केन्द्रीय विद्यालय संगठन ,भोपाल संभाग (म.प्र.)

KENDRIYA VIDYALAYA SANGATHAN, BHOPAL REGION(M.P.)

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Ultimate Learning Pack for Class XII"

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MESSAGE FROM DEPUTY COMMISSIONER

It gives me immense pleasure to publish the study material for Class XII BIOLOGY I am sure that the support material will definitely be great help to the Class XII Students of all Kendriya Vidyalayas of our region.

This students' Support Maternal has been prepared to improve their academic performance. This is a product of the combined efforts of a team of dedicated and experienced teachers with expertise in their subjects. This material is designed to supplement the NCERT text book.

The support material contains all the important aspects required by the students. Care has been taken to include the latest syllabus, summary of all the chapters, important formula, sample question papers, problem solving and case-based questions. It covers all essentral components that are required for quick and effective revision of the subject.

I would like to express my sincere gratitude to the in-charge Principal and all the teachers who have persistently striven for the preparation of this study maternal. Their selfless contribution in making this project successful is commendable.

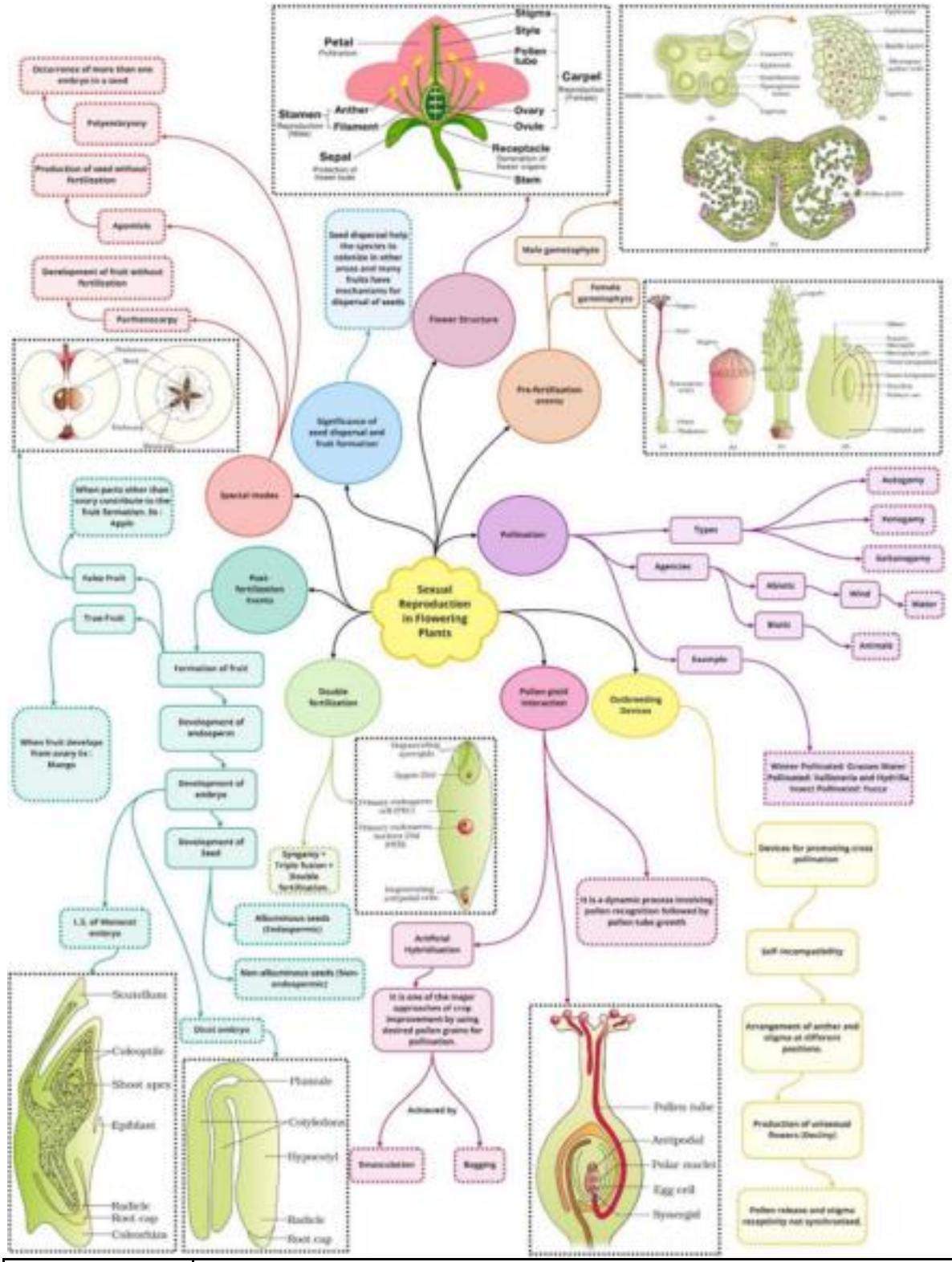
"An ounce of practice is worth tons of Knowledge. Students will make use of the material meticulously to reap the best out of this effort.

With Best Wishes.

(R SENTHIL KUMAR)
DEPUTY COMMISSIONER

INDEX

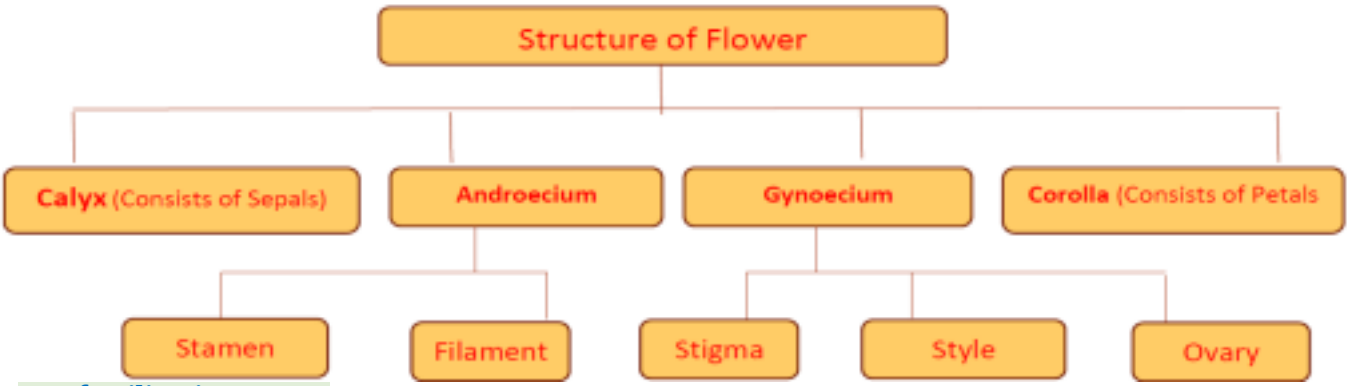
CHAPTER -1
SEXUAL REPRODUCTION IN FLOWERING PLANTS



Flower	Reproductive part of a plant
Sporogenous tissue	Compactly arranged homogenous cells in the center of microsporangia, undergo meiosis (Microsporogenesis) to form tetrads of microspores

Germ pore	Apertures in the pollen grain, facilitate the exchange of gases and water, help in emerging of pollen tube

Autogamy	When pollination occurs between the same flower of the same plants
Egg apparatus	Consists of synergids and filiform apparatus, help in the entry of pollen tube into the embryo sac
Synergid	Present in the embryo sac, two in number
Filiform apparatus	Present in synergids, guider pollen tube entry into the embryo sac
Geitnogamy	Transfer of pollen grains from the anther to the stigma of another flower of the same plant
Xenogamy	Transfer of pollen grains from the anther to the stigma of a different plant
Triple fusion	Male gamete fuses with two polar nuclei to form the triploid endosperm
Embryogeny	Formation of embryo
Cotyledons	the embryonic leaf in seed-bearing plants
Scutellum	Cotyledons of monocotyledon plants
Dormancy	State of inactiveness
Parthenocarpy	Development of fruit without fertilization ex- banana, orange
Polyembryony	Occurrence of more than one embryo in seed Ex- lemon

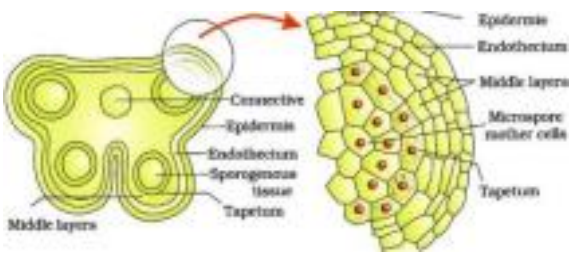


Pre-fertilization events

- It involves the formation of male and female gametes (gametogenesis) and gamete transfer.
- Gamete transfer- Bringing together male & female gamete

Male reproductive structure- Stamen

- Stamens consists of – Filament, Stalk and Anther



Structure of microsporangium

Epidermis- It is a single layer and outermost layer. The main function lies in the protection of pollen.

Endothecium- It is the layer that is present beneath the epidermis and it helps in thickening or provides thickening.

Middle layers- It is made of further 2-3 layers.

Tapetum- It is the innermost multinucleated layer with dense cytoplasm. The main function lies in nourishment. The cells of tapetum may be multinucleate.

Microsporogenesis (formation of microspore)

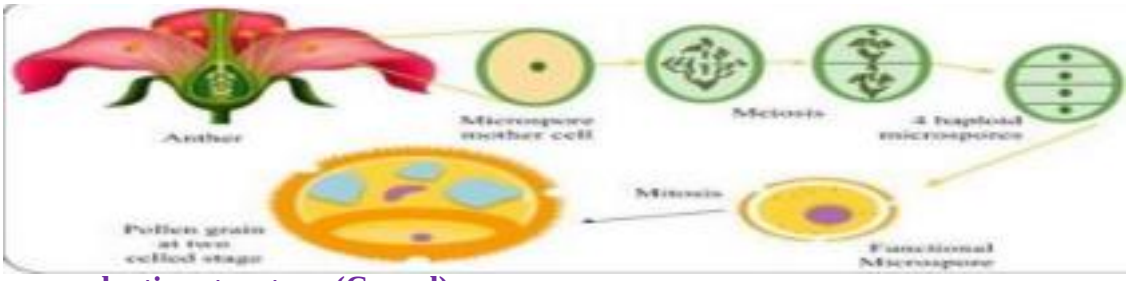
- Microsporogenesis is the process in which sporogenous tissues in microsporangia form

meiocytes (2n).The latter divide meiotically and form microspore tetrad (n).

- Each microspore matures into Pollen grains (male gametophyte)

Pollen grains

Inline (inner layer): it is composed of cellulose & pectinExine (outer layer): it is composed of sporopollenin.



Female reproductive structure (Carpel)

- Carpel has stigma, style and ovary. The ovary encloses ovules (megasporangium) in it.
- Ovule consists of Funicle, Hilum, Integuments, Micropyle, Chalaza, Nucellus and embryo sac.
- The embryo sacis 7 celled and 8-nucleate structure
  - *7 cell- 3 antipodal cell + 2 synergids + egg + central cell*
  - *8 nucleate- 3 antipodal cell + 2 synergids + egg + 2 polar nuclei*

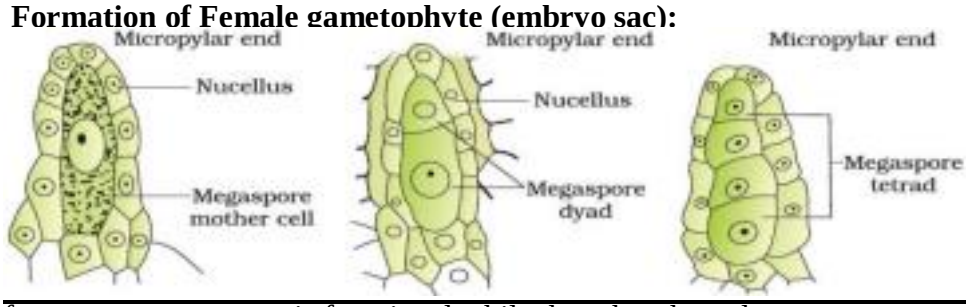
Megasporogenesis

-It is the formation of megaspores from **megaspore mother cell (MMC)**.

-Ovules generally differentiate a single MMC in micropylar region of the nucellus.It is a large cell containing dense cytoplasm and a prominent nucleus.

-MMC undergoes meiosis to produce 4 megaspores.

Formation of Female gametophyte (embryo sac):



-Out of the four megaspores , one is functional while the other three degenerate.

-The functional megaspore develops into the female gametophyte. The embryo sac formation from a single megaspore is called monosporic development.

-The nucleus of the functional megaspore divides mitotically to form two nuclei. They move to the opposite poles, forming 2-nucleate embryo sac.

-The nuclei again divide two times forming 4-nucleate and 8-nucleate stages of the embryo sac. -

After the 8-nucleate stage, cell walls are laid down leading to the organization of the typical female gametophyte or embryo sac.

Distribution of cells within the embryo sac:

- A typical mature embryo sac is 8-nucleate and 7-celled.
- 3 cells are grouped at the micropylar end and form egg apparatus. It consists of 2 synergids and one egg cell.

- Synergids have special cellular thickenings at the micropylar tip called filiform apparatus. It helps to guide the pollen tubes into the synergid.
- 3 cells at the chalazal end are called the antipodals.
- The large central cell has two polar nuclei.

POLLINATION

Adaptation in pollination

Wind pollen grains are light, non-sticky, stamen well-exposed, large often-feathery stigma, often monolocular ovule, numerous flowers packed into an inflorescence.		
Water	Pollen grains are long, ribbon like, and protected from wetting by a mucilaginous covering.	
Insect	Flowers are large, colourful, fragrant and rich in nectar. When the flowers are small, severalflowers are clustered into an inflorescence to make them conspicuous.	

Pollen-Pistil Interaction:

FERTILIZATION (Fusion of male and female gametes)

• Fusion of male gamete (in pollen) and female gamete (egg) in the embryosac. • In some plants there are two male gametes. One fuses with an egg (syngamy) and the other fuses with twopolar nuclei (triple fusion). This is known as double fertilization. **POST FERTILIZATION EVENT**

Ovary

PEC

Endosperm

Zygote Embryo

Fruit

Ovule Seed

Endospermic / Albuminous seeds

Seeds that have endosperm wheat, rice

Non-endospermic / non-albuminous seeds

Seeds that lack endosperm at maturity pea, bean

EMBRYO

• Zygote undergoes mitosis division to form 2- cell stage, 8-cell stage, Globular, Heart shaped stage, Torpedostage and finally the mature embryo.

Embryonal axis	The main axis of the embryo which divides it into different regions
Cotyledons	Food storage and nourishment
Epicotyl and hypocotyl	Part of the embryonal axis above and below the cotyledons

	respectively
Plumule a radicle	Stem tip and root tip respectively
Root cap	Covering of root tip

Structure of a dicotyledonous embryo

Coleorrhiza	Sheath enclosing radicle & root cap
Coleoptile	Sheath enclosing plumule

OUT BREEDING DEVICES (to avoid inbreeding depression some plants develop devices to discourage self-pollination).

Pollen release and stigma receptivity are not synchronized.

Stigma and another position in the same flower are such in a way that they can't come in contact.Self - incompatibility

Production of the unisexual flower.

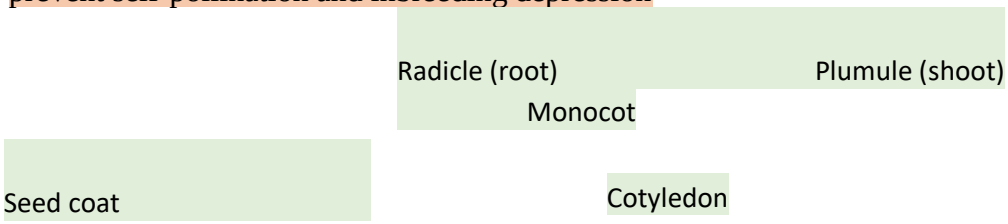
ARTIFICIAL HYBRIDIZATION

Emasculation- removal of anther before attaining maturity

Bagging- bagging of emasculated flower with a paper bag

Dusting- removal of bag and dusting with desired pollen on the stigmaAdvantage- to prevent self-pollination and inbreeding depression

SEED



Importance of seeds

Dicot

Protect embryo, provide nourishment to young seedlings, undergo dormancy to overcome the stressed situation

APOMIXIS

- Formation of seed without fertilization is known as apomixis.
- Diploid nucellar cells divide and enter inside the embryo sac and later develop into embryos.
- Sometimes, the egg cell is diploid due to the failure of meiosis. Such diploid egg cell later directly developsinto an embryo.

Polyembryony- the occurrence of many embryos in value. E.g. Citrus, mango, etc.

PRACTICE QUESTIONS

MULTIPLE CHOICE QUESTIONS -

1.Pollen banks
(1) Store pollen grain in liquid nitrogen
(2) Store pollen of extinct plants only
(3) Are source of pollen grains for various artificial plant breeding programmes
(4) Both (1) & (3)

Answer - (4) Both (1) & (3)
2.The innermost layer of anther wall in angiospermic plant is
(1) Endothecium which is nutritive layer
(2) Tapetum which is polyploid
(3) Middle layers which are ephemeral
(4) Tapetum which plays a vital role in dehiscence of anther
Answer - (2)Tapetum which is polyploid
3.Perisperm is
1) Diploid sporophytic tissue
(2) Represents the future sporophytic generation
(3) Seen in seeds of bean
(4) Remain of endosperm
Answer - (1) Diploid sporophytic tissue
4.Plant breeder has set up an experiment to perform artificial hybridisation in maize. Which of the following steps will he follow?
(1) Emasculation, Bagging, Dusting
(2) Dusting, Bagging, Emasculation
(3) Bagging, Dusting, Rebagging
(4) Rebagging, Emasculation, Dusting
Answer - (3) Bagging, Dusting, Rebagging
5. Persistent nucellus in the seed is known as
(1) Chalaza.
(2) Perisperm
(3) Hilum.
(4) Tegmen
Answer - (2) Perisperm
6. A dioecious flowering plant prevents both
(1) Autogamy and xenogamy
(2) Autogamy and geitonogamy
(3) Geitonogamy and xenogamy
(4) Cleistogamy and xenogamy
Answer - (2) Autogamy and geitonogamy
7.Double fertilisation is exhibited by
(1)Gymnosperms
(2) fungi
(3) Algae

(4) Angiosperms
Answer - (4) Angiosperms
8. In majority of angiosperms
(1) Egg has a filiform apparatus
(2) There are numerous antipodal cells
(3) Reduction division occurs in the megaspore mother cells
(4). A small central cell is present in the embryo sac
Answer - (3) Reduction division occurs in the megaspore mother cells
9. The coconut water from tender coconut represents
(1) Free nuclear endosperm
(2) Endocarp
(3) Fleshy mesocarp
(4) Free nuclear proembryo
Answer - (1) Free nuclear endosperm
10. Filiform apparatus is characteristic feature of :
(1) Synergids
(2) Generative cell
(3) Nucellar embryo
(4) Aleurone cell

Answer - (1) Synergids
11. Which one of the following fruits is parthenocarpic?
(1) Banana
(2) brinjal
(3) Apple
(4) jackfruit
Answer - (1) Banana
12. Which one of the following may require pollinators, but is genetically similar to autogamy? (1) Cleistogamy
(2)Geitonogamy
(3) Xenogamy
(4)Apogamy
Answer - (2)Geitonogamy
13. Megasporangium is equivalent to
(1)Fruit.
(2) Nucellus
(3)Ovule.
(4) Embryo sac
Answer - (3)Ovule.
14. What is the function of germpore
(1) Emergence of radicle
(2) Absorption of water for seed germination
(3) Initiation of pollen tube
(4) Release of male gametes
Answer - (3) Initiation of pollen tube
15. Wind pollinated flowers are
(1) Small, producing nectar and dry pollen
(2) Small, brightly coloured, producing large number of pollen grains
(3) Small, producing large number of dry pollen grains
(4) Large, producing abundant nectar and pollen
Answer - (3) Small, producing large number of dry pollen grains
16. Transfer of pollen grains from the anther to the stigma of another flower of the same plant is called
(1) Autogamy
(2) Xenogamy

(3) Geitonogamy
(4) Karyogamy
Answer - (3) Geitonogamy
17. In a cereal grain the single cotyledon of embryo is represented by
1) Coleorhiza
(2) Scutellum
(3) Prophyll
(4) Coleoptile
Answer - (2) Scutellum
18. Male gametes in angiosperms are formed by the
(1) Microspore mother cell
(2) Microspore
(3) Generative cell
(4) Vegetative cell
Answer - (3) Generative cell
19. What is the direction of micropyle in anatropous ovule?
(1) Upward.
(2)Downward
(3) Right.
(4) Left

Answer - (2)Downward
20 .Eight nucleated embryosac is
(1) Only monosporic
(2) Only bisporic
(3) Only tetrasporic
(4) Any of these
Answer - (4) Any of these

ASSERTION / REASON

(a) Both assertion and reason are true, and reason is the correct explanation of assertion. (b) Both assertion and reason are true, but reason is not the correct explanation of the assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false

.

1 Assertion - If the female parent produces unisexual flowers, there is no need of emasculation.
Reason- Emasculation is the removal of anthers from the flower bud before the anther dehisces.
Answer - C
2. Assertion - Sporopollenin is an oxidative polymer of carotenoids which helps in fossilization. Reason - Sporopollenin is a tough substance that provides resistant to biological decomposition, high temperature and alkali.
Answer- A
3. Assertion: Pollination is essential for sexual reproduction in plants.
Reasoning: Pollination is the process of transfer of pollen from the anther to the stigma, enabling fertilization to occur.
Answer- A
4. Assertion: The ovary develops into the fruit after fertilization in plants.
Reasoning: After fertilization, the ovule develops into a seed, and the ovary surrounding the seed develops into a fruit.
Answer - B
5. Assertion: Double fertilization is a unique feature of flowering plants.
Reasoning: In double fertilization, one sperm fertilizes the egg to form a zygote, while the other sperm combines with two polar nuclei to form endosperm in the seed.
Answer - A
6. Assertion: fruit is the mature or ripened ovary developed after fertilisation .

Reasoning: fruit formed without fertilisation of the ovary is called parthenocarpic fruit.
Answer- B
7. Assertion : Parthenium is known to cause pollen allergy.
Reason : It is not a native plant species.
Answer - B
8. Assertion : Cleistogamous flowers produce assured seed set in the absence of pollinators. Reason : Cleistogamous flowers do not open at all .
Answer - A
9. Assertion : Non - albuminous seeds have no residual endosperm.
Reason : The endosperm is completely consumed during embryo development.
Answer -A
10. Assertion : Entomophilous plants produce less pollen when compared to anemophilous plants . Reason: The wastage of pollen is reduced to the minimum in entomophilous plants because of the directional pollination.
Answer : B

2 MARK QUESTIONS

1.You are conducting artificial hybridization on papaya and potato. Which one of them would require the step of emasculation and why ? However for both you will use the process of bagging. Justify giving one reason.(2019)
2.Farmers prefer apomictic seeds to hybrid seeds." Justify giving two reasons.(2024) 3.Do you think apomixis can be compared to asexual reproduction ? Justify your answer. State the benefits of apomixis to

the farmers.(2024)

3 MARKS QUESTIONS

1.Pollen banks are playing a very important role in promoting plant breeding programme the world over. How are pollens preserved in the pollen banks ? Explain. How are such banks benefitting our farmer ? Write any two ways.(2019)

2.Draw a schematic transverse section of a mature anther of an angiosperm. Label its epidermis, middle layers, tapetum, endothecium, sporogenous tissue and the connective.(2020)

3.Differentiate between wind pollinated and insect pollinated flowers.(2020)

4.One of the major approaches of crop improvement programme is Artificial Hybridisation. Explain the steps involved in making sure that only the desired pollen grain pollinate the stigma of a bisexual flower by a plant breeder. (2023)

5 MARK QUESTIONS

1.(a)Explain any two ways by which apomictic seed can develop.
(b)List one advantage and one disadvantage of a apomictic crop.
(c)Why do farmers find production of hybrid seeds costly ? (2019)

2.(a) Explain the monosporic development of embryo sac in the ovule of an angiosperm. (b) Draw a diagram of the mature embryo sac of an angiospermic ovule and label any four parts in it. (2023)

3.(a) With the help of labelled diagram only, show the different stages of embryo development in a dicot plant.
(b) Endosperm development precedes embryo development. Justify .(2024)

4.Explain the development of male gametophyte in an angiosperm . OR
Draw a labelled diagram of a three-celled male gametophyte.

CASE BASED QUESTIONS

CASE 1.

1. Read the following and answer questions given below .

In major approaches of crop improvement programme as in crossing experiments, it is important to make sure that only the desired pollen grains are used for pollination and the stigma is protected from contamination from unwanted pollens. So, if the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces is necessary (Emasculation). Emasculated flowers have to be

covered with bags of suitable size to prevent contamination of their stigma with unwanted pollen-bagging. When the stigma of bagged flower attains receptivity, mature pollen grains collected from anthers of the male parent are dusted on the stigma and the flowers are re-bagged and the fruits are allowed to develop. If the female parent produces unisexual flowers, there is no need for emasculation.

1. How does emasculation contribute to the success of crop improvement programmes in crossing experiments?
A) It prevents the development of male flowers on the female parent.
B) It ensures that only desired pollen grains are used for pollination.
C) It accelerates the growth rate of the plants.
D) It increases the number of seeds produced by the plant.
Answer: B) It ensures that only desired pollen grains are used for pollination.
Feedback: This process ensures that only desired pollen grains are used for pollination, leading to controlled breeding and the production of offspring with specific traits.

2. What would be the likely outcome if unwanted pollen grains contaminated the stigma during pollination in crop improvement experiments?
A) Increased genetic diversity in the offspring.
B) Reduced chances of successful fertilization.
C) Enhanced resistance to pests and diseases.
D) Accelerated growth of the resulting plants.
Answer: B) Reduced chances of successful fertilization.
Feedback : When unwanted pollen grains contaminate the stigma, they may compete with the desired pollen for fertilization, leading to reduced chances of successful fertilization. This can result in a decrease in the quality and yield of the crop being studied.

3. In what scenario would emasculation not be required in crop improvement experiments involving unisexual flowers?
A) When the male parent produces a large quantity of pollen grains.
B) When the female parent is genetically modified.
C) When the female parent bears unisexual flowers.
D) When the male parent is a hybrid variety.
Answer: C) When the female parent bears unisexual flowers.
Feedback: since the female parent plant already has only female reproductive organs, there is no need to emasculate it to prevent self-pollination. The male parent's pollen can be directly applied to the female flowers for cross-pollination without the risk of self-fertilization.

4. How does bagging flowers after pollination contribute to successful fruit development in crop improvement programmes?
A) It prevents insects from damaging the flowers.
B) It protects the stigma from contamination with unwanted pollen.
C) It increases the size of the resulting fruits.
D) It accelerates the ripening process of the fruits.
Answer: B) It protects the stigma from contamination with unwanted pollen.
Feedback : By bagging flowers, the stigma is shielded from receiving pollen from undesired sources, ensuring that only desired pollen contributes to fertilization.

CASE 2.
Read the following and answer the questions given below .
Pollen grains are generally spherical shaped and each is surrounded by two layers – exine and intine. Exine is made up of sporopollenin which is resistant to high temperatures and strong acids and alkali. Sporopollenin remains absent at germ pores. Pollen grains are well preserved as fossils because of the presence of sporopollenin. The inner wall of pollen grain is intine.
The pollen grains shed when they get matured. Pollen grains of many species cause severe allergies and bronchial afflictions, leading to chronic respiratory disorders. It is mentioned that Parthenium that came into

India as contaminant with imported wheat, has become ubiquitous in occurrence and causes pollen allergy. However, pollen grains are used as pollen tablets as food supplements.
1. What is the main reason for the preservation of pollen grains as fossils?
A) Presence of vegetative cell
B) Presence of germ pores
C) Presence of intine
D) Presence of sporopollenin
Answer: (D) Presence of sporopollenin
Feedback : Sporopollenin is resistant to high temperatures and strong acids and alkali, making it an ideal preservative for pollen grains.
2. At what stage are pollen grains mainly shed?
A) Multi-celled stage
B) 2-celled stage
C) 1-celled stage
D) 3-celled stage
Answer: (B) 2-celled stage
Feedback : Pollen grains are mainly shed at 2-celled stage, comprising a vegetative cell and a generative cell. 3. What is the purpose of pollen tablets as food supplements?
A) To cure respiratory disorders
B) To provide nutrients
C) To increase the performance of athletes
D) To treat pollen allergies
Answer: (B) To provide nutrients
Feedback : Pollen grains are rich in nutrients, making them a popular ingredient in food supplements. 4. What is the main component of exine?
A) Vegetative cell
B) Sporopollenin

C) Intine
D) Generative cell
Answer: (B) Sporopollenin
Feedback : Exine is made up of sporopollenin, a resistant material that helps preserve pollen grains. 5. What is the name of the plant that causes pollen allergy?
A) Parthenium
B) Carrot grass
C) Wheat
D) Both a and b
Answer: (D) Both a and b
Feedback : Parthenium, also known as carrot grass, is a plant that causes severe pollen allergies.

CASE 3.

Read the following and answer the questions given below .

Pollination, transfer of pollen grains from the stamens, the flower parts that produce them, to the ovule bearing organs or to the ovules themselves. In plants such as conifers and cycads, in which the ovules are exposed, the pollen is simply caught in a drop of fluid secreted by the ovule. In flowering plants, however, the ovules are contained within a hollow organ called the pistil, and the pollen is deposited on the stigma. There the pollen germinates and gives rise to a pollen tube, which grows down through the pistil toward one of the ovules in its base. In an act of double fertilization, one of the two sperm cells within the pollen tube fuses with the egg cell of the ovule, and the other cell combines with the two subsidiary sexual nuclei of the ovule, which initiates formation of a reserve food tissue, the endosperm. The growing ovule then transforms itself into a seed.

1.The types of flowers which always produce seeds even in the absence of pollinators
(A) Chasmogamous flowers
(B)Cleistogamous flowers

(C)Bisexual flowers
(D) Unisexual flowers.
Answer :(B) Cleistogamous flowers
Feedback : Cleistogamous flowers always produce seeds even in the absence of pollinators. Cleistogamous flowers are a type of self-pollinating flowers where the flower remains closed and self-fertilizes without the need for external pollinators.

2.What is the function of the stigma in the pollination process?
(A) To produce pollen grains
(B) To secrete a drop of fluid to catch pollen grains
(C) To provide a receptive surface for pollen deposition
(D) To form the endosperm tissue
Answer - (C) To provide a receptive surface for pollen deposition
Feedback : The stigma is the sticky, often enlarged tip of the pistil in a flower, and its main role is to capture pollen grains that are carried by pollinators or the wind. Once the pollen lands on the stigma, it germinates and grows a tube through which the male gametes can travel to reach the ovules for fertilization. 3.What is the result of the fusion of one sperm cell with the egg cell of the ovule?
(A) Formation of the endosperm tissue
(B) Development of the pistil
(C) Development of an embryo
(D) Production of pollen grains
Answer (C) Development of an embryo
Feedback : When a sperm cell fuses with the egg cell of the ovule, it results in the formation of an embryo. This process is known as fertilization and marks the beginning of the development of a new organism.
4.What is the role of the pollen tube in the pollination process?
(A) To produce pollen grains
(B) To secrete a drop of fluid to catch pollen grains
(C) To allow the sperm cells to reach the ovule
(D) To form the seed coat

Answer -(C) To allow the sperm cells to reach the ovule
Feedback : The pollen tube plays a crucial role in the pollination process by facilitating the transport of sperm cells from the pollen grain to the ovule. Once a pollen grain lands on the stigma of a flower, it germinates and forms a pollen tube. This tube grows down through the style of the pistil and reaches the ovary where it penetrates the ovule. Through this process, the sperm cells are able to travel to the ovule and fertilize it, leading to seed formation.
5.What initiates the formation of endosperms?
A) Fertilization
B) Triple fusion
C) Fusion
D) Double fusion
Answer: (B) Triple fusion
Feedback : The formation of endosperms is initiated by the fusion of a sperm cell with two polar nuclei in the central cell of the female gametophyte.
CASE 4.
Study the given diagram and answer the following questions .

1. Ovules in angiosperms
(A) are also called integumented dehiscent megasporangium
(B) May be either one or many in each ovary
(C) Lack nucellus in seeds of beet
(D) Has chalaza, representing its apical part
Answer -(B)
Feedback : The number of ovules in an ovary can vary greatly among different species of angiosperms; some plants have a single ovule per ovary, while others can have many.
2. Megapore mother cell in ovule
(A) Generally differentiates in chalazal region of the nucellus
(B) Is a large cell containing dense cytoplasm and a prominent nucleus
(C) Divides by mitosis to form a linear tetrad that further divides to form eight
nuclei (D) Both (2) and (3)
Answer is (B)
Feedback : The megaspore mother cell is indeed a large cell with dense cytoplasm and a prominent nucleus. 3). Largest cell in polygonum type of embryo sac is
(A) Synergid
(B) Egg
(C) Central cell
(D) Antipodal cells
Answer is (C)
Feedback : In the Polygonum type of embryo sac, which is the most common type of embryo sac development in angiosperms, the structure includes: One egg cell , Two synergids ,Three antipodal cells ,One central cell, which contains two polar nuclei.
The central cell is the largest cell in the embryo sac because it contains two polar nuclei and is destined to become the primary endosperm nucleus upon fertilization.
4). Synergids in embryo sac
(A) Generally have micropylar nucleus and chalazal vacuole
(B) Lack a cell wall on their micropylar side at maturity
(C) Consist of filiform apparatus that guides pollen tube entry in ovule
(D) Generally possess a chalazal nucleus and micropylar ovule.

Answer is (A)
Feedback : Synergids possess a structure called the filiform apparatus, which plays a crucial role in guiding the pollen tube into the ovule.

COMPETENCY BASED QUESTIONS.

Ques 1. The farmer gazed out over his fields, his brow furrowed with determination. For years, he had struggled to grow the perfect fruits, only to be thwarted by the fickle nature of pollination. But now, he had discovered a solution - growing parthenocarpic fruits allowing him to bypass the unpredictable dance of bees and wind. With meticulous care, he tended to his crops, experimenting with specialized pruning techniques and environmental controls. It was a delicate balancing act, requiring precise temperature, humidity, and nutrient levels to coax these virgin fruits into existence. Each success fueled his passion, as he inched closer to mastering this revolutionary approach to fruit cultivation. In the end, his perseverance would pay off, as his farm became known for its exceptional, seedless produce - a true testament to the power of innovation and the unyielding spirit of the modern-day agriculturalist.

1.What problem had the farmer been struggling with for years before discovering parthenocarpic fruits? (A) Poor soil quality
(B) Inconsistent pollination
(C) Lack of rainfall
(D) Pest infestation
Answer: (B) Inconsistent pollination

2.What is the main advantage of parthenocarpic fruits mentioned in the passage?
(A) They are larger in size
(B) They develop without the need for fertilization

(C) They have a longer shelf life
(D) They require less water
Answer: (B) They develop without the need for fertilization

3.What was the farmer's reaction to the growth and transformation of the swelling buds? (A) Indifference
(B) Eagerness and anticipation
(C) Disappointment
(D) Frustration
Answer: (B) Eagerness and anticipation

4.What drove the farmer to continue his meticulous care and experimentation with parthenocarpic fruits? (A) The challenge of the process
(B) The ease of growing parthenocarpic fruits
(C) Pressure from his competitors
(D) The advice of agricultural experts
Answer: (A) The challenge of the process

5.What was the key feature of the fruits produced by the farmer's new method? (A) They were larger and had more seeds
(B) They were seedless and had flawless texture and flavor
(C) They were more colorful
(D) They had a longer growing season
Answer: (B) They were seedless and had flawless texture and flavor

Ques 2. Observe the diagram and choose the correct option .
(A)A-Root cap; B-Coleoptile; C-Scutellum; D-Coleorhiza; E-Epiblast; F-Shoot apex (B)A-Shoot apex;B-Epiblast;C-Coleorhiza;D-Scutellum;E-Coleoptile;F-Radicle (C)A-Epiblast; B-Scutellum; C-Coleoptile; D-Radicle;E-

Coleorhiza; F-Shoot apex (D)A-Epiblast; B-Radicle; C-Coleoptile; D-Scutellum; E-Coleorhiza; F-Shoot apex
Answer :(A)A-Root cap; B-Coleoptile; C-Scutellum; D-Coleorhiza; E-Epiblast; F-Shoot apex Ques 3. Answer the questions based on the picture given below.
1.Which of the following plants is an example of a species that uses water pollination?
(A) Rose
(B) Water lily
(C) Vallisneria
(D) Sunflower
Answer: (C) Vallisneria
2.In hydrophilous plants, where does pollination typically occur?
(A) On the surface of the water
(B) In the air

(C) Underwater
(D) A and C both are correct
Answer: (D) On the surface of the water and (C) Underwater
3.Which of the following characteristics is typical of hydrophilous flowers?
(A) Brightly colored petals to attract pollinators
(B) Pollen that is buoyant and water-resistant
(C) Strong fragrance to attract aquatic animals
(D) Nectar production to feed fish
Answer: (B) Pollen that is buoyant and water-resistant
4.Hydrophily is limited to 30 genera which are mostly
(A)Gymnosperms
(B)Monocots
(C)Dicots
(D)More than one option is correct
Answer - (B) Monocots.
Ques 4.
With reference to the image shown , answer the following questions.

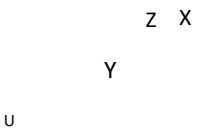
1.What is artificial hybridization?
(A) The process of inducing mutations in plants
(B) The manual transfer of pollen from one plant to the stigma of another plant to produce hybrids (C) The natural cross-pollination between two different plant species
(D) The application of chemicals to enhance plant growth
Answer: (B) The manual transfer of pollen from one plant to the stigma of another plant to produce hybrids 2.What is the primary purpose of artificial hybridization in agriculture?
(A) To increase the height of plants
(B) To produce new plant varieties with desirable traits

(C) To enhance the natural pollination process
(D) To prevent the spread of plant diseases
Answer: (B) To produce new plant varieties with desirable traits
3.Which of the following steps is essential in the process of artificial hybridization? (A) Removal of all leaves from the plant
(B) Emasculation of the flowers
(C) Application of fertilizers
(D) Pruning of the plant
Answer: (B) Emasculation of the flowers
4.Emasculation in artificial hybridization involves:
(A) Removing the petals of a flower
(B) Removing the anthers before they release pollen
(C) Cutting the stem of the plant
(D) Removing the stigma of the flower
Answer: (B) Removing the anthers before they release pollen
5.Which of the following is a potential advantage of artificial hybridization?
(A) Decreased genetic diversity
(B) Increased susceptibility to pests

(C) Development of disease-resistant plant varieties
(D) Reduced crop yield
Answer: (C) Development of disease-resistant plant varieties

PREVIOUS YEAR QUESTIONS

1. Select the option that shows the correctly identified 'U', 'X', 'Y' and 'Z' in a developing dicot embryo. **[CBSE 2023]**



(1) X-Plumule (2n), Y-Suspensor (n), Z-Cotyledon (2n), U-Radicle (2n).
(2) X-Plumule (2n), Y-Suspensor (2n), Z-Radicle (2n), U-Cotyledon (2n). (3) X-Suspensor (2n), Y-Cotyledon (2n), Z-Radicle (2n), U-Plumule (2n).
(4) X-Cotyledon (2n), Y-Radicle (n), Z-Plumule (n), U-Suspensor (n).

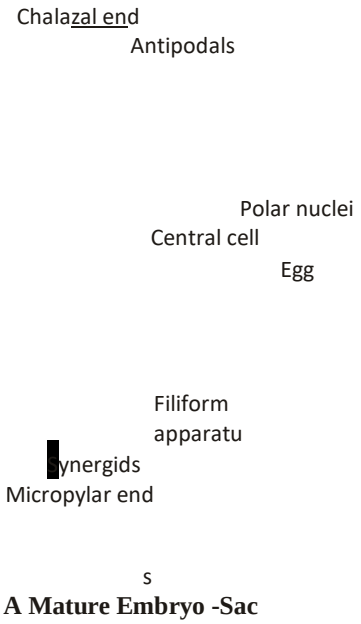
Ans. (3) X-Suspensor (2n), Y-Cotyledon (2n), Z-Radicle (2n), U-Plumule (2n).

2. (i) Explain the monosporic development of embryo sac in the ovule of an angiosperm. (ii) Draw a diagram of the mature embryo sac of an angiospermic ovule and label any four parts in it. [CBSE 2023]

Ans. (i) The process of formation of megaspores from megaspore mother cell (MMC) is called megasporogenesis.

- ❖ The four haploid megaspores are generally arranged in linear tetrad.
- ❖ In a majority of flowering plants the lower most or chalazal megaspore remains functional out of four megaspores and the other three which lie towards the micropyle degenerate.
- ❖ The functional megaspore produces female gametophyte (embryo sac).

❖ This method of embryo sac formation from a single megaspore is termed monosporic development



A Mature Embryo -Sac

(ii)

3. One of the major approaches of crop improvement programme is Artific . Explain the steps involved in making sure that only the desired pollen grain pollinate the stigma of a bisexual flower by a plant breeder. [CBSE 2023]

Ans. Artificial hybridisation is one of the major approaches of crop improvement programme. In such crossing experiments it is important to make sure that only the desired pollen grains are used for pollination and the stigma is protected from contamination (from unwanted pollen).

This is achieved by emasculation and bagging techniques.

- If the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary. This step is referred to as emasculation.
- Emasculated flowers have to be covered with a bag of suitable size, generally made up of butter paper, to prevent contamination of its stigma with unwanted pollen. This process is called bagging.
- When the stigma of bagged flower attains receptivity, mature pollen grains collected from anthers of the male parent are dusted on the stigma, and the flowers are rebagged, and the fruits allowed to develop.

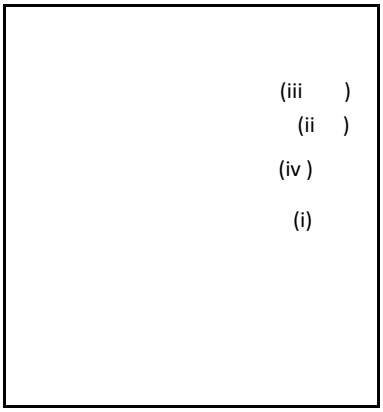
4. The hilum in a typical angiospermic ovule represents the junction between:-

[CBSE Term-I 2022]

(1) Integuments and the embryo sac. (2) Embryo sac and the nucellus
(3) Body of the ovule and the funicle (4) Nucellus and the fumicle

Ans. (3) Body of the ovule and the funicle

5. In the given diagram of a transverse section of a young anther. Choose the labellings showing the correct placement of the wall layers from the table given below. **[CBSE Term-I 2022]**



(i) (ii) (ii) (iii)

(1) Epidermis Middle layers Tapetum Endothecium

(2) Tapetum Endothecium Epidermis Middle layers

(3) Endothecium Tapetum Middle layers Epidermis

(4) Middle layers Epidermis Endothecium Tapetum

Ans. (2) (i) Tapetum (ii)Endothecium (iii)Epidermis (iv) Middle layers

6. The term used for the embryo entering into the state of inactivity as the seed mature is:- **[CBSE Term-I 2022]**

(1) Quiescent (2) Parthenogenesis (3) Parthenocarpy (4) Dormancy

Ans. (4) Dormancy

7. The ploidy of the apomictic embryo developed from the integument cells and megaspore mother cell without reduction division respectively will be:– **[CBSE Term-I 2022]** (1) 2 n and 2n (2) n and n (3) 2n and n (4) 3n and 2n **Ans. (1) 2 n and 2n**

1. Why does endosperm development precede embryo development? [CBSE] Ans. The cells of endosperm are filled with reserve food materials and are used for the nutrition of the developing embryo.

2. How many meiotic divisions are required to produce 76 seeds in a Guava fruit? [CBSE IMP-Question] Ans. 95

3. How does pollination take place in water hyacinth and water lily? [CBSE IMP-Question] Ans. In water hyacinth and water lily, the flowers emerge above the level of water and are pollinated by insects or wind as in most of the land plants.

4. Self-pollination is fully ensured if **[CBSE 2020]** (1) The flower is bisexual. (2) The style is longer that the filament.

(3) The flower is cleistogamous. (4) The time of pistil and anther maturity is different. **Ans. (3)**

5. Draw a schematic transverse section of a mature anther of an angiosperm. Label its epidermis, middle layers, tapetum, endothecium, sporogenous tissue and the connective. [CBSE 2018,20] Ans.

Epidermis

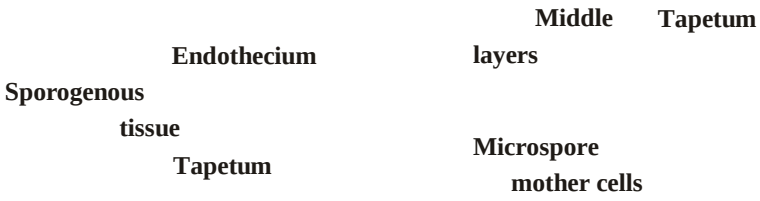
Endothecium

Epidermis

Middle

layers

Connective



(A) T.S of young anther

(B) Enlarged view of one microspora ngium

16. Differentiate between wind pollinated and insect pollinated flowers. [CBSE 2020]Ans.

Wind Pollinated	Insect Pollinated
Wind Pollinated flowers do not have nectar.	Insect Pollinated flowers are rich in nectar to attract insects.
The petals are dull and does not attract the insects.	The petals of these flowers are very colourful and attractive.
They do not have any scent.	The scent of these flowers are another factor that attracts insects.
The pollen grains are non-sticky, light.	The pollen grains are sticky.
Stigma is feathery, to catch the pollen grain.	Stigma is non-feathery and sticky.

17. Some flowers, selected for artificial hybridization, do not require do not require emasculation bessential or them. Give a reason [CBSE 2019]

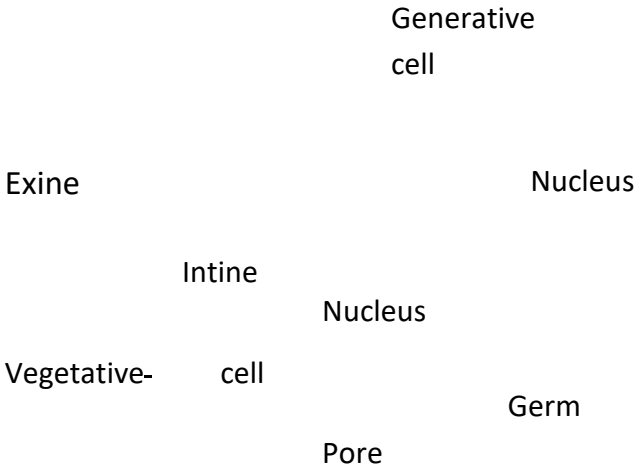
Ans. As some flowers are unisexual, to prevent contamination of its stigma with unwanted pollen grains.

18. Write any two ways by which apomictic seeds may be developed in angiosperms. [CBSE 2019]

Ans. Develops from a diploid egg cell (formed without reduction division) which grows into an embryo without fertilization.

Develops from nuclear cell which divides and protrudes into the embryo sac and develops into an embryo

19. Draw a labeled diagram of a mature male gametophyte of an angiosperm. [CBSE 2019] Ans.



Mature male gametophyte

20. Draw a diagram of L.S. of an embryo of grass and label any six parts. [CBSE 2019] Ans.

L.S. of an embryo of grass

21. State one difference and one similarity between geitonogamy and xenogamy. [CBSE 2018] Ans.
Difference - In geitonogamy pollen grains from one flower are transferred to the stigma of anther flower on the same plant whereas in xenogamy the pollen grains are transferred to the stigma of a flower on another plant (of the same species) genetically similar, genetically different.

Similarity - In both types of pollination pollen grains from the anther are transferred to the stigma of another flower of the same species.

22. Explain any three devices developed in flowering plants to discourage self pollination and encourage cross pollination. [CBSE 2018] Ans. Pollen release & stigma receptivity not synchronised / hence the maturity of stigma and pollen are different /Protandry / Protogyny- Anther and Stigma are placed at different positions so that pollen cannot come Iin contact with stigma of the same flower.

Self incompatibility/ Self sterility.

Production of unisexual flowers.

23. Write one advantage and one disadvantage of cleistogamy to flowering plants. [CBSE 2018] Ans. Advantage - Assured seed set / maintain purelines.

Disadvantage - No variation / only parental characters are preserved / it can lead to inbreeding depression

24. If the meiocyte of a maize plant contains 20 chromosomes, write the number of chromosomes in the endosperm and embryo of the maize grain and give reasons in support of your answer. [CBSE 2018] Ans. Endosperm = 30, Embryo = 20

Diploid meiocyte (20 chromosomes) form haploid gametes (10 chromosomes) Two haploid gametes fuse to form diploid (20) zygote which develops into a (diploid = 20) embryo / syngamy of two haploid gametes to form a diploid zygote.

One haploid gamete (chromosome 10) fuses with two polar nuclei (chromosome 10 + 10) to form (triploid - 30) endosperm nuclei (which divides to form endosperm) / Triple fusion of three haploid nuclei (1 gamete + 2 polar nuclei) to form a triploid endosperm.

25. (a) Draw a diagram of Pistil showing pollen tube growth in angiosperm and label (i) Stigma (ii) male gametes (iii) micropyle and (iv) Ovule.

a. **Write the function of micropyle. [CBSE 2018] Ans. (a)**

(b) The pollen tube enters the ovule through micropyle, it facilitates the entry of oxygen and water for seed germination.

26. (a) Describe the process of microsporogenesis upto the formation of a microspore. a. **Write the function of 'germ pore' in a pollen grain of an angiosperm. [CBSE 2018] Ans. (a)** The process of formation of microspore from a pollen mother cell by meiosis is called **micro sporogenesis.**

Each cell of the sprogenous tissue in microsporangium acts as potential PMC (Pollen mother cell/ or micro sporemother cell.)

PMC under goes meiotic divisions to form cluster of four cells called microspore tetrad.

On maturity, the anther dehydrates and the microspores separate from each other to form pollen grains.

Sporogenous tissue Microspore mother cell microspore tetrad

(b) Germ pores allow the germinating / growing pollen tube with contents of the pollen grain/ male gametes + vegetative cell to come out of the pollen grains

VERY SHORT ANSWER QUESTIONS

1. The diploid number of chromosomes in an angiospermic plant is 16. What will be the number of chromosomes in its endosperm and antipodal cells ?

Ans. Endosperm - 24 chromosomes, Antipodals - 8 chromosomes.

2. State the reason why pollen grains lose their viability when the tapetum in the anther malfunctioning.

Ans. Lack of nourishment for the developing pollen grain due to malfunctional tapetum.

3. Can a plant flowering in Mumbai be pollinated by pollen grains of the same species growing in New Delhi ? Provide explanations to your answer.

Ans. Yes, By artificial means (any relevant explanation)

4. How many microsporangia are present in a typical anther of an angiosperm?

Ans. Four

5. Name the part of the flower which the tassels of the corn-cob represent.
Ans. Style and stigma.

6. Write the function of coleoptile.
Ans. It protects the plumule of the monocot embryo.

7. Name the part of gynoecium that determines the compatible nature of pollen grain.
Ans. Stigma

8. What is shield-shaped single cotyledon of monocots called?
Ans. Scutellum

9. Who discovered double fertilisation in agiosperms?
Ans. S.G. Nawaschin (1897) discovered double fertilisation in angiosperms.

10. Name a plant is which dichogamy is found.
Ans. *Magnolia*

SHORT ANSWER QUESTIONS

1. How do plants produce seeds through apomixis?

Ans.

2. Why do moss plants produce very large numbers of male gametes? Provide one reason. What are these gametes called?
Ans. To ensure the fertilization of egg cell, because it depend on water. High numbers of male gametes confirm the continuity of life. These gametes are called as antherozoid.

3. Explain the role of tapetum in the formation of pollen –grain wall.
Ans. The tapetum forms ubsich bodies sporollenin, which participate in the formation of outer hard layer of pollen grain, called exine. Tapetum also deposits compatibility proteins in exine as well as pollen –kitt in insect pollinated pollen grains.

4. Geitonogamous flowering plants are genetically autogamous but functionally pollinated. Justify.
Ans. In these plants male and female flowers are present on same plant but different branches. Pollination occur in between these male and female flowers by medium. So, functionally cross pollination. Genetically pollen grain belongs to the same plant so it is genetically autogamous.

5. Differentiate between Parthenocarpy and Parthenogenesis. Give one example of each.
Ans.

S.No.	Parthenocarpy	Parthenogenesis
1	Formation of fruit without fertilization	New organism develops without fertilization
2	-e.g. banana / grapes / any other	e.g. Drones /rotifers/male honey bee / turkey

6. A single pea plant in your kitchen garden produces pods with viable seeds, but the individual papaya plant does not. Explain.

Ans. **Pea**- flowers of pea plants are bisexual, monoecious / self pollinated (to produce pods with viable seeds)

Papaya- Dioecious plant / unisexual plant bearing male and female flowers on separate plants, unable to produce viable seeds as there is no cross pollination / it could be a male plant which is unable to produce fruit and seeds

(G) LONG ANSWER QUESTIONS

1. As a senior biology student you have been asked to demonstrate to the students of secondary level in you school, the procedure(s) that shall ensure cross-pollination in a hermaphrodite flower. List the different steps that you would suggest and provide reasons for each one of them.

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Ans. The following steps would be followed :

(i) Emasculation or removal of anthers from the flower bud, before the anther dehisce, to avoid self pollination.

(ii) Bagging, to prevent contamination of its stigma with unwanted pollen grains.

(iii)Rebagging, the stigma of the mature ovary are dustred with desired pollen grains and rebagged to allow the fruit to develop.

2. (a) Why both wind water pollinated flowers are not very colourful and do not produce nector.
(b) How do flowers reward their insect pollinators? Explain.
(c) Write the characteristics feature of anther, pollen and stigma of wind pollinated flowers. Ans. (a) Because there pollinator are abiotic (water and wind) so that do not required any substrate for attraction of water and wind.

(b) Insect pollinators are rewarded in following ways:

- The flowers offer floral reward like nector and pollen grain.
- In some species floral reward provided safe place to laying egg.

(c) The characteristics of wind pollinated flowers are:

- Pollen grains are light in weight, non sticky, dry and winged, so that they can be easily transported.
- Well –exposed stamens for easy dispersal of pollen grains in the wind.
- The stigma is sticky, large, feathery to trap the pollen grains in air.
- Numerous flower are packed together to form inflorescence.
- The flowers are small and inconspicuous.

3. A flower of brinjal plant following the process of sexual reproduction procedure 360 viable seeds. Answer the following questions giving a reasons :

(a) How many ovule minimally involved?
(b) How many megaspore mother cells are involved?
(c) What is the minimum number of pollen grains that must land on stigma for pollination?
(d) How many male gametes are involves in the above case?
(e) How many microspore mother cells must have undergone reduction division prior to dehiscence of anther in the above case?

Ans. (a) 360 ovules are involved. One ovule after fertilization forms one seed.

(b) 360 MMC. Each MMC form four megaspore out of which only one remains functional.

(c) 360 pollen grains .One pollen grains participate in fertilization of one ovule.

(d) 720 male gametes are involved. Each pollen grains carries two male gametes (which participate in double fertilization) **(360 × 2 = 720)**

(e) 90 MMC undergoes reduction division. Each microspore mother cells meiotically divided to form four pollen grains. **(360 / 4 = 90)**

4. Describe the process of megasporogenesis upto fully developed embryo sac formation in an angiosperm.
Ans. A single large cell of nucellus with dense cytoplasm and prominent nucleus differentiated as megaspore mother cell (MMC), in the micropylar region, the megaspore mother cell undergoes meiosis to form 4 megaspores, 3 cells degenerates and one is functional. Functional megaspore undergoes three successive mitotic divisions, to develop 8 nucleated (7 celled) embryo sac,

(3 antipodals, one egg cell (female gamete), 2 synergids, two polar nuclei.)

For the above explanation the following diagram can be considered

(a) - Parts of the ovule showing a large megaspore mother cell to tetrad
(b) - 2, 4 and 8 nucleate of embryo sac and mature embryo sac
(c) A diagrammatic representation of the mature embryo sac

CHAPTER 2 -HUMAN REPRODUCTION

Key Words

Scrotum	It is a pouch-like structure outside the abdominal cavity in which the testers are situated.It helps in maintaining the low temperature of the testes (2–2.5^{o} C lower than the normal internal body temperature) necessary for spermatogenesis.

Somniferous tubule	In each testicular lobule 1- 3 highly coiled seminiferous tubules in which sperms areproduced.
Sertoli cells	Sertoli cells provide nutrition to the male germ cells.
Leydig cell	Present in interstitial space (regions outside the seminiferous tubules). It secretes testicular hormones called androgens
Urethral meatus	It is the external opening of the penis.
Seminal plasma	Secretion of the male accessory glands (seminal vesicles, prostate and bulbourethral gland) constitute the seminal plasma.
Male accessory glands	Paired seminal vesicles, prostate and paired bulbourethral glands
Lactiferous duct	Through which milk is sucked out.
Spermatogonia	Immature diploid male germ cells (Spermatogonia) produce sperms by spermatogenesis. These are present on the inside wall of the seminiferous tubule.
Acrosome	Cap-like structure on sperm head. it is enzymes that help fertilization of the ovum.
Semen	The seminal plasma along with the sperms constitutes the semen.
Oogonia	Gamete mother cells (oogonia) are formed within each fetal ovary which later develops into the egg.
Graafian follicle	Mature follicles formed during oogenesis. When it own ruptures releases the secondary oocyte (ovum) and reaming part forms the carpus luteum.
Zona pellucida	The membrane on the secondary oocypreventsvent polyspermy
Carpus luteum	After ovulation remaining parts of the Graafian follicle transform in the corpus luteum. Itsecretes progesterone hormone, which is essential for the maintenance of the endometrium.
Polar body	It is a small haploid cell that is formed during oogenesis. It can’t be fertilized.
Cleavage	The mitotic division in the zygote is called cleavage.
Placenta	The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit called the placenta
Chorionic villi	After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood.
Stem cell	Inner cell mass contains certain cells called stem cells which have the potency to give rise to all the tissues and organs.

Implantation	Implantation is the process in which the mammalian embryo (blastocyst) becomes attached to the endometrium of the uterus.
Fetus ejection reflex	Mild uterine contractions are generated by the placenta when the fetus is fully developed, at the time of parturition.

HUMAN MALE REPRODUCTIVE SYSTEM

The Male Reproductive System: It consists of:

- Primary sex organs i.e. a pair of testes suspended in a scrotum.
- Secondary sex organs i.e. a pair of ducts each differentiated into rete testis, vasa efferentia, epididymis and vas deferens, ejaculatory duct and the associated glands
- External genitalia
- The testes are situated outside the abdominal cavity in a pouch called scrotum, which help in maintaining the low temperature of testes necessary for spermatogenesis.
- Each testes has about 250 testicular lobules and each lobule contain highly coiled seminiferous tubules in which sperms are produced. Each seminiferous tubules is lined by two types of cells, spermatogonia (male germ cell) and Sertoli cells.
- Leydig cells or interstitial cells present around the seminiferous tubules synthesize and secrete androgen hormone.

- Ejaculatory duct store and transport the sperm from testes to outside through urethra which originate from urinary bladder and extend through penis to its external opening urethral meatus. • The penis is male external genitalia. The enlarged end of penis is called the glans penis is covered by a loose fold of skin called foreskin.
- Male accessary glands include -
- paired seminal vesicles,
- prostrate and
- paired bulbourethral glands.

- Secretion of these glands forms the seminal plasma which contains fructose, calcium and enzymes. The secretion of bulbourethral glands also helps in lubrication of the penis.

Structure of sperm- sperm is a microscopic structure composed of a head, neck, a middle piece and a tail. The sperm head contain elongated haploid nucleus, anterior portion of which is covered by cap like structure acrosome.

THE FEMALE REPRODUCTIVE SYSTEM: It consists of :

- a)The primary sex organ that is a pair of ovaries
- b)Secondary sex organs- the duct system consisting of a pair of fallopian tube , a uterus , cervix and vagina
- c)External genitalia
- d)Mammary glands
- Ovaries are primary female sex organ that produce the female gamete and several steroid hormones. Each ovary is covered by thin epithelium which encloses the ovarian stroma, which is divided into a peripheral cortex and an inner medulla.
- Fallopian tube extends from periphery of ovary to the uterus. The part closer to ovary is a funnel shaped structure called infundibulum having finger like projection called fimbriae. • Infundibulum leads to ampulla and join with uterus with isthmus. Uterus is pear shaped structure also called womb.
- Uterus open vagina through a narrow cervix. The cavity of cervix (cervical canal) along with vagina forms the birth canal.

- The wall of uterus has three layers of tissue:

I. Perimetrium- external membrane.
II. Myometrium – middle thick layer of smooth muscles which exhibit strong contraction during delivery of baby.
III. Endometrium – line the uterine wall and undergo cyclic changes during menstrual cycle.

Female external genitalia includes

- Mons pubis – cushion of fatty tissues covered by skin and pubic hair.
- Labia majora- fleshy fold that surround the vaginal opening.
- Labia manora – paired fold of tissue under labia majora.
- The opening of vagina is often partially covered by a membrane called hymen. The tiny finger like projection present at the upper junction of two labia manora above the urethral opening is called clitoris.
- Mammary glands are paired structures that contain glandular tissues and variable fats. Each glandular tissue contains 15-20 mammary lobes containing alveoli that secrete milk. Mammary ducts join to form mammary ampulla.

GAMETOGENESIS: The process of formation of male and female gametes in testes and ovary respectively is called gametogenesis. It is of two types: **Spermatogenesis** in males and Oogenesis in Females.

Spermatogenesis and Oogenesis

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FERTILIZATION

The fusion of sperm and ovum is called fertilization.

- Site- ampulla-isthmic junction.
- Zona-pellucida layer of the ovum block the entry of the additional sperms thus only one sperm fertilizes the ovum.

IMPLANTATION

PREGNANCY AND EMBRYONIC DEVELOPMENT

STAGES OF EMBRYO DEVELOPMENT

One month	Heart is formed
Two month	Development of limbs and digits
12 weeks (first trimester)	Most of the major organ systems are formed, for example, the limbs and external Genital organs are well-developed.
Fifth month	First movements and appearance of hair on the head
After 24 weeks (end of the secondtrimester)	The body is covered with fine hair, eyelids separate, and eyelashes are formed.
9 month	Foetus is fully developed

PARTURITION

Gestation period: The average duration of human pregnancy (9 months).

Parturition: the process of delivery of the fetus.
Parturition is a neuroendocrine mechanism. The signals for parturition originate from the fully developed fetus and placenta which induces mild uterine contractions called **foetal ejection reflex**. Due to this oxytocin hormone is released from the maternal pituitary which causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin. Continuous secretion of oxytocin causes stronger and stronger contractions. This leads to the expulsion of the baby out of the uterus through the birth canal – parturition.

LACTATION

- The mammary glands of the female starts producing milk towards the end of pregnancy through the processcalled lactation.
- The milk produced during the initial few days of lactation is called colostrum which contains severalantibodies essential to develop resistance for newly born babies.

PREVIOUS YEAR QUESTIONS

1. Given below are structural details of a human mammary gland : **[CBSE 2023]** **(i)** The glandular tissue in the breast has 15-20 clusters of cells called alveoli.

(ii) The milk is stored in the lumen of alveoli.

(iii) The alveoli join to form the mammary ducts.

(iv) Mammary ampulla is connected to lactiferous ducts.

Choose the option that gives the correct detail of human mammary gland.

(1) (i) and (ii) (2) (ii) and (iii) (3) (ii) and (iv) (4) (i) and (iii)

Ans. (3) (ii) and (iv)

2. The graph given below shows the number of primordial follicles per ovary in women at different ages. Study. the graph and answer the questions that follow. **[CBSE 2023]**

Age (y)

(a) What is the average age of the women at the onset of menopause?

(b) At what age are maximum primordial follicles present in the ovary, according to the given graph?

Ans. (a) 45-50 year (b) 0-10 year

3. (i) Explain the formation of placenta after the implantation in a human female. (ii) Draw a diagram showing human foetus within the uterus and label any four parts in its. [CBSE 2023]

Ans. (i) After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood.

The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal body called placenta man foetus within the uterus.

The human foetus within the

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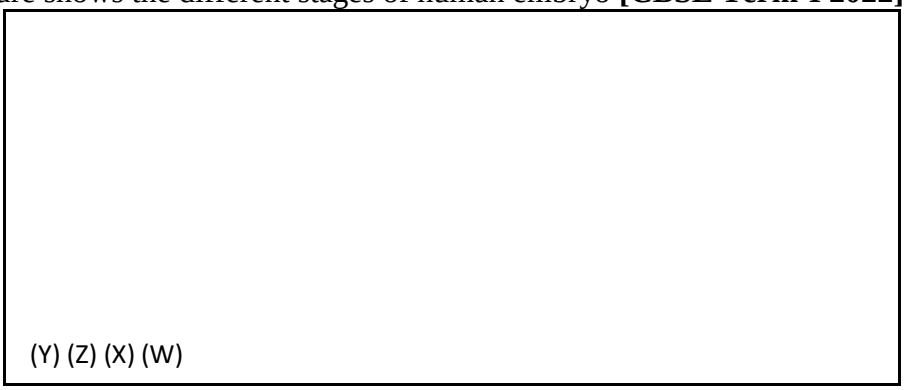
4. Breast-feeding the baby acts as a natural contraceptive for the mother because it prevents: **[CBSE Term-I 2022]**

(i) Ovulation (ii) Menstruation (iii) Insemination (iv) Fertilisation (1) (ii) and (iv) (2) (i) and (iii) (3) (i) and (iv) (4) (i) and (ii)

Ans. (4) (i) and (ii)

5. The given figure shows the different stages of human embryo **[CBSE Term-I 2022]**



W	X	Y	Z
Cleavage	Blastocyst	Morula	Fertilisation

~~Blastocyst Morula Cleavage~~
~~Morula Cleavage~~ Blastocyst
~~Morula Blastocyst~~ Cleavage

Identify the
correct labelings
for W, X, Y and Z and choose the correct option

from the table below.

(1) (2) (3) (4)

Ans. (3)

W-Morula X-Cleavage Y-Blastocyst Z-Fertilisation

6. During human embryonic development the external genital organs are well developed in the foetus by the end of – **[CBSE Term-I 2022]**

(1) 6 weeks of pregnancy (2) 12 weeks of pregnancy

(3) 18 weeks of pregnancy (4) 24 weeks of pregnancy

Ans. (2) 12 weeks of pregnancy

7. The accessory ducts in the human male reproductive system consists of **[CBSE Term – I 2022]**

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(1) Epididymis, Prostate, Rete testis (2) Rete testis, Vas efferentia, Seminal vesicles (3) Vas efferentia, Bulbourethral, Epididymis (4) Rete testis, epididymis, Vas deferens

Ans. (4) Rete testis, epididymis, Vas deferens

8. The source of gonadotropin LH and its corresponding function is: **[CBSE Term-I 2022]** (1) Anterior pituitary, ovulation (2) Anterior pituitary, Graafian follicle formation (3) Hypothalamus, Ovulation (4) Hypothalamus, Graafian follicle formation **Ans. (1) Anterior pituitary, ovulation**

9. Name the glands that contribute to human seminal plasma. [CBSE IMP-Question]

Ans. Prostate, Seminal vesicle and Bulbourethral gland. (any two)

10. A fully developed foetus initiates its delivery from the mother's womb. Justify the statement. [CBSE IMP-Question] Ans. The signals for parturition originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex.

- This triggers the release of oxytocin from the maternal pituitary.
- Oxytocin acts on the uterine muscle and causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin.
- The stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions.
- Parturition is induced by a complex neuroendocrine mechanism involving cortisol, oestrogens and oxytocin.
- This leads to expulsion of the baby out of the uterus through the birth canal – parturition.

11. Study the graph given below related with menstrual cycle in females: [CBSE IMP-Question] a. Identify ovarian hormones X and Y mentioned in the graph and specify their source.

Ovulation

X

Y

Day

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29/1

b. Correlate and describe the uterine events that take place according to the ovarian hormone levels X and Y mentioned in the graph on -

i. 6 – 15 days

ii. 16 – 25 days

iii. 26 – 28 days (when ovum is not fertilized) Ans. a. X- Estrogen secreted by growing follicles; Y – Progesterone secreted by corpus luteum

b. Uterine events that take place according to the ovarian hormone levels X and Y on - (i) 6 – 15 days: Endometrium of the uterus regenerates by proliferation under the influence of estrogen. (ii) 16 – 25 days: Under the influence of Progesterone the endometrium of the uterus is maintained for implantation of fertilised ovum and other events of pregnancy.

(iii)26 – 28 days (when ovum is not fertilized): in the absence of fertilisation, corpus luteum degenerates which causes disintegration of endometrium leading to menstruation, marking a new cycle. **12. The following figure shows a foetus within the uterus. On the basis of the given figure, answer the questions that follow: [CBSE IMP-Question]**

a. In the above figure, choose and name the correct part (A, B, C or D) that act as a temporary endocrine gland and substantiate your answer. Why is it also called the functional junction? b. Mention the role of B in the development of the embryo.

c. Name the fluid surrounding the developing embryo. How is it misused for sex determination?

Ans. (a) Part labeled A -Placenta. It acts as an endocrine tissue as it produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL),estrogens, progestogens, etc. It is also called the *functional junction* because it facilitates the supply of oxygen and nutrients to the embryo and removes carbon dioxide and excretory/waste materials produced by the embryo.

(b)The placenta is connected to the embryo through an umbilical cord which helps in the transport of substances to the embryo.

(c)Amniotic fluid; a foetal sex determination test is based on the chromosomal pattern of the cells in the amniotic fluid surrounding the developing embryo.

13. Study the given diagram where A is an embryonic stage that gets transformed into B, which in turn gets implanted in the endometrium in human females. [CBSE 2020]

a. Identify A, B and its parts C and D.

b. Write the name of cavity present in the stage B.

c. What is the fate of C and D in the course of embryonic development in human.

Ans. (a) A - Morula,

B - Blastocyst,

C - Inner cell mass,

D - Trophoblast

(b)Blastocoel

(c) C-It differentiated as the embryo.

D-It helps in implantation and further develop into placenta.

14. Given below is the diagram of a human ovum surrounded by a few sperms. Study the diagram and answer the following questions: [CBSE 2019]

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a. Which one of the sperms would reach the ovum earlier?
b. Identify 'D' and 'E'.

c. Mention what helps the entry of sperm into the ovum and write the changes occurring in the ovum during the process.
d. Name the specific region in the female reproductive system where the event represented in the diagram takes place. Ans. (a)
Sperm 'A'
(b) D = Cells of corona radiata, E = zona pellucida,
(c) The secretion of acrosome (enzymes) helps the entry of sperm into the ovum, induces the completion of meiotic division of secondary oocyte.
(d) Ampulla /ampullary - isthmic junction of the fallopian tube

15. Medically it is advised to all young mothers that breast feeding is the best for their newborn babies. Do you agree ? Give reasons in support of your answer. [CBSE 2018] Ans. Yes, The milk produced during the initial few days of lactation is called colostrum.
The colostrum contains several antibodies **(IgA)** absolutely essential to develop resistance for the new-born babies. Breast-feeding during the initial period of infant growth is recommended by doctors for bringing up a healthy baby.

16. State from where do the signals for parturition originate in human females. [CBSE 2017] Ans Fully developed foetus, and the placenta.

IMPORTANT QUESTIONS

Multiple Choice Questions:

1. Which of the following statements are true for spermatogenesis but do not hold true for Oogenesis?
   (a) It results in the formation of haploid gametes
   (b) Differentiation of gamete occurs after the completion of meiosis
   (c) Meiosis occurs continuously in a mitotically dividing stem cell population

(d) It is controlled by the Luteinising hormone (LH) and Follicle Stimulating Hormone (FSH) secreted by the anterior pituitary
(e) It is initiated at puberty

Choose the most appropriate answer from the options given below:
(1) (c) and (e) only
(2) (b) and (c) only
(3) (b), (d) and (e) only
(4) (b), (c) and (e) only
Answer - Option (4)

2. At which stage of life the oogenesis process is initiated?
a. Puberty
b. Embryonic development stage
c. Birth
d. Adult
Answer- option b

3. Match the following columns and select the correct option.

Column - I	Column - II
(a) Placenta	(i) Androgens
(b) Zona pellucida	(ii) Human Chorionic Gonadotropin (hCG)
(c) Bulbo-urethral	(iii) Layer of the ovum
(d) Leydig cells	(iv) Lubrication of the Penis

(a) (b) (c) (d)
(1) (iv) (iii) (i) (ii)
(2) (i) (iv) (ii) (iii)
(3) (iii) (ii) (iv) (i)
(4) (ii) (iii) (iv) (i)
Answer- Option -4

4. Meiotic division of the secondary oocyte is completed
a. At the time of fusion of a sperm with an ovum
b. At the time of copulation
c. Prior to ovulation
d. At the time of fertilization
Answer – A

5. Which of the following hormone levels will cause release of ovum from the graafian follicle?
a. Low concentration of FSH
b. High concentration of Progesterone
c. Low concentration of LH
d. High concentration of Estrogen
Answer- Option D

6. Hormones secreted by the placenta to maintain pregnancy are –
a. hCG, hPL, progestogens, prolactin
b. hCG, hPL, estrogens, relasin, oxytocin
c. hCG, hPL, progestogens, estrogens
d. hCG, progestogens, estrogens, glucocorticoids
Answer- Option C

7. Receptors for sperm binding in mammals are present on –
a. Zona pellucida
b. Corona radiate
c. Vitelline membrane

d. Previtelline space
Answer – Option A

8. Which of these is not an important component of initiation of parturition in humans?
a. Release of prolactin
b. Increase in estrogen and progesterone ratio
c. Synthesis of prostaglandins
d. Release of oxytocin
Answer – Option A

9. Which of the following secretes the hormone, relaxin, during the later phase of pregnancy?
a. Uterus
b. Graafian follicle
c. Corpus luteum
d. Foetus
Answer – Option C

10. Arrange the components of mammary gland. (from proximal to distal).
(a) Mammary duct
(b) Lactiferous duct
(c) Alveoli
(d) Mammary ampulla
(e) Mammary tubules
Choose the most appropriate answer from the options given below :
a. (e)->(c)->(d)->(b)->(a)

b. (c)->(a)->(d)->(e)->(b)
c. (b)->(c)->(e)->(d)->(a)

d. (c)->(e)->(a)->(d)->(b)
Answer - Option (d)
Alveoli→Mammarytubules→Mammaryduct→Mammaryampulla→Lactiferousduct 11. Which of the following statements are correct regarding female reproductive cycle? A. In non-primate mammals cyclical changes during reproduction are called oestrus cycle. B. First menstrual cycle begins at puberty and is called menopause.
C. Lack of menstruation may be indicative of pregnancy.
D. Cyclic menstruation extends between menarche and menopause.
Choose the most appropriate answer from the options given below:
a. A and B only
b. A, B and C only
c. A, C and D only
d. A and D only
Answer- Option C

12. How many secondary spermatocytes are required to form 400 million spermatozoa?
a. 400 million
b. 50 million
c. 100 million
d. 200 million
Answer- Option (d)

13. Given below are two statements:

Statement I: The presence or absence of hymen is not a reliable indicator of virginity. Statement II: The hymen is torn during the first coitus only.

In the light of the above above statements, choose the correct answer from the options given below : a. Both statement I and Statement II are true
b. Both statement I and Statement II are false
c. statement I is true and Statement II is false

d. statement I is false and Statement II is true
Answer - Option C
14. Identify the correct option A, B, C, D with respect to spermatogenesis

a. FSH, Leydig cells, sertoli cells, spermiogenesis
b. ICSH, interstitial cells, Leydig cells, spermiogenesis
c. FSH, Sertoli cells, Leydig cells, spermatogenesis
d. ICSH, Leydic cells, sertoli cells, spermatogenesis
Answer-Option A

15. Given below are two statements regarding oogenesis:

Statement I :- The primary follicles get surrounded by more layers of granulosa cells, a theca and shows fluid filled cavity antrum. Now it is called secondary follicle.

Statement II :- Graffian follicle ruptures to release the secondary oocyte from the ovary by the process called ovulation.

In the light of the above statements, choose the correct answer from the options given below: a. statement I is true and Statement II is false
b. statement I is false and Statement II is true
c. Both statement I and Statement II are true
d. Both statement I and Statement II are false
Answer- Option b

16. Which of the following is not a component of fallopian tube?
a. Uterine fundus
b. Isthmus
c. Infundibulum
d. Ampulla
Answer – option –A

17. Given below are two statements:

Statement I: The presence or absence of hymen is not a reliable indicator of

virginity. Statement II: The hymen is torn during the first coitus only.

In the light of the above above statements, choose the correct answer from the options given below : a. Both statement I and Statement II are true
b. Both statement I and Statement II are false
c. statement I is true and Statement II is false
d. statement I is false and Statement II is true
Answer – option C

18. The difference between spermiogenesis and spermiation is
a. In spermiogenesis spermatids are formed while in spermiation spermatozoa are formed b. In

spermiogenesis spermatozoa are formed while in spermiation spermatids are formed c. In spermiogenesis spermatozoa from sertoli cells are released into the cavity of seminiferous tubules while in spermiation spermatozoa are formed

d. In spermiogenesis spermatozoa are formed while in spermiation spermatozoa are released from sertoli cells into the cavity of seminiferous tubules

Answer – option D

19. Several hormones like hCG, hPL, estrogen, progesterone are produced by –
    a. Ovary
    b. Placenta
    c. Fallopian tube
    d. Pituitary

    Answer – Option B
20. Select the incorrect statement
    a. LH and FSH decreases gradually during the follicular phase
    b. LH triggers secretion of androgen from the leydig cells
    c. FSH stimulates the sertoli cells which help in spermiogenesis
    d. LH triggers ovulation in ovary.

Answer- Option A

SECTION B – ASSERTION REASON TYPE QUESTIONS

21. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.
    Assertion A : Endometrium is necessary for implantation of blastocyst.
    Reason R : In the absence of fertilization, the corpus luteum degenerates that causes disintegration of endometrium.
    In the light of the above statements, choose the correct answer from the options given below :
    1. Both A and R are true and R is the correct explanation of A.
    2. Both A and R are true but R is NOT the correct explanation of A.
    3. A is true but R is false.
    4. A is false but R is true.

    Ans. Option (2)
22. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
    Assertion (A): During pregnancy the level of thyroxine is increased in the maternal blood. Reason (R): Pregnancy is characterised by metabolic changes in the mother.
    In the light of the above statements, choose the most appropriate answer from the options given below:
    1. Both A and R are true and R is the correct explanation of A.
    2. Both A and R are true but R is NOT the correct explanation of A.
    3. A is true but R is false.
    4. A is false but R is true.

    Answer : Option 1
23. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
    Assertion(A): seminiferous tubules is lined by male germ cells and sertoli cells.
    Reason (R): seminiferous tubule is structural and functional unit of testes.
    1. Both A and R are true and R is the correct explanation of A.
    2. Both A and R are true but R is NOT the correct explanation of A.
    3. A is true but R is false.
    4. A is false but R is true.

    Answer- Option 1
24. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
    Assertion (A): the penis is the male external genitalia and made up of special erectile tissue.
    Reason (R): the enlarged end of penis is glans penis and is covered by a loose fold of skin, i.e.

foreskin.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is NOT the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true

Answer- Option 2

25. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): mons pubis is a cushion of fatty tissue covered by skin and pubic hairs. Reason (R): the clitoris is a tiny finger like structure and it is equivalent to scrotum. 1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is NOT the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true

Answer – Option C

26. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): The spermatids are transformed into spermatozoa by the process of spermiogenesis. Reason (R): Mitosis and meiosis are involved during spermiogenesis.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is NOT the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true

Answer- Option C

27. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): At puberty 60, 000 to 80, 000 primary follicles are left in both ovaries of female. Reason (R): Both ovaries play equal role in menstrual cycle.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is NOT the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true

Answer – Option 4

28. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Zona pellucida is a cellular layer of ovum in human female.
Reason (R): Corona radiata is a non-cellular layer of ovum.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is NOT the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true

Answer – Option 4

29. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Eight to sixteen cells stage of the embryo is morula.
Reason (R): It is internally hollow and has inner cell mass and trophoblast.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is NOT the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true

Answer- Option C

30. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Human placental lactogen (hPL) is secreted by placenta.

Reason (R): It induces lactation towards the end of pregnancy.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is NOT the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true

Answer – Option 1

Very Short and Short Answer Type Questions

1. **Despite the presence of So many sperms in the vicinity of an egg cell, only one sperm enters the ovum. Why?**

   Ans: Because when sperm comes in contact with the ovum (Zona pellucida) & induces

   changes in the membrane to block entry of other sperms

2. **Define spermiogenesis. Where does it occur?**

   Ans: The transformation of non-motile spermatids into motile spermatozoa is called spermiogenesis. It occursinside the seminiferous tubules of the testes.

3. **Name the cells which produce testosterone. What is the function of this hormone?** Ans: Interstitial cells (Leydig's cells) of the testis secrete the testosterone hormone. Function. They control secondary sexual characters.
4. **The Spermatogonia cell has 46 chromosomes in human males. Give the number of chromosomes in (a) Primary spermatocyte (b) Spermatid**

   Ans: (a) Primary spermatocyte – 46 (b) Spermatid- 23

5. **How does colostrum provide initial protection against diseases in newborn infants? Give one reason.**

   Ans: Colostrum contains immunoglobin which provides immunity to the infants. **6. Name the embryonic stage which gets implanted in the uterine wall of a human female.** Ans: blastocyst stage

7. **Name the hormone which causes strong uterine contraction during parturition. Does the parturition signaloriginate from the mother or the fetus?**

   Ans: Hormone - is Oxytocin, The signal originates from the placenta and fully developed fetus. **8. Where are sperm stored in males?**

   Ans: Epididymis

9. **How is a primary oocyte different from a secondary oocyte?**

Ans: The primary oocyte is a diploid cell (2n) whereas the secondary oocyte is a haploid cell (n). The primary oocyte is formed when oogonia are at the prophase-I of the meiotic division in the foetal ovary whereas the secondary oocyte is formed from the primary oocyte after meiosis-I – I division to produce ova in females during the stage of puberty.

10. **Name the muscular and glandular layers of the human uterus. Which one of these layers undergoes cyclic changes during the menstrual cycle? Name the hormone essential for the maintenance of this layer.**

Ans: Muscular layer MyometriumGlandular layer – Endometrium.
The endometrium undergoes cyclic changes during the menstrual cycle.LH hormone maintains the lining of the uterus.

11. **State the fate of the Trophoblast of a human blastocyst at the time of implantation and that of the innercell mass immediately after implantation.**

Ans: The Trophoblast layer of the human blastocyst gets attached to the endometrium and the inner cell mass gets differentiated into an embryo. After attachment, the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. It is termed Implantation.

12. **Where are fimbriae present in the human female reproductive system? Give their function.**

Ans: Fimbriae are fingerlike projections present at the end of the fallopian tubes.Through fimbriae, eggs move from the ovaries to the uterus.

13. **Name the muscular and glandular layers of the human uterus. Which one of these layers undergoes cyclic changes during the menstrual cycle? Name the hormone essential for the maintenance of this layer.**

Ans: Muscular layer – Myometrium, Glandular layer – Endometrium, Endometrium undergoes cyclic changes during the menstrual cycle.
Progesterone hormone maintains the lining of the uterus.

14. What are the functions of the placenta other than its endocrine function? Ans: The placenta helps in the supply of nutrients and oxygen to the embryo, the elimination of excretory wastes and carbon dioxide produced by the embryo.

15. What is corpus luteum? How does it function as an endocrine gland?

Ans. During LH surge the Graafian follicle ruptures to release secondary oocyte. The remaining part of the Graafian follicle forms the corpus luteum. Corpus luteum functions as endocrine glands as they secrete progesterone.

16. Differentiate between Sertoli cells and Leydig cells concerning their location in the organand their function.

Ans: Sertoli cells are the nutritive cells present inside seminiferous tubules. They provide nourishment to the male germ cells.
Leydig cells are present outside the seminiferous tubules in the interstitial spaces, they secrete androgens.

17. Draw a sectional view of the seminiferous tubules of humans fmales and label any four parts.

Ans: fig 3.4, page 47, NCERT

18. What are the various male accessory glands? Give their function.

Ans. The male accessory glands include paired seminal vesicles, a prostate gland and paired bulbourethral glands.
These glands secrete seminal plasma rich in fructose, calcium and certain enzymes. Secretions of bulbourethralglands help in the lubrication of the penis.

Long Answer Type Questions

1. (a) Explain the menstrual phase in a human female. State the levels of ovarian and pituitary hormones during this phase.
(b) Why is follicular phase in the menstrual cycle also referred as proliferative phase? Explain.
(c) Explain the events that occur in a Graafian follicle at the time of ovulation and there after.

Ans. (a) Menstrual phase occurs when released ovum not fertilized, break down of endometrial lining (of the uterus) and its blood vessel form the liquid that comes out through the vagina, lasts for 3 to 5 days, Note - Low level of ovarian and pituitary hormones.

(b) In the ovary follicular development takes place and in the same phase the regeneration of endometrium through proliferation takes place inside uterus.

(c) Graafian follicle ruptures to release the ovum (secondary oocyte), remaining parts of the Graafian follicle transform into corpus luteum.

2. Mention the name and role of hormones which are involved in regulation of gamete formation in human male.

Ans. GnRH : Stimulates adenohypophysis to secrete gonadotropins.
GSH : Stimulates Sertoli cells to secrete factors while help in spermatogenesis.
ICSH : Stimulates interstitial cells to secrete testosterone.

3. Differentiate between spermatogenesis and oogenesis.

Ans. Spermatogenesis :

1. It occurs inside the testes.
2. All the stages are completed inside the testes.
3. Spermatogonia develop from the germinal epithelium lining in the seminiferous tubules. **4.** All spermatogonia give rise to spermatocytes.
5. Primary spermatocytes divide by meiosis I to give rise to two secondary spermatocytes.
6. Secondary spermatocyte divides by meiosis

Oogenesis :

1. It occurs inside the ovary.
2. Majority occurs inside the ovary but last stages occur in the oviduct.

3. Oogonia develop from the germinal epithelium overlying the ovary.
4. Only few oogonia give rise to oocytes.
5. Primary oocyte undergoes meiosis I to give rise to one secondary oocyte and a polar body.

4. Answer the following questions.
(i) State the levels of FSH, LH and Progesterone simply by mentioning high or low around

13^{th} and 14^{th} day and 21^{st} to 23^{rd} day.
(ii) In which of the above mentioned phases does egg travel to fallopian tube ?
(iii) Why there is no mensuration after fertilisation ?
Ans. (i) 13-14th day 21st -23rd day
FSH - High Low
LH - High Low
Progesterone - Low High
(ii) End of follicular or proliferative phase.
(iii) Menstruation does not occur during pregnancy upon fertilization due to high level of progesterone secreted by persisting corpus luteum and Placenta.

5. (a) Read the graph given below. Correlate the ovarian events that take place in the human female according to the level of the pituitary hormone during the following day. (i) 10th - 14th days (ii) 14th -15th days
(iii) 16th - 23th days (iv) 25th - 29th days
If the ovum is not fertilised)
(b) What are the uterine events that follow beyond 29th day if the ovum is not fertilised ?
Ans. (a) (i) Gonadotropins and FSH increases
(ii) LH attains peak level but FSH decreases
(iii) LH and FSH level decreases
(iv) LH remains low and FSH increases.
(b) After 29th day there is a menstrual flow involving discharge of blood and cast off endometrium lining.

6. T.S. of mammalian testis revealing seminiferous tubules show different ty (i) Name the two types of cells of germinal epithelium.
(ii) Name of cells scattered in connective tissue and lying between seminiferous tubules. Differentiate between them on the basis of their functions.
Ans. (i) Germinal epithelium have two types of cell. (1) Spermatogonium (2) Sertoli cells (ii) Leydig cells or Interstitial cells.
Functions
Spermatogonium undergoes meiotic division leading to sperm formation.
Sertoli cell : Nourishes germ cells
Leydig cell : Synthesise and Secrete hormone androgen.

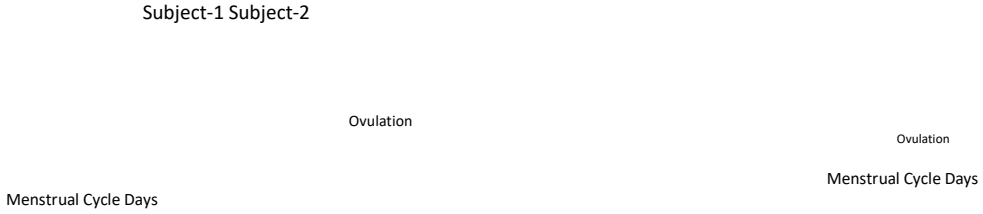
7. What are the various male accessory glands ? Give their function.
Ans. The male accessory glands include paired seminal vesicles, a prostrate gland and paired bulbourethral glands.
These glands secrete seminal plasma rich in fructose, calcium and certain enzymes. Secretions of bulbourethral glands help in lubrication of the penis.

8. Explain the menstrual cycle with a diagram.
Ans. Menstrual cycle has three phases: menstrual, proliferative and secretory.
(a) Menstrual Phase: The phase lasts for 3-5 days in human females and during this period the endometrial lining of the uterus is cast off and is slowly passed out from vagina as a mixture of blood.
(b) Proliferative or Follicular Phase: It lasts for 11 days between 6th to 16th day of the cycle. During this phase one ovarian follicle is changed into Graafian follicle and the endometrial layer is rebuilt along with repair of the ruptured blood vessels. Estrogen increases. It ends with ovulation.
(c) Secretory Phase: It lasts for 12 days between 17-28 days. The Graafian follicle is converted to Corpus Luteum. The endometrium grows and thickens further. Progesterone increases. It end with the conversion of corpus luteum to corpus albicans.

(H) CASE BASED QUESTIONS

1. Study the following and answer the questions given below: The following is the illustration of sequence of ovarian events during menstrual cycle in human female.

Observe it and give the answer of question that follow:



(i) Which structure in subject -1 and subject -2 form corpus luteum?

Ans. Graafian Follicle

(ii) Ovulation takes place on which day of menstrual cycle?

Ans. About the 14^{th} day

(iii) In subject-1 structure 'C' is?

Ans. Corpus albicans

(iv) Withdrawal of which hormone causes degeneration of corpus luteum in subject-1? Ans. LH

2. To answer the questions, study the diagram below for Subject 1 and 2 showing different types of structure.

(i) At the end of first meiotic division in subject -1 the structure A differentiate into ? Ans. Secondary spermatocytes

(ii) Structure-A in subject-2 is produced during the formation of?

Ans. Secondary oocyte

(iii) What is the correct sequence of structure-E formation in subject-1?

Ans. Spermatogonia, spermatocyte, spermatid, spermatozoa **(iv)**

Polar bodies are formed during in which subject?

Ans. Subject-2

3. Read the following and answer the questions given below:

The female reproductive system consists of a pair of ovaries along with a pair of oviducts, uterus, cervix, vagina and the external genitalia located in the pelvic region. These parts of the system along with a pair of the mammary glands are integrated structurally and functionally to support the processes of ovulation, fertilisation, pregnancy, birth and child care. Each ovary is about 2 to 4 cm in length and is connected to the pelvic wall and uterus by ligaments. The oviducts which consist of 3 parts, uterus and vagina constitute the female accessory ducts. The uterus is single and it is also called the womb. The shape of the uterus is like an inverted pear. The wall of the uterus has three layers of tissue.

(i) Why ovaries consider as primary sex organs of FRS ?

Ans. They produce the female gametes (Ovum) and several steroid hormone.

(ii) Write the name of parts of fallopian tube .

Ans. Infundibulum, Ampulla, Isthmus

(iii) Write the name of external genitilia of FRS.

Ans. Mons pubis, Labia majora, Labia minora, Hymen and Clitoris.

(iv) Write the name of layers of uterus.

Ans. Perimetrium, Myometrium and Endometrium.

(v) "The presence or absence of hymen is not a reliable indicators of virginity or sexual experience''. Explain.

Ans. The hymen can also be broken by a sudden fall or jolt, insertion of a vaginal tampon, active participation in some sports like horseback riding, cycling, etc. In some women the hymen persists even after coitus.

4. Read the following and answer the questions given below:

The process of formation of a mature female gamete is called oogenesis which is markedly different from spermatogenesis. Oogenesis is initiated during the embryonic development stage when a couple of million gamete mother cells (oogonia) are formed within each fetal ovary; no more oogonia are formed and added after birth. These cells start division and enter into prophase-I of the meiotic division and get temporarily arrested at that stage, called primary oocytes. Each primary oocyte then gets surrounded by a layer of granulosa cells and then called the primary follicle A large number of these follicles degenerate during the phase from birth to puberty. Therefore, at puberty only 60,000-80,000 primary follicles are left in each ovary. The primary follicles get surrounded by more layers of granulosa cells and a new theca and called secondary follicles.

(i) Differentiate between primary oocytes and primary follicle.

Ans. Primary oocytes: - These cells start division and enter into prophase-I of the meiotic division and get temporarily arrested at that stage, called primary oocytes. **Primary follicle**: - Each primary oocyte then gets surrounded by a layer of granulosa cells and then called the primary follicle.

(ii) Where and when the oogenesis initiated in female.

Ans. In the fetal ovary during embryonic development stage.

(iii) Name the ovarian hormone that induced the oogenesis process.

Ans. Estrogen

(iv) Write the name of stage in which the gametes mother cell get temporarily arrested?

Ans. Dictyotene of prophase-I of meiosis- I.

(v) How many primary follicles there are left in ovaries at puberty?

Ans. At puberty only 120,000-1600,000 primary follicles are left in ovaries.

1- **Explain the organization of the mammary gland with the help of a diagram.** Ans: Mammary gland occurs in pairs. It contains glandular tissues which are organized into 15-20 mammary lobes in each breast. Mammary lobes possess alveolar cells. These cells secrete milk. The alveoli open into themammary tubules which combine to form the mammary duct. Mammary ducts join to form a mammary ampulla that is connected to the lactiferous ducts. Through these structures, milk is sucked.

Fig- 3.4, page 46, NCERT

2- Explain the menstrual cycle in human females by giving a suitable diagram.

Ans: Menstrual cycle has three phases: menstrual, proliferative, and secretory.

a) Menstrual Phase (3-5 days)- During the endometrial lining of the uterus is ruptured and is released out fromthe vagina along with blood vessels and mucus.

b) Proliferative or Follicular Phase about 11 days): in this phase ovarian follicle matures into a Graffian follicle.The endometrial layer again proliferates. In this phase, ovulation occurs. c) Secretory Phase 9about 12 days)- Corpus Luteum is formed from a ruptured Graffian follicle. Theendometrium grows and thickens further.

Fig-3.9, page 50, NCERT

3- Explain the changes that take place during maturation of a follicle top Graffian follicle in the ovary.

Ans: Oogonia (gamete mother cells) are formed within each fetal ovary. No more Oogonia are formed after birth. Oogonia enter into the prophase-I stage of meiotic division and form primary oocytes.

The primary oocytes get surrounded by granulosa layers forming the primary follicle and then secondary follicles. The secondary follicle is transformed into a tertiary follicle characterized by an antrum (a fluid-filled cavity). The tertiary follicle matures into the Graafian follicle. 4- **Give a schematic representation of spermatogenesis and oogenesis**.

Ans: Fig 3.8, page 49, NCERT

5- Describe the hormonal control of the male reproductive system.

Ans:

i- Hypothalamus: It releases GnRH (gonadotropin-releasing hormones) which stimulate the pituitaryglands to secrete gonadotropins.

ii- LH and FSH

iii- Follicle Stimulating Hormone (FSH): It stimulates spermatogenesis in seminiferous tubules of thetestis.

iv- LH stimulates testosterone production from the interstitial cells of the testes. v- Sertoli cells secrete androgen binding protein (ABP) which concentrates testosterone in theseminiferous tubules

5. A women of 35 years age with a married life of eight years and having normal reproductive cycles visits a doctor along with her husband for consultation for infertility. They were not using any

contraceptive methods. They have no child. The doctor advises them after a detailed physical examination of both of them to undergo following investigations:
– Seminal analysis of the husband.
– Follicular study of the wife.
– Blood test for follicle Stimulating Hormone (FSH) estimation for both
With your basic knowledge of human embryology and the case given above, answer the following questions:

(i) Seminal analysis of the husband was done for determining **[CBSE Term-I 2022]** (i) Sperm morphology
(ii) Quantity and pH of semen
(iii) Rate of sperm release into the Vagina
(1) (i) only (2) (i) and (ii) (3) (ii) and (iii) (4) (ii) only
Ans. (2) (i) and (ii)
(ii) An ultrasound – guided follicular study was done for the wife for determining the size and physical appearance of the [CBSE Term-I 2022] (1) Ovary (2) Oogonia (3) Antral follicles (4) Corpus Luteum **Ans. (1)** Ovary
(iii) The blood test report of the wife showed low FSH value, which is indicative of – [CBSE Term-I 2022]
(1) low rate of formation of ovarian follicles (2) high rate of formation of ovarian follicles (3) low rate maturation of ovarian follicles (4) high rate of maturation of ovarian follicles **Ans. (1) low rate of formation of ovarian follicles**
(iv) In the above case if the husband is found to have sperm count of less than 20 million/mL and the wife is diagnosed with blockage in the oviduct, the couple would be advised for: **[CBSE Term-I 2022]**

(i) ZIFT (ii) AI (iii) IVF (iv) ICSI
(1) (i) and (iii) (2) (ii) and (iii) (3) (iii) and (iv) (4) (i) and (iv)
Ans. (1) (i) and (iii)
(v) The high level of which gonadotropin/ovarian hormone in the blood sample of the wife taken on day 20 of her reproductive (menstrual) cycle would indicate the letual phase of the ovarian cycle? **[CBSE Term-I 2022]**

(1) FSH (2) LH (3) Estrogens (4) Progesterone **Ans. (4) Progesterone**
(vi) In which phase of the menstrual cycle is the blood sample of a women take it shows high levels of L.H. and estrogen? **[CBSE Term-I 2022]**
(1) Ovulatory phase (2) Menstrual phase (3) Secretory phase (4) Follicular phase
Ans. (1) Ovulatory phase

WHO: reproductive health means total Well-being in all aspects of reproduction i.e. physical, emotional, behavioraland social.

REPRODUCTIVE HEALTH: PROBLEM AND STRATEGIES

Amniocentesis –

- Amniocentesis is a procedure used to take out a small sample of the amniotic fluid for testing of chromosomal abnormalities in a developing embryo.
- Misuse- It is also misused to check fetal sex determination based on the chromosomal pattern in the amnioticfluid surrounding the developing embryo.

POPULATION EXPLOSION AND BIRTH CONTROL/ CONTRACEPTIVE

METHODS

MMR- Maternal mortality rate

IMR- Infant mortality rate

An ideal contraceptive should be

Natural methods	work on the principle of avoiding chances of ovum and sperm meeting.
Periodic abstinence	couples avoid or abstain from coitus from day 10 to 17 of the menstrual cycle when ovulation could be expected
Withdrawal or coitus interruptus	The male partner withdraws his penis from the vagina just before ejaculation to avoid insemination
Lactational amenorrhea	as long as the mother breast-feeds the child fully, chances of conception are almost nil (up to 6 months)
Barrier methods	Ovum and sperm are prevented from physically meeting with the help of barriers.
Condoms	Also, protect from STDs
Other examples of barrier methods	Diaphragms, cervical caps, and vaults.
IUDs	Inserted in the uterus through the vagina. IUDs increase phagocytosis of sperms within the uterus and the Cu ions released suppress sperm motility and the fertilizing capacity of sperms.
Non-medicated	Lippes loop

Copper releasing	CuT, Cu7, Multiload 375
Hormone releasing IUDs	Progestasert, LNG-20
Pills	
progestogens or progestogen–estrogen combinations	taken daily for a period of 21 days starting preferably within the first five days of the menstrual cycle. After a gap of 7 days (menses), it has to be repeated in the same pattern. Pills inhibit ovulation and implantation and alter the quality of cervical mucus to prevent/ retard entry of sperms. CDRI:- Central drug research institute (Lucknow) It develops Saheli–a new oral contraceptive pill for females. Saheli –the new oral contracept tive for females contains a non-steroidal preparation. It is a 'once a week'. pill with very few side effects and high contraceptive value
Injection	
	Progestogens alone or in combination with estrogen are also used. If used within 72 hours of coitus is very effective.
Surgical Methods/ Sterilization	
Vasectomy	in males, a small part of the vas deferens is removed or tied up through a small incision on the scrotum
Tubectomy	a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through the vagina.

MEDICAL TERMINATION OF PREGNANCY (MTP)

- Voluntary termination of pregnancy before full term is called MTP or induced abortion.

- In India, MTP is legalized in 1971 with some strict conditions to avoid its misuse like female foeticide.
- MTP is used to get rides of unwanted pregnancy due to unprotected intercourse or failure of contraceptivesused during coitus or rapes.
- It is relatively safe during the first trimester or up to 12 weeks of pregnancy.

SEXUALLY TRANSMITTED DISEASES (STDS)

- Diseases or infections which are transmitted through sexual intercourse are collectively called sexuallytransmitted diseases (STD) or venereal diseases (VD) or reproductive tract infections (RTI).
- Examples- HIV- AIDS, Genital warts, Hepatitis, Gonorrhea, syphilis, genital herpes, chlamydiosis,trichomoniasis etc.
- Some infections like Hepatitis-B and HIV are also transmitted by sharing injection needles, surgical instrumentswith the infected person, transfusion of blood, or from infected mother to foetus.

One could be free of these infections by following the simple principles given below: (i) Avoid sex with unknown partners/multiple partners.
(ii) Always use condoms during coitus.
(iii) In case of doubt, one should go to a qualified doctor for early detection and get complete treatment if diagnosedwith the disease.

INFERTILITY: Couples which are unable to reproduce children in despite of protected sexual cohabitation are called infertile.

Reason of infertility

Physical, Congenital, Diseases, Drugs, Immunological, Psychological,

ART (assisted reproductive technologie

Infertile couples can be assisted to have children through certain special techniques commonly called (ART).

1. TEST TUBE BABY PROGRAMMES–

(a) IN VITRO FERTILISATION (IVF)-In this method, ova from the wife/donor (female) and the sperms from the husband/donor (male) are collected and induced to form zygote under simulated conditions in the laboratory.

(b) ZYGOTE INTRA FALLOPIAN TRANSFER OR ZIFT -The zygote or early embryo with up to 8 blastomeres is transferred into the fallopian tube (process is called zygote intra fallopian transfer or ZIFT).

(c) INTRA UTERINE TRANSFER OR IUT- if embryo with more than 8 blastomeres is transferred into the uterus (process is called intra uterine transfer or IUT).

2. GAMETE INTRA FALLOPIAN TRANSFER (GIFT)- It is the transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one, but can provide suitable environment for fertilisation and further development of the embryo.

3. INTRA CYTOPLASMIC SPERM INJECTION (ICSI)- It is a procedure to form an embryo in the laboratory by directly injecting the sperm into an ovum. The embryo is later transferred by ZIFT or IUT. 4. ARTIFICIAL INSEMINATION (AI)**- In this method, the semen collected either from the husband or a healthy donor is artificially. introduced into the vagina or into the uterus (intra uterine insemination or IUI). This technique is used in cases where the male is unable to inseminate sperms in the female reproductive tract or due to very low sperm counts in the ejaculation.**

PREVIOUS YEAR QUESTIONS

1. Given below are four aspects of Reproductie Health in Column A and their related information in

Column B : **[CBSE 2023]**

Column - A		**Column - B**	
S. No.	Terms used in Reproductive Heath	**S. No.**	Significant information
(A)	MTP	(i)	Analysing fetal cells from amniotic fluid of the foetus
(B)	Amniocentesis	(ii)	Legalised in 1971

(C)	Saheli	(iii)	Programme initiated in 1951
(D)	Family Planning	(iv)	Non - steroidal oral contraceptive

Select the correct match from the following options :

(1) (A) - (iv), B - (ii), (C) - (iii), (D) - (i) (2) (A) - (ii), B - (i), (C) - (iv), (D) - (iii) (3) (A) - (i), B - (iii), (C) - (ii), (D) - (iv) (4) (A) - (ii), B - (i), (C) - (iii), (D) - (iv) **Ans. (2) (A) - (ii), B - (i), (C) - (iv), (D) - (iii)**

2. Given below are Column - A with a list of certain Assisted Reproductive Technologies (ART) and in Column - B the procedures followed during ART : **[CBSE 2023]**

Column - A		**Column - B**	
S.No.	**Names of ART**	**S.No.**	**Procedures**
(A)	GIFT	(i)	Transfer of ovum from a donor into the fallopian tube of another female.
(B)	ICSI	(ii)	Transfer of semen from the donor into the vagina of the female.
(C)	ZIFT	(iii)	Injecting sperms directly into the ovum.
(D)	IUI	(iv)	Transfer of early embroys into the fallopian tube.

Choose the option where ART correctly matches with the procedure.

(1) (A) - (i), (B) - (ii), (C) - (iii), (D) - (iv) (2) (A) - (iv), (B) - (i), (C) - (ii), (D) - (iii) (3) (A) - (iv), (B) - (iii), (C) - (i), (D) - (ii) (4) (A) - (i), (B) - (iii), (C) - (iv), (D) - (ii) **Ans. (4) (A) - (i), (B) - (iii), (C) - (iv), (D) - (ii)**

3. Assertion (A): Through Reproductive and Child Health (RCH) programmes in India ; we could bring down the population growth rate.

Reason (R): A rapid increase MMR and IMP were the reasons, along other reasons for this. **[CBSE Term-I 2022]**

(1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. (2) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion. (3) Assertion is true but Reason is false.

(4) Both Assertion and Reason are false.

A is true but Reason is false.

4. Assertion (A): Sterilisation methods are generally advised for male/female pa l method to prevent any more pregnancies.

Reason (R): These techniques are less effective and have high reversibility. **[CBSE Term-I 2022]** (1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(2) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(3) Assertion is true but Reason is false.

(4) Both Assertion and Reason are false.

Ans. (3) Assertion is true but Reason is false.

5. Select the correct option for Human Chorionic Gonadotropin (hCG) released during embryonic development in humans. **[CBSE Term-I 2022]**

(i) Helps in maintenance of pregnancy.

(ii) Leads to rupture of Graafian follicle.

(iii) Cause strong uterine contraction during childbirth.

(iv) Brings metabolic changes in the mother.

(1) (i) and (ii) (2) (i) and (iv) (3) (ii) and (iii) (4) (ii) and (iv) **Ans. (2) (i) and (iv)**

6. A specialized procedure to form an embryo in the laboratory in which sperm is directly, injected into the ovum is : **[CBSE Term-I 2022]**

(1) IUT (2) IUI (3) ICSI (4) ZIFT **Ans. (3) ICSI**

7. Listed below are all reproductive tract infections except [CBSE Term-I 2022] (1) Genital herpes (2) Filariasis (3) Trichomoniasis (4) Syphilis

Ans. (2) Filariasis

8. Assertion (A) : Determining the sex of an unborn child followed by MTP is an illegal practice. **Reason (R) :** Amniocentesis is a practice to test the presence of genetic disorders also. **[CBSE 2023]**

(1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. (2) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion. (3) Assertion is true but Reason is false.

(4) Both Assertion and Reason are false.

Ans. (2) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion. 9. Name and explain a surgical contraceptive method that can be adopted by the male partner of a couple. [CBSE 2023] Ans. Vasectomy. In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum.

10. State the composition and principle of oral pills as a contraceptive measure taking the example of Saheli. [CBSE-IMP Question]

Ans. The composition of oral pills comprises: Either progestogens alone or progestogen – estrogen combination. Saheli is a Non-steroidal preparation. It inhibits ovulation and implantation. It also alters the quality of cervical mucus to prevent/ retard the entry of sperms.

11. (a) IUDs are said to be effective contraceptives. Name any two common d write the mode of their actions.

(b) When is sterilisation advised to married couples? How is it carried out in a human male and a female, respectively? [CBSE 2020]

Ans. (a) Hormone releasing IUDs- It makes the uterus unsuitable for implantation and the cervix hostile to the sperms.

Copper releasing IUDs – Cu ions released suppress sperm motility and the fertilising capacity of sperms.

(b) When a desired family size is attained, and couple don't need any more child then only sterilisation methods are advised.

Sterilisation procedure

(i) Male- in male it is called **'vasectomy'-** In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum.

(ii) Female- in female it is called **'tubectomy'-** In tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.

12. Explain one application of each one of the following :

(a) Amniocentesis

(b) Lactational amenorrhea

(c) ZIFT

(d) Prepare a poster for the school programme depicting the objectives of : "Reproductive and Child Health Care Programme". [CBSE 2019] Ans. (a) To detect chromosomal disorders / sex determination (legally banned) / detect genetic disorder. **(b)** To prevent pregnancy / means of natural

contraception.

(c) To assist an infertile couple to have children by tranferring the zygote / early embryo / embryo at eight blastomere stage into fallopian tube.

(d) A poster made on RCH - Any relevant slogan or sketch made should be awarded like e.g. - Hum Do Hamare Do,

- Gender selection and detection is punishable, or (Any other relevant theme)

MULTIPLE CHOICE QUESTIONS

1. What is the full form of WHO?

(1) Ware House Organization (2) War and Health Organization

(3) World Health Office (4) World Health Organization

Ans. (4) World Health Organization

2. What are the various aspects of reproduction covered by WHO?

(1) Physical, Emotional, Behavioural (2) Physical, Emotional, Behavioural, Social (3) Physical, Emotional, Gestational, Social (4) Physical, Emotional, Social **Ans. (2) Physical, Emotional, Behavioural, Social.**

3. Which was the first country in the world to initiate a nationwide programme for reproductive health? (1) China (2) USA (3) India (4) Russia

Ans. (3) India

4. The figure indicates which contraceptive device?

(1) Condom for female (2) Condom for male (3) Diaphragm (4) Cervical cap **Ans. (2) Condom for male**

(2) The programme of '*Family Planning*' was initiated in the year _____

1. 1950 (2) 1947 (3) 1949 (4) 1951

Ans. (4) 1951

5. The reproductive program RCH stands for

(1) Reproductive and Community Health Care (2) Restorative and Communal Health Care

(3) Reproductive and Child Health Care

(4) Reproductive and Congenital Health Care

Ans. (3) Reproductive and Child Health Care

6. In context of reproductive health, STIs stands for

(1) Sexually Terminal Infections (2) Sexually Transmitted Infections

(3) Sexually Transformed Infections (4) Sexually Transducted Infections

Ans. (2) Sexually Transmitted Infections

7. The fluid which envelops the developing foetus is called

(1) Chorionic fluid (2) Placental fluid (3) Amniotic fluid (4) Uterine fluid **Ans. (3) Amniotic fluid**

8. Statutory ban has been laid on _____ to check female foeticide.

(1) Choriocentesis (2) Amniocentesis (3) Uterocentesis (4) Embryocentesis **Ans. (2) Amniocentesis**

9. The amniocentesis test is based on _____ to determine the sex of developing foetus. (1) External genitalia (2) Secondary sexual characters

(3) Chromosomal pattern (4) Embryonic enzymes

Ans. (3) Chromosomal pattern

10. CDRI, Lucknow developed which new female contraceptive?

(1) 'Sakhi' (2) 'Saheli' (3) 'Saloni' (4) 'Smiti'

Ans. (2) 'Saheli'

11. CDRI stands for

(1) Contraceptive Drug Research Institute (2) Central District Research Institute (3) Central Drug Research Institute (4) Central Dermatologic Research Institute **Ans. (3) Central Drug Research Institute**

12. The world population was 2000 million in the year

(1) 1980 (2) 1970 (3) 1960 (4) 1900

Ans. (4) 1900

13. Which IUD is shown in the given figure?

(1) Lippes loop (2) Progestasert (3) Copper T (4) Multiload-375 **Ans. (3) Copper T**

14. Coitus interrupts/withdrawal method concerns with

(1) Withdrawal of penis from vagina before ejaculation
(2) Withdrawal of penis from vagina after ejaculation
(3) Prevention of coitus
(4) Alternate prevention of coitus

Ans. (1) Withdrawal of penis from vagina before ejaculation

15. After parturition, which natural contraception way can be utilized? (1) Lactational menorrhea (2) Lactational amenorrhea (3) Lactational deficiency (4) Lactational prevention **Ans. (2) Lactational amenorrhea**

16. In lactational amenorrhea, which event does not occur in menstrual cycle? (1) Menstrual flow (2) Ovulation (3) Funicular phase (4) Luteal phase **Ans. (2) Ovulation**

17. Lactational amenorrhea is effective only up to a maximum of _____ months. (1) Two (2) Four (3) Six (4) Eight **Ans. (3) Six**

18. _____ is a popular brand of condom for males.

(1) 'Nishodh' (2) 'Nirodh' (3) 'Nidosh' (4) 'Nirdosh' **Ans. (2) 'Nirodh'**

19. Which of the following is not applicable to females for contraception? (1) Diaphragms (2) Vasectomy (3) Condoms (4) Cervical caps

A y

(D) ASSERTION – REASON QUESTIONS

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:

(1) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(3) If Assertion is true but Reason is false.

(4) If both Assertion and Reason are false.

1. Assertion: A person should be considered reproductively healthy if they have healthy reproductive organs but are emotionally imbalanced.
Reason: This statement about reproductive health was given by WHO.
Ans (4)

2. Assertion: Family planning is an action plan to attain reproductive health among people. **Reason:** Improved programmes covering reproduction related areas were propagated by RCH to create awareness among people.
Ans (2)

3. Assertion: Reproductive and Child Healthcare Programmes is for reproduction related areas.

Reason: It deals with creating awareness among various reproduction related aspects. **Ans (1)**

4. Assertion : Introduction of sex education in schools should be encouraged.
Reason : This will encourage children to believe in myths about sex related aspects.
Ans (3)

5. Assertion: Natality increases both population density and population size.
Reason: Natality increases the number of individuals in an area by births.
Ans (1)

6. Assertion: Zero population growth should be achieved as early as possible to control human population.
Reason: This as requires not two children per couple but a lilttle more.
Ans (1)

7. Assertion: Periodic abstinence is a method in which couples avoid from coitus from day 17 to 27 of menstrual cycle.
Reason: It is a very effective method and 100% sure of birth control.
Ans (4)

8. Assertion: Syphilis, gonorrhea and AIDS are STIs.
Reason: These diseases are transmitted through sexual intercourse.
Ans (1)

9. Assertion : HIV infection can be avoided by use of condoms.
Reason : Condoms secrete anti-viral interferon's.
Ans (3)

10. Assertion: STIs are transmitted through sexual intercourse.
Reason: STIs can be prevented by using barrier contraceptives like condoms.
Ans (1)

(E) VERY SHORT ANSWER QUESTIONS

Ideal contraceptives for the females who wants to delay pregnancy.
Ans. IUDs

2. Oral pills for females causes Ans. Inhibit ovulation and implantation

3. Once a-week oral pill is :
Ans. Saheli

4. In emergency which contraceptive methods may be used within 72 hours of coitus.
Ans. IUD & progestogen or progestogen estrogen combination pills.

5. Which contraceptive method are also known as sterilisation?
Ans. Surgical method

6. Sterilisation in male is known as :
Ans. Vasectomy

7. Government of India legalised MTP in.
Ans. 1971

8. MTP is considered relatively safe during.
Ans. First trimester

9. In ZIFT-early embryo is transferred in (upto 8 blastomeres)
Ans. Fallopian tube

10. Full form of ZIFT
Ans. Zygote Intra Fallopian Transfer

11. In IUT, embryos with more than 8 blastomeres are transferred in
Ans. Uterus

12. Full form of GIFT
Ans. Gamete Intra Fallopian Transfer

13. Procedure to form an embryo in the laboratory in which a sperm is directly injected into the cytoplasm of ovum

Ans. ICSI-Intracytoplasmic sperm injection.

(F) SHORT ANSWER QUESTIONS

How does 'Saheli' Work like a contraceptive?

Ans. 'Saheli' is a non-steroid oral contraceptive. It contains hormone. It shows following effects - 1. Alter the quality of cervical mucus to prevent or retard entry of sperms into uterus. 2. It prevents implantation.

2. What is copper –T?

Ans. It is an intra uterine device. It is implanted into uterus through vagina by expert doctor or trained nurse. It is T shaped, made of copper. It releases Cu^{++} which decrease the mortality and fertilizing ability of sperms.

3. Name the physical methods of contraceptives.

Ans. They are barriers. They prevent physical association of sperm and ovum. Example are

1. Condoms

2. Others - Diaphragm, Vaults, Cervical caps.

4. What is infertility? Suggest the methods used for curing the infertility. Ans.

Infertility - When couples are unable to produce children inspite of un protected sexual cohabitation for at least two or more years duration.

- ART = Assisted Reproductive Technologies are used to cure infertility.
- These technologies are- **1. In-vitro fertilisation = IVF**

(a) ZIFT (b) IUT

2. In vivo fertilization 3. GIFT 4. ICSI

5. What are the suggested reasons for population explosion?

Ans. The suggested reasons of population explosion are:

(a) Rapid decline in death rate.

Decline in maternal mortality rate (MMR)

Decline in infant mortality rate (IMR) and

(b) Increase in number of people in reproducible age.

6. Our government has intentionally imposed strict conditions for M.T.P. in our country. Justify giving a reason.

Ans. **(i)** To prevent female foeticide

(ii) To maintain sex ratio

(iii) To avoid any danger for (young) mother (and foetus)

(G) LONG ANSWER QUESTIONS

Reproductive and Child Healthcare (RCH) programmes are currently in operation. One of the major tasks of these programmes is to create awareness amongst people about the wide range of reproduction related aspects. As this is important and essential for building a reproductively healthy society.

(a) "Providing sex education in schools is one of the ways to meet this goal." Give four points in support of your opinion regarding this statement.

(b) List any two 'indicators' that indicate a reproductively healthy society.

Ans. (a) Provide right information to the young so as to discourage children from believing in myths and misconception about sex related aspects. Proper information about reproductive organs- Proper information about adolescence and related changes-Safe hygienic practices STDs/AIDS - Available birth control options – Care of pregnant mothers-Post natal care Importance of breast feeding - Equal opportunities for male and female child awareness of problems due uncontrolled population growth - Sex abuse - Sex related crimes (Any four)

(b) Better awareness about sex related matters / increase number of assisted deliveries/better post natal care/decrease in IMR (Infant Mortality Rate)/decrease MMR(Maternal Mortality Rate)/increase number of couples with small families/better detection and cure of STDs/ overall increased medical facilities for sex related problems / total well being in all aspects of reproduction/physical - behavioural - social / physically and functionally normal reproductive organs/normal emotional

and behavioural interaction among all sex related aspects.

2. (a) Name and explain the mode of action of any two types of IUDs.

(b) List the advantages of using 'Saheli' as a contraceptive.

Ans. (a)

- Non- medicated (e.g. lippes loop), phagocytosis of sperms
- Copper releasing IUDs (CuT, Cu7, Multiload 375), suppress sperm motility/reduces fertilizing capacity of sperm.

Hormone releasing IUDs (Progestasert, LNG – 20), makes uterus unsuitable for implantation/cervix hostile to sperms.

(b) Advantages of Saheli-

(i) Non -steroidal (ii) Once a week (iii) High contraceptive value (iv) Less side effects **3. Name two hormones that are constituents of contraceptive pills. Why do they have high and effective contraceptive value? Name a commonly prescribed non-steroidal oral pill. Ans.** Progestogen-estrogen combination, Progestogen or progesterone are present in contraceptive pills. They inhibit ovulation, implantation and alter quality of cervical mucus to retard entry of sperm. *Saheli* is a commonly prescribed oral pill.

4. (a) Mention the problems that are taken care of by Reproduction and Child Health Care programme.

(b) What is amniocentesis and why there is a statutory ban on it?

Ans. (a) (i) Uncontrolled population growth (ii) social evil like sex abuse (iii) sex related crime (iv) STDs.

(b) Foetal sex determination test based on chromosomal pattern in the amniotic fluid/to study chromosomal abnormalities in the foetus, banned to legally check female foeticide.

H) CASE-STUDY BASED QUESTIONS

1.

The following us the illustration of male reproductive system. Observe it and give the answer of question that follow:

Subject-1 **Subject-2**

Study the following and answer the questions given below:

(i) In subject-1 a small portion of which duct is removed and tied up?

Ans. Vas deferens

(ii) Which subject needs barrier?

Ans. Subject-2

(iii) Subject-1 shows infertility due to?

Ans. Vasectomy

(iv) What are the permanent method of family planning?

Ans. Vasectomy, Tubectomy

2. Study the following and answer the of question that follow:

questions given below:

The following us the illustration of female reproductive system. Observe it and give the answer

Subject-1 Subject-2

(i)

Which part is removed in a subject-1?

Ans. Fallopian tube

(ii) Ovulation occur in which subject?

Ans. Both subject-1 and subject-2

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(iii) In which subject does not show menstruation cycle?

Ans. Subject-1

(iv) n which subject fertilization does occurs?

Ans. Subject-2 Only

. Read the following and answer the questions given below:

Intentional or voluntary termination of pregnancy before full term is called MTP or induced abortion. Nearly 45 to 50 million MTPs are performed in a year all over the world which accounts to 1/5th of the total number of conceived pregnancies in a year. Obviously, MTP has a significant role in decreasing the population though it is not meant for that purpose. Whether to accept /legalise MTP or not is being debated upon in many countries due to emotional, ethical, religious and social issues involved in it. Government of India legalised MTP in 1971 with some strict conditions to avoid its misuse. Such restrictions are all the more important to check indiscriminate and illegal female foeticides which are reported to be high in India.

(i) Expand MTP.

Ans. Medical Termination of Pregnancy

(ii) What is relatively safe duration for MTPs ?

Ans. First trimester, i.e., upto 12 weeks of pregnancy.

(iii) When Government of India legalised MTP with some strict conditions to avoid its misuse?

Ans. 1971

(iv) What is disturbing trend observed related to MTPs?

Ans. The MTPs are performed illegally by unqualified quacks which are not only unsafe but could be fatal too.

(v) Amniocentesis for sex determination is banned in our country. Is this ban necessary? Comment.

Ans. Yes, the ban is necessary because amniocentesis is misused for determining the sex of the foetus and then aborting the child if it is a female.

4. Read the following and answer the questions given below:

India was amongst the first countries in the world to initiate action plans and programmes at a national level to attain total reproductive health as a social goal. These programmes called 'family planning' were initiated in 1951 and were periodically assessed over the past decades. Improved programmes covering wider reproduction-related areas are currently in operation under the popular

name RCH programmes'. Creating awareness among people about various reproduction related aspects and providing facilities and support for building up a reproductively healthy society are the major tasks under these programmes. With the help of audio-visual and the printmedia governmental and non-governmental agencies have taken various steps to create awareness among the people about reproduction-related aspects.

(i) Expand RCH.

Ans. Reproductive and Child Health Care

(ii) Mention the problems that are taken care of by RCH.

Ans. The uncontrolled population growth, social evil like sex abuse , sex related crime and STDs. **(iii) Prepare a slogan for poster for the school programme depicting the objectives of : "Reproductive and Child Health Care Programme".**

Ans. A poster made on RCH - Any relevant slogan or sketch made should be awarded marks e.g. Hum Do Hamare Do, Gender selection and detection is punishable.

(iv) "Providing sex education in schools is one of the ways to meet the goal of RCH ". Give a points in support of your opinion regarding this statement.

Ans. Provide right information to the young so as to discourage children from believing in myths and misconception about sex related aspects.

(v) What do you think is the significance of reproductive health in a society?

Ans. In a society if the people are aware of birth control methods to avoid sexually transmitted diseases and the importance of breast-feeding and post-natal care of the mother and baby, then the society can have healthy children who are the future citizens of a nation.

CHAPTER –4

PRINCIPLES OF INHERITANCE AND VARIATION

Mendel's Laws of Inheritance:

1. Genetics is the branch of biology, which deals with inheritance and variation of characters from parents to offspring.

2. Inheritance is the process by which characters or traits are transferred from one generation to the next.

3. Variation is the degree by which progeny differs from each other and with their parents. Humans knew from as early as 8000-1000 BC, that one of the causes of variation was hidden in sexual reproduction. **4. Gregor Johann Mendel,** for the first time conducted experiments to understand the pattern of inheritance of variation in living beings.

5. Mendel's Experimental Material

(i) He conducted experiments on garden pea plant (Pisum sativum) for seven years (1856-1863) and proposed the laws of inheritance in living organisms.

(ii) He selected garden pea plant as a sample for experiment because of:

(a) Easy availability on a large scale.

(b) Many varieties are available with distinct characteristics.

(c) They are self-pollinated and can be cross-pollinated easily in case self-pollination does not occur.

(iii) Mendel selected 14 true-breeding (a breeding line which has undergone continuous self-pollination shows stable trait inheritance and expression for several generations) pea plant varieties, as pairs, which were similar except for one character with contrasting traits.

Seven contrasting characters and their traits as taken by Mendel are listed in the table given

below:

6. Mendel's Experimental Procedure
(i) He observed one trait or character at a time. For example, he crossed tall and dwarf pea plants to study the inheritance of one gene.
(ii) Mendel hybridised plants with alternate forms of a single trait (monohybrid cross). The seeds produced by these crosses were grown to develop into plants of Filial$_1$ progeny or F_1-generation. (iii) He then self-pollinated the tall F_1 plants to produce plants of Filial$_2$ progeny or F_2-generation. (iv) In later experiments, Mendel also crossed pea plants with two contrasting characters known as dihybrid

cross.

(v) Mendel self-pollinated the F_2 plants also.

7. Mendel's Observation in his Experiment
(i) In Frgeneration, Mendel found that all pea plants were tall and none were dwarf. (ii) He also observed other pair of traits and found that F_1 always resembled either one of its parents and the traits of the other parent was not found in them.

(iii) In F_2-generation, he found that some of the off springs were dwarf, i.e. the character which were not seen in F_1-generation were expressed in F_2-generation.
(iv) These contrasting traits (tall/dwarf) did not show any mixing either in F_1 or in F_2-generation.

(v) Similar results were obtained with the other traits that he studied. Only one of the parental traits was expressed in F_1-generation, while at F_2-generation stage, both the traits were expressed in the ratio of 3:1. (vi) Mendel also found identical results in dihybrid cross as in monohybrid cross. (vii) On self-pollinating F_2 plants, he found that dwarf F_2 plants continued to generate dwarf plants in F_3 and F_4-generations.
8. Inferences of Mendel's Experiments
(i) Mendel inferred that something was being passed down, from parents to offspring through the gamete over successive generations. He called them 'factors', now known as genes.
(ii) Genes are the unit of inheritance. They contain the information required to express a trait. (iii) Genes which codes for a pair of contrasting traits are called alleles or allelomorphs, i.e. they are slightly different forms of the same gene.

(iv) Mendel also proposed that in a true breeding variety, the allelic pair of genes are identical or homozygous, TT and tt for tall or dwarf pea variety respectively.
(v) TT and tt are genotype of the plant.
(vi) Descriptive term tall and dwarf are the phenotype.
(vii) When the tall (TT) and dwarf (tt) pea plant produce gametes, the alleles of the parental pair segregate from each other and only one allele is transmittted to a gamete.
(viii) The gametes of the tall TT plants have the allele T and the dwarf tt plants have the allele t. (ix) This segregation of alleles is a random process and, so there is a 50% chance of a gamete containing either allele, as verified by the results of crossings. After fertilisation of TT and tt traits, hybrids contain Tt and are called heterozygous.

(x) Mendel found the phenotype of Tt to be similar as TT parent in appearance, he proposed that in a pair of dissimilar factor, one dominates the other (T in this case) and hence, is called the dominant factor, while the other factor (t) is recessive.
(xi) Allele can be similar in case of homozygous TT or tt and dissimilar in case of heterozygous Tt. (xii) In Tt plant, one character (height) is controlled by a gene hence, it is monohybrid and cross between TT and tt is called monohybrid cross.

10. Mendel's law of inheritance are based on his observations on monohybrid and dihybrid crosses, he proposed three laws:
(i) Law of dominance (first law) States that characters are controlled by genes which occur in pair, when two alternate forms of a trait or character (genes or alleles) are present in an organism, only one factor (dominant) expresses itself in F_1-generation. While, the other factor (recessive) remains hidden. It explains expression of genes in a cross and 3:1 ratio obtained in the F_2-generation.

(ii) Law of segregation (second law) States that the factors or alleles of a pair segregate from each other during gamete formation, in a way that a gamete receives only one of the two factors. They do not show any blending.
(iii) Law of independent assortment (third law) It is based on inheritance of two genes, i.e. dihybrid cross which states that when two pairs of contrasting traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters. These factors randomly rearrange in the offsprings producing both parental and new combination of characters. The Punnett square can be used to understand the independent during meiosis.

11. Incomplete dominance is a phenomenon in which the F: – hybrid shows characters intermediate of the parental genes. In this process, the phenotypic ratio of F_2-generation deviates from the Mendel's monohybrid ratio.

Example, inheritance of flower colour in the dog flower (snapdragon or Antirrhinum sp) and four O' clock plant (Mirabilis jalapa).

In a cross between red flower (RR) and white flower plant (rr), the F_1 (Rr) was pink (in figure). When F_1 was self-pollinated, the F_2 resulted in the ratio 1: 2: L

12. Codominance is a phenomenon in which two alleles are able to express themselves independently when present together. These alleles are called codominant alleles.
The offsprings show resemblance to both the parents.
(i) A common example of codominance is ABO blood groups in humans.
(ii) The gene for blood group exist in three allelic forms I^A, $I^B$and i.
(iii) $I^A$and I^Bproduce RBC surface antigens A and B, respectively, whereas 'i' does not produce any antigen.
(iv) IA and I^Bboth are dominant alleles, whereas T is the recessive allele.
(v) In case $I^A$and $I^B$are present together, both express equally and produce both the surface antigens A and B.

13. Multiple allelism It can also be explained by ABO blood grouping. In this case, more than two, i.e. three alleles are governing the same character. Multiple alleles can be found only when population studies

are made since, an individual can have only two alleles.

14. Test cross It is a method devised by Mendel to determine the genotype of an organism. A cross is made of unknown dominant genotype with the recessive parent.

(i) For example, Fj hybrid (Tt) heterozygous of a pure tall plant (TT) and a pure dwarf plant (tt) is crossed with a pure dwarf plant.

In this example, the progeny consists of tall and dwarf plants in the ratio 1:1. Thus, monohybrid test cross ratio is 1:1.

(ii) In case of both homozygous parents, i.e. TT, the progeny obtained will have to tall plants.

(Tall)

(iii) In case of dihybrid test cross, where two traits are taken, a heterozygous individual is crossed with a homozygous recessive parent.

15. Pleiotropy It is the phenomenon in which a single gene exhibits multiple phenotypic expressions. A single pleiotropic gene may produce more than one effect.
For example,
(i) Phenylketonuria, a disorder caused by mutation in the gene coding the enzyme phenylalanine hydroxylase. The affected individuals show hair and skin pigmentation and mental problems. (ii) Starch synthesis in pea seeds is controlled by one gene with two alleles (B and b). (a) Starch is synthesised effectively by the homozygotes, BB and hence, the starch grains are large and the seeds at maturity are round.
(b) The homozygotes, bb are less efficient in starch synthesis, hence they have small starch grains and the seeds are wrinkled.
(c) The heterozygotes, Bb produce round seeds, indicating that B is the dominant allele, but the starch grains are intermediate in size and hence, for the starch grain size, the alleles show incomplete dominance. (d) It is an example of pleiotropy as the same gene controls two traits, i.e. seed shape and size of starch grains.
(e) Here, it is to be mentioned that dominance is not an autonomous feature of the gene or its product, but it depends on the production of a particular phenotype from the gene product.
16. Polygenic inheritance was given by Galton in 1833. In this, traits are controlled by three or more genes (multiple genes). These traits are called polygenic traits. The phenotype shows participation of each allele and is also influenced by the environment and is called quantitative inheritance as the character/phenotype can be quantified.
For example, human skin colour which is caused by a pigment melanin. The quantity of melanin is due to three pairs of polygenes (A, B and C). If it is black or very dark (AA BB CC) and white or very light (aa bb cc) individuals marry each other, the offspring shows intermediate colour often called mulatto (Aa Bb Cc). A total of eight allele combinations is possible in the gametes forming 27 distinct genotypes. **17. Complementary genes Complement** the effect of each other to produce a phenotype. For example, in case of sweet pea, the flower colour is due to complementary genes. Here, one gene complements the expression of another gene.

18. Rediscovery of Mendel's Laws

(i) Though, Mendel published his work on inheritance of characters in 1865, it remained unrecognised for several reasons till 1900. Some of them are as follow:
(a) Communication was difficult, so his work could not be widely publicised.
(b) His concept of genes as stable unit that controlled the expression of traits and of the pair of alleles

which did not blend was not accepted.
(c) His approach of using mathematics to explain biological phenomenon was new and unacceptable. (d) He could not provide any physical proof for the existence of factors.
(ii) In 1900, de Vries, Correns and Von Tschermak rediscovered Mendel's results independently. Due to microscopy, they carefully observed cell division.
(iii) This led to discovery of chromosomes (structure in the nucleus that appeared to double and divide just before each cell division).

19. Chromosomal theory of inheritance was proposed independently by Walter Sutton and Theodore Boveri in 1902. They united the knowledge of chromosomal segregation with Mendelian principles and called it chromosomal theory of inheritance.
The main points are as follow:
(i) Gametes (sperm and egg) transmit hereditary characters from one generation to another. (ii) Nucleus is the site of hereditary characters.
(iii) Chromosomes as well as genes are found in pairs.
(iv) The two alleles of a gene pair are located on homologous sites on the homologous chromosomes. (u) The sperm and egg having haploid sets of chromosomes fuse to regain the diploid state. (vi) Homologous chromosomes synapse during meiosis and get separated to pass into different cells and is the basis of segregation and independent assortment during meiosis.

20. Experimental verification of the chromosomal theory of inheritance was done by Thomas Hunt Morgan and his colleagues.
(i) Morgan selected fruit fly, Drosophila melanogaster for his experiments because:

(a) They could be grown on simple artificial medium in the laboratory.
(b) Their life cycle is only about two weeks.
(c) A single mating could produce a large number of flies.
(d) There was a clear differentiation of the sexes, i.e. male (smaller) and female (bigger). (e) It has many types of hereditary variation that can be easily seen through low power microscopes.

(ii) Linkage and Recombination

(a) The physical association of two genes on a chromosome is called linkage.
(b) Recombination explains the generation of non-parental gene combinations.
(c) To explain the phenomena of linkage and recombination, Morgan carried out several dihybrid crosses in Drosophila to study genes that were sex-linked, i.e. the genes are located on X-chromosome. He observed that two genes did not segregate independently of each other.
(d) He observed that the proportion of parental gene combinations were much higher than the non-parental type, when two genes in a dihybrid cross were situated on the same chromosome. Morgan concluded this as a physical association or linkage.
(e) Morgan and his group also found that even when genes were grouped on the same chromosome, some genes were very tightly linked (very low recombination), while others were loosely linked (higher recombination).

(f) Recombination of linked genes is by crossing over (exchange of corresponding parts between the chromatids of homologous chromosomes).

Linkage results of two dihybrid crosses conducted by Morgan. Cross 'A' shows crossing between genes y and w. Cross 'B1 shows crossing between genes w and m. Here, dominant wild type alleles are represented with (+) sign.

(g) Alfred Sturtevant (Morgan's student) used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and 'mapped' their position on the chromosome. Genetic maps are now used as a starting point in the sequencing of whole genomes as done in case of Human Genome Sequencing Project.

Sex Determination

Henking discovered the genetic/chromosomal basis of sex determination by working on insects. He observed specific nuclear structures during spermatogenesis in insects. He named these structures as X bodies.

He observed that after spermatogenesis, 50% of the sperm obtained these structures, while 50% did not.

Later on, it was found that the X body observed by Henking was actually a chromosome and thus, this chromosome was named X chromosome.

Chromosomes involved in sex determination are called sex chromosomes, while the other chromosomes are called autosomes. ● XO type of sex determination

Other than autosomes, at least one X chromosome is present in all insects.

Some sperms contain X chromosomes, while some do not. Eggs fertilised by sperms having X chromosomes become females. So, females have two X chromosomes.

Eggs fertilised by sperms not having X chromosomes become males. So, males have only one X chromosome.

Example of organisms with XO type of sex determination – Insects

● XY type of sex determination

Males have X chromosome and its counterpart Y chromosome, which is distinctly smaller. Hence, males are XY.
Females have a pair of X chromosomes. Hence, females are XX. Example of organisms with XY type of sex determination – Humans and *Drosophila*
● Male heterogamety – XO and XY types of sex determination are examples of male heterogamety.
In XO type, some gametes have X chromosomes, while some gametes are without X chromosomes.
In XY type, some gametes have X chromosomes, while some gametes have Y chromosomes.
Female heterogamety – ZW type of sex determination is an example of female heterogamety.
In ZW type, the female has one Z and one W chromosome, while the male has a pair of Z chromosomes.

Mutation, Pedigree Analysis, & Genetic Disorders

Mutation

Alteration of DNA sequence resulting in changes in genotype and phenotype of organisms
DNA helix runs in a chromatid, hence any change (insertion or deletion) in the DNA sequence affects the chromosome. Point Mutation – Mutation arising due to change in single base pair of DNA as in sickle cell anaemia
Frameshift Mutation – Mutations arising due to deletion or insertion in DNA sequence
Mutagens – Chemical or physical agents that lead to mutations Example – UV radiations

Mendelian Disorders

Characterized by mutation in a single gene
Their mode of inheritance follows the principles of Mendelian genetics. Mendelian disorders can be
autosomal dominant (muscular dystrophy)
autosomal recessive (sickle cell anaemia)
sex linked (haemophilia)

Haemophilia

Sexlinked
recessive disease
Transmission – From unaffected female (carrier) to male progeny
Females act as carriers of disease, but rarely suffer from haemophilia since for a female to become haemophilic, the mother should be carrier and father should be haemophilic.
In this disease, protein involved in blood clotting is affected. Therefore, even a simple cut results in uncontrolled bleeding. ● Sickle cell anaemia
Autosomal recessive disease
Transmission – From parent to offspring when both parents are carriers of disease

Pair of alleles Hb A and Hb S controls the expression of this disease.

Hb A and Hb A – Normal

Hb A and Hb S – Carrier of disease

Hb S and Hb S – Diseased

Cause of the disease – Change in gene causes the replacement of GAG by GUG leading to the substitution of Glu by Val at sixth position of beta globin chain of haemoglobin.

The mutant haemoglobin so formed polymerises at low oxygen tension, resulting in change in shape of RBC to sicklelike. ● Phenylketonuria

Autosomal recessive disease

Phenylalanine Tyrosine

The enzyme responsible for this conversion gets mutated. Phenylalanine accumulates. Then,

Phenylalanine → Phenylpyruvic acid → Accumulates in brain → Mental retardation

Phenylpyruvic acid also gets excreted through urine since kidneys poorly reabsorb it.

Chromosomal Disorders

Total number of chromosomes in humans = 46 (23 pairs) Total 23 pairs = Autosomes (22 pairs) + Sex chromosomes (1 pair) Monosomy – Lack of any one pair of chromosomes Trisomy – Inclusion of an additional copy of chromosomes Aneuploidy – Loss or gain of chromosomes due to failure of segregation of chromatids during cell division

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● Down's Syndrome

Cause: Presence of an additional copy of chromosome 21 (Trisomy of 21)

Affected individual has short stature, small, round head, furrowed tongue, partially opened mouth, palm crease, congenital heart disease and mental retardation.

● Klinefelter Syndrome

Cause: Additional copy of X chromosome, i.e., 47 chromosomes (XXY)

Affected individual has an overall masculine development with gynaecomastia; individual is sterile

● Turner's Syndrome

Cause: Absence of one X chromosome, i.e., 45 chromosomes (XO).

Affected females are sterile; have rudimentary ovaries;
secondary sexual characters are absent

MULTIPLE CHOICE QUESTION

1. All genes located on the same chromosome:
a. Form different groups depending upon their relative distance
b. Form one linkage group
c. Will not from any linkage groups
d. Form interactive groups that affect the phenotype

2. Conditions of a karyotype 2n ± 1 and 2n ± 2 are called:
a. Aneuploidy
b. Polyploidy
c. Allopolyploidy
d. Monosomy

3. Distance between the genes and percentage of recombination shows:
a. a direct relationship
b. an inverse relationship
c. a parallel relationship
d. no relationship

4. If a genetic disease is transferred from a phenotypically normal but carrier female to only some of the male
progeny, the disease is:
a. Autosomal dominant
b. Autosomal recessive
c. Sex-linked dominant
d. Sex-linked recessive

5. In sickle cell anaemia glutamic acid is replaced by valine. Which one of the following triplets codes for valine?
a. G G G
b. A A G

c. G A A

d. G U G

6. Person having genotype IA IB would show the blood group as AB. This is because
of: a. Pleiotropy
b. Co-dominance
c. Segregation
d. Incomplete dominance

7. Z Z / ZW type of sex determination is seen in:
a. Platypus
b. Snails
c. Cockroach
d. Peacock
8. A Across between two tall plants resulted in offspring having few dwarf plants. What would be the

genotypes of both the parents?

a. TT and Tt
b. Tt and Tt
c. TT and TT
d. Tt and tt

9. In a dihybrid cross, if you get 9:3:3:1 ratio it denotes that:
a. The alleles of two genes are interacting with each other
b. It is a multigenic inheritance
c. It is a case of multiple allelism
d. The allels of two genes are segregating independently.

10. Which of the following will not result in variations among siblings?
a. Independent assortment of genes
b. Crossing over
c. Linkage
d. Mutation

11. Mendel's Law of independent assortment holds good for genes situated on the: a. non-homologous chromosomes
b. homologous chromosomes
c. extra nuclear genetic element
d. same chromosome

12. Occasionally, a single gene may express more than one effect. The phenomenon is called: a. multiple allelism
b. mosaicism
c. pleiotropy
d. polygeny

13. In a certain taxon of insects some have 17 chromosomes and the others have 18 chromosomes. The 17 and 18 chromosome-bearing organisms are:
a. males and females, respectively
b. females and males, respectively

c. all males

d. all females

14. The inheritance pattern of a gene over generations among humans is studied by the pedigree analysis. Character studied in the pedigree analysis is equivalent to:
a. quantitative trait
b. Mendelian trait
c. polygenic trait
d. maternal trait

15. It is said that Mendel proposed that the factor controlling any character is discrete and independent. This proposition was based on the:
a. results of F3 generation of a cross.
b. observations that the offspring of a cross made between the plantshaving two contrasting characters shows only one characterwithout any blending.
c. self pollination of F1 offsprings
d. cross pollination of parental generations

16. Two genes ‘A’ and ‘B’ are linked. In a dihybrid cross involving these two genes, the F1 heterozygote is crossed with homozygous recessive parental type (aa bb). What would be the ratio of offspring in the next generation?
a. 1 : 1 : 1: 1
b. 9 : 3 : 3 : 1
c. 3 : 1
d. 1 : 1

17. In the F2 generation of a Mendelian dihybrid cross the number of phenotypes and genotypes are: a. phenotypes - 4; genotypes - 16
b. phenotypes - 9; genotypes - 4
c. phenotypes - 4; genotypes - 8
d. phenotypes - 4; genotypes – 9

18. Mother and father of a person with ‘O’ blood group have ‘A’ and ‘B’ blood group respectively. What would be the genotype of both mother and father?
a. Mother is homozygous for ‘A’ blood group and father is heterozygous for ‘B’
b. Mother is heterozygous for ‘A’ blood group and father is homozygous for ‘B’
c. Both mother and father are heterozygous for ‘A’ and ‘B’ blood group, respectively d. Both mother and father are homozygous for ‘A’ and ‘B’ blood group, respectively

1-b 2-a 3-b 4-d 5-d 6-b
7-d 8-b 9-d 10-c 11-a 12-c
13-a 14-b 15-b 16-a 17-d 18-c

ASSERTION &REASONING TYPE QUESTIONS:
A If both A and R are true and R is the correct explanation of A.
B If both A and R are true and R is not the correct explanation of A.
C If A is true but R is false

D If both A and R are false

Assertion: In four o’clock plant or Snap dragon plant, a cross between homozygous white flowered individual and a homozygous red flowered one, produces pink flowered plants. Reason: In these plants, the flower colour is determined by three alleles.
2. Assertion: It is not possible for human parents heterozygous for skin colour to have children darker or lighter than themselves.
Reason: Human skin colour is controlled by a single pair of alleles.
3. Assertion: The person heterozygous for sickle-cell trait produces both normal (HbA) and abnormal haemoglobin (Hbs)
Reason: The normal allele and sickle allele are codominant.
4. Assertion: The defect called erythroblastosis foetalis results if Rh-negative mother carries a second Rh-positive foetus.
Reason: Replacement of the infant’s blood immediately after birth often cures the defect.
5. Assertion:Haemophilia shows criss-cross inheritance
Reason: The gene that causes haemophilia is recessive and lies in the sex (X) chromosome.
6. Assertion : Drosophila melangaster is widely used in genetic reserch.
Reason : Droshophila melanogaster is a readily availbble insect.

7.Assertion : A gamete contains a single allele for each trait.

Reason : During gametogenesis, the two alleles of each trait segregate, on passing into each gamete at random.
8.Assertion : In a person with AB blood group, the erthrocyes carry both A and B antigenes on their surface.
Reason : The allels IAandIB, that produe AB blood group, are codominant and both are expressed.

9.Assertion : It is not possible for human parents heterozygous for skin colour to have children darker or lighter than themselves.
Reason : Human skin colour is controlled by a single pair of alleles.

10.Assertion : Frequency of crossing overs is higher then the observed frequency of recombinatin of traits in the offsprings.
Reason : More than one cross over many occur simultaneously between the same chromatids.

ANSWERS:
C 2. D 3. A 4. B 5. A
C 7. A 8. A 9. D 10. A

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Important Questions Principles of Inheritance and Variation
VERY SHORT ANSWER QUESTION
Question 1.
Name the pattern of inheritance where F_1phenotype
(i) resembles only one of the two parents.
(ii) does not resemble either of the two parents and is in between the two. (All India 2019) Or
Name the respective pattern of inheritance, where F_1 phenotype
(i) does not resemble either of the two parents and is in between the two.

(ii) resembles only one of the two parents. (All India 2012)

Answer:
(i) Dominance
(ii) Incomplete dominance
Or
(i) Incomplete dominance
(ii) Dominance.
Question 2.
British geneticist RC Punnett developed a graphical representation of a genetic cross called 'Punnett Square'. Mention the possible result this representation predicts of the genetic cross carried. (Delhi 2019) Answer:
Punnett square helps to predict the probability of all the possible genotypes of offspring in a genetic cross. Question 3.
Name the type of cross that would help to find the genotype of a pea plant bearing violet flowers. (All India 2017)
Answer:
To find the genotype of a pea plant bearing violet flowers, test cross would be carried out in which the plant with dominant trait, i.e. violet flowers, will be crossed with its recessive parent. Question 4.
State a difference between a gene and an allele. (All India 2016)
Answer:
A unit of inheritance which is passed down from parent to offspring through the gametes over successive generations is known as gene. Genes consist of a pair of contrasting forms for a character that are known as alleles.
Question 5.
Give an example of polygenic trait in humans. (Delhi 2016C)
Or

On what basis is the skin colour in humans considered polygenic? (Delhi 2016)
Answer:
An example of a polygenic trait in humans is skin colour.
Or
Skin colour is considered to be a polygenic trait because it is under the control of many genes. Question 6.
A geneticist interested in studying variations and patterns of inheritance in living beings prefers to choose organisms for experiments with shorter life cycle. Provide a reason. (Delhi 2015)
Answer:
A geneticist interested in studying variations and patterns of inheritance in living beings prefers to choose organisms with shorter life cycle, because it enables the geneticist to study many generations of the organism in a short time period.
Question 7.
Mention any two contrasting traits with respect to seeds in pea plant that were studied by Mendel. (All India 2014)
Answer:
Two contrasting seed traits studied by Mendel are
Seed shape Round and wrinkled.
Seed colour Yellow and green.
Question 8.
What are 'true-breeding lines' that are used to study inheritance pattern of traits in plants. (Delhi 2014) Answer:
True-breeding lines are those plants, which have undergone continuous self-pollination and show stable

trait inheritance and expression for several generations.

Question 9.
How many kinds of phenotype would you expect in F_2-generation in a monohybrid cross exhibiting codominance? (All India 2014)
Answer:
In codominance, alleles are able to express themselves independently when present together. Thus, in a monohybrid cross there would be three kinds of phenotype in the F_2-generation showing codominance.
Question 10.
Name the stage of cell division where segregation of an independent pair of chromosomes occurs. (All India 2014)
Or
Name the event during cell division cycle that results in the gain and loss of chromosomes. (Delhi 2011) Answer:
During meiotic anaphase-I of cell division, the separation of independent pair of chromosomes occurs. Or
Non-disjunction of chromosomes during anaphase-I of meiosis results in the gain or loss of chromosomes. Question 11.
A garden pea plant (A) produced inflated yellow pod and another plant (B) of the same species produced constricted green pods. Identify the dominant traits. (Delhi 2012)
Answer:
The dominant trait in the pea plant is inflated green pods while the recessive trait is constricted yellow pod? Question 12.
A garden pea plant produced axial white flowers another of the same species produced terminal violet flowers. Identify the dominant traits. (All India 2012)
Answer:
The dominant trait in the pea plant is axial violet flowers, while the recessive trait is terminal white flowers.
Question 13.
In a dihybrid cross, when would the proportion of parental gene combinations be much higher than non parental types, as experimentally shown by Morgan and his group? (All India 2012) Answer:
The proportion of parental gene combination is much higher than non-parental types, when the two genes show linkage and are inherited together.

Question 14.
Write possible genotypes Mendel got when he crossed F_1 tall plant with a dwarf pea plant. (Foreign 2012)
Answer:
Tt and tt (in ratio of 1:1) genotypes were obtained on crossing F_1 tall plant with a dwarf parent plant. It is a test cross.
Question 15.
Garden pea plant produced round, green seed. Another of same species produced wrinkled yellow seeds. Identify dominant traits. (Foreign 2012)
Answer:
The dominant trait in pea plant is round and green seeds, while the recessive trait is wrinkled and yellow seeds.
Question 16.
Mention two contrasting flower related traits studied by Mendel in pea plant experiments. (All India 2011C)
Answer:
The two contrasting flower traits in pea plant are
Violet flowers and white flowers.

Axial flowers and terminal flowers.

Question 17.
Name the contrasting pod related traits studied by Mendel in his pea plant experiment. (All India 2011C) Answer:
The two contrasting pod related traits in pea plant are
Inflated/Constricted shape.
Green/Yellow colour.
Question 18.
Mention the type of allele that expresses itself only in homozygous state in an organism. (Foreign 2011) Answer:
Recessive allele expresses itself only in homozygous condition because in the presence of a dominant allele its effect is masked.
Question 19.
Pea flowers produce assured seed sets. Give a reason. (All India 2010)
Answer:
Pea flowers produce assured seed sets because they have cleistogamous flowers, which undergo natural self-pollination.
Question 20.
Why did TH Morgan select Drosophila melanogaster to study sex-linked genes for his lab experiments. (Foreign 2015)
Or
Write the scientific name of the fruitfly. Why did Morgan prefer to work with fruit flies for his experiments? State any three reasons. (All India 2014)
Answer:
The scientific name of fruitfly is Drosophila melanogaster.
TH Morgan preferred this organism for his study because of the following
reasons It has fast and short life cycle.
It has'only four pairs of chromosomes.
It reproduces quickly.
Question 21.
Write the sex of a human having XXY chromosome With 22 pairs of autosomes. Name the disorder this human suffers from. (2018C)
Answer:
The sex of a human having XXY chromosomeswith 22 pairs of autosomes is
male. The disorder from which this human is suffering is Klinefelter's syndrome.
Question 22.
State the fate of a pair of autosome during gamete formation. (Delhi 2017)

Answer:
During gamete formation, the homologous pair of autosomes gets separated from each other and moves to different gametes, so that each gamete receives haploid set of chromosomes.
Question 23.
Give an example of a human disorder that is caused due to a single gene mutation. (Delhi 2016) Answer:
Sickle-cell anaemia is an example of a human disorder that is an caused due to a single gene mutation. Question 24.
Give an example of a sex-linked recessive disorder in humans. (Delhi 2016C)
Answer:
Haemophilia is a sex-linked recessive disorder in humans.
Question 25.
Give an example of an organism that exhibits haplo-diploidy sex-determination system. (Delhi 2016)