

OCR AS GCE Biology (25 pages)

F211 Cells, Transport and Exchange

Mark schemes from January 2009-June 2012

Topics:

1.2.3 Transport in Plants

Explain the need for transport systems in multicellular plants in terms of size and surface area:volume ratio;

Describe, with the aid of diagrams and photographs, the distribution of xylem and phloem tissue in roots, stems and leaves of dicotyledonous plants;

Describe, with the aid of diagrams and photographs, the structure and function of xylem vessels, sieve tube elements and companion cells;

Define the term *transpiration*;

Explain why transpiration is a consequence of gaseous exchange;

Describe the factors that affect transpiration rate;

Describe, with the aid of diagrams, how a potometer is used to estimate transpiration rates

Explain, in terms of water potential, the movement of water between plant cells, and between plant cells and their environment. (No calculations involving water potential will be set);

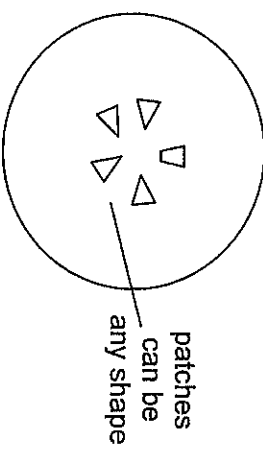
Describe, with the aid of diagrams, the pathway by which water is transported from the root cortex to the air surrounding the leaves, with reference to the Casparian strip, apoplast pathway, symplast pathway, xylem and the stomata;

Explain the mechanism by which water is transported from the root cortex to the air surrounding the leaves, with reference to adhesion, cohesion and the transpiration stream;

Describe, with the aid of diagrams and photographs, how the leaves of some xerophytes are adapted to reduce water loss by transpiration;

(l) explain translocation as an energy-requiring process transporting assimilates, especially sucrose, between sources (eg leaves) and sinks (eg roots, meristem);

Describe, with the aid of diagrams, the mechanism of transport in phloem involving active loading at the source and removal at the sink, and the evidence for and against this mechanism

Question	Expected Answers	Marks	Additional Guidance
6 (a)	3 – 5 discrete patches in ring (near centre) ;	1	if xylem drawn then phloem <u>must</u> be labelled DO NOT ACCEPT vascular bundles around edge DO NOT ACCEPT if phloem occupies more than half total width 
6 (b)	A / labelled carbon can be observed in the phloem soon after being supplied to the plant ; B / the rate of flow of sugars in the phloem is higher than diffusion ; C / an insect such as an aphid feeds by inserting its proboscis (mouth parts) into the phloem ;	max 2	mark first two letters only

Question	Expected Answers	Marks	Additional Guidance
(c)	<p><i>source</i> site where, sucrose / sugars / assimilates, loaded (into phloem) / AW ;</p> <p><i>sink</i> site where, sucrose / sugars / assimilates, unloaded / removed (from phloem) / AW ;</p>	2	<p>DO NOT ACCEPT glucose / substance throughout</p> <p>ACCEPT where, sucrose / sugars / assimilates, produced/created or converted from stored products</p> <p>DO NOT ACCEPT terms 'loading' and 'unloading' in wrong context</p> <p>ACCEPT where, sucrose / sugars / assimilates, stored or used (in metabolic processes)</p> <p>DO NOT ACCEPT 'required' or 'needed' instead of 'used'</p>
6 (d)	<p>(sugars) cannot pass the cut / AW ;</p> <p>decrease water potential ;</p> <p>water moves into cells ;</p> <p>(damage triggers) increased cell division ;</p> <p>to produce cells to store sugars ;</p> <p>cut causes, gall / infection ;</p>	2 max	<p>ACCEPT sugars, stuck above cut / stuck at top of tree / can't move down/build up above cut</p>
		[Total: 7]	

Question		Expected Answer	Mark	Additional Guidance
6	(a) (i)	sucrose ;	1	Mark the first answer. If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks
6	(a) (ii)	sink ; neither ; sink ;	3	Mark the first answer for each tissue. If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks
6	(b)	1 elongated elements ; 2 elements , joined end to end / form column ; 3 sieve plates / pores in end walls / perforated end plates / sieve pores ; 4 little cytoplasm / cytoplasm pushed to cell edges / thin (layer of) cytoplasm ; 5 no nucleus / few organelles ;	max 2	Mark the first <u>two</u> adaptations. 1 ACCEPT cells 2 ACCEPT cells 3 response must refer to pores at ends of sieve elements 4 IGNORE hollow 5 IGNORE no organelles / few cell contents

Question	Expected Answer	Mark	Additional Guidance
6 (c)	<p>1 active transport of, hydrogen ions / protons / H⁺, out of companion cells ;</p> <p>2 creates, hydrogen ion / concentration / diffusion, gradient ;</p> <p>3 (facilitated) diffusion (of H⁺) back into companion cells ;</p> <p>4 sucrose / assimilates, move in with hydrogen ions ;</p> <p>5 by cotransport / through cotransport protein ;</p> <p>6 sucrose / assimilates, (diffuse) through plasmodesmata (from companion cell to sieve element) ;</p> <p>7 into sieve, tube / element ;</p>	<p>max 3</p>	<p>1 ACCEPT description of active transport DO NOT CREDIT hydrogen, H, H₂, hydrogen molecules</p> <p>2 ACCEPT description of gradient created</p> <p>5 IGNORE carrier protein</p> <p>For mark points 4 and 6 IGNORE sugar If wrong assimilate is named e.g. glucose penalise once and then apply ECF</p> <p>Any three with correct spelling and a suitable context from: companion, gradient, facilitated, plasmodesmata, sieve element, diffuse / diffusion, concentration, cotransport, sieve tube, hydrogen ions / protons</p>
	Total	[10]	

Question	Answer	Marks	Guidance
6 (a) (i)	<p>sucrose and phloem ;</p>	1	<p>Both needed for one mark Mark the first answer on each line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks DO NOT CREDIT sucrose DO NOT CREDIT phloem sieve tubes / companion cells</p>
(ii)	<p>1 hydrogen ions / H⁺ / protons, pumped out of companion cells ; 2 increases, hydrogen ion / H⁺ / proton, concentration (gradient) (outside companion cell) ; 3 hydrogen ions, re-enter / flow back into, companion cells ; 4 sucrose / sugar, moves with hydrogen ions / AW ; 5 down concentration gradient ; 6 ref. cotransporter proteins / cotransport(ation) ; 7 by facilitated diffusion ; 8 sucrose / sugar, diffuses into sieve tube (element) ; 9 through plasmodesmata ;</p>	3 max	<p>1 ACCEPT hydrogen ions leave companion cells using ATP 2 ACCEPT creates gradient 2 DO NOT CREDIT increase, hydrogen ion / H⁺ / proton concentration, in sieve tube element 3 ACCEPT diffuse / move 4 DO NOT CREDIT glucose (penalise once) 4 DO NOT CREDIT sucrose follows H⁺ 8 IGNORE sucrose diffuses into phloem</p>

Question	Answer	Marks	Guidance
(b)	<p>1 active transport requires ATP ;</p> <p><i>at low temperatures:</i></p> <p>2 (molecules have) little kinetic energy ;</p> <p>3 (therefore) less, respiration / ATP made ;</p> <p>4 less active transport or less, movement / loading, of sugars into sieve tube (element) ;</p> <p>5 less, osmosis / movement of water, into sieve tube (element) ;</p> <p>6 low (hydrostatic) pressure created ;</p> <p><i>as temperature increases:</i></p> <p>7 (molecules have) more kinetic energy ;</p> <p>8 (therefore) more, respiration / ATP made ;</p> <p>9 more active transport or more, movement / loading, of sugars into sieve tube (element) ;</p> <p>10 more , osmosis / movement of water, into sieve tube (element) ;</p> <p>11 higher / more (hydrostatic) pressure created ;</p> <p>12 at high temperature (plant), enzymes / proteins, denatured ;</p>	<p>3 max</p> <p>Total 7</p>	<p>1 ACCEPT loading / uptake for transport</p> <p>3 IGNORE no respiration / no ATP made / no loading of sucrose</p> <p>4 ACCEPT slow active transport / slow loading</p> <p>9 ACCEPT faster active transport / faster loading</p> <p>12 DO NOT CREDIT cells denatured CREDIT change to tertiary structure, damage to proteins</p>

Question	Expected Answers	Marks	Additional Guidance
3 (a)	transpiration ; xylem ; osmosis ; stoma(ta) / stomatal pore ;	4	DO NOT ACCEPT 'diffusion' alone ACCEPT diffusion with osmosis used as qualification DO NOT ACCEPT 'pore' or 'guard cells'
3 (b) (i)	stomata (open to) allow, gaseous exchange / carbon dioxide in / oxygen out / AW ; (gaseous exchange) for photosynthesis ; (photosynthesis) essential for plant to, gain energy / make sugars ; some water lost through cuticle ;	2 max	look for reverse argument DO NOT ACCEPT ref to air OR to get gases OR let gases in ACCEPT 'gases in <u>and</u> out'
(b) (ii)	xerophyte ;	1	DO NOT ACCEPT cactus

Question	Expected Answers	Marks	Additional Guidance
(b) (iii)	<p>Allow the first point once as further explanation for A1 – A4 in addition to the linked explanation: reduce water (vapour) potential gradient / diffusion gradient ;</p> <p>[A 1] hairy leaves ; trap water vapour / moisture ;</p> <p>[A 2] stomata, in pits / sunken ; pits trap, water vapour / moisture ;</p> <p>[A 3] rolled leaves / presence of hinge cells ; reduce surface area OR (rolled leaves) trap water vapour / moisture ;</p> <p>[A 4] high solute concentration in cells ; reduces water potential inside leaf cells ;</p> <p>[A 5] thick(er) cuticle ; (which is) waterproof / (relatively) impermeable ;</p> <p>[A 6] small leaves / needles ; smaller surface area ;</p> <p>[A 7] fewer stomata ; reduces diffusion (of water vapour) ;</p> <p>[A 8] stomata close, during the day ; reduces diffusion (of water vapour) ;</p> <p>[A 9] most stomata on lower surface ; less exposure to sun OR cooler OR reduces diffusion (of water vapour) ;</p>		<p>MARK FIRST TWO ADAPTATIONS ONLY ALLOW max 2 for adaptation [A] marks</p> <p>Explanation must be linked to an appropriate statement of adaptation. Allow an explanation mark even if adaptation mark not awarded.</p> <p>DO NOT ACCEPT 'water' for 'water vapour' throughout</p> <p>DO NOT ACCEPT 'transpiration' for diffusion of water vapour throughout</p> <p>DO NOT ACCEPT surface area to volume ratio</p> <p>ACCEPT 'spines' DO NOT ACCEPT surface area to volume ratio</p>

Question	Expected Answers	Marks	Additional Guidance
	<p>[A 10] more densely packed spongy mesophyll ; smaller surface area for evaporation (from mesophyll cell surface) ; 4 max</p> <p>QWC - technical terms used appropriately and spelt correctly ; 1</p>	5 max	Use three terms from: cuticle, impermeable, water vapour, potential gradient, diffuse / diffusion, stoma(ta), needles, surface area, hinge cells, saturated
	Total	12	

Question	Expected Answers	Mark	Additional Guidance
4 (a)	timer OR scale / ruler ;	1	
4 (b)			
	shoot is healthy ;		<i>Mark the first three suggestions irrespective of numbered points</i> <i>IGNORE reasons – just mark steps in the process</i>
	assemble apparatus / cut shoot, under water ;		ACCEPT shoot not wilted
	cut last 2-3 cm off cut end / cut at an angle ;		ACCEPT cut end off shoot
	check there are no air bubbles in apparatus ;		ACCEPT make sure cut end of shoot is in contact with water once apparatus assembled
	apparatus, water tight / air tight / has no leaks ;		ACCEPT screw clip tight
	leaves dry ;		DO NOT ACCEPT use Vaseline unqualified
		3 max	DO NOT CREDIT allow time for acclimatisation, equilibration

Question		Expected Answers	Mark	Additional Guidance
4	(c)	(i) <u>25.3</u> ;	1	IGNORE any units
4	(c)	(ii) to make results (more) <u>reliable</u> ;		DO NOT ACCEPT accurate and reliable (use of both terms) anywhere in the answer
		to help identify anomalies ;		Look for idea of spotting the anomaly e.g. spot, notice, recognise, show, detect. DO NOT CREDIT prevents / take out / remove / accounts for, anomalies DO NOT CREDIT 'ensure there is no anomaly' unless qualified ACCEPT outliers for anomalies ACCEPT to identify other factors / (uncontrolled) variables that may be having an effect
4	(c)	(iii) <i>in afternoon:</i> plant dying / less healthy / wilting ; ref to stomatal closure ; more humid / higher water (vapour) potential in air ; less air movement / wind / draughts ;	2 max	<i>Mark first response in each numbered section (1-2). If not all sections are used, return to the first section and mark further suggestions</i> Assume answer is for different conditions in the afternoon ACCEPT ORA if stated 'in morning...' IGNORE ref to light / dark Look for comparative statements – higher, greater etc DO NOT CREDIT more moisture in air

Question		Expected Answers	Mark	Additional Guidance
4	(c) (iv)	(potometer) measures (water) uptake ; not all water (taken up) is lost ;	2 max	ACCEPT ref to figs e.g. 99% water taken up is lost ACCEPT the assumption that water loss is equal to water uptake is incorrect
		some water used (in photosynthesis / making cells turgid) ;		
		Total	11	

Question	Expected Answers	Marks	Additional Guidance
5 (a) (i)	osmosis ;	1	
(ii)	2 = symplast (pathway) ; 3 = apoplast (pathway) ;	2	ACCEPT symplastic ACCEPT apoplastic
(iii)	S ;	1	

Question	Expected Answers	Marks	Additional Guidance
5 (b)	<p><i>This is a QWC question</i></p> <p>1 water moves into xylem down water potential gradient ;</p> <p>2 root pressure / high (hydrostatic) pressure at bottom of xylem ;</p> <p>3 water vapour loss / transpiration / evaporation, at leaves / top of plant ;</p> <p>4 (creating) low (hydrostatic) pressure at top of xylem ;</p> <p>5 water, under tension / pulled up (in a continuous column) ;</p> <p>6 cohesion between water molecules / described ;</p> <p>7 adhesion of water molecules to xylem / described ;</p> <p>8 capillary action / described ;</p> <p>9 water moves up (xylem / stem) by mass flow ;</p> <p>10 from high(er) (hydrostatic) pressure to low(er) (hydrostatic) pressure / down (hydrostatic) pressure gradient ;</p>	max 4	<p>ACCEPT up for water potential</p> <p>ACCEPT water moves from high ψ to low ψ</p> <p>IGNORE drawn for pulled up</p> <p>ACCEPT ref to xylem being very narrow so water rises</p>
	QWC (three terms used in correct context and spelt correctly) ;	1	Any three terms from the following : water potential, hydrostatic pressure, transpiration / evaporation, cohesion / cohesive, adhesion / adhesive, tension, root pressure, capillary action / capillarity, mass flow

Question	Expected Answers			Marks	Additional Guidance
5 (c)	xylem vessel	phloem sieve tube element		13	<p>One mark per row Both statements must be correct to achieve mark</p> <p>DO NOT CREDIT ticks and crosses</p> <p>Read whole list – if any suggestion is wrong then do not award mark XYLEM PHLOEM DO NOT CREDIT 'nutrients' OR 'water' alone ACCEPT 'sugar' in place of sucrose IGNORE unspecified 'solute's' DO NOT CREDIT glucose</p> <p>ACCEPT arrows ↑ (xylem) ↓ (phloem) DO NOT CREDIT 'all directions' IGNORE ref to pits / lateral movement</p>
present	absent	;			
present	absent	;			
present	products of photosynthesis / sucrose / assimilates / amino acids / minerals / ions / salts / plant 'hormones'	;			
(only) up stem / towards leaves	both directions / up and down / from source to sink	;			
Total				13	

Question	Expected Answers	Marks	Additional Guidance
4 (a)	U ; R ; V ;	3	Mark the first answer for each tissue. If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks.
(b)	no cross walls / cells joined end to end / continuous ; hollow / no contents / no organelles / no cytoplasm ; (walls / vessels) lignified ; (bordered) pits in walls ;	2 max	IGNORE ref to dead cells / tubes DO NOT CREDIT lined / covered with lignin DO NOT CREDIT (walls) made of lignin ACCEPT xylem has lignin
(c)	(i) evaporation / loss of water vapour ; from, aerial parts of plant / leaf / leaves ; via stomata ;	2 max	movement of water vapour out of leaf = 2 marks DO NOT CREDIT loss of water alone CREDIT loss through cuticle / epidermis

Question	Expected Answers	Marks	Additional Guidance
(c)	(ii) <i>In the leaf:</i> <i>idea of:</i> 1 water loss (from leaf) is replaced ; 2 via, apoplast / symplast / vacuolar , pathways ; 3 down water potential gradient / AW ; 4 (lost water replaced) by water from the xylem ; <i>In the xylem:</i> 5 (loss of water) causes, low / negative, (hydrostatic) pressure (at top / in leaf) OR creates pressure gradient ; <i>idea of:</i> 6 water moves, from higher pressure to lower pressure / down pressure gradient ; 7 under tension / pulled up / drawn up ; 8 by mass flow ; 9 cohesion / attraction, between water molecules ; <i>idea of:</i> 10 column / stream / chain, of water (molecules) ; QWC ;	4 max 1	DO NOT CREDIT ref to water potential in context of xylem IGNORE ref to root pressure or capillarity ACCEPT ψ / W/P for water potential For mp 2 & 3 DO NOT CREDIT in context of root CREDIT pathways described in correct context <i>Idea of:</i> water leaving xylem to enter leaf cells (that have lost water) IGNORE 'water moves by the cohesion-tension theory' without further explanation ACCEPT along pressure gradient <i>Idea of:</i> pulling force and not just water movement created by transpiration DO NOT CREDIT mp 7 or 8 in context of adhesion / capillarity IGNORE suction, transpiration pull unqualified or water potentials CREDIT hydrogen bonding between water molecules IGNORE long unqualified <i>TWO</i> terms used appropriately and spelt correctly: xylem, apoplast/symplast/vacuolar, hydrostatic, gradient, cohesion / cohesive, tension, mass flow, water potential

Question	Expected Answers	Marks	Additional Guidance
(iii)	<i>Ref to :</i> bubbles / air (present / being removed) ; (blockage) in xylem ; restore (continuous) column of water (in xylem) ;	2 max	air in the xylem = 2 marks
	Total	14	

Question	Expected Answers	Marks	Additional Guidance
6 (a)	(i) osmosis ;	1	Mark the first answer. If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks. DO NOT CREDIT diffusion
	(ii) fit between (phospho)lipids / through (phospho)lipid (b)layer ; via, protein channels / protein pores / aquaporins ;	2	DO NOT CREDIT fit through phospholipids (molecules) DO NOT CREDIT carrier proteins – if this is used do not award mp 2 IGNORE transport proteins
	(b) cell wall ; provides strength / withstands (internal) pressure / prevents cell membrane over expanding / exerts pressure potential ; limits uptake of water ;	2 max	'has a strong cell wall' = 2 marks IGNORE rigidity (of wall), cytoplasm pushes against cell wall ACCEPT stops uptake of water (when turgid)
	(c) (i) between –1451 and –1799 ;	1	Ensure figure is a negative number CREDIT a range or single value within this range

Question	Expected Answers	Marks	Additional Guidance
(ii)	<p><i>idea of:</i> 1 plot, percentage plasmolysed against water potential (of solution) / water potential on X axis and % plasmolysed on Y axis ;</p> <p><i>idea of:</i> 2 read down from 50% plasmolysed to water potential ;</p> <p>OR</p> <p><i>idea of:</i> 1 plot, % plasmolysed against sucrose concentration / sucrose concentration on X axis and % plasmolysed on Y axis ;</p> <p><i>idea of :</i> 2 read down from 50% plasmolysed to sucrose concentration AND look up equivalent water potential ;</p>	2	<p>IGNORE ref to bars / bar graph ACCEPT axes wrong way round ACCEPT marking points shown correctly on annotated sketch line graph</p>

Question	Expected Answers	Marks	Additional Guidance
(d)	<p><i>reliable</i></p> <p>R1 observe more pieces of onion (epidermis from each solution) ;</p> <p>R2 count more cells (in each piece of epidermis) ;</p> <p>R3 calculate a mean ;</p> <p>R4 identify / ignore anomalous results ;</p> <p style="text-align: center;">max 3</p> <p><i>accurate</i></p> <p><i>idea of:</i></p> <p>A1 use, more / intermediate, concentrations within existing range / smaller gap between concentrations / closer (concentration) values ;</p> <p>A2 narrower range around 50% plasmolysis / 0.4 - 0.7 mol dm⁻³ / -1120 to -2180 kPa ;</p> <p>A3 take photographs and mark cells as counting ;</p>	<p>4 max</p> <p style="text-align: center;">Total 12</p>	<p>DO NOT CREDIT 'repeats' unless qualified</p> <p>ALLOW 'repeat the results / experiment' to indicate more pieces of epidermis</p> <p>IGNORE average</p> <p>ACCEPT outliers for anomalies</p> <p>IGNORE removes / avoids, anomalies</p> <p>IGNORE lack of units</p> <p>ACCEPT examples of values quoted in between original values e.g. 0.25, 0.35, etc.</p> <p>ACCEPT 0.2 and 0.9</p> <p>ACCEPT examples of values if clearly showing application of correct narrower range e.g. 0.45, 0.55 , 0.65</p> <p>For A2 DO NOT CREDIT quoted values extend beyond correct narrower range e.g. 0.35, 0.55, 0.75</p>

Question	Answer	Marks	Guidance
(d)	(named) membranes / phospholipid bilayer ; ribosomes ; Golgi ; endoplasmic reticulum / ER / RER / SER ; cytoskeleton / microtubules / microfilaments / spindle fibres ; centrioles ; vesicles / lysosomes ; mitochondria ;	2 max 10	<p>Mark the first two suggestions eg plasma / cell surface / nuclear / thylakoid / cristae / tonoplast, chloroplast membrane</p> <p>DO NOT CREDIT flagellum / chromosomes / chromatin / nucleolus</p> <p>IGNORE ref to molecules</p>
	Total		

Question	Answer	Marks	Guidance
(ii)	<p>1 <u>thick</u>, <u>cuticle</u> / waxy or layer ;</p> <p>2 leaf is, folded / rolled / curled / curved / AW ;</p> <p>3 reduces (exposed) <u>surface area</u> (for evaporation) ;</p> <p>4 hairs ;</p> <p>5 reduces, <u>evaporation</u> / <u>diffusion</u> through leaf, surface / <u>epidermis</u> ;</p> <p><i>for points 6, 7 & 8 credit only in context of folded leaf or hairs:</i></p> <p>6 trap <u>water vapour</u> ;</p> <p>7 creates high water (vapour) potential outside (stomata) ;</p> <p>8 reduces water (vapour) potential gradient ; max 4</p> <p>Q QWC – two technical terms used and spelt correctly ; 1</p>	<p>5 max</p> <p>11</p>	<p>IGNORE ref to moisture / moist air</p> <p>IGNORE ref to sunken / small / closed / few stomata</p> <p>ACCEPT waterproof for waxy</p> <p>DO NOT CREDIT ref to surface area to vol ratio / SA:Vol</p> <p>DO NOT CREDIT if hairs described in wrong place eg on palisade</p> <p>DO NOT CREDIT cilia</p> <p>DO NOT CREDIT evaporation of water vapour</p> <p>ACCEPT water <u>vapour</u> builds up in enclosed area</p> <p>ACCEPT stop wind blowing, water vapour / diffusion shells, away</p> <p>ACCEPT humid air collects in enclosed space</p> <p>ACCEPT ψ for water potential</p> <p>DO NOT CREDIT high water potential gradient outside stoma</p> <p>any 2 from: cuticle water vapour epidermis</p> <p>(derivatives of) evaporation potential gradient surface area diffusion</p>
	Total	11	