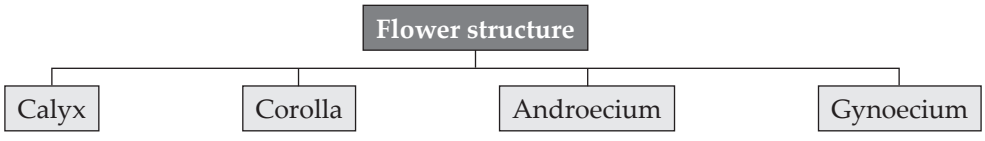
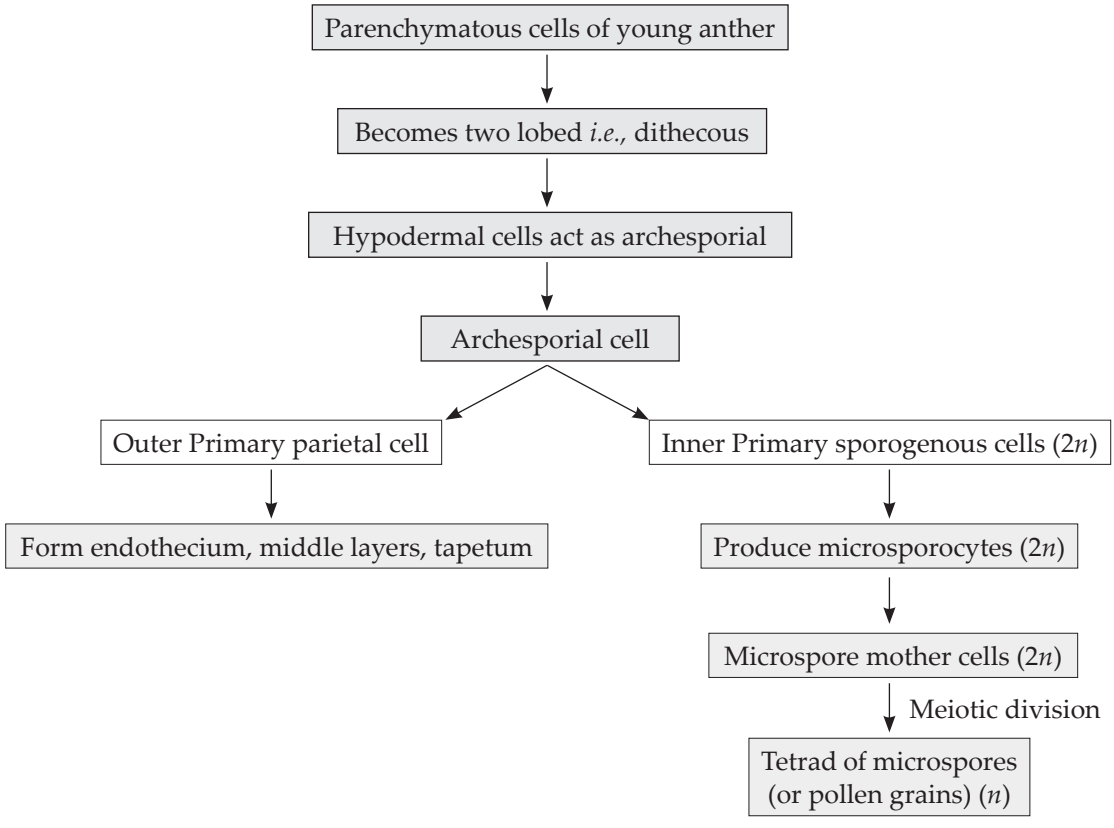
# Sexual Reproduction in Flowering Plants

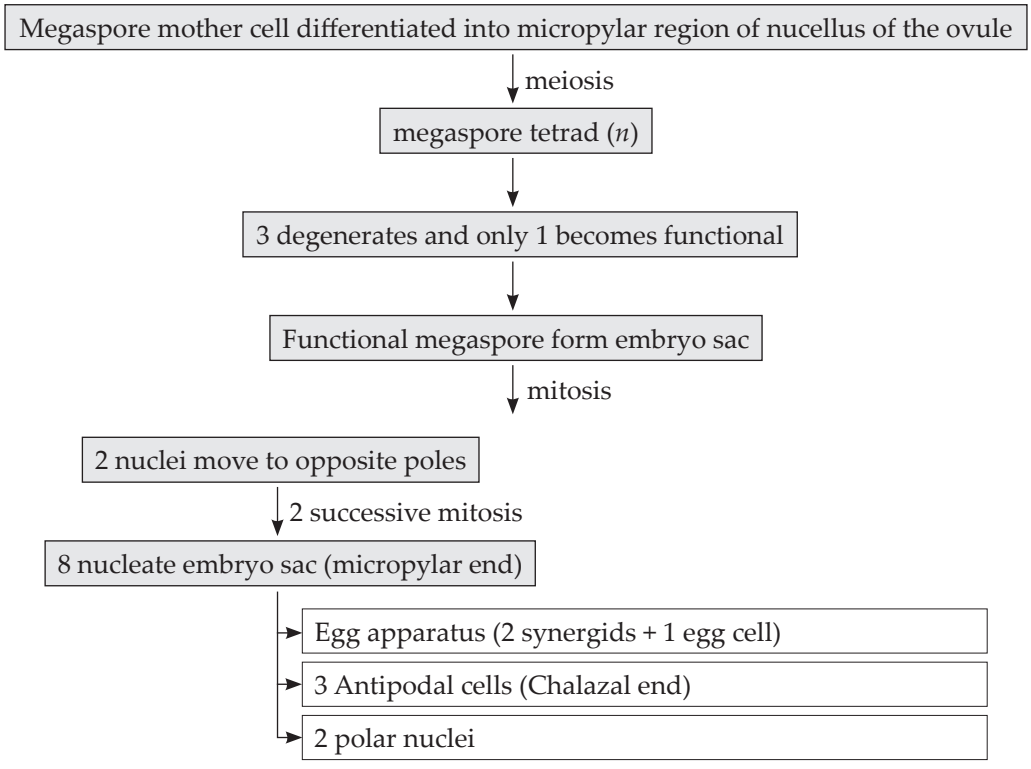
## Chapter at a Glance



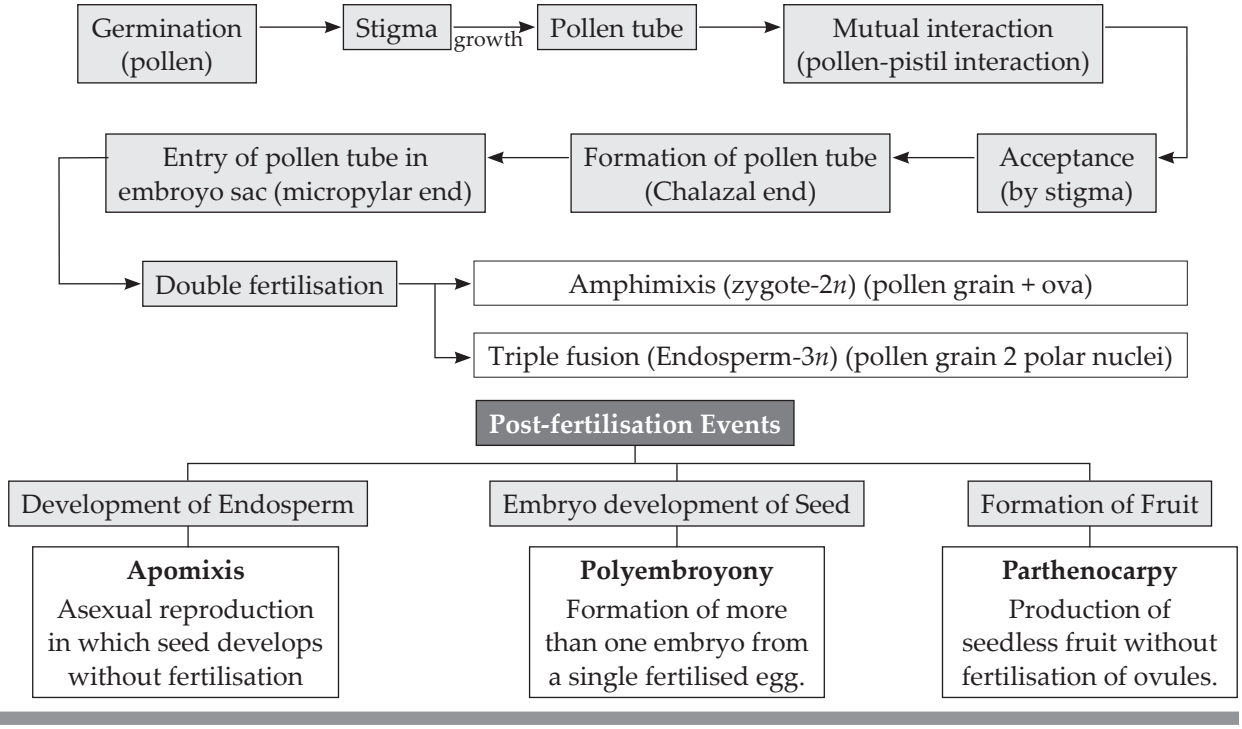

1. **Pollen-Pistil interaction**—It is the sequential events from pollination to before fertilisation. It includes pollen recognition by stigma, mediated by chemical factors of pollen and pistil. This inhibits the growth of pollen from other species.
2. **Microsporogenesis**—Process of formation of pollen grains.




3. **Megasporogenesis**—Process of development of egg or ova.




6. **Process of fertilisation—**




## Multiple choice questions

**1.** Filiform apparatus in the embryo sac of an angiosperm is present at the micropylar tip of :
(a) Central cell (b) Egg cell
(c) Synergids (d) Antipodals

**2.** A dicotyledonous plant bears flowers but never produces fruits and seeds. The most probable cause for the above situation is:
(a) Plant is dioecious and bears only pistillate flowers
(b) Plant is dioecious and bears both pistillate and staminate flowers
(c) Plant is monoecious
(d) Plant is dioecious and bears only staminate flowers.

3. Embryo sac occurs in—
(a) embryo (b) axis part of embryo
(c) ovule (d) stamen

4. Fertilisation involving carrying of male gametes by pollen tube is—
(a) porogamy (b) siphonogamy
(c) chalazogamy (d) syngonogamy

5. One of the most resistant biological material is—
(a) lignin (b) cutin
(c) sporopollenin (d) cellulose

6. Fragrant flowers with well developed nectaries are an adaptation for—
(a) Chiropterophily (b) Entomophily
(c) Anemophily (d) Hydrophily

7. Micropyle occurs in—
(a) ovary (b) ovule
(c) seed (d) Both (b) and (c)

8. Usually pollen grains are shed at—
(a) one-celled stage (b) two-celled stage
(c) four-celled stage (d) five-celled stage

9. Meiosis occurs in—
(a) endosperm cells
(b) intercalary meristems
(c) apical meristems
(d) spore mother cells

10. In angiosperms, triple fusion is required in the formation of—
(a) embryo (b) endosperm
(c) suspensor (d) fruit wall

11. In the embryos of a typical dicot and a grass, true homologous structures are:
(a) Coleorhiza and coleoptile
(b) Coleoptile and scutellum
(c) Cotyledons and scutellum
(d) Hypocotyl and radicle.

12. Embryo sac is also called—
(a) microspore (b) megaspore
(c) megagametophyte (d) microgametophyte

13. Sexual reproduction in flowering plants was discovered by—
(a) Carmerarius (b) Nawaschin
(c) Strasburger (d) Maheshwari

14. Which among the following exhibit Anemophily?
(a) Salvia (b) Vallisneria
(c) Coconut (d) Bottle brush

15. Which one of the following is not found in a female gametophyte of an angiosperm ?
(a) Germ pore (b) Synergids
(c) Filiform apparatus (d) Central cell

16. Which of the following is a post-fertilisation event in flowering plants?
(a) Transfer of pollen grains
(b) Embryo development
(c) Formation of flower
(d) Formation of pollen grains

17. The gamete mother cell is known as:
(a) Diploid (b) Meiocytes
(c) Haploid (d) Isogamete

18. Among the terms listed below, those that of are not technically correct names for a floral whorl are:
(i) Androecium (ii) Carpel
(iii Corolla (iv) Sepal
(a) (i) and (iv) (b) (iii) and (iv)
(c) (ii) and (iv) (d) (i) and (ii)

19. The given below are the steps performed in an artificial hybridisation programme in plants with bisexual flowers.
(i) Re-bagging
(ii) Emasculation
(iii) Dusting the pollen on stigma
(iv) Bagging
(v) Collection of pollen grains from male parent
(vi) Selection of male and female parent plants
Select the correct option with the correct sequence of these events.
(a) (v) → (ii) → (i) → (iv) → (iii) → (vi)
(b) (ii) → (v) → (vi) → (iv) → (iii) → (i)
(c) (v) → (ii) → (i) → (iv) → (iii) → (vi)
(d) (vi) → (ii) → (iv) → (v) → (iii) → (i)

20. Marchantia is a :
(a) Monoecious plant (b) Homothallic plant
(c) Dioecious plant (d) Bisexual plant

21. Which is the innermost wall layer of microsporangium?
(a) Tapetum (b) Epidermis
(c) Endothecium (d) Endodermis

22. Sporopollenin occurs in—
(a) female gametophyte
(b) male gametophyte
(c) vegetative cells of pollen grain
(d) exine of pollen wall

23. In a flower, if the megaspore mother cell forms megaspores without undergoing meiosis and if one of the megaspores develops into an embryo sac, its nuclei would be:
(a) Haploid
(b) Diploid
(c) A few haploid and a few diploid
(d) With varying ploidy.

**24.** The part that determines the compatible nature of pollen grains is:
(a) stigma (b) style
(c) ovary (d) ovule

**25.** The number of microsporangia in an anther is:
(a) 2 (b) 3
(c) 4 (d) 1

**26.** Read the following statements about self-incompatibility and select the option with correct statements.
(i) It is a device to prevent inbreeding
(ii) This is a genetic mechanism
(iii) It ensures cross-fertilisation
(iv) It prevents self-pollen from fertilising the ovules by inhibiting pollen germination of pollen tube growth in the pistil
(a) (i) and (ii) (b) (ii) and (iii)
(c) (i), (ii), and (iv) (d) All of the above

**27.** The stamens represent the:
(a) microsporophylls (b) male gametophyte
(c) microsporangia (d) None of these

**28.** A 3-celled pollen grain has:
(a) one vegetative cell, one generative cell, and one male gamete.
(b) one vegetative cell, one generative cell, and two male gametes.
(c) one generative cell and two male gametes.
(d) one vegetative cell and two male gametes.

**29.** Select the incorrect statement about sporopollenin.
(a) Exine is made up of sporopollenin.
(b) It can withstand high temperatures and strong acids and alkali.
(c) It can be degraded by enzymes.
(d) Both (a) and (b)

**30.** A typical angiospermic embryo sac is:
(a) 7-celled and 7-nucleate.
(b) 8-celled and 7-nucleate.
(c) 7-celled and 8-nucleate.
(d) None of these

**31.** Starting from the innermost part, the correct sequence of parts in an ovule are—
(a) egg, nucleus, embryo sac, integument
(b) egg, embryo sac, nucellus, integument
(c) embryo sac, egg, nucellus, integument
(d) egg, embryo sac, integument, nucellus

**32.** Filiform apparatus is a characteristic feature of—
(a) suspensor cells (b) egg
(c) synergids (d) zygote

**33.** Synergids are—
(a) Haploid (b) Diploid
(c) Triploid (d) Tetraploid

**34.** In angiosperms, triple fusion is required in the formation of—
(a) embryo (b) endosperm
(c) suspensor (d) fruit wall

**35.** Double fertilisation involve—
(a) Fertilisation of the egg by two male gametes
(b) Fertilisation of two eggs in the same embryo sac by two sperms brought by one pollen tube
(c) Fertilisation of the egg and the central cell by two sperms brought by different pollen tubes
(d) Fertilisation of egg and central cell by two sperms brought by the same pollen tube

**36.** After fertilisation, the integuments of an ovule develop into: **[ISC 2016]**
(a) Seed (b) Seed coat
(c) Fruit (d) Fruit wall

**37.** Fragrant flowers with well developed nectaries are an adaptation for—
(a) Chiropterophily (b) Anemophily
(c) Entomophily (d) Hydrophily

**38.** Seedless banana is—
(a) Parthenocarpic fruit (b) Drupe fruit
(c) Multiple fruit (d) Tree fruit

## Choose the odd one out of the following

**39.** Which of the following is odd one out with reference to sexual reproduction?
(a) Diverse organisms show great diversity in sexual mode of reproduction
(b) Juvenile phase is called vegetative phase in plants
(c) Offsprings are not identical to the plants
(d) Fusion of gametes results in formation of zygote

**40.** Which of the following is odd one out with reference to sexual reproductive structures?
(a) Stamen (b) Pistil
(c) Pollen grain (d) Eyes of potato

## Numerical based questions

**41.** The number of meiotic divisions required for the formation of 50 functional megaspores is:
(a) 75 (b) 25
(c) 100 (d) 50

**42.** Number of meiotic divisions required to produce 200 seeds of pea would be:
(a) 200 (b) 400
(c) 300 (d) 250

**43.** Endosperm cell of an angiosperm has 36 chromosomes. The number of chromosomes in the gametes would be—

(a) 11 (b) 12
(c) 8 (d) 9

## Fill in the blanks

**44.** In angiosperms …… lead to the formation of a mature male gametophyte from a pollen mother cell.

(a) two meiotic divisions
(b) three mitotic division
(c) two mitotic and one meiotic division
(d) a single mitotic division

**45.** …… discovered double fertilisation in *Lilium* and *Fritillaria*.

(a) Nawaschin (b) Strasburger
(c) Leeuwenhoek (d) Both (a) and (b)

**46.** ……comprises the egg apparatus.

(a) Polar nuclei
(b) Antipodal cells
(c) Egg cell and synergids
(d) Male gametes

**47.** Pollen grains are well preserved as fossils because of the presence of …… .

(a) Exine (b) Intine
(c) Germ pores (d) Sporopollenin

**48.** Ovule integument gets transformed into ……

(a) Seed (b) Fruit wall
(c) Seed coat (d) Cotyledons

**49.** The outer layer pollen grain is called …… A …… . This is made up of …… B …… which is absent on the …… C …… .

(a) A-intine, B-cellulose, C-micropyle
(b) A-exine, B-sporopollenin, C-germ pores
(c) A-intine, B-sporopollenin, C-germ pores
(d) A-exine, B-cellulose, C-micropyle

**50.** Embryo sac is to ovule as …… is to an anther.

(a) Stamen (b) Filament
(c) Pollen grain (d) Androecium

**51.** Larger nucleus in a pollen grain is called……

(a) callus (b) generative nucleus
(c) vegetative nucleus (d) none of these

**52.** Microsporogenesis is the formation of …… A …… and megasporogenesis is the formation of …… B.

(a) A-3-celled pollen grains, B-female gametophyte
(b) A-microspores, B-megaspores
(c) A-3-celled pollen grains, B-megaspores
(d) A-microspores, B- female gametophyte

## Match the following

**53.** Match column I with column II and select the correct option from the given codes.

| Column I | Column II |
|---|---|
| A. Integuments | (i) A mass of cells |
| B. Chalaza | (ii) Stalk of ovule |
| C. Funicle | (iii) Protective envelopes |
| D. Nucellus | (iv) Basal part of the ovule |

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

**54.** Match the items given in column I with those given in column II and choose the correct option given below:

| Column I | Column II |
|---|---|
| A. Tapetum | (i) Oxalis and Commelina |
| B. Chasmogamous Flowers | (ii) Allogamy |
| C. Hydrophily | (iii) Nourishes the developing pollen grains |
| D. Xenogamy | (iv) Zostera |

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

**55.** Match the structures given in column I with their ploidy levels given in column II and select the correct option.

| Column I (Structures) | Column II (Ploidy) |
|---|---|
| A. Megaspore | (i) $2n$ |
| B. Microspore mother cell | (ii) $(n + n)$ |
| C. Central cell | (iii) $n$ |
| D. Antipodal cell | |

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

**56.** Match the parts given in column I with the structures that will be formed from these parts given in column II and select the correct option.

| Column I (Parts) | Column II (Structures formed) |
|---|---|
| A. Ovule | (i) Endosperm |
| B. Nucellus | (ii) Seed |
| C. Polar nuclei | (iii) Perisperm |

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

**57.** Match the phenomena given in column I with their descriptions given in column II and choose the option with correct combination.

| Column I (Phenomena) | Column II (Descriptions) |
|---|---|
| A. Polyembryony | (i) Development of fruit without fertilisation |
| B. Parthenocarpy | (ii) Development of seed without fertilisation |
| C. Apomixis | (iii) Occurrence of more than one embryo |

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

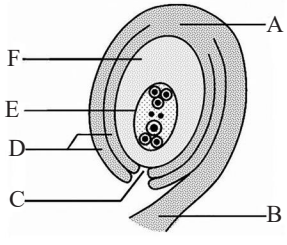
**58.** Match the terms given in column I with their examples given in column II and select the correct option.

| Column I (Terms) | Column II (Examples) |
|---|---|
| A. Apomixis | (i) Banana |
| B. Parthenocarpy | (ii) Mango |
| C. Polyembryony | (iii) Grasses |

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

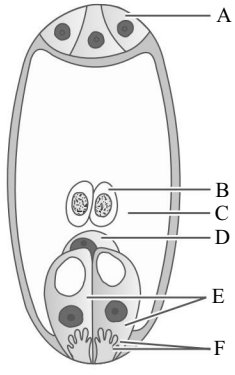
## Figure based questions

**59.** Identify the parts labelled as A to F in the given



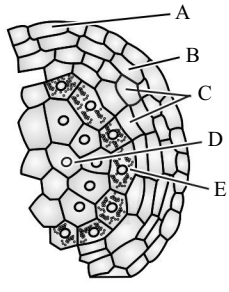

(a) A-Funicle; B-Embryo sac; C-Integuments; D-Chalaza; E-Nucellus; F-Micropyle
(b) A-Chalaza; B-Funicle; C-Micropyle; D-Integuments; E-Embryo sac; F-Nucellus
(c) A-Embryo sac; B-Funicle; C-Chalaza; D-Integuments; E-Nucellus; F-Micropyle
(d) A-Chalaza; B-Funicle; C-Micropyle; D-Integuments; E-Nucellus; F-Embryo sac

**60.** The diagram given below represents different cells of a typical angiospermic embryo sac labelled from A to F. Identify these cells and select the correct option.



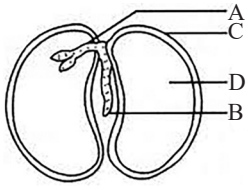

(a) A-Antipodals; B-Polar nuclei; C-Central cell; D-Egg; E-Synergids; F-Filiform apparatus
(b) A-Antipodals; B-Central cell; C-Polar nuclei; D-Egg; E-Synergids; F-Filiform apparatus
(c) A-Filiform apparatus; B-Polar nuclei; C-Central cell; D-Synergids; E-Egg; F-Antipodals
(d) A-Filiform apparatus; B-Central cell; C-Polar nuclei; D-Antipodals; E-Egg; F-Synergids

**61.** The diagram below represents the microsporangium in an enlarged view. Identify the parts labelled from A to E and select the correct option.




(a) A-Epidermis, B-Endothecium, C-Middle layers, D-Sporogenous tissue, E-Tapetum
(b) A-Epidermis, B-Endothecium, C-Middle layers, D-Tapetum, E-Sporogenous tissue
(c) A-Endothecium, B-Epidermis, C-Middle layers, D-Sporogenous tissue, E-Tapetum
(d) A-Middle layers, B-Epidermis, C-Sporogenous tissue, D-Tapetum, E-Endothecium

**62.** The image given below shows the parts of a seed. Select the option from which the part of the seed labelled as C develops.




(a) Zygote
(b) Primary endosperm cell
(c) Integuments of ovule
(d) None of these

## Assertion and Reason

**In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:**
(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true, but reason is false.
(d) Both assertion and reason are false.

**63.** **Assertion:** Gynoecium consists of pistil.
**Reason:** It represents the male reproductive part in flowering plants.

**64.** **Assertion:** Megaspore mother cell undergoes meiosis to produce four megaspores.
**Reason:** Megaspore mother cell and megaspore both are haploid.

**65.** **Assertion:** Pollen grain of angiosperm is considered as a male gametophyte.
**Reason:** Pollen grain consists of stigma, style, and ovary.

**66.** Assertion: In a microsporangium, the tapetal cells possess high cytoplasm and generally have a single prominent nucleus.

## Source based questions

**Read the passages and answer the questions that follow:**

**67.** A typical stamen shows two important parts – the long and slender stalk called the filament, and the terminal generally bilobed structure called the anther. The proximal end of the filament is attached to the thalamus or the petal of the flower.

The number and length of stamens are variable in flowers of different species.

A typical angiosperm anther is bilobed with each lobe having two theca, i.e., they are dithecous. Often a longitudinal groove runs lengthwise separating the theca.

The bilobed nature of an anther is very distinct in the transverse section of the anther. The anther is a four-sided (tetragonal) structure consisting of four microsporangia located at the corners, two in each lobe. The microsporangia develop further and become pollen sacs. They extend longitudinally all through the length of an anther and are packed with pollen grains.

(i) The long and slender stalk of a stamen is called:
(a) Filament (b) Anther
(c) Connective (d) None of the above

(ii) The terminal generally bilobed structure of stamen is called:
(a) Filament (b) Anther
(c) Sporangium (d) All of the above

(iii) A typical angiosperm anther is bilobed with each lobe having two theca, i.e., they are:
(a) Monothecous (b) Dithecous
(c) Trithecous (d) Quadrithecous

(iv) In tetragonal structure of anther how many microsporangia are present ?
(a) 32 (b) 16
(c) 8 (d) 4

**68.** A typical microsporangium in transverse section appears near circular in outline. It is generally surrounded by four wall layers – the epidermis, endothecium, middle layers and the tapetum. The outer three wall layers perform 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. When the anther is young, a group of compactly arranged homogenous cells called the sporogenous tissue occupies the centre of each microsporangium. As the anther develops, the cells of the sporogenous tissue undergo meiotic divisions to form microspore tetrads.

As each cell of the sporogenous tissue is capable of giving rise to a microspore tetrad. Each one is a potential pollen or microspore mother cell. The process of formation of microspores from a pollen mother cell (PMC) through meiosis is called microsporogenesis. The microspores, as they are formed, are arranged in a cluster of four cells–the microspore tetrad.

(i) If we cut Microsporangium transversely how many layers are found in the wall of Microsporangium?
(a) 1 (b) 2
(c) 3 (d) 4

(ii) Which of the following is the innermost wall layer of Microsporangium?
(a) Epidermis (b) Endodermis
(c) Middle Layer (d) Tapetum

(iii) Which among the following layers of microsporangium nourishes the developing pollen grains?
(a) Epidermis (b) Endodermis
(c) Middle Layer (d) Tapetum

(iv) What is called a group of compactly arranged homogeneous cells of anther?
(a) Endosperm
(b) Double fertilization
(c) Sporogenous Tissue
(d) Syngamy

(v) What type of cell division takes place in the sporogenous tissue to form microspore tetrads?
(a) Amitosis (b) Mitosis
(c) Meiosis (d) None of these

**69.** The pollen grains represent the male gametophytes. Pollen grains are generally spherical measuring about 25-50 micrometers in diameter. It has a prominent two-layered wall. The hard outer layer called the exine is made up of sporopollenin which is one of the most resistant organic material known. It can withstand high temperatures and strong acids and alkali. No enzyme that degrades sporopollenin is so far known. Pollen grain exine has prominent apertures called germ pores where sporopollenin is absent. Pollen grains are well preserved as fossils because of the presence of sporopollenin. The exine exhibits a fascinating array of patterns and designs.

The inner wall of the pollen grain is called the intine. It is a thin and continuous layer made up of cellulose and pectin. The cytoplasm of pollen grain is surrounded by a plasma membrane. When the pollen grain is mature it contains two cells, the vegetative cell and generative cell. The vegetative cell is bigger, has abundant food reserve and a large irregularly shaped nucleus. The generative cell is small and floats in the cytoplasm of the vegetative cell.

(i) Which of the following structures is represented by pollen grains?
(a) Female Gametophytes
(b) Male Gametophytes
(c) Cellular Endosperm
(d) Zygote

(ii) What is the general form and size of pollen grains?
(a) Rectangular, 10-20 micrometres
(b) Square, 5-10 micrometres
(c) Spherical , 20-50 micrometres
(d) Spherical, 2-4 micrometres

(iii) What is called the hard outer layer of a pollen grain?
(a) Germpore (b) Exine
(c) Intine (d) Tapetum

(iv) The exine of pollen grain bears an aperture which is known as:
(a) Tapetum (b) Epidermis
(c) Germpore (d) Chalaza

**70.** The gynoecium represents the female reproductive part of the flower. The gynoecium may consist of a single pistil (monocarpellary) or may have more than one pistil (multicarpellary). When there are more than one, the pistils may be fused together (syncarpous) or may be free (apocarpous). Each pistil has three parts, the stigma, style and ovary. The stigma serves as a landing platform for pollen grains. The style is the elongated slender part beneath the stigma. The basal bulged part of the pistil is the ovary. Inside the ovary is the ovarian cavity (locule). The placenta is located inside the ovarian cavity. It has become a fashion in recent years to use pollen tablets as food supplements. In western countries, a large number of pollen products in the form of tablets and syrups are available in the market. Pollen consumption has been claimed to increase the performance of athletes and race horses. Arising from the placenta are the megasporangia, commonly called ovules. The number of ovules in an ovary may be one (wheat, paddy, mango) to many (papaya, water melon, orchids).

(i) Which one of the following structure represents the female reproductive part of the flower?
(a) Microsporangium (b) Placentation
(c) Gynoecium (d) Ovule

(ii) If we study the gynoecium in well developed angiospermic plant which of the following structure(s) is/are found?
(a) Monocarpellary pistil
(b) Multicarpellary pistil
(c) Both Monocarpellary and Multicarpellary pistils
(d) None of the above

(iii) Which of the following structures is / are a part of pistil?
(a) Stigma (b) Style
(c) Ovary (d) All of the above

(iv) Which of the following structures or parts of a pistil serves as a landing platform for pollen grains?
(a) Ovary (b) Style
(c) Stigma (d) All of the above

(v) Which of the following structure is the basal bulged part of a pistil?
(a) Ovary (b) Placenta
(c) Stigma (d) Style

**71.** The ovule is a small structure attached to the placenta by means of a stalk called funicle. The body of the ovule fuses with funicle in the region called hilum. Thus, hilum represents the junction between ovule and funicle. Each ovule has one or two protective envelopes called integuments. Integuments encircle the nucellus except at the tip where a small opening called the micropyle is organised. Opposite the micropylar end, is the chalaza, representing the basal part of the ovule. Enclosed within the integuments is a mass of cells called the nucellus.

Cells of the nucellus have abundant reserve food materials. Located in the nucellus is the embryo sac or female gametophyte. An ovule generally has a single embryo sac formed from a megaspore. Megasporogenesis : The process of formation of megaspores from the megaspore mother cell is called megasporogenesis. Ovules generally differentiate a single megaspore mother cell (MMC) in the micropylar region of the nucellus. It is a large cell containing dense cytoplasm and a prominent nucleus. The MMC undergoes meiotic division. Meiosis results in the production of four megaspores.

(i) Which of the following structure attaches an ovule to the placenta?
(a) Chalaza (b) Stigma
(c) Funicle (d) Hilum

(ii) What is called the body of ovule fusing with funicle?
(a) Style (b) Hilum
(c) Micropyle (d) Antipodal

(iii) What is called the protective layer of each ovule?
(a) Chalaza (b) Embryo sac
(c) Integument (d) Nucellus

(iv) Which of the following represents the full form of MMC?
(a) Micropyle Mother Cell
(b) Multiple Mother Cell
(c) Mother Micropyle Cell
(d) Megaspore Mother Cell

## Solutions

**1.** (c) Synergids.
**Explanation:** The synergids have special cellular thickening at the micropylar tip called filiform apparatus, which plays an important role in guiding the pollen tube into the synergids.

**2.** (d) Plant is dioecious and bears only staminate flowers.
**Explanation:** In dioecious plants, the unisexual male flower is staminate, i.e., bearing stamens only, while the female is pistillate or bearing pistils only. For the production of fruits and seeds fertilisation must take place, which is possible only in the presence of both male and female flowers.
When the plant is dioecious, it will give rise to the following situations:
(i) If the plant is dioecious and bears only pistillate flowers, fertilisation can take place with the help of pollinators.
(ii) If the plant is dioecious and bears only staminate flowers, fertilisation can't take place, because female gamete is non-motile which can't reach the male gamete in order to fuse with it.
(iii) When the plant is monoecious (i.e., carrying both stamen and pistil together, it may lead to self-fertilisation and production of seed.

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

**4.** (b) siphonogamy
**Explanation:** Siphonogamy is a condition in plants in which pollen tubes are developed for the transfer of the male cells to the eggs. It was discovered by Strasburger 1884.

**5.** (c) sporopollenin
**Explanation:** Outer layer (exine) of pollen grain is made of a highly resistant substance called sporopollenin. Sporopollenin is not degraded by any enzyme. It is not affected by

high temperature, strong acid or string alkali. Because of sporopollenin, pollen grains are well preserved as fossils.

**6.** (b) Entomophily

**Explanation:** In entomophily, insects are the pollinating agents. These are the most common biotic agents of pollination. Bees are the most common insect which acts as pollinating agents. The flowers are colourful and possess fragrance to attract the insects. Nectar is given as a reward to insects.

**7.** (d) Both (b) and (c)

**Explanation:** Micropyle is the small minute pores which are differentiated from the surface of the egg. It is formed by the projection of integuments into which the male gamete through pollen tube enters into the egg of the ovule. It is usually located at the top of the seed or ovule.

**8.** (b) two-celled stage

**Explanation:** Pollen grain is uninucleate (1-celled) in the beginning but at the time of liberation, it becomes 2-3 celled. Actually, pollen grain nucleus grows in size and shifts to one side near the wall. The protoplast then divides to form two unequal cells - generative cells (small) and tube or vegetative cell (large). In some species, the generative cell divides into two male gametes prior to the dehiscence of anther and release of the pollen grains. Thus, at the time of pollination, pollen grain is either 2-celled (tube cell + generative cell) or 3-celled (tube cell + two male gametes).

**9.** (d) spore mother cells

**Explanation:** Spore mother cells are diploid. They undergo meiosis to form four haploid spores. This process of formation of haploid spores from diploid spore mother cell through meiosis is called sporogenesis. The spores can either be microspores or megaspores. Microspores are formed from the meiosis of microspore mother cell and megaspores are formed from the meiosis of megaspore mother cell.

**10.** (b) endosperm

**Explanation:** Angiosperms shows double fertilisation in which after the release of two male gametes inside the embryo sac by the pollen tube, one male gamete fuses with egg nucleus and this phenomenon is known as fertilisation or syngamy and results in the formation of zygote. The second male gamete migrates towards the secondary nucleus (formed from fusion of two polar nuclei) and fuses with it. This is known as triple fusion and results in the formation of a triploid endosperm.

**11.** (c) Cotyledons and scutellum

**Explanation:** In dicot plants, cotyledons are present that store the food for the seed. In monocot plant, there is only one terminal cotyledon which is known as scutellum. The second cotyledon is reduced in monocots and which is known as epiblast. These two structures are homologous to each other as they have similar functions but different structures.

**12.** (c) megagametophyte

**Explanation:** Megaspores are produced by meiosis in megaspore mother cell. Megaspore then develops into female gametophyte or embryo sac. Megagametophyte or the female gametophyte is the embryo sac that develops from the megaspore through megagametogenesis. Megasporangium is a structure which along with its protective coverings forms the ovule. Female gamete is the egg cell which upon fusion with male gamete forms a diploid zygote. Hence, embryo sac is also called megagametophyte.

**13.** (c) Strasburger

**Explanation:** Strasburger first discovered syngamy and monosporic embryo sac in angiosperms.

**14.** (c) Coconut

**Explanation:** Anemophily is also called as wind pollination in which pollen grains are transported through wind from male flower of one plant to female flower of another plant. For example, coconut. In Salvia, the pollination is taken place by insects (Entomophily). In Vallisneria, the pollination occurs through water (Hydrophily). In Bottle brush the pollination occurs through birds (Ornithophily).

**15.** (a) Germ pore

**Explanation:** Germ Pore is not found in a female gametophyte of an angiosperm. A germ pore is a small pore in the outer wall of a fungal spore through which the germ tube exits upon germination. The main work of a germ pore is to do absorption of water for seed germination.

**16.** (b) Embryo development

**Explanation:** Events in sexual reproduction after the fertilization are called post-fertilization events. After fertilization, a diploid zygote is formed in all sexually reproducing organisms. Zygote divides by mitosis and gives rise to the

proembryo and subsequently to the globular, heart shaped mature embryo. The process of development of an embryo from the zygote is called embryogenesis.

**17.** (b) Meiocytes

**Explanation:** Gamete mother cell in diploids are specialized cells called meiocytes.

**18.** (c) (ii) and (iv)

**Explanation:** The technically correct terms for the floral whorls are (from outermost to innermost) calyx, corolla, androecium and gynoecium. They are made up of sepals, petals, stamens and carpels respectively.

**19.** (d) (vi) → (ii) → (iv) → (v) → (iii) → (i)

**Explanation:** The correct sequential order in which the steps should be followed in the artificial hybridisation programme are:

(a) Selection of parents is done first.

(b) Emasculation – After parents are selected, in bisexual female flower anthers are removed from flowed bud before the anther dehisces, this is called Emasculation.

(c) Bagging – Now the stigma is bagged with butter paper bag to prevent its contamination with unwanted pollen.

(d) Collection of pollen from male parent

(e) Dusting the pollen on stigma – When the stigma of bagged flower attains receptivity, the collected mature pollen grains are dusted on the stigma.

(f) Re-bagging

**20.** (c) Dioecious plant

**Explanation:** Marchantia can reproduce sexually or asexually. In sexual reproduction, sperm from the antheridia fertilizes an egg in the archegonia. These antheridia and archegonia are the special gametophyte stalks which are present on the separate thalli. So, Marchantia is considered as a heterothallic plant because these plants are dioecious.

**21.** (a) Tapetum

**Explanation:** The wall layers of a microsporangium from outermost to innermost are: epidermis, endothecium, middle layers and tapetum. The first three layers generally provide protection and help in dehiscence of anther. Tapetum performs nutritive function for pollen grains.

**22.** (d) exine of pollen wall

**Explanation:** Sporopollenin is hardest organic substance and it made up of fatty acid and carotenoids are present in outer wall of pollen grain. Pollen grain has two layers one is inner which is known as intine and other is outer which is known as exine. It protect pollen grain and increases its viability.

**23.** (b) Diploid

**Explanation:** Meiosis is the reductional division and this occurs in the megaspore mother cell so that the diploid cell divide and form a haploid gamete. If the megaspore mother cell does not undergo meiosis then the ploidy of the embryo sac will be 2n or diploid.

**24.** (a) stigma

**Explanation:** Compatible nature of pollen grain is determined by the stigma of carpel/pistil.

**25.** (c) 4

**Explanation:** The anther consists of four microsporangia located at the corners or two microsporangia in each lobe.

**26.** (d) All of the above

**Explanation:** Self-incompatibility is a genetic mechanism that prevents self-pollen, i.e., pollen from the same flower or other flowers of the same plant from fertilising the ovules by inhibiting pollen germination or pollen tube growth in the pistil.

**27.** (a) microsporophylls

**Explanation:** Microsporophylls are the leaf-like structures that bear the microsporangia and stamens of the angiosperms bear the microsporangia in their anthers so these represent the modified microsporophylls.

**28.** (d) one vegetative cell and two male gametes.

**Explanation:** A 3-celled pollen grain results when the generative cell undergoes mitosis and forms two male gametes. So, such pollen grains have one vegetative cell and two male gametes.

**29.** (c) It can be degraded by enzymes.

**Explanation:** Sporopollenin is one of the most resistant organic material and cannot be degraded by any enzyme known so far.

**30.** (c) 7-celled and 8-nucleate.

**Explanation:** A typical embryo sac contains 8 nuclei but 7 cells which are 3 micropylar, 3 chalazal, and one central. The three micropylar cells are collectively known as egg apparatus. The three chalazal cells of the embryo sac are called antipodal cells.

**31.** (b) egg, embryo sac, nucellus, integument

**Explanation:** The embryo sac in the ovule contains the egg cell. The nucellus, a parenchymatous tissue that feeds sustenance to the developing foetus, surrounds the embryo sac. Nucellus is eventually encircled by integuments.

**32.** (c) synergids

**Explanation:** At the micropylar end, the synergid cell wall thickens and produces

the filiform apparatus, which consists of many finger-like extensions into the synergid cytoplasm.

**33.** (a) haploid

**Explanation:** Synergid cells are two specialised cells in the female gametophyte of angiosperms that reside next to the egg cell and play an important role in pollen tube guidance and function. Synergids are haploid in nature since they are generated via meiosis from the mother gametophyte.

**34.** (b) endosperm

**Explanation:** The production of endosperm in angiosperms requires triple fusion. The fusion of the nucleus of a male gamete with the two polar nuclei or the diploid secondary (fusion) nucleus is referred to as triple fusion.

**35.** (d) Fertilisation of egg and central cell by two sperms brought by the same pollen tube

**Explanation:** Flowering plants use a complex method of fertilisation method called double fertilisation (angiosperms). A female gametophyte (megagametophyte, also known as the embryo sac) is joined to two male gametes (sperm) in this procedure.

**36.** (b) seed coat

**Explanation:** On the ovule, integuments can be found. These serve as a protective shell for the nucellus cells, one of which will grow into a megasporangium. The integuments are converted into the seed coat after the fertilisation process. The seed will have two seed coats if there are two integuments, which is known as bitegmic. The ovule becomes a seed, and the ovary becomes the fruit.

**37.** (c) Entomophily

**Explanation:** An adaptation for entomophily is fragrant flowers with well-developed nectaries. Insects are the pollination agents in entomophily. These are the most frequent pollination biotic agents. The most frequent insect that serves as a pollinator is the bee.

**38.** (a) parthenocarpic fruit

**Explanation:** Parthenocarpy refers to the artificial or naturally induced generation of fruit without ovule fertilisation, resulting in seedless fruit.

**39.** (a) Diverse organisms show great diversity in sexual mode reproduction

**Explanation:** The sexual reproduction is defined as the process in which the male gamete and female gamete fuse to form a zygote, which then develops in to a young organism. Hence, there is an involvement of two parents in this process. Sexual reproduction occurs on the same lines in organisms. It is the asexual reproduction that shows great diversity in the mode.

Hence, the correct answer is 'Diverse organisms show great diversity in sexual mode of reproduction'

**40.** (d) Eyes of potato

**Explanation:** Eyes of potato is Vegetative propagules in angiosperms where as all others are related to sexual reproductive structures.

**41.** (d) 50

**Explanation :** Since only one megaspore is functional out of four megaspores formed from a megaspore mother cell through one meiotic division, 50 divisions will be required to form 50 functional megaspores.

**42.** (d) 250

**Explanation :** 200 pea seeds will be produced from the fusion of 200 pollen grains and 200 eggs. Since one microspore mother produces four microspores from one meiotic division, 200 pollen grains will be formed from 50 microspore mother cells by 50 meiotic divisions while one functional mother cell resulting from one meiotic division of megaspore mother cell forms one egg, 200 eggs will be formed by 200 megaspore mother cells so total 250 meiotic divisions will be required to produce 200 pea seeds.

**43.** (b) 12

**Explanation :** Endosperm of flowering plants is a triploid structure. As $3n = 36$, the gametes are haploid *i.e.* $n$, then $n = 12$.

**44.** (c) two mitotic and one meiotic division

**Explanation:** Meiosis produces pollen grain. Its cell divides mitotically to form generative nucleus and tube cell. The generative nucleus undergoes another mitosis to form two male gametes.

**45.** (a) Nawaschin

**Explanation:** The fusion of one sperm with the egg cell to form the embryo and of the other sperm with the polar nucleus to give rise to the endosperm ('double fertilization') was discovered by Nawaschin in 1898 in the liliaceous plants, *Lilium martagon* and *Fritillaria tenella*.

**46.** (c) Egg cell and synergids

**Explanation:** Egg apparatus is present at the micropylar end. It consists of two synergids and one egg cell.

**47.** (d) Sporopollenin

**Explanation:** Outer layer (exine) of pollen grain is made of a highly resistant substance called sporopollenin. Sporopollenin is not

degraded by any enzyme. It is not affected by high temperature, strong acid or string alkali. Because of sporopollenin, pollen grains are well preserved as fossils.

**48.** (c) Seed coat

**Explanation:** Integument is a protective envelope covering the ovule. After the process of fertilization, the integument gets transformed to form the seed coat. If there are two integuments the condition is known as bitegmic. In such a case the seed will have two seed coats.

**49.** (b) A-exine, B-sporopollenin, C-germ pores

**Explanation:** Pollen grain has a two-layered wall i.e., exine and intine. The hard outer layer of pollens, named exine, is made of sporopollenin. It is one of the most resistant organic materials known. It can withstand high temperature and strong acids and alkali. It has prominent apertures called germ pores where sporopollenin is absent.

**50.** (c) Pollen grain

**Explanation:** Embryo sac is the female gametophyte which is an oval structure in the nucellus of the ovule of flowering plants and the ovule is the megasporangium. Similarly, the Pollen grain is the male gametophyte and the anther is the microsporangium.

**51.** (b) generative nucleus

**Explanation:** In mature pollen grains, there are two nuclei: vegetative (larger, responsible for pollen grain development) and generative (smaller, responsible for pollen grain development and the smaller one, fuses with the egg).

**52.** (b) A-microspores, B-megaspores

**Explanation:** Microsporogenesis is the process of formation of microspores from a pollen mother cell through meiosis and megasporogenesis is the process of formation of megaspores from megaspore mother cell.

**53.** (d) A-(iii), B-(iv), C-(ii), D-(i)

**Explanation :** Funicle is the stalk through which the ovule is attached to the placenta, integuments are the protective envelopes of an ovule, chalaza represents the basal part of the ovule opposite to the micropyle, and nucellus is the mass of cells enclosed within the integuments.

**54.** (c) A-(iii), B-(i), C-(iv), D-(ii)

**Explanation :** Tapetum nourishes the developing pollen grains, Oxalis, and Commelina produce chasmogamousflowers with exposed anthers and stigma, hydrophily occurs in Vallisneria and Hydrilla and Zostera and xenogamy is an allogamy in which pollen grains are transferred from the anther to the stigma of a different plant.

**55.** (b) A-(iii), B-(i), C-(ii), D-(iii)

**Explanation :** Megaspore and antipodal are haploid cells, central cell has two haploid polar nuclei, and megaspore mother cell is diploid.

**56.** (a) A-(ii), B-(iii), C-(i)

**Explanation :** Ovule develops into seed, polar nuclei after fusion with a male gamete form primary endosperm cell which forms the endosperm and the residual and persistent nucellus in some seeds is perisperm.

**57.** (b) A-(iii), B-(i), C-(ii)

**Explanation :** Polyembryony is the development of more than one embryo in a seed; parthenocarpy is the development of fruit without fertilisation and apomixes is the formation of seeds without fertilisation.

**58.** (b) A-(iii), B-(i), C-(ii)

**Explanation :** Grasses produce seeds without fertilisation through the phenomenon of apomixis. Banana is an example of parenthocarpic fruit and mango is an example of polyembryony, i.e., presence of many embryos in an ovule.

**59.** (b) A-Chalaza; B-Funicle; C-Micropyle; D-Integuments; E-Embryo sac; F-Nucellus

**Explanation :** A-Chalaza; B-Funicle; C-Micropyle; D-Integuments; E-Nucellus; F-Embryo sac. The given figure represents an anatropous ovule where the parts labelled from A to F are chalaza, funicle, micropyle, integuments, embryo sac, and nucellus, respectively.

**60.** (a) A-Antipodals; B-Polar nuclei; C-Central cell; D-Egg; E-Synergids; F-Filiform apparatus

**Explanation :** Three cells grouped together at the micropylar end constitute the egg apparatus which, in turn, consists of two synergids (labelled as E) and one egg cell (labelled as D). The special cellular thickenings at the micropylar tip of synergids is the filiform apparatus (labelled as F). Antipodals (labelled as A) are the three cells which are at the chalazal end. The large central cell (labelled as C) has two polar nuclei (labelled as B).

**61.** (a) A-Epidermis, B-Endothecium, C-Middle layers, D-Sporogenous tissue, E-Tapetum

**Explanation :** A microsporangium is surrounded by four wall layers–the epidermis (labelled as A), endothecium (labelled as B), middle layers (labelled as C), and the tapetum (labelled as E). When the anther is young, a group of compactly arranged homogenous cells called the sporogenous tissue occupies the centre of each microsporangium.

**62.** (c) Integuments of ovule
**Explanation :** The part of the seed labelled as C represents the seed coat which develops from the integuments of the ovule.

**63.** (c) Assertion is true, but reason is false.
**Explanation :** The gynoecium represents the female reproductive part of the flower consisting of pistil. Thus assertion is true, but reason is false.

**64.** (c) Assertion is true, but reason is false.
**Explanation :** The megaspore mother cell is diploid and has a large nucleus and dense cytoplasm. This cell undergoes meiosis (reduction division) to produce a group of four haploid cells called megaspore. One of these develops into the functional rnegaspore that develops into female gametophyte. Thus assertion is true, but reason is false.

**65**. (c) Assertion is true, but reason is false.
**Explanation :** The pollen grains represent the male gametophytes. The pistil or gynoecium represents the female reproductive part of flower. Each pistil has three parts- the stigma, style, and ovary. The stigma serves as a landing platform for pollen grains. The style is the elongated slender part beneath the stigma. The basal bulged part of the pistil is the ovary. Thus assertion is true, but reason is false.

**66.** (d) Both assertion and reason are false.
**Explanation :** Tapetum is the innermost wall layer of a microsporangium. It nourishes the developing pollen grains. The tapetal cells enlarge radically and become filled with dense protoplasmic contents as well as nutrients. Microsporogenesis refers to the process of formation of haploid microspores mother cell or pollen mother cell through meiosis. Thus both assertion and reason are false.

**67.** (i) (a) Filament
(ii) (b) Anther
(iii) (b) Dithecous
(iv) (d) 4

**68.** (i) (d) 4
(ii) (d) Tapetum
(iii) (d) Tapetum
(iv) (d) Syngamy
(v) (c) Meiosis

**69.** (i) (b) Male Gametophytes
(ii) (c) Spherical, 20-50 micrometers
(iii) (b) Exine
(iv) (c) Germpore

**70.** (i) (c) Gynoecium
(ii) (c) Both Monocarpellary and Multicarpellary pistils
(iii) (d) All of the above
(iv) (c) Stigma
(v) (a) Ovary

**71.** (i) (c) Funicle
(ii) (b) Hilum
(iii) (c) Integument
(iv) (d) Megaspore Mother Cell

## Word of Advice

1. Many students, instead of describing the features of flowers pollinated by insects, described those of wind-pollinated flowers. Some students wrote about the advantages of cross-pollination.
2. Some students made errors in the diagram by drawing the *L.S of anther* instead of *T.S of the anther*; some drew stamens or whole flower. Few did incorrect labelling.
3. Many students did not make a clear-cut distinction between *cellular* and *nuclear endosperms* based on *cytokinesis* and *karyokinesis*. They did not know the *examples of cellular* and *helobial type*.
4. A few students were confused between *endospermic and non-endospermic seeds*.
5. Most candidates, instead of writing valid points like wastage of pollen grains and to ensure pollination, wrote general answers, for the statement *'Pollen grains are produced in large number'*. Some candidates wrote about how the wind helps in the process of pollination.
6. A few candidates wrote the features of *anemophilous* flowers, confusing them with *entomophilous* and mentioned the role of insects. In a few answer scripts, contrivances of cross-pollination were written in detail.
7. Many candidates, instead of drawing the embryo sac of angiosperm drew the entire anatropous ovule.
8. For *polyembryony*, several candidates wrote *"formation of many embryos"* without mentioning plant, animal, ovule or seed, which made the definition vague and incomplete.
9. A few candidates were confused between the terms *'Porogamy'* and *'Mesogamy'*.
10. A number of the candidates, instead of describing *parthenocarpy*, described *parthenogenesis*. Many of them defined it as the formation of embryo without fertilisation or development of animals without fertilisation. Some candidates gave the example of the honey bee.