CHAPTER 2

Sexual Reproduction in Flowering Plants

2.2 Pre-Fertilisation : Structures and Events

1. The plant parts which consist of two generations- one within the other
(1) pollen grains inside the anther
(2) germinated pollen grain with two male gametes
(3) seed inside the fruit
(4) embryo sac inside the ovule
(a) (1) only (b) (1), (2), and (3)
(c) (3) and (4) (d) (1) and (4).
(NEET 2020)

2. In water hyacinth and water lily, pollination takes place by
(a) insects or wind (b) water currents only
(c) wind and water (d) insects and water.
(NEET 2020)

3. Which is the most common type of embryo sac in angiosperms ?
(a) Tetrasporic with one mitotic stage of divisions
(b) Monosporic with three sequential mitotic divisions
(c) Monosporic with two sequential mitotic divisions
(d) Bisporic with two sequential mitotic divisions
(Odisha NEET 2019)

4. What type of pollination takes place in *Vallisneria*?
(a) Pollination occurs in submerged condition by water.
(b) Flowers emerge above surface of water, and pollination occurs by insects.
(c) Flowers emerge above water surface, and pollen is carried by wind.
(d) Male flowers are carried by water currents to female flowers at surface of water.
(Odisha NEET 2019)

5. In which one of the following, both autogamy and geitonogamy are prevented?
(a) Wheat (b) Papaya
(c) Castor (d) Maize
(Odisha NEET 2019)

6. Pollen grains can be stored for several years in liquid nitrogen having a temperature of
(a) –120°C (b) –80°C
(c) –196°C (d) –160°C. *(NEET 2018)*

7. Which of the following has proved helpful in preserving pollen as fossils?
(a) Pollenkitt (b) Cellulosic intine
(c) Oil content (d) Sporopollenin
(NEET 2018)

8. Winged pollen grains are present in
(a) mustard (b) *Cycas*
(c) mango (d) *Pinus.* *(NEET 2018)*

9. Functional megaspore in an angiosperm develops into an
(a) endosperm (b) embryo sac
(c) embryo (d) ovule. *(NEET 2017)*

10. Attractants and rewards are required for
(a) entomophily (b) hydrophily
(c) cleistogamy (d) anemophily.
(NEET 2017)

11. Flowers which have single ovule in the ovary and are packed into inflorescence are usually pollinated by
(a) bee (b) wind
(c) bat (d) water. *(NEET 2017)*

12. A dioecious flowering plant prevents both
(a) autogamy and geitonogamy
(b) geitonogamy and xenogamy
(c) cleistogamy and xenogamy
(d) autogamy and xenogamy. *(NEET 2017)*

13. In majority of angiosperms,
(a) egg has a filiform apparatus
(b) there are numerous antipodal cells
(c) reduction division occurs in the megaspore mother cells
(d) a small central cell is present in that embryo sac. *(NEET-II 2016)*

14. Pollination in water hyacinth and water lily is brought about by the agency of
(a) water (b) insects or wind
(c) birds (d) bats. *(NEET-II 2016)*

15. The ovule of an angiosperm is technically equivalent to
(a) megasporangium
(b) megasporophyll
(c) megaspore mother cell
(d) megaspore. *(NEET-II 2016)*

16. Which one of the following statements is not true?
(a) Pollen grains of many species cause severe allergies.
(b) Stored pollen in liquid nitrogen can be used in the crop breeding programmes.
(c) Tapetum helps in the dehiscence of anther.
(d) Exine of pollen grains is made up of sporopollenin. *(NEET-I 2016)*

17. Which of the following statements is not correct?
(a) Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil.
(b) Some reptiles have also been reported as pollinators in some plant species.
(c) Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style.
(d) Insects that consume pollen or nectar without bringing about pollination are called pollen/nectar robbers. *(NEET-I 2016)*

18. Proximal end of the filament of stamen is attached to the
(a) placenta (b) thalamus or petal
(c) anther (d) connective.
(NEET-I 2016)

19. Filiform apparatus is characteristic feature of
(a) aleurone cell (b) synergids
(c) generative cell (d) nucellar embryo.
(2015)

20. In angiosperms, microsporogenesis and megasporo-genesis
(a) involve meiosis
(b) occur in ovule
(c) occur in anther
(d) form gametes without further divisions. *(2015)*

21. Male gametophyte in angiosperms produces
(a) single sperm and two vegetative cells
(b) three sperms
(c) two sperms and a vegetative cell
(d) single sperm and a vegetative cell. *(2015)*

22. Which of the following are the important floral rewards to the animal pollinators ?
(a) Floral fragrance and calcium crystals
(b) Protein pellicle and stigmatic exudates
(c) Colour and large size of flower
(d) Nectar and pollen grains *(2015 Cancelled)*

23. Which one of the following may require pollinators, but is genetically similar to autogamy?
(a) Apogamy (b) Cleistogamy
(c) Geitonogamy (d) Xenogamy
(2015 Cancelled)

24. Which one of the following statements is not true?
(a) The flowers pollinated by flies and bats secrete foul odour to attract them.
(b) Honey is made by bees by digesting pollen collected from flowers.
(c) Pollen grains are rich in nutrients and they are used in the form of tablets and syrups.
(d) Pollen grains of some plants cause severe allergies and bronchial afflictions in some people. *(2015 Cancelled)*

25. The hilum is a scar on the
(a) fruit, where style was present
(b) seed, where micropyle was present
(c) seed, where funicle was attached
(d) fruit, where it was attached to pedicel.
(2015 Cancelled)

26. Transmission tissue is characteristic feature of
(a) dry stigma (b) wet stigma
(c) hollow style (d) solid style.
(2015 Cancelled)

27. Geitonogamy involves
(a) fertilisation of a flower by the pollen from another flower of the same plant
(b) fertilisation of a flower by the pollen from the same flower
(c) fertilisation of a flower by the pollen from a flower of another plant in the same population
(d) fertilisation of a flower by the pollen from a flower of another plant belonging to a distant population. *(2014)*

28. Pollen tablets are available in the market for
(a) *in vitro* fertilisation (b) breeding programmes
(c) supplementing food (d) *ex situ* conservation.
(2014)

29. Function of filiform apparatus is to
(a) recognise the suitable pollen at stigma
(b) stimulate division of generative cell
(c) produce nectar
(d) guide the entry of pollen tube. *(2014)*

30. Advantage of cleistogamy is
(a) no dependence on pollinators
(b) vivipary
(c) higher genetic variability
(d) more vigorous offspring. *(NEET 2013)*

31. Megasporangium is equivalent to
(a) nucellus (b) ovule
(c) embryo sac (d) fruit. *(NEET 2013)*

32. Which one of the following statements is correct?
(a) Endothecium produces the microspores.
(b) Tapetum nourishes the developing pollen.
(c) Hard outer layer of pollen is called intine.
(d) Sporogenous tissue is haploid. *(NEET 2013)*

33. Animal vectors are required for pollination in
(a) *Vallisneria* (b) mulberry
(c) cucumber (d) maize.
(Karnataka NEET 2013)

34. Megaspores are produced from the megaspore mother cells after
(a) mitotic division
(b) formation of thick wall
(c) differentiation
(d) meiotic division. *(Karnataka NEET 2013)*

35. Which one of the following statements is correct?
(a) Cleistogamous flowers are always autogamous.
(b) Xenogamy occurs only by wind pollination.
(c) Chasmogamous flowers do not open at all.
(d) Geitonogamy involves the pollen and stigma of flowers of different plants.
(Karnataka NEET 2013)

36. Which of the following statements is correct?
(a) Sporopollenin can be degraded by enzymes.
(b) Sporopollenin is made up of inorganic materials.
(c) Sporopollenin can withstand high temperatures as well as strong acids and alkalis.
(d) Sporopollenin can withstand high temperatures but not strong acids. *(Karnataka NEET 2013)*

37. Both, autogamy and geitonogamy are prevented in
(a) papaya (b) cucumber
(c) castor (d) maize. *(2012)*

38. An organic substance that can withstand environmental extremes and cannot be degraded by any enzyme is
(a) cuticle (b) sporopollenin
(c) lignin (d) cellulose. *(2012)*

39. Even in absence of pollinating agents seed-setting is assured in
(a) *Commelina* (b) *Zostera*
(c) *Salvia* (d) fig. *(2012)*

40. What is the function of germ pore?
(a) Emergence of radicle
(b) Absorption of water for seed germination
(c) Initiation of pollen tube
(d) Release of male gametes *(Mains 2012)*

41. Plants with ovaries having only one or a few ovules, are generally pollinated by
(a) bees (b) butterflies
(c) birds (d) wind. *(Mains 2012)*

42. Filiform apparatus is a characteristic feature of
(a) suspensor (b) egg
(c) synergid (d) zygote. *(2011)*

43. Which one of the following pollinations is autogamous?
(a) Geitonogamy (b) Xenogamy
(c) Chasmogamy (d) Cleistogamy *(2011)*

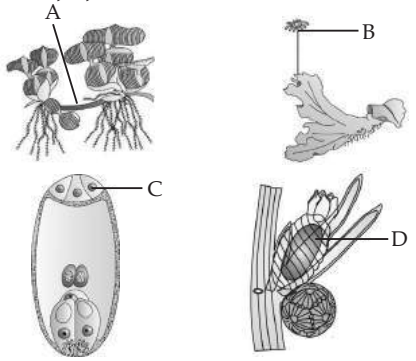
44. Wind pollination is common in
(a) legumes (b) lilies
(c) grasses (d) orchids. *(2011)*

45. In angiosperms, functional megaspore develops into
(a) embryo sac (b) ovule
(c) endosperm (d) pollen sac.
(Mains 2011)

46. Transfer of pollen grains from the anther to the stigma of another flower of the same plant is called
(a) xenogamy (b) geitonogamy
(c) karyogamy (d) autogamy. *(2010)*

47. Wind pollinated flowers are
(a) small, brightly coloured, producing large number of pollen grains
(b) small, producing large number of dry pollen grains
(c) large producing abundant nectar and pollen
(d) small, producing nectar and dry pollen. *(2010)*

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



	A	B	C	D
(a)	Rhizome	Sporangio-phore	Polar cell	Globule
(b)	Runner	Archegonio-phore	Synergid	Antheridium
(c)	Offset	Antheridio-phore	Antipodals	Oogonium
(d)	Sucker	Seta	Megaspore mother cell	Gemma cup

(Mains 2010)

49. Which one of the following pairs of plant structures has haploid number of chromosomes?
(a) Nucellus and antipodal cells
(b) Egg nucleus and secondary nucleus
(c) Megaspore mother cell and antipodal cells
(d) Egg cell and antipodal cells *(2008)*

50. What does the filiform apparatus do at the entrance into ovule?
(a) It brings about opening of the pollen tube.
(b) It guides pollen tube from a synergid to egg.
(c) It helps in the entry of pollen tube into a synergid.
(d) It prevents entry of more than one pollen tube into the embryo sac. *(2008)*

51. Unisexuality of flowers prevents
(a) geitonogamy, but not xenogamy
(b) autogamy and geitonogamy
(c) autogamy, but not geitonogamy
(d) both geitonogamy and xenogamy. *(2008)*

52. Which one of the following is resistant to enzyme action?
(a) Pollen exine (b) Leaf cuticle
(c) Cork (d) Wood fibre
(Mains 2008)

53. Male gametes in angiosperms are formed by the division of
(a) generative cell
(b) vegetative cell
(c) microspore mother cell
(d) microspore. *(2007)*

54. Which one of the following is surrounded by a callose wall?
(a) Male gamete
(b) Egg
(c) Pollen grain
(d) Microspore mother cell *(2007)*

55. The arrangement of the nuclei in a normal embryo sac in the dicot plants is
(a) 3 + 3 + 2 (b) 2 + 4 + 2
(c) 3 + 2 + 3 (d) 2 + 3 + 3. *(2006)*

56. Which one of the following represents an ovule, where the embryo sac becomes horse-shoe shaped and the funiculus and micropyle are close to each other?
(a) Amphitropous (b) Circinotropous
(c) Atropous (d) Anatropous *(2005)*

57. An ovule which becomes curved so that the nucellus and embryo sac lie at right angles to the funicle is
(a) hemitropous (b) campylotropous
(c) anatropous (d) orthotropous. *(2004)*

58. Anthesis is a phenomenon which refers to
(a) reception of pollen by stigma
(b) formation of pollen
(c) development of anther
(d) opening of flower bud. *(2004)*

59. In a flowering plant, archesporium gives rise to
(a) only the wall of the sporangium
(b) both wall and the sporogenous cells
(c) wall and the tapetum
(d) only tapetum and sporogenous cells. *(2003)*

60. In angiosperm, all the four microspores of tetrad are covered by a layer which is formed by
(a) pectocellulose (b) callose
(c) cellulose (d) sporopollenin. *(2002)*

61. What is the direction of micropyle in anatropous ovule?
(a) Upward (b) Downward
(c) Right (d) Left *(2002)*

62. In grasses what happens in microspore mother cell for the formation of mature pollen grains?
(a) One meiotic and two mitotic divisions
(b) One meiotic and one mitotic divisions
(c) One meiotic division
(d) One mitotic division *(2001)*

63. Anemophily type of pollination is found in
(a) *Salvia* (b) bottlebrush
(c) *Vallisneria* (d) coconut. *(2001)*

64. Eight nucleated embryo sac is
(a) only monosporic (b) only bisporic
(c) only tetrasporic (d) any of these. *(2000)*

65. If there are 4 cells in anthers, what will be the number of pollen grains?
(a) 16 (b) 12
(c) 8 (d) 4 *(1996)*

66. The anthesis is a phenomenon, which refers to
(a) development of anthers
(b) opening of flower bud
(c) stigma receptors
(d) all of these. *(1995)*

67. In an angiosperm, how many microspore mother cells are required to produce 100 pollen grains?
(a) 75 (b) 100
(c) 25 (d) 50 *(1995)*

68. When pollen of a flower is transferred to the stigma of another flower of the same plant, the pollination is referred to as
(a) autogamy (b) geitonogamy
(c) xenogamy (d) allogamy. *(1994)*

69. Embryo sac represents
(a) megaspore (b) megagametophyte
(c) megasporophyll (d) megagamete. *(1994)*

70. Number of meiotic divisions required to produce 200/400 seeds of pea would be
(a) 200/400 (b) 400/800
(c) 300/600 (d) 250/500. *(1993)*

71. Ovule is straight with funiculus, embryo sac, chalaza and micropyle lying on one straight line. It is
(a) orthotropous (b) anatropous
(c) campylotropous (d) amphitropous. *(1993)*

72. Meiosis is best observed in dividing
(a) cells of apical meristem
(b) cells of lateral meristem
(c) microspores and anther wall
(d) microsporocytes. *(1992)*

73. Point out the odd one.
(a) Nucellus (b) Embryo sac
(c) Micropyle (d) Pollen grain *(1991)*

74. Pollination occurs in
(a) bryophytes and angiosperms
(b) pteridophytes and angiosperms
(c) angiosperms and gymnosperms
(d) angiosperms and fungi. *(1991)*

75. Entry of pollen tube through micropyle is
(a) chalazogamy (b) mesogamy
(c) porogamy (d) pseudogamy. *(1990)*

76. Female gametophyte of angiosperms is represented by
(a) ovule
(b) megaspore mother cell
(c) embryo sac
(d) nucellus. *(1990)*

77. Male gametophyte of angiosperms/monocots is
(a) microsporangium (b) nucellus
(c) microspore (d) stamen. *(1990)*

78. Which is correct?
(a) Gametes are invariably haploid.
(b) Spores are invariably haploid.
(c) Gametes are generally haploid.
(d) Both spores and gametes are invariably haploid. *(1989)*

79. Generative cell was destroyed by laser but a normal pollen tube was still formed because
(a) vegetative cell is not damaged
(b) contents of killed generative cell stimulate pollen growth
(c) laser beam stimulates growth of pollen tube
(d) the region of emergence of pollen tube is not harmed. *(1989)*

80. Total number of meiotic divisions required for forming 100 zygotes/100 grains of wheat is
(a) 100 (b) 75
(c) 125 (d) 50. *(1988)*

81. Male gametophyte of angiosperms is shed at
(a) four celled pollen grain
(b) three celled pollen grain
(c) microspore mother cell
(d) anther. *(1988)*

2.3 Double Fertilisation

82. What is the fate of the male gametes discharged in the synergid?
(a) One fuses with the egg and other fuses with central cell nuclei.
(b) One fuses with the egg, other(s) degenerates in the synergid.
(c) All fuse with the egg.
(d) One fuses with the egg, other(s) fuse(s) with synergid nucleus. *(NEET 2019)*

83. Double fertilisation is
(a) fusion of two male gametes of a pollen tube with two different eggs
(b) fusion of one male gamete with two polar nuclei
(c) fusion of two male gametes with one egg
(d) syngamy and triple fusion. *(NEET 2018)*

84. Double fertilisation is exhibited by
(a) algae (b) fungi
(c) angiosperms (d) gymnosperms. *(NEET 2017)*

85. Which one of the following statements is wrong?
(a) When pollen is shed at two-celled stage, double fertilisation does not take place.
(b) Vegetative cell is larger than generative cell.
(c) Pollen grains in some plants remain viable for months.
(d) Intine is made up of cellulose and pectin. *(Mains 2012)*

86. Through which cell of the embryo sac, does the pollen tube enter the embryo sac?
(a) Egg cell
(b) Persistant synergid
(c) Degenerated synergids
(d) Central cell *(2005)*

87. In angiosperms, pollen tube liberate their male gametes into the
(a) central cell (b) antipodal cells
(c) egg cell (d) synergids. *(2002)*

88. Endosperm is formed during the double fertilisation by
(a) two polar nuclei and one male gamete
(b) one polar nuclei and one male gamete
(c) ovum and male gamete
(d) two polar nuclei and two male gametes. *(2000)*

89. The role of double fertilisation in angiosperms is to produce
(a) cotyledons (b) endocarp
(c) endosperm (d) integuments.
(1998, 1996)

90. Double fertilisation is characteristic of
(a) angiosperms (b) anatropous
(c) gymnosperms (d) bryophytes. *(1993)*

91. Double fertilisation is fusion of
(a) two eggs
(b) two eggs and polar nuclei with pollen nuclei
(c) one male gamete with egg and other with synergid
(d) one male gamete with egg and other with secondary nucleus. *(1991)*

92. Syngamy means
(a) fusion of gametes
(b) fusion of cytoplasms
(c) fusion of two similar spores
(d) fusion of two dissimilar spores. *(1991)*

93. Which of the following pair have haploid structures?
(a) Nucellus and antipodal cells
(b) Antipodal cells and egg cell
(c) Antipodal cells and megaspore mother cell
(d) Nucellus and primary endosperm nucleus
(1991)

94. Double fertilisation and triple fusion were discovered by
(a) Hofmeister
(b) Nawaschin and Guignard
(c) Leeuwenhoek
(d) Strasburger. *(1988)*

2.4 Post-Fertilisation : Structures and Events

95. Persistent nucellus in the seed is known as
(a) tegmen (b) chalaza
(c) perisperm (d) hilum. *(NEET 2019)*

96. Which one of the following statements regarding post-fertilisation development in flowering plants is incorrect?
(a) Ovules develop into embryo sac.
(b) Ovary develops into fruit.
(c) Zygote develops into embryo.
(d) Central cell develops into endosperm.
(NEET 2019)

97. The coconut water from tender coconut represents
(a) free nuclear proembryo
(b) free nuclear endosperm
(c) endocarp
(d) fleshy mesocarp. *(NEET-I 2016)*

98. Coconut water from a tender coconut is
(a) innermost layers of the seed coat
(b) degenerated nucellus
(c) immature embryo
(d) free nuclear endosperm. *(2015)*

99. Which one of the following fruits is parthenocarpic?
(a) Jackfruit (b) Banana
(c) Brinjal (d) Apple *(2015)*

100. Non-albuminous seed is produced in
(a) maize (b) castor
(c) wheat (d) pea. *(2014)*

101. Seed coat is not thin, membranous in
(a) groundnut (b) gram
(c) maize (d) coconut.
(NEET 2013)

102. Perisperm differs from endosperm in
(a) being a diploid tissue
(b) its formation by fusion of secondary nucleus with several sperms
(c) being a haploid tissue
(d) having no reserve food. *(NEET 2013)*

103. Albuminous seeds store their reserve food mainly in
(a) endosperm (b) cotyledons
(c) hypocotyl (d) perisperm.
(Karnataka NEET 2013)

104. The viability of seeds is tested by
(a) 2, 6 dichlorophenol indophenol
(b) 2, 3, 5 triphenyl tetrazolium chloride
(c) DMSO
(d) Safranine. *(Karnataka NEET 2013)*

105. Two plants can be conclusively said to belong to the same species if they
(a) have more than 90 percent similar genes
(b) look similar and possess identical secondary metabolites
(c) have same number of chromosomes
(d) can reproduce freely with each other and form seeds. *(2007)*

106. In a cereal grain the single cotyledon of embryo is represented by
(a) coleoptile (b) coleorhiza
(c) scutellum (d) prophyll. *(2006)*

107. The embryo in sunflower has
(a) two cotyledons (b) many cotyledons
(c) no cotyledon (d) one cotyledon. *(1998)*

108. Embryo sac occurs in
(a) embryo (b) axis part of embryo
(c) ovule (d) endosperm. *(1991)*

109. Perisperm is
(a) remnant of endosperm
(b) persistent nucellus
(c) peripheral part of endosperm
(d) disintegrated secondary nucleus. *(1989, 1988)*

110. Tegmen develops from
(a) funiculus (b) chalaza
(c) inner integument (d) outer integument. *(1990)*

2.5 Apomixis and Polyembryony

111. Seed formation without fertilisation in flowering plants involves the process of
(a) somatic hybridisation
(b) apomixis
(c) sporulation
(d) budding. *(NEET-I 2016)*

112. Nucellar polyembryony is reported in species of
(a) *Citrus* (b) *Gossypium*
(c) *Triticum* (d) *Brassica.* *(2011)*

113. What is common between vegetative reproduction and apomixis?
(a) Both are applicable to only dicot plants.
(b) Both bypass the flowering phase.
(c) Both occur round the year.
(d) Both produce progeny identical to the parent. *(Mains 2011)*

114. Apomictic embryos in *Citrus* arise from
(a) synergids
(b) maternal sporophytic tissue in ovule
(c) antipodal cells
(d) diploid egg. *(2010)*

115. In a type of apomixis known as adventive embryony, embryos develop directly from the
(a) nucellus or integuments
(b) zygote
(c) synergids or antipodals in an embryo sac
(d) accessory embryo sacs in the ovule. *(2005)*

116. Adventive embryony in *Citrus* is due to
(a) nucellus (b) integuments
(c) zygotic embryo (d) fertilized egg. *(2001)*

117. The polyembryony commonly occurs in
(a) tomato (b) potato
(c) *Citrus* (d) turmeric. *(1995)*

118. Study of formation, growth and development of new individual from an egg is
(a) apomixis (b) embryology
(c) embryogeny (d) cytology. *(1993)*

119. Nucellar embryo is
(a) amphimictic haploid (b) amphimictic diploid
(c) apomictic haploid (d) apomictic diploid. *(1989)*

120. Development of an organism from female gamete/egg without involving fertilization is
(a) adventitive embryony
(b) polyembryony
(c) parthenocarpy
(d) parthenogenesis. *(1989)*

121. Formation of gametophyte directly from sporophyte without meiosis is
(a) apospory (b) apogamy
(c) parthenogenesis (d) amphimixis. *(1988)*

122. Prothallus (gametophyte) gives rise to fern plant (sporophyte) without fertilization. It is
(a) apospory (b) apogamy
(c) parthenocarpy (d) parthenogenesis. *(1988)*

ANSWER KEY

1.	(d)	**2.**	(a)	**3.**	(b)	**4.**	(d)	**5.**	(b)	**6.**	(c)	**7.**	(d)	**8.**	(d)	**9.**	(b)	**10.**	(a)
11.	(b)	**12.**	(a)	**13.**	(c)	**14.**	(b)	**15.**	(a)	**16.**	(c)	**17.**	(c)	**18.**	(b)	**19.**	(b)	**20.**	(a)
21.	(c)	**22.**	(d)	**23.**	(c)	**24.**	(b)	**25.**	(c)	**26.**	(d)	**27.**	(a)	**28.**	(c)	**29.**	(d)	**30.**	(a)
31.	(b)	**32.**	(b)	**33.**	(c)	**34.**	(d)	**35.**	(a)	**36.**	(c)	**37.**	(a)	**38.**	(b)	**39.**	(a)	**40.**	(c)
41.	(d)	**42.**	(c)	**43.**	(d)	**44.**	(c)	**45.**	(a)	**46.**	(b)	**47.**	(b)	**48.**	(c)	**49.**	(d)	**50.**	(b)
51.	(c)	**52.**	(a)	**53.**	(a)	**54.**	(d)	**55.**	(c)	**56.**	(a)	**57.**	(a)	**58.**	(d)	**59.**	(b)	**60.**	(a)
61.	(b)	**62.**	(b)	**63.**	(d)	**64.**	(d)	**65.**	(a)	**66.**	(b)	**67.**	(c)	**68.**	(b)	**69.**	(b)	**70.**	(d)
71.	(a)	**72.**	(d)	**73.**	(d)	**74.**	(c)	**75.**	(c)	**76.**	(c)	**77.**	(c)	**78.**	(a)	**79.**	(a)	**80.**	(c)
81.	(b)	**82.**	(a)	**83.**	(d)	**84.**	(c)	**85.**	(a)	**86.**	(c)	**87.**	(d)	**88.**	(a)	**89.**	(c)	**90.**	(a)
91.	(d)	**92.**	(a)	**93.**	(b)	**94.**	(b)	**95.**	(c)	**96.**	(a)	**97.**	(b)	**98.**	(d)	**99.**	(b)	**100.**	(d)
101.	(d)	**102.**	(a)	**103.**	(a)	**104.**	(b)	**105.**	(d)	**106.**	(c)	**107.**	(a)	**108.**	(c)	**109.**	(b)	**110.**	(c)
111.	(b)	**112.**	(a)	**113.**	(d)	**114.**	(b)	**115.**	(a)	**116.**	(a)	**117.**	(c)	**118.**	(b)	**119.**	(d)	**120.**	(d)
121.	(a)	**122.**	(b)																

Hints & Explanations

1. (d)

2. (a) : In many aquatic plants with emergent flowers, pollination occurs by wind or insects, *e.g.*, lotus, water lily, water hyacinth.

3. (b)

4. (d) : In *Vallisneria*, the female flower reach the surface of water by the long stalk and the male flowers or pollen grains are released on to the surface of water. They are carried passively by water currents, some of them eventually reach the female flowers and the stigma.

5. (b)

6. (c) : Pollen grains can be stored for several years in liquid nitrogen at –196°C. This is also known as cryopreservation.

7. (d) : Exine of pollen grain is made up of highly resistant fatty substance called sporopollenin, which is not degraded by any enzyme. It is not affected by high temperature, strong acid or strong alkali. Because of the sporopollenin, pollen grains are well preserved as microfossils.

8. (d) : Each pollen grain of *Pinus* has two wing like structures which enable it to float in air, as an adaptation for dispersal by wind. Pollen grains of mustard, *Cycas* and mango are not winged.

9. (b) : In angiosperms, the functional megaspore is the first cell of female gametophyte. It enlarges and undergoes three nuclear mitotic divisions to form embryo sac.

10. (a) : Entomophily is the most common type of zoophily where pollination takes place through the agency of insects. Entomophilous flowers are brightly coloured and secrete nectar to attract visiting insects.
Anemophily (wind pollination) and hydrophily (water pollination) do not require attractants or rewards due to the involvement of abiotic pollinating agents. Cleistogamy is self pollination in closed flowers.

11. (b) : Single ovule in the ovary and flowers packed into inflorescence are characteristics of wind pollinated flowers.

12. (a) : Dioecious plants are those plants in which male flowers and female flowers are borne on different plants. Therefore, they prevent both autogamy and geitonogamy.

13. (c)

14. (b) : *Refer to answer 2.*

15. (a) : The ovule of an angiosperm is equivalent to integumented megasporangium.

16. (c) : Tapetum is the innermost wall layer of microsporangium that nourishes developing pollen grains.

17. (c) : Pollen-pistil interaction is the group of events that occur from the time of pollen deposition over the stigma to the time of pollen tube entry into ovule. It is a safety measure to ensure that illegitimate crossing does not occur. Pollen grains of number of plants may settle over a stigma. The pollens belonging to same species would germinate while other fail to do so, but the pollen tube of the compatible pollen will grow through the style to reach the ovule whereas growth of incompatible pollens will be arrested at stigmatic disc or sometimes in the beginning part of style.

18. (b)

19. (b) : Filliform apparatus is a mass of finger-like projections of the wall into the cytoplasm. It is present in synergids (help cells) of the embryo sac, in the micropylar region. It guides the pollen tube inside the ovule towards the embryo sac.

20. (a) : In angiosperms, microsporogenesis, *i.e.*, formation of microspores (or pollen grains) occurs by the meiotic divisions of diploid microspore mother cells (or pollen mother cells). Microsporogenesis takes place in the anther. Megasporogenesis, *i.e.*, formation of megaspores occurs by the meiotic divisions of diploid megaspore mother cells. Megasporogenesis takes place in the ovule.

21. (c) : The protoplast of the male gametophyte divides mitotically to produce two unequal cells — a small generative cell and a large vegetative cell. The generative cell divides later into two non-motile male gametes (or sperms). Thus, the male gametophyte in angiosperms produces two sperms and a vegetative cell. The vegetative cell, later on, grows to produce pollen tube.

22. (d)

23. (c) : Geitonogamy involves transfer of the pollen from one flower of a plant to the stigma of another flower of the same plant, *e.g.*, in maize. As the pollen has to move from one flower to another flower, it requires a pollinating agent. Yet it is genetically similar to autogamy, as both the flowers of the plant, share the same genotype of the plant.

24. (b) : Honey is made from nectar through a process of regurgitation and evaporation. Honeybees transform saccharides (carbohydrates) into honey by regurgitating it a number of times, until it is partially digested. The

bees do the regurgitation and digestion as a group. After the last regurgitation, the aqueous solution is still high in water, the process continues by evaporation of much of the water and enzymatic transformation. Honey is produced by bees as a food source.

25. (c) : Ovule is an integumented megasporangium found in spermatophytes which develops into seed after fertilisation. An angiospermic ovule is typically an ovoid and whitish structure. It occurs inside ovary where it is attached to a parenchymatous cushion called placenta either singly or in a cluster. The ovule is stalked. The stalk is called funiculus or funicle. The point of attachment of the body of the ovule with the funiculus is known as hilum. It is present as a scar on a mature seed.

26. (d) : Style is traversed by the pollen tube to reach the ovule. It is of two types - hollow and solid. In hollow styles, the stylar canal is lined by glandular cells, which are usually multinucleate and polyploid whereas solid style has a core of transmitting tissue, composed of thin walled cells, through which the pollen tube moves.

27. (a) : Geitonogamy is the pollination taking place between the two flowers of the same plant or genetically similar plant. Hence, genetically it is self pollination but since the agency is involved, it is ecologically, cross pollination.

28. (c) : Pollen grains are believed to be rich in nutrients (protein 7-26 % carbohydrates 24-48%, fats 0.9-14.5%). They are taken as tablets or syrups to improve health. They also enhance performance of athletes and race horses.

29. (d) : In the ovule, the pollen tube is attracted by secretions of synergids. Usually the pollen tube enters the embryo sac by passing into one of the two synergids and is guided by the filiform apparatus of the synergids in their movement. Pollen tube then breaks open and releases its contents in the embryo sac. Antipodals and synergids later degenerate.

30. (a) : Cleistogamy is the process of pollination and fertilisation before the flower has opened. In such flowers, the anther and stigma lie close to each other. When anthers dehisce in the flower buds, pollen grains come in contact with the stigma to effect pollination. Thus, cleistogamous flowers are invariably autogamous as there is no chance of cross-pollen landing on the stigma. Cleistogamous flowers produce assured seed-set even in the absence of pollinators.

31. (b)

32. (b) : A microsporangium is generally surrounded by four wall layers – the epidermis, endothecium, middle layers and the tapetum. The outer three wall layers perfom the function of protection and help in dehiscence of anther to release the pollen. The innermost wall layer is the tapetum. It nourishes the developing pollen grains. Cells of the tapetum are food rich and possess dense cytoplasm and generally have more than one nucleus. They disintegrate to liberate the contents which is absorbed by the developing spores.

33. (c) : In *Vallisneria*, water pollination occurs while mulberry and maize undergo wind pollination. In cucumber, animal pollination is observed.

34. (d) : In angiosperms, microsporogenesis, *i.e.*, formation of microspores (or pollen grains) occurs by the meiotic divisions of diploid microspore mother cells (or pollen mother cells). Microsporogenesis takes place in the anther. Megasporogenesis, *i.e.*, formation of megaspores occurs by the meiotic divisions of diploid megaspore mother cells. Megasporogenesis takes place in the ovule.

35. (a) : In cleistogamy, as the flowers never open so there is no alternative of self pollination. It is invariably autogamous. In xenogamy, pollination takes place between two flowers of different plants (genetically and ecologically). It can ocur by wind, water, insects and animals.
Chasmogamy occurs when the flowers expose their mature anther and stigma to the pollinating agents.
Geitonogamy is the pollination taking place between the two flowers of the same plant or genetically similar plant. Genetically, it is self pollination but as the agency is involved it is ecologically cross pollination.

36. (c) : Pollen grain is a haploid, unicellular body. It is cuticularised and the cutin is of special type called sporopollenin, which is resistant to chemical and biological decomposition. It can withstand high temperatures as well as strong acids and alkalis. This is why, pollen wall is preserved for long periods in fossil deposits. In addition pollen wall possesses proteins for enzymatic and compatability reactions.

37. (a) : Autogamy and geitonogamy are two forms of self pollination. In autogamy, pollen falls on stigma of the same flower. While in geitonogamy pollens from a flower fall on the stigma of some other flower of the same plant. Papaya is a dioecious plant thus both autogamy and geitonogamy are prevented in it.

38. (b) : Sporopollenin is a major component of the tough outer (exine) walls of spores and pollen grains. It is chemically very stable and is usually well preserved in soils and sediments. It can withstand environmental extremes and cannot be degraded by enzymes and strong chemical reagents.

39. (a) : Some plants such as *Viola* (common pansy), *Oxalis*, and *Commelina* produce two types of flowers-chasmogamous flowers which are similar to flowers of other species with exposed anthers and stigma and cleistogamous flowers which do not open at all. In such

flowers, the anthers and stigma lie close to each other. When anthers dehisce in the flower buds, pollen grains come in contact with the stigma to effect pollination. Thus, cleistogamous flowers are invariably autogamous as there is no chance of cross-pollen landing on the stigma. Cleistogamous flowers produce assured seed-set even in the absence of pollinators.

40. (c) : In a pollen grain, exine is thin or absent at certain places. These areas may have thickened intine or deposition of callose. They are called germ pores (if rounded) or germinal furrows (if elongated). After pollination, the pollen grain on the stigma absorbs water and nutrients from the stigmatic secretion through its germ pores. The tube or vegetative cell enlarges and comes out of pollen grains through germ pore to form a pollen tube.

41. (d) : Anemophily is an abiotic means of pollination by wind and being non-directional, a wasteful process as the pollen would reach the stigma through wind is a hit-or-miss affair. During the transit of pollen through wind, a considerable amount of pollen is lost because it never reaches a proper stigma. To stand this loss, anemophilous plants have to produce enormous quantities of pollen. Anemophily is also associated with reduction in the number of ovules per ovary. Some models predict that plants benefit from numerous inexpensive flowers distributed throughout the inflorescence, each with a single ovule or a few ovules. In grasses there is just one ovule per ovary. This is to increase the probability of successful pollination of each ovule.

42. (c) : Filliform apparatus is a mass of finger like projections of the wall into the cytoplasm. It is present in synergids (help cells) of the embryo sac, in the micropylar region. It guides the pollen tube inside the ovule towards the embryo sac.

43. (d) : Autogamy is a kind of pollination in which the pollen from the anthers of a flower are transferred to stigma of the same flower. Cleistogamy, homogamy, bud pollination are three methods of the autogamy. Cleistogamy occurs in those plants, which never open and ensure complete self-pollination. *E.g.*, *Commelina bengalensis*, *Oxalis*, *Viola,* etc.

44. (c) : Anemophily is pollination of a flower in which the pollen is carried by the wind. Examples of anemophilous flowers are those of grasses and conifers.

45. (a) : In angiosperms, the functional megaspore is the first cell of female gametophyte. It enlarges and undergoes three nuclear mitotic divisions to form embryo sac.

46. (b) : Geitonogamy involves transfer of the pollen from one flower of a plant to the stigma of another flower of the same plant, *e.g.*, in maize. As the pollen has to move from one flower to another flower, it requires a pollinating agent. Yet it is genetically similar to autogamy, as both the flowers of the plant, share the same genotype of the plant.

47. (b) : Pollination by wind is called anemophily and such plants in which pollination occurs by wind are called anemophilous plants. Anemophilous plants are characterised by small flowers, pollens present in large number which are small, dry and light in weight (carried upto 1300 km by wind), number of ovules generally reduced in ovary (biological significance), feathery or brushy stigma (to receive the pollen). Grasses and palms are generally anemophilous.

48. (c) : A – Offset of water hyacinth (*Eichhornia*)
B – Antheridiophore of *Marchantia*
C – Antipodals of the mature embryo sac
D – Oogonium of *Chara*

49. (d)

50. (b) : Within the embryo sac three cells are grouped together at the micropylar end and constitute the egg apparatus. The egg apparatus, in turn, consists of two synergids and one egg cell. The synergids have special cellular thickenings at the micropylar tip called filiform apparatus, which plays an important role in guiding the pollen tubes from synergid to egg. Three cells are at the chalazal end and are called the antipodals. The large central cell, has two polar nuclei.

51. (c) : Unisexuality or dicliny is a condition in which two types of unisexual flowers are present *i.e.*, staminate (male flower) and pistillate (female flower). The plant may be monoecious or dioecious. This is a device for cross pollination (or xenogamy). Both xenogamy and geitonogamy (*i.e.,* transfer of pollen from anther of one flower to stigma of another flower of either the same or genetically similar plant) are included under allogamy/ cross pollination. Autogamy or self pollination (*i.e.,* transfer of pollen from anther to stigma of the same flower) occurs in bisexual flower.

52. (a) : Sporopollenin is a major component of the tough outer (exine) walls of spores and pollen grains. It is chemically very stable and is usually well preserved in soils and sediments. It can withstand environmental extremes and cannot be degraded by enzymes and strong chemical reagents.

53. (a) : In the pollen sac (microsporangium) of the anther, haploid microspores are formed by mitosis. Mitosis then follows to produce a two-celled pollen grain with a small generative cell and a large vegetative cell. This generative cell will undergo further mitosis to form two male gametes (nuclei). The pollen tube grows through a spore in the pollen grain, with the tube (vegetative) nucleus at its tips and the male nuclei behind.

54. (d) : Anther consists of microsporangia or pollen sacs. The archesporium gives rise to parietal cells and primary sporogenous tissue. Sporogenous cells divide to form pollen grain or microspore mother cells. They are diploid and connected by plasmodesmata. The microspore, mother cells consists of a callose wall inner to the cell wall. The mother cell then undergoes meiosis and forms tetrads of microspores. Finally the wall of the mother cell degenerates and pollen grains are separated.

55. (c)

56. (a) : Depending upon position of micropyle in relation to chalaza, ovules are of 6 types in angiosperms. In amphitropous type, the curvature is observed both in body of ovule and embryo sac. The embryo sac assumes horse shoe-shape. Micropyle is directed downwards. It is commonly found in families Papaveraceae, Alismataceae and Butomaceae.

Circinotropous ovule is characteristic of Family Cactaceae. Here, the ovule is straight first but due to more growth on one side gets inverted and later becomes straight again.

Orthotropous ovule is the most primitive and of simplest type. It is also known as atropous or straight ovule.

Anatropous ovule is the most common type of ovule found in angiosperms. Here, the body of the ovule gets inverted and micropyle is on lower side.

57. (a) : In hemianatropous or hemitropous ovule, the nucellus and integuments are at right angles to stalk or funiculus so that the ovule becomes curved. It is commonly found is Primulaceae and *Ranunculus*. In campylotropous ovule, the body of the ovule gets curved and micropyle is directed downwards. Atropous (orthotropous) ovule is erect and micropyle, chalaza and funiculus are in the same straight line. Anatropous ovule is the most common type of ovule in angiosperms. In this, the body of the ovule gets inverted and the micropyle is on lower side.

58. (d) : Anthesis is the process of opening floral buds. Reception of pollen by stigma is called pollination. Formation of pollen is called microsporogenesis.

59. (b) : In flowering plants, archesporial cells are vertical rows of hypodermal cells at four angles of anther. These undergo periclinal (transverse) division to form an outer primary parietal cell and inner sporogenous cell. Primary parietal cell after few more periclinal divisions forms anther wall and sporogenous cells give rise to sporogenous tissue.

60. (a) : Each microspore or pollen is having a two layered wall. Outer layer is thick tough cuticularised called exine, which is chiefly composed of a material called 'sporopollenin'. Inner layer is thin, delicate and smooth called intine, which is made of pectocellulose.

Exine is not uniform but is thin at one or more places in the form of germ pores. Whereas intine made of pectocellulose covers the entire surface of pollen grains.

61. (b) : Anatropus ovule is the most common type of ovule found in angiosperms. Here, the body of the ovule gets inverted and micropyle is on lower side or downwards. It comes very close to the hilum and the chalaza is upwardly directed.

62. (b) : Grass is a monocot plant. Primary sporogenous cell gives rise to microspore mother cells or pollen mother cells. Each MMC on reduction division gives rise to 4 microspores or pollens and this formation of microspores or pollens is called microsporogenesis. Karyokinesis is of successive type. The successive type of cytokinesis is common in monocots. This leads to the formation of isobilateral tetrad. Among the four pollen grains formed, three degenerates and only one becomes functional. During the maturation of pollen grain, the microspore nucleus moves from a central position to an eccentric one, close to the wall. In this position, the first pollen mitosis occurs and gives two unequal cells. The larger one is the vegetative cells which contains a large and diffuse haploid nucleus and the other cell is generative cell with a small and condensed nucleus. Thus, in the formation of mature pollen grains from microspore mother cell, one meiotic and one mitotic divisions occur.

63. (d) : Anemophily is the pollination by wind. Anemophilous plants are characterised by small flowers, pollens present in large number which are small, dry and light in weight, number of ovules generally reduced in ovary, feathery or brushy stigma to recieve the pollen. All these features are shown by coconut flower.

In *Vallisneria,* pollination occurs outside water called epihydrophily. *Callistemon* (Bottlebrush) is pollinated by birds and is an example of ornithophily. *Salvia* is insect pollinated and is an example of entomophily.

64. (d) : On the basis of number of megaspore nuclei taking part in development of female gametophyte or embryo sac, there are 3 types of embryo sacs–

(i) Monosporic type – In this type the single nucleus of functional megaspore undergoes 3 mitotic divisions to form 8 nuclei, 7 cells.

(ii) Bisporic type – Here embryo sac develops from 2 megaspore nuclei out of 4 nuclei formed after reduction division of MMC. It is also 8 nucleated.

(iii) Tetrasporic type – Here all the 4 megaspore nuclei formed after reduction division of megaspore mother cell are functional and take part in development of

embryo sac. It is further of different types. *Fritillaria* type, *Plumbago* type and *Adoxa* type are 8 nucleated.

65. (a) : Pollen grains or microspores are formed inside anther, which is the fertile portion of stamen or microsporophyll. Inside the anther, primary sporogenous cell gives rise to microspore mother cells or pollen mother cells (MMC or PMC). Each MMC on reduction division gives rise to 4 microspores or pollens. So, these four cells will give rise to $4 \times 4 = 16$ pollen grains.

66. (b) : *Refer to answer 58.*

67. (c) : Pollen grains or microspores are formed inside anther, which is the fertile portion of stamen or microsporophyll. The formation of microspores or pollens is called microsporogenesis. The primary sporogenous cell gives rise to microspore mother cells or pollen mother cells. Each microspore mother cell on reduction division gives rise to 4 microspores or pollens. So, for the formation of 100 pollen grains, 25 MMC are required. It involves karyokinesis followed by cytokinesis.

68. (b) : Geitonogamy involves transfer of the pollen from one flower of a plant to the stigma of another flower of the same plant, *e.g.*, in maize. As the pollen has to move from one flower to another flower, it requires a pollinating agent. Yet it is genetically similar to autogamy, as both the flowers of the plant, share the same genotype of the plant.

69. (b)

70. (d) : Number of meiotic divisions required to produce 200/400 seeds of pea would be 250/500. 200 seeds of pea would be produced from 200 pollen grains and 200 eggs. 200 pollen grains will be formed by 50 microspore mother cell while 200 eggs will be formed by 200 megaspore mother cell so 250/500.

71. (a) : *Refer to answer 57.*

72. (d) : Meiosis is best observed in dividing microsporocytes. Microsporocytes or microspore mother cell after meiosis give rise to microspore. Other cells do not divide by meiosis.

73. (d) : Pollen grain is odd one among all the other three. Pollen grain is a male gametophytic structure whereas all the other three are found inside ovule (nucellus, micropyle and embryo sac).

74. (c) : The term pollination refers to the transfer of pollen from anther to stigma. Because pollens are found only in angiosperms and gymnosperms so this phenomenon relates to angiosperms and gymnosperms only.

75. (c) : In most of the plants, the pollen tube enters the ovule through the micropyle and the phenomenon is called as porogamy. Entry through chalaza is chalazogamy and through integuments or funiculus is mesogamy.

76. (c) : Female gametophyte of angiosperms is represented by embryo sac. The polygonum type of embryo sac contains 8-nuclei and 7-cells. It is found in more than 80% plant families. The nucleus of megaspore undergoes division and give rise to embryo sac or female gametophyte by the process of megagametogenesis.

77. (c) : Male gametophyte of angiosperms is microspore. Microspore is haploid, uninucleate, minute spores produced in large numbers as a result of meiosis in microspore mother cell inside the microsporangia. These are the first cell of gametophytic generations in angiosperms.

78. (a) : Gametes are invariably haploid. Spores are formed in lower plants by mitotic division and they may be diploid but gametes are always be made by meiosis and they are always haploid.

79. (a) : Generative cell was destroyed by laser but a normal pollen tube was still formed because vegetative cell is not damaged. Each microspore divide by mitotic division making a smaller generative cell and a larger vegetative cell or tube cell. If generative cell is damaged then the normal pollen tube will be formed because pollen tube is formed by vegetative cell not by generative cell of microspore.

80. (c) : For formation of 100 zygotes, 100 male gametes and 100 female gametes (eggs) are required. 100 male gametes are developed from 100 microspores (from 25 meiotic divisions) and 100 eggs are developed from 100 megaspores (from 100 meiotic division).
Hence, number of meiotic divisions necessary for 100 zygotes formation = 25 + 100 = 125.

81. (b) : The male gametophyte or microspore is shed at 3-nucleate stage. The microspore undergoes only two mitotic divisions.

82. (a) : During double fertilisation in angiosperms, one male gamete fuses with the egg to form the diploid zygote (syngamy or generative fertilisation). The diploid zygote finally develops into embryo. The other male gamete fuses with the two polar nuclei (or secondary nucleus) to form the triploid primary endosperm nucleus, PEN (triple fusion or vegetative fertilisation).

83. (d) : Double fertilisation is unique and universal feature of angiosperms. Total number of nuclei involved in double fertilisation is five, *i.e.*, 2 in syngamy and 3 in triple fusion. Syngamy is fusion of one male gamete with egg to form zygote. Triple fusion occurs when the second male gamete fuses with 2 polar nuclei or secondary nucleus to form triploid primary endosperm nucleus.

84. (c)

85. (a) : In 60% of flowering plants, the pollen grains are shed at two-celled stage (tube cell + generative cell). Further, development of male gametophyte (pollen grain) occurs on stigma. Pollen grain gives rise to pollen tube which absorbs nourishment from the cells of style

for its growth. Generative cell divides to give rise to two male gametes. Out of these, one fuses with the egg to form diploid zygote (generative fertilisation or syngamy) whereas the second male gamete fuses with the two haploid polar nuclei or diploid secondary nucleus of the central cell to form primary endosperm nucleus (vegetative fertilisation or triple fusion). These two acts of fertilisation occur in the same embryo sac and are referred to as double fertilisation.

86. (c) : The pollen tube enters into the embryo sac at the micropylar end. This entry may be between egg and one synergid or between wall of embryo sac and synergid or through one synergid. So, one synergid is always degenerated to allow the entry of the pollen tube.

87. (d) : On reaching of pollen tube inside the embryo sac, the 2 male gametes are discharged through a sub-terminal pore in pollen tube. The contents of pollen tube are discharged in the synergid and the pollen tube does not grow beyond it in the embryo sac. Further, the cytoplasm of pollen tube is restricted to chalazal end of this synergid cell.

88. (a) : Double fertilisation is the simultaneous occurrence of syngamy and triple fusion. Syngamy involves fusion of one male gamete with egg cell to form zygote. The result of syngamy is zygote (2n) which ultimately develops into embryo.
The second male gamete fuses with 2 polar nuclei or secondary nucleus to form triploid primary endosperm nucleus and this is called triple fusion. This primary endosperm nucleus (3n) ultimately develops into a nutritive tissue for developing embryo called endosperm.

89. (c) : *Refer to answer 88.*

90. (a) : Double fertilisation is the characteristic feature of angiosperms. This phenomenon first observed by Nawaschin and Guignard, 1898 in *Lilium* and *Fritillaria*. In angiosperms, one male gamete fuses with the two polar nuclei to form triploid primary endosperm nucleus. The process is called triple fusion. These two acts together are known as double fertilisation.

91. (d) : Double fertilisation is the simultaneous occurrence of syngamy and triple fusion. Syngamy involves fusion of one male gamete with egg cell to form zygote. The result of syngamy is zygote (2n) which ultimately develops into embryo.
The second male gamete fuses with 2 polar nuclei or secondary nucleus to form triploid primary endosperm nucleus and this is called triple fusion. This primary endosperm nucleus (3n) ultimately develops into a nutritive tissue for developing embryo called endosperm.

92. (a) : Syngamy means fusion of gametes. Syngamy is the phenomenon in which male gamete fuses with an egg.

93. (b) : Antipodal cells and egg cell are haploid structures as they are formed after meiosis while the others nucellus, megaspore mother cell and primary endosperm nucleus are diploid structures.

94. (b) : *Refer to answer 90.*

95. (c) : In some seeds, remains of nucellus persist. This residual nucellus which persists in the seed is called perisperm, *e.g.*, black pepper, coffee, castor, cardamum, *Nymphaea*.

96. (a) : Ovules develop into seeds.

97. (b) : Coconut has multicellular endosperm (called coconut meal) in the outer part and free nuclear as well as vacuolate endosperm (called coconut milk or coconut water) in the centre.

98. (d) : *Refer to answer 97.*

99. (b) : Parthenocarpic fruits are the fruits which are formed without fertilisation. These fruits are naturally seedless, *e.g.*, banana.

100. (d) : In majority of dicot seeds, including pea, the endosperm is consumed during seed development and the food is stored in cotyledons and other regions. They are called non-endospermic or exalbuminous seeds.

101. (d)

102. (a) : Both perisperm and endosperm are nutritive layers. Perisperm is residual persistent nucellus of seed prior to fertilisation while endosperm develops when one of the sperm cells fuses with two haploid polar nuclei. Thus, perisperm is diploid while endosperm is a triploid tissue.

103. (a) : In some seeds, the endosperm persists in the seed as food storage tissue. Such seeds are called endospermic or albuminous, *e.g.*, castor, maize, wheat, barley, rubber, coconut.

104. (b) : Viability of seeds can be known by two methods: (i) ability to germinate, (ii) testing their ability to respire. All viable seeds respire. This can be tested by immersing a section of seed containing the embryo in 0.1% solution of 2,3,5-triphenyl tetrazolium chloride. The viable embryo will turn pink due to conversion of colourless triphenyl tetrazolium chloride into insoluble coloured dye called triphenyl formazone due to reduction.

105. (d) : If two plants can reproduce freely with each other and form seeds, they are concluded to belong to same species. Plants belonging to same species have mostly every character common and will be able to reproduce freely with each other to produce new generations.

106. (c) : The cotyledons are known as seed leaves, they are attached to the embryonic axis. Dicotyledons typically have two cotyledons and monocotyledons have only one cotyledon. The single shield shaped cotyledon in grains is known as scutellum.

The scutellum does not contain food and its function is to absorb food from the endosperm and transfer it to the growing parts of the embryo. The plumule consists of growing tip of the shoot along with few young leaf primordia. It is covered by a sheath called coleoptile. The radicle which lies at the base of the grain is also covered with a sheath called coleorhiza. The hypocotyl is very short and is represented by a short axis in between radicle and plumule.

107. (a) : Sunflower (*Helianthus*) belongs to Family Asteraceae of dicotyledons. A dicot embryo has an embryonal axis and 2 cotyledons attached to it laterally. So the number of cotyledons in sunflower will be two.

108. (c) : Embryo sac occurs in ovule. Ovule is integumented megasporangium. It consists of nucleus covered by one or two integuments, mounted on a funicle, chalaza and micropyle. The ovule is vascularised.

109. (b) : Perisperm is persistent nucellus. Endosperm formation is accompanied by degeneration of nucellus.

110. (c) : Outer protective covering of seed is called seed coat which develops from integuments of ovules. The seeds developing from bitegmic ovule have two layers. The outer layer is called testa and inner layer is called tegmen which develops from inner integuments.

111. (b) : Apomixis is a reproductive process which does not involve gametic fusion. In apomictic flowering plants there is no fertilisation and embryos develop simply by division of a cell of ovule.

112. (a) : In nucellar polyembryony, some of the nucellar cells surrounding the embryo sac start dividing. Then it protrudes into the embryo sac and develop into the embryos. In such species, each ovule contains many embryos. Occurrence of more than one embryo in a seed is referred as polyembryony. Nucellar polyembryony is found in many of the *Citrus* and mango varieties.

113. (d) : Apomixis is a reproductive process in plants that superficially resembles normal sexual reproduction but in which there is no fusion of gametes. The embryos develop simply by division of a diploid cell the ovule. So, the progenies produced are identical to the parent. In vegetative reproduction, the progenies produced are also identical to the parent.

114. (b) : Apomixis is abnormal kind of sexual reproduction in which egg or other cells associated with egg (synergids, antipodals, etc.) develop into embryo without fertilisation and meiosis. Development of embryos directly from sporophytic tissues like nucellus and integuments is called adventive embryony which is also a type of apoximis, *e.g.*, *Citrus*, mango.

115. (a) : Normal type of sexual reproduction having two regular features, *i.e.*, meiosis and fertilisation, is called amphimixis. But in some plants, this normal sexual reproduction (amphimixis) is replaced by some abnormal type of sexual reproduction called apomixis.

Apomixis may be defined as, 'abnormal kind of sexual reproduction in which egg or other cells associated with egg (synergids, antipodals, etc.) develop into embryo without fertilisation and with or without meiosis'.

Adventive embryony is a type of apomixis in which development of embryos directly takes place from sporophytic tissues like nucellus and integuments, *e.g.*, *Citrus*, mango, etc.

116. (a) : Presence of more than one embryo inside the seed is called polyembryony. It is more common in gymnosperms than angiosperms. In angiosperms, it is generally present as an unusual feature in few cases like *Citrus*, mango, etc.

In *Citrus* many embryos are formed from the structures outside the embryo (like nucellus). This is commonly called adventive polyembryony.

In *Citrus* upto 10 nucellar embryos are formed.

117. (c) : *Refer to answer 116.*

118. (b) : Study of formation, growth and development of new individual from an egg is embryology. Study of an individual's life cycle after the fertilisation takes place till it develops into a new organism.

119. (d) : Nucellar embryo is apomictic diploid. Substitution of usual sexual reproduction by a form of reproduction which does not include meiosis and syngamy is called apomixis. In this process, embryo is developed by some other tissue without fertilisation, *e.g.*, nucellus or integuments or unfertilised egg. Nucellus is a diploid tissue so nucellar embryo is apomictic diploid.

120. (d) : Development of an organism from female gamete/egg without involving fertilisation is parthenogenesis and when a fruit is developed by this technique it is called parthenocarpy.

121. (a) : Formation of gametophyte directly from sporophyte without meiosis and spore formation is apospory. The gametophyte thus has diploid number of chromosomes. Such gametophyte may form viable gametes which fuse to form tetraploid sporophyte. Apogamy is development of sporophyte directly from gametophytic tissue without fusion of gametes. Amphimixis is normal sexual reproduction. Parthenogenesis is development of embryo from egg without fertilisation.

122. (b) : Prothallus (gametophyte) gives rise to fern plant (sporophyte) without fertilization. This phenomenon is called apogamy. Development of sporophyte from gametophyte without forming gamete is apogamy. Such sporophyte is haploid in nature.

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