7. Transport in Plants

7.1 Structure of Transport Tissues

Paper 2

Question Paper

1 In the mesophyll tissue of leaves, products of photosynthesis can be used to synthesise organic compounds, such as the polysaccharide cellulose and some amino acids.

A source of nitrogen for amino acid synthesis can be provided by nitrate ions that have been taken up in the roots and transported to the leaves.

(c) In the leaf, transport of amino acids from mesophyll cells to companion cells involves using a number of different membrane transport proteins called amino acid transporters.

There is evidence that amino acids can move from the apoplast into the cytoplasm of a companion cell using the same transport mechanism that is used for sucrose transport.

(ii) Suggest why amino acid transporters are **not** needed to move amino acids from the companion cell into a phloem sieve tube element.

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..... [1]

2 The olive plant, *Olea europaea*, is grown in many parts of the world. The fruits of the plant (olives) and the oil that can be obtained from the fruits (olive oil), provide food for humans.

Triglycerides are the main type of lipid in olive oil. They are synthesised in the olive plant from glycerol and fatty acids.

Scientists can analyse samples of different olive oils to identify:

- the fatty acids used to synthesise triglycerides
- the composition of the different triglycerides present.

(c) Phloem is the plant tissue responsible for the transport of organic substances, such as fatty acids, from one area of a plant to another. The tissue is composed of more than one type of cell.

Name the type of cell that forms the transport vessels of phloem tissue.

..... [1]

3 **(b)** Plants transport sucrose from a source to a sink.

Fig. 4.2 is a scanning electron micrograph (SEM) of a transverse section through a plant tissue used to transport sucrose.

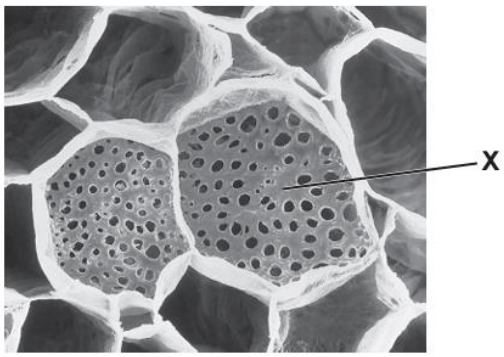


Fig. 4.2

(i) Name the structure labelled **X** in Fig. 4.2.

..... [1]

4 Water that is absorbed from the soil solution by the roots of a plant enters xylem vessels and is transported to the leaves and buds.

Fig. 6.1 shows four important requirements for the efficient transport of water from the roots to the leaves of a plant.

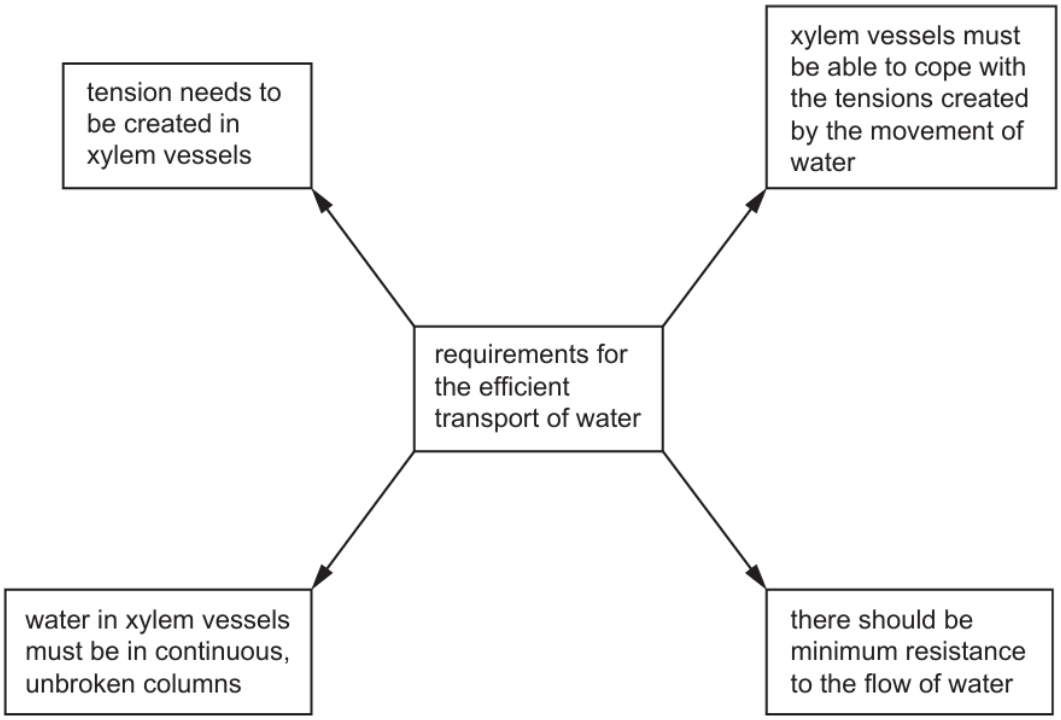


Fig. 6.1

(a) Name the specialised cells that are arranged end to end to form xylem vessels.

..... [1]

(c) Fig. 6.1 highlights how the structure of xylem vessels must be related to their function. This means that during the development of xylem vessels changes need to occur to the cells forming the vessels.

(i) The walls of the cells forming the xylem vessel walls become lignified during development.

Explain how this feature is important for the efficient transport of water.

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..... [2]

(ii) During the development of xylem vessels, the end walls of the cells forming the vessels break down. This contributes to minimising resistance to the flow of water.

Describe **one** other main change that needs to occur to these cells so that their structure becomes suited to their function.

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..... [1]

5 Plants have specialised cells for the efficient transport of assimilates.

(a) Table 3.1 shows some of the features of two different types of cell found in plant tissue, which are adapted for the efficient transport of assimilates.

Table 3.1

feature of cell	cell type A	cell type B
cytoplasm	✓	✓
nucleus	✗	✓
mitochondria	few	many
cellulose in the cell wall	✓	✓
ribosomes	✗	✓

Key
✓ present
✗ absent

Many plasmodesmata connect type **A** cells with type **B** cells.

Identify cell type **A and** explain why the plasmodesmata are important.

cell type **A** .....

explanation .....

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[3]

6 The transport tissues of plants are phloem and xylem.

The role of xylem is the transport of water and mineral ions from the soil solution to the different parts of the plant body.

The role of phloem is the translocation of assimilates and other substances from sources to sinks.

(b) Phloem tissue consists of different cell types.

Complete the passage using the most appropriate terms to summarise some of the features of phloem tissue.

The end walls of sieve tube elements are modified to allow efficient flow of phloem sap by the formation of ..... . These structures also prevent the cells from bursting under pressure. The cytoplasm of sieve tube elements is very much reduced and is found at the ..... of the cells. Most of the organelles in the cell are absent. Adjacent to sieve tube elements are ..... cells that carry out the metabolic processes of the missing organelles, allowing the sieve tube elements to function. [3]

7 **(b)** Fig. 5.1 is a photomicrograph of a transverse section through the stem of a flowering plant.

On Fig. 5.1, draw a label line and the letter **T** to identify xylem tissue. [1]

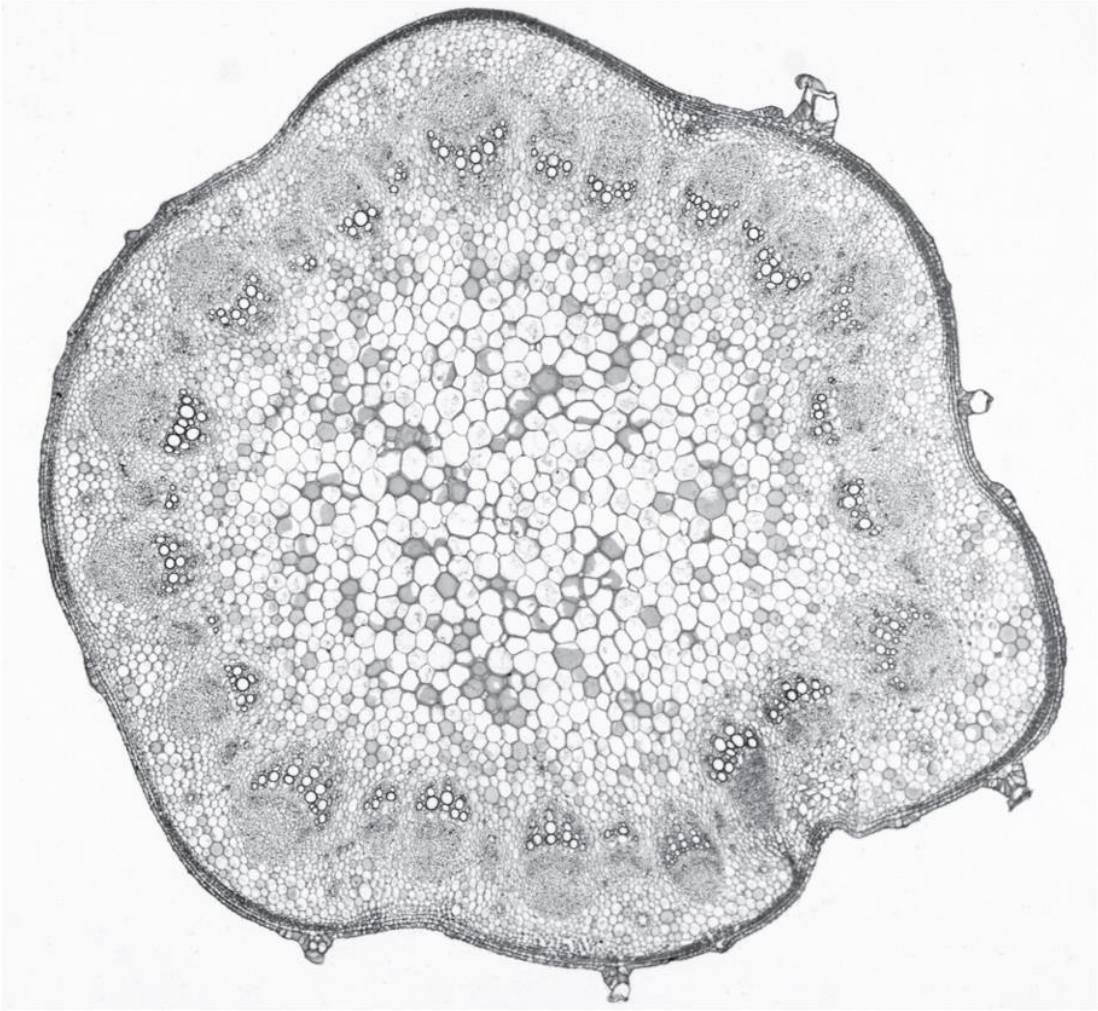


Fig. 5.1

8 Sugars are transported within phloem sieve tubes from a source, such as a mature leaf, to a young leaf, which acts as a sink. The young leaf also needs water and dissolved mineral ions, which arrive at the leaf within xylem vessels.

(b) The features listed in Table 2.1 are present in one or more of the three cell types:

- companion cell
- phloem sieve tube element
- xylem vessel element.

Complete Table 2.1 using a tick (✓) if the feature is present and a cross (✗) if the feature is absent.

Table 2.1

feature	companion cell	phloem sieve tube element	xylem vessel element
cytoplasm			
cell surface membrane			
lignified cell wall			
nucleus			

[4]

9 Fig. 1.1 shows the structure of the amino acid glycine.

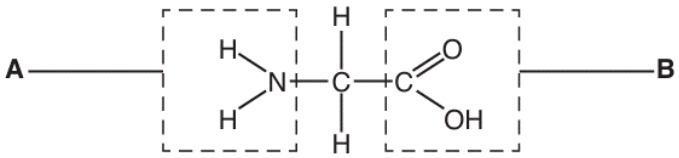


Fig. 1.1

(c) Sieve tube elements in plants have very few organelles such as mitochondria.

Explain how having very few organelles is an adaptation of the sieve tube element to its function.

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..... [2]

10 Fig. 1.1 is a photomicrograph of a transverse section through the stem of creeping buttercup, *Ranunculus repens*.

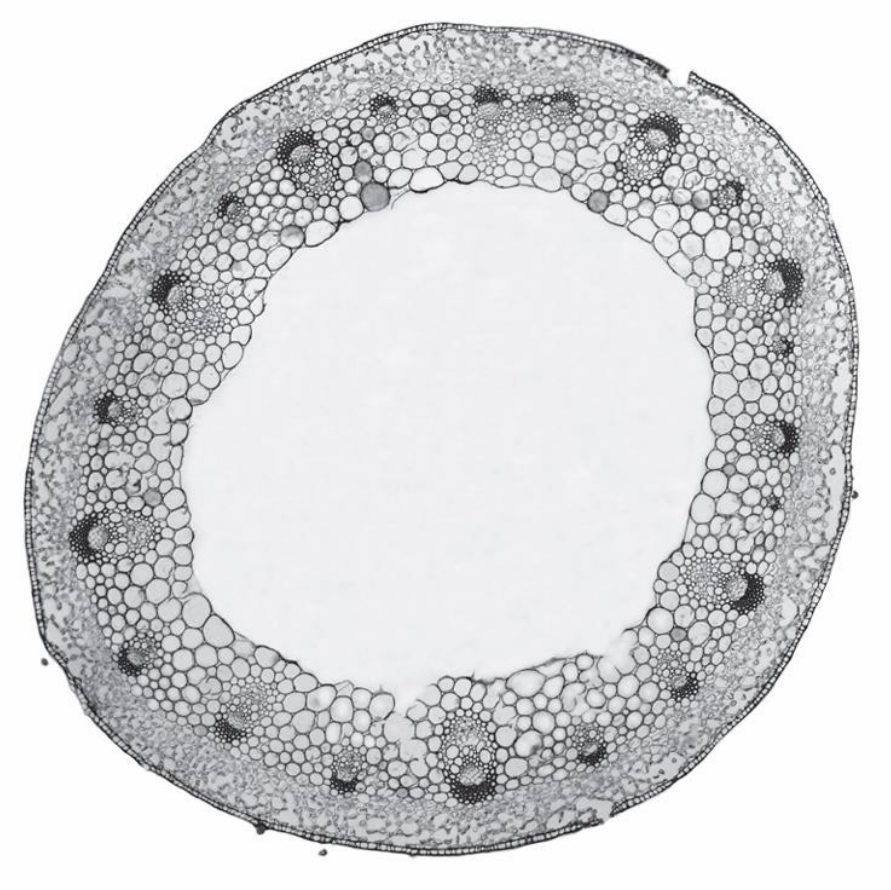


Fig. 1.1

(a) Draw **one** label line on Fig. 1.1 to indicate **one** precise location where phloem sieve tubes occur. [1]

(c) A good quality plan diagram of Fig. 1.1 will show only the tissues in the stem in their correct location and in the correct proportions.

(i) State the name of the tissue that forms the outer layer of the stem section of *R. repens* in Fig. 1.1.

..... [1]

11 Meristematic tissue is found in the growing regions of plants, such as shoot tips. Meristematic cells have a similar role to stem cells in animals.

Fig. 4.1 shows some of the stages in the formation of a mature phloem sieve tube element and companion cells from a meristematic cell.

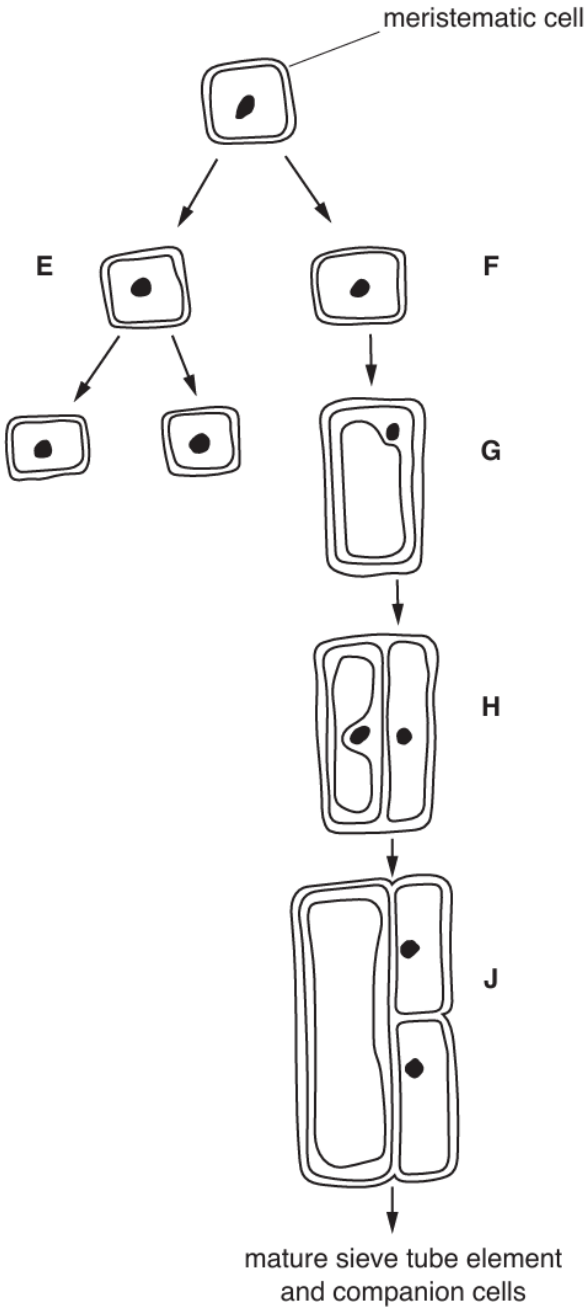


Fig. 4.1

(b) Complete Table 4.1 to describe the changes that are shown in Fig. 4.1 between stages:

- **F** and **G**
- **G** and **H**
- **H** and **J**.

Table 4.1

stages	description
F and **G**	
G and **H**	
H and **J**	

[3]

(c) Explain how the structure of a mature sieve tube element is related to its function.

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..... [4]

12 Fig. 1.1 is a photomicrograph of a low power image of part of the common sunflower, *Helianthus annuus*. Fig. 1.1 is a transverse section.

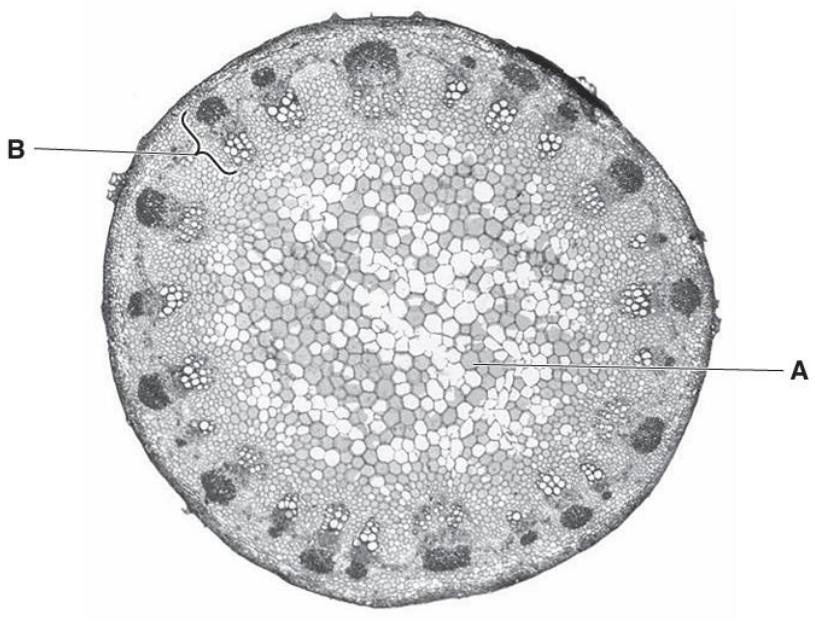


Fig. 1.1

(a) State, **with a reason**, whether Fig. 1.1 shows a section through the root or the stem of *H. annuus*.

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..... [1]

(b) Cell type **A** in Fig. 1.1 has a large central vacuole.

Suggest, with reasons, the role of the tissue formed by this type of cell.

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..... [2]

(c) Structure **B** in Fig. 1.1 contains phloem tissue and xylem tissue and other tissues that provide support.

(i) Name structure **B**.

..... [1]

(ii) The actual length of structure **B** is 650 μm.

State the actual length of structure **B** in mm.

..... [1]

(d) When structure **B** is observed at a higher magnification, more detail of xylem vessel elements and phloem sieve tube elements can be seen.

Outline the differences in the structure of a xylem vessel element and a phloem sieve tube element.

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..... [3]

13 Woolly foxglove, *Digitalis lanata*, shown in Fig. 2.1**A**, and common oleander, *Nerium oleander*, shown in Fig. 2.1**B**, are plants grown for the attractive flowers that they produce.

Both plants are poisonous, as their leaves produce toxic organic compounds known as cardiac glycosides. Cardiac glycosides have a powerful effect on the action of cardiac muscle.



A



B

Fig. 2.1

(b) Aphids are small insects that feed on plant fluids using piercing and sucking mouthparts. When aphids feed on the sap present in vascular tissue of leaves and stems, a sugary liquid called honeydew is passed out of the gut. The honeydew can be analysed to find out what is present in the sap.

(i) State the name of the vascular tissue from which the aphids feed.

..... [1]