06

Anatomy of Flowering Plants

TOPIC 1
Tissues and Tissue System

01 Match the List-I with List - II. **[NEET 2021]**

	List-I		List-II
A.	Cells with active cell division capacity	1.	Vascular tissues
B.	Tissue having all cells similar in structure and function	2.	Meristematic tissue
C.	Tissue having different types of cells	3.	Sclereids
D.	Dead cells with highly thickened walls and narrow lumen	4.	Simple tissue

Select the correct answer from the options given below.

	A	B	C	D
(a)	2	4	1	3
(b)	4	3	2	1
(c)	1	2	3	4
(d)	3	2	4	1

Ans. ***(a)***

(A)-(2), (B)-(4), (C)-(1), (D)-(3)

Meristematic cells are totipotent and are capable of continued cell division. Division of meristematic cells provides new cells for expansion and differentiation of tissues and the initiation of new organs, providing the basic structure of the plant body. Hence, they have cells with active cell division capacity.

Permanent tissues having all cells similar in structure and function are called simple tissue.

Vascular tissues are formed of more than one cell type, found in vascular plants.

The primary components of vascular tissues are the xylem and phloem. These two tissues transport fluid and nutrients internally.

Sclereids are a kind of sclerenchyma cells that are irregular or short. These are dead cells. Their walls are irregular, very thick and their lumen is very narrow. They do not conduct any metabolic activities. They exhibit different types of lignin depositions and also have pits. Sclereids are found in hard parts such as hard seed coats, endocarp of coconut. They are also referred to as stone cells.

02 Regeneration of damaged growing grass following grazing is largely due to **[NEET (Odisha) 2019]**

(a) lateral meristem
(b) apical meristem
(c) intercalary meristem
(d) secondary meristem

Ans. ***(c)***

Regeneration of damaged growing grass following grazing is largely due to intercalary meristem. It is the meristem which occurs between mature tissues. It is found in grasses and regenerates parts damaged by the grazing herbivores.

03 Root hairs develop from the region of **[NEET 2017]**

(a) maturation
(b) elongation
(c) root cap
(d) meristematic activity

Ans. ***(d)***

The root is covered at the apex by a thimble-like structure called the root cap. It protects the tender apex of the root as it makes its way through the soil. A few millimetres above the root cap is the region of meristematic activity. The cells of this region are very small, thin-walled and with dense protoplasm. They divide repeatedly. The cell proximal to this region undergo rapid elongation and enlargement and are responsible for the growth of the root in length. This region is called the region of elongation. The cells of the elongation zone gradually differentiate and mature. Hence, this zone, proximal. From this region, some of the epidermal cells form very fine and delicate, thread-like structure called root hairs. These root hairs absorb water and minerals from the soil.

04 Which of the following is made up of dead cells? **[NEET 2017]**

(a) Xylem parenchyma
(b) Collenchyma
(c) Phellem
(d) Phloem

Ans. ***(c)***

Phellem or cork is a tissue formed on the outer side of cork cambium. It is composed of dead cells. The cell wall become impermeable due to suberisation.

05 Specialised epidermal cells surrounding the guard cells are called **[NEET 2016, Phase I]**

(a) subsidiary cells
(b) bulliform cells
(c) lenticels
(d) complementary cells

Ans. ***(a)***

Few epidermal cells, in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells. These cells are devoid of chloroplasts.

The stomatal aperture, guard cells and the surrounding subsidiary cells are together called stomatal apparatus.

06 Tracheids differ from other trachery elements in **[CBSE AIPMT 2014]**

(a) having casparian strips
(b) being imperforate
(c) lacking nucleus
(d) being lignified

Ans. ***(b)***

Tracheids and vessels both are called tracheary elements because their main function is conduction of sap. Tracheids differ from other trachaery elements in being imperforate. Tracheids are the specific cells which have pits to support upwards and lateral conduction of water sap. Tracheid are comparatively short and single cell, while vessels have more than one cell and up to 10 cm long.

07 The common bottle cork is a product of **[CBSE AIPMT 2012]**

(a) dermatogen
(b) phellogen
(c) xylem
(d) vascular cambium

Ans. ***(b)***

The cork cambium or phellogen cells divide periclinally cutting off cells towards the outside and inside. The cells cut off towards the out side becomes suberised and dead. These are compactly packed in radial rows without intercellular spaces and form cork or phellem.

Cork is impervious to water due to the suberin and provides protection to underlying tissues. The cells cut off from cork cambium towards inside add to the cortex and are called secondary cortex cells or phelloderm cells.

08 Companion cells are closely associated with **[CBSE AIPMT 2012]**

(a) sieve elements (b) vessel elements
(c) trichomes (d) guard cells

Ans. ***(a)***

Companion cells are characteristic elements of phloem tissue associated with the sieve tubes (sieve elements) in the angiosperms. The sieve tubes and companion cells are related ontogenically as they develop from the same mother cell. The companion cells and sieve tubes maintain close cytoplasmic connections through plasmodesmata.

09 Closed vascular bundles lack **[CBSE AIPMT 2012]**

(a) ground tissue
(b) conjunctive tissue
(c) cambium
(d) pith

Ans. ***(c)***

Closed vascular bundles lack cambium. In dicot stems, cambium is present between phloem and xylem. Such vascular bundles because of the presence of cambium, possess the ability to form secondary xylem and phloem tissues and hence, are called open vascular bundles. On the contrary, vascular bundles in monocots have no cambium. Hence, they do not form secondary tissues, and are referred to as closed.

10 Ground tissue includes **[CBSE AIPMT 2011]**

(a) all tissues except epidermis and vascular bundles
(b) epidermis and cortex
(c) all tissues internal to endodermis
(d) all tissues external to endodermis

Ans. ***(a)***

All tissues except epidermis and vascular bundles constitute the ground tissue or fundamental tissue. It consists of simple tissues such as parenchyma, collenchyma and sclerenchyma. It includes cortex, pericycle, medullary rays, in leaves the ground tissue consists of mesophyll.

11 The chief water conducting elements of xylem in gymnosperms are **[CBSE AIPMT 2010]**

(a) vessels
(b) fibres
(c) transfusion tissue
(d) tracheids

Ans. ***(d)***

The tracheids are elongated, angular dead cells with hard lignified wide lumen and narrow end walls. The walls of tracheids possess different types of thickenings and the unthickened areas of its wall allow the rapid movement of water from one tracheid to another. Tracheids are the characteristic cell types of xylem tissues in gymnosperms and pteridophytes, where they are the chief elements of water conduction.

12 Which one of the following is not a lateral meristem? **[CBSE AIPMT 2010]**

(a) Intrafascicular cambium
(b) Interfascicular cambium
(c) Phellogen
(d) Intercalary meristem

Ans. ***(d)***

Intercalary meristems are the portions of apical meristems which are separated from the apex during the growth of axis and formation of permanent tissues . It is present mostly at the base of node, (e.g. *Mentha viridis*), base of internode, (e.g. stem of many monocots *viz,* wheat, paddy, grasses; pteridophytes like *Equisetum*) or at the base of leaf, (e.g. *Pinus*).

13 Palisade parenchyma is absent in leaves of **[CBSE AIPMT 2009]**

(a) *Sorghum* (b) mustard
(c) soyabean (d) gram

Ans. ***(a)***

Sorghum (family-Poaceae) is a monocot plant. The leaves of monocot do not contain palisade parenchyma because the mesophyll of monocot leaf is not differentiated into palisade and spongy parenchyma, all being thin walled, chlorophyllous and irregularly compactly arranged with fewer intercellular spaces.

Palisade cells occur in dicotyledonous plants and also in the net-veined monocots, the Araceae and Dioscoreaceae.

14 The annular and spirally thickened conducting elements generally develop in the protoxylem when the root or stem is **[CBSE AIPMT 2009]**

(a) maturing (b) elongating
(c) widening (d) differentiating

Ans. ***(c)***

Vessels or tracheae are made up of a row of cells, placed one above the other, with their intervening walls absent or variously pored. The walls of vessels are lignified and hard but not very thick. The cell cavity or the lumen is wide. The thickening may be annular, spiral, scalariform, reticulate and pitted.

15 In barley stem, vascular bundles are **[CBSE AIPMT 2009]**

(a) open and scattered
(b) closed and scattered
(c) open and in a ring
(d) closed and radial

Ans. ***(b)***

The vascular bundles in *Hordeum vulgare* (barley) plant are scattered in ground tissues, many in number and vary in size-smaller towards periphery and bigger towards centre of the ground tissue, oval or rounded in outline, conjoint, collateral and closed.

16 Reduction in vascular tissue, mechanical tissue and cuticle is characteristic of **[CBSE AIPMT 2009]**

(a) xerophytes (b) mesophytes
(c) epiphytes (d) hydrophytes

Ans. ***(d)***

In hydrophytes, vascular tissue and mechanical tissue are reduced. Cuticle is either completely absent or if present, it is thin and poorly developed.

In xerophytes, cuticle is heavy and well developed. Vascular tissue and mechanical tissue are well developed and differentiated.

In mesophytes, cuticle in aerial part is moderately developed. Vascular and mechanical tissues are fairly developed and well differentiated.

17 The length of different internodes in a culm of sugarcane is variable because of **[CBSE AIPMT 2008]**

(a) shoot apical meristem
(b) position of axillary buds
(c) size of leaf lamina at the node below each internode
(d) intercalary meristem

Ans. ***(d)***

Intercalary meristem is present away from apical meristem in primary permanent tissue. It is present at the base of internodes, e.g. in family-Gramineae or at the base of leaves, e.g. *Pinus* or at the base of node, e.g. *Mentha*. Intercalary meristem is responsible for increase in length.

The shoot apical meristem present at the apices of shoot, is self determining and autonomous organising centre. The primary growth and differentiation of primary tissues is entirely due to this meristem as it continuously divides giving rise to new cells. These are the apical meristems that increase the length of plant but not internodes variability.

18 Vascular tissues in flowering plants develop from **[CBSE AIPMT 2008]**

(a) phellogen
(b) plerome
(c) periblem
(d) dermatogen

Ans. ***(b)***

Histogen theory for shoot apical meristem has been proposed by Hanstein (1870). It advocates that there are three distinct meristematic zones (layers) called dermatogen, periblem and plerome. The dermatogen is the outermost histogen giving rise to epidermis, periblem is the middle one producing the cortex and plerome is the innermost resulting in central cylinder, (i.e. vascular tissue).

Cork cambium (phellogen) is the secondary lateral meristem found in outer cortical region. Its cells divide periclinally cutting off cells towards the outside (forming cork or phellem) and inside (forming secondary cortex or phelloderm).

19 Passage cells are thin walled cells found in **[CBSE AIPMT 2007]**

(a) endodermis of roots facilitating rapid transport of water from cortex to pericycle
(b) phloem elements that serve as entry points for substances for transport to other plant parts
(c) testa of seeds to enable emergence of growing embryonic axis during seed germination
(d) central region of style through which the pollen tube grows towards the ovary

Ans. ***(a)***

In roots, endodermis is the innermost layer of cortex. Some of the endodermal cells present opposite to the xylem patches are thin walled and are called **passage cells** or **transfusion cells**.

Passage cells help in transfer of water and dissolved salts from cortex directly into the xylem and ultimately to the pericycle.

20 A common structural feature of vessel elements and sieve tube elements are **[CBSE AIPMT 2006]**

(a) pores on lateral walls
(b) presence of p-protein
(c) enucleate condition
(d) thick secondary walls

Ans. ***(a)***

The vessels are nucleated and the sieve tube elements are enucleated.

The wall of both the vessel and sieve tube elements are perforated by large openings. Due to these adaptation the cell to cell contact is possible.

21 Chlorenchyma is known to develop in the **[CBSE AIPMT 2003]**

(a) pollen tube of *Pinus*
(b) cytoplasm of *Chlorella*
(c) mycelium of a green mould such as *Aspergillus*
(d) spore capsule of a moss

Ans. ***(d)***

The apophysis of moss capsule contains chloroplast bearing parenchymatous cells, called as chlorenchyma. Due to the presence of chloroplasts, chlorenchyma cells have the ability to prepare food by the process of photosynthesis.

22 The apical meristem of the root is present **[CBSE AIPMT 2003]**

(a) in all the roots
(b) only in radicals
(c) only in tap roots
(d) only in adventitious roots

Ans. ***(a)***

Apical meristems are primary meristems which are located in the growing points (roots and shoot apices), as well as buds in the axils of leaves. The various organs increase in length due to the activity of apical meristem.

23 The cells of the quiescent centre are characterised by **[CBSE AIPMT 2003]**

(a) dividing regularly to add to tunica
(b) having dense cytoplasm and prominent nuclei
(c) having light cytoplasm and small nuclei
(d) dividing regularly to add to the corpus

Ans. ***(c)***

The region of quiescent centre was discovered by **Clowes** (1958). The cells of quiescent centre have lower concentration of DNA, RNA and protein as compared to other cells in the root apex. These cells also have fewer mitochondria, little endoplasmic reticulum and very small nuclei and nucleoli.

24 Vessels are found in **[CBSE AIPMT 2002]**

(a) all angiosperms and some gymnosperms
(b) most of angiosperms and few gymnosperms
(c) all angiosperms and few gymnosperms and some pteridophytes
(d) all pteridophytes

Ans. ***(b)***

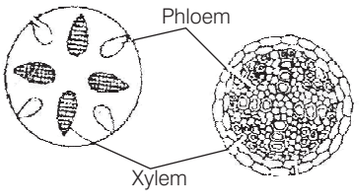
Most angiosperms have vessels except a few, (e.g. *Drimys, Tetracentron, Trochodendron*). The gymnosperms, as a rule, lack vessels but these are found in the order-Gnetales. Vessels are the constituent of xylem. They are composed of row of cells placed one above the other. Transverse wall of these cells is absent due to the dissolution.

25 Four radial vascular bundles are found in **[CBSE AIPMT 2002]**

(a) dicot root (b) monocot root
(c) dicot stem (d) monocot stem

Ans. ***(a)***

Roots have radial vascular bundles while stems have conjoint vascular bundles. Dicot roots have 3-6 vascular bundles while monocot roots have more than 6 vascular bundles.



Radial vascular bandies in dicot root

26 Axillary bud and terminal bud are derived from the activity of **[CBSE AIPMT 2002]**

(a) lateral meristem
(b) intercalary meristem
(c) apical meristem
(d) parenchyma

Ans. ***(c)***

It is the shoot apical meristem which gives rise to lateral buds. The lateral buds however remain suppressed due to the apical dominance.

27 Which of the following statements is true? **[CBSE AIPMT 2002]**

(a) Vessels are multicellular with narrow lumen
(b) Tracheids are multicellular with narrow lumen
(c) Vessels are unicellular with wide lumen
(d) Tracheids are unicellular with wide lumen

Ans. ***(a)***

Each vessel is made up of a number of components called 'vessel members' arranged end-to-end running parallel to the long axis of the organ in which it lies.

28 What happens during vascularisation in plants? **[CBSE AIPMT 2000]**

(a) Differentiation of procambium is immediately followed by the development of secondary xylem and phloem
(b) Differentiation of procambium followed by the development of xylem and phloem
(c) Differentiation of procambium, xylem and phloem is simultaneous
(d) Differentiation of procambium followed by the development of primary phloem and then by primary xylem

Ans. ***(c)***

From the procambium, primary xylem and phloem arise simultaneously.

29 Which of the following meristems is responsible for extrastelar secondary growth in dicotyledonous stem? **[CBSE AIPMT 1998]**

(a) Intrafascicular cambium
(b) Interfascicular cambium
(c) Intercalary meristem
(d) Phellogen

Ans. ***(d)***

Phellogen or cork cambium is a part of periderm. It presents between phellem or cork towards outerside and phelloderm or secondary cortex towards inner side. Phellogen appearing in the cortical regions cuts off new cells for extrastelar secondary growth—cork on the outer side and secondary cortex on the inner side.

30 A leaf primordium grows into the adult leaf lamina by means of **[CBSE AIPMT 1998]**

(a) apical meristem
(b) lateral meristem
(c) marginal meristem
(d) at first by apical meristem and later largely by marginal meristem

Ans. ***(d)***

Apical meristem is present at the tips of stems, roots and leaves, it takes part in initial growth or elongation of roots, stems and leaves. Marginal meristem or plate meristem has parallel layers of cells which divide anticlinally in two planes as in growing flat organs like-leaves.

31 At maturity which of the following is enucleate? **[CBSE AIPMT 1997]**

(a) Sieve cell (b) Companion cell
(c) Palisade cell (d) Cortical cell

Ans. ***(a)***

Phloem (complex tissue) is composed of companion cells, phloem parenchyma, phloem fibre and sieve tube cells. Sieve tube cells are cylindrical and tube-like structure which are involved in transport of organic solute. In sieve cells nucleus is evident in the younger stage but disappears in mature stage.

32 What is not true about sclereids? **[CBSE AIPMT 1996]**

(a) These are parenchyma cells with thickened lignified walls
(b) These are elongated and flexible with tapered ends
(c) These are commonly found in the shells of nuts and in the pulp of guava, pear, etc
(d) These are also called the stone cells

Ans. ***(a)***

Sclereids are broad sclerenchyma cells which may be oval, spherical, cylindrical, or stellate in structure. Sclereids develop from sclerenchyma cells, occur

singly or in groups to provide stiffness. These may be of different types, such as brachysclereids (stone cells) found in grit of pear, apple, macrosclereids (columnar), e.g. legume seeds, astrosclereids (star shaped), e.g. tea leaves, etc.

33 Bordered pits are found in **[CBSE AIPMT 1993]**

(a) sieve cells
(b) vessel wall
(c) companion cells
(d) sieve tube wall

Ans. ***(b)***

Pits are the depressions or cavity formed in the cell wall that are found in the sclerenchyma, thick walled parenchyma cells and the tracheary elements, (i.e. vessels and tracheids).

Simple pits are uniform while bordered pits are the flask shaped depressions.

34 Which is correct about transport or conduction of substances? **[CBSE AIPMT 1991, 97]**

(a) Organic food moves up through phloem
(b) Organic food moves up through xylem
(c) Inorganic food moves upwardly and downwardly through xylem
(d) Organic food moves upwardly and downwardly through phloem

Ans. ***(d)***

Sieve tubes are the conducting elements of phloem that carry the organic nutrients upwardly and downwardly. Organic nutrients absorbed through roots reaches the shoot apex and other parts through phloem cells. Moreover, nutrients are also translocated downwardly through phloem as demonstrated by girdling experiment (Malpighi; 1671) in which removal of ring of bark (including phloem) prevents downward translocation of food and causing starvation and death of roots.

35 Angular collenchyma occurs in **[CBSE AIPMT 1991]**

(a) *Cucrbita* (b) *Tagetes*
(c) *Althaea* (d) *Salvia*

Ans. ***(b)***

Depending upon the thickening, collenchyma is of three types—(a) Angular—thickening at the angles, e.g. stem of tomato, *Datura, Tagetes* (marigold), (b) Lamellar—thickening on tangential walls, e.g. stem of sunflower, (c) Lacunate—thickening on the walls bordering intercellular spaces, e.g. stem of *Cucurbita*.

36 An organised and differentiated cellular structure having cytoplasm but no nucleus is **[CBSE AIPMT 1991]**

(a) vessels (b) xylem parenchyma
(c) sieve tubes (d) tracheids

Ans. ***(c)***

Sieve tubes are food conducting elements of phloem. They possess nucleus in the young stage but disappears in mature ones. The central part of sieve tube has an organised and differentiated cellular structure with a network of cytoplasmic strands, though the peripheral cytoplasm is thin and tonoplast is absent.

37 Collenchyma occurs in the stem and petioles of **[CBSE AIPMT 1990]**

(a) xerophytes (b) monocots
(c) dicot herbs (d) hydrophytes

Ans. ***(c)***

Collenchyma is a simple permanent tissue, made of elongated living cells having thickened pectocellulosic walls. It is a living mechanical tissue which provides both mechanical strength and elasticity and allow them to grow in size. Collenchyma is found in epidermis of dicot stem and petioles and abundant in climbing stems.

38 Monocot leaves possess **[CBSE AIPMT 1990]**

(a) intercalary meristem
(b) lateral meristem
(c) apical meristem
(d) mass meristem

Ans. ***(a)***

Intercalary meristems are derived from the apical meristems and separated from the same by permanent cells. These meristems occur at leaf bases and above or below the nodes (e.g. grass, mint). They help in elongation of leaves and internodes besides allowing the prostrate stems to become erect.

39 Organisation of stem apex into corpus and tunica is determined mainly by **[CBSE AIPMT 1989]**

(a) planes of cell division
(b) regions of meristematic activity
(c) rate of cell growth
(d) rate of shoot tip growth

Ans. ***(a)***

Tunica (outer zone of shoot apex) forms protoderm which through anticlinal divisions gives rise to epidermis of stem and leaves. **Corpus** is inner mass of meristem where cells undergo divisions in different planes to form procambium and ground meristem.

40 Sieve tubes are suited for translocation of food because they possess **[CBSE AIPMT 1989]**

(a) bordered pits
(b) no ends walls
(c) broader lumen and perforated cross walls
(d) no protoplasm

Ans. ***(c)***

Sieve tubes function as the food conducting elements of phloem which are elongated tubular channels formed by end to end union of numerous cells. Sieve tubes have broader lumen, thin walls. Septa present between sieve tube cells are called sieve plates, they possess a number of perforations called sieve pores or sieve pits.

41 Death of protoplasm is a prerequisite for a vital function like **[CBSE AIPMT 1989]**

(a) transport of sap
(b) transport of food
(c) absorption of water
(d) gaseous exchange

Ans. ***(a)***

Certain cells get lignified, leading to death of protoplasm such as xylem cells. Xylem cells are dead, i.e. devoid of protoplasm, and performs the function of conducting water or sap inside the plant.

42 Out of diffuse porous and ring porous woods, which is correct? **[CBSE AIPMT 1989]**

(a) Ring porous wood, carries more water for short period
(b) Diffuse porous wood carries more water
(c) Ring porous wood carries more water when need is higher
(d) Diffuse porous wood is less specialised but conducts water rapidly through out

Ans. ***(c)***

In dicots, large sized vessels are arranged in two ways—ring porous (large sized vessels in early wood, e.g. *Quercus*) and diffuse porous (large sized vessels distributed throughout, e.g. *Azadirachta*). Ring porous vessels are more efficient and advanced as they provide quicker translocation when water requirement is maximum.

43 Which meristem helps in increasing girth? **[CBSE AIPMT 1988]**

(a) Lateral meristem
(b) Intercalary meristem
(c) Primary meristem
(d) Apical meristem

Ans. ***(a)***

Lateral meristem occurs on the sides and helpful in increasing girth of stem and root, e.g. vascular cambium, phellogen (cork cambium).

44 Tunica corpus theory is connected with **[CBSE AIPMT 1988]**

(a) root apex
(b) root cap
(c) shoot apex
(d) secondary growth

Ans. ***(c)***

Tunica corpus theory, given by **Schmidt** (1927) is related with shoot apex or stem apical meristem. According to it, tunica is the outer zone of shoot apex while corpus is inner zone. Tunica forms protoderm that give rise to epidermis of stem and leaves. Corpus is the inner mass which undergoes divisions to form procambium and ground meristem.

TOPIC 2
Internal Structure of Dicot Plants

45 In dicot root, the vascular cambium originates from **[NEET (Odisha) 2019]**

(a) tissue located below the phloem bundles and a portion of pericycle tissue above protoxylem
(b) cortical region
(c) parenchyma between endodermis and pericycle
(d) intrafascicular and interfascicular tissue in a ring

Ans. ***(a)***

In dicot root, the vascular cambium originates from tissues located below the phloem bundles and a portion of pericycle tissue above protoxylem.

Vascular cambium is the meristematic layer that is responsible for cutting off vascular tissues (xylem and phloem). In young stem, it is present in patches as a single layer between the xylem and phloem.

46 Casparian strips occur in **[NEET 2018]**

(a) cortex (b) pericycle
(c) epidermis (d) endodermis

Ans. ***(d)***

Casparian strips are found in endodermis of roots. It is a band of thickening which runs along the radial and tangential walls of endodermal cells. It is made up of suberin and lignin. Casparian strips prevent plasmolysis of endodermal cells.

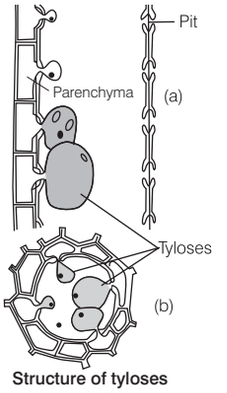
Cortex is found below epiblema. It is made up of thin-walled parenchymal cells. **Epidermis** is the outermost layer made up of thin-walled flattened and slightly elongated parenchymal cells. **Pericycle** is found below endodermis and it is made of parenchymatous cells.

47 The balloon-shaped structures called tyloses **[NEET 2016, Phase II]**

(a) originate in the lumen of vessels
(b) characterise the sapwood
(c) are extensions of xylem parenchyma cells into vessels
(d) are linked to the ascent of sap through xylem vessels

Ans. ***(c)***

The tyloses are the structures found in the woody tissues of dicot stems. These are the extensions of xylem parenchyma cells into the vessel elements.



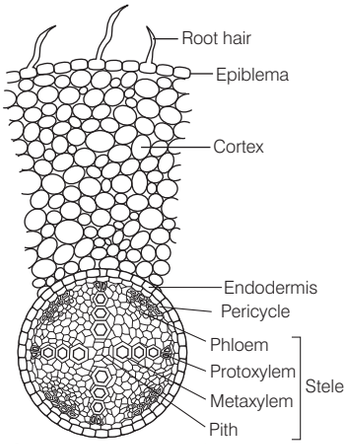
Structure of tyloses in woody tissue
(a) in longitudinal section (b) in cross section

48 Cortex is the region found between **[NEET 2016, Phase II]**

(a) epidermis and stele
(b) pericycle and endodermis
(c) endodermis and pith
(d) endodermis and vascular bundle

Ans. ***(a)***

Cortex tissue is found in between the epidermis and stele. It is multilayered and is made up of parenchymatous cells with big intercellular spaces.



Structure of a portion of TS of Gram root

49 Anatomically fairly old dicotyledonous root is distinguished from the dicotyledonous stem by **[CBSE AIPMT 2009]**

(a) absence of secondary xylem
(b) absence of secondary phloem
(c) presence of cortex
(d) position of protoxylem

Ans. ***(d)***

In dicotyledonous root, the condition of xylem is exarch as the protoxylem is away from the centre and metaxylem is towards the centre. In dicotyledonous stem, (e.g. *Cucurbita*), the condition of xylem is endarch as the metaxylem is away from the centre and protoxylem is towards the centre.

50 In a woody dicotyledonous tree which of the following parts will mainly consist of primary tissues? **[CBSE AIPMT 2005]**

(a) All parts
(b) Stem and root
(c) Flowers, fruits and leaves
(d) Shoot tips and root tips

Ans. ***(d)***

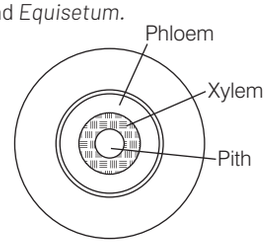
Primary tissues are those meristematic tissues which are derived directly from embryonal tissues.
e.g. shoot apex and root apex.

51 Ectophloic siphonostele is found in **[CBSE AIPMT 2005]**

(a) *Adiantum* and Cucurbitaceae
(b) *Osmunda* and *Equisetum*
(c) *Marsilea* and *Botrychium*
(d) *Dicksonia* and maiden hair fern

Ans. ***(b)***

In the ectophloic siphonostele, the xylem surrounds pith and this xylem is surrounded by phloem, pericycle and endodermis respectively. e.g. *Osmunda* and *Equisetum.*



Ectophloic siphonostele

52 In a longitudinal section of root, starting from the tip upward, the four zones occur in the following order **[CBSE AIPMT 2004]**

(a) root cap, cell division, cell enlargement, cell maturation
(b) root cap, cell division, cell maturation, cell enlargement
(c) cell division, cell enlargement, cell maturation, root cap
(d) cell division, cell maturation, cell enlargement, root cap

Ans. ***(a)***

In a longitudinal section of root, starting from the tip upward the four zones occur in the following order

Root cap → Zone of cell division → Zone of cell enlargement → Zone of cell maturation

53 Pericycle of roots produces **[CBSE AIPMT 1990]**

(a) mechanical support
(b) lateral roots
(c) vascular bundles
(d) adventitious buds

Ans. ***(b)***

In roots, pericycle lies below endodermis and is made of one or more layers of parenchymatous cells. Pericycle gives rise to lateral roots, root branches of vascular cambium and whole of cork cambium.

54 Where do the casparian bands occur? **[CBSE AIPMT 1990, 94, 99]**

(a) Epidermis (b) Endodermis
(c) Pericycle (d) Phloem

Ans. ***(b)***

In roots, the inner most layer of cortex, i.e. endodermis consists of compactly arranged barrel shaped cells that possess ligno-suberin thickenings called **casparian strips.** In dicot stems, endodermis is called starch sheath, it does not contain casparian strips.

55 A bicollateral vascular bundle is characterised by **[CBSE AIPMT 1992]**

(a) phloem being sandwitched between xylem
(b) transverse splitting of vascular bundle
(c) longitudinal splitting of vascular bundle
(d) xylem being sandwitched between phloem

Ans. ***(d)***

Bicollateral vascular bundles are conjoint bundles having phloem both on the outer and inner side of xylem, e.g. *Cucurbita*. These vascular bundle generally seen in Solanaceae (the potato family) and cucurbitaceae (the cucumber family). In this situation phloem is present on both outside and inside the xylem.

TOPIC 3
Secondary Growth

56 Select the correct pair. **[NEET 2021]**

(a) Large colourless empty cells in the epidermis of grass leaves – Subsidiary cells
(b) In dicot leaves, vascular bundles are surrounded by large thick-walled cells – Conjunctive tissue
(c) Cells of medullary rays that form part of cambial ring – Interfascicular cambium
(d) Loose parenchyma cells rupturing the epidermis and forming a lens-shaped opening in bark – Spongy parenchyma

Ans. ***(c)***

Medullary rays (pith rays or wood rays) are sheets or ribbons of cells running from the inside of the plant to the outside. That is, they run at right angles to the xylem and phloem, which run vertically. While the plant is alive, these medullary cells are alive. In dicot stems, the cambium which is present between primary xylem and primary phloem is called intrafascicular cambium. The cells of medullary rays near these intrafascicular cambium become meristematic and form interfascicular cambium. This leads to the formation of a continuous ring of cambium.
Other options can be corrected as :

Few epidermal cells in the vicinity of guard cells become specialised in their shape and size and are called subsidiary cells.

The parenchymatous cells which lie between xylem and the phloem are called conjunctive tissue.

A spongy layer of irregular chlorophyll bearing cells interspersed with air spaces that fills the interior part of leaf below the palisade layer is called spongy parenchyma.

57 Match the List -I with List - II.

	List-I		List-II
A.	Lenticels	1.	Phellogen
B.	Cork cambium	2.	Suberin deposition
C.	Secondary cortex	3.	Exchange of gases
D.	Cork	4.	Phelloderm

Choose the correct answer from the options given below. **[NEET 2021]**

	A	B	C	D
(a)	4	1	3	2
(b)	3	1	4	2
(c)	2	3	4	1
(d)	4	2	1	3

Ans. ***(b)***

(A)-(3), (B)-(1), (C)-(4), (D)-(2)

Lenticels permit the exchange of gases between the environment and the internal tissue spaces of the organs (stems and some fruits). They permit the entrance of oxygen and simultaneously the output of carbon dioxide and water vapour. Thus, they are responsible for gaseous exchange.

Cambium, called the phellogen or cork cambium, is the source of the periderm, a protective tissue that replaces the epidermis when the secondary growth

displaces, and ultimately destroys, the epidermis of the primary plant body.

Phelloderm is the parenchymatous tissue which originates from the phellogen towards its inner side known as the secondary cortex. It is a living tissue having a cellulosic cell wall.

Cork tissue, consisting of dead cells surrounded by alternating layers of suberin and wax, has a particularly high suberin content. Cork cells are found in a secondary protective layer (periderm) in the bark of trees.

58 Which of the following statements about cork cambium is incorrect? **[NEET (Oct.) 2020]**

(a) It forms secondary cortex on its outerside
(b) It forms a part of periderm
(c) It is responsible for the formation of lenticels
(d) It is a couple of layers thick

Ans. ***(a)***

Cork cambium is a meristematic tissue involved in secondary growth. It is also called phellogen. It is few layer thick and it cut off cells into an outer layer and an inner layer. The former differentiates into cork or phellem while the latter differentiate into secondary cortex or phelloderm. The phellogen, phellem and phelloderm are collectively known as periderm. In woody trees, phellogen cuts off closely arranged parenchymatous cells which ruptures the epidermis and form lenticels. Thus, statement 1 is incorrect while other are correct.

59 Which of the statements given below is not true about formation of annual rings in trees? **[NEET (National) 2019]**

(a) Differential activity of cambium causes light and dark bands of tissue early and late wood, respectively
(b) Activity of cambium depends upon variation in climate
(c) Annual rings are not prominent in trees of temperate region
(d) Annual ring is a combination of springwood and autumnwood produced in a year

Ans. ***(c)***

The statement "annual rings are not prominent in trees of temperate region" is incorrect. Correct information about the statement is as follows:

Annual rings are formed due to the seasonal activity of cambium. In the plants of temperate region, cambium is highly active in spring and less active in autumn season. Hence, prominent rings are formed in these plants having light and dark bands of tissue. Rest statements are correct about the formation of annual rings in trees.

60 Plants having little or no secondary growth are **[NEET 2018]**

(a) conifers
(b) deciduous angiosperms
(c) grasses
(d) cycads

Ans. ***(c)***

Secondary growth occurs due to the presence of vascular cambium. **Grasses** are monocot and lacks vascular cambium. Therefore, they do not show secondary growth.

Deciduous angiosperms are usually woody dicot plants and show secondary growth. **Conifers** and **cycads** are gymnosperms and usually show anomalous secondary growth.

61 Secondary xylem and phloem in dicot stem are produced by **[NEET 2018]**

(a) phellogen
(b) vascular cambium
(c) apical meristems
(d) axillary meristems

Ans. ***(b)***

Secondary vascular tissues, *i.e.,* secondary xylem and pholem are formed by the **vascular cambium**. It is produced by two types of meristems; fascicular or intrafascicular and interfascicular cambium. Intrafascicular cambium is a primary meristem which occurs as strips in vascular bundles.

It divides to form secondary phloem on outer side and secondary xylem on the inner side. Interfascicular cambium arises secondarily from the cells of medullary rays.

Phellogen or **cork cambium** is produced in the outer cortical cells of dicot stems. It is helpful in increasing the girth. **Apical meristems** are present at the tips of stem, root and their branches. They are responsible for increase in length of the plant. **Axillary meristem** is found in axillary buds. These cells are left behind from shoot apical meristem during the formation of leaves and elongation of stems.

62 Plants having little or no secondary growth are **[NEET 2018]**

(a) conifers
(b) deciduous angiosperms
(c) grasses
(d) cycads

Ans. ***(c)***

Secondary growth occurs due to the presence of vascular cambium. **Grasses** are monocot and lacks vascular cambium. Therefore, they do not show secondary growth.

Deciduous angiosperms are usually woody dicot plants and show secondary growth. **Conifers** and **cycads** are gymnosperms and usually show anomalous secondary growth.

63 Identify the wrong statement in context of heartwood. **[NEET 2017]**

(a) Organic compounds are deposited in it
(b) It is highly durable
(c) It conducts water and minerals efficiently
(d) It comprises dead elements with highly lignified walls

Ans. ***(c)***

Heartwood also called duramen is the central dead wood of trees. It comprises of dead, lignified cells containing organic compounds, e.g. tannins or other substances. These substances make it darker in colour and aromatic. Heartwood is strong durable and resistant to decay. It does not conduct water and minerals because of the presence of dead elements.

Thinking Process The conduction of water and minerals is carried out by sapwood, because it contains living cells.

64 The vascular cambium normal gives rise to **[NEET 2017]**

(a) phelloderm
(b) primary phloem
(c) secondary xylem
(d) periderm

Ans. ***(c)***

Vascular cambium located between xylem and phloem in the stems and roots of vascular plants. It produces secondary xylem towards the pith and secondary phloem towards the bark.

Phellogen is made of narrow thin-walled and nearly rectangular cells. phellogen cuts off cells on both sides. The outer cells differentiate into cork or phellem while inner cells differentiate into

secondary cortex or phelloderm. The phellogen, phellem and phelloderm are collectively known as periderm.

65 Read the different components from I-IV in the list given below and tell the correct order of the components with reference to their arrangement from outer side to inner side in a woody dicot stem. **[CBSE AIPMT 2015]**

I. Secondary cortex
II. Wood
III. Secondary phloem
IV. Phellem

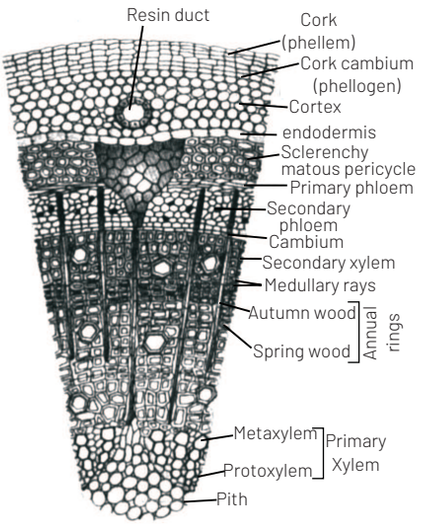
The correct order is

(a) III, IV, II, I (b) I, II, IV, III
(c) IV, I, III, II (d) IV, III, I, II

Ans. ***(c)***

The correct order of arrangement of the given components from outside to inside in a woody dicot stem is as follows

Phellem ⟶ Secondary cortex ⟶ Secondary phloem ⟶ Wood



TS of a typical dicot stem showing secondary growth

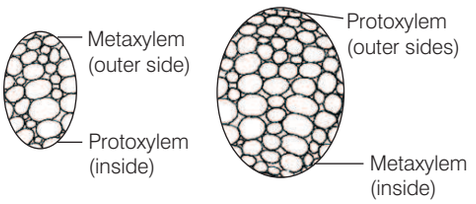
66 You are given a fairly old piece of dicot stem and a dicot root. Which of the following anatomical structures will you use to distinguish between the two? **[CBSE AIPMT 2014]**

(a) Secondary xylem
(b) Secondary phloem
(c) Protoxylem
(d) Cortical cells

Ans. ***(c)***

We will observe the protoxylem of the dicot stem and dicot root to distinguish between them. In dicot stem the protoxylem is present towards center (pith) and metaxylem is present towards the periphery of the organ. This type of xylem is known as endarch.

In root protoxylem is present towards periphery and metaxylem is present towards center that is called exarch.



TS of dicot stem **TS of dicot root**

67 Interfascicular cambium develops from the cells of **[NEET 2013]**

(a) medullary rays
(b) xylem parenchyma
(c) endodermis
(d) pericycle

Ans. ***(a)***

In dicot stems, the cells of cambium present between primary xylem and primary phloem is the intrafascicular cambium. The cells of medullary rays, adjoining these intrafascicular cambium become meristematic and form the interfascicular cambium.

Xylem parenchyma are living and thin-walled and their cell walls are made up of cellulose. In dicot roots the innermost layer of the cortex is called endodermis. Next to endodermis lies a few layers of thick walled parenchymatous cells called as pericycle.

68 Age of a tree can be estimated by **[NEET 2013]**

(a) its height and girth
(b) biomass
(c) number of annual rings
(d) diameter of its heartwood

Ans. ***(c)***

Age of a tree can be estimated by counting the number of annual rings. This study is known as dendrocronology. The two kinds of woods that appear as alternate concentric rings, constitute an annual ring heartwood comprises dead elements with highly lignified walls that give mechanical support to the stem. The height and girth of a tree increases due to the activity of vascular cambium.

69 The cork cambium, cork and secondary cortex are collectively called **[CBSE AIPMT 2011]**

(a) phellogen (b) periderm
(c) phellem (d) phelloderm

Ans. ***(b)***

The periderm is a secondary protective structure and is made up of cork cambium (phellogen), cork (phellem) and secondary cortex (phelloderm).

70 Heartwood differs from sapwood in **[CBSE AIPMT 2010]**

(a) presence of rays and fibres
(b) absence of vessels and parenchyma
(c) having dead and non-conducting elements
(d) being susceptible to pests and pathogens

Ans. ***(c)***

As a result of continued secondary growth in subsequent years, the older part of secondary xylem or wood becomes non-functional (dead) as it loses the power of conduction. The cells of this wood are filled with resins or tannins produced by adjacent functional cells. The activities of vessels become blocked by tyloses. Due to these activities, non-functional, secondary xylem becomes hard, durable and blackish in colour, called heartwood. Now, the function of secondary xylem (water and mineral conduction from roots) is performed by outer younger-rings of xylem which is called sapwood.

71 For a critical study of secondary growth in plants which one of the following pairs is suitable? **[CBSE AIPMT 2007]**

(a) Sugarcane and sunflower
(b) Teak and pine
(c) Deodar and fern
(d) Wheat and maiden hair fern

Ans. ***(b)***

The increase in diameter or thickness is due to the formation of secondary tissues as a result of the activities of vascular cambium and cork cambium. This secondary growth is characteristic of dicot stem and root. Thus, sugarcane, pine, ferns, wheat, etc. cannot be used to study secondary growth.

72 Main function of lenticel is **[CBSE AIPMT 2002]**

(a) transpiration
(b) guttation
(c) gaseous exchange
(d) bleeding

Ans. ***(c)***

The primary function of lenticels is gaseous exchange. Lenticel respiration generally seen in stem of dicotyledons plants. Transpiration takes place mostly through stomata. Guttation and bleeding takes place through hydathodes.

73 As the secondary growth takes place (proceeds) in a tree, thickness of **[CBSE AIPMT 1994]**

(a) heartwood increases
(b) sapwood increases
(c) both increase
(d) both remain the same

Ans. ***(a)***

As a result of continous secondary growth in subsequent year, the older part of secondary xylem becomes non-functional. Due to this activities of vessels become blocked by bladder like ingrowths which are called tyloses. Due to this non-functional xylem becomes hard and blackish in colour called duramen or heartwood.

Now, the function of secondary xylem is continoued by younger rings called sapwood or alburnum with the passage of time and addition of new outer rings of secondary xylem more rings of sapwood changes into heartwood. This is why the heartwood increases in diameter year after year but the sapwood remains almost in the same thickness.

74 Procambium forms **[CBSE AIPMT 1994]**

(a) only primary vascular bundles
(b) only vascular cambium
(c) only cork cambium
(d) primary vascular bundles and vascular cambium

Ans. ***(d)***

The meristematic tissue which forms the primary xylem and phloem is known as procambium. The term procambium is used to indicate the meristematic tissue that give rise to the morphological vascular units.

75 Abnormal/anomalous secondary growth occurs in **[CBSE AIPMT 1993]**

(a) *Dracaena* (b) ginger
(c) wheat (d) sunflower

Ans. ***(a)***

Secondary growth in monocotyledons is rather rare, it is commonly seen in woody monocotyledons such as *Dracaena, Aloe, Agave,* etc. In *Dracaena* sp exceptionally large secondary growth in thickness occurs that begins with the formation of secondary meristematic tissue—the cambium, in the parenchyma outside the primary bundles. Moreover, cork in *Dracaena* appears in seriated bands without the formation of cork cambium (phellogen) and is known as storied cork.

76 A narrow layer of thin walled cells found between phloem/bark and wood of a dicot is **[CBSE AIPMT 1993]**

(a) cork cambium
(b) vascular cambium
(c) endodermis
(d) pericycle

Ans. ***(b)***

Vascular cambium is formed by strips of fascicular cambium and interfascicular cambium. It consists of narrow layer of thin walled cells found between phloem and xylem tissues. Vascular cambium helps in secondary growth in dicot root and stem.

77 Periderm is produced by **[CBSE AIPMT 1993]**

(a) vascular cambium
(b) fascicular cambium
(c) phellogen
(d) intrafascicular cambium

Ans. ***(c)***

Phellogen or cork cambium which develops secondarily from some outer layer of cortex (or pericycle) divides on the outside as well as inside to form respectively cork or phellem and secondary cortex or phelloderm. Cork, cork cambium and secondary cortex are together called periderm.

78 Which exposed wood will decay faster? **[CBSE AIPMT 1993]**

(a) Sapwood
(b) Softwood
(c) Wood with lot of fibres
(d) Heartwood

Ans. ***(a)***

In old trees, secondary xylem or wood gets differentiated into outer light coloured functional sapwood or alburnum and inner dark coloured non-functional heartwood or duramen. Heartwood is stronger and highly durable because of presence of oils, resins, gums, tannins and tyloses which are plugged into the tracheids and vessel elements.

As the secondary growth takes place size of heart wood increases because of conversion of inner alburnum (sapwood) into it.

79 Commercial cork is obtained from **[CBSE AIPMT 1991]**

(a) *Berberis*/Barberry
(b) *Salix*/Willow
(c) *Quercus*/Oak
(d) *Betula*/Birch

Ans. ***(c)***

Cork or phellem develops from cork cambium and is made up of dead suberised and rectangular cells which are filled with air and tannins. Cork is protective and is obtained commercially from *Quercus suber* (cork oak, bottle cork).

80 Cork cambium and vascular cambium are **[CBSE AIPMT 1990]**

(a) parts of secondary xylem and phloem
(b) parts of pericycle
(c) lateral meristems
(d) apical meristems

Ans. ***(c)***

Lateral meristems are present along the lateral sides of stem and root. They divide only in radial direction. The cambium of vascular bundles (fascicular, intrafascicular) and the cork cambium or phellogen belongs to this category and are found in dicotyledons and gymnosperms.

81 For union between stock and scion in grafting which one is the first to occur? **[CBSE AIPMT 1990]**

(a) Formation of callus
(b) Production of plasmodesmata
(c) Differentiation of new vascular tissues
(d) Regeneration of cortex and epidermis

Ans. ***(a)***

In grafting, cambium bearing shoot (scion) of one plant is joined to cambium bearing stump (root system = stock) of related plant through different union like tongue grafting, wedge grafting, etc.

The union of scion and stock leads to irregular, unorganised and undifferentiated mass of actively dividing cells known as callus.

82 Vascular cambium produces **[CBSE AIPMT 1990, 92]**

(a) primary xylem and primary phloem
(b) secondary xylem and secondary phloem
(c) primary xylem and secondary phloem
(d) secondary xylem and primary phloem

Ans. ***(b)***

Vascular cambium is formed by fascicular and interfascicular cambium. It leads to secondary growth in dicot roots and dicot stems. Cells of vascular cambium, known as fusiform initially produce secondary phloem on the outside and secondary xylem on the inner side.

Youngest xylem layer occur inner to vascular cambium while oldest layer of secondary xylem is found outside the primary xylem or towards pith. In case of phloem, youngest layer of secondary phloem lies just outside the vascular cambium while oldest layer is towards outside, inner to primary phloem.

83 Cork is formed from **[CBSE AIPMT 1988]**

(a) cork cambium (phellogen)
(b) vascular cambium
(c) phloem
(d) xylem

Ans. ***(a)***

Cells of cork cambium (phellogen) divide on the outside as well as inside to form respectively cork or phellem and secondary cortex or phelloderm. Cork or phellem is made up of dead suberised and rectangular cells, filled with air and tannins, it is protective in nature.

TOPIC 4
Internal Structure or Monocot Plants

84 The transverse section of a plant shows following anatomical features. **[NEET (Sep.) 2020]**

I. Large number of scattered vascular bundles surrounded by bundle sheath.
II. Large conspicuous parenchymatous ground tissue.
III. Vascular bundles conjoint and closed.
IV. Phloem parenchyma absent.

Identify the category of plant and its part.

(a) Monocotyledonous root
(b) Dicotyledonous stem
(c) Dicotyledonous root
(d) Monocotyledonous stem

Ans. ***(d)***

The transverse section of monocotyledonous stem shows following anatomical features :
The monocot stem have conjoint and closed vascular bundles, scattered in the ground tissue containing the parenchyma. Each vascular bundle is surrounded by sclerenchymatous bundle-sheath cells. Phloem parenchyma and medullary rays are absent in monocot stems.

85 Water containing cavities in vascular bundles are found in **[CBSE AIPMT 2012]**

(a) sunflower (b) maize
(c) *Cycas* (d) *Pinus*

Ans. ***(b)***

In monocot stem like *Zea mays*, vascular bundles are conjoint, collateral and closed. In vascular bundles, the lowermost protoxylem vessels and xylem parenchyma cells dissolve forming a water containing schisolysigenous cavity called protoxylem cavity or lacuna or lysigenous cavity. Protoxylem cavity and protophloem may be absent in the smaller vascular bundles in maize.

86 What is true about a monocot leaf? **[CBSE AIPMT 1990]**

(a) Reticulate venation
(b) Absence of bulliform cells from epidermis
(c) Mesophyll not differentiated into palisade and spongy tissues
(d) Well diffferentiated mesophyll

Ans. ***(c)***

Monocot leaves are characterised by parallel venation, leaves are isobilateral (both the surfaces equally green), amphistomatic with dumb bell-shaped guard cells. The upper epidermis possesses groups of larger sized thin walled vacuolate cells called bulliform or motor cells. Mesophyll is undifferentiated and consists of isodiametric cells enclosing intercellular spaces. Midrib region does not contain mesophyll and possesses number of parallel vascular bundles.

87 Pith and cortex do not differentiate in **[CBSE AIPMT 1988]**

(a) monocot stem (b) dicot stem
(c) monocot root (d) dicot root

Ans. ***(a)***

In monocot stem, ground tissue is undifferentiated, thus endodermis, pericycle cortex and pith are not recognisable. Ground tissue consists of only parenchyma cells that store food.