Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **October/November 2023**

MARK SCHEME

Maximum Mark: 60

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	‘List rule’ guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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Examples of how to apply the list rule

State **three** reasons … [3]

A	1	Correct	✓	**2**
	2	Correct	✓	
	3	Wrong	×	
B	1	Correct, Correct	✓, ✓	**3**
(4 responses)	2	Correct	✓	
	3	Wrong	ignore	
C	1	Correct	✓	**2**
(4 responses)	2	Correct, Wrong	✓, ×	
	3	Correct	ignore	
D	1	Correct	✓	**2**
(4 responses)	2	Correct, CON (of 2.)	×, (discount 2)	
	3	Correct	✓	

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E	1	Correct	✓	**3**
(4 responses)	2	Correct	✓	
	3	Correct, Wrong	✓	

F	1	Correct	✓	**2**
(4 responses)	2	Correct	✓	
	3	Correct CON (of 3.)	× (discount 3)	

G	1	Correct	✓	**3**
(5 responses)	2	Correct	✓	
	3	Correct Correct CON (of 4.)	✓ ignore ignore	
H	1	Correct	✓	**2**
(4 responses)	2	Correct	×	
	3	CON (of 2.) Correct	(discount 2) ✓	

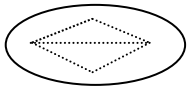
I	1	Correct	✓	**2**
(4 responses)	2	Correct	×	
	3	Correct CON (of 2.)	✓ (discount 2)	

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Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
A	accept (for answers correctly cued by the question, or by extra guidance)
R	reject
I	ignore
( )	the word / phrase in brackets is not required, but sets the context
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
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
AVP	alternative valid point

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Question	Answer	Marks
1(a)	histones **;** **A** basic / histone, proteins	**1**
1(b)	*max 2 if the spindle / centrioles extend outside the cell* 1 two chromosomes, each with two chromatids, drawn approximately along central equator area **;** **R** if drawn as a, bivalent / homologous pair (close together or further apart) **A** if equator is drawn across wider diameter 2 plus one other drawn feature **;** e.g. spindle  *diamond/oval shape, minimum three spindle fibres as shown* **or** spindle fibre from each pole connecting to centromere area of one chromosome **or** centromere drawn holding sister chromatids together **or** <u>pair</u> of centrioles at each pole **3** any three labels **; I** label to chromosome e.g. (sister / identical) chromatid/s centromere spindle / spindle fibres spindle equator / metaphase plate **A** equator *if spindle / spindle fibre label given* centriole/s **A** centrosome(s) / pole(s) *annotations may contain more than one acceptable label* *label lines to touch structure*	**3**

Question	Answer	Marks
1(c)	*assume sequential interphase to prophase if not named* *any **three** from:* *interphase max 2* (chromosomal) DNA replicates **;** **A** DNA synthesis **I** chromatin **R** if stated as in, G1 / G2 (each new molecule of) DNA, complexes / associates / AW, with, histones / proteins **;** sister / identical, chromatids form, qualified **;** e.g. after (DNA) replication /during / end of, S phase *must be clear they are formed before prophase* *prophase max 2* chromatids / chromosome, condense **;** **R** if also in prophase **A** become(s) shorter and fatter **A** coiling / supercoiling, *in context of,* DNA / chromosomes / chromatids **R** chromosomes condense to form chromatin becomes visible / appears, as two (sister / identical) chromatids **;** **I** composed of two chromatids becomes attached to the spindle fibres **;** (spindle) microtubules attach to centromere / kinetochore formation **;**	**3**

Question	Answer	Marks
2(a)	secondary (structure) **;**	**1**
2(b)	*any **one** from:* *idea that* area to be, hydrolysed / AW, could be between same amino acids **;** **A** *ref. to* (always), hydrolyses / breaks down / acts on, peptide bonds suggestion that active site has (some) flexibility for, hydrolysing / binding to / AW, similar substrates **;** (proteins / substrates) similar shape(s) so fit active site **;** active site and, substrates / proteins, (still) have complementary shapes **;** **R** 'complementary to the antigen or the shape' AVP **;** e.g. (large enzyme / enzyme complex, with) more than one active site	**1**

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Question	Answer	Marks
2(c)	*any **three** from:* fibrous **;** **A** not globular **I** structural insoluble / does not dissolve / does not dissolve easily **;** (high proportion of) disulfide bonds / disulfide bridges / covalent bonds (because of cysteines) **;** high proportion of / many / AW, hydrogen bonds (between polypeptides) **;** high proportion of / many, hydrophobic interactions **;** **A** many, amino acids with hydrophobic R-groups / hydrophobic R-Groups tight / close, packing, of, chains / polypeptides / molecules **; I** triple helix AVP **;** e.g. arranged so peptide bonds are not accessible parts of molecule needing to bind to active site not accessible many amino acids with small R-groups / small amino acids **I** details specific to collagen e.g. gly every third amino acid amino acids	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(d)</td><td>
<table>
<tr><th>keratinase</th><th>temperature range at 60% relative activity / °C</th><th>pH range at 60% relative activity</th></tr>
<tr><td>K12</td><td>41 – 63</td><td>6.8 / 6.9 – 8.4 ;</td></tr>
<tr><td>A22</td><td>36 / 36.5 – 57 ;
A 57.1 / 57.2</td><td>6.0 – 9.0</td></tr>
<tr><td>P3</td><td>29 – 56</td><td>5.3 – 7.5</td></tr>
</table>
P3 ;

A22 ;
</td><td>4</td></tr>
</table>

Question	Answer	Marks
2(e)	*must have pH <u>and</u> °C <u>and</u> %, at least once* *max 2 if only Fig. 2.1 **or** only Fig. 2.2 used for the response.* *any **three** from:* *advantage from **Fig. 2.1** (temperature)* 1 A22 <u>and</u> K12, active / remove stains, at a wide range of temperature **or** stated (active) temperature range of**,** A22 is 20.5 / 21 °C **or** K12 is 22 °C **or** use of Fig. 2.1 to give % activity and stated temperature of, good / above 60%, activity at, medium / hotter, temperature washes for, A22 / K12 **;** **or** K12 active at low temperature (washes) **;** **A** data e.g. 37–40% activity at 20 °C / 41–43% activity at 30 °C *disadvantage from **Fig. 2.1** (temperature)* 2 low activity / poor stain removal, at 30 °C / 70 °C / 80 °C, for A22 **or** at 20 °C / 30 °C / 70 °C, for K12 **;** **A** data extracted from **Fig. 2.1** *advantage from **Fig. 2.2** (pH) – activity in alkaline conditions* 3 A22, greatest activity / most effective / AW, pH 7.5 – 8.0 **or** (at least 60%) activity between pH 7.5 – 9.0 **;** **A** range of pH 6.0 – 9.0 but **R** i*f stated pH 6.0–7.0 is alkaline* **or** K12, active between pH 7.5 – 8.0 / 8.5 **or** optimum activity at pH 8.0 **or** data for (good) activity at stated pH values from Fig. 2.2 for either A22 or K12 **;** *disadvantage from Fig. 2.2 (pH)* 4 use of **Fig. 2.3** to show a decrease in activity at higher pH values **;**	**3**

Question	Answer	Marks
2(e)	5 any wash feature in context of mp 1–4 **;** e.g. have (some) activity at low temperatures so, more economic /less energy used (to heat water) **A** ora active at high temperatures but, more costly / needs (more) energy can wash at high(er) temperature so, can sanitise clothes / can kill insect pests / can kill pathogens / shorter time to remove stains comparison of K12 and A22 for washes e.g. K12 more, thermostable / stable in (washes at) higher temperatures K12 has higher optimum temperature so more, costly / energy used K12 only useful at lower alkaline pH A22 has wide(r) working range of pH A22 more tolerant to / stable at, higher pH	

Question	Answer	Marks
3(a)	aorta / dorsal aorta **;** *correct spelling needed*	**1**
3(b)(i)	*any **one** from:* *context is using gaps for movement between, hepatocyte / tissue fluid, and, blood / sinusoid* **I** *ref. to* red blood cells **I** shorter diffusion, distance / pathway higher rate of / easier for / AW, exchange / movement / AW, of substances **; A** named substances / nutrients substances do not have to cross, a cell layer / into and out of endothelial cells **;** larger molecules / plasma proteins, can pass through **;** Kupffer cells can pass through (into tissue fluid) **;** AW **A** *ref. to* other phagocytic cells **R** Kupffer cells can diffuse through **R** if stated as entering hepatocytes	**1**

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Question	Answer	Marks
3(b)(ii)	*max 3 if described as phagocytosis of a pathogen rather than a red blood cell* *allow rbc for red blood cell* *any **four** from:* 1 endocytosis / phagocytosis **;** 2 described **;** e.g. red blood cell, engulfed / enveloped pseudopodia surround red blood cell *max three from* 3 forms (phagocytic) vacuole / (phagocytic) vesicle / phagosome **;** 4 lysosome fuses (with phagosome) **;** AW merges / joins to / combines with **I** attaches / binds to 5 (lysosome contains) hydrolytic / digestive, enzymes **; A** hydrolases / named examples 6 digestion to produce haem and globin **; A** amino acids for globin 7 AVP **;** e.g. suggestion of, detection / recognition, of red blood cell	**4**

Question	Answer	Marks
3(c)(i)	*any **three** from:* **I** Golgi body / lysosome / vesicle *mp1 and mp2 complete term needed either in the text or labelled* 1 smooth endoplasmic reticulum labelled on Fig. 3.2 and detail **;** e.g. for, lipid / triglyceride / cholesterol, synthesis tubular appearance / no ribosomes 2 rough endoplasmic reticulum labelled on Fig. 3.2 and detail **;** e.g. for protein, synthesis / AW **A** for enzyme synthesis flattened (sac) appearance ribosomes **A** ribosome(s) labelled and for (plasma) protein synthesis 3 mitochondrion labelled on Fig. 3.2 and detail **;** e.g. many mitochondria for (aerobic) respiration produce ATP / provide energy, (for hepatocyte reactions) **R** generate / make, energy double membrane / presence of cristae *allow if one mitochondrion is correctly labelled and one of the 'circular' mitochondria has a different label e.g lysosome* 4 presence of glycogen granule(s) as, energy / glucose, store **; A** releases / provides, glucose 5 presence of lipid droplet(s), as energy store **;** **A** provides fatty acids **A** provides components for cholesterol synthesis *penalise once (from mp1, 2, or 3) if diagram not labelled but structures named correctly and correct detail given*	

Question	Answer	Marks
3(c)(ii)	*any **one** from:* **I** *ref. to* staining or size mitochondrion, bound by / has, double membrane / two membranes **; I** peroxisome has (only) one membrane peroxisome no cristae / mitochondrion has cristae **; R** cisternae peroxisome spherical shape <u>and</u> mitochondria, different shapes / AW **; I** if only peroxisome shape stated **A** circular *for spherical* **A** description e.g. 'sausage' shape	**1**
3(c)(iii)	*any **two** from:* *mitochondrion (ora for peroxisomes)* has, DNA / genes (coding for enzymes) **;** **R** linear DNA **A** genetic, material / information, qualified with, transcription / *ref. to* mRNA / coding for enzymes (70S) ribosomes (site of enzyme synthesis) **; R** 80S ribosomes has the enzymes for, transcription / translation, (to synthesise enzymes) **;** can produce ATP (for enzyme synthesis) **; R** produce energy **I** has ATP AVP **; ;** *other suggestions* e.g. has (chaperone) proteins involved in, folding / formation of tertiary structure ATP cannot enter peroxisome to provide energy source peroxisome has enzymes that cause degradation of, one / or more, substance(s) involved in protein synthesis	**2**

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Question	Answer	Marks
3(c)(iv)	*any **two** from:* (peroxisome) membrane bound, so rest of cell protected (from hydrogen peroxide) **;** **A** hydrogen peroxide can have toxic effects on (rest of) cell / AW (peroxisome) acts as a compartment / specific area / contained, for, more efficient breakdown of hydrogen peroxide / control of reactions **;** high concentration of enzyme in one location **;** **A** more enzyme-substrate complexes can form provides, optimum / AW, conditions, for (other peroxisome) reactions **;** production of oxygen as by-product, so useful for, peroxisome reactions requiring oxygen / mitochondrial function / aerobic respiration **;** AVP **;** e.g. isolates (peroxisomes) enzymes from rest of cell	**2**

Question	Answer	Marks
4(a)	*allow ideas from a diagram* 1 blood arriving, is deoxygenated / has low(er) partial pressure of oxygen **A** low, concentrations / levels, of oxygen **or** oxygen-poor **or** blood arriving has, high(er) partial pressure / AW, of carbon dioxide **;** **A** carbon dioxide-rich 2 *idea that* newly oxygenated blood is, constantly / continually, removed **;** **A** oxygenated blood passed to pulmonary vein **A** oxygen that diffuses, from alveoli / into blood, is transported away (by blood flow)	**2**

Question	Answer	Marks
4(b)	*any **two** from:* allow alveoli to, expand / stretch, on, inhalation / inspiration / breathing in / AW **;** prevent alveoli from, overstretching / rupturing / bursting (on, inhalation / inspiration / breathing in) **; I** collapse recoil / recoiling, to help, exhalation / expiration / breathing out / force air out **;**	**2**
4(c)	*if stated as facilitated diffusion allow max 1 for mp1 or mp2 or mp5* *any **three** from:* 1 membrane / carrier / transport, protein (move phospholipids across into lamellar body) **;** **R** channel protein / cotransporter (protein) 2 has binding site(s) (specific for surfactant phospholipids) **;** **R** ATP binding site for phospholipids / binds ATP **R** has receptors to bind to phospholipids 3 ATP, used / hydrolysed / needed, for active transport / to provide energy (for transport) **;** **A** ATP binding site for active transport **A** *ref. to* ATPase and, active transport / for energy release **I** has / presence of, ATP energy 4 (surfactant) phospholipids move, against a concentration gradient / from a low(er) to a high(er) concentration **;** 5 able to carry out conformational change / AW **;**	**3**
4(d)(i)	**X**: transcription **;** **Y**: translation **;**	**2**

Question	Answer	Marks
4(d)(ii)	*any **three** from:* *allow ecf if introns and exons consistently the wrong way round* 1 introns, are non-coding / do not code for amino acids / are not involved in polypeptide synthesis **;** **R** introns are triplets / codons, that are non-coding **I** exons are coding 2 introns are removed, after transcription / from primary transcript / before mRNA is formed **;** **R** introns removed from, mRNA / primary mRNA 3 (only) exons (join to) form mRNA **;** **A** mRNA, contains / AW, exons **A** only exons are translated *if mp 2 and 3 not awarded, allow one mark for:* gene splicing / RNA splicing / mRNA does not contain introns **or** splicing *if RNA noted within response – this includes the* **A** *for mp4 (*UAA *etc because these are RNA codons)* **;** **R** DNA splicing 4 some (DNA) triplet(s) / (mRNA) codon(s) are STOP codons **;** **A** UAA / UAG / UGA, is a STOP codon **or** STOP, codons / triplets, do not code for an amino acid / terminate translation **A** some, triplets / codons, terminate translation so do not code for amino acids **I** *ref. to* premature STOP codons 5 *ref. to* met / first amino acid / amino acid coded for by START codon, (may be) removed after translation **;** 6 AVP **;** e.g. *ref. to* (non-coding) regulatory sequences	**3**

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Question	Answer	Marks
5(a)	*Mycobacterium bovis* **;** **A** *M. bovis*	**1**
5(b)	pasteurising / drinking pasteurised, milk **;** **I** vaccines / antibiotics **A** heat treatment of / sterilise / boil, milk **I** cook milk **A** use pasteurised milk to make dairy products **A** meat from (deceased dairy) cattle should be cooked, thoroughly / AW	**1**
5(c)	(infected), person, coughs / breathes (out) / talks / sneezes / AW, and (uninfected) animal, inhales / inspires / breathes in **;** aerosol / droplet, infection / transmission **A** transmitted by aerosol **or** organism / pathogen / bacteria / *M. tuberculosis*, in, airborne droplets / droplets in air **;** **A** contaminated, airborne droplets / droplets in air	**2**
5(d)	*any **two** from:* antibiotics / antibacterials **;** **I** vaccines / vaccination detail **;** e.g. combination treatment / combination of antibiotics **I** many antibiotics **A** many different antibiotics *allow ecf e.g. if stated as drugs for mp1* named antibiotics **;** e.g. rifampicin / isoniazid / rifampentine / moxifloxacin / pyrazinamide / ethambutol *accept other correct* four months – 12 months **;** *accept range or stated months* *allow 'must take for 6 months to more than 12 months' as this has noted a time less than 12 months* shorter time using combination than single antibiotic **;**	**2**

Question	Answer	Marks
5(e)	*any **three** from:* *allow elastic tissue for elastic fibres* 1 loss of / damage to, elastic fibres (and smooth muscle) from tunica media **;** **A** scar tissue replaces, elastic fibres / smooth muscle, in tunica media **A** middle layer for tunica media 2 loss of / damage to, collagen (fibres), in / damage to, tunica, externa / adventitia **;** **A** outer layer for tunica, externa / adventitia *mp1 and mp2 if layers not named, use diagram to confirm location of elastic fibres in (thicker) middle layer and collagen fibres in (thinner) outer layer* *any **two** from mp3-5* **;** 3 cannot withstand, high pressure / increase in pressure / pressure of blood **;** 4 overstretching / over-expansion / described **; A** cannot, stretch / expand 5 impaired / poor / no / AW, recoil **;** *in context of loss of elastic fibres*	**3**

Question	Answer	Marks
6(a)	xylem vessel elements **;** **A** singular **A** vessel elements **A** xylem elements	**1**
6(b)	*any **two** from:* transpiration pull **;** **A** water, drawn up / pulled up owing to / AW, water evaporating from spongy mesophyll surfaces / water vapour lost from, leaf / plant, during transpiration **;** *ref. to transpiration not required if transpiration pull stated* (overall) water potential gradient **;** *in context of creates pulling force* *low water pressure at top and high water p at bottom* **A** pressure gradient **A** hydrostatic pressure gradient cohesion and adhesion (of water molecules) / cohesive and adhesive forces (of water) **;** **A** cohesion between water molecules **or** adhesion between water molecules and (xylem vessel) walls / cellulose / hydrophilic parts of lignin	**2**

Question	Answer	Marks
6(c)(i)	*any **two** from*: 1 (lignified wall / lignin) prevents, (inward) collapse / compression / AW (from tensions created) **; R** bursting 2 (lignified wall / lignin) rigid / strong / secondary thickening, for support (of xylem vessels) **; R** support, stem / plant 3 adhesion of water to hydrophilic groups in lignin, to maintain column of water / for water pathway / for transpiration stream / AW **;** 4 waterproofing properties (of lignin) / AW / water prevented from leaving xylem vessels (supports idea of continuous columns) **;** 5 lignification, associated with cell death / allows formation of hollow cells / allows formation of hollow tubes (for minimum resistance to flow) **;** 6 AVP **;** cell walls rigid to allow tension to develop	**2**
6(c)(ii)	*any **one** from:* cell death / apoptosis **;** loss of cell contents / become hollow **; A** loss of (all) organelles **R** *idea that* some organelles remain loss of cytoplasm **; A** loss of protoplasm loss of nucleus **;** AVP **;** e.g. formation of pits	**1**

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