UNIT-I:

CHAPTER – 2

SEXUAL REPRODUCTION IN FLOWERING PLANTS

- Pollinium – Pollen grains contained in a pollen sac and remained united in a single grain mass is called Pollinium.
- At the time of pollination, the pollen grain is either 2-celled (1 tube cell + 1 generative cell) or 3 – celled (1 tube cell + 2 male gametes).
- The cellular thickening at the micropylar tip is called as **filiform apparatus**. It plays an important role in guiding the pollen tube into synergids.

VERY SHORT ANSWER QUESTIONS 1 Mark Each

Q.1.What is tapetum?

Ans:- Tapetum is the inner specialized layer of microsporangial wall.

Q.2. Define microsporogenesis.

Ans:-The phenomenon of formation of haploid microspores from a microspore mother cell through meiosis is known as microsporogenesis.

Q.3. What is pollinium?

Ans:- Pollen grains contained in a pollen sac that remain united in a single grain mass is called Pollinium.

Q.4. What is polyspory?

Ans:- If more than four microspores are produced from one microspore mother cell, it is called Polyspory.

Q.5. What is pollen kitt?

Ans:- The pollen kitt is a sticky layer found on the outer side of exine of mature pollen grains of many insect pollinated species.

Q.7. Define pollination.

Ans:- Pollination is the transfer of pollen grains from the anther to the stigma (whether of the same flower or different flower).

Q.8. Define Geitonogamy.

Ans:- Geitonogamy is a type of self pollination in which the pollen grains of one flower are transferred to the stigma of another flower belonging to the same plant.

Q.9. Which type of pollination will you perform to maintain parental characters?

Ans:- Self pollination.

Q.10. Define xenogamy.

Ans:- Xenogamy is the transfer of pollen grains from the anther of one flower to the stigma of a genetically different flower.

Q.11. Define Entomophily.

Ans:- Entomophily is transfer of pollen grains from anthers of one flower to stigma of another flower with the help of insects.

Q.12. What is pollen – pistil interaction?

Ans:- Pollen-pistil interaction is the group of events that occur from time of pollen deposition over the stigma to the time of pollen tube entry into ovule.

Q.13. What is double fertilization in angiosperms?

Ans:- The process of fertilization that occurs twice in the same embryo sac at a time by two male gametes (syngamy and triple fusion) is called double fertilization.

Q.14. Write the name and function of innermost whorl of a flower.

Ans:- Innermost whorl is Carpel. Its function is production of seed.

Q.15. Name the parts of an angiosperm flower in which development of male and female gametophyte take place.

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

Q.16. What is meant by monosporic development of female gametophyte?

Ans:- The female gametophyte or the embryo sac develops from a single functional megaspore. This is known as monosporic development of the female gametophyte.

Q.17. Define parthenocarpy.

Ans:- Production and development of seedless fruits is called parthenocarpy.

Q.18. Though 'Cultivation of hybrids has tremendously increased productivity,' yet why do farmers need to purchase hybrid seeds every year?

Ans:- One of the problems of hybrids is that hybrid seeds have to be produced every year. If the seeds collected from hybrids are sown, the plants in the progeny will segregate and do not maintain hybrid characters.

Q.19. Give an example of a plant in which malacophily is performed.

Ans:- *Arisaema*

Q.20. Who discovered double fertilization in plants?

Ans:- S. G. Nawaschin discovered double fertilization.

Q.21. Name the type of flower which favours cross pollination.

Ans:- Unisexual flowers.

Q.22. Pea flowers produce assured seed sets. Give a reason.

Ans:- Because pea flowers perform bud pollination (autogamy). Hence, seed formation is ensured if the plant gives flowers.

Q.23. Night blooming flowers are colourless and emit pleasure smell. Why?

Ans:- For attracting insect pollinators.

Q.24. What is ornithophily?

Ans:- Ornithophily is cross pollination performed through the agency of birds. e.g. *Bombax* (Red silk cotton), *Erythrina* (Coral tree), *Callistemon* (Bottle Brush).

Q.25. What is chiropterophily?

Ans:- Chiropterophily is cross pollination performed by bats. e.g. It occurs in *Kigelia pinnata* (Sausage Tree).

Q.26. What is malacophily? Give an example of malacophilous plant.

Ans:- Malacophily is cross pollination performed through the agency of snails. It occurs in *Arisaema*.

Q.27. What is dicliny?

Ans:- Dicliny is the condition in which the plants bear unisexual flowers so that self pollination is not possible.

Q.28. What is dichogamy?

Ans:- Dichogamy is the condition in which anthers and stigmas mature at different times in a bisexual flower so as to prevent self pollination.

Q.29. Differentiate between Coleoptile and Coleorrhiza.

Ans:- Difference between Coleoptile and Coleorrhiza:

Coleoptile	Coleorrhiza
1. It is a conical protective sheath that encloses the plumule in a monocot seed.	1. It is an undifferentiated sheath that encloses the radicle and the root cap in a monocot seed.

Q.30. A bilobed, dithecous anther has 1000 microspore mother cells per microsporangium. How many male gametophytes this anther can produce?

Ans:- 4 x 1000 x 4 = 16000 male gametophytes as each microspore mother cell undergoes meiosis producing 4 microspores.

Q.31. Name the four wall layers of a typical angiospermic microsporangium.

Ans:- The four wall layers of a typical angiospermic microsporangium are Epidermis, Endothecium, Middle layer and Tapetum.

Q.32. At what stage of a typical angiospermic embryo sac matures?

Ans:- A typical angiospermic embryo sac matures at 8-nucleate and 7-celled stage.

Q.33. State one point of difference between a Chasmogamous and a Cleistogamous flower.

Ans:- The flower which exposes their sex organs are called Chasmogamous flower while the flower which never exposes their sex organs are called cleistogamous flower.

SHORT ANSWER TYPE QUESTIONS 2 Marks Each

Q.1. Draw and label a L.S. of a flower showing all the four whorls.

Q.2. Why is apple called a false fruit? Which part(s) of the flower forms the fruit?

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

Q.3. If one can induce parthenocarpy through the application of growth substances, which fruits would you select to induce parthenocarpy and why?

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

Q.4. Explain the role of tapetum in the formation pollen-grain wall.

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

Q.5. How does endosperm in angiosperms become triploid?

Ans:- Endosperm in angiosperm is formed as a result of fusion of haploid male gamete and a diploid secondary nucleus. Hence, it is triploid.

Q.6. What is double fertilization? Who discovered double fertilization and in which year?

Ans:- The process of fertilization that occurs twice in the same embryo sac at a time by two male gametes (syngamy and triple fusion) is called double fertilization. S.G. Nawaschin discovered double fertilization in 1898.

Q.7. Explain any two advantages of cross pollination over a self one.
Ans:- In nature, cross pollination is preferred over self pollination because –
i) Cross pollination keeps variability of race while self one does not.
ii) Cross pollination produces better offsprings due to phenomenon of hybrid vigour while vigour and vitality is absent in self pollination.
iii) Cross pollination makes offspring adaptable towards the changing environment. Adaptation towards the changing environment is low in self pollination.
Q.8. Write two advantages of cross pollination.
Ans:- Advantages of Cross pollination:
i). It introduces variations due to genetic recombination.
ii). It produces better offspring than either of the parents due to phenomenon of *hybrid vigour or heterosis*.
Q.9. Explain the phenomenon of apomixis. Write one advantage of using apomictic seeds.
Ans:- Apomixis is the mechanism of seed production without involving the process of meiosis and syngamy. It plays an important role in hybrid seed production. The method of producing hybrid seeds by cultivation is very expensive for farmers. Also, by sowing hybrid seeds, it is difficult to maintain hybrid characters as characters segregate during meiosis. Apomixis prevents the loss of specific characters in the hybrid. Also, it is a cost-effective method for producing seeds.
Q.10. How does endospermic seeds differ from non-endospermic seeds?
Ans:- i) Endospermic or Albuminous Seeds: Seeds in which the developing embryo cannot exhaust the complete endosperm are known as Endospermic or Albuminous Seeds. In such seeds, endosperm persists even after attaining maturity. E.g. Wheat, Rice, Maize.
ii) Non-endospermic or Exalbuminous Seeds: In such type of seeds before maturation, the embryo during its developmental process consumes the endosperm completely. E.g. Pea, Groundnut, beans,etc.
Q.11. Arrange the following terms in the correct developmental sequence:
Pollen grain, sporogenous tissue, microspore tetrad, pollen mother cell, male gametes
Ans:- The correct development sequence is as follows:
Sporogenous tissue – pollen mother cell – microspore tetrad – Pollen grain – male gamete.
During the development of microsporangium, each cell of the sporogenous tissue acts as a pollen mother cell and gives rise to a microspore tetrad, containing four haploid microspores by the process of meiosis (microsporogenesis). As the anther matures, these microspores dissociate and develop into pollen grains. The pollen grains mature and give rise to male gametes.
Q.12. What is filiform apparatus? Mention its function.
Ans:- The cellular thickening at the micropylar tip is called as filiform apparatus. It plays an important role in guiding the pollen into synergids.
Q.13. Give two differences between Geitonogamy and xenogamy.
Ans:- Differences between Geitonogamy and xenogamy:

Geitonogamy	Xenogamy
1. It is pollination between two flowers of the same plant. 2. The flowers are genetically similar.	1. It is pollination between two flowers of different plants. 2. The flowers are genetically different.

Q.14. In angiosperms, zygote is diploid while primary endosperm cell is triploid. Explain.
Ans:- In angiosperm, zygote is formed by the fusion of a haploid male gamete and a haploid egg, hence it is diploid. While primary endosperm cell is formed by the fusion of another haploid male gamete and a diploid secondary nucleus, hence it is triploid.
Q.15. The flower of brinjal is referred to as chasmogamous while that of beans is cleistogamous. How are they different from each other?
Ans:-

Flowers brinjal	Flowers of bean
1. Flowers are open (Chasmogamous). 2. Pollination can be carried out by self or cross.	1. Flowers are closed. 2. Only self pollination is possible.

Q.16. Coconut palm is monoecious while date palm is dioecious. Why are they called so?
Ans:- Coconut palm is monoecious because the plants bear unisexual male and female flowers on the same plant. On the other hand, date palm is dioecious because the plants have unisexual male and female flowers on separate plants.
Q.17. Explain any two devices by which autogamy is prevented in flowering plants.
Ans:- Two devices by which autogamy is prevented are:
i). Dicliny (Unisexuality): Flowers are unisexual so that self pollination is not possible. The plants may be monoecious (bearing both male and female flowers, e.g. Maize) or dioecious (bearing male and female flowers on different plants, e.g. Mulberry, Papaya). In such flowers, autogamy is possible, instead cross pollination is favoured.

ii). Herkogamy: It is the presence of natural and physical barrier between androecium and gynoecium and thus autogamy is not possible. e.g. in *Calotropis*, gynoecium is fused with pollinium (anthers) and form gynostegium.
Q.18. What are chasmogamous flowers? Can cross-pollination occur in cleistogamous flowers? Give reasons for your answer.
Ans:-There are two types of flowers present in plants namely − chasmogamous and cleistogamous flowers. Chasmogamous flowers have exposed anthers and stigmata similar to the flowers of other species. Cross-pollination cannot occur in cleistogamous flowers. This is because cleistogamous flowers never open at all. Also, the anther and the stigma lie close to each other in these flowers. Hence, only self-pollination is possible in these flowers.
Q.19. Write the fate of egg cell and polar nuclei after fertilization.
Ans:- On fertilization, the egg cell forms zygote which further develops into an embryo while polar nuclei after being fertilized develops into primary endosperm nucleus by the process of triple fusion. Then this gives rise to a nutritive triploid endosperm tissue.
Q.20. What is self-incompatibility? Why does self-pollination not lead to seed formation in self-incompatible species?
Ans:- Self-incompatibility is a genetic mechanism in angiosperms that prevents self- pollination. It develops genetic incompatibility between individuals of the same species or between individuals of different species. The plants which exhibit this phenomenon have the ability to prevent germination of pollen grains and thus, prevent the growth of the pollen tube on the stigma of the flower. This prevents the fusion of the gametes along with the development of the embryo. As a result, no seed formation takes place.
Q.21. How does self sterility prevent self pollination?
Ans:- Self Sterility (Self Incompatibility) refers to the condition in which pollen grains of a flower do not germinate on the stigma of the same flower due to presence of similar self sterility gene. Thus self pollination is prevented. e.g. Tobacco, Potato, Crucifers.
Q.22. What is herkogamy? How does it prevent self pollination?
Ans:- Herkogamy is the presence of natural and physical barrier between androecium and gynoecium. Due to this barrier, self pollination is prevented.
Q.23. How does protandry differ from protogyny?
Ans:- In Protandry, anthers mature earlier than stigma of the same bisexual flowers.
In protogyny, Stigmas mature earlier than anthers of bisexual flowers so that they get pollinated before the anthers of the same flower develop pollen grains.
Q.24. How does prepotency differ from self sterility (self incompatibility)?
Ans:- Prepotency refers to the condition in which pollen grains of another flower germinate more rapidly over the stigma than the pollen grains of the same flower, e.g. Apple, Grape.
Self Sterility (Self Incompatibility) refers to the condition in which pollen grains of a flower do not germinate on the stigma of the same flower due to presence of similar self sterility gene. e.g. Tobacco, Potato, Crucifers.
Q. 25: Why do you think the zygote is dormant for sometime in a fertilized ovule?
Ans:- The zygote is formed by the fusion of the male gamete with the nucleus of the egg cell. The zygote remains dormant for some time and waits for the endosperm to form, which develops from the primary endosperm cell resulting from triple fusion. The endosperm provides food for the growing embryo and after the formation of the endosperm, further development of the embryo from the zygote starts.
Q.26. Even though each pollen grain has two male gametes, why are atleast 10 pollen grains and not 5 pollen grains required to fertilize 10 ovules present in a particular carpel?
Ans:- It is the pollen tube and not the individual male gamete which enter an ovule. Both the male gametes are used up in fertilizing two different structures in angiosperms – syngamy and triple fusion. Therefore, 10 pollen grains are required to fertilize 10 ovules.
Q.27. Differentiate between Hypocotyl and Epicotyl.
Ans:- Difference between Hypocotyl and Epicotyl:

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

SHORT ANSWER TYPE QUESTIONS 3 Marks Each
Q.1. Give three points of difference between microsporogenesis and megasporogenesis.
Ans:- Three points of difference between microsporogenesis and megasporogenesis are

Microsporogenesis	Megasporogenesis
1. It is meiotic formation of haploid microspores from diploid microspore mother cell. 2. The arrangement of microspores in a tetrad is	1. It is meiotic formation of haploid megaspores from megaspore mother cell. 2. The arrangement of megaspores in a tetrad is

generally tetrahedral. 3. All the four microspores of a spore tetrad are functional.	commonly linear. 3. Only one megaspore of a spore tetrad is functional.

Q.2. Give three points of difference between fertilization and double fertilization.

Ans:- Difference between fertilization and double fertilization:

Fertilization	Double Fertilization
1. It is union of two compatible gametes. 2. It occurs in almost all eukaryotes. 3. Fertilization produces a diploid zygote.	1. It is the union of one male gamete with egg and the other male gamete with secondary nucleus of the same embryo sac. 2. It is restricted to angiosperms only. 3. Double fertilization produces a diploid zygote and a triploid primary endosperm cell.

Q.3. Differentiate between perisperm and pericarp.

Ans:- Difference between perisperm and pericarp.

Perisperm	Pericarp
1. It is unused nucellus in the seed. 2. It is a part of seed. 3. It is usually dry.	1. It is the cover of fruit that develops from ovary wall. 2. It is a part of a fruit. 3. It is dry or fleshy.

Q.4. What is triple fusion? Where and how does it take place? Name the nuclei involved in triple fusion.

Ans:- Triple fusion is the fusion of haploid male gamete with two polar nuclei inside the embryo sac of the angiosperm. This process of fusion takes place inside the embryo sac. One male gamete nucleus and two polar nuclei are involved in this process.

Q. 5. Explain the importance of apomixis in the field of horticulture and agriculture. 3 (CoHSEM-2013)

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

Q.6. . Illustrate *any three* disadvantages of self pollination.

Ans:- Disadvantages of self pollination:

i). No new traits are introduced.

ii). Vigour and vitality of the race decreases with prolonged self pollination.

iii). Variability and hence adaptability to changed environment are reduced.

Q.7. Describe the structure of a megasporangium (ovule) in flowering plants.

Ans:- Ovule is an integumented megasporangium which develops into seed after fertilization. It occurs inside ovary where it is attached to a parenchymatous cushion called placenta either singly or in a cluster. The attachment is by means of stalk of ovule called funicle or funiculus. The point of attachment of funiculus to the body of ovule is known as hilum. In typical (anatropous) ovule, funiculus is fused lengthwise beyond hilum to form a ridge called raphe. The body of the ovule consists of a mass of parenchymatous cells named nucellus with one or more coverings or integuments. The integuments surround the nucellus all around except at the apex, leaving a narrow passage called the micropyle. The basal portion of the nucellus from where the integuments appear is called Chalaza.

Q.8. What is triple fusion? What is the product of the process? What does the product develop into?

Ans:- Triple fusion is the fusion of second male gamete with two haploid polar nuclei or diploid secondary nucleus of central cell to form triploid primary endosperm nucleus. The product of triple fusion is primary endosperm cell. The primary endosperm cell gives to nutritive tissue called endosperm.

Q.9. Explain by giving three points of difference between male gametophyte and female gametophyte of an angiosperm.

Q.10. Name the type of pollination taking place in coconut palms. List five characteristics of the flowers of coconut plant favouring this type of pollination.

Ans:- Anemophily (a kind of autogamy).

Characteristics of Anemophilous Flowers:

i) Flowers are small and inconspicuous.

ii) The flowers are colourless, odourless and nectarless.

iii) Non-essential parts are either absent or reduced.

iv) A large number of pollen grains are produced.

v) Pollen grains are light, small and winged or dusty.

Q.11. Fertilization is essential for production of seeds, but in some angiosperms, seeds develop without fertilization. i) Give an example of an angiosperm that produces seeds without fertilization. Name the process.

ii) Explain the two ways by which seeds develop without fertilization.

Ans:- i) *Citrus.*

ii) The two ways by which seeds develop without fertilization are

a) Agamospermy: In some species, the diploid egg cell is formed without reduction division and develops into the embryo without fertilisation.

b) Adventive Embryony: More often, as in many *Citrus* varieties some of the nucellar cells surrounding the embryo sac start dividing, protrude into the embryo sac and develop into the embryos. In such species each ovule contains many embryos.

Q.12. (a) Mention any four strategies adopted by flowering plants to prevent self-pollination.

(b) Why is geitonogamy also referred to as genetic autogamy?

Ans:- (a) Four strategies adopted by flowering plants to prevent self pollination are:-

(i). Dicliny (Unisexuality): Flowers are unisexual so that self pollination is not possible. The plants may be monoecious (bearing both male and female flowers, e.g. Maize) or dioecious (bearing male and female flowers on different plants, e.g. Mulberry, Papaya).

(ii). Prepotency: Pollen grains of another flower germinate more rapidly over the stigma than the pollen grains of the same flower, thus it promotes cross pollination. e.g. Apple, Grape.

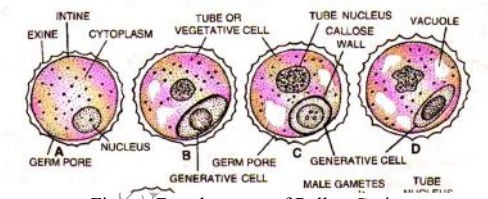
(iii). Herkogamy: It is the presence of natural and physical barrier between androecium and gynoecium. It prevents autogamy (self pollination). e.g. in *Calotropis*, gynoecium is fused with pollinium (anthers) and form gynostegium.

(iv). Dichogamy: In this, anthers and stigmas mature at different times in a bisexual flower so as to prevent self pollination.

b) In Geitonogamy, pollination takes place between the flowers of genetically similar flowers (i.e. between different flowers of same plant). Hence it is referred to as genetic autogamy.

Q.13. How does the pollen mother cell develop into a mature pollen grain? Illustrate the stages with labelled diagrams.

Ans:- The microspore mother cells round off and undergo meiosis to form four haploid microspores. Microspores grow and differentiate into pollen grains. The microspores, as they are formed, are arranged in a cluster of four cells–the microspore tetrad. The pollen grain nucleus grows in size and shifts to one side near the wall. The protoplast then divides to form 2 unequal cells, small generative cell and large tube cell or vegetative cell. In some species, generative cell divides into 2 male gametes before pollination.



Figre: Development of Pollen Grain

Q.14. Bring out the structure of Female gametophyte (embryo sac). Mention about the structure of cells present in a female gametophyte.

Ans:- Structure of Embryo sac (Female Gametophyte):

Embryo sac is an oval multicellular haploid structure which is embedded in the nucellus towards micropylar half of the ovule. Embryo sac generally contains seven cells – one large central, three micropylar and three chalazal.

i) Egg Apparatus: It is a grouping of three micropylar cells of embryo sac. One middle cell is larger and is called *egg* or *oosphere*. The remaining two cells are called *synergids*. Synergids form seat for pollen tube discharge.

ii) Antipodal Cells: They are three cells present in the chalazal end of embryo sac. They are vegetative cells of embryo sac which seem to take an active part in absorbing nourishment from nucellus. They ultimately degenerate.

iii) Central Cell: It is the largest cell of the embryo sac. In the middle, the cell contains two polar nuclei. The polar nuclei often fuse to form a single diploid secondary or fusion or definitive nucleus.

Q.15. Bring out the three strategies evolved by flowers to promote autogamy (self pollination).

Ans:- The three strategies evolved by flowers to promote autogamy are

i) Both sexes i.e. anthers and stigmas should get mature at the same time (Homogamy). e.g. *Catharanthus*.

ii) In some cases, flowers are bisexual and cleistogamous, i.e. remain closed. e.g. *Commelina bengalensis*

iii) In some cases, pollination occurs in bud condition before the opening (anthesis) of flower. e.g. Pea, Wheat, Rice.

LONG ANSWER (ESSAY) TYPE QUESTIONS:

Q.1. Explain by three points of difference between male and female gametophyte of angiosperm.

Ans:- Difference between male and female gametophyte:

Male Gametophyte	Female Gametophyte
1. It is derived from a pollen grain or microspore. 2. It is not retained inside the microsporangium. 3. Development occurs in two stages – pre-pollination	1. It is derived from a megaspore. 2. It is retained permanently inside megasporangium. 3. Development is completed in a single stage prior to

and post pollination. 4. It has three cells (1 tube cell + 2 male gametes). 5. All the cells are essential. The two male gametes take part in double fertilization while tube cell is required to form pollen tube for carrying the male gametes.	fertilization. 4. It has seven cells (3 antipodals + 1 central cell + 1 oosphere + 2 synergids). 5. All the cells are not essential. Egg cell and central cell are involved in double fertilization. Only one synergid receives the pollen tube.

Q.2. Write five important functions of tapetum.
Ans:- Functions of Tapetum:
i) It provides nourishment to growing sporogenous cells, microspore mother cells as well as young microspores.
ii) It (Secretory tapetum) produces lipid rich Ubisch granules for forming exine of pollen grains.
iii) It secretes hormones (e.g. IAA) that are stored in pollen grains for their early growth.
iv) It also secretes enzymes like callase responsible for the degradation of callose wall around pollen tetrad.
v) It provides covering around the entomophilous pollen grains.
Q.3. Describe the development of male gametophyte in angiosperm.
Ans:- Male gametophyte development occurs in two stages:

a) Pre-pollination Development: Development of male gametophyte begins inside the pollen sac. The pollen grain nucleus grows in size and shifts to one side near the wall. The protoplast then divides to form 2 unequal cells, small generative cell and large tube cell or vegetative cell.

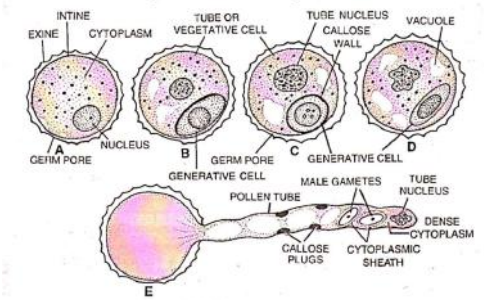


Fig: Germination of pollen Grain and formation of male Gametophyte in an Angiosperm.

b) Post-pollination Development: On the stigma, pollen grains absorb water and nutrients. The tube cell enlarges. It comes out of the pollen grain through one of the germpore to form a pollen tube. Pollen tube is covered by only intine. The generative cell also passes into it. It soon divides into two male gametes. The tube nucleus may degenerate completely. The pollen tube contains dense cytoplasm only towards its tip, which also contains 2 male gametes and a degenerated tube nucleus.
Q.4. Write five important features of wind pollinating (anemophilous) flowers.
Ans:- Characteristics of Anemophilous Flowers:
i) Flowers are small and inconspicuous.
ii) The flowers are colourless, odourless and nectarless.
iii) Non-essential parts are either absent or reduced.
iv) Pollen grains are light, small and winged or dusty.
v) A large number of pollen grains are produced, e.g. *Cannabis* produces 5,00,000 pollen grains.
Q.5. How does fertilization take place in angiosperms? Why is angiospermic fertilization known as double fertilization?
Ans:- In angiosperms, after pollination, the intine of pollen grain forms pollen tube through germ pore. The growth of pollen tube is stimulated by the sugary substances produced in the stigma. The pollen tube with 2 male gametes and tube nucleus runs through the style and finally turns towards the micropylar end of the ovule in the cavity of ovary.

When the pollen tube enters through the micropyle for fertilization, it is called porogamy. However, if the pollen tube enters through chalaza (the base) of the ovule, it is called Chalazogamy (Basigamy/aporogamy). When the pollen tube pierces through the integuments, it is called mesogamy.

On piercing the nucellus, the pollen tube penetrates the embryo sac and reaches the egg and synergids or between one synergid and wall of the embryo sac. Ultimately the tip of the pollen tube bursts and both male gametes are set free. One of the male gamete fuses with the egg cell or oosphere (Syngamy) which results in the formation of diploid zygote. The other male gamete fuses with the secondary nucleus (triple fusion) to form triploid primary endosperm nucleus.

In angiosperm, the process of fertilization occurs twice in the same embryo sac at a time by two male gametes (syngamy and triple fusion). Hence, it is called double fertilization.

Q.6. Write five difference between self pollination and cross pollination.
Q.7. List four main adaptations promoting cross pollination. Some rare species of orchids are grown on commercial basis. How will you increase the production of orchids remarkably?
Ans:- Four main adaptations promoting cross pollination are:-
1. Dicliny (Unisexuality): Flowers are unisexual so that self pollination is not possible. The plants may be monoecious (bearing both male and female flowers, e.g. Maize) or dioecious (bearing male and female flowers on different plants, e.g. Mulberry, Papaya).
2. Prepotency: Pollen grains of another flower germinate more rapidly over the stigma than the pollen grains of the same flower, thus it promotes cross pollination. e.g. Apple, Grape.
3. Herkogamy: It is the presence of natural and physical barrier between androecium and gynoecium. It prevents autogamy (self pollination). e.g. in *Calotropis*, gynoecium is fused with pollinium (anthers) and form gynostegium.
4. Dichogamy: In this, anthers and stigmas mature at different times in a bisexual flower so as to prevent self pollination.

Rare species of orchids, grown on commercial basis, can be increased its production by micropropagation (tissue culture).
Q.8. Describe the three modes of endosperm formation in angiosperms.
b) A hypodermal cell in the micropylar region of nucellus becomes more prominent owing to its larger size and denser cytoplasm, and forms (differentiates into) primary archesporial cell. The archesporial cell often divides once into outer primary parietal or wall cell and inner primary sporogenous cell. The primary sporogenous cell commonly functions directly as diploid megaspore mother cell or megasporocyte. The megaspore mother cell (MMC) undergoes meiosis and forms a linear tetrad of four haploid megaspores. Commonly the chalazal megaspore remains functional while the other three degenerate.

The functional megaspore cell enlarges and undergoes three successive nuclear mitotic divisions to form an eight nucleate female gametophyte or embryo sac. Out of the eight nuclei, three get organized at the micropylar end as egg apparatus, three at the chalazal end as antipodals, and two at the centre as polar nuclei (n+n). This seven celled and eight nucleate structure formed from functional megaspore is called embryo sac or female gametophyte.
Q.9. Briefly describe the structure of pollen grain of angiosperm.
Ans:- Pollen grains are generally spherical measuring about 25-50 micrometers in diameter. It has a prominent two-layered wall. The hard outer layer called the exine is made up of **sporopollenin** which is one of the most resistant organic material known. It can withstand high temperatures and strong acids and alkali. No enzyme that degrades sporopollenin is so far known. Pollen grain exine has prominent apertures called germ pores where sporopollenin is absent. Pollen grains are well preserved as fossils because of the presence of sporopollenin. The exine exhibits a fascinating array of patterns and designs. The inner wall of the pollen grain is called the intine. It is a thin and continuous layer made up of cellulose and pectin. The cytoplasm of pollen grain is surrounded by a plasma membrane. When the pollen grain is mature it contains two cells, the vegetative cell and generative cell. The vegetative cell is bigger, has abundant food reserve and a large irregularly shaped nucleus. The generative cell is small and floats in the cytoplasm of the vegetative cell. It is spindle shaped with dense cytoplasm and a nucleus. In over 60 per cent of angiosperms, pollen grains are shed at this 2-celled stage. In the remaining species, the generative cell divides mitotically to give rise to the two male gametes before pollen grains are shed (3-celled stage).
Q.10. Describe the development of female gametophyte in an angiospermic flower.
Ans:- DEVELOPMENT OF FEMALE GAMETOPHYTE (MEGASPOROGENESIS):

A hypodermal cell in the micropylar region of nucellus becomes more prominent owing to its larger size and denser cytoplasm, and forms (differentiates into) *primary archesporial cell*. The archesporial cell often divides once into outer *primary parietal or wall cell* and inner *primary sporogenous cell*. Primary parietal cell may divide one or more times. The primary sporogenous cell commonly functions directly as diploid *megaspore mother cell* or *megasporocyte*. The *megaspore mother cell* (MMC) undergoes meiosis and forms a linear tetrad of four haploid *megaspores*. The process of meiotic formation of haploid megaspores from diploid megaspore mother cell is called *megasporogenesis*. Commonly the chalazal megaspore remains functional while the other three degenerate.

The functional megaspore is the first cell of female gametophyte. The cell enlarges and undergoes three successive nuclear mitotic divisions to form an eight nucleate female gametophyte or embryo sac. Out of the eight nuclei, three get organized at the micropylar end as egg apparatus, three at the chalazal end as antipodals, and two at the centre as polar nuclei (n+n). The egg apparatus consists of two synergids and an egg cell (n). This seven celled and eight nucleate structure formed from functional megaspore is called *embryo sac* or *female gametophyte*. The synergids have specialized cellular thickening at the micropylar tip called as filiform apparatus. It plays an important role in guiding the pollen tube into synergids.
Q.11. Bring out five important characteristic features of insect pollinating flowers (Entomophilous flowers).
Ans:- Characteristics of Entomophilous Flowers:
i) They are brightly coloured.

ii) The small flowers become conspicuous by their grouping, e.g. head in Sunflower.
iii) The flowers produce an *odour* which may be pleasant (e.g. *Jasmine*) or foul (e.g. *Aristolochia, Arum, Rafflesia*). Foul smell attracts flies and beetles. Odour of *Rafflesia* attracts Carrion flies.
iv) Nectar is secreted for feeding the visiting insects. Nectar glands are placed in such a position that an insect must touch both the anthers and the stigmas.
v) Stigma is inserted and sticky.

Q.12. Describe 5 characteristic features of anemophilous flowers.
Ans:- Characteristics of Anemophilous Flowers are:
i) Flowers are small and inconspicuous.
ii) The flowers are colourless, odourless and nectarless.
iii) Non-essential parts are either absent or reduced.
iv) A large number of pollen grains are produced, e.g. *Cannabis* produces 5,00,000 pollen grains.
v) Pollen grains are light, small and winged or dusty.

Q.13. Giving five points, differentiate Anemophilous Flowers from Entomophilous Flowers.
Ans:- Differences between Anemophilous Flowers from Entomophilous Flowers are:

Anemophilous Flowers	Entomophilous Flowers
1. They are small.	1. The flowers are either large or if small they are grouped to form a large mass.
2. The flowers are inconspicuous due to the absence of bright colours.	2. The flowers are conspicuous from a distance.
3. They are odourless.	3. Odour is commonly present.
4. The flowers are devoid of nectar and edible pollen.	4. The flowers usually possess nectar or edible pollen.
5. Pollen grains are produced in very large number.	5. They are fewer.

Q.14. Explain five strategies evolved by flowers of angiosperms to prevent self pollination (autogamy).
Or, Explain five Outbreeding Devices or Contrivances to Ensure Cross Pollination.
Ans:- Outbreeding Devices or Contrivances to Ensure Cross Pollination are given below:
1. Dicliny (Unisexuality): Flowers are unisexual so that self pollination is not possible. The plants may be monoecious (bearing both male and female flowers, e.g. Maize) or dioecious (bearing male and female flowers on different plants, e.g. Mulberry, Papaya).
2. Dichogamy: In this condition, Anthers and stigmas mature at different times in a bisexual flower so as to prevent self pollination. It may occur by two methods:
a) Protandry: In this, Anthers mature earlier than stigma of the same flowers, e.g. Sunflower, *Salvia*.
b) Protogyny: In this, Stigmas mature earlier so that they get pollinated before the anthers of the same flower develop pollen grains.
3. Herkogamy: It is the presence of natural and physical barrier between androecium and gynoecium and thus self pollination is prevented. e.g. in *Calotropis*, gynoecium is fused with pollinium (anthers) and form gynostegium.
4. Prepotency: Pollen grains of another flower germinate more rapidly over the stigma than the pollen grains of the same flower, thus it promotes cross pollination. e.g. Apple, Grape.
5. Self Sterility (Self Incompatibility): Pollen grains of a flower do not germinate on the stigma of the same flower due to presence of similar self sterility gene. e.g. Tobacco, Potato, Crucifers.

Q.15. How does dicot embryo differ from monocot embryo? Give 5 points.
Ans:- Difference between dicot embryo and monocot embryo:

Dicot Embryo	Monocot Embryo
1. Basal cell forms a 6 – 10 celled suspensor.	1. Basal cell produces a single celled suspensor.
2. Terminal cell produces embryo except the radicle.	2. It forms the whole of the embryo.
3. The first division of terminal cell is generally longitudinal.	3. It is transverse.
4. It has two cotyledons.	4. There is a single cotyledon.
5. Plumule is terminal and lies in between the two elongated cotyledons.	5. Plumule appears lateral due to excessive growth of the single cotyledon.

Q.16. Give 5 differences between Integument and Testa.
Ans:- Difference between Integument and Testa.

Integument	Testa
1. It is the covering of the ovule.	1. It is outer covering of seed.
2. It is thin, one or two layered.	2. It is quite thick and one layered.
3. Its cells are living.	3. Its cells are dead.
4. It arises from the chalazal end of ovule.	4. It is derived from outer integument of ovule after fertilization.
5. It is a prefertilized structure.	5. It is post fertilized structure.

Q.17. Tabulate perisperm from pericarp by giving 5 points.

Ans:- Difference between Perisperm and Pericarp:

Perisperm	Pericarp
1. It is unused nucellus in the seed.	1. It is the cover of fruit that develops from ovary wall.
2. It is a part of seed.	2. It is a part of a fruit.
3. It is usually dry.	3. It is dry or fleshy.
4. It is often nonfunctional for seed.	4. It is protective covering and also helps in dispersal and nutrition.
5. Perisperm is present in only a few seeds.	5. It is found in all fruits.

Q.18. Write the advantages of bearing seeds in flowering plants.
Ans:- Advantages of bearing seeds bearing seeds:
i) Reproduction events such as pollination and fertilization are independent of water but seeds formation is more dependable.
ii) Seeds have better adaptive strategies for the dispersal to new habitats.
iii) Seeds are the product of sexual reproduction. Hence, they generate new genetic combinations leading to variations.
iv).The hard and tough seed coat provides protection to the young embryo.
v). Dormant and dehydrated seeds can be stored for a long period of time. Such seeds germinate when exposed to favourable conditions, thus forming a basis for agriculture.

HUMAN REPRODUCTION

VERY SHORT ANSWER TYPE QUESTIONS:

Q.1. Where does fertilization normally take place in human female?
Ans:- In Fallopian tube (Oviduct).
Q.2. What is Corpus luteum?
Ans:- Corpus luteum is a mass of large and yellowish conical cells, formed after ovulation by the granulose cells of the Graafian follicle in the ovary.
Q.3. Why does failure of testes to descend into the scrotum produce sterility?
Ans:- Sterility results because spermatogenesis requires a temperature lower (by 2 – 2.5^{0}C) than the internal body temperature, which is provided by scrotum.
Q.4.Which structure of female external genitalia is homologous to glans penis of the male?
Ans:- Clitoris
Q.5. How many sperms will be produced from 100 primary spermatocytes and how many eggs will be produced from 100 primary oocytes?
Ans:- 400 spermatozoa and 100 eggs.
Q.6. "Spermatids possess haploid number of chromosomes". Explain.
Ans:- Spermatids are formed as a result of meiosis, hence they possess haploid number of chromosomes.
Q.7.Name the layer of cells forming the outer wall of the blastocyst.
Ans:- Trophoblast.
Q.8. Which part of the blastula is destined to form the germ layers of the developing embryo in human?
Ans:- Inner cell mass.
Q.9. At what stage is the mammalian embryo implanted in the uterus?
Ans:- Blastocyst.
Q.10. What is the fate of the trophoblast in a mammalian embryo?
Ans:- The trophoblast layer gets attached to the endometrium (it forms the foetal part of the placenta).
Q.11. What is corona radiata?
Ans:- Corona radiata is an investment of radially elongated follicle cells, outside the zona pellucida of an ovum.
Q.12. What do you mean by morphogenetic movements?
Ans:- The movements of undifferentiated cells of embryo during gastrulation in small masses to attain new shape and morphology of the embryo are called morphogenetic movements.
Q.13. From which cell organelle is the acrosome of sperm formed?
Ans:- Golgi complex.
Q.14. What is capacitation of sperms?
Ans:- Capacitation is the phenomenon of sperm activation by which the sperms develop the ability fertilize ova.
Q.15. Where does capacitation of sperms develop?
Ans:- Capacitation develops in the female genital tract.
Q.16. Give the term for the appearance of the first menstrual flow in the life of a girl?
Ans:- Menarche.
Q.17. Name the hormone responsible for the vigorous contractions of the uterine muscles.
Ans:- Oxytocin
Q.18. Define foetal ejection reflex.

Ans:- Foetal ejection reflex refers to the initial mild contraction of the uterus initiated from the fully formed foetus and the placenta.
Q.19. What is pregnancy hormone? Why is it so called? Name the sources of this hormone in a human female.
Ans:- Progesterone is the pregnancy hormone. Because it is required for continually during the entire period of gestation; it prepares the uterus for implantation and helps in the formation of placenta. It is secreted by placenta and corpus luteum.
Q.20. Where are Leydig's cells located? What is their role in spermatogenesis?
Ans:- Leydig's cells are located in between the seminiferous tubules of testes. They secrete testosterone hormone which stimulates formation of sperms (spermatogenesis) in the seminiferous tubules.
Q.21. Name the two types of cells present in inner lining of seminiferous tubules. What are their functions?
Ans:- Seminiferous tubules contain two types of cells:
i) Male germ cells which produce sperms. ii) Sertoli cells, which nourish the sperms.
Q.22. What is the number of the chromosomes in the following cells of a human male?
i) Spermatogonial cells, ii) Spermatids, iii) Primary spermatocytes and iv) Sertoli cells.
Ans:- Number of chromosomes in -
i) Spermatogonial cells = 46,
ii) Spermatids = 23,
iii) Primary spermatocytes = 46 and
iv) Sertoli cells = 46.
Q.23. What is the number of the chromosomes in the following cells of a human female?
i) Primary oocyte ii) ootid iii) secondary oocyte iv) follicle cells.
Ans:- Number of chromosomes in
i) Primary oocyte = 46,
ii) ootid = 23
iii) secondary oocyte = 23
iv) follicle cells = 46
Q.24. What is the main content of acrosome? What is its function?
Ans:- Acrosome contains sperm lysins. They help in dissolving the egg envelopes to make way for the sperm to reach the ovum to fertilize it.
Q.25. What will happen if the fallopian tubes are partially blocked and the ovulated eggs are prevented from reaching the uterus?
Ans:- Fertilization may take place but the zygote may develop in the tube instead of uterus.
Q.26. What is follicular atresia?
Ans:- The process of degeneration of follicles in the ovaries is called follicular atresia.
Q.27. Name the hormone present in urine that is secreted by the placenta and is used in the pregnancy test.
Ans:- HCG (Human Chorionic Gonadotropin).
Q.28. What is the other name of the trophoblast cells lying over the embryonic disc?
Ans:- Cells of Rauber.
Q.29. What name is given to the cells of inner cell mass, that has the potential to give rise to all tissue and organs in a human being?
Ans:- Stem cells /Embryonal Knob.
Q.30. How many autosomes are present in a human sperm?
Ans:- 22 autosomes.
Q.31. What is epididymis?
Ans:- Epididymis is a mass of long narrow closely coiled tubule which lies along the inner side of testis.
Q.32. Where are sperms stored in human male?
Ans:- Sperms are stored in epididymis.
Q.33. Why is cleavage in a mammalian zygote referred to as holoblastic?
Ans:- The cleavage is referred to as holoblastic because it cuts the zygote completely into two halves, as there is no interference by yolk.
Q.34. When does a woman attain puberty?
Ans:- A woman attains puberty between 10 to 14 years.
Q.35. Give one point of difference between Menarche and Menopuase.
Q.36. Which cells provide nourishment to the developing male germs cells?
Ans:- Sertoli cells.
Q.37. What is parturition? Which hormones are involved in induction of parturition?
Ans:- Expulsion of the foetus at the end of pregnancy is called parturition. The hormones involved in the induction of parturition are oxytocin and relaxin.
Q.38. What are stem cells in human embryo?

Ans:- Those cells in the inner cell mass of blastocyst which have the potency to give rise to all tissues and organs are called stem cells.
Q.39. Why is there no menstrual cycle during pregnancy?
Ans:- During pregnancy, progesterone level in blood is high which inhibits the secretion of FSH and LH from anterior pituitary gland and thus prevents maturation of follicle and ovulation. So there is no menstruation during pregnancy.
Q.40. Suppose the acrosome of mammalian spermatozoa does not function normally, how would it affect fertilization? Give reasons.
Ans:- There would be no fertilization. Because acrosome releases hydrolytic enzymes which help in entry of sperm into ovum.
Q.41. Which hormone in females stimulates the production of milk during lactation?
Ans:- Prolactin secreted by anterior lobe of the pituitary gland.
Q.42.i) Name the mitotic division occurring in zygote to form 2,4,6,……cells.
ii) Name the cells formed as a result mitotic division. Also mention ploidy of the cells.
iii) Write range of cells found in morula stage.
iv) Name the stage at which implantation takes place. Which part of this stage actually develops into an embryo?
Ans:- i) Cleavage
ii) Blastomeres, Diploid.
iii) 8 to 16 cells, occasionally 32 cells.
iv) Blastocyst. Inner cell mass develops into embryo proper.
Q.43. It is observed that male gametes are produced in large number in comparison to female gametes in mammals. Why?
Ans:- Fertilization is internal (in the body of female), so ovum is secure while sperms are motile and many sperms are killed in the reproductive tract of female. So they are to be produced in large number to ensure fertilization.
Q.44. Sometimes the doctor injects some medicines into the body of women to induce uterine contraction and delivery. What do you think the doctor has injected?
Ans:- Synthetic Oxytocin is injected into the women to induce uterine contraction and delivery.
Q.45. "Cleavage is fractionating process." Justify.
Ans:- During cleavage, there is no growth during interphase period. So the size of blastomeres becomes smaller and smaller. So the cleavage is called fractionating process.
Q.46. In which phase of menstrual cycle does fertilization takes place?
Ans: - Secretory phase (Luteal Phase).
Q.47. What is spermiation?
Ans:- The process of release of sperms from the seminiferous tubules, after their heads become embedded in the sertoli cells, is called spermiation.
Q.48. What name is given to human placenta?
Ans:- Chorionic placenta.
Q.49. Corpus luteum in pregnancy has a long life. However, if fertilization does not take place, it remains active only for 10-12 days. Explain.
Ans:- During pregnancy, placenta secretes HCG (human chorionic gonadotropin) whose function is to stimulate corpus luteum to secrete progesterone. But if fertilization does not take place, no placenta will be formed, and hence corpus luteum degenerates.
Q.50. What is the signal that triggers parturition in humans?
Ans:- Foetal ejection reflex.
Q.51. Mention the fate of trophoblast after implantation of the blastocyst.
Ans:- After implantation, trophoblasts develop into extra-embryonic membranes.
Q.52. Where and at what stage does implantation take place?
Ans:- Implantation takes place at Blastocyst stage in the uterine endometrial wall.
Q.53. What harm is caused if the testes fail to descend into the scrotal sac?
Ans:- Scrotal sac maintains testicular temperature $2 - 2.5^0$ C lower than internal body temperature, which is optimum temperature for normal spermatogenesis. Thus, if the testes fail to descend into the scrotal sac, testicular temperature will be high and hence no spermatogenesis takes place.
Q.54. 'Failure of testes to descend into scrotum produces sterility'. Why?
Q.55. Define puberty.
Ans:- Puberty is a period when reproductive organs start functioning.
Q.56. What is ovulation?
Ans:- The process of release of ovum (at secondary oocyte stage) from the ovary by rupturing the wall of ovary is called *Ovulation*.

SHORT ANSWER TYPE QUESTIONS: 2 Marks Each

Q.1. Write two functions of fallopian tube.

Ans:- Functions of fallopian tubes:
i) Conduction of ovum or zygote towards the uterus.
ii) Site of fertilization.

Q.2. What is fertilization membrane? How does it prevent polyspermy?
Or, How does the ovum ensure that only one sperm fertilizes it?
Or, An ovum allows the entry of only one sperm at a time. Why?

Ans:- Just after the sperm entry, cortical granules are extruded beneath the plasma membrane of secondary oocyte and thickens. It is now called *fertilization membrane*. Fertilization membrane does not allow entry second sperm. Thus it prevents polyspermy.

Q.3. The first half of the menstrual cycle is called the proliferative phase as well as the follicular phase. Explain.

Ans:- The first half of menstrual cycle is called follicular phase because during this phase, primary follicles or ovarian follicles are transformed into mature Graafian follicle under the stimulation of FSH of anterior pituitary gland. Follicular cells of Graafian follicle secrete estrogens that control the changes in the secondary sex organs. It is also called proliferative phase because growth and proliferation of tissue on the wall of uterus, vagina take place under the stimulation of estrogens.

Q.4. Failure of fertilization leads to menstruation. Explain.

Ans:- If there is no fertilization, corpus luteum will be degenerated, as a result of which secretion of progesterone will be markly reduced. This results in the breakdown of uterine endometrium. The unfertilized ovum along with ruptured epithelium, blood and some mucus is discharged through vaginal orifice. Thus, failure of fertilization leads to menstruation.

Q.5. The second half of the menstrual cycle is called the luteal phase as well as the secretory phase. Explain.

Ans:- The second half of menstrual cycle is called secretory phase as well as luteal phase because during this phase secretion occurs due to the luteinizing hormone, LH which stimulates ovulation. LH causes formation of Corpus luteum from Graafian follicle. And during this phase, Corpus luteum secretes a significant amount of progesterone and small amount of estrogens.

Q.6. Write two functions of human placenta.

Ans:- Functions of placenta:
i). Nutrition: All the nutrient elements from the maternal blood pass into the foetus through placenta.
ii). Respiration: Placenta helps in the exchange of respiratory gases (O_2 from mother and CO_2 from foetus) between foetus and mother.

Q.7. "Primary sex organs control the growth, function and maintenance of secondary sex organs." Justify the statement by giving two suitable reasons.

Ans:- Primary sex organs control the growth, function and maintenance of secondary sex organs.
i) Primary sex organs secrete sex hormones that control the growth of secondary sex organs.
e.g. Ovaries secrete Estrogens that controls the growth of secondary sex organs like uterus, fallopian tubes, vaginal canals, mammary glands (breasts), etc.
ii) Hormones of Primary sex organs regulate the function of secondary sex organs.
e.g. Hormone testosterone secreted by testes regulate the function of secondary sex organs like vasa deferens, secretion of prostate gland, cowper's glands and seminal vesicles, etc.

Q.8. What are the major functions of male accessory ducts and glands?

Ans:- The male accessory ducts are vasa efferentia, epididymis, vas deferens, and rete testis. They play an important role in the transport and temporary storage of sperms. On the contrary, male accessory glands are seminal vesicles, prostate glands, and bulbourethral glands. These glands secrete fluids that lubricate the reproductive system and sperms. The sperms get dispersed in the fluid which makes their transportation into the female body easier. The fluid is rich in fructose, ascorbic acid, and certain enzymes. They also provide nutrients and activate the sperm.

Q.9. Define spermiogenesis and spermiation.

Ans:-Spermiogenesis: It is the process of transforming spermatids into matured spermatozoa or sperms.
Spermiation: It is the process when mature spermatozoa are released from the sertoli cells into the lumen of seminiferous tubules.

Q.10. What are the major components of seminal plasma?

Ans:- Semen (produced in males) is composed of sperms and seminal plasma. The major components of the seminal plasma in the male reproductive system are mucus, spermatozoa, and various secretions of accessory glands. The seminal plasma is rich in fructose, calcium, ascorbic acid, and certain enzymes. It provides nourishment and protection to sperms.

Q.11. Describe the structure of a seminiferous tubule.

Ans:- The production of sperms in the testes takes place in a highly coiled structure called the seminiferous tubules. These tubules are located in the testicular lobules. Each seminiferous tubule is lined by germinal epithelium. It is lined on its inner side by two types of cells namely spermatogonia and sertoli cells respectively. Spermatogonia are male germ cells which produce primary spermatocytes by meiotic divisions. Primary spermatocytes undergo further meiotic division to form secondary spermatocytes and finally, spermatids. Spermatids later metamorphoses into male gametes called spermatozoa. Sertoli cells are known as nurse cells of the testes as they provide nourishment to the germ cells. There are large polygonal cells known as interstitial cells or Leydig's cells just adjacent to seminiferous tubules. These cells secrete the male hormone called testosterone.

Q.12.What is pregnancy hormone? Why is it so called? Name two sources of this hormone in a human female.

Ans:- Pregnancy hormone is progesterone. It is so called because it maintains pregnancy. Two sources are – corpus luteum of ovaries and placenta.

Q.13. Where are the Leydig's cells present? What is their role in reproduction?

Ans:- Leydig's cells are present in the connective tissues in between the seminiferous tubules. They secrete testosterone, male sex hormone which controls the development of secondary sexual characters of male and partly controls spermatogenesis.

Q.14. Placenta acts as an endocrine gland. Why is it said so? What are its other functions?

Ans:- Placenta acts as an endocrine gland because it secretes a number of hormones. The placenta facilitates the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory/waste materials produced by the embryo.

Q.15. In which parts of the human reproductive system do the following events take place?
I – Release of 1st polar body
II – Release of second polar body.
III – Fertilization
IV. Implantation.

Ans:- I – Ovary during growth of tertiary follicle.
II – In fallopian tube after the entry of sperm.
III – In fallopian tube in the area of *ampulla – isthmus* junction.
IV – Uterus.

Q.16. Placenta acts as an endocrine tissue. Justify.

Ans:- Placenta secretes a number of hormones such as oestrogens, progesterone, human chorionic gonadotropin (HCG), human chorionic somatomammotropin (HCS), chorionic corticotrophin, chorionic thyrotropin and relaxin. Hence, it acts as an endocrine tissue.

Q.17. Differentiate between menarche and menopause.

Ans:- Difference between menarche and menopause:

Menarche	Menopause
1. It refers to beginning of menstruation at puberty in primate/human females. 2. In human being, menstruation begins at about 13 years of age. 3. It marks the beginning of reproductive phase.	1. It refers to stoppage of menstruation and menstrual cycle. 2. It occurs between the age of 45 – 55 years. 3. It marks the end of reproductive phase.

Q.18. Different between major structural changes in the human ovary during the follicular and luteal phase of the menstrual cycle.

Ans:-

Follicular phase	Luteal phase
1. During this phase, a primary follicle changes into a Graafian follicle. 2. Follicle cells secrete estrogens.	1. During this phase, the empty Graafian follicle changes into a corpus luteum. 2. Corpus luteum secretes a significant amount of progesterone and a small amount of estrogens.

Q.19. How is placenta formed in human female?

Ans:- After implantation, finger-like projections appear on the trophoblast called Chorionic villi which are surrounded by uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal body called placenta.

Q.20. Name the hormones involved in regulation of spermatogenesis.

Ans:- GnRH or Gonadotropin releasing hormone is produced by the hypothalamus. It stimulates the anterior lobe of pituitary to produce two gonadotropins, FSH (Follicle stimulating Hormone) and LH (Luteinising Hormone) or ICSH. ICSH acts on Leydig's cells for secreting testosterone and other androgens. Testosterone is required for spermatogenesis. Testosterone and FSH help in differentiation and functioning of sertoli cells. Testosterone is under negative feed-back. Sertoli cells produce inhibin that suppresses FSH synthesis by anterior pituitary and GnRH synthesis by hypothalamus.

Q.21. Write two important functions of testes.

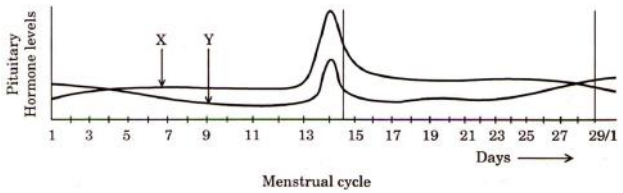
Ans:- Functions of Testes:
i) Production of sperms.
ii) Secretion of male sex hormones.

Q.22. What is colostrum? Why is it important to be given to the new born infants?
Ans:- The first milk which comes from mammary glands of the mother just after child birth, 2 or 3 days is called the *colostrum*. The yellowish fluid contains cells from the alveoli and rich in protein (lactalbumin and lactoprotein) but low in fat. Colostrum contains antibodies (Ig A) which are essential to develop resistance for new born babies, so in initial period of infant growth, doctors recommend breast feeding.
Q.23. Describe the functions of endometrium and myometrium of uterine wall.
Ans:- The endometrium undergoes cyclic changes during menstrual cycle and implantation occure on this membrane while *myometrium* shows strong contraction during delivery of the baby.
Q.24. Write two major functions each of testis and ovary.
Ans:- Functions of the Testis:
(a) They produce male gametes called spermatozoa by the process of spermatogenesis.
(b) The Leydig's cells of the seminiferous tubules secrete the male sex hormone called testosterone. Testosterone aids the development of secondary sex characteristics in males.
Functions of the ovary:
(a) They produce female gametes called ova by the process of oogenesis.
(b) The growing Graafian follicles secrete the female sex hormone called oestrogen. Oestrogen aids the development of secondary sex characteristics in females.

SHORT ANSWER TYPE QUESTIONS: 3 Marks Each
Q.1. "Fertilization is a physico-chemical process". Explain.
Ans:- PHYSICO – CHEMICAL PROCESS OF FERTILIZATION
In contact with the surface of egg covering, the acrosome releases its contained hydrolytic enzymes called sperm lysins and dissolves the membranes around egg. Head of sperm containing nucleus and proximal centriole physically passes into ovum. Normally, these reactions result in the formation of fertilization membrane beneath the plasma membrane. Sperm entry stimulates the secondary oocyte to meiosis-II. The male and female pronuclei move towards each other and mixing up of chromosomes of sperm and ovum takes place. The fertilized ovum is now called Zygote.
Q.2. Differentiate between spermatogenesis and spermiogenesis by giving three points. 3 (CoHSEM-2007)
Ans:-

Spermatogenesis	Spermiogenesis
1. It is the process of formation of spermatozoa from germinal cells.	1. It is the process of differentiation of spermatozoan from a spermatid.
2. It involves conversion of a diploid structure into haploid structures.	2. It changes a haploid structure into another haploid structure.
3. There is growth and divisions during spermatogenesis.	3. There is reconstruction during spermiogenesis. Division and growth are absent.

Q.3. Explain why is there no menstrual cycle before puberty, after menopause and during pregnancy.
Ans:- There is no menstrual cycle before puberty and after menopause, because pituitary hormones like FSH and LH, and ovarian hormones like estrogens and progesterone are not secreted.
During pregnancy, progesterone level in blood is high, which inhibits the secretion of FSH and LH from anterior pituitary. Thus there is no formation of mature follicle. Hence, menstrual cycle is absent during pregnancy.
Q.4. Explain the development of an ovum from an oogonium in a human female.
Ans:- One oogonium grows in size by taking food from surrounding follicle cells, after puberty and functions as primary oocyte.
In this, the diploid primary oocyte undergoes meiosis I (reductional division) to form two unequal haploid daughter cells – a large *secondary oocyte* and a very small *first polar body* or polocyte.
The secondary oocyte again undergoes meiosis II (equational division) to form a large *ootid* and a very small second polar body. The ootid grows into a functional ovum. Meanwhile, the first polar body may divide into two.
So in oogenesis, a diploid oogonium forms one ovum and 2 or 3 polar bodies.
Q.5. In our society the women are often blamed for giving birth to daughters. Can you explain why this is not correct?
Ans:- Sex chromosome pattern in female is XX, i.e. all gametes have X chromosome. While in males, it is XY, i.e. some gametes have X and some have Y chromosome. So 50% sperms carry X and 50% carry Y chromosome. As females always contribute similar ova having X chromosome but female child is produced if sperm containing X-chromosome of male fertilizes the ovum and male child if sperm containing Y-chromosome of male fertilizes it. So sex of baby depends on father not on mother.
Q.6. Study the graph given below and answer the questions that follow:



Menstrual cycle

a) Name the hormones 'X' and 'Y'.
b) Identify the ovarian phases during a menstrual cycle
   i) 5th day to 12th day of the cycle
   ii) 14th day of the cycle
   iii) 16th day to 25th of the cycle.
c) Explain the ovarian events i), ii) and iii) under the influence of hormones 'X' and 'Y'.

Ans:- a) The hormones X = LH and Y = FSH.
b)
i) 5th day to 12th day of the cycle = Proliferative Phase.
ii) 14th day of the cycle = Ovulatory phase.
iii) 16th day to 25th of the cycle = Secretory Phase.
c)
i) During this phase, there is increase in secretion of FSH from anterior pituitary. FSH stimulates the change of a primary follicle into a Graafian follicle. Follicular cells of Graafian follicle secrete estrogen.
ii) Sudden rise in LH induces rupturing of Graafian follicle and thereby the release of ovum (secondary oocyte).
iii) Under the influence of LH the empty Graafian follicle develops into *Corpus Luteum*. The *Corpus Luteum* secretes large amount of progesterone and small quantity of estrogen. Progesterone further proliferates or thickens the endometrium and is ready for implantation.

Q.7. Describe the three layers of uterus wall.
Ans:- Wall of uterus is formed of –
i) Myometrium: is the Outer peritoneal layer,
ii) Myometrium: is the middle layer of smooth muscles, which shows strong contraction during delivery of the baby and
iii) Endometrium: is the inner highly vascular and glandular mucosa.

Q.8. Describe the hormonal control of menstrual cycle.
Ans:- Hormonal control of menstrual cycle are given below:
i). Menstrual phase is caused by the reduction of progesterone and estrogens.
ii) Proliferative phase is caused by the increased production of oestrogens.
iii) LH causes ovulation.
iv) Secretory phase is caused by increased production of progesterone.
Q.9. Write 3 functions of sertoli cells.
Ans:- Functions of Sertoli Cells or sustencular cells:
a) Sertoli cells secrete *androgen binding protein* (ABP) that concentrates testosterone in the seminiferous tubules.
b) Sertoli cells also secrete another protein called *inhibin* which suppresses FSH synthesis.
c) Sertoli cells provide nutrition to the developing sperms.
Q. 10. Write 3 characteristic changes occured during puberty in human male?
Ans:- Characters at Puberty:
   a) The seminiferous tubules start producing sperms.
   b) The development and maturation of secondary sex organs (prostate, scrotum, penis).
   c) The development of secondary sexual characters like growth of hair on face, chest, pubic and axillae; broadening of shoulders; deepening of voice due to enlargement of voice box etc.
Q.11. Describe three functions of human male reproductive system.
Ans:- Functions of Male Reproductive System:
i). Spermatogenesis: The germinal epithelial cells of seminiferous tubules produce sperms.
ii). Male Sex Hormones: Leydig's cells (interstitial cells) produce male sex hormones (e.g. testosterone).
iii). Transfer of Sperms: Copulatory organ (e.g. *penis*) transfers sperms into vagina of the female during copulation.
Q. 12. 'Presence of ovaries is essential for onset of puberty in human female'. Justify.
Ans:- Ovaries secrete estrogens and progesterone. Oestrogen stimulates growth, maintenance and normal functioning of secondary sex organs. Progesterone further stimulates growth of secondary sexual characters. If

these hormones are absent, secondary sexual characters will not be developed. Therefore, presence of ovary is essential for the onset of puberty.

Q.13. Discuss the significance of oogenesis.

Ans:- Significance of Oogenesis:

i) One oogonium produces one ovum and three polar bodies.

ii) During meiosis I crossing over takes place which brings about variation.

iii) Polar bodies have small amount of cytoplasm. It helps to retain sufficient amount of cytoplasm in the ovum which is essential for the development of early embryo. Formation of polar bodies maintains half number of chromosome in the ovum.

Q.14. Give three similarities between spermatogenesis and oogenesis.

Ans:- Similarities in Spermatogenesis and Oogenesis:

i) Both processes consist of three main phases, *viz.,* multiplication, growth and maturation phases.

ii) In multiplication phase, the primordial germ cells of testes and ovaries proliferate mitotically, forming numerous gametogonia (spermatogonia/oogonia) in both processes.

iii) In growth phase, the cells accumulate food reserves and grow to primary gametocytes (spermatocytes/oocytes) in both processes.

ESSAY TYPE QUESTIONS: 5 Marks Each

Q.1. How do vasa efferentia differ from vasa deferentia? Give atleast 5 points.

Ans:- Difference between Vasa efferentia and vasa deferentia:

Vasa Efferentia	Vasa deferentia
1. They arise from the rete testis.	1. They arise from the cauda epididymis.
2. They vary from 15 to 20 in number.	2. They are only 2 in number.
3. Vasa efferentia are fine.	3. Vasa deferentia are thick.
4. Their lining bears many cilia.	4. Their lining has many stereocilia.
5. It carries spermatozoa from rete testis to the epididymis.	5. It carries spermatozoa from cauda epididymis to the ejaculatory duct.

Q.2. A woman has conceived and implantation has occurred in her uterus. Explain the sequence of changes upto parturition which takes place within her body?

Ans:- The sequence of changes upto parturition which takes place within her body -

i) The human pregnancy lasts 9 months. In human beings, after one month of pregnancy, the embryo's heart is formed.

ii) The first sign of growing foetus may be noticed by listening to the heart sound carefully through the stethoscope.

iii) By the end of the second month of pregnancy, the foetus develops limbs and digits.

iv) By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well-developed.

v) The first movements of the foetus and appearance of hair on the head are usually observed during the fifth month. By the end of 24 weeks (second trimester), the body is covered with fine hair, eye-lids separate, and eyelashes are formed. By the end of nine months of pregnancy, the foetus is fully developed and is ready for delivery.

Q.3. What is menstrual cycle? Explain phases of menstrual cycle.

Ans:- During reproductive period, ovaries and female reproductive tract undergo a series of cyclic changes which are primarily meant for fertilization and pregnancy. This cycle is called *menstrual cycle*. It consists of following phases:

i). Menstrual Phase: The cycle starts with the menstrual phase, when menstrual flow occurs and it lasts for 3-5 days. The menstrual flow results due to breakdown of endometrial lining of the uterus and its blood vessels which forms liquid that comes out through vagina. Menstruation only occurs if the released ovum is not fertilised. Lack of menstruation may be indicative of pregnancy.

ii). Follicular Phase (Proliferative Phase) : The menstrual phase is followed by the follicular phase. During this phase, the primary follicles in the ovary grow to become a fully mature Graafian follicle and simultaneously the endometrium of uterus regenerates through proliferation. These changes in the ovary and the uterus are induced by changes in the levels of pituitary and ovarian hormones. The secretion of gonadotropins (LH and FSH) increases gradually during the follicular phase, and stimulates follicular development as well as secretion of estrogens by the growing follicles.

iii). Ovulatory Phase: Both LH and FSH attain a peak level in the middle of cycle (about 14th day). Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (**ovulation**).

iv). Luteal Phase (Secretory Phase) : The ovulation (ovulatory phase) is followed by the luteal phase during which the remaining parts of the Graafian follicle transform as the **corpus luteum**. The corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium. Such an endometrium is necessary

for implantation of the fertilised ovum and other events of pregnancy. During pregnancy all events of the menstrual cycle stop and there is no menstruation. In the absence of fertilisation, the corpus luteum degenerates which results into sudden decline of progesterone level in blood. This causes disintegration of the endometrium leading to menstruation, marking a new cycle.

Q.4. Give five differences between Primary sex organs and secondary sex organs.

Ans:- Differences between Primary sex organs and secondary sex organs are

Primary Sex Organs	Secondary Sex Organs
1. They are represented by gonads. 2. The sex organs produce gametes. 3. Primary sex organs have no role in conduction of gametes. 4. They produce sex hormones. 5. Function of primary sex organs is controlled by hormones of anterior pituitary gland.	1. They are represented by sex organs, ducts and glands other than gonads. 2. They do not form gametes. 3. Secondary sex organs are connected with conduction of gametes. 4. Hormone secretion is absent. 5. Function of secondary sex organs is controlled by gonads.

Q.5. Elaborate any five functions of Human female reproductive system. 5 (CoHSEM-2014)

Ans:-

1. Functions of Ovaries:
   i) To Produce ova and sex hormones.
2. Functions of Fallopian tubes:
   ii) Conduction of Ovum or Zygote towards the uterus by peristalsis and ciliary action.
   iii) It is also the site of fertilization (*ampulla – isthmus* junction).
3. Functions of Uterus:
   iv) It is the site of implantation and foetal growth during pregnancy.
   v) It also takes part in the placenta formation and expelling of the baby during parturition.

Q.6. State the functions of the following.

(a) Corpus luteum
(b) Endometrium
(c) Acrosome
(d) Sperm tail
(e) Fimbriae

Ans:-

(a) Corpus luteum – Corpus luteum is formed from the ruptured Graafian follicle. It secretes progesterone hormone during the luteal phase of the menstrual cycle. A high level of progesterone inhibits the secretions of FSH and LH, thereby preventing ovulation. It also allows the endometrium of the uterus to proliferate and to prepare itself for implantation.

(b) Endometrium – It is the innermost lining of the uterus. It is rich in glands and undergoes cyclic changes during various phases of the menstrual cycle to prepare itself for the implantation of the embryo.

(c) Acrosome – It is a cap-like structure present in the anterior part of the head of the sperm. It contains hyaluronidase enzyme, which hydrolyses the outer membrane of the egg, thereby helping the sperm to penetrate the egg at the time of fertilization.

(d) Sperm tail – It is the longest region of the sperm that facilitates the movement of the sperm inside the female reproductive tract.

(e) Fimbriae – They are finger-like projections at the ovarian end of the fallopian tube. They help in the collection of the ovum (after ovulation), which is facilitated by the beating of the cilia.

Q.7.

Q.8. Differentiate Graafian follicle from Corpus luteum by giving five points.

Ans:- Difference between Graafian follicle and Corpus luteum:

Graafian Follicle	Corpus Luteum
1. The follicle contains an ovum.	1. An ovum is lacking.
2. It has a cavity or antrum.	2. It contains a central blood clot.
3. The follicle secretes estrogen.	3. It secretes progesterone with little estrogen.
4. It grows under the influence of FSH.	4. It grows under the influence of LH.
5. It is formed during proliferative phase.	5. It is formed during secretory phase.

Q.9. Describe the post-zygotic events leading to implantation and placenta formation in humans. Mention any two functions of placenta. 4+1=5 (CBSE-2010)

Ans:- The mitotic division starts as the zygote moves through the isthmus of the oviduct called cleavage towards the uterus and forms 2, 4, 8, 16 daughter cells called blastomeres. The embryo with 8 to 16 blastomeres is called a morula. The morula continues to divide and transforms into blastocyst as it moves further into the uterus. The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called the inner cell mass. The trophoblast layer then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo. After attachment, the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This is called implantation and it leads to pregnancy. After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal body called placenta.

Functions of Placenta:

i). Nutrition: All the nutrient elements from the maternal blood pass into the foetus through placenta.

ii). Respiration: Placenta helps in the exchange of respiratory gases (O_2 from mother and CO_2 from foetus) between foetus and mother.

Q.10. (a) Draw a diagrammatic labelled sectional view of seminiferous tubule of a human.
(b) Describe in sequence the process of spermatogenesis in humans.

Q.11. Give five significants of fertilization.

Ans:- Significance of Fertilization:

i). It provides the stimulus for completion of meiosis II.

ii). The diploid number of chromosome number is restored.

iii). It determines the sex of the baby, depending upon the chromosome complement of the fusing sperm.

iv). It combines the characters of two parents.

v). Fertilization membrane developed after the entry of sperm prevents the entry of other sperms into the ovum.

Q.12. Give five points of difference between human sperm and human ovum.

Ans:- Difference between human sperm and human ovum:

Sperm	Ovum
1. It is the male gamete.	1. It is the female gamete.
2. Sperm is motile.	2. Ovum is non-motile.
3. It contains a special cap called acrosome.	3. Acrosome like structure is absent.
4. It is externally differentiated into head, neck, middle piece and tail.	4. It is not externally differentiated into regions.
5. It has very small amount of cytoplasm.	5. It has a large amount of cytoplasm called *ooplasm*.
6. Mitochondria form a spiral in the middle piece.	6. Mitochondria are scattered in the ooplasm.

Q.13. Where does spermatogenesis occur in human? Describe the stages of the process.

Ans:- Spermatogenesis occurs in seminiferous tubules of testes.

For spermatogenesis, see class notes.

Q.14. What are the major features of embryonic development at various months of pregnancy?

Ans:- In human beings, after one month of pregnancy, the embryo's heart is formed. The first sign of growing foetus may be noticed by listening to the heart sound carefully through the stethoscope. By the end of the second month of pregnancy, the foetus develops limbs and digits. By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well-developed. The first movements of the foetus and appearance of hair on the head are usually observed during the fifth month. By the end of 24 weeks (second trimester), the body is covered with fine hair, eye-lids separate, and eyelashes are formed. By the end of nine months of pregnancy, the foetus is fully developed and is ready for delivery.

Q.15. What are the post zygotic events in human females that lead to implantation of foetus in the uterus? Elaborate in five points. CoHSEM-2017

(What are the post zygotic events that lead to implantation of human embryo in the uterus? Elaborate in five points.)

Ans:- The post zygotic events that lead to implantation in human embryo are given below:

i) The fertilized zygote undergoes a series of rapid mitotic division called cleavage which converts the single celled zygote into a multicellular structure. Cleavage involves a series of mitotic divisions, so daughter cells are genetically similar to the parent cell.

ii) As the embryo undergoes cleavage it reaches the morula stage which looks like little mulberry with a solid ball of cells. It has 8 – 16 cells, occasionally 32 cells. There is an outer layer of smaller, clearer cells around an inner mass of larger cells. The morula reaches the uterus in 4 – 6 days after fertilization. It is surrounded by *zona pellucida*.

iii) As the morula enters uterus, it obtains enriched supply of nutrients. Therefore, there is spurt in growth. Outer peripheral cells enlarge, flatten further and form trophoblast. The fluid absorbed by the trophoblast collects in a

cavity, the blastocoel. The inner cell mass now comes to lie on one side. It is now called the blastocyst. The inner cell mass gives rise to the embryo.

The trophoblast does not take part in the formation of embryo proper and gives rise to the extraembryonic membranes.

iv) At blastocyst stage, the embryo attaches to the uterine wall. It occurs after 7 days of fertilization. It takes about 3 days for the process to be completed. The portion of blastocyst where the inner cell mass is located lies against the endometrium of the uterus.

v) The surface cells of trophoblast secrete lytic enzymes which cause corrosion of endometrial lining. They give rise to finger like outgrowths called chorionic villi. Chorionic villi and uterine tissue become interdigitated. Villi not only help in fixation but also absorption of nourishment. Implantation causes nutrient enrichment, enlargement of cells and formation of uterine part of placenta leading to pregnancy.

Q.16. Where does oogenesis occur in human? Describe the stages of the process.

Ans:- Oogenesis occurs in ovaries. It consists of three phases: multiplication, growth and maturation.

1. Multiplication Phase: Certain cells in the germinal epithelium of the foetal ovary undergo rapid mitotic divisions to form diploid groups of diploid *egg mother cells*, *oogonia*. No more oogonia are formed or added after birth.

2. Growth Phase: This phase is of very long duration and extends over many years. It happens after puberty. During growth phase, one oogonium grows in size by taking food from surrounding follicle cells and functions as primary oocyte.

3. Maturation Phase: In this, the diploid primary oocyte undergoes meiosis I (reductional division) to form two unequal haploid daughter cells – a large *secondary oocyte* and a very small *first polar body* or polocyte.

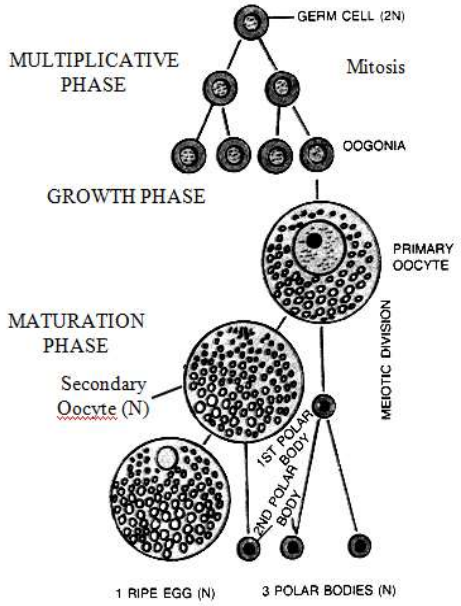


Figure : Oogenesis

The secondary oocyte again undergoes meiosis II (equational division) to form a large *ootid* and a very small second polar body. The ootid grows into a functional ovum. Meanwhile, the first polar body may divide into two.

So in oogenesis, a diploid oogonium forms one ovum and 2 or 3 polar bodies.

REPRODUCTIVE HEALTH

SEXUALLY TRANSMITTED DISEASES (STDs): Diseases or infections which are transmitted through sexual intercourse are collectively called Sexually Transmitted Diseases (STDs) or Venereal Diseases (VD) or Reproductive Tract Infections (RTI).

Mode of Transmission: STDs are transmitted by

i) Sexual intercourse with infected persons,

ii) sharing of injection needles, surgical instruments, etc. and
iii) transfusion of blood from an infected mother to the foetus.

For prevention, following **simple principles** should be followed:
i) Avoid sex with unknown partners/ multiple partners.
ii) One should always use condoms during intercourse.
iii) If a person is in doubt, he/she must consult a qualified doctor. If STD is detected, one should get complete treatment.

VERY SHORT ANSWER TYPE QUESTIONS:

Q.1. What is Amniocentesis?
Ans:- Amniocentesis is a foetal sex determination and disorder test based on the chromosomal pattern in the amniotic fluid surrounding the developing foetus.
Q.2. Why is amniocentesis for sex determination legally banned in India? Or, Give one reason for a statutory ban on amniocentesis.
Ans:- Amniocentesis is being used to kill the normal female foetus. It is, therefore, legally banned for the determination of sex.
Q.3. What are contraceptions?
Ans:- Contraceptions are devices which prevent conception or pregnancy without in any way interfering in reproductive health of the individuals.
Q.4. "MTP may be legalised". Comment.
Ans:- MTP may be legalized if it is done to get rid of unwanted pregnancy due to rapes and other pregnancies that could pose threat to the life of either mother or foetus or both.
Q.5. What does the gamete intra fallopian transfer (GIFT) represent?
Ans:- Gamete Intra Fallopian Transfer (GIFT) is the transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one, but can provide suitable environment for fertilisation and further development.
Q.6. Removal of gonads cannot be considered a contraceptive option. Why?
Ans:- Contraceptives are used against a natural reproductive event. These are used to delay the pregnancy. Removal of gonads leads the people to become infertile and sterile. So it is not considered as a contraceptive option.
Q.7. Explain the reproduction related problems?
Ans:- Reproduction related problems are sexually transmitted diseases (STDs), abortions, menstrual problems, infertility, etc.
Q.8. After a successful in vitro fertilization, the fertilized egg begins to divide. Where is this egg transferred before it reaches the 8-celled stage and what is this technique named?
Ans:- The embryo will be transferred to fallopian tube. The technique is called ZIFT (Zygote Intra Fallopian Transferred).
Q.9. How will you explain Lactational amenorrhea?
Ans:- Lactational amenorrhea is the absence to menstruation during intense lactation following parturition.
Q.10. What are Intra Uterine Contraceptive Devices (IUCDs)?
Ans:- Intra Uterine Contraceptive Devices (IUCDs) devices, inserted by doctors or expert nurses in the uterus through vagina, to prevent pregnancy.
Q.11. A mother of one year old daughter wanted to space her second child. Her doctor suggested Cu-T. Explain its contraceptive actions.
Ans:- Copper IUDs commonly called copper Ts (Cu-T, Multiload 375) have ionized copper (which slowly diffuses at the rate of some 50 mg/day). They suppress sperm motility and the fertilizing capacity of the sperms.
Q.12. Why is hormone releasing IUD considered a good contraceptive to escape children?
Ans:- The hormone releasing IUDs make
i) the uterus unsuitable for implantation. ii) the cervix hostile to the sperms.
iii) IUDs also increase phagocytosis of sperms within the uterus.
Q.13. What are oral contraceptive pills?
Ans:- Contraceptive pills are preparation containing either progestin (=progestogen=progesterone) alone or a combination of progestogen and oestrogens. They check ovulation by inhibiting secretion of FSH and LH. There is no release of egg to woman and therefore no chance of conception.
Q.14. What are morning after pills?
Ans:- Morning after pills are emergency contraceptive pills which can prevent pregnancy if taken within 72 hours, not just the morning after unprotected sexual intercourse. e.g. i – pills, PILL – 72 and UNWANTED – 72.
Q.15. What is the significant role of MTP in human population?
Ans:- MTP plays a significant role in decreasing the human population.

Q.16. Explain the reproduction related problems?
Ans:- Reproduction related problems are sexually transmitted diseases (STDs), abortions, menstrual problems, infertility, etc.
Q.17. How will you explain Lactational amenorrhea?
Ans:- Lactational amenorrhea is the absence to menstruation during intense lactation following parturition. Sexual contact is safe during this period. But it is generally effective upto maximum of 6 months.
Q.18. Define IVF (*in vitro fertilization*).

SHORT ANSWER TYPE QUESTIONS: 2 Marks Each

Q.1. How can amniocentesis be used to determine the sex of a developing human foetus?
Ans:- Amniotic fluid surrounding the foetus contains cells from the skin of the foetus. These cells can be used to determine the sex of the infant.
Q.2. In a human female, due to infection by a micro-organism, symptoms of vaginitis with foul smell, yellow vaginal discharge and burning sensation reported. Which organism may be the probable pathogen and how the treatment would be made for curing this disease?
Ans:- The microorganism is *Trichomoniasis vaginalis*.
Treatment: Standard treatment is *metronidazole* but partners be treated simultaneously. Arsenic and iodine drugs, and antibiotics like Aureomycin, Terramycin and metranidazole have been found effective.
Q.3.Is the use of contraceptives justified? Give reasons.
Ans:- Yes, the use of contraceptives is absolutely justified. The human population is increasing tremendously. Therefore, to regulate the population growth by regulating reproduction has become a necessary demand in the present times. Various contraceptive devices have been devised to reduce unwanted pregnancies, which help in bringing down the increased birth rate and hence, in checking population explosion.
Q.4. Removal of gonads cannot be considered as a contraceptive option. Why?
Ans:- Contraceptive devices are used to prevent unwanted pregnancy and to prevent the spreading of STDs. There are many methods, such as natural, barrier, oral, and surgical methods, that prevent unwanted pregnancy. However, the complete removal of gonads cannot be a contraceptive option because it will lead to infertility and unavailability of certain hormones that are required for normal functioning of accessory reproductive parts. Therefore, only those contraceptive methods can be used that prevent the chances of fertilization rather than making the person infertile forever.
Q. 5. Sex education is necessary in schools. Why? Justify the statement by giving at least two reasons to support your answer.
Or, Is sex education necessary in schools? Why?
Ans:- Yes, introduction of sex education in schools is necessary. It would provide right information to young individuals at the right time about various aspects of reproductive health such as reproductive organs, puberty, and adolescence related changes, safe sexual practices, sexually transmitted diseases, etc. The young individual or adolescents are more susceptible in acquiring various sexually transmitted diseases. Hence, providing information to them at the right time would help them to lead a reproductively healthy life and also protect them from the myths and misconceptions about various sex related issues.

Q.6. What is amniocentesis? Write its procedure.
Ans:- Amniocentesis is a foetal sex determination and disorder test based on the chromosomal pattern in the amniotic fluid surrounding the developing foetus.
Procedure: Amniotic fluid contains cells from the skin of the foetus and other sources. These cells can be used to determine the sex of the infant, to identify some abnormalities in the number of chromosomes and to detect certain biochemicals and enzymatic abnormalities. If it is established that the child is likely to suffer from a serious incurable congenital defect, the mother should get the foetus aborted.
Q.7. a) Expand IUD.
b) Why is hormone releasing IUD considered a good contraceptive to escape children?
Ans:- a) IUD = Intra Uterine Devices.
b) The hormone releasing IUDs make
ii) the uterus unsuitable for implantation. ii) the cervix hostile to the sperms.
iv) IUDs also increase phagocytosis of sperms within the uterus.
Q.8. Why do some women use "Saheli" pills?
Ans:- *Saheli* contains a non steroidal preparation called *'centchroman'* which is taken once in a week. It has high contraceptive value with very little side effects. That is why women use 'Saheli' pills.
Q.9. Give two important functions of hormonal pills.
Ans:- Two important functions Hormonal pills:
i) Inhibition of ovulation.
ii) Alteration in uterine endometrium to make it unsuitable for implantation.

Q.10. Explain the zygote intra fallopian transfer technique (ZIFT). How is intrauterine transfer technique (IUT) different from it?
Ans:- After in vitro fertilization, the embryo having upto 8 blastomeres is transferred into Fallopian tube. It is called ZIFT (Zygote Intra Fallopian Transfer).

Difference between ZIFT and IUT:

ZIFT	IUT
1. Embryo upto 8 blastomeres can be implanted. 2. Site of implantation is fallopian tube.	1. Embryo more than 8 blastomeres can be implanted. 2. Site of implantation is uterus.

Q.11. What were the main aims of RCH (Reproductive and Child Health care) programme?
Ans:- The main aims of RCH were:
i) Creating awareness about health related issues in the society.
ii) Providing facilities and supports to build a reproductively healthy society.

Q.12. What are the measures one has to take to prevent from contracting STDs?
Ans:- Sexually transmitted diseases (STDs) get transferred from one individual to the other through sexual contact. Adolescents and young adults are at the greatest risk of acquiring these sexually transmitted diseases. Hence, creating awareness among the adolescents regarding its after-effects can prevent them from contracting STDs. The use of contraceptives, such as condoms, etc. while intercourse, can prevent the transfer of these diseases. Also, sex with unknown partners or multiple partners should be avoided as they may have such diseases. Specialists should be consulted immediately in case of doubt so as to assure early detection and cure of the disease.

Q.13. Give two contraceptive devices used in barrier methods.
Ans:- Barrier methods used in barrier methods are -
a) Condoms: It is tubular latex sheath which is role over the male copulatory organ during sex. It provides protection against STDs including AIDS.
b) Diaphragm: It is a soft rubber cup that covers entrance to uterus. It prevents a sperm from reaching an egg; and holds spermicide.

Q.14. Suggest the aspects of reproductive health which need to be given special attention in the present scenario.
Answer:- Reproductive health is the total wellbeing in all aspects of reproduction. The aspects which have to be given special attention in the present scenarios are -
(a) Counselling and creating awareness among people, especially the youth, about various aspects of reproductive health, such as sexually transmitted diseases, available contraceptive methods, case of pregnant mothers, adolescence, etc.
(b) Providing support and facilities such as medical assistance to people during pregnancy, STDs, abortions, contraceptives, infertility, etc. for building a reproductively healthy society.

SHORT ANSWER TYPE QUESTIONS: 3 Marks Each

Q.1. Give your comments on the significance of reproductive health in a society.
Ans:- Significance of Reproductive Health:
i) Creating awareness among the people about reproductive related aspects.
ii) Awareness about pre and postnatal care, small family concept.
iii) Awareness about STDs.
iv) Reproduction related aspects can be taken by NGO's and government agencies.

Q.2. Do you think that reproductive health in our country has improved in the past 50 years? If yes, mention some such areas of improvement?
Ans:- Yes, the reproductive health has tremendously improved in India in the last 50 years. The areas of improvement are as follows:
(i) Massive child immunization programme, which has led to a decrease in the infant mortality rate
(ii) Maternal and infant mortality rate, which has been decreased drastically due to better post natal care
(iii) Family planning, which has motivated people to have smaller families
(iv) Use of contraceptive, which has resulted in a decrease in the rate of sexually transmitted diseases and unwanted pregnancies.

Q.3. Give three measures to be taken up for controlling over population.
Ans:- Three measures to be taken up for controlling over population are given below:
i. People, particularly of reproductive age group, should be educated about the advantage of small family.
ii. Raising of the age of marriage is more effective means to control the population.
iii. Couples of small families should be given incentives. Birth control measures must be used.

Q.4. What is MTP? Why is it done?
Ans:- Voluntary or intentional termination of pregnancy before full term is known as Medical Termination of Pregnancy (MTP) or induced abortion.
MTP is done to get rid of unwanted pregnancy due to
i) Casual unprotected intercourse.

ii) Failure of the contraceptive used during coitus and
iii) Rapes
MTP is also essential in cases where continuation of pregnancy could pose threat to the life of either mother or foetus or both.

Q.5. Give 3 points of difference between vasectomy and tubectomy.
Ans:- Difference between vasectomy and tubectomy :

Vasectomy	Tubectomy
1. It is a surgical sterilization technique for male. 2. The two vasa deferentia are cut and tied up. 3. Passage of sperms is prevented.	1. It is a surgical sterilization technique for female. 2. The two fallopian tubes (oviducts) are cut and tied up. 3. Passage of ova is prevented.

Q.6. Write three simple principles for prevention of STD?
Ans:- For prevention, following simple principles should be followed:
i) Avoid sex with unknown partners/ multiple partners.
ii) One should always use condoms during intercourse.
iii) If a person is in doubt, he/she must consult a qualified doctor. If STD is detected, one should get complete treatment.

Q.7. "It is now estimated that the population of our country will be doubled in the next 15 years or so". Give at least three possible reasons for the increase of human population in our country.
Ans:- Reasons for population explosion:
i). Decline in the death rate, maternal mortality rate (MMR), and infant mortality rate (IMR) and an increase in number of people in reproductive age.
ii). Certain religions are against family planning.
iii). Despite ban on childhood marriages, early marriages do occur, especially to rural areas.

Q.8. Write any three ecological problems of over populations.
Ans:- Three ecological problems of over populations are:
i) Pollution: There will be an added problem of population. As everything is taken from environment in excess, so it will result in pollution.
ii) Natural Resources: There is excessive consumption of natural resources in order to meet the requirement of rising population. It results in shortage of new materials.
iii) Deforestation: There is an even increasing demand for agricultural land in order to grow more food crops for feeding growing human population which can be done only through clearing forest areas.

Q.9. Write about *any three* methods of temporary birth control.
Ans:- *Three* methods of temporary birth control are -
i) Oral Contraceptives (Oral pills):
They are preparation containing either progestin (=progestogen=progesterone) alone or a combination of progestogen and oestrogen. They are used in the form of tablets, therefore they are called pills. They inhibit ovulation.
ii) Intra Uterine Contraceptive Devices (IUCDs)/Intra Uterine Devices (IUDs): These devices are inserted by doctors in the uterus through vagina. During their use, pregnancy is prevented.
iii). Barrier methods: In these methods ovum and sperms do not meet due to barriers. e.g. Condoms is tubular latex sheath which is role over the male copulatory organ during sex. It prevents deposition of sperms into the vaginal tract of female.

Q.10. Explain *any three* traditional methods of birth control.
Ans:- Three traditional methods of birth control are -
a) Avoidance of Sex (Periodic absence): It is one such method in which the couples avoid from coitus (copulation) from day 10 to 17 of the menstrual cycle, because ovulation can occur during this period.
b) Withdrawal or Coitus interruptus: Male withdraws his penis from vagina just before ejaculation to avoid insemination so that the semen is carried outside the vagina.
c) Lactational amenorrhea (absence of menstruation): The menstrual cycle, and therefore, ovulation do not occur during intense lactation following parturition.

LONG ANSWER TYPE QUESTIONS:
Q.1. Define Infertility. In our country, large numbers of couple are not having children even after having unprotected sexual intercourse for 2 – 3 years of marriage. But now they can have children with the help of Assisted Reproductive Technology (ART). Explain any 4 such technologies available in our country.
Or, Suggest some methods to assist infertile couples to have children.
Ans:- Infertility is the failure to conceive when after 1-2 years of regular unprotected sex. The techniques used to assist infertile couples to have children are as follows:

(a) Test tube baby Programme: This involves in-vitro fertilization where the sperms meet the egg outside the body of a female. The zygote, hence produced, is then transferred in the uterus or fallopian tube of a normal female. The babies produced from this method are known as test tube babies.
(b) Gamete Intra fallopian transfer (GIFT): It is a technique that involves the transfer of gamete (ovum) from a donor into the fallopian tube of the recipient female who is unable to produce eggs, but has the ability to conceive and can provide right conditions for the development of an embryo.
(c) Intra Cytoplasmic sperm injection (ICSI): It is a method of injecting sperm directly into the ovum to form an embryo in laboratory.
(d) Artificial insemination: Artificial insemination is a method of transferring semen (sperm) from a healthy male donor into the vagina or uterus of the recipient female. It is employed when the male partner is not able to inseminate the female or has low sperm counts.

Unit-II: GENETICS AND EVOLUTION (18 Marks)

CHAPTER – 5: PRINCIPLE OF INHERITANCE AND VARIATION

VERY SHORT ANSWER TYPE QUESTIONS: 1 Mark Each

Q.1. Define alleles.
Ans:- Genes which code for a pair of contrasting traits (i.e., they are slightly different forms of the same gene) are known as **alleles.**
Q.2. Define genome.
Ans:- Genome is a complete set of chromosomes where every gene and chromosome is represented singly as in a gamete.
Q.3. What is gene pool?
Ans:- The aggregate of all the genes and their alleles present in an interbreeding population is known as gene pool.
Q.4. What is polygenic inheritance?
Ans:- Polygenic inheritance is the inheritance of characters in which one character is controlled by many genes and intensity of character depends upon the number of dominant allele. e.g. Colour of the skin in Human.
Q.5. Who propounded the Theory of Linkage?
Ans:- Morgan.
Q.6. Why is the sex chromosomes important in diploid organisms?
Ans:- In diploid organisms, sex chromosomes determine the sex of the organism.
Q.7. What is pleiotropy?
Ans:- Responsibility of single gene for more than one phenotypic effect, often seemingly unrelated, is known as pleiotropy.
Q.8. What is criss-cross inheritance?
Ans:- Criss cross Inheritance is a type of sex linked inheritance where a parent passes the traits to the grand child of the same sex through offspring of opposite sex.
Q.9. What is nondisjunction?
Ans:- Nondisjunction is the failure of synapsed homologous chromosomes to separate during *anaphase I* of meiosis.
Q.10. Define multiple allelism.
Ans:- Multiple alleles (multiple allelism) is the presence of more than two alleles of a gene which occur in the population of the same species.
Q.11. Give one point of difference between Genotype and Phenotype.
Ans:- Difference between Genotype and Phenotype

PHENOTYPE	GENOTYPE
1. It is an external appearance of an individual with regard to one or more characters.	1. It is a gene compliment of an individual with regard to one or more characters.

Q.12. Give one point of difference between a heredity variation and an environmental variation.
Ans:- Difference between a heredity variation and an environmental variation.

Heredity variation	Environment variation
1. They are produced in germ cells of an organism and are inheritable.	1. They are variations which affect the somatic or body cells of the organisms and are are non-inheritable.

Q.13. State the law of the purity of Gametes.
Ans:- The law of law of purity of Gametes states that when a pair of contrasting factors or allelomorphs or genes brought together in a hybrid (heterozygote), these factors do not blend or mix-up but simply associate themselves and remain together and separate at the time of gamete formation.
Q.14. What is Linkage?
Ans:- Linkage is the phenomenon of certain genes staying together during inheritance through generation to generation without any change or separation due to their being present on the same chromosome.
Q.15. How does crossing over help in the independent assortment of genes?

Ans:- Crossing over assorts or separates the genes present on the same chromosome and pass them to different gametes. Thus crossing over helps in the independent assortment of genes.
Q.16. What are linked characters?
Ans:- The characters controlled by the linked genes are called linked characters.
Q.17. How many autosomes are present in a human sperm?
Ans:- 22 autosomes.
Q.18. "Genes are regarded as the hereditary character carriers." Justify the statement by giving suitable reason.
Ans:- Hereditary characters are coded by genes which are located on the chromosomes. Chromosomes are transferred from one generation to next carrying genes on them. Hence, genes are regarded as the hereditary carriers.
Q.19. Mention the phenomenon of primary non-disjunction.
Ans:- Non-disjunction is the failure of synapsed homologous chromosomes to separate during *anaphase I* of meiosis. The initial nonseparation of synapsed chromosomes that occurs in meiocytes is called *primary nondisjunction*.
Q.20. What is codominance? Give one example of it.
Ans:- The phenomenon of expression of both the alleles in a heterozygote is called Codominance.
e.g. In AB blood group individual, alleles I^A for blood group A and I^B for blood group B are co-dominant.
Q.21. How does trisomic condition differ from triploid condition?
Ans:- Trisomic is an aneuploid having one chromosome represented four times. Triploid (3n) is a polyploid in which there are three sets of chromosomes or genomes.
Q.22. Write two symptoms of Klinefelter's syndrome.
Ans:- Symptoms of Klinefelter's syndrome are the development of breast, i.e., Gynaecomastia) and feminine pubic hair.
Q.23. A human being suffering from Down's Syndrome shows trisomy of 21st chromosome. Mention the cause of this chromosomal abnormality.
Ans:- Down's Syndrome that shows trisomy of 21st chromosome is due to non-disjunction.
Q.24. Write the genotype of i) an individual who is carrier of sickle cell anaemia gene but apparently unaffected, and ii) an individual affected with the disease.
Ans:- i) An individual who is carrier of sickle cell anaemia gene but apparently unaffected = Hb^AHb^S, and
ii) An individual affected with the disease = Hb^AHb^A.
Q. 25. When a tall pea plant was self – pollinated, one – fourth of the progeny were dwarf. Give the genotype of the parents and dwarf progenies.
Ans:- Genotype of the parents = Tt
Genotype of the dwarf progenies = tt.
Q.26. Which enzyme is absent in patients suffering from phenylketonuria (PKU)?
Ans:- Phenylalanine hydroxylase.
Q.27. In a sickle cell anaemia patient, which amino acid is replaced by what?
Ans:- Glutamic acid (Glu) is replaced by valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule.
Q.28. Give one example of an autosomal disorder?
Ans:- Down's syndrome and sickle cell anaemia.
Q.29. Give one example of sex-linked disorder.
Ans:- Colour blindness.
Q.30. Even if a character shows multiple allelism, an individual will only have two alleles for that character. Why?
Ans:- Human blood group has 3 multiple alleles - I^A,I^B and *i*. All of them are found on the same gene locus on the chromosome or its homologue. However, a chromosome has only one allele and hence, a diploid individual only two alleles.
Q.31. What is the significance of a test cross? Elaborate.
Ans:- Test cross is used in detecting whether a given plant is homozygous or heterozygous for a trait.
Q.32. Why sex linked disease (X –linked) gene cannot be passed from a father to his son?
Ans:- Human male has 44 + XY. Male compulsorily transfers his X chromosome to his daughter. Instead he transfers Y chromosome to his son. Hence, sex linked disease (X linked) gene cannot be passed from father to son.
Q.33. A 40 years old woman delivered a son with flattened nasal bridge and habitually opens mouth with large protruding tongue. What is the child suffering from? What has caused such a defect?
Ans:- The child is suffering from Down's syndrome. It is due to non-disjunction of 21st chromosomes during oogenesis.

SHORT ANSWER TYPE QUESTIONS: 2 Marks Each

Q.1. How does sickle cell anaemia exhibit the phenomena pleiotropy as well as codominance?

Ans:- In sickle cell anaemia, a single gene controls the characters of normal haemoglobin as well as sickle cell haemoglobin. Thus it shows pleiotropy. On the other hand, in patients of sickle cell anaemia (Hb^AHb^s), both normal haemoglobin Hb^A is expressed when oxygen tension in the atmosphere is high/normal; and sickle cell haemoglobin Hb^S is expressed when oxygen tension in the atmosphere is very low. This is due to Co-dominance of their alleles.

Q.2. Why Haemophilia is called "Bleeder's Disease"? In which section of the society it occurs?

Ans:- Haemophilia is called Bleeder's disease because exposed blood of the patient fails to coagulate. Haemophilia disease has been quite common in royal families of Europe.

Q.3. Write in brief Mendel's law of segregation.

Ans:- The law of segregation states that when a pair of contrasting factors or allelomorphs or genes are brought together in a hybrid (heterozygote), these factors do not blend or mix-up but simply associate themselves and remain together and separate at the time of gamete formation.

Q.4. A person fails to distinguish red and green colours. What is the name of the disease the person is suffering? Comment upon the probable genotype of the person.

Ans:- The disease is colour blindness. Since gene for colour blindness is located on X – Chromosome and is recessive, the genotype of the colour blind female would be $X^c X^c$ and that of male, X^cY.

Q.5. In human beings black eye colour is dominant over blue eye colour. A black eyed man has blue eyed mother. Find out the genotype and phenotype of the offsprings of this man married with a blue eyed woman.

Q.6. Do linked genes show independent assortment? Explain.

Ans:- No, Linked genes do not show independent assortment. Linked genes are located on the same chromosome and are inherited together without changing their parental combination. Linked genes do not assort at the time of gamete formation.

Q.7. Write a brief note on haemophilia.

Ans:- Haemophilia is a sex linked recessive disorder. It is also known as bleeder's disease because the exposed blood of haemophilic patient fails to coagulate due to deficiency of blood clotting *factor VIII or factor IX*. Haemophilia disease (Royal disease) has been quite common in royal families of Europe. The disease spread to them through the children of *Queen Victoria*. Human females are generally carrier of this disorder and remain normal throughout their life. If double recessive condition appears in a female, the same dies before birth. Human males suffer from this disorder because of the *hemizygous* nature of most sex linked traits. The defective males must be given either blood transfusion or the required clotting factor if they are to lead a normal life. Otherwise even a small cut will cause loss of blood from the whole body so as to kill the individual.

Q.8. Suppose, a cross is made between the red flower pea (RR) and white flower (rr) one. The offspring in F_1 generation bear pink flowers (Rr). How will you explain this condition in relation to Mendel's law of inheritance?

Ans:-Appearance of pink flowers in the hybrid is due to phenomenon of Incomplete dominance which is exception to Principle of dominance. In this, neither of the two alleles of a gene being dominant over each other so that when both of them are present together, a new phenotype i.e. Pink is formed which somewhat intermediate between the independent expression of the two alleles.

Q.9. Give two points of difference between Heterochromatin and Euchromatin.

Ans:- Difference between Heterochromatin and Euchromatin:

Euchromatin	Heterochromatin
1. It is lightly stained.	1. It is darkly Stained.
2. It contains active genes.	2. Heterochromatin does not possess active genes.
3.Euchromatin takes part in transcription.	3. Transcription is absent in heterochromatin.

Q.10. A diploid organism is heterozygous for 4 loci, how many types of gametes can be produced?

Ans:- Locus is a fixed position on a chromosome, which is occupied by a single or more genes. Heterozygous organisms contain different alleles for an allelic pair. Hence, a diploid organism, which is heterozygous at four loci, will have four different contrasting characters at four different loci. For example, if an organism is heterozygous at four loci with four characters, say Aa, Bb, Cc, Dd, then during meiosis, it will segregate to form 8 separate gametes. If the genes are not linked, then the diploid organism will produce 16 different gametes. However, if the genes are linked, the gametes will reduce their number as the genes might be linked and the linked genes will be inherited together during the process of meiosis.

Q.11. A woman with blood group B has a child with blood group O. But her husband has blood group A. How can you prove genetically that this man the father of the child?

Q.12. A woman with blood group O married a man with AB group. Show the possible blood groups of the progeny. List the alleles involved in this inheritance.

Q.13. A plant *Antirrhinum majus* with red flowers was crossed with another plant of the same species with white flowers. Explain the pattern of the inheritance with the help of a cross. 2 (CBSE – 2008)

Ans:- White (rr) x Red (RR)

Gametes → r, R

F_1 → Rr (Pink)

Appearance of pink flowers in the F_1 hybrids is due to the phenomenon of incomplete dominance.

Q.14. Write any two points of chromosome theory of heredity as proposed by Sutton and Boveri.

Ans:- According to chromosome theory of heredity, proposed by Sutton and Boveri,

i). Mendelian factors are located on the chromosomes which show segregation and independent assortment at the time transmission from one generation to next.

ii) They proposed that chromosomes were the carriers of the Mendelian factors. It is the chromosome and not genes which segregate and assort independently during meiosis and recombine at the time of fertilization in the zygote.

Q.15. How does sickle cell anaemia exhibit the phenomena pleiotropy and co-dominance?

Ans:- In sickle cell anaemia (Hb^AHb^S), the gene which controls the normal haemoglobin, Hb – A, also controls the sickle cell anaemic character, Hb – S. Thus sickle cell anaemia exhibits the phenomenon pleiotropy.

On the other hand, in patients of sickle cell anaemia (Hb^AHb^S), both normal haemoglobin Hb^A and sickle cell haemoglobin Hb^S are expressed at different conditions. The trait expresses its effects only under condition of oxygen deficiency. This is due to Co-dominance of their alleles.

Q.16. Why is Mendel's law of segregation known as law of purity of gametes as well as law of universal?

Ans:- According to law of segregation, gametes are always pure for a particular character. A gamete may carry either the dominant or the recessive factor. That is why Mendel's law of segregation known as law of purity of gametes.

This law is applicable to all sexually reproducing plants and animals without any exceptions; this law is known as law of universal.

Q.17. If the black (BB) *Andalusian* fowl is crossed with a white (bb) one, what will be the colour of the offsprings? What type of dominance is seen there?

Q.18. Tabulate two differences between linkage and crossing over.

Ans:- Difference between linkage and crossing over:

Linkage	Crossing Over
1. It is tendency of genes on a chromosome to remain together and passed as such in the next generation.	1. It is the exchange of genetic material between non-sister chromatids of 2 homologous chromosomes.
2. Strength of linkage between two genes increases if they are closely placed on a chromosome.	2. Frequency of crossing over between two genes decreases if they are closely placed.

SHORT ANSWER TYPE QUESTIONS: 3 Marks Each

Q.1. Write a brief about phenylketonuria.

Ans:- Phenylketonuria is an inborn error of metabolism, inherited as the autosomal recessive trait. The affected individual lacks an enzyme ***phenylalanine hydroxylase*** that converts the amino acid phenylalanine into tyrosine in liver. As a result of this phenylalanine is accumulated and converted into phenylpyruvic acid and other derivatives. Accumulation of these in brain results in mental retardation. These are also excreted through urine because of its poor absorption by kidney.

Q.2.In a cross to identify dominant colour between red-white among flowers of a plant, pink colour flowers were seen in F_1 hybrids. How can you explain this phenomenon? Find out the genotypic and phenotypic characteristics of the four F_2 offsprings.

Q.3. List *any six* characters of garden pea which selected by Mendel in his experiment.

Ans:- Six characters of garden pea selected by Mendel are

i) Plant height

ii) Flower position.

iii) Flower colour.

iv) Pod shape

v) Seed coat colour.

vi) Seed shape.

Q.4. Who discovered sex linked inheritance? Name any two sex linked disease in human beings.

Ans:- T.H.Morgan discovered sex linked inheritance.

Two sex linked disease in human beings are – colour blindness and haemophilia.

Q.5. State the reasons for the selection of *Drosophila* as a tool of genetics by Morgan.

Ans:- Thomas Hunt Morgan (the father of experimental genetics) selected fruitfly *Drosophila melanogaster* as experimental materials because of following advantages:-

i) It is easily available hovering over ripe fruits where it feeds over yeast cells present over the fruit surface.

ii) The flies can be reared inside bottles having yeast culture over medium containing cream of wheat, molasses and agar.
iii) A new generation can be raised within 2 weeks with single mating producing hundreds of individuals.
iv) Breeding *Drosophila* is quite cheap. Further, it can be done throughout the year.

Q.6. A woman has normal vision but her father is colour blind. She marries a man who is colour blind. Give the phenotypic ratios of their male and female progenies.

Q.7. Explain the difference between Test cross and Back Cross.

Ans:- Difference between Back cross and Test cross:

Back-Cross	Test-Cross
1. F_1 may be crossed either with dominant parent or with recessive parents. 2. Back cross may be of two types- out cross and test cross. 4. It is used by plant and animal breeders as a rapid method of purifying (making homozygous) the desired stock.	1. The cross is in between individual with dominant trait and recessive parent. 2. Test cross has no such classification. 4. It is used in detecting whether a given plant is homozygous or heterozygous.

Q.8. Why did Mendel select garden pea for his experiments? Give three points.

Ans:- Mendel selected Garden pea (*Pisum sativum*) for his experiments because-
i). Pea flowers normally remain closed and undergo self-pollination.
ii). The pea plant was easy to cultivate and for one generation to next generation took only a single growing season.
iii). Pea plants possess sharply defined inherited characters and many desirable features.

Q.9. Differentiate Turner's syndrome from Klinefelter's syndrome by giving 3 points.

Ans:- Difference between Turner's syndrome and klinefelter's syndrome:

Turner's Syndrome	Klinefelter's Syndrome
1. The person has 44+X0. 2. The individual is sterile female. 3. It is characterised undeveloped ovaries and breasts, small uterus, absence of sex chromatin, narrow hips.	1. The person has 44+XXY. 2. The individual is sterile male. 3. It is characterized by undeveloped testes, sparse body hair, feminine pubic hair, gynaecomastia, presence sex chromatin, feminine pitch voice.

Q.10. Write difference between Incomplete dominance and codominance.

Incomplete Dominance	Codominance
1. Effect of one of the two alleles is more conspicuous. 2. The effect in hybrid is intermediate of the expression of the two alleles. 3. The hybrid possesses a new phenotype. 4. The expressed phenotype is new. It has no allele of its own. 5. The incomplete dominant allele has quantitative effect.	1. The effect of both the alleles is equally conspicuous. 2. Both the alleles produce their effect independently, e.g. I^A and I^B, Hb^S and Hb^A. 3. A new phenotype does not develop. 4. The expressed phenotype is combination of two phenotypes and their alleles. 5. A quantitative effect is absent.

Q.11. A tall pea plant with yellow seeds (heterozygous for both the traits) is crossed with a dwarf pea plant with green seeds. Using a Punnet square, work out the cross to show the phenotypes and genotypes of F_1 generation.

Q.12. In peas, let the alleles for tallness be represented by T (dominant allele) and alleles for dwarfness by t (recessive allele). What will be the gametes produced by the parents and height of the offsprings (tall and dwarf) from the Tt and tt?

Q.13. A child has blood group "O". If the father has blood group "A" and mother has blood group "B", work out the genotype of parents and the possible genotypes of other offsprings.

Q.14. In human being brown eye colour is dominant over blue eye while black hair colour is dominant over red hair colour. A man with brown eye and red hair colour has blue eye mother. He marries a woman having blue eye and black hair whose father is red hair. Find out the phenotype of their progeny.

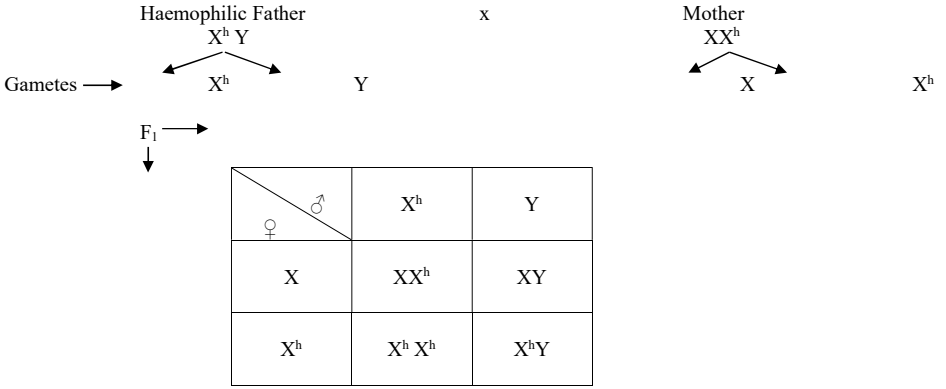
Q.15. Who discovered Down's syndrome? Write *any two* symptoms of this chromosomal disorder.

Ans:- Down's syndrome was discovered by Langdon Down in 1866.

Symptoms :
i) The affected individual is short statured with small round head, furrowed tongue and partially open mouth.
ii) Palm is broad with characteristic palm crease.
iii) Physical, psychomotor and mental development is retarded.

Q.16. Recently a girl baby has been reported to suffer from haemophilia. How is it possible? Explain with the help of a cross?

Ans:- Haemophilic daughter can be born only when mother carries the gene for haemophilia (i.e. carrier) and father is haemophilic.



♀ \ ♂	X^h	Y
X	XX^h	XY
X^h	X^hX^h	X^hY

Phenotype of the children
= 1 Normal daughter (carrier) : 1 Haemophiliac daughter (dies) : 1 Normal son : 1 Haemophiliac son.
Hence, Possibility of the daughter being haemophiliac is 25%.

Q.17. Give differences between Dominant and Recessive genes in three points.

Ans:- Differences between Dominant and Recessive genes:

Dominant genes	Recessive genes
1. It is able to express itself even in the presence of its recessive allele. 2. It does not require another similar allele to produce its effect on the phenotype, e.g. Tt is tall. 3. Dominant allele can form complete polypeptide or enzyme for expressing its effects, e.g. violet colour of flower in pea.	1. It is unable to express itself even in the presence of dominant allele. 2. It produces a phenotypic effect only in the presence of a similar allele, e.g. tt is dwarf. 3. The recessive allele forms an incomplete or defective polypeptide or enzyme so that the expression consists of absence of the effect of the dominant allele, e.g. white colour of flower in pea.

Q.18. Explain the mechanism of sex determination in insects like *Drosophila* and grasshopper.

Ans:- In *Drosophila*, the females have two sex chromosomes, XX, while the males have XY sex chromosomes. The females are homogametic because they produce only one type of eggs (A+X). Males are heterogametic with half the male gametes (gynosperms) carrying X-chromosome (A+X) while the other half (androsperms) carrying Y-chromosome of it (A+Y).

In grasshoppers, the females have two sex chromosomes, XX, while the males have only one sex chromosome, X. There is no second sex chromosome. The females are homogametic because they produce only one type of eggs (A+X). Males are heterogametic with half the male gametes (gynosperms) carrying X-chromosome (A+X) while the other half (androsperms) being devoid of it (A+0).

Q.19. Explain the sex determination mechanism in humans. How is it different in birds?

Ans:- In *human beings*, the females have two sex chromosomes, XX, while the males have XY sex chromosomes. The females are homogametic because they produce only one type of eggs (A+X). Males are heterogametic with half the male gametes (gynosperms) carrying X-chromosome (A+X) while the other half (androsperms) carrying Y-chromosome of it (A+Y).

In birds	In human being
1) Birds have ZZ- ZW type of sex determination. 2) There is female heterogamy. 3) Sex of the individual is determined by the type of ovum that is fertilized.	1) Humans have XX - XY type of sex determination. 2) There is male heterogamy. 3) Sex of the individual is determined by the type of Sperm fertilizing the ovum.

Q.20. What is Down's syndrome? Give its symptoms and cause. Why is it said that the chances of having a child with Down's syndrome increased if the age of the mother exceeds forty years?

Ans:- Down's syndrome is an autosomal aneuploidy, caused by the presence of an extra chromosome number 21.
Symptoms: The affected individual is short statured with small round head, furrowed tongue and partially open mouth. Palm is broad with characteristic palm crease. Physical, psychomotor and mental development is retarded.
Cause: Both the chromosomes of the pair 21 pass into a single egg due to nondisjunction during oogenesis. The egg possesses 24 chromosomes instead of 23 and offspring has 47 chromosomes (45+ XY in male, 45 + XX in female) instead of 46.

If the age of the mother exceeds forty years, chance of occurring non-disjunction increases. Hence the chance of having a child with Down's syndrome is increased with advancing the age of mother.

Q.21. State the chromosome theory of Inheritance as proposed by Sutton and Boveri.

LONG ANSWER TYPE QUESTIONS:

Q.1. In Snapdragon, tall (DD) is dominant over dwarf (dd), red flower (RR) incompletely dominant over white (rr) flower, the hybrid being pink. A pure white is crossed to a pure dwarf red flower and F_1 are self fertilized. Give the proportion of the expected genotypes and phenotypes in F_1 and F_2.

Q.2. What is Linkage? State four salient features of chromosome theory of linkage as proposed by Morgan.

Ans:- Linkage is the phenomenon of certain genes staying together during inheritance through generation to generation without any change or separation due to their being present on the same chromosome.

In 1911, Morgan proposed chromosome theory of linkage. It states that

i) Linked genes occur in the same chromosome.
ii) They lie in a linear sequence in the chromosome.
iii) There is a tendency to maintain the parental combination of genes except for occasional crossovers.
iv) Strength of the linkage between two genes is inversely proportional to the distance between the two, i.e. two linked genes show higher frequency of crossing over if distance between them is higher and lower frequency if the distance is small.

Q.3. A man does not possess the natural phenomenon of blood clotting after a minor cut. Name the disease of this symptom. Which factors are responsible for this symptom? If the person marries with a normal woman, what would be the probable offsprings?

Q.4. a) State the law of independent assortment.

b) Using Punnet Square demonstrate the law of independent assortment in a dihybrid cross involving two heterozygous parents.

Q.5. A homozygous tall pea plant with green seeds is crossed with a dwarf pea plant with yellow seeds.

i. What would be the phenotype and genotype of F_1?
ii. Work out the phenotypic and genotypic ratio of F_2 generation with the help of a punnet square.

Q.6. Enlist five salient features of salient features of chromosome theory of inheritance.

Ans:- The salient features of chromosome theory of inheritance are as follows:-

1. Bridge between one generation and the next is through sperm and ovum. The two must carry all the hereditary characters.
2. Both the sperm and egg contribute equally in the heredity of the offspring. The sperm provides only nuclear part to the zygote. There is fusion of the sperm and egg nuclei during fertilization.
3. Nucleus contains chromosomes. Therefore, chromosomes must carry the hereditary traits.
4. Both chromosomes as well as genes occur in pairs in the somatic or diploid cells.
5. A gamete contains only one chromosome of a type and only one of the two alleles of a character.

Q.7. (i) Explain the monohybrid cross, taking seed coat colour as a trait in *Pisum sativum.* Work out the cross upto F_2 generation.

(ii) State the laws of inheritance that can be derived from such a cross.

(iii) What is the phenotypic ratio in a dihybrid cross?

Q.8. (i) Why is human ABO blood group gene considered a good example of multiple alleles?

(ii) Work out the cross upto F1 generation only, between a mother with blood group A (homozygous) and the father with blood group B (homozygous). Explain the pattern of inheritance.

MOLECULAR BASIS OF INHERITANCE

MUTATION

Mutation is a phenomenon which results in alteration of DNA sequences and consequently results in changes in the genotype and the phenotype of an organism. In addition to recombination, mutation is another phenomenon that leads to variation in DNA. One DNA helix runs continuously from one end to the other in each chromatid, in a highly supercoiled form. Therefore, loss (deletions) or gain (insertion/duplication) of a segment of DNA, results in alteration in chromosomes. Since genes are known to be located on chromosomes, alteration in chromosomes results in abnormalities or aberrations. Chromosomal aberrations are commonly observed in cancer cells.

- In addition to the above, mutation also arise due to change in a single base pair of DNA. This is known as point mutation. A classical example of such a mutation is sickle cell anaemia.
- Insertion or deletion of three or its multiple bases insert or delete one or multiple codon hence one or multiple amino acids, and reading frame remains unaltered from that point onwards. Such mutations are referred to as **frame-shift insertion** or **deletion mutations**. This forms the genetic basis of proof that codon is a triplet and it is read in a contiguous manner. Deletions and insertions of base pairs of DNA, causes frame-shift mutations. There

are many chemical and physical factors that induce mutations. These are referred to as mutagens. UV radiations can cause mutations in organisms – it is a mutagen.

- Mutations that involve a change in only a single nucleotide or nitrogen base of the cistron are known as point mutations.
- A mutation involving more than one base pair is termed as gross mutation.
- A gene may undergo several point mutations. They produce multiple alleles.

IMPORTANT TERMS:

- A **cistron** is the segment of DNA coding for a polypeptide.
- Wobble hypothesis: This hypothesis was proposed by Crick in 1966. It states that the first two bases of the tRNA anticodon undergo hydrogen bonding specifically with the first two bases of the mRNA codon but the third base can undergo unusual base pairing, i.e. it can 'wobble'. The third position in the codon is therefore, called **wobble position.**
- **VNTRs**: It is a type of DNA polymorphism in which tandem repeats found at specific loci in the genome show variation in the number of repeating units between individual of a population. VNTRs are also called **minisatellites**.
- **RFLP (Restriction Fragment Length Polymorphism):** It is a type of DNA polymorphism in which there is variation between individuals of a species in the banding pattern of DNA fragments generated when DNA samples from individuals are cleaved by a restriction endonuclease.

VERY SHORT ANSWER TYPE QUESTIONS: 1 MARK EACH.

Q1. What is a codon? 1 (CoHSEM-1995)

Ans:- Codon is a sequence of three adjacent bases in one polynucleotide chain of mRNA which codes for a specific amino acid.

Q2. Give the definition of mutation. 1 (CoHSEM-1995)

Ans:- Mutation is a phenomenon which results in alteration of DNA sequences and consequently results in changes in the genotype and the phenotype of an organism.

Q3. Name any two types of mutation. ½ + ½ = 1 (CoHSEM-1996)

Ans:- Two types of mutation are: Point mutation and Frame shift mutation.

Q4. How does DNA differ from RNA? Write any two points. ½ + ½ = 1 (CoHSEM-1996)

Ans:- Difference between DNA and RNA

DNA	RNA
1. Sugar is deoxyribose.	1. Sugar is ribose.
2. It is a double stranded molecule.	2. It is a single stranded molecule.

Q.5.

Q.6. Write any two characteristics of bacterial chromosomes. ½ + ½ = 1 (CoHSEM-1996)

Ans:- Characteristics of bacterial chromosomes:

i) Two ends of a DNA duplex are covalently linked to form circular DNA.

ii) DNA is naked, i.e. without association with histone proteins, though polyamines do occur.

Q.7. If the base sequence of a DNA strand is 5′− CAT TAG − 3′, what will be the base sequence in the

I. Complementary DNA strand and 1/2+1/2=1 (CoHSEM-1998)
II. Of its complementary RNA strand?

Q.8. Name the molecules that bear codons and anticodons. 1/2+1/2=1 (CoHSEM-2002)

Ans:- The molecules that bears codons and anticodons are respectively mRNA and tRNA.

Q.9. What is meant by a non-sense codon? 1 (CoHSEM-2003)

Ans:- A non-sense codon is meant for a codon which does not specify any amino acid. e.g. UAA, UAG or UGA.

Q.10. "DNA is the genetic material". Write two points in support of this statement. 1 (CoHSEM-2006)

Ans:- A molecule that can act as a genetic material must fulfill the following criteria:

(i) It should be able to generate its replica (Replication).

(ii) It should chemically and structurally be stable.

The above conditions are met by DNA, hence it is the genetic material.

Q.11. Codon AUG has dual functions. Justify.

Ans:- AUG has dual functions- i) It codes for Methionine (met) , and ii) it also act as *initiator* codon.

Q.12. How is peptide bond established during protein synthesis over ribosome?

Ans:- A peptide bond (- CO – NH -) is established between the carboxyl group (- COOH) of amino acid attached to tRNA at P-site and amino group (- NH_2) group of another amino acid attached to tRNA at A-site. The reaction is catalysed by the enzyme peptidyl transferase (an RNA enzyme).

Q13. Who coined the term gene?

Ans:- Johannsen in 1909.

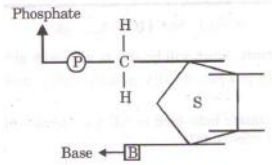
Q.14. Define split genes. Where are they found?

Ans:- Split genes are those genes which possess extra or nonessential regions called introns interspersed with essential or coding parts called Exons. Split genes are found in eukaryotes.
Q.15. What are transposons (Jumping genes)? Who discovered the jumping genes?
Ans:- Transposons are segments of DNA that can jump or move from one place in the genome to another. Transposons were first discovered by Mc Clintock (1951) in case of Maize.
Q.16. Who propounded 'one gene one enzyme hypothesis'?
Ans:- Beadle and Tatum in 1948.
Q.17. State 'one gene one enzyme hypothesis'.
Ans:- 'One gene one enzyme hypothesis' states that a gene controls (metabolic machinery) a structural or functional trait through controlling the synthesis of a specific protein or enzyme.
Q.18. What do you mean by Central dogma?
Ans:- Central Dogma is the flow of information from DNA to mRNA (transcription) and then decoding the information present in mRNA in the formation of polypeptide chain or protein (translation).

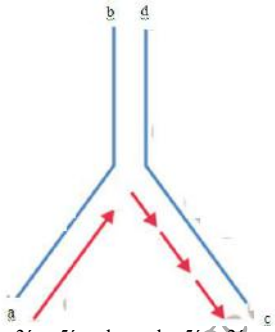
DNA ⟶ mRNA ⟶ Polypeptide (protein)

Q.19. Who gave the concept of central dogma?
Ans:- The concept of central dogma was advanced by Crick in 1958.
Q.20. What is teminism or reverse transcription?
Ans:- Teminism or reverse transcription is inverse flow of information from RNA to DNA.
mRNA of these retroviruses first synthesizes DNA through reverse transcription or teminism. DNA then transfers information to RNA which takes part in translation to form polypeptide.
Q.21. Name of the two molecular biologists who first reported reverse transcription.
Ans:- Temin (1970) and Baltimore (1970) reported reverse transcription or teminism.
Q.22. What is an Operon?
Ans:- An operon is a part of genetic material (or DNA) which acts as a single regulated unit having one or more structural genes, an operator gene, a promoter gene, a regulator gene, a repressor and an inducer or corepressor (from outside).
Q.23. Name the molecule that acts as inducer in lac operon.
Ans:- Lactose
Q.24. What are the 2 recognition sites of tRNA?
Ans:- AA – binding site and anticodon are the two recognition sites of tRNA.
Q.25. What is nucleosome?
Ans:- Nucleosome is sub-microscopic sub-unit of chromatin which is formed wrapping of DNA over a core of histone proteins.
Q.26. What makes the backbone of DNA?
Ans:- Alternate sugar –phosphate.
Q.27. What is the role of helicase enzyme during DNA replication?
Ans:- Enzyme *helicase* acts over the ***ori*** site & unzips the two strands of DNA.
Q.28. What do you mean by primer?
Ans:- Primer is a short chain of RNA, formed on the DNA template at the 5′ end with the help of enzyme called primase.
Q.29. What is the importance of primer during DNA replication?
Ans:- Formation of RNA primer essential because without the presence of RNA primer, DNA polymerases cannot add nucleotides.
Q.30. What are Okazaki fragments?
Ans:- Okazaki fragments are short DNA segments formed on the template strand with polarity 5′ → 3′. Each Okazaki fragment is formed in the 5′ → 3′direction.
Q.31. What do you mean by proof reading during DNA replication?
Ans:- Proofreading is the removal of a mismatched base immediately after it has been added during DNA replication.
Q.32. Which enzyme is known as Kornberg's enzyme?
Ans:- DNA polymerase I.
Q.33. Define transcription.
Ans:- The process of copying of genetic information from template or antisense strand of the DNA into RNA is called transcription.
Q.34. What is splicing?
Ans:- The process of removal of introns through cutting and joining the essential sequences or exons is called splicing.
Q.35. Mention *any* two objectives (goals) Human Genome Project.
Ans:- Some of the important goals of HGP were as follows:
(i) Identify all the approximately 20,000-25,000 genes in human DNA;

(ii) Determine the sequences of the 3 billion chemical base pairs that make up human DNA;
Q.36. Mention the carbon positions to which the nitrogenous base and the phosphate molecule are respectively linked to the nucleotide given below:



Ans:- The carbon positions to which the nitrogenous base and the phosphate molecule are respectively linked to the nucleotide are 1 and 5.
Q37. Mention the polarity of the DNA strands, a—b and c—d shown in replicating fork given below:



Ans:- Polarity of the DNA strands a—b = 3′ →5′ and c—d = 5′→3′.
Q.38. How is gene expressed in an organism?
Ans:- Gene can be expressed by the formation of a polypeptide or protein.
Q.39. Why is tRNA called an adapter molecule?
Ans:- tRNA is called adapter molecule because of transferring amino acids to ribosomes for synthesis of polypeptides.
Q.40. Why is mRNA molecule called informational molecule?
Ans:- mRNA brings instructions from the DNA for the formation of particular type of polypeptide. mRNA is therefore, also called informational molecule.
Q.41. When and at what end does the 'tailing' of hnRNA take place?
Ans:- The *tailing* takes place by adding adenylate residues (200-300) at 3′-end of hnRNA during post transcriptional process.
Q. 42. Name the enzyme involved in the continuous replication of DNA strand. Mention the polarity of the template strand.
Ans:- The enzyme is DNA polymerase. The polarity of the template strand is 3′→5′.
Q.43. What are restriction fragments?
Ans:- DNA of each organism has specific sequence which can be cleaved by several restriction enzymes and fragments of different of lengths can be produced. These fragments are called restriction fragments.
Q.44. What is Restriction Fragment Length Polymorphism (RFLP)?
Ans:- Occurrence of different lengths of DNA sequences cleaved at restriction sites is referred to as Restriction Fragment Length Polymorphism (RFLP).
Q.45. Why do RNA viruses have shorter life span than DNA viruses?
Ans:- Being unstable, RNA mutates at a much faster rate, that is why RNA viruses have shorter life span and mutate and evolve very fast.
Q.46. Write a brief of : (a) Promoter (b) tRNA (c) Exons (d) Bioinformatics
Ans:- (a) Promoter: Promoter is a region of DNA that helps in initiating the process of transcription. It serves as the binding site for RNA polymerase.
(b) tRNA: tRNA or transfer RNA is a small RNA that reads the genetic code present on mRNA. It carries specific amino acid to mRNA on ribosome during translation of proteins.
(c) Exons:- Exons are coding sequences of DNA in eukaryotes that transcribe for proteins.
(d) Bioinformatics: Bioinformatics is the application of computational and statistical techniques to the field of molecular biology.
Q.47. State the function of promoter in a transcription unit?

Ans:- Promoter serves as the binding site for RNA polymerase enzyme and transcription factors.

SHORT ANSWER TYPE QUESTIONS: 2 Marks Each.

Q1. Write any two important features of DNA proposed by Watson and Crick.

Ans:- The salient features of the Double-helix structure of DNA are as follows:

(i) It is made of two polynucleotide chains, where the backbone is constituted by sugar-phosphate, and the bases project inside.

(ii) The two chains have anti-parallel polarity. It means, if one chain has the polarity 5′ → 3′, the other has 3′ →5′.

Q2. State any two important features of Gene.

Ans:- Important features of Gene

i) It should be situated at a specific locus (gene locus).

ii) It carries coded information associated with a specific function and can undergo crossing over as well as mutation.

Q. 3. How does Euchromatin differ from Heterochromatin?

Ans:- In a typical nucleus, some region of chromatin are loosely packed (and stains light) and are referred to as *euchromatin*. The chromatin that is more densely packed and stains dark are called as *Heterochromatin.* Euchromatin is said to be transcriptionally active chromatin, whereas heterochromatin is inactive.

Q.4. Would it be possible to originate the first formed cell if enzymes were not formed before the formation of the first living cell? Give one reason of your answer.

Ans:- Yes, it would be possible. RNA used to act as a genetic material as well as a catalyst (there are some important biochemical reactions in living systems that are catalysed by RNA catalysts and not by protein enzymes).

Q.5. What is satellite DNA? Give their function.

Ans:- Satellite DNA is that part of repetitive DNA which has long repetitive nucleotide sequences in tandem and forms a separate fraction on density ultracentrifugation.

Minisatellites are useful for genetic mapping (DNA fingerprinting) because of high variability.

Q.6. Explain the term Variable Number Tandem Repeats (VNTRs).

Ans:- *Variable number tandem repeats* or VNTRs is hypervariable repeats minisatellite sequences. Each VNTR has 11 – 60 base pairs surrounded by conserved restriction sites. VNTRs differ in families due to some small deletions, insertions and mutations. Each child will receive 50% of DNA from father parent and 50% DNA from mother parent. Therefore, the number of VNTRs in a particular area of the two homologous chromosomes or DNA molecules are likely to be different. As a result each individual comes to have a distinct combination of VNTRs which is peculiar to that person only.

Q7. In what ways do mutation affect the protein synthesis? Give two points.

Ans:- A gene mutation (like the one that causes polydactyly, sickle-cell anaemia, Tay Sachs, PKU) is when the base sequence (A,T,C,G) of DNA is altered, which results in

i) changes the mRNA codon during transcription

ii) which codes for the wrong amino acid.

iii) which produces an abnormal protein.

Q.8. Mention the role of ribosomes in peptide-bond formation. How does ATP facilitate it?

Ans:- Peptide bond (- CO – NH -) is established between the carboxyl group (- COOH) of amino acid attached to tRNA at P-site and amino group (- NH_2) group of another amino acid attached to tRNA at A-site. The reaction is catalysed by the enzyme peptidyl transferase, which is a component of larger sub-unit of ribosome.

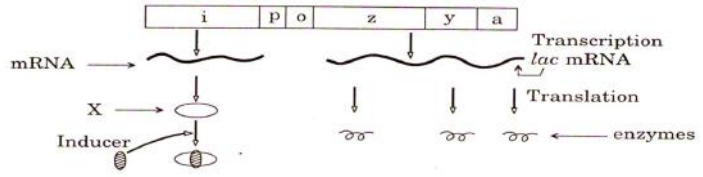
For every single amino acid incorporated in peptide chain one ATP and two GTP are used.

Q.9. Compare the roles of the enzymes DNA polymerase and DNA ligase in the replicating fork of DNA.

Ans:- DNA polymerase catalyses polymerisation of a large number of nucleotides.

DNA ligase joins the Okazaki fragments to form a continuous strand.

Q.10.



a) Name the molecule 'X' synthesised by *'i'* gene. How does this molecule get inactivated?

b) Which one of the structural genes codes for β-galactosidase?

c) When will the transcription of this gene stop?

Ans:- a) The molecule 'X' is repressor. The repressor gets inactivated when an inducer (lactose) comes in contact with it.

b) lac z codes for the enzyme β-galactosidase.

c) Structural genes stop transcription when a repressor binds over operator gene.

Q.11. Initiator tRNA has dual functions. Justify.

Ans:- The initiator tRNA has dual function i) initiation of protein synthesis
ii) bringing in of the first amino acid to ribosome.

Q.12. Explain the dual function of AUG codon. Give the sequence of bases it is transcribed from and its anticodon.

Ans:- AUG has dual functions- i) It codes for Methionine (met), and ii) it also act as *initiator* codon.

The sequences of DNA from where AUG is 5′ TAC - 3′and the sequence of bases at anticodon of tRNA is 5′ UAC - 3′.

Q.13. List two essential roles of ribosome during translation.

Ans:- The important functions of ribosome during translation are as follows.

(a) Ribosome acts as the site where protein synthesis takes place from individual amino acids. It is made up of two subunits. The smaller subunit comes in contact with mRNA and forms a protein synthesizing complex whereas the larger subunit acts as an amino acid binding site.

(b) Ribosome acts as a catalyst for forming peptide bond. For example, 23S r-RNA in bacteria acts as a ribozyme.

Q.14. What do you mean by monocistronic and polycistronic?

Ans:- An mRNA (or the structural gene in a transcription unit) that specifies only a single polypeptide is known as monocistronic (mostly in eukaryotes).

On the other hand, if an mRNA (or the structural gene in a transcription unit) specifies a number of polypeptide, then it is known as polycistronic (mostly in bacteria or prokaryotes).

Q.15. What do you mean by untranslated sequences (UTR)? Mention their functions.

Ans:- An mRNA also has some additional sequences that are not translated and are referred as untranslated regions (UTR). The UTRs are present at both 5′-end (before start codon) and at 3′-end (after stop codon).

They are required for efficient translation process.

Q.16. Describe the structure of an mRNA.

Ans:- mRNA has methylated region at the 5′ terminus. Cap is followed by an initiation codon (AUG) either immediately or after a small non-coding leader region. Then there is coding region followed by termination codon (UAA, UAG or UGA). After termination codon there is a small non-coding trailer region and poly A area or tail at the 3′ terminus.

Q.17. What are the components of histone octamer (core of nucleosome)?

Ans:- Core of nucleosome is composed of four types of histone proteins occurred in pairs i.e. 2 pairs of each of H2A, H2B, H3 and H4, hence called histone octamer (or *nu* body).

Q.18. In the medium where *Escherichia coli* was growing, lactose was added which induced the lac operon. But why does lac-operon shut down sometime after addition of lactose in the medium.

Ans:- *Lac operon* is switched on adding lactose in the medium. Due to this switch on of lac operon system, β-galactosidase is formed which converts lactose into glucose and galactose. As soon as lactose is consumed, repressor again become active and cause switch off (shut down) of system.

Q.19. What are the sense and antisense strands?

Ans:- Out of the two strands of DNA duplex, only one carries the genetic information. It has 3′ → 5′ polarity and is called template or antisense strand.

The other strand is its mirror copy with a polarity of 5 ′ → 3′. It is called coding or sense strand.

SHORT ANSWER TYPE QUESTIONS: 3 Marks Each.

Q1. Draw and label Watson and Crick's double helical model of DNA molecule.

Q.2.Draw a diagram showing the structure of DNA double helix and label the following:

a) Sugar b) Phosphate c) Adenine and Thymine d) Guanine and Cytosine

Q.3. Mention three points of difference purine and pyrimidine.

Ans:- Three points of difference purine and pyrimidine:

Purine	Pyrimidine
1. Purines are larger-sized nitrogen containing biomolecules.	1. Pyrimidines are smaller-sized nitrogen containing biomolecules.
2. A purine is nine-membered double ring.	2. A pyrimidine is 6-membered single ring.
3. Purine bases are of two types – Adenine (A) and Guanine (G).	3. Pyrimidine bases are of three types- cytosine (C), Thymine(T) and Uracil (U)

Q.4. Which property of DNA double helix led Watson and Crick to hypothesise semi- conservative mode of DNA replication? Explain.

Ans:- Watson and Crick observed that the two strands of DNA are anti-parallel and complementary to each other with respect to their base sequences. This type of arrangement in DNA molecule led to the hypothesis that DNA replication is semi- conservative. It means that the double stranded DNA molecule separates and then, each of the separated strand acts as a template for the synthesis of a new complementary strand. As a result, each DNA

molecule would have one parental strand and a newly synthesized daughter strand. Since only one parental strand is conserved in each daughter molecule, it is known as semi-conservative mode of replication.

Q.5. A Policeman finds a cluster of hairs with follicle cells from the site of crime and takes it to the forensic department. Another team of policemen captured two suspected persons including the real culprit and sent them to court. But the court could not finalize the case by legal procedure. In what way a biologist can solve the problem? Explain it in brief.

Ans:- DNA is isolated from the hair follicle cells. With the help of restriction enzymes, DNA is cut to separate VNTRs. Cut DNA is exposed to Gel electrophoresis to separate DNA fragments. The separated VNTRs can be recognized by staining them with dye. VNTRs are treated with alkaline chemicals to split them into single stranded VNTRs. The separated single stranded VNTRs sequences are transferred to nitrocellulose or nylon membrane placed over a gel. Nylon sheet or nitrocellulose is immersed in a bath to which DNA probes are added. The DNA probes get attached to single stranded VNTRs having complementary nucleotide sequences. The nylon membrane containing the radioactive DNA probes and VNTRs is exposed to X-ray film. The hybridized radioactive VNTRs appear as dark bands. The film gives the DNA prints of real culprit.

The same procedure is repeated for those two suspected persons. And DNA fingerprints are compared. The DNA fingerprint taken from hair follicle cells will be exactly identical to that of real culprit. Thus the real criminal can be identified.

Q.6. In a series of experiments with *Streptococcus* and mice, F. Griffith concluded that R-strain bacteria had been transformed. Explain.

Ans:- Transformation experiment was performed by a British doctor, *Frederick Griffith* in 1928 on bacterial strains *Streptococcus pneumoniae.* The bacterium has two strains –

i) Virulent or S – strain which causes disease pneumonia.
ii) Non-virulent or R – strain which is unable to cause pneumonia.

Virulent bacteria are known as S – type because when grown on suitable medium they form smooth colonies. These diplococci are covered by sheath of mucilage (polysaccharide) around them. The sheath is not only the cause of toxigenicity but also protects the bacteria from phagocytes of host. The nonvirulent types of bacteria do not produce the disease. They form irregular or rough colonies.

Griffith performed his experiment by injecting the above bacteria into mice and found the following results:

i) S-strain (Virulent) bacteria were injected into mice, the mice developed pneumonia and finally died.
ii) R- strain (non-virulent) bacteria were injected into mice, the mice suffered no illness because R – strain was non- pathogenic.
iii) Heat killed S-strain bacteria were injected into mice, they did not suffer from pneumonia and thus survived.
iv) A mixture of R-strain (non-virulent) and heat killed S-bacteria were injected into mice, the mice developed pneumonia and died.

Thus some genetic factor from dead S-strain bacteria converted the live R-strain bacteria into live S – strain and later produced the disease.

Q.7. State *any three* applications of DNA Fingerprinting.

Ans:- Applications of DNA Fingerprinting

i) Identification: DNA fingerprinting is a sure method of identification of criminals involved in various types of crime including rape and murder.
ii) Paternity – Maternity Disputes: The method can provide reliable information as to real biological father, mother or offspring.
iii) Close Relations: DNA fingerprinting can establish the closeness of relation of an intending immigrant.

Q.8. Write in brief about *three* components of protein synthesis. 1+1+1= 3(CoHSEM-2016)

Ans:- Three components of protein synthesis are -

i). Ribosomes: Protein synthesis occurs over the ribosomes. Ribosomes are, therefore, called protein factories. Each ribosome has two unequal parts, small and large.
ii). Amino Acids: Some 20 amino acids and amides constitute building blocks or monomers of proteins. They occur in cellular pool.
iii). mRNA: It is a long RNA which brings instructions from the DNA for the formation of particular type of polypeptide.

Q.9. "We accept DNA as better genetic material than RNA".
Support the above quotation with three points.

Ans:- DNA as better genetic material than RNA:

i) RNA has 2′ - OH group in every nucleotide which is quite reactive. This 2′ - OH group is absent in DNA.
ii) Uracil present in RNA is less stable as compared to thymine of DNA.
iii) The nucleotides of DNA are not exposed all the times due to presence of complementary strands. It is not so in case of RNA.

Thus DNA which is stable enough is a better genetic material for storage of genetic information.

Q.10.

Q.11. Give three differences between Variable Number Tandem Repeat and DNA probe.

Ans:- Differences between Variable Number Tandem Repeat and DNA probe:

VNTR	Probe
1. It is a natural small sequence of DNA.	1. It is synthetic DNA fragment.
2. VNTR is nonradioactive.	2. It is a radioactive.
3. VNTRs help in identification of a person.	3. Probes help in identification of VNTRs.

Q.12. "Universal", "initiation codon" and "termination codon" are some of the salient features of genetic code. Explain.

Ans:-

Universal: The code is nearly universal, i.e. a codon specifies the same amino acid from bacteria to a tree or human being. E.g bacteria to human UUU would code for Phenylalanine (phe). Some exceptions to this rule have been found in mitochondrial codons, and in some protozoans.

Initiation Codon: Polypeptide synthesis is signaled by an initiation codon – commonly AUG or methionine codon and rarely GUG or valine codon.

Termination codon: Polypeptide chain termination is signalled by any of the three termination codons – UAA, UAG and UGA. They do not specify amino acid.

Q.13. a) Why is DNA molecule a more stable genetic material than RNA? Explain.
b) "Unambiguous", "degenerate" and "universal" are some of the salient features of genetic code. Explain.

Ans:- a) RNA has 2′ - OH group in every nucleotide which is quite reactive. This 2′ - OH group is absent in DNA. Hence, DNA is more stable genetic material than RNA.

b) Unambigous Codons: It means that one codon specifies only one amino acid and not any other, and specific.

Degeneracy of code: The code is degenerate. For a particular amino acid more than one codon can be used. One amino acid has more than one code triplet. e.g. Phenylalanine has two codons *i.e.* UUC and UUU. Similarly Arginine has 6 codons.

Universal: The code is nearly universal, i.e. a codon specifies the same amino acid from bacteria to a tree or human being.

Q.14. a) Draw a schematic representation of structure of a transcription unit and show the following in it:

i) Direction in which transcription occurs.
ii) Polarity of the two strands involved
iii) Template strand
iv) Terminator gene.

b) Mention the function of the promoter gene in transcription.

Ans:- a)

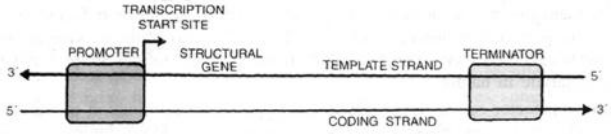


Figure : Components of a transcription unit

b) The function of the promoter gene in transcription is to provide the site for attachment of RNA polymerase enzyme.

Q.15. Why is Human Genome Project (HGP) called a mega project?

Ans:- HGP is called mega project because

i) It involved many countries (USA, Japan, France, Germany, China) for determining the nucleotide sequences of genes.
ii) As a mega project, it was to sequence 3 x 10^9 base pairs costing 9 billion US dollars.
iii) It required bioinformatics data basing and other high speed computational devices for analysis, storage and retrieval of information.

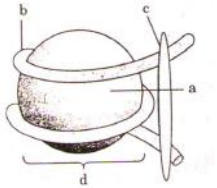
Q.16.

a) In human genome which one of the chromosomes has the most genes and which one has the fewest?
b) Scientists have identified about 1.4 million single nucleotide polymorphs in human genome. How is the information of their existence going to help the scientists? 3 (CBSE – 2009)

Ans:- a) Chromosome 1 has the most genes while Y-chromosome has the fewest genes.

b) Single nucleotide polymorphs in human genome have the potential to help find chromosomal locations for disease associated sequences and tracing human history.

Q.17.



a) What is this diagram representing?
b) Name the parts *a*, b and c.
c) In the eukaryotes the DNA molecules are organized within the nucleus. How is the DNA molecules organized in a bacterial cell in absence of a nucleus? 3 (CBSE – 2009)

Ans:- a) This diagram represents 'Nucleosome'.
b) The part *a* is core of nucleosome; b is DNA and c is H1 histone.
c) In prokaryotes, such as, *E. coli*, though they do not have a defined nucleus, the DNA is not scattered throughout the cell. DNA (being negatively charged) is held with some proteins (that have positive charges) in a region termed as 'nucleoid' or prochromosome. The DNA in nucleoid is organised in large loops held by proteins (non-histone proteins).

Q18. What are satellite DNA in a genome? Explain their role in DNA fingerprinting. 3 (CBSE – 2009)

Ans:- In some specific regions in DNA sequence a small stretch of DNA is repeated many times and hence called as repetitive DNA. These repetitive DNA which are separated from bulk genomic DNA, in non coding regions are referred to as satellite DNA.

Satellite DNAs (minisatellite DNA) make every individual unique. Hence they are used in DNA Fingerprinting.

Q19. Give three differences between Template strand and Coding strand.

Ans:- Difference between Template strand and Coding strand:

Template Strand	Coding Strand
1. It is also called antisense or (−) strand or master strand. 2. It has 3′→ 5′ polarity. 3. It is that strand upon which RNA is transcribed in 5′→ 3′ direction.	1. It is called sense strand or coding strand or (+) or nontemplate strand. 2. It has 5′→ 3′polarity. 3. It has same sequence of bases found in mRNA except T at the place of U. It does not code any information.

Q.20. Give three differences between codon and anticodon.

Ans:- Differences between codon and anticodon:

Codon	Anticodon
1. It is found in mRNA and DNA. 2. Codon is complementary to a triplet of template strand. 3. It determines the position of an amino acid in a polypeptide.	1. It occurs in tRNA. 2. It is complementary to a codon. 3. It helps in bringing a particular amino acid at its proper position during translation.

Q.21. What are the essential properties that a molecule is to be genetic material?

Ans:- A molecule that can act as a genetic material must fulfill the following criteria:
(i) It should be able to generate its replica (Replication).
(ii) It should chemically and structurally be stable.
(iii) It should provide the scope for slow changes (mutation) that are required for evolution.
(iv) It should be able to express itself in the form of 'Mendelian Characters'.

LONG ANSWER TYPE QUESTIONS: 5 MARKS EACH.

Q1. Discuss briefly about the role DNA as medico – legal tool.

Ans:- DNA is used as medico-legal tool in the solution of disputed problems of parentage, identity of criminals etc.

1) DNA fingerprinting is a sure method of identification of criminals involved in various types of crime including rape and murder.
2) DNA Fingerprinting method can provide reliable information to identify the real biological father, mother or offspring in disputed cases. Thus paternity – maternity cases can be solved in court using DNA Fingerprinting.
3) DNA fingerprinting can establish the closeness of relation of an intending immigrant.
4) The reunion of the lost children with their parents or vice-versa separated due to war, violence, natural disaster, etc is possible by comparing DNA profile of the parents and lost children and vice-versa.

Q.2. Define transcription and translation. Write briefly the role of these processes in protein synthesis.

Ans:- The process of copying of genetic information from antisense strand of the DNA into RNA is called transcription.

Translation is the synthesis of polypeptide over ribosome.

During transcription, genetic information is copying from one strand of the DNA into RNA. It is meant for taking coded information from DNA to the site where it is required for protein synthesis. It produces mRNA that carries coded information which is necessary for protein or polypeptide synthesis.

During translation, amino acids polymerise to form a polypeptide. The order and sequence of amino acids are defined by the sequence of bases in the mRNA. The amino acids are joined by a bond which is known as a peptide bond.

Q.3. Mention 5 important Goals of Human Genome Project.

Ans:- Some of the important goals of HGP were as follows:
(i) Identify all the approximately 20,000-25,000 genes in human DNA;
(ii) Determine the sequences of the 3 billion chemical base pairs that make up human DNA;
(iii) Store this information in databases;
(iv) Improve tools for data analysis;
(v) Transfer related technologies to other sectors, such as industries.

Q.4. a) How did Griffith explain the transformation of R-strain (non-virulent) bacteria into S-strain (virulent)?
b) Explain how Mac Leod, Mc Carty and Avery determined the biochemical nature of the molecule responsible for transforming R-strain bacteria into S-strain bacteria.

Ans:- a) Transformation experiment was performed by a British doctor, *Frederick Griffith* in 1928 on bacterial strains *Streptococcus pneumoniae* or *Diplococcus* or *Pneumococcus pneumoniae.* The bacterium has two strains –

i) Virulent or S – strain which causes disease pneumonia.
ii) Non-virulent or R – strain which is unable to cause pneumonia.

Virulent bacteria are known as S – type because when grown on suitable medium they form smooth colonies. These diplococci are covered by sheath of mucilage (polysaccharide) around them. The sheath is not only the cause of toxigenicity but also protects the bacteria from phagocytes of host. The nonvirulent types of bacteria do not produce the disease. They form irregular or rough colonies.

Griffith performed his experiment by injecting the above bacteria into mice and found the following results:
i) S-strain (Virulent) bacteria were injected into mice, the mice developed pneumonia and finally died.
ii) R- strain (non-virulent) bacteria were injected into mice, the mice suffered no illness because R – strain was non- pathogenic.
iii) Heat killed S-strain bacteria were injected into mice, they did not suffer from pneumonia and thus survived.
iv) A mixture of R-strain (non-virulent) and heat killed S-bacteria were injected into mice, the mice developed pneumonia and died.

Thus some genetic factor from dead S-strain bacteria converted the live R-strain bacteria into live S – strain and later produced the disease.

b) In 1944, Avery, MacLeod and Mc Carty purified biochemicals from the heat killed S- type bacteria into 3 components – DNA, carbohydrates and protein. DNA fraction was further divided into 2 parts: One with DNase (Deoxyribonuclease) and other without it. The four components were then added to separate culture tubes containing R – type bacteria.

They were then analysed for bacterial population.

R – type + Protein S- type ⟶ R – type.

R – type + Carbohydrate S- type ⟶ R – type.

R – type + DNA S- type + *DNase* ⟶ R – type.

R – type + DNA S- type ⟶ S – type.

Only DNA of S – type can change R – type bacteria into S –type. Therefore, the character or gene of virulence is located in DNA. Thus they proved that the chemical to be inherited is DNA.

Q.5. Two blood samples A and B picked up from the crime scene were handed over to the forensic department for genetic fingerprinting. Describe how the technique of genetic fingerprinting is carried out. How will it be confirmed whether the samples belonged to the same individual or two different individuals?

Ans:- DNA is isolated from the White blood corpuscles of sample A. With the help of restriction enzymes, DNA is cut to separate VNTRs. Cut DNA is exposed to Gel electrophoresis to separate DNA fragments. The separated VNTRs can be recognized by staining them with dye. VNTRs are treated with alkaline chemicals to split them into single stranded VNTRs. The separated single stranded VNTRs sequences are transferred to nitrocellulose or nylon membrane placed over a gel. Nylon sheet or nitrocellulose is immersed in a bath to which DNA probes are added. The DNA probes get attached to single stranded VNTRs having complementary nucleotide sequences. The nylon membrane containing the radioactive DNA probes and VNTRs is exposed to X-ray film. The hybridized radioactive VNTRs appear as dark bands. The film gives the DNA prints of real culprit.

The same procedure is repeated for sample B. The two DNA fingerprints are then compared. If the two DNA fingerprints are identical, they belong to the same individual, or if non-identical, they belong to two different individuals.

Q. 6. How did Alfred Hershey and Martha Chase arrive at the conclusion that DNA is the genetic material?

Ans:- A.D. Hershey and Martha Chase (1952) raised T_2 bacteriophage over two different colonies, one having radioactive phosphorus ^{32}P and the other having radioactive sulphur ^{35}S. Radioactive sulphur got incorporated in the capsid proteins of bacteriophage. Radioactive phosphorus ^{32}P became component of DNA of bacteriophage. The two types of bacteriophages were taken out and allowed to infect bacteria, *Escherichia coli* separately. Soon after infection, the cultures were gently agitated in a blender to separate the adhering protein coats of the virus from the bacterial cells. The empty phage capsids or ghosts got separated from the bacterial cells. In the experiment using ^{35}S, radioactivity remained limited to supernatant having phage ghosts. In the experiment using ^{32}P, radioactivity was absent in the supernatant having phage ghosts. The ^{32}P was present in bacteria and the phages which multiplied in them. Therefore, DNA is the genetic material which could enter the bacteria and helped in phage multiplication.

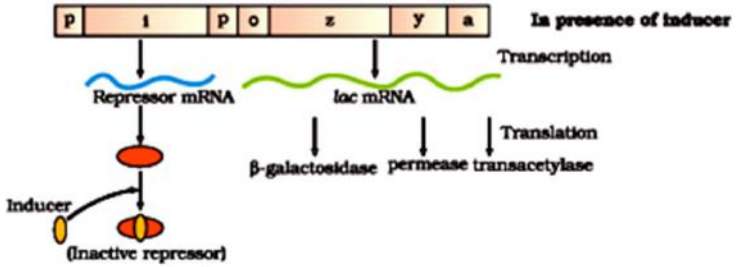
Q.7. a) State the arrangement of different genes that in bacteria is referred to as 'operon'.

b) Draw a schematic labelled illustration of lac operon in a 'switched on' state.

c) Describe the role of lactose in lac operon.

Ans:- a) An operon consists of a regulator gene, promoter gene, operator gene and structural genes.

b) Fig: A schematic labelled illustration of lac operon in a 'switched on' state.



c) In lac operon, lactose acts as inducer and in its presence, the system is switched on.

Q.8. Give five points of difference between repetitive DNA and satellite DNA.

Ans:- Difference between repetitive DNA and satellite DNA:

Repetitive DNA	Satellite DNA
1. It is that part of DNA which contains same sequence of bases repeated several times in a genome.	1. It is part of DNA having highly repeated short sequences of nitrogen bases.
2. Length of repetitive DNA varies from a few nitrogen bases to several hundred.	2. Length of DNA sequence of satellite DNA is short, 1-60 bp.
3. Repeated DNA sequences may or may not be present in tandem.	3. Repeated sequences of nitrogen bases occur in tandem.
4. It does not separate during density gradient ultracentrifugation.	4. It separates out during density gradient ultracentrifugation.
5. Variability may or may not be present.	5. Variability occurs during misalignment in chromosome pairing.

Q.9. What are Chargaff's rules?

Ans:- Erwin Chargaff (1950) gave the following observations on the base and other contents of DNA molecule:

i) Purine and pyrimidine base pairs are equal in amount, that is,

adenine + guanine = thymine + cytosine. [A + G] = [T + C] i.e. $\frac{[A+G]}{[T+C]} = 1$

ii) Molar amount of adenine is always equal to the molar amount amount of thymine. Similarly, molar concentration of guanine is equalled by molar concentration of cytosine.

[A] = [T], i.e. $\frac{[A]}{[T]} = 1$; [G] = [C], i.e. $\frac{[G]}{[C]} = 1$

iii) Sugar deoxyribose and phosphate occur in equimolar proportions.

iv) The ratio of $\frac{[A+T]}{[G+C]}$ is variable but constant for a species. It can be used to identify the source of DNA. The ratio is low in primitive organisms and higher in advanced ones.

Q.10. Explain the salient features of Double helix structure of DNA as proposed by Watson and Crick.

Ans:- The salient features of the Double-helix structure of DNA are as follows:

(i) It is made of two polynucleotide chains, where the backbone is constituted by sugar-phosphate, and the bases project inside.

(ii) The two chains have anti-parallel polarity. It means, if one chain has the polarity 5′ → 3′, the other has 3′ →5′.

(iii) The bases in two strands are paired through hydrogen bonds (H-bonds) forming base pairs (bp). Adenine forms two hydrogen bonds with Thymine from opposite strand and vice-versa. Similarly, Guanine is bonded with Cytosine with three H-bonds. As a result, always a purine comes opposite to a pyrimidine. This generates approximately uniform distance between the two strands of the helix.

(iv) The two chains are coiled in a right-handed fashion. The pitch of the helix is 34 A^0 (3.4) nm and there are roughly 10 base pairs in each turn. Consequently, the distance between a bp in a helix is approximately equal to 3.4A^0.

(v) The plane of one base pair stacks over the other in double helix. This, in addition to H-bonds, confers stability of the helical structure.

Q.11. How can you say that DNA is a better genetic material than RNA? Explain by giving at least 5 points.

Ans:-

i) Heat which killed bacteria in Griffith's experiment did not destroy their DNAs but RNA is labile and easily degradable.

ii) RNA has 2′ - OH group in every nucleotide which is quite reactive. This 2′ - OH group is absent in DNA.

iii) Uracil present in RNA is less stable as compared to thymine of DNA.

iv) The rate of mutation is slow in case of DNA. Being unstable, RNA mutates at a much faster rate, that is why RNA viruses have shorter life span and mutate and evolve very fast.

v) The nucleotides of DNA are not exposed all the times due to presence of complementary strands. It is not so in case of RNA.

Thus DNA which is stable enough is a better genetic material for storage of genetic information.

Q.12. Give five differences between Leading strand and Lagging strand.

Ans:- Differences between Leading strand and Lagging strand:

Leading Strand	Lagging Strand
1. It is a replicated strand of DNA which grows continuously without any gap.	1. Lagging strand is a replicated strand of DNA which is formed in short segments called Okazaki fragments. Its growth is discontinuous.
2. It does not require DNA ligase for its growth.	2. DNA ligase is required for joining Okazaki fragments.
3. The direction of growth of leading strand is 5′→3′.	3. The direction of growth of lagging strand is 3′→5′though in each Okazaki fragment it is 5′→3′.
4. Only a single RNA primer is required.	4. Starting of each Okazaki fragment requires a new RNA.
5. Formation of leading is quite rapid.	5. Formation of lagging strand is slower.

Q.13. Define transcription unit. Discuss the components of a transcription unit.

Ans:- The segment of DNA that takes part in transcription is called transcription unit. It has 3 components –

a) A promoter region in the beginning

b) A terminator region in the end and

c) A structural gene in between.

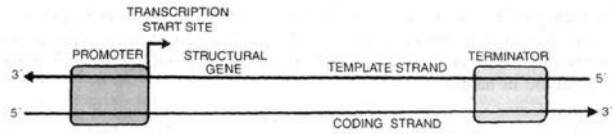


Figure : Components of a transcription unit

In many cases, the promoter has AT rich septumer called TATA box or Pribnow box *after the name of discoverer*. Promoter region is the proximal area of transcription unit which provides sites for attachment of transcription factors and RNA polymerase.

Terminator region is either palindromic sequences or poly A sequences. There is a site for attachment of rho factor for release RNA polymerase.

Structural gene is the area of template strand that is involved in transcription or formation of RNA. Structural gene is component of that strand of DNA which has 3′ → 5′ polarity (as transcription can occur only in 5′→3′).

Q14. Differentiate transcription from translation by giving at least five points.
Ans:-

Transcription	Translation
1. It is the formation of RNA from DNA.	1. It is the synthesis of polypeptide over ribosome.
2. The template is antisense strand of DNA.	2. The template is mRNA.
3. It occurs inside the nucleus in eukaryotes and cytoplasm in prokaryotes.	3. It occurs in cytoplasm.
4. The raw materials are four types ribonucleotide triphosphates – ATP, GTP, CTP and UTP.	4. The raw materials are 20 types of amino acids.
5. Transcription requires RNA polymerases and some transcription factor.	5. All the three types of RNAs take part in translation.

Q.15. Describe any five salient features of Genetic code.
Ans:- The salient features of genetic code are as follows:
1. Triplet Code: Genetic code is triplet code where three adjacent nitrogen bases specify one amino acid, e.g. UGG for tryptophan, AUG for methionine.
2. Non –Overlapping: Three successive nucleotides or nitrogen bases code for only one amino acid. None of these nitrogen bases become part of any other codon.
3. Commaless: Once the reading is commenced at a specific codon, there is no punctuation between codons, and the message is read in a continuing sequence of nucleotide triplets until a translation stop codon is reached. If a nucleotide is deleted or added, the whole genetic code will read differently.
4. Nonambigous Codons: It means that one codon specifies only one amino acid and not any other, and specific.
5. Degeneracy of code: The code is degenerate. For a particular amino acid more than one codon can be used. One amino acid has more than one code triplet. e.g. Phenylalanine has two codons *i.e.* UUC and UUU.
Q.16. State five salient features of Human Genome.
Or Describe the revelation of Human Genome Project (HGP).
Ans:- Salient Features of Human Genome (Revelation of HGP):
(i) The human genome contains 3164.7 million nucleotide bases.
(ii) The average gene consists of 3000 bases, but sizes vary greatly. The largest gene is that of Duchenne Molecular Dystrophy on X-chromosome at 2.4 million bases.
(iii) The total number of genes is estimated at 30,000–much lower than previous estimates of 80,000 to 1,40,000 genes. Almost all (99.9 per cent) nucleotide bases are exactly the same in all people.
(iv) The functions are unknown for over 50 per cent of discovered genes.
(v) Chromosome 1 has most genes (2968), and the Y has the fewest (231). They are the maximum and minimum genes for the human chromosomes.
Q.17. State five applications and future challenges of Human Genome Project (HGP).
Or Enlist prospects and implications of Human Genome project (HGP).
Ans:- Applications and Future challenges (Prospects and Implications of Human Genome Projects):
i). Disorder: More than 1200 genes are responsible for common human cardiovascular diseases, endocrine diseases (like diabetes), neurological disorders (like Alzheimer's disease), cancers and many more.
ii). Cancer: Efforts are in progress to determine genes that will change cancerous cells to normal.
iii). Health Care: It will indicate prospects for a healthier living, designer drugs, genetically modified diets and finally our genetic identity.
iv). Interaction: It will be possible to study how various genes and proteins work together in an interconnected network.
v). Study of Tissues: All the genes or transcripts in a particular tissue, organ or tumour can be analysed to know the cause of effect produced in it.

Q.18. Give applications and future challenges of Human Genome Project (HGP).
Or, Mention 5 Prospects and implications of HGP.
Ans:- Applications and Future challenges (Prospects and Implications of Human Genome Projects) are
1. Disorder: More than 1200 genes are responsible for common human cardiovascular diseases, endocrine diseases (like diabetes), neurological disorders (like Alzheimer's disease), cancers and many more.
2. Cancer: Efforts are in progress to determine genes that will change cancerous cells to normal.

3. Health Care: It will indicate prospects for a healthier living, designer drugs, genetically modified diets and finally our genetic identity.
4. Interaction: It will be possible to study how various genes and proteins work together in an interconnected network.
5. Study of Tissues: All the genes or transcripts in a particular tissue, organ or tumour can be analysed to know the cause of effect produced in it.

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HUMAN HEALTH AND DISEASE

VERY SHORT ANSWER TYPE QUESTIONS: 1 Mark Each
Q.1. How does vaccination protect a person from a particular disease? 1 (CoHSEM, 1998)
Ans:- Vaccination provides temporary or permanent immunity by inducing antibody formation.
Q.2. Differentiate between communicable disease and degenerative disease. 1 (CoHSEM, 1999)
Ans:- Communicable diseases are produced due to pathogens and parasites; and can pass from infected person to healthy one. Degenerative diseases are due to malfunctioning of some vital organs.
Q.3. Give one point of difference between infection and infestation. 1 (CoHSEM, 1999)
Ans:- Infection is the invasion of an organism's body tissues by disease-causing agents, their multiplication, and the reaction of host tissues to these organisms and the toxins they produce. Infestation refers to the presence of large number of disease causing organisms of the same type in host's body.
Q.10. How anaphylactic shock affects to our body? 1 (CoHSEM, 2010)
Ans:- Histamine released from ruptured mast cells due to anaphylactic shock, causes marked dilation of all arteries so that a large amount fluid is passed from the blood to the tissues and there is drastic fall in B.P. The affected person may become unconscious and the individual may die within a short time.
Q.11. How does Primary Immune Response differ from Secondary Immune Response?
Ans:- Primary immune response occurs as a result of the first contact with an antigen. Secondary immune response occurs at the second and subsequent exposure of the same host to the same antigen.
Q.10. What is the confirmation test for Typhoid? 1 (CoHSEM-2014)
Ans:- Widal test is the confirmatory test for typhoid.
Q.11. What are cannabinoids?
Ans:- Cannabinoids are the drugs obtained from *Cannabis sativa* which bind to receptors in brain.
Q.12. Name the two types of cells in which the HIV multiplies after gaining entry into the human body.
Ans:- Macrophages and Helper T – Cells.
Q.13. How do neutrophils act as a cellular barrier to pathogens in humans? 1 (CBSE-2008)
Ans:- Neutrophils of WBCs phagocytose and destroy microbes. Thus they act as cellular barrier.
Q.14. Why do sportspersons often fall a victim to coccain addiction? 1 (CBSE-2008)
Ans:- Coccain is a powerful CNS stimulant. It induces a sense of wellbeing and pleasure and delays fatigue. Hence sportpersons consume it and become addiction.
Q.15. Name the type of cells the AIDS virus enters into after getting in the human body. 1 (CBSE-2009)
Ans:- Macrophages and Helper T-Cells.
Q.16. A boy of ten years had chicken pox. He is not expected to have the same disease for the rest of his life. Mention how is it possible. 1 (CBSE-2009)
Ans:- Antibodies produced during the first infection results in memory of the following encounter of same disease, chicken pox. Thus, the boy is expected to protect from the chicken pox in future.
Q.17. Define infestation.
Ans:- Infestation refers to the presence of large number of disease causing organisms of the same type in host's body.
Q.18. Why does a doctor administer tetanus antitoxin and not a tetanus vaccine to a child injured in a road accident with a bleeding wound? Explain.
Ans:- If a person is infected with some deadly microbes to which quick immune response is required as in tetanus, then doctor directly inject the preformed antibodies (or antitoxin). This is called passive immunization.
Q.19. A boy of 6 years had mumps. He is not expected to have the same disease for the rest of his life. Mention how is it possible.
Ans:- Antibodies produce during the first infection result in memory of the first encounter to protect the body in future. Hence he will not suffer from mumps again.
Q.20. Define allergy.
Ans:- An allergy is the hypersensitivity of immune system of a person to some foreign substance, called allergen, which either comes in contact with or enters the body.
Q.21. What is metastasis?

Ans:- The phenomenon in which cancer cells spread to distant sites through body fluids to develop secondary tumour is called *metastasis*.
Q.22. Name the infective stage of *Plasmodium* which *Anopheles* mosquito takes in along with the blood meal from an infected human.
Ans:- Gametocytes
Q.23. Name the infective stage of *Plasmodium* which is injected the blood of a healthy man by the female Anopheles mosquito.
Ans:- Sporozoite.
Q.24. What is the infective stage of *Plasmodium*?
Ans:- Sporozoite.
Q.What type of virus causes AIDS? Name its genetic material?
Ans:- AIDS is caused by the Human immune deficiency virus (HIV). RNA is its genetic material.
Q.25. What is the responsible for malarial fever?
Ans:- Haemozoin released by ruptured RBCs causes recurring chill and high fever.
Q.26. What are interferons? How do they help in developing resistance to infection?
Ans:- Interferons are proteins secreted by viral infected cells that protects non-infected cells from further viral infection. Interferons make the surrounding cells resistant to viral infection by inhibiting multiplication of viral particles.
Q.27. Name an opioid drug and its source plant. How does the drug affect the human body?
Ans:- Opium is dried latex of unripe fruits of poppy plant, *Papaver somniferum*.
Q.28. What are psychedelic drugs (hallucinogens)?
Ans:- Psychedelic drugs (Hallucinogens) are those drugs which change one's behaviour, thoughts, feelings and perceptions without any actual sensory stimulus.
Q.29. How do killer T-cells work?
Ans:- These cells attack directly and destroy antigens. In the process, these cells move to the site of invasion and produce chemicals that attract phagocytes and stimulate them so that they can feed more vigorously on antigens. They also produce substances that attract other T-cells.
Q.30. Define adolescence.
Ans:- Adolescence is the period of rapid growth and physical and mental development between childhood and adulthood.
Q.31. Why is said that once a person starts taking alcohol or drugs, it is difficult to get rid of this habitat? Discuss.
Ans:- Once a person starts taking alcohol or drugs, he becomes addict to these substances physically and mentally. Whenever, he tries to get rid of this habit, he shows unpleasant withdrawal symptoms and these include vomiting, diarrhoea, shivering, twitching, perspiration, abdominal and muscular cramps, etc.
Q.32. What are carcinogens?
Ans:- Chemical, physical and biological agents which can cause cancer are called carcinogens.
Q.33. Name the most abundant immunoglobulin.
Ans:- IgG
Q.34. What do you mean by innate immunity?
Ans:- Innate Immunity is resistant to infection which an individual possesses by virtue of his/her genetic and constitutional make up. Thus innate immunity comprises all those defence elements with which an individual is born, and which are always available to protect a living body.
Q.35. Name the type of immunoglobulin involved in allergic reaction.
Ans:- Ig E.
Q.36. What are congenital diseases?
Ans:- Congenital diseases are diseases which a person has already contracted at birth. e.g. sickle cell anaemia, turner's syndrome.
Q.37. What is an Auto-immune disorder? 1 (CoHSEM-2017)
Ans:- Auto-immune disorder is a disorder or disease in which self cells are attacked by own antibodies or immunoglobulins, resulting in damage to the body.
Q.38. The following are some well-known abbreviations, which have been used in this chapter. Expand each one to its full form:
(a) MALT
(b) CMI
(c) AIDS
(d) NACO
(e) HIV
Ans:-
(a) MALT- Mucosa-Associated Lymphoid Tissue
(b) CMI- Cell-Mediated Immunity

(c) AIDS- Acquired Immuno Deficiency Syndrome
(d) NACO- National AIDS Control Organization
(e) HIV- Human Immuno Deficiency virus
Q.39. Name the toxin responsible for the appearance of symptoms of malaria in human. Why do these symptoms occur periodically?
Ans:- the toxin responsible for symptoms of malaria is haemozoin. It is released when RBCs get ruptured due to erythrocytic schizogony of *Plasmodium* that takes place every 48 hours.
Q.40. Define adolescence.
Q.41. Write the name of the plant from which morphine is obtained.
Q.42. Name the drug obtained from the latex of unripe fruits of *Papaver somniferum*?
Q.43. What is the source of drug LSD?

SHORT ANSWER TYPE QUESTIONS: 2 Marks Each.

Q.1. Write any two effects each of narcotics and stimulants on the body of man. 2 (CoHSEM, 1996)
Ans:- Narcotic acts as depressant and slows down body functions while stimulants provides sense of wellbeing, alertness; and thinking becomes clear, improve performance.
Q.2. Write the full forms of HIV and AIDS. 1+1=2 (CoHSEM, 1997)
Ans:- HIV = Human Immuno Deficiency Virus.
AIDS = Acquire Immuno Deficiency Syndrome.
Q.3. It was diagnosed that the body of a patient has lost its power of fighting any infection. Name the possible disease. What type of microbes may be responsible for the disease and how it may spread from one person to another?
Ans:- The disease is AIDS (Acquire Immuno Deficiency Syndrome).
The microbe is HIV (Human Immuno Deficiency Virus), an RNA virus. Transmission of HIV-infection generally occurs by (a) sexual contact with infected person, (b) by transfusion of contaminated blood and blood products, etc.
Q.4. Differentiate between 1+1=2 (CoHSEM, 2004)
i) Congenital and Acquired diseases
ii) Communicable and Degenerative diseases
Ans:- i) Congenital diseases are those diseases which a person has already contracted at birth. Acquired diseases are contracted after birth due to various reasons like infection, degeneration, diet, addiction, depression, cancer, etc.
ii) Communicable diseases are produced due to pathogens and parasites; and can pass from infected person to healthy one. Degenerative diseases are due to malfunctioning of some vital organs.
Q.5. Write 2 points of differences between antibodies and antigens.
Ans:- Difference between Antibodies and Antigens:

Antibodies(Immunoglobulins)	Antigens (Immunogens)
1. Antibody is a protein molecule. 2. It is synthesized by an animal to combat foreign material.	1. Antigen is a protein or polysaccharide molecule. 2. It is usually a foreign material that stimulates antibody formation.

Q.6. Explain the difference between Sarcoma and Carcinoma.
Ans:- Difference between Sarcoma and Carcinoma:

CARCINOMA	SARCOMA
1. It is the malignant growth of epithelial tissues that are ectodermal in origin. 2. These include lung cancer, breast cancer.	1. It is the malignant growth of tissues derived from primitive mesoderm. 2. These include bone cancer and cancer of lymph nodes.

Q.7. List at least four danger signals of cancer.
Ans:- Danger signals of cancer are -
i) A persistent cough or hoarseness in a smoker.
ii) A persistent change in digestive and bowel habits.
iii) A change in a wart or mole.
iv) A lump or hard area in the breast.
v) Unexplained loss of weight.
vi) Any uncurable ulcer.
vii) Non-injury bleeding from the surface of the skin, mouth and any other opening of the body.

Q.8. Write four symptoms of AIDS RELATED Complex.
Ans:- Symptoms of AIDS RELATED Complex are swollen lymph nodes, fever, sweating at nights, and weight loss. Patients with ARC have a high possibility of early development of AIDS.

Q.9. A person has been diagnosed to be HIV positive.

i) Name the test which the person underwent.
ii) Which particular cells of this person are likely to get destroyed?
Ans:-
i) ELISA (Enzyme Linked Immuno sorbent Assay)
ii) Helper T-cells.

Q.10. What is the mechanism by which AIDS virus causes deficiency of immune system of infected person?
Ans:- After the entrance of the virus into body of the person, the virus specially binds to a surface receptor on a helper T-cells and introduces its RNA and reverse transcriptase enzyme into the cells. Here it multiplies and the release of new viruses destroys the cell. AIDS occurs when the number of helper T-cells falls too low to fight the disease.
Q.11. How does active immunity differ from passive immunity?
Ans:- Active Immunity involves the active functioning of the person's own immune system leading to synthesized of antibodies and production of immunologically active cells.
In Passive immunity, there is transfer of immune products like antibodies to a recipient in a readymade form.
Q.12. Differentiate primary immune response and secondary immune response.
Ans:- Primary immune response is produced by the initial contact of an animal with an antigen. It takes relatively a longer time, and is feeble and declines rapidly.
Secondary immune response: Subsequent encounter with the same pathogen elicits a highly intensified secondary response. It is heightened and quick response which lasts much longer and may be life-long. A person having survived one attack of chicken pox or measles or mumps remains immune to the disease throughout due to secondary immune response.
Q.13. Which other cells, besides the helper T-cells, are infected by HIV? What makes these cells susceptible?
Ans: Besides helper T-cell, HIV also infects macrophages and some B-Lymphocytes. HIV enters these three types of cells as they all bear a surface protein CD4 on them. Recently it has been found that a second protein molecule, called co-receptor, is also necessary for the infection of the host cells.
Q.14. A person in a family is suffering from cholera. Suggest two measures to protect other members of the family from the spread of the disease.
Ans:- Two measures to protect other members of the family from the spread of the disease.
a) Proper disposal of faeces or vomits of the patient.
b) Washing hands before meals.
Q.15. One of your neighbour is suffering from amoebiasis. Suggest any four measures to be taken up so that the disease should not spread to other persons of the locality. 2 (CoHSEM, 2003)
Ans:- Following measures should be taken up:
a) Proper disposal of human faeces.
b) Proper coverage of eatables from vectors (flies etc)
c) Proper washing of eatables.
d) Washing hands before meals.
Q.16. Give any four symptoms of Drug addiction.
Ans:- Symptoms of Drug addiction:
i) All drugs affect the Central Nervous System and their prolonged use causes permanent damage.
ii) Continuous use of narcotics and stimulants can cause impotency, chromosomal aberration and production of abnormal babies.
iii) The side effects of the use of anabolic steroids in female sportspersons include musculization (males like features), increase aggressiveness, depression, abnormal menstrual cycles, excessive hair growth on face and body.
iv) Drugs, alcohol and tobacco affect liver and kidneys as they become involved in metabolism and elimination of their products. This is not their function. They, therefore, become damaged.
Q.17. Name the four types of T-cells. What are Primed cells?
Ans:- Helper T-cells, Cytotoxic/killer T-cells, Suppressor T-cells and Memory T-cells.
Primed cells are Memory T-cells.
Q.18. a) Name the lymphoid organ in humans where all the blood cells are produced.
b) Where do the lymphocytes produced by the lymphoid organ mentioned above migrate and how they affect immunity?
Ans:- a) Bone marrow.
b) T-lymphocytes migrate to thymus whereas B-lymphocytes differentiate in the gut associated lymphoid tissues. B-lymphocytes provide Humoral immune system. T-lymphocytes provide Cell mediated immune system.
Q.19. List the specific symptoms of typhoid. Name its causative agent.
Ans:- Sustained high fever (39° to 40°C), weakness, stomach pain, constipation, headache and loss of appetite are some of the common symptoms of this disease.
Causative agent is *Salmonella typhi*.

Q.20. Explain metastasis. Why is it fatal?
Ans:- A phenomenon in which cancer cells spread to distant sites through body fluids to develop secondary tumour is called *metastasis*. It is fatal when they disrupt the function of some vital organ.
Q.21. If a man suffers from pain in abdomen and passes of faeces with blood; which disease will you recommend and how it is transmitted?
Ans:- The disease is Amoebiasis (Amoebic Dysentry or Enteritis) caused by *Entamoeba histolytica*. It transmitted through the following ways -
Human infection is direct and oral. The tetranucleate cysts are ingested with contaminated food and water. Houseflies and cockroaches act as passive vector.
Q.22.Name and explain the types of barrier of innate immunity when some cells release interferons when infected.
Ans:- The type of barrier is cytokine barrier.
In this barrier type, Virus-infected cells secrete proteins called interferons which protect non-infected cells from further viral infection. Interferons make the surrounding cells resistant to viral infection by inhibiting multiplication of viral particles.
Q.23. Name an opioid drug and its source plant. How does the drug affect the human body?
Ans:- Opium. It is obtained from *Papaver somniferum*.
Q.24. Name and explain the types of barrier of innate immunity when some cells release interferon when infected.
Ans:- The barrier is Cytokine barrier. Viral infected cells secrete proteins known as interferons which protect non-infected cells from further viral infection. Interferons make the surrounding cells resistant to viral infection by inhibiting multiplication of viral particles.
Q.25. Why does a doctor administer tetanus antitoxin and not a tetanus vaccine to a child injured in a road accident with a bleeding wound? Explain.
Ans:- If a person is infected with some deadly microbes to which quick immune response is required as in tetanus, then the doctor directly inject the preformed antibodies (antitoxin). This is called artificial passive immunisation.
Q.26. Who discovered Monoclonal Antibodies? Write any one use of MAB?
(Who discovered Monoclonal Antibodies? Write any one use of MAbs?)
Ans:- Georges Kohler and Cesar Milstein discovered Monoclonal Antibodies.
Use of MAbs: (any one)
i) MAbs may be employed as diagnostic reagents for biochemical analysis or as tools for diagnostic imaging of diseases.
ii) MAbs are used in the treatment of cancer, transplantation of bone marrow and organs, autoimmune diseases, cardiovascular diseases and infectious diseases.
Q.27. Why does a doctor administer tetanus antitoxin and not a tetanus vaccine to a child injured in a roadside accident with a bleeding wound? Explain. 2
Q.28. In cases of snakebites, why does a doctor administer injection which contain ***preformed*** antibodies but not vaccine (against the snake venom) to the patients?

SHORT ANSWER TYPE QUESTIONS: 3 Marks Each.
Q.1. Give two differences between Infectious diseases and Non- Infectious diseases.
Ans:- Difference between Infectious diseases and Non- Infectious diseases:

Infectious diseases	Non-infectious diseases
1. They are caused by parasitic living organisms or pathogens. 2. The diseases are passed from infected persons to healthy persons. 3. A direct or indirect transmission is involved.	1. They are caused by agents other than organisms. 2. The diseases cannot pass from one person to another. 3. Transmission is absent except congenital diseases.

Q.2. Any person can become allergic to anything and at any time of his life. Explain how?
Ans:- Allergy is the hypersensitivity of immune system of a person to some foreign substance, called allergen, which either comes in contact with or enters the body. Anytime an allergen may come in contact or enter the body. Allergens combine with antibody-bound mast cells which rupture and release histamine and serotonin. On exposure to the allergen body produces IgE that activates mast cells of WBCs and produce symptoms. Continued exposure may increase one's chances of developing allergy. Thus, any person can become allergic to anything and at any time of his life.
Q.3. How do B-lymphocytes differ from T-lymphocytes?
Ans:-

B-Lymphocytes (B cells)	T-Lymphocytes (T-Cells)
1. They arise from bone marrow and differentiate in Bursa fabricus (in birds), gut associated lymphoid tissue (Payer patches). 2. B-cells form Humoral immune system.	1. They arise from bone marrow and migrate to Thymus for differentiation. 2. T-cells form Cell mediated immune system. 3. They defend against pathogens including

3. They defend against viruses and bacteria that enter the blood and lymph. 4. Plasma cells do not react against transplant and cancer cells.	protists and fungi that enter the cells. 4. Killer cells react against transplants and cancer cells.

Q.4. It was diagnosed that the body of a patient has lost its power of fighting any infection. Name the possible disease. What type of microbes may be responsible for the disease and how it may spread from one person to another?

Ans:- The disease is AIDS (Acquire Immuno deficiency Syndrome). It is caused by HIV (Human Immuno Deficiency Virus).

The disease may spread through –

i) Transfusion of infected blood or blood products.

ii) Used of contaminated needles and syringes to inject drugs or vaccines.

iii) Sexual intercourse with an infected partner without a condom.

Q.5 Describe how primary lymphoid organs differ from secondary lymphoid organs. Give an example of each.

Ans:-

Primary Lymphoid Organs: They are those organs where T lymphocytes and B lymphocytes, mature and acquire their antigen-specific receptors. After maturation, the lymphocytes migrate to secondary lymphoid organs. Primary lymphoid organs include bone marrow and thymus.

Secondary Lymphoid organs: After maturation B lymphocytes and T lymphocytes migrate via blood vascular and lymphatic system to the secondary lymphoid organs where they undergo proliferation and differentiation. The acquired immune response to antigens usually develops in these organs and become effector cells. The secondary lymphoid organs are lymph nodes, spleen, tonsils, peyer's patches of small intestine and mucosal associated lymphoid tissues (MALT).

Q.6. Explain how AIDS is transmitted. Give three points only. 3 (CoHSEM, 2007)

Ans:- Three ways through which AIDS is transmitted are

i). Transfusion of infected blood or blood products.

ii). Used of contaminated needles and syringes to inject drugs or vaccines.

iii). Sexual intercourse with an infected partner without a condom.

Q.7. Give any three danger signals of cancer. 3 (CoHSEM, 2007)

Ans:- i) A persistent cough or hoarseness in a smoker.

ii) A persistent change in digestive and bowel habits.

iii) A change in a wart or mole.

Q.8. How does Humoral or Antibody mediated immune system differ from cell mediated immune system?

Ans:- Difference between Humoral or Antibody mediated immune system and cell mediated immune system :

Humoral Immunity	Cell Mediated Immunity
1. It consists of antibodies that circulate in the body fluids. 2. It defends the body against viruses and bacteria. 3. It does not respond to transplants. 4. It does not provide immunity against cancer.	1. It consists of lymphocytes – T cells and B-cells which attack the antigens and produce antibodies. 2. It defends the body against all pathogens including fungi and protozoa. 3. It reacts against transplants. 4. It provides immunity against cancer.

Q.9. Distinguish between Benign and Malignant tumour by giving five points. 3 (CoHSEM, 2010)

Ans:- Difference between Benign tumour and Malignant tumour :

BENIGN TUMOUR	MALIGNANT TUMOUR
1. It remains confined to the affected organ. 2. Growth is slow. 3. There is no latent stage. 4. There is no metastasis. 5. It is non cancerous.	1. It also spreads to the other organs of the body. 2. Once started, growth of tumour is rapid. 3. There is latent stage. 4. There is metastasis. 5. It is cancerous.

Q.10. Define lymphoid organs. Explain about the two lymphoid organs. 1+1+1= 3 (CoHSEM-2015)

Ans:- Lymphoid organs are those organs where the maturation and proliferation of lymphocytes takes place.

Lymphoid organs are -

i) Bone marrow: Bone marrow is the main lymphoid organs where all blood cells including lymphocytes are formed. Maturation of B-lymphocytes occurs here.

ii) Thymus: Thymus is the site of T lymphocyte maturation. Thymus is situated near the heart. Thymus is quite large in size at the time of birth but keeps reducing with age.

Q.11. Name the causal organism of typhoid. How will this disease be transmitted? What test will you undergo for confirmation of this disease?

Ans:- The causal organism is *Salmonella typhi.*

The organisms of the disease are present in the stool or may be present in urine. Hence the disease is transmitted through contaminated food and water. A test to confirm typhoid infection is called **Widal Test.**

Q.12. Explain any three possible factors for the cause of cancer. 3 (CoHSEM- 2008)

Ans:- Three factors for the cause of cancer are:

i) Oncogenic Transformation: They change genetic material from non- oncogenic state to oncogenic state. Example: Chemicals, Radiation (*X*-rays, *UV*- rays etc.)

ii) Tumour Promoters: They promote proliferation of cells which have undergone oncogenic transformation. Example: Some growth factors, hormones.

iii) Tumour Viruses: Some viruses are known to be connected with oncogenic transformation.

Q.13. a) Why do the symptoms of malaria not appear after the entry of sporozoites into the human body when bitten by female *Anopheles*? Explain.

b) Give the scientific name of the malarial parasite that causes malignant malaria in humans.

Ans:- a) *Plasmodium* enters the human body as sporozoites through the bite of infected female *Anopheles* mosquito. The parasites initially multiply within the liver cells and then attack the red blood cells (RBCs) resulting in their rupture. The rupture of RBCs is associated with release of a toxic substance, haemozoin, which is responsible for the chill and high fever. That is why the symptoms of malaria do not appear after the entry of sporozoites into the human body.

b) *Plasmodium falciparum*.

Q.14. Explain any three the health hazardous effects of drug abuse.

Ans:- i) All drugs affect the Central Nervous System and their prolonged use causes permanent damage.

ii) Continuous use of narcotics and stimulants can cause impotency, chromosomal aberration and production of abnormal babies.

iii) The side effects of the use of anabolic steroids in female sportspersons include muscularization (males like features), increase aggressiveness, depression, abnormal menstrual cycles, excessive hair growth on face and body.

Q.15. a) Name the infective stage of *Plasmodium* which *Anopheles* mosquito takes in along with blood meal from an infected human.

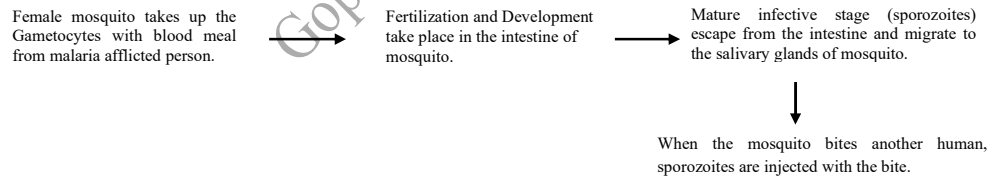
b) Why does the infection cause fever in humans?

c) Give a flow chart of the part of the life cycle of this parasite passed in the insect.

Ans:- a) Merozoite stage.

b) . The rupture of RBCs is associated with release of a toxic substance, haemozoin, which is responsible for the chill and high fever recurring every three to four days.

c) Flow chart of the part of the life cycle of *Plasmodium* passed in the Female *Anopheles*.



Q.16. Mention the name of the causal organism, symptoms and the mode of transmission of the disease Amoebiasis.

Ans:- Causative agent of amoebiasis is *Entamoeba histolytica.*

Symptoms:- Ulceration, acute diarrhoea and blood and mucus in the stools. Patient feels abdominal pain, nausea, nervousness etc.

Transmission: Human infection is direct and oral. The tetranucleate cysts are ingested with contaminated food and water. Houseflies and cockroaches act as passive vector.

Q. 17. Discuss the role of parents during adolescence of their children.

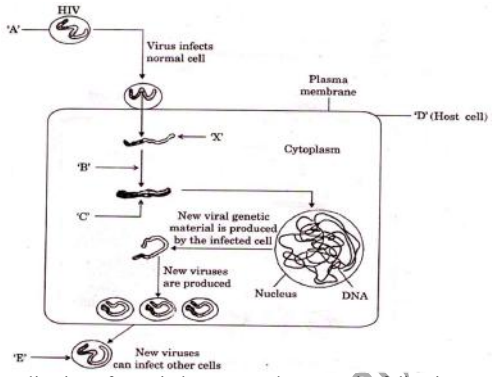
Ans:- Role of parents during adolescence:

(i) Every child has his/her own choice and personality, which should be respected and nurtured. A child should not be pushed unduly to perform beyond his/her threshold limits; be it studies, sports or other activities.

(ii) Educating and counselling him/ her to face problems and stresses, and to accept disappointments and failures as a part of life. It would also be worthwhile to channelize the child's energy into healthy pursuits like sports, reading, music, yoga and other extracurricular activities.

(iii) Help from parents and peers should be sought immediately so that they can guide appropriately. Help may even be sought from close and trusted friends. Besides getting proper advise to sort out their problems, this would help young to vent their feelings of anxiety and guilt.
(iv) Alert parents and teachers need to look for and identify the danger signs discussed above. Even friends, if they find someone using drugs or alcohol, should not hesitate to bring this to the notice of parents or teacher in the best interests of the person concerned. Appropriate measures would then be required to diagnose the malady and the underlying causes. This would help in initiating proper remedial steps or treatment.

Q.18.



Study the diagram showing replication of HIV in humans and answer the following questions accordingly:

i) Write the chemical of the coat 'A'.
ii) Name the enzyme 'B' acting on 'X' to produce molecule 'C'. Name 'C'.
iii) Mention the name of the host cell 'D' the HIV attacks first when it enters into the human body.
iv) Name two different cells the new viruses 'E' subsequently attack.

Ans:- i) Protein.
ii) B is reverse transcriptase and 'C' is DNA.
iii) 'D' is animal cell.
iv) Two different cells that the viruses subsequently attack are Macrophages and Helper T cells.
Q.19. Write three difference between Active immunity and Passive Immunity.
Ans:-

Active immunity	Passive immunity
1. It is developed when the person's own cells produce antibodies in response to infection or vaccine. 2. It provides relief only after long period. 3. It has no side effects. 4. It is long lasting.	1. It is developed when antibodies in other organisms are injected into a person to counter act antigen such as snake venom. 2. It provides immediate relief. 3. It may cause reaction. 4. It is not long lasting.

Q.20. Give difference between Primary Immune response and Secondary Immune response with three points.
Ans:-

Primary Immune Response	Secondary Immune Response
1. This immune response occurs as a result of the first contact with an antigen. 2. It takes longer time to establish immunity. 3. It declines rapidly.	1. This immune response occurs at the second and subsequent exposure of the same host to the same antigen. 2. It is more rapid. 3. It lasts for a longer period.

LONG ANSWER TYPE QUESTIONS:
Q.1. What are carcinogens? Give four examples. Describe in about 60 words, the major types of cancer.
Ans:- Chemical, physical and biological agents which can cause cancer are called carcinogens. Examples are *X*-rays, *UV*- rays, Vinyl chloride and Coaltar.

On the basis of the tissue from where they arose, cancers are of four types:
1. Carcinoma: This type is mainly derived from epithelial cells. They include cervical cancer, breast cancer, brain cancer, lung cancer, stomach cancer, etc.
2. Melanomas: They are (tumours) cancerous growth arising from melanocytes of skins and other organs.

3. Sarcoma: These are located in connective and muscular tissues derived from mesoderm. They include the cancers of bones, cartilages, tendons, adipose tissues, lymphoid tissues and muscles.
4. Leukemias and Lymphomas: They are cancer of haemopoetic cells. Leukemias are characterized by abnormal increased of WBC's count due to increased formation in the bone marrow. Leukemias are commonly are called blood cancer. Cancers of lymphatic tissues are termed as lymphomas.
Q.2. What is cancer? Describe three main types of cancer. Write two causes of the disease.
Ans:- Cancer is an abnormal and uncontrolled division of cells, known as cancer cells, that invade and destroy the surrounding tissues.
TYPES OF CANCERS: On the basis of the tissue from where they arose, cancers are of four types:
1. Carcinoma: This type is mainly derived from epithelial cells. They include cervical cancer, breast cancer, brain cancer, lung cancer, stomach cancer, etc.
2. Melanomas: They are (tumours) cancerous growth arising from melanocytes of skins and other organs.
3. Sarcoma: These are located in connective and muscular tissues derived from mesoderm. They include the cancers of bones, cartilages, tendons, adipose tissues, lymphoid tissues and muscles.
4. Leukemias and Lymphomas: They are cancer of haemopoetic cells. Leukemias are characterized by abnormal increased of WBC's count due to increased formation in the bone marrow. Leukemias are commonly are called blood cancer. Cancers of lymphatic tissues are termed as lymphomas.
Causes of the cancer are:
i) Oncogenic Transformation: They change genetic material from non- oncogenic state to oncogenic state. Examples: Chemicals, Radiation (*X*-rays, *UV*- rays etc.)
ii) Tumour Promoters: They promote proliferation of cells which have undergone oncogenic transformation. Examples: Some growth factors, hormones.

Q.4. "Adolescence period is more important than other period of our life". Discuss in brief with physical and behavioural changes during this period. How parents should accompany with their children during this period?
Ans:- Adolescence is marked by physical growth, development of reproductive organs, and changes in functioning of the neuro-endocrine system. Curiosity, excitement and need for adventure and experimentation are common during this period.

Help from parents and peers should be sought immediately so that they can guide appropriately. Help may even be sought from close and trusted friends. Besides getting proper advise to sort out their problems, this would help young to vent their feelings of anxiety and guilt. Alert parents and teachers need to look for and identify the danger signs.
Q.5. i) Where are B-cells and T-cells produced in the human body? How do they differ from each other? Mention any two differences.
ii) Name any three classes of immunoglobulins in humans. Write one function of each.
Ans:- i) B – cells and T – cells are produced in bone marrow.

B-Lymphocytes (B-cells)	T-Lymphocytes (T-Cells)
1. B-cells form Humoral immune system. 2. They defend against viruses and bacteria that enter the blood and lymph.	1. T-cells form Cell mediated immune system. 2. They defend against pathogens including protists and fungi that enter the cells.

ii) Three classes of immunoglobulins are described below:
a) IgA: It is the second most abundant class. It is the major immunoglobulin in colostrum (the first milk secreted by a nursing mother), saliva and tears. It protects from inhaled and ingested pathogens.
b) IgD: It is present on the surface of B lymphocytes which are destined to differentiate into antibody producing plasma cells.
c) IgE: It mediates hypersensitivity (anaphylaxis). It acts as mediator in allergic response.

Q.6. Differentiate cancer cells from normal cells. Give 5 points.
Ans:- Difference between cancer cells and normal cells:

Cancer cells	Normal cell
1. These cells divide in an unregulated/uncontrolled manner. 2. Their life span is not definite. 3. These cells do not respond to control mechanism and do not show contact inhibition. 4. They do not undergo differentiation 5. Cell death is inhibited.	1. These cells divide in a regulated manner. 2. They have a definite life span. 3. They live in a complex interdependence manner and show the phenomenon of contact inhibition. 4. They undergo differentiation. 5. Normal cells have cells death.

Q.7. Differentiate Active immunity from Passive immunity.
Ans:- Difference between Benign tumour from malignant tumour.

Active immunity	Passive immunity
1. It is developed by a person in response to an infection or vaccine. 2. It affords durable and effective protection. 3. It is effective only after a lag phase. 4. In this system, immunological memory develops and hence subsequent challenges are more effective. 5. It does not cause harm to the host.	1. The immunity induced by ready-made antibody injected in a person is called passive immunity. 2. It affords temporary protections which are less effective. 3. This immunity is effective immediately. 4. Immunological memory does not develop and hence subsequent administration of antibody is less effective. 5. It may have side effect and cause harm to the host.

Q.8. What are the various public health measures which you would suggest us against infectious diseases?
Ans:- Common preventive measures are –
i) Education: People should be educated about the infectious diseases.
ii) Vaccination: People should get vaccination to avoid infection.
iii) Sterilization: Proper sanitation can prevent spread of diseases.
iv) Sterilization: Patient's belongings should be sterilized.
v) Eradication of vectors: The breeding places of the vectors (if any) should be destroyed and adult vectors killed by suitable methods.

Q.9. What are psychotropic drugs? Describe its main types.
Ans:- Psychotropic drugs are mood alternating drugs which affect behaviour and mental activity of a person. Psychotropic drugs are classified into 4 major groups:
1. Tranquilizers: They are antidepressant drugs with calming and soothing effect. Tranquilizers are of 2 types:
i) Antipsychotic Drugs (Major Tranquilizers) have good effect in all types of psychosis, especially Schizophrenia. In a psychosis patient, these drugs reduce aggressiveness. e.g. Reserpine (alkaloid from *Rauwolfia serpentina*),Phenothiazines, etc.
ii) Anti-anxiety Drugs (Minor Tranquilizers) drugs are used for anxiety and phobic conditions. e.g. Hypnotic e.g. Diazepam(e.g. Valium, calmpose), Alprazolam Clonazepam, Oxazepam, Flurazepam, Tamazepam etc.
2. Sedative and Hypnotic drugs: Sedative is a drug that reduces excitement, assuages pain and lowers the physiological or functional activity leading to drowsiness or sleep.
Hypnotic is also a drug that induces sleep. Sedative and Hypnotics include *Barbiturates* and *Benzodiazepines*.
3. Opiate or Opioid Narcotics: The drugs derived from opium along with their synthetic relatives are called opiates or opioids.
4. Stimulants: These drugs stimulate the nervous system, make a person more wakeful, alert and active and cause excitement. e.g. Coccain.

Q.10. Describe 5 drug withdrawal symptoms.
Ans:- DRUGS WITHDRAWAL SYMPTOMS:
i) Severe hypertension and sympathetic overactivity may occur just after discontinuing Clonidine.
ii) Acute adrenal deficiency may occur due to sudden stoppage of corticosteroid treatment.
iii) Frequency of seizures may increase by abrupt withdrawal of an abrupt withdrawal of an antiepileptic.
iv) Sleeplessness or insomnia occurs.
v) An internal feeling of apprehension, uneasiness, fear agitation and uncertainty occurs.
vi) Excessive sweating, nausea, vomiting, tremors, cramps, twitching and convulsions are other symptoms.

Q.11. "Nowdays most of the school going children in secondary and higher secondary level are abuse to unexpected drugs". How can you detect psychologically a child is abuse to drugs? Analyse your detection techniques.
Ans:- A child can be detected from abuse to drugs by the following signs:
a) Behavioural : Change of eating, sleeping, toilet habit, abstinence from friends and parents.
b) Physical: Fatigue, weakness, vomiting, etc.
c) Mental: Frequent mood change, unexpressed sad and happiness.
Simple detection techniques are:-
i) Alcohol abuses are detected by standing with one leg. He will not be able to stand erect.
ii) Other drugs can be detected by spitting. The drug abusers cannot spit properly.

Q.12. Describe any five measures for prevention and controlling alcohol and drugs abuse among adolescence.

Ans:- Some of the measures mentioned here would be particularly useful for prevention and control of alcohol and drugs abuse among adolescents.
(i) Avoid undue peer pressure - Every child has his/her own choice and personality, which should be respected and nurtured. A child should not be pushed unduly to perform beyond his/her threshold limits; be it studies, sports or other activities.
(ii) Education and counselling - Educating and counselling him/ her to face problems and stresses, and to accept disappointments and failures as a part of life. It would also be worthwhile to channelize the child's energy into healthy pursuits like sports, reading, music, yoga and other extracurricular activities.
(iii) Seeking help from parents and peers - Help from parents and peers should be sought immediately so that they can guide appropriately. Help may even be sought from close and trusted friends. Besides getting proper advise to sort out their problems, this would help young to vent their feelings of anxiety and guilt.
(iv) Looking for danger signs - Alert parents and teachers need to look for and identify the danger signs discussed above. Even friends, if they find someone using drugs or alcohol, should not hesitate to bring this to the notice of parents or teacher in the best interests of the person concerned. Appropriate measures would then be required to diagnose the malady and the underlying causes. This would help in initiating proper remedial steps or treatment.
(v) Seeking professional and medical help - A lot of help is available in the form of highly qualified psychologists, psychiatrists, and deaddiction and rehabilitation programmes to help individuals who have unfortunately got in the quagmire of drug/alcohol abuse. With such help, the affected individual with sufficient efforts and will power, can get rid of the problem completely and lead a perfectly normal and healthy life.

Q. 13. Describe five classes of immunoglobulins in humans. Write one function of each.
Ans:- Five classes of immunoglobulins are described below:
1) IgA : It is the second most abundant class. It is the major immunoglobulin in colostrum (the first milk secreted by a nursing mother), saliva and tears. It protects from inhaled and ingested pathogens.
2) IgD: It is present on the surface of B lymphocytes which are destined to differentiate into antibody producing plasma cells.
3) IgE: It mediates hypersensitivity (anaphylaxis). It acts as mediator in allergic response.
4) IgG: It is the most abundant class of Ig. IgG is the only maternal Igs that is normally transported across the placenta and provides natural passive immunity in the foetus and new born. It is also present in milk and also stimulates phagocytes and complement system.
5) IgM: It is the largest Ig. It activates B cells. It is also earliest immunoglobulin to be synthesized by the foetus, beginning about 20 weeks of age. It cannot cross the placental barrier.
Q.14. List the harmful effects caused by the alcohol and drug abuse.
Q.15. In your view what motivates youngsters to take alcohol or drugs and how can this be avoided?
Or
Why do some adolescents start taking drugs? How can this be avoided?
Q. Write difference between cancer cells from Normal cells.
Ans:-

Cancer cells	Normal cell
1. These cells divide in an unregulated/uncontrolled manner. 2. Their life span is not definite. 3. These cells do not respond to control mechanism and do not show contact inhibition. 4. They do not undergo differentiation 5. Cell death is inhibited.	1. These cells divide in a regulated manner. 2. They have a definite life span. 3. They live in a complex interdependence manner and show the phenomenon of contact inhibition. 4. They undergo differentiation. 5. Normal cells have cells death.

CHAPTER: 10
MICROBES IN HUMAN WELFARE

VERY SHORT ANSWER TYPE QUESTIONS:
Q.1. What is biofertilizer?
Ans:- Biofertilizers are micro-organisms, which bring about nutrient enrichment of soil by enhancing the availability of nutrients like nitrogen and phosphorus to crops.
Q.2. Which one of the following is the baker's yeast used in fermentation?
Saccharum barberi, Saccharomyces cerevisiae, Sonalika
Ans:- *Saccharomyces cerevisiae*.
Q.3. A farmer adds *Azotobacter* culture to the soil before sowing maize seeds. How does it increase the yield of maize?

Ans:- *Azotobacte*r is a free living nitrogen fixing bacteria. It fixes atmospheric nitrogen in the soil and increases the fertility of the soil. Maize plants cultivated in the fertile soil results in the increase in yield.
Q.4. Illustrate any two advantages of bio-gas plant.
Ans:- Two advantages of bio-gas plant are
i) Production of biogas used for cooking and lighting.
ii) The removed waste materials may be used as fertiliser.
Q.5. What is the biological significance of *Azolla pinnata* in agriculture?
Ans:- The aquatic fern *Azolla pinnata* has an important symbiotic association with nitrogen fixing cyanobacteria – *Anabaena azollae*. It grows in the rice fields and brings about soil enrichment in order to increase crop production.
Q.6. Why are leguminous plants cultivated as green manure crop?
Ans:- Leguminous plants possess root nodules where atmospheric nitrogen is fixed by symbiotic bacteria – *Rhizobium*. The fixed nitrogen fertilizes the soil. Moreover, the green plants provide manure by their death and decay.
Q.7. A farmer adds *Azotobacter* culture to the soil before sowing maize seeds. How does it increase the yield of maize?
Ans:- *Azotobacte*r is a free living nitrogen fixing bacteria. It fixes atmospheric nitrogen in the soil and increases the fertility of the soil. Maize plants cultivated in the fertile soil result in the increase in yield.
Q.8. Name the organism that fixes nitrogen in symbiotic association with a water fern. Where does it live in such plants?
Ans:- The cyanobacteria – *Anabaena azolla*. It grows as symbiont within the cavities formed in the upper lobes of the aerial chlorophyllous leaves of *Azolla*.
Q.9. "Legumes fertilise the soil but cereals do not". Discuss.
Ans:- Leguminous plants are characterized by possessing root nodules where nitrogen is fixed by symbiotic bacteria *Rhizobium*. The fixed nitrogen fertilizes the soil. The cereals, on the other hand, do not possess nitrogen fixing ability and therefore, do not fertilize the soil.
Q.10. How does *Anabena azollae* help in enrichment of rice field soil?
Ans:- *Anabene azollae* resides in the leaf cavities of the fern. It fixes nitrogen. A part of the fixed nitrogen is excreted in the cavities and becomes available to the fern. The decaying fern plants release the same for utilization of the rice plants. When field is dried at the time of harvesting, the fern functions as the green manure, decomposing and enriching the field for the next crop.
Q.11. What is the biological significance of *Azolla pinnata* in agriculture?
Ans:- The aquatic fern-*Azolla pinnata* has an important association with nitrogen fixing Cyanobacteria-*Anabaena azollae*. It grows in the rice field and brings about soil enrichment in order to increase crop production.
Q.12. What is the significance of fungus *Trichoderma polysperum* in organ transplantation?
Ans:- Cyclosporin A, obtained from *Trichoderma polysporum* has immunosuppressive property. It inhibits activation of T-cells and therefore, prevents rejection reaction in organ transplantation.
Q.13. What is Biochemical oxygen demand (B.O.D.)?
Ans:- Biochemical oxygen demand (B.O.D.) refers to the amount of the oxygen that would be consumed if all the organic matter in one liter of water were oxidised by bacteria.
Q.14. What is mycorrhiza?
Ans:- Mycorrhiza is symbiotic association between fungi with the roots of higher plants.
Q.15. Why does 'Swiss cheese' have big holes? (CoHSEM – 2017)
Ans:- Bacterium *Propionibacterium sharmanii* produces CO_2 during fermentation to produce large holes.
Q.16. Why bio gas plants are more available in rural areas than urban areas? Give one point.
Ans:- Biogas plants require large quantities of cow dung which is enough available in rural areas, as slurry. So biogas plants are more often built in rural areas.

SHORT ANSWER TYPE QUESTIONS: 2 MARKS EACH
Q.1. What is the role of mycorrhiza as biofertilizers?
Ans:- Mycorrhiza is symbiotic association between fungi with the roots of higher plants. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development.
Q.2. Lactic acid is commonly used in domestic purposes. List *any four* common uses of lactic acid in domestic purposes.
Ans:- Use of lactic acid:
i) Lactic acid is used in confectionery, essences, curing of meat, canned vegetables and fish products.
ii) It is also employed as mordant in tanning, printing of wool in preparation of plastics and pharmaceuticals.
iii) Lactic acid causes coagulation and partial digestion of milk protein casein. Milk is changed into curd, yoghurt and cheese.

iv) Lactic acid is used in preparation of fruit juices.
Q.3. State the role of Flocs in effluent treatment and their ultimate fate in sewage treatment. 2 (CoHSEM – 2014)
Ans:- Flocs contain masses of bacteria associated with fungal filaments to form mesh like structures.
These microbes consume the major part of the organic matter present in the effluent.
Q.4. Write any four importance of biofertilizers.
Ans:- Importance of biofertilizers:
i) Biofertilisers do not cause pollutions.
ii) Biofertilisers are cheap and economical. They can be used even by poor farmers.
iii) Biofertilisers improve physical and chemical properties of soil (such as water holding capacity, buffer capacity etc.).
iv) Besides fixing atmospheric nitrogen, Cyanobacteria synthesize and excrete several growth hormones (auxin and ascorbic acid) and vitamins (B_{12}) which enhance seed germination and growth of crop plants.
Q.5. How do bioactive molecules of fungal origin help in restoring good health to humans? Give *two* examples.
Ans:- Bioactive Molecules fungal origin that help in restoring good health to humans are
a) **Cyclosporin A** is an eleven membered cyclic oligopeptide obtained through fermentative activity fungus *Trichoderma polysporum*. It has **antifungal**, **anti-inflammatory** and **immunosuppressive** properties. It inhibits activation of T-cells and therefore, prevents rejection reaction in organ transplantation.
b) **Statins** produced by *Monoscus purpureus*, a yeast, are commercial used as blood cholesterol lowering agents.
Q.6. Name the microbes from which Cyclosporin A (an immunosuppressive drug) and Statins (blood cholesterol lowering agents) are obtained.
Ans:-

	Drugs	Functions	Microbes
1.	Cyclosporine – A	Immunosuppressive drug	*Trichoderma polysporum*
2.	Statin	Blood cholesterol lowering agent	*Monascus purpureus.*

Q.7. Green manures are not sufficient to meet the total requirements of agriculture, so they have to be supplemented by the use of biofertilizers. Give two reasons for the use of biofertilizers in agriculture to support your answer.
Ans:- Reasons for the use of biofertilizers in agriculture:
i) Biofertilisers do not cause pollutions.
ii) Biofertilisers improve physical and chemical properties of soil (such as water holding capacity, buffer capacity etc.).
Q.8. Why are flocs important in biological treatment of waste water?
Ans:- Flocs are masses of bacteria associated with fungal filament to form mesh like structures. These microbes consume major part of organic matter in effluent. This significantly reduces the BOD of effluent after which flocs are settled.
Q.9. Name the blank spaces a, b, c and d from the table given below: 2 (CBSE – 2008)

Type of microbe	Scientific name	Commercial product
Bacteria	a	Lactic acid
Fungus	b	Cyclosporin-A
c	*Monaseus purpureus*	Statin
Fungus	*Penicillium notatum*	d

Ans:- a is *Lactobacillus acidophilus*, b is *Trichoderma polysporum;* c is yeast (fungus) and d is Penicillin.
Q.10. If you have to carry a sample from your home to your biology laboratory to demonstrate the presence of microbes under a microscope, which sample would you carry and why?
Ans:- Curd can be used as a sample for the study of microbes. Curd contains a numerous lactic acid bacteria (LAB) or Lactobacillus. These bacteria produce acids that coagulate and digest milk proteins. A small drop of curd contains millions of bacteria, which can be easily observed under a microscope.
Q.11. In which food would you find lactic acid bacteria? Mention some of their useful applications.
Ans:- Lactic acid bacteria can be found in curd. It is this bacterium that promotes the formation of milk into curd. The bacterium multiplies and increases its number, which converts the milk into curd. They also increase the content of vitamin B_{12} in curd. Lactic acid bacteria are also found in our stomach where it keeps a check on the disease causing micro-organisms.
Q.12. What is sewage? In which way can sewage be harmful to us?
Ans:- Sewage is the municipal waste matter that is carried away in sewers and drains. It includes both liquid and solid wastes, rich in organic matter and microbes. Many of these microbes are pathogenic and can cause several water borne diseases. Sewage water is a major cause of polluting drinking water. Hence, it is essential that sewage water is properly collected, treated and disposed.
SHORT ANSWER TYPE QUESTIONS: 3 MARKS EACH.
Q.1. Explain the role of baculoviruses as biological control agents. Mention their importance in organic farming.

Ans:- Baculoviruses are pathogens that attack insects and other arthropods. The majority of baculoviruses used as biological control agents are in the genus *Nucleopolyhedrovirus.* These viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications. They have been shown to have no negative impacts on plants, mammals, birds, fish or even on non-target insects. This is especially desirable when beneficial insects are being conserved to aid in an overall integrated pest management (IPM) programme, or when an ecologically sensitive area is being treated.

Q.2. Mention the product and its use produced by each of the microbes listed below: 3 (CBSE – 2010)

i) *Streptococcus* ii) *Lactobacillus* iii) *Saccharomyces cerevisiae*

Ans:- i) *Streptococcus*

Q.3. Differentiate Primary sludge from activated sludge by giving three points.

Ans:- Difference between Primary sludge and activated sludge:

Primary sludge	Activated Sludge
1. It is the sludge formed during primary sewage treatment. 2. It does not possess flocs of decomposers microbes. 3. It does not require aeration.	1. It is sludge formed during secondary sewage treatment. 2. It possesses flocs of decomposer microbes. 3. Formation of activated sludge requires aeration.

Q.4. How does Primary Treatment differ from secondary treatment? Give three points.

A*ns:*- Difference between primary treatment and secondary treatment:

Primary Treatment	Secondary Treatment
1. It is a physical process. 2. It involves both grit and large pieces of organic matter. 3. It does not require aeration. 4. It involves shredding, churning, filtration and sedimentation.	1. It is a biological process. 2. It removes small sized organic materials. 3. Aeration is required. 4. It involves microbial digestion of organic matter, formation of flocs, sludge and sludge digestion.

Q.5. How do biofertilizers enrich the fertility of the soil.

Ans:- Biofertilizers are living organisms which help in increasing the fertility of soil. It involves the selection of beneficial micro-organisms that help in improving the through the supply of plant nutrients by their biological activity. Thus, they are extremely beneficial in enriching the soil with organic nutrients. Many species of bacteria and cyanobacteria have the ability to fix free atmospheric nitrogen. *Rhizobium* is a symbiotic bacteria found in the roots of nodules of leguminous plants. *Azoprillium* and *Azotobacter* are free living nitrogen fixing bacteria, whereas *Anabaena, Nostoc* and *Oscillitoria* are examples of nitrogen fixing cyanobacteria. Biofertilizers are cost effective and eco-friendly.

Q.6. How can microbes be used as source of energy? Explain.

Ans:- Microbes can be used as a source of energy. Bacteria such as Methane bacterium is used for the generation of gobar gas or biogas. The generation of biogas is an anaerobic process in a biogas plant, which consists of concrete tank (10 – 15 feet deep) with sufficient outlets and inlets. The dung is mixed with water to form the slurry and thrown into the tank. The digester of the tank is filled with numerous anaerobic methane – producing bacteria, which produce biogas from the slurry. Biogas can be removed through the pipe which is then used as a source of energy, while the spent slurry is removed from the outlet and is used as fertilizers.

Q.7. What are Baculoviruses? Write down two uses of these viruses as Biocontrol agents?

Ans:- Baculoviruses are pathogens that attack insects and other arthropods.

i) These viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications. They have been shown to have no negative impacts on plants, mammals, birds, fish or even on non-target insects.

ii) This is especially desirable when beneficial insects are being conserved to aid in an overall integrated pest management (IPM) programme, or when an ecologically sensitive area is being treated.

LONG ANSWER TYPE QUESTIONS: 5 MARKS EACH.

Q.1. Describe advantages of biofertilisers over chemical fertilizers.

Ans:- ADVANTAGES OF USING BIOFERTILISERS:

i) Biofertilisers do not cause pollutions while chemical fertilizers pollute soil.

ii) Biofertilisers are cheap and economical. They can be used even by poor farmers. On the other hand, chemical fertilizers are costly.

iii) Biofertilisers improve physical and chemical properties of soil (such as water holding capacity, buffer capacity etc.) on the other hand, chemical fertilizers deteriorate soil properties.

iv) Besides fixing atmospheric nitrogen, Cyanobacteria synthesize and excrete several growth hormones (auxin and ascorbic acid) and vitamins (B_{12}) which enhance seed germination and growth of crop plants.

v) *Azotobacter* and microbe biofertilizers increase 15-35 percent additional yield in most of the vegetables crops.

Unit-IV: BIOTECHNOLOGY

BIOTECHNOLOGY: Principle and Processing

AIMS OF BIOTECHNOLOGY:

i) To develop industrial processes for producing organic acids, various types of solvents, antibiotics, enzymes, hormones, insulin, steroids, vitamins, etc from ordinary raw materials.

ii) To develop recombinant microorganisms through genetic engineering for specific use in agriculture and industries.

iii) To cure genetic diseases and to develop gene therapy.

iv) To develop technology for organ culture and use of plant tissue culture technique for micropropagation of commercially important plants.

v) To develop and utilize bio-energy.

vi) To reduce the impact of pollution by the use of suitable biological processes of waste treatment.

vii) To create improved varieties of plants and animals through gene manipulation and breeding.

viii) To develop suitable technology for food preservation, food processing, etc.

Gene cloning: It involves isolation of suitable gene from any source and incorporation of the gene into suitable hosts to allow its replication.

DNA Library (Genetic library or genomic library):

Desired DNA fragments can be multiplied by introducing it into the hosts. The hosts multiply along with introduced DNA fragments. The daughter cells are exact replica of the treated cells. The daughter cells so formed are called cell clones and the process is called gene cloning. All the genes of an organism can be identified, multiplied and presented as a set of clones. The various genes representing all the genes of an organism are referred to **gene library** or **DNA library**.

Difference between Genomic DNA library and cDNA :

In genomic library, genes are cloned by incorporating donor DNA into the plasmid of host DNA whereas cDNA is synthesised from mRNA rather than from a DNA template.

Three Basic Steps in Creating Genetically Modified Organism (GMO) or Transgenic Organism:

i) Identification of DNA with desirable genes.
ii) Introduction of the identified DNA into host.
iii) Maintenance of introduced DNA in the host and transfer of the DNA to its progeny.

MONOCLONAL ANTIBODIES:

The monoclonal antibodies are pure, high affinity, antigen specific proteinaceous bodies developed outside the body from clonal culture of hybrid cells called **hybridomas.**

Discovery: Monoclonal antibodies were first discovered by **George Kohler** and **Cesar Milstein** (1974), who proposed that the normal antibody producing cells can be used to fuse and inhibit cells from cancerous tumours called **myelomas.**

Monoclonal antibodies have the following uses:

1) These are more specific and reproducible, so these are used for differentiating diseases caused by pathogens.

2) Being specific these can be conjugated to toxic drugs (e.g.cancer drugs) and injected to kill or inhibit specific cells without harming others. So, these can be used in cancer treatment.

3) These can be used to developed immune defence system against microbial diseases.

4) These are used for immune suppression for kidney transplantation. The immune cells which mediate rejection of graft are suppressed by these antibodies.

VERY SHORT ANSWER TYPE QUESTIONS:

Q.1. An *E. coli* containing plasmid pBR322 is placed in a culture medium. The bacterium can grow when antibiotic tetracycline is added in the medium, but the bacterium cannot grow when antibiotic ampicillin is added to the medium. What conclusion can be made from this experiment?

Ans:- Foreign DNA is present in ampicillin resistant gene of **pBR322**.

Q.2. Explain the term Plasmid.

Ans:- Plasmids are extra – chromosomal, self replicating, usually circular, double stranded DNA molecules.

Q.3. What is plasmid?

Ans:- Plasmids are extra – chromosomal, self replicating, usually circular, double stranded DNA molecules, found naturally in many bacteria and also in some yeasts.

Q.4. What is genetic engineering (recombinant DNA technology)?

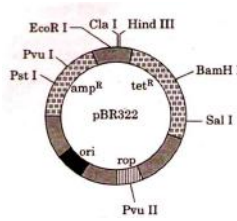
Ans:- Genetic Engineering is generation of new combination of heritable material by the insertion of desired genes or DNA sequences into any carrier system so as to allow their incorporation into a host organism.

Q.5. We can cut DNA base sequence by a particular scissors namely Molecular Scissors.
What is Biotechnological term of Molecular Scissors?
Ans:- Restriction endonuclease.
Q.6. From which organism, plasmid is isolated for preparation of pBRR 322?
Ans:- *E. coli*.
Q.7. Which type of restriction endonuclease is used in genetic engineering?
Ans:- Type II restriction endonuclease.
Q.8. Why is DNA ligase called genetic gum?
Ans:- DNA ligase is called "genetic gum" because it forms phosphodiester bonds between adjacent nucleotides and covalently link two individual fragments of double stranded DNA.
Q.9. Give an important action of alkaline phosphatase.
Ans:- The enzyme alkaline phosphatase is used to remove the phosphate from the 5′ end of a DNA molecule, leaving a free 5′ hydroxyl group, thus prevents ligation of cut desired DNA segment.
Q.10. What is the role of ethidium bromide during agarose-gel electrophoresis of DNA fragments? 1(CBSE-2011)
Ans:- Ethidium bromide stains DNA during agarose gel electrophoresis after exposing on UV radiation.
Q.11. How is the action of exonuclease different from that of endonuclease?
Ans:- Exonucleases cleave base pairs of DNA at their terminal ends while endonucleases cleave DNA at any point except the terminal ends.
Q.12. How can retroviruses be used as vectors for cloning genes in animals?
Ans:- Retroviruses in animals have the capability to transform normal cells into cancerous cells. Retroviruses have also been disarmed and are being utilized to transfer genes of interest to animal cells.
Q.13. What are bioreactors?
Ans:- The container in which the biochemical process is carried out by using living cells and their growth medium is called bioreactor or fermenter.
Q.14. What do you mean by Downstream processing?
Ans:- Downstream processing is the recovery of the product from the fully grown genetically modified cells, its purification and preservation.
Q.15. What is Ti plasmid?
Ans: Ti plasmid is the extra-chromosomal DNA in bacterial cells (*Agrobacterium tumefaciens*), which contain the tumour causing gene.
Q.16. What is T-DNA?
Ans:- Part of Ti-plasmid transferred into plant cell DNA, is called T-DNA.
Q.17. Give an example of natural form of genetic engineering in which the bacterium inserts gene into plants to cause gall or tumour formation.
Ans:- The best example of a natural form of genetic engineering is *Agrobacterium tumifaciens* inserting genes into plants to express those genes in the form of proteins. This infection results in the formation of a gall or tumour in the host.
Q.19. What are passenger DNAs?
Ans:- Passenger DNA is the DNA which is transferred from one organism into another by combining it with the vehicle (vector) DNA.
Q.20. What is cloning?
Ans:- The process of producing genetically similar molecule, cells or organisms from a common precursor is known as cloning.
Q.21. What is PCR?
Ans:- The Polymerase Chain Reaction (PCR) is *in vitro* synthesis of multiple copies of a gene or DNA segment.
Q.22. **Do eukaryotic cells have restriction endonucleases? Justify your answer.**
Ans:- No, eukaryotic cells do not have restriction endonucleases. This is because the DNA of eukaryotes is highly methylated by a modification enzyme, called methylase. Methylation protects the DNA from the activity of restriction enzymes. These enzymes are present in prokaryotic cells where they help to prevent the invasion of DNA by virus.
Q.23. Can you recall meiosis and indicate at what stage a recombinant DNA is made?
Ans:- A recombinant DNA is made in the pachytene stage of prophase I by crossing over.
Q.24. From what you have learnt, can you tell whether enzymes are bigger or DNA is bigger in molecular size? How did you know?
Ans:- The molecular size of DNA molecules is more than that of enzymes. It is because an enzyme (protein) is synthesized from a segment of DNA called the gene.
SHORT ANSWER TYPE QUESTIONS: 2 Marks Each
Q.1. What are the basic tools of rDNA technology?
Ans:- Three types of biological tools are used in the formation rDNA are:
A) Enzymes

B) Cloning Vectors
C) Competent host (for transformation with recombinant DNA).
Q.2. What were the two main discoveries that led to the birth of genetic engineering?
Ans:- The two main discoveries that led to the birth of genetic engineering are -
a) Discoveries of restriction enzymes.
b) Presence of plasmid in bacteria.
Q.3. What are the three cleaving enzymes and discuss their actions.
Ans:- The three cleaving enzymes are
a) Exonucleases: They remove nucleotides from the terminal ends (either 5′ or 3′) of DNA in one strand of duplex.
b) Endonuclease: They make cuts at specific position within the DNA. They do not cleave the ends.
c) Restriction endonucleases: They cut DNA duplex at specific points. Their single stranded free ends are called sticky ends.
Q.4. What are 'molecular scissors'? Give an example.
Ans:- The restriction endonucleases are called as molecular scissors, as they cut DNA segments at particular sites into desired segments.
e.g. *EcoRI* cuts DNA at the site

5′ —— G A A T T C — 3′
3′ —— C T T A A G — 5′

Q.5. Draw the diagram of vector pBR322 and label *ori,* rop and amp$^{R.}$
Ans:-



Q.6. **Besides better aeration and mixing properties, what other advantages do stirred tank bioreactors have over shake flasks?**
Ans:- Shake flasks are used for growing microbes and mixing the desired materials on a small scale in the laboratory. However, the large-scale production of a desired biotechnological product requires large stirred tank bioreactors.
Besides better aeration and mixing properties, bioreactors have the following advantages:
i). It has an oxygen delivery system.
ii). It has a foam control, temperature and pH control system.
iii). Small volumes of culture can be withdrawn periodically.
Q.7. Differentiate between Exonucleases and Endonucleases by giving two points.
Ans:- Differences between Exonuclease and Endonuclease:

Exonucleases	Endonucleases
1. These nucleases cleave base pairs of DNA at their terminal ends.	1. They cleave DNA at any point except the terminal ends.
2. They act on single strand of DNA or gaps in double stranded DNA.	2. They cleave one strand or both strands of double stranded DNA.

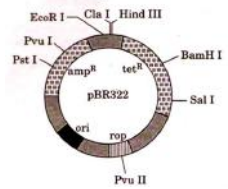
Q.8. How can DNA segments, separated by gel electrophoresis, be visualized and isolated?
Ans:- The separated DNA segments are stained with ethidium bromide. Then by exposure to UV-radiation, the separated and stained DNAs become visible as orange coloured bands. The separated bands are cut out from the agarose gel and then extracted from the gel piece, this process is called as elution.
Q.9. i) Mention the number of primers required in each cycle of polymerase chain reaction (PCR). Write role of primers and DNA polymerase in PCR.
ii) Give the characteristic feature and source organism of DNA polymerase used in PCR.
Ans:- i) Two primers are required in each cycle of polymerase chain reaction (PCR).
Without the presence of primers, DNA polymerase cannot initiate polymerisation. DNA polymerase (Taq polymerase) synthesizes DNA.
Q.10. A recombinant DNA is formed when sticky ends of a vector DNA and foreign DNA join. Explain how the sticky ends are formed and get joined.

Ans:- The complementary sticky ends of a vector DNA and foreign DNA can be produced by cutting with same restriction endonuclease. The two sticky ends can be joined by DNA ligase to produce rDNA.
Q.11. What is recombinant proteins? How do bioreactors help in their production?
Ans:- The proteins produced through recombinant DNA technology inside heterologous host cells, are called recombinant proteins or biochemical.
Q.12. Explain the contribution of *Thermus aquaticus* in amplification of a gene of interest.
Ans:- *Thermus aquaticus* yields a thermostable DNA polymerase. It can withstand the high temperature used for the denaturation and separation of DNA strands during polymerase chain reaction (PCR) and hence can be used for repeated amplification of DNA.
Q.13. How is DNA isolated in purified form from a bacterial cell?
Ans:- The bacterial cells are treated with enzymes, lysozymes to break the cells and open to release DNA along with RNAs and proteins. RNAs are removed by treatment with ribonucleases, and proteins are removed with by treatment with proteases, thus, the DNA is obtained in a pure form. The purified DNA finally precipitates out after addition of chilled ethanol.
Q.14. Name the source of Taq polymerase. Explain the advantage of its use in biotechnology.
Ans:- Taq polymerase is obtained from the bacterium *Thermus aquaticus*. This enzyme is thermostable and can withstand high temperature used for denaturation and separation of the two strands of DNA. Amplification can be carried out to produce even a billion copy of DNA using this enzyme Taq polymerase.
Q.15. What are selectable markers? What is their use in genetic engineering?
Ans:- Selectable markers are genes which help in selecting those host cells which contain the vector (transformant) and eliminating the non-transformants.
Selectable marker is meant for distinguishing a recombinant from non-recombinant DNA.

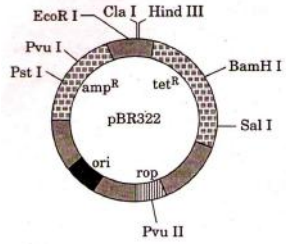
SHORT ANSWER TYPE QUESTIONS: 3 Marks Each
Q.1. "*Agrobacterium tumefaciens* is known as natural genetic engineer in plants". Analyse the statement with suitable reasons to support your answer. 3 (CoHSEM – 2013)
Ans:- *Agrobacterioum tumifaciens*, a pathogen of several dicot plants is able to deliver a piece of DNA known as 'T-DNA' to transform normal plant cells into a **tumor** and direct these tumor cells to produce the chemicals required by the pathogen. As the gene transfer occurs without human effort, the bacterium is known as "*natural genetic engineer*" of the plants. The tumor inducing (Ti) plasmid of *Agrobacterium tumifaciens* has now been modified into a cloning vector which is no more pathogenic to the plants but is still able to use the mechanisms to deliver genes of our interest into a variety of plants.
Q.2. What are the biological tools which are used in formation of Recombinant DNA? 3 (CoHSEM – 2014)
Ans:- The biological tools used in recombinant DNA are:
A) Enzymes: These include lysing enzymes (which dissolve cell walls), restriction enzymes (which cut DNA), DNA polymerase (which synthesise DNA), DNA ligase (which joins DNA fragments) and alkaline phosphatase (which prevents ligation of DNA fragments).
B) Cloning vectors: The vectors are DNA molecules that can carry a foreign DNA segment and replicate inside the host Cell.
C) Competent host: In order to force bacteria to take up the plasmid, the bacterial cells must first be made 'competent' to take up DNA.
Q.3. What are the essential properties of vectors?
Ans:- An ideal cloning vector must possess the following features:
a. It should contain an origin of replication (Ori).
b. It should incorporate a selectable marker, which helps in identifying and eliminate non transformants.
c. The vector must also have atleast one unique restriction endonuclease recognition site.
Q.4. Write the major steps involved in gene cloning.
Ans:- The technique of gene cloning involves –
(i) Isolation of desired DNA fragments containing the gene to be cloned;
(ii) Incubation of the vector used as cloning vehicle;
(iii) Incubation of DNA fragments and digested vector in presence of DNA ligase producing recombinant DNA molecules; and
(iv) Introduction of recombinant DNA into the host.

Q.5. Why are restriction endonucleases so called? Explain their role as 'molecular scissors' in recombinant DNA technology.
Ans:- Restriction endonucleases are specific enzymes which can cleave double stranded DNA at specific site. Hence they are so called.
Role in rDNA technology:

i) It binds to a specific DNA sequence and cut the two strands of the double helix at specific points on their sugar-phosphate backbone.
ii) They cut the strand a little away from the palindrome site, but between same two bases on both the complementary strands
iii) When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of sticky ends which facilitate their joining end to end.
Q.6. Explain the importance of a) *ori,* b) *amp*^{R} and c) *rop* in the *E. coli* vector shown below: 3 (CBSE-2008)



Ans:-
a) ori is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells.
b) amp^R is a selectable marker which can be used to distinguish recombinant and non-recombinant.
c) *rop* codes for the proteins involved in the replication of the plasmid.
Q.7. Why is *Agrobacterium tumifaciens* a good vector? Explain. 3(CBSE-2008)
Ans:- *Agrobacterium tumefaciens* is a pathogen of several dicot plants and is able to deliver a piece of DNA known as T-DNA, which transforms the normal cells into tumour and directs the tumour cells to secrete chemicals necessary for the pathogen.
The inducing (Ti) plasmid of *Agrobacterium tumefaciens* has now been modified into cloning vector. It is no more pathogenic, but still has the capacity to deliver the genes of interest into a variety of plants. Hence, it is a good vector.
Q.8. Name and explain the techniques used in the separation and isolation of DNA fragments to be used in recombinant technology. 3 (CBSE-2008)
Ans:- The technique is Gel electrophoresis.
Gel electrophoresis has an electric field with a cathode (–) and anode (+) and an agarose medium. DNA fragments are negatively charged. They move towards the positively charged anode end. The separated DNA fragments can be seen only after staining the DNA with a compound known as ethidium bromide, followed by exposure to UV-radiation and stained DNAs become visible as orange coloured bands. The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece.
Q.9. i) Name the organism in which the vector shown is inserted to get the copies of the desired gene.
ii) Mention the area labelled in the vector responsible for controlling the copy number of the inserted gene.
iii) Name and explain the role of a selectable marker in the vector shown.



Ans:- i) *Escherichia coli*.
ii) *ori* is responsible for producing number of copies.
iii) The selectable markers in the vector pBR322 are *amp*^{R} and *tet*^{R}. They can be used to distinguish recombinant (transformant) from non-recombinant (non-transformant).
Q.10. Name the source of Taq polymerase. Explain the advantage of its use in biotechnology.
Ans:- Taq polymerase is obtained from the bacterium *Thermus aquaticus*. This enzyme is thermostable and can withstand high temperature used for denaturation and separation of the two strands of DNA. Amplification can be carried out to produce even a billion copy of DNA using this enzyme *Taq polymerase*.
Q.11. How can *rDNA* be inserted into a bacterial cell?

Ans:- The bacterial cells can be made capable to take up DNA by treating them with a specific concentration of divalent cation, such as calcium, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall.

Recombinant DNA can then be forced into such cells by incubating the cells with rDNA on ice, followed by placing them briefly at 42^0 C (Heat shock), and then putting them back on ice. This enables the bacteria to take up the rDNA.

Q.12. What is shuttle vector? Write its advantage over ordinary cloning vector. How is Ti plasmid modified to serve as cloning vector?

Ans:- The vectors which can exist in both the eukaryotic and prokaryotic cell (*E. coli*) are known as Shuttle vectors.

Advantage:

These vectors have two origin of replication, one functions in eukaryotic cell and another that functions in *E.coli*.

The tumor inducing (Ti) plasmid has now been modified into cloning vector which is no more pathogenic to the plants but is still able to use the mechanisms to deliver genes of our interest into a variety of plants because Ti plasmid has been modified.

Q.13. Describe briefly the following:

(a) Origin of replication

(b) Bioreactors

(c) Downstream processing

Ans:-

(a) Origin of replication (ori): This is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells. This sequence is also responsible for controlling the copy number of the linked DNA. So, if one wants to recover many copies of the target DNA it should be cloned in a vector whose origin supports a high copy number.

(b) Bioreactors: Bioreactors are vessels in which raw materials are biologically converted into specific products, individual enzymes etc. using microbial plant, animal or human cells. A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen). The most commonly used bioreactors are of stirring type. A biogas plant is a good example of a bioreactor.

(c) Downstream processing: After completion of the biosynthetic stage, the product is subjected through a series of processes before it is ready for marketing as a finished product. The processes include separation and purification, which are collectively referred to as downstream processing. The product has to be formulated with suitable preservatives. Such formulation has to undergo thorough clinical trials as in the case of drugs. Strict quality control testing for each product is also required. Downstream processing and quality control testing vary from product to product.

Q.14. Illustrate *any three* types of enzymes which used in the process of DNA recombinant technology.

(Illustrate *any three* types of enzymes which are used in the process of recombinant DNA technology.)

Ans:- Enzymes used in the rDNA technology are :

i) Lysing Enzymes:- These enzymes are used to open up the cells to get DNA for genetic experiments. Lysozyme is used to dissolve the bacterial cell wall, cellulase for plant cell wall and chitinase for fungal cell wall (Chitin).

ii) DNA ligase:- These enzymes , called "genetic gum" form phosphodiester bonds between adjacent nucleotides and covalently link two individual fragments of double stranded DNA. The action of ligase enzyme requires a phosphate group at the 5′ carbon of one nucleotide and a hydroxyl (-OH) group at the 3′ carbon of the adjacent nucleotide to form the phosphodiester bond between these two nucleotides.

iii) Alkaline Phosphatase (AP):- Ligation absolutely requires the presence of 5′ phosphate group at the DNA site to be ligated. If this phosphate group is removed, this DNA cannot be ligated. The enzyme alkaline phosphatase is used to remove the phosphate from the 5′ end of a DNA molecule, leaving a free 5′ hydroxyl group.

LONG ANSWER TYPE QUESTIONS: 5 MARKS EACH.

Q.1. Discuss any five applications of Polymerase chain reaction (PCR).

Ans:- Application of PCR:

a). Diagnosis of Pathogens: PCR-based assay has been developed that detect the presence of gene sequences of the infectious agents.

b). DNA Fingerprinting: PCR is of immense value in generating abundant amount of DNA for analysis in the DNA fingerprinting technique used in forensic science to link a suspect's DNA recovered at a crime scene.

c). In Prenatal Diagnosis: It is useful to detect genetic disease in the foetus before birth. If the disease is not curable, abortion is recommended.

d). Gene Therapy: PCR proves to be of immense help in monitoring a gene in gene therapy experiments.

e). Detection of Specific Microorganisms: In recent years, PCR has also found use for detecting specific microorganisms from the environment samples of soil, sediments and water.

Q.2. Differentiate Polymerase Chain Reaction (PCR) from Gene cloning.

Ans:- Differences between PCR and Gene cloning:

PCR	Gene cloning
1. Biological reagents required are- DNA, *Taq polymerase*, RNA primers and deoxyribonucleotide triphosphates. 2. Automation is present. 3. Error probability is less. 4. Applications are more. 5. User's skill is not required. 6. Its cost is less.	1. Biological reagents required are- restriction enzyme, ligase, vector, bacterial cell. 2. Automation is absent. 3. Error probability is more. 4. Applications are less. 5. User's skill is required. 6. Its cost is very high.

Q.3. Illustrate vectorless gene transfer. Explain any four methods in this regards.

Ans:- Vectorless gene transfer involves direct gene transfer to the host without involving vector.

i). Microinjection: In this method foreign DNA is directly injected into the nucleus of animal cell or plant cell by using micro needles or micropipettes. It is used in oocytes, eggs and embryo.

ii). Electroporation: In this method the electrical impulses induce transient (temporary) pores in the plant cell membrane through which, the DNA molecules are incorporated into the plant cells.

iii). Direct DNA injection: Direct injection of DNA into skeletal muscle led to the possibility of using gene as vaccines. Due to low level of expression therapeutic benefits for the treatment of genetic disorder could not be derived. This method gave birth to the concept of DNA vaccine or genetic immunization.

iv). Gene Gun or Biolistic: Gene gun where tungsten or gold particles coated with desired genes are shot with high velocity into target cells.

Q.4. Give five points of difference between plasmid DNA and chromosomal DNA.

Ans:- Difference between plasmid DNA and chromosomal DNA:

Plasmid DNA	Chromosomal DNA
1. It is always double stranded. 2. It is circular. 3. It is naked without histone protein. 4. Introns are absent. 5. It does not carry any vital gene necessary for the cell.	1. It may be single stranded or double stranded. 2. It is linear or circular. 3. It is coated with histone protein. 4. Both exons and introns are present. 5. It carries vital gene necessary for the cell.

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BIOTECHNOLOGY AND ITS APPLICATION

A few transgenic animals with their uses:

1. Transgenic Sheep: This sheep contains bacterial genes which code for the enzymes needed for the synthesis of amino acid cysteine. They give higher wool yield. This amino acid is also an important component of the protein keratin of wool. Sheep with gene for growth hormone yields more meat.
2. Transgenic Goat: This type of goat contains a human gene that codes for a blood clot dissolving protein. This protein is secreted in the milk which is used to treat coronary thrombosis.
3. Transgenic Cow: This type of cow produces lactoferrin due to the presence of cDNA coding. It is an antibacterial human iron-binding protein.
4. Transgenic Pig: These pigs have been given human genes so that their organs carry human antigens. Pig organs like kidney, heart and pancreas can be transplanted into humans. Due to the presence of human antigens, these organs are not rejected by the human body.
5. Transgenic Fish: Some of the transgenic fish like common carp, catfish, salmon, goldfish contain human growth hormone (hGH) gene. They also grow double in size to that of non-transgenic fish.

BIOSAFETY ISSUES: Biosafety is the prevention of large – scale loss of biological integrity, focusing both ecology and human health.

Under biosafety issues, main emphasis has been given to facilitate biosafety procedures for ensuring safety from the use of GMOs to the users as well as to the environment. Some biosafety issues related to biotechnology are as follows:

i) Violation of integrity of species due to transfer of transgene from species to species.

ii) Effects on biodiversity due to various biotechnological experiments pose threat to environment.
iii) Animals suffer greatly while performing experiments, on them.

VERY SHORT ANSWER TYPE QUESTIONS: 1 Mark Each.

Q.1. What is the significance of the process of RNA interference (*RNAi*) in eukaryotic organisms? (CBSE-2008)
Ans:- In Eukaryotes, RNA interference is used as defensive process.
Q.2. Name the vector used for introducing the nematode specific gene in tobacco plant.
Ans:- *Agrobacterium tumefaciens*.
Q.3. Name the American company which first prepared genetically engineered insulin.
Ans:- Eli Lilly (1983).
Q.4. How can post harvesting loss of Tomato be prevented by rDNA technology?
Ans:- This Enzyme *polygalacturonase* degrades pectin which promotes softening of fruit. In absence of enzyme, pectin degradation is stopped and the fruit fresh for long. It retains flavour, has superior taste and higher quantity of total soluble solid. The expression of a native gene for production of enzyme *polygalacturonase* has been blocked by using rDNA technology. Post harvesting loss of tomato is thus prevented.
Q.5. What is the importance of 'Golden rice'?
Ans:- Golden Rice contains good quantities of *β-carotene* (provitamin A), a principal source of vitamin A. Since the grains of rice are yellow in colour due to *β-carotene*, the rice is commonly known as golden rice.
Q.6. What was the speciality of the milk produced by the transgenic cow Rosie?
Ans:- Milk produced by transgenic cow, Rosie has high protein content (2.4 gram/litre) having human alpha lactalbumin. It is more nutritionally balanced for human babies than natural cow milk.
Q.7. A multinational company outside India tried to sell new varieties of turmeric without proper parent rights. What is such an act referred to?
Ans:- This is called Biopiracy.
Q.8. What is gene therapy?
Ans:- Gene Therapy is therapeutic treatment of defective heredity by introduction of normal healthy and functional genes which also silence the defective genes of an individual.
Q.9. What does the organisation GEAC check with reference to genetic engineering? 1 (CBSE-2008)
Ans:- GEAC checks the validity of GM research and safety of introducing GM-organisms for public services.
Q.10. What is biopatent?
Ans:- Biopatent is an official right from a government granting an inventor or establishment the sole monopoly to use a particular biological material for certain period.
Q.11. What is biopiracy?
Ans:- Biopiracy is patenting and exploitation of bioresources of other nations without proper authorization or access and benefit sharing agreement.
Q.12. What is molecular farming?
Ans:- "Molecular farming" is an application of *rDNA* technology which involves the use of plants, and potentially also animals, as the means to produce compounds of therapeutic value.
Q.13. State the role of C peptide in human insulin.
Ans:- C peptide is found in pro-insulin and is removed during the successive steps of insulin formation. C peptide is non-functional in nature and it keeps the chain A and chain B separate, so that disulphide bond between chain A and B can be formed at correct position.
Q.14. What are transgenic plants?
Ans:- The plants produced through genetic engineering contain gene or genes usually from an unrelated organism. Such genes are transgenes and the plants having transgenes are called *transgenic plants.*
Q.15. Why does Bt toxin protein not kill the *Bacillus thuringiensis* (bacterium)?
Ans:- Because Bt toxin proteins exist as inactive protoxins but once an insect ingests the inactive protoxin it is converted into an active form of toxin due to alkaline *p*H of the alimentary canal that solubilizes the crystals.
Q.16. Explain the word "biopiracy".
Ans:- Biopiracy is patenting and exploitation of bioresources of other nations without proper authorization or access and benefit sharing agreement.
Q.17. Name the first transgenic animal.
Ans:- The first transgenic animal produced in 1982, was a mouse, known as '*supermouse*'.
Q.18. Why is humulin more preferred than non human insulin?
Ans:- Since insulin produced from non human sources causes allergy or other reactions. Genetically engineered insulin (Humulin) is exactly similar to human insulin and does not cause allergy. Hence it is preferred.
Q.19. How many amino acids form an insulin?
Ans:- 51 amino acids.

SHORT ANSWER TYPE QUESTIONS: 2 MARKS EACH

Q.1. "Genetic engineering will be of much importance in future". How would you account for this? Give two points to support your answer.
Ans:- Genetic engineering will be of very much importance in future -
i) Genetic engineering is of very much important in producing transgenic plants. Pest resistance, herbicide tolerance and high yield transgenic plants can be developed.
ii) Transgenic animals (e.g. pigs) having human genes possess human antigens. As a result their organs if transplanted do not produce any reaction. It will eliminate the requirement of human organs for transplantation, e.g. Pancreas, Kidney, Heart. Besides this, genetic engineering is very useful in generating medicines like human insulin using microbes.
Q.2. Give two reasons as to why transgenic plants are to be developed.
Ans:- Transgenic plants are to be developed because -
i) Pest Resistance Crop has reduced the dependence of crops on chemical pesticides as they are made pest-resistant. e.g. Bt cotton
ii) Transgenic plants have helped to reduce post harvest losses. e.g. *Flavr Savr transgenic* Tomato.
Q. 3. Narrate the disadvantages of GM plants in relation to Human health risk.
Ans:- Disadvantages of GM plants in relation to Human Health Risk:
i) Allergies: The transgenic may cause toxicity and produce allergies. The enzyme produced by the antibiotic resistance gene can cause allergies, because it is a foreign protein.
ii) Effect on Bacteria of Alimentary Canal: The bacteria present in the human alimentary canal can take up the antibiotic resistance gene that is present in the GM food. These bacteria can become resistant to the concerned antibiotic and will be difficult to manage.

Q.4. Name the pest that destroys the cotton bolls. Explain the role *Bacillus thuringiensis* in protecting the cotton crop against the pest to increase the yield.
Ans:- Cotton is attacked by bollworms, *Earias vitella* and *E. insulana*. Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into several crop plants such as cotton. Thus the transgenic cotton is protected from the pest.
Q.5. Enumerate the three basic steps in creating genetically modified organism (GMO).
Ans:- Three Basic Steps in Creating Genetically Modified Organism (GMO) are as follows:
iv) Identification of DNA with desirable genes.
v) Introduction of the identified DNA into host.
vi) Maintenance of introduced DNA in the host and transfer of the DNA to its progeny.
Q. 6. Write the two types of Gene therapy.
Ans:- Types of Gene therapy:
1) Germ line gene therapy: In this therapy the functional genes are introduced into the germ cells for correction of genetic defects.
2) Somatic Gene therapy: In this case, the functioning genes are introduced into body cells that lack them and the effects of the therapy are confined to the person undergoing treatment and are not passed on the offspring.
Q.7. Explain the word Biosafety. Name an organization which established in relation to Biosafety.
Ans:- *Biosafety* is the prevention of large-scale loss of biological integrity, focusing both on ecology and human health. These prevention mechanisms include conduction of regular reviews of the *biosafety* in laboratory settings, as well as strict guidelines to follow. *Biosafety* is used to protect from harmful incidents.
GEAC (Genetic Engineering Approval Committee) is an organisation set up by Indian Government for making decision regarding the validity of GM research and safety of introducing GM organisms for public services.
Q.8. What is the difference between *cry* and Cry?
Ans:- *cry* is the gene present in soil bacterium *Bacillus thuringiensis* that codes for the crystal toxin Crystal proteins called Cry proteins that are toxic to certain insects.
Cry is Bt toxin protein which exists as inactive *protoxins* but once an insect ingest the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals and kills the insects.
Q.9. How did Eli Lilly synthesise the human insulin? Mention one difference between this insulin and the one produced by the human pancreas.
Ans:- Eli Lilly synthesized the human insulin by rDNA technology. Insulin synthesised through rDNA tecgnology (Eli Lilly) is produced in mature form while human pancreas insulin is produced as pro-hormone (proinsulin).
Q.10. A four year old girl was introduced genetically engineered lymphocytes (collected from her own blood) for her treatment of ADA deficiency. What is the name of such therapy? What alternative technique can be taken for a permanent cure?
Ans:- The name of such therapy is somatic gene therapy. If the isolated gene from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it can be a permanent cure.
Q.11. Why are transgenic animals produced? Give three reasons.

Ans:- Transgenic animals are produced mainly for the following reasons:
a) Some transgenic animals are produced for economic benefits. e.g. Transgenic cattle are created to produce a particular type of milk containing specific human proteins which help in human emphysema treatment.
b) Some transgenic animals are produced as disease models. e.g. genetically modified mouses carry a gene that promotes the development of several types of cancers in human.
Q.12. What is Bio-safety issue and write "RDAC" in expanded form.
Ans:- Biosafety issue is the prevention of large – scale loss of biological integrity, focusing both ecology and human health.

RDAC stands for Recombinant DNA Advisory Committee.

Q.12. Mention the role of GEAC (Genetic Engineering Approval Committee).

SHORT ANSWER TYPE QUESTIONS: 3 MARKS EACH.

Q.1. Write three environmental hazards caused by GM crops.
Ans:- Environmental Hazards of GM crops:
i) Unintended Harm to other Organisms: If pollen from *Bt* corn is blown by the wind onto milkweed plants in neighbouring fields, the caterpillars can eat the pollen and die.
ii) Reduced effectiveness of pesticides: Just as some populations of mosquito developed resistance to the pesticide DDT, many people are concerned that insects will become resistant to Bt or other crops that have been genetically modified to produce their own pesticides.
iii) Gene Transfer to non-target Species: Another concern is that crop plants engineered for herbicide tolerance and weeds will cross breed, resulting in the transfer of the herbicide resistance gene from the crops into the weeds. These "*Superweeds*" would then be herbicide tolerant as well.

Q.2. Name the insect pest that is killed by the products of *cry* IAc gene. Explain how the gene makes the plant resistant to the insect.
Ans:- *cry I AC* controls cotton bollworms.
This gene codes for the crystal toxin Crystal proteins called Cry proteins that are toxic to certain insects and toxin binds to the surface of epithelial cells of midgut and creates pores. This causes swelling and lysis of cells leading to the death of the insects.

Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into several crop plants such as cotton.

Q.3. Discuss in brief about three advantages of transgenic microorganisms.
Ans:- Advantages of transgenic microorganisms are -
i) The bacteria *Escherichia coli* has been used for production of human insulin by incorporating DNAs that code human insulin. The drug industry has made use of this discovery to produce medication for diabetes.
ii) Similar bacteria have been used to produce clotting factors to treat haemophilia, and human growth hormone to treat various forms of dwarfism. These recombinant proteins are safer than the products they replaced.
iv) Genetically engineered *Pseudomonas* bacteria have also been used as 'oil eating bacteria'. .

Q.4. What is Gene therapy? What are two types of Gene therapy?
Ans:- Gene Therapy is therapeutic treatment of defective heredity by introduction of normal healthy and functional genes which also silence the defective genes of an individual.
Types:
1) Germ line gene therapy: In this therapy the functional genes are introduced into the germ cells for correction of genetic defects.
2) Somatic Gene therapy: In this case, the functioning genes are introduced into body cells that lack them and the effects of the therapy are confined to the person undergoing treatment and are not passed on the offspring.

Q.5. What are the biosafety issues related to biotechnology?
Ans:- Some biosafety issues related to biotechnology are as follows :
i) Violation of integration of species due to transfer of transgene from species to species.
ii) Effect on biodiversity due to various biotechnological experiments poses threat to the environment.
iii) Animals suffer greatly while performing experiments, on them.

Q.6. In what purposes biopatents are granted?
Ans:- Biopatents are now being granted for the following purposes:
a) Genetically modified strains of plants and animals.
b) Proteins encoded by DNA sequences.
c) Cell lines.
d) New strains of micro-organisms.
e) Particular biotechnological procedures.
f) Biotechnological products.
g) Production processes, etc.

LONG ANSWER TYPE QUESTIONS

Q.1. What is meant by ADA deficiency? How is gene therapy a solution of this problem? Why is it not a permanent cure?
Ans:- ADA deficiency is caused due to the deletion of the gene for adenosine deaminase. In absence of enzyme ADA, purine metabolism is disturbed and T-Lymphocytes fail to function. Such patients suffer from Severe Combined Immuno Deficiency (SCID).

Through gene therapy, lymphocytes are extracted from the patient's bone marrow and are grown in a culture outside the body. A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are then reinjected to the patient's bone marrow. But as these cells do not always remain alive, this therapy is not a permanent cure. The patient requires periodic infusion of such genetically engineered lymphocytes.

Q.2. How is a transgenic tobacco plant protected against *Meloidegyne incognitia*? Explain the procedure.
Ans:- A nematode, *Meloidegyne incognitia* infects the roots of tobacco plants and cause drastic reduction in yield. Transgenic tobacco plants were produced based on the process of *RNAi* (RNA interference). *RNAi* involves silencing of a specific mRNA by a complementary dsRNA that prevents the translation of the mRNA. RNAi takes place in all eukaryotic organisms as a method of cellular defense.

The specific genes in the form of cDNA from the parasite are introduced into the plant using *Agrobacterium tumefaciens* as the vector. The genes are introduced in such a way that both the sense RNA and antisense RNA (complementary to the coding or sense RNA) are produced. Since these two RNAs are complementary, they form a double stranded RNA (*dsRNA*). This neutralizes the specific RNA of the nematode, by a process called RNA interference (*RNAi*) and silenced the specific mRNA of the nematode.

As a result, the parasite cannot live in the transgenic host, which expresses the specific interfering RNA and thus the transgenic plant is protected from the nematode.

Q.3. a) Name the source of Taq polymerase. Explain the advantages of its use in biotechnology.
b) Expand the name of this enzyme ADA. Why is this enzyme essential in the human body? Suggest a gene therapy for its deficiency.
Ans:- a) Taq polymerase is obtained from the bacterium *Thermus aquaticus*. This enzyme is thermostable and can withstand high temperature used for denaturation and separation of the two strands of DNA. Amplification can be carried out to produce even a billion copy of DNA using this enzyme Taq polymerase.
b) ADA means adenosine deaminase.

Adenosine deaminase enzyme is required for purine metabolism. In absence of enzyme ADA, purine metabolism is disturbed and T-Lymphocytes fail to function. The patients suffer from SCID (Severe Combined Immuno Deficiency) and lack functional T-lymphocytes and therefore fail to fight in infective pathogens.

As a first step towards the gene therapy, lymphocytes are extracted from the patient's bone marrow and are grown in a culture outside the body. A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are reinjected to the patient's bone marrow. But as these cells do not always remain alive (not a permanent cure), the patient requires periodic infusion of such genetically engineered lymphocytes. However, if the isolated gene from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it can be a permanent cure.

Q.4. Discuss five uses of Genetically modified Plants.
Ans:- Use Of Genetically Modified Plants:
i) Tolerance: Genetic modification has made the crops more tolerant to abiotic stresses like cold, heat, drought, salinity, etc.
ii) Pest Resistance Crops: It has reduced the dependence of crops on chemical pesticides as they are made pest-resistant. e.g. Bt cotton
iii) Reduction in Post-harvest losses: They have helped to reduce post harvest losses. e.g. Flavr Savr transgenic Tomato.
iv) Increasing Nutritional Value of Food: Food produced from GM crops has enhanced nutritional value. e.g. golden rice is rich in vitamin A.
v) Phytoremediation: Plants such as popular trees have been genetically engineered to clean up heavy metal pollution from contaminated soil.

Q.5. What are transgenic animals? Explain any five ways in which such animals can be beneficial to humans.
Ans:- The animals which carry foreign genes are called transgenic animals. Some of the important uses of transgenic animals are as follows:
1. Milk: Transgenic cattle with extra genes for growth hormones and casein give very high yield of milk. The first transgenic cow, Rosie, yielded milk with high protein content (2.4 gram/litre) having human alpha lactalbumin. It is more nutritionally balanced for human babies than natural cow milk.
2. Transgenic Pigs: Transgenic pigs having human genes possess human antigens. As a result their organs if transplanted do not produce any reaction. It will eliminate the requirement of human organs for transplantation, e.g. Pancreas, Kidney, Heart.

3. Vaccine Safety Testing: Transgenic animals are the best for checking the safety of vaccines before their use in humans. Polio vaccine is being tested on transgenic mice.
4. Chemical safety Testing: Transgenic animals are made more sensitive to toxic substances as compare to non transgenic animals. They are then used in studying the effect of toxic chemicals.
5. Study of Disease: Many transgenic animals are developed to increase our understanding of how genes contribute to the development of disease so that investigation of new treatments for diseases is made possible. Now transgenic model for many human diseases such as cancer, rheumatoid, arthritis, Alzheimer's disease, Haemophilia, Thalassaemia etc.

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ORGANISMS AND POPULATIONS

VERY SHORT ANSWER TYPE QUESTIONS: 1 Marks Each.

Q.1. What is high altitude sickness? Write its symptoms.
Answer:- High altitude sickness is experienced by the people going to high altitudes, where oxygen concentrations are low and the body system reacts by developing the symptoms like nausea, headache and heart palpitations.
Q.2. Differentiate Autecology from Synecology.
Ans:- Autecology (Species ecology) is the study of relationship of a single species or population with the environment for its various aspects like life history, population dynamic, adaptation etc.
Synecology (Community ecology) is the study of biotic community in their various aspects like structure, development, distribution, adaptation, etc. in relation to their environment.
Q.3. Define adaptation.
Ans:- Changes occurring in structure, behaviour, physiology and development which are useful to organism in adjusting themselves favourably to prevailing set of environmental condition are called adaptations.
Q.4. Name an organism that undergoes aestivation.
Ans:- Snail and fish.
Q.5. Name the mechanism to suspend development in zooplankton.
Ans:- Diapause.
Q.6. Define daipause.
Ans:- The mechanism that some organisms (many zooplankton species in lakes and ponds) under unfavourable conditions suspend their development is known as *diapause*.
Q.7. What are the organisms that feed on plant sap and other plant parts called?
Answer:- The organism that feed on plant sap and other parts of plants are termed as phytophagous.
Q.8. What is Synecology?
Ans:- Synecology (Community ecology) is the study of biotic community in their various aspects like structure, development, distribution, adaptation, etc. in relation to their environment.
Q.9. In what way Crocodile bird develops relationship with Crocodile?
Ans:- Leeches often enter the mouth of Crocodile, sucking blood. The crocodile bird enters the mouth of Crocodile and feeds upon the leech. The relationship is known as protocol-operation.
Q.10. What are the component members of Lichens?
Ans:- The component members of Lichens are a photosynthetic alga and a fungus.
Q.11. Differentiate between Amensalism and Commensalism.
Ans:- Amensalism is an interaction between two living individuals of different species in which an organism does not allow other organism to grow or live near it.
Commensalism is an interaction between the individuals of two different species in which one is benefitted while the other remains unaffected.
Q.12. Cite any two consequences of increase number of predators in an ecosystem.
Ans:- i) Number of preys will be depleted.
ii) There will be ecological imbalance.
Q.13. Mention any two significant roles predation plays in nature.
Ans:- Roles of Predation are:
a) It maintains the species diversity of a biotic community by reducing competition amongst the prey species.
b) Predation keeps the prey population under control. It is called biological control.
Q.14. Why is the polar region not a suitable habitat for tiny humming birds?
Ans:- Tiny humming birds have a large surface area relative to their volume. They tend to lose body heat quickly if it is cold outside. It is because of this reason that small animals (e.g. humming bird) are rare in polar and alpine region.

Q.15. List the advantage that a mycorrhizal association provides to the plant. 1 (CBSE – 2011)
Ans:- The fungi help the plant in the absorption of essential nutrients from the soil while the plant in turn provides the fungi with energy-yielding carbohydrates.
Q.16. What is meant by Allen's rule?
Ans:- Allen's rule refers to the minimizing heat loss in animals by possessing shorter ears and limbs. (Animals of colder areas have shorter extremities e.g. tail, ears, feet, as compared to animals to warmer areas.)
Q.17. Why are very small animals generally not found on polar region?
Ans:- Heat loss or gain is a function of the surface area. Small animals have a large surface area relative to their volume. So loose heat rapidly. Considering the cost and benefits of energy expenditure very small animals are generally not found in polar regions.
Q.18. State Gause's Competitive Exclusion Principle.
Ans:- Gause's Competitive Exclusion Principle is referred to as the process where two closely related species compete with each other for the resource. These species cannot co-exist in a single place thereby resulting in elimination of either one of the species.
Q.19. What is carrying capacity of environment?
Ans:- The maximum number of individuals of a population which can be provided with optimum resources for their healthy living is called Carrying capacity of the environment.
Q.20. What are Eurythermal organisms? Give examples.
Ans:- Eurythermal (*eurys*-wide) organisms are those organisms which can tolerate a wide range of temperature variations. e.g. most mammals ,birds, Cyclops, toad, wall lizard, etc.
Q.21. What are Stenothermal organisms? Give examples.
Ans:- *Stenothermal* (*thermos*-temperature, *stenos*-narrow) organisms are those organisms which live within narrow range of temperature because of their requirement of nearly constant temperature throughout the year. e.g. Polar bear, fishes, plants, snails.
Q.22. What are ephemeral?
Ans:- Ephemerals (Drought Escaping) are plants which grow in dry areas only during rain for a short period of 4-6 weeks. Examples: *Euphorbia, Tribulus.*
Q.23. What are halophytes?
Ans:- Halophytes are those plants which can adapt to grow in saline environment (habitats).
Q.24. Define camouflage.
Ans:- The phenomenon of blending with surroundings due to similar colour, marking, and shapes is called camouflage. e.g. Stick insect (*Carausius morasus*). Praying mantis (*Mantis religiosa*)
Q.25. Define Mimicry.
Ans:- Mimicry is resemblance of one animal with another so as to confuse a third animal as to its identity.
Q.26. Define mimic and model.
Ans:- The animal which resembles another for driving a benefit is called mimic. The animal with which the mimic shows resemblance is known as model.
Q.27. Define population.
Ans:- Population is an aggregation or grouping of individuals of same species at the same time in a particular area or space.
Q.28. What is amensalism?
Ans:- Amensalism is an interaction between two living individuals of different species in which an organism does not allow other organism to grow or live near it.
Q.29. What is commensalism?
Ans:- Commensalism is an interaction between the individuals of two different species in which one is benefitted while the other remains unaffected.
Q.30. Pilot fish follows Shark and feeds upon its leftovers. What is the relationship between these two organisms called?
Ans:- Commensalism.
Q.31. Define proto cooperation.
Ans:- Proto-cooperation is an interaction between two living organisms of different species in which both are mutually benefitted but they can live without each other.
Q.32. 'Leeches enter the mouth of Crocodile, sucking blood. The bird Plover (*Pluvianus aegyptius*) enters the mouth of Crocodile and feeds upon the leeches'. Name the relationship between bird and crocodile?
Ans:- Proto-cooperation.
Q.33. Define Symbiosis.
Ans:- Symbiosis is an interaction between two organisms of different species where both the partners are benefitted with none of the two capable of living separately.
Q.34. Why do syberians birds migrate?
Ans:- To avoid extreme cold conditions and thermoregulation.

Q.35. Define habitat.
Ans:- Habitat is the locality along with sum total of abiotic and biotic factors of that specific place where an organism lives.
Q.36. Define niche.
Ans:- Niche is a specific part of habitat utilized by an organism which represents a range of conditions.
Q.37. What is Resource Partitioning?
Ans:- Resource partitioning is the mechanism where competing species either utilize alternative resources or change their foraging time or pattern.
Q.38. List the various abiotic environmental factors.
Ans:- Temperature, Water, Soil, Light.
Q.39. What is the ecological principle behind the biological control method of managing the pest insects?
Ans:- Predation.
Q.40. Mention the association type shown by pollinators and plants.
Ans. Mutualism
Q.41. Define Co-evolution.
Ans:- The changes that help one species to evolve against the other is equally balanced by the other species that depends on the first by changes in itself is called co-evolution, i.e. both evolve simultaneously.
Q.42. What is brood parasitism?
Ans:- The laying of eggs by a parasitic bird in the nest of its host and lets it to incubate is called brood parasitism.
Q.43. How does the temperature affect the organisms?
Ans:- Temperature affects the enzyme kinetics and through this it affects the basal metabolism of the individual.
Q.44. Give two examples to biomes.
Ans:- (1) Desert and (2) Rain forest
Q.45. When and why do some animals like frogs hibernate?
Ans:- Frogs hibernate during winter, as during winter atmospheric temperature is low during winter, body temperature of the frog also lowers. Hence they undergo hibernation.
Q.45. Give an example for:
(a) An endothermic animal.
(b) An ectothermic animal.
(c) An organism of benthic zone.
Answer:
(a) Birds or mammals;
(b) Amphibians or reptiles;
(c) Sponges, corals, star fishes, etc.
Q.46. Define population and community.
Ans:-
(i) Population: A population is the total number of individuals of a species in a specific geographical area which can interbreed under natural conditions to produce fertile offsprings and share a common gene pool.
(ii) Community: A biotic community is the assemblage of all the populations of different species found in the same geographical area.
Q.47. Why do submerged plants receive weaker illumination than exposed floating plants in a lake?
Ans:- Submerged plants receive weaker illumination than exposed floating plants in a lake because all colours of the visible components of the spectrum of light do not enter or penetrate in the depths of water.
Q.48.What are eurythermal species?
Ans:-Eurythermal species are those species which possess or show a wide range of temperature tolerance.
Q.49. Define stenohaline species.
Ans:- Stenohaline species are those species which show a narrow range of salinity tolerance.
Q.50.What is the interaction between two species called?
Ans:-Interaction between two species is called interspecific interaction. These could be beneficial, detrimental or neutral to one of the species or both.
Q.51.Name the association in which one species produces poisonous substance or a change in environmental conditions that is harmful to another species.
Ans:- Parasitism is the association in which one species produces poisonous substance or a change in environmental conditions that is harmful to another species.
Examples are protozoans such as Amoeba and Plasmodium vivax that lives in human body and cause diseases.

Q.52. What is mycorrhiza?
Answer:- Mycorrhiza is a symbiotic association between a Fungus and the root of higher plants like conifers i.e., Pinus.
Q.53.What is homeostasis?
Answer:- Homeostasis is the tendency of the organism to maintain a constant internal environment despite varying external environmental conditions like temperature.
Q.54.Define aestivation.
Answer:- Aestivation is a behavioural adaptation to avoid extreme heat and dessication in summer season. In which the organism slows down its metabolic activities. It is also known as summer sleep.
Q.55. What is diapause and its significance?
Answer:- Diapause is a stage of suspended development that some organisms like zooplanktons in lakes and ponds, adopt to survive under unfavourable conditions.
Q.56.What would be the growth rate pattern, when the resources are unlimited?
Answer:- In case of unlimited resources, the pattern of growth rate is exponential.

SHORT ANSWER TYPE QUESTIONS: 2 MARKS EACH
Q.1. How does habitat differ from niche? Give two points.
Ans:- Difference between habitat and niche:

HABITAT	NICHE
1. It is area or locality of residence of an organism which has a particular set of abiotic factors. 2. A number of species may occur in a habitat.	1. It is the component of habitat which is governed by functioning of an organism. 2. A niche has only one species.

Q.2. 'Niche is a part of habitat'. Explain with the help of an example.
Ans:- Niche of an organism represents the defined range of conditions that it can tolerate, the diversity in the resources it utilises and the distinct functional role it plays in the ecological system.
The green plants/ algae are not found in very deep waters, as they need light for photosynthesis, they are the producers of the ecosystem.
Q.3. Give two differences between camouflage and mimicry.
Ans:- Difference between camouflage and mimicry:

Camouflage	Mimicry
1. It is resemblance of animals as to their colour and marking with surroundings. 2. The animals remain unnoticed from a distance.	1. It is resemblance of an animal with another. 2. The mimic is not easily differentiable from model.

Q.4. Differentiate between population and species by giving two points.
Ans:- Differences between population and species:

Population	Species
1. It is grouping of individuals of the same species at the same species at the same time in a particular area. 2. A population belongs to a single ecotype.	1. It is the grouping of individuals which resemble one another in all important characters besides ability to ability to interbreed freely. 2. A species may have several ecotypes.

Q.5. Some organisms live together so that one organism benefits by the relationship while the other organism neither help nor harm". Name the type of relationship with an example.
Ans:- Commensalism.
Example: Growing of epiphytes (e.g. Orchids) on a branch of mango tree.
Q.6. Differentiate population from biological community by giving at least 2 points.
Ans:- Difference between population and biological community:

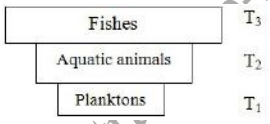
Population	Biological community
1. It is the grouping of individuals of same species found in a particular area. 2. The members do not have a relation of eating and being eaten.	1. It is an assemblage of population of different species found in a particular area. 2. The members have a relation of eating and being eaten.

Q.7. Describe two factors that control the population size in a given area.
Ans:- The two factors that control the population size are:
1) Natality: It is the number of births per unit population per unit time. It increases the size of population.
2) Mortality: It is the average number of natural deaths per unit population per unit time. It decreases the size of the population.

Q.8. Why do people suffer from altitude sickness after reaching the high altitude regions? How does their body acclimatise after a couple of days?
Q.9. How will you differentiate between Immigration and Emigration? Give two points.
Ans:- Differences between Emigration and Immigration:

Emigration	Immigration
1. It is outward movement of some individuals from a population. 2. It decreases the size of population.	1. It is inward movement of some individuals into a local population from an outside population. 2. It decreases the size of population.

Q.10. Name the interaction in each of the following:
(a) Cuckoo lays her eggs in the crow's nest.
(b) Orchid grows on a mango tree.
(c) Ticks live on the skin of dogs.
(d) Sea anemons is often found on the shell of hermit crab.
Ans:- a) Brood parasitism.
b) Commensalism.
c) Parasitism.
d) Commensalism.
Q.11. Certain species of Wasps are seen to frequently visit flowering Fig trees. What type of interaction is interaction is seen between them and why?
Ans:- Symbiosis or Mutualism. Because fig can be pollinated only by its partner wasp while the female wasp uses the fruit not only as oviposition (egg laying) site but uses the developing seeds for nourishing its larvae within the fruit. During their association both partners are benefitted but none of the two capable of living separately. Hence the relationship is mutualism.
Q.12. Construct a pyramid of biomass starting with the phytoplanktons. Lebel 3 trophic levels. Is the pyramid upright or inverted? Why?
Ans:-



The pyramid is inverted. Since the biomass of fishes far exceeds than that of phytoplanktons, the pyramid is inverted.
Q.13. Mention the adaptations the Kangaroo rat in North American desert has to survive in the absence of an external source of water.
Ans:- (i) Rat kangaroo is capable of meeting all its water requirements through its internal oxidation of fat in which water is a byproduct.
(ii) It can concentrate its urine, so that only minimal volume of water is removed during excretion of wastes.
Q.14. Lianas are vascular plants rooted in the ground and maintain erectness of their stem by making use of other trees for support. They do not maintain direct relation with those trees. Discuss the type of association the lianas have with the trees.
Ans:- The type of association, the lianas have with the trees is commensalism because the plant gets the support of the tree without affecting harming or providing any benefit to the tree.

Q.15. How is diapause different from hibernation?
Ans:-Hibernation is the period of dormancy during winter months so is also called winter sleep. It is characterized by greatly reduced metabolic rate and only reserve food is consumed. Diapause is the state of suspended morphological growth and development during summer months so is a special type of aestivation.
Q.16. Define phenotypic adaptation. Give one example.
Ans:- Phenotypic adaptation involves non-genetic changes in individuals, such as physiological modifications, e.g., acclimatization, or behavioural changes. Adaptations of organisms determine their survival in the respective environments.
The gradual physiological adjustments to the changed environmental conditions is called acclimatisation.
Q.17. Most living organisms cannot survive at temperature above 45°C. How are some microbes able to live in habitats with temperatures exceeding 100°C?
Ans:- Most living organisms cannot survive at temperature above 45°C because very high temperature causes denaturation of their enzymes. But certain bacteria, cyanobacteria, shelled protozoans, etc. are

known to survive even in thermal springs. Tolerance power to the extremes of temperature varies from species to species,
e.g. Certain bacteria and cyanobacteria have thermal-resistant enzymes and peculiar cell wall.
Q.18. List the attributes that populations but not the individuals possess.
Ans:- A population has some attributes which are not shown by its individual members. An individual born and dies, where as the population has a birth rate and a death rate. Each population has a certain pattern of distribution, variation in numbers, age structure, natality (birth rate), mortality (death rate), dispersal, biotic potential, growth forms and sex ratio. All these attributes are not possessed by individuals. Further, a population has a gene pool shared by its members.
Q.19. Define heliophytes and sciophytes.
Ans:- Plants growing well in bright sunlight or favour bright light are called heliophytes or sun plants. While those plants which require low intensity of light or partial shade for growing are termed as shade loving plants or sciophytes.

Q.20. Name important defence mechanisms in plants against herbivory.
Ans:- Many plants develop thick cuticle on their leaf surfaces.
• In some plants the leaves are modified into spines to protect themselves from browsing herbivores
e.g. Leaf-spines in *Opuntia* while *Bougainvillea*, and *Duranta* have stem thorns; and Acacia has leaf-stipular spines.
• Many plants produce and store toxic chemicals which cause discomforts to the herbivores e.g. cardiac glycosides by *Calotropis* (Ak plant);" nicotine by tobacco, etc.
Q.21. An orchid plant is growing on the branch of mango tree. How do you describe this interaction between the orchid and the mango tree?
Ans:-In such interspecific interaction, orchid grows as an epiphyte on the branch of a mango tree and derives the benefit of habitat only but derives no nutrition from the mango tree. In this, though orchid is benefitted but the mango tree is neither benefitted nor harmed. Such an interaction is called commensalism.
Q.22.What is the ecological principle behind the biological control method of managing with pest insects?
Ans:-Biological control method adopted in the management of agricultural pest insects is based on the principle of predation. In this, certain living organisms act as predators and help to regulate the pest insects which act as their prey e.g. control of mosquito larvae in the water bodies by Gambusia fish; and control of aphids by lady bird beetles.
Q.23. Distinguish between:
(a) Hibernation and aestivation;
(b) Ectotherms and endotherms.
Ans:-(a) Hibernation (winter sleep) is the period of dormancy and reduced metabolic rate during winter months mostly found in the poikilo-thermal animals like amphibians, lizards, snakes, etc. Aestivation (summer sleep) is the period of dormancy and reduced metabolic rate during summer months and is found in lung fish.
(b) Endotherms are homeothermal or warm-blooded animals which can keep their body temperature constant even in changing environmental temperatures e.g. birds and mammals;
While ectotherms are poikilothermal or cold-blooded animals are those whose body temperature changes with the change in environmental temperature e.g. fishes, amphibians and reptiles.
Q.24. List the various abiotic environmental factors.
Ans:-
(i) Climatic factors e.g., (a) Light (b) Temperature (c) Humidity (d) Wind (e) Rainfall (f) Water (g) Atmospheric gases.
(ii) Edaphic factors e.g., (a) Soil type (b) Topography of soil (c) pH of soil.
Q.25. List any four characters that are employed in human population census.
Ans:- A population has the following characteristics that are employed in human population census.
(i) Natality and mortality
(ii) Sex ratio
(iii) Population density
(iv) Age distribution
(v) Population growth.
Q.26. What is brood parasitism? Explain with the help of an example.
Ans:- Brood parasitism is the phenomenon in which an organism (parasite) lays eggs on the nest of other organism (host).e.g., Cuckoo (koel) bird lays its eggs in the nest of its host and lets the host incubate them. The eggs of the parasitic bird resemble the host's egg in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest.

Q.27. If a freshwater fish is placed in an aquarium containing sea water, will the fish be able to survive? Explain giving reasons.
Ans:- No, a freshwater fish placed in the aquarium containing sea water, will not be able to survive. Because, its body system is adapted to function normally in a narrow range of salinity and it cannot survive in the high salinity of sea water.
Q.28. Why do all the freshwater organisms have contractile vacuoles whereas majority of marine organisms lack them?
Ans:- Contractile vacuole helps in osmoregulation. Because of the cellular environment of a fresh water organism being hypertonic, the water diffuses inside the cell constantly and gets collected in the contractile vacuole, which squeezes the extra water out of the cell periodically. Thus, keeping the internal environment constant, while in case of marine organisms, this does not occur due to high salinity, therefore no need of contractile vacuole.
Q.29.Define ectoparasite and endoparasite and give suitable examples.
Ans:- Ectoparasite feeds on the external surface of the host organism, e.g., Lice on humans and ticks on dogs. Many marine fish are infested with ectoparasitic copepods.
Endoparasites live inside the host body at different sites (liver, kidney, lungs, red blood cells ,etc.). Such as malarial parasites *Plasmodium vivax*.

SHORT ANSWER TYPE QUESTIONS: 3 MARKS EACH.

Q.1. If a marine fish is placed in a fresh aquarium, will the fish be able to survive? Why or why not?
Ans:- A marine fish placed in fresh water will not be able survive because-
i) Water will enter its body due to endosmosis.
ii) It has water drinking habit that causes excess water to the body.
iii) It does not have salt absorbing mechanism of fresh fishes.
Therefore, maintenance of osmolarity will not be possible and the fish will die.
Q.2. Differentiate Intraspecific competition and Interspecific competition by giving at least 3 points.
Q.3. Differentiate between hibernation and aestivation.
Ans:- Difference between hibernation and aestivation:

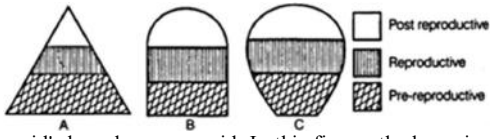
Hibernation	Aestivation
1. It is winter sleep in which animal passes the winter period in dormant condition. 2. The animal rests in a warm place. 3. It is longer duration and lasts for the whole duration of water.	1. It is summer sleep. 2. Animal rests in a cool/ shady and moist place. 3. It lasts for hot dry day time as night are cooler.

Q.4. Differentiate predation from parasite by giving at least 3 points.
Ans:- Differences between predation and parasite:

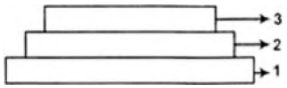
Predator	Parasite
1. It catches and kills the prey. 2. The predator is larger and stronger. 3. Predator feeds on killed prey.	1. It lives on or inside the body of host. 2. The parasite is smaller and weaker. 3. It feeds on living host.

Q.5. What are the four basic processes that change the density of a population? Describe them.
Ans:- The density of a population in a given habitat during a given period, fluctuates due to changes in four basic processes, two of which (natality and immigration) contribute an increase in population density and two (mortality and emigration) to a decrease.
(i) *Natality* refers to the number of births during a given period in the population that are added to the initial density.
(ii) *Mortality* is the number of deaths in the population during a given period.
(iii) *Immigration* is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration.
(iv) *Emigration* is the number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.
Q.6. How do organisms like fungi, zooplanktons and bears overcome the temporary short lived climatic stressful conditions? Explain.
Ans:- During stressful environment conditions:
Fungi form thick wall spores and suspend their activities. Zooplanktons undergo *diapause*, a stage of suspended development while Bears undergo hibernation.
Q.7. While living in and on the host species, the animal parasite has evolved certain adaptations. Describe these adaptations with examples.
Ans:- Parasites have evolved special adaptations such as
(i) The loss of unnecessary sense organs as in lice, mites and fleas don't have wings.
(ii) Presence of adhesive organs or suckers to cling on to the host-in tapeworms and leeches.

(iii) Loss of digestive system i.e., tapeworm.
(iv) High reproductive capacity i.e., roundworm produces large progeny.
Q.8.The following diagrams are the age pyramids of different populations. Comment on the status of these populations.

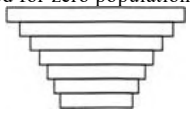


Ans:- Figure A: It is a 'pyramid' shaped age pyramid. In this figure, the base, i.e., pre-reproductive stage is very large as compared with the reproductive and post-reproductive stages of the population. This type of age structure indicate that the population would increase rapidly.
Figure B: It is an 'inverted bell' shaped pyramid. In this figure, the pre-reproductive and reproductive stages are same. This type of age structure indicates that the population is stable.
Figure C: It is 'urn' shaped pyramid. In this figure, the pre-reproductive and reproductive stages are less than the post-reproductive stages of this population. In this population, more older people are present. This type of age structure indicates that the population definitely is declining.
Q.9.



(a) Label the three tiers 1, 2, 3 given in the above age pyramid.
(b) What type of population growth is represented by the above age pyramid?
Answer:
(a) The three tiers are to be labelled as - (i) Pre-reproductive phase
(ii) Reproductive phase
(iii) Post-reproductive phase
(b) The given age pyramid represents the expanding type of population growth.
Q.10. In an aquarium two herbivorous species of fish are living together and feeding on phytoplanktons. As per the Gause's principle, one of the species is to be eliminated in due course of time, but both are surviving well in the aquarium. Give possible reasons.
Ans:- Competition is a rivalry relationship between two or more organisms. A competition between individual of same species (intra specific) is more acute than the competition between individual of different species as all the members in a interspecific competition have same basic requirements like food, water, light, space, mating and shelter. But this is true only when resources are limited. According to Gause's principle, one of the species is to be eliminated. But studies recently have revealed that species facing intra specific competition may evolve mechanism to encourage co-existence rather than exclusion. This can also be done by a method known as 'resource partitioning'.

Q.11. Define 'zero population growth rate'. Draw an age pyramid for the same.
Ans:- When the pre-reproductive age group individuals are comparatively fewer and both reproductive and post-reproductive stages are almost in equal stage, i.e.at same level, it is zero population growth rate. An inverted bell shaped age pyramid is obtained for zero population growth rate.



LONG ANSWER TYPE QUESTIONS: 5 MARKS EACH
Q.1. Give 5 differences between J-shaped growth form and S-shape growth form.
Ans:- Differences between J-shaped Growth form and S-shaped Growth form:

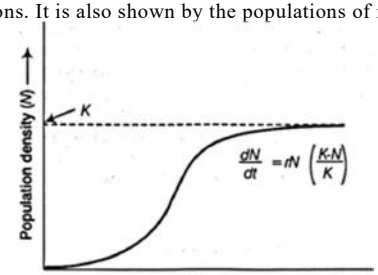
J-shaped population Growth Form	S-shaped population Growth form
1. It occurs in irruptive type of population. 2. An equilibrium is never reached in the population. 3. A phase of deceleration never occurs. 4. Population grows beyond the carrying capacity of the area. 5. A crash phase occurs at the end of J-shaped growth.	1. It is found in stable type of population. 2. An equilibrium is reached when the size of the population approaches the carrying capacity of the area. 3. A phase of deceleration occurs before equilibrium is reached. 4. Population seldom grows beyond the carrying capacity. 5. A crash phase does not occur.

Q.2. What are Xerophytes? Describe the four types of xerophytes with their characteristic features.
Ans:- Plants adapted to condition of water scarcity and heat are called Xerophytes. Four types of plants occur in deserts.
A. Ephemerals/Drought Escaping: They are plants which grow in dry areas only during rain for a short period of 4-6 weeks. Examples: *Euphorbia, Tribulus.*
B. Annual/Drought Evading: The plants grow in aerial areas for 3-4 months a few weeks longer than rain. They have modifications to reduce transpiration. Example: *Echinops, Solanum surattense.*
C. Succulents/Drought Resisting: They are perennial plant of dry areas which stored water. They are fleshy or succulents. Example: *Opuntia, Cacti*.
D. Non-Succulent Perennial/Drought Enduring: They are true xerophytes which actually endured draught condition.
Q.3. Describe the special adaptations of xerophytes with respect to root system, stem and leaves.
Ans:- Adaptations of xerophytes –
i. Root: The roots are well spread reaching almost the water table.
ii. Epigeal growth: The shoot system is the smaller as compared to root system.
iii. Leaves: They are thick, small or dull green with either a dense covering of hair.
iv. Spines, prickles and thorn: True xerophytes often possess this hard sharp pointed structures for reducing transpiration.
v. Stomata: Stomata are sunken. Presence of sunken stomata also reduces transpiration.
Q.4. How does Ectotherm differ from Endotherm? Give 5 points.
Ans:- Difference between Ectotherm and Endotherm :

ECTOTHERM	ENDOTHERM
1. They are unable to regulate their body temperature.	1. They are able to regulate their body temperature.
2. Body temperature changes with the temperature of environment.	2. There is little effect of environment temperature on body temperature.
3. The animal shows hibernation and aestivation.	3. The two activities are rare.
4. They live only in those areas which have favourable environment temperature.	4. They live in all places including the ones with highly unfavourable Environment temperature.
5. The animals are less active.	5. The animals are more active.

Q.5. Describe the 5 phases of S-shape growth form.
Ans:- S-shaped or Sigmoid Growth Curve is more common type of population growth form. It has 5 phases:
i) Lag Phase: There is slow increase in population size.
ii) Positive acceleration Phase: Increase in population starts and occurs at a slow rate in the beginning.
iii) Exponential Phase: Increase in population become rapid and soon attains its full potential rate. It continuous till environmental resistance comes to play.
iv) Negative acceleration (Deceleration) Phase: The growth rate finally slows down as environmental resistance increases. Environmental resistance is due to many factors such as more competition for food, space and greater mortality.
v) Equilibrium Phase: Finally, the population becomes stable when the population size reaches the point of carrying capacity of the area. Every population tends to reach a number at which it becomes stabilized with the resources of its environment.
Q.6. Define the following terms and give one example of each:
(a) Commensalism
(b) Parasitism
(c) Camouflage
(d) Mutualism
(e) Interspecific competition.
Ans:-
(a) Commensalism: Interspecific positive interaction in which smaller member, called commensal, is benefitted, while the larger member, called host, is neither benefitted nor harmed, e.g. Orchid growing as an epiphyte on a mongo branch.
(b) Parasitism: Antagonistic interspecific interaction in which smaller partner, called parasite, is benefitted and draws food and shelter from the body of larger partner called host, e.g. *Plasmodium* (malarial parasite) feeding upon liver cells and RBCs of man.
(c) Camouflage: The phenomenon of blending with surroundings due to similar colour, marking, and shapes is called camouflage. e.g. Praying mantis is green coloured so remains unnoticed in green grass.

(d) Mutualism: Interspecific positive interaction in which both the partners are mutually beneficial and increase the chances of survival of each other. Lichens and mycorrhizae.
(e) Interspecific competition: Antagonistic interaction in which two or more members of different species compete for common resource like food, light, water, etc. which are in short supply, e.g. Visiting flamingoes and resident fishes competing for zooplanktons in S. American lake.
Q.7. An individual and a population has certain characteristics. Name these attributes with definitions.
Ans:- An individual and a population has following certain attributes like pattern of distribution, dispersal biotic potential and gene pool. Phenomenon of distribution of individual within geographical boundaries of the population is termed as intra population dispersion or internal distribution patterns or dispersion. Dispersal an individual is dispersed at one or another time during their life in a population which is revealed by immigration or emigration.
i) Immigration: Immigration is the number of individuals of the same species that have come into the habitat from elsewhere during a specified time period.
(ii) Emigration: Emigration is the number of individuals of the population who exit or leave the habitat and go elsewhere during a specified time period.
iii) Biotic Potential: Biotic potential is the natural capacity of a population to increase its size under ideal environmental conditions.
iv) Gene pool: All the genotypes of all individuals in a breeding population is referred to as gene pool.
Q.8. With the help of suitable diagram describe the logistic population growth curve.
Ans:- Logistic population growth curve or S-shaped or sigmoid growth curve is shown by the yeast cells grown under laboratory conditions. It is also shown by the populations of most organisms.



Logistic growth curve

It has 5 phases: lag phase, positive acceleration phase, exponential phase, negative acceleration phase, and stationary phase.

In lag phase there is little or no increase in population, in positive acceleration phase increase in population starts and occurs at a slow rate in the beginning.

During exponential phase, increase in population becomes rapid and soon attains its full potential rate. This is due to the constant environment, to the availability of food and other requirements of life in plenty, to no predations and interspecific competition and to no serious intraspecific competition so that the curve rises steeply upward.

Whereas in negative acceleration phase, the growth rate finally slows down as environmental resistance increases. Finally, the population becomes stable during the stationary phase because now the number of new cells produced almost equals to the number of cells that die. Every population tends to reach a number at which it becomes stabilized with the resources of its environment. A stable population is said to be in equilibriums, or at saturation level. This limit in population is a constant K and is imposed by the carrying capacity of the environment. S-shaped curve is also called Verhulst-Pearl logistic curve. The sigmoid growth form is represented by the following equation:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right) = rN\left(1-\frac{N}{K}\right)$$

Where $\frac{dN}{dt}$ = rate of change in population size

r= intrinsic rate of natural increase,
N= population size; K= carrying capacity,
$\frac{(K-N)}{K}$ = environmental resistance.

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ECOSYSTEM

VERY SHORT ANSWER TYPE QUESTIONS: 1 MARK EACH

Q.1. Name the different trophic level in a food chain. 1 (CoHSEM – 1997)

Ans:- Producer and consumer.

Q.2. What are four types of autotrophs of a pond community? 1(CoHSEM – 2003)

Ans:- Phytoplanktons, algae, submerged floating and amphibious plants are the autotrophs of a pond community.

Q.3. Define the term "Food-Web".

Ans:- Food web is a network of food chains which become interconnected at various trophic levels so as to form a number of feeding connections amongst the different organisms of a biotic community.

Q.4. Name the dominant producers in a deep aquatic ecosystem. What other name could you give to primary consumer?

Ans:- In deep aquatic ecosystems, main producers are floating minute autotrophs called phytoplankton. Primary consumer is also called herbivores.

Q.5. Name the dominant producers in shallow aquatic ecosystem.

Ans:- In shallow waters, the aquatic ecosystem bear larger sized rooted plants called macrophytes.

Q.6. Differentiate Gaseous cycle from sedimentary cycle.

Ans:-

Gaseous cycle	Sedimentary cycle
1. Reservoir is atmosphere. e.g. Nitrogen cycle.	1. Reservoir is soil. e.g. Phosphorus cycle

Q.7. Name the pioneer species organisms on a bare rock.

Ans:- Lichens.

Q.8. What are causes of ecological succession?

Ans:- Biotic and physiographic factors operating simultaneously are the causes of ecological succession.

Q.9. Why the pyramid of energy is always upright?

Ans:- Because when the energy flows from one trophic level to another trophic level, always some energy is lost.

Q.10. What are decomposers? Write their functions.

Ans:- Decomposers are saprotrophs that feed on dead bodies of organisms.

Functions:- Decomposition and mineralization.

Q.11. Define ecotone.

Ans:- Ecotone is a transitional zone between two adjacent communities (such as forest and grassland),containing species characteristic of both as well as other species occurring within the zone.

Q.12. Define Edge effect.

Ans:- Edge effect is the tendency, within a given ecotone, to increase among the variety and density of plant and animal life (i.e.species diversity).

Q.13. What is secondary productivity of an ecosystem?

Ans:- The rate of re-synthesis of organic matter by the consumers is known as secondary productivity.

Q.14. What is standing crop?

Ans:- Each trophic level has a certain mass of living material at a particular time. It is called as the standing crop.

Q.15. What are causes of ecological succession?

Ans:- Biotic and physiographic factors operating simultaneously are the causes of ecological succession.

Q.16. Why is the length of a food chain in an ecosystem generally limited to 3—4 trophic levels?

Ans:- There is progressive reduction in available biomass, energy and number of individuals with rise in trophic level. Hence, the length of a food chain in an ecosystem is limited to 3 – 4 trophic levels.

Q.17. State 10% law (lindeman law).

Ans:- The passage of about 10% of biomass energy from one trophic level to the next is called 10% law (Lindeman law).

Q.18. Why are producers also known as transducers?

Ans:- Because producers convert solar energy into chemical energy.

Q.19. How does primary productivity differ from secondary productivity?

Ans: Difference between Primary and secondary productivity:

Primary productivity	Secondary productivity
1. It is defined as the amount of organic matter produced by producers per unit area over a period of time.	1. It is defined as the rate of production of organic matter by consumers over a period of time.

Q.20. What is the ultimate source of energy for the ecosystem?

Ans:- Sunlight.

Q. 21. Why are Oceans least productivity?

Ans:- The productivity of ocean is limited by the light available to the plants in deeper regions and nitrogen nutrient.

Q.22. Name the raw material for decomposition.

Ans:- Detritus

Q.23. What is the basic requirement of any ecosystem to function and sustain?

Ans:- Constant solar input.

SHORT ANSWER TYPE QUESTIONS: 2 MARKS EACH

Q.1. Give two differences between biotic components and abiotic components.

Ans:- Differences between biotic components and abiotic components:

BIOTIC COMPONENTS	ABIOTIC COMPONENTS
1. They represent the living organisms present in an ecosystem. 2. Biotic components include producers, consumers and decomposers.	1. They represent nonliving structures and factors of the ecosystem. 2. Abiotic components include inorganic nutrients, organic remains and physical factors.

Q.2. Describe pond as an ecosystem.

Ans:- Pond is a self-sustained ecosystem present in a shallow water body. It has both abiotic and biotic components. Abiotic components include water, dissolved inorganic and organic substances and soil deposited at bottom. Biotic components include producers (phytoplanktons, algae, submerged floating and amphibious plants), consumers and decomposers (fungi, bacteria).

Q.3. Give two differences between Gross primary productivity and net primary productivity.

Ans:- Differences between Gross primary productivity and Net primary productivity:

Gross Primary Productivity	Net Primary Productivity
1. It is the rate of total amount of energy captured and organic matter formed by producers. 2. It depends upon the amount of photosynthetic area and photosynthetic efficiency.	1. It is the rate of energy stored and biomass accumulated by the producers. 2. It depends upon rate of photosynthesis as well as respiration.

Q.4. How do detrivores differ from decomposers. Give two points.

Ans:- Difference between detrivores and decomposers:

Detrivores	Decomposers
1. They are animals which feed on detritus. 2. Detrivores ingest the organic food matter. e.g. Earthworms, Carrion beetle.	1. They are micro-organisms which obtain nourishment from organic remains. 2. They decompose the organic matter by secreting digestive enzymes. e.g. *Pseudomonas*, slime moulds.

Q.5. Define primary and secondary productivity in an ecosystem.

Ans:- Primary Productivity is the rate at which energy of sunlight is trapped and biomass synthesized by producers per unit time per area through the process of photosynthesis.

Secondary Productivity is the rate of re-synthesis of organic matter by the consumers. It depends upon the loss of while transferring energy containing organic matter from previous trophic level plus consumption due to respiration and predation.

Q.6. State the difference between the first trophic level of detritus food chain and grazing food chain.

Ans:- First trophic level organisms are producers in Grazing food chain. While in detritus food chain, the first trophic level organisms are detrivores and decomposers.

Q.7. Differentiate Grazing food chain from detritus food chain by giving at least two points.

Ans:- Difference between Grazing food chain and Detritus food chain:

Grazing Food Chain	Detritus Food Chain
1. It is based on energy obtained from sun. 2. First trophic level organisms are producers.	1. It is based on energy present in detritus. 2. First trophic level organisms are detrivores and decomposers.

Q.8. How do the different trophic levels interrelate? Explain.

Ans:- Organisms belonging to different trophic levels interrelate. The energy trapped by the producer is either passed on to a consumer. Producers synthesise organic foods which are transferred to organism of higher trophic levels through food chains or food web.

Q.10. Why is the concept of food web more real ecologically than the concept of a simple food chain? Give two points only.

Ans:- Concept of food web is more real than ecologically simple food chain.

i) Food web provides alternate sources of food.

ii) None gets starved if its preferred species is reduced in number. The animal switches over to alternate food item.

Q.11. Give two differences between Litter and Detritus.

Ans:- Difference between Litter and Detritus:

Litter	Detritus
1. Litter contains all kinds of wastes generated above the ground. 2. Litter contains both biodegradable and non-biodegradable matters.	1. Detritus is composed of remains of dead plants and animals. 2. Detritus contains only biodegradable matters.

Q.12. What are Ecological pyramids or elotnian pyramids?
Ans:- Ecological pyramids or eltonian pyramids are graphic representation of various ecological parameters at the successive trophic levels of food chains with producers at base, top carnivores at the apex and intermediate levels in between.
Q.13. Give two points of difference between Upright and inverted pyramid.
Ans:- Difference between Upright and inverted pyramid:

Upright pyramid	Inverted pyramid
1. The pyramid of energy is always upright. 2. The pyramid of biomass and the pyramid of numbers can be inverted.	1. The pyramid of biomass and the pyramid of numbers can be inverted. 2. In an inverted pyramid, the number and biomass of organisms in the producer level of an ecosystem is the lowest, which keeps on increasing at each tropic level.

Q.14. What is primary productivity? Give brief description of factors that affect primary productivity.
Ans:- It is defined as the amount of organic matter or biomass produced by producers per unit area over a period of time. Primary productivity of an ecosystem depends on the variety of environmental factors such as light, temperature, water, precipitation, etc. It also depends on the availability of nutrients and the availability of plants to carry out photosynthesis.

Q.15. Write important features of a sedimentary cycle in an ecosystem.
Ans:-Sedimentary cycles have their reservoirs in the Earth's crust or rocks. Nutrient elements are found in the sediments of the Earth. Elements such as sulphur, phosphorus, potassium, and calcium undergo sedimentary cycles. Sedimentary cycles are very slow. They take a long time to complete their circulation and are considered as less perfect cycles. This is because during recycling, nutrient elements may get locked in the reservoir pool, thereby taking a very long time to come out and continue circulation. Thus, it usually goes out of circulation for a long time.
Q.16. Differentiate between standing state and standing crop.
Ans:-

Standing state	Standing crop
1. It refers to the amount of nutrients such as nitrogen, phosphorus, calcium, etc. present in the soil of an ecosystem at a given time. 2. It is the abiotic component.	1. It refers to the amount of biomass or organic matter available at a given trophic level/ecosystem at a given time. 2. It is the biotic component.

SHORT ANSWER TYPE QUESTIONS: 3 MARKS EACH.
Q.1. Give any three points difference between primary succession and secondary succession in an ecosystem.
Ans:- Difference between primary succession and secondary succession:

Primary succession	Secondary succession
1. It occurs in biologically sterile areas. 2. Organic matter and humus are absent in early stages. 3. It begins on a soilless area.	1. It occurs in an area which is biologically quite fertile. 2. Organic matter or humus is present from the very beginning. 3. It begins on an area having sufficient soil.

Q.2. Name the pioneer and the climax species in a water body. Mention the changes observed in the biomass and biodiversity of the successive seral communities developing in the water body.
Ans:- The pioneer species and climax species in a water body are respectively planktons and forest. With increasing seral communities in the water body, biomass is progressively increased and biodiversity also increases, since the area is progressively enriching soil, as a result many aquatic plants can develop there. Thus many aquatic plants and aquatic animals are added in the water body.
Q.3.How do animals depend on the plants? Give three points.
Ans:-
i) Plants trap solar energy for synthesising food.
ii) Energy stored in plants is transferred to higher trophic levels (herbivores) through food chains.
iii) Carnivores obtain energy by feeding herbivores.
Thus, animals depend on the plants.

Q.4. Differentiate grazing food chain from detritus food chain.
Ans:- Difference between Grazing Food chain and Detritus Food chain:

Grazing Food Chain	Detritus Food Chain
1. It is based on energy obtained from sun. 2. First trophic level organisms are producers. 3. It provides organic matter to detritus food chain.	1. It is based on energy present in detritus. 2. First trophic level organisms are detrivores and decomposers. 3. It provides inorganic nutrients to the grazing food chain.

Q.5. Why is food web more important than food chain? Give two reasons.
Ans:- Food web is more important than food chain because -
i) Food web provides for alternate sources of food chain.
ii) None gets starved if its preferred species is reduced in number. The animal switches over to alternate sources of food item.
iii) No species is exploited beyond the degree of its recovery.
iv) Food webs provide stability to ecosystem.
Q.7. Give 3 differences between food chain and food web.
Ans:- Difference between food chain and food web:

Food Chain	Food Web
1. A food chain is a single series of trophic levels. 2. Each food chain is distinct from other food chain. 3. Only one type organisms are available as food for higher trophic level organisms.	1. A food web is a multiple series trophic levels. 2. A food web consists of a number interconnected chains. 3. Several types of organisms are available at each trophic level.

Q.8. An ecosystem is the sum total of all living organisms, the environment and the process of interaction between these in a certain area. Explain how do the different biotic components in an ecosystem interact with each other? What is the expected end product of their interaction?
Ans:- Biotic components of an ecosystem is composed of producers, consumers, decomposers, etc. Producers include plants and algae. They contain chlorophyll pigment, which help them to carry out photosynthesis in the presence of sunlight. Thus they are also called transducers. Consumers or heterotrophs are organisms that are directly or indirectly dependent on the producers for food. Decomposers include bacteria and fungi. They form the largest population in a food chain and obtain nutrients by breaking down the remains dead plants and animals.
Their interaction produces biotic community.

Q.9. Write in brief about three factors of Secondary Succession.
Ans:- Three factors *Secondary succession*
i) Climate: When the vegetation is destroyed by the action of drought, wind, snow or frost.
ii) Physiography: The configuration of the land surface helps the agents of erosion, i.e. wind, water and gravity to create new soils, e.g., land slide may take place on a steep slope, destroying the forest.
iii) Biotic factor: A forest is destroyed by the activity of man, his animals, wild animals, insects, etc. causes soil modification, e.g., heavy grazing, cutting, burning, etc.
Q.10. Differentiate between carbon cycle and phosphorus cycle.
Ans:- Difference between carbon cycle and phosphorus cycle:

Carbon cycle	Phosphorus cycle
1. Cycling pool is air and water. 2. It is gaseous cycle of matter. 3. It is released to cycling pool by respiration of all organisms. 4. Rainfall brings a lot of dissolved carbon.	1. Cycling pool is soil and water (for aquatic habitat). 2. It is sedimentary cycle of matter. 3. There is no such release. 4. There is no such dissolution as atmospheric content of phosphorus is negligible.

Q.11. "Deforestation is one of the main causes of ecological imbalance". Justify the above statement elaborately by giving *three* suitable possibilities.
Ans:- Main causes of ecological imbalance due to deforestation are -
i) Climate: Deforestation results in reduced rainfall, increased drought, hotter summers and colder winters.
ii) Soil Erosion: Soil is exposed to insolation, dries up and gets.
iii) Global Warming: Deforestation increases atmospheric CO_2 content by releasing carbon stored in organic matter and reduced primary productivity.
Q.12. Describe the components of an ecosystem.
Answer:-An ecosystem is defined as an interacting unit that includes both the biological community as well as the non-living components of an area. The living and the non-living components of an ecosystem

interact amongst themselves and function as a unit, which gets evident during the processes of nutrient cycling, energy flow, decomposition, and productivity. There are many ecosystems such as ponds, forests, grasslands, etc. The two components of an ecosystem are:
Biotic component: It is the living component of an ecosystem that includes biotic factors such as producers, consumers, decomposers, etc.

Producers include plants and algae. They contain chlorophyll pigment, which helps them carry out the process of photosynthesis in the presence of light. Thus, they are also called converters or transducers. Consumers or heterotrophs are organisms that are directly (primary consumers) or indirectly (secondary and tertiary consumers) dependent on producers for their food. Decomposers include micro-organisms such as bacteria and fungi. They form the largest population in a food chain and obtain nutrients by breaking down the remains of dead plants and animals.

Abiotic component: They are the non-living component of an ecosystem such as light, temperature, water, soil, air, inorganic nutrients, etc.

Q.13. Give an account of energy flow in an ecosystem.
Ans:- Energy enters an ecosystem from the Sun. Solar radiations pass through the atmosphere and are absorbed by the Earth's surface. These radiations help plants in carrying out the process of photosynthesis. Also, they help maintain the Earth's temperature for the survival of living organisms. Some solar radiations are reflected by the Earth's surface. Only 2-10 percent of solar energy is captured by green plants (producers) during photosynthesis to be converted into food. The rate at which the biomass is produced by plants during photosynthesis is termed as 'gross primary productivity'. When these green plants are consumed by herbivores, only 10% of the stored energy from producers is transferred to herbivores. The remaining 90 % of this energy is used by plants for various processes such as respiration, growth, and reproduction. Similarly, only 10% of the energy of herbivores is transferred to carnivores. This is known as ten percent law of energy flow.
Q.14. Define ecological pyramids and describe with examples, pyramids of number and biomass.
Ans:- Ecological pyramids or eltonian pyramids (*Elton,1972*) are graphic representation of various ecological parameters at the successive trophic levels of food chains with producers at base, top carnivores at the apex and intermediate levels in between.
There are three types of pyramids:
i) Pyramid of numbers.
ii) Pyramid of energy.
iii) Pyramid of biomass.
i) Pyramid of numbers: It is a graphical representation of the number of individuals present at each trophic level in a food chain of an ecosystem. The pyramid of numbers can be upright or inverted depending on the number of producers. For example, in a grassland ecosystem, the pyramid of numbers is upright. In this type of a food chain, the number of producers (plants) is followed by the number of herbivores (mice), which in turn is followed by the number of secondary consumers (snakes) and tertiary carnivores (eagles). Hence, the number of individuals at the producer level will be the maximum, while the number of individuals present at top carnivores will be least. On the other hand, in a parasitic food chain, the pyramid of numbers is inverted. In this type of a food chain, a single tree (producer) provides food to several fruit eating birds, which in turn support several insect species.
ii) Pyramid of biomass: A pyramid of biomass is a graphical representation of the total amount of living matter present at each trophic level of an ecosystem. It can be upright or inverted. It is upright in grasslands and forest ecosystems as the amount of biomass present at the producer level is higher than at the top carnivore level. The pyramid of biomass is inverted in a pond ecosystem as the biomass of fishes far exceeds the biomass of zooplankton (upon which they feed).

Q. 15. Distinguish between Production and decomposition.
Ans:- Difference between Production and decomposition:

Production	Decomposition
1. It is the rate of producing organic matter (food) by producers. 2. It depends on the photosynthetic capacity of the producers. 3. Sunlight is required by plants for primary production.	1. It is the process of breaking down of complex organic matter or biomass from the body of dead plants and animals with the help of decomposers into organic raw material such as CO_2, H_2O, and other nutrients. 2. It occurs with the help of decomposers. 3. Sunlight is not required for decomposition by decomposers.

Q.16. Give three points of difference between Biotic components and Abiotic components.

Ans:- Difference between Biotic components and Abiotic components.

BIOTIC COMPONENTS	ABIOTIC COMPONENTS
1. They represent the living organisms present in an ecosystem. 2. Biotic components include producers, consumers and decomposers. 3. They obtain inorganic nutrients and energy from abiotic components for their body building.	1. They represent nonliving structures and factors of the ecosystem. 2. Abiotic components include inorganic nutrients, organic remains and physical factors. 3. They are influenced by physical form of energy as light and heat.

LONG ANSWER TYPE QUESTIONS: 5 MARKS EACH.
Q.1. Differentiate succession on land and succession on water.
Ans:- Difference between Succession on land and Succession on water:

Succession on land	Succession on water
1. It begins with lichens or blue green algae. 2. Initial succession is a slow process. 3. It changes the bare area into forest. 4. The whole of the area is involved in formation of climax community. 5. Succession converts xeric environment to mesic environment.	1. It begins with phytoplanktons. 2. Initial succession is quite fast. 3. It fills up the water body and forms the forest. 4. Climax community develops on the edge only. 5. It converts aquatic environment to mesic environment.

Q.2. Give five points difference between primary succession and secondary succession in an ecosystem.
Ans:- Difference between primary succession and secondary succession:

Primary succession	Secondary succession
1. It occurs in biologically sterile areas. 2. Organic matter and humus are absent in early stages. 3.It begins on a soilless area. 4.The area is bare from beginning. 5. It has many seral communities.	1. It occurs in an area which is biologically quite fertile. 2. Organic matter or humus is present from the very beginning. 3. It begins on an area having sufficient soil. 4. The area is denuded recently. 5. The number of seral communities is very low.

Q.3. Write five characteristic features of a climax community.
Ans:- Characteristic features of a climax community:
1. It is the final biotic community that develops in an area.
2. It occurs over an area previously occupied by seral communities.
3. The area is favourable for the climax community.
4. Life span of individuals is generally long.
5. It grows on built up soil.
Q.4. What is xerosere? Describe the various stages of biotic succession on bare rock.
Ans:- Xerosere is biotic succession that occurs on bare rocks. The pioneers of such a habitat are usually lichens in temperate region and blue green algae in tropical region.
The various stages are as follows:
1. Lichen Stage: Wind borne lichen propagules settle on the wet rock surface soon after rain. Lichens bring about slow weathering of rocks and formation of soil. The lichenic acid and carbonic acid secreted by lichens slowly corrode rock surface and release minerals required for their growth.
2. Moss Stage: Lichens growing on rocks make the condition favourable for growth of hardy mosses. Their rhizoids penetrate deeper in the rocks. Mosses accumulate more soil and organic matter. This invites more moisture loving mosses.
3. Annual Grass Stage: A number of xerophytic grasses and herbs reach the rock surface occupied by moss plant. Their roots penetrate deeper causing more weathering of rock surface and building of more soil.
4. Perennial Grass Stage: With built up of more soil and retention of more water, perennial herbs and grasses reach the area. Their roots penetrate deeper. As a result more soil is built up and more moisture becomes available.
5. Shrub Stage: Hardy xerophytic shrubs invade the area occupied by perennial grasses. e.g. *Zizyphus, Fragaria.* Their roots reach greater depth causing further crack in the rocky substratum. Thus the shrubs make it moister forming more soil and invite hardy trees and several animal types.
5. Climatic Community: Several hardy and light demanding trees grow in the area occupied by shrubs. Slowly environment becomes more moist and shadier so that plants of climax community spread in the area. Type of climax community depends upon the climate.

Q.5. Define ecosystem services. Discuss the main components of ecosystem service.

Ans:- Products and benefits from the ecosystem are ecosystem services. The important components of ecosystem services are

a) Air: Industrialised areas are producing a lot of pollutant gases and suspended particulate matter. The gases are absorbed by the plants. Suspended particulate matter is intercepted by the vegetation and made to settle down. Air is thus removed of its pollutants.

b) Biodiversity: Natural ecosystems are a source of biodiversity with a variety of genes, gene pools, species and habitats. Biodiversity also has scenic attraction and aesthetic value which attracts holiday tourism.

c) Climate: Ecosystems, especially forests, maintain good climatic conditions by increasing humidity, reducing extremes of temperature and increasing periodicity of rainfall.

d) Nutrient cycling: This is important ecosystem service which maintains the continuity of life on earth. Through cycling, biogenic nutrients are made available all the time for absorption.

e) Wild life: Ecosystems provide habitats to wild life. It maintains a stable and healthy ecosystem.

Q.6. Why decomposition is necessary to an ecosystem? Explain *any four* factors which inhibit the process of decomposition.

Ans:- Decomposition breaks down the complex organic matters into simpler inorganic substances that can be easily absorbed by the plants which helps nutrient cycling in the ecosystem.

Factors affecting Decomposition:

i) It is an oxygen-requiring process. Absence or low oxygen condition inhibits the process of decomposition.

ii) Rate of decomposition depends on climate factors such as temperature, soil moisture, etc.

ii) Chemical composition of detritus is an important controlling factor that determines the rate of decomposition.

iii) Soil moisture affects the activities of soil microbes that decomposes detritus.

iv) Lignin and chitin rich detritus undergoes slow decomposition.

Q.7. Define decomposition and describe the processes and products of decomposition.

Ans:- Decomposition is the process that involves the breakdown of complex organic matter or biomass from the body of dead plants and animals with the help of decomposers into inorganic raw materials such as carbon dioxide, water, and other nutrients.

The various processes involved in decomposition are as follows:

i) Fragmentation: It is the first step in the process of decomposition. It involves the breakdown of detritus into smaller pieces by the action of detrivores such as earthworms.

ii) Leaching: It is a process where the water-soluble nutrients go down into the soil layers and get locked as unavailable salts.

iii) Catabolism: It is a process in which bacteria and fungi degrade detritus through various enzymes into smaller pieces.

iv) Humification: The next step is humification which leads to the formation of a dark coloured colloidal substance called humus, which acts as reservoir of nutrients for plants.

v) Mineralization: The humus is further degraded by the action of microbes, which finally leads to the release of inorganic nutrients into the soil. This process of releasing inorganic nutrients from the humus is known as mineralization. Decomposition produces a dark coloured, nutrient-rich substance called humus. Humus finally degrades and releases inorganic raw materials such as CO_2, water, and other nutrient in the soil.

Q.8. Justify the importance of decomposers in an ecosystem.

Ans:- Decomposers are those microorganisms which meet their requirements by degrading dead organic matter.

i)They help in the breakdown of complex organic matter into inorganic substances.

ii) They secrete enzymes that breakdown the complex organic matter and the simple nutrients formed as a result of this, are absorbed by the pants, the producers.

iii) Humification and mineralisation occur due to decomposition process in the soil, the humus being colloidal serves as a storehouse of nutrients and improve the water holding capacity of soil.

iv) When humus is further decomposed, i.e. when mineralisation occurs, the mineral nutrients are liberated in the soil and are used by plants.

v) In terrestrial ecosystem, larger fraction of energy flows through the detritus food chain.

Q.9. a) Explain the differences and similarities between hydrarch and xerarch successions of the plants.

b) Mention the role of living organisms in the phosphorus cycle.

Ans:-

(a) (any 2 of the following)

Hydrarch succession	Xerarch succession
1. It begins with phytoplanktons.	1. It begins with lichens or blue green algae.
2. Initial succession is quite fast.	2. Initial succession is a slow process.
3. It fills up the water body and forms the forest.	3. It changes the bare area into forest.
4. Climax community develops on the edge only.	4. The whole of the area is involved in formation of climax community.
5. It converts aquatic environment to mesic environment.	5. Succession converts xeric environment to mesic environment.

Similarities:

i) They both lead towards mesic condition.

ii) The structure and composition undergoes an orderly and sequential change.

(b) Role of organisms:

- The roots of the plant absorb the minute quantities of phosphates found dissolved in the soil solution.
- The consumers obtain this element either directly (herbivores) or indirectly (carnivores) from the plants.
- The organic wastes from the living organisms and the dead organisms are decomposed and the phosphate solubilizing bacteria release phosphorus.

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BIODIVERSITY AND CONSERVATION

VERY SHORT ANSWER:

Q.1. Give the name of an endangered animal in Manipur?

Ans:- Sangai (*Rucervus eldii eldii*)

Q.2. What are Hot Spots?

Ans:- Hot spots are areas of high endemism and high level of species richness.

Q.3. Identify the first Biosphere Reserve in India. Where is it located?

Ans:- Nilgiris *Biosphere Reserve* is *India's first* and foremost Biosphere Reserve. It is located in the Western Ghats and Nilgiri Hills ranges of South India.

Q.4. India has more than 50,000 strains of rice. Mention the level of biodiversity it represents.

Ans:- Genetic diversity.

Q.5. What are the main objectives of MAB?

Ans:- Man and Biosphere programme is an international biological programme of UNESCO. MAB has studied human environment, impact of human interference and pollution on biotic and abiotic environments and conservation strategies for present as well as future.

Q. 6. What is Red data book?

Ans:- Red list/ Red data book is a catalogue of species and subspecies facing various degree of extinction risk by using a set criteria relevant to all species all over the world.

Q.7. Give a short note on:

a) Biodiversity

b) Extinct

c) Extinct in wild

d) Critically endangered

e) Endangered species

f) Vulnerable

Ans:- a) Biodiversity: The occurrence of different types of genes, gene pools, species, habitats and ecosystem in a particular place and various parts of the earth is called biodiversity.

b) Extinct: A taxon is Extinct when there is no reasonable doubt that the last individual has died. e.g. Dodo.

c) Extinct in Wild: A taxon is Extinct in wild when exhaustive surveys in known and/or expected habitat, have failed to record an individual.

d) Critically Endangered: A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future. e.g. Pigmy Hog.

e) Endangered: A taxon is Endangered when it is not Critically endangered, but is facing a high risk of extinction in the wild in the near future. e.g. Red Panda, Blue Whale, Sangai(*Rucervus eldii eldii)*

f) Vulnerable: Presently the population is sufficient but is undergoing depletion due to some factors so that it is facing risk of extinction in medium future. e.g. Black buck.

Q.8. Name the three important components of biodiversity.

Ans:- Three important components of biodiversity are:

i) Genetic diversity,
ii) Species diversity and
iii) Ecosystem diversity.

Q.9. Why is genetic variation important in the plant *Rauwolfia vomitoria*?

Ans:- Genetic variation is important as it affects the production of the drug reserpine in the medicinal plant *Rauwolfia*.

SHORT ANSWER TYPE QUESTIONS: 2 MARKS EACH

Q.1. Which is the most endangered species of deer found in Manipur? Give one reason of its becoming endangered.

Ans:- Sangai (*Rucervus eldii eldii*). It becomes endangered due to poaching.

Q.2. What is the difference between National Parks and Sanctuaries? Give the name of two National Parks located in Manipur.

Ans:- National park is meant for protection of both flora and fauna while sanctuary is meant for protection of only fauna.

The national parks located in Manipur are Keibul Lamjao National Park and Sirui National Park.

Q.3. Explain how diversity is important for human.

Q.4. What is Red Data Book? Name *any two* endemic species of Manipur.

Ans:- . Red Data Book is a catalogue of species and subspecies facing various degree of extinction risk by using a set criteria relevant to all species all over the world.

Rucervus eldii eldii (Sangai) and *Lilium mackliniae* (Siroi Lilly) are two endemic species of Manipur.

Q. 5. Differentiate between In-situ conservation and Ex-situ conservation.

Ans:- Difference between In-situ conservation and Ex-situ conservation:

In situ conservation	Ex situ conservation
1. These conservation strategies involve protecting, preserving and restoring the threatened species and ecosystem in natural habitats.	1. They are conservation strategies in which the threatened species are reared and preserved outside their natural habitats.
2. These include protected areas like National Park, Biosphere reserves, Sanctuary etc.	2. These include botanical garden, Zoological gardens, DNA banks, etc.

Q.6. What does the term genetic diversity refers to? What is the significance of large genetic diversity in a population?

Ans:- Genetic diversity is the diversity in the number and types of genes as well as chromosome present in different species and the variations in the genes and their alleles in the same species. Genetic diversity enables a species to survive in more diverse habitats, i.e. natural selection. Thus it also helps in speciation or evolution of new species.

Q.7. Alien species are a threat to native species. Justify taking examples of an animal and a plant alien species.

Ans:- Introduction of alien species are a threat to species.

i) Water hyacinth (*Eichhornia crassipes*) was introduced in Indian waters to reduce pollution. It has clogged water bodies resulting in death of several aquatic plants and animals.

ii) Africans Catfish, *Clarias gariepinus*, has been illegally introduced for aquaculture in India. It is threatening native Catfish (*Clarias batrachus*) of Indian river.

Q.8. How do ecologists estimate the total number of species present in the world?

Ans:- The diversity of living organisms present on the Earth is very vast. According to an estimate by researchers, it is about seven millions. The total number of species present in the world is calculated by ecologists by statistical comparison between a species richness of a well-studied group of insects of temperate and tropical regions. Then, these ratios are extrapolated with other groups of plants and animals to calculate the total species richness present on the Earth.

Q.9. What is endangered species? How many animals and plants are endangered in India?

Ans:- A taxon is Endangered when it is not Critically endangered, but is facing a high risk of extinction in the wild in the near future. In India, their number is 54 animals and 113 plants.

SHORT ANSWER TYPE QUESTIONS: 3 MARKS EACH

Q.1. Citing three examples, show how introduction of exotic species has threatened biodiversity.

Ans:- Introduction of alien species often become invasive and drive away the local species.

e.g. i) Water hyacinth (*Eichhornia crassipes*) was introduced in Indian waters to reduce pollution. It has clogged water bodies resulting in death of several aquatic plants and animals.

ii) Nile Perch, a predator fish was introduced in the Lake Victoria of South Africa. It killed and eliminated over 200 native species.

iii) Africans Catfish, *Clarias gariepinus*, has been illegally introduced for aquaculture in India. It is threatening native Catfish (*Clarias batrachus*) of Indian river.

Q.2. "We need to conserve Biodiversity for present and future generation". Explain the above quotation with suitable reasons.

Ans:- We should conserve biodiversity for present and future generation because of the following reasons –

i). Preservation of Environments: It preserves environments having recreational, aesthetic, socio cultural and other importance.

ii). Pollutants: It is involved in absorption and degradation of pollutants.

iii). Gaseous Composition: Ecosystem maintains the gaseous composition of atmosphere through fixation of carbon dioxide and release of oxygen in photosynthesis. Amazon rain forest is estimated to contribute 20% of the total oxygen.

Q.3. Differentiate Genetic diversity from species diversity.

Ans:- Difference between Genetic diversity and species diversity:

Genetic diversity	Species diversity
1. It is related to number of genes and their alleles found in organisms.	1. It is related to number and distribution of species found in an area.
2. It is trait of species.	2. It is trait of the community.
3. It influences adaptability and distribution of a species in diverse habitats.	3. It influences biotic interactions and stability of the community.

Q.4. How is biodiversity important for ecosystem functioning?

Ans:- Importance of Species diversity:

i). Biodiversity is essential for stability of an ecosystem. Communities with more species tend to be more stable than those with less species. It is able to resist occasional disturbance.

ii). Ecosystems with higher biodiversity (e.g., tropical forests) are more productive than ecosystem with lower biodiversity (e.g., temperate forests).

iii). Biodiversity is essential for maintenance and health of ecosystem through the occurrence of various checks, controls, negative and positive feed backs, critical link and keystone species.

Q.5. What are biosphere reserves? Discuss the components biosphere reserve.

Ans:- Biosphere reserves are multipurpose protected areas which are meant for preserving genetic diversity in representative ecosystem by protecting wildlife, traditional life styles of tribals and varied plant and animal genetic resources. Each biosphere reserve has

(i) Core and Natural Zone:-No human activity is allowed. The area is undisturbed and legally protected ecosystem.

(ii) Buffer Zone: It surrounds the core area. Limited human activity is allowed like resource use strategies, research and education.

(iii) Transition Zone (Manipulation Zone): It is the outermost or peripheral part of biosphere reserve where an active cooperation is present between reserve management and local people for activities like settlements, cropping, recreation, forestry and other economic uses without disturbing ecology.

Q.6. Among the ecosystem services are control of floods and soil erosion. How is this achieved by the biotic components of the ecosystem?

Ans:- The biotic components of an ecosystem include the living organisms such as plants and animals. Plants play a very important role in controlling floods and soil erosion. The roots of plants hold the soil particles together, thereby preventing the top layer of the soil to get eroded by wind or running water. The roots also make the soil porous, thereby allowing ground water infiltration and preventing floods. Hence, plants are able to prevent soil erosion and natural calamities such as floods and droughts. They also increase the fertility of soil and biodiversity.

Q.7. What are sacred groves? What is their role in conservation?

Ans:- Sacred groves are tracts of forest which are regenerated around places of worship. Sacred groves are found in Rajasthan, Western Ghats of Karnataka and Maharashtra, Meghalaya and Madhya Pradesh. Sacred groves help in the protection of many rare, threatened, and endemic species of plants and animals found in an area. The process of deforestation is strictly prohibited in this region by tribals. Hence, the sacred grove biodiversity is a rich area.

Q.8. How is biodiversity important for ecosystem functioning?

Ans:- An ecosystem with high species diversity is much more stable than an ecosystem with low species diversity. Also, high biodiversity makes the ecosystem more stable in productivity and more resistant towards disturbances such as alien species invasions and floods. If an ecosystem is rich in biodiversity, then the ecological balance would not get affected. As we all know, various trophic levels are connected through food chains. If anyone organism or all organisms of any one trophic level is killed, then it will disrupt the entire food chain. For example, in a food chain, if all plants are killed, then all deer's will die due to the lack of food. If all deer's are dead, soon the tigers will also die.

Therefore, it can be concluded that if an ecosystem is rich in species, then there will be other food alternatives at each trophic level which would not allow any organism to die due to the absence of their food resource. Hence, biodiversity plays an important role in maintaining the health and ecological balance of an ecosystem.

Q.9. Give three hypotheses for explaining why tropics show greatest levels of species richness.

Ans:- There are three different hypotheses proposed by scientists for explaining species richness in the tropics.
(a) Temperate regions were subjected to frequent glaciation in the past which had killed most of the species, but the tropics have remained undisturbed and hence, had evolved more species diversity.
(b) Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity and
(c) There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity.
Q.10. Among the ecosystem services are control of floods and soil erosion. How is this achieved by the biotic components of the ecosystem?
Ans:-The biotic components of an ecosystem include the living organisms such as plants and animals. Plants play a very important role in controlling floods and soil erosion. The roots of plants hold the soil particles together, thereby preventing the top layer of the soil to get eroded by wind or running water. The roots also make the soil porous, thereby allowing ground water infiltration and preventing floods. Hence, plants are able to prevent soil erosion and natural calamities such as floods and droughts. They also increase the fertility of soil and biodiversity.
Q.11. What are the three different types of Ecological Diversity?
Ans:- . Ecological Diversity (Community and Ecosystem Diversity) is of three types–
(i). Alpha Diversity:- It is species diversity in a given community or habitat. α – diversity is dependent upon species richness and evenness.
(ii) Beta Diversity:- It is biodiversity which appears in a range of communities due to replacement of species with the change in community/habitat due to presence of different microhabitats, niches and difference in environmental conditions.
(iii) Gamma Diversity:- It is diversity present in ranges of communities as represented by diversity of habitat/ecosystems over a total landscape or geographical area.
LONG ANSWER TYPE QUESTIONS: 5 MARKS EACH.
Q.1. Define Biodiversity. What are the major '**Evil quartet**' that lead to the loss of species in a geographical region?
Ans:- Biodiversity is the variety of living forms present in various ecosystems. It includes variability among life forms from all sources including land, air, and water. Biodiversity around the world is declining at a very fast pace. The following are the major causes for the loss of biodiversity around the world.
i) Habitat loss and fragmentation: Habitats of various organisms are altered or destroyed by uncontrolled and unsustainable human activities such as deforestation, slash and burn agriculture, mining, and urbanization. This results in the breaking up of the habitat into small pieces, which effects the movement of migratory animals and also, decreases the genetic exchange between populations leading to a declination of species.
ii) Over-exploitation: Due to over-hunting and over-exploitation of various plants and animals by humans, many species have become endangered or extinct (such as the tiger and the passenger pigeon).
iii) Alien species Invasions: Accidental or intentional introduction of non-native species into a habitat has also led to the declination or extinction of indigenous species. For example, the Nile perch introduced in Lake Victoria in Kenya led to the extinction of more than two hundred species of native fish in the lake.
iv) Co-extinction: In a native habitat, one species is connected to the other in an intricate network. The extinction of one species causes the extinction of other species, which is associated with it in an obligatory way. For example, the extinction of the host will cause the extinction of its parasites.
Q.2. Explain the causes of biodiversity losses.
Ans:- Causes of biodiversity loss are -
i). Habitat loss and Fragmentation: Over population, urbanization and industrialization require additional land every year. It can come through destruction fragmentation of natural habitats through filling wetlands, ploughing grasslands, cutting down trees, burning a forest and clearing some area of vegetation. Loss of habitat results in annihilation of plants, microorganisms and forcing out of animals which in alien lands die out after some time.
ii). Over –exploitation: Excessive tree felling, over grazing, hunting and uprooting of medicinal herbs have resulted in extinction of many species (Passenger Pigeon in America).
iii). Introduction of alien or exotic species: Exotic species often become invasive in new habitats due to removal of natural biocontrols. They kill the local species (*Lantana, Eupatorium, Parthenium,* Water hyacinth, Nile Perch in Lake Victoria)
iv). Pollution: Oil spills destroy marine flora and fauna. Acid rain has destroyed 50% of natural forests and most fresh water lakes in Europe. Run-off from fields and sewage are causing eutrophication of water bodies that is killing aquatic animals and fouling of water.

v) Disturbance and Degradation: Manmade disturbance and degradation are more severe. They include felling of trees, use of fire for clearing, collection of litter and over exploitation for economically important products. These disturbances and degradation result in loss of biodiversity.
Q.3. Why should we conserve Biodiversity?
Q.4. State Five important aims for preparing a red list.
Ans:- The various aims of preparing a red list are:
i) To provide information and develop awareness about the importance of threatened species.
ii) Identification and documentation of endangered species.
iii) Preparation of global index of decline of biodiversity.
iv) Imparting information about the urgency and scale of conservation problems to public and policy makers.
v) Preparing conservation priorities at local levels guiding conservation and restoration work.
vi) Giving information about various international agreement related to biodiversity like Convention on Biological Diversity and Conservation on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
Q.5. Define Hot spots. What are factors that an area is to be declared as hot spots?
Ans:- Hot Spots are areas of high endemism and high level of species richness. Some 34 hot spots have been identified globally. India has 4 hot spots:-North East, Eastern Himalayas, Western Ghats and Andaman and Nicobar islands. Ecologically hot spots are determined by four factors.
i) Number of species/ species diversity.
ii) Degree of endemism.
iii) Degree of threat to habitat to habitat due to its degradation and fragmentation.
iv) Degree of exploitation.
Q. 6. Give five differences between a National park and a sanctuary.
Ans:- Differences between a National park and a sanctuary:

National Park	Sanctuary
1. It is meant for protection of both flora and fauna.	1. It is meant for protection of only fauna.
2. Cultivation of land is not allowed.	2. Cultivation of land is permitted.
3. Grazing is not allowed.	3. Grazing is allowed.
4. Forest products are not harvested.	4. Forest products are harvested.
5. Private ownership is not permitted.	5. Private ownership is permitted.

Q.7. a) Why should we conserve biodiversity? How can we do it?
(b) Explain the importance of biodiversity hotspots and sacred groves?
Q.8. (a) Why is there a need to conserve biodiversity?
(b) Name and explain any two ways that are responsible for the loss of biodiversity.
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