# 5

# Morphology of Flowering Plants

## Multiple Choice Questions (MCQs)

**Q. 1** Rearrange the following zones as seen in the root in vertical section and choose the correct option.

A. Root hair zone
B. Zone of meristems
C. Root cap zone
D. Zone of maturation
E. Zone of elongation

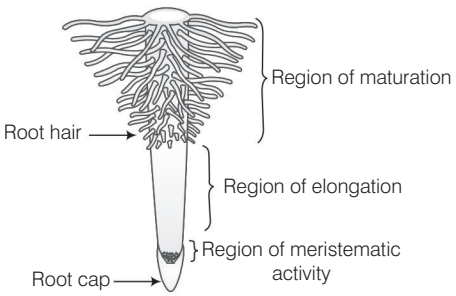
**Codes**

(a) C, B, E, A, D (b) A, B, C, D, E (c) D, E, A, C, B (d) E, D, C, B, A

**Ans.** *(b)* **Root Cap Zone** protective covering at the root apex, secretes mucilage to soften the hard soil for the growth of root.

**Zone of Meristem** region of actively dividing densely packed cells resulting into root growth.

**Zone of Elongation** divided cells grow in size and elongate increasing the lenght of root. They cannot divide furthrer.




**The regions of the root**

**Root Hair Zone** root hair arises and grow in this region, helps in water and mineral absorption from the soil.

**Zone of Maturation** the cells of root at this region are fully differentiated and mature, performing different functions of root.

**Q. 2** In an inflorescence where flowers are borne laterally in an acropetal succession, the position of the youngest floral bud shall be

(a) proximal (b) distal (c) intercalary (d) any where

**Thinking Process**

*The arrangement of flower on the main axis of the plant is called inflorescence. Think of the different kind of flower arrangement. How do the plants put up their flower to attract the pollinating agencies?*

**Ans.** *(b)* In racemose inflorescence younger flowers are born at the apex or distal end while older flowers are at the base, this type of succession is acropetal succession. Thus, the position of youngest floral but would be distal.

**Q. 3** The mature seeds of plants such as gram and peas possess no endosperm, because

(a) these plants are not angiosperms

(b) there is no double fertilisation in them

(c) endosperm is not formed in them

(d) endosperm gets used up by the developing embryo during seed development

**Thinking Process**

*Gram and peas are dicot plants belonging to angiosperms. All angiosperms bear seeds. During seed development inside the embryo sac, embryo needs nourishment for its development. It is provided by endosperm. It is a product of triple fusion (3n) ploidy.*

**Ans.** *(d)* Endosperm is a nourishing tissue of seed which provide nourishment to the developing embryo either before or after germination. In gram and peas, the endosperm gets used up at the time of development of seed. So, seed is non-endospermic, *i.e.,* endosprem is not present in the mature seed.

**Q. 4** Roots developed from parts of the plant other than radicle are called

(a) tap roots (b) fibrous roots (c) adventitious roots (d) nodular roots

**Thinking Process**

*As the seed germinates, it gives rise to plumule and radicle. Radicle develops into root system. Other plant parts also can give rise to roots depending upon the need of the plants.*

**Ans.** *(c)* Roots developed from parts of the plant other than radicle are called adventitious roots. They branch like tap roots and may be underground or aerial, and may develop from nodes internodes on leaves, etc.

*Other options are incorrect because*

**Tap roots** are the roots developed from the radicle of embryo and persists and grows directly into primary root.

Fibrous roots are thin, thread-like branched roots developing from base of stem. These are modifications of tap root, found in monocots.

Nodular roots are also modifications of tap roots in which roots and its branches develop small or large swalling called nodules. They help in nitrogen fixation.

**Q. 5** Venation is a term used to describe the pattern of arrangement of

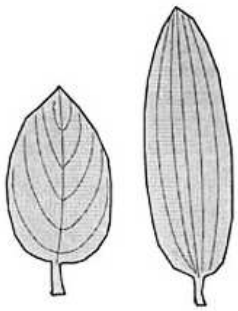
(a) floral organs

(b) flower in infloresence

(c) veins and veinlets in a lamina

(d) all of them

**Ans.** *(c)* **Venation** The veins are the part of leaf which possess vascular tissues, *i.e.,* xylem and phloem. They are meant for the conduction of water, minerals and food to and from in the leaf. The special arrangement of veins in a leaf is called as venation.



(a) (b)

**Venation in leaves (a) Reticulate venation** (dicot leaf)

**Q. 6** Endosperm, a product of double fertilisation in angiosperms is absent in the seeds of

(a) Coconut (b) Orchids (c) Maize (d) Castor

**Ans.** *(b)* Orchid seed is a non-endospermic seed, *i.e.*, endosperm is absent in it.

Endosperm is a nourishing tissue present in the seed which nourishes the developing embryo. In orchid seed endosperm is absent because it is used up during the time of seed development.

Nourishment for germinating seed is provided by the food material present in cotyledons.

Rest of the options are examples of endospermic seeds.

**Q. 7** Many pulses of daily use belong to one of the families below.

(a) Solanaceae (b) Fabaceae

(c) Liliaceae (d) Poaceae

**Ans.** *(b)* **Fabaceae** is a subfamily of Leguminosae which was earlier called Papilionoideae. Plants of this family are the source of pulses and edible oils. Pulses are rich in protein contents.

**Q. 8** The placenta is attached to the developing seed near the

(a) testa (b) hilum (c) micropyle (d) chalaza

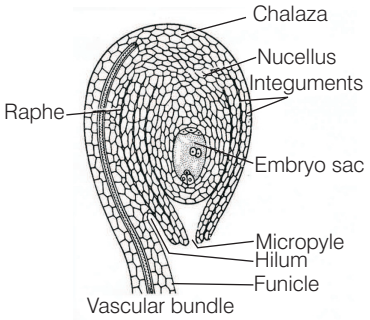
**Thinking Process**

*Placenta is a special tissue by which ovule is attached to the ovary. It has a special kind of arrangement in the ovary which is called placentation.*

**Ans.** *(b)* The placenta is attached to the developing seed near hilum. It is the scar located near the edge where seed breaks from stalk of funiculus, *i.e.,* connecting the seed with fruit wall and placenta.

*Rest of the options are incorrect as*

Testa is the outer most covering of seed, micropyle is a small opening in seed coat through which water enters seed and chalaza is a tissue where nucellus and integument are joined. Nutrients from the plant travel through vascular tissue in the funiculus and outer integuments through the chalaza into the nucellus.




**Detailed structure of an anatropous ovule showing chalaza, hilum and micropyle**

**Q. 9** Which of the following plants is used to extract the blue dye?

(a) *Trifolium* (b) *Indigofera* (c) *Lupin* (d) *Cassia*

**Thinking Process**

*Dyes are the secondary metabolites of certain plants and are important economically.*

**Ans.** *(b)* *Indigofera tintoria* and *T suffruticoga* are the two plants belonging to the family–Fabaceae that produce blue indigo dye.

*The other options are incorrect as*

**Trifolium** is used as fodder.

*Lupin* is an ornamental plant.

*Cassia* is a shrub usually grown on the road side as an ornamental plant.

**Q. 10** Match the following columns.

| | Column I | | Column II |
|---|---|---|---|
| A. | Aleurone layer | 1. | Nutrition |
| B. | Parthenocarpic fruit | 2. | Without fertilisation |
| C. | Ovule | 3. | Seed |
| D. | Endosperm | 4. | Double fertilisation |

**Codes**

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

**Ans.** *(a)* It is the correct sequence of the options in the two columns.

**Aleurone layer** surrounds the tissue of monocot seed and morphologically and biochemically distinct from seed. It is a proteinaceous layer (surrounding the endosperm and separating embryo) which provides nutrition and helps in germination .

**Parthenocarpic fruit** are seedless fruit which develops without the fertilisation of egg cell present in the ovule of the plants.

**The ovule** cantains the female reproductive unit, *i.e.,* embryo sac that develop into a seed after it is fertilised.

Endosperm is formed during the process of double fertilisation by the fusion of one male gamete with the two polar nuclei at the centre of the embryo sac.

## Very Short Answer Type Questions

**Q. 1** Roots obtain oxygen from air in the soil for respiration. In the absence or deficiency of $O_2$, root growth is restricted or completely stopped. How do the plants growing in marsh lands or swamps obtain their $O_2$ required for root respiration?

**Thinking Process**

*Every plant cell require $O_2$ for cell respiration. The air present in between the soil particles is used up by the roots. The plant growing in water logged conditions do not get $O_2$ form the soil so they evolve some other mechanism to get it.*

**Ans.** The roots of the plants (*e.g., Rhizophora*) growing in marshy/swamp areas become negatively geotropic. They grow vertically upwards in air, above the soil level and respire so called respiratory roots or pneumatophores.

**Q. 2** Write floral formula for a flower which is bisexual, actinomorphic sepals five, twisted aestivation, petals five valvate aestivation; stamens six, ovary tricarpellary, syncarpous, superior, trilocular with axile placentation.

**Ans.** **Floral formula** is a formula by which we can describe the flower by using some symbols. *The various symbols describing the above given conditions are as follows*

(i) Bisexual ♀♂ (ii) Actinomorphic ⊕
(iii) Sepals five $K_5$ (iv) Twisted aestivation
(v) Petals five $C_5$ (vi) Valvate aestivation
(vii) Stamens $A_6$ (viii) Tricarpellary ovary $G_3$
(ix) Syncarpus $G_{(3)}$

(x) Trilocular  (xi) Axile placentation 

(xii) Floral formula would be ♀♂ ⊕ $K_5 C_5 A_6 G_{(3)}$

**Q. 3** In *Opuntia,* the stem is modified into a flattened green structure to perform the function of leaves, (*i.e.*, photosynthesis). Cite some other examples of modifications of plant parts for the purpose of photosynthesis.

**Thinking Process**

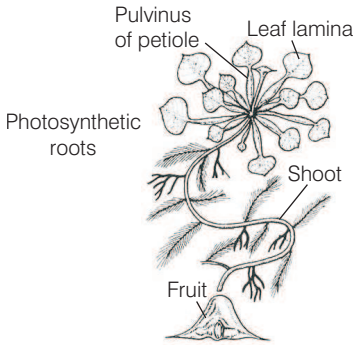
*Photosynthesis is performed by green parts of the plants (mainly leaves). Think of plants in which the function is performed by other plant part except leaf. It has to be green and contain chlorophyll pigment.*

**Ans.** *Opuntia* is a xerophytic plant, in which leaves are modified into spine to reduce the rate of transpiration and they do not perform the photosynthesis at all.

So function of photosynthesis in *Opuntia* plant is performed by stem which is thick fleshy and flattened structure containing chlorophyll and stores food. It is known as phylloclade.

Sometimes, the stem, *i.e.,* about one internode long modifies into a leaf like structure to carry out photosynthesis, as in *Asparagus.* They are present in axil of scale leaves while true leaves are reduced to scales or spines.

**Similarly in some plants, roots** become assimilatory as in the case of *Trapa* and *Tinospora*. These roots grow outside the soil, develop chlorophyll in them and perform photosynthesis.




**Assimilatory roots of *Trapa***

**Q. 4** In swampy areas like the sunderbans in West Bengal, plants bear special kind of roots called .....

**Thinking Process**

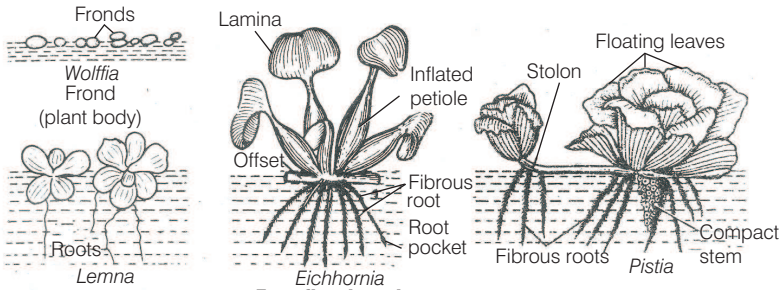
*There are many plants that can grow in swamp areas like water lily, cypress trees, etc. sunderbans have halophytic mangroove forest.*

**Ans.** **Pneumatophores Roots** are the organs meant for the absorption of water and minerals from the soil. Cells of roots require $O_2$ to respire. In swampy areas, soil does not have air, so no $O_2$ is available to them.

In such cases, roots come out of the soil shows negative geotropism and breathe after coming in contact with air, *e.g*., *Rhizophora*. Such roots are called pneumatophores respiratory roots.

**Q. 5** In aquatic plants like *Pistia* and *Eichhornia*, leaves and roots are found near .....

**Ans.** In *Pistia* and *Eichhornia*, in these floating plantes, the stem is like a runner where it branches to form leaves at the apex and roots below. The roots are found near the surface of water as both the plants are hydrophytes.



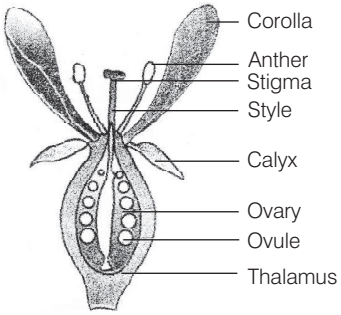

**Free floating plants**

**Q. 6** Reticulate and parallel venation are the characteristic of ..... and ..... respectively.

**Ans.** **Dicot and monocot plants** All dicot plants have reticulate venation (*i.e.,* veinlets forms network) except is *Alocasia* and *Smilex*, whereas all monocot plants have parallel venation (veins run parallel to each other within a lamina) with the exception *Calophyllum*.

**Q. 8** In epigynous flower, ovary is situated below the ..... .

**Ans.** In epigynous flower, ovary is situated below the thalamus (inferior) while the other whorls of flower like sepals, petals and androecium grows above the ovary (superior), *e.g.,* carrot, guava, *Cucurbita,* sunflower, etc.




**Epigynous flower**

**Q. 9** Add the missing floral organs of the given floral formula of Fabaceae.

$$\% \, ♂♀ \, K_{(\,)} \ldots C_{(\,)} \; A_{(9+..)} \; \underline{G}_{(\,)}$$

**Ans.** The floral formula of Fabaceae family is

$$= \% \, ♂♀ K_5 \, C_{1+2+(2)} \, A_{(9)+1} \, \underline{G}_{(1)}$$

Floral character of Fabaceae shows bisexual, zygomorphic, petals-five, gamosepalous, corolla-petals 5, consists of a posterior standard, two lateral wings, two anterior ones forming a keel, androecium, ten diadelphous, gynoecium-superior, ovary monocarpellay.

**Q. 10** Name the body part modified for food storage in the following

(a) Carrot .....
(b) *Colocasia* .....
(c) Sweet potato .....
(d) *Asparagus* .....
(e) Radish .....
(f) Potato .....
(g) Dahlia .....
(h) Turmeric .....
(i) *Gladiolus* .....
(j) Ginger .....
(k) *Portulaca* .....

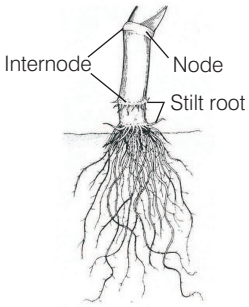
**Ans.** (a) Carrot — **Tap root**
(b) *Colocasia* — **Stem-(corm)**
(c) Sweet potato — **Root**
(d) *Asparagus* — **Root**
(e) Radish — **Root**
(f) Potato — **Stem**
(g) Dahlia — **Adventitious root**
(h) Turmeric — **Stem**
(i) *Gladiolus* — **Stem**
(j) Ginger — **Stem**
(k) *Portulaca* — **Adventitious root**

## Short Answer Type Questions

**Q. 1** Give two examples of roots that develop from different parts of the angiospermic plant other than the radicle.

**Ans.** In banyan tree, prop roots develop from the lower nodes of stem of banyan tree. They grow downwards and touch the soil. Prop roots are meant for support.
In sugarcane, stilt roots arise from the lower nodes of stem and enter the soil to provide strength to the plant. These protect the plant against winds.


Prop roots of banyan



Stilt roots of sugarcane

**Q. 2** The essential functions of roots are anchorage and absorption of water and minerals in the terrestrial plant. What functions are associated with the roots of aquatic plants. How are roots of aquatic plants and terrestrial plants different?

**Thinking Process**

*Aquatic plants grow where plenty of water is available. These may be free floating, submerged, attached floating or attached emergent hydrophytes. Their roots possess several aquatic adaptations.*

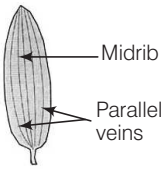
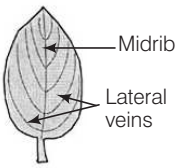
**Ans.** Usually the terrestrial roots show a branched network that helps in anchorage and absorption of water and minerals from soil to the plant.
While in aquatic plants, roots show modifications and deviation from their normal function. *e.g.,* in plants like *Trapa, Tinospora* the roots are green and highly branched to increase the photosynthetic area, whereas in plants like *Jussiaea*. They get inflated due to air project out of water so to help the plant in floating and exchange of gases.

*Difference between roots of aquatic plants and terrestrial plants are as*

| Aquatic Plants | Terrestrial Plants |
|---|---|
| Roots may be absent, *e.g., Wolffia*. If roots are present they are not well developed. Usually thin adventitious roots are present. | Roots are well developed with root cap and root hairs and branches. |
| Vascular strands are poorly developed. | Vascular bundles are well developed. |
| Modified to carry out photosynthesis food storage and exchange of gases. | Provide anchorage and help in absorption of nutrients from soil. |

**Q. 3** Draw diagrams of a typical monocot and dicot leaves to show their venation pattern.

**Ans.** **Venation** is the pattern of distribution of veins and veinlets in the lamina of leaf. It's pattern is different in monocot and dicot leaf.

| Monocot leaf | Dicot leaf |
|---|---|
| The veins run parallel to each other within a lamina. It is called parallel venation. | Veins and veinlets form a network in the lamina. It is called reticulate venation. |
|  |  |
| Parallel venation, *e.g.*, grasses, wheat, maize, etc., (usually found in monocots). | Reticulate venation, *e.g.*, *Hibiscus*, bean, pear etc., (usually found in dicots). |

**Q. 4** A typical angiosperm flower consists of four floral parts. Give the names of the floral parts and their arrangements sequentially.

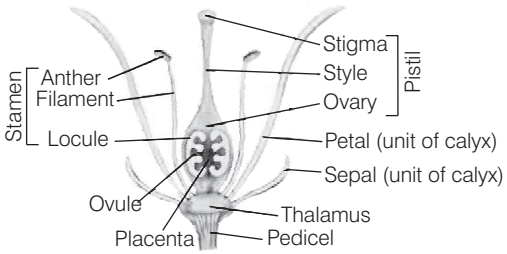
**Ans.** *The four floral parts of typical angiospermic flower are*

**Calyx** It is the outermost whorl of the flower and members are called calyx or sepals. These are usually green and are protective in function (in bud stage).

**Corolla** It is composed of petals, usually bright coloured to attract insects for pollination.

**Androecium** It is composed of stamens, the male reproductive organ. Each stamen has stalk or filament and anther (containing pollen sac and pollen grains).

**Gynoecium** It is the female reproductive part and made up of one or more carpels. Each carpel has stigma, style and ovary.




**L.S. of flower showing different whorls**

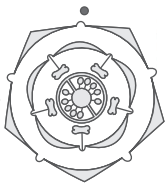
**Q. 5** Given below are a few floral formulae of some well known plants. Draw floral diagrams from these formulae.

(i) ⊕ $K_{(5)}\ C_{(5)}\ A_5\ \underline{G_{(2)}}$

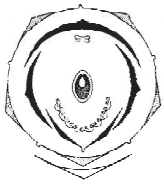
(ii) $K_{(5)}\ C_{1+2+2}\ A_{(9)+1}\ \underline{G_1}$

(iii) ⊕ $K_5\ C_5\ A_{5+5}\ G_{(5)}$

**Ans.** (i) **Floral Formula** ⊕ $K_{(5)}\ C_{(5)}\ A_5\ \underline{G_{(2)}}$ represents flowers of Solanaceae family.



(ii) **Floral Formula** % $K_{(5)}\ C_{1+2+2}\ A_{(9)+1}\ \underline{G_1}$ represents flowers of Fabaceae family.



(iii) **Floral Formula** ⊕♂♀ $K_5\ C_5\ A_{5+5}\ \underline{G_{(5)}}$ represents flowers of Malvaceae family.

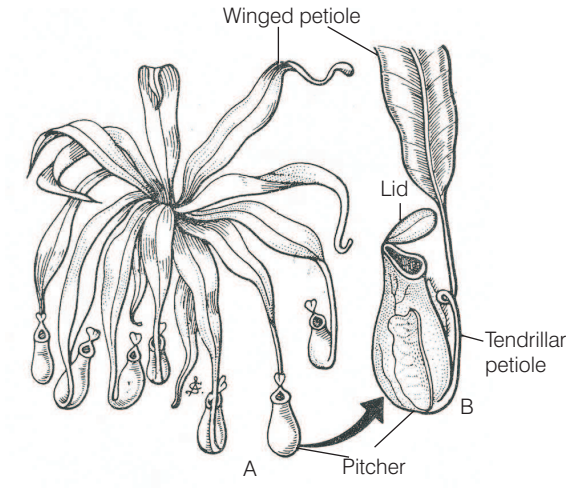
**Q. 6** Reticulate venation is found in dicot leaves while in monocot leaves venation is of parallel type. Biology being a 'Science of exceptions', find out any exception to this generalisation.

**Ans.** Reticulate venation is a characteristic of dicots and parallel venation is of monocots. But few exceptions are also seen in this generalisation parallel venation is also found in dicot plants, *e.g., Calophyllum,* corymbium, etc., and reticulate venation is also found in monocot plants such *Alocasia, Smilax,* etc.

**Q. 7** You have heard about several insectivorous plants that feed on insects. *Nepenthes* or the pitcher plant is one such example, which usually grows in shallow water or in marsh lands. What part of the plant is modified into a pitcher? How does this modification help the plant for food even though it can photosynthesise like any other green plant?

**Ans.** In insectivorous plant, *e,g., Nepenthes,* the leaf lamina gets modified in the form of pitcher and anterior part of petiole coils like **tendril** which keeps the pitcher in a vertical direction. Posterior part of the petiole remains flattened like a leaf. The apex of lamina forms a lid. Pitcher contains digestive enzyme which digest the trapped insects.

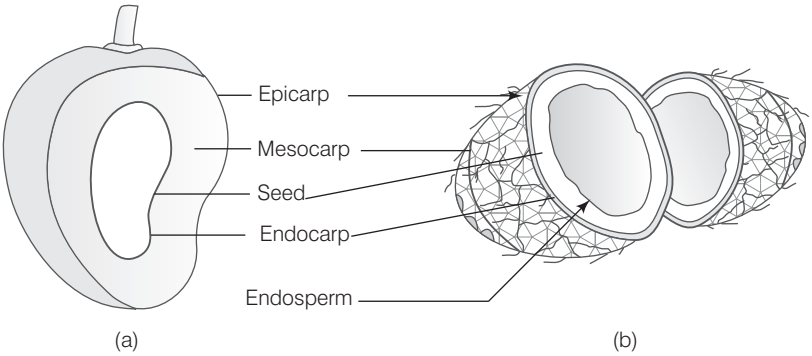
All these modifications and adaptation are developed to make up the nitrogen deficiency in the plant because these plants are found in $N_2$ deficient soil, (marshy/swamp soils)




***Nepenthes : pitcher shaped leaf***

**Q. 8** Mango and coconut are 'drupe' type of fruits. In mango, fleshy mesocarp is edible. What is the edible part of coconut? What does milk of tender coconut represent?

**Ans.** Mango and coconut are drupe fruits. They develop from monocarpellary superior ovaries and are one seeded. It is differentiated into outer thin epicarp, middle fleshy mesocarp and inner stony endocarp.



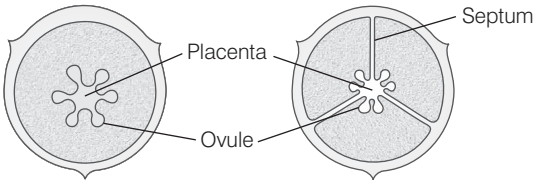

**Parts of fruit : (a) Mango (b) Coconut**

The edible part of coconut (*Cocos nucifera*) is endosperm. The milk of tender coconut represents the oily endosperm in liquid form. Later it gets deposited along the walls of endocarp and forms edible flesh.

**Q. 9** How can you differentiate between free central and axile placentation?

**Ans.** **Placentation** is the arrangement of ovules on the walls of ovary with the help of special kind of tissue called placenta. Plants show different types of placentation, central and axile are among them.

*They have the following differences*

| Free Central Placentation | Axile Placentation |
|---|---|
| Ovary contains only one chambers the placenta bearing. | Ovary is syncarpous and multi-carpellary, *i.e.,* contain many chambers. |
| The ovules are borne on the central axis and less free inside the ovary. The septa are absent. | Placenta arise from the central axis where the septa fuse to form axile column to which ovules are attached. |
|  | |
| *e.g., Dianthus, Silensa,* etc, | *e.g., Citrus,* tomato etc. |

**Q. 10** Tendrils are found in the following plants. Identify whether they are stem tendrils of leaf tendrils.

(a) Cucumber
(b) Peas
(c) Pumpkins
(d) Grapevine
(e) Watermelon

**Ans.** (a) **Cucumber** (*Cucums sativus*), have stem tendril from axillary bud.
(b) **Peas** (*Pisum sativum*) leaf gets modified into tendril for climbing.
(c) **Pumpkins** (*Cucurbita pepo*), stem tendril from axillary bud.
(d) **Grape wine** (*Vitis*), stem tendril from axillary bud.
(e) **Water melon** (*Citrullus lanatus*), stem tendril from axillary bud.

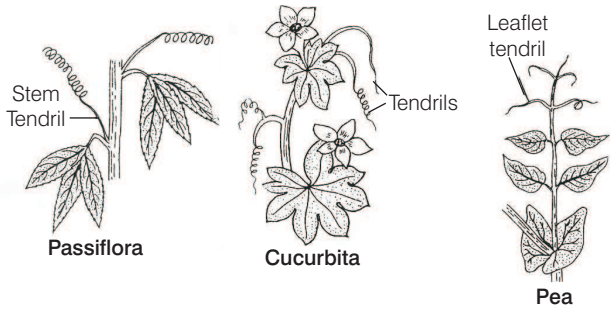
**Q. 11** Why is maize grain usually called as a fruit and not a seed?

**Ans.** The maize grain is usually known as fruit because it is infact a ripend ovary which contains a ripened ovule, *e.g.,* a single seed. This fruit is known as caryopsis in which the pericarp is fused with the seed coat. The maize grain occurs attached to a thick cob or peduncle.

**Q. 12** Tendrils of grapevines are homologous to the tendril of pumpkins, but are analogous to that of pea. Justify the above statement.

**Ans.** **Homologous Organs** are organs that have similar origin but they differ functionally. Axillary bud of stem gives rise to tendril of both grapevine and pumpkins so they have same origin, *i.e.,* homologous, whereas **analogous organs** are organs having different origin, but perform same function. The tendril of pea arises from the leaf and helps the plant to climb.

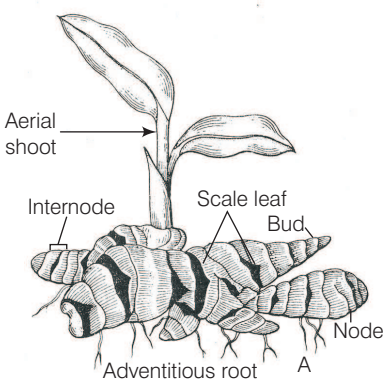
Hence, the origin of pea tendril is different but, its function is similar to the tendrils of grapevines.




**Q. 13** Rhizome of ginger is like the roots of other plants that grows underground. Despite this fact ginger is a stem and not a root. Justify.

**Ans.** **Rhizome of Ginger** is a type of underground modification of stem which grows horizontally underground and bear nodes, internodes and scaly leaves and buds, which gives rise to aerial shoots.

The adventitious root arises from the lower surface of nodes. It is not a root because root does not have nodes and internodes. Further the rhizome donot perform the function of roots, *i.e.,* anchorage and absorption, rather serves as resevoir for storage of food. All these characteristics support the fact that ginger is a stem and not a root.




**Rhizome of ginger**

**Q. 14** Differentiate between

(a) Bract and bracteole
(b) Pulvinus and petiole
(c) Pedicel and peduncle
(d) Spike and spadix
(e) Stamen and staminoid
(f) Pollen and pollenium

**Ans.** (a) **Bract and Bracteolate** Bract is a leaf like structure in the axil. *i.e.,* at the base of which flowers are borne. They can be small or scaly, green and coloured and usually single, whereas bracteolate are bract like structures borne on the stalk of a flower.

(b) **Pulvinus and Petiole** Pulvinus is the leaf base, which is the proximal swollen region with which a leaf is attached to the stem. Petiole is cylindrical or sub-cylindrical stalk which connects the leaf base with the lamina.

(c) **Pedicel and Peduncle** The stalk of a flower is known as pedicle, whereas the stalk of whole inflorescence is known as peduncle.

(d) **Spike and Spadix** In spike inflorescence, the flowers are sessile that develop on an elongated peduncle in acropetal succession, *e.g.*, *Adhatoda.* The peduncle is non-fleshy. The spadix inflorescence is like spike, but it is covered by one to a few large bracts called spathes, *e.g., Colocasia.* The peduncle is fleshy and its opical portion is naked, *i.e.,* without flowers.

(e) **Stamen and Staminoid** The male reproductive organs or microsporophylls of a flower are called stamen. A fully sterile under developed or abrtive stamen is called a staminoid, *e.g.*, *Verbascum*.

(f) **Pollen and Pollinium** Microspore of an angiospermic flower is known as pollen. It is haploid, whereas a mass of pollen grains from the same anther constitute the pollinium as in *Calotropis*.

# Long Answer Type Questions

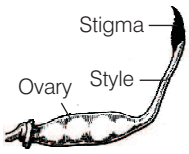
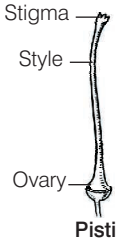
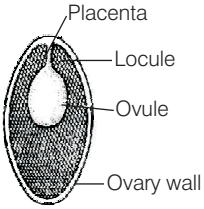
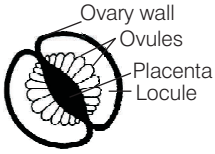
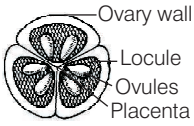
**Q. 1** Distinguish between families - Fabaceae, Solanaceae, Liliaceae on the basis of gynoecium characteristics (with figures). Also write economic importance of any one of the above family.

**Thinking Process**

*The families mainly differ from each other in their reproductive structures. Try to differentiate the above families on the basis of androecium and gynoecium.*

**Ans.** *The difference between the three families on the bases of charateristics of hynoecium are as follows*

| Gynoecium Characteriseies | Fabaceae | Solanaceae | Liliaceae |
|---|---|---|---|
| Carpels | Monocarpellary free, single | Bicarpellary Syncarpous | Tricarpellary syncarpous |
| Ovary | Superior unilocular | Superior bilocular (2-4 locular in tomato) | Superior |
| Ovules | Margin in two alternate rows | Many in each locular | Trilocular |
| Placentation | Marginal | Axile | 2-many ovules in each locules |
| Style | Bent, single | Simple | Simple but may be united or separate |
| Stigma | Simple and capitate | Simple and lobe | Free or fused trilobed |
| Floral formula | Br % $K_{(5)}\ G_{1+2+(2)}$ $A_{1+(9)+1}\ \underline{G}_1$ | -Br ⊕ $K_{(5)}\ G_5 A_5\ \underline{G}_{(2)}$ | Br ⊕ $P_{3+3}\ A_{3+3}\ \underline{G}_{(3)}$ |

| Gynoecium Characteriseies | Fabaceae | Solanaceae | Liliaceae |
|---|---|---|---|
| Diagram of gnoecium |  Pistil |  Pistil |  Pistil |
| Floral diagram |  T.S. of ovary |  T.S. of ovary |  T.S. of ovary |
| Examples | Garlic, onion, *Colchicum* | Potato, tomato, brinjal, datura, etc | All pulses, sunhemp, *Lupin*, Indigo, *Cassia* |

**Economic Importance of Fabaceae**

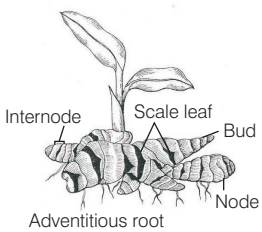
Plants of this family are the sources of pulses and edible oils. Dye is extracted from *Indigofera* which is a plant of this family. It serves as a source of various other products like fibres (sunnhemp), facter (*Sesbania* and *Trifolium*), ornamentals (lupin, sweet pea) and medicine (multiathi).

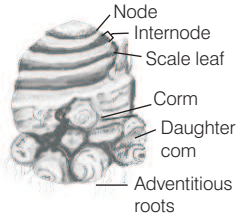
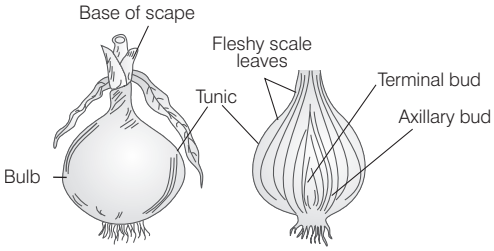
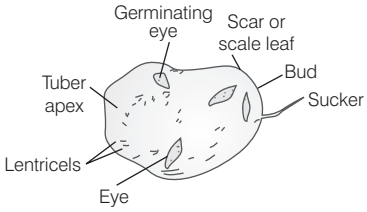
**Q. 2** Describe various stem modifications associated with food storage climbing and protection.

**Thinking Process**

*Stem is the aerial part of plant bearing nodes, internodes, buds, flowers, fruits and seeds. Besides these functions and forms, under special conditions, it gets modified and perform many functions, e.g., storage, protection and climbing. Search out different forms of stem and its modified forms performing variety of functions.*

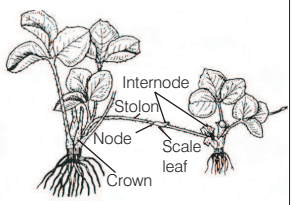
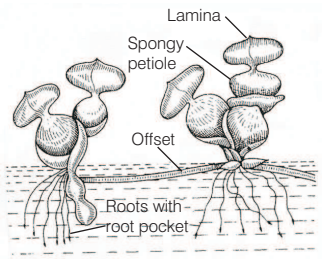
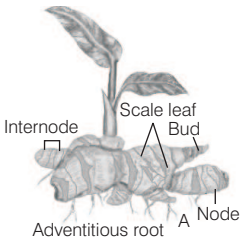
**Ans.** *The various stem modifications are as follows*

| Stem | Modification of Stem for Storage of Food |
|---|---|
| Rhizome | In this case the stem becomes underground and grows horizontally, stores food material. It bears nodes, internodes and buds which give rise to aerial shoots, *e.g.*, ginger, banana, turmeric.  **Rhizome of ginger** |

| Stem | Modification of Stem for Storage of Food |
|---|---|
| Corm | Stem is underground, grows vertically and bears nodes as well as internodes *e.g. Colocasia*.<br>  <br><br>**Corm of *Colocasia***<br>  <br><br>**Tunicated bulb of and L.S. of bulbs** |
| Bulb | In this case, the stem becomes underground, the internode is shortened in such a way that the leaves are condensed and these leaves become thick and fleshy and store food material e.g.,-onion. |
| Tuber | This is also a special kind of stem modification, which arises at the tips of special narrow underground branches. They have nodes, internodes apical buds, scale leaf in the form of ridge. They gave no. of eyes which represent nodes. It is meant for storing food material, *e.g.*, potato<br>  <br><br>**Tuber of potato** |
| Stem tendrils | **Modification of Stems for Climbing** These are found in cucurbits and grapevine. The axillary buds of the stem become elongated and spirally coiled and twine around a support for the plant to grow as the stem is weak and herbaceous. |
| Stem thorns | **Modification of Stem for Protection** These are present in the axil of leaf or apex of stem performing the function of either climbing or defence, *e.g., Duranta, Calamus* and also reduce transpiration. |

**Q. 3** Stolon, offset and rhizome are different forms of stem modifications. How can these modified forms of stem be distinguished from each other?

**Ans.** **Stem modifications** Stem gets modified in different forms like stolon, offset and rhizomes. *These can be distinguished from each other in the following manner*

| Stolon | Offset | Rhizome |
|---|---|---|
| The stem is a creeper. It is a long distance runner with longer and thicker internodes. Horizontal branches arise from the internodes, *e.g.*, strawberry *Colocaica*.   **Stolon** | It is like small a runnes of one internode long, but inter nodes are shorter and thicker branches arise all around the main stem usually found in rosette plants on water or ground surface. *e.g., Eichhornia, Pistia.*   **An offset of *Eichhornia*** | These are stem which bear nodes and internodes, scaly leaves, axillary buds and roots arising from nodes e.g.,Ginger, banana, turmeric. They are modified to store food in plants.   **Rhizome of ginger** |

**Q. 4** The mode of arrangement of sepals or petals in a floral bud is known as aestivation. Draw the various types of aestivation possible for a typical pentamerous flower.

**Ans.** The mode of arrangement of petals or sepals in a flower bud with respect to the members of the same whorl or with each other is known as aestivation. *It is of following types*

**Valvate** Margin of adjacent petals or sepals touch each other, but do not overlap, *e.g.*, mustard (*Brassica*).

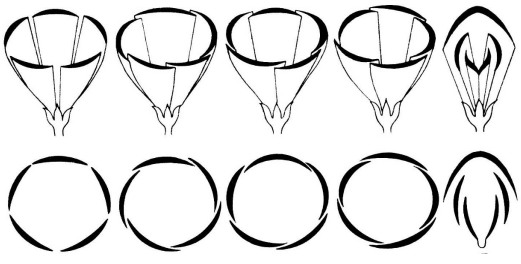
**Twisted** Regular overlapping of petals or sepals occurs in which margin of one petal overlap with the adjacent next one petal, *e.g.*, China rose (*Hibiscus rosa sinensis*).

**Imbricate** There are five petals arranged in such a way that one petal is completely external and one petal is completely internal, three petals are partially external and partially internal, *e.g.*, *Cassia*, *Callistemon*, *Caesalpinia*.

**Quincuncial** There are five sepals or petals of which two are completely out and two are completely inside, while one is partially out and partially in *e.g.*, *Cucurbita* (Cucurbitaceae).

**Vexillary** It is the characteristic aestivation of corolla of family - Papilionaceae, in which corolla (petals) are papilionaceous.

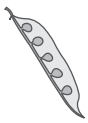
The largest petal overlap the two lateral petals (wings), which in turn overlap the two smallest anterior petals (keel) *e.g.*, *Artobotrys*, *Polyalthea*, *Pisum*.




**Different types of aestivation of calyx and corolla**
**(a) Valvate, (b) Twisted, (c) Imbricate,**
**(d) Quincuncial and (e) Vexillary**

**Q. 5** The arrangement of ovules within the ovary is known as placentation. What does the term placenta refer to? Name and draw various types of placentations in the flower as seen in T.S. or V.S.

**Ans.** **Placenta** is a flattened, cushion like tissue on which one or more ovules are attached.
*The various types of placentation seen in the flowers are described in the following table*

| Type of Placentation | Description with example | Diagram |
|---|---|---|
| Marginal | There is a single placenta which develop along the junction of two fused margins, *e.g.*, pea. |  |
| Axile | Mutlicarpellary, syncarpous gynoecium inward growth of carpel's margin forms a multicarpellary condition that contains an axis in the centre. Placenta arises from central axis bearing ovules. *e. g.*, *Solanum*, China rose. |  |
| Parietal | The number of placenta corresponds to number of fusing carpels. Sometimes the ovules bearing placenta grow inward to form false septa and thus ovary becomes bilocular (*e.g.,* mustard) and trilocular *e.g., Curcurbita* |  |
| Free central | The ovary is unilocular and ovules are borne on the central-axis and not connected to the ovary wall by septum. *e.g.*, *Dianthus*, *Silensa*. |  |
| Basal | The ovary is unilocular and the single ovule is borne at the base of the ovary attached by a single placenta, *e.g.*, sunflower, wheat. |  |

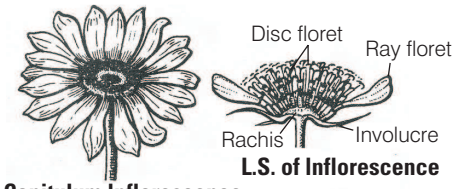
**Q. 6** Sunflower is not a flower. Explain.

**Ans.** Sunflower is not a flower, but it is a kind of inflorescence called capitulum in which the receptacle is flattened. It bears numerous sessile and small florets. The youngest floret is in the center and oldest lies at the periphery. Whole cluster of florets gets surrounded by bracts, known as involucre.

*Two kinds of florets are recognised in sunflower*

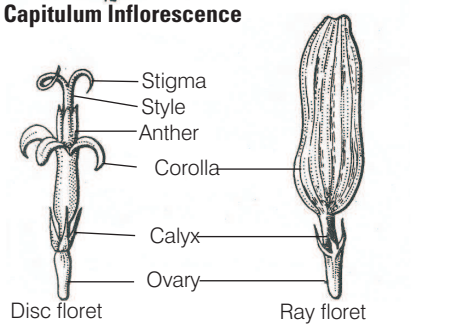
(i) **Ray Florets** Arranged on the rim of receptacle having distinct yellow and strap shaped petals. These florets are female, sterile and are always zygomorphic and may be arranged in one or more whorls.

(ii) **Disc florets** Grouped in the center, bisexual and actinomorphic.




**L.S. of Inflorescence**

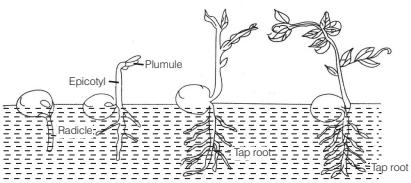
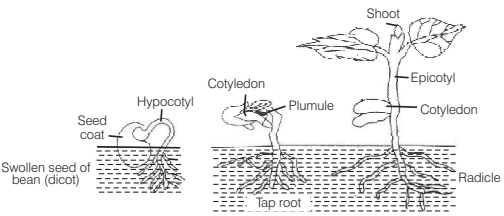
**Capitulum Inflorescence**




**Capitulum of sunflower with disc and ray florets**

**Q. 7** How do you distinguish between hypogeal germination and epigeal germination? What is the role of cotyledon(s) and the endosperm in the germination of seeds?

**Ans.** *Difference between hypogeal germination and epigeal seed sermination are as*

| Hypogeal Seed Germination | Epigeal Seed Germination |
|---|---|
| Rapid growth and elongation of epicotyl. | Rapid growth and elongation of hypocotyl. |
| Cotyledons remain inside the soil. | Seed cotyledons emerge above the soil level/ |
| Cotyledons remain non-green, non photosynthetic | Cotyledons become green and photosynthetic |
| *e.g.,* castor, beans. | *e.g.,* maize, rice. |
|  |  |
| **Hypogeal germination** | **Epigeal germination** |

**Role of Cotyledons and Endosperm** Cotyledons and endosperm contain reserved food materials. When seed imbibes water, enzymes get activated, hydrolyse reserve food material and makes it available for the germinating seed.

**Q. 8** Seeds of some plants germinate immediately after shedding from the plants while in other plants they require a period of rest before germination. The later phenomena is called as dormancy. Give the reasons for seed dormancy and some methods to break it.

**Ans.** Dormant seeds remain under non-germination conditions only for a specific period of time that may vary from days to years. This specific period is called **dormancy period**.

**Causes of Seed Dormancy**

(a) In many plants the cause of dormancy is due to the impermeability of seed coat to water, (*e.g.*, *Chenopodium*, *Trigonella*, *Meliotus*) or *oxygen* (*e.g.*, *Brassica alba*, *Pyrus malus*-Apple, *Sinapis arvensis*) or *chemicals*, (*e.g.*, *Xanthium*)

(b) In many plants, **tough** (hard) **seed coats** are the cause of dormancy as they provide mechanical resistance to embryo growth, *e.g.*, *Capsella*, *Lepidium*.

(c) Some seeds produce certain chemical substances, such as abscisic acid (ABA,most common), phenolic acids, coumarin, short chain fatty acid, etc. which inhibit the seed germination. These inhibitors may be present inside the fruit, (*e.g.*, the fruit juice of tomato contains ferulic acid), in the embryo (*e.g.*, *Xanthium*), endosperm, (*e.g.*, *Iris*) or seed-coat, (*e.g.*, *Cucurbita*)

(d) Shedded seeds like those of wheat, barley, oat *etc*., need an interval for ripening and gaining the ability to germinate. During the interval, the seeds produce necessary growth hormones.

*Methods of breaking dormancy are as follows*

(i) Inactivation of growth inhibitors by heat or cold treatment.
(ii) Mechanical abrasions weaken the tough and impermeable seed coat.
(iii) Microorganisms present in the soil weaken and decompose hard seed coat.
(iv) Washing away of inhibitors by rain or irrigation water.
(v) Maturation of embryo.