



## 4: Transport and gas exchange – Topic questions

The questions in this document have been compiled from past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
5	2017	May/June	21
1	2017	May/June	23
4	2016	May/June	21

The mark scheme for each question is provided at the end of the document.

5 Sugar molecules enter cells through transport proteins.

- (a) Explain why transport proteins are required for the movement of sugar molecules, such as glucose and fructose, into cells.

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.....[2]

Some plant cells convert fructose and glucose into sucrose for transport from sources to sinks. Sucrose is moved into phloem sieve tubes as shown in Fig. 5.1.

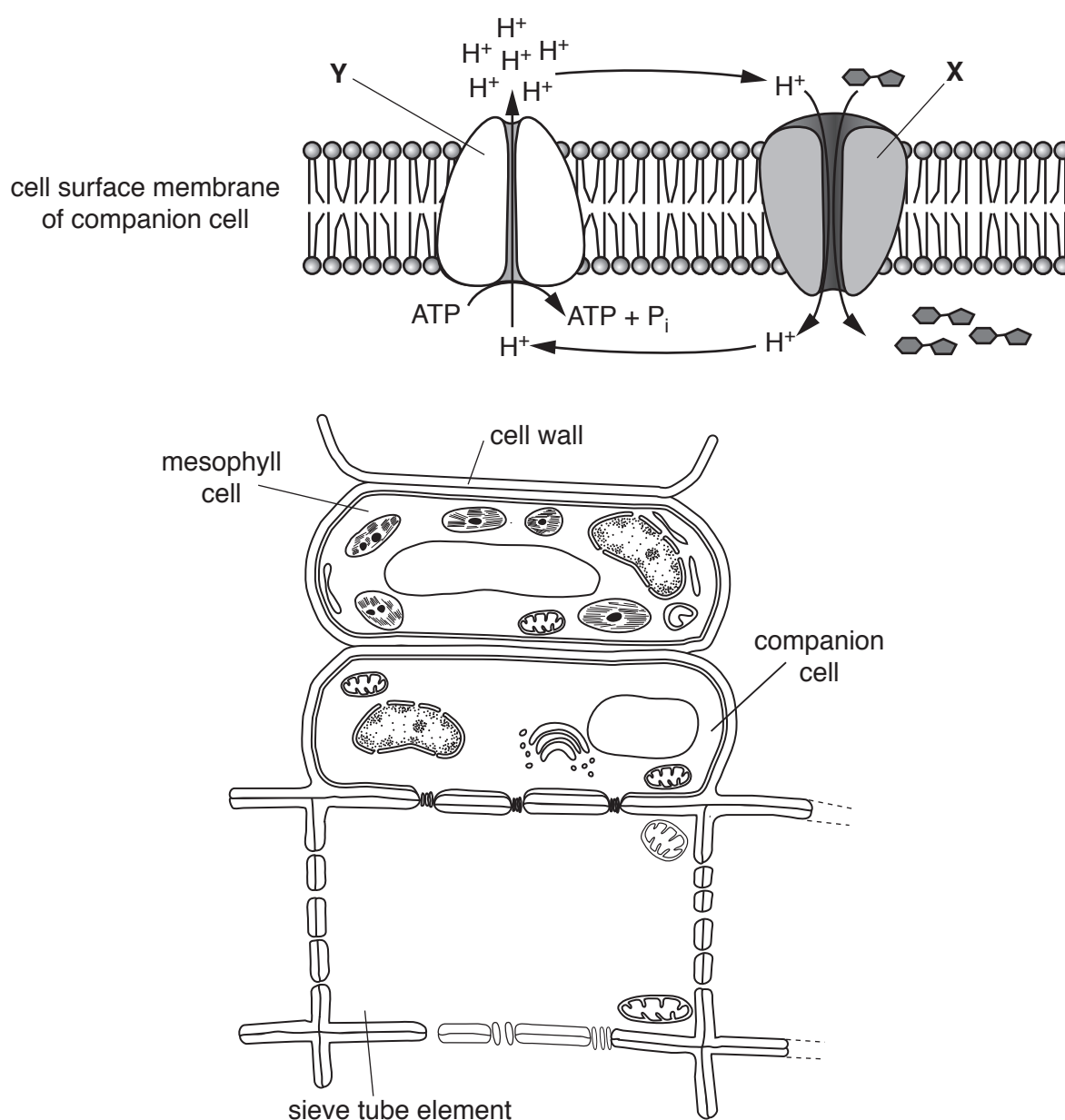


Fig. 5.1

not to scale

**(b)** Use the information in Fig. 5.1 to explain how sucrose:

- moves into the companion cell
- moves from the companion cell into the sieve tube element.

[5]

**(c)** Sucrose travels in phloem sieve tubes to sinks.

State two examples of sinks.

1 .....

2 .....[1]

[Total: 8]

1 Mammals have a closed double circulation system.

(a) Explain what is meant by a *closed double circulation*.

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.....[2]

(b) Table 1.1 shows some structures in the mammalian circulatory system.

Complete Table 1.1 to show the sequence of structures through which blood flows, starting with the pulmonary vein.

Use the numbers 2 to 5 to indicate the correct sequence.

**Table 1.1**

structure	sequence of blood flow
left ventricle	
vena cava	
pulmonary vein	1
aorta	
right atrium	

[2]

- (c) (i) Explain why arteries have thicker walls than veins.

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.....[2]

- (ii) Smoking causes carbon monoxide and nicotine to enter the blood.

Describe the short-term effects of each of these substances on the cardiovascular system.

*carbon monoxide*

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.....

.....

*nicotine*

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.....[4]

[Total: 10]

- 4 (a) Transpiration is often described as ‘an inevitable consequence of gas exchange in leaves’.

Explain what is meant by this description.

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.....[3]

- (b) Explain how hydrogen bonding is involved in the movement of water in the xylem.

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.....[3]

Southern beech trees of the genus *Nothofagus* grow in forests in the South Island of New Zealand. Fig. 4.1 shows a small part of a forest.

Most of the trees in the forests form a thick canopy of leaves. These are known as canopy trees. The tallest trees are known as emergent trees. Some trees do not reach the canopy and are known as suppressed trees.

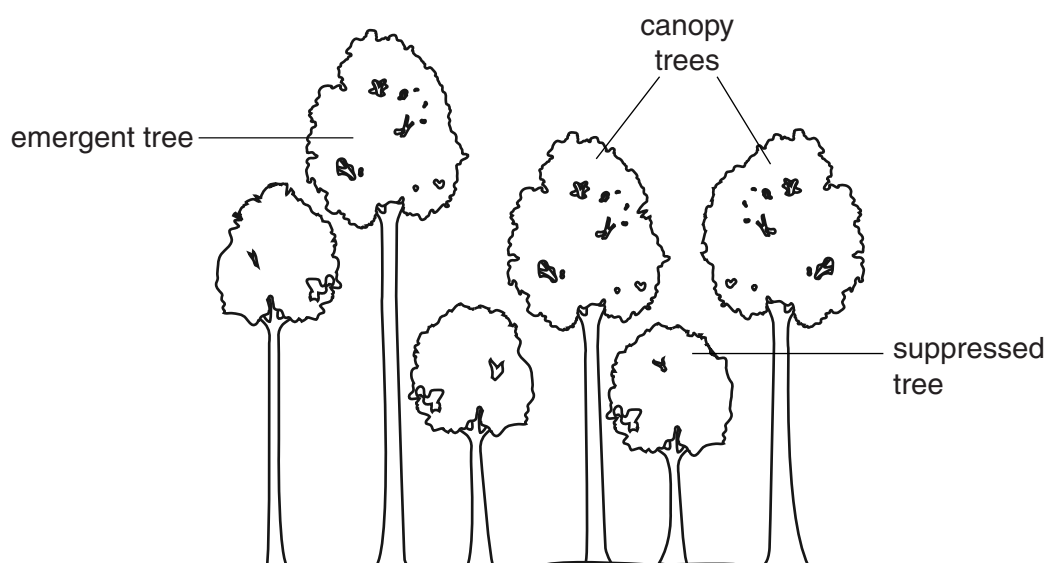
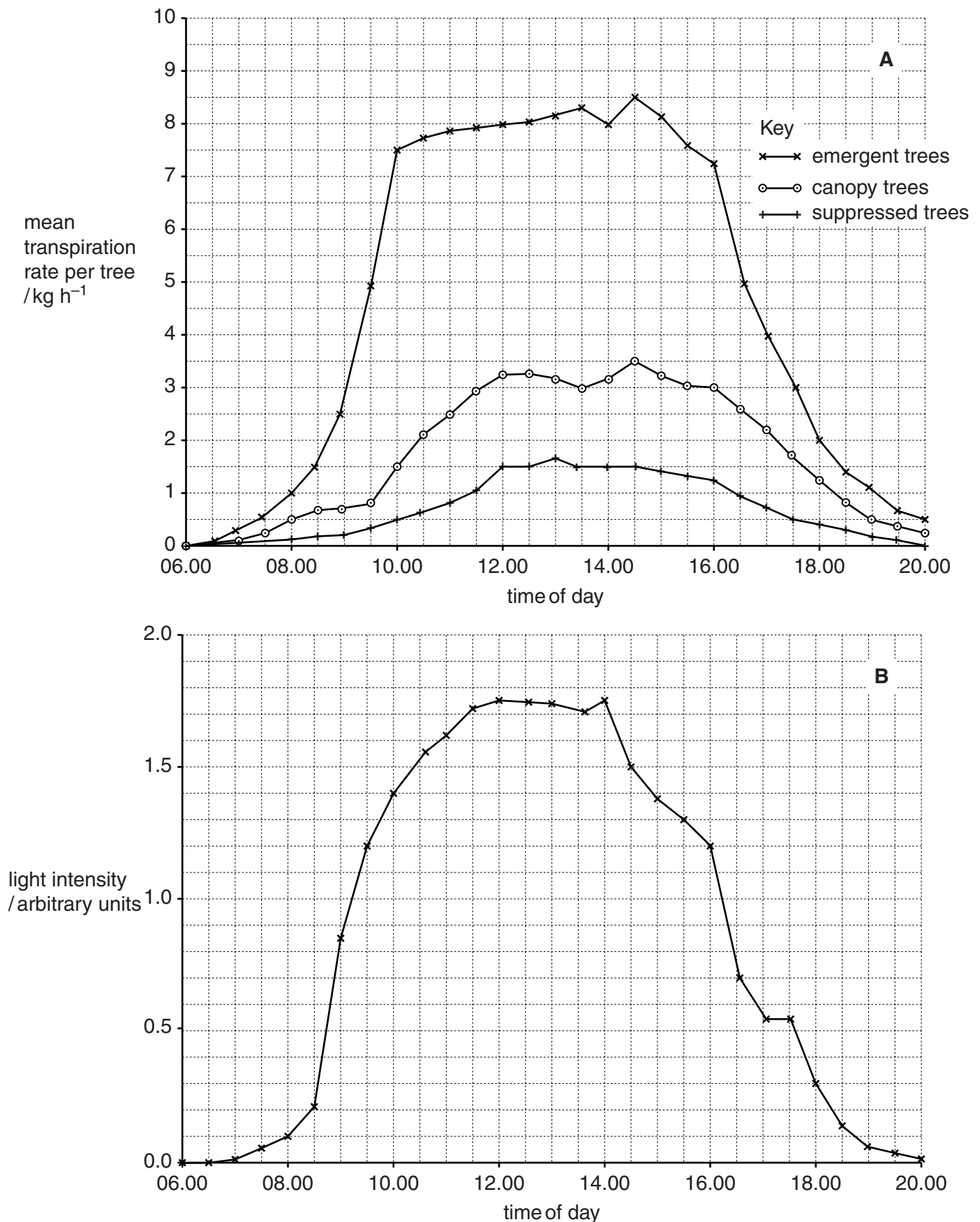


Fig. 4.1

Researchers determined the rates of transpiration of emergent, canopy and suppressed trees in a forest over a 14 hour period from 06.00 until 20.00 on one day in the summer. The results are shown in Fig. 4.2A. They also recorded changes in light intensity above the canopy over the same time period as shown in Fig. 4.2B.



**Fig. 4.2**

[4]

Use the information in Fig. 4.1 and Fig. 4.2 to suggest reasons for the difference in the transpiration rates of the emergent and suppressed trees.

[4]

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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
AW	alternative wording (where responses vary more than usual)
<u>underline</u>	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
I	ignore
AVP	alternative valid point

Question	Answers	Marks
5(a)	sugar (molecules) / glucose / fructose, is polar / is water soluble / not lipid soluble / hydrophilic ; cannot pass through, (phospho)lipid bilayer / hydrophobic core / fatty acid 'tails' / hydrocarbon 'tails' ; <b>A</b> non-polar regions	<b>2</b>
5(b)	<p><i>accept <math>H^+</math> for proton throughout</i></p> <p><b>1</b> (at <b>Y</b>) protons, pumped out (of companion cell) / moved out by active transport / move out through proton pump ; <b>A</b> protons are moved out against concentration gradient</p> <p><b>2</b> creates a, proton gradient / electrochemical gradient ;</p> <p><b>3</b> protons go into the, cell wall / apoplast ; <b>R</b> mesophyll cell</p> <p><b>4</b> (at <b>X</b>) protons enter cell by <u>facilitated diffusion</u> ;</p> <p><b>5</b> (<b>X</b> is) cotransporter / cotransport protein ;</p> <p><b>6</b> sucrose transported into (companion) cell together with protons ;</p> <p><b>7</b> (sucrose enters) against concentration gradient ;</p> <p><b>8</b> sucrose concentration, increases / maintained, in companion cell ;</p> <p><b>9</b> sucrose diffuses into sieve tube (element) ;</p> <p><b>10</b> through plasmodesmata ;</p> <p><b>11</b> AVP ; e.g. <i>ref. to</i>, secondary / indirect, active transport</p>	<b>max 5</b>

Question	Answers	Marks
5(c)	<p><i>look for names of plant organs other than leaves, ignore names such as potato, iris, onions</i></p> <p><b>R</b> leaves unqualified</p> <p><i>any two for max 1</i></p> <p>root / root tip  stem / stem tip / shoot / shoot tip  tubers  bulbs  corms  rhizomes  buds  flowers  fruits  seeds  young / maturing / developing / infected, leaves  AVP</p>	max 1
		Total: 8

Question	Answer	Marks
1(a)	<p>blood contained in (blood) vessels AW  <b>or</b>  blood contained in <i>any three of</i>  heart, arteries, veins, capillaries ;</p> <p>systemic and pulmonary, systems / circulation ;  <b>A</b> described <i>if circulations not named</i>  e.g. for each complete circuit (round the body) blood passes through heart twice  blood transported from heart to lungs and back, then to (rest of) body and back</p>	2
1(b)	<div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">2</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">4</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; background-color: #cccccc;">1</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">3</div> <div style="border: 1px solid black; padding: 2px;">5</div> </div> <p>1st and 5th boxes (2 and 5) correct ;  2nd and 4th boxes (4 and 3) correct ;</p>	2
1(c)(i)	<p><i>assume answer refers to arteries unless stated otherwise</i>  withstand / AW, higher pressure (of blood) ;  prevent rupturing / bursting (from high blood pressure) ; <b>I</b> collapsing</p> <p><i>one from</i>  thicker / AW, tunica media ;  more elastic, tissue / fibres, and (smooth) muscle tissue ;  more / AW, elastic, tissue / fibres, to maintain, blood pressure / blood flow ;  more (smooth) muscle to maintain, blood pressure / blood flow ;</p>	max 2
Total: 6		

Question	Answers	Marks
4(a)	<p><i>transpiration is an inevitable consequence because</i></p> <ol style="list-style-type: none"> <li>1 stomata open ;</li> <li>2 for <u>diffusion</u> in of carbon dioxide/ carbon dioxide required for photosynthesis ;</li> <li>3 water <u>vapour</u>, <u>diffuses out</u>/moves out down the water potential gradient ;  A description of water potential gradient/high to low water potential  A vapour pressure gradient/ water vapour gradient  <i>allow water vapour if it is clear that evaporation has occurred</i>  A water evaporates and diffuses out  R water evaporates out  I water (vapour) concentration gradient</li> </ol>	3
4(b)	<ol style="list-style-type: none"> <li>1 <u>adhesion</u> of water to, cellulose / lining / walls (of xylem vessels) ;  A <u>adhesive</u> force</li> <li>2 ref to, hydrophilic/polar, property of <u>cellulose</u> (fibres) ;  A hydrophilic/polar, parts of <u>lignin</u></li> <li>3 <u>cohesion</u> between water molecules ; <u>cohesive</u> force</li> <li>4 maintains column of water/prevents water column breaking/ AW ;</li> <li>5 <i>ref. to transpiration pull/ AW ; I transpiration <u>unqualified</u></i></li> </ol>	max 3
4(c)	<p><i>mp3 – units for rates of transpiration must appear once correctly in the whole answer to award this point</i></p> <ol style="list-style-type: none"> <li>1 rate (of transpiration) of all trees is 0 at, 06.00/start ; A no transpiration</li> <li>2 rates (of transpiration) increase and decrease (<u>in all three</u>) ; A peaks</li> <li>3 highest rates:  emergent trees at 14.30 at <math>8.5 \text{ kg h}^{-1}</math>  canopy trees at 14.30 at <math>3.5 \text{ kg h}^{-1}</math>  suppressed trees at 13.00 at <math>1.6\text{--}1.7 \text{ kg h}^{-1}</math> ;  <i>must have units at least once</i>  <i>accept kg/h or kg per hour</i></li> <li>4 emergent trees (always) have highest rate or suppressed trees have lowest rate;  A emergent trees have higher rate than, canopy and suppressed, trees</li> <li>5 rate of emergent trees is, much/ AW, higher than rates for canopy and suppressed trees ;</li> <li>6 emergent trees have, steeper/ steepest, <u>increase</u> in (transpiration) rate ;  A emergent trees have, steeper/ steepest, <u>decrease</u> in (transpiration) rate</li> </ol>	max 4

Question	Answers	Marks
4(d)	<p><i>following factors may be given in answers, any three of these factors = 1 mark</i></p> <p>light, intensity/wavelength I 'more light'</p> <p>humidity</p> <p>temperature</p> <p>wind speed/air movement</p> <p>size of tree/height/area of leaves</p> <p>water availability/depth or length of roots</p> <p><i>transpiration rate for emergent trees is higher because ... accept <b>ora</b> for suppressed trees</i></p> <p><i>accept vapour pressure gradient/water vapour pressure gradient/water vapour diffusion gradient for water potential gradient</i></p> <ol style="list-style-type: none"> <li>1 high(er) light intensity for emergent trees increase stomatal aperture ; ora  <b>A</b> more sunlight  <b>A</b> stomata open more  <b>I</b> more stomata open</li> <li>2 lower humidity for emergent trees so steeper water potential gradient ; ora  <b>A</b> description of water potential gradient</li> <li>3 higher temperature/AW, for emergent trees so higher rate of, evaporation/diffusion ; ora</li> <li>4 higher wind speed for emergent trees so, steeper water potential gradient/lower humidity ; ora  <b>A</b> ref. to diffusion shells/descriptions of water potential gradient</li> <li>5 emergent trees have longer roots so take up more water ;</li> <li>6 emergent trees have more leaves so, greater surface area/more stomata per unit area (of leaf)</li> </ol>	max 4
		<b>Total: 14</b>