Question 1:

Name the parts of an angiosperm flower in which development of male and female gametophyte take place.

Answer

The male gametophyte or the pollen grain develops inside the pollen chamber of the anther, whereas the female gametophyte (also known as the embryo sac) develops inside the nucellus of the ovule from the functional megaspore.

Question 2:

Differentiate between microsporogenesis and megasporogenesis. Which type of cell division occurs during these events? Name the structures formed at the end of these two events.

Answer

(a)

	Microsporogenesis	**Megasporogenesis**
1.	It is the process of the formation of microspore tetrads from a microspore mother cell through meiosis.	It is the process of the formation of the four megaspores from a megaspore mother cell in the region of the nucellus through meiosis
2.	It occurs inside the pollen sac of the anther.	It occurs inside the ovule.

(b) Both events (microsporogenesis and megasporogenesis) involve the process of meiosis or reduction division which results in the formation of haploid gametes from the microspore and megaspore mother cells.

(c) Microsporogenesis results in the formation of haploid microspores from a diploid microspore mother cell. On the other hand, megasporogenesis results in the formation of haploid megaspores from a diploid megaspore mother cell.

Question 3:

Arrange the following terms in the correct developmental sequence:

Pollen grain, sporogenous tissue, microspore tetrad, pollen mother cell, male gametes

Answer

The correct development sequence is as follows:

Sporogenous tissue – pollen mother cell – microspore tetrad – Pollen grain – male gamete

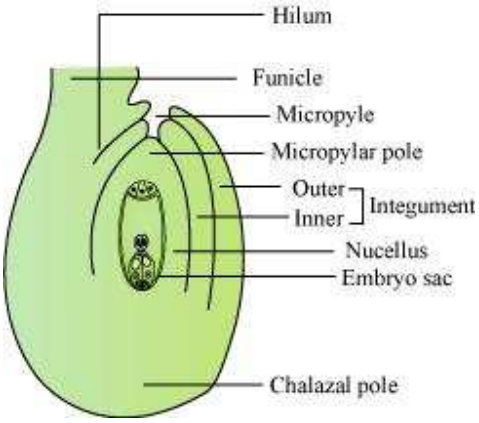
During the development of microsporangium, each cell of the sporogenous tissue acts as a pollen mother cell and gives rise to a microspore tetrad, containing four haploid microspores by the process of meiosis (microsporogenesis). As the anther matures, these microspores dissociate and develop into pollen grains. The pollen grains mature and give rise to male gametes.

Question 4:

With a neat, labelled diagram, describe the parts of a typical angiosperm ovule.

Answer

An ovule is a female megasporangium where the formation of megaspores takes place.



The various parts of an ovule are –

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(1) Funiculus – It is a stalk-like structure which represents the point of attachment of the ovule to the placenta of the ovary.

(2) Hilum – It is the point where the body of the ovule is attached to the funiculus.

(3) Integuments –They are the outer layers surrounding the ovule that provide protection to the developing embryo.

(4) Micropyle – It is a narrow pore formed by the projection of integuments. It marks the point where the pollen tube enters the ovule at the time of fertilization.

(5) Nucellus – It is a mass of the parenchymatous tissue surrounded by the integuments from the outside. The nucellus provides nutrition to the developing embryo. The embryo sac is located inside the nucellus.

(6) Chalazal – It is the based swollen part of the nucellus from where the integuments originate.

Question 5:

What is meant by monosporic development of female gametophyte?

Answer

The female gametophyte or the embryo sac develops from a single functional megaspore. This is known as monosporic development of the female gametophyte. In most flowering plants, a single megaspore mother cell present at the micropylar pole of the nucellus region of the ovule undergoes meiosis to produce four haploid megaspores. Later, out of these four megaspores, only one functional megaspore develops into the female gametophyte, while the remaining three degenerate.

Question 6:

With a neat diagram explain the 7-celled, 8-nucleate nature of the female gametophyte.

Answer

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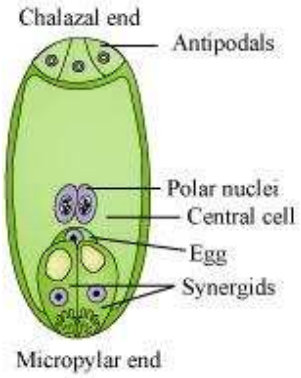

The female gametophyte (embryo sac) develops from a single functional megaspore. This megaspore undergoes three successive mitotic divisions to form eight nucleate embryo sacs.

The first mitotic division in the megaspore forms two nuclei. One nucleus moves towards the micropylar end while the other nucleus moves towards the chalazal end. Then, these nuclei divide at their respective ends and re-divide to form eight nucleate stages. As a result, there are four nuclei each at both the ends i.e., at the micropylar and the chalazal end in the embryo sac. At the micropylar end, out of the four nuclei only three differentiate into two synergids and one egg cell. Together they are known as the egg apparatus. Similarly, at the chalazal end, three out of four nuclei differentiates as antipodal cells. The remaining two cells (of the micropylar and the chalazal end) move towards the centre and are known as the polar nuclei, which are situated in a large central cell. Hence, at maturity, the female gametophyte appears as a 7-celled structure, though it has 8 nucleate.

Question 7:

What are chasmogamous flowers? Can cross-pollination occur in cleistogamous flowers? Give reasons for your answer.

Answer

There are two types of flowers present in plants namely *Oxalis* and *Viola* – chasmogamous and cleistogamous flowers. Chasmogamous flowers have exposed anthers and stigmata similar to the flowers of other species.

Cross-pollination cannot occur in cleistogamous flowers. This is because cleistogamous flowers never open at all. Also, the anther and the stigma lie close to each other in these flowers. Hence, only self-pollination is possible in these flowers.

Question 8:

Mention two strategies evolved to prevent self-pollination in flowers.

Answer

Self-pollination involves the transfer of pollen from the stamen to the pistil of the same flower. Two strategies that have evolved to prevent self-pollination in flowers are as follows:

(1) In certain plants, the stigma of the flower hasthecapability to prevent the germination of pollen grains and hence, prevent the growth of the pollen tube.It is a genetic mechanism to prevent self-pollination called **self- incompatibility**. Incompatibility may be between individuals of the same species or between individuals of different species. Thus, incompatibility prevents breeding.

(2) In some plants, the gynoecium matures before the androecium or vice-versa. This phenomenon is known as **protogyny** or **protandry** respectively. This prevents the pollen from coming in contact with the stigma of the same flower.

Question 9:

What is self-incompatibility? Why does self-pollination not lead to seed formation in self-incompatible species?

Answer

Self-incompatibility is a genetic mechanism in angiosperms that prevents self-pollination. It develops genetic incompatibility between individuals of the same species or between individuals of different species.

The plants which exhibit this phenomenon have the ability to prevent germination of pollen grains and thus, prevent the growth of the pollen tube on the stigma of the flower. This prevents the fusion of the gametes along with the development of the embryo. As a result, no seed formation takes place.

Question 10:

What is bagging technique? How is it useful in a plant breeding programme?

Answer

Various artificial hybridization techniques (under various crop improvement programmes) involve the removal of the anther from bisexual flowers without affecting the female reproductive part (pistil) through the process of emasculation. Then, these emasculated flowers are wrapped in bags to prevent pollination by unwanted pollen grains. This process is called bagging.

This technique is an important part of the plant breeding programme as it ensures that pollen grains of only desirable plants are used for fertilization of the stigma to develop the desired plant variety.

Question 11:

What is triple fusion? Where and how does it take place? Name the nuclei involved in triple fusion.

Answer

Triple fusion is the fusion of the male gamete with two polar nuclei inside the embryo sac of the angiosperm.

This process of fusion takes place inside the embryo sac.

When pollen grains fall on the stigma, they germinate and give rise to the pollen tube that passes through the style and enters into the ovule. After this, the pollen tube enters one of synergids and releases two male gametes there. Out of the two male gametes, one gamete fuses with the nucleus of the egg cell and forms the zygote (syngamy). The other male gamete fuses with the two polar nuclei present in the central cell to form a triploid primary endosperm nucleus. Since this process involves the fusion of three haploid nuclei, it is known as triple fusion. It results in the formation of the endosperm.

One male gamete nucleus and two polar nuclei are involved in this process.

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Question 12:

Why do you think the zygote is dormant for sometime in a fertilized ovule?

Answer

The zygote is formed by the fusion of the male gamete with the nucleus of the egg cell. The zygote remains dormant for some time and waits for the endosperm to form, which develops from the primary endosperm cell resulting from triple fusion. The endosperm provides food for the growing embryo and after the formation of the endosperm, further development of the embryo from the zygote starts.

Question 13:

Differentiate between:

(a) Hypocotyl and epicotyl;

(b) Coleoptile and coleorrhiza;

(c) Integument and testa;

(d) Perisperm and pericarp.

Answer

Differentiate between

(a)

	Hypocotyl	**Epicotyl**
1.	The portion of the embryonal axis which lies below the cotyledon in a dicot embryo is known as the hypocotyl.	The portion of the embryonal axis which lies above the cotyledon in a dicot embryo is known as the epicotyl.
2.	It terminates with the radicle.	It terminates with the plumule.

(b)

Coleoptile	**Coleorrhiza**

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	It is a conical protective sheath that encloses the plumule in a monocot seed.	It is an undifferentiated sheath that encloses the radicle and the root cap in a monocot seed.

(c)

	Integument	**Testa**
	It is the outermost covering of an ovule. It provides protection to it.	It is the outermost covering of a seed.

(d)

	Perisperm	**Pericarp**
	It is the residual nucellus which persists. It is present in some seeds such as beet and black pepper.	It is the ripened wall of a fruit, which develops from the wall of an ovary.

Question 14:

Why is apple called a false fruit? Which part(s) of the flower forms the fruit?

Answer

Fruits derived from the ovary and other accessory floral parts are called false fruits. On the contrary, true fruits are those fruits which develop from the ovary, but do not consist of the thalamus or any other floral part. In an apple, the fleshy receptacle forms the main edible part. Hence, it is a false fruit.

Question 15:

What is meant by emasculation? When and why does a plant breeder employ this technique?

Answer

Emasculation is the process of removing anthers from bisexual flowers without affecting the female reproductive part (pistil), which is used in various plant hybridization techniques.

Emasculation is performed by plant breeders in bisexual flowers to obtain the desired variety of a plant by crossing a particular plant with the desired pollen grain. To remove the anthers, the flowers are covered with a bag before they open. This ensures that the flower is pollinated by pollen grains obtained from desirable varieties only. Later, the mature, viable, and stored pollen grains are dusted on the bagged stigma by breeders to allow artificial pollination to take place and obtain the desired plant variety.

Question 16:

If one can induce parthenocarpy through the application of growth substances, which fruits would you select to induce parthenocarpy and why?

Answer

Parthenocarpy is the process of developing fruits without involving the process of fertilization or seed formation. Therefore, the seedless varieties of economically important fruits such as orange, lemon, water melon etc. are produced using this technique. This technique involves inducing fruit formation by the application of plant growth hormones such as auxins.

Question 17:

Explain the role of tapetum in the formation pollen-grain wall.

Answer

Tapetum is the innermost layer of the microsporangium. It provides nourishment to the developing pollen grains. During microsporogenesis, the cells of tapetum produce various enzymes, hormones, amino acids, and other nutritious material required for the development of pollen grains. It also produces the exine layer of the pollen grains, which is composed of the sporopollenin.

Question 18:

What is apomixis and what is its importance?

Answer

Apomixis is the mechanism of seed production without involving the process of meiosis and syngamy. It plays an important role in hybrid seed production. The method of producing hybrid seeds by cultivation is very expensive for farmers. Also, by sowing hybrid seeds, it is difficult to maintain hybrid characters as characters segregate during meiosis. Apomixis prevents the loss of specific characters in the hybrid. Also, it is a cost-effective method for producing seeds.

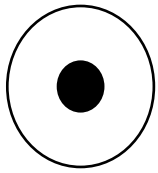
Sporogenous tissue → **MMC 2n** —**meiosis**→ **Microspore tetrad (n)** ↓ **mitosis**

4 Microspores (n) → **4 Pollen Grains (n)**

3. Pollen grain

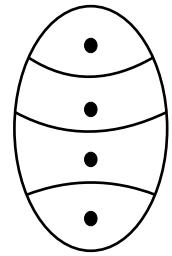
- → **outer wall (Exine) - Thick, hard and made of sporopollenin**
- → **Innerwall (intine) - Thin, made of cellulose and pectin**
- → **cells - a vegetative cell (large in size) and a generative cell (small in size)**

4. **Megasporogenesis .** Process of formation of megaspore from the mega spore mother cell.



Megaspore mother cell (2n)

Meiosis →



four megaspores (n)

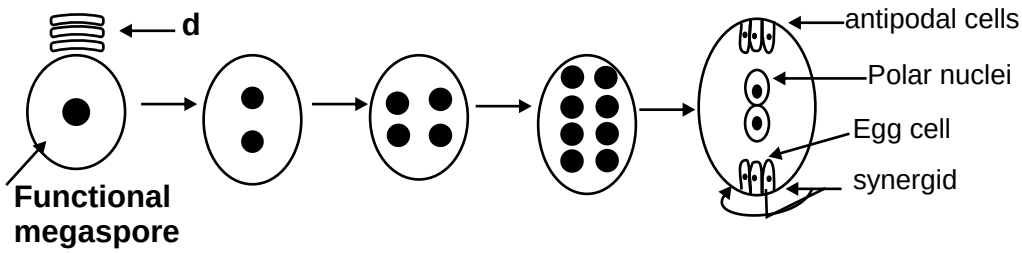
5. Megasporangium (Ovule) :

- The ovule is a small structure attached to the placenta by means of a stalk called funicle.
- The point of attachment of the body of the ovule to the funicle is known as hilum. The main body of the ovule is composed of paranchymatous cells known as nucellus.
- Each ovule has one or two protective integument, which encircle the ovule except at the tip having small opening called micropyle.
- Opposite to micropylar end, is chalaza.

  Generally a single embryosac or female gametophyte located in nucellus.
- Cells of nucellus have abundant reserve food material and provide nourishment to the developing embryo.

6. Female gametophyte (Embryo sac) : In a majority of flowering plant one of the megaspore is functional while other three degenerate.

- The functional megaspore develops in embryo sac.
- The nucleus of the functional megaspore (n) undergoes three successive mitotic cell division which results the formation of eight nucleate stage of embryo sac (free nuclear division)
- The cell wall formation starts at eight nuclear stages. Three cells are grouped together at micropylar end to form the egg apparatus (2 synergids + 1 egg cell).



- ❑ Three cells are grouped at chalazal end, called antipodal cells.
- ❑ The remaining 2 nuclei are called polar nuclei move to the centre of embryo sac, called central cell.

  Thus, typical angiospermic embryo sac at maturity is 8 nucleated and 7 celled.

7. **Pollen - pistil interaction**

- The pistil has the ability to recognize the pollen, whether it is right type (Compatible) or of the wrong type (incompatible).
- If it is compatible, the pistil accepts the pollen.

- The pollen grains germinate on stigma to produce tubes. The contents of the generative cell (or the two male gametes in those species whose pollen is liberated in the three celled stage). move into the pollen tube.
- Pollen tube grows through the tissue of stigma and style by secreating enzyme and enters the ovule.

8. **Double Fetilisation :** The pollen tube releases two male gamete into the cytoplasm of synergid

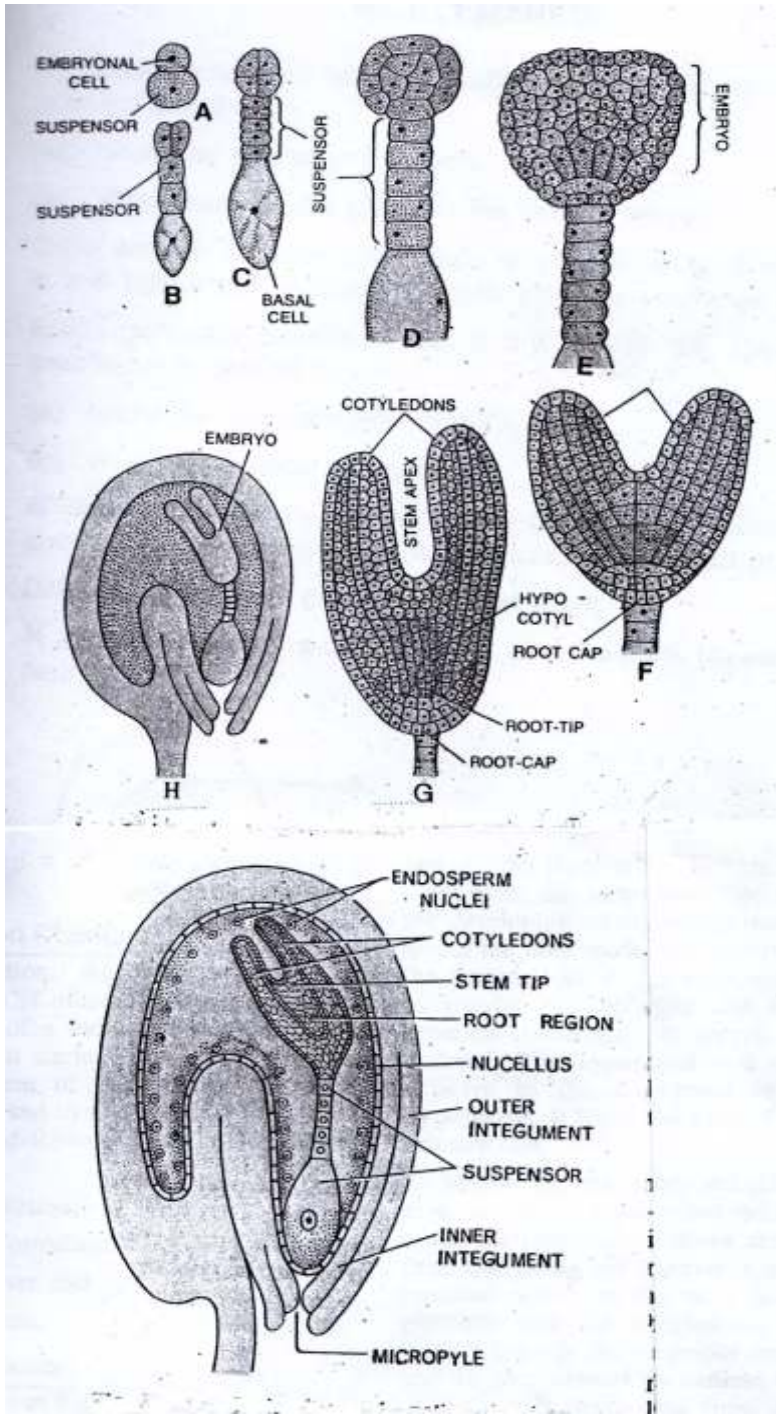
Syngamy : One male gamete + Egg cell → Zygote (2n)

Triple Fusion : Second male gamete + 2 polar nuclei →PEN (3n)

9. **Post Fertilisation events :** (i) Endosperm and embryo development (ii) Maturation of ovule and ovary

Ovary	Fruit	(2n)
Ovary wall	Pericarp	(2n)
Ovule	Seed	(2n)
Outer Integument	Testa	(2n)
Inner Integument	Tegmen	(2n)
Zygote	Embryo	(2n)
Primary Endosperm cell	Endosperm	(3n)

Embryo formation starts after certain amount of endosperm is formed Zygote → Pro-embryo → Globular embryo → Heart shaped embryo → Mature embryo



Stages of development of Embryo

10. **Dicot Embryo :** A typical dicot embryo consist of an embryonal axis and two cotyledons. The portion of embryonal axis above the level of cotyledons is the epicotyle which terminates with the plumule or stem tip.

The portion below the level of cotyledons is hypocotyl that terminates at its lower end in the radicle or root tip.

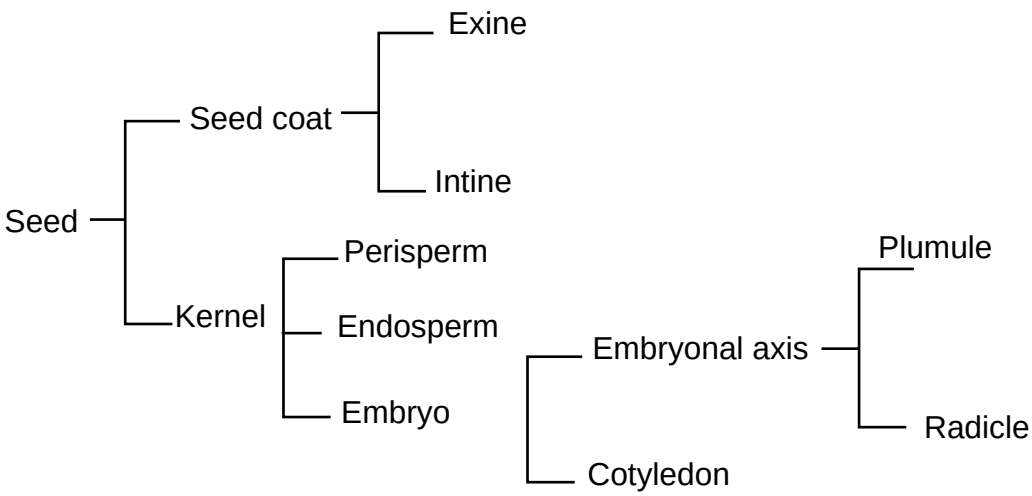
Monocot Embryo : Monocot (Rice, Maize etc.) has one cotyledon called Scutellum. The embryonal axis has the radicle and root cap enclosed by a sheath called Coleorrhiza.

The upper end (epicotyle) has plumule which is covered by hollow folder sturcture, the coleoptile.

Apomixis : Apomixis is a form of asexual reproduction that mimics sexual reproduction where seed are formed without fertilisation.

Polyembryony : Occurance of more than one embryo in a seed. e.g. Orange, lemon, onion, mango, ground nut.

Reasons of polyembryony : More than one egg may be formed in the embryo sac. More than one embryo sac may be formed in an ovule.



QUESTIONS
VSA (1 MARK)

1. In a young anther, a group of compactly arranged homogenous cells were observed in the centre of each microsporangium. What is the name given to these cells?

2. Give the scientific name of a plant which came to India as a contaminant with imported wheat and causes pollen allergy.

3. Pollen grains of water pollinated species have a special characteristics for protection from water. What is that?

4. Why are pollen grains produced in enormous quantity in Maize?

5. In some species of Asteraceae and grasses, seeds are formed without fusion of gametes. Mention the scientific term for such form of reproduction.

6. Arrange the following in correct developmental sequence : Male gamete, Potential pollen mother cell, sporogenous tissue, Pollen grains, Microspore tetrad.

7. If the diploid number of chromosomes in an angiospermic plant is 16. Mention number of chromosomes in the endosperm and antipodal cell.

SA-II (2 MARKS)

8. In angiospermic plant before formation of microspore sporogenous tissue undergo cell division

   (a) Name the type of cell division.

   (b) What would be the ploidy of the cells of tetrad?

9. Outer envelop of pollen grain made of a highly resistant substance. What is that substance? At which particular point the substance is not present?

10. Fruits generally develops from ovary, but in few species thalamus contributes to fruit formation.

    (a) Name the two categories of fruits.

    (b) Give one example of each.

11. Among the animals, insects particularly bees are the dominant pollinating agents. List any four characteristic features of the insect pollinated flower.

12. Differentiate between geitonogamy and xenogamy.

13. In the given figure of a dicot embryo, label the parts (A) and (B) and give their function.

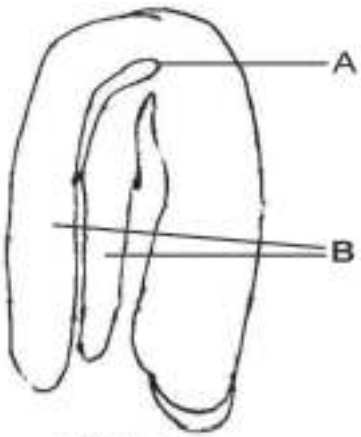


Figure 1

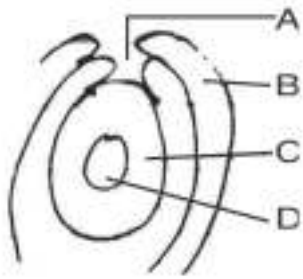
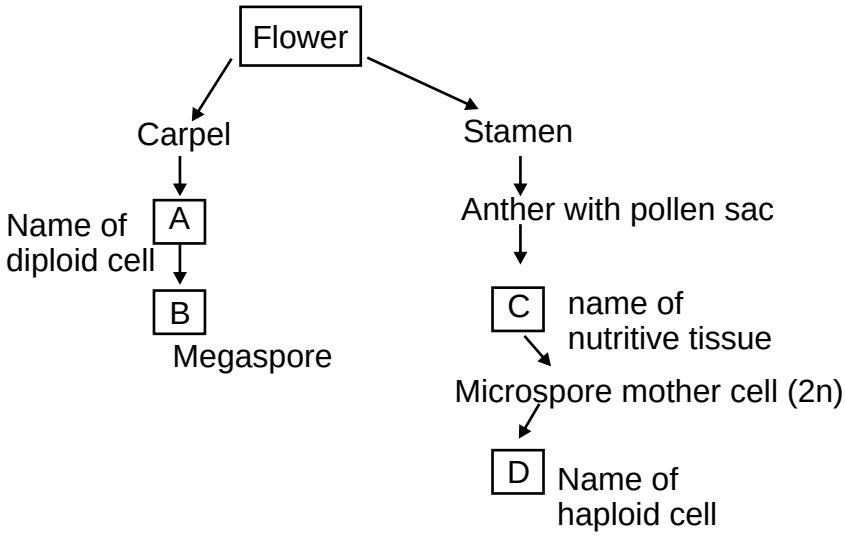


Figure 2

14. Name the parts A, B, C and D of the anatropous ovule (Figure 2) given above.

15. Given below is an incomplete flow chart showing formation of gamete in angiospermic plant. Observe the flow chart carefully and fill in the blank A, B, C and D.



16. Name the blank spaces a, b, c and d is the table given below :

Item		What it represents in the plant
(i)	Pericarp	a
(ii)	b	Cotyledon in seeds of grass family
(iii)	Embryonal axis	c
(iv)	d	Remains of nucellus in a seed.

17. Even though each pollen grain has two male gametes. Why are at least 10 pollen grains and not 5 pollen grains required to fertilise 10 ovules present in a particular carpel?

SA-I (3 MARKS)

18. Continued self pollination lead to inbreeding depression. List three devices, which flowering plant have developed to discourage self pollination?

19. What will be the fate of following structures in the angiospermic plant? Ovary wall, Ovule, zygote, outer integument Inner integument and primary endosperm nucleus.

20. Differentiate between microsporogenesis and megasporogenesis. What type of cell division occurs during these events. Name the structure formed at the end of these two events.

LA (5 MARKS

21. Draw the embryo sac of a flowering plants and label :
    (a) (i) Central Cell (ii) Chalazal end
    (iii) Synergids

    (b) Name the cell that develops into embryo sac and explain how this cell leads to formation of embryo sac.

    (c) Mention the role played by various cells of embryo sac.

    (d) Give the role of filiform apparatus.

ANSWERS

VSA (1 Mark)

1. Sporogenous tissue
2. Parthenium
3. Presence of mucilagenous covering
4. To ensure pollination because Maize is pollinated by wind.
5. Apomixis
6. Sporogenous tissue $\rightarrow$ Potential pollen mother cell $\rightarrow$ microspore tetrad $\rightarrow$ Pollen grain $\rightarrow$ male gamete.
7. 24 Chromosomes in endosperm and 16 chromosomes in antipodal cell.

SA - II (2 MARKS)

8. (a) meiosis division (b) haploid
9. Sporopollenin; at germpore sporopollenin is absent.
10. Two categories of fruits are :
    (i) True fruits e.g., Mango
    (ii) False fruit e.g., Apple
11. 1. Flowers are large.
    2. Colorful petals of flowers.
    3. Presence of fragrance.
    4. Rich in nectar.

12.

	Geitonogamy	*Xenogamy*
1.	Transfer of pollen grains from the anther to stigma of another flower of the same plant	Transfer of Pollen grains from anther to stigma of different plant.
2.	Does not provide opportunity for gametic recombination.	

13. A = Plumule - To form shoot system

    B = Cotyledons - Storage of food

14. A = Micropyle, B = Outer integument, C = Nucellus, D = Emnbryo sac

15. A = Ovule/megasporangium, C = Tapetum

    B = Megaspore mother cell, D = Pollen grains

16. a = wall of fruit, b = scutellum, c = shoot and root tip, d = perisperm

17. Because only one male gamete is involved in syngamy. ie fursionof male gamete with egg cell.

SA - I (3 MARKS)

18. (a) Release of pollen and stigma receptivity is not synchronised in some species.

    (b) Anther and stigma are at different position/heights in some plants

    (c) Self-incompatibility (a genetic mechenism).

19. Ovary wall = Pericarp ; Ovule = Seed,

    Zygote - Embryo; Outer integument = Testa;

    Inner integument = Tegmen; Primary endosperm nucleus = Endosperm.

20. Microsporogenesis : Process of formation of microspore from a Pollen mother cell.

Megsporogenesis : Process of formation of megaspore from megaspore mother cell.

Meiotic division in both

Microsporogenesis results in the formation of pollen grain while megasporogenesis results in the formation of megaspore.

LA (5 MARKS)

21. A. Refer to figure 2.8(c) page 26 NCERT book.

B. Functional Megaspore, Refer text on page 27 NCERT book.

C. Egg : Fuses with male gamete to form zygote or future embryo Synergid : Absorption of nutrient, attract and guides pollen tube.

Antipodal Cells : Take part in absorbing nourishment from the surrounding nucleolar cells (or may degenerate)

Central Cell : After fusion with second male gamete forms Primary endosperm cell which gives rise to Endosperm

D. Guides the entry of pollen tube.