



Mark schemes

**Q1.**

- |     |  |            |
|-----|--|------------|
| (a) | (has) spikes / thorns / prickles<br><i>allow (has a) tough outer layer</i>                     | 1          |
| (b) | chemical   | 1          |
| (c) | the plant will not lose as much water  | 1          |
| (d) | chlorophyll / chloroplasts   | 1          |
| (e) | to allow it to photosynthesise<br><b>or</b><br>to make sugar / glucose / carbohydrate / starch | 1          |
| (f) | organ  | 1          |
| (g) | water / mineral ions<br><i>allow named mineral ions</i><br><i>allow minerals / ions</i>        | 1          |
| (h) | phloem (tissue)  | 1          |
|     |  | <b>[8]</b> |

**Q2.**

- |     |  |   |
|-----|--|---|
| (a) | A  | 1 |
| (b) | chloroplast(s)<br><i>ignore chlorophyll</i>                                    | 1 |
| (c) | guard (cells)<br><i>ignore stoma(ta)</i>                                       | 1 |
| (d) | transpiration stream<br><i>ignore transpiration unqualified</i>                | 1 |
| (e) | increased humidity   | 1 |
| (f) | <b>Level 2:</b> Scientifically relevant features are identified; the way(s) in |   |



which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted. 4-6

**Level 1:** Relevant features are identified and differences noted. 1-3

**No relevant content.** 0

**Indicative content:**

*Structure*

- xylem is made of dead cells  
**and**  
phloem is made of living cells
- phloem cells have pores in their end walls  
**and**  
xylem cells do not have pores in their end walls
- xylem is hollow **or** xylem does not contain cytoplasm  
**and**  
phloem contains cytoplasm
- xylem contains lignin  
**and**  
phloem does not (contain lignin)
- both made of cells
- both tubular

*Function*

- xylem transports water / mineral ions  
**and**  
phloem transports (dissolved) sugars
- xylem is involved in transpiration  
**and**  
phloem is involved in translocation
- xylem transports unidirectionally  
**and**  
phloem transports bidirectionally
- both transport liquids / substances throughout the stem / leaves / roots / plant

For **Level 2**, students must refer to both structure and function of xylem and phloem tissue.

(g) *(correct division)*

40 ÷ 7 (in hours)

**or**

40 ÷ 420 (in minutes)

*allow correct answer from student's readings throughout*

1

5.71 (in hours)

**or**

0.0952...(in minutes)



*allow correct division from incorrect reading(s) from the tangent*

1

*(correct conversion to minutes)*  
0.0952...

*allow correct conversion at any point in the calculation*

*allow correct conversion of calculated value to minutes*

1

*(answer in standard form)*  
 $9.5(238) \times 10^{-2}$

*allow correct conversion of calculated value to standard form*

1

(h) (less water loss at night)

*allow converse if clearly describing 12:00*

stomata are (almost completely) closed

1

(because) it's cooler / colder

**or**

(because) there's less / no light

*ignore it's dark at night*

1

[17]

**Q3.**

(a) movement / spreading out of molecules / particles

*allow movement / spreading out of (named)*

*substances / chemicals / gases / liquids*

*ignore reference to membranes / cells*

1

from (an area of) high(er) concentration to (an area of) low(er) concentration

*allow down / with the concentration gradient*

*ignore along / across the concentration gradient*

*do **not** accept movement from / to a concentration gradient*

1

(b) increased carbon dioxide concentration in the air

1



increased number of stomata that are open	1
(c) <b>Level 3:</b> Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5-6
<b>Level 2:</b> Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3-4
<b>Level 1:</b> Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1-2
<b>No relevant content</b>	0
<b>Indicative content</b>	
<ul style="list-style-type: none"> <li>• (many) alveoli             <ul style="list-style-type: none"> <li>• provide a large(r) surface area (: volume)</li> </ul> </li> <li>• capillaries are thin             <ul style="list-style-type: none"> <li>• <b>or</b> alveoli / capillary walls are thin <b>or</b> one cell thick</li> <li>• <b>or</b> capillaries are close to the alveoli</li> <li>• which provides short diffusion path (for oxygen / carbon dioxide)</li> </ul> </li> <li>• breathing (mechanism) moves air in and out <b>or</b> lungs are ventilated             <ul style="list-style-type: none"> <li>• to bring in (fresh) oxygen</li> <li>• to remove carbon dioxide</li> <li>• to maintain a concentration / diffusion gradient</li> </ul> </li> <li>• large capillary network (around alveoli) <b>or</b> good blood supply             <ul style="list-style-type: none"> <li>• to remove oxygen(ated blood) quickly</li> <li>• to bring carbon dioxide to the lungs quickly</li> <li>• to maintain a concentration / diffusion gradient</li> </ul> </li> </ul>	
(d) Osmosis	
<i>allow diffusion</i>	1
(e) active transport	1
(because) energy is needed	1
(to move nitrate ions) from a low(er) concentration (in the soil) to a high(er) concentration (in the root / cell)	
<i>allow (to move nitrate ions) against / up the concentration gradient</i>	
<i>allow (because) there is a lower concentration (of nitrate ions) in the soil <b>or</b> (because) there is a higher</i>	



*concentration (of nitrate ions) in the root / cell*

*ignore reference to amount / number of nitrate ions*

*ignore along / across the concentration gradient*

*do **not** accept if reference to molecules / atoms moving*

1

[14]

**Q4.**

(a) epidermis

palisade mesophyll

*allow palisade / mesophyll*

xylem

3

(b) guard cells

1

(c) to let carbon dioxide into the leaf

1

(d) by evaporation

1

(e)

*an answer of 4 (cm<sup>3</sup>) scores 2 marks*

evidence of correct graph readings (5 and 1)

*allow in range 4.8 to 5.2 and 0.8 to 1.2*

1

4 (cm<sup>3</sup>)

*allow correct subtraction from their graph readings*

*allow their calculated value from readings in the range 4.6 to 5.4 and 0.6 to 1.4*

1

(f) plant **A** has more leaves

1

(g) any **one** from:  
(the new room was)

- windier
- warmer
- drier / less humid
- brighter

*answers must be comparative*



*allow sunnier*  
*ignore more sun*

1

(h) any **one** from:

- spikes / points / thorns / sharp
- poisonous / toxic
- brightly coloured berries
- leaves are tough / leathery

**or**

leaves are hard to chew

*ignore reference to predators eating*

*holly*

*allow unpleasant taste*

1

[11]

**Q5.**

(a) (by the guard cells) opening **and** closing the stomata

*ignore ref to guard cells being*

*plasmolysed / turgid*

1

(b) (water is) transported in xylem

*ignore mechanism of water entering the*

*roots*

*do **not** accept translocation*

1

water evaporates (from leaves)

*allow loss of water vapour*

1

through the stomata

*allow between the guard cells*

*if no other marks awarded allow 1 mark*

*for reference to transpiration*

1

(c) any **one** from:

*allow converse for plant **B***

- plant **A** has more stomata  
*allow (the plants) have different numbers of stomata*
- plant **A** has more leaves  
*allow (the plants) have different numbers of leaves*
- plant **A** has bigger leaves  
*allow (the plants) have different sized leaves*
- plant **A** has a greater total surface area of leaves  
*allow (the plants) have different total surface area of leaves*



*allow plant A has less (waxy) cuticle*  
**or**  
*(the plants) have different amounts of (waxy) cuticle*  
*allow plant A has fewer hairs on leaves*  
**or**  
*(the plants) have different number of hairs on the leaves*

1

(d)

*an answer of 10 scores 3 marks*

5.2

*allow in range 4.8 to 5.6*

1

$(5.2 \times 2 =) 10.4$

**or**

$$\left(\frac{5.2}{0.5} =\right) 10.4$$

*allow their calculated value in the range 8.8 to 12.0*

1

10 (cm<sup>3</sup>/hour)

*allow their calculated value in the range 8.8 to 12.0 correct to 2 significant figures*

1

(e) (rate increased because)

any **two** from:

*answers must be comparative*

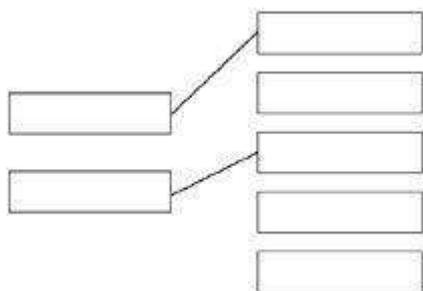
- (it was) warmer
- light intensity was higher
- (it was) less humid  
*allow greater water vapour gradient between leaves and environment*
- (it was) windier

2

[10]

**Q6.**

(a)



*additional line from a level of organisation negates the mark for that level of organisation*

- |     |  |   |
|-----|--|---|
|     |  | 2 |
| (b) | palisade mesophyll   | 1 |
| (c) | $\frac{50}{8}$   | 1 |
|     | 6 / 6.25 / 6.3 (micrometres)   | 1 |
|     | <i>an answer of 6 / 6.25 / 6.3 scores 2 marks</i>  |   |
| (d) | they have no chloroplasts / chlorophyll<br><i>allow they are underground</i><br><i>allow they don't get (access to) light</i><br><i>allow (because) photosynthesis needs light</i><br><i>allow they can't absorb light</i><br><i>ignore 'sun'</i><br><i>ignore 'it is dark'</i>  | 1 |
| (e) | differentiation  | 1 |
| (f) | to protect endangered plants from extinction   | 1 |
| (g) | plants can be produced quickly   | 1 |
| (h) | any <b>one</b> from: <ul style="list-style-type: none"> <li>• glucose / sugars / starch</li> <li>• amino acids / protein</li> <li>• hormones<br/><i>allow named hormones e.g. auxin</i></li> <li>• ions / minerals<br/><i>allow magnesium / nitrate</i></li> <li>• vitamins<br/><i>allow named vitamins e.g. vitamin B</i></li> <li>• water<br/><i>allow H<sub>2</sub>O / H2O</i></li> </ul> |   |



*ignore oxygen / carbon dioxide / agar / nutrients /  
fertiliser*

1  
[10]

**Q7.**

(a) phloem 1

(b) translocation 1

(c) either:  
less (sugars for) respiration 1

(so) less energy released 1

**or**

less amino acids made (1)

(so) less protein produced **or** less protein synthesis (1)

**or**

less cellulose made (1)

(so) weaker cell walls (1)

(d) (aphids) can fly to another plant **or** part of the plant  
*ignore to fly unqualified* 1

to get (more) food

*allow to find a mate*

*allow idea of less competition for food*

*allow to escape predators*

*do **not** accept escape prey*

1

(e) (oil) prevents aphids from attaching to leaf **or** causes aphids to slide  
off leaf

*ignore 'the leaf is slippery'*

**or**

idea that oil may harm / kill the aphid

*allow oil may be unpleasant to the aphid*

1

(f) (plant / stem has) thorns  
*allow spines / spikes / prickles*



*ignore stings*  
*do **not** accept thorns protect (the plant)*  
*from predators*

1

(g) C

*if any other letter given then no marks*  
*for the question*

1

(fungi / spores) blown by / in direction of the wind  
*allow black spot / disease is blown by /*  
*in direction of the wind*

**or**

it's the closest plant (to A)

*do **not** accept reference to bacteria /*  
*viruses / pollen being blown*

1

(h) any **one** from:

- spread rose bushes out more  
*allow isolate the infected plant*  
*allow idea of barrier around infected*  
*plant*  
*ignore separate unless qualified*
- remove any infected parts of the plant  
*allow remove infected plant / A*
- use a fungicide  
*ignore pesticide*  
*do **not** accept insecticides / herbicide*

1

[11]

**Q8.**

(a) (A) bronchus

*allow bronchi*  
*allow bronchiole*

1

(B) trachea

*allow windpipe*

1

(C) alveolus

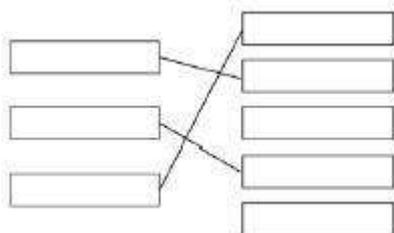
*allow alveoli*  
*ignore air sac*

1

(b) circulatory system



- (c) Q 1
- (d) guard cell 1
- (e) a group of cells with a similar structure / function 1



- (f) 1
- 1 mark for each correct line  
extra line from a tissue negates the mark for that tissue*

3  
[10]

**Q9.**

- (a) 86 1
- allow this answer only  
do **not** accept 85.7  
if no answer given, check for answer in the table*
- (b) as salt concentration increases, percentage of open stomata (in field of view) decreases (above 0.1 mol / dm<sup>3</sup>) 1
- or**  
allow percentage of open stomata stays the same between 0.0 and 0.1 (mol / dm<sup>3</sup> then decreases as salt concentration increases)  
*ignore references to number of open stomata  
allow converse  
allow idea that mean concentration (of salt) in guard cells is between 0.3 and 0.4 mol per dm<sup>3</sup>*
- (c) use concentrations between 0.3 (mol / dm<sup>3</sup>) and 0.4 (mol / dm<sup>3</sup>) 1
- or**  
draw a graph of the data and read off the value at 50% (open stomata)  
*allow a list of appropriate concentrations i.e. 0.32 mol / dm<sup>3</sup>, 0.34 (mol / dm<sup>3</sup>), 0.36 (mol / dm<sup>3</sup>) etc.*
- (d)  $(\pi \times 0.1875^2) = 0.11$  (mm<sup>2</sup>) 1
- an answer of 36 scores 3 marks*



$$\frac{4}{0.11}$$

1

36 (per mm<sup>2</sup>)

*allow 36.22 / 36.23 or 36.2*

*if answer is incorrect allow for 2 marks for sight of number of open stomata = 9 per mm<sup>2</sup> (diameter used instead of radius)*

*if no other marks awarded allow for 1 mark any **one** from:*

- *sight of area = 0.44(mm<sup>2</sup>) (diameter used instead of radius)*
- *sight of number of open stomata = 9.1 / 9.05 / 9.06 per mm<sup>2</sup> (diameter used instead of radius and no rounding)*

1

(e) (potassium) ions increase the concentration of the solution (inside guard cells)

**or**

(potassium) ions make cell more concentrated / less dilute

*allow (potassium) ions decrease concentration of water / water potential (of guard cells)*

1

water moves into the (guard) cell by osmosis

1

cell swells unevenly (so stoma opens)

1

as inner wall is less flexible than outer wall **or** thick part of the wall is less flexible than the thin part (of the wall)

1

[10]

**Q10.**

(a) electron (microscope)

1

$$\frac{30000}{200}$$

(b)

*an answer of 150 (µm) scores 2 marks*

1

150 (µm)

*if answer is incorrect allow for 1 mark sight of 0.015 / 0.15 / 1.5 / 15*

*allow ecf for incorrect measurement of line X for max 1 mark*

1

(c) **either**



large surface area		
	<i>allow (vacuole contains) cell sap that is more concentrated than soil water (1)</i>	1
for more / faster osmosis		
	<i>create / maintain concentration / water potential gradient (1)</i>	
<b>or</b>		
allow thin (cell) walls		
for short(er) diffusion distance		1
(d) (on hot day) more water lost		
	<i>allow converse for a cold day if clearly indicated</i>	1
more transpiration		
<b>or</b>		
more evaporation		1
so more water taken up (by roots) to replace (water) loss (from leaves)		1
(e) (aerobic) respiration occurs in mitochondria		
	<i>do <b>not</b> accept anaerobic respiration</i>	1
(mitochondria / respiration) release energy		
	<i>do <b>not</b> accept energy produced / made / created</i>	1
(energy used for) active transport		1
to transport ions, against the concentration gradient		
<b>or</b>		
from a low concentration to a high concentration		1
		<b>[12]</b>

**Q11.**

(a) active transport		1
(b) by transpiration stream / pull		1
in xylem		1



- (c) any **three** in the correct order from:
- mount epidermis on a slide
  - count stomata in one area
  - repeat in four more areas
  - repeat method on other surface of leaf
  - calculate mean
- allow nail varnish film*
- 3
- (d) 1
- allow numbers written out in a line with middle number circled*
- 1
- (e)  $(44 + 41 + 40 + 42 + 39) / 5 = 41.2$
- 1
- 41
- allow 41 with no working shown for 2 marks*
- 1
- allow 41.2 for 1 mark*
- (f) less water lost
- 1
- so it does not wilt
- 1
- [11]**

**Q12.**

- (a) guard (cells)
- allow phonetic spelling*
- 1
- (b) (i) as carbon dioxide (concentration) increases, the (mean) number of stomata decreases
- allow there is a negative correlation*
- 1
- (there is a) rapid drop initially
- allow use of any number between 1.5 and 3.0 to indicate "initially"*
- 1
- (ii) (there is) more carbon dioxide so plant doesn't need as many stomata (to obtain the amount needed)
- or**
- (there is) less carbon dioxide so the plant needs more stomata (to obtain enough)
- 1
- (c) (i) may lose too much water



*allow plant may wilt*  
*ignore references to oxygen / carbon dioxide*  
*plants lose a lot of water is insufficient*  
*ignore flaccid*

1

(ii) any **one** from:

- hot
- dry
- windy

*ignore environments unqualified eg desert*

1

[6]

### Q13.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.

#### **Level 3 (5–6 marks):**

Processes used for obtaining specified materials are given.

**and**

correctly linked to the vessels that the materials are transported in

**or**

correctly linked to a description of the direction of movement of the materials.

**For full credit**, in addition to the above descriptors at least **one** of the processes must be linked to the vessel that the material is transported in **and** the direction of the movement of the material.

#### **Level 2 (3–4 marks):**

At least **one** process for obtaining a specified material is given

**and**

is correctly linked to the vessel that the material is transported in

**or**

correctly linked to a description of the direction of movement of the material

#### **Level 1 (1–2 marks):**

At least **one** process (P) for obtaining a material is given

**or**

at least **one** vessel (V) and the material it carries is given

**or**

there is a description of the direction of movement (M) for at least **one** material

#### **0 marks:**

No relevant points are made

#### **examples of points made in the response ions:**

(P) taken up by diffusion or active transport

- from an area of high to low concentration (diffusion) **or** an area of low to high concentration (active transport)

(V) travels in the xylem

(M) to the leaves **or** from the roots / soil

#### **Water:**



(P) taken up by osmosis

- from an area of low to high concentration

*allow high concentration of water to low concentration of water*

*allow from high water potential to low water potential*

*ignore along a concentration gradient*

(V) travels in the xylem

(M) to the leaves **or** from the roots / soil

(P) transpiration stream

- movement replaces water as it evaporates from leaves  
(V) in the xylem

**Sugar:**

(P) made during photosynthesis

(V) travels in the phloem

(M) to other parts of the plant **or** to storage organs **or** travels up and down

[6]