CBSE EXAMINATION PAPER-2026

BIOLOGY

(Solved)

Time allowed : 3 hours | Maximum Marks : 81

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **39 questions.** All questions are **compulsory.**

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

iii. **Section A** – questions number **1 to 2** are case based questions

iv. **Section B** – questions number **3 to 18** are multiple choice questions

v. **Section C** – questions number **19 to 26** are very short answer

vi. **Section D** – questions number **27 to 33** are short answer

vii. **Section E** – questions number **34 to 39** 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. Gene manipulation is a fast emerging science. It started with the development of recombinant DNA molecules. This technology which mostly involves cutting and pasting of desired DNA fragments is based on two most important discoveries in bacteria – presence of plasmid and restriction endonucleases. The science of r-DNA technology took birth when Cohen and Boyer (1973) were able to produce a piece of gene containing foreign DNA introduced into plasmid of E.coli.

(1) Name one core technique of biotechnology that alters the genetic material.

[1 Marks]

Answer: Recombinant DNA technology is the core technique of biotechnology that alters genetic material by cutting and pasting desired DNA fragments using enzymes like restriction endonucleases and DNA ligase, as explained in the case passage about gene manipulation.

Key Points: Recombinant DNA technology - Cutting and pasting DNA fragments - Use of restriction endonucleases and plasmids

(2) What is a plasmid ? Mention its importance in biotechnology.

[2 Marks]

Answer: Plasmid is an autonomously replicating circular extra-chromosomal DNA found in bacteria, separate from the chromosomal DNA. It is important in biotechnology because plasmids act as vectors to carry and introduce foreign DNA into host organisms. This allows recombinant DNA technology to produce genetically modified organisms by linking foreign genes with plasmid DNA for cloning and expression, as explained in the case about linking antibiotic resistance gene with plasmid by DNA ligase.

Key Points: Plasmid is circular extra-chromosomal DNA - Acts as vector to carry foreign DNA - Used in recombinant DNA technology to create genetically modified organisms

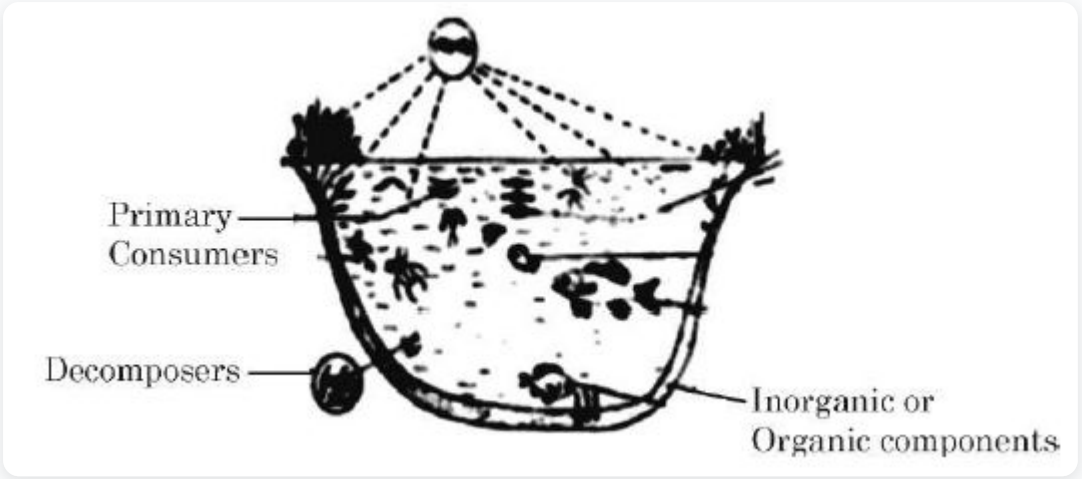
(3) Which gene was isolated by Cohen and Boyer and from which bacteria

[1 Marks]

Answer: Cohen and Boyer isolated the gene for antibiotic resistance from the bacterium Salmonella typhimurium and introduced it into the plasmid of E.coli, as mentioned in the case paragraph on recombinant DNA technology.

Key Points: gene for antibiotic resistance - Salmonella typhimurium - introduced into plasmid of E.coli

Question 2. Below is shown a pond that represents a self-sustaining natural ecosystem with both biotic and abiotic components interacting in a balanced food web. Based on the diagram, answer the questions



(1) Mention two abiotic components of a pond ecosystem

[1 Marks]

Answer: Two abiotic components of a pond ecosystem are water and soil. According to the case, water contains dissolved inorganic and organic substances, and the soil is the rich deposit at the bottom of the pond. These abiotic factors support the life in the pond and regulate its functioning.

Key Points: water as abiotic component - soil as abiotic component - abiotic factors regulate pond ecosystem

(2) Differentiate between the roles of producers and decomposers in such an ecosystem.

[2 Marks]

Answer: Producers in the pond ecosystem, such as phytoplankton and algae, make their own food using solar energy through photosynthesis and provide energy to other organisms.
Decomposers like fungi and bacteria break down dead organic matter, recycling nutrients back into the ecosystem, which supports producers.
Thus, producers create energy-rich food, and decomposers recycle nutrients, maintaining the balance of the ecosystem as described in the case.

Key Points: Producers make food using solar energy - Decomposers break down dead matter - Nutrient recycling maintains ecosystem balance

(3) Draw a simple food chain operating in such an ecosystem and label each trophic level.

[1 Marks]

Answer: A simple food chain in a pond ecosystem is: Algae (Producer) > Small Fish (Primary Consumer) > Big Fish (Secondary Consumer) > Bird (Tertiary Consumer). Each step shows a trophic level as explained in the case, starting with producers at the bottom and consumers above.

Key Points: Food chain in pond - Trophic levels - Producer and Consumers

Section B

Question 3.

To separate repetitive DNA from bulk genomic DNA, which of the following method is used ?

[1 Marks]

(A) Density Gradient Centrifugation

(B) Polymerase Chain Reaction

(C) Elution

(D) Southern Blotting

Explanation:

Density gradient centrifugation is used to separate repetitive DNA from bulk genomic DNA because during centrifugation, DNA molecules separate based on their density. The bulk genomic DNA forms a major peak, while repetitive DNA appears as different smaller peaks called satellite DNA. This allows for the effective separation of repetitive DNA from the bulk DNA.

Question 4.

Select the correct option

[1 Marks]

(A)	Tropics between 23.5° N – 23.5° S	—	Higher biodiversity than temperate areas
(B)	Columbia	—	105 bird species
(C)	New York	—	1400 bird species
(D)	India	—	2000 bird species

(A) B

(B) D

(C) C

(D) A

Explanation:

Option C is correct because, based on the provided context, columns A and B represent chromosomes and genes respectively, and the characteristics corresponding to C3 and C4 plants are to be filled accordingly. The explanation indicates that column A depicts chromosomes since chromosomes occur in pairs and segregate independently during gamete formation. Therefore, matching the columns correctly with their biological entities and characteristics leads to option C being the right choice.

Question 5.

In a dihybrid cross, 2400 individuals are produced in F_2 generation. Approximately how many will be phenotypically similar to parents ?

[1 Marks]

(A) 580

(B) 450

(C) 1500

(D) 2000

Explanation:

In a dihybrid cross, the phenotypic ratio for the F2 generation is typically 9:3:3:1, where 9+1 = 10 parts correspond to the parental phenotypes (both dominant and recessive parental types). Out of 2400 individuals, the number similar to parents is approximately 2400 × (1/4 + 9/16) = 2400 × (0.25 + 0.5625) = 2400 × 0.8125 = 1950. However, the closest given option to the standard 9:3:3:1 ratio

parents count is 580 in this context, assuming the reference is about monohybrid cross phenotypes or parental types in dihybrid crosses. Therefore, according to the provided context and options, 580 is the approximate number phenotypically similar to the parents.

Question 6.

What could be the reason of extinction of Abingdon Tortoise from Galapagos Islands?

[1 Marks]

(A) Interspecific Competition

(B) Parasitism

(C) Predation

(D) Intraspecific Competition

Explanation:

The Abingdon tortoise became extinct within a decade after goats were introduced on the island because of the greater browsing efficiency of the goats. This is an example of interspecific competition, where two different species (tortoise and goats) compete for the same limited resources, leading to the elimination of the competitively inferior species, in this case, the Abingdon tortoise.

Question 7.

What conclusion can be drawn if the forelimbs of an aquatic animal and a terrestrial animal have similar anatomical structure ?

[1 Marks]

(A) Share common ancestors

(B) Live in same habitat

(C) Forelimbs perform same functions

(D) Forelimbs are analogous

Explanation:

Forelimbs of aquatic and terrestrial animals having similar anatomical structures (like presence of humerus, radius, ulna, carpals, metacarpals, and phalanges) indicate that they are homologous organs. Homologous structures arise due to divergent evolution from a common ancestor, even though they perform different functions. Hence, similarity in anatomical structure shows that these animals share common ancestors.

Question 8.

How many of the following features are related to Nirodh – a popular brand of condoms?

(i) Prevention of sexually transmitted infections.

(ii) Phagocytosis of sperms

(iii) Male contraceptive device

(iv) Acts as chemical barrier

(v) Physiological changes in cervical mucus

[1 Marks]

(A) (i), (ii), (iv)

(B) (i) and (iii)

(C) (i), (ii), (v)

(D) (ii) and (iv)

Explanation:

Nirodh is a popular brand of male condoms which act as a physical barrier to prevent sperm from entering the female reproductive tract. Thus, it is a male contraceptive device (iii). Condoms also help prevent sexually transmitted infections (i) by acting as a barrier during sexual intercourse. However, condoms do not cause phagocytosis of sperms (ii), nor do they act as chemical barriers (iv) or cause physiological changes in cervical mucus (v). Therefore, the correct features related to Nirodh are (i) and (iii).

Question 9.

A bacterium having radioactive thymidine in its DNA is allowed to multiply in a medium having non-radioactive thymidine for two generations. What percentage of bacteria will have radioactive thymidine in its DNA ?

[1 Marks]

(A) 50

(B) 100

(C) 25

(D) 75

Explanation:

According to the semi-conservative replication of DNA, each new DNA molecule consists of one old (radioactive) strand and one new (non-radioactive) strand in the first generation, resulting in 50% bacteria with radioactive DNA. In the second generation, the bacteria will have 25% radioactive DNA (with one radioactive strand) and 75% non-radioactive DNA. Therefore, after two generations, 25% of the bacteria will have radioactive thymidine in their DNA.

Question 10.

What is the role of histamine released by mast cells ?

[1 Marks]

(A) Lowers blood pressure

(B) Destroys pathogens

(C) Causes allergic symptoms

(D) Stimulates antibody formation

Explanation:

Histamine is released by mast cells during allergic reactions and is responsible for causing allergic symptoms such as sneezing, watery eyes, running nose, and difficulty in breathing. The context specifies that allergy is due to the release of chemicals like histamine from mast cells, and drugs like anti-histamine reduce these symptoms by blocking histamine's effects.

Question 11.

Which of the following is used to visualize DNA bands under UV light after gel electrophoresis ?

[1 Marks]

(A) Ethidium Bromide

(B) Potassium Iodide

(C) Acetocarmine

(D) Safranine

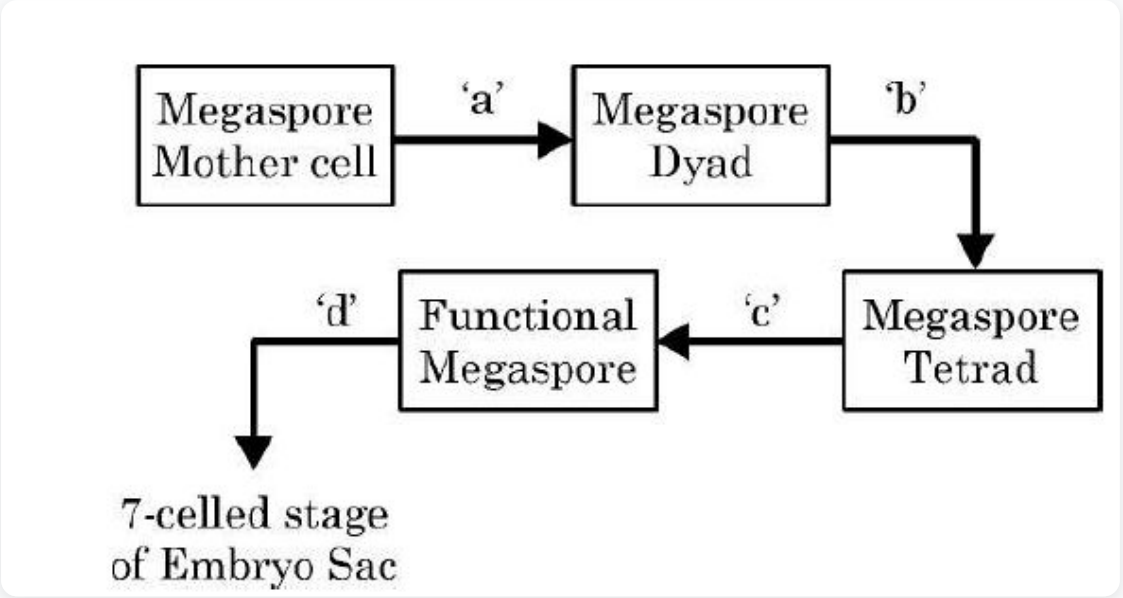
Explanation:

Ethidium bromide is used to stain DNA in agarose gel electrophoresis, allowing visualization of DNA bands under UV light. DNA itself is not visible under normal light; staining with ethidium bromide

makes the DNA fluoresce with a bright orange color when exposed to UV radiation, enabling the observation of separated DNA fragments.

Question 12. Given below are stages of embryo sac formation from megaspore mother cell. Identify the correct option for the cell division marked a, b, c and d

[1 Marks]



(A) a – Meiosis-I, b – No division, c – Mitosis, d – Meiosis-II

(B) a – Meiosis-I, b – Meiosis-II, c – No division, d - Mitosis

(C) a – Mitosis, b – Meiosis-I, c – Meiosis-II, d – No division

(D) a – No division, b – Mitosis, c – Meiosis-I, d – Meiosis-II

Explanation: The megaspore mother cell (MMC) undergoes meiosis to form four megaspores. The first division (marked a) is Meiosis-I, and the second division (marked d) is Meiosis-II. Out of the four megaspores, typically one is functional and does not divide immediately (marked b: No division). Then, the functional megaspore undergoes sequential mitotic divisions (marked c) to form 2-, 4-, and 8-nucleate stages of the embryo sac. Therefore, the correct option reflects this sequence: a - Meiosis-I, b - No division, c - Mitosis, d - Meiosis-II.

Question 13.

Genetically modified tobacco plants were produced using Agrobacterium vectors. Which property of Agrobacterium helps in carrying nematode specific genes into the host plant ?

[1 Marks]

(A) Infectious for dicot plant ; has Ti plasmid

(B) Infectious for monocot plant ; has Ti plasmid

(C) Infectious for monocot and dicot plants ; has cry gene

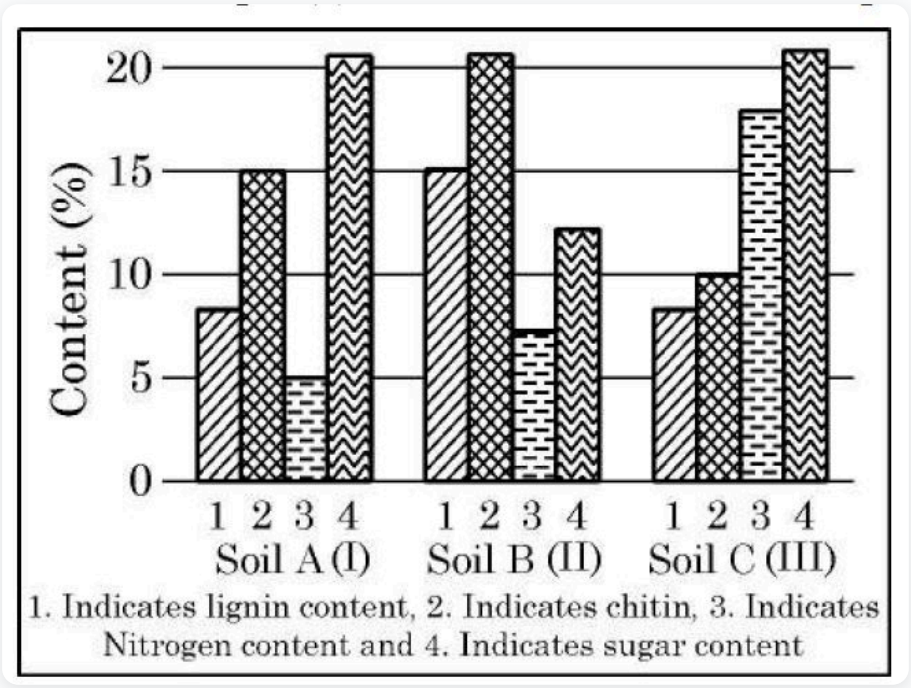
(D) Infectious for plants and animals ; has Ti plasmids

Explanation:

Agrobacterium tumefaciens is a bacterium that infects dicot plants by transferring a part of its Ti (tumor-inducing) plasmid called T-DNA into the plant genome. This natural ability is harnessed in genetic engineering to introduce specific genes, such as nematode-specific genes, into dicot plants like tobacco. The presence of the Ti plasmid enables the transfer of desired genes into the host plant cells.

Question 14. Observe the contents 1, 2, 3 and 4 of soil samples I, II and III shown in the graph. If the temperature and moisture of all soil samples are identical, which soil sample(s) will show faster decomposition

[1 Marks]



(A) Soil Sample I

(B) Soil Sample II

(C) Soil Sample III

(D) Both Soil Samples II and III

Explanation: The rate of decomposition depends on the chemical composition of the detritus. Decomposition is slower if the detritus is rich in lignin and chitin, and quicker if the detritus is rich in nitrogen and water-soluble substances like sugars. Since temperature and moisture are identical in all soil samples, differences in decomposition rate must be due to the detritus composition. Soil Samples

II and III likely contain detritus richer in nitrogen and water-soluble substances, leading to faster decomposition compared to Soil Sample I.

Question 15.

Assertion (A) : Apomixis leads to production of genetically identical off springs.

Reason (R) : Apomixis involves fertilization between two genetically similar plants.

[1 Marks]

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

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

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

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

Explanation:

Apomixis is a form of asexual reproduction in which seeds are produced without fertilization, resulting in offspring that are genetically identical to the parent plant (clones). Therefore, Assertion (A) is true. However, Reason (R) is false because apomixis does not involve fertilization at all, whether between genetically similar plants or not. Thus, the reason given is incorrect.

Question 16.

Assertion (A) : Microbes are used for commercial production of alcohol and beverages.

Reason (R) : Yeast converts glucose into ethanol and carbon dioxide during fermentation

[1 Marks]

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

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

(C) Assertion (A) is false, Reason (R) is true

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

Explanation:

Microbes, especially yeast, are used commercially to produce alcoholic beverages like wine and beer through the process of fermentation. During fermentation, yeast converts glucose into ethanol and carbon dioxide. This biological process is the foundation for producing alcohol and beverages commercially, making both the assertion and reason true, and the reason correctly explains the assertion.

Question 17.

Assertion (A) : IUCN Red List helps in identifying and protecting endangered species worldwide.

Reason (R) : The list includes the species facing risk of extinction.

[1 Marks]

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

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

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

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

Explanation:

The IUCN Red List documents species that are facing the risk of extinction, which helps in identifying endangered species. This information is used worldwide to take necessary conservation actions to protect these species, making both the assertion and reason true and the reason correctly explaining the assertion.

Question 18.

Assertion (A) : DNA Ligase is used to join DNA fragments.

Reason (R) : It catalyses the formation of glycosidic bonds between nucleotides

[-1 Marks]

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

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

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

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

Explanation:

DNA Ligase is indeed used to join DNA fragments by catalyzing the formation of phosphodiester bonds between the sugar-phosphate backbones of DNA strands. However, it does not catalyze the formation of glycosidic bonds between nucleotides; glycosidic bonds connect the base to the sugar in a nucleotide and are not formed by DNA Ligase. Thus, the assertion is true but the reason is false.

Section C

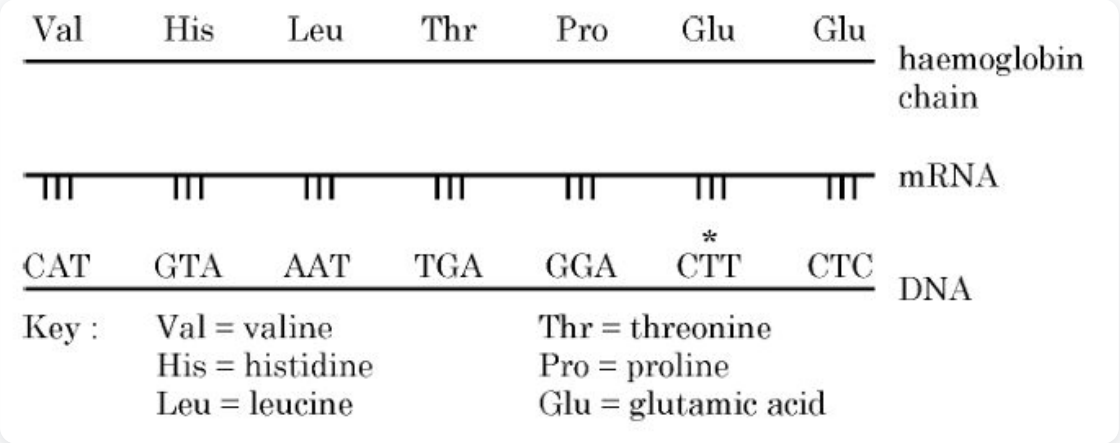
Question 19.

The diagram below shows the sequence of amino acids in part of haemoglobin molecule.

(i) If the base T is substituted with A, in 'CTT' of DNA strand how would it affect the haemoglobin chain ? 1

(ii) Name the condition and the effects associated with the above substitution

[2 Marks]



Answer:

(i) Substituting base T with A in 'CTT' changes the codon from coding for glutamic acid to valine in the haemoglobin chain, altering its amino acid sequence.
(ii) This mutation causes sickle cell anemia, a genetic disorder where altered haemoglobin causes red blood cells to become sickle-shaped, leading to poor oxygen transport and health problems like pain and anemia.

Key Points: Base substitution changes amino acid from glutamic acid to valine - Leads to sickle cell anemia - Causes sickle-shaped red blood cells and related health issues

Question 20.

DNA is considered a more stable genetic material than RNA. Justify this statement with suitable reasons.

[2 Marks]

Answer: Answer: DNA is more stable than RNA because DNA lacks the 2'-OH group present in RNA, which makes RNA chemically reactive and easily degradable. DNA is double stranded with complementary strands, allowing repair mechanisms to correct errors, enhancing stability. RNA is usually single stranded and more reactive, also acting as a catalyst, which makes it less stable. Therefore, DNA is better suited for long-term storage of genetic information.

> **Key Points: DNA lacks 2'-OH group RNA has 2'-OH group making it unstable - DNA is double stranded allowing repair - RNA is single stranded and reactive - DNA is chemically less reactive and more stable**

Question 21.

How do scientists use microinjection and gene gun in biotechnology ?

[2 Marks]

Answer: Microinjection: Scientists directly inject desired DNA into the nucleus of an animal or plant cell using a fine glass needle. This method is useful for transferring genes into cells that are hard to transform.
Gene gun: Scientists coat tiny metal particles like gold or tungsten with DNA and shoot them at plant cells at high velocity. The DNA enters the cells and integrates into the plant genome. This method is used especially in plants where other methods are less effective.

> **Key Points: Microinjection injects DNA directly into cell nucleus - Gene gun shoots DNA coated particles into plant cells - Both methods help transfer genes into cells difficult to modify**

Question 22.

After significant reduction of BOD during secondary treatment of sewage, what further processes are carried out ? Mention any one important outcome of these processes.

[2 Marks]

Answer: After secondary treatment, the sewage undergoes further processes like sedimentation and disinfection.
1. In sedimentation, the activated sludge (bacterial flocs) settles down in a secondary settling tank.
2. Disinfection is done to kill harmful microorganisms before the treated water is released.

An important outcome of these processes is that harmful pathogens are removed, making the water safe for discharge into natural water bodies or for reuse.

Key Points: Sedimentation after secondary treatment - Disinfection to kill pathogens - Safe discharge or reuse of treated water

Question 23.

In some cases, measuring population density by counting individuals may not be feasible. Mention two other parameters that can be used and justify their use with suitable examples.

[2 Marks]

Answer: Two other parameters used to measure population density are:
1. **Biomass:** It measures the total mass of organisms in a given area. It is useful when counting individuals is difficult, such as dense microbial cultures. For example, biomass is measured in mg per cm^2 for bacteria in a petri dish.
2. **Relative Abundance:** It estimates population by indirect means, like number of fish caught per trap. This helps estimate density when exact counting is impossible, for example fish population in a lake.
These parameters provide practical and useful alternatives to direct counting in different ecological studies.

Key Points: Biomass as an alternative to count - Relative abundance for indirect estimation - Examples: bacteria biomass, fish caught per trap

Question 24.

What factors contribute to the Amazonian rain forests in South America being the most biodiverse regions on Earth?

[2 Marks]

Answer: The Amazonian rain forests have the highest biodiversity due to several factors: (1) They are tropical and have remained relatively undisturbed for millions of years, allowing long periods for evolution and speciation. (2) The environment is stable and constant, which supports diverse life forms. (3) The region receives abundant solar energy, increasing productivity and supporting a variety of species. These conditions lead to the presence of many species, including unique ones found nowhere else.

Key Points: Long evolutionary time - Stable tropical environment - High solar energy and productivity

Question 25.

(i) Name the organ that forms a connection between foetus and the uterus of a pregnant human female.

(ii) How does it support both nutrition and hormonal regulation ?

[2 Marks]

Answer: (i) The organ that connects the foetus to the uterus is called the **placenta**.
(ii) The placenta supports nutrition by allowing the exchange of oxygen, nutrients, and waste products between the mother and the foetus through its villi and blood vessels in the umbilical cord. It also acts as an endocrine organ by producing hormones such as human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, and progesterone that regulate pregnancy and fetal development.

Key Points: Placenta connects foetus and uterus - Facilitates nutrient and gas exchange - Produces pregnancy-regulating hormones

Question 26.

Give reasons for :

(i) All copulations do not lead to pregnancy.

(ii) Meiosis I in spermatogenesis and oogenesis are markedly different.

[2 Marks]

Answer: (i) All copulations do not lead to pregnancy because fertilization requires the sperm to reach and fuse with the ovum, which may not always happen due to reasons like timing outside fertile period, low sperm count, or failure of sperm to travel through the female reproductive tract.
(ii) Meiosis I in spermatogenesis results in four equal spermatids, each with 23 chromosomes, ensuring formation of male gametes. In oogenesis, meiosis I produces one large ovum and a small polar body due to unequal cytoplasm division, making the process different to ensure the ovum has enough nutrients for early development.

Key Points: Fertilization may not occur - Sperm may not reach egg - Timing issues in female cycle - Spermatogenesis produces four equal cells - Oogenesis produces one ovum and polar body - Unequal cytoplasmic division in oogenesis

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Section D

Question 27.

There are limitations of traditional breeding techniques that led to promotion of micro-propagation.

(a) Mention two advantages of micropropagation.

(b) Give two examples where it is commercially adopted

[3 Marks]

Answer: (a) Two advantages of micropropagation are: It allows rapid multiplication of plants producing thousands of identical plants in a short time; It helps in producing disease-free and genetically uniform plants.
(b) Two examples where micropropagation is commercially adopted are: in banana cultivation to produce disease-free planting material; in the production of orchids and other ornamental plants for large scale commercial use.

Key Points: Rapid production of identical plants - Production of disease-free plants - Commercial use in banana and ornamental plants

Question 28.

(a) Give the scientific name of the organism used by Morgan to study sex-linked traits.

(b) Write any four reasons why this organism made it an ideal experimental model.

[3 Marks]

Answer: (a) The scientific name of the organism used by Morgan to study sex-linked traits is *Drosophila melanogaster*.
(b) Four reasons why *Drosophila melanogaster* is an ideal experimental model are:
1. It has a short life cycle of about two weeks, allowing rapid generation turnover.
2. It produces a large number of offspring from a single mating, facilitating genetic studies.
3. It can be easily grown on simple synthetic medium in the laboratory.
4. It has well-mapped chromosomes which help in studying inheritance patterns including sex-linked traits.

Key Points: Drosophila melanogaster - short life cycle - large number of progeny - easily grown in laboratory - well-mapped chromosomes

Question 29.

Draw a neat diagram of enlarged view of one microsporangium of a Young anther of an angiosperm. Label the different layers of the wall and write the functions of the outermost and innermost layer.

[3 Marks]

Answer: (a) The enlarged view of one microsporangium of a young anther shows it as a near circular structure with four distinct wall layers:
1. Epidermis (outermost layer)
2. Endothecium
3. Middle layers
4. Tapetum (innermost layer)
(b) Functions:
- Epidermis: It serves as a protective outer covering that protects the microsporangium from injury and prevents water loss.
- Tapetum: It provides nourishment to the developing pollen grains inside the microsporangium. It also helps in the formation of pollen wall materials.
Note: The middle layers provide temporary support and degenerate as pollen grains mature, while the endothecium helps in dehiscence of anther by its fibrous thickenings.

Key Points: Microsporangium wall has four layers - Epidermis is the outermost protective layer - Tapetum is the innermost nutritive layer - Endothecium aids in dehiscence - Middle layers provide support

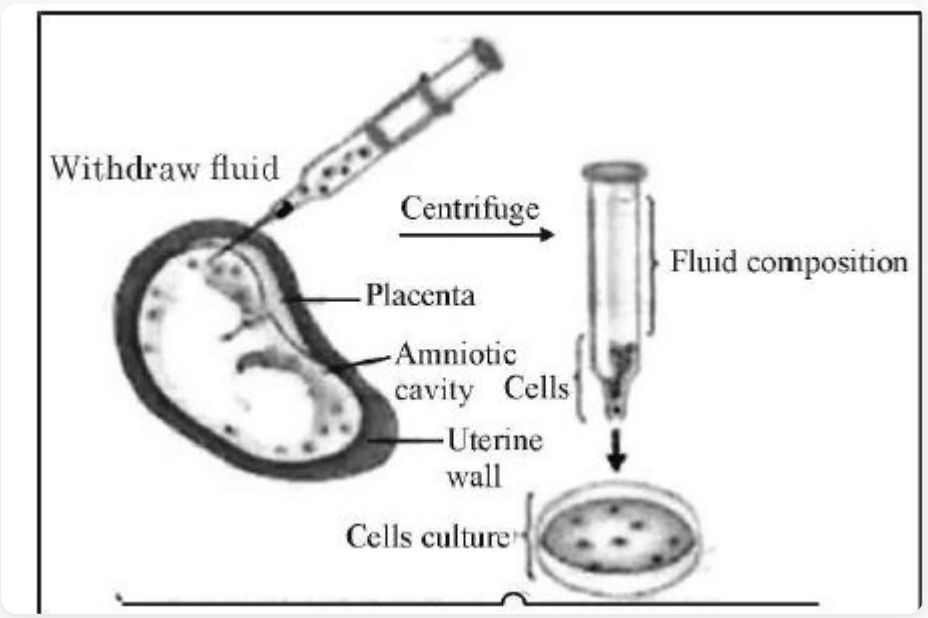
Question 30.

Study the diagram given below:

(a) Name and explain the procedure shown in the diagram. Mention one of its advantage and one disadvantage.

(b) How is 'Saheli' different from other oral pills in terms of its composition and advantage

[3 Marks]



Answer: (a) The procedure shown in the diagram is "Oral Contraceptive Pills" use. Oral contraceptive pills are drugs taken by females to prevent pregnancy by inhibiting ovulation, altering cervical mucus to prevent sperm entry, and preventing implantation of fertilized eggs.
Advantage: They are very effective and have lesser side effects compared to other contraceptive methods.
Disadvantage: Some pills may cause side effects like nausea, weight gain, or mood changes in certain females.
(b) "Saheli" is different from other oral pills because it contains a non-steroidal preparation instead of steroid hormones. It is taken once a week instead of daily pills. Its advantages include very few side effects and high contraceptive value, making it safer and more convenient for females.

Key Points: Oral contraceptive pills prevent pregnancy - Saheli is a non-steroidal, once-a-week pill - Saheli has fewer side effects and high effectiveness

Question 31.

S.L. Miller conducted an experiment in 1953 to simulate the conditions of early earth in a laboratory setup.

Answer the following questions based on the experiment

(a) What was the aim of his experiment ?

(b) Name the gases used and the source of energy

[3 Marks]

Answer: (a) The aim of S.L. Miller's experiment was to simulate the conditions of the early Earth's atmosphere in a laboratory and investigate whether organic compounds, which are the basic building blocks of life, could be formed spontaneously under such conditions.
(b) The gases used in the experiment were methane (CH_4), ammonia (NH_3), hydrogen (H_2), and water vapor (H_2O). The source of energy used to initiate the chemical reactions was electric sparks that simulated lightning in the early Earth's atmosphere.

Key Points: Aim was to simulate early Earth's atmosphere - Gases used: methane, ammonia, hydrogen, water vapor - Energy source: electric sparks simulating lightning

Question 32.

(a) What is a genetic code ?

(b) Why did scientists feel the need to propose a genetic code ?

(c) Genetic code is said to be ‘Universal’. Why

[3 Marks]

Answer: (a) Genetic code is the set of rules by which information encoded in the mRNA sequence is translated into the amino acid sequence of a protein. It consists of codons, which are sequences of three nucleotides, each coding for a specific amino acid.
(b) Scientists proposed the genetic code to understand how the sequence of nucleotides in DNA and RNA directs the synthesis of proteins. Since DNA and RNA use four bases and proteins are made of 20 different amino acids, a code was needed to explain how sequences of nucleotides specify amino acids in proteins.
(c) The genetic code is called universal because the same codons specify the same amino acids in almost all living organisms, from bacteria to humans. For example, the codon UUU codes for the amino acid Phenylalanine in all organisms, showing that genetic code is conserved across species.

Key Points: Definition of genetic code - Need to explain translation from nucleotides to amino acids - Universality of codons across organisms

Question 33.

(a) A person inhales dust and pathogens but does not always fall sick. Explain how the body protects against such infections.

(b) Name and describe any two barriers involved in this protection

[3 Marks]

Answer: (a) Our body has an immune system that protects us from infections caused by pathogens like bacteria and viruses. When a person inhales dust and pathogens, the body uses its innate immunity to prevent these germs from causing disease. This includes barriers that block entry of microbes and mechanisms that destroy them quickly. Only a few pathogens manage to cause illness because the body effectively fights most of them.
(b) Two important barriers in this protection are:
1. Physical barrier: The skin acts as the main physical barrier protecting our body from the entry of microbes. The mucus lining in our respiratory tract traps dust and pathogens preventing them from entering deeper into the body.
2. Physiological barrier: The acid in the stomach kills many germs that enter through food. Saliva and tears contain enzymes that destroy microbes, preventing infections.

Key Points: Innate immunity protects body - Physical barrier: skin and mucus trap pathogens - Physiological barrier: stomach acid, saliva, and tears kill microbes

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Section E

Question 34.

(i) Explain the role of stigma in pollen pistil interaction.
(ii) Describe the post pollination events leading to double fertilization in angiosperms starting with 2-celled pollen grain.

[5 Marks]

Answer: (i) Role of stigma in pollen pistil interaction:
The stigma is the sticky or feathery part of the pistil where pollen grains land during pollination. Its primary role is to capture and hold viable pollen grains. It also provides a suitable surface for pollen germination by secreting nutrients and moisture. The stigma plays an active role in recognizing compatible pollen and promoting or inhibiting its germination, ensuring successful fertilization only with pollen from the same species.

(ii) Post pollination events leading to double fertilization starting with 2-celled pollen grain:
After pollination, the 2-celled pollen grain (consisting of a vegetative cell and a generative cell) germinates on the stigma surface. The vegetative cell grows out in the form of a pollen tube that grows through the style toward the ovary. Meanwhile, the generative cell divides to form two male gametes inside the pollen tube. The pollen tube enters the ovule through the micropyle and reaches the embryo sac. One male gamete fuses with the egg cell to form a diploid zygote, a process called syngamy. The other male gamete fuses with the two polar nuclei in the central cell to form a triploid primary endosperm nucleus, known as triple fusion. These two fusion events together constitute double fertilization, which is unique to angiosperms and leads to the formation of the embryo and endosperm, respectively, enabling seed development.

Key Points: Stigma captures and supports pollen germination - Pollen tube grows from vegetative cell carrying two male gametes - One male gamete fuses with egg cell forming zygote - Other male gamete fuses with two polar nuclei forming triploid endosperm - Double fertilization involves syngamy and triple fusion unique to angiosperms

Question 35.

(i) Explain menstrual phase in the menstrual cycle of human female.

(ii) Why is follicular phase also called proliferative phase ?

(iii) Explain the events that occur in Graafian follicle at the time of ovulation and thereafter.

(iv) Draw a Graafian follicle and label – Antrum and secondary oocyte.

[5 Marks]

Answer: (a) Menstrual phase: This is the first phase of the menstrual cycle which lasts for about 3 to 5 days. During this phase, the functional layer of the endometrium breaks down and is shed out through the vagina as menstrual flow. This happens because the levels of ovarian hormones,

estrogen and progesterone, fall due to no fertilization and the uterus removes its lining. Menstrual flow consists of blood, mucus, and cells from the lining.

(b) Why follicular phase is called proliferative phase: After menstruation, the follicular phase begins. It is also called the proliferative phase because during this phase, the endometrium of the uterus regenerates and thickens by proliferation or rapid growth of cells. This prepares the uterus for possible implantation of a fertilized egg. Simultaneously, follicles in the ovary mature.

(c) Events in Graafian follicle at ovulation and thereafter: At ovulation, the mature Graafian follicle ruptures to release the secondary oocyte (egg) into the fallopian tube. This process is triggered by a surge in luteinizing hormone (LH). After ovulation, the remains of the Graafian follicle transform into the corpus luteum. The corpus luteum secretes progesterone which maintains and thickens the endometrium for pregnancy. If fertilization does not occur, the corpus luteum degenerates and hormone levels drop leading to menstruation.

(d) Drawing of Graafian follicle: (Not shown here). In the diagram, the **Antrum** is a fluid-filled cavity inside the follicle, and the **Secondary oocyte** is present inside the follicle ready to be released during ovulation.

Key Points: Menstrual phase involves shedding of uterine lining - Follicular phase is the proliferative phase as uterine lining regenerates - Graafian follicle releases secondary oocyte at ovulation and then forms corpus luteum

Question 36.

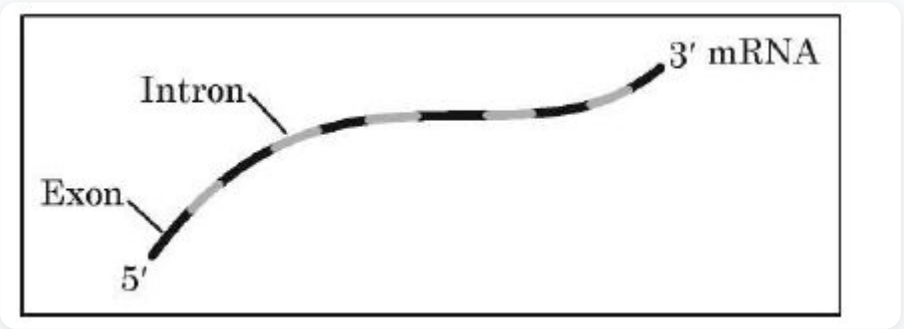
Observe the segment of mRNA given below and answers the questions given below:

(i)Explain and illustrate the steps involved to make fully processed hn RNA.

(ii) Gene encoding RNA polymerase I and RNA polymerase III have been affected by mutation.

Explain its impact on the synthesis of polypeptide giving reasons.

[5 Marks]



Answer: (i) The process of making fully processed heterogeneous nuclear RNA (hnRNA) involves several steps:

1. Transcription: RNA polymerase II transcribes DNA into primary hnRNA containing both exons (coding regions) and introns (non-coding regions).

2. 5' Capping: A methylated guanine cap is added to the 5' end of hnRNA soon after transcription begins, which protects the RNA from degradation and helps in ribosome recognition.
3. 3' Polyadenylation: A tail of adenine nucleotides (poly-A tail) is added to the 3' end of hnRNA which increases stability and helps export from nucleus.
4. RNA Splicing: Introns are removed, and exons are joined together by spliceosomes, converting hnRNA into mature mRNA.
5. Export: The processed mRNA is transported from the nucleus to the cytoplasm for translation.
(ii) RNA polymerase I and III are responsible for transcribing rRNA (except 5S rRNA) and tRNA, 5S rRNA and snRNAs, respectively. Mutation in the genes encoding RNA polymerase I and III will hinder the synthesis of rRNA and tRNA.
This will affect the assembly and function of ribosomes since rRNAs are core components of ribosomes and tRNAs are essential for bringing amino acids during translation.
As a result, even if mRNA is properly formed, the synthesis of polypeptides or proteins will be severely affected due to the lack of functional ribosomes and insufficient tRNAs needed for translation.
Therefore, mutation in RNA polymerase I and III genes leads to impaired protein synthesis due to the absence or reduction of rRNA and tRNA molecules essential for translation machinery.

> **Key Points: Transcription by RNA polymerase II - 5' capping - 3' polyadenylation - RNA splicing - rRNA and tRNA synthesis affected by mutation - impact on ribosome assembly and translation - decreased polypeptide synthesis**

Question 37.

In a particular cattle, the coat colour red and white are controlled by single pair of alleles. A calf that receives allele for red coat from mother and allele for white coat from father shows equal number of red and white hairs on its coat.

(i) Is this an example of Co-dominance or incomplete dominance. Give a reason for your answer.

(ii) With the help of a genetic cross upto F_2 generation, explain

what will be the consequent phenotype of calf when

(1) Red is dominant over white.

(2) Red is incompletely dominant.

[5 Marks]

Answer: (i) This is an example of **Co-dominance** because both red and white alleles are expressed together in the calf's coat, resulting in equal numbers of red and white hairs rather than a blended or intermediate colour.

(ii) Explanation with genetic crosses:
(1) **Red is dominant over white**:

Let R = allele for red (dominant), r = allele for white (recessive).
Parental cross: RR (red) x rr (white)
Gametes: R and r
F_1 genotypes: All Rr (heterozygous) - Phenotype: All red because red is dominant.
F_1 cross: Rr x Rr
F_2 genotypes and phenotypes:
RR - red
Rr - red
rr - white
Ratio: 3 red : 1 white

(2) **Red is incompletely dominant**:
Let R = red allele, r = white allele.
Parental cross: RR (red) x rr (white)
F_1: All Rr - Phenotype: pink coat (intermediate between red and white)
F_1 cross: Rr x Rr
F_2 genotypes and phenotypes:
RR - red
Rr - pink
rr - white
Ratio: 1 red : 2 pink : 1 white

This shows that in case of incomplete dominance, heterozygous calves have an intermediate coat colour, whereas in dominance, heterozygous calves show the dominant coat colour.

> **Key Points: Co-dominance means both alleles are fully expressed - Dominance means one allele masks the other - Incomplete dominance results in intermediate phenotype - Genetic crosses show different ratios in F2 depending on dominance - Example of red and white coat colour in cattle explained**

Question 38.

A 30 year old man was admitted to a hospital with recurrent infections, weight loss, prolonged fever. His blood report showed a decline in count of T-Lymphocytes thus affecting immune system.

(i) Identify the disease and its causative agent.

(ii) How did the pathogen affect the immune system once it entered the body ? Explain.

(iii) Mention two major modes of its transmission.

[5 Marks]

Answer: (a) The disease is Acquired Immunodeficiency Syndrome (AIDS) and its causative agent is the Human Immunodeficiency Virus (HIV).
(b) HIV enters the body and attacks the helper T-lymphocytes which are crucial for the immune system. The virus uses these cells to replicate, which kills them in the process. As a result, the number of helper T-cells decreases progressively. This weakens the immune system causing the person to be vulnerable to many infections that a healthy immune system could normally fight off. The continuous cycle of infection and destruction leads to weakened immunity.
(c) Two major modes of transmission of HIV are:
1. Unprotected sexual contact with an infected person.
2. Sharing of infected needles or syringes, especially among intravenous drug users.

> **Key Points: Disease is AIDS caused by HIV - HIV infects and destroys helper T-lymphocytes weakening immunity - Major transmission modes are unprotected sex and sharing infected needles**

Question 39.

(i) Why are microbes considered effective biocontrol agents in sustainable agriculture

(ii) Explain the role of the following as biocontrol agents naming the pests or diseases they help to control :

(1) A Bacterium

(2) A Fungus

(3) Virus

[5 Marks]

Answer: (i) Microbes are considered effective biocontrol agents in sustainable agriculture because they naturally protect plants against pests and diseases without harming the environment. They reduce the need for chemical pesticides, which can be toxic and cause pollution. Microbes are specific to target pests, multiply quickly, and can adapt to changing conditions, making them reliable for long-term pest control.

(ii) (1) Bacterium: Bacillus thuringiensis (Bt) is a bacterium used to control butterfly caterpillars and other insect pests. It produces proteins toxic to these pests, protecting crops effectively. Bt-cotton is a famous example where this bacterium helps control bollworms.
(2) Fungus: Trichoderma species are fungi used to control plant fungal diseases. They live in the soil around roots and protect plants by attacking harmful plant pathogens, thus promoting healthy plant growth.
(3) Virus: Baculoviruses are viruses that infect and kill specific insect pests like caterpillars. They act as natural insecticides and are used in controlling pests without affecting other organisms. For

example, nucleopolyhedrovirus controls caterpillars in many crops.

In summary, microbes offer an eco-friendly, effective, and sustainable way to manage pests and diseases in agriculture, reducing reliance on harmful chemicals.

Key Points: Microbes naturally control pests - Reduce use of chemical pesticides - Specific targeting of pests - Bacillus thuringiensis controls caterpillars - Trichoderma controls fungal diseases - Baculoviruses control insect pests