

## Chapter 4

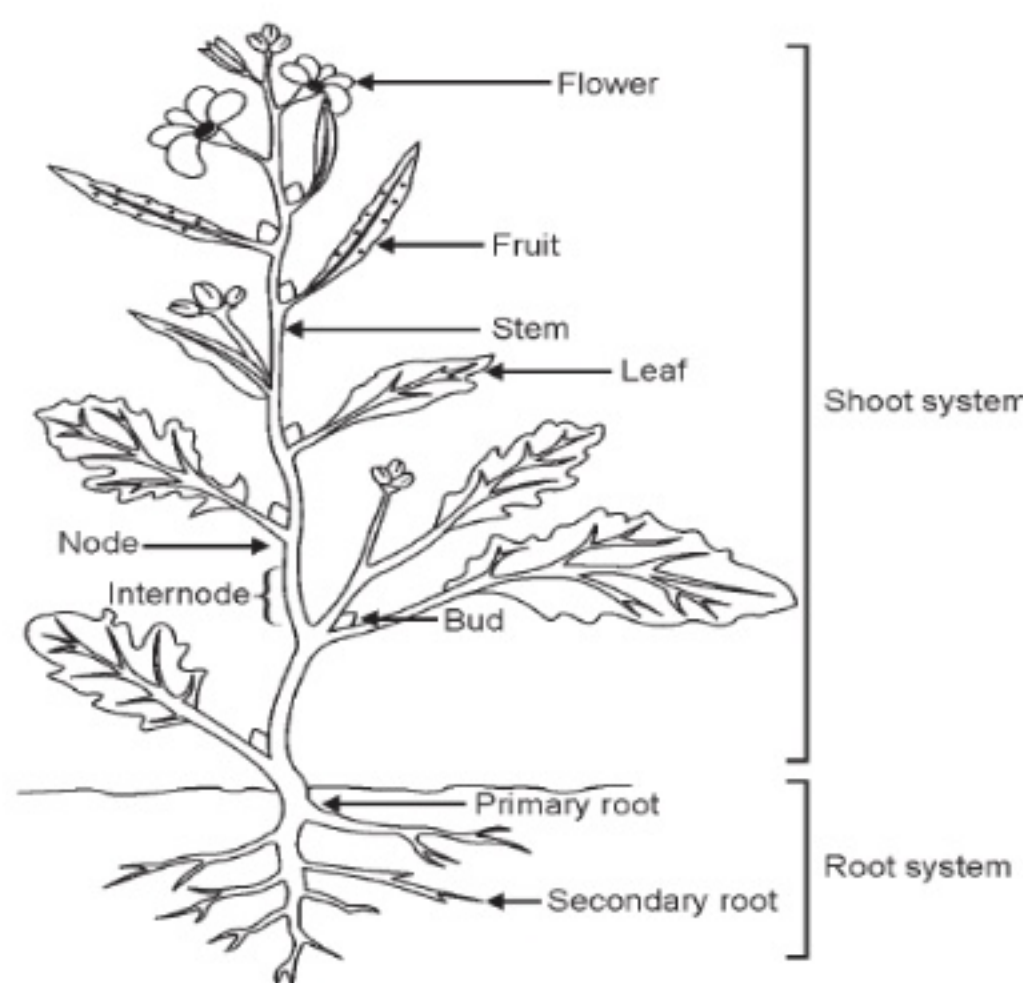
# Morphology of Flowering Plants

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### Introduction

You know that flowering plants are multicellular organisms. They grow by cell division and their morphological features and traits are genetically determined. Even though the angiosperms show such a large diversity in external structure, they are all characterised by presence of roots, stems, leaves, flowers and fruits. Morphology deals with the study of forms and features of different plant organs like roots, stem, leaves, flowers, seeds, fruits etc. Morphology plays a key role in the classification of angiosperms. In this unit, you will learn about the important morphological features of the flowering plants. We shall learn how to describe a flowering plant, using examples from selected families. You will also learn how different parts of plants are modified to serve specific needs including defence from their enemies. You will get some idea of the economic importance of selected plant families.



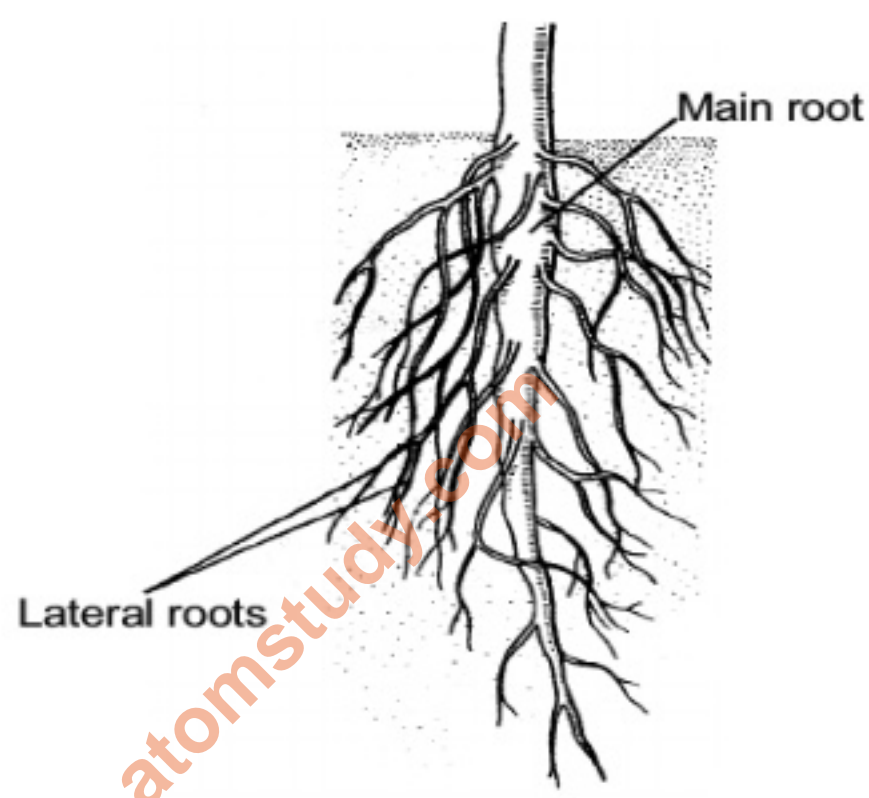
**Fig. : Parts of a Flowering Plant**

## THE ROOT

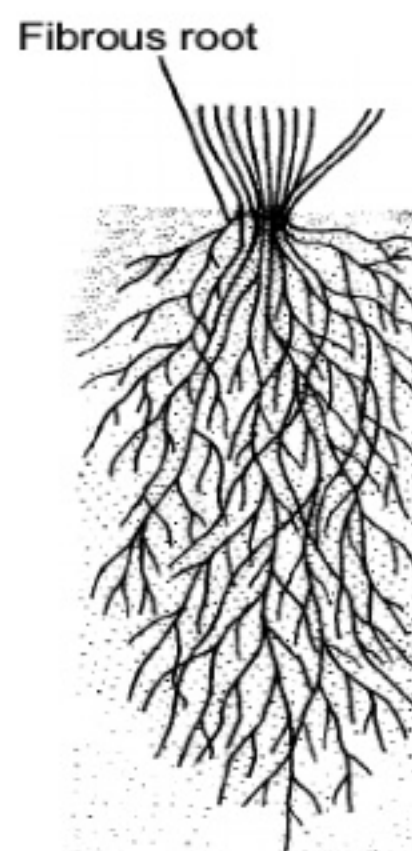
Roots are cylindrical, underground and non-green part of the plant. It is generally the descending portion of the plant axis *i.e.*, it grows downward into the soil. It lacks nodes, leaves, buds but gives rise to endogenous lateral branches. Roots move in the direction of gravity (geotropism) and against the direction of light (phototropism). Hence, the roots are said to be positively geotropic and negatively phototropic.

Plants have well developed root systems. The main root and its lateral branches form the **root system**. There are three types of root system.

- (i) **Tap root system** : The **primary root** is directly elongated from the radicle and grows inside the soil (*e.g.* dicots). It bears lateral roots of several orders that are referred to as secondary, tertiary roots etc. The primary roots and its branches constitute the tap root system.



- (ii) **Fibrous root system** : In monocotyledonous plants, the primary root is short-lived and is generally replaced by a number of fine fibrous roots. These roots originate from base of the stem and constitute the fibrous root system as seen in wheat plant.





- (iii) **Adventitious root system** : Some plants have specialised roots called adventitious roots. These roots develop from any parts of the plant other than the radicle e.g., Grass, *Monstera*, Banyan tree.



Adventitious root of sweet potato

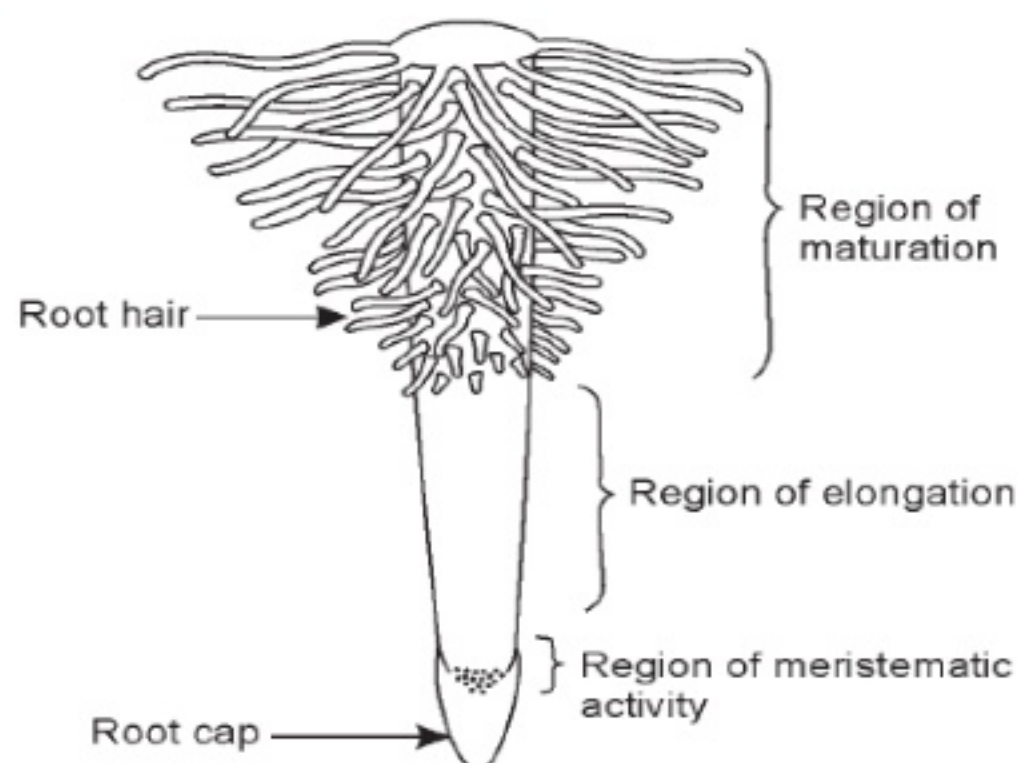
### Main Functions of Root

- I. Absorption of water and minerals from the soil.
- II. Provide anchorage to the plant parts.
- III. Storage of reserve food material.
- IV. Synthesis of plant growth regulators.

### Regions of the Root

- (i) **Root cap** : The apex of the root is covered by a thimble-like, structure called **root cap**. It is multicellular and is made up of parenchymatous cells. It protects the tender apex of the root as it makes its way through the soil.
- (ii) **Region of meristematic activity** : This layer is few millimetre above the root cap. The cells of this layer are thin-walled, small, with dense protoplasm. They divide repeatedly to produce new cells.
- (iii) **Region of elongation** : The cells proximal to the meristematic region undergo rapid elongation and enlargement and are responsible for the growth of roots in length.
- (iv) **Region of maturation** : The cells elongation zone gradually differentiate and mature. Hence, this zone proximal to region of elongation, is called the **region of maturation**.

Some epidermal cells from the region of maturation form very fine and delicate thread-like structures called **root hair**. The root hair increases the surface area for absorption of water and minerals from the soil.



**Fig. :** The regions of the root-tip



## Modifications of Root

The roots are mainly involved in absorption of water and minerals from the soil.

Roots in some plants undergo modifications in their shape and structure in order to perform functions like respiration, storage and protection.

- (i) **Storage roots** : In some plants the primary tap root is modified to store food and assumes various shapes. e.g., tap root of carrot, turnip, radish, beet and adventitious roots of sweet potato get swollen and store food.

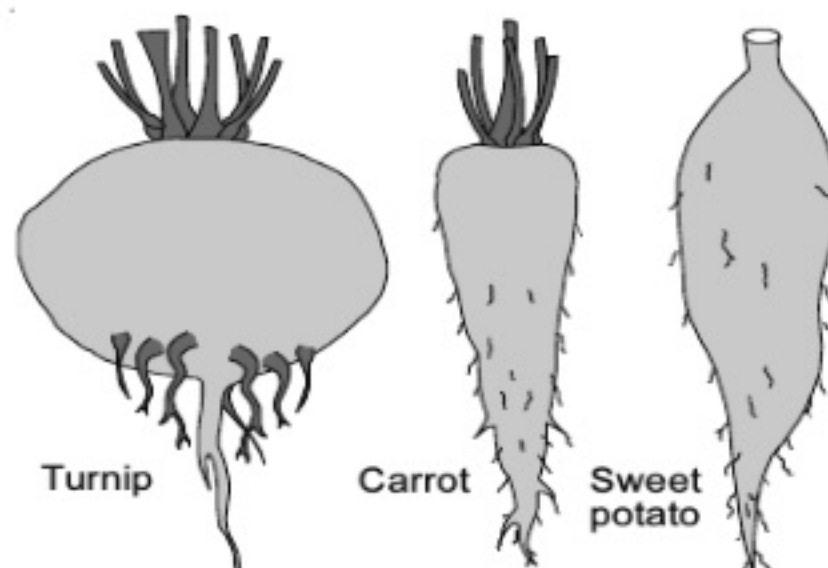


Fig. : Modification of root for storage

- (ii) **Respiratory roots** : In some plants such as *Rhizophora* growing in swampy areas, many roots come out of the ground vertically upwards to get oxygen for respiration. Such roots are called **pneumatophores**.

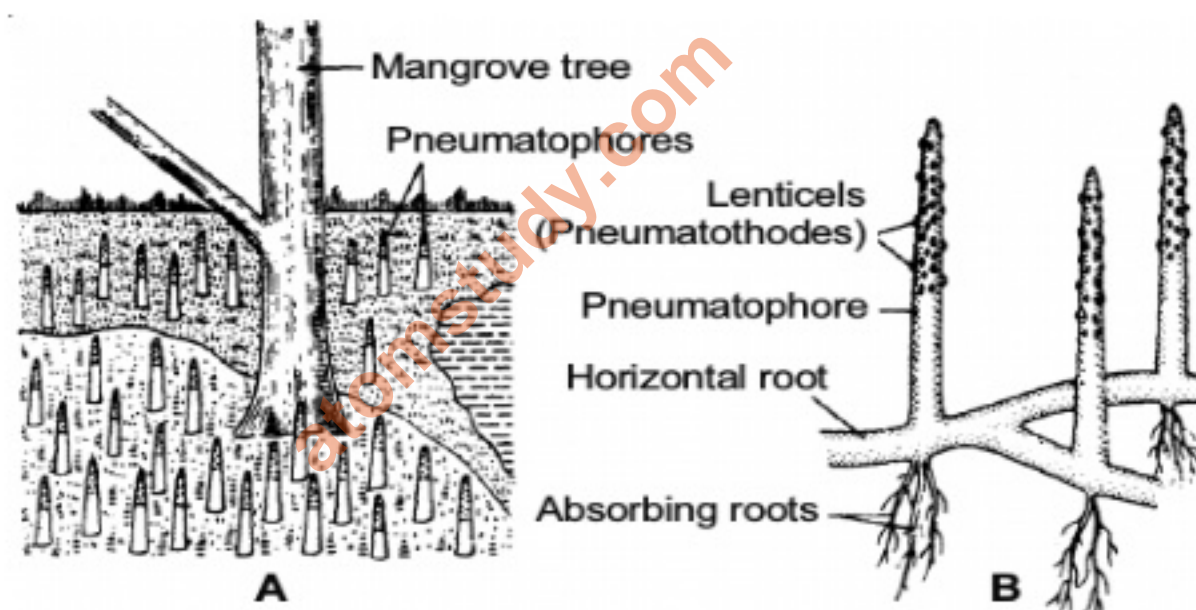


Fig. : Pneumatophores or respiratory roots : A - Mangrove tree with pneumatophores, B - Pneumatophores with lenticels

- (iii) **Prop roots** : They arise from the branches of stem for providing mechanical support to heavy branches, as pillars e.g., banyan tree.



Fig. : Prop or pillar roots of *Ficus benghalensis* (banyan tree)



- (iv) **Stilt roots** : They arise from lower nodes of stem to support main axis and enter the soil obliquely e.g., sugarcane, maize.

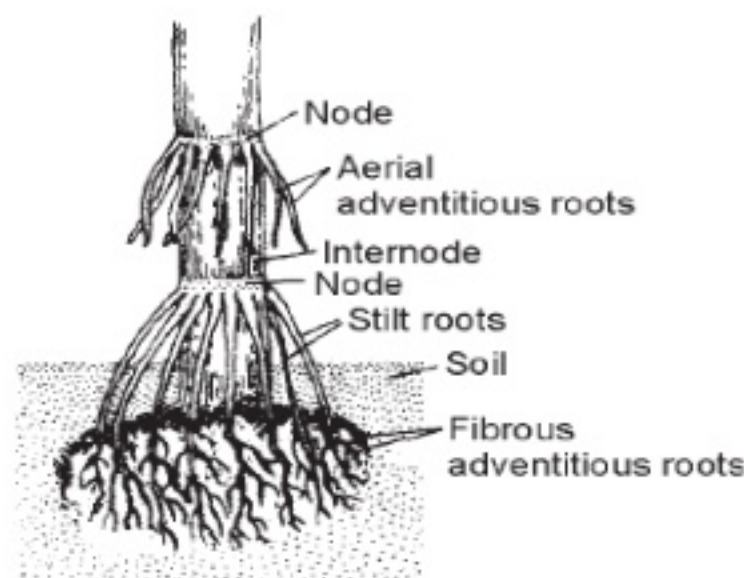


Fig. : Stilt roots of Maize

### Knowledge Cloud

#### Adventitious root with special functions :

- (i) **Floating roots.** In aquatic plants (e.g., *Jussiaea*) white spongy roots arise from branches and help in floating and respiration.

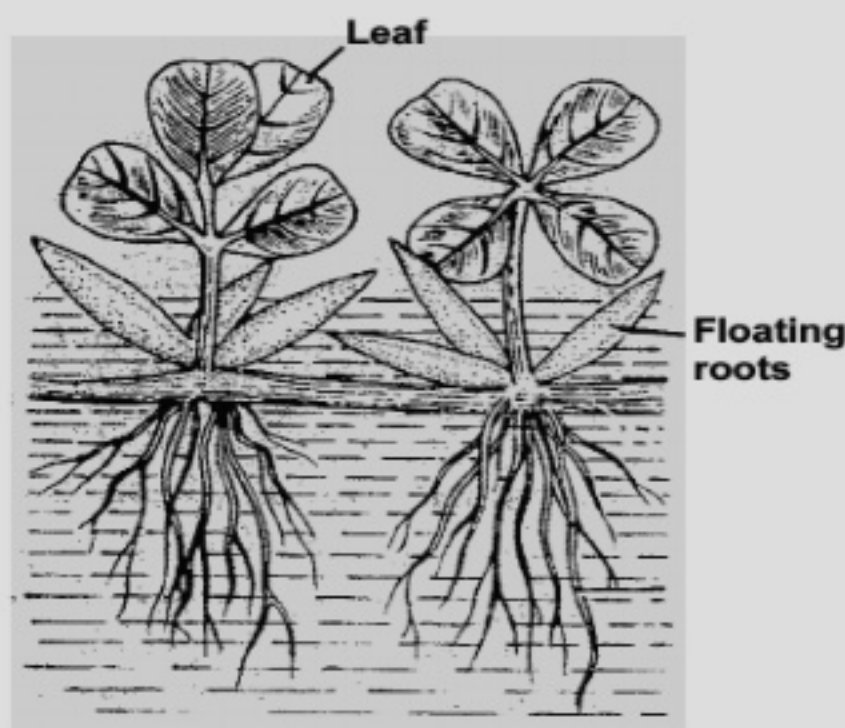


Fig. : Floating roots of *Jussiaea*

- (ii) **Assimilatory roots.** The aerial roots of *Tinospora* and submerged roots of *Trapa* (Water chestnut) become green and synthesize food. *Podostemon* also has green assimilatory roots.
- (iii) **Sucking or haustorial roots.** These roots suck food and water from host and are found in parasitic plants e.g., *Cuscuta*, *Orobanche*, *Viscum*.
- (iv) **Hygroscopic roots.** These are found in epiphytes, specifically orchids and help in absorption of moisture from the atmosphere using special tissue called **velamen**.

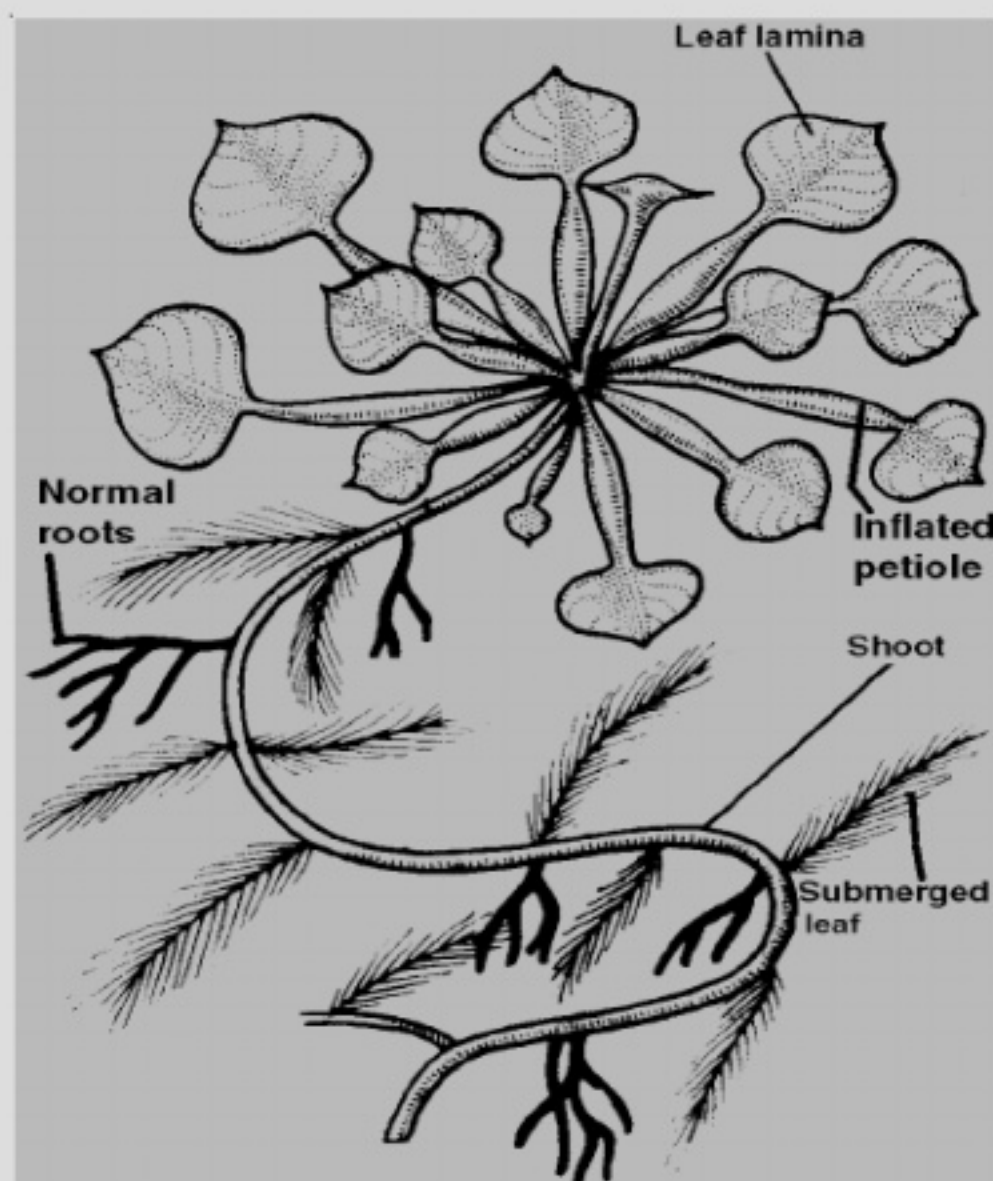
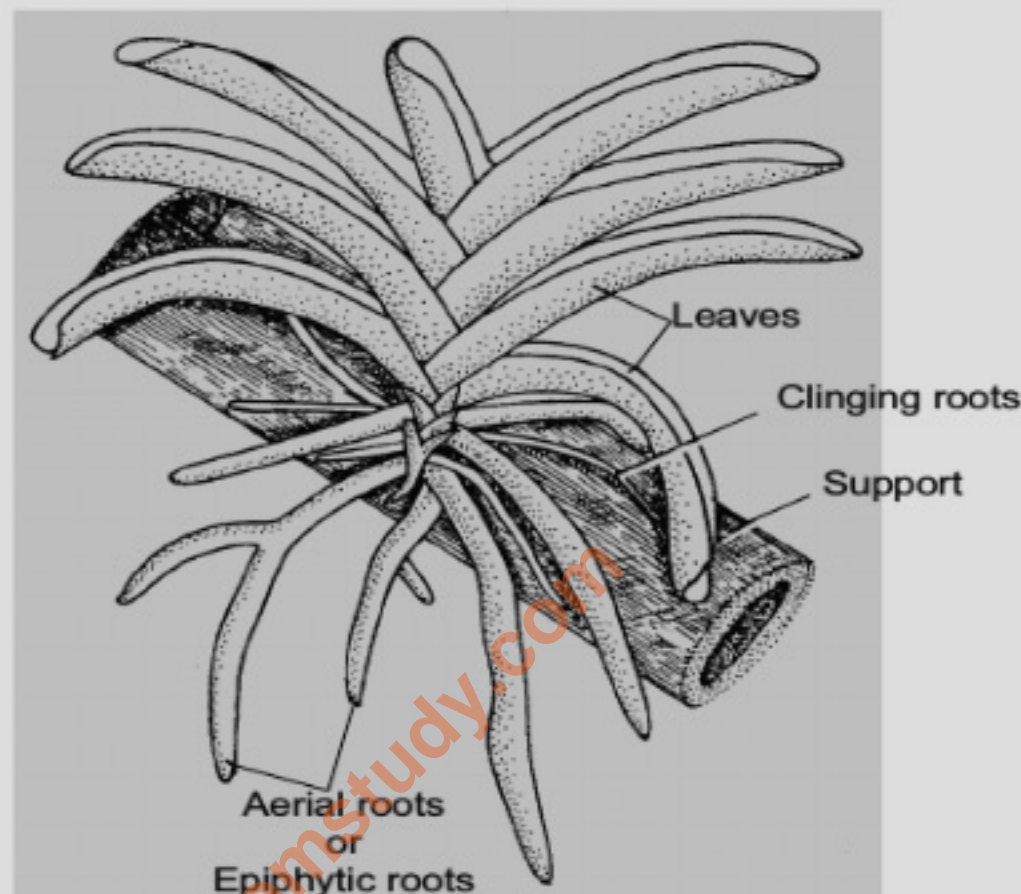


Fig. : Assimilatory roots of *Trapa*



- (v) **Contractile roots** – They shrink 60 – 70% of the original length and bring underground organs at proper depth in the soil *e.g.*, corm of *Crocus* (saffron), *Freesia*.
- (vi) **Root thorns** – These are hard, thick and pointed thorns *e.g.*, *Pothos armatus* and *Acanthorhiza*.
- (vii) **Clinging roots** – These are non absorptive adventitious roots arising either from nodes (*e.g.*, *Tecoma*, betel), internodes (*Ficus pumila*) or both (*e.g.*, juvenile stage of *Ivy*).
- (viii) **Reproductive roots** - These are fleshy, adventitious roots used for vegetative reproduction *e.g.*, sweet potato (*Ipomoea batatas*), *Dahlia*.
- (ix) **Leaf roots** – In *Salvinia*, one leaf of each node modifies into root like structure for balancing the plant in water.
- (x) **Epiphyllous roots** – These roots arise from the margins of leaf lamina for vegetative reproduction *e.g.*, *Bryophyllum*.



**Fig. : Modification of adventitious root : Epiphytic roots of *Vanda* (an orchid)**

**Example 1 :** Name the different parts of a typical root.

**Solution :** Different parts of a typical root are :

- (i) Root cap
- (ii) Region of meristematic activity
- (iii) Region of elongation
- (iv) Region of maturation



### Try Yourself

1. Which of the following is not a part of root system?
 

(1) Root cap	(2) Node
(3) Root hair	(4) Meristematic zone
2. Which of the following is an incorrect statement?
 

(1) Roots are positively geotropic	(2) Roots are always positively phototropic
(3) Roots are negatively phototropic	(4) Both (1) & (2)



**Example 2 :** *What is fibrous root?*

**Solution :** The root which is originated from the base of the stem. *e.g.*, wheat.



### Try Yourself

3. The radicle elongates and forms \_\_\_\_\_.
  - (1) Primary root
  - (2) Secondary root
  - (3) Rootlets
  - (4) Tertiary root
4. Monocotyledon plants generally contain \_\_\_\_\_.
  - (1) Tap root system
  - (2) Naked seeds
  - (3) Fibrous root system
  - (4) Archegonia

**Example 3 :** *What are pneumatophores?*

**Solution :** In some plants growing in swampy areas, roots grow vertically upward to absorb  $O_2$  from the atmosphere are called pneumatophores.



### Try Yourself

5. Which of the following is not a storage root?
  - (1) Tap root of carrot
  - (2) Tap root of turnip
  - (3) Adventitious root of sweet potato
  - (4) Roots of banyan tree
6. Which of the following is not the main function of a root?
  - (1) Respiration
  - (2) Anchorage
  - (3) Synthesis of plant growth regulators
  - (4) Absorption of water and minerals

**Example 4 :** *What are root hairs?*

**Solution :** Some epidermal cells from the region of maturation form very fine and delicate thread-like structures called the root hairs. The root hair increases the surface area for absorption of water and minerals.



### Try Yourself

7. The region of root responsible for growth of root in length is
  - (1) Region of maturation
  - (2) Root cap
  - (3) Meristematic zone
  - (4) Zone of elongation
8. The apex of root is protected by the
  - (1) Root hair
  - (2) Root cap
  - (3) Meristematic cells
  - (4) Cells present in the region of maturation



## THE STEM

The ascending part of the plant axis which bears branches, leaves, flowers and fruits is called **stem**. It generally grows above the ground and hence is considered as the aerial part of the plant. The plumule of the embryo, present in the germinating seed gives rise to the stem.

The stem is generally green in colour at the initial young stage but later it becomes woody and dark brown. It is differentiated into nodes and internodes. The region bearing leaves, present at regular intervals on the stem and its branches are called **nodes** and the part of stem present between the two nodes is called **internode**. The stem bears buds which may be terminal or axillary. A **bud** is defined as the young, immature, under developed, compact shoot. The buds present on the stem are of two types namely :

- (i) **Terminal bud** : The bud present at the tip of the stem is called **terminal bud**. The growth of the stem and its branches is accomplished through the terminal bud. The terminal bud is also called apical bud.
- (ii) **Axillary bud** : The leaf makes an angle with the upper part of the stem. The angle made between the leaves and the upper part of the stem is called the axil. The bud which is present at the axil is called **axillary bud**.

### Functions of the Stem

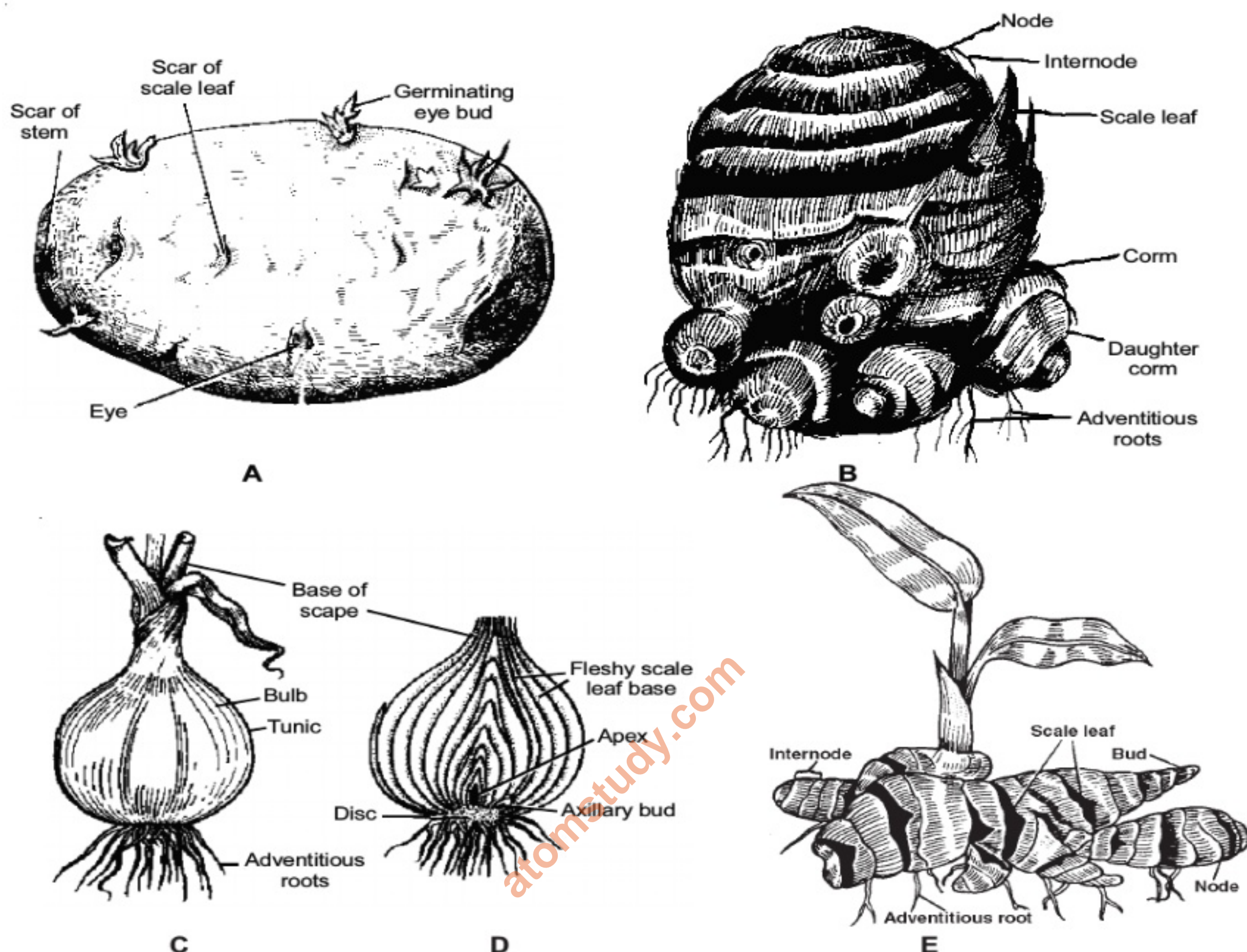
1. Stem bears and supports leaves, flowers and fruits.
2. It conducts water and minerals salts from roots to leaves and fruits.
3. The food manufactured in the leaves is transported to the roots, fruits and organs of storage through the stem.

### Modifications of Stem

The stem of some plants is modified to perform different functions in order to help plants to adapt to the present environmental conditions. Some of the modification occurring in plants are :

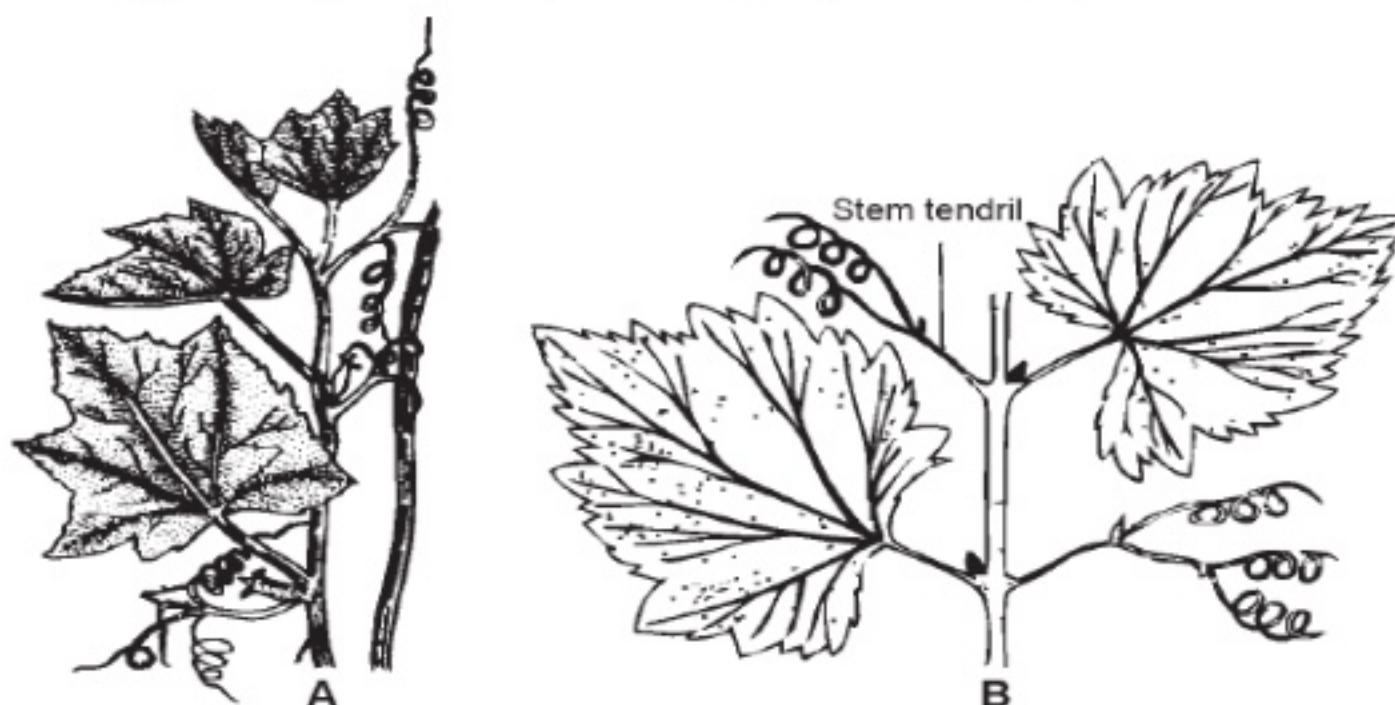
- (i) **Underground stem** : Stem is generally the aerial part of the plant *i.e.*, it is present above the ground but in some plants it is modified for storing food materials, where it forms underground stem which penetrates the soil and lies below it *e.g.*, underground stem of potato, ginger etc. store food material. They also act as organs of perennation to tide over conditions unfavourable for growth.
  - (a) **Rhizome** : It grows parallel or horizontal to soil surface. It bears nodes, internodes, buds and scaly leaves *e.g.*, Ginger, Banana, Turmeric, Ferns. It is of two types :
    - (i) **Rootstocks** : It is upright or oblique with the tip almost reaching the soil surface *e.g.*, *Dryopteris*.
    - (ii) **Straggling** : It is horizontal and branched. Branching may be:
      - Racemose** - Axis is monopodial, *e.g.*, *Saccharum*, Lotus.
      - Uniparous cymose** - Axis is sympodial, *e.g.*, *Zingiber officinale* (ginger), *Curcuma domestica* (turmeric) and *Canna*.
  - (b) **Tuber**. It is terminal portion of underground stem branch which is swollen on account of accumulation of food, *e.g.*, Potato, *Helianthus tuberosus* (Jerusalem artichoke).
  - (c) **Corm**. It grows vertically beneath soil surface. It is usually unbranched. It bears nodes, internodes, buds and scale leaves, *e.g.*, *Colocasia*, *Gladiolus*, *Colchicum*, *Crocus*, *Amorphophallus* (Zaminkand).
  - (d) **Bulb**. Stem is reduced and disc shaped. The bud is surrounded by many concentric scale leaves. Leaf bases of inner ones are fleshy and edible and of outer ones are dry, *e.g.*, onion, lily, garlic. It is of two types— tunicated and scaly. Tunicated bulb is covered by a sheath of membranous scales called **tunic**. It may be **simple tunicated bulb**— covered by a sheath, *e.g.*, onion and *Narcissus* or **compound tunicated bulb**—concentric rings of bulblets surrounded by a white membranous sheath or tunic *e.g.* garlic. **Scaly** or **naked** bulbs do not have tunic, *e.g.*, lily.





**Fig. : Underground modifications of stem: A. Tuber of potato; B. Corm of *Colocasia* C, D. Tunicated bulbs of onion (C, entire; D, longitudinally cut) E. Rhizome of ginger**

- (ii) **Stem tendrils** : In some plants the axillary buds present on the stem modify to form **tendrils**. Tendrils are long, thin, thread-like spirally coiled, sensitive structures. They are the climbing organs of the plant which coil around the nearby support. They provide support to the weak and tender stem e.g., tendrils are present in grape vine, gourds (pumpkins, watermelon, cucumber).



**Fig. : Stem tendrils : A - Cucurbits, B - Grape vine**





### Knowledge Cloud

Tendrils are formed as modifications of :

- **Entire leaf** – Leaf tendril e.g., *Lathyrus sativus*.
- **Leaflet** – Leaflet tendril e.g., *Pisum*.
- **Petiole** – Petiolar tendril e.g., *Clematis*, *Nepenthes*.
- **Stipule** – Stipular tendril e.g., *Smilax*.
- **Leaf apex** – Leaf apex or tip tendril e.g., *Gloriosa*.
- **Inflorescence** – Inflorescence tendril e.g., *Antigonon*.
- **Stem** – Stem tendril e.g., *Vitis* (modified apical bud), *Passiflora* (modified axillary bud), cucumber, pumpkins, watermelon.

(iii) **Thorn** : The axillary buds of plants like *Citrus* and *Bougainvillea* lose their ability to grow and form hard, **woody** and pointed structures called **thorns**. These thorns protect the plants from browsing animals. Thus, these thorns are protective in function.

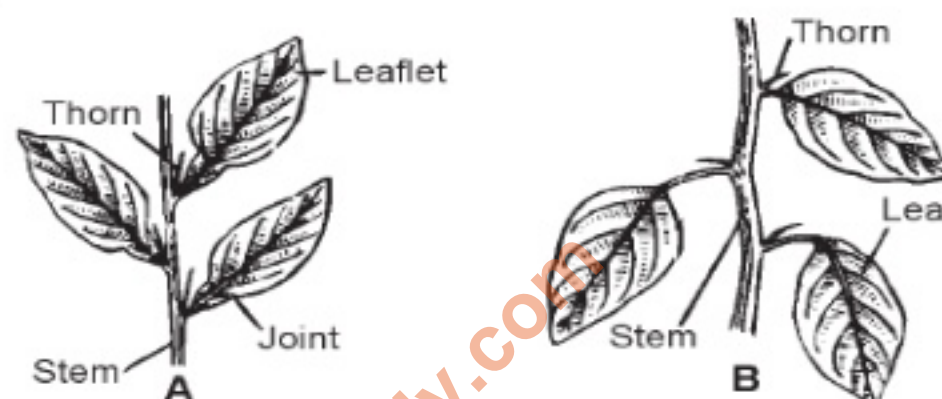


Fig. : Stem Thorns : A - *Citrus*, B - *Bougainvillea*

(iv) **Sub-aerial Weak Stem**

(a) **Offsets** : Aquatic plants such as *Pistia* and *Eichhornia* contain a lateral branch which bear short internodes. In these lateral branches the distance between the two nodes decreases and each node bears a rosette of leaves above and a cluster (tuft) of roots below.

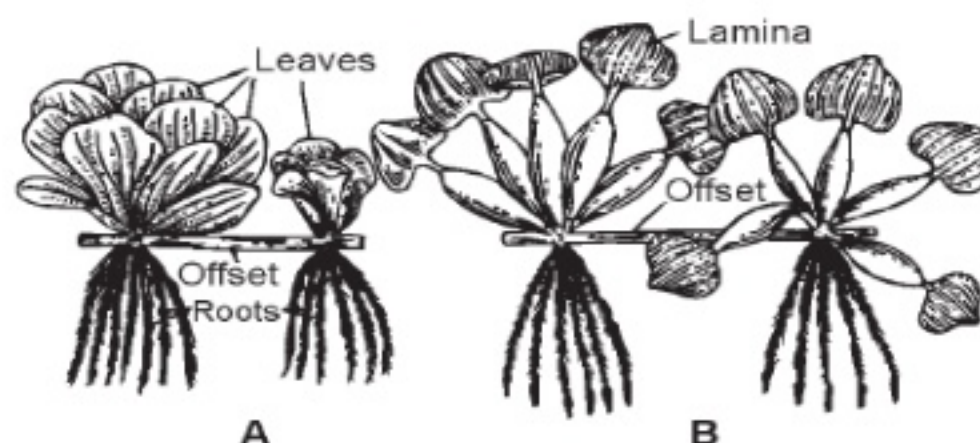


Fig. : Offsets : A - *Pistia*, B - *Eichhornia*

(b) **Suckers** : In plants like banana, pineapple, *Chrysanthemum*, the lateral branches originate from the basal and underground portion of the main stem. They grow below the surface of the soil to some distance and then emerges out obliquely to form the aerial shoot.

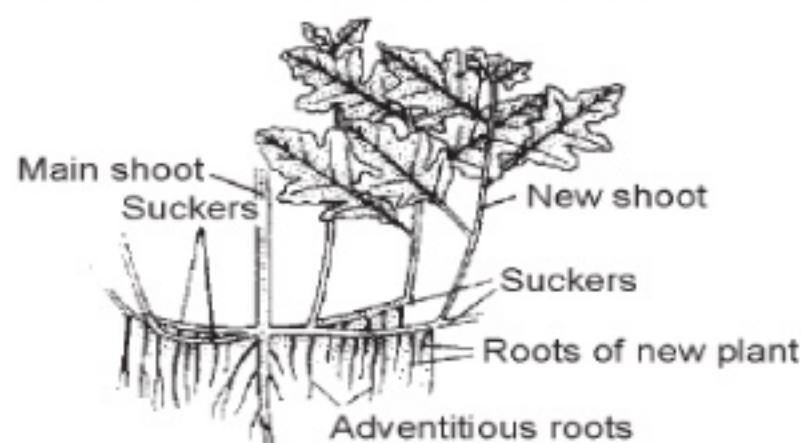
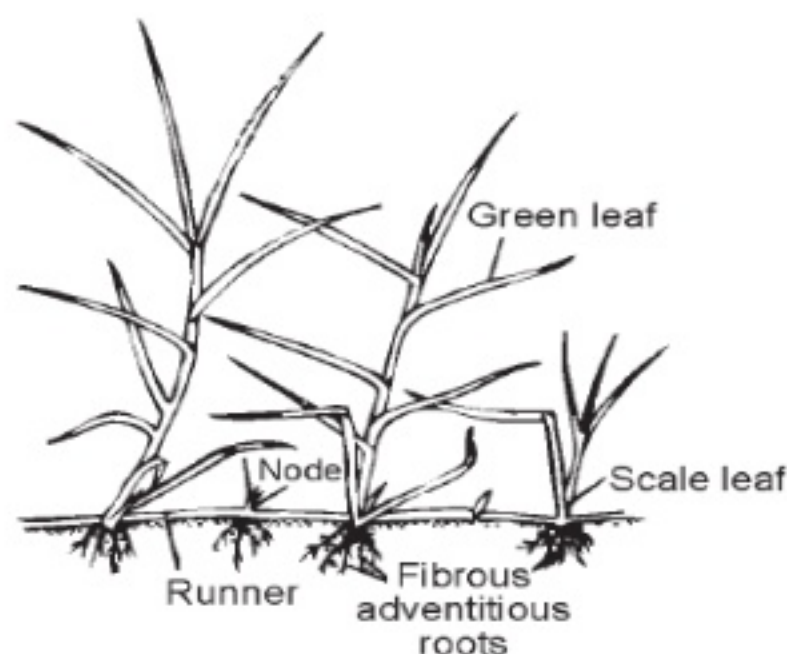


Fig. : Suckers of *Chrysanthemum*



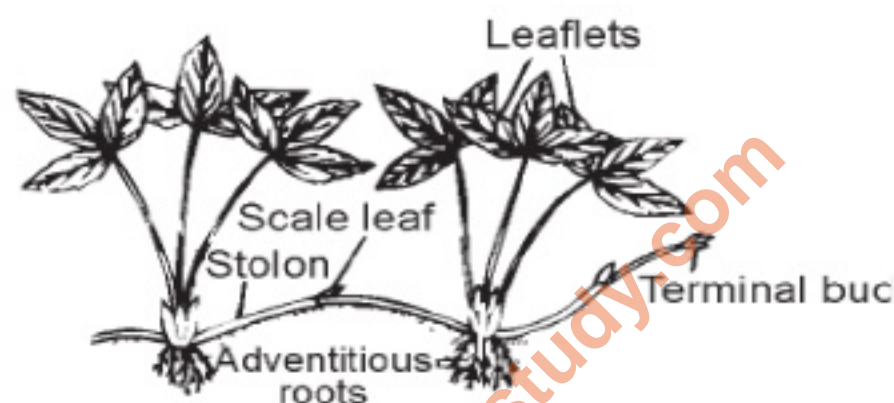
- (c) **Runners** : It is elongated, prostrate branch with long internodes and roots at nodes. *e.g.*, grasses.



**Fig. : Runners: Grass**

- (d) **Stolons** : In plants like mint and jasmine a slender lateral branch arises from the base of the main axis and after growing aurally for some time arch downwards to touch the ground.

Example - Jasmine, Mint.



**Fig. : Stolon**

- (v) **Aerial stem** : Plants present in arid regions modify their stem into flattened (*Opuntia*) or fleshy cylindrical structures (*Euphorbia*), called **phylloclade**. These structures are green in colour due to the presence of photosynthetic pigments. These are green stems have unlimited growth. These structures perform the function of photosynthesis.

**Example 5 :** What is a stem?

**Solution :** The ascending part of the plant axis which bears branches, leaves, flowers and fruits, is called the stem.



### Try Yourself

9. Nodes and internodes are present in the
  - (1) Leaf
  - (2) Fibrous root
  - (3) Tap root
  - (4) Stem
10. \_\_\_\_\_ are modified to form tendrils in cucumber.
  - (1) Terminal buds
  - (2) Axillary buds
  - (3) Thorns
  - (4) More than one option is correct



**EXERCISE**

1. Thick roots arising in *Ficus* to support heavy branches are called
  - (1) Stilt roots
  - (2) Prop roots
  - (3) Assimilatory roots
  - (4) Floating roots
2. In *Amorphophallus* and *Crocus* vegetative reproduction occurs by means of
  - (1) Offset
  - (2) Rhizome
  - (3) Corm
  - (4) Both (1) & (2)
3. Stem tendrils occur in
  - (1) Cucumber
  - (2) Watermelon
  - (3) Pumpkin
  - (4) All of these
4. Thorn is a stem structure because it
  - (1) Develops from stipule
  - (2) Arises from leaf directly
  - (3) Develops from axillary bud
  - (4) Is structure of defence
5. A. Cells of root meristematic zone has dense cytoplasm.  
B. *Chrysanthemum*, Pineapple and *Jasminum* are examples of sucker.  
C. A fleshy bud is called bulbil.  
D. Root cap is absent in hydrophytes.
  - (1) All are correct
  - (2) All are correct, except B
  - (3) A & B are correct
  - (4) B & C are correct
6. Reduced, discoid and underground stem is found in
  - (1) Ginger
  - (2) Turmeric
  - (3) Potato
  - (4) Onion
7. Find odd one w.r.t. plants having green succulent stem
  - (1) *Opuntia*
  - (2) *Euphorbia*
  - (3) *Citrus*
  - (4) Both (1) & (2)
8. All given modifications belong to adventitious roots, *except*
  - (1) Reproductive root of *Asparagus*
  - (2) Storage roots of sweet potato
  - (3) Conical roots of carrot
  - (4) Prop roots of banyan tree
9. Which of the following function is not performed by underground stem?
  - (1) Reproduction
  - (2) Assimilation
  - (3) Perennation
  - (4) Storage
10. Bud associated with the underground stem of potato is
  - (1) Axillary
  - (2) Apical
  - (3) Adventitious
  - (4) Internodal



## THE LEAF

A leaf is a lateral, generally flattened structure borne on the stem. It develops at the node and bears a bud in its axil. It originates from the shoot apical meristem and arranged in an acropetal order of the stem. Leaves are the most important vegetative organ for photosynthesis.

### Parts of a Leaf

A typical leaf consists of three parts :

- (i) **Leaf base** : The lowermost (basal) part of the leaf by which the leaf is attached to the node of the stem is called **leaf base**. Leaf base may bear two lateral small leaf like structures called **stipules**. In monocots, leaf base expands to form a sheath covering the stem wholly or partially. In some leguminous plants, the leaf base swells and is called **pulvinus**.
- (ii) **Petiole** : The cylindrical stalk that joins the leaf base with the leaf blade (lamina) is called **petiole**. It holds the leaf blade above the level of the stem so as to provide sufficient light to the leaf. The long, thin, cylindrical, flexible petiole allows leaf blade to flutter in wind. It thus produces a cooling effect in the leaves by bringing fresh air to the leaf surface.
- (iii) **Lamina or leaf blade** : It is green expanded part of the leaf. The leaf blade is supported by the veins and veinlets. The prominent vein present in the middle of the leaf blade is called **midrib**. The veins provide rigidity and strength to the leaf blade and also act as a channel for transport of water, minerals and food material. The shape, margin, apex, surface and extent of incision of lamina varies in different leaves.

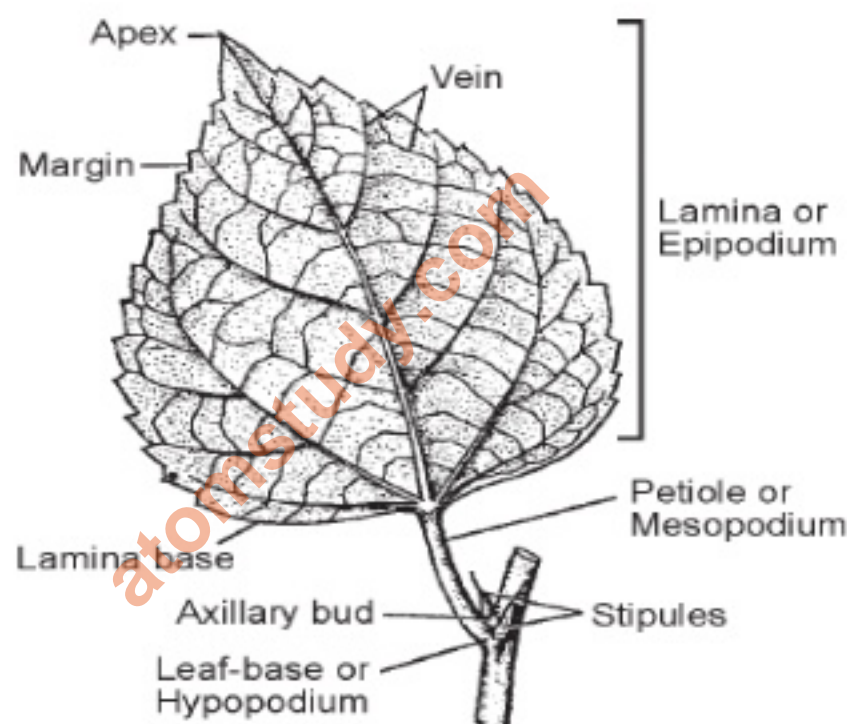


Fig. : Parts of a typical leaf

### Venation

The lamina or leaf blade contains veins and veinlets. The arrangement of veins and veinlets in the lamina or leaf blade is termed as **venation**. It gives us a pattern in which the veins and veinlets are distributed or arranged in the leaf blade. Venation can occur in two ways :

- (i) **Reticulate venation**: The veinlets form a network. It generally occurs in dicots such as peepal, *Hibiscus*, *Luffa* etc.

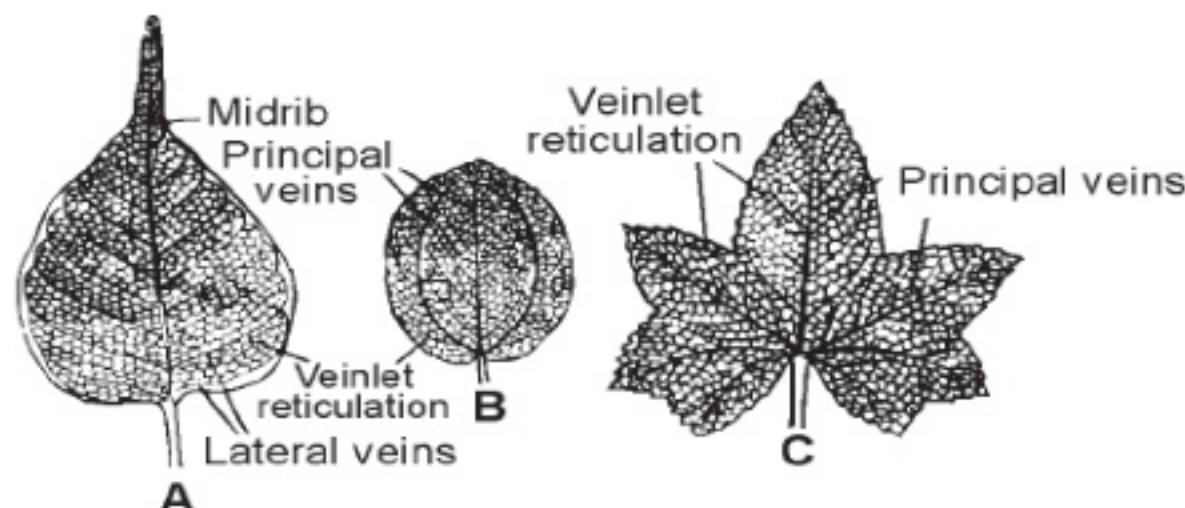


Fig. : Reticulate venation



- (ii) **Parallel venation** : The venation where the veins run parallel to each other within a lamina. It generally occurs in monocots e.g., banana.

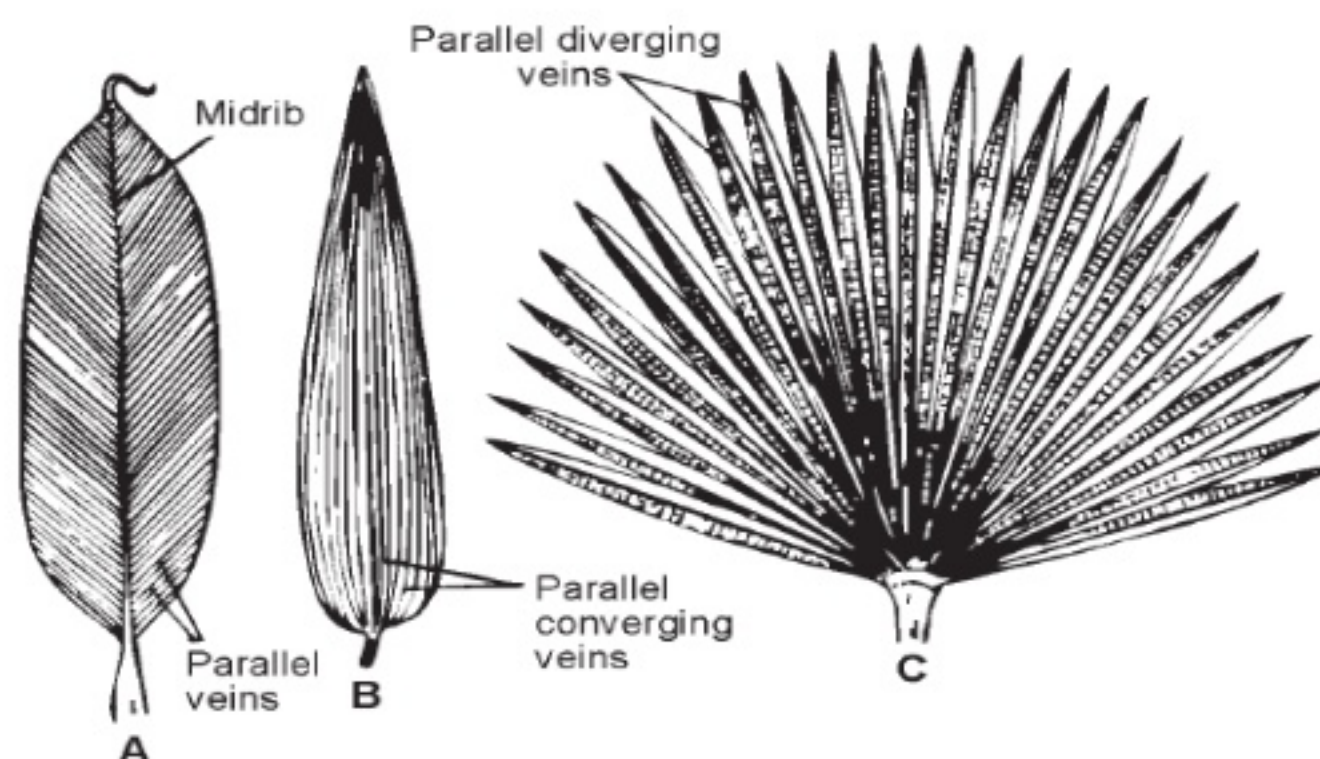


Fig. : Parallel venation

## Types of Leaves

Different types of leaves which exist in nature are :

- (I) **Simple leaf** : The leaf in which the leaf blade is not divided or when incised, the incisions do not touch the midrib. It has bud at the axil of the petiole.

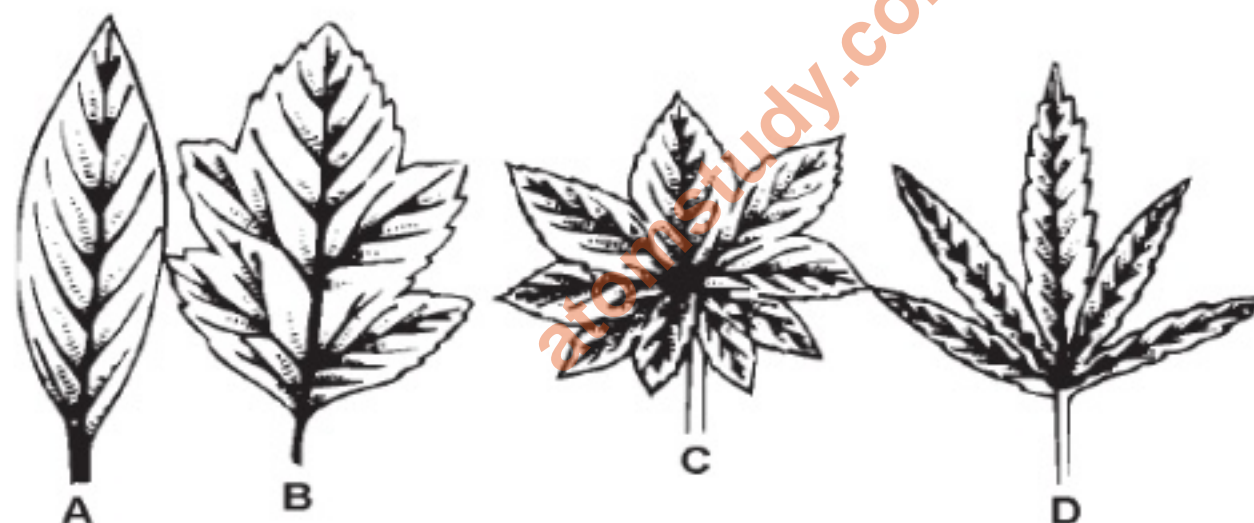


Fig. : Simple leaves (A to D)

- (II) **Compound leaf** : The leaf in which the lamina or leaf blade is completely broken into distinct leaflets is called **compound leaf**. The leaf has incisions which reach the midrib. Compound leaf contains a bud at the axil of the petiole but is absent in the axil of leaflets. The compound leaves are of two types:

- (a) **Pinnately compound leaf** : In pinnately compound leaf, the midrib forms a common axis called **rachis**. A number of leaflets are present on rachis e.g., Neem.



Fig. : Compound leaves: Pinnately compound leaf



These may be :

- (i) **Unipinnate.** Midrib of the leaf directly bears the leaflet and is now called rachis. The unipinnate compound leaf is called **paripinnate** when terminal leaflet is absent (leaflets are in even number) e.g., *Cassia*, *Tamarindus* or **imparipinnate** when terminal leaflet is present (leaflets are in odd number) e.g., *Rosa*, *Tephrosia*, *Azadirachta* (Neem).

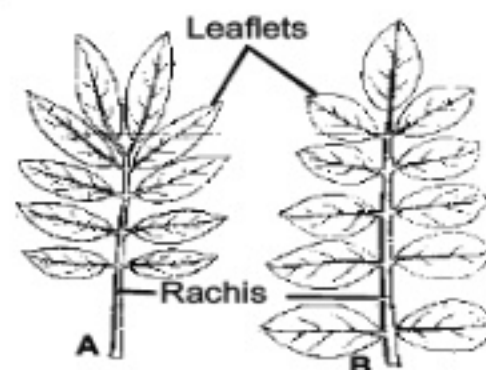


Fig. : Unipinnate Leaves : A. Paripinnate; B. Imparipinnate

- (ii) **Bipinnate.** Midrib produces secondary axis or branches which bear leaflets e.g., *Acacia*, *Mimosa*, *Delonix*.

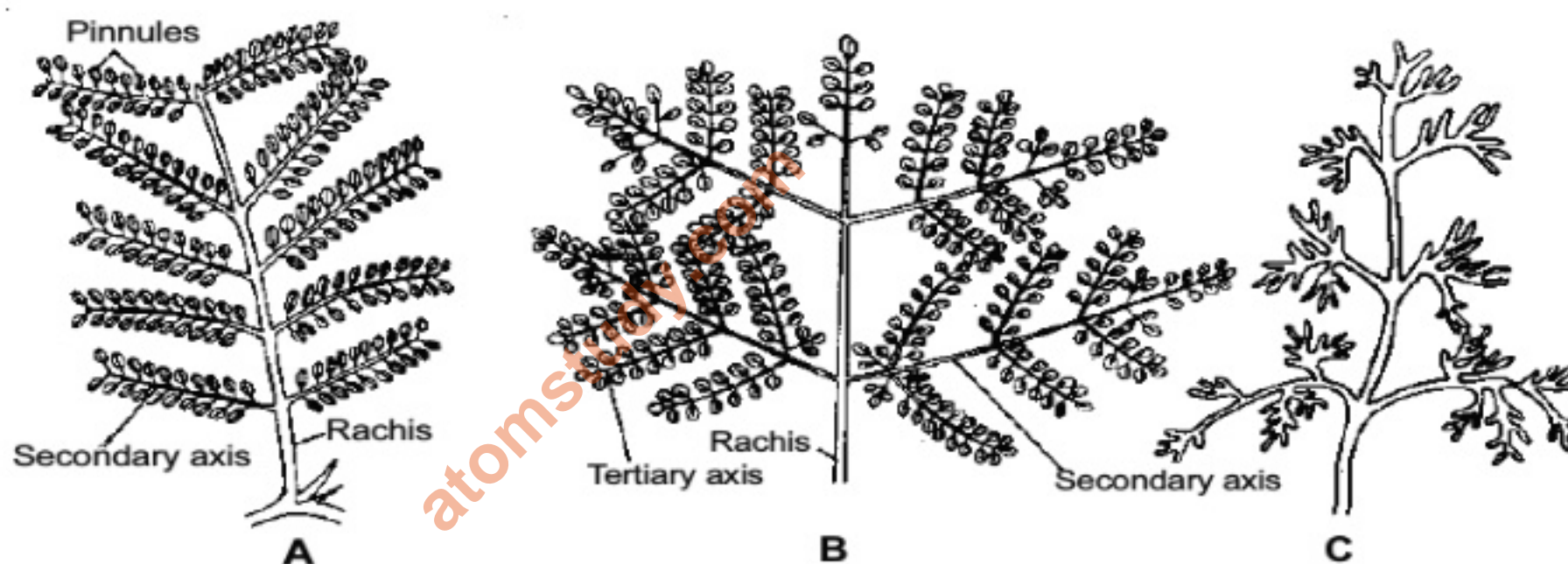


Fig. : Pinnate leaves : A. Bipinnate; B. Tripinnate; C. Decomposed

- (iii) **Tripinnate.** Secondary axis produces tertiary axis which bear leaflets e.g., *Moringa*, *Melia*.
- (iv) **Decomposed.** Rachis is divided repeatedly without any definite pattern so that the lamina is dissected into narrow segments e.g., *Carrot*, *Parthenium*, *Coriandrum*.
- (b) **Palmately compound leaf :** In palmately compound leaf, the leaflets are attached to a common point i.e., at the tip of the petiole. The tip of the petiole bears all the leaflets in a form of a bunch or cluster e.g., silk cotton.

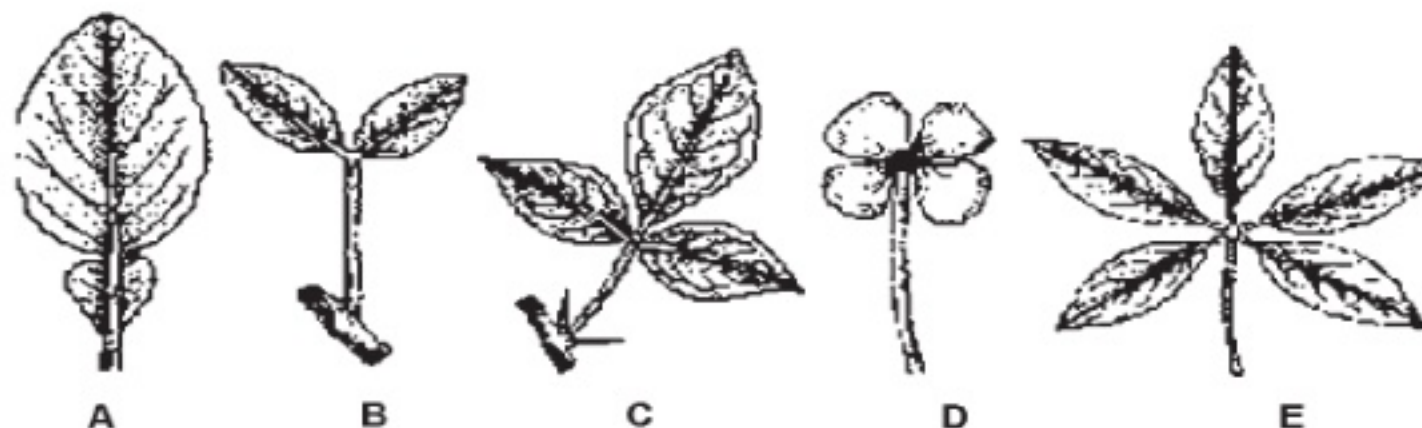


Fig. : Compound leaves : Palmately compound leaf



They may be :

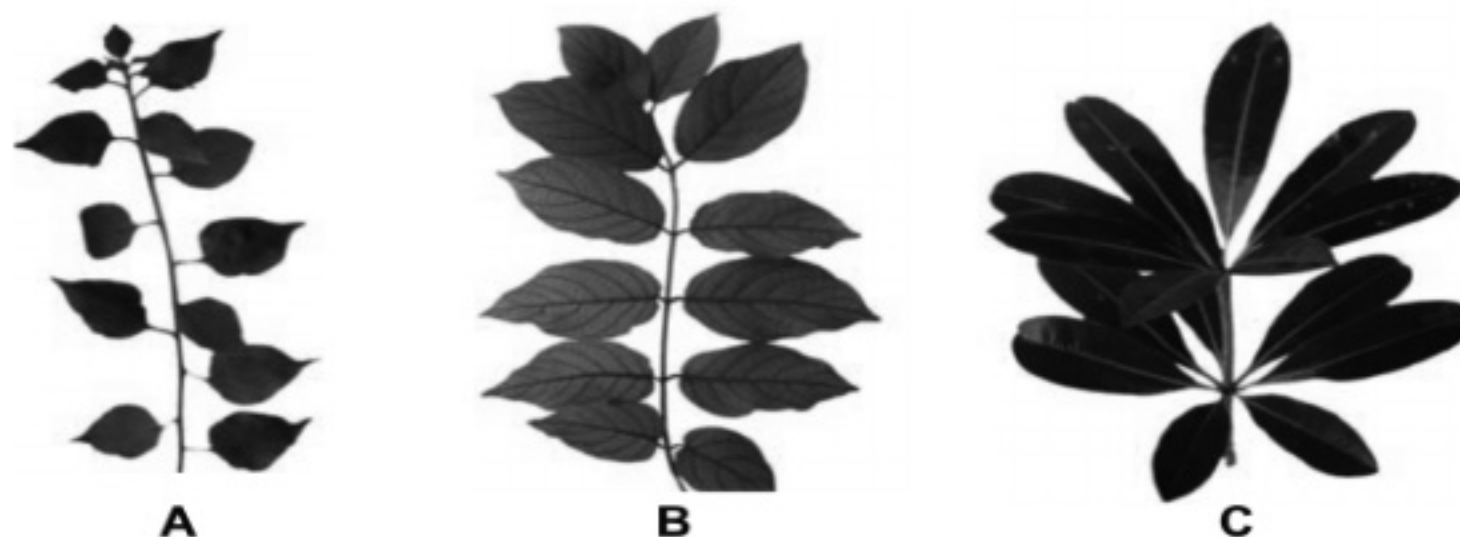
- (i) **Unifoliate** e.g., *Citrus* (lemon and orange).
- (ii) **Bifoliate** e.g., *Bignonia*.
- (iii) **Trifoliate** e.g., *Dolichos*, *Trifolium*, *Aegle*, *Butea*
- (iv) **Quadrifoliate** e.g., *Marsilea*, *Paris*
- (v) **Multifoliate** e.g., *Bombax* (silk cotton tree)



**Fig. : Palmately Compound Leaves : A. Unifoliate; B. Bifoliate; C. Trifoliate; D. Quadrifoliate; E. Multifoliate (digitate)**

**Phyllotaxy** : The pattern in which the leaves are arranged on the stem or its branches is called **phyllotaxy**. The leaves are arranged in such a way so that all of them get proper sunlight. The leaves can be arranged in three ways i.e., phyllotaxy is of three types :

- (i) **Alternate phyllotaxy** : In alternate phyllotaxy, single leaf is present at each node in an alternate fashion. e.g., china rose (shoe flower), mustard, sunflower.
- (ii) **Opposite phyllotaxy** : In opposite phyllotaxy, a pair of leaves arise at each node on opposite side. The leaves generally lie opposite to each other at each node e.g., Guava, *Calotropis*.
- (iii) **Whorled phyllotaxy** : In whorled phyllotaxy, more than two leaves arise at each node and form a whorl or a circle. The leaves of one whorl alternate the leaves of the next successive whorl so that all the leaves receive maximum sunlight e.g., *Alstonia*, *Nerium*.



**Fig. : Different types of phyllotaxy: A. Alternate, B. Opposite, C. Whorled**

### Modification of Leaves

Leaves are generally responsible for the process of photosynthesis, transpiration, gaseous exchange etc. But at some places where the conditions are unfavourable, leaves get modify and perform other functions such as storage, protection, support, defence etc. Different types of modifications that occur in leaves are :

- (i) **Leaf tendrils** : In some plants, leaves modify into long, slender, thread-like, sensitive structures called tendrils. They are sensitive to touch and therefore coil around a support to which they come in contact with and help the plant while climbing. Their main function is to provide support to the climbing plants e.g., peas, sweet pea.





Fig. : Leaflet tendrils of garden pea

- (ii) **Leaf spines** : In some plants such as *Aloe*, cactus etc. leaves modify into small, sharp-pointed structures which reduce transpiration and protect the plants from browsing animals. The sharp-pointed structures are called **leaf spines**.

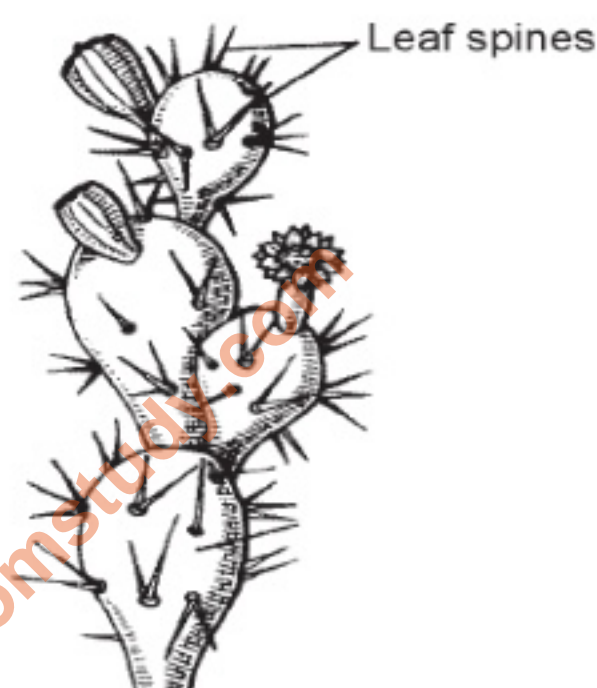


Fig. : Leaf spines : Cactus

- (iii) **Storage organ** : In some plants such as onion, garlic etc., fleshy leaves store food and hence forms the storage organ in plants.
- (iv) **Phyllodes** : In certain plants such as Australian *Acacia* the leaves are small and short lived. In these plants the petioles modify to form flat, green-coloured leaf-like structure which performs the function of photosynthesis. These are known as **phyllodes**.

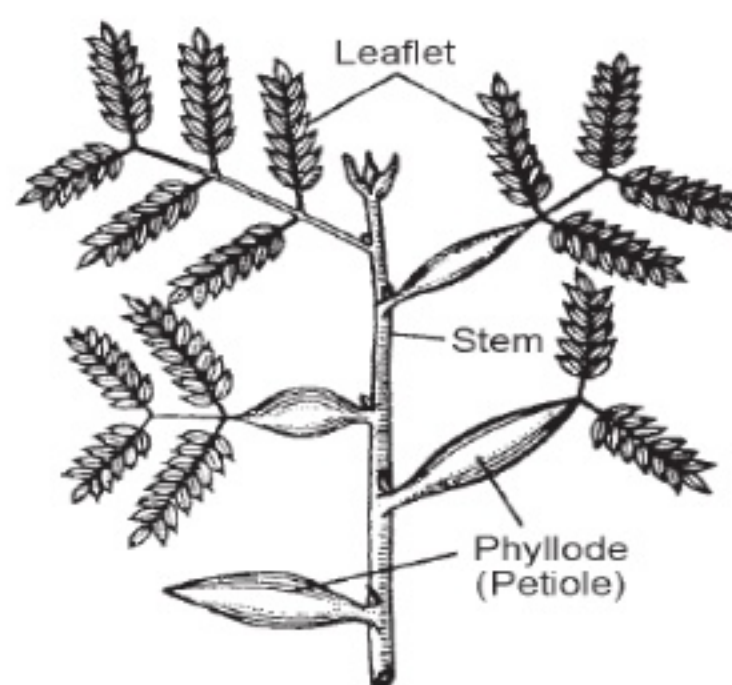


Fig. : Phyllode



- (v) Leaves of certain insectivorous plants such as pitcher plant, venus-fly trap are modified leaves. Pitcher is used to trap insects. These plants obtain nutrients by digesting the insects trapped in the pitcher.

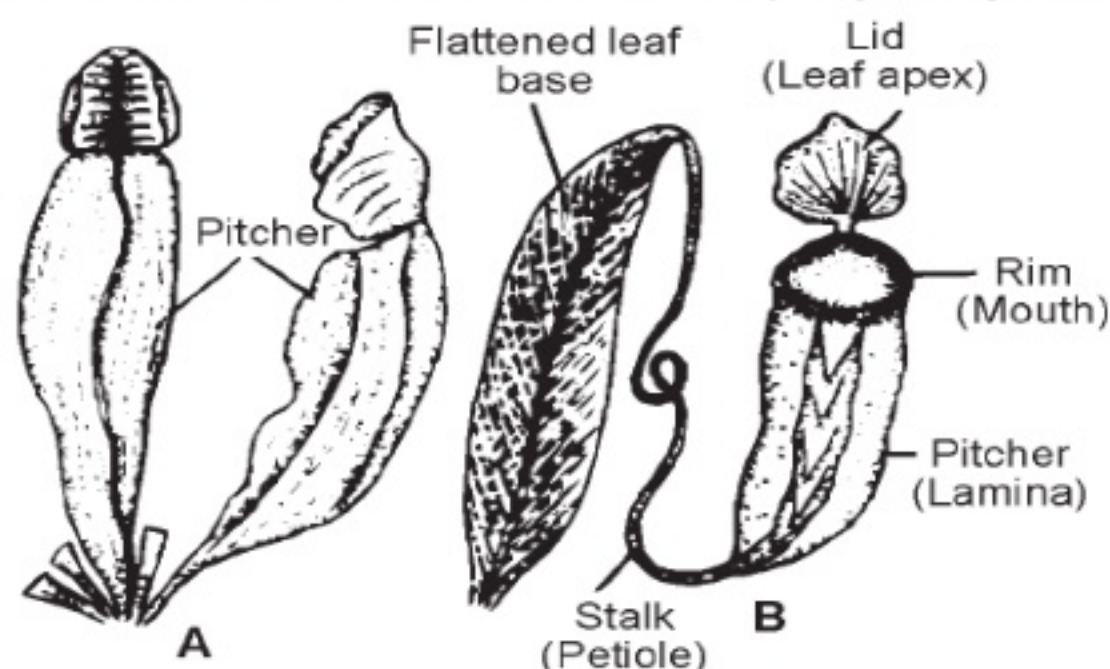


Fig. : Leaf pitchers (A : *Sarracenia*, B : *Nepenthes*)

**Example 8 :** What is a leaf?

**Solution :** A leaf is a lateral, green and generally flattened structure borne on the stem.



### Try Yourself

15. The alternate type of phyllotaxy is found in
- (1) China rose
  - (2) *Alstonia*
  - (3) *Calotropis*
  - (4) Guava
16. Phyllodes are observed in
- (1) *Pisum sativum*
  - (2) *Allium cepa*
  - (3) *Allium sativum*
  - (4) Australian *Acacia*

**Example 9 :** What is the function of petiole?

**Solution :** Petiole holds the leaf blade to light. Long thin flexible petioles allow the leaf blade to flutter in wind, thereby cooling the leaf and bringing fresh air to the leaf surface.



### Try Yourself

17. Parallel venation occurs in
- (1) Banana
  - (2) Peepal
  - (3) *Hibiscus*
  - (4) Mango
18. Incision in the leaf does not reach the midrib in
- (1) Simple leaf
  - (2) Bipinnately compound leaf
  - (3) Tripinnately compound leaf
  - (4) More than one option is correct



## THE INFLORESCENCE

The shoot modifies to form the flower *i.e.*, the flower is considered as the modified shoot. When the apical shoot meristem changes to floral meristem then the shoot bears flowers. During the formation of floral meristem the axis condenses and internodes do not elongate. The axis bears flowers at successive nodes instead of leaves.

The flowers are borne either singly or in clusters on the shoot. When the shoot tip transforms into a flower, it is always **solitary**. The arrangement of flowers on the floral axis of the plant is known as **inflorescence**.

The flowers can be arranged in different ways, depending upon whether the shoot apex continues to grow or convert into a flower. Two major types of inflorescence that can occur are :

- (i) **Racemose** : In racemose inflorescence, the shoot axis continues to grow indefinitely and the flowers are borne in an **acropetal succession** *i.e.*, younger flowers are present towards the apex and the older flowers are present at the base *e.g.*, radish, lupin, mustard.



Fig. : Racemose inflorescence

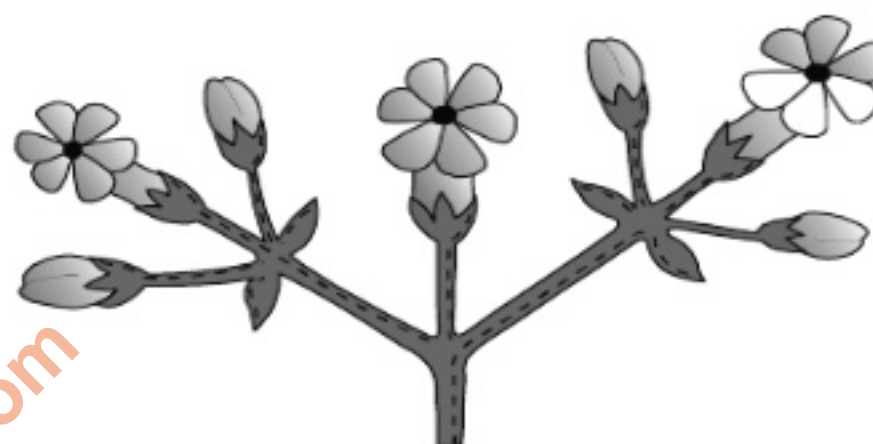


Fig. : Cymose inflorescence



### Knowledge Cloud

Racemose inflorescence is of following types :

- (a) **Raceme** : Peduncle has bisexual and pedicellate flowers arranged acropetally, *e.g.*, Larkspur, radish.
- (b) **Panicle**. Peduncle branched and branches have pedicellate flowers, *e.g.*, Gulmohur, *Rhus*.
- (c) **Spike**. Peduncle has bisexual and sessile flowers, *e.g.*, *Achyranthes*, *Adhathoda*.
- (d) **Spikelet**. It is a small, special spike. Flowers are produced in the axil of fertile bracts called **lemma**, *e.g.*, wheat, grasses (Poaceae).
- (e) **Catkin**. It is pendulous spike in leaf axis which bears unisexual flowers, *e.g.*, *Morus*, Birch, Oak, *Acalypha*.
- (f) **Spadix**. It is spike with fleshy axis and having both male and female flowers. It is surrounded by large coloured bracts called **spathe**, *e.g.*, *Musa*, Palm, *Colocasia*, *Alocasia* (**characteristically found in monocots**).
- (g) **Corymb**. The main axis is short. Lower flowers have long pedicels than upper ones so that all the flowers are brought more or less to the same level, *e.g.*, *Iberis*, *Capsella*.  
**Compound corymb**, *e.g.*, Cauliflower. **Corymbose raceme** is found in mustard.
- (h) **Umbel**. The main axis is reduced very much and all flowers appear to be arising from the same point. At the base of flowers, cluster of bracts form an involucre, *e.g.*, *Hydrocotyle*. **Scapigerous umbel** is found in onion.  
**Compound umbel** *e.g.*, Coriander.
- (i) **Capitulum** or **head**. Main axis becomes flat and called receptacle. It bears many sessile and small florets. Peripheral florets called ray florets are pistillate or neuter and zygomorphic, whereas disc florets are bisexual and actinomorphic *e.g.*, Sunflower, *Zinnia*, *Cosmos* (Asteraceae).



- (ii) **Cymose** : In cymose inflorescence, the main axis (peduncle) terminates into a flower and hence has a limited growth. In cymose inflorescence the flowers are borne in a **basipetal order**. *e.g.*, *Begonia*, *Teak*, *Bougainvillea*, *Dianthus*, *Solanum*.



### Knowledge Cloud

**Special inflorescences** : These are of following types :

- (a) **Verticillaster**. A cluster of sessile or subsessile flowers borne on a dichasial cyme ending in monochasial cyme (scorpioid) in the form of condensed whorl on either side of the node. *e.g.*, *Ocimum* (Tulsi), *Salvia* (Lamiaceae).
- (b) **Cyathium**. It looks like a single flower. A cup shaped involucre formed by bracts encloses a single female flower and a number of male flowers. Each male flower is represented by single stamen, while a single pistil represents a female flower *e.g.*, *Poinsettia* (*Euphorbia pulcherrima*), *Pedilanthus*.
- (c) **Hypanthodium**. Fleshy receptacle forming a hollow cavity with an apical opening called **ostiole**. The flowers are developed on inner wall of the hollow cavity. The male flowers are situated at the top near the opening, at the bottom are situated the female flowers with long styles and in between both are situated short styled **gall flowers** which are sterile. *e.g.*, *Ficus* (Banyan, Fig, Gular).

**Example 10** : *What is inflorescence?*

**Solution** : The arrangement of flowers on the floral axis of the plant is called inflorescence.



### Try Yourself

19. What all changes occur when shoot apical meristem converts into floral meristem?
20. Define cymose inflorescence.

### EXERCISE

11. Leaf base expands into a sheath in
- |                   |                   |
|-------------------|-------------------|
| (1) Grasses       | (2) Legumes       |
| (3) Prickly poppy | (4) <i>Mimosa</i> |
12. Select an **incorrect** match :
- |                                    |  |
|------------------------------------|--|
| (1) Unipinnate leaf - Neem         | (2) Unifoliate leaf – Silk cotton tree |
| (3) Bipinnate leaf – <i>Mimosa</i> | (4) Simple leaf – Banyan               |
13. Petiole when becomes green, flat and tends to function as leaf, is called
- |                 |              |
|-----------------|--------------|
| (1) Phylloclade | (2) Cladode  |
| (3) Cladophyll  | (4) Phyllode |
14. More than two leaves are present at each node in
- |                     |               |
|---------------------|---------------|
| (1) <i>Alstonia</i> | (2) Sunflower |
| (3) Guava           | (4) Mustard   |
15. Leaf tendril is not seen in
- |                  |                      |
|------------------|----------------------|
| (1) <i>Pisum</i> | (2) <i>Lathyrus</i>  |
| (3) Cucurbits    | (4) <i>Nepenthes</i> |



16. Pendulous spike in leaf axis that bears unisexual flowers is called  
 (1) Panicle (2) Catkin  
 (3) Spikelet (4) Raceme
17. Select an **incorrect** statement w.r.t. capitulum inflorescence of sunflower  
 (1) Main axis becomes a flat receptacle (2) Florets are sessile and many in number  
 (3) Ray florets are bisexual (4) Disc florets are actinomorphic
18. Select an **incorrect** match :  
 (1) Phyllode – *Acacia* (2) Leaf spine – Pea  
 (3) Storage leaf – Onion (4) Leaf pitcher – *Nepenthes*
19. All given statements w.r.t. cymose inflorescence are correct, *except*  
 (1) Centrifugal opening pattern of flowers (2) Unlimited growth of axis  
 (3) Main axis terminates in a flower (4) Basipetal arrangement of flowers
20. Stamens represent the male flowers and pistil represents a female flower in  
 (1) Cyathium (2) Spadix  
 (3) Verticillaster (4) Hypanthodium

## THE FLOWER

The flower is the reproductive unit in the angiosperms. It is a modified shoot, meant for sexual reproduction. It consists of four whorls which are successively arranged on the thalamus or receptacle. **Thalamus** is the swollen end of the pedicel or the stalk. The four whorls present in a flower are **calyx, corolla, androecium, gynoecium**. The calyx and corolla are non-essential, accessory organs and androecium and gynoecium are the reproductive organs of a flower. In some flowers like lily, the calyx and corolla are not distinct and are termed as perianth.

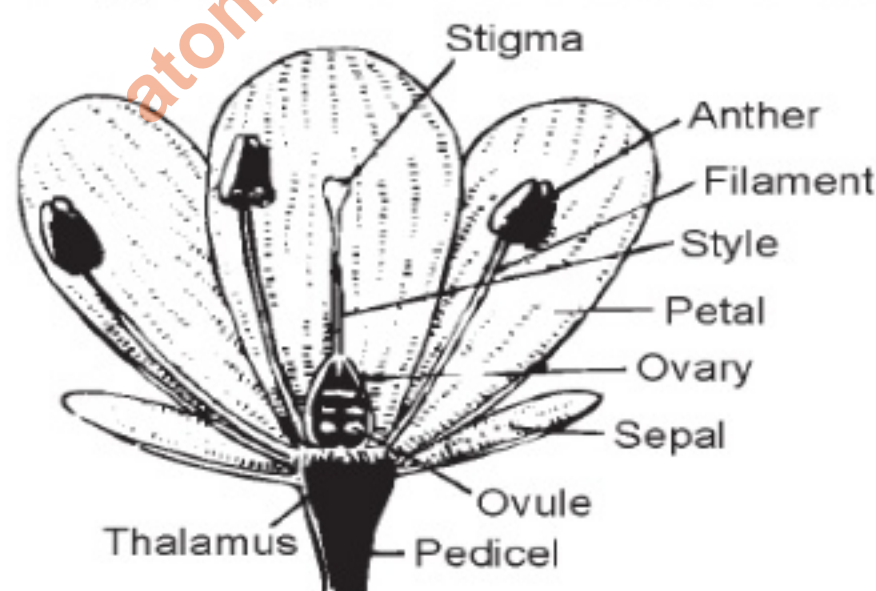


Fig. : Parts of a Typical Flower

### Terminology used w.r.t. Flower

- (i) **Bisexual flower** : When a flower has both androecium and gynoecium e.g., Pea, *Hibiscus*.
- (ii) **Unisexual flower** : A flower having either only stamens (androecium) or only carpels (gynoecium). e.g., Maize.
- (iii) **Trimerous flower** : When all the floral appendages (whorls) are in the multiples of three.
- (iv) **Tetramerous flower** : When all the floral appendages are in the multiples of four.
- (v) **Pentamerous flower** : When all the floral appendages are in the multiples of five.
- (vi) **Bracteate flower** : Flower with bracts (reduced leaf found at the base of the pedicel).
- (vii) **Ebracteate flower** : Flower without bracts.



## Symmetry of Flower

The arrangement of the floral organs around the axis of a flower is known as floral symmetry.

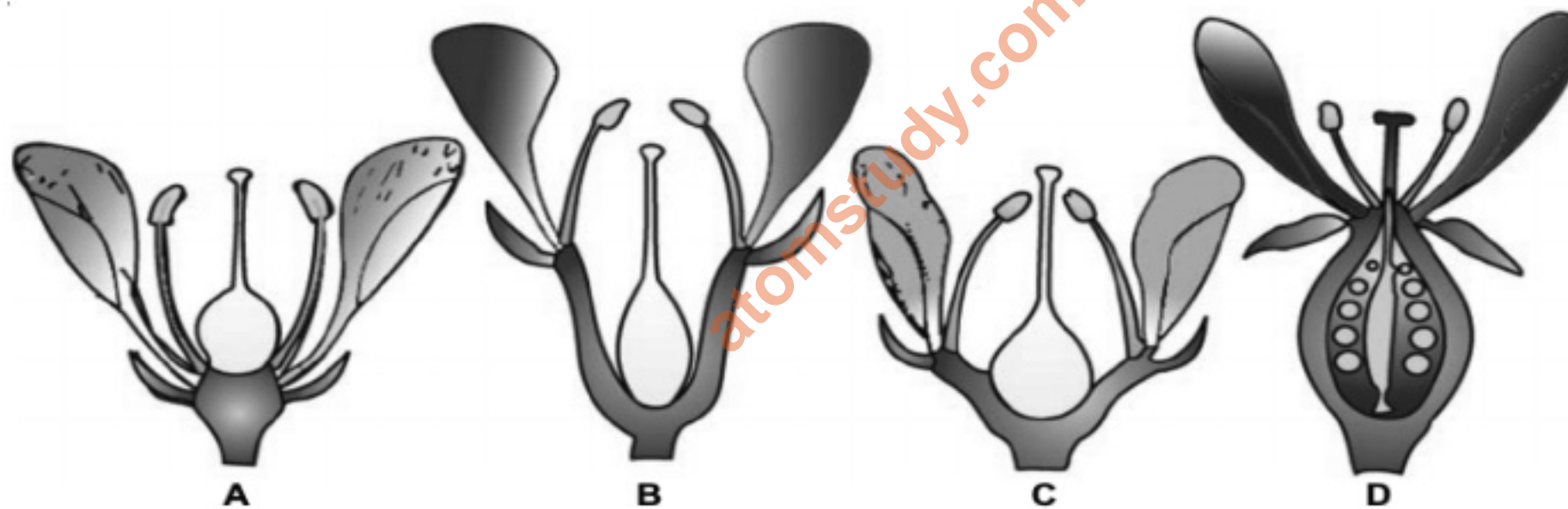
- I. **Actinomorphic flower (radial symmetry)** : When a flower can be divided into two equal radial halves in any radial plane passing through the centre e.g., mustard, *Datura*, chilli.
- II. **Zygomorphic flower (bilateral symmetry)** : When a flower can be divided into two similar halves only in one particular vertical plane e.g., pea, gulmohur, bean, *Cassia*.
- III. **Asymmetric flower (irregular)** : When a flower cannot be divided into two similar halves by any vertical plane passing through the centre e.g., canna.

## Position of Floral Parts on Thalamus

Depending upon the position of calyx, corolla, androecium in respect of the ovary on the thalamus, the flowers can be hypogynous, perigynous and epigynous. The flower in which gynoecium *i.e.*, female reproductive part (ovary) occupies the highest position while the other parts are situated below it are called **hypogynous** flowers. The ovary in such flowers is said to be **superior** e.g., mustard, china rose, brinjal, petunia.

If gynoecium is situated in the centre and other parts of the flower are located on the rim or periphery of the thalamus, almost at the same level as the ovary, then flower is called **perigynous**. The ovary in such flowers are said to be **half inferior** e.g., plum, rose, peach.

The flowers in which the margin of the thalamus grows upward enclosing the ovary completely and getting fused with it, the other parts of the flower arise above the ovary. Such type of flowers are called **epigynous**. The ovary is said to be **inferior** e.g., guava, cucumber, bittergourd, the ray floret of sunflower.



**Fig. :** Position of floral parts on thalamus :  
A. Hypogynous, B. Perigynous, C. Perigynous, D. Epigynous

**Example 11 :** What is a thalamus?

**Solution :** Thalamus is the swollen end of the pedicel or the stalk.



### Try Yourself

21. Superior ovary occurs in
 

(1) Hypogynous flower	(2) Perigynous flower
(3) Epigynous flower	(4) Ray florets of sunflower
22. Which of the following is an accessory organ of flower?
 

(1) Calyx	(2) Stamen
(3) Gynoecium	(4) Carpel



**Example 12 :** Name the four whorls present in a flower.

**Solution :** The four whorls of a flower are calyx, corolla, androecium and gynoecium.



### Try Yourself

23. What are epigynous flowers? Give example.
24. Half inferior ovary occurs in the flowers of
 

(1) Mustard	(2) Guava
(3) Cucumber	(4) Plum

### Parts of a Flower

A flower normally has four whorls namely calyx (sepals), corolla (petals), androecium (stamen) and gynoecium (carpel).

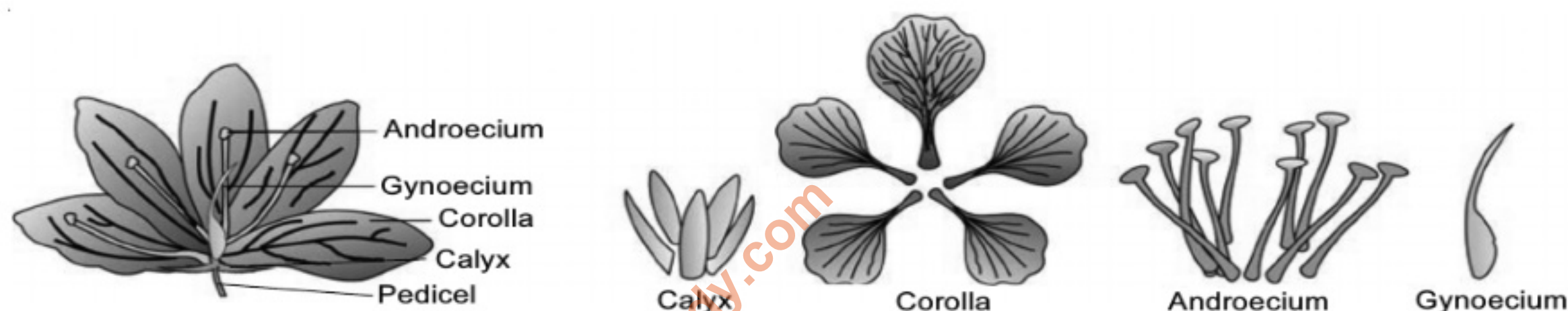


Fig. : Parts of a Flower

#### Calyx (Sepals)

Calyx is the outermost whorl of the flower and the members are called **sepals**. The sepals are generally green leaf-like structure that protect the flower in the bud stage. The calyx may be gamosepalous (sepals united) or polysepalous (sepals free).

#### Corolla (Petals)

Corolla is the second whorl of the flower. The individual leaf segment of the corolla is said to be **petals**. The corolla or petals are generally brightly coloured, have fragrance, which makes the flower more attractive. The colourful and fragrant petals attract insects for pollination. The shape and structure of corolla varies in different flowers. The different shapes of corolla that exist in nature are – tubular, bell-shaped, funnel-shaped, wheel-shaped etc. Like calyx, corolla may be also free (polypetalous) or united (gamopetalous).

#### Aestivation

The mode of arrangement of sepals or petals in a floral bud with respect to the other member of the same whorl is called **aestivation**. It may be of following types :

- (i) **Valvate** : In valvate aestivation, the margin of sepals or petals, present in a whorl just touch each other. There is no overlapping between the sepals or petals. *e.g.*, *Calotropis*.
- (ii) **Twisted** : In twisted aestivation, margin of one petal or sepal overlaps the margin of the adjacent successive petal or sepal and so on *e.g.*, China rose, lady's finger and cotton.
- (iii) **Imbricate** : In imbricate aestivation, margin of petals or sepals overlaps each other but not in a particular direction. *e.g.*, *Cassia*, gulmohur.
- (iv) **Vexillary** : In vexillary aestivation, the largest petal (standard) overlaps the two smaller lateral petals (wings) which in turn overlap the two smallest anterior petals (keel) *e.g.*, Pea and bean flower.



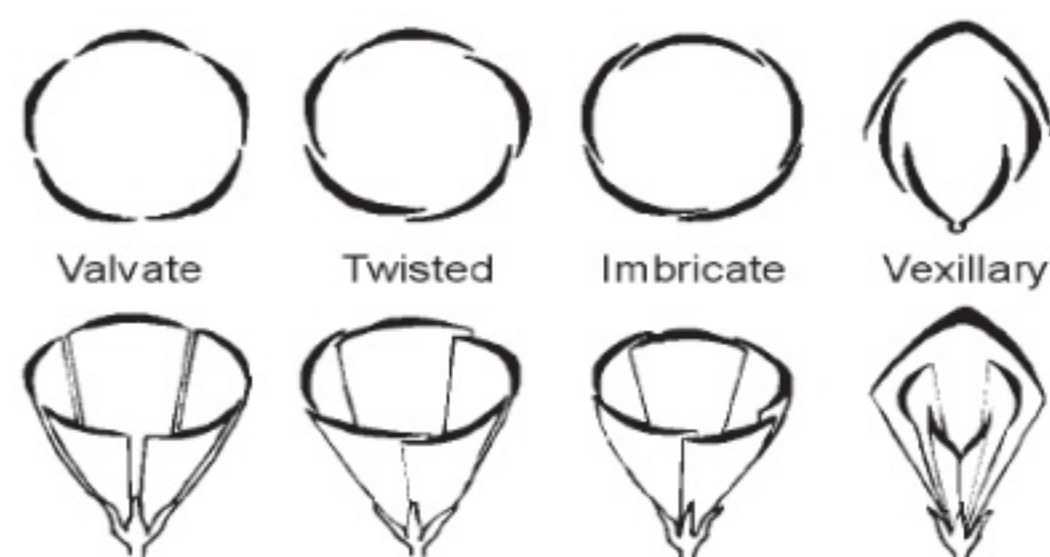


Fig. : Types of Aestivation in Corolla

## Androecium

Androecium is the third whorl of the flower which arises inner to the corolla. It is the male reproductive system which is composed of **stamens**. A stamen consists of a filament and anther. Anthers are usually bilobed. Each lobe contains two microsporangia or pollen sacs. The pollen grains are produced in pollen sacs. A sterile stamen is called **staminode**. There may be a variation in the length of filaments within a flower, as in *Salvia* and mustard.

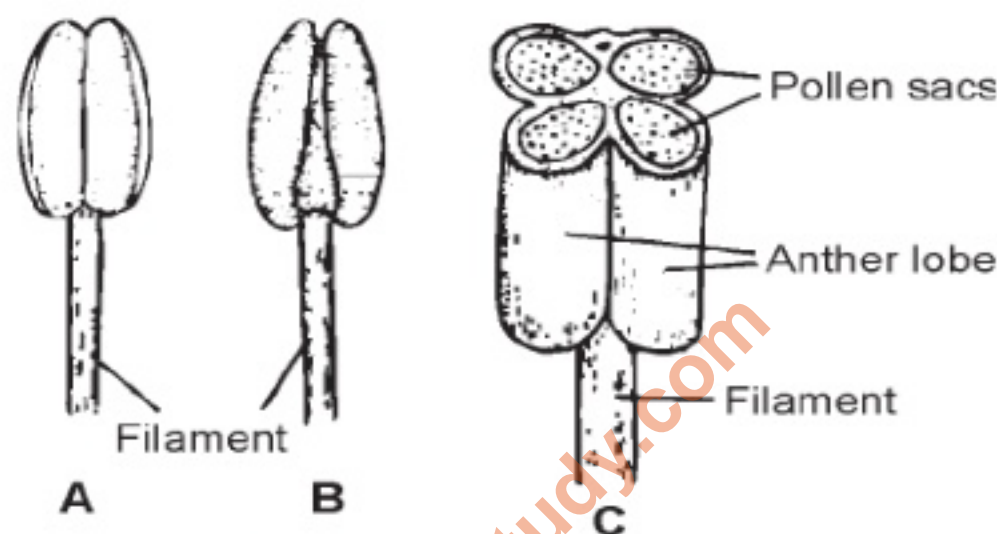


Fig. : Parts of a Stamen

**Adhesion of stamens** : The stamen may be attached to other floral organs such as petals, sepals etc. When a stamen is attached to the petal, then it is called **epipetalous** e.g., brinjal and when the stamen is attached to the perianth then it is said to be **epiphyllous** e.g., lily.

**Cohesion of stamens** : The stamens may be free or united. When the stamens are free then they are called **polyandrous** and when stamens are united in a single bundle, then it is called **monoadelphous**, as in china rose, when they are united in two bundles, then it is called **diadelphous** e.g., pea and when united into more than two bundles it is called **polyadelphous** e.g., *Citrus*.

## Gynoecium

It is the fourth and the last whorl of the flower. Gynoecium is the female reproductive part of the flower which is composed of one or more carpels. Carpels may be free or fused. When the carpels are free (as in lotus and rose) then they are said to be **apocarpous** and when the carpels are fused (as in mustard and tomato) then they are said to be **syncarpous**. A carpel has three parts namely.

- (i) **Ovary** : Ovary is the basal, swollen part of the carpel. It is the lower part of the carpel which bears one or more ovules. These ovules, after fertilisation mature into seeds. The ovules are attached to a flattened, cushion-like structure called **placenta**. The ovary has one or more chambers or loculi. The ovary containing one chamber is **unilocular**, two chambers is **bilocular**, three chamber is **triocular** and so on. The ovules are borne in these chambers. The wall of the ovary after fertilisation forms the pericarp (fruit wall).
- (ii) **Style**: The tube-like structure which connects the stigma to the ovary is called style. It lies above the ovary in a carpel.
- (iii) **Stigma** : Stigma is generally situated at the tip of the style. Stigma acts as the receptive organ for pollen grains during pollination.

After fertilisation ovules develop into seeds and ovary matures into a fruit.



**Example 13 :** Distinguish between epipetalous and epiphyllous stamens.

**Solution :** **Epipetalous stamen :** When a stamen is attached to the petals, then it is called epipetalous.

**Epiphyllous stamen :** When a stamen is attached to tepal, then it is said epiphyllous or epitepalous.



### Try Yourself

25. Leaf like structures that protect the flower in bud stage are called
- |            |             |
|------------|-------------|
| (1) Petals | (2) Carpels |
| (3) Sepals | (4) Stamens |
26. Calyx having fused sepals is called
- |                  |                  |
|------------------|------------------|
| (1) Polysepalous | (2) Polypetalous |
| (3) Gamosepalous | (4) Gamopetalous |

**Example 14 :** What is staminode?

**Solution :** A sterile stamen is called staminode.



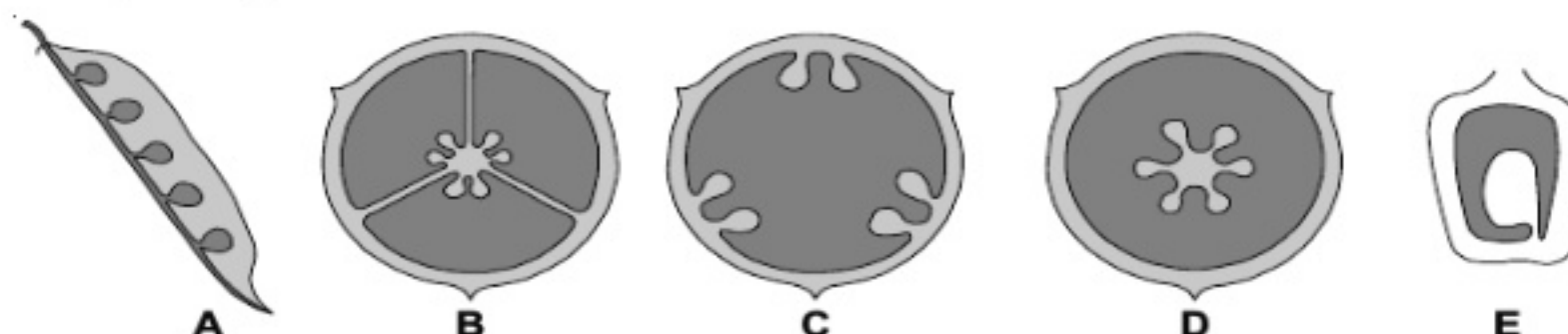
### Try Yourself

27. Define apocarpous and syncarpous condition.
28. The individual leaf segment of the corolla is called
- |            |            |
|------------|------------|
| (1) Petal  | (2) Sepal  |
| (3) Stamen | (4) Carpel |

### Placentation

Ovary bears ovules on a cushion-like structure called **placenta**. An ovary may have one or more placenta. The arrangement of ovules on placenta within the ovary is known as placentation. It is of following types :

- Marginal :** The placenta in marginal placentation forms a ridge along the ventral suture of the ovary. The ovules are borne in two alternate rows along the ridge e.g., Pea plant.
- Axile :** In axile placentation, the placenta is present in the axial position and the ovules are attached to it in a multilocular ovary e.g., China rose, tomato and lemon.
- Parietal :** The ovary is one-chambered (unilocular) but become two-chambered due to the formation of the false septum. The ovules develop on the inner wall of the ovary or on the peripheral part e.g., Mustard, *Argemone*.
- Free central :** The ovules are borne on central axis and septa are absent in the ovary e.g., *Primrose*, *Dianthus*.
- Basal :** The placenta develops at the base of the ovary. It has a single ovule attached to the placenta e.g., Sunflower, Marigold.



**Fig. :** Types of placentation : **A.** Marginal, **B.** Axile, **C.** Parietal, **D.** Free central, **E.** Basal



**Example 15 :** Define placentation.

**Solution :** The arrangement of ovules within ovary is called placentation.



### Try Yourself

29. In which of the following plant, the type of placentation is free central?
- |                     |                |
|---------------------|----------------|
| (1) Mustard         | (2) Garden pea |
| (3) <i>Dianthus</i> | (4) Wheat      |
30. The type of placentation that occurs in sunflower is
- |              |                  |
|--------------|------------------|
| (1) Marginal | (2) Free central |
| (3) Parietal | (4) Basal        |

### EXERCISE

21. Flower in angiosperms
- |   |  |
|---|--|
| (1) Is a modified reproductive shoot                        |  |
| (2) Possess different floral appendages at successive nodes |  |
| (3) Have floral appendages which are modified leaves        |  |
| (4) More than one option is correct                         |  |
22. Which of the following aestivation involves non-uniform overlapping of petals?
- |               |               |
|---------------|---------------|
| (1) Valvate   | (2) Twisted   |
| (3) Imbricate | (4) Contorted |
23. Find odd one w.r.t. zygomorphic flower
- |              |          |
|--------------|----------|
| (1) Mustard  | (2) Pea  |
| (3) Gulmohur | (4) Bean |
24. Stamens are united to petals in
- |                |                       |
|----------------|-----------------------|
| (1) Lily       | (2) <i>Calotropis</i> |
| (3) China rose | (4) <i>Verbena</i>    |
25. Syncarpous condition is seen in
- |                       |                        |
|-----------------------|------------------------|
| (1) Lotus and rose    | (2) Mustard and tomato |
| (3) Mustard and lotus | (4) Rose and tomato    |
26. Large posterior petal is characteristic to vexillary aestivation found in members of
- |                |               |
|----------------|---------------|
| (1) Solanaceae | (2) Liliaceae |
| (3) Fabaceae   | (4) Malvaceae |
27. When only the filaments of stamens are united into more than two bundles, the condition is called
- |                  |                   |
|------------------|-------------------|
| (1) Monodelphous | (2) Diadelphous   |
| (3) Polyandrous  | (4) Polyadelphous |



28. In which placentation type, the ovary is two to many chambered and the ovules arise from central axis?
- (1) Axile (2) Marginal  
(3) Parietal (4) Basal
29. Select a **correct** match :
- (1) Didynamous stamen – *Cassia* (2) Tetradynamous stamen – Mustard  
(3) Epiphyllous condition – China rose (4) Syngenesious condition – Cucumber
30. Flower is perigynous and the ovary is said to be half inferior in
- (1) Rose (2) Peach  
(3) Plum (4) All of these

## THE FRUIT

The flowering plants or the angiosperms are characterised by the presence of a fruit. After fertilisation the ripened or mature ovary is called fruit. Some fruits which are formed without fertilisation are called **parthenocarpic fruits**. e.g., Banana.

### Parts of a Fruit

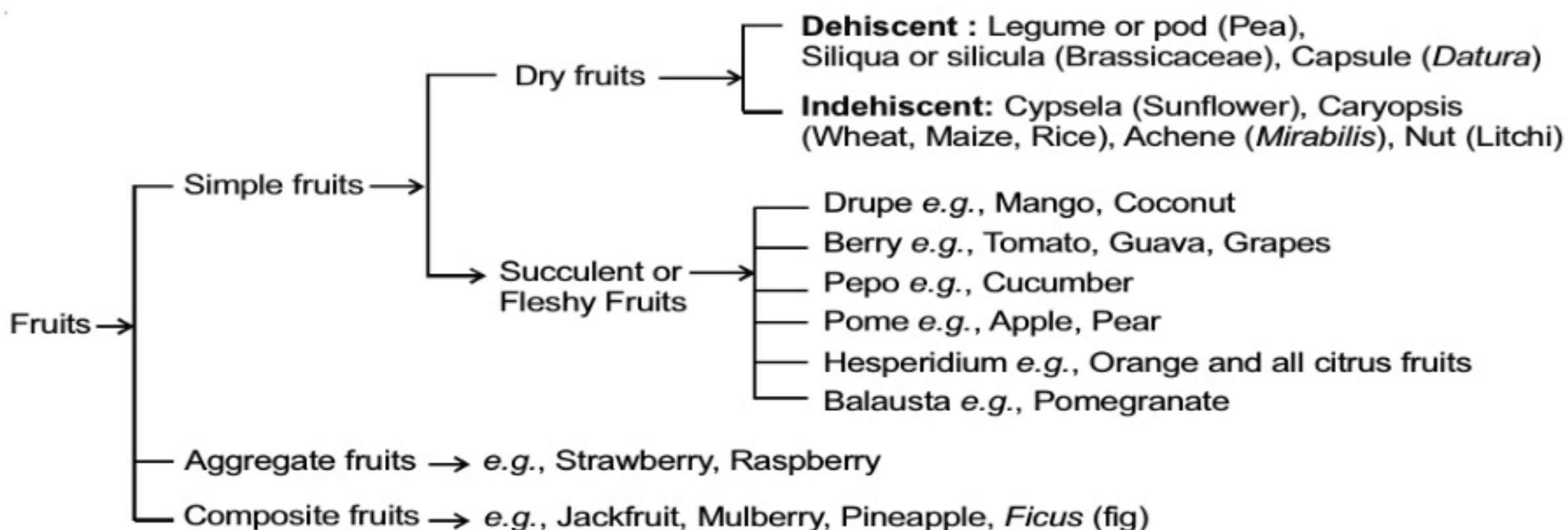
A fruit mainly consists of two parts namely fruit wall and seed.

- (i) **Fruit wall : Fruit wall** or **pericarp** develops from the wall of the ovary. It can be dry or fleshy. If the pericarp is thick and fleshy then it differentiates into three different layers namely :
- (a) **Epicarp** (outer cover)  
(b) **Mesocarp** (middle layer)  
(c) **Endocarp** (innermost layer)
- (ii) **Seeds Develop from Ovules** : In some plants ovary grows into fruit without fertilization, such fruits are called **parthenocarpic fruits**. They are seedless, e.g., Banana, Grapes.

The fruit which develops from ovary is called **true fruit**. Most of the fruits are true fruits. If any other floral part takes part in fruit formation, it is called **false fruit (pseudocarp)**, e.g., Apple, Pear.

Simple fruit develops from the syncarpous ovary of the single flower with or without accessory parts. Aggregate fruits are formed from polycarpellary, apocarpous ovary. Each carpel develops into a fruitlet and all fruitlets together form an aggregate fruit. The multiple fruit develops from the entire inflorescence.

### Classification of different kinds of fruits





## Types of Fruits

### 1. Simple Fruits

Fruit developing from the syncarpous ovary of the single flower with or without accessory parts is called simple fruit. Simple fruits are of following types :

- A. Dry indehiscent fruits.** They do not split or burst. Seeds are liberated only by the decomposition or destruction of pericarp.



#### Content Builder

##### Types of dry indehiscent fruits :

- (i) **Caryopsis** : Develops from monocarpellary, unilocular ovary. Fruit wall or pericarp is completely fused with seed coat. *e.g.*, wheat, maize, rice (Graminae).
- (ii) **Achene** : It develops from monocarpellary, unilocular ovary. Fruit wall (pericarp) is not completely attached with seed coat (as that of caryopsis), *e.g.*, *Mirabilis*.
- (iii) **Cypsela** : Develops from bicarpellary, unilocular and inferior ovary. Calyx is hair like and called **pappus** which helps in dispersal of fruits (seeds), *e.g.*, Sunflower, *Sonchus*, *Zinnia*, *Taraxacum*. It is characteristic fruit of family Compositae (Asteraceae).
- (iv) **Nut** : Develops from polycarpellary superior ovary. Pericarp is hard (stony) and sometimes woody, *e.g.*, *Anacardium* (cashew nut), Litchi (marking nut), *Trapa* (water chestnut) and *Quercus* (oak).

- B. Dry dehiscent fruits.** These fruits burst automatically and discharge their seeds.



#### Content Builder

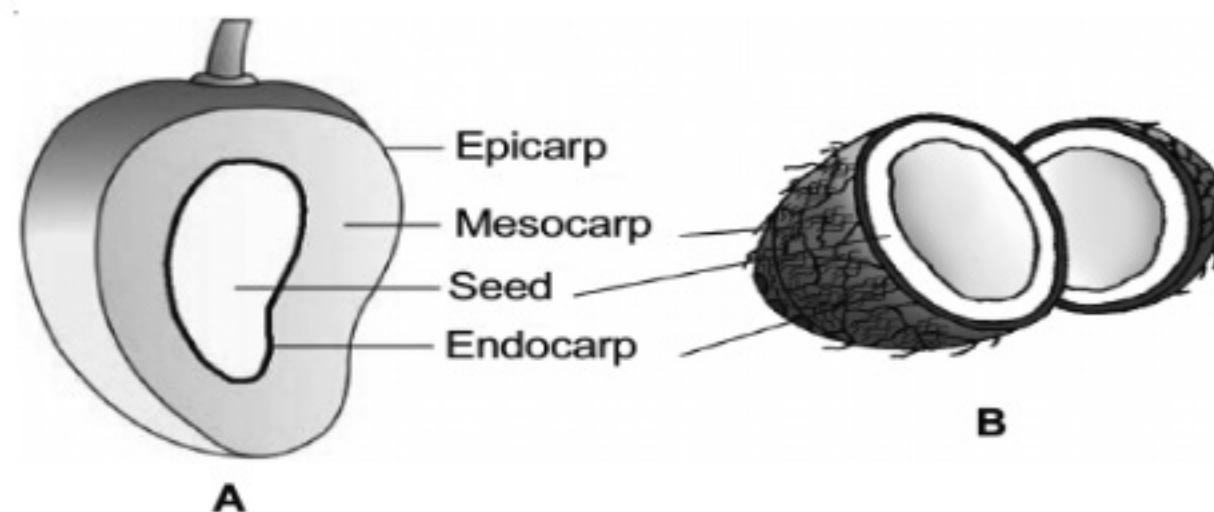
##### Types of dry dehiscent fruits :

- (i) **Legume or pod**: Dry, one chambered fruit developing from a superior and monocarpellary ovary. Mature fruit dehisces by both sutures or margins, *e.g.*, Gram, lentil, pea.
- (ii) **Siliqua** : Develops from bicarpellary, unilocular ovary with parietal placentation, dehiscence of fruits occur by both the halves from base to apex, *e.g.*, Mustard, radish. This is characteristic fruit of family **Cruciferae** or **Brassicaceae**.
- (iii) **Silicula** : A short, broad, flat siliqua with few seeds is known as silicula. *e.g.*, *Iberis*, *Capsella*.
- (iv) **Capsule** : Develops from multicarpellary, syncarpous ovary. Dehiscence occurs by many ways.
  - (a) **By Pores** : Porocidal, *e.g.*, *Opium* (Poppy), *Argemone*.
  - (b) **By locules or valves** : Loculicidal, *e.g.*, Cotton.
  - (c) **By Septa**. **Septicidal**, *e.g.*, Linseed.
  - (d) **Septa breakdown into fragments** : Septifragal, *e.g.*, *Datura*.

- C. Fleshy or Succulent fruits.** These are of following types :

- (i) **Drupe**: Mostly one seeded fruits with pericarp differentiated into **epicarp**, **mesocarp** and hard and **stony endocarp**, *e.g.*, *Mangifera indica* (**Mango**—epicarp forms skin, mesocarp—fleshy, juicy and edible, endocarp is hard and stony), *Cocos nucifera* (**Coconut**—Mesocarp is fibrous which is used in making coir so called as **fibrous drupe**), *Juglans regia* (walnut).





Parts of a fruit. A. Mango; B. Coconut

- (ii) **Berry** : One to many seeded fruits. Epicarp forms the outer skin. Middle thick and fleshy part is called mesocarp with a membrane like endocarp, e.g., Tomato, guava, papaya, grapes, banana, brinjal, chillies. **Betel nut is a one seeded berry.**
- (iii) **Pepo (hard walled berry)** : Develops from tricarpellary, syncarpous, unilocular and **inferior ovary**. Epicarp forms skin of fruit. Mesocarp and endocarp are fleshy and edible. Sometimes, fruits are bitter in taste due to **tetracyclic triterpenes** e.g., Cucumber, gourd, watermelon.
- (iv) **Pome** : Develops from syncarpous inferior ovary which is surrounded by fleshy thalamus. So, true fruit lies inside the swollen fleshy and edible thalamus. It is false fruit or **pseudocarp**. e.g., Apple, pear. Edible part is fleshy thalamus.
- (v) **Hesperidium** : Develops from multicarpellary, multilocular, syncarpous, superior ovary with axile placentation. The epicarp and mesocarp fused together to form skin or rind of the fruit. Endocarp projects inwards forming a number of distinct chambers. The juicy unicellular hairs are present on the inner side of the endocarp. e.g., Orange and all citrus fruits.
- (vi) **Balausta** : Develops from multilocular, syncarpous, inferior ovary. Epicarp is tough and leathery. Endocarp is membranous. Seeds are irregularly distributed inside the fruit. **Juicy testa of the seeds is edible.** The fruit has persistent calyx e.g., pomegranate.
- (vii) **Amphisarca** : Develops from multicarpellary, syncarpous, multilocular and superior ovary. The epicarp is hard and woody, mesocarp, endocarp and swollen placenta are fleshy and edible e.g., *Aegle marmelos* (wood apple or bael), *Feronia limonia* (Kaith or elephant apple).

## 2. Aggregate Fruits

Aggregate fruits are formed from polycarpellary, apocarpous ovary. Each carpel develops into a fruitlet and all fruitlets together form an aggregate fruit. An aggregate of simple fruits borne by apocarpous ovary of a single flower is otherwise known as '**etaerio**'. Aggregate fruits are of the following types :

- (i) **An etaerio of achenes** e.g., Strawberry
- (ii) **An etaerio of berries** e.g., *Artobotrys*
- (iii) **An etaerio of follicles** e.g., *Delphinium*, *Michelia*.
- (iv) **An etaerio of drupes** e.g., Raspberry.

## 3. Multiple or Composite Fruits

The multiple fruit develops from the entire inflorescence. These fruits are of two types :

- (i) **Sorosis** : These fruits develop from spike, spadix or catkin inflorescence. The flowers fuse together by their sepals or perianth and the whole inflorescence forms a compact mass e.g., Jackfruit, mulberry, pineapple.
- (ii) **Syconus** : This fruit develops from hypanthodium inflorescence e.g., *Ficus* sp. (Fig, gular, banyan, peepal). The fruitlets are achenial in nature.



## Edible parts of Some Common Fruits and their Types

Common / English name	Botanical Name	Type	Edible parts
<b>I. Simple fruits</b>			
Pea	<i>Pisum sativum</i>	Legume	Seeds
Lady's finger/Okra	<i>Abelmoschus esculentus</i>	Capsule	Entire fruit
<b>Wheat</b>	<i>Triticum aestivum</i>	<b>Caryopsis</b>	Entire fruit
Corn/Maize	<i>Zea mays</i>	Caryopsis	Entire fruit
<b>Cashew nut</b>	<i>Anacardium occidentale</i>	Nut	Cotyledons and fleshy thalamus
<b>Litchi</b>	<i>Litchi chinensis</i>	Nut	<b>Aril</b>
Water chestnut	<i>Trapa bispinosa</i>	Nut	Seeds
Ground nut	<i>Arachis hypogea</i>	<b>Lomentum</b>	Seeds
Coriander	<i>Coriandrum sativum</i>	Cremocarp	Entire fruit
<b>Mango</b>	<i>Mangifera indica</i>	<b>Drupe</b>	<b>Fleshy mesocarp</b>
<b>Coconut</b>	<i>Cocos nucifera</i>	<b>Drupe</b>	<b>Endosperm</b>
Almond	<i>Prunus amygdalus</i>	Drupe	Seeds
Walnut	<i>Juglans regia</i>	Drupe	<b>Cotyledons</b>
<b>Apple</b>	<i>Pyrus malus</i>	<b>Pome</b>	<b>Fleshy thalamus</b>
<b>Pear</b>	<i>Pyrus communis</i>	Pome	Fleshy thalamus
Tomato	<i>Lycopersicon esculentum</i>	Berry	Pericarp and placentae
Grape	<i>Vitis vinifera</i>	Berry	Pericarp and placentae
Date palm	<i>Phoenix dactylifera</i>	Berry	Pericarp
<b>Banana</b>	<i>Musa paradisiaca</i> var. <i>sapientum</i>	<b>Berry</b>	<b>Mesocarp and endocarp</b>
Guava	<i>Psidium guajava</i>	<b>Berry</b>	Pericarp, placenta and thalamus
<b>Betel nut</b>	<i>Areca catechu</i>	<b>Berry</b>	<b>Seeds</b>
Bottle gourd	<i>Lagenaria siceraria</i>	Pepo	Mesocarp, endocarp and young seeds
<b>Cucumber</b>	<i>Cucumis sativus</i>	<b>Pepo</b>	Mesocarp, endocarp and young seeds
Loose skinned orange	<i>Citrus reticulata</i>	Hesperidium	Placental glandular hair along with endocarp
<b>Pomegranate</b>	<i>Punica granatum</i>	Balausta	<b>Succulent testa</b>
<b>II. Aggregate Fruits</b>			
Strawberry	<i>Fragaria vesica</i>	Etaerio of achenes	Fleshy thalamus and seeds
Custard apple	<i>Annona squamosa</i>	Etaerio of berries	Inner layer of pericarp and thalamus
<b>III. Multiple or Composite Fruits</b>			
<b>Mulberry</b>	<i>Morus alba</i> and <i>M. nigra</i>	<b>Sorosis</b>	Succulent perianth and fleshy axis
<b>Pineapple</b>	<i>Ananas comosus</i>	<b>Sorosis</b>	Fleshy axis, bracts, fused perianth and pericarp
Jack fruit	<i>Artocarpus heterophyllus</i>	Sorosis	Fleshy axis, bracts, perianth and seeds
<b>Fig</b>	<i>Ficus carica</i>	<b>Syconus</b>	<b>Fleshy receptacle or thalamus</b>



**Example 16 :** What are parthenocarpic fruits?

**Solution :** The fruits which are formed without fertilisation are called parthenocarpic fruit. Ex. Banana



### Try Yourself

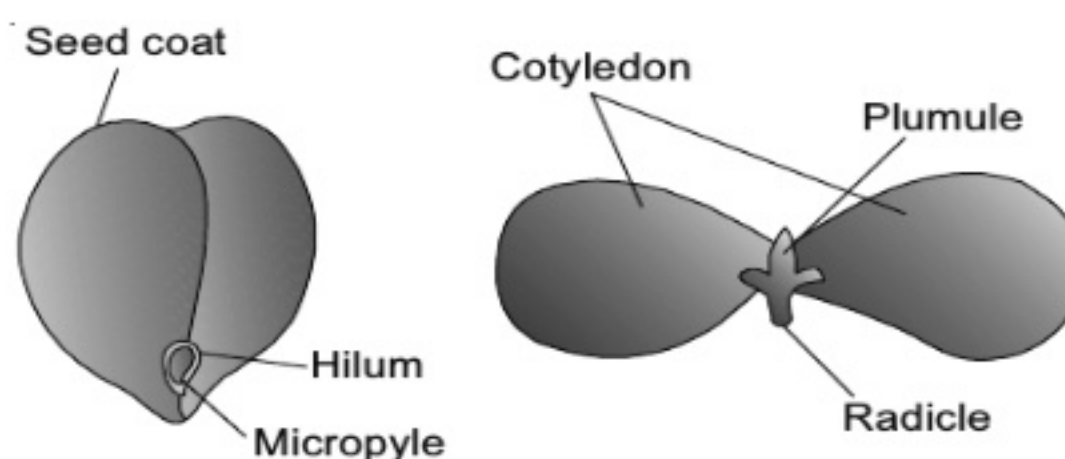
31. Which of the following is the edible part of the mango?
- |              |              |
|--------------|--------------|
| (1) Epicarp  | (2) Mesocarp |
| (3) Endocarp | (4) Seed     |
32. Fruit is a mature or ripened \_\_\_\_\_, developed after fertilisation.
- |                        |           |
|------------------------|-----------|
| (1) Ovule              | (2) Ovary |
| (3) Female gametophyte | (4) Seed  |

## THE SEED

The ovules develop into seeds after fertilization. A seed is made up of a **seed coat** and an **embryo**. The embryo is made up of an embryonal axis and one (as in wheat, maize) or two cotyledons (as in gram and pea).

### Structure of Dicotyledonous Seed

- I. **Seed coat** : Outer, protective covering of the seed is called seed coat, which develops from integuments of ovule. The seed coat has two layers, the outer **testa** and the inner **tegmen**. The **hilum** is a scar on the seed coat through which the developing seeds were attached to the fruit. Above the hilum is a small pore called the **micropyle**.
- II. **Embryo** : Embryo is the most important part of the seed. Embryo consists of an **embryonal axis** and two **cotyledons**. The cotyledons are often fleshy and full of reserve food materials. At the two ends of the embryonal axis are present the **radicle** and the **plumule**.
- III. **Endosperm** : Endosperm is formed as a result of double fertilization. In some seeds such as castor it is a food storing tissue. But in plants such as bean, gram and pea, the endosperm is not present in mature seed and such seeds are called non-endospermous.

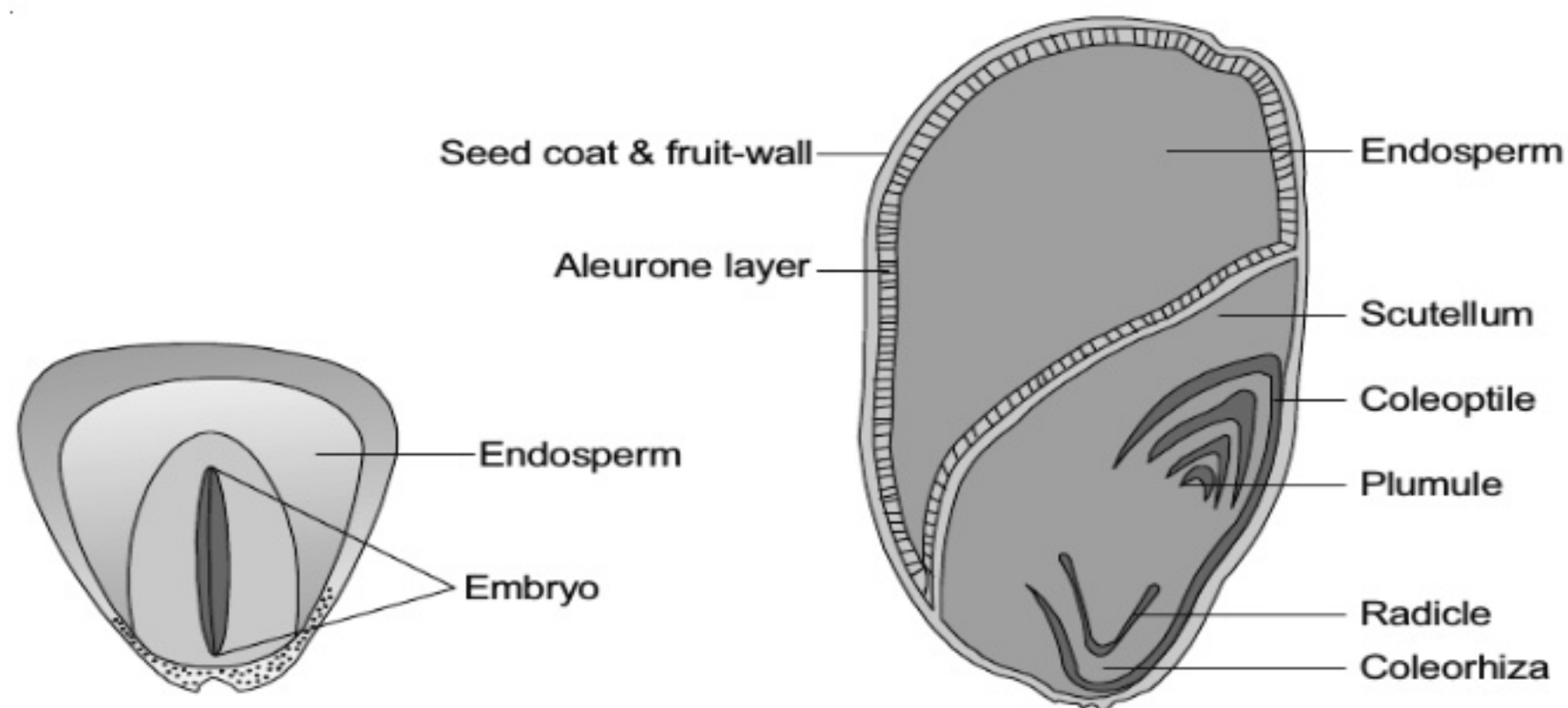


**Fig. :** Structure of Dicotyledonous Seed

### Structure of Monocotyledonous Seed

In the seeds of cereals such as maize the seed coat is membranous and generally fused with the fruit wall. Below the grain covering are present two structures, **endosperm** and **embryo**. The endosperm is bulky and stores food. So monocotyledonous seeds are endospermic but some as in orchids are non-endospermic. The outer covering of endosperm separates the embryo by a proteinaceous layer called **aleurone layer**. The embryo is small and situated in a groove at one end of the endosperm. It consists of one large and shield shaped cotyledon known as **scutellum** and a short axis with a **plumule** and a **radicle**. The plumule and radicle are enclosed in sheaths which are called **coleoptile** and **coleorrhiza** respectively.





**Fig. :** Structure of a monocotyledonous seed

### Perispermic Seed

Mostly nucellus is consumed after fertilization due to absorption of food by the endosperm and embryo. Sometimes, the nucellus remains persistent in the seed and is called **perisperm**. Such seeds are called perispermic seeds, e.g., *Piper nigrum* (black pepper).

**Example 17 :** In maize seed, the outer covering of endosperm is proteinaceous and called as

- |                    |                |
|--------------------|----------------|
| (1) Scutellum      | (2) Pericarp   |
| (3) Aleurone layer | (4) Coleoptile |

**Solution :** (3) Aleurone layer



### Try Yourself

33. In maize seed, the plumule is enclosed by a sheath, called as
- |                |                |
|----------------|----------------|
| (1) Testa      | (2) Tegmen     |
| (3) Coleoptile | (4) Coleorhiza |
34. The small pore present above the hilum at one end of the seed is called
- |               |               |
|---------------|---------------|
| (1) Tegmen    | (2) Micropyle |
| (3) Endosperm | (4) Embryo    |

### EXERCISE

31. Choose odd one w.r.t. parthenocarpic fruit
- |             |            |
|-------------|------------|
| (1) Mango   | (2) Banana |
| (3) Oranges | (4) Grapes |
32. Fruit developed from monocarpellary, superior and unilocular ovary, where the pericarp is fully fused with seed coat is
- |              |               |
|--------------|---------------|
| (1) Follicle | (2) Caryopsis |
| (3) Achene   | (4) Capsule   |



33. All given are dry fruits, except  
 (1) Legume (2) Capsule  
 (3) Caryopsis (4) Berry
34. Select an **incorrect** match :  
 (1) Legume – Pea (2) Lomentum – Maize  
 (3) Siliqua – Mustard (4) Drupe – Mango
35. Edible part in pome fruit of apple is  
 (1) Bract (2) Thalamus  
 (3) Cotyledon (4) Endosperm
36. Mesocarp and endocarp are edible in  
 (1) Pomegranate (2) Banana  
 (3) Coconut (4) Mango
37. Syconus fruit develops from hypanthodium inflorescence, its fruitlets are \_\_\_\_\_ in nature.  
 (1) Achenes (2) Nuts  
 (3) Cocci (4) Samara
38. Aleurone layer of maize seed stores \_\_\_\_\_ and is \_\_\_\_\_ in ploidy.  
 (1) Proteins, n (2) Cellulose, 2n  
 (3) Proteins, 3n (4) Fat, 3n
39. Find odd one w.r.t. non-endospermic seeds  
 (1) Gram (2) Groundnut  
 (3) Pea (4) Castor
40. Scar on the seed coat through which the developing seeds are attached to the fruit is called  
 (1) Hilum (2) Kernel  
 (3) Epicotyl (4) Caruncle

### SEMI-TECHNICAL DESCRIPTION OF A TYPICAL FLOWERING PLANT

Different characteristics of a family are the diagnostic features which enable us to differentiate them. These diagnostic features are mainly based on floral characters like sexuality of flowers, symmetry of flowers, position of ovary with respect to floral whorls, bracts, and conditions of calyx, corolla, androecium and gynoecium.

For a systematic study and quick comprehension of all the diagnostic features of a family, these characters are symbolised and put in the form of a floral formula. Floral diagrams are also drawn which give some extra informations like placentation, position of the mother axis, aestivation etc. Floral formulae and diagrams are given with the respective family descriptions later in the chapter.

#### Symbols used in Floral Formula

- |              |   |                                  |
|--------------|---|----------------------------------|
| (1) Br       | : | Bracteate flower                 |
| (2) Ebr      | : | Ebracteate flower (bract absent) |
| (3) $\oplus$ | : | Actinomorphic flower             |
| (4) %        | : | Zygomorphic flower               |
| (5) ♂<br>♀   | : | Bisexual flower                  |
| (6) ♂        | : | Unisexual; male flower           |
| (7) ♀        | : | Unisexual; female flower         |



(8) K : Calyx

$K_n$  : Polysepalous

$K_{(n)}$  : Gamosepalous

where n = Number of sepals

(9) Epi : Epicalyx (below sepals)

(10) C : Corolla

$C_n$  : Polypetalous

$C_{(n)}$  : Gamopetalous

where n = Number of petals

(11) P : Perianth

(12) A : Androecium

$A_\infty$  : Infinite stamens

$\overbrace{C \ A}$  : Epipetalous stamens

$\overbrace{P \ A}$  : Epitepalous or epiphyllous stamens

(13) G : Gynoecium

$G_{(n)}$  : Syncarpous ovary

$G_n$  : Apocarpous ovary

$\underline{G}_n$  : Superior ovary

$\overline{G}_n$  : Inferior ovary

where n : Number of carpels

(14) In the floral diagram the dot (•) represents the position of mother axis. It denotes the posterior side of the flower.

#### Distinguishing features of a family (Brassicaceae):

- (1) Inflorescence corymb or corymbose-raceme
- (2) Flowers tetramerous
- (3) Cruciform corolla
- (4) Tetradynamous condition, sometimes didynamous
- (5) Bicarpeal, syncarpous, superior ovary, unilocular but becomes bilocular due to false septum or **replum**, parietal placentation, stigma bifid.
- (6) Fruit is silique or silicula

Floral Formula : Ebr.  $\oplus$  or  $\% \begin{smallmatrix} \uparrow \\ \downarrow \end{smallmatrix} K_{2+2} C_{\times 4} A_{2+4} \underline{G}_{(2)}$



(Floral Diagram)

Fig. : *Brassica campestris*



## DESCRIPTION OF SOME IMPORTANT FAMILIES

This includes major distinguishing features and important plants of the family with floral diagram and floral formula.

### Fabaceae

It is distributed all over the world. This family was earlier called papilionoideae, a sub-family of family leguminosae.

#### Vegetative Characters

- Habit** : Trees, shrubs, herbs, climbers.  
**Root** : Tap root system, roots with root nodules, branched. Root nodules contain nitrogen-fixing bacteria (*Rhizobium*).  
**Stem** : Erect or climber.  
**Leaves** : Alternate, rarely simple, generally pinnately compound, stipulate, leaf base pulvinate, venation reticulate, leaves or leaflets modified into tendrils.

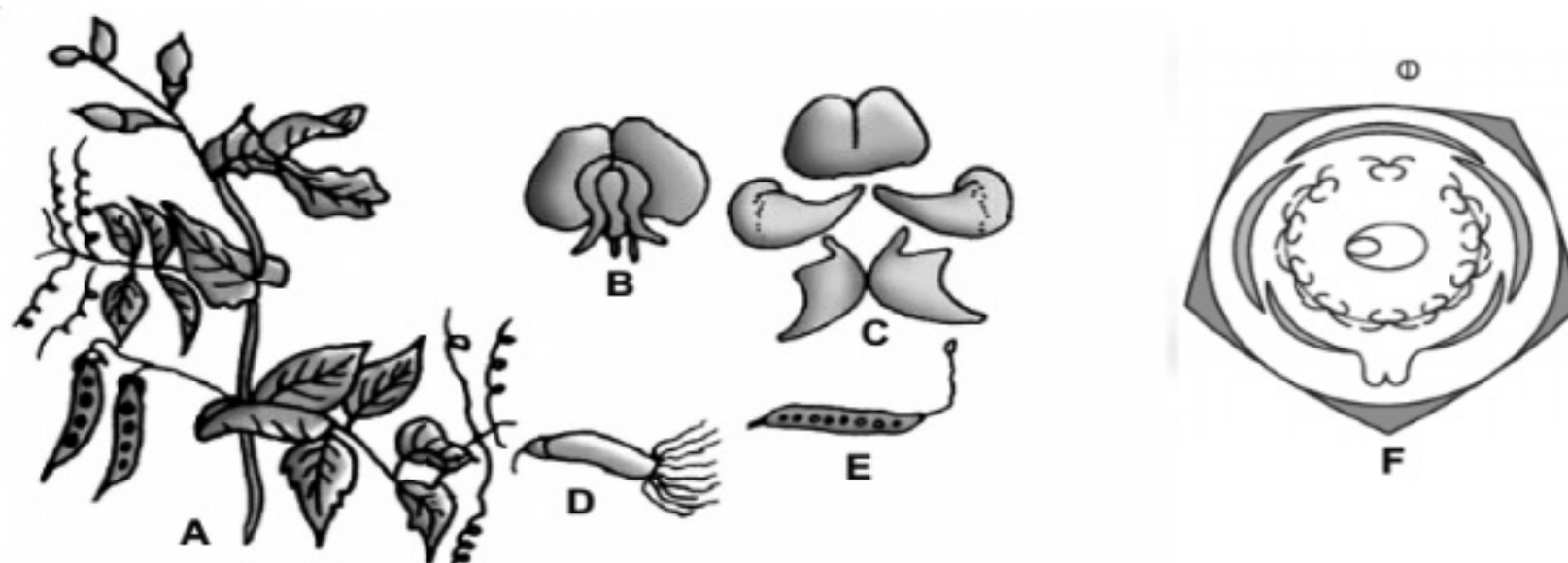
#### Floral Characters :

- Inflorescence** : Racemose.  
**Flower** : Bisexual, zygomorphic.  
**Calyx** : Sepals five, gamosepalous, valvate/imbricate aestivation.  
**Corolla** : Petal five, polypetalous, papilionaceous, consisting of a posterior standard, two lateral wings, two anterior ones forming a keel (enclosing stamens and pistil), vexillary aestivation.  
**Androecium** : Ten, diadelphous, anther dithecous.  
**Gynoecium** : Ovary superior, monocarpellary, unilocular with many ovules, style single, many ovules in two alternate rows.  
**Fruit** : Legume  
**Seed** : One to many, non-endospermic.

**Floral formula** :  $\% \frac{\sigma}{\text{♀}} K_{(5)} C_{1+2+(2)} A_{(9)+1} \underline{G}_1$

#### Economic Importance :

- Pulses** : Gram, arhar, sem, moong, soyabean.
- Fodder** : *Trifolium*, *Sesbania*, etc.
- Edible oil** : Soyabean, groundnut, etc.
- Dyes** : *Indigofera*
- Fibres** : Sunhemp
- Ornamental** : Lupin, sweet pea
- Medicines** : Muliathi



**Fig. :** *Pisum sativum* (pea) plant : **A.** Flowering twig, **B.** Flower, **C.** Petals, **D.** Reproductive parts, **E.** L.S. carpel, **F.** Floral diagram



## Solanaceae

It is a large family, commonly called as the 'potato family'. It is widely distributed in tropics, sub-tropics and temperate zone.

### Vegetative Characters

**Habit** : Herbs, shrubs, small trees.

**Root** : Tap roots.

**Stem** : Herbaceous rarely woody, aerial, erect, cylindrical, solid, branched or hollow, hairy or glabrous (smooth), underground stem in potato (*Solanum tuberosum*).

**Leaves** : Alternate, simple, rarely pinnately compound, exstipulate, hairy, venation reticulate.

### Floral Characters

**Inflorescence** : Solitary, axillary or cymose as in *Solanum*.

**Flower** : Bisexual, actinomorphic.

**Calyx** : Sepals five, united, persistent, valvate aestivation, gamosepalous.

**Corolla** : Petals five, gamopetalous, valvate aestivation.

**Androecium** : Stamens five, epipetalous, anthers bitheous.

**Gynoecium** : Bicarpellary, syncarpous, ovary superior with oblique septa, bilocular, placenta swollen with many ovules, placentation axile.

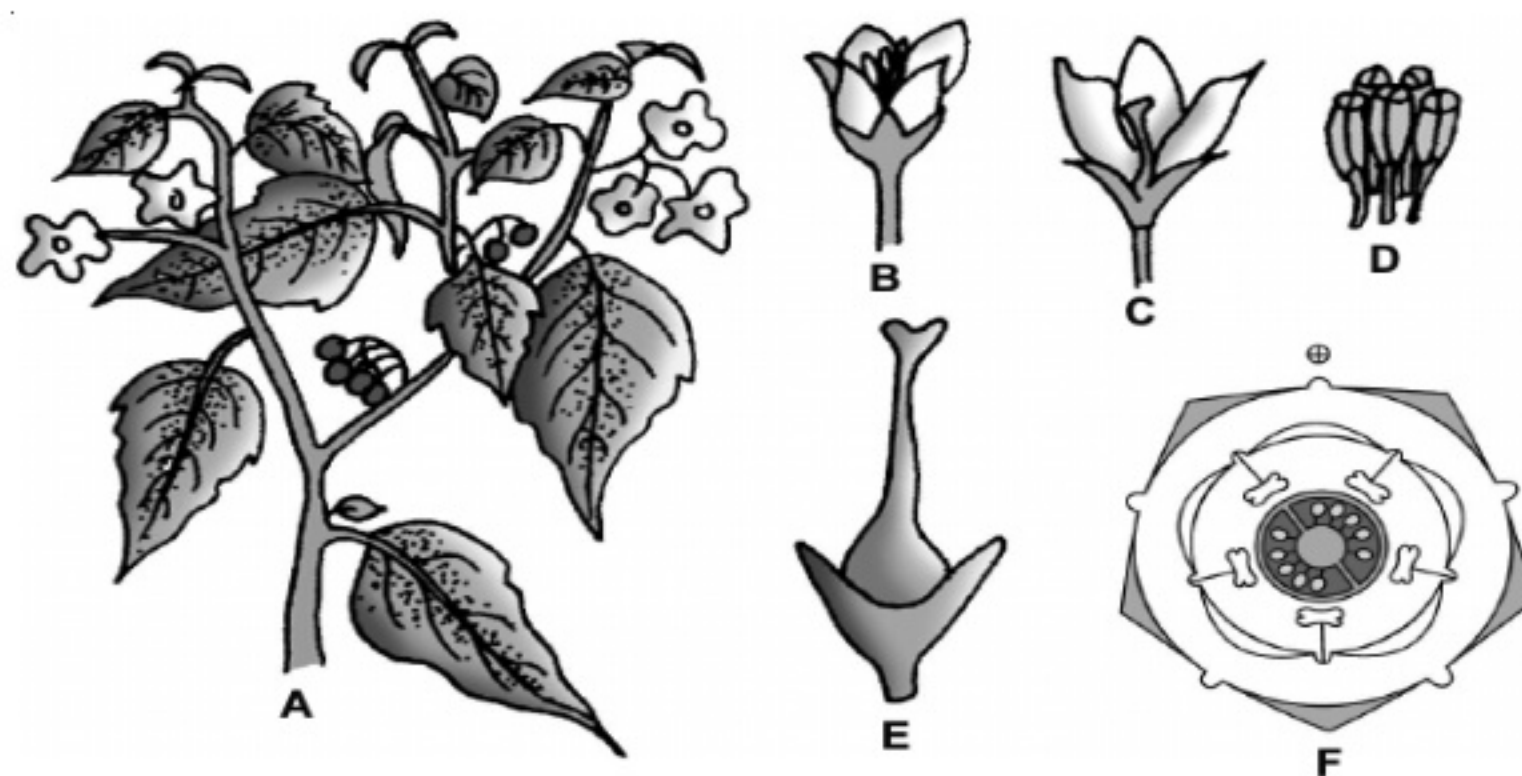
**Fruit** : A many seeded berry or capsule.

**Seed** : Many, endospermous.

**Floral formula** :  $\oplus \text{ } \text{K}_{(5)} \text{C}_{(5)} \text{A}_5 \text{G}_{(2)}$

### Economic Importance :

1. **Food** : Potato, tomato, brinjal.
2. **Spices** : Chilli
3. **Tobacco** : It comes from the dried and cured leaves of *Nicotiana tabacum*. It is a fumigatory plant.
4. **Medicine** : Belladonna, Ashwagandha
5. **Ornamental** : *Petunia*



**Fig. :** *Solanum nigrum* (makoi) plant : **A.** Flowering twig, **B.** Flower, **C.** L.S. of Flower, **D.** Stamens, **E.** Carpel, **F.** Floral diagram



**Liliaceae**

It is commonly called 'the lily family'. The plants belonging to this family are monocotyledonous plants. They are widely distributed worldwide.

**Vegetative Characters :**

- Habit** : Perennial herbs with underground bulbs, corms, rhizomes.  
**Roots** : Adventitious, fibrous.  
**Stem** : Aerial or underground, herbaceous or woody.  
**Leaves** : Mostly basal, alternate, linear, exstipulate with parallel venation.

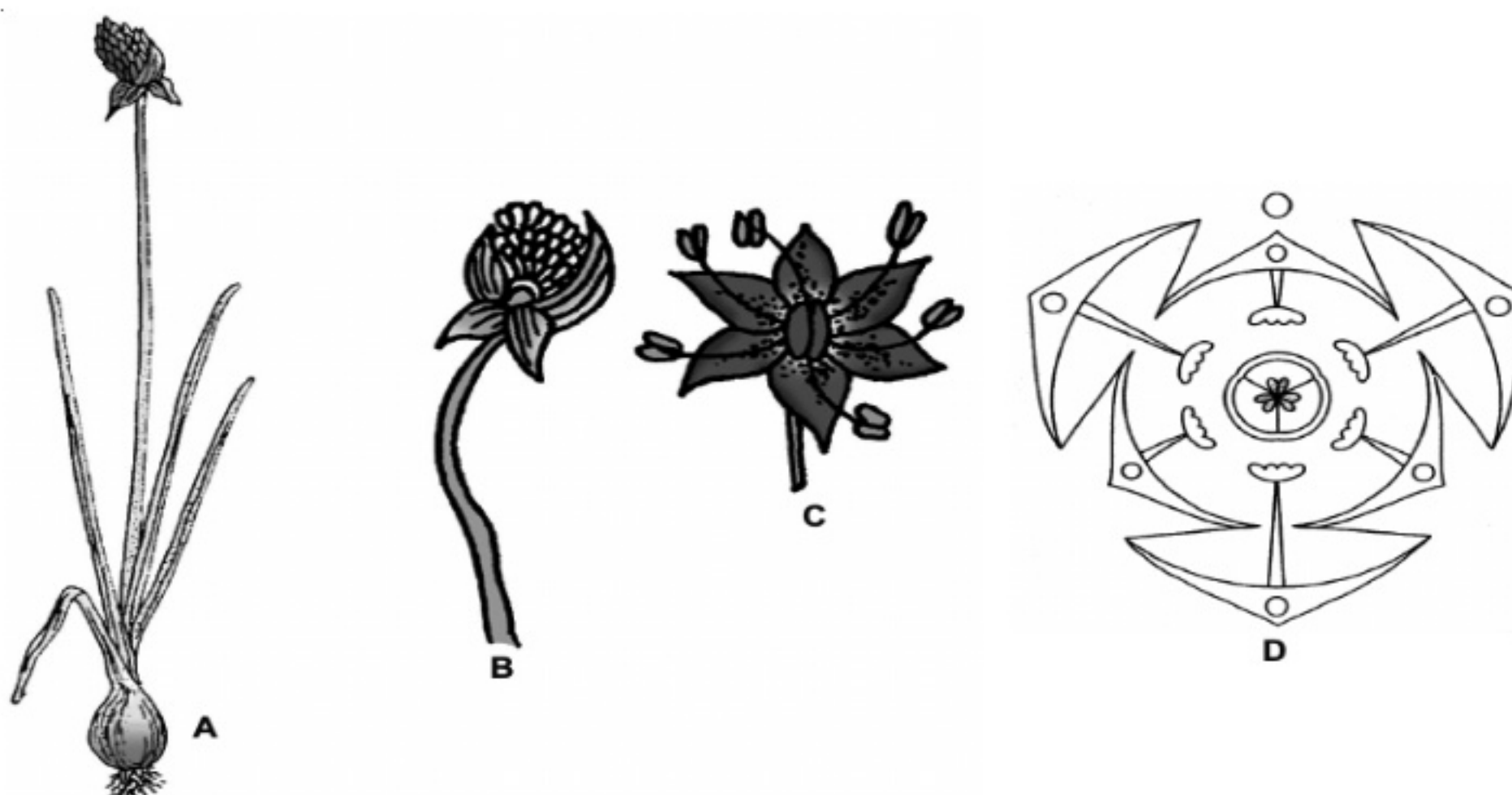
**Floral Characters :**

- Inflorescence** : Solitary/cymose, often umbellate clusters.  
**Flower** : Bisexual, actinomorphic.  
**Perianth** : Tepal six (3 + 3), often united into tube, valvate aestivation,  
**Androecium** : Stamen six, (3 + 3).  
**Gynoecium** : Tricarpellary, syncarpous, ovary superior, trilocular with many ovules, axile placentation.  
**Fruit** : Capsule, rarely berry.  
**Seeds** : Endospermous.

**Floral Formula:**  $\oplus \frac{\sigma}{\text{P}} \overbrace{(3+3)}^{\text{A}} \underline{\text{G}}_{(3)}$

**Economic Importance :**

- Food** : Young shoots and root tubers of *Asparagus* species are cooked.
- Medicines** : *Aloe* is a source of medicine.
- Ornaments** : *Gloriosa* and tulip.
- Colchicine** : *Colchicum autumnale* yield colchicine which is used in doubling of chromosomes.



**Fig. :** *Allium cepa* (onion) plant :

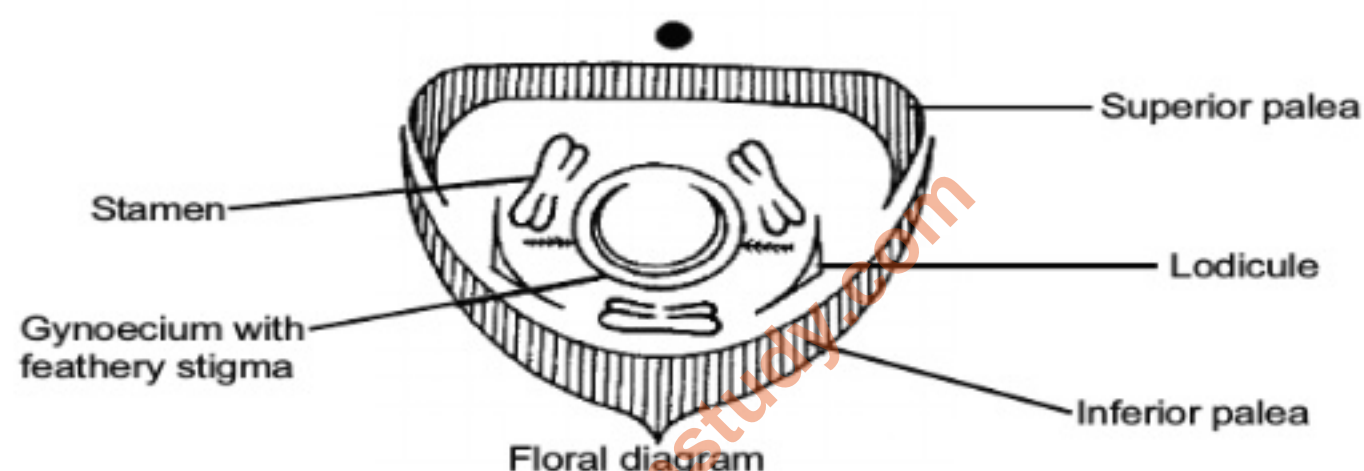
**A.** Plant, **B.** Inflorescence, **C.** Flower, **D.** Floral diagram



**Family Gramineae (Poaceae) :****Most advanced family among monocots**

- (1) Inflorescence spike of spikelets (*Triticum*), panicle of spikelets (*Avena*).
- (2) Flowers small, sessile, surrounded by two scales, **lemma** (fertile bract, inferior or outer palea) and **palea** (superior or inner palea). The lemma bears a long, stiff process called awn.
- (3) Flowers zygomorphic, incomplete, hypogynous.
- (4) Perianth represented by two or sometimes three lodicules.
- (5) Androecium 3 or 6, polyandrous, versatile fixation of anthers.
- (6) Monocarpellary, superior, unilocular ovary with basal placentation. Stigma is feathery.
- (7) Fruit is caryopsis or nut (*Dendrocalamus*) or berry (*Bambusa*)

Floral Formula :  $\% \begin{matrix} \text{♂} \\ \text{♀} \end{matrix} P_{2 \text{ or } 3} \text{ (lodicules)} A_{3 \text{ or } 6} \underline{G}_1$

**Important plants :**

- (1) *Avena sativa* (Oat)
- (2) *Triticum aestivum* (Wheat)
- (3) *Sorghum vulgare* (Jowar)
- (4) *Pennisetum typhoides* (Bajra)
- (5) *Saccharum officinalis* (Sugarcane)
- (6) *Zea mays* (Maize)
- (7) *Oryza sativa* (Rice)
- (8) *Bambusa tulda* (Bamboo)
- (9) *Secale cereale* (Rye)
- (10) *Cymbopogon citratus* (Lemon grass)

**Example 18 :** Give an account of the inflorescence seen in the members of Solanaceae family.

**Solution :** Inflorescence – Solitary, axillary or cymose as in *Solanum*.





### Try Yourself

35. The type of placentation occurring in the individuals of the family Liliaceae is
- |           |                  |
|-----------|------------------|
| (1) Axile | (2) Free central |
| (3) Basal | (4) Marginal     |
36. The type of venation present in the leaves of the individuals belonging to the family Solanaceae is
- |                |                    |
|----------------|--------------------|
| (1) Parallel   | (2) Furcate        |
| (3) Reticulate | (4) Both (1) & (2) |

**Example 19 :** Give the floral formula of the potato family.

**Solution :**  $\oplus \text{ } \text{♀} \text{ } K_{(5)} \text{ } \overbrace{C_{(5)}} \text{ } A_5 \text{ } \underline{G_{(2)}}$



### Try Yourself

37. Which of the following plant is a source of dye?
- |                       |                      |
|-----------------------|----------------------|
| (1) Sunhemp           | (2) <i>Trifolium</i> |
| (3) <i>Indigofera</i> | (4) Pea              |
38. Colchicine is obtained from
- |                             |                                |
|-----------------------------|--------------------------------|
| (1) <i>Colchicum luteum</i> | (2) <i>Colchicum autumnale</i> |
| (3) <i>Asparagus</i>        | (4) <i>Allium cepa</i> (onion) |

## EXERCISE

41. Which of the given symbol represents epitepalous condition?
- |  |  |
|--|--|
| (1) $\text{C} \text{ } \overbrace{\text{A}}$ | (2) $\text{P} \text{ } \overbrace{\text{A}}$ |
| (3) $\text{K} \text{ } \overbrace{\text{A}}$ | (4) %  |
42.  $C_{x4} A_{2+4}$  condition is characteristic to
- |                |                  |
|----------------|------------------|
| (1) Asteraceae | (2) Brassicaceae |
| (3) Fabaceae   | (4) Liliaceae    |
43. Select an **incorrect** match
- |                       |   |            |
|-----------------------|---|------------|
| (1) <i>Indigofera</i> | – | Fabaceae   |
| (2) <i>Helianthus</i> | – | Asteraceae |
| (3) <i>Capsicum</i>   | – | Malvaceae  |
| (4) <i>Aloe</i>       | – | Liliaceae  |



44. To how many families the given plants belong?

*Glycirriza, Glycine, Abrus, Yucca, Dracaena, Colchicum*

- (1) Two (2) Three  
(3) Four (4) Five

45. Mark the **incorrect** option (w.r.t. Floral formula of lily family)

- (1)  $A_{(6)}$  (2)  $\frac{\sigma}{\oplus}$   
(3)  $\underline{G}_{(3)}$  (4)  $\oplus$

46. Obliquely placed ovary, swollen placenta and epipetalous stamens are features of family

- (1) Solanaceae  
(2) Liliaceae  
(3) Fabaceae  
(4) Brassicaceae

47. Which of the given is/are fodder plant/s of fabaceae?

- (1) *Sesbania*  
(2) *Trifolium*  
(3) *Withania*  
(4) More than one option is correct

48. Floral formula  $Br \% \frac{\sigma}{\oplus} K_{(5)} C_{1+2+(2)} A_{(9)+1} \underline{G}_1$  belongs to family

- (1) Solanaceae (2) Brassicaceae  
(3) Fabaceae (4) Liliaceae

49. Mark the odd one (w.r.t. poaceae)

- (1) Orchids (2) *Avena*  
(3) *Pennisetum* (4) *Secale*

50. Ornamental plants of liliaceae family is

- (1) Lupin (2) *Gloriosa*  
(3) Sweet pea (4) Belladonna

### ADDITIONAL INFORMATION

- Thigmonasty is movement in response to stimulus of contact (bending of tentacles in *Drosera*, folding of leaves in venus fly trap, *Dionaea*)
- Development of fruit inside the soil is called as geocarpy e.g., ground nut.
- Caruncle is an outgrowth of integument which helps in seed germination and seed dispersion e.g., castor.
- Cremocarp** : It develops from bicarpellary inferior ovary. The mature fruit splits into two indehiscent one seeded mericarps which may remain attached for some time to a central axis or carpophore by means of stylopod. e.g. coriander, cumin (umbelliferae or apiaceae)





## Some Important Definitions

- **Morphology** : The science that deals with the study of form, size, colour, structure and relative position of various parts of the organism.
- **Plant organs** : The different structures present on the plant axis.
- **Vegetative organs** : The organs which take part in nutrition, growth and maintenance of the plant body.
- **Reproductive organs** : The organ responsible for producing new plants.
- **Roots** : Cylindrical, underground, non-green part of the plant which is specialized for absorbing water and minerals from the soil.
- **Root cap** : Thimble-shaped, cap-like structure covering the root apex.
- **Stem** : The ascending part of the plant axis which bears branches, leaves, flowers and fruits.
- **Terminal bud** : The bud present at the tip of the stem.
- **Axillary bud** : The bud which is present at the axil of the stem.
- **Axil** : The angle made between the leaves and the upper part of the stem.
- **Leaf** : A green, flat, thin, expanded lateral outgrowth of the stem.
- **Acropetal succession** : Younger leaves towards the growing point and the oldest towards the base of the parent stem.
- **Foliage** : All photosynthetic green leaves of a plant are collectively called foliage.
- **Leaf base** : The lower most, basal part of the leaf by which the leaf is attached to the node of the stem.
- **Petiole** : The cylindrical stalk that joins the leaf base with the leaf blade or lamina.
- **Lamina or leaf blade** : Green expanded part of the leaf where all the functions of a leaf is carried out.
- **Midrib** : The prominent vein present in the middle of the leaf blade.
- **Venation** : The arrangement of veins and veinlets in the lamina or leaf blade.
- **Phyllotaxy** : The pattern in which the leaves are arranged on the stem or its branches.
- **Inflorescence** : The arrangement and distribution of flower on the floral axis of the plant.
- **Flower** : The reproductive part of the plant, which is meant for sexual reproduction.
- **Thalamus** : The swollen, basal part of the pedicel or the stalk.
- **Bracts** : Reduced leaf-like structure present at the base of the pedicel.
- **Floral symmetry** : The arrangement and distribution of the floral organs around the axis of the flower.
- **Sepals** : Leaf-like structure that protects the flower or floral organs in the bud stage.
- **Staminode** : A sterile anther which does not produce pollen grains.
- **Ovary** : The basal swollen part of the carpel.
- **Placenta** : Parenchymatous tissue on the inner ovarian wall to which ovules are attached.
- **Style** : The tube-like structure which connects the stigma and the style.
- **Stigma** : Receptive organ for pollen grain which is present at the tip of the style.
- **Aestivation** : The mode of arrangement of sepals or petals in a floral bud with respect to the other members of the whorl.
- **Placentation** : The arrangement and distribution of ovules bearing placenta.
- **Seed coat** : The outer covering of the seed.



26. Pericarp is the fruit wall. It is differentiated into endocarp, mesocarp and epicarp.
27. A seed contains embryo, enclosed in a seed coat.
28. An embryo contains cotyledon, embryonal axis. Embryonal axis is divided into plumule and radicle.
29. Radicle gives rise to root system and plumule forms shoot system.
30. Depending upon the number of cotyledons present, seeds are of two types – monocotyledonous seed and dicotyledonous seed.



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# Assignment

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**(SET - 1)**

## **School/Board Examinations**

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Students are required to solve and write the solutions in their exercise book.

For referring solutions to the assignment (Set-1), please visit our Library at the Centre or log on to our website: [www.aakash.ac.in](http://www.aakash.ac.in)

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## SECTION - A

## School/Board Exam. Type Questions

## Very Short Answer Type Questions :

1. Which parts in ginger and potato are edible?
2. What type of venation occurs in banana?
3. What type of aestivation is found in *Calotropis*?
4. Name the phyllotaxy in *Alstonia*.
5. What is the nature of ovary in an epigynous flower?
6. What is the unit of gynoecium?
7. Write down the name of plant in which leaflets are modified into tendrils.
8. Which family is commonly called potato family?
9. Add the missing floral organs of the given floral formula of fabaceae.

$$\% \text{ } \overline{\text{K}}_{(5)} \text{ } \underline{\text{A}}_{(9)+1} \text{ } \underline{\text{G}}_1$$

10. Define internodes and nodes.

## Short Answer Type Questions :

11. What are trimerous flowers? Give one example.
12. What do the following terms stand for in a floral formula?

$$\overline{\text{K}}, \%, \text{P}, \text{Br}$$

13. Define aleurone layer. Give one example.
14. Differentiate between hypogynous and epigynous flower.
15. What are pitcher plants? Give example.
16. Rhizome of ginger is like the roots of other plants that grows underground. Despite this ginger is a stem not a root. Justify.
17. Name the two plants, belonging to the Solanaceae family, which are used as medicines.
18. Given below are few floral formulae of some well known plants. Draw floral diagrams from these formulae.

$$(a) \oplus \overline{\text{K}}_{2+2} \text{C}_4 \text{A}_{2+4} \underline{\text{G}}_{(2)}$$

$$(b) \oplus \overline{\text{K}} \text{P}_{3+3} \text{A}_{3+3} \underline{\text{G}}_{(3)}$$

19. Differentiate between stem tendrils and thorns.
20. Draw a labelled diagram of a dicot seed.
21. What do you understand by the term venation? Explain its types.
22. Explain briefly the modification of stem found in *Pistia* and *Eichhornia*.
23. Explain the vexillary and imbricate aestivation.
24. Describe the axile placentation with the help of an example.
25. Describe calyx, corolla and fruit of Solanaceae.



26. Write two differences and two similarities in the ovaries of Solanaceae and Liliaceae.
27. What are respiratory roots? How do they help the plant? Give an example.
28. Tendrils are found in the following plants. Identify whether they are stem tendrils or leaf tendrils.
 

(a) Cucumber	(b) Peas
(c) Pumpkins	(d) Grapevine
(e) Watermelons	
29. Define root hair. From which region of the root do they arise? What is their function?
30. Draw a well-labelled diagram of a typical leaf and label any five parts.

### Long Answer Type Questions :

31. Describe various root modifications associated with food storage, mechanical support and respiration.
32. Describe briefly the various regions of root.
33. Describe various stem modifications associated with food storage, climbing and protection.
34. What is a leaf? Where does it arise from? How is it borne on a stem? What is its function?
35. What is a compound leaf? Explain its two types with the help of example and diagram.
36. Explain the different types of floral symmetry.
37. Write a short note on fourth whorl of a flower.
38. Explain with diagram the placentation found in pea and mustard.
39. Tabulate the essential differences in the structure of a dicotyledonous and monocotyledonous seed.
40. Write the floral characters of fabaceae.
41. Why are the plants of Solanaceae family important to us?
42. Write any 10 symbols and what they stand for, used in a floral formula.
43. Why are leaves modified in some plants? Write any two modifications of leaves.
44. (a) Give the reproductive unit in angiosperms.  
(b) What is perianth? Give two examples.  
(c) Differentiate between radial and bilateral symmetry.
45. Write a short note on endosperm, embryo and seed coat found in seed of maize plant.

## SECTION - B

### Model Test Paper

### Very Short Answer Type Questions :

[1 Mark]

1. There may be a variation in the length of filaments of stamens within a flower. Give two examples.
2. Write the floral formula for family Liliaceae.
3. Name the fumigatory plant belonging to the family Solanaceae.
4. What is the ploidy level of aleurone layer?



5. Name the inflorescence in which the flowers are arranged in a basipetal manner.
6. What is mesocarp?
7. What is the fate of ovule and ovary after fertilisation?
8. Which drupe has a fibrous mesocarp?

**Short Answer Type Questions :**

**[2 Marks]**

9. What is the family of *Aloe*? Why is it important?
10. Explain valvate aestivation.
11. Explain alternate phyllotaxy with the help of an example.
12. Describe the type of leaf present in neem.
13. Diagrammatically explain the difference between parallel and reticulate venation.
14. What do you understand by asymmetric symmetry?
15. What is stigma? Why is it important?

**Short Answer Type Questions :**

**[3 Marks]**

16. Draw the floral diagram for the family Solanaceae.
17. Which symbols are used to represent the following in a floral formula?
  - (a) Inferior ovary
  - (b) Calyx
  - (c) Male
  - (d) Zygomorphic flower
  - (e) Perianth
  - (f) Gynoecium
18. Describe the function of a stem.
19. Explain the modified stem – stolon, in brief.
20. What is a floral diagram? Explain with a diagram.
21. Give two examples that develop from different part of the angiospermic plant other than radicle. Name the roots which are modified for respiration.

**Long Answer Type Questions :**

**[5 Marks]**

22.
  - (a) What is fruit?
  - (b) Define parthenocarpic fruit.
  - (c) Describe various zones of fruit by taking any fleshy fruit.
23. Distinguish between families Solanaceae, Liliaceae and Fabaceae on the basis of gynoecium characteristics. Also write economic importance of any one of the above family.







# Assignment

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**(SET - 2)**

**NEET & AIIMS**  
**(Competitive Entrance Exams.)**

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**SECTION - A****Objective Type Questions**





- Primary root is the direct elongation of the
  - Pedicle
  - Radicle
  - Plumule
  - Stamen
- The type of roots present in mustard plant is
  - Fibrous roots
  - Adventitious roots
  - Tap roots
  - Nodulated roots
- Which of the following is not the lateral branches of the roots?
  - Tertiary roots
  - Secondary roots
  - Primary root
  - More than one option is correct
- In wheat plant \_\_\_\_\_ root system is present.
  - Nodulated
  - Tap
  - Fibrous
  - Prop
- Which of the following is not the main function of the root system?
  - Provide anchorage to the plant parts
  - Synthesis of PGRs
  - Absorption of water and minerals from soil
  - Photosynthesis
- A root grows in length, which region of the root is responsible for this growth?
  - Root cap
  - Region of meristematic activity
  - Region of elongation
  - Region of maturation
- Root hairs are present in/on
  - Region of elongation
  - Region of maturation
  - Region of meristematic activity
  - Root cap
- The region or part of root that increases the surface area for water absorption is
  - Root cap
  - Zone of elongation
  - Meristematic zone
  - Root hair
- The tap roots of \_\_\_\_\_ gets modified to store food.
  - Carrot
  - Onion
  - Ginger
  - Sweet potato
- Adventitious roots of \_\_\_\_\_ get swollen and store food.
  - Carrot
  - Turnip
  - Radish
  - Sweet potato
- Supporting roots coming out of the lower nodes of the sugarcane stem are called
  - Prop roots
  - Stilt roots
  - Pneumatophores
  - Fusiform roots
- In *Rhizophora*, roots are modified to form
  - Tuberous roots
  - Pneumatophores
  - Stilt roots
  - Storage roots
- The hanging structures that support banyan tree are called
  - Prop roots
  - Stilt roots
  - Pneumatophores
  - Root hair
- Stem develops from \_\_\_\_\_ of the embryo of a germinating seed.
  - Radicle
  - Plumule
  - Pedicle
  - Pneumatophore
- \_\_\_\_\_ are the regions of the stem that bear leaves.
  - Internode
  - Nodes
  - Foliar bud
  - Radical bud
- Stems of potato, ginger and turmeric are modified to
  - Respiration
  - Perform photosynthesis
  - Store food
  - Provide support



17. In gourds, axillary buds develop spirally coiled structures called
  - (1) Thorns
  - (2) Tendril
  - (3) Offsets
  - (4) Suckers
18. \_\_\_\_\_ protect *Bougainvillea* from grazing animals.
  - (1) Tendrils
  - (2) Suckers
  - (3) Offsets
  - (4) Thorns
19. Stems are modified into flattened structures, which carryout photosynthesis in
  - (1) *Euphorbia*
  - (2) *Opuntia*
  - (3) *Bougainvillea*
  - (4) *Colocasia*
20. Chlorophyll containing fleshy cylindrical structures found in *Euphorbia* are modified
  - (1) Roots
  - (2) Fruit
  - (3) Leaves
  - (4) Stem
21. In *Pistia* and *Eichhornia*, stems are modified to form
  - (1) Offsets
  - (2) Tendrils
  - (3) Stolons
  - (4) Suckers
22. Leaves originate from \_\_\_\_\_ and are arranged in an \_\_\_\_\_ order.
  - (1) Root apical meristem, acropetal
  - (2) Floral meristem, basipetal
  - (3) Shoot apical meristem, acropetal
  - (4) Internodes, basipetal
23. Which of the following is not a part of a leaf?
  - (1) Pedicel
  - (2) Leaf base
  - (3) Petiole
  - (4) Lamina
24. Leaf base may bear two lateral small leaf like structures called
  - (1) Lamina
  - (2) Pulvinus
  - (3) Stipules
  - (4) Sepals
25. Swollen leaf base found in leguminous plants is called
  - (1) Leaf blade
  - (2) Petiole
  - (3) Stipules
  - (4) Pulvinus
26. Which one of the following plants shows alternate phyllotaxy?
  - (1) Sunflower
  - (2) Guava
  - (3) *Nerium*
  - (4) *Calotropis*
27. The petiole expand and become green to synthesize food in
  - (1) *Solanum*
  - (2) *Pisum sativum*
  - (3) Venus-fly trap
  - (4) Australian *Acacia*
28. Mark the incorrect statement
  - (1) Flower is a modified shoot
  - (2) In cymose inflorescence, the main axis terminates in a flower
  - (3) Flowers are borne on successive internodes on the stems and roots
  - (4) When a shoot tip transforms into a flower, the flower is always solitary
29. The four whorls of a flower are arranged on the
  - (1) Thalamus
  - (2) Petiole
  - (3) Corolla
  - (4) Stamens
30. Radial symmetry is found in flowers of
  - (1) *Cassia*
  - (2) Chilli
  - (3) Gulmohur
  - (4) *Canna*
31. The flower of which of the following plant is zygomorphic?
  - (1) Bean
  - (2) *Datura*
  - (3) Mustard
  - (4) *Canna*
32. Which of the following plant has a superior ovary?
  - (1) Peach
  - (2) Guava
  - (3) China rose
  - (4) Rose
33. Which of the following plant has epigynous flower?
  - (1) Cucumber
  - (2) Brinjal
  - (3) Mustard
  - (4) Peach
34. The ray florets of sunflower has
  - (1) Superior ovary
  - (2) Half inferior ovary
  - (3) Half superior ovary
  - (4) Inferior ovary
35. Mark the incorrect match
  - (1) *Calotropis* – Valvate
  - (2) Lady's finger – Twisted
  - (3) *Cassia* – Valvate
  - (4) Gulmohur – Imbricate



36. Match the column-I with column-II w.r.t. aestivation.

Column-I	Column-II
a. 	(i) Valvate
b. 	(ii) Vexillary
c. 	(iii) Twisted
d. 	(iv) Imbricate

- (1) a(ii), b(i), c(iv), d(iii)  
 (2) a(iii), b(ii), c(iv), d(i)  
 (3) a(iv), b(ii), c(iii), d(i)  
 (4) a(i), b(iii), c(iv), d(ii)

37. Carpels are fused in the flowers of

- (1) Lotus (2) Tomato  
 (3) Rose (4) Both (1) & (3)

38. Ovary containing the false septum occurs in

- (1) *Primrose* (2) *Dianthus*  
 (3) *Argemone* (4) *Pisum sativum*

39. In \_\_\_\_\_ placentation, the placenta forms a ridge along the ventral suture of the ovary.

- (1) Axile (2) Basal  
 (3) Free central (4) Marginal

40. The stony hard part of the mango represents

- (1) Mesocarp (2) Epicarp  
 (3) Endosperm (4) Endocarp

41. Select the correct statement w.r.t. Mango and coconut

- (1) They develop from monocarpellary superior ovaries  
 (2) They develop from monocarpellary inferior ovaries  
 (3) They have fibrous epicarp  
 (4) They have fleshy edible mesocarp

42. The inner layer of the seed coat is called

- (1) Testa (2) Hilum  
 (3) Micropyle (4) Tegmen

43. Which of the following parts of the embryo contains radicle and plumule?

- (1) Cotyledon (2) Seed coat  
 (3) Embryonal axis (4) Endosperm

44. Which of the following plant has endospermic seed?

- (1) Bean (2) Gram  
 (3) Pea (4) Castor

45. While representing a floral formula, G stands for

- (1) Epigynous flower (2) Superior ovary  
 (3) Inferior ovary (4) Androecium

46. Select the correct option.

Column-I	Column-II
a. Br	(i) Corolla
b. K	(ii) Perianth
c. C	(iii) Calyx
d. P	(iv) Bracteate
(1) a(iv), b(ii), c(iii), d(i)	(2) a(iv), b(i), c(iii), d(ii)
(3) a(iv), b(iii), c(i), d(ii)	(4) a(i), b(ii), c(iii), d(iv)

47. Actinomorphic nature of flower is represented by which of the following symbols?

- (1) A (2) %  
 (3)  $\oplus$  (4)  $\text{♀}$

48. The floral formula of the plants belonging to the family Fabaceae is

- (1)  $\oplus \text{♀} K_{(5)} C_{1+2+(2)} A_{(9)+1} \underline{G}_1$   
 (2)  $\% \text{♂} K_{(5)} C_{1+2+(2)} A_{(9)+1} \underline{G}_1$   
 (3)  $\oplus \text{♀} K_5 C_{1+2+2} A_{9+1} \underline{G}_1$   
 (4)  $\% \text{♀} K_{(5)} C_{1+2+(2)} A_{(9)+1} \underline{G}_1$

49. The plants belonging to the family Solanaceae is represented by the floral formula

- (1)  $\oplus \text{♀} K_5 C_5 A_5 \overline{G}_2$   
 (2)  $\oplus \text{♀} K_{(5)} C_{(5)} A_{(5)} \underline{G}_{(2)}$   
 (3)  $\oplus \text{♀} K_{(5)} \overbrace{C_{(5)} A_5} \underline{G}_{(2)}$   
 (4)  $\oplus \text{♀} K_5 \overbrace{C_{(5)} A_{(5)}} G_{(2)}$

50. Which of the following plants is used to extract the blue dye?

- (1) *Trifolium* (2) *Lupin*  
 (3) *Indigofera* (4) *Cassia*



## SECTION - B

### Objective Type Questions

- The origin of root hairs and lateral roots is
  - (1) Exogenous and endogenous respectively
  - (2) Endogenous and exogenous respectively
  - (3) Both endogenously
  - (4) Both exogenously
- Find odd one w.r.t radicle leaves
  - (1) Maize
  - (2) Radish
  - (3) Carrot
  - (4) Turnip
- Cuscuta*, *Viscum* and *Orobancha* are similar in having
  - (1) Hygroscopic roots
  - (2) Assimilatory roots
  - (3) Epiphyllous roots
  - (4) Haustorial roots
- Match the following
 

Column I	Column II
a. <i>Cuscuta</i>	(i) Hygroscopic root
b. <i>Rhizophora</i>	(ii) Stilt root
c. <i>Vanda</i>	(iii) Haustorial root
d. <i>Pandanus</i>	(iv) Respiratory root

  - (1) a(i), b(iii), c(iv), d(ii)
  - (2) a(iii), b(iv), c(i), d(ii)
  - (3) a(iii), b(i), c(iv), d(ii)
  - (4) a(ii), b(iv), c(i), d(iii)
- Stem modified into green, flattened branches of unlimited growth for assimilatory function is
  - (1) Phyllode
  - (2) Phylloclade
  - (3) Cladode
  - (4) Bulbil
- Leafless stem of onion which produces cluster of terminal flowers is called as
  - (1) Peduncle
  - (2) Floral axis
  - (3) Scape
  - (4) Rachis

- Which is not a modification of stem?
  - (1) Tuber of potato
  - (2) Pitcher of *Nepenthes*
  - (3) Corm of *Colocasia*
  - (4) Rhizome of ginger
- Reticulate venation is the feature of dicots but some monocots also exhibit this venation, like
  - (1) *Calophyllum*
  - (2) *Smilax*
  - (3) *Eryngium*
  - (4) *Corymbium*
- Thorns, spines and prickles work as \_\_\_\_\_ in plants.
  - (1) Respiratory organs
  - (2) Excretory organs
  - (3) Organs of offense
  - (4) Defensive organs
- Leaflet tendril and entire leaf tendril are found in respectively
  - (1) *Cucurbita*, *Smilax*
  - (2) *Pisum*, *Lathyrus sativus*
  - (3) *Passiflora*, *Vitis*
  - (4) *Luffa*, *Pisum*
- Select an **incorrect** match
  - (1) Whorled phyllotaxy – *Alstonia*, *Nerium*
  - (2) Decussate phyllotaxy – *Quisqualis*, *Psidium*, *Syzygium*
  - (3) Alternate phyllotaxy – Mustard, China rose, Sunflower
  - (4) Opposite phyllotaxy – *Zinnia*, *Calotropis*
- Which of the following is not the modification of leaf?
  - (1) Tendril in *Antigonon*
  - (2) Tendril in *Clematis*
  - (3) Tendril in *Gloriosa*
  - (4) Tendril in *Nepenthes*
- Select a **correct** set.
 

Plant	Organ	Function
(1) <i>Vanda</i>	Tap root	Moisture absorption
(2) Jasmine	Offset	Photosynthesis
(3) Pineapple	Sucker	Propagation
(4) <i>Nepenthes</i>	Leaf tip	Photosynthesis
- Inflorescence with thick, fleshy axis and large coloured bracts is
  - (1) Spathe
  - (2) Spadix
  - (3) Spikelet
  - (4) Hypanthodium



- 
- Flowers

- (1) *Crotolaria* and *Astragalus*
- (2) *Lepidium* and *Iberis*
- (3) *Allium* and *Asparagus*
- (4) *Vetiveria* and *Cymbopogon*



31. Find correct match

**Column I**

**Column II**

- |                                |                                |
|--------------------------------|--------------------------------|
| a. Sinigrin                    | (i) Liliaceae                  |
| b. Carthamin                   | (ii) Brassicaceae              |
| c. Atropine                    | (iii) Solanaceae               |
| d. Aloin                       | (iv) Asteraceae                |
| (1) a(ii), b(iv), c(iii), d(i) | (2) a(ii), b(iv), c(i), d(iii) |
| (3) a(i), b(ii), c(iii), d(iv) | (4) a(i), b(ii), c(iv), d(iii) |

32. Find out a set of common N<sub>2</sub> fixing fodder plants

- |  |                                    |
|--|------------------------------------|
| (1) <i>Trifolium</i> , <i>Atropa</i>   | (2) <i>Withania</i> , <i>Abrus</i> |
| (3) <i>Sesbania</i> , <i>Trifolium</i> | (4) <i>Aloe</i> , <i>Gloriosa</i>  |

33. Family fabaceae is concerned with

- (1) Diadelphous stamen, marginal placentation, obliquely placed ovary and vexillary corolla
- (2) Diadelphous stamen, marginal placenta and large posterior petal
- (3) Basal placentation, versatile stamens, spikelet inflorescence
- (4) Axile placentation, non-endospermic seed, legume fruit

34. Butterfly shaped corolla, monocarpellary ovary and zygomorphic flowers are found in family

- (1) Caesalpinoideae
- (2) Solanaceae
- (3) Papilionaceae / Fabaceae
- (4) Graminae

35. Most primitive and advanced families of dicots are respectively

- (1) Solanaceae and Asteraceae
- (2) Leguminosae and Poaceae
- (3) Ranunculaceae and Asteraceae
- (4) Asteraceae and Cucurbitaceae

2. How many plants among *Indigofera*, *Sesbania*, *Salvia*, *Allium*, *Aloe*, mustard, groundnut, radish, gram and turnip have stamens with different lengths in their flowers? **[NEET (Phase-2) 2016]**

- |           |          |
|-----------|----------|
| (1) Three | (2) Four |
| (3) Five  | (4) Six  |

3. Radial symmetry is found in the flowers of

**[NEET (Phase-2) 2016]**

- |                     |                      |
|---------------------|----------------------|
| (1) <i>Brassica</i> | (2) <i>Trifolium</i> |
| (3) <i>Pisum</i>    | (4) <i>Cassia</i>    |

4. Free-central placentation is found in

**[NEET (Phase-2) 2016]**

- |                     |                     |
|---------------------|---------------------|
| (1) <i>Dianthus</i> | (2) <i>Argemone</i> |
| (3) <i>Brassica</i> | (4) <i>Citrus</i>   |

5. Match **Column-I** with **Column-II** and select the correct option using the codes given below

**[NEET (Phase-2) 2016]**

**Column-I**

**Column-II**

- |                                 |                   |
|---------------------------------|-------------------|
| a. Pistils fused together       | (i) Gametogenesis |
| b. Formation of gametes         | (ii) Pistillate   |
| c. Hyphae of higher Ascomycetes | (iii) Syncarpous  |
| d. Unisexual female flower      | (iv) Dikaryotic   |

**Codes :**

- |                                |                                |
|--------------------------------|--------------------------------|
| (1) a(iv), b(iii), c(i), d(ii) | (2) a(ii), b(i), c(iv), d(iii) |
| (3) a(i), b(ii), c(iv), d(iii) | (4) a(iii), b(i), c(iv), d(ii) |

6. Cotyledon of maize grain is called **[NEET-2016]**

- |                |                |
|----------------|----------------|
| (1) Scutellum  | (2) Plumule    |
| (3) Coleorhiza | (4) Coleoptile |

7. Tricarpellary, syncarpous gynoecium is found in flowers of **[NEET-2016]**

- |                |               |
|----------------|---------------|
| (1) Poaceae    | (2) Liliaceae |
| (3) Solanaceae | (4) Fabaceae  |

8. Which of the following is **not** a stem modification? **[NEET-2016]**

- (1) Flattened structures of *Opuntia*
- (2) Pitcher of *Nepenthes*
- (3) Thorns of citrus
- (4) Tendrils of cucumber

**SECTION - C**

**Previous Years Questions**

1. The term 'polyadelphous' is related to

**[NEET (Phase-2) 2016]**

- (1) Gynoecium
- (2) Androecium
- (3) Corolla
- (4) Calyx



9. Stems modified into flat green organs performing the functions of leaves are known as **[NEET-2016]**
  - (1) Scales (2) Cladodes
  - (3) Phyllodes (4) Phylloclades
10. The standard petal of a papilionaceous corolla is also called **[NEET-2016]**
  - (1) Corona (2) Carina
  - (3) Pappus (4) Vexillum
11. Among china rose, mustard, brinjal, potato, guava, cucumber, onion and tulip, how many plants have superior ovary? **[Re-AIPMT-2015]**
  - (1) Four (2) Five
  - (3) Six (4) Three
12. Flowers are unisexual in : **[Re-AIPMT-2015]**
  - (1) Onion (2) Pea
  - (3) Cucumber (4) China rose
13. Leaves become modified into spines in **[AIPMT-2015]**
  - (1) Silk Cotton (2) *Opuntia*
  - (3) Pea (4) Onion
14. Keel is the characteristic feature of flower of **[AIPMT-2015]**
  - (1) Tomato (2) Tulip
  - (3) *Indigofera* (4) *Aloe*
15. Perigynous flowers are found in **[AIPMT-2015]**
  - (1) Rose (2) Guava
  - (3) Cucumber (4) China rose
16.  $\oplus \frac{\sigma}{\text{K}} \frac{\text{C}}{(5)} \frac{\text{A}}{(5)} \frac{\text{G}}{(2)}$  is the floral formula of **[AIPMT-2015]**
  - (1) *Brassica* (2) *Allium*
  - (3) *Sesbania* (4) *Petunia*
17. Which one of the following statements is **correct**? **[AIPMT-2014]**
  - (1) The seed in grasses is not endospermic
  - (2) Mango is a parthenocarpic fruit
  - (3) A proteinaceous aleurone layer is present in maize grain
  - (4) A sterile pistil is called a staminode
18. An example of edible underground stem is : **[AIPMT-2014]**
  - (1) Carrot (2) Groundnut
  - (3) Sweet potato (4) Potato
19. Placenta and pericarp are both edible portions in : **[AIPMT-2014]**
  - (1) Apple (2) Banana
  - (3) Tomato (4) Potato
20. When the margins of sepals or petals overlap one another without any particular direction, the condition is termed as : **[AIPMT-2014]**
  - (1) Vexillary (2) Imbricate
  - (3) Twisted (4) Valvate
21. An aggregate fruit is one which develops from **[AIPMT-2014]**
  - (1) Multicarpellary syncarpous gynoecium
  - (2) Multicarpellary apocarpous gynoecium
  - (3) Complete inflorescence
  - (4) Multicarpellary superior ovary
22. Non-albuminous seed is produced in **[AIPMT-2014]**
  - (1) Maize (2) Castor
  - (3) Wheat (4) Pea
23. Seed coat is **not** thin, membranous in **[NEET-2013]**
  - (1) Coconut (2) Groundnut
  - (3) Gram (4) Maize
24. Among bitter gourd, mustard, brinjal, pumpkin, china rose, lupin, cucumber, sunnhemp, gram, guava, bean, chilli, plum, petunia, tomato, rose, withania, potato, onion, aloe, and tulip how many plants have hypogynous flower? **[NEET-2013]**
  - (1) Ten (2) Fifteen
  - (3) Eighteen (4) Six
25. In china rose the flower are **[NEET-2013]**
  - (1) Actinomorphic, epigynous with valvate aestivation
  - (2) Zygomorphic, hypogynous with imbricate aestivation
  - (3) Zygomorphic, epigynous with twisted aestivation
  - (4) Actinomorphic, hypogynous with twisted aestivation
26. Placentation in tomato and lemon is **[AIPMT (Prelims)-2012]**
  - (1) Marginal
  - (2) Axile
  - (3) Parietal
  - (4) Free central



27. Vexillary aestivation is characteristic of the family

[AIPMT (Prelims)-2012]

- |                |                  |
|----------------|------------------|
| (1) Solanaceae | (2) Brassicaceae |
| (3) Fabaceae   | (4) Asteraceae   |

28. Phyllode is present in

[AIPMT (Prelims)-2012]

- (1) Australian *Acacia*  
 (2) *Opuntia*  
 (3) *Asparagus*  
 (4) *Euphorbia*

29. How many plants in the list given below have composite fruits that develop from an inflorescence? Walnut, poppy, radish, fig, pineapple, apple, tomato, mulberry

[AIPMT (Prelims)-2012]

- |          |           |
|----------|-----------|
| (1) Two  | (2) Three |
| (3) Four | (4) Five  |

30. Cymose inflorescence is present in

[AIPMT (Prelims)-2012]

- |                      |                     |
|----------------------|---------------------|
| (1) <i>Trifolium</i> | (2) <i>Brassica</i> |
| (3) <i>Solanum</i>   | (4) <i>Sesbania</i> |

31. Which one of the following organisms is **correctly** matched with its three characteristics ?

[AIPMT (Mains)-2012]

- (1) Pea :  $C_3$  pathway, Endospermic seed, Vexillary aestivation  
 (2) Tomato: Twisted aestivation, Axile placentation, Berry  
 (3) Onion: Bulb, Imbricate aestivation, Axile placentation  
 (4) Maize :  $C_3$  pathway, Closed vascular bundles, Scutellum

32. How many plants in the list given below have marginal placentation ?

[AIPMT (Mains)-2012]

Mustard, Gram, Tulip, *Asparagus*, Arhar, Sun hemp, Chilli, Colchicine, Onion, Moong, Pea, Tobacco. Lupin

- |          |           |
|----------|-----------|
| (1) Four | (2) Five  |
| (3) Six  | (4) Three |

33. The 'Eyes' of the potato tuber are

[AIPMT (Prelims)-2011]

- |                   |                |
|-------------------|----------------|
| (1) Axillary buds | (2) Root buds  |
| (3) Flower buds   | (4) Shoot buds |

34. Which one of the following statements is **correct**?

[AIPMT (Prelims)-2011]

- (1) Flower of tulip is a modified shoot  
 (2) In tomato, fruit is a capsule  
 (3) Seeds of orchids have oil - rich endosperm  
 (4) Placentation in Primose is basal

35. The **correct** floral formula of chilli is

[AIPMT (Prelims)-2011]

- |  |  |
|--|--|
| (1) $\oplus \frac{\text{K}_5}{\text{C}_5} \text{A}_{(5)} \text{G}_2$             | (2) $\oplus \frac{\text{K}_{(5)}}{\text{C}_5} \text{A}_{(5)} \text{G}_{(2)}$ |
| (3) $\oplus \frac{\text{K}_{(5)}}{\text{C}_{(5)}} \text{A}_{(5)} \text{G}_{(2)}$ | (4) $\oplus \frac{\text{K}_{(5)}}{\text{C}_{(5)}} \text{A}_{(5)} \text{G}_2$ |

36. A drupe develops in

[AIPMT (Prelims)-2011]

- |            |           |
|------------|-----------|
| (1) Tomato | (2) Mango |
| (3) Wheat  | (4) Pea   |

37. Flowers are Zygomorphic in

[AIPMT (Prelims)-2011]

- |                   |             |
|-------------------|-------------|
| (1) <i>Datura</i> | (2) Mustard |
| (3) Gulmohur      | (4) Tomato  |

38. Whorled simple leaves with reticulate venation are present in

[AIPMT (Mains)-2011]

- |                       |                     |
|-----------------------|---------------------|
| (1) China Rose        | (2) <i>Alstonia</i> |
| (3) <i>Calotropis</i> | (4) Neem            |

39. Which one of the following pairs is **wrongly** matched while the remaining three are correct?

[AIPMT (Mains)-2011]

- (1) *Bryophyllum* – Leaf buds  
 (2) *Agave* – Bulbils  
 (3) *Penicillium* – Conidia  
 (4) Water hyacinth – Runner

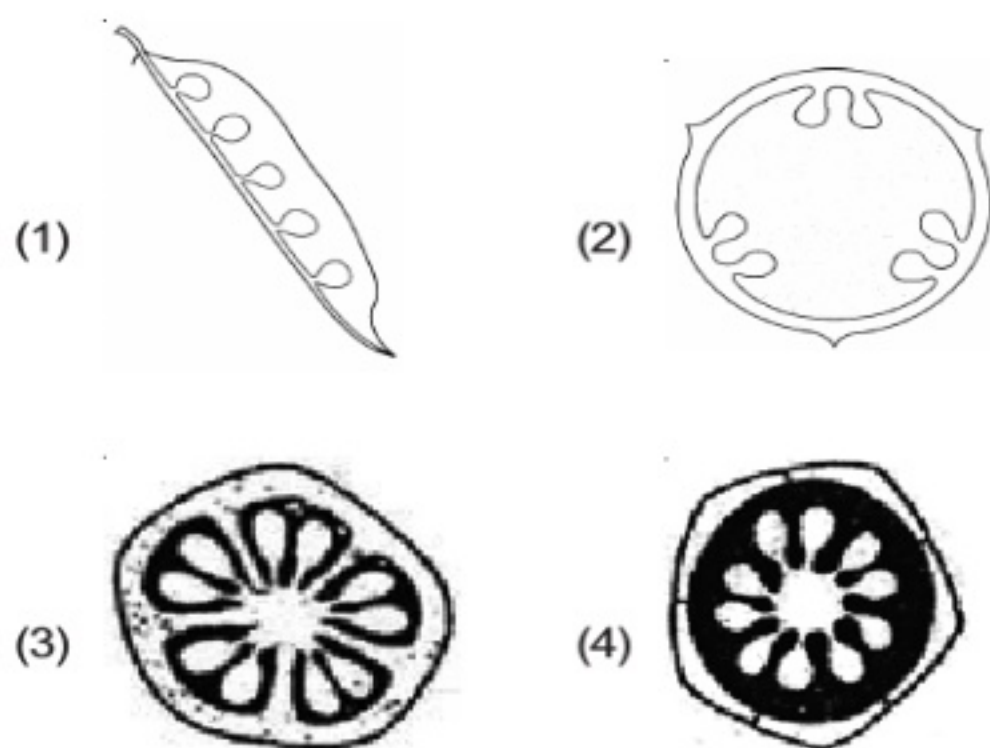
40. Sweet potato is homologous to

[AIPMT (Mains)-2011]

- |            |                      |
|------------|----------------------|
| (1) Ginger | (2) Turnip           |
| (3) Potato | (4) <i>Colocasia</i> |



41. Which one of the following diagrams represent the placentation in *Dianthus*? [AIPMT (Mains)-2011]



42. The ovary is half inferior in flowers of : [AIPMT (Prelims)-2011]

- (1) Guava  
(2) Peach  
(3) Cucumber  
(4) Cotton

43. The technical term used for the androecium in a flower of China rose (*Hibiscus rosa-sinensis*) is [AIPMT (Prelims)-2010]

- (1) Polyadelphous (2) Monadelphous  
(3) Diadelphous (4) Polyandrous

44. The scutellum observed in a grain of wheat or maize is comparable to which part of the seed in other monocotyledons? [AIPMT (Prelims)-2010]

- (1) Plumule (2) Cotyledon  
(3) Endosperm (4) Aleurone layer

45. Keel is characteristic of the flowers of [AIPMT (Prelims)-2010]

- (1) Bean (2) Gulmohur  
(3) *Cassia* (4) *Calotropis*

46. In unilocular ovary with a single ovule the placentation is [AIPMT (Prelims)-2010]

- (1) Axile (2) Marginal  
(3) Basal (4) Free central

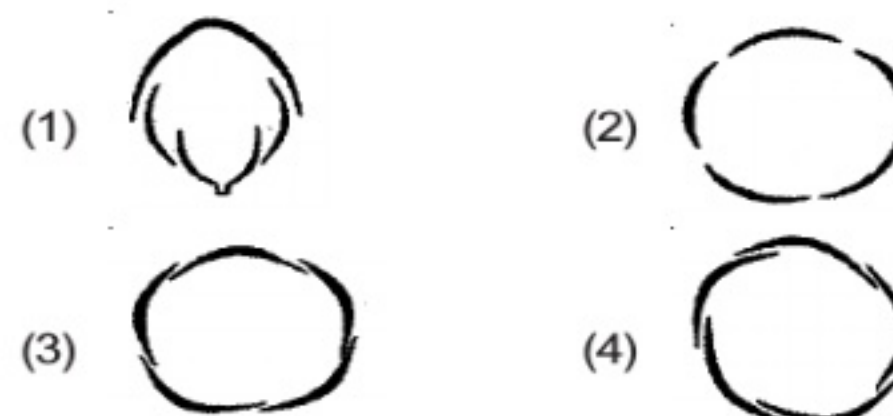
47. Ovary is half-inferior in the flowers of [AIPMT (Prelims)-2010]

- (1) Cucumber (2) Guava  
(3) Plum (4) Brinjal

48. Which one of the following is a xerophytic plant in which the stem is modified into the flat, green and succulent structure? [AIPMT (Mains)-2010]

- (1) *Opuntia* (2) *Casuarina*  
(3) *Hydrilla* (4) *Acacia*

49. Aestivation of petals in the flower of cotton is correctly shown in [AIPMT (Mains)-2010]

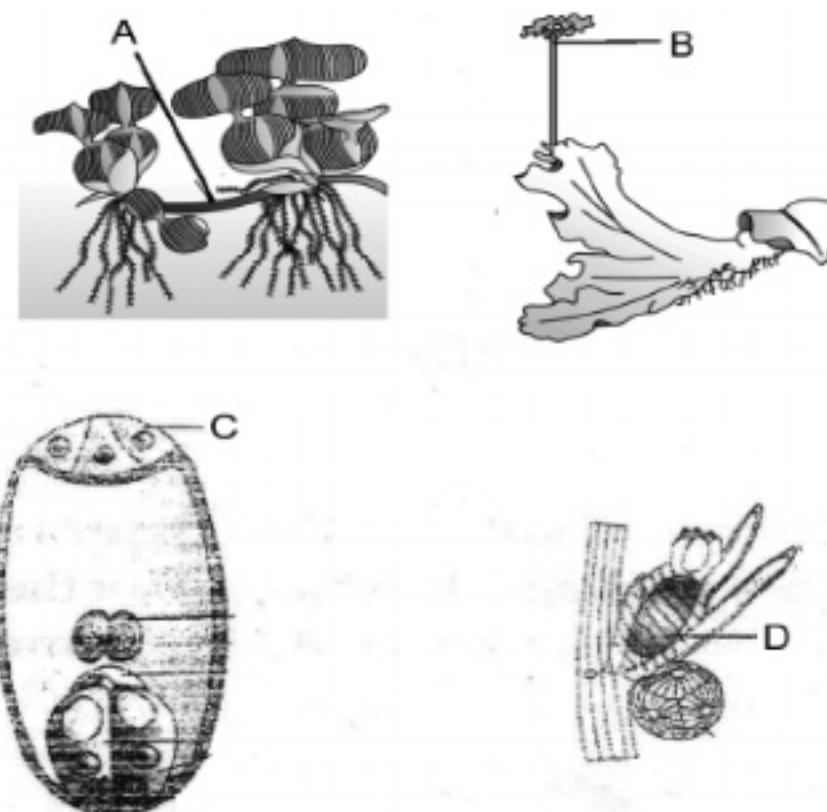


50. The correct floral formula of soyabean is [AIPMT (Mains)-2010]

- (1)  $\% \text{ } \overline{\text{K}}_{(5)} \text{C}_{1+(2)+2} \text{A}_{(9)+1} \text{G}_{\overline{\text{T}}}$  (2)  $\% \text{ } \overline{\text{K}}_5 \text{C}_{1+(2)+2} \text{A}_{(9)+1} \text{G}_{\underline{1}}$   
(3)  $\% \text{ } \overline{\text{K}}_{(5)} \text{C}_{1+2+(2)} \text{A}_{(9)+1} \text{G}_{\underline{1}}$  (4)  $\% \text{ } \overline{\text{K}}_{(5)} \text{C}_{1+2+(2)} \text{A}_{1+(9)} \text{G}_{\overline{\text{T}}}$

51. Examine the figures (A-D) given below and select the right option out of 1-4, in which all the four structures A, B, C and D are identified correctly

Structures :



[AIPMT (Mains)-2010]

Options :

	A	B	C	D
(1)	Rhizome	Sporangiophore	Polar cell	Globule
(2)	Runner	Archegoniophore	Synergid	Antheridium
(3)	Offset	Antheridiophore	Antipodals	Oogonium
(4)	Sucker	Seta	Megaspore mother cell	Gemma cup

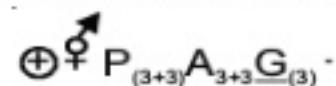


52. Consider the following four statements A, B, C and D and select the right option for two **correct** statements

**Statements**

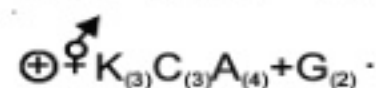
(A) In vexillary aestivation, the large posterior petal is called - standard, two lateral ones are wings and two small anterior petals are termed keel

(B) The floral formula for Liliaceae is



(C) In pea flower the stamens are monadelphous

(D) The floral formula for Solanaceae is



The **correct** statements are

[AIPMT (Mains)-2010]

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

53. Vegetative propagation in *Pistia* occurs by

[AIPMT (Mains)-2010]

- (1) Stolon (2) Offset  
(3) Runner (4) Sucker

54. The floral formula  $\oplus \text{P}_{(3+3)} \text{A}_{3+3} \text{G}_{(3)}$  is that of

[AIPMT (Prelims)-2009]

- (1) Soybean (2) Sunnhemp  
(3) Tobacco (4) Tulip

55. A fruit developed from hypanthodium inflorescence is called:

[AIPMT (Prelims)-2009]

- (1) Sorosis (2) Syconus  
(3) Caryopsis (4) Hesperidium

56. Vegetative propagation in mint occurs by :

[AIPMT (Prelims)-2009]

- (1) Offset (2) Rhizome  
(3) Sucker (4) Runner

57. Cotyledons and testa respectively are edible parts in:

[AIPMT (Prelims)-2009]

- (1) Walnut and tamarind  
(2) French bean and coconut  
(3) Cashew nut and litchi  
(4) Groundnut and pomegranate

58. An example of axile placentation is :

[AIPMT (Prelims)-2009]

- (1) *Dianthus* (2) Lemon  
(3) Marigold (4) *Argemone*

59. Thorn of *Bougainvillea* and tendril of cucurbita are example of [AIPMT (Prelims)-2008]

- (1) Retrogressive evolution  
(2) Analogous organs  
(3) Homologous organs  
(4) Vestigial organs

60. The fruit is chambered, developed from inferior ovary and has seeds with succulent testa in

[AIPMT (Prelims)-2008]

- (1) Cucumber (2) Pomegranate  
(3) Orange (4) Guava

61. Dry indehiscent single-seeded fruit formed bicarpellary syncarpous inferior ovary is

[AIPMT (Prelims)-2008]

- (1) Cremocarp  
(2) Caryopsis  
(3) Cypsela  
(4) Berry

62. Endosperm is consumed by developing embryo in the seed of [AIPMT (Prelims)-2008]

- (1) Maize (2) Coconut  
(3) Castor (4) Pea

63. Replum is present in the ovary of flower of

[AIPMT (Prelims)-2008]

- (1) Pea (2) Lemon  
(3) Mustard (4) Sunflower

64. The fleshy receptacle of syconus of fig encloses a number of [AIPMT (Prelims)-2008]

- (1) Mericarps (2) Achenes  
(3) Samaras (4) Berries

65. Pineapple (annanas) fruit develops from :

[AIPMT (Prelims)-2006]

- (1) A unilocular polycarpellary flower  
(2) A multipistillate syncarpous flower  
(3) A cluster of compactly borne flowers on a common axis  
(4) A multilocular monocarpellary flower

66. In which of the following fruits is the edible part the aril ? [AIPMT (Prelims)-2006]

- (1) Custard apple (2) Pomegranate  
(3) Orange (4) Litchi



67. Pentamerous, actinomorphic flowers, bicarpellary ovary with oblique septa, and fruit a capsule or berry, are characteristic features of :  
[AIPMT (Prelims)-2006]  
(1) Asteraceae (2) Brassicaceae  
(3) Solanaceae (4) Liliaceae
68. What type of placentation is seen in sweet pea ?  
[AIPMT (Prelims)-2006]  
(1) Basal (2) Axile  
(3) Free central (4) Marginal
69. Which of the following represents the edible part of the fruit of litchi ?  
[AIPMT (Prelims)-2005]  
(1) Pericarp  
(2) Mesocarp  
(3) Juicy aril  
(4) Endocarp
- Questions asked Prior to Medical Ent. Exams. 2005**
70. Angiosperm, to which the largest flowers belong, is  
(1) Total root parasite  
(2) Partial root parasite  
(3) Total stem parasite  
(4) Partial stem parasite
71. The plant, which bears clinging roots, is  
(1) Screw pine (2) *Podostemon*  
(3) *Trapa* (4) Orchid
72. Pneumatophores are found in  
(1) The vegetation which is found in marshy and saline lake  
(2) The vegetation which is found in acidic soil  
(3) Xerophytes  
(4) Epiphytes
73. In a longitudinal section of a root, starting from the tip upward, the four zones occur in the following order  
(1) Root cap, cell division, cell enlargement, cell maturation  
(2) Root cap, cell division, cell maturation, cell enlargement  
(3) Cell division, cell enlargement, cell maturation, root cap  
(4) Cell division, cell maturation, cell enlargement, root cap
74. A plant bears fruit, has a column of vascular tissue and a tap root system. This plant is a/an  
(1) Angiosperm and dicot  
(2) Gymnosperm and dicot  
(3) Angiosperm and monocot  
(4) Gymnosperm and monocot
75. What is the eye of potato?  
(1) Axillary bud (2) Accessory bud  
(3) Adventitious bud (4) Apical bud
76. How many plants among China rose, *Ocimum*, sunflower, mustard, *Alstonia*, guava, *Calotropis* and *Nerium* (Oleander) have opposite phyllotaxy?  
(1) Two (2) Three  
(3) Four (4) Five
77. The lid of pitcher in pitcher plant, is the modification of  
(1) Leaf apex (2) Leaf base  
(3) Petiole (4) Lamina
78. A pair of insectivorous plants is  
(1) *Dionaea* and *Viscum*  
(2) Venus fly trap and *Rafflesia*  
(3) *Drosera* and *Rafflesia*  
(4) *Nepenthes* and bladderwort
79. The ability of the Venus Flytrap to capture insects is due to  
(1) Specialized "muscle-like" cells  
(2) Chemical stimulation by the prey  
(3) A passive process requiring no special ability on the part of the plant  
(4) Rapid turgor pressure changes
80. In a cymose inflorescence the main axis  
(1) Terminates in a flower  
(2) Has unlimited growth  
(3) Bears a solitary flower  
(4) Has unlimited growth but lateral branches end in flowers
81. Inflorescence is racemose in  
(1) Soyabean (2) Brinjal  
(3) Tulip (4) *Aloe*
82. Hypanthodium is a specialized type of  
(1) Fruit (2) Inflorescence  
(3) Thalamus (4) Ovary



83. Hairs found in the inflorescence of *Zea mays* are the modification of  
 (1) Style (2) Stigma  
 (3) Spathe (4) Filaments
84. Floral features are chiefly used in angiosperms, identification, because  
 (1) Flowers can be safely pressed  
 (2) Reproductive parts are more stable and conservative than vegetative parts  
 (3) Flowers are nice to work with  
 (4) Flowers are of various colours
85. Tetrastynamous condition occurs in  
 (1) Cruciferae (2) Malvaceae  
 (3) Solanaceae (4) Liliaceae
86. Anthesis is a phenomenon which refers to  
 (1) Reception of pollen by stigma  
 (2) Formation of pollen  
 (3) Development of anther  
 (4) Opening of flower bud
87. Pappus in sunflower family is the modification of  
 (1) Hairs  
 (2) Anthers  
 (3) Calyx  
 (4) Corolla
88. How many plants in the list given below have composite fruits that develop from an inflorescence?  
 Walnut, poppy, radish, fig, pineapple, apple, tomato, mulberry.  
 (1) Two (2) Three  
 (3) Four (4) Five
89. Which of the following is a 'true fruit'?  
 (1) Banana (2) Pineapple  
 (3) Apple (4) Pear
90. Coir is the commercial product of coconut's  
 (1) Endocarp  
 (2) Endosperm  
 (3) Pericarp  
 (4) Mesocarp
91. Aril represents the edible part of  
 (1) Mango (2) Apple  
 (3) Banana (4) Litchi
92. Which plant will lose its economic value, if its fruits are produced by induced parthenocarpy?  
 (1) Orange  
 (2) Banana  
 (3) Grape  
 (4) Pomegranate
93. Edible part in coconut is  
 (1) Endosperm  
 (2) Pericarp  
 (3) Mesocarp  
 (4) Fleshy aril
94. Geocarpic fruit is  
 (1) Carrot  
 (2) Radish  
 (3) Ground nut  
 (4) Turnip
95. Which is correct pair for edible part?  
 (1) Tomato-thalamus  
 (2) Maize-cotyledons  
 (3) Guava-mesocarp  
 (4) Date palm-mesocarp
96. Edible part of banana is  
 (1) Epicarp  
 (2) Mesocarp and less developed endocarp  
 (3) Endocarp and less developed mesocarp  
 (4) Epicarp and mesocarp
97. Edible part in mango is  
 (1) Mesocarp  
 (2) Epicarp  
 (3) Endocarp  
 (4) Epidermis
98. Geocarpic fruit is  
 (1) Potato  
 (2) Peanut  
 (3) Onion  
 (4) Garlic



99. Juicy hair-like structures observed in the lemon fruit develop from
- (1) Exocarp
  - (2) Mesocarp
  - (3) Endocarp
  - (4) Mesocarp and endocarp
100. Select correct statement w.r.t. hard walled berry.
- (1) Multiseeded fruit developing from superior ovary
  - (2) Edible part is juicy unicellular hairs
  - (3) Develops from  $\overline{G(3)}$
  - (4) Develops from  $\underline{G(3)}$
101. Scutellum in a caryopsis represents
- (1) Outermost layer of endosperm
  - (2) A sheath that protects the radicle
  - (3) The place where the seed is attached to raphe
  - (4) A cotyledon
102. An example of a seed with endosperm, perisperm and caruncle is
- (1) Castor
  - (2) Cotton
  - (3) Coffee
  - (4) Lily
103. Among flowers of *Calotropis*, tulip, *Sesbania*, *Asparagus*, Colchicine, Sweet pea, *Petunia*, *Indigofera*, Mustard, Soybean, Tobacco and groundnut how many plants have corolla with valvate aestivation?
- (1) Five
  - (2) Six
  - (3) Seven
  - (4) Eight
104. Which is expressing right appropriate pairing?
- (1) Brassicaceae - Sunflower
  - (2) Malvaceae - Cotton
  - (3) Papilionaceae - Catechu
  - (4) Liliaceae - Wheat
105. Bicarpellary gynoecium and oblique ovary occur in
- (1) Mustard
  - (2) Banana
  - (3) *Pisum*
  - (4) Brinjal

## SECTION - D

## Assertion - Reason Type Questions

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

- (1) If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).
  - (2) If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).
  - (3) If Assertion is true statement but Reason is false, then mark (3).
  - (4) If both Assertion and Reason are false statements, then mark (4).
1. A : In head inflorescence florets are arranged centrifugally.  
R : There always occurs two types of florets in a head.
  2. A : Staminal tube is present in Malvaceae.  
R : It is due to monadelphous condition.
  3. A : Prop roots are rope like showing oblique growth.  
R : Prop roots are adventitious roots for extra-support and assimilation.
  4. A : The storage region of maize grain is whitish or yellow.  
R : It is rich in protein granules.
  5. A : There are two alae in *Pisum sativum* flower.  
R : Both alae are covered by largest petal.
  6. A : Corm grows vertically beneath soil surface.  
R : It bears nodes, internodes, buds & green leaves.
  7. A : In *Smilax*, stipule changes into tendril & helps in climbing.  
R : Parallel venation is found in this plant.
  8. A : Androecium of *Cucurbita* is synandrous.  
R : Anthers as well as filaments of stamens are united throughout their whole length.
  9. A : Nucellus remains persistent in the seeds of black pepper  
R : It is haploid parenchymatous tissue.
  10. A : Epiphyllous roots arise from the margins of leaf lamina.  
R : Epiphyllous roots help in vegetative reproduction.

