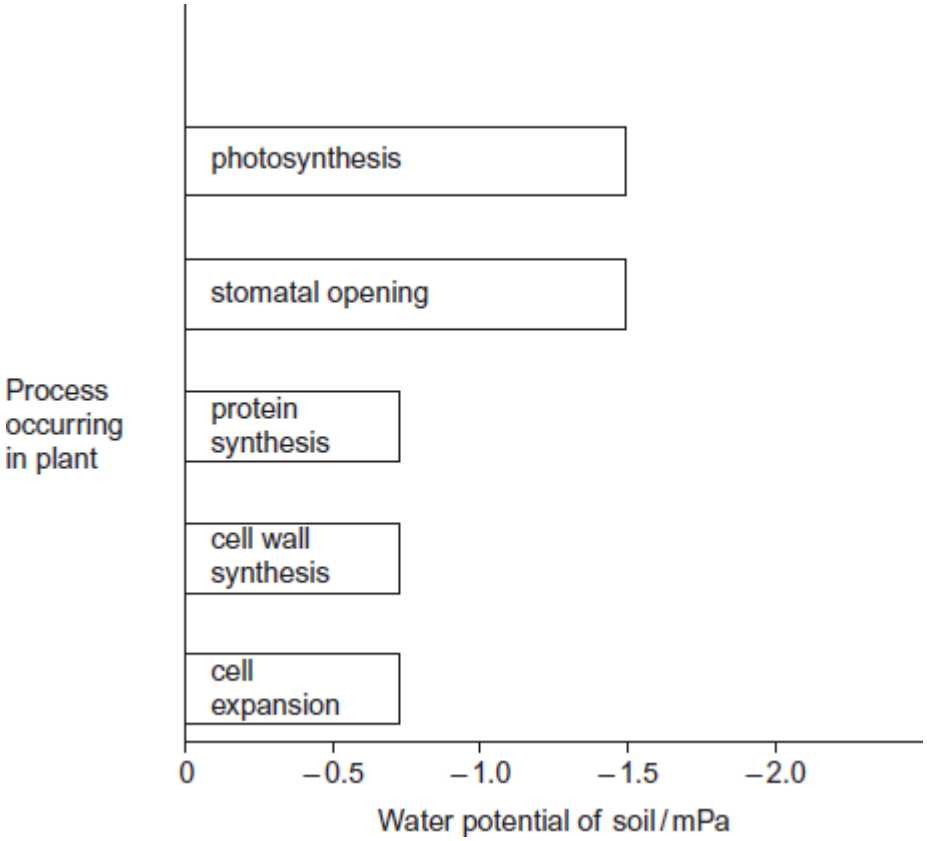
(Total 8 marks)

Q13.

Scientists investigated the effect of the water potential of soil water on plant growth. They investigated the effect of this water potential on several plant processes.

The figure below shows their results in the form they were presented. The bars show whether or not each process was occurring.

The plants stopped growing when the water potential of the soil water was below –0.7 mPa. All of the changes in the plants were related to the ability of the roots to take up water from the soil.



(a) Describe the results in the figure.

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(2)

(b) Explain the relationship between stomatal opening and photosynthesis.

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(2)

(c) Although photosynthesis is still occurring, plants stop growing when the soil water potential falls below –0.7 mPa.

Use information from the figure above to suggest two reasons why.

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(3)

(Total 7 marks)

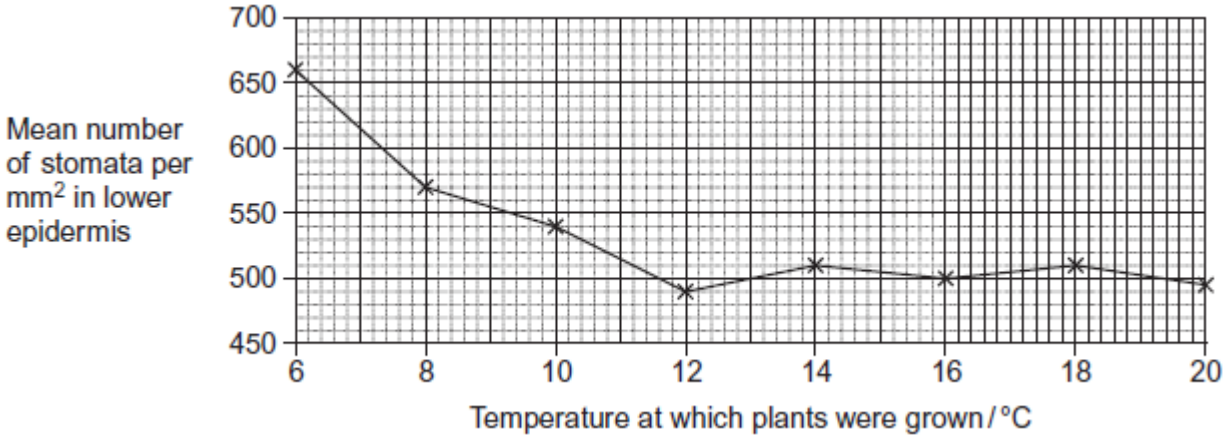
Q14.

Environmental factors can affect the density of stomata in the lower epidermis of leaves of plants of the same species.

Scientists investigated how growing plants at different temperatures affected the density of stomata in the lower epidermis of leaves. They grew plants of the same species from seeds.
Their method is outlined below.

- They took 8 trays containing soil and planted 50 seeds in each tray.
- They put each tray in a controlled environment at a different temperature.
- When the plants had grown from the seeds, they selected 20 fully grown leaves from the plants in each tray.
- They determined the mean number of stomata per mm^2 in the lower epidermis for each group of leaves.

Their results are shown in the graph.



(a) Give **three** environmental variables, other than temperature, that the scientists would have controlled when growing the plants.

1. _____

2. _____

3. _____

(3)

(b) The scientists used a range of temperatures from 6 to 20 °C.
Using their data, explain why they did not use temperatures above 20 °C.

_____

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(1)

(c) The scientists only selected fully grown leaves from the plants.

Suggest why.

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_____

(1)

(d) The plants grown at higher temperatures had a lower number of stomata per mm^2.
This would be an advantage to the plant because the transpiration rate increases as the temperature increases.

Explain why the transpiration rate increases when the temperature increases.

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(2)

(Total 7 marks)

Q15.

Scientists used fossil leaves from one species of pine tree to investigate whether changes in the concentration of carbon dioxide in the air over long periods of time had led to changes in the number of stomata in the leaves.

Their method is outlined below.

- They selected sites of different ages.
- They collected between 11 and 24 fossil leaves from each site.
- They found the mean number of stomata per mm^2 on the leaves from each site.
- They estimated the age of each sample by dating organic remains around the leaves at each site.

They compared results from the fossil leaves with leaves from the same species of pine tree growing today.

They knew the concentration of carbon dioxide in the air at different times in the past.

Their results are shown in the table.

Age of sample/years	Concentration of carbon dioxide in the air/%	Mean number of stomata per mm^2 (± standard deviation)
present day	0.0350	92 (±2)
5000	0.0270	87 (±4)
10 000	0.0250	95 (±2)
15 000	0.0205	108 (±6)
20 000	0.0195	115 (±4)
25 000	0.0188	118 (±6)
30 000	0.0190	130 (±6)

(a) The concentration of carbon dioxide in the air has changed with time. Use the data to describe how.

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(2)

(b) The scientists calculated the mean number of stomata per mm^2 and the standard deviation.

What does the standard deviation show?

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(2)

(c) The scientists found the age of the fossil leaves by dating the organic remains around them.
Would this have affected the accuracy of their data? Explain your answer.

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(1)

(d) 30 000 years ago the mean number of stomata per mm^2 on the lower epidermis of pine tree leaves was much higher than it is today. This would have enabled the plant to grow faster when the carbon dioxide concentration of the air was low.

Explain why.

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_____

(1)

(e) A student who saw these results concluded that as the carbon dioxide concentration of the air had increased the number of stomata per mm^2 in leaves had decreased.
Do the results support this conclusion?

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(3)

(f) The leaves of plants that grow in dry areas usually have a low number of stomata per mm^2. Use your knowledge of leaf structure to suggest **three** other adaptations that the leaves might have that enable the plants to grow well in dry conditions.

1. _____

2. _____

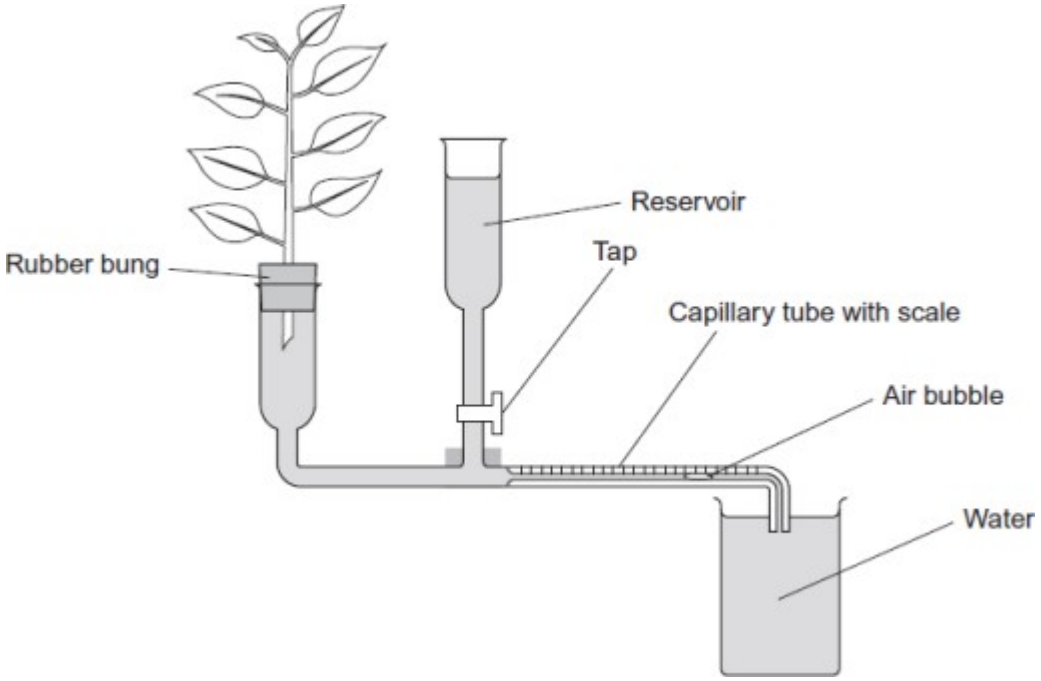
3. _____

(3)

(Total 12 marks)

Q16.

Students investigated the effect of removing leaves from a plant shoot on the rate of water uptake. Each student set up a potometer with a shoot that had eight leaves. All the shoots came from the same plant. The potometer they used is shown in the diagram.



(a) Describe how the students would have returned the air bubble to the start of the capillary tube in this investigation.

_____

_____

_____

(1)

(b) Give **two** precautions the students should have taken when setting up the potometer to obtain reliable measurements of water uptake by the plant shoot.

1. _____

2. _____

(2)

(c) A potometer measures the rate of water uptake rather than the rate of transpiration. Give **two** reasons why the potometer does **not** truly measure the rate of transpiration.

1. _____

2. _____

(2)

(d) The students' results are shown in the table.

Number of leaves removed from the plant shoot	Mean rate of water uptake / cm^3 per minute
0	0.10
2	0.08
4	0.04
6	0.02
8	0.01

Explain the relationship between the number of leaves removed from the plant shoot and the mean rate of water uptake.

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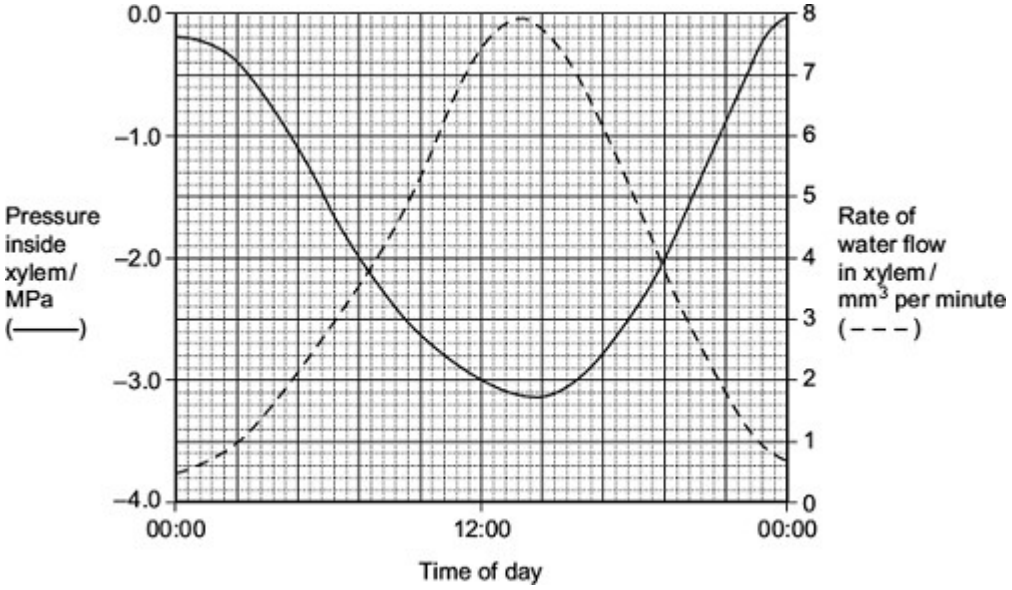
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(3)

(Total 8 marks)

Q17.

(a) Scientists measured the rate of water flow and the pressure in the xylem in a small branch. Their results are shown in the graph.



(i) Use your knowledge of transpiration to explain the changes in the rate of flow in the xylem shown in the graph.

_____

_____

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(3)

(ii) Explain why the values for the pressure in the xylem are negative.

_____

_____

_____

(1)

(b) Doctors measured the thickness of the walls of three blood vessels in a large group of people. Their results are given in the table.

Name of vessel	**Mean wall thickness /mm (± standard deviation)**
Aorta	5.7 ± 1.2
Pulmonary artery	1.0 ± 0.2
Pulmonary vein	0.5 ± 0.2

(i) Explain the difference in thickness between the pulmonary artery and the pulmonary vein.

_____

_____

_____

(1)

(ii) The thickness of the aorta wall changes all the time during each cardiac cycle. Explain why

_____

_____

_____

_____

_____

_____

(3)

(iii) Which of the three blood vessels shows the greatest variation in wall thickness?
Explain your answer.

_____

_____

_____

(1)

(c) Describe how tissue fluid is formed **and** how it is returned to the circulatory system.

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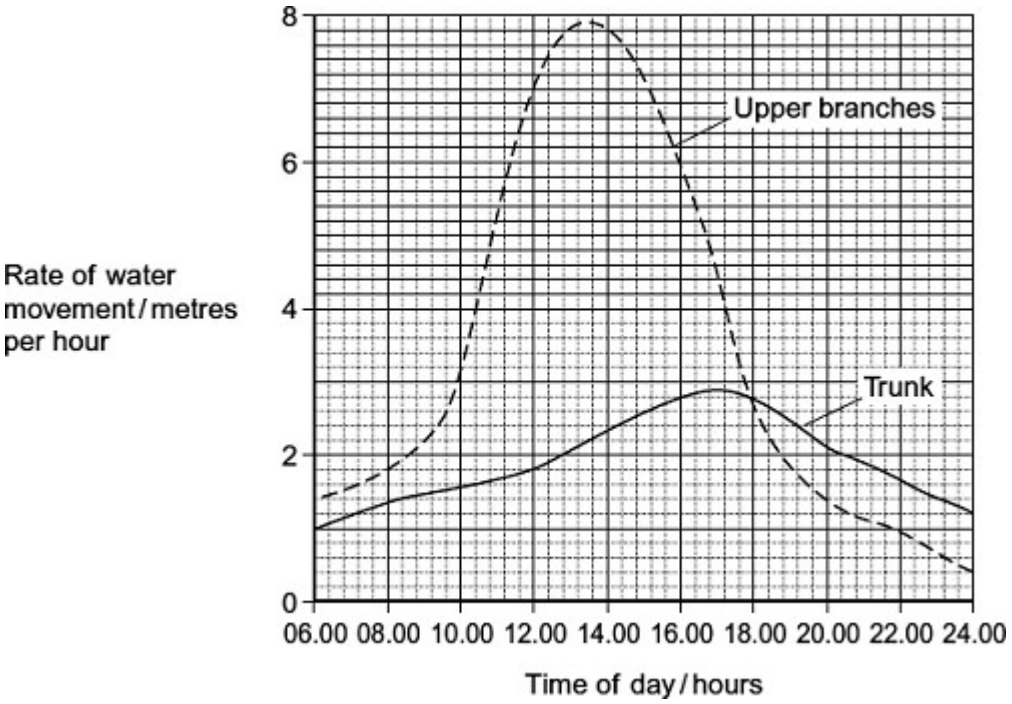
_____

(6)

(Total 15 marks)

Q18.

A biologist investigated the rate of water movement during the day in different parts of a tree. The results are shown in the graph.



(i) Describe how the rate of water movement in the upper branches changed over the period shown in the graph.

_____

_____

_____

_____

_____

(2)

(ii) The rate of water movement in the upper branches was different from the rate of water movement in the trunk. Describe how.

_____

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(2)

(iii) The results of this investigation support the cohesion tension theory. Explain how.

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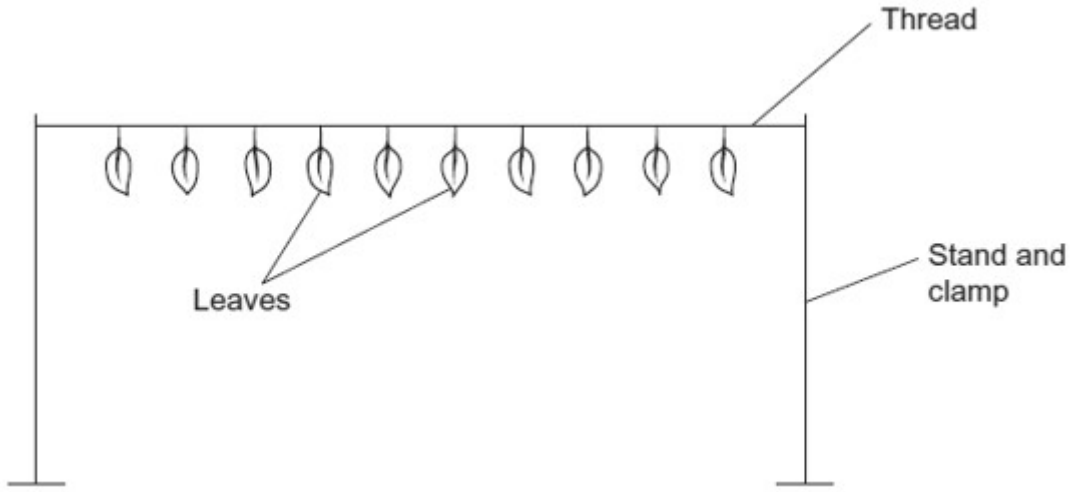
(2)

(Total 6 marks)

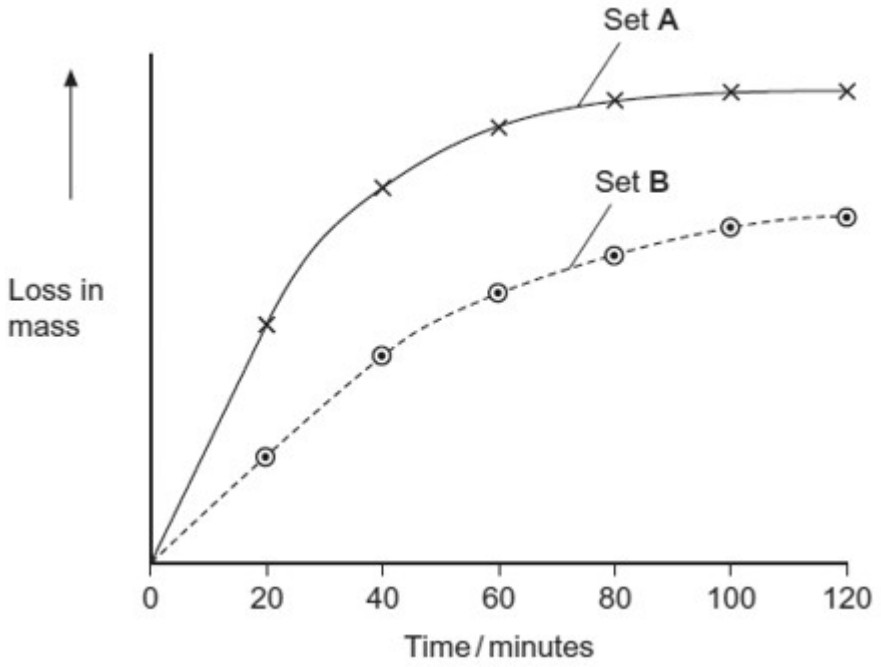
Q19.

A student investigated the rate of transpiration from privet leaves.

- She obtained two sets of ten privet leaves.
- She left the ten leaves in set **A** untreated. She covered the upper surfaces of the ten leaves in set **B** with grease.
- She weighed each set of leaves and then tied all the leaves in each set to a separate length of thread. This is shown in the diagram.



- She then weighed each set of leaves every 20 minutes over a period of 2 hours and plotted a graph of her results.



(a) Give **two** environmental conditions that the student should have kept constant during this investigation.

1. _____

2. _____

(2)

(b) The student measured the water loss in milligrams. Explain the advantage of using ten leaves when taking measurements in milligrams.

_____

_____

(1)

(c) Explain the change in mass of untreated leaves in set **A** shown in the graph.

_____

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(3)

(d) The results that the student obtained for the leaves in set **B** were different from those for set **A**. Suggest an explanation for this difference.

_____

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(2)

(Total 8 marks)

Q20.

(a) Students measured the rate of transpiration of a plant growing in a pot under different environmental conditions. Their results are shown in the table.

Conditions	Transpiration rate / g h^{-1}
A Still air 15°	1.2
B Moving air 15°	1.7
C Still air 25°	2.3

During transpiration, water diffuses from cells to the air surrounding a leaf.

(i) Suggest an explanation for the difference in transpiration rate between conditions **A** and **B**.

_____

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_____

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(2)

(ii) Suggest an explanation for the difference in transpiration rate between conditions **A** and **C**.

_____

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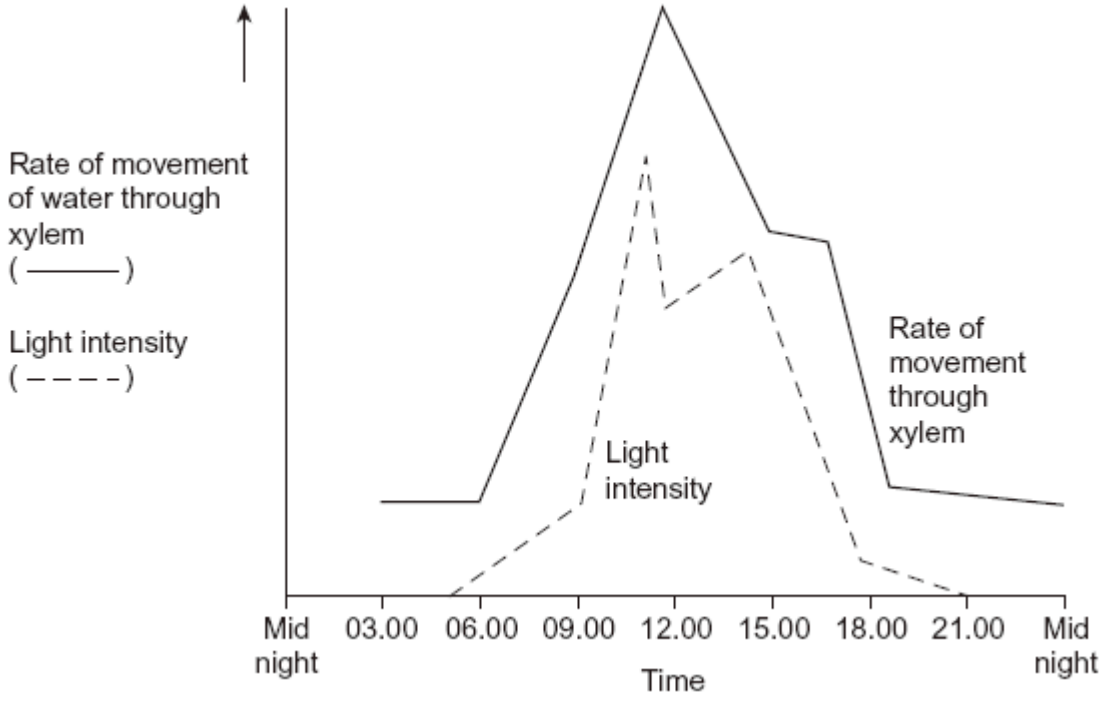
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(2)

(b) Scientists investigated the rate of water movement through the xylem of a twig from a tree over 24 hours. The graph shows their results. It also shows the light intensity for the same period of time.



(i) Describe the relationship between the rate of water movement through the xylem and the light intensity.

_____

_____

_____

(1)

(ii) Explain the change in the rate of water movement through the xylem between 06.00 and 12.00 hours.

_____

_____

_____

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(2)

(iii) The scientists also measured the diameter of the trunk of the tree on which the twig had been growing. The diameter was less at 12.00 than it was at 03.00 hours.

Explain why the diameter was less at 12.00 hours.

_____

_____

_____

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_____

(2)

(c) Arteries and arterioles take blood away from the heart.

Explain how the structures of the walls of arteries and arterioles are related to their functions.

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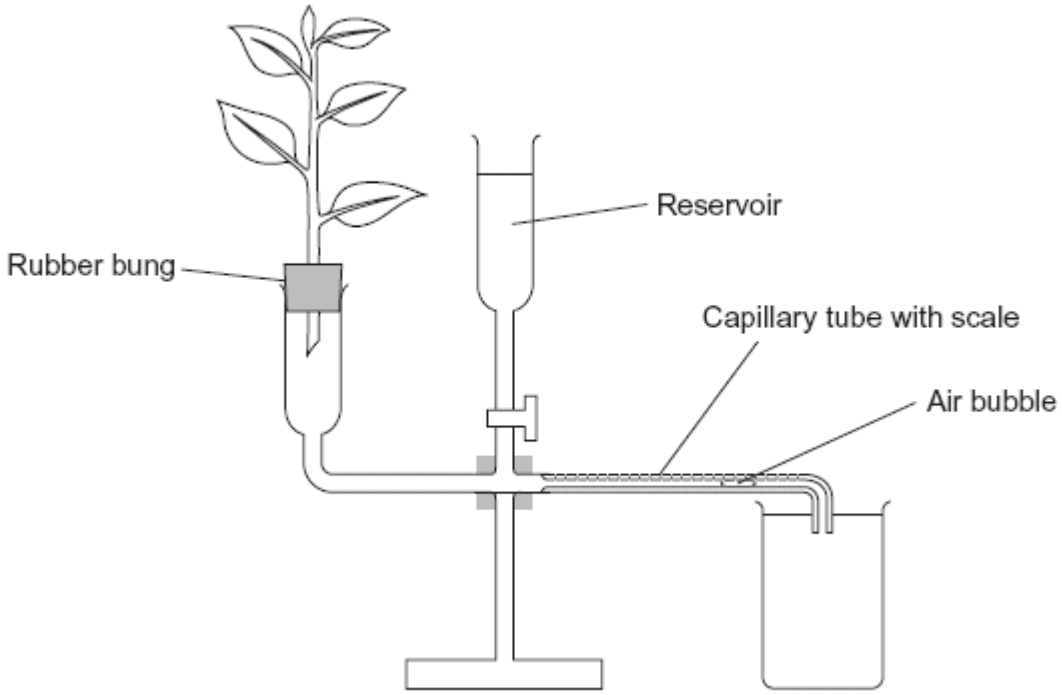
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(6)

(Total 15 marks)

Q21.

A student investigated the rate of transpiration from a leafy shoot. She used a potometer to measure the rate of water uptake by the shoot. The diagram shows the potometer used by the student.



(a) Give **one** environmental factor that the student should have kept constant during this investigation.

_____

(1)

(b) The student cut the shoot and put it into the potometer under water. Explain why.

_____

_____

(1)

(c) The student wanted to calculate the rate of water uptake by the shoot in cm^3 per minute. What measurements did she need to make?

_____

_____

_____

_____

(2)

(d) The student assumed that water uptake was equivalent to the rate of transpiration.

Give **two** reasons why this might **not** be a valid assumption.

1. _____

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2. _____

_____

(2)

(e) The student measured the rate of water uptake three times.

(i) Suggest how the reservoir allows repeat measurements to be made.

_____

_____

(1)

(ii) Suggest why she made repeat measurements.

_____

_____

(1)

(Total 8 marks)

Q22.

A student found the number of stomata per cm^2 on the lower surface of a daffodil leaf.
He removed a small, thin piece of lower epidermis and mounted it on a microscope slide.

He examined the slide using an optical microscope.

(a) Explain why it was important that the piece of the epidermis that the student removed was thin.

_____

_____

_____

_____

(2)

(b) Suggest how the student could have used his slide to find the number of stomata per cm^2.

_____

_____

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(3)

(c) The stomata on the leaves of pine trees are found in pits below the leaf surface. Explain how this helps to reduce water loss.

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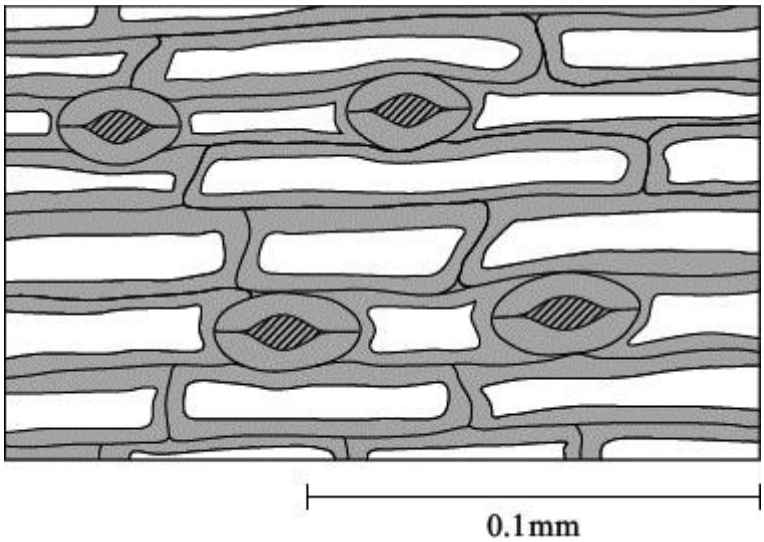
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(2)

(Total 7 marks)

Q23.

The drawing shows part of the lower leaf epidermis of sorghum.



(a) Calculate the number of stomata per mm^2 of the leaf surface. Show your working.

Answer _____ stomata per mm^2

(2)

(b) Sorghum has few stomata per mm^2 of leaf surface area. Explain how this is an adaptation to the conditions in which sorghum grows.

_____

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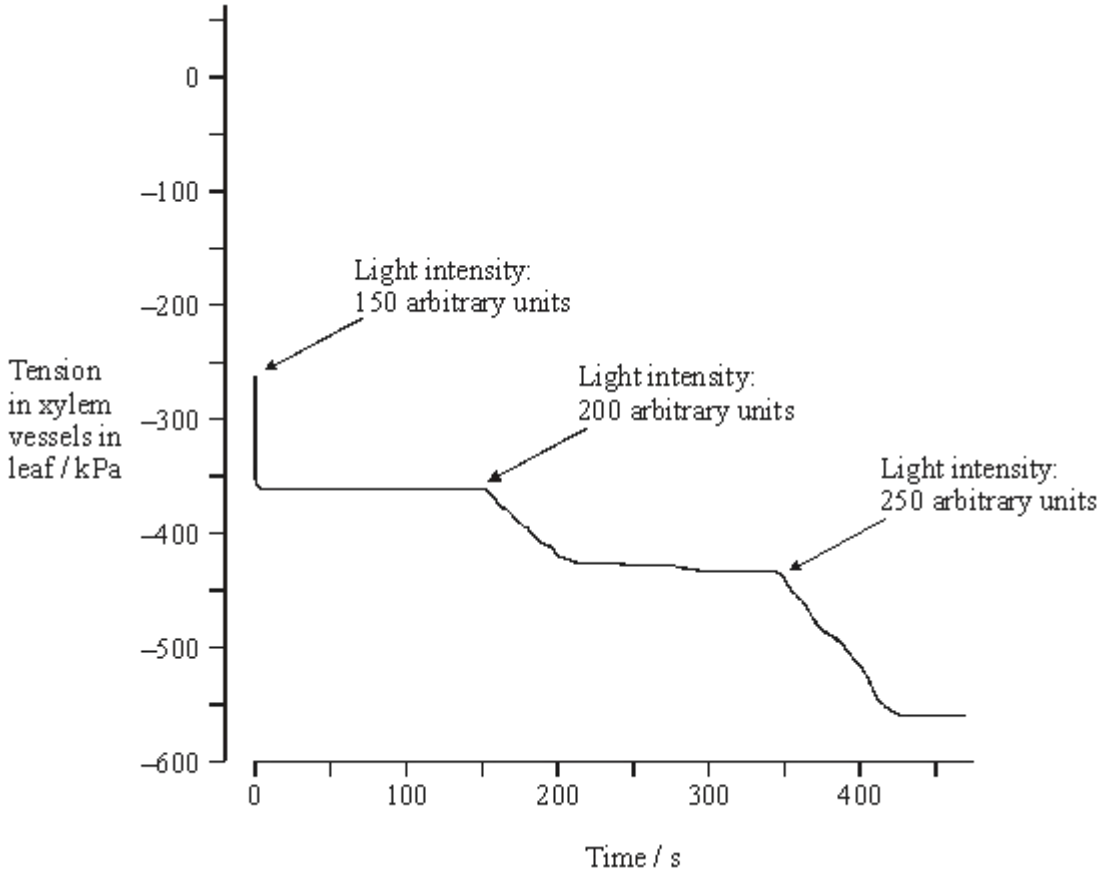
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(3)
(Total 5 marks)

Q24.

The chart shows the results obtained from an investigation to determine the effect of light intensity on the tension in xylem vessels in the leaves of a plant.



(a) Describe and explain the effects of increasing light intensity on the tension in the xylem vessels in the leaves.

(5)

(b) Explain why it was important to keep the humidity constant during the investigation.

_____

_____

_____

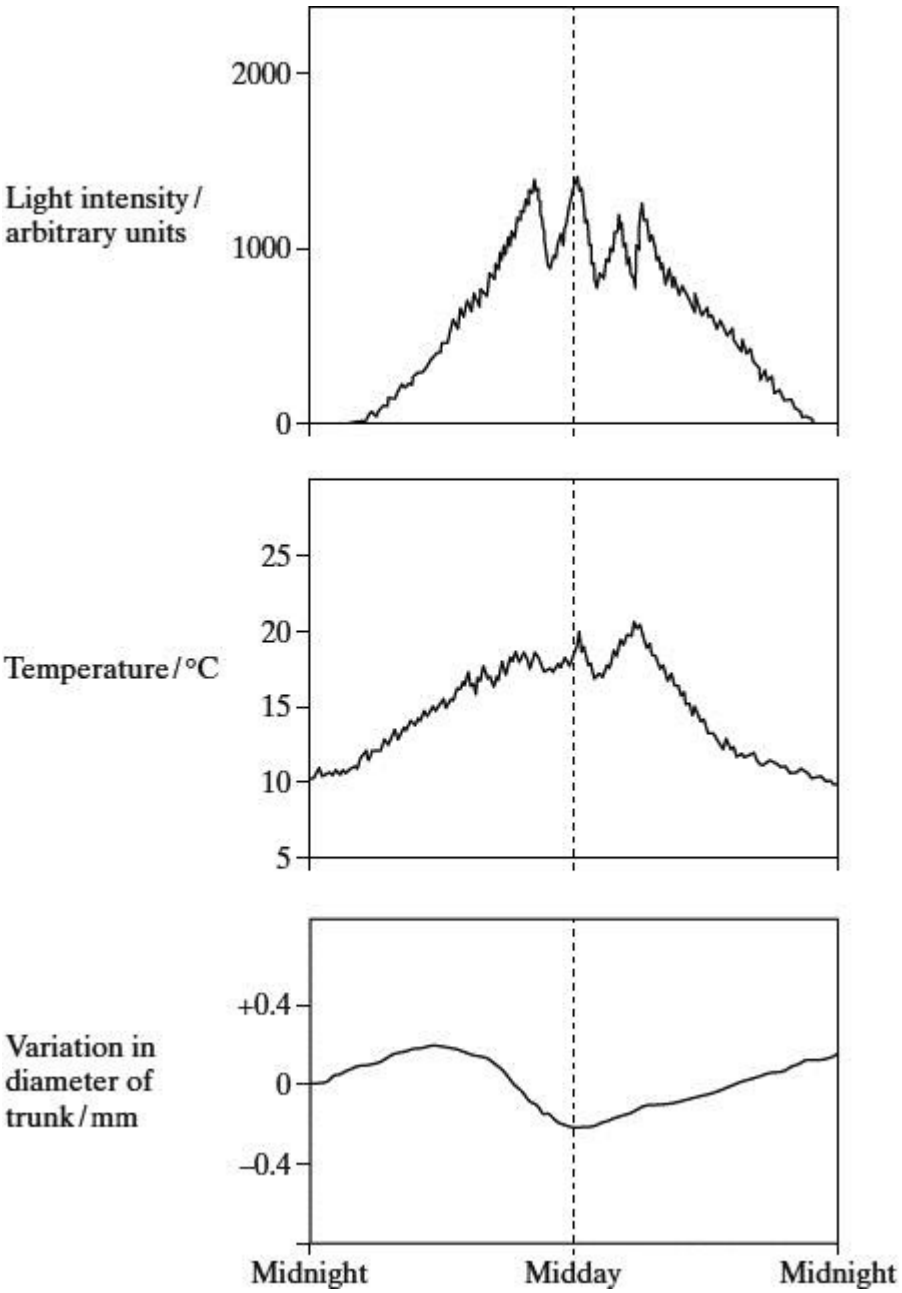
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(2)

(Total 7 marks)

Q25.

(a) The graphs show the daily changes in environmental temperature and light intensity, and changes in the diameter of the trunk of a pine tree.



Use information from the graphs, and your knowledge of the cohesion-tension theory of water movement through a plant, to explain why the diameter of the trunk is smallest at midday.

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(6)

(b) Describe and explain **three** ways in which the leaves of xerophytic plants may be adapted to reduce water loss.

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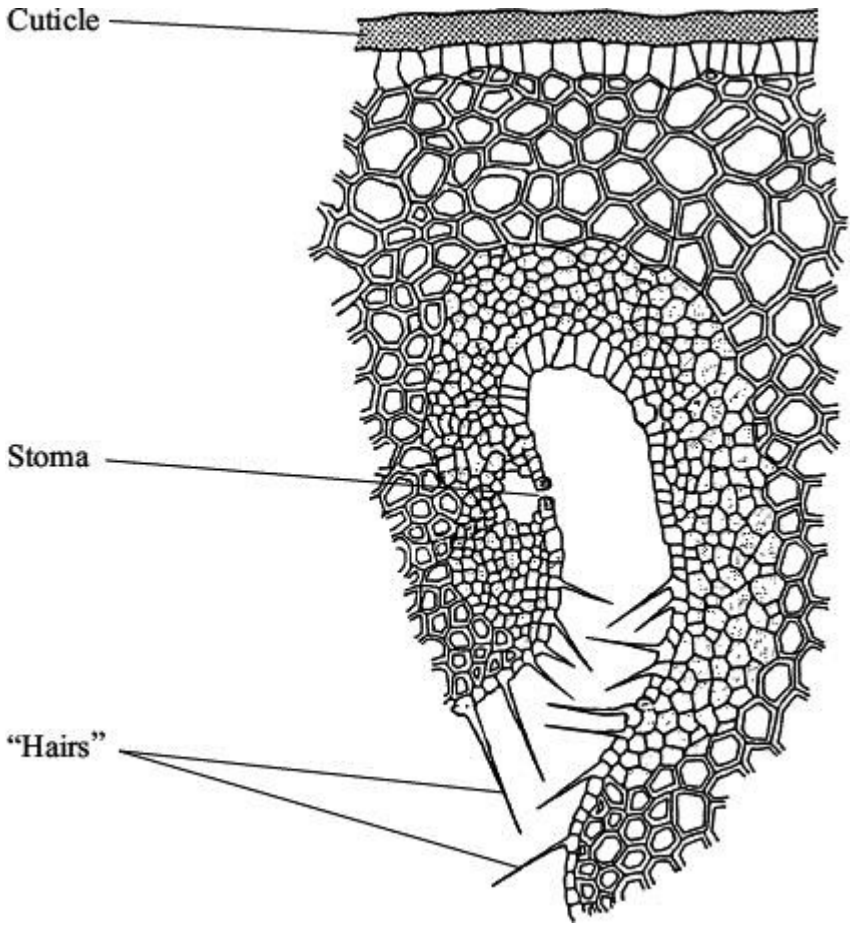
(3)

(Total 9 marks)

Q26.

Figure 1 shows a single stoma and surrounding cells from the leaf of a xerophytic plant.

Figure 1



(i) Explain how the cuticle reduces water loss.

_____

_____

(1)

(ii) Explain how **one** of the other labelled parts reduces water loss.

_____

_____

_____

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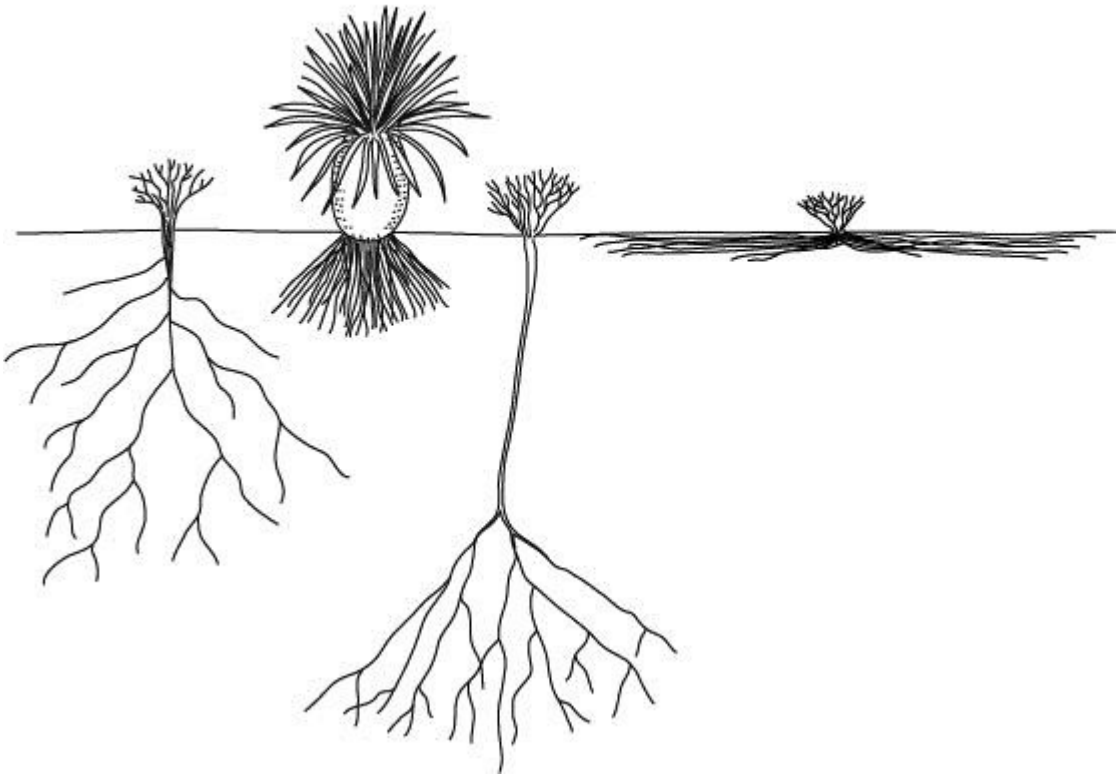
(2)

(Total 3 marks)

Q27.

The drawing shows four common plants found in the Mojave Desert.

W X Y Z



(a) Explain how **three** features of the plants shown in the drawing are adaptations to desert conditions.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(b) Resurrection plants can lose up to 95% of their water content without dying. They can survive for many years in this desiccated state and will revive within hours of rainfall. Suggest which of the plants **W** to **Z** is most likely to be a resurrection plant. Give a reason for your choice.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q28.

(a) Explain how xylem tissue is adapted for its function.

_____

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_____

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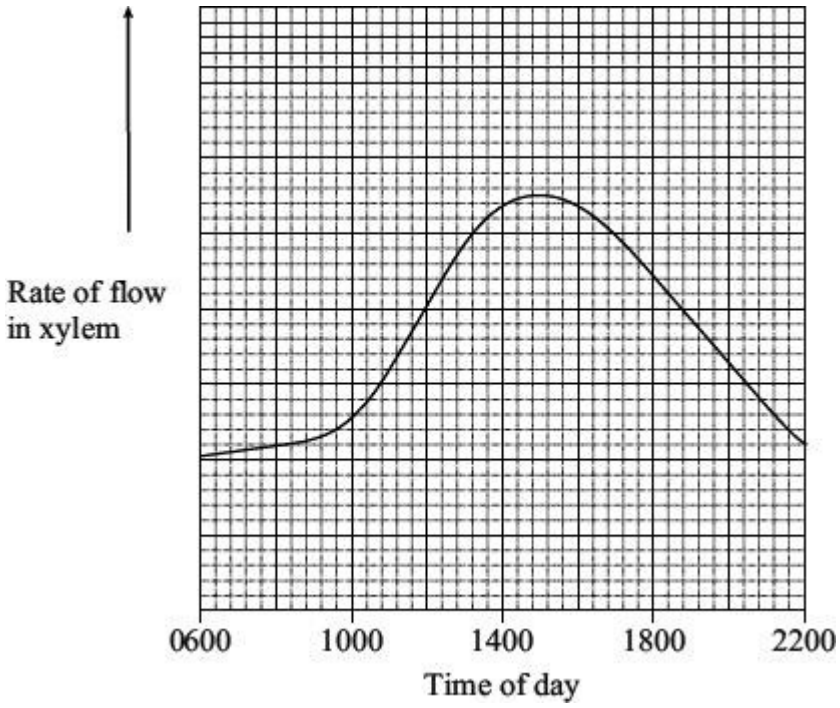
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(4)

(b) The graph shows the flow rate in the xylem in the trunk of a tree.



(i) Explain the increase in the flow rate between 1000 and 1400 hours.

_____

_____

_____

_____

(2)

(ii) The diameter of the trunk decreased during the same period, reaching its minimum when the flow rate was highest. Use your knowledge of the

cohesion-tension theory to suggest an explanation for this decrease.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q29.

(a) Explain how each of the following is related to the function of xylem tissue.

(i) Xylem tissue contains hollow tubes.

_____

_____

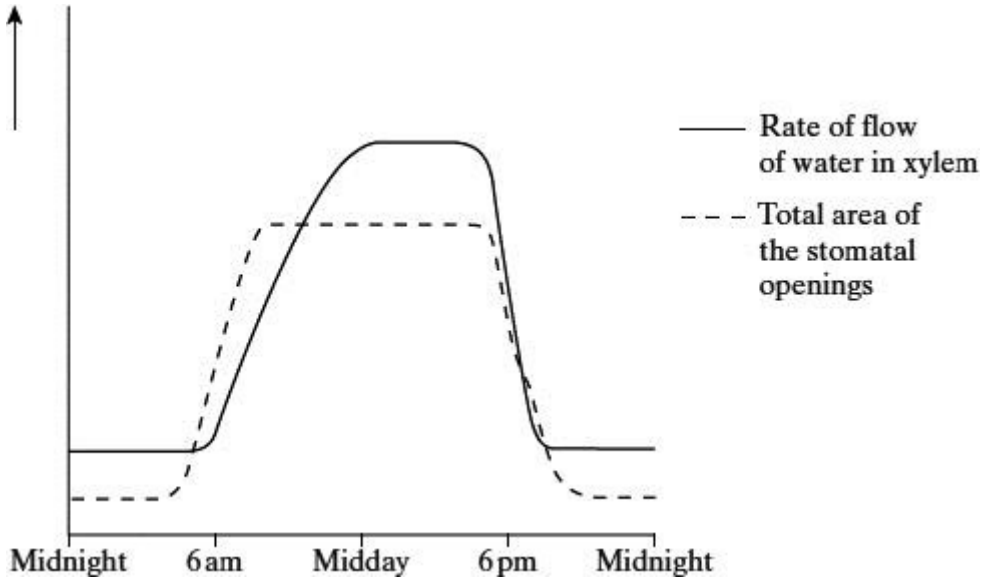
(ii) Lignin is present in xylem cell walls.

_____

_____

(2)

(b) In an investigation the total area of the stomatal openings and the rate of flow of water through xylem were measured in a plant over a period of 24 hours. The results are shown in the graph.



(i) Describe the relationship between the rate of flow of water and the total area of the stomatal openings for the period of time between midday and midnight.

_____

_____

(1)

(ii) Between 8 am and midday the rate of flow of water continues to rise although the total area of the stomatal openings remains constant. Explain why the rate of flow of water rises.

_____

(1)

(iii) How would the curve showing the total area of the stomatal openings differ if the investigation was repeated on a dull day?

_____

_____

(1)

(c) Some xerophytic plants have sunken stomata. Explain the advantage of this adaptation.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q30.

(a) Describe how water is moved through a plant according to the *cohesion-tension* hypothesis.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) The mass of water lost from a plant was investigated. The same plant was used in every treatment and the plant was subjected to identical environmental conditions. In some treatments, the leaves were coated with a type of grease. This grease provides a waterproof barrier. The results of the investigation are given in the table.

Treatment	Mass lost in 5 days / g

No grease applied	10.0
Grease applied only to the upper surface of every leaf	8.7
Grease applied to both surfaces of every leaf	0.1

(i) What is the advantage of using the same plant in every treatment?

_____

_____

(1)

(ii) Why was it important to keep the environmental conditions constant?

_____

_____

(1)

(iii) What is the evidence that the grease provides a waterproof barrier?

_____

_____

(1)

(c) (i) Calculate the mass of water lost in 5 days through the upper surface of the leaves.

Answer _____

(1)

(ii) Use your knowledge of leaf structure to explain why less water is lost through the upper surface of leaves than is lost through the lower surface.

_____

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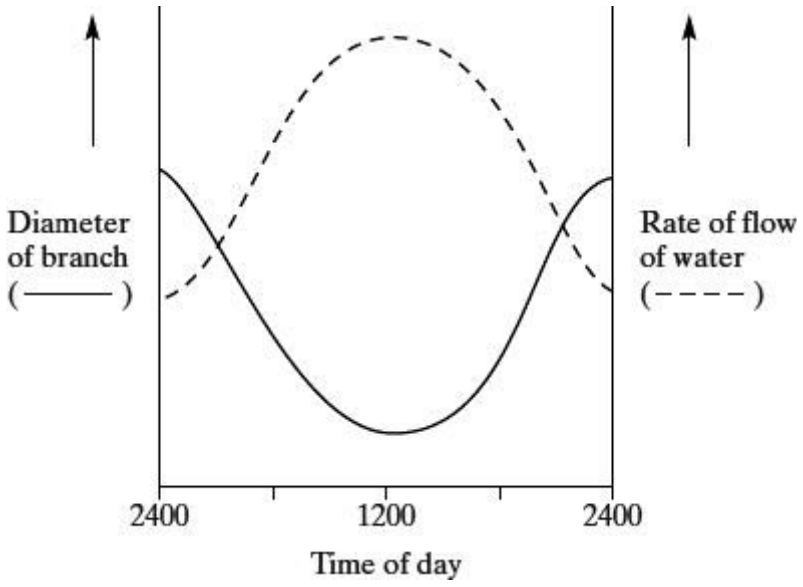
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(2)

(Total 10 marks)

Q31.

(a) The diameter of a branch of a tree and the rate of flow of water through the branch were measured over a 24-hour period. The results are shown in the graph.



Using your knowledge of cohesion-tension theory

(i) describe and explain the changes in rate of flow of water in the branch over the 24 hour period;

_____

_____

_____

_____

_____

_____

(3)

(ii) explain why the diameter of the branch decreased during the first 12 hours.

_____

_____

(1)

(b) A stem was cut from a transpiring plant. The cut end of the stem was put into a solution of picric acid, which kills plant cells. The transpiration stream continued. Suggest an explanation for this observation.

_____

_____

_____

_____

(2)
(Total 6 marks)

Q32.

(a) The table shows the transpiration rate of a group of plants exposed to different humidities at a temperature of 25°C.

Humidity / %	Transpiration rate / arbitrary units
20	26.0
40	21.0
50	16.5
60	11.0
70	9.5

Describe and explain the relationship between humidity and transpiration rate.

_____

_____

_____

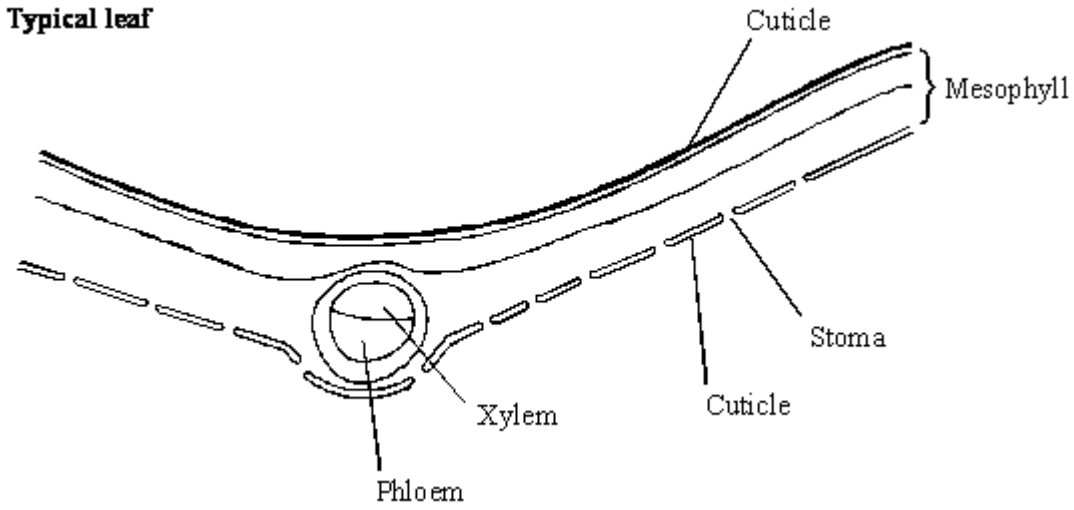
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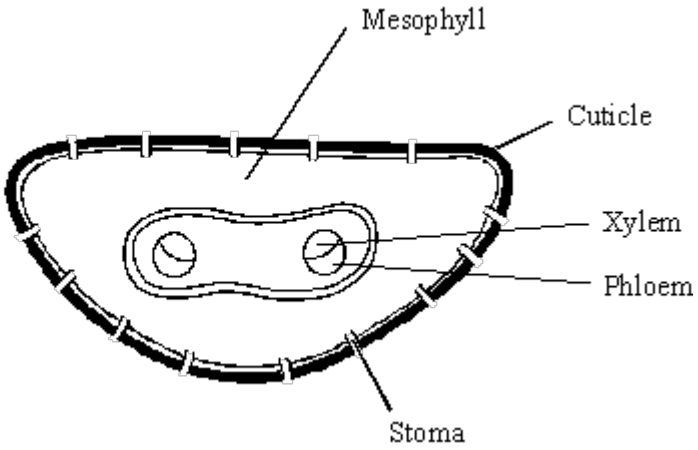
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(3)

(b) The diagrams show a section through a typical leaf and a section through a leaf from a xerophytic plant. The xerophytic leaf has a lower transpiration rate than the typical leaf.



Xerophytic leaf



Describe **two** features shown in the diagram of the xerophytic leaf which reduce transpiration rate. Explain how each of these features contributes to a lower transpiration rate.

Feature 1_____

Explanation _____

_____

Feature 2_____

Explanation _____

_____

(4)

(Total 7 marks)