8. Transport in plants

8.4 Translocation

Paper 4

Question Paper

Paper 4

Questions are applicable for extended candidates only

1 **(b)** Aphids have been used to investigate the translocation of sucrose in phloem tissue. While they are feeding on phloem sap aphids excrete a sucrose-rich fluid known as honeydew.

In an investigation, two groups of four aphids were placed at intervals along the stem of a young willow plant, as shown in Fig. 3.2.

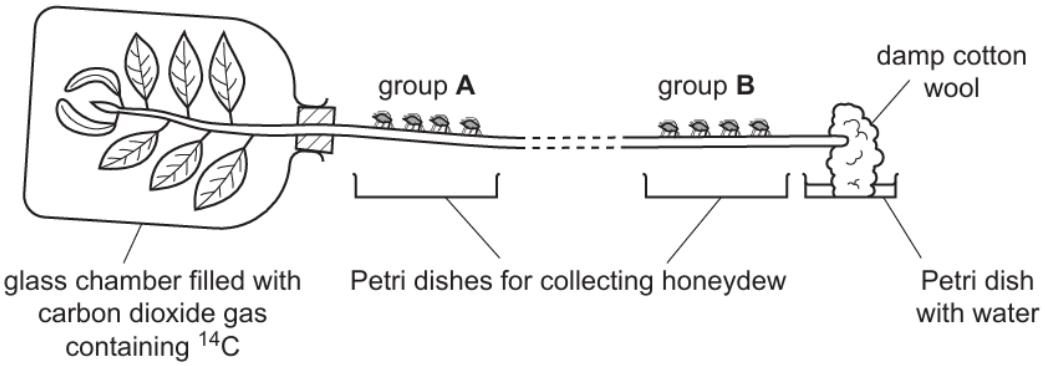

Fig. 3.2

The leaves were enclosed in an airtight glass chamber. A special form of carbon dioxide gas that contained radioactive carbon-14 (^{14}C) was supplied to the leaves for a short period of time.

Samples of honeydew were collected at intervals from the groups of aphids. The time taken for sucrose containing ^{14}C to travel the distance between group **A** and group **B** was recorded.

The investigation was repeated twice using a fresh stem and different groups of aphids for each trial. The results are shown in Table 3.1.

(i) Complete Table 3.1 by calculating the rate of movement of ^{14}C in trial 3.

Table 3.1

trial	distance between group **A** and group **B** on the stem / mm	time taken for ^{14}C to travel between group **A** and group **B** / minutes	rate of movement of ^{14}C / mm per hour
1	650	120	325
2	340	75	272
3	630	150	

[1]

(ii) Outline how ^{14}C in carbon dioxide gas becomes incorporated into the sucrose molecules that are translocated in the phloem.

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..... [3]

(c) Sucrose travels from the stem to other parts of the plant known as sinks, where it is used.

(i) State **two** parts of a plant that are sinks for sucrose.

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2 .....

[2]

(ii) Sucrose is used in the cells of the sinks in a plant.

Describe the uses of sucrose by sinks.

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..... [3]

2 **(a)** Fig. 6.1 is a diagram showing some parts of a plant. The circle shows a magnified cross-section of part of the stem.

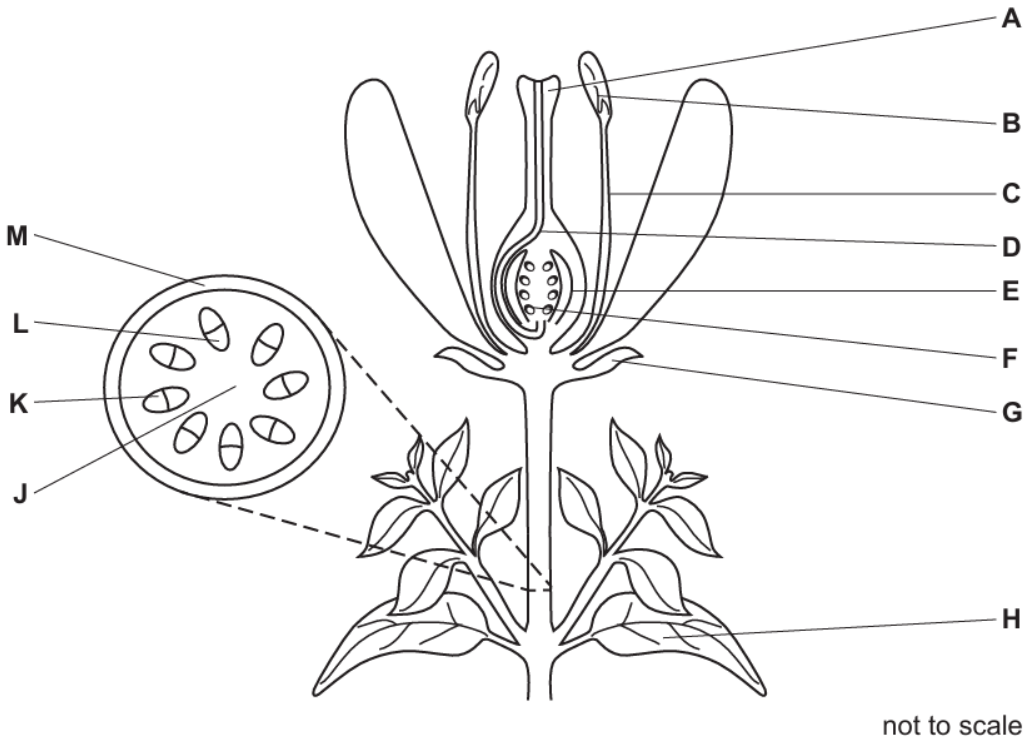

Fig. 6.1

(i) Table 6.1 contains statements about the functions of some of the structures in Fig. 6.1.

Complete the table by:

- stating the name of the structure
- identifying the letter that labels that structure.

Table 6.1

function	name of structure	letter from Fig. 6.1
provides support to the stem		
protects flower bud		
produces glucose		
produces pollen		
delivers male nuclei to the site of fertilisation		

[5]

(ii) State **one** letter from Fig. 6.1 that identifies a structure that contains a **haploid** nucleus.

..... [1]

(iii) State the name of the process that describes the transport of sucrose in a plant.

..... [1]

(iv) State **one** letter from Fig. 6.1 that is a structure that is an example of a source for sucrose transport.

..... [1]

3 **(b)** Fig. 2.1 shows a diagram of a plant. The arrows point to circles containing magnified cross-sections of those parts of the plant.

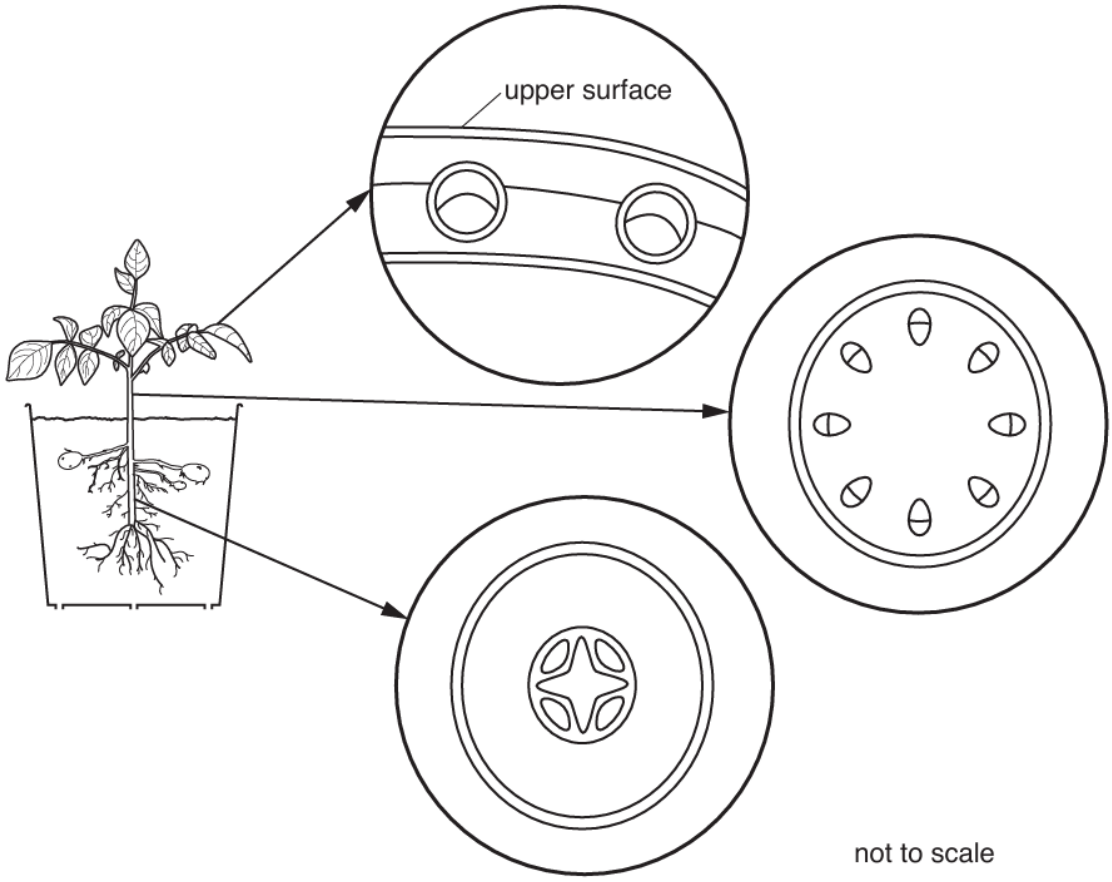

Fig. 2.1

Label the position of the phloem in each of the three magnified sections in Fig. 2.1.

Use a label line and the letter **P** for each section. [3]

(c) Aphids are used by investigators to discover how plants transport sucrose.

Fig. 2.2 shows an aphid with its mouthparts inserted into a plant stem to feed on the liquid in the phloem.

Fig. 2.2

A plant was put in a dark cupboard for several days.
Four aphids, **A**, **B**, **C** and **D**, were then placed on the plant in the dark cupboard as shown in Fig. 2.3.

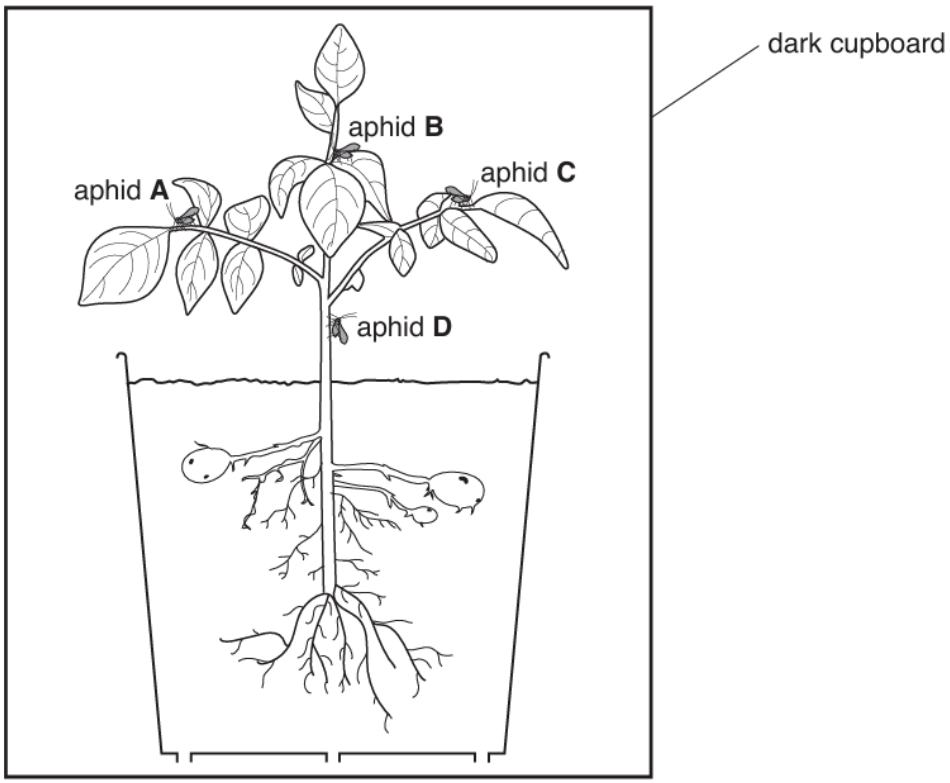

Fig. 2.3

(i) Immediately after the aphids were placed on the plant it was observed that:

- all the aphids ingested the same volume of liquid from the phloem
- aphid **D** ingested the highest concentration of sucrose.

Explain why aphid **D** ingested the highest concentration of sucrose.

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4 **(c)** Researchers used carbon dioxide that contained a traceable source of carbon (^{13}C) to investigate translocation of sucrose from the leaves of bean plants, *Phaseolus vulgaris*.

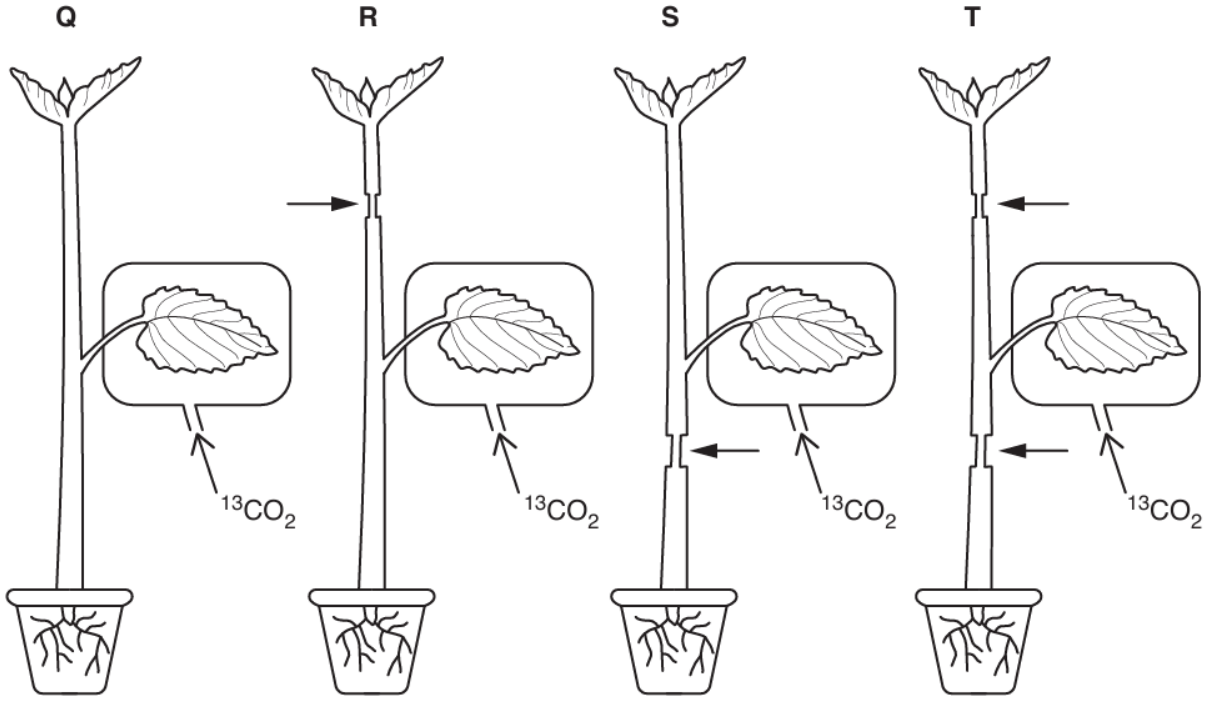
Fig. 2.2 shows that glucose produced in photosynthesis is converted to sucrose for translocation.

carbon dioxide ⟶ glucose ⟶ sucrose

Fig. 2.2

Researchers selected four plants, **Q**, **R**, **S** and **T**, which had leaves that were of similar sizes. The leaves on the four plants were supplied with $^{13}CO_2$.

After the leaves had started to make sucrose, the researchers cut away a ring of tissue in different places as shown in Fig. 2.3. The rings of tissue that were removed from plants **R**, **S** and **T** contained the phloem.



Key: ⟶ the positions on the stems where rings of tissue containing phloem were removed.

Fig. 2.3

The quantities of sucrose containing ^{13}C in the shoot tips and in the roots were determined.

The results are shown in Table 2.1.

Table 2.1

plant	quantity of sucrose containing ^{13}C / arbitrary units	
	shoot tip	root
Q	3.24	0.94
R	0.00	0.44
S	4.14	0.00
T	0.00	0.00

Describe **and** explain the effect of removing the phloem on the translocation of sucrose in plants **Q**, **R**, **S** and **T**.

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5 Aphids are insects that feed on the phloem sap in plants.

Fig. 3.1 shows a diagram of an aphid with its mouth parts inserted into the stem of a plant.

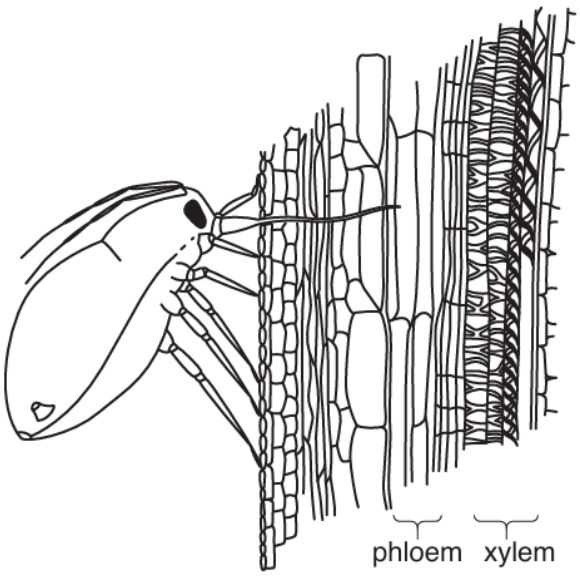

Fig. 3.1

(a) The mouth parts of the aphid reach the phloem tissue of the stem.

(i) State the name of the foods the aphid could suck out of the phloem tissue.

1 .....

2 .....
[2]

(ii) Explain the role of phloem in plant transport. Use the words **source** and **sink** in your answer.

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