

Mark scheme

Question		Answer/Indicative content	Marks	Guidance
1	a	<p><i>Adaptation</i> stomata, in pits / sunken / AW or hairs or curled / rolled, leaves /AW ✓</p> <p><i>Explanation</i> reduces air movement / increases humidity (around stomata) / AW</p> <p>or reduces water potential gradient (across stomata) / AW ✓</p> <p>OR</p> <p><i>Adaptation</i> curled / rolled, leaves / AW ✓</p> <p><i>Explanation</i> reduces surface area (exposed for transpiration) ✓</p> <p>OR</p> <p><i>Adaptation</i> Thick waxy cuticle ✓</p> <p><i>Explanation</i> Impermeable to water /AW ✓</p>	2 max	<p>Award 1 mark for adaptation and 1 mark for correctly linked explanation (only award the explanation mark if adaptation mark awarded)</p> <p>e.g. leaves are curved or stomata face inwards or leaves reduced to spines /spikes / needles (as candidates not familiar with bell heather)</p> <p>e.g. 'to trap moist air' /reduces effect of wind / create a humid environment / trap water vapour IGNORE 'traps moisture'</p> <p>e.g. reduces water vapour, diffusion / concentration, gradient</p> <p>e.g. leaves are curved or stomata face inwards or leaves reduced to spines /spikes / needles (as candidates not familiar with bell heather)</p> <p>e.g. stops / reduces, water vapour escaping</p> <p><u>Examiner's Comments</u></p> <p>Many candidates were able to correctly identify an adaptation of <i>E. cinerea</i>. The most frequent correct responses related to a thick waxy cuticle, sunken stomata, and curled leaves. These were often well explained. A noticeable proportion of candidates mentioned a thick epidermis rather than a thick waxy cuticle. Many incorrect responses tried to explain how the air spaces were involved in the reduction of water loss, or their involvement in trapping carbon dioxide for photosynthesis or use in buoyancy in an aquatic plant.</p>

					<p>mark as prose <i>Explanation mark can only be awarded if linked to relevant idea of safety precaution</i></p> <p><i>examples 'be careful when using, a scalpel / sharp instruments, to avoid cutting yourself = 1 mark (no precaution but has explanation) 'wear goggles to prevent plant sap going into your eye' =2 marks (safety precaution and explanation)</i></p> <p>IGNORE 'be careful when using a scalpel' / 'take care when using sharp instruments'</p> <p>ALLOW 'take care when using a sharp, scalpel / scissors / knife / razor blade'</p> <p>ALLOW use forceps to hold plant tissue / use of, dissection board / glass tile / slate</p> <p>e.g. to avoid penetrating the skin' / 'to avoid stabbing, yourself / someone else'</p> <p>ALLOW wear eye protection</p> <p><u>Examiner's Comments</u></p> <p>Most candidates achieved at least one mark in this question. Many were able to achieve both marking points. This was most often achieved by describing the use of a sharp scalpel (or similar) linked to the risk of cutting themselves. Many described cutting the vascular tissue away from themselves. However, it was less common for those candidates who selected to wear gloves or eye protection to accurately describe an appropriate risk; many responses described the use of gloves or goggles as a measure to reduce cuts, rather than avoid plant material causing irritation or infection.</p>
	b	i	<p><i>Safety precaution</i> cut away from the body</p> <p>or <i>idea that</i> only one person at a time should work on the specimen</p> <p>or use sharp, scalpel / scissors / knife / (razor) blade ✓</p> <p><i>explanation</i> to avoid cuts / AW ✓</p> <p>OR</p> <p><i>Safety precaution</i> wash specimen / wash hands / wear gloves ✓</p> <p><i>explanation</i> to avoid, infection (with plant pathogens) / allergic reaction / AW ✓</p>	2max	
		ii	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.17 award two marks</p>	2	<p>ALLOW 1 mark if answer not given to 2 sig figs</p> <p>ALLOW any number of significant figures for mp1 (the working mark)</p>

		<p>15 (mm) / 90 or 0.166 ✓</p> <p>(2 significant figures =>) 0.17 (mm) ✓</p>		<p>ALLOW ECF from step 1 for an incorrect measurement divided by 90 and correctly rounded to 2 sig figs for 1 mark</p> <p>e.g. 1.5(cm) / 90 = 0.0166 and = 0.017 for 1 mark</p> <p><u>Examiner's Comments</u></p> <p>This mathematical calculation posed little challenge to the majority of candidates. The most frequent source of error related to undertaking the initial measurement in centimetres and not correctly converting this unit to millimetres. Occasionally, candidates did not round the response appropriately. An incorrect measurement divided by 90 and correctly rounded to 2 sig figs was awarded 1 mark.</p>
c	i	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 28 / 28.3 award two marks</p> <p>1mm / 2 = 0.5 0.5² = 0.25 × π = 0.78539 x 18 = 14.137 ✓ x 2 = 28.274</p> <p>= 28 mm³ h⁻¹ ✓</p>	2	<p>ALLOW 1 mark for correct answer not rounded to two or three significant figures (e.g. 28.27433, 28.2857, 28.26, 28.278) (depending on value of π used)</p> <p>ALLOW 1 mark for correctly working out volume of water lost in 30 minutes to any number of sig figs (e.g. 14.137165, 14.142855, 14.13, 14.139) (depending on value of π used)</p> <p>ECF if diameter rather than radius used to calculate volume (110 or 113) for 1 mark</p> <p><u>Examiner's Comments</u></p> <p>Although many candidates achieved both marks for this question, this proved more challenging than Question 3 (b) (ii). Errors were spread across the different steps of the calculation. A reasonable proportion of candidates did not correctly calculate</p>

				<p>the radius from the provided diameter; others did not square this number before proceeding through the remainder of the calculation. The most common error related to the conversion of 30 minutes into hours: either not converting it (and expressing an answer per 30 minutes) or halving their answer (and expressing an answer per 15 minutes). The response could be given to either two or three significant figures to take into account the analogue scale of the potometer provided. However, many candidates inappropriately responded to four significant figures (28.57) and were not able to gain 1 mark. On some scripts, no working was shown and so 1 mark for correctly working out the volume of water lost in 30 minutes, even if the final answer was incorrect, could not be given.</p>
	ii	<p>Level 3 (5-6 marks) Detailed description of data to be collected and description of control variables and appropriate choice of statistical test.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3-4 marks) Detailed description of data to be collected and Description of control variables or appropriate choice of statistical test.</p> <p><i>There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1-2 marks) Description of data to be collected or description of control variables or appropriate choice of statistical test.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by</i></p>	6	<p>Loss of mark for communication statement - if the data collected was inappropriate for the experiment e.g. temp range not given or inappropriate (less than 5 temps used, temp range below 10 or above 45°C), use of a water bath to control temperature, OR statistical test inappropriate for data collected (see below) OR if the answer contained lots of irrelevant detail of how to set up and use a potometer.</p> <p>Indicative scientific points may include (but are not limited to):</p> <p><i>data collected</i></p> <ul style="list-style-type: none"> • (appropriate) range of temperatures (e.g. 10, 15, 20, 25, 30, 35, 40, 45 °C) • detail of how temperature will be regulated (e.g. use of a climate-controlled room) (note a water bath is not appropriate in this experiment) • at least three repeats (at each temperature)

		<p><i>limited evidence and the relationship to the evidence may not be clear.</i></p> <p>0 marks No response or no response worthy of credit.</p>	<ul style="list-style-type: none"> • identify anomalies • calculate, means / standard deviation <p><i>validity/controls</i></p> <ul style="list-style-type: none"> • area of leaf / number of leaves • humidity • light intensity • same plant (but ignore same spp. as this is given in stem of question) • air movement • time • distance bubble moves • details of how to control these variables <p><i>Statistical test</i></p> <ul style="list-style-type: none"> • Spearman's rank / Pearson correlation coefficient (if comparing 5 or more temperature values) • t test (if comparing two temperatures) <p><u>Examiner's Comments</u></p> <p>This level of response question was generally well-attempted by candidates, who demonstrated knowledge of investigative skills developed through their studies. Although many candidates gained credit in line with Level 3, relatively few candidates achieved the communication mark. Despite the question stating that no details of the potometer set-up were needed, a large number of candidates did include this within their responses. Very rarely did candidates suggest an appropriate range of temperatures, with many exceeding 50°C or going below 10°C. Sometimes only three or four values were suggested (which would be too few to analyse with Spearman's rank correlation coefficient) or candidates didn't give a temperature range at all. Few candidates were able to describe how a change in temperature could be maintained appropriately around the plant within the potometer (e.g.</p>
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references to using a water bath, which would be inappropriate for a land-based plant, or vague references to using a thermometer). As a result, these candidates would not be able to gain the communications mark. The selection of a Student t-test was commonly seen but was not appropriate for assessing the significance of a correlation between a temperature range (that most candidates chose to include) and the rate of transpiration; it would be appropriate if comparing two temperatures. Many candidates made sound statements relating to undertaking a suitable number of repeats at each temperature and calculating a mean or SD, although some candidates merely stated 'repeat the experiment' which was unclear. The most common controlled variables provided related to the duration of each test, leaf surface area, the light intensity, or humidity. Some answers listed many irrelevant control variables, such as water volume, pH, and carbon dioxide concentration. Few candidates articulated how a variable, such as light intensity, would be controlled.

Exemplar 1

The distance moved by the air bubble should be measured over 30 minutes at 20°C, 25°C, 30°C, 35°C and 40°C. The measurement should only begin after the potometer and plant have acclimatised to the new temperature for 15 minutes. The measurements should be repeated for each temperature 10 times, and the mean and standard deviation of the rate of transpiration should be calculated for each temperature. The rates of transpiration for each temperature should be noted and Spearman's rank correlation coefficient can be calculated to determine if there is a positive, negative or no correlation between temperature and rate of transpiration. [4]

Although the temperatures are listed in an unusual order and are not evenly spaced, this range can be credited as a 'data collected' point. 'Repeated for each temperature' and 'calculate a mean/standard deviation' can also be credited. The answer includes an appropriate statistical test (Spearman's rank). However, there is only one clear control variable (acclimatising for 15 minutes). For Level 3 more than one

					<p>data collection point is needed (which this answer has), an appropriate statistical test (which this answer has), and more than one control variable point (which this answer does not have). This means that Level 2 is the maximum level that can be awarded. The temperature range given is suitable as is the stats test and the answer does not contain irrelevant information, so the communication mark can be awarded – Level 2, 4 marks.</p>
			Total	14	
2	a	i	<p>Tissue E = cambium ✓ Tissue F = phloem ✓</p>	2	<p>If no response check labels on picture ALLOW meristematic tissue / meristem DO NOT ALLOW stem cells</p> <p>DO NOT ALLOW phloem sieve tubes</p> <p><u>Examiner's Comments</u></p> <p>Candidates who were familiar with microscopic images of plant tissues and their histology were given both marks. Many knew that the first label was meristem/cambium, but many thought that the second one was xylem. Some candidates could not label either correctly, although candidates did generally attempt to put a form of plant tissue as a response which showed that they knew the content but were unable to apply it to an unfamiliar image.</p> <p> Assessment for learning</p> <p>Picture quizzes are a fun and quick way to recap and explore different images of key parts of the course. They can be done within a topic or built up over the course to include various images such as specialised cells, biological molecule structures, plant transport tissues, root structure, different blood cells, different blood</p>

					vessels, different ECG traces, etc. The images can also be linked to different types of microscopes and used as talking points to recap and revise content.
		ii	<p>pits allow water to move into,</p> <ol style="list-style-type: none"> 1. adjacent xylem vessels / other cells / lateral parts of the plant ✓ (vessel) walls contain lignin, for structural support / to prevent collapse 2. OR (vessel) walls contain lignin to prevent water loss from vessel ✓ no end walls (in vessel) / hollow (vessels), for continuous water transport / continuous column of water ✓ 3. vessels are narrow to contribute to 4. capillary action (for water transport) ✓ 5. lignin allows for adhesion of water molecules to the vessel walls ✓ 	2 max	<p>DO NOT ALLOW if linked to incorrect tissue e.g. phloem</p> <p>DO NOT ALLOW ref to 'cell' walls</p> <p>IGNORE no cell walls at ends of cells ALLOW no cytoplasm / cell contents ALLOW does not impeded flow of water for continuous water transport</p> <p>ALLOW capillary action linked to lignin in (vessel) walls</p> <p><u>Examiner's Comments</u></p> <p>This question discriminated well with more successful responses being given 2 marks. These candidates were able to correctly identify xylem, but then were also able to use good biological terminology to explain the adaptations stated. Those who were not given any marks often just stated the adaptations without explaining their function, suggesting they had not picked up on the 'explain' in the stem of the question or that their content knowledge was lacking. Few candidates stated that the cell walls were lignified showing good understanding of the structure of xylem as a tissue not a cell. Candidates who did not score well also referred to water storage features such as succulent/fleshy leaves and/or water collection methods like deep roots so not interpreting the question correctly or not knowing xylem's function.</p>
	b		<p>cell walls ✓</p> <p>Casparian strip ✓</p> <p>plasmodesmata ✓</p>	3	<p>ALLOW phonetic spelling for Casparian and plasmodesmata</p> <p><u>Examiner's Comments</u></p> <p>Many candidates were given 3 marks here, but there were some who could not fill in the gaps at all. The most commonly known missing term was 'cell wall', although some lost this by</p>

					giving 'spaces between cell walls'. Many variations of the spelling of 'casparian' and 'plasmodesmata' were seen and phonetic spelling was accepted.
	c		<p>rolled / small leaves / leaves reduced to spines/ scales/ needles , to reduce the surface area for transpiration ✓</p> <p>1. OR leaves reduced to spines/ scales/ needles, to reduce the surface area for transpiration ✓</p> <p>2. thick(er) waxy cuticle to reduce/prevent transpiration ✓</p> <p>3. sunken stomata / stomata in sunken pits to , maintain humidity / reduce water potential gradient / reduce transpiration ✓</p> <p>curled leaves / rolled leaves / hairs / spines / sunken stomata, to reduce, air movement / effect of wind / reduce water potential gradient</p> <p>4. OR curled leaves / rolled leaves / hairs / spines / sunken stomata, to, trap water vapor / increase humidity ✓</p> <p>5. reduced number of stomata/leaves , to reduce transpiration ✓</p> <p>6. hinge cells shrink when flaccid so leaf rolls , creating a humid space / to reduce transpiration ✓</p> <p>7. stomata on upper epidermis so they open into the rolled space which is more humid , to reduce transpiration ✓</p> <p>8. stomata closed during day / only open at night , to reduce transpiration ✓</p>	2 max	<p>IGNORE ref to fleshy leaves / deeper roots</p> <p>IGNORE water loss throughout</p> <p>ALLOW water vapor loss and/or ref to evaporation for transpiration throughout</p> <p>DO NOT ALLOW thorns</p> <p>DO NOT ALLOW thorns</p> <p>IGNORE regulate humidity</p> <p><u>Examiner's Comments</u></p> <p>Most candidates were not given any marks for this question. Some were given 1 mark, but very few were given 2. Candidates who were given 2 marks were aware of the need to 'explain' the water loss, so picked up on the command word in the stem and were also aware of the need to use proper terminology linking adaptations to water 'vapour' loss and/or 'reduced transpiration' which was key for a number of the marking points. Many candidates referred to 'small leaves' but did not mention 'surface area'. Like wise, 'thick' was often missing from marking point (MP) 2. MP3 was seen, but many candidates were vague in their responses and did not receive marks. MP4 and 5 were commonly described. MP6 and 7 were rarely seen. Quite often, information from the stem of the question (prevents water loss) was used rather than an explanation of how the adaptation prevented the water loss. Candidates who did not interpret the question well also discussed xerophyte having long roots and water storage features.</p> <p> Misconception</p>

					<p>Many candidates referenced stomata on the underside of the leaf and did not recognise that this also applies to non-xerophytic plants too. This was also seen where candidates noted that the waxy cuticle reduced evaporation of water from leaves without pointing out that xerophytes have 'thick(er)' waxy cuticles, as all plants have a waxy cuticle.</p> <p>Exemplar 2</p> <p><i>1. Thick waxy cuticle to prevent water loss through the transpiration.</i> <i>2. Sunken stomata to slow the rate of evaporation.</i></p> <p>Exemplar 2 clearly states the adaptation and how this links to reducing water loss in a concise way using the correct terminology and they are given 2 marks. They do not need to state water 'vapour' loss as they have used other correct terminology to make this point apparent.</p>
			Total	9	
3			C ✓	1	<p><u>Examiner's Comments</u></p> <p>Most candidates were able to get the correct response C by using the line of best fit to estimate the rate (difference in y/difference in x), and a number were seen to annotate the graph to help them do this which is good practice.</p>
			Total	1	
4	a	i	evaporation of water (molecules) / loss of water vapour/ water potential gradient (between leaf and atmosphere) / gaseous exchange (for photosynthesis) ✓	1 (AO1.2)	<p>IGNORE ref to osmosis ALLOW water potential gradient described</p> <p><u>Examiner's Comments</u></p> <p>Although this was a state descriptor, candidates struggled to summarise one aspect of water transport that could cause transpiration and often referred to the movement of water through the xylem rather than the terminal aspect of transpiration in the leaf. Some candidates did refer to the loss of water but were not precise</p>

					enough with their language and did not refer to water vapour or evaporation.
		ii	<p><i>Any one from</i></p> <p>temperature ✓ light <u>intensity</u> ✓</p>	1 (AO1.2)	ACCEPT soil water content / (number of) stomata
	b	i	<p><i>Any three from:</i></p> <p>1 close dome off at bottom/ seal a clear plastic bag which can be tied (to stem of shoot) ✓ 2 testing, more/ lots of, humidities OR repeat more than x3 ✓</p> <p>3 group A cover leafy shoot (with a clear dome) ✓ 4 control, (room) temperature / light intensity ✓ 5 limit air movement ✓ 6 same area sprayed/even spray, each time ✓ 7 same/measure, volume (of water) in each spray ✓ 8 same, type of plant/size of leaves, used each time ✓ 9 check humidity level with, relative humidity meter / hygrometer OR use a humidifier ✓</p>	Max 3 (AO3.3)	<p>IGNORE ref to (all use same) apparatus as this is stated in the question. 1 ALLOW ensure the, dome/bag is airtight</p> <p>2 IGNORE do more trials unqualified/ Group A use apparatus in Fig 2.2 2 ALLOW all groups should do all humidities. 3 ALLOW Group A use a clear dome</p> <p>6 ALLOW distance the spray is used stays same 7 IGNORE amount for 'volume' 8 ALLOW same, stomatal density/ number of leaves/ surface area for 'same size leaves'</p> <p>Examiner's Comments</p> <p>Most candidates achieved 1 mark although few achieved all 3 marks available. Candidates tended to confuse the improvements with the setting up of the potometer itself. Candidates were discussing how to make sure the potometer is set up under water and various aspects of the components in Figure 2.1, suggesting they had not appreciated the given statement that all groups already had the potometer set up. Many candidates did appreciate that the volume of water in each spray should be constant but did not state volume, referring to amount of water.</p> <p> Assessment for learning</p> <p>Visualisation is key to questions like this that have more than one figure and a long stem. Candidates should realise that each group had the same set up, then they varied in their</p>

				<p>experimental design and it is the latter that the question was asking about. Working in groups, potometers could be already set up on tables (or cut out from a picture if actual apparatus is not plentiful) and then candidates asked to add apparatus that could test a particular factor. This will make it clear that all questions related to potometers are not just about how they are set up and how they work but what else can be added to enhance an investigation into transpiration rate.</p> <p> Assessment for learning</p> <p>Precision of language is very important and a good mantra to use with candidates every lesson is to 'be as precise as you can with the knowledge that you have'.</p>
	ii	<p>FIRST CHECK THE ANSWER IN TABLE / ON ANSWER LINE.</p> <p>mean = 31.7 ✓</p> <p>rate of bubble movement = 10.6 ✓</p>	<p>2 (AO2.8)</p>	<p>ALLOW for 1 mark mean and rate given to >1 decimal place mean = 31.66(66) rate per minute group A = 10.55(56)</p> <p>ECF from incorrect mean e.g. 'Mean 31.6/ 3 = 10.5' = 1 mark</p> <p><u>Examiner's Comments</u></p> <p>Most candidates correctly worked out a rate from their mean value. The most common error for the mean was 31.6 from an incorrectly rounded calculation. Some candidates wrote 31.6 with the recurring dot notation without appreciating that this is not showing the answer to one decimal place.</p> <p> OCR support</p> <p>Correctly rounding values is discussed in maths skills handbook as well as the 'Maths for Biology' resources (Module 0).</p>

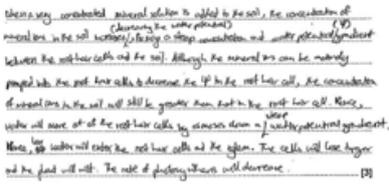
		iii	the greater the humidity, the lower the, (rate of) water uptake / transpiration ✓	1 (AO3.2)	<p>IGNORE ref to movement/distance, of bubble</p> <p><u>Examiner's Comments</u></p> <p>A lot of candidates stated the conclusion 'of' the candidate's results with reference to the movement of the bubble with increasing sprays. They did not develop this further to a conclusion that can come 'from' the candidate's result by referring back to humidity and transpiration as stated in the original stem of the question.</p>
	c		<p>1 remove , plastic dome / cover / spray bottle✓</p> <p>2 place fan at different distances (from the apparatus) / fan, set to/with, different speeds (at same distance) ✓</p>	2 (AO3.3)	<p>1 ALLOW use a fan instead of, plastic dome/water spray/spraying the plant</p> <p>1 ALLOW ref to plastic bag for 'plastic dome'</p> <p>1 ALLOW diagram showing absence of dome/spray bottle</p> <p>2 ALLOW hair dryer set on cold for 'fan'.</p> <p>2 ALLOW fan placed at a set distance compared with no fan.</p> <p>IGNORE use fan to look at different air movement unqualified.</p> <p><u>Examiner's Comments</u></p> <p>This question was well answered with most candidates referring to the use of fan at different settings. It was often not stated that the plastic dome should be removed to avoid humidity being a conflicting variable. Candidates should appreciate that investigations at this level should focus on one variable only and control any other factor that could have an impact on the results.</p>
			Total	10	
5			C ✓	1	
			Total	1	
6	a	i	<p>FIRST CHECK ON ANSWER LINE</p> <p>(SA:V cube is) 3:1 ✓✓</p>	2 (AO2.6)	<p>ALLOW one mark for:</p> <p>Surface area/SA (of cube): $2 \times 2 = 4$, $4 \times 6 = 24$ Volume/V (of cube): $2 \times 2 \times 2 = 8$ OR $24:8 \checkmark$</p>

					<p><u>Examiner's Comments</u></p> <p>The majority of candidates achieved this mark and showed clear calculation steps for their workings. Some candidates did not simplify their ratio or worked out the volume: surface area ratio, instead.</p>
		ii	<p><i>Any 2 from:</i></p> <p><i>Large/Multicellular plant/ It</i></p> <p>1 SA:V ratio is small(er) ✓ 2 diffusion, distance / pathway, long(er) ✓</p> <p>3 diffusion / gas exchange, (too) slow OR (named) assimilates/ nutrients / ions / gases, unable to reach inner cells (quickly enough) ✓</p> <p>4 metabolic/energy, demand is great(er) ✓</p>	Max 2 (AO1.2)	<p>ALLOW ORA for small plant throughout</p> <p>4 ALLOW metabolic demand is not met</p> <p><u>Examiner's Comments</u></p> <p>This question was well answered with most candidates achieving 1 mark for recognising that large multicellular plants have a small SA:V although less successful candidates stated they had a large SA:V. Candidates who did not achieve maximum marks discussed the increased distance in large plants without relating this to diffusion.</p>
	b		<p>Level 3 (5–6 marks)</p> <p>Full and detailed description of the structure and function of both sieve tubes and companion cells. Refers to labels as shown in Fig 1.2.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks)</p> <p>A clear description of the structure and functions of phloem tissue. Some labels from Fig. 1.2 referred to.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks)</p>	6 (AO1.2×3) (AO2.5×3)	<p>Indicative points can include:</p> <p><u>Function</u></p> <p>Sieve tube elements</p> <ul style="list-style-type: none"> -translocation - transport of, assimilates/ (organic) solutes/sucrose/amino acids. -tissue made up of sieve tube elements and companion cells. -allows mass flow / transport down a pressure gradient -up and down plant / From source to sink/ bidirectional. -allows movement with less resistance. -(assimilates/AW used in) respiration / synthesis of (named) molecules. <p>Companion cells</p> <ul style="list-style-type: none"> -'life (non-structural) support' to sieve tube elements -gains sucrose from, mesophyll cell/source -(gains sucrose using) protons/H+/energy/ active

		<p>An account of some of the description of the structure AND function of phloem tissue OR</p> <p>A clear description of the structure OR function of phloem tissue. Limited reference to Fig. 1.2.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 mark</p> <p><i>No response or no response worthy of credit.</i></p>	<p>transport/active loading -allow / load, sucrose/ (organic) solutes (into sieve tube element)</p> <p><u>Structure</u> Sieve tube elements – -living cells -long / hollow/ continuous, tubes -stacked end to end, to allow mass flow/ for less resistance/to connect source to sink -no nucleus/little cytoplasm/few organelles -end walls are sieve plates -walls are, thin -(walls are) not lignified -sieve, plates /pores, to allow (named) solutes through/limit size passing through -sieve pores linking cytoplasm of adjacent cells -sieve, pores/plates to reduce (rate of) flow</p> <p>Companion cells – -(dense) cytoplasm / (lots of) mitochondria -(large) nucleus. -plasmodesmata, (connecting to sieve tube elements).</p> <p><u>Examiner's Comments</u></p> <p>This was a highly discriminatory question. More successful candidates referred to the wording in the question to set out their answer, discussing structure of the phloem first and then function. Less successful candidates confused the phloem with xylem, with lots of references to water and mineral ion transport as well as the sieve tube elements composed of dead/lignified cells. Few candidates referred to sieve tube elements having limited cytoplasm although they did recognise that companion cells provide life support to the sieve tube elements. Candidates often referred to assimilates simply as sugars or substances and sometimes glucose.</p> <p>Exemplar 1</p>
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					<p>assimilates are in the sieve tube element, movement is by mass flow.</p> <p> Assessment for learning</p> <p>To help embed the understanding of sucrose being transported in phloem, reference could be made to aphids and insects that suck out the cell sap and the relative sweetness of sucrose compared to glucose (or indeed water as some candidates stated). Acronyms like PSST (whispered) are good tools for recall, Phloem (with) Sweet Sucrose (for) Transport- as an example.</p>
			Total	10	
7	a	i	<p>movement of <u>water</u> ✓</p> <p>from roots to leaves ✓</p>	2 (AO1.2)	<p><u>Examiner's Comments</u></p> <p>Generally, well answered with most candidates describing the movement of water. However, some candidates stated '...through the xylem', without including the fact that transport starts at the roots and ends at the leaves. Some candidates went into unnecessary detail about the cohesion-tension theory or focused on the loss of water vapour from the leaves rather than on the transpiration stream.</p>
		ii	<p>to prevent air from breaking the water column ✓</p> <p>to reduce , evaporation / loss of water vapour ✓</p> <p>prevent entry of pathogens ✓</p>	max 1 (AO2.7)	<p>ALLOW prevents air locks (in xylem) ALLOW maintain continuous column of water / not break the transpiration stream</p> <p><u>Examiner's Comments</u></p> <p>Good responses recognised that pathogens could potentially enter the bore hole or that it was important not to break the transpiration stream. Some candidates stated the sealing of the borehole prevented the loss of water or the dye and did not appreciate that it would prevent water <u>vapour</u> leaving the hole rather than liquids.</p>

		iii	<p><i>idea</i> of cutting a series of sections at intervals along stem ✓</p> <p>transverse / longitudinal , section(s) ✓</p> <p><i>idea of taking</i> from above and below the site of injection ✓</p> <p>(view sections) using a microscope ✓</p>	<p>max 2 (AO3.3)</p>	<p>ALLOW e.g. cut several sections , at intervals / along the stem</p> <p>ALLOW cross section for transverse</p> <p>ALLOW see if dye visibly appears in leaves / flowers / stem</p> <p><u>Examiner's Comments</u></p> <p>Most candidates described how to observe the dye, e.g. using microscope. It is possible that candidates lacked practical experience of sectioning and staining a specimen for viewing under the microscope as some responses were vague and did not include reference to cutting sections at intervals. Many candidates were able to gain credit for describing the visible appearance of dye in the leaves, flowers or stem, although some incorrectly described the use of fluorescent, radioactive, or different coloured dyes. Incorrect responses often gave suggestions of inappropriate apparatus to use, e.g. a potometer or colorimeter, again perhaps demonstrating lack of practical knowledge.</p>
	b	i	<p>the (fertiliser) solution would lower water potential (of soil) ✓</p> <p>water moves out of (root) cells (into soil) by osmosis OR less water enters (root) cells (from soil) by osmosis ✓</p> <p>plant loses more water than it gains / AW ✓</p> <p>(in aerial parts of plant) turgor (pressure) is reduced ✓</p>	<p>max 3 (AO2.3)</p>	<p>ALLOW water potential of root cells would be higher than soil</p> <p>ALLOW down water potential gradient for osmosis</p> <p>ALLOW (leaf) cells are , flaccid / plasmolysed</p> <p><u>Examiner's Comments</u></p> <p>Good responses were those where candidates recognised that increased mineral ion content would lower the water potential of the soil so prevent uptake of water into root hair cells by osmosis. Weak responses often repeated the question stem about the plant wilting rather than describing that</p>

				<p>it is the loss of turgor pressure in the cells of the leaves which caused the plant to wilt.</p> <p>Exemplar 3</p>  <p>This exemplar shows a good response for this question. All 3 marking points clearly stated using appropriate scientific terminology.</p>
	ii	<p><i>correct because</i></p> <p>1 ATP is required for active transport of mineral ions into , root (cells) / xylem ✓</p> <p>2 (so) no water potential gradient (into root / xylem) / AW ✓</p> <p><i>incorrect because</i></p> <p>3 cyanide (ions) may not have entered roots ✓</p> <p>4 plant cells may be tolerant to cyanide ions ✓</p> <p>5 concentration of cyanide ions may not be high enough (to inhibit ATP synthesis) ✓</p>	<p>max 2 (AO3.1)</p>	<p>ALLOW more mineral ions remain in soil</p> <p>Examiner's Comments</p> <p>Most candidates agreed with the teacher in the question stem for their responses so few alternative statements were seen. Some candidates were unable to link ATP to active transport of mineral ions into root hair cells, necessary to allow a water potential gradient to be established. Some responses included reference to generic situations where ATP would not be synthesised so the plants would not be able to carry out metabolic processes, growth, photosynthesis, sucrose loading etc. which were not credited.</p>
	iii	<p>(high light intensity) increases (rate of), light-dependent reaction / LDR / photosynthesis ✓</p> <p>more stomata open to allow , gas exchange / entry of carbon dioxide ✓</p> <p>(high light intensity) increases transpiration so more , evaporation / water vapour is lost ✓</p>	<p>max 2 (AO2.3)</p>	<p>ALLOW more photolysis</p> <p>ALLOW stomata widen to allow , gas exchange / entry of carbon dioxide</p> <p>Examiner's Comments</p> <p>Good responses showed understanding that high light intensity would increase the rate of photosynthesis and included good use of comparative descriptions. Weak responses often stated that no photosynthesis would occur in the</p>

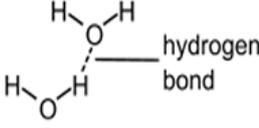
					<p>shade. Some candidates correctly described the effect of light intensity would have on increased stomatal opening but did not link this to more gas exchange. Although some candidates did refer to increased transpiration it was not always linked to increased loss of water vapour.</p> <p> Misconception</p> <p>A common misconception is about transpiration. Loss of water is often identified but it is important that correct terms are used, and candidates are aware that it is water <u>vapour</u> that leaves through stomata. It would be acceptable to state loss of water by evaporation.</p>
			Total	12	
8			A ✓	1 (AO1.2)	<p><u>Examiner's Comments</u></p> <p>This question required knowledge of different water transport pathways, properties of water and also osmosis to formulate a response. A variety of incorrect options were seen, e.g. option C where candidates had confused adhesion and cohesion.</p>
			Total	1	
9	a		<p>any three from:</p> <p>Max 2 from explanations... 1 (large size requires) transport over long distances / AW ✓</p> <p>2 diffusion too slow / diffusion distance too great / cannot rely on diffusion alone ✓</p> <p>3 low / small, surface area to volume ratio / SA to V ratio / SA:V ✓</p> <p>Max 2 from examples... 4 (to) transport, water / ions, from roots to, cells / other parts of the plant ✓</p>	3 (AO1.1)	<p>MP1 ALLOW e.g. transporting water from roots to the leaves (in a tree) is a long way =MP1 + MP4</p> <p>MP2 ALLOW diffusion is not sufficient to meet the needs of the plant or meet metabolic demand</p> <p>MP 2 IGNORE diffusion is not efficient</p> <p>MP5 IGNORE glucose</p>

			<p>5 (to) transport, sucrose / products of photosynthesis / (named) assimilates, from, source to sink ✓</p> <p>6 (to) transport (named) hormones produced in one part to site of action / AW ✓</p>		<p>MP5 ALLOW correct examples of source and sink MP5 ALLOW e.g. amino acids for assimilates</p> <p><u>Examiner's Comments</u></p> <p>Generally, this question was well answered, with the majority of candidates able to gain 1 or 2 marks for explanations. Candidates demonstrated their knowledge of transport systems in plants and why they were needed, but examples often lacked required detail about the substance being transported or its source or destination, e.g. water transported from roots to leaves. Some candidates stated that glucose, not sucrose, is transported in the phloem and others made incorrect reference to multicellular plants having a large surface area to volume ratio.</p> <p> Assessment for learning</p> <p>Candidates should be encouraged to learn how to distinguish between specific organs that have an increased surface area, such as the leaf, and an entire multicellular organism which has a much lower SA:V.</p>
	b	i	B = phloem ✓	1 (AO1.1)	<p>IGNORE cambium</p> <p><u>Examiner's Comments</u></p> <p>The majority of candidates were able to identify phloem tissue from Fig. 16.1.</p>
		ii	<p>transport of, water / (named) ions ✓</p> <p>(mechanical / structural) support ✓</p>	2 (AO1.2)	<p>Mark as continuous prose</p> <p>ALLOW transport of (some) hormones</p> <p>IGNORE strength</p> <p><u>Examiner's Comments</u></p> <p>Good responses stated two distinct functions, i.e. transport and support, to gain both marks. Some candidates</p>

					considered transport of water and transport of mineral ions as two separate functions, thereby only gaining 1 mark.
	c		<p>The feature (F) and explanation (E) must match <i>max 2 for features and max 2 for explanations</i></p> <p>F1: lignin / lignification ✓</p> <p>E1: provides support / prevents collapse / prevents water loss ✓</p> <p>OR</p> <p>F2: <u>spiral</u> (thickening) ✓</p> <p>E2: allows flexibility ✓</p> <p>OR</p> <p>F3: hollow (vessels) ✓</p> <p>E3: minimises resistance to flow of water / AW ✓</p> <p>OR</p> <p>F4: (bordered) <u>pits</u> / <u>pitted</u> ✓</p> <p>E4: allows, passage / lateral movement, of water between, xylem / vessels ✓</p>	Max 4 (AO2.5)	<p>Mark as continuous prose If reference to phloem is in incorrect context penalise once and then use ECF</p> <p>E1 ALLOW waterproofing E1 IGNORE strength</p> <p>F3 ALLOW no organelles / no cytoplasm / no end walls F3 IGNORE tube / named organelle e.g. nucleus</p> <p>E3 ALLOW allows water to flow freely / move as one (continuous) column</p> <p>F4 DO NOT ALLOW plasmodesmata</p> <p>E4 ALLOW allows passage of water into / out of xylem / vessels E4 ALLOW e.g. allows water to move from xylem / vessels to cells</p> <p>Examples: e.g. has lignin but no nuclei to allow water to flow freely = 2 marks e.g. is a vessel to minimise resistance to water flow and holes to allow lateral flow of water between vessels = 2 marks e.g. if F1, F2 and E3 are seen within the response = 2 marks as feature and explanation do not match</p> <p><u>Examiner's Comments</u></p> <p>Many candidates clearly understood the role of lignin in supporting xylem vessels, waterproofing them and preventing collapse under tension. Responses referring to spiral</p>

					<p>thickening providing flexibility and hollow tubes facilitating free flow of water were less commonly seen by examiners. Some candidates incorrectly identified the tissue in Fig. 16.2 as phloem or thought that both xylem and phloem were present. Other candidates misidentified the pits in the xylem vessel walls as plasmodesmata found in phloem tissue.</p> <p> Assessment for learning</p> <p>When comparing pits in xylem vessels with plasmodesmata in phloem, it is interesting to note that the role of plasmodesmata is to avoid passage through membranes, whereas bordered pits have 'pit membranes' through which water and dissolved ions travel.</p>
			Total	10	
10		i	<p>sucrose, diffuses / moves down a concentration gradient, into the, Visking tubing bag / delivery tube ✓</p>	1	<p>DO NOT ALLOW sucrose solution diffuses</p> <p><u>Examiner's Comments</u></p> <p>Only the most able candidates scored well here. The uncertainty about the role of osmosis continued into this question. It was clear that many candidates were not confident with the nature of an aqueous solution, osmosis or diffusion. Most candidates did not understand that sucrose molecules diffused from the flask into the Visking tubing. Many suggested that the sucrose solution moved or even diffused into the Visking tubing.</p>
		ii	<p>water potential inside the Visking tubing is reduced ✓</p> <p>(water potential inside the Visking tubing) is lower than the water potential in the beaker ✓</p> <p>(so) water moves, by osmosis / down water potential gradient, into the Visking tubing ✓</p>	Max 2	

			pushing water into the capillary ✓		<p>ALLOW pushing / moving, coloured water up</p> <p><u>Examiner's Comments</u></p> <p>Only a few candidates gave excellent answers with correct references to water potential and the relative differences or gradients. Some candidates realised that the sucrose lowered the water potential in the tubing but did not link that to movement of water by osmosis or did not make it clear that the water moved into the Visking tubing. Most responses, however, simply talked about the sucrose solution moving through the apparatus or capillary action moving fluid up the capillary tube. Quite a few candidates referred to active transport or facilitated diffusion being responsible for the observed changes showing a misunderstanding of the question.</p>
		iii	<p>phloem / sieve tube (element) ✓</p> <p>xylem ✓</p> <p>companion cell ✓</p>	3	<p>Mark first answer only</p> <p>ALLOW named surrounding tissue eg. Parenchyma</p> <p><u>Examiner's Comments</u></p> <p>Many candidates were able to identify the capillary as representing the phloem or the sieve tube, but few were able to identify the other tissues represented. Indeed, many candidates identified plant organs (the leaf, the root) or abiotic factors, such as soil, rather than plant cells or tissues as asked in the question. It was clear that few candidates were able to correctly match the model to sucrose movement in a plant. This suggests that few have had access to similar models or used apparatus to demonstrate sucrose transport.</p>
			Total	6	

11	a	i	<p>water molecules correctly drawn ✓</p> <p>horizontal / vertical, dashed line between H of one molecule and O of the adjacent molecule ✓</p> <p>hydrogen bond labeled ✓</p>	3	 <p>Examiner's Comments</p> <p>Many candidates were able to draw correct diagrams of two water molecules and most went on to gain full credit for both the bond and labelling. Occasional errors included water molecules with two oxygen atoms to one hydrogen and bonds drawn between two hydrogen atoms on separate molecules.</p>
		ii	<p>cohesion, attracts / holds, water molecules together ✓</p> <p>allows chain of water molecules to be pulled up xylem ✓</p> <p>adhesion allows water molecules, to stick / AW, to xylem vessel <u>walls</u> ✓</p> <p>(moving water up vessel) by capillary action ✓</p> <p>(water as) a solvent to dissolve, sucrose / assimilates, for, transport in the phloem / translocation</p> <p>OR</p> <p>(water as) a solvent to dissolve ions for transport in the, xylem / transpiration stream ✓</p>	Max 3	<p>ALLOW cohesion, water molecules form hydrogen bonds with each other</p> <p>ALLOW named ions /correct ion formulae</p> <p>Examiner's Comments</p> <p>There was a lot of good knowledge about the properties of water, but the wording used often lacked scientific precision. In particular many candidates had an understanding of both cohesion and adhesion. However, answers were imprecise and often did not relate to the role of water as a transport medium in plants. Many candidates did not specify that water 'molecules' stick together or that water 'molecules' adhere to the walls of the xylem. Very few candidates mentioned specific transport vessels merely saying things like 'water forms a</p>

					<p>column that allows it to move up the stem.</p> <p>Some candidates included properties of water unrelated to transport functions such as specific heat capacity.</p> <p> Misconception</p> <p>Some candidates have a basic misunderstanding of solutions and wrote phrases such as 'water is soluble' while others wrote about water 'wanting' to go up the stem. This was the same with Question 24.</p> <p>Exemplar 3</p> <p><i>Water has cohesive and adhesive properties. Cohesion means that water can form bonds via other water molecules and adhesion means that it can also attach to surfaces. In the stem, water molecules are attracted to each other and the narrow xylem tissue system which creates a supply of water which can then be drawn up.</i></p> <p>The exemplar shows a clear script that uses scientific terms correctly.</p>
b	i		<p>meristem correctly identified ✓</p> <p>ruler used and no arrow on label ✓</p>	2	<p></p> <p>ALLOW any one of the four areas</p> <p>Examiner's Comments</p> <p>Relatively few candidates gained credit here. Most were unable to identify the correct area of the image as meristem, possibly because they were confused by the sclerenchyma. Many candidates also did not use a ruler for the label line or added an arrowhead.</p> <p> OCR support</p> <p>Guidance on how to correctly label</p>

					<p>images is given in the drawing skills handbook available at:</p> <p>https://www.ocr.org.uk/Images/251799-biology-drawing-skills-handbook.pdf</p>
		ii	<p>light microscope ✓</p> <p>Any two from: low magnification ✓</p> <p>low resolution / resolution is not high enough for TEM/SEM ✓ can see, tissues / whole cells ✓</p>	Max 3	<p>IGNORE lower</p> <p>ALLOW cannot see, organelles / components of cells / ultrastructure</p> <p>If candidate answers transmission mic on top line: ALLOW mark for 2D IGNORE not 3D</p> <p><u>Examiner's Comments</u></p> <p>A good proportion of candidates knew that a light microscope was used and gave valid reasons for their choice. However, a high proportion of candidates suggested that an electron microscope was used and suggested that organelles were visible. This suggests that they have had little experience of viewing specimens with a light microscope and/or interpreting photomicrographs and electron micrographs. Candidates must be able to use the evidence provided for them.</p> <p> Assessment for learning</p> <p>Biology is a practical subject. It is essential that candidates have the opportunity to view and interpret slides and make biological drawings along with many other practical tasks.</p>
			Total	11	
12			C ✓	1	<p><u>Examiner's Comments</u></p> <p>Most candidates gave the correct</p>

					<p>response (C). The most common incorrect response appeared to be D.</p> <p> Assessment for learning</p> <p>It is important for candidates to be able to understand scientific words rather than just memorise them. In this case breaking down scientific words into prefixes would have helped them identify plants' habitats, when choosing between C and D.</p> <p>The glossary from OCR, can be used to expand the scientific words students identify throughout the course:</p> <p>https://www.ocr.org.uk/qualifications/as-a-level-gce-biology-a-h020-h420-from-2015/delivery-guide/Images/123-235347-asa-biologya-cell-structure-dg-lr4.pdf</p> <p>Alternative resources:</p> <p>http://www.biologyreference.com/</p>
			Total	1	
13			C ✓	1	<p><u>Examiner's Comments</u></p> <p>Relatively few candidates gave the correct response (C). The most common incorrect response appeared to be D. Candidates need to think carefully and link different parts of the syllabus together – here they should appreciate that nitrates are required to manufacture amino acids, and also the fact that xylem tissue doesn't carry only water but also essential mineral ions.</p>
			Total	1	