Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Transport in plants

Time allowed: 1 hour 30 minutes

Subject code **0610**

Biology

Questions from Paper 3, Paper 4 and Paper 6

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 89

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 89 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 **(a)** **(i)** Fig. 6.1 shows the outline of the young stem of a eudicotyledonous (dicotyledonous) plant.

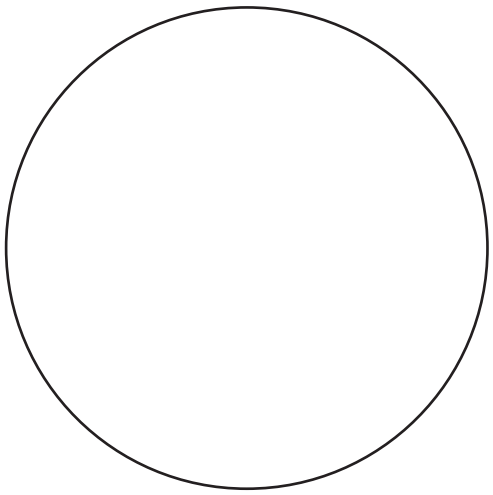


Fig. 6.1

On Fig. 6.1, draw and label the position of the phloem and xylem in the stem. [2]

(ii) Name a substance that is transported in the phloem.

.....

..... [1]

(b) Describe the pathway taken by water from the soil to a leaf.

.....

.....

.....

.....

.....

..... [3]

[Total: 6]

Xylem, phloem and water uptake Click for more variations

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1 **(a) (i)**	ring of xylem / phloem (bundles); inner most part labelled as xylem / outermost part labelled phloem;	 [2]	A – if only half bundles (xylem) are drawn in a ring
(ii)	sucrose / amino acids;	[1]	
(b)	water enters root hair (cell); by osmosis / diffusion; moves across root cortex (by osmosis); enters xylem; moves to leaf mesophyll (cells); by transpirational pull / force;	 max [3]	 Any three – 1 mark each
		[Total: 6]	

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2 **(a)** Fig. 9.1 shows a green plant.

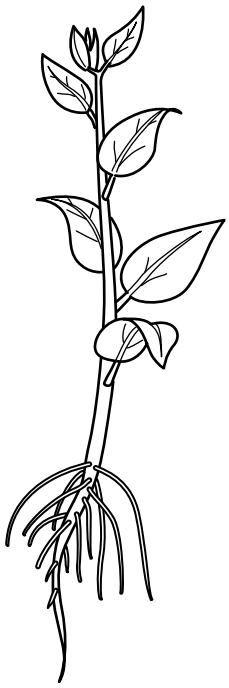


Fig. 9.1

Plants need to move substances around between their leaves, stems and roots. One of the processes they use is translocation.

Describe the process of translocation.

.....

.....

.....

.....

.....

.....

..... [3]

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(b) Fig. 9.2 shows the whole plant and sections through its root, stem and a leaf.

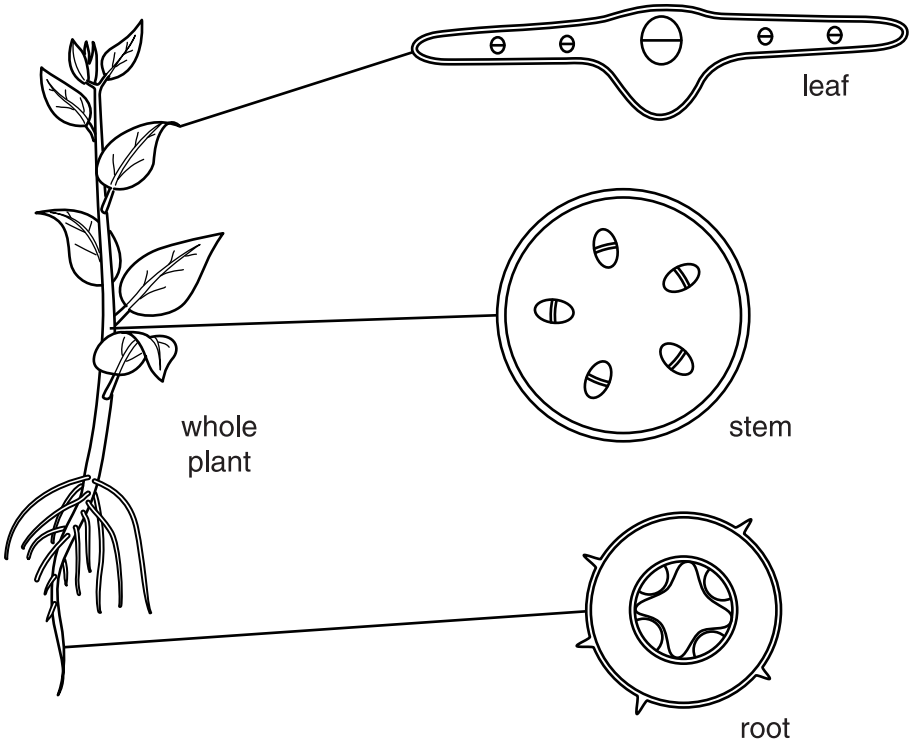


Fig. 9.2

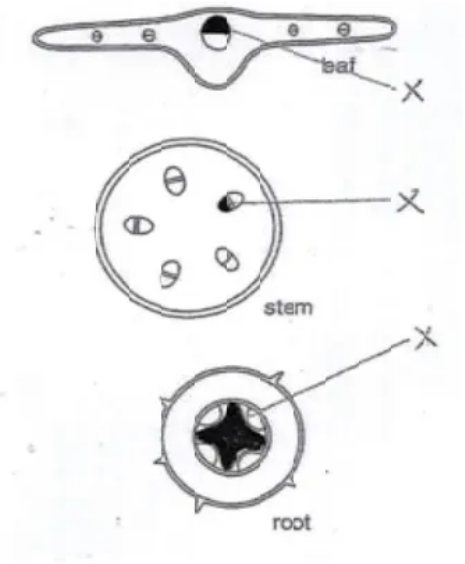
On Fig. 9.2 use label lines and the letter **X** to identify one region of xylem in **each** section (root, stem and leaf). [3]

[Total: 6]

Translocation Click for more variations

Reduced to 72% to fit the page (wider than A4).

2	**(a)**	movement of sugars / named sugar / amino acids ; in phloem ; from region of production / leaves / source ; to region of utilisation / storage / growth ; energy required / AW ;	max [3]	**A** water and sugars / water and amino acids **R** starch

(b) **2**	*correctly labelled:* *xylem in leaf* ; *xylem in stem* ; *xylem in root* ;  	[3] **[Total: 6]**	

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3 A student carried out an investigation into transpiration from leaves.

She chose leaves of a similar size from the same plant.

She weighed them and then placed them in different conditions.

As the leaves transpired they lost mass.

Table 3.1 shows the results.

Table 3.1

leaf	conditions	mass at start / g	mass at end / g	change in mass / g	% change in mass
H	hot and dry	6.3	2.1	4.2	66.7
J	cool and dry	6.4	4.6	1.8	
K	hot and humid	6.2	3.7		40.3
L	cool and humid	5.1	4.7	0.4	7.8

(a) Complete the table by calculating:

(i) the change in mass for leaf **K** ..... [1]

(ii) the percentage change in mass for leaf **J**.

Show your working. Write your answer to one decimal place.

..... [2]

(b) State which conditions caused the most transpiration in the leaves.

..... [1]

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(c) Fig. 3.1 shows four types of plant tissue involved in the transport of water through a plant.

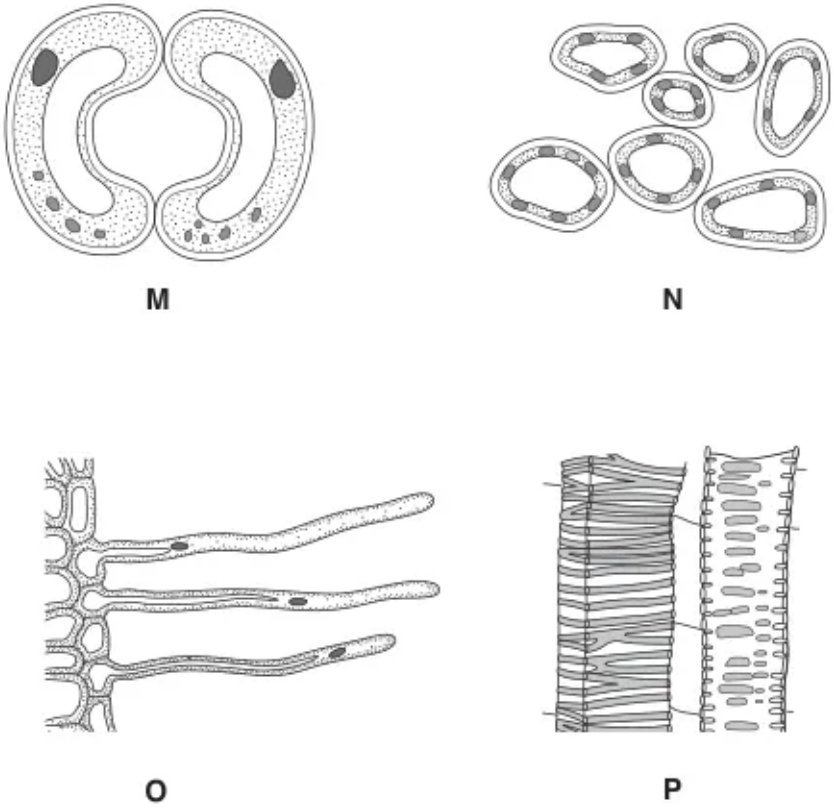


Fig. 3.1

(i) Describe how tissue **O** is adapted for its function.

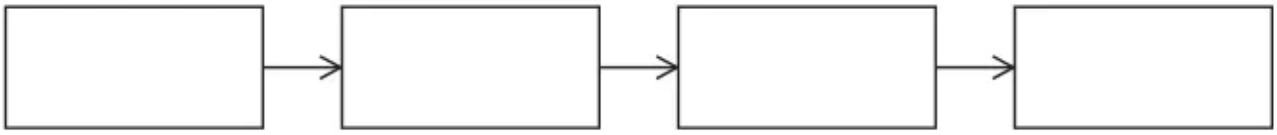
.....

.....

..... [1]

(ii) Complete the flow chart by placing the letters of the cells **M**, **N**, **O** and **P** in the correct order, starting with the absorption of water.

absorption of water → **transpiration from the leaf**



[3]

(d) State the name of:

(i) the type of tissue in which water is carried up the stem

..... [1]

(ii) another substance which is carried in the same tissue.

..... [1]

[Total: 10]

Measurements, tables, graphs and conclusions Click for more variations

3(a)(i)	2.5 g;	**1**	
3(a)(ii)	28.1%;;	**2**	$\frac{1.8 \times 100}{6.4}$ or 0.281×100
3(b)	hot and dry;	**1**	
3(c)(i)	large surface area / elongated cells;	**1**	
3(c)(ii)	**O** at start; **P** before **N**; **M** at the end;	**3**	
3(d)(i)	xylem;	**1**	
3(d)(ii)	mineral ions;	**1**	
		Total: 10	

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4 Fig. 1.1 is a photograph of a plant.



Fig. 1.1

(a) (i) Draw **two** arrows on Fig. 1.1 to show the direction of movement of water into and out of the plant. [2]

(ii) State the name of the type of tissue that transports water in a plant.

..... [1]

(b) (i) Complete the definition of the term transpiration.

Transpiration is the loss of water vapour from plant leaves by

..... of water at the surfaces of .....

cells, followed by diffusion of water vapour through the ..... .

[3]

(ii) Fig. 1.2 is a graph showing the effect of temperature on the rate of transpiration from the upper and lower surfaces of leaves.

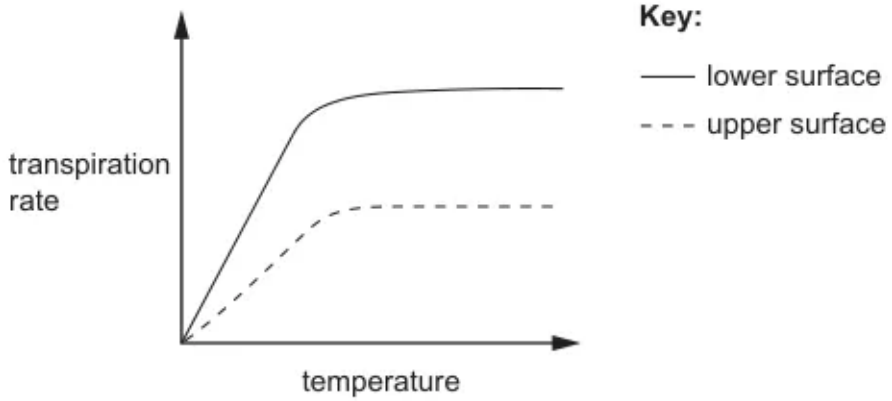


Fig. 1.2

State **two** conclusions for the data shown in Fig. 1.2.

1 .....

.....

.....

2 .....

.....

.....

[2]

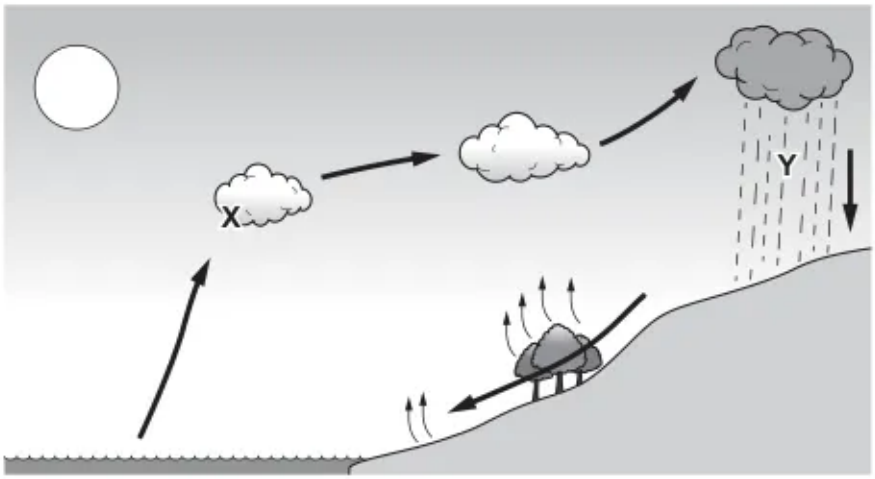
(c) State the effect of increasing humidity on the rate of transpiration.

.....

.....

..... [1]

(d) Fig. 1.3 is a diagram of the water cycle.



not to scale

Fig. 1.3

Identify processes **X** and **Y** in Fig. 1.3.

X .....

Y .....

[2]

[Total: 11]

Transpiration Click for more variations

4(a)(i)	arrow drawn going **into** the root **;** arrow drawn coming **out** from (either surface) of the **l**eaf **;**	**2**	**R** if no arrowheads shown
4(a)(ii)	xy**l**em **;**	**1**	
4(b)(i)	evaporation **;** (spongy) mesophy**ll** **;** stoma(ta) **;**	**3**	
4(b)(ii)	*any two from:* *idea of* rate of transpiration increasing in both, (then **l**eve**l**s out with increasing temperature) **;** (rate of) transpiration is greater in the **l**ower surface (than in the upper surface) AW **;** AVP **;**	**2**	e.g., there are more stomata on the **l**ower surface
4(c)	(as the humidity increases, the rate of transpiration) decreases **;**	**1**	
4(d)	**X -** condensation **;** **Y -** precipitation **;**	**2**	

5 **(a)** Define the term *transpiration*.

.....

.....

.....

.....

.....

.....

.....[3]

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(b) Fig. 2.1 shows four leaves from the same tree.

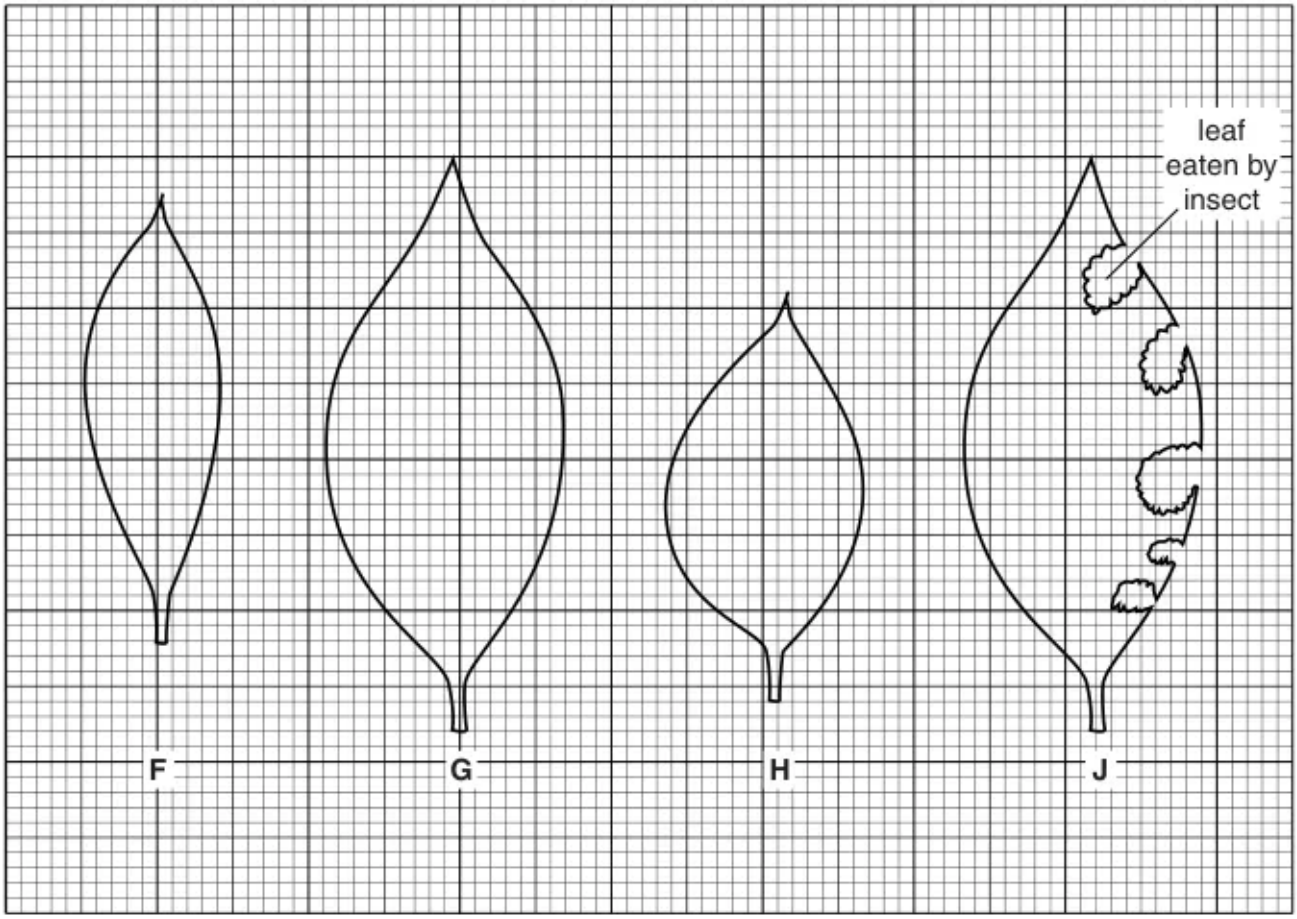


Fig. 2.1

Suggest which leaf will transpire most rapidly and give a reason for your answer.

leaf .....

reason .....

.....

.....

.....

.....

[3]

STEM | EX

(c) Fig. 2.2 shows a healthy plant during an investigation into transpiration.

It was kept in the same environment, apart from the light changing, during 24 hours.

The mass of the plant and pot was measured at the start, after 12 hours in the light and after a further 12 hours in the dark.

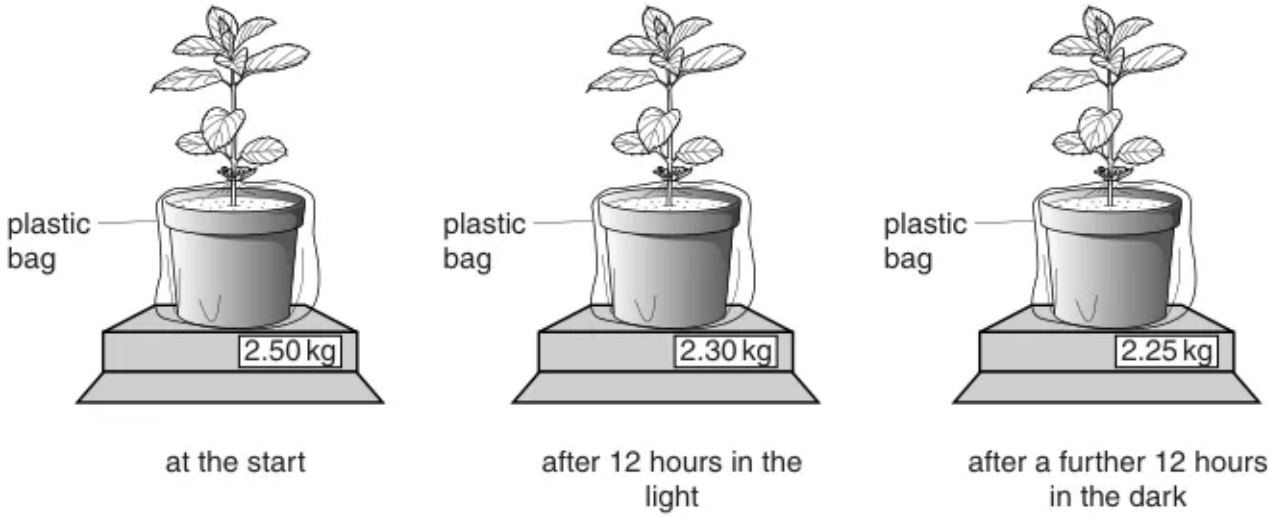


Fig. 2.2

(i) Describe the results of the investigation shown in Fig. 2.2.

.....

.....

.....

.....

.....[2]

(ii) Suggest **and** explain why the plant pot was enclosed in a plastic bag for this investigation.

.....

.....

.....

.....

.....[2]

STEM

(iii) State **two** environmental factors, other than light, that would change the rate of transpiration in the plant shown in Fig. 2.2.

1 .....

.....

2 .....

.....

[2]

[Total: 12]

Transpiration Click for more variations

Reduced to 78% to fit the page (wider than A4).

5 **(a)**	evaporation of water ; from (surface of) mesophyll cells ; (followed by) loss of water vapour ; diffusion of water ; through stomata ; of (plant) leaves ;	max [3]	
(b)	**G** ; *any two from:* has largest surface area; (so it has the) greatest number of stomata; more water vapour will escape;	max [3]	**A J** with *two* of the following reasons mesophyll cells directly exposed to air ; water vapour escapes without passing through stomata ; so more water vapour will escape ;
(c) (i)	plant lost mass ; (plant lost more mass) during 12 hours in light than during 12 hours in dark / in dark and light for same amount of time ; data (to support) ;	max [2]	
(ii)	(bag) impermeable to water ; prevents loss of water from soil ; water only lost from leaves ; so mass lost is only due to transpiration ;	max [2]	
(iii)	temperature ; humidity ; wind speed ;	[2]	
		[Total 12]	

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6 A student cut a section of a root and made an outline drawing of the distribution of tissues as shown in Fig. 3.1.

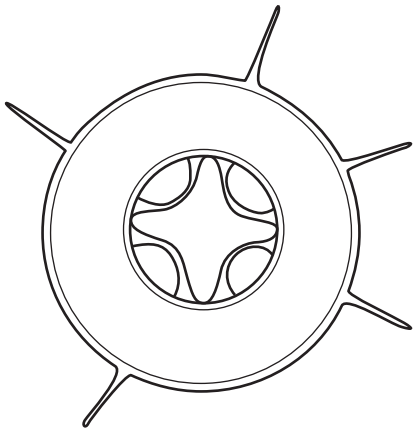


Fig. 3.1

(a) **(i)** Identify the position of the xylem tissue by drawing a label line and the letter **X** on Fig. 3.1. [1]

(ii) State why xylem is a tissue.

.....

.....

.....

.....[2]

(b) Water absorbed by the roots moves through the stem and enters the leaves. Most of this water is lost in transpiration.

Explain how the internal structure of leaves results in the loss of large quantities of water in transpiration.

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 6]

Transpiration Click for more variations

STEM | Exam Builder

6(a)(i)	label line and **X** pointing to any part of the 'star' in the centre of the root section ;	**1**	
6(a)(ii)	composed of (group of) cells with similar structures ; working together to perform shared functions ;	**2**	
6(b)	xylem supplies water ; air spaces ; large (internal) surface area ; water evaporates from surface of mesophyll cells ; guard cells, open / close, stomata ; water vapour, diffuses / moves, out through stomata ;	**3**	

7 In plants, water moves up the stem in xylem vessels as a column of water molecules as a result of transpiration.

A celery stalk that still has its leaves attached can be used to investigate the movement of water in a plant, as shown in Fig. 2.1.

Fig. 2.2 shows dye in the xylem vessels of a celery stalk.



Fig. 2.1



not to scale

Fig. 2.2

Plan an investigation to determine the effect of temperature on the rate of movement of a coloured dye through celery stalks.

.....

.....

.....

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.....

.....

.....

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.....

.....

.....

.....

..... [6]

Planning investigations: variables, controls and safety Click for more variations

Reduced to 77% to fit the page (wider than A4).

7	*independent variable:* **1** at least two different temperatures **;** *dependent variable:* **2** time for dye to reach the leaves or a set distance **or** distance moved by dye in a set time **or** number of cut sections containing dye **;** **3 and 4** *detail of method – max two from* **;;** • method of maintaining (at least one) air temperature • *idea of* slicing the end off the celery before immersion • cutting sections (with a, knife / scalpel) **5, 6 and 7** *variables kept constant - max three from* **;;;** • wind-speed • humidity • light intensity • length / height / size, of, celery / stalk • number of leaves / surface area of leaves • species / type / age, of, celery • (named) colour / concentration / volume, of dye • time (in dye) / time stated • thickness of cut sections / sections cut in the same plane / AW **8** two or more replicates at each temperature / repeat the investigation at least two more times **;** **9** suitable safety precaution **;**	**6**	e.g. cutting sections on a flat or stable surface / cut away from body / gloves / goggles

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8 Fig. 5.1 is a graph showing the effect of temperature on the rate of transpiration from the upper and lower surfaces of a leaf that is provided with a constant supply of water.

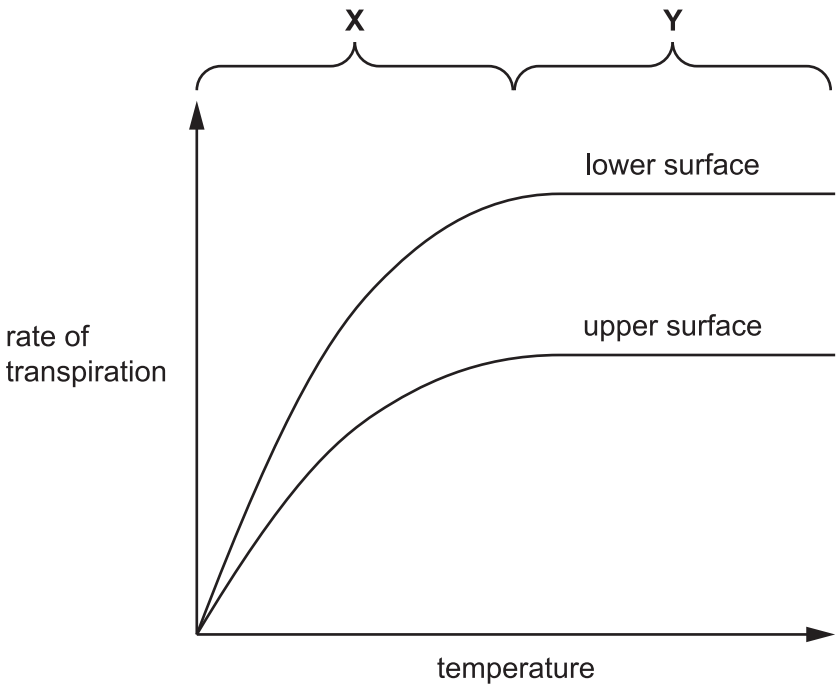


Fig. 5.1

(a) Describe the results shown in Fig. 5.1.

.....

.....

.....

.....

.....

.....

..... [3]

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(b) Explain reasons for the shape of the graph for the **upper** surface of the leaf at **X** and at **Y** in Fig. 5.1.

at **X** .....

.....

.....

.....

.....

at **Y** .....

.....

.....

.....

.....

[4]

(c) Suggest how the structure of the lower surface differs from the upper surface of the leaf used in this investigation.

.....

.....

..... [1]

[Total: 8]

Transpiration Click for more variations

STEM | Exam Builder

8(a)	*any three from:* rate of transpiration increases and then remains constant with increasing temperature **;** ora (the rate of transpiration) is higher from the lower surface **;** rates of both become constant at (nearly) the same temperature **;** transpiration from lower surface increases, at a greater rate / faster, than from the upper surface (in X) **;**	**3**	
8(b)	*total of four from:* ***X*** *to max 3:* *as temperature increases and rate increases* 1 the rate of <u>evaporation</u> from the mesophyll (cells) increases **;** 2 the rate of <u>diffusion</u> of water vapour (through the stomata / from the leaf) increases **;** 3 particles / molecules, have more kinetic energy / move faster **;** 4 temperature is the limiting factor (for transpiration) **;** 5 more stomata opening / stomata open wider **;** ***Y*** *to max 3:* *as temperature increases and rate remains constant* 6 rate of diffusion of water vapour through stomata at a maximum **;** 7 evaporation from mesophyll (cells) at a maximum **;** 8 rate of movement of water in xylem slows **;** 9 rate of uptake of water is at a maximum **;** 10 the stomata are, all / fully, open **;** 11 humidity / light intensity / number of stomata, is the limiting factor **;**	**4**	
8(c)	more stomata on the lower surface **/** lower surface has a thinner cuticle **;** ora	**1**	

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9 **(a)** Fig. 3.1 is a photomicrograph of some xylem vessels.

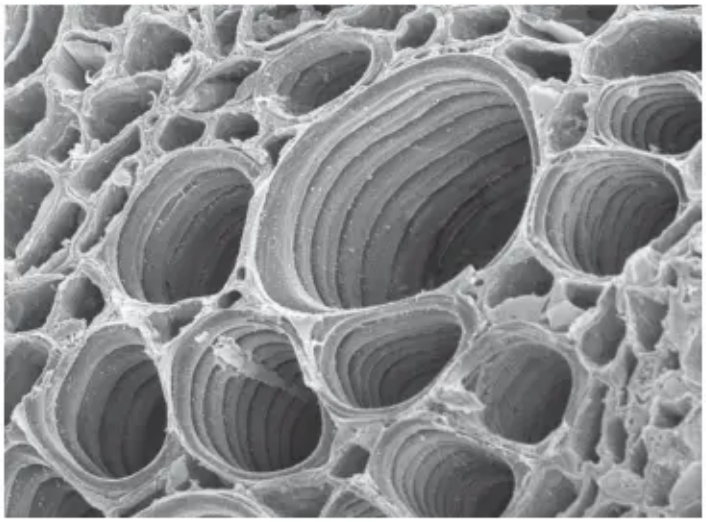


Fig. 3.1

(i) State **one** structural feature of xylem vessels and explain how this is related to the function of water transport.

feature .....

.....

explanation .....

.....

.....

.....

[2]

(ii) Explain the mechanism that is responsible for the movement of water in xylem vessels.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(iii) State **one** role of xylem vessels **other than** transport.

..... [1]

(b) The rate of transpiration is affected by several factors including the temperature and the humidity of the air.

State **and** explain the effect of an increase in temperature on the rate of transpiration.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

Transpiration Click for more variations

STEM | Exam Builder

9(a)(i)	thick / strong, (cell) wall ; withstanding, tension / collapse / hydrostatic pressure / AW ; lignin (in walls) / walls are impermeable ; prevents collapse / waterproofing ; wide / AW ; transport large volumes of water ; no (cell) contents / empty / dead cells / like pipes / like tubes ; no / little resistance to flow of water / allows water to flow easily / lots of water / continuous columns of water / no obstruction ; no, cross walls / end walls ; no / little, resistance to flow of water / allows water to flow easily / lots of water / continuous columns of water / no obstruction ; (bordered) pits ; lateral transport / AW ;	**2**	

9(a)(ii)	evaporation from (cell walls) in mesophyll ; diffusion of water vapour through stomata ; reduction of, pressure / water potential, at top (of plant) resulting in water moving upwards ; continuous column of water (in the xylem) ; cohesion of water (molecules) ; **A** if described incorrectly cohesion described as, forces / attraction, between water molecules ; transpiration pull ; water enters *or* leaves xylem, by osmosis / down water potential gradient ; AVP ;	**4**	
9(a)(iii)	support / described ;	**1**	
9(b)	increase / decrease (in rate of transpiration) ; more / less, evaporation ; increase / decrease, rate of diffusion (of water vapour) ; *ref. to* (kinetic) energy of (molecules of) water ; stomatal pores become, wider / narrower ; guard cells become, turgid / flaccid ;	**3**	**A** stomata close

STEM | Exam Builder

10 Fig. 4.1 shows a cross section of part of a stem of buttercup, *Ranunculus*.

Fig. 4.2 is an outline drawing of one vascular bundle from the stem of *Ranunculus*.

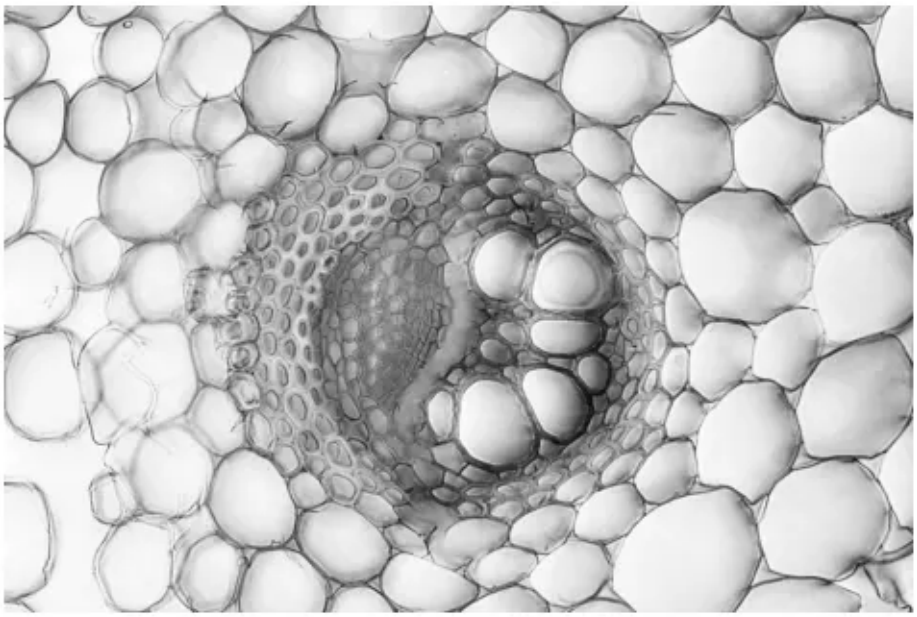


Fig. 4.1

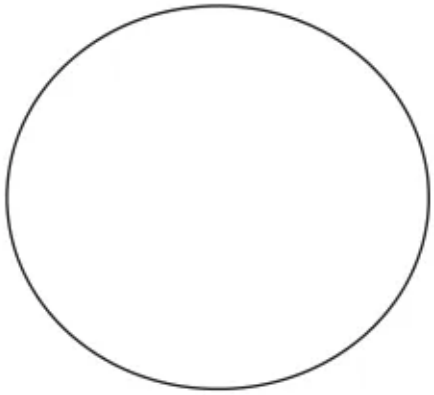


Fig. 4.2

(a) Draw **and** label the position of the xylem and the phloem in the outline of the vascular bundle in Fig. 4.2. [2]

(b) Name the carbohydrate that is transported in the phloem.

..... [1]

STEM

(c) Substances transported in the phloem are carried upwards in the stem at some times of the year and downwards at other times.

Explain why substances are transported in the phloem upwards at one time of the year **and** downwards at another.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(d) Define the term *transpiration*.

.....

.....

.....

.....

.....

..... [3]

(e) The rattan palm is a plant that climbs on rainforest trees to heights of about 40 metres.

Explain how water is moved to the tops of tall plants, such as the rattan palm.

.....

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.....

.....

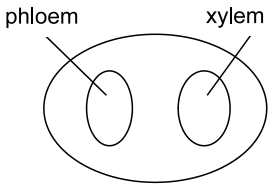
.....

.....

..... [4]

[Total: 14]

Translocation Click for more variations

10 (a)			[2]	1 mark for drawing and 1 mark for labelling *drawing must represent correct position of xylem and phloem as shown in Fig. 4.1* *if cells are drawn, these must be in the correct positions for xylem and phloem as in the photograph*
(b)		<u>sucrose</u> **;**	[1]	**ignore** sugar / non-reducing sugar **A** phonetic spellings
(c)	**1**	during growing season / when photosynthesising / when food is made **;**		**A** when there is plenty of light
	2	(substances are) transported (down), to the roots *or* to (named)		
	3	transported (up) to the, growing points / flowers / fruits / seeds / new leaves / AW **;**		**A** move for are transported **MP3 A** transported up for either time of year once only
	4	(time of year) when no photosynthesis / when food is not made **;**		
	5	(substances are transported upwards) from, roots / storage organ / seed **;**		
	6	(substances transported) from <u>source</u> to <u>sink</u> **;**	[max 4]	*source may be a storage organ or a leaf depending on the time of year*
(d)	**1**	<u>evaporation of water</u>, from (surfaces of) mesophyll **;**		
	2	movement / diffusion / loss of, water vapour **;**		
	3	from, leaves **; A** (named) aerial / upper, parts **;**		
	4	through / from, stomata / cuticle **;**	[max 3]	
(e)	**1**	evaporation / transpiration, causes movement of water **;**		**ignore** capillarity (except if discussing events at interface between water and air in mesophyll in leaf)
	2	in xylem **;**		
	3	reduces pressure at the top of the plant / ref to a water potential		
	4	transpiration pull **;**		
	5	maintained by <u>cohesion</u> between water molecules **;**		
	6	maintains a continuous column of water / AW **;**		
	7	adhesion of water / AW, to walls of xylem **;**	[max 4]	

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