NEET-UG Biology Sample Paper-19

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. A unicellular organism exhibits both plant-like and animal-like characteristics, including photosynthesis and motility using flagella. Based on these features, under which kingdom should this organism be classified?

(A) Monera

(B) Protista

(C) Fungi

(D) Plantae

Q2. Certain bacteria are capable of surviving in extreme environmental conditions such as high salinity and temperature. Which group of organisms do these belong to?

(A) Eubacteria

(B) Archaebacteria

(C) Cyanobacteria

(D) Mycoplasma

Q3. Which of the following characteristics is common to both bryophytes and pteridophytes but absent in algae?

(A) Presence of chlorophyll

(B) Multicellular structure

(C) Embryo formation

(D) Asexual reproduction

Q4. In gymnosperms, pollination occurs directly to the ovule due to absence of ovary. What is this condition called?

(A) Enclosed ovules

(B) Naked ovules

(C) Double fertilization

(D) Triploid endosperm

Q5. In a dicot root, vascular tissues are arranged in a specific pattern. Which arrangement is typically observed?

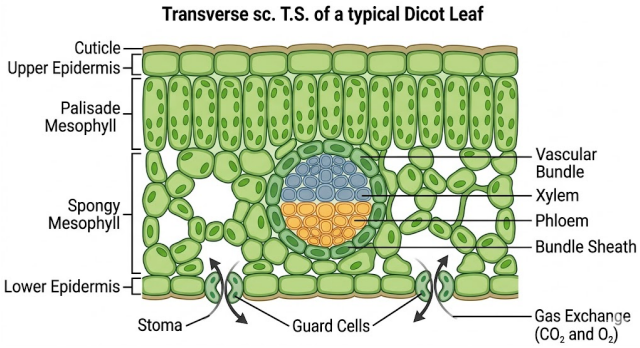
(A) Radial arrangement

(B) Collateral arrangement

(C) Bicollateral arrangement

(D) Scattered arrangement

Q6. The diagram below represents a transverse section of a leaf. Identify the tissue responsible for maximum photosynthesis.



(A) Spongy mesophyll

(B) Palisade mesophyll

(C) Epidermis

(D) Vascular bundle

Q7. Muscle contraction requires calcium ions and ATP. Which cellular structure stores calcium ions in muscle cells?

(A) Mitochondria

(B) Sarcoplasmic reticulum

(C) Golgi apparatus

(D) Lysosome

Q8. Which type of connective tissue provides structural support and protection to internal organs?

(A) Blood

(B) Cartilage

(C) Bone

(D) Adipose tissue

Q9. The plasma membrane is selectively permeable due to its lipid bilayer structure. Which component increases membrane fluidity?

(A) Cholesterol

(B) Proteins

(C) Carbohydrates

(D) DNA

Q10. Which organelle is responsible for packaging and secretion of proteins synthesized in the cell?

(A) Ribosome

(B) Golgi apparatus

(C) Endoplasmic reticulum

(D) Nucleus

Q11. In meiosis, homologous chromosomes pair and exchange genetic material. What is this pairing called?

(A) Synapsis

(B) Crossing over

(C) Disjunction

(D) Segregation

Q12. Water potential plays a major role in plant water relations. Water moves from higher to lower water potential by which process?

(A) Diffusion

(B) Osmosis

(C) Active transport

(D) Translocation

Q13. In photosynthesis, which molecule acts as the primary electron donor?

(A) CO_2

(B) NADP

(C) Water

(D) Glucose

Q14. Respiration in plants can occur under both aerobic and anaerobic conditions. Which process occurs in absence of oxygen?

(A) Krebs cycle

(B) Electron transport chain

(C) Fermentation

(D) Oxidative phosphorylation

Q15. Which plant hormone is responsible for fruit ripening and is gaseous in nature?

(A) Auxin

(B) Cytokinin

(C) Ethylene

(D) Gibberellin

Q16. The human heart has four chambers. Which chamber pumps oxygenated blood to the body?

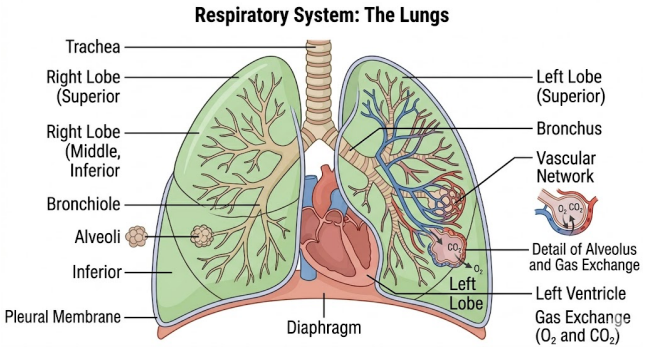
(A) Right atrium

(B) Right ventricle

(C) Left atrium

(D) Left ventricle

Q17. The diagram below represents the human respiratory system. Identify the site where gaseous exchange takes place.



(A) Trachea

(B) Bronchi

(C) Alveoli

(D) Larynx

Q18. Which enzyme is responsible for digestion of starch in the human mouth?

(A) Pepsin

(B) Trypsin

(C) Amylase

(D) Lipase

Q19. Neurons transmit signals through electrical impulses. What is the insulating layer around axons called?

(A) Myelin sheath

(B) Synapse

(C) Dendrite

(D) Axon terminal

Q20. Which hormone regulates blood glucose levels by lowering it?

(A) Glucagon

(B) Insulin

(C) Adrenaline

(D) Thyroxine

Q21. During the cardiac cycle, the closing of which valves produces the first heart sound (lub), indicating the beginning of ventricular systole?

(A) Semilunar valves

(B) Atrioventricular valves

(C) Pulmonary valve

(D) Aortic valve

Q22. Which part of the nephron plays a crucial role in concentrating urine by creating an osmotic gradient in the medulla?

(A) Proximal convoluted tubule

(B) Distal convoluted tubule

(C) Loop of Henle

(D) Bowman's capsule

Q23. In human endocrine regulation, which gland is often referred to as the "master gland" because it controls other endocrine glands?

(A) Thyroid gland

(B) Pituitary gland

(C) Adrenal gland

(D) Pancreas

Q24. Double fertilization in angiosperms involves fusion of one male gamete with the egg and another with polar nuclei. What is the ploidy of the endosperm formed?

(A) Haploid

(B) Diploid

(C) Triploid

(D) Tetraploid

Q25. Which structure in a flower develops into a fruit after fertilization, playing a protective role for developing seeds?

(A) Ovule

(B) Ovary

(C) Style

(D) Stigma

Q26. In Mendelian genetics, a dihybrid cross involves two pairs of contrasting traits. What is the phenotypic ratio observed in the F_2 generation of a typical dihybrid cross?

(A) 3:1

(B) 1:2:1

(C) 9:3:3:1

(D) 1:1:1:1

Q27. Which type of RNA carries amino acids to the ribosome during protein synthesis?

(A) mRNA

(B) rRNA

(C) tRNA

(D) snRNA

Q28. A mutation that shifts the reading frame of the genetic code due to insertion or deletion of nucleotides is known as:

(A) Point mutation

(B) Silent mutation

(C) Frameshift mutation

(D) Missense mutation

Q29. According to Darwin's theory, organisms with favorable variations are more likely to survive. What is this concept called?

(A) Use and disuse

(B) Survival of the fittest

(C) Mutation theory

(D) Genetic drift

Q30. Which evolutionary force results in random changes in allele frequency in small populations?

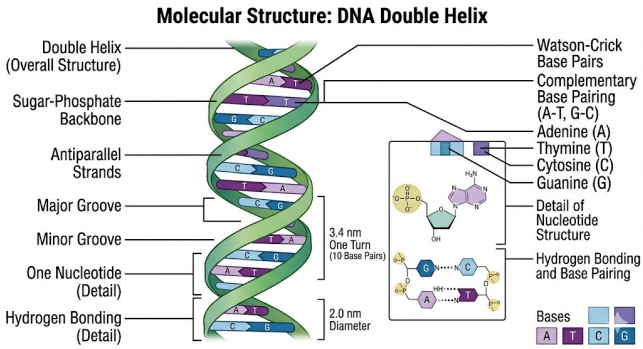
(A) Natural selection

(B) Gene flow

(C) Genetic drift

(D) Mutation

Q31. The diagram below represents the structure of DNA showing base pairing. Identify the type of bond between complementary nitrogenous bases.



(A) Ionic bond

(B) Hydrogen bond

(C) Covalent bond

(D) Peptide bond

Q32. In human health, antibiotics are effective against certain pathogens. Which of the following organisms are primarily targeted by antibiotics?

(A) Viruses

(B) Bacteria

(C) Fungi

(D) Protozoa

Q33. Which disease is transmitted through the bite of an infected female Anopheles mosquito?

(A) Dengue

(B) Malaria

(C) Tuberculosis

(D) Typhoid

Q34. Which type of immunity involves direct transfer of antibodies from one individual to another?

(A) Natural active immunity

(B) Artificial active immunity

(C) Passive immunity

(D) Innate immunity

Q35. Which biotechnological product is produced using genetically modified bacteria to treat diabetes?

(A) Vaccine

(B) Insulin

(C) Antibiotic

(D) Enzyme

Q36. Restriction enzymes recognize specific nucleotide sequences in DNA. What are these specific sequences called?

(A) Codons

(B) Anticodons

(C) Recognition sites

(D) Promoters

Q37. In an ecosystem, decomposers play a crucial role. What is their primary function?

(A) Producing energy

(B) Breaking down organic matter

(C) Fixing nitrogen

(D) Consuming producers

Q38. Which ecological pyramid can sometimes be inverted due to smaller biomass of producers compared to consumers?

(A) Pyramid of energy

(B) Pyramid of biomass

(C) Pyramid of numbers

(D) Pyramid of productivity

Q39. Which gas is primarily responsible for acid rain formation?

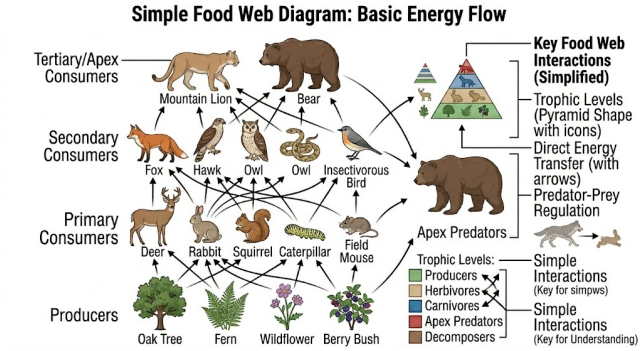
(A) CO_2

(B) SO_2

(C) O_2

(D) N_2

Q40. The diagram below represents a food web. Identify the primary consumers in the ecosystem.



(A) Producers

(B) Herbivores

(C) Carnivores

(D) Decomposers

Q41. Which vitamin is essential for blood clotting and is synthesized by bacteria in the human intestine?

(A) Vitamin A

(B) Vitamin B

(C) Vitamin K

(D) Vitamin D

Q42. Which part of the brain regulates hunger, thirst, and body temperature?

(A) Cerebrum

(B) Cerebellum

(C) Hypothalamus

(D) Medulla

Q43. Which structure connects the placenta to the developing embryo and facilitates nutrient exchange?

(A) Amnion

(B) Umbilical cord

(C) Chorion

(D) Yolk sac

Q44. Which stage of meiosis is characterized by separation of homologous chromosomes?

(A) Prophase I

(B) Metaphase I

(C) Anaphase I

(D) Telophase I

Q45. Which term describes organisms that can synthesize their own food using inorganic substances?

(A) Heterotrophs

(B) Autotrophs

(C) Parasites

(D) Saprophytes

Q46. Which enzyme unwinds the DNA helix during replication?

(A) Ligase

(B) Helicase

(C) Polymerase

(D) Primase

Q47. Which type of RNA forms the structural component of ribosomes?

(A) mRNA

(B) tRNA

(C) rRNA

(D) siRNA

Q48. Which greenhouse gas has the highest heat-trapping ability per molecule?

(A) CO_2

(B) CH_4

(C) N_2O

(D) CFCs

Q49. Which process converts nitrate into nitrogen gas, completing the nitrogen cycle?

(A) Nitrification

(B) Ammonification

(C) Denitrification

(D) Fixation

Q50. Which biodiversity level refers to variation within a species?

(A) Genetic diversity

(B) Species diversity

(C) Ecosystem diversity

(D) Functional diversity

Q51. In plants, transpiration plays a significant role in the ascent of sap. Which factor primarily contributes to the upward movement of water in tall trees?

(A) Root pressure only

(B) Capillary action only

(C) Transpiration pull

(D) Osmotic pressure

Q52. Which enzyme catalyzes the conversion of glucose into glucose-6-phosphate in the first step of glycolysis?

(A) Hexokinase

(B) Phosphofructokinase

(C) Pyruvate kinase

(D) Aldolase

Q53. In human physiology, which component of blood is primarily responsible for transporting carbon dioxide from tissues to lungs?

(A) RBC as carbaminohemoglobin

(B) Plasma as bicarbonate ions

(C) Platelets

(D) WBC

Q54. Which part of the digestive system is responsible for maximum absorption of nutrients due to presence of villi and microvilli?

(A) Stomach

(B) Small intestine

(C) Large intestine

(D) Esophagus

Q55. In neural transmission, the gap between two neurons where neurotransmitters are released is known as:

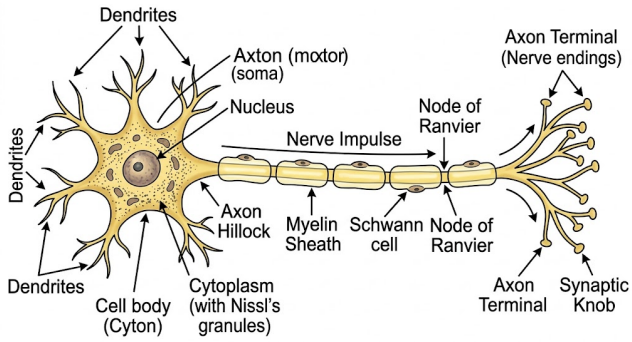
(A) Axon hillock

(B) Synapse

(C) Dendrite

(D) Node of Ranvier

Q56. The diagram below represents a neuron showing different parts. Identify the region where impulse transmission begins.



(A) Dendrite

(B) Axon hillock

(C) Axon terminal

(D) Synapse

Q57. Which hormone is responsible for stimulating uterine contractions during childbirth?

(A) Estrogen

(B) Progesterone

(C) Oxytocin

(D) Prolactin

Q58. Which structure in human sperm contains enzymes necessary for penetration of the ovum?

(A) Nucleus

(B) Acrosome

(C) Midpiece

(D) Flagellum

Q59. Which stage of embryonic development involves formation of three germ layers?

(A) Cleavage

(B) Blastulation

(C) Gastrulation

(D) Organogenesis

Q60. Which type of inheritance is observed in the case of ABO blood group system?

(A) Incomplete dominance

(B) Codominance

(C) Polygenic inheritance

(D) Sex-linked inheritance

Q61. Which enzyme synthesizes complementary RNA strand during transcription?

(A) DNA polymerase

(B) RNA polymerase

(C) Ligase

(D) Topoisomerase

Q62. Which evolutionary process results in adaptation of organisms to their environment over generations?

(A) Genetic drift

(B) Natural selection

(C) Mutation

(D) Migration

Q63. Which disease is caused by deficiency of iodine in diet?

(A) Diabetes

(B) Goitre

(C) Scurvy

(D) Rickets

Q64. Which pathogen is responsible for causing tuberculosis in humans?

(A) Virus

(B) Bacteria

(C) Protozoa

(D) Fungus

Q65. Which technique is used to detect the presence of specific proteins or antigens in a sample?

(A) PCR

(B) ELISA

(C) Gel electrophoresis

(D) Chromatography

Q66. Which organism is commonly used in recombinant DNA technology as a host for gene cloning?

(A) Homo sapiens

(B) Escherichia coli

(C) Amoeba

(D) Yeast

Q67. Which ecological factor limits population growth in an ecosystem?

(A) Unlimited resources

(B) Carrying capacity

(C) Infinite reproduction

(D) Absence of predators

Q68. Which type of ecological interaction involves one organism benefiting while the other is neither harmed nor benefited?

(A) Parasitism

(B) Mutualism

(C) Commensalism

(D) Predation

Q69. Which level of biodiversity refers to variation among ecosystems in a region?

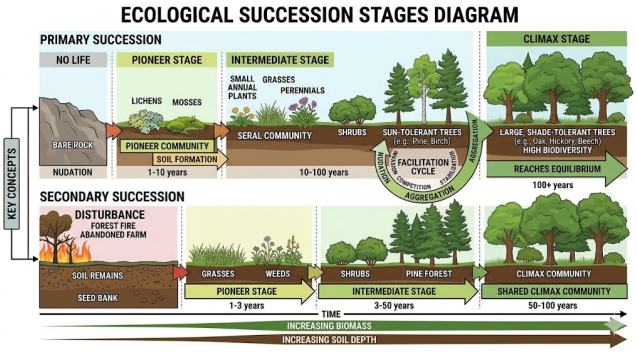
(A) Genetic diversity

(B) Species diversity

(C) Ecosystem diversity

(D) Molecular diversity

Q70. The diagram below shows ecological succession stages. Identify the first colonizing organisms in a barren area.



(A) Shrubs

(B) Trees

(C) Pioneer species

(D) Climax species

Q71. Which component of ecosystem is responsible for recycling nutrients?

(A) Producers

(B) Consumers

(C) Decomposers

(D) Herbivores

Q72. Which gas is released during photosynthesis as a by-product?

(A) CO_2

(B) O_2

(C) N_2

(D) H_2

Q73. Which stage of ecological succession is stable and self-sustaining?

(A) Pioneer stage

(B) Seral stage

(C) Climax stage

(D) Intermediate stage

Q74. Which process involves conversion of ammonia into nitrites and nitrates?

(A) Nitrogen fixation

(B) Nitrification

(C) Denitrification

(D) Ammonification

Q75. Which international protocol deals with reduction of greenhouse gas emissions?

(A) Montreal Protocol

(B) Kyoto Protocol

(C) Paris Agreement

(D) Rio Summit

Q76. In plant physiology, phloem is responsible for translocation of organic nutrients. Which process explains the movement of sucrose from source to sink?

(A) Diffusion

(B) Active transport

(C) Mass flow hypothesis

(D) Osmosis

Q77. During aerobic respiration, which molecule acts as the final electron acceptor in the electron transport chain?

(A) NADH

(B) Oxygen

(C) Carbon dioxide

(D) ATP

Q78. In human physiology, which blood component is responsible for clot formation at the site of injury?

(A) RBC

(B) WBC

(C) Platelets

(D) Plasma proteins only

Q79. Which part of the brain is responsible for involuntary actions such as breathing and heartbeat regulation?

(A) Cerebrum

(B) Cerebellum

(C) Medulla oblongata

(D) Hypothalamus

Q80. In the menstrual cycle, which phase follows ovulation and is characterized by formation of corpus luteum?

(A) Menstrual phase

(B) Follicular phase

(C) Luteal phase

(D) Proliferative phase

Q81. Which type of genetic disorder is caused by an extra copy of chromosome 21?

(A) Turner syndrome

(B) Klinefelter syndrome

(C) Down syndrome

(D) Hemophilia

Q82. Which enzyme is responsible for synthesizing DNA primers during DNA replication?

(A) DNA polymerase

(B) Primase

(C) Ligase

(D) Helicase

Q83. Which evolutionary concept explains the development of similar structures in unrelated species due to similar environmental pressures?

(A) Divergent evolution

(B) Convergent evolution

(C) Adaptive radiation

(D) Genetic drift

Q84. Which pathogen causes cholera in humans through contaminated water?

(A) Virus

(B) Bacteria

(C) Protozoa

(D) Fungus

Q85. In biotechnology, which technique separates DNA fragments based on size using an electric field?

(A) PCR

(B) Gel electrophoresis

(C) ELISA

(D) Chromatography

Q86. Which type of ecosystem is characterized by low rainfall, sparse vegetation, and extreme temperature variations?

(A) Grassland

(B) Desert

(C) Tundra

(D) Rainforest

Q87. Which level of organization in ecology includes all living organisms interacting with their physical environment?

(A) Population

(B) Community

(C) Ecosystem

(D) Biosphere

Q88. Which process converts organic nitrogen in dead organisms into ammonia?

(A) Nitrogen fixation

(B) Nitrification

(C) Ammonification

(D) Denitrification

Q89. Which gas is primarily responsible for depletion of the ozone layer in the stratosphere?

(A) Oxygen

(B) Carbon dioxide

(C) Chlorofluorocarbons

(D) Nitrogen

Q90. Which ecological law states that only about 10% of energy is transferred from one trophic level to the next?

(A) Law of minimum

(B) Ten percent law

(C) Competitive exclusion principle

(D) Hardy-Weinberg principle

Detailed Solutions

Q1.

Solution

Concept: Five-kingdom classification based on characteristics like cell structure, mode of nutrition, and body organization.

Solution: The organism described is unicellular and exhibits both autotrophic (photosynthesis, a plant-like trait) and motile (using flagella, an animal-like trait) characteristics. The Kingdom Protista is a diverse group of eukaryotic organisms that do not fit into the other kingdoms (Plantae, Fungi, Animalia). It includes unicellular autotrophs, heterotrophs, and mixotrophs. Organisms like Euglena are classic examples that fit this description perfectly.

- **Monera:** Consists of unicellular prokaryotes.
- **Fungi:** Are heterotrophic, mostly multicellular eukaryotes with chitinous cell walls.
- **Plantae:** Are multicellular, autotrophic, non-motile eukaryotes.

Thus, the organism belongs to Kingdom Protista.
Final Answer : "Protista"

Answer: (B)

Q2.

Solution

Concept: Classification of bacteria based on their habitat and cell wall structure.

Solution: The domain Archaea, or Archaebacteria, is known for its members that thrive in extreme environmental conditions. These organisms are often called extremophiles.

- **Halophiles:** Live in extremely saline environments.
- **Thermophiles:** Live in very hot environments like hot springs.
- **Methanogens:** Live in anaerobic environments and produce methane.

Eubacteria ("true bacteria"), Cyanobacteria (photosynthetic bacteria), and Mycoplasma (bacteria lacking a cell wall) typically inhabit more moderate environments and are not primarily defined by their ability to survive in such extremes.
Final Answer : "Archaebacteria"

Answer: (B)

Q3.

Solution

Concept: Evolutionary trends in the plant kingdom, specifically the transition from aquatic to terrestrial life.

Solution: Bryophytes and pteridophytes are classified as Embryophytes (land plants). A key evolutionary adaptation for life on land is the protection of the developing offspring. In these groups, after fertilization, the zygote develops into a multicellular embryo that is retained within the female reproductive structure (archegonium) and is nourished by the parent plant.

- **Algae:** Lack this feature. Their zygote is often released or develops independently without forming a protected, dependent embryo.
- **Chlorophyll, Multicellularity, and Asexual reproduction:** These are features found in all three groups (Algae, Bryophytes, and Pteridophytes), although the complexity and form may vary.

Therefore, embryo formation is a characteristic common to bryophytes and pteridophytes but absent in algae.

Final Answer : "Embryo formation"

Answer: (C)

Q4.

Solution

Concept: Reproductive structures in gymnosperms versus angiosperms.

Solution: The term "gymnosperm" is derived from the Greek words 'gymnos' (naked) and 'sperma' (seed). This name directly reflects their defining characteristic: the ovules are not enclosed within a protective ovary. Instead, they are exposed, typically on the surface of scales (megasporophylls), which are often arranged in cones. This condition of exposed ovules is referred to as having "naked ovules". Because there is no ovary and stigma, pollination occurs directly, with pollen grains landing on or near the micropyle of the ovule. In contrast, angiosperms have enclosed ovules within an ovary. Double fertilization is a characteristic of angiosperms.

Final Answer : "Naked ovules"

Answer: (B)

Q5.

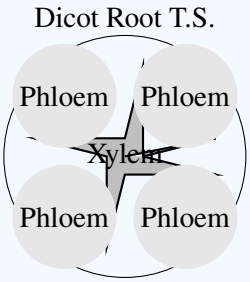
Solution

Concept: Internal anatomy of plant roots and stems, specifically the arrangement of vascular tissues.

Solution: In a typical dicot root, the primary xylem and phloem are arranged in a specific pattern within the stele. They are located on different radii, alternating with each other. This is known as a radial arrangement. The number of xylem bundles is usually small (from two to six), referred to as diarch, triarch, etc.

- **Collateral arrangement:** Xylem and phloem are on the same radius. This is typical of stems.
- **Scattered arrangement:** Vascular bundles are scattered throughout the ground tissue. This is characteristic of monocot stems.

The radial arrangement in roots is an efficient design for water absorption and transport to the core of the root.



Radial arrangement of vascular tissue

Final Answer : "Radial arrangement"

Answer: (A)

Q6.

Solution

Concept: Leaf histology and its relation to the function of photosynthesis.

Solution: The primary site of photosynthesis in a leaf is the mesophyll tissue, which is rich in chloroplasts. The mesophyll is typically differentiated into two layers:

- **Palisade mesophyll:** Located directly beneath the upper epidermis, this layer consists of one or more rows of elongated, columnar cells that are tightly packed. These cells are densely filled with chloroplasts and are oriented to maximize light absorption. Due to its position and high chloroplast density, the palisade mesophyll is responsible for the majority of photosynthesis that occurs in the leaf.
- **Spongy mesophyll:** Located below the palisade layer, this tissue consists of irregularly shaped cells with large intercellular air spaces. These spaces facilitate gas exchange (CO uptake, O release) with the stomata. While these cells do contain chloroplasts and photosynthesize, they do so to a lesser extent than the palisade cells.

The epidermis is a protective layer, and vascular bundles are for transport. Thus, the palisade mesophyll performs maximum photosynthesis.

Final Answer : "Palisade mesophyll"

Answer: (B)

Q7.

Solution

Concept: Excitation-contraction coupling in muscle cells.

Solution: Muscle contraction is a highly regulated process initiated by a nerve impulse and fueled by ATP. Calcium ions (Ca^2) act as the key regulatory signal. In a resting muscle cell, Ca^2 concentration in the cytoplasm (sarcoplasm) is kept very low. The vast majority of calcium is stored within a specialized organelle called the sarcoplasmic reticulum (SR), which is a modified form of the smooth endoplasmic reticulum. When the muscle cell is stimulated, the SR releases its stored Ca^2 into the sarcoplasm. This sudden increase in Ca^2 concentration allows the contractile proteins, actin and myosin, to interact, leading to muscle contraction. When the stimulation ends, Ca^2 is actively pumped back into the SR, causing the muscle to relax.

Final Answer : "Sarcoplasmic reticulum"

Answer: (B)

Q8.

Solution

Concept: Types and functions of connective tissues in the body.

Solution: Connective tissues serve various functions, including binding, support, protection, and transport.

- **Bone (Osseous Tissue):** is a hard, mineralized connective tissue that forms the body's skeleton. Its primary functions are to provide a rigid framework for structural support, protect vital internal organs (e.g., the skull protects the brain; the rib cage protects the heart and lungs), and serve as levers for muscle action to produce movement.
- **Blood:** is a fluid connective tissue for transport.
- **Cartilage:** provides flexible support and cushioning in areas like joints and the nose.
- **Adipose tissue:** provides insulation, energy storage, and cushioning.

While cartilage and adipose tissue offer forms of support and protection, bone provides the primary rigid structural support and protection for the body's major organs.
Final Answer : "Bone"

Answer: (C)

Q9.

Solution

Concept: The Fluid Mosaic Model of the plasma membrane.

Solution: The plasma membrane's fluidity is essential for its functions, such as transport and signaling. This fluidity is determined by the composition of the lipid bilayer. Cholesterol, a steroid molecule embedded within the membrane, plays a crucial role as a "fluidity buffer".

- At **low temperatures**, phospholipids tend to pack closely together, making the membrane rigid. Cholesterol fits between them, preventing this tight packing and thus *increasing* fluidity, keeping the membrane from freezing.
- At **high temperatures**, phospholipids move more freely, which can make the membrane too fluid. Cholesterol restrains their movement, thus *decreasing* fluidity and providing stability.

Since it prevents the membrane from becoming too rigid at low temperatures, cholesterol is a key component that can increase membrane fluidity under those conditions.
Final Answer : "Cholesterol"

Answer: (A)

Q10.

Solution

Concept: The role of the endomembrane system in protein processing and transport.

Solution: The synthesis, modification, and transport of proteins destined for secretion follow a specific pathway through the endomembrane system.

(a) **Ribosomes** on the Rough Endoplasmic Reticulum (RER) synthesize the proteins.

(b) The proteins enter the **RER lumen** for folding and initial modification.

(c) Transport vesicles bud off the RER and carry the proteins to the **Golgi apparatus**.

(d) In the Golgi apparatus, the proteins are further processed, sorted, and packaged into secretory vesicles. It acts like a cellular "post office."

(e) These secretory vesicles move to the plasma membrane, fuse with it, and release their contents outside the cell (exocytosis).

Therefore, the Golgi apparatus is the central organelle for the final packaging and direction of proteins for secretion.

Final Answer : "Golgi apparatus"

Answer: (B)

Q11.

Solution

Concept: Key events during Prophase I of Meiosis.

Solution: Meiosis I is characterized by the pairing and subsequent separation of homologous chromosomes. During Prophase I, several key events occur:

- **Synapsis:** Homologous chromosomes (one from each parent) find each other and pair up very precisely along their entire length. This process of pairing is called synapsis. The resulting structure, consisting of two homologous chromosomes (and four chromatids), is called a bivalent or tetrad.
- **Crossing over:** While the chromosomes are in synapsis, an exchange of genetic material occurs between non-sister chromatids of the homologous pair. This event is called crossing over and it creates new combinations of alleles.

The question specifically asks for the name of the pairing process, which is synapsis.

Final Answer : "Synapsis"

Answer: (A)

Q12.

Solution

Concept: Principles of water movement in biological systems.

Solution: Water potential () is a concept that combines the effects of solute concentration and pressure to predict the direction of water movement. The fundamental rule is that water always moves passively down its potential gradient, from an area of higher water potential to an area of lower water potential. When this movement of water occurs across a selectively permeable membrane, such as a plant cell membrane, it is defined by the specific term **osmosis**.

- **Diffusion** is a more general term for the movement of any substance from high to low concentration.
- **Active transport** requires energy to move substances against their gradient.
- **Translocation** refers to sugar transport in phloem.

Therefore, osmosis is the correct term for the movement of water from higher to lower water potential across a membrane.

Final Answer : "Osmosis"

Answer: (B)

Q13.

Solution

Concept: The light-dependent reactions of photosynthesis and electron flow.

Solution: The light-dependent reactions of photosynthesis convert light energy into chemical energy in the form of ATP and NADPH. This process involves a flow of electrons through photosystems and electron transport chains. The source of these electrons in oxygenic photosynthesis (which occurs in plants, algae, and cyanobacteria) is water. At Photosystem II, light energy is used to split water molecules in a process called photolysis. The reaction is: 2 H 2 O $\rightarrow$ 4 H + + 4 e + O 2 2H 2 O$\rightarrow$4H + +4e +O 2

The electrons (e e

) released from the splitting of water are used to replace the electrons lost by the chlorophyll P680 reaction center when it absorbs light. These electrons are then energized and passed along the electron transport chain. Thus, water is the primary electron donor. NADP is the final electron acceptor.

Final Answer : "Water"

Answer: (C)

Q14.

Solution

Concept: Cellular respiration under anaerobic conditions.

Solution: Cellular respiration starts with glycolysis, which does not require oxygen. In the presence of oxygen (aerobic conditions), the products of glycolysis proceed to the Krebs cycle and the electron transport chain for maximum ATP production. In the absence of oxygen (anaerobic conditions), the Krebs cycle and electron transport chain cannot function. To continue producing ATP via glycolysis, the cell must regenerate the NAD that is converted to NADH during the process. This regeneration is achieved through **fermentation**. In plants and yeast, this process is alcoholic fermentation, where pyruvate is converted into ethanol and CO, regenerating NAD in the process. This allows glycolysis to continue producing a small but vital amount of ATP.

Final Answer : "Fermentation"

Answer: (C)

Q15.

Solution

Concept: The roles and chemical nature of plant hormones (phytohormones).

Solution: Plant hormones regulate various aspects of growth and development. The hormone that fits both descriptions—responsible for fruit ripening and being gaseous—is ethylene.

- **Ethylene (CH):** is a simple gaseous hydrocarbon. It is widely known for its role in stimulating the ripening of many types of fruit (e.g., bananas, apples, tomatoes). The production of ethylene often increases dramatically at the onset of ripening, triggering changes in color, texture, and aroma. It also promotes senescence and abscission (shedding of leaves and flowers).
- **Auxin, Cytokinin, and Gibberellin:** are not gaseous and have different primary functions related to cell elongation, cell division, and stem growth, respectively.

Final Answer : "Ethylene"

Answer: (C)

Q16.

Solution

Concept: The structure of the human respiratory system is specialized for efficient gas exchange.

Solution: The primary function of the respiratory system is the exchange of oxygen and carbon dioxide between the inhaled air and the bloodstream. The path of air is through the larynx, trachea, bronchi, and bronchioles. These are conducting pathways. The actual exchange of gases occurs in the alveoli, which are tiny, thin-walled air sacs at the end of the bronchioles. The walls of the alveoli are only one cell thick and are surrounded by a dense network of capillaries. This structure provides a vast surface area and a very short diffusion distance, allowing for rapid and efficient exchange of gases between the air in the lungs and the blood in the capillaries.

Final Answer : "Alveoli"

Answer: (C)

Q17.

Solution

Concept: Enzymatic digestion of carbohydrates starts in the oral cavity.

Solution: Chemical digestion begins in the mouth. Saliva, produced by the salivary glands, contains an enzyme called salivary amylase (also known as ptyalin). Salivary amylase initiates the breakdown of complex carbohydrates (polysaccharides) like starch into simpler sugars (disaccharides) like maltose. Pepsin and trypsin are proteases that digest proteins in the stomach and small intestine, respectively. Lipase is an enzyme that digests fats (lipids).

Final Answer : "Amylase"

Answer: (C)

Q18.

Solution

Concept: The structure of a neuron is adapted for rapid transmission of electrical signals.

Solution: A neuron is a nerve cell that transmits electrical signals called action potentials. The axon is the long, slender projection of a neuron that conducts these signals away from the cell body. To increase the speed of signal transmission, many axons are covered by a fatty, insulating layer called the myelin sheath. This sheath is not continuous but has gaps called nodes of Ranvier. The electrical impulse "jumps" from one node to the next in a process called saltatory conduction, which is much faster than continuous conduction along an unmyelinated axon.

Final Answer : "Myelin sheath"

Answer: (A)

Q19.

Solution

Concept: Hormonal regulation of blood glucose levels by the pancreas.

Solution: The pancreas produces two key hormones that regulate blood glucose: insulin and glucagon. When blood glucose levels rise (e.g., after a meal), the beta cells of the pancreas secrete insulin. Insulin promotes the uptake of glucose from the blood into cells, particularly liver, muscle, and fat cells. It also stimulates the liver to convert excess glucose into glycogen for storage. Both actions effectively lower blood glucose levels. Glucagon, produced by alpha cells, has the opposite effect, raising blood glucose levels when they are too low.

Final Answer : "Insulin"

Answer: (B)

Q20.

Solution

Concept: The cardiac cycle and the origin of heart sounds.

Solution: The two main heart sounds, "lub" (S1) and "dup" (S2), are produced by the closing of heart valves. The first heart sound, "lub," marks the beginning of ventricular systole (the phase when the ventricles contract). This sound is generated by the forceful closure of the atrioventricular (AV) valves—the mitral (bicuspid) valve on the left side and the tricuspid valve on the right. Their closure prevents blood from flowing back into the atria as the ventricles pump blood out to the lungs and body. The second sound, "dup," is caused by the closure of the semilunar (aortic and pulmonary) valves.

Final Answer : "Atrioventricular valves"

Answer: (B)

Q21.

Solution

Concept: The role of the nephron in concentrating urine.

Solution: The nephron is the functional unit of the kidney responsible for filtering blood and forming urine. The Loop of Henle is a crucial part of the nephron that descends into the renal medulla and then ascends back to the cortex. It functions as a countercurrent multiplier, actively pumping salts (like NaCl) out of the ascending limb into the surrounding interstitial fluid of the medulla. This creates a hypertonic (high solute concentration) environment in the medulla. As the filtrate later passes through the collecting duct, which also runs through the medulla, this osmotic gradient allows water to be reabsorbed from the filtrate (under the control of ADH), thereby concentrating the urine.

Final Answer : "Loop of Henle"

Answer: (C)

Q22.

Solution

Concept: Hierarchical control within the human endocrine system.

Solution: The endocrine system is a network of glands that produce hormones to regulate various bodily functions. The pituitary gland, located at the base of the brain, is often referred to as the "master gland" because it synthesizes and secretes a variety of hormones that control the activity of other endocrine glands. For example, it produces Thyroid-Stimulating Hormone (TSH) to control the thyroid gland, Adrenocorticotropic Hormone (ACTH) to control the adrenal cortex, and gonadotropins (FSH and LH) to control the ovaries and testes. The pituitary gland itself is under the control of the hypothalamus.

Final Answer : "Pituitary gland"

Answer: (B)

Q23.

Solution

Concept: Double fertilization is a unique reproductive process in angiosperms (flowering plants).

Solution: In angiosperms, the pollen grain contains two male gametes (sperm nuclei), both of which are haploid (n). After pollination, a pollen tube grows and delivers these two gametes to the ovule.

(a) One male gamete (n) fuses with the egg cell (n) to form the diploid (2n) zygote, which develops into the embryo.

(b) The second male gamete (n) fuses with the two polar nuclei in the central cell (n + n) to form the primary endosperm nucleus.

This resulting endosperm nucleus is triploid (n + n + n = 3n). It develops into the endosperm, a nutritive tissue that provides nourishment for the developing embryo.

Final Answer : "Triploid"

Answer: (C)

Q24.

Solution

Concept: Post-fertilization development in flowering plants.

Solution: After successful fertilization in a flower, several transformations occur to produce the fruit and seed. The ovule, which contains the fertilized egg, develops into the seed. The ovary, which is the part of the pistil that encloses the ovules, matures and ripens to become the fruit. The wall of the ovary develops into the pericarp, which is the wall of the fruit. The primary functions of the fruit are to protect the enclosed seeds and to aid in their dispersal.

Final Answer : "Ovary"

Answer: (B)

Q25.

Solution

Concept: Mendel's Law of Independent Assortment and dihybrid crosses.

Solution: A dihybrid cross is a genetic cross between individuals who have different alleles for two specific genes. A classic example is Mendel's cross of pea plants differing in two traits, such as seed color (Yellow/green) and seed shape (Round/wrinkled). When F_1 heterozygotes (e.g., RrYy) are self-crossed, the alleles for each trait assort independently. This results in four possible phenotypes in the F_2 generation: Round Yellow, Round green, wrinkled Yellow, and wrinkled green. The expected phenotypic ratio for this cross, assuming independent assortment and complete dominance, is 9:3:3:1.

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

Answer: (C)

Q26.

Solution

Concept: The roles of different types of RNA in the process of translation (protein synthesis).

Solution: Protein synthesis involves three main types of RNA:

- **mRNA (messenger RNA):** Carries the genetic code transcribed from DNA to the ribosome. It acts as the template for protein synthesis.
- **rRNA (ribosomal RNA):** A major structural and catalytic component of ribosomes, the cellular machinery where proteins are made.
- **tRNA (transfer RNA):** Acts as an adapter molecule. Each tRNA molecule has an anticodon at one end that binds to a specific codon on the mRNA, and it carries the corresponding amino acid at the other end. tRNA molecules bring the correct amino acids to the ribosome in the sequence dictated by the mRNA codons.

Therefore, tRNA is responsible for carrying amino acids to the ribosome.

Final Answer : "tRNA"

Answer: (C)

Q27.

Solution

Concept: Types of gene mutations and their effect on the genetic code.

Solution: The genetic code is read in three-nucleotide units called codons. A frameshift mutation is a type of genetic mutation caused by the insertion or deletion of one or more nucleotides in a DNA sequence, where the number of inserted/deleted nucleotides is not a multiple of three. This alteration disrupts the grouping of codons from the point of the mutation onwards. Consequently, the reading frame is shifted, and all subsequent codons are read incorrectly. This typically leads to the production of a truncated and non-functional protein. Point mutations (missense, silent) involve the substitution of a single nucleotide and do not shift the reading frame.
Final Answer : "Frameshift mutation"

Answer: (C)

Q28.

Solution

Concept: Gene mutations and their effect on the genetic code.

Solution: The genetic code is read in groups of three nucleotides called codons, which specify particular amino acids. This sequence of codons is known as the reading frame. A frameshift mutation occurs when nucleotides are inserted or deleted in a number that is not a multiple of three. This insertion or deletion alters the grouping of the nucleotides into codons from the point of the mutation onwards. As a result, the entire downstream sequence of amino acids is changed, often leading to a non-functional protein.

- **Point mutation** is a general term for a change in a single nucleotide. It can be a missense, silent, or nonsense mutation.
- **Silent mutation** is a point mutation that does not change the amino acid sequence.
- **Missense mutation** is a point mutation that results in a codon that codes for a different amino acid.

Since the question specifies a shift in the reading frame due to insertion or deletion, the correct answer is frameshift mutation.
Final Answer : "Frameshift mutation"

Answer: (C)

Q29.

Solution

Concept: Darwin's theory of evolution by natural selection.

Solution: Charles Darwin's theory of evolution is based on the principle of natural selection. One of the key postulates of this theory is that within any population, there is natural variation. Some of these variations may be more advantageous (favorable) in a particular environment than others. Organisms possessing these favorable variations are better adapted to their environment, giving them a higher chance of surviving, reproducing, and passing on these advantageous traits to their offspring. This concept is commonly summarized as "Survival of the fittest".

- **Use and disuse** is a concept from Lamarck's theory, suggesting that traits acquired during an organism's lifetime could be inherited.
- **Mutation theory** was proposed by Hugo de Vries, emphasizing the role of large, sudden mutations in evolution.
- **Genetic drift** refers to random changes in allele frequencies, which is a mechanism of evolution but distinct from the concept of fitness-based survival.

Final Answer : "Survival of the fittest"

Answer: (B)

Q30.

Solution

Concept: Mechanisms of evolution.

Solution: Genetic drift is an evolutionary mechanism that causes random fluctuations in allele frequencies within a population from one generation to the next. These changes are due to chance events, such as which individuals happen to survive and reproduce. The effect of genetic drift is most pronounced in small populations, where random events can have a significant impact on the genetic makeup of the population, sometimes leading to the loss or fixation of alleles, irrespective of their adaptive value.

- **Natural selection** is a non-random process where allele frequencies change based on their effect on survival and reproduction.
- **Gene flow** is the transfer of alleles from one population to another through migration.
- **Mutation** is the ultimate source of new genetic variation but refers to the change in the DNA sequence itself, not the population-level change in frequency due to chance.

Final Answer : "Genetic drift"

Answer: (C)

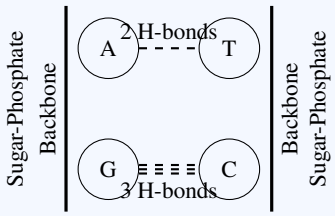
Q31.

Solution

Concept: The chemical structure of DNA and bonding.

Solution: The DNA molecule is a double helix composed of two polynucleotide chains. These chains are held together by bonds between complementary nitrogenous bases. Adenine (A) pairs with Thymine (T), and Guanine (G) pairs with Cytosine (C). The bonds that form between these complementary base pairs are hydrogen bonds. Specifically, there are two hydrogen bonds between Adenine and Thymine, and three hydrogen bonds between Guanine and Cytosine. These hydrogen bonds are relatively weak individually, which allows the two strands to be separated for processes like replication and transcription, but they are strong enough collectively to maintain the stable double-helix structure.

- **Covalent bonds** (specifically phosphodiester bonds) link the sugar and phosphate groups to form the backbone of each DNA strand.
- **Ionic bonds** and **Peptide bonds** are not involved in holding the two DNA strands together. Peptide bonds link amino acids in proteins.



Final Answer : "Hydrogen bond"

Answer: (B)

Q32.

Solution

Concept: Action of antibiotics.

Solution: Antibiotics are a class of antimicrobial drugs used in the treatment and prevention of bacterial infections. They work by targeting specific cellular processes or structures that are unique to bacteria and absent or different in eukaryotic cells (like human cells, fungi, and protozoa) and viruses. Common targets include the bacterial cell wall (e.g., penicillin), bacterial ribosomes (e.g., tetracycline), and bacterial DNA replication machinery.

- **Viruses** are not affected by antibiotics because they are not living cells and lack the metabolic machinery that antibiotics target. They replicate inside host cells, using the host's machinery. Antiviral drugs are used to treat viral infections.
- **Fungi** and **Protozoa** are eukaryotes. While they are pathogens, they have different cellular structures from bacteria, so antibiotics are generally ineffective against them. Antifungal and antiprotozoal drugs are used instead.

Therefore, antibiotics are specifically effective against bacteria.
Final Answer : "Bacteria"

Answer: (B)

Q33.

Solution

Concept: Vector-borne diseases and their specific vectors.

Solution: Many infectious diseases are transmitted by vectors, which are organisms that carry and transmit pathogens from one host to another. It is important to know the specific vector for major diseases.

- **Malaria** is a parasitic disease caused by the protozoan *Plasmodium*. It is transmitted exclusively through the bite of an infected female *Anopheles* mosquito.
- **Dengue** is a viral disease transmitted by the bite of an infected female *Aedes* mosquito, primarily *Aedes aegypti*.
- **Tuberculosis** is a bacterial disease caused by *Mycobacterium tuberculosis* and is primarily spread through the air when an infected person coughs or sneezes. It is not vector-borne.
- **Typhoid** is a bacterial infection caused by *Salmonella Typhi*, usually spread through contaminated food or water. It is not vector-borne.

The question specifically asks for the disease transmitted by the female *Anopheles* mosquito, which is Malaria.

Final Answer : "Malaria"

Answer: (B)

Q34.

Solution

Concept: Types of adaptive immunity.

Solution: The immune system can be broadly divided into innate and adaptive immunity. Adaptive immunity can be further classified as active or passive.

- **Active immunity** is when the individual's own immune system produces antibodies and memory cells in response to an antigen. This provides long-lasting protection. It can be *natural* (from an infection) or *artificial* (from a vaccine).
- **Passive immunity** is when an individual receives pre-made antibodies from another source, rather than producing them themselves. This provides immediate but temporary protection because no memory cells are formed. Examples include a baby receiving antibodies from its mother through the placenta and breast milk (natural passive immunity), or a patient receiving an injection of antiserum containing antibodies (artificial passive immunity).
- **Innate immunity** is the non-specific, first line of defense that is present from birth.

The question describes the direct transfer of antibodies, which is the definition of passive immunity.
Final Answer : "Passive immunity"

Answer: (C)

Q35.

Solution

Concept: Application of recombinant DNA technology in medicine.

Solution: Diabetes is a metabolic disorder characterized by high blood sugar levels resulting from defects in insulin production or action. Many diabetics require regular injections of insulin. Using biotechnology, specifically recombinant DNA technology, scientists have been able to produce human insulin on a large scale. The process involves:

(a) Isolating the human gene that codes for insulin.

(b) Inserting this gene into a plasmid (a small, circular piece of DNA) from a bacterium, such as *E. coli*.

(c) Introducing this recombinant plasmid back into the bacteria.

(d) These genetically modified bacteria are then cultured in large fermentation tanks, where they multiply and, as they express their genes, produce large quantities of pure human insulin.

This product, often called 'humulin', was the first genetically engineered pharmaceutical product approved for human use. It has largely replaced insulin derived from animal sources (pigs and cattle) due to its lower risk of allergic reactions and higher availability.

Final Answer : "Insulin"

Answer: (B)

Q36.

Solution

Concept: Molecular tools in biotechnology, specifically restriction enzymes.

Solution: Restriction enzymes, also known as restriction endonucleases, are enzymes that cut DNA molecules at specific locations. Each restriction enzyme recognizes a particular short sequence of nucleotides in the DNA. This specific sequence is known as a **recognition site** or restriction site. The enzyme scans a DNA molecule and makes a cut whenever it encounters its specific recognition site. This ability to cut DNA at precise locations is fundamental to genetic engineering.

- **Codons** are three-nucleotide sequences in mRNA that specify which amino acid to add during protein synthesis.
- **Anticodons** are three-nucleotide sequences on tRNA molecules that are complementary to codons on mRNA.
- **Promoters** are DNA sequences that define where transcription of a gene by RNA polymerase begins.

Final Answer : "Recognition sites"

Answer: (C)

Q37.

Solution

Concept: Ecological roles and nutrient cycling.

Solution: In an ecosystem, decomposers (primarily bacteria and fungi) have the essential function of breaking down dead organic matter and waste products from all trophic levels (dead plants, dead animals, and feces). This process, called decomposition, releases inorganic nutrients (like carbon, nitrogen, and phosphorus) back into the soil, water, and air. These nutrients are then available for uptake by producers (plants), thus completing the nutrient cycle. Without decomposers, nutrients would remain locked in dead organic material, and ecosystems would cease to function.

- **Producing energy** is the function of producers (autotrophs).
- **Fixing nitrogen** is a specific process carried out by nitrogen-fixing bacteria, not the primary role of all decomposers.
- **Consuming producers** is the role of primary consumers (herbivores).

Final Answer : "Breaking down organic matter"

Answer: (B)

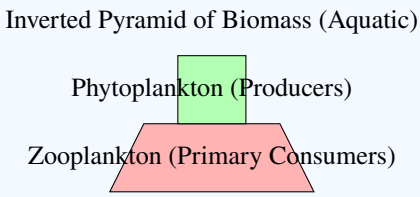
Q38.

Solution

Concept: Ecological pyramids (Pyramid of Biomass).

Solution: Ecological pyramids are graphical representations of the trophic structure of an ecosystem.

- **Pyramid of Energy:** This is always upright because energy is lost at each successive trophic level (typically only 10% is transferred).
- **Pyramid of Numbers:** This can be inverted. For example, a single large tree (producer) can support thousands of insects (primary consumers).
- **Pyramid of Biomass:** This pyramid represents the total dry weight (biomass) of organisms at each trophic level. While usually upright, it can be inverted in certain aquatic ecosystems. In these cases, the producers are phytoplankton, which have a very short lifespan and high turnover rate. They are consumed by zooplankton (primary consumers) so rapidly that their standing crop (the biomass present at any given moment) is smaller than the biomass of the zooplankton they support.



Final Answer : "Pyramid of biomass"

Answer: (B)

Q39.

Solution

Concept: Air pollution and the formation of acid rain.

Solution: Acid rain is precipitation that is more acidic than normal due to atmospheric pollutants. The primary gases responsible for this are sulfur dioxide (SO_2) and nitrogen oxides (NO_x). These gases are released into the atmosphere primarily from the burning of fossil fuels in power plants and vehicles. In the atmosphere, they react with water, oxygen, and other chemicals to form sulfuric acid (H_2SO_4) and nitric acid (HNO_3). These strong acids then fall to the Earth as rain, snow, fog, or dry particles.

- **CO_2** (Carbon dioxide) dissolves in rainwater to form weak carbonic acid, making normal rain slightly acidic (pH 5.6), but it is not the main cause of the environmental problem known as acid rain.
- **O_2** (Oxygen) and **N_2** (Nitrogen) are major components of air but do not cause acid rain.

Final Answer : "SO_2"

Answer: (B)

Q40.

Solution

Concept: Trophic levels in a food web.

Solution: In any ecosystem, organisms are classified into trophic levels based on their source of food.

- **Producers (First Trophic Level):** These are autotrophs, typically plants or algae, that produce their own food through photosynthesis. They form the base of the food web.
- **Primary Consumers (Second Trophic Level):** These are organisms that feed directly on producers. The common term for these plant-eating animals is **herbivores**.
- **Secondary Consumers (Third Trophic Level):** These are carnivores or omnivores that feed on primary consumers.
- **Tertiary Consumers (Fourth Trophic Level):** These are carnivores or omnivores that feed on secondary consumers.
- **Decomposers:** These organisms break down dead organic matter from all trophic levels.

The question asks to identify the primary consumers, which are, by definition, herbivores.
Final Answer : "Herbivores"

Answer: (B)

Q41.

Solution

Concept: Functions of vitamins in the human body.

Solution: Vitamins are essential organic compounds required in small amounts for various metabolic functions.

- **Vitamin K** is a fat-soluble vitamin crucial for the synthesis of proteins required for blood coagulation (clotting). It is necessary for the formation of prothrombin and other clotting factors in the liver. A deficiency in Vitamin K can lead to excessive bleeding. A significant portion of the body's Vitamin K is synthesized by beneficial bacteria residing in the large intestine.
- **Vitamin A** is essential for vision, immune function, and cell growth.
- **Vitamin B complex** includes several vitamins involved in energy metabolism.
- **Vitamin D** is essential for calcium absorption and bone health.

Final Answer : "Vitamin K"

Answer: (C)

Q42.

Solution

Concept: Functions of major parts of the human brain.

Solution: The brain is the control center of the nervous system. Different parts have specialized functions.

- The **Hypothalamus** is a small region located at the base of the brain that plays a vital role in maintaining the body's internal balance (homeostasis). It acts as a control center for many autonomic functions, including regulating hunger, thirst, satiety, body temperature, sleep cycles, and blood pressure. It also links the nervous system to the endocrine system via the pituitary gland.
- The **Cerebrum** is responsible for higher-level functions like thought, language, memory, and voluntary actions.
- The **Cerebellum** coordinates movement, posture, and balance.
- The **Medulla oblongata** controls vital involuntary functions like breathing, heart rate, and digestion.

Final Answer : "Hypothalamus"

Answer: (C)

Q43.

Solution

Concept: Structures involved in human fetal development.

Solution: During pregnancy, several structures support the growth and development of the embryo/fetus.

- The **Umbilical cord** is a flexible, tube-like structure that connects the developing embryo/fetus to the placenta. It contains one vein (carrying oxygenated, nutrient-rich blood from the placenta to the fetus) and two arteries (carrying deoxygenated, waste-laden blood from the fetus to the placenta). It is the lifeline for nutrient exchange, gas exchange, and waste removal.
- The **Amnion** is a membrane forming the amniotic sac, which encloses the embryo in protective amniotic fluid.
- The **Chorion** is the outermost fetal membrane that contributes to the formation of the placenta.
- The **Yolk sac** is an early embryonic structure involved in initial nourishment and blood cell formation.

Final Answer : "Umbilical cord"

Answer: (B)

Q44.

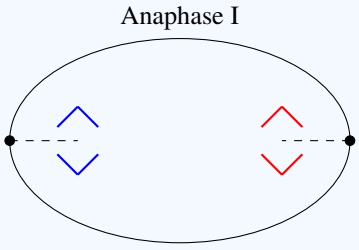
Solution

Concept: The process of meiosis.

Solution: Meiosis is a type of cell division that reduces the number of chromosomes in the parent cell by half to produce four gamete cells. It involves two rounds of division: Meiosis I and Meiosis II. Meiosis I is the reductional division.

- **Prophase I:** Homologous chromosomes pair up to form bivalents, and crossing over occurs.
- **Metaphase I:** The bivalents (homologous pairs) align at the metaphase plate.
- **Anaphase I:** The key event of this stage is the separation of homologous chromosomes. The spindle fibers pull the entire homologous chromosomes (each still composed of two sister chromatids) to opposite poles of the cell. This reduces the chromosome number from diploid to haploid.
- **Telophase I:** The chromosomes arrive at the poles, and the cell divides.

The separation of sister chromatids occurs later, during Anaphase II.



Final Answer : "Anaphase I"

Answer: (C)

Q45.

Solution

Concept: Modes of nutrition in organisms.

Solution: Organisms can be classified based on how they obtain energy and carbon. The primary distinction is between autotrophs and heterotrophs.

- **Autotrophs** (literally "self-feeders") are organisms capable of producing their own food, typically using inorganic substances. They synthesize complex organic compounds (like glucose) from simple molecules like carbon dioxide (CO_2) and water (H_2O). Most autotrophs, like plants and algae, use light energy in a process called photosynthesis. They are the producers in an ecosystem.
- **Heterotrophs** ("other-feeders") cannot produce their own food and must obtain energy and nutrients by consuming other organisms.
- **Parasites** and **Saprophytes** are specific types of heterotrophs.

Final Answer : "Autotrophs"

Answer: (B)

Q46.

Solution

Concept: Enzymes involved in DNA replication.

Solution: DNA replication is a complex process involving several key enzymes.

- **Helicase**: This enzyme's primary function is to unwind the DNA double helix. It moves along the DNA, breaking the hydrogen bonds between the complementary base pairs, thus separating the two strands and creating a replication fork where replication can begin.
- **Ligase**: This enzyme joins DNA fragments together by forming phosphodiester bonds. It is crucial for sealing the nicks in the DNA backbone, especially in joining the Okazaki fragments on the lagging strand.
- **Polymerase** (DNA Polymerase): This enzyme synthesizes new DNA strands by adding nucleotides that are complementary to the template strand.
- **Primase**: This enzyme synthesizes short RNA primers that provide a starting point (a 3'-OH group) for DNA polymerase to begin synthesis.

Final Answer : "Helicase"

Answer: (B)

Q47.

Solution

Concept: Types and functions of RNA molecules.

Solution: There are several types of ribonucleic acid (RNA) involved in gene expression and other cellular processes.

- **rRNA (ribosomal RNA)**: This is the most abundant type of RNA in the cell. It associates with a set of proteins to form ribosomes, which are the complex molecular machines responsible for protein synthesis (translation). rRNA has both a structural role in holding the ribosome together and a catalytic role in forming peptide bonds.
- **mRNA (messenger RNA)**: Carries the genetic code transcribed from DNA to the ribosome.
- **tRNA (transfer RNA)**: Acts as an adaptor molecule, bringing the correct amino acid to the ribosome based on the mRNA codon.
- **siRNA (small interfering RNA)**: Involved in the process of RNA interference, which leads to gene silencing.

Final Answer : "rRNA"

Answer: (C)

Q48.

Solution

Concept: Greenhouse gases and their Global Warming Potential (GWP).

Solution: Greenhouse gases trap heat in the atmosphere, contributing to the greenhouse effect. Their effectiveness at trapping heat is measured by their Global Warming Potential (GWP), which compares their heat-trapping ability to that of carbon dioxide (CO_2) over a specific time period (usually 100 years).

- **CO_2** (Carbon Dioxide) is the baseline and has a GWP of 1.
- **CH_4** (Methane) is more potent than CO_2, with a GWP of about 28-36.
- **N_2O** (Nitrous Oxide) is more potent still, with a GWP of about 265-298.
- **CFCs** (Chlorofluorocarbons) and other fluorinated gases are extremely potent greenhouse gases. Their GWP values are in the thousands. For example, CFC-12 has a GWP of over 10,000.

Therefore, on a per-molecule basis, CFCs have the highest heat-trapping ability among the given options.

Final Answer : "CFCs"

Answer: (D)

Q49.

Solution

Concept: The biogeochemical nitrogen cycle.

Solution: The nitrogen cycle describes the movement of nitrogen through the living and non-living parts of the Earth. It involves several key processes:

- **Nitrogen Fixation**: Conversion of atmospheric nitrogen gas (N_2) into ammonia (NH_3), which can be used by plants.
- **Ammonification**: Decomposition of organic nitrogen from dead organisms into ammonia (NH_3) or ammonium ions (NH_4^+).
- **Nitrification**: Oxidation of ammonia/ammonium to nitrite (NO_2^-) and then to nitrate (NO_3^-) by nitrifying bacteria.
- **Denitrification**: The reduction of nitrate (NO_3^-) back into gaseous nitrogen (N_2), which is then released into the atmosphere. This process is carried out by denitrifying bacteria under anaerobic (low-oxygen) conditions and completes the nitrogen cycle.

Final Answer : "Denitrification"

Answer: (C)

Q50.

Solution

Concept: The different levels of biodiversity.

Solution: Biodiversity, or biological diversity, is the variety and variability of life on Earth. It is typically measured at three main levels:

- **Genetic Diversity**: This refers to the total number of genetic characteristics in the genetic makeup of a species. It is the variation of genes and alleles within a species or a population. This variation provides the raw material for populations to adapt to changing environments. For example, the variety of breeds of dogs or the different colors of a single species of flower.
- **Species Diversity**: This refers to the variety of different species present in an ecosystem. It includes both the number of different species (richness) and their relative abundance (evenness).
- **Ecosystem Diversity**: This refers to the variety of different habitats, biological communities, and ecological processes, as well as the diversity within ecosystems.

The question asks about variation *within* a species, which is the definition of genetic diversity.
Final Answer : "Genetic diversity"

Answer: (A)

Q51.

Solution

Concept: Water transport in plants (Ascent of Sap).

Solution: The upward movement of water and dissolved minerals from the roots to the leaves through the xylem is called the ascent of sap. While root pressure and capillary action contribute to a minor extent, they are insufficient to push water to the tops of tall trees. The primary driving force is the **transpiration pull**, explained by the Cohesion-Tension Theory.

(a) **Transpiration:** Water evaporates from the surfaces of leaf cells, exiting through stomata.

(b) **Tension:** This water loss creates a negative water potential, or tension, in the xylem of the leaves.

(c) **Cohesion:** Water molecules are cohesive (stick to each other) due to hydrogen bonds. This allows the tension to be transmitted as a continuous pull down the entire column of water in the xylem from the leaves to the roots.

(d) **Adhesion:** Water molecules also adhere to the xylem walls, which helps to counteract gravity.

This continuous pull lifts water up the plant, even to great heights.

Final Answer : "Transpiration pull"

Answer: (C)

Q52.

Solution

Concept: Enzymes of the Glycolysis pathway.

Solution: Glycolysis is the metabolic pathway that converts glucose into pyruvate. The very first step is the phosphorylation of glucose, which traps it inside the cell and prepares it for subsequent reactions. This irreversible reaction is catalyzed by the enzyme **Hexokinase**. The reaction is: Glucose + ATP $\xrightarrow{\text{Hexokinase}}$ Glucose-6-phosphate + ADP

- **Phosphofructokinase** is the key regulatory enzyme that catalyzes a later step: the phosphorylation of fructose-6-phosphate.
- **Pyruvate kinase** catalyzes the final step of glycolysis, converting phosphoenolpyruvate to pyruvate.
- **Aldolase** splits fructose-1,6-bisphosphate into two three-carbon molecules.

Final Answer : "Hexokinase"

Answer: (A)

Q53.

Solution

Concept: Transport of gases in human blood.

Solution: Carbon dioxide (CO_2), a waste product of cellular respiration, is transported from the tissues to the lungs via the blood in three forms:

(a) Dissolved in plasma (7-10%).

(b) Bound to hemoglobin in Red Blood Cells (RBCs) to form **carbaminohemoglobin** (20-23%).

(c) As **bicarbonate ions (HCO_3^-) in the plasma** (70%).

The majority of CO_2 diffuses into RBCs, where the enzyme carbonic anhydrase rapidly converts it into carbonic acid (H_2CO_3). This acid then dissociates into a hydrogen ion (H^+) and a bicarbonate ion (HCO_3^-). The bicarbonate ion is then transported out of the RBC into the blood plasma in exchange for a chloride ion (the chloride shift). Because about 70% of all CO_2 is transported in this form, it is the primary method of transport.

Final Answer : "Plasma as bicarbonate ions"

Answer: (B)

Q54.

Solution

Concept: Anatomy and physiology of the human digestive system.

Solution: The **small intestine** is the primary site for the chemical digestion and absorption of nutrients. Its structure is highly specialized to maximize this function. The inner lining of the small intestine has a very large surface area due to several features:

- **Circular folds (Plicae circulares):** Large folds of the intestinal wall.
- **Villi:** Tiny, finger-like projections that cover the folds.
- **Microvilli:** Microscopic projections on the surface of the individual cells (enterocytes) lining the villi. These form a "brush border."

This enormous surface area provides ample space for digestive enzymes to act and for the efficient absorption of digested nutrients (like amino acids, simple sugars, and fatty acids) into the bloodstream and lymphatic system. The stomach is mainly for protein digestion, while the large intestine primarily absorbs water and electrolytes.

Final Answer : "Small intestine"

Answer: (B)

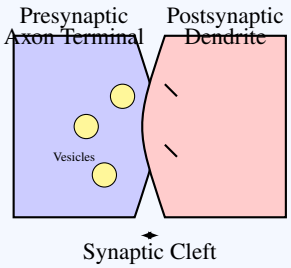
Q55.

Solution

Concept: Structure of a neuron and synaptic transmission.

Solution: A **synapse** is the specialized junction where a nerve impulse is transmitted from one neuron (the presynaptic neuron) to another neuron, a muscle cell, or a gland cell (the postsynaptic cell). The synapse includes the axon terminal of the presynaptic neuron, a microscopic gap called the **synaptic cleft**, and the membrane of the postsynaptic cell. When an action potential reaches the axon terminal, it triggers the release of chemical messengers called **neurotransmitters** into the synaptic cleft. These neurotransmitters diffuse across the gap and bind to receptors on the postsynaptic membrane, transmitting the signal.

- **Axon hillock** is where the axon joins the cell body and action potentials are generated.
- **Dendrite** is a branched extension that receives signals.
- **Node of Ranvier** is a gap in the myelin sheath.



Final Answer : "Synapse"

Answer: (B)

Q56.

Solution

Concept: Generation and propagation of a nerve impulse.

Solution: The flow of information in a neuron generally proceeds from dendrites to the cell body, and then down the axon.

(a) **Dendrites** receive incoming signals (neurotransmitters) from other neurons. These signals generate graded potentials (small, localized changes in membrane potential).

(b) These graded potentials travel to the **axon hillock**, the region where the cell body tapers into the axon.

(c) The axon hillock acts as an integrator. If the sum of the incoming graded potentials reaches a certain threshold level, it triggers the generation of an all-or-none nerve impulse, known as an **action potential**.

(d) This action potential is then propagated, or transmitted, down the length of the axon to the axon terminal.

Therefore, the axon hillock is the critical site where the decision to fire an impulse is made and where the impulse transmission truly begins.

Final Answer : "Axon hillock"

Answer: (B)

Q57.

Solution

Concept: Hormonal control of childbirth (parturition).

Solution: **Oxytocin** is the key hormone responsible for initiating and sustaining uterine contractions during labor. It is produced in the hypothalamus and released from the posterior pituitary gland. The process operates on a positive feedback loop:

(a) The baby's head pushes against the cervix, causing it to stretch.

(b) Stretch receptors in the cervix send nerve impulses to the hypothalamus.

(c) The hypothalamus signals the posterior pituitary to release oxytocin into the bloodstream.

(d) Oxytocin travels to the uterus and stimulates the muscles in the uterine wall to contract more forcefully.

(e) These stronger contractions push the baby further, causing more cervical stretching, which leads to more oxytocin release.

This loop continues until the baby is born.

- **Progesterone** inhibits uterine contractions during pregnancy.
- **Prolactin** stimulates milk production after childbirth.

Final Answer : "Oxytocin"

Answer: (C)

Q58.

Solution

Concept: Sperm structure and the process of fertilization.

Solution: The head of a human sperm contains the genetic material and a specialized structure called the **acrosome**. The acrosome is a cap-like organelle derived from the Golgi apparatus that covers the anterior portion of the nucleus. It contains powerful hydrolytic enzymes, such as hyaluronidase and acrosin. During fertilization, when a sperm reaches the ovum (egg), the acrosome releases these enzymes. This process, known as the acrosome reaction, digests the protective outer layers of the egg (the corona radiata and zona pellucida), allowing the sperm to penetrate and fuse with the egg membrane.

- The **Nucleus** contains the haploid set of chromosomes (paternal DNA).
- The **Midpiece** is packed with mitochondria to provide ATP for movement.
- The **Flagellum** (tail) propels the sperm.

Final Answer : "Acrosome"

Answer: (B)

Q59.

Solution

Concept: Key stages of early embryonic development.

Solution: Gastrulation is a fundamental process in early embryonic development. It follows the blastulation stage (formation of a hollow ball of cells called the blastula). During gastrulation, the single-layered blastula undergoes a dramatic reorganization and cell migration to form a three-layered structure called the gastrula. These three layers are the primary germ layers:

(a) **Ectoderm** (outer layer): Gives rise to the nervous system, skin, hair, and nails.

(b) **Mesoderm** (middle layer): Forms muscle, bone, connective tissue, circulatory system, and kidneys.

(c) **Endoderm** (inner layer): Develops into the lining of the digestive and respiratory tracts, as well as the liver and pancreas.

The formation of these three layers is the foundation for **Organogenesis**, the subsequent development of all the body's organs and tissues.

Final Answer : "Gastrulation"

Answer: (C)

Q60.

Solution

Concept: Non-Mendelian patterns of inheritance.

Solution: The ABO blood group system in humans is a classic example of both multiple alleles and **codominance**.

- **Multiple Alleles:** The gene for blood type exists as three different alleles in the human population: I^A, I^B, and i.
- **Dominance:** I^A and I^B are both completely dominant over i.
- **Codominance:** I^A and I^B are codominant with respect to each other. This means that if a person has the genotype I^AI^B, neither allele masks the other. Instead, both alleles are fully and equally expressed. The person's red blood cells will have both A-type antigens and B-type antigens on their surface, resulting in the AB blood type.

This is different from incomplete dominance, where the heterozygous phenotype is a blend of the two homozygous phenotypes.
Final Answer : "Codominance"

Answer: (B)

Q61.

Solution

Concept: The central dogma of molecular biology: Transcription.

Solution: Transcription is the process of creating a complementary RNA copy of a sequence of DNA. This is the first step in gene expression. The enzyme that carries out this synthesis is **RNA polymerase**. It works by:

(a) Binding to a specific DNA sequence called a promoter, located near the beginning of a gene.

(b) Unwinding the DNA double helix to expose the template strand.

(c) Reading the DNA template strand and synthesizing a complementary RNA strand by adding ribonucleotides (A, U, G, C) in the 5' to 3' direction.

In contrast, **DNA polymerase** is the main enzyme for DNA replication, **Ligase** joins DNA fragments, and **Topoisomerase** relieves strain in the DNA helix.
Final Answer : "RNA polymerase"

Answer: (B)

Q62.

Solution

Concept: Mechanisms of evolution.

Solution: **Natural selection** is the primary mechanism driving adaptive evolution. It is the process by which organisms with heritable traits that are advantageous for survival and reproduction in a specific environment tend to produce more offspring than their peers. As a result, the frequency of these advantageous traits increases in the population over successive generations. This leads to the population becoming better adapted to its environment.

- **Mutation** is the ultimate source of new genetic variation, but it occurs randomly, not in response to environmental needs.
- **Genetic drift** refers to random, non-adaptive changes in allele frequencies, which are more pronounced in small populations.
- **Migration** (gene flow) is the movement of genes between populations, which can introduce new variation but is not in itself a process of adaptation.

Natural selection is the only process that consistently results in adaptation.
Final Answer : "Natural selection"

Answer: (B)

Q63.

Solution

Concept: Nutrient deficiency diseases.

Solution: Iodine is an essential micronutrient required for the proper functioning of the thyroid gland. The thyroid gland uses iodine to synthesize thyroid hormones (thyroxine and triiodothyronine), which regulate metabolism. When there is a deficiency of iodine in the diet, the thyroid gland is unable to produce sufficient amounts of these hormones. In response, the pituitary gland secretes more Thyroid-Stimulating Hormone (TSH) to stimulate the thyroid. This constant stimulation causes the thyroid gland to grow abnormally large in an attempt to absorb more iodine from the blood, resulting in a swelling in the neck known as a **goitre**.

- **Diabetes** is a metabolic disorder related to insulin function, not iodine.
- **Scurvy** is caused by a deficiency of Vitamin C.
- **Rickets** is caused by a deficiency of Vitamin D, calcium, or phosphate.

Final Answer : "Goitre"

Answer: (B)

Q64.

Solution

Concept: Causative agents of infectious diseases.

Solution: Tuberculosis (TB) is a contagious infection that usually attacks the lungs but can also affect other parts of the body. The causative agent of tuberculosis is a type of **bacterium** called *Mycobacterium tuberculosis*. It is an airborne disease, spreading from person to person through microscopic droplets released into the air when an infected person coughs, sneezes, or talks. Treatment involves a long course of multiple antibiotics. It is not caused by a virus (like influenza), a protozoan (like malaria), or a fungus (like ringworm).

Final Answer : "Bacteria"

Answer: (B)

Q65.

Solution

Concept: Diagnostic techniques in molecular biology and immunology.

Solution: **ELISA** (Enzyme-Linked Immunosorbent Assay) is a plate-based assay technique designed for detecting and quantifying substances such as peptides, proteins, antibodies, and hormones. The core principle of ELISA is the specific binding between an antigen and an antibody. An enzyme is chemically linked to one of the reactants, and its activity is measured by its ability to convert a colorless substrate into a colored product. The amount of color produced is proportional to the amount of the specific protein/antigen present in the sample. It is widely used in medical diagnostics, for example, in HIV tests and pregnancy tests.

- **PCR** (Polymerase Chain Reaction) is used to amplify specific DNA sequences.
- **Gel electrophoresis** separates macromolecules like DNA, RNA, and proteins based on size and charge.
- **Chromatography** is a technique for separating the components of a mixture.

Final Answer : "ELISA"

Answer: (B)

Q66.

Solution

Concept: Tools and organisms used in genetic engineering.

Solution: In recombinant DNA technology, a host organism is needed to replicate and maintain the foreign DNA (gene of interest). The bacterium ***Escherichia coli*** (*E. coli*) is the most common and widely used host for gene cloning. It is chosen for several key reasons:

- It is easy to grow and manipulate in the laboratory.
- It has a very rapid generation time (dividing every 20 minutes), allowing for quick amplification of the cloned gene.
- Its genetics and physiology are very well understood.
- Many well-established vector systems (like plasmids) and transformation protocols are available for *E. coli*.

While yeast (*Saccharomyces cerevisiae*) is also used, particularly for expressing eukaryotic proteins that require post-translational modifications, *E. coli* remains the workhorse of gene cloning.
Final Answer : "Escherichia coli"

Answer: (B)

Q67.

Solution

Concept: Population ecology and limiting factors.

Solution: In any ecosystem, resources like food, water, sunlight, and space are finite. These limitations prevent populations from growing indefinitely. The **carrying capacity (K)** of an ecosystem is defined as the maximum population size of a biological species that can be sustained by that specific environment, given the available resources. As a population approaches its carrying capacity, its growth rate slows down and eventually levels off due to density-dependent limiting factors such as increased competition, predation, and disease. Unlimited resources and infinite reproduction would lead to unsustainable exponential growth, which is not observed in nature for long periods.
Final Answer : "Carrying capacity"

Answer: (B)

Q68.

Solution

Concept: Ecological interactions between species.

Solution: The interactions between different species in an ecosystem are classified based on their effect on each organism involved.

- **Commensalism (+/0):** A relationship where one species benefits, and the other species is neither harmed nor benefited. An example is an orchid growing on a tree; the orchid gets support and sunlight, while the tree is unaffected.
- **Parasitism (+/-):** One organism (the parasite) benefits at the expense of the other (the host).
- **Mutualism (+/+):** Both organisms benefit from the interaction.
- **Predation (+/-):** One organism (the predator) hunts and kills another (the prey).

The question describes a (+/0) interaction, which is commensalism.
Final Answer : "Commensalism"

Answer: (C)

Q69.

Solution

Concept: Levels of biodiversity.

Solution: Biodiversity is the variety of life on Earth, and it is considered at three main levels:

(a) **Genetic Diversity:** The variation of genes within a single species.

(b) **Species Diversity:** The variety of different species within a particular ecosystem or region.

(c) **Ecosystem Diversity:** The variety of different ecosystems, habitats, and biological communities in a region. This refers to the diversity at the broadest scale, for example, the diversity of ecosystems like forests, grasslands, wetlands, and deserts within a continent.

The question asks about the variation among ecosystems, which directly corresponds to ecosystem diversity.
Final Answer : "Ecosystem diversity"

Answer: (C)

Q70.

Solution

Concept: Ecological succession.

Solution: Ecological succession is the process of change in the species structure of an ecological community over time. When succession begins in a completely barren area devoid of life and soil, such as on bare rock after a volcanic eruption, it is called primary succession. The first organisms to colonize this inhospitable environment are called **pioneer species**. These are typically very hardy organisms, like lichens and mosses, which can survive extreme conditions. They play a crucial role by breaking down rock and contributing organic matter as they die, initiating the process of soil formation. This makes the environment suitable for subsequent, less hardy species like grasses, shrubs, and eventually trees.

Final Answer : "Pioneer species"

Answer: (C)

Q71.

Solution

Concept: Nutrient cycling and trophic roles in an ecosystem.

Solution: In an ecosystem, energy flows in one direction (from producers to consumers), but nutrients are recycled. The crucial role of nutrient recycling is performed by **decomposers**, which are primarily bacteria and fungi. They break down dead organic matter from all trophic levels—dead plants (producers), dead animals (consumers), and waste products (feces). This process of decomposition releases inorganic nutrients (such as carbon, nitrogen, and phosphorus) back into the soil, water, and air. These recycled nutrients can then be taken up again by the producers, completing the cycle and sustaining the entire ecosystem.

Final Answer : "Decomposers"

Answer: (C)

Q72.

Solution

Concept: The chemical process of photosynthesis.

Solution: Photosynthesis is the process by which green plants, algae, and some bacteria convert light energy into chemical energy in the form of glucose. The overall balanced chemical equation for photosynthesis is: $6CO_2$ (Carbon Dioxide) + $6H_2O$ (Water) $\xrightarrow{\text{Light Energy}}$ $C_6H_{12}O_6$ (Glucose) + $6O_2$ (Oxygen) The reactants are carbon dioxide and water, and the main product is glucose, which serves as food for the plant. **Oxygen (O_2)** is produced as a by-product during the light-dependent reactions when water molecules are split (a process called photolysis) to provide electrons and protons. This released oxygen is essential for the respiration of most living organisms.

Final Answer : "O_2"

Answer: (B)

Q73.

Solution

Concept: Stages of ecological succession.

Solution: Ecological succession is a directional, predictable process of community change over time. It progresses through a series of stages:

- **Pioneer stage:** The initial colonization of a barren habitat by hardy pioneer species.
- **Seral stages (or Intermediate stages):** A sequence of communities that replace one another over time. Each stage modifies the environment, making it more suitable for the next stage.
- **Climax stage:** The final, terminal stage of succession. A climax community is a mature, relatively stable, and self-sustaining ecosystem that is in equilibrium with its environment. It has high species diversity, complex food webs, and a stable biomass, and it will persist indefinitely unless disturbed by a major event.

Final Answer : "Climax stage"

Answer: (C)

Q74.

Solution

Concept: The biogeochemical nitrogen cycle.

Solution: **Nitrification** is a key process in the nitrogen cycle where ammonia (NH_3) or ammonium ions (NH_4^+), which are produced during ammonification and nitrogen fixation, are converted into nitrates (NO_3^-). This is the form of nitrogen most easily absorbed by plant roots. Nitrification is a two-step process carried out by different types of soil bacteria:

(a) **Oxidation of Ammonia to Nitrite:** Nitrifying bacteria such as *Nitrosomonas* oxidize ammonia to nitrite (NO_2^-).

(b) **Oxidation of Nitrite to Nitrate:** Other bacteria, like *Nitrobacter*, then oxidize the nitrite to nitrate (NO_3^-).

This process is essential for making nitrogen available to the producers in an ecosystem.
Final Answer : "Nitrification"

Answer: (B)

Q75.

Solution

Concept: International environmental agreements.

Solution: Several international agreements have been established to address global environmental issues.

- The **Kyoto Protocol**, adopted in Kyoto, Japan, in 1997, was an international treaty that extended the 1992 United Nations Framework Convention on Climate Change (UNFCCC). It committed industrialized countries and economies in transition to limit and reduce greenhouse gas (GHG) emissions in accordance with agreed individual targets. It was the first major international agreement to set legally binding targets for GHG reductions.
- The **Montreal Protocol** deals with phasing out ozone-depleting substances.
- The **Paris Agreement** (2015) is a more recent agreement under the UNFCCC, dealing with GHG emissions mitigation, adaptation, and finance, with the aim of keeping global temperature rise well below 2°C.
- The **Rio Summit** (1992) was a conference that led to the creation of several important environmental frameworks, including the UNFCCC itself.

The Kyoto Protocol is specifically known for being a formal protocol with binding targets for reducing greenhouse gas emissions.
Final Answer : "Kyoto Protocol"

Answer: (B)

Q76.

Solution

Concept: Phloem translocation and the Pressure-Flow Hypothesis.

Solution: The movement of sugars (primarily sucrose) in the phloem from a source (e.g., leaves where sugars are produced) to a sink (e.g., roots or fruits where sugars are used or stored) is explained by the Mass Flow Hypothesis, also known as the Pressure-Flow Hypothesis.
This process involves several steps:

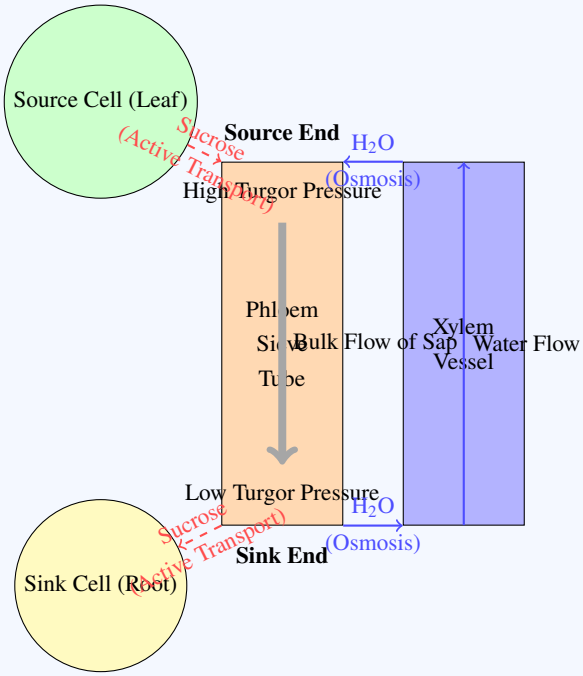
(a) **Phloem Loading:** At the source, sucrose is actively transported from mesophyll cells into the sieve-tube elements of the phloem. This active transport requires energy (ATP).

(b) **Pressure Gradient Creation:** The high concentration of sucrose in the sieve tube at the source lowers the water potential. Water then moves by osmosis from the adjacent xylem into the sieve tube, creating a high hydrostatic (turgor) pressure.

(c) **Bulk Flow:** At the sink, sucrose is actively transported out of the sieve tube for use or storage. This removal of sucrose increases the water potential in the sieve tube.

(d) **Water Return:** Water moves by osmosis out of the sieve tube at the sink and returns to the xylem.

This creates a continuous pressure gradient from the high-pressure source to the low-pressure sink, driving the bulk flow of the phloem sap containing sucrose. Diffusion and osmosis are components of this hypothesis, but the overall mechanism is mass flow.



Final Answer : "Mass flow hypothesis"

Answer: (C)

Q77.

Solution

Concept: Cellular Respiration and the Electron Transport Chain (ETC).

Solution: Aerobic respiration is the process of producing ATP in the presence of oxygen. It culminates in the electron transport chain, which takes place on the inner mitochondrial membrane.

(a) Electron carriers, NADH and FADH 2 2

, generated during glycolysis and the Krebs cycle, donate high-energy electrons to the ETC. Thus, NADH is an electron donor, not the final acceptor.

(b) These electrons are passed along a series of protein complexes (I, II, III, IV). As they move, they lose energy.

(c) This energy is used to pump protons (H + +

) from the mitochondrial matrix to the intermembrane space, creating an electrochemical gradient.

(d) At the end of the chain, the low-energy electrons must be removed to allow the process to continue. Oxygen serves as the **final electron acceptor**.

(e) Each oxygen atom accepts two electrons and combines with two protons from the matrix to form a molecule of water .

Without oxygen, the chain would back up, and ATP production via oxidative phosphorylation would cease. Carbon dioxide is a waste product of earlier stages (Krebs cycle), and ATP is the energy currency produced by this process, not an electron acceptor.
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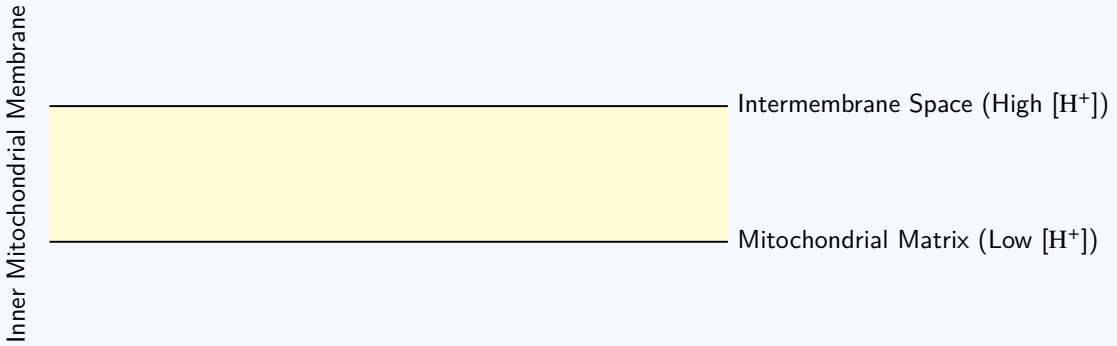


Final Answer : "Oxygen"

Answer: (B)

Q78.

Solution

Concept: Hemostasis (Blood Clotting).

Solution: Blood clotting, or coagulation, is a critical process to prevent excessive blood loss following an injury. It involves several components of the blood, but platelets play the primary initiating role.

- **Platelets (Thrombocytes):** These are small, irregular-shaped cell fragments. When a blood vessel is damaged, the exposed collagen fibers in the vessel wall attract platelets. The platelets adhere to the site, become activated, and change shape. They then aggregate to form a temporary **platelet plug**, which is the initial step in stopping the bleeding. Activated platelets also release chemical signals that initiate the coagulation cascade.
- **Plasma Proteins:** A complex series of reactions called the coagulation cascade is then triggered. This involves numerous clotting factors, which are mostly plasma proteins. The final step of this cascade is the conversion of a soluble plasma protein, **fibrinogen**, into insoluble threads of **fibrin**.
- **Fibrin Clot:** The fibrin threads form a meshwork that traps platelets, Red Blood Cells (RBCs), and White Blood Cells (WBCs), creating a stable, robust clot that seals the wound.

While plasma proteins (like fibrinogen) are essential for forming the final clot, the process is initiated and driven by the action of platelets. RBCs are passively trapped in the clot, and WBCs are involved in the subsequent immune response, not clotting itself. Therefore, platelets are the component most directly responsible for clot formation at the site of injury.

Final Answer : "Platelets"

Answer: (C)

Q79.

Solution

Concept: Functional Regions of the Human Brain.

Solution: The human brain is divided into several distinct regions, each with specialized functions. The regulation of vital involuntary actions is a key function of the brainstem.

- **Cerebrum:** The largest part of the brain, responsible for higher-order functions such as consciousness, thought, memory, language, and voluntary muscle control.
- **Cerebellum:** Located at the back of the brain, it is crucial for coordinating voluntary movements, posture, balance, and motor learning.
- **Medulla Oblongata:** This structure is the most inferior part of the brainstem. It contains vital autonomic centers that control involuntary functions essential for life. These include the cardiac center (regulates heart rate and contraction strength), the vasomotor center (regulates blood pressure by controlling vessel diameter), and the respiratory rhythmicity center (controls the basic rhythm and rate of breathing).
- **Hypothalamus:** Located below the thalamus, it is a key regulator of homeostasis. It controls body temperature, hunger, thirst, and fatigue, and it links the nervous system to the endocrine system via the pituitary gland. While it controls many involuntary processes, the most fundamental life-sustaining ones like heartbeat and breathing are controlled by the medulla.

Therefore, the medulla oblongata is the specific part of the brain responsible for regulating heartbeat and breathing.

Final Answer : "Medulla oblongata"

Answer: (C)

Q80.

Solution

Concept: Phases of the Human Menstrual Cycle.

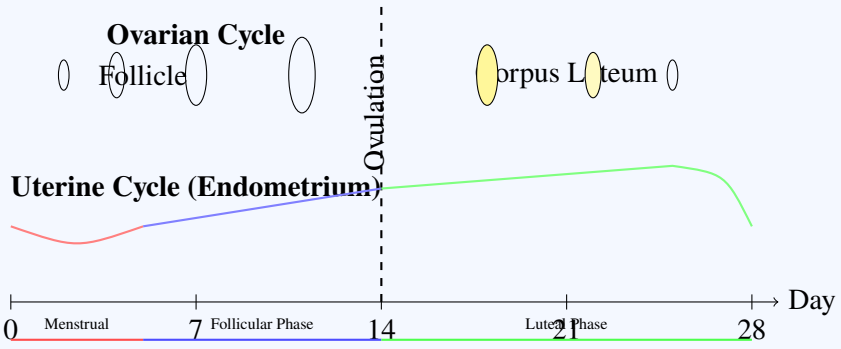
Solution: The menstrual cycle is a series of changes in the ovary and uterus, typically lasting about 28 days, controlled by hormones. It can be divided into distinct phases.

(a) **Follicular Phase (Days 1-14):** This phase begins on the first day of menstruation. Under the influence of Follicle-Stimulating Hormone (FSH), several ovarian follicles begin to mature. One dominant follicle continues to grow, producing estrogen. The rising estrogen levels cause the uterine lining (endometrium) to thicken and rebuild, a process known as the proliferative phase.

(b) **Ovulation (around Day 14):** A surge in Luteinizing Hormone (LH) triggers the mature follicle to rupture and release an egg from the ovary.

(c) **Luteal Phase (Days 15-28):** This is the phase that **follows ovulation**. The ruptured follicle transforms into a temporary endocrine structure called the **corpus luteum** (Latin for "yellow body"). The corpus luteum secretes high levels of progesterone and some estrogen. Progesterone is crucial for making the endometrium receptive to implantation of a fertilized egg. If fertilization does not occur, the corpus luteum degenerates, hormone levels fall, and a new cycle begins with menstruation.

The menstrual phase is the initial part of the follicular phase where the old uterine lining is shed. The proliferative phase is the uterine equivalent of the follicular phase. The luteal phase is the distinct period after ovulation characterized by the presence and function of the corpus luteum.



Final Answer : "Luteal phase"

Answer: (C)

Q81.

Solution

Concept: Chromosomal Aberrations (Aneuploidy).

Solution: Genetic disorders can be caused by mutations in single genes or by abnormalities in chromosome number or structure. An abnormal number of chromosomes is called aneuploidy.

- **Down Syndrome:** This is a condition caused by a trisomy, specifically the presence of an extra, full or partial, copy of chromosome 21. It is therefore also known as Trisomy 21. This is the most common chromosomal disorder and causes characteristic physical features and intellectual disabilities.
- **Turner Syndrome:** This is a monosomy of the sex chromosomes, where a female has only one X chromosome (genotype XO) instead of two (XX). It leads to developmental issues, including short stature and infertility.
- **Klinefelter Syndrome:** This is a trisomy of the sex chromosomes, where a male has an extra X chromosome (genotype XXY) instead of the usual XY. It can cause reduced fertility and other physical and developmental differences.
- **Hemophilia:** This is not a chromosomal number disorder. It is a single-gene, X-linked recessive disorder. A mutation in a gene on the X chromosome leads to a deficiency in a blood clotting factor, causing prolonged bleeding.

Therefore, the disorder caused by an extra copy of chromosome 21 is Down syndrome.
Final Answer : "Down syndrome"

Answer: (C)

Q82.

Solution

Concept: Enzymology of DNA Replication.

Solution: DNA replication is a complex process requiring the coordinated action of several enzymes to accurately duplicate the entire genome.

- **Helicase:** This enzyme initiates replication by unwinding the DNA double helix, separating the two parental strands to create a replication fork.
- **DNA Polymerase:** This is the main enzyme responsible for synthesizing new DNA strands. It reads the template strand and adds complementary nucleotides to the 3' end of the growing new strand. However, DNA polymerase has a crucial limitation: it cannot start a new strand from scratch. It can only add nucleotides to a pre-existing 3'-hydroxyl (-OH) group.
- **Primase:** To overcome the limitation of DNA polymerase, the enzyme primase is required. Primase is a type of RNA polymerase that synthesizes a short RNA sequence (about 5-10 nucleotides long) called a **primer**. This RNA primer is complementary to the template DNA and provides the necessary free 3'-OH group for DNA polymerase to attach the first DNA nucleotide and begin synthesis.
- **Ligase:** On the lagging strand, DNA is synthesized in short, discontinuous pieces called Okazaki fragments, each starting with its own primer. After the RNA primers are replaced with DNA, DNA ligase joins these fragments together by forming phosphodiester bonds, creating a continuous strand.

Thus, primase is the enzyme specifically responsible for synthesizing the primers needed to initiate DNA synthesis.

Final Answer : "Primase"

Answer: (B)

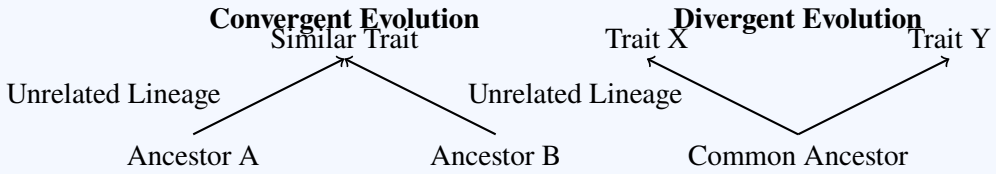
Q83.

Solution

Concept: Patterns of Evolution.

Solution: The development of similar traits or structures (analogous structures) in unrelated species is known as convergent evolution. This occurs because the species live in similar environments or face similar selective pressures, and they independently evolve similar solutions. A classic example is the wing of a bird and the wing of an insect. Both are used for flight, but they evolved independently from ancestors that did not have wings.

- **Divergent evolution** is the opposite, where related species evolve different traits, often leading to speciation. This results in homologous structures (e.g., the pentadactyl limb in mammals).
- **Adaptive radiation** is a form of divergent evolution where a single ancestral species rapidly diversifies into multiple new species, each adapted to a different ecological niche.
- **Genetic drift** refers to random fluctuations in allele frequencies within a population, which is not driven by environmental pressures.



Final Answer : "Convergent evolution"

Answer: (B)

Q84.

Solution

Concept: Pathogens and Waterborne Diseases.

Solution: Cholera is an acute diarrheal illness caused by infection of the intestine with a specific pathogen.

- **Bacteria:** The causative agent of cholera is the bacterium *Vibrio cholerae*. This bacterium is typically transmitted through the fecal-oral route, most commonly by consuming water or food contaminated with the feces of an infected person. The bacterium produces a toxin (cholera toxin) that causes the cells lining the intestine to secrete large amounts of fluid, leading to severe diarrhea and dehydration.
- **Virus:** Viruses are infectious agents that cause diseases like influenza, HIV/AIDS, and COVID-19. They are not the cause of cholera.
- **Protozoa:** These are single-celled eukaryotes that can cause diseases like malaria (*Plasmodium*) and giardiasis (*Giardia*). They are not the cause of cholera.
- **Fungus:** Fungi are a kingdom of eukaryotic organisms that can cause infections such as athlete's foot or candidiasis. They do not cause cholera.

Therefore, cholera is a classic example of a bacterial disease transmitted via contaminated water.
Final Answer : "Bacteria"

Answer: (B)

Q85.

Solution

Concept: Molecular Biology Laboratory Techniques.

Solution: Gel electrophoresis is the standard technique used in molecular biology to separate macromolecules like DNA, RNA, and proteins. For DNA fragments, the process works as follows:

(a) A gel matrix, typically made of agarose, is prepared. This gel acts as a molecular sieve.

(b) The DNA samples are loaded into small wells at one end of the gel.

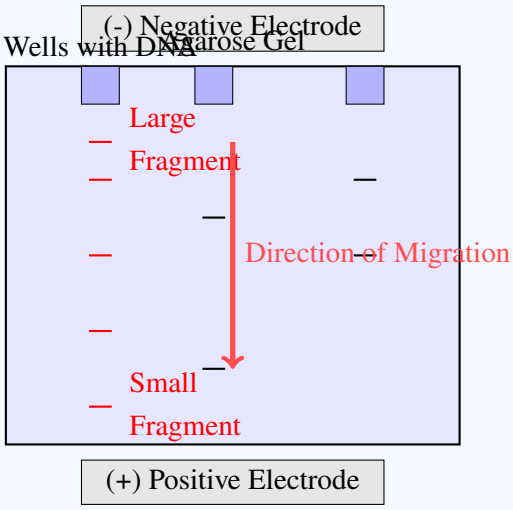
(c) The gel is placed in a buffer solution, and an electric field is applied across it.

(d) Since the phosphate backbone of DNA is negatively charged, the DNA fragments will migrate through the gel towards the positive electrode (anode).

(e) Smaller DNA fragments can move more easily and quickly through the pores of the gel matrix than larger fragments.

(f) Over time, the fragments separate based on their size, with the smallest fragments traveling the farthest and the largest fragments traveling the shortest distance.

PCR is for amplifying DNA, ELISA is for detecting antigens/antibodies, and chromatography is a broader category of separation techniques. Gel electrophoresis is the specific method described.



Final Answer : "Gel electrophoresis"

Answer: (B)

Q86.

Solution

Concept: Major Terrestrial Biomes.

Solution: Biomes are large-scale ecosystems classified primarily by their dominant vegetation and climate. The description given matches the desert biome.

- **Desert:** Deserts are defined by their aridity, receiving very low annual rainfall (typically less than 250 mm per year). This lack of water severely limits plant life, leading to sparse vegetation, often with specialized adaptations like succulents (cacti) or deep-rooted shrubs. Due to the clear skies and low humidity, deserts experience extreme temperature variations, with very hot days and cold nights.
- **Grassland:** These biomes receive more rain than deserts but less than forests. They are dominated by grasses and have moderate temperature ranges.
- **Tundra:** This is a cold biome characterized by permafrost (permanently frozen soil), low-growing vegetation, and low precipitation. The defining feature is the extreme cold, not heat.
- **Rainforest:** This biome is characterized by very high rainfall, high humidity, stable warm temperatures, and dense, layered vegetation, resulting in the highest biodiversity of all terrestrial biomes.

The combination of low rainfall, sparse vegetation, and extreme temperatures is uniquely characteristic of the desert biome.

Final Answer : "Desert"

Answer: (B)

Q87.

Solution

Concept: Levels of Ecological Organization.

Solution: Ecology studies the interactions between organisms and their environment at several levels of organization, arranged in a hierarchy.

- **Population:** A group of individuals of the same species living in a particular area. (e.g., all the deer in a forest).
- **Community:** All the different populations of different species living and interacting in a particular area. This includes only the biotic (living) components. (e.g., all the deer, trees, birds, insects, and fungi in the forest).
- **Ecosystem:** This level includes the entire community of living organisms (biotic factors) as well as their interactions with the non-living, physical environment (abiotic factors) such as soil, water, sunlight, and climate. The question's definition of "all living organisms interacting with their physical environment" directly corresponds to the definition of an ecosystem.
- **Biosphere:** The highest level of organization, encompassing all of Earth's ecosystems where life exists.

Therefore, the ecosystem is the level that includes both the biotic community and the abiotic environment.

Final Answer : "Ecosystem"

Answer: (C)

Q88.

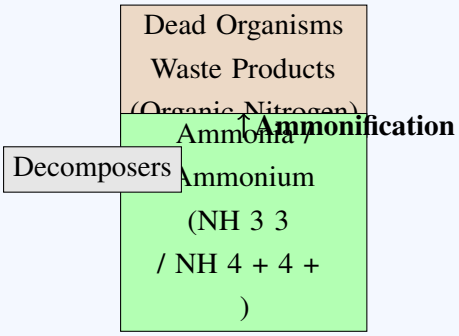
Solution

Concept: The Nitrogen Cycle.

Solution: The nitrogen cycle describes the movement and conversion of nitrogen through living organisms and the environment. The process of converting organic nitrogen into ammonia is a key step carried out by decomposers.

- **Ammonification:** When plants and animals die, or when animals excrete waste, the organic nitrogen contained in their tissues (e.g., in proteins and nucleic acids) is broken down by decomposer organisms (bacteria and fungi). This decomposition process releases the nitrogen in the form of ammonia (NH 3 3
) or ammonium ions (NH 4 + 4 +
). This is also known as mineralization.
- **Nitrogen Fixation:** The conversion of atmospheric nitrogen gas (N 2 2
  ), which is unusable by most organisms, into ammonia (NH 3 3
) by certain bacteria.
- **Nitrification:** The conversion of ammonia/ammonium into nitrites (NO 2 2
) and then nitrates (NO 3 3
  ), which are readily absorbed by plants.
- **Denitrification:** The conversion of nitrates (NO 3 3
) back into atmospheric nitrogen gas (N 2 2
  ), returning it to the atmosphere.

The question specifically asks for the process that converts organic nitrogen from dead organisms into ammonia, which is the definition of ammonification.



Final Answer : "Ammonification"

Answer: (C)

Q89.

Solution

Concept: Stratospheric Ozone Depletion.

Solution: The ozone layer, located in the stratosphere, protects life on Earth by absorbing the majority of the sun's harmful ultraviolet (UV) radiation. Its depletion is a major environmental concern.

- **Chlorofluorocarbons (CFCs):** These are synthetic chemical compounds once widely used in refrigerants, aerosol propellants, and solvents. When released, they are stable in the lower atmosphere and gradually drift up to the stratosphere. There, intense UV radiation breaks them down, releasing chlorine (Cl) atoms. These chlorine atoms act as catalysts in a destructive cycle that breaks down ozone (O 3 3

) molecules into ordinary oxygen (O 2 2

). A single chlorine atom can destroy thousands of ozone molecules before it is removed from the stratosphere.

-): Part of the natural cycle of ozone creation and destruction, but it is not the primary cause of anthropogenic depletion.

-): A primary greenhouse gas responsible for global warming, but it does not directly deplete the ozone layer.

-): The most abundant gas in the atmosphere and is largely non-reactive in this context.

The catalytic cycle involving chlorine from CFCs is the main driver of anthropogenic ozone depletion.
Catalytic Cycle:

(a) Cl + O 3 3

$\rightarrow \rightarrow$ ClO + O 2 2

(b) ClO + O $\rightarrow \rightarrow$ Cl + O 2 2

Net Reaction: O 3 3
+ O $\rightarrow \rightarrow$ 2O 2 2
(The chlorine atom is regenerated to destroy another ozone molecule).
Final Answer : "Chlorofluorocarbons"

Answer: (C)

Q90.

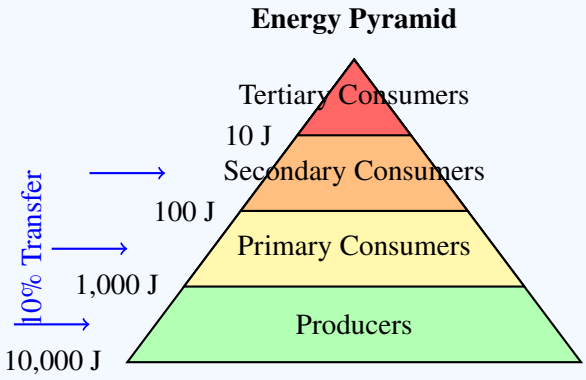
Solution

Concept: Energy Flow in Ecosystems and Trophic Levels.

Solution: The transfer of energy between different feeding levels (trophic levels) in an ecosystem is governed by fundamental thermodynamic principles.

- **Ten Percent Law:** This ecological principle, proposed by Raymond Lindeman, states that on average, only about 10% of the energy stored as biomass in one trophic level is transferred and stored as biomass in the next higher trophic level. The remaining 90% is used for metabolic processes (like respiration, movement, reproduction), lost as heat to the environment, or is not consumed (e.g., bones, fur, wood). This inefficiency limits the number of trophic levels an ecosystem can support.
- **Law of Minimum:** States that growth is controlled by the scarcest resource, not the total amount of resources available.
- **Competitive Exclusion Principle:** States that two species competing for the same limited resources cannot coexist indefinitely.
- **Hardy-Weinberg Principle:** A principle of population genetics related to allele frequencies, not ecosystem energy flow.

The rule describing the 10% energy transfer between trophic levels is explicitly called the Ten Percent Law.



Final Answer : "Ten percent law"

Answer: (B)

Answer Key

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