

Roll No.

--	--	--	--	--	--	--	--

Candidates must write the Code on
the title page of the answer-book

Biology (Theory) & Solution

Time allowed : 3 hours**Maximum Marks : 70****General Instructions :**

- (i) There are a total of 27 questions and four sections in the question paper. All questions are compulsory.
- (ii) Section A contains questions number 1 to 5, very short-answer type questions of 1 mark each.
- (iii) Section B contains questions number 6 to 12, short-answer type I questions of 2 marks each.
- (iv) Section C contains questions number 13 to 24, short-answer type II questions of 3 marks each.
- (v) Section D contains questions number 25 to 27, long-answer type questions of 5 marks each.
- (vi) There is no overall choice in the question paper, however, an internal choice is provided in two questions of 1 mark, two questions of 2 marks, four questions of 3 marks and all the three questions of 5 marks. In these questions, an examinee is to attempt any one of the two given alternatives.
- (vii) Wherever necessary, the diagram drawn should be neat and properly labelled.

Class-XII / (CBSE) | Biology

SECTION-A

1. Mention one example each from plants and animals exhibiting divergent evolution. [1 Mark]
Ans. **Animal** - Forelimb of man, cheetah, whale, bat
Plant - Bougainvillea thorn and cucurbit tendril.
2. Give one reason to justify statutory ban on amniocentesis. [1 Mark]
Ans. Amniocentesis is banned to check increasing number of female foeticides.
3. Name any two physiological barriers that provide innate immunity. [1 Mark]
Ans. Two physiological barriers that provide innate immunity are skin which prevent entry of the microorganism and mucus coating of the epithelium lining the respiratory, gastrointestinal, and urogenital tracts also help in trapping microorganism and entering body.
- OR**
- Select two disease resistant crop varieties from the list of crop varieties given below :
Himgiri, Pusa Gaurav, Pusa Koomal, Pusa A-4.
Ans. Pusa komal & Himgiri
4. Name a human genetic disorder due to the following: [1 Mark]
(a) An additional X-chromosome in a male
(b) Deletion of one X-chromosome in a female.
Ans. (a) klinefelter's syndrome
(b) Turner's syndrome
- OR**
- State what does aneuploidy lead to.
Ans. Failure of segregation of chromatids during cell division cycle results in the gain or loss of a chromosome(s), called aneuploidy.
It could lead to genetic disorders for example, Down's syndrome and Turner's syndrome.
5. Why is the rate of secondary succession much faster than that of primary succession ? [1 Mark]
Ans. The rate of secondary succession is much faster than that of primary succession as soil or sediment is already present, so there is no need for pioneer species.

SECTION-B

6. State 'two' observations made by German naturalist, Alexender von Humboldt during his extensive explorations in South American jungles. [2 Marks]
Ans. His observations were -
 - Within a region species richness increased with increasing explored area but only upto a limit.
 - The relation between species richness and area for a wide variety of taxa is a rectangular hyperbola.
- OR**
- If in a population of size 'N' the birth rate is represented as 'b' and the death rate as 'd', the increase or decrease in 'N' during a unit time period 't' will be :
- $$\frac{dN}{dt} = (b - d) \times N$$
- The equation given above can also be represented as :
- $$\frac{dN}{dt} = r \times N, \text{ where } r = (b - d)$$
- Ans.** What does 'r' represent ? Write any one significance of calculating 'r' for any population.
R = Intrinsic rate of natural increase.
It is a very important parameter as required for assessing impacts of any biotic or abiotic factor on population growth.

Class-XII / (CBSE) | Biology

7. A segment of DNA molecule comprises of 546 nucleotides. How many cytosine nucleotides would be present in it if the number of adenine nucleotides is 96 ? **[2 Marks]**

Ans. In a double stranded DNA,
 Number of Adenine = Number of Thymine
 Number of Guanine = Number of Cytosine
 Given that, Number of Adenine = 96
 \therefore Number of Thymine = 96
 Total Number of Adenine and Thymine = 192
 Total Number of Nucleotide = 546
 Number of Cytosine and Guanine = $546 - 192 = 354$
 \therefore Number of Guanine = Number of Cytosine
 Number of Cytosine = $354 / 2 = 177$

8. (a) You are given castor and bean seeds. Which one of the two would you select to observe the endosperm ? **[2 Marks]**

(b) The development of endosperm precedes that of embryo in plants. Justify.

Ans. (a) I will select castor seed as despite being a dicotyledonous seed it contains endosperm which is not utilised during the development of embryo and thus persists in the seed.
 (b) It is so because the cells of endosperm are filled with reserve food material and are used for the nutrition of the developing embryo.

9. Name a distinguishing structure seen in a mature black pepper seed and not in a pea seed. State how does it develop. **[2 Marks]**

Ans. Ruminant of nucellus which persist in some seed is called perisperm. It is a nutritive tissue surrounding the embryo, e.g. black pepper. It originates from the nucellus, which is the central part of the ovule in the embryo sac.

10. Why does the insecticidal protein produced by *Bacillus thuringiensis* not kill the bacterium, but kills the cotton bollworm ? Explain. **[2 Marks]**

Ans. The BT toxin protein exists as inactive prototoxin. Once an insect ingest the inactive prototoxin it is converted into an active form of the toxin due to alkaline pH of gut which solubilises the crystals. Therefore, it does not kill the bacteria.

11. Write the palindromic nucleotide sequence that EcoRI reads and indicate the site of its action. **[2 Marks]**



Restriction enzyme cut the strand of DNA little away from the centre of the palindrome sides but between the same to basis on the opposite strand.

Class-XII / (CBSE) | Biology

12. Mosses and frogs both need water as a medium for fertilisation. Where does syngamy occur and how is it ensured in both these organisms ? **[2 Marks]**

Ans. In both the cases syngamy occurs outside the body. Organisms exhibiting external fertilisation show great synchrony between the sexes and release a large number of gametes into the surrounding medium (water) in order to enhance the chances of syngamy.

OR

Write the basis of categorising animals as oviparous or viviparous, giving one example of each.

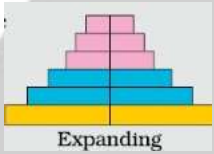
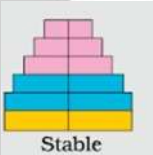
Ans.

Oviparous	Viviparous
Development of zygote takes place outside the body of the female parent.	Development of zygote takes place inside the body of the female parent.
Lay Fertilized eggs and after the period of incubation young one hatches out.	Zygote develop inside the body of the female and young one is delivered after certain stage of growth.
Example - Reptiles and Birds.	Example - Majority of Mammals Including Humans.

SECTION-C

13. Differentiate between an 'Expanding age pyramid' and a 'Stable age pyramid'. Substantiate your answer with diagrams. **[3 Marks]**

Ans.

Expanding	Stable
This type of graph has a triangular shape, with a very wide base and pointed apex.	This type of population distribution shows a rectangular or squarish shape, with almost the same number of people in all age groups.
Each age group shows a bar less wider than that of the age group before it, indicating that more people die at each higher group.	There is a slight taper at the top, which is perfectly natural, due to more deaths occurring among the elderly.
The large base shows a high birth rate, which is probably due to factors like a developing economy, poverty, low levels of female education, and less awareness of birth control measures.	Such countries have a high life expectancy, where more people live to a ripe old age, due to better living conditions, medical facilities, and geriatric care.
Post-reproductive :  Reproductive Pre-reproductive Expanding	Post-reproductive  Reproductive Pre-reproductive Stable

14. A child is born with ADA-deficiency. **[3 Marks]**

- (a) Suggest and explain a procedure for possible life-long (permanent) cure.
- (b) Name any other possible treatment for this disease.

Ans. (a) Gene isolated from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

(b) ADA deficiency can be cured by bone marrow transplantation or by enzyme replacement therapy, in which functional ADA is given to the patient by injection. Another option is gene therapy in which lymphocytes from the blood of the patient are grown in a culture outside the body. A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient

15. Name the most commonly used bioreactor in biotechnology labs. Mention the most essential components this bioreactor must have so as to provide the optimum conditions to the culture medium, resulting in production of large volume of desired product. **[3 Marks]**

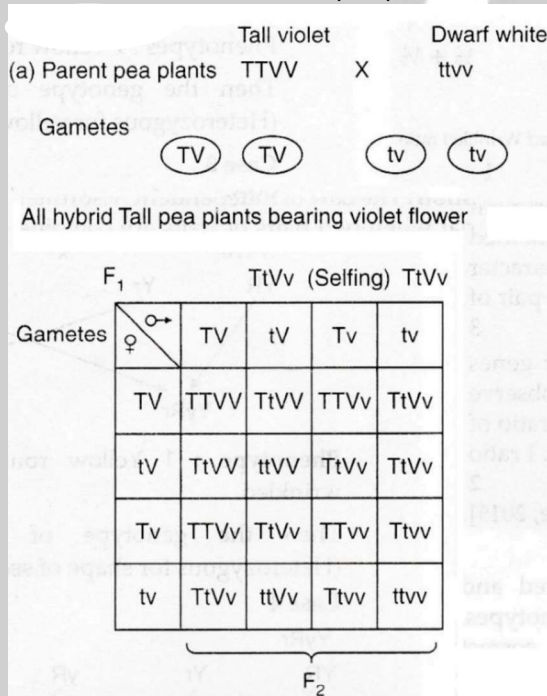
Ans. The most commonly used bioreactors are of **stirring type**.

A bioreactor should has the following components -

1. Agitator system,
2. Oxygen delivery system,
3. Foam control system,
4. Temperature
5. pH control system,
6. Sampling ports.

16. A tall pea plant bearing violet flowers is crossed with a tall pea plant bearing white flowers. In the F₁ progeny, there were tall pea plants with white flowers, tall pea plants with violet flowers, dwarf pea plants with violet flowers and dwarf pea plants with white flowers. Work out the cross to show how is it possible. **[3 Marks]**

Ans. Let us work out a cross of tall pea plant with violet flowers and dwarf pea plant with white flowers



In the above cross we could notice that

T_vv are tall with white flowers

T_V_ are tall with violet flowers

ttV_ are dwarf plant with violet flowers

And

ttvv are dwarf with white flowers

Class-XII / (CBSE) | Biology

17. (a) Differentiate between inbreeding and outbreeding. [3 Marks]
 (b) List any three advantages & one important disadvantage of inbreeding practice in animal husbandry.

Ans. (a)

Inbreeding	Outbreeding
Inbreeding is the production of offspring from the breeding of organisms that are closely related genetically.	Outbreeding is the production of offspring from the breeding of organisms that are genetically unrelated.
Parents used for inbreeding are the same breed for 4-6 generations.	Parents used for outbreeding should not be the common ancestor for 4-6 generations.
Mating occurs between individuals of the same species in inbreeding.	Mating occurs between separate species, genera, breeds or varieties.
Inbreeding typically reduces the vigour of the offspring.	Outbreeding increase the vigour of the offspring.

(b) Advantage

- (1) Inbreeding is used for the development of pure lines.
- (2) It helps in accumulation of superior genes and elimination of less desirable genes.
- (3) It increases homozygosity

Disadvantages : Harmful recessive alleles may be exposed during inbreeding. Inbreeding also leads to loss of fertility and productivity.

18. Explain Hardy-Weinberg principle. [3 Marks]

Ans. Hardy-Weinberg Principle

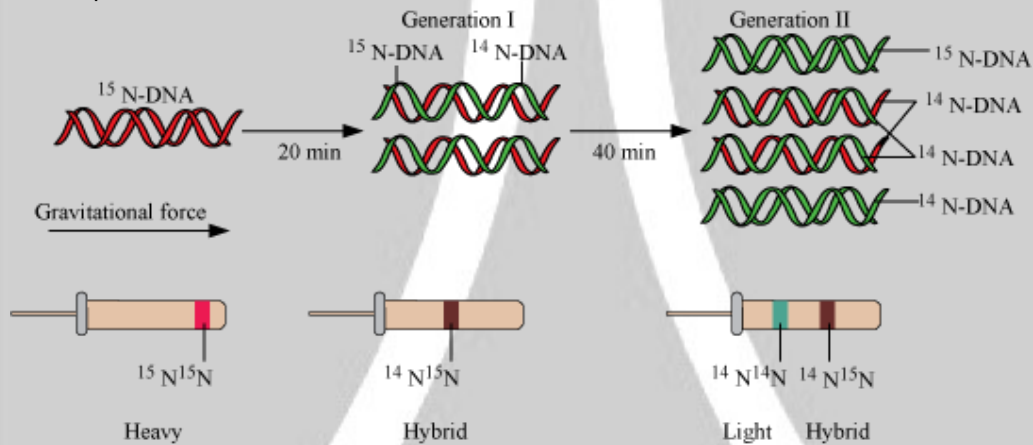
- The frequency of occurrence of alleles of a gene in a population remains constant through generations unless disturbances such as mutations, non-random mating, etc. are introduced.
- Sum total of all allelic frequencies is 1.
- Individual frequencies are represented as p and q such as in a diploid, where p and q represent the frequency of allele A and a. The frequency of AA is p^2 , that of aa is q^2 , and that of Aa is $2pq$.
- Hence, $p^2 + 2pq + q^2 = 1$, which is the expansion of $(p + q)^2$.
- When the frequency measured is different from that expected, it is indicative of evolutionary change.
- Hardy-Weinberg equilibrium is affected by
 1. Gene flow or gene migration
 2. Genetic drift (changes occurring by chance)
 3. Mutation
 4. Genetic recombination
 5. Natural selection

Class-XII / (CBSE) | Biology

19. "Use of heavy isotope of nitrogen by Meselson and Stahl demonstrated semi-conservative mode of replication of a DNA molecule." Explain how did they arrive at this conclusion. **[3 Marks]**

Ans. Experiment to Prove That DNA Replicates Semi-Conservatively

- *E. coli* was grown in a medium containing heavy isotope ^{15}N as the nitrogen source.
- ^{15}N was incorporated into newly synthesised DNA and the DNA became Heavy DNA.
- Heavy DNA molecule can be differentiated from normal DNA by density gradient centrifugation using cesium chloride as the gradient.
- Then, cells were again transferred into a medium with ^{14}N as nitrogen source. Samples were taken from this media and their DNA was extracted.
- *E. coli* divides every 20 minutes. Therefore, the DNA extracted after 20 minutes had a hybrid density.
- DNA extracted after 40 minutes had equal amount of hybrid and light intensities.
- This implies that the newly synthesised DNA obtained one of its strands from the parent. Thus, replication is semi-conservative.



OR

19. Explain the mechanism of translation that occurs in the ribosomes in a prokaryote.

Ans. Mechanism of translation

Translation

- The mRNA contains the genetic information, which is translated into the amino acid sequence with help of tRNA.
- First of all, charging of tRNA (amino-acylation of tRNA) takes place.
- Ribosomes are the workbenches for translation. Ribosomes have 2 subunits: a large subunit and a small subunit. Smaller subunit comes in contact with mRNA to initiate the process of translation.
- Translational unit in an mRNA is the region flanked by start codon and stop codon.
- Untranslated regions (UTR) are the regions on mRNA that are not themselves translated, but are required for efficient translation process. They may be present before start codon (5' UTR) or after stop codon (3' UTR).
- Initiator tRNA recognises the start codon (Initiation).
- Then t-RNA-amino acid complexes bind to their corresponding codon on the mRNA and base pairing occurs between codon on mRNA and tRNA anticodon.
- tRNA moves from codon to codon on the mRNA and amino acids are added one by one. (Elongation)
- Release factor binds to stop codon to terminate the translation (Termination).

20. (a) Name the causative agents of pneumonia and common cold. [3 Marks]

(b) How do these differ in their symptoms ?
(c) Mention two symptoms common to both.

Ans. a) *Streptococcus pneumoniae* and *Haemophilus influenzae* are responsible for the disease pneumonia. Common cold is caused by rhinoviruses.
b) The symptoms of pneumonia include fever, chills, cough and headache. The common cold is characterised by nasal congestion and discharge, sore throat, hoarseness, cough, headache, tiredness, etc., which usually last for 3-7 days.
c) Cough & headache are common in both.

OR

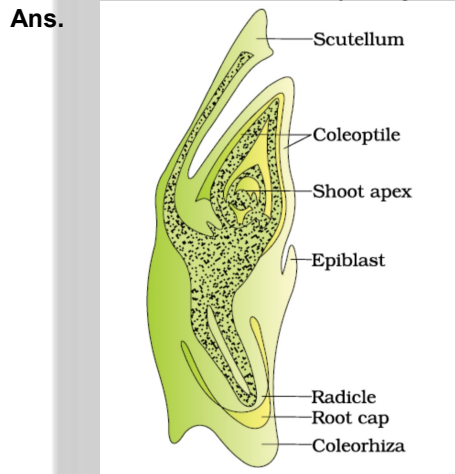
(a) Write the scientific names of the causative agent and vector of malaria, and write its symptoms.

(b) Name any two diseases spread by *Aedes* sp.

Ans. (a) *Plasmodium vivax*, *P. malaria* and *P. falciparum* are causative agents of malaria. Female *Anopheles* mosquito is the vector of malaria. Symptoms include chill and high fever recurring every three to four days.

(b) *Aedes* mosquitoes spread diseases like dengue and chikungunya.

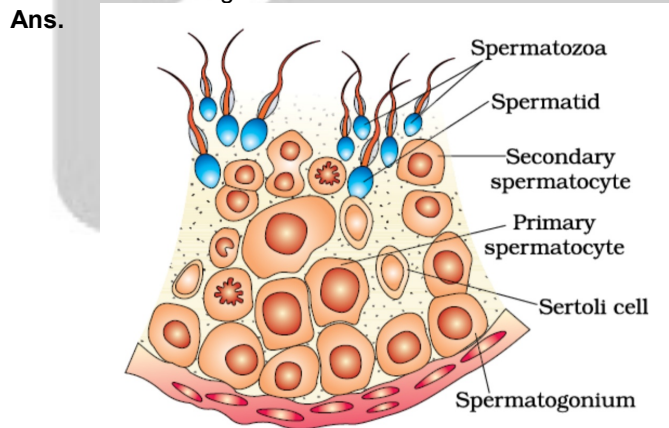
21. Draw L.S. of an embryo of grass and label its parts. [3 Marks]



L.S. of an embryo of grass

OR

Draw a diagrammatic sectional view of a seminiferous tubule (enlarged) in humans and label its parts.



Seminiferous tubule

Class-XII / (CBSE) | Biology

22. Construct a flow chart exhibiting sequential events of oogenesis.
 Ans. Flow chart of sequential events of oogenesis

[3 Marks]

Stages in oogenesis

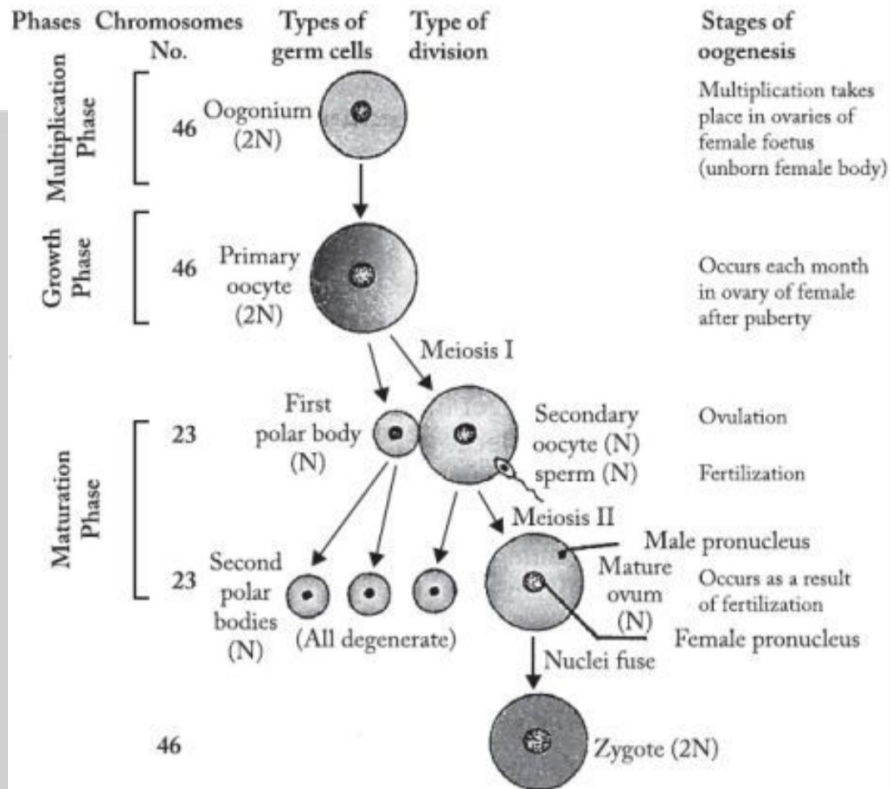
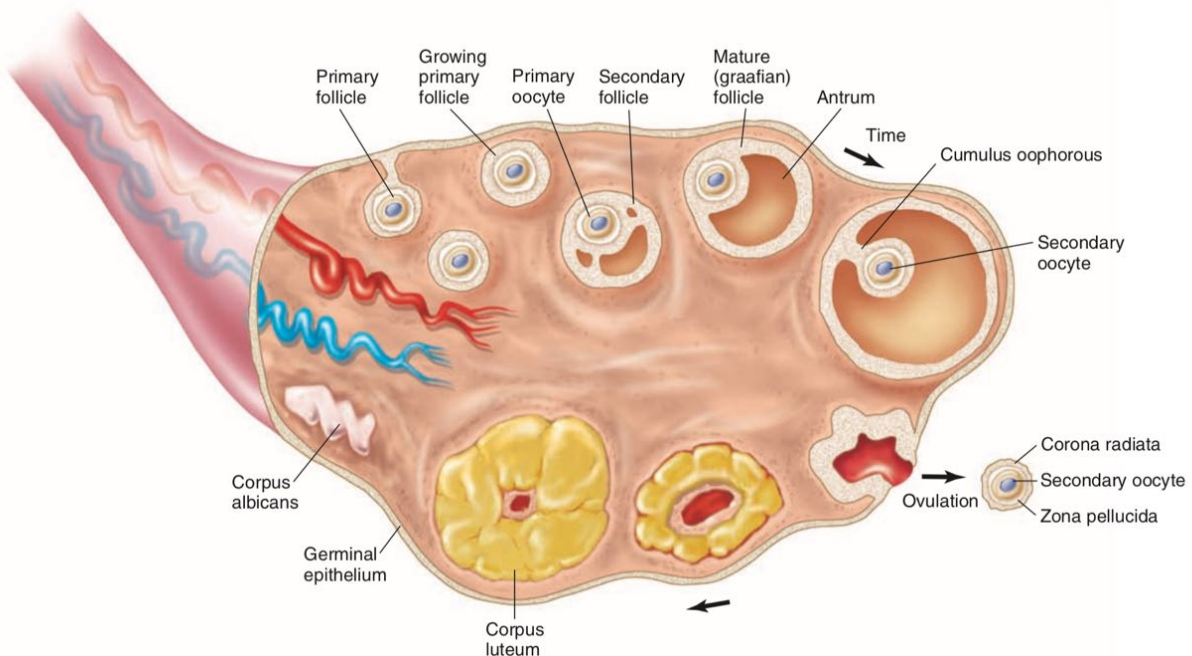


Fig.: Stages in oogenesis.



Class-XII / (CBSE) | Biology

23. When and where do tapetum and synergids develop in flowering plants ? Mention their functions.

[3 Marks]

Ans. Tapetum is formed during the process of formation of microsporangium.

It is formed as a cellular layer outside the sporogenous tissue.

It helps in providing nutrition to microspore.

Synergids are formed inside the embryo sac during the process of megasporogenesis.

They have filiform Apparatus which release boron rich chemical which help in directing the growth of pollen tube towards the embryo sac.

OR

Where are the following structures present in a male gametophyte of an angiosperm ? Mention the function of each one of them.

(a) Germ pore

(b) Sporopollenin

(c) Generative cell

Ans. (a) Germ pore is present on the pollen grains. It is the place where exine and sporopollenin is absent.

The contents of the pollen grain move into the pollen tube through the germ pore.

(b) Sporopollenin is present on the outer surface of pollen grains. Sporopollenin is one of the most resistant organic material known. It can withstand high temperatures and strong acids and alkali. No enzyme that degrades sporopollenin is so far known.

(c) Germinative cell is one of the two cells present inside the pollen grain which gives rise to male gametes through Mitosis.

24. Describe the carbon cycle in nature. How does deforestation affect this cycle ?

[3 Marks]

Ans. **Carbon cycle** is a series of processes by which carbon compounds are interconverted in the environment, involving the incorporation of carbon dioxide into living tissue by photosynthesis and its return to the atmosphere through respiration, the decay of dead organisms, and the burning of fossil fuels.

- About 49% of the dry weight of living organisms is made up of carbon.
- The ocean reserves and fossil fuels regulate the amount of CO₂ in the atmosphere.
- Plants absorb CO₂ from the atmosphere for photosynthesis, of which a certain amount is released back through respiratory activities.
- A major amount of CO₂ is contributed by the decomposers who contribute to the CO₂ pool by processing dead and decaying matter.
- The amount of CO₂ in the atmosphere has been increased considerably by human activities such as burning of fossil fuels, deforestation.

Affect of Deforestation: The plant convert the atmospheric CO₂ into organic compound by the process of photosynthesis. Due to deforestation the plant performing photosynthesis will decrease and less amount of CO₂ will be fixed into organic compounds. In this way the amount of CO₂ will increase in the environment which could further lead to greenhouse effect and global warming.

Class-XII / (CBSE) | Biology

SECTION-D

25. A normal couple has a colour-blind child, whereas a child suffering from thalassemia is born to normal parents. **[5 Marks]**
Compare the pattern of inheritance of these two traits in the said case. State the reasons how is it possible.

Ans. This is because colour blindness is a sex linked recessive disorder whereas thalassemia is an autosome linked recessive.

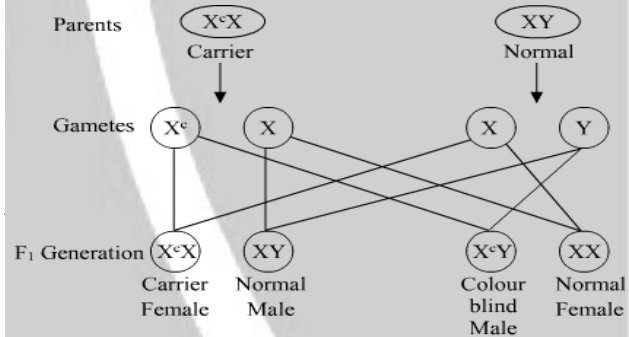
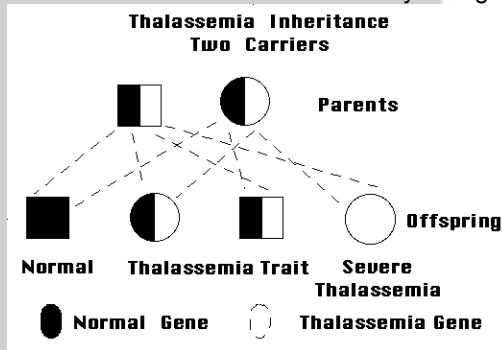
Color blindness: Red-green color blindness means that a person cannot distinguish shades of red and green (usually blue-green), but their ability to see is normal.

There are no serious complications; however, those affected may not be considered for certain occupations involving transportation or the Armed Forces where color recognition is required.

Males are affected more often than females, because the gene is located on the X chromosome.

Thalassemia: Thalassemia is an autosomal recessively inherited disorder transmitted to the offspring when both the parents are heterozygous or carriers for the disease

Alpha Thalassemia is controlled by two closely linked genes HBA1 and HBA2 located on chromosome 16 beta Thalassemia is controlled by a single gene HBB located on chromosome 11.



OR

- (a) State the reasons for which Hershey and Chase carried out their experiments.
(b) Answer the following questions based on the experiments of Hershey and Chase :
(i) Name the different radioactive isotopes they used, and explain how they used them.
(ii) Why did they need to agitate and spin their culture ?
(iii) Write their observations and the conclusions they arrived at.

Ans. A) Hershey and Chase carried out their experiment to find out whether the genetic material is DNA or protein.

B) i) Hershey and Chase used T₂ phage, a bacteriophage. The phage infects a bacterium by attaching to it and injecting its genetic material into it.

- They put labels on phage DNA with radioactive Phosphorus-32.
- They then followed the phages while they infected E. coli.
- In a second experiment, Hershey and Chase put labels on the phage protein with radioactive Sulfur-35.

ii) Radioactive phages were allowed to attach to E. coli bacteria. Then, as the infection proceeded, the viral coats were removed from the bacteria by agitating them in a blender. The virus particles were separated from the bacteria by spinning them in a centrifuge.

iii) Bacteria which was infected with viruses that had radioactive DNA were radioactive, indicating that DNA was the material that passed from the virus to the bacteria.

Bacteria that were infected with viruses that had radioactive proteins were not radioactive.

This indicates that proteins did not enter the bacteria from the viruses. DNA is therefore the genetic material that is passed from virus to bacteria.

Class-XII / (CBSE) | Biology

26. A plastic sack manufacturer in Bangaluru, Ahmed Khan has managed to find an ideal solution to the problem of plastic waste. Explain in five steps the efforts of Ahmed Khan to meet the challenges of solid waste management. **[5 Marks]**

- Ans.** (1) Polyblend, a fine powder of recycled modified plastic, was developed by Ahmed Khan's company.
 (2) This mixture is mixed with the bitumen that is used to lay roads.
 (3) In collaboration with R.V.College of Engineering and the Bangalore City Corporation, Ahmed Khan proved that blends of Polyblend and bitumen, when used to lay roads, enhanced the bitumen's water repellent properties, and helped to increase road life by a factor of three.
 (4) The raw material for creating Polyblend is any plastic film waste.
 (5) So, against the price of Rs. 0.40 per kg that rag pickers had been getting for plastic waste, Khan now offers Rs.6.

OR

(a) What does an ecological pyramid represent ? State any two limitations that these pyramids have **[5 Marks]**.

(b) Describe an inverted pyramid of biomass with the help of an example.

Ans. A) An ecological pyramid is a graphical representation designed to show the biomass or bio productivity at each trophic level in a given ecosystem.

Limitations -

- It does not take into account the same species belonging to two or more trophic levels.
- It assumes a simple food chain, something that almost never exists in nature; it does not accommodate a food web.

B) In aquatic ecosystem, the pyramid of biomass may be inverted.

Example : Biomass of zooplanktons is higher than that of phytoplanktons as the lifespan of former is longer and latter multiply much faster though having shorter lifespan.

A number of generations of phytoplanktons may thus be consumed by single generation of zooplanktons .



Inverted pyramid of biomass-small standing crop of phytoplankton supports large standing crop of zooplankton

27. (a) Differentiate between active and passive immunity. **[5 Marks]**
 (b) Comment on the role of vaccination and immunization in keeping human population healthy.

Ans.

Active Immunity	Passive Immunity
1. It is produced due to contact with pathogen or its antigen.	1. It is produced due to antibodies obtained from outside.
2. Immunity is not immediate. A time lapse occurs for its development.	2. Immunity develops immediately.
3. It lasts for sufficiently long period, may be life long.	3. It lasts for a few days.
4. Antibodies are produced by the body in response to pathogen or antigen.	4. Antibodies are obtained from outside.
5. Side effects are very few.	5. At times the body reacts to the introduction of antisera. It is called serum sickness.

Class-XII / (CBSE) | Biology

b) The principle of immunisation or vaccination is based on the property of 'memory' of the immune system. In vaccination, a preparation of antigenic proteins of pathogen or inactivated/weakened pathogen (vaccine) are introduced into the body. The antibodies produced in the body against these antigens would neutralise the pathogenic agents during actual infection. The vaccines also generate memory – B and T-cells that recognise the pathogen quickly on subsequent exposure and overwhelm the invaders with a massive production of antibodies. Thus, it helps in keeping human population healthy.

OR

Describe the process of secondary treatment given to municipal waste water (sewage) before it can be released into fresh waterbodies. Mention another benefit provided by this process.

Ans. Secondary treatment or Biological treatment: 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.

The sewage water is treated till the BOD is reduced. 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.

Additional benefit of this process is that, during this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. These gases form biogas and can be used as source of energy as it is inflammable.

Class-XII / (CBSE) | Biology