

CBSE Class 12 Biology
NCERT Exemplar Solutions
CHAPTER 1
REPRODUCTION IN ORGANISMS

Long Answer Type Questions

1. Enumerate the differences between asexual and sexual reproduction. Describe the types of asexual reproduction exhibited by unicellular organisms.

Ans.

Asexual Reproduction	Sexual Reproduction
(i) A single parent is involved in the process.	(i) Two parents are involved in the process.
(ii) Meiosis does not happen.	(ii) Meiosis happens during gametogenesis.
(iii) Gametogenesis does not happen.	(iii) Gametogenesis happens.
(iv) Genotype of offspring is identical to that of parent.	(iv) Genotype of offspring is a combination of two parents and is hence different from parents.
(v) It is mostly seen in simple organisms.	(v) It is prevalent in complex organisms.

Type of Asexual Reproduction in Unicellular Organisms:

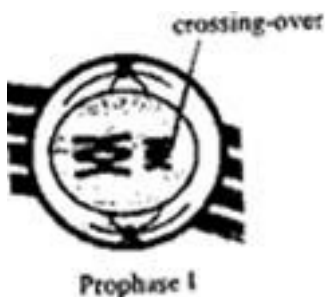
A. Binary Fission: In this case, the unicellular organism undergoes cell division and two daughter cells are produced. The parent generation ceases to exist after binary fission.

Example: Amoeba.

B. Multiple Fission: In this case, the nucleus of the mother cell divides into multiple nuclei. A cyst develops around the mother cell. The cyst helps the mother cell to tide over unfavourable circumstances. On resumption of favourable circumstances, the cyst disintegrates and daughter nuclei develop into new individuals. Example: Plasmodium, Entamoeba

C. Budding: In this case, a bud develops at one end of the cell. The nucleus produces a daughter nucleus which then goes to the bud. The bud then gets detached from the mother cell and develops into a new individual. Example: yeast

2. Do all the gametes formed from a parent organism have the same genetic composition (identical DNA copies of the parental genome)? Analyse the situation with the background of gametogenesis and provide or give suitable explanation.



Ans. Gamete formation happens after meiosis. During the pachytene stage of Prophase I in meiosis, crossing over takes place. Crossing over is an important steps of meiotic cell division. Non-sister chromatids combine during crossing over. This leads to recombination of various genes.

Thus, the daughter cells produced after meiosis have slightly different genotype compared to the mother cell. In fact, crossing over is responsible for bringing variations in subsequent generations. We know the evolution becomes possible because of accumulation of minor variations over thousands of generations.

In the context of above facts about meiosis, it is clear that the gametes do not have the same genetic composition as the parental genome.

3. Although sexual reproduction is a long drawn, energy-intensive complex form of reproduction, many groups of organisms in Kingdom Animalia and Plantae prefer this mode of reproduction. Give atleast three reasons for this.

Ans. Sexual reproduction gives various survival benefits and hence higher organisms in Kingdom Animalia and Plantae prefer this mode of reproduction.

Asexual reproduction is a fast process through which a large number of offspring can be produced in shorter time span. However, since offspring are clones of their parents hence they have same shortcomings as their parents. They will be equally susceptible to diseases and various other stresses as their parents. But offspring; produced after sexual reproduction have better genotype because it is a combination of genotype of two individuals.

Sexual reproduction helps an organism to easily tide over a bad phase. Many plants utilize asexual reproduction as a preferred mode when the conditions are favourable; like plenty of food, water and sunlight. But under unfavourable conditions, they resort to sexual reproduction.

Asexual reproduction can only depend on mutation for bringing evolution, while sexual reproduction can easily bank on variation for bringing evolution.

4. Differentiate between (a) oestrus and menstrual cycles; (b) ovipary and vivipary. Cite an example for each type.

Ans.

Oestrus Cycle	Menstrual Cycle
(i) Female is sexually active only during the ovulation phase.	(i) Ovulation has no correlation with sexual activity of the female.
(ii) Endometrium is absorbed in case conception does not take place.	(ii) Endometrium is shed in fragments if conception does not take place.

(iii) Is marked by visible signs on female genitalia.	(iii) Is marked by discharge of blood and tissue fragments from female genitalia.
(iv) Examples: cat, dog, horse, 1etc.	(iv) Examples: humans, chimpanzee, monkey
Ovipary	Vivipary
(i) Animal lays eggs	(i) Animal gives birth to young ones.
(ii) Less demand of resources from the female's body.	(ii) Greater demand of resources from the female's body.
(iii) Chances of survival of progeny is low.	(iii) Chances of survival or progeny is high.
(iv) Examples: reptiles and aves	(iv) Examples: most of the mammals, shark, dolphin

5. Rose plants produce large, attractive bisexual flowers but they seldom produce fruits. On the other hand a tomato plant produces plenty of fruits though they have small flowers. Analyse the reasons for failure of fruit formation in rose.

Both these plants - rose and tomato - both selected by human beings for different characteristics, the rose for its flower and tomato for its fruit. Roses, being vegetatively propagated do not need to produce seeds.

Ans. Production of fruits or absence of fruits in these plants is result of human intervention through horticulture. To understand this issue, we first need to keep in mind the specific purpose for which a particular plant growth by humans.

Rose plants are mainly grown for ornamental purpose. Rose flowers are considered to be epitome of beauty. Additionally, most varieties of rose produce nice fragrance which further

adds to its value. Seeds or fruits are not important for rose plants. Rose is grown by the horticulturists worldwide through vegetative propagation. Usually, a portion of the stem is cut off and is put in the soil to produce a new plant. Sometimes, the stem is peeled off at a small section and clay is applied to produce a new plantlet. Since producing a plant through vegetative propagation requires less time, so it is much beneficial for growing ornamental plants.

- Rose is a natural seed bearing plant but in domestically grown varieties, the petals are so tightly fit that they may do not permit pollination and hence fruits do not develop in these plants.
- Rose plants may not produce viable cell or functional egg.
- Rose plants may have abortive ovule.
- They may be self-incompatible
- There may be internal barriers for pollen tube growth and/or fertilization.

Tomato, on the other hand, is produced for its juicy fruits. Hence, cultivators have to follow a method which enables them to get as many fruits as possible.

In both the cases, the number or size of flowers on a particular plant is not the deciding factor. But the purposes for which a particular plant is grown is the main deciding factor whether a plant produces a fruit or not.

CBSE Class 12 Science
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CHAPTER 1
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Multiple Choice Questions (MCQs)

1. A few statements describing certain features of reproduction are given below:

- (i) Gametic fusion takes place**
- (ii) Transfer of genetic material takes place**
- (iii) Reduction division takes place**
- (iv) Progeny have some resemblance with parents**

Select the options that are true for both asexual and sexual reproduction from the options given below:

- (a) (i) and (ii);**
- (b) (ii) and (iii);**
- (c) (ii) and (iv);**
- (d) (i) and (iii).**

Ans. (c) (ii) and (iv)

Explanation: Gametic fusion and reduction division take place only in case of sexual reproduction. Hence, (ii) and (iv) are correct statements.

2. The term 'clone' cannot be applied to offspring formed by sexual reproduction because:

- (a) Offspring do not possess exact copies of parental DNA**

(b) DNA of only one parent is copied and passed on to the offspring

(c) Offspring are formed at different times

(d) DNA of parent and offspring are completely different.

Ans. (a) Offspring do not possess exact copies of parental DNA

Explanation: Gametogenesis takes place through meiosis and crossing over takes place during meiosis. Crossing over is responsible for some alteration in genotype. Moreover, fertilization results in gene pools from two different individuals and thus zygote has a somewhat different genotype than both the parents. Hence, the term clone cannot be applied to offspring formed by sexual reproduction.

3. A sexual method of reproduction by binary fission is common to which of the following?

(i) Some eukaryotes

(ii) All eukaryotes

(iii) Some prokaryotes

(iv) All prokaryotes

(a) (i) and (ii)

(b) (ii) and (iii)

(c) (i) and (iii)

(d) (iii) and (iv)

Ans. (c) (i) and (iii)

Explanation: Various methods of asexual reproduction are seen in prokaryotes, like binary fission, multiple fission, spore formation, etc. In eukaryotes; many methods of asexual reproduction as well as sexual reproduction are seen.

4. A few statements with regard to sexual reproduction are given below:

- (i) Sexual reproduction does not always require two individuals
- (ii) Sexual reproduction generally involves gametic fusion
- (iii) Meiosis never occurs during sexual reproduction
- (iv) External fertilisation is a rule during sexual reproduction

Choose the correct statements from the options below:

- (a) (i) and (iv)
- (b) (i) and (ii)
- (c) (ii) and (iii)
- (d) (i) and (iv)

Ans. (b) (i) and (ii)

Explanation: In some case, both the sexes are present on the some individual and some of those cases, both the gametes from the same individual are involved in fertilization, e.g. self-pollination in many flowering plants. Fusion of gametes, i.e., fertilization is an important step in sexual reproduction. Hence, (i) and (ii) are correct.

5. A multicellular, filamentous alga exhibits a type of sexual life cycle in which the meiotic division occurs after the formation of zygote. The adult filament of this alga has

- (a) haploid vegetative cells and diploid gametangia
- (b) diploid vegetative cells and diploid gametangia
- (c) diploid vegetative cells and haploid gametangia
- (d) haploid vegetative cells and haploid gametangia.

Ans. (d) haploid vegetative cells and haploid gametangia.

Explanation: Many algae show haplontic life cycle. In this case, the dominant phase is free-living gametophyte. Sporophytic generation is represented by single-celled zygote. Meiosis results in formation of haploid spores, e.g. Spirogyra and Chlamydomonas.

6. The male gametes of rice plant have 12 chromosomes in their nucleus. The chromosome number in the female gamete, zygote and the cells of the seedling will be, respectively,

(a) 12, 24, 12

(b) 24, 12, 12

(c) 12, 24, 24

(d) 24, 12, 24.

Ans. (c) 12, 24, 24

Explanation: Gametes have haploid number of chromosomes, zygote and plant have diploid number of chromosomes.

7. Given below are a few statements related to external fertilization. Choose the correct statements.

(i) The male and female gametes are formed and released simultaneously

(ii) Only a few gametes are released into the medium

(iii) Water is the medium in a majority of organisms exhibiting external fertilization

(iv) Offspring formed as a result of external fertilization have better chance of survival than those formed inside an organism

(a) (iii) and (iv)

(b) (i) and (iii)

(c) (ii) and (iv)

(d) (i) and (iv)

Ans. (b) (i) and (iii)

Explanation: Release of both the gametes simultaneously is necessary to ensure fertilization. The male gametes need some medium through which they can travel up to the female gamete. Water is the medium for most the cases; while air is a medium in some cases.

8. The statements given below describe certain features that are observed in the pistil of flowers.

(i) Pistil may have many carpels

(ii) Each carpel may have more than one ovule

(iii) Each carpel has only one ovule

(iv) Pistil have only one carpel

Choose the statements that are true from the options below:

(a) (i) and (ii)

(b) (i) and (iii)

(c) (ii) and (iv)

(d) (iii) and (iv)

Ans. (a) (i) and (ii)

Explanation: (i) and (ii)

9. Which of the following situations correctly describe the similarity between an angiosperm egg and a human egg?

(i) Eggs of both are formed only once in a lifetime

(ii) Both the angiosperm egg and human egg are stationary

(iii) Both the angiosperm egg and human egg are motile transported

(iv) Syngamy in both results in the formation of zygote

Choose the correct answer from the options given below:

(a) (ii) and (iv)

(b) (iv) only

(c) (iii) and (iv)

(d) (i) and (iv)

Ans. (b) (iv) only

Explanation: In angiosperms, eggs are formed several times in the lifetime, hence option (i) is incorrect. In humans, eggs travel from ovary to fallopian tubes; so, option (ii) is incorrect. In angiosperms, eggs are stationary and hence option (iii) is incorrect.

10. Appearance of vegetative propagules from the nodes of plants such as sugarcane and ginger is mainly because:

(a) Nodes are shorter than internodes

(b) Nodes have meristematic cells

(c) Nodes are located near the soil

(d) Nodes have non-photosynthetic cells

Ans. (b) Nodes have meristematic cells

Explanation: Presence of meristematic cells gives the ability of vegetative propagation.

11. Which of the following statements, support the view that elaborate sexual reproductive process appeared much later in the organic evolution.

(i) Lower groups of organisms have simpler body design

- (ii) Asexual reproduction is common in lower groups**
- (iii) Asexual reproduction is common in higher groups of organisms**
- (iv) The high incidence of sexual reproduction in angiosperms and vertebrates**

Choose the correct answer from the options given below:

- (a) (i), (ii) and (iii);**
- (b) (i), (iii) and (iv)**
- (c) (i), (ii) and (iv)**
- (d) (ii), (iii) and (iv)**

Ans. (c) (i), (ii) and (iv)

Explanation: Asexual reproduction is not common in higher groups of organisms; especially in animals. Hence, option (iii) is incorrect. Rest of the options are correct.

12. Offspring formed by sexual reproduction exhibit more variation than those formed by Asexual reproduction because:

- (a) Sexual reproduction is a lengthy process**
- (b) Gametes of parents have qualitatively different genetic composition**
- (c) Genetic material comes from parents of two different species**
- (d) Greater amount of DNA is involved in sexual reproduction.**

Ans. (b) Gametes of parents have qualitatively different genetic composition

Explanation: Fertilization during sexual reproduction results in gene pools from two different individuals and thus zygote has a somewhat different genotype than both the parents and show more variation.

13. Choose the correct statement from amongst the following:

- (a) Dioecious (hermaphrodite) organisms are seen only in animals
- (b) Dioecious organisms are seen only in plants
- (c) Dioecious organisms are seen in both plants and animals
- (d) Dioecious organisms are seen only in vertebrates

Ans. (c) Dioecious organisms are seen in both plants and animals

Explanation: Many flowering plants are dioecious. Pheretima is an example of dioecious animal.

14. There is no natural death in single celled organisms like Amoeba and bacteria because:

- (a) They cannot reproduce sexually
- (b) They reproduce by binary fission
- (c) Parental body is distributed among the offspring
- (d) They are microscopic

Ans. (c) Parental body is distributed among the offspring

Explanation: Binary fission results in culmination of parental generation and beginning of the next generation but the mother cell does not die in the process rather it gets divided into two daughter cells.

15. There are various types of reproduction. The type of reproduction adopted by an organism depends on:

- (a) The habitat and morphology of the organism
- (b) Morphology of the organism
- (c) Morphology and physiology of the organism

(d) The organism's habitat, physiology and genetic makeup

Ans. (d) The organism's habitat, physiology and genetic makeup

Explanation: The organism's habitat, physiology and genetic makeup

16. Identify the incorrect statement.

(a) In asexual reproduction, the offspring produced are morphologically and genetically identical to the parent

(b) Zoospores are sexual reproductive structures

(c) In asexual reproduction, a single parent produces offspring with or without the formation of gametes

(d) Conidia are asexual structures in Penicillium

Ans. (b) Zoospores are sexual reproductive structures

Explanation: Zoospores are asexual reproductive structures.

17. Which of the following is a post-fertilisation event in flowering plants?

(a) Transfer of pollen grains

(b) Embryo development

(c) Formation of flower

(d) Formation of pollen grains

Ans. (b) Embryo development

Explanation: The sequence is as follows: formation of flower → formation of pollen grains → transfer of pollen grains → fertilization → Embryo development.

18. The number of chromosomes in the shoot tip cells of a maize plant is 20. The number of chromosomes in the microspore mother cells of the same plant shall be:

(a) 20

(b) 10

(c) 40

(d) 15

Ans. (a) 20

Explanation: Microspore mother cell has same ploidy as the vegetative parts.

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Short Answer Type Questions

1. In haploid organisms that undergo sexual reproduction, name the stage in the life cycle when meiosis occurs. Give reasons for your answer.

Ans. In haploid organisms that undergo sexual reproduction, gametes are usually formed by meiotic division and chromosome number is reduced to half of the total. The stage in the life cycle when meiosis occurs is called sporophytic generation and is represented by one-celled zygote. In such plants, the dominant phase is gametophytic phase which is haploid. This kind of life cycle is called haplontic. Volvox, Spirogyra and some species of Chlamydomonas show this type of life cycle.

2. The number of taxa exhibiting asexual reproduction is drastically reduced in higher plants (angiosperms) and higher animals (vertebrates) as compared with lower groups of plants and animals. Analyse the possible reasons for this situation.

Ans. Asexual reproduction involves mitosis. In organisms with complex level of organization, mitosis alone cannot produce all kinds of differentiation which is required for making various types of tissue. Due to this, asexual reproduction is frequently seen in lower groups of plants and animals which show simple level of organization. But incidence of asexual reproduction drastically reduces as we go higher in terms of complexity of body design.

3. Honeybees produce their young ones only by sexual reproduction. In spite of this, in a colony of bees we find both haploid and diploid individuals. Name the haploid and diploid individuals in the colony and analyse the reasons behind their formation.

Ans. In a colony of bees, the females and workers are diploid while the male drones are haploid. The male drones are developed from unfertilized eggs. Development of an individual from unfertilized eggs is called parthenogenesis. This phenomenon is also seen in

many plants, e.g. banana. In that case, the fruit is called parthenocarpic fruit.

4. With which type of reproduction do we associate the reduction division? Analyse the reasons for it.

Ans. Reduction division is associated with sexual reproduction. We know that fertilization is an important step in sexual reproduction. Since fertilization involves fusion of two gametes, the number of chromosomes becomes diploid in zygote. To ensure continuity of characters in a species, it is necessary to develop some mechanism by which number of chromosomes can be haploid in the gametes. Hence, gametogenesis involves reduction division and thus gametes have haploid number of chromosomes.

5. Is it possible to consider vegetative propagation observed in certain plants like Bryophyllum, water hyacinth, ginger etc., as a type of asexual reproduction? Give two/three reasons.

Ans. Vegetative propagation in certain plants; like Bryophyllum, water hyacinth, ginger, etc. can be termed as asexual reproduction. Following are some of the reasons for this:

- (a) Reproduction involves a single parent
 - (b) Meiosis does not happen during any stage of reproduction.
 - (c) Offspring get the set of DNA from a single parent.
-

6. 'Fertilisation is not an obligatory event for fruit production in certain plants'. Explain the statement.

Ans. Many plants have an inbuilt ability to produce fruits without fertilisation. Fruits produced in that way are called parthenocarpic fruit. Banana is a very good example of parthenocarpic fruit. Many other fruits are produced by artificially inducing parthenocarpy in plants, e.g. papaya and watermelon. Such plants do not produce seeds because seeds cannot be produced without fertilization. Hence, it can be said that fertilization is not mandatory for fruit production in certain plants.

7. In a developing embryo, analyse the consequences if cell divisions are not followed by cell differentiation.

Ans. During development of an embryo, cell differentiation is necessary to produce different kinds of tissues which could later develop various organs and organ system. If cell differentiation does not happen, then different tissues would not be produced and the embryo would only develop into a mass of identical cells; unable to develop into a new individual. This can be compared with differentiation of meristematic cell in plants. In vascular plants, it is differentiation which ultimately results in formation of specialized tissues which performs various functions.

8. List the changes observed in an angiosperm flower subsequent to pollination and fertilisation.

Ans. Following changes take place in an angiosperm flower after pollination and fertilization:

- (a) Sepals, petals and stamens wither and fall off
 - (b) Zygote develops into the embryo and ovule develops into the seed
 - (c) Ovary develops into fruit
 - (d) Fruit develops a thick outer covering; called pericarp.
-

9. Suggest a possible explanation why the seeds in a pea pod are arranged in a row, whereas those in tomato are scattered in the juicy pulp.

Ans. In a pea pod, the pericarp is not differentiated into many layers. In a tomato fruit, the pericarp is differentiated into epicarp, mesocarp and endocarp. Most of the edible part of tomato is composed of mesocarp which is juicy and fleshy. Moreover, placentation is responsible for arrangement of seeds in a fruit. A pea flower shows marginal placentation, while a tomato shows axial placentation.

10. Draw the sketches of a zoospore and a conidium. Mention two dissimilarities between them and atleast one feature common to both structures.

Ans. Difference

Zoospores	Conidium
(i) They are motile.	(i) They are non-motile.
(ii) Flagella is present.	(ii) Flagella is absent.

Similarities

- (i) Both are involved in asexual reproduction.
- (ii) Both help the organism to tide over the bad phase.



11. Justify the statement 'Vegetative reproduction is also a type of asexual reproduction'.

Ans. It is true that vegetative reproduction is also a type of asexual reproduction. In vegetative reproduction, a single parent is involved. There is no gamete formation. Reduction division never takes place during vegetative propagation. Offspring; produced after vegetative propagation are clones of their parent. These features justify that vegetative reproduction is a type of asexual reproduction.

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CHAPTER 2

SEXUAL REPRODUCTION IN FLOWERING PLANTS

Multiple Choice Questions

1. Among the terms listed below, those that are not technically correct names for a floral whorl are:

- (i) Androecium
- (ii) Carpel
- (iii) Corolla
- (iv) Sepal

- (a) (i) and (iv)
- (b) (iii) and (iv)
- (c) (ii) and (iv)
- (d) (i) and (ii)

Ans. (c) (ii) and (iv)

Explanation: Carpel and sepal are individual parts and make gynoecium and calyx respectively.

2. Embryo sac is to ovule as ____ is to an anther.

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

Ans. (c) Pollen grain

Explanation: Embryo sac is present in ovule, while pollen grains are present in anther.

3. In a typical complete, bisexual and hypogynous flower the arrangement of floral

whorls on the thalamus from the outermost to the innermost is:

- (a) Calyx, corolla, androecium and gynoecium
- (b) Calyx, corolla, gynoecium and androecium
- (c) Gynoecium, androecium, corolla and calyx
- (d) Androecium, gynoecium, corolla and calyx

Ans. (a) Calyx, corolla, androecium and gynoecium

Explanation: Calyx, corolla, androecium and gynoecium

4. A dicotyledonous plant bears flowers but never produces fruits and seeds. The most probable cause for the above situation is:

- (a) Plant is dioecious and bears only pistillate flowers
- (b) Plant is dioecious and bears both pistillate and staminate flowers
- (c) Plant is monoecious
- (d) Plant is dioecious and bears only staminate flowers.

Ans. (d) Plant is dioecious and bears only staminate flowers

Explanation: A pistillate flower can be pollinated from pollen grains from another flower, hence option 'a' is incorrect. A dioecious flower can show self or cross pollination and hence can be transformed into fruit. So, option 'd' is the correct answer.

5. The outermost and innermost wall layers of microsporangium in an anther are respectively:

- (a) Endothecium and tapetum
- (b) Epidermis and endodermis
- (c) Epidermis and middle layer
- (d) Epidermis and tapetum

Ans. (d) Epidermis and tapetum

Explanation: Epidermis and tapetum

6. During microsporogenesis, meiosis occurs in:

- (a) Endothecium
- (b) Microspore mother cells
- (c) Microspore tetrads
- (d) Pollen grains.

Ans. (b) Microspore mother cells

Explanation: Microspore mother cell undergoes meiosis to produce haploid pollen grains.

7. From among the sets of terms given below, identify those that are associated with the gynoecium.

- (a) Stigma, ovule, embryo sac, placenta
- (b) Thalamus, pistil, style, ovule
- (c) Ovule, ovary, embryo sac, tapetum
- (d) Ovule, stamen, ovary, embryo sac

Ans. (a) Stigma, ovule, embryo sac, placenta

Explanation: Thalamus, tapetum and stamen are not associated with gynoecium.

8. Starting from the innermost part, the correct sequence of parts in an ovule are,

- (a) egg, nucellus, embryo sac, integument
- (b) egg, embryo sac, nucellus, integument
- (c) embryo sac, nucellus, integument, egg
- (d) egg, integument, embryo sac, nucellus.

Ans. (b) egg, embryo sac, nucellus, integument

Explanation: egg, embryo sac, nucellus, integument

9. From the statements given below choose the option that are true for a typical female gametophyte of a flowering plant:

- (i) It is 8-nucleate and 7-celled at maturity
- (ii) It is free-nuclear during the development
- (iii) It is situated inside the integument but outside the nucellus

(iv) It has an egg apparatus situated at the chalazal end

- (a) (i) and (iv)**
- (b) (ii) and (iii)**
- (c) (i) & (ii)**
- (d) (ii) & (iv)**

Ans. (c) (i) & (ii)

Explanation: (i) & (ii)

10. Autogamy can occur in a chasmogamous flower if:

- (a) Pollen matures before maturity of ovule**
- (b) Ovules mature before maturity of pollen**
- (c) Both pollen and ovules mature simultaneously**
- (d) Both anther and stigma are of equal lengths.**

Ans. (c) Both pollen and ovules mature simultaneously

Explanation: Relative lengths of stigma and anther are not the only factors, time of maturity of pollens and ovules is also important in deciding the type of pollination. If pollens mature before ovules; they will become ineffective by the time the ovule matures. Hence, option 'c' is the correct answer.

11. Choose the correct statement from the following:

- (a) Cleistogamous flowers always exhibit autogamy**
- (b) Chasmogamous flowers always exhibit geitonogamy**
- (c) Cleistogamous flowers exhibit both autogamy and geitonogamy**
- (d) Chasmogamous flowers never exhibit autogamy**

Ans. (a) Cleistogamous flowers always exhibit autogamy

Explanation: Cleistogamous flowers do not open at all and thus entry of pollens from another flower is not possible. Hence, cleistogamous flowers always exhibit autogamy.

12. A particular species of plant produces light, non-sticky pollen in large numbers and

its stigmas are long and feathery. These modifications facilitate pollination by:

- (a) Insects
- (b) Water
- (c) Wind
- (d) Animals.

Ans. (c) Wind

Explanation: Light and non-sticky pollens are ideal to be blown away by wind. Feathery stamens are able to sway with the wind which helps in release of pollens into air.

13. From among the situations given below, choose the one that prevents both autogamy and geitonogamy.

- (a) Monoecious plant bearing unisexual flowers
- (b) Dioecious plant bearing only male or female flowers
- (c) Monoecious plant with bisexual flowers
- (d) Dioecious plant with bisexual flowers

Ans. (a) Monoecious plant bearing unisexual flowers

Explanation: Autogamy can happen in case of bisexual flowers. Geitonogamy can happen in case of dioecious plants bearing only male or female flowers. Hence, option 'a' is correct.

14. In a fertilised embryo sac, the haploid, diploid and triploid structures are:

- (a) Synergid, zygote and primary endosperm nucleus
- (b) Synergid, antipodal and polar nuclei
- (c) Antipodal, synergid and primary endosperm nucleus
- (d) Synergid, polar nuclei and zygote.

Ans. (a) Synergid, zygote and primary endosperm nucleus

Explanation: Synergid, zygote and primary endosperm nucleus

15. In an embryo sac, the cells that degenerate after fertilisation are:

- (a) Synergids and primary endosperm cell

- (b) Synergids and antipodals
- (c) Antipodals and primary endosperm cell
- (d) Egg and antipodals.

Ans. (b) Synergids and antipodals

Explanation: PEN provides food for the growing embryo, while egg develops into embryo. Hence, option 'b' is the correct answer.

16. While planning for an artificial hybridization programme involving dioecious plants, which of the following steps would not be relevant:

- (a) Bagging of female flower
- (b) Dusting of pollen on stigma
- (c) Emasculation
- (d) Collection of pollen

Ans. (c) Emasculation

Explanation: In case of dioecious plant, male and female flowers are not usually on a single plant. Hence, emasculation may not be necessary in certain cases.

17. In the embryos of a typical dicot and a grass, true homologous structures are:

- (a) Coleorhiza and coleoptile
- (b) Coleoptile and scutellum
- (c) Cotyledons and scutellum
- (d) Hypocotyl and radical.

Ans. (c) Cotyledons and scutellum

Explanation: In monocot, the cotyledon is called scutellum.

18. The phenomenon observed in some plants wherein parts of the sexual apparatus is used for forming embryos without fertilisation is called:

- (a) Parthenocarpy
- (b) Apomixis

(c) Vegetative propagation

(d) Sexual reproduction.

Ans. (b) Apomixis

Explanation: When seeds are produced without fertilization, this phenomenon is called apomixes. In parthenocarpy, seeds are not produced which means embryos are not produced. Hence, option 'b' is the correct answer.

19. In a flower, if the megaspore mother cell forms megaspores without undergoing meiosis and if one of the megaspores develops into an embryo sac, its nuclei would be:

(a) Haploid

(b) Diploid

(c) A few haploid and a few diploid

(d) With varying ploidy.

Ans. (b) Diploid

Explanation: Since no meiosis takes place so no change in ploidy will take place.

20. The phenomenon wherein, the ovary develops into a fruit without fertilisation is called:

(a) Parthenocarpy

(b) Apomixis

(c) Asexual reproduction

(d) Sexual reproduction

Ans. (a) Parthenocarpy

Explanation: Parthenocarpy

CBSE Class 12 Biology
NCERT Exemplar Solutions
CHAPTER 3
HUMAN REPRODUCTION

Short Answer Type Questions

1. A human female experiences two major changes, menarche and menopause during her life. Mention the significance of both the events.

Ans. Significance of Menarche: Menarche marks the onset of puberty. Thus, it marks the beginning of reproductive phase in female. Significance of Menopause: Menopause marks the culmination of reproductive phase in female.

2. (a) How many spermatozoa are formed from one secondary spermatocyte?

(b) Where does the first cleavage division of zygote take place?

Ans. (a) Four spermatids are formed from one secondary spermatocyte. All of them subsequently develop into spermatozoa through a process called spermiogenesis.

(b) The first cleavage division of zygote takes place in the ampullary-isthmus junction.

3. Corpus luteum in pregnancy has a long life. However, if fertilisation does not take place, it remains active only for 10-12 days. Explain.

Ans. Corpus luteum secretes progesterone which is essential for maintaining the endometrium. This is essential for proper development of the foetus. Hence, corpus luteum has a long life during pregnancy. On the other hand, in the absence of fertilization; there is no work for corpus luteum and hence it remains active only for 10-12 days.

4. What is foetal ejection reflex? Explain how it leads to parturition?

Ans. Mild uterine contraction at the time of child birth is called foetal ejection reflex. This triggers the release of oxytocin from the maternal pituitary. Oxytocin induces strong uterine

contraction which finally leads to parturition.

5. Except endocrine function, what are the other functions of placenta.

Ans. Other than endocrine function; following are the remaining functions of placenta:

- (a) Facilitates supply of oxygen and nutrients to the foetus.
- (b) Facilitates removal of carbon dioxide and other waste products from the foetus.

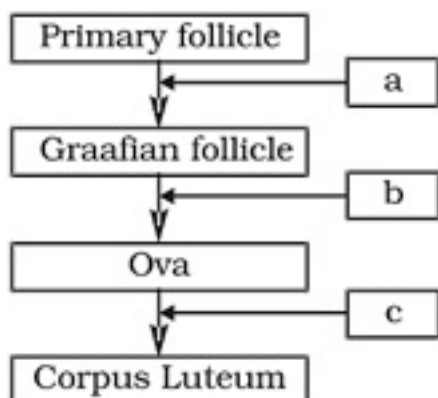
6. Why doctors recommend breast feeding during initial period of infant growth?

Ans. The milk producing during the initial few days of lactation is called colostrums. It contains several antibodies which are important for developing diseases resistance in the baby. Due to this, doctors recommend breast feeding during initial period of infant growth.

7. What are the events that take place in the ovary and uterus during follicular phase of the menstrual cycle.

Ans. Following events takes place in the ovary and uterus during follicular phase of the menstrual cycle:

- (a) Primary follicle in the ovary grow to become fully mature Graafian follicle.
- (b) Endometrium in the uterus regenerates through proliferation.
- (c) Estrogen is secreted by growing follicle.



8. Given below is a flow chart showing ovarian changes during menstrual cycle. Fill in the spaces giving the name of the hormones responsible for the events shown.

Ans. Following hormones are responsible for various changes during the menstrual cycle:

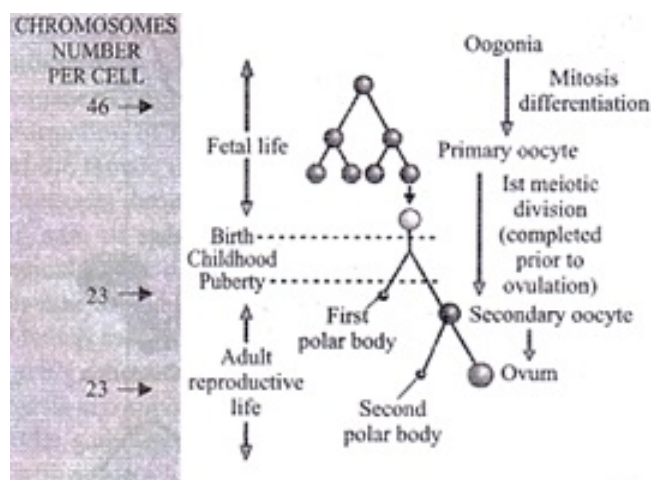
(a) **FSH (Follicle Stimulating Hormone)**: It is responsible for transformation of primary follicle into Graafian follicle.

(b) FSH is responsible for ovulation as well, i.e. release of ovum. It is important to note that both FSH and LH work in coordination and complement each other's functions.

(c) **LH (Luteinizing Hormone)**: It is responsible for development of corpus luteum from Graafian follicle.

9. Give a schematic labelled diagram to represent oögenesis (without descriptions).

Ans.



10. What are the changes in the oogonia during the transition of a primary follicle to Graafian follicle?

Ans. Following changes happen in the oogonia during the transition of a primary follicle to Graafian follicle:

(a) Each primary oocyte gets surrounded by a layer of granulosa cells; called primary follicle.

(b) Primary follicle gets surrounded by another layer of granulosa cells and a new theca. This called secondary follicle.

(c) The secondary follicle soon transforms into tertiary follicle. The tertiary follicle is characterized by a fluid filled cavity called antrum. At this stage, the primary oocyte undergoes second meiotic division and forms secondary oocyte and a tiny polar body.

(d) The tertiary follicle then changes into mature Graafian follicle. During this stage, a new layer; called zona pellucida; develops around the secondary oocyte.

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CHAPTER 5
PRINCIPLE OF INHERITANCE AND VARIATION

Multiple Choice Questions (MCQs)

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 form any linkage groups**
- (d) Form interactive groups that affect the phenotype**

Ans. (b) Form one linkage group

Explanation: Morgan showed that genes located on the same chromosome formed one linkage group. But linkage or no linkage depends on proximity of two genes. Genes which are closer show more likelihood of linkage. Hence, option 'b' is correct.

2. Conditions of a karyotype $2n \pm 1$ and $2n \pm 2$ are called:

- (a) Aneuploidy**
- (b) Polyploidy**
- (c) Allopolyploidy**
- (d) Monosomy**

Ans. (a) Aneuploidy

Explanation: Failure of segregation of chromatids during cell division cycle results in gain or loss of chromosome. This condition is called aneuploidy

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**

Ans. (b) an inverse relationship

Explanation: Chances of recombination decreases with increased distance between genes. Hence there is an inverse relationship between the two.

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**

Ans. (d) Sex-linked recessive

Explanation: In this case, the defective gene is present on the X-chromosome but the disease is manifested in men and women are carriers. So, it is a sex-linked recessive disease. Haemophilia is one example and is also referred to as X-linked recessive disease.

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

Ans. (d) G U G

Explanation: The substitution of amino acid in the globin protein results due to the single base substitution at the sixth codon of the beta globin gene from GAG to GUG. Condon GUG codes for valine which results in sickle cell anaemia.

6. Person having genotype $I^A I^B$ would show the blood group as AB. This is because of:

(a) Pleiotropy

(b) Co-dominance

(c) Segregation

(d) Incomplete dominance

Ans. (b) Co-dominance

Explanation: When F_1 generation resembles both parents, this is called co-dominance. This is often seen in ABO blood grouping. Since both A and B sugars are dominant, hence it results in AB blood group.

7. ZZ / ZW type of sex determination is seen in:

(a) Platypus

(b) Snails

(c) Cockroach

(d) Peacock

Ans. (d) Peacock

Explanation: This type of sex determination is seen in birds. The female has a ZW

combination while the male has ZZ combination.

8. A cross 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

Ans. (b) Tt and Tt

Explanation: In case of TT and Tt; all offspring would be tall (TT, Tt). In case of option 'c' no gene for dwarf is present, so all offspring will be tall. In case of option 'd' one of the parent plant is dwarf, so it is incorrect. In case of option 'b' most of the offspring will be tall and a few will be dwarf (TT, Tt, tt). Option 'b' is the correct answer.

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 alleles of two genes are segregating independently.

Ans. (d) The alleles of two genes are segregating independently.

Explanation: This shows the perfect dihybrid ratio according to Mendel. Hence, the alleles 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

Ans. (c) Linkage

Explanation: Linkage happens in all cases whenever two genes are located on the same chromosome and are close to each other. Thus, linkage has nothing to do with variation.

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

Ans. (a) non-homologous chromosomes

Explanation: Independent assortment cannot take place in case of options (b), (c) and (d).

12. Occasionally, a single gene may express more than one effect. The phenomenon is called:

(a) multiple allelism

(b) mosaicism

(c) pleiotropy

(d) polygeny

Ans. (c) pleiotropy

Explanation: (c) pleiotropy

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**

Ans. (a) males and females, respectively

Explanation: XO type of sex determination is seen in these insects. In such cases, the males have only one X-chromosome and the females have a pair of X-chromosome.

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**

Ans. (b) Mendelian trait

Explanation: The pattern of inheritance of Mendelian disorders can be traced through pedigree analysis.

15. It is said that Mendel proposed that the factor controlling any character is discrete and independent. His proposition was based on the:

- (a) results of F_3 generation of a cross.**
- (b) observations that the offspring of a cross made between the plants having two contrasting characters shows only one character without any blending.**

(c) self-pollination of F_1 offsprings

(d) cross pollination of F_1 generation with recessive parent.

Ans. (b) observations that the offspring of a cross, made between the plants having two contrasting characters shows only one character without any blending.

Explanation: During dihybrid cross, Mendel observed that when two pairs of contrasting characters were selected for analysis; it was found that a particular character behaved independently from another character. Hence, option 'b' is correct.

16. Two genes 'A' and 'B' are linked. In a dihybrid cross involving these two genes, the F_1 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

Ans. (a) 1: 1: 1:1

Explanation: (d) 1: 1: 1: 1

17. In the F_2 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

Ans. (d) phenotypes - 4; genotypes – 9

Explanation: Let us take example of dihybrid cross between round yellow (RRYY) and wrinkled green (rryy). In F₂ generation there were four Phenotypes: round yellow, round green, wrinkled yellow and wrinkled green. The genotypes were; RRYY, RRYy, RRyy, RrYY, RrYy, Rryy, rrYY, rrYy and rryy. Option 'd' is correct.

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

Ans. (c) Both mother and father are heterozygous for 'A' and 'B' blood group, respectively

Explanation: Possible genotype of parents are; I^Ai (A blood group) and I^Bi (B blood group) and phenotype of offspring is ii (O blood group).

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NCERT Exemplar Solutions
CHAPTER 6
MOLECULAR BASIS OF INHERITANCE

Multiple Choice Questions (MCQs)

1. In a DNA strand the nucleotides are linked together by:

- (a) glycosidic bonds**
- (b) phosphodiester bonds**
- (c) peptide bonds**
- (d) hydrogen bonds**

Ans. (b) phosphodiester bonds

Explanation: (b) phosphodiester bonds

2. A nucleoside differs from a nucleotide. It lacks the:

- (a) base**
- (b) sugar**
- (c) phosphate group**
- (d) hydroxyl group**

Ans. (c) phosphate group

Explanation: (c) phosphate group

3. Both deoxyribose and ribose belong to a class of sugars called:

- (a) trioses**

(b) hexoses

(c) pentoses

(d) polysaccharides

Ans. (c) pentoses

Explanation: Ribose is the pentose sugar in RNA, while deoxyribose is the pentose sugar in DNA.

4. The fact that a purine base always paired through hydrogen bonds with a pyrimidine base leads to, in the DNA double helix:

(a) the antiparallel nature

(b) the semiconservative nature

(c) uniform width throughout DNA

(d) uniform length in all DNA

Ans. (c) uniform width throughout DNA

Explanation: (c) uniform width throughout DNA

5. The net electric charge on DNA and histones is:

(a) both positive

(b) both negative

(c) negative and positive, respectively

(d) zero

Ans. (c) negative and positive, respectively

Explanation: The negatively charged DNA is wrapped around positively charged histone; making a structure called nucleosome. This explains the efficient packing of DNA in such a

small space inside the nucleus.

6. The promoter site and the terminator site for transcription are located at:

- (a) 3' (downstream) end and 5' (upstream) end, respectively of the transcription unit**
- (b) 5' (upstream) end and 3' (downstream) end, respectively of the transcription unit**
- (c) the 5' (upstream) end**
- (d) the 3' (downstream) end**

Ans. (b) 5' (upstream) end and 3' (downstream) end, respectively of the transcription unit

Explanation: (b) 5' (upstream) end and 3' (downstream) end, respectively of the transcription unit

7. Which of the following statements is the most appropriate for sickle cell anaemia?

- (a) It cannot be treated with iron supplements**
- (b) It is a molecular disease**
- (c) It confers resistance to acquiring malaria**
- (d) All of the above**

Ans. (d) All of the above

Explanation: Sickle cell anaemia is a genetic disorder and hence cannot be treated with iron supplements. Altered shape of RBCs confer resistance to malaria in people suffering from sickle cell anaemia.

8. One of the following is true with respect to AUG

- (a) It codes for methionine only**
- (b) It is also an initiation codon**

(c) It codes for methionine in both prokaryotes and eukaryotes

(d) All of the above

Ans. (d) All of the above

Explanation: (d) All of the above

9. The first genetic material could be:

(a) protein

(b) carbohydrates

(c) DNA

(d) RNA

Ans. (d) RNA

Explanation: There are many conclusive proofs which show that RNA was the first genetic material. But RNA being a catalyst was reactive and unstable. So, this paved the way for DNA as genetic material in the living world.

10. With regard to mature mRNA in eukaryotes:

(a) exons and introns do not appear in the mature RNA

(b) exons appear but introns do not appear in the mature RNA

(c) introns appear but exons do not appear in the mature RNA

(d) both exons and introns appear in the mature RNA

Ans. (b) exons appear but introns do not appear in the mature RNA

Explanation: (b) exons appear but introns do not appear in the mature RNA

11. The human chromosome with the highest and least number of genes in them are

respectively:

- (a) Chromosome 21 and Y
- (b) Chromosome 1 and X
- (c) Chromosome 1 and Y
- (d) Chromosome X and Y

Ans. (c) Chromosome 1 and Y

Explanation: Chromosome 1 has 2968 genes, while chromosome Y has 231 genes.

12. Who amongst the following scientists had no contribution in the development of the double helix model for the structure of DNA?

- (a) Rosalind Franklin
- (b) Maurice Wilkins
- (c) Erwin Chargaff
- (d) Meselson and Stahl

Ans. (d) Meselson and Stahl

Explanation: (d) Meselson and Stahl

13. DNA is a polymer of nucleotides which are linked to each other by 3'-5' phosphodiester bond. To prevent polymerisation of nucleotides, which of the following modifications would you choose?

- (a) Replace purine with pyrimidines
- (b) Remove/Replace 3' OH group in deoxy ribose
- (c) Remove/Replace 2' OH group with some other group in deoxy ribose
- (d) Both 'B' and 'C'

Ans. (b) Remove/Replace 3' OH group in deoxy ribose

Explanation: (b) Remove/Replace 3' OH group in deoxy ribose

14. Discontinuous synthesis of DNA occurs in one strand, because:

(a) DNA molecule being synthesised is very long

(b) DNA dependent DNA polymearse catalyses polymerisation only in one direction (5' →3')

(c) it is a more efficient process

(d) DNA ligase has to have a role

Ans. (b) DNA dependent DNA polymearse catalyses polymerisation only in one direction (5' →3')

Explanation: (b) DNA dependent DNA polymearse catalyses polymerisation only in one direction (5' →3')

15. Which of the following steps in transcription is catalysed by RNA polymerase?

(a) Initiation

(b) Elongation

(c) Termination

(d) All of the above

Ans. (d) All of the above

Explanation: RNA polymerase facilitates initiation, elongation and termination during transcription. Option 'd' is correct answer.

16. Control of gene expression takes place at the level of:

(a) DNA-replication

(b) Transcription

(c) Translation

(d) None of the above

Ans. (b) Transcription

Explanation: Transcription is the first step of gene expression. In this process, a particular segment of DNA is copied into mRNA. Thus, it controls gene expression.

17. Regulatory proteins are the accessory proteins that interact with RNA polymerase and affect its role in transcription. Which of the following statements is correct about regulatory protein?

(a) They only increase expression

(b) They only decrease expression

(c) They interact with RNA polymerase but do not affect the expression

(d) They can act both as activators and as repressors

Ans. (d) They can act both as activators and as repressors

Explanation: Regulatory proteins affect the ability of RNA to recognize initiation sites. Regulatory proteins have both negative (repressor) and positive (activator) role.

18. Which was the last human chromosome to be completely sequenced:

(a) Chromosome 1

(b) Chromosome 11

(c) Chromosome 21

(d) Chromosome X

Ans. (a) Chromosome 1

Explanation: (a) Chromosome 1

19. Which of the following are the functions of RNA?

(a) It is a carrier of genetic information from DNA to ribosomes synthesising polypeptides.

(b) It carries amino acids to ribosomes.

(c) It is a constituent component of ribosomes.

(d) All of the above.

Ans. (d) All of the above.

Explanation: (d) All of the above.

20. While analysing the DNA of an organism a total number of 5386 nucleotides were found out of which the proportion of different bases were: Adenine = 29%, Guanine = 17%, Cytosine = 32%, Thymine = 17%. Considering the Chargaff's rule it can be concluded that:

(a) it is a double stranded circular DNA

(b) It is single stranded DNA

(c) It is a double stranded linear DNA

(d) No conclusion can be drawn

Ans. (b) It is single stranded DNA

Explanation: Chargaff's rules states that DNA from any cell of all organisms should have a 1:1 ratio (base Pair Rule) of pyrimidine and purine bases. This means that the amount of guanine is equal to cytosine and the amount of adenine is equal to thymine. This pattern is found in both strands of the DNA. In this case, percentage of adenine is not equal to that of guanine and same holds true for cytosine and thymine. Hence, it is a single stranded DNA.

21. In some viruses, DNA is synthesised by using RNA as template. Such a DNA is called:

- (a) A-DNA
- (b) B-DNA
- (c) c DNA
- (d) r DNA

Ans. (c) c DNA

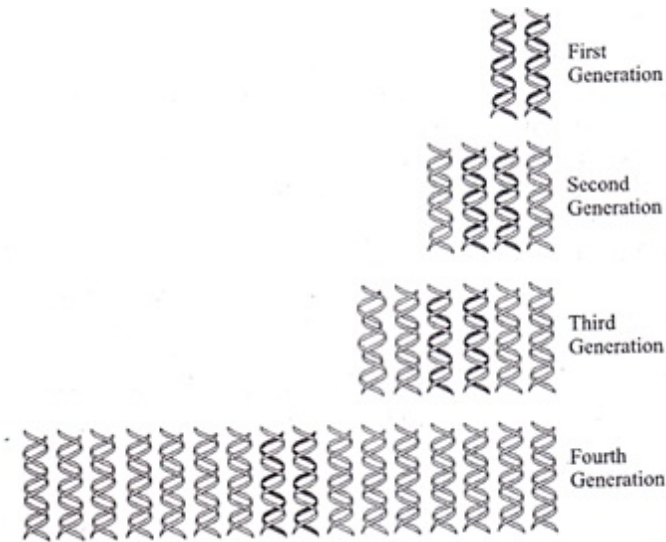
Explanation: Complementary DNA (cDNA) is double-stranded DNA synthesized from a messenger RNA (mRNA) template in a reaction catalysed by the enzyme reverse transcriptase.

22. If Meselson and Stahl's experiment is continued for four generations in bacteria, the ratio of $^{15}\text{N}/^{15}\text{N}$: $^{15}\text{N}^{14}\text{N}$: $^{14}\text{N}^{14}\text{N}$ containing DNA in the fourth generation would be:

- (a) 1:1:0
- (b) 1:4:0
- (c) 0:1:3
- (d) 0:1:7

Ans. (d) 0:1:7

Explanation: The ratio of $^{15}\text{N}/^{15}\text{N}$ remains zero in subsequent generation. The ratio of $^{15}\text{N}/^{14}\text{N}$ remains constant (remains one) and that of $^{14}\text{N}/^{14}\text{N}$ increases. Following figure illustrates this.



23. If the sequence of nitrogen bases of the coding strand of DNA in a transcription unit is:

5' - A T G A A T G - 3',

the sequence of bases in its RNA transcript would be;

(a) 5' - A U G A A U G - 3'

(b) 5' - U A C U U A C - 3'

(c) 5' - C A U U C A U - 3'

(d) 5' - G U A A G U A - 3'

Ans. (a) 5' - A U G A A U G - 3'

Explanation: (a) 5' - A U G A A U G - 3'

24. The RNA polymerase holoenzyme transcribes:

(a) the promoter, structural gene and the terminator region

(b) the promoter, and the terminator region

(c) the structural gene and the terminator regions

(d) the structural gene only.

Ans. (c) the structural gene and the terminator regions

Explanation: (c) the structural gene and the terminator regions

25. If the base sequence of a codon in mRNA is 5'-AUG-3', the sequence of tRNA pairing with it must be:

(a) 5' - UAC - 3'

(b) 5' - CAU - 3'

(c) 5' - AUG - 3'

(d) 5' - GUA - 3'

Ans. (b) 5' - CAU - 3'

Explanation: (b) 5' - CAU - 3'

26. The amino acid attaches to the tRNA at its:

(a) 5' - end

(b) 3' - end

(c) Anti codon site

(d) DHU loop

Ans. (b) 3' - end

Explanation: (b) 3' – end

27. To initiate translation, the mRNA first binds to:

(a) The smaller ribosomal sub-unit,

(b) The larger ribosomal sub-unit

(c) The whole ribosome

(d) No such specificity exists.

Ans. (a) The smaller ribosomal sub-unit

Explanation: (a) The smaller ribosomal sub-unit

28. In E.coli, the lac operon gets switched on when:

(a) lactose is present and it binds to the repressor

(b) repressor binds to operator

(c) RNA polymerase binds to the operator

(d) lactose is present and it binds to RNA polymerase

Ans. (a) lactose is present and it binds to the repressor

Explanation: (a) lactose is present and it binds to the repressor

CBSE Class 12 Biology
NCERT Exemplar Solutions
CHAPTER 6
MOLECULAR BASIS OF INHERITANCE

Very Short Answer Type Questions

1. What is the function of histones in DNA packaging?

Ans. Histone acts like a spool around which DNA is wrapped.

2. Distinguish between heterochromatin and euchromatin. Which of the two is transcriptionally active?

Ans.

Heterochromatin	Euchromatin
(i) They are darkly staining and are scattered or accumulated near the nuclear envelope.	(i) Euchromatin is not readily stainable and is dispersed.
(ii) These are transcriptionally less active or inactive.	(ii) These are transcriptionally active.

3. The enzyme DNA polymerase in E.coli is a DNA dependent polymerase and also has the ability to proof-read the DNA strand being synthesised. Explain. Discuss the dual polymerase.

Ans. DNA polymerase uses DNA template to catalyse the polymerization of deoxynucleotides and hence it is called DNA – dependent. When a new strand of DNA is being processed, this enzyme moves along to hasten the speed of polymerization. While doing so, it “proof reads” the strand being formed. By doing so, it helps in speeding up the process. Hence, its nature

can be said as dual, i.e. of reading the template and then proof reading the new strand.

4. What is the cause of discontinuous synthesis of DNA on one of the parental strands of DNA? What happens to these short stretches of synthesised DNA?

Ans. DNA polymerase catalyses polymerization in only one direction, i.e. 5' – 3'. Due to this, replication is continuous on one strand (3'-5'), while it is discontinuous on another strand (5' – 3'). The fragments which is discontinuous is later joined by DNA ligase.

5. Given below is the sequence of coding strand of DNA in a transcription unit

3'-A A T G C A C T A T T A G G - 5'

Write the sequence of

(a) its complementary strand

(b) the mRNA

Ans. (a) 5' – T T A C G T C G A T A A C C – 3'

(b) 5' – U U A C G U C G A U A A C C – 3'

6. What is DNA polymorphism? Why is it important to study it?

Ans. If an inheritable mutation appears in a population at high frequency, this is known as DNA polymorphism. Since inheritable mutations finally lead to evolution, hence study of DNA polymorphism is important from the evolutionary perspective.

7. Based on your understanding of genetic code, explain the formation of any abnormal hemoglobin molecule. What are the known consequences of such a change?

Ans. Normally human beings have following types of hemoglobin, Hb^A, Hb^{A2} and Hb^F. Alteration in genes for beta chain on hemoglobin results in formation of Hb^S type of hemoglobin. This type of hemoglobin molecule is responsible for sickle cell anemia.

8. Sometimes cattle or even human beings give birth to their young ones that are having extremely different sets of organs like limbs/position of eye(s) etc. Comment.

Ans. Presence of any different sets of organ in an animal is due to disturbance in co-ordinated regulation of expression of sets of genes.

9. In a nucleus, the number of ribonucleotide triphosphates, is 10 times the number of deoxy ribonucleotide triphosphates, but only deoxy ribonucleotides are added during the DNA replication. Suggest a mechanism.

Ans. DNA polymerase is highly specific to recognise only deoxyribonucleoside triphosphates. Therefore, it cannot hold RNA nucleotides.

10. Name a few enzymes involved in DNA replication other than DNA polymerase and ligase. Name the key functions for each of them.

Ans. Following are some other enzymes and their key functions:

- Primase: It adds RNA primers to template strands.
 - RNase: Removes the RNA primer.
 - Exonuclease: Initiate cleaving of nucleotides one at a time.
-

11. Name any three viruses which have RNA as the genetic material.

Ans. Following viruses have RNA as genetic material:

- Ebola virus
- Tobacco Mosaic Virus
- SARS

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CHAPTER 7
EVOLUTION

Long Answer Type Questions

1. Name the law that states that the sum of allelic frequencies in a population remains constant. What are the five factors that influence these values?

Ans. Hardy Weinberg Principle: This principle says that the sum of allelic frequencies in a population remains constant and remains the same through generations. The sum total of allelic frequencies in a population is 1. If p represents the frequency of allele A and q represents the frequency of allele a then in a diploid individual the frequency of allele AA can be shown by p^2 and that of allele aa can be shown by q^2 . Additionally, frequency of alleles Aa can be shown by $2pq$. This can be shown by the following equation which is derived from the algebraic identity $(p+q)^2 = p^2 + 2pq + q^2 = 1$

When a measured frequency differs from this value; it indicates the extent of evolutionary change.

Following five factors influence these values:

- (a) Gene migration or gene flow
 - (b) Genetic drift
 - (c) Genetic recombination
 - (d) Mutation
 - (e) Natural selection
-

2. Explain divergent evolution in detail. What is the driving force behind it?

Ans. The accumulation of differences that can lead to formation of new species is called

divergent evolution. When two groups of the same species face isolation from each other, group adapts to the changed circumstances in its own way. Natural selection and adaptation result in formation of adaptations in a particular group. These variations accumulate over various generations and finally a new species comes into origin.

Homologous organs are results of divergent evolution. We know that organs which are similar in basic design but serve different purposes in different organisms are called homologous organs. Forelimbs of mammals and birds are very good examples of divergent evolution. In most of the mammals, the forelimbs are suited for walking, running and for doing various other chores. In birds, the forelimbs are modified into wings as part of flight adaptations in birds. In both organisms; the forelimbs are composed of humerus, radio-ulna, carpals and metacarpals. But they serve different purposes in mammals and birds. Homology indicates towards common ancestry.

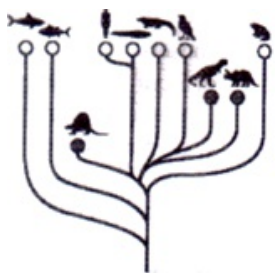
3. You have studied the story of Pepper moths in England. Had the industries been removed, what impact could it have on the moth population? Discuss.

Ans. Before industrialisation population of white-winged moths was more than the black-winged moth. This is because white wings of moth helped them in camouflaging. Thus, they were not picked by the predators and survived. But dark-winged moths were picked up by the predators due to their contrasting colour.

When lichens did not survive and tree trunks become dark because of industrial smoke or soot. This resulted in better chances of survival of dark wings in moths. This showed that evolution is apparently reversible. The same theory would apply when industries will be removed. Removal of industries would help in bringing down population level. This will help in lichens to once again flourish on tree trunks and the tree trunks will gain a whitish layer of lichens. This will result in survival of more white wings in the moths.

4. What are the key concepts in the evolution theory of Darwin?

Ans. Branching descent and natural selection are the two key concepts in the evolutionary theory of Darwin.



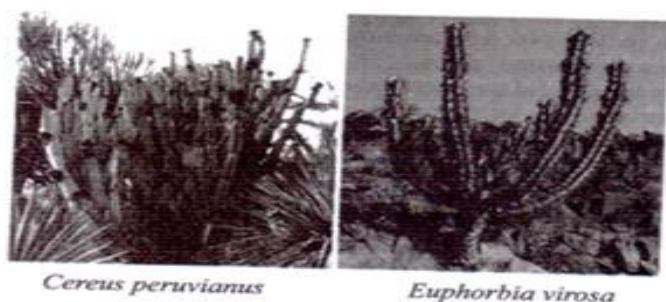
Branching Descent: This is based on the premise that various life forms can be represented as branches coming out of the same tree. This is often referred to as the “Tree of Life”. Following is a simple illustration of this which shows branching descent.

It is obvious from the given diagram that all the life forms we see today have evolved from a common ancestor. A branch has evolved into fishes and another branch has evolved into amphibians. A third branch has given rise to various land animals; like reptiles, aves and mammals. Darwin used various proofs to show that living beings have evolved from a common ancestor.

Natural Selection: Environmental conditions keep on changing. These changes offer new challenges to the organisms. All living beings try to come up with the changed environment by developing certain adaptations. Organisms with useful adaptations are able to produce more progenies. Thus, organisms with useful adaptations are able to maintain their lineage. Nature selects only those which are fit to survive and others perish in the long run. Thus, natural selection has an important role to play in biological evolution.

5. Two organisms occupying a particular geographical area (say desert) show similar adaptive strategies. Taking examples, describe the phenomenon.

Ans. When two organisms in a particular geographical area show similar adaptive strategies, this is called convergent evolution. Many desert plants show convergent evolution in spite of the fact that they are not closely related. *Cereus peruvianus* is a species of cactus which is primarily found in the South America. *Euphorbia virosa* is found in most parts of the world.



Both the plants are unrelated but show similar adaptations in order to conserve water. Following are some similarities in them:

- Stem is modified into fleshy succulent greenish parts which store water and carry out photosynthesis.
- Leaves are modified into spines in order to prevent water loss through transpiration.
- Roots penetrate much deeper in the ground to access water.

These examples show analogous organs which are manifestations of convergent evolution.

6. We are told that evolution is a continuing phenomenon for all living things. Are humans also evolving? Justify your answer.

Ans. Some scientists have been studying this aspect of human evolution and have come with interesting observations which suggest the evolution is indeed taking place in modern humans. Some of the observations are as follows:

- Human evolution has accelerated since the discovery of farming about 10,000 years ago. There is substantial genetic difference between hunter gatherers and current humans.
- Human reproductive period has prolonged than it was 10,000 years ago. Earlier, the average life expectancy of human beings was about 30 years which is now more than double.
- Lactase persistence into adulthood is another sign of human evolution. All other mammals develop lactose intolerance because young ones are weaned away from mother's milk after a certain age. Unlike humans; other mammals do not have the facility to consume other mammal's milk. But human beings consume milk throughout their life because they get it from domesticated animals.
- Humans have also developed resistance to many infectious diseases. This is another sign of evolution.

However, evolution of modern humans cannot happen through geographical isolation because modern means of transport has blurred geographical boundaries. But evolution can happen because of genetic drift.

7. Had Darwin been aware of Mendel's work, would he been able to explain the origin of variations. Discuss.

Ans. Mendel conducted a series of experiments on pea plants to come out with his theories on variations. For this, Mendel observed reproduction of pea plants for many generations and tabulated and analysed those findings. He could attribute the origin of variations to some 'factors' which may have been present in the organism. At that time, scientists did not know about genes.

Darwin was about 10 years older than Mendel and hence it can be said that he was born in the same era. He would have had access to same technology and information as Mendel had. Moreover, he was on an exploration in which conducting a Mendelian experiment could not have been possible. While Mendel's study was focused on a single species; Darwin's study was encompassing much wider scope, i.e. of almost the whole species present at that time. Their respective goals of study were also entirely different.

There is least likelihood that Darwin would have been able to explain the origin of variations.

CBSE Class 12 Biology
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CHAPTER 1
REPRODUCTION IN ORGANISMS

Very Short Answer Type Questions

1. Mention two inherent characteristics of Amoeba and yeast that enable them to reproduce asexually.

Ans. Amoeba and yeast are able to reproduce asexually because of following reasons:

- (a) They are unicellular organisms
 - (b) They have simple organization
-

2. Why do we refer to offspring formed by asexual method of reproduction as clones?

Ans. In asexual reproduction, a single parent is involved in reproduction and the process involves mitosis only. Due to this, variation is not possible in offspring and they are clones of their parent.

3. Although potato tuber is an underground part, it is considered as a stem. Give two reasons.

Ans. Following features on potato tuber are signs of it being a stem:

- (a) Presence of nodes (eyes)
 - (b) Presence of scaly leaves
-

4. Between an annual and a perennial plant, which one has a shorter juvenile phase? Give one reason.

Ans. Annual plants have shorter juvenile phase compare to perennial plans. Moreover, it also depends on number of flowering seasons in a given year. Some perennial plants

produce flower only once in a year. Some others may produce flowers once in 50 years or even 100 years. This is not the situation in annual plants.

5. Rearrange the following events of sexual reproduction in the sequence in which they occur in a flowering plant: embryogenesis, fertilisation, gametogenesis, pollination.

Ans. Gametogenesis → Pollination → Fertilisation → Embryogenesis

6. The probability of fruit set in a self-pollinated bisexual flower of a plant is far greater than a dioecious plant. Explain.

Ans. A self-pollinated plant does not have to depend on agents of pollination. But a dioecious plant has to depend on the agents of pollination for carrying out sexual reproduction. In certain circumstances, the agents of pollination may not be available because of various external factors. For example; use of high level of pesticides has reduced the number of pollinating insects. This is playing havoc with sexual reproduction in many flowering plants. So, the probability of fruit set in a self-pollinated bisexual flowers of a plant is far greater than a dioecious plant.

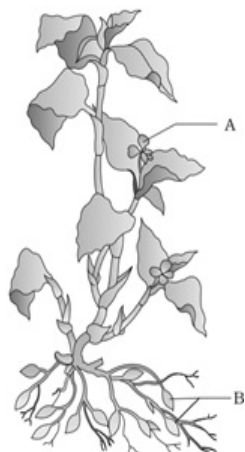
7. Is the presence of large number of chromosomes in an organism a hindrance to sexual reproduction? Justify your answer by giving suitable reasons.

Ans. The presence of large number of chromosomes in an organism is not a hindrance to sexual reproduction because number of chromosomes has no role in deciding a particular mode of reproduction. For example; there are 8 chromosomes in a somatic cell of fruit fly, while there are 380 chromosomes in a somatic cell of butterfly but both of them produce sexually.

8. Is there a relationship between the size of an organism and its life span? Give two examples in support of your answer.

Ans. There is no relationship between the size of an organism and its life span. For example; both mango and peepal tree are similar in size but a mango tree has a much shorter life span compared to a peepal tree. A tortoise is much smaller than an elephant yet the tortoise lives

more than hundred years.



9. In the figure given below the plant bears two different types of flowers marked 'A' and 'B'. Identify the types of flowers and state the type of pollination that will occur in them.

Ans. 'A' shows chasmogamous flowers with exposed anthers and stigma and cross pollination will happen in them. 'B' shows flowers which do not open at all. These are bisexual flowers and self-pollination will happen in them. On the other hand, agents of pollination can easily work in flower 'A' as its anthers and stigma are exposed.

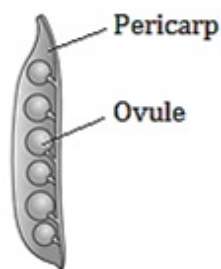
10. Give reasons as to why cell division cannot be a type of reproduction in multicellular organisms.

Ans. Most of the multicellular organisms have complex organization. Especially the animals show tissue level and organ system level organization. For a single cell, it is not possible to produce different tissues just by undergoing mitosis. Hence, cell division cannot be a type of reproduction in multicellular organisms.

11. In the figure given below, mark the ovule and pericarp.



Ans.



12. Why do gametes produced in large numbers in organisms which exhibit external fertilization?

Ans. In case of external fertilization, gametes are at the mercy of surrounding. Gametes can get blown off by wind, washed away by water or eaten by predators. So, most of the gametes perish before fertilization. To ensure the survival of the species, it is necessary to produce as many gametes as possible so that at least some of them would be able to carry out fertilization. Hence, organisms which exhibit fertilization produce a large number of gametes.

13. Which of the followings are monoecious and dioecious organisms.

(a) Earthworm_____

(b) Chara_____

(c) Marchantia_____

(d) Cockroach_____

Ans. (a) Dioecious

(b) Monoecious

(c) Dioecious

(d) Monoecious

14. Match the organisms given in Column-'A' with the vegetative propagules given in

column 'B'.

Column A	Column B
(i) Bryophyllum	(a) Offset
(ii) Agave	(b) Eyes
(iii) potato	(c) Leaf buds
(iv) Water hyacinth	(d) Bulbils

Ans. (i) → (c)

(ii) → (d)

(iii) → (b)

(iv) → (a)

15. What do the following parts of a flower develop into after fertilisation?

(a) Ovary _____

(b) Ovules _____

Ans. (a) Fruits

(b) Seeds

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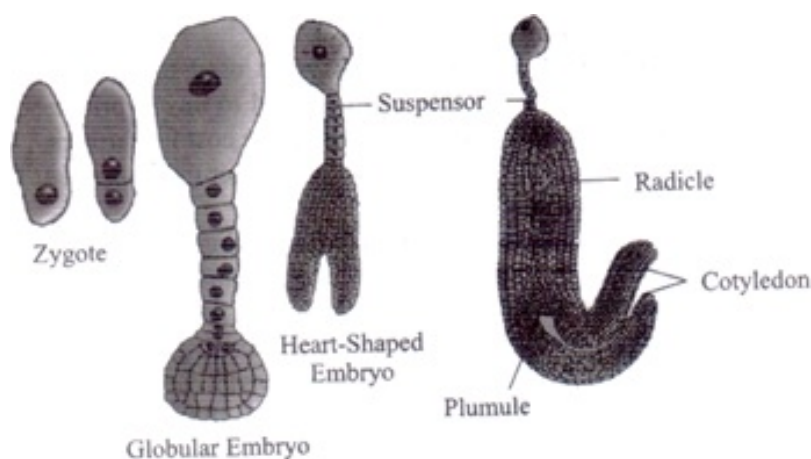
CHAPTER 2

SEXUAL REPRODUCTION IN FLOWERING PLANTS

Long Answer Type Questions

1. Starting with the zygote, draw the diagrams of the different stages of embryo development in a dicot.

Ans.



2. What are the possible types of pollinations in chasmogamous flowers. Give reasons.

Ans. Chasmogamous flowers: These are open flowers in which stigma and anthers are exposed and flowers are similar to other species. Possible types of pollinations in chasmogamous flowers are as follows:

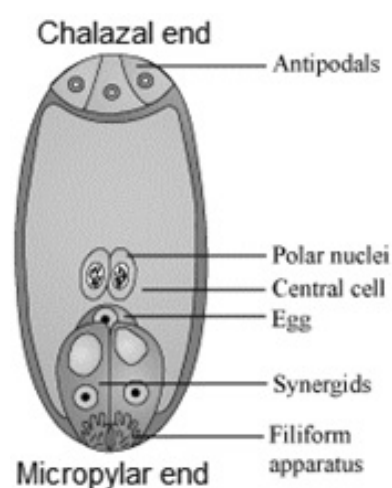
(a) **Geitonogamy:** The situation in which pollen grains from the same plant but different flower reaches the stigma is called geitonogamy. This is similar to autogamy because the zygote gets the gene pool from the same plant.

(b) **Xenogamy:** The situation in which pollen grains from a different plant reaches the stigma is called xenogamy. This can be termed as the true cross-pollination because the zygote gets the gene pool from two different plants.

Most of the plants produce hermaphrodite flowers and thus self-pollination is a clear cut eventuality. But continuous self-pollination can result in inbreeding depression. Variation will not be possible in case of self-pollination. Hence, plants have evolved various ways and means to facilitate cross pollination even in dioecious flowers. One of the strategies followed by plants is loss of synchronization between pollen release and stigma maturity. Another strategy is self-incompatibility between pollens and stigma of the same flower. A third strategy is the positional difference between anthers and stigma so that pollens from the same flower are unable to reach the stigma.

3. With a neat, labelled diagram, describe the parts of a mature angiosperm embryo sac. Mention the role of synergids.

Ans.



Structure of a Mature Embryo Sac: A mature embryo sac is a 7-celled structure and has 8 nuclei. The end near the micropyle is called the micropylar end while the opposite end is called the chalazal end. Following are the main parts of the embryo sac:

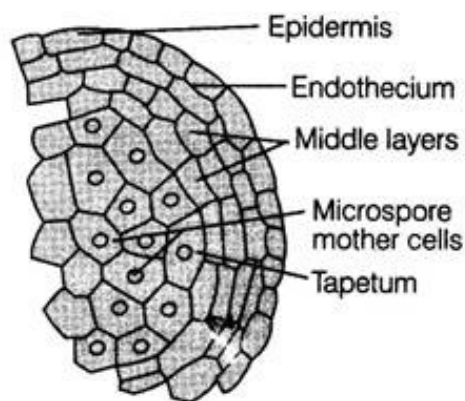
Egg Apparatus: The egg apparatus is composed of two synergids and an egg. There are special thickenings at the micropylar end of synergids. These thickenings are called filiform apparatus.

Function of Synergids: The synergids provide a channel to the pollen tube to enter through filiform apparatus.

Polar Nuclei: The two nuclei enclosed in the central cell are called polar nuclei.

Antipodals: The three cells at the chalazal end are called antipodals.

4. Draw the diagram of a microsporangium and label its wall layers. Write briefly on the role of the endothecium.



Ans. Role of Endothecium: Endothecium; along with the epidermis and the middle layer; provides protection to the pollens during development. Once pollen grains are mature, the three layers (including endothecium) rupture and thus facilitate dehiscence of pollens.

5. Embryo sacs of some apomictic species appear normal but contain diploid cells. Suggest a suitable explanation for the condition.

Ans. Condition in which seeds are produced without fertilization is called apomixis. Apomixis is a kind of asexual reproduction but it mimics sexual reproduction. There are several mechanisms for apomixis. One of them is seen in citrus and mango fruits. In this case, the nucellus begins to divide and intrude into the embryo sac. It eventually develops into seed. Since nucellus is composed of diploid cells, embryo sac in such case has diploid cells.

It is also important to recall that fertilization cannot happen in those cells which were not formed after meiosis. Moreover, haploid cells are never involved in apomixis rather it is the diploid cells which bring apomixis. Hence, embryo sacs apomictic species appear normal but contain diploid cells.

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CHAPTER 2

SEXUAL REPRODUCTION IN FLOWERING PLANTS

Short Answer Type Questions

1. List three strategies that a bisexual chasmogamous flower can evolve to prevent self-pollination (autogamy).

Ans. Following are the three strategies that a bisexual chasmogamous flower can evolve to prevent self-pollination (autogamy):

(a) In many flowers, pollen release and stigma receptivity are not synchronized. Either the pollen is released much before the maturity of stigma or stigma matures much before the release of pollen.

(b) In some flowers, anthers and stigma are placed at different places so that pollen grains from the same flower cannot reach the stigma.

(c) Some flowers follow self-incompatibility between pollen and stigma. This is a genetically mediated process which prevents autogamy in these flowers.

2. Given below are the events that are observed in an artificial hybridization programme. Arrange them in the correct sequential order in which they are followed in the hybridization programme.

(a) Re-bagging

(b) Selection of parents

(c) Bagging

(d) Dusting the pollen on stigma

(e) Emasculation

(f) Collection of pollen from male parent.

Ans. Following is the correct sequence of steps being followed in hybridization:

Selection of parents → Emasculation → Bagging → Collection of pollen from male parent → Re-bagging

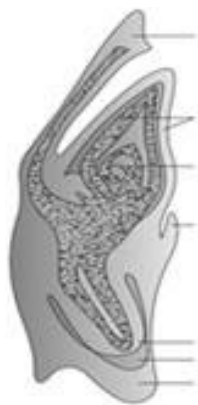
3. Vivipary automatically limits the number of offsprings in a litter. How?

Ans. Viviparity is a condition which is presents in both animals and plants. In case of animals; viviparity means an animal gives birth to young ones. In case of plants, viviparity means germination of embryo on the plant itself; without normal sequence of development of seed. Viviparity involves too much drain of resources on the mother. In case of animals; a female has to constantly supply the nutrients and oxygen to the growing foetus, if the foetus developing in the womb. Enough resources are not available to support a large litter and hence viviparity automatically limits the number of offsprings in a litter. This is true in case of plants also because a germinating embryo on the plant would require resources from the mother plant

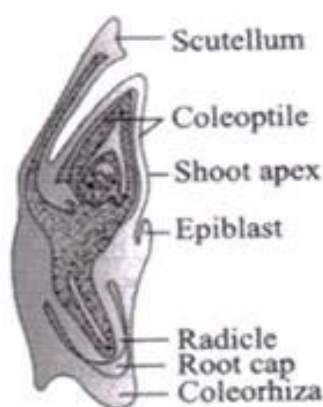
4. Does self-incompatibility impose any restrictions on autogamy? Give reasons and suggest the method of pollination in such plants.

Ans. Self-incompatibility is the condition in which pollen from the same plant cannot pollinate the flower. Thus, self-incompatibility imposes complete restriction on autogamy. This evolution might have occurred in order to prevent too much inbreeding because continuous inbreeding prevent variations. In such plants, cross pollination is the norm and pollen from a plant pollinates the flower on another plant. This ensures accumulation of gene pools from two different plants.

5. In the given diagram, write the names of parts shown with lines.



Ans.



6. What is polyembryony and how can it be commercially exploited?

Ans. In some varieties of citrus and mango, the nucellar cells start dividing and protrude into the embryo sac. They eventually produce multiple embryos. This condition is called polyembryony. This is an apomictic condition in which embryos develop without fertilization. Polyembryony can be commercially exploited by producing seeds of hybrid varieties at lower cost. In case of hybrid plants, a farmer needs to buy seeds every year because plants from hybrid seeds fail to produce hybrid seeds due to laws of inheritance. Buying fresh seeds in every season is very costly. If hybrid seeds are produced with polyembryonic condition, then it would be possible for the farmers to utilize those seeds for the next year and subsequent years. This is still at research stage but there are bright prospects for future.

7. Are parthenocarpy and apomixis different phenomena? Discuss their benefits.

Hint: Yes, they are different. Parthenocarpy leads to development of seedless fruits. Apomixis leads to embryo development.

Ans. Parthenocarpy is the condition in which fruits develop without seeds, while apomixis is a condition in which seeds develop without fertilization. Fertilization is absent in both the case but seeds are present in apomixis only. Benefits of Parthenocarpy: Seedless fruits are easier to consume; especially those fruits which naturally contain too many seeds, e.g. papaya, watermelon and banana.

Benefits of Apomixis: Apomixis can be used to produce apomicts hybrid seeds so that farmers will not need to buy hybrid seeds every year. This will help in drastically cutting the cost for farmers.

8. Why does the zygote begin to divide only after the division of Primary endosperm cell (PEC)?

Ans. Endosperm plays the important role of supplying food to the developing embryo. Once the division of Primary Endosperm Cell (PEC) is complete, there is sufficient availability of food for the embryo. In the absence of food, the zygote won't be able to get the necessary raw materials for making new cells. Hence, division of zygote beings only after the division of Primary Endosperm Cell (PEC).

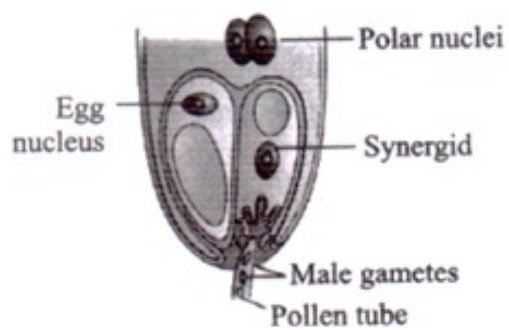
9. The generative cell of a two-celled pollen divides in the pollen tube but not in a three-celled pollen. Give reasons.

Ans. In a three-celled pollen, one of the cells is a vegetative cell which has no role to play in fertilization. The remaining two cells are the male gametes and they are the actual participants in fertilization. Hence, inside the pollen tube, the generative cells divide rather than the vegetative cell. In 60% of the cases, the generative cell divides inside the pollen tube. In remaining case, the generative cell divides much before pollination.

10. In the figure given below label the following parts: male gametes, egg cell, polar nuclei, synergid and pollen tube



Ans.



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CHAPTER 2

SEXUAL REPRODUCTION IN FLOWERING PLANTS

Very Short Answer Type Questions

1. Name the component cells of the 'egg apparatus' in an embryo sac.

Ans. The egg apparatus consists of two synergids and one egg cell.

2. Name the part of gynoecium that determines the compatible nature of pollen grain.

Ans. Pistil has the ability to recognize a compatible pollen grain.

3. Name the common function that cotyledons and nucellus perform.

Ans. Cotyledons and nucellus contain abundant food which is utilized by the developing cells.

4. Complete the following flow chart



Ans.



5. Indicate the stages where meiosis and mitosis occur (1, 2 or 3) in the flow chart.

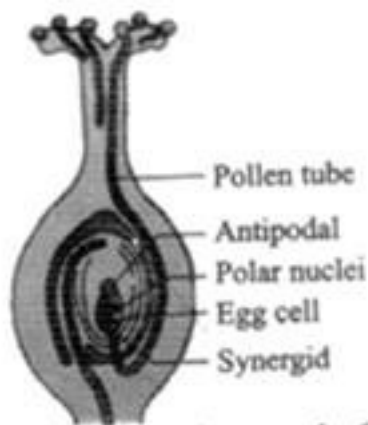


Ans. 1: Meiosis, 2: Mitosis, 3: Mitosis

6. In the diagram given below, show the path of a pollen tube from the pollen on the stigma into the embryo sac. Name the components of egg apparatus.



Ans.



Longitudinal section of a flower showing growth of pollen tube

Synergids and egg cell are the components of egg apparatus.

7. Name the parts of pistil which develop into fruit and seeds.

Ans. The ovary develops into fruits and ovules develop into seeds.

8. In case of polyembryony, if an embryo develops from the synergid and another from the nucellus which is haploid and which is diploid?

Ans. The embryo developing from synergid will be haploid and the embryo developing from nucellus will be diploid.

9. Can an unfertilised, apomictic embryo sac give rise to a diploid embryo? If yes, then how?

Ans. We know that when seeds develop without fertilization, this condition is called apomixis. During apomixis, embryo can develop from nucellus which is diploid. Thus, an apomictic embryo sac can give rise to a diploid embryo.

10. Which are the three cells found in a pollen grain when it is shed at the three celled stage?

Ans. When a pollen grain is shed at the three celled stage, it contains a vegetative cell and two male gametes. The generative cell divides into two male gametes.

11. What is self-incompatibility?

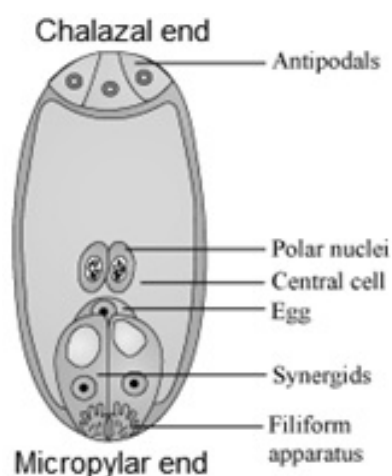
Ans. When pollen from the same plant is incompatible for fertilization, this condition is called self-incompatibility.

12. Name the type of pollination in self-incompatible plants.

Ans. In case of self-incompatible plants, cross-pollination takes place.

13. Draw the diagram of a mature embryo sac and show its 8-nucleate, 7-celled nature. Show the following parts: antipodals, synergids, egg, central cell, polar nuclei.

Ans.



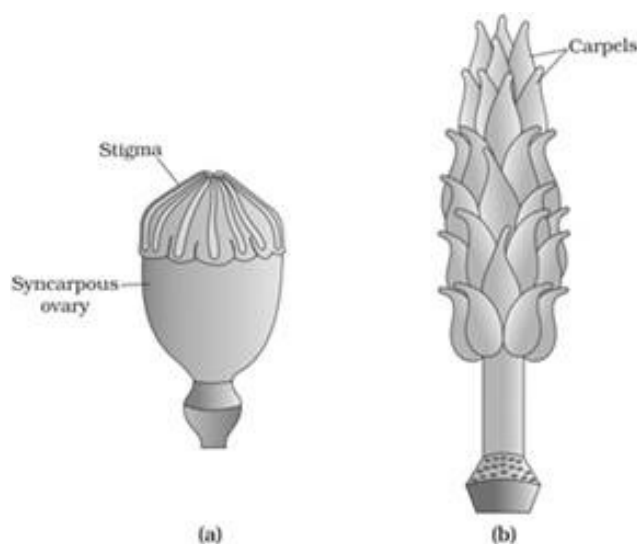
14. Which is the triploid tissue in a fertilised ovule? How is the triploid condition achieved?

Ans. Primary Endosperm Nucleus (PEN) shows triploid condition. When one of the male gametes fuses with the polar nuclei, it results in the formation of triploid PEN.

15. Are pollination and fertilisation necessary in apomixis? Give reasons.

Ans. Apomixis is a condition in which embryo develops without fertilization. Hence, pollination and fertilization are not necessary for apomixis.

16. Identify the type of carpel with the help of diagrams given below:



Ans. Figure 'a' shows multicarpellary syncarpous condition and figure 'b' shows multicarpellary apocarpous condition.

17. How is pollination carried out in water plants?

Ans. Water mediated pollination happens in selected number of plants. In Vallisneria, the female flower reaches the surface of water. Pollen grains are sprinkled on water surface and they are passively transported to the female flower for pollination. In seagrasses, the female flower remains submerged in water and pollen grains are released below the water surface. In case of pollination by water, pollen grains have mucilaginous covering which prevents the pollens from becoming wet.

18. What is the function of the two male gametes produced by each pollen grain in angiosperms?

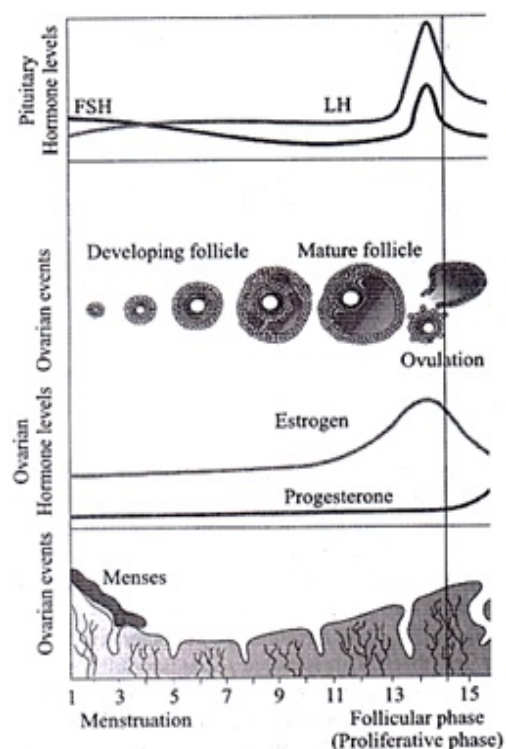
Ans. One of the male gametes fuses with the female gamete and forms the embryo. The embryo subsequently develops into a new plant. Another male gamete fuses with polar nuclei and eventually forms endosperm. Endosperm supplies food to the developing embryo.

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CHAPTER 3
HUMAN REPRODUCTION

Long Answer Type Questions

1. What role does pituitary gonadotropins play during follicular and ovulatory phases of menstrual cycle? Explain the shifts in steroidal secretions.

Ans. FSH and LH are the two pituitary gonadotropins which play important role during follicular and ovulatory phases of menstrual cycle.



- FSH stimulates the release of ovum from the Graafian follicle. It also stimulates the development and subsequent rupture of Graafian follicle. Thus, FSH plays major role during follicular and ovulatory phases.
- The given figure shows varying levels of LH, FSH and steroid hormones during follicular and ovulation phases of menstrual cycle.
- At this stage, level of estradiol (a steroid hormone) increases. This suppresses the level of Luteinizing hormone (LH). Once the level of estradiol reaches a threshold level; its

effect is reversed.

- After that, level of estrogen (another steroid hormone) increases. This stimulates a surge in levels of LH. High level of LH stimulates development of corpus luteum and proliferation of endometrium. This marks the beginning of the luteal phases.
-

2. Meiotic division during oogenesis is different from that in spermatogenesis. Explain how and why?

Ans. It is true that meiotic division during oogenesis is different from that in spermatogenesis. Following are the details about significant differences between them:

- In case of spermatogenesis, meiotic division begins at the time of puberty. This is the time when spermatogenesis begins in a male. On the other hand, oogenesis begins in female when the female is still in the womb. Thus, it can be said that meiotic division during oogenesis begins when the girl child is still in the womb.
- Formation of primary oocytes stop by the 20th week of gestation of the female child. On the contrary, production of spermatocytes continues throughout the reproductive phase of a male.
- In case of spermatogenesis, all the stages of meiosis take place quickly after one another and there is no time lag between them. In case of oogenesis, meiosis is suspended at the Prophase I state.
- Meiosis resumes only once the puberty begins.

Following are some possible reasons for this difference in patterns of oogenesis and spermatogenesis:

- Male gametes need to be formed in very large number to ensure fertilization.
 - Female gametes are not exposed to external hazards and hence a less number of them would be enough. Limiting the production of female gametes helps in conservation of resources from the female body. The resources can then be properly utilized during development of foetus.
-

3. The zygote passes through several developmental stages till implantation. Describe each stage briefly with suitable diagrams.

Ans. Following figure shows various stages of zygote development till implantation:



(a) The zygote divides into two-cell stage called cleavage. This development takes place when the zygote is still in the isthmus.

(b) The cleavage undergoes further rounds of mitosis to form 2, 4, 8 and finally 16-celled stage.

These daughter cells are called blastomere.

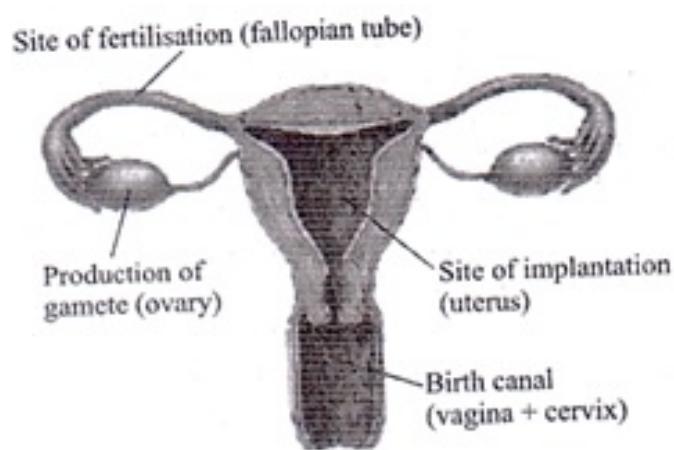
(c) The 16-celled stage is called morula.

(d) The morula changes into blastocyst; with more rounds of meiosis. At this stage, the blastomeres are arranged in an outer layer of cells; called trophoblast and an inner mass of cells.

(e) Implantation to uterine wall happens at the blastocyst stage.

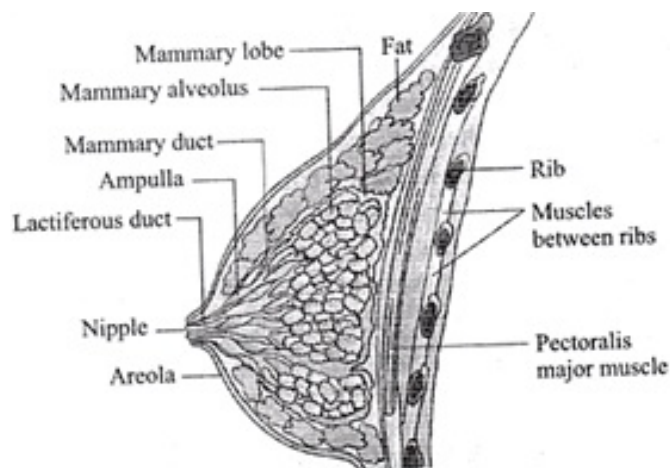
4. Draw a neat diagram of the female reproductive system and label the parts associated with the following (a) production of gamete, (b) site of fertilisation (c) site of implantation and, (d) birth canal.

Ans.



5. With a suitable diagram, describe the organisation of mammary gland.

Ans. Mammary glands are paired structures which contain glandular tissue and variable amount of fat.



- In each breast, glandular tissue is divided into 15 – 20 mammary lobes. These lobes have clusters of cells called alveoli.
- The cells of alveoli secrete milk, which is stored in the cavities (lumens) of alveoli. The alveoli open in mammary tubules.
- Tubules from each lobe join to form a mammary duct.
- Many mammary ducts join to form a wider mammary ampulla.
- A mammary ampulla is connected to the lactiferous duct. Milk is sucked out through the lactiferous duct.

CBSE Class 12 Biology
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CHAPTER 3
HUMAN REPRODUCTION

Multiple Choice Questions (MCQs)

1. Choose the incorrect statement from the following:

- (a) In birds and mammals internal fertilisation takes place**
- (b) Colostrum contains antibodies and nutrients**
- (c) Polyspermy in mammals is prevented by the chemical changes in the egg surface**
- (d) In the human female implantation occurs almost seven days after fertilization**

Ans. (c) Polyspermy in mammals is prevented by the chemical changes in the egg surface

Explanation: Absorption of water by zona pellucida results in its swelling. This prevents further entry of sperms and thus polyspermy is prevented. So physical change rather than chemical change is responsible for prevention of polyspermy in mammals.

2. Identify the correct statement from the following:

- (a) High levels of estrogen triggers the ovulatory surge.**
- (b) Oogonial cells start to proliferate and give rise to functional ova in regular cycles from puberty onwards.**
- (c) Sperms released from seminiferous tubules are highly motile.**
- (d) Progesterone level is high during the post ovulatory phase of menstrual cycle.**

Ans. (d) Progesterone level is high during the post ovulatory phase of menstrual cycle.

Explanation: High levels of LH and FSH trigger the ovulatory surge. Sperms released from seminiferous tubules are non-motile. Oogonial cells cease activity when the girl child is still

in the womb. Hence, option 'd' is the correct answer.

3. Spot the odd one out from the following structures with reference to the male reproductive system.:

- (a) Rete testis
- (b) Epididymis
- (c) Vasa efferentia
- (d) Isthmus

Ans. (d) Isthmus

Explanation: Isthmus is a part of the oviduct in female reproductive system. Others are parts of the male reproductive system.

4. Seminal plasma, the fluid part of semen, is contributed by.

- (i) Seminal vesicle
- (ii) Prostate
- (iii) Urethra
- (iv) Bulbourethral gland

- (a) (i) and (ii)
- (b) (i), (ii) and (iv)
- (c) (ii), (iii) and (iv)
- (d) (i) and (iv)

Ans. (b) (i), (ii) and (iv)

Explanation: Urethra has no contribution to seminal plasma.

5. Spermiation is the process of the release of sperms from:

- (a) Seminiferous tubules**
- (b) Vas deferens**
- (c) Epididymis**
- (d) Prostate gland**

Ans. (a) Seminiferous tubules

Explanation: (a) Seminiferous tubules

6. Mature Graafian follicle is generally present in the ovary of a healthy human female around day:

- (a) 5 – 8 day of menstrual cycle**
- (b) 11– 17 day of menstrual cycle**
- (c) 18– 23 day of menstrual cycle**
- (d) 24– 28 day of menstrual cycle**

Ans. (b) 11– 17 day of menstrual cycle

Explanation: This is the period during which ovulation takes place after rupture in Graafian follicle.

7. Acrosomal reaction of the sperm occurs due to:

- (a) Its contact with zona pellucida of the ova**
- (b) Reactions within the uterine environment of the female**
- (c) Reactions within the epididymal environment of the male**
- (d) Androgens produced in the uterus**

Ans. (a) Its contact with zona pellucida of the ova

Explanation: Enzyme from acrosome breaks down the zona pellucida so that sperm can enter the ova.

8. Which one of the following is not a male accessory gland?

- (a) Seminal vesicle
- (b) Ampulla
- (c) Prostate
- (d) Bulbourethral gland

Ans. (b) Ampulla

Explanation: Ampulla is a part of fallopian tube.

9. The immature male germ cells undergo division to produce sperms by the process of spermatogenesis. Choose the correct one with reference to above.

- (a) Spermatogonia have 46 chromosomes and always undergo meiotic cell division
- (b) Primary spermatocytes divide by mitotic cell division
- (c) Secondary spermatocytes have 23 chromosomes and undergo second meiotic division
- (d) Spermatozoa are transformed into spermatids

Ans. (c) Secondary spermatocytes have 23 chromosomes and undergo second meiotic division

Explanation: Spermatogonia have 46 chromosomes and they undergo meiotic cells division, primary spermatocytes undergo meiotic cell division, spermatids are transformed into spermatozoa. So, option 'a', 'c' and 'd' are incorrect.

10. Match between the following representing parts of the sperm and their functions and choose the correct option.

Column A	Column B
(A) Head	(i) Enzymes
(B) Middle piece	(ii) Sperm motility
(C) Acrosome	(iii) Energy
(D) Tail	(iv) Genetic material

Options:

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

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

Explanation: The nucleus is present in the head. Acrosome releases enzyme which dissolves zona pellucida. Tail helps in swimming of sperm and middle piece is the place where mitochondria are present.

11. Which among the following has 23 chromosomes?

- (a) Spermatogonia
- (b) Zygote
- (c) Secondary oöcyte
- (d) Oögonia

Ans. (c) Secondary oöcyte

Explanation: Secondary oöcyte

12. Match the following and choose the correct options:

Column I	Column II
(A) Trophoblast	(i) Embedding of blastocyst in the endometrium
(B) Cleavage	(ii) Group of cells that would differentiate as embryo
(C) Inner cell mass	(iii) Outer layer of blastocyst attached to the endometrium
(D) Implantation	(iv) Mitotic division of zygote

Options:

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

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

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

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

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

Explanation: (b) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)

13. Which of the following hormones is not secreted by human placenta?

(a) hCG

(b) Estrogens

(c) Progesterone

(d) LH

Ans. (d) LH

Explanation: LH (Luteinizing hormone) is secreted by pituitary gland.

14. The vas deferens receives duct from the seminal vesicle and opens into urethra as:

(a) Epididymis

(b) Ejaculatory duct

(c) Efferent ductile

(d) Ureter

Ans. (b) Ejaculatory duct

Explanation: (b) Ejaculatory duct

15. Urethral meatus refers to the:

(a) Urinogenital duct

(b) Opening of vas deferens into urethra

(c) External opening of the urinogenital duct

(d) Muscles surrounding the urinogenital duct

Ans. (c) External opening of the urinogenital duct

Explanation: (c) External opening of the urinogenital duct

16. Morula is a developmental stage:

(a) Between the zygote and blastocyst

(b) Between the blastocyst and gastrula

(c) After the implantation

(d) Between implantation and parturition

Ans. (a) Between the zygote and blastocyst

Explanation: (a) Between the zygote and blastocyst

17. The membranous cover of the ovum at ovulation is:

(a) Corona radiata

(b) Zona radiata

(c) Zona pellucida

(d) Chorion

Ans. (a) Corona radiata

Explanation: (a) Corona radiata

18. Identify the odd one from the following:

(a) Labia minora

(b) Fimbriae

(c) Infundibulum

(d) Isthmus

Ans. (a) Labia minora

Explanation: All other structures are associated with fallopian tubes. Hence, 'a' is the correct answer.

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CHAPTER 3
HUMAN REPRODUCTION

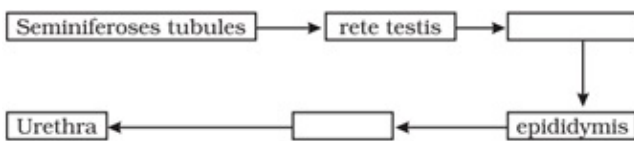
Very Short Answer Type Questions

1. Given below are the events in human reproduction. Write them in correct sequential order.

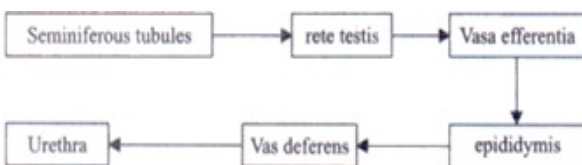
Insemination, gametogenesis, fertilization, parturition, gestation, implantation

Ans. Gametogenesis → Insemination → Fertilization → Implantation → Gestation → Parturition

2. The path of sperm transport is given below. Provide the missing steps in blank boxes.



Ans.



3. What is the role of cervix in the human female reproductive system?

Ans. Along with the vagina; cervix forms the birth canal. Parturition happens through the birth canal.

4. Why are menstrual cycles absent during pregnancy.

Ans. High level of progesterone and estrogens during pregnancy suppress the gonadotropins which is required for the development of new follicles. Therefore, a new cycle cannot be

initiated.

5. Female reproductive organs and associated functions are given below in column A and B. Fill the blank boxes.

Column A	Column B
Ovaries	Ovulation
Oviduct	a
b	Pregnancy
Vagina	Birth

Ans. (a) Fertilization, (b) Uterus

6. From where the parturition signals arise-mother or foetus? Mention the main hormone involved in parturition.

Ans. Parturition signals arise from the foetus. This triggers release of oxytocin from the maternal pituitary gland. Oxytocin is the main hormone involved in parturition.

7. What is the significance of epididymis in male fertility?

Ans. Secretion from epididymis is essential for maturation and motility of sperms. Secretions from vas deferens, prostate and seminal vesicle are also involved in this. Thus, these organs; along with epididymis play an important role in male fertility.

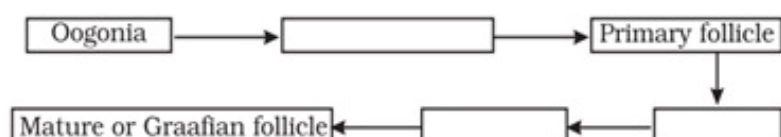
8. Give the names and functions of the hormones involved in the process of spermatogenesis. Write the names of the endocrine glands from where they are released.

Ans.

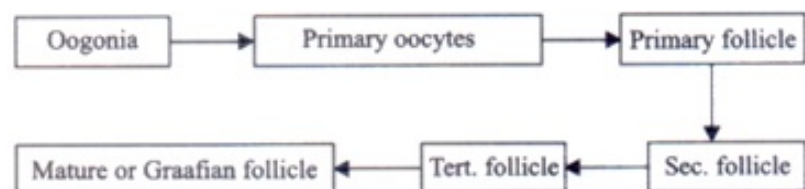
Hormone	Function	Origin of hormone

Gonadotropin Releasing Hormone (GnRH)	Act on anterior pituitary gland and stimulates the release of LH and FSH	Hypothalamus
Luteinizing hormone (LH)	Acts at Leydig cells and stimulates secretion of androgen.	Pituitary
Follicle Stimulating Hormone (FSH)	Acts on Sertoli cells and stimulates factors which are involved in spermatogenesis.	Pituitary

9. The mother germ cells are transformed into a mature follicle through series of steps. Provide the missing steps in the blank boxes.



Ans.



10. During reproduction, the chromosome number (2n) reduces to half (n) in the gametes and again the original number (2n) is restored in the offspring, What are the processes through which these events take place?

Ans. Gametogenesis involves meiosis which results in haploid number of chromosomes in daughter cells. Thus, chromosome number is half (n) in gametes. Fertilisation is the step in which the chromosome number becomes diploid (2n) because of fusion of male and female gametes.

11. What is the difference between a primary oöcyte and a secondary oöcyte?

Ans.

Primary Oocyte	Secondary Oocyte
(i) Primary oocyte is formed when the female is still in the womb.	(i) Secondary oocyte is formed at the onset of puberty.
(ii) It is surrounded by secondary follicle.	(ii) It is surrounded by tertiary follicle as well.
(iii) Chromosome number is 46.	(iii) Chromosome number is 23.

12. What is the significance of ampullary–isthmic junction in the female reproductive tract?

Ans. First cleavage division of zygote occurs in the ampullary-isthmic junction in the female reproductive tract.

13. How does zona pellucida of ovum help in preventing polyspermy?

Ans. Once a sperm comes in contact with zona pellucida of the ovum, it induces changes in its membrane. These changes prevent the entry of other sperm into the ovum and thus prevent polyspermy.

14. Mention the importance of LH surge during menstrual cycle.

Ans. Rapid surge in LH induces rupture of Graafian follicle. This facilitates the release of ovum. Thus, rapid surge in LH facilitates ovulation.

15. Which type of cell division forms spermatids from the secondary spermatocytes?

Ans. Meiosis results in formation of spermatids from secondary spermatocytes.

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CHAPTER 4
REPRODUCTIVE HEALTH

Long Answer Type Questions

1. What are the Assisted Reproductive Techniques practised to help infertile couples? Describe any three techniques.

Ans. Following are the various Assisted Reproductive Techniques:

(a) **IVF (In-vitro Fertilisation):** In this technique, sperm from the male and ovum and from the female are taken out. They are then allowed to undergo fertilization in the laboratory.

(b) **ET (Embryo Transfer):** This technique is the next step after IVF. There are two ways of doing the embryo transfer. Zygote which are up to 8 blastomeres are transferred to the fallopian tube and this technique is called ZIFT (Zygote Intra Fallopian Transfer). Another technique involves transferring blastocyst into the uterus and this is called Intra Uterine Transfer (IUT).

(c) **GIFT (Gamete Intra Fallopian Transfer):** This technique involves transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one.

(d) **ICSI (Intra Cytoplasmic Sperm Injection):** This is a highly-specialized technique. In this technique, sperm is directly injected into the ovum; in laboratory.

(e) **AI (Artificial Insemination):** In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into uterus of the female.

2. Discuss the mode of action and advantages/disadvantages of hormonal contraceptives.

Ans. Mode of Action of Hormonal Contraceptives: These contraceptives prevent ovulation and implantation. They also alter the quality of cervical mucus which suppresses the entry of

sperms into the uterus.

Advantages: These are convenient because most of them are available as oral pills. They do not disturb the normal sexual activity of the couple. They have less side effects.

Disadvantages: Some long-term side effects are associated with hormonal contraceptives. These may result in increased cholesterol level and may cause obesity. They can also alter the menstrual cycle in some cases. Other side-effects include nausea, abdominal pain, breakthrough bleeding, irregular menstrual bleeding or even breast cancer, though not very significant, should not be totally ignored.

3. STDs are a threat to reproductive health. Describe any two such diseases and suggest preventive measures.

Ans. Trichomoniasis: This happens because of a protozoon named *Trichomonas vaginalis*. The symptoms of this disease include whitish discharge from vagina, constant itching in the genitalia and foul smell. While females suffer from this disease, male is the carrier of the parasite. So, both partners should be treated with suitable medication.

Prevention of trichomoniasis: This disease can be prevented by maintaining good hygiene especially during menstruation. Using barrier method of contraceptive during coitus.

AIDS: Acquired Immunodeficiency Syndrome is a sexually transmitted disease but it affects the immune system. Till date, no cure for this disease has been found. This disease progresses to certain death.

Prevention of AIDS: Following are various means to prevent AIDS:

- (a) Avoiding sexual contact with unknown/multiple partners.
 - (b) Use of disposable syringes and needles.
 - (c) Taking proper precaution during blood transfusion.
 - (d) Using barrier method of contraceptive during coitus.
-

4. Do you justify the statutory ban on amniocentesis in our country? Give reasons.

Ans. Amniocentesis is a useful technique which can provide clues to any abnormality in the foetus. But this technique is being used for the wrong purpose in our country.

India is a country where male child is most sought after and a female child is often given second class treatment. Many people resort to MTP when they discover that the unborn child is going to be girl. This is termed as female foeticide. The girl child is killed while she is still in the womb. This is cruel practice and is the root of many social evils in our country. The sex ratio is highly skewed throughout the country and is worse with such some states; like Haryana and Punjab. Many boys grow with such a mindset that they have little respect for women. This malaise is evident in rising cases of rapes and dowry deaths. This trend can only be arrested if girls are given better chances of survival and career development. Hence, statutory ban on amniocentesis is fully justifiable in our country. But we also need to change the mindset of the people to ensure equal treatment of girls.

5. Enumerate and describe any five reasons for introducing sex education to school-going children.

Ans. Following are the five reasons for introducing sex education to school-going children.

(a) **Addressing Curiosity of Adolescents:** School going children are of impressionable age. At this age, any wrong information can create long lasting impressions on their mind. This can be highly counter-productive from them as far as reproductive health is concerned.

(b) **Different Aspects of Reproductive Health:** We know that reproductive health does not have physical health as the only aspect. Reproductive health also includes social, behavioural and psychological aspects.

(c) **Preparing Better Adults:** If children are given sex education at the right age, they will learn to understand the importance of right behavior, proper age of marriage and child bearing and of small family size. They will also learn to respect the privacy of other individuals.

(d) **Reducing the Chances of STDs:** Proper awareness about reproductive system can help in reducing the prevalence of STDs. This can also motivate people to give up stigma and go to a doctor at the right time.

(e) **Family Planning:** Proper awareness will help people understand the importance of small family. It will help in controlling the population growth in country.

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CHAPTER 4
REPRODUCTIVE HEALTH

Multiple Choice Questions (MCQs)

1. The method of directly injecting a sperm into ovum in assisted by reproductive technology is called:

- (a) GIFT**
- (b) ZIFT**
- (c) ICSI**
- (d) ET**

Ans. (c) ICSI

Explanation: ICSI stands for Intra Cytoplasmic sperm, Injection.

2. Increased IMR and decreased MMR in a population will:

- (a) Cause rapid increase in growth rate**
- (b) Result in decline in growth rate**
- (c) Not cause significant change in growth rate**
- (d) Result in an explosive population/exp**

Ans. (c) Not cause significant change in growth rate

3. Intensely lactating mothers do not generally conceive due to the:

- (a) Suppression of gonadotropins**
- (b) Hyper secretion of gonadotropins**

(c) Suppression of gametic transport

(d) Suppression of fertilization

Ans. (a) Suppression of gonadotropins

Explanation: (a) Suppression of gonadotropins

4. Sterilisation techniques are generally fool proof methods of contraception with least side effects. Yet, this is the last option for the couples because:

(i) It is almost irreversible

(ii) Of the misconception that it will reduce sexual urge/drive

(iii) It is a surgical procedure

(iv) Of lack of sufficient facilities in many parts of the country

Choose the correct option:

(a) (i) and (iii)

(b) (ii) and (iii)

(c) (ii) and (iv)

(d) (i), (ii), (iii) and (iv)

Ans. (d) (i), (ii), (iii) and (iv)

Explanation: (d) (i), (ii), (iii) and (iv)

5. A national level approach to build up a reproductively healthy society was taken up in our country in:

(a) 1950s

(b) 1960s

(c) 1980s

(d) 1990s

Ans. (a) 1950s

Explanation: (a) 1950s

6. Emergency contraceptives are effective if used within:

- (a) 72 hrs of coitus
- (b) 72 hrs of ovulation
- (c) 72 hrs of menstruation
- (d) 72 hrs of implantation

Ans. (a) 72 hrs of coitus

Explanation: (a) 72 hrs of coitus

7. Choose the right one among the statements given below:

- (a) IUDs are generally inserted by the user herself
- (b) IUDs increase phagocytosis reaction in the uterus
- (c) IUDs suppress gametogenesis
- (d) IUDs once inserted need not be replaced

Ans. (b) IUDs increase phagocytosis reaction in the uterus

Explanation: A qualified medical professional is needed to insert IUD. IUD has no effect on gametogenesis because ovulation takes place in the ovary while IUD is placed at the junction of fallopian tubes and uterus. IUDs can be easily taken out. So, option 'b' is correct.

8. Following statements are given regarding MTP. Choose the correct options given below:

- (i) MTPs are generally advised during first trimester
 - (ii) MTPs are used as a contraceptive method
 - (iii) MTPs are always surgical
 - (iv) MTPs require the assistance of qualified medical personnel
- (a) (ii) and (iii)
 - (b) (ii) and (iii)
 - (c) (i) and (iv)
 - (d) (i) and (ii)

Ans. (c) (i) and (iv)

Explanation: MTP is carried out after conception and hence it cannot be a contraceptive method. MTP involves curettage of foetus by inserting a suitable tool in the uterus and this does not involve surgery. Hence, option (i) and (iv) are correct.

9. From the sexually transmitted diseases mentioned below, identify the one which does not specifically affect the sex organs:

- (a) Syphilis
- (b) AIDS
- (c) Gonorrhoea
- (d) Genital warts

Ans. (b) AIDS

Explanation: AIDS can be transmitted through sexual contact but it does not affect the reproductive system. It affects the immune system.

10. Condoms are one of the most popular contraceptives because of the following reasons:

- (a) These are effective barriers for insemination
- (b) They do not interfere with coital act
- (c) These help in reducing the risk of STDs
- (d) All of the above

Ans. (d) All of the above

Explanation: (d) All of the above

11. Choose the correct statement regarding the ZIFT procedure:

- (a) Ova collected from a female donor are transferred to the fallopian tube to facilitate zygote formation.
- (b) Zygote is collected from a female donor and transferred to the fallopian tube
- (c) Zygote is collected from a female donor and transferred to the uterus
- (d) Ova collected from a female donor and transferred to the uterus

Ans. (b) Zygote is collected from a female donor and transferred to the fallopian tube

Explanation: ZIFT stands for Zygote Intra Fallopian Transfer. The name shows that zygote is transferred to the fallopian tube. Transfer to the uterus will be useless because zygote needs to develop into blastocyst for implantation.

12. The correct surgical procedure as a contraceptive method is:

- (a) Ovariectomy
- (b) Hysterectomy
- (c) Vasectomy
- (d) Castration

Ans. (c) Vasectomy

Explanation: Ovariectomy is removal of ovary which is carried out in case of ovarian cyst or cancer. Hysterectomy is removal of uterus which is carried out in case of uterine cancer or risk of uterine cancer. Castration is done in males (usually in animals).

13. Diaphragms are contraceptive devices used by the females. Choose the correct option from the statements given below:

- (i) They are introduced into the uterus
- (ii) They are placed to cover the cervical region
- (iii) They act as physical barriers for sperm entry
- (iv) They act as spermicidal agents

- (a) (i) and (ii),
- (b) (i) and (iii),
- (c) (ii) and (iii),
- (d) (iii) & (iv)

Ans. (c) (ii) and (iii)

Explanation: Diaphragms are made of rubber and rubber has no spermicidal property. Diaphragm is placed over cervix and not into the uterus. Hence, (ii) and (iii) are correct.

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CHAPTER 4
REPRODUCTIVE HEALTH

Short Answer Type Questions

1. Suggest some important steps that you would recommend to be taken to improve the reproductive health standards in India.

Ans. Some steps which should be followed to improve the reproductive health standards in India are as follows:

- Proper education of girls and boys right from the school level to make them aware about reproduction-related aspects.
 - Prevention of child marriage.
 - Prevention of female foeticide.
 - Strict regulation and monitoring of MTP.
 - Free distribution of contraceptives for poor people.
 - Good network of healthcare workers up to small villages.
-

2. The procedure of GIFT involves the transfer of female gamete to the fallopian tube. Can gametes be transferred to the uterus to achieve the same result? Explain.

Ans. Transfer of gametes of the uterus will not give the same result. To understand this, we need to recall the process from insemination to implantation. This happens in following stages:

- After ovulation, ovum enters the fallopian tube.
- Sperm needs to reach the ampulla in order to fertilise the egg. Fertilisation cannot happen inside the uterus.
- After fertilization, zygote undergoes several rounds of mitosis to produce blastocyst.
- All these developments take place inside the ampulla and isthmus of the fallopian tube.

- Blastocyst then goes to the uterus where implantation takes place.

Hence, GIFT involves transfer of female gamete to the fallopian tube rather than to the uterus.

3. Copper ions-releasing IUDs are more efficient than non-medicated methods. Why?

Ans. IUDs induce phagocytosis of sperms and thus prevent conception. Non-medicated IUDs; like Lippes loop; work on this concept. However, copper ions-releasing IUDs give some add on benefits apart from the normal effect of IUDs. Copper ions suppress sperm motility. Thus, sperms are unable to reach the fallopian tube. In case of non-medicated IUDs, some sperms may be able to reach the fallopian tube and failure rate of IUDs can increase. Hence, copper ions-releasing IUDs are more efficient than non-medicated methods.

4. What are the probable factors that contributed to population explosion in India?

Ans. Many factors have contributed to population explosion in India. Some of the them are as follows:

- (a) Prevalence of underage marriage.
 - (b) Having children is considered a necessary obligation from religious and social perspective. A childless couple often has to face the social stigma.
 - (c) Illiteracy and lack of awareness was a major factor in big size of families.
 - (d) Better food production and improvements in healthcare facilities helped in reducing IMR and MMR right from the 1950s.
 - (e) More children are seen as asset because they could contribute in the farm work and other economic activities.
-

5. Briefly explain IVF and ET What are the conditions in which these methods are advised?

Ans. IVF stands for in-vitro fertilization. In this technique, sperm from the male (or donor) and ovum from the female (or donor) are taken out. Ovum is then fertilized in the

laboratory; usually in a petri dish. ET stands for embryo transfer and is the next procedure after IVF. Embryo up to 8 blastomere stage is transferred in the fallopian tube. Embryo with more than 8 blastomeres is transferred to the uterus. Since, the technique involves carrying out fertilization and some development of zygote in the laboratory hence babies born out of this method are often called test tube babies. These methods are parts of Assisted Reproductive Technologies (ART). These methods are employed when medical treatment and psychotherapy may have failed in helping the couple in conception. These methods require very high degree of precision and can only be carried out by highly specialized doctors. Moreover, employing these technologies require costly equipments. Hence, facilities for IVF or ET are available only at select centres across the country.

6. What are the advantages of natural methods of contraception over artificial methods?

Ans. Following are some of the advantages of natural methods of contraception over artificial methods:

- They are cost effective.
 - They do not have side effects.
 - They do not disturb the normal sexual life of the couple.
-

7. What are the conditions in which medical termination of pregnancy is advised?

Ans. Medical termination of pregnancy (MTP) can be advised under following conditions if:

- (a) there is risk to the pregnant lady or to the foetus.
 - (b) foetus has some teratogenic defects.
 - (c) it is a case of unwanted pregnancy which may be because of unsafe coitus.
-

8. Comment on the essential features required for an ideal contraceptive.

Ans. An ideal contraceptive should have following features:

- (a) It should be cost effective.

- (b) It should be easier to use.
 - (c) It should have no side effect.
 - (d) It should not interfere in normal sexual activity.
-

9. All reproductive tract infections RTIs are STDs, but all STDs are not RTIs. Justify with example.

Ans. All Reproductive Tract Infections (RTIs) can be transmitted through coitus and hence all RTIs are STDs. But some STDs may not affect the reproductive system at all, e.g. AIDS and Hepatitis B. Hence, all STDs need not be RTIs.

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CHAPTER 4
REPRODUCTIVE HEALTH

Very Short Answer Type Questions

1. Reproductive health refers only to healthy reproductive functions. Comment.

Ans. This statement is not correct, because reproductive health not only refers to healthy reproductive function but also to other aspects of reproduction; like emotional, social and behavioural.

2. Comment on the Reproductive and Child Health Care programme of the government to improve the reproductive health of the people.

Ans. Reproductive and Child Health Care Programme tries to address all the aspects of reproductive health. This programme focuses on proper care of child and the mother. It also promotes proper use of contraceptives so that family size can be planned and can be limited. This programme has been continuous since many decades and has borne good results.

3. The present population growth rate in India is alarming. Suggest ways to check it.

Ans. Some of the ways to check the population growth in India are as follows:

- Increasing public awareness about the benefits of small family.
 - Improving child care and mother care.
 - Improving access to various contraceptive methods for the masses.
-

4. STDs can be considered as self-invited diseases. Comment.

Ans. STDs are communicable diseases; which means these diseases can spread from one person to another. All the STDs happen because of lack of precaution during coitus. If sufficient precautions are taken, then STDs can be avoided. Hence, it can be said that STDs

are self-invited diseases.

5. Suggest the reproduction-related aspects in which counselling should be provided at the school level.

Ans. Reproduction-related aspects in which counseling should be provided at the school level are as follows:

- (a) Physical and psychological changes at puberty.
 - (b) Misconceptions about reproductive system.
 - (c) STDs
 - (d) Reproductive health
-

6. Mention the primary aim of the “Assisted Reproductive Technology” (ART) programme.

Ans. The primary aim of the “Assisted Reproductive Technology” (ART) programme is to help childless couples in becoming parents through certain special techniques.

7. What is the significance of progesterone-estrogen combination as a contraceptive measure?

Ans. Significance of progesterone-estrogen combination as a contraceptive pill are as follows:

- (a) They are convenient as they need to be taken orally.
 - (b) They have least side effects and hence are user-friendly.
-

8. Strict conditions are to be followed in medical termination of pregnancy (MTP) procedures. Mention two reasons.

Ans. Two reasons for need of strict conditions in MTP are as follows:

- Many people resort to MTP for female foeticide.
 - It may result in serious consequences for the woman if performed at the wrong trimester of pregnancy.
-

9. Males in whom testes fail to descend to the scrotum are generally infertile. Why?

Ans. For optimum sperm production, the temperature of testis should be lower than the body temperature. If testes fail to descend to scrotum then the temperature of testis would be same as that of body temperature. Due to this, males in whom testes fail to descend to scrotum are generally infertile.

10. Mention two advantages of lactational amenorrhea as a contraceptive method.

Ans. Two advantages of lactational amenorrhea as a contraceptive method are as follows:

- (a) It has no side effect.
- (b) It does not hamper in regular sexual activity.

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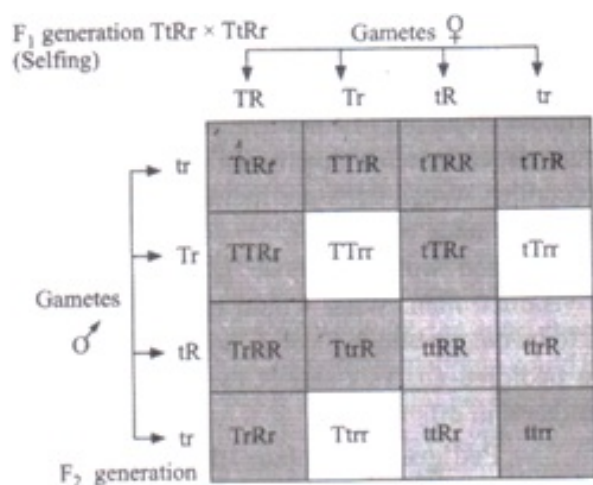
CHAPTER 5

PRINCIPLE OF INHERITANCE AND VARIATION

Long Answer Type Questions

1. In a plant tallness is dominant over dwarfness and red flower is dominant over white. Starting with the parents work out a dihybrid cross. What is standard dihybrid ratio? Do you think the values would deviate if the two genes in question are interacting with each other?

Ans. The following Punnett Square shows cross between tall plant with red flowers (TTRR) and dwarf plant with white flowers (ttrr). All the plants in F₁ generation will be tall and will produce red flowers.



When plants of F₁ generation are allowed to self-pollinated, phenotype of plants in F₂ generation can be shown by following Punnett Square.

In this case, the standard dihybrid ratio 9 : 3 : 3 : 1 which can be shown as follows:

- Tall plant red flower = 9
- Tall plant white flower = 3
- Dwarf plant red flower = 3
- Dwarf plant white flower = 1

The standard dihybrid ratio works only when the genes for contrasting characters are on different chromosomes. If characters are on the same chromosome, they may interact with each other. In that situation, the dihybrid ratio would show variation from the standard dihybrid ratio.

2. (a) In humans, males are heterogametic and females are homogametic. Explain. Are there any examples where males are homogametic and females heterogametic?

(b) Also, describe as to, who determines the sex of an unborn child? Mention whether temperature has a role in sex determination.

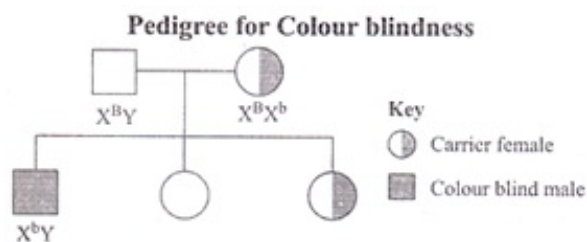
Ans. (a) In humans, the 23rd pair of chromosome contains an X chromosome and a Y chromosome. Hence, males are called heterogametic. Females, on the other hand, have XX chromosomes in the 23rd pair. Hence, females are called homogametic. But in bird's females have ZW chromosome and male have ZZ Chromosome. So, in some cases, males can be homogametic and females can be heterogametic.

(b) In case of humans, sex is determined by X and Y-chromosomes. Out of the 23 pairs of chromosomes in human beings, the 23rd pair is called sex chromosome while the remaining 22 pairs are called autosomes. All males have X and Y-chromosomes in the 23rd pair while females have XX-chromosomes in the 23rd pair. Thus, a sperm can have either X or Y-chromosome, while all the eggs will have X-chromosome. When a sperm with X chromosome fertilizes the ovum; the zygote will result in development of a girl child. If a sperm with Y-chromosome fertilizes the ovum; the zygote will result in development of a male child.

Temperature dependent sex determination is found in many animals, e.g. in crocodiles. When eggs are incubated at higher temperature, it results in birth of male crocodiles.

3. A normal visioned woman, whose father is colour blind, marries a normal visioned man. What would be probability of her sons and daughters to be colour blind? Explain with the help of a pedigree chart.

Ans. Following pedigree analysis shows the probability of prevalence of colour blindness in offspring:



- The P generation shows a normal husband and a carrier wife.
- The F₁ generation shows one male child and two female children.

The male child will suffer from colour blindness and one of the females may be a carrier.

The genes for colour blindness are mainly present on the X-chromosome. We know that only one X-chromosome is present in males. Hence, if a boy has defective X-chromosome (without some genes of photoreception) the boy would be colour blind. Females have another X-chromosome which compensates for the deficiency of its counterpart. Due to this, females, are usually carriers of this disease and seldom suffer from this disease. In terms of prevalence; about 8% of the male population suffers from colour blindness, while just 0.5% of the females suffer from this condition.

4. Discuss in detail the contributions of Morgan and Sturtevant in the area of genetics.

Ans. Morgan and his group conducted various experiments in the field of genetics.

Sturtevant was a student of Morgan. Some of the contributions by them are as follows:

Morgan carried out several dihybrid crosses of *Drosophila*. He observed that the phenotypic ratio was not similar to the standard phenotypic ratio as observed by Mendel. Morgan and his team were aware that the genes were located on X chromosome. They inferred that when the genes were situated on the same chromosome, they did not segregate independently of each other.

When the genes are situated on the same chromosome, the chances of parental combination are much higher than non-parental combination. The physical association of genes on the same chromosome was termed as linkage; by Morgan. Morgan also coined the term recombination to describe generation of non-parental combination.

Sturtevant came out with the finding that relative distance between two genes on the same chromosome was an important factor in recombination or lack of recombination. If the

genes were tightly linked, they did not show recombination. But if the genes were far apart then chances of recombination were higher. Today's genetic mapping could be developed because of contributions made by Morgan and his team.

5. Define aneuploidy. How is it different from polyploidy? Describe the individuals having following chromosomal abnormalities.

(a) Trisomy of 21st Chromosome

(b) XXY

(c) XO

Ans. Failure of chromatid segregation during cell division results in loss or gain of a chromosome. This is called aneuploidy. Failure of cytokinesis; after telophase; results in an increase in a whole set of chromosomes. This condition is called polyploidy. Polyploidy is often seen in plants but is rare in animals.

(a) Trisomy or 21th Chromosome: Presence of an additional copy of 21th chromosome is called trisomy of 21th chromosome. This was first described by Langdon Down (1866) and hence is called Down's Syndrome. The person suffering from Down's syndrome is short stature and has small round head. He has furrowed tongue and partially opened mouth. His palm is broad with characteristic palm crease. Physical, psychomotor and mental development is retarded in such person.

(b) XXY: This genetic disorder happens because of an additional copy of X chromosome resulting in a karyotype of 47. There are three chromosomes (XXY) in the 23rd set. This condition is known as Klinefelter's syndrome. Such a person shows overall masculine development but also show enlarged breasts (gynaecomastia). Such a person is sterile as well.

(c) XO: This genetic disorder happens because of lack of an X chromosome resulting in a ploidy of 45 (XO). This condition is called Turner's syndrome. Ovaries are rudimentary in such females and hence such females are sterile. Secondary sexual characters are also absent in such females.

CBSE Class 12 Biology
NCERT Exemplar Solutions
CHAPTER 5
PRINCIPLE OF INHERITANCE AND VARIATION

Short Answer Type Questions

1. In a Mendelian monohybrid cross, the F₂ generation shows identical genotypic and phenotypic ratios. What does it tell us about the nature of alleles involved? Justify your answer.

Ans. When plants of F₁ generation are allowed to reproduce without cross, the alleles segregate and one allele goes to one parent while another allele goes to another parent. This is in accordance with transfer of halved number of chromosome during meiosis. This segregation is a random process and there is 50% chance of a particular allele going to either the male gamete or the female gamete. Due to this, the genotype produced in F₂ generation is same as the phenotype produce in that generation. So, percentage of plants with pure genotype and those with mixed genotype will be same, i.e. 50%

2. Can a child have blood group O if his parents have blood group 'A' and 'B'. Explain.

Ans. A child from parents with blood group 'A' and 'B' can have blood group O. If genotype of one parent is I^Ai and that of another parent is I^Bi; then gametes from the parents can have any one of the genotype, i.e. I^A or I^B or i. If fertilization happens between gametes with i only, then the child's genotype will be ii and hence the child can have blood group O.

3. What is Down's syndrome? Give its symptoms and cause. Why is it that the chances of having a child with Down's syndrome increases if the age of the mother exceeds forty years?

Ans. Down's syndrome is a chromosomal disorder. A person suffering from Down 's syndrome shows following symptoms:

- Short stature
- Small round head
- Furrowed tongue and partially open mouth
- Palm is broad with characteristic palm crease.
- Physical, psychomotor and mental development is retarded in the person.

This condition happens because of an extra copy of chromosome 21. As per various research reports, chances of having a child with Down's syndrome increases with advancing maternal age because ova are present in females right from their birth. More is the age of the mother, cells will be more older. Hence, chances of chromosomal non-disjunction will be more because of various physico-chemical exposures during the mother's life-time.

4. How was it concluded that genes are located on chromosomes?

Ans. Walter Sutton and Theodor Boveri studied the behaviour of chromosome and genes during meiosis. They observed that the movement of chromosome and that of gene was similar. Based on this observation, they proposed that genes are located on chromosomes.

5. A plant with red flowers was crossed with another plant with yellow flowers. If F_1 showed all flowers orange in colour, explain the inheritance.

Ans. Sometime, dominance of a particular trait over another trait may not be complete. This results in a situation that both the characters manifest together in some progeny. This condition is called incomplete dominance. Let us assume that red flowers have genotype RR and yellow flowers have genotype rr. All progenies in the F_1 generation will have Rr genotype. Since red colour fails to completely dominate the yellow colour; all plants in F_1 generation produce orange flowers.

6. What are the characteristic features of a true-breeding line?

Ans. Following are the characteristic features of a true-breeding line:

- Self-pollination through successive generation.
- Stable trait inheritance through several generations.

- Stable expression of characters through several generations.
-

7. In peas, tallness is dominant over dwarfness, and red colour of flowers is dominant over the white colour. When a tall plant bearing red flowers was pollinated with a dwarf plant bearing white flowers, the different phenotypic groups were obtained in the progeny in numbers mentioned against them:

- Tall, Red = 138
- Tall, White = 132
- Dwarf, Red = 136
- Dwarf, White = 128

Mention the genotypes of the two parents and of the four offspring types.

Ans. Genotypes of parents: TtRr and ttrr

Offspring: Tall, Red: TtRr

Offspring: Tall, White: Ttrr

Offspring: Dwarf, Red: ttRr

Offspring: Dwarf, White: ttrr

8. Why is the frequency of red-green colour blindness is many times higher in males than that in the females?

Ans. The genes that produce photopigments are present on X-chromosomes. If some of the gene is missing or damaged, it can result in colour blindness. Since males have only one X-chromosome, the chances of colour blindness is very high in males. In case of females, to be colourblind must have the allele for it in both her X-chromosomes. In case, if female possesses the allele for colourblind in only one X-chromosome, then she will act as a carrier and won't be affected by it.

9. If a father and son are both defective in red-green colour vision, is it likely that the son inherited the trait from his father? Comment.

Ans. The genes for colour blindness are present on the X chromosome. But X chromosome in a son (male child) is not contributed by the father but comes from the mother. Hence, even if a father and his son both are suffering from colour blindness, the son has inherited this trait from his mother.

10. Discuss why Drosophila has been used extensively for genetical studies.

Ans. Following features of Drosophila make it ideal for genetical studies:

- It can be grown on simple synthetic medium in laboratory.
 - It completes its life cycle in two weeks.
 - A single mating produces a large number of offsprings.
 - There is clear cut sexual dimorphism in Drosophila.
 - It has many hereditary variations which can be easily observed with a low power microscope.
-

11. How do genes and chromosomes share similarity from the point of view of genetical studies?

Ans. Following are the similarities in genes and chromosomes from the point of view of genetical studies:

They are found in pairs.

They segregate at the time of gamete formation and only one of the pair is transmitted to a gamete.

Independent pairs segregate independently of each other.

12. What is recombination? Discuss the applications of recombination from the point of view of genetic engineering.

Ans. The gene combination which is different from parental genes is called recombination. This can happen naturally during meiosis. This can also be artificially induced through genetic engineering. Genetic engineering has been applied in creating recombination for various species to produce useful products for humans. For example; Bt cotton and Bt brinjal

have been produced through genetic engineering. Some vaccines are also being produced through this process, e.g. hepatitis B vaccine.

13. What is artificial selection? Do you think it affects the process of natural selection? How?

Ans. Artificial selection is the selective breeding of plants and animals to include beneficial traits in them. This is also called selective breeding. While some selective breeding can be purely artificial, many others are natural breeding done in a controlled environment. From the point of ethics, it may be wrong to go for artificial selection. But if we follow the law of natural selection and survival of the fittest, then it can be safely assumed the even in case of artificial selection only those varieties are going to survive which are fit to survive. Hence, it can be inferred that artificial selection is not going to affect the process of natural selection.

14. With the help of an example differentiate between incomplete dominance and co-dominance.

Ans.

Incomplete dominance	Co-dominance
(i) Phenotypes from both the parents are partially manifested in F_1 generation.	(i) Phenotypes from both the parents are completely manifested in F_1 generation.
(ii) Example: When snapdragon plants with red flowers were crossed with flowers, the F_1 generation produced pink flowers.	(ii) Example: ABO blood grouping in humans shows co-dominance.

15. It is said, that the harmful alleles get eliminated from population over a period of time, yet sickle cell anaemia is persisting in human population. Why?

Ans. The sickle cell anemia is controlled by a single pair of allele; Hb^A and Hb^S . If both the parents are heterozygous ($Hb^A Hb^S$) then the offspring can suffer from this disease. The offspring should be homozygous ($Hb^S Hb^S$). Heterozygous individuals are carriers of this of this disease. Heterozygous individuals are advantageous in terms of adaptation. Due to this, sickle cell anemia is persisting in human population.

CBSE Class 12 Biology
NCERT Exemplar Solutions
CHAPTER 5
PRINCIPLE OF INHERITANCE AND VARIATION

Very Short Answer Type Questions

1. What is the cross between the progeny of F_1 and the homozygous recessive parent called? How is it useful?

Ans. The cross between the progeny of F_1 and the homozygous recessive parent is called test cross. The progenies of a test cross are studied to determine the phenotype in F_1 generation.

2. Do you think Mendel's laws of inheritance would have been different if the characters that he chose were located on the same chromosome.

Ans. If the characters were located on some chromosome, then results could have been entirely different. This was seen by Morgan's experiments on *Drosophilla*. He observed that the phenotype in the F_1 generation was in a different ratio than what was observed by Mendel. This happened because the characters were located on the same chromosome.

3. Enlist the steps of controlled cross pollination. Would emasculation be needed in a cucurbit plant? Give reasons for your answer.

Ans. Following are the steps of controlled cross pollination:

Emasculation → Transfer of pollen from a different flower → Pollination → Fertilisation

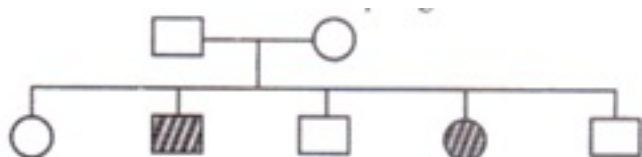
Plants of cucurbitaceae have unisexual flowers, so cross pollination is the norm and emasculation is not needed. But in case of a monoecious plant, emasculation would be necessary.

4. A person has to perform crosses for the purpose of studying inheritance of a few traits / characters. What should be the criteria for selecting the organisms?

Ans. For this type to study, the organism should meet following criteria:

- There must be easily identifiable sets of contrasting characters.
- Life cycle of the organism should be short enough so that study can be conveniently completed within a couple of years.
- Hybridization should be easy to induce in the organism.

5. The pedigree chart given below shows a particular trait which is absent in parents but present in the next generation irrespective of sexes. Draw your conclusion on the basis of the pedigree.



Ans. The first row shows mating between parents. The next row shows the number of progenies. There are three male and 2 female children. One boy and one girl are affected with some genetic disorder. Thus, the trait is autosome linked and recessive in nature.

6. In order to obtain the F₁ generation Mendel pollinated a pure-breeding tall plant with a pure breeding dwarf plant. But for getting the F₂ generation, he simply self-pollinated the tall F₁ plants. Why?

Ans. When plants of F₁ generation were produced, all of them were tall plants. After that, Mendel wanted to understand the fate of recessive character. He did not want any other character set to mask the effect of inheritance to F₂ generation. Hence, he simply self-pollinated the tall F₁ plants

7. “Genes contain the information that is required to express a particular trait.” Explain.

Ans. During Mendel’s period, genes were not known to the scientists. But after the discovery of chromosomes, scientists could discover that genes are present on chromosomes and they were responsible for inheritance of characters. Hence, it is said that genes contain the

information that is required to express a particular trait.

8. How are alleles of particular gene differ from each other? Explain its significance.

Ans. Genes which code for a pair of contrasting characters are called alleles. Alleles of a pair are slightly different from each other. This difference may or may not be manifested as observable characters or phenotype. But the difference can be in the form of absence or presence of an extra molecule of a particular substance; such as sugar polymers present on the gene I which controls the ABO blood grouping. Alleles are significant in the sense that a particular trait can be dominant or recessive. In some instances, co-dominance can also be seen.

9. In a monohybrid cross of plants with red and white flowered plants, Mendel got only red flowered plants. On self-pollinating these F_1 plants got both red and white flowered plants in 3:1 ratio. Explain the basis of using RR and rr symbols to represent the genotype of plants of parental generation.

Ans. Symbols RR and rr are used for the sake of convenience and using a particular alphabet has no scientific basis. Usually, the first letter of a particular trait is used to describe that character and the contrasting character is shown by the same letter but in a different case. As per convention, dominant trait is shown by capital letter and recessive trait is shown by lower case letter.

10. For the expression of traits genes provide only the potentiality and the environment provides the opportunity. Comment on the veracity of the statement.

Ans. Genes are the carriers of inheritable traits and hence it can be said that the genes provide the potentiality for the expression of a particular trait. Expression of a particular trait is termed as phenotype and it is dependent on many factors. A particular trait may become recessive if it gets combined with a dominant trait. Moreover, survival of a particular trait also depends on the fact whether the trait passes the natural selection. Hence, it can be said that the environment provides the opportunity for expression of a particular trait.

11. A, B, D are three independently assorting genes with their recessive alleles a, b, d, respectively. A cross was made between individuals of Aa bb DD genotype with aa bb dd. Find out the type of genotypes of the offspring produced.

Ans. The following Punnett Square shows the genotype of F₁ generation:

	abd
AbD	AabbDd
abd	aabbDd

12. In our society, a woman is often blamed for not bearing male child. Do you think it is right? Justify.

Ans. From the concept of sex determination in humans, it is clear that Y chromosome which is present in males comes from the father and not from the mother. Hence, it is the man who should be blamed for not having a male child rather than the woman. But probability of an X or Y chromosome ending up in the zygote is equal, i.e. 50: 50. So, it is purely a chance that a girl or a boy is borne and no one should be blamed or rewarded for that. The society should learn to respect the girl child as well.

13. Discuss the genetic basis of wrinkled phenotype of pea seed.

Ans. Seeds dry before they are ready for dispersal and subsequent germination. If there is enough amount of starch in the seed, then the seed is round otherwise wrinkled seeds are produced. Relative amount of starch in seed is controlled by a gene. A mutant gene in pea plants results in enzymes which lessen the amount of starch in seeds and thus seeds become wrinkled.

14. Even if a character shows multiple allelism, an individual will only have two alleles for that character. Why?

Ans. Most of the organisms are diploid and thus alleles can only be present in pairs. Hence, in spite of multiple allelism; an individual will only have two alleles for that character. A good example of this can be shown by I^A , I^B and i alleles which govern the ABO blood grouping in humans.

15. How does a mutagen induce mutation? Explain with example.

Ans. Mutagens are chemical and physical factors which can induce mutation. They do so by altering the base pair sequence in the DNA during replication.

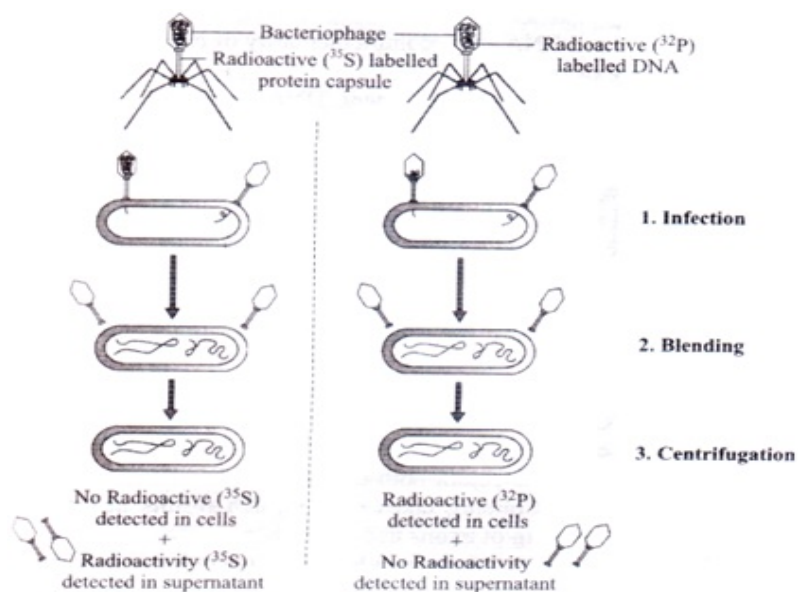
CBSE Class 12 Biology
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CHAPTER 6
MOLECULAR BASIS OF INHERITANCE

Long Answer Type Questions.

1. Give an account of Hershey and Chase experiment. What did it conclusively prove? If both DNA and proteins contained phosphorus and sulphur do you think the result would have been the same?

Ans. Hershey and Chase Experiment:

- Viruses were grown on two media. One medium contained radioactive phosphorus and another contained radioactive Sulphur.
- Viruses grown on radioactive phosphorus contained radioactive DNA but no such protein because protein does not contain phosphorus.
- Viruses grown on radioactive Sulphur contained radioactive protein but no such DNA because DNA does not contain Sulphur.
- Radioactive phages were allowed to attach to E.coli bacteria. One the infection proceeded, the viral coat was removed from bacteria and then viral particles were separated from bacteria for further analysis.



Observation:

- Radioactive DNA was seen in only those bacteria which were infected with phages grown on radioactive phosphorus.
- Radioactive DNA was not seen in those bacteria which were infected with phages grown on radioactive Sulphur.

Conclusion: DNA was found to be the genetic material.

If both the DNA and proteins contained Sulphur and phosphorus, it would have not been possible to pinpoint the exact genetic material, i.e. DNA or proteins.

2. During the course of evolution why DNA was chosen over RNA as genetic material? Give reasons by first discussing the desired criteria in a molecule that can act as genetic material and in the light of biochemical differences between DNA and RNA.

Ans. Following are the desired criteria in a molecule that can act as genetic material:

- It should have the capability of replication.
- It should be chemically and structurally stable.
- It should be able to incorporate slow changes (mutation) which are required for evolution.
- It should be able to express itself in the form of Mendelian characters.

Biochemistry of DNA and RNA:

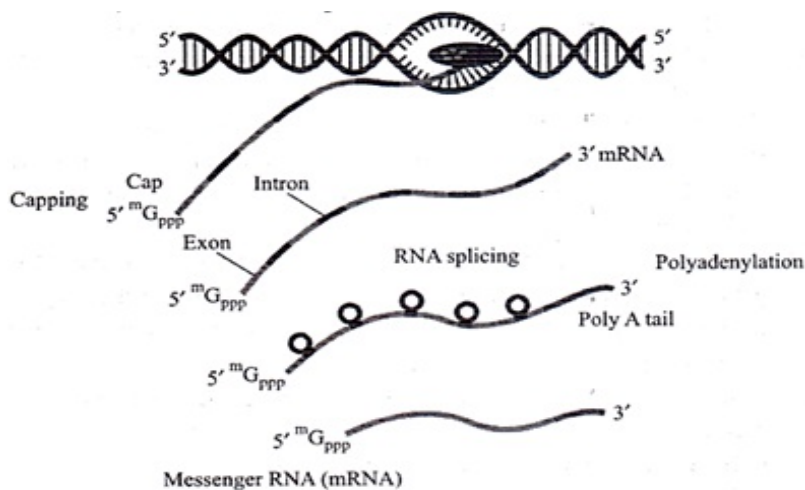
- Both DNA and RNA show complementarity of base pairs and hence are capable of replication.
- As shown by Griffith's experiment, DNA is more stable than RNA because it could survive even heat-killing during the experiment.
- 2'-OH group is present in RNA. This makes RNA labile and degradable; which is not the case with DNA.
- Both RNA and DNA can carry on mutations. But DNA being more stable is better suited for long term storage of mutations.

Hence, DNA was preferred as the genetic material during the course of evolution.

3. Give an account of post transcriptional modifications of a eukaryotic mRNA.

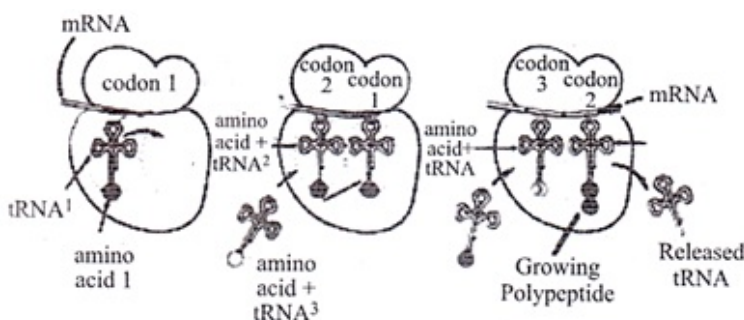
Ans. Following events happen during transformation of hnRNA (precursor of mature mRNA):

- Polymerase II facilitates transcription of hnRNA into mature mRNA.
- Primary transcripts contain both the introns and exons and these are non-functional. Splicing takes place which results in removal of introns and joining of exons in definite order.
- Capping and tailing happens in hnRNA. It acquires a cap of methyl guanosine and a tail of poly adenylate. Cap is added at 5' end and Poly-A tail is added at 3' end of hnRNA.
- Now, the hnRNA changes into mature mRNA.



4. Discuss the process of translation in detail.

Ans. The process of polymerization of amino acid to form a polypeptide is called translation. Thus, the biological process through which protein is synthesized is called translation. Translation happens in following main steps:



Initiation: Ribosome assembles around the target mRNA and we know that ribosome is the site of protein synthesis. The first tRNA gets attached at the start codon. A codon is a triplet of amino acids.

Elongation: The tRNA transfers an amino acid to the tRNA corresponding to the next codon. This phase involves addition of subsequent amino acids to form a long chain. This step forms the bulk of the protein synthesis.

Translocation: The ribosome then moves to the next mRNA codon and continues the process. This creates an amino acid chain.

Termination: When a stop codon is reached, the ribosome releases the polypeptide.

5. Define an operon. Giving an example, explain an Inducible operon.

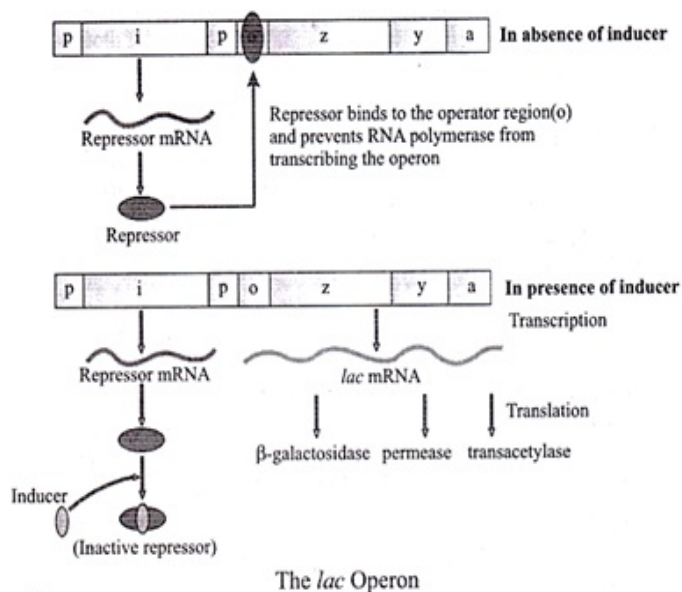
Ans. A functioning unit of genomic DNA containing a cluster of genes under the control of a single promoter is called operon. An operon is generally transcribed into polycistronic mRNA. A single mRNA which codes for more than one protein is called polycistronic mRNA. An operon is made up of 3 basic DNA components:

(a) **Promoter:** A nucleotide sequence that enables a gene to be transcribed is called promoter. It is recognized by RNA polymerase, which then initiates transcription.

(b) **Operator:** A segment of DNA to which a repressor binds is called operator.

(c) **Structural genes:** The genes that are co-regulated by the operon are called structural genes.

Inducible Operon: When the operon is regulated by an inducer, it is called inducible operon. An inducer can switch on or off the operon. Lac operon is an example of inducible operon. Lactose is a substrate of enzyme beta-galactosidase and is the inducer of lac operon.



The given diagram shows the working of lac operon. In the absence of an inducer the repressor binds to the operator region and prevents transcription.

In the presence of an inducer, repressor becomes inactive. This allows transcription in the operator region which results in release of mRNA. Subsequently, mRNA promotes translation and protein synthesis is accomplished.

6. 'There is a paternity dispute for a child'. Which technique can solve the problem. Discuss the principle involved.

Ans. Dispute regarding paternity for a child can be resolved by using DNA fingerprinting. DNA fingerprinting is based on following principle:

DNA fingerprinting: This involves identifying difference in some specific regions of DNA. The sequence in such regions is called repetitive DNA. A small stretch of DNA is repeated many time in such sequences.

During density, gradient centrifugation, these sequences are separated from bulk DNA as different peaks. The bulk DNA forms major peaks and other small peaks are called satellite DNA. Satellite DNA can be classified into various types, depending on base composition, length of segment and number of repetitive units. Base composition reveals whether the sequence is A: T rich or G: C rich. These sequences show high degree of polymorphism and hence form the basis of DNA fingerprinting.

In case of an individual, DNA from every tissue shows the same degree of polymorphism. Hence, DNA from any tissue can be utilized to analyse DNA fingerprinting of an individual. Moreover, polymorphism is inheritable from parents to children. Hence, DNA fingerprinting can be utilized to assess paternity for a child.

7. Give an account of the methods used in sequencing the human genome.

Ans. Two approaches were involved in sequencing the Human genome.

Using Expressed Sequence Tags (ESTs): In this approach, all the genes that are expressed as RNA are identified and then sequenced.

Blind Approach: This approach involved sequencing the whole set of genome and then assigning different regions in the sequence with functions. This is referred to as sequence annotation. This approach is comprised of following steps:

- Total DNA from a cell is isolated and converted into random fragments of smaller sizes.
 - These fragments are cloned in a suitable host by using specialized vectors. The cloning results into amplification of each fragment, and makes it easy to sequence the fragment. Bacteria and yeast are the commonly used hosts for this purpose. The vectors were called as BAC (bacterial artificial chromosomes) and YAC (yeast artificial chromosomes).
 - Automated DNA sequencers were used to sequence the fragments. Then these sequences were arranged on the basis of some overlapping regions present in them.
 - For generating overlapping fragments in these sequences; help of computer programmes was taken because it was not possible for humans to do so.
 - Then the sequences were annotated and assigned to each chromosome.
 - Genetic physical mapping of genome was done on the basis of polymorphism in some segments of the DNA.
-

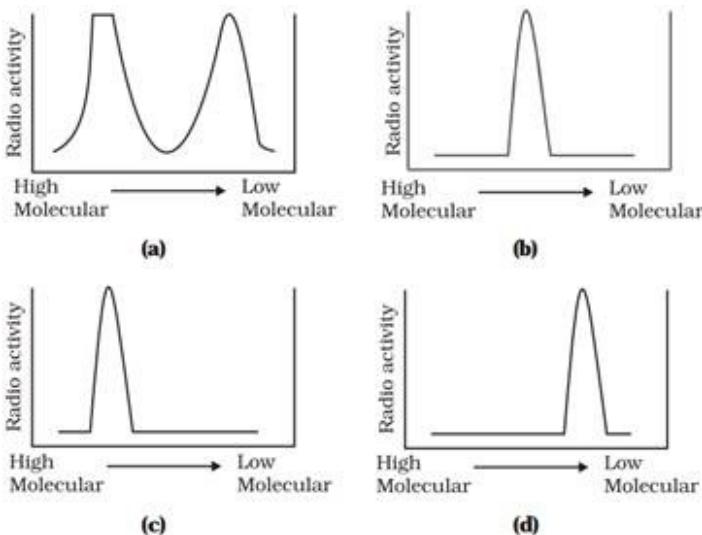
8. List the various markers that are used in DNA finger printing.

Ans. A DNA marker is a gene sequence on a known chromosome which can be used to identify an individual or a species. A genetic marker or DNA marker can be a short sequence

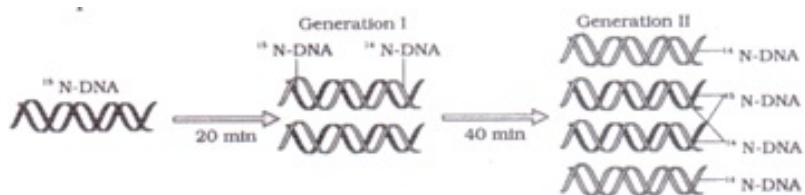
or a long sequence. Following are the commonly used markers for DNA fingerprinting.

- RFLP (Restriction fragment length polymorphism)
- SSLP (Simple sequence length polymorphism)
- AFLP (Amplified fragment length polymorphism)
- RAPD (Random amplification of polymorphic DNA)
- VNTR (Variable number tandem repeat)
- SSR Microsatellite polymorphism, (Simple sequence repeat)
- SNP (Single nucleotide polymorphism)
- STR (Short tandem repeat)
- SFP (Single feature polymorphism)
- DArT (Diversity Arrays Technology)
- RAD markers (Restriction site associated DNA markers)

9. Replication was allowed to take place in the presence of radioactive deoxynucleotides precursors in E.coli that was a mutant for DNA ligase. Newly synthesised radioactive DNA was purified and strands were separated by denaturation. These were centrifuged using density gradient centrifugation. Which of the following would be a correct result?



Ans. Option 'a' shown the correct result. The following diagram explains this:



Let us assume that heavier nitrogen was used in this experiment. This nitrogen molecule from parents' cell would be transmitted equally in daughter cells. Each daughter cell will have half of the DNA with heavier nitrogen and another half with lighter nitrogen.

In the F_2 generation, 50% of daughter cells will have a combination of radioactive and non-radioactive DNAs. The rest 50% of daughter cells will have non-radioactive DNAs.

This is the reason; the graph shows two peaks; each peak representing a particular form of nitrogen in DNA.

CBSE Class 12 Biology
NCERT Exemplar Solutions
CHAPTER 6
MOLECULAR BASIS OF INHERITANCE

Short Answer Type Questions

1. Define transformations in Griffith's experiment. Discuss how it helps in the identification of DNA as the genetic material.

Ans. During the course of Griffith's experiment, bacteria changed its physical form. This was termed as transformation. In this experiment, the DNA of the S strain bacteria survived heating of bacteria. When a mice was injected with mixture of killed S strain and R strain, the mice died of pneumonia. This showed that DNA had the capability of surviving adverse circumstances and manifesting itself on return of favourable conditions. Stability and survival are key considerations for a material to be classified as genetic material. Thus, transformation in Griffith's experiment helped in identification on DNA as genetic material.

2. Who revealed biochemical nature of the transforming principle? How was it done?

Ans. Oswald Avery, Colin MacLeod and Maclyn McCarty (1933 – 1944) conducted experiments to reveal the biochemical nature of the transforming principle. They purified biochemical (proteins, DNA and RNA) from the heat-killed S cells. They wanted to see which one of them was able to transform the R strain. So, they discovered that protein digesting enzymes (proteases) and RNA-digesting enzymes (RNases) did not affect transformation but DNase inhibit transformation. Thus, they concluded that it was the DNA which was able to transform the R strain.

3. Discuss the significance of heavy isotope of nitrogen in the Meselson and Stahl's experiment.

Ans. The heavy isotope of nitrogen was used in Meselson and Stahl's experiment for various reasons. The heavy DNA molecule (containing ^{15}N) could be easily distinguished from the normal DNA by centrifugation in a Cesium chloride (CsCl) density gradient. It could be easily

separated from lighter nitrogen (^{14}N) on the basis of density. Use of lighter and heavier nitrogen made the task of identifying transfer of DNAs through subsequent generation quite easier.

4. Define a cistron. Giving examples differentiate between monocistronic and polycistronic transcription unit.

Ans. A segment of DNA coding for polypeptide is called cistron. A cistron is basically a gene. If a stretch of replicating DNA contains a single cistron (or gene), it is called monocistronic, e.g. eukaryotes. If a stretch of replicating DNA contains more than one cistron, it is called polycistronic, e.g. bacteria and prokaryotes.

5. Give any six features of the human genome.

Ans. Six features of the human genome are as follows:

- The human genome contains 3164.7 million nucleotides.
 - The average gene in the human genome contains 3000 bases.
 - The total number of genes is estimated to be 30,000.
 - Almost all (about 99.9%) of nucleotides are same in all human beings.
 - Less than 2 percent of the genome codes for protein.
 - Chromosome 1 has the most genes (2968) and chromosome Y has the least (231).
-

6. During DNA replication, why is it that the entire molecule does not open in one go? Explain replication fork. What are the two functions that the monomers (dNTPs) play?

Ans. DNA replication is an energy-intensive process and requires very high amount of energy. So, the practical solution is to replicate a DNA segment by segment. Due to this, the entire DNA molecule does not open in one go.

Replication Fork: DNA replication happens in a small opening of DNA helix. This opening is called replication fork.

Monomers like nucleotide triphosphate (NTPs) is a molecule containing a nucleotide bound to three phosphates. The NTPs present in DNA are called dNTP. They are basic building

blocks of life. They play important role in various metabolic functions.

7. Retroviruses do not follow central Dogma. Comment.

Ans. Francis and Crick proposed the central dogma in molecular biology. According to this, genetic information flows from DNA → RNA → Protein. In retroviruses, genetic information flows in reverse direction, i.e. Protein → RNA → DNA. Hence, it is said that retroviruses do not follow central dogma. The process followed by retroviruses is also called reverse transcription because of the opposite sequence of the process involved.

8. In an experiment, DNA is treated with a compound which tends to place itself amongst the stacks of nitrogenous base pairs. As a result of this, the distance between two consecutive base increases. from 0.34nm to 0.44 nm. Calculate the length of DNA double helix (which has 2×10^9 bp) in the presence of saturating amount of this compound.

Ans. The length of DNA double helix can be calculated by multiplying the distance between two consecutive base pairs with total number of base pairs.

$$\begin{aligned} &0.44 \times 10^{-9} \text{ m} \times 2 \times 10^9 \text{ bp} \\ &= 0.88 \text{ m} \end{aligned}$$

9. What would happen if histones were to be mutated and made rich in acidic amino acids such as aspartic acid and glutamic acid in place of basic amino acids such as lysine and arginine?

Ans. Aspartic and glutamic acid are acidic amino acids, while lysine and arginine are basic amino acids. Lysine and arginine carry positive charge on their side chains which is not the case with aspartic acid and glutamic acid. DNA is negatively charged and hence is wrapped around the positively charge histone octamer. If acidic amino acids are present in histone because of mutation, DNA won't be able to wrap around itself. Thus, long strand of DNA will not be able to fit inside the small space in the nucleus. This will mean an end to nuclear organization which is possible because of efficient packaging.

10. Recall the experiments done by Frederick Griffith, Avery, MacLeod and McCarty, where DNA was speculated to be the genetic material. If RNA, instead of DNA was the genetic material, would the heat killed strain of Pneumococcus have transformed the R-strain into virulent strain? Explain.

Ans. RNA is less stable than DNA and hence, DNA replaced RNA as the genetic material in the living world. If RNA was the genetic material in Griffith's experiment, it would have been destroyed by heat. Thus, the heat killed strain of Pneumococcus could not have transformed the R-strain into virulent strain.

11. You are repeating the Hershey-Chase experiment and are provided with two isotopes: ^{32}P and ^{15}N (in place of ^{35}S in the original experiment). How do you expect your results to be different?

Ans. Selection of phosphorus and Sulphur was based on the facts that DNA contains phosphorus while protein contains Sulphur. In this experiment, phosphorus was used as a marker for DNA. Similarly, Sulphur was used as a marker for protein. By tracing the movement of Sulphur and phosphorus; it was easier to trace the movement of DNA and protein through subsequent generations. But nitrogen is present in DNA as well as in protein. Hence, use of ^{15}N will not help in finding whether the DNA or protein is the genetic material.

12. There is only one possible sequence of amino acids when deduced from a given nucleotides. But multiple nucleotides sequence can be deduced from a single amino acid sequence. Explain this phenomenon.

Ans. There are 61 codons and 20 amino acids. Hargobind Khorana and Marshall Neirenberg worked on this principle. It was proposed that a codon for an amino acid is made up of 3 nucleotides. It was also seen that one codon codes for only one amino acid (unambiguous and specific). Some amino acids are coded by more than one codon (degeneracy of codon). In simple terms, it can be said that there is only one possible sequence of amino acids when deduced from a given set of nucleotides. But multiple nucleotides sequence can be deduced from a single amino acid sequence.

13. A single base mutation in a gene may not 'always' result in loss or gain of function.

Do you think the statement is correct? Defend your answer.

Ans. A single base mutation in a gene may not always results in loss or gain of function. We know that a codon is composed of three nucleotides. In simple terms, a codon can be taken as a word which is composed of 3 letters. For making any meaningful sentence we need a complete word. Addition or deletion of a single letter may not result in a meaningful word. Hence, in most of the cases, there is a need of mutation in three bases to affect loss or gain of function. This can be illustrated by following example of a sentence being altered:

RAM HAS RED CAP

RAM HAS BRE DCA P

RAM HAS BIR EDC AP

RAM HAS BIG RED CAP

It is clear that a meaningful sentence is made only when at least three letters are inserted in this sequence.

14. A low level of expression of lac operon occurs at all the time. Can you explain the logic behind this phenomena.

Ans. A very low level of expression of lac operon has to be present in the cell all the time, otherwise lactose cannot enter the cells.

15. How has the sequencing of human genome opened new windows for treatment of various genetic disorders. Discuss amongst your classmates.

Ans. Sequencing of human genome has opened new windows for treatment of various genetic disorders. We know that genetic disorders are caused by some alteration in genes. At present, we do not have exact information about the base pair sequence where this alteration takes place. Hence, we are unable to devise any tool to prevent genetic disorders. By proper understanding of the particular sequence responsible for a particular genetic disorder, the scientist may be able to devise some tools to prevent genetic disorders. A future may come when nobody will be suffering from genetic disorders; especially those which

create serious disability.

16. The total number of genes in humans is far less (< 25,000) than the previous estimate (upto 1,40,000 gene). Comment.

Ans. When scientists began estimating the number of human genes, they began with a very high figure, i.e. more than 100,000. At that time, the technology for studying human genes was not sophisticated enough and the estimate was more qualitative in nature as it was mainly based on assumptions. With gradual progress of technology and knowledge about the human genes, the estimated number began to come down. The present knowledge tells us that total number of genes in humans is between 20,000 to 25,000.

17. Now, sequencing of total genomes getting is getting less expensive day by the day. Soon it may be affordable for a common man to get his genome sequenced. What in your opinion could be the advantage and disadvantage of this development?

Ans. Advantages of Affordable Genome Sequencing: It can help in settling disputes which may arise in case of parentage of a child. This can also help in disputes of property inheritance by finding the bonafide beneficiary. Human genome can also help in preparing a database on people with criminal record. It can help in identifying the chances of genetic disorders in a family.

Disadvantages: Genome sequencing can have serious issues of privacy. Some employers may misuse the data to blackmail their employees. Many private matters may leak into public domain; creating embarrassment for the affected person.

18. Would it be appropriate to use DNA probes such as VNTR in DNA finger printing of a bacteriophage?

Ans. VNTR (Variable Number Tandem Repeat) is a location in genome where a short nucleoside is organized as tandem repeat. Analysis of VNTR is used for many purposes; including DNA finger printing. But bacteriophage does not have too many DNAs rather only a few strands of DNA are available in bacteriophage. This does not leave scope for repeating sequence in DNA. Hence, VNTR cannot be used in DNA finger printing of a bacteriophage.

19. During in vitro synthesis of DNA, a researcher used 2', 3' – dideoxy cytidine triphosphate as raw nucleotide in place of 2'-deoxy cytidine. What would be the consequence?

Ans. 2', 3' – dideoxy cytidine triphosphate is a reverse transcriptase inhibitor. Reverse transcriptase is a viral DNA polymerase which facilitates DNA replication in HIV and other retroviruses. The commercial name of ddC is Zalcitabine and it is sold as a pharmaceutical product for management of HIV. If 2', 3'- dideoxy cytidine triphosphate is used as a raw nucleotide in place of 2' – deoxy cytidine, it will stop DNA replication. The researcher will not be able to proceed on his experiment because of contrary effect of his chosen reagent.

20. What background information did Watson and Crick have made available for developing a model of DNA? What was their contribution?

Ans. Watson and Crick made following background information available for developing a model of DNA:

- Pairing between the two strands of polynucleotide chains.
- Base pairing of polynucleotide chains is complementary in nature.
- If base sequence of one strand is known, then the base sequence of another strand can be predicted.
- If each strand from a DNA acts like a template, then both the daughter DNAs would be similar to the mother DNA.

Contributions of Watson and Crick:

- A simple model of DNA was available because of them.
 - Genetic implications of DNA replication could be easily understood.
 - The model brought revolution in understanding of biology at a molecular level.
-

21. What are the functions of (i) methylated guanosine cap, (ii) poly-A “tail” in a mature on RNA?

Ans. Function of Methylated Guanosine Cap: It regulates nuclear export of mRNA. It promotes translation. (Fully processed hnRNA is called mRNA).

Function of Poly-A Tail: Protects RNA from degradation by exonucleases. Plays important role in transcription termination.

22. Do you think that the alternate splicing of exons may enable a structural gene to code for several isoproteins from one and the same gene? If yes, how? If not, why so?

Ans. In humans about 95% of multi-exonic genes are alternatively spliced. Alternative splicing helps in generating many proteins from one and the same gene. In this process, a particular exon may be excluded from or included in a specific RNA. Splicing which results in a single gene coding for multiple proteins is called alternative splicing.

23. Comment on the utility of variability in number of tandem repeats during DNA finger printing.

Ans. Variability in number of tandem repeats (VNTR) is highly useful in DNA finger printing. DNA sample is subjected to gel electrophoresis or Southern blotting. After that VNTR manifests as a pattern of lines of different lengths. The variability in lengths of lines and their respective arrangement varies from one individual to another. This is more or less unique the way a person's finger print is. Thus, VNTR helps in establishing exact identity of an individual through DNA finger printing.

CBSE Class 12 Biology
NCERT Exemplar Solutions
CHAPTER 7
EVOLUTION

Multiple Choice Questions (MCQs)

1. Which of the following is used as an atmospheric pollution indicator?

- (a) Lepidoptera**
- (b) Lichens**
- (c) Lycopersicon**
- (d) Lycopodium**

Ans. (b) Lichens

Explanation: Lichens do not possess roots and hence air is their primary source for most elements. They will not grow in the areas that are polluted. So, lichen is used as a reliable indicator of atmospheric pollution.

2. The theory of spontaneous generation stated that:

- (a) life arose from living forms only**
- (b) life can arise from both living and non-living**
- (c) life can arise from non-living things only.**
- (d) life arises spontaneously, neither from living nor from the non-living.**

Ans. (c) life can arise from non-living things only.

Explanation: This theory was based on the assumption that life could have formed from non-animate matters. Option 'c' is correct.

3. Animal husbandry and plant breeding programmes are the examples of:

- (a) reverse evolution**
- (b) artificial selection**
- (c) mutation**
- (d) natural selection**

Ans. (b) artificial selection

Explanation: Animal husbandry and plant breeding programmes need human intervention and desirable characters are introduced in plants and animals through manipulation. Hence, these are examples of artificial selection.

4. Palaentological evidences for evolution refer to the:

- (a) development of embryo**
- (b) homologous organs**
- (c) fossils**
- (d) analogous organs.**

Ans. (c) fossils

Explanation: In fact, study of fossils is called palaentology. The term 'palaeo' is related to old and historic items.

5. The bones of forelimbs of whale, bat, cheetah and man are similar in structure, because:

- (a) one organism has given rise to another**
- (b) they share a common ancestor**
- (c) they perform the same function**

(d) they have biochemical similarities

Ans. (b) they share a common ancestor

Explanation: Similarity in structural design indicates towards a common ancestry.

6. Analogous organs arise due to:

(a) divergent evolution

(b) artificial selection

(c) genetic drift

(d) convergent evolution

Ans. (d) convergent evolution

Explanation: Analogous organs have evolved from different ancestors but all of them show similar function. Hence, they show convergent evolution.

7. $(p + q)^2 = p^2 + 2pq + q^2 = 1$ represents an equation used in:

(a) population genetics

(b) mendelian genetics

(c) biometrics

(d) molecular genetics

Ans. (a) population genetics

Explanation: (a) population genetics

8. Appearance of antibiotic-resistant bacteria is an example of:

(a) adaptive radiation

(b) transduction

(c) pre-existing variation in the population

(d) divergent evolution

Ans. (c) pre-existing variation in the population

Explanation: Adaptive radiation is related to evolution of different designs for a single organ according to varied needs of different groups. Transduction is related to transfer of viral or bacterial genetic material. Divergent evolution is related to homologous organs. Hence, option 'c' is correct.

9. Evolution of life shows that life forms had a trend of moving from:

(a) land to water

(b) dryland to wet land

(c) fresh water to sea water

(d) water to land

Ans. (d) water to land

Explanation: Most of the primitive organisms live in water, while most of the complex organisms live on land. This shows that evolution of life progressed from water to land.

10. Viviparity is considered to be more evolved because:

(a) the young ones are left on their own

(b) the young ones are protected by a thick shell

(c) the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival

(d) the embryo takes a long time to develop

Ans. (c) the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival

Explanation: (c) the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival

11. Fossils are generally found in:

(a) Sedimentary rocks

(b) Igneous rocks

(c) Metamorphic rocks

(d) Any type of rock

Ans. (a) Sedimentary rocks

Explanation: Igneous rocks are formed from lava and hence no fossil can be found in them. Metamorphic rocks can be made from igneous or sedimentary rocks. Hence, 'a' is the correct answer.

12. For the MN-blood group system, the frequencies of M and N alleles are 0.7 and 0.3, respectively. The expected frequency of MN-blood group bearing organisms is likely to be

(a) 42%

(b) 49%

(c) 9%

(d) 58%

Ans. (a) 42%

Explanation: This can be solved by using the binomial expression:

$$(a + b)^2 = a^2 + 2ab + b^2$$

Here; $M = a$ and $N = b$

$$\begin{aligned} \text{So, } (M + N)^2 &= M^2 + 2MN + N^2 \\ &= 0.7^2 + 2 \times 0.7 \times 0.3 + 0.3^2 \\ &= 0.49 + 0.42 + 0.09 \end{aligned}$$

In this equation; value of $2MN = 0.42 = 42\%$

13. Which type of selection is industrial melanism observed in moth, Biston bitularia:

- (a) Stabilising
- (b) Directional
- (c) Disruptive
- (d) Artificial

Ans. (b) Directional

Explanation: Industrial melanism is not a mean character but is acquired by most of the individuals. Hence, it is an example of directional change.

14. The most accepted line of descent in human evolution is:

- (a) Australopithecus → Ramapithecus → Homo sapiens → homo habilis
- (b) Homo erectus → Homo habilis → Homo sapiens
- (c) Ramapithecus → Homo habilis → Homo erectus → Homo sapiens
- (d) Australopithecus → Ramapithecus → Homo erectus → Homo habilis → Homo sapiens.

Ans. (c) Ramapithecus → Homo habilis → Homo erectus → Homo sapiens

Explanations: (c) Ramapithecus → Homo habilis → Homo erectus → Homo sapiens

15. Which of the following is an example for link species?

(a) Lobe fish

(b) Dodo bird

(c) Sea weed

(d) Chimpanzee

Ans. (a) Lobe fish

Explanation: Lobe fish shows characters from cartilaginous fishes and from amphibia. They belong to bony fishes. Since, they show characters from two other groups of animals, they are considered as link species.

16. Match the scientists listed under column 'A' with ideas listed under column 'B'.

	Column A	Column B
(i)	Darwin	M. abiogenesis
(ii)	Oparin	N. use and disuse of organs
(iii)	Lamarck	O. continental drift theory
(iv)	Wagner	P. evolution by natural selection

(a) (i) M; (ii) P; (iii) N; (iv) O

(b) (i) P; (ii) M; (iii) N; (iv) O

(c) (i) N; (ii) P; (iii) O; (iv) M

(d) (i) p; (ii) O; (iii) N; (iv) M

Ans. (b) (i) P; (ii) M; (iii) N; (iv) O

Explanation: (b) (i) P; (ii) M; (iii) N; (iv) O

17. In 1953 S. L. Miller created primitive earth conditions in the laboratory and gave experimental evidence for origin of first form of life from preexisting non-living organic molecules. The primitive earth conditions created include:

(a) low temperature, volcanic storms, atmosphere rich in oxygen

(b) low temperature, volcanic storms, reducing atmosphere

(c) high temperature, volcanic storms, non-reducing atmosphere

(d) high temperature, volcanic storms, reducing atmosphere containing CH₄, NH₃ etc.

Ans. (d) high temperature, volcanic storms, reducing atmosphere containing CH₄, NH₃ etc.

18. Variations during mutations of meiotic recombinations are:

(a) random and directionless

(b) random and directional

(c) random and small

(d) random, small and directional

Ans. (a) random and directionless

Explanation: (a) random and directionless

CBSE Class 12 Biology
NCERT Exemplar Solutions
CHAPTER 7
EVOLUTION

Short Answer Type Questions

1. Louis Pasteur's experiments, if you recall, proved that life can arise from only pre-existing life. Can we correct this as life evolves from pre-existent life or otherwise we will never answer the question as to how the first forms of life arose? Comment.

Ans. For this experiment, Louis Pasteur used a sterilized flask and another flask which was open to air. Killed yeast did not produce new organism in sterilized flask, while yeast new organisms could come into origin in the second flask. This experiment helped in rejecting the theory of spontaneous generation. But later experiments by Miller showed that organic molecules could develop from inorganic molecules; subsequently leading to origin of life. So, Pasteur's observation could be corrected to some degree by Miller's experiment.

2. The scientists believe that evolution is gradual. But extinction, part of evolutionary story, are 'sudden' and 'abrupt' and also group-specific. Comment whether a natural disaster can be the cause for extinction of species.

Ans. As the theory about extinction of dinosaurs tells; a natural disaster can be the cause for extinction of species. A majority of scientists agree that a meteor hit the earth which led to large scale destruction and eventual extinction of dinosaurs.

3. Why is nascent oxygen supported to be toxic to aerobic life forms?

Ans. Nascent oxygen is a highly reactive substance. It can react with many molecules; including the DNA. This can result in unwanted mutations which may threaten the life forms. Hence, nascent oxygen is supposed to be toxic to aerobic life forms.

4. While creation and presence of variation is directionless, natural selection is directional as it is in the context of adaptation. Comment.

Ans. Variations keep on occurring in each subsequent generation. But most of them may not be retained by the organism because nature may not support such variations. When a particular variation passes the test of natural selection, then only it is inherited in a species in the long run. Hence, it can be said that creation and presence of variation is directionless but natural selection and adaptation are directional.

5. The evolutionary story of moths in England during industrialisation reveals, that 'evolution is apparently reversible'. Clarify this statement.

Ans. In the story of moths in England; white winged moths survived because whitish lichens proliferated on tree trunks during pre-industrialisation days. White-winged moths had better chances of survival against a whitish background. But when the tree trunks become dark due to pollution, the white-winged moths perished; and dark-winged moths reappeared and survived. Thus, evolution of white wings was reversed because of pollution. This shows that evolution is apparently reversible.

6. Comment on the statement that "evolution and natural selection are end result or consequence of some other processes but themselves are not processes".

Ans. This is a debatable point that evolution and natural selection are end result or consequence of some other processes but themselves are not processes. When we discuss about success of life on the earth then we treat evolution and natural selection as process. But when discuss about how life has evolved from simple forms then evolution and natural selection appear to results of some other processes. Among the scientific community; this issue is still a moot point.

7. State and explain any three factors affecting allele frequency in populations.

Ans. following are the three out of five factors which affect allele frequency in populations:

(a) Genetic Drift: The change in the frequency of a gene variant in a population due to random sampling is called genetic drift. Genetic drift may cause a gene variant to disappear completely and result in reduced genetic variation.

(b) Genetic Recombination: Production of offspring with traits which differ from parents is

called genetic recombination.

(c) Natural Selection: This theory is based on the premise that nature selects only those traits which help an organism to survive in the changed conditions. Natural selection leads to survival of the fittest. Those which are not fit to survive perish in the long run; paving the way for evolution of a new species.

8. Gene flow occurs through generations. Gene flow can occur across language barriers in humans. If we have a technique of measuring specific allele frequencies in different population of the world, can we not predict human migratory patterns in pre-history and history? Do you agree or disagree? Provide explanation to your answer.

Ans. Yes, I agree. With human genome project turning into a reality; it is now possible to understand gene flow in different populations of the world. This can help us in assessing and predicting human migratory patterns in pre-history and history.

9. How do you express the meaning of words like race, breed, cultivars or variety?

Ans. Race: A race is an informal taxon and is kept below the species. This means that members from different races of the same species can interbreed.

Breed: A breed is a specific group of domestic animals which are homogenous in appearance. This homogeneity has been achieved through selective breeding.

Cultivar: A selected group of plants which can be raised through vegetative propagation is called cultivar.

Variety: Variety is similar to a race but is used for the plants. Thus, a variety is an informal taxon which is kept below the species in the plant kingdom.

10. When we say "survival of the fittest", does it mean that

(a) those which are fit only survive, or

(b) those that survive are called fit?

Comment.

Ans. Survival of fittest means that those that survive are called fit. Organisms with useful adaptations survive in the long run and are considered to be fit.

11. Enumerate three most characteristic criteria for designating a Mendelian population.

Ans. The three most important criteria for designating a Mendelian population are as follows:

- Population must be sufficiently large.
 - Free flow of genetic materials is ensured through sexual reproduction.
 - There should be negligible or nil migration in the population.
-

12. "Migration may enhance or blurr the effects of selection". Comment.

Ans. Natural selection involves selection of a beneficial gene and rejection of a harmful gene. But migration can disturb natural selection by enriching the gene pool of the population. Hence, it can be said that migration may enhance or blur the effects of natural selection.

CBSE Class 12 Biology
NCERT Exemplar Solutions
CHAPTER 7
EVOLUTION

Very Short Answer Type Questions

1. What were the characteristics of life forms that had been fossilised?

Ans. Fossilised life forms had some hard parts which could be preserved between layers of rocks.

2. Did aquatic life forms get fossilised? If, yes where do we come across such fossils?

Ans. Many aquatic life forms too got fossilized. Many such fossils have been found from oil wells. Many others have been found from sedimentary rocks because many water bodies got filled up by sedimentation.

3. What are we referring to? When we say 'simple organisms' or 'complex organisms'.

Ans. When we say 'simple organisms' or 'complex organisms' we refer to the complexity of division of labour and relative level of organization in the organisms.

4. How do we compute the age of a living tree?

Ans. Age of a living tree can be determined by comparing the diameter of the trunk with average growth factor of that species. Average growth factor of a species can be found from records. Diameter can be calculated by measuring the girth of the trunk.

5. Give an example for convergent evolution and identify the features towards which they are converging.

Ans. Similar evolution in species of different lineage is called convergent evolution. Convergent evolution happens in an isolated geographical area. Flippers of dolphin and

penguin are examples of convergent evolution. In both animals; flippers have different origins but serve similar purpose.

6. How do we compute the age of a fossil?

Ans. Age of a fossil is computed by using carbon dating. Relative presence of ^{14}C (radioactive carbon) is calculated to compute the age of a fossil.

7. What is the most important pre-condition for adaptive radiation?

Ans. Common ancestry is the most important pre-condition for adaptive radiation.

8. How do we compute the age of a rock?

Ans. Age of a rock is computed by using carbon dating. Relative presence of ^{14}C (radioactive carbon) is calculated to compute the age of a rock.

9. When we talk of functional macromolecules (e.g. proteins as enzymes, hormones, receptors, antibodies etc), towards what are they evolving?

Ans. Functional macromolecules are evolving towards living forms.

10. In a certain population, the frequency of three genotypes is as follows:

Genotypes	BB	Bb	bb
Frequency	22%	62%	16%

What is the likely frequency of B and b alleles?

Ans. Frequency of B alleles = $BB + \frac{1}{2}Bb$

$$= 22\% + 31\% = 53\%$$

Frequency of b alleles = $bb + \frac{1}{2}Bb$

$$= 16\% + 31\% = 47\%$$

11. Among the five factors that are known to affect Hardy Weinberg equilibrium, three factors are gene flow, genetic drift and genetic recombination. What are the other two factors?

Ans. Mutation and Natural Selection are the other two factors.

12. What is founder effect?

Ans. When a new species evolves are by a small number of individuals from a larger population; the loss of genetic variation in the new species is called the founder effect.

13. Who among the Dryopithecus and Ramapithecus was more man-like?

Ans. Ramapithecus

14. By what Latin name the first hominid was known?

Ans. Homo habilis

15. Among Ramapithecus, Australopithecines and Homo habilis - who probably did not eat meat?

Ans. Homo habilis
