CBSE EXAMINATION PAPER-2025

BIOLOGY

(Solved)

Time allowed : 3 hours | Maximum Marks : 83

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **40 questions.** All questions are **compulsory.**

ii. This question paper is divided into **5 sections.**

iii. **Section A** – questions number **1 to 3** are case based questions

iv. **Section B** – questions number **4 to 19** are multiple choice questions

v. **Section C** – questions number **20 to 27** are very short answer

vi. **Section D** – questions number **28 to 34** are short answer

vii. **Section E** – questions number **35 to 40** are long answer

viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

ix. Use of calculator is NOT allowed.

Section A

Question 1.

Question 2.

Highly conserved proteins such as Haemoglobin and Cytochrome-C provide the best biochemical evidences to trace evolutionary relationships between different groups. Cytochrome-C is formed of 104 amino acids. Cytochrome-C is the respiratory pigment present in all eukaryotic cells. It has evolved at a constant rate during evolution. In chimpanzees and humans, Cytochrome-C genes are

identical. The given data shows the evolution of the Cytochrome-C gene in different mammals from kangaroos, cows, rodents to humans :

Groups	Nucleotide substitution in the gene of Cytochrome-C	Millions of years ago
Human/Kangaroo	100	125 mya
Human/Cow	75	120 mya
Human/Rodent	60	75 mya

(1)

Select the correct option for the time of separation of two groups and the number of nucleotide substitutions in the gene of Cytochrome-C :

Options	Time of separation of two groups during evolution	Number of nucleotide substitutions
(i)	Lesser	Greater
(ii)	Greater	Lesser
(iii)	Greater	Greater

[1 Marks]

Answer: The time of separation of two groups can be estimated based on the number of nucleotide substitutions in the Cytochrome-C gene. It is known that Cytochrome-C genes have evolved at a constant rate, indicating its use as a molecular clock. In the context of mammals, studies have shown that humans and chimpanzees have identical Cytochrome-C genes, suggesting that their divergence occurred recently. Based on molecular data, the time of separation between humans and chimpanzees is estimated to be around 5 to 7 million years ago. Additionally, the number of nucleotide substitutions can vary depending on the groups being compared, but it generally aligns with the divergence time; for every million years, there is a certain number of substitutions that occur. Therefore, one would need to refer to specific data to provide an exact figure for substitutions, typically ranging from 1 to 2 substitutions per million years across different taxa.

Key Points: Time of separation estimated based on nucleotide substitutions; Cytochrome-C as a molecular clock; divergence time of humans and chimpanzees about 5 to 7 million years ago; number of nucleotide substitutions varies with divergence time.

(2)

What do you infer about the type of evolution (convergent ordivergent) for the given pair of groups and why ?

(i) Human and Kangaroo

(ii) Human and Rodent

[1 Marks]

Answer: The type of evolution observed between the human and kangaroo can be interpreted as divergent evolution. Despite both being mammals, they have evolved independently from a common ancestor, leading to adaptations that suit their respective environments. On the other hand, the relationship between humans and rodents indicates convergent evolution. While they both share similarities in their Cytochrome-C gene, which hints at a common evolutionary pathway, the biochemical functionalities have adapted to different lifestyles. These genetic similarities suggest that while they share a relatively recent common ancestor, the differences in their evolutionary paths have become pronounced.

Key Points: Divergent evolution indicates common ancestry; Humans and Kangaroos have adapted to different environments; Convergent evolution shows similarity in gene functions despite different lineages; Cytochrome-C gene similarities suggest a shared ancestry between Humans and Rodents.

(3)

Define divergent evolution.

[2 Marks]

Answer: Divergent evolution is the process by which two or more related species become more dissimilar over time, often due to differing environmental pressures or adaptations. This phenomenon leads to the formation of new species from a common ancestor, as seen in the variation of homologous structures, such as limb bones in mammals which have evolved to serve different functions in different environments. Divergent evolution supports the theory of evolution by demonstrating how species diversify from a shared lineage, adapting to their unique habitats and lifestyles.

Key Points: Divergent evolution definition - Common ancestor - Dissimilar adaptations - Evidence in homologous structures - Evolutionary relationships

(4)

Define convergent evolution.

[2 Marks]

Answer: Convergent evolution is a process in which different species evolve similar traits or characteristics independently, often as a response to similar environmental pressures or challenges. This phenomenon occurs despite the species not sharing a recent common ancestor. For example, both bats and birds have developed the ability to fly, but their wing structures are anatomically different, illustrating how different organisms can converge on similar functional adaptations through evolution.

Key Points: Definition of convergent evolution-Independently evolved traits-Example of bats and birds

Question 3.

In 2021, 5·3 percent of 15 to 16-year-olds worldwide (13·5 million individuals) had used *Cannabis* in the past year according to UNODC. The adolescent brain is still developing and drug use can have long-term negative effects. Early drug use initiation can lead to faster development of dependence than in adults and other problems in adulthood. Parts of the Amazon Basin are at the intersection of multiple forms of organised crimes that are accelerating devastation, with severe implications for the

security, health and well-being of the population across the region. The direct impact of coca cultivation on deforestation is minimal, but indirectly it acts as a catalyst for “Narco-deforestation”. The laundering of drug trafficking profits into land speculation etc. is posing a growing danger to the world’s largest rainforest.

(1)

Which age group or period of growth people are more vulnerable to drug abuse?

[1 Marks]

Answer: The age group that is most vulnerable to drug abuse is adolescents, specifically those between the ages of 12 to 18 years. This period, known as adolescence, is crucial as it involves significant physical, emotional, and social development. During this time, teenagers are susceptible to peer pressure and stress related to academic and social environments, leading them to experiment with drugs and alcohol. The statistics indicating that 5.3 percent of 15 to 16-year-olds globally have used cannabis in the past year underline this vulnerability. Early initiation into drug use can result in dependence and more severe issues in adulthood, as the adolescent brain is still developing and is more prone to addiction. This highlights the need for proper education and parental guidance to help mitigate the risks associated with drug abuse during this critical developmental stage.

Key Points: Adolescents aged 12-18 years are most vulnerable-peer pressure and stress contribute to experimentation-addiction potential due to brain development-need for education and guidance

(2)

Explain the negative impact of coca cultivation on the world’s largest rainforest.

[1 Marks]

Answer: Coca cultivation negatively impacts the world's largest rainforest, the Amazon, primarily through a phenomenon known as 'Narco-deforestation.' While the direct effects of coca farming on deforestation may seem minimal, the indirect consequences are severe. The profits generated from drug trafficking have led to increased land speculation and illegal activities in the rainforest region, resulting in habitat destruction and ecosystem degradation. As criminal organizations seek to expand their operations, they often clear vast areas of forest to establish illicit plantations, leading to biodiversity loss and threatening countless species. Furthermore, the activities associated with coca cultivation can exacerbate pollution and environmental degradation, further compromising the health of this vital ecosystem which is crucial for global climate stability.

Key Points: Narco-deforestation; land speculation related to drug profits; habitat destruction; biodiversity loss; pollution and environmental degradation

(3)

State the scientific name of the plant from which coca alkaloids are derived and state one negative impact of use of excessive dosage of cocaine.

[2 Marks]

Answer: The scientific name of the plant from which coca alkaloids are derived is Erythroxylum coca. One negative impact of excessive cocaine use is its interference with the transport of the neurotransmitter dopamine, which can lead to addiction and various mental health issues.

Key Points: Erythroxylum coca - Cocaine interferes with dopamine transport - Potential for addiction - Mental health issues

(4)

From which part of the plant are cannabinoids mainly obtained ? Mention any one negative effect of this drug on adolescents.

[2 Marks]

Answer: Cannabinoids are primarily obtained from the flowers and leaves of the cannabis plant. One negative effect of cannabis use on adolescents is that it can lead to the faster development of dependence compared to adults, potentially impacting their psychological and social well-being.

Key Points: Cannabinoids obtained from flowers and leaves - Negative effect: faster development of dependence - Impact on psychological and social well-being

Section B

Question 4.

The histone core in a nucleosome of chromatin thread is a/an:

[1 Marks]

(A) pentamer

(B) heptomer

(C) hexamer

(D) octamer

Explanation: The correct answer is 'octamer' because the context states that histones are organised to form a unit of eight molecules known as a histone octamer. Nucleosomes are formed when negatively charged DNA wraps around this positively charged histone octamer.

Question 5.

Given below are few statements with reference to the uterus in the female reproductive system:

(i) The myometrium exhibits strong contractions during the delivery of the baby.

(ii) The uterus opens into the cervix through a narrow opening called vagina.

(iii) The cavity of the cervix and the vagina forms the birth canal.

(iv) The outermost layer of uterus is a thin membranous perimetrium.

(v) The uterus is supported by tendons attached to the pelvic wall.

[1 Marks]

(A) (ii), (iv) and (v)

(B) (i), (ii) and (iv)

(C) (ii), (iii) and (v)

(D) (i), (iii) and (iv)

Explanation: The correct option is (i), (iii) and (iv). Statement (i) is correct because the myometrium is known for its strong contractions during childbirth. Statement (iii) is correct as the cervical canal and the vagina constitute the birth canal. Statement (iv) is correct as the outer layer of the uterus is indeed referred to as the perimetrium. Statement (ii) is incorrect since the uterus opens into the vagina via the cervix, not the other way around, and statement (v) is also incorrect as the uterus is supported by ligaments, not tendons.

Question 6.

During the process of transcription, after binding to a promoter, RNA polymerase catalyses and makes the bases in the template strand of DNA available for base pairing, with the bases of:

[1 Marks]

(A) Ribonucleotide triphosphate

(B) Deoxyribonucleoside triphosphate

(C) Ribonucleoside triphosphate

(D) Deoxyribonucleotide triphosphate

Explanation: The correct answer is 'Ribonucleotide triphosphate' because during transcription, RNA polymerase utilizes ribonucleotide triphosphates (NTPs) as substrates to synthesize RNA, pairing them with the complementary bases in the DNA template strand. This is supported by the reference to RNA polymerase using nucleoside triphosphates as substrates while catalyzing RNA synthesis.

Question 7.

Which of the following is not an example of aneuploidy?

[1 Marks]

(A) Turner’s syndrome

(B) Klinefelter’s syndrome

(C) Down’s syndrome

(D) Phenylketonuria

Explanation: Phenylketonuria is not an example of aneuploidy as it is caused by a mutation in a single gene, rather than an abnormal number of chromosomes. In contrast, Turner’s syndrome, Klinefelter’s syndrome, and Down’s syndrome are all characterized by an abnormal number of chromosomes, classifying them as types of aneuploidy.

Question 8.

Colostrum secreted by the mother's mammary glands in human female during the initial days of lactation is rich in antibody:

[1 Marks]

(A) IgA

(B) IgG

(C) IgD

(D) IgE

Explanation:

The correct answer is IgA. The context mentions that the yellowish fluid colostrum secreted by the mother during the initial days of lactation has abundant antibodies, specifically IgA, which are essential to protect the newborn infant.

Question 9.

Select the statements that are true for pollination mechanism in flowering plants from the given options.

(i) In Vallisneria, the female flowers are pollinated by pollen grains inside the water.

(ii) In Zostera, pollen grains are released on the surface of water.

(iii) In most of the water-pollinated species, pollen grains are covered by a mucilaginous coating.

(iv) Pollination by water is quite rare and limited to about 30 genera.

[1 Marks]

(A) (i) and (iv)

(B) (iii) and (iv)

(C) (ii) and (iii)

(D) (i) and (ii)

Explanation: The correct options are (iii) and (iv). Statement (iii) is correct because the context states that in most water-pollinated species, pollen grains have a mucilaginous coating that protects them from wetting. Statement (iv) is also correct as it specifies that pollination by water is quite rare and limited to about 30 genera of flowering plants, which is directly supported by the provided context.

Question 10.

Which of the following combinations is a correct example of convergent evolution in Australian marsupials and Placental mammals?

[1 Marks]

(A) Bobcat Lemur

(B) Numbat Anteater

(C) Tasmanian tiger cat Anteater

(D) Lemur Spotted cuscus

Explanation: The correct answer is 'Numbat Anteater'. This combination illustrates convergent evolution as the numbat (a marsupial) and the anteater (a placental mammal) have evolved similar adaptations to feed on ants and termites, despite belonging to different evolutionary lineages. This aligns with the provided context, which discusses how marsupials and placental mammals in Australia exhibit similar characteristics due to adaptive radiation in an isolated geographical area.

Question 11.

Isolation of DNA from a fungal cell can be achieved by using:

[1 Marks]

(A) Protease

(B) Lysozyme

(C) Cellulase

(D) Chitinase

Explanation: The correct option is Chitinase. Chitinase is an enzyme that specifically breaks down chitin, which is a component of the fungal cell wall. According to the context provided, the isolation of

DNA from cells, including fungal cells, can be achieved through the use of specific enzymes designed to break down cellular components, and chitinase is the appropriate enzyme for fungi.

Question 12.

During a monohybrid cross involving a tall pea plant with a dwarf pea plant, the offspring populations were tall and dwarf in equal ratio. Find out the genotype of parent pea plants.

[1 Marks]

(A) TT Tt

(B) tt tt

(C) Tt tt

(D) Tt Tt

Explanation: The correct option is 'TT, tt'. In a monohybrid cross between a true-breeding tall plant (TT) and a true-breeding dwarf plant (tt), the offspring will have a 1:1 ratio of tall (Tt) and dwarf (tt) plants in the F2 generation. This aligns with Mendel's principles where TT represents the genotype for the tall parent and tt represents the genotype for the dwarf parent.

Question 13.

What would happen if a gene encoding a polypeptide of 50 amino acids, 25th codon (UAU) is mutated to "UAU"?

[1 Marks]

(A) A polypeptide of 50 amino acids will be formed.

(B) A polypeptide of 49 amino acids will be formed.

(C) A polypeptide of 25 amino acids will be formed.

(D) A polypeptide of 24 amino acids will be formed.

Explanation:

If a gene encoding a 50 amino acid polypeptide has its 25th codon (UAU) mutated to UAA, **the polypeptide chain will terminate prematurely at the 25th codon**. This is because UAA is a stop codon, which signals the end of translation. Therefore, a shorter polypeptide of only **24 amino acids** will be produced

Question 14.

Large scale industrial production of Butyric acid for human welfare is done using the microbe:

[1 Marks]

(A) Aspergillus sp.

(B) Trichoderma sp.

(C) Streptococcus sp.

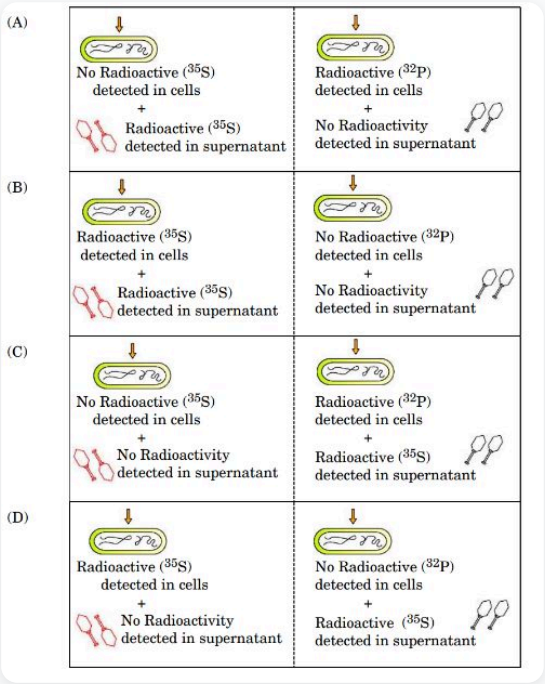
(D) Clostridium sp.

Explanation: The correct answer is Clostridium sp. This is because Clostridium butylicum, a bacterium mentioned in the context, is specifically known for producing butyric acid on an industrial scale.

Question 15.

The correct depiction of the centrifugation step of the experiment conducted by Alfred Hershey and Martha Chase on using radioactive labelled phages to prove that DNA is the genetic material is :

[1 Marks]



(A) No Radioactive (35S) detected in cells + Radioactive (35S) detected in supernatant. Radioactive (32P) detected in cells + No Radioactivity detected in supernatant.

(B) No Radioactive (35S) detected in cells + No Radioactivity detected in supernatant. Radioactive (32P) detected in cells + Radioactive (35S) detected in supernatant.

(C) Radioactive (35S) detected in cells + Radioactive (35S) detected in supernatant. No Radioactive (32P) detected in cells + No Radioactivity detected in supernatant.

(D) Radioactive (35S) detected in cells + No Radioactivity detected in supernatant. No Radioactive (32P) detected in cells + Radioactive (35S) detected in supernatant.

Explanation: The correct answer is 'Radioactive (32P) detected in cells + No Radioactivity detected in supernatant.' This is because in the Hershey-Chase experiment, when bacteriophages with radioactive DNA (labelled with 32P) infected the bacteria, the DNA entered the bacterial cells while the protein coats (labelled with 35S) remained outside, leading to no radioactivity detected in the supernatant.

Question 16.

Assertion (A): To generate only a part of the plant from a cell is totipotency.

Reason (R): Suitable special nutrient media and sterile conditions are required in conditions for the division of cells in explants.

[1 Marks]

(A) Assertion (A) is true, but Reason (R) is false.

(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 false, but Reason (R) is true.

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

Explanation: The correct answer is 'Assertion (A) is false, but Reason (R) is true.' Totipotency refers to the ability of a single cell to develop into a whole organism or plant, not just a part. Therefore, the assertion is incorrect. However, the reason correctly states that specific nutrient media and sterile conditions are necessary for the successful culture and division of cells in explants, making it true.

Question 17.

Assertion (A): Biogas plants are more often built in rural areas.

Reason (R): The excreta or gobar of cattle is rich in Methanobacterium.

[1 Marks]

(A) Assertion (A) is false, but Reason (R) is true.

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

(C) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(D) Assertion (A) is true, but Reason (R) is false.

Explanation: Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). Biogas plants are commonly built in rural areas because cattle dung, which contains Methanobacterium, is readily available there, enabling the production of biogas.

Question 18.

Assertion (A): Gene pairs present on the same chromosome may be tightly linked or loosely linked.

Reason (R): Frequency of recombination between gene pairs on different chromosomes as a measure of the distance the chromosomes.

[1 Marks]

(A) Assertion (A) is false, but Reason (R) is true.

(B) Assertion (A) is true, but Reason (R) is false.

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

(D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

Explanation: The assertion is correct because genes present on the same chromosome can be tightly linked (low recombination frequency) or loosely linked (higher recombination frequency), depending on how close they are to each other. The reason is incorrect because the frequency of recombination between gene pairs on different chromosomes is not used to measure the distance between chromosomes; recombination frequency is used to measure the relative distance between genes on the same chromosome, not between different chromosomes.

Question 19.

Assertion (A): Cu-T, Cu-7 and LNG-20 are the most widely used copper-releasing IUDs.

Reason (R): Cu-ions in IUDs effectively suppress sperm motility and the fertilising capacity of sperms.

[1 Marks]

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

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is 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.

Explanation: Cu-T, Cu-7, and LNG-20 are commonly used copper-releasing IUDs that provide long-term contraception. The copper ions (Cu^{2+}) released from these IUDs act as spermicides by suppressing the motility and fertilising capacity of sperms. This action prevents fertilization and thus explains why these copper IUDs are effective contraceptives, supporting both the assertion and the reason correctly.

Section C

Question 20. Give an account of the generalised structure of an antibody molecule produced by B-lymphocytes in response to the pathogen.

[2 Marks]

Answer: An antibody molecule, produced by B-lymphocytes, typically has a Y-shaped structure consisting of four polypeptide chains—two heavy chains and two light chains. These chains are linked by disulfide bonds. The antibody has two binding sites at the tips of the Y, allowing it to attach to specific antigens on pathogens. The constant region of the antibody defines its class (e.g., IgA, IgG), while the variable region allows for antigen specificity, enabling the immune system to neutralize pathogens effectively.

Key Points: Y-shaped structure-heavy chains-light chains-antigen binding sites-constant region-variable region

Question 21. Other than public awareness and counselling, enlist four measures taken up by NACO, WHO and other NGOs to prevent the spread of HIV infection in the society.

[2 Marks]

Answer: To prevent the spread of HIV infection, several measures have been implemented by NACO, WHO, and NGOs. Firstly, making blood safe from HIV through rigorous screening in blood banks is essential. Secondly, ensuring the use of only disposable needles and syringes in healthcare settings helps reduce transmission. Thirdly, free distribution of condoms promotes safe sex practices. Lastly, controlling drug abuse and advocating for regular check-ups within high-risk populations are crucial in reducing HIV infections.

Key Points: Making blood safe from HIV-Ensuring the use of disposable needles-Free distribution of condoms-Control drug abuse-Advocating safe sex and regular check-ups

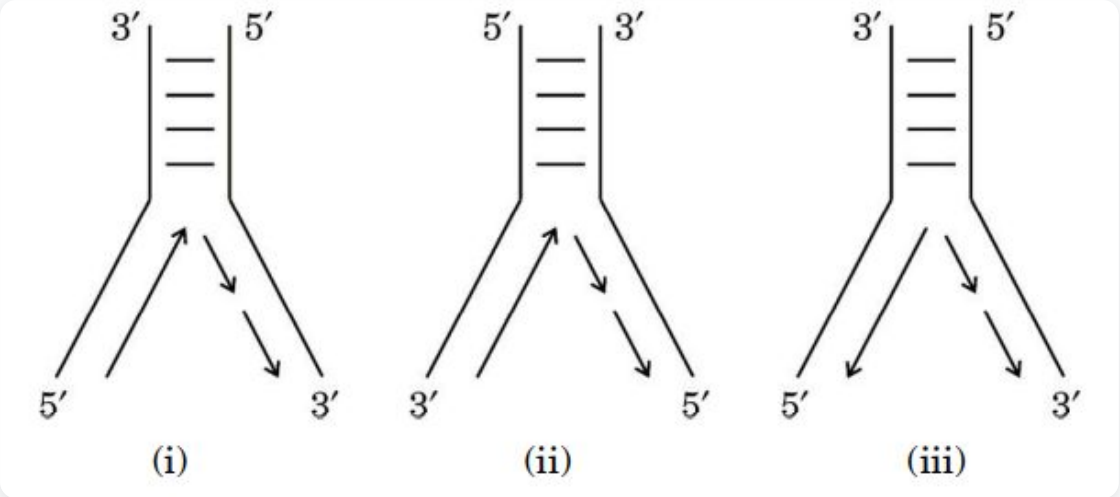
Question 22.

Given below are the diagrammatic representations of the replicating fork of DNA in E. coli. Study the diagrams and answer the questions that follow.

(a) Which one of the three diagrams (i), (ii) or (iii) is the correct representation of the replicating fork of DNA replication ? Explain your answer.

(b) Name the enzyme used in E. coli to join the newly synthesised fragments of DNA.

[2 Marks]



Answer: The correct representation of the replicating fork of DNA replication in E. coli is diagram (i). It accurately depicts the direction of synthesis for both leading and lagging strands, illustrating that DNA polymerase synthesizes new DNA complementary to the template strand. The enzyme responsible for joining the newly synthesized fragments of DNA, known as Okazaki fragments, is DNA ligase, which connects these discontinuously synthesized sections.

Key Points: Correct diagram indicates directionality of DNA synthesis-DNA polymerase synthesizes complementary strands-DNA ligase joins Okazaki fragments

Question 23.

Explain what is meant by the term amniocentesis. How is this technique misused in India ?

[2 Marks]

Answer: Amniocentesis is a medical procedure used to collect a small amount of amniotic fluid surrounding a fetus for testing. This technique helps identify genetic disorders and congenital disabilities. In India, amniocentesis is misused primarily for sex determination, leading to illegal abortions if the baby is female. This practice has contributed to the rising incidence of female foeticides, which is both unethical and dangerous for the health of the mother and fetus.

Key Points: Definition of amniocentesis-Usage for genetic testing-Misuse for sex determination-Consequences of female foeticide-Health risks associated with the procedure

Question 24.

Name any two VDs which might occur in a human female. State any two complications in a female if it is left untreated.

[2 Marks]

Answer: Two sexually transmitted diseases (STDs) that can occur in human females are gonorrhea and chlamydia. If left untreated, these infections can lead to several complications, which include pelvic inflammatory disease (PID) and infertility. PID can cause chronic pain and damage to reproductive organs, while infertility can prevent successful conception in the future.

Key Points: gonorrhea-chlamydia-pelvic inflammatory disease-infertiity

Question 25.

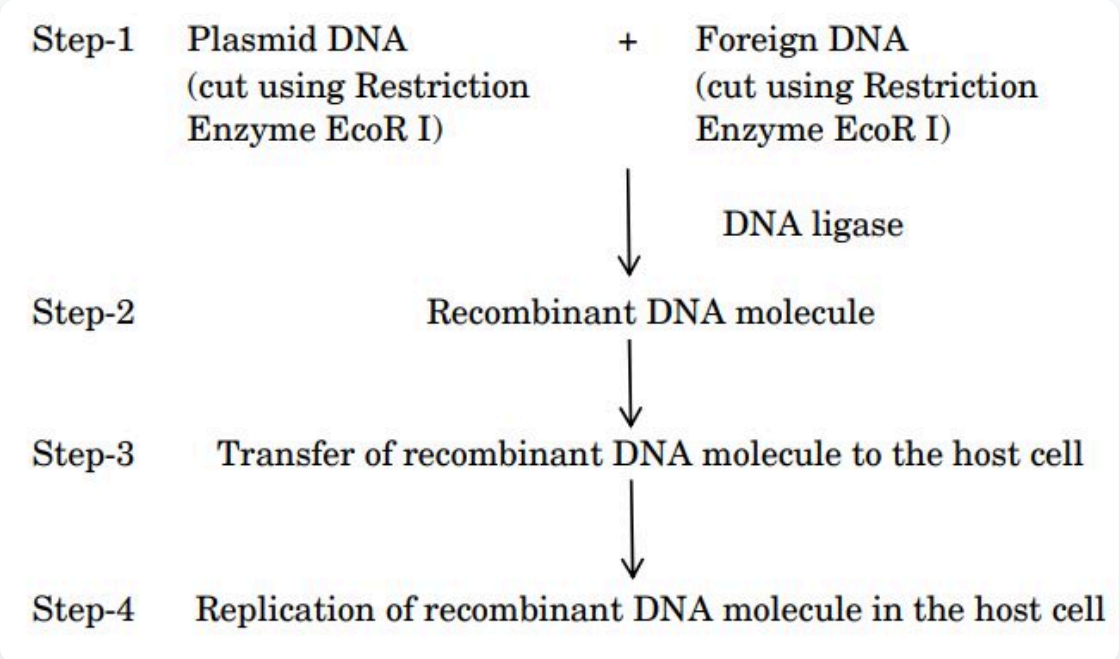
The basic scheme of the essential steps involved in the process of recombinant DNA technology is summarised below in the form of a flow diagram. Study the given flow diagram and answer the questions that follow :

(a) Name the specific enzyme that might have been used to make the multiple copies of foreign DNA before undergoing Step-1 of the process.

(b) How does the use of restriction enzyme EcoR I in Step-1 facilitate the action of DNA ligase to form the recombinant DNA molecule ? Explain.

(c) Name the most commonly used host in the above process.

[2 Marks]



Answer: The specific enzyme used to make multiple copies of foreign DNA before Step-1 of the recombinant DNA technology process is DNA polymerase. This enzyme synthesizes new DNA

strands by adding nucleotides complementary to the template strand, allowing for amplification of the desired DNA fragment.

Key Points: DNA polymerase, amplification of DNA, synthesis of new DNA strands

Question 26.

Explain how the interaction between a fig tree and its tight one-to-one relationship with the pollinator species of wasp is one of the best examples of mutualism.

[2 Marks]

Answer: The interaction between fig trees and their pollinator wasps exemplifies mutualism, where both species benefit. The fig provides a habitat and food source for the wasp's larvae by offering its seeds. In return, the wasp pollinates the fig's flowers while laying its eggs. This one-to-one relationship means that each fig species is specifically adapted to a particular wasp species, ensuring successful reproduction for both organisms. Thus, they co-evolve, benefiting mutually from their interaction.

Key Points: benefits both organisms - wasp pollinates fig - fig provides food for wasp larvae - one-to-one relationship - co-evolution

Question 27.

Correctly depict (also indicate the trophic level) and describe the ecological pyramid of number with 32 birds dependent on 20 insects feeding on one banyan tree.

[2 Marks]

Answer: In the ecological pyramid of numbers, the first trophic level consists of one banyan tree, the producer. This level supports 20 insects that feed on the tree (second trophic level). At the third trophic level, 32 birds depend on these insects. This structure resembles a pyramid, broad at the base with the tree, narrowing as it rises to the apex with the birds. The pyramid clearly illustrates the decrease in numbers at higher trophic levels.

Key Points: Producers (1 banyan tree) - 1st level; Primary consumers (20 insects) - 2nd level; Secondary consumers (32 birds) - 3rd level; Pyramid shape: broad base to narrow top; Decrease in numbers at higher trophic levels.

Section D

Question 28.

Explain the neuroendocrine mechanism involved in the process of parturition in a human female leading to the expulsion of the baby out of the uterus through the birth canal.

[3 Marks]

Answer: Parturition, the process of childbirth, is regulated by a complex neuroendocrine mechanism initiated by signals from the fully developed fetus and the placenta. This leads to the activation of the fetal ejection reflex which triggers the release of oxytocin from the maternal pituitary gland. Oxytocin enhances uterine contractions, inducing further release of this hormone, creating a positive feedback loop. Resulting strong, rhythmic contractions lead to the expulsion of the baby through the birth canal, followed by the placenta. Additionally, hormones such as cortisol and estrogens play crucial roles in preparing the uterus for these contractions and facilitating childbirth.

Key Points: parturition process and definition - neuroendocrine mechanism initiation - fetal ejection reflex - oxytocin release and effects - positive feedback loop of contractions - role of cortisol and estrogens - expulsion of the baby and placenta

Question 29.

During a medical investigation, an infant was found to possess an extra copy of chromosome no. 21. Identify the disorder the child is suffering from. Describe the symptoms the child is likely to develop later in life.

[3 Marks]

Answer: The disorder that the infant is suffering from is known as Down’s Syndrome, or trisomy 21, characterized by the presence of an extra copy of chromosome number 21. This genetic condition results in various physical and cognitive symptoms that can significantly affect the individual’s development. Common physical features include a short stature, a small round head, and a flat facial profile. Additionally, children with Down's syndrome often have a furrowed tongue and a partially open mouth. As they grow older, they may experience challenges such as delayed speech and language development, lower cognitive abilities, and an increased risk of heart defects and other health issues, including vision and hearing problems. Early intervention and supportive therapies can help manage these symptoms and improve quality of life.

Key Points: Down's Syndrome; trisomy 21; extra chromosome; short stature; small round head; furrowed tongue; cognitive challenges; delayed speech; health risks; early intervention.

Question 30.

(a) Write the full form of BOD.

(b) Define BOD. Explain how it is a measure of the organic matter present in the water body.

[3 Marks]

Answer: The full form of BOD is Biochemical Oxygen Demand. BOD is defined as the amount of oxygen required by microorganisms to decompose organic matter in water at a specified temperature over a fixed period, typically five days. It serves as an important measure of organic pollution in water bodies. Higher BOD values indicate a greater amount of organic matter present, which suggests more oxygen is consumed by microbes for decomposition. As waste water treatment progresses, microorganisms break down organic pollutants, consequently reducing the BOD—indicating an improvement in water quality.

Key Points: Full form of BOD is Biochemical Oxygen Demand - BOD measures the oxygen required for microbial decomposition of organic matter - High BOD values indicate high levels of organic pollution - Reduced BOD signifies effective sewage treatment and improved water quality.

Question 31.

Enlist three advantages of genetically modified plants.

[3 Marks]

Answer: Genetically modified (GM) plants offer several advantages that enhance agricultural productivity and sustainability. Firstly, they increase crop yields by providing resistance to various environmental stresses such as drought, heat, and salinity, thus ensuring that crops thrive under adverse conditions. Secondly, GM plants reduce reliance on chemical pesticides by being engineered for pest resistance, which not only lowers production costs but also minimizes the environmental impact of agriculture. Lastly, these plants demonstrate improved nutritional value, as evidenced by developments like golden rice, which is enriched with Vitamin A, helping address nutritional deficiencies in populations that rely heavily on rice as a staple food.

Key Points: Increased crop yields; Reduced reliance on chemical pesticides; Improved nutritional value

Question 32.

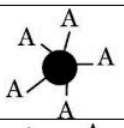
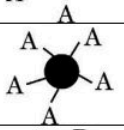
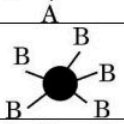
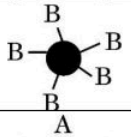
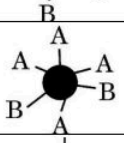
Study the diagram above and answer the following questions:

(a) How many alleles are involved in blood grouping?

(b) A person having ‘AB’ blood group has both dominant alleles. What is this inheritance type called?

(c) A man with ‘A’ blood group marries a woman with ‘B’ blood group. Can they have a child with ‘O’ blood group? Explain with the help of a cross.

[3 Marks]

Genotype	RBC	Phenotype
I^AI^A		A
I^Ai		A
I^BI^B		B
I^Bi		B
I^AI^B		AB
ii		O

Answer: In humans, three alleles determine blood grouping: A, B, and O. The inheritance type for the AB blood group, which showcases both A and B alleles, is called co-dominance. To illustrate the possible blood types of the offspring in a cross between a man with A blood group (genotype I^A I^O) and a woman with B blood group (genotype I^B I^O), we create a Punnett square. The outcomes from this cross include potential blood groups A (I^A I^O), B (I^B I^O), AB (I^A I^B), and O (I^O I^O), indicating they can indeed have a child with O blood group.

Key Points: Three alleles (A, B, O); Co-dominance in AB blood group; Punnett square examples showing genotypes.

Question 33.

Explain how the loss of habitat and fragmentation drives plants and animals to extinction with the help of an example of habitat loss in the Tropical Rain Forest. Also write the effect of fragmentation of a habitat on the population decline.

[3 Marks]

Answer: The loss of habitat and fragmentation significantly contribute to the extinction of both plants and animals. In tropical rain forests, a prime example is the Amazon, which once spanned over 14% of Earth's land but now covers only about 6%. Human activities like agriculture and cattle ranching lead to widespread habitat destruction. Fragmentation results in smaller, isolated patches of habitat that can severely impact species needing large territories, such as certain mammals and migrating birds, leading to declining populations. These isolated groups struggle to find mates and resources, intensifying their risk of extinction. Habitat degradation further threatens species survival, establishing a dire need for conservation efforts to protect biodiversity.

Key Points: Habitat loss and fragmentation, Amazon rainforest example, impact on large territory species, decline of populations, need for conservation

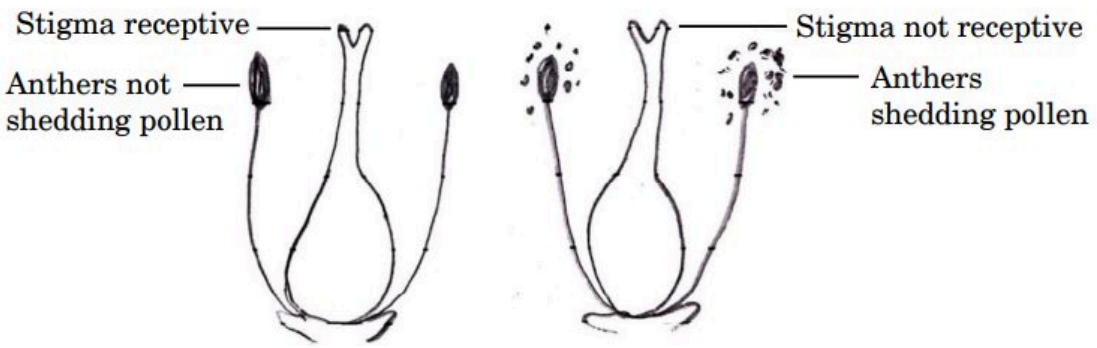
Question 34.

Many of the flowering plants producing hermaphrodite flowers have developed many devices to discourage self-pollination and to encourage cross-pollination. Given below is a picture of one such outbreeding device in a flowering plant. Study the picture and answer the questions that follow :

(a) Explain how the given type of pollination is advantageous to the plant.

(b) Can this flowering plant show geitonogamy ? Justify your answer.

[3 Marks]



Flowers present on different plants of same species

Answer: Cross-pollination provides several advantages to flowering plants. It enhances genetic diversity, which increases the resilience of plant populations against diseases and environmental changes. By promoting hybrid vigor, cross-pollination allows for offspring that are better adapted to survive and reproduce. Moreover, varied genetic combinations can lead to improved traits such as higher yield and better nutritional profiles. Regarding geitonogamy, while it is a form of cross-pollination with pollen from the same plant, it is not advantageous as it does not increase genetic diversity. Therefore, although possible, geitonogamy does not provide the same benefits as true cross-pollination from different plants.

Key Points: Genetic diversity increases resilience; offspring better adapted; promotes hybrid vigor; geitonogamy brings no new genetic material; geitonogamy still allows for cross-pollination.

Section E

Question 35. Define transgenic animals. Explain in detail any four areas where they can be used for human benefit.

[5 Marks]

Answer: Transgenic animals are those genetically modified organisms that contain a gene or genes from another species, typically achieved through gene transfer technologies. These modifications allow scientists to create animals with desirable traits, enabling both research and practical applications in various fields. One area of benefit is the study of normal physiology and development; for example, transgenic mice can be engineered to produce human proteins like α-1-antitrypsin, which helps in treating emphysema. Another significant use is in disease modeling; transgenic animals can mimic human diseases allowing researchers to understand mechanisms of diseases like cancer, cystic fibrosis, and Alzheimer's, facilitating the development of new therapies. Transgenic animals can also produce biological products; for instance, they can be engineered to produce proteins for pharmaceuticals at lower costs. Lastly, transgenic animals are valuable in agricultural enhancements, leading to improved livestock that can resist diseases, produce more milk or meat, and require fewer resources. These advancements demonstrate the potential of transgenic technology to enhance human health, understanding of diseases, and agricultural sustainability.

Key Points: Definition of transgenic animals: animals genetically modified to contain genes from other species; Use in normal physiology studies: producing human proteins; Use in disease modeling: understanding diseases like cancer, cystic fibrosis; Production of biological products: cheaper pharmaceutical proteins; Agricultural improvements: enhancing livestock traits.

Question 36.

Describe the structure and working of a sparged stirred-tank bioreactor.

[5 Marks]

Answer: A sparged stirred-tank bioreactor is a cylindrical vessel designed to facilitate the cultivation of microorganisms or cells in a controlled environment. Its structure includes several essential components: a stirrer for mixing, a sparger for air delivery, a foam control system, and systems for temperature, pH, and nutrient control. The stirrer ensures uniform mixing and oxygen distribution, which is crucial for cell growth. To enhance oxygen transfer, sterile air or oxygen is sparged through the liquid culture via the sparger, forming bubbles that increase the surface area for gas exchange. The foam control system prevents excessive foam formation, which can impede operation. Additionally, sampling ports allow for periodic withdrawal of the culture to monitor growth and product formation. Overall, the combination of mixing and sparging in this bioreactor type promotes optimal growth conditions, thus maximizing the production yield of desired metabolites or cells.

Key Points: Cylindrical structure-Components include stirrer and sparger-Oxygen delivery through sparging-Uniform mixing for optimal growth-Foam control system-

Sampling ports for monitoring culture.

Question 37.

(i) Describe the population growth curve applicable in a population of any species in nature that has unlimited resources at its disposal.

(ii) Explain the equation of this growth curve.

(iii) Name the growth curve and depict a graphical plot for this type of population growth.

[5 Marks]

Answer: In nature, when a population has unlimited resources, it experiences exponential growth, characterized by an unrestricted increase in numbers. This growth continues until environmental limitations arise, but in theory, it accelerates indefinitely due to the endless provision of food and space. The equation representing this growth is dN/dt = rN, where N represents the population size, r is the intrinsic rate of increase, and t is time. Graphically, this growth curve is plotted as a J-shaped curve, reflecting the rapid increase in population without restrictions. The growth curve showcases how populations can potentially flourish under ideal conditions, illustrating the concept of exponential growth. However, it is important to note that in nature, such ideal conditions are rarely sustained long-term due to various limiting factors that ultimately affect population dynamics.

Key Points: Exponential growth description-Equation: dN/dt = rN-J-shaped curve depiction-Importance of ideal conditions rarely sustained in nature

Question 38.

(i) Explain the conclusion drawn by Alexander von Humboldt during his extensive explorations in the wilderness of South American jungles.

(ii) Give the equation of the Species-Area relationship.

(iii) Draw a graphical representation of the relation between species richness and area for a wide variety of taxa such as birds, bats, etc.

[5 Marks]

Answer: Alexander von Humboldt's explorations in South America led him to conclude that species richness, or the number of species in a given area, increases with the size of the explored area, though only up to a certain point. This observation is encapsulated in the Species-Area relationship. It is described mathematically by the equation: log S = log C + Z log A, where S represents species richness, A is the area, C is the y-intercept, and Z is the slope of the line. A graphical representation of this relationship shows a growth pattern where species richness rises as area increases, suggesting that larger areas tend to support more diverse ecosystems. This relationship is crucial for understanding biodiversity, as well as for conservation efforts by highlighting areas of high species

richness. The graph typically takes the form of a rectangular hyperbola, illustrating how richness plateaus at larger areas. Thus, Humboldt's findings laid the foundational principles of ecology and the importance of habitat size in determining diversity.

Key Points: Humboldt's conclusion on species richness and area;Species-Area relationship equation: log S = log C + Z log A;Graphical representation of species richness increases with area, reaching a plateau.

Question 39.

(i) Explain the structure of a typical monocotyledonous embryo of a flowering plant.

(ii) How are multiple embryos formed in a citrus fruit ? What is the mechanism known as ?

[5 Marks]

Answer: A typical monocotyledonous embryo consists of a single cotyledon, an embryonal axis, and two primary components: the plumule and the radicle. The cotyledon is the leaf-like structure that absorbs nutrients and supports early growth. The embryonal axis contains the plumule, which develops into the shoot and contributes to the stem, and the radicle, which becomes the root and anchors the plant. Upon fertilization, the ovary transforms into fruit while the ovules develop into seeds. In citrus fruits, multiple embryos can form through a mechanism known as polyembryony. This occurs when the nucellar cells surrounding the embryo sac divide, protruding into the sac and forming multiple embryos. Each ovule can then house several embryos of varying sizes and shapes. This form of reproduction allows for genetic variability and is beneficial in ensuring successful seed germination in varying conditions. Apomixis, where seeds form without fertilization, can also lead to similar reproductive outcomes, becoming an important aspect in horticulture and agriculture.

Key Points: Monocot embryo structure: single cotyledon, embryonal axis, plumule, and radicle; Fertilization leads to ovary becoming fruit and ovules forming seeds; Polyembryony mechanism in citrus: nucellar cells division creating multiple embryos; Genetic nature of embryos in polyembryony; Apomixis allows seeds to form without fertilization.

Question 40.

(i) Name and explain the structural organisation of the male sex accessory ducts in the human male reproductive system.

(ii) Describe the role of gonadotropin FSH in the regulation of spermatogenesis.

[5 Marks]

Answer: The male sex accessory ducts in the human reproductive system consist of several critical structures: the rete testis, vasa efferentia, epididymis, and vas deferens. The rete testis is a network of

tubules that carries sperm from the seminiferous tubules to the vasa efferentia, which are a series of small tubes that transport sperm from the testis to the epididymis. The epididymis is a coiled tube where sperm mature and are stored. The vas deferens then transports mature sperm to the ejaculatory duct. These ducts facilitate the transport and maturation of sperm, contributing significantly to male fertility.\n\nGonadotropin FSH (Follicle-Stimulating Hormone) plays a vital role in spermatogenesis, which is the process of sperm formation. FSH acts primarily on Sertoli cells located within the seminiferous tubules. Upon stimulation by FSH, Sertoli cells secrete several factors that support the development and maturation of spermatogenic cells. These factors include androgen-binding protein and various growth factors that enhance the process of spermiogenesis. Thus, FSH is crucial for the adequate development of sperm and the overall regulation of the male reproductive system.

Key Points: Male sex accessory ducts include the rete testis, vasa efferentia, epididymis, vas deferens; these structures function to transport and mature sperm. FSH acts on Sertoli cells in the seminiferous tubules; it stimulates the secretion of factors essential for spermatogenesis and spermiogenesis.