

05

Morphology of Flowering Plants

Quick Revision

- **Morphology** deals with the study of external features, forms and relative position of plant organs.
- Plants adopt various morphological features according to the surrounding environment. The two main plant parts are the underground root system and the above ground shoot system.

Inflorescence

It is the arrangement of flowers on the floral axis of stem.

The inflorescence can be of following three types

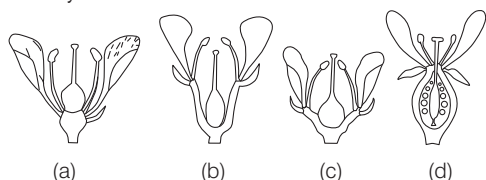
- **Racemose inflorescence** In this type of inflorescence, the main axis continues to grow and the flowers are borne laterally in an **acropetal** or **centripetal** succession.
- **Cymose inflorescence** In this inflorescence, the tip of the main axis terminates in a flower and further growth continues by one or more lateral branches, which also behave like the main axis. The flowers are borne in a basipetal order. Hence, it is limited in growth.
- **Special inflorescence** It mainly involves highly modified and densely crowded inflorescence. It can be divided into following types, i.e. cyathium, verticillaster and hypanthodium (*Ficus religiosa*).

The Flower

Flower is the reproductive unit in the angiosperms. It is meant for sexual reproduction. Morphologically, it is considered as a shoot bearing nodes and modified floral leaves.

- A flower arises in the axil of a leaf-like structure called **bract**. Flowers with bracts are called **bracteate** and those without bracts are called **ebracteate**.
- The terminal and swollen part of the axis of the flower is the **receptacle** or **thalamus**. The receptacle contains sepals, petals, stamens and carpels. If the leaves are present on the pedicel, they are called **bracteoles**.
- Flowers that do not have distinct calyx and corolla are called **perianth**.
- A flower is either **unisexual** (having either stamen or pistil) or **bisexual** (having both stamen and pistil).
- On the basis of the number of floral appendages present, a flower may be **trimerous**, **tetramerous** or **pentamerous**.
- **Insertion of floral parts** (forms of thalamus) Based on the position of ovary with respect to other floral whorls (calyx, corolla and androecium), the flowers are of following three types
 - **Hypogynous flower** Ovary is present at the top of thalamus.

- **Perigynous flower** Margin of thalamus grows upwards forming a cup-like structure.
- **Epigynous flower** Having fused thalamus and ovary.



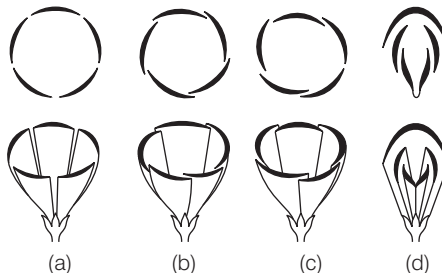
Position of floral parts on thalamus : (a) Hypogynous, (b) and (c) Perigynous, (d) Epigynous

- **Symmetry of a flower** The symmetry of a flower depends upon the shape, size and arrangement of the floral parts. On the basis of this, it can be **actinomorphic** (radial symmetry, e.g. *Datura*) or **zygomorphic** (bilateral symmetry, e.g. *Cassia*).
- **Placentation** is the arrangement of ovules inside an ovary. **Placenta** refers to the parenchymatous cushion present inside the ovary where ovules are borne. These may be **marginal** (e.g. peas), **axile** (e.g. China rose), **parietal** (e.g. *Cucurbita*), **free-central** (e.g. *Dianthus*) and **basal** (e.g. *Aster*).

Parts of a Flower

- A typical flower consists of four distinct parts, i.e. the calyx, corolla, androecium and gynoecium. The calyx and corolla are accessory or non-essential parts and the androecium and gynoecium are essential parts.
- Different parts of flowers are as follows
 1. **Calyx** is the outermost, green in colour, leaf-like whorl that protects the bud stage of flower. The individual members are sepals. The calyx may be **gamosepalous** (sepals united) or **polysepalous** (sepals free).
 2. **Corolla** is the whorl of brightly coloured petals to attract insects for pollination. Petals are also either **fused** (gamopetalous) or **free** (polypetalous).
- **Aestivation** It is the arrangement of sepals or petals in relation to one another in a floral bud.
 - **Valvate** Units in a whorl just touch at margin, without overlapping, e.g. *Calotropis*.
 - **Twisted** One margin of unit overlaps that of the next one, e.g. *Hibiscus*.

- **Imbricate** Both margins of one petal/sepals overlaps and another petal/sepals are overlapped, rest other are twisted, e.g. *Cassia*.
- **Vexillary/Papilionaceous** Large petal (standard) overlaps the two lateral petals (wings), which in turn overlap the two smallest anterior petals (keel), e.g. *Pisum*.



Types of aestivation in corolla : (a) Valvate, (b) Twisted, (c) Imbricate, (d) Vexillary

3. **Androecium** (stamen) male reproductive part of flower. Each stamen consists of a filament and an anther. The anther contains pollen sacs where pollen grains are formed.
 - On the basis of cohesion and adhesion of their parts, stamens may be **monadelphous** (filaments united to form one bundle, e.g. *Hibiscus*), **diadelphous** (filaments united to form two bundles, e.g. *Pisum*), **polyadelphous** (filaments united to form more than two bundles, e.g. *Citrus*), **syngenesious** (only anthers are united in bundle, e.g. *Helianthus*), **synandrous** (both anthers and filament united to form bundle, e.g. *Cucurbita*).
 - When stamens are adhered to petals the condition is known as **epipetalous** (e.g. *Solanum*) and when stamens are attached to perianth the condition is called epiphyllous, e.g. lily. If stamens or anthers are attached to gynoecium condition is known as **gynandrous** (e.g. *Calotropis*).
4. **Gynoecium** (pistils or carpels) female reproductive part of flower consisting of the receptive and sticky **stigma**, the elongated stalk **style** and the enlarged base **ovary** that bears ovules. When more than one carpels are present they may be **apocarpous** (free) as in *Viscum* or **syncarpous** (united) as in *Hibiscus*.

Semi-Technical Description of a Typical Flowering Plant

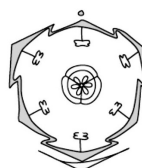
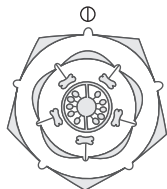
- Flower is the distinct identifying feature of a plant. To describe the characteristics of a flower in brief, floral formula and floral diagram are used. They use some specific symbols as

Br	–	Bracteate	P	–	Perianth (Unit-tepals)
Ebr	–	Ebracteate	A	–	Androecium (Unit-stamens)
⊕	–	Actinomorphic or regular flower	G	–	Gynoecium (Unit-carpels)
%	–	Zygomorphic or irregular flower	\overline{G}	–	Superior ovary
♂	–	Bisexual flower	\underline{G}	–	Inferior ovary
♀	–	Female flower	1, 2, 3, 4, ... ∞	–	Number of units
♂	–	Male flower	()	–	Fused
K	–	Calyx (Unit-sepals)			
C	–	Corolla (Unit-petals)	$\widehat{C} A$	–	Epipetalous condition

Description of Some Important Families

Characteristics	Solanaceae	Liliaceae
General description	Commonly known as potato family . It is distributed in tropics and subtropics.	Commonly called as lily family . It is a representative of monocots.
Plant structure	Herb, shrub and small trees.	Perennial herb.
Stem structure	Herbaceous, rarely woody, hairy, hollow, underground (potato).	Stem may be underground partially.
Inflorescence	Solitary, axillary or cymose.	Solitary/cymose often umbellate clusters.
Flower	Bisexual and actinomorphic, rarely zygomorphic.	Bisexual and actinomorphic.
Calyx	Sepal five united, persistent, valvate.	Perianth [6 tepals arranged in two whorls (3 + 3). Free or rarely united, valvate].
Corolla	Five united, valvate.	–
Androecium	Stamens five, epipetalous.	Stamens 6 (3 + 3), epipetalous
Gynoecium	Bicarpellary, syncarpous and superior.	Tricarpellary, syncarpous and superior.
Fruit	Berry or Capsule.	Capsule and rarely berry.
Seed	Many and endospermic.	Endospermic.
Floral formula	$\oplus \text{ } \overline{\text{K}}_{(5)} \widehat{\text{C}}_{(5)} \text{A}_{(5)} \underline{\text{G}}_{(2)}$	$\text{Br} \oplus \text{ } \overline{\text{K}}_{(3+3)} \widehat{\text{A}}_{3+3} \underline{\text{G}}_{(3)}$
Economic importance	Plants of this family are source of food (potato underground stem), tomato and brinjal, spices (chilli), medicines (<i>Belladonna</i>), fumigatory (tobacco).	Plants of this family are used as ornament and medicines <i>Aloe</i> , vegetable (<i>Asparagus</i>) and colchicine (<i>Colchicum autumnale</i>).

Floral diagram



Objective Questions

Multiple Choice Questions

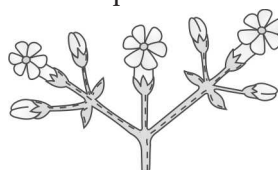
1. A flower is a modified shoot because
 - (a) certain flowers have well-developed nodes and internodes
 - (b) it arises in the axile of plants
 - (c) the growing point of thalamus may give rise to shoots
 - (d) All of the above
2. When a shoot tip transforms into a flower, it is always
 - (a) solitary
 - (b) axillary
 - (c) racemose
 - (d) cymose
3. Inflorescence is the arrangement of
 - (a) leaves on the floral axis
 - (b) buds on the floral axis
 - (c) flowers on the floral axis
 - (d) petioles on the floral axis
4. Depending on whether the apex gets converted into a flower or continues to grow, how many major types of inflorescences are defined?

(a) Two	(b) Three
(c) Four	(d) Five
5. In racemose inflorescence,
 - I. the main axis continues to grow into a flower.
 - II. flowers are borne in acropetal manner.
 - III. young flowers are present towards the base and older at the apex.

Choose the correct option to complete the statement.

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

6. Identify the given diagram and choose the incorrect option.



- (a) The main axis terminates into a flower
 - (b) Flowers are basipetally arranged
 - (c) Growth of the peduncle is determined
 - (d) Older flowers are towards the base and younger at the apex
7. In an inflorescence, where flowers are borne laterally in an acropetal succession, the position of the youngest floral bud shall be **(NCERT Exemplar)**

(a) proximal	(b) distal
(c) intercalary	(d) any where
8. A typical flower has four different kinds of whorls arranged on end of the stalk or pedicel called

(a) peduncle	(b) thalamus
(c) receptacle	(d) Both (b) and (c)
9. Perianth is the condition in which
 - (a) calyx and corolla are not distinct
 - (b) calyx is present, but corolla is absent
 - (c) corolla is present, but calyx is absent
 - (d) calyx and corolla are not present
10. I. When flower has both an androecium and gynoecium, it is called ... *A*....
 II. When flower has either stamens or only carpel, it is called ... *B*....

Fill up the blanks by choosing appropriate options for *A* and *B*.

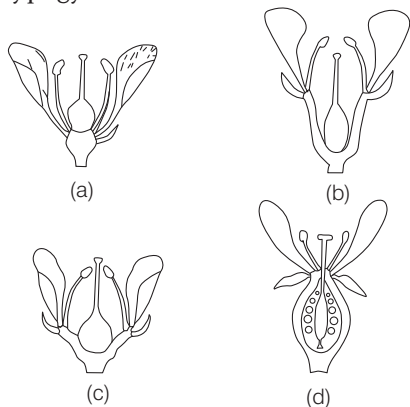
(a) <i>A</i> -bisexual, <i>B</i> -unisexual	(b) <i>A</i> -unisexual, <i>B</i> -bisexual
(c) <i>A</i> -bisexual, <i>B</i> -hermaphrodite	(d) <i>A</i> -hermaphrodite, <i>B</i> -bisexual

11. Choose the incorrect match.

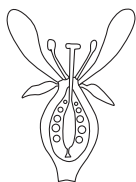
- (a) Actinomorphic flower – Mustard
- (b) Zygomorphic flower – Gulmohar
- (c) Asymmetrical flower – Bean
- (d) All of the above

12. Which of the following statement is correct?

- (a) Actinomorphic are bilaterally symmetrical flowers
- (b) Zygomorphic are radially symmetrical flowers
- (c) Asymmetric are irregularly symmetrical flowers
- (d) All of the above

13. Which of the following represents hypogynous condition?**14. Select the correct match with respect to the position of floral parts on thalamus.**

- (a) Hypogynous – Half inferior – Guava
- (b) Epigynous – Superior – Cucumber
- (c) Perigynous – Inferior – Ray florets of sunflower
- (d) Hypogynous – Superior – China rose

15. All statements are correct with respect to the figure given below, except.

- (a) the margin of thalamus grows upwards enclosing
- (b) ovary is said to be inferior
- (c) the flower is said to be perigynous
- (d) it is seen in the flowers of guava and cucumber

16. Match the following columns.

Column I (Parts of flower)	Column II (Description)
A. Calyx	1. Female reproductive part
B. Corolla	2. Male reproductive part
C. Androecium	3. Outermost whorl of flower
D. Gynoecium	4. Composed of petals

Codes

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

17. Read the following statements and choose the option with correct statements.

- I. Generally sepals are green, leaf like and protect the flower in the bud stage.
- II. Petals are usually bright coloured to attract insect pollinators.
- III. The shape and colour of corolla vary greatly in plants.
- IV. Corolla may be tubular, bell-shaped, funnel-shaped or wheel-shaped.

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

18. Match the following columns.

Column I	Column II
A. Sepals free	1. Gamopetalous
B. Petals united	2. Gamosepalous
C. Petals free	3. Polysepalous
D. Sepals united	4. Polypetalous

Codes

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

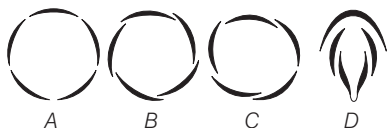
19. The mode of arrangement of sepals or petals in a floral bud with respect to the other members of same whorl is known as

(a) aestivation (b) cohesion
(c) placentation (d) adhesion

20. Which type of aestivation occurs when sepals or petals in a whorl just touch one another at the margin without overlapping?

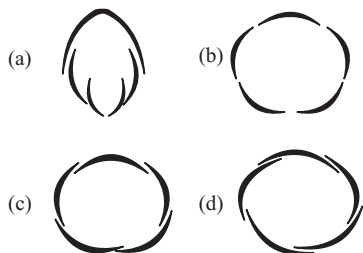
(a) Imbricate aestivation
(b) Valvate aestivation
(c) Twisted aestivation
(d) Vexillary aestivation

21. Arrange in correct order according to the given figures.



- (a) A - Imbricate, B - Vexillary, C - Valvate, D - Twisted
(b) A - Vexillary, B - Valvate, C - Twisted, D - Imbricate
(c) A - Valvate, B - Twisted, C - Vexillary, D - Imbricate
(d) A - Valvate, B - Twisted, C - Imbricate, D - Vexillary

22. Aestivation of petals in the flower of cotton is correctly shown in



23. Find out the pairs, which are correctly matched with respect to aestivation of petals.

I. Valvate – *Calotropis*

II. Twisted – Bean

III. Imbricate – *Cassia*

IV. Vexillary – China rose

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

24. Staminode is a fertile stamen.

(a) True
(b) False
(c) Cannot say
(d) Partially true or false

25. The technical term used for the androecium in a flower of China rose (*Hibiscus rosa-sinensis*) is

(a) monadelphous (b) diadelphous
(c) polyandrous (d) polyadelphous

26. Match the following columns.

	Column I	Column II
A.	When stamens unite into more than two bundles	1. Epipetalous
B.	When stamens are attached to the petals	2. Epiphyllous
C.	When stamens are attached with perianth	3. Diadelphous
		4. Polyadelphous

Codes

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

27. Select the incorrect pair out of the following.

(a) Epipetalous – Brinjal
(b) Diadelphous – *Cucurbita*
(c) Polyadelphous – *Citrus*
(d) Epiphyllous – Lily

28. In a carpel, ...*A*... is the enlarged basal part, on which lies the elongated tube, ...*B*... The ...*C*... is the tip of carpel, which is receptive for pollen grains.

- (a) *A*-stigma, *B*-style, *C*-ovary
- (b) *A*-ovary, *B*-style, *C*-stigma
- (c) *A*-style, *B*-stigma, *C*-ovary
- (d) *A*-stigma, *B*-ovary, *C*-style

29. The expression 'gynoecium is apocarpous' implies that the

- (a) gynoecium comprises only one pistil which is fused with the stamen
- (b) gynoecium comprises more than one carpel, all of which are free
- (c) gynoecium comprises only one carpel which is free
- (d) gynoecium comprises more than one carpel which are fused

30. Gynoecium with fused carpels is called

- (a) syncarpous (b) apocarpous
- (c) syngenesious (d) None of these

31. Placentation can be defined as an arrangement of

- (a) ovules within the ovary
- (b) synergids within the ovary
- (c) carpels in a flower
- (d) pistils in a flower

32. In marginal placentation, the ovules are arranged

- (a) along the inner wall of carpel in a syncarpous ovary
- (b) along the margin of single carpel
- (c) in the middle of the ovary
- (d) to the base of the ovary

33. Axile placentation is found in syncarpous ovaries. In this placentation, the ovules are arranged along the

- (a) base of the ovary
- (b) margin of the ovary
- (c) axis in the centre of the ovary
- (d) None of the above

34. Match the following columns.

Column I (Placentations)	Column II (Examples)
A. Basal	1. Mustard
B. Axile	2. China rose
C. Parietal	3. <i>Dianthus</i>
D. Free-central	4. Sunflower

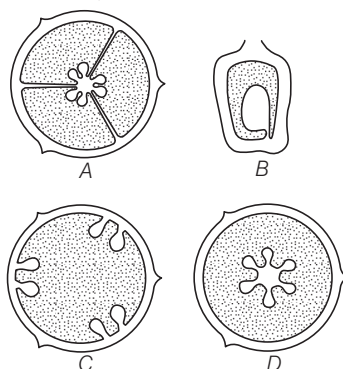
Codes

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

35. In a multicarpellary syncarpous unilocular ovary, if the ovules are borne on the central axis and septa are absent this is defined as

- (a) marginal placentation
- (b) parietal placentation
- (c) axile placentation
- (d) free-central placentation

36. In the diagram of types of placentation given below, *A*, *B*, *C* and *D*, respectively represent



- (a) *A*-Basal, *B*-Axile, *C*-Parietal, *D*-Free-central
- (b) *A*-Free-central, *B*-Parietal, *C*-Basal, *D*-Axile
- (c) *A*-Axile, *B*-Basal, *C*-Parietal, *D*-Free-central
- (d) *A*-Parietal, *B*-Axile, *C*-Free-central, *D*-Basal

37. When both essential floral organs (stamens and carpels) are present in a flower, we write in its floral formula.

- (a) ♀ (b) ♂
(c) ♀ (d) ⊕

38. ♀ stands for ...A... .

⊕ stands for ...B... .

% stands for ...C... .

Here, A to C refer to

- (a) A-Female, B-Actinomorphic, C-Zygomorphic
(b) A-Male, B-Actinomorphic, C-Zygomorphic
(c) A-Male, B-Zygomorphic, C-Actinomorphic
(d) A-Female, B-Zygomorphic, C-Actinomorphic

39. What would we interpret if % is given for a flower in its floral formula?

- (a) Any vertical section passing through its centre divides it into two equal vertical halves
(b) Only one vertical section divides it into equal vertical halves
(c) Cannot be divided into equal vertical halves by any vertical section
(d) Only one vertical section passing through its centre divides it into two equal vertical halves

40. Give the symbol of bicarpellary syncarpous, inferior ovary

- (a) $\underline{G}_{(2)}$ (b) G_0
(c) G_2 (d) $\overline{G}_{(2)}$

41. Which of the following statements is correct with reference to the flowers of family-Solanaceae?

- (a) Pentamerous, actinomorphic, unisexual, hypogynous
(b) Pentamerous, zygomorphic, bisexual, epigynous
(c) Pentamerous, bisexual, actinomorphic, hypogynous
(d) Trimerous, actinomorphic, bisexual, hypogynous

42. Brinjal, datura and tobacco belong to family

- (a) Liliaceae (b) Fabaceae
(c) Solanaceae (d) Leguminosae

43. The correct floral formula of chilli is

- (a) $\oplus \varnothing K_{2+2} C_4 A_{2+4} \overline{G}_{(2)}$
(b) $Br \% K_4 C_4 A_1 G_1$
(c) $\oplus \varnothing K_{(5)} \overline{C}_{(5)} A_5 \overline{G}_{(2)}$
(d) $\oplus \varnothing P_{3+3} A_{3+3} G_{(3)}$

44. I. Plants belonging to the family...A... possesses a persistent calyx.

II. The family ...B... mainly contains monocotyledonous plants.

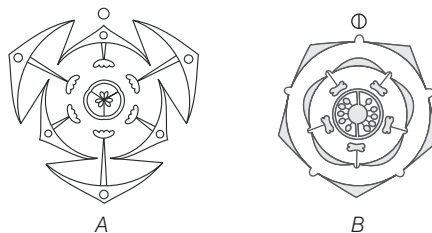
Choose the correct option to fill in the blanks 'A' and 'B'.

- | A | B |
|----------------|------------|
| (a) Fabaceae | Poaceae |
| (b) Solanaceae | Fabaceae |
| (c) Solanaceae | Liliaceae |
| (d) Asteraceae | Solanaceae |

45. Bicarpellary obligated placed syncarpous ovary with axile placentation is found in

- (a) potato family (b) lily family
(c) pea family (d) mustard family

46. Given are two floral diagrams A and B.



The correct floral diagram of the family to which tulip and tomato belongs are and, respectively.

- (a) A, B (b) B, B (c) B, A (d) A, A

47. Tricarpellary, syncarpous gynoecium is found in flowers of Solanaceae.

- (a) True (b) False
(c) Cannot say (d) Partially true or false

48. Familiar examples of family-Liliaceae are

- (a) *Allium cepa*, *Aloe vera* and *Tamarindus indica*
- (b) *Saraca indica*, *Allium cepa* and *Aloe vera*
- (c) *Allium sativum*, *Allium cepa* and *Aloe vera*
- (d) *Tamarindus indica*, *Allium cepa* and *Allium sativum*

49. Gynoecium having three fused carpels with a single ovule containing chamber is

- (a) Tricarpellary, syncarpous, unilocular
- (b) Tricarpellary, apocarpous, unilocular
- (c) Tricarpellary, syncarpous, trilocular
- (d) Tricarpellary, apocarpous, trilocular

50. Perianth occurs in family-Liliaceae.

- (a) True
- (b) False
- (c) Cannot say
- (d) Partially true or false

51. The floral characters of Liliaceae are

- (a) Six tepals, zygomorphic, six stamens, bilocular ovary, axile placentation
- (b) Tetramerous, actinomorphic, polyphyllous, unilocular ovary, axile placentation
- (c) Bisexual, actinomorphic, polyandrous, superior ovary, axile placentation
- (d) Bisexual, zygomorphic, gamophyllous, inferior ovary, marginal placentation

Assertion-Reasoning MCQs

Direction (Q. Nos. 52-61) Each of these questions contains two statements Assertion (A) and Reason (R). Each of these questions also has four alternative choices, any one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

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

52. Assertion (A) Type of inflorescence in *Sphaeranthus* is cyathium.

Reason (R) In cyathium type inflorescence, the flowers are achlamydeous.

53. Assertion (A) In racemose type of inflorescence, the main axis grows indefinitely.

Reason (R) Main axis is not terminated by flower.

54. Assertion (A) Monadelphous stamens are found in China rose.

Reason (R) When the stamens are united into one bunch or bundle the condition is said to be monadelphous.

55. Assertion (A) In some flowers like lily, perianth is a term used when calyx and corolla are not distinct.

Reason (R) Calyx and corolla are the reproductive organs.

56. Assertion (A) Monadelphous stamens are found in pea.

Reason (R) In pea, stamens are united into two bunch or bundles.

57. Assertion (A) Epiphyllous condition is found in the flowers of lily.

Reason (R) In lily, stamens are attached to the perianth.

58. Assertion (R) Parietal placentation is observed in pea plant.

Reason (R) In pea plant, the placenta forms a ridge along the ventral suture of ovary and ovules are borne on this ridge forming two rows.

59. Assertion (A) G_2 is the symbol for inferior ovary.

Reason (R) Fusion is indicated by enclosing the number within bracket.

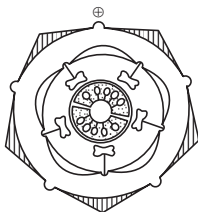
- (ii) The term 'polyadelphous' is related to
 (a) gynoecium
 (b) androecium
 (c) corolla
 (d) calyx
- (iii) Ovary is half-inferior in the flowers of
 (a) guava (b) plum
 (c) brinjal (d) cucumber
- (iv) The enlarged basal part on which lies the elongated tube of style is
 (a) corolla (b) calyx
 (c) ovary (d) ovule
- (v) Trimerous, tetramerous and pentamerous are terms related to
 (a) placentation
 (b) position of ovary
 (c) number of floral appendages
 (d) number of stamens

64. Identify the given floral diagram and answer the questions that follow



- (i) The given floral formula is of
 (a) Aloe (b) lupin
 (c) chilli (d) All of these
- (ii) Which of the following is the correct representation of floral diagram given above?
 (a) $\otimes \text{P}_{(3+3)} \text{A}_{3+3} \text{G}_{(3)}$ (b) $\otimes \text{P}_6 \text{A}_6 \text{G}_{(3)}$
 (c) $\otimes \text{P}_{5+5} \text{A}_{(5)} \text{G}_{(2)}$ (d) $\otimes \text{P}_5 \text{K}_{(5)} \text{C}_{(5)} \text{A}_5 \text{G}_{(2)}$
- (iii) Plants having the above given floral diagram are
 (a) leguminous
 (b) dicots
 (c) medicinal and perennial
 (d) having pinnately compound leaves
- (iv) The given floral formula is of plants belonging to
 (a) dicots
 (b) monocots
 (c) Both dicots and monocots
 (d) monoecious plants
- (v) Choose the incorrect match for family in the floral diagram.
 (a) Fruit - Capsule
 (b) Seed - Endospermic
 (c) Androecium - Epipetalous
 (d) Gynoecium - Inferior ovary
- 65. Direction** Read the following and answer the questions that follow
- Floral formula is a symbolic and numerical representation of various floral parts of a plant family. It helps to ascertain the symmetry, sexuality and the arrangement of various floral parts like calyx, corolla, androecium and gynoecium. It also helps to describe the families of flowering plants in a sequential, brief and scientific language. While writing the floral formula, the bract are represented first, followed by bracteate, symmetry, sex of flower, calyx, corolla, androecium and gynoecium. The number of parts of each structure is indicated in numerals after their relevant symbol.
- (i) The number of 'K' and 'C' in family-Solanaceae is
 (a) 5 and 6, respectively (b) 5 each
 (c) 6 each (d) 3 and 6, respectively
- (ii) The symbol $\underline{\text{G}}_{(3)}$ represents
 (a) tricarpeal gynoecium
 (b) inferior ovary
 (c) apocarpous ovary
 (d) All of the above
- (iii) *Petunia* belongs to the family
 (a) Liliaceae (b) Fabaceae
 (c) Solanaceae (d) Orchidaceae
- (iv) To represent bracteate and actinomorphic condition, which symbol is used?
 (a) $\text{Br} \ominus$ (b) $\text{Br} \text{I} \%$ (c) $\text{Br} \text{I}$ (d) $\text{Br} \oplus$

- (v) Study and identify the correct conclusions with respect to the floral diagram given below.



- I. The calyx has 5 gamosepalous sepals.
 II. Corolla has 5 gamopetalous petals.
 III. Flowers possess radial symmetry.
 IV. Androecium has 5 polyandrous stamens.

Codes

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

ANSWERS

Multiple Choice Questions

1. (d) 2. (a) 3. (c) 4. (a) 5. (d) 6. (d) 7. (b) 8. (d) 9. (a) 10. (a)
 11. (c) 12. (c) 13. (a) 14. (d) 15. (c) 16. (c) 17. (d) 18. (d) 19. (a) 20. (b)
 21. (d) 22. (d) 23. (c) 24. (b) 25. (a) 26. (b) 27. (b) 28. (b) 29. (b) 30. (a)
 31. (a) 32. (b) 33. (c) 34. (c) 35. (d) 36. (c) 37. (a) 38. (a) 39. (d) 40. (d)
 41. (c) 42. (c) 43. (c) 44. (c) 45. (a) 46. (a) 47. (b) 48. (c) 49. (a) 50. (a)
 51. (c)

Assertion-Reasoning MCQs

52. (d) 53. (a) 54. (a) 55. (c) 56. (d) 57. (a) 58. (d) 59. (d) 60. (c) 61. (a)

Case Based MCQs

62. (i) (d), (ii) (c), (iii) (b), (iv) (c) (v) (a) 63. (i) (c), (ii) (b), (iii) (b), (iv) (c), (v) (c)
 64. (i) (a), (ii) (a), (iii) (c), (iv) (b), (v) (d) 65. (i) (b), (ii) (a), (iii) (c), (iv) (d), (v) (c)

EXPLANATIONS

- (d) A flower is a modified shoot wherein the shoot apical meristem changes to floral meristem. Internodes do not elongate and axis gets condensed. The apex produces different kind of floral appendages laterally at successive nodes instead of leaves.
 Thus, option (d) is correct.
- (a) When a shoot tip transforms into a flower, it is always solitary, i.e. it is not a part of an inflorescence.
- (c) The arrangement and distribution of flower on the floral axis is called inflorescence. It is the modified shoot that is specialised to bear flower.
- (d) The given diagram shows cymose inflorescence in which the main axis terminates into a flower. Flowers are basipetally arranged, growth of the peduncle is determined and young flowers are present towards the base and older at the apex.
- (b) In racemose inflorescence, younger flowers are borne 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 flower would be distal.
- (a) In some flowers like lily, the calyx and corolla are not distinct and hence, termed as perianth.

10. (a) A–bisexual, B–unisexual
11. (c) Option (c) is incorrect match and can be corrected as
Canna is an asymmetrical flower and bean plant flower is zygomorphic.
 Rest options are correct matches.
12. (c) Statement in option (c) is correct.
 Rest other statements are incorrect and can be corrected as
 - Actinomorphic are radially symmetrical flowers.
 - Zygomorphic are bilaterally symmetrical flowers.
13. (a) In the hypogynous flower, the gynoecium occupies the highest position, while the other parts are situated below it.
 Thus, option (a) is correct.
15. (c) Statement in option (c) is incorrect and can be corrected as
 The flower is said to be epigynous.
18. (d) A–3, B–1, C–4, D–2
20. (b) In valvate aestivation, the sepals or petals just touch one another at margin without overlapping, e.g. *Calotropis*.
22. (d) Option (d) shows aestivation of petals in cotton flower. In cotton, China rose and lady's finger margins of sepals or petals overlap each other. This mode of arrangement is called twisted.
23. (c) Pairs I and III are correct.
 - *Calotropis* shows valvate aestivation, the petals are arranged close to each other, but do not overlap each other.
 Rest other pairs are not correctly matched with respect to aestivation of petals and can be corrected as
 - *Cassia* shows the imbricate aestivation, the petals are irregularly overlapped.
 - Beans show vexillary imbricate aestivation because of the papilionaceous corolla.
 - China rose shows the twisted aestivation, the petals are regularly overlapped by the next one and overlapping the previous one.
24. (b) A sterile stamen is called staminode.
25. (a) China rose of Malvaceae family possesses numerous stamens. The filaments of stamens are united in one group, thus forming a staminal tube around the style. Such stamens are called monadelphous.
27. (b) Option (b) is incorrect pair and can be corrected as
 Diadelphous kind of arrangement, i.e. (9) + 1 or (5) + (5), in which fusion of filaments produces two groups is seen in members of family–Fabaceae.
 In cucurbits, synandrous condition of stamens is present in which stamens are fused by both their filaments as well as anthers.
 Rest options are correct pairs.
29. (b) Apocarpous gynoecium is characterised by the presence of more than one carpel that are separate or free. It is a primitive condition, e.g. strawberry, buttercup, etc.
30. (a) Gynoecium in which two or more carpels are fused is known as syncarpous. This phenomenon is found mostly in Malvaceae family.
34. (c) A–4, B–2, C–1, D–3
37. (a) Bisexual or Hermaphrodite are the terms used for flowers when both male and female reproductive (floral) organs are present in the same flower. Thus, the symbol ♂, denotes a bisexual flower.
38. (a) A–Female, B–Actinomorphic, C–Zygomorphic
39. (d) The symbol (%) indicates that the flower is zygomorphic, i.e. it is a term used for a bilaterally symmetrical flower. Such a flower can be divided into two equal halves only in a single vertical plane through its centre, e.g. pea, etc.
41. (c) Solanaceae family is characterised by pentamerous, bisexual, actinomorphic and hypogynous features.
42. (c) *Petunia*, *Datura* and *Nicotiana* belong to Solanaceae family, i.e. potato family.
43. (c) Chilli is the member of Solanaceae, in which flowers are bisexual (♂), actinomorphic ⊕; calyx-5 sepals united, valvate aestivation, corolla-5 petals united, androecium 5 free, epipetalous; gynoecium - bicarpellary, syncarpous and superior ovary.
45. (a) Bicarpellary obligated placed syncarpous ovary with axile placentation is found in family–Solanaceae also called potato family.

47. (b) Tricarpellary, syncarpous gynoecium is found in family–Liliaceae. Bicarpellary, syncarpous gynoecium is found in family–Solanaceae. Monocarpellary gynoecium is found in family–Fabaceae and family–Poaceae.
50. (a) Perianth occurs in family–Liliaceae.
52. (d) A is false, but R is true. A can be corrected as
Sphaeranthus belongs to family–Asteraceae, in which head capitulum inflorescence is found. Cyathium inflorescence represents the neuter or sterile flower, which are pedicellate achlamydeous.
53. (a) Both A and R are true and R is the correct explanation of A.
 In racemose inflorescence, the peduncle never ends in a flower, but continues to grow indefinitely and bears flower laterally.
54. (a) Both A and R are true and R is the correct explanation of A.
 Androecium is composed of stamens. The adelphous stamens are fused by their filaments only. The anthers are free. When fusion of filaments produces one bunch or bundle it is called monadelphous, e.g. China rose.
55. (c) A is true, but R is false. R can be corrected as
 Sepals or calyx and petals or corolla are non-essential or accessory floral organs or floral leaves which do not take any direct part in sexual reproduction.
56. (d) A is false, but R is true. A can be corrected as
 In pea, stamens are united into two bundles, i.e. diadelphous condition.
58. (d) A is false, but R is true. A can be corrected as
 In marginal placentation, one or two alternate rows of the ovules occur longitudinally along the ridge in the wall of the ovary in the area of fusion of its two margins or ventral suture. A true placenta is believed to be absent.
- Ovary is unilocular. Marginal placentation is found in monocarpellary pistils of Leguminosae (e.g. pea, *Cassia*, *Acacia*) and other plants (e.g. Larkspur).
59. (d) A is false, but R is true and A can be corrected as
 A flower is represented by a floral diagram and floral formula. The floral formula is represented by various symbols. $\underline{G}_{(2)}$ is the symbol for superior ovary. Fusion is indicated by enclosing the number within bracket.
60. (c) A is true, but R is false because
 The floral formula of family–Solanaceae is

$$\oplus \varnothing K_{(5)} \overbrace{C_{(5)}}^{\text{---}} A_5 \underline{G}_{(2)}$$

 Family–Solanaceae is commonly called potato family. This floral formula tells that flower is bisexual, actinomorphic, sepals are five and united, petals are five and united, stamens are five, epipetalous and gynoecium is bicarpellary and syncarpous, ovary is superior, bilocular and placenta is swollen with many ovules.
61. (a) Both A and R are true and R is the correct explanation of A.
 Seeds of Solanaceae, e.g. tomato, brinjal, etc., are mostly endospermous. This is because their endosperm remains in the mature seed even after embryo development.
62. (i) (d) Flower is a modified shoot wherein the shoot apical meristem changes into floral meristem.
 (ii) (c) Individual flowers are attached to inflorescence axis by pedicel.
 (iv) (c) Epipetalous is a condition of stamens in which stamens are attached to the petals.
63. (i) (c) Option (c) is incorrect because part-C is corolla not pedicel.
 (ii) (b) When the filaments are united into more than two bundles, but anthers are free, such condition is known as polyadelphous. Since, anther and filament are parts of androecium, the term polyadelphous is related to androecium.

- (iii) (b) A flower in which floral parts arise from around the ovary is called perigynous.
In this, the ovary is half-inferior. It can be seen in the flowers of plum, peach, etc.
- (iv) (c) Ovary is the enlarged basal part on which the elongated tube, the style lies.
- (v) (c) A flower may be trimerous, tetramerous or pentamerous when the number of floral appendages are in multiple of 3, 4 or 5, respectively.
- 64.** (i) (a) The given floral formula is of Liliaceae family. It includes *Aloe*, tulip, etc. Lupin belongs to Fabaceae and chilli belongs to Solanaceae.
- (ii) (a) The floral formula given in option (a) is correct for the floral diagram that is of family–Liliaceae. Flowers of the family are bracteate or ebracteate, actinomorphic bisexual, trimerous, hypogynous and pentacyclic. Calyx and corolla are undifferentiated and called perianth. Perianth 6, in two alternate whorls (3 + 3). Androecium 6, polyandrous, arranged in two whorls, antipetalous, often epipetalous. Gynoecium is tricarpeal, syncarpous, ovary trilobular with axile placentation. The option (a) denotes the correct floral formula.
- (iii) (c) The given floral diagram is of Liliaceae family.
Most plants of this family are good ornamentals, source of medicine, vegetables and colchicine.
- (iv) (b) The given floral formula is of Liliaceae family. This family is a characteristic representative of monocot plants.
- (v) (d) Option (d) is incorrect and can be corrected as
The ovary of the plants of Liliaceae family is superior.
- 65.** (i) (b) In family–Solanaceae, the number of calyx (K) and corolla (C) is 5 each, i.e. $K = C = 5$.
- (ii) (a) \underline{G}_3 symbol for gynoecium represents that it is tricarpeal, syncarpous and possesses superior ovary.
- (iii) (c) *Petunia* belongs to family–Solanaceae.
- (iv) (d) To represent the bracteate condition, symbol Br is used. Actinomorphic flowers are represented by the symbol \oplus .
- (v) (c) All features are correct.