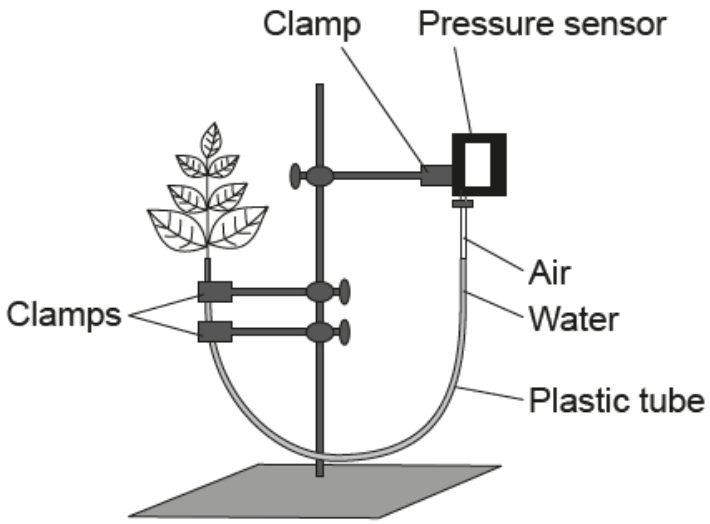
HL Paper 3

The rate of transpiration can be measured using a data-logging pressure sensor connected to a plant cutting via a plastic tube. In an experiment, a control set-up was connected to the tube and placed in a well-lit room with normal humidity levels.



[Source: © International Baccalaureate Organization 2017]

a. State the specific type of plant tissue that the plastic tube is meant to model. [1]

b. Predict, with a reason, what will happen to the pressure in this tube as transpiration occurs. [2]

c. Outline how this control set-up could be modified to test the effect of either humidity or temperature on the rate of transpiration. [2]

Markscheme

a. xylem

b. a. pressure will decrease

b. water volume decreases «in tube» due to evaporation transpiration

c. «cohesion/tension of water column» causes increase in air volume «thus air pressure decreases» *OWTTE*

c. ***Alternative 1***

humidity:

a. outline of how independent variable is varied
eg: *cover experimental plant«s» with a plastic bag*
OR
mist the experimental plant«s».

b. outline of control treatment *eg*: *control plant«s» is/are not covered/not misted*.

c. control of other variable«s» *eg*: *light is kept constant*.

Alternative 2

temperature:

d. outline of how independent variable is varied *eg*: *place set-up under/away from heat lamps at different distances.*

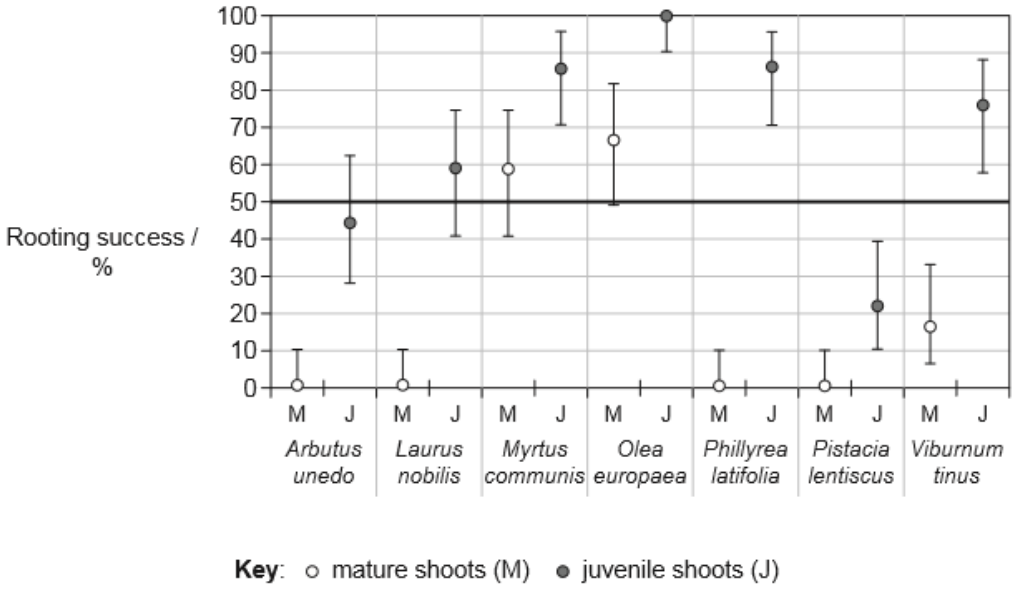
e. outline of control treatment *eg*: *no heat lamp for control*.

f. control of other variable«s» *eg*: *use hygrometer to verify that heat lamp does not change humidity level*.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

Achieving successful rooting of cuttings is difficult in some shrub species. An experiment was undertaken to determine whether juvenile shoots (J) of shrubs root more successfully than mature shoots (M).



[Source: "Effects of rejuvenation on cutting propagation of Mediterranean shrub species" by G. Pignatti and S. Crobeddu, *Forest@*, vol. 2, pp. 290-295 (Sep 2005): Figure 3. Used with permission.]

a. Distinguish between the rooting success of the juvenile shoots and the mature shoots. [1]

b. Suggest **one** reason for the difference in the rooting success in the juvenile shoots and the mature shoots. [1]

c. Outline **one** variable that would need to be controlled in this experiment. [1]

d. Auxin is a hormone that can be applied to improve the percentage success of rooting in those study plants with poor rooting success. Explain the effects of auxin on plant cells. [3]

Markscheme

a. «all» juvenile shoots root more successfully/significantly/show higher percentage rooting success

Need comparative wording for the mark

b. Juvenile shoots have more undifferentiated/meristem/dividing tissues

Juvenile shoots have faster response to auxin

c. The starting leaf area/size/mass/length of cutting would need to be kept similar in all treatment groups (*Accept other reasonable answers*)

Light/temperature/nutrients/rooting mixture/moisture would need to be the same for all plants and both treatment groups

Cutting taken from same relative point of the shrub/branch

A brief description is required rather than a simple naming of the variable.

d. Increases cell elongation/growth/enlargement

OR

has effect on rate of mitosis

Changes the pattern of gene expression
OR
promotes transcription of some genes

Changes the pH of the extracellular environment/cell wall
OR
increases activity of proton pumps

Breaks cross links/connections between cellulose fibres in cell wall

Increases cell wall plasticity

«varying» auxin concentrations have different effects in different parts of the plant

Examiners report

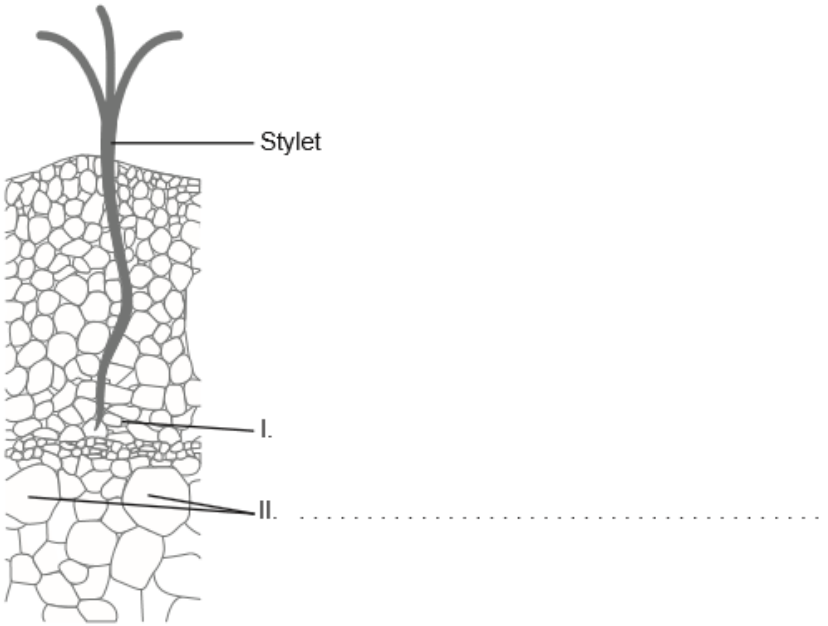
a. Almost all were able to use the data and see that juvenile shots rooted more successfully than mature shoots.

b. Only the better candidates were able to give a correct reason for this. Many candidates incorrectly simply said that juvenile shoots were more adaptable to change or better able to grow without suggesting why. Few remembered meristem tissue.

c. This question asked candidates to ‘outline’ which is to give a brief account or summary, not ‘state’. Thus more than simply naming a variable was required for the mark.

d. This was a very discriminating question with a range of marks from 0 to 3. Many received zero or were only able to score one out of the 3 marks available for noting that auxin played a role in cell elongation. Candidates overlooked the fact that the question asked for ‘the effects of auxin on plant cells’, often describing phototropism in plants shoots instead which was not awarded any marks. How auxin works on plant cells walls was a new addition to the syllabus and does not seem to have been covered by all.

The image shows a severed aphid stylet embedded in plant tissue.



a. Identify the tissue labelled II. [1]

b. Outline **one** piece of evidence that the tissue labelled I is phloem tissue. [1]

c. Explain how aphid stylets can be used to study the movement of solutes in plant tissues. [3]

Markscheme

a. Xylem

b. It has a stylet embedded in it

OR

Aphids insert their stylets into phloem

Is closer to the surface/exterior/outside the xylem

Cells smaller than xylem tissue «below it»

Smaller «companion» cells are adjacent to larger «sieve tube» cells

c. Aphids tap into phloem with their stylets «to use sap as a food source»

Plants grown in radioactive CO_2/$^{14}CO_2$ incorporate it into carbohydrate

Phloem contents/sap/fluid flows through the stylet

Aphid body severed/cut from stylet «after stylet inserted into phloem»

Analyze «sap/fluid exuded from stylet» for solutes/carbohydrates

OR

Radioactive-labelled carbon can be detected «in the phloem sap»

Stylets at different parts of the plant can show sequence/rate of movement

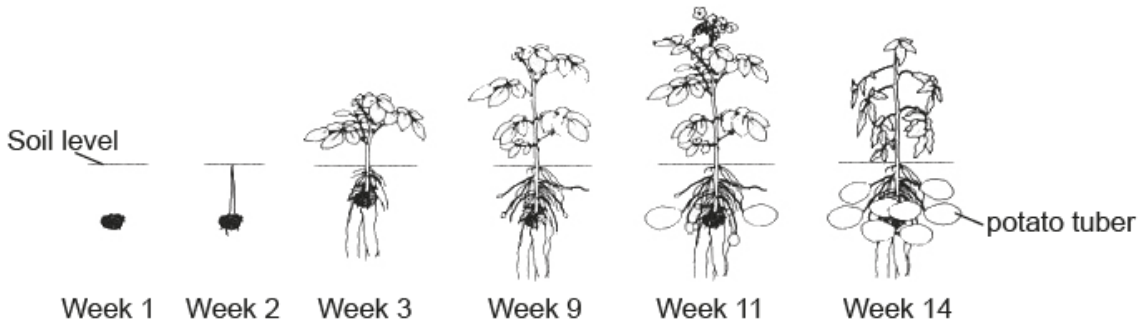
Examiners report

a. The vast majority of candidates were able to correctly label this as xylem although many respondents on the G2 form indicated that they found the diagram difficult.

b. Most candidates were able to score the one mark for this part of the question as many alternatives were given in the markscheme. However, many candidates did not seem to know what an aphid stylet was and mistakenly talked about the stylet 'growing' or referred to it as part of the root.

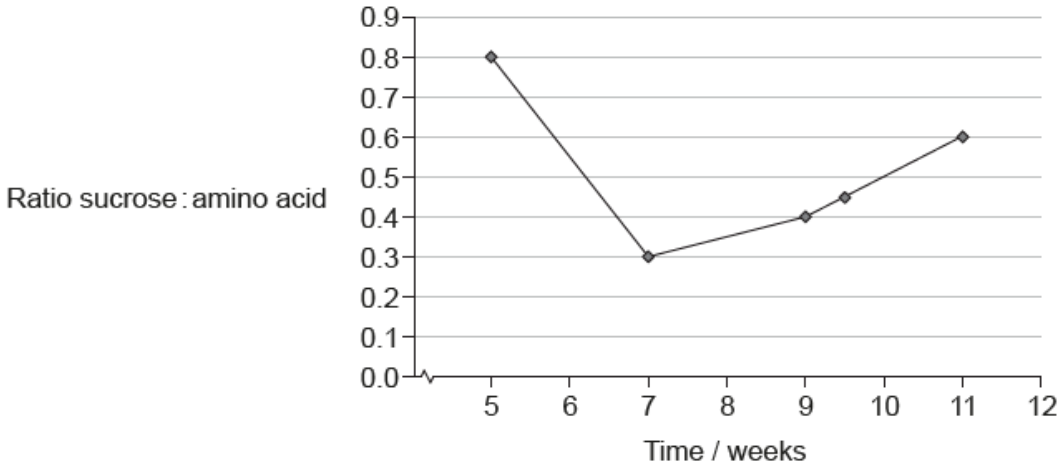
c. This was a discriminating question with better candidates able to clearly explain how aphid stylets were used to study the movement of solutes in phloem, also referring to the use of radioactive carbon dioxide. Many unfortunately seemed to have not been exposed to this topic, used imprecise language, referred to the aphid stylet as if it were a piece of lab equipment they could use, or left this blank.

The diagram shows the development of potato plants (*Solanum tuberosum*) over 14 weeks. New tubers start growing from week 9. These are modified underground stems serving as a starch reserve and bearing buds from which new plants arise.



[Source: adapted from http://humanitiespotato.weebly.com/potato-production.html]

Scientists planted several potato plants in a greenhouse. The sucrose and amino acids in potato plant phloem exudates were measured during several weeks.



[Source: adapted from A. J. Karley, A. E. Douglas, W. E. Parker, Amino acid composition and nutritional quality of potato leaf phloem sap for aphids. *Journal of Experimental Biology* 2002 205: 3009-3018.© The Company of Biologists Limited 2002.]

a. Describe briefly how scientists obtained leaf phloem sap from the potato plants. [2]

b. Suggest reasons for different amounts of sucrose in the leaf phloem sap of the potato plants. [3]

Markscheme

a. a. aphids insert stylet in «potato» plants/feed from «potato» plants

"Aphids" is essential for the mark.

b. phloem exudates/sap obtained from severed stylets

"Stylets" is essential for the mark.

b. a. sucrose produced by leaves during photosynthesis

b. sucrose moves/translocates from source/leaves to sink/roots/tubers
OR
sucrose carried by phloem to tuber

c. «wk 5» high sucrose with increased leaf growth/photosynthesis / OWTTE

d. «wk 5-7» more sucrose used for general plant growth / OWTTE

e. «wk 7-11» concentration sucrose increases due to greater production/photosynthesis «than usage/storage» / OWTTE

f. sucrose transformed into starch in tuber «from week 9»

g. contribution of amino acids unknown so difficult to know about different amounts of sucrose / OWTTE

Award the mark for realizing that amino acids play a role in the ratio

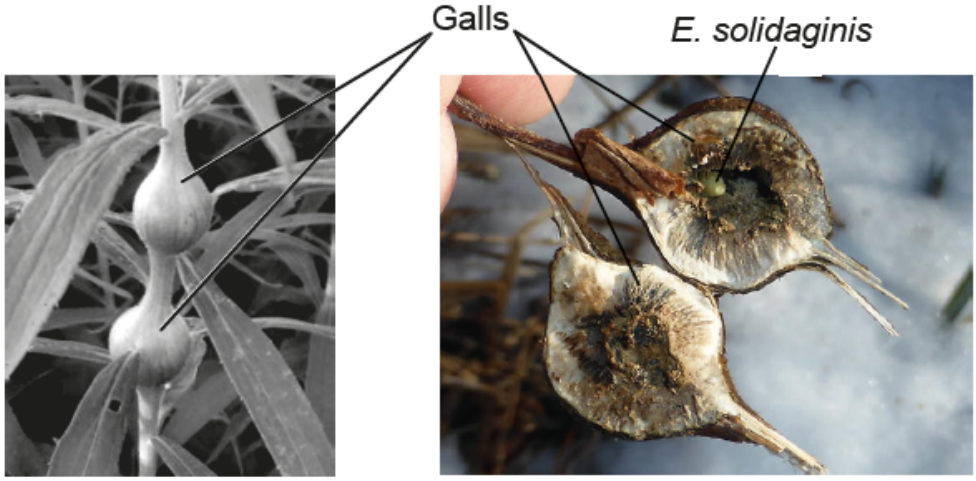
h. «abiotic» conditions in greenhouse may vary over time / OWTTE

Accept abiotic factors only if variation through time is explicit.

Examiners report

a. [N/A]
b. [N/A]

The larval stage of the fly *Eurosta solidaginis* develops in the plant *Solidago altissima*. The larva secretes a chemical which causes plant tissue to grow around it forming a swelling called a gall. The gall provides the developing insect with protection from predators.



[Source: https://nhgardensolutions.files.wordpress.com]

[Source: Masumi Palhof]

The *E. solidaginis* fly is preyed upon by the parasitic wasp *Eurytoma gigantea*. The graph shows the relationship between gall diameter and the percentage of flies that avoid predation by *E. gigantea*.

a. In order to form galls, the insects choose a location where cell division occurs at a high rate. State the term for a region of rapid cell division within a plant. [1]

b. Describe the relationship between gall diameter and percentage survival of *E. solidaginis*. [2]

c. Explain the concept of directional selection with respect to this example. [2]

Markscheme

a. «apical» meristem/shoot apex

b. a. percentage survival is higher with larger diameter galls

OR

positive relationship

b. variation/outlier at the lower diameters *OWTTE*

c. little variation in survival percentage at highest diameters *OWTTE*

c. a. directional selection is when an extreme phenotype/characteristic is favoured *OWTTE*

b. flies that form small galls will be selectively predated *OWTTE – accept vice versa*

c. over time, flies that produce small galls will become rarer
OR
mean gall size will increase

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]