Mark scheme - Transport in Plants

<table>
<tr><td>25</td><td></td><td></td><td>idea of long distance from external surface to cells (1)
small surface area to volume ratio (1)
diffusion not fast enough (1)
named example of substance that is transported e.g. sucrose (1)</td><td>3</td><td>ALLOW from source to sink / root to leaf etc.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>3</td><td></td></tr>
<tr><td>26</td><td>a</td><td></td><td>2.4 (SA) : 1.0 (volume)✓✓✓</td><td>3</td><td>If correct answer not given AWARD 1 mark for calculating surface area = 19.625

AWARD 1 mark for calculating volume = 8.177</td></tr>
<tr><td></td><td>b</td><td>i</td><td>surface area: volume ratio too small ✓

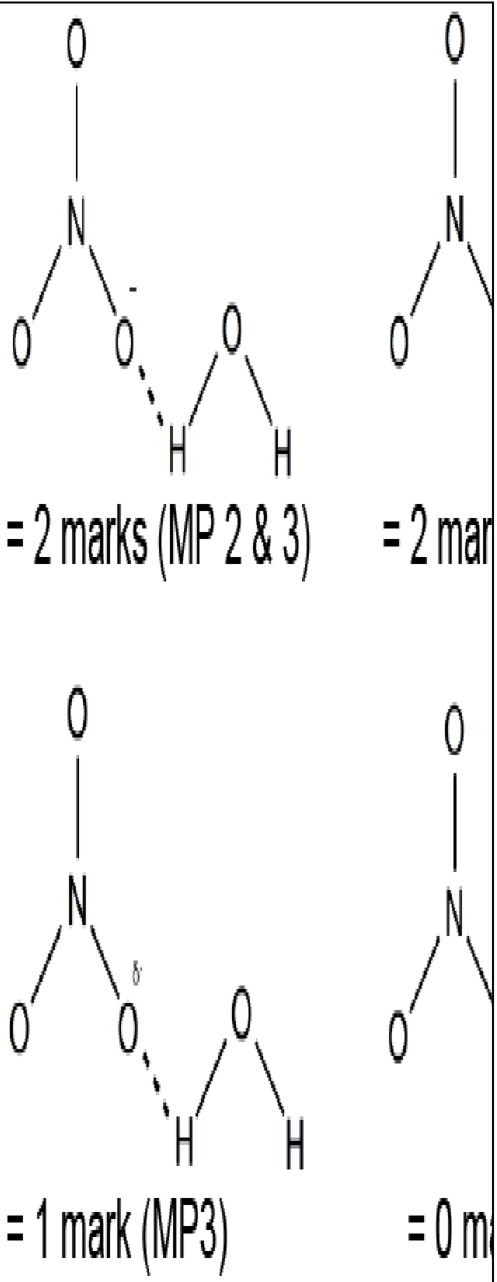
idea of diffusion from outer surface not sufficient ✓

(transport system) ensures molecules / nutrients / sugars / water, reach all tissues s ✓

(allows) high metabolic rate ✓</td><td>2 max</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td><table><tr><th>Cell</th><th>Location</th><th>Example of a substance transported</th></tr><tr><td>Guard cell</td><td>Leaf</td><td>carbon dioxide</td></tr><tr><td>Companion cell</td><td>Vascular tissue / phloem / next to sieve tube</td><td>Sucrose</td></tr><tr><td>Root hair cell</td><td>roots</td><td>Nitrate ions</td></tr></table></td><td>3</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>8</td><td></td></tr>
</table>

27		i	**A** phloem (1) **C** xylem (1)	2	
		ii	meristem	1	**ALLOW** meristematic **DO NOT ALLOW** stem cells / undifferentiated cells
			Total	**3**	
28		i	DNA / RNA / nucleic acid	1	
		ii	lower / reduce / make more negative	1	
		iii	*two from* **1** strip is impervious to, water / solutions (1) **2** forces water / solutions, to pass through, <u>plasma</u> / <u>cell surface</u>, membrane (1) **3** phospholipid (bilayer), repels / AW, ions / charged particles (1)	2	**1** **IGNORE** ref to suberin. **3** The idea of charge / ion impermeability is wanted here. **ALLOW** answer in terms of ions / charged particles needing channels because

					phospholipid bilayer does not allow charged particles through.
			Total	**4**	
2 9		i	water is (a) polar (molecule) ✓ nitrate (ion) / NO_3^-, is, charged / negative ✓ (hydrogen bonds form) between H on water and O on nitrate ✓	**2 max**	*Read answer first; if two marks from written response,* ***IGNORE*** *diagram. If two marks not awarded refer to diagram to find additional mark(s).* **DO NOT ALLOW** water is charged **ALLOW** water has slightly positive / δ^+, H **IGNORE** 'δ^- O' if describing water **IGNORE** 'δ^- O' if describing nitrate or on diagram **DO NOT ALLOW** nitrate is polar **IGNORE** solid line for H bond on diagram **NOTE** 'delta plus of water is attracted to negative charge of nitrate' = 2 marks (MP1 and 2) **NOTE** the following examples

					 **Examiner's Comments** The majority of candidates gained the maximum two marks for **Q18(c)(i)**. However, there were those who incorrectly described or drew the bonding between the hydrogen on water and the nitrate ion rather than the oxygen atom of nitrate. Numerous candidates also suggested that the oxygen on the nitrate ion is 'slightly' negative or that nitrate is a polar molecule in an attempt to gain marking point two; neither of these options could be credited. It was noted by Examiners that candidates were often better at expressing their ideas in a diagram rather

					than in written text and many candidates scored the maximum marks from their diagrams.
		ii	solutes / ions / named ion, enter, against concentration gradient / by active transport ✓ reduces water potential of (endodermal) <u>cell</u>(s) ✓ water, moves / diffuses, by osmosis / down water potential gradient ✓	**2 max**	**ALLOW** *Ψ* for water potential throughout **DO NOT ALLOW** ref to concentration of water in mps 2 or 3 **ALLOW** 'pumped' as AW for active transport **ALLOW** water potential of <u>cell</u>(s) becomes more negative **ALLOW** from high to low water potential **Examiner's Comments** **Q18(c)(ii)** was surprisingly challenging despite the desired responses being fairly straightforward. Good responses clearly indicated that active transport of mineral ions or solutes into the endodermis would lead to water entering by osmosis. A large number of incorrect responses were seen which referred to water being actively transported or water moving down a concentration gradient.
			Total	**4**	
30			M = xylem ✓ N = phloem ✓	**2**	**DO NOT ALLOW** xylem, vessels /elements **DO NOT ALLOW** phloem, sieve tubes / companion cells **IGNORE** vascular tissue **<u>Examiner's Comments</u>** The majority of candidates correctly identified tissues M and N. In some cases, candidates made reference to vessels, elements or sieve tubes which were not given credit as these are cells rather than tissues.
			Total	**2**	
31	a		**D1** put, (leaf) stalk(s) / petiole(s), in, dye / stain / food colouring ✓	**2**	**IGNORE** any observations **D1 ACCEPT** 'stick' for 'stalk'

			D2 (then) cut, transversely / cross section ✓ **OR** **M1** cut a (thin), transverse / cross, section ✓ **M2** (then) add (named) stain / observe with microscope under low power ✓		**D2 ACCEPT** cut across, (leaf) stalk / petiole (with a sharp blade) a longitudinal, cut / section cut in half **IGNORE** **IGNORE** **M1 ACCEPT** cut a (thin) slice of (leaf) stalk / petiole (with a sharp blade) a longitudinal, cut / section cut in half **IGNORE** **IGNORE** **Examiner's Comments** The responses suggested that few candidates had carried out, or even seen, a practical procedure used to observe the distribution of xylem. Standing the leaf stalk in a coloured solution was the most common basic method described but this was often not followed up with the need to cut a section in order to observe the location of the xylem vessels. Few had any understanding of the difference between the stem, leaf and leaf stalk of celery or how to produce a cross or transverse section for viewing with a low power microscope, and often confused transverse and longitudinal or even suggested cutting lengthways. Credit was given for recognising that a stain was needed but naming a suitable stain for xylem

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>was rare. Many candidates knew to observe under a microscope but did not specify under low power. Some candidates described the use of a potometer to view xylem vessels.</td></tr>
<tr><td></td><td>b</td><td></td><td>lignin
(Water Starwort) has no / less, <u>lignin</u>
(than deciduous woodland plants) ✓

(Cholla) more <u>lignified</u> (walls) /
(walls) contain more <u>lignin</u>
(than deciduous woodland plants) ✓

OR

thickness of walls
(Water Starwort) has thinn<u>er</u> walls (of xylem vessels)
(than deciduous woodland plants) ✓

(Cholla) has thick<u>er</u> wall (of xylem vessels)
(than deciduous woodland plants) ✓</td><td>2</td><td>The comparison is between each of these plants with a woodland deciduous plant and not a comparison between the 2 species

Examiner's Comments
Many candidates were able to give a good comparison between each of the two plants and a woodland deciduous plant, referring to amounts of lignin and thickness of walls. Not all responses were comparative or referred to other adaptations of hydrophytes and xerophytes and so could not gain credit. A few candidates incorrectly only compared Water Starwort with Cholla, and some attempted to explain the reasons for the differences rather than state what they were.</td></tr>
<tr><td></td><td>c</td><td></td><td>similarity
both made up of cells joined end to end
or
xylem (vessels) and phloem <u>sieve</u> tube <u>elements</u> both lack, nuclei / contents
or
both are, complex tissues / made up of more than one cell type ✓

differences max 2

<table><tr><th></th><th>xylem</th><th>phloem</th><th></th></tr><tr><td>1</td><td>lignified / contains lignin</td><td>not lignified / only contain cellulose</td><td>✓</td></tr><tr><td>2</td><td>wide lumen</td><td>lumen not wide / lumen small</td><td>✓</td></tr></table></td><td>1

2 max</td><td>IGNORE ref to function

ACCEPT both are tubes
DO NOT ACCEPT hollow tubes

Only award a mark for a comparative statement
Read through as prose and mark the first 2 differences

IGNORE ref to dead / living

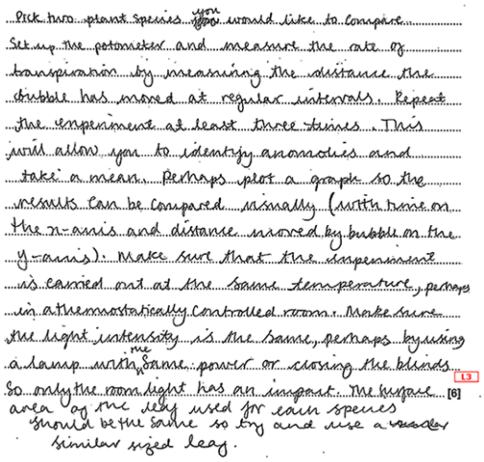
Examiner's Comments

Responses to the similarities between xylem and phloem were generally weak with the most frequent incorrect response being they</td></tr>
</table>

			3 | no end walls / no sieve plates / continuous tube | sieve plates ✓ 4 | no companion cells | companion cells ✓ 5 | vessels | no vessels ✓ 6 | no sieve tube elements | sieve tube elements ✓ 7 | (bordered) pits | no pits ✓ 8 | no cytoplasm / no organelles | has cytoplasm / has (named) organelles ✓		are both hollow tubes. Many candidates also focused on what was being transported and in which direction. In the differences section the majority of candidates compared functions rather than structures, or compared them as being dead and living, which failed to gain credit. Statements were not always comparative, with references to only xylem or phloem structural features being given. Non-specific language also hindered some answers. It is useful for candidates to be able to recall the correct terminology when answering this style of question.
			Total	**7**	
3 2		i	A vessel wall ✓ B (vessel) lumen ✓ C (bordered) pit ✓	3	**ALLOW** 'lignified wall' **DO NOT ALLOW** 'cell' **<u>Examiner's Comments</u>** Knowledge of xylem structure was poor. Responses gaining even 1 mark were rare and this was almost always for 'bordered pits'. Incorrect responses seen most frequently included: For A: using the term 'cell wall' rather than 'vessel wall'. For B: 'hollow tube', 'phloem' and 'xylem vessel' in place of 'lumen'. For C: 'plasmodesmata' was often used in place of 'pits'.
		ii	large surface area to volume ratio ✓ idea that distance, water / mineral (ions), need(s) to travel is short ✓	max 1	**DO NOT ALLOW** larg<u>er</u> / high<u>er</u> surface area to volume ratio **IGNORE** refs to support **<u>Examiner's Comments</u>** Many candidates understood that a large SA:V ratio was important here and a few managed to link this to a short distance over which water needed to be transported. However, many candidates concentrated on the support role of xylem tissue and pointed out that little support was needed for a small

					plant. Some candidates only mentioned that mosses live in damp places.
			Total	**4**	
33		i	*B* comment about detail of organelles (1) comment about shapes of cells (1)	2	**No Mark for identification of B** e.g. light microscope would not allow nuclear pores / ribosomes / endoplasmic reticulum / plasmodesmata to be seen. e.g. sieve tube elements are angular / hexagonal.
		ii	the ability to see more detail / separate two objects (1)	1	
		iii	Nile blue (1) to increase contrast / to make nuclei visible / to show no nuclei in sieve tubes (1)	2	
			Total	**5**	
34			lateral movement of water	1	
			Total	**1**	
35	a		**P1** do not allow air to enter, cut end / shoot ✓ **E1** prevent airlock / ensures continuous column of water ✓ **OR** **P2** keep named abiotic factor constant / AW ✓ **E2** affects, rate of transpiration / evaporation of water ✓ **OR** **P3** keep screw clip closed ✓ **E3** prevents entry of water whilst measuring / AW ✓	max 2 (AO1.2)	1 mark for precaution and 1 mark for **corresponding** explanation **P1 ALLOW** method that prevents entry of air, e.g. cutting / assembling under water **P1 IGNORE** do not introduce air bubbles into the capillary tube. **P2** e.g. temperature / humidity
	b	i	**FIRST CHECK ON ANSWER LINE** **If answer = 2.3 award 2 marks** SD = 2.30217 ✓ Correct answer to 2 s.f. ✓	2 (AO2.8)	**ALLOW** for 1 mark 2.30
		ii	data for ‘fan off’ are, more spread out about the mean / less precise ✓	1 (AO3.2)	**ALLOW** data were less repeatable **ALLOW ora** for ‘fan on’

	c	i	flatten / AW, leaves (on to graph paper) ✓ account for / AW, partially covered squares ✓ double leaf area to give total of both surfaces / AW ✓	max 2 (AO2.6)	**ALLOW** e.g. only count squares more than 50% covered
		ii	**FIRST CHECK ON ANSWER LINE** **If answer = 4.9 × 10^{-2} award 2 marks** 30 $mm^3\ min^{-1}$ = 1 800 $mm^3\ hr^{-1}$ = 1.8 $cm^3\ hr^{-1}$ ✓ 1.8 ÷ 37 = 0.0486 = 4.9 × 10^{-2} $cm^3\ hr^{-1}\ cm^{-2}$ ✓	2 (AO2.6 AO2.6)	**Must** be **2SF** and **standard form** for 2 marks If answer is incorrect **ALLOW** for 1 mark 0.049 / 0.0486
			Total	**9**	
36			***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ◦ award the higher mark where the Communication Statement has been met. ◦ award the lower mark where aspects of the Communication Statement have been missed. • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.*** **Level 3 (5–6 marks)** Full and detailed plan of how to carry out a valid investigation into the rate of transpiration. *There is a well-developed plan and*	6	**Indicative scientific points may include…** **IGNORE** potometer set up detail These are **not** mark points **See appendix** *Method and planning to obtain valid data* • method described • movement of bubble in potometer / mass measured • timing distance travelled by bubble • repeating investigation with two different plant species • repetition to gain replicates • calculation (rate / mean) • statistical test *Variables* • named variables controlled e.g. temperature humidity light wind movement surface area of leaves • how variables are controlled **<u>Examiner's Comments</u>** This Level of Response question assessed AO3 and practical skills in the context of

			sequence as well as an appreciation of the need to obtain valid data. The information presented is relevant and clearly explained. **Level 2 (3–4 marks)** Detailed plan of how to carry out a valid investigation into the rate of transpiration. *There is a reasonable explanation and sequence as well as an appreciation of the need to obtain valid data. The information presented is in the most-part relevant and well-explained.* **Level 1 (1–2 marks)** Response is aware of how to plan a valid investigation. *The information is basic and communicated in an unstructured way. The information is supported by limited method which may be unclear.* **0 marks** No response worthy of credit **NR** No response		using a bubble or mass potometer. Good Level 3 responses could explain the basic principles, the need to control variables, and mentioned performing replicates for both species of plants. Many went on to describe relevant calculations for processing the data obtained. Level 2 responses described a basic method with less attention given to processing the data obtained. Some lower level responses described the wrong apparatus with mention of counting oxygen bubbles or measuring volumes in a gas syringe. It was important that candidates followed the instruction that advised "Details of how to set up a potometer are not required" to avoid writing irrelevant material. Some candidates also forgot to mention how to measure the rate of transpiration i.e. by measuring the distance travelled by the bubble or meniscus in a fixed time interval. **Exemplar 2**  Pick two plant species you would like to compare. Set up the potometer and measure the rate of transpiration by measuring the distance the bubble has moved at regular intervals. Repeat the experiment at least three times. This will allow you to identify anomolies and take a mean. Perhaps plot a graph so the results can be compared visually (with time on the x-axis and distance moved by bubble on the y-axis). Make sure that the experiment is carried out at the same temperature, perhaps in a thermostatically controlled room. Make sure the light intensity is the same, perhaps by using a lamp with the same power or closing the blinds so only the room light has an impact. The surface area of the leaf used for each species should be the same so try and use a similar sized leaf. L3 [6] This is a good example of a Level 3 six mark response. The candidate provided a concise, well-written response to the question in the available space provided.
			Total	**6**	
3 7	a		**P1** some water vapour not condensed ✓ **S1** (so) record mass of bag ✓ **P2** water accumulating in bag / AW, reduces	4 max (AO3.3) (AO3.4)	Mark first two problems and solutions only Mark as pairs of answers **P** for problem and **S** for suggested improvement

			transpiration ✓ **S2** record for, shorter time / less than 6 hours ✓ **P3** not all (liquid) water enters syringe as some left in the bag✓ **S3** record mass of bag before and after experiment✓ **P4** time of day / temperature / light intensity, not controlled ✓ **S4** do all experiments at the same, time of day / temperature / light intensity ✓ **P5** paperclip seal not completely airtight (water vapour might escape) ✓ **S5** use, elastic band / sticky tape , to seal bag on leaf ✓ **P6** insufficient time for water to accumulate ✓ **S6** leave for longer time ✓ **P7** leaves of different size ✓ **S7** pick similar sized leaves / measure leaf area and divide ✓		**ALLOW** e.g. record for 1 hour **ALLOW** not all water collected from bag **IGNORE** measure leaf surface area **<u>Examiner's Comments</u>** In this question candidate's understanding of what constitutes a problem (or limitation) in the procedure was unclear, as were their suggestions for modifications. Many candidates suggested a new completely different procedure rather than modifying the one given to reduce the limitations. When writing an alternative method, candidates could follow the lead given in the PAGs and write numbered steps rather than full prose. **OCR support** The Practical skills handbook provides support with practice exam questions relating to limitations in practical skills. It can be found at https:/www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf

	b			*conclusion* there is (probably) no (significant) difference between the transpiration rates of tomato and water melon leaves ✓ *because* difference in, water collected / transpiration rate, between tomato and watermelon very small ✓ standard deviations (very) large / data very spread out ✓ *max 1*	2 max (AO3.1/ 3.2)	**ALLOW** only 0.008 cm^3 difference 'for very small' **ALLOW** error bars / standard deviations overlap **ALLOW** SD for standard deviation **ALLOW** range bars overlap **Examiner's Comments** Candidates often did not make full use of the information provided in the stem of questions. Many candidates seemed to struggle when faced with extracting information from a graph. For example in this question the small difference between the means and the huge overlap of the error bars was ignored. In this question almost all candidates did not correctly interpret the relevance of error bars that were very large and had a large overlap between two sets of data. Large error bars suggest data that is variable (and perhaps not easily repeatable). While it is not a significance test in itself, the degree of overlap between error bars can be a good indicator that two sets of data are not significantly different. **Misconception** Where two sets of data appear to be only slightly different a statistical significance test can help to determine whether the difference is significant. Statistical data such as the standard deviation can also help to indicate the significance of a small difference between sets of data.

<table>
<tr><td></td><td>c</td><td></td><td>1 ref. potometer airtight / watertight✓

2 dry leaves ✓

3 cut shoot under water / slanted cut ✓

4 measure distance air bubble travels per (named) time interval
OR
Measure time for air bubble to travel known distance ✓

5 calculate volume of water uptake ✓

6 ref. maintaining (named) constant conditions ✓</td><td>4 max (AO1.2)</td><td>ALLOW use of Vaseline

ALLOW set up potometer under water

ALLOW use of correct unit to indicate measurement eg. mm min^{-1}

ALLOW use πr^2 / cross sectional area x distance (to calculate water uptake)</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>10</td><td></td></tr>
<tr><td>38</td><td>a</td><td>i</td><td>differences completed correctly ✓

squares of differences completed correctly ✓</td><td>2</td><td>IGNORE all negative signs in Difference of ranks column

DO NOT ALLOW negatives in Difference squared
column

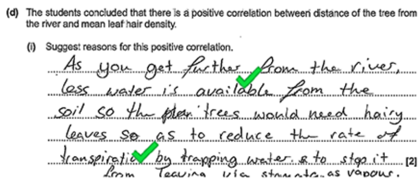
ALLOW ECF for mp 2

<table>
<tr><th>Rank of hair density</th><th>Difference in ranks (d)</th><th>Difference squared (d^2)</th></tr>
<tr><td>2</td><td>2</td><td>4</td></tr>
<tr><td>1</td><td>0</td><td>0</td></tr>
<tr><td>7</td><td>0</td><td>0</td></tr>
<tr><td>10</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>4</td><td>16</td></tr>
<tr><td>3</td><td>0</td><td>0</td></tr>
<tr><td>8</td><td>1</td><td>1</td></tr>
<tr><td>6</td><td>0</td><td>0</td></tr>
<tr><td>9</td><td>(-)7</td><td>49</td></tr>
<tr><td>5</td><td>0</td><td>0</td></tr>
</table>

<u>Examiner's Comments</u>

Candidates were asked to complete the table by making a number of simple</td></tr>
</table>

					calculations. Most able candidates did this successfully. A number of candidates were unable to rank the hair density correctly and therefore the difference in ranks was incorrect. These candidates could still achieve a mark if they correctly squared the difference they had calculated. A few made errors in calculating the square of the difference.
		ii	rs = 0.576 / 0.58 ✓✓	2	**ALLOW** ECF from table **ALLOW** one mark for working e.g. n(n2-1) = 990 ✓ 6x70/10(99) ✓ 0.57 = one mark (incorrect rounding) 0.580 = one mark (for incorrect rounding) 0.6 = one mark (rounding too far) **Examiner's Comments** Candidates were asked to calculate Spearman's rank correlation coefficient. Many candidates managed to do this successfully. If the values in the table were incorrect the error was carried forward to enable candidates to achieve these marks using their own data from the table in part (i). Less able candidates often struggled to carry out this calculation correctly. Sometimes this was because they did not transfer data accurately into the table.
	b	i	further away from the river less water (available) / ORA ✓ transpiration causes water loss ✓ hairs, trap water vapour / reduce transpiration / reduce loss of water (vapour)✓ reduced water (vapour) potential gradient from inside to outside leaf ✓	2 max	**DO NOT ALLOW** 'further from source' 'no source' **DO NOT ALLOW** hairs prevent water (vapour) loss **Examiner's Comments** This question asked candidates to explain how leaf hairs enabled the plant to conserve water in the context of differing water availability at different distances from the river. More able candidates had a good idea

						that leaf hairs could reduce water loss. They also understood that this was required because there was less water available further from the river. Less able candidates often became confused and wrote about leaf hairs absorbing water from the less humid environment. Some even seemed to think that leaves closer to the river had more hairs which helped the leaf to lose water. **Exemplar 7**  (d) The students concluded that there is a positive correlation between distance of the tree from the river and mean leaf hair density. (i) Suggest reasons for this positive correlation. As you get further from the river, less water is available from the soil so the ~~plan~~ trees would need hairy leaves so as to reduce the rate of transpiration by trapping water & to stop it from leaving via stomata as vapour. [2] In this exemplar the candidate has written a clear and concise response. It shows a clear understanding that water is less available further away from the river and that the leaf hairs will reduce transpiration. The candidate goes on to explain that transpiration is loss of water vapour via the stomata.
		ii	same / similar, size / age, trees ✓ same / similar, size / age, leaves ✓ repeated leaves from each tree **and** calculate mean ✓ record results at same, time of year / day ✓ ensure leaves selected are from, same side / same height / evenly distributed around tree ✓ systematic sampling / sample at set distances (from river) / described ✓	3 max	<u>**Examiner's Comments**</u> This question asked for candidates to describe ways to improve the validity of their sampling techniques. Validity is all about controlling the variables around the collection of data so that the data are not affected by inconsistencies. The technique is valid if it measures what it is supposed to measure. There was a wide range of responses. It was clear that many candidates did not really understand the meaning of the term 'validity'. Few candidates achieved full credit and many responses described ways to improve repeatability. In many cases the responses were not well phrased. **Exemplar 8**

					Suggest **three** ways in which the students could improve the validity of their sampling method. 1 Use leaves from the same height from the trees. 2 Use similar size trees 3 Use ~~similar~~ ~~ß~~ leaves of a similar area. [3] In this exemplar the candidate has given three clear statements. Each statement describes a way to remove a variable to ensure the data collected are comparable. This makes the sampling techniques valid.
	c		their conclusion is incorrect ✓ reject (the student's), hypothesis / H1 ✓ there is no, relationship / correlation, (between leaf hair density and distance from river) / the pattern seen is due to chance ✓	2 max	**ORA** accept the null hypothesis / H_0 **<u>Examiner's Comments</u>** Candidates were asked to evaluate a conclusion. It was clear that many candidates did not really know how to interpret the results of a statistical test. If the calculated value of Spearman's rank is below the critical value then we can say that there is no correlation. Many candidates seemed to suggest that because the calculated value was close to the critical value that was OK. Less able candidates become very confused and compared the calculated value to 5% or even to 9. Definitions of the terms associated with practical work are available in the practical skills handbook. **Exemplar 9** Evaluate the conclusion of this group of students. The rs value is blow the critical value so there isn't a ~~no~~ significant correlation and it may be due to chance so their conclusion is wrong. [2] This exemplar shows a rare case where the candidate has a good understanding of how to interpret the results of a statistical test. The candidate makes clear that the calculated result is below the critical value and states that this means there is no significant correlation.
			Total	**11**	

3 9			B	1	**Examiner's Comments** This was another question that drew upon the candidates' practical skills. Again, it might have been that some candidates misread the question and suggested a precaution that is needed, accounting for the incorrect answers seen.
			Total	**1**	
4 0	a	i	*two from* units on axes (1) plotted points (1) title (1)	2	
		ii	= 5.25 (mm min^{-1}) (1)(1)	2	**ALLOW** answer in range 5.0 to 6.0 **(**mm min^{-1}) **ALLOW** one mark for correct working if final answer incorrect e.g. $\frac{21-0}{4}$
	b		evaporation (1) from upper leaf surfaces (1)	2	
	c		*two from* not all lower leaf surface covered (1) leaks in apparatus (1) shoot not cut under water (1) error in reading position of meniscus (1)	2	e.g. seal around the plant is not airtight.
			Total	**8**	
4 1			symplast pathway passing through the cytoplasm / plasmodesmata ✓ apoplast pathway passing, along / between, the cell walls ✓ vacuolar pathway passing through the vacuoles ✓	2 max (AO1.2)	**ALLOW** 1 mark for two named pathways even if descriptions not given or incorrect **ALLOW** 1 mark for two correct descriptions even if names not given
			Total	**2**	
4 2	a		find/control/tandardise/account for, leaf <u>area</u> ✓ calculate / compare, transpiration <u>rate per unit area</u> ✓	2(AO3. 3 x2)	**ALLOW** unit for ‘area’ e.g. mm^2/cm^2/m^2 **IGNORE** size/number of stomata **IGNORE** surface area to volume ratio ALLOW water, loss/uptake, for ‘transpiration’ ALLOW mm^2/cm^2/m^2 for ‘unit area’ **<u>Examiner’s Comments</u>**

					Many candidates wrote about a selection of variables that should be controlled but did not address the crucial one of leaf surface area. **OCR support** Useful resources for teaching about the use of the potometer are given in the OCR 'Transport in Plants' delivery guide and the Practical Skills Handbook: https:/www.ocr.org.uk/qualifications/as-a-level-gce-biology-a-h020-h420-from-2015/delivery-guide/module-ba03-module-3-exchange-and-transport/delivery-guide-badg009-transport-in-plants-313#231117 http:/www.saps.org.uk/secondary/teaching-resources/1263-investigating-transpiration-with-a-potometer There is also a link within the delivery guide to estimating leaf surface area. https:/www.ocr.org.uk/qualifications/as-a-level-gce-biology-a-h020-h420-from-2015/delivery-guide/module-ba03-module-3-exchange-and-transport/delivery-guide-badg009-transport-in-plants-313#231115
	b	i	**1** 57 / trial 4 of condition 3 ✓ **2** has made mean higher ✓ **3** (ignoring / excluding 57) mean = 29.4 ✓ **4** (using 57) increases mean by, 4.6 (mm) / 15.6% ✓	max 3 (AO3.2) (AO3.1) (AO3.2) (AO3.2)	**1 ALLOW** lower leaf covered / with jelly for 'condition 3' **1 ALLOW** 57, marked / circled, in table **ECF** for mps 2, 3 and 4 if figure other than 57 selected **2 ALLOW** if 57 not included mean would be less **4 ALLOW ora** ignoring 57 decreases mean by, 4.6 mm / 13.5% **ECF** from wrong mean calculated for mp 3 **Examiner's Comments**

					Most candidates identified the anomaly clearly and stated that including it made the mean higher. Many candidates gained full marks by performing a relevant calculation of the mean without the anomaly, or the difference between this and the existing mean.
		ii	bubble was not (fully) returned to starting position **or** misread, scale / ruler / distance **or** timed for longer than five minutes **or** air movement / temperature / light increased ✓	1(AO3.1)	**ALLOW** leaf not fully covered with petroleum jelly **<u>Examiner's Comments</u>** This question was widely misunderstood. Candidates gave a reason based on the difference of the anomalous number from the other readings to explain how they made their choice, rather than a reason based on a problem in the conduct of the experiment.
		iii	6.63 ✓ ✓ ✓	3 (AO2.4 x3)	**Correct answer = 3 marks** even if no working shown. **ALLOW** answer in table 4.2 **ALLOW** close figure showing, rounding error / error due to rounding during calculation, but deduct 1 mark **If final answer incorrect award 2 marks** for: *answer not to 2 d.p:* 7 / 6.6 / 6.631 / 6.632 or more d.p. *answer for 5 mins:* 33.16 *diameter used:* 26.53 *radius not squared:* 18.95 **Award 1 mark** if two errors occur: *wrong answer not to 2 d.p:* 33 / 33.2 / 27 / 26.5 / or more d.p. *diameter used & 5 mins:* 132.63 **If no calculated answer** then **award 1 mark** for working: $(3.14 \times 0.35^2) \times (86.2 \div 5)$ **or** $(3.14 \times 0.35^2) \times 17.24$

					ALLOW π for 3.14 **<u>Examiner's Comments</u>** Candidates were mostly successful in tackling this calculation. Candidates who used the diameter rather than the radius gained 2 marks, if the rest of the steps in their working were correct. Some candidates did not convert the data from Table 4.1 into a value for one minute rather than five; error carried forward marks were again given. The final answer should have been given to two decimal places to match the rest of the data in Table 4.2. Candidates were given full credit for using a more precise value of π than 3.14, such as 22/7 or the π button on a calculator. **OCR support** The Maths for Biology website contains support on calculating the surface areas and volumes of regular shapes: https://www.ocr.org.uk/subjects/biology/maths-for-biology/geometry-and-trigonometry/
		iv	to, see / compare, effect of, other (named) treatment(s) / changed conditions ✓	1 (AO2.4)	**<u>Examiner's Comments</u>** Few answers adequately explained the idea of comparing the effect of the other treatments using changed conditions.
	c		*capillary tube:* measures smaller volumes **or** small diameter so distance, greater / easier to measure **or** has, smaller units / finer gradations / closer scale (divisions) / more calibration marks ✓ less uncertainty ✓	max 1(AO3.2)	**ALLOW ora** for calibrated pipette **throughout** **ALLOW** thinner / narrower for 'small diameter' **ALLOW AW** to give the idea of more marks or sub-divisions on measuring scale **ALLOW** (gives more) precise (readings) **ALLOW** lower / smaller, percentage error **IGNORE** accuracy

					Examiner's Comments Candidates struggled to express a reason why the capillary tube was better. Correct ideas mostly focused on the greater degree of measuring precision allowed. It was not correct to relate the different apparatus to greater accuracy. **AfL** Terms used by OCR relating to practical measurements can be found in the Practical Skills Handbook, Appendix 4: https:/www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf These are also available in the Nuffield Foundation and Association for Advancement of Science 'Language of Measurement' handbook available here: http:/www.gettingpractical.org.uk/Books.php
	d	i	water loss / transpiration / evaporation, equals uptake ✓	1(AO1.2)	**ALLOW** all the water taken up is, lost / transpired / evaporated **ALLOW** none of the water (taken up) is used **Examiner's Comments** Candidates often wrote about details of using the apparatus such as having the tap closed. Candidates did not refer to the underlying assumption that the apparatus actually measures transpiration only if the water taken up is indeed lost (and not used) by the leafy shoot. .
		ii	***Please refer to the marking instructions on this mark scheme for guidance on how to mark this question.*** ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)*	6	**Indicative scientific points may include** *setting up:* • D cut stem under water • **D** have apparatus under water • **D** insert stem under water • **D** joint(s) must be, sealed / tight

			Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *caward the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.*** **Level 3 (5–6 marks)** A detailed description **and** explanation of the precautions needed when setting up **and** using the apparatus. *There is a well-developed line of reasoning which is clear and logically structured. All the information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A basic description **and** explanation of the precautions needed when setting up **and** using the apparatus. **OR** A detailed description and explanation of the precautions needed when setting up **or** using the apparatus. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** A description of some of the precautions needed when setting up **and** using the apparatus. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*		• **E** so no air can enter, stem / shoot / xylem / apparatus • **E** air / bubble, could block xylem • **E** obtain a continuous column of water *using:* • **D** do not allow the bubble to move too far • **D** use syringe to move bubble • **E** so air bubble does not enter, xylem / stem • **E** so same air bubble can be re-used • **D** place open end in water • **E** so no, air / (new) bubble, introduced • **D** keep shoot, still / supported • **E** to avoid breaking, seal / water column • **E** to measure transpiration accurately • **E** ensure validity ***Allow gas for 'air' throughout.*** ***Ignore oxygen.*** ***Ignore air / bubbles being present or leaving.*** **Examiner's Comments** Most candidates made some relevant points about the precautions to be taken when *setting up* the apparatus. Candidates did not complete their answer by describing and explaining the precautions that should be taken while actually *using* the apparatus to measure the rate of transpiration. This restricted many answers to Level 1. **Exemplar 3**

			0 marks *No response or no response worthy of credit.*		Firstly, the stem of the plant must be cut underwater, so that no bubbles get into the stem. The apparatus should also be set up and the plant inserted underwater so that no air gets into the tube. When using the apparatus, the opposite end of the tube to the end with the plant in should remain fully submerged in water so that no unwanted air bubbles enter the potometer. The tap should also be used to reset the air bubble and stop it from reaching the [6] stem of the plant. The apparatus should also be kept upright and the rubber tube secured tightly when setting up the apparatus. Exemplar 3 provides a full treatment of both aspects of the question, and the reason for each described precaution is clearly explained in terms of preventing entry of air.
			Total	**18**	
43		i	hydrophyte	1	
		ii	**X** symplast (1) **Y** apoplast (1)	2	
			Total	**3**	
44			B	1 (AO1.2)	
			Total	**1**	
45		i	temperature (1) humidity (of air) (1) air currents (1) light intensity (1) *idea of* health of leaves (1)	2	**DO NOT ALLOW** species of leaves **DO NOT ALLOW** surface area **IGNORE** age of leaf (as this is correlated with surface area) **IGNORE** air bubbles in potometer, etc. **DO NOT ALLOW** 'warmth' or 'heat' **ALLOW** water (vapour) potential **DO NOT ALLOW** 'moisture' or 'water levels' alone **ALLOW** wind **ALLOW** 'leaves should not be damaged'
		ii	*high rate of transpiration does not matter because:*	1	**IGNORE** references to hydrophyte adaptations

			(plant lives in an) aquatic / AW habitat, so water lost is easily / AW, replaced (1)		
			Total	**3**	
46		i	respiration produces, carbon dioxide / CO_2, that is used in photosynthesis ✓ photosynthesis produces, oxygen / O_2, that is used in respiration ✓ dead leaves / decomposition, replaces (named) nutrients ✓	max 1 (AO2.5 AO2.5)	
		ii	because they are xerophytes ✓ because the conditions are too, moist / wet ✓	max 1 (AO2.1 AO2.1)	**ALLOW** suited to / live in, dry environments **IGNORE** hot environment
			Total	**2**	
47			there is a lower water potential inside root hair (cells) ✓ actively transport / pump, (mineral) ions / salts, into root hair(s) (cells) **or** root hair(s) (cells) store / contain, (mineral) ions / salts / solutes ✓	2	**IGNORE** ref to large surface area and short diffusion path **IGNORE** ref to solute potential / isotonic **ACCEPT** Ψ for water potential 'it' or 'they' = root hairs **IGNORE** ref to roots or root cells unqualified as hairs **ACCEPT** root hair, has / creates, a lower water potential (than soil) **ACCEPT** maintains / sets up / establishes, a (steep) water potential gradient Look for a comparison in water potential between the cell and the soil **IGNORE** solutes / sugars / hydrogen ions **ACCEPT** named ions **ACCEPT** named ions **ACCEPT** named solutes e.g. sugars **Examiner's Comments** This question highlighted the failure of many candidates to use the correct scientific terminology. In particular was the use of 'concentration gradient' without showing an appreciation of, or even mentioning, water potential, despite the previous parts of the question being on that subject. Where active

					transport was mentioned some thought it was the water that was pumped into the cell or that transpiration was also involved. Many candidates understood the principal of reducing the water potential of the root hair cells but failed to gain credit by referring to the roots or the plant without specifying the 'root hair cells'.They also talked about the large surface area of root hair cells, which also failed to gain credit.
			Total	**2**	
4 8			no / thin, (waxy) cuticle **and** *idea that* wax production is a waste (1) large surface area to, increase / maximise, photosynthesis, as transpiration is not an issue (1) many stomata to, increase / maximise, gas exchange (1) stomata on the top surface, as gas concentration is higher in air than water (1)	2	**ALLOW** stomata do not close at night to maximise gas exchange
			Total	**2**	
4 9			***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*** ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1, Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* ***• The science content determines the level.*** ***• The Communication Statement determines the mark within a level.*** **Level 3 (5–6 marks)**	6 (AO1.1)	*Indicative scientific points may include* **Phloem loading** • Glucose is converted to an assimilate / sucrose in photosynthesising cells • Apoplast route • Active process • Proton pump in companion cells • H^+ concentration gradient • Co-transport of H^+ and sucrose into companion cell • Structural adaptations of companion cells, e.g. many mitochondria, increase surface area of cell surface membranes • Passive loading via symplast route • Role of plasmodesmata • entry of sucrose / solutes decreases water potential of phloem / sieve elements • water enters phloem from surrounding cells / xylem • results in higher hydrostatic pressure

			A description that includes mass flow **and** phloem loading **and** unloading. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A description that includes mass flow **and** phloem loading **or** unloading. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** A description that includes either mass flow **or** phloem loading **or** unloading. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*		**Mass flow** • Bulk transport of sucrose caused by pressure difference • Entry / exit of water / solutes affects hydrostatic pressure • Movement from source to sink • e.g. leaf is source • e.g. root is sink • Role of hydrostatic pressure gradient from source to sink • High hydrostatic pressure in source phloem explains rapid transport over long distance **Phloem unloading** • Diffusion of sucrose from phloem to surrounding cells • Sucrose converted back to glucose • Glucose used for respiration • Converted to starch for storage • Concentration gradient of sucrose maintained between phloem and cells • Occurs wherever cells need glucose / sucrose • Loss of sucrose / solutes increases water potential of phloem • water leaves phloem to surrounding cells / xylem • results in lower hydrostatic pressure
			Total	**6**	
5 0	a	i	sucrose is soluble so can be transported in sap (1) but metabolically (relatively) inactive so no, used / removed, during transport (1)	2	
		ii	*similar – one of* solutes carried in solution in both (1) both carry mineral salts (1) both use, mass flow / generated hydrostatic pressure (1)	2	

			different – one of transport in phloem can take place in different directions **and** transport in xylem only takes place up the plant (1) phloem carries carbohydrates **and** xylem does not (1) phloem transport uses living cells **and** xylem does not (1) xylem uses, capillary action / cohesion and adhesion, **and** phloem does not (1)		
	b	i	certain parts can store and then release carbohydrates when needed (1) suitable examples include root or leaf, which can act as sink or source at different times of year (1)	2	
		ii	* **Level 3 (5–6 marks)** A clear, thorough explanation, showing a good understanding of the principles of loading into phloem, incorporating use of the diagram. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A partial explanation showing some understanding of the principles of loading into phloem. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** An attempt including some correct principles, but likely to be confused, showing limited understanding of the principles of loading into phloem. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks**	6	**Relevant principles include:** • sucrose pumped into companion cell • by active transport • H+ / proton, co-transport of sucrose • **B** / sucrose diffuses into phloem sieve tube • **A** / water, enters sieve tube from companion cell • **C** / water, enters sieve tube from xylem • increased pressure forces flow of sap down phloem • through the pores in the sieve plates.

			No response or no response worthy of credit.		
	c	i	glycosidic	1	
		ii	*two from* 19 × greater in modified (1) 1811% increase in modified compared with unmodified (1) standard deviation indicates greater spread of data for modified (1)	2	
		iii	*two from* sucrose unloaded at sinks and invertase converts sucrose into, glucose / monosaccharide (1) increases sucrose concentration gradient between phloem and sink (1) causes increased unloading of sucrose from phloem (1) *two from* increases solute gradient between source and sink (1) removal of water from phloem increases pressure gradient between source and sink (1) contributes to increased movement in phloem (1)	4	
		iv	modified produce fewer **and** larger tubers (1) **ora** modified produce greater mass of tuber (1) **ora** 109.34 g for modified **and** 89.04 g for not modified (1)	3	
			Total	**22**	
51			Phloem = B **AND** contains sucrose / non-reducing sugar ✓ non-reducing sugar / sucrose, hydrolysed / broken down, to monosaccharides ✓ Liver = A **AND** does not contain starch / gives negative result for iodine test ✓	**3**	**ALLOW** non-reducing sugars broken down to, reducing sugars / named monosaccharide **ALLOW** 'colour after iodine added was yellow' **Examiner's Comments**

						Many candidates identified tissue B as phloem since it contained sucrose, or a non-reducing sugar, which would result in a red precipitate with Benedict's reagent after treatment with hydrochloric acid. Fewer mentioned that this treatment would hydrolyse sucrose into its monosaccharide constituents. Some candidates lost the mark for stating that sucrose is a reducing sugar. Most candidates correctly identified tissue A as liver due to the fact that it contained no starch resulting in a negative result for the iodine test. Lower ability candidates identified C as the liver stating that it would contain both glycogen and reducing sugars such as glucose, but ignoring the fact that tissue C also contained starch.
			Total	**3**	
5 2	a			B C ✓✓	2	One mark for each correct answer e.g. B C = 2 B or C (only) = 1 B D✗= 1 If one extra incorrect letter = max1 If two extra incorrect letters = 0 marks e.g. B C D✗= 1 B C D✗ E✗= 0
				A D F ✓✓	2	**If any incorrect or extra letters are written, cross each one.** e.g. A D E✗ Then look at any correct letters written. We have 1 cross so only 1 more mark available, A and D both right so gets this 1 mark) e.g. A D E✗ C✗ We have 2 crosses so 0 marks even though the correct letters have also been given **If no extra or incorrect letters are written:** Three answers written, all correct = 2 marks A, D, F = 2 Two answers written, both correct = 1 mark A, D = 1 A, F = 1 D, F = 1 One answer written and correct = 0 A = 0 F = 0 D = 0

					Examiner's Comments Most candidates gained some credit here but only a few gained all four marks. Commonly, correct responses were contradicted by incorrect answers particularly when identifying the evidence for translocation as an active process. It would seem that these students have limited experience of interpreting data/observations or relating them to processes.
	b		1 sugar / sucrose / assimilates, in the sieve tube (elements) ✓ 2 (assimilates) enter, sieve tube / phloem (at source) **and** lowers water potential (in sieve tube)✓ 3 water enters (sieve tube), by osmosis / down water potential gradient / described **and** increases hydrostatic pressure ✓ 4 (assimilates) leave, sieve tube / phloem (at sink) **and** increases water potential (inside sieve tube) ✓ 5 water leaves (sieve tube), by osmosis / down water potential gradient / described **and** lowers hydrostatic pressure ✓ 6 (assimilates) move, from high to low (hydrostatic) pressure / down pressure gradient ✓	max 3	2 **IGNORE** details of loading mechanism and companion cells 6 **IGNORE** 'mass flow' as given in Q **Examiner's Comments** A significant number of candidates were able to describe the process of mass flow correctly but failed to gain credit by not specifying that the sieve tube elements of the phloem that are involved. Some talked

					about loading sap rather than sucrose. Many also concentrated on a detailed description of the loading mechanism rather than fully addressing the information required.There was some evidence of a lack of care when reading the question. Often there was confusion with the transport in the xylem, e.g. sugars moving along symplast / apoplast pathways, by cohesion and adhesion. The term ‘concentration gradient’ was commonly uses as a catch-all phrase to explain the movement of anything from one place to another. The terminologies of water potential gradient and/or hydrostatic pressure gradient were only correctly used by the better candidates. It seems that few candidates appreciate that a pressure gradient is set up between the source and sink.
			Total	**7**	
5 3	a		70 ✓ ✓ (root hairs) mm^{-2} ✓	3	**ALLOW** 35 two marks for correct answer **ALLOW** one mark if not given to 2 s.f. if answer incorrect **ALLOW** one mark for correct surface area calculated (6.28 - 6.284 or 12.56 -12.57) **ALLOW** / mm^2 **Examiner’s Comments** Most candidates demonstrated good mathematical skills in this part of the question. Using the formula provided to calculate the surface area of a cylinder produced an answer of 35 root hairs mm^{-2}. Many candidates achieved this answer. These candidates were given full marks. However, the formula provided includes the circular surfaces at the top and bottom of the cylinder which would not contain hairs. The higher ability candidates realised this and correctly calculated the density of root hairs over the length of the root as 70 mm^{-2}. The correct unit is mm^{-2} rather than /mm^2 or per mm^2, not many candidates were able to give the correct unit.

					OCR support The Maths for Biology website provides support on calculating surface area and use of units: https://www.ocr.org.uk/subjects/biology/maths-for-biology/index.aspx-id=biology-a-h020-h420-from-2015
	b	i	12.1 ✓ ✓ ✓	3	*Max 2 if answer not given to 1 decimal place.* If answer is incorrect **ALLOW** 1 mark for evidence of correct mean calculation: 36 or 36.2 **Examiner's Comments** Most candidates gained 1 mark for correctly calculating the mean at 36.2. Many were also able to use the formula to calculate the standard deviation correctly although a significant number of candidates gave up after calculating the mean. In common with other calculations on this examination paper the most frequent reason for loss of marks was incorrect rounding. Candidates should be reminded to round their final answer rather than rounding earlier in the calculation. All processed data is recorded to up to one significant figure more than the raw data. **OCR support** The maths skills handbook is provided on the OCR website: https://www.ocr.org.uk/Images/294471-biology-mathematical-skills-handbook.pdf
		ii	(students) (unpaired) t-test ✓	1	**DO NOT ALLOW** paired t-test **Examiner's Comments** Judging by the number of crossed-out alternatives seen on scripts, candidates

					were unprepared for selecting appropriate statistical tests. Only a few candidates gave the correct response. The most common incorrect answers were chi-squared or Spearman's rank correlation and some candidates referred to 'calculate a mean'. **OCR support** The Mathematical skills statistics booklet is provided on the OCR website: https:/www.ocr.org.uk/Images/338621-mathematical-skills-statistics-booklet.doc
			Total	**7**	
5 4	a	i	sieve tube (cell / element / member) ✓	1(AO1. 2)	**Mark the first answer.** If an additional answer is given that is incorrect, then = **0 marks** **IGNORE** vessel **<u>Examiner's Comments</u>** This was frequently correctly identified as a sieve tube cell, with errors being 'companion cell' or just 'sieve cell'.
		ii	Benedict's / Fehling's (solution / reagent) ✓ blue / turquoise ✓ orange / yellow / brown ✓ acid ✓	4 (AO1.1) (AO1.2) (AO1.2) (AO1.1)	**Mark the first answer in each space.** If an additional answer is given that is incorrect, then = **0 marks** **IGNORE** dark / light / cloudy / opaque **IGNORE** dark / light / cloudy / opaque **ALLOW** named e.g. HCl, H_2SO_4, HNO_3 **IGNORE** spelling error e.g. hydrocholic **<u>Examiner's Comments</u>** Many candidates knew that Benedict's reagent is used to test for glucose. They applied knowledge of the test to Table 1 to give the colour for a negative test as blue. Similarly many integrated their knowledge with Table 1 to name orange, yellow or

					brown as a negative result with iodine. The use of acid or a named acid in the test for sucrose was also widely known. **OCR support** Qualitative testing for glucose and sucrose is covered in this activity: https:/www.ocr.org.uk/qualifications/as-a-level-gce-biology-a-h020-h420-from-2015/delivery-guide/module-ba02-module-2-foundations-in-biology/delivery-guide-badg001-cell-structure-211#373046
	b	i	*starch:* is not soluble / does not dissolve (in water) **or** does not affect osmosis / is osmotically inactive **or** cannot, enter / leave, cells ✓ makes, it / sap, thick / viscous / sticky / glue-like ✓	max 1 (AO2.5 x2)	**ALLOW** could block, tubes / flow / phloem **ALLOW** H_2O would not follow to, increase hydrostatic pressure / set up pressure gradient **ALLOW** no co-transporter proteins for starch **OR** starch is too big to, enter cells / cross cell (surface) membranes / pass through cell wall **IGNORE** big / too big, unqualified **<u>Examiner's Comments</u>** Correct answers mostly related to starch being insoluble. Many candidates referred to starch being big but did not consider why this would cause a transport problem, e.g. by making the sap more viscous or by causing a problem in loading the molecule into companion cells. Some candidates did gain credit for saying that as starch is big it could block the holes in sieve plates.
		ii	*sucrose:* entry / exit / loading / unloading, controlled / uses transport proteins **or** (is) less likely to, leave / exit / diffuse out of (sieve tubes) **or** (is) less, reactive / likely to be used (in respiration / by mitochondria / for energy) ✓	1	**ALLOW ora** throughout for glucose **ALLOW** co-transporters for 'transport protein' **DO NOT ALLOW** channels / pores **IGNORE** ref. osmosis / size / solubility / metabolically inactive

				(AO2.5)	**Examiner's Comments** This 'suggest' question posed a challenge to candidates. Many responses showed little relevant knowledge of the differences between sucrose and glucose or how they gain access to phloem sap. Correct answers usually focused on glucose being more likely to be used up or to be lost by diffusion during the transport process. A few candidates applied their knowledge of how substances enter and leave the phloem by co-transporters at companion cell membranes to think of a difference in the transport possibilities of glucose and sucrose.
			Total	**7**	