8. Transport in plants

8.3 Transpiration

Paper 3 and 4

Marking Scheme

Q1.

(a)(i)	0.11 ;;	**2**	MP1 (20 mm / (180 s)) / 0.11(111111) MP2 calculated value expressed to two decimal places ecf from previous step
(a)(ii)	decreased ; distance ; mesophyll ; stomata ; shoot / plant / left / leaf / AW ;	**5**	 **A** guard cells **A** fan / reservoir
(a)(iii)	temperature / AVP ;	**1**	
(b)	*any two from:* photosynthesis ; solvent ; transport ; support ; germination ; AVP ;	**2**	 e.g. cooling / metabolic reactions / transpiration

Q2.

(a)	mesophyll ; evaporation ; stomata ;	**3**	
(b)(i)	4 (g) ;	**1**	

(b)(ii)	65 (%) ;	**3**	MP1 correct reading from the graph i.e. readings 3.4 and 5.6 MP2 calculation ((2.2÷3.4) × 100 =) 64.70588 MP3 correct rounding **ecf** from previous step for MP2 and MP3
(b)(iii)	line between **A** and **B** at all times ; faster initial rate, followed by a slower rate ;	**2**	
(c)	*any one from:* temperature ; AVP ;	**1**	 e.g. humidity / light intensity

Q3.

(c)	*any two from:* wind (speed) ; temperature ; AVP ; e.g. humidity	**2**	

Q4.

(b)(i)	evaporation ; (spongy) mesophyll ; stoma(ta) ;	**3**	
(b)(ii)	*any two from:* *idea of* rate of transpiration increasing in both, (then levels out with increasing temperature) ; (rate of) transpiration is greater in the lower surface (than in the upper surface) AW ; AVP ;	**2**	e.g., there are more stomata on the lower surface
(c)	(as the humidity increases, the rate of transpiration) decreases ;	**1**	

Q5.

(a)	evaporation ; diffusion ; stomata ;	**3**	
(b)	species **B** lost more water than species **A** (in, either / both, conditions) ; both species lost more water in hot conditions (than in cool) ; the increase in water loss was greater in species A ; data, comparison / quote, for, cool / hot / difference, with units ;	**3**	**A** ora throughout
(c)	one bar drawn on Fig. 5.1, with a height that is less than 4.8 cm^3 per hour ;	**1**	

Q6.

(a)	leaves ; evaporates ; (spongy) mesophyll ; diffusion ; stoma(ta) ;	**5**	**A** stomata / stem
(b)	*environmental condition* / *effect of a **decrease** on the rate of transpiration* humidity ; / increases ; temperature ; / decreases ;	**4**	**A** light (intensity) / decreases **A** wind (speed) / decreases

Q7.

(a)	*any three from:* rate of transpiration increases and then remains constant with increasing temperature ; ora (the rate of transpiration) is higher from the lower surface ; rates of both become constant at (nearly) the same temperature ; transpiration from lower surface increases, at a greater rate / faster, than from the upper surface (in X) ;	**3**	
(b)	*total of four from:* ***X** to max 3:* *as temperature increases and rate increases* 1 the rate of evaporation from the mesophyll (cells) increases ; 2 the rate of diffusion of water vapour (through the stomata / from the leaf) increases ; 3 particles / molecules, have more kinetic energy / move faster ; 4 temperature is the limiting factor (for transpiration) ; 5 more stomata opening / stomata open wider ; ***Y** to max 3:* *as temperature increases and rate remains constant* 6 rate of diffusion of water vapour through stomata at a maximum ; 7 evaporation from mesophyll (cells) at a maximum ; 8 rate of movement of water in xylem slows ; 9 rate of uptake of water is at a maximum ; 10 the stomata are, all / fully, open ; 11 humidity / light intensity / number of stomata, is the limiting factor ;	**4**	
(c)	more stomata on the lower surface **/** lower surface has a thinner cuticle ; ora	**1**	

Q8.

(c)	*any four from:* (water enters) root hair cells, by osmosis ; through the (root) cortex (cells) ; to xylem (in the root) ; a column of water molecules moves up (the stem in xylem) / AW ; water molecules are held together by forces of attraction (between the molecules) / ref. to cohesion ; (water) diffuses / moves, out (of xylem in the leaf) into mesophyll cells ; (water) evaporates (from surface of mesophyll cells) into the air spaces ;	**4**	

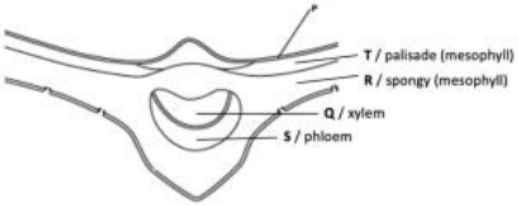
Q9.

(a)(i)	transpiration ;	**1**	
(a)(ii)	ensure continuous column of water / prevents air bubbles / prevents airlock ;	**1**	
(a)(iii)	prevent, evaporation / condensation (from the top of the burette, affecting the volume of water in the burette) / AW ;	**1**	
(a)(iv)	measure the decrease in the volume of water (in burette over a period of time) / record the decrease in mass (over time) ;	**1**	
(b)(i)	12 096 g (per m^2) / 12.096 kg (per m^2) ;;;	**3**	**A** 12 / 12.1 kg (per m^2) MP1 correct reading from graph 0.28 (g per m^2 per s) MP2 correct calculation $0.28 \times 60 \times 60 \times 12 = 12\,096$ g MP3 correct unit – g or kg ; ecf for MP2 from incorrect MP1
(b)(ii)	*any five from:* **1** as temperature increases, (rate of) water loss increases ; **2** ref to steeper rate / greater loss of water, after 37 / 38 °C ; **3** any correct comparative data quote (with units at least once) ; **4** water vapour lost, through stomata / between guard cells ; **5** evaporation from mesophyll into air spaces ; **6** (diffusion) down a, water potential, gradient ; **7** increasing temperature increases kinetic energy (of water molecule) ; **8** faster (rate of) more, diffusion ; **9** stomata open wider / more stomata open in high(er) temperatures ; **10** AVP ;	**5**	e.g. transpiration / evaporation, cools the plant

(c)(i)	no diffusion (of water vapour) ; (because) no water potential gradient / described ;	**2**	
(c)(ii)	(it has a) continuous supply of water / AW ;	**1**	
(c)(iii)	line drawn below original line ;	**1**	

Q10.

(a)(i)	*prediction:* set, **A** / in bag, will lose less, mass (than set **B**) ; *explanation*: because high(er) humidity (in **A**) ; less steep diffusion gradient / AW (in **A**) ; less transpiration (in **A**) ;	**3**	ORA throughout
(a)(ii)	*any three from:* water evaporates ; from (surface of) mesophyll / into air spaces ; water <u>vapour</u> diffuses / described ; through stomata (out of leaf) / AW ;	**3**	
(a)(iii)	balance / scale / AW ; stop-clock / timer / AW ;	**2**	

(b)	 ;;	**4**	*max 2 for diagram* 4 correct labels on the diagram = 2 marks 2 or 3 correct labels = 1 mark 1 correct label = 0 marks

letter	description	name of tissue
P	a protective transparent layer that allows light to reach inner tissues	upper epidermis
Q	conducts water from the stem	xylem
R	contains many interconnected air spaces	spongy mesophyll
S	transports sucrose and amino acids	phloem
T	traps the most light energy to synthesise carbohydrates	palisade mesophyll

;;

max 2 for table
4 correctly named tissues = 2 marks
2 or 3 correct tissues = 1 mark
1 correct tissue = 0 marks

Q11.

(b)	<u>xylem</u> supplies water ; air spaces ; large (internal) surface area ; water evaporates from surface of mesophyll cells ; guard cells, open / close, stomata ; water vapour, diffuses / moves, out through stomata ;	**3**	

Q12.

(b)	*functions* conduct / transport, water (and mineral ions) ; *ref to* transpiration ; reduced resistance to water flow / AW ; structural) support (for plant) ; prevents (inward) collapse (of xylem vessels) ; (spirals) allows (some) flexibility / bending, of stems (to prevent breaking) ; *adaptations* long / elongated (cells / vessels / tubes) ; *ref to* lignin (in walls) ; (cell walls) are water impermeable / waterproof / AW ; (secondary) thickening of cell walls ; hollow / no cytoplasm / no (named) organelles ; no, end / cross, walls (between cells) ; end plates to connect vessels (end to end) ; pits in walls (for water movement between vessels) ;	**6**	max 5 from one section **A** rings / spirals / AW

Q13.

(a)	no, cytoplasm / (named organelle) / hollow ; *ref.* to lignin (in walls) (cell walls) are waterproof / water impermeable / AW (secondary) thickening of cell wall ; long / elongated (cells / vessels / tubes) ; (bordered) pits (for water movement between vessels) ; no, (perforated) end / cross walls (between cells) / end plates to connect vessels (end to end) ;	**3**	
(b)	(water enters) root hair (cells) / **M** ; by osmosis ; the soil has a higher water potential than the root (cells) ; ora water moves from an area of high(er) water potential to low(er) water potential ; active transport of ions to create a water potential gradient ; (across / through partially permeable), membrane(s) ; *ref to* root cortex / **L** – cortex / **M** to **L** to **(K)** to **J** ; AVP ;	**5**	

Q14.

(a)(i)	thick / strong, (cell) wall ; withstanding, tension / collapse / hydrostatic pressure / AW ; lignin (in walls) / walls are impermeable ; prevents collapse / waterproofing ; wide / AW ; transport large volumes of water ; no (cell) contents / empty / dead cells / like pipes / like tubes ; no / little resistance to flow of water / allows water to flow easily / lots of water / continuous columns of water / no obstruction ; no, cross walls / end walls ; no / little, resistance to flow of water / allows water to flow easily / lots of water / continuous columns of water / no obstruction ; (bordered) pits ; lateral transport / AW ;	**2**	

(a)(ii)	evaporation from (cell walls) in mesophyll ; diffusion of water vapour through stomata ; reduction of, pressure / water potential, at top (of plant) resulting in water moving upwards ; continuous column of water (in the xylem) ; cohesion of water (molecules) ; **A** if described incorrectly cohesion described as, forces / attraction, between water molecules ; transpiration pull ; water enters *or* leaves xylem, by osmosis / down water potential gradient ; AVP ;	**4**	
(a)(iii)	support / described ;	**1**	
(b)	increase / decrease (in rate of transpiration) ; more / less, evaporation ; increase / decrease, rate of diffusion (of water vapour) ; *ref. to* (kinetic) energy of (molecules of) water ; stomatal pores become, wider / narrower ; guard cells become, turgid / flaccid ;	**3**	**A** stomata close