

# Namma Kalvi



## BIOLOGY - BOTANY



*Based on the New Syllabus 2019 - 2020*

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## PREFACE

Greetings,

**SURYA BIOLOGY - BOTANY** has been written strictly in accordance with new syllabus and new textbook released by the government of Tamil Nadu. **Surya Biology Botany for standard 12** is written with the sole objective of guiding the students to score the maximum marks for the type of questions they are expected to answer in the board examination. This guide has been framed based on the 'New 100 mark pattern' and the public exam question paper is for 70 marks. Ample number of question were added in each category, which help the students to gain mastery over the subjects and can able to answer different types of questions asked in Public examination.

It provides a precise and clear understanding of text and exercise from the examination perspective. Each chapter consists of points to remember, Answer to textual question, multiple choice question, important additional questions in 2 mark, 3 mark and 5 mark questions category, Creative questions, **NEET** based multiple choice questions. It helps to face all India competitive examination like **NEET, JIPMER ENTRANCE, B.Sc., AGRICULTURAL UNIVERSITY ENTRANCE** and other central and state entrance examination.

**Questions and answers are provided under the following headings**

**PART A - Choose the correct answer (MCQ)**

- Textual questions
- Additional questions
- Match the following
- Assertion and reasoning
- NEET Based questions

**PART B - Two mark question and answers**

- Textual questions
- Additional questions
- Diagram based questions

**PART C - Three mark question and answers**

- Textual questions
- Additional questions

**PART D – Five mark question and answers**

- Textual questions
- Additional questions

It is hoped that this guide the present form will specify all types of learners and help them improve their learning potential, apart from mentally preparing them to face any type of questions in the examinations.

Friendly suggestion for the enrichment of this book are welcome. I present this book before the Enlightened Teaching Faculty and learning Fraternity for their precious suggestions and sustained patronage.

**Publisher**

## UNIT VI: REPRODUCTION IN PLANTS

### CHAPTER 1

## ASEXUAL AND SEXUAL REPRODUCTION IN PLANTS

### Points to Remember

- Two major categories in reproduction are 1. Asexual reproduction 2. Sexual reproduction.
- Some plants can be propagated more economically by vegetative propagation.
- A plant cell to produce the entire plant under suitable conditions is called **totipotency**.
- Sexual reproduction involves the production and fusion of male and female gametes
- The **sporogenous tissue** functions as microspore mother cells.
- All microspores in a microsporangium remain held together called **pollinium**.
- Sporopollenin is present in the exine of pollen grains.
- Palynology is the study of **pollen grains**
- Pollenkitt is contributed by the tapetum
- In 60% of the angiosperms pollen is liberated in 2 celled stage
- Ovule is also called **megasporangium**.
- Nucellus contains large oval, sac-like structure called embryo sac or female gametophyte
- The process of development of a megaspore from a megaspore mother cell is called megasporogenesis.
- Embryo sac contains 7 celled with 8 nucleus.
- Pollination is a characteristic feature of spermatophyte (Gymnosperms and Angiosperms)
- The fusion of male and female gamete is called fertilization.
- Fertilization in angiosperms is **double fertilization** type
- One male gametes fuses with the egg to form Zygote.
- The primary endosperm nucleus (PEN) divides and produce endosperm.
- The embryo develops at micropylar end of **embryo sac**
- In monocot seed, the embryo is small and shield-shaped cotyledon known as **scutellum**
- Reproduction does not involve union of male and female gametes is called **apomixis**.
- Presence of more than one embryo in a seed is called **polyembryony**
- Fruit may develop from the ovary without fertilization are called parthenocarpic fruits.
- The meiotic division of microspore mother cells gives rise to haploid microspores
- In some plants, the pollen is liberated at 3 celled stage.
- The word pistil refers to the ovary, style and stigma.
- Ovules in an ovary may be one (paddy, wheat and mango) or many (papaya, water melon and orchids)
- Embryo sac, there are three types **monosporic**, **bisporic** and **tetrasporic**.
- An ovule generally has a single **embryo sac**.
- In water plants like *Eichhornia* and water lilly pollination takes place through wind or by insects.
- In most of the hydrophilous flowers, the pollen grains cover mucilage to protects them from wetting.
- Pollen tube enters the embryo sac at the micropylar end.
- The pollen enters into embryo sac directly into one of the synergids.
- The growth of pollen tube is due to the presence of chemotropic substances.
- S.G. Nawaschin and L.Guignard observed in *Lilium* and *Fritillaria* two male gametes are released.
- The receptacle becomes fleshy and edible in *Pyrus malus* (apple)
- The calyx may persist and enlarge in *Solanum melongena*
- The calyx may cover the fruit in *Physalis minima*
- The flower stalk below the gynoecium enlarges pear shaped in *Anacardium occidentale*.
- The Perianth becomes fleshy as in Jack fruit.
- **Coconut water** from tender coconut is free-nuclear endosperm and white kernel part is cellular.
- In pea and castor the endosperm contains reserve food and the cotyledons are thin.
- In Pea plant the tegmen and testa are fused.
- In *Amorphophallus*, flowers providing floral rewards, also forms safe site for laying eggs.



## Book Evaluation

### PART – A

( 1 MARK)

#### 1. Choose the correct statement from the following

- a) Gametes are involved in asexual reproduction
- b) Bacteria reproduce asexually by budding
- c) Conidia formation is a method of sexual reproduction
- d) Yeast reproduce by budding

Ans : d

#### 2. An eminent Indian embryologist is

- a) S.R.Kashyap                      b) P.Maheswari
- c) M.S. Swaminathan          d) K.C.Mehta

Ans : b

#### 3. Identify the correctly matched pair

- a) Tuber - *Allium cepa*          b) Sucker - *Pistia*
- c) Rhizome - *Musa*              d) Stolon - *Zingiber*

Ans : c

#### 4. Pollen tube was discovered by

- a) J.G.Kolreuter                      b) G.B.Amici
- c) E.Strasburger                  d) E.Hanning

Ans : b

#### 5. Size of pollen grain in *Myosotis*

- a) 10 micrometer                  b) 20 micrometer
- c) 200 micrometer                d) 2000 micrometer

Ans : a

#### 6. First cell of male gametophyte in angiosperm is

- a) Microspore                      b) megaspore
- c) Nucleus                          d) Primary Endosperm Nucleus

Ans : a

#### 7. Match the following

- I) External fertilization      i) pollen grain
- II) Androecium                  ii) anther wall
- III) Male gametophyte        iii) algae
- IV) Primary parietal layer    iv) stamens

- a) I-iv; II-i; III-ii; IV-iii
- b) I-iii; II-iv; III-i; IV-ii
- c) I-iii; II-iv; III-ii, IV-i
- d) I-iii; II-i; III-iv; IV-ii

Ans : b

#### 8. Arrange the layers of anther wall from locus to periphery

- a) Epidermis, middle layers, tapetum, endothecium
- b) Tapetum, middle layers, epidermis, endothecium
- c) Endothecium, epidermis, middle layers, tapetum
- d) Tapetum, middle layers endothecium epidermis

Ans : d

#### 9. Identify the incorrect pair

- a) sporopollenin - exine of pollen grain
- b) tapetum – nutritive tissue for developing microspores
- c) Nucellus – nutritive tissue for developing embryo
- d) obturator – directs the pollen tube into micropyle

Ans : c

#### 10. Assertion : Sporopollenin preserves pollen in fossil deposits

Reason : Sporopollenin is resistant to physical and biological decomposition

- a) assertion is true; reason is false
- b) assertion is false; reason is true
- c) Both Assertion and reason are not true
- d) Both Assertion and reason are true.

Ans : d

#### 11. Choose the correct statement (s) about tenuinucellate ovule

- a) Sporogenous cell is hypodermal
- b) Ovules have fairly large nucellus
- c) sporogenous cell is epidermal
- d) ovules have single layer of nucellus tissue

Ans : a

#### 12. Which of the following represent mega gametophyte

- a) Ovule                                  b) Embryo sac
- c) Nucellus                              d) Endosperm

Ans : b

#### 13. In *Haplopappus gracilis*, number of chromosomes in cells of nucellus is 4. What will be the chromosome number in Primary endosperm cell?

- a) 8                      b) 12                      c) 6                      d) 2

Ans : b

#### 14. Transmitting tissue is found in

- a) Micropylar region of ovule  
b) Pollen tube wall  
c) Stylar region of gynoecium  
d) Integument

Ans : c

**15. The scar left by funiculus in the seed is**

- a) tegmen                      b) radicle  
c) epicotyl                    d) hilum

Ans : d

**16. A Plant called X possesses small flower with reduced perianth and versatile anther. The probable agent for pollination would be**

- a) water                      b) air  
c) butterflies                d) beetles

Ans : b

**17. Consider the following statement(s)**

- i) In Protandrous flowers pistil matures earlier  
ii) In Protogynous flowers pistil matures earlier  
iii) Herkogamy is noticed in unisexual flowers  
iv) Distyly is present in *Primula*

- a) i and ii are correct      b) ii and iv are correct  
c) ii and iii are correct    d) i and iv are correct

Ans : b

**18. Coelorrhiza is found in**

- a) Paddy                      b) Bean  
c) Pea                         d) Tridax

Ans : a

**19. Parthenocarpic fruits lack**

- a) Endocarp                    b) Epicarp  
c) Mesocarp                   d) seed

Ans : d

**20. In majority of plants pollen is liberated at**

- a) 1 celled stage              b) 2 celled stage  
c) 3 celled stage              d) 4 celled stage

Ans : b

**PART – B, C AND D****(2, 3 AND 5 MARKS)****21. What is reproduction?**

- Reproduction is a vital process for the existence of a species.
- It also brings suitable changes through variation in the off springs for their survival on earth.

**22. Mention the contribution of Hofmeister towards Embryology.**

- Described the structure of pollen tetrad is the contribution of Hofmeister towards Embryology

**23. List out two sub-aerial stem modifications with example.**

- 1.Runner                      - *Centella asiatica*
- 2.Offset                      - *Pistia*, and *Eichhornia*
- 3.Stolon                      - *Dioscorea* and *Agave*
- 4.Sucker                      - *Chrysanthemum*

**24. What is layering?**

- The stem of a parent plant is allowed to develop roots while still intact.
- The root develops, the rooted part is cut and planted to grow as a new plant.
- Examples: *Ixora* and *Jasminum*.
- Mound layering and Air layering are two types of layering

**25. What are clones?**

- The individuals formed by asexual method is morphologically and genetically identical and are called **clones**.

**26. A detached leaf of *Bryophyllum* produces new plants. How?**

- In *Bryophyllum*, the leaf is succulent and notched on its margin.
- Adventitious buds develop at these notches and are called **epiphyllous buds**.
- They develop into new plants forming a root system.
- They become independent plants when the leaf gets decayed.

**27. Differentiate Grafting and Layering.**

Grafting	Layering
The tissues of one plant are encouraged to fuse with those of another	There is no fusion between tissues of different plants
Stock plant contains a very strong root system.	Roots are formed on a stem of a mother plant
1) bud grafting, ii) approach grafting, iii) tongue grafting, iv) crown grafting and v) wedge grafting are five types of Grafting	Mound layering and Air layering are two types of layering

**28. "Tissue culture is the best method for propagating rare and endangered plant species"- Discuss.**

The growth of plant tissue in special culture medium under suitable controlled conditions is known as tissue culture. The plants which do not produce viable seeds and seeds that are difficult to germinate can be propagated by tissue culture. So using this method Rare and endangered plants can be propagated.

**29. Distinguish mound layering and air layering.**

Mound layering	Air layering
Applied for the plants having flexible branches	The stem is girdled at nodal region.
The lower branch with leaves is bent to the ground	Hormones are applied to girdled region
The part of the stem is buried in the soil	Girdled portion is covered with damp soil
Roots emerge in buried part of the stem	Roots emerge in these branch

**30. Explain the conventional methods adopted in vegetative propagation of higher plants.**

- The plants produced are genetically uniform.
- Many plants can be produced quickly by this method.
- Plants can be produced in a short period by this method.
- Propagated more economically by vegetative propagation. Example: *Solanum tuberosum*.
- Disease resistant and high yield can be grafted and grown as a new plant with the same desirable characters.

**31. Highlight the milestones from the history of plant embryology.**

**1682** - Nehemiah Grew mentioned stamens as the male organ of a flower.

**1694** - R.J.Camerarius described the structure of a flower, anther, pollen and ovule

**1761** - J.G. Kolreuter gave a detailed account on the importance of insects in pollination

**1824** - G.B.Amici discovered the pollen tube.

**1848** - Hofmeister described the structure of pollen tetrad

**1870** - Hanstein described the development of embryo in *Capsella* and *Alisma*

**1878** - E.Strasburger reported polyembryony

**1884** - E.Strasburger discovered the process of Syngamy.

**1898** - S.G.Nawaschin and L. Guignard independently discovered Double fertilization

**1904** - E.Hanning initiated embryo culture.

**1950** - D.A. Johansen proposed classification for embryo development

**1964** - S.Guha and S.C.Maheswari raised haploids from *Datura* pollen grains

**1991** - E.S.Coen and E. M. Meyerowitz proposed the ABC model to describe the genetics of initiation and development of floral parts

**2015** -K.V.Krishnamurthy summarized the molecular aspects of pre and post fertilization reproductive development in flowering plants

**32. Discuss the importance of Modern methods in reproduction of plants.**

- Plants with desired characteristics can be multiplied rapidly in a short duration.
- Plants produced are genetically identical.
- Tissue culture can be carried out in any season to produce plants.
- Plants which do not produce viable seeds and seeds that are difficult to germinate can be propagated by tissue culture.
- Rare and endangered plants can be propagated.
- Disease free plants can be produced by meristem culture.

**33. What is Cantharophily?**

Pollination by beetle is called Cantharophily

**34. List any two strategy adopted by bisexual flowers to prevent self-pollination.**

The flowers are bisexual and the special adaptation of the flowers prevents self-pollination.

**i. Dichogamy:** In bisexual flowers anthers and stigmas mature at different times.

**a. Protandry:** The stamens mature earlier than the stigmas of the flowers.

**b. Protogyny:** The stigmas mature earlier than the stamens of the flower

**ii. Herkogamy:** In bisexual flowers, the stamens and stigmas, are arranged different positions.

a. style is reflexed away from the stamens

b. stigmas project far above the stamens



**35. What is endothelium>**

- It is found between epidermis and middle layer in T.S of mature anther.
- It is generally a single layer of radially elongated cells
- The inner tangential wall develops bands (sometimes radial walls also) of a cellulose (sometimes also slightly lignified)
- The cells are **hygroscopic**.

**36. "The endosperm of angiosperm is different from gymnosperm". Do you agree. Justify your answer.**

Yes I agreed. The endosperm of angiosperm is triploid. but in gymnosperm is haploid

**37. Define the term Diplospory.**

- A diploid embryo sac is formed from megaspore mother cell without a regular meiotic division.
- It also called Generative apospory
- Examples. *Eupatorium* and *Aerva*.

**38. What is polyembryony. How it can commercially exploited?**

- Presence of more than one embryo in a seed is called polyembryony.

**It can commercially exploited as follows**

- The seedlings formed from the nucellar tissue in *Citrus* are found better clones for Orchards.
- Embryos derived through polyembryony are found virus free.

**39. Why does the zygote divides only after the division of Primary endosperm cell?**

- Zygote needs nourishment during its development.
- As the mature, fertilized embryosac offers very little nourishment to the zygote.
- The primary endosperm cell divides and generate the endosperm tissue which nourishes the zygote.
- So the zygote always divides after the division of Primary endosperm cell.

**41. "Endothecium is associated with dehiscence of anther" Justify the statement.**

- The cells along the junction of the two sporangia of an anther lobe lack these thickenings.
- This region is called **stomium**.
- This region along with the hygroscopic nature of endothecium helps in the dehiscence of anther at maturity.

**42. List out the functions of tapetum.**

- It supplies nutrition to the developing microspores.
- It contributes sporopollenin through **ubisch bodies** thus plays an important role in pollen wall formation.
- The pollenkitt material is contributed by tapetal cells and is later transferred to the pollen surface.
- Exine proteins responsible for '**rejection reaction**' of the stigma are present in the cavities of the exine.
- These proteins are derived from tapetal cells.
- Tapetum also controls the fertility or sterility of the microspores or pollen grains.

**43. Write short note on Pollen kitt.**

- Pollenkitt is contributed by the tapetum.
- It is yellow or orange coloured and is chiefly made of carotenoids or flavonoids.
- It is an oily layer forming a thick viscous coating over pollen surface.
- It attracts insects and protects damage from UV radiation.

**45. 'Pollination in Gymnosperms is different from Angiosperms' – Give reasons.**

- In gymnosperms the pollens are deposited directly on the exposed ovules.
- In angiosperms the pollens are deposited on the stigma of the pistil.

**46. Write short note on Heterostyly.**

- Some plants produce two or three different forms of flowers.
- They are different in length of stamens and style.
- Pollination will take place only between organs of the same length.

**47. Enumerate the characteristic features of Entomophilous flowers**

**Characteristic features of entomophilous flowers:**

- Flowers are large or if small they are aggregated in dense inflorescence. Ex: Asteraceae flowers.
- Flowers are brightly coloured to attract insects. ex : Poinsettia and Bougainvillea
- Flowers are scented and produce nectar.
- Pollen and nectar are the floral rewards for the visitors.
- Flowers pollinated by flies and beetles produce foul odour to attract pollinators.



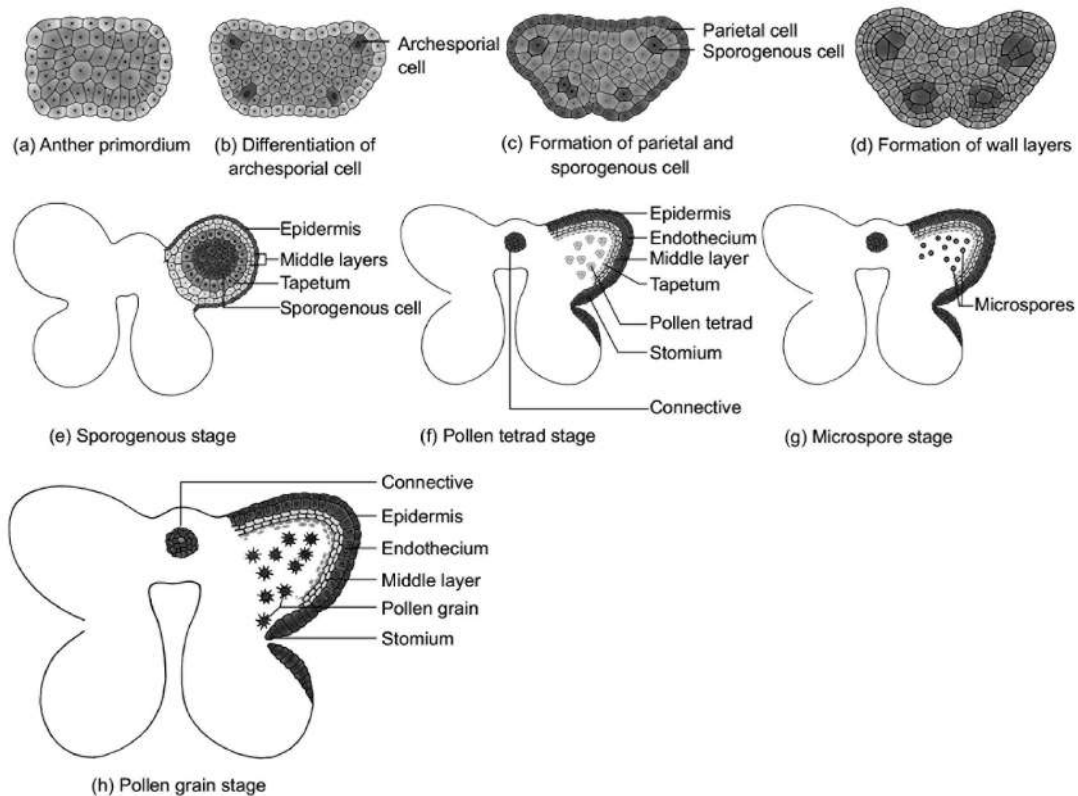
- In some flowers juicy cells are present which are pierced and the contents are sucked by the insects

#### 48. Discuss the steps involved in Microsporogenesis.

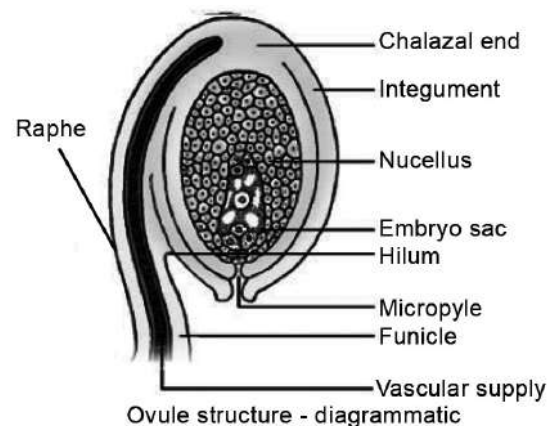
The formation of haploid microspores ( $n$ ) from diploid microspore mother cell ( $2n$ ) by meiosis is called Microsporogenesis.

##### The steps involved in Microsporogenesis

- A very young anther develops as a homogenous mass of cells surrounded by an epidermis.
- During its development, the anther assumes a four-lobed.
- In each lobe contains archesporial cells.
- Archesporial cells periclinally produce outer primary parietal cells and inner primary sporogenous cells
- The primary parietal cells divide periclinally and anticlinally to form endothecium, middle layers and tapetum, from periphery to centre.
- The primary sporogenous cells directly, or mitotic divisions to form **sporogenous tissue**.
- The sporogenous tissue functions as microspore mother cells.
- Each microspore mother cell divides meiotically to form a four haploid microspores (microspore tetrad)
- Microspores remain free and develop into pollen grains.



#### 49. With a suitable diagram explain the structure of an ovule.



**Structure of ovule:**

- Ovule is also called megasporangium.
- It is protected by one or two covering called **integuments**.
- A mature ovule consists of a stalk called **funiculus** ( funicle)
- The point of attachment of funicle to the body of the ovule is known as **hilum**.
- It represents the junction between ovule and funicle are called **hilum**.
- The funicle is adnate to the body of the ovule forming a ridge called **raphe**.
- The body of the ovule is made up of a central mass of parenchymatous tissue called **nucellus**.
- It has large reserve food materials.
- The nucellus is enveloped by one or two protective coverings called **integuments**.
- Integument encloses the nucellus except at the top and forms a pore called **micropyle**.
- The ovule with one integument said to be **unitegmic** or two integuments are said to be **bitegmic**.
- The nucellus, the integument and the funicle meet at the basal region of the ovule is called as **chalaza**.
- The micropylar end of the nucellus contains large oval, sac-like structure called **embryo sac** or female gametophyte
- It develops from the functional megaspore formed within the nucellus.

**50. Give a concise account on steps involved in fertilization of an angiosperm plant.**

- The fusion of male and female gamete is called **fertilization**.
- Fertilization in angiosperms is **double fertilization**.

**Events of fertilization**

The stages involved in double fertilization are:-

- Germination of pollen to form pollen tube in the stigma;
- Growth of pollen tube in the style;
- Direction of pollen tube towards the micropyle of the ovule;

- Entry of the pollen tube into one of the synergids of the embryo sac,
- Discharge of male gametes.
- One male gametes fuses with the egg to form **Zygote**.



- Second male gamete fuses with the **polar nuclei** and forms the **primary endosperm nucleus (PEN)**
- This phenomenon is called **double fertilization** and is unique to angiosperms.
- One male gametes (n) fuses with the egg (n) to form zygote (2n) is called syngamy
- Second male gamete (n) fuses with the polar nuclei (2n) and forms the primary endosperm nucleus (3n) this phenomenon is called triple fusion.
- It results endosperm which forms the nutritive tissue for the embryo

**51. What is endosperm? Explain the types.**

- The primary endosperm nucleus (PEN) divides immediately after fertilization but before the zygote starts to divide, into an endosperm.

**Three types of endosperm in angiosperms.**

1. nuclear endosperm, 2. cellular endosperm and 3. helobial endosperm

**Nuclear endosperm:**

- Primary Endosperm Nucleus undergoes several mitotic divisions without cell wall formation.
- Thus a free nuclear condition exists in the endosperm. Examples: *Coccinia*, *Capsella* and *Arachis*

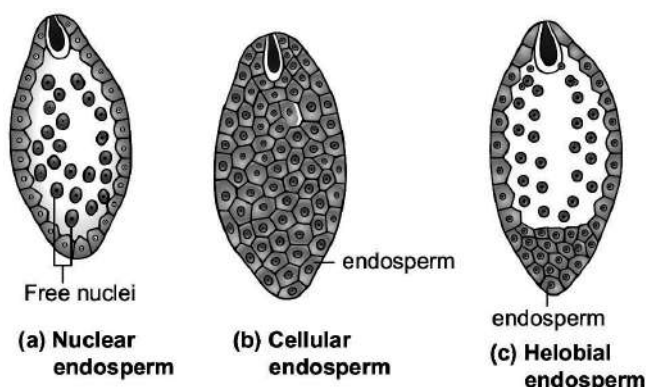
**Cellular endosperm:**

- Primary endosperm nucleus divides into 2 nuclei and it is immediately followed by wall formation.

- Subsequent divisions also follow cell wall formation. Examples: *Adoxa*, *Helianthus* and *Scoparia*

### Helobial endosperm:

- Primary Endosperm Nucleus divides into two nuclei 1.large micropylar 2.small chalazal chamber.
- The nucleus of the micropylar chamber undergoes several free nuclear division.
- The chalazal chamber may or may not divide. Examples : *Hydrilla* and *Vallisneria*.



## 52. Differentiate the structure of Dicot and Monocot seed.

Dicot seed	Monocot seed
Two cotyledons in the embryo	One cotyledon in the embryo
Plumule is terminal, cotyledons are lateral	Plumule is lateral, cotyledons are terminal
No sheath	Plumule and radicle are surrounded by coleoptile and coleorhiza respectively
Albuminous and ex albuminous	Mostly albuminous
Germination usually epigeal	Germination usually hypogeal

## 53. Give a detailed account on parthenocarpy. Add a note on its significance

- Fruit may develop from the ovary without fertilization.
- Such fruits are called **parthenocarpic fruits**.
- They donot have true seeds.
- Examples: Banana, Grapes and Papaya.

### Classification :

- Nitsch in 1963 classified the parthenocarpy into following types:

### 1. Genetic Parthenocarpy:

- Parthenocarpy arises due to hybridization or mutation
- Examples: *Citrus*, *Cucurbita*.

### 2. Environmental Parthenocarpy:

- Environmental conditions like frost, fog, low temperature, high temperature etc., induce Parthenocarpy.
- Example, low temperature for 3-19 hours induces parthenocarpy in Pear.

### 3. Chemically induced Parthenocarpy:

- Application of growth promoting substances like Auxins and Gibberellins induces parthenocarpy.

### Significance parthenocarpic fruits

- The seedless fruits have great significance in horticulture.
- The seedless fruits have great commercial importance.
- Seedless fruits are useful for the preparation of jams, jellies, sauces, fruit drinks etc.
- High proportion of edible part is available in parthenocarpic fruits due to the absence of seeds.

## PART – A

### ADDITIONAL QUESTIONS (1 MARK)

#### 1. Who mentioned stamens as the male organ of a flower.

- a) Nehemiah Grew      b) Hofmeister  
c) E.Hanning      d) Hanstein      **Ans : a**

#### 2. Who described the structure of a flower, anther, pollen and ovule

- a) G.B.Amici      b) R.J.Camerarius  
c) E.Hanning      d) Hanstein      **Ans : b**

#### 3. A detailed account on the importance of insects in pollination given by

- a) G.B.Amici      b) R.J.Camerarius  
c) J.G. Kolreuter      d) Hanstein      **Ans : C**

#### 4. Scientist who described the structure of pollen tetrad by

- a) Hofmeister      b) R.J.Camerarius  
c) - J.G. Kolreuter      d) Hanstein      **Ans : a**

**5. Which scientist described the development of embryo in *Capsella* and *Alisma***

- a) Hofmeister                      b) R.J.Camerarius  
c) - J.G. Kolreuter                d) Hanstein                      **Ans : d**

**6. Who reported polyembryony and discovered the process of Syngamy**

- a) G.B.Amici                        b) E.Strasburger  
c) E.Hanning                      d) Hanstein                      **Ans : b**

**7. Who initiated embryo culture.**

- a) G.B.Amici                        b) E.Strasburger  
c) E.Hanning                      d) Hanstein                      **Ans : c**

**8. Who proposed classification for embryo development**

- a) G.B.Amici                        b) E.Strasburger  
c) E.Hanning                      d) D.A. Johansen              **Ans : d**

**9. Who raised haploids from *Datura* pollen grains**

- a) G.B.Amici                        b) S.Guha and  
S.C.Maheswari  
c) E.Hanning                      d) E.S.Coen and  
E. M. Meyerowitz              **Ans : b**

**10. Which scientist/ scientists proposed the ABC model to describe the genetics of initiation and development of floral parts**

- a) G.B.Amici                        b) S.Guha and  
S.C.Maheswari  
c) E.Hanning                      d) E.S.Coen and  
E.M. Meyerowitz              **Ans : b**

**11. Who summarized the molecular aspects of pre and post fertilization reproductive development in flowering plants**

- a) K.V.Krishnamurthy            b) R.J.Camerarius  
c) - J.G. Kolreuter                d) Hanstein                      **Ans : a**

**12. Presence of many embryos (Polyembryony) is a characteristic feature of**

- a) Citrus                              b) Mango  
c) Banana                            d) None of these              **Ans : a**

**13. Match the items in columnn -I with those in column - II and choose the correct answer**

Column -I	Column - II
A. Funicle	i. Small opening of ovule
B. Integuments	ii. Stalk of ovule
C. Chalaza	iii. Protective envelopes of ovules
D. Hilum	iv. Junction part of ovule
E. Micropyle	v. Basal part of the ovule

- a) A -ii; B - iii; C - v; D - iv; E - i  
b) A -i; B -iii; C - ii; D - iv; E - v  
c) A -ii; B - iii; C - i; D - iv; E - v  
d) A -ii; B - iv; C - v; D - i; E - iii                      **Ans : a**

**14. Match the entries in Column - I with those of Column- II and choose the correct answer**

Column - I	Column - II
A. Cleistogamy	i. Insect pollination
B. Geitonogamy	ii. Bud pollination
C. Entomophily	iii. Pollination between flowers in the same plant
D. Xenogamy	iv. Wind pollination
	v. Cross pollination

- a) A - iii; B - i; C - v; D - ii  
b) A - i; B - v; C - ii; D - iii  
c) A - ii; B - iii; C - i; D - v  
d) A - v; B - iv; C - iii; D - ii                      **Ans : c**

**15. Match the following**

Column - I	Column - II
A. Zoophily	i. Pollination by birds
B. Ornithophily	ii. Pollination by insect
C. Entomophily	iii. Pollination by bats
D. Chiropterophily	iv. Pollination by animals
	v. Cross pollination

- a) A - iii; B - ii; C - i; D - iv  
b) A - i; B - ii; C - iii; D - iv  
c) A - iv; B - i; C - ii; D - iii  
d) A - iv; B - ii; C - iii; D - i                      **Ans : c**

**16. Which of these is not a part of the anther wall ?**

- a) Tapetum                      b) Middle layers  
c) Endothecium                d) Nucellus                      **Ans : d**

**17. Consider the following statements and choose the correct option.**

- A. The ovule is attached to the placenta by means of a stalk called filament.  
B. the ovule fuses with the stalk in the region called hilum.  
C. The two protective envelopes of ovule are called integuments.  
D. The small opening in the tip of ovule are called germ pore.

Of the above statements

- a) A and D are correct  
b) A and C are correct  
c) B and D are correct  
d) B and C are correct                      **Ans : d**

**18. Presence of many embryos (Polyembryony) is a characteristic feature of**

- a) Citrus                              b) Mango  
c) Banana                            d) None of these                      **Ans : a**

**19. Match the items in columnn -I with those in column - II and choose the correct answer**

Column -I	Column - II
A. Funicle	i. Small opening of ovule
B. Integuments	ii. Stalk of ovule
C. Chalaza	iii. Protective envelopes of ovules
D. Hilum	iv. Junction part of ovule
E. Micropyle	v. Basal part of the ovule

- a) A -ii; B - iii; C - v; D - iv; E - i  
b) A -i; B -iii; C - ii; D - iv; E - v  
c) A -ii; B - iii; C - i; D - iv; E - v  
d) A -ii; B - iv; C - v; D - i; E - iii                      **Ans : a**

**20. Match the entries in Column - I with those of Column- II and choose the correct answer**

Column - I	Column - II
A. Cleistogamy	i. Insect pollination
B. Geitonogamy	ii. Bud pollination
C. Entomophily	iii. Pollination between flowers in the same plant
D. Xenogamy	iv. Wind pollination
	v. Cross pollination

- a) A - iii; B - i; C - v; D - ii

- b) A - i; B - v; C - ii; D - iii

- c) A - ii; B - iii; C - i; D - v

- d) A - v; B - iv; C - iii; D - ii                      **Ans : c**

**21. Match the following**

Column - I	Column - II
A. Zoophily	i. Pollination by birds
B. Ornithophily	ii. Pollination by insect
C. Entomophily	iii. Pollination by bats
D. Chiropterophily	iv. Pollination by animals

- a) A - iii; B - ii; C - i; D - iv

- b) A - i; B - ii; C - iii; D - iv

- c) A - iv; B - i; C - ii; D - iii

- d) A - iv; B - ii; C - iii; D - i                      **Ans : c**

**22. Which of these is not a part of the anther wall ?**

- a) Tapetum                              b) Middle layers  
c) Endothecium                      d) Nucellus                      **Ans : d**

**23. Consider the following statements and choose the correct option.**

- A. The ovule is attached to the placenta by means of a stalk called filament.  
B. the ovule fuses with the stalk in the region called hilum.  
C. The two protective envelopes of ovule are called integuments.  
D. The small opening in the tip of ovule are called germ pore.

Of the above statements

- a) A and D are correct    b) A and C are correct  
c) B and D are correct    d) B and C are correct                      **Ans : d**

**24. What would be the number of chromosomes in the cells of the aleurone layer in a plant species with 8 chromosomes in its synergids**

- a) 8                      b) 16                      c) 24                      d) 32                      **Ans : b**

**25. Male gametes in angiosperms are formed by the division of**

- a) generative cell  
b) vegetative cell  
c) microspore mother cell  
d) microspore                      **Ans : a**



**26. Which one of the following pairs of plant structures has haploid number of chromosomes?**

- a) Nucellus and antipodals
- b) egg nucleus and secondary nucleus
- c) megaspore mother cell and antipodal cells
- d) egg cell and antipodal cells **Ans : d**

**27. What does the filiform apparatus do at the entrance into ovule**

- a) it brings about opening of the pollen tube
- b) It guides the pollen tube from synergid to egg
- c) it helps the entry of pollen tube into a synergid
- d) it prevents the entry of more than one pollen tube into the embryo sac **Ans : c**

**28. Unisexuality of flowers prevents**

- a) Geitonogamy but not xenogamy
- b) autogamy and geitonogamy
- c) autogamy but not geitonogamy
- d) both geitonogamy and xenogamy **Ans : c**

**29. Which one of the following is resistant to enzyme action?**

- a) Pollen exine                      b) Cuticle
- c) Cork                                d) wood fibre **Ans : a**

**30. Insect pollinated flowers have ----- pollen grains.**

- a) light and sticky                  b) hygroscopic
- c) light and rough                  d) heavy and colored **Ans : a**

**31. In some plants anthers of stamens and pistil mature at the same time. This is called as**

- a) homogamy                      b) Syngamy
- c) Allogamy                        d) Autogamy **Ans : a**

**32. Egg apparatus consists of**

- a) Egg and antipodals            b) synergids and egg
- c) egg and central cell          d) synergid and antipodal **Ans : a**

**33. The term Apomixis was introduced by**

- a) Winkler.                        b) Maheswari
- c) Hofmeister                      d) E.Strasburger **Ans : a**

**34. Embryos are formed by eliminating meiosis and syngamy are called**

- a) Amphimixis                      b) Agamospermy
- c) Apomixis                        d) all of these **Ans : b**

**35. The different methods of asexual reproduction and examples are given. Identify the wrong pair**

- |                         |                                |
|-------------------------|--------------------------------|
| Asexual reproduction    | Example                        |
| a) Budding              | Yeast and Hydra                |
| b) Fragmentation        | <i>Spirogyra</i>               |
| c) production of Gemma  | <i>Marchantia</i>              |
| d) formation of Conidia | <i>Planaria</i> <b>Ans : d</b> |

**36. Which type of cutting is widely used for Conventional methods of propagation.**

- a) Root cutting                      b) Stem cutting
- c) Leaf cutting                      d) all of these **Ans : b**

**37. Which part of the plant used for natural methods of propagation is.**

- a) Root                                b) Stem
- c) Leaf                                d) all of these **Ans : d**

**38. Which part the rhizome produce new plants**

- a) roots                                b) eyes
- c) axillary buds                      d) all of these **Ans : c**

**39. Which part the tuber give rise to new plants.**

- a) roots                                b) eyes
- c) axillary buds                      d) all of these **Ans : b**

**40. The external fertilization takes place in**

- a) angiosperms                      b) algae
- c) gymnosperms                      d) all of these **Ans : b**

**41. The internal fertilization occurs in.**

- a) higher plants                      b) algae
- c) algae and higher plants          d) none of these. **Ans : a**

**42. Fresh weight of an orchid seed may be**

- a) 23.33 microgram                  b) 22.33 microgram
- c) 21.33 microgram                  d) 20.33 microgram **Ans : d**

**43. Fresh weight of double coconut (*Lodoicea maldivica*) is about**

- a) 4 kg.    b) 5 kg.    c) 6 kg.    d) 7 kg. **Ans : c**



**44. Maheswari Who classified Apomixis into Recurrent and Non recurrent**

- a) Maheswari                      b) E.Strasburger  
c) E.Hanning                      d) D.A. Johansen

**Ans : a****ASSERTION**

**Direction:** In the following questions a statement of Assertion is following by a statement of reason Mark the correct choice as

- A) it both Assertion and reason are true and reason is the correct explanation of Assertion.  
b) if both Assertion and Reason are true and Reason not the correct explanation of Assertion  
c) If Assertion is true but Reason is false  
d) If both Assertion and Reason are false.

**45. Assertion: Leaves of Bryophyllum, Begonia help in vegetative multiplication.**

**Reason: Leaves of these plants possess adventitious buds**

**Ans: a****46. Assertion: Coconut is a monoecious plant**

**Reason: Both male and female flowers are present on the same plant**

**Ans: a****47. Assertion: Chasmogamous flowers require their sex orgAns:**

**Reason: Cleistogamous flowers donot expose their sex organs**

**Ans: b****48. Assertion: Pollen mother calls (PMC's) are the first male gametophytic cells.**

**Reasons: Each PMC gives rise to two pollens.**

**Ans: d****49. Assertion: Double Fertilization is characteristic feature of Angiosperms.**

**Reasons: Double fertilization involves two fusions**

**Ans: b****50. Which one of the following is correctly matched**

- a) *Chlamydomonas* - Conida  
b) Onion - Bulb  
c) Yeast - Zoospore  
d) Ginger - Sucker

**Ans: b****51. What is common between vegetative reproduction and apomixes?**

- a) both occur round the year  
b) both are applicable to only dicot plants  
c) both produces progeny identical to the parent  
d) both bypass the flowering phase.

**Ans: c****52. The Eyes of the potato tuber are**

- a) shoot buds                      b) root buds  
c) axillary buds                      d) flower buds

**Ans: c.****53. Panthogenesis is**

- a) development of fruit without hormones  
b) development of embryo without fertilization  
c) development of embryo from egg without fertilization  
d) development of fruit without fertilization.

**Ans: c****54. Formation of gametophyte directly from sporophyte without meiosis is**

- a) parthenogenesis                      b) apospory  
c) amphimixis                      d) apogamy

**Ans: b****55. Development of an organism from female gamete / egg without involving fertilization is**

- a) Parthenocarpy                      b) Adventive embroyony  
c) Parthenogenesis                      d) Polyembryony

**Ans: c****56. Female gametophyte of angiosperm is represented by**

- a) Embry sac                      b) ovule  
c) Nucellus                      d) Megaspore mother cell

**Ans: a****57. Embryosac occurs in**

- a) Ovule                      b) Embryo  
c) endosperm                      d) axis part of embryo

**Ans: a****58. Pollination occus in**

- a) Angiosperms and Gynosperms  
b) Bryophytes and angiosperms  
c) Angiosperms and Fungi  
d) Pteridophytes and angiosperm

**Ans: a****59. Cellular totipotency was demonsated by**

- a) Theodore Schwann                      b) F.C. steward  
c) Robert Hooke                      d) A.V. Leeuwenhock

**Ans: b****60. Entry of pollen tube through micropyle is**

- a) Porogamy                      b) Chalazogamy  
c) Pseudogamy                      d) Mesogamy

**Ans: a**

**61. Double Fertilization is fusion of**

- a) One male gamete with egg and other with synergid
- b) two eggs
- c) One male gamete with egg and other with secondary nucleus
- d) two eggs and polar nuclei with pollen nuclei

**Ans: c**

**62. Syngamy means**

- a) fusion of two similar spores
- b) fusion of gametes
- c) fusion of two dissimilar spores
- d) fusion of cytoplasm

**Ans: b**

**63. Point out the odd one?**

- a) Micropyle
- b) Nucellus
- c) Pollengrains
- d) Embryosac

**Ans: c**

**64. Albuminous seeds above their reserve food mainly in**

- a) cotyledons
- b) Perisperm
- c) Hypocotyle
- d) Endosperm

**Ans: d.**

**65. Which one of the following statements is correct?**

- a) Xenogamy occurs only by wind pollination
- b) Geitonogamy involves the pollen and stigma of flowers of different plants
- c) Chasmogamous flowers do not open at all
- d) Cleistogamous flowers are always autogamous

**Ans: d**

**66. Megaspores are produced from the megaspore mother cells after**

- a) Formation of a thick wall
- b) Meiotic division
- c) Differentiation
- d) mitotic division

**Ans: b**

**67. Which of the following statements is correct?**

- a) Sporopollenin is made up of inorganic materials
- b) Sporopollenin can withstand high temperature but not strong acids.
- c) Sporopollenin can withstand high temperature as well as strong acids and alkalis
- d) Sporopollenin can be degraded by enzymes

**Ans: c**

**68. Megasporangium is equivalent to**

- a) ovule
- b) fruit
- c) embryosac
- d) Nucellus

**Ans: a**

**69. Seed coat is not thin, membranous in**

- a) Gram
- b) Coconut
- c) maize
- d) Groundnut

**Ans: b**

**70. Which one of the following statement is correct?**

- a) Tapetum nourishes the developing pollen
- b) Sporogenous tissue is haploid
- c) Hard outer layer of pollen is called intine
- d) Endothecium produces the microspores

**Ans: a**

**71. Even in absence of pollinating agents seed setting is assured in**

- a) *Salvia*
- b) *Commellina*
- c) Fig
- d) *zostera*

**Ans: b.**

**72. What is the function of germ pore?**

- a) initiation of pollen tube
- b) Emergence of radical
- c) Release of male gametes
- d) Absorption of water for seed germination

**Ans: a.**

**73. In which one of the following pollination is autogamous?**

- a) Chasmogamy
- b) Geitonogamy
- c) Cleistogamy
- d) Xenogamy

**Ans: c.**

**74. Wind pollination is common in**

- a) Grasses
- b) Legumes
- c) Orchids
- d) Lilies

**Ans: a.**

**75. An organic substance that can withstand environmental extremes and cannot be degraded by any enzyme is**

- a) Lignin
- b) Cuticle
- c) Cellulose
- d) Sporopollenin

**Ans: d.**

**76. Transfer of pollen grains from the anther to the stigma of another flower of the same plant is called**

- a) Karyogamy
- b) Xenogamy
- c) Autogamy
- d) Geitonogamy

**Ans: d**

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

- a) Aleurone layer                      b) Cotyledon  
c) Plume                                  d) Endosperm      **Ans: b**

**78. Wind pollinated flowers are**

- a) Large producing abundant nectar and pollen  
b) small, brightly coloured, producing large number of pollen grains  
c) small, producing nectar and dry pollen  
d) small, producing large number of dry pollen grains      **Ans: d**

**79. Filiform apparatus is characteristic feature of**

- a) Synergid                              b) Suspensor  
c) Zygote                                  d) Antipodals      **Ans: a**

**80. Nucellar polyembryony is reported in species of**

- a) *Triticum*                                b) *Citrus*  
c) *Brassica*                               d) *Gossypium*      **Ans: b**

**81. In angiosperms all the four microspores of tetrad are covered by a large which is formed by**

- a) Cellulose                                b) Pectocellulose  
c) Sporopollenin                        d) Callose              **Ans: c**

**82. In a flowering plant, archesporium gives rise to**

- a) both wall and the sporogenous cells  
b) only tapetum and sporogenous cells  
c) wall and the tepetum  
d) only the well of the sporangium      **Ans: a**

**83. A ovule which becomes curved so that the nucellus and embryosac lie at right angles to the funicle is**

- a) Anatropous                              b) Hemitropous  
c) Orthotropous                              d) Campylotropous      **Ans: b**

**84. Eight nucleated embryo sacs are**

- a) always bisporic  
b) always tetrasporic  
c) sometime monosporic, sometime bisporic and sometime telrasporic  
d) always monosporic      **Ans: d**

**85. Adventive polyembryony in citrus is due to**

- a) Zygotic embryo                      b) Nucellus  
c) Fertilized egg                      d) Integuments      **Ans: b**

**86. What is the direction of Micropyle in anatropous ovule?**

- a) right                                      b) upward  
c) left                                        d) downward      **Ans: d**

**87. In angiosperms pollen tubes liberate their male gametes into the**

- a) Egg cell                                  b) Central cell  
c) Synergids                              d) Antipodal cell      **Ans: c**

**88. In angiosperms, triple fusion is required for the formation of**

- a) Seed coat                                b) Embryo  
c) Fruit wall                                d) Endosperm      **Ans: d**

**89. The endosperm of gymnosperm is**

- a) diploid                                    b) triploid  
c) polyploid                                d) haploid              **Ans: d**

**90. One of the most resistant biological material is**

- a) lignocellulose                        b) lignin  
c) sporopollenin                        d) hemicellulose      **Ans: c**

**91. Reproducing new plants by cells instead of seeds is known as**

- a) antibiotics                                b) mutation  
c) bio fertilizer                              d) tissue culture      **Ans: d**

**92. How many pollen grains will be formed after meiotic division in ten microspore**

**mother cells?**

- a) 40                      b) 10                      c) 80                      d) 20      **Ans: a**

**93. A population of genetically identical individuals obtained from asexual reproduction is**

- a) Deme                                      b) Callus  
c) Aggregate                                d) Clone              **Ans: d**

**94. Identify the correct pair of combinations.**

- i. *Vallisneria* – Long stalked female flowers – Hydrophily
- ii. *Tribulus* – Annual – Root succulents
- iii. *Hydrilla* – Submerged rooted hydrophytes - Aerenchyma
- iv. *Casurina* – Perennial – Phylloclades

- a) iii. and iv.                      b) ii. and iii.  
c) i. and iv.                        d) i. and iii.                      **Ans: d**

**95. Study the following**

List I		List II	
A.	Apices of underground branches store food material	i.	<i>Mentha</i>
B.	Underground branches grow obliquely upward from the axillary buds of nodes of the stem below the soil	ii.	<i>Hydrocotyle</i>
C.	Aerial branches grow obliquely downwards and produce adventitious roots after touching the soil	iii.	<i>Agave</i>
D.	Weak stemmed plants have a cluster of leaves and roots at every node	iv.	<i>Stachys</i>
		v.	<i>Jasminum</i>

- A   B   C   D**  
**a** ii.   v.   i.   iii.  
**b** iii.   iv.   ii.   i.  
**c** iv.   v.   iii.   ii.  
**d** iv.   i.   v.   ii.

**Ans: d****96. Which is proper modified structure for vegetative reproduction for *Centella*, *Fragaria* and offset respectively?**

- a) Runner, stolon, offset    b) Offset, stolon, runner  
c) Stolon, runner, offset    d) Runner, offset, stolon

**Ans: a****97. Which option is proper for vegetative reproduction in *Bryophyllum***

- a) Axillary buds at the leaf margin – vegetative Reproduction – adventitious buds  
b) At the leaf margins vegetative, meristematic – food storage – vegetative reproduction - adventitious buds  
c) Buds at leaf base – vegetative reproduction - adventitious buds  
d) Buds on lamina – vegetative reproduction - adventitious buds                      **Ans : b**

**98. The nuclei situated at chalazal end it known as**

- a) Egg cell                                      b) Synergid cell  
c) Antipodal cell                              d) Secondary nucleus

**Ans: c****99. The point of attachment of funicle to the body of the ovule is known as**

- a) hilum    b) nucellus  
c) funiculus                                      d) chalaza

**Ans: a****100. Which is more effective pollinator, from the following?**

- a) honey bees                                      b) butterfly  
c) wasp    d) ants

**Ans: a****101. Which is not related to wind pollination?**

- a) Hairy and sticky stigma  
b) Pollen grains produced in large amounts  
c) Attractive inflorescence  
d) Male flowers are located higher than female flower

**Ans: c****102. Match the following of Column I & Column II**

Column I		Column II	
A.	Anemophily	i.	Mucilage
B.	Hydrophily	ii.	Dried, Smooth light
C.	Zoophily	iii.	Hairy spiny
D.	Entomophily	iv.	Edible

- A   B   C   D**  
**a** iii.   iv.   i.   ii.  
**b** iv.   iii.   ii.   i.  
**c** ii.   i.   iv.   iii.  
**d** i.   iii.   iv.   ii.

**Ans: c****PART – B****ADDITIONAL QUESTIONS (2 MARKS)****1. Write two major categories of reproduction**

Two major categories of reproduction are  
1. Asexual reproduction 2. Sexual reproduction.

**2. Define asexual reproduction**

The reproduction takes place without the involvement of gametes and helps to perpetuate its own species is called asexual reproduction.

**3. How does *Penicillium* and *Aspergillus* reproduce Asexually ?**

*Penicillium* and *Aspergillus* reproduce Asexually by the formation of Conidia

**4. What is reproductive propagules ?**

The unit of reproductive structure used in propagation is called reproductive propagules or diaspores.

**5. Write the disadvantage of natural vegetative reproduction**

New plants produced have no genetic variation.

**6. What is artificial propagation ?**

A number of Artificial methods are used in agriculture and horticulture to propagate plants from their parts. Such methods are said to be artificial propagation.

**7. What is modern methods propagation of propagation?**

Many technology is used for propagation to produce large number of plants in a short period of time.

Such methods are called modern methods.

**8. Define tissue culture.**

The growth of plant tissue in special culture medium under suitable controlled conditions is known as tissue culture.

**9. What is Micropropagation?**

The regeneration of a whole plant from single cell, tissue or small pieces of vegetative structures through tissue culture is called micropropagation.

**10. Define Sexual reproduction.**

Male and female gametes fuse together to form a diploid zygote that grows into a new individual are called Sexual reproduction.

**11. What is gametogenesis and fertilization ?**

The production of male and female gametes are called gametogenesis and the fusion of male and female gametes are called fertilization.

**12. What is microsporogenesis ?**

The formation of haploid microspores (n) from diploid microspore mother cell (2n) by meiosis is called Microsporogenesis.

**13. Describe pollinium.**

All microspores in a microsporangium remain held together called **pollinium**. Example: *Calotropis*.

**14. What is corpusculum ?**

Pollinia are attached to a clamp or clip like sticky structure called **corpusculum**.

**15. What is retinaculum ?**

The filamentous or thread like part arising from each pollinium is called **retinaculum**.

**16. Describe translator.**

The whole structure of pollinium looks like inverted letter 'Y' and is called **translator**.

**17. What is mellitopalynology ?**

The study of honey pollen is called Mellitopalynology.

**18. What is megasporangium ?**

Ovule is also called megasporangium.

**19. What is integuments ?**

ovule is protected by one or two covering called **integuments**.

**20. What is funiculus ?**

A mature ovule consists of a stalk called **funiculus** (funicle)

**21. What is funiculus hilum ?**

The point of attachment of funicle to the body of the ovule is known as **hilum**.

**22. What is raphe ?**

The funicle is adnate to the body of the ovule forming a ridge called **raphe**.

**23. What is nucellus ?**

The body of the ovule is made up of a central mass of parenchymatous tissue called **nucellus**.

**24. What is micropyle ?**

Integument encloses the nucellus except at the top and forms a pore called **micropyle**.

**25. Unitegmic and bitegmic differentiate.**

The ovule with one integument said to be **unitegmic** or two integuments are said to be **bitegmic**.

**26. What is chalaza ?**

The nucellus, the integument and the funicle meet at the basal region of the ovule is called as **chalaza**.



**27. What is an embryo sac ?**

The micropylar end of the nucellus contains large oval, sac-like structure called **embryo sac** or female gametophyte

**28. What is stomium ?**

The cells along the junction of the two sporangia of an anther lobe lack these thickenings.

This region is called **stomium**.

**29. What is hypostase ?**

Group of cells found at the base of the ovule between the chalaza and embryo sac is called **hypostase**

**30. What is epistase ?**

The thick -walled cells found above the micropylar end above the embryo sac is called **epistase**

**31. What is bisporic embryo sac ?**

- Out of four megaspores, two are involved in Embryo sac formation.
- This development is called **bisporic**. Example: *Allium*.

**32. What is tetrasporic embryo sac ? give an example.**

- All the four megaspores are involved in Embryo sac formation.
- This development is called **tetrasporic**. Example: *Peperomia*.

**33. What is synergids ?**

In egg apparatus of embryo sac, one on each side of the egg cell are called synergids.

It secrete chemotropic substances that help to attract the pollen tube.

**34. Define pollination.**

Transfer of pollen grains from the anther to a stigma of a flower is called **pollination**.

**35. Classify the types of pollination.**

Pollination is classified into **self-pollination (Autogamy)** and **cross-pollination (Allogamy)**

**36. Describe self-pollination or autogamy. In what type of flowers it is possible.**

- The transfer of pollen on the stigma of the same flower is called **self-pollination or Autogamy**.
- It is possible only in bisexual flowers.

**37. Define Cross - pollination.**

The transfer of pollens on the stigma of another flower is called cross-pollination.

**38. What is Xenogamy ?**

Genetically different pollen deposits on another flower of a different plant of the same species is called as xenogamy.

**39. Differentiate epihydrophily and hypohydrophily**

Epihydrophily	Hypohydrophily
Pollination occurs at the water level	Pollination occurs inside the water
Examples: <i>Vallisneria spiralis</i> , <i>Elodea</i> .	Examples: <i>Zostera marina</i> and <i>Ceratophyllum</i> .

**40. Describe zoophilous flowers.**

Pollination by animals is called zoophily and flowers are said to be zoophilous.

**41. Name the animal pollinators.**

Animal pollinators are birds, bats, snails, insects, Larger animals like primates (lemurs), arboreal rodents, reptiles (gecko lizard and garden lizard)

**42. What is entomophily ?**

Pollination by insects is called Entomophily.

**43. What is myrmecophily ?**

Pollination by ant is called myrmecophily.

**44. What is cantharophily ?**

Pollination by Beetle is called Cantharophily

**45. What is Phalaenophily ?**

Pollination by Moths is called Phalaenophily

**46. What is Mellitophily ?**

Pollination by Bees is called Mellitophily

**47. What is Psychophily ?**

Pollination by Butter flies is called Psychophily

**48. What is Malacophily ?**

Pollination by Snails is called Malacophily

**49. What is Ornithophily ?**

Pollination by Birds is called Ornithophily

**50. What is Chieropterophily ?**

Pollination by Bats is called Chieropterophily



**51. What is Myrmecophily ?**

Pollination by Ants is called Myrmecophily

**52. Name some Insects pollinators**

Insects pollinators are bees, moths, butterflies, flies, wasps and beetles.

**53. Which is the dominant pollinators of flowers ?**

Bees are the main flower visitors and dominant pollinators.

**54. Which are the chief pollinating agents of angiosperms ?**

Insects are chief pollinating agents and majority of angiosperms are adapted for insect pollination.

**55. Which type of pollination is most common type of pollination ?**

Entomophily is the most common type of pollination.

**56. Describe ornithophily.**

- Pollination by birds is called Ornithophily.

**57. Name the plants pollinated by birds ?**

- The plants pollinated by birds are *Erythrina*, *Bombax*, *Syzygium*, *Bignonia*, *Sterlitzia* etc.,

**58. Name some of the birds which regularly visit flowers and bring about pollination.**

- Humming birds, sun birds, and honey eaters are some of the birds which regularly visit flowers and bring about pollination.

**59. What is fertilization ?**

The fusion of male and female gamete is called **fertilization**.

**60. What is pollen- pistil interaction ?**

- To the entry of pollen tube in to the ovule is called **pollen- pistil interaction**.

**61. Define cheiropterophily ? Give examples.**

- Pollination by bats is called cheiropterophily.
- Example : *Kigelia africana*, *Adansonia digitata*, etc.,

**62. Write the disadvantages of self-pollination**

- Continuous self-pollination, produce weaker progeny.
- Less chances of producing new species and varieties.

**63. What is Porogamy?**

The pollen tube enters through the micropyle called Porogamy.

**64. What is Chalazogamy?**

The pollen tube enters through the chalaza called Chalazogamy.

**65. What is Mesogamy ?**

The pollen tube enters through the integument called Mesogamy.

**66. Define syngamy**

One male gametes (n) fuses with the egg (n) to form zygote (2n) is called syngamy

**67. What is caruncle ? Give an example.**

The cells present at the tip of the outer integument around the micropyle develop into a fleshy structure called **caruncle**. Ex. *Ricinus communis*.

**68. What is aril ? Give examples.**

- The funiculus develops into a fleshy structure which is often very colourful and called **aril**. Ex. *Myristica* and *Pithecellobium*

**69. What is Ruminant endosperm ?**

- The endosperm with irregularity and unevenness in its surface forms ruminant endosperm.

Examples : *Areca catechu*, *Passiflora* and *Myristica*

**70. Define endosperm**

The primary endosperm nucleus (PEN) divides immediately after fertilization form a structure is called endosperm

**71. Name the three types of endosperm in angiosperms.**

1. nuclear endosperm, 2. cellular endosperm and 3. helobial endosperm

**72. Define Caryopsis ?**

The seed of paddy is one seeded and is called **Caryopsis**

**73. What is coleoptile ?**

In monocot seed, the radicle including root cap is also covered by a protective sheath called **coleorhiza**.

**74. What is amphimixis ?**

Reproduction involving fertilization in flowering plants is called amphimixis

**75. Describe recurrent apomixis**

It includes vegetative reproduction and agamospermy

**76. Describe non recurrent apomixis.**

Haploid embryo sac developed after meiosis, develops into an embryo without fertilization.

**77. Define mellitopalynology.**

The study of honey pollen is called Mellitopalynology.

**PART – C****ADDITIONAL QUESTIONS (3 MARKS)****1. Give some examples of vegetative reproduction in roots**

- The roots of some plants develop adventitious buds. Example *Murraya*, *Dalbergia* and *Millingtonia*.
- Some tuberous adventitious roots store food. Example *Ipomoea batatas* and *Dahlia*.

**2. Which plant is called "Terror of Bengal"? what is the significant role in water bodies ?**

- Water hyacinth (*Eichhornia crassipes*) is called "Terror of Bengal".
- It spreads all over the water bodies like ponds, lakes and reservoirs.
- It depletes the dissolved oxygen and causes death of other aquatic organisms

**3. Describe different methods of vegetative reproduction in leaf.**

- In some plants adventitious buds are developed on their leaves.
- They are detached from the parent plant they grow into new individual plants.

Examples: *Bryophyllum*, *Scilla*, and *Begonia*.

**4. Bring out the advantages of natural vegetative reproduction**

- Only one parent is required for propagation.
- The new individual plants produced are genetically identical.
- In some plants, this enables to spread rapidly. Example: *Spinifex*
- Horticulturists and farmers utilize this for cultivation and to harvest plants in large scale.

**5. Explain cutting type of Conventional methods propagation. Give examples**

- Producing a new plant by cutting the plant parts. (root, stem and leaf)
- The cut part is placed in a suitable medium for growth.
- It produces root and grows into a new plant.
- Examples:  
1. Root cutting (*Malus*), 2. Stem cutting (*Hibiscus*, *Bougainvillea* and *Moringa*) and 3. Leaf cutting (*Begonia*, *Bryophyllum*)

**6. What is Grafting ? give examples. Write their types?.**

- The parts of two different plants are joined and they continue to grow as one plant.
- The plant which is in contact with the soil is called **stock**
- The plant used for grafting is called **scion**.
- Example: Citrus, Mango and Apple.

They are

i) bud grafting, ii) approach grafting, iii) tongue grafting, iv) crown grafting and v) wedge grafting.

**7. Define conventional methods of propagation.**

- Artificial propagation methods are used by man for a long time are called conventional methods.
- The common methods are cutting, grafting and layering

**8. "Conventional methods of propagation has some disadvantages". Discuss**

- Use of virus infected plants as parents produces viral infected new plants.
- Vegetative structures used for propagation are bulky and so they are difficult to handle and store.

**9. What is totipotency ? in which field this is utilized ?**

- The genetic ability of a plant cell to produce the entire plant under suitable conditions is said to be **totipotency**.
- This is utilized in horticulture, forestry and industries to propagate plants.

**10. Name the three events in sexual reproduction of higher plants?**

Three events in sexual reproduction of higher plants are

1. Pre-fertilization,
2. Fertilization and
3. Post fertilization changes.

**11. Tapetum is dual in origin – Justify your answer**

- Tapetum is derived partly from the peripheral wall layer and partly from the connective tissue of the anther locule.
- Thus, the tapetum is dual in origin.

**12. Describe two types of tapetum based on its behaviour.**

- **Secretory tapetum** (parietal/glandular/cellular): The tapetum retains the original position and cellular integrity and nourishes the developing microspores.
- **Invasive tapetum** (periplasmodial): The cells lose their inner tangential and radial walls and the protoplast of all tapetal cells coalesces to form a periplasmodium.

**13. Describe the shape and size of the pollen grain**

- Shape varies from species to species.
- It may be globose, ellipsoid, fusiform, lobed, angular or crescent shaped.
- The size varies from 10 micrometers in *Myosotis* to 200 micrometers in members of the family Cucurbitaceae and Nyctaginaceae

**14. Define Palynology. Mention their importance.**

- Palynology is the study of pollen grains.

**Importance**

- It helps to identify the distribution of coal and to locate oil fields.
- Pollen grains reflect the vegetation of an area.

**15. What is cryopreservation? Write its importance.**

- Liquid nitrogen (-196°C) is used to preserve pollen in viable condition for prolonged duration.
- This technique is called **cryopreservation**.

**Importance**

- It is used to store pollen grains (pollen banks) of economically important crops for breeding programmes..

**16. Describe about pollenkit ? Write its importance.**

- Pollenkit is contributed by the tapetum.
- It is yellow or orange coloured and is chiefly made of carotenoids or flavonoids.
- It is an oily layer forming a thick viscous coating over pollen surface.

**Importance**

- It attracts insects and protects damage from UV radiation.

**17. What is integumentary tapetum ?**

- The inner layer of the integument may become specialized to perform the nutritive function for the embryo sac.
- It is called as endothelium or integumentary tapetum. Example : Asteraceae.

**18. Describe two types of ovule based on the position of the sporogenous cell.**

There are two types of ovule based on the position of the sporogenous cell

1. Tenuinucellate type    2. Crassinucellate type

**1. Tenuinucellate type**

- The sporogenous cell is hypodermal with a single layer of nucellar tissue around.
- Normally ovules have very small nucellus.

**2. crassinucellate type**

- Ovules with sub hypodermal sporogenous cell.
- Normally these ovules have fairly large nucellus.

**19. What is meant by monosporic development of an embryo sac**

- The megaspores are usually arranged in a linear tetrad.
- Usually the chalazal one is functional and other three megaspores degenerate.
- The functional megaspore forms the female gametophyte or embryo sac.
- Example: *Polygonum*. So it also called *Polygonum* type

**20. What is filiform apparatus? What is its function.**

- The special cellular thickening in synergids are called filiform apparatus.

**Function**

- It helps in the absorption, conduction of nutrients from the nucellus to embryo sac.
- It also guides the pollen tube into the egg.

**21. What is chasmogamy ? Give examples**

- The flower opens and exposes its mature anthers and stigma for pollination.
- Such flowers are called **chasmogamous**. This phenomenon is **chasmogamy**.
- Example: angiosperms

**22. a) What is Cleistogamy ? b) It can favour only for self pollination. Give reasons.**

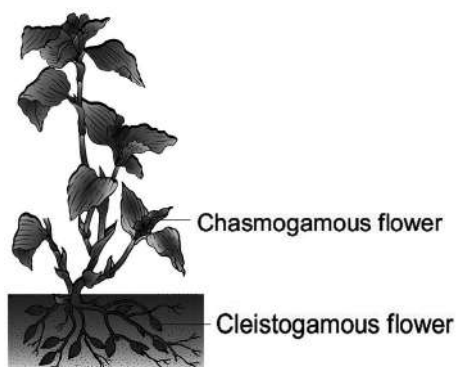
- a) The pollination occurs without opening and exposing their sex organs.

Such flowers are called **cleistogamous**. This phenomenon is **cleistogamy**.

- b) Foreign pollen will not land on the stigma of such plants. So it can favour only for self pollination

**23. Describe the different types of pollination types in *Commelina benghalensis*.**

- In *Commelina benghalensis*, are produced 1. aerial and 2. underground flowers.
- The aerial flowers are brightly coloured, chasmogamous and insect pollinated.
- The underground flowers dull and subterranean, cleistogamous and self pollinated.
- They are not depended on pollinators for pollination.



**24. What is geitonogamy ? It is functionally cross-pollination but is similar to self pollination. Justify your answer.**

- The pollen deposits on another flower of the same individual plant is called geitonogamy.
- It occurs in monoecious plants.
- It is functionally cross-pollination but is similar to self pollination, because the pollen comes from same plant.

**25. What is Self sterility/ Self- incompatibility? Why does autogamy not lead to seed formation in self sterility species. Give examples.**

- The pollen grain of a flower reaches the stigma of the same.
- It is unable to germinate on its own stigma. It is called Self sterility/ Self-Incompatibility.
- So fertilization does not takes place, as a result no seeds are produced.
- Examples: *Abutilon*, *Passiflora*.

**26. What are the abiotic and biotic agents of pollination.**

**Abiotic agents**

1. Anemophily - pollination by Wind
2. Hydrophily - pollination by Water

**Biotic agents**

3. Zoophily - pollination through animals
4. Entomophily - pollination through insects

**27. What is anemophilous flowers.? Where these plants are situated ? Give examples.**

- Pollination by wind is called anemophily. This flowers are called **anemophilous**.
- These plants are generally situated in wind exposed regions.
- Example - grasses, sugarcane, bamboo, coconut, palm, maize etc.,

**28. What is hydrophilous flowers ? Give examples.**

- Pollination by water is called hydrophily. This flowers are said to be **hydrophilous**.
- Example: *Vallisneria*, *Hydrilla*.

**29. Name some of the other interesting pollination mechanisms found in plants and give examples.**

- Trap mechanism. Ex. *Aristolochia*
- Pit fall mechanism. Ex. *Arum*
- Clip or translator mechanism. Ex. *Asclepiadaceae*
- Piston mechanism. Ex. *Papilionaceae*

**30. Write advantages of cross-pollination.**

- Produce much healthier offsprings.
- Germination capacity is much better.
- New varieties may be produced.
- The adaptability of the plants to their environment is better.

**31. Write disadvantages of cross-pollination.**

- Depend on external agencies for the pollination.
- The process is uncertain.
- Various devices have to be adopted to attract pollinating agents.

**32. What is malacophily ?**

- Pollination by slugs and snails is called malacophily.
- Some plants of Araceae are pollinated by snails.
- Water snails crawling among *Lemna* pollinate them.

**33. What is obturator ?**

- The pollen tube after travelling the whole length of the style enters into the ovary locule.
- It is guided towards the micropyle of the ovule by a structure called **obturator**

**34. Why is the process of fertilization in angiosperms termed as double fertilization ?**

- In angiosperms, one male gametes fuses with the egg to form **Zygote**.
- Second male gamete fuses with the **polar nuclei** and forms the **primary endosperm nucleus (PEN)**
- So, this phenomenon is called **double fertilization** and it is unique to angiosperms.

**35. What is triple fusion ? Mention its significance.**

- Second male gamete (n) fuses with the polar nuclei (2n) and forms the primary endosperm nucleus (3n)
- This phenomenon is called triple fusion.
- It results endosperm which forms the nutritive tissue for the embryo

**36. Define perisperm. Give examples**

- The nucellar tissue is absorbed completely by the developing embryo sac and embryo.
- The small portion may remain as storage tissue.
- Thus the remnant of nucellar tissue in the seed is called **perisperm**.
- Example: Black pepper and beet root

**37. Differentiate ex - albuminous seeds and albuminous seeds**

Endospermous or albuminous seeds	Non- endospermous or ex -albuminous seeds
• The seeds with endosperms	• The seeds without endosperms
• Endosperm persist and is used up during seed germination.	• Endosperm is completely consumed during embryo development.
• Examples: Paddy, Coconut and Castor	• Examples: Pea, Groundnut and Beans.

**38. Aleurone tissue- explain**

- It is highly specialised cells of one or few layers found around the endosperm of cereals (barley and maize)
- It contains sphaerosomes.
- During seed germination cells secrete certain hydrolytic enzymes like amylases, proteases.
- These digest reserved food material present in the endosperm cells.

**39. Write the functions of endosperm**

- It is the nutritive tissue for the developing embryo.
- Endosperm regulates the precise mode of embryo development.

**40. What is scutellum ? Mention its function.**

- In monocot seed, the embryo is small and shield-shaped cotyledon known as scutellum.
- It supplies food material for the growing embryo.

**41. What is apomixis ?**

- Reproduction does not involve union of male and female gametes is called apomixis.
- Embryos develops directly from the nucellus, synergids or egg.
- There is no need of pollination and fertilization.

**42. Which decide the incompatibility and compatibility of the pollen**

- The stigmatic fluid in wet stigma and pellicle in dry stigma decide the incompatibility and compatibility of the pollen through recognition-rejection protein reaction between the pollen and stigma surface.



**43. What is polyembryony ? Who first reported this ?**

- Presence of more than one embryo in a seed is called polyembryony.
- It first reported in oranges by Anton van Leeuwenhoek (1719)

**44. Classify four categories of polyembryony based on its origin and give examples.**

- Cleavage polyembryony** (Example: Orchids)
- Formation of embryo by cells of the Embryo sac other than egg** (Synergids – *Aristolochia*; antipodals – *Ulmus* and endosperm – *Balanophora*)
- Development of more than one Embryo sac within the same ovule.**  
(Derivatives of same MMC, derivatives of two or more MMC – *Casuarina*)
- Activation of some sporophytic cells of the ovule** (Nucellus/ integuments-*Citrus* and *Syzygium*)

**45. Write the practical applications of polyembryony.**

- The seedlings formed from the nucellar tissue in *Citrus* are found better clones for Orchards.
- Embryos derived through polyembryony are found virus free.

**46. What is parthenocarpy ? Give examples.**

- Fruit may develop from the ovary without fertilization.
- Such fruits are called **parthenocarpic fruits**. They do not have true seeds.
- Examples: Banana, Grapes and Papaya.

**47. Write the significance parthenocarpic fruits.**

- The seedless fruits have great significance in horticulture.
- The seedless fruits have great commercial importance.
- Seedless fruits are useful for the preparation of jams, jellies, sauces, fruit drinks etc.
- High proportion of edible part is available in parthenocarpic fruits due to the absence of seeds.

**48. Describe adventive embryony. Give examples**

- An Embryo arises directly from the diploid sporophytic cells either from nucellus or integument.
- It is also called **sporophytic budding** because gametophytic phase is completely absent.
- Example : *Citrus* and *Mangifera*

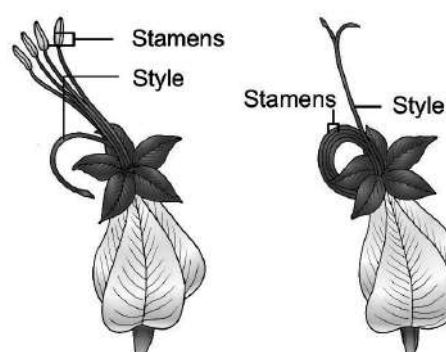
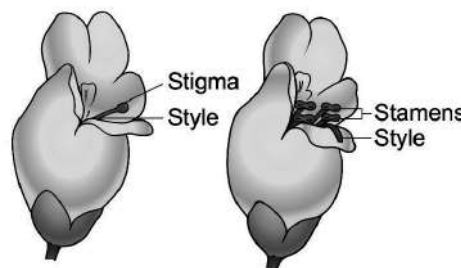
**49. Describe diplospory (Generative apospory) Give examples**

- A diploid embryo sac is formed from megaspore mother cell without a regular meiotic division
- Examples. *Eupatorium* and *Aerva*.

**50. Apospory –Explain**

- A nucellar cell becomes activated and develops into a diploid embryo sac.

This type of apospory is also called somatic apospory. Examples *Hieracium* and *Parthenium*.

**51. How dichogamy adopted to promote cross pollination explain? Give example for each.****(a) Protandry - *Clerodendrum*****(b) Protogyny - *Scrophularia*****i. Dichogamy:**

- In bisexual flowers anthers and stigmas mature at different times.
- It prevents self-pollination. It is of two types.

**a. Protandry:**

- The stamens mature earlier than the stigmas of the flowers.
- Examples: *Helianthus*, *Clerodendrum*

**b. Protogyny:**

- The stigmas mature earlier than the stamens of the flower.
- Examples: *Scrophularia nodosa* and *Aristolochia bracteata*

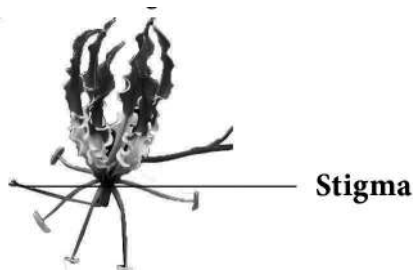


### 52. Herkogamy adopted by flowering plants to prevent self- pollination – justify your answer.

- In bisexual flowers, the stamens and stigmas, are arranged different positions.
- so self-pollination becomes impossible.

Example :

1. *Gloriosa superba*, the style is reflexed away from the stamens
2. *Hibiscus* the stigmas project far above the stamens

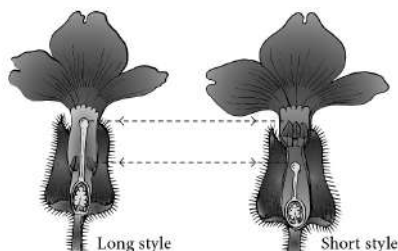


### 53. Explain any one contrivances of cross-pollination in heterostyly flowers with suitable examples.

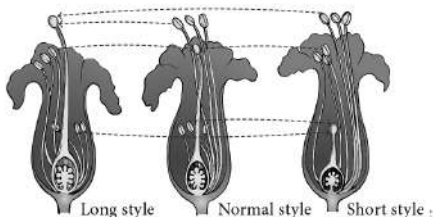
- Some plants produce two or three different forms of flowers.
- They are different in length of stamens and style.
- Pollination will take place only between organs of the same length.

#### a. Distyly:

- The plant produces two forms of flowers,
  - 1. Pin or long style, long stigmatic papillae, short stamens and small pollen grains.
  - 2. Thrum-eyed or short style, small stigmatic papillae, long stamens and large pollen grains.
- Example: *Primula*.



a) Distyly - *Primula*

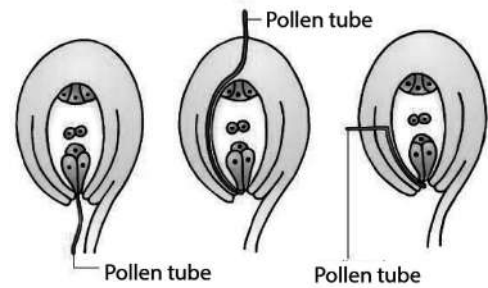


b) Tristyly - *Lythrum*

#### b. Tristyly:

- The plant produces three kinds of flowers, with respect to the length of the style and stamens.
- The pollen from flowers of one type can pollinate only the other two types but not their own type.
- Example : *Lythrum*

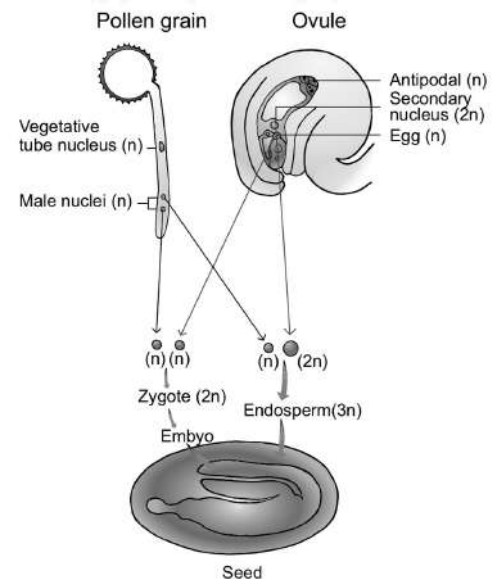
### 54. Name the following diagram. a,b and c



a) b) c)

a) Porogamy b) Chalazogamy c) Mesogamy

### 55. a) In the given representation, what does it stand for ? b) Explain this process.



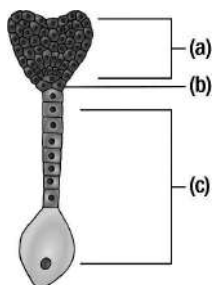
a) In given representation stand for double fertilization in Angiosperms.

b) one male gametes fuses with the egg to form **Zygote**.

Second male gamete fuses with the **polar nuclei** and forms the **primary endosperm nucleus (PEN)**.

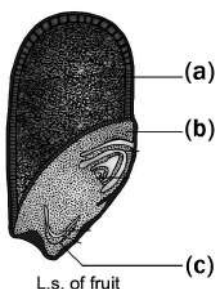
So, this phenomenon is called **double fertilization** and it is unique to angiosperms.

**56. i) Name the given structure. ii) Label the parts (a), (b) and (c)**



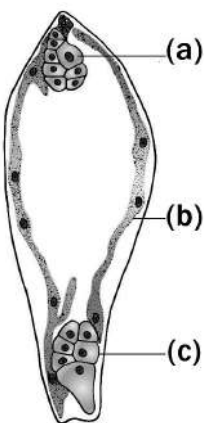
- i) The given structure is Heart shaped embryo of Dicot
- ii) a) Embryonal mass  
b) Hypophysis  
c) Suspensor

**57. i) Name the given structure. ii) Label the parts (a), (b) and (c)**



- i) The given structure is Monocot seed
- ii) a) Endosperm  
b) Scutellum  
c) Coleorhiza

**58. i) Name the given structure. ii) Label the parts (a), (b) and (c)**



- i) The given structure is Polyembryony – Embryo sac
- ii) a) Zygotic embryo  
b) Endosperm  
c) Antipodal embryo

**59. Describe pollen tablets and syrups**

- Bee pollen contains high protein, carbohydrate, trace amount of minerals and vitamins.
- It is used as dietary supplement and is sold as pollen tablets and syrups.
- It increases the performance of athletes, race horses and also heals the wounds caused by burns.

**60. Describe palynology**

- Palynology is the study of pollen grains.
- It helps to identify the distribution of coal and to locate oil fields.
- Pollen grains reflect the vegetation of an area.

**61. Describe pollen calendar**

- Pollen calendar shows the production of pollen by plants during different seasons.
- This benefits the allergic persons.
- Pollen grains cause allergic reactions like asthma, bronchitis, hay fever, allergic rhinitis etc.,

**62. Describe carrot grass**

- *Parthenium hysterophorus* L. (Family-Asteraceae) is commonly called Carrot grass.
- It is a native of tropical America.
- It was introduced into India as a contaminant along with cereal wheat.
- The pollen of this plant cause Allergy.

**63. Pollination – A composite event discuss**

- Pollination provides information about evolution, ecology, animal learning and foraging behaviour.
- Flowers not only supply nectar but also provide microclimate, site and shelter for egg laying insects.
- The association of insects benefits the flower by getting pollinated and ensures the propagation of its own progeny.

- The floral parts are well modified in shape, size to attract the pollinators to accomplish pollination.

**64. *Yucca* and moth is an example for obligate mutualism. Justify your answer**

- The relationship between *Yucca* and moth (*Tegeticula yuccasella*) is an example for obligate mutualism.
- The moth cannot survive without *Yucca* flowers and the plant fails to reproduce sexually without the moth.

**65. Define pollen / nectar robbers**

- Many visitors consume pollen and nectar from the flowers and do not help in pollination.
- They are called pollen / nectar robbers.

**66. Plant – insect interaction - Describe**

- In Bee orchid (*Ophrys*) the morphology of the flower mimics that of female wasp (*Colpa*)
- The male wasp mistakes the flowers for a female wasp and tries to copulate.
- This act of pseudocopulation helps in pollination.
- The pollination in Fig (*Ficus carica*) by the Wasp (*Blastophaga psenes*) is also an example for similar Plant – insect interaction.

**67. Describe about the seed**

- The fertilized ovule is called seed
- It possesses an embryo, endosperm and a protective coat.
- Seeds may be endospermous - wheat, maize, barley and sunflower
- Non endospermous. - Bean, Mango, Orchids and cucurbits.

**68. List the Plants propagate by any part other than seeds.**

- Bulbils – *Fritillaria imperialis*;
- Bulbs – *Allium*;
- Runner – *Mentha arvensis*;
- Sucker - *Chrysanthemum*

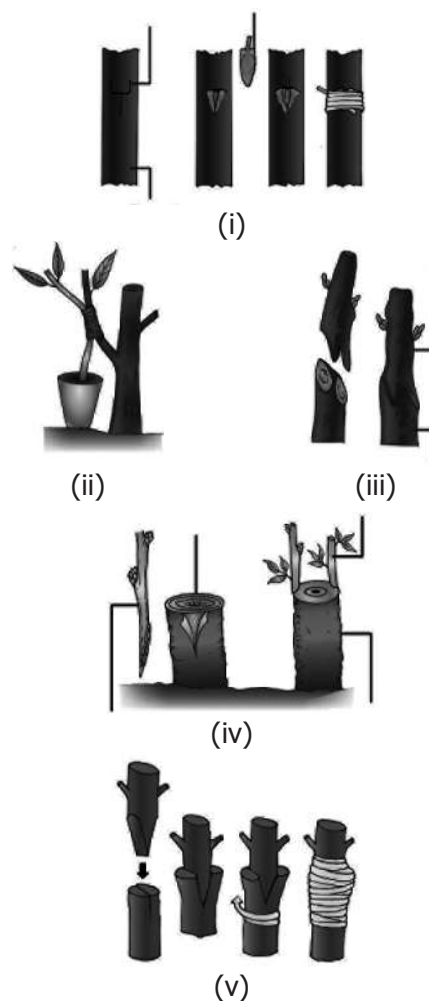
## PART – D

### ADDITIONAL QUESTIONS (5 MARKS)

**1. Tabulate the different methods of Vegetative reproduction in stem.**

Vegetative reproduction in stem	examples
rhizome	<i>Musa paradisiaca</i> , <i>Zingiber officinale</i> and <i>Curcuma longa</i>
corm	<i>Amorphophallus</i> and <i>Colocasia</i>
tuber	<i>Solanum tuberosum</i>
bulb	<i>Allium cepa</i> and <i>Lilium</i>
runner	<i>Centella asiatica</i>
bulbils	<i>Mentha</i> , and <i>Fragaria</i>
offset	<i>Pistia</i> , and <i>Eichhornia</i>
sucker	<i>Chrysanthemum</i>
stolon	<i>Dioscorea</i> and <i>Agave</i> .

**2. Observe carefully the given grafting diagrams. Find this and explain.**

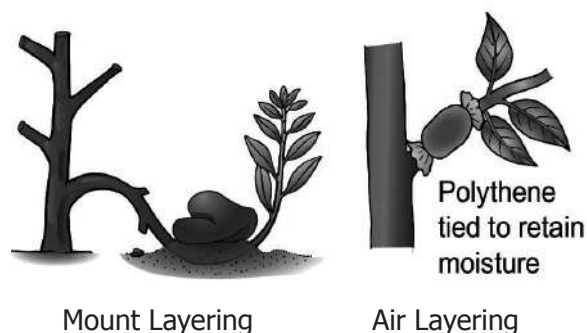


- i) The given grafting diagram (i) is Bud grafting
  - A T-shaped incision is made in the stock and the bark is lifted.
  - The scion bud with little wood is placed in the incision beneath the bark
  - It is properly bandaged with a tape.
- ii) The given grafting diagram (ii) is Approach grafting:
  - Both the scion and stock remain rooted.
  - The stock is grown in a pot and it is brought close to the scion.
  - Both of them should have the same thickness.
  - A small slice is cut from both
  - The cut surfaces are brought near and tied together and held by a tape.
  - After 1-4 weeks the tip of the stock and base of the scion are cut off and detached.
  - This grown in a separate pot.
- iii) The given grafting diagram (iii) is Tongue grafting
  - A scion and stock having the same thickness is cut obliquely
  - The scion is fit into the stock and bound with a tape.
- iv) The given grafting diagram (iv) is Crown grafting.
  - The stock is large in size scions are cut into wedge shape
  - This is inserted on the slits or clefts of the stock and fixed in position using graft wax.
- v) The given grafting diagram (v) is Wedge grafting
  - a slit is made in the stock or the bark is cut.
  - A twig of scion is inserted and tightly bound so that the cambium of the two is joined.

### 3. What is Layering ? Give examples and explain different types of Layering using the diagrams

- The stem of a parent plant is allowed to develop roots while still intact.
- When root develops, the rooted part is cut and planted to grow as a new plant.
- Examples: *Ixora* and *Jasminum*.

Mound layering and Air layering are two types of layering



#### i. Mound layering:

- This method is applied for the plants having flexible branches.
- The lower branch with leaves is bent to the ground
- The part of the stem is buried in the soil and tip of the branch is exposed above the soil.
- After the roots emerge from the part of the stem buried in the soil,
- a cut is made in parent plant so that the buried part grow into a new plant.

#### ii. Air layering

- The stem is girdled at nodal region
- Hormones are applied to girdled region to promotes rooting.
- This portion is covered with damp or moist soil using a polythene sheet.
- Roots emerge in these branches after 2-4 months.
- Such branches are removed from the parent plant and grown in a separate pot or ground.

### 4. Enumerate the advantages of conventional methods of propagation

- Produce genetically uniform plants.
- Plants are produced quickly.
- Plants can be produced in a short period.
- More economic propagation. Example: *Solanum tuberosum*.
- Produce desirable characters such as disease resistant and high yield plants.
- Grown a new plant with the same desirable characters.

**5. List out the Advantages of modern methods of propagation**

- Plants with desired characteristics can be multiplied rapidly in a short duration.
- Plants produced are genetically identical.
- Tissue culture can be carried out in any season to produce plants.
- Plants with non-viable seeds and seeds are difficult to germinate can be propagated by tissue culture.
- Rare and endangered plants can be propagated.
- Disease free plants can be produced by meristem culture.
- Cells can be genetically modified and transformed using tissue culture.

**6. Write the disadvantages of modern methods of propagation**

- It is labour intensive and requires skilled workers.
- Sterile condition must be maintained which adds to the cost.
- The clones are genetically identical, the entire crop is susceptible to new diseases.
- Changes in environmental conditions will wipe out the species.
- Sometimes, callus undergoes genetical changes which are undesirable for commercial use.

**7. How is a flower viewed in various aspects ?**

- Multidimensional perspectives from time immemorial.
- It is an inspirational tool for the poets.
- It is a decorative material for all the celebrations.
- In Tamil literature the five lands are denoted by different flowers.
- The flags of some countries are embedded with flowers.
- Flowers are used in the preparation of perfumes.
- For a Morphologist, a flower is a highly condensed shoot meant for reproduction.

**8. Give reason for each of the following.**

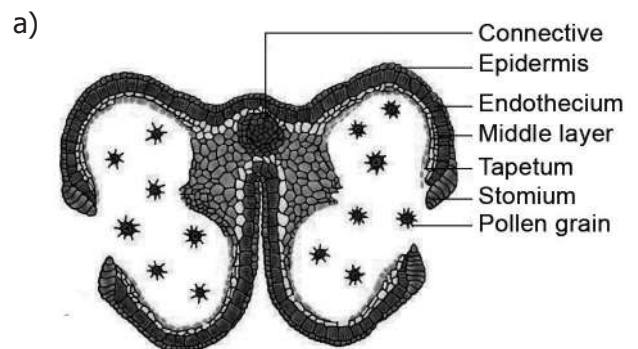
**a) Anthers of angiosperm flowers are described as dithecous.**

**b) pollen grains are well preserved as fossils.**

- a) • Anthers of angiosperm flowers are bilobed, each lobe having 2 theca (dithecous)
- A typical anther is tetrasporangiate.
- b) • Sporopollenin is present in the exine of pollen grains.

- It is resistant to physical and biological decomposition.
- It helps to withstand high temperature and is resistant to strong acid, alkali and enzyme action.
- It preserves the pollen for long periods in fossil deposits,

**9. a) Draw a labelled diagram of the T.S. of Mature anther. b) Mention the different anther wall layers. c) Describe the wall layers and write their role.**



b) The mature anther wall consists of the following layers i) Epidermis ii) Endothecium ii) Middle layers iv) Tapetum.

**c) i) Epidermis:**

- It is single layered and protective in function.
- The cells undergo repeated anticlinal divisions to cope up with the rapidly enlarging internal tissues.

**ii) Endothecium:**

- It is found below the epidermis.
- It is generally a single layer of radially elongated cells
- The inner tangential wall develops bands of a cellulose (sometimes also slightly lignified)
- The hygroscopic nature of endothecium helps in the dehiscence of anther at maturity.

**iii) Middle layers:**

- Two to three layers of cells next to endothecium constitute middle layers.
- They are generally ephemeral. They disintegrate or get crushed during maturity.

**iv) Tapetum:**

- It is the innermost layer of anther wall.
- It attains maximum development at the tetrad stage of microsporogenesis.
- It nourishes the developing sporogenous tissue, microspore mother cells and microspores.



### 10. Mention the functions of Tapetum.

- It supplies nutrition to the developing microspores.
- It contributes sporopollenin through **ubisch bodies**.
- The pollenkit material is contributed by tapetal cells.
- Exine proteins responsible for '**rejection reaction**' are derived from tapetal cells.
- Tapetum also controls the fertility or sterility of the microspores or pollen grains.

### 11. Describe microspores and pollen grains

- Microspores are the immediate product of meiosis of the microspore mother cell.
- The pollen grain is derived from the microspore.
- The microspores have protoplast surrounded by a wall.
- The protoplast consists of dense cytoplasm with a nucleus.
- The wall is differentiated into inner **intine** and outer called **exine**.
- Intine is thin, uniform.
- It is made up of pectin, hemicellulose, cellulose and callose with proteins.
- Exine is thick and is made up of cellulose, sporopollenin and pollenkit.
- The exine is not uniform and is thin at certain areas called germ pores.
- The surface of the exine is either smooth or sculptured in various patterns
- The sculpturing pattern is used in the plant identification and classification.
- The sporopollenin is generally absent in germ pores.

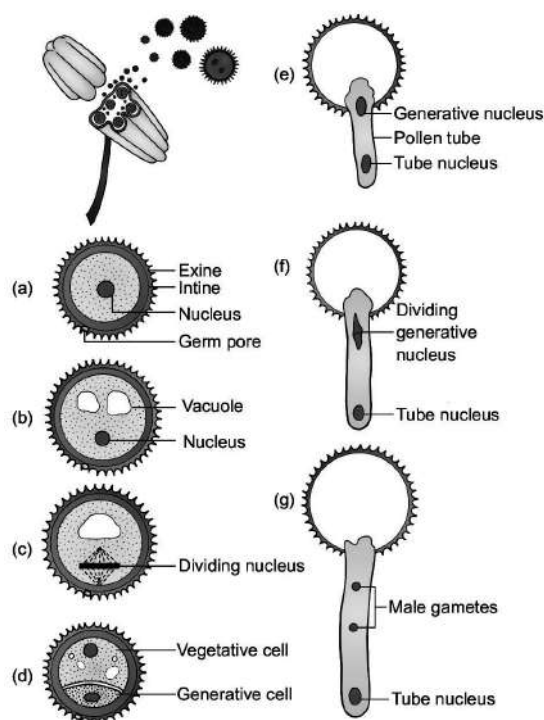
### 12. Where is sporopollenin ? State its significance.

- Sporopollenin is present in the exine of pollen grains.
- It contributed by both pollen cytoplasm and tapetum.
- It is derived from carotenoids.
- It is resistant to physical and biological decomposition.
- It helps to withstand high temperature and is resistant to strong acid, alkali and enzyme action.
- It preserves the pollen for long periods in fossil deposits,

- It also protects pollen during its journey from anther to stigma.

### 13. Write events of development of Male gametophyte.

- The microspore is the first cell of the male gametophyte and is haploid.
- The development is takes place in the microsporangium.
- The microspore nucleus divides to form a **vegetative** and a **generative nucleus**.
- A **large** irregular nucleus is **vegetative cell**
- A **smaller** cell is generative cell.
- At this 2 celled stage, the pollens are liberated from the anther.
- The pollen on reaching the stigma absorbs moisture and swells.
- The intine grows as pollen tube through the germ pore.
- The generative cell divides in the pollen into **2 male cells** (sperms) after reaching the stigma



### 14. Explain types of ovules with illustrations.

The ovules are many types.They are

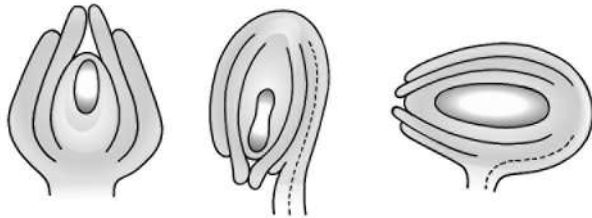
#### Orthotropous:

- The micropyle is at the distal end.
- The micropyle, the funicle and the chalaza lie in one straight vertical line.
- Examples: Piperaceae, Polygonaceae.

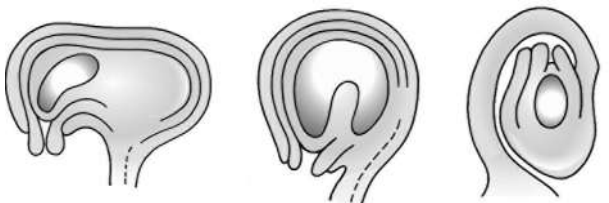


**Anatropous:**

- The body of the ovule completely inverted.
- The micropyle and funiculus come to lie very close to each other.
- Examples: dicots and monocots.



(a) Orthotropous (b) Anatropous (c) Hemianatropous



d) Campylotropous (e) Amphitropous (f) Circinotropous

**Hemianatropous:**

- The body of the ovule is placed transversely and at right angles to the funicle.
- Example: Primulaceae.

**Campylotropous:**

- The body of the ovule at the micropylar end is curved and more or less bean shaped.
- The embryo sac is slightly curved.
- Hilum, micropyle and chalaza are adjacent to one another.
- Example: Leguminosae

**Amphitropous:**

- The distance between hilum and chalaza is less.
- The curvature of the ovule leads to horse-shoe shaped nucellus.
- Example: some Alismataceae.

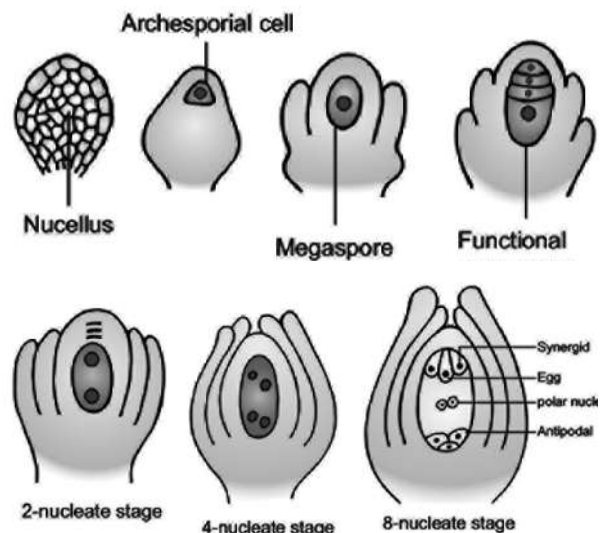
**Circinotropous:**

- Funiculus is very long and surrounds the ovule.
- Example: Cactaceae

**15. Describe megasporogenesis.**

- The process of development of a megaspore from a megaspore mother cell is called **megasporogenesis**.
- A single hypodermal cell in the nucellus enlarged and functions as **archesporium**.

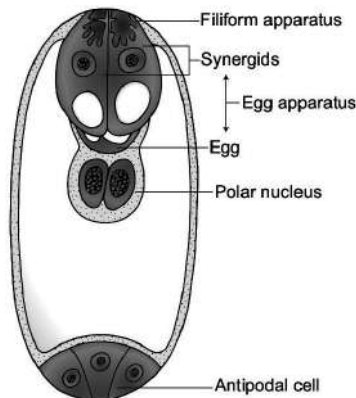
- In some plants, the archesporial cell may directly function as megaspore mother cell.
- In others, it divides transversely form outer primary parietal cell and inner primary sporogenous cell.
- The parietal cell may remain undivided or divide to embed the primary sporogenous cell deep into the nucellus.
- The primary sporogenous cell functions as a megaspore mother cell.
- The megaspore mother cell divides meiotically to form **four** haploid megaspores.

**16. Trac the development of megaspore mother cell up to the formation of a mature monosporic embryo sac.**

- The megaspore elongates along micropylar-chalazal axis.
- The nucleus undergoes a mitotic division without wall formation.
- A large central vacuole now appears between the two daughter nuclei.
- The vacuole expands and pushes the nuclei towards the opposite poles of the embryo sac.
- Both the nuclei divide twice mitotically, forming four nuclei at each pole.
- At this stage all the **eight nuclei** are present in a common cytoplasm (free nuclear division)
- This is followed by cellular organization of the embryo sac.
- Of four nuclei, three nuclei of the **micropylar end** form an egg apparatus and the fourth one is left free is called upper polar nucleus.
- Three nuclei of the **chalazal end** form three antipodal cells and fourth one functions as the lower polar nucleus.

- Based on the plant the **2 polar nuclei** may remain free or may fuse to form a secondary nucleus (central cell)
- The **egg apparatus** is made up of a central **egg cell** and **two synergids**.
- Thus, a 7 celled with 8 nucleated embryo sac is formed.

**17. Draw a neat labelled diagram of the 7 celled, 8 nucleated embryo sac.**



**18. Explain any three adaptations by which autogamy (self pollination) is promoted in flowering plants.**

- Cleistogamy:** In cleistogamy (Greek Kleisto = closed. Gamos = marriage)
  - The flowers never open and expose the reproductive organs ∴
  - The pollination is carried out within the closed flower.
  - Example : *Commelina*, *Viola*, *Oxalis*
- Homogamy:**
  - The stamens and stigma of a flower mature at the same time are called homogamy.
  - It favours self-pollination.
  - Example: *Mirabilis jalapa*, *Catharanthus roseus*
- Incomplete dichogamy:**
  - The stamen and stigma of a flower mature at different time called dichogamous.
  - Sometimes, the time of maturation of these essential organs overlap.
  - so It favours self-pollination.

**19. Explain the strategies adopted by flowering plants to promote cross pollination with examples.(or) Explain the contrivances of cross-pollination (or) Mention the strategies adopted by flowering plants to prevent self-pollination.**

- The flowers of the plants have also several mechanisms that promote cross-pollination.

- They are also called **contrivances of cross-pollination or outbreeding** devices.

**1. Dicliny or Unisexuality**

- The flowers are unisexual only cross-pollination is possible. There are two types.

**i. Monoecious:**

- Male and female flowers on the same plant. Coconut, Bitter gourd.
- In plants like castor and maize, autogamy is prevented but geitonogamy takes place.

**ii. Dioecious :**

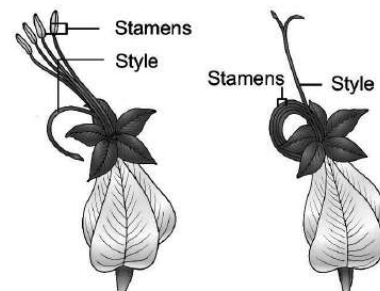
- Male and female flowers on different plants. *Borassus*, *Carica papaya* and date palm.
- In Dioecious both autogamy and geitonogamy are prevented.

**2. Monocliny or Bisexuality**

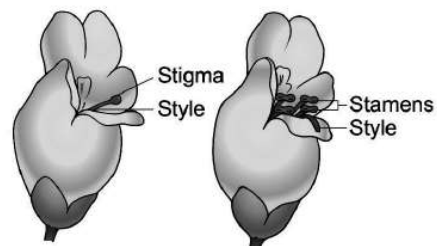
- The flowers are bisexual and the special adaptation of the flowers prevents self-pollination.

**i. Dichogamy:**

- In bisexual flowers anthers and stigmas mature at different times.
- It prevents self-pollination. It is of two types.



**(a) Protandry - *Clerodendrum***



**(b) Protogyny - *Scrophularia***

**a. Protandry:**

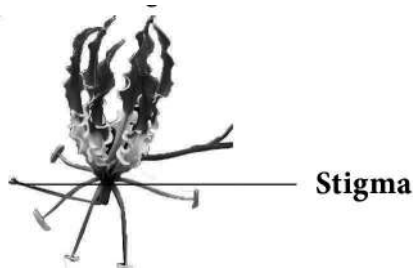
- The stamens mature earlier than the stigmas of the flowers.
- Examples: *Helianthus*, *Clerodendrum*

**b. Protogyny:**

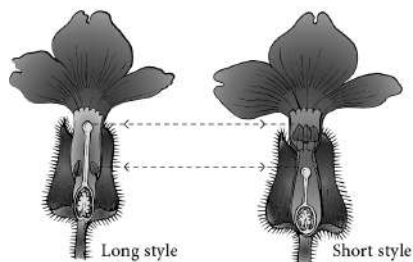
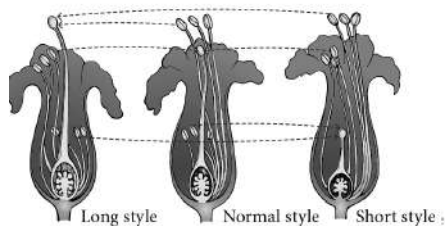
- The stigmas mature earlier than the stamens of the flower.
- Examples: *Scrophularia nodosa* and *Aristolochia bracteata*)

**ii. Herkogamy:**

- In bisexual flowers, the stamens and stigmas, are arranged different positions.
- so self-pollination becomes impossible.
- example :
  1. *Gloriosa superba*, the style is reflexed away from the stamens
  2. *Hibiscus* the stigmas project far above the stamens

**iii. Heterostyly:**

- Some plants produce two or three different forms of flowers.
- They are different in length of stamens and style.
- Pollination will take place only between organs of the same length.

**a) Distyly - Primula****b) Tristyly - Lythrum****a. Distyly:**

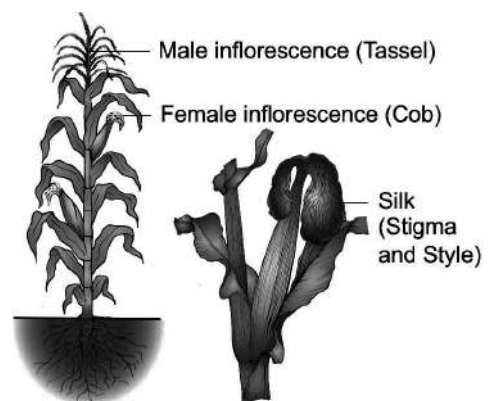
- The plant produces two forms of flowers,
- 1. Pin or long style, long stigmatic papillae, short stamens and small pollen grains.
- 2. Thrum-eyed or short style, small stigmatic papillae, long stamens and large pollen grains. Example: *Primula*.

**b. Tristyly:**

- The plant produces three kinds of flowers, with respect to the length of the style and stamens.
- The pollen from flowers of one type can pollinate only the other two types but not their own type.
- Example : *Lythrum*

**20. Write the characters of anemophilous plants**

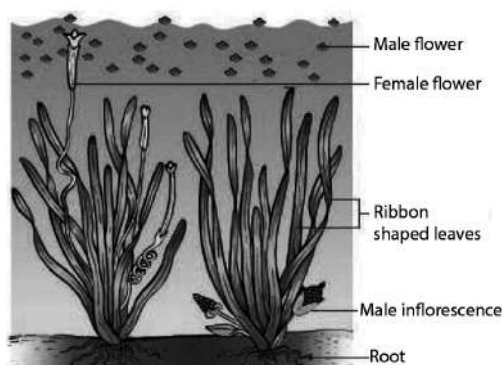
- The perianth is absent or highly reduced.
- The flowers are small, inconspicuous, colourless, not scented, do not secrete nectar.
- The stamens are numerous, filaments are long, exerted and versatile.
- Anthers produce minute, light and dry enormous quantities of pollen grains. so they carried to long distances
- Anthers burst violently and release the pollen into the air. Example: *Urtica*.
- Stigmas are large, protruding, sometimes branched and feathery, adapted to catch the pollen grains.

**21. Explain pollination in Maize (Zea mays):**

- The maize is monoecious and unisexual.
- The male inflorescence (tassel) is borne terminally and female inflorescence (cob) laterally at lower levels.
- Maize pollens are large and heavy and cannot be carried by light breeze.
- Mild wind shakes the male inflorescence to release the pollen which falls vertically below.

- The female inflorescence has long stigma(silk), which projects beyond leaves.
- The pollens drop from the tassel is caught by the stigma
- The female inflorescence of *Zea mays* has long stigma measuring upto 23 cm in length

## 22. Explain pollination in *Vallisneria spiralis*



- It is a dioecious, submerged and rooted hydrophyte.
- The female plant bears solitary flowers.
- They rise to the surface of water level using a long coiled stalk at the time of pollination.
- A small cup shaped depression is formed around the female flower on the surface of the water.
- The male plant produces male flowers which get detached and float on the surface of the water.
- Male flower comes in closer to a female flower, it gets settled in the depression
- Male flower contacts with the stigma thus bringing out pollination.
- Later the stalk of the female flower coils and brings back the flower from surface to under water where fruits are produced.

## 23. Characters ornithophilous flowers:

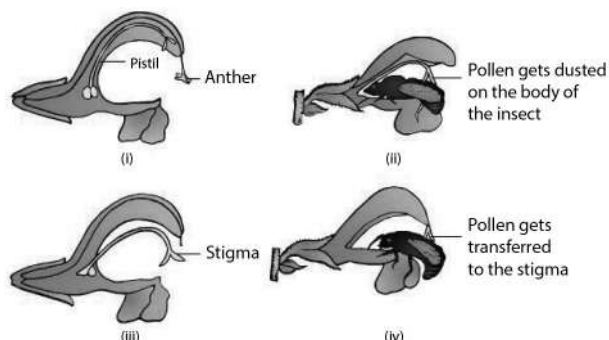
- The flowers are usually large in size.
- The flowers are tubular, cup shaped or urn-shaped.
- To attract the birds the flowers are brightly coloured., (red, scarlet, pink, orange, blue and yellow )
- The flowers are scentless and produce nectar in large quantities.
- Pollen and nectar form the floral rewards for the birds visiting the flowers.
- The floral parts are tough and leathery to withstand the powerful impact of the visitors.

## 24. Consolidate the characters of entomophilous flowers:

- Flowers are large or if small they are aggregated in dense inflorescence. Eg: Asteraceae flowers.
- Flowers are brightly coloured to attract insects. example : Poinsettia and Bougainvillea
- Flowers are scented and produce nectar.
- Pollen and nectar are the floral rewards for the visitors.
- Flowers pollinated by flies and beetles produce foul odour to attract pollinators.
- In some flowers juicy cells are present which are pierced and the contents are sucked by the insects.

## 25. Explain pollination in *Salvia* (Lever mechanism):

- This flower is adapted for Bee pollination.
- The flower is protandrous and the corolla is bilabiate with 2 stamens.
- A lever mechanism helps in pollination.



- Each anther has an upper fertile lobe and lower sterile lobe.
- This is separated by a long connective which helps the anthers to swing freely.
- When a bee visits a flower, it sits on the lower lip which acts as a platform.
- It enters the flower to suck the nectar by pushing its head into the corolla.
- During the entry of the bee into the flower the body strikes against the sterile end of the connective.
- This makes the fertile part of the stamen to descend and strike at the back of the bee.
- The pollen gets deposited on the back of the bee.
- Bees visit another flower, the pollen gets rubbed against the stigma.
- It completes the act of pollination in *Salvia*.



**26. Write advantages of self-pollination.**

- Pollination is almost certain in bisexual flowers.
- When the members of the species are uncommon.
- They are separated by large distances, the plant has to depend on self-pollination.
- All the chances of cross-pollination fails, self-pollination will take place.
- Self pollination prevents the extinction of the species.

**27. Enumerate the significance of Pollination.**

- Pollination is a pre-requisite for the process of fertilisation.
- Fertilisation helps in the formation of fruits and seeds.
- It brings the male and female gametes closer for the process of fertilisation.
- It introduces variations in plants due to the mixing up of different genes.
- These variations help the plants to adapt to the environment and results in speciation.

**28. List the events of fertilization**

The stages involved in double fertilization are:-

- Germination of pollen to form pollen tube in the stigma;
- Growth of pollen tube in the style;
- Direction of pollen tube towards the micropyle of the ovule;
- Entry of the pollen tube into one of the synergids of the embryo sac,
- Discharge of male gametes; syngamy and triple fusion.

**29. Explain different types of style**

There are three types of style

- Hollow or open style
- solid style or closed style
- semi-solid or half closed style.

**Hollow style (Open style):**

- It is common among monocots.
- A hollow canal lined by a single layer of glandular canal cells (Transmitting tissue)
- They secrete mucilaginous substances which serve as nutrition for growing pollen tubes.
- It also controlling incompatibility reaction between the style and pollen tube.

- The secretions contain carbohydrates, lipids and some enzymes like esterases, acid phosphatases as well as compatibility controlling proteins.

**Solid style (Closed type):**

- It is common among dicots.
- Presence of central core of elongated, highly specialised cells called transmitting tissue.
- The pollen tube grows through the intercellular spaces of the transmitting tissue.

**Semi-solid style (half closed type):**

- This is intermediate between solid and open type.
- There is a difference of opinion on the nature of transmitting tissue.
- Some authors consider that it is found only in solid styles while others consider the lining cells of hollow style also has transmitting tissue.

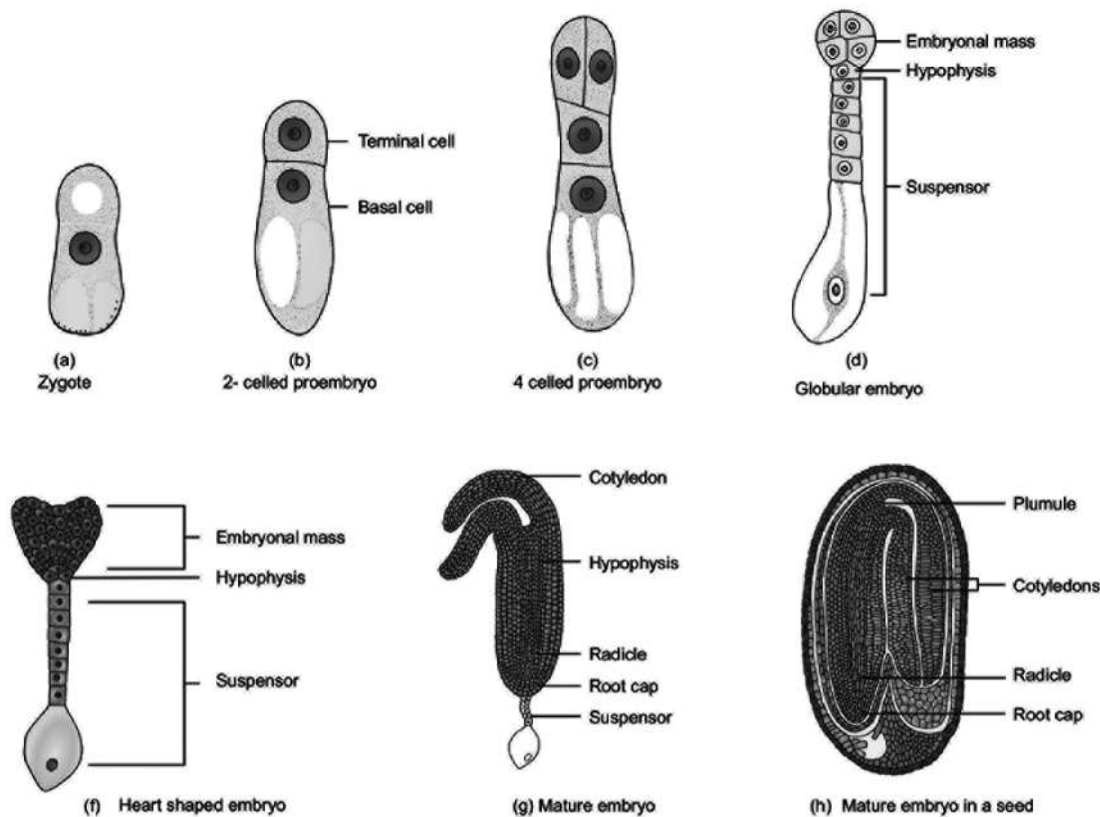
**30. Post Fertilization structure and events**

Parts before fertilization	Transformation after fertilization
Sepals, petals, stamens, style and stigma	Usually wither and fall off
Ovary	Fruit
Ovule	Seed
Egg	Zygote
Funicle	Stalk of the seed
Micropyle (ovule)	Micropyle of the seed (facilitates O <sub>2</sub> and water uptake)
Nucellus	Perisperm
Outer integument of ovule	Testa (outer seed coat)
Inner integument	Tegmen (inner seed coat)
Synergid cells	Degenerate
Secondary nucleus	Endosperm
Antipodal cells	Degenerate

**31. Development of dicot embryo (*Capsella bursa-pastoris* – Onagrad or crucifer type)**

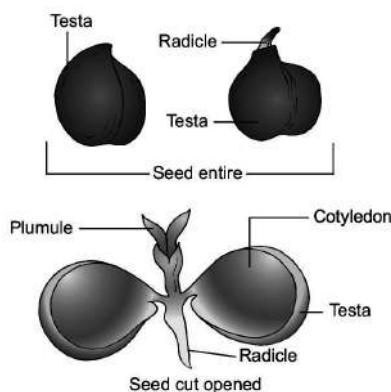
- The embryo develops at micropylar end of embryo sac.
- The zygote undergoes transverse division to form upper or terminal cell and lower or basal cell.
- Further divisions in the zygote during the development lead to the formation of embryo.
- Embryo undergoes globular, heart shaped stages before reaching a mature stage.
- The mature embryo has a **radicle**, two **cotyledons** and a **plumule**.





### 32. Structure of a *Cicer* seed (Dicot seed )

- The mature seeds are attached to the fruit wall by a stalk called **funiculus**.
- The funiculus disappears leaving a scar called **hilum**.
- Below the hilum a small pore called **micropyle**.
- It facilitates entry of oxygen and water into the seeds during germination.
- Each seed has a thick outer covering called seed coat it developed from integuments.
- The outer coat is called **testa** and is hard and the inner coat is thin, membranous and is called **tegmen**.
- Two cotyledons laterally attached to the embryonic axis are present.



- The portion of embryonal axis projecting beyond the cotyledons is called **radicle** or embryonic root.
- The other end of the axis called embryonic shoot is the **plumule**.
- An embryonal axis above the level of cotyledon is called **epicotyl**.
- The cylindrical region between the level of cotyledon is called **hypocotyl**.
- The epicotyl terminates in plumule whereas the hypocotyl ends in radicle.

### 33. Structure of *Oryza* seed (Monocot seed)

The seed of paddy is one seeded and is called **Caryopsis**.

Each seed enclosed by a brownish husk which consists of **glumes** arranged in two rows.

The **seed coat** is a brownish, membranous layer closely adhered to the grain.

**Endosperm** forms the bulk of the grain and is the storage tissue.

It is separated from embryo by a definite layer called **epithelium**.

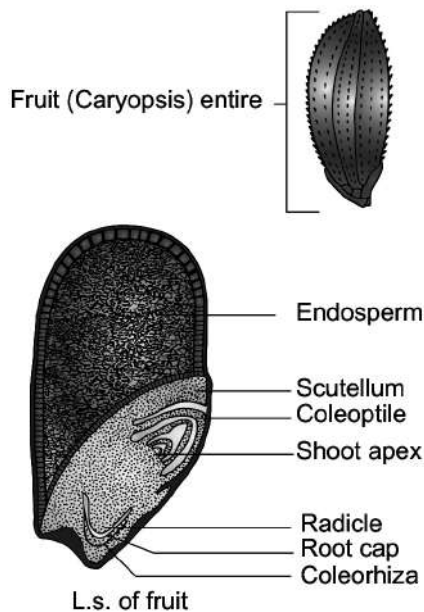
The embryo is small and shield-shaped cotyledon known as **scutellum**

It is present towards lateral side of **embryonal axis**

A short axis with plumule and radicle protected by the **root cap**.

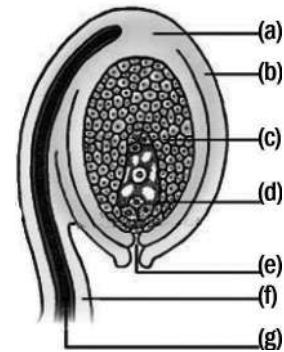
The plumule is surrounded by a protective sheath called **coleoptile**.

The radicle including root cap is also covered by a protective sheath called **coleorhiza**.



34. i) Name the given structure. ii) Label the parts a) to (g) iii) Define any three parts.

35. Draw the flow chart of pollination.



i) The given structure is an ovule (diagrammatic)

- ii) a) Chalazal end      e) Micropyle  
b) Integument      f) Funicle  
c) Nucellus      g) Vascular supply  
d) Embryo sac

- **Chalaza:** The integument and the funicle meet at the basal region of the ovule.
- **Integuments:** Ovule is protected by one or two covering.
- **Nucellus:** The body of the ovule is made up of a central mass of parenchymatous tissue.
- **Embryo sac:** The micropylar end of the nucellus contains large oval, sac-like structure.
- **Micropyle:** Integument encloses the nucellus except at the top and forms a pore.
- **Funicle:** The stalk of a mature ovule.

