OCR AS GCE Biology *(18 pages)*

F211 Cells, Transport and Exchange

Exam questions from January 2009-June 2012

Topics:

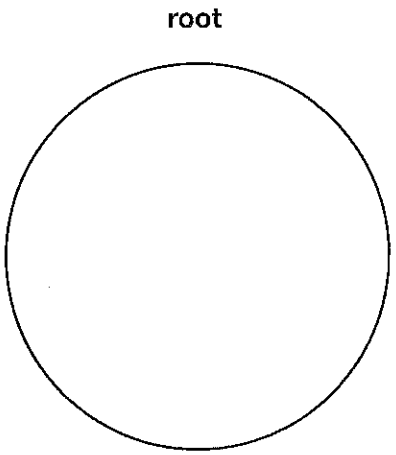
1.2.3 Transport in Plants

Explain the need for transport systems in multicellular plants in terms of size and surface area:volume ratio;
Describe, with the aid of diagrams and photographs, the distribution of xylem and phloem tissue in roots, stems and leaves of dicotyledonous plants;
Describe, with the aid of diagrams and photographs, the structure and function of xylem vessels, sieve tube elements and companion cells;
Define the term *transpiration*;
Explain why transpiration is a consequence of gaseous exchange;
Describe the factors that affect transpiration rate;
Describe, with the aid of diagrams, how a potometer is used to estimate transpiration rates
Explain, in terms of water potential, the movement of water between plant cells, and between plant cells and their environment. (**No** calculations involving water potential will be set);
Describe, with the aid of diagrams, the pathway by which water is transported from the root cortex to the air surrounding the leaves, with reference to the Casparian strip, apoplast pathway, symplast pathway, xylem and the stomata;
Explain the mechanism by which water is transported from the root cortex to the air surrounding the leaves, with reference to adhesion, cohesion and the transpiration stream;
Describe, with the aid of diagrams and photographs, how the leaves of some xerophytes are adapted to reduce water loss by transpiration;
(l) explain translocation as an energy-requiring process transporting assimilates, especially sucrose, between sources (eg leaves) and sinks (eg roots, meristem);
Describe, with the aid of diagrams, the mechanism of transport in phloem involving active loading at the source and removal at the sink, and the evidence for and against this mechanism

6 Translocation is the movement of the products of photosynthesis within a plant.

Translocation occurs in the phloem and involves sources and sinks.

(a) Using the outline below, draw in the position of the phloem in the root of a dicotyledonous plant.



[1]

(b) Research using carbon dioxide containing a radioactive label, C^{14}, has revealed the following evidence about the mechanism of translocation:

A labelled carbon can be observed in the phloem soon after being supplied to a well-lit plant;

B the rate of movement of sugars in the phloem is many times faster than could be achieved by diffusion alone.

Different research has revealed that:

C an insect such as an aphid feeds by inserting its proboscis (mouth parts) into the phloem;

D the pH of the phloem companion cells is lower than surrounding cells;

E the phloem companion cells contain many mitochondria.

Using the letters **A**, **B**, **C**, **D** and **E**, select **two** pieces of evidence from the list above which support the theory that translocation occurs in the phloem.

.....

..... **[2]**

(c) State what is meant by the terms *source* and *sink*.

.....

.....

.....

.....

..... **[2]**

(d) When the bark is removed from a tree, the phloem is also removed. If a complete ring of bark is removed, the tree trunk can be seen to swell above the cut.

Suggest **two** reasons why the trunk swells above the cut.

.....

.....

.....

.....

.....

..... **[2]**

[Total: 7]

END OF QUESTION PAPER

6 **(a)** Translocation is the movement of assimilates along the phloem from one part of a plant to another.

(i) Name the sugar molecule most commonly translocated.

..... [1]

(ii) A tissue may act as a source or a sink at different times.

For each tissue listed below, state whether it is acting as a source, a sink or neither. The first one has been done for you.

tissue	source, sink or neither
a leaf in summer	source
a developing bud	
xylem	
an actively growing root tip	

[3]

(b) The sap in the phloem sieve tubes is moved by mass flow.

State **two** adaptations of sieve tubes that enable mass flow to occur.

.....

.....

.....

..... [2]

(c) Describe how assimilates are loaded into the phloem.

In your answer, you should use appropriate technical terms, spelt correctly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

[Total: 10]

END OF QUESTION PAPER

6 Fig. 6.1 shows an aphid feeding from a plant stem. The aphid feeds by inserting its tube-like mouthparts into the tissue that transports sugar solution. Some details of this transport tissue are shown in the vertical section.

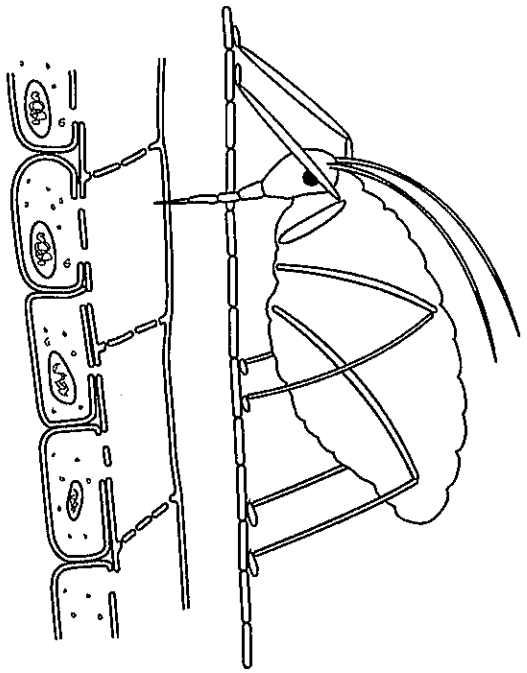


Fig. 6.1

(a) (i) Name the sugar most commonly transported through the stem of a plant **and** the tissue that transports this sugar.

sugar .....

tissue ..... **[1]**

(ii) Sugar molecules are actively loaded into the transport tissue.

Describe how active loading takes place.

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

(b) A classic experiment investigated the effect of temperature on the rate of sugar transport in a potted plant.

Aphid mouthparts were used to take samples of sugar solution from the transport tissue in the stem. The sugary solution dripped from the mouthparts. The number of drips per minute was counted.

The procedure was repeated at different temperatures.

Table 6.1 shows the results obtained.

Table 6.1

temperature (°C)	number of drips per minute
5	3
10	6
20	14
30	26
40	19
50	0

Suggest brief explanations for these results.

.....

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

[Total: 7]

END OF QUESTION PAPER

3 **(a)** Complete the following paragraph about the loss of water from plants.

The loss of water from the aerial parts of a plant is known as ..... .

The majority of water is lost from the leaves. Water is transported up the stem in the ..... and passes into the mesophyll cells of the leaf by ..... . Water evaporates from the surface of these cells. From the air spaces in the leaf, the water vapour diffuses out of the leaf through the ..... . **[4]**

(b) **(i)** Explain why water loss from the leaves of a plant is unavoidable.

.....

.....

.....

..... **[2]**

(ii) Name the **type** of plant adapted to reduce water loss from its leaves.

..... **[1]**

(iii) State **and** explain **two** adaptations of leaves that reduce evaporation.

In your answer, you should use appropriate technical terms, spelt correctly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[5]**

[Total: 12]

4 Fig. 4.1 shows a potometer, a piece of apparatus used for estimating the rate of transpiration.

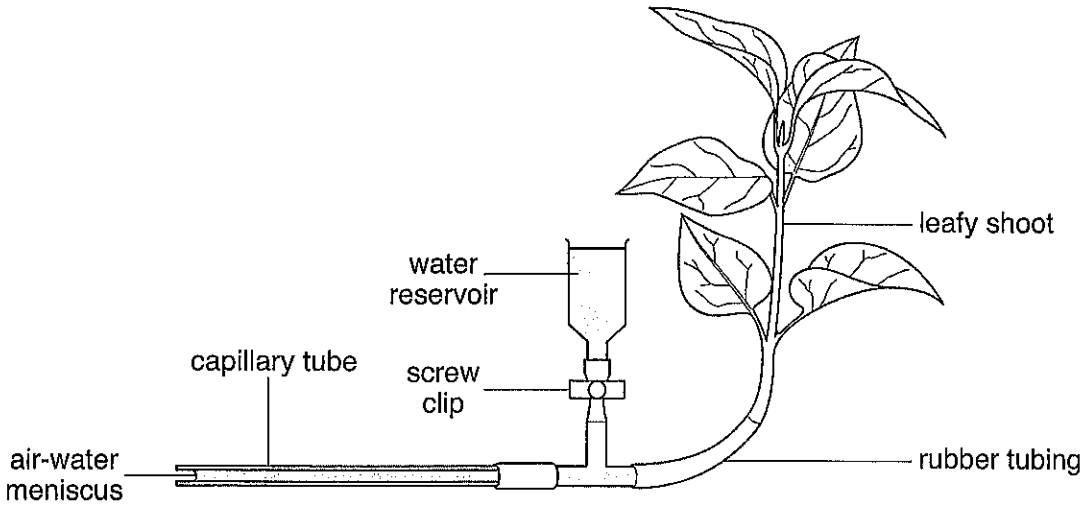


Fig. 4.1

(a) State **one** essential component of the apparatus, not shown in Fig. 4.1, that must be added before any results can be recorded.

..... [1]

(b) Describe **three** steps a student should take when **setting up** the potometer to ensure that the apparatus works correctly.

1 .....

.....

2 .....

.....

3 .....

..... **[3]**

(c) A student used the apparatus shown in Fig. 4.1 to investigate how transpiration rates vary during the day. The student placed the potometer on a window ledge in the laboratory and estimated the rate of transpiration four times during the day.

The results are shown in Table 4.1.

Table 4.1

time of day	rate of transpiration (arbitrary units)			
	replicate 1	replicate 2	replicate 3	mean
10.00	32	29	31	30.7
12.00	37	35	38	36.7
14.00	23	26	25	24.7
16.00	25	27	24	

(i) Calculate the mean value for the rate of transpiration at 16.00 hours.

Give your answer to **one decimal place**.

Answer = ... **[1]**

(ii) Explain why, for each time of the day, the student carried out three replicates to calculate a mean.

.....

.....

.....

..... **[2]**

(iii) Suggest **two** possible reasons, other than light and temperature, why the rate of transpiration was **lower** in the afternoon than in the morning.

1 .....

.....

2 .....

..... **[2]**

(iv) Explain why the potometer only gives an **estimate** of the rate of transpiration.

.....

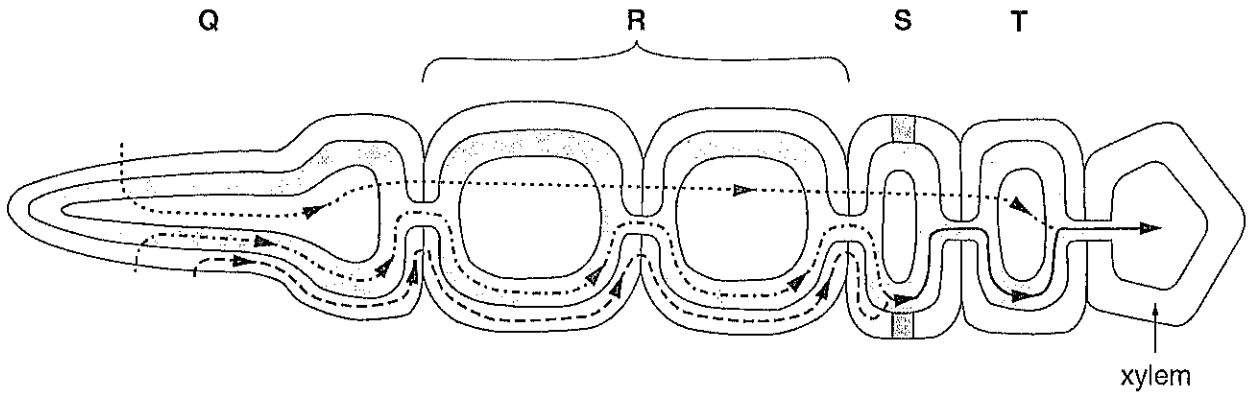
.....

.....

..... **[2]**

[Total: 11]

5 Fig. 5.1 shows the possible pathways taken by water across the root of a plant.



Key:

pathway 1

pathway 2

pathway 3

common pathways

Fig. 5.1

(a) (i) Name the process by which water enters cell **Q** from the soil.

.....[1]

(ii) Pathway 1 is known as the vacuolar pathway, as the water passes into and through the cell vacuoles.

Name pathway 2 and pathway 3.

pathway 2 .....

pathway 3 .....[2]

(iii) State which letter, **Q**, **R**, **S** or **T**, on Fig. 5.1, represents the endodermis.

.....[1]

(b) Describe **and** explain how water is moved up the xylem from the roots to the leaves.

In your answer you should use appropriate technical terms, spelt correctly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(c) Table 5.1 shows a comparison of xylem vessels and phloem sieve tube elements.

Complete the table. The first row has been done for you.

Table 5.1

feature	xylem vessel	phloem sieve tube element
cells living or dead	dead	living
bordered pits present or absent		
lignin present or absent		
substances transported		
direction of transport		

[4]

[Total: 13]

4 **(a)** Fig. 4.1 is a diagram showing the position of the vascular bundles in a transverse section of the stem of a young dicotyledonous plant.

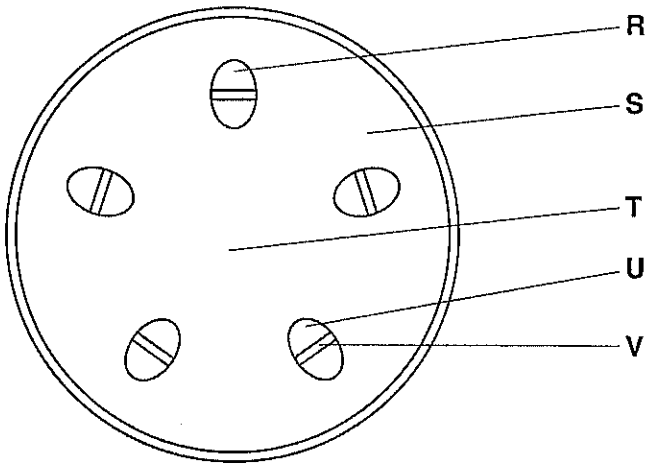


Fig. 4.1

Select the correct letter from Fig. 4.1 to identify each of the following tissues in the stem.

xylem .....

phloem .....

cambium ..... **[3]**

(b) Fig. 4.2, **on the insert**, shows the cut end of a stem from a woody plant. The other end of the stem is being heated in a fire. Steam can be seen coming from the vascular tissue at the cut end of the stem.

Describe the features of the xylem that enable the steam to pass from the heated end of the stem to the cut end.

.....

.....

.....

.....

..... **[2]**

(c) (i) Define the term *transpiration*.

.....

.....

.....

..... **[2]**

(ii) Describe **and** explain how transpiration contributes to the mechanism of water transport up the stem.

In your answer, you should use appropriate technical terms, spelt correctly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[5]**

(iii) Suggest why a bunch of flowers may survive longer if the ends of the stems are removed immediately before the flowers are placed in water.

.....

.....

.....

.....

..... **[2]**

[Total: 14]

6 (a) (i) Name the process by which water leaves a cell.

..... [1]

(ii) Describe the routes that water molecules take through the **cell surface membrane**.

.....

.....

.....

.....

.....

..... [2]

A student carried out an investigation to determine the effects of different sucrose concentrations on cells from pieces of onion epidermis.

- Strips of epidermis were taken from an onion.
- Separate pieces of epidermis were placed into water and a range of sucrose solutions.
- The pieces of epidermis were left for 30 minutes before being removed.
- The pieces of epidermis were then viewed at high power under the microscope.

The student counted 100 cells from each piece of epidermis. The student noted how many cells had become plasmolysed.

The results are shown in Table 6.1.

Table 6.1

concentration of sucrose solution ($mol\,dm^{-3}$)	water potential of sucrose solution (kPa)	percentage of cells plasmolysed (%)
0.0	0	0
0.1	–260	0
0.3	–860	3
0.4	–1120	7
0.5	–1450	39
0.6	–1800	57
0.7	–2180	83
0.8	–2580	94
1.0	–3500	100

(b) None of the onion epidermis cells this student observed had burst when left in pure water.

Explain why plant cells do not burst when they are left in pure water.

.....

.....

..... **[2]**

(c) **(i)** The water potential of the onion epidermis cells can be assumed to be the same as the water potential of a solution that causes 50% plasmolysis.

Use the information in Table 6.1 to **estimate the water potential** inside these onion epidermis cells.

..... **[1]**

(ii) Suggest how the student could construct and use a graph to obtain a better estimate of the water potential.

.....

.....

.....

.....

..... **[2]**

(d) Suggest how the student could modify the procedure to make the results more reliable and accurate.

reliable .....

.....

.....

.....

accurate .....

.....

.....

.....

..... **[4]**

[Total: 12]

END OF QUESTION PAPER

5 (a) A student used a potometer to investigate the effect of light intensity on the rate of transpiration in a healthy leafy shoot.

The results obtained are shown in Table 5.1.

Table 5.1

light intensity in arbitrary units (a.u.)	rate of transpiration (mm min^{-1})			
	trial 1	trial 2	trial 3	mean
10	5.0	7.0	5.0	5.7
20	5.0	7.0	5.0	5.7
30	12.0	12.0	11.0	11.7
40	24.0	23.0	26.0	24.3
50	32.0	33.0	32.0	32.3

(i) Describe the trend shown in the mean rate of transpiration as light intensity increases from 20 to 50 a.u.

.....

.....

..... [2]

(ii) Suggest why the rate of transpiration did not change between light intensities 10 a.u. and 20 a.u.

.....

..... [1]

(b) (i) Explain why transpiration is unavoidable during the day.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) Fig. 5.1, **on the insert**, is a photograph of a transverse section of a leaf taken from a xerophyte.

Describe the xerophytic features of this leaf **and** explain how each feature reduces loss of water vapour.

In your answer you should use appropriate technical terms, spelt correctly.

.... [5]

[Total: 11]