SURA'S

BIO-BOTANY & BOTANY

(Short version and Long version)

12th Standard

Public Exam Edition 2021-22

Strictly as per the Reduced (Prioritised) Syllabus released on 13th August, 2021 (G.O.(Ms).No126)

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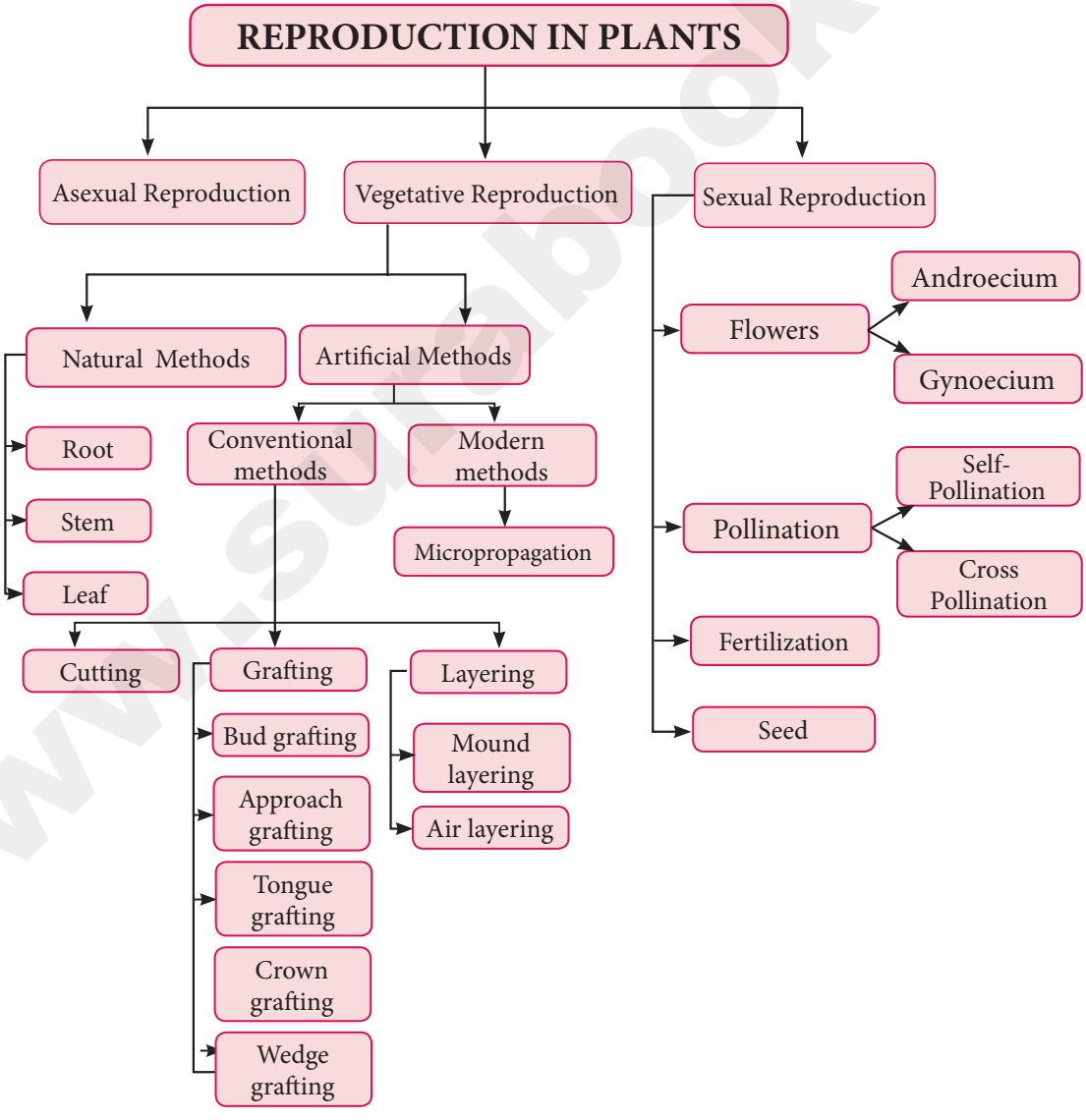
Chapter 1

Asexual and Sexual Reproduction in Plants

Concept Map



MUST KNOW DEFINITIONS

Polyembryony	:	Occurrence of more than one embryo in a seed.
Amphimixis	:	Method of reproduction which involves fertilization.
Apomixis	:	Method of reproduction which does not involve fertilization.
Endosperm	:	A triploid nutritive tissue that nourishes the developing embryo.
Microsporogenesis	:	Stages involved in formation of haploid microspores from diploid microspore mother cells.
Embryo sac	:	Oval sac-like structure found in the nucellus of the ovule and acts as female gametophyte.
Megasporogenesis	:	The process of development of a megaspore from a megaspore mother cell.
Pollination	:	Transfer of pollen from anther to stigma.
Self pollination	:	Transfer of pollen from anther to stigma of the same flower.
Cross pollination	:	Transfer of pollen from anther of a flower to the stigma of another flower on the same plant or different plant of the same species.
Double fertilization	:	One sperm fuses with the egg to form the diploid zygote and another sperm fuses with the secondary nucleus to form primary endosperm nucleus which is triploid. This is called double fertilization.
Triple fusion	:	Fusion of sperm with diploid secondary nucleus to form triploid endosperm nucleus.
Radicle	:	Embryonic root is called radicle.
Plumule	:	Embryonic shoot is called plumule.
Apospory	:	The process of embryo sac formation from diploid cells of nucellus as a result of mitosis.
Budding	:	A method of asexual reproduction where small outgrowth (Bud) from a parent cell are produced.
Callus	:	Undifferentiated mass of cells obtained through tissue culture.
Clone	:	Genetically identical individuals.
Endothecium	:	A single layer of hygroscopic, radially elongated cells found below the epidermis of anther which helps in dehiscence of anther.
Fertilization	:	The act of fusion of male and female gamete

Grafting : Conventional method of reproduction where stock and scion are joined to produce new plant.

Horticulture : Branch of plant science that deals with the art of growing fruits, vegetables, flowers and ornamental plants.

Nucellus : The diploid tissue found on the inner part of ovule next to the integuments.

Pollenkitt : A sticky covering found on the surface of the pollen that helps to attract insects.

Regeneration : Ability of organisms to replace or restore the lost parts.

Sporopollenin : Pollen wall material derived from carotenoids and is resistant to physical and biological decomposition.

Tapetum : Nutritive tissue for the developing sporogenous tissue.

Transmitting tissue : A single layer of glandular canal cells lining the inner part of style.

TERMINOLOGIES & EXAMPLES

Conidia	:	*Aspergillus* and *Penicillium*
Budding	:	*Yeast* and *Hydrilla*
Fragmentation	:	*Spirogyra*
Gemma	:	*Marchantia*
Regeneration	:	*Planaria*
Binary Fission	:	*Bacteria*
Buds in Roots	:	*Murraya, Dalbergia* and *Millingtonia*
Tuberous Roots	:	*Ipomoea batatus* and *Dahlia*
Rhizome	:	*Musa paradisiaca, Zingiber officinale* and *curcuma longa*
Corm	:	*Amorphophallus* and *Colocasia*
Tuber	:	*Solanum tuberosum*
Bulb	:	*Allium cepa* and *Lilium*
Runner	:	*Centella asiatica*

Stolon	:	*Mentha* and *Fragaria*
Offset	:	*Pistia* and *Eicchornia*
Sucker	:	*Chrysanthemum*
Bulbil	:	*Diascorea* and *Agave*
Epiphyllous Bud	:	*Bryophyllum*
Root Cutting	:	*Malus*
Stem Cutting	:	*Hibiscus, Bougainvillea* and *Moringa*
Leaf Cutting	:	*Begonia* and *Bryophyllum*
Grafting	:	Citrus, Mango, Apple
Layering	:	*Ixora* and *Jasminum*
Pollinium	:	*Calotropis*
Compound Pollen grain	:	*Drosera* and *Drymis*
Pollen-10 micrometer	:	*Myosotis*
Pollen-200 micrometer	:	Cucurbitaceae and Nyctaginaceae

Orthotropous Ovule	:	Piperaceae and Polygonaceae
Anatropous Ovule	:	Dicot and Monocot
Hemianatropous Ovule	:	Primulaceae
Campylotropous Ovule	:	Leguminosae
Amphitropous Ovule	:	Alismataceae
Circinotropous Ovule	:	Cactaceae
Monosporic megaspore	:	*Polygonum*
Bisporic Megaspore	:	*Allium*
Tetrasporic Megaspore	:	*Peperomia*
Cleistogamous flowers	:	*Commelina, Viola* and *Oxalis*
Homogamy	:	*Mirabilis jalaba, Catharanthus roseus*
Monoecious flower	:	Coconut and Bitter gourd
Dioecious flower	:	*Borassus* and *Carica papaya*
Protandry	:	*Helianthus* and *Clerodendrum*
Protogyny	:	*Scrophularia nodosa* and *Aristolochia bracteata*
Distyly	:	*Primula*
Tristyly	:	*Lythrum*
Self sterility	:	*Abutilon* and *Passiflora*
Anemophily	:	Grasses, Sugarcane, Bamboo, Coconut, Palm and Maize
Hydrophily	:	*Vallisneria* and *Hydrilla*

Epihydrophily	:	*Vallisneria spiralis* and *Elodea*
Hypohydrophily	:	*Zostera marina*, *Ceratophyllum*
Ornithophily	:	*Erythrina*, *Bombax*, *Syzygium*, *Bignonia* and *Strelitzia*
Perianth (Fleshy and Edible)	:	Jack fruit
Funiculus - fleshy structure	:	*Myristica* and *Pithecellobium*
Nuclear Endosperm	:	*Coccinia*, *Capsella* and *Arachis*
Cellular Endosperm	:	*Adoxa*, *Helianthus* and *Scoparia*
Helobial Endosperm	:	*Hydrilla* and *Vallisneria*
Ruminate Endosperm	:	Myristica
Endospermous Seed	:	Wheat, Maize, Barley and Sunflower
Non-Endospermous Seed	:	Bean, Mango, and Cucurbits.
Bulbil	:	*Fritillaria imperialis*
Adventive Embryony	:	*Citrus* and Mangifera
Diplospory	:	*Eupatorium* and *Aerva*
Apospory	:	*Hieracium* and *Parthenium*
Parthenocarpic fruits	:	Banana, Grapes and Papaya
Genetic parthenocarpy	:	*Citrus* and *cucurbita*
Environmental parthenocarpy	:	Pear

EVALUATION

1. Choose the correct statements 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) Yeast reproduce by budding]**

2. An eminent Indian embryologist is

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

[***Ans.*** **(b) P. Maheshwari]**

3. Identify the correctly matched pair

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

[***Ans.*** **(c) *Rhizome - Musa*]**

4. Pollen tube was discovered by

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

[***Ans.*** **(b) G. B. Amici]**

5. Size of pollen grain in *Myosotis*

[Govt.MQP-2019]

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

[***Ans.*** **(a) 10 micrometer]**

6. First cell of male gametophyte in angiosperm is

(a) Microspore
(b) Megapore
(c) Nucleus
(d) Primary Endosperm Nucleus

[***Ans.*** **(a) Microspore]**

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) I – iii, II – iv, III – i, IV – ii]**

8. 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) Nucellus – Nutritive tissue for developing embryo]**

9. 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) Both assertion and reason are true]**

10. Choose the correct statement(s) about tenuinucellate ovule _____.

(a) Sporogenous cell is hypodermal
(b) Ovules have fairy large nucellus
(c) Sporogenous cell is epidermal
(d) Ovules have single layer of nucellus tissue

[***Ans.*** **(a) Sporogenous cell is hypodermal & (d) Ovules have single layer of nucellus tissue]**

11. Which of the following represent megagametophyte?

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

[***Ans.*** **(b) Embryo sac]**

12. 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) 12]

13. Transmitting tissue is found in _____.
(a) Micropylar region of ovule
(b) Pollen tube wall
(c) Stylar region of gynoecium
(d) Integument
[**Ans.** (c) Stylar region of gynoecium]

14. The scar left by funiculus in the seed is
(a) tegmen (b) radicle
(c) epicotyl (d) hilum
[**Ans.** (d) hilum]

15. A plant called X possesses small flower with reduced perianth and versatile anther. The probable agent for pollination would be
(a) water (b) air *[QY-2019]*
(c) butterflies (d) beetles
[**Ans.** (b) air]

16. 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 flower.
(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) (ii) and (iv) are correct]

17. Coelorhiza is found in
(a) Paddy (b) Bean
(c) Pea (d) Tridax
[**Ans.** (a) Paddy]

18. Parthenocarpic fruits lack
(a) Endocarp (b) Epicarp
(c) Mesocarp (d) Seed
[**Ans.** (d) Seed]

19. 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) 2 celled stage]

20. What is reproduction?

Ans. *(i)* Reproduction is a vital process for the existence of a species.
(ii) It brings suitable changes through variation in the off springs for their survival on Earth.
(iii) Plant reproduction is important for all other organisms.

21. Mention the contribution of Hofmeister towards Embryology.

Ans. In the year of 1848, Hofmeister described the structure of pollen tetrad.

22. List out two sub-aerial stem modifications with example.

Ans. *(i)* Runner – *Centella asiatica*
(ii) Stolon – *Fragaria* and *Mentha*.

23. What are clones?

Ans. The individuals formed by asexual reproduction are **morphologically and genetically identical** are called clones.

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

Ans. *(i)* *Bryophyllum* can be reproduced by vegetative propagation by using piece of its stem or leaves.
(ii) The leaves of a *Bryophyllum* plant have special buds with notches called epiphyllous buds in their margins which may get detached from the leaves, fall to the ground and then grow to produce a new plant.

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

Ans. Micropropagation is one of the best method for propagating rare and endangered plant.
The regeneration of a whole plant can be done from single cell, tissue or small pieces of vegetative structures through tissue culture is called micropropagation.
It's a best method because,
(i) Plants with desired characteristics can be multiplied in a short duration.
(ii) Plants produced are genetically identical.
(iii) It can be carried out in any season.
(iv) Plants which do not produce viable seeds and seeds that are difficult to germinate can be propagated by tissue culture.
(v) Thus this method is ideal to propagate rare and endangered plants.

26. What is Cantharophily?

Ans. **The cross pollination of flowers by beetles** is called cantharophily. The beetles feed the pollen or on some of the juicy tissues of the flowers.

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

Ans. Two types of strategies adopted by bisexual flowers to prevent self-pollination.

(1) **Maturation of stamens and stigmas:**

Dichogamy: Anthers and stigmas mature at different times in bisexual flowers.

(i) **Protandry:** Stamens mature earlier than stigmas. **Examples:** *Helianthus* and *Clerodendrum*.

(ii) **Protogyny:** Stigmas mature earlier than stamens. **Examples:** *Scrophularia nodosa* and *Aristolochia bracteata*.

(2) **Arrangement of stamens and stigmas:**

Herkogamy: Essential organs like stamens and stigmas arranged in a such way that self-pollination becomes impossible.

Example: ***Gloriosa superba*:** Style is reflexed away from the stamen.

***Hibiscus*:** Stigmas far above the stamen.

28. What is endothelium?

Ans. *(i)* It is otherwise known as integumentary tapetum.

(ii) In some species, the inner layer of integument may become specialized to perform nutritive function for the **embryosac** and is called endothelium.

Example : Asteraceae.

29. 'The endosperm of angiosperm is different from gymnosperm'. Do you agree. Justify your answer. *[Govt.MQP-2019]*

Ans. Yes I agree.

	Endosperm of Angiosperm	Endosperm of Gymnosperm
1.	It is formed after fertilization.	It is formed before fertilization.
2.	It is a triploid tissue.	It is a haploid tissue.
3.	The function is to nourish the developing embryo.	It acts as the female gametophyte and later acts as nutritive tissue.

Thus the endosperm tissue is different in Angiosperms and gymnosperm.

30. Define the term Diplospory.

Ans. A diploid embryo sac is formed from megaspore mother cell without a regular meiotic division. It is a type of apomixis.

Example: *Eupatorium* and *Aerva*.

31. What is polyembryony? How it can commercially exploited?

Ans. Occurrence of **more than one embryo in a seed** is called polyembryony.

Commercial application:

(i) The nucellar tissue in *Citrus* are found better clones for Orchards.

(ii) Embryos from polyembryony are virus free.

Hint: ORCHARDS - A piece of enclosed land planted with fruit trees.

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

Ans. *(i)* Zygote requires nourishment during its development.

(ii) As mature, fertilized embryo sac offers very little nourishment to the zygote, the primary endosperm cell (PEC) divides and generates the endosperm tissue which nourishes the zygote. Hence the zygote always divides after division of Primary Endosperm Cell (PEC).

33. What is mellitophily?

Ans. *(i)* Pollination of flowers by bees is known as mellitophily.

(ii) It is a type of cross-pollination by biotic agencies like bees.

34. 'Endothecium is associated with dehiscence of anther' Justify the statement.

Ans. *(i)* **Endothecium** is a single layer of radially elongated cells below the epidermis of anther wall.

(ii) The inner tangential wall develops bands or thickenings of α cellulose.

(iii) The cells at the junction of two sporangia of an anther lobe lacks thickening and this region is called **stomium**.

(iv) Stomium along with the hygroscopic nature of endothecium helps in the dehiscence of anther at maturity.

35. List out the functions of Tapetum.

Ans. *(i)* It supplies nutrition to the developing microspores.

(ii) It contributes sporopollenin through **ubisch bodies** pollen wall formation.

(iii) The pollenkitt material is contributed by tapetal cells and is later transferred to the pollen surface.

(iv) Exine proteins responsible for **'rejection reaction'** of the stigma are present in **exine** and derived from tapetal cells.

36. Write short note on Pollen kitt. (OR) What is Pollenkit? *[HY-2019]*

Ans. *(i)* It is a oily layer forming a thick viscous coating pollen surface.

(ii) The pollenkitt material is contributed by tapetal cells and made of carotenoids or flavonoids. (Orange or Yellow).

(iii) It attracts insects and protects damage from UV radiation.

37. Distinguish Tenuinucellate and Crassinucellate ovules.

Ans.

	Tenuinucellate type	Crassinucellate type
1.	Sporogenous cell is hypodermal with a single layer of nucellar tissue around in the ovule.	Ovules with sub-hypodermal sporogenous cell
2.	Ovules have very small nucellus.	Ovules have fairly large nucellus.

Note: These two types of ovules are differentiated based on the position of the sporogenous cell.

38. Write short note on heterostyly.

Ans. It is a contrivance of cross-pollination. Some plants produce two or three different forms of flowers that are different in their length of stamens and style. Pollination will take place only between organs of the same length.

(a) **Distyly:**

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

(ii) The stigma of the Thrum-eyed flowers and the anther of the pin lie in same level to bring out pollination.

(iii) Similarly the anther of Thrum-eyed and stigma of pin ones is found in same height. This helps in effective pollination.

(b) **Tristyly:**

(i) The plant produces three kinds of flowers, with respect to the length of the style and stamens.

(ii) Here, the pollen from flowers of one type can pollinate only the other two types but not their own type. **Example** : *Lythrum*.

39. Enumerate the characteristic features of Entomophilous flowers.

Ans. *(i)* Flowers are generally large or if small, they are aggregated in dense inflorescence.
Examples: Asteraceae flowers.

(ii) Flowers are brightly coloured to attract insects.
Examples: *Poinsettia* and *Bougainvillea*.

(iii) Flowers are scented and produce nectar.

(iv) Flowers with no secretion of nectar, the pollen is consumed as food or used in building up of its hive by honey bees. Pollen and Nectar are the floral rewards for the visitors.

(v) Flowers pollinated by flies and beetles produce foul odour to attract insects.

(vi) Juicy cells are pierced and the contents are sucked by the insects.

40. Discuss the steps involved in Microsporogenesis.

Ans. Formation of haploid microspores from diploid microspore mother cell through meiosis is called **Microsporogenesis**.

(i) The primary sporogeneous cells undergo mitotic to form **sporogenous tissue**.

(ii) The last generation of sporogenous tissue functions as microspore mother cells.

(iii) Each microspore mother cell divides meiotically to form a tetrad of four haploid microspores (microspore tetrad).

(iv) Arrangement of microspore tetrad tetrahedral, decussate, linear, T shaped or isobilateral manner are 4 haploid microspore.

(v) Microspores separate from one another and remain free in the anther locule and develop into pollen grains.

(vi) In some plants, all the microspores in a microsporangium remain held together called pollinium.

Example: *Calotropis*, Compound pollen grains are found in *Drosera* and *Drymis*.

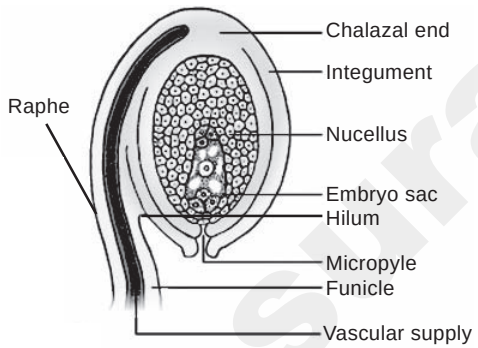
41. With a suitable diagram explain the structure of an ovule. *[Govt.MQP-2019]*

Ans. (i) Ovule is also called megasporangium.

(ii) A mature ovule consists of a stalk and a body. Stalk or **funiculus** is present at the base and attaches the ovule to the placenta.

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

(iv) In an inverted ovule, the funicle is adnate to the body of the ovule forming a ridge called **raphe**.



Structure of ovule

(v) Body of the ovule is made up of central mass of parenchymatous tissue called **nucellus**, has large reserve food materials.

(vi) Nucellus is enveloped by one or two protective coverings called **integuments**.

(vii) Integuments encloses the nucellus completely but forms a pore at the top called **micropyle**.

(viii) Ovule with one or two integuments are said to be **unitegmic** or **bitegmic** ovules.

(ix) The basal region of the body of the ovule where the nucellus, the integument and the funicle merge is called as **chalaza**.

(x) Large, oval, sac-like structure in the nucellus toward the micropylar end called **embryo sac** or **female gametophyte**.

(xi) It develops from the functional megaspore formed within the nucellus.

(xii) In some species (unitegmic tenuinucellate), the inner layer of the integument may perform the nutritive function for the embryo sac and is called as **endothelium** or **integumentary tapetum Example :** Asteraceae.

Two types of ovule based on the position of the sporogenous cell.

(a) **Tenuinucellate type:**

1. Sporogenous cell is hypodermal with a single layer of nucellar tissue around it.
2. It has very small nucellus.

(b) **Crassinucellate type:**

1. Ovules with **subhypodermal sporogenous cell**.
2. It has fairly large nucellus.

(xiii) Group of cells at the base of the ovule between the chalaza and embryo sac is called **hypostase**.

(xiv) Thick-walled cells found above the micropylar end above the embryo sac is called **epistase**.

42. What is Endosperm? Explain the types.

Ans. The primary endosperm nucleus (PEN) divides after fertilization into an endosperm. The primary endosperm nucleus is the result of triple fusion (two polar nuclei and one sperm nucleus) and thus has 3n number of chromosomes. It is a nutritive tissue and regulatory structure that nourishes the developing embryo.

Depending upon the mode of development, 3 types of endosperm are recognized in angiosperms. They are:

(1) **Nuclear endosperm:**

(i) Primary endosperm nucleus (PEN) divides into two without any wall formation.

(ii) The subsequent division of these two nuclei are free nuclear so that the endosperm consists of only free nuclei and cytoplasm around them.

(iii) The nuclei may either remain free or may become separate by walls in later stages.
Example: *Coccinia, Capsella* and *Arachis*.

(2) Cellular endosperm:

(i) Primary endosperm nucleus (PEN) divides into 2 nuclei followed by a wall formation. Further divisions are also followed by walls.
Example: *Adoxa, Helianthus* and *Scoparia*.

(3) Helobial endosperm:

(i) Primary endosperm nucleus (PEN) moves towards the base of the embryo sac and divides into two nuclei.

(ii) These 2 nuclei are separated by a wall to form a large micropylar chamber and a small chalazal chamber.

(iii) The nucleus of the micropylar chamber undergoes several free nuclear divisions whereas that of the chalazal chamber may or may not divide.
Example: *Hydrilla* and *Vallisneria*.

Endospermous and Non-endospermous seeds:

(i) Seeds without endosperms are called non-endospermous or **eg**- albuminous seeds.
Examples: Pea, Groundnut and Beans.

(ii) Seeds with endosperms are called **endospermous** or **albuminous seeds**.
Example: Paddy, Coconut and Castor.

(iii) **Ruminate endosperm:**
The endosperm with irregularity and unevenness in its surface forms ruminate endosperm.
Example: *Areca catechu*.

43. Differentiate the structure of Dicot and Monocot seed.

Ans.

	Dicot seed	Monocot seed
1.	The seed coat is distinct from the fruit coat or pericarp	The seed coat is fused with the pericarp.
2.	The seed encloses two cotyledons.	The seed encloses only a single cotyledon.
3.	The seed coat is differentiated into outer testa and inner tegmen.	The seed coat is unilayered and is inseparable from the pericarp.
4.	The seeds may or may not possess endosperm. They are known respectively as the endospermic or non-endospermic seeds.	Most of the monocot members possess endospermic seeds.
5.	The two cotyledons enclose the embryonic axis in between them.	The embryo is found in the cotyledon.
6.	In the endospermic seed, the endosperm encloses the embryo.	The endosperm is found above the embryo. The endosperm and the embryo are separated by the epithelium.
7.	The embryonic root and shoot are not covered by sheaths.	The radicle is protected by a sheath called coleorhiza and plumule is protected by coleoptile.

44. Give a detailed account on parthenocarpy. Add a note on its significance.

Ans. **Parthenocarpy:**

(i) Fruit like structures develop from the ovary without the act of fertilization. Such fruits are called **parthenocarpic fruits**.

(ii) Many commercial fruits are made seedless.
Example: Banana, Grapes and Papaya.

(iii) Nitsch in 1963, classified parthenocarpy into:

(a) Genetic parthenocarpy:
Parthenocarpy arises due to hybridization or mutation.
Example: *Citrus* and *Cucurbita*.

(b) 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.

(c) Chemically induced parthenocarpy:
Application of growth promoting substances like Auxins and Gibberellins induces parthenocarpy.

Significance:

(i) Have great significance in horticulture.
(ii) Have great commercial importance.
(iii) Used for the preparation of jams, jellies, sauces, fruit drinks etc.
(iv) High proportion of edible part is available due to the absence of seeds.

Botany Long Version Questions (for pure science Group)

Long Version Evaluation

Q.No. 1 to 10 Refer Evaluation.

11. The correct order of haploid, diploid and triploid structure is fertilized embryosac is

(a) Synergid, zygote and PEN
(b) Synergid, antipodal and polar nuclei
(c) Antipodal, synergid and PEN
(d) Synergid, polar nuclei and zygote

[***Ans.*** **(a) Synergid, zygote and PEN]**

12. Refer Evaluation Q.No. 11

13. Refer Evaluation Q.No. 12

14. Refer Evaluation Q.No. 13

15. Refer Evaluation Q.No.14

16. Refer Evaluation Q.No.15

17. Refer Evaluation Q.No. 16

18. Ruminate endosperm is found in

(a) *Cocos* (b) *Areca*
(c) *Vallisneria* (d) *Arachis*

[***Ans.*** **(b) *Areca*]**

19. Refer Evaluation Q.No.17

20. Caruncle develops from

(a) funicle (b) nucellus
(c) integument (d) embryo sac

[***Ans.*** **(c) integument]**

21. Refer Evaluation Q.No. 18

22. Refer Evaluation Q.No. 19

23. Refer Evaluation Q.No. 20

24. Refer Evaluation Q.No. 21

25. Refer Evaluation Q.No. 22

26. Refer Evaluation Q.No. 23

27. How do *Dioscorea* reproduce vegetatively?

Ans. *Dioscorea* reproduces vegetatively by means of bulbils.

28. Refer Evaluation Q.No. 24

29. Write short notes on approach grafting.

Ans. ***(i)*** Both the scion and stock remain rooted.
(ii) Stock is grown in a pot and brought close to the scion.
(iii) Both of them should have the same thickness.
(iv) A small slice is cut from both and the cut surfaces are brought near and tied together and held by a tape.
(v) After 1-4 weeks the tip of the stock and base of the scion are cut off and detached and grown in a separate pot.

Approach grafting

30. Refer Evaluation Q.No. 25

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

Ans.
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 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. Differentiate secretory and invasive tapetum.

Ans.

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

33. Refer Evaluation Q.No. 26

34. Refer Evaluation Q.No. 27

35. Refer Evaluation Q.No. 28

36. Name the cell which divides to form male nuclei.

Ans. Generative cells of Microspore.

37. Refer Evaluation Q.No. 29

38. Refer Evaluation Q.No. 30

39. Refer Evaluation Q.No. 31

40. Do you think parthenocarpy and apomixis are different process. Justify?

Ans. Yes. Parthenocarpy and apomixis are different processes.

	Parthenocarpy	Apomixis
1.	Formation of fruit from the ovary without the act of fertilization.	Method of reproduction which does not involve union of male and female gemetes.
2.	Formation of fruits without fertilization.	Formation of seeds without fertilization.
3.	Ovary becomes fruit without fertilization, thus fruits are seedless.	Megaspore mother cell does not undergo mieosis or cell from the nucellus develops into the embryo.

41. Refer Evaluation Q.No. 32

42. Refer Evaluation Q.No. 33

43. Give examples for Helobial endosperm.

Ans. *Hydrilla* and *Vallisneria*.

44. Refer Evaluation Q.No. 34

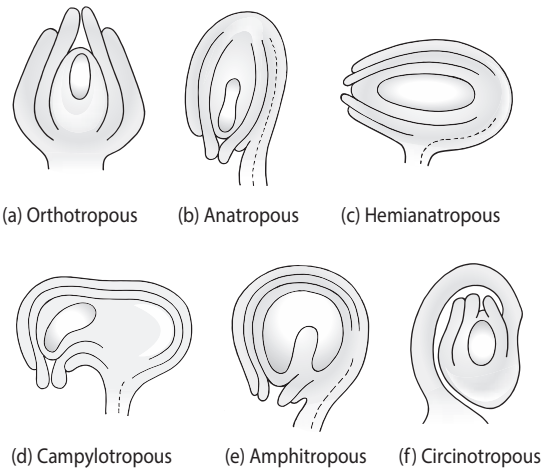
45. Refer Evaluation Q.No. 35

46. Refer Evaluation Q.No. 36

47. Give short notes on types of ovules.

Ans. **Types of Ovules:**

Ovules are classified into six main types based on the orientation, form and position of the micropyle with respect to funicle and chalaza.



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

(d) Campylotropous (e) Amphitropous (f) Circinotropous

(a) Orthotropous:

(i) Micropyle is at the distal end.

(ii) Micropyle the funicle and the chalaza lie in one straight vertical line.

Examples: Piperaceae, Polygonaceae

(b) Anatropous:

(i) Body of the ovule inverted so that the micropyle and funiculus come to lie very close to each other.

Eg: Dicots and monocots.

(c) Hemianatropous:

(i) Body is transverse.

(ii) It is right angles to the funicle.

Example: Primulaceae.

(d) Campylotropous:

(i) Body is curved at micropylar end

(ii) More or less bean shaped.

(iii) Embryo sac is slightly curved.

(iv) All the three, hilum, micropyle and chalaza are adjacent to one another, with the micropyle oriented towards the placenta.

Example: Leguminosae.

There are two more types of ovules they are:

(e) Amphitropous:

(i) The distance between hilum and chalaza is less.

(ii) The curvature of the ovule leads to horse-shoe shaped nucellus.

Example: some Alismataceae.

(f) Circinotropous: Funiculus is very long and surrounds the ovule. **Example:** Cactaceae.

48. Refer Evaluation Q.No. 37

49. Refer Evaluation Q.No. 38

50. Refer Evaluation Q.No. 39

51. Explain the pollination mechanism in *Salvia*.

Ans. **Pollination in *Salvia* (Lever mechanism):**

(i) *Salvia* is adapted for Bee pollination.

(ii) The flower is protandrous and the corolla is bilabiate with 2 stamens.

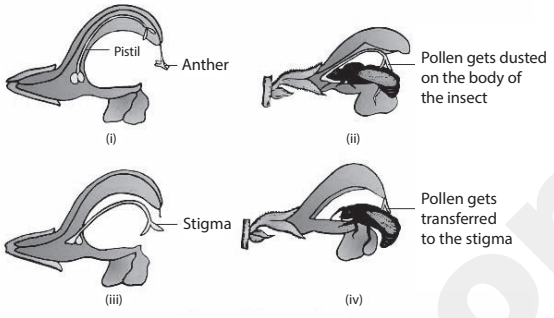
(iii) A lever mechanism helps in pollination.

(iv) Each anther has an upper fertile lobe and lower sterile lobe separated by a long connective which helps the anthers to swing freely.

(v) When a bee visits a flower, it sits on the lower lip which acts as a platform.

(vi) It enters the flower to suck the nectar by pushing its head into the corolla.

(vii) During the entry of the bee into the flower the body strikes against the sterile end of the connective.



Pollination in *Salvia* - Lever mechanism

(viii) The fertile part of the stamen to descend and strike at the back of the bee.

(ix) The pollen gets deposited on the back of the bee. When it visits another flower, the pollen gets rubbed on stigma and completes the pollination in *Salvia*.

52. Refer Evaluation Q.No. 40

53. Refer Evaluation Q.No. 41

54. Refer Evaluation Q.No. 42

55. Refer Evaluation Q.No. 43

56. Explain the development of a Dicot embryo.

Ans. **Development of Dicot embryo:**

Development of Dicot embryo (*Capsella bursa-pastoris*) is of Onagrad or crucifer type. The embryo develops at micropylar end of embryo sac.

(i) The Zygote divides into **upper or terminal cell** and **lower or basal cell**.

(ii) The basal cell divides transversely and the terminal cell divides vertically to form a 4 celled **proembryo**.

(iii) A second vertical division right angle to the first one takes place in terminal cell forming a 4 celled stage **called quadrant**.

(iv) Transverse division in the quadrant results in 8 cells arranged in 2 tiers of 4 each **called octant stage**.

(v) Upper tier of 4 cells of the octant is called **epibasal** or **anterior octant** and the lower tier of 4 cells constitute **hypobasal** or **posterior octants**.

(vi) A periclinal division in the octants results in the formation of 16 celled stage with **8 cells in the outer** and **8 in the inner**.

(vii) The outer 8 cells represent the dermatogen and undergoes anticlinal division to produce epidermis.

(viii) The inner 8 cells divide by vertical and transverse division to form outer layer of **periblem** which give rise to cortex and a central region of **pleurome** which forms stele. During the development, the 2 cells of the basal cell undergoes several transverse division to form a **6 to 10 celled** suspensor.

(ix) The embryo at this stage become globular and the suspensor helps to push the embryo deep into the endosperm.

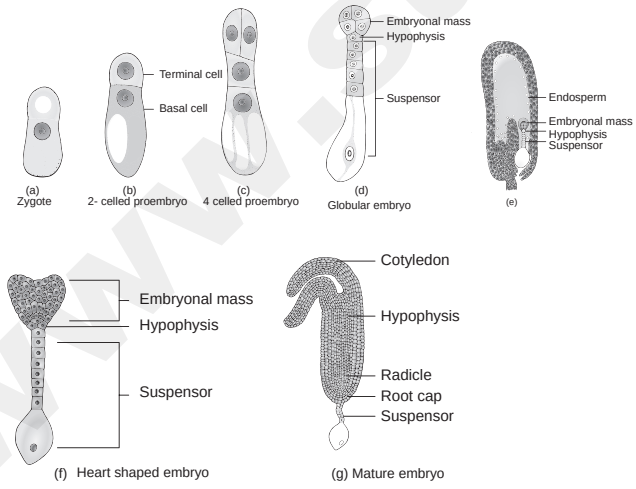
(x) The uppermost cell of the suspensor enlarge to form a haustorium. The lowermost cell of the suspensor is called hypophysis.

(xi) A transverse division and two vertical division right angle to each other of hypophysis results in the formation of 8 cells.

(xii) The eight cells are arranged in two tiers of **4 cells** each. The upper tier give rise to root cap and epidermis.

(xiii) At this stage, embryo appears heart shaped, cell divisions in the **hypocotyl** and **cotyledon** regions of the embryo results in elongation.

(xiv) Further development results in curved horse shoe shaped embryo in the embryo sac. The mature embryo has a **radicle, hypocotyl,** two **cotyledons** and a **plumule.**



Development of Dicot embryo (*Capsella bursa-pastoris*)

57. **Refer Evaluation Q.No. 44**

58. **Refer Evaluation Q.No. 45**

PTA Question & Answers

Choose the Correct Answers 1 mark

1. **Which one of the following is not an advantage of micro propagation?** *[PTA-1]*

(a) Plants produced are genetically identical

(b) Endangered plants can be propagated

(c) Sometimes undesirable genetical changes occur

(d) Disease free plants can be produced

[***Ans.*** **(c) Sometimes undesirable genetical changes occur]**

2. **Which one of the following statements is not true regarding sporopollenin?** *[PTA-2]*

(a) Sporopollenin is contributed by both pollen cytoplasm and tapetum

(b) It helps the pollen to withstand against strong acid

(c) Sporopollenin is derived from phycobilins

(d) It helps pollen during long period preservation in fossil deposits.

[***Ans.*** **(c) Sporopollenin is derived from phycobilins]**

3. **In a male gametophyte, the chromosomal number of generative nucleus is (A) and tube nucleus is (B).** *[PTA-4]*

(a) (A) – (n) (B) – (2n)

(b) (A) – (2n) (B) – (n)

(c) (A) – (2n) (B) – (2n)

(d) (A) – (n) (B) – (n)

[***Ans.*** **(d) (A) – (n) (B) – (n)]**

4. **Which one of the following is a dioecious plant?** *[PTA-5]*

(a) Coconut (b) Bitter gourd

(c) Pea plant (d) Date palm

[***Ans.*** **(d) Date palm]**

5. **Eyes of potato are referred to** *[PTA-6]*

(a) adventitious roots

(b) axillary buds

(c) terminal buds

(d) intercalary buds [***Ans.*** **(b) axillary buds]**

Very Short Answers — 2 Marks

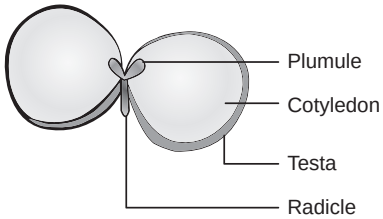
1. Differentiate bisporic megaspore development from tetrasporic development. *[PTA-1]*

Ans.

	Bisporic megaspore development	Tetrasporic development
1.	Of the four megaspores formed, two are involved in Embryo sac formation.	All the four megaspores are involved in Embryo sac formation.
2.	Example: *Allium*.	Example: *Peperomia*.

2. Draw this diagram and label the parts. *[PTA-3]*

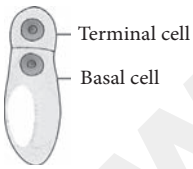
Ans.



3. Redraw the diagram and label the parts.

2 celled proembryo

Ans. *[PTA-4]*



2- celled proembryo

4. Write the practical application of activation of nucellar tissue. *[PTA-5]*

Ans. **Practical applications:**

(i) The seedlings formed from the nucellar tissue in *Citrus* are found better clones for Orchards.

(ii) Embryos are virus free.

5. Write any two difference between male gametophyte and female gametophyte. *[PTA-6]*

Ans.

	Male gametophyte	Female gametophyte
1.	Microspore produces the male gametophyte.	Megaspore prouces the female gametophyte.
2.	It produces male gametes.	It produces female gametes.

Short Answers — 3 Marks

1. Differentiate heterostyly from herkogamy.

Ans. *[PTA-2]*

Heterostyly	Herkogamy
Plants produce two or three different forms of flowers that are different in their length of stamens and style. Pollination will take place only between organs of the same length. Eg: Primula	In bisexual flowers the essential organs, the stamens and stigmas, are arranged in such a way that self-pollination becomes impossible. Eg: *Gloriosa superba*, the style is reflexed away from the stamens and in *Hibiscus* the stigmas project far above the stamens.

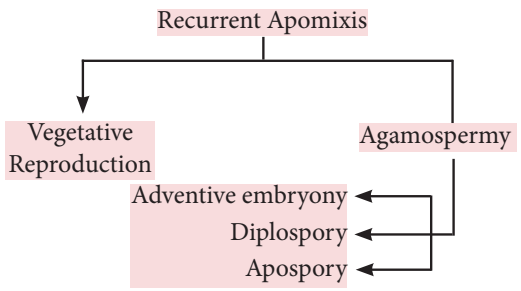
Long Answers — 5 Marks

1. A reproduction without the involvement of male and female gametes is called apomixis. Give an outline of the method. *[PTA-2]*

Ans. **Recurrent apomixis:** It includes vegetative reproduction and agamospermy

Non recurrent apomixis: Haploid embryo sac developed after meiosis, develops into a embryo without fertilization.

The outline classification of Recurrent apomixis is given below.



Vegetative reproduction: Plants propagate by any part other than seeds
Bulbils – *Fritillaria imperialis*; Bulbs – *Allium*; Runner – *Mentha arvensis*; Sucker - *Chrysanthemum.*

Agamospermy: It refers to processes by which Embryos are formed by eliminating meiosis and syngamy.

Adventive embryony:
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. Adventive embryos are found in Citrus and Mangifera

Diplospory (Generative apospory): A diploid embryo sac is formed from megaspore mother cell without a regular meiotic division Examples. Eupatorium and Aerva.

Apospory: Megaspore mother cell undergoes the normal meiosis and four megaspores formed gradually disappear. 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.

2. Enumerate the characteristic features of anemophilous plants. *[PTA-3]*

Ans. Anemophilous plants have the following characteristic features:

(i) The flowers are produced in pendulous, catkin-like or spike inflorescence.
(ii) The axis of inflorescence elongates so that the flowers are brought well above the leaves.
(iii) The perianth is absent or highly reduced.
(iv) The flowers are small, inconspicuous, colourless, not scented, do not secrete nectar.
(v) The stamens are numerous, filaments are long, exerted and versatile.
(vi) Anthers produce enormous quantities of pollen grains are minute, light and dry so that they can be carried to long distances by wind.
(vii) In some plants anthers burst violently andrelease the pollen into the air. **Example:** Urtica.
(viii) Stigmas are comparatively large, protruding, sometimes branched and feathery, adapted to catch the pollen grains. Generally single ovule is present.
(ix) Plant produces flowers before the new leaves appear, so the pollen can be carried without hindrance of leaves.

3. Describe the structure of dicot seed. *[PTA-5]*

Ans. Structure of a *Cicer* seed as an example for Dicot seed:

(i) The mature seeds are attached to the fruit wall by a stalk called funiculus.
(ii) The funiculus disappears leaving a scar called hilum. Below the hilum a small pore called micropyle is present.
(iii) It facilitates entry of oxygen and water into the seeds during germination. Each seed has a thick outer covering called seed coat.
(iv) The seed coat is developed from integuments of the ovule.
(v) The outer coat is called testa and is hard whereas the inner coat is thin, membranous and is called tegmen.
(vi) In Pea plant, the tegmen and testa are fused.
(vii) Two cotyledons laterally attached to the embryonic axis are present. It stores the food materials in pea whereas in other seeds like castor the endosperm contains reserve food and the cotyledons are thin.
(viii) 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.
(ix) Embryonal axis above the level of cotyledon is called epicotyl whereas the cylindrical region between the level of cotyledon is called hypocotyl.
(x) The epicotyl terminates in plumule whereas the hypocotyl ends in radicle.

GOVERNMENT EXAM QUESTIONS

Bio-Botany (Short version)

CHOOSE THE CORRECT ANSWERS **1 MARK**

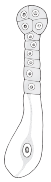
1. Match the following *[QY-2019]*

	Column-A		Column - B
i	Syngenesious	A	Pollen grain
ii	Androecium	B	Anther wall
iii	Male gametophyte	C	Asteraceae
iv	Primary Parietal Layer	D	Stamens

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

[**Ans.** (b) i-C, ii-D, iii-A, iv-B]

2. **Identify the type of embryo state** ⟶



[HY-2019]

(a) Zygote
(b) Globular embryo
(c) Mature embryo
(d) 4 celled embryo

[**Ans.** (b) Globular embryo]

Very Short Answers — 2 Marks

1. **What is the process of micropropagation?**

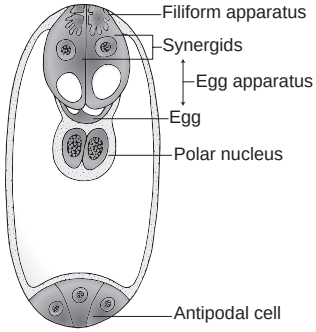
[QY-2019]

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

(ii) This is one of the modern methods used to propagate plants.

2. **Draw and label the structure of Embryo sac.**

Ans. *[HY-2019]*



Structure of Embryo sac

Short Answers — 3 Marks

1. **Draw and lable the T.S. of mature anther.**

Ans. *[QY-2019]*