Q1.

(a) A scientist measured the pressure in a phloem tube in a willow plant stem. He repeated his measurements to obtain nine readings.

His results are shown in the table below.

Phloem pressure / arbitrary units								
7.4	8.0	7.0	8.6	8.2	9.3	7.4	9.1	8.8

The percentage error of the mean phloem pressure in this phloem tube is calculated using this equation.

$$\text{Percentage error} = \frac{\text{uncertainty in measurement}}{\text{mean}} \times 100$$

The uncertainty in measurement is half the range of the measured values.

Calculate the percentage error of the mean phloem pressure in this phloem tube.

Show your working.

Percentage error _____ %

(2)

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

Use your understanding of the mass flow hypothesis to explain how pressure is generated inside this phloem tube.

_____

_____

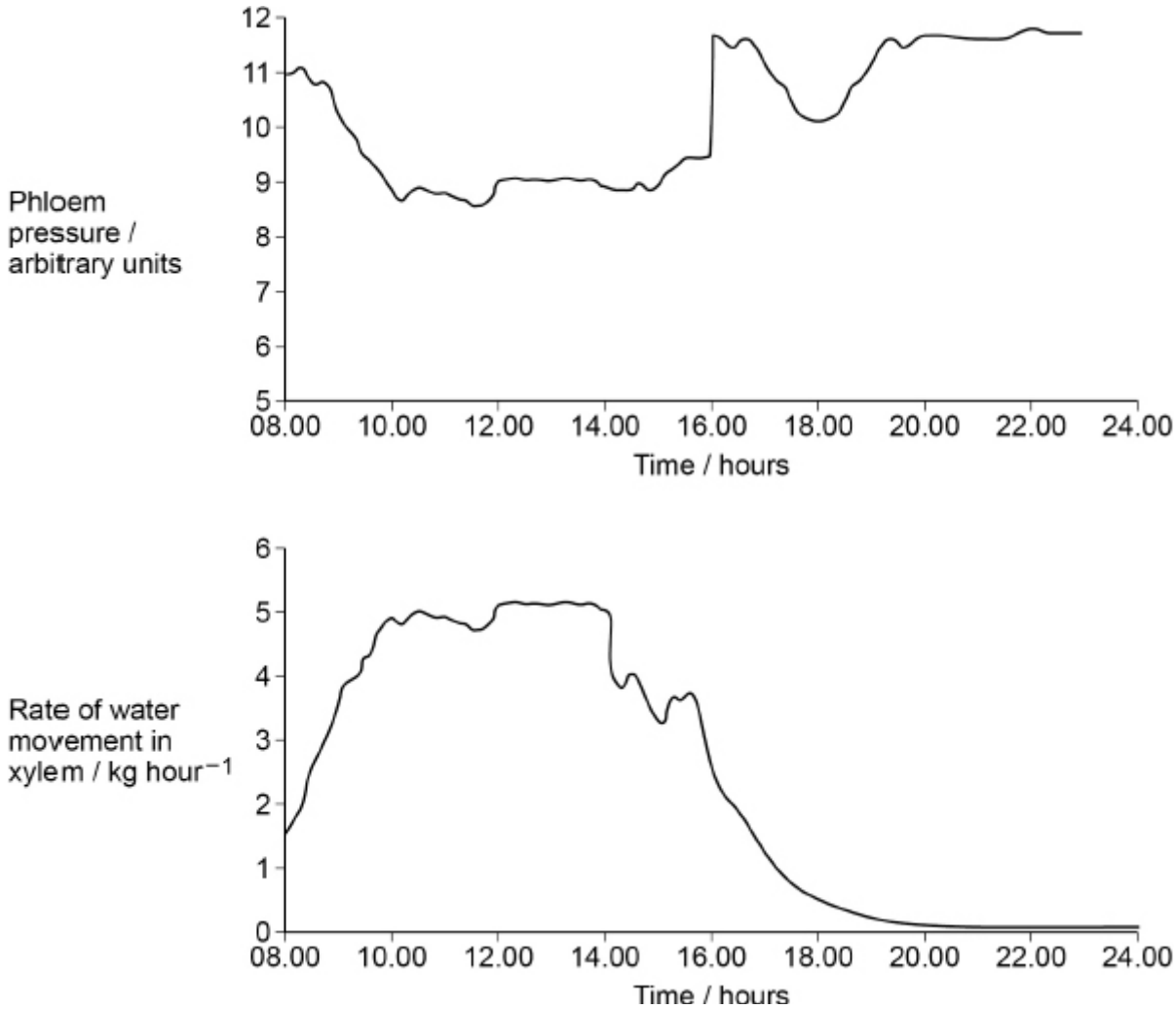
_____

_____

(3)

(c) The scientist also measured changes in the phloem pressure and changes in the rate of water movement in the xylem of a willow plant at intervals during a day.

His results are shown in the graph below.



Describe the relationship between phloem pressure and the rate of water movement in xylem in this plant.

(1)

(d) Phloem pressure is reduced during the hottest part of the day. Use information in the graph above along with your understanding of transpiration and mass flow to explain why.

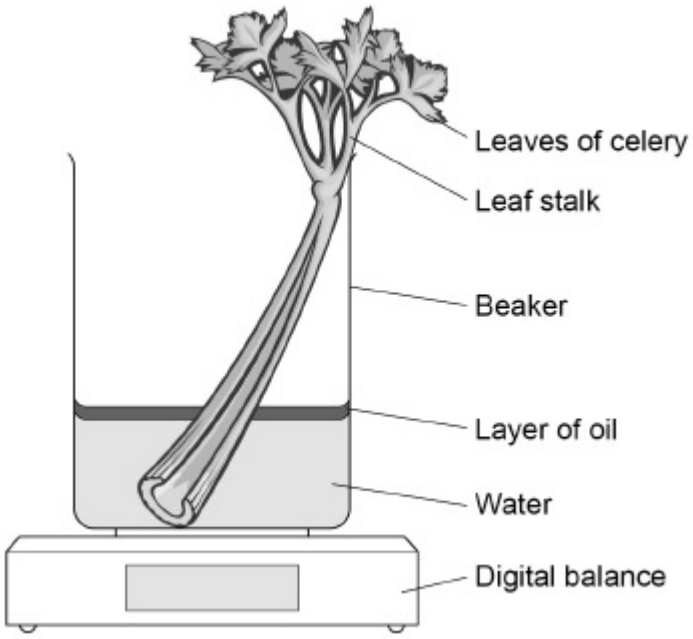
(3)

(Total 9 marks)

Q2.

A student used the apparatus shown in **Figure 1** and a digital balance to determine the rate of water movement in a celery stalk in grams per hour per group of xylem vessels.

Figure 1



(a) The student measured the time taken for water movement.

Give **two** other measurements he made to calculate the rate of water movement.

1 _____

_____

_____

2 _____

_____

_____

(2)

(b) Give the reason for adding a layer of oil to the water in the beaker.

_____

_____

_____

(1)

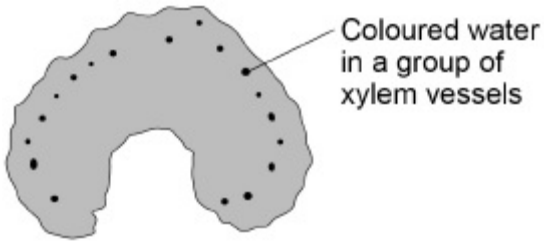
(c) A different student used coloured water to investigate the movement of water in leaf stalks of celery.

During the procedure she:

- cut equal lengths of stalk from each plant
- put the cut end of each stalk into coloured water
- left these stalks to take up the coloured water for 20 minutes
- used a sharp scalpel to cut slices from the stalks at 1 mm intervals until she reached a slice with no coloured water.

Figure 2 shows a slice of leaf stalk with coloured water inside groups of xylem vessels.

Figure 2



Explain why coloured water moved up the stalks.

(3)

(d) The student used a sharp scalpel to cut the celery. Describe how she should ensure she handled the scalpel safely during this procedure.

_____

_____

_____

_____

_____

(2)

The student measured the distance the coloured water had travelled in eight celery stalks.
Her results are shown in the table.

Distance / mm							
70	35	40	35	30	80	42	44

(e) The student had to choose whether to summarise her measurements by calculating the mean, the median or the mode.

Circle the most appropriate measure for this set of measurements.
Give a reason for your choice and find the value using the measurements from all eight stalks.

Mean* Median* Mode*

*circle one word.

Reason: _____

_____

_____

Calculation:

Answer = _____

(2)

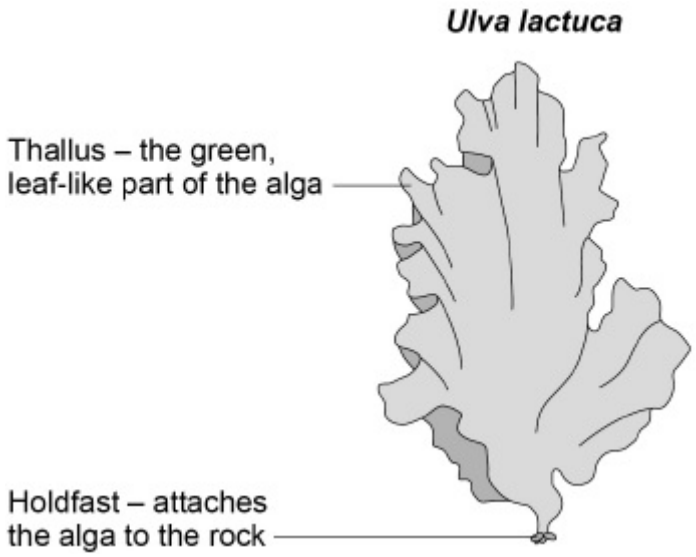
(Total 10 marks)

Q3.

Ulva lactuca is an alga that lives on rocks on the seashore. It is regularly covered by seawater.

Figure 1 shows a diagram of one *Ulva lactuca* alga.

Figure 1



(a) Unlike plants, *Ulva lactuca* does not have xylem tissue.

Suggest how *Ulva lactuca* is able to survive without xylem tissue.

_____

_____

_____

_____

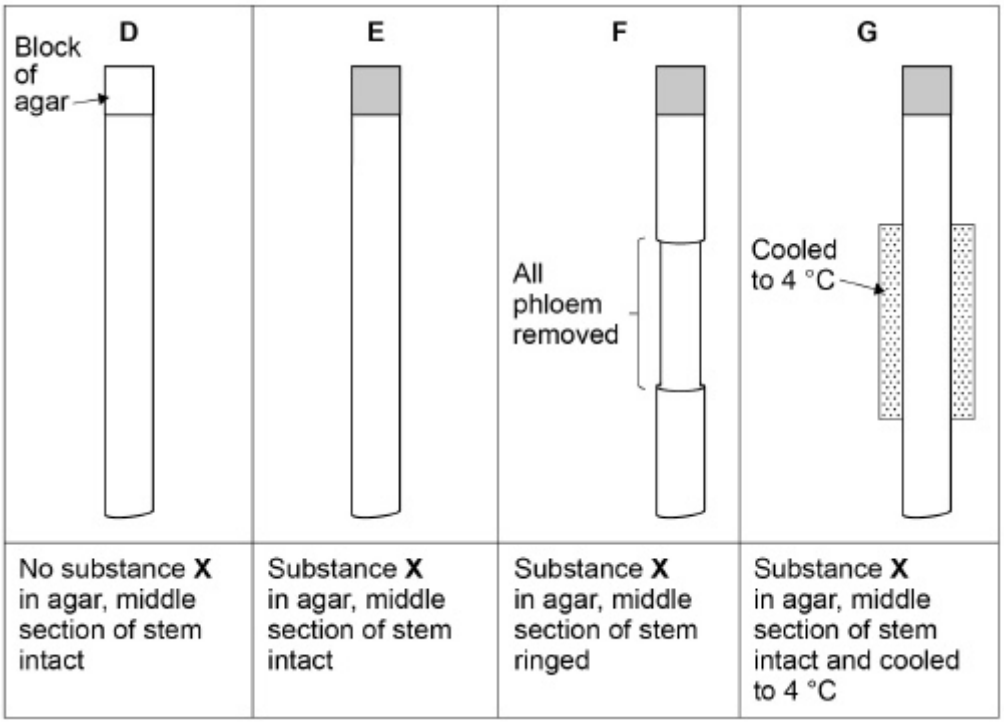
(1)

Q4.

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.

(4)

(Total 9 marks)

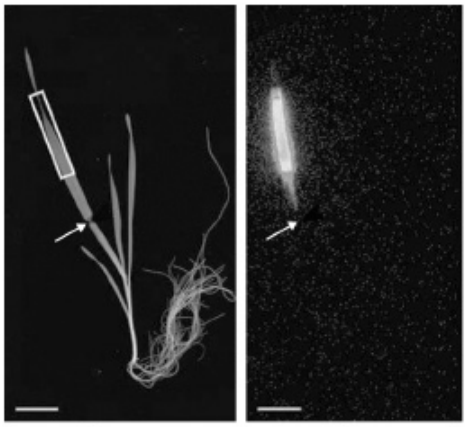
Q5.

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.

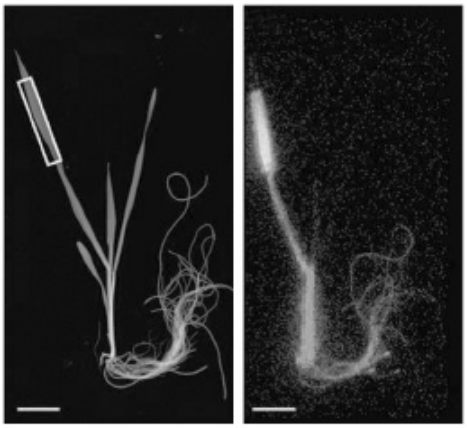
Figure 1

A – Heat-treated Plant



0 hours 4 hours

B – Control Plant, not heat treated



0 hours 4 hours

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.

(2)

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

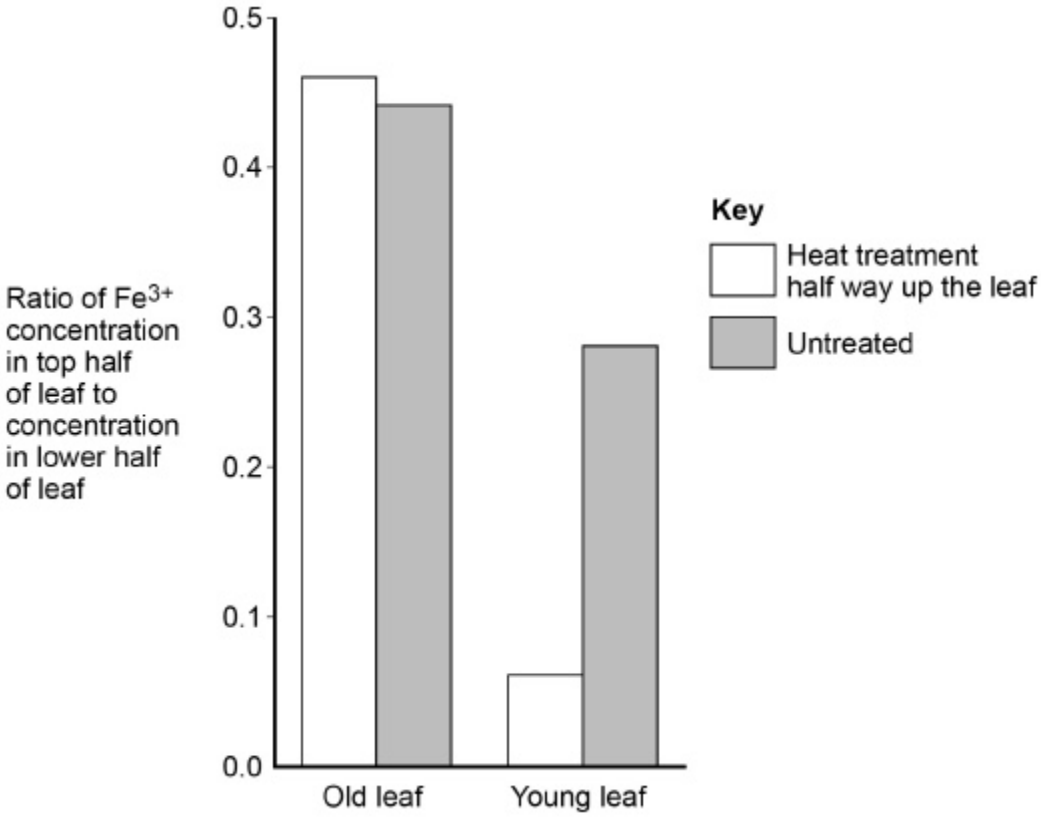
Explain how the results in the table support this conclusion.

(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)

Q6.

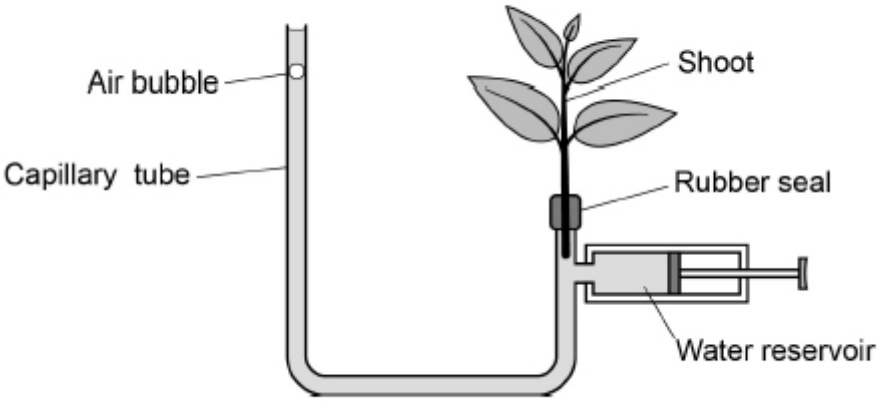
(a) Describe the cohesion-tension theory of water transport in the xylem.

(5)

Q7.

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.

_____

_____

_____

(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.

(1)

Q8.

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

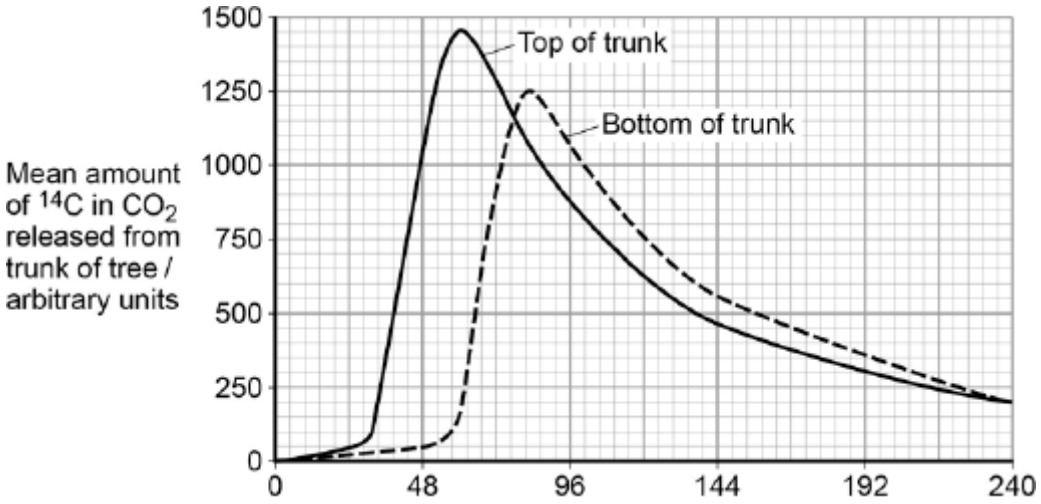
(4)

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)