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Morphology of Flowering Plants



If you want to create shade in your garden, the Bougainvillea plant can be an excellent choice. It's from the tropics, and it stays evergreen throughout the greater part of the year. It can also withstand damage from birds and cattle, ensuring that your beautiful view remains unchanged regardless of the environment.

Topic Notes

- *Morphology and Parts of the Flowering Plants*
- *Semi-Technical Description of Flowering Plants*

MORPHOLOGY AND PARTS OF THE FLOWERING PLANTS

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TOPIC 1

PARTS OF PLANTS

Morphology is derived from the word *morphos* which means forms and morphology is the science which deals with the study of forms, size, colour, structure and their relative position of different organs in the organism.

Plant morphology generally includes the study of external features, forms, relative position of organs of plants and their adaptation.

Adaptation is any modification in the structure or function of an organism that results from natural selection and by which the organism becomes more suited to the environment.

Flowering plants consist of roots, stems, leaves, flowers, fruits and seeds.

The Root

The underground part of the plant developed from elongation of radicles of the embryo is **Root**. It helps in anchorage of plants in soil and absorption of water and minerals from soil.

Primary root: It is formed by the direct elongation of the radicle present in the majority of the dicotyledonous plants. Primary root bears lateral roots of several orders that are called secondary, tertiary, etc., roots.

Functions of root

- (1) Anchorage of the plant in soil.
- (2) Stores reserve food material and synthesizes plant growth regulators such as cytokinins.
- (3) Absorption of water and minerals from the soil.

Types of root

- (1) **True root:** The root that develops from the radicle and grows deep inside the soil.
- (2) **Adventitious root:** The root that develops from an organ other than the radicle and does not grow deep into the soil.

Types of root system

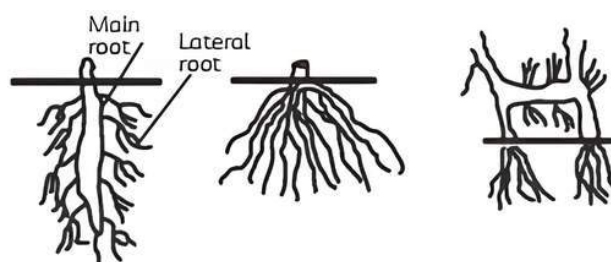
(Root System: Root with its branches is known as root system)

Tap root system	Fibrous root system	Adventitious root system
Develops from the radicle.	Develops from the base of the stem.	Develops from parts of the plant other than the radicle.

Found in dicotyledonous plants (e.g. gram and mango).

Found in monocotyledonous plants (e.g. wheat and paddy).

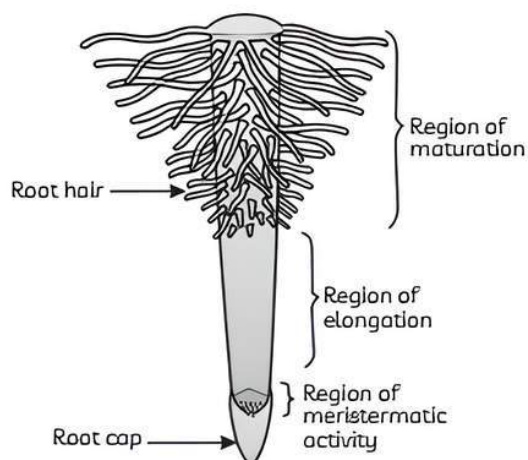
Eg. Banyan tree and Maize.



(a) Tap Root (b) Fibrous Root (c) Adventitious Root
Types of Root Systems

Regions of the root

- (1) **Root Cap:** The tip of the root is covered by a thimble-like structure called a root cap. Root cap is made up from a meristem called calyptragen. It performs the function of protection of root tip against any injury.
- (2) **Region of meristematic activity:** It is about 1 mm in length. This is a region of rapid cell division, in which the cells are small, thin-walled and meristematic cells having dense cytoplasm.



Regions of a Typical Root

- (3) **Region of elongation:** This region is about 4-8 mm in length. Cells of this region do not divide but they undergo rapid elongation and

enlargement. These cells are responsible for growth of root length. The external cells possess the power of absorption of water and mineral salts from the soil.

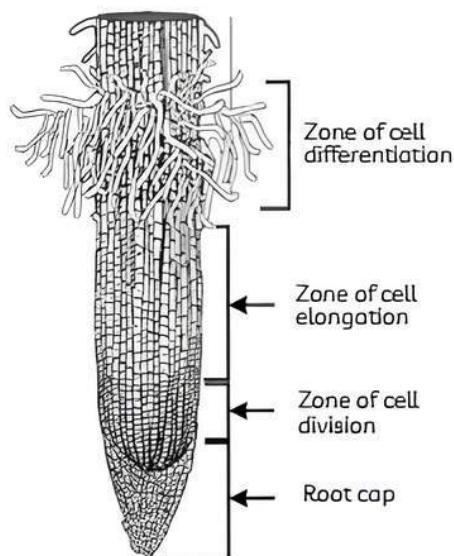
- (4) **Region of Maturation (Root hair zone):** This region has differentiated and matured cells. This region does not undergo further changes. It lies adjacent to the region of elongation. The outmost layer of this region has thick-walled or permeable cells. So this region cannot help the root in water absorption. Its only function is to anchor the plant firmly in the soil. Lateral roots also arise from the interior part of this region.

Root hairs are thread-like structures present in the zone of differentiation or maturation. It is about 1-6 cm in length. Most of the water and mineral absorption occurs in this region as the root hair increases the surface area of the root for better absorption.

Example 1.1: Case Based:

During a practical class, students were told to bring an onion root with them to observe the root under a microscope. Students saw the image as shown here. An onion root tip contains root cap, zone of cell division and zone of elongation.

Teacher explained to them about all the parts of the root.



- (A) Where are root hairs present in the root?
 (a) Zone of cell differentiation
 (b) Zone of cell division
 (c) Zone of cell elongation
 (d) Zone of cell maturation
- (B) Development of root branches is
 (a) endogenous (b) exogenous
 (c) hypogynous (d) isogenous
- (C) Observe the structure 'root cap' shown above. How is it defined?
- (D) State the function of root hairs.

- (E) **Assertion (A):** The root's apical meristem is subterminal.

Reason (R): Root cap is found at the root's terminal end.

- (a) Both A and R are true and R is the correct explanation of A.
 (b) Both A and R are true and R is not the correct explanation of A.
 (c) A is true but R is false.
 (d) A is false but R is true.

Ans. (A) (d) Zone of cell maturation

Explanation: The root bears unicellular root hairs in the zone of maturation. Some of the epidermal cells of this region bear delicate thread-like root hairs. This region has differentiated and matured cells and it lies adjacent to the region of elongation. Most of the water and minerals absorption occurs through this region.

- (B) (a) endogenous

Explanation: Development of root branches is endogenous in origin. These branches develop from the interior, usually pericycle of the parent plant.

- (C) Root cap is a thimble-like structure that covers the root at its tip and provides protection from injury and helps the root to penetrate into the soil.
 (D) Main function of root hairs is to absorb water and minerals from the soil.
 (E) (a) Both A and R are true and R is the correct explanation of A.

Explanation: Root cap is terminal part of the root which covers the root tip.

Example 1.2: What is the main function of the roots of the hydrophytic plants?

Ans. The hydrophytic plants like *Trapa* and *Tinospora* have green and branched roots. These roots play some important functions such as:

- (1) Provides an increased photosynthetic area for the plants.
- (2) Helps the plants in floating.
- (3) Helps the plants in gaseous exchange.

The Stem

Stem is the aerial part of the plant body developed from plumule and epicotyl of germinating seeds. It bears nodes (region of the stem where leaves are born) and internodes (portions between two nodes). Stem branches are exogenous in origin. Stems also bear buds (terminal or axillary). Stem is negatively geotropic and positively phototropic as it grows away from the soil towards sunlight. Stem performs the function of exposure of leaves, flowers and fruits, conduction of water and minerals, translocation of food.

The Leaf

It arises from the shoot apical meristem and produces food by photosynthesis. A typical leaf has three elements— leaf base (hypopodium), petiole and lamina (leaf blade).

- (1) **Leaf Base (Hypopodium):** This is the point at which a leaf joins the stem. Stipules are two little leaf-like structures at the base of the leaf. This leaf base is wide and covers the stem in monocotyledons like rice, wheat, and other monocotyledons.
- (2) **Petiole (Mesopodium):** It is a cylindrical or subcylindrical smooth or grooved stalk of the leaf which lifts the lamina above the level of stem so as to provide it with maximum exposure. Leaf having petiole is called petiolate and sessile when petiole is absent.
- (3) **Lamina (Epipodium or leaf blade):** It is the terminal thin, expanded, green and conspicuous part of the leaf which is specialised to perform photosynthesis. It is supported by veins and veinlets. There are two surfaces of lamina— adaxial (ventral) towards the upper part of stem and abaxial (dorsal) towards the lower part of the stem.



Important

→ Some legume plants develop swollen leaf bases which are known as pulvinus.

Venation

An arrangement of veins and veinlets within a leaf lamina is called venation. There are two types of venation:

Reticulate Venation	Parallel Venation
Veins are arranged as a network or web-like structure.	Veins run parallel to one another.
Found in leaves of dicotyledonous plants.	Found in leaves of monocotyledonous plants.
Examples: China rose and Peepal.	Examples: Grass, Maize and Sugarcane.



Reticulate



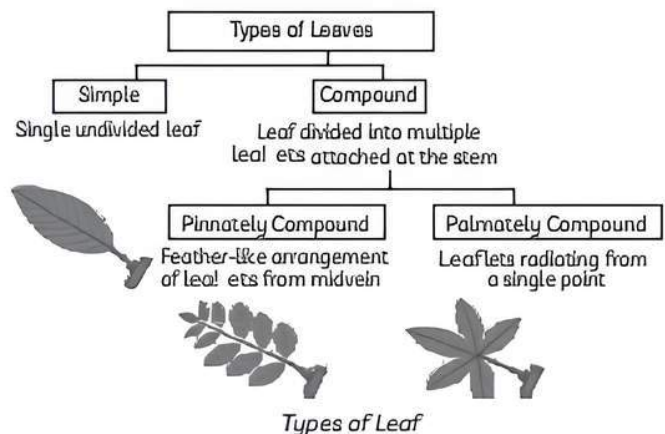
Parallel

Types of Leaf

- (1) **Simple leaves:** Those leaves that have single undivided lamina are known as simple leaves.

The lobes of a simple leaf may be pinnately arranged (such as the *Brassica*) or palmately arranged (such as the *Gossypium*, *Passiflora*, and *Ricinus*).

- (2) **Compound leaves:** Compound leaves are those in which the lamina or leaf blade is entirely divided into many units called leaflets or pinnae. Pinnately compound leaves and palmately compound leaves are two types of compound leaves.
 - (i) **Pinnately compound leaves:** A common type of compound leaf in which the leaflets are divided into two rows and the rachis is long and elongated. *E.g.* Neem and rose.
 - (ii) **Palmately compound leaves:** At the tip of the petiole, the leaflets are arranged palmately in accordance with the number of leaflets present. Leaflets are attached to common points at the petiole tip. *E.g.* Silk and cotton.



Phyllotaxy

Leaves are arranged in a pattern on the stem or branch known as phyllotaxy.

Following are the different types of phyllotaxy:

- (1) **Alternate:** In this type of phyllotaxy, leaves originate alternately at each node. *E.g.* China rose and Mustard.
- (2) **Opposite:** At each node of opposite type, there are two leaves arranged oppositely. *E.g.* *Calotropis* and Guava.
- (3) **Whorled:** When a node has more than two leaves that arise at the same time and form a whorl. *E.g.* *Nerium* and *Alstonia*.



Alternate

Opposite

Whorled

Example 1.3: Explain with suitable examples the different types of phyllotaxy.

Ans. The pattern of leaf arrangement on the stem or branch is known as phyllotaxy. It comes in three types— alternating, opposite, and whorled. In an alternate phyllotaxy, a single leaf emerges alternately at each node, e.g.

China rose, mustard, and sunflower plants. In the opposite form, as in *Calotropis* and guava plants, a pair of leaves emerges at each node and lies opposite to each other, e.g. *Calotropis* and Guava. If more than two leaves arise at a node and form a whorl it is called whorled phyllotaxy as in *Alstonia*.

TOPIC 2

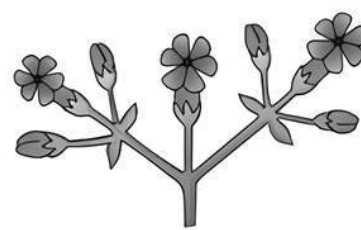
INFLORESCENCE

It is the arrangement of flowers on the floral axis (Peduncle). There are two main types of Inflorescence:

Racemose	Cymose
It shows unlimited growth in the axis.	It shows limited growth in the axis.
Order of opening of flower is centripetal.	Order of opening of flower is centrifugal.
Main axis continues to grow.	Main axis terminates into a flower.
Eg., Radish, Mustard and Amaranthus.	Eg., Cotton, Jasmine and <i>Calotropis</i> .



Racemose



Cymose

TOPIC 3

THE FLOWER

Flower is a specialised condensed shoot of an angiospermic plant in which the shoot apical meristem gets transformed into a floral meristem and it is also known as the reproductive unit of plant. There are four types of organs found in a flower — sepals (green in colour), petals (colourful structure), stamen (male reproductive part of flower) also known as androecium and lastly, carpels (female reproductive part of flower) also known as gynoecium.

Flowers have short or long flower stalks which are called pedicels. Thalamus/Receptacle is the conical or spherical upper part of the pedicel.

Types of Flowers

Flowers are classified under different categories depending on their symmetry, number of appendages and ovary position.

On the basis of symmetry

(1) **Actinomorphic (Radial symmetry):** An actinomorphic flower is a flower with two equal radial halves when cut from any plane that passes through its centre. Eg., Mustard and *Datura*.

(2) **Zygomorphic (Bilateral symmetry):** When a flower can be divided into two similar halves only in one vertical plane, it is called a zygomorphic flower. Eg., Pea, Bean and Gulmohar.

(3) **Asymmetric (Irregular):** When a flower cannot be divided into two identical halves by any vertical plane passing through the middle, it is asymmetric (irregular). Eg., *Canna*.



Actinomorphic



Zygomorphic



Asymmetric

Example 1.4: Radial symmetry is found in the flowers of:

- | | |
|----------------------|---------------------|
| (a) <i>Cassia</i> | (b) <i>Pisum</i> |
| (c) <i>Trifolium</i> | (d) <i>Brassica</i> |

Ans. (d) Brassica

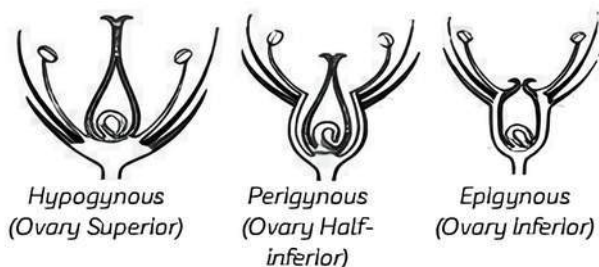
Explanation: The petals of *Cassia*, *Pisum*, and *Trifolium* flowers show bilateral symmetry. While *Brassica* is radial in symmetry.

On the basis of floral appendages

- (1) **Trimerous flower:** Floral appendages in multiple of three.
- (2) **Tetramerous flower:** Floral appendages in multiple of four.
- (3) **Pentamerous flower:** Floral appendages in multiple of five.

On the basis of position of calyx, corolla and androecium with respect to ovary

- (1) **Hypogynous:** Here, Ovary is superior and petals, sepals and stamens are located below the ovary. *Eg.* Mustard and China rose.
- (2) **Perigynous:** The thalamus grows upwards into a cup-shaped structure, such that the gynoecium is positioned in the centre and other parts of the flower are positioned on the rim of the thalamus almost at the same level. The ovary will be half inferior or half superior. *Eg.* Plum, Peach and Rose.
- (3) **Epigynous:** The ovary is enclosed completely by the thalamus and is fused with it, while the rest of the flower parts grows above the ovary, and thus the ovary is said to be inferior. *Eg.* Guava and Cucumber.



Important

→ Flower can be bisexual if have both androecium and gynoecium or it may be unisexual if it has only androecium/stamen or only gynoecium/carpel.

Aestivation

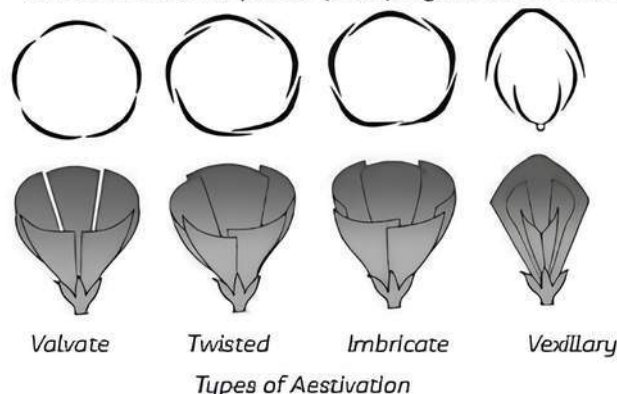
Aestivation is the arrangement of accessory floral organs (sepals or petals) in relation to one another in the floral bud.

Following are the four different types of aestivation found in flowers:

- (1) **Valvate:** There is no gap between the petals or sepals of the same whorl and they just touch each other end when they are adjacent but do not overlap. *Eg.* *Calotropis*.
- (2) **Twisted:** A petal has two parts, one of which is covered by the adjacent petals and the other by the posterior petals. *Eg.* China rose, cotton and lady finger.

(3) **Imbricate:** A sepal or a petal is overlapping, but not in a definite direction. *Eg.* *Cassia* and Gulmohar.

(4) **Vexillary or papilionaceous:** Out of the five petals the largest petal (standard) overlaps the two lateral petals (wings), which overlap the two smallest anterior petals (keels). *Eg.* Bean and Pea.



Parts of a Flower

Calyx

In most flowers, the calyx is the outermost whorl of the flower, and the individual calyx is known as sepal. Generally, sepals are green and leaf-like and they protect the flower during the bud stage. The calyx can be gamosepalous (sepals united) or polysepalous (sepals free).

Corolla

Corolla is composed of petals and is the second whorl. They are usually brightly coloured and help in attracting insects for pollination. Corolla can be tubular-shaped, bell-shaped, funnel-shaped or wheel-shaped. Corolla can be gamopetalous (petals united) or polypetalous (petals free).



Important

→ When there is no distinction between sepals and petals, then there is perianth. They may be sepaloid (greenish) or petaloid (colourful). The individual parts of the perianth are known as tepals. Examples: Onion, Lily, etc.

Androecium

Androecium is a male reproductive organ composed of stamens. It is the third whorl of flower part. Each stamen consists of a stalk or a filament and an anther lobes which contain pollen grains. A sterile stamen is called staminode.

Stamen can be:

- (1) **Epipetalous:** Stamens are attached to the petals, *eg.* Brinjal.
- (2) **Epiphyllous:** Stamens attached to the perianth, *eg.* Lily flowers.
- (3) **Monadelphous:** Stamens united into one bundle, *eg.* China rose.
- (4) **Diadelphous:** Stamens united into two bundles, *eg.* Pea.

- (5) **Polyadelphous:** Stamens united into more than two bundles, e.g., Citrus.

Anther: Anther is a pollen-producing part. Each anther has two lobes (bilobed) containing pollen sacs (also known as microsporangia). The pollen grains (male gametophyte) are produced inside the pollen sacs.

Filament: Stalk-like structure that attaches to the base of the flower.

Gynoecium

Gynoecium is a female reproductive organ composed of carpels. Carpels consist of stigma, style and ovary. It is the third or innermost whorl and is also called pistil.

Ovary: It is an enlarged basal part on which lies in the elongated tube, the style. This style connects to the ovary to the stigma. Each ovary has ovules attached to the placenta.

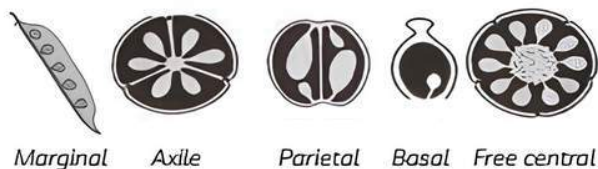
Stigma: Sticky part present on the tip of the style. Stigma is a receptive surface for pollen grains.

Placentation

Placenta is a parenchymatous cushion present inside the ovary where ovules are borne. An ovary may have one or more placentae. The number, position and distribution or arrangement of placentae inside the ovary is known as placentation.

Types of Placentation:

- (1) **Marginal:** A marginal placenta is found in the unilocular ovary. It forms a ridge along the ventral suture of the ovary, and the ovules are borne in two rows along this ridge. E.g., Pea.
- (2) **Axile:** Axile placentation, in which the ovules are attached to the axial placenta in a multilocular ovary. E.g., Lemon.
- (3) **Parietal:** This kind of placentation is found in the unilocular syncarpous ovary. In it the ovule originates on the inner wall of the ovary or on the peripheral part. E.g., Argemone.
- (4) **Free central:** When there are no septa and ovules are borne on the central axis, the placentation is free central. E.g., *Dianthus* and *Primrose*.
- (5) **Basal:** Placenta develop at the base of ovary. E.g., Sunflower and Marigold.



Types of Placentation

Example 1.5: Case Based:

A group of students made a project on morphology of flowering plants. While making the project they studied the different plants like peas, peaches, roses, etc. All the plants were observed on the basis of different characteristics including inflorescence,

placentation, etc. Some common characteristics of flowers were observed. A flower is a specialised reproductive shoot with sepals, petals, stamens, and carpels. These appendages are actually leaves that have been modified. The two outer sets of appendages are sterile if all four sets of appendages are present. Male and female regions of flowers have also been studied.

- (A) Which type of placentation is found in *Pisum sativum*?

- (a) Basal (b) Free Central
(c) Axile (d) Marginal

- (B) flower has superior ovary.

- (a) Cotton (b) Cucumber
(c) Guava (d) Peach

- (C) Corolla is vexillary in the pea flowers. Give an explanation.

- (D) What is the name given to a plant called that has both male and female flowers?

- (E) Assertion (A): Buds can develop into leaves and flowers.

Reason (R): A bud is a condensed immature shoot.

- (a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

Ans. (A) (d) Marginal

Explanation: Marginal placentation is found in monocarpellary pistils of Leguminosae. Examples: Pea (*Pisum sativum*), *Cassia* and *Acacia*. In this type of placentation, one or two alternate rows of ovules occur longitudinally along the ridge in wall of the ovary in the area of fusion of its two margin or ventral suture.

In basal placentation, pistil can be monocarpellary or syncarpous. The ovary is unilocular. It bears a single placenta at the base with generally in a single ovule. Examples: *Ranunculus*, Sunflower, Marigold, etc.

In free-central placentation, pistil is polycarpellary and syncarpous but the ovary is unilocular. The ovules are borne around a central column which is not connected with the ovary wall by any septum. Examples: *Dianthus* and *Primula*.

In axile placentation, syncarpous pistils are seen. The ovary is partitioned into two or more chambers. Placentae occur in the central region where the septa meet, so that an axile column bearing ovules is formed. Examples: *Petunia*, *Althaea*, etc.

(B) (a) Cotton

Explanation: An ovary connected to the receptacle just above the attachment of other floral components is known as a superior ovary. Fruits with a superior ovary include real berries, drupes, and other fleshy fruits. hypogynous refers to a flower with this arrangement. While cucumber, guava and peach have an inferior ovary.

- (C) Peas are made up of five petals. In a series of overlaps, the largest petal (standard) covers lateral two petals (wings) which overlap the two smallest anterior petals

(keels). Thus, corolla in peas is also called vexillary.

- (D) A plant having both male and female flowers is termed as monoecious flower.

- (E) (a) Both A and R are true and R is the correct explanation of A.

Explanation: A bud is a condensed embryonic shoot with a developing point surrounded by immature leaves that are packed tightly. Cabbage has the largest bud. Buds can be vegetative, reproductive, or mixed depending on their nature.

TOPIC 4

THE FRUIT

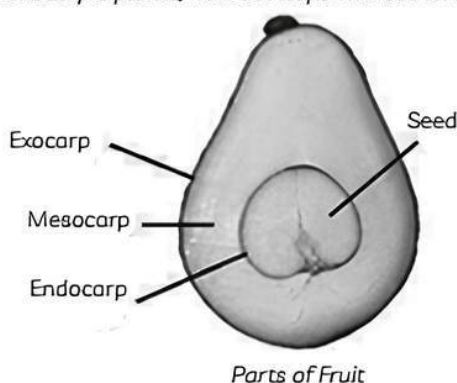
A true fruit or eucarpic fruit is a ripened ovary which develops under the influence of ripening ovules and is meant for protecting them. It consists of a pericarp formed from the ovary and seeds formed from ovules. A fruit in which other floral parts like thalamus, base of sepals, petals, etc, fuse with pericarp is called false fruit, accessory fruit or pseudocarp. Examples: Apple, Mulberry, Strawberry, etc. A fruit formed without fertilisation, i.e. a seedless fruit is called parthenocarpic or parthenocarp fruit. Example: Banana.

Fruit (ripened ovary) is made up of seeds and a wall called pericarp. Pericarp is a thick and fleshy part, made up of Epicarp (outer), Mesocarp (middle) and Endocarp (inner).



Important

→ Ovaries are the source of true fruits. False fruits can emerge from any portion of the plant other than the ovary. Apple is a false fruit since it does not grow from the ovary. In parthenocarpic plants, fruit develops without fertilisation.



Types of Fruit

Fruits are categorised into three classes according to the number of ovaries and flowers involved in the fruit formation process:

- (1) **Simple Fruits:** A simple fruit generally develops from the simple or compound ovary of flower. It can be dry (dry pericarp) or succulent (pericarp fleshy). Examples: Tomato, Grapes, Pear, Plum, etc.
- (2) **Aggregate Fruits:** An aggregate fruit or etaerio is a group of simple fruitlets that are made up of several developed free ovaries that form in a single flower. Fruitlets are the individual ovaries. Aggregate fruits include fruits like blackberry, raspberry and strawberry.
- (3) **Composite Fruits:** A composite or multiple fruits is a group of fruitlets which develops from the different flowers of an inflorescence. Examples: Peepal, Pineapple, Jackfruit, etc.



Important

→ **Drupe:** Fruit of mango and coconut is termed as drupe. Such fruits develop from monocarpellary superior ovaries and consist of a single seed. The pericarp is differentiated in mango as:

- (1) an outer thin epicarp.
- (2) a middle fleshy edible mesocarp (in case of coconut, mesocarp is fibrous).
- (3) an inner stony hard endocarp.

TOPIC 5

THE SEED

The seeds are composed of a seed coat and an embryo. The embryo of a seed has a radicle, an

embryonal axis, and has one cotyledon (as in wheat or corn) or two cotyledons (as in gram or pea).

Monocotyledonous Seed

Monocot seeds, sometimes known as monocotyledons, include corn, wheat, and rice. Scutellum is the only large cotyledon found in monocotyledonous seed embryos. The scutellum is a shield-shaped structure that occurs laterally to one side of the embryo axis.

Monocotyledons have a branch tip, plumule that is enclosed in a sheath called coleoptile, and a root point, radicle, that is enclosed in coleorhiza, just like dicotyledons. The endosperm of monocotyledonous seeds is protected by a proteinous covering known as the aleurone layer.

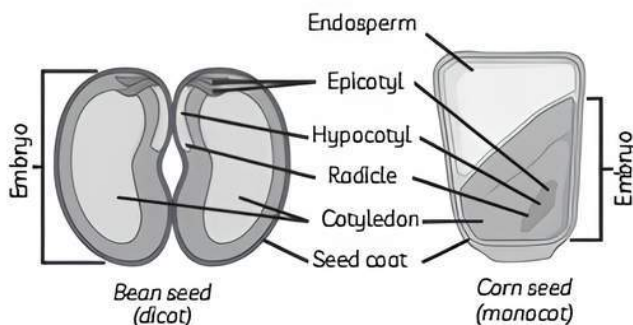
The bulk of monocotyledonous seeds is albuminous, meaning they have thick, swollen endosperms that provide nutrition. Hence, monocotyledonous seeds are also called albuminous seeds. Endosperm is the feeding tissue in seeds that are not completely consumed throughout embryo development. Some monocotyledons, such as orchids, are exceptions as endosperm is absent in them. Ginger, banana, coconut, and garlic are examples of monocot seeds.

Dicotyledonous Seed

Dicotyledonous seeds include peas, almonds, and cashews. Dicots are another name for dicotyledons. The word dicotyledons refer to the fact that the seed has two cotyledons. The embryo of a dicotyledonous seed comprises an embryo axis and two cotyledons.

The swollen look of cotyledons is due to the fact that they serve as a reserve food resource for the developing embryo. There are two ends to the embryo axis. The plumule is the portion at the upper end that develops the shoot tip, while the radicle is the region at the lower end that makes the root tip.

The seed coat is a protective shell that surrounds the entire surface. The seed coat is composed of two layers—**testa** on the outside and **tegmen** on the inside. Furthermore, a structure known as the **hilum** connects the seed to the fruit. Gram seed is dicotyledonous. The stored food is also present in the cotyledons. An endosperm is absent. Gram seed is, therefore, dicotyledonous seed.



Types of Seeds

Differences between Monocotyledonous and Dicotyledonous seeds:

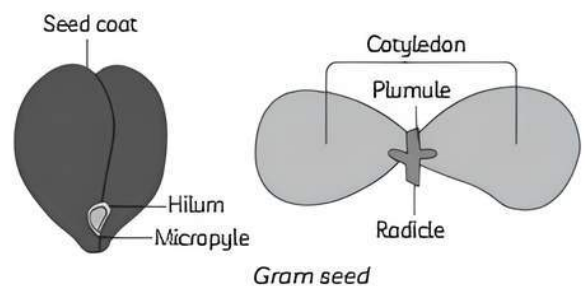
S. No.	Monocotyledonous Seed	Dicotyledonous Seed
(1)	The seed contains a single cotyledon.	The seed possesses two cotyledons.
(2)	The food is commonly stored inside endosperm (except-Orchids).	The food may be stored inside endosperm or cotyledon.
(3)	An aleurone layer of special protein-rich cell is found on the outside of endosperm.	This layer is commonly absent in dicots.
(4)	The embryo tip may bear special sheaths, coleoptile over plumule and coleorhiza over radicle.	Coleoptile and coleorhiza are absent.
(5)	Embryo occupies one side of the seed.	Embryo occupies the whole interior or only the central part of the seed.
(6)	Plumule lies at one end near the cotyledon.	Plumule lies in between the two cotyledon.

Example 1.6: Draw the labelled diagram of the following:

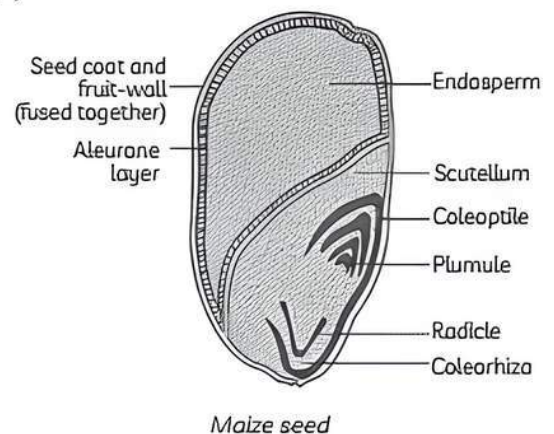
(A) Gram seed

(B) Vertical section of maize seed

Ans. (A)



(B)



OBJECTIVE Type Questions

[1 mark]

Multiple Choice Questions

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

- (I) Zone of root hair
- (II) Zone of meristems
- (III) Zone of root cap
- (IV) Zone of maturation
- (V) Zone of elongation

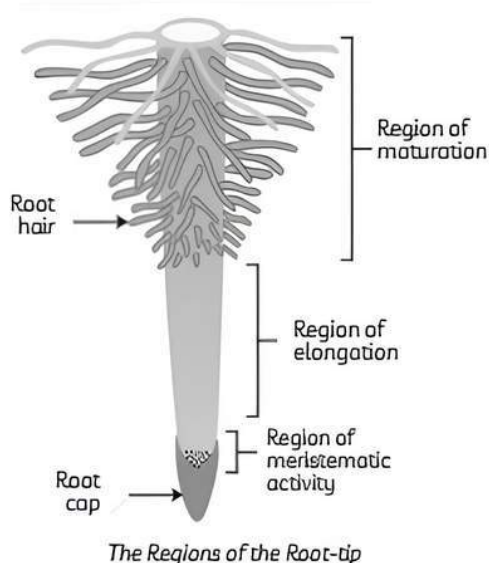
Select the correct option:

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

[NCERT Exemplar]

Ans. (a) (III), (II), (V), (I), (IV)

Explanation: The diagram shows the vertical arrangement of regions of root. Thus, (a) is the correct option.



2. Match the following and choose the correct option.

Column I	Column II
(A) Valvate aestivation	(i) <i>Cassia</i>
(B) Twisted aestivation	(ii) <i>Cotton</i>
(C) Imbricate aestivation	(iii) <i>Calotropis</i>
(D) Vexillary aestivation	(iv) <i>Pea</i>

Choose the correct match.

- (a) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)
- (b) (A)-(iii), (B)-(ii), (C)-(i), (D)-(iv)

- (c) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii)
- (d) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)

Ans. (b) (A)-(iii), (B)-(ii), (C)-(i), (D)-(iv)

Explanation: Sepals or petals are arranged in floral buds with respect to the other members of the same whorl, this mode of arrangement is known as aestivation.

Types of aestivation are:

- (1) **Valvate:** There is no gap between the petals or sepals of the same whorl and they just touch each other when they are adjacent but do not overlap. *Eg.* *Calotropis*.
- (2) **Twisted:** A petal has two parts, one of which is covered by the adjacent petals and the other by the posterior petals. *Eg.* China rose, cotton and lady finger.
- (3) **Imbricate:** A sepal or a petal is overlapping, but not in a definite direction. *Eg.* *Cassia* and Gulmohar.
- (4) **Vexillary or papilionaceous:** Out of the five petals present, the largest petal (standard) overlaps the two lateral petals (wings), which overlap the two smallest anterior petals (keel). *Eg.* Bean and Pea.

3. Statement A: Potatoes and sweet potatoes are called tubers.

Statement B: Both are tuberous swollen plant parts, having definite shapes.

- (a) Both A and B are correct.
- (b) Both A and B are incorrect.
- (c) Only A is correct.
- (d) Only B is correct.

Ans. (c) Only A is correct.

Explanation: Both potatoes and sweet potatoes are bloated, knobby, tuberous plant components that lack distinct shapes. They serve as a food storage system. As a result, they are known as tubers.

4. The axillary buds emerge from:

- (a) pericycle (endogenously)
- (b) tissues of the shoot apex (exogenously)
- (c) cambium tissues (endogenously)
- (d) innermost layers of cortex (exogenously)

Ans. (b) tissues of the shoot apex (exogenously)

Explanation: Axillary buds emerge in a basipetal wave from nodes near the shoot tip to the older basal nodes as the plant progresses from vegetative to flowering development.

5. The swollen leaf base of leguminous plant is called:

- (a) Stipules (b) Pulvinus
(c) Petiole (d) Lamina [Diksha]

Ans. (b) Pulvinus

Explanation: Pulvinus is swollen in several legumes. Pulvinus refers to the inflated leaf base. In some leaves, such as *Mimosa pudica* and *Cassia*, it is responsible for sleep and shock motions.



Related Theory

→ A stipule is an outgrowth of the leaf base or hypopodium. A stalk which connects the blade to the leaf base is known as the petiole. The lamina refers to the entire flat and extended section of the leaf.

6. Statement A: Leaves possess stomata in their epidermis.

Statement B: Stomata are primarily meant for gaseous exchange required for photosynthesis and respiration.

- (a) Both A and B are correct.
(b) Both A and B are incorrect.
(c) Only A is correct.
(d) Only B is correct.

Ans. (a) Both A and B are correct.

Explanation: The little apertures known as stomata are found on the epidermis of leaves. Stomata are visible under a light microscope. Stomata can be found on the stems and other portions of various plants. In gaseous exchange and photosynthesis, stomata are crucial. Through opening and closing, they regulate the rate of transpiration.

7. Match the following and choose the correct option.

Column I	Column II
(A) Aleurone layer	(i) Without fertilisation
(B) Parthenocarpic fruit	(ii) Nutrition
(C) Ovule	(iii) Double fertilisation
(D) Endosperm	(iv) Seed

Choose the correct match.

- (a) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)
(b) (A)-(ii), (B)-(i), (C)-(iv), (D)-(iii)
(c) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii)
(d) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)

[NCERT Exemplar]

Ans. (b) (A)-(ii), (B)-(i), (C)-(iv), (D)-(iii)

Explanation: Correct matches are as follows:

- (A) Aleurone layer is present in the monocotyledonous endospermic seed containing protein-storage vacuoles which provides nutrition.
(B) In parthenocarpy, the development of fruit is from an ovary, and hence pollination and fertilisation processes are absent.
(C) After fertilisation, each ovule develops into a seed.
(D) In double fertilisation, one sperm fertilizes the egg cell to form the zygote and other fuses with the two polar nuclei that form the endosperm.



Caution

→ Students usually get confused while selecting the correct answer as some terms in this question are related to each other. The endosperm provides the nutrition to seed but more specifically the aleurone layer of endosperm provides nutrition to seed. Thus, option (b) is the more correct answer for this.

8. Which of the following statement(s) is/are correct?

- (I) In an opposite phyllotaxy, leaves arising at each node lie opposite to each other. For example, Mustard.
(II) In an alternate phyllotaxy, leaf arises from each node in an alternate manner. For example, Guava.
(III) In a whorled phyllotaxy, more than two leaves arise at each node and form a whorl. For example, Sunflower.

Select the correct option:

- (a) (I) and (II) (b) (I) and (III)
(c) (II) and (III) (d) (I), (II) and (III)

Ans. (a) (I) and (II)

Explanation: Leaves are arranged in a pattern on the stem or branch known as phyllotaxy.

Types of phyllotaxy are:

- (1) **Alternate:** In this type of phyllotaxy, leaves originate alternately at each node. Eg., Mustard.
(2) **Opposite:** At each node of opposite type, there are two leaves arranged oppositely. Eg., Guava.
(3) **Whorled:** When a node has more than two leaves that arise at the same time and form a whorl. Eg., Nerium, Alstonia.

9. Geocarpic fruits are formed in:

- (a) Onion (b) Carrot
(c) Groundnut (d) Watermelon

Ans. (c) Groundnut

Explanation: Onion is a bulb, not a fruit. Carrot is a root, not a fruit. Geocarpic are fruits which mature inside the soil. It is true in the case of groundnuts. Watermelon ripens above the surface of soil.

10. Statement A: Plants growing in mangroves develop pneumatophores.

Statement B: Pneumatophores possess lenticels and help in reproduction.

- (a) Both A and B are correct.
- (b) Both A and B are incorrect.
- (c) Only A is correct.
- (d) Only B is correct.

Ans. (c) Only A is correct.

Explanation: In hydrophytic trees, such as many kinds of mangroves, pneumatophores are specialised root structures that extend above the water's surface and aid in the aeration required for root respiration.

11. Placenta and pericarp are edible portions in:

- (a) Tomato (b) Banana
- (c) Potato (d) Apple

Ans. (a) Tomato

Explanation: There are two edible parts of tomato, the placenta and pericarp. The placenta provides nutrition to the embryo, and the pericarp is the remains of the ovular wall.



Caution

Students usually get confused and are unable to identify edible part of the fruit.



Related Theory

The endocarp and the less developed mesocarp are the parts of the banana that are edible. The stem of the potato tuber is a modified and edible component of the potato. The thalamus and pericarp are edible portions of apples.

12. Which of the following is one-seeded winged fruit?

- (a) Nut (b) Samara
- (c) Cypsela (d) Achene

Ans. (b) Samara

Explanation: Samara seeds are encircled by a papery wing that, when the wind blows, seeds are carried further than most other organic product seeds.

13. The cells of this region in a root are small, thin walled and have dense protoplasm. Identify the region.

- (a) Region of maturation
- (b) Region of root hair

(c) Region of elongation

(d) Region of meristematic activity [Diksha]

Ans. (d) Region of meristematic activity

Explanation: A few millimetre above the root cap is the region of meristematic activity. The cells of this region are very small, thin-walled and have dense cytoplasm. They divide repeatedly.

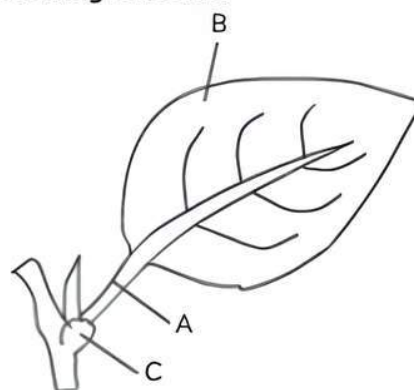
14. Which among the following is incorrect about seeds based on the presence of the endosperm?

- (a) Endosperm is usually absorbed and digested by the developing embryo.
- (b) Seeds that lack endosperm at maturity are called non-endospermic seeds.
- (c) Seeds that contain endosperm are called endospermic seeds.
- (d) In endospermic seeds, embryo gets absorbed and digested even before the seed gets detached from the plant.

Ans. (d) In endospermic seeds, embryo gets absorbed and digested even before the seed gets detached from the plant.

Explanation: Endosperm is usually absorbed and digested by the developing embryo. Seeds that lack endosperm at maturity are called non-endospermic seeds. Seeds that contain endosperm are called endospermic seeds. In non-endospermic seeds, embryo gets absorbed and digested even before the seed gets detached from the plant.

15. Which among the following is correct about the following structure?



- (a) A-Petiole; B-Lamina; C-Axillary bud
- (b) A-Axillary bud; B-Lamina; C-Petiole
- (c) A-Petiole; B-Axillary bud; C-Lamina
- (d) A-Petiole; B-Leaf base; C-Axillary bud

Ans. (a) A-Petiole; B-Lamina; C-Axillary bud

Explanation: The green expanded surface on the leaf is called lamina or leaf blade. The

axillary bud later develops into a branch. The stalk-like structure that attaches the leaf to the stem is called petiole. The part of the leaf at one end of the petiole that attaches the leaf to the node is called the leaf base.

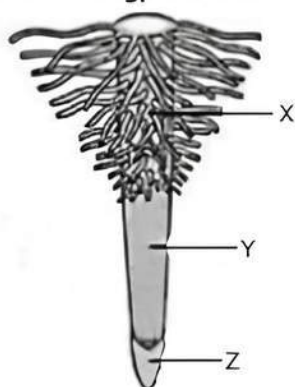
16. Which among the following is incorrect about different modes of modifications in stems?

- (a) Tendrils are tender and spirally coiled structures that arise from the axillary buds and help in climbing of plants.
- (b) Stem thorns are woody and pointed structures that develop from apical buds and provide protection of plants.
- (c) Phylloclades are similar to stem thorns in structure but phylloclades are modifications of leaves that carry photosynthesis and also reduce transpiration.
- (d) In cladodes, only some part of stem is fleshy and green and they are capable of performing photosynthesis.

Ans. (b) Stem thorns are woody and pointed structures that develop from apical buds and provide protection of plants.

Explanation: Stem thorns are woody and pointed structures that develop from axillary buds and in some plants from terminal buds, and provide protection of plants.

17. Which of the following statements is correct with respect to the given figure showing different zones of a typical root?



- (a) Part Y mainly helps in absorption of water.
- (b) Quiescent centre is present in part Y.
- (c) Part X is most suitable for anatomical studies of root.
- (d) Differentiation of cells can be observed in part Z.

Ans. (c) Part X is most suitable for anatomical studies of root.

Explanation: Part X is the root hair zone which represents the zone of differentiation

or maturation. This is the most suitable part for anatomical studies of root because different types of primary tissues differentiate or mature in this region. Xylem, phloem, pericycle, endodermis, cortex and epidermis are clearly visible in this region.

Assertion-Reason (A-R)

Given below are two statements labelled as Assertion (A) and Reason (R). Select the most appropriate answer from the options given below:

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true and R is not the correct explanation of A.
- (c) A is true but R is false.
- (d) A is false but R is true.

18. Assertion (A): Adventitious roots develop from the radicle.

Reason (R): These adventitious roots are usually found in the monocots.

Ans. (d) A is false but R is true.

Explanation: Adventitious roots develop from the parts of the plant other than the radicle. These are usually found in the monocots.



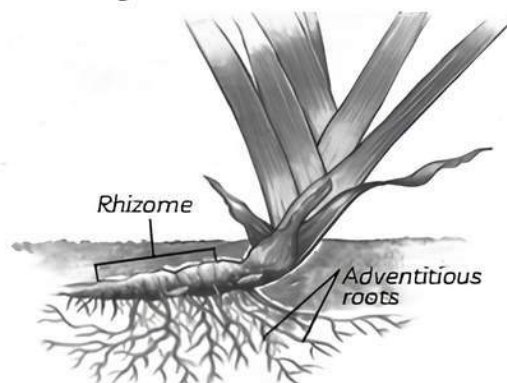
Related Theory

Adventitious roots are produced during the normal development (crown roots on cereals and nodal roots on strawberries) as well as in response to stress conditions, such as flooding, nutrient deprivation and wounding.



Caution

Students usually get confused and do not know the actual location of rhizome and adventitious roots. Look at the figure below:



19. Assertion (A): Assimilatory roots can perform photosynthesis.

Reason (R): Chlorophyll is present in assimilatory roots.

Ans. (a) Both A and R are true and R is the correct explanation of A.

Explanation: Assimilatory roots can perform photosynthesis due to presence of chlorophyll. They are also known as green roots.

20. Assertion (A): Stem is negatively geotropic and positively phototropic.

Reason (R): Stem grows away from the soil towards sunlight.

Ans. (a) Both A and R are true and R is the correct explanation of A.

Explanation: Stem is the aerial part of the plant body which develops from plumule and epicotyl of germinating seeds. It is negatively geotropic and positively phototropic because it grows away from the soil towards sunlight.

CASE BASED Questions (CBQs)

[4 & 5 marks]

Read the following passages and answer the questions that follow.

21. Father asks Neha, a Biology student, to show him a flower of the sunflower plant by pointing to it. Neha plucked a blossoming twig and pointed to the large yellow structure at the twig's tip. Her father smiled and said that it is a bunch of multiple flowers grouped in different structures, not a single flower.

- (A) What kind of petal arrangement is found in sunflowers?
- (B) Give examples of racemose and cymose inflorescence.
- (C) What is the difference between a racemose and a cymose inflorescence?

Ans. (A) In the sunflower, petal arrangement is centripetal, actinomorphic and radially symmetrical.

(B) Examples of flowers with racemose inflorescence are mustard and wheat. Examples of flowers with cymose inflorescence are night jasmine and *Drosera*.

(C) The primary axis of a racemose inflorescence has a bud that develops indefinitely, resulting in lateral and axillary flowers. The main axis of the cymose type finishes in flowers, and growth is accomplished by lateral plant branches that reach below the terminal flower.



Related Theory

→ The sunflower's inflorescence is a capitulum, which is made up of many florets arranged in a spiral. Ray florets are zygomorphic, ligulate, and unfinished, while disc florets are actinomorphic, ligulate, and complete.

22. A group of students were told to identify some characteristics of the plant from a given leaf. The given picture shows the structure of the leaf. From the picture student identified the types of venation and characteristics of monocot leaf.



- (A) The major veins diverge towards the tip is:
 - (a) divergent venation
 - (b) convergent venation
 - (c) both (a) and (b)
 - (d) none of the above
- (B) Identify the correct option for venation.
 - (a) Veins on the lamina are arranged.
 - (b) Leaves are arranged on the stalk.
 - (c) Leaves are folded in bud.
 - (d) Arrangement of leaves in bud.
- (C) Parallel venation is found in:
 - (a) Banana
 - (b) *Syzygium*
 - (c) *Dalbergia*
 - (d) *Mentha*
- (D) Choose the correct botanical name of wild-type species of banana.

- (a) *Citrus sinensis*
- (b) *Allium cepa*
- (c) *Mangifera indica*
- (d) *Musa balbisiana*

(E) Parthenocarpy occurs in which of the plant species?

- (a) Peach
- (b) Mango
- (c) Banana
- (d) None of these

Ans. (A) (a) divergent venation

Explanation: The primary veins diverge towards the tip in divergent venation. Castor and cotton are two examples. Convergent venation occurs when the veins converge at the leaf's apex.

(B) (d) Arrangement of leaves in bud.

Explanation: The phenomenon of venation is the arrangement of leaves in the bud stage.

Caution

Students may get confused between vernation and venation and select wrong answers. Vernation is the appearance of new leaves whereas a venation is the arrangement of leaves in a bud.

(C) (a) *Banana*

Explanation: Banana leaf shows parallel venation.

(D) (d) *Musa balbisiana*

Explanation: (a) *Citrus sinensis*-Orange
(b) *Allium cepa*-Onion
(c) *Mangifera indica*-Mango

(E) (c) *Banana*

Explanation: The process of fruit growth in the absence of preceding fertilisation is known as parthenocarpy. Bananas produce fruits without the need for ovule fertilisation because they are seedless.

Caution

Other fruits mentioned in the options are non-parthenocarpic fruits.

VERY SHORT ANSWER Type Questions (VSA)

[1 mark]

23. In mangroves, pneumatophores are the modified adventitious roots. How are these roots helpful to the plant?

[Delhi Gov. QB 2022]

Ans. Pneumatophores in mangroves help in respiration.

24. The endosperm is formed as a result of double fertilisation (triple fusion). What is its function?

[Delhi Gov. QB 2022]

Ans. The function of endosperm is to store food and provide nutrition to the developing embryo.

25. In pea flowers, the aestivation in corolla is known as vexillary. Give a reason.

[Delhi Gov. QB 2022]

Ans. In peas, there are five petals. The largest one (standard) overlaps the two lateral petals (wings) which in turn overlap the two smallest anterior petals (keels).

26. Name the three main parts of the typical leaf structure.

Ans. A typical leaf has three main parts:

- (1) **Leaf base (Hypopodium):** This is the point at which a leaf joins the stem.

(2) **Petiole:** The long, thin stalk that connects the leaf blade to the stem.

(3) **Lamina (Leaf blade):** The green, smooth surface of the leaves. It is made up of veinlets and a short branching vein.

27. Shalini studied venation in her class recently. But after some days when her teacher asked about venation to her, she is confused and is unable to answer. Help her by writing its definition and types.

Ans. Venation is an arrangement of veins and veinlets within a leaf lamina. It is of two main types:

- (1) Reticulate venation
- (2) Parallel venation

28. What the arrangement of flowers on the floral axis is called?

[Diksha]

Ans. Arrangement of flowers on the floral axis is called inflorescence.

29. Give the three regions of the root tip.

Ans. The root tip has three main zones— a zone of cell division, a zone of elongation and a zone of maturation.

SHORT ANSWER Type-I Questions (SA-I)

[2 marks]

30. Identify, define and give two examples of the following type of flower.



Ans. The figure shows a perigynous flower.
Perigynous flower: The thalamus grows upwards into a cup-shaped structure, such that the gynoecium is positioned in the centre and other parts of the flower are positioned on the rim of the thalamus almost at the same level. The ovary will be half inferior. *Eg.*, Plum, Peach and Rose.

31. In the below given image, two types of leaves are shown, pinnately compound and palmately compound. Describe them and also provide suitable examples.



Pinnately Compound

Palmately Compound

Ans. **Pinnate compound leaves:** A common type of compound leaf in which the leaflets are divided into two rows and the rachis is long and elongated. *Eg.*, Neem and Rose.

Palmate compound leaves: At the tip of the petiole, the leaflets are arranged palmately in accordance with the number of leaflets present. Leaflets are attached to common points at the petiole tip. *Eg.*, Silk and Cotton.

32. Write the differences between fibrous and adventitious roots. [NCERT Exemplar]

Ans. The differences between fibrous and adventitious roots are:

Fibrous Root	Adventitious Root
This root arises from the base of the stem.	This root arises from parts other than the radicle.
These roots are always underground.	These roots may grow above ground or underground.
Fibrous roots are thin and fibrous.	Adventitious roots are thick and modified.
It performs the function of absorption of water and minerals.	They perform the function of storage, nitrogen fixation, absorption, etc.
<i>Examples:</i> Wheat	<i>Examples:</i> Grass

33. Write the difference between Monocotyledonous seed and Dicotyledonous seed.

Ans.	Monocotyledonous Seed	Dicotyledonous Seed
	Fibrous root system present.	Tap root system present.
	Single cotyledon present.	A pair of cotyledons present.
	Leaves have parallel venation.	Leaves have reticulate or net venation.
	<i>Examples:</i> Garlic, Onions and wheat.	<i>Examples:</i> Beans and Cauliflower.

34. Roots in a few huge trees are modified to provide mechanical support. Justify using an example.

Ans. Roots in some huge trees are modified to provide mechanical support. For example, prop roots are present in banyan tree, stilt roots are present in sugarcane and maize, and climbing roots in betel plant.

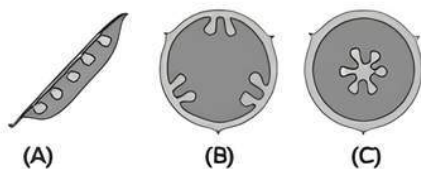
35. Name the type of root of the following:

- Roots performing the function of photosynthesis.
- Roots come above the surface of the soil to absorb air.
- The pillar-like roots developed from lateral branches for providing mechanical support.

(D) Roots coming out of the lower nodes of the stem and provide the support to the plant. [Delhi Gov. QB 2022]

Ans. (A) Assimilatory roots (B) Respiratory roots
(C) Prop roots (D) Stilt roots

36. Observe the given figure showing various types of placentation. Identify the type of placentation. Give one example of each.



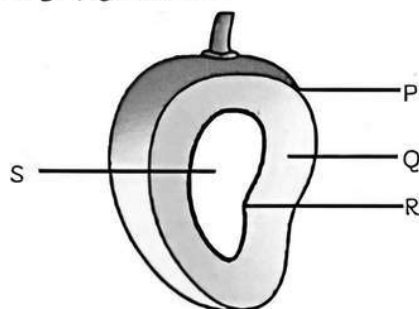
[Delhi Gov. QB 2022]

Ans. (A) Marginal placentation – Pea.
(B) Parietal placentation – Mustard and Argemone
(C) Free central placentation – *Dianthus* and Primrose.

37. Maize grain is usually called a fruit and not a seed. Why? [Delhi Gov. QB 2022]

Ans. Maize grain is a single-seeded fruit in which the seed covering or testa is fused with the pericarp of the fruit wall. A micropyle is not found but a base of style is present.

38. Given figure represents a drupe of mango. Identify P, Q, R and S.



Ans. P– Epicarp, the outer leathery covering, that changes colour from green to yellow).

Q– Mesocarp, the central fleshy portion, also called the pulp, which is edible.

R– Endocarp, inner stony covering that encloses the seed.

S– Seed.

SHORT ANSWER Type-II Questions (SA-II)

[3 marks]

39. 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?

[NCERT Exemplar]

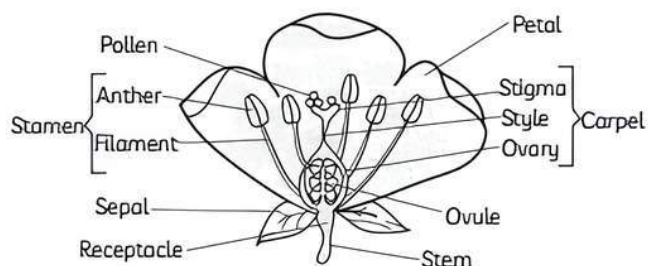
Ans. **Hypogeal germination:** Plant germination which takes place below ground is hypogeal germination. Hypocotyl is short and not curved while epicotyl is long. In hypogeal germination, the cotyledons remain inside the soil and do not undergo photosynthesis.

Epigeal germination: Plant germination which takes place above ground is Epigeal germination. Epicotyl is short and hypocotyl is long which protects the plumule. In epigeal germination, the cotyledon emerges and turns green to perform photosynthesis.

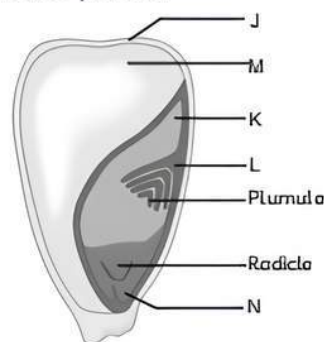
Role of cotyledons and endosperm: Cotyledons and endosperm act as a food reservoirs. Food in them becomes available to the embryo during germination. Once the first set of leaves emerges, the sapling begins photosynthesis. Till then, food is supplied by endosperm and cotyledons.

40. Draw a well-labelled diagram of a flower.

Ans.



41. In the given structure of a monocotyledonous seed, label the parts J, K, L, M and N. Give the function of part 'J'.



[Delhi Gov. QB 2022]

Ans. J– Endosperm K– Scutellum
L– Coleoptile M– Coleorrhiza
N– Aleurone layer

Function of J– It stores food and provides nutrition to the developing embryo.

LONG ANSWER Type Questions (LA)

[4 & 5 marks]

42. Write a note on phyllotaxy and different types of leaves.

Ans. The pattern of leaf arrangement on the stem or branch is referred to as phyllotaxy. There are different types of phyllotaxy—alternating, opposite, and whorled. Alternate phyllotaxy refers to a single leaf that emerges in an alternate fashion at each node, such as in China rose. In calotropis, for example, opposite phyllotaxy occurs when a pair of leaves emerge at each node and lie opposite each other. Whorled phyllotaxy occurs when more than two leaves emerge from a node and create a whorl, as in *Alstonia*.

The leaf is said to be simple when the lamina is complete or incised but the incisions do not touch the midrib. When the lamina incisions reach up to the midrib, breaking the leaf into a number of leaflets, it is said to be compound. In both simple and compound leaves, a bud can be found in the petiole's axil. The complex leaf, on the other hand, does not have a bud in the axil of the leaflets.

Compound leaves are of two types:

- (a) Pinnately compound leaf and
- (b) Palmately compound leaf

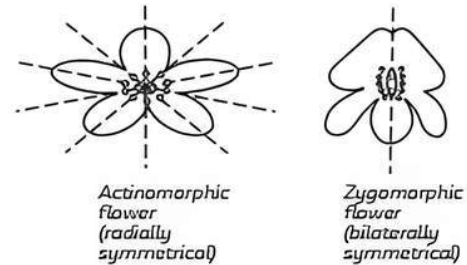
A number of leaflets are located on a common axis, the rachis, which forms the leaf's midrib in a pinnately compound leaf. The leaflets of palmately compound leaves, on the other hand, are joined at a common place, i.e., the petiole's tip.

43. Define the following terms:

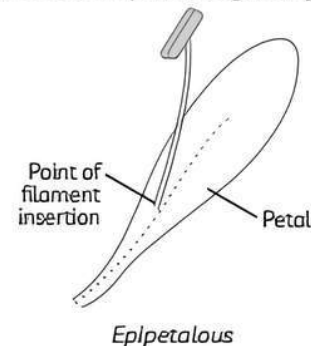
- (A) Actinomorphic
- (B) Zygomorphic
- (C) Epipetalous Stamen
- (D) Superior ovary
- (E) Placentation

Ans. (A) Actinomorphic (Radial symmetry): An actinomorphic flower is a flower with two equal radial halves in any radial plane that passes through its centre. *E.g.*, Mustard and *Datura*.

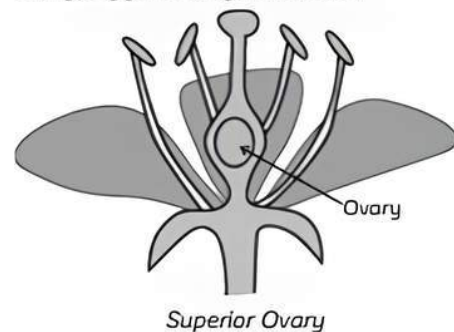
(B) Zygomorphic (Bilateral symmetry): When a flower can be divided into two similar halves only in one vertical plane, it is called a zygomorphic flower. *E.g.*, Pea, Bean and Gulmohar.



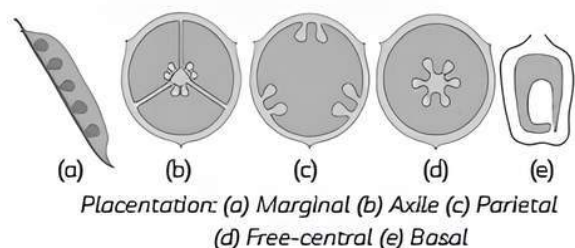
(C) Epipetalous stamen: Stamens that are attached to the petals. *E.g.*, Brinjal.



(D) Superior ovary: Superior ovary flowers are those flowers in which the gynoecium is present at the highest position while other floral parts are arranged below it. A flower with this arrangement is known as hypogynous. *E.g.*, Mustard.



(E) Placentation: The arrangement of ovules within the ovary of a flower. It is primarily of five types, namely marginal, basal, parietal, axile and free central.



SEMI-TECHNICAL DESCRIPTION OF FLOWERING PLANTS

2

TOPIC 1

FLORAL DIAGRAM AND FLORAL FORMULA

Morphological features are used to describe a particular flowering plant species. It needs to be in simple scientific language, brief, and in a proper sequence. The plant is described by its habitat, vegetative characteristics like roots, stems and leaves, and its floral characteristics like inflorescence and flower parts. After describing the morphology of the plant we proceed to its floral diagram and floral formula.

Floral Diagram

A floral diagram is a diagrammatic representation of flower structure and shows various parts of the flower, their number, their arrangement, and their fusion.

Floral Formula

It is the symbolic representation of floral symmetry, presence or absence, number, cohesion and adhesion of various parts.

A floral formula is a notation that uses numbers, letters, and symbols to give information about the morphology of a flower and its organs. It is used for systematic study and quick comprehension of all the diagnostic features of a flowering plant or a family.

The floral formula gives some extra information like placentation, the position of the mother axis, aestivation, etc., of a flowering plant.

Symbols used in floral formula

Symbols	Description
Br	Bracteate flower
Ebr	Ebracteate flower (bract absent)
Ebrl	Ebracteolate
⊕	Actinomorphic flower
⊗	Zygomorphic flower
♂	Bisexual flower/Hermaphrodite flower
♂	Unisexual male flower
♀	Unisexual female flower
K	Calyx
K _n	Polysepalous (sepals are free) n: No. of sepals
K _(n)	Gamosepalous (sepals are united)
Epi	Epicalyx (below sepals)
C	Corolla

C _n	Polypetalous (petals are free) n: No. of petals
C _(n)	Gamopetalous (petals are united)
P _n	Perianth n: No. of petals
A _∞	Infinite stamens
A _n	Polyandrous (Free stamens) n: No. of stamens
A _(n)	Synandrous and Monadelphous
A _{n+m}	Diadelphous
A ₀	Sterile stamen (Staminode)
C _A	Epipetalous stamens
P _A	Epitepalous or epiphyllous stamens
G _n	Apocarpous ovary n: No. of carpels
G _(n)	Syncarpous ovary
G _u	Superior ovary
G _i	Inferior ovary

Habit and Habitat of Flowering Plants

Habit

It can be a herb, shrub, tree, climber, or creeper.

Habitat

It can be hydrophyte, xerophyte, or mesophyte.

- (1) Hydrophyte plants are those plants that are adapted to live in an aquatic environment.
- (2) Xerophytes are those plants that are adapted to live in dry habitats like deserts.
- (3) Mesophytes are those plants that are terrestrial but are neither adapted to particularly dry nor particularly wet environments.

Floral Characters of Flowering Plants

- (1) **Inflorescence:** It can be racemose or cymose.
- (2) **Flower parts:** Can be Bracteate or Ebracteate; Sessile or Pedicellate; Unisexual or Bisexual and Actinomorphic or Zygomorphic.
- (3) **Calyx:** Gamosepalous (sepals united) or Polysepalous (sepals free).
- (4) **Corolla:** Gamopetalous (petals united) or Polypetalous (petals free).

(5) **Gynoecium:** Apocarpous (free carpels) or Syncarpous (fused carpels).

- (i) Hypogynous (Superior Ovary).
- (ii) Perigynous (Half inferior Ovary).
- (iii) Epigynous (Inferior Ovary).

(6) **Androecium:**

- (i) Staminode (Sterile Stamen).
- (ii) Epipetalous (Stamens attached to Petals).
- (iii) Epiphyllous (Stamens attached to Perianth).
- (iv) Polyandrous (Free stamens).
- (v) Monadelphous (Stamens united into one bunch).
- (vi) Diadelphous (Stamens united into two bundles).
- (vii) Polyadelphous (Stamens united into many bundles).



Caution

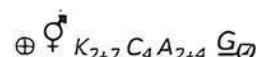
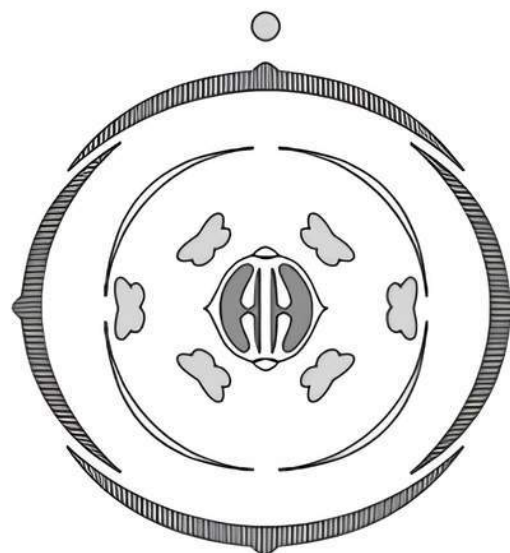
→ While writing the symbols, students must pay attention to the subscript and superscript characters.



Important

→ Students must understand that fusion is indicated by enclosing the figure within brackets and adhesion by a line drawn above the symbols of the floral parts.

→ A dot on the top of the floral diagram represents the position of the mother axis with respect to the flower.



Floral diagram with floral formula

Example 2.1: Write the floral formula of a flower actinomorphic, bisexual, hypogynous flower with five united sepals, five free petals, five free stamens and two united carpels with superior ovary and axile placentation.

Ans. $\oplus \text{ } \overline{\text{K}}_{(5)} \text{ } \overline{\text{C}}_5 \text{ } \overline{\text{A}}_5 \text{ } \overline{\text{G}}_{\overline{\text{A}}}$

TOPIC 2

FAMILY SOLANACEAE

Potatoes are a common food used in a lot of dishes. It is used with green vegetables frequently. Potatoes are the main ingredient in a sandwich, and one can say that potato is the king of all vegetables because we use them frequently and it contains high amounts of carbohydrates and gives us a lot of energy. Similarly, other plants like tomato, brinjal, and chilli are also used extensively. All these plants belong to the family Solanaceae. This is an important family, and it has certain characteristics that are unique to them, studying can help us understand the family Solanaceae better.



Important

→ The members of this family are widely distributed in tropics, subtropics, and temperate zones. This is a large family which is commonly called the 'Potato family'.

Vegetative Characters

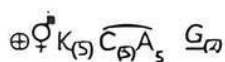
- (1) **Habit:** It includes herbs, shrubs, and rarely small trees.
- (2) **Root:** taproot.
- (3) **Stem:** Herbaceous rarely woody, aerial, erect, cylindrical, branched, solid or hollow, Hairy or glabrous (smooth), Stem is underground in potatoes.

- (4) **Leaves:** Leaves are alternate, simple, rarely pinnately compound, exstipulate (without stipulate), hairy, and show reticulate venation.

Floral Characters

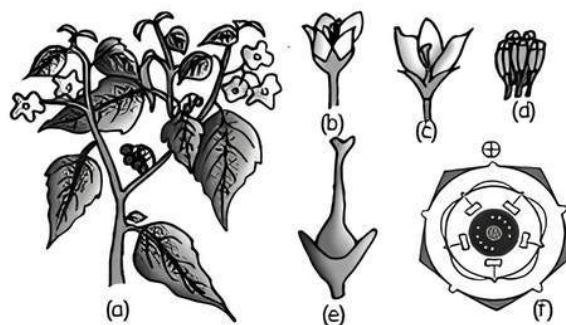
- (1) **Inflorescence:** Solitary, axillary, or cymose (the main axis terminates in a flower, so there is limited growth, shows basipetal succession).
- (2) **Flower:** Bisexual and actinomorphic (flower can be divided into two equal or more radial halves).
- (3) **Calyx:** Sepals are five in number, gamosepalous, valvate aestivation, and persistent.
- (4) **Corolla:** Petals are five in number, gamopetalous, and show valvate aestivation.
- (5) **Androecium:** Stamens are five in number, epipetalous, anthers ditheous (contains two lobes).
- (6) **Gynoecium:** Bicarpellary (two carpels), syncarpous, ovary superior with oblique septa, bilocular, placenta is swollen with many ovules, axile placentation.
- (7) **Fruit:** Many-seeded berries or capsules.
- (8) **Seed:** Many, endospermic (mostly monocots, endosperm present).

Floral formula



Economic Importance

- (1) **Food:** Potato, tomato, brinjal
- (2) **Spices:** Chilli
- (3) **Ornamental:** *Petunia*
- (4) **Tobacco:** Comes from dried and cured leaves of *Nicotiana tabacum*.
- (5) **Medicine:** *Belladonna*, *Ashwagandha*



Solanum nigrum (mako) plant: (a) Flowering twig
(b) Flower (c) LS. of Flower (d) Stamens (e) Carpel
(f) Floral diagram

OBJECTIVE Type Questions

[1 mark]

Multiple Choice Questions

1. Which of the given plants belongs to the family Solanaceae?

- (I) *Lycopersicon esculentum*
- (II) *Trifolium pratense*
- (III) *Solanum melongena*
- (IV) *Capsicum annum*

Select the correct option:

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

Ans. (d) (I), (III) and (IV)

Explanation: The plants *Lycopersicon esculentum* (tomato), *Solanum melongena* (brinjal) and *Capsicum annum* (chillies) belong to the family Solanaceae. All of these are used as edible food. On the other hand, the plant *Trifolium pratense* belongs to the family Fabaceae. The flowers of this plant are used in whooping cough.

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

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

[NCERT Exemplar]

Ans. (b) *Indigofera*

Explanation: The leaves of *Indigofera* contain a colourless chemical which on exposure to air turns bluish. *Trifolium*, *Lupin*, and *Cassia* are not used in the extraction of dye.

3. Stamens attached to the petals are called:

- (a) Epipetalous
- (b) Epiphyllous
- (c) Staminode
- (d) Perianth [Diksha]

Ans. (a) Epipetalous

Explanation: When the stamens are attached to petals, they are called epipetalous, whereas when they are attached to the perianth they are called epiphyllous. A flower with no stamen is called a staminode. The perianth is the condition in which petals and sepals are united.

4. Solanaceae is also known as:

- (a) nightshade family
- (b) sunlight family
- (c) moonlight family
- (d) daylight family

Ans. (a) nightshade family

Explanation: Solanaceae, also known as the nightshade or potato family, is made up of about 90 genera and almost 3,000 species found all over the world. Flowers with five petals, sepals, and stamens are typical of their members, and it also has alternating leaves.

5. Match the following and choose the correct option.

Column I	Column II
(A) <i>Atropa belladonna</i>	(i) Mexican husk tomato
(B) <i>Solanum melongena</i>	(ii) Guinea squash
(C) <i>Physalis philadelphica</i>	(iii) Deadly nightshade
(D) <i>Solanum rostratum</i>	(iv) Horned nightshade

Codes:

- (a) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)
- (b) (A)-(iii), (B)-(ii), (C)-(i), (D)-(iv)
- (c) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii)
- (d) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)

Ans. (b) (A)-(iii), (B)-(ii), (C)-(i), (D)-(iv)

Explanation: *Atropa belladonna*, also called deadly nightshade is the tall bushy herb of the nightshade family (Solanaceae). This plant is highly poisonous and it is native of wooded or waste areas in central and southern Eurasia.

Solanum melongena is also called as guinea squash. It is the tender perennial plant of the Solanaceae family and it is grown for its edible fruits.

Physalis philadelphica also called as Mexican husk tomato. It is the annual plant of the Solanaceae family and it has tart edible fruits.

Solanum rostratum also called as horned nightshade. This plant is native to high plains east of the Rocky Mountains from North Dakota to Mexico.

6. Family Solanaceae is concerned with:

- (a) Diadelphous stamen, marginal placentation, and large posterior petal
- (b) Epipetalous stamen, axile placentation, and valvate aestivation.
- (c) Epiphyllous stamens, axile placentation, and valvate aestivation.
- (d) None of the above

Ans. (b) Epipetalous stamen, axile placentation, and valvate aestivation

Explanation: Family Solanaceae has epipetalous stamen, axile placentation, and valvate aestivation.

Epipetalous- Stamens are united with Petals.

Axile placentation- Ovary consists of multiple chambers and ovules arise from the centre.

Valvate aestivation- When sepals or petals in a whorl just touch one another at the margin without overlapping.



Related Theory

- Solanaceae is a large family which is commonly called the 'Potato family'. It includes plants like potatoes, tomatoes, brinjal, chilli, etc.



Caution

- Students usually get confused with the conditions given and mark wrong answers. They should understand the terms first in order to identify the correct option.

7. To how many families do the plants given below belong to?

- (I) *Withania* (II) *Capsicum*
- (III) *Cape gooseberry* (IV) *Nicotiana*

Select the correct option:

- (a) 4 families (b) 2 families
- (c) 3 families (d) 1 family

Ans. (d) 1 family

Explanation: All of the above mentioned plants belong to a single family, Solanaceae. *Withania somnifera* is commonly known as ashwagandha or winter cherry. It is an evergreen shrub which is thought to be useful as a medicinal herb in Ayurveda and sold in many countries as a dietary supplement.

Capsicum is also known as red pepper or chilli pepper. It is a herb and its fruit is commonly applied to the skin for arthritis pain and other conditions.

Cape gooseberry is known as *Physalis peruviana*. These are a good source of vitamin C, which can help in boosting the immunity and is also good for the skin.

Nicotiana tabacum is a cultivated tobacco. It is an annually grown herbaceous plant of the *Nicotiana* genus. It is used for chewing, smoking and snuffing.

8. Five petals, sepals, and stamens are characteristic of which plant?

- (a) Tomato (b) Potato
- (c) Chilli (d) All of these

Ans. (a) Tomato

Explanation: All the plants belong to the Family Solanaceae the members of the family Solanaceae are characterised by flowers with five petals, sepals, and stamens. It consists of:

- (1) **Corolla:** Petals are five in number, gamopetalous, and show valvate aestivation.
- (2) **Calyx:** Sepals are five in number, gamosepalous, valvate aestivation, and persistent.
- (3) **Androecium:** Stamens are five in number, epipetalous, anthers ditheous (contains two lobes).

9. Statement A: Epigynous ovary is never inferior.

Statement B: All the floral parts lie above the level of the ovary in an epigynous condition.

- (a) Both A and B are correct.
- (b) Both A and B are incorrect.
- (c) Only A is correct.
- (d) Only B is correct.

Ans. (d) Only B is correct.

Explanation: The ovary is subordinate to the other three parts in epigynous flowers. The other three whorls are situated above the thalamus, which contains the ovaries here. Cucumbers, daffodiles, and other examples.

10. Which among the following is not correct about a floral diagram?

- (a) A floral diagram represents a clear pictorial view of a flower.
- (b) The position of the mother axis with respect to the other floral parts is represented by the dot on the top of the floral diagram.
- (c) It is possible to represent the cohesion and adhesion within parts of whorls and between whorls using a floral diagram.
- (d) In a floral diagram, the fusion is represented by enclosing the figure within brackets and adhesion is represented by drawing a line over the symbols of the floral parts.

Ans. (d) In a floral diagram, the fusion is represented by enclosing the figure within brackets and adhesion is represented by drawing a line over the symbols of the floral parts.

Explanation: A floral diagram represents a clear pictorial view of a flower. The position of the mother axis with respect to the other floral parts is represented by the dot on the top of the floral diagram. It is possible to represent the cohesion and adhesion within parts of whorls and between whorls using a floral diagram. In a floral formula, the fusion is represented by enclosing the figure within brackets and adhesion is represented by drawing lines over the symbols of the floral parts.

11. Which among the following is incorrect about the symbols used in a floral formula?

- (a) K is used to represent the calyx of a flower.
- (b) C is used to represent the perianth of a flower.

- (c) Br is used to represent the bracteate of a flower.
- (d) A is used to represent the androecium of a flower.

Ans. (b) C is used to represent the perianth of a flower.

Explanation: K is used to represent the calyx of a flower. Br is used to represent the bracteate of a flower. A is used to represent the androecium of a flower. C is used to represent the corolla of a flower. P indicates the perianth of a flower.

Assertion-Reason (A-R)

Given below are two statements labelled as Assertion (A) and Reason (R). Select the most appropriate answer from the options given below:

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true and R is not the correct explanation of A.
- (c) A is true but R is false.
- (d) A is false but R is true.

12. Assertion (A): Perianth is the outer part of a flower in which the calyx and corolla are undifferentiated and combined.

Reason (R): Single unit of Perianth is called tepal.

Ans. (a) Both A and R are true and R is the correct explanation of A.

Explanation: When corolla and calyx are fused and are not distinct it is called perianth (also termed as perigonium). The individual leaflike parts are termed as tepals.

13. Assertion (A): In potato plants, the corolla shows vexillary aestivation.

Reason (R): Corolla of the potato plant consists of five petals which are united.

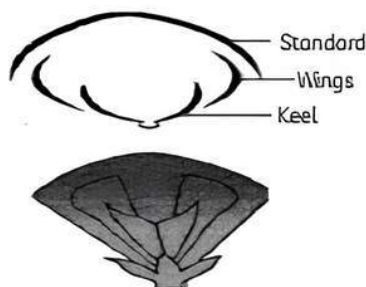
Ans. (d) A is false but R is true.

Explanation: Potato plant belongs to the family Solanaceae in which corolla consists of five petals which are united and show valvate aestivation. In this aestivation, margins of adjacent petals or sepals touch each other without overlapping.



Related Theory

In vexillary aestivation, the largest petal (standard) overlaps the two lateral petals (wings), which overlap the two smallest anterior petals (keel).



- 14.** Tomatoes belong to the Solanaceae family. There are 7,500 varieties of tomatoes, including beefsteak, plum tomatoes, pear tomatoes, cherry tomatoes and grape tomatoes. Tomatoes require cross-pollination for growth. China, India, the U.S., Turkey, Egypt, Iran, Italy and Uzbekistan are among the largest producers of tomatoes. Israel exports more than USD 2 billion worth of produce, tomatoes are its fourth-largest commodity and is among the world's top developers of better-looking, better-tasting, disease-resistant, and more nutritious varieties.



Assertion (A): The Androecium of the Solanaceae family is epipetalous.

Reason (R): Stamens are attached to Perianth in epipetalous condition.

Ans. (c) A is true but R is false.

Explanation: The androecium of the Solanaceae family is epipetalous. It is the condition in which stamens are attached to petals. While in epiphyllous condition, stamens are attached to perianth.

CASE BASED Questions (CBQs)

[4 & 5 marks]

Read the following passages and answer the questions that follow.

- 15.** Ram used to go to the vegetable market with his father, who was a Biology professor. Father told Ram that potato, tomato, brinjal and chilli belong to the same family of plants, and asked Ram to find out the name of the family.



- What are some leaf features of the plants described in the paragraph?
- Describe about the seed of the plants described in the paragraph.
- Write about the inflorescence of the plants described in the paragraph.

- Ans.** (A) Leaves are alternate, simple, rarely pinnately compound, exstipulate (without stipulate), hairy, and show reticulate venation.
- (B) Seeds are many, endospermic (mostly monocots, endosperm present).
- (C) Inflorescence is solitary or cymose. Flower is bisexual and actinomorphic (flower can be divided into two equal or more radial halves).

- 16.** Rahim's uncle is a farmer who took Rahim to his field, where Rahim observed a specific crop.



His uncle told him that this particular crop has bisexual flowers which have pentamerous floral appendages and shows radial symmetry. In this, hypogynous condition is seen and the ovary is said to be superior.

- (A) The flower which shows radial symmetry is termed as:
 (a) Zygomorphic (b) Actinomorphic
 (c) Asymmetric (d) None of these
- (B) What is the meaning of a hypogynous flower?
 (a) Ovary is superior.
 (b) Ovary is inferior.
 (c) Petals are fused.
 (d) Both (b) and (c)
- (C) Identify the family of the above mentioned plant crop.
 (a) Monocotyledonae (b) Dicotyledonae
 (c) Solanaceae (d) All of these
- (D) Match the correct options of systematic position for the above mentioned crop.

Column I	Column II
(A) Division	(i) Dicotyledonae
(B) Class	(ii) Polymoniales
(C) Order	(iii) Spermatophyta
(D) Family	(iv) Solanaceae

Codes:

- (a) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)
 (b) (A)-(iii), (B)-(i), (C)-(ii), (D)-(iv)
 (c) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii)
 (d) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)
- (E) When is a flower said to be bisexual?
 (a) When it has androecium and petals.
 (b) When it has gynoecium and petals.

- (c) When it has gynoecium and androecium.
 (d) When it has sepals and petals.

Ans. (A) (b) Actinomorphic

Explanation: Actinomorphic (Radial symmetry): An actinomorphic flower is a flower with two equal radial halves in any radial plane that passes through its centre. *Eg.* Mustard and *Datura*.

(B) (a) Ovary is superior

Explanation: Hypogynous flowers are those in which the ovary is superior to the other three whorls. Here the ovary is positioned high on the thalamus and other parts are below it. *Eg.* Tomato, Tulip, Brinjal, etc.

(C) (c) Solanaceae

(D) (b) (A)-(iii), (B)-(i), (C)-(ii), (D)-(iv)

Explanation: Correct matches are:

Division	-	Spermatophyta
Class	-	Dicotyledonae
Order	-	Polymoniales
Family	-	Solanaceae

(E) (c) When it has gynoecium and androecium.

Explanation: A flower is said to be bisexual when it has both gynoecium (female reproductive part) and androecium (male reproductive part).

VERY SHORT ANSWER Type Questions (VSA)

[1 mark]

17. Add the missing floral organs of the given floral formula of Solanaceae.

$\oplus \text{---} K_{(5)} \dots\dots\dots \underline{G}_{(2)}$

Ans. $\oplus \text{---} \overset{\circ}{K}_{(5)} \overset{\circ}{C}_{(5)} \overset{\circ}{A}_5 \underline{G}_{(2)}$

18. Name the family which is also called the potato family.

Ans. Solanaceae is the family which is also called as potato family.

19. Write about the stem and leaves of the Family Solanaceae.

Ans. **Stem:** Herbaceous rarely woody, aerial, erect, cylindrical, branched, solid or hollow, Hairy or glabrous (smooth). Stem is underground in potatoes.

Leaves: Leaves are alternate, simple, rarely pinnately compound, exstipulate (without stipulate), hairy, and show reticulate venation.

20. Define actinomorphic flowers.

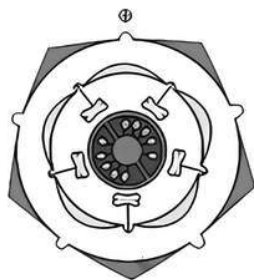
Ans. When a flower can be divided into two or more equal radial halves then, it is called an actinomorphic flower. *Eg.* Mustard flower, *Datura* flower, etc.

SHORT ANSWER Type-I Questions (SA-I)

[2 marks]

21. Draw the floral diagram of the Family Solanaceae.

Ans. The floral diagram of the Family Solanaceae is:



22. Describe the type of androecium and gynoecium of *Solanum nigrum*.

Ans. Androecium: Five in number, polyandrous, epipetalous, filaments short, ditheous anthers, basifixed, alternipetalous, dehiscence porous, inferior.

Gynoecium: Bicarpellary, syncarpous, hypogynous (superior obliquely placed ovary), placenta swollen, axile placentation, bilocular, style is long, stigma bilobed, capitate and green.

23. Name two plants of the Family Solanaceae which are used as narcotics and medicinals.

Ans. Narcotics: *Datura innoxia* and *Hyoscyamus*.

Medicinals: *Atropa belladonna* and *Withania somnifera*.

24. What do the following terms stand for in a floral formula?

P, G, K_(n), %

Ans. P - Perianth

G - Hypogynous ovary

K_(n) - Gamosepalous

% - Zygomorphic

25. Fill up the blank spaces (A), (B), (C) and (D) in the table given below

Type of flower	Position of calyx, corolla and position of the ovary with respect to thalamus	Type of ovary
Hypogynous	 (A)	Superior
Perigynous	On the rim of the thalamus almost at the same level of ovary.	 (B)
..... (C)	 (D)	Inferior

[Delhi Gov. QB 2022]

Ans. (A) Floral parts are situated below the ovary.

(B) Half inferior

(C) Epigynous

(D) Floral parts are situated above the ovary.

26. Plants are usually described beginning with their habit, vegetative characteristics and floral characteristics like inflorescence and parts of a flower – Gynoecium, Androecium, Calyx and Corolla. Is this true? Why or why not?

Ans. Statement is true. Plants are usually described beginning with their habit, vegetative characteristics and floral characteristics like inflorescence and parts of a flower – Gynoecium, Androecium, Calyx and Corolla.

SHORT ANSWER Type-II Questions (SA-II)

[3 marks]

27. Write the floral formula of *Petunia alba* and also, draw its floral diagram.

Ans. The floral formula of *Petunia alba* is:

$\oplus \frac{\text{K}_{(5)}}{\text{C}_{(5)}} \text{A}_5 \underline{\text{G}_{(2)}}$

The floral diagram of *Petunia alba* is:



28. Write about economic importance of the Family Solanaceae.

Ans. Economic importance of the Family Solanaceae:

(1) **Food:** Potato, tomato and brinjal.

(2) **Spices:** Chilli

(3) **Ornamental:** *Petunia*

(4) **Tobacco:** Comes from dried and cured leaves of *Nicotiana tabacum*

(5) **Medicine:** *Belladonna*, *Ashwagandha*.

29. Write the economic importance of the plant *Atropa belladonna*, *Solanum melongena* and *Capsicum*.

Ans. Economic importance of the *Atropa belladonna*:

- (1) Belladonna is cultivated in France and elsewhere for the medicinal alkaloids hyoscyamine and hyoscine (scopolamine), which is used in sedatives, stimulants, and antispasmodics.
- (2) This plant also contains an atropine alkaloid and is used in eye testing. It is also used for checking cough, perspiration, and dilating the pupils. (Any one)

Economic importance of the *Solanum melongena*:

- (1) This plant is grown for its edible fruits.
- (2) It is frequently served as a baked, grilled, fried, or boiled vegetable and is used as a garnish and in stews. (Any one)

Economic importance of the *Capsicum*:

- (1) This genus comprises all the varied forms of fleshy-fruited peppers, including the mild bell peppers that are used as a vegetable and hot peppers, such as habanero and tabasco, that are used as relishes, pickled, or ground into a fine powder for use as a spice.
- (2) Some peppers are grown as ornamentals.
- (3) Peppers are native to tropical America and are particularly important in the cuisines of tropical Asia and equatorial America.

(Any one)

LONG ANSWER Type Questions (LA)

[4 & 5 marks]

30. Describe the various basic characteristics of flowering plants that must be understood before placing the plants in their correct taxonomic position.

Ans. Habit and habitat of flowering plants:

- (1) **Habit:** It can be a herb, shrub, tree, climber, or creeper.
- (2) **Habitat:** It can be hydrophyte, xerophyte, or mesophyte.
 - (i) Hydrophyte plants are those plants that are adapted to live in an aquatic environment.
 - (ii) Xerophytes are those plants that are adapted to live in dry habitats like deserts.
 - (iii) Mesophytes are those plants that are terrestrial but are neither adapted to particularly dry nor particularly wet environments.

Vegetative characteristics of flowering plants:

- (1) **Root:** It can be of three types; tap root, fibrous root, and adventitious root.
- (2) **Stem:** It can be runner, stolon, trailers, tuber, rhizome, corm, bulb, and tendril.
- (3) **Leaf:** They can show parallel or reticulate venation. Leaves can be simple or compound leaves.

Floral characteristics of flowering plants:

- (1) **Inflorescence:** It can be racemose or cymose.
- (2) **Flower parts:** Can be Bracteate or Ebracteate; Sessile or Pedicellate; Unisexual or Bisexual and Actinomorphic or Zygomorphic.
- (3) **Calyx:** Gamosepalous (sepals united) or Polysepalous (sepals free).
- (4) **Corolla:** Gamopetalous (petals united) or Polypetalous (petals free).
- (5) **Gynoecium:** Apocarpous (free carpels) or Syncarpous (fused carpels).
 - (i) Hypogynous (Superior Ovary).
 - (ii) Perigynous (Half inferior Ovary).
 - (iii) Epigynous (Inferior Ovary).
- (6) **Androecium:**
 - (i) Staminode (Sterile Stamen).
 - (ii) Epipetalous (Stamens attached to Petals).
 - (iii) Epiphyllous (Stamens attached to Perianth).
 - (iv) Polyandrous (Free stamens).
 - (v) Monadelphous (Stamens united into one bunch).
 - (vi) Diadelphous (Stamens united into two bundles).
 - (vii) Polyadelphous (Stamens united into many bundles).

31. Farmers in India usually grow *Solanum nigrum* and *Petunia alba* in fields. Discuss their floral characters.

Ans.

Floral Characters	<i>Solanum nigrum</i>	<i>Petunia alba</i>
Inflorescence	Extra axillary cyme	Solitary axillary
Flower	Ebracteate, pedicellate, actinomorphic, bisexual, pentamerous except gynoecium, regular, hypogynous, cyclic, white coloured.	Bracteate, pedicellate, complete actinomorphic, bisexual, hypogynous, variously coloured.
Corolla	Five, gamopetalous, rotate, white, inferior.	Five, gamopetalous, infundibuliform, pentafid, inferior.
Androecium	Five in number, polyandrous, epipetalous, filaments short, ditheous anthers, basifixed, alternipetalous, dehiscence porous, inferior.	Five in number, polyandrous, epipetalous, alternate to the petals, basifixed, filaments long, longitudinal dehiscence, inferior.
Gynoecium	Bicarpellary, syncarpous, hypogynous (superior obliquely placed ovary), placenta swollen, axile placentation, bilocular, style is long, stigma bilobed, capitate and green.	Bicarpellary, syncarpous, hypogynous (superior obliquely placed ovary), placenta swollen, each loculus with numerous ovules, axile placentation, style is long, stigma bifid, capitate.

