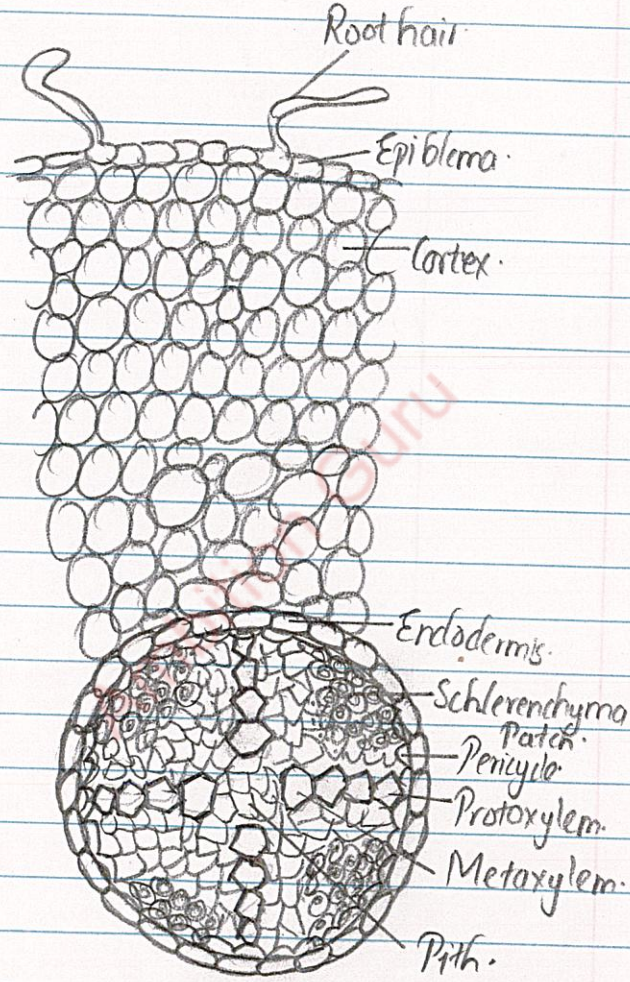
Plant Anatomy

1) Describe the anatomical structure of dicot root and compare it with monocot root. (8 marks). (2076)

Dicot root:

i) Epiblema / Rhizodermis:
- Outermost covering of dicot root.
- Consists of living, thin walled compactly arranged barrel shaped parenchymatous cells.
- Provides protection to the root.
- Some of the epidermal cells provide rise to root hairs for the absorption.
- No deposition of cuticle.

ii) Cortex:
- Multilayered parenchymatous region with intercellular spaces.
- Helps in the storage of food materials.



T.S. of Dicot Root.

iii) Endodermis:
- Innermost layer of cortex.
- Forms covering of stele.
- Composed of single layered barrel shaped parenchymatous cells.
- Most of the cells of endodermis are characterized by the presence of Casparian strip.

iv) Pericycle:
- Single parenchymatous layer present just below the endodermis.
- Lateral roots arise from this pericycle layer.
- During secondary growth it forms cambium.

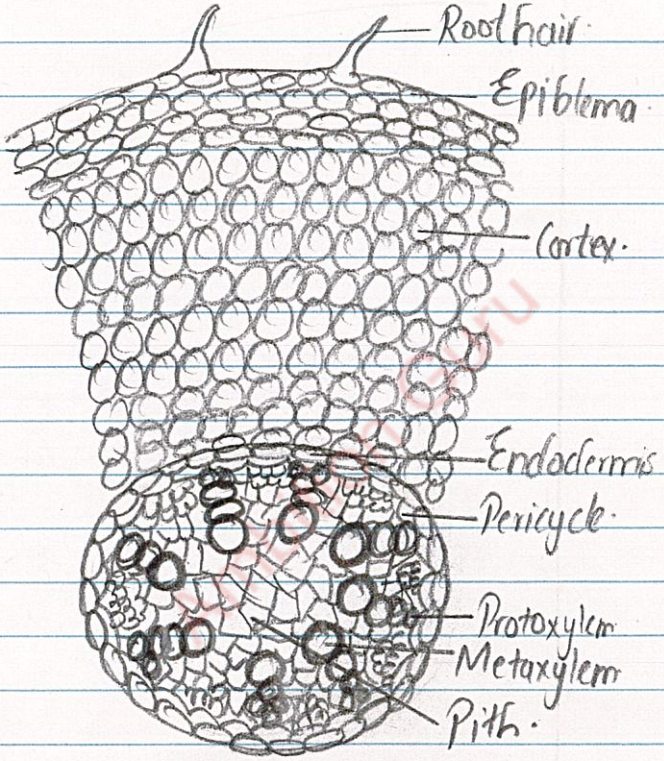
v) Vascular bundles:
- They are radial i.e. the xylem and phloem lie on different radii alternating with each other.

- Xylem and phloem are present is separate bundles and are equal in number.
- Number of xylem and phloem bundles may vary from 2-6.
- Xylem shows exarch condition.
- Xylem vessels are angular in outline.

vi) Conjunctive tissue:
- Xylem and phloem tissues are separated by parenchymatous tissue: conjunctive tissue.
- Function: storage.

vii) Pith:
- Parenchymatus central zone.
- Pith is usually absent or highly reduced.

Monocot root:
i) Epiblema / Rhizodermis:
- Single layered parenchymatous and protective layer.



T.S. of Monocot Root.

- Externally epiblema possesses root hairs for the absorption.
- Characterized by the absence of cuticle and stomata.

ii) Cortex:
- Broad region of parenchymatous tissue.
- Cells of cortical region are oval or rounded, living and having intercellular spaces.
- Protective layer which protects internal tissues from outer agencies.

iii) Endodermis:
- Innermost layer of cortex.
- Consists of single layered barrel shaped parenchymatous tissues with casparian strips.

iv) Pericycle:
- A single layer of parenchymatous tissue and forms the lateral roots.

v) Vascular bundle:
- They are of radial type.
- Xylem and phloem bundles are found in different bundles and number is 8-20.
- Xylem shows exarch condition.
- Xylem vessels are oval in outline.

vi) Conjuctive Tissue:
- Found between xylem and phloem.
- They are parenchymatous or sclerenchymatous tissue.

vii) Pith:
- Central portion of root is composed of broad zone of parenchymatous tissues.
- Well developed in monocot root.

1) Define permanent tissue and discuss the structure and function of complex permanent tissues. (8 marks).

Permanent tissue.

- Composed of cells which have lost the dividing capacity and attain definite shape, size and function.
- 2 Types:
  a) Simple permanent tissue.
  b) Complex permanent tissue.

Complex permanent tissue:

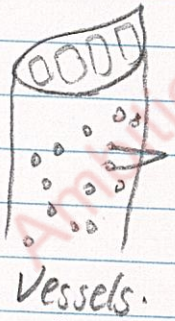
- Heterogeneous system of cells.
- Consists of more than one type of cells working together as a unit.
- Consists of parenchymatous and sclerenchymatous cells.
- Most important complex tissues:
  i) Xylem
  ii) Phloem.

i) Xylem / Wood:
- Conducting tissue which conducts water and mineral nutrients upward from the root to the leaves.
- Xylem is composed of different kinds of elements.
- They are:
a) Xylem tracheids.
b) Xylem fibres.
c) Xylem vessels.
d) Xylem parenchyma.

a) Xylem tracheids:
- Elongated, tube like cell having tapering, rounded or oval ends.
- Walls are lignified.
- Secondary wall layers are deposited in different manner, thus the wall shows various types of thickening - annular, spiral, reticulate, scalariform and pitted.
- Conducts the water and mineral.

b) Xylem fibres (Wood fibres):
- Common in secondary xylem.
- Made up of sclerenchymatous cells.
- Cells of xylem fibres contain thick lignified walls and narrow ~~them~~ lumen.
- Helps in mechanical support

c) Xylem vessels:



- Rows of elongated tube like dead cells.
- Cells are joined end to end to form chain of cells called vessels.
- Septum between two xylem vessels are almost dissolved.

- Shorter and boarder than tracheids.
- Xylem with smaller vessels - protoxylem.
- Xylem with larger vessels - metaxylem.

d) Xylem parenchyma:
- Thin walled living parenchyma without intercellular spaces present in xylem.
- Helps in storage of water and slow lateral conduction of sap.

ii) Phloem (Bast):
- Specialized complex permanent tissue.
- Mainly conducts organic food synthesized by leaves to different parts of plant.
- Composed of following elements.
a) Sieve tube.
b) Companion cells.
c) Phloem fibres.
d) Phloem parenchyma.

a) Sieve elements:
- Conducting elements of the phloem.
- Elongated tube like cells without nucleus at maturity.
- Walls are thin and made of cellulose
- Sieve tubes are arranged one upon another and cross wall has pergoration.

b) Companion cells:
- Specialized thin walled parenchymatous cells found to be associated with sieve tube.
- Thin walled and contain dense cytoplasm and prominent nucleus that controls the metabolic activities of sieve elements also.
- Found in angiosperms only.

c) Phloem Parenchyma:
- Thin walled living parenchymatous cells.

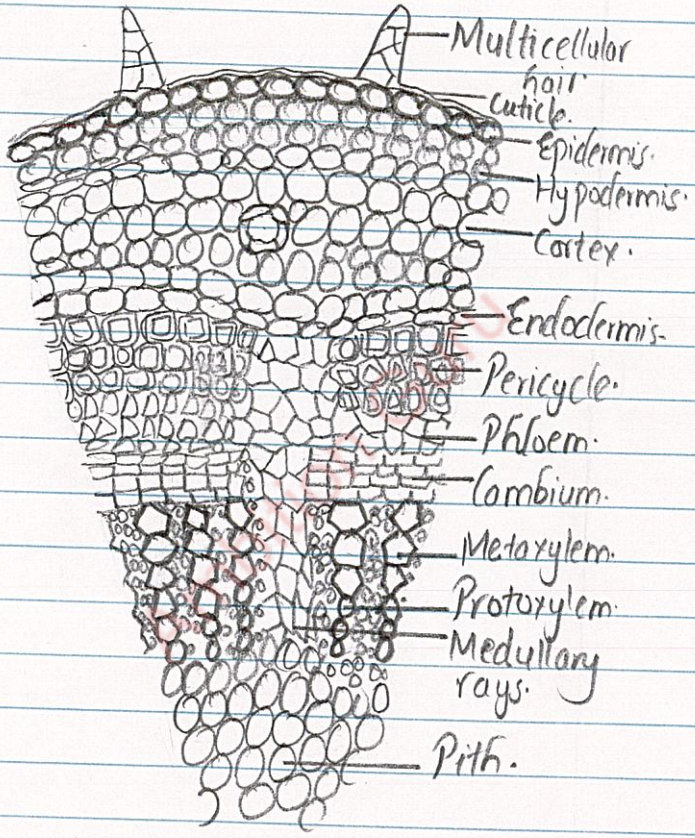
- Absent in most of monocots and herbaceous plants.
- Cells contain cytoplasm and nucleus.
- Store food material in the form of starch, fat and other organic substances.

d) Phloem fibres:
- Made up of thick sclerenchymatous cells.
- Give mechanical strength to phloem and plant body as a whole -

3) Describe the T.S. of dicot stem with well labelled diagrams and compare it with monocot stem. (8 marks) (2072).

Dicot stem:

1) Epidermis:
- Outermost, single, protective parenchymatous layer.



T.S. of dicot stem.

- Externally covered by cuticle and numerous epidermal hairs.
- Also possess stomata.

2) Hypodermis:
- Lies below epidermis and is of 3-4 layered collenchyma.
- Helps in mechanical support, elasticity, photosynthesis due to presence of chlorophyll.

3) Cortex:
- Several layered parenchymatous zone which lies just below the hypodermis.
- Function: Storage of food.

4) Endodermis:
- Innermost layer of cortex.
- Made up of by barrel shaped parenchymatous tissue.
- Characterized by the presence of starch sheath / casparian strips (sometimes absent).

5) Vascular Bundles:
- VB are conjoint, collateral and open type.
- VB are wedge shapes and arranged in a ring.

6) Phloem:
- Lies outer side of VB.
- Helps in conduction of organic food.

7) Xylem:
- Lies towards inner side (pith).
- Helps in conduction of water and mechanical support.

8) Cambium:
- Lies between xylem and phloem of same vascular bundle.
- Helps in secondary growth (increasing the girth of stem).

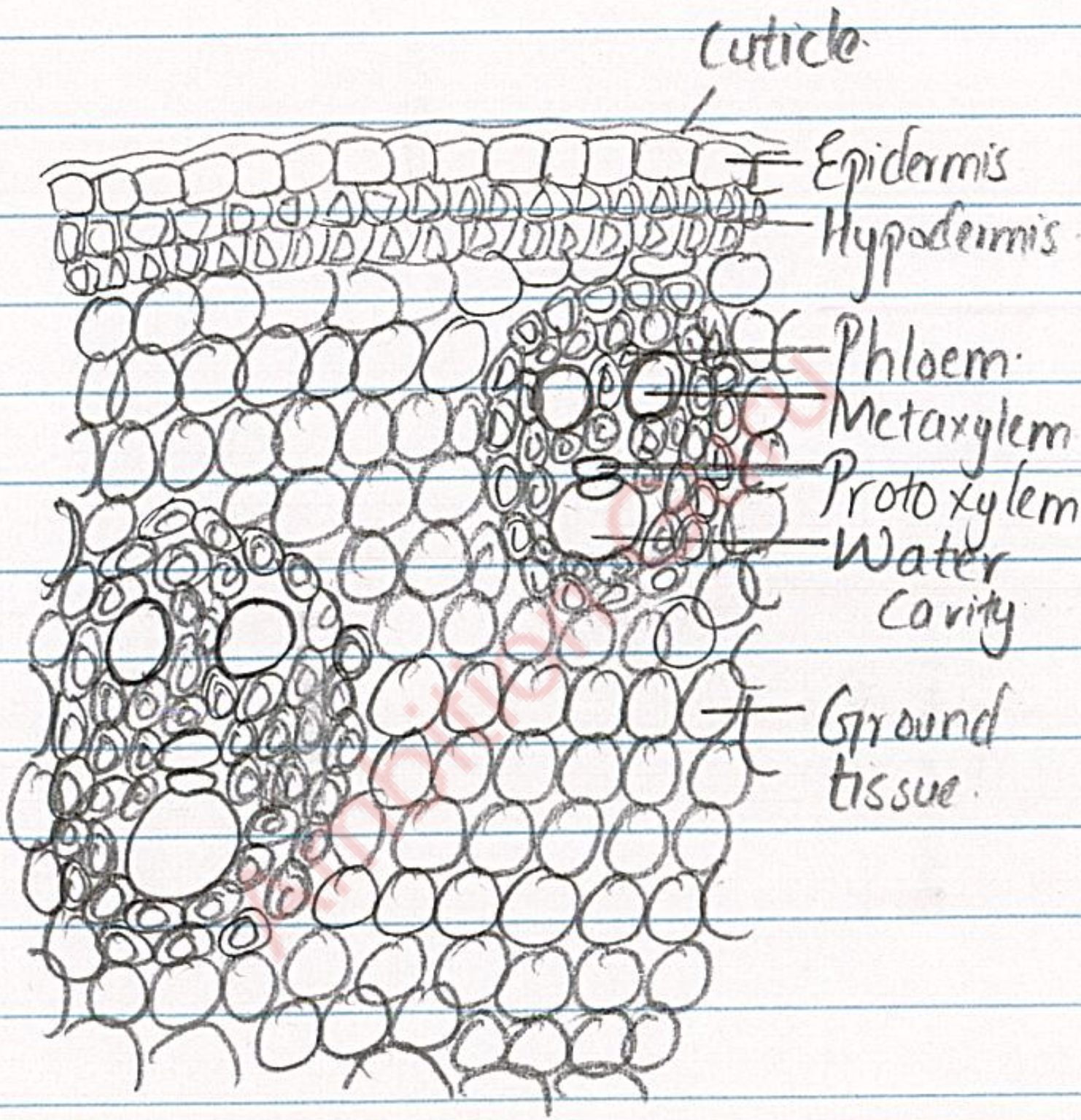
9) Medullary rays:
- Radially elongated parenchyma.

- Present in between vascular bundles.
- Some of medullary cells form secondary cambium (interfascicular cambium) at the time of secondary growth.

10) Pith:
- Central, parenchymatous zone.
- Helps in storage of food.
- Pith is reduced in mature stem of dicots.

Monocot Stem:
1) Epidermis:
- Single, outermost, protective parenchymatous layer.
- Externally covered with cuticle and numerous stomata.

2) Hypodermis:
- Few layered sclerenchymatous layer which lies just below epidermis.
- Provides mechanical support.



T.S. of Monocot stem.

3) Ground Tissue:
- Multilayered parenchymatous zone.
- Not differentiated into cortex, endodermis, pericycle and pith.

4) Vascular Bundles:
- VB are conjoint, collateral and closed type.
- Larger VB are found near center.
- VB are numerous in number and scattered throughout the ground tissue.

5) Xylem:
- Usually Y-shaped.
- Two larger metaxylems forms its arms and smaller protoxylem forms its base.
- Xylem shows endarch condition.

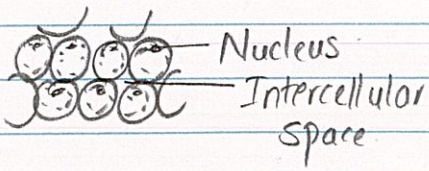
6) Phloem:
- Lies in the outer side of VB.
- Monocot stem lacks phloem parenchyma.
- Helps in conduction of organic food.

4) Define permanent tissue and discuss the structure and function of simple permanent tissue. (8 marks) (2075).

Permanent Tissue:
- Composed of cells which have lost the dividing capacity and attain definite shape, size and function.
- 2 types:
a) Simple Permanent Tissue.
b) Complex Permanent Tissue.

Simple Permanent Tissue:
- Made up of similar types of cells forming a uniform of homogeneous mass of cells.

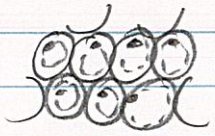
-May be living or deat.
-3 types:
i) Parenchyma:



Parenchyma.
-Living tissue - most common tissue that makes ground tissue.
-Shape may vary (oval, elongated, rectangular, polygonal).
-Thin walled made up of cellulose.
-Loosely arranged with intercellular spaces.
-Found in different parts of the plants
-Abundantly found on soft parts of the plants.
-Main function is storage of food material.

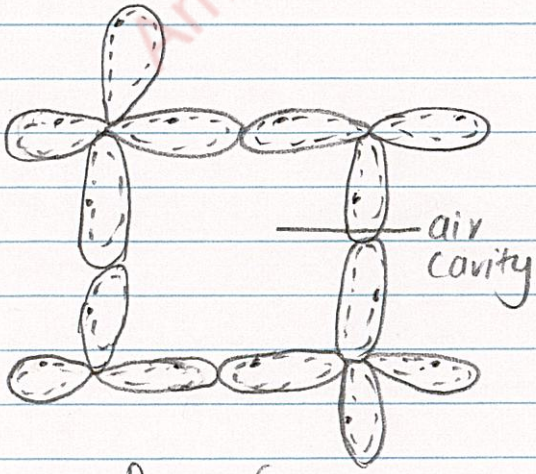
Types of parenchyma:

1) Chlorenchyma:
chlorophyll containing parenchyma.



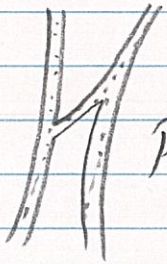
Chlorenchyma.

2) Aerenchyma:
- Parenchyma bearing large air cavities/chamber between them.



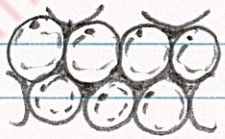
Aerenchyma.

3) Prosenchyma:
- Elongated and tapering at one end.



Prosenchyma

ii) Collenchyma:
- Simple, non-lignified, living mechanical tissue with or without inter cellular spaces.



Collenchyma.

- Originated from the ground meristem.
- Cell walls is unevenly thickened and rich in pectin and hemicellulose.

- Contain chloroplast and perform photosynthesis.
- Provides mechanical support to stem and provide flexibility of organs.

Types of collenchyma.
1) Angular collenchyma.
2) Lacuna collenchyma
3) Plate collenchyma.

iii) Sclerenchyma:
- Long elongated cell with narrow and pointed ends.
- Lignified and thick walled dead cell that does not perform metabolism.
- Simple tissue with little or no protoplasm.
- Supporting tissue that withstands various strains which results from stretching and bending of plant organs without any damage.

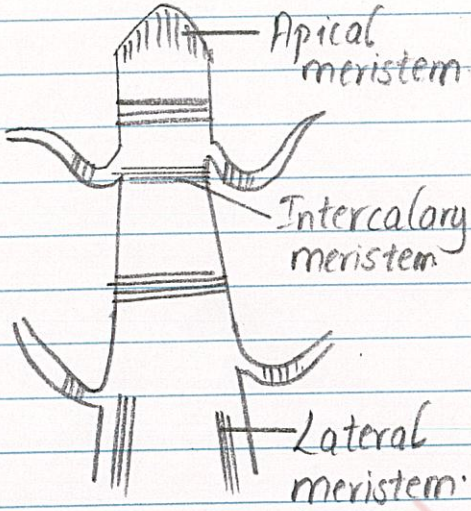
- Most commonly, sclerenchyma cells are grouped into fibres and sclereids.

5) "Meristem is also known as Juvenile tissue." Justify. Explain the types of meristem on the basis of position. (4 marks) (2079)

"Meristem is also known as Juvenile tissue because the cells of meristem are undifferentiated and it undergoes differentiation to form the permanent tissue.

- Types of meristem on the basis of position.

a) Apical meristem
b) Intercalary meristem
c) Lateral meristem.



Different parts of meristem based on position.

a) Apical Meristem:
- Occurs at the apices of the main and lateral shoots and roots.
- Gives rise to the primary permanent tissues.
- Responsible for the increase in length of the plant body.
- Also called as growing points.
- Types of apical meristem:
  i) Root apical meristem.
  ii) Shoot apical meristem.

5) Intercalary meristem:
- Occurs between masses of permanent tissues.
- Originate when actively growing primary tissue regions get detached from the apical meristems due to the growth of the organs.
- As a result, they finally remain embedded between masses of permanent tissues.
- Give rise to primary permanent tissues.
- Responsible for the increase in length of the axis and its branches.
- Generally, short lived.

c) Lateral meristem:
- Found along the lateral sides of roots and stems.
- Responsible for the growth in thickness of the plant body.
Example: cambium and cork cambium.