UP Board Biology - 348 (KI) - 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.

1. (a) Cells of which layer of microsporanguim are binucleate?

(A) Epidermis

(B) Endothelium

(C) Middle layer

(D) Tapetum

Correct Answer: (D) Tapetum

Solution:

Step 1: Understand the structure of microsporangium.

A microsporangium is a part of the plant that contains the microspores. These structures are vital for the formation of pollen grains.

Step 2: Identify the layers.

The microsporangium has several layers, including: - **Epidermis:** The outermost layer. - **Endothelium:** A middle layer responsible for nutrient transport. - **Middle layer:** Provides structural support. - **Tapetum:** The innermost layer.

Step 3: Focus on the tapetum.

The tapetum is unique because its cells are binucleate (contain two nuclei). These cells are essential for providing nutrients and enzymes to the developing pollen.

Step 4: Conclusion.

Since binucleate cells are found in the tapetum, the correct answer is (D) Tapetum.

Final Answer: The cells of the tapetum layer in the microsporanguim are binucleate.

Quick Tip

The tapetum plays a critical role in the development of pollen by providing essential nutrients.

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1. (b) Mendel's finding related to inheritance of characters were rediscovered by:

(A) de Vries

(B) Correns

(C) von Tschermak

(D) All of the above

Correct Answer: (D) All of the above

Solution:

Step 1: Review Mendel's original findings.

Mendel's discoveries on inheritance, made in the mid-19th century, focused on the inheritance of traits through discrete units (genes). However, his work was largely ignored for several decades.

Step 2: Rediscovery.

In the early 20th century, three scientists independently rediscovered Mendel's findings: - **de Vries** recognized the importance of Mendel's work in relation to the theory of heredity. - **Correns** confirmed Mendel's findings in pea plants. - **von Tschermak** also replicated Mendel's experiments and validated his work.

Step 3: Conclusion.

All three scientists contributed to the rediscovery of Mendel's laws, making the correct answer (D) All of the above.

Final Answer: Mendel's findings related to inheritance were rediscovered by de Vries, Correns, and von Tschermak.

Quick Tip

Mendel's laws form the foundation of modern genetics and are essential for understanding inheritance patterns.

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1. (c) Ti plasmid vector is used to deliver gene of interest into which of the following hosts?

(A) Bacteria

(B) Animal

(C) Plant

(D) Virus

Correct Answer: (C) Plant

Solution:

Step 1: Understand Ti plasmids.

Ti plasmids are found in *Agrobacterium tumefaciens*, a bacterium that causes crown gall disease in plants. These plasmids can transfer a piece of DNA into the plant genome.

Step 2: Use of Ti plasmids in genetic engineering.

Scientists have harnessed the ability of Ti plasmids to deliver foreign genes into plants, making them one of the most important tools in plant genetic engineering.

Step 3: Identify the host.

While Ti plasmids can be found in bacteria, they are used to deliver genes into plant cells, not animal, virus, or bacterial cells.

Step 4: Conclusion.

Since Ti plasmids are primarily used for genetic modification in plants, the correct answer is (C) Plant.

Final Answer: Ti plasmid vectors are used to deliver genes into plant hosts.

Quick Tip

Ti plasmids are a key tool in developing genetically modified crops, enabling the introduction of new traits like pest resistance.

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1. (d) Which of the following is an example of commensalism?

(A) Epiphytes

(B) Lichens

(C) Mycorrhizae

(D) All of the above

Correct Answer: (D) All of the above

Solution:

Step 1: Understand commensalism.

Commensalism is a type of symbiotic relationship between two organisms in which one organism benefits, while the other is neither helped nor harmed.

Step 2: Review the examples.

- **Epiphytes:** These are plants that grow on other plants (usually trees) but do not take nutrients from them. They benefit from the support of the host plant for physical access to sunlight, but the host plant is not affected. This is a clear example of commensalism. - **Lichens:** Lichens are a mutualistic relationship between fungi and algae or cyanobacteria. However, in some cases, lichens can act as commensals when the fungus benefits from the host but does not harm it. - **Mycorrhizae:** These are symbiotic relationships between fungi and plant roots, where the fungus benefits from nutrients provided by the plant and, in return, helps the plant absorb minerals. While typically mutualistic, in some cases, the plant may not be significantly affected by the fungus, making it a commensal relationship.

Step 3: Conclusion.

Since all of the examples can demonstrate commensalism, the correct answer is (D) All of the above.

Final Answer: All of the above are examples of commensalism.

Quick Tip

Commensalism is common in nature and helps organisms thrive without negatively affecting their hosts.

Q2. (a) Write the names of different parts of a typical stamen.

Solution:

A typical stamen consists of two main parts: 1. **Anther:** The part of the stamen that produces pollen grains. It is typically made up of two lobes and contains pollen sacs. 2. **Filament:** A long stalk that supports the anther and connects it to the flower's receptacle. It holds the anther in place, ensuring that pollen can be transferred efficiently.

Final Answer: The two main parts of a typical stamen are the Anther and the Filament.

Quick Tip

The anther produces pollen, which is essential for fertilization in plants.

Q2. (b) Name the hormone synthesised and secreted by Leydig cells.

Solution:

Leydig cells are found in the testes and are responsible for the synthesis and secretion of the hormone **Testosterone**.

Testosterone plays a critical role in the development of male secondary sexual characteristics, such as facial hair, deepening of the voice, and increased muscle mass. It also regulates spermatogenesis and promotes sexual drive.

Final Answer: The hormone synthesized and secreted by Leydig cells is Testosterone.

Quick Tip

Testosterone is essential for male reproductive health and development of secondary sexual characteristics.

Q2. (c) What are alleles?

Solution:

Alleles are different forms of a gene that exist at the same locus (position) on homologous chromosomes. Each individual has two alleles for each gene (one inherited from each parent). These alleles may be: - **Dominant Allele:** The allele that expresses its effect even if only one copy is present (e.g., B for brown eyes). - **Recessive Allele:** The allele whose effect is masked when a dominant allele is present (e.g., b for blue eyes).

Example: For the gene that determines eye color, there may be two alleles: one for brown eyes (dominant) and one for blue eyes (recessive).

Final Answer: Alleles are alternative forms of a gene that are found at the same location on homologous chromosomes and control the expression of traits.

Quick Tip

Alleles can be dominant or recessive, and their combinations determine the expression of traits in an organism.

Q2. (d) Give names of any two artificial ecosystems.

Solution:

Artificial ecosystems are man-made environments that mimic natural ecosystems. Two examples of artificial ecosystems are: 1. **Aquariums:** These are controlled aquatic environments where aquatic organisms such as fish, plants, and corals are kept for research, ornamental purposes, or as pets. 2. **Crop Fields:** These ecosystems are created for the cultivation of crops. They are artificially maintained and manipulated by humans for food production.

Both of these ecosystems rely on human intervention for maintenance.

Final Answer: Two examples of artificial ecosystems are Aquariums and Crop Fields.

Quick Tip

Artificial ecosystems are designed and maintained by humans for specific purposes such as research or food production.

Q2. (e) Give a classical example of adaptive radiation.

Solution:

Adaptive radiation is the process by which a single ancestral species diversifies into a wide range of forms, each adapted to different environments. A classic example of adaptive radiation is the case of **Darwin's Finches**.

Explanation: On the Galápagos Islands, Darwin's finches evolved from a single ancestor into multiple species with different beak shapes and sizes. These variations were adaptations to different food sources, such as seeds, insects, or nectar. This rapid diversification of species from a common ancestor is an example of adaptive radiation.

Final Answer: A classical example of adaptive radiation is Darwin's Finches on the Galápagos Islands.

Quick Tip

Adaptive radiation allows species to rapidly diversify and adapt to various ecological niches.

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3. (a) What is multiple allelism? Give an example.

Solution:

Multiple allelism refers to the presence of more than two alleles for a particular gene within a population. Although an individual organism can have only two alleles for a gene (one from each parent), multiple alleles can exist in the population, contributing to genetic diversity.

Example: An example of multiple allelism is the ABO blood group system in humans. There are three alleles for the gene controlling blood type: - $\mathbf{I^A}$ (A allele) - $\mathbf{I^B}$ (B allele) - $\mathbf{I^O}$ (O allele)

These alleles can combine in different ways to produce four possible blood types: A, B, AB, and O.

Final Answer: Multiple allelism is the occurrence of more than two alleles for a gene in a population. A classic example is the ABO blood group system.

Quick Tip

Multiple alleles contribute to genetic diversity and can result in different phenotypes, even within a single population.

3. (b) Give a brief account of different components of a nucleotide.

Solution:

A nucleotide is the basic building block of nucleic acids (DNA and RNA). It consists of three main components: 1. **Phosphate group:** A molecule containing one phosphorus atom bonded to four oxygen atoms. This group links adjacent nucleotides together to form a strand of nucleic acid. 2. **Sugar molecule:** In DNA, the sugar is deoxyribose, while in RNA, it is ribose. Both are pentose sugars (five-carbon sugars) that form the backbone of the nucleotide. 3. **Nitrogenous base:** There are four types of nitrogenous bases: - **Purines:** Adenine (A) and Guanine (G). - **Pyrimidines:** Cytosine (C), Thymine (T) in DNA, and Uracil (U) in RNA.

These components combine to form nucleotides, which are the structural units of nucleic acids.

Final Answer: A nucleotide consists of a phosphate group, a sugar molecule, and a nitrogenous base.

Quick Tip

The sequence of nitrogenous bases in DNA or RNA determines the genetic information carried by these molecules.

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3. (c) Draw a well-labelled diagram of an antibody molecule.

Solution:

Antibody structure: An antibody, or immunoglobulin (Ig), has a Y-shaped structure composed of four polypeptide chains: 1. **Two heavy chains:** The longer chains that form the central portion of the Y. 2. **Two light chains:** The shorter chains attached to the outer arms of the Y. 3. **Antigen-binding sites:** Located at the tips of the arms, these sites are specific to the antigen that the antibody recognizes. 4. **Constant region:** The stem of the Y that is the same in all antibodies of the same class, determining the antibody's class (IgG, IgM, etc.). 5.

Variable region: The part of the antibody that binds to the antigen; it varies between different antibodies to recognize different pathogens.

Diagram: (Here, you would include a diagram of an antibody showing the labeled parts.)

Final Answer: An antibody molecule consists of two heavy chains, two light chains, antigen-binding sites, a constant region, and a variable region.

Quick Tip

The variable region of an antibody allows it to specifically bind to antigens, while the constant region determines its immune function.

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3. (d) What is age pyramid? Give a diagrammatic representation of the age pyramid of an expanding human population.

Solution:

An **age pyramid**, also called a population pyramid, is a graphical representation of the distribution of various age groups in a population. It typically shows the number or percentage of individuals in each age group, separated by gender. The shape of the pyramid provides insights into the growth and demographic trends of the population.

In an expanding human population, the pyramid has a broad base, indicating a high number of young people, and tapers towards the top, reflecting fewer elderly individuals. This suggests a high birth rate and relatively low mortality rate.

Diagram: (Here, you would include a diagram of an expanding age pyramid with labels for each age group.)

Final Answer: An age pyramid is a graphical representation of the population's age distribution. An expanding population has a broad base and a narrow top.

Quick Tip

The shape of an age pyramid reflects the birth rate, death rate, and overall population growth.

3. (e) Comment upon Gause's "competitive exclusion principle".

Solution:

Gause's Competitive Exclusion Principle states that two species competing for the same resources cannot coexist at constant population values. One species will always outcompete the other, leading to the exclusion of the less competitive species from the ecological niche.
Explanation: This principle is based on the concept of ecological niches, which describe how species interact with their environment and resources. If two species occupy the same niche and require the same resources, one will eventually gain a competitive advantage and exclude the other. This can lead to the extinction or migration of the weaker species.

Final Answer: The competitive exclusion principle suggests that no two species can occupy the same niche in an ecosystem for an extended period of time.

Quick Tip

In nature, competition for resources often leads to niche differentiation, where species adapt to occupy different ecological niches.

Q4. (a) Describe the process and importance of artificial hybridization in brief.

Solution:

Artificial hybridization refers to the controlled pollination of plants or mating of animals to combine desirable traits from two different varieties or species. This technique is often used in agriculture and animal breeding to improve yield, disease resistance, or other beneficial traits.
Process: 1. **Selection of parents:** The desired traits from two different organisms are identified. One may have a desirable size, while the other may have better disease resistance.
2. **Crossing:** The male and female gametes from the selected organisms are combined through artificial means, such as controlled pollination in plants or insemination in animals.
3. **Fertilization and growth:** After fertilization, the resulting hybrid is monitored to ensure that the desired traits are present in the offspring.

Importance: - **Increased productivity:** Hybrid plants and animals often show increased yields and improved traits. - **Disease resistance:** Hybrids may be more resistant to pests or diseases, increasing agricultural sustainability. - **Improved quality:** Hybridization allows for the development of high-quality crops and livestock.

Final Answer: Artificial hybridization is a method used to improve the desirable traits of plants and animals. It involves controlled mating or pollination and is important for increasing productivity, disease resistance, and quality.

Quick Tip

Hybridization is a powerful tool in improving agricultural and livestock traits, ensuring better productivity and disease resistance.

Q4. (b) Write a note on Intra-Uterine Devices (IUD's) and their applications.

Solution:

Intra-Uterine Devices (IUDs) are small T-shaped plastic and copper devices inserted into the uterus to prevent pregnancy. They are one of the most effective forms of reversible birth control.

Types of IUDs: 1. **Copper IUDs:** These are wrapped with copper wire, which interferes with sperm movement and egg fertilization. 2. **Hormonal IUDs:** These release hormones such as progestin to thicken cervical mucus and prevent sperm from reaching the egg.

Applications: 1. **Contraception:** IUDs are one of the most effective birth control methods with a very low failure rate. 2. **Menstrual regulation:** Hormonal IUDs can reduce heavy menstrual bleeding and even stop periods entirely. 3. **Long-term use:** IUDs are long-lasting and can remain effective for several years, with minimal maintenance. 4. **Postpartum contraception:** IUDs can be inserted after childbirth as a long-term contraception method.

Final Answer: IUDs are small devices inserted into the uterus to prevent pregnancy. They are highly effective for long-term contraception and can also regulate menstrual flow.

Quick Tip

IUDs are among the most reliable forms of contraception and require minimal maintenance.

Q4. (c) Write a note on enzymes used in DNA replication.

Solution:

DNA replication is the process by which a cell duplicates its DNA before cell division. Several enzymes are involved in ensuring that this process occurs accurately:
1. **Helicase:** Unwinds the double-stranded DNA helix, creating two single-stranded templates for replication. 2. **DNA Polymerase:** Adds nucleotides to the growing DNA strand. It works in the 5' to 3' direction and requires a primer to start. 3. **Primase:** Synthesizes RNA primers that provide the starting point for DNA polymerase to begin adding nucleotides. 4. **Ligase:** Seals the gaps between the Okazaki fragments on the lagging strand, completing the replication process. 5. **Topoisomerase:** Prevents DNA from getting tangled or supercoiled during replication by making temporary cuts and resealing the DNA strands.

Final Answer: Enzymes such as helicase, DNA polymerase, primase, ligase, and topoisomerase work together to ensure accurate DNA replication.

Quick Tip

DNA replication is a complex process that requires several enzymes to ensure accurate and efficient copying of genetic material.

Q4. (d) Describe the law of independent assortment in a dihybrid cross.

Solution:

The law of independent assortment is one of Mendel's principles of inheritance. It states that the alleles for different traits segregate, or assort, independently of each other during

gamete formation. This means that the inheritance of one trait does not affect the inheritance of another trait.

In a dihybrid cross, two different traits are considered, each controlled by different genes. For example, the genes for seed color and seed shape in pea plants. Each gene has two alleles, with one inherited from each parent. According to the law of independent assortment, the inheritance of the allele for seed color does not influence the inheritance of the allele for seed shape.

Example: In a dihybrid cross between two heterozygous pea plants (YyRr × YyRr), the offspring can inherit different combinations of alleles for the two traits. The possible gametes from these parents would be: - YR, Yr, yR, yr

This results in a 9:3:3:1 phenotypic ratio in the F2 generation, where 9 represent plants with both dominant traits, 3 with one dominant and one recessive trait, and so on.

Final Answer: The law of independent assortment states that genes for different traits assort independently of each other during gamete formation, leading to genetic variation.

Quick Tip

The law of independent assortment explains how genetic variation is produced in offspring during sexual reproduction.

Q5. (a) Write short note on primary and secondary lymphoid organs.

Solution:

Primary lymphoid organs are the sites where lymphocytes are produced and mature. These include: 1. **Bone marrow:** It is the primary site for the production of all blood cells, including lymphocytes. 2. **Thymus:** It is where T lymphocytes (T cells) mature and gain the ability to recognize specific antigens.

Secondary lymphoid organs are the sites where immune responses are initiated. These include: 1. **Lymph nodes:** Small, bean-shaped structures that filter lymph and trap pathogens, allowing lymphocytes to respond to infections. 2. **Spleen:** Filters blood, removes old blood cells, and helps initiate immune responses against blood-borne pathogens. 3.

Mucosa-associated lymphoid tissues (MALT): Found in areas like the intestines and respiratory tract, where they protect mucosal surfaces.

Final Answer: Primary lymphoid organs include bone marrow and thymus, while secondary lymphoid organs include lymph nodes, spleen, and MALT.

Quick Tip

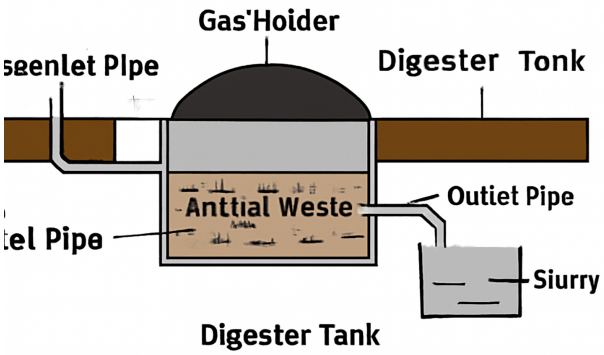
The primary lymphoid organs are involved in the development and maturation of lymphocytes, while secondary lymphoid organs initiate immune responses.

Q5. (b) Describe the structure of a typical biogas plant with the help of a suitable diagram.

Solution:

A typical biogas plant consists of the following main components: 1. **Digester tank:** A sealed, anaerobic chamber where organic waste, such as animal manure, is decomposed by microorganisms to produce biogas. 2. **Gas holder:** A large container where biogas is stored after production. It is usually placed above the digester tank. 3. **Inlet and outlet pipes:** Used for feeding the organic waste into the digester and removing the digested slurry. 4. **Slurry pit:** The solid waste or slurry that remains after digestion is removed and can be used as a fertilizer.

Diagram: (Here, you would include a labeled diagram of a biogas plant showing the digester tank, gas holder, inlet and outlet pipes, and slurry pit.)



Final Answer: A biogas plant consists of a digester tank for anaerobic digestion, a gas holder for storing biogas, inlet and outlet pipes for feeding and removing materials, and a slurry pit for handling waste by-products.

Quick Tip

Biogas plants are an effective way to generate renewable energy from organic waste while providing organic fertilizers.

Q5. (c) Write short notes on the following: (i) Vaccination (ii) Bio-fertilizer

Solution:

(i) Vaccination: Vaccination is the administration of a vaccine to stimulate the immune system to produce an immune response against a specific pathogen. Vaccines typically contain inactivated or weakened forms of the pathogen, or parts of it, such as proteins. This helps the body recognize and fight the pathogen in case of future exposure. Vaccination has played a major role in the control of infectious diseases like polio, measles, and influenza.

(ii) Bio-fertilizer: Bio-fertilizers are natural fertilizers that contain living microorganisms, such as bacteria, fungi, or algae, which promote the growth of plants by increasing nutrient availability. These microorganisms help in fixing nitrogen, decomposing organic matter, and enhancing soil health. Common examples include Rhizobium, Azotobacter, and mycorrhizal fungi.

Final Answer: Vaccination involves administering a vaccine to stimulate an immune response, while bio-fertilizers are natural fertilizers containing beneficial microorganisms that improve soil fertility.

Quick Tip

Vaccines help in preventing diseases, while bio-fertilizers play a key role in sustainable agriculture by enhancing soil health.

Q5. (d) Describe the applications of r-DNA technology in medicine.

Solution:

Recombinant DNA (r-DNA) technology involves manipulating DNA molecules to combine genetic material from different sources. This technology has several important applications in medicine:

1. **Production of Insulin:** r-DNA technology is used to produce human insulin by inserting the insulin gene into bacteria, allowing them to produce insulin for treating diabetes. 2. **Gene Therapy:** This involves inserting a healthy copy of a gene into a patient's cells to correct genetic disorders, such as cystic fibrosis or sickle cell anemia. 3. **Vaccine Production:** Recombinant DNA technology is used to produce vaccines, such as the hepatitis B vaccine, by introducing a gene from the virus into yeast or bacterial cells. 4. **Monoclonal Antibodies:** r-DNA technology is used to create monoclonal antibodies for targeted therapy in diseases like cancer, where antibodies specifically bind to cancer cells and deliver treatments directly to the tumor.

Final Answer: Applications of r-DNA technology in medicine include the production of insulin, gene therapy, vaccine production, and monoclonal antibodies for targeted therapies.

Quick Tip

r-DNA technology is transforming medicine by enabling the production of therapeutic proteins, gene therapies, and personalized treatments.

Q6. (a) Differentiate between innate immunity and acquired immunity giving suitable examples.

Solution:

Innate Immunity: - Innate immunity is the body's first line of defense against pathogens. It is present from birth and provides a non-specific response. - Components: Skin, mucous membranes, phagocytes, and natural killer cells. - Response time: Immediate or within hours of exposure. - Example: The inflammation response when a pathogen is detected.

Acquired Immunity: - Acquired immunity develops after exposure to a pathogen. It is specific to the pathogen and has a memory component. - Components: T-cells and B-cells, which produce antibodies. - Response time: Slower initially but faster upon subsequent exposure due to memory cells. - Example: Immunity developed after vaccination or infection (e.g., immunity to chickenpox after infection).

Final Answer: Innate immunity is the body's immediate, nonspecific defense, while acquired immunity is specific and develops after exposure to a pathogen.

Quick Tip

Innate immunity is rapid but general, while acquired immunity is slow but provides lasting protection.

Q6. (b) What are cloning vectors? Write a short note on characteristics of cloning vectors.

Solution:

Cloning vectors are DNA molecules used to carry foreign genetic material into a host cell for cloning. They are essential tools in genetic engineering.

Characteristics of Cloning Vectors: 1. **Origin of replication (Ori):** Allows the vector to replicate within the host cell. 2. **Selectable marker:** A gene, such as antibiotic resistance, that helps identify host cells that contain the vector. 3. **Multiple cloning site (MCS):** A region containing several restriction enzyme sites, allowing easy insertion of foreign DNA. 4. **Small size and stable:** Cloning vectors must be small for efficient transformation into host cells and stable to maintain the inserted gene. 5. **Easy to manipulate:** Vectors should be easy to insert or remove foreign genes, using enzymes like restriction endonucleases.

Final Answer: Cloning vectors are DNA molecules that facilitate the insertion of foreign genes into a host cell for replication and expression. Key characteristics include an origin of replication, selectable markers, MCS, small size, and stability.

Quick Tip

Cloning vectors are the backbone of genetic engineering, enabling the cloning and propagation of specific genes.

Q6. (c) What are transgenic animals? Describe the benefits of transgenic animals in brief.

Solution:

Transgenic animals are animals that have been genetically modified to contain genes from other species. These genes, known as transgenes, are integrated into the animal's genome and can be inherited by offspring.

Benefits of Transgenic Animals: 1. **Medical Research:** Transgenic animals are used to model human diseases, aiding in the study of genetic disorders and testing of treatments. 2. **Gene Therapy:** Transgenic animals can be used to produce proteins that are important for human therapy, such as insulin or clotting factors. 3. **Improved Livestock:** Genetic modification can improve disease resistance, growth rates, and nutritional content in livestock. 4. **Pharmaceutical Production:** Transgenic animals can be used to produce valuable pharmaceuticals in their milk or blood, such as antibodies or hormones.

Final Answer: Transgenic animals are genetically modified to contain foreign genes, and their benefits include advancing medical research, gene therapy, improving livestock, and pharmaceutical production.

Quick Tip

Transgenic animals have revolutionized medicine by providing new ways to produce therapeutic proteins and model diseases.

Q6. (d) Write short notes on the following: (i) DNA Palindrome (ii) Carrying capacity

Solution:

(i) DNA Palindrome: A DNA palindrome is a sequence of base pairs in double-stranded DNA where the sequence of bases reads the same forward and backward on complementary strands. Palindromes are often recognized by restriction enzymes, which cleave DNA at these sites. Example: 5'–GAATTC–3' (on one strand) 3'–CTTAAG–5' (on the complementary strand)
(ii) Carrying Capacity: Carrying capacity refers to the maximum population size that an environment can sustainably support, given the available resources (food, space, etc.). It is determined by factors such as food availability, habitat space, and the presence of predators. Populations that exceed the carrying capacity experience a population crash due to resource depletion.

Final Answer: DNA palindromes are sequences that read the same in both directions on complementary strands, while carrying capacity refers to the maximum population size an environment can support.

Quick Tip

Understanding DNA palindromes is crucial for DNA analysis and manipulation, while carrying capacity helps in understanding population dynamics.

Q7. Briefly describe the role of hormones in follicular and luteal phase of menstrual cycle in female primates.

Solution:
The menstrual cycle in female primates is regulated by hormones that fluctuate throughout the cycle. The cycle consists of two main phases: the follicular phase and the luteal phase.
Follicular Phase: - The follicular phase starts on the first day of menstruation and lasts until ovulation. - **Hormones involved:** 1. **Follicle-stimulating hormone (FSH):** Stimulates the growth of follicles in the ovaries, each containing an egg. 2. **Estrogen:** Produced by developing follicles, estrogen stimulates the thickening of the uterine lining in preparation for possible pregnancy. 3. **Luteinizing hormone (LH):** A peak in LH levels triggers ovulation (the release of an egg from a mature follicle).

Luteal Phase: - The luteal phase begins after ovulation and lasts until the start of menstruation. - **Hormones involved:** 1. **Progesterone:** After ovulation, the ruptured follicle transforms into the corpus luteum, which secretes progesterone. Progesterone helps maintain the thickened uterine lining to support potential implantation of a fertilized egg. 2. **Estrogen:** Estrogen levels remain elevated in the luteal phase, supporting the actions of progesterone. If pregnancy does not occur, the corpus luteum degenerates, leading to a drop in estrogen and progesterone, triggering menstruation.

Final Answer: In the follicular phase, FSH and estrogen help stimulate follicle growth and uterine lining thickening. In the luteal phase, progesterone and estrogen maintain the uterine lining, preparing for potential pregnancy.

Quick Tip

The hormonal regulation of the menstrual cycle ensures the preparation of the female reproductive system for potential pregnancy each month.

Q7. OR Write short notes on the following: (i) Types of pollination in flowering plants (ii) Mammary gland

Solution:

(i) Types of Pollination in Flowering Plants:

Pollination is the transfer of pollen from the male part (anther) to the female part (stigma) of a flower. The types of pollination are: 1. **Self-pollination:** The transfer of pollen from the anther to the stigma of the same flower or another flower of the same plant. It does not require external agents. - Example: Peas, tomatoes. 2. **Cross-pollination:** The transfer of pollen from the anther of one plant to the stigma of a different plant of the same species. This is facilitated by external agents such as wind, insects, or animals. - Example: Apple trees, sunflowers. 3. **Artificial pollination:** Human-assisted pollination, where pollen is manually transferred from one flower to another, used in agriculture and plant breeding. - Example: Commercial fruit production.

(ii) Mammary Gland:

The **mammary glands** are specialized organs in female mammals that produce and secrete milk to nourish offspring. These glands are composed of: 1. **Lobes and lobules:** The glandular tissue where milk is produced. 2. **Mammary ducts:** Tubes that carry milk from the lobules to the nipple. 3. **Nipple:** The external opening through which milk is excreted during breastfeeding.
Mammary glands are regulated by hormones such as prolactin (which stimulates milk production) and oxytocin (which facilitates milk ejection).

Final Answer: Pollination in flowering plants can be self-pollination, cross-pollination, or artificial pollination, each facilitated by different mechanisms. Mammary glands are specialized organs in female mammals for milk production, crucial for nourishing offspring.

Quick Tip

Pollination ensures genetic diversity in plants, while mammary glands play a vital role in the survival of mammalian offspring by providing nourishment.

Q8. Briefly describe the mechanism of transcription in prokaryotes.

Solution:

Transcription in prokaryotes is the process by which an RNA molecule is synthesized from a DNA template. It occurs in the cytoplasm in prokaryotic cells. The main steps of transcription are:
1. **Initiation:** - The process begins when the enzyme **RNA polymerase** binds to the promoter region of the gene. - The promoter is a specific sequence of DNA that signals the start of transcription. - The RNA polymerase enzyme unwinds the DNA double helix and begins to synthesize RNA from the template strand.
2. **Elongation:** - RNA polymerase moves along the DNA template strand in the 3' to 5' direction, synthesizing the RNA strand in the 5' to 3' direction. - The RNA molecule is complementary to the template DNA strand, replacing thymine (T) with uracil (U).
3. **Termination:** - The RNA polymerase continues to synthesize RNA until it reaches a termination signal in the DNA sequence, known as the terminator. - The RNA molecule is

released, and the RNA polymerase dissociates from the DNA.
The RNA produced in prokaryotes is often mRNA, which can be immediately translated into proteins.

Final Answer: Transcription in prokaryotes involves RNA polymerase binding to the promoter, synthesizing RNA during elongation, and terminating when a specific DNA sequence is reached.

Quick Tip

In prokaryotes, transcription and translation occur simultaneously in the cytoplasm.

Q8. OR Write short notes on the following: (i) Genetic code (ii) S.L. Miller's experiment regarding origin of life

Solution:
(i) Genetic Code: The **genetic code** is a set of rules by which the information encoded in mRNA is translated into proteins. The code is universal, meaning it is used by almost all organisms. It is composed of codons, which are triplets of nucleotides (A, T, C, G) that correspond to specific amino acids.
Key features of the genetic code: 1. **Degeneracy:** More than one codon can specify the same amino acid. 2. **Start and Stop Codons:** The start codon (AUG) signals the beginning of translation, and stop codons (UAA, UAG, UGA) signal the end. 3. **Universal:** The genetic code is nearly identical in all living organisms.
(ii) S.L. Miller's Experiment Regarding Origin of Life: In 1953, **Stanley Miller** conducted an experiment to simulate early Earth conditions and test the hypothesis of abiogenesis (life arising from non-living matter).
- **Setup:** Miller used a closed apparatus with water, methane, ammonia, and hydrogen to mimic the atmosphere of early Earth. He then subjected the mixture to electrical sparks to simulate lightning. - **Result:** After a week, Miller found that amino acids, the building blocks of proteins, had formed in the mixture, suggesting that simple organic molecules could form under primitive Earth conditions.

Final Answer: The genetic code is a set of triplet codons that specify amino acids for protein synthesis. S.L. Miller's experiment demonstrated that amino acids could form under conditions similar to early Earth, supporting theories of abiogenesis.

Quick Tip

Miller's experiment was a key milestone in understanding the chemical origins of life on Earth.

Q9. Give a brief account of different population growth models.

Solution:

There are two main types of population growth models used to describe how populations change over time:

1. Exponential Growth Model: - In this model, populations grow at a constant rate when resources are abundant, and there are no limiting factors. - The growth rate is proportional to the size of the population, leading to a J-shaped curve. - The equation for exponential growth is:

$$N(t) = N_0 e^{rt}$$

Where: - $N(t)$ is the population size at time t, - N_0 is the initial population size, - r is the rate of growth (birth rate - death rate), - t is the time period.

- Example: Bacteria in a culture under ideal conditions.

2. Logistic Growth Model: - In this model, population growth is initially exponential but slows down as the population reaches the carrying capacity of the environment. - The logistic model includes a limiting factor (carrying capacity) that prevents indefinite growth. - The equation for logistic growth is:

$$N(t) = \frac{K}{1 + \frac{K - N_0}{N_0} e^{-rt}}$$

Where: - $N(t)$ is the population size at time t, - K is the carrying capacity, - N_0 is the initial population size, - r is the growth rate, - t is time.

- Example: A population of deer in a forest with limited resources.

Final Answer: The exponential growth model describes unlimited population growth, while the logistic growth model incorporates a carrying capacity that limits growth as the population reaches environmental limits.

Quick Tip

The exponential model assumes unlimited resources, while the logistic model accounts for environmental constraints and carrying capacity.

Q9. OR Describe in detail energy flow in an ecosystem.

Solution:

Energy Flow in an Ecosystem: Energy flow in an ecosystem refers to the movement of energy through the food chain, from primary producers to consumers and decomposers. The flow of energy is unidirectional, meaning it only flows in one direction — from producers to consumers and finally to decomposers.

1. **Producers (Autotrophs):** - Primary producers, such as plants and algae, convert solar energy into chemical energy via photosynthesis. They form the base of the food chain. - Energy from the sun is captured by chlorophyll and stored in the form of glucose.

2. **Primary Consumers (Herbivores):** - Herbivores feed on primary producers and obtain chemical energy by consuming plants. Examples: cows, deer, and insects. - Only about 10% of the energy from plants is passed on to herbivores (this is known as the 10% energy rule).

3. **Secondary and Tertiary Consumers (Carnivores and Omnivores):** - These organisms feed on other animals (primary consumers or other carnivores) to obtain energy. Examples: lions, hawks, and wolves. - Energy decreases as you move up trophic levels, and only a small percentage of energy is transferred to each successive level.

4. **Decomposers (Detritivores and Saprotrophs):** - Decomposers, such as bacteria, fungi, and earthworms, break down dead organic matter, returning nutrients to the soil. - They play a critical role in recycling nutrients and ensuring the continuity of the energy cycle.

5. **Energy Losses:** - As energy flows through the ecosystem, it is lost as heat at each trophic level due to metabolic processes (cellular respiration, digestion, etc.). - The energy that

remains at each trophic level is used for growth, reproduction, and other life processes. The flow of energy is typically depicted in a food chain or food web, with producers at the base, followed by primary consumers, secondary consumers, and tertiary consumers. The flow of energy through trophic levels creates ecological pyramids, with the greatest amount of energy found at the base.

Final Answer: Energy flows from producers to consumers and decomposers in an ecosystem. The flow is unidirectional and decreases with each trophic level due to energy losses.

Quick Tip

Energy efficiency decreases with each trophic level, which is why food webs typically have fewer apex consumers than primary producers.
