UNIVERSITY of CAMBRIDGE
International Examinations

Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants excepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore
ACE	Analysis, Conclusions and Evaluation (skills)
PDO	Presentation of Data and Observations (skills)
MMO	Manipulations, Measurement and Observation (skills)

1 (a) (i) Use information in Table 1.1 to predict which substances you would expect to be present in each of the four plant extracts, complete Table 1.2. [2]

MMO decisions 2

source of plant extract	substances present in each of the plant extracts		
	starch	**sucrose**	**glucose**
root in winter/S2	✓	X or gap	X or gap
root in spring/S4	✓	(X or ✓ or gap)	✓
phloem sap in summer/S3	X or gap	✓	X or gap
phloem sap in winter/S1	X	X	X

[1] 4 ticks only in correct place for first three rows;
[1] (phloem sap in winter) all crosses/all gaps if in whole table;

Additional guidance	**Do not give if** • hybrid tick / cross • or mixture of gaps and crosses

(ii) Describe the tests that show that sucrose is present in a plant extract. [2]
Tick where mark awarded.

MMO decisions 2

[1] (with Benedict's / reducing sugar test)
negative test or no result / reaction or no change or stays blue;

[1]	add (hydrochloric) acid and boil/heat	**AND** neutralise OR add sodium hydrogen (bi)carbonate sodium carbonate sodium/potassium hydroxide alkali	**AND** <u>Benedict's</u>;
	Additional guidance	**Do not give mark if** • warm or just put in water-bath	

(iii) Prepare the space below and record your observations. **[4]**
Use vertical line of ticks

PDO recording 2	[1]	table with all cells drawn	**AND** heading (top or left) sample(s) ;
		Additional guidance	**Ignore** • test-tube/additional columns **Can have** • no outer boundary • solution(s) or extract
	[1]	(heading to show results of tests being recorded) colour or observations or description or result(s) AW;	
		Additional guidance	**Do not give mark if** • heading for description of test or test only needs to be what is being recorded • additional columns/rows with volumes of reagents or temperatures • if 'result' heading is actually for conclusion/identification
MMO collection 2	[1]	shows **only** tests for starch, reducing sugar and non-reducing sugar	**AND** (for starch and reducing sugar) show have done the test for ALL four samples;
		Additional guidance	**Do not give mark if** • Biuret or protein test with results anywhere
	[1]	(non-reducing sugar result for **S3)**	(reducing sugar Benedict's) blue or no change **AND** (after hydrolysis) any correct colour (green / yellow / orange / brown / red);
		Additional guidance	**Can have** • combination of colours greeny yellow **Do not give mark if** • just positive and negative or ticks and crosses

(iv) Complete Table 1.4 to match the samples, S1, S2, S3 and S4, with each plant extract. [1]

ACE interpretation 1 — [1]

Source of plant extract	sample
root in winter	(S)2
root in spring	(S)4
phloem sap in summer	(S)3
phloem sap in winter	(S)1;

all correct only one per box;

(b) (i) State *three* variables which the student should keep the same in this investigation. Describe how the student would keep each of these variables the same. [4]

MMO decision 1	[1]	three relevant variables selected from below	
ACE improvements **max 3**	max 3	**1.** size / dimensions / e.g. of dimensions / length OR (surface) area or / to volume OR mass / weight (of root tissue) OR **2.** root or plant	use (metre) ruler or Vernier callipers or describes use of knife / blade / scalpel / cork borer to cut discs / cylinders OR use balance to keep mass the same; same plant or species / type or same root or part of root or same age;
		3. volume of (sodium chloride) solution or example of volume (10 or more) with units (**Ignore** amount)	uses syringe / measuring cylinder / graduated pipette or graduated test-tube or burette to keep same / example of volume;
		4. evaporation (from solutions or test-tubes/ beakers)	cover the containers / bungs into test-tubes;
		5. temperature	use thermostatic(ally-controlled) water-bath or describes method; **Give mark for** incubator or temperature controlled room **Do not give mark if** air-conditioned room
		6. example of time more than 20 mins;	(time only)use stop clock or stopwatch or clock or timer / chronograph / chronometer;

(ii) Plot a graph of the data shown in Table 1.1. [4]
If CHART then max 2 for O and S

PDO layout 4

[1]

x-axis
conc(entration) of sodium chloride / NaC*l*
(/) mol dm ^{3} or mol / dm^{3}

AND *y*-axis
change in / Δ volume (of solution)
(/) cm^{3} ;
Do not give mark if V

Additional guidance **Must have**
- units on *x*-axis and *y*-axis

[1]

scale as *x*-axis
0.20 to 2 cm
Must label each 2 cm

AND *y*-axis
2.0 to 2 cm;
Must label each 2 cm

Additional guidance **Do not give mark if**
- awkward scale e.g. 0.25 to 2 cm *x*-axis
- scale not written on each 2 cm
- if numbers to right of *y*-axis

Must have
- negative below 0 **and** positive above 0

[1]

correct plotting of each point;

Additional guidance

0.00	(–)6.0
0.25	(+)1.0
0.50	(+)4.5
0.80	(+)5.2
1.00	(+)5.2

Can have
- small cross or dot in circle or cross in circle
- ecf if *x*-axis not 0 if scale 20 to 2 cm. even

Do not give mark if
- awkward *y*-axis scale
- blobs or dots alone
- cross too large with any part of line touching 4 mm by 4 mm square –
- an **additional plotted point at 0.0** volume same as other plotted points

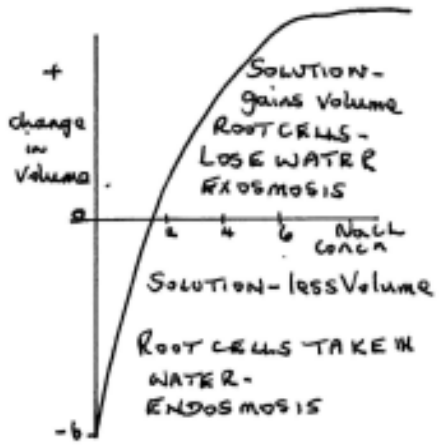
[1]

lines point to point or smooth curve through all points and horizontal line between last two points

AND
- ruled, clear sharp –
- quality – ruled lines thinner than half square;

		Additional guidance **Do not give mark if** • less than 5 plots • line of best fit • any feathery line • irregular thickness • no extrapolation or meets axes 2 mm or more
(iii) Show on graph the sodium chloride concentration where there is no change in volume of solution. [1] **Use to estimate the sodium chloride concentration. [1]**		
ACE interpretation 2	[1]	clearly shows with line(s) or point on line shown at 0 change in volume;
	[1]	estimate correct from graph at 0 change in volume; Additional guidance **Must have** • rounding down to two decimal places e.g. 0.20 or with (0.025 scale) e.g. 8.5 x 0.025 = 0.2125 so must be 0.21 **Do not give mark if** • any estimate if shown on graph if between 0.8 and 1.0 • estimate any scale precision is to half square e.g. 0.2 to 2 cm therefore 2 mm = 0.02 and half square is 0.01 so answers can only be to 2 decimal places. So on the awkward scale of 0.25 to 2 cm therefore 2 mm = 0.025 and half square is 0.0125 therefore can only read to half square values, not in between.
(iv) Use your graph to explain the effect of the different concentrations of sodium chloride solution on root cells. [3]		
ACE conclusions max 3	max 3	**1.** *(water)* moves from high/less negative to low/more negative water potential OR from higher/less negative water potential OR to lower/more negative water potential OR down a water potential gradient;

Additional guidance



Can have
- even if direction is incorrect from roots to solution

Ignore
- refs. to hypertonic and hypotonic even if incorrect

2. (in context of water)
by (endo) /(ex) osmosis;

Additional guidance

Can have
- even if direction is incorrect from roots to solution

3. *(in correct context of)* describes correct direction of movement of water;
e.g. (when volume decreases –6 from 0.0 to where it crosses line 0.2+ NaC*l*)
idea of water moving into cells or correct use of endosmosis (into cells)
OR
(when volume increases all + values from 0.2+ to 1.00 NaC*l*)
idea of water moving out of cells or correct use of exosmosis (out of cells)

4. (in context of zero change in volume **ECF** from graph)
ref. to idea of no net movement of water;

[Total: 22]

2 (a) Draw a large plan diagram of the specimen shown in Fig. 2.1. Label the epidermis.					[6]
PDO layout 1	[1]	clear, sharp, unbroken lines	**AND** no shading	**AND** larger than **50** mm across bottom of arc to top;	
		Additional guidance	**Must have minimum of** • three or more hand-drawn lines and at least two enclosed area/vascular bundles in a semicircle or less **Do not give mark if** • drawn over the print of question • any line thicker – 1 mm or more • any feathery line or broken or overlaps in the lines		
MMO collection 2	[1]	no cells drawn	**AND** section drawn with **four/five** complete vascular bundles;		
	[1]	(inner layer) drawn irregular (not smooth);			
PDO recording 1	[1]	(stoma) drawn as gap or feature	**AND** at lowest point of epidermis;		
MMO decision 2	[1]	*(vascular bundles* observed and drawn the (incomplete) vascular bundle at left hand side;			
	[1]	correct label with label line or adjacent to correct layer to <u>epidermis;</u>			
		Additional guidance	**Do not give mark if** • lower or upper or cells • labelled top irregular line epidermis • no top or bottom line drawn (no context) • any label which is biologically incorrect e.g. from incorrect organ or animal • any label within drawn area		

(b) (i) Prepare the space below so that it is suitable for you to record the observable differences between the specimens on Fig. 2.1 and that in Fig. 2.2. [4]

Mark first *four* differences only for THREE marks.

PDO recording 1 [1]

organise as a table/Venn diagram/ruled boxes | **AND** headed Fig. 2.1 and Fig. 2.2 | **AND** first difference opposite each other;

Additional guidance (Fig.) 2.1 | (Fig.) 2.2 (Fig.) 2.2 | (Fig.) 2.1

ACE interpretation max 3 — max 3

	feature	Fig. 2.1.	Fig. 2.2
1.	vascular tissue / xylem / phloem	bundles / more / separate near middle / pith / edge	(no) bundle / one / less; middle / centre;
3.	hollow centre / pith	present / has / yes	absent / none / no
4.	OR stele OR endodermis / bundle sheath / Casparian strip / suberised / pericycle	absent / none / no absent / none / no	present / has / yes present / has / yes;
5.	air spaces OR chains of cells shape of cells	small(er) / not large / less absent / none / no round / circular	large(r) / more present / has / yes long;
6.	thickened cell layer / collenchyma or epidermis(layers)	absent / none / no thin(ner) or 2 / few layers thick(er) or 2	present / has / yes thick(er) or 3 / more layers thin(ner) or 1
7.	epidermis or cuticle cuticle	regular / smooth absent / none / no	irregular / rough (do not give damaged) present / has / yes;
8.	gap / stomata / guard cells	present / has / yes / one	absent / none / no;
9.	cortex / cells	present / has / yes / more	absent / none / no few(er);
10.	one ref. to size of any of features above but not air spaces or specimens	small(er)	large(r);

	Additional guidance	**Ignore** • tick and cross without a key • diagrams • 3-D descriptions such as spherical • colours/staining
(ii) Actual length of line Y is 495 µm. Use this to calculate the *magnification* of Fig.2.2.		**[4]**
MMO collection 1	[1]	measures line Y in mm; *80 or 80.5 or 81 or 81.5 or 82 mm*
	Additional guidance	**Must have** • units somewhere that is clear • Check **Fig.** For measurement
MMO decision 1	[1]	(converts to same units) (mm to µm) X 1000 Or 80 000 or 80 500 or 81 000 or 81 500 or 82 000;
		OR (converts µm to mm) 495/1000 or 0.495;
	Additional guidance	**Do not give mark if** • metres anywhere or conversion to metres **Can have** • even if **no units** mm or cm anywhere • if incorrect measurement
PDO display 2	[1]	shows division of converted measurement in µm by 495 OR division of actual measurement in mm/0.495;
	Additional guidance	**Can have** • if no units or incorrect measurement or no or incorrect conversion e.g. metres.
	[1]	answer as whole number only; 162 or 163 or 164 or 165 or 166

		Additional guidance		Mark final answer as given on the line provided. If no answer on the line then accept the final number shown BOD. **Do not give mark if** • two or more answers • any units given • more significant figs e.g. 0
	(iii) Make large drawings of two different patterns of thickening in the walls of the xylem vessels. Label the part of the vessel where lignin is found. **[4]**			
PDO layout 1	[1]	no shading anywhere everything drawn	**AND** any line **longer** length is 50 mm or more	**AND** (clear, sharp, unbroken lines) **Do not give mark if** • any ruled lines • any line too thick (thinner than 1 mm) • drawn over the print of question
MMO collection 3	[1]	**EITHER** **only** xylem vessels with thickening (same or two types) **OR** **only** two different bandings (on any number of vessels);		
		Additional guidance		**Can have** • differences in pattern e.g. rings to spiral or in spacing • bandings circular, spirals or reticulate or shows as pits/circles or walls showing clear extra thickening as in section of bands **Do not give mark if** • any cell(s) or bundles of lines drawn
	[1]	drawn any **one** set of bandings as two lines or shaded bands or if no bands then allow circles for pits;		
	[1]	correct label with label line to lignin which can be the wall or band;		
		Additional guidance		**Do not give mark if any label** • to a middle of a pit • any label which is biologically incorrect e.g. from incorrect organ or animal • label within drawn area **Must have** • line to touch wall or band
				[Total: 18]