NEET- UG Biology Sample Paper-9

Duration: 1 Hour **Maximum Marks: 360**

Instructions

- This paper contains a total of **90** Multiple Choice Questions.
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries **-1 mark**.
- No negative marking for unattempted questions.

Q1. Which of the following taxonomic categories contains organisms least similar to one another?

(A) Class

(B) Genus

(C) Family

(D) Species

Q2. In a longitudinal section of a root, starting from the tip upward, the four zones are arranged in the following order:

(A) Root cap, Cell division, Cell enlargement, Cell maturation

(B) Root cap, Cell division, Cell maturation, Cell enlargement

(C) Cell division, Cell enlargement, Cell maturation, Root cap

(D) Cell maturation, Cell enlargement, Cell division, Root cap

Q3. Which of the following organelles is responsible for extracting energy from carbohydrates to form ATP?

(A) Lysosome

(B) Ribosome

(C) Chloroplast

(D) Mitochondrion

Q4. The process of osmosis involves the movement of:

(A) Solute from low concentration to high concentration

(B) Solvent from higher water potential to lower water potential

(C) Solute from semi-permeable membrane

(D) Solvent from lower water potential to higher water potential

Q5. The volume of air that remains in the lungs after a normal expiration is known as:

(A) Vital Capacity

(B) Tidal Volume

(C) Residual Volume

(D) Functional Residual Capacity

Q6. Double fertilization is a characteristic feature of:

(A) Gymnosperms

(B) Angiosperms

(C) Pteridophytes

(D) Bryophytes

Q7. If a color-blind man marries a woman who is homozygous for normal color vision, the probability of their son being color-blind is:

(A) 0

(B) 0.5

(C) 0.75

(D) 1

Q8. The term 'Antibiotics' was coined by:

(A) Alexander Fleming

(B) Selman Waksman

(C) Louis Pasteur

(D) Edward Jenner

Q9. The DNA fragments separated on an agarose gel can be visualized after staining with:

(A) Acetocarmine

(B) Aniline blue

(C) Ethidium bromide

(D) Bromophenol blue

Q10. Which of the following is a primary pollutant?

(A) O_3

(B) PAN

(C) SO_2

(D) Aldehydes

Q11. Identify the correct sequence of taxonomic hierarchy:

(A) Species → Genus → Family → Order → Class → Phylum → Kingdom

(B) Kingdom → Family → Order → Class → Phylum → Genus → Species

(C) Kingdom → Phylum → Order → Cohort → Family → Genus → Species

(D) Phylum → Order → Family → Kingdom → Genus → Species

Q12. Presence of pneumatophores is a characteristic of plants growing in:

(A) Sandy soil

(B) Saline marshy soil

(C) Marshy soil

(D) Acidic soil

Q13. Which stage of the cell cycle involves the synthesis of DNA?

(A) G_1 phase

(B) S phase

(C) G_2 phase

(D) M phase

Q14. The reaction centre in Photosystem II has an absorption maximum at:

(A) 700 nm

(B) 680 nm

(C) 660 nm

(D) 720 nm

Q15. Which of the following hormones is called 'emergency hormone'?

(A) Insulin

(B) Adrenaline

(C) Thyroxine

(D) Oxytocin

Q16. Which of the following represents the correct floral formula of the family Fabaceae?

(A) $\% \uparrow K_{(5)}\, C_{1+2+(2)}\, A_{(9)+1}\, \underline{G}_1$

(B) $\oplus \uparrow K_{(5)}\, C_{1+2+2}\, A_{10}\, \underline{G}_1$

(C) $\% \uparrow K_{(5)}\ C_5\ A_{(9)+1}\ \underline{G}_1$

(D) $\oplus \uparrow K_5\ C_{1+2+(2)}\ A_{(9)+1}\ \underline{G}_1$

Q17. The process of conversion of atmospheric nitrogen to ammonia by living organisms is called:

(A) Nitrification

(B) Denitrification

(C) Biological nitrogen fixation

(D) Ammonification

Q18. The part of the human brain responsible for the regulation of body temperature and hunger is:

(A) Cerebellum

(B) Cerebrum

(C) Hypothalamus

(D) Medulla oblongata

Q19. Identify the incorrect statement regarding the human heart:

(A) The tricuspid valve guards the opening between the right atrium and right ventricle.

(B) The bicuspid valve is also known as the mitral valve.

(C) Nodal tissue is specialized cardiac musculature distributed in the heart.

(D) The SAN is located in the lower-left corner of the right atrium.

Q20. A cross between a homozygous recessive and an individual of unknown genotype to determine the latter's zygosity is called a:

(A) Back cross

(B) Test cross

(C) Monohybrid cross

(D) Dihybrid cross

Q21. Which of the following is not a functional unit of an ecosystem?

(A) Energy flow

(B) Decomposition

(C) Stratification

(D) Productivity

Q22. The primary carbon dioxide acceptor in C_4 plants is:

(A) RuBP

(B) PEP

(C) PGA

(D) OAA

Q23. Restriction endonucleases are enzymes which:

(A) Make cuts at specific positions within the DNA molecule

(B) Recognize a specific nucleotide sequence for binding DNA ligase

(C) Restrict the action of the enzyme DNA polymerase

(D) Remove nucleotides from the ends of the DNA molecule

Q24. In human females, meiosis-II is not completed until:

(A) Birth

(B) Puberty

(C) Fertilization

(D) Uterine implantation

Q25. The association between a shark and a suckerfish (Remora) is an example of:

(A) Parasitism

(B) Mutualism

(C) Commensalism

(D) Predation

Q26. The relationship between Gross Primary Productivity (GPP), Net Primary Productivity (NPP), and Respiration (R) is correctly represented as:

(A) $GPP = NPP - R$

(B) $NPP = GPP - R$

(C) $GPP = R - NPP$

(D) $NPP = GPP + R$

Q27. Identify the correct sequence of the electrical conduction pathway in the human heart:

(A) SAN → AVN → Bundle of His → Purkinje fibers

(B) AVN → SAN → Purkinje fibers → Bundle of His

(C) SAN → Purkinje fibers → AVN → Bundle of His

(D) Bundle of His → SAN → AVN → Purkinje fibers

Q28. The pyramid of biomass in an aquatic ecosystem (like a sea) is typically:

(A) Upright

(B) Inverted

(C) Spindle-shaped

(D) Urn-shaped

Q29. Seminal plasma in human males is rich in:

(A) Fructose and certain enzymes but poor in calcium

(B) Fructose, calcium and certain enzymes

(C) Fructose and calcium but has no enzymes

(D) Glucose and certain enzymes but has no calcium

Q30. In genetic engineering, a 'plasmid' is defined as:

(A) The main bacterial chromosome

(B) A linear fragment of DNA

(C) Extra-chromosomal, circular DNA

(D) A viral protein coat

Q31. Which of the following is an example of an autosomal recessive disorder?

(A) Hemophilia

(B) Sickle-cell anemia

(C) Color blindness

(D) Myotonic dystrophy

Q32. The hormone that stimulates the process of erythropoiesis is produced by:

(A) Bone marrow

(B) Juxtaglomerular cells of the kidney

(C) Liver

(D) Spleen

Q33. In 'Bt cotton', the 'Bt' refers to:

(A) Biotechnology

(B) Bio-toxin

(C) *Bacillus thuringiensis*

(D) *Bacteroides thalassica*

Q34. The ozone hole is most prominent over which region of the Earth?

(A) Equator

(B) Arctic region

(C) Antarctica

(D) Tropical forests

Q35. The process of charging of tRNA is technically called:

(A) Aminoacylation

(B) Transcription

(C) Deamination

(D) Phosphorylation

Q36. The enzyme Recombinase is required at which stage of meiosis?

(A) Pachytene

(B) Zygotene

(C) Diplotene

(D) Diakinesis

Q37. The first stable product of CO_2 fixation in C_3 plants is:

(A) Oxaloacetic acid (OAA)

(B) 3-phosphoglyceric acid (PGA)

(C) Phosphoenolpyruvate (PEP)

(D) Ribulose biphosphate (RuBP)

Q38. Which part of the poppy plant is used to obtain the drug 'Smack'?

(A) Flowers

(B) Latex

(C) Roots

(D) Leaves

Q39. A population interaction where one species is harmed and the other is unaffected is:

(A) Amensalism

(B) Commensalism

(C) Mutualism

(D) Competition

Q40. The functional unit of contraction in a muscle fiber is the:

(A) Myofibril

(B) Sarcomere

(C) Sarcoplasm

(D) Z-line

Q41. The process of 'Montreal Protocol' was signed in 1987 to control the emission of:

(A) Greenhouse gases

(B) Ozone depleting substances

(C) Metallic pollutants

(D) CO2 and Methane

Q42. In a double-stranded DNA, the ratio of Adenine + Thymine to Guanine + Cytosine is:

(A) Constant for all species

(B) Constant for a given species

(C) Always equal to 1

(D) Always more than 1

Q43. Which of the following is a non-medicated Intrauterine Device (IUD)?

(A) Lippes loop

(B) Cu7

(C) Multiload 375

(D) LNG-20

Q44. The 'Lock and Key' hypothesis of enzyme action was proposed by:

(A) Koshland

(B) Emil Fischer

(C) Kuhne

(D) Dixon

Q45. Which of the following ecosystems has the maximum net primary productivity?

(A) Temperate forests

(B) Tropical rain forests

(C) Coral reefs

(D) Mangroves

Q46. Which of the following is the correct sequence of steps in a PCR (Polymerase Chain Reaction)?

(A) Denaturation, Extension, Annealing

(B) Extension, Denaturation, Annealing

(C) Denaturation, Annealing, Extension

(D) Annealing, Extension, Denaturation

Q47. The 'Evil Quartet' is a term used to describe the four major causes of:

(A) Population explosion

(B) Air pollution

(C) Biodiversity losses

(D) Global warming

Q48. Which part of the human ear plays no role in hearing but is otherwise very much required?

(A) Eustachian tube

(B) Organ of Corti

(C) Vestibular apparatus

(D) Ear ossicles

Q49. The cork cambium, cork and secondary cortex are collectively called:

(A) Phelloderm

(B) Phellogen

(C) Periderm

(D) Phellem

Q50. In a dihybrid cross, if you get a 9 : 3 : 3 : 1 ratio, it denotes that:

(A) The alleles of two genes are interacting with each other

(B) It is a multigenic inheritance

(C) It is a case of codominance

(D) The alleles of two genes are segregating independently

Q51. Which of the following is a hormone-releasing Intrauterine Device (IUD)?

(A) Multiload 375

(B) Lippes loop

(C) Cu7

(D) LNG-20

Q52. The process of guttation takes place:

(A) When the root pressure is high and the rate of transpiration is low

(B) When the root pressure is low and the rate of transpiration is high

(C) When the root pressure equals the rate of transpiration

(D) When the root pressure as well as the rate of transpiration are high

Q53. Select the correctly matched pair:

(A) Parthenocarpic fruit - Apple

(B) Apocarpous ovary - Rose

(C) Syncarpous ovary - Lotus

(D) Polyadelphous stamens - Pea

Q54. The site of production of ADA (Adenosine Deaminase) in the body is:

(A) Erythrocytes

(B) Lymphocytes

(C) Blood plasma

(D) Osteocytes

Q55. Which of the following is not a feature of the plasmids?

(A) Circular structure

(B) Transferable

(C) Single-stranded

(D) Independent replication

Q56. Which of the following is considered the 'Powerhouse of the cell'?

(A) Golgi complex

(B) Mitochondria

(C) Ribosome

(D) Nucleus

Q57. The term 'Nuclein' for the genetic material was coined by:

(A) Friedrich Miescher

(B) James Watson

(C) Francis Crick

(D) Maurice Wilkins

Q58. An example of a colonial alga is:

(A) Chlorella

(B) Volvox

(C) Ulothrix

(D) Spirogyra

Q59. The process of conversion of complex food substances to simple absorbable forms is called:

(A) Absorption

(B) Digestion

(C) Assimilation

(D) Egestion

Q60. Which of the following is a 'stop' codon during translation?

(A) AUG

(B) UGG

(C) UAA

(D) GUG

Q61. In which of the following, the male and female gametophytes do not have an independent free-living existence?

(A) Pteridophytes

(B) Algae

(C) Angiosperms

(D) Bryophytes

Q62. The most abundant protein in the whole of the biosphere is:

(A) Collagen

(B) Trypsin

(C) Insulin

(D) RuBisCO

Q63. Removal of RNA polymerase III from nucleoplasm will affect the synthesis of:

(A) tRNA

(B) hnRNA

(C) mRNA

(D) rRNA

Q64. The 'Montreal Protocol' refers to the control of:

(A) Water pollution

(B) Ozone depleting substances

(C) Global warming

(D) Biodiversity conservation

Q65. Which of the following organisms is used in the production of 'Swiss Cheese'?

(A) *Propionibacterium sharmanii*

(B) *Saccharomyces cerevisiae*

(C) *Lactobacillus*

(D) *Penicillium roqueforti*

Q66. The first human-like hominid was called:

(A) *Homo erectus*

(B) *Homo habilis*

(C) *Ramapithecus*

(D) *Australopithecus*

Q67. Which of the following is a criterion for being a 'Biodiversity Hotspot'?

(A) High degree of endemism

(B) Low levels of species richness

(C) Total absence of human interference

(D) Minimal accelerated habitat loss

Q68. In a pyramid of energy, if the producers have $10,000$ J of energy, the energy available at the secondary consumer level will be:

(A) 1,000 J

(B) 100 J

(C) 10 J

(D) 1 J

Q69. The enzyme used to join DNA fragments is:

(A) DNA polymerase

(B) DNA ligase

(C) Helicase

(D) Topoisomerase

Q70. Which of the following is a primary lymphoid organ?

(A) Spleen

(B) Lymph nodes

(C) Thymus

(D) Peyer's patches

Q71. The association of Mycorrhiza is an example of:

(A) Parasitism

(B) Amensalism

(C) Mutualism

(D) Commensalism

Q72. Which plant was used by Hugo de Vries to propose the Mutation Theory?

(A) *Pisum sativum*

(B) *Oenothera lamarckiana*

(C) *Drosophila melanogaster*

(D) *Antirrhinum majus*

Q73. The structural and functional unit of the human kidney is:

(A) Nephridia

(B) Neuron

(C) Nephron

(D) Henle's loop

Q74. Which of the following is an example of an ex-situ conservation method?

(A) National Park

(B) Wildlife Sanctuary

(C) Biosphere Reserve

(D) Seed Bank

Q75. The process of synthesis of mRNA from DNA is called:

(A) Translation

(B) Transformation

(C) Transcription

(D) Transduction

Q76. Which hormone is responsible for the 'Milk Ejection Reflex'?

(A) Prolactin

(B) Estrogen

(C) Oxytocin

(D) Progesterone

Q77. The 'Wings of Butterfly' and 'Wings of Bird' are examples of:

(A) Homologous organs

(B) Analogous organs

(C) Vestigial organs

(D) Atavism

Q78. What is the destination of the pollen tube after it reaches the embryo sac?

(A) Egg cell

(B) Central cell

(C) One of the synergids

(D) Antipodal cells

Q79. The 'Gause's Principle of Competitive Exclusion' states that:

(A) Two closely related species can coexist indefinitely

(B) Competitively superior species will eventually eliminate the inferior one

(C) Species will evolve to avoid competition

(D) Competition leads to mutual benefit

Q80. Which metal ion is a constituent of Chlorophyll?

(A) Fe^{2+}

(B) Mg^{2+}

(C) Cu^{2+}

(D) Mn^{2+}

Q81. In the C_4 pathway, the bundle sheath cells are rich in which enzyme?

(A) PEPcase

(B) RuBisCO

(C) Carbonic anhydrase

(D) Hexokinase

Q82. The total number of biodiversity hotspots identified in the world is:

(A) 25

(B) 34

(C) 40

(D) 15

Q83. Which of the following is the 'Start Codon'?

(A) UAA

(B) AUG

(C) UAG

(D) UGA

Q84. The 'Statins' used for lowering blood cholesterol are obtained from:

(A) *Acetobacter aceti*

(B) *Monascus purpureus*

(C) *Clostridium butylicum*

(D) *Aspergillus niger*

Q85. The fluid mosaic model of cell membrane was proposed by:

(A) Schleiden and Schwann

(B) Singer and Nicolson

(C) Robert Hooke

(D) Camillo Golgi

Q86. Which of the following is a Greenhouse gas?

(A) N_2

(B) O_2

(C) CH_4

(D) Ar

Q87. The 'Ploidy level' of the endosperm in Angiosperms is:

(A) n

(B) $2n$

(C) $3n$

(D) $4n$

Q88. The enzyme that breaks the hydrogen bonds between DNA strands during replication is:

(A) Ligase

(B) Helicase

(C) Polymerase

(D) Nuclease

Q89. The concept of 'Omnis cellula-e cellula' was given by:

(A) Rudolf Virchow

(B) Aristotle

(C) Robert Brown

(D) Antonie van Leeuwenhoek

Q90. Which of the following is used as a 'Biological Scissor' in DNA technology?

(A) DNA Ligase

(B) Restriction Endonuclease

(C) Polymerase

(D) RNA Primase

Detailed Solutions

Q1.

Solution

Concept:

In the biological classification system, the taxonomic hierarchy consists of several levels. As we move from Species to Kingdom, the number of common characteristics decreases, and the organisms become more diverse.

Solution:

1. The taxonomic hierarchy is: Species < Genus < Family < Order < Class < Phylum < Kingdom. 2. In this hierarchy, 'Species' is the most specific level where organisms share the maximum number of common features. 3. As we go higher in the hierarchy, specifically to 'Class' in the given options, the organisms share fewer common features compared to Family or Genus. 4. Therefore, organisms in a 'Class' are least similar to one another compared to those in a Genus or Family.

Final Answer: The correct option is Class.

Answer: (A)

Q2.

Solution

Concept:

The root tip is organized into distinct biological regions that facilitate growth and nutrient absorption. Understanding the spatial arrangement from the apex upwards is crucial for plant anatomy.

Solution:

1. At the very tip of the root is the Root Cap, which protects the tender growing point. 2. Just above the root cap is the Meristematic zone (Zone of Cell Division), where cells actively divide. 3. Above the division zone is the Zone of Elongation (Cell Enlargement), where cells increase in length, responsible for root growth. 4. The uppermost region is the Zone of Maturation, where cells differentiate into specific types and root hairs are formed.

Final Answer: The correct sequence is Root cap, Cell division, Cell enlargement, Cell maturation.

Answer: (A)

Q3.

Solution

Concept:

Cellular respiration is the process by which cells convert biochemical energy from nutrients into Adenosine Triphosphate (ATP). Different organelles have specific roles in metabolic pathways.

Solution:

1. Mitochondria are known as the "powerhouse of the cell." 2. They are the sites of aerobic respiration. 3. Within the mitochondria, the Krebs cycle and the electron transport chain take place. 4. These processes break down derivatives of carbohydrates (like pyruvate) to produce a high yield of ATP. 5. While chloroplasts produce ATP during photosynthesis, the primary organelle for extracting energy from ingested carbohydrates in all aerobic eukaryotic cells is the mitochondrion.

Final Answer: The correct option is Mitochondrion.

Answer: (D)

Q4.

Solution

Concept:

Osmosis is a specific type of diffusion involving water molecules across a semi-permeable membrane. It is driven by the potential energy of water.

Solution:

1. Water potential (ψ_w) is a measure of the free energy of water in a system. Pure water has the highest potential. 2. Osmosis is the movement of solvent (water) molecules. 3. Water always moves spontaneously from a region of higher water potential (dilute solution) to a region of lower water potential (concentrated solution). 4. This movement occurs through a semi-permeable membrane until equilibrium is reached.

Final Answer: The process involves the movement of solvent from higher water potential to lower water potential.

Answer: (B)

Q5.

Solution

Concept:

Pulmonary volumes and capacities represent different quantities of air that the lungs can hold or move during various phases of respiration.

Solution:

1. Tidal Volume (TV) is the air inspired or expired during normal breathing. 2. Expiratory Reserve Volume (ERV) is the additional volume of air a person can expire by forceful expiration. 3. Residual Volume (RV) is the air remaining in lungs even after forceful expiration. 4. Functional Residual Capacity (FRC) is the volume of air that remains in the lungs after a normal expiration. 5. Mathematically, FRC = ERV + RV.

Final Answer: The volume is known as Functional Residual Capacity.

Answer: (D)

Q6.

Solution

Concept:

Double fertilization is a complex fertilization mechanism unique to flowering plants. It involves the join of a female gametophyte with two male gametes.

Solution:

1. In Angiosperms, the pollen grain releases two male gametes into the embryo sac. 2. The first male gamete fuses with the egg cell to form a diploid zygote ($2n$). This process is called Syngamy. 3. The second male gamete fuses with the two polar nuclei (or the secondary nucleus) in the center to form a triploid Primary Endosperm Nucleus ($3n$). This is called Triple Fusion. 4. Because two types of fusion (Syngamy and Triple Fusion) occur in the same embryo sac, the phenomenon is termed Double Fertilization. 5. This process is absent in Gymnosperms, Bryophytes, and Pteridophytes.

Final Answer: Double fertilization is a characteristic feature of Angiosperms.

Answer: (B)

Q7.

Solution

Concept:

Color blindness is an X-linked recessive disorder. Since males have only one X chromosome (XY), the presence of the defective gene on that single X chromosome causes the condition. Females (XX) must have the gene on both chromosomes to be affected.

Solution:

1. The genotype of a color-blind man is X^cY. 2. The genotype of a normal homozygous woman is XX. 3. When they cross: - The daughters receive X^c from the father and X from the mother, making them carriers (X^cX). - The sons receive the Y chromosome from the father and a normal X chromosome from the mother. 4. Therefore, the genotype of all sons will be XY (Normal vision). 5. The probability of a son being color-blind is 0%.

Final Answer: The probability is 0.

Answer: (A)

Q8.

Solution

Concept:

The history of microbiology includes several key figures who discovered or named the substances used to inhibit the growth of microorganisms.

Solution:

1. Alexander Fleming discovered the first antibiotic, Penicillin, in 1928, but he did not coin the general term. 2. Selman Waksman, a microbiologist who discovered streptomycin and several other antibiotics, coined the term "Antibiotic" in 1942 to describe substances produced by microorganisms that inhibit the growth of other microbes. 3. Louis Pasteur is known for pasteurization and vaccines, while Edward Jenner developed the smallpox vaccine.

Final Answer: The term 'Antibiotics' was coined by Selman Waksman.

Answer: (B)

Q9.

Solution

Concept:

DNA is a colorless molecule and is not visible under ordinary light even after separation by electrophoresis. Specific fluorescent dyes are required for visualization.

Solution:

1. In gel electrophoresis, DNA fragments are separated based on their size. 2. To see these fragments, the gel is stained with a compound called Ethidium bromide ($EtBr$). 3. Ethidium bromide intercalates between the nitrogenous bases of the DNA. 4. When the stained gel is exposed to Ultraviolet (UV) radiation, the DNA fragments appear as bright orange-colored bands. 5. Other dyes like Acetocarmine are used for staining chromosomes, but not for DNA in gels.

Final Answer: DNA fragments can be visualized after staining with Ethidium bromide.

Answer: (C)

Q10.

Solution

Concept:

Air pollutants are classified into two categories: Primary pollutants (emitted directly from a source) and Secondary pollutants (formed in the atmosphere through chemical reactions between primary pollutants).

Solution:

1. SO_2 (Sulfur dioxide) is emitted directly from the combustion of fossil fuels and volcanic eruptions, making it a primary pollutant. 2. O_3 (Ozone) and PAN (Peroxyacetyl nitrate) are secondary pollutants formed in the presence of sunlight from nitrogen oxides and volatile organic compounds. 3. Aldehydes can be both, but in the context of typical environmental studies, SO_2 is the classic example of a primary pollutant.

Final Answer: SO_2 is a primary pollutant.

Answer: (C)

Q11.

Solution

Concept:

Taxonomic hierarchy is the process of arranging various organisms into successive levels of the biological classification in either a decreasing or an increasing order from kingdom to species and vice versa. Each level of the hierarchy is called a taxonomic category or rank.

Solution:

1. The correct ascending order of categories is: Species → Genus → Family → Order → Class → Phylum (for animals) or Division (for plants) → Kingdom. 2. Species is the lowest category consisting of individuals with fundamental similarities. 3. Kingdom is the highest category. 4. As we go from species to kingdom, the number of common characteristics goes on decreasing. 5. Option (A) correctly reflects this sequence starting from the most specific (Species) to the most general (Kingdom).

Final Answer: The correct sequence is Species → Genus → Family → Order → Class → Phylum → Kingdom.

Answer: (A)

Q12.

Solution

Concept:

Pneumatophores are specialized root structures that grow out from the water surface or mud to facilitate gas exchange. They are typically found in plants growing in oxygen-poor environments.

Solution:

1. In saline marshy areas or swampy regions (mangroves), the soil is waterlogged and anaerobic (lacking oxygen). 2. Because the roots cannot breathe underground, some roots grow vertically upwards, emerging above the soil/water level. 3. These "breathing roots" have small pores called lenticels or pneumathodes through which the plant gets oxygen for respiration. 4. Examples include *Rhizophora* and *Avicennia*. 5. Sandy soil or acidic soil generally do not necessitate this specific respiratory adaptation.

Final Answer: Presence of pneumatophores is a characteristic of plants growing in saline marshy soil.

Answer: (B)

Q13.

Solution

Concept:

The cell cycle is divided into Interphase and M phase. Interphase is further divided into G_1, S, and G_2 phases, each having a specific metabolic role.

Solution:

1. G_1 phase (Gap 1) is the interval between mitosis and initiation of DNA replication; the cell is metabolically active but does not replicate DNA yet. 2. S phase (Synthesis phase) marks the period during which DNA synthesis or replication takes place. The amount of DNA per cell doubles during this time (from $2C$ to $4C$). 3. G_2 phase (Gap 2) involves protein synthesis in preparation for mitosis. 4. M phase is where actual cell division (mitosis) occurs. 5. Centriole duplication also occurs in the cytoplasm during the S phase in animal cells.

Final Answer: The S phase involves the synthesis of DNA.

Answer: (B)

Q14.

Solution

Concept:

Photosynthesis involves two photosystems (PS I and PS II). Each system has a light-harvesting complex and a reaction centre consisting of a specific chlorophyll a molecule.

Solution:

1. The reaction centre is chlorophyll a. 2. In Photosystem I (PS I), the reaction centre chlorophyll a has an absorption peak at 700 nm, hence it is called $P700$. 3. In Photosystem II (PS II), the reaction centre chlorophyll a has an absorption peak at 680 nm, hence it is called $P680$. 4. PS II is physically associated with the oxygen-evolving complex where photolysis of water occurs.

Final Answer: The reaction centre in PS II has an absorption maximum at 680 nm.

Answer: (B)

Q15.

Solution

Concept:

The body's "fight or flight" response is triggered by specific hormones secreted by the adrenal medulla during stressful or dangerous situations.

Solution:

1. Adrenaline (also known as Epinephrine) and Noradrenaline are secreted in response to stress of any kind. 2. These hormones increase alertness, pupilary dilation, heart rate, and the rate of respiration. 3. They also stimulate the breakdown of glycogen, resulting in an increased concentration of glucose in the blood to provide immediate energy. 4. Because they prepare the organism to either face the danger or flee from it, they are termed "emergency hormones." 5. Insulin regulates blood sugar, Thyroxine regulates metabolism, and Oxytocin is involved in childbirth and milk ejection.

Final Answer: Adrenaline is called the 'emergency hormone'.

Answer: (B)

Q16.

Solution

Concept:

The floral formula is a symbolic representation of the structure of a flower. Family Fabaceae (formerly Papilionaceae) includes plants like peas and beans, characterized by zygomorphic symmetry and a specific arrangement of petals and stamens.

Solution:

1. Symmetry: Fabaceae flowers are zygomorphic (bilateral symmetry), represented by the percentage symbol (%). 2. Calyx: There are 5 sepals, usually fused (gamosepalous), represented as $K_{(5)}$. 3. Corolla: They exhibit papilionaceous aestivation with 5 petals arranged as 1 (standard) + 2 (wings) + (2) (fused keel), represented as $C_{1+2+(2)}$. 4. Androecium: There are 10 stamens in a diadelphous condition—9 fused into a tube and 1 free, represented as $A_{(9)+1}$. 5. Gynoecium: The ovary is superior, monocarpellary, and unilocular, represented as $\underline{G}_1$.

Final Answer: The correct floral formula is $\% \uparrow K_{(5)}\ C_{1+2+(2)}\ A_{(9)+1}\ \underline{G}_1$.

Answer: (A)

Q17.

Solution

Concept:

Nitrogen fixation is the process by which atmospheric nitrogen (N_2), which is relatively inert, is converted into reactive nitrogen compounds like ammonia (NH_3).

Solution:

1. Biological Nitrogen Fixation (BNF) is carried out by certain prokaryotes (bacteria and cyanobacteria) that possess the enzyme nitrogenase. 2. Nitrification is the conversion of ammonia to nitrites and then to nitrates. 3. Denitrification is the conversion of nitrates back into atmospheric nitrogen. 4. Ammonification is the process where organic nitrogen from dead plants and animals is converted into ammonia. 5. Since the question specifies the conversion of atmospheric nitrogen to ammonia by living organisms, it refers specifically to the biological fixation process.

Final Answer: The process is called Biological nitrogen fixation.

Answer: (C)

Q18.

Solution

Concept:

The human brain is divided into the forebrain, midbrain, and hindbrain. The forebrain contains the hypothalamus, which acts as the main control center for the autonomic nervous system and endocrine system.

Solution:

1. The Hypothalamus is a small but vital part of the brain located below the thalamus. 2. It contains several centers which control body temperature, urge for eating (hunger), and drinking (thirst). 3. It also secretes hypothalamic hormones that regulate the pituitary gland. 4. The Cerebellum controls balance and posture, the Cerebrum handles complex sensory/motor functions, and the Medulla oblongata regulates cardiovascular and respiratory centers.

Final Answer: The part of the brain responsible is the Hypothalamus.

Answer: (C)

Q19.

Solution

Concept:

The human heart is a four-chambered muscular organ. Its function is regulated by specialized nodal tissue and protected by valves that ensure unidirectional blood flow.

Solution:

1. Statement A is correct: The tricuspid valve (three muscular flaps) is located between the right atrium and right ventricle. 2. Statement B is correct: The bicuspid valve, located between the left atrium and left ventricle, is also called the mitral valve. 3. Statement C is correct: Nodal tissue, like the SAN and AVN, are specialized patches of cardiac muscle that can generate action potentials. 4. Statement D is incorrect: The Sino-Atrial Node (SAN) is actually located in the **upper-right corner** of the right atrium, not the lower-left corner. The Atrio-Ventricular Node (AVN) is located in the lower-left corner of the right atrium.

Final Answer: The incorrect statement is that the SAN is located in the lower-left corner of the right atrium.

Answer: (D)

Q20.

Solution

Concept:

In genetics, crosses are used to analyze the inheritance patterns of traits. A specific type of cross is used to identify whether an individual showing a dominant phenotype is homozygous (AA) or heterozygous (Aa).

Solution:

1. A Test Cross involves crossing an individual showing the dominant phenotype with a homozygous recessive parent (aa). 2. If the unknown individual is homozygous dominant (AA), 100% of the offspring will show the dominant phenotype. 3. If the unknown individual is heterozygous (Aa), 50% of the offspring will show the dominant phenotype and 50% will show the recessive phenotype (ratio 1:1). 4. A Back Cross is a broader term where an F1 individual is crossed with either of the parents. 5. Monohybrid and Dihybrid crosses refer to the number of traits being studied.

Final Answer: This cross is called a Test cross.

Answer: (B)

Q21.

Solution

Concept:

An ecosystem has four main structural and functional components that allow it to operate as a self-sustaining unit: Productivity, Decomposition, Energy flow, and Nutrient cycling.

Solution:

1. Productivity refers to the rate of biomass production. 2. Decomposition is the breakdown of complex organic matter into inorganic substances. 3. Energy flow is the unidirectional transfer of energy through trophic levels. 4. Stratification, however, is a structural feature of an ecosystem. It refers to the vertical distribution of different species occupying different levels (e.g., trees in the top layer, shrubs in the middle, and herbs/grasses at the bottom). 5. While stratification is important for organization, it is not considered a functional process like the other three.

Final Answer: The correct option is Stratification.

Answer: (C)

Q22.

Solution

Concept:

The C_4 pathway (Hatch-Slack pathway) is an adaptation in plants like maize and sugarcane to minimize photorespiration. It involves a double fixation of carbon dioxide.

Solution:

1. In C_4 plants, the initial CO_2 fixation occurs in the mesophyll cells. 2. The primary CO_2 acceptor is a 3-carbon molecule called Phosphoenolpyruvate (PEP). 3. This reaction is catalyzed by the enzyme PEP carboxylase (PEPcase). 4. The result of this fixation is the formation of a 4-carbon acid, Oxaloacetic acid (OAA). 5. RuBP is the primary acceptor in C_3 plants, not C_4 plants.

Final Answer: The primary carbon dioxide acceptor in C_4 plants is PEP.

Answer: (B)

Q23.

Solution

Concept:

Restriction endonucleases, often called "molecular scissors," are fundamental tools in recombinant DNA technology. They are highly specific in their action.

Solution:

1. Restriction endonucleases belong to a larger class of enzymes called nucleases. 2. They function by "inspecting" the length of a DNA sequence. 3. Once they find a specific recognition sequence (palindrome), they bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar-phosphate backbones. 4. Exonucleases remove nucleotides from the ends, whereas endonucleases make cuts at specific positions within the DNA. 5. They do not bind DNA ligase; ligase is a separate enzyme used for joining DNA fragments.

Final Answer: Restriction endonucleases make cuts at specific positions within the DNA molecule.

Answer: (A)

Q24.

Solution

Concept:

Oogenesis is the process of formation of a mature female gamete. Unlike spermatogenesis, it is a discontinuous process that begins during the embryonic stage and is completed only upon a specific trigger.

Solution:

1. Oogenesis starts in the fetal ovary where oogonia begin meiosis but get arrested at Prophase-I. 2. At puberty, meiosis-I is completed just before ovulation, resulting in a secondary oocyte and a first polar body. 3. The secondary oocyte begins meiosis-II but is arrested again at Metaphase-II. 4. Meiosis-II is only completed when a sperm comes into contact with the oocyte (Fertilization). 5. This final division results in the formation of an ootid (ovum) and a second polar body.

Final Answer: In human females, meiosis-II is not completed until fertilization.

Answer: (C)

Q25.

Solution

Concept:

Population interactions are classified based on whether the species involved are benefited (+), harmed (-), or unaffected (0).

Solution:

1. Commensalism is an interaction where one species benefits and the other is neither harmed nor benefited (+, 0). 2. The suckerfish (Remora) attaches itself to the underbelly of a shark using a modified dorsal fin (suction disk). 3. The suckerfish benefits by getting a "free ride," protection from predators, and scraps of food left over by the shark. 4. The shark is neither harmed nor helped by the presence of the small suckerfish. 5. Parasitism involves harm to one, Mutualism involves benefit to both, and Predation involves one eating the other.

Final Answer: This interaction is an example of Commensalism.

Answer: (C)

Q26.

Solution

Concept:

The primary productivity of an ecosystem is the rate at which organic matter is created by producers. It is divided into Gross Primary Productivity (GPP) and Net Primary Productivity (NPP).

Solution:

1. Gross Primary Productivity (GPP) is the total rate of production of organic matter during photosynthesis. 2. A considerable amount of GPP is utilized by plants in respiration (R). 3. Net Primary Productivity (NPP) is the available biomass for the consumption to heterotrophs (herbivores and decomposers). 4. The relationship is expressed as: $NPP = GPP - R$. 5. Therefore, NPP is always less than GPP because of the energy loss during metabolic activities of the producers.

Final Answer: Net primary productivity is $GPP - R$.

Answer: (B)

Q27.

Solution

Concept:

The heart's electrical conduction system allows it to beat rhythmically. The sequence of excitation must be precise to ensure coordinated contraction of the atria and ventricles.

Solution:

1. The impulse originates at the Sino-atrial Node (SAN), the "pacemaker," located in the right atrium. 2. The impulse then travels to the Atrio-ventricular Node (AVN) located near the inter-atrial septum. 3. From the AVN, the impulse passes to the AV Bundle (Bundle of His). 4. The Bundle of His then branches into right and left bundles that give rise to minute fibers called Purkinje fibers throughout the ventricular musculature. 5. This ensures the ventricles contract from the apex upwards.

Final Answer: The correct pathway is SAN → AVN → Bundle of His → Purkinje fibers.

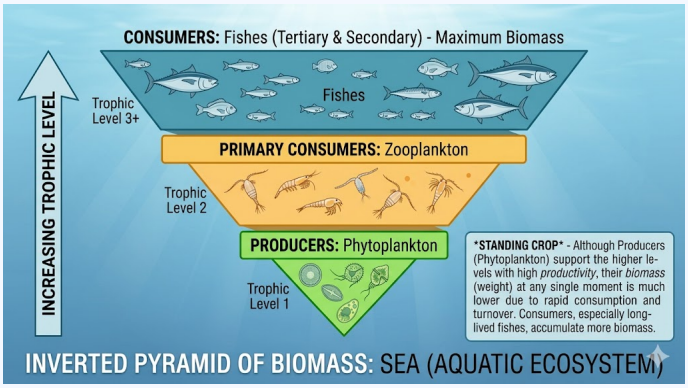
Answer: (A)

Q28.

Solution

Concept:

Ecological pyramids represent the relationship between different trophic levels. While most pyramids are upright, the pyramid of biomass in aquatic ecosystems is a notable exception.



Solution:

1. In a sea or lake, the producers are tiny phytoplanktons which have a very small standing crop (biomass) at any given time. 2. However, they have a very high rate of reproduction and turnover. 3. The consumers (zooplanktons and then small/large fish) have a much higher biomass because they live longer and accumulate more mass. 4. This results in an "Inverted" pyramid where the base (producers) is smaller than the higher trophic levels. 5. In contrast, the pyramid of energy is always upright in all ecosystems.

Final Answer: The pyramid of biomass in sea is generally inverted.

Answer: (B)

Q29.

Solution

Concept:

The human male reproductive system includes accessory glands that provide the fluid medium and nutrients for sperm survival and motility.

Solution:

1. Seminal plasma is the collective secretion of the male accessory glands: Seminal vesicles, Prostate gland, and Bulbourethral glands. 2. It is rich in Fructose (which serves as an energy source for sperm), Calcium, and certain enzymes. 3. Glucose is usually not the primary sugar; fructose is the specific marker for seminal vesicle secretion. 4. Therefore, the presence of fructose, calcium, and enzymes is the defining characteristic of this fluid.

Final Answer: Seminal plasma in humans is rich in fructose, calcium and certain enzymes.

Answer: (D)

Q30.

Solution

Concept:

In Recombinant DNA technology, vectors are used as vehicles to deliver foreign DNA into a host cell. Plasmids are the most commonly used vectors.

Solution:

1. A plasmid is an extrachromosomal, double-stranded, circular DNA molecule found in bacteria. 2. It replicates independently of the genomic DNA. 3. To be a useful vector, it must have an Origin of replication (ori), Selectable markers (like antibiotic resistance genes), and Cloning sites. 4. pBR322 is a famous example of an engineered plasmid vector. 5. It is not linear, single-stranded, or part of the main bacterial chromosome.

Final Answer: A plasmid is an extra-chromosomal, circular DNA.

Answer: (C)

Q31.

Solution

Concept:

Genetic disorders are classified based on their inheritance patterns. Autosomal recessive disorders require two copies of the abnormal gene (one from each parent) for the disease to manifest.

Solution:

1. Sickle-cell anemia is an autosomal linked recessive trait that can be transmitted from parents to the offspring when both the partners are carriers for the gene. 2. It is caused by the substitution of Glutamic acid by Valine at the sixth position of the beta globin chain of hemoglobin. 3. Hemophilia and Color blindness are sex-linked (X-linked) recessive disorders. 4. Myotonic dystrophy is an autosomal dominant disorder. 5. In sickle-cell anemia, the homozygous recessive condition ($Hb^S Hb^S$) results in the diseased phenotype.

Final Answer: Sickle-cell anemia is an example of an autosomal recessive disorder.

Answer: (B)

Q32.

Solution

Concept:

Erythropoiesis is the process of formation of red blood cells (erythrocytes). This process is regulated by a specific hormone in response to low oxygen levels in the blood.

Solution:

1. Erythropoietin (EPO) is the primary hormone that stimulates the bone marrow to produce more red blood cells. 2. While the bone marrow is the site where the cells are produced, it is not the site of hormone production. 3. The Juxtaglomerular (JG) cells of the kidney are responsible for sensing low oxygen and secreting erythropoietin into the bloodstream. 4. The liver produces a small amount of EPO in adults, but the kidney is the major source. 5. The spleen is primarily involved in the destruction of old RBCs, not the stimulation of their production.

Final Answer: The hormone is produced by the Juxtaglomerular cells of the kidney.

Answer: (B)

Q33.

Solution

Concept:

Bt cotton is a genetically modified pest-resistant plant. The technology utilizes a specific bacterium found in the soil to produce an insecticidal protein.

Solution:

1. 'Bt' stands for *Bacillus thuringiensis*, a Gram-positive, soil-dwelling bacterium. 2. This bacterium naturally produces crystalline (Cry) proteins that are toxic to certain insect larvae (like bollworms). 3. In genetic engineering, the genes responsible for these toxins (Cry genes) are isolated from the bacterium and incorporated into the cotton plant's genome. 4. When an insect feeds on the plant, the protoxin is converted into an active form in the alkaline pH of the insect's gut, leading to its death. 5. It does not stand for "Biotechnology" or "Bio-toxin" in the taxonomic sense.

Final Answer: In 'Bt cotton', the 'Bt' refers to *Bacillus thuringiensis*.

Answer: (C)

Q34.

Solution

Concept:

The ozone layer in the stratosphere protects the Earth from harmful UV radiation. Thinning of this layer, known as the "ozone hole," occurs due to the release of chlorofluorocarbons (CFCs).

Solution:

1. While ozone depletion occurs globally, the most severe thinning is observed over the Antarctic region. 2. This is due to unique meteorological conditions during the winter, such as the formation of Polar Stratospheric Clouds (PSCs). 3. These clouds provide a surface for chemical reactions that release chlorine atoms from CFCs. 4. When sunlight returns in the spring, these chlorine atoms rapidly break down ozone molecules. 5. The ozone hole is a seasonal phenomenon that is most prominent over Antarctica between late August and early October.

Final Answer: The ozone hole is most prominent over Antarctica.

Answer: (C)

Q35.

Solution

Concept:

Protein synthesis (translation) requires the activation of amino acids and their attachment to specific tRNA molecules. This is the first step of translation.

Solution:

1. The process of attaching an amino acid to its specific tRNA is called "charging" of tRNA. 2. Chemically, this is known as Aminoacylation. 3. This reaction is catalyzed by the enzyme aminoacyl-tRNA synthetase and requires ATP for energy. 4. Transcription is the synthesis of RNA from DNA, Deamination is the removal of an amino group, and Phosphorylation is the addition of a phosphate group. 5. The aminoacyl-tRNA complex then carries the amino acid to the ribosome to be added to the growing polypeptide chain.

Final Answer: The process is technically called Aminoacylation.

Answer: (A)

Q36.

Solution

Concept:

Meiosis is a reductional division consisting of two stages. Meiosis I is characterized by the pairing of homologous chromosomes and the exchange of genetic material through crossing over.

Solution:

1. Prophase I of Meiosis I is divided into five substages: Leptotene, Zygotene, Pachytene, Diplotene, and Diakinesis. 2. During the Pachytene stage, crossing over occurs between non-sister chromatids of homologous chromosomes. 3. This process involves the physical exchange of genetic material and is mediated by an enzyme complex. 4. The specific enzyme responsible for facilitating this recombination is called Recombinase. 5. Synapsis occurs in Zygotene, while the dissolution of the synaptonemal complex occurs in Diplotene.

Final Answer: The enzyme Recombinase is required at Pachytene.

Answer: (A)

Q37.

Solution

Concept:

The C_3 pathway, or the Calvin cycle, is the standard mechanism for carbon fixation in plants. It is named after the number of carbon atoms in the first stable intermediate formed.

Solution:

1. In the Calvin cycle, CO_2 combines with a 5-carbon acceptor molecule called Ribulose-1,5-bisphosphate (RuBP). 2. This carboxylation reaction is catalyzed by the enzyme RuBisCO. 3. The immediate product is a highly unstable 6-carbon intermediate that quickly splits into two molecules. 4. Each of these molecules is a 3-carbon compound called 3-phosphoglyceric acid (PGA). 5. Because the first stable product (PGA) has 3 carbon atoms, the pathway is termed the C_3 pathway.

Final Answer: The first stable product is 3-phosphoglyceric acid (PGA).

Answer: (B)

Q38.

Solution

Concept:

Many drugs are derived from secondary metabolites produced by plants. 'Smack' is a common name for a derivative of the poppy plant, *Papaver somniferum*.

Solution:

1. 'Smack' is chemically diacetylmorphine, more commonly known as heroin. 2. It is obtained by the acetylation of morphine. 3. Morphine is extracted from the latex of the unripe seed pods (capsules) of the poppy plant. 4. The latex is a milky white fluid that oozes out when the seed pod is incised. 5. It acts as a depressant and slows down body functions.

Final Answer: The latex of the poppy plant is used to obtain 'Smack'.

Answer: (B)

Q39.

Solution

Concept:

Biological interactions describe the way organisms in a community affect one another. These are categorized based on whether the effect is positive, negative, or neutral.

Solution:

1. Amensalism is an interaction in which one species is harmed, while the other species remains unaffected (neither benefited nor harmed). 2. A classic example is the production of antibiotics by fungi (like *Penicillium*), which kills bacteria but does not affect the fungus itself. 3. Commensalism (+, 0) involves one benefiting and one unaffected. 4. Mutualism (+, +) involves both species benefiting. 5. Competition (-, -) involves both species being harmed by the shared use of limited resources.

Final Answer: The interaction is called Amensalism.

Answer: (A)

Q40.

Solution

Concept:

Muscle contraction occurs through the interaction of thin (actin) and thick (myosin) filaments. The microscopic organization of these filaments determines the functional unit of the muscle.

Solution:

1. A muscle fiber consists of many parallelly arranged myofibrils. 2. Each myofibril has alternate dark (A) and light (I) bands. 3. The portion of the myofibril between two successive Z-lines is considered the functional unit of contraction. 4. This unit is called a Sarcomere. 5. During contraction, the sarcomeres shorten as the thin filaments slide over the thick filaments.

Final Answer: The functional unit of contraction is the Sarcomere.

Answer: (B)

Q41.

Solution

Concept:

International treaties are established to address global environmental issues. The Montreal Protocol is one of the most successful environmental agreements focused on atmospheric protection.

Solution:

1. The Montreal Protocol was signed in Montreal, Canada, in 1987 (and became effective in 1989). 2. Its primary objective was to curb the destruction of the stratospheric ozone layer. 3. The protocol mandates the phase-out of the production and consumption of Ozone Depleting Substances (ODS). 4. These substances mainly include Chlorofluorocarbons (CFCs), halons, and carbon tetrachloride. 5. Greenhouse gas emissions (like CO_2) are primarily addressed by the Kyoto Protocol and the Paris Agreement, not the Montreal Protocol.

Final Answer: The Montreal Protocol was signed to control the emission of Ozone depleting substances.

Answer: (B)

Q42.

Solution

Concept:

DNA structure follows specific base-pairing rules discovered by Erwin Chargaff. While some ratios are universal for all double-stranded DNA, others vary between different organisms.

Solution:

1. According to Chargaff's rules, the amount of Adenine equals Thymine ($A = T$) and Guanine equals Cytosine ($G = C$). 2. Therefore, the ratio $(A+G)/(T+C) = 1$ is constant for all species. 3. However, the ratio of $(A+T)/(G+C)$ varies significantly between different groups of organisms. 4. This specific ratio is constant for a given species but differs from one species to another, acting as a genetic marker for that species. 5. For example, in humans, this ratio is approximately 1.52, whereas in $E.coli$, it is about 0.93.

Final Answer: The ratio is constant for a given species.

Answer: (B)

Q43.

Solution

Concept:

Intrauterine Devices (IUDs) are contraceptive methods inserted into the uterus. They are categorized based on whether they release chemicals/hormones or act purely through physical presence.

Solution:

1. Non-medicated IUDs function by increasing the phagocytosis of sperms within the uterus without releasing any additional chemical agents. 2. Lippes loop is the classic example of a non-medicated IUD. 3. Cu7 and Multiload 375 are copper-releasing IUDs that release copper ions to suppress sperm motility. 4. LNG-20 and Progestasert are hormone-releasing IUDs that make the cervix hostile to sperms and the uterus unsuitable for implantation.

Final Answer: Lippes loop is a non-medicated IUD.

Answer: (A)

Q44.

Solution

Concept:

Enzymes are highly specific catalysts. Various models have been proposed to explain how an enzyme binds to its substrate to facilitate a chemical reaction.

Solution:

1. The 'Lock and Key' hypothesis was proposed by Emil Fischer in 1894. 2. It suggests that the enzyme (the lock) has a specific rigid geometric shape that exactly fits the substrate (the key). 3. Only the correctly sized/shaped substrate can fit into the active site of the enzyme. 4. Koshland later proposed the 'Induced Fit' theory, which suggested that the active site is flexible and molds around the substrate. 5. Fischer's model was the first to explain the high degree of enzyme specificity.

Final Answer: The 'Lock and Key' hypothesis was proposed by Emil Fischer.

Answer: (B)

Q45.

Solution

Concept:

Net Primary Productivity (NPP) is the rate at which producers store energy minus the energy lost to respiration. It is influenced by environmental factors like sunlight, moisture, and temperature.

Solution:

1. Tropical rain forests are located near the equator, where they receive consistent, intense sunlight and heavy rainfall throughout the year. 2. These conditions allow for year-round growth and a very high density of diverse vegetation. 3. Because there are no limiting seasons (like a cold winter or a long dry season), the rate of photosynthesis is extremely high. 4. While coral reefs also have high productivity per unit area, on a global terrestrial scale, tropical rain forests are the most productive ecosystems. 5. Temperate forests have lower NPP due to seasonal dormancy during winter months.

Final Answer: Tropical rain forests have the maximum net primary productivity.

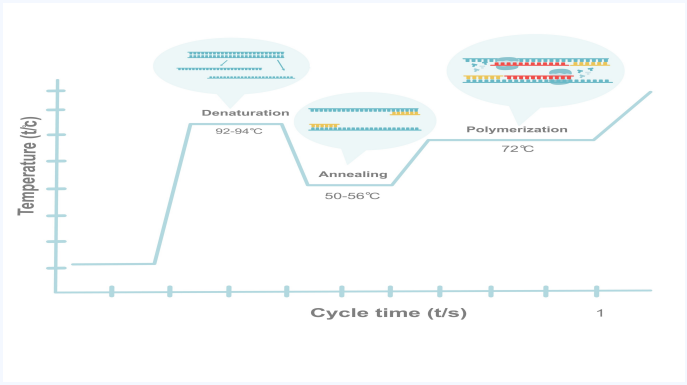
Answer: (B)

Q46.

Solution

Concept:

Polymerase Chain Reaction (PCR) is a technique used to amplify a specific segment of DNA. It involves a cycle of three temperatures that facilitate different enzymatic and physical processes.



Solution:

1. **Denaturation:** The double-stranded DNA is heated (approx. 94°C) to separate it into two single strands. 2. **Annealing:** The temperature is lowered (approx. 50 – 65°C) to allow DNA primers to bind (anneal) to their complementary sequences on the single-stranded DNA templates. 3. **Extension:** The temperature is raised (approx. 72°C) for the enzyme DNA polymerase (Taq polymerase) to add nucleotides to the primers, synthesizing a new DNA strand. 4. This cycle is repeated many times to achieve exponential amplification of the target DNA.

[Image of PCR cycle steps]

Final Answer: The correct sequence is Denaturation, Annealing, Extension.

Answer: (C)

Q47.

Solution

Concept:

Conservation biology identifies specific factors that lead to the accelerated rates of species extinction. The "Evil Quartet" refers to the four most significant drivers of this loss.

Solution:

1. The term 'Evil Quartet' was popularized by Jared Diamond to describe the impacts of human activities on the environment. 2. The four causes are: - Habitat loss and fragmentation - Over-exploitation - Alien species invasions - Co-extinctions 3. These factors work together to reduce biological diversity across various ecosystems. 4. While global warming and pollution are serious, they are often considered sub-factors or additional pressures alongside this quartet in the context of classical biodiversity studies.

Final Answer: The term describes the four major causes of Biodiversity losses.

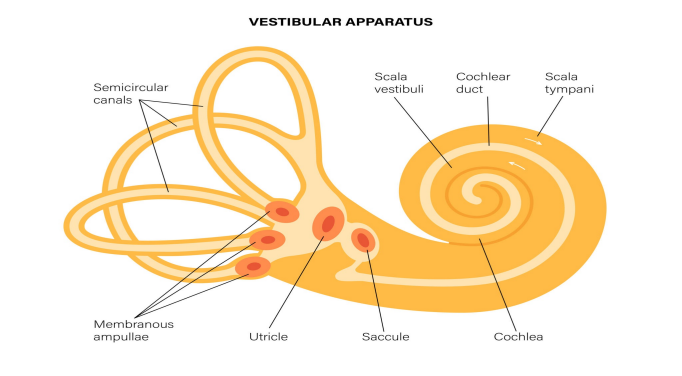
Answer: (C)

Q48.

Solution

Concept:

The human ear is an organ for both hearing and equilibrium (balance). Different anatomical structures within the ear are specialized for one or both of these functions.



Solution:

1. The **Organ of Corti** and **Ear ossicles** (Malleus, Incus, Stapes) are essential components of the auditory pathway. 2. The **Eustachian tube** helps equalize pressure but is physically connected to the auditory system. 3. The **Vestibular apparatus** (composed of semicircular canals and the otolith organ) is located in the inner ear. 4. Its primary and exclusive function is to detect changes in body position and maintain dynamic and static equilibrium (balance). 5. It does not process sound waves or contribute to the sense of hearing.

[Image of human inner ear vestibular apparatus]

Final Answer: The Vestibular apparatus plays no role in hearing.

Answer: (C)

Q49.

Solution

Concept:

During secondary growth in dicot stems, the cork cambium (a lateral meristem) produces protective layers to replace the ruptured epidermis.

Solution:

1. **Phellogen** is the cork cambium itself. 2. **Phellem** is the cork produced by the phellogen towards the outer side. 3. **Phelloderm** is the secondary cortex produced by the phellogen towards the inner side. 4. All these three layers—Phellogen, Phellem, and Phelloderm—are collectively referred to as the **Periderm**. 5. The periderm acts as a protective tissue that prevents water loss and provides mechanical protection to the aging stem.

Final Answer: They are collectively called Periderm.

Answer: (C)

Q50.

Solution

Concept:

Gregor Mendel's experiments with pea plants led to the formulation of the Law of Independent Assortment, which explains how different genes are inherited relative to one another.

Solution:

1. In a dihybrid cross ($AaBb \times AaBb$), the phenotypic ratio $9:3:3:1$ is observed in the F2 generation. 2. This ratio occurs because the segregation of the pair of alleles for one trait (e.g., seed shape) is entirely independent of the segregation of the pair of alleles for another trait (e.g., seed color). 3. If the genes were linked (located close together on the same chromosome), this ratio would be significantly distorted. 4. The $9:3:3:1$ ratio is the mathematical result of $(3:1) \times (3:1)$, proving that the two traits are inherited independently.

Final Answer: It denotes that the alleles of two genes are segregating independently.

Answer: (D)

Q51.

Solution

Concept:

Intrauterine Devices (IUDs) are classified into three types based on their mechanism of action: Non-medicated, Copper-releasing, and Hormone-releasing.

Solution:

1. Hormone-releasing IUDs, such as Progestasert and LNG-20, release specific hormones (like levonorgestrel) that alter the cervical mucus, making it thick and hostile to sperm. 2. They also cause the endometrium of the uterus to become thin and unsuitable for the implantation of a fertilized egg. 3. Multiload 375 and Cu7 are copper-releasing IUDs that suppress sperm motility. 4. Lippes loop is a non-medicated IUD. 5. LNG-20 is specifically known for releasing a steady dose of progestogen.

Final Answer: LNG-20 is a hormone-releasing IUD.

Answer: (D)

Q52.

Solution

Concept:

Guttation is the loss of water in the form of liquid droplets from the margins of leaves through specialized structures called hydathodes.

Solution:

1. Guttation occurs when there is a significant build-up of root pressure within the plant's xylem. 2. This typically happens during the night or early morning when soil moisture is high (leading to high water absorption). 3. Simultaneously, the rate of transpiration must be very low (due to high humidity or closed stomata), so the excess water cannot escape as vapor. 4. The positive hydrostatic pressure forces liquid water out of the hydathodes. 5. If transpiration were high, the water would be pulled up and evaporated rather than pushed out as liquid.

Final Answer: Guttation takes place when root pressure is high and the rate of transpiration is low.

Answer: (A)

Q53.

Solution

Concept:

Botanical terms describe the arrangement and fusion of floral parts. Identifying correct associations between these terms and specific plants is a key requirement for plant morphology.

Solution:

1. **Apocarpous ovary:** This refers to a condition where the carpels are free (not fused). Both Rose and Lotus are classic examples of apocarpous gynoecium. 2. **Syncarpous ovary:** This refers to fused carpels. Lotus is apocarpous, while Mustard and Tomato are syncarpous. 3. **Parthenocarpic fruit:** These are fruits developed without fertilization (seedless). Apple is a "false fruit" (pome), but generally not parthenocarpic in its natural state like a banana. 4. **Polyadelphous stamens:** This occurs when stamens are fused into more than two bundles. This is seen in Citrus, whereas Pea shows diadelphous (two bundles) arrangement.

Final Answer: Apocarpous ovary - Rose is the correctly matched pair.

Answer: (B)

Q54.

Solution

Concept:

Adenosine Deaminase (ADA) is an enzyme essential for the functioning of the immune system. A deficiency in this enzyme leads to SCID (Severe Combined Immunodeficiency).

Solution:

1. ADA is produced by many cells in the body, but it is critically important and highly active in the lymphocytes (T-cells and B-cells). 2. Lymphocytes are the primary cells of the immune system responsible for recognizing and fighting pathogens. 3. In gene therapy for ADA deficiency, functional ADA cDNA is typically introduced into the lymphocytes extracted from the patient's bone marrow/blood and then returned to the body. 4. Erythrocytes (RBCs) and Osteocytes (bone cells) are not the primary sites of ADA function or therapeutic focus.

Final Answer: The site of production is Lymphocytes.

Answer: (B)

Q55.

Solution

Concept:

Plasmids are extrachromosomal DNA molecules found in bacteria, utilized extensively as vectors in biotechnology due to their specific structural and functional properties.

Solution:

1. **Circular structure:** Plasmids are naturally occurring double-stranded, circular DNA molecules. 2. **Transferable:** They can be transferred between bacteria through processes like conjugation. 3. **Independent replication:** They have their own origin of replication (ori), allowing them to replicate autonomously inside the host cell. 4. **Single-stranded:** This is incorrect. Plasmids are always double-stranded DNA molecules. Single-stranded DNA is typical of some viruses (like $phiX174$), but not plasmids used in genetic engineering.

Final Answer: Single-stranded is NOT a feature of plasmids.

Answer: (C)

Q56.

Solution

Concept:

Mitochondria are double-membrane-bound organelles found in most eukaryotic organisms. They are essential for aerobic respiration and the generation of chemical energy.

Solution:

1. Mitochondria are the primary sites of ATP (Adenosine Triphosphate) production through the process of oxidative phosphorylation. 2. ATP is the "energy currency" of the cell, providing the power required for various biochemical reactions and physiological processes. 3. Because they generate the vast majority of the cell's energy supply, they are traditionally referred to as the "powerhouse of the cell." 4. Other organelles have different roles: the Nucleus stores genetic information, Ribosomes synthesize proteins, and the Golgi complex processes and packages proteins.

Final Answer: Mitochondria is considered the 'Powerhouse of the cell'.

Answer: (B)

Q57.

Solution

Concept:

The discovery of DNA involved several milestones. Before the double-helix structure was understood, the substance itself had to be isolated and named.

Solution:

1. In 1869, Friedrich Miescher isolated a substance from the nuclei of white blood cells (pus cells) that was rich in phosphorus and acidic in nature. 2. He named this substance 'Nuclein' because it was found within the nucleus. 3. Later, when its acidic properties were confirmed, it was renamed 'Nucleic Acid' by Richard Altmann. 4. Watson, Crick, and Wilkins were instrumental in determining the 3D double-helical structure of DNA much later, in the 1950s.

Final Answer: The term 'Nuclein' was coined by Friedrich Miescher.

Answer: (A)

Q58.

Solution

Concept:

Algae exhibit a wide variety of forms and sizes. They can be unicellular, colonial, or filamentous in their structural organization.

Solution:

1. **Volvox** is a classic example of a colonial alga. It forms large, spherical colonies made of thousands of individual cells that are coordinated in movement. 2. **Chlorella** is a unicellular alga. 3. **Ulothrix** and **Spirogyra** are filamentous algae, where cells are arranged in long, thread-like structures. 4. Colonial algae like Volvox often show a high degree of organization, including specialized reproductive cells.

Final Answer: An example of a colonial alga is Volvox.

Answer: (B)

Q59.

Solution

Concept:

Nutrition involves several stages, including ingestion, digestion, absorption, assimilation, and egestion. Each term describes a specific physiological step in the processing of food.

Solution:

1. Food consists of complex organic macromolecules like proteins, polysaccharides, and fats. 2. These cannot be utilized by the body in their complex form; they must be broken down. 3. **Digestion** is the mechanical and chemical process of breaking these complex food substances into simple, smaller, and water-soluble molecules (like amino acids, glucose, and fatty acids). 4. **Absorption** is the process where these simple forms pass into the blood or lymph. 5. **Assimilation** is the utilization of absorbed nutrients for energy, growth, and repair.

Final Answer: The process is called Digestion.

Answer: (B)

Q60.

Solution

Concept:

The genetic code consists of 64 codons. While 61 codons code for amino acids, 3 codons signal the termination of the translation process.

Solution:

1. Stop codons are also known as termination codons or nonsense codons. 2. There are three stop codons in the universal genetic code: **UAA** (Ochre), **UAG** (Amber), and **UGA** (Opal). 3. When a ribosome encounters one of these codons during translation, no tRNA molecule can bind to it, causing the newly synthesized polypeptide chain to be released. 4. **AUG** is the start (initiation) codon and also codes for Methionine. 5. **UGG** codes for Tryptophan, and **GUG** usually codes for Valine (though it can occasionally act as a start codon in prokaryotes).

Final Answer: UAA is a 'stop' codon.

Answer: (C)

Q61.

Solution

Concept:

The alternation of generations in plants involves a diploid sporophyte and a haploid gametophyte. The degree of dominance and independence of these stages varies significantly across plant groups.

Solution:

1. In Bryophytes (mosses) and Pteridophytes (ferns), the gametophyte is a free-living, independent stage of the life cycle. 2. In Seed plants (Gymnosperms and Angiosperms), the gametophyte is highly reduced and physically retained within the sporophyte tissues (the ovule or pollen grain). 3. In Angiosperms, the male gametophyte (pollen grain) and the female gametophyte (embryo sac) are microscopic and entirely dependent on the sporophyte for nutrition and protection. 4. Therefore, they do not have a free-living, independent existence in these higher plants.

Final Answer: In Angiosperms, the gametophytes do not have an independent free-living existence.

Answer: (C)

Q62.

Solution

Concept:

Proteins are the most diverse group of biomolecules. Two specific proteins are often cited for their abundance: one in the animal world and one in the entire biosphere (plants included).

Solution:

1. **Collagen** is the most abundant protein in the animal kingdom, forming the primary component of connective tissues. 2. **RuBisCO** (Ribulose bisphosphate carboxylase-oxygenase) is the enzyme responsible for carbon fixation in the Calvin cycle of photosynthesis. 3. Because photosynthesis occurs in all green plants, algae, and many bacteria, RuBisCO is quantitatively the most abundant protein on Earth (the biosphere). 4. Trypsin and Insulin are specialized proteins but are not found in high concentrations globally.

Final Answer: The most abundant protein in the whole of the biosphere is RuBisCO.

Answer: (D)

Q63.

Solution

Concept:

In eukaryotes, there are three types of RNA polymerases in the nucleus, each responsible for transcribing specific classes of RNA.

Solution:

1. **RNA polymerase I** transcribes rRNAs (28*S*, 18*S*, and 5.8*S*). 2. **RNA polymerase II** transcribes the precursors of mRNA, known as heterogeneous nuclear RNA (hnRNA). 3. **RNA polymerase III** is responsible for the transcription of tRNA, 5*S* rRNA, and snRNAs (small nuclear RNAs). 4. Therefore, the removal or inhibition of RNA polymerase III would specifically prevent the production of tRNA.

Final Answer: Removal of RNA polymerase III will affect the synthesis of tRNA.

Answer: (A)

Q64.

Solution

Concept:

The Montreal Protocol is a landmark international environmental treaty designed to protect the Earth's atmosphere from specific chemical threats.

Solution:

1. Signed in 1987, the Montreal Protocol specifically targets the phase-out of Ozone Depleting Substances (ODS). 2. The primary chemicals regulated are chlorofluorocarbons (CFCs), which release chlorine into the stratosphere, destroying ozone molecules. 3. This is distinct from the Kyoto Protocol, which focuses on greenhouse gases and global warming. 4. It is widely considered one of the most successful international agreements, as it has led to the gradual recovery of the ozone layer.

Final Answer: The 'Montreal Protocol' refers to the control of Ozone depleting substances.

Answer: (B)

Q65.

Solution

Concept:

Microbes are used in the dairy industry to provide specific textures and flavors to various types of cheese through fermentation and gas production.

Solution:

1. Swiss cheese is characterized by large holes (eyes) in its structure. 2. These holes are produced by the bacterium *Propionibacterium sharmanii*. 3. During the ripening process, the bacterium produces a large amount of carbon dioxide (CO_2) gas, which forms the characteristic holes. 4. *Saccharomyces* is used in baking and brewing; *Lactobacillus* is used for curd; *Penicillium roqueforti* is used for Roquefort cheese (blue cheese).

Final Answer: *Propionibacterium sharmanii* is used in the production of Swiss Cheese.

Answer: (A)

Q66.

Solution

Concept:

The evolution of humans involves several intermediate stages. Hominids are members of the biological family Hominidae, which includes modern humans and their extinct ancestors.

Solution:

1. *Ramapithecus* and *Dryopithecus* were early primates, with *Ramapithecus* being more man-like. 2. *Australopithecus* lived in East African grasslands and hunted with stone weapons. 3. *Homo habilis* is considered the first "human-like" hominid (the first member of the genus *Homo*). 4. They had a brain capacity between $650 - 800$ cc and likely did not eat meat. 5. *Homo erectus* came later, with a larger brain (900 cc) and definitely ate meat.

Final Answer: The first human-like hominid was *Homo habilis*.

Answer: (B)

Q67.

Solution

Concept:

Biodiversity Hotspots are regions with very high levels of species richness and a high degree of endemism (species found nowhere else) that are under significant threat from human activities.

Solution:

1. To be qualified as a hotspot, a region must meet two strict criteria. 2. First, it must contain at least 1,500 species of vascular plants as endemics. 3. Second, it has to have lost at least 70% of its original native habitat. 4. Therefore, a "High degree of endemism" is a primary criterion. 5. Hotspots are identified specifically to prioritize conservation efforts in areas where extinction rates are highly accelerated.

Final Answer: A criterion for being a 'Biodiversity Hotspot' is High degree of endemism.

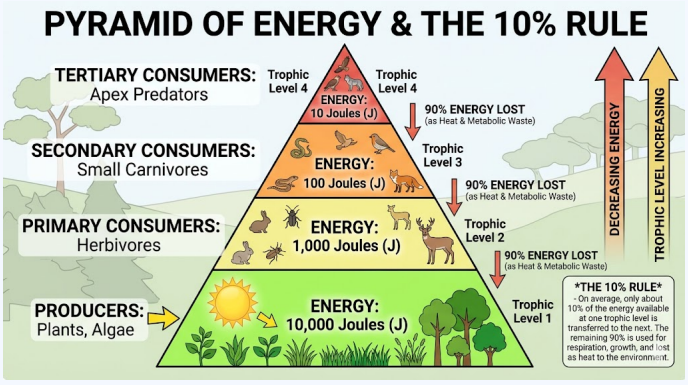
Answer: (A)

Q68.

Solution

Concept:

The flow of energy in an ecosystem follows the 10% Law proposed by Raymond Lindeman. This law states that only about 10% of the energy available at one trophic level is transferred to the next.



Solution:

1. **Producer Level:** 10,000 J 2. **Primary Consumer Level (Herbivore):** 10% of 10,000 = 1,000 J 3. **Secondary Consumer Level (Carnivore):** 10% of 1,000 = 100 J 4. The remaining 90% of energy is lost as heat during respiration and other metabolic processes at each level. 5. Energy flow is always unidirectional and decreases significantly at higher trophic levels.

Final Answer: The energy available at the secondary consumer level will be 100 J.

Answer: (B)

Q69.

Solution

Concept:

In molecular biology and genetic engineering, different enzymes perform specific "tools" functions. DNA ligase is often referred to as "molecular glue."

Solution:

1. **DNA Ligase** facilitates the joining of DNA strands together by catalyzing the formation of a phosphodiester bond. 2. It is essential for sealing nicks in the sugar-phosphate backbone, such as those between Okazaki fragments during DNA replication. 3. In biotechnology, it is used to join a gene of interest into a plasmid vector. 4. **DNA polymerase** synthesizes new DNA, **Helicase** unwinds the strands, and **Topoisomerase** relieves tension.

Final Answer: The enzyme used to join DNA fragments is DNA ligase.

Answer: (B)

Q70.

Solution

Concept:

The immune system's lymphoid organs are classified as primary or secondary based on their role in the maturation and activation of lymphocytes.

Solution:

1. **Primary lymphoid organs** are the sites where immature lymphocytes differentiate into antigen-sensitive lymphocytes. These include the **Bone marrow** and **Thymus**. 2. B-cells mature in the bone marrow, while T-cells mature in the thymus. 3. **Secondary lymphoid organs** are sites where lymphocytes interact with antigens and proliferate. Examples include the Spleen, Lymph nodes, Tonsils, and Peyer's patches of the small intestine. 4. Therefore, the Thymus is a primary lymphoid organ.

Final Answer: The primary lymphoid organ is the Thymus.

Answer: (C)

Q71.

Solution

Concept:

Mycorrhiza is a symbiotic association between a fungus and the roots of higher plants (such as Pinus). It is a classic example of a relationship where both participating species derive significant benefits.

Solution:

1. The fungus colonizes the host plant's roots and provides increased absorption of water and mineral nutrients (especially phosphorus) from the soil due to its high surface area. 2. In return, the plant provides the fungus with energy-rich carbohydrates produced through photosynthesis. 3. This (+, +) interaction, where both species benefit and are often dependent on each other for survival, is termed Mutualism. 4. Without this association, many plants cannot thrive in nutrient-poor soils, and the fungus would lack a steady carbon source.

Final Answer: The association of Mycorrhiza is an example of Mutualism.

Answer: (C)

Q72.

Solution

Concept:

The Mutation Theory, proposed in the early 20th century, explains that evolution occurs through large, sudden, and inheritable changes in the genetic material rather than through small, continuous variations.

Solution:

1. Hugo de Vries conducted extensive breeding experiments on the Evening Primrose plant. 2. The scientific name for this plant is *Oenothera lamarckiana*. 3. Based on his observations of sudden phenotypic changes in these plants, he proposed that mutations are the raw material of evolution. 4. He believed these mutations were random and directionless, contrasting with Darwin's small, directional variations. 5. He termed large single-step mutations as "saltation."

Final Answer: The plant used was *Oenothera lamarckiana*.

Answer: (B)

Q73.

Solution

Concept:

The human excretory system consists of organs that filter blood to remove metabolic wastes. Each organ has a microscopic structure where the actual filtration, reabsorption, and secretion occur.

Solution:

1. The **Nephron** is the structural and functional unit of the kidney. Each human kidney contains approximately one million of these complex tubular structures. 2. A nephron consists of two main parts: the Glomerulus (a tuft of capillaries) and the Renal tubule. 3. The renal tubule begins with a double-walled cup-like structure called Bowman's capsule, which encloses the glomerulus. 4. Nephridia are excretory organs in earthworms, while Neurons are the units of the nervous system. 5. Henle's loop is only a specific segment of the nephron, not the entire functional unit.

Final Answer: The structural and functional unit is the Nephron.

Answer: (C)

Q74.

Solution

Concept:

Biodiversity conservation is divided into two broad types: In-situ (on-site) and Ex-situ (off-site). Ex-situ methods involve protecting threatened species outside their natural habitats.

Solution:

1. **In-situ conservation** includes National Parks, Wildlife Sanctuaries, and Biosphere Reserves where the whole ecosystem is protected in its natural state. 2. **Ex-situ conservation** includes methods where threatened animals or plants are taken out from their natural habitat and placed in special settings where they can be protected and given special care. 3. Examples include Zoological parks, Botanical gardens, and **Seed Banks** (where seeds are stored at very low temperatures for long periods). 4. Cryopreservation of gametes and tissue culture are also advanced ex-situ techniques.

Final Answer: Seed Bank is an example of an ex-situ conservation method.

Answer: (D)

Q75.

Solution

Concept:

The Central Dogma of molecular biology describes the two-step process, transcription and translation, by which the information in genes flows into proteins: DNA → RNA → Protein.

Solution:

1. **Transcription** is the process of copying genetic information from one strand of the DNA into a complementary strand of RNA (specifically mRNA). 2. It is catalyzed by the enzyme DNA-dependent RNA polymerase. 3. Only a segment of DNA and only one of the strands is copied into RNA during this process. 4. **Translation** is the subsequent step where the code in mRNA is used to synthesize a polypeptide chain (protein). 5. **Transformation** and **Transduction** are methods of genetic recombination in bacteria.

Final Answer: The process is called Transcription.

Answer: (C)

Q76.

Solution

Concept:

The process of lactation and milk release involves a neuroendocrine reflex. While one hormone is responsible for the production of milk, another is responsible for its actual release or "ejection" from the mammary glands.

Solution:

1. **Prolactin**, secreted by the anterior pituitary, is the primary hormone responsible for the synthesis and production of milk within the mammary alveoli. 2. **Oxytocin**, secreted by the posterior pituitary (specifically synthesized in the hypothalamus), is responsible for the contraction of the myoepithelial cells surrounding the alveoli. 3. When the infant suckles, sensory impulses are sent to the brain, triggering the release of oxytocin. 4. This contraction forces the milk into the ducts and out through the nipple, a process known as the 'Milk Ejection Reflex' or 'Let-down Reflex'. 5. Estrogen and Progesterone primarily prepare the mammary glands during pregnancy but inhibit actual milk secretion until after birth.

Final Answer: Oxytocin is responsible for the 'Milk Ejection Reflex'.

Answer: (C)

Q77.

Solution

Concept:

Evolutionary biology distinguishes between organs based on their anatomical origin and their functional utility. These provide evidence for divergent and convergent evolution.

Solution:

1. **Analogous organs** are structures that have different anatomical origins and internal structures but perform similar functions. 2. The wings of a butterfly (composed of a thin integumentary membrane) and the wings of a bird (composed of a bony skeleton covered with feathers) are anatomically very different. 3. However, both structures have evolved to serve the same function: flight. 4. This is a result of **convergent evolution**, where different species adapt to similar environmental needs. 5. Homologous organs, by contrast, share a common anatomical origin but may have different functions (e.g., human arm and bat wing).

Final Answer: These are examples of Analogous organs.

Answer: (B)

Q78.

Solution

Concept:

During fertilization in Angiosperms, the pollen tube enters the ovule and then the embryo sac to deliver the two male gametes. This entry is highly regulated and guided by chemical signals.

Solution:

1. The pollen tube typically enters the embryo sac through the micropylar end. 2. It specifically penetrates through the **filiform apparatus** located in the **synergids**. 3. The synergids are specialized cells that guide the pollen tube by secreting chemotactic substances. 4. Upon entry, the pollen tube ruptures within one of the synergids, releasing the two male gametes into its cytoplasm. 5. From there, one gamete moves to the egg cell (Syngamy) and the other moves to the central cell (Triple Fusion).

Final Answer: The destination is one of the synergids.

Answer: (C)

Q79.

Solution

Concept:

The Competitive Exclusion Principle, formulated by G.F. Gause, addresses how species with identical ecological requirements interact when resources are limited.

Solution:

1. The principle states that two species competing for the exact same limiting resources cannot coexist indefinitely in the same niche. 2. If resources are limited, the species that is even slightly more efficient at utilizing those resources (the competitively superior one) will eventually outcompete and eliminate the other. 3. This leads to the local extinction of the inferior competitor unless it evolves to occupy a different niche (resource partitioning). 4. This principle is fundamental to understanding community structure and the distribution of species.

Final Answer: It states that the competitively superior species will eventually eliminate the inferior one.

Answer: (B)

Q80.

Solution

Concept:

Chlorophyll is the green pigment responsible for capturing light energy during photosynthesis. Its molecular structure consists of a porphyrin head and a phytol tail, with a central metallic atom.

Solution:

1. The porphyrin ring of the chlorophyll molecule is structurally similar to the heme group in hemoglobin, but with a different central metal. 2. In hemoglobin, the central metal is Iron (Fe). 3. In all types of chlorophyll (Chlorophyll a, b, c, etc.), the central metal atom is **Magnesium** (Mg^{2+}). 4. This magnesium ion is essential for the stabilization of the ring and for the pigment's ability to absorb light efficiently. 5. Magnesium deficiency in plants leads to chlorosis, where leaves turn yellow due to the inability to synthesize chlorophyll.

Final Answer: Magnesium (Mg^{2+}) is a constituent of Chlorophyll.

Answer: (B)

Q81.

Solution

Concept:

The C_4 pathway (Hatch-Slack pathway) involves a division of labor between two types of photosynthetic cells: Mesophyll cells and Bundle sheath cells. Each cell type is specialized with specific enzymes.

Solution:

1. In C_4 plants, the initial fixation of CO_2 occurs in the mesophyll cells using the enzyme PEPcase. 2. The resulting 4-carbon acids are transported to the Bundle sheath cells. 3. In the Bundle sheath cells, these acids are broken down to release CO_2. 4. These cells possess a high concentration of the enzyme **RuBisCO** (Ribulose bisphosphate carboxylase-oxygenase) and lack PEPcase. 5. The released CO_2 is then fixed by RuBisCO in the standard Calvin cycle (C_3 cycle). The high CO_2 concentration in these cells ensures that RuBisCO functions as a carboxylase, minimizing photorespiration.

Final Answer: The bundle sheath cells are rich in RuBisCO.

Answer: (B)

Q82.

Solution

Concept:

Biodiversity Hotspots are regions with high species richness and endemism that are under severe threat. The identification and number of these hotspots have evolved as more data on global ecosystems is gathered.

Solution:

1. Initially, 25 biodiversity hotspots were identified globally by Norman Myers. 2. Subsequently, 9 more were added to the list, bringing the total number to **34**. 3. These hotspots cover less than 2% of the Earth's land area but house an extremely high proportion of the world's species. 4. Strict protection of these hotspots can reduce the ongoing mass extinction rate by almost 30%. 5. India has three such hotspots: Western Ghats and Sri Lanka, Indo-Burma, and the Himalayas.

Final Answer: The total number of biodiversity hotspots identified in the world is 34.

Answer: (B)

Q83.

Solution

Concept:

The genetic code consists of 64 codons. While most codons specify amino acids, specific codons are required to signal where the translation process should begin and where it should end.

Solution:

1. **AUG** is the universal start (initiation) codon. 2. It has a dual function: it signals the start of the polypeptide chain synthesis and also codes for the amino acid Methionine. 3. In prokaryotes, it codes for N-formyl methionine. 4. The codons **UAA**, **UAG**, and **UGA** are stop (termination) codons and do not code for any amino acids. 5. Translation cannot begin without the recognition of the AUG codon by the initiator tRNA.

Final Answer: The 'Start Codon' is AUG.

Answer: (B)

Q84.

Solution

Concept:

Microbes are used commercially to produce various bioactive molecules. Statins are a class of drugs used to lower blood cholesterol levels by inhibiting the enzyme responsible for cholesterol synthesis.

Solution:

1. Statins are produced by a yeast (fungus) called ***Monascus purpureus***. 2. They act as competitive inhibitors of the enzyme HMG-CoA reductase, which is essential for the internal synthesis of cholesterol in the liver. 3. *Acetobacter aceti* is used for acetic acid production. 4. *Clostridium butylicum* is used for butyric acid production. 5. *Aspergillus niger* is used for citric acid production.

Final Answer: Statins are obtained from *Monascus purpureus*.

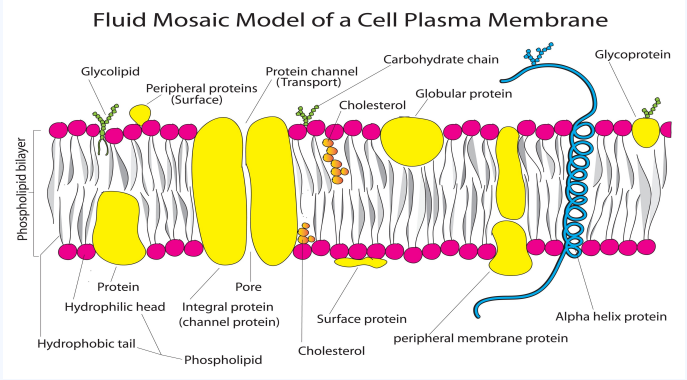
Answer: (B)

Q85.

Solution

Concept:

The cell membrane is a dynamic and selective barrier. Various models were proposed to explain its structure, but only one is currently accepted as the most accurate representation of its physical properties.



Solution:

1. The **Fluid Mosaic Model** was proposed by **Singer and Nicolson** in 1972. 2. According to this model, the membrane consists of a "quasi-fluid" lipid bilayer with protein molecules embedded in it or attached to its surface. 3. The "fluid" part refers to the lateral movement of lipids and proteins within the bilayer. 4. The "mosaic" part refers to the varied pattern of proteins, carbohydrates, and lipids. 5. Schleiden and Schwann proposed the Cell Theory, while Robert Hooke first discovered the cell.

Final Answer: The fluid mosaic model was proposed by Singer and Nicolson.

Answer: (B)

Q86.

Solution

Concept:

The greenhouse effect is a natural process where certain gases in the atmosphere trap heat, preventing it from escaping into space. This maintains the Earth's temperature but is currently accelerated by human activity.

Solution:

1. Greenhouse gases (GHGs) include Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), and Chlorofluorocarbons (CFCs). 2. CO_2 and CH_4 are the two most significant contributors to global warming. 3. Nitrogen (N_2) and Oxygen (O_2) make up the bulk of the atmosphere but do not trap heat and are not greenhouse gases. 4. Methane is highly effective at trapping heat, even in smaller concentrations than CO_2.

Final Answer: CH_4 (Methane) is a Greenhouse gas.

Answer: (C)

Q87.

Solution

Concept:

Endosperm is the nutritive tissue for the developing embryo in flowering plants. Its ploidy level is determined by the specific fusion events that occur during double fertilization.

Solution:

1. During double fertilization, one male gamete (n) fuses with the egg cell (n) to form a zygote ($2n$). 2. The second male gamete (n) fuses with the two polar nuclei (each n) or the secondary nucleus ($2n$) in the central cell. 3. This fusion of three haploid nuclei is called **Triple Fusion**. 4. The result is the Primary Endosperm Nucleus (PEN), which is **triploid** ($3n$). 5. In Gymnosperms, the endosperm is formed before fertilization and is haploid (n), but in Angiosperms, it is always triploid ($3n$).

Final Answer: The ploidy level of the endosperm in Angiosperms is $3n$.

Answer: (C)

Q88.

Solution

Concept:

DNA replication is a complex process requiring several enzymes to manage the structural challenges of the double helix.

Solution:

1. The DNA double helix is held together by hydrogen bonds between complementary base pairs ($A = T$ and $G \equiv C$). 2. To start replication, the two strands must be separated to serve as templates. 3. The enzyme **Helicase** moves along the DNA molecule and breaks these hydrogen bonds, effectively "unzipping" the double helix. 4. This creates the replication fork. 5. **Ligase** joins fragments, **Polymerase** synthesizes the new strand, and **Nucleases** cut DNA for repair or degradation.

Final Answer: The enzyme is Helicase.

Answer: (B)

Q89.

Solution

Concept:

The Cell Theory was a landmark in biology, but the original version proposed by Schleiden and Schwann did not explain how new cells were formed.

Solution:

1. In 1855, **Rudolf Virchow** modified the cell theory by adding a critical third tenet. 2. He stated, "Omnis cellula-e cellula," which is Latin for "**All cells arise from pre-existing cells**." 3. This debunked the idea of spontaneous generation and explained that cell division is the mechanism by which organisms grow and reproduce. 4. Robert Brown discovered the nucleus, and Leeuwenhoek was the first to see living cells.

Final Answer: The concept was given by Rudolf Virchow.

Answer: (A)

Q90.

Solution

Concept:

In genetic engineering, specific tools are needed to manipulate DNA at the molecular level. Enzymes that can cut DNA at precise locations act as "scissors."

Solution:

1. **Restriction Endonucleases** (Restriction enzymes) recognize specific palindromic nucleotide sequences in DNA and cut the strands at specific points. 2. Because they allow scientists to "cut" genes out of chromosomes with surgical precision, they are known as "biological" or "molecular scissors." 3. **DNA Ligase** acts as the "molecular glue" to join fragments. 4. **RNA Primase** synthesizes short RNA primers to initiate DNA replication.

Final Answer: Restriction Endonuclease is used as a 'Biological Scissor'.

Answer: (B)

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	A	3	D	4	B	5	D
6	B	7	A	8	B	9	C	10	C
11	A	12	B	13	B	14	B	15	B
16	A	17	C	18	C	19	D	20	B
21	C	22	B	23	A	24	C	25	C
26	B	27	A	28	B	29	D	30	C
31	B	32	B	33	C	34	C	35	A
36	A	37	B	38	B	39	A	40	B
41	B	42	B	43	A	44	B	45	B
46	C	47	C	48	C	49	C	50	D
51	D	52	A	53	B	54	B	55	C
56	B	57	A	58	B	59	B	60	C
61	C	62	D	63	A	64	B	65	A
66	B	67	A	68	B	69	B	70	C
71	C	72	B	73	C	74	D	75	C
76	C	77	B	78	C	79	B	80	B
81	B	82	B	83	B	84	B	85	B
86	C	87	C	88	B	89	A	90	B