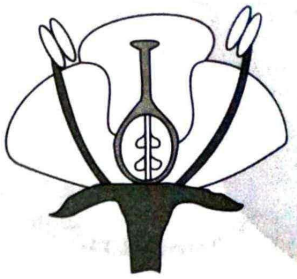
CHAPTER



5 Morphology of Flowering Plants

5.1. The Root

1. The roots that originate from the base of the stem are:
(A) primary roots (B) prop roots
(C) lateral roots (D) fibrous roots.
[NEET Sept. 2020]

2. Pneumatophores occur in:
(A) carnivorous plants
(B) free-floating hydrophytes
(C) halophytes
(D) submerged hydrophytes. **[NEET 2018]**

3. Sweet potato is a modified:
(A) tap root (B) adventitious root
(C) stem (D) rhizome. **[NEET 2018]**

4. Root hairs develop from the region of:
(A) maturation (B) elongation
(C) root cap (D) meristematic activity.
[NEET 2017]

5. Roots play insignificant role in absorption of water in:
(A) Sunflower (B) *Pistia*
(C) Pea (D) Wheat.
[AIPMT Latest July 2015]

6. In a longitudinal section of a root, starting from the tip upward the four zones occur in the following order:
(A) root cap, cell division, cell enlargement, cell maturation
(B) root cap, cell division, cell maturation, cell enlargement
(C) cell division, cell enlargement, cell maturation, root cap
(D) cell division, cell maturation, cell enlargement, root cap. **[AIPMT 2004]**

7. Roots of which plant contains an oxidising agent?
(A) Carrot (B) Soybean
(C) Mustard (D) Radish **[AIPMT 2001]**

8. Velamen is found in:
(A) roots of screwpine
(B) aerial and terrestrial roots of orchids
(C) leaves of *Ficus elastica*
(D) aerial roots of orchids. **[AIPMT 1991]**

5.2. The Stem

9. In *Bougainvillea* thorns are the modifications of:
(A) stipules (B) adventitious root
(C) stem (D) leaf. **[NEET 2017]**

10. Which of the following is not a stem modification?
(A) Thorns of citrus.
(B) Tendrils of cucumber.
(C) Flattened structures of *Opuntia.*
(D) Pitcher of *Nepenthes.* **[NEET Phase-I 2016]**

11. An example of edible underground stem is:
(A) carrot (B) groundnut
(C) sweet potato (D) potato. **[AIPMT 2014]**

12. The 'Eyes' of the potato tuber are:
(A) flower buds (B) shoot buds
(C) axillary buds (D) root buds.
[AIPMT Screening 2011]

13. Which one of the following is a xerophytic plant in which the stem is modified into the flat green and succulent structure?
(A) *Opuntia* (B) *Casuarina*
(C) *Hydrilla* (D) *Acacia*
[AIPMT Mains 2010]

14. New banana plants develop from.
(A) rhizome (B) sucker
(C) stolon (D) seed **[AIPMT 1990]**

5.3. The Leaf

15. Identify the correct set of statements:
(I) The leaflets are modified into pointed hard thorns in *Citrus* and *Bougainvillea.*

(II) Axillary buds form slender and spirally coiled tendrils in cucumber and pumpkin.

(III) Stem is flattened and fleshy in *Opuntia* and modified to perform the function of leaves.

(IV) *Rhizophora* shows vertically upward growing roots that help to get oxygen for respiration.

(V) Subaerially growing stems in grasses and strawberry help in vegetative propagation.

Choose the correct answer from the options given below:

(A) (I) and (IV) only

(B) (II), (III), (IV) and (V) only

(C) (I), (II), (III) and (V) only

(D) (II) and (III) only **[NEET 2022]**

16. Leaves become modified into spines in:

(A) *Opuntia* (B) pea

(C) onion (D) silk cotton.

[AIPMT Cancelled 2015]

17. How many plants among China rose, *Ocimum*, sunflower, mustard, *Alstonia*, guava, *Calotropis* and *Nerium* (oleander) have opposite phyllotaxy?

(A) Three (B) Four

(C) Five (D) Two

[NEET Karnataka 2013]

18. Phyllode is present in:

(A) *Asparagus* (B) *Euphorbia*

(C) Australian *Acacia* (D) *Opuntia.*

[AIPMT Screening 2012]

19. Whorled, simple leaves with reticulate venation are present in:

(A) *Calotropis* (B) Neem

(C) China rose (D) *Alstonia.*

[AIPMT Mains 2011]

5.4. Inflorescence

20. Inflorescence is racemose in:

(A) brinjal (B) tulip

(C) *Aloe* (D) soybean.

[NEET Karnataka 2013]

21. Cymose inflorescence is present in:

(A) *Solanum* (B) *Sesbania*

(C) *Trifolium* (D) *Brassica.*

[AIPMT Screening 2012]

22. Hair found in the inflorescence of *Zea mays* are the modification of:

(A) style (B) stigma

(C) spathe (D) filaments. **[AIPMT 2000]**

5.5. The Flower

23. Match List-I with List-II:

List-I	List-II
(a) Vexillary aestivation	(i) Brinjal
(b) Epipetalous stamens	(ii) Peach
(c) Epiphyllous stamens	(iii)Pea
(d) Perigynous flower	(iv)Lily

Choose the correct answer from the options given below:

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

[Re-NEET 2024]

24. Match List-I with List-II:

List-I	List-II
(a) China rose	(i) Free central
(b) Mustard	(ii) Basal
(c) *Primrose*	(iii) Axile
(d) Marigold	(iv) Parietal

Choose the correct answer from the options given below:

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

[Re-NEET 2024]

25. Which of the following is an example of actinomorphic flower?

(A) *Cassia* (B) *Pisum*

(C) *Sesbania* (D) *Datura* **[NEET 2024]**

26. Identify the type of flowers based on the position of calyx, corolla and androecium with respect to the ovary from the given figures (a) and (b)

(a) (b)

(A) (a) Hypogynous; (b) Epigynous

(B) (a) Perigynous; (b) Epigynous

(C) (a) Perigynous; (b) Perigynous

(D) (a) Epigynous; (b) Hypogynous **[NEET 2024]**

27. Match List I with List II:

List I	List II
(a) Rose	(i) Twisted aestivation

(b) Pea	(ii) Perigynous flower
(c) Cotton	(iii) Drupe
(d) Mango	(iv) Marginal placentation

Choose the correct answer from the options given below:

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

[NEET 2024]

28. Match List I with List II:

List I (Types of Stamens)	List II (Example)
(a) Monoadelphous	(i) *Citrus*
(b) Diadelphous	(ii) Pea
(c) Polyadelphous	(iii) Lily
(d) Epiphyllous	(iv) China rose

Choose the correct answer from the options give below:

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

[NEET 2024]

29. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R):

Assertion (A): A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem.

Reason (R): Internode of the shoot gets condensed to produce different floral appendages laterally at successive node instead of leaves.

In the light of the above statements, choose the correct answer from the options given below:

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

(B) (A) is false but (R) is true.

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

(D) Both (A) and (R) are true but (R) is not the correct explanation of (A). **[NEET 2023]**

30. Axile placentation is observed in:

(A) Tomato, *Dianthus* and Pea

(B) China rose, *Petunia* and Lemon

(C) Mustard, Cucumber and *Primrose*

(D) China rose, Beans and Lupin **[NEET 2023]**

31. Diadelphous stamens are found in:

(A) China rose (B) *Citrus*

(C) Pea (D) China rose and *Citrus*.

[NEET 2021]

32. Correct position of floral parts over thalamus in mustard plant is:

(A) gynoecium occupies the highest position, while the other parts are situated below it.

(B) margin of the thalamus grows upward, enclosing the ovary completely and other parts arise below the ovary.

(C) gynoecium is present in the centre and other parts cover it partially.

(D) gynoecium is situated in the centre and other parts of the flower are located at the rim of the thalamus, at the same level. **[NEET Oct. 2020]**

33. Ray florets have:

(A) superior ovary (B) hypogynous ovary

(C) half inferior ovary (D) inferior ovary.

[NEET Sept. 2020]

34. The term 'polyadelphous' is related to:

(A) gynoecium (B) androecium

(C) corolla (D) calyx.

[NEET Phase-II 2016]

35. How many plants among *Indigofera*, *Sesbania*, *Salvia*, *Allium*, *Aloe*, mustard, groundnut, radish, gram and turnip have stamens with different lengths in their flowers?

(A) Three (B) Four

(C) Five (D) Six

[NEET Phase-II 2016]

36. Radial symmetry is found in the flowers of:

(A) *Brassica* (B) *Trifolium*

(C) *Pisum* (D) *Cassia*.

[NEET Phase-II 2016]

37. The standard petal of a papilionaceous corolla is also called:

(A) pappus (B) vexillum

(C) corona (D) carina.

[NEET Phase-I 2016]

38. Keel is the characteristic feature of flower of:

(A) Tulip (B) *Indigofera*

(C) *Aloe* (D) Tomato.

[AIPMT Cancelled 2015]

39. Axile placentation is present in:

(A) *Dianthus* (B) lemon

(C) pea (D) *Argemone*.

[AIPMT Latest July 2015]

40. Among bitter gourd, mustard, brinjal, pumpkin, China rose, lupin, cucumber, sunn hemp, gram, guava, bean, chilli, plum, *Petunia*, tomato, rose, *Withania*, potato, onion, *Aloe* and tulip, how many plants have hypogynous flower?

(A) Six (B) Ten

(C) Fifteen (D) Eighteen **[NEET 2013]**

41. Among flowers of *Calotropis*, tulip, *Sesbania, Asparagus, Colchicum*, sweet pea, *Petunia, Indigofera*, mustard, soybean, tobacco and groundnut, how many plants have corolla with valvate aestivation?

(A) Six (B) Seven
(C) Eight (D) Five

[NEET Karnataka 2013]

42. The gynoecium consists of many free pistils in flowers of:

(A) *Aloe* (B) Tomato
(C) *Papaver* (D) *Michelia.*

[AIPMT Screening 2012]

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

Mustard, Gram, Tulip, *Asparagus*, Arhar, Sunn hemp, Chilli, *Colchicum*, Onion, Moong, Pea, Tobacco, Lupin

(A) Four (B) Five
(C) Six (D) Three

[AIPMT Mains 2012]

44. Flowers are zygomorphic in:

(A) gulmohur (B) tomato
(C) datura (D) mustard.

[AIPMT Screening 2011]

45. The ovary is half inferior in flowers of:

(A) cucumber (B) cotton
(C) guava (D) peach.

[AIPMT Screening 2011]

46. Keel is characteristic of the flowers of:

(A) gulmohar (B) *Cassia*
(C) *Calotropis* (D) bean.

[AIPMT Screening 2010]

47. Ovary is half-inferior in the flowers of:

(A) guava (B) plum
(C) brinjal (D) cucumber.

[AIPMT Screening 2010]

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

(A) monoadelphous (B) diadelphous
(C) polyandrous (D) polyadelphous.

[AIPMT Screening 2010]

49. Aestivation of petals in the flower of cotton is correctly shown in:

(A)  (B) 

(C)  (D) 

[AIPMT Mains 2010]

50. An example of axile placentation is:

(A) *Argemone* (B) *Dianthus*
(C) lemon (D) marigold.

[AIPMT Screening 2009]

51. Replum is present in the ovary of flower of:

(A) lemon (B) mustard
(C) sunflower (D) pea.

[AIPMT Screening 2008]

52. What type of placentation is seen in sweet pea?

(A) Marginal (B) Basal
(C) Axile (D) Free central

[AIPMT 2006]

5.6. The Fruit

53. In some plants thalamus contributes to fruit formation. Such fruits are termed as:

(A) false fruits (B) aggregate fruits
(C) true fruits (D) parthenocarpic fruits.

[NEET Oct. 2020]

54. Identify the correct features of mango and coconut fruits.

(I) In both, fruit is a drupe.
(II) Endocarp is edible in both.
(III) Mesocarp in coconut is fibrous and in mango it is fleshy.
(IV) In both, fruit develops from monocarpellary ovary.

Select the correct option:

(A) (I), (III) and (IV) (B) (I), (II) and (III)
(C) (I) and (IV) (D) (I) and (II)

[NEET Oct. 2020]

55. Coconut fruit is a:

(A) drupe (B) berry
(C) nut (D) capsule. **[NEET 2017]**

56. Among China rose, mustard, brinjal, potato, guava, cucumber, onion and tulip, how many plants have superior ovary?

(A) Five (B) Six
(C) Three (D) Four

[AIPMT Latest July 2015]

57. Which one of the following fruit is parthenocarpic?

(A) Brinjal (B) Apple
(C) Jackfruit (D) Banana

[AIPMT Latest July 2015]

58. Placenta and pericarp are both edible portions in:

(A) apple (B) banana
(C) tomato (D) potato. **[AIPMT 2014]**

59. An aggregate fruit is one which develops from:
(A) multicarpellary syncarpous gynoecium
(B) multicarpellary apocarpous gynoecium
(C) complete inflorescence
(D) multicarpellary superior ovary **[AIPMT 2014]**

60. A drupe develops in:
(A) wheat (B) pea
(C) tomato (D) mango.
[AIPMT Screening 2011]

61. A fruit developed from hypanthodium inflorescence is called:
(A) hesperidium (B) sorosis
(C) syconus (D) caryopsis.
[AIPMT Screening 2009]

62. Dry indehiscent single-seeded fruit formed from bicarpellary syncarpous inferior ovary is:
(A) caryopsis (B) cypsela
(C) berry (D) cremocarp.
[AIPMT Screening 2008]

63. The fleshy receptacle of syconus of fig encloses a number of:
(A) achenes (B) samaras
(C) berries (D) mericarps.
[AIPMT Screening 2008]

64. The fruit is chambered, developed from inferior ovary and has seeds with succulent testa in:
(A) pomegranate (B) orange
(C) guava (D) cucumber.
[AIPMT Screening 2008]

65. Pineapple (*Ananas*) fruit develops from:
(A) a multilocular monocarpellary flower
(B) a unilocular polycarpellary flower
(C) a multipistillate syncarpous flower
(D) a cluster of compactly borne flowers on a common axis. **[AIPMT 2006]**

66. Which of the following represents the edible part of the fruit of litchi?
(A) Mesocarp (B) Endocarp
(C) Pericarp (D) Juicy aril. **[AIPMT 2005]**

67. Edible part of mango is:
(A) endocarp (B) receptacle
(C) epicarp (D) mesocarp.
[AIPMT 2004, 02]

68. Juicy hair-like structures observed in the lemon fruit develop from:
(A) exocarp (B) mesocarp
(C) endocarp (D) mesocarp and endocarp
[AIPMT 2003]

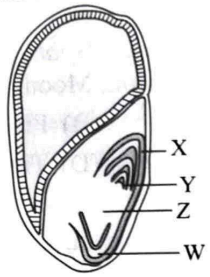
69. Geocarpic fruit is:
(A) potato (B) peanut
(C) onion (D) garlic. **[AIPMT 2002]**

70. Which is correct pair of edible part?
(A) Tomato – Thalamus
(B) Maize – Cotyledous
(C) Guava – Mesocarp
(D) Date palm – Pericarp **[AIPMT 2002]**

71. Which of the following is a 'true fruit'?
(A) Banana (B) Fig
(C) Apple (D) Pear **[AIPMT 1996]**

5.7. The Seed

72. Identify the part of the seed from the given figure which is destined to form root when the seed germinates.



(A) Y (B) Z
(C) W (D) X **[NEET 2024]**

73. Cotyledon of maize grain is called:
(A) coleorhiza (B) coleoptile
(C) scutellum (D) plumule.
[NEET Phase-I 2016]

74. Which one of the following statement is correct?
(A) The seed in grasses is not endospermic.
(B) Mango is a parthenocarpic fruit.
(C) A proteinaceous aleurone layer is present in maize grain.
(D) A sterile pistil is called a staminode. **[AIPMT 2014]**

75. Non-albuminous seed is produced in:
(A) maize (B) castor
(C) wheat (D) pea. **[AIPMT 2014]**

76. Seed coat is not thin, membranous in:
(A) maize (B) coconut
(C) groundnut (D) gram. **[NEET 2013]**

77. Albuminous seeds store their reserve food mainly in:
(A) endosperm (B) cotyledons
(C) hypocotyl (D) perisperm.
[NEET Karnataka 2013]

78. Which one of the following statement is correct?
(A) Seeds of orchids have oil-rich endosperm.
(B) Placentation in *Primrose* is basal.
(C) Flower of tulip is a modified shoot.
(D) In tomato, fruit is a capsule.
[AIPMT Screening 2011]

79. The scutellum observed in a grain of wheat or maize is comparable to which part of the seed in other monocotyledons?

(A) Cotyledon (B) Endosperm

(C) Aleurone layer (D) Plumule

[AIPMT Screening 2010]

80. Cotyledons and testa are edible parts of:

(A) groundnut and pomegranate

(B) walnut and tamarind

(C) french bean and coconut

(D) cashew nut and litchi. **[AIPMT Screening 2009]**

81. An example of a seed with endosperm, perisperm and caruncle is:

(A) cotton (B) coffee

(C) lily (D) castor.

[AIPMT Screening 2009]

82. In a cereal grain, the single cotyledon of embryo is represented by:

(A) coleoptile (B) coleorhiza

(C) scutellum (D) prophyll. **[AIPMT 2006]**

83. The aleurone layer in maize grain is specially rich in:

(A) proteins (B) starch

(C) lipids (D) auxins. **[AIPMT 2003]**

5.8. Semi-technical Description of a Typical Flowering Plant

84. Floral features are chiefly used in angiosperm identification because:

(A) flowers can be safely pressed.

(B) reproductive parts are more stable and conservative than vegetative parts.

(C) flowers are nice to work with.

(D) flowers are of various colours. **[AIPMT 1998]**

5.9. Description of Some Important Families

*85. Which of the following examples show monocarpellary, unilocular ovary with many ovules?

(I) *Sesbania* (II) Brinjal

(III) *Indigofera* (IV) Tobacco

(V) *Asparagus*

Choose the correct answer from the options given below:

(A) (II) and (V) only

(B) (III), (IV) and (V) only

(C) (I), (II) and (IV) only

(D) (I) and (III) only **[Re-NEET 2024]**

*86. Family Fabaceae differs from Solanaceae and Liliaceae. With respect to the stamens, pick out the characteristics specific to family Fabaceae but not found in Solanaceae or Liliaceae.

(A) Monoadelphous and Monothecous

(B) Epiphyllous and Dithecous anthers

(C) Diadelphous and Dithecous anthers

(D) Polyadelphous and epipetalous stamens

[NEET 2023]

87. In some members of which of the following pairs of families, pollen grains retain their viability for months after release?

(A) Poaceae ; Rosaceae

(B) Poaceae ; Leguminosae

(C) Poaceae ; Solanaceae

(D) Rosaceae ; Leguminosae **[NEET 2021]**

88. Which of the following is the correct floral formula of Liliaceae?

(A) $\oplus\,♀♂\, C_{1+2+(2)} A_{(9)+1} \underline{G}_1$ (B) $\oplus\,♀♂\, K_{(5)} \overbrace{C_{(5)}} A_1 G_1$

(C) $Br\oplus\,♀♂\, \overbrace{P_{(3+3)}} A_{3+3} \underline{G}_{(3)}$ (D) $\oplus\,♀♂\, K_{(5)} \overbrace{C_{(5)}} A_5 G_{(2)}$

[NEET Oct. 2020]

*89. Tricarpellary, syncarpous gynoecium is found in flowers of:

(A) Solanaceae (B) Fabaceae

(C) Poaceae (D) Liliaceae.

[NEET Phase-I 2016]

90. In China rose the flowers are:

(A) actinomorphic, hypogynous with twisted aestivation

(B) actinomorphic, epigynous with valvate aestivation

(C) zygomorphic, hypogynous with imbricate aestivation

(D) zygomorphic, epigynous with twisted aestivation.

[NEET 2013]

*91. Vexillary aestivation is characteristic of the family:

(A) Fabaceae (B) Asteraceae

(C) Solanaceae (D) Brassicaceae.

[AIPMT Screening 2012]

92. The correct floral formula of chilli is:

(A) $\oplus\,♀♂\, K_{(5)}\, \overbrace{C_{(5)}\, A_5} G_{(2)}$ (B) $\oplus\,♀♂\, K_{(5)}\, C_{(5)}\, A_{(5)} G_2$

(C) $\oplus\,♀♂\, K_5\, \overbrace{C_5\, A_{(5)}} G_2$ (D) $\oplus\,♀♂\, K_{(5)}\, C_5\, A_5 G_{(2)}$

[AIPMT Screening 2011]

*93. The correct floral formula of soybean is:

(A) $\%\,♀♂\, K_{(5)} C_{1+(2)+2} A_{(9)+1} \underline{G}_1$

(B) $\%\,♀♂\, K_{(5)} C_{1+(2)+2} A_{(9)+1} G_1$

(C) $\%\,♀♂\, K_{(5)} C_{1+2+(2)} A_{(9)+1} G_1$

(D) $\%\,♀♂\, K_{(5)} C_{(1)+2+(2)} A_{(9)+1} G_1$ **[AIPMT Mains 2010]**

*Topics/Qs are in NEET latest syllabus but has been removed from NCERT.

94. Consider the following four statements and select the right option for two correct statements.

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

(II) The floral formula for Liliaceae is $\oplus \male P_{3+3}A_{3+3}\underline{G_3}$

(III) In pea flower, the stamens are monoadelphous.

(IV) The floral formula for Solanaceae is $\oplus \male K_{(3)}C_{(3)}A_{(4)}+\underline{G_{(2)}}$

Select the correct option:

(A) (I) and (III) (B) (I) and (II)
(C) (II) and (III) (D) (III) and (IV)

[AIPMT Mains 2010]

95. The floral formula $\oplus \male K_{(5)}\overset{\frown}{C_{(5)}}A_5\,\underline{G_{(2)}}$ is that of:

(A) tulip (B) soybean
(C) sunn hemp (D) tobacco.

[AIPMT Screening 2009]

***96.** Epipetalous and syngenesious stamens occur in:

(A) Solanaceeae (B) Brassicaceae
(C) Fabaceae (D) Asteraceae.

[AIPMT 1991]

***97.** A family delimited by type of inflorescence is:

(A) Fabaceae (B) Asteraceae
(C) Solanaceae (D) Liliaceae.

[AIPMT 1991]

SOLUTIONS

1. (D) A fibrous root is usually formed by thin, moderately branching roots growing from the base of the stem. A fibrous root system is universal in monocotyledonous plants and ferns. The primary root, or radicle, is the first organ to appear when a seed germinates. It grows downward into the soil, anchoring the seedling. In gymnosperms and dicotyledons, the radicle becomes a tap root. Prop roots develop from the upper part of the stem, especially the horizontal branches while stilt roots develop from the basal nodes of the main stem. Prop roots are adventitious in nature, and are also called pillar roots, *e.g.*, mangrove tree or corn. Lateral roots, emerging from the pericycle (meristematic tissue), extend horizontally from the primary root (radicle) and ultimately organise a second root meristem.

2. (C) Pneumatophores are breathing roots, found in halophytes, such as mangroves.

Related Theory

- *Pneumatophores are a type of aerial roots that grow from above the ground and absorb water directly from the air. Pneumatophores are formed by certain plant species submerged in water, in waterlogged soil, or in strongly compacted soil. They emerge from the typical roots and then stick up out of the soil.*
- *The root surface of the pneumatophores is covered with lenticels allowing gas exchange between the atmosphere and the internal tissues.*
- *Mangrove plants form pneumatophores since the saline soil is anaerobic and therefore, hampers the submerged roots to carry out gaseous exchange through the soil.*

3. (B) Sweet potato is a modified adventitious root, meant for storage of food. It is the edible part of sweet potato. Adventitous roots grow from parts other than the radicle.

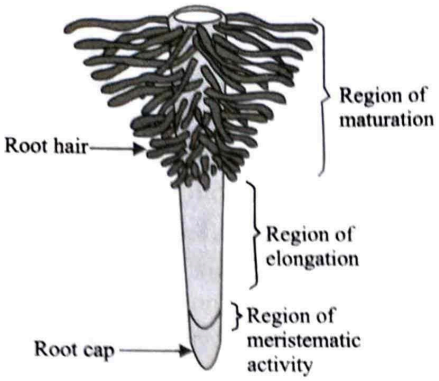
Caution

- *Students must understand that potato is a modified underground stem (stolon) and sweet potato is a modified root, both functioning in storage of food.*

4. (A) In roots, the root hairs arise from the region of maturation. This zone is a differentiated zone, bearing root hairs. A few millimetres above the root cap is the region of meristematic activity. The cells proximal to this zone undergo rapid division and elongation and form the region of elongation.

5. (B) *Pistia* is a hydrophyte. In hydrophytes, roots are not well developed, as plants are present around water. They play an insignificant role in absorption of water. However, roots are well developed in mesophytic and xerophytic plants.

6. (A) The root tip can be divided into three zones: a zone of cell division, a zone of elongation, and a zone of maturation. The zone of cell division is closest to the root tip and is made up of the actively-dividing cells of the root meristem, which contains the undifferentiated cells of the germinating plant. The zone of elongation is where the newly-formed cells increase in length, thereby lengthening the root. Zone of cell maturation is the region away from the root tip where the root cells differentiate into specialized cell types.



Regions of the Root-tip

Related Theory

- *Root growth begins with seed germination. When the plant embryo emerges from the seed, the radicle of the embryo forms the root system. The tip of the root is protected by the root cap, a structure exclusive to roots and unlike any other plant structure. The root cap is continuously replaced because it is easily damaged as the root pushes through soil.*

7. (B) Leguminous plants, such as soybean, pea, *etc.*, have root nodules, which contain a red coloured pigment called leghaemoglobin. It is an oxygen binding pigment, which is present in the cytoplasm of infected nodule cells at high concentration and provides a pink colour. The main function of this pigment is to transport oxygen to respiring symbiotic bacterial cells in same manner as hemoglobin transports oxygen in respiring tissues of animals.

Related Theory

- *Leghaemoglobin is an oxygen-carrying phytoglobin found in the nitrogen-fixing root nodules of leguminous plants. It is produced by such plants in response to the roots being colonised by nitrogen-fixing bacteria, as part of the symbiotic interaction between plant and bacterium. Roots that are not colonised by Rhizobium do not synthesise leghaemoglobin.*

8. (D) Velamen tissue is found in the aerial roots of orchids. These roots are called hygroscopic roots. They hang freely in the air and absorb moisture with the help of velamen tissue.

Related Theory

- *Velamen is a spongy, multiple epidermis that covers the roots of some epiphytic or semi-epiphytic plants, such as orchid. The tissues arise from the root tip by a division of special tissue. The dead cells of velamen diffuse with light and give it a greyish appearance and after absorbing the water, these dead cells become transparent and the whole velamen tissue appears green.*

9. (C) In *Bougainvillea*, thorns are the modification of stems. They are stiff, sharp structures, which have lost their growing point and become hard. They help to reduce transpiration and protect from browsing animals.

10. (D) Pitcher is a modified leaf, also known as pitfall traps. It consists of a deep cavity filled with digestive liquid, for the prey. It is found in *Nepenthes*. Flattened structures in *Opuntia* are called phylloclade, is a modified, photosynthetic stem. In citrus plants, stem is modified to thorns to reduce transpiration and act as defensive organ. In cucumbers, stem is modified into tendrils, and climbs along the support.

Related Theory

- *Opuntia is a xerophytic plant, in which leaves are modified into spine to reduce the rate of transpiration and they do not perform the photosynthesis. The function of photosynthesis in Opuntia is performed by thick fleshy, food storing and flattened stem containing chlorophyll, also known as phylloclade.*
- *In Asparagus, the stem modifies into a leaf like structure to carry out photosynthesis while leaves are reduced to spines.*
- *In Trapa and Tinospora roots grow outside the soil, and develop chlorophyll to perform photosynthesis.*

Caution

- *Students should remember that thorns are modified stem, while spines are modified leaves.*

11. (D) Potato is a modified stem tuber, which is edible. Carrot and sweet potato are root tubers.

Caution

- *Groundnut or peanut is a false fruit that grows below the surface of the ground.*

12. (C) In potatoes, each eye represents a node in the stem as the potatoes are modified stems. New stems are developed from these eyes because these are axillary buds and are capable of giving rise to new branches.

13. (A) Flattened structures in *Opuntia* are called phylloclade, is a modified, photosynthetic stem. *Acacia* is covered with sharp thorns, which are modified branches or leaf-stipules. Leaves are very much reduced, small scale-like, appearing only for a brief period (caducous) sometimes modified into spines or scales as in *Casuarina*, *Ruscus*, *Asparagus*. *Hydrilla* is a hydrophyte.

Related Theory

- *Physiological adaptations of xerophytes:*
  - *(1) The stomata of these plants open during night hours and remain closed during the day. This unusual feature is associated with metabolic activities of these plants.*
  - *(2) In xerophytes, the chemical compounds of cell sap are converted into wall forming compounds. E.g., cellulose, suberin, etc.*
  - *(3) Some enzymes, such as catalase, peroxidases are more active in xerophytes than in mesophytes.*
  - *(4) The capacity of xerophytes to survive in long period of drought is due to the resistance of the hardened protoplasm to heat and desiccation.*
  - *(5) The xerophytes have very high osmotic pressure, which increases the turgidity of the cell sap.*

14. (B) New banana plants develop from sucker. Sucker is a special non-green slender stem branch, which arises from the underground base of an erect shoot.

15. (B) Stems of many plants, such as *Citrus* and *Bougainvillea* are modified into thorns.

16. (A) Leaves are modified into spines in xerophytes (*Opuntia*) to reduce rate of transpiration. In pea, leaves are modified into tendrils to help them in climbing around the support. In onion, leaves are modified to fleshy succulent to store food.

Related Theory

In a few plants like Nepenthes, the leaf-lamina is modified into a pitcher-like structure. The insect is digested into the inner walls of the pitcher which secretes a digestive fluid into the pitcher cavity. On the other hand, in some plants, the segments of the leaves are modified into bladders. These plants are found in water. The inner wall is provided with digestive glands which helps in digesting the trapped insect, e.g., Utricularia. In Drosera, the lamina possesses numerous hair with a sticky globule at its tip containing digestive enzymes. The moment an insect sits on the lamina, the hair covers the insect completely.

17. (A) *Ocimum*, guava and *Calotropis* have opposite phyllotaxy, while China rose, sunflower, grass, mustard shows alternate phyllotaxy and *Alstonia*, *Nerium* (Oleander) shows whorled phyllotaxy.

Related Theory

The three types of phyllotaxy are as follows:

(1) ***Alternate type of phyllotaxy:*** *A single leaf arises at each node in an alternate manner.*

(2) ***Opposite type of phyllotaxy:*** *A pair of leaves arise at each node and lie opposite to each other.*

(3) ***Whorled type of phyllotaxy:*** *More than two leaves arise at a node and form a whorl.*

Alternate *Opposite* *Whorled*

18. (C) A phyllode is a modified petiole or a shoot that connects the stem with leaf; its function resembles that of a leaf, *e.g.*, Australian *Acacia*. Phylloclade are seen in *Euphorbia* and *Opuntia*. Cladodes are seen in *Asparagus*.

Related Theory

A cladode is a stem, which is modified into a leaf-like structure for photosynthesis. A phylloclade is a branch, which is modified into a leaf-like structure for photosynthesis. A phyllode is winged leaf stalk, which functions as a leaf.

19. (D) In *Alstonia*, leaves are simple, elliptical or ovale, linear to lanceolate and wedge-shaped at the base. These are leathery and sessile. The leaf blade is dorsiventral and arranged in a whorl with the entire margin. The leaf venation is reticulate and has many veins ending in a marginal vein.

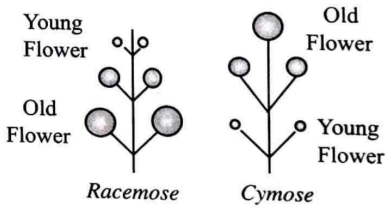
In China rose, leaves have reticulate venation, with alternate phyllotaxy. In neem, leaves are reticulate and simple, but not whorled. In *Calotropis*, opposite phyllotaxy is present.

20. (D) Soybean belongs to Fabaceae, which shows racemose inflorescence. Brinjal belongs to Solanaceae, which shows cymose inflorescence. *Aloe* and tulip belongs to Liliaceae family with cymose inflorescence.

Related Theory

Differentiate between racemose and cymose inflorescence:

	Racemose inflorescence	***Cymose inflorescence***
(1)	*The main axis continues to grow.*	*The main axis terminates in a flower.*
(2)	*Growth is unlimited.*	*Growth is limited.*
(3)	*The flowers are borne in an acropetal succession.*	*Flowers are borne in a basipetal succession.*
(4)	*The grouping of flowers is less common and arrangement of flowers in a group is centripetal.*	*The grouping of flower is more common and arrangement of flowers in a group is centrifugal.*



21. (A) Cymose inflorescence is one during which the tip of the most axis ends in an exceedingly flower. This kind of inflorescence is seen in *Solanum* (Family Solanaceae). *Trifolium*, *Sesbania* and *Brassica* shows racemose inflorescence. When the main axis does not terminate in a flower and continues to grow, it is referred to as racemose inflorescence.

22. (A) In *Zea mays* (maize), style is very long, which comes out of the cob to expose stigma for wind pollination. These are collectively known as silk.

23. (A) Vexillary aestivation is characterized by the covering of two small petals by large petals and it can be seen in pea.

In Brinjal, epipetalous stamen is found, which means that the stamens are attached to the petals of the flower.

Epiphyllous stamen is defined as the stamens are attached with perianth of flower. Lily represents the best example of the same.

Peach is a perigynous flower in which gynoecium is located at the centre of the flower.

24. (C) Axile placentation is found in china rose in which ovules are borne on inner walls of ovary, when the two or more placenta evolve along the wall of ovary is called parietal placentation and it is found in mustard, free central placentation is found in primrose, in which the ovules are not associated with the ovary wall by any septum. In basal placentation at the base, a single placenta is present and is found in marigold.

25. (D) *Datura* is an example of actinomorphic flower, where a flower can be divided into two equal radial halves in any radial plane passing through the centre.

Related Theory

➥ *In Cassia, Pisum and Sesbania, zygomorphic flowers are seen.*

26. (C) Given figures (a) and (b) show perigynous condition in which gynoecium is situated in the centre and other parts of the flower are located on the rim of the thalamus almost at the same level, it is called perigynous. For example, plum, rose, and peach.

27. (D) (a) Rose have perigynous flowers as their gynoecium is situated in the centre and other parts of the flower are located on the rim of the thalamus almost at the same level.

(b) Pea shows marginal placentation, where the placenta forms a ridge along the ventral suture of the ovary and the ovules are borne on this ridge forming two rows.

(c) Flowers of cotton show twisted aestivation where one margin of the floral appendage overlaps that of the next one and so on.

(d) Fruit of mango is known as a drupe. They develop from monocarpellary superior ovaries and are one seeded.

28. (D) In China rose, monoadelphous androecium is present.

Diadelphous androecium is found in pea plant.

Polyadelphous androecium is found in *Citrus*.

Epiphyllous androecium is found in lily.

29. (C) The assertion states that a flower is a modified shoot where the shoot apical meristem changes to a floral meristem. This is a true statement.

The reason given explains how the shoot apical meristem changes to a floral meristem. It states that the internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves. This is also a true statement and it provides the correct explanation of how the shoot apical meristem changes to a floral meristem.

30. (B) Axile placentation is a type of arrangement of ovules within the ovary of a flower. In this type of placentation, the ovary is divided into several chambers or locules, separated by the septa, with the ovules attached to a central column or axis in the center of the ovary. The number of chambers is usually the same as the number of carpels that make up the ovary. This type of placentation is observed in many plants, including tomatoes, beans, and mustard. Axile placentation is considered to be one of the most common types of placentation in flowering plants.

31. (C) Diadelphous stamens occur in Papilionaceae. It is majorly seen in the largest family under the order legumes like pea.

Related Theory

➥ *China rose – Monadelphous;*
Citrus – Polyadelphous.

32. (A) Mustard flower is a hypogynous flower, *i.e.*, the gynoecium occupies the highest position over the other floral parts. The ovary is said to be superior.

Related Theory

➥ *Flower types are based on the position of the ovary in a flower. There are three categories: hypogynous (if sepals, petals and stamens are attached to the receptacle below the ovary; e.g. tomato), perigynous (if sepals, petals and stamens are fused at the base to form a cup-shaped structure called a hypanthium which is inserted beneath the ovary; e.g., cherry), and epigynous (if sepals, petals and stamens arise from the top of the ovary, or from a hypanthium inserted above the ovary, e.g., ray florets of sunflower).*

Caution

➥ *The students tend to make mistakes as they are not clear between the concept of hypogynous, epigynous and perigynous flowers.*

33. (D) Ray florets have inferior ovary. Rays florets in sunflower are epigynous flowers in which all floral parts are attached above the level of ovary. Ovary is completely covered by thalamus.

34. (B) Polyadelphous is the condition in which stamens are present in more than two groups. It is found in castor, *Citrus*, *Bombax malabarica*, etc.

Related Theory

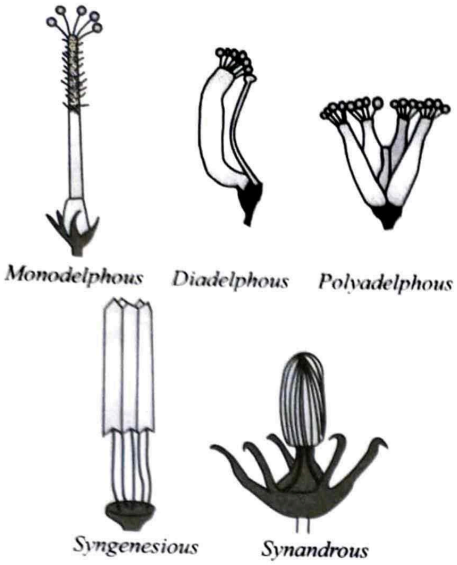
➥ ***(1) Monoadelphous stamens:*** *Filaments of all stamens are united forming a single bundle but the anthers are free. Example- Cotton.*

(2) Diadelphous stamens: *Filaments are united forming two bundles and anthers are free. Example- Pea.*

(3) Polyadelphous stamens: *Filaments are united forming a number of bundles but the anthers remain free. Example- Lemon.*

(4) Syngenesious stamens: *Anther of filaments are united and filaments are free. Example – Tridax, Sunflower.*

(5) Synandrous stamen: *All stamens are united completely to form one structure. Example-family of cucurbitaceae.*



35. (B) Only *Salvia*, mustard, radish and turnip have stamens of different length in their flowers. It is found that the family Brassicaceae and Lamiaceae have distinct stamen length.

Related Theory

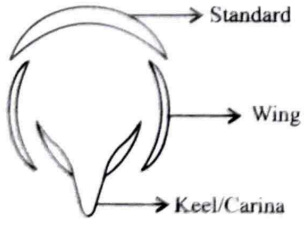
When styles and filaments in a flower are of different lengths, it is called heterostyly. It promotes cross-pollination.

36. (A) Flowers of Brassicaceae family have actinomorphic flowers, which shows radial symmetry. *Pisum*, *Trifolium* and *Cassia* are the members of Fabaceae family having zygomorphic flower, which shows bilateral symmetry.

Related Theory

Flowers that are radially symmetrical (actinomorphic) are able to be bisected into similar halves in more than one vertical plane, forming mirror while flowers that are bilaterally symmetrical (zygomorphic) are able to be bisected into similar halves in only one plane, forming mirror.

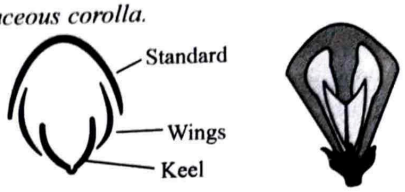
37. (B) In papilionaceous corolla, the largest petal known as standard or vexillum, while two keel petals are fused together at the base to form a boat like structure known as carina. Pappus or corona is derived from a modified calyx, which surrounds the fruit and can stick to animal fur or be lifted by the wind, aiding in seed dispersal.



38. (B) Keel is the characteristic feature of vexillary aestivation found in family Fabaceae (*e.g.*, *Indigofera*, pea). Tulip and *Aloe* belong to Liliaceae family, while tomato belongs to Solanaceae family.

Related Theory

Vexillary or descending imbricate aestivation is a characteristic of family Fabaceae. In it, the posterior largest petal (vexillary or standard) overlaps two lateral petals (wings) which in turn overlap two anterior petals (carina or keel). It is also called papilionaceous corolla.



Vexillary Aestivation

39. (B) Axile placentation is seen in lemon, China rose and tomato. Free central placentation is present in *Dianthus*. Pea shows marginal placentation. *Argemone* shows parietal placentation.

Related Theory

Placentation refers to the arrangement of ovules within the ovary. Ovules are attached to ovarian walls through special structures called placenta. Axile placentation is the type of placentation in which carpels are folded inward with ovules placed along the central axis of the ovary. Placenta is axial and the ovules are formed at the angles where the septa join the central placenta.

Axile Placentation

Mnemonics

Examples of placentation can be learned as:
***M**any **P**eople **A**re **L**iving in **C**hina **T**oday*
*(1) **M**any **P**eople (**M**arginal: **P**ea).*
*(2) **A**re **L**iving in **C**hina **T**oday (**A**xile: **L**emon, **C**hina rose, **T**omato).*

40. (C) **Perigynous flowers (half inferior):** Plum, rose, peach.

Epigynous Flowers (inferior ovary): Pumpkin, bitter gourd, guava and cucumber, ray florets of sunflower.

Hypogynous Flowers (superior ovary): Mustard, brinjal, china rose, lupin, sunn hemp, gram, bean, chilli, *Petunia*, tomato, *Withania*, potato, onion, *Aloe*, and tulip.

Related Theory

Plant Family: *Liliaceae, Solanaceae, Fabaceae have hypogynous flowers, while Cucurbitaceae family have epigynous flowers.*

Caution

Students may get confused in the examples and usually do not attempt such question. In order to solve such question, one should use elimination method. Out of the list, first mark the flowers which cannot be hypogynous. (Mark all the NCERT

examples). Then, study the rest of the examples and mark according to their family characteristics (e.g., all cucurbitaceae members are epigynous). Now out of the flowers left, select all the flowers which are hypogynous as per your knowledge. Now compare your selected number of hypogynous flowers with the four options and mark the nearest greatest number.

41. (B) Valvate aestivation is found in *Calotropis*, tulip, *Asparagus*, *Colchicum*, *Petunia*, mustard and tobacco. Sweet pea, groundnut, soybean, *Indigofera*, and *Sesbania* have vexillary aestivation.

Related Theory

The mode of arrangement of either sepals or petals of a flower in bud condition is said to be an aestivation. In valvate aestivation, sepals or petals in a whorl just meet by their edges without overlapping. In descending imbricate or vexillary aestivation the posterior petal of overlaps one margin of the two lateral petals.

42. (D) Apocarpous is a condition, which arises when number of carpels is two or more and they are free in number. *E.g.*, *Michelia* (Magnoliaceae), *Ranunculus etc,*. *Aloe*, tomato and *Papaver* shows syncarpous (fused pistil) condition.

Related Theory

Difference between apocarpous and syncarpous ovary are:

Apocarpous ovary	*Syncarpous ovary*
The flowers with apocarpus ovary have more than one carpel. These carpels are free.	*The flowers with syncarpous ovary have more than one carpel. However, these carpels are fused.*
It forms an aggregate of fruits.	*It forms only one fruit with one or many seeds.*
Apocarpous condition seen in Ranunculus, Aconitum, etc.	*The is seen in flowers of tomato and mustard.*

43. (C)

Placentation	Example
Axile	Tomato, onion, *Asparagus*, tobacco, chilli, tulip, *Colchicum*
Marginal	Gram, arhar, moong, pea, lupin, sunn hemp

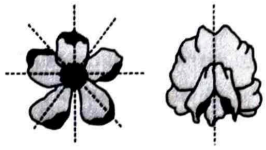
Related Theory

Marginal placentation is found in monocarpellary pistils of Leguminosae (e.g., Pea, Cassia, Acacia) and other plants (e.g., Larkspur). Axile placentation occurs in syncarpous pistils in families Solanaceae and Liliaceae. Parietal placentation is found in bicarpellary to a multi-carpellary syncarpous ovary. Unilocular ovary becomes bilocular due to the formation of the false septum, occurs in the Brassicaceae family.

44. (A) Zygomorphic flowers are the characteristics of Fabaceae family (*e.g.*, gulmohar, green pea, soybean, lentil, beans, *etc.*) and Poaceae family (bamboo, barley, *etc.*), Solanaceae (*e.g.*, tomato, *Datura*, potato, *etc.*) and Brassicaceae (*e.g.*, mustard, cabbage, *etc.*) flowers are actinomorphic. Cannaceae flowers are asymmetric.

Related Theory

Actinomorphic flower is a flower that is radially symmetrical and can be divided into two equal parts along any diameter, while zygomorphic flower is a flower that is bilaterally symmetrical and can be bisected into two equal parts only in one plane.



Radial *Bilateral*

Caution

Brassicaceae family is also known as Cruciferae, due to presence of four 'crossed petals'.

45. (D) If gynoecium is situated in the centre and other parts of the flower are located on the rim of the thalamus almost at the same level, it is called perigynous. The ovary here is said to be half inferior, *e.g.*, plum, rose, peach. Cucumber and guava have epigynous ovary. Cotton has a hypogynous ovary.

Related Theory

Plant Family: Liliaceae, Solanaceae, Fabaceae – hypogynous flowers (epigynous ovary); Cucurbitaceae – Epigynous flower (inferior ovary); Papilionaceae – Perigynous flowers (half inferior ovary).

Caution

Students usually get confused with the examples and usually do not attempt such questions. In order to solve such questions, one should use elimination method.

46. (D) Keel is the characteristic feature of vexillary aestivation found in family Fabaceae Papilionaceae (*e.g.*, bean, *Indigofera*, pea). Imbricate aestivation is seen in *Cassia* and gulmohar, Valvate aestivation is seen in the *Calotropis* plant.

47. (B) Perigynous flowers are found in rose, peach, cherry, plum, *Prunus*, *etc*. Guava and cucumber have epigynous flower. China rose and brinjal have hypogynous flower.

48. (A) China rose family shows cohesion of stamens by union of filaments into single bundle, known as monoadelphous.

Polyadelphous flowers are those in which the stamens have united filaments and are fused in two or more groups. A flower having the stamens joined by their filaments into several separate bundles, *e.g.*, castor.

Diadelphous flowers are those in which the filaments of the stamens are fused and form into two bundles. *E.g.*, members of family Fabaceae.

Polyandrous: When the stamens of a flower are free, the condition is called polyandrous. *E.g.*, *Petunia*.

49. (D) Lady's finger and cotton show twisted aestivation.

50. (C) Lemon (*Citrus sp.*) belongs to family Rutaceae, and shows axile placentation. *Argemone* belongs to family Papaveraceae, contains parietal placentation. *Dianthus* belongs to Family Caryophyllaceae, contains free-central placentation. Marigold belongs to Family Asteraceae, contains basal placentation.

51. (B) Replum is a false septum formed due to the ingrowth of parietal placenta. This makes the ovary bilocular. It is mainly seen in the ovary of flowers of Brassicaceae (Cruciferae) family, *e.g.*, mustard, candytuft, *etc.* In family Asteraceae (Compositae) basal placentation is found, *e.g.*, sunflower. In family Fabaceae (Leguminosae) marginal placentation occurs, *e.g.*, pea. Lemon or *Citrus* (family Rutaceae), tomato or *Lycopersicon sp.* (family Solanaceae), China rose (family Malvaceae), *etc.*, have axile placentation.

52. (A) In sweet pea, the placentation is marginal, in which the placenta develops along the junction of two carpels in an unilocular ovary.

53. (A) A fruit formed from any floral part other than ovary is termed as false fruit, while the fruit formed of ovary is considered as true fruit. Aggregate fruits develop from the multicarpellary apocarpous ovary. Parthenocarpic fruits are seedless fruits formed without fertilisation.

Related Theory

- *Fruit is a matured ovary developed after fertilisation. After fertilisation, ovary forms fruits and ovules form the seeds. After ripening, the ovary wall changes into pericarp. This pericarp may be thick and fleshy or thick and hard or thin and soft.*

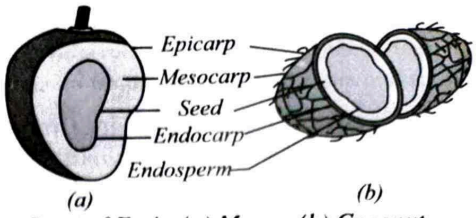
54. (A) The fruits of mango and coconut are drupe, with endocarp being stony and non-edible. They develop from monocarpellary ovary. In coconut, mesocarp is fibrous, while in mango, it is fleshy and pulpy.

Related Theory

- *Drupe fruit develops from mono or multicarpellary, syncarpous, superior ovary. The endocarp is hard and stony so these fruits are also called stony fruits. E.g., mango, coconut, almond, peach walnut, plum. In mango the outermost cover or rind is called epicarp. Edible fleshy part is mesocarp and the part where seed is protected is called as endocarp. The rind of almond and walnut are endocarp and their edible part is seed. In coconut epicarp is hard and thin while mesocarp is thick and consists of hard fibres. The endocarp is hard and seed is protected in it. The sweet water of coconut is liquid and solid endosperm.*

55. (A) Coconut fruit is a drupe. It has a membranous epicarp, fibrous mesocarp and stony endocarp. Tomato fruit is a berry, litchi is a nut and cotton is a capsular fruit.

Related Theory



Parts of Fruit: (a) Mango (b) Coconut

56. (B) China rose, mustard, brinjal, potato, onion and tulip have superior ovary, while guava and cucumber have inferior ovary.

Related Theory

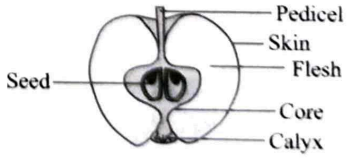
- *Superior ovary is an ovary attached to the receptacle above the attachment of other floral parts. A superior ovary is found in types of fleshy fruits, such as true berries, drupes, etc. A flower with this arrangement is known as hypogynous. Examples include the legumes (beans and peas and their relatives).*
- *Inferior ovary lies below the attachment of other floral parts. Flowers with inferior ovaries are termed epigynous. Some examples of flowers with an inferior ovary are orchids (inferior capsule), Fuchsia (inferior berry), banana (inferior berry), Asteraceae (inferior achene-like fruit, called a cypsela) and the pepo of the squash, melon and gourd (Cucurbitaceae) family.*

57. (D) Parthenocarpy is the development of fruits without seed formation or fertilisation. Thus, seedless fruits are formed using this technique. It involves inducing fruit formation by the application of auxin hormones. Example of parthenocarpic fruits are pineapple, banana, grapes, cucumble, *etc.*

58. (C) In tomato, both placenta and pericarp are edible. Apple is a false fruit in which edible part is receptacle. Potato is a stem tuber, not a fruit. Banana is formed by parthenocarpy.

Related Theory

- *The fruit wall, or pericarp, is divided into three regions: the inner layer, or endocarp; the middle layer, or mesocarp; and the outer layer, or exocarp.*



Apple (False Fruit)

59. (B) An aggregate fruit results from the fusion of several ovaries (or multicarpellary apocarpous gynoecium) of the same flower.

Related Theory

- *In aggregate fruits, they (fruitlets) coalesce together giving the appearance of a single fruit or remain free from one another forming a bunch or etaerio of fruitlets.*

Caution

- *While aggregate fruits are formed out of a number of free ovaries within a single flower, the multiple or composite fruit is formed by all the flowers of a whole inflorescence grouped together.*

60. (D) In mango, coconut, plum, *etc.*, the fruit is known as drupe (stony fruit). The caryopsis, popularly called a grain is the fruit typical of the family Poaceae (or Gramineae), which includes wheat, rice, and corn. Grapes and tomatoes are classified as berries. Pods are the fruits of legume plants, such as peas.

Related Theory

- *Drupe fruit develops from monocarpellary, superior ovaries and are one seeded. In mango, the pericarp is well differentiated into an outer thin epicarp, a middle fleshy edible mesocarp and an inner stony hard endocarp.*

61. (C) Syconus fruit develops from hypanthodium inflorescence, *e.g., Ficus carica, F. religiosa, F. benghalensis*. Hesperidium is a modified berry resulting from a single ovary. *E.g., Citrus* fruits. Sorosis is a type of composite fruit which is formed from a complete inflorescence. *E.g.*, pineapple. Caryopsis is a dry fruit in which the wall of the ovary is united with the seed coat.

Related Theory

- *In hypanthodium, the receptacle is fleshy and forms hollow ball like structure with an apical opening. Three types of flowers develop on the inner surface of the receptacle. The female flowers are towards the base, male flowers are towards the orifice and short styled sterile female flowers are in between, e.g., Ficus sp. The inflorescence is pollinated by a gall wasp.*

62. (B) Cypsela is dry, indehiscent, single seeded fruit develops from an unilocular, single ovulate inferior ovary of bicarpellary, syncarpous, gynoecium possessing basal placentation. *E.g., Helianthus*.

Related Theory

- *Caryopsis are dry, indehiscent, small, single seeded fruit develop from unilocular, single ovule, superior ovary of multicarpellary gynoecium. E.g., Poaceae.*
- *Berry is a fleshy, indehiscent, multi seed fruit derived from multicarpellary syncarpous gynoecium. E.g., tomato, avocados, etc.*
- *Cremocarp are bilocular and two seeded schizocarpic fruits (small, dry) developed from inferior ovary of bicarpellary, syncarpous gynoecium possessing persistent stylopodium, e.g., Apiaceae.*

Caution

- *Strawberry is not a berry but a false fruit or pseudocarp. A strawberry is actually a multiple fruit, which consists of many tiny individual fruits embedded in a fleshy receptacle.*

63. (A) The fleshy receptacle of syconus of fig encloses a number of achenes. Achene is the thin dry pericarp is free from seed except at one point. The fruit develops from a monocarpellary pistil having superior unilocular and ovuled ovary.

Related Theory

- *Syconus develop from hypanthodium type of inflorescence. The flask shaped fleshy receptacle encloses female flower, which produces small achene like fruitlets and has a small pore protected by scale leaves. Example: syconus of fig (Ficus carica).*

64. (A) In pomegranate, the whole fruit is covered by a hard rind made up of exocarp and a part of mesocarp. It develops from multilocular syncarpous inferior ovary. Mesocarp forms plate like infolding (*i.e.*, chambered) and the seeds are covered by endocarp and contain bright red succulent testa. The fruit of cucumber is pepo. In this the exocarp is not separable from mesocarp and the seeds from placenta. The fruit of guava is berry. A berry is pulpy, indehiscent few to multiseed fruit derived from multicarpellary syncarpous gynoecium. The fruit of orange is hespiridium. It develops from multicarpellary, syncarpous multilocular, superior ovary with axile placentation.

Related Theory

- *Balausta is special type of false or pseudocarpic berry develops from multilocular, syncarpous inferior ovary. The whole fruit is enclosed by a hard rind made up of exocarp (epicarp fused with thalamus) and part of mesocarp. Plate-like infoldings are developed by mesocarp. The papery endocarp covers the individual group of seeds.*

65. (D) The fruit of *Ananas comosus* (pineapple) is sorosis (a type of multiple fruits), developing from spike, spadix or catkin. In this type, the flowers associate by their succulent petals, the axis bearing them, grows and becomes fleshy or woody, thus, the whole inflorescence turns into a compact fruit. Here, the whole inflorescence turns into a compact fruit.

66. (D) Litchi is a simple fruit. When a single fruit develops from a single ovary of a single flower, it is called a simple fruit. An aril, which is a specialised outgrowth from a seed that partly or completely covers the seed is the edible part of litchi.

67. (D) In mango, pericarp is differentiated into the exocarp, mesocarp and endocarp. Exocarp forms the outer covering of the fruit. Mesocarp is the edible part of the mango and endocarp is hard and stony (seed).

68. (C) Juicy hair-like structures present in the lemon fruit develop from the endocarp.

69. (B) Geocarpic fruit is groundnut (peanut). Geocarpic refers to an extremely rare means of plant reproduction. Here, the plants are produced *via* diaspores within the soil. This has evolved as an effective means of ensuring a suitable environment for the plant's offspring.

70. (D) One seeded, oblong drupe makes up the edible pericarp of each date palm fruit. We consume mesocarp of tomato, endosperm of maize and thalamus and pericarp of guava.

71. (A) Banana is a true fruit, as it develops from ripened ovary. Banana is a fleshy fruit called berry. It develops from multicarpellary, syncarpous, superior or inferior ovary. Apple, pear and fig are false fruits, which develop from any part of the flower except the ovary.

Related Theory

On the basis of the formation of fruits, they are classified into two types, true fruits and false fruits. The main difference between true fruit and false fruit is that true fruit or the eucarp develops from the mature, ripened ovary, whereas the false fruit or pseudocarp develops from the floral parts other than the ovary.

72. (B) Given figure shows the structure of monocotyledonous seed, where X - Coleoptile, Y - Plumule, Z - Radicle, W - Coleorhiza. Radicle is the part of seed, which is destined to form root after the seed germinates, while plumule is destined to form shoot.

73. (C) Cotyledon in monocots, such as maize, rice, is large and shield shaped, known as scutellum. Coleorhiza is a protective sheath around primary root, while coleoptile is a protective sheath around primary shoot in monocots. Plumule refers to the embryonic shoot of the plant.

74. (C) In monocotyledonous endospermic seed, endosperm is surrounded by a special one-cell thick layer, called aleurone layer. The cells of aleurone layer are filled with proteinaceous aleurone grains, which play an important role at the time of germination. The seeds in grasses are endospermic. They have albuminous seeds. Mango is formed by the fertilisation and involves the formation of seed. Banana is a parthenocarpic fruit. A sterile pistil is called pistillode, while a sterile stamen is called staminode.

Related Theory

Aleurone layer is a single layer of cells that forms the outermost layer of the endosperm, which is triploid and the cells on the root tip are diploid.

75. (D) Albuminous (or endospermic) seeds store their food in the endosperm. *E.g.*, corn, wheat, onion, maize, castor *etc.*, while non-albuminous (or non-endospermic) seeds store food material in cotyledons. Endosperm is absent in mature seed. *E.g.*, bean, gram, and pea.

Related Theory

Difference between albuminous and non-albuminous seeds are:

Albuminous Seed	*Non-Albuminous Seed*
The seed, which retains some part of endosperm not completely used up during embryo development.	*The seed, which does not retain any endosperm as it is completely used up during embryo development.*
Food is stored mainly in endosperm.	*Food is stored in cotyledon. Endosperm is absent in mature seed.*

76. (B) Seed coat is thick in coconut seed and thin, membranous in groundnut, gram and maize seeds.

Related Theory

A typical seed will possess the following features:

(1) ***Testa:*** *An outer seed coat that protects the embryonic plant.*

(2) ***Micropyle:*** *A small pore in the outer covering of the seed that allows for the passage of water.*

(3) ***Cotyledon:*** *Contains the food stores for the seed and forms the embryonic leaves.*

(4) ***Plumule:*** *The embryonic shoot (also called the epicotyl).*

(5) ***Radicle:*** *The embryonic root.*

77. (A) The seed, which store food materials in endosperm are called endospermic or albuminous seed. Cotyledon is the seed leaf within the embryo of a seed. These stored nutrients are supplied to the seedling during germination. Upon germination, the hypocotyl pushes the cotyledons above the ground to develop. It eventually becomes part of the plant stem, while radicle forms roots. Perisperm is the remnant of nucellus, which are persistent. It surrounds, stores food and provide nourishment to the embryo in an angiosperm seed. It is diploid in nature.

Related Theory

The cotyledon is described as a seed leaf that stores food in the form of starch and protein for use by the embryo. An embryo of a monocotyledon (monocot) plant has one cotyledon, while that of a dicotyledon (dicot) plant has two cotyledons. A monocot stores the bulk of its energy in the endosperm.

78. (C) Flower of tulip is highly condensed and modified shoot meant for sexual reproduction. The thalamus shows four nodes with highly condensed internodes. These four nodes give rise to four whorls of the flower- calyx, corolla, androecium and gynoecium. Orchids have non-endospermic oil. *Primrose* has free-central placentation. Tomato has berry fruit.

79. (A) The scutellum is referred to as equivalent to thin cotyledon in monocots (especially members of the grass family). It is very thin with high surface area, and serves to absorb nutrients from the endosperm during germination.

Related Theory

Scutellum is the tissue in a grass or wheat or maize seed that lies between the embryo and the endosperm. It is the modified cotyledon, being specialised for the digestion and absorption of the endosperm.

80. (A) Cotyledons and testa are edible parts of groundnut and pomegranate, respectively. The edible part of walnut is cotyledon, tamarind is mesocarp; French bean-seeds, coconut-endosperm, testa, cotyledons and embryo, cashewnut-cotyledons, and fleshy pedicels and of litchi is fleshy aril.

Related Theory

The mesocarp is the middle part of the banana fruit. The mesocarp extends up to the innermost portion of the fruit, which is called the endocarp. The endocarp is the portion, which is eaten. The endocarp is the innermost part of the fruit and it bears seeds.

81. (D) The seeds of castor are endospermic dicot seeds. They possess endosperm, which acts as the food storage tissue of seed. They also possess perisperm and caruncle.

Related Theory

The perisperm is developed from the residual, persistent nucellus in some seeds. It is found in black pepper and beet.

Caution

Students might get confused between option (A) and (D) because cotton seeds are endospermic seeds, consist of perisperm but lack caruncle.

82. (C) In a cereal grain (*e.g.*, wheat), the single cotyledon of embryo is represented by the scutellum. Scutellum is specialised for nutrient absorption from the endosperm. Coleoptile is a modified ensheathing leaf that covers and protects the young primary leaves of a grass seedling. Coleorhiza is a sheath like structure found on the radicle, which covers and protects it during the growth into the soil.

Related Theory

The scutellum is a modified cotyledon, or seed leaf in grasses which never develops into a green structure but serves only to digest endosperm and transfer nutrients to the rest of the embryo. Scutellum is diploid, while endosperm is triploid.

83. (A) The aleurone layer of maize grain is specially rich in proteins in mature seeds and tubers. It forms the outermost layer of the endosperm.

Related Theory

Aleurone layer lies between the pericarp and the hyaline layer of the endosperm. Unlike the cells of the starchy endosperm, aleurone cells remain alive at maturity. The ploidy of the aleurone is (3n), as a result of double fertilisation.

84. (B) Floral features are chiefly used in angiosperm identification because reproductive parts are more stable and conservative than vegetative parts.

85. (D) *Sesbania* and *Indigofera* are the members of family fabacea which is characterised by the monocarpellary, unilocular ovary with many ovules. Brinjal and tobacco are belong to the family solanaceae and *Asparagus* is the member of family liliaceae.

86. (C) Family Fabaceae is characterised by the presence of 10 stamens that are diadelphous (9+1 arrangement) and dithecous (having two pollen sacs or thecae) in nature. The anthers are usually basifixed or dorsifixed and are versatile in nature.

87. (D) Pollen grains of cereals, such as wheat, rice, *etc.*, show viability only for 30 minutes, whereas some maintain viability for months, *e.g.*, some plants belonging to the Family Rosaceae, Fabaceae Leguminosae and Solanaceae.

Related Theory

Viability depends on external factors also, such as temperature and humidity. Pollen grains can be preserved for many years in liquid nitrogen (-196°C).

88. (C) Flowers of Liliaceae family are bracteate, actinomorphic, bisexual, having two whorls of gamophyllous tepals and six polyandrous epiphyllous stamens. Ovary is superior and present with three bilobed stigma.

Related Theory

Liliaceae family (or lily family) belongs to the angiosperm, and are monocotyledonous. It is characterised by the presence of perianth. General floral characters includes cymose inflorescence, with syncarpous ovary with axile placentation. Fruits includes capsules or berry. Some important plants includes Allium cepa (onion), A. sativum (garlic), Aloe vera, and Asparagus officinalis.

Caution

Students generally make mistakes in questions related to floral formula out of confusion between the plant families. Remembering two-three significant characteristics of each family helps to reduce the chances of error.

89. (D) In Liliaceae family, gynoecium is syncarpous, tricarpellary, trilocular, superior ovary with axile placentation, *e.g.*, *Aloe vera*, Tulips, *Gloriosa* and *Ruscus*. In Solanaceae family, gynoecium is syncarpous, bicarpellary, bilocular, superior ovary, axile placentation. *e.g.*, tomato, potato. In Fabaceae family, gynoecium is superior, monocarpellary, unilocular, single, short-style and flat, hairy-stigma. *e.g.*, soybean, bean, and pea. In Poaceae family, gynoecium is monocarpellary with superior unilocular ovary containing a single anatropous ovule; stigma usually two; feathery; basal placentation. *e.g.*, bamboo, barley, maize, *etc.*

90. (A) China rose belong to family Malvaceae. The features of Malvaceae family are given below:

Symmetry	Actinomorphic, bisexual
Inflorescence	Cyme or solitary
Calyx (sepals)	5, separate or basally connate
Corolla (petals)	5, separate, twisted
Androecium	Numerous, monoadelphous (filaments united in a tube and basally joined to corolla), anthers unilocular, large pollen

Gynoecium	5 or more carpels, united, superior ovary (hypogynous), branched style, ovules have axile placentation
Fruit	Capsule or schizocarp
Other features	Epicalyx = whorl of bracts below the calyx
	Showy flowers with nectar, seeds often covered in fine hair.

91. (A) Vexillary or descending imbricate aestivation is a characteristic of family Fabaceae. In it, the posterior largest petal (standard) overlaps two lateral petals (wings), which in turn overlap two anterior petals (keel). It is also called papilionaceous corolla. In Solanaceae and Brassicaceae, valvate aestivation is found. In Asteraceae, imbricate aestivation is present.

Related Theory

➥ *Aestivation is the mode of arrangement of sepals or petals in a floral bud with respect to the other members of the same whorl. There are four main types of aestivation. They are as follows:*

(1) ***Valvate aestivation:*** *Sepals or petals in a whorl just touch one another. They do not overlap one another.*

(2) ***Twisted aestivation:*** *One margin of the appendage overlaps the margin of the next appendage.*

(3) ***Imbricate aestivation:*** *Margins of sepals or petals overlap one another but not in any particular direction.*

(4) ***Vexillary aestivation:*** *It is also known as papilionaceous type of aestivation. There are five petals. The largest petal (called standard) overlaps the two lateral petals (called wings), which further overlap the two smallest anterior petals (called keel).*

Caution

➥ *According to NCERT, in Fabaceae family calyx has imbricate aestivation.*

92. (A) Chilli (*Capsicum annuum*) belongs to nightshade family (Solanaceae). In this family, flower is actinomorphic, complete and bisexual; calyx has five sepals, which are gamosepalous showing valvate aestivation; corolla has five petals, which are polypetalous showing valvate aestivation; androecium has five free stamens (polyandrous) but epipetalous; gynoecium is bicarpellary, syncarpous, bilocular with superior ovary having axile placentation.

Caution

➥ *Students usually confuse between the characteristics of plant family and their floral formula. Preparing of comparative charts and memorising certain differentiating characteristics of each family helps in better retention of the topic.*

93. (C) Floral formula of Fabaceae: Fabaceae have five sepals that are often fused and five clawed petals, upper posterior petal or the vexillum, two lateral free petals or wings, and two anterior petals or the keel. These are hermaphrodites with a short hypanthium, which is cup shaped. Stamens are ten in number, exhibit diadelphous, monocarpellary and superior ovary, elongated and curved style. Placentation is marginal and inflorescence is racemose or cymose.

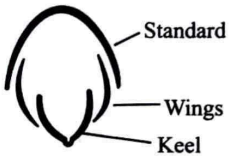
Related Theory

➥ *The family Fabaceae is also known as Leguminosae or Papilionaceae since it belongs to the pea or legume family.*

Caution

➥ *Students must be familiar with each symbol present in a floral formula.*

94. (B) Vexillary aestivation is found in Papilionaceae.



In Liliaceae, the flower is complete, bisexual, bracteate, trimerous, actinomorphic, hypogynous. The perianth is with 6 tepals, in two whorls 3 + 3, often united into a tube, valvate aestivation, odd tepal anterior. The androecium is with 6 stamens, arranged in two whorls 3 + 3, polyandrous, epiphyllous, anther is dithecous, basifixed or versatile, introse. Gynoecium with tricarpellary, syncarpous ovary, axile placentation, trilocular, stigma trifid.

In pea flower the stamens are diadelphous.

The floral formula for Solanaceae is: $\oplus \, ♀ \, K_{(5)} \, \overset{\frown}{C_{(5)}} \, A_5 \, \underline{G}_{(2)}$

95. (D) The floral formula belongs to family Solanaceae (*e.g.*, Tobacco). Tulip belongs to Liliaceae family.

Soybean and sun hemp belongs to Fabaceae family.

96. (D) Asteraceae (Compositae) or sunflower family is a large and widespread family of flowering plants. In this family, the stamens are 5 rarely 4; epipetalous (stamens are attached to the petals), syngenesious (anthers are free and filaments are united), forming a tube, which encloses style.

97. (B) Family Asteraceae (compositae) is characterised by inflorescence head or capitulum. The inflorescence consists of a few or large number of flowers closely arranged on an axis surrounded by involucral bracts. The whole head with racemose is apparently similar to a single flower.