CUET UG Biology Sample Paper - 6

Duration: 1 Hour **Maximum Marks: 250**

Instructions

- This paper contains a total of 50 Multiple Choice Questions.
- Each correct answer carries **+5 marks**.
- Each incorrect answer carries **-1 mark**.
- No negative marking for unattempted questions.

Q1. A typical mature angiosperm embryo sac is:

(A) 8-nucleate, 8-celled

(B) 7-nucleate, 8-celled

(C) 8-nucleate, 7-celled

(D) 7-nucleate, 7-celled

Q2. Double fertilization involves:

(A) Syngamy and Triple Fusion

(B) Two syngamy events

(C) Triple fusion only

(D) Pollination and Syngamy

Q3. Which of the following is a characteristic of wind-pollinated flowers?

(A) Large, colorful petals

(B) Presence of nectar

(C) Light and non-sticky pollen grains

(D) Feathery stamens but small stigma

Q4. The part of the gynoecium that determines the compatible nature of pollen is:

(A) Ovary

(B) Style

(C) Stigma

(D) Thalamus

Q5. Persistence of nucellus in the seed is known as:

(A) Perisperm

(B) Endosperm

(C) Scutellum

(D) Epicotyl

Q6. Which cells provide nutrition to the developing spermatozoa?

(A) Leydig cells

(B) Sertoli cells

(C) Interstitial cells

(D) Spermatogonia

Q7. The process of release of a mature ovum from the Graafian follicle is called:

(A) Implantation

(B) Fertilization

(C) Ovulation

(D) Parturition

Q8. The secretion of which hormone is at its peak during the "LH Surge"?

(A) Estrogen

(B) Progesterone

(C) Luteinizing Hormone

(D) FSH

Q9. The blastocyst becomes embedded in the layer of the uterus called:

(A) Perimetrium

(B) Myometrium

(C) Endometrium

(D) Ectoderm

Q10. The first milk produced by the mother after childbirth, rich in IgA antibodies, is:

(A) Sebum

(B) Colostrum

(C) Serum

(D) Plasma

Q11. Which of the following is a non-medicated IUD?

(A) Lippes Loop

(B) Cu7

(C) Multiload 375

(D) LNG-20

Q12. "Saheli," a new oral contraceptive for females, was developed by:

(A) AIIMS, Delhi

(B) CDRI, Lucknow

(C) WHO

(D) ICMR

Q13. In which technique are the embryos transferred into the fallopian tube?

(A) IUI

(B) ZIFT

(C) ICSI

(D) GIFT

Q14. A cross between a tall plant (TT) and a short plant (tt) results in all tall plants in F1. This is due to:

(A) Law of Segregation

(B) Law of Dominance

(C) Incomplete Dominance

(D) Linkage

Q15. What is the phenotypic ratio of a dihybrid cross in the F2 generation?

(A) 3:1

(B) 1:2:1

(C) 9:3:3:1

(D) 1:1:1:1

Q16. Down's Syndrome is caused by the presence of an extra chromosome number:

(A) 18

(B) 21

(C) 13

(D) 23

Q17. Which of the following is a Mendelian disorder?

(A) Turner's Syndrome

(B) Klinefelter's Syndrome

(C) Haemophilia

(D) Down's Syndrome

Q18. Experimental verification of the chromosomal theory of inheritance was done by:

(A) Mendel

(B) Sutton and Boveri

(C) T.H. Morgan

(D) Henking

Q19. In a test cross, the individual with an unknown genotype is crossed with:

(A) Dominant parent

(B) Recessive parent

(C) F1 hybrid

(D) Heterozygous parent

Q20. The backbone of the DNA double helix is made of:

(A) Sugar and Nitrogenous base

(B) Sugar and Phosphate

(C) Phosphate and Nitrogenous base

(D) Hydrogen bonds

Q21. If a DNA strand has 30% Adenine, the percentage of Cytosine will be:

(A) 30%

(B) 70%

(C) 20%

(D) 40%

Q22. The enzyme used to join DNA fragments (Okazaki fragments) is:

(A) DNA Polymerase

(B) DNA Ligase

(C) Helicase

(D) RNA Primase

Q23. In the Lac Operon, the inducer molecule is:

(A) Glucose

(B) Galactose

(C) Lactose

(D) Permease

Q24. The process of copying genetic information from one strand of DNA into RNA is:

(A) Replication

(B) Translation

(C) Transcription

(D) Reverse Transcription

Q25. Which of the following is a "Stop Codon"?

(A) AUG

(B) UGG

(C) UAA

(D) GUG

Q26. DNA Fingerprinting involves identifying differences in specific regions of DNA called:

(A) Repetitive DNA

(B) Coding DNA

(C) Single-stranded DNA

(D) Exons

Q27. The search for genetic material: The Transforming Principle was given by:

(A) Hershey and Chase

(B) Oswald Avery

(C) Frederick Griffith

(D) Meselson and Stahl

Q28. According to Hardy-Weinberg principle, the sum total of all allelic frequencies is:

(A) 0

(B) 1

(C) 100

(D) 0.5

Q29. Darwin's Finches are an excellent example of:

(A) Convergent evolution

(B) Adaptive Radiation

(C) Industrial melanism

(D) Parallel evolution

Q30. The "First Human-like being" the hominid was:

(A) Homo erectus

(B) Homo habilis

(C) Homo sapiens

(D) Neanderthal man

Q31. Analogous organs arise due to:

(A) Divergent evolution

(B) Convergent evolution

(C) Genetic drift

(D) Artificial selection

Q32. The infective stage of Plasmodium that enters the human body through a mosquito bite is:

(A) Trophozoite

(B) Sporozoite

(C) Gametocyte

(D) Merozoite

Q33. Which of the following is an example of "Innate Immunity"?

(A) T-lymphocytes

(B) B-lymphocytes

(C) Interferons

(D) Vaccination

Q34. HIV (AIDS virus) primarily attacks which cells?

(A) Red Blood Cells

(B) Cytotoxic T-cells

(C) Helper T-lymphocytes

(D) B-cells

Q35. The property of normal cells by which they inhibit the uncontrolled growth of neighboring cells is:

(A) Metastasis

(B) Benign growth

(C) Contact inhibition

(D) Mutation

Q36. The "flocs" in sewage treatment consist of:

(A) Bacteria and Fungal filaments

(B) Viruses and Bacteria

(C) Algae and Protozoa

(D) Small pebbles

Q37. Which of the following is used as a biocontrol agent against plant pathogens?

(A) Bacillus thuringiensis

(B) Trichoderma

(C) Aphids

(D) Dragonflies

Q38. Name the fungus used in the production of Statins (blood cholesterol-lowering agents):

(A) Saccharomyces cerevisiae

(B) Monascus purpureus

(C) Aspergillus niger

(D) Penicillium notatum

Q39. Restriction enzymes are also known as:

(A) Molecular glues

(B) Molecular scissors

(C) Vector DNA

(D) RNA Polymerase

Q40. In PCR, the correct sequence of steps is:

(A) Extension, Denaturation, Annealing

(B) Denaturation, Annealing, Extension

(C) Annealing, Extension, Denaturation

(D) Denaturation, Extension, Annealing

Q41. The enzyme used in PCR for extension because of its thermo-stability is:

(A) DNA Ligase

(B) Taq Polymerase

(C) Reverse Transcriptase

(D) EcoRI

Q42. Downstream processing includes:

(A) Separation and Purification

(B) Gene cloning

(C) Transformation

(D) Inoculation

Q43. Bt cotton contains a toxin that kills insects by:

(A) Blocking their nervous system

(B) Creating pores in the midgut epithelial cells

(C) Stopping DNA replication

(D) Preventing respiration

Q44. RNA interference (RNAi) is used to make plants resistant against:

(A) Fungi

(B) Viruses

(C) Nematodes

(D) Bacteria

Q45. The "A" and "B" chains of human insulin are linked together by:

(A) Hydrogen bonds

(B) Disulfide bridges

(C) Glycosidic bonds

(D) Phosphodiester bonds

Q46. If the age pyramid shows a broad base (young individuals) and a narrow top, the population is:

(A) Declining

(B) Stable

(C) Expanding

(D) Vanishing

Q47. An interaction where one species is benefited and the other is neither harmed nor benefited is:

(A) Mutualism

(B) Commensalism

(C) Amensalism

(D) Parasitism

Q48. The rate of production of organic matter during photosynthesis is called:

(A) Net Primary Productivity (NPP)

(B) Gross Primary Productivity (GPP)

(C) Secondary Productivity

(D) Decomposition

Q49. Which of the following is an example of "In-situ" conservation?

(A) Botanical Garden

(B) Wildlife Safari Park

(C) Biosphere Reserve

(D) Cryopreservation

Q50. The "Evil Quartet" is a term used to describe:

(A) Four stages of evolution

(B) Four causes of biodiversity loss

(C) Four types of ecological pyramids

(D) Four levels of biodiversity

Detailed Solutions

Q1.

Solution

Concept: Structure and Development of the Female Gametophyte (Megagametogenesis).
Solution: In the majority of flowering plants, a single functional megaspore undergoes three successive free-nuclear mitotic divisions to form the embryo sac.

1. The first division produces 2 nuclei which move to opposite poles.

2. The second division produces 4 nuclei (2 at each pole).

3. The third division produces 8 nuclei (4 at each pole).

Following these divisions, cell walls are organized. Three nuclei at the micropylar end form the egg apparatus (one egg cell and two synergids). Three nuclei at the chalazal end form the antipodal cells. The remaining two nuclei, known as polar nuclei, migrate to the center and are contained within a single large central cell. Consequently, the mature embryo sac contains 8 nuclei but only 7 distinct cells.

Final Answer : "8-nucleate, 7-celled"

Answer: (C)

Q2.

Solution

Concept: The Mechanism of Double Fertilization.
Solution: Double fertilization is a unique event in angiosperms involving two distinct fusion processes:

1. Syngamy: One of the two male gametes released by the pollen tube moves toward the egg cell and fuses with its nucleus to form a diploid zygote ($2n$), which eventually develops into the embryo.

2. Triple Fusion: The second male gamete moves toward the central cell and fuses with the two haploid polar nuclei (or the secondary nucleus) to form a triploid Primary Endosperm Nucleus (PEN) ($3n$), which develops into the endosperm to provide nutrition.

The combination of these two events—Syngamy and Triple Fusion—is what constitutes double fertilization.

Final Answer : "Syngamy and Triple Fusion"

Answer: (A)

Q3.

Solution

Concept: Floral Adaptations for Anemophily (Wind Pollination).

Solution: Wind-pollinated (anemophilous) flowers have evolved specific traits to maximize the chances of pollen capture by air currents:

- Pollen Characteristics: They produce massive amounts of pollen because the process is directional-random. The grains are light and non-sticky so they can be easily transported by even a light breeze without clumping together.
- Floral Structure: The flowers often have well-exposed stamens to shed pollen into the wind and large, feathery stigmas to "trap" passing pollen. They usually lack nectar, scent, and bright colors because they do not need to attract insects.

Final Answer : "Light and non-sticky pollen grains"

Answer: (C)

Q4.

Solution

Concept: Pollen-Pistil Interaction and Compatibility.

Solution: The pistil has the ability to recognize whether the pollen is of the right type (compatible) or the wrong type (incompatible). This identification is mediated by chemical components of the pollen interacting with those of the pistil. The stigma serves as the landing platform where this "chemical dialogue" begins. If the stigma identifies the pollen as compatible, it allows the pollen to germinate and form a pollen tube. If it is incompatible (from a different species or self-incompatible), the stigma inhibits the germination or growth of the pollen tube.

Final Answer : "Stigma"

Answer: (C)

Q5.

Solution

Concept: Post-Fertilization Changes in the Seed.

Solution: In most seeds, the nucellus (the diploid tissue within the ovule that surrounds the embryo sac) is completely consumed during the development of the endosperm and embryo. However, in some plants like black pepper and beet, a portion of the nucellus persists in the mature seed as a nutritional tissue. This persistent, residual nucellus is called the perisperm. It is a diploid maternal tissue, whereas the endosperm is triploid.

Final Answer : "Perisperm"

Answer: (A)

Q6.

Solution

Concept: Anatomy of Seminiferous Tubules and Spermatogenesis.

Solution: The seminiferous tubules are lined on their inside by two types of cells: male germ cells (spermatogonia) and Sertoli cells. While spermatogonia undergo meiotic divisions to produce spermatozoa, the Sertoli cells act as "nurse cells." They provide structural support, metabolic waste removal, and essential nutrition to the germ cells during their transformation into mature sperm. Leydig cells, conversely, are located in the interstitial spaces outside the tubules and produce testosterone.

Final Answer : "Sertoli cells"

Answer: (B)

Q7.

Solution

Concept: The Menstrual Cycle - Ovulatory Phase.

Solution: During the middle of the menstrual cycle (approximately day 14), high levels of estrogen trigger a sharp increase in Luteinizing Hormone (LH) from the pituitary gland. This "LH Surge" causes the mature Graafian follicle to rupture. The process by which the secondary oocyte (mature ovum) is released from the ovary into the fallopian tube is called ovulation. Implantation refers to attachment to the uterus, and parturition refers to childbirth.

Final Answer : "Ovulation"

Answer: (C)

Q8.

Solution

Concept: Hormonal Regulation of Ovulation.

Solution: The "LH Surge" specifically describes the rapid, peak secretion of Luteinizing Hormone (LH) during the mid-cycle. While Follicle Stimulating Hormone (FSH) also shows a peak at this time, it is the massive surge of LH that is directly responsible for the final maturation and subsequent rupture of the Graafian follicle. This hormonal peak is a prerequisite for the release of the egg.

Final Answer : "Luteinizing Hormone"

Answer: (C)

Q9.

Solution

Concept: The Process of Implantation.

Solution: After fertilization in the ampulla, the zygote undergoes cleavage as it moves toward the uterus, forming a blastocyst. The blastocyst consists of an outer layer called the trophoblast and an inner cell mass. The trophoblast attaches to the endometrium, which is the innermost, glandular, and highly vascularized layer of the uterine wall. Following attachment, the endometrial cells divide rapidly to cover the blastocyst, embedding it firmly into the uterine wall.

Final Answer : "Endometrium"

Answer: (C)

Q10.

Solution

Concept: Post-Partum Lactation and Immunology.

Solution: The milk produced during the initial few days of lactation immediately following childbirth is called colostrum. It is distinct from later milk as it is thick, yellowish, and exceptionally rich in protein and antibodies, particularly IgA (Immunoglobulin A). These antibodies provide natural passive immunity to the newborn, protecting the infant's digestive and respiratory tracts from pathogens while its own immune system is still developing.

Final Answer : "Colostrum"

Answer: (B)

Q11.

Solution

Concept: Classification of Intrauterine Devices (IUDs).

Solution: IUDs are classified based on their mechanism of action:

1. Non-medicated IUDs: These are typically made of plastic or stainless steel and work by inducing a local inflammatory response that promotes sperm phagocytosis. Lippes Loop is the standard example.

2. Copper-releasing IUDs: (CuT, Cu7, Multiload 375) release copper ions to suppress sperm motility.

3. Hormone-releasing IUDs: (LNG-20, Progestasert) release progestogens to thicken cervical mucus.

Final Answer : "Lippes Loop"

Answer: (A)

Q12.

Solution

Concept: Development of Modern Contraceptives in India.

Solution: "Saheli" is a revolutionary oral contraceptive for women because it is non-steroidal (it contains Centchroman) and is taken only once a week after an initial loading dose. Because it does not use hormones like estrogen, it has very few side effects. This drug was researched and developed entirely in India by the scientists at the Central Drug Research Institute (CDRI) in Lucknow.

Final Answer : "CDRI, Lucknow"

Answer: (B)

Q13.

Solution

Concept: Assisted Reproductive Technology (ART) Procedures.

Solution: In the "Test Tube Baby" program, fertilization occurs in a lab (IVF). The resulting embryo is then transferred using different techniques:

- ZIFT (Zygote Intra Fallopian Transfer): The zygote or early embryo (containing up to 8 blastomeres) is transferred into the fallopian tube.
- IUT (Intra Uterine Transfer): Embryos with more than 8 blastomeres are transferred into the uterus.
- GIFT: Involves transferring an ovum (not an embryo) into the tube.
- IUI: Involves artificial insemination of sperm into the uterus.

Final Answer : "ZIFT"

Answer: (B)

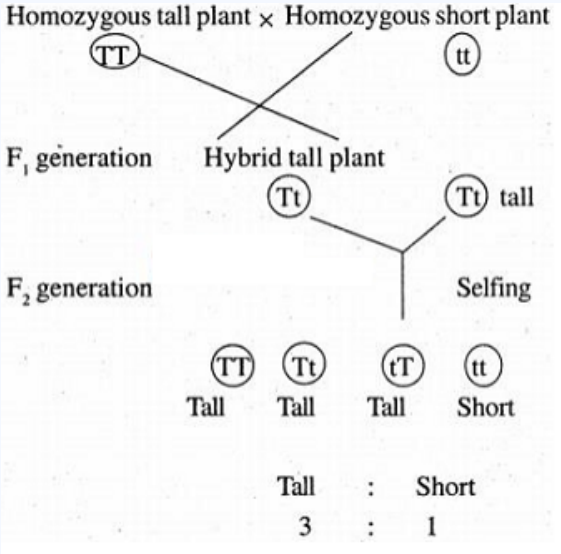
Q14.

Solution

Concept: Mendel's Law of Dominance and Monohybrid Cross.

Solution: When a homozygous tall plant (TT) is crossed with a homozygous short plant (tt), all the offspring in the F_1 generation receive one allele for tallness (T) and one for shortness (t), resulting in the heterozygous genotype Tt.

According to the Law of Dominance, in a pair of dissimilar factors (alleles), one member of the pair dominates (dominant) the other (recessive). Here, the T allele masks the expression of the t allele, making all F_1 plants phenotypically tall.



Final Answer : "Law of Dominance"

Answer: (B)

Q15.

Solution

Concept: Dihybrid Cross and Independent Assortment.

Solution: A dihybrid cross involves two pairs of contrasting traits (e.g., seed color and seed shape). In the F_2 generation, which is obtained by selfing the F_1 hybrid ($RrYy$), the alleles for each trait assort independently during gamete formation.

This results in four types of gametes (RY, Ry, rY, ry) which, when crossed in a Punnett square, produce 16 combinations. The physical appearance of these offspring follows a specific ratio: 9 (dominant for both), 3 (dominant for first, recessive for second), 3 (recessive for first, dominant for second), and 1 (recessive for both).

Final Answer : "9:3:3:1"

Answer: (C)

Q16.

Solution

Concept: Chromosomal Disorders: Aneuploidy.

Solution: Down's Syndrome is a genetic disorder caused by the presence of an additional copy of chromosome number 21. This condition is known as Trisomy 21. It usually occurs due to non-disjunction during meiosis, where the chromosome pair fails to separate, leading to a gamete with an extra chromosome. Affected individuals typically exhibit small stature, a furrowed tongue, partially open mouth, and characteristic mental development delays.

Final Answer : "21"

Answer: (B)

Q17.

Solution

Concept: Mendelian Disorders vs. Chromosomal Disorders.

Solution: Mendelian disorders are determined by alteration or mutation in a single gene. These are transmitted to the offspring as per the principles of inheritance. Haemophilia is a classic Mendelian disorder (specifically X-linked recessive) where blood clotting is impaired.
In contrast, Down's, Turner's, and Klinefelter's syndromes are chromosomal disorders caused by the excess, absence, or abnormal arrangement of entire chromosomes.

Final Answer : "Haemophilia"

Answer: (C)

Q18.

Solution

Concept: Chromosomal Theory of Inheritance.

Solution: While Sutton and Boveri (1902) proposed that the behavior of chromosomes is parallel to the behavior of genes, the experimental verification of this theory was provided by T.H. Morgan. Working with the fruit fly (*Drosophila melanogaster*), Morgan provided the evidence that genes are indeed located on chromosomes and discovered the basis for variation through linkage and recombination.

Final Answer : "T.H. Morgan"

Answer: (C)

Q19.

Solution

Concept: Test Cross Mechanism.

Solution: To determine the genotype of a plant showing a dominant phenotype (whether it is homozygous TT or heterozygous Tt), a test cross is performed. In this cross, the individual with the unknown genotype is crossed with the recessive parent (tt).

If the offspring are 100% dominant, the parent was TT. If the offspring follow a 1:1 ratio of dominant to recessive, the parent was Tt.

Final Answer : "Recessive parent"

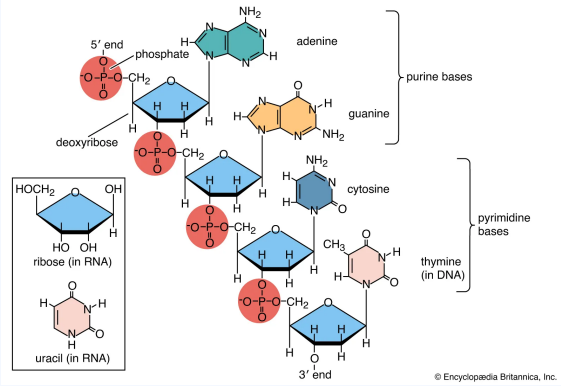
Answer: (B)

Q20.

Solution

Concept: Molecular Structure of DNA.

Solution: The DNA double helix is a polymer of nucleotides. Each nucleotide consists of a nitrogenous base, a pentose sugar, and a phosphate group. The two polynucleotide chains are held together by hydrogen bonds between bases, but the structural "rails" or backbone of each strand are formed by alternating Sugar and Phosphate groups linked by phosphodiester bonds.



Final Answer : "Sugar and Phosphate"

Answer: (B)

Q21.

Solution

Concept: Chargaff's Rule.

Solution: According to Chargaff's rule, in double-stranded DNA, the percentage of Adenine equals Thymine ($A = T$) and Guanine equals Cytosine ($G = C$).

1. Given $A = 30\%$, therefore $T = 30\%$.
2. Sum of $A + T = 60\%$.
3. The remaining 40% must be $G + C$.
4. Since $G = C$, the percentage of Cytosine is $40\%/2 = 20\%$.

Final Answer : "20%"

Answer: (C)

Q22.

Solution

Concept: DNA Replication: Lagging Strand.

Solution: During DNA replication, the lagging strand is synthesized discontinuously in short segments known as Okazaki fragments. These fragments must be joined together to form a continuous strand. The enzyme DNA Ligase catalyzes the formation of the phosphodiester bond that seals the gaps between these fragments.

Final Answer : "DNA Ligase"

Answer: (B)

Q23.

Solution

Concept: Regulation of Gene Expression (Lac Operon).

Solution: In the *lac* operon of *E. coli*, the genes are expressed only when a specific substrate is present. Lactose (or allolactose) acts as the inducer. It binds to the repressor protein, which undergoes a conformational change and detaches from the operator region. This allow RNA polymerase to access the promoter and begin transcription of the structural genes.

Final Answer : "Lactose"

Answer: (C)

Q24.

Solution

Concept: Central Dogma: Transcription.

Solution: The process of transfer of genetic information from the coding strand of DNA to RNA is called Transcription. This process involves three main steps: Initiation (RNA polymerase binds to the promoter), Elongation (synthesis of the RNA strand), and Termination (RNA polymerase reaches the terminator sequence). The resulting mRNA then serves as a template for protein synthesis.

Final Answer : "Transcription"

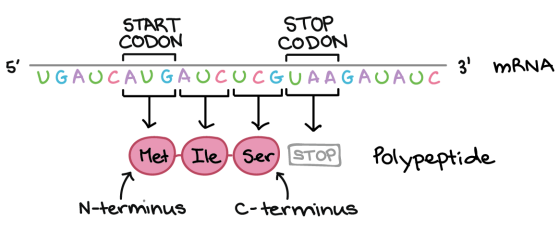
Answer: (C)

Q25.

Solution

Concept: Genetic Code: Termination Codons.

Solution: Out of the 64 codons, 61 code for amino acids. The remaining 3 do not code for any amino acids and are called Stop Codons or termination codons because they signal the end of translation. These are UAA (Ochre), UAG (Amber), and UGA (Opal). In the given options, UAA is the stop codon.



Final Answer : "UAA"

Answer: (C)

Q26.

Solution

Concept: DNA Profiling Principles.

Solution: DNA fingerprinting involves identifying differences in specific regions of DNA where a small sequence is repeated many times. These regions are called Repetitive DNA. They are separated from bulk genomic DNA as different peaks during density gradient centrifugation, which is why they are also called satellite DNA. The high degree of polymorphism in these sequences is the basis of DNA fingerprinting.

Final Answer : "Repetitive DNA"

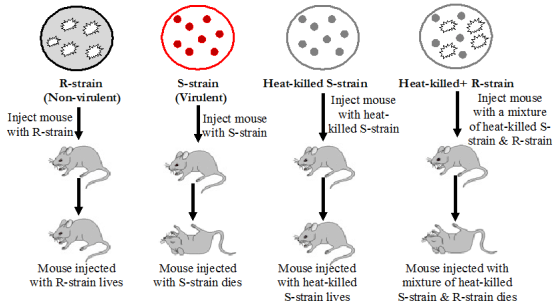
Answer: (A)

Q27.

Solution

Concept: Transforming Principle in Microbiology.

Solution: In 1928, Frederick Griffith conducted a series of experiments using *Streptococcus pneumoniae* and mice. He observed that when heat-killed S-strain (virulent) bacteria were mixed with live R-strain (non-virulent) bacteria, the R-strain was transformed into the virulent S-strain. He concluded that a "transforming principle" was transferred from the dead S-strain to the live R-strain, which was later identified as DNA.



Final Answer : "Frederick Griffith"

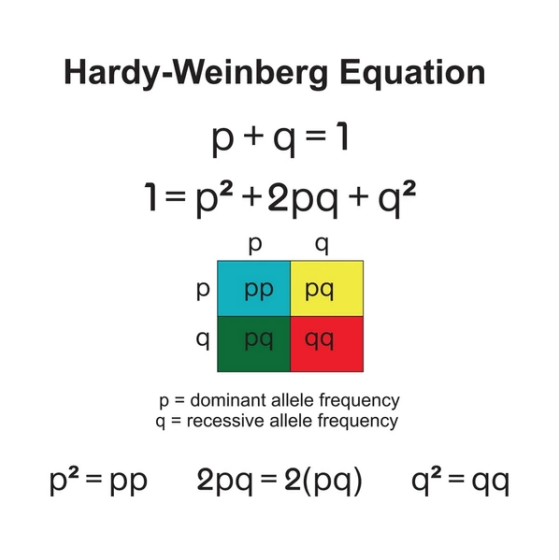
Answer: (C)

Q28.

Solution

Concept: Hardy-Weinberg Principle and Genetic Equilibrium.

Solution: The Hardy-Weinberg principle states that allele frequencies in a population are stable and is constant from generation to generation in the absence of evolutionary influences (like mutation, gene flow, genetic drift, and natural selection). This state is called genetic equilibrium.



Mathematically, if p represents the frequency of the dominant allele and q represents the frequency of the recessive allele, the sum total of all allelic frequencies is represented as:

$$p + q = 1$$

Furthermore, the distribution of genotypes can be represented by the binomial expansion:

$$p^2 + 2pq + q^2 = 1$$

where p^2 is the frequency of homozygous dominant individuals, $2pq$ is the frequency of heterozygotes, and q^2 is the frequency of homozygous recessive individuals. In all cases, the sum total is always unity (1).

Final Answer : "1"

Answer: (B)

Q29.

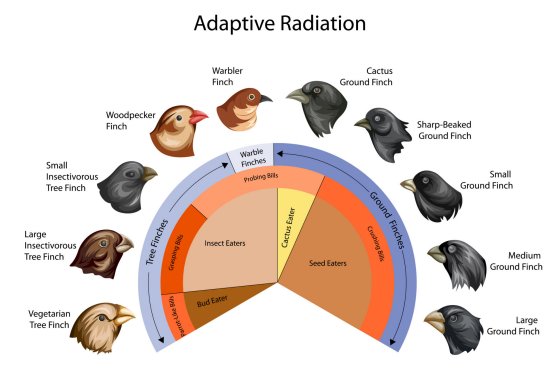
Solution

Concept: Adaptive Radiation in Evolution.

Solution: During his journey to the Galapagos Islands, Charles Darwin observed a variety of small black birds later called Darwin's Finches. He realized that all these varieties evolved on the same island from an original seed-eating ancestor.

- The Process: As the birds spread to different habitats on the islands, they adapted to different food sources (insects, cactus, seeds, etc.).
- The Result: This led to the evolution of different beak shapes and sizes.

This process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called Adaptive Radiation. It is a form of divergent evolution.



Final Answer : "Adaptive Radiation"

Answer: (B)

Q30.

Solution

Concept: Stages of Human Evolution.

Solution: The evolutionary history of humans involves several key ancestors.

- Australopithecines lived in East African grasslands and were essentially "ape-men."
- The first human-like being, the hominid, was Homo habilis.
- Characteristics: They had a brain capacity between 650–800cc. They probably did not eat meat and are known as the "handy man" because they were the first to use tools.
- Following Homo habilis was Homo erectus (around 1.5 million years ago) with a larger brain (900cc) and a meat-eating diet.

Final Answer : "Homo habilis"

Answer: (B)

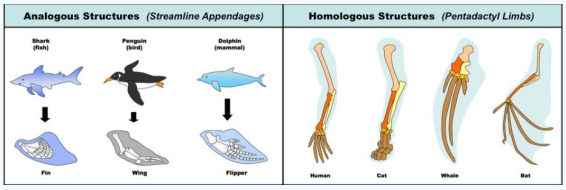
Q31.

Solution

Concept: Convergent Evolution and Analogous Organs.

Solution: Analogous organs are structures that are anatomically different and have different evolutionary origins, but perform similar functions.

- Cause: This happens because different organisms are subjected to similar environmental pressures or live in similar habitats, leading them to evolve similar adaptations.
- Process: This is known as Convergent Evolution.
- Examples: The wings of a butterfly (membranous) and a bird (bony/feathery); the eye of an octopus and a mammal; the flippers of penguins and dolphins; and the sweet potato (root modification) vs. potato (stem modification).



Final Answer : "Convergent evolution"

Answer: (B)

Q32.

Solution

Concept: Life Cycle of Plasmodium (Malaria Parasite).

Solution: Malaria is caused by the protozoan Plasmodium. Its life cycle requires two hosts: humans and the female Anopheles mosquito.

1. When an infected female Anopheles mosquito bites a human, it injects the parasite into the bloodstream.
2. The parasite is injected in the form of Sporozoites, which is the infective stage.
3. These sporozoites travel through the blood to the liver, where they multiply asexually before attacking Red Blood Cells (RBCs) as merozoites.
4. The rupture of RBCs releases hemozoin, which causes the characteristic recurring chills and high fever.

Final Answer : "Sporozoite"

Answer: (B)

Q33.

Solution

Concept: Types of Immunity - Innate vs. Acquired.

Solution: Innate Immunity is a non-specific type of defense that is present at the time of birth. It consists of four types of barriers:

1. Physical barriers: Skin and mucus coating.
2. Physiological barriers: Acid in the stomach, saliva in the mouth, tears from eyes.
3. Cellular barriers: Certain WBCs like PMNL-neutrophils and monocytes.
4. Cytokine barriers: Interferons. These are proteins secreted by virus-infected cells which protect non-infected cells from further viral infection.

In contrast, B-lymphocytes, T-lymphocytes, and vaccination are parts of Acquired Immunity, which is pathogen-specific and characterized by memory.

Final Answer : "Interferons"

Answer: (C)

Q34.

Solution

Concept: Pathogenesis of HIV/AIDS.

Solution: The Human Immunodeficiency Virus (HIV) is a retrovirus that targets the body's immune system. Upon entering the human body, the virus enters macrophages and eventually moves into Helper T-lymphocytes (TH cells).

- Inside these cells, the viral RNA replicates into DNA using the enzyme reverse transcriptase. - The virus then replicates and produces progeny viruses, which are released into the blood to attack other Helper T-lymphocytes.
- This leads to a progressive decrease in the number of Helper T-lymphocytes in the body.
- Because these cells are crucial for stimulating both B-cell and T-cell mediated immune responses, the person becomes severely immunocompromised and susceptible to opportunistic infections.

Final Answer : "Helper T-lymphocytes"

Answer: (C)

Q35.

Solution

Concept: Cellular Regulation and Oncogenic Transformation.

Solution: 1. In a healthy multicellular organism, cell growth and differentiation are highly controlled and regulated processes. One of the most critical regulatory mechanisms is contact inhibition.

2. Contact inhibition is the property shown by normal eukaryotic cells where, upon coming into physical contact with one another, they send inhibitory signals that stop further cell division and movement. This ensures cells grow in a neat, organized monolayer.

3. Cancer cells are characterized by the loss of this specific property. Because they no longer "feel" the presence of neighboring cells, they continue to divide uncontrollably, piling up on top of one another to form masses of cells known as tumors (neoplasms).

4. Metastasis is a later stage of cancer where cells slough off from the primary tumor and reach distant sites via blood to start new tumors, which is the most feared property of malignant tumors.

Final Answer : "Contact inhibition"

Answer: (C)

Q36.

Solution

Concept: Secondary (Biological) Sewage Treatment.

Solution: 1. After the primary treatment of sewage (which involves physical removal of particles), the effluent is passed into large aeration tanks.

2. Here, the liquid is constantly agitated mechanically and air is pumped into it. This allows for the vigorous growth of useful aerobic microbes.

3. These microbes grow into structures called flocs. Flocs are essentially masses of bacteria associated with fungal filaments that form a mesh-like or network-like structure.

4. The significance of flocs is that as they grow, the bacteria consume the majority of the organic matter present in the effluent. This process drastically reduces the Biochemical Oxygen Demand (BOD) of the water, making it less polluting before it is discharged into natural water bodies.

Final Answer : "Bacteria and Fungal filaments"

Answer: (A)

Q37.

Solution

Concept: Biological Control of Pests and Pathogens.

Solution: 1. Biocontrol involves the use of biological organisms to control plant diseases and pests, reducing the reliance on toxic chemical pesticides.

2. Trichoderma species are a genus of free-living fungi that are very common in soil and root ecosystems (the rhizosphere).

3. They are highly effective biocontrol agents against various soil-borne plant pathogens (fungi and bacteria). They work through mechanisms such as competition for nutrients, antibiosis (secreting toxins), and mycoparasitism (attacking other fungi).

4. Bacillus thuringiensis is used specifically for controlling insect larvae (caterpillars), while aphids and dragonflies are predatory insects used to control other insect populations like mosquitoes.

Final Answer : "Trichoderma"

Answer: (B)

Q38.

Solution

Concept: Bioactive Molecules and Medical Biotechnology.

Solution: 1. Statins are a class of bioactive molecules that have commercial importance as blood-cholesterol lowering agents.

2. They are produced through the fermentation process of the yeast (a fungus) known as Monascus purpureus.

3. The medical utility of statins lies in their ability to act as competitive inhibitors. They resemble the substrate for the enzyme HMG-CoA reductase, which is the rate-limiting enzyme in the synthesis of cholesterol in the liver.

4. By binding to this enzyme, statins prevent the liver from producing cholesterol, thereby lowering the overall cholesterol levels in the patient's blood and reducing the risk of cardiovascular diseases.

Final Answer : "Monascus purpureus"

Answer: (B)

Q39.

Solution

Concept: Tools of Recombinant DNA Technology.

Solution: 1. Restriction enzymes (specifically restriction endonucleases) are proteins produced by bacteria as a defense mechanism against invading viruses (bacteriophages).

2. In biotechnology, they are referred to as molecular scissors because they have the unique ability to "cut" DNA strands at very specific locations.

3. Each restriction enzyme recognizes a specific palindromic nucleotide sequence (a sequence that reads the same on both strands when the orientation is kept the same, e.g., 5'-GAATTC-3').

4. By cutting the sugar-phosphate backbone of the DNA at these precise points, they allow scientists to isolate specific genes or create "sticky ends" that can be joined with other DNA fragments.

Final Answer : "Molecular scissors"

Answer: (B)

Q40.

Solution

Concept: Mechanism of Polymerase Chain Reaction (PCR).

Solution: PCR is a process used to amplify a single copy or a few copies of a specific DNA segment. One complete cycle consists of three sequential steps:

1. Denaturation: The reaction mixture is heated to about 94–96°C. This high temperature breaks the hydrogen bonds between the two strands of the DNA double helix, resulting in single-stranded DNA.

2. Annealing: The temperature is lowered to about 50–65°C. This allows the DNA primers (short sequences) to bind or "anneal" to their complementary sequences on the single-stranded DNA templates.

3. Extension: The temperature is raised to approximately 72°C. The DNA polymerase enzyme adds nucleotides to the primers, extending them to create a complete double-stranded DNA molecule identical to the original.

Final Answer : "Denaturation, Annealing, Extension"

Answer: (B)

Q41.

Solution

Concept: Thermostable Enzymes in Genetic Engineering.

Solution: 1. PCR involves repeated cycles of high temperature (up to 95°C) to denature DNA. Most enzymes, including standard human DNA polymerase, are proteins that would be permanently destroyed (denatured) at these temperatures.

2. To make PCR practical, scientists use Taq Polymerase, a DNA polymerase isolated from the bacterium Thermus aquaticus.

3. This bacterium thrives in extreme environments like hydrothermal vents and hot springs. Consequently, its enzymes are evolved to be thermostable, meaning they remain active and functional even after repeated exposure to the high temperatures required for the denaturation step in PCR.

Final Answer : "Taq Polymerase"

Answer: (B)

Q42.

Solution

Concept: Bioprocess Engineering and Product Recovery.

Solution: 1. Recombinant DNA technology produces a desired protein or compound within a host cell or bioreactor. Once the biosynthetic stage is complete, the product must be recovered and refined.

2. Downstream processing refers to the collection of stages that follow the completion of the fermentation or synthesis.

3. The two primary components of downstream processing are Separation (extracting the product from the cells, debris, and culture medium) and Purification (removing all other contaminants to get a pure chemical or biological entity).

4. This stage is critical for ensuring the safety and efficacy of products, especially for pharmaceuticals and food additives.

Final Answer : "Separation and Purification"

Answer: (A)

Q43.

Solution

Concept: Mechanism of Bacillus thuringiensis (Bt) Toxin.

Solution: 1. Bt cotton is a genetically modified crop that contains the cry genes from the bacterium Bacillus thuringiensis. These genes produce protein crystals called protoxins.

2. The protoxin is inactive while inside the plant or the bacterium. However, once an insect (such as a bollworm) consumes the plant tissue, the protoxin enters its gut.

3. The alkaline pH of the insect's midgut converts the inactive protoxin into an active form.

4. The activated toxin then binds to the surface of the midgut epithelial cells and creates pores. These pores cause cell swelling and lysis (bursting), which eventually leads to the death of the insect by starvation and sepsis.

Final Answer : "Creating pores in the midgut epithelial cells"

Answer: (B)

Q44.

Solution

Concept: Gene Silencing and Pest Resistance.

Solution: 1. RNA interference (RNAi) is a biological process in which RNA molecules inhibit gene expression or translation, typically by neutralizing targeted mRNA molecules.

2. This mechanism occurs in all eukaryotic organisms as a method of cellular defense.

3. In biotechnology, RNAi has been successfully used to develop plants resistant to Nematodes (specifically Meloidogyne incognita), which infect the roots of tobacco plants.

4. By introducing DNA that produces both sense and anti-sense RNA in the host plant, a double-stranded RNA (dsRNA) is formed. When the nematode feeds on the plant, this dsRNA triggers the silencing of specific essential nematode genes, causing the parasite to die.

Final Answer : "Nematodes"

Answer: (C)

Q45.

Solution

Concept: Chemical Structure and Synthesis of Human Insulin.

Solution: 1. In mammals, including humans, insulin is initially synthesized as a "pro-hormone" (much like a pro-enzyme needs to be processed to become active). This pro-insulin contains an additional stretch of amino acids called the C-peptide.

2. For insulin to become functionally mature, this C-peptide must be removed during processing. The mature, active form of human insulin consists of two distinct polypeptide chains: Chain A (comprising 21 amino acids) and Chain B (comprising 30 amino acids).

3. These two polypeptide chains are physically held together by covalent bonds known as disulfide bridges (or disulfide bonds). These bridges form specifically between the sulfur-containing cysteine residues of the two chains. There are two inter-chain disulfide bonds connecting Chain A to Chain B, and one intra-chain disulfide bond within Chain A.

4. This structural knowledge was crucial for the biotechnology firm Eli Lilly in 1983. They used recombinant DNA technology to produce two DNA sequences corresponding to the A and B chains, inserted them into E. coli plasmids to produce the chains separately, and then extracted and combined them by creating these specific disulfide bonds in a laboratory setting to create "Humulin."

Final Answer : “Disulfide bridges”

Answer: (B)

Q46.

Solution

Concept: Population Growth Models and Age Structures.

Solution: 1. An age pyramid is a graphical illustration showing the distribution of various age groups in a specific population. These groups are generally categorized as Pre-reproductive (0-14 years), Reproductive (15-44 years), and Post-reproductive (45+ years).

2. When the age pyramid has a broad base, it indicates that the population has a very high proportion of young (pre-reproductive) individuals.

3. This demographic structure suggests that as the large younger generation enters their reproductive years, they will produce even more offspring, leading to a rapid increase in the total population size.

4. Ecologically, a pyramid with a broad base and a narrow top (a triangular shape) is characteristic of an expanding population.

5. In comparison:

- A stable population has an "Urn-shaped" or bell-shaped pyramid where pre-reproductive and reproductive age groups are almost equal.
- A declining population has a narrow base, indicating fewer young individuals than adults, which leads to a decrease in population over time.

Final Answer : "Expanding"

Answer: (C)

Q47.

Solution

Concept: Types of Interspecific Population Interactions.

Solution: 1. Population interactions involve the relationship between individuals of two different species living in the same community. These are represented as positive (+), negative (-), or neutral (0).

2. Commensalism is defined as an interaction where one species is benefited (+) while the other species is neither harmed nor benefited (0). The host species remains completely unaffected by the presence of the commensal.

3. Classic examples include:

- Epiphytes: An orchid growing on the branch of a mango tree gets better light and support, while the mango tree derives no benefit and suffers no harm.
- Barnacles on Whales: The barnacles are transported to different feeding grounds, but the whale is generally unaffected by their weight or presence.
- Cattle Egrets and Grazing Cattle: The birds (egrets) catch insects that are flushed out from the grass by the movement of the cattle. The cattle gain nothing, but the egrets find food easily.

4. Other interactions include Mutualism (+/+), Parasitism (+/-), and Amensalism (-/0), where one is harmed and the other is unaffected.

Final Answer : "Commensalism"

Answer: (B)

Q48.

Solution

Concept: Energy Flow and Primary Productivity in Ecosystems.

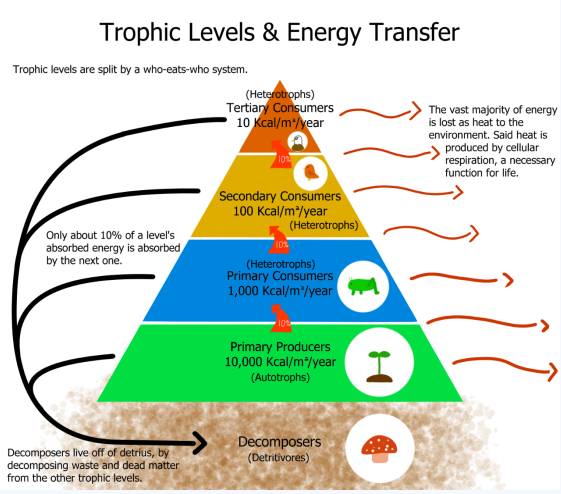
Solution: 1. Productivity in an ecosystem is the rate at which biomass or organic matter is produced per unit area over a period of time.

2. Gross Primary Productivity (GPP) represents the total amount of solar energy captured by the chlorophyll-bearing plants (producers) and converted into chemical energy (organic matter) through the process of photosynthesis.

3. However, the plants do not store all of this energy. A considerable amount of GPP is utilized by the plants themselves for their metabolic needs, specifically through the process of respiration (R).

4. The organic matter that remains after respiration is called Net Primary Productivity (NPP). This is the actual biomass available for consumption by herbivores and decomposers. The mathematical relationship is: $NPP = GPP - R$.

5. Therefore, while NPP is what moves up the food chain, the initial total production during photosynthesis is the Gross Primary Productivity.



Final Answer : "Gross Primary Productivity (GPP)"

Answer: (B)

Q49.

Solution

Concept: Biodiversity Conservation Methods.

Solution: 1. Conservation of biodiversity can be approached in two ways: In-situ (on-site) and Ex-situ (off-site).

2. In-situ conservation is the process of protecting an endangered plant or animal species in its natural habitat. This is achieved by protecting or cleaning up the habitat itself, or by defending the species from predators.

3. Biosphere Reserves are a prime example of in-situ conservation. They are large, protected areas meant for the conservation of biodiversity and the traditional lifestyle of the tribals living in the vicinity. Other examples include National Parks, Wildlife Sanctuaries, and Sacred Groves.

4. Ex-situ conservation involves moving the threatened species to a new, protected location. This includes:

- Botanical Gardens and Zoological Parks (Wildlife Safari Parks).
- Cryopreservation (preserving gametes at very low temperatures).
- Seed Banks for preserving plant genetics.

Final Answer : "Biosphere Reserve"

Answer: (C)

Q50.

Solution

Concept: The "Evil Quartet" and Threats to Biodiversity.

Solution: 1. The "Evil Quartet" is a term popularized by ecologists to categorize the four major ways in which human activities are causing the current high rates of species extinction.

2. The four pillars of the Evil Quartet are:

- Habitat Loss and Fragmentation: This is the most significant cause. Large habitats (like the Amazon rainforest) are broken into small fragments due to human activities, leading to the decline of animals requiring large territories.
- Over-exploitation: When the biological system is harvested beyond its capacity to recover (e.g., overfishing or the extinction of the Passenger Pigeon).
- Alien Species Invasions: When non-native species are introduced (intentionally or accidentally), they can become invasive and kill off indigenous species (e.g., the Nile Perch in Lake Victoria).
- Co-extinctions: When a species goes extinct, the other species (parasites or pollinators) that are obligately associated with it also go extinct.

Final Answer : "Four causes of biodiversity loss"

Answer: (B)

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	A	3	C	4	C	5	A
6	B	7	C	8	C	9	C	10	B
11	A	12	B	13	B	14	B	15	C
16	B	17	C	18	C	19	B	20	B
21	C	22	B	23	C	24	C	25	C
26	A	27	C	28	B	29	B	30	B
31	B	32	B	33	C	34	C	35	C
36	A	37	B	38	B	39	B	40	B
41	B	42	A	43	B	44	C	45	B
46	C	47	B	48	B	49	C	50	B