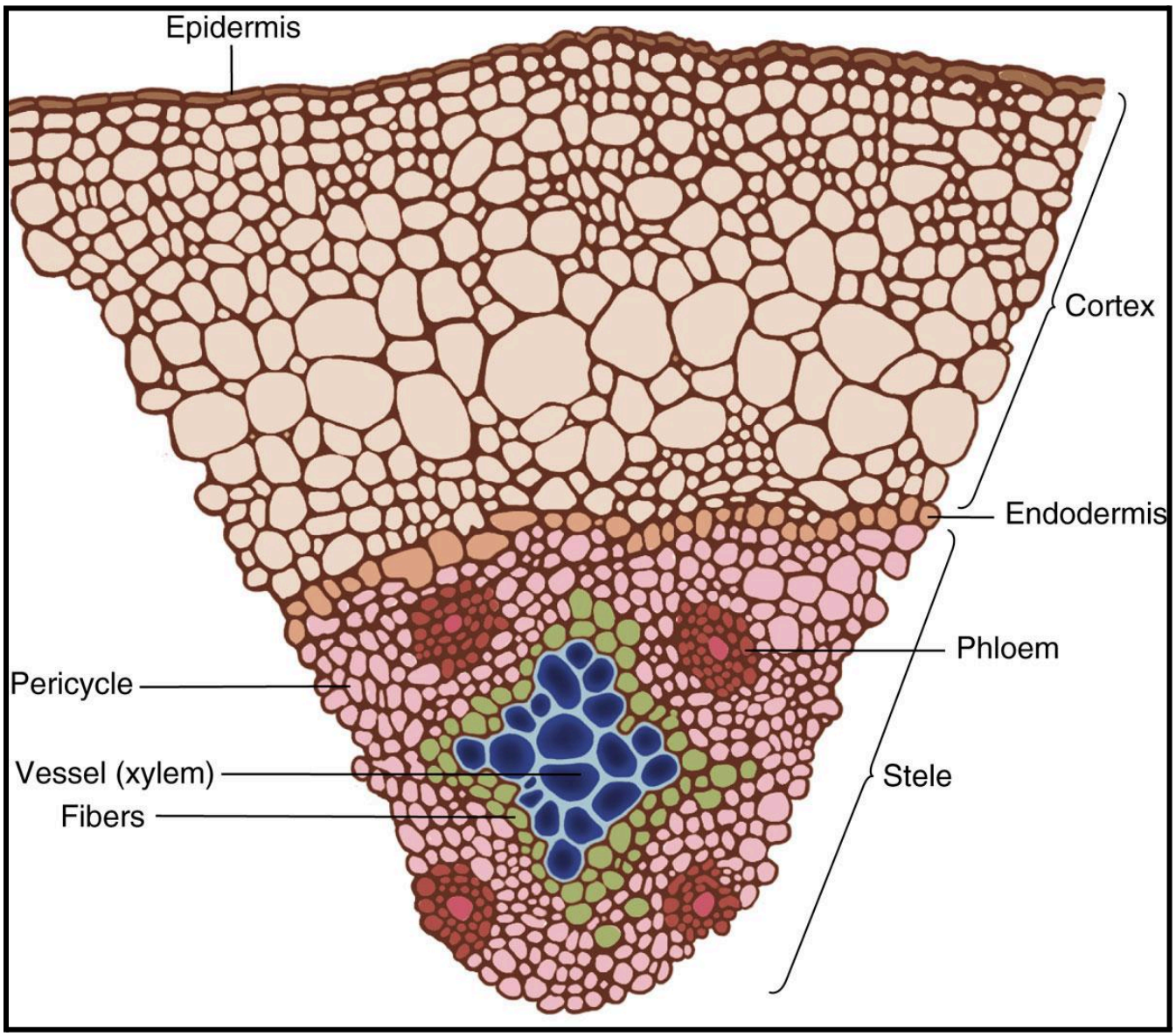
A Level Biology.

Transpiration & Translocation - Examination Practice.

Name:



Q1.(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 _____

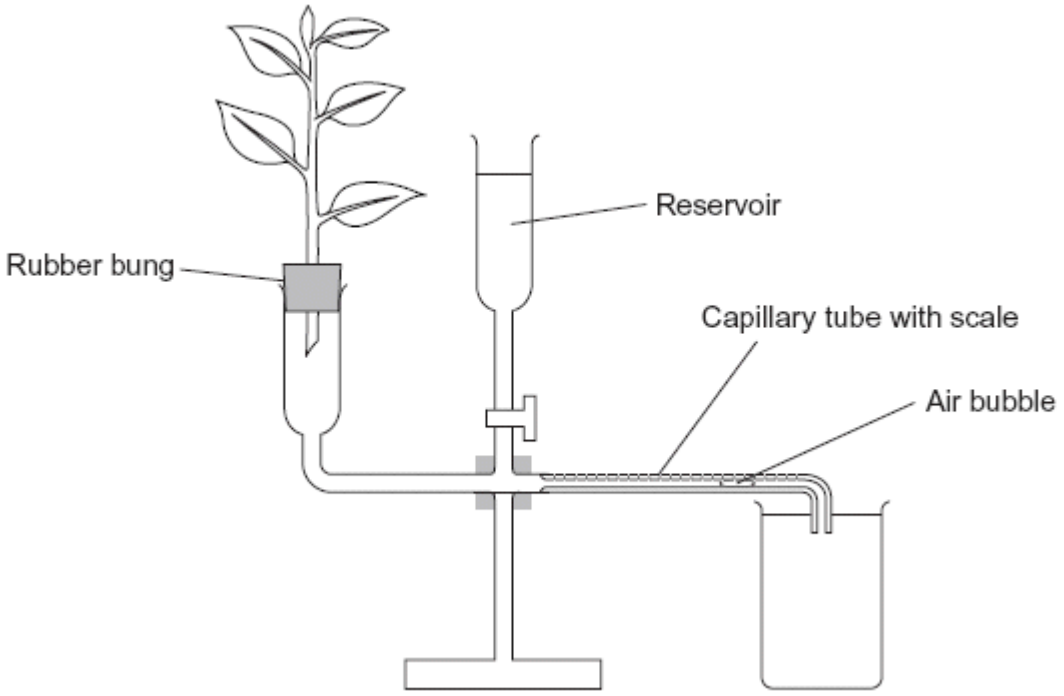
(1)

(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.

(2)

(Total 10 marks)

Q2.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.
2.

(2)

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

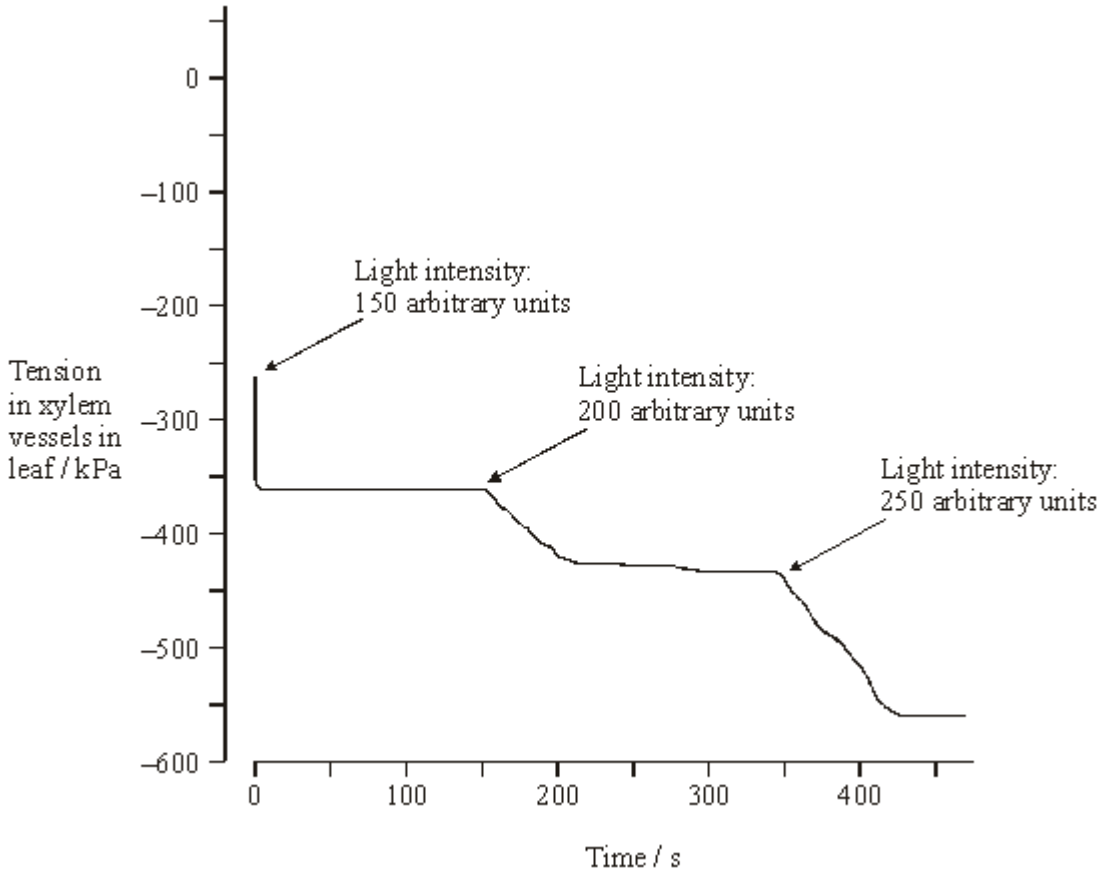
(i) Suggest how the reservoir allows repeat measurements to be made.

(1)

(ii) Suggest why she made repeat measurements.

(1)
(Total 8 marks)

Q3.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.

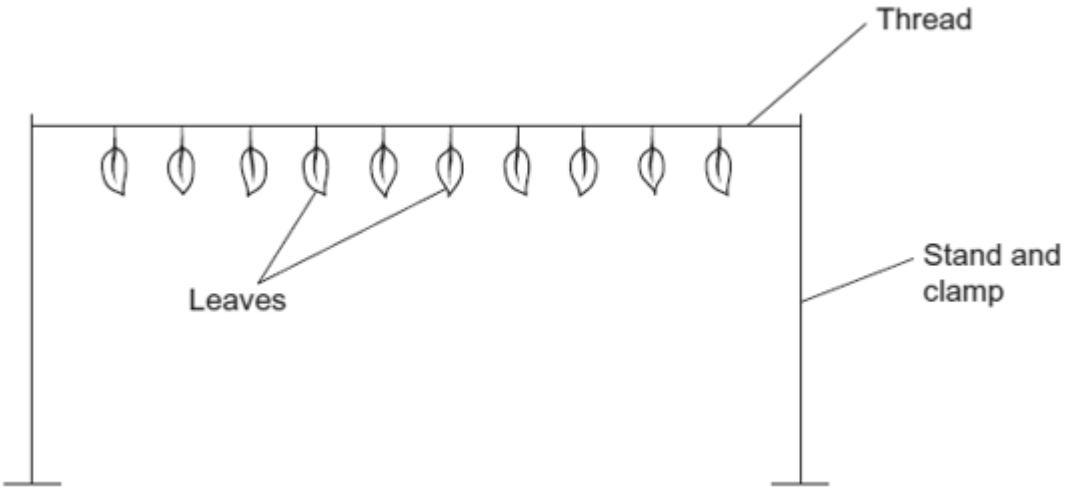
(5)

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

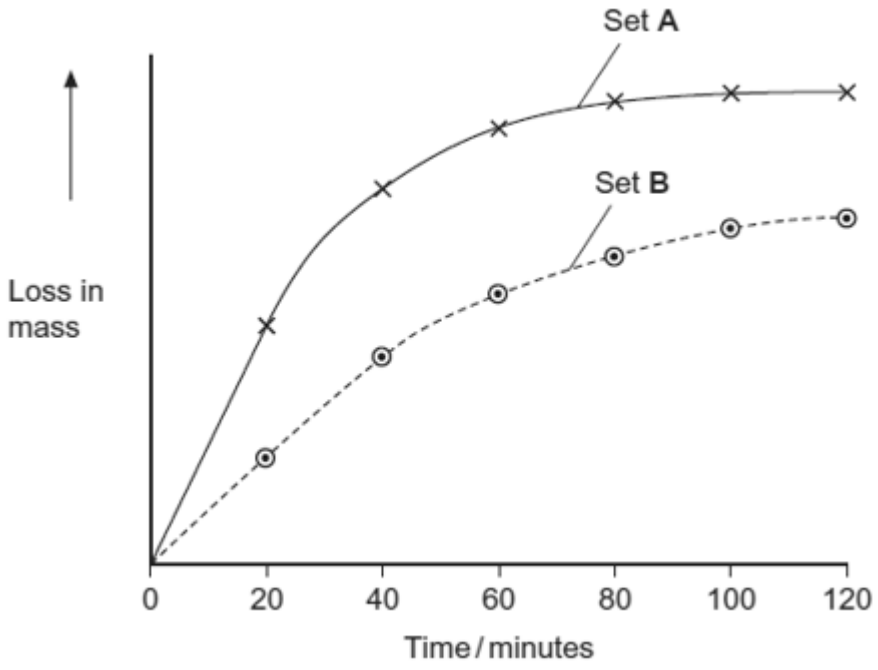
(2)
(Total 7 marks)

Q4.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)

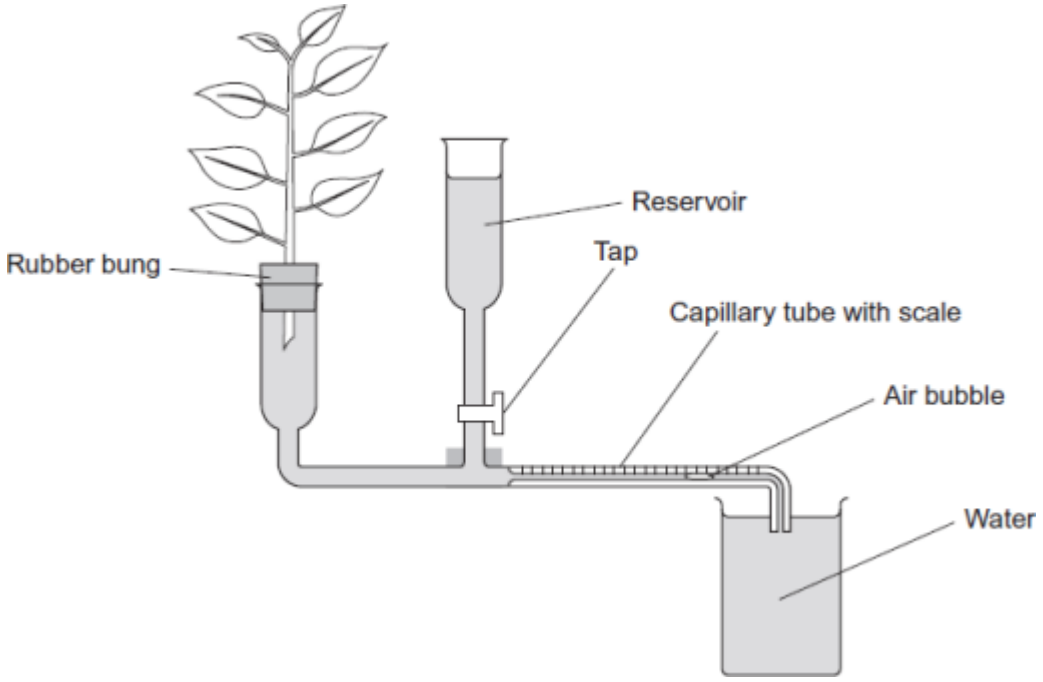
(c) Explain the change in mass of untreated leaves in set A shown in the graph.

(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.

(2)

Q5.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.

(3)
(Total 8 marks)

Q6.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.

(3)

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

(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.

(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.
2.

(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.

(1)

(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.

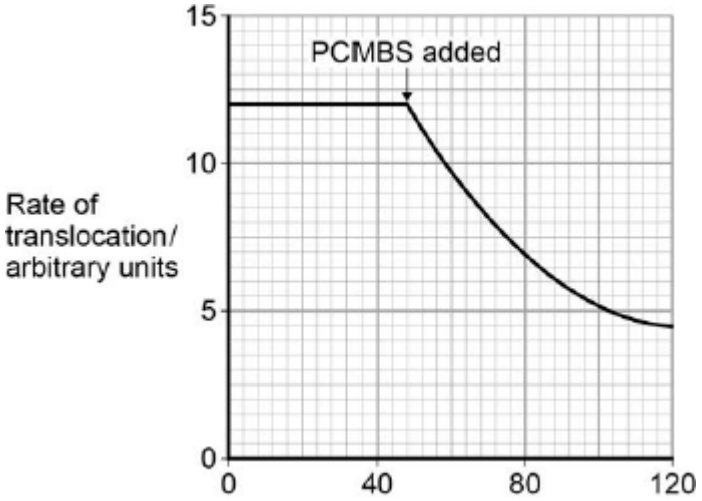
(a) One theory of translocation states that organic substances are pushed from a high pressure in the leaves to a lower pressure in the roots.

Describe how a high pressure is produced in the leaves.

(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.

(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.

(2)
(Total 7 marks)

Q8.(a) Describe the mass flow hypothesis for the mechanism of translocation in plants.

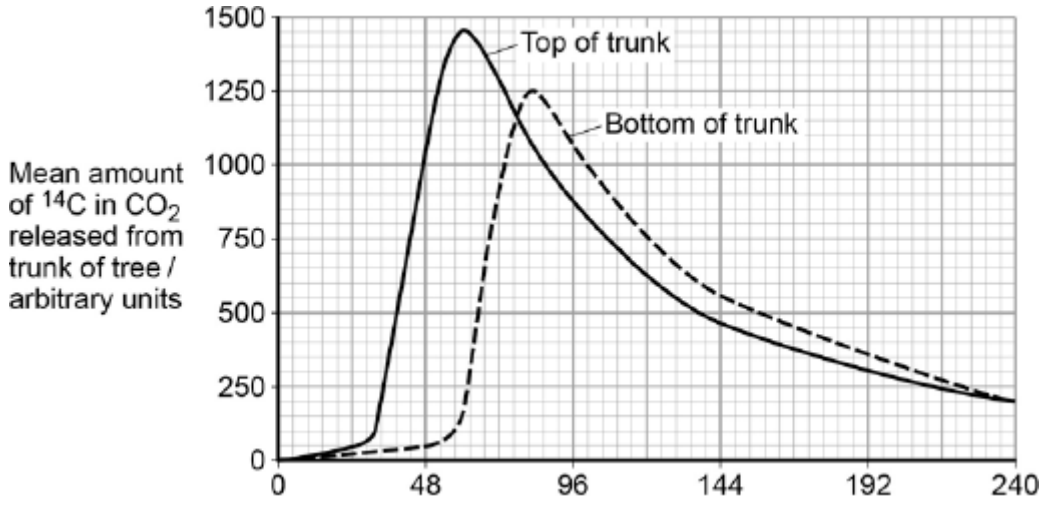
(4)

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.

(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.

(2)

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

(1)

(Total 8 marks)

Q9.(a) (i) Give two ways in which the structure of starch is similar to cellulose.

1.
2.

(2)

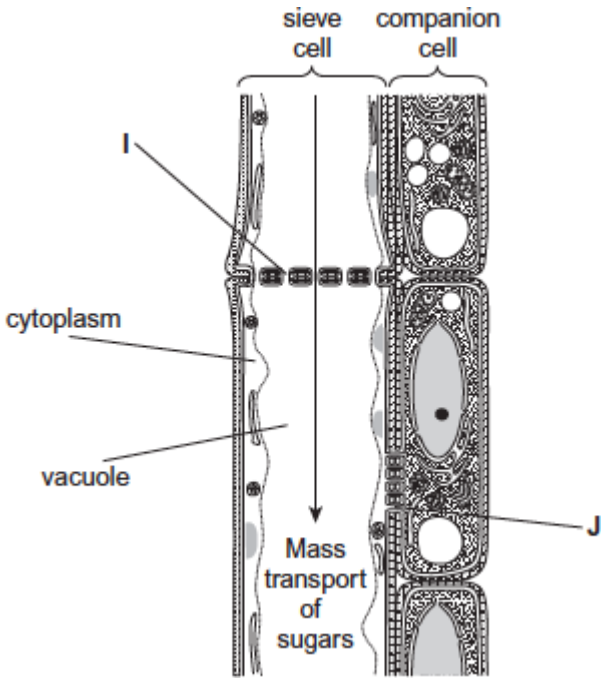
(ii) Give two ways in which the structure of starch is different from cellulose.

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.

(2)

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

(2)

(Total 8 marks)

Markscheme.

M1.(a) **1. water <u>evaporates / transpires</u> from leaves;**
2. reduces water potential in cell / water potential / osmotic gradient across cells *(ignore reference to air space)*;
3. water is drawn out of xylem;
4. creates tension *(accept negative pressure, not reduced pressure)*;
5. cohesive forces between water molecules;
6. water pulled up as a column;

4 max

(b) **(i)** **same surface area of leaf / number of leaves / age / thickness of cuticle;**

1

(ii) **(environmental conditions) affect rate of transpiration / evaporation;**

1

(iii) **presence of grease reduces water loss;**

1

(c) **(i)** **1.2 / 1.3g;**

1

(ii) **more stomata on the lower surface;**
(thicker) waxy cuticle on the upper surface;

2

[10]

M2.(a) **Light (intensity) / temperature / air movement / humidity;**

1

(b) **Prevent air entering / continuous water column;**

Allow answer in context of shoot, xylem or potometer.

1

(c) **Distance and time;**

Reject 'amount bubble moves'

1

Radius / diameter / area (of capillary tube);

1

(d) **(used to provide) turgidity / support / description of;**

(used in) photosynthesis / (produced in) respiration;

Apparatus not sealed / 'leaks';

2 max

(e) **(i)** **Returns bubble (to start);**

1

(ii) **Increases reliability (of results) / anomalous result can be identified;**

Q Ignore references to validity / precision / accuracy etc.

1

[8]

M3.(a) 1. (when light intensity is increased) tension in the xylem becomes greater / more negative / stronger;

2. **(this increase) takes place over ≈100 second;**
3. **then levels out;**
4. **stomata open (more);**
5. **increased evaporation / transpiration;**
6. **therefore the water potential of leaf cells becomes more negative / lower;**
7. **therefore more water moves from xylem to surrounding cells;**
8. **down a water potential gradient;**
9. **correct ref. to hydrogen bonds / cohesion;**

5 max

(b) humidity will affect (the rate of) evaporation / transpiration;
increased humidity / humid conditions decreases rate of water loss;

2

[7]

M4.(a) Light;

Humidity / moisture in air;

Air movement / wind;

Temperature;

2 max

(b) Decreases chance of error / larger difference in mass / improves accuracy / precision;

Neutral: Reliability, references to anomalies.

1

(c) 1. Stomata open, (water) transpired / evaporates / diffuses out (via) water potential gradient / leaf has higher water potential;

2. Water potential / diffusion gradient reduces (during investigation) as water not being replaced / no water supply;

3. Stomata close / closing;

Must clearly indicate that stomata are open for third marking point. However, allow correct descriptions of guard cells being turgid or flaccid as being equivalent to stomata being open or closed. 'Loss through stomata' on its own is not sufficient.

Neutral: Any reference to 'loss by osmosis'.

3

(d) Stomata (on upper surface) covered / stomata close due to lack of light / (grease provides) longer diffusion pathway;

Less evaporation / transpiration / diffusion out;

Accept: Evaporation / transpiration / diffusion 'stops' for second point as this could be referring to upper surface.

2

[8]

M5.(a) Open / use tap / add water from reservoir;

1

(b) 1. Seal joints / ensure airtight / ensure watertight;

Answer must refer to precautions when setting up the apparatus

Ignore: references to keeping other factors constant

2. Cut shoot under water;

3. Cut shoot at a slant;

4. Dry off leaves;

5. Insert into apparatus under water;

6. Ensure no air bubbles are present;

7. Shut tap;

8. Note where bubble is at start / move bubble to the start position;

2 max

(c) 1. Water used for support / turgidity;

Accept: water used in (the cell's) hydrolysis or condensation (reactions) for one mark. Allow a named example of these reactions

2. Water used in photosynthesis;

3. Water produced in respiration;

4. Apparatus not sealed / 'leaks';

2 max

(d) As number of leaves are reduced (no mark),

Accept: converse arguments

1. Less surface area / fewer stomata;

3. Less evaporation / transpiration;

4. Less cohesion / tension / pulling (force);

3

[8]

M6.(a) 1. Contents of phloem vessel pushed into insect's mouth by high pressure;

2. (High pressure in phloem vessel) caused by loading of sugars into phloem in leaf;

3. And (resulting) entry of water by osmosis.

3

(b) 1. Polysaccharides are insoluble;

2. So do not affect water potential of gut.

2

(c) 1. (Only few bacteria passed from parent, so) only a few (copies of) genes passed on (in bacteria);

2. May not / does not include all alleles (of genes, so diversity reduced)
OR
Small number of bacteria transmitted means unrepresentative sample.

2

(d) 1. Number / mass / density of insects per plant;

2. Stage of development / size of plants / insects;
Ignore any abiotic factor

2

(e) Draw around leaf on graph paper and count squares;

1

[10]

M7.(a) 1. Water potential becomes lower / becomes more negative (as sugar enters phloem);
2. Water enters phloem by osmosis;
3. Increased volume (of water) causes increased pressure.

3

(b) 1. Rate of photosynthesis related to rate of sucrose production;
2. Rate of translocation higher when sucrose concentration is higher.

2

(c) 1. Rate of translocation does not fall to zero / translocation still occurs after 120 minutes;
2. But sucrose no longer able to enter cytoplasm of phloem cells.

2

[7]

M8.(a) 1. In source / leaf sugars actively transported into phloem;
2. By companion cells;
3. Lowers water potential of sieve cell / tube and water enters by osmosis;
4. Increase in pressure causes mass movement (towards sink / root);
5. Sugars used / converted in root for respiration for storage.

Accept starch

4 max

(b) Respiration.

1

(c) 1. (About) 30 hours;
2. Time between peak ^{14}C at top of trunk and bottom.

2

(d) Length of trunk (between top and bottom).

1

[8]

M9.(a) (i) ***(Both)***

1. **Are polymers / polysaccharides / are made of monomers / of monosaccharides;**
2. **Contain glucose / carbon, hydrogen and oxygen;**
3. **Contain glycosidic bonds;**
4. **Have 1−4 links;**

   Neutral: references to 'unbranched', insoluble, formed by condensation, flexible and rigid

   Are made of the monomer glucose = MP 1 and 2 = 2 marks
5. **Hydrogen bonding (within structure).**

   Ignore reference to H bonds between cellulose molecules

2 max

(ii) (Starch)

1. **Contains α / alpha glucose;**

   Assume 'it' refers to starch

   Accept: converse arguments only if linked directly to cellulose

   Accept: forms α glycosidic bonds
2. **Helical / coiled / compact / branched / not straight;**
3. **1,6 bonds / 1,6 branching;**
4. **Glucoses / monomers same way up;**
5. **No H-bonds between molecules;**
6. **No (micro / macro) fibres / fibrils.**

2 max

(b) (i) 1. No / few organelles / very little cytoplasm / cytoplasm at edge / more room / hollow / large vacuole / large space / thick walls;

Accept strong walls for thick walls

2. **(So) easier / more flow / (thick / strong walls) resist pressure.**

   Easier flow may be expressed in other ways e.g. lower resistance to flow

2

(ii) 1. Mitochondria release energy / ATP / site of respiration;

Q Reject: 'produce energy'

but accept produce energy in form of ATP

2. **For active transport / uptake against concentration gradient.**

   Note: no mark is awarded for simply naming an organelle

***OR*:**

3. **Ribosomes / rough endoplasmic reticulum produce(s) proteins;**

   Concept of making proteins needed

4. **(Proteins) linked to transport e.g. carrier proteins / enzymes.**

2

[8]