7.1 Structure of transport tissues

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS xylem • vessel • phloem • sieve tube • companion cell

Objective

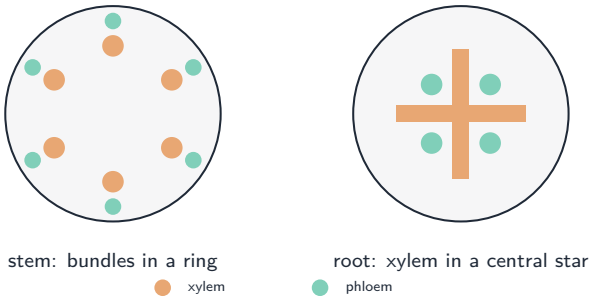
Build the skills to answer exam questions on the **structure of transport tissues** – the distribution and structure of **xylem** and **phloem**, and how their cells suit their functions.

You must be able to:

- describe the distribution of xylem and phloem in stems, roots and leaves
- relate the structure of xylem vessels, sieve tubes and companion cells to their functions
- draw plan diagrams and use magnification calculations

1 Key knowledge and worked examples

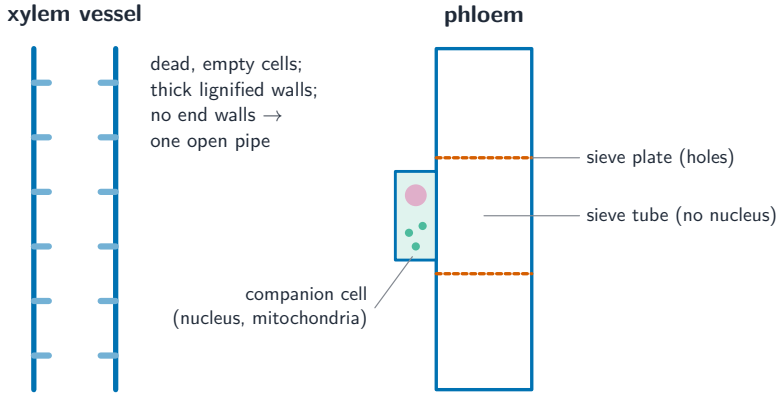
■ Where xylem and phloem are



Stem: bundles in a ring near the edge, xylem inside. Root: xylem in a central star.

- **stem** – vascular bundles in a ring near the edge; xylem on the inside of each bundle.
- **root** – xylem in a central star, phloem between the arms.
- **leaf** – both in the veins.

■ Structure suited to function

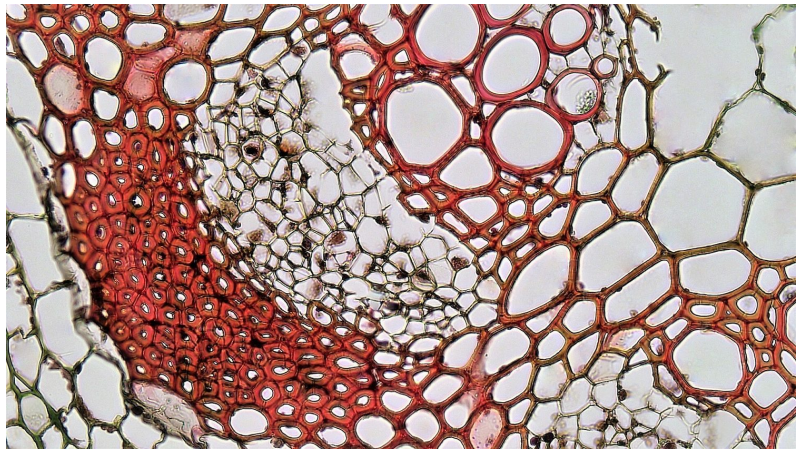


Xylem: dead, open pipe. Phloem: living sieve tubes with sieve plates and companion cells.

- **xylem vessels** – dead, empty cells joined end to end with no end walls (one open tube); walls thickened with **lignin**. So water flows fast and the lignin gives support.
- **sieve tubes** – living cells with **sieve plates** (holes for sap); lose most contents and the nucleus.
- **companion cells** – keep the nucleus and many **mitochondria**; do the living work and load sugars.

■ Drawing plan diagrams

Draw only the **outlines** of the tissue regions (not single cells), in correct proportions, with clear unbroken lines.



A real vascular bundle: large red xylem vessels (lignified) below; smaller phloem above

2 Practice

2.1 State one structural feature of a xylem vessel and explain how it suits the vessel's function. [2]

2.2 State **two** ways a companion cell differs from a mature sieve tube. [2]

3 Exam-style questions

3.1 Which feature is found in xylem vessels but **not** in phloem sieve tubes? [1]

- ☐ **A** living cytoplasm
- **B** sieve plates
- **C** lignified walls and no contents
- **D** companion cells

3.2 In a transverse section of a root, the xylem is found: [1]

- ☐ **A** in a ring near the edge
- **B** in the centre, often in a star shape
- **C** only in the veins
- **D** outside the phloem

3.3 A xylem vessel is drawn 40 mm wide. The real width of the vessel is 50 µm.

(a) Calculate the magnification of the drawing. [2]

(b) Explain why a xylem vessel having no cell contents and no end walls is an advantage. [2]

3.4 Relate the structure of phloem sieve tubes and companion cells to their function in transport. [4]

Solutions

Each answer shows the steps, then the **result**.

2.1

- e.g. lignified walls
- give strength/support and waterproofing; *or* no end walls/empty
- continuous open tube for fast water flow

2.2

- any two: companion cell keeps its nucleus (sieve tube loses it); companion cell has many mitochondria; companion cell retains most cytoplasm

3.1 C

- Only xylem vessels have lignified walls and no living contents

3.2 B

- In the root, xylem is central, often star-shaped

3.3

(a)

- 40 mm = 40 000 µm; magnification $= \dfrac{40\,000}{50} = \times 800$

(b)

- no contents and no end walls make one continuous open tube, so water flows quickly with little resistance

3.4

- sieve tubes have sieve plates with pores so sap flows through; they lose most contents/nucleus to leave room for flow; companion cells keep a nucleus and many mitochondria to provide ATP and load sugars into the sieve tube