KENDRIYA VIDYALAYA SANGATHAN

CHANDIGARH REGION

SESSION:- 2023-2024

SUBJECT ENRICHMENT MATERIAL

BIOLOGY

CLASS 12TH

ACKNOWLEDGEMENT

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CHAPTER -1
SEXUAL REPRODUCTION IN FLOWERING PLANTS

Important Diagrams

1. T.S. mature anther(page 6 of NCERT)
2. Stages of microspore maturing into a pollen grain (page 7 of NCERT)
3. V.S. anatropous ovule (page 9 of NCERT)
4. Development of embryo sac (page 10 of NCERT)
5. Development of embryo (page 18 of NCERT)
6. T.S. monocot and dicot embryo(page 19 of NCERT)
7. T.S. monocot seed (page 21 of NCERT)

KEY CONCEPTS

Microsporogenesis-The process of formation of microspores from microspore mother cell through meiosis. Microspores develop into pollen grains(male gametophytes).

Megasporogenesis-The process of formation of megaspores from megaspore mother cell through meiosis.(diag. page 10 of NCERT)

Monosporic development-The method of embryo sac formation from a single megaspore.

Kinds of pollination-

- Autogamy-Transfer of pollen grains from anther to stigma of the same flower.
- Geitonogamy-Transfer of pollen grains from anther to stigma of another flower of the same plant.
- Xenogamy-Transfer of pollen grains from anther to stigma of another flower of another plant but of same species.

Some plants like Viola, Oxalis and Commelina produce two types of flowers-

- Chasmogamous flowers-Such flowers have exposed anthers and stigma. Cross pollination is common among such flowers.
- Cleistogamous flowers-Such flowers do not open at all. In such flowers only self pollination occurs.

Outbreeding devices-Devices developed by bisexual plants to prevent self pollination and to encourage cross pollination are called outbreeding devices. They are

- Pollen release and stigma receptivity not synchronized.
- Different positions of anther and stigma of the same flower.
- Self incompatibility i.e. genetic mechanism which inhibits pollen germination or pollen tube growth in the pistil.
- Production of unisexual flowers on different plants (dioecy) as in papaya.

Polyembryony- Production of more than one embryo in a seed as in orange.

Apomixis- Production of seeds without fertilization. It's advantageous in the hybrid seed industry. Production of hybrid seeds is costly. Moreover if the seeds collected from hybrids are sown, the plants in progeny will segregate and don't maintain hybrid characters. But if these hybrids are made into apomicts, there is no segregation of characters in the hybrid progeny.

True fruit- Fruits which develop only from the ovary. Ex-Mango, Guava

False fruit-In fruits like apple, strawberry, cashew thalamus also contributes to fruit formation.

MULTIPLE CHOICE QUESTIONS

Choose the correct answer:(1 mark)

1.The root cell of a wheat plant has 42 chromosomes. What would be the number of chromosomes in the synergid cell?

(a) 7 (b) 14 (c) 21 (d) 28.

Ans :(c) 21

2.Egg apparatus consists of-

(a)Egg (b) Egg and polar nuclei (c) Egg and synergids (d) Egg and antipodal cells.

Ans:(c) Egg and synergids

3.Endosperm of flowering plants develops from-

(a)Haploid nucleus (b) Diploid nucleus (c) Triploid nucleus (d) Tetraploid nucleus.

Ans: (c) Triploid nucleus

4.Persistent nucellus in black pepper is called-

(a)Pericarp (b) Perisperm (c) Primary endosperm nucleus (d) Endosperm

Ans: (b) Perisperm

5.In a monocot, endosperm cells have24 chromosomes. What shall be the chromosome number in embryo-

(a) 24 (b) 16 (c) 12 (d) 8

Ans: (b) 16 as embryos are diploid in nature.

6.Secondary nucleus present in the middle of embryo sac is:

(a)Tetraploid (b) Triploid (c) Diploid (d) Haploid

Ans: (c) Diploid

7.In nature cleistogamous flowers are-

(a) Wind pollinated (b) Bird pollinated (c) Self-pollinated (d) Insect pollinated

Ans:(c) Self-pollinated

8.In a bilobed anther one locule contains 100 pollen mother cells. Calculate the amount of pollens that the plant will form-

(a)100 (b)200 (c) 300 (d)400

Ans: (d)100 x 4 = 400

9. How many male nuclei are present in 3- celled stage pollen grains-

(a) 1 (b) 2 (c)3 (d) infinite

Ans: (b) 2

10.Through which cell of the embryo sac, does the pollen tube enter the embryo sac?

(a)Egg cell (b) Central cell (c) Persistent synergid (d) degenerated synergid.

Ans: (d) degenerated synergid

11.Double fertilization involves:

(a)Syngamy + triple fusion (b) Double fertilization

(c) Development of antipodal cell (d) None of the above.

Ans: (a)Syngamy + triple fusion

12. Functional megaspore in a flowering plant develops into-

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

Ans: (c) Embryo-sac

13. Which of the following is similar to autogamy, but requires pollinators?

(a)Geitonogamy (b) Cleistogamy (c)Apogamy (d)Xenogamy

Ans:(a) Geitonogamy

14. What is the function of the filiform apparatus?

(a)Guide the entry of pollen tube (b) Recognize the suitable pollen at the stigma
(c)Produce nectar (d)Stimulate division of the generative cell

Ans:(a) Guide the entry of pollen tube

15. A mass of nutritive material outside the embryo sac is called _____

(a)Protoplasm (b)Pericarp (c)Ectoderm (d) Perisperm

Ans: (d) Perisperm

16.Which of the following statements is correct?

(a)Sporogenous tissue is haploid (b)The hard outer layer of pollen is called intine
(c)Tapetum nourishes the developing pollen (d)Microspores are produced by endothecium

Ans: (c)Tapetum nourishes the developing pollen

17. Which of the following fruits is produced by parthenocarpy?

(a)Brinjal (b)Apple (c)Banana (d)Jackfruit

Ans: (c)Banana

18. The process of formation of seeds without fertilization in flowering plants is known as-

(a)Budding (b)Apomixis (c)Sporulation (d)Somatic hybridization

Ans: (b)Apomixis

19. Rewards and attractants are required for-

(a)Entomophily (b)Cleistogamy (c)Anemophily (d)Hydrophily

Ans: (a)Entomophily

20. A dioecious flowering plant prevents-

(a)Geitonogamy and xenogamy (b)Autogamy and xenogamy
(c)Autogamy and geitonogamy (d)Cleistogamy and xenogamy

Ans: (c)Autogamy and geitonogamy

ASSERTION REASON TYPE QUESTIONS: (1Mark)

These questions consist of two statements each, printed as Assertion and Reason. While answering these questions, you are requested to choose any one of the following four responses.

(a)If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b)If both Assertion and Reason are true but reason is not the correct explanation of Assertion.
(c)If Assertion is true but Reason is false.
(d)If both Assertion and Reason are false.

1.Assertion: Megaspore mother cell undergoes meiosis to produce four megaspores.
Reason: Megaspore mother cell and megaspores both are haploid.
Ans:(c) If Assertion is true but Reason is false.

2. Assertion: Insects visit flowers to gather honey.
Reason: Attraction of flowers prevents the insects from damaging the parts.
Ans:(c) If Assertion is true but Reason is false.

3.Assertion: Ovule after fertilization form the fruit.
Reason: The fruit contains diploid endosperm.
Ans:(d) If both Assertion and Reason are false.

4.Assertion: Continued self-pollination generation after generation results in pure line formation.
Reason: By continued self-pollination, plants become pure or homozygous for its characters.

Ans:(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

5.Assertion: Cross pollination in true genetic sense within species is called xenogamy.

Reason: When there is cross pollination, resultant hybrid is a combination of characters of two plants.
Ans:(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
6. Assertion: The pre-pollination growth of male gametophyte occurs inside the microsporangium whereas the rest of the growth occurs over the female reproductive organs.
Reason: Growth of the entire female gametophyte occurs inside the megasporangium.
Ans(b)If both Assertion and Reason are true but reason is not the correct explanation of Assertion.
7.Assertion: If an endosperm cell of angiosperm contains 24 chromosomes, the number of chromosomes in the cell of root will be 16.
Reason: As the endosperm is triploid and root cells are diploid, the chromosome number in each root cell will be 16.
8.Assertion: Some fruits are seedless or contain empty or non-viable seeds.
Reason: They are produced without fertilization.
Ans:(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
9. Assertion: Geitonogamy is genetically similar to autogamy.
Reason: The pollen grains come from same plant.
Ans:(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
10. Assertion: Cleistogamous flowers produce assured seed set in the absence of pollinators.
Reason: These flowers do not open at all.
Ans:(a)If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

SHORT ANSWER TYPE QUESTIONS:(2 MARKS)

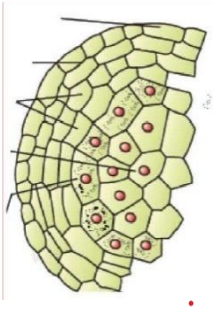
1.Explain how geitonogamy is functionally similar to cross-pollination and genetically similar to autogamy.
Ans: Since geitonogamy involves two different flowers of the same plant, it is genetically similar to autogamy; both autogamy and geitonogamy do not result in genetic variation in the progeny.
Geitonogamy and cross-pollination involve different flowers and a pollinating agent.
2. If you squeeze a seed of orange, you might observe many embryos of different sizes. How is it possible? Explain.
Ans: 2. It is a case of polyembryony, the phenomenon of occurrence of more than one embryo in a seed.
It is possible in the following ways:
(i) Some of the nucellar cells surrounding the embryo sac start dividing, protrude into the embryos.
(ii) In some species, the diploid egg cell is formed without reduction division and develops into the embryo without fertilization.
3. Why should a breeder need to emasculate a bisexual flower? Mention a condition in a flower, where emasculation is not necessary?
Ans:3.Emasculation is necessary to prevent the self-pollen grains falling on the stigma.
Emasculation is not needed when the female parent chosen bears unisexual, i.e. female flowers.
4. **Name all the haploid cells present in an unfertilised mature embryo sac of a flowering plant. Write the total number of cells in it.**
Ans:4 An unfertilised embryo sac of angiosperm is composed of 7 cells, i.e. 7-celled and 8-nucleated. Among 8-nuclei, 6 are enclosed by cell walls and organised into cells, which are haploid in number (3 antipodal, 2 synergids and 1 egg cell) and a large central cell with 2 pollen nuclei.
5.Why do species with an abiotic mode of pollination produce a larger number of pollen-grains, when compared to those with biotic pollination?

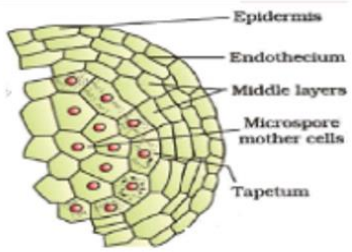
Ans:5(i) Pollination by abiotic agents (like wind and water) is not precise.

(ii) Many pollen grains fail to reach the stigma of female/bisexual flowers.

(iii) To compensate for the wastage, a large number of pollen grains are produced.

6. Label the following.





Ans:6

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

Ans:7 The fruits selected to induce parthenocarpy can be watermelon, papaya, etc. It is because these fleshy fruits have a large number of seeds, which interfere with the preparation of jams, jellies, etc.

8. Not all hydrophytes are pollinated by water. Justify by giving two examples.

Ans:8 All hydrophytes are not pollinated by water. Those hydrophytes whose flowers emerge above the surface of water are pollinated by insects or wind, e.g., water hyacinth and water lily are pollinated by insects.

9. Strawberry is sweet and eaten raw just like any other fruit. Why do botanists call it a false fruit?

Ans:9 In most of the plants, by the time fruit develops from the ovary, other floral parts degenerate and fall off. However, in the case of strawberries, thalamus also contributes to fruit formation. So, it is called false fruit.

10.Are pollination and fertilization necessary in apomixis?

Ans10: No, pollination and fertilization are not necessary in apomixis. It is a form of asexual reproduction that mimics sexual reproduction. It is the formation of seeds without fertilization.

SHORT ANSWER TYPE QUESTIONS (3 Marks)

1.If the meiocyte of a maize plant contains 20 chromosomes, write the number of chromosomes in the endosperm and embryo of the maize grain and give reasons in support of your answer.

Ans:1 The endosperm will have 30 chromosomes and the embryo will have 20 chromosomes.

The meiocyte is a diploid cell (with 20 chromosomes) and it undergoes meiosis; hence, the haploid cells of maize will have 10 chromosomes.

The endosperm develops from the triple fusion. So the endosperm cells are triploid with 30 chromosomes.

The embryo develops from the zygote, which is formed by the fusion of a female gamete with a male gamete; so it is diploid with 20 chromosomes. primary endosperm cell, where the primary endosperm nucleus (PEN) is formed by triple fusion, i.e., fusion of three haploid nuclei-two polar nuclei (fuse to form a diploid secondary nucleus) and a haploid male gamete.

2.Given below are the events that are observed in an artificial hybridization programme. Selection of parents --> Emasculation --> Bagging --> Collection of pollen from other male plant --> Dusting of pollen on stigma --> Rebagging. While planning for crop improvement involving dioecious plants, which of the above-mentioned steps would not be relevant?

Ans:2 While planning for an artificial hybridization programme for crop improvement involving dioecious plants, there is no need of emasculation. Dioecious plants have both the male and female reproductive organs borne on separate individuals of the same species.

If the female parent produces unisexual flowers, emasculation is not required. The female flower buds are bagged before the flowers open. When the stigma becomes receptive, pollination is carried out using the desired pollen and the flower is rebagged. This protects them from contamination by unwanted pollen grains.

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

Ans:3 (a) Release of pollen and stigma receptivity is not synchronized in some species

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

(c) Self-incompatibility is a genetic mechanism.

4. Give any three advantages of sexual incompatibility.

Ans:4 (a)it prevents self pollination.

(b)it has made plants outbreeders and this maintains the vigour and vitality of the race.

(c)variations appear due to outbreeding provide adaptability to the changes in the environment.

5. How do self-incompatibility restrict autogamy? How does pollination occur in such plants?

Ans:5 Self-incompatibility restricts autogamy by a mechanism known as self-sterility. This is a **genetic mechanism** in which the germination of pollen grains or the pollen tube growth in the pistil is inhibited which prevents the pollen from fertilizing the ovules. Such plants pollinate by the process of cross-pollination.

6. Differentiate between microsporogenesis and megasporogenesis.

Ans:6

Microsporogenesis	**Megasporogenesis**
1. It is the formation of haploid microspores or pollen grains from the diploid microspore mother cell.	1. it is the formation of megaspores from the diploid megaspore mother cell.
2. The pollen grains are arranged in tetrahedral tetrad.	2. The megaspores are arranged in linear tetrad.
3. All the microspores are functional.	3. Only one megaspore is functional. Others degenerate.

7. Where is sporopollenin present in plants? State its significance with reference to its chemical nature.

Ans:7 Sporopollenin is present in exine of pollen grains in plants. It is one of the most resistant organic substances and can withstand high temperatures, strong acids and alkalis. It protects the pollen grains from enzymes and helps them to be well preserved**.**

8. Parthenocarpy and apomixis have been observed in some plants. Give an example of each. State a similarity and a difference observed between the two processes.

Ans: Parthenocarpy is exhibited by banana plant whereas the apomixis is exhibited by some plants belonging to family Asteraceae and grasses.

Similarity between apomixis and parthenocarpy : In both processes, the fertilization does not take place.

Difference between apomixis and parthenocarpy: In parthenocarpy, development of fruits occurs without fertilization. On the other hand, in apomixis, development of seeds occurs without fertilization.

9. Majority of angiosperms have hermaphrodite flowers, but self-pollination is discouraged by them. Explain any three outbreeding devices that they have developed to achieve it.

Ans:9 The outbreeding devices are as follows:

1.Self incompatibility is the genetic mechanism that prevents self-pollen from fertilizing the ovule by inhibiting pollen germination or retarding the growth of Pollen tube.

2.Certain plant species produce male and female flowers on different plants, i.e., the plants are Dioecious; this prevents both autogamy and geitonogamy

3.Pollen release and stigma receptivity are not synchronized, either the anthers mature first or the pistil mature first

4.The anthers and stigma of a flower are placed in such a way that the pollen of the flower cannot fall on the stigma of the same flower. (any 3)

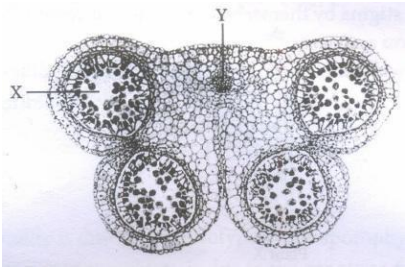
10. Is it possible that an unfertilized apomictic embryo sac gives rise to a diploid embryo? Give a reason in support of your answer.

Ans:10 Yes, an unfertilized apomictic embryo sac can give rise to a diploid embryo. If the megaspore develops into an embryo sac without mitotic division, it will give rise to a diploid embryo.

CASE BASED QUESTIONS: (4 MARKS)

Read the following and answer any four questions from (i) to (iv) given below:

CASE:1 Many adaptations are found in flowers to achieve certain kinds of pollination. The pollination achieved by insects is known as entomophily. The given diagram shows the cross-section of an anther of an insect pollinated flower.



(i) Which of the following is/are the function(s) of structure Y?

(a) To carry waste products away from the anther.

(b)To supply oxygen to the cells of the anther.

(c) To transport food and mineral salts to the anther.

(d)To supply water to the anther.

(a) C only	(b) C and D only	(c) A, Band D only	(d) A,B,C and D

Ans (b)

(ii) Which of the following most accurately describes the structures found in compartment X?

(a) They contain two haploid nuclei resulting from meiosis

(b) They contain two haploid nuclei resulting from mitosis

(c) They contain two haploid male gametes resulting from mitosis

(d) They contain a vegetative nucleus and pollen tube nucleus

Ans (b)

(iii) Which of the following is a distinctive characteristic of insect-pollinated flowers?

(a) All of them have nectar guides on their flowers

(b) They produce sugary fruit

(c) Their pollen grains tend to have rough surfaces

(d) They produce abundant quantities of pollen to make up for pollen grains that might be removed by the wind

Ans (c)

(iv) Which of the following are likely characteristics of the structures found in X and stamens of this plant?

Structure of X	Stamens
(a) Abundant and light	**Pendulous**
(b) Rough surfaces	**Non-pendulous**
(c) Light and sticky	**Pendulous**
(d) Coarse and sticky	**Protrude outside the flower**

Ans (b)

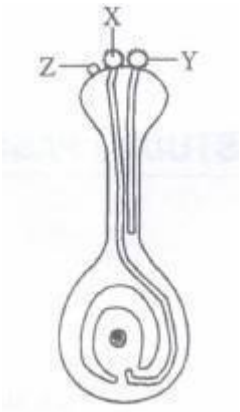
or

Spiny or sticky pollen grains and large, attractively coloured flowers are associated with

(a) hydrophily	**(b) entomophily**	**(c) ornithophily**	**(d) anemophily**

Ans (b)

CASE:2 Cross pollination is the transfer-of pollen grains from the anther of one flower to the stigma of a genetically different flower. It is performed with the help of an external agency which may be abiotic (e.g., wind, water) or biotic (e.g., insects, birds, bats, snails). The diagram shows the carpel of an insect pollinated flower.



(i) **What is the most likely reason for non-germination of pollen grain Z?**

(a) Pollen grains X and Y were brought to the stigma earlier, therefore, their germination inhibited the germination of pollen grain Z.

(b) Pollen grain Z was brought to the flower by wind, while pollen grains X and Y were brought to the flower by insect

(c) Pollen grain Z lacks protrusions that allow it to adhere properly onto the stigma surface

(d) Pollen grain Z comes from a flower of an incompatible species

Ans:(d**)**

(ii) Which of the following best describes the function of the pollen tube?

(a) It acts as a conduit to transport male gametes from the anther to the ovule

(b) It acts as a conduit to transport male gametes from the stigma to the ovule.

(c) It contains key nutrients that serve to nourish the newly-formed zygote

(d) It digests the tissues of the stigma, style and ovary.

Ans: (b)

(iii) Pollination of a flower in which the pollen is carried by an insect is called-

(a) anemophily	(b) ornithophily	(c) entomophily	(d) malacophily

Ans: (c)

(iv) Pollenkit is generally found in

(a) anemophilous flowers	(b) entomophilous flowers	(c) ornithophilous flowers	(d) malacophilous flowers

Ans: (b)

Or

(v) Refer to the given characteristics of some flowers:

A. The stamens hang out of the flower, exposing the anthers to the wind.	B. The pollen grains are tiny and light	C. The flower has a sweet scent.	D. The flower petals are brightly coloured.

How many of the above characteristics are of insect-pollinated flowers?

(a) One	(b) Two	(c) Three	(d) Four

Ans:(b)

CASE:3 The pollen grains or microspores are the male reproductive bodies of a flower and are contained in the pollen sac or microsporangia. Each pollen grain consists of a single microscopic cell, possessing two coats : the exine and the intine. The exine of a pollen grain is made of chemically stable material. Because of this, pollen grains are often very well preserved for thousands of years in soil and sediments.

(i) One of the most resistant biological material present in the exine of pollen grain is-

(a) pectocellulose	(b) sporopollenin	(c) suberin	(d) cellulose

Ans:(b)

(ii) The exine possesses one or more thin places known as-

(a) raphe	(b) germ pores	(c) hilum	(d) endothecium

Ans:(b)

(iii) What is the function of germ pore?

(a) Emergence of radicle	(b) Absorption of water for seed germination	(c) Initiation of pollen tube	(d) All of these.

Ans:(c)

(iv) What is the key advantage to the plant for having such strong pollen grain walls?

(a) It protects the vital genetic material in the pollen grain

(b) It allows pollen to serve as a valuable fossil record for the study of ancient plants.

(c) It prevents the pollen tube from growing out before the pollen grain reaches the stigma of a compatible species.

(d) It gives weight to the pollen grain, allowing it to cling better to the body surfaces of insect pollinators.

Ans:(a)

or

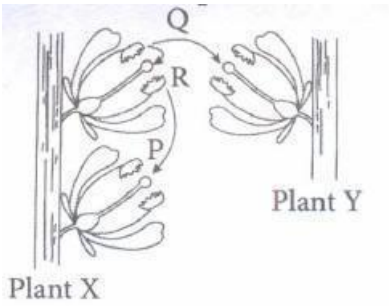
The number of germ pores in dicots and monocots respectively are-

(a) three and one	(b) three and two	(c) two and three

Ans:(a)

CASE :4 In angiosperms, the pollen grains are being transferred from the anther to the stigma and is termed pollination. This phenomenon was first discovered by Camerarius (1694) in the end of the seventeenth century. Pollen grains are immobile. They cannot reach the stigma by themselves. An external agent is required for this. The pollination is mainly of two types-self-pollination and cross pollination.

The diagram given below shows two plants of the same species showing different types of pollination.



(i) What is transferred between the plants in the process indicated by arrow P?

(a) Ova	(b) Pollen	(c) Nutrients	(d) Seeds

Ans:(b)

(ii) Which of the following statements is correct regarding processes P,Q and R?

(a) Processes P, Q and R introduce genetic variability in the offspring of sexually reproducing plants X andY.

(b) Wind serves as an agent for process Q if plants X and Y belong to Genus Salvia.

(c) Flowers of plants X and Y need to produce odour and nectar for completion of processes P and Q if they-are entomophilous.

(d) If plants X and Y belong to Genus Cannabis, then their flowers need to produce sticky and heavy pollen in very small amounts for the accomplishment of process Q.

Ans:(c)

(iii) Identify the processes P,Q and R.

P	Q	R
(a) Geitonogamy	Xenogamy	Autogamy
(b) Allogamy	Chasmogamy	Cleistogamy
(c) Autogamy	Geitonogamy	Xenogamy
(d) Geitonogamy	Allogamy	Autogamy

Ans:(a)

(iv) Which of the given processes represents a type of pollination that would result in greater adaptability of the particular species to potential environmental changes?

(a) P	(b) Q	(c) R	(d) All of these

Ans:(b)

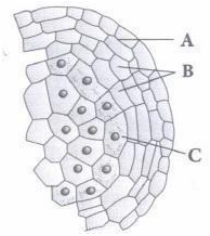
CASE:5 The anther is a four-sided structure consisting of four microsporangia located at the corners two in each lobe. The microsporangia develop further and become pollen sacs. In a transverse section, a typical microsporangium appears near circular in outline. It is generally surrounded by four wall layers-the epidermis, endothecium, middle layers and the tapetum.

(**i) A dithecous anther consists of (A) microsporangia, (B) in each lobe. Select the option that correctly fills the blanks**

A	B
(a) four	Two
(b) two	One
(c) two	Two
(d) four	One

Ans:(a)

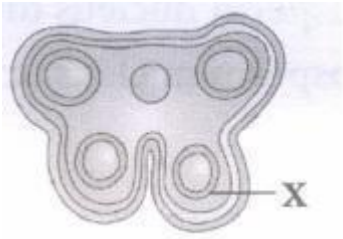
(ii) The given diagram shows microsporangium of a mature anther. Identify A, Band C.



(a) A-Middle layer	B-Endothecium	C-Tapetum
(b) A-Endothecium	B-Tapetum	C- Middle layer
(c) A-Endothecium	B-Middle layer	C-Tapetum
(d) A-Tapetum	B-Middle layer	C- Endothecium

Ans:(c)

(iii) The function of labelled part X is



(a) dehiscence	(b) mechanical	(c) nutrition	(d) protection

Ans:(c)

(iv) Select the incorrect statement

(a) Microsporangium is generally surrounded by four wall layers-epidermis, endothecium, middle layers and tapetum

(b) Outer three layers perform functions of protection and dehiscence of anthers.

(c) Cells of tapetum possess dense cytoplasm and generally have more than one nucleus.

(d) Cells of tapetum undergo meiosis and produce microspore tetrads.

Ans:(d)

or

Which function of tapetum is correct?

(a) Helps in pollen wall formation

(b) Transportation of nutrients to the inner side of anther.

(c) Synthesis of callase enzyme for separation of microspore tetrads.

(d) All of these

Ans:(d)

LONG ANSWER TYPE QUESTIONS:(5 MARKS)

1. Draw the embryo sac of a flowering plants and label:

(a) (i) Central Cell (ii) Chalazal end (iii) Synergids

(b) Name the cell that develops into the embryo sac.

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

(d) Give the role of a filiform apparatus.

Ans: NCERT Page 10, 11

2.Trace the events that would take place in flower from the time of Pollen grain of species fall on stigma up to completion of fertilization.

Ans: NCERT Page 15- 17

3.i) Why is zygote dormant for some time in a fertilized ovule?

ii) What is polyembryony? Give an example.

iii) In fruits, what is formed from following parts:- a) Ovary wall b) Outer integument c) zygote d) Inner integument e) primary endosperm f) Ovary g) Nucellus

Ans: NCERT Page20, 22

4. A flower of tomato plant following the process of sexual reproduction produces 240 viable seeds. Answer the following questions giving reasons:

(i) What would have been the minimum number of ovules present per pollinated pistil?

(ii) How many microspore mother cells would minimally be required to produce the requisite number of pollen grains?

(iii) How many pollen grains must have minimally pollinated the carpel?

(iv) How many male gametes would have used to produce these 240 viable seeds?

(v) How many megaspore mother cells were required in this process?

Ans: NCERT Page 6,7 and 9, 10

5.(i) Name the structures which the parts A and B shown in the diagram given below, respectively develop into.

ii) Explain the process of development which B undergoes in albuminous and exalbuminous seeds. Give one example of each of these seeds.

Ans: NCERT Page 18, 20

SELF ASSESSMENT TEST **M.M 40**

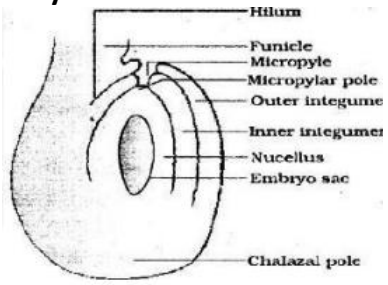
Q.1.MULTIPLE CHOICE QUESTIONS (1x7=7)

1. Which of the following statements is NOT true?

(a) Tapetum helps in the dehiscence of anther (b) Exine of pollen grains is made up of sporopollenin

(c) Most species of pollen grains can cause allergic reactions (d) None of the above

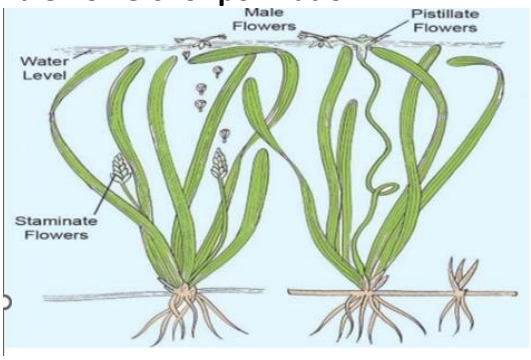
2. In the figure of anatropous ovule given below, choose the correct option for the characteristic distribution of cells within the typical embryo sac.



	Number of cells at chalazal end	Number of cells at micropylar end	Numbers of nuclei left in central cell
A	3	2	3
B	3	3	2
C	2	3	3

D	2	2	4

3.In the dioecious aquatic plant shown, identify the characteristics of the male flowers that reach the female flowers for pollination.



	Size of the flower	Colour of flower	Characteristic feature of pollen grain
A	small	Brightly coloured	Light weight and non-sticky
B	large	Colourless	Large and sticky
C	small	White	Small, covered with mucilage
D	large	Colourless	Non sticky

4. The coconut water from tender coconut is-

(a) cellular endosperm. (b) free nuclear endosperm.

(c)both cellular and nuclear endosperm. (d)free nuclear embryo

5.Pollen grains are well preserved as fossils because of presence of-

(a) sporopollenin (b)cellulose (c)lignocellulose (d)pectocellulose

6.A botanist studying Viola (common pansy) noticed that one of the two flower types withered and developed no further due to some unfavorable condition, but the other the flower type on the same plant survived and it resulted in an assured seed set. Which of the following will be correct?

(a) The flower type which survived is Cleistogamous and it always exhibits autogamy

(b) The flower type which survived is Chasmogamous and it always exhibits geitonogamy.

(c)The flower type which survived is Cleistogamous and it exhibits both autogamy and geitonogamy.

(d)The flower type which survived is Chasmogamous and it never exhibits autogamy.

7.In a fertilized ovule, n, 2n and 3n conditions occur respectively in-

(a) antipodal, zygote and endosperm (b) zygote, nucellus and endosperm

(c) endosperm, nucellus and zygote. (d) antipodals, synergids and integument

Q.2-ASSERTION REASON TYPE QUESTIONS(1x4=4)

These questions consist of two statements each, printed as Assertion and Reason. While answering these questions, you are requested to choose any one of the following four responses.

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

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

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

(d)If both Assertion and Reason are false.

1.Assertion (A) Tapetum is the innermost wall layer It performs the function of providing nourishment to the developing pollen grains.
Reason (R): The cells of tapetum have dense cytoplasm and usually have more than one nucleus
2.Assertion (A) The pollen mother cell undergoes meiosis to form microspores; this process is called microsporogenesis.
Reason (R) Some cells of the sporogenous tissue are potential pollen mother cells (PMC)
3.Assertion (A) Pollen grains are well preserved and can stay viable for long periods of time
Reason (R) The hard outer layer of pollen grains called exine is made up sporopollenin
4**.Assertion (A):** Pollen grains are shed at 3-celled stage in some angiosperms.
Reason (R) In some species, the vegetative cell of pollen grain divides mitotically to form two male gametes

Q.3 SHORT ANSWER TYPE QUESTIONS:(2x3=6)

1.How bagging technique is helpful in a plant breeding programme?
2.Why is an apple called a false fruit? Which part of the flower forms the fruit?
3. What relationship exists between a species of moth and Yucca plant?

Q.4SHORT ANSWER TYPE QUESTIONS (3x3=9)

1.What are chasmogamous flowers? Can cross-pollination occur in cleistogamous flowers? Give reasons for your answer.
2.Name the mechanism responsible for the formation of seed without fertilization in angiosperms. and what is its importance?
3.A single pea plant in your kitchen garden produces pods with viable seeds, but the individual papaya plant does not.

Q.5.CASE BASED QUESTIONS: (1x4=4 Marks)

Read the following and answer any four questions:

All flowering plants show sexual reproduction. In the flowering plant male, the reproductive part is androecium while the female reproductive part is gynoecium. The male reproduction part consists of filament and anther. The proximal end of the filament is attached to the thalamus. A typical end of the filament is attached to the thalamus. A typical angiosperm anther is bilobed. The anther is a four-sided structure consisting of 4 microsporangia that appear near-circular in outline. It is surrounded by 4 layers. calls of the sporogenesis anther mature and dehydrated, the microspores dissociate from each other and develop in the pollen grain. pollen grain represents the male gametophytes. pollen grain made up of two-layer.

1.Each lobe in typical angiosperm anther have ____.
(a)two theca (b) three theca (c) four theca (d) one theca
2.The innermost layer of microsporangium:
(a)Epidermis (b) tapetum (c) endothecium (d) middle layer
3.The Center of the microsporangium is occupied by:
(a)Epidermis (b) tapetum (c) sporogenous tissue (d)cytoplasm
4.The process of formation of microspores from pollen mother cell through meiosis is called:
(a)Microsporangia (b)microsporogenesis (c)megasporangia (d)megasporogenesis

or

Assertion- As the anther mature and dehydrate the microspores disassociate from each other and develop into a pollen grain.
Reasons- As the anther develop, the cell of the sporogenous tissue undergo meiotic division to form microspore tetrads.
Both Assertion and Reason are true and Reason is the correct explanation of the Assertion
Both Assertion and Reason are true but Reason is not the correct explanation of the Assertion

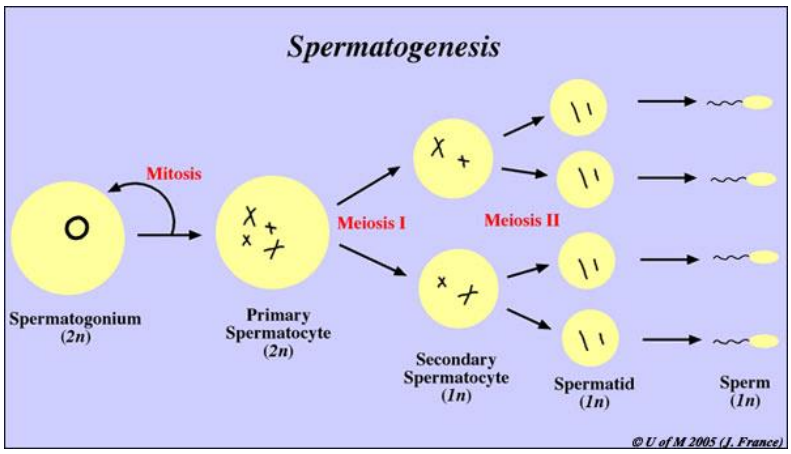
The assertion is true but the Reason is false
Both the statements are false

Q.6.LONG ANSWER TYPE QUESTIONS(5X2=10)

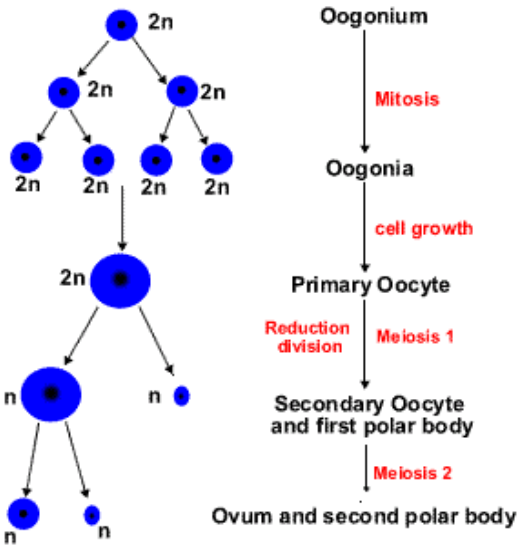
1. Draw a labeled diagram of LS of an embryo of grass (any six labels).
(ii) Give reason for each of the following
(a) Anthers of angiosperm flowers are described as dithecous.
(b) Hybrid seeds have to be produced year after year.
2.Give reasons why?
(i) Most zygotes in angiosperms divide only after a certain amount of endosperm is formed.
(ii) Groundnut seeds are exalbuminous and castor seeds are albuminous.
(iii) Micropyle remains as a small pore in the seed coat of a seed.
(iv) Integuments of an ovule hardens and the water content is highly reduced as the seed matures.
(v) Apple and cashew nuts are not called true fruits.

CHAPTER 2 -HUMAN REPRODUCTION

1. **Male reproductive system**- It consists of a pair of testis, accessory ducts(rete testis, vasa efferentia, epididymis and vas deferens), glands(paired seminal vesicles, a prostate and paired bulbourethral gland) and the external genitalia(penis). Diag. page 27 of NCERT.
2. **Female reproductive system**- It consists of a pair of ovaries, paired oviduct(fallopian tubes), uterus, cervix, vagina and external genitalia(mons pubis, labia majora, labia minora, hymen and clitoris). Diag. page 29 of NCERT.
3. Structure of sperm(page 32 of NCERT)
4. T.S. ovary and testis(page 33,31 of NCERT)
5. Menstrual cycle(page34 of NCERT)
6. **Spermatogenesis-** The process of formation of sperms from spermatogonia through meiosis.



7. **Spermiogenesis**- The transformation of spermatids into spermatozoa is called spermiogenesis.
8. **Spermiation-** Release of spermatids from the sertoli cells is called spermiation.
9 .**Oogenesis**- The process of formation of ovum from oogonia through meiosis.



10**. Ovulation**- The release of ovum from ovary is called ovulation.

11. Functions of placenta- Supply of oxygen and nutrients to the embryo and removal of carbon dioxide and excretory waste by the embryo. Hormones secreted by it are human chorionic gonadotrophin (hCG), human placental lactogen(hPL), estrogens, progesterone etc

Multiple Choice Questions:

1. Select the correct sequence of stages of spermatogenesis in a human male.
(a) Spermatogonium → Spermatids → Spermatocytes → Spermatozoa
(b) Spermatogonium → Spermatocytes → Spermatids → Spermatozoa
(c) Spermatids → Spermatogonium → Spermatocytes → Spermatozoa
(d) Spermatocytes → Spermatogonium → Spermatids → Spermatozoa
Answer: b

2. Vas deferens receives the duct of seminal vesicle and forms the
(a) epididymis (b) urethra (c) ejaculatory duct (d) urethral meatus
Answer: c

3. How many functional sperms and how many ova will be formed by a primary spermatocyte and a primary oocyte, respectively?
(a) One, One (b) One, Four (c) Four, One (d) Four, Four
Answer: c

4. Proliferative phase of menstrual cycle, is also called
(a) follicular phase (b) luteal phase (c) secretory phase (d) ovulatory phase
Answer: a

5. Ovulation occurs under the influence of
(a) follicle-stimulating hormone (b) luteinising hormone
(c) progesterone (d) estrogen.
Answer: b

6. There is no cell division involved in
(a) spermatogenesis (b) oogenesis (c) embryogenesis (d) spermiogenesis
Answer: d

7. The cell division in secondary oocyte is suspended at
(a) Anaphase II (b) Metaphase II (c) Prophase II (d) Telophase II
Answer: b

8. After the release of the secondary oocyte, the Graafian follicle develops into
(a) corpus callosum (b) corpus albicans (c) corpus luteum (d) primary follicle
Answer: c
9. The outermost layer of a blastocyst is called
(a) ectoderm (b) mesoderm (c) endoderm (d) trophoblast
Answer: d
10. Urethral meatus refers to the
(a) urinogenital duct
(b) opening of vas deferens into urethra
(c) external opening of the urinogenital duct
(d) muscles surrounding the urinogenial duct
Answer: c
11. Morula is a developmental stage.
(a) between the zygote and blastocyst
(b) between the blastocyst and gastrula
(c) after the implantation
(d) between implantation and parturition
Answer: a
12. Spermiation is the process of the release of sperms from
(a) seminiferous tubules (b) vas deferens (c) epididymis (d) prostate gland
Answer: a
13. Which of the following hormones prepares the uterus for implantation?
(a) Progesterone (b) FSH (c) Estrogen (d) LH
Answer: a
14. The cell which undergoes meiosis I during spermatogenesis, is the
(a) spermatogonium (b) spermatid (c) primary spermatocyte (d) secondary spermatocyte
Answer: c
15. Seminal plasma, the fluid part of semen is formed by
(a) seminal vesicle and bulbourethral gland.
(b) bulbourethral gland and prostate.
(c) prostate and seminal vesicle.
(d) seminal vesicles, prostate and bulbourethral gland.
Answer: d
16.The male reproductive system is located in the
(a) pelvis region (b) chest region (c) back region d) none of the above.
Answer:a
17.The uterus is single and it is also called
(a) fimbriae (b) isthmus (c) ampulla (d) womb
Answer: (d) womb
18.The finger like projections is the infundibulum are called
(a) fimbriae (b) ampulla (c) isthmus (d) none of the above
Answer: (a) fimbriae
19.Milk is sucked out from the
(a) mammary lobes (b) mammary glands (c) mammary duct (d) lactiferous duct
Answer: (d) lactiferous duct
20.Besides activating the egg another role of a sperm is to carry to egg
(a) RNA (b) mitochondria (c) DNA (d) ribosomes.
Answer: (c) DNA

Assertion Reason

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

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

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

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

(d) If both Assertion and Reason are false.

Q.1. Assertion : In human male, testes are extra abdominal and lie in scrotal sacs.

Reason : Scrotum acts as thermoregulator and keeps testicular temperature lower by 2°C for normal spermatogenesis.

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

Q.2. Assertion : Testicular lobules are the compartments present in testes.

Reason : These lobules are involved in the process of fertilization.

Answer(d) If both Assertion and Reason are false.

Q.3. Assertion : Interstitial cell is present in the region outside the seminiferous tubule called interstitial spaces.

Reason : Interstitial cells provide nutrition to the sertoli cells.

Answer (c) If Assertion is true but Reason is false.

Q.4. Assertion: The testes are situated outside the abdominal cavity within the scrotum.

Reason: Muscles in scrotum helps to maintain low temperature of testes, necessary for spermatogenesis.

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

Q.5. Assertion: The bulbourethral gland is a male accessory gland.

Reason: Its secretion helps in the lubrication of the penis, thereby facilitating reproduction.

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

Q.6. Assertion: Each seminiferous tubule is lined on its inside by three types of cells.

Reason: These cells are male germ cells, Sertoli cells and Leydig cells.

Answer(d) If both Assertion and Reason are false.

Q.7. Assertion: In human male, there are perianal glands near the anus.

Reason: Perianal glands secrete sex-attractant pheromone which initiates sexual desire in humans.

Answer (d) If both Assertion and Reason are false.

Q.8. Assertion: Testes are located in the scrotum, outside the coelom.

Reason: A vaginal coelom partly surrounds the testes in the scrotum.

Answer (c) If Assertion is true but Reason is false.

Q.9. Assertion: Fimbriae are finger-like projections of the infundibulum part of the oviduct which is closest to the ovary.

Reason: They are important for collection of ovum after ovulation from ovary.

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

Q.10. Assertion: Finger-like projections called chorionic villi appear on the trophoblast after implantation.

Reason: Chorionic villi are surrounded by the uterine tissue and maternal blood.

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

VERY SHORT ANSWER TYPE QUESTION (2 marks)

1. Why are human testes located outside the abdominal cavity? Name the pouch in which they are present.

Ans Human testes are located outside the abdominal cavity as it helps in maintaining low temperature (2-2.5^{0}C) lower than body temperature) required for spermatogenesis. Testes are enclosed in a pouch called scrotum.

2. Write the location and functions of following in human testes

(i) Sertoli cells (ii) Leydig cells

Ans (i) Location of Sertoli cells Within the lining of the seminiferous tubule of testis. Function of Sertoli cells They provide nutrition to the developing sperms or germ cells.
(ii) Location of Leydig cells In the interstitial spaces between the seminiferous tubules. Function of Leydig cells They synthesize and secrete male hormones, i.e. androgens, testosterone.

3.Write the function of the seminal vesicle.

Ans Seminal vesicle produces an alkaline secretion containing prostaglandins, proteins and fructose. The high fructose content provides energy to the spermatozoa. These secretions form 60-70% of the fluid found in the semen.

4. List the different parts of the human oviduct through which the ovum travels till it meets the sperm for fertilization.

Ans The different parts of human oviduct through which the ovum travels, till it gets fertilized are given below in the sequence

- Fimbriae, finger-like projections Collect the ovum from ovary after ovulation.
- Infundibulum Ovum from fimbriae is guided into funnel-shaped infundibulum, part of the Fallopian tube.
- Ampulla A wider part of the oviduct that leads ovum into isthmus.
- Isthmus It has a narrow lumen which opens into the uterus. In the junction of ampulla- isthmus, the ovum gets fertilized

5 Name and explain the role of inner and middle walls of human uterus.

Ans The innermost wall of uterus is called endometrium.Role of Endometrium(i) It lines the uterine cavity and is glandular in nature.(ii) It undergoes cyclic changes during the menstrual cycle.The middle wall or layer of the uterus is called myometrium. Role- It consists of smooth muscles. It brings about contractions during delivery of the baby.

6 When do the oogenesis and the spermatogenesis initiate in human females and males, respectively?

Ans Oogenesis initiates during foetal or embryonic stage in females, whereas spermatogenesis in males starts at puberty.

7 Mention the differences between spermiogenesis and spermiation.

Spermiogenesis	Spermiation
It is the process of transforming spermatids into mature spermatozoa or sperms through differentiation.	Sperm heads are embedded in Sertoli cells to obtain nourishment and finally released from seminiferous tubules by the process called spermiation.

8. Where is the acrosome present in humans? Write its function.

Ans In humans, the acrosome is present in the anterior portion of the head of human sperm. Function Hydrolytic enzymes or sperm lysins present in acrosome help in the penetration of sperm into egg, during fertilization.

9 What happens to corpus luteum in human female if the ovum is (i) fertilized, (ii) not fertilized?

Ans In case of fertilization, the corpus luteum continues secreting progesterone which is required for the maintenance of endometrium during pregnancy.

- In the absence of fertilization, the corpus luteum degenerates and gets converted into corpus albicans. Deficiency of progesterone causes disintegration of the endometrium leading to menstruation and thus, a new cycle starts.

10. Write the effect of high concentrations of LH on a mature Graafian follicle.

Ans The high concentration of LH (also known as LH surge) induces the rupture of Graafian follicle, which results in the release of secondary oocyte hence, causing ovulation in females.

SHORT ANSWER TYPE QUESTION (3 Marks)

1**. Why is the female reproductive system complex in comparison to male reproductive system?**

Ans .This is because the male reproductive system functions only to produce and transfer sperm (male gametes) into the females, while the female reproductive system has to safely harbor the child and provide it with appropriate nutrition and oxygen in addition to production of eggs (female gametes).

2**. Why does Scrotum provide a low temperature to testis?**

Ans The scrotum maintains a temperature of 2^0C to 3^0C lower than that of the body temperature as the production of sperms in the testis require a lower temperature as compared to the normal body temperature.

3. **Why is the presence or absence of hymen not a reliable indicator of virginity or sexual experience?**

Ans It's true that the presence or absence of hymen is not a reliable indicator of virginity or sexual experience. Note: The hymen can stretch or tear by the use of tampons, menstrual cups or pelvic examination. Regular physical activity or sexual intercourse can also lead to tearing of hymen

4**. What are the major differences between spermatogenesis and oogenesis?**

Ans Spermatogenesis vs Oogenesis

Spermatogenesis	Oogenesis
Produces motile gametes	Produces non-motile gametes
Equal cytokinesis occurs during the spermatogenesis producing four sperms	Unequal cytokinesis occurs during oogenesis ultimately producing one large ovum and tiny polar bodies

5. **What is the advantage to be found in a secondary oocyte which is large in comparison to the polar body?**

Ans The secondary oocyte retains the major bulk of the cytoplasm of the primary oocyte. Similarly, the second meiotic division is also unequally distributed and leads to the formation of a larger ovum or ootid and the second polar body. The unequal cytoplasmic division ensures that the egg has ample nutrients.

6. Why does all copulation not lead to fertilization and pregnancy?

Ans All copulations do not lead to the fertilization and pregnancy. Reason: Fertilization can occur only if the ovum and sperms are transported simultaneously to the ampullary - isthmic junction.

7. **Define placenta and how it is formed?**

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

8. What is foetal ejection reflex?

Ans The fetal ejection reflex is when the body “expels” a baby involuntarily — that is, without forced pushing on your part.

9. **Define parturition. Which mechanism induces parturition?**

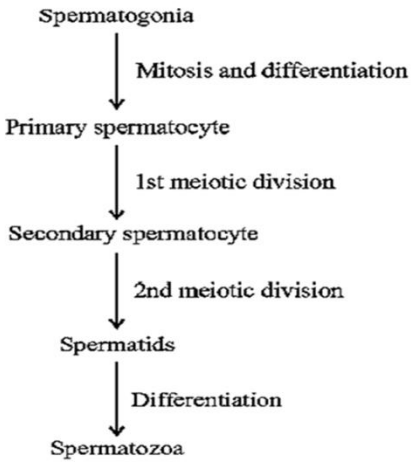
Ans Parturition is the act of giving birth to the young; childbirth. Fully developed foetus and placenta send signals for parturition which in turn induces mild uterine contractions by stretching of cervix referred to as foetal ejection reflex.

10. What is lactation? Which hormone is called milk ejecting hormone?

Ans Lactation is the process of making human milk. Oxytocin is a hormone produced by the hypothalamus. But it is stored and released by the posterior lobe of the pituitary gland. It is responsible for the ejection of milk.

Case study based Questions

Case 1: Spermatogenesis is the production of sperms from male germ cells (spermatogonia) inside the testes (seminiferous tubule). This process begins at puberty. Observe the following flow diagram and answer the questions that follows-



(i) This happens during spermatogenesis

(a) Meiosis (b) Mitosis (c) Meiosis and mitosis (d) None of these

Ans:-c

(ii) The process of spermatogenesis is induced by

(a) TSH (b) FSH (c) MSH (d) ACTH

Ans:-b

(iii) The number of spermatozoa, a single primary spermatocyte finally produced in spermatogenesis is

(a) 2 (b) 4 (c) 6 (d) 8

Ans:-b

(iv) In spermatogenesis, the phases of maturation involve

(a) formation of spermatids from primary spermatocyte through meiosis

(b) growth of spermatogonia into primary spermatocytes

(c) formation of spermatogonia from gonocytes through mitosis

(d) formation of oogonia from spermatocyte through meiosis

Ans-a

OR

(v) The correct sequence of cell stage in spermatogenesis is

(a) spermatocyte → spermatids → spermatogonia → spermatozoa

(b) spermatogonia → spermatids → spermatocyte → spermatozoa

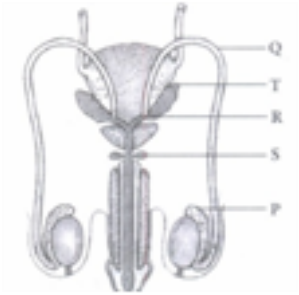
(c) spermatocytes → spermatogonia → spermatid → spermatozoa

(d) spermatogonia → spermatocytes→ spermatids → spermatozoa

Ans:- d

Case 2: Read the following and answer any four questions from (i) to (v) given below:

Human male reproductive system comprises a pair of testes, primary sex organs associated with formation of gametes and production of sex hormone. Study the given figure of the human male reproductive system and answer the following questions.



(i) Which of the following is correct for labeled part P?

(a) P is rete testis which transports sperms to outside.

(b) P is epididymis which secretes fluid that nourish the sperms

(c) P is epididymis that carry sperms and secretion of seminal vesicles

(d) P is rete testis which lies along inner side of each testis and stores the sperms

Ans (b)

(ii) Identify the correctly matched pair.

(a) Q - Vasa efferentia b) R - Ejaculatory duct c) S - Seminal vesicle d) T - Cowper's gland

Ans (b)

(iii) Which statement is incorrect for Q?

(a) It carries spermatozoa from epididymis to ejaculatory duct.

(b) Q are only 2 in number.

(c) It arises from rete testis.

(d)) It constitutes male sex accessory duct

Ans (c)

(iv) Which structure passes through the prostate gland and carries sperms and secretion of seminal vesicles?

(a) P b) T c) S d) R

Ans (d)

OR

(v) Assertion: Mucus present in secretion of bulbourethral gland decreases the number of sperms damaged during ejaculation

Reason: Mucus lubricates the end of penis and lining of the urethra.

(a) Both assertion and reason are true and reason is the correct explanation of assertion.

(b) Both assertion and reason are true but reason is not the correct explanation of assertion.

(c) Assertion is true but reason is false.

(d) Both assertion and reason are false .

Ans (a)

Case3: Read the following and answer any four questions from (i) to (v) given below:

The first menstruation is called menarche, that usually occurs between 12 and 15 years. In human females, menstruation is repeated at an average interval of about 28129 days and is called the menstrual cycle. It is regulated by certain hormones, as the pituitary gland is stimulated by releasing factors produced in the hypothalamus. The hormones produced by the pituitary gland influence the ovaries. The hormones secreted by the ovaries affect the walls of the uterus

(i) The breakdown of endometrium is characteristic of

(a) proliferative phase (b) luteal phase (c) ovulatory phase (d) menstrual phase

Ans (d)

(ii) Which days of the menstrual cycle marks the proliferative phase?

(a) 1-5 (b) 15-28 (c) 6-13 (d) 10-14

Ans (c)

(iii) Which of the following occurs during the secretory phase?

(a) Empty Graafian follicle changes into corpus luteum.
(b) Primary follicle changes' into Graafian follicle.
(c) Endometrium rebuilds and estrogen secretion increases
(d) LH surge inducing release of an ovum.
Ans (a)
(iv) Identify the hormones that attain peak level during ovulatory phase
(a) FSH (b) Progesterone (c) LH (d) Both (a) and ©
Ans (d)

OR

(v) Withdrawal of which hormone causes degeneration of corpus luteum?
(a) FSH (b) LH (c) Progesterone (d) Estrogen
Ans (b)

LONG ANSWER TYPE QUESTION (5 marks)

1. Give a brief account of male reproductive system.
ANSWER . NCERT Page 27
2. Give a brief account of the female reproductive system.
ANSWER NCERT Page 29
3. Describe spermatogenesis.
ANSWER NCERT Page 33
4. Explain the process of oogenesis.
ANSWER NCERT Page 33
5. What are the various events that take place during a menstrual cycle?
ANSWER 5.Refer NCERT Page no 34
6. Explain the importance of different hormones during pregnancy and embryonic development.
ANSWER Refer NCERT Page no 37
7. How does ovum is transported into the fallopian tube and helps to form blastocyst?
NCERT Page 36

SELF ASSESSMENT TEST (40 MARKS)

Q1	Mature Graafian follicle is generally present in the ovary of a healthy human female around (a) 5-8 day of menstrual cycle (b) 11-17 day of menstrual cycle (c) 18-23 day of menstrual cycle (d) 24-28 day of menstrual cycle.	1
Q2	Identify the odd one from the following (a) Labia minora (b) Fimbriae (c) Infundibulum (d) Isthmus	1
Q3	Temperature of the scrotum which is necessary for the functioning of the testis is always _____ around below body temperature. (a) 2°C (b) 4°C (c) 6°C (d) 8°C	1
Q4	Prostate glands are located below (a) gubernaculum (b) seminal vesicles (c) epididymis (d) bulbourethral glands	1
Q5	Lower narrow end of uterus is called (a) urethra (b) cervix (c) clitoris (d) vulva.	1
Q6	Seminal plasma, the fluid part of semen, is contributed by (i) seminal vesicle (ii) prostate (iii) urethra (iv) bulbourethral gland (a) (i) and (ii) (b) (i), (ii) and (iv) (c) (ii), (iii) and (iv) (d) (i) and (iv)	1
Q7	Which part of the ovary in mammals acts as an endocrine gland after ovulation ? (a) Stroma (b) Germinal epithelium (c) Vitelline membrane (d) Graafian follicle	1
	Choose the answers from the following options for solving Q. no. 8 to Q. no. 11: A) If both assertion and reason are true and the reason is the correct explanation of the assertion. B) If both assertion and reason are true but reason is not the correct explanation of the assertion. C) If assertion is true but reason is false. D) If both assertion and reason are false.	
Q8	Assertion: Infundibulum is a funnel shaped part closer to the ovary. Reason: The edges of the infundibulum help in collection of the ovum after ovulation.	1
Q9	Assertion: The female external genitalia includes mons pubis, labia majora and labia minora. Reason: The glandular tissue of each breast is divided into 5-10 mammary lobes.	1
Q10	Assertion: Vagina acts as copulation canal and fertilization canal. Reason: Both insemination and fusion of gametes occur in the vagina of females.	1
Q11	Assertion: In the testis, spermatogenesis occurs in the seminiferous tubules and testosterone secretion takes place from the sertoli cells. Reason: Testosterone brings growth and maturation of primary sex organs and also development of accessory sex characters.	1
Q12	Why are human testes located outside the abdominal cavity? Name the pouch in which they are present.	2
Q13	Write the location and functions of following in human testes (i) Sertoli cells (ii) Leydig cells	2
Q14	When do oogenesis and spermatogenesis initiate in human females and males, respectively?	2

Q15	Three of the steps of neuro endocrine mechanism in respect of parturition are mentioned below. Write the missing steps in proper sequence. (a) Signals originate from fully developed foetus and placenta. (b) _____. (c) _____. (d) Oxytocin causes strong uterine contraction (e) Uterine contraction stimulates further secretion of oxytocin. (f) _____.	3
Q16	T.S. of mammalian testis revealing seminiferous tubules show different types of cell. (i) Name the two types of cells of germinal epithelium. (ii) Name of cells scattered in connective tissue and lying between seminiferous tubules. Differentiate between them on the basis of their functions.	3
Q17	Mention the name and role of hormones which are involved in regulation of gamete formation in human male.	3
Q18	Read the following and answer any four questions from (i) to (v) given below: The first menstruation is called menarche, that usually occurs between 12 and 15 years. In human females, menstruation is repeated at an average interval of about 28-29 days and is called the menstrual cycle. It is regulated by certain hormones, as the pituitary gland is stimulated by releasing factors produced in the hypothalamus. The hormones produced by the pituitary gland influence the ovaries. The hormones secreted by the ovaries affect the walls of the uterus. (i) The breakdown of endometrium is characteristic of which phase (a)proliferative (b) luteal (c)ovulatory (d) menstrual (ii) Which days of the menstrual cycle marks the proliferative phase? (a) 1-5 (b) 15-28 (c) 6-13 (d) 10-14 (iii) Which of the following occurs during the secretory phase? (a) Empty Graafian follicle changes into corpus luteum (b) Primary follicle change into Graafian follicle (c)Endometrium rebuilds and estrogen secretion increases (d) LH surge inducing release of an ovum (iv) Identify the hormones that attain peak level during ovulatory phase (a) FSH (b) Progesterone (c) LH (d) Both (a) and (c) (v) Withdrawal of which hormone causes degeneration of corpus luteum? (a) FSH (b) LH (c) Progesterone (d) Estrogen	4
Q19	Explain the development of human embryo with diagrams.	5
Q20	What is menstruation? What are the specific actions of FSH, LH, estrogen & progesterone in menstrual cycle?	5

CHAPTER 3 : REPRODUCTIVE HEALTH

Abbreviations:

Abbreviations	Expanded form
IUCD	IntraUterine Contraceptive Device
RCH	Reproductive and Child Health care
STD	Sexually Transmitted Disease
HIV	Human Immunodeficiency virus
AIDS	Acquired immunodeficiency syndrome
CDRI	Central Drug Research Institute
MMR	Maternal Mortality Rate
IMR	Infant mortality rate
MTP	Medical Termination of Pregnancy
VD	Venereal Disease
RTI	Reproductive Tract Infection
PID	Pelvic Inflammatory Disease
ART	Assisted Reproductive Technologies
IVF	*In Vitro* Fertilisation
ZIFT	Zygote Intrafallopian Transfer
AI	Artificial insemination
IUI	Intrauterine insemination
ICSI	IntraCytoplasmic Sperm Injection
ET	Embryo transfer
IUT	Intrauterine transfer

Characteristics of an ideal contraceptive.

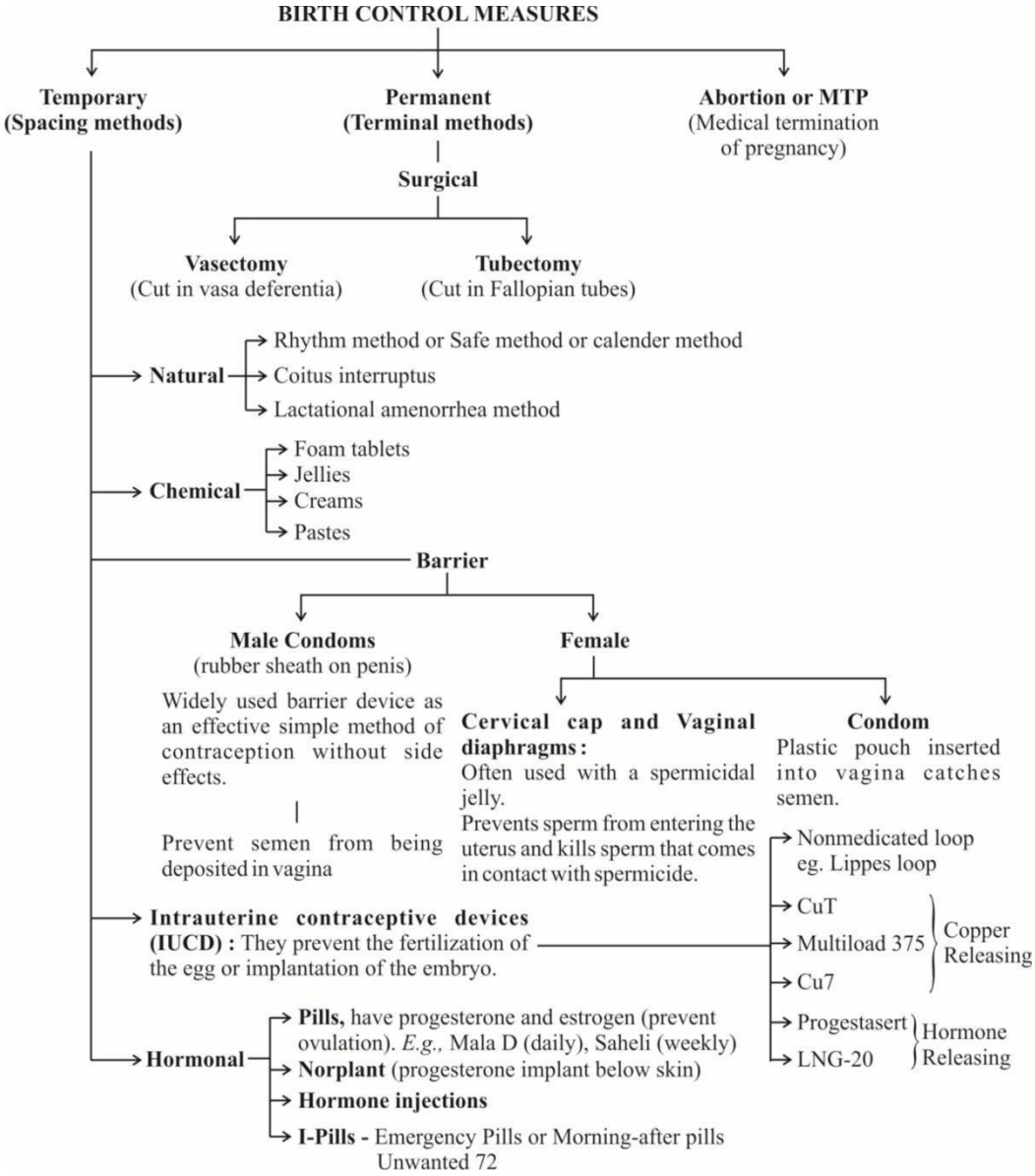
It should be user friendly, easily available, effective with no or least side – effects and do not interfere with the sexual drive of the user.

Contraceptive methods- To prevent unwanted pregnancies.

- Periodic abstinence-Couples avoid coitus from 10-17th day of menstrual cycle when ovulation could be expected.
- Coitus interuptus-Male partner withdraws penis from vagina just before ejaculation
- Lactational amenorrhoea-Ovulation and menstrual cycle do not occur during intense lactation, so chances of conception are less.
- Barrier methods include use of condoms, diaphragms, cervical caps and vaults
- Intra-uterine devices-CuT,Cu7,Multiload 375
- Pills having progestogen or progestogen-estrogen combination.
- Surgical method- Tubectomy in females(small part of fallopian tube removed) and vasectomy in males(small part of vas deferens removed)

Sexually Transmitted Diseases(STD)-AIDS, Gonorrhoea, syphilis, Hepatitis-B, Trichomoniasis

MEDICAL TERMINATION OF PREGNANCY: Intentional or voluntary termination of pregnancy before full term is called medical termination of pregnancy (MTP) or induced abortion.



MULTIPLE CHOICE QUESTIONS

Q1) **Given below are four methods (i-iv) and their modes of action (A-D) in achieving contraception. Select their correct matching from the four options that follow**

Method	**Mode of Action**
i. The pill	(A) Prevents sperms reaching cervix
ii. Condom	(B) Prevents implantation
iii. Vasectomy	(C) Prevents ovulation
iv. Copper T	(D) Semen contains no sperms

Matching:

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

Ans: c

Q2**) Fertilised ovum implanted somewhere outside of the uterus, normally in the fallopian tube, is known as _____.**
(a) uterine prolapse (b) miscarriage
(c) ectopic pregnancy (d) placenta praevia
Ans: c

Q3) **At what point is a pregnancy considered post-term and there is an increased risk to woman and foetus?**
(a) 37 weeks (b) 40 weeks (c) 41 weeks (d) 42 weeks
Ans: d

Q4) **Reproductive health refers to _____**
(a) healthy baby (b) frequent coitus
(c) longer lifetime (d) healthy reproductive organs and functions
Ans: d

Q5) **Which of the following is not the role of Reproductive and Child Health Care (RCH) programs?**
(a) Awareness about reproductive health
(b) Providing facilities to build a reproductively healthy society
(c) Providing support to reproductively sick people
(d) Promote abortion
Ans: d

Q6) **What modes have not been used by the agencies to generate awareness on reproductive health?**
(a) Radio (b) Newspaper (c) Protests (d) Television
Ans: c

Q7) **Which of the following is the correct reason for delivering sex education at schools?**
(a) Discouraging myths and misconceptions (b) Encouraging rise in population
(c) Solve the issue of global warming (d) Promote myths
Ans: a

Q8) **What test is used to determine the sex of the foetus?**
(a) Amniocentesis (b) Widel test (c) CBC (d) ELISA
Ans: a

Q9) **Amniocentesis deals with patterns of _____ in the amniotic fluid.**
(a) foetal fingers (b) foetal DNA (c) foetal chromosomes (d) foetal proteins
Ans: c

Q10) **Saheli was developed by scientists at _____ in India.**
(a) Indian Institute of Science (b) Indian Institute of Technology
(c) Central Drug Research Institute (d) Acropolis
Ans: c

Q11) **Which of the following groups includes all STD?**
(a) Hepatitis-B, Hemophilia, AIDS (b) AIDS, Syphilis, Cholera
(c) Gonorrhea, Hepatitis-B, Chlamydiasis (d) HIV, Malaria, Trichomoniasis
Ans: c

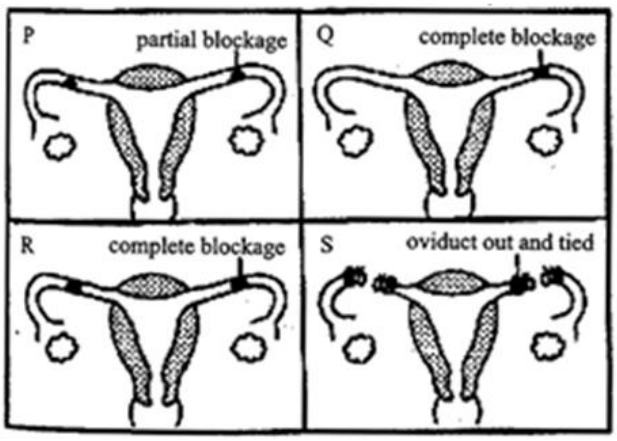
Q12) MTP is considered safe up to how many weeks of pregnancy?
(a) 8 (b) 12 (c) 18 (d) 6
Ans: b

Q13) **Which of the following tests is used to detect AIDS?**
(a) Western blot and ELISA (b) Northern blot and ELISA
(c) ELISA and Southern blot (d) ELISA and Immunoblot
Ans: a

Q14) **Which of the following is a hormone releasing IntraUterine Device (IUD)?**
(a) Multiload 375 (b) Cervical cap (c) LNG – 20 (d) Vault
Ans: c

Q15**) The accompanying diagram shows the uterine tubes of four women (P, Q, R and S).**

In which of the two women, fertilization is impossible at present?



(a) P & Q (b) Q & R (c) R & S (d) S & P
Ans: c

Q16) **Test tube baby employs which of the following techniques?**
(a) ICSI (b) ZIFT (c) GIFT (d) IUI
Ans: b

Q17) **AIDS is:**
(a) Reduction in number of killer T cells (b) Reduction in number of Helper T cells
(c) Autoimmune disease (d) Inability to produce interferons
Ans: b

Q18) **What are the programs called to get total reproductive health as a social goal of the national level?**
(a) Family care (b) Family planning (c) Family organization (d) Reproductive care
Ans: b

Q19) **When was family planning initiated?**
(a) 1950 (b) 1951 (c) 1952 (d) 1953
Ans: c

Q20) **What is the reason for the popularity of the barrier method of family planning?**
(a) The absence of side effect (b) Comparatively more reliable
(c) Protection from sexually transmitted diseases. (d) Both a and b
Ans: d

Assertion reasoning questions

Directions: In the following questions, a statement of assertion is followed by a statement of reason.
Mark the correct choice as:
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

Q.1. Assertion: A person should be considered reproductively healthy if they have healthy reproductive organs but are emotionally imbalanced.
Reason: This statement about reproductive health was given by WHO.
Ans: d) A person is reproductively healthy if he/ she is capable of producing offspring.

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

Q.3. Assertion: RCH (Reproductive and Child Healthcare) Programmes is for reproduction related areas.
Reason: It deals with creating awareness among various reproduction related aspects.
Answer: (a)
Q.4. Assertion: A wide range of contraceptive methods are available for family planning.
Reason: Natural methods include condoms, diaphragms, etc., while barrier methods include methods like periodic abstinence, lactation amenorrhea etc.
Answer: (c)
Q.5. Assertion: Introduction of sex education in schools should be encouraged.
Reason: This will encourage children to believe in myths about sex related aspects.
Answer: (c)
Q.6. Assertion: Amniocentesis is often miss-employed.
Reason: Amniocentesis is meant for determining the genetic disorders in the foetus, but it is being used to determine the sex of the foetus, leading to death of the normal female foetus.
Answer: (a)

Q.7. Assertion: Natality increases both population density and population size.
Reason: Natality increases the number of individuals in an area by births.
Answer: (a)
Q.8. Assertion: Saheli, the new oral contraceptive for the females, contains a steroidal preparation.
Reason: It is a "once in a day" pill with very few side effects.
Answer: (d)
Q.9. Assertion: Rapid decline in death rate, MMR and IMR have led to a staggering rise in population.
Reason: Such an alarming growth rate has led to an absolute scarcity of even the most basic requirements, i.e. food and shelter.
Answer: (b)
Q.10. Assertion: There is a chance of fertilization during the 10 -17 days menstrual cycle.

Reason: Ovulation occurs during these days.
Answer: (a)

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

Q1) **What is amniocentesis? Why has the government imposed a statutory ban in spite of its importance in the medical field?**

Ans: Amniocentesis is a prenatal diagnostic test. It is named so, because it is based on the chromosomal pattern of the cells in the amniotic fluid that surrounds the developing foetus in the womb.
It is misused to detect the sex of a pre-born child that leads to female foeticide. Hence, there is statutory ban on amniocentesis.

Q2) **Why is Cu-T considered a good contraceptive device to space children?**

Answer: Copper-T (Cu-T) is an IntraUterine Device (IUD) that is inserted by experts and it serves as an effective contraceptive in the following ways:

. Increases phagocytosis of sperms within the uterus.
a. Copper ions released by Cu-T suppress the motility of sperms and their fertilizing ability.

Q3) **How do hormone releasing IUDs act as contraceptives? Explain.**

Answer: Hormone releasing IUDs (progestasert, LNG-20) act as contraceptives because:
(a) They inhibit ovulation.
(b) They make the cervix unreceptive to sperm.
(c) They make the uterus unsuitable for implantation.
(d) They increase the phagocytosis of sperms within the uterus.

Q4) **How do 'implants' act as an effective method of contraception in human females? Mention its one advantage over contraceptive pills.**

Answer: Subcutaneous 'implants' contain synthetic progesterone and are placed under the skin. They are an effective contraceptive method as they check ovulation and thicken cervical mucus to prevent sperm transport. Subcutaneous implants' are more advantageous than contraceptive pills as they are long lasting and once implanted, they are effective for up to 5 years.

Q5) **Name any two assisted reproductive technologies that help infertile couples to have children.**

Answer: The assisted reproductive technology methods that can help infertile couple to have children are:

. Zygote IntraFallopian Transfer (ZIFT)
a. Artificial Insemination (AI) Technique

Q6) **Expand GIFT and ICSI.**

Answer: a) GIFT – Gamete Intrafallopian Transfer.
b) ICSI – IntraCytoplasmic Sperm Injection.

Q7) **Give any two reasons for infertility among young couples.**

Answer: The reasons for infertility in young people can be physical, congenital diseases, use of drugs, immunological or even psychological factors.

Q8) **List any four characteristics of an ideal contraceptive.**

Answer: An ideal contraceptive must have the following four characteristics

. It must be safe and user friendly.
a. It must be easily available.
b. It must be reversible with little or no side effects.
c. It must not interfere with the sexual drive/desire or sexual act of the user.

Q9) **State one reason, why breastfeeding the baby acts as a natural contraceptive for the mother.**
Ans: Lactation or Breastfeeding the baby delays the onset or return of menstruation and ovulation cycle due to interference of hormone prolactin. Therefore, the chances of conception are nil during this period, i.e. up to six months. Hence, breastfeeding the baby may act as a natural contraceptive (lactational amenorrhea) for the mother.
Q10) **"Removal of Gonads cannot be a Contraceptive Option". Why?**
Ans. "Removal of Gonads cannot be a contraceptive option" because due to these methods, the gonads are removed surgically resulting in infertility & then both males & females in their remaining life will be dependent on hormones to regulate the functioning of the reproductive organs.

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

Q1**) What do oral pills contain and how do they act as effective contraceptives?**
Ans: Oral contraceptives or pills contain either progestogens or progesterone-oestrogen combinations. They function as contraceptives by:
a) Inhibiting ovulation.
b) Inhibiting implantation.
c) Altering the quality of cervical mucus to prevent the motility of sperms in the female reproductive tract.

Q2) **What do you mean by lactation amenorrhea? How does it act as a natural method for birth control?**
Answer: Lactation amenorrhea refers to the absence of menstruation during the period of intense lactation following parturition. It is a birth control method because:
. Ovulation and other events of the menstrual cycle are stopped at this time.
a. As long as the mother breastfeeds her child, chances of conception are nil because of the suppressed gonadotropin activity.
However, this method is generally reliable up to only six months after delivery.

Q3) **At the time of Independence, the population of India was 350 million, which exploded to over 1 billion by May 2000. List any two reasons for this rise in population and any two steps taken by the government to check this population explosion.**
Answer: Reasons for rise in population include:
. All-round development in various fields and increased health facilities along with better living conditions.
a. Reduced maternal and infant mortality rate.
Two major steps taken by the government to check this population growth are:
. People are educated and support the idea of a small family by using various contraceptive methods.
a. There is statutory raising of the marriageable age of females and of males to 21 years.

Q4) **Name and explain the surgical method advised to human males and females as a means of birth control. Mention its one advantage and one disadvantage.**
Answer: The surgical or sterilization methods advised to human males and females as effective means of birth control are:

1. Vasectomy (In males): A sterilization method in which a small portion of vas deferens is removed or tied up through a cut or incision on scrotum, thus blocking the transport of sperms from the testes to the copulatory organ.
2. Tubectomy (In females): A sterilization method in which a small part of the fallopian tube is removed or tied up through incision in abdomen or through vagina. It blocks the passage of ova from ovary to the site of fertilization.

The advantage of these two sterilization methods in both human males and females is that it is a very effective method for preventing conception as it blocks the transport of gametes.
The disadvantage of this method is that this surgical procedure cannot be reversed, so it is helpful for only those who already have children and do not want to extend their family further.

Q5) **After a brief medical examination a healthy couple came to know that both of them are unable to produce functional gametes and should look for an 'ART' (Assisted Reproductive Technique). Name the 'ART' and the procedure involved that you can suggest to them to help them bear a child.**
Answer: The ART that would help the couple to bear a child is IVF (In Vitro Fertilisation) or Test tube baby programme. In this process, ova from the wife/donor female and sperms from the husband/donor male are collected and fused to form zygote in the laboratory under the same conditions as in the body. This is *in vitro* fertilization (fertilization outside the body). Zygote or early embryo is transferred into the fallopian tube or uterus for further development. This is called Embryo Transfer (ET). It can be Zygote IntraFallopian Transfer (ZIFT) or Intra Uterine Transfer (IUT) depending upon the developmental stage of embryo.
Q6) **Intracytoplasmic Sperm Injection (ICSI)' and 'Gamete Intra Fallopian Transfer (GIFT)' are two assisted reproductive technologies. How is one different from the other?**
Answer: In Gamete Intra Fallopian Transfer (GIFT), the ovum from a healthy donor female is transferred to a female, who cannot produce ova. However, she can provide a suitable environment for fertilization and embryo development (*in vivo* fertilization).

In IntraCytoplasmic Sperm Injection (ICSI), the fertilization is done *in vitro* by injecting sperms directly into the ovum from a donor female, under simulated conditions. The embryo is thus formed in the laboratory and is later transferred to the uterus or fallopian tube for further development.
Q7) **What are MTPs? Under What Conditions MTPs are legally permitted?**
Ans. Intentional or voluntary termination of pregnancy before full term is called medical termination of pregnancy (MTP) or induced abortion. They are legally permitted in our country only: -

1. in case of rape.
2. in case of casual unprotected intercourse
3. in case pregnancy is harmful to the foetus or for the mother.

Q8) **Differentiate between Vasectomy and Tubectomy**.
Ans. The difference between Vasectomy and Tubectomy are:

Vasectomy	Tubectomy
Method of sterilization in males.	Method of sterilization in females.
Vasa deference of both sides is cut and tied.	The Fallopian tube of both sides is cut and tied.
Prevent the movements of sperms at the cut end.	Prevent the movements of ovum at the cut end.

Q9) **Name the Techniques which are employed in the following cases:**
. Transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce an ova but can provide a suitable environment for fertilization and development.
a. Embryo is formed in the laboratory in which sperm is directly injected into the ovum.
b. Semen collected either from husband or a healthy donor is artificially introduced either into the vagina or uterus.
Ans. (a) The technique that involves the collection of the ovum from the donor and transfers it into the fallopian tube of another female is called the Gamete intra-fallopian transfer. In this case, the second female is unable to produce ovum but has the ability to undergo fertilization and development.
(b) The technique in which the sperm is introduced into the egg of the female inside the laboratory and results in the formation of an embryo is called Intracytoplasmic sperm injection.
(c) When the semen is taken from either husband or the male donor and is injected into the vagina or the uterus of the female inside the laboratory by an artificial method called Intra-uterine insemination.

Q10) **Enlist Any Three Causes of Infertility in Men and Women.**

Ans. The three causes of infertility in men and women are:

(i) Physical – due to defect in genital parts, undescended testicles, enlarged veins in testes, etc.

(ii) Diseases – diseases like diabetes, gonorrhoea, chlamydia, HIV, etc.

(iii) Drugs – Due to the continuous consumption of drugs, lower sperm motility, and production rate, etc.

CASE STUDY (4 MARKS)

CASE STUDY 1

(Read the following and answer the following questions)

Overpopulation causes a number of family problems. Strategies like birth control methods help to control population explosion. Natural methods of birth control do not involve medication or devices to prevent pregnancy but rather rely on behavioral practices or making observations about the menstrual cycle. Natural methods include Coitus interruptus/withdrawal method, rhythm method / Periodic abstinence and lactational amenorrhea method

(Q1) **Which method helps in contraception by temporary absence of sex?**

(a) Coitus interruptus (b) Withdrawal method

(c) Periodic abstinence (d) Lactational amenorrhea method

Ans (c)

(Q2) **Assertion: The effectiveness of coitus interruptus method is limited.**

Reason: Some sperms may pass into vagina before ejaculation.

(a) Both assertion and reason are true and reason is the correct explanation of assertion.

(b) Both assertion and reason are true but reason is not the correct explanation of assertion.

(c) Assertion is true but the reason is false.

(d) Both assertion and reason are false.

Ans2: (a)

(Q3) **Why is lactational amenorrhea effective for about 4-5 months of parturition?**

Ans3: Ovulation does not occur during intense lactation.

(Q4) **On what principle natural methods of birth control work?**

Ans4: Natural methods work on the principle of avoiding the chances of meeting of ovum and sperm.

CASE STUDY 2

(Read the following and answer any four questions)

Intrauterine devices are the most widely accepted methods of contraception. These are used by females and are inserted by doctors or nurses in the uterus through vagina. However these devices are not recommended for those who eventually intend to conceive. Many types of IUDs like CuT, LNG-20, Multiload 375, Cu7, Lippes loop and progestasert etc. are available in the market the mode of action of which is slightly different from each other.

(Q1) **How does CuT prevent conception?**

Ans1: CuT releases Cu ions which suppress sperms motility

(Q2) **Write names of two IUDs which make the uterus unsuitable for implantation?**

Ans2: Hormone releasing IUDs progestasert and LNG-20 make the uterus unsuitable for implantation and the cervix hostile to sperms.

(Q3) Identify the correct statement for IUDs:

(a) They slowly release synthetic progesterone in the body.

(b) They increase phagocytosis of sperms within the uterus

(c) They block the entry of sperms through the cervix.

(d) Both (b) and (c)

Ans3: (b)

(Q4) **Select the correct matched pair.**

(a) Hormone releasing IUD - LNG-20 (b) Non-medicated IUD - Progestasert

(c) Copper releasing IUD - Lippes loop (d) None of these

Ans4: (a)

OR

(Q5) Assertion: IUDs can cause excess menstrual bleeding and pain.
Reason: IUDs can perforate uterus.

(a) Both assertion and reason are true and reason is the correct explanation of assertion.

(b) Both assertion and reason are true but reason is not the correct explanation of assertion

(c) Assertion is true but reason is false

(d) Both assertion and reason are false.

Ans5: (b)

CASE STUDY 3

(Read the following and answer any four questions)

Medical termination of pregnancy is termination of pregnancy before the fetus becomes viable. To reduce the incidence of illegal abortion and consequent maternal mortality, MTP Amendment Act, 2017 was enacted by the government of India. About 40-50 million MTPs are done in a year all over the world.

(i) Abortion can be safely done for about_____ weeks of pregnancy.

(a) 4 (b) 12 (c) 8-10 (d) 15-18

Ans (b)

(ii) How is MTP helpful in decreasing human population?

(a) By aborting normal female fetus (b) By increasing maternal mortality rate

(c) By getting rid of unwanted pregnancies (d) None of these

Ans (c)

(iii) Select an incorrect statement for MTP.

(a) Second trimester abortions are more risky than first trimester

(b) It is being misused to abort normal female fetus.

(c) It helps to get rid of unwanted pregnancies.

(d) Child detected with congenital heart disease cannot be aborted

Ans (d)

(iv) MTP was legalized by Government of India in

(a) 1971 (b) 1982 (c) 1973 (d) 1991.

Ans (a)

OR

(v) Assertion: MTPs are safe during the first trimester of pregnancy.

Reason: After the first trimester, the fetus becomes intimately associated with the maternal tissues.

(a) Both assertion and reason are true and reason is the correct explanation of assertion

(b) Both assertion and reason are true but reason is not the correct explanation of assertion.

(c) Assertion is true but reason is false

(d) Both assertion and reason are false

Ans (a)

CASE STUDY 4

(Read the following and answer any four questions)

A young couple married for 5 years is unable to bear a child in spite of not practicing any birth control method. Upon consultation, the doctor advised them of assisted reproductive technology involving transfer of gametes into oviducts.

(Q1) **Identify the technique adopted by the couple**
Ans1: GIFT: Gamete Intra Fallopian Transfer

(Q2) **What is the prerequisite of this technique?**
Ans2: Fallopian tubes should be normal

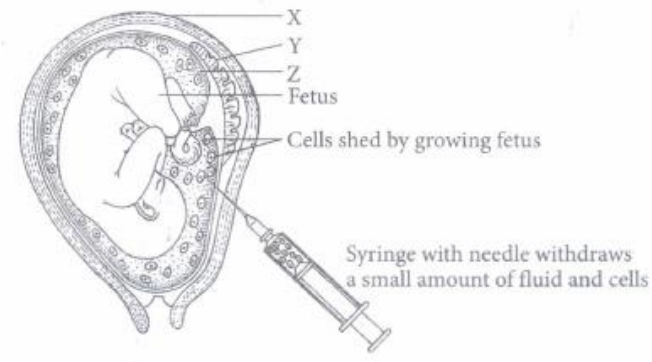
(Q3) Assertion : GIFT is an in-vitro fertilization technique.
Reason : In GIFT, gametes are fertilized outside the female body
(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false
Ans3: (d) GIFT is an in vivo technique, in which fertilization takes place inside the body of a female.
Ans4: (c) In GIFT both the sperm and unfertilized oocytes are transferred into fallopian tube

(Q4) **The procedure advised to couple involves the transfer of**
(a) fertilized ovum (b) embryo with 8 blastomeres
(c) sperms and unfertilised ovum (d) embryo with 16 blastomeres

(Q5) **The method of directly injecting a sperm into ovum in Assisted Reproductive Technology is called**
(a) GIFT
(b) ZIFT
(c) ICSI
(d) ET
Ans5: (c)

CASE STUDY 5
(Read the following and answer any four questions)

The following diagram shows the technique known as amniocentesis which is used to determine foetal abnormalities. This test is based on the chromosomal pattern in amniotic fluid surrounding the developing embryo. However, this technique is legally banned now.



(Q1) **Identify X and Y in the above given figure.**
Ans1: X= Uterine wall, Y= Placenta
(Q2) **What does Z represent here? What is its function?**
Ans2: Z is an amniotic fluid which prevents desiccation of an embryo

(Q3) **Which of the following diseases can not be diagnosed by amniocentesis?**
(a) Down's syndrome (b) Sickle cell disease (c) Jaundice (d) Cystic fibrosis
Ans3: (c)
(Q4) **Assertion: Amniocentesis is legally banned for sex determination.**
Reason: Amniocentesis was being misused for aborting normal female foetus
(a) Both assertion and reason are true and reason is the correct explanation of assertion
(b) Both assertion and reason are true but reason is not the correct explanation of assertion
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.
Ans4: (a)
OR
(Q5) **Which of these is a non-invasive technique of detecting foetal disorder?**
(a) Fetoscopy (b) Chorionic villi sampling (c) Amniocentesis (d) Ultrasound imaging
Ans5: (d)

LONG ANSWER TYPE QUESTIONS (5 MARKS)

Q1) What do you mean by infertility? What are the causes of infertility in males and females? Describe any three assisted reproductive techniques practised to treat infertility.
Ans: Refer page no. 47 and 48 of NCERT book

Q2) What do you mean by contraceptives? What type of contraceptives are available in the market? What are the advantages and disadvantages of hormonal contraceptives?
Ans: Refer page no. 44 and 45 of NCERT book

Q3) What do you mean by STDs? Explain any two STDs and suggest ways to prevent them.
Ans: Refer page no. 47 of NCERT book

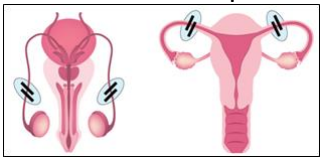
Q4) Why should sex education be introduced to school-going children? List any five reasons.
Ans: Refer page no. 42 of NCERT book

Q5) What do you mean by MTP? Write any 5 conditions when the MTP can be advised?
Ans: Refer page no. 46 of NCERT book

SELF ASSESSMENT TEST (40 MARKS)

Q1	From what day of the menstrual cycle should hormonal contraceptive pills be started? (a) 5th day (b) 7th day (c) 1st day (d) 2nd day	1
Q2	Which is not related to hormonal contraceptive pills? (a) Prevent ovum to release from the ovary (b) Thicken the cervical mucus (c) Inhibits sperm penetration (d) Partial activation of cervical mucus	1
Q3	Which are the permanent methods of family planning? (a) Vasectomy, Tubectomy (b) Condom for female, condom for male (c) Copper T and pills. (d) Vasectomy, copper T	1
Q4	What do you mean by induced abortion? (a) Voluntary termination of pregnancy after the foetus become viable (b) Voluntary termination of pregnancy before the foetus becomes viable (c) Foetus removed at incomplete gestation months (d) Accidently foetus is lost	1

Q5	When was the Induced abortion act passed by the Indian Government? (a) 1970 (b) 1971 (c) 1972 (d) 1980	1
Q6	Which microbes cause sexually transmitted diseases? (a) Bacteria and virus (b) Protozoans and Fungi (c) Nematodes & viroids (d) Both a and b	1
Q7	From the sexually transmitted diseases mentioned below, identify the one which does not specifically affect the sex organs: a. Syphilis b. AIDS c. Gonorrhea d. Genital warts	1
	Choose the answers from the following options for solving Q. no. 8 to Q. no. 11: A) If both assertion and reason are true and the reason is the correct explanation of the assertion. B) If both assertion and reason are true but reason is not the correct explanation of the assertion. C) If the assertion is true but the reason is false. D) If both assertion and reason are false.	
Q8	Assertion: Alarming growth rate of India could lead to an absolute scarcity of even the basic requirements, i.e., food, shelter and clothing, in spite of significant progress made in those areas. Reason Many couples, mostly the young, urban, working ones have even adopted a one child norm.	1
Q9	Assertion: Pills are less effective with more side effects and are less accepted by females. Reason: Implants are generally advised for the male/female partner as a terminal method to prevent any more pregnancies.	1
Q10	Assertion: MTP has a significant role in decreasing the population. Reason: MTP is a contraceptive device.	1
Q11	Assertion: Females infected with STDs remain undetected for long. Reason: Infected females may often be asymptomatic.	1
Q12	Why is ZIFT a boon to childless couples? Explain the procedure.	2
Q13	List any two 'indicators' that indicate a reproductively healthy society	2
Q14	Identify the devices used for the following methods of birth control: Barrier, IUd, Surgical technique and administering hormone.	2
Q15	Mention any three probable reasons for the rapid rise of population in our country.	3
Q16	. What is the significance of progesterone- estrogen combination as a contraceptive measure? In which contraceptives such a combination is present? a. Males in whom testes fail to descend to the scrotum are generally infertile. Why? b. 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?	3
Q17	If implementation of better techniques and new strategies are required to provide more efficient care and assistance to people, then why is there a statutory ban on amniocentesis? Write the use of this technique and give reason to justify the ban.	3

Q18	Case study (Read the given paragraph and answer any 4 questions) Intentional or Voluntary termination of the pregnancy before full terms is called medical termination of pregnancy (MTP) or induced abortion. Nearly 45 to 50 million MTPs are performed in a year all over the world which accounts to 1/5th of the total number of conceived pregnancies in a year. Whether to accept / legalize MTP or not is being debated upon in many countries due to emotional, ethical , religious , and social issues involved in it. The Government of India legalized MTP in 1971 with some strict conditions to avoid its misuse. Such restrictions are all the more important to check indiscriminate and illegal female foeticides which are reported to be high in India. MTPS are considered as relatively safe during the first trimester or up to 12 weeks of pregnancy 1. In which year the MTP is legalized by Indian Government :- (a) 1970 (b) 1971 (c) 1972 (d) 1973 2. How many MTPs are reported in entire world in a year : (a) 40-45 million (b) 45-50 million (c) 50-55 million (d) 55-60 millions 3. The destruction of a female foetus, before birth is called (a) Abortion (b) MTP (c) female foeticide (d) Miscarriage 4. At what time the MTP is considered as safe: (a) In first week (b) in first quarter (c) in first trimester (d) in first month OR 5. Assertion: - Indian Government allows MTPs under some restricted conditions. Reason: - Some foetus have genetic disorders and have retarded development. Which one of the following will be the correct answer for this question:- (a) Assertion is correct and reason is also correct and the reason is the correct explanation of the Assertion. (b) Assertion is correct and reason is also correct and the reason is not the correct explanation of the assertion. (c) Assertion is correct and reason is not correct. (d) Assertion is incorrect and reason is correct.	4
Q19	. Which age group has the highest infection rates of sexually transmitted infection including HIV? a. What are the causes of death of women between ages 15 and 19 years? b. Suggest the reproduction-related aspects in which counseling should be provided at the school level.	1+2+2=5
Q20	Study the diagram of the male and female reproductive system given below.  Answer the questions based on the diagram. (i) What does the diagram depict? (ii) Name the parts of male and female reproductive system which are cut in this? (iii) Write the advantage and disadvantage of this method of birth control. (iv) Removal of gonads cannot be considered a contraceptive option why?	5

CH 4 PRINCIPLES OF INHERITANCE AND VARIATIONS

Some Important Points to remember:

Mendelian's laws of inheritance-

Law of dominance-In a dissimilar pair of factors, one member of the pair dominates the other. This law is proved using a monohybrid cross.

Law of segregation-According to this law, factors of a pair segregate from each other such that a gamete receives only one of the two factors.

Law of independent assortment-It states that when two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters. Mendel explained it using a dihybrid cross.

Monohybrid cross-Cross between organisms differing in one trait.

Dihybrid cross-Cross between organisms differing in two traits.

Test cross-In such a cross dominant phenotype is crossed with the recessive parent to determine the genotypic composition of the dominant trait i.e. whether it is homozygous or heterozygous.

Back cross-When F1 progeny is crossed with the either of the parents.

Reciprocal cross- Hybridization involving a pair of crosses that reverse the sexes associated with each genotype.

Incomplete dominance-When dominant character is not completely dominant when present in heterozygous condition. Ex-Flower colour in dog flower (snapdragon or *Antirrhinum* sp.).

Co-dominance-When two dominant genes occur together and both are equally dominant. Ex- AB blood group.

Sex determination-

Male heterogamety-

XX-XY type in Drosophila, mammals including humans

XX-XO type in grasshopper

Female heterogamety-

ZW-ZZ type in birds and some fish.

ZO-ZZ type in butterflies and moths

Mendelian disorders-Disorders due to mutation in a single gene. These are Haemophilia, Sickle cell anaemia and Phenylketonuria

Mnemonic for Normal Chain of Haemoglobin:

Very- **H**onest- **L**oving- **T**rustworthy-**P**erson is-**G**reat –**G**andhi

Val-His-Leu-Thr-Pro-Glu-Glu

Mnemonic for defective Haemoglobin in Sickle Cell Anaemia:

Very- **H**onest- **L**oving- **T**rustworthy-**P**erson is-**V**ictorious **G**andhi

Val-His-Leu-Thr-Pro-Val-Glu

Chromosomal disorders-Disorders due to absence or excess of one or more chromosomes. These are:

Down's syndrome-Due to an additional copy of chromosome no. 21

Klinefelter's syndrome-Due to an additional copy of X-chromosome

Turner's syndrome-Due to absence of one of the X-chromosomes.

MULTIPLE CHOICE QUESTIONS

1. The number of true breeding pea plant varieties selected by Mendel were _____

a) 12 b) 13 c) 15 d)14

ANS: d)

2. Mendel proposed that _____was being stably passed down, unchanged, from parent to offspring through the gametes, over successive generations.

a) Factors b) Vectors c) Traits d) Characters

ANS: a)

3. _____ are the genes which codes for a pair of contrasting traits.

a) Recessive b) Dominant c) Alleles d) Factors

ANS: c)

4. _____is the graphical representation to calculate the probability of all possible genotypes of offspring in a genetic cross.

a) Gene map b) Karyotype c) Punnett Square d) Gene pool

ANS: c)

5. A botanist crossed true breeding red flowered plants of snapdragon with true breeding white flowered plants. What could be the colour of flowers the botanist may observe in plants obtained in F1 generation?

a) Red b) Pink c) White d) Red with white spots

ANS: b)

6. In the case of _____ the F1 generation resembles both the parents.

a) Incomplete dominance b) Pleiotropy c) Multiple allelism d) Co – Dominance

ANS: d)

7. If a father has AB blood group, mother has B blood group, his daughter is having A blood group and son is having B blood group. The alleles for the B blood group in the mother is _____.

a) I^BI^B b) I^Bi c) I^AI^B d) I^AI^A

ANS: b)

8. The blood group that shows the phenomenon of Co Dominance in humans is :

a) A b) B c) AB d) O

ANS: c)

9. Which one is correctly matched:

a) Down's syndrome –44 autosomes c) Klinefelter's syndrome-44 autosomes +XXY

b) Colour blindness -Y linked d) Turner's syndrome – trisomy 21

ANS: b)

10. A human female with Turner's syndrome

a) Is having normal IQ c) Has an additional X chromosome

b) Has 45 chromosomes with XO d) Exhibits male characters

ANS: c)

11. Trisomy 21 results in to

a) Turner's syndrome c) Down's syndrome

b) Klinefelter's syndrome d) Thalassemia

ANS: b)

12. The genes that control α Thalassemia are:

a) HBB on chromosome 11 c) HBA1 and HbA2 on chromosome 16

b) HBB on chromosome 16 d) HBA1 and HbA2 on chromosome 11

ANS: b)

13. Match the column I with their description in column II and choose the correct option:

COLUMN I	**COLUMN II**
A Dominance	(i) Many genes govern a single character
B Codominance	(ii) In a heterozygous organism only one allele expresses
C Pleiotropy	iii) In a heterozygous organism both alleles express themselves
D Polygenic inheritance	(iv) A single gene influences many characters

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

ANS: a)

14. The flies that Morgan worked on for his experimental verification of chromosomal theory of inheritance were _____

a) *Drosophila melanogaster* c) *Musca domestica*

b) *Apis indica* d)*Kerria lacca*

ANS: a)

15. Human skin colour is an example of?

a) Incomplete dominance c) Pleiotropy

b) Polygenic inheritance d) Codominance

ANS: c)

16. In human skin colour, if an individual have all the dominant genes AABBCC, the skin colour will be _____

a) Intermediate skin colour c) White skin colour

b) Lightest skin colour d) Darkest skin colour

ANS: d)

17. XO type of sex determination is shown by _____

a) *Drosophila* b) Humans c) Grasshopper d) Birds

ANS: c)

18. In birds females has _____chromosomes and males have ____chromosomes

a) ZZ, ZW b) ZW, ZZ c) ZZ, WW d) ZW, ZW

ANS: b)

19. Male heterogamety is shown by which correct organisms?

a) Humans and *Drosophila* c) *Drosophila* and Grasshopper

b) Humans and Birds d) *Drosophila* and Birds

ANS: a)

20. In honeybee the drones develop by the process of _____

a) Fertilization b) Parthenogenesis c) Parthenocarpy d) Incomplete Dominance

ANS: b)

21. In honey bees, the offspring's formed by the union of a sperm and an egg develops as a _____

a) Female, Queen or workers c) Males, workers

b) Males, Drones d) Female, Drones

ANS: a)

22. The mechanism of sex determination in honey bees is known as _____

a) Dominance b) Parthenogenesis c) Haplodiploidy d) Multiple allelism

ANS: c)

23. Sickle cell anaemia is an example of

a) Frame-shift mutation c) Point mutation

b) Chromosomal mutation d) Continuous mutation

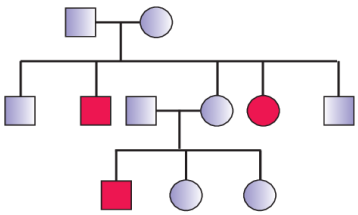
ANS: b)

24. The chemical and physical factors that results in to mutations are called as ____

a) Mutagens b) Antigens c) Allergens d) Radiations

ANS: a)

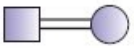
25. The following pedigree is showing _____trait



a) Autosomal recessive b) Autosomal dominant c) X linked recessive d) X linked dominant

ANS: a)

26. The following symbol is used in pedigree analysis to show _____



a) Affected individuals b) Mating c) Consanguineous mating d) Sex unspecified

ANS: c)

27. A colour-blind man marries a normal vision woman the probability of their male children to be colour blind would be?

a) 0% b) 25% c) 75% d) 100%

ANS: a)

28. The three scientists who independently rediscovered Mendel's work is_____

a) Avery, McLeod, McCarty b) Sutton, Morgan and Bridges

c) Bateson, Punnet and Bridges d) De Vries, Correns and Tschemark

ANS: d)

29. In sickle cell anaemia, single base substitution at the 6th position of globin gene from GAG to GUG produces _____amino acid

a) Valine b) Glutamic acid c) Phenylalanine d) Serine

ANS: a)

30. Genes that are located very close to one another on same chromosome and tend to be transmitted together are called as

a) Alleles b) Dominant genes c) Linked genes (d) Recessive genes

ANS: c)

<u>Assertion and Reason Type questions</u>

Each question consists of two statements, namely, Assertion (A) and Reason (R).For selecting the correct answer, use the following code:

(a) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).

(c) Assertion (A) is true and Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is true.

1. **Assertion:** Hb^SHb^S is a homozygous condition of sickle cell anaemia.

Reason: It occurs due to substitution of glutamic acid by valine at 6th position of beta chain of hemoglobin.

Ans: b)

2. **Assertion:** Some genes tend to travel together from one generation to the next generation.

Reason: The genes are linked.

Ans: a)

3. **Assertion:** The progeny produced have both the characters of parents.

Reason: The process by which characters pass from parent to progeny is known as inheritance.

Ans: b)

4. **Assertion:** Down's syndrome is produced due to trisomy of chromosome 21.

Reason: The homologous chromosomes fail to separate during meiosis.
Ans: a)
5. **Assertion:** Colour blindness is an X linked recessive disorder.
Reason: This defect is due to mutation in certain genes present in X chromosome.
Ans: a)
6. **Assertion:** In XX-XY type of sex determination the males show heterogamety.
Reason: The males produce two different gametes.
Ans: a)
7. **Assertion:** The characters segregate during formation of gametes during meiosis.
Reason: The Law of segregation is a universal law.
Ans: b)
8. **Assertion**: The possibility of a female becoming haemophiliac is extremely rare.
Reason: Mother of such a female has to be at least haemophiliac and the father should be normal.
Ans: c)
9. **Assertion:** When the inheritance of two characters is considered at a time in a cross, it is called monohybrid cross.
Reason: In a monohybrid cross by Mendel, all F1 individuals do not resemble any parent.
Ans: d)
10. **Assertion:** In *Antirrhinum*, the plants with red flowers crossed with the plants with white flowers produce pink-coloured flowers in F1 generation.
Reason: Dominant allele for flower colour is not able to express its character completely.
Ans: a)

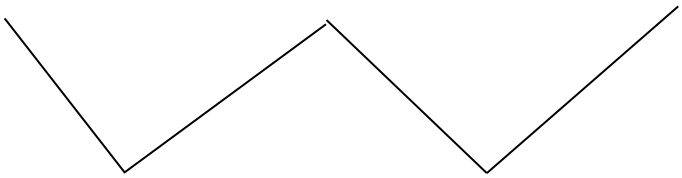
SA (2 MARKS)

1. How is Turner's syndrome different from Klinefelter's syndrome?
Ans:

Turner's syndrome	**Klinefelter's syndrome**
It occurs in females	It occurs in males
Karyotype: 45, XO	47, XXY
Caused due to the absence of one of the X chromosomes.	Caused due to the presence of an additional copy of X chromosome.
Short stature and underdeveloped feminine character.	Tall stature with feminine character.

2. What is a test cross? How is it useful in genetics?
Ans: In a typical test cross an organism showing a dominant phenotype (and whose genotype is to be determined) is crossed with the recessive parent instead of self-crossing. The progenies of such a cross can easily be analyzed to predict the genotype of the test organism.
3. Why is the human ABO gene considered a good example of multiple alleles?
Ans: In ABO blood groups, there are more than two, i.e., three alleles I^A, I^B, i, governing the same character.
4. How do males show homogamety and females show heterogamety in birds?
Ans: Male birds have ZZ chromosomes so it produces the same type of gametes thus they are homogametic and female birds have ZW chromosomes, so they have two different chromosomes, and produce two types of gametes so they are heterogametic.

Parents	ZZ (male)		ZW (female)
Gametes	Z	Z	W



5. The possibility of a female becoming a haemophilic is extremely rare. Explain.

Ans: The possibility of a female becoming a haemophilic is extremely rare because the mother of such a female has to be at least carrier and the father should be haemophilic.

6. What is point mutation? Give one example.

Ans: Mutation that arises due to change in a single base pair of DNA. This is known as point mutation. A classic example of such a mutation is sickle cell anaemia.

7. Why did Morgan choose to work with fruit flies, *Drosophila* for his experiments?

Ans: Morgan worked with the tiny fruit flies, *Drosophila melanogaster* because:

They could be grown on a simple synthetic medium in the laboratory.

They complete their life cycle in about two weeks, and a single mating could produce a large number of progeny flies. Also, there was a clear differentiation of the sexes – the male and female flies are easily distinguishable.

Also, it has many types of hereditary variations that can be seen with low power microscopes.

8. How is alpha (α) thalassemia different from beta(β) thalassemia?

Ans: In α Thalassemia, production of α globin chain is affected while in β Thalassemia, production of β globin chain is affected. α Thalassemia is controlled by two closely linked genes HBA1 and HBA2 on chromosome 16 of each parent and it is observed due to mutation or deletion of one or more of the four genes. The more genes affected; the less alpha globin molecules produced.

While β Thalassemia is controlled by a single gene HBB on chromosome 11 of each parent and occurs due to mutation of one or both the genes.

9. Who proposed chromosome theory of inheritance? Point out any two similarities in the behavior of chromosomes and genes.

Ans: Sutton and Boveri (A Chromosomes and B Genes)

Table 5.3: A Comparison between the Behaviour of Chromosomes and Genes

A	B
Occur in pairs	*Occur in pairs*
Segregate at the time of gamete formation such that only one of each pair is transmitted to a gamete	*Segregate at gamete formation and only one of each pair is transmitted to a gamete*
Independent pairs segregate independently of each other	*One pair segregates independently of another pair*

SA (3 MARKS)

1. Explain the mechanism of sex determination in honey bees.

Ans: The sex determination in honey bees is based on the number of sets of chromosomes an individual receives. An offspring formed from the union of a sperm and an egg develops as a female (queen or worker), and an unfertilized egg develops as a male (drone) by means of parthenogenesis. This means that the males have half the number of chromosomes than that of a female. The females are diploid having 32 chromosomes and males are haploid, i.e., having 16 chromosomes. This is called the haplo-diploid sex determination system**.**

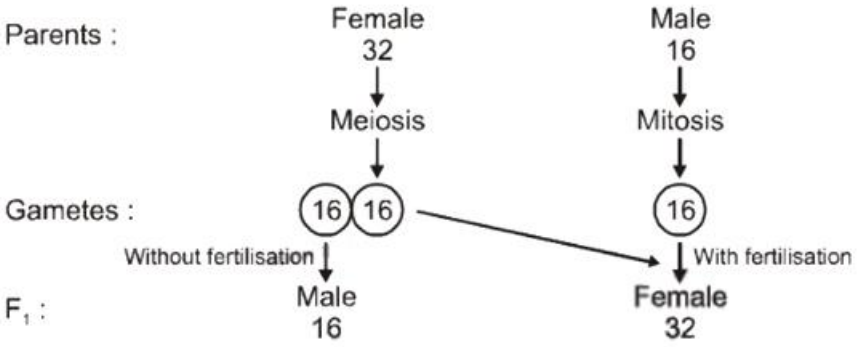
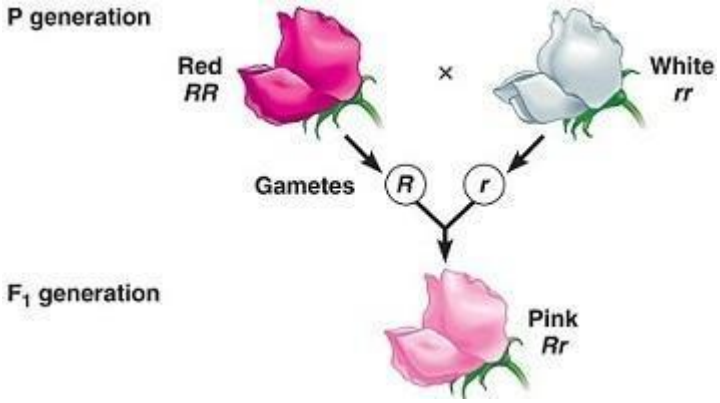


Fig.: Sex-determination in honey bee

2. Observe the following cross and answer the following:

a) Identify the given phenomenon.



b) What would be the phenotypic and genotypic ratio of individuals of F2 generation?

c) What results in the production of pink flowers in the F1 generation?

Ans: a) Incomplete dominance

b) 1:2:1 (genotypic and phenotypic ratio is same) red: pink: white

c) Dominant allele for flower colour is not able to express its character completely.

3. During a study an infant's karyotype was found to possess an extra chromosome (autosome). Name the disorder which an infant is suffering from? Describe the symptoms the child is likely to develop later in the life.

Ans: Infant is suffering from Down's syndrome. He will show the following symptoms:

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

4. How is polygenic inheritance different from Pleiotropy? Give one example of each.

Ans: The inheritance in which traits are generally controlled by three or more genes is called polygenic inheritance. It takes into account the influence of the environment. In a polygenic trait the phenotype reflects the contribution of each allele. For example: human skin colour.

There are however instances where a single gene can exhibit multiple phenotypic expressions. Such a gene is called a pleiotropic gene. And the phenomenon is said to be pleiotropy. The underlying mechanism of pleiotropy in most cases is the effect of a gene on metabolic pathways which contributes towards different phenotypes. An example of this is the disease phenylketonuria.

5. A haemophiliac man marries a carrier woman for haemophilia. Work out the genotypes of the couple and their offspring using a punnett square.

Ans: Genotype: X^hY (man) and X^hX (carrier woman)

	X^h	Y
X^h	X^hX^h hemophiliac daughter	X^hY Hemophiliac son
X	X^hX Carrier daughter	XY Normal son

6. a) Explain the linkage and recombination as put forth by T.H Morgan based on his observations with the *Drosophila melanogaster* crossing experiment.

b) How does Sturtevant explain gene mapping.

Ans: a) Morgan and his group knew that the genes were located on the X chromosome and saw quickly that when the two genes in a dihybrid cross were situated on the same chromosome, the proportion of parental gene combinations were much higher than the non-parental type.

Morgan attributed this due to the physical association or linkage of the two genes and coined the term linkage to describe this physical association of genes on a chromosome and the term recombination to describe the generation of non-parental gene combinations.

Morgan and his group also found that even when genes were grouped on the same chromosome, some genes were very tightly linked (showed very low recombination) while others were loosely linked (showed higher recombination).

b) Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and 'mapped' their position on the chromosome.

7. A phenomenon results in alternation of DNA sequences and consequently results in changes in the genotype and phenotype of an organism. Identify the phenomenon. Differentiate between its two types.

Ans: The phenomenon is Mutation. It has two types of mutations: point mutations and frameshift mutations.

Point mutation: Mutations that arise due to change in a single base pair of DNA. For e.g. In sickle cell anaemia.

Frameshift mutations: deletions and insertions of base pairs of DNA causes frameshift mutations.

8. a) What is aneuploidy? How is it different from polyploidy?

b) State whether Down Syndrome and Turner's syndrome occurs due to aneuploidy or Polyploidy.

c) Which organisms show polyploidy?

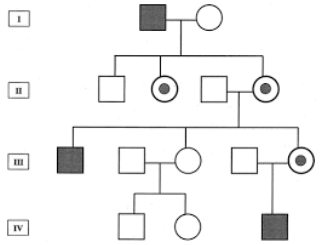
Ans: a) Failure of segregation of chromatids during cell division cycle results in the gain or loss of a chromosome(s), called aneuploidy.

Failure of cytokinesis after the telophase stage of cell division results in an increase in a whole set of chromosomes in an organism and it is called polyploidy.

b) Aneuploidy

c) Plants

9. Observe the given pedigree for the trait colour blindness and answer the following questions:



a) Identify whether the given pedigree is Autosomal /X linked and Dominant /Recessive.

b) What could be the genotype of parents in the First generation?

c) Depict the genotype and phenotype of male 1 and female at no 4 in III generation.

Ans: a) The given pedigree is X linked Recessive.

b) Father is X^CY and mother is XX^C

c) Genotype of male is X^CY, phenotype is colour blind,

d)Genotype of females is XX^C, phenotype is carrier for colour blindness.

10. How is a chromosomal disorder different from Mendelian disorders? Name any two chromosomal disorders.

Ans: Mendelian disorders are mainly determined by alteration or mutation in the single gene.

These disorders are transmitted to the offspring on the same lines as we have studied in the principle of inheritance.

The pattern of inheritance of such Mendelian disorders can be traced in a family by the pedigree analysis.

Most common and prevalent Mendelian disorders are Haemophilia, Cystic fibrosis, Sickle-cell anaemia, Colour blindness, Phenylketonuria, Thalassemia, etc.

The chromosomal disorders on the other hand are caused due to absence or excess or abnormal arrangement of one or more chromosomes.

Down's syndrome and Turner's syndrome are two chromosomal disorders.

CASE STUDY BASED QUESTIONS (4 MARKS)

1. Colour blindness frequently happens when a person cannot distinguish among certain colours like red and green. Colour blindness is a usually hereditary condition that means it is commonly passed down from our parents. Red/green colour blindness is passed from mother to son on the 23rd chromosome that is called the sex chromosome as it additionally determines sex.

Based on the above information Answer the following questions:

A) What type of disease is colour blindness?

Ans: It is an X linked recessive disorder**.**

B) What would be the phenotype of daughters born to A colour blind man married to a normal woman?

Ans: All daughters will be 100% carriers of colour blindness gene.

C) The human male never passes on the gene for colour blindness to his son. Why is it so?

Ans: The gene for colour blindness is present on the X chromosome. A male has only one X chromosome which he receives from his mother and Y chromosome from father. The human male passes the X chromosome to his daughters but not to the male progeny (sons).

D) What type of inheritance is shown by Colour blindness?

Ans: Criss cross inheritance**.**

2. Thalassemia affects approximately 4.4 out of every 10,000 live births throughout the world. This condition causes both males and females to inherit the relevant gene mutations equally because it follows an autosomal pattern of inheritance with no preference for gender. Approximately 5% of the worldwide population has a variation in the alpha or beta part of the haemoglobin molecule, although not all of these are symptomatic and some are known as silent carriers. In fact, only 1.7% of the global population has signs as a result of the gene mutations, which is known as a thalassemia trait.

However, particular ethnic groups are more likely to be affected, with between 5% and 30% of these populations experiencing symptoms of thalassemia.

A) What type of disease is Thalassemia?

a) Autosomal recessive b) X linked recessive c) X linked dominant d) Autosomal dominant

Ans: a) It is an autosomal recessive blood disease.

B) How is alpha (α) thalassemia different from beta (β) thalassemia? (Any one difference)

Ans: In α Thalassemia, production of α globin chain is affected while in β Thalassemia, production of β globin chain is affected. α Thalassemia is controlled by two closely linked genes HBA1 and HBA2 on chromosome 16 of each parent and it is caused due to mutation or deletion of one or more of the four genes**.**

While β Thalassemia is controlled by a single gene HBB on chromosome 11 of each parent and occurs due to mutation of one or both the genes.

C) How is Thalassemia different from sickle cell anaemia?

Ans: Thalassemia is a quantitative disease of synthesizing too few globin molecules whereas sickle cell anaemia is a qualitative problem of synthesizing an incorrectly functioning globin.

3. Gregor Mendel (1822-1884) was an Austrian monk who discovered the basic rules of inheritance. From 1858 to 1866, he bred garden peas in his monastery garden and analyzed the offspring of these mating's. The garden pea was a good choice of experimental organism because many varieties were available that bred true for clear-cut, qualitative traits. Furthermore, peas are normally self-pollinated because the stamens and carpels are enclosed within the petals. By removing the stamens from unripe flowers, Mendel could brush pollen from another variety on the carpels when they ripened.

A) Give the scientific name of the garden pea that Mendel used for his experiments.

Ans: *Pisum sativum*

B) What were the reasons for Mendel's success? (Any two reasons)

Ans: During Mendel's investigations into inheritance patterns, it was for the first time that statistical analysis and mathematical logic were applied to problems in biology.

His experiments had a large sampling size, which gave greater credibility to the data that he collected.

Also, the confirmation of his inferences from experiments on successive generations of his test plants proved that his results pointed to general rules of inheritance rather than being unsubstantiated ideas.

Mendel investigated characters in the garden pea plant that were manifested as two opposing traits, e.g., tall or dwarf plants, yellow or green seeds. This allowed him to set up a basic framework of rules governing inheritance, which was expanded on by later scientists to account for all the diverse natural observations and the complexity inherent in them.

C) Why was Mendel's work not recognized? (Any two reasons)

Ans: Firstly, communication was not easy (as it is now) in those days and his work could not be widely publicized.

Secondly, his concept of genes (or factors, in Mendel's words) as stable and discrete units that controlled the expression of traits and, of the pair of alleles which did not 'blend' with each other, was not accepted by his contemporaries as an explanation for the apparently continuous variation seen in nature.

Thirdly, Mendel's approach of using mathematics to explain biological phenomena was totally new and unacceptable to many of the biologists of his time.

Finally, though Mendel's work suggested that factors (genes) were discrete units, he could not provide any physical proof for the existence of factors or say what they were made of.

D) Name the scientists who rediscovered Mendel's work?

Ans: De Vries, Correns and von Tschermak independently rediscovered Mendel's results on the inheritance of characters.

4.A botanist crossed plants with red flowers with yellow flowers. To his surprise he obtained orange-coloured flowers in the F1 generation. On selfing the plants of F1 plants he obtained plants with red, orange and yellow flowers. Answer the following questions:

A) What is the pattern of inheritance in the above case?

Ans: Incomplete dominance

B) Give the genotypic and phenotypic ratios of the plants obtained in the F2 generation.

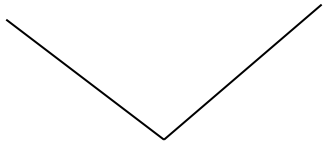
Ans : Both are same 1:2:1 red : orange : yellow

C)Draw a cross to show the above phenomenon by using YY for red flowers and yy for yellow flowers.

Ans:

Parents : RED **YELLOW**

YY **yy**



F1 **Yy**

Orange

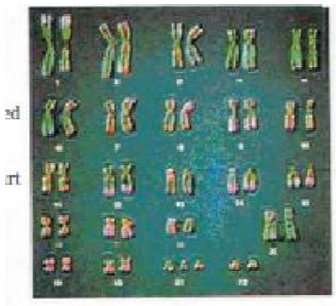
F2 **Yy x Yy**

YY Yy yy
Red Orange Yellow
1 : 2 : 1

D) Assertion: In *Antirrhinum,* the plants with red flowers crossed with the plants with white flowers produce pink-coloured flowers in the F1 generation.
Reason: Dominant allele for flower colour is not able to express its character completely.
ANS: a)

5. In 1911, while studying the chromosome theory of heredity, biologist Thomas Hunt Morgan had a major breakthrough. Morgan occasionally noticed that "linked" traits would separate. Meanwhile, other traits on the same chromosome showed little detectable linkage. Morgan considered the evidence and proposed that a process of crossing over, or recombination, might explain his results. Specifically, he proposed that the two paired chromosomes could "cross over" to exchange information. Today, we know that recombination does indeed occur during prophase of meiosis, and it creates different combinations of alleles in the gametes that result.
A) Crossing over in diploid organisms is responsible for?
a) dominance of genes b) linkage c) recombination of linked genes d) segregation of alleles
Ans: c)
B) How is linkage related to cross over?
Ans: More the linkage lesser will be the crossing over and lesser the linkage more will be the crossing over between the genes.
C) Lack of independent assortment in two genes of Drosophila is due to _____
Ans: Linkage
C)Assertion: Frequency of crossing over is higher than the observed frequency of recombination of traits in the offspring.
Reason: More than one cross may occur simultaneously between the same chromatids.
ANS: a)

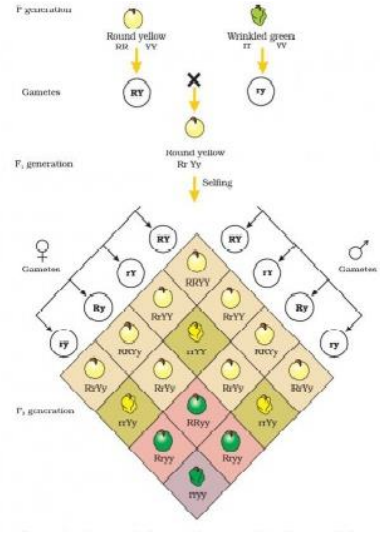
LONG ANSWER TYPE QUESTIONS (5 MARKS)
Given below is the karyotype of a child. Observe and answer accordingly.



a) Name the disorder that child may be suffering from?
b) What is the reason for the disorder?
c) Write its symptoms?
d) Why is this disorder called a chromosomal disorder?
Ans: a) Down's syndrome.
b) Trisomy 21.
c) ref pg ,76 of Text book

d) As it is caused due to the presence of an extra copy of chromosome no. 21.

2. Observe the cross given below and answer the following:



a) What type of cross is shown above?

b) Which Law can be inferred from the above cross? State the law also.

c) Give the phenotypic ratio of individuals obtained in F2 generation and also explain the results obtained.

Ans: a) it is a Dihybrid cross.

b) Law of independent assortment. ref pg, for statement

c) Ref pg no 63, of textbook

3. How is starch grain size determined in Pea plant? Which inheritance pattern is followed in this?

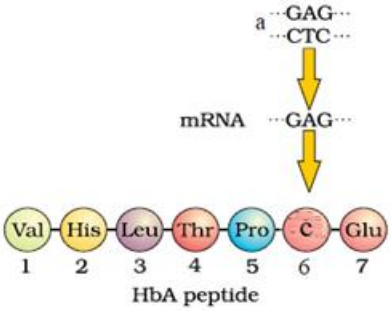
Ans: Ref pg,62 of Textbook.

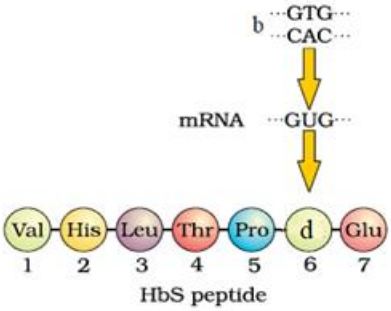
4. Explain the Polygenic inheritance with examples of human skin colour. Why is this inheritance said to be quantitative inheritance?

Ans: Ref pg no 69 of Textbook.

5.In reference to picture given below,

a) Identify the disorder which results due to such mutation.





b) Explain the genetics behind this disease.

c) How does the change in shape of RBCs occur in this disease?

Ans: Ref p.g. no 74-75 of text book.

PRACTISE TEST:

M.M: 40

I. Choose the most appropriate option (1*7=7)

A female having rudimentary ovaries, short stature suggests which disorder?

a) Down's syndrome b) Turner's syndrome c) Klinefelter's syndrome d) Haemophilia

2. Which of the following individuals are affected by sickle cell anaemia?

a) Hb^SHb^A b) Hb^AHb^A c) Hb^SHb^s d) both a and b

3. In humans' Polygenic inheritance is shown by:

a) skin colour b) colour blindness c) pleiotropy d) Haemophilia

4. Independent assortment can be deduced from?

a) Monohybrid cross b) Test cross c) Back cross d) Dihybrid cross

5. AB blood group in humans show:

a) Dominance b) incomplete dominance c) Codominance d) Pleiotropy

6. Haplodiploidy is seen in

a) Grasshoppers and Cockroaches b) Birds and reptiles

c) Moths d) Honey Bees

7. Mendel's laws were rediscovered by:

a) Carl Correns b) Lamarck and Correns

c) DeVries, Correns and Tschermak d) Morgan

II. Each question consists of two statements, namely, Assertion (A) and Reason (R). (1*4=4)

For selecting the correct answer, use the following code:

(a) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).

(c) Assertion (A) is true and Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is true.

8. Assertion: Haemophilia shows grandfather to grandson transmission.

Reason: The recessive gene that cause Haemophilia is lying on X chromosome

9. Assertion: Mutation is sudden, inheritable change in DNA

Reason: Mutation is caused by mutagens.

10. Assertion: Human skin colour is controlled by three genes.

Reason: It is a quantitative inheritance.

11. Assertion: Three alleles I^A ,I^B,i control blood groups in humans

Reason: ABO blood groups show multiple allelism.

III. Answer the following questions, SA (2*3=6)

1. What is point mutation? Give one example.
2. Differentiate between multiple allelism and pleiotropy.
3. What is a test cross? How does it determine the heterozygosity of the plants?

IV. Answer the following questions, SA (3*3=9)

1. Name a disorder, give its Karyotype and symptoms, which a human male suffers, as a result of an addition X chromosome.
2. Fill in the a, b, c, d, e, f in the table given below:

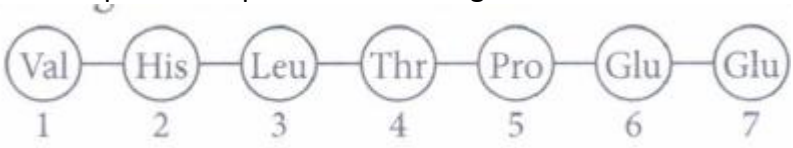
Organism	males	females
Humans	A	XX
B	ZZ	C
D	XY	XX
Grasshopper	E	F

3. A normal man marries a woman who is a carrier of Haemophilia. Workout their possible genotypes and the genotypes of their offspring using a punnett square.

V. Case based question (1*4=4)

Read the following and answer any four questions from (i) to (v) given below:

A relevant portion of β-chain of haemoglobin of a normal human is as follows



The codon for the sixth amino acid is GAG. The sixth codon GAG mutates to GAA as a result of mutation X and into GUG as a result of mutation Y.

A) Name the disease caused due to such mutation.

B) Due to mutation Y the shape of RBCs under oxygen tension will be

(a) biconcave disc like (b) sickle shaped (c) circular (d) spherical

C) GUG is code for

(a) valine (b) proline (c) glutamic acid (d) leucine

D) Which of the following genotype shows diseased phenotype due to mutation Y?

(a) $Hb^S Hb^S$ (b) $Hb^A Hb^S$ (c) $Hb^A Hb^A$ (d) Both (a) and (b)

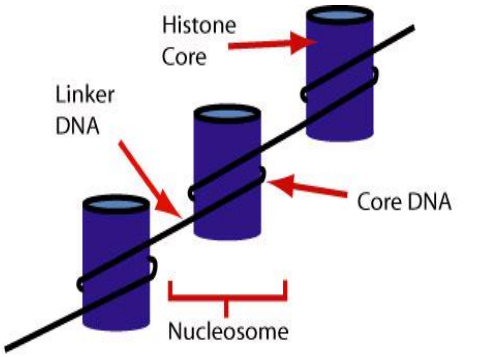
VI. Long answer type questions (5*2=10)

1. Explain the phenomenon of incomplete dominance shown by snapdragon flowers by using a cross.
2. a) Why is Thalassemia categorized as a mendelian inheritance?
   b) Define aneuploidy.
   c) Name any one sex linked and one autosomal blood related mendelian disorders.
d) Write the metabolism that is impaired in Phenylketonuria.

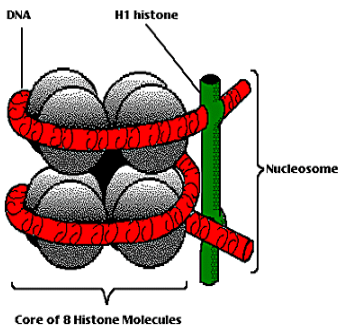
CH5 MOLECULAR BASIS OF INHERITANCE

1.Central Dogma-It means genetic information flows from DNA to RNA to Proteins

2.Packaging of DNA helix-The negatively charged DNA is wrapped around positively charged histone octamer to form a nucleosome. Nucleosomes are repeating units on chromatin.



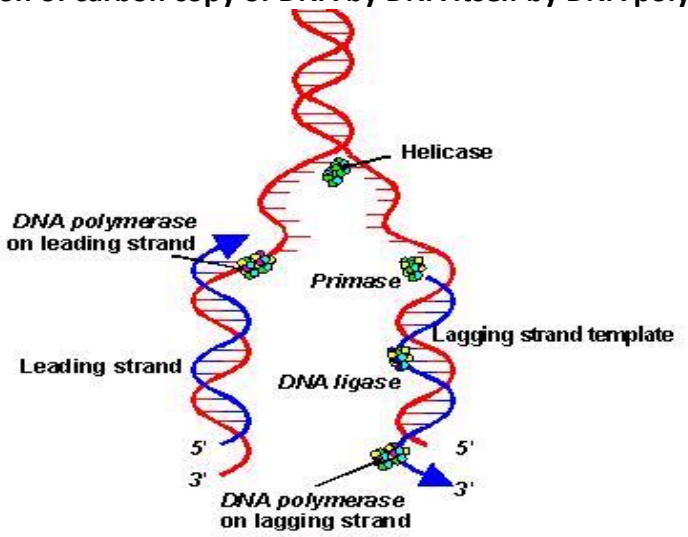
a nucleosome is a complex of a histone and 146 nucleotide pairs



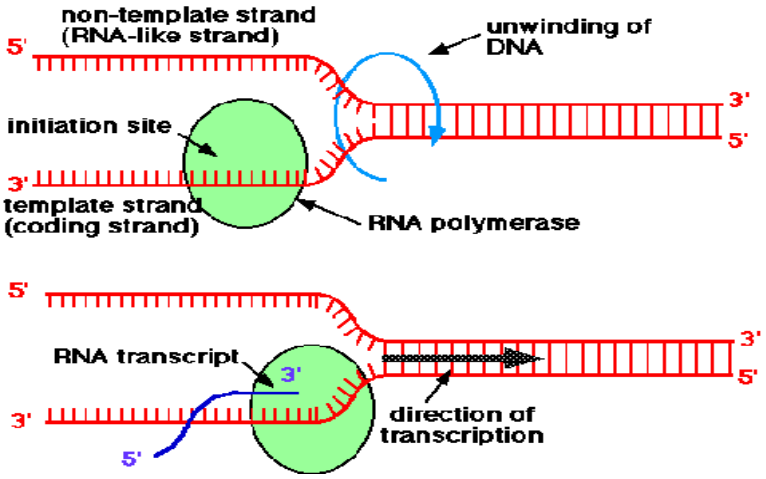
Nucleosome

http://www.accessexcellence.com/AB/GG/nucleosome.gif

3. Replication-Formation of carbon copy of DNA by DNA itself by DNA polymerase.

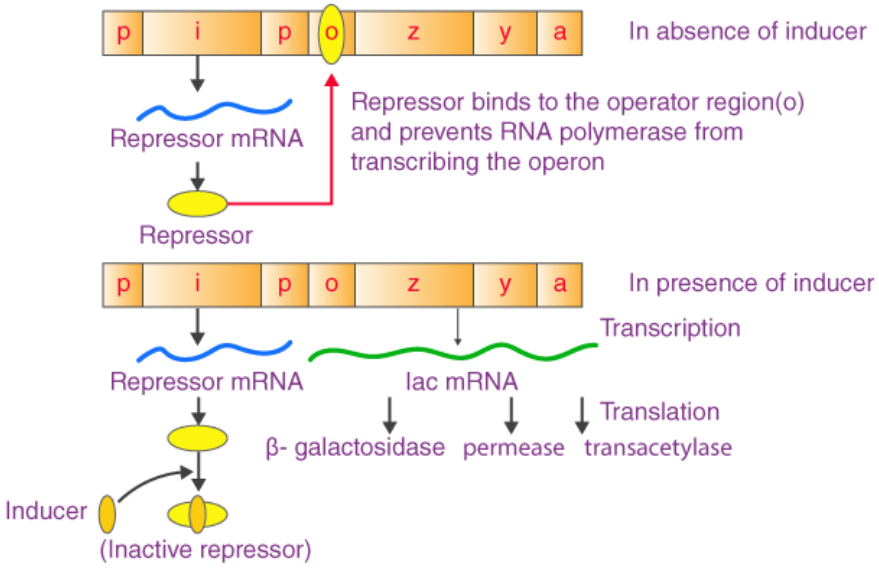


4. Transcription-It is the process of copying genetic information from one strand of DNA into RNA by RNA polymerase.

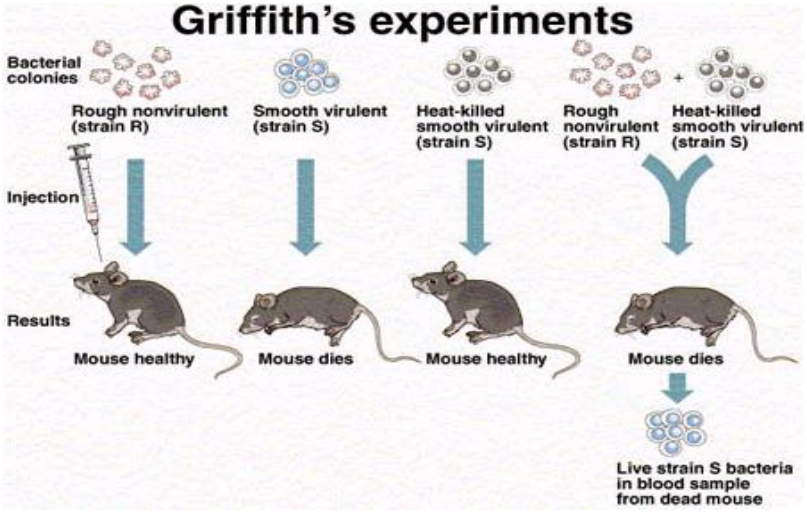


5. Translation-The process of polymerization of amino acids to form a polypeptide chain using genetic information stored in RNA. Diag NCERT Page No 99

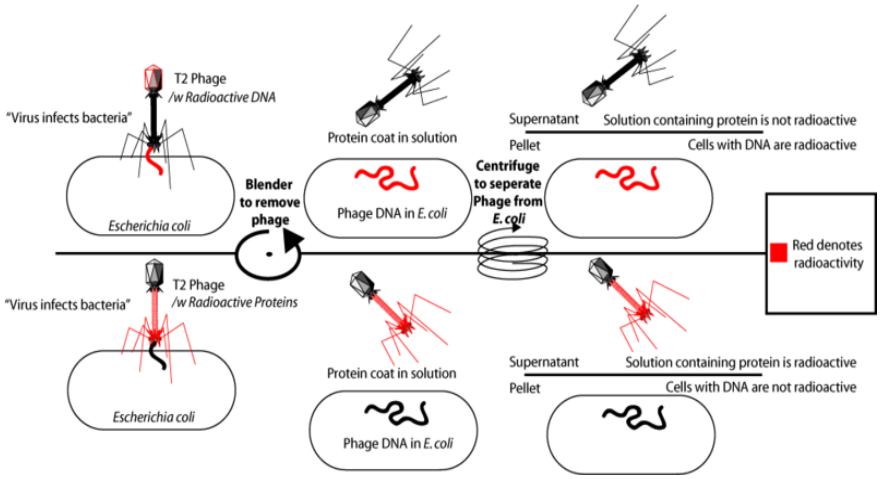
6. Lac operon-



7. **Various Experiments- a) Griffith's experiment (Transforming Principle)**



b) Hershey and Chase experiment to show DNA is the genetic material-



c) Messelson and Stahl experiment to show semi-conservative nature of DNA replication- Diag NCERT Page No 88-89

Multiple choice Questions :

1. **Genes are the segment of DNA, that contain instructions for assembly of**

a) Purines (c) pyrimidines
b) Proteins (d) nucleosome

Ans: b)

2. **Which of the following units is the largest among all?**

(a) Nucleotide (c) pyrimidines
(b) Nucleoside (d) purines

Ans: a)

3. **Select the incorrect statement regarding heterochromatin**.

(a) It is a tightly packed form of chromatin.
(b) It has high DNA density
(c) It actively participates in the process of transpiration.
(d) It stains dark.

Ans: c)

4. The formation polynucleotide chain of m RNA is catalyzed by the enzyme

(a) RNA helicase (c) DNA polymerase

(b) RNA polymerase (d) DNA helicase

Ans: b)

5. Choose the chromosome in a human that possesses least number of genes

(a) 21st chromosome (c) X chromosome

(b) Autosome (d) Y chromosome

Ans: d)

6. Which of the following organisms do not follow central dogma of molecular biology.

(a) DNA viruses (c) Retroviruses

(b) RNA viruses (d) both (b) and (c)

Ans: d)

7. Histones are rich in

(a) Lysine and histidine (c) arginine and lysine

(b) Valine and histidine (d) arginine and histidine

Ans: c)

8. Control of gene expression takes place at the level of

(a) DNA-replication (c) translation

(b) transcription (d) none of the above.

Ans: b)

9. Which was the last human chromosome to be completely sequenced ?

(a) Chromosome 1 (c) Chromosome 21

(b) Chromosome 11 (d) Chromosome Y

Ans: a)

10. The RNA polymerase enzyme do not transcribes

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

(b) the promoter and the terminator region

(c) the structural gene and the terminator region

(d) the structural gene only.

Ans: b)

11.Find out the wrong statement about heterochromatin,

(a) It is densely packed (c) It is transcriptionally active

(b) It stains dark. (d) It is late replicating.

Ans: c)

12.The three codons which result in the termination of polypeptide chain synthesis are

(a) UAA, UAG, GUA (c) UAA, UAG, UGA

(b) UAA, UGA, UUA (d) UGU,UAG,UGA

Ans: c)

13. Amino acids which are specified by single codons are

(a) phenylalanine and arginine (c) valine and proline

(b) tryptophan and methionine (d) methionine and arginine.

Ans: b)

14. Which out of the following statements is incorrect ?

(a) Genetic code is ambiguous. (c) Genetic code is universal

(b) Genetic code is degenerate (d) Genetic code is non-overlapping.

Ans: a)

15.The mutations that involve addition, deletion or substitution of a single pair of

nitrogen base.

(a) point mutation (c) lethal mutations
(b) silent mutation (d) retrogressive mutations.

Ans: a)

16. RNA is the genetic material in

(a) prokaryotes (c) Tobacco Mosaic Virus (TMV)
(b) eukaryotes (d) E.coli.

Ans: c)

17. Which of the following life processes evolved around RNA ?

(a) Metabolism (c) Splicing
(b) Translation (d) All of these

Ans: b)

18. Chemically, RNA is (i) reactive and (ii) stable as compared to DNA.

(a) (i) equally, (ii) equally (c) (i) more, (ii) less
(b) (i) less, (ii) more (d) (i) more, (ii) equally

Ans: c)

19. Which of the following phenomena was experimentally proved by Meselson and Stahl

(a) Transformation (c) Semi-conservative DNA replication
(b) Transduction (d) Central dogma

Ans: c)

20. The enzyme DNA dependent RNA polymerase catalyzes the polymerisation reaction in _____direction.

(a) only 5' → 3' (c) both (a) and (b)
(b) only 3' → 5' (d) none of these

Ans: a)

21. If the sequence of bases in coding strand of DNA is ATTCGATG, then the sequence of bases in mRNA will be

(a) TAAGCTAC (c) ATTCGATG
(b) UAAGCUAC (d) AUUCGAUG.

Ans: d)

22. During transcription, the site of DNA molecule at which RNA polymerase binds is called

(a) promoter (c) receptor
(b) regulator (d) enhancer.

Ans: a)

23. In eukaryotes, the process of processing of primary transcript involves

(a) removal of introns (c) capping at 5'end
(b) tailing (polyadenylation) at 3' end (d) all of these.

Ans: c)

24. In a n/RNA molecule, untranslated regions (UTRs) are present at

(a) 5' – end (before start codon) (c) both (a) and (b)
(b) 3' – end (after stop codon) (d) 3'- end only.

Ans: c)

25. The sequence of structural genes in lac operon is

(a) Lac A, Lac Y, Lac Z (c) Lac Y, Lac A, Lac A
(b) Lac A, Lac Z, Lac Y (d) Lac Z, Lac Y, Lac A

Ans: d)

26. Human genome consists of approximately

(a) 3×10^9 bp (c) 20,000 – 25,000 bp
(b) 6×10^9 bp (d) 2.2×10^4 bp.

Ans: a)

27. The process where DNA fragments are transferred to nylon sheet on the gel for soaking is called as ……..

(a) Southern blotting (c) Northern blotting

(b) Blood clotting (d) Nitro Blot

Ans: a)

28. Which of the following can be biological samples for DNA fingerprinting?

(a) Blood (c) Saliva

(b) Hair (d) All of them

Ans: d)

29. Which of the following enzymes is useful to cut DNA into fragments?

(a) Scissor (c) Restriction

(b) Sensor (d) Freedom

Ans: c)

30. During density gradient centrifugation minor peaks represent.

(a) Bulk DNA (c) Repetitive DNA

(b) Genomic DNA (d) Satellite DNA

Ans: d)

ASSERTION AND REASONING

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

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

(c) If the **Assertion** is true but the **Reason** is false.

(d) If both the **Assertion** and **Reason** are false

1.**Assertion:** Transcription is the mode in which DNA passes its genetic information to RNA.

Reason: Transcription takes place in the cytoplasm of eukaryotic cells.

Ans: c)

2.**Assertion :** The RNA molecules are essential for cell function in both prokaryotes and eukaryotes.

Reason : They play an important role in protein synthesis.

Ans: a)

3.**Assertion:** The genetic codes are comma less.

Reason: Genetic codes are overlapping..

Ans: c)

4.**Assertion :**The hnRNA in humans has exons and introns.

Reason : The primary transcript produced in eukaryotes is translated without undergoing any modification or processing.

Ans: c)

5.**Assertion :**The two strands of DNA are antiparallel.

Reason : Only antiparallel polynucleotides form a stable double helix.

Ans: a)

6.**Assertion:** RNA was the first genetic material.

Reason: Essential life processes (such as metabolism, translation, splicing, etc.) evolve around RNA.

Ans: a)

7.**Assertion** :DNA fingerprinting is also known as genetic fingerprinting.

Reason : It was developed by James Watson, the first director of human genome project.

Ans: c)

8.**Assertion** :A single mRNA strand is capable to produce different polypeptide chains.
Reason : The mRNA strand has terminator codons.
Ans: b)

9.**Assertion**: Enzymes required for DNA replication are efficient enzymes
Reason: They can polymerise large number of nucleotides in very short time
Ans: a)

10.**Assertion** :Ribosomal RNA is synthesized in the cytoplasm of the cell.
Reason : It is translated with the enzyme RNA polymerase III.
Ans: d)

SHORT ANSWER TYPE QUESTIONS (2 MARK)

Q1. State the difference between the structural genes in a transcription unit of prokaryotes and eukaryotes

Ans: Prokaryotic structural genes are continuous and are without any non-coding region, while eukaryotic structural genes contain exons (coding DNA) and introns (non-coding DNA). 1+1

Q2. A template strand is given below. Write down the corresponding coding strand and the mRNA strand that can be formed, along with their polarity.
3'- ATGCATGCATGCATGCATGCATGC-5'

Ans: For the given template strand 3- ATGCATGCATGCATGCATGCATGC- 5'
Coding strand is 5'- TACGTACGTACGTACGTACG TACG – 3'
and mRNA strand is 5'- UACGUACGUACGUACGU ACGUACG – 3' 1+1

Q3. What is the origin of replication in a chromosome? State its function.

Ans: Replication does not initiate randomly at any place in DNA (chromosome). So, there is a definite region in DNA (chromosome) termed as the origin of replication.
Function: It is the place from where DNA replication originates. 1+1

Q4. Name the enzyme involved in continuous replication of DNA strands. Mention the polarity of the template strand.

Ans: Enzymes involved in continuous replication of DNA strands are DNA polymerase.
Template strand has 3' → 5' polarity. 1+1

Q5. Differentiate between the following: Inducer and repressor in lac operon.

Ans: Inducer It is a chemical which after coming in contact with repressor, changes it into a non-DNA binding state, so as to free the operator gene.
Repressor It is a regulator protein meant for blocking the operator gene. 1+1

Q6. In a typical nucleus, some regions of chromatin are stained light and others dark. Explain why it is so and what its significance is.

Ans: In a typical nucleus, some regions of chromatin are stained light because of loose packing of chromatin and some regions of chromatin are stained dark because, chromatin is densely packed. Euchromatin is transcriptionally active chromatin (lightly stained) while heterochromatin (darkly stained) is transcriptionally inactive. 1+1

Q7. Why does hnRNA undergo splicing? Where does splicing occur in the cell?

Ans: hnRNA undergoes splicing to remove non-coding sequences, i.e. introns and joins exons. Splicing occurs in the nucleus of the cell. 1+1

Q8. Write the full form of VNTR. How is VNTR different from Probe?

Answer: VNTR-Variable Number Tandem Repeat.
Difference between VNTR and Probe is as follows
VNTR: It is a class of satellite DNA, where a small sequence is arranged tandemly

in many copy number.

Probe: It is single stranded DNA or RNA tagged with radioactive molecule which is Complementary to DNA 1+1

Q8. What is aminoacylation? State its significance.

Or

Explain aminoacylation of tRNA.

Ans: Aminoacylation or charging of tRNA is a process in which amino acids get activated in the presence of ATP and get linked to their cognate tRNA.

Significance of aminoacylation: The charged tRNA carries amino acids to the site of protein synthesis. If two charged tRNAs are brought close to each other, the peptide is formed between two amino acids. 1+1

Q9. State the dual function of deoxyribonucleoside triphosphate during DNA replication.

Ans: (i) it is a substrate for DNA formation. 1+1

(ii) These serve as energy source in the form of ATP from two terminal phosphate

Q10. List two essential roles of ribosomes during translation

Ans: Only rRNA acts as a peptidyl transferase ribozyme for formation of peptide bonds. They provide site formation for attachment during protein synthesis. 1+1

SHORT ANSWER TYPE QUESTIONS (3 Mark)

Q1. The base sequence in one of the strands of DNA is TAGCATGAT.

(i) Give the base sequence of the complementary strand.

(ii) How are these base pairs held together in a DNA molecule?

(iii) Explain the base complementarity rule. Name the scientist who framed this rule.

Ans: (i) ATCGTACTA.

(ii) Base pairs are held together by weak hydrogen bonds, adenine pairs with thymine by two H-bonds and guanine pairs with cytosine through three H-bonds.

(iii) Base complementarity rule : For a double-stranded DNA, this rule states that the ratio between adenine and thymine and that between guanine and cytosine are constant and equal to one. Erwin Chargaff framed this rule. 1+1+1

Q2. (i) List the two methodologies which were involved in the human genome project.Mention how they were used.

(ii) Expand YAC and mention what it was used for.

Ans:(i) Two major methodologies involved in HGP are as follows

Expressed Sequence Tags (ESTs) This method focuses on identifying all the genes that are expressed as RNA. Sequence annotation This method involves the sequencing of whole set of genome (that contained all coding and non-coding sequence) and then assigning functions to the different regions in the sequence.

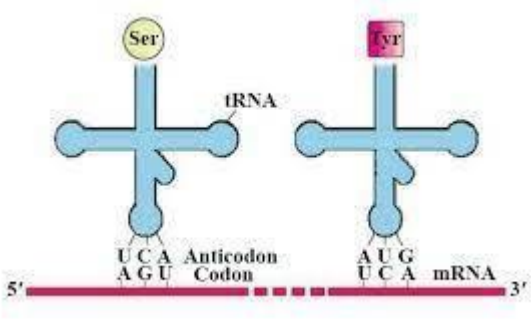
(ii) YAC stands for yeast artificial chromosome. These were used as vectors in which fragments of whole DNA of human were inserted and cloned. 2+1

Q3. (i) Why is tRNA called an adapter?

(ii) Draw and label a secondary structure of tRNA. How does the actual structure of tRNA look like

Ans: (i) tRNA binds to a specific amino acid and it also reads the codon of the amino acid bound to it through its anticodon. So, it is called an adapter molecule. 1+2

(ii)



In actual structure, the /RNA is a compact molecule that looks like an inverted L.

Q4. (i) What are the transcriptional products of RNA polymerase-III?

(ii) Differentiate between capping and tailing.

(iii) Expand hnRNA.

Ans: (i) RNA polymerase-III is responsible for the transcription of tRNA, SrRNA and snRNAs (small nuclear RNAs).

(ii) In capping process, an unusual nucleotide (methyl guanosine triphosphate) is added to '5' end of hnRNA. In the tailing process, 200-300 adenylate residues are added at 3' end of hnRNA.

(iii) hnRNA is heterogeneous nuclear RNA. 1+1+1

Q5. (i) Explain the role of DNA-dependent RNA polymerase in initiation, elongation and termination during transcription in bacterial cells.

(ii) How is transcription a more complex process in eukaryotic cells? Explain.

Ans: (i) Role of DNA-dependent RNA polymerase

RNA polymerase becomes associated transiently with initiation factor (σ) and binds to the promoter site on DNA and initiates transcription.

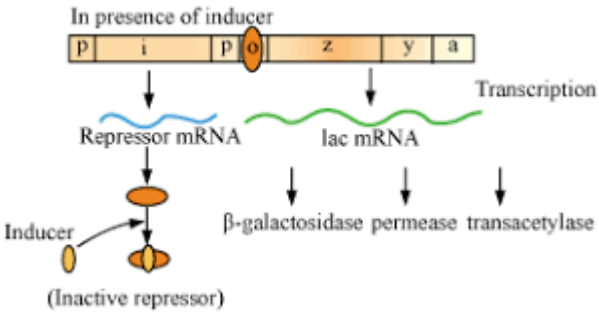
(ii) It uses the nucleoside triphosphate as substrates and polymerises them in a template-dependent fashion following the base complementarity rule in the 5′ → 3′ direction.It also facilitates the opening of the DNA helix and continues the elongation process.When the polymerase falls off a terminator region on the DNA, the nascent RNA separates. This results in termination.

Q6. How are the structural genes activated in lac operon in E. coli ?

Ans: Lac operon consists of

(i) an operator, which controls all structural genes as a unit

(ii) a regulatory gene (i gene), three structural genes (z, y, a), which code for enzymes and a promoter, where RNA polymerase binds for transcription. The regulatory gene codes for a repressor protein that has high affinity for the operator region and which prevents RNA polymerase from transcribing the structural genes, i.e. the lac operon is switched off or inactive.



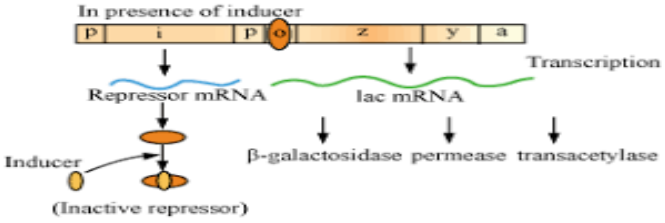
Lac operon in the presence of inducer When inducer (lactose) is added, it binds with repressor protein

and inactivates it. This allows RNA polymerase to have access to the promoter and transcription proceeds via the activation of structural genes. 2+1

Q7. Given below is the schematic representation of lac operon of E.coli. Explain the functioning of this operon when lactose is provided in the growth medium of the bacteria.

P	**i**	**P**	**O**	**z**	**y**	**a**

Ans: Lactose in the lac operon regulates operon, by switching on and off. If lactose is present in the medium, it acts as an inducer here and the substrate for the enzyme p-galactosidase .It binds to the repressor and forms an inactive repressor, which fails to bind to the operator region of the operon.



The RNA polymerase thus binds to the operator and transcribes lac-mRNA. Lac mRNA produces all three enzymes, i.e. beta-galactosidase, permease and transacetylase of polycistronic structural gene present in E.coli. Therefore, operon will be switched on in the presence of the lactose. 2+1

Q8.(i) DNA polymorphism is the basis of DNA fingerprinting technique. Explain.

(ii) Mention the causes of DNA polymorphism.

Ans: (i) DNA polymorphism It is the occurrence of inheritable mutations at a frequency greater than 0.01 in a population.

(a) Such variations often occur in non-coding sequences. They keep on accumulating generation after generation.

(b)Types of polymorphism range from single nucleotide change to very large scale changes.

(c)Single nucleotide polymorphism is used to diagnose disease related sequences of DNA on the chromosome.

(d)Variable number of tandem repeats show a high degree of polymorphism.

(ii) DNA polymorphism occurs due to mutations. 2+1

Q9. What is mutation? Explain with the help of an example how does a point mutation affect the genetic code. Name another type of mutation.

Ans: A mutation is a sudden, stable, inheritable change in genetic material. A classical example of point mutation is a change of single base pair in the gene for p-globin chain that results in the change of amino acid residue glutamate to valine in a cell of a person suffering from sickle-cell anaemia. It is a genetic disease.

The other type of mutation includes frameshift insertion or deletion mutation. The insertion or deletion of one or more bases may change the reading frame from the point of insertion or deletion. Insertion or deletion of three or its multiple bases insert or delete one or multiple codon, hence one or multiple amino acid may be formed in polypeptide. 1+1+1

Q10.(i) Mention the contributions of the following scientists:

(a) Maurice Wilkins and Rosalind Franklin

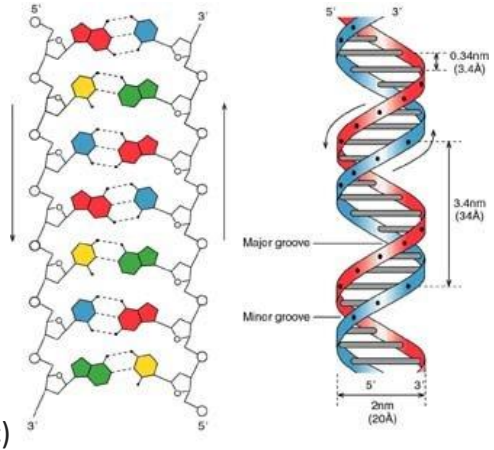
(b) Erwin Chargaff

(ii) Draw a double-stranded dinucleotide chain with all the four nitrogen bases. Label the polarity and the components of the dinucleotide.

Ans: (i) (a) Maurice Wilkins and Rosalind Franklin: They carried out X-ray diffraction studies on the structure of DNA molecules.

(b) Erwin Chargaff: He proposed the base complementarity rule, according to which [A+G][T+C] = 1

(c)



CASE BASED QUESTIONS

Q1. DNA replicates during S-phase of the cell cycle .Replication requires a lot of energy, raw materials, polymerases and supporting enzymes. DNA first separates from histone protein and unzips at places each called ori . Both the strands of DNA functions as templates. On one side of ori the orientation of one replicating strand is 3'-5' while it is 5'-3'on the other side. Similar conditions occur on the other side. 5'- 3'on one side and 3'-5' on the other side.

After going through the above paragraph, and your knowledge of subject answer the following (i) to (iv) questions with the correct options:

i. New strand of DNA is formed by Okazaki fragments over the parental strand that Opens in the direction

(a) 3'-3' (b) 3'-5'

(c)5'-5' (d) 5'-3'

ii. Okazaki fragments are formed in the area of opening of DNA in the direction.

(a) 5'-3' direction (b) 5'-5' direction

(c)3'-5' direction (d) 3'-3' direction

iii. DNA is unwound during replication by

(a) Helicase (b) topoisomerase

(c)SSBP (d) primase

iv. The function of the enzyme Primase is to

(a)Built primary transcript (b) form DNA primer

(c)Form RNA primer (d) help in separating two strands of DNA

Q2. Transcription unit is a segment of DNA that takes part in synthesis of RNA. It has a Promoter region , structural gene and terminator region. Promoter region has special Sequences called boxes that recognise one or two factors of RNA polymerase. There is a Single RNA polymerase in prokaryotes and three different polymerase in eukaryotes. After going through the above paragraph, and your knowledge of subject answer the following (i) to (iv) questions with the correct options:

i) tRNA of eukaryotes is built with the help of

(a) RNA polymerase I (c) RNA polymerase III

(b) RNA polymerase II (d) RNA polymerase IV

ii) The promoter region of prokaryotic transcription unit has

(a) TATA (b) TATAAT

(c)Pribnow box (d) both (b) and (c)

iii) m RNA is synthesized in eukaryotes by enzyme

(a) Helicase (b) RNA polymerase II

(c)Primase (d) RNA polymerase II

iv) Sigma factor is involved in RNA transcription in

a) Recognition of promoter in prokaryotes.
b) Recognition of terminator in prokaryotes.
c) Recognition of terminator region in eukaryotes.
d) Attaching to promoter region in eukaryotes

Q3. tRNA has several names , like soluble RNA, transfer RNA and adapter RNA .It has two ends 3'-5' like any polynucleotide. The body is folded variously to form loops giving a clover leaf or an inverted L shaped ,5, end has phosphate while 3'end is specialized . similarly loops are specialized to make contact with different structures. It also possesses a base with special arrangement of nucleotides for making contact with a codon of mRNA. After going through the above paragraph and from your knowledge of the subject,

answer questions (i) to (iv) with correct options:

i) What is the name of 3' end of tRNA ?

(a) Terminator end (b) Promoter end (c) CCA-OH end (d) Anticodon region

ii) What is an alternate name of anticodon ?

(a) Magnet (b) codon (c)AA-synthetase (d) TϕC

iii) What is the wobble position of an anticodon ?

(a) 3'end (b) middle part

(c)5'end (d) none of the above

iv) As compared to amino acids ,the number of tRNAs is

(a) Same (b) less (c)More (d) variable

Q4. DNA is very long .It has to be packed and repacked to accommodate it in small space. DNA itself has a charge over it due to phosphate radicals. It is packed over and stabilized with the aid of positively charged proteins. These proteins are called histones in case of eukaryotes . The joining of two gives rise to chromatin. Initially very small subunits are formed which produce a chain that is folded variously to form chromatin observed under the microscope. After going through the above paragraph and from your knowledge of the subject, answer questions (i) to (iv) with correct options:

i) What is the name of the basic subunit of the DNA histone complex ?

(a) Kinetochore (b) centromere (c)Nucleosome (d) nucleoid

ii) Number of histones associated in the core of nucleosome is:

(a) Four (b) five (c)Six (d) four pairs

iii) Length of linker DNA between two nucleosome is

(a) 54 bp (b) 200 bp (c)146 bp (d) 34 bp

iv) Under electron microscope , fibre containing nucleosomes appear as

(a) Beads on string (c) solenoid coils

(b) Dense bodies like kinetochore and heterochromatin (d) loops

	(i)	(ii)	(iii)	(iv)
Q1	D	A	B	B
Q2	C	D	B	A

Q3	C	B	C	C
Q4	C	D	A	A

5 MARK

Q1.(i) How are the following formed and involved in DNA packaging in the nucleus of a cell?
(a) Histone octamer
(b) Nucleosome
(c) Chromatin
(ii) Differentiate between euchromatin and heterochromatin. Refer page no 99

Q2.Describe Meselson and Stahl's experiment that was carried out in 1958 on E. coli. Write the conclusion they arrived at after the experiment.

Or

(i) What is central dogma? Who proposed it?
(ii) Describe Meselson and Stahl's experiment to prove that the DNA replication is semi-conservative. Refer Page no. 98 &105

Q3. (i) Name the stage in the cell cycle where DNA replication occurs.
(ii) Explain the mechanism of DNA replication. Highlight the role of enzymes in the process.
(iii) Why is DNA replication said to be semi-conservative?

Or

(i) Explain the process of DNA replication with the help of a schematic diagram.
(ii) In which phase of the cell cycle does replication occur in eukaryotes? What would happen if cell division is not followed after DNA replication? Refer Page no.105 &106

Q4. Answer the following questions based on Hershey and Chase's experiments
(i) Name the kind of virus they worked with and why?
(ii) Why did they use two types of culture media to grow viruses in? Explain.
(iii) What was the need for using a blender and later a centrifuge during their experiments?
(iv) State the conclusion drawn by them after the experiments. Refer page no. 102

Or

How did Hershey and Chase establish that DNA is transferred from virus to bacteria?

Q5. (i) Describe the process of aminoacylation.
(ii) 'Process of transcription and translation are coupled in prokaryotes, but not in eukaryotes'. Explain. Refer Page no. 114

SELF ASSESSMENT **Max marks : 40**

Question no 1 to 11 carries 1 mark.

Q1. 5-methyl uracil is
(a) Adenine (c) Thymine
(b) Guanine (d) Cytosine

Q2. The enzyme taking part in joining two fragments of DNA is
(a) Ligase (c) Polymerase

(b) Gyrase (d) Helicase

Q3. Which of the following does not follow central dogma of molecular biology

(a) Mucor (c) Chlamydomonas

(b) Pea (d) HIV

Q4. RNA polymerase I catalyses the synthesis of

(a) mRNA (c) tRNA

(b) snRNA (d) rRNA

Q5. Site for protein synthesis is

(a) nucleus (c) cytosol

(b) ribosome (d) lysosome

Q6. Anticodon occur in

(a) tRNA (c) mRNA

(b) mtRNA (d) rRNA

Q7. Which can not be used for DNA fingerprinting in humans

(a) Leukocytes (c) erythrocytes

(b) Hair bulbs (d) sperm

ASSERTION AND REASONING

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

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

(c) If the **Assertion** is true but the **Reason** is false.

(d) If both the **Assertion** and **Reason** are false

Q8. **Assertion:** Watson and Crick provided experimental proof of semi-conservative nature of DNA replication.

Reason : RNA polymerase adds nucleotides in replication.

Q9 .**Assertion:** A lagging strand of DNA is formed on both sides of *ori.*

Reason : 5' end on one side of *ori* becomes 3' end on the other side.

Q10. **Assertion:** The two strands of DNA are antiparallel.

Reason: The same strand replicates a leading stand on one side of ori and lagging strand on the other side.

Q11. **Assertion**: Prokaryotic RNA polymerase recognises the promoter region with the help of sigma factor.

Reason: Only the core enzyme is required for transcription

2 mark Questions

Q12. A genetic code is specific and nearly universal. Justify.

Q13. Write down the possible levels of regulation of gene expression in eukaryotes.

Q14. Differentiate between leading strand and lagging strand.

3 mark Questions

Q15. Why are both the strands of DNA not copied during transcription? Explain

Q16. Describe the structure of an RNA polynucleotide chain having four different types of nucleotides.

Q17. Explain the significance of satellite DNA in DNA fingerprinting.

Q18. **Case Study** The search for genetic material began quite easily but it got impetus with the discovery of transformation of live bacteria by picking up chemicals of the dead relatives. Obviously these chemicals should be genetic material of dead relatives. In 1944, three scientist set out to know the chemical nature of genetic material – Whether protein , RNA, nucleotides of DNA or DNA itself .They conclusively proved that the

transforming principle or genetic material is DNA. After going through the above paragraph and our knowledge of transforming principle , answer the following (i) to (iv) questions with correct option:

i) Name the scientist who discovered transformation in organisms through absorption of components of their dead relatives

(a) Fleming (c) Griffith

(b) Watson and crick (d) Florey

ii) Name the organism over which transformation experiments were carried out

(a) *Salmonella typhimurium* (c) *Entamoeba histolytica*

(b) *Streptococcus pneumonia* (d) *Plasmodium falciparum*

iii) Name the animal on which test were performed to know transformation

(a) Guinea Pig (c) Monkey

(b) Rat (d) Squirrel

iv) Name the scientist involved in finding the nature of transforming factor

(a) Avery, Macleod , and McCarty (c) Meselson and Stahl

(b) Hershey and Chase (d) Taylor et al. 4mark

5 mark Questions

Q19. Write the sequence of steps involved in the sequencing of genome of an organism

Q20. Explain the structure of tRNA with the help of a diagram. Describe its role in the process of transcription.

CH 6 EVOLUTION

Miller's experiment – S.L. Miller experimentally proved that the first form of life has come from pre-existing non-living organic molecules.

Mnemonic for Gases in Miller's Experiment :

A **M**an **W**as **H**ungary.

Ammonia **M**ethane **W**ater **h**ydrogen

Homologous organs-Organs which have similar anatomy and origin but differ in function. These show divergent evolution.

Ex-Forelimbs of man, cheetah, whale, bat and bird

Thorns of Bougainvillea and tendrils of Cucurbita

Analogous organs-Organs which are not anatomically similar but perform similar functions. These are the result of convergent evolution.

Ex-Wings of butterfly and bird, sweet potato and potato, Eye of octopus and mammal, Flippers of penguins and dolphins, etc.

Adaptive radiation-The process of evolution of different species in a geographical area starting from a point and literally radiating to other areas of geography.

Evolution by anthropogenic action (human action)- Antibiotic resistant microbes, pesticide resistant pests, DDT resistant mosquitoes.

Theories of evolution-

Darwin's theory- Branching descent and natural selection are the two key concepts of evolution.

Lamarck' theory- According to this theory, evolution of life forms occurred due to use and disuse of organs.

Hugo DeVries theory- Hugo DeVries based on his work on evening primrose said that mutation causes evolution and hence called it saltation.

Hardy Weinberg Principle-It states that allele frequencies in a population are stable and is constant from generation to generation

Factors affecting Hardy –weinberg equilibrium- Mnemonic:
Gappu **M**amma **N**e **S**abki **Gu**d **M**ithai **Gi**rai
Gene **M**igration,**N**atural **selection**, **G**enetic **d**rift,**M**utation, **G**enetic **R**ecombination

Evolution of man		**Mnemonic**
Dryopithecus	-	Daya
Ramapithecus	-	Ram ka
Australopithecus	-	Australia me
Homo habilis	-	Home Hai
Homo erectus	-	Home Erect
Neanderthal man	-	Nahi
Cro-magnon	-	Kar
Homo sapiens sapiens	-	sakta

Chronological order of geological periods
Mnemonic: Silly Dev Carbon Painted Taj Chahta Tha ?

S	-	Silurian
D	-	Devonian
C	-	Carboniferous
P	-	Permian
T	-	Triassic
J	-	Jurassic
C	-	Cretaceous
T	-	Tertiary
Q	-	Quaternary

Multiple Choice Questions

Question 1.
Life on earth appeared
(a) 800 million years after the formation of the earth
(b) 700 million years after the formation of the earth
(c) 600 million years after the formation of the earth
(d) 500 million years after the formation of the earth
Answer: (a) 800 million years after the formation of the earth

Question 2.
The scientist who demonstrated experiments that life comes only from pre-existing life was
(a) Darwin (b) Mendel (c) Louis Pasteur (d) Oparin
Answer: (c) Louis Pasteur

Question 3.
Name the Russian scientist who proposed that the first form of life could come from pre-existing non-living organic molecules and that the formation of life was preceded by chemical evolution.

(a) Darwin (b) Mendel (c) Louis Pasteur (d) Oparin
Answer: (d) Oparin

Question 4.
Name the English scientist who proposed the same idea that the Russian scientist proposed
(a) Oparin (b) Haldane (c) Darwin (d) Mendel
Answer: (b) Haldane

Question 5.
Which scientist concluded that existing living forms share similarities to varying degrees not only among themselves but also with life forms that existed millions of years ago?
(a) Darwin (b) Haldane (c) Oparin (d) Mendel
Answer: (a) Darwin

Question 6.
The name of the naturalist who worked in Malay Archipelago regarding evolution is
(a) Darwin (b) Alfred Wallace (c) Haldane (d) Oparin
Answer: (b) Alfred Wallace

Question 7.
Homology indicates
(a) Common structure (b) Common organs (c) Common brain (d) Common ancestry
Answer: (d) Common ancestry

Question 8.
Homology is based on
(a) Divergent evolution (b) Natural evolution (c) Unnatural evolution (d) None of the above
Answer: (a) Divergent evolution

Question 9.
Use of herbicides, pesticides etc. has resulted in
(a) More varieties in a much lesser time scale (b) Less varieties in a much lesser time scale
(c) Resistant varieties in a much lesser time scale (d) None of the above
Answer: (c) Resistant varieties in a much lesser time scale

Question 10.
Biological evolution is
(a) Evolution by natural selection (b) Evolution by unnatural selection
(c) Could be both (a) and (b) (d) None of the above
Answer: (a) Evolution by natural selection

Question 11.
The work of ……. on population influenced Darwin.
(a) Mendel (b) Lamarck (c) Malthus (d) None of the above
Answer: (c) Malthus

Question 12.
The French naturalist who said that evolution of life forms had occurred but driven by use and disuse of organs is

(a) Lamarck (b) Malthus (c) Mendel (d) Darwin
Answer: (a) Lamarck

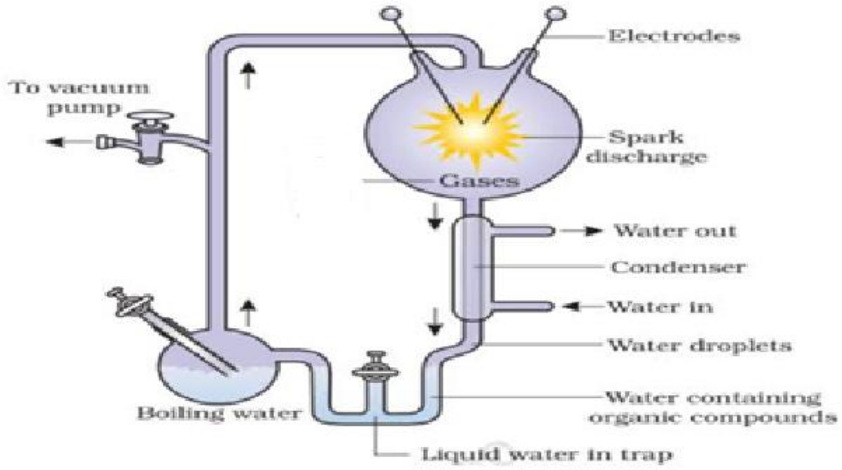
Question 13.
The scientist who believed mutation caused speciation and hence called it saltation is
(a) Darwin (b) Mendel (c) de Vries (d) Hardy
Answer: (c) de Vries

Question 14.
The principle that says that allele frequencies in a population are stable and is constant from generation to generation is
(a) Hardy-Weinberg Principle (b) Charles Darwin Principle
(c) de Vries Principle (d) Lamarck Principle
Answer: (a) Hardy-Weinberg Principle

Question 15.
The first cellular form of life appeared on earth in about
(a) 3000 mya (b) 2500 mya (c) 2000 mya (d) 1500 mya
Answer: (c) 2000 mya

Question 16.
The theory of use and disuse was given by
(a) Aristotle (b) Lamarck (c) Stebbins (d) Vavilox
Answer:(b) Lamarck

Question 17.
What was the mixture of gases used in chamber marked A?



(a) Oxygen O_2, ammonia (NH_3), hydrogen H_2, and water H_2O
(b) Methane (CH_4) , ammonia(NH_3), hydrogen H_2 and water H_2O
(c) Oxygen O_2, ozone O_3, hydrogen H_2, and water H_2O
(d) Oxygen O_2, ozone O_3, hydrogen H_2, and water H_2O
Answer:(b) Methane (CH_4) , ammonia(NH_3), hydrogen H_2 and water H_2O

Question 18.

Match the correct brain capacities given in Column B with the primates given in Column A

Column A	**Column B**
(1) Homo erectus	**(i) 650 – 800 cc**
(2) Neanderthal man	**(ii) 900 cc**
(3) Homo habilis	**(iii) 1400 cc**
(4) Australopithecus	**(iv) 600 cc**

(a) (1) – ii, (2) – iii, (3) – i, (4) – iv (b) (1) – iii, (2) – i, (3) – ii, (4) – iv
(c) (1) – i, (2) – ii, (3) – iv, (4) – iii (d) (1) – iii, (2) – ii, (3) – iv, (4) – i
Answer:(a) (1) – ii, (2) – iii, (3) – i, (4) – iv

Question 19.
In 1938, Coelocanth was caught from:
(a) North America (b) South America (c) India (d) South Africa
Answer: (d) South Africa

Question 20.
Which fish- like reptiles evolved probably 200mya?
(a) Tyrannosaurus (b) Ichthyosaurs (c) Pelycosaurs (d) None of these.
Answer: (b) Ichthyosaurs

Reason Assertions

Q1. **Assertion:** According to big-bang hypothesis about 20 billion years ago the universe was a big ball of only neutrons.
Reason: Movement of these particles is known to generate tremendous heat which causes explosion due to temperature and pressure changes.
Answer: (a)

Q.2. **Assertion**: The number of white winged moths decreased drastically after industrialization in England.
Reason: Effects of industrialization were more marked in rural areas of England.
Answer: (c)

Q.3. **Assertion:** Chimpanzee is the closest relative of present-day humans.
Reason: The banding pattern in the autosome numbers 3 & 6 is remarkably similar.
Answer: (a)

Q.4. **Assertion:** The primitive atmosphere was reducing once i.e., without oxygen.
Reason: In the primitive atmosphere, oxygen was involved in forming ozone.
Answer: (c)

Q.5 **Assertion:** Mostly accepted version of theory of abiogenesis, i.e., the first form of life arose slowly through evolutionary forces from non- living molecules is accepted by majority.
Reason: Lamarck's theory of evolution is popularly called the theory of germplasm.
Answer: (c)

Q.6. **Assertion:** Theory of chemical evolution proposed that life comes from pre-existing non-living organic molecules.
Reason: The primitive earth conditions led to production of organic molecules.

Answer: (a)

Q.7. **Assertion:** Amphibians have evolved from fishes.

Reason: Archaeopteryx is a fossil linking fishes and amphibians.
Answer: (c)

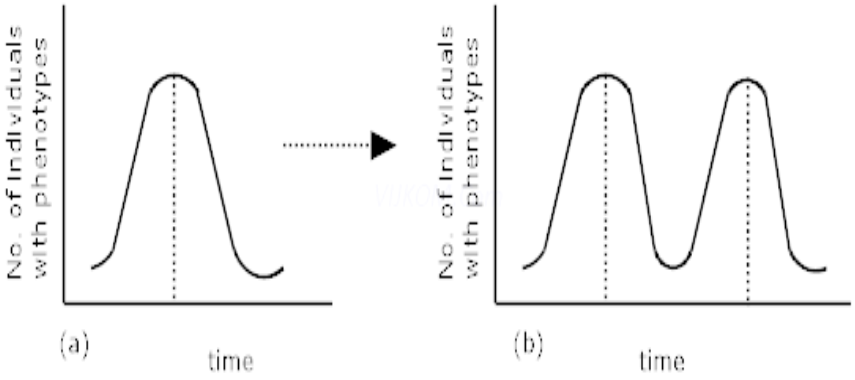
Q.8. **Assertion:** Mutations are basically different from fluctuations.
Reason: Mutations are sudden discontinuous and large variations, while fluctuations are small and continuous variations.
Answer: (a)

Q.9. **Assertion:** The earliest organisms that appeared on the earth were non-green and presumably anaerobes.
Reason: The first autotrophic organisms were the chemoautotrophs that never released oxygen.
Answer:(b)

Q.10. **Assertion:** Darwin's finches show a variety of beaks suited for eating large seeds, flying insects and cactus seeds.
Reason: Ancestral seed-eating stock of Darwin's finches radiated out from South America main land to different geographical areas of the Galapagos Islands, where they found competitor-free new habitats.
Answer: (a)

Case Study Questions (4 Marks)

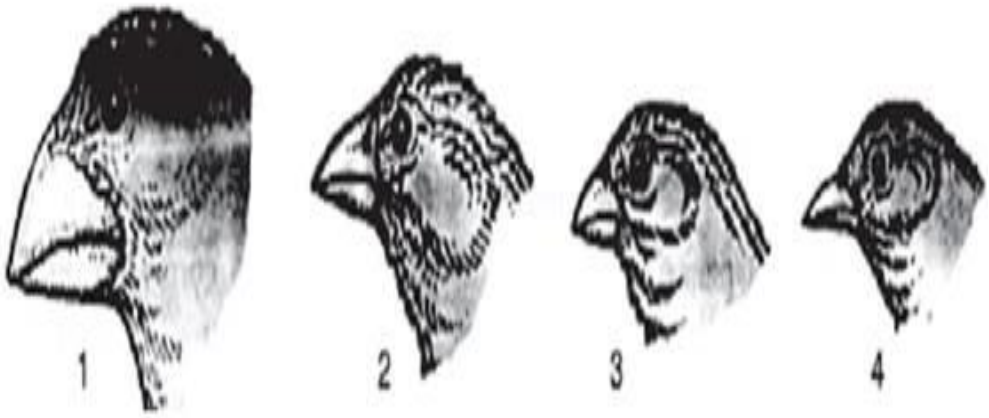
Q1. **Study the figures given below & answer the following question.**



i) Under the influence of which type of natural selection would graph (a) become like graph (b).
ii) What could be the likely reason for new variations arising in a population.
OR
When Natural selection could lead to stabilisation?
iii) Who suggested natural selection as a mechanism of evolution?
iv) When will directional change occur?
Ans. (i) Disruptive & elective.
(ii) Because individuals at the extremes contribute more offspring compared to those in the centre produces two peaks in distribution of a trait.
OR
Natural selection can lead to stabilisation when more individuals acquire mean character value.

(iii) Charles Darwin.
(iv) When more individuals acquire values other than the mean character value.

Q2. Figures given below are of Darwin's finches?



Variety of beaks of Darwin's finches.
(a) Mention the specific geographical area where these were found.
(b) Name and explain the phenomenon that has resulted in the evolution of such diverse species in the region.

OR

What was his observation regarding the beaks of the birds?
(c) How did Darwin visit the particular geographical area?
(d) Give any other example of such a phenomenon.

Ans. (a) Galapagos Island.
(b) Adaptive radiation – The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation.

OR

He realized that there were many varieties of finches. From the original seed-eating features many other forms with altered beaks arose., enabling them to become insectivorous and vegetarian finches.
(c) Through sea voyage in a sail ship called H.M.S. Beagle.
(d) Australian Marsupials.

Q3. Organic evolution states that present complex plants and animals have evolved from earlier simpler forms of life by gradual changes over a long period of time. Doctrine of organic evolution is supported by many types of evidence. Observe the following diagram and answer the questions listed below (related to the concept of organic evolution).

(a) Identify the diagram.
(b) Why is it called the missing link between the birds and reptiles?
(c) To which period of the Geological Time Scale, it belongs to?
OR
Which view is supported by its palaeontological studies?
(d) Give one character each of the birds and reptiles in the given diagram.

Ans:

. The provided diagram is of *Archaeopteryx.*

a. Because it had certain characteristics of both birds and reptiles.

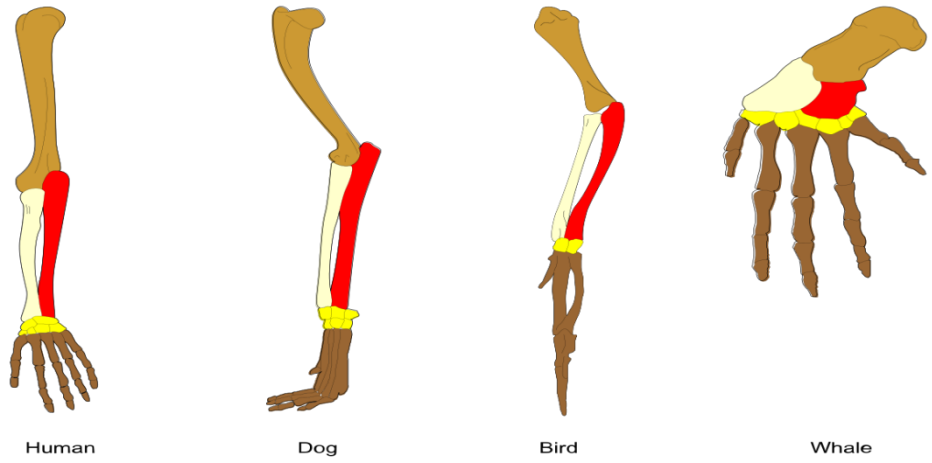
b. Jurassic period of Mesozoic era.

OR

Birds are glorified reptiles / Birds evolved from the reptiles.

d. It had a beak and wings like birds. And teeth inside the beak like reptiles. Moreover, its claws were horny like reptiles.

Q4.



The forelimbs of four vertebrates are shown in the diagram shown above.
(a) What type of evolution is exhibited by the similarity among these organs in those organisms?
(b) What are such organs known as?
OR
Besides forelimbs give two other examples in vertebrates.
(c) What do they indicate?
(d) What is similar in the anatomical structure of their forelimbs?

Ans:(a) Divergent evolution.
(b) Homologous organs.
OR
Vertebrate hearts and brains.
(c) Homology indicates common ancestry.
(d) All of them have humerus, radius, ulna, carpals, metacarpals, and phalanges.

Q5. When the reptiles came down, mammals took over the earth. There were mammals in South America, which resembled some of the modern-day mammals. But due to continental drift, they disappeared

whereas the pouched mammals of Australia flourished and evolved into the various forms of pouched mammals that we see today.

a) Give any two examples of mammals living wholly in water.
(b) Name the animal to which the first mammals resemble in size.
(c) Why did dinosaurs suddenly disappear from the earth?
(d) Mention two characteristic features that were the reasons for the successful existence of mammals on earth.

OR

Why did the continental drift affect the mammals of South America and Australia, differently?

Ans:

a) Whales, dolphins, seals, sea cows.
b) Shrews
c) (i) Climatic changes killed them
(ii) Most of them evolved into birds.

(d) (i) Most of the mammals were viviparous and protected their unborn young ones inside the mother's body.
(ii) With increased brain size, they became intelligent in sensing and avoiding danger.

OR

(i) Due to continental drift, when South America joined North America, the South American mammals were overridden by those of North America.
(ii) But Australia became separated and due to lack of competition from any other mammal, the pouched mammals flourished and evolved.

2 Mark Questions

Q1. Explain Oparin-Haldane theory of chemical evolution of life.

Ans. The first life form could have come from the pre-existing, non-living organic molecules (like RNA, Proteins, etc.) and the formation of life was preceded by chemical evolution.

Q2. **Distinguish between convergent and divergent evolution giving one example of each.**
Ans. Divergent Evolution – Development of different functional structures from a common ancestral form is called divergent evolution.
Homologous organs show divergent evolution.
Examples: Darwin's Finches, Australian Marsupials, locomotion in mammals.
Convergent Evolution – Development of similar adaptive functional structures in unrelated groups of organisms is called convergent evolution.
Analogous organs show convergent evolution.
Examples: Australian Marsupials and Placental mammals, various aquatic vertebrates and wings of insects, bird and bat.

Q3. **What is adaptive radiation? Explain with an example.**
Ans. Adaptive radiation is an evolutionary process that produces new species from a single, rapidly diversifying lineage. This process occurs due to natural selection. An example of adaptive radiation is Darwin finches, found in Galapagos Island. A large variety of finches is present in Galapagos Island that arose from a single species, which reached this land accidentally. As a result, many new species have evolved, diverged, and adapted to occupy new habitats. These finches have developed different eating habits and different types of beaks to suit

their feeding habits. The insectivorous, blood sucking, and other species of finches with varied dietary habits have evolved from a single seed eating finch ancestor.

Q4. **How did Louis Pasteur disprove spontaneous generation theory?**
Ans. Louis Pasteur showed that in pre-sterilized flasks, life did not come from killed yeast while in another flask open to air, new organisms arose from 'killed yeast.

Q5. **Define homologous organs? Give one example of organ homologous to hand of man?**
Ans. Homologous organs are those organs which are similar in basic structure & embryonic developments but perform different functions. e.g. bones of forelimbs of whales, bat, birds and human beings.

Q6. **What is the role of variation in evolution?**
Ans. Variations are useful for survival of species in changed environmental situations. If a population of reproducing organisms are suited to a particular niche & if the niche is drastically altered the population could be wiped out however if some variations were to be present in few individuals, there would be some chances for them to survive.

Q7. **Describe one evidence which decisively proves that birds have evolved from reptiles?**
Ans. Missing link between birds & reptiles called. *Archaeopteryx* showed that "Birds have evolved from reptiles". These are organisms which show the characters of both birds (e.g. presence of wings & feathers in the body) as well as of reptiles (e.g. gong tail & jaws with identical teeth).

Q8. Give examples to show evolution by anthropogenic action.
Ans. Excess use of herbicides pesticides etc. has resulted in selection of resistant varieties in a much lesser time scale. Same is true for antibiotic or drug resistant microbes.

Q9. **What is speciation? List any two events that lead to speciation?**
Ans. Speciation refers to the origin of new species or the phenomena of development of new species from pre-existing one.
The two factors which lead to speciation are – Genetic drift, mutation & natural selection.

Q10. **Would you consider wings of butterfly & a bat as homologous or Analogous & why?**
Ans. Wings of butterfly & bat are said to be analogous because they have originated from different parts – e.g. in butterfly wings are originated from skin and feather & in bats wings are originated from forelimbs but both of them perform the same function of flying.

3 Mark Questions

Q1. **(i) State the Hardy-Weinberg principle.**
(ii) When there is a disturbance in the Hardy-Weinberg equilibrium, what would it result in?
(iii) According to this principle, what is the sum total of all allelic frequencies?
Ans. (i) The allele frequencies in a population are stable and constant from generation to generation.
(ii) Evolution.
(iii) One.

Q2. **Classify the following as examples of homology and analogy**
(i) Hearts of fish and crocodile
(ii) Wings of butterfly and birds
(iii) Eyes of Octopus and Mammals

(iv) Tubers of potato and Sweet potato
(v) Thorns of Bougainvillea and spines of Opuntia
(vi) Thorn of Bougainvillea and tendrils of cucurbits.
Ans. (i) Homology (ii) Analogy (iii) Analogy (iv) Analogy (v) Analogy (vi) Homology

Q3. Stanley Miller and Harold Urey performed an experiment by recreating in the laboratory the probable conditions of the atmosphere of the primitive earth.
(i) What was the aim of the experiment?
(ii) In what forms was the energy supplied for chemical reactions to occur?
(III) For how long was the experiment run continuously? Name two products formed.
Ans. (i) To prove Oparin's theory of origin of life.
(ii) Electric discharge using electrodes.
(iii) One week; Amino acids and Sugar.

Q4. **What are vestigial organs? Give examples.**
Answer: Vestigial organs – These are the organs in an organism which are fully developed but non-functional in present time. They had proper functions and use in the ancestors.
There are about 80 vestigial organs in the human body which mainly include coccyx (tail bone), nictitating membrane (3rd eyelid), caecum and vermiform appendix, canines, wisdom teeth, body hair, auricular muscles, mammary glands in male, etc.
Vestigial organs are also present in some other animals e.g., splint bones in the horse, hind limbs and pelvic girdles in python, wings, and feathers in flightless birds, etc.

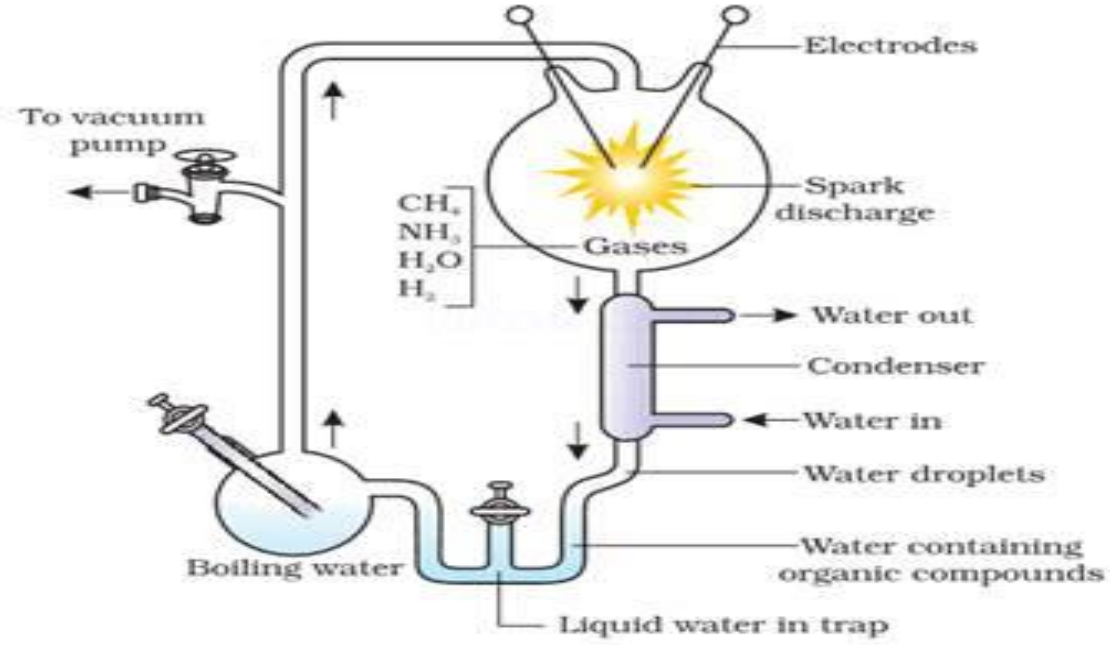
Q5. (i)In which part of the world, the Neanderthal man lived?
(ii)What was his brain's capacity?
(iii) Mention the advancement which Neanderthal man showed over *Homo erectus*.
Ans.(i) Near Eastern and Central Asia
(ii) 1400 c.c.
(iii) More brain capacity, use of hides to cover the body and burial of the dead.

Q6. What are the facts that support Darwin's theory of Natural selection?
Ans. The following facts that supports Darwin's theory of Natural selection
Overproduction: – All organisms tend to multiply at a high rate but it is not possible for all organisms to survive.
Struggle for Existence: – Because of limitation of space & food all the offspring of the result of overproduction will not survive & they will compete with one another to grow. This develops a struggle for existence not only among individuals of different species but also among same species.
Variations: - No two individuals of the same species are exactly alike even coming out from the same parental stock.
Survival of fittest: - The individuals with useful variation will survive during the struggle of existence while those with less fortunate variation would perish.

Q7. What is the study of fossils called? Mention any three points how the fossils throw light on past life?
Ans. Study of fossils is known as paleontology.
→ Cross-section of the earth's crust indicates the arrangement of sediments one over the other during the long history of Earth.
→ Different sediments contain different life forms which probably died during the formation of particular sediments.
→ Connecting or missing link – which contains characters of different groups.

Q8. **By taking industrial melanism as an example, explain the concept of natural selection by evolution?**
Ans. Theory of natural selection states that due to survival of fittest, the species change readily owing to preservation & transmission of minute variation & gradually give rise to new forms.
Example – In collection of moths in 1850 it was observed that there was whiter winged moth than dark winged but after industrialization there were darker winged moths. This is due to the reason that During post-industrial period trees trunk become dark due to industrial smoke under this condition, white winged moth do not survive due to predators dark winged moth survived Before industrialization sets in, thick growth off white coloured lichen covered trees in that background white winged moth survived but dark – coloured moth was picked out by predators hence nature selects which species is suitable.

Q9. Who were the two scientists that conducted an experiment to synthesise organic molecules abiotically? How did they provide the probable condition of the primitive earth in this experiment?



Ans. Urey & Miller tried to create in the laboratory the similar conditions which might have existed in the early primitive atmosphere. A mixture of water vapours methane, ammonia & hydrogen is exposed to electric discharge in a closed chamber, this fluid thus formed is allowed to stand for several weeks as a result, amino acids e.g. glycerine & alanine are formed from fluid. They suggested that electric discharge produced during lightning in the primitive atmosphere of earth might have resulted in formation of organic compounds.

Q10. Chemical insecticides remain useful only for a limited time. Explain with reference to evolution with a suitable example.
Ans. "Chemical insecticides remain useful only for a limited time" because of the phenomena of natural selection with the course of time when chemical insecticides are excessively used to kill insects, some of the resistant varieties of the organism would have been created which are not killed lay the insect icicle such resistant varieties of the unseats are selected lay nature & they multiply after sometime population of this resistant variety increases & the chemical insecticide would lee ineffective to control these insects for example DDT is a common insecticide for mosquitoes lout is now ineffective because DDT – resistant mosquitoes have appeared & selected in nature.

5 Marks Questions

Q1. What does Hardy Weinberg's principle state? What are the factors which affect Hardy Weinberg's equilibrium?
Ans. Ref, p.g 120-121

Q2. Fill up the blanks left in the table showing Era, period and organism.

Era	Period	Organisms
Cenozoic	**A**	**Modern man, mammals, birds, rise of monocot**
B	**Tertiary**	**Rise of first Primate, angiosperm**
Mesozoic	**C**	**Gingko, Gnetales**
D	**Jurassic**	**Conifers, cycads, Reptiles**
Paleozoic	**E**	**Early reptiles (extinct)**
F	**Silurian**	**Psilophyton**

Ans. (A) Quaternary (B) Cenozoic (C) Cretaceous
(D) Mesozoic (E) Carboniferous (F) Paleozoic

Q3. **With the help of suitable diagrams, represent the operation of natural selection on different traits.**
Ans. Ref, p.g 115-116

Q4. **What are the three different ways in which natural selection may occur/operate on different traits? Explain diagrammatically.**
Answer: Ref, p.g. 120

Q5. Trace the important events or stages of human development?
Ans. Ref, p.g. 124-125

Self Assessment Test MM=40

Q1. Which period is known as "Age of amphibians"? 1 Mark
a) Carboniferous period b) Jurassic period c) Cretaceous period d) Quaternary Period.

Q2. Name the phenomenon by which rapid speciation takes place? 1 Mark
a) Genetic Drift. b) Natural selection c) Gene Migration d) Gene Flow.

Q3. Variations caused by mutation, as proposed by Hugo de Vries are:
a) Random and directional c) Random and directionless
b) Small and directional d) Small and directionless

Q4. Coelacanth was a:
a) Invertebrate b) Fish c) Amphibian d) Reptile

Q5. How many mya, the jawless fish probably evolved?

a) 320 b) 350 c) 400 d) 500

Q6. Flippers of penguins and dolphins are examples of:

a) Adaptive Radiation c) Convergent evolution

b) Industrial melanism d) Natural selection

Q7. The factor that leads to Founder effect in a population is:

(a)Genetic drift c) Natural selection

(b) Genetic combination d) Mutation

Q8. **Assertion** : The earliest organisms that appeared on the earth were non-green and presumably anaerobes.

Reason :The first autotrophic organisms were the chemoautotrophs that never released oxygen.

Q9. Assertion: We have lost all the direct evidence of the origin of life.

Reason: The persons responsible for protecting evidences were not skilled.

Q10. Assertion : Coacervates are believed to be the precursors of life.

Reason : Coacervates were self-duplicating aggregates of proteins surrounded by lipid molecules.

Q11. Assertion: The first cells used RNA as their hereditary molecule.

Reason: DNA evolved from RNA.

Q12. How do Darwin and Hugo de Vries differ regarding Mechanism of Evolution?

Q13. Match the scientists listed under column-A with ideas listed in column-B.

Column-A	Column-B
Darwin	Abiogenesis
Oparin	Use & disuse of organs
Lamarck	Saltation
DeVries	Evolution by natural selection

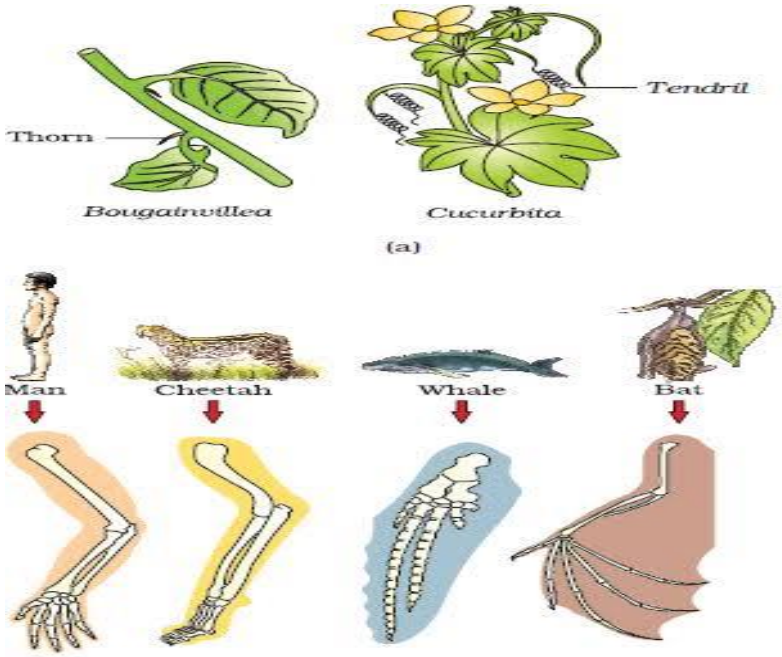
Q14. List the conditions of primitive Earth created in the laboratory by S.L Miller in 1953. What was the inference of this experiment?

Q15. What do you mean by Divergent evolution? Give examples. What is the driving force behind it?

Q16. Which law states that the sum of allelic frequencies in a population is constant? List the five factors that influence the law.

Q17. Where do you find fossils? What is their significance in evolution?

Q18. Case Study : Observe the following diagrams and answer the questions given below:



. What is the relation between thorns of Bougainvillea and tendrils of cucurbits?

a. What is the relation between the forelimbs of animals in the given diagram?

b. What is the significance of Homologous structures in evolution ?

c. Give any example of Analogous organs.

OR

What clue can be obtained from the biochemical similarities in proteins and genes among diverse organisms?

Q19. Enumerate the key concepts in the evolution theory of Darwin

Q20. What is adaptive radiation? Explain it with reference to Australian marsupials. Can this fauna indicate its parallel evolution with placental mammals? How do you explain their geographic distribution?

CH 7 HUMAN HEALTH AND DISEASES

1.

S.NO.	DISEASE	CAUSAL AGENT	MODE OF TRANSMISSION	BODY PART AFFECTED	SYMPTOMS
1	TYPHOID	*Salmonella typhi*	Contaminated food and water	Stomach and intestine	Sustained high fever (39° to 40°C), weakness, stomach pain, constipation,

					headache and loss of appetite. Intestinal perforation and death may occur in severe cases.
2	PNEUMONIA	*Streptococcus pneumoniae, Haemophilus influenzae*	By inhaling the droplets/ aerosols released by an infected person or by sharing glasses and utensils with an infected person.	Alveoli of the lungs	Fever, chills, cough and headache. The alveoli get filled with fluid leading to severe problems in respiration. In severe cases, the lips and fingernails may turn gray to bluish in colour.
3	MALARIA	*P. vivax*, *P. malaria* and *P. falciparum*	Through the bite of infected female *Anopheles* mosquito	Liver & RBCs of human	Chill and high fever recurring every three to four days.
4	AMOEBIASIS or (AMOEBIC DYSENTERY)	*Entamoeba histolytica*	Drinking water/ food contaminated by the faecal. Houseflies act as mechanical carriers.	Large intestine	Constipation, abdominal pain and cramps, stools with excess mucus and blood clots
5	ASCARIASIS	*Ascaris* and *Wuchereria* (the filarial worm)	Contaminated water, vegetables, fruits, etc.	Intestine	Internal bleeding, muscular pain, fever, anemia and blockage of the intestinal passage.
6	ELEPHANTIASIS OR FILARIASIS	*Wuchereria bancrofti* and *W. malayi*	Through the bite by the female mosquito vector- Culex, Anopheles, Aedes	The lymphatic vessels of the lower limbs, genital organs	Chronic inflammation of the infected organs.
7	RINGWORMS	*Microsporum*, *Trichophyton* and *Epidermophyton*	From soil or by using towels, clothes or even the comb of	Skin folds such as those in the groin or	Dry, scaly lesions on various parts of the body such as skin, nails and

			infected individuals.	between the toes	scalp, intense itching.
8	COMMON COLD	*Rhinovirus*	Droplets resulting from cough or sneezes of an infected person are either inhaled directly or transmitted through contaminated objects such as pens, books, cups, etc.	Nose and respiratory passage but not the lungs.	Nasal congestion and discharge, sore throat, hoarseness, cough, headache, tiredness, etc., which usually last for 3-7 days

2. Life cycle of Plasmodium.NCERT Page 132

3. AIDS (Acquired Immuno Deficiency Syndrome) caused by HIV (Human Immunodeficiency Virus).It is a retrovirus i.e. has RNA as the genetic material. Life cycle of retrovirus **NCERT Page 139**

4. Immunity-The ability of the host to fight the pathogens.

Innate immunity-It is a non specific type of defense present at the time of birth. It consists of 4 types of barriers-

i) Physical barriers-skin, mucus coating if epithelium lining the respiratory, gastrointestinal and urogenital tract.

ii) Physiological barrier-acid in stomach, saliva in mouth, tears from eyes

iii) Cellular barriers-WBC's, macrophages

iv) Cytokine barriers-Virus infected cells secrete proteins called interferons which protect non-infected cells from further viral infection.

Acquired immunity-It is pathogen specific and is acquired by the person during its lifetime. It is characterized by memory.

Active immunity-When a host is exposed to antigens, antibodies are produced in the host body itself. This type of immunity is called active immunity. Ex-Injecting microbes deliberately during immunization or pathogens entering the body during natural infection induce active immunity.

Passive immunity-When ready made antibodies are directly given to protect the body against pathogens, it is called passive immunity. Ex-colostrum

5. Autoimmunity-When the body attacks self cells, it is called autoimmune disease. Ex-Rheumatoid arthritis, multiple sclerosis, Type I Diabetes Mellitus

6. Lymphoid organs-Organs where origin and/or maturation and proliferation of lymphocytes occur. Two types-primary and secondary

i) Primary lymphoid organs-Bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes.

ii) Secondary lymphoid organs-spleen, lymph nodes, tonsils, peyer's patches of small intestine and appendix. These are the sites for interaction of lymphocytes with the antigen.

7. Cancer-In our body, cell growth and differentiation is highly controlled and regulated. In cancer cells, there is breakdown of these regulatory mechanisms. Normal cells show a property called contact inhibition by virtue of which contact with other cells inhibits their uncontrolled growth. Cancer cells appear to have lost that property.

8. Drugs, their effects and sources- The drugs which are commonly abused are opioids, cannabinoids and coca alkaloids

9. MNEMONICS

Derivatives of Cannabis

Govt. **M**edical **C**ollege & **H**ospital
Ganja Marijuana Charas Hashish

MASH(Opioids)

Morphine is **A**cetylated to form **S**mack or **H**eroine

Different types of Antibodies/ Immunoglobulins

German **MADE**
IgG IgM IgA IgD IgE

MULTIPLE CHOICE QUESTIONS

1.Opium is obtained from
a. *Papaver somniferum* b. *Cannabis sativa*
c. *Erythroxylum coca* d. *Datura metel*
Ans:- a

2.Which type of immune response is responsible of rejection of organs/tissues in the patient's body post transplantation?
a. Auto immune response b. Humoral immune response
c. Physiological immune response d. Cell mediated immune response
Ans:- d

3.Diseases are broadly grouped into infectious and non infectious diseases. In the list given below identify the infectious diseases. (i) Cancer (ii) Influenza (iii) Allergy (iv) Smallpox
a. (i) and (ii) b. (ii) and (iiI) c. (iii) and (iv) d. (ii) and (iv)
Ans:- d

4. Which of the following is not a causative organism of ringworm?
a*. Microsporum* *b. Trichophyton* *c. Epidermophyton* *d. Macrosporum*
Ans:- d

5._____is a CNS stimulant as it interferes with the transport of the neurotransmitter dopamine.
a. Valium b. Barbiturate c. Cocaine d. Opium
Ans:- c

6.The chronic intake of…….. causes cirrhosis of the liver.
a. Opium b. Alcohol c. Cocaine d. Tobacco
Ans:- b

7.Virus infected cells secrete proteins called ---------- which protect non infected cells from further viral infection.
a. Serotonin b. Colostrum c. Interferon d. Histamine
Ans:- c

8.The secondary lymphoid organ which contains lymphocytes and phagocytes acts as a filter of blood by trapping blood borne microorganisms is
a. Tonsils b. Spleen c. Lymph nodes d. Appendix
Ans:- b

9. The antibodies produced by allergy are
a. Ig A b. Ig E c. Ig M d. Ig G
Ans:- b

10.The RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase in the --------cells

a. Platelets b. B cells c. Mast cells d. Macrophages

Ans:- d

11.The nature of the spread of communicable diseases is known as _____.

a. Parasitology b. Immunology c. Epidemiology d. None of these.

Ans:- c

12.Syringes and needles used by the youth for taking the drug could prove to be very fatal as:

a. They can acquire serious infections. b. They can lead to malnutrition.

c. They can cause transmission of parasitic disease. d. They can lead to cardiac arrest.

Ans:- a

13. The immunoglobulin found in a mother's milk is

a. IgM b. IgA c. IgE d. IgG

Ans:- b

14. 'Smack' is a drug obtained from the:

a. latex of *Papaver somniferum* *b.* leaves of *Cannabis sativa*

c. flowers of Datura d. fruits of *Erythroxylum coca*

Ans:- a

15. The chemical test that is used for diagnosis of disease caused by human immuno virus is :

a. Serum test b. ESR test c. Widal test d. ELISA test

Ans:- d

16. Malignant malaria is caused by which pathogen?

a. *Plasmodium falciparum* b. *Plasmodium vivax*

c. *Plasmodium malignancies* d. None of these

Ans:- a

17.Chemically interferons are-

a. Carbohydrates b. Glycosides c. Peptides d. Lipoproteins

Ans:- c

18.Which of the following is not lymphoid tissue?

a. Spleen b. Tonsils c. Liver d. Thymus

Ans:- c

19.Ig E is released during-

a. Allergy b. Colostrum secretion c. Tear formation d. None of these

Ans:- a

20.Genetic material of HIV is

a. ds DNA b. ssDNA c. dsRNA d. ss RNA

Ans:- d

ASSERTION AND REASON

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

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

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

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

(d) If both Assertion and Reason are false.

1. Assertion: There is no chance of malaria to a man on the bite of male *Anopheles* mosquito.

Reason: It carries a non-virulent strain of *Plasmodium*.

Ans:- c

2. Assertion : *Plasmodium vivax* is responsible for malaria.

Reason **:** Malaria is caused by polluted water.

Ans:- c

3. Assertion : Tapeworm, roundworm and pinworm are endoparasites of the human intestine.
Reason: Improperly cooked food is the source of all intestinal infections.

Ans:- c

4.Assertion: Innate immunity is non-specific defense.
Reason: It consists of four types of barriers.

Ans:- b

5. Assertion: T-lymphocytes mediate CMI response.
Reason: The above response makes it easy to transplant organs.

Ans:- c

6. Assertion: Artificially acquired passive immunity when antibodies or lymphocytes produced outside the host are introduced into a host.
Reason: A bone marrow transplant given to a patient with genetic immunodeficiency is an example of artificially acquired passive immunity.

Ans:- b

7. Assertion: Interferons help in the elimination of viral infections.
Reason: Interferons released by infected cells, reach nearby unaffected cells and make them resistant to viral infection.

Ans:- a

8. Assertion: Allergens cause excessive immune response in the human body.
Reason: Allergy involves IgA antibodies and interferons.

Ans:- c

9. Assertion: AIDS is a disorder caused by HIV.
Reason: HIV is a virus that damages the immune system of its host.

Ans:- a

10. Assertion: Anti venom against snake poison contains antibodies
Reason: Such type of immunization is active immunization

Ans:- c

SHORT ANSWER TYPE QUESTIONS (2 Marks)

1. **It is often observed that the chances of a person suffering from measles in his or her lifetime are low if he or she has suffered from the disease in their early childhood. Justify the statement.**

Ans:- Memory cells develop during measles in early childhood , subsequent encounters with the same pathogen elicits a highly intensified secondary or anamnestic response

2. Why is sharing injection needles between two individuals not recommended?

Ans:- It is more likely to cause serious infections like AIDS and Hepatitis B

3. Mention the name of the causal organism and the mode of transmission of the disease Amoebiasis.

Ans:-It is caused by an intestinal endoparasite, *Entamoeba histolytica* found in the large intestine of humans. Housefly acts as a mechanical carrier and transmits the parasite from faeces of infected persons to the food. Infection takes place through contaminated food and water.

4. When does a human body elicit an anamnestic response? How does it differ from the primary response?

Ans:- At the time of secondary response. It is of high intensity due to memory cells.

5. State the functions of mast cells in allergy response.

Ans:- Allergy is due to the release of chemicals like histamine and serotonin from the mast cells.

6. How are malignant tumors different from benign tumors?

Ans:- Benign tumors remain confined to their original location, do not spread to other part of the body, cause little damage, no metastasis and malignant tumors proliferate and spread to other body parts, is more harmful, cause serious damage, shows metastasis.

7. What is an autoimmune disease? Give an example.

Ans:- It is an abnormal immune response in which the immune system of the body starts rejecting its own body cells or 'self ' cells and molecules. For example rheumatoid arthritis.

8. 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.

Ans:- Tetanus is caused by a microbe which has a deadly and fast action. Action of the vaccine is slow and this delay may become fatal. Therefore, antitoxins are administered which show an instant response against tetanus toxin.

9. Name the bacterium that causes typhoid. Mention two diagnostic symptoms. How is this disease transmitted to others?

Ans:- *Salmonella typhi*. Constipation, stomach pain, headache, weakness, loss of appetite, high fever. (Any two) The disease is transmitted through contaminated food/water.

10. Provide two means of passive immunity through which the foetus and newly born baby get protected from infection.

Ans: The yellowish fluid colostrum is secreted by the mother during the initial days of lactation. The fetus also receives some antibodies from their mother, through the placenta during pregnancy.

SHORT ANSWER TYPE QUESTIONS (3 Marks)

1 (a) Name the causative agents of pneumonia and common cold.

(b) How do these differ in their symptoms ?

(c) Mention two symptoms common to both.

Ans:- (a) *Streptococcus pneumoniae/ Haemophilus influenzae*, and Rhinoviruses

(b) Different symptoms (any two)

Pneumonia	Common cold
Infects alveoli of lungs	Infects nose and respiratory tract
Chills	Sore throat
Lips/fingers turn grey or black	Hoarseness

(c) Common symptoms- cough and headache.

2 Define the term 'health'. Mention any two ways of maintaining it.

Ans:- Health is a state of complete physical, mental and social well-being. Good health is maintained by a balanced diet, personal hygiene and regular exercise, yoga, vaccination against infectious diseases, proper disposal of wastes, control of vectors, etc.

3 Differentiate between benign and malignant tumors.

Ans:-

Benign tumour	Malignant tumour
It is non cancerous	It is cancerous
Localized	Spreads to other parts of the body
No metastasis	Shows metastasis
Causes limited damage	Causes serious damage

4 (i) Write the scientific names of the two species of filarial worms causing filariasis.

(ii) How do they affect the body of an infected person(s)?

(iii) How does the disease spread?

Ans:- (i) *Wuchereria bancrofti, Wuchereria malayi*.

(ii) Filariasis results in inflammation of the lymphatic vessels of the lower limbs and of the genital organs. It can also lead to gross deformity of the lower limbs and the genital organs (Any two).

(iii) Through the bite of a female *Culex* mosquito.

5 List the two types of immunity a human baby is born with. Explain the differences between the two types.

Ans:- The two types of immunity are innate and passive.. Innate immunity is a non-specific type of defence that provides barriers to the entry of antigens. Passive immunity is a pathogen-specific type of defence that develops in response to an encounter with pathogen. The foetus receives antibodies through the placenta.

6 Why is tobacco smoking associated with a rise in blood pressure and emphysema? Explain.

Ans:- Tobacco has nicotine that stimulates the release of adrenaline and noradrenaline which raise blood pressure. Smoking tobacco releases carbon monoxide which reduces the concentration of haem-bound oxygen. This causes emphysema.

7 Name the two special types of lymphocytes in humans. How do they differ in their roles in immune response?

Ans:- B lymphocytes, T lymphocytes. B-cells produce pathogen specific antibodies/humoral immune response. T-cells help the B-cells to produce antibodies/are responsible for cell mediated immunity.

8 Trace the life-cycle of malarial parasites in the human body when bitten by an infected female Anopheles.

Ans:- Sporozoite of Plasmodium gets into human blood through the bite of female Anopheles mosquito. Sporozoites

reproduce asexually in liver cells, and then they get into red blood cells, where they reproduce asexually and infect

more blood cells. After that they change into gametocytes, which are picked up by the mosquitoes and the entire

cycle occurs again. / Flow chart.

9.Name the cells that act as HIV factories in humans when infected by HIV. Explain the events that occur in the infected cell.

Ans:- Macrophages/Helper T-cells act as HIV factories. The virus enters macrophages or helper T-cells where

RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase. The viral DNA then gets incorporated into the host cell's DNA and directs infected cells to produce virus particles.

10 (i) Name two recent incidences of widespread diseases caused by *Aedes* mosquitoes.

(ii) Mention the name of two pathogens that are responsible for ringworm disease.

(iii) Which pathogen infects the alveoli (of the lungs that result in severe breathing problems?

ANS: (i) Dengue and Chikungunya (ii) *Microsporum, Trichophyton*

iii) *Streptococcus pneumoniae or Haemophilus influenzae*

CASE STUDIES QUESTIONS

CASE-1.The Disease caused by filarial worm *Wuchereria bancrofti* also known as filarial bancrofti and *W. malayi*. These nematodes, commonly called human filarial worms, are endoparasites and are commonly found in the lymphatic vessel and lymph nodes of human beings particularly in the growing regions. Humans are the only definitive host of *W. bancrofti*, while a large number of mosquitoes act as secondary hosts. In India *Culex* mosquito is responsible for the transmission of Filariasis.

(i) Identify the diseases transmitted by mosquitoes.

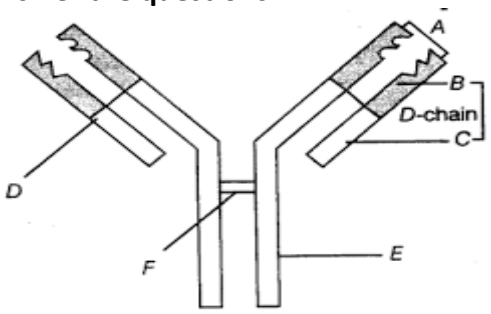
(a) Elephantiasis, malaria, dengue

(b) Wuchereria, Ascariasis, Taeniasis

(c) AIDS, Syphilis, Filariasis

(d) Filariasis, dengue, typhoid.
Ans. (a)
(ii) This Disease can be transmitted during the day if the parasitic worms are sucked by:
(a) *Anopheles sps*
(b) *Culex sps*
(c) Houseflies
(d) *Aedes sps*
Ans. (b)
(iii) Identify the parasite for which only the Aedes mosquito acts as a vector.
(a) Wuchereria
(b) *Plasmodium*
(c) *Entamoeba*
(d) Dengue virus
Ans (d)
(iv) Filarial worm is an endoparasite infected in one of the following organs:
(a) Blood vessels
(b) Urinary vessels
(c) Lymph vessels
(d) All the above
Ans. (c)
(v) Elephantiasis is an example of mosquito-borne disease. Which of the following are correct with respect to this?
(a) The causative worms block the flow of lymph in the body due to their accumulation in the lymph nodes.
(b) Elephantiasis is caused by *Wuchereria*
(c) It causes swelling in the legs
(d) All the above
Ans. (d)

CASE:-2 Observe the diagram and answer the questions



i) Antibodies are
a. Proteins
b. Cholesterol
c. Carbohydrates
d. Nucleic acid
Ans. (a)
ii) Antibodies consist of
a. 2 light chains and 2 heavy chains
b. 1 light chain and 2 heavy chains
c. 2 light chains and 1 heavy chain
d. all of the above
Ans. (a)
iii) The antigen binding site of the antibody is

a. B
b. D
c. F
d. A

Ans. (d)

iv) Light and heavy chains are joined by (F)
a. hydrogen bond
b. hydrophobic bond
c. ionic bond
d. disulphide bond

Ans. (d)

v) The hypervariable region resides in
a. N terminal region of light chain
b. N terminal region of light and heavy chain
c. C terminal region of light chain
d. C terminal region of light and heavy chain

Ans. (b)

CASE-3 Read the given paragraph and answer the following questions. The overall ability of the host to fight the disease-causing organisms conferred by the immune system is called immunity: It is of two types. One type is a non-specific type of defense which is accomplished by providing different types of barriers. The other type of immunity is pathogen specific. Immune responses in such a type of immunity are carried out with the help of two special types of lymphocytes. One of these lymphocytes produce proteins called antibodies, which counteract the pathogen. When a host is exposed to antigens, antibodies are produced in its body. Preformed antibodies can also be administered to develop immunity in the same cases. Sometimes the immune system shows exaggerated responses to certain antigens. The substances to which such an immune response is produced are called allergens.

a) Differentiate between active and passive immunity. (2 Marks)

Ans:-Active Immunity – antibodies are produced in the host cell after infection with antigens. Active immunity is slow and takes time to give its full effective response.

Passive Immunity- When ready-made antibodies are directly given to protect the body against foreign agents. e.g. baby receives a mother's antibodies through the placenta and breast milk.

b) What are allergens. (1 Mark)

Ans:-The agents which cause allergies are called allergens.eg pollens, dust etc.

(c) What are Interferons? (1 Mark)

Ans:- Interferons released by infected cells, reach nearby unaffected cells and make them resistant to viral infection.

(d) Name the antibody sound in colostrum. (1 Mark)

Ans:-Ig A

CASE - 4

Read the given paragraph and answer the following questions.

Some of the human diseases are caused by protozoans. *Plasmodium*, a tiny protozoan, causes malaria. Different species of plasmodium are responsible for different types of malaria. Female *Anopheles* mosquito acts as its transmitting agent from an infected person to a healthy person. Another protozoan parasite that lives in the large intestine of humans and causes amoebic dysentery (amoebiasis). This protozoic disease is also transmitted by an insect and through the contaminated food and water. Maintenance of personal and public hygiene is very important for prevention and control of such infections and diseases. Measures of personal hygiene include keeping the body clean. Consumption of clean drinking water, food, vegetables, fruits, etc. Public hygiene includes proper disposal of waste and excreta, periodic cleaning and disinfection of water reservoirs, pools and tanks.

(a) Name the vector that transmits malarial parasites from one person to another. (1 Mark)

Ans:-Female *Anopheles* mosquito.

(b) Which species of plasmodium causes the most serious malaria? (1 Mark)

Ans:-Female *Plasmodium falciparum*.

(c) What are vectors? Give examples (2 Mark)

Ans:-Organisms which carry pathogens from diseased person to a healthy person are called vectors. For example mosquitos, sand fly, dog, pig etc.

(d)Name the disease caused by *Entamoeba histolytica* (1 Mark)

d. Ans:- Amoebiasis

LONG ANSWER TYPE QUESTIONS

1 What is innate immunity? What are the four types of barriers that protect the body from the entry of foreign agents? Refer NCERT Pg No. 134 & 135.

2 Describe the ill – effects of drug abuse in males and females. Also, mention the preventive measures that are to be taken to reduce such effects. Refer NCERT Pg No. 144 & 145

3 a. Mention any two causes of drug abuse. Refer NCERT Pg No. 144

b. What are the two corollaries of autoimmune disorder? Refer NCERT Pg No.137

c. Name the genes present in normal cells when activated becomes an oncogene. Refer NCERT Pg No.141

4 a. Principle of vaccination is based on the property of "memory" of the immune system. Taking one suitable example, justify the statement. Refer NCERT Pg No.136

b. Comment on the role of vaccination and immunization in keeping the human population healthy. Pg No. 136

c. Mention the chemical nature of an antibody. Refer NCERT Pg No.135

5 a. Why is there a fear amongst the guardians that their adolescent wards may get trapped in drug/alcohol abuse? Refer NCERT Pg No. 144

b. Explain 'addiction' and 'dependence' in respect of drug/alcohol abuse in youth. Refer NCERT Pg No.145

c. Name two diseases whose spread can be controlled by the eradication of *Aedes* mosquitoes. Pg 134.

SELF ASSESSMENT TEST (40 Marks)

SECTION A (1 – Mark each)

1.Opium is obtained from

a. *Papaver somniferum* b. *Cannabis sativa*

c. *Erythroxylum coca* d. *Datura metel*

2.Which type of immune response is responsible for rejection of organs/tissues in the patient's body post transplantation?

a. Auto immune response b. Humoral immune response

c. Physiological immune response d. Cell mediated immune response

3.Which of the following is not a causative organism of ringworm?

a*. Microsporum* *b. Trichophyton* *c. Epidermophyton* *d. Macrosporum*

4.The chronic intake of…….. causes cirrhosis of the liver.

a. Opium b. Alcohol c. Cocaine d. Tobacco

5.Virus infected cells secrete proteins called ---------- which protect non infected cells from further viral infection.

a. Serotonin b. Colostrum c. Interferon d. Histamine

6.The RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase in the --------cells

a. Platelets b. B cells c. Mast cells d. Macrophages

7. The immunoglobulin found in a mother's milk is

a. IgM b. IgA c. IgE d.IgG

SECTION B (1 – Mark each)

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

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

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

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

(d) If both Assertion and Reason are false.

8. Assertion : *Plasmodium vivax* is responsible for malaria.

Reason **:** Malaria is caused by polluted water.

9. Assertion: Innate immunity is non-specific defense.

Reason: It consists of four types of barriers.

10. Assertion: T-lymphocytes mediate CMI response.

Reason: The above response makes it easy to transplant organs.

11. Assertion: AIDS is a disorder caused by HIV.

Reason: HIV is a virus that damages the immune system of its host.

SECTION C (2 – Marks each)

12.Mention the name of the causal organism and the mode of transmission of the disease Amoebiasis.

13. 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.

14 Provide two means of passive immunity through which the foetus and newly born baby get protected from infection.

SECTION D (3 – Marks each)

15 (i) Write the scientific names of the two species of filarial worms causing filariasis.

(ii) How do they affect the body of an infected person(s)?

(iii) How does the disease spread?

16.Trace the life-cycle of malarial parasites in the human body when bitten by an infected female Anopheles.

17.Name the cells that act as HIV factories in humans when infected by HIV. Explain the events that occur in the infected cell.

SECTION E (4 – Marks)

18 Read the given paragraph and answer the following questions. The overall ability of the host to fight the disease-causing organisms conferred by the immune system is called immunity: It is of two types. One type is a non-specific type of defence which is accomplished by providing different types of barriers. The other type of immunity is pathogen specific. Immune responses in such a type of immunity are carried out with the help of two special types of lymphocytes. One of these lymphocytes produce proteins called antibodies, which counteract the pathogen. When a host is exposed to antigens, antibodies are produced in its body. Preformed antibodies can also be administered to develop immunity in the same cases. Sometimes the immune system shows exaggerated responses to certain antigens. The substances to which such an immune response is produced are called allergens.

a) Differentiate between active and passive immunity. (2 Marks)

b)What are allergens.(1 Mark)

(c)What are Interferons? (1 Mark)

SECTION F ((5– Mark each)

19. What is innate immunity? What are the four types of barriers that protect the body from the entry of foreign agents?

20 a. Principle of vaccination is based on the property of “memory” of the immune system. Taking one suitable example, justify the statement.

b. Comment on the role of vaccination and immunization in keeping the human population healthy.

c. Mention the chemical nature of an antibody.

CH 8 MICROBES IN HUMAN WELFARE

S.NO	MICROBE	APPLICATIONS
1	Lactic acid bacteria (LAB)	a) Grows in milk and convert it to curd. b) LAB produce acids that coagulate and partially digest the milk proteins. c) Also improves its nutritional quality by increasing vitamin B12. d) In our stomach too, the LAB play very beneficial role in checking disease causing microbes.
2	(*Saccharomyces cerevisiae)* Baker's Yeast	*a)* used for making foods such as *dosa* and *idli* b) puffed-up appearance of dough is due to the production of CO2 gas by the yeast through the process of fermentation c) Used in making bread
3	*Propionibacterium sharmanii* (a bacterium)	The large holes in 'Swiss cheese' are due to production of a large amount of CO2 by this bacteria.
4	Specific Fungi	The 'Roquefort cheese' are ripened by growing a specific fungi *Pénicillium roqueforti* on them, which gives them a particular flavour.
5	Microbes	a) Traditional drinks and foods are also made by fermentation by the microbes. b) 'Toddy', a traditional drink of southern India, is made by fermenting sap from palms. c) Microbes are also used to ferment fish, soyabean and bamboo shoots to make foods.

Applications of microbes in industrial products-

a) Brewer's yeast *Saccharomyces cerevisiae* is used for fermenting malted cereals and fruit juices to produce ethanol
b) The antibiotic Penicillin obtained from *Penicillium notatum* is a wonder drug
c) Fungus *Aspergillus niger* is used in production of citric acid.
d) Bacterium *Acetobacter aceti* is used in production of acetic acid.
e) Bacterium *Clostridium butylicum* is used in production of butyric acid
f) Microbes are used in production of lipases which are used in detergent formulations
g) Pectinases and proteases obtained from microbes are used to clear the fruit juices.
h) Streptokinase produced from *Streptococcus* is used as a clot buster for removing clots from the blood vessels of patients.
i) Bioactive molecule Cyclosporin A produced from fungus *Trichoderma polysporum* is used as an immunosuppressive agent in organ transplant patients
j) Statins produced by the yeast *Monascus purpureus* are used as blood cholesterol lowering agents.
Microbes in sewage treatment

In primary treatment of sewage water there is physical removal of small and large particles through sedimentation and filtration. The sewage water is then subjected to secondary or biological treatment where aerobic microbes (called flocs consisting of masses of bacteria and fungus) grow and reduce the Biochemical Oxygen Demand (BOD). The effluent is then passed to the settling tank where the bacterial flocs are allowed to sediment. The sediment is called activated sludge. Activated sludge is pumped into Anaerobic Sludge Digesters. Here anaerobic bacteria digest the floc and produce methane, carbon dioxide and hydrogen sulphide. These gases form the biogas.

Microbes in biogas production.

Microbes as biocontrol agents- Biocontrol refers to the use of biological methods to control plant diseases and pests.

a) Baculoviruses attack insects and other arthropods which damage the plants. Ex-*Nucleopolyhedrovirus*

b) Fungus *Trichoderma* which lives in root ecosystems doesn't allow plant pathogens to grow.

c) Bacteria *Bacillus thuringenesis* control butterfly caterpillars. It is available in sachets as dried spores.

d) In Bt cotton, the toxin gene of *Bacillus thuringenesis* is introduced by the scientists through genetic engineering. It is resistant to attack by insect pests.

Microbes as biofertilisers- Biofertilisers are the microbes which enrich the nutrient quality of the soil.

a) Symbiotic association of fungus with plants is called mycorrhiza. Fungal partener absorbs phosphorus from soil and passes it to the plant. Such plants are also resistant to pathogens, tolerant to salinity and drought.

b) Cyanobacteria like *Anabaena, Nostoc* and *Oscillatoria* in paddy fields serve as important biofertilizers.

c) Symbiotic bacteria like *Rhizobium* can fix atmospheric nitrogen which is used by the plants.

MCQ

1 Microbes are used in

1. primary treatment of sewage 2. secondary treatment of sewage
3. anaerobic sludge digesters 4. production of bioactive molecules

(A) 1, 3 and 4
(B) 1, 2, 3 and 4
(C) 2, 3 and 4
(D) 3 and 4
Answer: C

2.Which one of the following statements regarding BOD is true?

(A). The greater the BOD of waste water, the more is its polluting potential.
(B). The greater the BOD of waste water, less is its polluting potential.
(C).The less the BOD of waste water, the more is its polluting potential.
(D.) The lesser the BOD of waste water, the less is its polluting potential.
Answer: A

3 Which one of the following pairs is correctly matched ?

(A) Parasite in the roots of leguminous plants. (B) Mycorrhizae - Mineral uptake from soil.
(C)Yeast - Production of biogas. (D) Cyclosporin A- Blood-cholesterol lowering agent
Answer: B

4 Which of the following antibiotics was discovered by Alexander Flemming?

(A) Streptomycin (B) Tetracycline (C) Penicillin (D) Terramycin
Answer: C

5 A chemical substance obtained from a living source & has the capacity to inhibit the growth or kill the microbes is called

(A) Toxoid (B) Toxin (C)Antibiotic (D) Vaccine
Answer: B

6 A patient brought to a hospital with myocardial infarction is normally immediately given:

(A) Penicillin (B) Streptokinase (C) Cyclosporin-A (D) Statin

Answer: B

7.What would happen if oxygen availability to activated sludge flocs is reduced?

(A) It will slow down the rate of degradation of organic matter

(B) The centre of flocs will become anoxic, which would cause death of bacteria and eventually breakage of flocs.

(C)Flocs would increase in size as anaerobic bacteria would grow around flocs.

(D) Protozoa would grow in large numbers.

Answer: B

8. The free-living fungus *Trichoderma* can be used for

(A) killing insects (B)biological control of plant diseases

(C)controlling butterfly caterpillar (D) producing antibiotics

Answer: B

9 Match the following list of bacteria and their commercially important products:

Bacterium Product

(i)Lactobacillus bulgaricus (a) Streptokinase

(ii) Acetobactoraceti (b) Lactic Acid

(iii) Streptococcus (c) Streptomycin

(iv) Streptomyces griseus (d) Acetic acid Choose the correct match:

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

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

Answer: C

10. The bottled fruit juices available in the market are clarified by

(A) lipases and proteases (B)lipases and pectinases

(C)pectinases and proteases (D) pectinases and amylases

Answer: C

11. Large holes in Swiss cheese are produced due to

(A) Ethyl alcohol (B) carbon dioxide (C)lactic acid (D) LAB

Answer: B

12. The dough used for making 'idli' and 'dosa' is fermented by

(A) Yeast (B) Fungi (C) Bacteria (D)Protozoa

Answer: C

13 The technology of biogas production from cow dung was developed in India largely due to the efforts of …….

(A) India Agricultural Research Institute

(B) Khadi and Village Industries Commission

(C) Gas Authority of India

(D) Both A & B

Answer: D

14 The vitamin whose content increases following the conversion of milk into curd by lactic acid bacteria is

(A) Vitamin C (B) Vitamin D (C)Vitamin B12 (D) Vitamin E

Answer: C

15. Methanogenic bacteria are present in

(a) Anaerobic sludge (B) Rumen (a part of stomach) of cattle

(C) Both (a) and (b) (D)None of these

Answer: C

***16.Monascus purpureus*, a yeast (fungus), that is used in the commercial production of**

(A) Acetic acid (B) Ethanol (C)Blood cholesterol lowering statin (D) streptokinase

Answer: C

17 The inoculum is added to the fresh milk in order to convert milk into curd, the term 'inoculum 'here refers to

(A) An aerobic digester (B) A starter rich in Vitamin B12

(C) A starter containing millions of LAB (D)A starter rich in proteins

Answer: C

18. Which of the following options includes biofertilizers?

(A) quick growing crop ploughed back in the field (B) Cow dung manure and farmyard manure

(C) *Nostoc. Oscillatoria* (D) All of theses

Answer: D

19.Select the correct group of biocontrol agents

(A.)*Bacillus thuringiensis*, TMV, Aphids (B) *Trichoderma*, Baculovirus, *Bacillus thuringiensis*

(C) *Oscillatoria, Rhizobium, Trichoderma* *(D) Nostoc, Azospirillum, Rhizobium*

Answer: B

20. To be a part of integrated pest management a biocontrol agent should be

(A) species specific and symbiotic (B) free living and broad spectrum

(C) narrow spectrum and symbiotic (D)species specific and inactive on non-target organisms

Answer: D

Assertion Reason Type Questions

Directions for (Qs.1-10): Each of these questions contains an Assertion followed by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

A) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

C) If Assertion is correct but Reason is incorrect.

D) If both the Assertion and Reason are incorrect

1 Assertion: Leguminous plants are nitrogen fixers.

Reason: Leguminous plants have *Rhizobium* in their root nodules

Answer: A)

2 Assertion: Biofertilizers are preferred over chemical fertilisers.

Reason: Most of the Chemical fertilisers are costly, hazardous & pollute the environment.

Answer: A)

3 Assertion: Yeasts such as Saccharomyces cerevisiae are used in the baking industry.

Reason: Carbon dioxide produced during fermentation causes bread dough to rise by thermal expansion.

Answer: A)

4 Assertion: Acetic acid production involves both aerobic and anaerobic processes.

Reason: Production of alcohol from glucose is an aerobic process and production of acetic acid from alcohol is an anaerobic process.

Answer: C)

5 Assertion: Leguminous plants are best preferred for rotation of crops

Reason: They have root nodules which have nitrogen fixing bacteria *Clostridium*

Answer: C)

6 Assertion: Curd is more nutritious than milk

Reason: LAB in curd partially digest the milk proteins and increase the quantity of vitamin B12

Answer: A)

7 Assertion: Production on an industrial scale, requires growing microbes in very large vessels called fermenters.

Reason: Microbes used to synthesize a number of products valuable to human beings like beverages, antibiotics etc.

Answer: B

8 Assertion: Different varieties of cheese are known by their characteristic texture, flavour and taste, the specificity coming from the microbes used.

Reason: The large hole in 'Swiss Cheese' are due to production of large amount of CO2 by a bacterium named *Staphylococcus aureus*

Answer: C)

9 Assertion (A): Biogas plants are generally built in rural areas.

Reason (R): Cattle dung is available in large quantities in these areas.

Answer: A)

10 Assertion: Statins are produced by yeast called *Trichoderma polysporum.*

Reason: It is used as a clot buster for removing clots from blood vessels of patients who have undergone myocardial infarction leading to heart attack.

Answer: D)

Case Study Based Questions

1 Primary sludge is all solids like soil, small pebbles that settle down in settling tanks during primary treatment of sewage. Activated sludge is the sediment of bacterial 'flocs' in settling tanks during biological treatment. A part of activated sludge is used as inoculum in an aeration tank and remaining is passed into a large tank called anaerobic sludge digester. In this tank, other kinds of bacteria which grow anaerobically, digest the bacteria, fungi and biomass in the sludge. Biogas produced in the Sewage treatment plant is a mixture of gasses.

Attempt any 4 out of 5 questions

i Flocs are

(a) masses of bacteria (b) masses of bacteria held together by slime and fungal filaments

(c) fungal filaments (d) none of the above

Answer: b

ii Biogas is a mixture of:

(a) Nitrogen, methane and oxygen (b) Methane, hydrogen and Carbon dioxide

(c) Oxygen, hydrogen and Carbon dioxide (d)Nitrogen, hydrogen and Carbon dioxide

Answer: b

iii Why is the sludge aerated?

(a) to inhibit the growth of bacteria (b) to remove the sediments

(c) to promote the growth of bacteria (d) none of the above

Answer: c

iv Primary and secondary sludge are generated respectively from

(a) mechanical treatment, biological treatments. (b) Biological treatment, chemical precipitation

(c) Biological treatment, mechanical treatment (d) None of the above

Answer: (a)

v) Assertion- A small part of activated sludge is pumped back in the aeration tank to serve as the inoculum.

Reason- Remaining part of sludge is pumped into large tanks called aerobic sludge digester.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

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

(c) Assertion is true but the Reason is false.

(d) Assertion and Reason are false

Answer: (a)

Case -2

Microorganisms include bacteria, viruses, fungi and protozoa. In our mind, we presume, most of the time, that microbes are always harmful. Microbes are, of course, the causal agents of many infectious diseases of

plants and animals including humans but they also have lots of beneficial roles. Lactic acid bacteria (LAB) are one of this kind of useful group. These are Gram positive, non-sporulating, either rod shaped or spherical bacteria. They produce lactic acid in milk products as a major metabolic end product of carbohydrate fermentation. LAB is considered a natural fermenter. *Lactobacillus* is a common LAB which converts lactose sugar of milk into lactic acid, which causes coagulation and partial digestion of milk protein casein. Milk is then changed into curd, yogurt and cheese. *Lactobacillus* is also used in probiotics which have potentially beneficial effects on the gut ecosystem of humans. Some other probiotic strains used belong to the Genus *Bifidobacterium.*

Attempt any four questions.

(1) Lactobacillus is a common LAB which:

(a) converts lactose sugar of milk into lactic acid

(b) causes coagulation and partial digestion of milk protein casein

(c) helps the body break down food and absorb nutrients

(d) All of the above

Answer: d

(ii) Select the incorrect option regarding the characteristics of lactic acid bacteria.

(a) They are rod-shaped or spherical (b) They are acid intolerant

(c) They are Gram positive (d) They take part in carbohydrate fermentation

Answer: b

(iii) Which of the following is called baker's yeast or brewer's yeast?

(a) *Saccharomyces* (b) *Streptococcus*

(c) *Lactococcus* (d)*Enterococcus*

Answer: a

(iv) Assertion: Compared to curd and yogurt, milk has more vitamin content.

Reason: Streptococcus thermophilus increases the nutritional value of milk.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

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

(c) Assertion is true but the Reason is false.

(d) Assertion and Reason are false

Answer: d

(v) The vitamin whose content increases following the conversion of milk into curd by lactic acid bacteria is:

a) Vitamin C b) Vitamin c) Vitamin B_{12} d) Vitamin E

Answer: c

Case-3

The environment is incomplete without microorganisms. With every breath you take, there are millions of microscopic organisms that you breathe in. Apart from that, the human body hosts a plethora of microbes both inside and outside. Besides this, they are a crucial part of the ecosystem and take part in activities like production of minerals like nitrogen, gases like oxygen, carbon dioxide, taking care of dead and decaying materials etc.

i) What are antibiotics?

a) Chemical secreted by one group of organisms which can kill or stop the growth of another group of organisms.

b) Medicine

c) Chemicals which alter the life of microorganisms

d)Group of organisms to kill other groups

Answer: a

ii) Probiotics belongs to which category of microorganisms?

(a) Bacteria or yeast (b) Bacteria or virus (c)Bacteria or protozoa (d) Yeast or protozoa

Answer: a

iii) Choose the microbes which are suited for organic farming, which is in great demand these days for various reasons.

(a) *Anabaena, Rhizobium, Methanogens* and *Trichoderma*

(b) *Rhizopus, Rhizobium, streptococcus* and *Aspergillus*

(c) *Monascus*, S*treptococcus, Rhizopus* and *Anabaena*.

(d) *Anabaena, Rhizobium, Rhizopus* and *Methanogens*

Answer: a

(iv)Mention the source and function of streptokinase enzyme.

(a) *Streptococcus* and used as immunosuppressive agent

(b) *Streptococcus* and used as 'clot -buster' for removing clot from blood vessels.

(c) *Streptococcus* and used as a blood -cholesterol lowering agent.

(d) *Streptococcus* and used as blood sugar lowering agent

Answer: b

(v)Which of the following is considered under single cell protein?

(a) Algae (b)Fungi (c)Cyanobacteria (d)All of these

Answer: d

Case -4

Clean water that is fit for use is unfortunately not available to all. It has been reported that more than one billion of our fellow human beings have no access to safe drinking water. This accounts for a large number of water-related diseases and even deaths. increasing scarcity of fresh-water due to population growth, pollution, industrial development, mismanagement and other factors. Cleaning of water is a process of removing pollutants before it enters a water body or is reused. This process of wastewater treatment is commonly known as Sewage Treatment. It takes place in several stages.

(i) Sewage is mainly

(a) Liquid waste

(b) Solid waste.

(c) Gaseous waste.

(d) Mixture of solid and gas

Answer: a

(ii) Treated wastewater has:

(a) Low BOD

(b) Maximum BOD

(c) Least BOD

(d) Moderate BOD

Answer: c

(iii) Select the correct statement

(a) Activated sludge sediment in settlement tanks of sewage treatment plant is a rich source of aerobic bacteria

(b) Biogas is produced by the activity of aerobic bacteria on animal waste

(c) Biogas, commonly known as gobar gas, is pure methane.

(d) Both (B) & (C) are correct

Answer: a

(iv) Main aim of Ganga action plan-(GAP) was:

(a) Beautification of river Ganga

(b) To improve water quality

(c) Pisciculture for domestic consumption.

(d) To attract tourism

Answer: b

v) Assertion: A part of activated sludge is pumped back into the aeration tank to serve as inoculum.
Reason: Activated sludge is composed of aerobic and anaerobic microorganisms such as bacteria, archaea, fungi, and protists.

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false

Answer: a) Activated sludge (AS) is composed of aerobic and anaerobic microorganisms such as bacteria, archaea, fungi, and protists. It is capable of degrading organic compounds.

5 Sunil and Amit went to eat Dosas in the roadside shop at about 2 pm one day. The shopkeeper told them that the batter was over and a few hours ago he had freshly ground batter and kept. He asked them to come later in the day for tasty Dosas. Both Sunil and Amit could not understand why? If fresh batter was already ground and kept, why is the shopkeeper not serving them, when they are ready to pay? Their classmate Sungandhi, came by and offered an explanation, saying Lactic acid bacteria needs some time to multiply and ferment the batter, to make it tasty. Just like how yeast is used to ferment the dough of Bread.

i) Yeast is a unicellular
a) Fungi
b) Protozoan
c) Bacteria
d) Algae
Answer: a

ii) Fermentation by Lactic acid bacteria produces
a) CO_2 and Alcohol
b) Only CO_2
c) Only Alcohol
d) CO_2 and Lactic Acid (which makes the batter sour) while the CO_2 helps the batter rise and make soft and tasty dosas
Answer: d

iii) The lactic acid produced in the batter after some time-
a) Promotes the growth of yeast in the batter.
b) Prevents the growth of yeast in the batter
c) Neither promotes nor prevents the growth of yeast in the batter.
d) Both Lactic acid bacteria and yeast grow together in the batter.
Answer: b

iv) The Lactic acid bacteria required for the fermentation of the batter is:
a) Found naturally in the urad dal used to make the batter along with rice.
b) Has to be added to the batter.
c) Comes from the dirty hands used to mix the batter.
d) It is present in the air and gets mixed while stirring the batter
Answer: d

v) Fermented food in limited quantities are:
a) Good for health, as they help in producing B Vitamins.
b) Are easy to digest
c) Tasty and healthy
d) All the above
Answer: a

6. Secondary treatment or Biological treatment of sewage: The primary effluent is passed into large aeration tanks, where it is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh like structures). While growing, these microbes consume the major part of the organic matter in the effluent. This significantly reduces the BOD (biochemical oxygen demand) of the effluent. BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one liter of water were oxidized by bacteria. The sewage water is treated till the BOD is reduced.
The BOD test measures the rate of uptake of oxygen by microorganisms in a sample of water and thus, indirectly, BOD is a measure of the organic matter present in the water. The greater the BOD of waste water, the more is its polluting potential. Once the BOD of sewage or wastewater is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This sediment is called activated sludge. A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters. Here, other kinds of bacteria, which grow anaerobically, digest the bacteria and the fungi in the sludge. During this digestion, bacteria produce a mixture of gasses such as methane, hydrogen sulphide and carbon dioxide.

These gasses form biogas and can be used as a source of energy as it is inflammable.
i) BOD indicates the degree of:
a. Pollution level of the water body
b. The condition of the activated sludge
c. The amount of air in the water
d. None of the above
Answer: a
ii) Inoculum is the:
a. Yeast
b. A small part of the activated sludge that is pumped back into the large tanks.
c. Made up of gasses and is inflammable
d None of the above
Answer: b
iii) A water body with very low value of BOD, implies that the water body is
a. Highly Contaminated
b. Poorly contaminated
c. Least contaminated
d. None of the above.
Answer: c
iv) Biogas, released during the digestion of the sludge by the anaerobic bacteria, consists of:
a. Hydrogen, Oxygen and Carbon dioxide
b. Nitrogen, Oxygen and water vapours
c. Methane, hydrogen sulphide and carbon dioxide
d. None of the above
Answer: c
v) Assertion: Both aerobic and anaerobic microbes help in sewage treatment.
Reason: The sewage water is treated till the BOD is reduced.
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false

Answer: b

Very Short Answer Questions (2 Marks)

Q.1 Mention a product of human welfare obtained with the help of help of each one of the following microbes:

a) LAB b) *Saccharomyces cerevisiae* *c) Propionibacterium sharmanii* *d) Aspergillus niger*

ANS---a) Convert milk to curd b) Bread/ alcoholic drinks

c)Swiss cheese d) Citric acid

Q.2 Name the microbes that help production of the following products commercially:

a) Statin b) Citric acid c) Penicillin d) Butyric acid

ANS a) *Monascus purpureus* *b) Aspergillus niger*

c)Penicillium notatum *d) Clostridium botulinum*

Q.3 Name the blank spaces a, b, c and d given in the following table:

Type of microbe	Name	Commercial product
Bacterium	A	Clot buster enzyme
B	*Aspergillus niger*	Citric acid
Fungus	*Trichoderma polysporum*	C
Bacterium	D	Butyric acid

4 Name the source of statin and state its action on the human body.

ANS---Yeast –*Monascus purpureus*. It acts a blood-cholesterol lowering agent by competitively inhibiting the enzyme

Q.5 Match the following list of bacteria and their commercially important products:

(i) *Aspergillus niger* (a) Lactic acid

(ii) *Acetobacter aceti* (b) Butyric acid

(iii) *Clostridium butylicum* *(c) Acetic acid*

(iv) Lactobacillus (d) Citric acid

ANS-. i d, ii c, iii b, iv a

Q. 6 What is activated sludge in a sewage treatment tank? How is this activated sludge used?

Ans; - a) Once that BOD of sewage water is reduced significantly, the effluent is passed into a settling tank where aerobic bacterial flocs undergo sedimentation and is called activated sludge.

b) A small part of the activated sludge is pumped into an aeration tank as inoculum for the treatment of sewage water.

Q.7 Expand the term BOD and give the meaning of it.

Ans; - a) Biochemical Oxygen Demand.

b) The amount of oxygen required for microorganisms to break organic content present in one litre of water.

Q. 8. How does anabaena and mycorrhiza act as biofertilizers?

Ans; - a) Anabaena fixes atmospheric nitrogen b) Mycorrhiza absorbs phosphorus from soil and passes it to the plant.

Q 9. Why is Rhizobium called a 'symbiotic bacterium'? How does it act as a biofertiliser?
Ans; - Rhizobium is present in the root nodules of leguminous plants. These bacteria fix atmospheric nitrogen into nitrate.

Q. 10. Name any two distilled and undistilled alcoholic beverages.
Ans; -a) Distilled alcoholic beverages: Whisky, Rum, Brandy
b) Undistilled alcoholic beverages: Beer and Wine

Q. 11.Write any two advantages of biofertilisers.
Ans; -a) Biofertiliser do not cause pollution
b) These are not expensive

SHORT ANSWER QUESTIONS (3 MARKS)

1. a. Name the gaseous components of bio gas?
b. Which bacterium is responsible for producing this gas?
c. Name the institute which developed the technology of gas production?
ANS- a. methane 60%, CO_2 40%
b. methanogens
c. IARI and KVIC

2. Given below is a list of six microorganisms. State their usefulness to humans.
a) Nucleopolyhedrovirus
(b) *Saccharomyces cerevisiae*
(c) Monascus purpureus
(d)*Trichoderma polysporum*
(e)Penicillium notatum
(f) *Propionibacterium sharmanii* NCERT Pg. No. 153

3. The excessive use of chemical pesticides causes soil pollution and adversely affects human health. An alternative to pesticide is use of biocontrol agents. Name a bacterium and a virus which are used as biocontrol agents and mention their action.
Ans Bacterium –Bacillus thuringiensis, Toxin released by his bacterium kills the pest larvae.
Virus- Baculoviruses/Nucleopolyhedrovirus attack insects and other arthropods

4.a) What is activated sludge?
b) Explain the fate of activated sludge in the sludge digester.
Ans a) The effluent from the aeration tank is passed into a settling tank where the bacterial flocs are allowed to sediment. This sediment is called activated sludge.
b) Used as inoculum by pumping it to an aeration tank and rest is pumped to anaerobic sludge digester.

Q.5 Match the following list of bacteria and their commercially important products:

(i) *Aspergillus niger*	(a) Lactic acid
(ii) *Acetobacter aceti*	(b) Butyric acid
(iii) *Clostridium butylicum*	*(c) Acetic acid*
(iv) Lactobacillus	(d) Citric acid

ANS-. i d, ii c, iii b, iv a

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4.a) What is activated sludge?
b) Explain the fate of activated sludge in the sludge digester.
a) The effluent from the aeration tank is passed into a settling tank where the bacterial flocs are allowed to sediment. This sediment is called activated sludge.
A small part of it is passed into an aeration tank to serve as inoculums. The remaining part is pumped into an anaerobic sludge digester. Here, the anaerobic bacteria digest bacteria and fungi in the sludge and form methane, hydrogen sulphide and carbon dioxide. These gasses form biogas

5. a) Name two photosynthetic biofertilisers. How do they improve soil fertility?
b) How is it different from mycorrhizae?
Ans. a) Anabaena, Nostoc, Oscillatoria (Any two), Fix atmospheric nitrogen- also add organic material to the soil.
b) Mycorrhizae are a symbiotic association between fungi and roots of higher plants.
Photosynthetic biofertilisers are free living or symbiotic

6. How is the Bt cotton plant created as a GM plant? How is it protected against bollworm infestation?
Ans. Bt cotton is created by using some strains of a bacterium known as Bacillus thuringiensis. This bacterium produces protein that kills certain insects such as Lepidopterans, Coleopterans and Dipterans. The Bt gene is cloned from this bacterium and has been expressed in cotton plants to provide resistance to the insects without the need for insecticides.
It is protected against corn borer disease by encoding Cry protein with the gene cry IAb. These genes produce Bt toxins which are released in the gut of insects, who feed upon them, thus killing them and protecting the plant from the pests.

7. (i) Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose. Justify.
(ii) Give an example of a bacterium, a fungus and an insect that are used as biocontrol agents.
Ans. (i) Organic farmers do not use any chemical for raising crops. They simply depend on biological control methods to control insects and pests. This way they avoid deleterious effects of chemicals on food products as well as on the environment. These chemicals get accumulated in the food chain and ecosystem whereas biological control methods are safe as they do not harm any form of life.
(ii) Examples of biological control agents are as follows
Bacterium *Bacillus thuringiensis* for the control of cotton bollworm.
Fungus Trichoderma species for controlling fungal soil borne diseases like damping off of vegetables.
Insects Ladybird beetle for the control of aphids.

8. What makes the *Nucleopolyhedrovirus* a desirable biological control agent?
Ans. *Nucleopolyhedrovirus,* a genus of baculoviruses, is useful in controlling many insects and other arthropods. They are species specific narrow spectrum bioinsecticide with no side effects on plants, mammals, birds, fish and non-target insects. Therefore, they serve as an important component of integrated pest management programmes in dealing with ecological sensitive areas. These properties are useful in organic farming. *Saccharomyces cerevisiae* Product is ethanol and it is used in making bread and beverages.

9. Mention the product and its use, produced by each of the microbes listed below
(i) *Streptococcus*
(ii) *Lactobacillus*
(iii) *Saccharomyces cerevisiae*
Ans. (i) Streptococcus Product is streptokinase. It is used as a clot buster for removing the clots from the blood vessels of patients suffering from myocardial infarction.
(ii) *Lactobacillus* Product is lactic acid. It is used to convert milk into curd and improves nutrient quality of curd by enriching it with vitamin-B12
(iii) *Saccharomyces cerevisiae* Product is ethanol and it is used in making bread and beverages.

10. Identify A, B, C, D, E and F in the table given below

Scientific name of the organism	Product produced	Use in human welfare
Streptococcus	Streptokinase modified	A
B	Cyclosporin-A	C
Monascus purpureus	D	E
Lactobacillus	F	Sets milk into curd

The codes are identified as
A- Clot buster in patients who underwent myocardial infarction.
B- Trichoderma polysporum
C- Immunosuppressive agent in organ transplantation D-Statins
E – Blood cholesterol lowering agents
F – Lactic acid

LONG ANSWER QUESTION (5 MARKS)

1. "Microbes play a dual role when used for sewage treatment as they not only help to retrieve usable water but also generate fuel". Explain. NCERT Pg. No. 154
2. Explain the significant role of the genus *Nucleopolyhedrovirus* in an ecological sensitive area.
OR
Explain the role of baculoviruses as biological control agents. Mention their importance in organic farming.
NCERT Pg. No. 157
3. Write the scientific name of a microbe from which following product is obtained:
a) Statins b) Penicillin c) Citric acid d) Streptokinase e) Cyclosporin – A
NCERT Pg. No. 153

Self-Assessment Test MM: 40

1 Identify the wrong pair: (1)
(a). Statin: *Monascus*
(b). Cyclosporin: *Trichoderma*
(c.) Penicillin: *Staphylococcus*
(d.) Ethanol: Yeast

2 The use of biocontrol agents in farming will greatly reduce our dependence on…… .
(a). Fertilizers, (b). manure, (c). chemical pesticides(d). weedicides.

3 Which of the following alcoholic drinks is produced without distillation? (1)
(a). Whisky (b). Brandy (c). Rum (d). Wine

4 Which of the following options includes biofertilizers? (1)
(a) cow dung manure and farmyard waste (b) A quick growing crop ploughed back into the field
(c) *Nostoc, Oscillatoria* (d) All of these

5 Wastewater treatment generates a large quantity of sludge, which can be treated by (1)
(a) anaerobic digesters (b) flocs (c) chemicals (d) oxidation pond

6 Methanogenic bacteria are not found in (1)
(a) rumen of cattle
(b) gobar gas plant
(c) bottom of water-logged paddy field
(d) activated sludge

7 The primary treatment of wastewater involves the removal of (1)
(a) dissolved impurities (b) stable particles (c) toxic substances (d) harmful bacteria

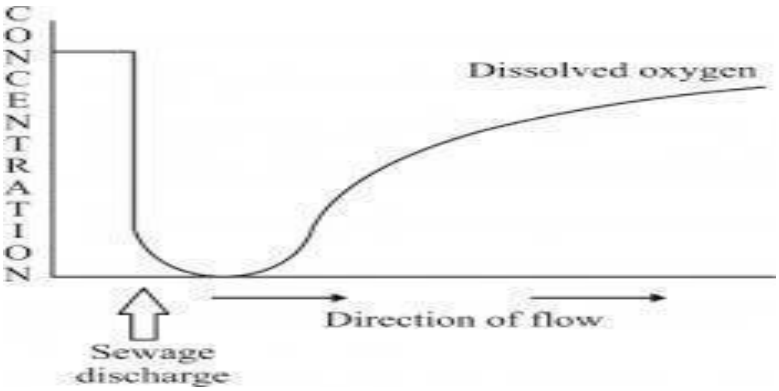
8 Assertion (A): Cyanobacteria like Nostoc and Anabaena are used as biofertilisers. (1)
Reason (R): Cyanobacteria absorb phosphorus from soil and pass it to crops.

9 Assertion (A): Dough used for making dosa and idli is fermented by bacteria. (1)
Reason (R) : The puffed-up appearance of dough is due to production of lactic acid.

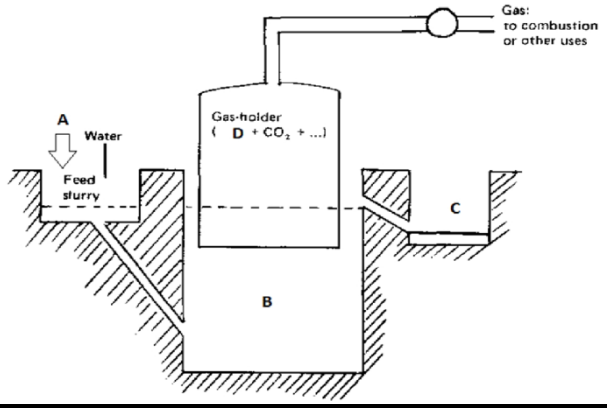
10 Assertion (A): *Bacillus thuringiensis* and Trichoderma are used as biocontrol agents by organic farmers. (1)
Reason (R): The use of biocontrol agents helps to reduce pollution caused by excessive use of fertilizers.

11 Assertion (A): *Saccharomyces cerevisiae* is used for making bread. (1)
Reason (R) : Fermentation carried out by Yeast enzymes produces CO_2.

12 Mention the importance of lactic acid bacteria to humans other than setting milk into curd. (2)
13 Bottled fruit juices are clearer as compared to those made at home. Explain. (2)
14 a) Observing the figure below comment on the relationship between DO and Sewage discharge.
b) Give the term for the criteria which decides the level of pollution of the water body. (2)



15 This is a biogas plant . label D,B and C (3)



CH 9 BIOTECHNOLOGY-PRINCIPLES AND PROCESSES

1. **rDNA technology**-Schematic representation. Ref, NCERT Pg No. 167.
2. **Restriction enzymes**- These are the enzymes which cut the DNA into fragments. Two types- exonucleases and endonucleases

a) Exonucleases remove nucleotides from the end of the DNA.

b) Endonucleases cut the DNA at specific sequences called palindromic sequence within the DNA. Restriction endonucleases are used in genetic engineering and called the '**molecular scissors'** . Palindromic sequence for restriction endonuclease EcoR1 is

5'--------GAATTC-------3'

3'--------CTTAAG-------5'

3. Cloning vectors- Vectors are the carriers of foreign genes. They are used to carry this foreign gene into the host. Cloning vectors used in rDNA technology are plasmids, bacteriophages, Ti plasmid of *Agrobacterium tumefaciens.*

4. Characters of a cloning vector-

a. It should have the origin **of replication** (ori).

b. It should have a **selectable marker** which helps in identifying and eliminating non-transformants and selectively permitting the growth of transformants. The genes encoding resistance to antibiotics like ampicillin, tetracycline, etc are used as useful selectable markers for E.coli.

c. It should have very few or single **recognition site** for restriction enzyme

Diag. of pBR322 on page 169 of NCERT

5. Polymerase Chain Reaction (PCR)- This technique is used to amplify the DNA to one billion times i.e to make multiple copies of genes of interest. Amplification is achieved by a thermostable DNA polymerase called Taq polymerase isolated from bacterium *Thermus aquaticus.* Diag. page 172 of NCERT.

6. Bioreactor-These are the vessels in which raw materials are biologically converted into specific products, individual enzymes, etc using microbial, plant, animal or human cells. Diag. page 174 of NCERT.

7. Gel-electrophoresis- The cutting of DNA by restriction enzymes result in the fragments of DNA. These segments can be separated by a technique called gel electrophoresis. The negatively charged DNA fragments can be separated by forcing them towards the anode under an electric field through a matrix of agarose. DNA fragments separate according to their size. The smaller the fragment, the farther it moves. The separated DNA fragments are then stained with ethidium bromide followed by exposure to UV rays. Bright orange colored bands of DNA are observed. The separated bands of DNA are cut out from the agarose gel. This step is called elution.

MCQ (1 Mark)

SECTION–A

1 What is the function of Restriction endonuclease:

(a) Synthesizes DNA (b) Cuts the DNA molecules randomly

(c) Cuts the DNA molecule at specific sites.

(d) Restricts the synthesis of DNA inside the nuclease.

ANSWER. c

2 The linking of antibiotic resistance gene with plasmid vector become possible with:

A) DNA polymerase B) Exonuclease C) DNA ligase D) Endonuclease.

3. Stirred-tank bioreactors have been designed for:

a) Addition of preservative to the product

b) Purification of product

c) Ensuring anaerobic condition in the cultural vessel

d) Availability of oxygen throughout the process.

ANSWER. d

4. Given below is a sample of a portion of DNA strand giving the base sequence on the opposite strands. What is so special about it?

5’ GAATTC _3’

3’ CTTAAG 5’

a) Replication completed b) Deletion mutation

c) Start codon at 5’level d) Palindromic sequence of base pairs

ANSWER. d

5.There is a restriction endonuclease called *EcoRI*.What does *“co”*in it stand for?

a) Colon b) Coelom c)Coenzyme d)Coli

ANSWER. d

6.Agarose extracted from seaweeds is used in:

a) Spectrophotometry B) tissue culture C)PCR D)Gel electrophoresis

ANSWER.D

7.An enzyme catalysing the removal of nucleotides from ends of DNA is:

a) endonuclease b) exonuclease c) DNA ligase d) Hind-II

ANSWER. b

8 The transfer of genetic material from one bacterium to another through mediation of a viral vector is termed as:

a) Transduction b) Conjugationc) Transformation d) translation

ANSWER. a

9.Which of the given statements is correct in the context of observing DNA Separated by agarose gel electrophoresis?
a) DNA can be seen in visible light
b) DNA can be seen without staining in visible light
c) Ethidium bromide stained DNA can be seen in visible light
d) Ethidium bromide stained DNA can be seen under exposure of UV lights.
ANSWER. d
10.Which of the following is not the characteristic of plasmid?
a) Extra nuclear b)single-stranded c)independent replication d)Circular DNA
ANSWER. b
11 Who among the following was awarded the Nobel Prize for the development of PCR technique?
(a) Herbert Boyer (b) Hargovind Khurana (c) Kary Mullis (d) Arthur Kornberg
ANSWER. c
12. In agarose gel electrophoresis, DNA molecules are separated on the basis of their
(a) charge only (b) size only (c) charge to size ratio (d) All of these
ANSWER. b
13 The most important feature in a plasmid to be used as a vector is
(a)Origin of replication (Ori) (b) presence of a selectable marker
(c) presence of sites for restriction endonuclease (d) its size
ANSWER. a
14. While isolating DNA from bacteria, which of the following enzymes is not used?
(a) Lysozyme (b) Ribonuclease
(c) Deoxyribonuclease(d) Protease
ANSWER. c
15. An antibiotic resistance gene in a vector usually helps in the selection of
(a) competent cells (b) transformed cells
(c) recombinant cells (d) None of these
ANSWER. b
16. The role of DNA ligase in the construction of a recombinant DNA molecule is
(a) formation of phosphodiester bond between two DNA fragments
(b) formation of hydrogen bonds between sticky ends of DNA fragments
(c)ligation of all purine and pyrimidine bases (d)None of the above
ANSWER. a
17. Which of the following steps are catalysed by Taq polymerase in a PCR reaction?
(a) Denaturation of template DNA (b) Annealing of primers to template DNA
(c)Extension of primer end on the template DNA (d) All of the above
ANSWER. c
18. Which of the following should be chosen for best yield if one were to produce a recombinant protein in large amounts?
(a) Laboratory flask of largest capacity
(b) A stirred-tank bioreactor without in-lets and out-lets
(c)A continuous culture system (d)Any of the above
ANSWER. c
19 Significance of heat shock method in bacterial transformation is to facilitate.
(a)Binding of DNA to the cell wall (b)Uptake of DNA through membrane transport proteins
(c)Uptake of DNA through transient pores in the bacterial cell wall
(d)Expression of antibiotic resistance gene
ANSWER. c
20 Which of the following statements does not hold true for restriction enzymes?

(a) It recognises a palindromic nucleotide sequence (b) It is an endonuclease
(c) It is isolated from viruses
(d) It produces the same kind of sticky ends in different DNA molecules
ANSWER c

Assertion and reason type questions

A).Assertion and reason both are correct statements and reason is correct to explain for assertion.
B).Assertion and reason both are correct statements but reason is incorrect to explain for assertion.
C). Assertion is correct but reason is wrong
D). Assertion is wrong but reason is correct
1 .Assertion: Restriction enzymes recognize palindromic sequence.
Reason: Palindromic sequences read the same in both directions of the two strands. **Answer: (b)**
2. Assertion: Restriction digestion is a process of cutting DNA by restriction enzyme.
Reason: DNA ligase joins two DNAs. **Answer: (b)**
3. Assertion: Restriction endonucleases are also called 'molecular scissors'.
Reason: When fragments generated by restriction endonucleases are mixed, they join together due to their sticky ends. **Answer: (b)**
4. Assertion : Restriction enzymes cut the strand of DNA to produce sticky ends.
Reason : Stickiness of the ends facilitates the action of the enzyme DNA polymerase.
Answer: (c)
5. Assertion: The matrix used in gel electrophoresis should have controllable pore size.
Reason: Agarose concentration can be changed to change pore sizes. **Answer: (b)**
6. Assertion: Foreign DNA and vector DNA cut with the help of ligase.
Reason: Ligase acts on the sugar phosphate backbone of DNA.
Answer: (d) In formation of rDNA, restriction endonucleases cut both foreign DNA and vector DNA and act on the sugar phosphate backbone of DNA. 1
7. Assertion: In gel electrophoresis, DNA fragments are separated.
Reason: DNA is negatively charged, so it moves towards anode under an electric field.
Answer: (a)
8. Assertion : All endonucleases cut DNA at specific sites.
Reason : Endonucleases are found in viruses.
Answer: (d
9. Assertion: Genetic engineering requires both nucleases and ligases.
Reason: Ligases produce the nick in the recombinant DNA molecule.
Answer: (c)
10. Assertion : In recombinant DNA technology, human genes are often transferred into bacteria (prokaryotes) or yeast (eukaryotes).
Reason : Both bacteria and yeast multiply very fast to form a huge population which express the desired gene.
Answer: (a)

SECTION-B(2MARKS)

1.What does 'competent' refer to in competent cells used in transformation experiments?
Ans. DNA being a hydrophilic molecule can not pass through cell membranes. Therefore, the bacteria should be made competent to accept the DNA molecules.
Competent means bacterial cells, on treatment with chemicals like $CaCl_2$, are made capable of taking up foreign DNA.
2 What is the significance of adding proteases at the time of isolation of genetic material (DNA)?

Ans. Proteases degrade the proteins present inside a cell (from which DNA is being isolated). If the proteins are not removed from DNA preparation then they could interfere with any downstream treatment of DNA.

3. While doing a PCR, 'denaturation' step is missed. What will be its effect on the process?

Ans. If denaturation of double-stranded DNA does not take place then primers will not be able to anneal (joining) to the template. Hence, no extension will take place and after that there will be no amplification.

4. What modification is done on the Ti-plasmid of Agrobacterium tumefaciens to convert it into a cloning vector?
Ans. The plasmid is disarmed by deleting the tumour inducing genes in the plasmid. So that it becomes an effective cloning vector. The modified tumour inducing (Ti) plasmid of Agrobacterium tumefaciens will no longer remain pathogenic to the plants but still deliver genes of interest into a variety of plants.

5. How does one visualise DNA on an agarose gel?
Ans. A compound called ethidium bromide stains DNA, which on exposure with ultra-violet, (uv) radiation gives orange light band of DNA. Hence, DNA fragments appear as orange band
in the presence of ethidium bromide and UV light.

6. Describe the role of CaCl2 in the preparation of competent cells?
Ans. CaCl2 is known to increase the efficiency of DNA uptake to produce transformed bacterial cells. The divalent Ca+2 ions create transient pores on the bacterial cell wall by which the entry of foreign DNA is facilitated into the bacterial cells.

7. What is meant by gene cloning?
Ans. Gene cloning refers to a process in which a gene of interest is ligated to a vector. The recombinant DNA thus produced is introduced in a host cell by transformation.

8. Write any four ways used to introduce a desired DNA segment into a bacterial cell in recombinant technology experiments.
Answer: Ways to introduce desired DNA into bacterial cell are
a. microinjection
b. disarmed pathogen vectors
c. treatment of host cell by bivalent cation such as calcium
d. biolistic or gene gun

9. Mention the uses of cloning vectors in biotechnology.
Answer:
I Uses of Cloning Vector in Biotechnology
ii Helps in linking the foreign/alien DNA with the host's DNA.
Iii Helps in the selection of recombinants from the non-recombinants.

10.Write the role of ori and restriction site in a cloning vector pBR322.
Answer: Ori is a sequence of DNA from where replication starts. Any piece of DNA that needs to replicate in the host cell has to be linked to it.
Restriction site is the recognition site made of palindromic sequence for restriction enzymes.

3 MARKS QUESTIONS

1.Why is making cells competent essential for biotechnology experiments? List any two ways by which this can be achieved.

Or
Why and how bacteria can be made 'competent'? Ref, NCERT Pg No. 170 & 171.

2. Study the diagram given below and answer the following questions.
(i) Why have DNA fragments in band D moved farther away in comparison to those in band C?
(ii) Identify the anode end in the diagram.
(iii) How are these DNA fragments visualised? Ref, NCERT Pg No. 168.

3 (i) Mention the importance of gel-electrophoresis in biotechnology.

(ii) Explain the process of this technique. Ref, NCERT Pg No. 168.

4. How does β-galactosidase coding sequence act as a selectable marker? Why is it a preferred selectable marker to antibiotic resistance genes? Explain. Ref, NCERT Pg No. 170.

5. Give reason why
(i) DNA cannot pass into a host cell through the cell membrane.
(ii) Proteases are added during isolation of DNA for genetic engineering.
(iii) Single cloning site is preferred in a vector. Ref, NCERT Pg No. 168.

6.(i) Explain the significance of palindromic nucleotide sequences in the formation of recombinant DNA.
(ii) Write the use of restriction endonuclease in the above process. Ref, NCERT Pg No. 166 & 167.

7. How is insertional inactivation of an enzyme used as a Selectable marker to differentiate recombinants from non-recombinants? Ref, NCERT Pg No. 170.

8.(i) Explain the basis on which the gel electrophoresis technique works.
(ii) Write any two ways the products obtained through this technique can be utilised.
Ref, NCERT Pg No. 168.

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 the selectable marker in the vector shown below. Ref, NCERT Pg No. 169.

10.Name the source of the DNA polymerase used in PCR technique. Why is it used?

Ref, NCERT Pg No. 172 & 173.

LONG ANSWER QUESTIONS (5) MARKS

1 Explain the role(s) of the following in biotechnology
(i) Restriction endonuclease Ref, NCERT Pg No. 165 & 166.
(ii) Gel-electrophoresis Ref, NCERT Pg No. 168.
(iii) Selectable markers in pBR322 Ref, NCERT Pg No. 169.
2.Describe the various steps involved in Recombinant DNA technology with the help of a well labelled. Diagram? Ref, NCERT Pg No. 171,172 & 173.
3.How can the following be made possible for biotechnology experiments?
(i) Isolation of DNA from bacterial cell.
(ii) Reintroduction of the recombinant DNA into a bacterial cell. Ref, NCERT Pg No. 171.

4.What are Restriction enzymes? Why do bacteria have these restriction enzymes? Show diagrammatically a restriction enzyme its recognition & the product it produces?
Ref, NCERT Pg No. 165.
5. Expand PCR? Describe the different Steps involved in this technique? Ref, NCERT Pg No. 172.

CASE STUDY QUESTIONS

CASE STUDY- 1

Biotechnology deals with techniques of using live organisms or enzymes from organisms to produce products and processes useful to humans. In this sense, making curd, bread or wine, which are all microbe-mediated processes, could also be thought of as a form of biotechnology. However, it is used in a restricted sense today, to refer to those processes which use genetically modified organisms to achieve the same on a larger scale. Further, many other processes/techniques are also included under biotechnology. For example, in vitro fertilisation leading to a 'test-tube' baby, synthesising a gene and using it, developing a DNA vaccine or correcting a defective gene, are all part of biotechnology.
The European Federation of Biotechnology (EFB) has given a definition of biotechnology that encompasses both traditional view and modern molecular biotechnology. The definition given by EFB is as follows: 'The integration of natural science and organisms, cells, parts thereof, and molecular analogues for products and services'.
Que. 1) ……is a technique where live enzymes or organisms are used to make products or methods which are useful to humans.
(a) Bio-technology (b) Info-technology (c) Medical technology (d) Business technology. **Ans. (a)**
Que. 2) In biotechnology, produced products and processes are useful to the ……
(a) Microbes (b) Reptiles (c) Humans (d) Cockroach **Ans.(c)**
Que. 3) The definition of Biotechnology is given by ……
(a) FFB (b) FBU (c) BFE (d) EFB **Ans. (d)**
Que. 4) Which are the microbe-mediated processes in biotechnology.
Answer : The process of making wine, bread and curd are microbe-mediated processes in Biotechnology.

CASE STUDY - 2

The techniques of genetic engineering which include creation of recombinant DNA, use of gene cloning and gene transfer, overcome this limitation and allow us to isolate and introduce only one or a set of desirable genes without introducing undesirable genes into the target organism.
Most likely, this piece of DNA would not be able to multiply itself in the progeny cells of the organism. But, when it gets integrated into the genome of the recipient, it may multiply and be inherited along with the host DNA. This is because the alien piece of DNA has become part of a chromosome, which has the ability to replicate. In a chromosome there is a specific DNA sequence called the origin of replication, which is responsible for initiating replication. Therefore, for the multiplication of any alien piece of DNA in an organism it needs to be a part of a chromosome(s) which has a specific sequence known as 'origin of replication'. Thus, an alien DNA is linked with the origin of replication, so that this alien piece of DNA can replicate and multiply itself in the host organism. This can also be called cloning or making multiple identical copies of any template DNA. The cutting of DNA at specific locations became possible with the discovery of the so- 'molecular scissors'– restriction enzymes.
Que. 1) Which DNA sequence is responsible for initiating replication?
(a) Endonuclease (b) Restriction DNA
(c) Gene clone (d) Origin of replication
Ans. (d)
Que. 2) DNA sequence is mainly present in ……
(a) Mitochondria (b) Chromosomes
(c) Chloroplast (d) Cytoplasm.

Ans. (b)

Que. 3) True or False

'The piece of DNA doesn't have the ability to multiply itself in the progeny cell of an organism.'

(a) True (b) False

Ans. (a)

Que. 4) Write name of molecular scissors which is useful in cutting DNA?

Answer: Restriction enzyme is a molecular scissor which is helpful in cutting DNA.

Case study -3

In 1963, the two enzymes responsible for restricting the growth of bacteriophage in Escherichia coli were isolated. One of these added methyl groups to DNA, while the other cut DNA. The latter was called restriction endonuclease. The first restriction endonuclease–Hind II, whose functioning depended on a specific DNA nucleotide sequence was isolated and characterised five years later. It was found that Hind II always cut DNA molecules at a particular point by recognising a specific sequence of six base pairs. This specific base sequence is known as the recognition sequence for Hind II. Besides Hind II, today we know more than 900 restriction enzymes that have been isolated from over 230 strains of bacteria each of which recognise different recognition sequences. The convention for naming these enzymes is that the first letter of the name comes from the genus and the second two letters come from the species of the prokaryotic cell from which they were isolated, e.g., EcoRI comes from *Escherichia coli* RY 13. In EcoRI, the letter 'R' is derived from the name of strain. Roman numbers following the names indicate the order in which the enzymes were isolated from that strain of bacteria

Restriction enzymes belong to a larger class of enzymes called nucleases. These are of two kinds; exonucleases and endonucleases. Exonucleases remove nucleotides from the ends of the DNA whereas endonucleases make cuts at specific positions within the DNA. Each restriction endonuclease functions by 'inspecting' the length of a DNA sequence. Once it finds its specific recognition sequence, it will bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar -phosphate backbones. Each restriction endonuclease recognises a specific palindromic nucleotide sequences in the DNA.

Que. 1) How many enzymes are there which can restrict growth of bacteriophage in E.coli?

(a) One (b) Two (c) Three (d) Four

Ans.(b)

Que. 2) The letter 'R' in the EcoRI is a name of ……

(a) Strain (b) Species (c) Genus (d) Kingdom

Ans.(a)

Que. 3) In the naming of enzymes, the first letter of name belongs to ……

(a) Species (b) Order (c) Strain (d) Genus

Ans.(d)

Que. 4) Which enzyme belongs to the nucleases class of enzymes?

Answer: Restriction enzymes mainly belong to the nucleases class of enzymes.

Case study -4

When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky-ends' and these can be joined together (end-to-end) using DNA ligases The cutting of DNA by restriction endonucleases results in the fragments of DNA. These fragments can be separated by a technique known as gel electrophoresis. Since DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix. Nowadays the most commonly used matrix is agarose which is a natural polymer extracted from sea weeds. The DNA fragments separate (resolve) according to their size through the sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves. The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation (you

cannot see pure DNA fragments in the visible light and without staining). You can see bright orange coloured bands of DNA in an ethidium bromide stained gel exposed to UV light.
The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified in this way are used in constructing recombinant DNA by joining them with cloning vectors.
Que. 1) …… is used to join sticky ends of DNA.
(a) DNA Ligase (b) DNA Host (c) DNA restriction (d) None of them
Ans.(a)
Que. 2) On the basis of ……., fragments of DNA get separated in the Gel electrophoresis.
(a) Nucleotide (b) Colour (c) Shape (d) Size
Ans.(d)
Que. 3) After DNA fragment separation, DNA is stained by …… for the visualisation.
(a) Toluidine (b) Ethidium bromide (c) Sulphuric acid (d) Phloroglucinol
Ans.(b)
Que. 4) Name the technique which is useful in the separation of fragments of DNA.
Answer: Gel electrophoresis is the technique which is useful in the separation of fragments of DNA.
Case Study- 5
Since DNA is a hydrophilic molecule, it cannot pass through cell membranes. Why? In order to force bacteria to take up the plasmid, the bacterial cells must first be made 'competent' to take up DNA. This is done by treating them with a specific concentration of a 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 recombinant DNA on ice, followed by placing them briefly at 420C (heat shock), and then putting them back on ice. This enables the bacteria to take up the recombinant DNA. This is not the only way to introduce alien DNA into host cells. In a method known as micro-injection, recombinant DNA is directly injected into the nucleus of an animal cell.
In another method, suitable for plants, cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA in a method known as biolistics or gene gun. And the last method uses 'disarmed pathogen' vectors, which when allowed to infect the cell, transfer the recombinant DNA into the host. Now that we have learnt about the tools for constructing recombinant DNA, let us discuss the processes facilitating recombinant DNA technology.
Que. 1) In …… method, recombinant DNA is transferred into the host to infect the cell.
(a) Restriction method (b) Gene Gun (c) Biolistics (d) Disarmed pathogen
Ans.(d)
Que. 2) Biolistics or Gene gum method is suitable for ……
(a) Reptiles (b) Plants (c) Birds (d) Insects
Ans.(b)
Que. 3) Calcium cation increases efficiency of ……. for the bacterium entry.
(a) Cell (b) DNA (c) RNA (d) Ribosome
Ans.(b)
Que. 4) Why can't DNA pass through cell membranes?
Answer: DNA is basically a hydrophilic molecule and the cell membrane is hydrophobic in nature. Hence, the DNA cannot pass through the cell membrane.

Self Assessment Test

(MCQ- 1 Mark))

1 Restriction enzymes were discovered by
a. Smith and Nathans b. Alexander Fleming

c. Berg d. None
2. Bacteria protect themselves from viruses by fragmenting viral DNA with
a. Ligase b. Endonuclease c. Exonuclease d.. Gyrase
3 The DNA fragments have sticky ends due to
a. Endonuclease b. Unpaired bases c. Calcium ions d. Free methylation
4. Plasmids are used as cloning vectors for which of the following reasons?
a . Can be multiplied in culture b. Self-replication in bacterial cells
c. Can be multiplied in laboratories with the help of enzymes
d. Replicate freely outside bacterial cells
5 PCR technique was invented by
a. Karry Mullis b. Boyer c Sanger d. Cohn
6 Plasmid DNA acts as _____ to transfer the piece of DNA attached to it into the host organism.
a) protein b) carrier c) vector d) antibody
7The two core techniques that enabled the birth of modern biotechnology are _____
a) red biotechnology and green biotechnology
b) classical and traditional biotechnology
c) genetics and mathematics
d) genetic engineering and maintenance of a sterile environment 1
Directions: In the following questions, a statement of assertion is followed by a statement of reason.
Mark the correct choice as: **(1 -Mark)**
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

8 Assertion: When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky-ends
Reason: These can be joined together (end-to-end) using DNA ligases
9 Assertion: bioreactors can be thought of as vessels in which raw materials are biologically converted into specific products, individual enzymes, etc. using microbial plant, animal or human cells.
Reason: A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen
10.Assertion: Cloning is making multiple unidentical copies of any template DNA.
Reason: No Ori site are required for cloning
11.Assertion: A bacterial cell with no restriction enzymes will be easily infected and lysed by bacteriophages.
Reason: Restriction enzymes catalyse synthesis of protective coat around bacterial cell that prevents bacteriophage attack.

(2- MARKS QUESTIONS)

12. Why do DNA fragments move towards the anode during gel electrophoresis? 2
13. Why is it not possible for an alien DNA to become part of a chromosome anywhere along its length and replicate normally? 2
14. How can retroviruses be used efficiently in biotechnology experiments in spite of them being disease causing? 2

SECTION-C (3- MARKS QUESTIONS)

15.How is insertional inactivation of an enzyme used as a Selectable marker to differentiate recombinants from non-recombinants? 3
16.Explain the work carried out by Cohen and Boyer that contributed immensely in biotechnology. 3
17.How are the DNA fragments separated by gel electrophoresis visualised and separated for use in constructing recombinant DNA? 3

CASE STUDY QUESTION

18.**CASE STUDY**

The techniques of genetic engineering which include creation of recombinant DNA, use of gene cloning and gene transfer, overcome this limitation and allow us to isolate and introduce only one or a set of desirable genes without introducing undesirable genes into the target organism.

Most likely, this piece of DNA would not be able to multiply itself in the progeny cells of the organism. But, when it gets integrated into the genome of the recipient, it may multiply and be inherited along with the host DNA. This is because the alien piece of DNA has become part of a chromosome, which has the ability to replicate. In a chromosome there is a specific DNA sequence called the origin of replication, which is responsible for initiating replication. Therefore, for the multiplication of any alien piece of DNA in an organism it needs to be a part of a chromosome(s) which has a specific sequence known as 'origin of replication'. Thus, an alien DNA is linked with the origin of replication, so that this alien piece of DNA can replicate and multiply itself in the host organism. This can also be called cloning or making multiple identical copies of any template DNA. The cutting of DNA at specific locations became possible with the discovery of the so- 'molecular scissors'– restriction enzymes.

Que. 1) Which DNA sequence is responsible for initiating replication?

(a) Endonuclease (b) Restriction DNA (c) Gene clone (d) Origin of replication

Que. 2) DNA sequence is mainly present in ……

(a) Mitochondria (b) Chromosomes (c) Chloroplast (d) Cytoplasm.

Que. 3) True or False

'The piece of DNA doesn't have the ability to multiply itself in the progeny cell of an organism.'

(a) True (b) False

Que. 4) Write name of molecular scissors which is useful in cutting DNA?

(5-MARKS QUESTIONS)

19.Give reason why

(i) DNA cannot pass into a host cell through the cell membrane.

(ii) Proteases are added during isolation of DNA for genetic engineering.

(iii) Single cloning site is preferred in a vector

20.(i) Name the selectable markers in the cloning vector pBR322. Mention the role they play.

(ii) Why is the coding sequence of an enzyme p-galactosidase a preferred selectable marker in comparison to the ones named above?

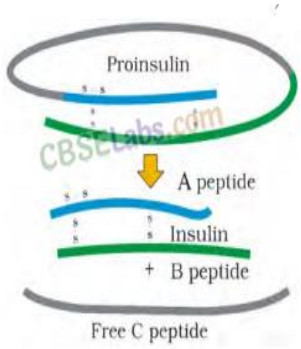
CH 9 BIOTECHNOLOGY AND ITS APPLICATIONS

1. **Genetically modified organisms**- The plants, bacteria, fungi and animals whose genes have been altered by manipulation are called Genetically Modified Organisms. Its advantages to crops are-
   - **.** Crops are more tolerant to abiotic stresses like cold, drought, etc.
   - **a.** Reduced dependence of crops on chemical pesticides.
   - **b.** Reduced post-harvest losses.
   - **c.** Increased efficiency of mineral usage by plants
   - **d.** Enhanced nutritional value of food.
2. **RNA interference-**This is the method of silencing of a specific mRNA due to a complementary double stranded RNA molecule that binds to and prevents the translation of the mRNA. This technique is used to make tobacco plants resistant to a nematode, *Meloidogyne incognitia*.
3. **Bt cotton**- Insecticidal protein produced by bacterium Bacillus thuringenesis kill certain insects like lepidopterans(budworm, armyworm),coleopterans(beetles) and dipterans(flies, mosquitoes). The gene encoding this protein is called cry gene which is isolated from bacterium and introduced into crop plants like cotton. Such plants become resistant to insect pests.

This toxin protein doesn't kill the bacterium itself because it exists as inactive protoxin but once an insect ingests the inactive toxin, it is converted into an active form due to alkaline pH of the insect gut. The activated toxin binds to the surface of midgut epithelial cells and creates pores that cause swelling and lysis and ultimately death of the insect.

4. Applications of biotechnology in medicine-

a) Genetically Engineered Insulin- In 1983, an American company Eli Lily prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains A and B separately. These A and B chains are extracted and combined by creating disulphide bonds to form human insulin.



b) Gene therapy- It is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo. It involves delivery of the normal gene into the embryo. This gene will then take over the function of the non-functional gene.

The first clinical gene therapy was given in 1990 to a 4-year old girl with adenosine deaminase deficiency (ADA deficiency). This enzyme is important for the functioning of the immune system. This disorder is caused due to the deletion of the gene for adenosine deaminase. If the gene isolate from the marrow cells producing ADA is introduced into the cells at early embryonic stages, it could be a permanent cure.

c) Molecular diagnosis of diseases-using PCR technique, probe and ELISA

5. Biopiracy-It is the use of bioresources by multinational companies and other organisations without proper authorization from the countries and people concerned. Ex-In 1997,an American company got patent rights on Basmati rice. This new variety of Basmati had actually been derived from Indian farmer's varieties.

MCQ (1 Mark)

1) ADA is an enzyme which is deficient in a genetic disorder SCID. What is the full form of ADA
(a) Adenosine deoxyaminase (b) Adenosine deaminase
(c) Aspartate deaminase (d) Arginine deaminase

Ans. (b)

2) Silencing of a gene could be achieved through the use
(a) RNAi only (b) antisense RNA only (c) both RNAi and antisense RNA (d) none of the above

Ans. (c)

3) Biopiracy means
(a) use of bio patents (b) thefts of plants and animals
(c) stealing of bioresources (d) exploitation of bioresources without authentic permission

Ans. (d)

4) Crystals of Bt toxin produced by some bacteria do not kill the bacteria themselves because:
(*a*) bacteria are resistant to the toxin (*b*) toxin is immature
(*c*) toxin is inactive (*d*) bacteria encloses toxin in a special sac.

Ans. (c)

5) A probe which is a molecule used to locate homologous sequences in a mixture of DNA or RNA molecules could be:

(*a*) a *ss*RNA (*b*) a *ss*DNA (*c*) either ssRNA or DNA (*d*) can be ssDNA but not ssRNA

Ans. (c)

6) Choose the correct option regarding retrovirus.

(*a*) An RNA virus that synthesises DNA during infection

(*b*) A DNA virus that synthesises RNA during infection

(*c*) A *ss*DNA virus

(*d*) A *ds*RNA virus

Ans. (c)

7) The trigger for activation of toxin of *Bacillus thuringiensis* is

(*a*) acidic pH of stomach (*b*) high temperature

(*c*) alkaline pH of gut (*d*) mechanical action in the insect gut

Ans. (c)

8. Bt corn has been made resistant from corn borer disease by introduction of the gene

(*a*) *cryIAb* (*b*) *ampR* (*c*) *cryIIAb* (*d*) *trp*

Ans. (a)

9. Which of the following statements is/are correct ?

I. The proinsulin has an extra peptide called C-peptide.

II. The functional insulin has A and B chains linked together by hydrogen bonds.

III. Genetically engineered insulin is produced in E. coli.

IV. In man, insulin is synthesised as a proinsulin.

(a) I and II (b) I and III (c) III and IV (d) I, III and IV

Ans. (d)

10. Which of the following statements about biopatents is/are correct?

I. Biopatents protect intellectual property right of an inventor.

II. Biopatents of all products are subjected to commercialisation.

III. Biopatents should be granted carefully and impartially.

IV. Biopatenting requires examination of legal, ethical, and social issues.

Choose the correct option.

(a) Only II (b) I, III and IV (c) II and IV (d) I, II, III and IV

Ans. (a)

11. Transgenic animals are produced

I. To study normal physiology and development. II. To study diseases.

III. To obtain useful biological products. IV. To test the vaccine safety.

V. To test the chemical safety.

Which of the above statements are correct?

(a) I, II and III (b) II, III and IV (c) I, II, III and V (d) I, II, III, IV and V

Ans. (d)

12.Which property of transgenic animals is used in chemical safety testing?

(a) Insensitivity to toxic substances (b) Sensitivity to toxic substances

(c) Resistance to toxic substances (d) Both (a) and (c)

Ans. (b)

13. Match the following columns:

Column-I	Column-II
Bt Tobacco	1.Vitamin-A
Lepidopterans	2. High yield and pest resistant
Bt cotton	3. *Manduca sexta*
Golden rice	4.Tobacco budworm

Choose the correct option:

(**a**) A–3, B–4, C–2, D-1 (**a**) A–3, B–1, C–2, D-4 (**a**) A–1, B–4, C–2, D-3 (**a**) A–3, B–1, C–2, D-4

Ans. (a)

14. Which bacterium was the first to be used as biopesticide on the commercial scale in the world?

(a) *Bacillus thuringiensis* (b) *E. coli* (c*) Pseudomonas aeruginosa* (d) *Agrobacterium tumefaciens*

Ans. (a)

15. Which Indian plants have either been patented or attempts have been made to patent them by Western nations for their use?

(a) Basmati rice (b) Turmeric (c) Neem (d) All of the above

Ans. (d)

16. **.** Which gene was introduced in the first transgenic cow?

(a) Human a -lactalbumin (b) b -1-antitrypsin (c) a -1-antitrypsin (d) cry l Ac

Ans. (a)

17. Biotechnology mainly deals with

(a) industrial scale production of pharmaceutical

(b) biological use of genetically modified microbes, fungi, plants and animals

(c) Both (a) and (b)

(d) None of the above

Ans. (c)

18. Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called

(a) genetically modified organisms (b) hybrid organisms

(c) pest resistant organisms (d) insect resistant organisms

Ans. (a)

19. Bt toxin is

(a) intracellular crystalline protein (b) extracellular crystalline protein

(c) intracellular monosaccharide (d) extracellular polysaccharide

Ans. (a)

20. Insect resistant transgenic cotton has been produced by inserting a piece of DNA from

(a) an insect (b) a bacterium (c) a wild relative of cotton (d) a virus

Ans. (b)

ASSERTION-REASON QUESTIONS (1 MARK)

In the following questions (I to X) a statement of Assertion is followed by a statement of Reason. Choose the correct option.

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

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

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

(D) If both Assertion and Reason are false.

I) Assertion : 'Cry' proteins are named so because they are crystal proteins.

Reason : 'Cry' proteins solubilize in alkaline pH of the insect's gut and activate Bt toxin. **Ans (B)**

II). Assertion : Patents are granted by the government to an inventor.

Reason : Patent prevents others from commercial use of an invention. **Ans (A)**

III). Assertion : Stem cells are undifferentiated biological cells found in multicellular organisms.

Reason : They are obtained from only umbilical cord blood just after birth. **Ans (c)**

IV). Assertion : Indian Patents Bill takes cases of biopiracy in consideration.

Reason : Biopiracy is the use of bioresources by multinational companies without proper authorization from concerned persons and countries occurring in all eukaryotic organisms. **Ans (B)**

V) Assertion : Organisations like Genetic Engineering Approval Committee (GAEC) monitor GM research.

Ans (A)

Reason : Some ethical standards are required to evaluate the morality of all human activities. **Ans (A)**

VI) . Assertion : Human insulin is produced in E. coli.
Reason : In mammals, insulin is synthesised as a pro-hormone which contains an extra stretch of protein.
Ans (B)
VII) .Assertion : The RNAi can be introduced in an organism only by inserting the gene encoding complementary RNA.
Reason : The complement of the mRNA sense strand usually contains the sequence of codons for producing functional protein. **Ans (**D)
VIII) Assertion: Many crops are incorporated with foreign genes to make them tolerant to abiotic stresses.
Reason: Genomes of many plants are manipulated or altered by combining them with other genes to get desired traits. **Ans (**A)
IX) Assertion: Agrobacterium tumefaciens is popular in genetic engineering because this bacterium is associated with the stems of all cereal and pulse crops.
Reason: Using Agrobacterium as a vector, the genes can be transferred in biotechnological techniques.
Ans (D))
X) Assertion: Humulin is better than conventional insulin.
Reason : Conventional insulin produces many side effects. **Ans (A)**

SHORT ANSWER QUESTIONS (2MARKS)

1. Name a molecular diagnostic technique to detect the presence of a pathogen in its early stage of infection. What are transgenic plants? Give some examples.
Ans.: Polymerase chain reaction (PCR) is a technique used in molecular biology to amplify a single copy or a few copies of a segment of DNA across several orders of magnitude, generating thousands to millions of copies of a particular DNA sequence.
2. What are transgenic plants? Give some examples.
Ans.: Transgenic plants are plants that have been genetically engineered, a breeding approach that uses recombinant DNA techniques to create plants with new characteristics. They are identified as a class of genetically modified organisms (GMO). Examples – Bt Cotton, Golden Rice, Flavr Savr tomato.
3. What is GEAC? What are its main objectives?
Ans. GEAC is the Genetic Engineering Approval Committee. It is an Indian government organisation. Its main objectives are as follows:
- To examine the validity of genetic modification research.
- To inspect whether the use of genetically modified crops is safe for public use or not

4. Explain the principle involved in ELISA.
Ans. In ELISA, the antigen-antibody interactions always use an enzyme labelled antigen or antibody. The enzyme activity is measured with the help of a calorimeter using a substrate that changes colour when modified by the enzyme. After the substrate addition, the light is absorbed by the product formed and is represented in the numeric values.
5.Who was given the first gene therapy? Why does this treatment reoccur in nature?
Ans. The first gene therapy was given to a four-year-old girl, on 14th September 1990, at the NIH Clinical Centre. She was suffering from a genetic disorder **Adenosine Deaminase deficiency**. The treatment is recurrent in nature because the genetically engineered lymphocytes used in the therapy are mortal and need to be administered periodically in the patient.
6. What is Golden Rice?
Ans. Golden rice is a transgenic variety of rice (*Oryza sativa*) containing good quantities of β- carotene (provitamin A) which is principle source of vitamin A. Since the grains of the rice are yellow in colour due to β-carotene, the rice is commonly called golden rice.
7. Tobacco Plants are damaged severely when infested with *Meloidogyne incognitia*. Name and explain the strategy that is adopted to stop this infestation.

Ans. Gene expression can be controlled by using RNA molecules and this technology is called RNAi or gene Silencing. During this process a Nematode specific gene is introduced into the host plant which produces dsRNA. This silences specific mRNA of the Nematode.

8. How is the matured, functional insulin hormone different from its Prohormone form?

Ans. Mature functional insulin is obtained by processing of prohormone which contains extra peptide called C-peptide. This C-peptide is removed during maturation of proinsulin to insulin.

9.Biopiracy should be prevented. State why and how?

Ans. Biopiracy is unauthorised exploitation of bioresources of developing or under developed countries. Hence, it should be prevented. it can be prevented by developing Laws to obtained proper authorisation and by paying compensatory benefits.

10. Name a genus of Baculovirus. Why are they considered good biocontrol agents?

Ans. *Nucleopolyhedrovirus* is a baculovirus. They are species-species , have narrow spectrum insecticidal application and no negative impact on non-target organisms, hence they are considered good biocontrol agents.

SHORT ANSWER QUESTIONS (3 MARKS)

1. cryIAb is introduced in a plant to control infestation by corn borer.

(a) Name the resultant plant after successful insertion of the gene desired.

(b) Summarise the action of the gene introduced.

Ans.(*a*) Bt corn

(*b*) *Cry*IAb/Bt toxin gene codes for crystal protein; the Bt toxin protein exists as an inactive protein, but once an insect ingests it, it gets converted into an active form due to the alkaline pH of the gut which solubilised the crystal. The activated toxin binds to the surface of midgut and creates pores that cause swelling, lysis and eventually death of the insect.

2. A corn farmer has a perennial problem of corn-borer infestation in his crop. Being environmentally conscious he does not want to spray insecticides. Suggest solution based on your knowledge of biotechnology. Write the steps to be carried out to achieve it.

Ans. The following steps should be followed:

(*i*) Isolation of Bt toxin genes from *Bacillus thuringiensis*.

(*ii*) Incorporation of genes into corn.

(*iii*) Toxin coded by gene *cryIAb* in corn, kills the pests and the pest dies.

3. (a) State the role of DNA ligase in biotechnology.

(b) What happens when *Meloidogyne incognitia* consumes cells with RNAi gene.

Ans.(*a*) DNA ligase joins the DNA fragments with the same sticky ends. It also links Okazaki fragments or discontinuously synthesised fragments. DNA ligase is used to link desired gene with plasmid to form recombinant DNA. (*Any one*)

(*b*) The specific *m*RNA of the nematode is silenced and the parasite dies

4. What are the drawbacks of the insulin obtained from the slaughtered cows and pigs?

Ans. The drawbacks of insulin obtained from slaughtered animals are as follows:

- Since insulin is produced in very small amounts in the body, therefore, a large number of animals are slaughtered which is unethical.
- If the slaughtered animals are infected, the insulin will also be contaminated which in turn will infect the acceptor.
- The humans might have a potential immune response against the administered insulin derived from animals.

5.Explain five areas where biotechnology has influenced human lives.

Ans. Biotechnology has influenced human lives as follows:

- Genetically modified crops with high nutritive value are provided by biotechnology.
- It has helped in the production of recombinant vaccines.

• It has devised techniques such as gene therapy for the treatment of genetic diseases.
• Genetically engineered microbes are produced to control environmental pollution.
• Transgenic animals are developed that can produce human proteins.

6. What are transgenic animals? Enlist any three areas where they can be used.

Ans. Transgenic animals are those whose genetic material has been altered by a gene of interest using genetic engineering techniques. Four areas where they can be used are:

- Transgenic animals serve as experimental models for the study of various human diseases.
- They are used to test vaccines such as polio vaccines.
- The gene expressions help scientists to understand the normal expression of genes at various stages of growth and development.
- To produce medicine, protein required for treatment of disease, human milk protein etc.

7.How did the process of RNA interference help to control the nematode from infecting the roots of tobacco plants? Explain.

Ans. Using *Agrobacterium* vectors, nematode specific genes are introduced into the host plant. The introduction of DNA produced both sense and antisense RNA in host cells. These two RNA's being complementary formed a double stranded RNA (*ds*RNA) that initiated RNAi and silenced the specific *m*RNA of the nematode. As a result, the parasite could not survive in the transgenic host expressing specific interfering RNA.

8.Plasmid is a boon to biotechnology. Justify this statement quoting the production of human insulin as an example.

Ans. Plasmids are extrachromosomal, self-replicating, usually circular, double-stranded DNA molecules found naturally in many bacteria. In 1983, Eli Lilly, an American company, first prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains. These chains A and B were produced separately, extracted, and combined by creating disulfide bonds to form functional human insulin (Humulin).

8. Write the difference between the proinsulin and mature insulin.

Ans. Insulin is a hormone secreted by the pancreas. It consists of two short polypeptide chains, i.e., chains A and B, linked together by disulphide bridges. Chain-A contains 21 amino acids, while chain-B contains 30 amino acids. In mammals, insulin is synthesised as a prohormone, i.e., it needs to be processed before it becomes a fully mature and functional hormone. This prohormone contains an extra stretch called the C-peptide of 33 amino acids. This is known as proinsulin. The insulin that lacks C-peptide is called mature insulin.

9. Explain process of gene therapy to treat adenosine deaminase deficiency. Mention two disadvantages of this procedure.

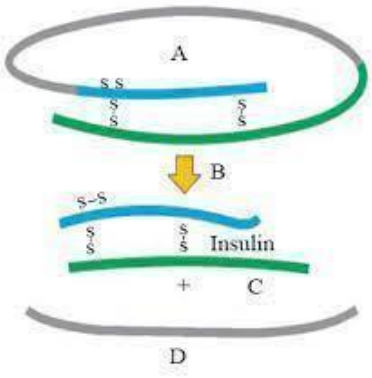
Ans. (i) Lymphocytes from the blood of the patient are grown on culture outside the body.
(ii) A functional ADA cDNA is then introduced into these lymphocytes using a retroviral vector.
(iii) The genetically engineered lymphocyte is returned to the blood of patient.

Disadvantages:

Therapy is not completely curative as cells do not remain alive and periodic infusion of lymphocyte is required.

***CASE BASE QUESTION* (4 MARKS EACH)**

Refer to the diagram of maturation of proinsulin into insulin to answer the any four questions from 1(i) to (IV) given below:



(i) How are two short polypeptide chains of insulin linked together?
Ans.: Two short polypeptide chains of insulin are linked together by disulphide bridges.
(ii) State the role of C-peptide in human insulin.
Ans.: C-peptide (extra stretch of polypeptide) makes the insulin inactive.
(iii) Mention the chemical change that proinsulin undergoes, to be able to act as mature insulin.
Ans: An extra stretch called C-peptide is removed from pro-insulin during maturation.
(iv) What do you mean by the term proinsulin?
Ans. The prohormone contains an extra stretch called the C-peptide of 33 amino acids. This is known as proinsulin.

OR

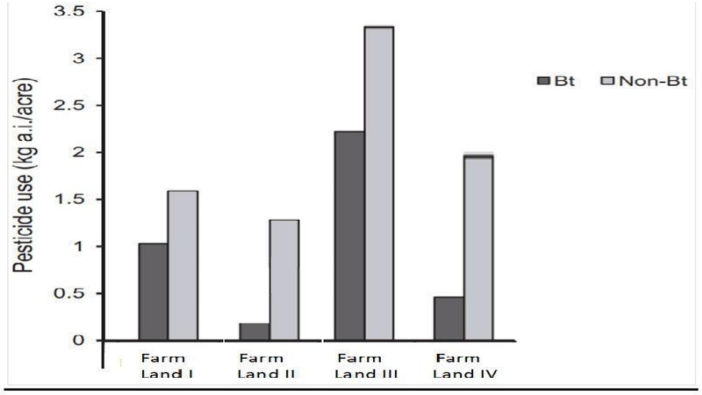
(iv) Which of the following companies started selling Humulin in the year 1983 ?
Ans.: Eli Lilly

Case -2. Read the following and answer any four questions from 2(i) to 2 (v) given below:
Nematodes like *Meloidogyne incognitia* infects the roots of tobacco plants and causes reduction in yield. The infestation of these nematodes can be prevented by the process of *RNA interference (RNAi).* RNAi is present in all eukaryotic organisms as cellular defence by silencing of specific mRNA due to complementary dsRNA molecules that bind to and prevents translation of the mRNA. The source of complementary dsRNA may be from an infection by viruses that have RNA genomes or mobile genetic elements that replicate through RNA intermediate. Nematode specific genes were introduced into host plant using Agrobacterium vectors. The parasite could not survive in a transgenic host expressing specific interfering RNA.
(i) In RNAi, genes are silenced using
(a) ss DNA (b) ds DNA (c) dsRNA (d) ssRNA
Ans.(c)
(ii) Silencing of a gene could be achieved through the use of
(a) (RNAi) only (b) Antisense RNA only (c) both (d) None of the above
Ans.©
(iii) Name the vector use in RNAi :
(a) *Agrobacterium tumefaciens* (b) *Bacillus thuringiensis* *(c) Aspergillus* *(d) Drosophila*
Ans. (a)
(iv) . Which among the following is not allowed to take place in the case of RNA interference employed in making tobacco plants resistant to the nematode, Meloidogyne incognitia?
(a) Transcription of mRNA (b) Translation of mRNA
(c) Replication of DNA (d) Maturation of hn RNA.
Ans.(b)
(v) A probe which is a molecule used to locate specific sequences in a mixture of, DNA or RNA molecules could be
(a) A single stranded RNA (b) A single stranded DNA

(c) Either RNA or DNA (d) Can be ssDNA but not ssRNA

Ana. (c)

Case-3. GM crops especially Bt crops are known to have higher resistance to pest attacks. To substantiate this an experimental study was conducted in 4 different farmlands growing Bt and non Bt-Cotton crops. The farm lands had the same dimensions, fertility and were under similar climatic conditions. The histogram below shows the usage of pesticides on Bt crops and non-Bt crops in these farm lands.



1.Which of the above 4 farm lands has successfully applied the concepts of Biotechnology to show better management practices and use of agrochemicals?

Ans. Farm Land II. (1 mark)

2. If you had to cultivate, which crop would you prefer (Bt or Non- Bt) and why?

Ans. Bt crop. Because the use of pesticides is highly reduced for Bt crop Decrease of pesticide used is also more significant for Bt crop. (1 mark)

3.Cotton Bollworms were introduced in another experimental study on the above farm lands wherein no pesticide was used. Explain what effect would a Bt and Non Bt crop have on the pest.

Ans: In Bt cotton a cry gene has been introduced from bacterium *Bacillus thuringiensis* (Bt) which causes synthesis of a toxic protein. This protein becomes active in the alkaline gut of bollworm feeding on cotton, punching holes in the lining causing death of the insect. However; a Non Bt crop will have no effect on the cotton bollworm/ the yield of cotton will decrease / non Bt will succumb to pest attack.

Case -4. Read the following and answer any four questions from 4(i) to 4(v) given below :

The Indian Government has set up organizations such as GEAC , which will make decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services. **Biopatent:** A patent is the right granted by a government to an inventor to prevent others from making commercial use of his invention. Now, patents are granted for biological entities and for products derived from biological resources. **Biopiracy:** It is the term used to refer to the use of bio-resources by multinational companies and other organizations without proper authorization from the countries and people concerned without compensatory payment. In 1997, an American company got patent rights on Basmati rice through the US Patent and Trademark Office. This allowed the company to sell a new variety of Basmati, in the US and abroad. This 'new' variety of Basmati had actually been derived from Indian farmer's varieties. Indian Basmati was crossed with semi-dwarf varieties and claimed as an invention or a novelty.

(i) GEAC stands for:

(a) Genome Engineering Action Committee

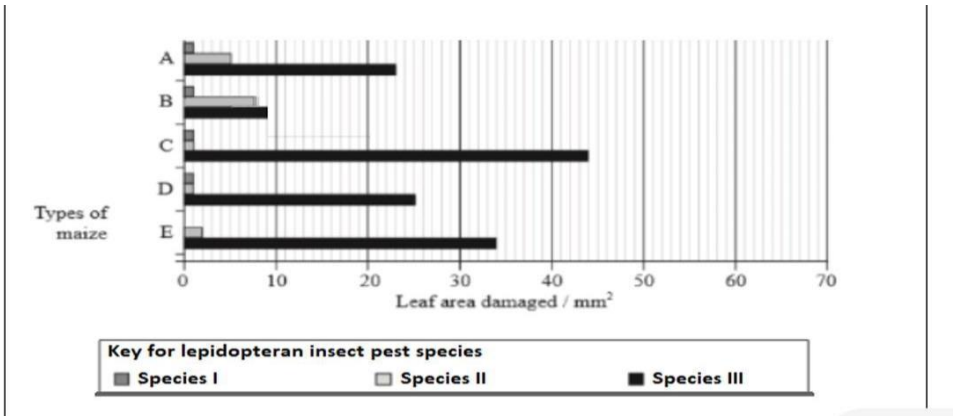
(b) Ground Environment Action Committee

(c) Genetic Engineering Approval Committee

(d) Genetic and Environment Approval Committee Golden rice

Ans. ©

(ii Golden rice is yellow in colour due to the presence of :
(a) riboflavin (b) β – carotene (c) vitamin B1 (d) complex genetic material.
Ans. (b)
(iii) Rules of conduct that may be used to regulate our activities in relation to the biological world is called:
(a) bioethics (b) bio war (c) biopatent (d) biopiracy
Ans. (a)
(iv) Biopiracy means
(a) use of biopatent (b) Thefts of plants and animal
(c) Stealing of bioresources (d) exploitation of bioresources without authentic permission
Ans.(d)
(v) Night blindness can be prevented by use of:
(a) golden rice (b) transgenic tomato (c) transgenic maize (d) Bt Brinjal
Ans.(a)
Case 5 . Read the following and answer questions given below:
Insects in the Lepidopteran group lay eggs on maize crops. The larvae on hatching feed on maize leaf and tender cob. In order to arrest the spread of three such Lepidopteran pests, Bt maize crops were introduced in an experimental field. A study was carried out to see which of the three species of lepidopteran pests



Insect gut pH was recorded as 10, 8 and 6 respectively for Species I, II and III respectively.
(a) Evaluate the efficacy of the Bt crop on the feeding habits of the three species of stem borer and suggest which species is least susceptible to Bt toxin. (1)
Ans. (a) Species III is least susceptible
(b) Which species is most susceptible to Bt-maize, (1)
Ans. (b) Species I is most susceptible.
(c) Using the given information, suggest why similar effect was not seen in the three insect species? (2)
Ans: c) Insect species I and II have alkaline gut pH which solubilised the insecticidal protein crystals of protoxin and makes it active. Species III has an acidic and the protoxin continues to remain in an inactive form doing no harm to insect species III.

LONG ANSWER QUESTION (5 MARKS)

1. How are transgenic tobacco plants protected against *Meloidegyne incognitia*? Explain the procedure.

Ans. Refer NCERT page 180.

2.a) What is gene therapy? (1)
b) Describe the procedure of such a therapy that could be a permanent cure for a disease. Name the disease.
Ans: Refer NCERT page-182 Gene Therapy.

3. An application of biotechnology in agriculture involves production of pest resistant plants using Cry gene from a bacterium. Name the bacterium. Explain why the Cry gene kills the pest but not the bacterium itself.

Ans: Refer NCERT page-179 Bt Cotton.

4.i) GM crops are designed to develop natural resistance from insects and pests. Which crops are modified using *Bacillus thuringiensis?*(1 mark)

ii) List four advantages of GMOs to a farmer.(2marks)

iii) State that foods derived from genetically modified crops should be tested for possible reaction in the people. Explain.

Ans. (i) Crops modified using *Bacillus thuringiensis* are corn, cotton, tomato, rice, potato, and soybean. In there, the insect resistant gene is transferred from *Bacillus thuringiensis* to make

It insect resistant. **[1]**

(ii) **Advantages of GMOs to a Farmer.**

(a) Crops become more tolerant to abiotic stresses like cold, drought, salt and heat.

(b) Dependence on chemical pesticides has reduced, i.e., pest-resistant crops.

(c) Helped to reduce post-harvest losses.

(d) Enhanced nutritional value of food, e.g., vitamin-A enriched rice. **[2]**

(iii) Genetically modified crops should be tested for possible reactions in people, because these crops are prepared by the insertion of genes of the other species into their DNA. So, there is a possibility that they can cause some health issues, i.e allergies due to release of new kinds of proteins. Hence, GM crops should be tested.**[2]**

5. a) Name the source source from which insulin was extracted earlier. Why is this insulin no more in use by diabetic patients?

b) Explain the process of synthesis of insulin by Eli Lilly company. Name the technique used by the company.

c) How is the insulin produced by the human body different from the insulin produced by the above-mentioned company?

Ans. Refer NCERT page 181 Genetically Engineered Insulin.

SELF ASSESSMENT TEST (40 MARKS)

MCQ(1 mark)

1.Biopiracy is related to the use of which of the following?

(a) Traditional knowledge

(b) Biomolecules and regarding bioresources

(c) Bioresources

(d) All of the above

2. In 1997, the first transgenic cow, Rosie produced

(a) human protein enriched milk (2.4 g/L)

(b) human protein enriched milk (2.8 g/L)

(c) human calcium enriched milk (2.4 g/L)

(d) human calcium enriched milk (2.8 g/L)

3. Consider the following statements.

I. Bt toxin gene has been cloned from the bacteria.

II. Genetic engineering works only on animals and has not yet been successfully used on plants.

III. Strains of *Bacillus thuringiensis* are used in producing bio insecticidal plants.

4. Peptide A and Peptide B are linked by how many disulfide linkage between their proinsulin.

a) 1b) 2 c) 4 d)5

5. CryIIAb endotoxin obtained from *Bacillus thuringiensis* are effective against

a) flies b) mosquitoes c) bollworms c) nematodes

6. *Meloidogyne incognitia* infects

a) stem of tobacco b)root of tobacco c) leaf of tobacco d) all of these

7. The site of production of ADA in the body is

(a) erythrocytes (b) lymphocytes (c) blood plasma (d) osteocytes

Assertion-Reason(1 mark)

Direction (Q. Nos. 1-2) Each of these questions contains two statements, Assertion (A) and Reason (R). Each of these questions also has four alternative choices, any one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true, but R is not the correct explanation of A

(c) A is true, but R is false

(d) A is false, but R is true

1. Assertion (A) Transgenic plant production can be achieved via recombinant DNA technology.

Reason (R) An organism that contains and expresses a transgene is called a transgenic organism.

2. Assertion (A) A crop expressing a cry gene is usually resistant to a group of insects.

Reason (R) Cry proteins produced from Bacillus thuringiensis are toxic to larvae of certain insects

3.Assertion: ADA gene therapy was done at first to treat immune disorder due to ADA deficiency.

Reason: The gene ADA cDNA was delivered into the patient's cells using a retroviral vector.

4. Assertion: Organisations like GEAC are necessary to monitor GM researches and to test the safety of introducing GM organisms for public services.

Reason: GM researches can have unpredictable results which even can be disastrous when genetically modified organisms are introduced into the ecosystem.

SA-1(2MARKS)

1. List the advantages of recombinant insulin.

2. What is ADA deficiency and how can it be cured?

3.How is Rosie considered different from a normal cow? Explain.

SA-II(3 MARKS EACH)

1. (i) Which insects are killed by *Bacillus thuringiensis*?

(ii) The Bt toxin binds to which cells?

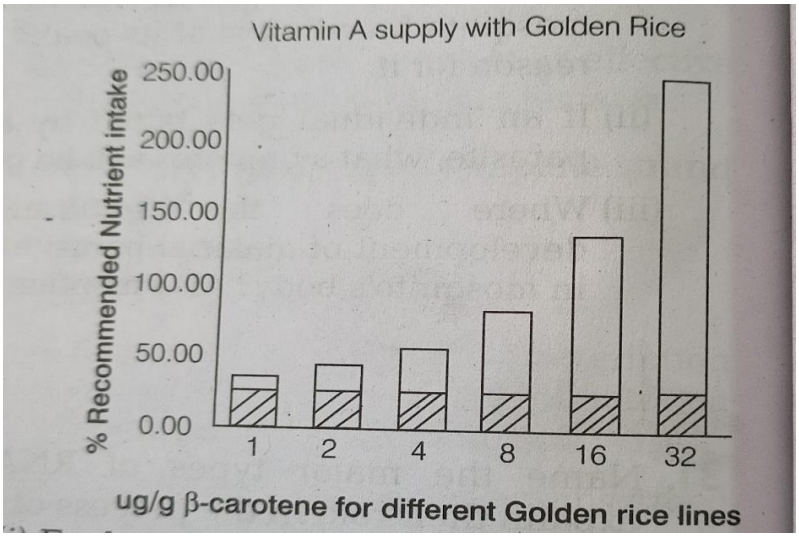
(iii) In which plants, Bt toxin is used?

2. Plasmid is boon to biotechnology. Justify this statement quoting the production of human insulin as an example.

3. What is *Agrobacterium* mediated genetic transformation described as natural genetic engineering in plants?

CASE BASE QUESTION

GM crops contributed to an increase in the number of functional foods or nutraceutical foods with added benefits. Nutraceutical foods are applied to isolated nutrients, dietary supplements and herbal products, specific diets, processed foods. Scientist have developed Golden rice that contains more Vitamin-A. Capacity of Golden rice lines with varying carotene content to supply the recommended nutrient intake of vitamin-A. The graph below shows the shaded part as dietary intake of vitamin-A from the other source and the unshaded part as dietary intake of vitamin-A from Golden Rice.



1. Evaluate the efficacy of golden rice to meet the daily intake of vitamin-A on people.(1 Mark)
2. GM crops are the best solution to overcome issues developed due to conventional breeding. Discuss. (2)
3. Which disease is cause by deficiency of Vitamin-A

LONG ANSWER QUESTION

1. Anil's father is suffering from high blood sugar. Doctors had advised regular insulin injections, which were declined by the family due to objections on the process used in insulin production. The doctor explained the process now used in insulin production and its advantages.
(i) Why did the family decline the use of insulin injection despite its necessity? (1)
(ii) Name the process by which insulin is produced now-a-days. Explain the process in detail.(3)
(iii) What values are shown by the doctor? (1)

2. Explain the different uses of biotechnology in the medical field.

CH 11 ORGANISMS AND POPULATIONS

ASTER CARD

Population Attributes

Birth Rate/Natality [B]: Number of babies born per 1000 people/Year in a population.
Death Rate/Mortality [D]: Number of deaths per 1000 people/Year in a population.
Sex ratio: Number of females per 1,000 males
Population density [N]: Number of individuals per unit land area.
Measured in numbers:
a) No. of Siberian cranes in wetland b) Percent cover or biomass: banyan tree vs grass
c)Relative densities: fish in pond d) Indirectly: tiger in forest [faecal pellets/ pug marks]

Factors affecting population growth [N]

(I)Natality [B]: Number of births during a given period in the population.
(ii) Mortality [D]: Number of deaths in the population during a given period.
(iii) Immigration [I]: Number of individuals that have come into the habitat
(iv) Emigration [E]: Number of individuals who left the habitat.

If N is the population density at time t, then its density at time t +1 is

$N_{t+1} = N_t + [(B + I) – (D + E)]$

1. **Exponential growth**-When resources in the habitat are unlimited, each species has the ability to grow exponentially or geometrically. Such type of growth is called exponential growth. (Graph page 194 of NCERT) It is represented by the following equation:

   $dN/dt = (b-d) \times N$ Let (b-d) = r, then $dN/dt = rN$

   where r is the 'intrinsic rate of natural increase" N is the population size

   b is the birth rate d is the death rate

   Integral form of above equation is $N_t = N_o e^{rt}$

   Where N_t = Population density after time t N_o= Population density after time zero

   e = the base of natural logarithm r = intrinsic rate of natural increase.

2.**Logistic growth**- A population growing in a habitat with limited resources shows initially a lag phase, followed by phases of acceleration and deceleration and finally stable when the population density reaches the carrying capacity. It results in a sigmoid curve. This type of population growth is called **Verhulst-Pearl Logistic Growth.** (graph page 194 of NCERT). It is represented by the following equation:

$dN/dt = rN(K-N/ K)$

where N = Population density at time t r = intrinsic rate of natural increase
K = Carrying capacity

Out of these growth models, the logistic growth model is considered the more realistic one because resources are never unlimited.

3.Carrying capacity- A given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible. This is called the carrying capacity of that habitat.

4.Population interactions-In any natural habitat, there is always interaction between populations of two different species. This interaction may be beneficial, detrimental or neutral to one of the species or both. These interactions are as follows:

(i) Predation: In this, one species preys upon other species. So one of them is benefited and the other is harmed. Predators play important roles in ecosystem: a) Keep prey population under control.
b) Maintain species diversity

Prey Defences:

1. Camouflage: Frog/ Insect change colour according to environment
2. Poisonous Monarch butterflies feed on poisonous weed as caterpillars and become distasteful.

Defence mechanisms in plants against herbivory- For plants herbivores are the predators. a)**Morphological defences-** thorns in Acacia, Cactus; b) **Chemical defences**- Calotropis produces poisonous cardiac glycosides. That's why cattle or goats don't browse on it. Chemicals like nicotine, caffeine,quirine, and opium are chemical defences.

(ii) Competition- Fitness of species is lowered in the presence of other species. **Gause's 'Competitive Exclusion Principle'** states that two closely related species competing for the same resources cannot coexist indefinitely and the competitively inferior one will be eliminated eventually. This is true only if resources are limited otherwise not.

Competitive Release- A species, whose distribution is restricted to a small geographical area because of the presence of competitively superior species, is found to expand its distributional range when the competitive species is experimentally removed.

(iii) Parasitism- Parasitic mode of life ensures free boarding and lodging**.** One species is benefited and the other is harmed**.** Parasites have **evolved special adaptations** like loss of sensory organs, presence of adhesive organs or suckers, loss of digestive system and high reproductive capacity. Ex- ectoparasites like lice on

humans, Cuscuta on hedge plants; endoparasites like sheep liver fluke, tapeworm in humans; **brood parasitism** in birds (crow incubates the eggs of cuckoo).

(iv) Mutualism- Both the interacting species benefited. Ex- lichens (mutualism between algae and fungi), mycorrhizae (mutualism between fungus and roots of higher plants), plant-pollinator relationship.

Sexual deceit- The Mediterranean orchid *Ophrys* employs sexual deceit to get pollinated by bees. One petal of its flower resembles a female bee in size, colour and markings. The male bee is attracted to it, '**pseudo copulates'** with the flower, pollen attached to its body. When the same bee pseudo copulates with another flower, it transfers pollen to it and thus pollinates the flower. Here co-evolution operates. If the female bee's colour patterns change during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain resemblance of its petal to the female bee.

(v) Commensalism: one species benefits and the other is neither harmed nor benefited

(vi)Ammensalism: one species is harmed and the other is neither harmed nor benefited

MCQ

Q1. Interaction between organism and environment is

a) Ecosystem b) Ecotone c) Ecology d) Auto ecotone

Ans a) Ecosystem

Q2. Which one of the following is a level of ecological organisation**?**

a) Biome b) Population c) Community d) all

Ans d) all

Q3. Which is a prerequisite for a population:

a) Interbreeding b) Physical Similarity c) Geographical similarity d) all

Ans d) all

Q4. Evolution takes place at what level:

a) population b) individual c) cell d) molecular

Ans a)

Q5. 10 mosquitoes died in a population of 200 mosquitoes, death rate would be:

a) 0.05 b) 2000 c) 210 d) 2000

Ans a)

Q6. 50 bacteria increase to 150 after an hour, the growth rate of population:

a) 50/hour b) 200/hour c) 5/hour d) 100/hour

Ans d)

Q7. Status of the population with more young individuals would

a) decline b) stabilize c) increase d) decline and stabilize

Ans c)

Q8. Decrease in the density of a population would be due to:

a) B > D b) I > E c) D > B d) B + I

Ans c)

Q9. What will be the number of protozoans after six generations if it divides by binary fission?

a) 128 b)24 c) 64 d)32

Ans c)

Q10. In 2023, for each of the 14 million people present in a country, 0.028 were born and 0.008 died during the year. Using exponential equation, the number of people in 2033 is predicted as:

a. 25 million b. 17 million c. 20 million d. 18 million

Ans b)

Q11 Darwinian fitness is represented by:

a) low r b) high r c) low k d) high k

Ans b)

Q12. Exotic species become invasive because:

a) limited resources b) no predator c) low indigenous population d) more competition

Ans b)

Q13. Removal of *Pisaster* affected invertebrates by

a) increase population b) increase diversity c) all d) decrease diversity

Ans d)

Q14.Which of the following is not an ectoparasite:

a) copepods b) mistletoe c) lice d) anopheles

Ans d)

Q15. Carrying capacity is represented by:

a) r b) K c) N D) None

Ans b)

Q16. Which is a function of predator:

a) energy conduit b) control prey population c) increased species diversity d) all

Ans d)

Q17. When population density reaches carrying capacity, growth curve has reached:

a) lag b) log c) asymptote d) none

Ans c)

Q18. Asymptote is obtained when

a) r= 0 b) K > N c) K < N d) K = N

Ans d)

Q19.Principle of competitive exclusion was given by:

a) Verhulst b) Gause c) mac Arthur d) Darwin

Ans b)

Q20. Increased population of rats during bamboo flowering shows

a) J growth b) S growth c) N growth d) K growth

Ans a)

Assertion and Reason

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

1. Assertion : Individual organism is the one that has to cope with a changed environment.
   Reasoning: Evolution occurs at individual level.
   Ans. c
2. Assertion : Population density of banyan is low relative to that of *Parthenium*

Reasoning: Role of the Banyan in that community is negligible**.**

Ans. d

3. Assertion : With unlimited Resources, each species can grow exponentially

Reason: source availability is essential for the unimpeded growth of a population.

Ans. b

4. Assertion : The size of a population for any species is not a static parameter

Reason: Changes in population density give us an idea if it is flourishing or declining.

Ans. b

5. Assertion : The 'fittest' individual will survive and reproduce

Reason: No population of any species in nature has at its disposal unlimited resources

Ans. b

6. Assertion : The life cycles of endoparasites are more complex

Reason: They show extreme specialization**.**

Ans. a

7. Assertion : Under normal conditions, births and deaths are the most important factors influencing population density

Reason: Under new colonisation, immigration may contribute more significantly to population growth

Ans. b

8. Assertion : Species growing exponentially with unlimited resources can reach enormous population densities.

Reasoning: Slow growing animal like elephant can reach enormous numbers in the absence of checks

Ans. b

9. Assertion : Parasite co evolves with host.

Reasoning: Host evolves special mechanisms for rejecting or resisting the parasite

Ans. a

10. Assertion : Size of the population tells us a lot about its status in the habitat.

Reasoning: Impact of a predator causes change in the population size**.**

Ans. b

SA (2 Marks)

Q1. What is the importance of population ecology?

. An individual organism copes with a changed environment, evolution of desired traits takes place at the population level. Population ecology links ecology to population genetics and evolution.

Q2. What attributes can a population have that an individual cannot?

A. Birth rate, death rate, age distribution pattern, sex ratio and population density.

Q3. If in a pond there were 100 frogs last year and through reproduction 20 new frogs were born, calculate the birth rate.

A. No. of Frogs in a Pond = 100 No. of frogs born in a year = 20 Total number of the frogs = 100 + 20 = 120

Birth rate = No. of births/ Original population ×100 = 20/100×100 = 20 %

Q4. Why are pug marks considered a reliable measure of population density in certain conditions?

A. Pugmarks can tell a lot about the animal's sex, age, size, health conditions, and the time and direction in which the animal had moved.

Q5. What is the significance of the Verhulst-Pearl Logistic Growth equation?

A. The Verhulst-Pearl equation is associated with the rate of reproduction that is proportional to both the existing population and the number of available resources.

Q6. What are the organisms that feed on plant sap and other plant parts called?

A.Phytophagous

Q7. Write the unit of measurement for density of a population in a habitat per unit area for the following:

a. Bacteria b. Banyan c. Deer d. Fish

a. Bacteria : biomass/number b. Banyan: Biomass/Area c. Deer : Number/area d. Fish: Number caught per trap

Q8. In an association of two animal species, one is a termite which feeds on wood and the other is a protozoan *Trichonympha* present in the gut of the termite. What type of association do they establish?

A. The Protozoa present in the gut digest the wood, which termite feeds upon, In the absence of *Trichonympha* the termite is unable to digest wood and hence dies. Thus, the association of two given animal species represent mutualism.

Q9. What relationship is exhibited by sea anemone and a clown fish. Explain

A. The clownfish and the sea anemone pair up for their struggle for life , the clown fish depends on sea anemone for protection from the predators whereas the sea anemone depends on clownfish for food . In this relationship both are benefited . This type of relationship is called mutualistic or symbiotic relationship .

Q10. Why are predators called prudent?

. If the predator over-exploits the prey, then the prey species will go extinct and eventually the predator too gets extinct due to the lack of food

SA (3 Marks)

Q1. How does age pyramids explain demographics for a country?

A. The width represents the size of the population of a given age; women on the right and men on the left. The bottom layer represents the number of newborns and above it, you find the numbers of older individuals. It also tells if the population will increase, decrease or remain stable.

Q2. Why population density cannot be measured only in terms of numbers?

A. In some cases population density in terms of number is either meaningless or difficult to determine. In an area, if there are 200 Parthenium plants but only a single huge banyan tree with a large canopy, stating that the population density of banyan is low relative to that of *Parthenium* amounts to underestimating the enormous role of the Banyan in that community. In such cases, the percent cover or biomass is a more meaningful measure of the population size. For instance, the number of fish caught per trap is a good enough measure of its total population density in the lake. We estimate population sizes indirectly, without actually counting them or seeing them. The tiger census in our national parks and tiger reserves is often based on pug marks and faecal pellets.

Q3. Explain the equation, emphasizing on the four factors affecting population growth: $N_{t+1} = N_t + [(B + I) – (D + E)]$

A. This equation $N_{t+1} = N_t + [(B + I) – (D + E)]$ shows the population density at time = t+ 1.

- where, N = Population density, t = Time, B = Birth rate, I = Immigration, D = Death rate, E = Emigration and Nt = Population in beginning.
- The equation demonstrates that the population density will increase if the number of births plus the number of immigrants (B + I) is more than the number of deaths plus the number of emigrants (D + E), otherwise, it will decrease.
- 1) Natality- is the number of births during a given period in the population.
  2) Mortality- is the number of deaths in the population during a given period.
  3) Immigration- is the number of individuals that have come into the habitat from elsewhere during the time period.
  4) Emigration- is the number of individuals of the population who left the habitat and moved elsewhere during a given time period.

Q4. *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.

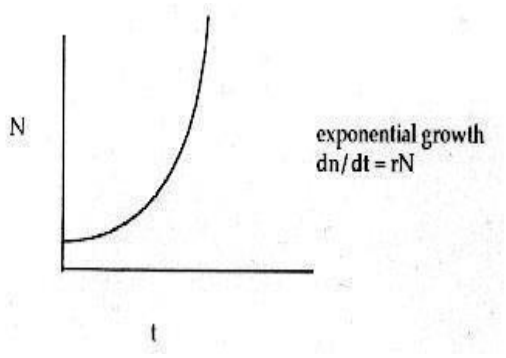
A. *Lianas* are structural parasites on other trees, while taking support from other trees, lianas usually strangulate the other tree. They also compete for sunlight and water and in the process harm the host tree.

Q5. Define 'zero population growth rate'. Draw an age pyramid for the same

A. 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, there is zero population growth rate. An inverted bell shaped age pyramid is obtained for zero population growth rate.

Q6. Give an example of an organism that shows exponential growth along with the graph.

A. Bacteria grown in the lab provide an excellent example of exponential growth.



Q7. A population of *Paramecium caudatum* was grown in a culture medium. After 5 days the culture medium became overcrowded with *Paramecium* and had depleted nutrients. What will happen to the population and what type of growth curve will the population attain? Draw the growth curve.

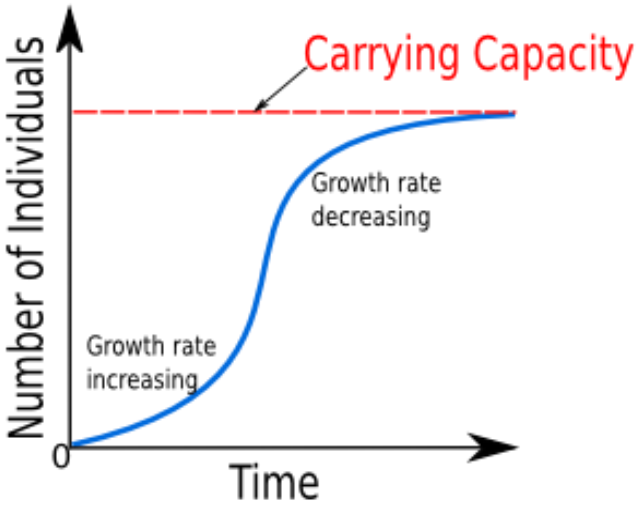
A. As the population of *Paramecium caudatum* was grown in a culture medium. After 5 days the culture medium became overcrowded with Paramecium and had depleted nutrients because after the overcrowding of *Paramecium* the nutrients became limited and depleted. Sigmoid type of growth curve would be obtained.

Q8. In an aquarium two herbivorous species of fish are living together and feeding on phytoplankton. 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.

A. In this case, two herbivorous fishes are living in the same niche and feeding on phytoplankton. In the aquarium, unlimited food resources are available in the form of phytoplankton. Moreover, the population inside the aquarium is very less as there are just 2 fishes inside. In short, there is sufficient food and less

number of individuals, which means that the competition is also less. Apart from this, as both the fishes are herbivorous there is no danger of predators in that niche. This can ensure better survival of both the fishes. And as neither of the species has been eliminated, niche overlapping may affect the expansion and development of individuals. However, studies have shown there is a fair chance that two species in the same niche can co-exist depending upon the fact as to how they segregated their use of the available resources.

Q9. Comment on the growth curve given below.



Ans

- A. Logistic population growth curve:
- (I) The resources become limited at the certain point of time, so no population can grow exponentially.
- (ii) This growth model is realistic
- (iii) Every ecosystem or environment has limited resources to support a particular maximum number of the individual called its carrying capacity (K).
- (iv) When N is plotted in relation to time t, the logistic growth curve shows the sigmoid curve and is also called. Verhulst-Pearl logistic growth. It is given by the following equation:
- $dN/dt=rN[K-NK]$
- where, N = population density at time t
- r = intrinsic rate of natural increase
- k = carrying capacity

Q10. What is the significance of 'r'?

A. Population evolves to maximize their "r" value which results in more Darwinian fitness. Increase in "r" value means birth rate is more and death rate is less. Decrease in "r" value means birth rate is less and death rate is more. This is how 'r" value affects the population size.

Case study (4 Marks)

Q1. Gause's competitive exclusion principle states that no two species can coexist if they occupy the same niche. In other words, an ecological niche cannot be simultaneously and completely occupied by stabilized populations of more than one species. In a classic experiment Gause (1934) first grew *Paramecium caudatum* and *Paramecium aurelia* in separate cultures and found that each species grew in numbers according to the logistic equation. However, *P. aurelia* grows in numbers more quickly than P. caudatum and shows more individuals in the same volume of culture. But when he grew the two species together in the same culture volume, he observed that initially both species grew in numbers, but eventually *P. caudatum* declined and

became extinct. He repeated the experiment and found that *P. aurelia* always won the competition between the two species.

A) Who gave the competitive exclusion principle Ans. Gause
B) Which species of paramecium grew faster? Ans. *P.aurelia*
C) Why did one species of paramecium grow faster? Ans. Due to competitive superiority of *P. aurelia*
D) What will happen if you remove P.aurelia experimentally and what is the phenomenon called ?
Ans. *P. caudatum* will expand its area . Competitive release

Q2. Brood parasites are animals that rely on others to raise their young. The strategy appears among birds, insects and fish. The brood parasite manipulates a host, either of the same or of another species, to raise its young as if it were its own, usually using **egg mimicry**, with eggs that resemble the host's. The evolutionary strategy relieves the parasitic parents from the investment of rearing young. Many hosts have developed strong defences against brood parasitism, such as recognizing and ejecting parasitic eggs, or abandoning parasitized nests. It is less obvious why most hosts do care for parasite nestlings, given that for example cuckoo chicks differ markedly from host chicks in size and appearance. Intraspecific brood parasitism also occurs, as in many duck species. Here there is no visible difference between host and parasite eggs, which may be why the parasite eggs are so readily accepted.

. Give an example of a brood parasite. B) Why do animals resort to brood parasitism
c. How do brood parasites prevent ejection of their eggs? **D)**Is brood parasitism ethical in the sense of survival?

Ans. A. Cuckoo B. relieves the parasitic parents from the investment of rearing young. C. During the course of evolution, the eggs of the parasitic bird have evolved to resemble the host's egg in size and colour
D. correct

Q3. Sexually deceptive orchids provide no reward to their pollinators. Instead, they mimic the sex pheromone of receptive insect females to attract males which pollinate the flowers in mating attempts. Most *Ophrys* species have an inconspicuous greenish perianth and a dark brownish petal.

a) Give an example of a pollinator of ophrys? B) Why is it called sexual deceit?
c) how do ophrys reward the pollinator? D) can this interaction be referred as mutualism

Ans. A. Bee B. provide no reward to their pollinators. Instead, they mimic the sex pheromone of receptive insect females to attract males or resemble female honey bee. C. no rewards D. NO

Q4. All of us would have that uncle or aunt who'd be living in the U.S., U.K. or Canada. This yearning to taste and live life in a Western country, is not from the bygone era. Over the years, millions of young talented Indians from various disciplines have left our soil in search of better opportunities. For a long time, the idea of people moving to a different country was seen as a badge of honour, a feather in the cap as it were. The most singularly pursued dream. And this was primarily because India was unable to offer those prospects to its citizens. It's not that we're adequately able to, right now as well. So is India's brain drain problem getting worse.

A) What is this phenomenon called in terms of population study B) How does it affect population density?
c) Is this phenomenon applicable in normal conditions? D) Do you support this phenomenon?
Ans. A. Emigration B. Decreases population density C. No, mostly during colonisation D. Correct ans

Q5. *Actoblastis cactorum* was first introduced to Australia in 1925 from Argentina, where it was successfully used as a biological control agent for *Opuntia* cacti. It diminished the population of the spineless *Opuntia* species valued as "cattle fodder". In 1956, the moth was introduced to the Caribbean island

of Nevis and successfully controlled a complex of native "prickly pear" cacti. In 1960 *Cactoblastis* was introduced into Montserrat and Antigua as a successful biological control agent.

a) Which interaction helped in control of prickly pear cactus
b) What other methods can be used for its control?
c) How is this method better?
d) Give any other example of natural predation?

Ans. A. Parasitism B. chemical control C. relies on biological predation, no chemicals D. Dragonflies for mosquitoes

LA (5 Marks)

Q1. Explain Verhulst-Pearl logistic growth of a population.
Ans NCERT Page 195
Q2.Apart from being a part of food chain, predators play other important roles. Mention other such roles supported by examples.
Ans NCERT Page 197
Q3. Explain coevolution with reference to parasites and their hosts. Mention any four special adaptive features evolved in parasites for their parasitic mode of life.
Ans NCERT Page 200
Q4. (i) What is an age pyramid?
(ii) Explain with the help of figures, the three different types of age pyramids represented by human population.
Ans NCERT Page 191
Q5. (i) Compare, giving reasons, the J-shaped and S-shaped models of population growth of a species.
(ii) Explain 'fitness of a species', as mentioned by Darwin.
Ans NCERT Page 194, 195

Self-Assessment test:

MCQ [1 MARK]
Q1. Geometric representation of age structure is characterized by:
a) community b) population c) organism d) biome
Q2. High density of population density can lead to
a) interspecific competition b) intraspecific competition c) predation d) none
Q3. Population dynamics is regulated by:
a) food b) climate c) competition d) all
Q4. If Bengal tiger becomes extinct then:
a) deer population stabilizes b) gene pool of tiger will be lost c) wolves will decrease d) all
Q5. Monarch butterfly escapes by:
a) foul smell b) bitter taste c) colour combination d) all
Q6. What parameters are used for tiger census?
a)pug marks b) faecal pellets c) both d) none
Q7. Which relationship is expressed by fig and wasp?
a)mutualism b) parasitism c) competition d)predation

ASSERTION REASONING [1 MARK]
Q8. ASSERTION: India's population will overtake that of China by 2030
REASONING: Birth rate of China is decreasing while that of India is increasing.
Q9. ASSERTION: Adaptation of both predator and prey are refined by natural selection.
REASONING: Prey evolves defences to escape predators.

Q10. ASSERTION: A population that fits a logistic growth model grows more rapidly at intermediate size.
REASONING: The population growth rate decreases dramatically as population size approaches carrying capacity.
Q11. ASSERTION: Age structure pyramids can predict population growth trends
REASONING: Age pyramids show distribution of various age groups in a population.

SA [2 Mark]

Q12. Name entities that sustain parts of plant and plant sap.
Q13. Calculate the death rate if 6 individuals in a laboratory population of 60 fruit flies died during a particular week.
Q14. What is the importance of pseudocopulation??

VSA [3 Mark]

Q15. Lichens are considered good examples of obligate mutualisms". Comment?
Q16. An orchid plant is growing on the branch of a mango tree. How do you describe this interaction between the orchid & the mango tree?
Q17. How will you measure population density in the following cases?
(I) fish in a lake (ii) tiger census in a national park (iii) single huge banyan tree with large canopy

Case study

Q18. The life cycle of the fig wasp is closely intertwined with that of the fig tree it inhabits. The pollinating wasps are part of an obligate nursery pollination mutualism with the fig tree, while the non-pollinating wasps feed off the plant without benefiting it. A mated mature female pollinator wasp enters the immature "fruit" deposits her eggs in the cavity. In depositing her eggs, the female also deposits pollen she picked up from her original host fig. This pollinates some of the female flowers on the inside surface of the fig and allows them to mature. After the female wasp lays her eggs and follows through with pollination, she dies. As the fig develops, the wasp eggs hatch and develop into larvae. After going through the pupal stage, the mature male's first act is to mate with a female - before the female hatches. Consequently, the female will emerge pregnant. The males of many species lack wings and cannot survive outside the fig for a sustained period of time. After mating, a male wasp begins to dig out of the fig, creating a tunnel through which the females escape. Once out of the fig, the male wasps quickly die. The females find their way out, picking up pollen as they do. They then fly to another tree of the same species, where they deposit their eggs and allow the cycle to begin again.

. How is wasp and fig connected by co evolution
A. What kind of relationship do they show
C) Why is it called an obligate relationship
D) give example of another such obligate relationship?

LA [5 MARK]

Q19. Describe the different kinds of positive interactions that take place between different species.
Q20. Explain the adaptations of the animal parasites while living in and on the host species with suitable examples.

CH12 ECOSYSTEM

1. **Productivity**-The rate of biomass production is called productivity. It is expressed in terms of g $^{-2}$yr $^{-1}$ or (kcal m^{-2}) yr $^{-1}$. Two types: primary and secondary
    - Primary productivity: The amount of biomass produced per unit area over a time period by plants during photosynthesis is called primary productivity.
      a.Gross primary productivity: The rate of production of organic matter during photosynthesis is called gross primary productivity.

b.Net primary productivity: Gross primary productivity minus respiration losses (R) by the plant is called net primary productivity(NPP) i.e. GPP-R = NPP

- Secondary productivity: Rate of formation of new organic matter by consumers is called secondary productivity.

2.Decomposition: The process of breakdown of complex organic matter into inorganic substances like CO_2 , water and nutrients by the decomposers is called decomposition. It involves following steps:

- Fragmentation: It is the process of breakdown of detritus into smaller particles by the detritivores (e.g., earthworm). **Detritus** means the dead plant remains like leaves, bark, flowers and dead remains of animals including faecal matter.
- Leaching: Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
- Catabolism**:** Bacterial and fungal enzymes degrade detritus into simpler inorganic substances.
- Humification**:** Formation of a dark colored amorphous substance called humus that is highly resistant to microbial action and decomposes at a very slow rate.
- Mineralisation**:** It is the further degradation of humus by some microbes to release inorganic nutrients.

- **Grazing food chain:** It starts with the producers
- **Detritus food chain**: It starts with dead organic matter.

III.ECOLOGICAL PYRAMIDS

• The relation between producers and consumers in an ecosystem can be graphically represented in the form of pyramid called ecological pyramid

i) Pyramid of number : the relationship between producer and consumer in an ecosystem can be represented in the form of pyramid in terms of number called pyramid of number.

(ii) Pyramid of biomass : the relationship between producer and consumer in an ecosystem can be represented in the form of a pyramid in terms of biomass called pyramid of biomass. It can be (a)Upright, e.g in case of grassland ecosystem; or (b)Inverted, e.g in the case of pond ecosystems.

(iii) Pyramid of energy: the relationship between producers and consumers in an ecosystem can be represented in the form of pyramid, in terms of flow of energy called pyramid of energy. It is always upright because energy is always lost as heat at each step.

MULTIPLE CHOICE QUESTIONS

Q1 - Vertical distribution of different species occupied at different levels in a biotic community is known as.

a. Divergence b. Stratification c. Zonation d. Pyramid

Ans: b

Q2- The primary productivity in an ecosystem is expressed as

a.gm2yr-1 b.gm-2yr c. kcal m-2 yr-1 d. kcal m-2

Ans: c

Q3- Which of the following is not a functional unit of the ecosystem?

a. decomposition b. productivity c. stratification d.Energy flow

Ans: c

Q4- secondary producers are

a. herbivores b. producers c. Carnivores d. none of these

Ans: d

Q5- How much of the net primary productivity of a terrestrial ecosystem is eaten and digested by herbivore

a. 1% b. 40% c. 90% d. 10%

Ans: d

Q6- Energy stored at the consumer level is

a. gross primary productivity b.net primary productivity c.net productivity d. Secondary productivity

Ans: d

Q7- The breakdown of detritus into small particles by detritivores is called

a. Leaching b.Humification c.Fragmentation d.Catabolism

Ans: c

Q8- Each trophic level has a certain mass of living material at a particular time called

a. standing crop b. biomass c. Branching lines d. Progressive straight line

Ans: a

Q9- Which of the following utilises inorganic materials?

a.Autotrophs b.Saprotrophs c.Heterotrophs d.Decomposer

Ans: a

Q10- In food chain of grassland ecosystem, the largest population is that of

a.Decomposer b.Producers c. Primary consumers d.Tertiary consumer

Ans: b

Q11- Match the column 1 and column 2 and choose the correct answer from the codes given below

COLUMN 1	COLUMN 2
A.Saprophyte	1.Symbiotic association of fungi with plant roots
B.Parasite	2.Decomposition of dead organic materials
C.Lichen	3.Living on living plants or animals
D.Mycorrhiza	4. Symbiotic association of algae and fungi

a. A (2) B(3)C (4) D (1) b.A (3) B (1) C (2) D(4) c.A(1) B(2)C (4) D (3) d.A (4)B(3) C (2) D (1)

Ans: a

Q12 – Identify the correct type of food chain shown below

Dead leaves	Insect	Crow

a. Grazing food chain b.Detritus food chain c.Aquatic food chain d.None of these

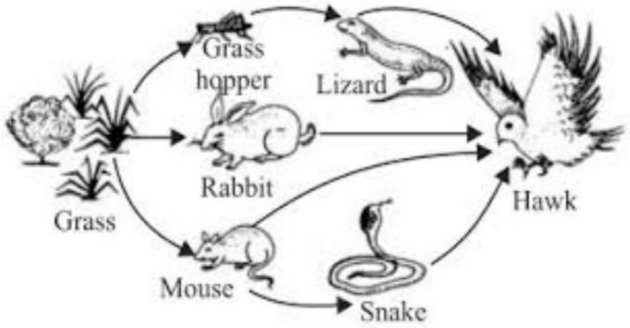
Ans: b

Q13- Which of the following food chains is the major conduit for energy flow in terrestrial and aquatic ecosystems, respectively?

Terrestrial ecosystem	Aquatic ecosystem
a.Grazing	Grazing
b.Detritus	Detritus
c.Detritus	Grazing
d. Grazing	Detritus

Ans: c

Q14- In the given food web, an increase in the population of hawks will not result in



a. decrease in the population of lizards b. increase in the world of grasshoppers
c. Decrease in the population of rabbits and snake d. decrease in the population of mouse
Ans: b

Q15 - the 10% law for energy transfer in food chain was given by
a.Stanley b.Tansley c.Lindemann d.Weismann
Ans: c

Q16- If 20 J of energy is trapped at a producer level, how much energy will be available to peacock as food in the following chain?
Plant— mice — snake — peacock
a. 0.0002J b. 0.02J c. 0.002J d. 0.2J
Ans: b

Q17- The upright pyramid of number is absent in
a. forest b. Lake c. Grassland d. Pond
Ans: a

ASSERTION AND REASONING

- Direction (Q. Nos. 19-29) In each of the following questions, a statement of Assertion (A) is given and followed by a corresponding statement of Reason (R). Of the statements, mark the correct answer as.

  a. Both if both A and R are true and R is correct explanation of the A
  b. If both A and R are true, but R is not the correct explanation of A
  c. If A is true , but R is false
  d. If A is false . But R is true

1. Assertion (A): An ecosystem is an interaction between biotic and abiotic components
Reason (R): AG Tansley coined the term
Ans: b

2. Assertion (A): Decomposition process is slower if detritus is rich in lignin and chitin.
Reason(R): Decomposition is largely an oxygen requiring process.
Ans: b

3. Assertion (A): Complex interactions occur in a Pond ecosystem.
Reason (R): Pond ecosystem is a self-sustainable Unit.
Ans: b

4. Assertion (A): Lignin slows down the process of decomposition.
Reason (R): Lignin is a water-soluble substance
Ans: c

5. Assertion (A): The standing crop is measured as the mass of living organisms.
Reason (R): It represents the entire living matter in a specific population at a particular time.
Ans: b

6. Assertion (A): Herbivores are also called as first order consumers.
Reason (R): These obtain their food directly from plants.
Ans: a

7. Assertion (A): Energy trapped in autotroph does not get circulated.
Reason (R): Autotrophs trap energy from the sun.
Ans: d

8. Assertion (A): A network of food chains existing together in an ecosystem is known as a food web.
Reason (R): A bird like a kite cannot be a part of a food web.
Ans: c

9. Assertion (A): In a terrestrial ecosystem, detritus Food chain is a major conduit for energy flow.
Reason (R): Solar energy is a direct source of energy supply in the detritus food chains.
Ans: c

10. Assertion (A): In most ecosystems, the pyramid of biomass is upright.
Reason (R): The producers are more in biomass than herbivores in an ecosystem.
Ans: a

SA(2 Marks)

Q1 Define primary production.

Ans It is defined as the amount of biomass or organic matter produced per unit area over a certain time period by plants during photosynthesis.

Q2 Name the important steps in the process of decomposition.

Ans Fragmentation, leaching, catabolism, humification and mineralization.

Q3 What is meant by humification?

Ans The process of formation of humus from detritus or organic matter is called humification.

Q4. List two factors that determine the vegetative and soil type of an ecosystem.

Ans Two factors that determine the vegetation and soil type of an ecosystem are
i) Precipitation ii)Temperature

Q5.Name the basic requirement of any ecosystem to function and sustain properly.

Ans .A constant input of solar energy is the ultimate source of all energy and requirement of any ecosystem to function and sustain properly.

Q6 Name the four functional aspects of an ecosystem.

Ans Functional aspects of an ecosystem are: i) Productivity ii) Decomposition iii) Energy flow iv)Nutrient cycle

Q7 Why are earthworms considered a farmer`s friend? .

Ans Earthworms help in breakdown of complex organic matter as well as loosening of the soil. This helps in the proper growth of the crops. Therefore, they are considered farmer's friends.

Q8 How are productivity, gross productivity, net primary productivity and secondary productivity interrelated?

Ans Productivity is the rate of biomass production. GPP – R = NPP
Where NPP is biomass available to consumers for secondary productivity.

Q9 Define trophic level.

Ans Each energy step or level in a food chain is called a trophic level.

Q10 Explain with the help of two examples, how the pyramid of a number and the pyramid of biomass can look inverted.

Ans The pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton. Also, in the pyramid of numbers, the number of insects feeding on a big tree is far greater

than the tree. Now the number of small birds depending on the insects and the number of larger birds eating the smaller ones also increases in the order.

SA (3 Marks)

Q1 Describe the process of decomposition detritus under the following head: fragmentation, leaching, catabolism, humification and mineralization.

Ans The process of breaking down complex organic matter into inorganic substances like CO2, water and nutrients is called decomposition.

Fragmentation: the process of breaking down of detritus into smaller particles is called fragmentation, e.g., as done by earthworm.

Leaching: the process by which water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts is called leaching.

Catabolism: the enzymatic process by which degraded detritus is converted into simpler inorganic substances is called catabolism.

Humification: the process of accumulation of a dark coloured amorphous substance called humus that is resistant to microbial action and undergoes decomposition at an extremely slow rate is called humification.

Mineralisation; the process by which humus is further degraded by some microbes to release inorganic nutrients is called mineralisation.

Q2.Justify the importance of decomposers in an ecosystem.

Ans Decomposers, which are heterotrophic organisms, mainly fungi and bacteria break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients. They meet their energy and nutrient requirements by degrading dead organic matter or detritus. These are also known as saprotrophs. Decomposers secrete digestive enzymes that break down dead and waste materials into simple, inorganic materials, which are subsequently absorbed by them.

Q3 What is stratification in an ecosystem? Explain with an example.

Ans The vertical distribution of different species occupying different levels in an ecosystem is called stratification. Trees occupy the topmost vertical layer of a forest, shrubs occupy the second layer and herbs and grasses occupy the bottom most or base layers.

Q4 A) what is primary productivity? Why does it vary in different types of ecosystems?
B) state the relation between gross and net primary productivity.

Ans primary productivity is defined as the amount of biomass energy produced per unit in a given time (per year) by plants during photosynthesis.

It depends upon plant species inhabiting a particular area, environmental factors, availability of nutrients and photosynthetic capacity of plants which vary in different types of ecosystems. GPP – R = NPP.

Q5 Why is the length of a food chain in an ecosystem generally limited to 3-4 trophic levels? Explain with an example.

Ans The amount of energy flow decreases with successive trophic levels as only 10% of energy is transferred from one trophic level to the next successive level. The energy is lost in the form of respiration and other vital activities to maintain life. If more trophic levels are present, the residual energy will be limited and decreased to such an extent that it cannot further support any trophic level by flow of energy. So, the food chain is generally limited to 3-4 trophic levels only.

Q6 Describe the components of an ecosystem.

Ans. An ecosystem consists of two types of components, i.e., biotic or living and abiotic or nonliving. There are three main types of biotic components on the basis of mode of obtaining their food- producers, consumers and decomposers.

Producers (autotrophs):They are photosynthetic or autotrophic plants that synthesise their own organic food from inorganic raw material with the help of solar radiations. Common producers are algae, plants and photosynthetic bacteria. Phytoplanktons are the producers of aquatic ecosystems.

Consumers (heterotrophs): they are animals which feed on other organisms or producers for obtaining their nourishment. Common consumers are deer, goats,etc.

Decomposers: they are saprotrophs which obtain nourishment from organic remains. They release digestive enzymes to digest the organic matter. Common decomposers are detritivores, e.g., earthworm.

Abiotic component of ecosystem consists of non-living substances and factors which are as follows

a)Temperature b) light c)wind d) humidity e) precipitation f) water

Q7 List the three parameters used for constructing ecological pyramids. Describe any one instance where the pyramid may look inverted.

Ans .The three parameters used are

Number of individuals in a trophic level.

Biomass of individuals in a trophic level

Rate of flow of energy in a trophic level

The pyramid may look inverted in a tree ecosystem where the number of consumers are numerous depending on a single producer.

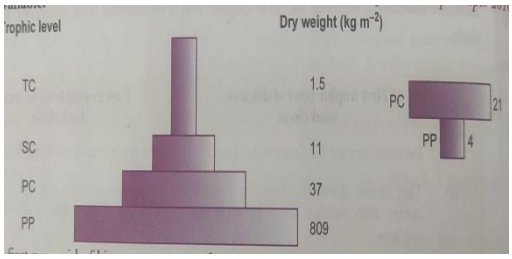
Q8 Explain primary productivity and the factors that influence it.

Ans. Primary productivity is defined as the amount of biomass or organic matter produced per unit area over a period by plants during photosynthesis. It varies in different types of ecosystems. It is expressed in terms of weight (g m^{-2}) or energy (kcal/m^{2}).

It depends on the following factors:

Plant species inhabiting a particular area, Environmental factors, Availability of nutrients, Photosynthetic capacity of plants.

Q9. Compare the two ecological pyramids of biomass given below and explain the situation in which this is possible. Also, construct an ideal pyramid of energy, if 200,000 joules of sunlight is available.



Ans The first pyramid of biomass corresponds to a terrestrial ecosystem. Second pyramid refers to a small standing crop of phytoplankton supporting a large standing crop of zooplankton or an aquatic ecosystem.

Q10 Describe how oxygen and chemical composition of detritus control decomposition.

Ans. Decomposition of detritus is slow if it contains lignin, chitin, tannins and cellulose, whereas it is quicker if detritus is made up of nitrogenous compounds and water-soluble substances like sugars. This is because the latter was easy to degrade. Oxygen is required for the activity of decomposers and detritivores. Therefore, a reduced oxygen amount will slow down the process of decomposition.

LA (5 Marks)

Q1.A) Draw the pyramid of biomass in the sea and in a forest. Explain giving reasons why the two pyramids are different.

B)"Pyramid of energy is always upright." Explain.

Ans. Ncert.pg 212 and pg 213

Q2.A) Explain the significance of ecological pyramids with the help of an example.

B) Why are the pyramids referred to as 'upright' or 'inverted'?

Ans.Ncert.pg 213 and 214

Q3.A) Draw a 'pyramid of numbers' of a situation where a large population of insects feed upon a very big tree. The insects in turn, are eaten by small birds which in turn are fed upon by big birds.

B) Differentiate giving reasons, between the pyramid of biomass of the above situation and the pyramid of numbers that you have drawn.

Ans. Ncert.pg 212 and pg 213

Q4 Taking example of a small pond, explain how the four components of an ecosystem function as a unit.

(ii) Name the type of food chain that exists in a pond.

Ans. Ncert. pg 206

Q5(i) what is trophic level in an ecosystem? What is 'standing crop' with reference to it?

explain the role of the 'first trophic level' in an ecosystem.

How is the detritus food chain connected with the grazing food chain in a natural ecosystem?

Ans. Ncert. pg 210

CASE BASED QUESTIONS:

Q1 A group of students go for an educational trip in the forest .They observe many microorganisms and insects accumulated on the wooden log. The process of breaking down complex organic matter into inorganic substances like water, carbon dioxide and nutrients is called decomposition. Detritus is the raw material for decomposition.

i) What can be the correct definition of leaching?

a. Process that leads to accumulation of dark coloured amorphous colloidal substances.

b. The process by which water soluble inorganic nutrients goes down into the soil horizon and precipitated as unavailable salt.

c. The process of degradation of humus by microbial action.

d. The process of breakdown of detritus into smaller particles by detritivores.

Ans(B)

(ii) The rate of decomposition is faster in the ecosystem due to the following factors except

(a) detritus is rich in sugars (b) warm and moist environment

(c) presence of aerobic soil microbes (d) detritus rich in lignin and chitin

Ans(d)

(iii) Which one of the following processes during decomposition is correctly described?

(a)fragmentation carried out by organisms such as earthworms

(b) Humification lead to the accumulation of dark coloured substance humus, which resistant to microbial action and decompose at very fast rate

(c) Catabolism is last step in the decomposition, occurs under fully anaerobic condition

(d) During leaching water-soluble inorganic nutrients arise to the top layers of soil

Ans (a)

(iv) It is said that decomposition is reduced at higher altitude. Justify.

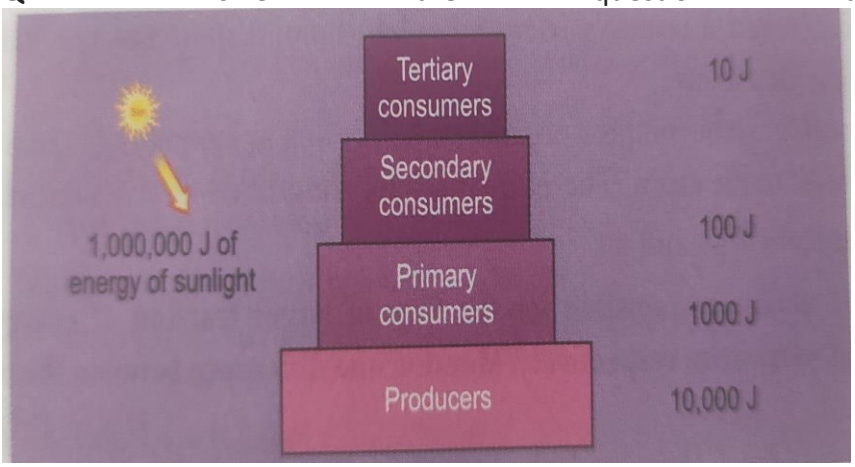
Ans: temperature is not favourable for microbial action.

Or

v. How does detritus differ from humus?

Ans Freshly fallen dead material is detritus while amorphous dark substance is Humus.

Q2 Answer the question based on diagram



(i) Primary consumer belong to which trophic level

(a) First (b) Second (c) Third (d) Fourth

Ans: (b)

(ii) How much PAR is captured by plants?

(a) 10% (b) 30% (c) 1% (d) 90%

Ans(c)

(iii) In which situation this pyramid can be inverted

(a) Terrestrial ecosystem (b) Aquatic ecosystem (c) Both (d) None

Ans (d)

(iv) Show the pyramid of energy in terrestrial ecosystem by taking an example.

Or

(v) In an aquatic ecosystem name the organism which occupy first trophic level

Ans : Phytoplankton

Q3 An ecosystem is the basic functional ecological unit in which living organisms interact among themselves and with their surrounding physical environment. The term ecosystem was coined by Tansley. The entire biosphere is referred to as a global ecosystem which consists of several local ecosystems of earth. The ecosystem consists of biotic and abiotic components and their interaction with each other, resulting in a physical structure. Answer the following questions based on the text above.

(i) Find the false statement:

a) Oceans act as a global sink of carbon dioxide.

b) An ecosystem is an isolated or closed unit.

c) An ecosystem composed of biotic and abiotic components

d) Sun is major source of energy in an ecosystem

Ans:b

(ii) Biotic components of an ecosystem are

(a) Plants (b) Decomposer (c) Air (d) Both a & b

Ans(d)

(iii) Who coined the term Ecosystem

(a) Tansley (b) Lindeman (c) Mendel (d) Darwin

Ans(a)

(iv) **List the biotic and abiotic components of the ecosystem.**

(a) bacteria (b) water (c) soil (d) all
Ans(a)

or

(v) **Interaction of biotic and abiotic components is**

(a) ecosystem (b) ecology (c) ecotone (d) all
Ans(a)

Q4 Organisms occupy a specific place in their natural surroundings or in a community according to their feeding relationship with other organisms. Based on the source of nutrition of food organisms occupy a particular place called trophic level. Organisms may occupy different trophic levels in different food chains in the same ecosystem.

(i) What technical term is given to organisms occupying the second and third trophic levels in a food chain?

(ii) Choose an example each for first and second trophic levels of food chain from the following organism: Rabbit, Wolf, Snail, Frog, Hydrilla, Grass, Fish

(iii) How does detritus food chain connect with grazing food chain?

Ans (i) Herbivore and Carnivore

(ii) First Trophic Level : Hydrilla and Grass; Second Trophic Level: Frog, Snail

(iii) Some organisms of DFC are prey to GFC animals

Self Assessment Test

MCQs

Q1 Which of the following is the largest man made ecosystem?

a) Zoo b) Garden c) Aquarium d) Agroecosystem

Q2 Rate of production of organic matter by producers per unit time and area is

a) GPP b) NPP c) GPP-R d) GPP +R

Q3 Which of the following mostly limits the primary productivity of the ecosystem

a) Light b) Oxygen c) Carbon dioxide d) Nitrogen

Q4 Major conduit of energy in aquatic ecosystem is

a) DFC b) GFC c) Both d) None

Q5 Decomposers like fungi are

a) Autotrophs b) Saprotrophs c)Heterotrophs d) Chemoautotrophs

Q6 Pyramid of number is

a) Always Upright b) Always inverted c)Both upright & Inverted d) None

Q7 Which of the following ecosystem is most productive in terms of net Primary Production

a) Ocean b) Desert c) Estuaries d) Tropical RainForest

Assertion and Reason:

Directions: In each of the following questions, a statement of Assertion (A) is given and followed by a corresponding statement of Reason (R). Of the statements, mark the correct answer as.

a) Both A and R are true and R is correct explanation of the A
b) Both A and R are true, but R is not the correct explanation of A
c) If A is true, but R is false
d) If A is false. But R is true

Q8 Assertion(A): Herbivore productivity is 10% of GPP of producer
Reason (R): Herbivore eat less and waste a lot of energy

Q9 Assertion(A): Decomposition of detritus helps in biogeochemical cycling
Reason (R): Humus formed in decomposition releases minerals

Q10 Assertion(A): Shallow water rooted plants are called phytoplankton
Reason (R): These are dominant producers in ponds

Q11 Assertion(A): All animals are consumer and heterotrophs
Reason(R): Animals are dependent on plants either directly or indirectly

Short Answer type Ques(2 Marks):

Q12 What two abiotic factors might affect
(i) An animal living at the bottom of the sea?
(ii) A plant growing on a mountain side?

Q13 Primary productivity varies from ecosystem to ecosystem. Explain.

Q14 Construct a pyramid of number considering a banyan tree supporting insects, birds and their predators

Short answer type Ques(3 Marks):

Q15. How would you differentiate between gross primary productivity from net primary productivity and secondary productivity of an ecosystem?

Q16 Why are earthworms considered as farmer's friends? Explain humification and mineralization occurring in a decomposition cycle.

Q17 Construct an ideal pyramid of energy when 10,00,000J of sunlight is available. Label all its levels.

Q18 Case Based Question:

The fallen parts of plants such as leaves, flowers, fecal matter of animals, dead remains of animals are ultimately broken down into simpler organic nutrients carbon dioxide and water. Fragmentation, Leaching and catabolism are some important steps in decomposition.

(I) What term is given to a group of organisms which carry out fragmentation and catabolism?
(II) Apart from the steps mentioned in the paragraph, mention two other steps which are involved in decomposition.
(III) Enlist the factors which influence the rate of decomposition.

Long answer type Ques:

Q19.(i) Taking example of a small pond , explain how the four components of an ecosystem function as a unit .

(ii) Name the type of food chain that exists in a pond.

Q20 Discuss relationship between detritus food chain and grazing food chain in terrestrial ecosystem

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CH13 BIODIVERSITY AND ITS CONSERVATION

1. **Types of biodiversity**- Diag. page 217 of NCERT
2. Genetic Diversity : It refers to the total number of genes in the genetic makeup of a species. e.g *Rauwolfia vomitoria*
3. Species Diversity : It represents the number of species in an ecological community. e.g Western Ghats and Eastern Ghats
4. Ecological Diversity: Diversity at the ecosystem level
5. **Species-area relationship**: Graph on page 220 of NCERT.
6. **Causes of biodiversity losses**:
   a. Habitat loss and fragmentation
   B. Over-exploitation
   c.Alien species invasion like Parthenium, water- hyacinth.

d.Co-extinctions: for ex. When a host fish becomes extinct, parasites also become extinct.

Reasons to conserve biodiversity :

a. Narrowly utilitarian arguments: Humans derive many economic benefits from nature-food, firewood, fibre, industrial products and products of medicinal importance.
b. Broadly utilitarian arguments: balance atmospheric gases, pollination, aesthetic pleasures.
c. Ethical arguments: Philosophically or spiritually, we need to realise that every species has an intrinsic value.

1. Conservation of biodiversity:

. **In situ conservation:** On site conservation.
    1. Biosphere reserves(14), national parks(90), and sanctuaries(448) in India.
    2. Biodiversity hotspots(regions with very high levels of species richness) and endemism(species confined to that region and not found anywhere else. Initially biodiversity hotspots were 25 in number but now it is 34 in the world. Three of them are in our country-Western Ghats and Sri Lanka, Indo-Burma and Himalaya.
    3. Sacred groves in Aravalli Hills of Rajasthan, Khasi and Jaintia Hills in Meghalaya.

b. **Ex situ conservation:** Off site conservation. Threatened animals and plants are taken out of their natural habitat and placed in special setting where they can be protected and given special care. Zoological parks, botanical gardens and wildlife safari parks, pollen banks, seed banks.

Ramsar sites are defined as wetland sites that are of convention importance and are developed under Ramsar convention. Ramsar convention is defined as an international treaty, where it originates this name after the city of Ramsar in Iran, which was signed in the year 1971 and the negotiation for the Ramsar convention was started in the year 1960 by different countries and NGO, 37 Ramsar sites in India are named under the Ramsar Convention.

- Ramsar convention first came into existence in 1975 with the mission to conserve and use all wetlands wisely.
- Wetlands are the areas of Marsh, Fern and they contain water, they may be natural or artificial and may be permanent or temporary, and they may be static or flowing, and the water that present are either fresh or brackish or salt or marine and are termed as Ramsar sites.
- Some of the examples of the wetlands include estuaries, rivers, and lakes, etc.
- It mainly makes cover on the conservation of habitats for water bodies.

MULTIPLE CHOICE QUESTIONS

1.One of the ex situ conservation methods for endangered species is
(a) Wild life sanctuaries
(b) Biosphere reserves
(c) Cryopreservation
(d) National parks
Ans c.

2. First National park developed in India is
(a) Gir
(b) Kaziranga
(c) Jim Corbett
(d) None of these
Ans: (c)

3.Which one of the following pairs of geographical areas show maximum biodiversity in our country?
a) Sunderbans and Rann of Kutch
(b) Eastern Ghats and West Bengal
(c) Eastern Himalayas and Western Ghats
(d) Kerala and Punjab
Ans. c
4. Which group of vertebrates comprises the highest number of endangered species?
(a) Fishes
(b) Reptiles
(c) Birds
(d) Mammals
Ans.d
5. The worst dangerous threat to wildlife is by
(a) Habitat destruction
(b) Hunting
(c) Overgrazing
(d) Exotic species
Ans.a
6. New approach to conservation is the establishment of
(a) Sanctuaries
(b) Biosphere reserves
(c) National parks
(d) Reserve forests
Ans.b
7. In situ conservation refers to
(a) On site conservation
(b) Off site conservation
(c) Could be both (a) and (b)
(d) None of the above
Ans.a
8. Endemism refers to
(a) Species confined to that region and not found anywhere else
(b) Species confined to. that Region and also found anywhere else
(c) Species of all varieties
(d) None of the above
Ans.a
9. Wildlife is destroyed most by
(a) Lack of proper care
(b) Mass scale hunting
(c) Destruction of natural habitats
(d) Natural calamity
Ans.c
10. More than 70 percent of all the recorded biotic components are
(a) Animals
(b) Plants
(c) Human beings
(d) None of the above
Ans.a

Q.11. The variation shown by the medicinal plant *Rauwolfia vomitoria* growing in different Himalayan ranges represents
(A) Genetic diversity
(B) Species diversity
(C) Ecological diversity
(D) Community diversity
Ans: a
Q.12. Which of the following groups represents minimum species diversity among vertebrates?
(A) Birds
(B) Mammals
(C) Reptiles
(D) Amphibians
Ans b
Q.13. More conservative and scientifically sound estimate made by Robert May places the global species diversity at about
(A) 1.5 million
(B) 7 million
(C) 1.7 million
(D) 17 million
Ans b
Q.14. Species diversity of plants on earth is
(A) 2.5 %
(B) 22 %
(C) 7.1 %
(D) 32 %
Ans b
Q.15. Species are relationships among very large areas like the entire continents the Z values in the range of
(A) 0.1 to 0.2
(B) 1.15
(C) 0.3 to 0.6
(D) 0.6 to 1.2
Ans d
Q.17. Which of the following is not an in situ technique?
(A) Cryopreservation
(B) National parks
(C) Sanctuaries
(D) Sacred forests
Ans a
Q.18. Relationship between species richness (S) and area (A) represented in the following graph is described by the equation.
(A) Log S = log A + Z log C
(B) Log S = log C + Z log A
(C) Log C = log A + S log A
(D) Log C = log S + Z log A
Ans b
Q.19. In global biodiversity of plants, the
(A) Angiosperms represent maximum number
(B) Algae represent the minimum number
(C) Fungi represent the minimum number

(D) Mosses represent the maximum number
Ans a

Q.20. Which of the following taxon shows maximum species diversity?
(A) Fishes
(B) Beetles
(C) Ants
(D) Orchids
Ans b

ASSERTION-REASON QUESTIONS

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

Q1. Assertion : Alpha diversity is said· to be higher if the dissimilarity between communities is higher.
Reason : Alpha diversity is a measure of diversity between the communities.
Ans.d

Q2. Assertion: The species diversity present in a given community or habitat is referred to as alpha diversity.
Reason: Alpha diversity is usually expressed by species richness and species evenness in that community habitat.
Ans.a

Q3. Assertion : Diversity observed in the entire geographical area, is called gamma diversity.
Reason : Biodiversity decreases from high altitude to low altitude.
Ans.c

Q4. Assertion:A biosphere reserve is a specified area.
Reason : No restriction on human activities has been imposed in biosphere reserve.
Ans.c

Q5. Assertion : In tropical rainforests. O-horizon and A-Horizon of soil profiles are shallow and nutrient-poor.
Reason : Excessive growth of microorganisms in the soil depletes its organic content.
Ans.c

Q6. Assertion: Communities that comprise more species tend to be more stable.
Reason: A higher number of species results in less animal variation in total biomass.
Ans.a

Q7. Assertion: Community with more species tends to be more stable than those with less species.
Reason: More will be the species, less will be year to year variation in total biomass.
Ans.a

Q8. Assertion: A stable community should not show too much variation in productivity from year to year.
Reason: A stable community must be resistant to invasions by the alien species.
Ans.b

Q9. Assertion: Decrease in species diversity occurs as we ascend a high mountain.
Reason: Decrease in species diversity occurs with increase in altitude due to rise in temperature.
Ans.c

Q10. Assertion : Tropical latitudes have greater biological diversity than temperate latitudes.
Reason : Tropical regions remain relatively undisturbed for millions of years.
Ans.a

SHORT ANSWER QUESTIONS (2 marks)

Q1. List four causes of biodiversity loss.

Answer: The four causes of biodiversity loss are as follows

Habitat loss and fragmentation
Overexploitation
Alien species invasions
Co Extinctions.

Q2. What is meant by alien species invasion? Name one plant and one animal alien species that are a threat to our Indian native species.

Answer: Intentional or chance introduction of exotic species into new Islands or countries by man is called alien species invasion. For example, Nile perch introduced into Lake Victoria in East Africa caused loss of more than 200 species of cichlid fish. Plant alien species-*Lantana camara* and animal alien species-*Clarias gariepinus* have posed threat to our Indian native species.

3. **'**Stability of a community depends on its species richness.' Justify.

Answer: The stability of a community depends on species richness. There are less year-to-year variations in total biomass.Increased diversity showed higher productivity.Food webs are also complex when species richness is more.

Q4.State the use of biodiversity in modern agriculture.

Answer: The use of biodiversity in agriculture is immense. It is a source of hybrids, GM plants, biopesticides, organic farming, bio fertilizer, improved varieties of plants, disease resistant plants. It also promotes sustainable management of agricultural resources, conservation and farming of all wild and native varieties of plants, etc.

Q5.Justify with the help of an example where a deliberate attempt by humans has led to the extinction of a particular species.

Answer: Overexploitation of natural resources or over hunting of animals has led to extinction of particular species, e.g. Steller's sea cow and passenger pigeon.

Other examples of human driven extinction include Dodo birds due to habitat fragmentation.

Q6. Why Western Ghats in India been declared as a biological hotspot?

Answer: Western Ghats have been declared as a biological hotspot due to its rich biodiversity and ecological condition favouring many species of plants and animals. Many endemic species of amphibians, reptiles and fishes are found in these regions.

Q7. Write the importance of cryopreservation in conservation of biodiversity.

Answer: The importance of cryopreservation in conservation of biodiversity is that gametes of threatened species can be preserved in viable and fertile conditions for long periods by cryopreservation.

Q8.Suggest two practices giving one example of each, that help to protect rare or threatened species.

Answer: Practices that help to protect rare threatened species are as follows

In situ (on-site) conservation involves protection of species in their natural habitat. In involves biosphere reserves, national parks, wildlife sanctuaries, sacred groves, etc,

Ex situ (off-site) conservation involves placing threatened animals and plants in special care units for their protection. Zoological parks, botanical gardens and wildlife safari parks serve this purpose.

Q9. Why are sacred groves highly protected?

Answer: Sacred groves are small patches of forests with special religious importance in a particular culture.These are also mythologically important.

These are undisturbed forests without any human interventions.

These are highly protected hence, they include a number of rare, endangered and endemic species.

Q10. Name an artificial ecosystem with high productivity.

Answer. Agricultural field of wheat or paddy.

SHORT ANSWER QUESTIONS (3 marks)

Q1. Define endangered species with an example for endangered plant and animal species.

A. It is a population of species on the brink of extinction. Endangered animal – Siberian Tiger, Endangered plant – Venus fly trap

Q2. Define sacred groves. What is their role in the conservation of biodiversity?

A. They are sacred tracts which are of utmost importance to local communities. They are devoted to ancestral spirits and local deities and are guarded by local communities through taboos and social traditions which include ecological and spiritual values. They are rich in biodiversity nurturing rare plant and animal species and are found in Aravalli hills, Meghalaya, western Ghats etc.

Q3. Is more solar energy available in the tropics? Justify your answer.

A. Yes, it is true. It is because of the following reasons:

The rays of the sun possess less atmosphere to pass through hence lesser energy is lost in reflection and absorption by the atmosphere. The rays of the sun are more concentrated. Presence of dense vegetation causes more absorption of radiation in the tropical rainforests.

Q4 State two ways through which humans are benefitted from biodiversity.

A. We derive economic benefits from the diversity of entities, such as:

Food, fibre, firewood,Industrial products, construction material

Medicinal products from plants ,Pure oxygen, flood and soil erosion control, natural pollinators

Recycling of wastes by microbes, Nutrient restoration.

Q5. Why does diversity amongst species decline as we move away from the equator?

A. It is because a decline in temperature causes the state to become severe. There is a dip in the intensity and amount of solar radiation and also a decrease in the vegetation is observed. Availability of resources is less to support the assemblage of species. Harsh conditions make the adaptation and survival of species difficult, which results in a decrease in biodiversity as we approach the poles.

Q6. What do you mean by latitudinal gradient? What could be the possible reasons for diversity between tropic and temperate regions?

Ans: The latitudinal gradient in diversity means that species diversity usually decreases as we move away from the equator towards the poles. The Tropic area of the latitudinal range 23.50c harbours more species than the temperate or polar area. To explain this difference three hypotheses have been proposed, these are:-

i) Speciation is a function of time, which temperate regions were subjected to frequent glaciations in the past, the tropics have to remain unchanged and hence evolved more species diversity.

ii) As compared to the temperate region, tropical environments are less seasonal, relatively more constant, and predictable. Niche specialization and greater species diversity have been promoted by such constant environments.

iii) There is more solar radiation available in the tropical region which contributes directly to greater productivity and indirectly to greater species diversity.

Q7. What is the relation between species richness and area? What is the significance of the slope of regression?

Ans: Alexander Von Humboldt has observed that within a region, species richness increased with increase explored area but only up to a limit thus the relationship between species richness and area for several taxa is considered to be a rectangular hyperbola. On a log scale, the relationship becomes linear and is described law equation:

Log S = Log C + Z Log A

The values of the slope of regression are identical regardless of the taxonomic group or the region. When such analysis is done among the species belonging to very large areas, the slope of regression would be much steeper.

Q8. List the important attributes of a stable community?

Ans: A stable community contains the following important attributes :

i) It shall not show too many variations in the year–to–year productivity.
ii) It must be either resistant or resilient to the disturbances occurring in season.
iii) It must be resistant to the invasion done by alien species.

Q9. "The Amazonian rainforest in South America has the greatest biodiversity on earth". Justify the statement.

Ans: The greatest biodiversity on earth is found in the amazonian rainforest in South America. The Amazonian rainforest is the birthplace of about 40000 species of plants, 1,25,000 species of insects, 3000 species of fishes, 427 amphibians, 378 reptiles, 1300 birds, and 427 mammals.

Q10. Hotspots are regions of exceptionally high biodiversity. But they have become regions of accidental habitat loss too. Name the three hot spots of our country. Why are they called 'Hot spots'?

Ans: The hot spots of our country are The Western Ghats and Sri Lanka, Indo-Burma, and Himalaya. They are called biodiversity hot spots as they show-
(i) High level of species richness.
(ii) High degree of endemism.

LONG ANSWER QUESTIONS (5 MARKS)

Q1. What are the different approaches to biodiversity conservation in India?

Ans: In India, there are two major approaches to the conservation of biodiversity. They are:-
i) In-situ Conservation:- It is the process of protecting the endangered species of plant or animal in the natural habitat lay either protecting or cleaning up the habitat or by defending species from predators It includes:-
a) Biosphere Reserves:- There are 425 biosphere reserves in the world of which 14 are in India. Hotspots have been identified for maximum protection to endemic or endangered species.
b) National Park or Wildlife Sanctuaries:- India has about 90 national parks and 448 wildlife sanctuaries.
c) Sacred Forests:- These are undisturbed forests without any human intervention and are surrounded by highly degraded landscapes.
ii) Ex-situ Conservation:- It is the process by which the endangered species of plants or animals are given protection by removing them from threatened habitat and placing them under the care of humans. It includes:-
a) Botanical garden, zoological park, and arboreta are conventional methods of ex-situ conservation
b) Cryopreservation to the storage of materials at an ultra-low temperature either by rapid cooling or by gradual cooling and simultaneous dehydration at low temperature.

Q2. Describe at least two approaches each for ex-situ conservation and in-situ conservation as a strategy for biodiversity conservation.

Ans: As a strategy for biodiversity conservation the two approaches for in-situ and ex-situ conservation is as follows:
In situ conservation :
(i) Identification and maximum protection should be provided to 'hot spots.'
(ii) Legal protection to ecologically rich areas.
(iii) Biosphere reserves, national parks, and sanctuaries.
(iv) Sacred groves.
Ex-situ Conservation :
(i) Creation of zoological parks, botanical gardens, a wildlife sanctuary.
(ii) Cryopreservation
(iii) Seed bank.

Q3. Explain how species diversity of an area is reduced by the invasion of an alien species.

A. When alien species acquire a particular habitat either purposely or inadvertently, some of these species resort to invasion thereby causing declination or extinction of native species. For instance – Lantana and water hyacinth have turned invasive, Invasion of Nile perch, a large predator fish, into Lake Victoria in East Africa led

to extinction of an ecologically unique collection of more than 200 species of Cichlid fish in the lake. As the Cichlid fish became extinct due to a lack of food, the predatory Nile perch died too.

Q4. What is the significance of Biodiversity to Human beings?

Ans: Biodiversity provides numerous direct or indirect services to human beings. These are:

i) Source of food and improved varieties:- Biodiversity directly or indirectly add as the source of food, cloth, and shelter.

ii) Fats and Oils:- A variety of plants are used to extract different kinds of oils.

iii) Fibres:- A variety of plants eg. cotton, hemp, jute are the chief sources of fibres.

iv) Resins:- Resins are sticky exudation of plants.

v) Gums, Timber, Paper, Tannins, Dyes:- Plants species provide a variety of useful products such as gums, raisins, dyes, similarly animal species also provide leather, fur, honey, silk, pearl, etc.

vi) Drugs and Medicines:- Living organisms also contain several therapeutically useful substances.

vii) Stability of Ecosystem:- The food web, food chain energy flow in various trophic levels, and biochemical cycles occurs in natural ways without any hindrance if there is proper availability of diversified species

viii) Aesthetic, Scientific and Recreational values:- Indian people grow many plants because they regard them as sacred.

Q5. Give an account of Biodiversity in India?

India is among the 10 mega-biodiversity countries in the world, thanks to the presence of diverse climatic conditions and ecological habitats, ranging from tropical, subtropical, and temperate zones.

1.India is home to around 47,000 plant species and 81,000 animal species.

2.Despite occupying only 2-4% of the world's land area, India contributes 10-35% of global biodiversity.

3.India has a large number of native species, including 5,000 species of flowering plants belonging to 141 genera and 47 families that originated in India.India has a high level of endemism, with 62% of amphibian species and 50% of lizards being endemic to the country, with many found in the Western Ghats.

4.India is the origin of 166 species of crop plants and 320 species of wild relatives of cultivated crops.

5.India is rich in marine biodiversity, with a coastline of 7,500 km.

6.India has two of the world's 25 biodiversity hotspots: the Western Ghats and the Eastern Himalayas.

CASE STUDY BASED QUESTIONS (4 MARKS)

1.In our biosphere immense diversity (or heterogeneity) exists not only at the species level but at all levels of biological organization ranging from macromolecules within cells to biomes. Biodiversity is the term popularised by the sociobiologist Edward Wilson to describe the combined diversity at all the levels of biological organization. The most important of them are– (i) Genetic diversity: A single species might show high diversity at the genetic level over its distributional range. The genetic variation shown by the medicinal plant *Rauwolfia vomitoria* growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (reserpine) that the plant produces. India has more than 50,000 genetically different strains of rice, and 1,000 varieties of mango. (ii) Species diversity: The diversity at the species level, for example, the Western Ghats have a greater amphibian species diversity than the Eastern Ghats. (iii) Ecological diversity: At the ecosystem level, India, for instance, with its deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows has a greater ecosystem diversity than a Scandinavian country like Norway.

1.Who was the one who popularised the term ‘Biodiversity’

(a) Edward Wilson

(b) Jack Wilson

(c) Albert William

(d) John William

Answer (a) Edward Wilson.

2) The …….. medicinal plant show genetic variation.

(a) *Hypera postia*
(b) *Nicrophorus aloinis*
(c) *Oecanthus allardi*
(d) *Rauwolfia vomitoria*
Answer (d) *Rauwolfia vomitoria*.

Que. 3) How many levels are there in the diversity?
(a) Six
b) Nine
(c) Three
(d) One
Answer (c) Three.
4) Which species shows more species diversity in Western Ghats?
Answer: Species of amphibians show more species diversity in Western GhATS
5) Give examples of ecological diversity in India.
Answer: In India, rain forests, coral reefs, deserts, estuaries and wetlands all show ecological diversity.
2. Let us look at some interesting aspects about earth's biodiversity based on the currently available species inventories. More than 70 per cent of all the species recorded are animals, while plants (including algae, fungi, bryophytes, gymnosperms and angiosperms) comprise no more than 22 percent of the total. Among animals, insects are the most species-rich taxonomic group, making up more than 70 per cent of the total. That means, out of every 10 animals on this planet, 7 are insects. Again, how do we explain this enormous diversification of insects? The number of fungi species in the world is more than the combined total of the species of fishes, amphibians, reptiles and mammals. Biodiversity is depicted showing species numbers of major taxa. It should be noted that these estimates do not give any figures for prokaryotes. Biologists are not sure about how many prokaryotic species there might be. The problem is that conventional taxonomic methods are not suitable for identifying microbial species and many species are simply not culturable under laboratory conditions. If we accept biochemical or molecular criteria for delineating species for this group, then their diversity alone might run into millions.
Que. 1) More than 70% …… species are recorded in biodiversity.
(a) Plants
(b) Animals
(c) Tigers
(d) None of these
Answer (b) Animals.
2) 22% of the total is occupied by …….. in biodiversity.
(a) Plants
(b) Reptile
(c) Birds
(d) Fishes
Answer (a) Plants.
3) In the given estimation, …… do not have any figures.
(a) Insects
(b) Gymnosperms
(c) Prokaryotes
(d) Worms
Answer (c) Prokaryotes.
Que. 4) Which is the most species rich taxonomic group in the animals?
Answer: Insects species are the most species rich group in the animals.

Que. 5) Why are not sure about prokaryotic species when it comes to estimates?
Answer: The issue which biologists are facing is conventional taxonomic methods. These are not suitable for the identification of microbial species. They might think that if they consider these species then their diversity alone runs into millions. Even the species are not culturable in the laboratories. Hence, the biologists are not sure about prokaryotic species when it comes to estimates.

3. During his pioneering and extensive explorations in the wilderness of South American jungles, the great German naturalist and geographer Alexander von Humboldt observed that within a region species richness increased with increasing explored area, but only up to a limit. In fact, the relation between species richness and area for a wide variety of taxa (angiosperm plants, birds, bats, freshwater fishes) turns out to be a rectangular hyperbola. On a logarithmic scale, the relationship is a straight line described by the equation log S = log C + Z log A where S= Species richness A= Area Z = slope of the line (regression coefficient) C = Y-intercept Ecologists have discovered that the value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the region (whether it is the plants in Britain, birds in California or molluscs in New York state, the slopes of the regression line are amazingly similar). But, if you analyse the species-area relationships among very large areas like the entire continents, you will find that the slope of the line to be much steeper (Z values in the range of 0.6 to 1.2). For example, for frugivorous (fruit-eating) birds and mammals in the tropical forests of different continents.
1) In the species-area relationship equation, species richness is shown by …….
(a) S
(b) Z
(c) A
(d) C
Answer: (a) S
2) According to the ecologist, the value of Z ranges between …….
(a) 0 to 10
(b) 0.1 to 10
(c) 0.1 to 0.2
(d) 0 to 6
Answer: (c) 0.1 to 0.2.

3) In the above equation, Z is a …….
(a) Y intercept.
b) Regression coefficient
(c) Slope of the line
(d) Both (b) and ©
Answer: (d) Both (b) and (c).

4) What did Alexander von Humboldt observe?
Answer: Alexander von Humboldt was a geographer and German naturalist. Alexander von Humboldt observed that species richness within an area increases with increasing explored area. But, this happens only up to a limit. This was his observation.

5) Write an equation which shows Species-area relationships.
Answer: log S = log C + Z log A. This is an equation of Species-area relationship.
4. The accelerated rates of species extinctions that the world is facing now are largely due to human activities. There are four major causes ('The Evil Quartet' is the sobriquet used to describe them). (i) Habitat loss and

fragmentation: This is the most important cause driving animals and plants to extinction. The most dramatic examples of habitat loss come from tropical rainforests. Once covering more than 14 percent of the earth's land surface, these rain forests now cover no more than 6 per cent. They are being destroyed fast. By the time you finish reading this chapter, 1000 more hectares of rainforest would have been lost. The Amazon rainforest (it is so huge that it is called the 'lungs of the planet') harbouring probably millions of species is being cut and cleared for cultivating soybeans or for conversion to grasslands for raising beef cattle. Besides total loss, the degradation of many habitats by pollution also threatens the survival of many species. When large habitats are broken up into small fragments due to various human activities, mammals and birds requiring large territories and certain animals with migratory habits are badly affected, leading to population declines.

1) Is the main reason behind plants and animals extinction.
(a) Crop yield
(b) Soil cultivation
(c) Species
(d) Habitat loss
Answer: (d) Habitat loss.

2) Which of the following causes loss of biodiversity?
(a) Fragmentation
(b) Gametogenesis
(c) Fermentation
(d) Budding
Answer: (a) Fragmentation.

3)…… used to cover more than 14% of earth's land before biodiversity loss.
(a) Rain
(b) Forests
(c) Animals
(d) Soil
Answer:(b) Forests.

4) What was the other name of the Amazon rainforest?
Answer: Answer: Amazon rain forest was also known for 'lungs of the planet'.

5) What is the main reason behind biodiversity loss?
Answer 5) Answer: Biodiversity loss mainly caused due to human activities.

Case study 5

Humans have always depended on nature for food and shelter, but when 'need' turns to 'greed', it leads to over -exploitation of natural resources. Many species extinctions in the last 500 years (Steller's sea cow, passenger pigeon) were due to overexploitation by humans. Presently many marine fish populations around the world are over harvested, endangering the continued existence of some commercially important species. Co-extinctions: When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct. When a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate. Another example is the case of a coevolved plant-pollinator mutualism where extinction of one invariably leads to the extinction of the other.

The narrowly utilitarian arguments for conserving biodiversity are obvious; humans derive countless direct economic benefits from nature food (cereals, pulses, fruits), firewood, fibre, construction material, industrial products (tannins, lubricants, dyes, resins, perfumes) and products of medicinal importance. More than 25

per cent of the drugs currently sold in the market worldwide are derived from plants and 25,000 species of plants contribute to the traditional medicines used by native peoples around the world.

1) When certain species undergoes extinction, then other related species of animals and plants undergo ……
(a) Decomposition.
(b) Reproduction
(c) Extinction
(d) Migration
Answer (c) Extinction.

2) In the biodiversity, species are ……. due to co-extinctions.
(a) Decreased
(b) Increased
(c) Remain the same
(d) Constant
Answer (a) Decreased.

3) Over-exploitation is done by the …….
(a) Birds
(b) Insects
(c) Fishes
(d) Humans
Answer (d) Humans.

4) What is a narrowly utilitarian argument?
AnswerMain reason behind the narrowly utilitarian argument is the conservation of biodiversity. This argument is about the economic benefits that humans get from plants and other animals. The cereals, pulses and fruits give us food. Medicinal plants are also important for diseases. The whole argument is about why to conserve biodiversity.

5) Give an example of coextinction.
Answer If a fish species will become extinct then the parasite which lives in the fish body will also become extinct. This is an example of coextinction.

SELF ASSESSMENT TEST 1 (**40 MARKS**)
1.MULTIPLE CHOICE QUESTIONS **(7** MARKS)
Q.1-a. The variation shown by the medicinal plant *Rauwolfia vomitoria* growing in different Himalayan ranges represents
(A) Genetic diversity
(B) Species diversity
(C) Ecological diversity
(D) Community diversity
Q.1-b. Which of the following groups represents minimum species diversity among vertebrates?
(A) Birds
(B) Mammals
(C) Reptiles
(D) Amphibians

Q.1-c. More conservative and scientifically sound estimate made by Robert May places the global species diversity at about
(A) 1.5 million
(B) 7 million
(C) 1.7 million
(D) 17 million
Q.1-d. Species diversity of plants on earth is
(A) 2.5 %
(B) 22 %
(C) 7.1 %
(D) 32 %
Q.1-e. Insects are the most numerous with estimate of
(A) 7 out of 10 invertebrates
(B) 4 out of 10 invertebrates
(C) 7 out of 10 animals
(D) 4 out of 10 animals
Q.1-f. Read the following statements
(1) India has a greater ecosystem diversity than Norway
(2) According to the IUCN (2004), the total number of plant and animal species described so far is slightly more than 15 million.
(A) Both (1) and (2) are correct
(B) Only (2) is correct
(C) Both (1) and (2) are incorrect
(D) Only (1) is correct
Q.1-g. Which of the following is not an in situ technique?
(A) Cryopreservation
(B) National parks
(C) Sanctuaries
(D) Sacred forests

ASSERTION-REASON QUESTIONS

Directions: In the following questions, a statement of assertion is followed by a statement of reason.
Mark the correct choice as:
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.
1. Assertion : Alpha diversity is said• to be higher if the dissimilarity between communities is higher.
Reason : Alpha diversity is a measure of diversity between the communities.
2. Assertion: The species diversity present in a given community or habitat is referred to as alpha diversity.
Reason: Alpha diversity is usually expressed by species richness and species evenness in that community habitat.
3. Assertion : Diversity observed in the entire geographical area, is called gamma diversity.
Reason : Biodiversity decreases from high altitude to low altitude.
4. Assertion : A biosphere reserve is a specified area.
Reason : No restriction on human activities has been imposed in biosphere reserve.

SHORT ANSWER QUESTIONS

5. What is a red list? Give two uses of the red list. 2
6. Name the three important components of biodiversity. 2

7 .Define biodiversity. Name the two most biodiversity rich zones of India. 2

8. What does the term genetic diversity refer to? What is the significance of large genetic diversity in a population? 3

9. Why are 3

(i) alien species invasion and

(ii) loss of habitat and fragmentation considered to be the major cause of loss of biodiversity? Explain with the help of one example each.

10.What is the significance of the slope of regression in a species area relationship ? Explain with a graph. 3

CASE STUDY 4 Marks

11.Humans have always depended on nature for food and shelter, but when 'need' turns to 'greed', it leads to over -exploitation of natural resources. Many species extinctions in the last 500 years (Steller's sea cow, passenger pigeon) were due to overexploitation by humans. Presently many marine fish populations around the world are over harvested, endangering the continued existence of some commercially important species. Co-extinctions: When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct. When a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate. Another example is the case of a coevolved plant-pollinator mutualism where extinction of one invariably leads to the extinction of the other.

The narrowly utilitarian arguments for conserving biodiversity are obvious; humans derive countless direct economic benefits from nature food (cereals, pulses, fruits), firewood, fibre, construction material, industrial products (tannins, lubricants, dyes, resins, perfumes) and products of medicinal importance. More than 25 per cent of the drugs currently sold in the market worldwide are derived from plants and 25,000 species of plants contribute to the traditional medicines used by native peoples around the world.

11-a) When a certain species undergoes extinction, then other related species of animals and plants undergo ……

(a) Decomposition.

(b) Reproduction

(c) Extinction

(d) Migration

11-b) In biodiversity, species are …… due to co-extinctions.

(a) Decreased

(b) Increased

(c) Remain the same

(d) Constant

11-c) Over-exploitation is done by the ……

(a) Birds

(b) Insects

(c) Fishes

(d) Humans

11-d. What is a narrowly utilitarian argument?

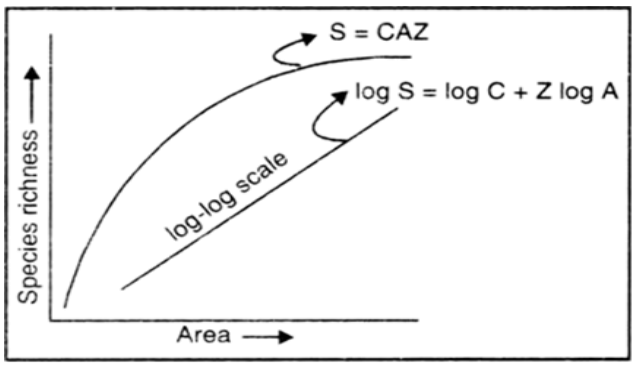
11-e.Give an example of coextinction.

LONG ANSWER QUESTIONS (5X2=10 MARKS)

12.(i) Explain the species-area relationship using the graphical representation given below.

Biodiversity and Conservation.

ii) Explain giving reasons why there is greater biodiversity in tropical regions of the earth.



13. There are many animals that have become extinct in the wild but continue to be maintained in zoological parks.
(i) What type of biodiversity conservation is observed in this case?
(ii) Explain any other two ways which help this type of conservation. 5 marks

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NEW TOPICS ADDED IN SYLLABUS

CH- MOLECULAR BASIS OF INHERITANCE
INTERNATIONAL RICE GENOME SEQUENCING PROJECT (IRGSP)

- Rice benefits from having the smallest genome of the major cereals, dense genetic maps.
- The IRGSP, formally established in 1998, pooled the resources of sequencing groups in 10 nations (Japan, Korea, UK, Taiwan, China, Thailand, India, United States, Canada and France)
- Estimated Cost - $ 200 million.
- India joined in June 2000 and chose to sequence a part of chromosome 11.
- Tools used in sequencing were: BAC (Bacterial Artificial chromosomes) PAC (P1-Phase derived Artificial chromosomes)

Sequencing Method

- Shotgun sequencing involved - generation of short DNA fragments that are then sequenced and linearly arranged.
- It enables full coverage of the genome in a fraction of time required for the alternative BAC sequence approach.

Salient Features of Rice Genome

- Rice is a monocarpic annual plant, wind pollinated. It is with only 389 base pairs
- The world's first genome of a crop plant that was completely sequenced. 2,859 genes seem to be unique to rice & other cereals.
- Repetitive DNA is estimated to constitute at least 50 % of the rice genome. The transposon content of the rice genome is at least 35%.

Applications

- To improve the efficiency of Rice breeding.
- To improve nutritional value of rice, enhance crop yield by improving seed quality, resistance to pests and diseases and plant hardiness.

CH- HUMAN HEALTH & DISEASE

DENGUE

- Pathogen: Viruses DEN-1, DEN-2, DEN-3, DEN-4
- Vector: Female mosquito *Aedes aegypti*
- Types of Dengue and their Symptoms

- Classical Dengue fever: Symptoms-high fever, headache, backache, joint pains, muscles pain, chill, rashes or arms, chest, back
- Dengue Haemorrhagic fever: Symptoms -high fever, nausea, vomiting, abdominal pain, palpable liver, internal bleeding, fall in platelets.

- Drugs: Paracetamol + blood platelet replacement Aspirin and disprin is harmful.

CHIKUNGUNYA

- Pathogen: Alpha virus
- Vector: Mosquitoes (*Aedes aegypti* and *A. albopictus*)
- Symptoms: rashes on limbs and trunk, arthritis of multiple joints, fever (102° 104°F), conjunctivitis etc.
- Drug: Chloroquine phosphate reduces impact of disease.
- Treatment: Rest & increase in fluid intake.
- Prevention of Dengue and Chikungunya: Protection against mosquitoes by wearing long sleeves and full pants. window and doors should have wire gauze screens, use mosquito repellents and there should be no stagnant water nearby

CH- MICROBES IN HUMAN WELFARE

ANTIBIOTICS- PRODUCTION & JUDICIOUS USE

- Secondary metabolites produced by microbes and used to kill pathogenic microbes.
- Penicillin: First antibiotic discovered by Alexander Flemming from fungus *Penicillium notatum*.

Mode of action of antibiotics

- Bactericidal: To kill bacteria by stopping cell wall formation
- Bacterio-static: To stop growth or multiplication of bacteria by stopping DNA replication or another cellular metabolism.

Production of Antibiotics

- Mass production of antibiotics is done in fermenter tanks from lichens, fungi, actinomycetes, eubacteria etc. Maximum antibiotics are produced from bacillus (eubacteria)

Precautions in taking antibiotics

- Keep intake continuous as prescribed by the doctor till the course gets completed.
- Avoid overuse otherwise our body becomes resistant to antibiotics.

CH-BIOTECHNOLOGY & ITS APPLICATIONS

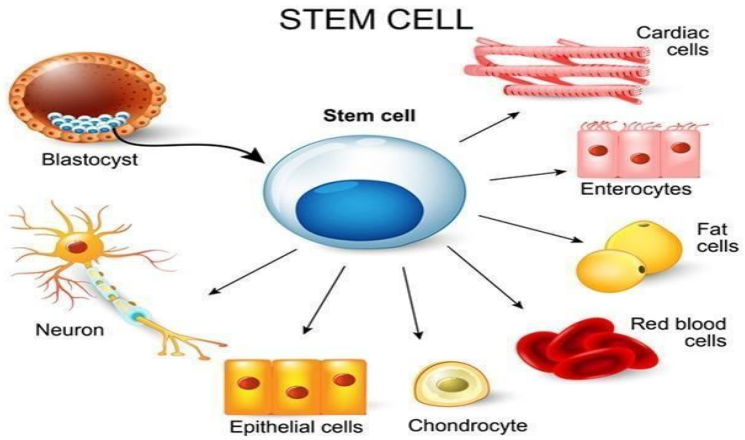
STEM CELL TECHNOLOGY

Introduction

Stem Cells are undifferentiated cells which are able to grow in any type of tissue with specialised function. Stem cells are involved in development, growth and repair in multicellular organisms. Stem cells are used to treat many diseases such as type-I diabetes, heart diseases, cancer, Spinal injuries, arthritis, muscular dystrophy, and Alzheimer. It can also be used to make new organs like heart, liver, kidneys, skin, even to produce transgenic animals.

Sources of Stem Cells

Stem cells can be obtained from inner cell mass of embryos, from bone marrow, umbilical cord and amniotic fluid.



Categories of stem cells

1. Embryonic stem cells: These easy embryo cells are removed and cultured in the laboratory.
2. Tissue stem cells: Bone marrow stem cells can be used to produce bone or cardiac muscle cells.
3. Reprogrammed stem cells: Adult special cells are reprogrammed to act as embryonic cells with the help of genetic engineering. Organs for transplantation are developed by this technique.

- Embryonic stem cells have the ability to differentiate into any at the three germ layers- ectoderm, mesoderm or endoderm.
- These cells are isolated from inner cells mass of the blastocyst, 4 to 5 days after in vitro fertilisation of an egg.
- The Cells are cultured and allowed to grow into cell lines.
- Transgenic animals can be produced by stem cell technology. The stem cells are isolated from the embryo of the selected animal and the desired gene is inserted into these cells. Then, these cells are incorporated in the embryo of the host. The embryo is now implanted into the uterus of the host animal to grow normally.

CH-BIODIVERSITY & ITS CONSERVATION

RAMSAR SITES

Named after city Ramsar in Iran where the Ramsar convention was signed in 1971 to develop awareness about the importance of wetlands.

Wetlands

- These are the areas where water is the primary factor, controlling the environment and the plants and animals life found there. They occur where the water table is at or near the surface of land or where the land is covered by water.
- These sites are mentioned for the conservation and sustainable utilisation of wetlands and recognising their ecological function, economic, cultural, scientific and recreational values.

Ramsar site in India

Chandra Taal (H.P), Chilka lake (Odisha) Deepor beel (Assam), Loktak Lake (Manipur), Sambhar lake in Rajasthan and Wular lake (J and K) etc.

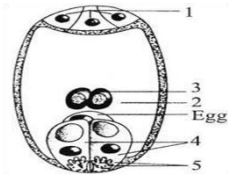
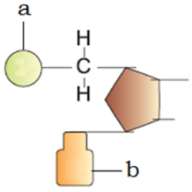
Threats to wetland

Loss of vegetation, Salinization, excessive inundation, water pollution, invasive species, excessive development and road buildings.

PRACTICE PAPER (2023-24)
KENDRIYA VIDYALAYA SANGATHAN CHANDIGARH REGION
CLASS: XII
SUBJECT: BIO (044) THEORY

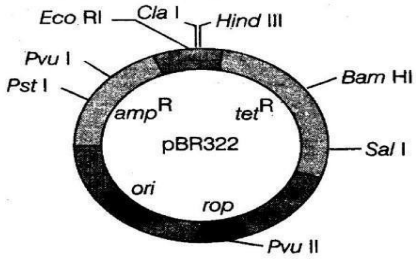
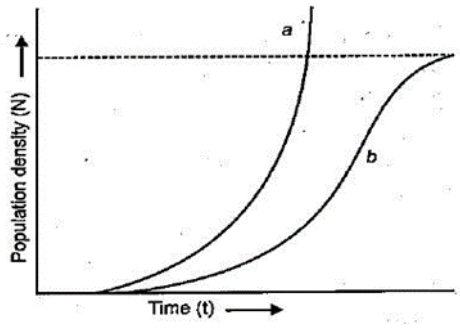
TIME: 3 HOURS **MM: 70**

General Instructions:
(i) All questions are compulsory.
(ii) The question paper has five sections and 33 questions. All questions are compulsory.
(iii) Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section– C has 7 questions of 3 marks each; Section– D has 2 case-based questions of 4 marks each; and Section–E has 3 questions of 5 marks each.
(iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
(v) Wherever necessary, neat and properly labelled diagrams should be drawn.

Q.NO.	**SECTION: A**	MM
1	Identify 1, 2, 3, 4 and 5 structures shown in figure of a female gametophyte respectively.  a) Antipodal cells, Central cell, Polar nuclei, Synergids and Acrosome b) Antipodal cells, Central cell, Polar nuclei, Synergids and Filiform apparatus c) Synergids, Central cell, Polar nuclei, Antipodal cells and Filiform apparatus d) Synergids, Megaspore mother cell, Polar nuclei, Synergids and Acrosome	1
2	Which type of ecological pyramid would be obtained with the following data? Secondary consumer: 120 g Primary consumer: 60 g Primary producer: 10 g a) Upright pyramid of numbers b) Upright pyramid of biomass c) Pyramid of energy d) Inverted pyramid of biomass	1
3	What are ‘a’ and ‘b’ in the nucleotide with purine represented below:  a) Phosphate and adenine b) Phosphate and Guanine c) Pentose Sugar and Adenine d) Phosphate and Adenine or Guanine	1
4	Significance of 'heat shock' method in bacterial transformation is to facilitate:	1

	a) Binding of DNA to the cell wall b) Uptake of DNA through membrane transport proteins c) Uptake of DNA through transient pores in the bacterial cell wall d) Expression of antibiotic resistance gene	
5	The mass of living material at a trophic level at a particular time is called a) Gross primary productivity b) Standing state c) Net primary productivity d) Standing crop	1
6	Select the hormone-releasing Intrauterine Devices. a) Lippes Loop, Multiload 375 b) Vaults, LNG-20 c) Multiload 375, Progestasert d) Progestasert, LNG-20	1
7	The vitamin whose content increases following the conversion of milk into curd by lactic acid bacteria is a) vitamin C b) vitamin D c) vitamin B_{12} d) vitamin E	1
8	The medicinal plant *Rauwolfia vomitoria* shows genetic variation in terms of: a) its geographic distribution b) the taste of the reserpine produced c) quantity of the reserpine produced d) the potency of the reserpine produced	1
9	The chronological order of human evolution from early to the recent is a) *Ramapithecus → Australopithecus → Homo habilis → Homo erectus* *b) Ramapithecus → Homo habilis → Australopithecus → Homo erectus* *c) Australopithecus → Homo habilis → Ramapithecus→ Homo erectus* *d) Australopithecus → Ramapithecus → Homo habilis → Homo erectus*	1
10	How many sperms and ova will be produced from 50 primary spermatocytes and 50 oocytes respectively a) 200 sperms,50 ova b) 100 sperms, 200 ova c) 100 sperms, 50 ova d) 50 sperms, 100 ova	1
11	_____gland is quite large at the time of birth and reduces in size with age is a) Thyroid b) Parathyroid c) Hypothalamus d) Thymus	1
12	Competition is most fierce between a) Unrelated species in the same environment b) Two or more closely related species in the same environment c) Two or more closely related species in a different environment d) None of the above	1
	Direction (Q. No. 11-14) In each of the following questions, a statement of Assertion (A) is given followed by a corresponding statement of Reason (R). Of the statements, mark the correct answer as	

<table>
<tr><td></td><td>a) If both A and R are true and R is the correct explanation of A
b) If both A and R are true, but R is not the correct explanation of A
c) If A is true, but R is false
d) If A is false, but R is true</td><td></td></tr>
<tr><td>13</td><td>Assertion (A): AIDS is a disorder caused by HIV.
Reason (R): HIV is a virus that damages the immune system of its host.</td><td>1</td></tr>
<tr><td>14</td><td>Assertion (A): Humulin is better than conventional insulin.
Reason (R): Conventional insulin produces many side-effects.</td><td>1</td></tr>
<tr><td>15</td><td>Assertion (A): In pigeons, females are heterogametic and males are homogametic.
Reason (R): In pigeons, females have ZZ sex chromosomes and males have ZW sex chromosomes.</td><td>1</td></tr>
<tr><td>16</td><td>Assertion (A): In case, a species becomes extinct, the plant and animal species associated with an obligatory way also become extinct.
Reason (R): When a host fish species becomes extinct its unique assemblage of parasites also become extinct.</td><td>1</td></tr>
<tr><td></td><td>SECTION: B</td><td></td></tr>
<tr><td>17</td><td>Write the technical term that describes each one of the following statements with reference to their evolution.
i) Microbes developing resistance to antibiotics in a much lesser time scale.
ii) Resemblance of varieties of placental mammals to corresponding marsupials in Australia.</td><td>1+1=2</td></tr>
<tr><td>18</td><td>Identify a, b, c and d. in the table given below
<table>
<tr><th>Organism</th><th>Bioactive molecules</th><th>use</th></tr>
<tr><td>Streptococcus</td><td>a</td><td>Clot buster</td></tr>
<tr><td>Tricoderma polysporum</td><td>c</td><td>immunosuppressant</td></tr>
<tr><td>Monascus purpureus</td><td>b</td><td>Blood cholesterol lowering agent</td></tr>
<tr><td>d</td><td>penicillin</td><td>antibiotic</td></tr>
</table></td><td>½*2=1</td></tr>
<tr><td>19</td><td>Name and explain the surgical method advised to human males and females as a means of birth control. Mention its one advantage and one Disadvantage.</td><td>2</td></tr>
<tr><td>20</td><td>Why does a patient of ADA-deficiency require repeated infusion of genetically engineered lymphocytes? Suggest a possible permanent remedy.
OR
Why does Bt toxin not kill the bacterium that produces it, but kill the that insect ingests it?</td><td>2</td></tr>
</table>

21	Name the Population 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 dog d) Sea anemone is often found on the shell of hermit crab.	2
	SECTION: C	
22	a) Three codons are not recognized by tRNA. What are these? State the general term used for them. b) Briefly explain the degenerate nature of codon.	1+1+1=3
23	a) Cancer is one of the most dreaded diseases of humans. Explain 'contact inhibition and metastasis with respect to the disease. b) Name the group of genes which have been identified in normal cells that could lead to cancer and how they do so?	2+1=3
24	 a) Name the organism in which the vector shown is inserted to get the copies of the desired gene. b) Mention the area labelled in the vector responsible for controlling the copy number of the inserted gene. c) Name and explain the role of a selectable marker in the vector shown.	1+1+1=3
25	(a)When and where does spermatogenesis occur in human male? (b)Draw a diagram of a mature human sperm. Label the following parts: Acrosome and middle piece.	1+2=3
26	Study the given graph given below and answer the questions:  i) Write the status of food and space in the curves (a) and (b). ii) In the absence of predators, which one of the two curves would appropriately depict the prey population. iii) Time has been shown on the x-axis and there is a parallel dotted line above it. Give the significance of this dotted line.	1+1+1=3

27	Karyotype of a child shows trisomy of chromosome number 21. Identify the disorder and state the symptoms which are likely to be exhibited in this case. OR In Snapdragon, A cross between true breeding red flower (RR) plants and true breeding white flower (rr) plants showed a Progeny of plants with all pink flowers. a) The appearance of pink flowers is not known as blending. Why? b) Name the phenomenon mentioned above.	3 2+1=3
28	Flowering plants have developed many devices to discourage self-pollination and to encourage cross-pollination. Explain three such devices.	3
	SECTION: D	
29	**Directions:** Read the passages below and answer the questions: Bill Gates, one of the founders of Microsoft, declared, 'DNA is like a computer program but far, far more advanced than any software ever created.' DNA is far more complicated than simply coding for proteins, as we are discovering all the time. DNA letters are read in groups of three, it makes a huge difference which letter we start from. E. g. the sequence GTTCAACGCTGAA … can be read from the first letter, GTT CAA CGC TGA A … but a totally different protein will result from starting from the second letter, TTC AAC GCT GAA … This means that DNA can be an even more compact information storage system. This partly explains the surprising finding of The Human Genome Project that there are 'only' about 35,000 genes, when humans can manufacture over 100,000 proteins.: Bacteria and yeast are the most commonly used hosts for the process of cloning in Human Genome Project. Not all types of fungi can be used for this process. But yeast and bacterium can be employed. Both BAC and YAC act as a suitable vector for the process of cloning in HGP whereas bacteria and yeast act as the host for cloning in HGP. The methodologies for the HGP are involved in two major processes. One among them is ESTs (Expressed Sequence Tags). It is used to identify all the genes that are expressed as RNA in HGP. i) Expand YAC. ii) Write the percentage of the total human genome that codes for proteins. iii) List the two methodologies which were involved in human genome project. How are they were used? OR iii) Write any two goals of human genome project.	1+1+2=4
30	**Directions:** Read the passages below and answer the questions: Rohit went to his grandparent's home during summer vacation. The home of grandparents was surrounded by farm lane from all sides and lots of crops were growing nearby. He went to visit the farm with his grandfather and by the evening he had running nose, watering eyes and continuous sneezing and which worsened with the time i) What could be the reason behind this and name the antibodies responsible. ii) Mention two chemicals secreted by mast cell in this situation. iii) Draw diagram of an antibody molecule and label any four parts. OR What kind of immunity is involved in this and why?	1+1+2=4

	SECTION: E	
31	Unless the vector and source DNA are cut, fragments separated and joined, the desired recombinant vector molecule cannot be created. i) How are the desirable DNA sequences cut? ii) Explain the technique used to separate the cut fragments. iii) How are the resultant fragments joined to the vector DNA molecule? OR Name the process involved in the production of nematode-resistance tobacco plants, using genetic engineering. Explain the strategy adopted to develop such plants.	1+2+2=5 5
32	i) Hershey and Chase carried their experiment in three steps: infection, blending and centrifugation. Explain each step. ii) Write the conclusion and interpretation of the result they obtained. OR i) Why are Thalassemia and Haemophilia categorized as Mendelian disorders? Write the symptoms of these diseases. ii) Explain their pattern of inheritance of Haemophilia. ii) How does hemophilia differ from Thalassemia?	3+2=5 2+2+1=5
33	i) How is 'oogenesis' markedly different from 'spermatogenesis' with respect to the growth till puberty in the humans? ii) Draw a sectional view of human ovary and label the different follicular stages, ovum and corpus luteum. OR i) Explain the different ways apomictic seeds can develop. Give an example of each. ii) Mention one advantage of apomictic seeds to farmers. iii) Draw a labelled mature stage of dicotyledonous embryo.	2+3=5 2+1+2=5

********** End of Paper **********

Series EF1GH/C

SET–2

प्रश्न-पत्र कोड Q.P. Code 57/C/2

रोल नं.
Roll No.

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

जीव विज्ञान (सैद्धान्तिक)
BIOLOGY (Theory)

निर्धारित समय : 3 घण्टे
Time allowed : 3 hours

अधिकतम अंक : 70
Maximum Marks : 70

नोट / NOTE :

(i) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ 19 हैं ।
Please check that this question paper contains 19 printed pages.

(ii) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।
Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(iii) कृपया जाँच कर लें कि इस प्रश्न-पत्र में 33 प्रश्न हैं ।
Please check that this question paper contains 33 questions.

(iv) कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।
Please write down the serial number of the question in the answer-book before attempting it.

(v) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।
15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

General Instructions :

Read the following instructions carefully and strictly follow them :

(i) This question paper contains **33** questions. **All** questions are **compulsory.**

(ii) This question paper is divided into **five** sections – Section **A**, **B**, **C**, **D** and **E**.

(iii) In **Section A** – Questions no. **1** to **16** are multiple choice (MCQ) type questions, carrying **1** mark each.

(iv) In **Section B** – Questions no. **17** to **21** are very short answer (VSA) type questions, carrying **2** marks each.

(v) In **Section C** – Questions no. **22** to **28** are short answer (SA) type questions, carrying **3** marks each.

(vi) In **Section D** – Questions no. **29** and **30** are case-based questions, carrying **4** marks each. Each question has subparts with internal choice in one subpart.

(vii) In **Section E** – Questions no. **31** to **33** are long answer (LA) type questions, carrying **5** marks each.

(viii) There is no overall choice. However, an internal choice has been provided in **1** question in Section B, **1** question in Section C, **2** questions in Section D and **3** questions in Section E. A candidate has to attempt only one of the alternatives in such questions.

(ix) Wherever necessary, neat and properly labelled diagrams should be drawn.

SECTION A

Questions no. **1** to **16** are Multiple Choice (MCQ) type Questions, carrying **1** mark each. $16 \times 1 = 16$

1. Which of the following hormone controls the function of Sertoli cells in humans ?
   (a) FSH (b) Estrogen
   (c) ACTH (d) Testosterone

2. The source organism of Taq polymerase is :
   (a) *Escherichia coli* (b) *Agrobacterium tumefaciens*
   (c) *Thermus aquaticus* (d) *Bacillus thuringiensis*

3. Among the seven pairs of contrasting traits in pea plant studied by Mendel, number of traits related to flower, pod and seed were respectively :
   (a) 2, 1, 2 (b) 2, 2, 2
   (c) 1, 2, 1 (d) 1, 1, 2

4. Which one of the following techniques is employed in test tube baby programme ?
   (a) Intra Cytoplasmic Sperm Injection
   (b) Intra Uterine Insemination
   (c) Gamete Intra Fallopian Transfer
   (d) Zygote Intra Fallopian Transfer

5. What forms the basis of DNA fingerprinting ?
   (a) Relative proportions of purines and pyrimidines in DNA
   (b) Relative difference in the DNA occurrence in blood, skin and saliva
   (c) Relative amount of DNA in ridges and grooves of fingerprints
   (d) Satellite DNA (repetitive sequences of DNA) that show high degree of polymorphism

6. Exponential growth in plants can be expressed as :
   (a) $L_t = L_0 + rt$ (b) $W_1 = W_0\ ert$
   (c) $W_1 = W_0\ e^{rt}$ (d) $W_1 = W_0 + e^{rt}$

7. A woman whose blood group is unknown marries a man with blood group 'B'. The first child born to the couple has blood group 'O' whereas their second child born after four years has blood group 'AB'. The possible blood group of the woman and its genotype on the basis of ABO blood grouping is :
   (a) Blood group A, I^AI^O (b) Blood group AB, I^AI^B
   (c) Blood group B, I^BI^O (d) Blood group O, I^OI^O

8. In asymptote state, population is :
   (a) Increasing (b) Decreasing
   (c) Stabilized (d) Changing

9. Choose the pair that is incorrectly matched.
   (a) Khasi and Jaintia Hills – Meghalaya
   (b) Aravalli Hills – Karnataka
   (c) Western Ghats – Maharashtra
   (d) Chanda and Bastar areas – Madhya Pradesh

10. Choose the correct option in which the diagram of the flowering plant shown below is correctly matched with the drug obtained from it :

   (a) Datura – Hallucinogen (b) Cannabis – Stimulant
   (c) Datura – Depressant (d) Poppy – Depressant

11. Plasmids are suitable vectors for gene cloning because :

(a) They are small circular DNA molecules which can integrate with the host chromosomal DNA.

(b) They are small circular DNA molecules with their own origin of replication site.

(c) They can shuttle between prokaryotic and eukaryotic cells.

(d) They carry antibiotic resistance genes.

12. The abbreviation 'Bt' in Bt Cotton stands for :

(a) Biotechnology

(b) Biotoxin

(c) Toxin released by *Bacillus thuringiensis*

(d) Toxin released by insect

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is *not* the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

13. *Assertion (A) :* Cocaine produces a sense of euphoria and energy.
Reason (R) : It interferes with the transport of neurotransmitter dopamine.

14. *Assertion (A) :* Cervical caps and vaults are barrier methods of contraception used by human females.
Reason (R) : They prevent conception by phagocytosis of sperms.

15. *Assertion (A) :* Banana is a parthenocarpic fruit.
Reason (R) : It develops only from the ovary.

16. *Assertion (A) :* Most "evolutionary trees" place information about pattern of relationship on horizontal axis and time on vertical axis.

Reason (R) : An "evolutionary tree" depicts pattern of relationship among parents and offsprings.

SECTION B

17. "Insects do pollinate flowers even when not rewarded with nectar and pollen grains." Explain with the help of an example. 2

18. Draw a schematic diagram of a part of double stranded dinucleotide DNA chain with all the four nitrogenous bases and showing correct polarity. 2

19. (a) How have transgenic animals proved to be beneficial in the study of : 2
    (i) Normal physiology and development ?
    (ii) Chemical safety testing ?

    OR

    (b) Mention four applications of plants whose genes have been altered by manipulation. 2

20. Differentiate between Follicular phase and Luteal phase of the Menstrual cycle in human females on the basis of the following criteria : 2
    (a) Days of their occurrence in the cycle
    (b) Stage of the follicle
    (c) Hormones influencing the phases
    (d) State of endometrium

21. (a) Name the lymphoid organ in humans that produces different types of cells.

    (b) Mention the name of the blood cells that migrate from this lymphoid organ to another lymphoid organ, and state the changes it undergoes so as to provide immunity. 2

SECTION C

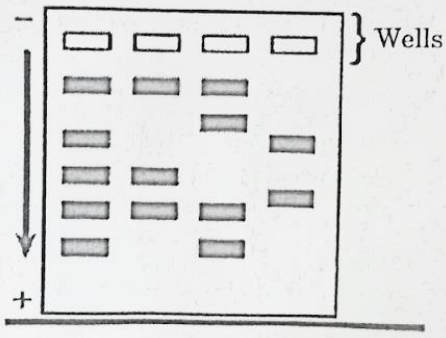
22. Name the antibiotic that was used to treat wounded soldiers in World War II. Explain its chance discovery. *2*

Name the scientists who were awarded the Nobel Prize for this discovery. *1*

23. (a) Why is thalassemia categorised as a Mendelian disorder ? Write the symptom and the cause of the disease. *2*

(b) How is it different from Sickle cell anaemia ? *1*

24. A restriction enzyme digests a certain DNA into fragments. The fragments are subjected to a technique, the result obtained is in the illustration given below. Observe and answer the questions that follow.



(a) Name the technique and its purpose.

(b) Explain the procedure carried out under the following steps :

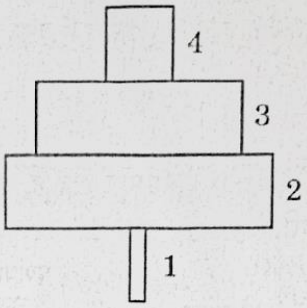
(i) Matrix used and its role

(ii) Staining and extraction of the DNA *3*

25. (a) Draw a neat diagram of a mature angiospermic embryo sac and label any four cellular components.

(b) Write the function of filiform apparatus. *3*

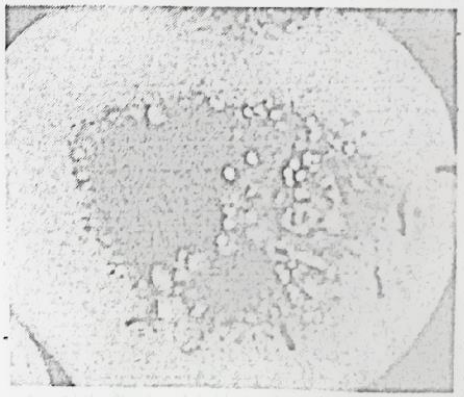
26. (a) (i) Identify the kind of pyramid given below and explain with the help of an example how it is formed. 2



(ii) "A given species may occupy more than one trophic level in the same ecosystem." Justify. 1

OR

(b) (i) Name and explain the kind of interaction in the following figure. 1



(ii) Explain two other examples where the same type of interaction among organisms is commercially useful in agriculture. 2

27. (a) Mention the difference between the 'R' strain and 'S' strain in *Streptococcus pneumoniae*. 3

(b) Write the steps followed by Griffith during the course of his experiment and the conclusion he arrived at, at the end of his experiment.

28. Explain with the help of a diagrammatic representation, how natural selection operates on different traits in a population. 3

SECTION D

*Questions number **29** and **30** are case-based questions. Each question has subparts with internal choice in one subpart.*

29. The diversity of plants and animals is not uniform throughout the world but shows a rather uneven distribution. Study carefully the illustrations 'A' and 'B' given below. Answer the questions based on them.

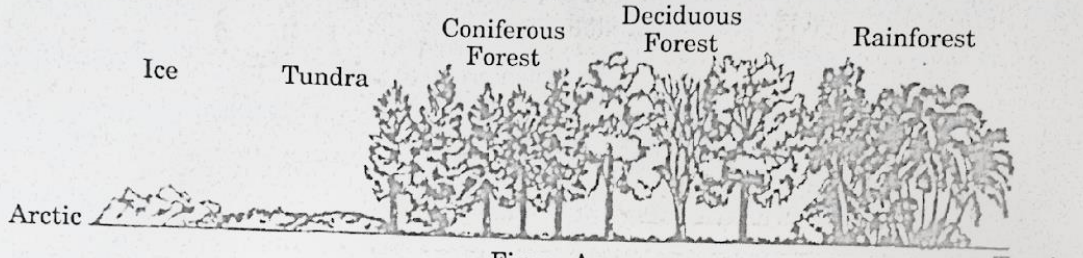


Figure A

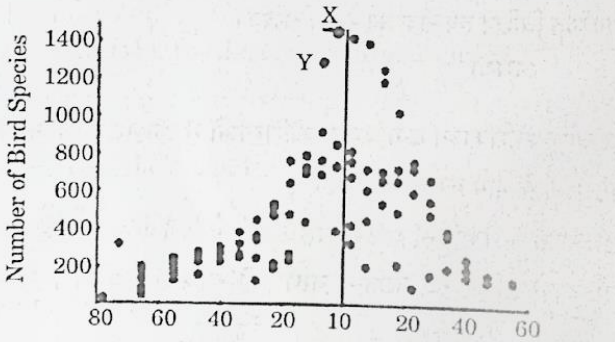


Figure B

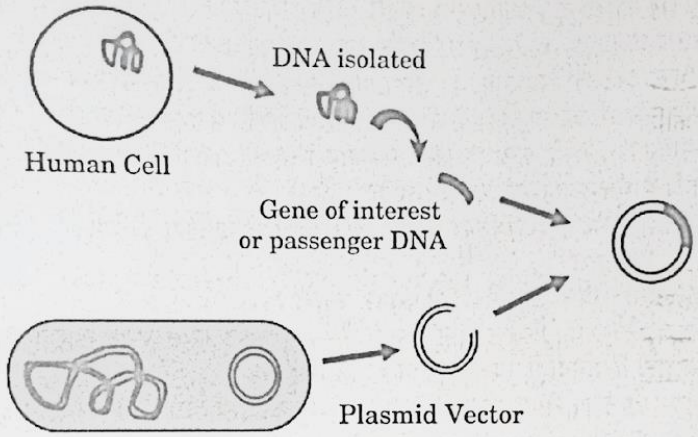
(i) (a) Mention the pattern of biodiversity that you observe in Figure A. *1*

OR

(b) Figure B shows number of bird species. Identify the countries marked 'X' and 'Y'. *1*

(ii) Explain the three reasons for the pattern of biodiversity that is observed in Figure A. *3*

30. An illustration given below was on the display board in the class. Study the illustration and answer the questions that follow.



(i) (a) Name the particular technique shown. *1*

OR

(b) Name the enzymes needed to isolate the DNA from bacterial and fungal cells respectively. *1*

(ii) Taking the help of the illustration, explain the steps used by the scientists at Eli Lilly Company to produce a drug that proved to be highly beneficial to diabetic patients. *3*

SECTION E

31. (a) Explain the following with reference to 'Cancer' :

(i) Contact Inhibition *1*

(ii) All normal cells have proto-oncogenes *1*

(iii) Name of carcinogens and their role *1*

(iv) Difference between benign and malignant tumours *2*

OR

(b) (i) Why is it necessary to treat sewage water before it can be discharged into rivers and streams ? Explain different steps carried out in the treatment of sewage water and the production of fuel during this process. *4*

(ii) Mention the initiative taken by the Ministry of Environment and Forests to save the major rivers of our country from pollution. *1*

32. (a) (i) Why is tRNA called an adapter molecule ? *1*

(ii) Draw the clover-leaf structure of initiator tRNA with the anticodon at the correct place. *1*

(iii) Name and explain the first step in formation of polypeptide and mention its significance. *2*

(iv) What are UTRs ? Mention their location and importance. *1*

OR

(b) (i) What is an 'operon' in a bacterial system ?

(ii) Draw a schematic self-explanatory diagram of a lac operon in a 'switched-on' condition. Give the correct labelling at the respective positions. *5*

33. (a) (i) Draw a labelled diagram of a matured human ovum ready for fertilization. Explain the events thereafter, leading to zygote formation. *4*

(ii) It is said that the sex of the baby is decided as soon as the process of fertilization begins. Justify the statement. *1*

OR

(b) (i) Write any four steps that you would recommend to improve the human reproductive health standards in India. *2*

(ii) Refer to the following diagrams 'A' and 'B' showing sterilization in humans and answer the questions.

A B

(1) Identify the labellings in the diagrams 'A' and 'B' where the procedure is carried out.

(2) Write the technical terms, and the procedures followed in the above-mentioned techniques. *3*