



# **A-Level Biology**

## **Mass Transport in Plants**

### **Mark Scheme**

**Time available: 82 minutes**

**Marks available: 61 marks**

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## Mark schemes

1.

- (a) Correct answer for 2 marks = 14/14.02/14.024;;

Accept for 1 mark,  
mean = 8.2

**OR**

uncertainty = 1.15

2

- (b) 1. Sucrose actively transported (into phloem);  
2. Lowering/reducing water potential

**OR**

More negative water potential;

3. Water moves (into phloem) by osmosis (from xylem);

3

- (c) Phloem pressure falls as (rate of) water movement (in xylem) increases

**OR**

Inversely proportional;

*Accept converse*

1

- (d) 1. High (rate of) transpiration/evaporation;  
2. Water lost through stomata

**OR**

(High) tension in xylem;

3. (Causes) less water movement from xylem to phloem

**OR**

Insufficient water potential in phloem to draw water from xylem;

3

[9]

2.

- (a) 1. Initial **and** final mass (of beaker and all contents);

*Accept change in mass/weight*

*Ignore volume*

*Reject change in mass of celery/beaker/water alone*

2. Number of (groups of) xylem vessels;

*Accept amount for 'number'*

2

(b) Prevent evaporation/water loss

**OR**

(So) evaporation/water loss/transpiration only from celery;

1

(c) 1. Water evaporates/is transpired (from leaves/ stalk/celery/plant);

2. Water potential gradient/lower water potential creates tension/pulls up water

**OR**

Osmosis creates tension/pulls up water;

*Accept negative pressure for tension*

3. Hydrogen bonds/cohesion/adhesion maintains column;

3

(d) 1. Cut away from body;

*Accept description of cutting technique to avoid cutting fingers*

2. Against hard/non-slip/flat surface;

*Accept named hard surface eg tile/board*

2

(e) Median (no mark)

1. (Presence of) outliers/80/70

**OR**

Small sample size/8 (measurements);

*Accept anomalies / extremes for 'outliers'*

2. 41;

Accept for 1 mark,

Mean of 47

**OR**

Mode of 35

2

**[10]**

**3.**

(a) 1. Used to compare effect of other treatments / as a baseline;

*Accept for 2 marks, substance (X) and not agar / block / water that caused the difference in the number of roots.*

*Do not accept unqualified reference to "compare results".*

2. Shows / Measures effect of substance (X);

**OR**

Accounts for effect of substances produced naturally;

*Accept measures effect of independent variable*

2

- (b) 1. (D shows) substance (X) is not required for (some) root growth / production of roots;  
**OR**  
 Substances (already) present in stem cause (some) root growth;
2. Substance X moves through plant;  
*Accept X moves through stem / phloem*
3. (E shows) substance (X) causes / increases / doubles number of roots / root growth;

3

(c) **In support of mass flow hypothesis**

1. (F shows) phloem is involved;
2. (G shows) respiration / active transport is involved (in flow / movement);
3. Because 4 °C / cooling reduces / slows / stops flow / movement;
4. The agar block is the source;
5. Roots are the sink;

**Against the mass flow hypothesis**

6. No bulge above ringing (in F);
7. No (role for) osmosis / hydrostatic pressure / water movement;  
*Accept no turgor pressure*
8. Movement could be due to gravity;
9. Roots still grow without (intact/functioning) phloem;
10. No leaves / sugars / photosynthesis to act as a source;  
*Each point must be clearly made in the context of support or against.*  
*Ignore sugar / sucrose*  
*3 max for "support" and 3 max for "against"*

4 max

[9]

4.

- (a) Correct answer 23.55 – 24 two marks;  
 For one mark  
 5.9  
**OR**  
 94.2;

2

- (b) 1. Method for measuring area;  
 e.g. draw round (each) leaf on graph paper and count squares;
2. Of both sides of (each) leaf;
3. Divide rate (of water loss / uptake from potometer) by (total) surface area (of leaves);

3

(c) Plant has roots  
**OR**  
xylem cells very narrow;  
*Ignore references to air bubbles / mass flow / photosynthesis*  
*Accept xylem damaged when cut*

1

(d) 1. Both small / similar size (so fit channel);  
2. Have a similar shape (so bind to / fit channel);  
1. *Accept same height and width*  
*Ignore refs to polar / non-polar*  
2. *Accept Aquaporin complementary to oxygen(s)*

2

(e) 1. Single-stranded RNA (has base sequence) complementary to PIP1 mRNA;  
2. Binds to mRNA (of PIP1) / leads to destruction of mRNA;  
3. Prevents / reduces translation (of PIP1);  
4. Reduces photosynthesis/named process that uses water;  
3. *Less made is insufficient*

3 max

(f) Not all of mRNA bound to single-stranded RNA / there is more mRNA than interfering RNA  
**OR**  
Not all mRNA destroyed / disabled;  
*Accept mutations in transgene,*  
*Accept not all cells with transgenes*

1

(g) 1. Loss of PIP reduces water **and** carbon dioxide movement;  
2. Differences significant because SDs don't overlap  
**OR**  
Need stats test to see whether significant differences (or not);  
3. Greater (proportional) effect on carbon dioxide transport;  
4. Not all movement through PIP;  
1. *Accept converse for wild type*  
2. *Reject references to results significant or not significant*  
2. *Accept error bars for SDs*

3 max

[15]

5.

(a) 1. In source / leaf sugars actively transported into phloem;  
2. By companion cells;  
3. Lowers water potential of sieve cell / tube and water enters by osmosis;  
4. Increase in pressure causes mass movement (towards sink / root);  
5. Sugars used / converted in root for respiration for storage.  
*Accept starch*

4 max

(b) Respiration.

1

- (c) 1. (About) 30 hours;  
 2. Time between peak  $^{14}\text{C}$  at top of trunk and bottom. 2
- (d) Length of trunk (between top and bottom). 1

[8]

6.

- (a) 1. Contents of phloem vessel pushed into insect's mouth by high pressure;  
 2. (High pressure in phloem vessel) caused by loading of sugars into phloem in leaf;  
 3. And (resulting) entry of water by osmosis. 3
- (b) 1. Polysaccharides are insoluble;  
 2. So do not affect water potential of gut. 2
- (c) 1. (Only few bacteria passed from parent, so) only a few (copies of) genes passed on (in bacteria);  
 2. May not / does not include all alleles (of genes, so diversity reduced)  
**OR**  
 Small number of bacteria transmitted means unrepresentative sample. 2
- (d) 1. Number / mass / density of insects per plant;  
 2. Stage of development / size of plants / insects;  
*Ignore any abiotic factor* 2
- (e) Draw around leaf on graph paper **and** count squares; 1

[10]