UP Board Biology - 348 (KK) - 2025 Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**70	**Total questions :**35

General Instructions

Instruction:

i) *All* questions are compulsory. Marks allotted to each question are given in the margin.

ii) In numerical questions, give all the steps of calculation.

iii) Give relevant answers to the questions.

iv) Give chemical equations, wherever necessary.

Q1(a). The endosperm of angiospermic plant is

(A) Haploid

(B) Diploid

(C) Triploid

(D) Tetraploid

Correct Answer: ((C) Triploid

Solution:

Step 1: Recall the concept.

The endosperm is a tissue formed by the fusion of a sperm cell and two polar nuclei of the female gametophyte. It provides nutrition to the developing embryo within the seed.

Step 2: Concept of endosperm in angiosperms.

In angiospermic plants, the endosperm is typically triploid (3n), formed after fertilization when one sperm cell fuses with two haploid polar nuclei.

Step 3: Conclusion.

Thus, the correct answer is ((C) Triploid.

Final Answer:

$$\boxed{\text{Triploid}}$$

Quick Tip

Endosperm is triploid in most angiosperms, ensuring adequate nourishment for seed development.

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Q1(b). In Mendel's monohybrid cross, the phenotypic ratio of long and dwarf pea is

(A) 3 : 1

(B) 1 : 3

(C) 1 : 2 : 1

(D) 1 : 1 : 2

Correct Answer: ((A) 3 : 1

Solution:

Step 1: Recall Mendel's monohybrid cross.

In a monohybrid cross between two heterozygous pea plants (Tt × Tt), where T represents the dominant allele for long and t represents the recessive allele for dwarf, Mendel observed the inheritance of these traits.

Step 2: Determine the genotypic and phenotypic ratios.

The genotypic ratio for this cross is 1 TT : 2 Tt : 1 tt. Since both TT and Tt plants express the long phenotype (dominant), and tt expresses the dwarf phenotype (recessive), the phenotypic ratio is 3 long : 1 dwarf.

Step 3: Conclusion.

Thus, the phenotypic ratio is 3 : 1.

Final Answer:

$$\boxed{3 : 1}$$

Quick Tip

The phenotypic ratio of long to dwarf in a monohybrid cross is always 3 : 1.

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Q1(c). The name of pathogen of typhoid is

(A) Ascaris

(B) Salmonella

(C) Plasmodium

(D) Amoeba

Correct Answer: ((B) Salmonella

Solution:

Step 1: Recall the pathogen of typhoid.

Typhoid fever is caused by the bacterium Salmonella enterica, which infects the intestines and can lead to severe illness.

Step 2: Conclusion.

Thus, the pathogen responsible for typhoid is Salmonella.

Final Answer:

$$\boxed{\text{Salmonella}}$$

Quick Tip

Salmonella bacteria cause typhoid fever and spread through contaminated food and water.

—

Q1(d). Which one of the following characters does not belong to xerophytic plant?

(A) Thick cuticle on leaf surface

(B) Stomata are arranged in deep groove

(C) Stem starts to perform the function of leaves

(D) Stomata are found equal in number on both surfaces of leaves

Correct Answer: ((D) Stomata are found equal in number on both surfaces of leaves

Solution:

Step 1: Define xerophytic adaptations.

Xerophytic plants are adapted to dry conditions. They have features like thick cuticles, stomata located in deep grooves or pits to reduce water loss, and some even have stems that perform photosynthesis in place of leaves.

Step 2: Analyze the options.

- Option ((A): A thick cuticle helps in reducing water loss, typical of xerophytes. - Option ((B): Stomata in deep grooves prevent direct exposure to air, limiting water loss, which is characteristic of xerophytes. - Option ((C): Xerophytes have modified stems (like succulents)

that perform photosynthesis when leaves are reduced or absent. - Option ((D): Stomata are usually fewer on the upper surface of xerophytic leaves to reduce water loss, so having equal stomata on both sides is not typical.

Step 3: Conclusion.

The correct answer is ((D), as it is not a characteristic of xerophytic plants.

Final Answer:

Stomata are found equal in number on both surfaces of leaves

Quick Tip

Xerophytic plants have fewer stomata on the upper surface to reduce water loss in arid environments.

Q2(a). Write two causes of biodiversity loss.

Solution:

Step 1: Identify causes of biodiversity loss.

Biodiversity loss refers to the decrease in the variety of life forms on Earth. The primary causes are:

((A) Habitat Destruction.

Deforestation, urbanization, and industrial activities lead to the loss of habitats for various species.

((B) Climate Change.

The changing climate, due to human activities such as burning fossil fuels, affects ecosystems and species' survival, leading to biodiversity loss.

Final Answer:

Habitat Destruction, Climate Change

Quick Tip

Preserving habitats and mitigating climate change are key strategies for reducing biodiversity loss.

—

Q2(b). Write the number of chromosomes in trisomic and monosomic conditions in humans.

Solution:

Step 1: Understand trisomy and monosomy.

Trisomy and monosomy refer to the conditions where an individual has an abnormal number of chromosomes, either having an extra chromosome (trisomy) or one less chromosome (monosomy).

Step 2: Normal human chromosome count.

Humans typically have 46 chromosomes, arranged in 23 pairs (22 pairs of autosomes and 1 pair of sex chromosomes).

Step 3: Number of chromosomes in trisomic and monosomic conditions.

- Trisomic condition: An individual has one extra chromosome. Therefore, the number of chromosomes is 47. - Monosomic condition: An individual is missing one chromosome. Therefore, the number of chromosomes is 45.

Final Answer:

$$\boxed{47 \text{ (Trisomic)}, 45 \text{ (Monosomic)}}$$

Quick Tip

Trisomy and monosomy result from errors in cell division (non-disjunction).

—

Q2(c). Write the name of the bacteria that converts milk into curd.

Solution:

Step 1: Bacterial action in curd formation.

The process of converting milk into curd is a fermentation process, where specific bacteria convert lactose (milk sugar) into lactic acid.

Step 2: Identify the bacteria.

The primary bacterium responsible for this process is *Lactobacillus* species, which includes *Lactobacillus bulgaricus*.

Final Answer:

Lactobacillus

Quick Tip

Lactobacillus bacteria are used in dairy fermentation to produce curd.

—

Q2(d). Who is the father of Green Revolution in India?

Solution:

Step 1: Understand the Green Revolution.

The Green Revolution refers to the series of agricultural advancements that led to increased food production in India through the use of high-yielding varieties of seeds, synthetic fertilizers, pesticides, and advanced irrigation techniques.

Step 2: Identify the key figure.

Dr. M.S. Swaminathan is widely regarded as the father of the Green Revolution in India, due to his work in developing high-yielding varieties of crops and promoting their adoption across India.

Final Answer:

Dr. M.S. Swaminathan

Quick Tip

Dr. M.S. Swaminathan's efforts helped India achieve self-sufficiency in food production.

—

Q2(e). What type of nucleus is found in bacterial cell?

Solution:

Step 1: Understand bacterial cell structure.

Bacterial cells are prokaryotic, meaning they lack a true nucleus. Instead of a defined nucleus, bacterial cells have a region called the nucleoid, where the genetic material (DNA) is located.

Step 2: Nucleoid in bacterial cells.

The nucleoid is not surrounded by a membrane, unlike the eukaryotic nucleus, and it contains a single, circular DNA molecule.

Final Answer:

$$\boxed{\text{Nucleoid}}$$

Quick Tip

Bacteria have a nucleoid instead of a membrane-bound nucleus, characteristic of prokaryotes.

Q3(a). Name two nitrogen-fixing microorganisms.

Solution:

Step 1: Understand nitrogen fixation.

Nitrogen fixation is the process of converting nitrogen gas (N_2) from the atmosphere into a form (ammonia, NH_3) that plants can use for growth. This process is carried out by certain microorganisms.

Step 2: Nitrogen-fixing microorganisms.

Two nitrogen-fixing microorganisms are: - *Rhizobium*: These bacteria form a symbiotic relationship with leguminous plants and fix nitrogen in the roots of these plants. - *Azotobacter*: A free-living bacterium that fixes nitrogen in soil independently.

Final Answer:

$$\boxed{\text{Rhizobium, Azotobacter}}$$

Quick Tip

Nitrogen-fixing bacteria are vital for the ecosystem as they enrich the soil with nitrogen, reducing the need for chemical fertilizers.

—

Q3(b). Name the enzymes ((A) which cut the DNA at specific site and ((B) which join two DNA fragments.

Solution:

Step 1: Enzymes that cut DNA.

((A) The enzymes that cut DNA at specific sites are called *Restriction enzymes* or *Restriction endonucleases*. They recognize specific sequences in the DNA and cut between particular nucleotide bases. Examples include *EcoRI*, *HindIII*, etc.

Step 2: Enzymes that join DNA fragments.

((B) The enzyme that joins two DNA fragments is called *DNA Ligase*. It forms phosphodiester bonds between the sugar-phosphate backbones of the DNA fragments, thereby joining them.

Final Answer:

$$\boxed{\text{((A) Restriction enzymes, ((B) DNA ligase}}$$

Quick Tip

Restriction enzymes are crucial in recombinant DNA technology, while DNA ligase is essential for repairing DNA and joining fragments in cloning processes.

—

Q3(c). What is a parthenocarpic fruit? Give one example.

Solution:

Step 1: Define parthenocarpic fruit.

Parthenocarpic fruits are those that develop without fertilization, meaning they do not contain seeds. These fruits can form without the need for pollination or fertilization, leading to seedless fruits.

Step 2: Example of parthenocarpic fruit.

An example of a parthenocarpic fruit is *Banana*. Bananas are typically seedless, as they develop without fertilization.

Final Answer:

$$\boxed{\text{Banana}}$$

Quick Tip

Parthenocarpic fruits are often preferred in the market due to their seedless nature, making them more convenient to consume.

—

Q3(d). What is transcription?

Solution:

Step 1: Define transcription.

Transcription is the process by which the genetic information in a DNA molecule is copied into a complementary RNA molecule. This is the first step in gene expression, which leads to protein synthesis.

Step 2: Process of transcription.

During transcription, RNA polymerase binds to the promoter region of a gene, unwinds the DNA, and synthesizes a messenger RNA (mRNA) molecule that is complementary to the DNA template strand.

Final Answer:

$$\boxed{\text{Transcription is the process of copying DNA into RNA.}}$$

Quick Tip

Transcription is essential for converting genetic information in DNA into functional proteins.

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Q3(e). Write the name of any one sexually transmitted disease and describe its condition in brief.

Solution:

Step 1: Name a sexually transmitted disease.

One sexually transmitted disease is *Gonorrhea*.

Step 2: Describe its condition.

Gonorrhea is caused by the bacterium *Neisseria gonorrhoeae*. It primarily infects the genital tract but can also affect the rectum, throat, and eyes. Symptoms include painful urination, abnormal discharge, and in women, pelvic pain. If untreated, gonorrhea can lead to infertility, pelvic inflammatory disease (PID), and increase the risk of HIV.

Final Answer:

$$\boxed{\text{Gonorrhea}}$$

Quick Tip

Early treatment with antibiotics can cure gonorrhea, but drug resistance is becoming a growing concern.

Q4(a). Write short notes on Lichen and Mycorrhiza.

Solution:

Step 1: Understand Lichen.

Lichen is a symbiotic association between a fungus and an alga (or cyanobacterium). The fungus provides a protective structure, while the alga or cyanobacterium performs photosynthesis, supplying food to the fungus. Lichens are sensitive to air pollution and are often used as bioindicators of environmental health.

Step 2: Understand Mycorrhiza.

Mycorrhiza is a symbiotic association between fungi and the roots of plants. The fungus helps in absorbing water and minerals, especially phosphorus, while the plant provides carbohydrates to the fungus. This mutualistic relationship enhances the plant's growth and is found in most plant species.

Final Answer:

Lichen: Symbiotic association between fungus and alga, Mycorrhiza: Symbiotic association between fu

Quick Tip

Both lichen and mycorrhiza play crucial roles in nutrient cycling and ecosystem stability.

—

Q4(b). What do you mean by bee-keeping? Explain in brief.

Solution:

Step 1: Definition of bee-keeping.

Bee-keeping, or apiculture, is the practice of maintaining and caring for bee colonies, primarily for the production of honey, beeswax, and other bee products. Beekeepers place hives in suitable locations, care for the bees, and harvest the products once they are produced.

Step 2: Importance of bee-keeping.

Bee-keeping is important for the production of honey and beeswax, which are used in various products. Additionally, bees play a vital role in pollination, which is crucial for agricultural productivity.

Final Answer:

Bee-keeping is the practice of maintaining bee colonies for honey, beeswax, and pollination.

Quick Tip

Bee-keeping contributes to both food production and biodiversity through pollination.

—

Q4(c). What is a seed? Describe the structure of any one seed.

Solution:

Step 1: Definition of seed.

A seed is the reproductive unit of a plant, typically consisting of an embryo, a supply of nutrients, and a protective coat. It develops from the fertilized ovule and is capable of growing into a new plant under favorable conditions.

Step 2: Structure of a seed.

Consider a *bean seed* as an example: - *Seed coat*: The outer protective layer of the seed. - *Embryo*: Contains the plant's genetic material, consisting of the radicle (develops into the root) and the plumule (develops into the shoot). - *Cotyledons*: These are the seed leaves that store food for the developing plant. - *Endosperm*: Provides additional nourishment to the growing embryo (present in some seeds).

Final Answer:

A seed is a plant reproductive unit. Bean seed structure: Seed coat, Embryo, Cotyledons, Endosperm.

Quick Tip

Seeds are essential for plant reproduction and provide nourishment to the embryo during its early growth.

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Q4(d). Describe the principle of immunization in brief. Also add a note on passive immunization.

Solution:

Step 1: Principle of Immunization.

Immunization is the process by which a person is made immune or resistant to an infectious disease, typically by the administration of a vaccine. Vaccines stimulate the body's immune system to recognize and fight pathogens, either by introducing weakened or inactivated pathogens or their components, thus preparing the immune system to respond effectively upon future exposure.

Step 2: Passive Immunization.

Passive immunization involves the transfer of active immunity in the form of antibodies from another individual (e.g., mother to child via breast milk) or from an external source (e.g., anti-serum or immunoglobulin). Unlike active immunization, passive immunization provides immediate protection but does not induce long-lasting immunity.

Final Answer:

Immunization involves stimulating the immune system to fight pathogens, Passive immunization transfe

Quick Tip

Passive immunization is useful for immediate protection but does not lead to long-term immunity like active immunization.

Q5(a). What is endosperm? Describe the process of development and its function.

Solution:

Step 1: Definition of Endosperm.

Endosperm is a tissue that forms during the fertilization process in angiosperms (flowering plants). It is formed by the fusion of one sperm cell with the two polar nuclei, resulting in a

triploid (3n) structure. The primary function of endosperm is to provide nourishment to the developing embryo within the seed.

Step 2: Process of Development.

During double fertilization, one sperm cell fuses with the egg cell to form the diploid zygote (embryo), while the other sperm fuses with the two polar nuclei to form the triploid endosperm. This triploid cell undergoes mitotic divisions to form the endosperm, which provides nutrients like starch, proteins, and lipids to the developing seed.

Step 3: Function of Endosperm.

The endosperm acts as a source of stored food for the developing embryo, which is crucial during the early stages of seedling growth before the seed can photosynthesize. In some plants, like corn, the endosperm remains a significant part of the mature seed, providing energy for germination.

Final Answer:

Endosperm is a triploid tissue formed during double fertilization, providing nourishment to the develop

Quick Tip

Endosperm serves as a nutrient reserve that supports seedling growth until the plant can produce its own food via photosynthesis.

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Q5(b). Hydrophytes are adapted to their environment. Explain with the help of examples and diagrams.

Solution:

Step 1: Understand Hydrophytes.

Hydrophytes are plants that grow in aquatic environments, either in water or on waterlogged soil. These plants have special adaptations that help them survive in these environments, including adaptations for oxygen and nutrient uptake, as well as structural modifications to deal with buoyancy and water stress.

Step 2: Adaptations of Hydrophytes.

1. *Floating plants* (e.g., *Water lilies*): These plants have broad, flat leaves that allow them to float on the water's surface, maximizing exposure to sunlight for photosynthesis. They also have air-filled cavities in their tissues (aerenchyma), helping with buoyancy.
2. *Submerged plants* (e.g., *Water weeds*): These plants have thin, feathery leaves that allow them to absorb nutrients directly from the water. Their roots are often reduced or absent, as they do not need to anchor in soil but instead obtain nutrients and oxygen directly from the water.
3. *Emergent plants* (e.g., *Cattails*): These plants have long stems that keep their leaves above the water's surface, allowing them to access atmospheric carbon dioxide for photosynthesis while remaining submerged in water.

Step 3: Diagrams.

clude a diagram of floating and submerged hydrophytes for better understanding.

Final Answer:

Hydrophytes exhibit various adaptations like buoyant leaves, reduced roots, and aerenchyma for life in

Quick Tip

Hydrophytes are key to aquatic ecosystems, providing oxygen, shelter, and food for aquatic organisms.

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Q5(c). Comment upon human insulin.

Solution:

Step 1: What is Human Insulin?

Human insulin is a peptide hormone produced by the pancreas, specifically by the beta cells of the islets of Langerhans. It plays a vital role in regulating blood glucose levels by facilitating the uptake of glucose into cells, thereby lowering blood sugar levels.

Step 2: Function of Insulin.

Insulin allows cells, particularly muscle and fat cells, to take in glucose from the bloodstream and convert it into energy. It also promotes the storage of glucose in the liver as glycogen for later use. In the absence or insufficient production of insulin, as in diabetes, blood glucose levels rise, leading to hyperglycemia.

Step 3: Human Insulin and Biotechnology.

Human insulin can be produced using recombinant DNA technology. Genetically engineered bacteria (e.g., *E. coli*) are modified to produce human insulin, which is then purified and used for medical treatments of diabetes. This method has greatly improved the availability and consistency of insulin for diabetic patients.

Final Answer:

Human insulin is a peptide hormone that regulates blood glucose levels and can be produced using reco

Quick Tip

Recombinant insulin has revolutionized diabetes treatment, ensuring a reliable and safe supply.

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Q5(d). What is restriction endonuclease? Give any two examples.

Solution:

Step 1: Definition of Restriction Endonuclease.

Restriction endonucleases, also known as restriction enzymes, are enzymes that cut DNA molecules at specific nucleotide sequences. They act as molecular scissors and are naturally found in bacteria, where they protect against viral DNA by cutting it into smaller pieces.

Step 2: Function of Restriction Enzymes.

These enzymes recognize specific sequences of nucleotides (restriction sites) in DNA and cut the DNA at or near these sites. Restriction enzymes are critical tools in molecular biology, particularly in cloning, DNA mapping, and recombinant DNA technology.

Step 3: Examples of Restriction Enzymes.

1. *EcoRI*: It recognizes the sequence GAATTC and cuts between G and A. 2. *HindIII*: It recognizes the sequence AAGCTT and cuts between the two A's.

Final Answer:

Restriction endonucleases are enzymes that cut DNA at specific sequences. Examples: EcoRI, HindIII.

Quick Tip

Restriction enzymes are essential for cutting and manipulating DNA, allowing researchers to study genes and produce recombinant organisms.

Q6(a). Describe Mendel's Law of Dominance.

Solution:

Step 1: Definition of Law of Dominance.

Mendel's Law of Dominance states that when two contrasting alleles (dominant and recessive) are present in an individual, only the dominant allele is expressed in the phenotype. The recessive allele is masked in the presence of the dominant allele.

Step 2: Mendel's experiments.

Mendel performed experiments on pea plants, crossing plants with different traits (e.g., tall vs. dwarf). He observed that when a homozygous dominant plant was crossed with a homozygous recessive plant, all F1 offspring showed the dominant trait, demonstrating the dominance of one allele over the other.

Step 3: Conclusion.

Thus, Mendel concluded that one allele could mask the expression of the other, and that dominant alleles are expressed in the phenotype, while recessive alleles are only expressed when both alleles are recessive.

Final Answer:

Mendel's Law of Dominance states that the dominant allele masks the expression of the recessive allele

Quick Tip

The Law of Dominance was one of Mendel's foundational contributions to the understanding of inheritance patterns.

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Q6(b). Write short notes on any two of the following: ((A) Central dogma of molecular biology

((B) Parasitism

((C) Apomixis

Solution:

Step 1: Central Dogma of Molecular Biology.

The central dogma of molecular biology describes the flow of genetic information in cells. It states that DNA is transcribed into RNA, which is then translated into protein. This process is essential for cellular function and gene expression. - *DNA $\rightarrow$ RNA $\rightarrow$ Protein* Example: In the process of gene expression, the DNA sequence is transcribed into messenger RNA (mRNA), which then directs protein synthesis in the ribosome.

Step 2: Parasitism.

Parasitism is a type of symbiotic relationship where one organism, the parasite, benefits at the expense of the host. The parasite depends on the host for food, shelter, or reproduction, often harming the host in the process. - Example: *Plasmodium* (malaria parasite) infects humans and is transmitted through mosquito bites, causing the disease malaria.

Step 3: Apomixis.

Apomixis is a form of asexual reproduction in plants where seeds are produced without fertilization. In this process, the offspring are genetically identical to the parent plant. - Example: *Dandelions* reproduce through apomixis, producing seeds that do not require fertilization by pollen.

Final Answer:

((A) Central dogma: DNA $\rightarrow$ RNA $\rightarrow$ Protein, ((B) Parasitism: Symbiotic relationship where the parasi

Quick Tip

Apomixis allows plants to reproduce without pollination, ensuring the preservation of desirable traits in offspring.

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Q6(c). What are fermented beverages? Describe them with examples.

Solution:

Step 1: Definition of Fermented Beverages.

Fermented beverages are drinks that are produced by the fermentation process, where microorganisms (such as bacteria, yeast, or molds) convert sugars into alcohol or acids. This process not only helps preserve the drink but also enhances its flavor, texture, and nutritional content.

Step 2: Examples of Fermented Beverages.

1. *Alcoholic beverages*: These are produced by the fermentation of sugars by yeast. - Example: *Beer*, which is made by fermenting malted barley. - Example: *Wine*, made by fermenting grapes. 2. *Non-alcoholic fermented beverages*: These drinks undergo fermentation but contain little to no alcohol. - Example: *Kefir*, a fermented milk drink with probiotics. - Example: *Kombucha*, a fermented tea beverage known for its health benefits due to its probiotic content.

Final Answer:

Fermented beverages are drinks produced through the fermentation process by microorganisms. Examp

Quick Tip

Fermented beverages offer various health benefits, including improved digestion due to their probiotic content.

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Q6(d). What are the cloning vectors? Briefly explain the characteristics of cloning vectors.

Solution:

Step 1: Definition of Cloning Vectors.

Cloning vectors are DNA molecules used to carry foreign genetic material into a host cell for replication or expression. They are essential tools in recombinant DNA technology. The vector allows the foreign gene to be inserted into the host cell and replicated, leading to the production of the desired protein or the creation of genetically modified organisms.

Step 2: Characteristics of Cloning Vectors.

1. *Origin of replication*: This sequence ensures that the vector can replicate within the host cell. 2. *Selectable marker*: This gene allows for the identification of cells that have successfully taken up the vector (e.g., antibiotic resistance). 3. *Multiple cloning site (MCS)*: This region contains several restriction enzyme sites, allowing the insertion of foreign DNA at specific locations. 4. *Size*: Cloning vectors must be of an appropriate size to carry foreign DNA but also small enough to be efficiently inserted into the host cell.

Step 3: Types of Cloning Vectors.

1. *Plasmids*: Small, circular DNA molecules that replicate independently in bacterial cells. 2. *Bacteriophages*: Viruses that infect bacteria and can be used to insert foreign genes into bacterial genomes. 3. *Cosmids*: Hybrid vectors that combine features of plasmids and bacteriophages for easier cloning of larger DNA fragments.

Final Answer:

Cloning vectors are DNA molecules used to transfer foreign genes into a host cell. Characteristics: Orig

Quick Tip

Cloning vectors are essential in genetic engineering, helping in gene cloning, protein production, and genetic modification.

Q7. What do you understand by sex-linked inheritance? Explain it with any one example.

Solution:

Step 1: Definition of Sex-Linked Inheritance.

Sex-linked inheritance refers to the pattern of inheritance for genes located on the sex chromosomes (X or Y). In humans, the X chromosome carries a larger number of genes compared to the Y chromosome. Traits controlled by genes on the X chromosome exhibit different inheritance patterns based on the sex of the offspring.

Step 2: Explanation of the Inheritance Pattern.

In males, who have only one X chromosome (XY), a recessive gene on the X chromosome will always be expressed because there is no second X chromosome to mask its effect. In females, who have two X chromosomes (XX), a recessive gene on one X chromosome may be masked by a dominant allele on the other X chromosome. This leads to a different pattern of inheritance in males and females.

Step 3: Example of Sex-Linked Inheritance.

An example of sex-linked inheritance is *hemophilia*, a genetic disorder where blood doesn't clot properly. The gene for hemophilia is located on the X chromosome. Males with the recessive allele for hemophilia on their single X chromosome will express the disease, while females need two copies of the recessive allele (one on each X chromosome) to express the disease.

Final Answer:

Sex-linked inheritance refers to traits controlled by genes on the sex chromosomes, with hemophilia bei

Quick Tip

Sex-linked traits are more commonly expressed in males due to their single X chromosome.

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OR

Q7. Write an essay on the role of microorganisms in human welfare.

Solution:

Introduction.

Microorganisms, though often associated with diseases, play a crucial role in human welfare. They are involved in various processes such as food production, agriculture, medicine, and environmental management. Their benefits extend beyond basic needs, contributing significantly to industrial and technological advancements.

Step 1: Role in Food Production.

Microorganisms are extensively used in the production of food and beverages. - *Fermentation*: Yeasts are used in brewing beer, fermenting wine, and making bread. Lactic acid bacteria are essential in the production of yogurt, cheese, and pickles. - *Probiotics*: Microorganisms like *Lactobacillus* in yogurt help in maintaining gut health by promoting the growth of beneficial bacteria.

Step 2: Role in Agriculture.

Microorganisms also play a vital role in soil fertility and agriculture. - *Nitrogen fixation*: Certain bacteria like *Rhizobium* and *Azotobacter* convert atmospheric nitrogen into a form usable by plants, enhancing soil fertility. - *Decomposers*: Microorganisms decompose organic matter, returning essential nutrients to the soil.

Step 3: Role in Medicine.

Microorganisms are central to the production of antibiotics and vaccines. - *Antibiotics*: Bacteria like *Streptomyces* are used to produce antibiotics like streptomycin, which have revolutionized the treatment of bacterial infections. - *Vaccines*: Certain microorganisms are used to develop vaccines, providing immunity against diseases like polio, tuberculosis, and hepatitis.

Step 4: Role in Biotechnology and Environment.

Microorganisms are also widely used in biotechnology for environmental and industrial purposes. - *Bioremediation*: Microorganisms help in cleaning up oil spills and breaking down harmful pollutants in the environment. - *Industrial applications*: Enzymes produced by microorganisms are used in various industries, including textiles, detergents, and paper.

Conclusion.

In conclusion, microorganisms have a profound impact on human welfare. From aiding in food production and maintaining agricultural systems to revolutionizing medicine and environmental management, their contributions are indispensable. Their beneficial

applications continue to expand with advances in biotechnology and microbial research.

Final Answer:

Microorganisms play an essential role in food production, agriculture, medicine, and environmental ma

Quick Tip

Microorganisms are invaluable for sustainable development, aiding in food security, health, and environmental sustainability.

Q8. Describe the semi-conservative method of DNA replication with suitable diagrams.

Solution:

Step 1: Definition of Semi-Conservative DNA Replication.

The semi-conservative method of DNA replication is a process by which DNA is copied, producing two identical DNA molecules. Each molecule consists of one original (parental) strand and one newly synthesized strand. This method was first proposed by Watson and Crick and later confirmed by the Meselson-Stahl experiment in 1958.

Step 2: Process of Semi-Conservative DNA Replication.

The process of semi-conservative DNA replication involves the following steps:

- *Step 2.1: Unwinding of the DNA double helix*. The enzyme *helicase* unwinds the DNA at the origin of replication, creating a replication fork. The two strands of the DNA double helix separate, forming single-stranded templates.

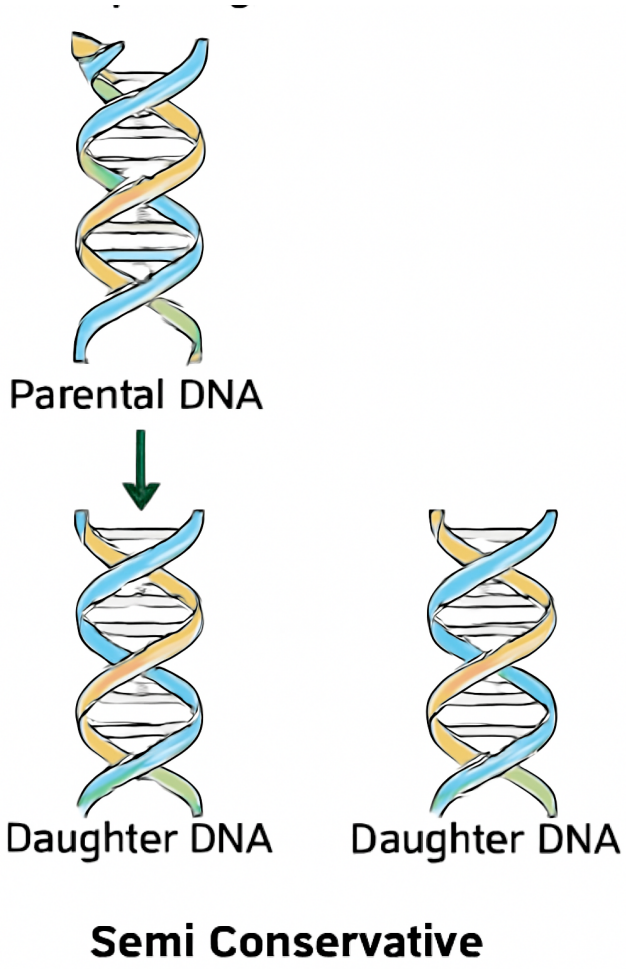
- *Step 2.2: Primer binding*. An RNA primer is synthesized by the enzyme *primase*. The primer provides a 3' hydroxyl group to which new nucleotides can be added.

- *Step 2.3: Elongation*. DNA polymerase adds complementary nucleotides (A pairs with T, C pairs with G) to the growing strand, using the original strand as a template. The leading strand is synthesized continuously, while the lagging strand is synthesized in short fragments (Okazaki fragments).

- *Step 2.4: Removal of primers and filling gaps*. The RNA primers are removed, and DNA polymerase fills in the gaps with DNA nucleotides. DNA ligase seals the sugar-phosphate backbone, completing the replication process.

Step 3: Diagram of Semi-Conservative DNA Replication.

clude diagram of DNA replication showing the parental strand and newly synthesized strands.



Final Answer:

Semi-conservative DNA replication involves each strand of the original DNA molecule serving as a tem

Quick Tip

In semi-conservative replication, each new DNA molecule consists of one parent strand and one newly synthesized strand, ensuring the accuracy of the replication process.

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OR

Q8. Write an essay on population explosion and its control.

Solution:

Introduction.

Population explosion refers to the rapid and unchecked increase in the number of people in a specific area. This phenomenon has been especially prominent in developing countries and is one of the major concerns of the modern world. The result of population explosion is an unsustainable pressure on resources, leading to environmental degradation, poverty, and poor living conditions.

Step 1: Causes of Population Explosion.

1. *High Birth Rate*: In many countries, cultural, economic, and social factors contribute to a high birth rate. Lack of awareness about family planning and access to contraception further exacerbates the problem. 2. *Decreased Mortality Rate*: Improvements in healthcare, sanitation, and nutrition have led to a decrease in mortality rates, resulting in longer life expectancy and population growth. 3. *Economic Development*: As economies develop, healthcare and living conditions improve, leading to an increase in life expectancy and a decrease in the death rate.

Step 2: Effects of Population Explosion.

1. *Pressure on Resources*: A rapidly growing population increases demand for food, water, energy, and shelter, leading to resource depletion. 2. *Environmental Degradation*: Overpopulation results in deforestation, loss of biodiversity, and increased pollution. 3. *Social Issues*: Overpopulation often leads to poverty, unemployment, and inadequate healthcare, straining social systems.

Step 3: Measures to Control Population Explosion.

1. *Family Planning*: Governments should promote family planning through education, awareness campaigns, and access to contraception. 2. *Improved Healthcare*: Providing better healthcare services to reduce infant mortality and promoting family planning methods can help control population growth. 3. *Education*: Educating women and girls about their rights, healthcare, and family planning can lead to delayed marriages and smaller families. 4. *Government Policies*: Governments can implement policies such as incentives for smaller families and penalties for larger families to encourage population control.

Conclusion.

Population explosion is a serious issue that requires immediate attention. Effective control measures, including education, awareness, and healthcare improvements, are essential to ensuring a sustainable future for humanity.

Final Answer:

Population explosion results from high birth rates and improved healthcare. Control measures include f

Quick Tip

Controlling population growth is essential for sustainable development, resource management, and environmental protection.

Q9. Explain the dihybrid cross with the help of a checkerboard.

Solution:

Step 1: Definition of Dihybrid Cross.

A dihybrid cross is a genetic cross between two individuals that differ in two traits controlled by two different genes. The purpose is to observe the inheritance of two traits simultaneously.

Step 2: Example and Genetic Setup.

For example, consider a cross between two pea plants, one with round yellow seeds (RRYY) and the other with wrinkled green seeds (rryy). In this cross, the two traits are seed shape (round or wrinkled) and seed color (yellow or green), where: - *R* = Round (dominant), *r* = Wrinkled (recessive) - *Y* = Yellow (dominant), *y* = Green (recessive)

Step 3: The F1 Generation.

The F1 generation from the cross between RRYY and rryy will all be heterozygous (RrYy), showing the dominant phenotypes (Round Yellow seeds).

Step 4: The F2 Generation (using a checkerboard).

To predict the possible genotypes and phenotypes of the F2 generation, we perform a Punnett square. The F1 generation (RrYy) is crossed with another F1 generation (RrYy).

The Punnett square for the dihybrid cross is a 16-cell grid, showing the possible combinations of alleles for the two traits:

RY	Ry	rY	ry
RY $Rryy$	$RRYy$	$RRyy$	$RrYy$
Ry $Rryy$	$RRYy$	$RRyy$	$RrYy$
rY $rryy$	$RrYy$	$Rryy$	$rrYy$
ry $rryy$	$RrYy$	$Rryy$	$rrYy$

Step 5: Phenotypic Ratios.

From the Punnett square, we can deduce the following phenotypic ratio for the F2 generation: - 9 Round Yellow - 3 Round Green - 3 Wrinkled Yellow - 1 Wrinkled Green

Final Answer:

Dihybrid cross predicts a 9:3:3:1 phenotypic ratio in the F2 generation for two traits.

Quick Tip

The dihybrid cross demonstrates the independent assortment of alleles for different traits, as proposed by Mendel's second law.

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OR

Q9. What do you mean by adaptation? Describe the various adaptations found in living organisms with suitable examples.

Solution:

Step 1: Definition of Adaptation.

Adaptation is the process by which an organism becomes better suited to its environment. This can involve structural, behavioral, or physiological changes that enhance survival and reproduction in a specific environment.

Step 2: Types of Adaptations.

There are three main types of adaptations: 1. **Structural Adaptations**: These are physical features of an organism that enhance its survival in its environment. - Example: The long neck of a giraffe is a structural adaptation that allows it to reach food high up in trees.
2. **Behavioral Adaptations**: These involve changes in the way an organism behaves to survive in its environment. - Example: Birds migrating during winter to find warmer climates and abundant food sources is a behavioral adaptation.
3. **Physiological Adaptations**: These are internal, biochemical processes that help an organism survive in its environment. - Example: Camels have the ability to conserve water and tolerate extreme heat, which is a physiological adaptation to life in the desert.

Step 3: Additional Examples of Adaptations.

1. **Cactus (Structural Adaptation)**: Cacti have thick, fleshy stems that store water and spines instead of leaves to reduce water loss in arid environments. 2. **Frog (Behavioral Adaptation)**: Frogs exhibit hibernation behavior, entering a state of dormancy during extreme cold to survive winter. 3. **Polar Bear (Physiological Adaptation)**: Polar bears have thick fur and a layer of fat under their skin to insulate them from the cold Arctic temperatures.

Step 4: Conclusion.

Adaptations are crucial for survival, allowing organisms to live and reproduce in a wide variety of environments. These adaptations ensure that organisms are well-suited to their ecological niches and can cope with environmental challenges.

Final Answer:

Adaptations are physical, behavioral, or physiological changes that enhance an organism's survival in it

Quick Tip

Adaptations help organisms cope with environmental pressures, enabling them to thrive and reproduce in specific habitats.
