

NEET-UG Biology Sample Paper-4

Duration: 1 Hour

Maximum Marks: 360

Instructions

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

Q1. Which feature is common to all members of Protista?

- (A) Multicellularity
- (B) Presence of nucleus
- (C) Autotrophy
- (D) Absence of cell wall

Q2. In Cyanobacteria, nitrogen fixation occurs in:

- (A) Chloroplast
- (B) Heterocyst
- (C) Mesosome
- (D) Pyrenoid

Q3. Which of the following is correctly matched?

- (A) Agaricus – Ascomycetes
- (B) Rhizopus – Zygomycetes
- (C) Puccinia – Basidiomycetes
- (D) Both (B) and (C)

Q4. Which phylum shows open circulatory system and jointed appendages?

- (A) Mollusca



- (B) Annelida
- (C) Arthropoda
- (D) Echinodermata

Q5. Radial symmetry is shown by:

- (A) Ascaris
- (B) Hydra
- (C) Pheretima
- (D) Periplaneta

Q6. The tissue responsible for secondary growth in plants is:

- (A) Apical meristem
- (B) Intercalary meristem
- (C) Lateral meristem
- (D) Ground tissue

Q7. Which animal tissue has maximum regenerative capacity?

- (A) Muscle
- (B) Nervous
- (C) Epithelial
- (D) Connective

Q8. The structural unit of compact bone is:

- (A) Nephron
- (B) Osteon
- (C) Sarcomere
- (D) Alveoli



Q9. Collenchyma differs from sclerenchyma due to:

- (A) Lignification
- (B) Uneven thickening
- (C) Dead cells
- (D) No intercellular space

Q10. Cardiac muscle fibers are:

- (A) Multinucleated
- (B) Non-striated
- (C) Branched and involuntary
- (D) Voluntary

Q11. Fluid mosaic model was proposed by:

- (A) Robert Hooke
- (B) Singer and Nicolson
- (C) Schleiden
- (D) Virchow

Q12. Which organelle has its own DNA and 70S ribosomes?

- (A) Lysosome
- (B) Mitochondria
- (C) Golgi
- (D) Peroxisome

Q13. Crossing over occurs during:

- (A) Leptotene
- (B) Zygotene
- (C) Pachytene



(D) Diplotene

Q14. Which phase shows maximum chromosome condensation?

- (A) Prophase
- (B) Metaphase
- (C) Anaphase
- (D) Telophase

Q15. Enzyme responsible for DNA replication is:

- (A) RNA polymerase
- (B) DNA ligase
- (C) DNA polymerase
- (D) Helicase

Q16. C4 plants show:

- (A) Photorespiration
- (B) High CO₂ compensation point
- (C) Kranz anatomy
- (D) Low productivity

Q17. Transpiration pull theory was proposed by:

- (A) Dixon and Joly
- (B) Darwin
- (C) Blackman
- (D) Calvin

Q18. Which mineral is essential for nitrogen fixation?

- (A) Iron
- (B) Molybdenum



- (C) Magnesium
- (D) Zinc

Q19. Phytochrome is sensitive to:

- (A) Blue light
- (B) Red and far-red light
- (C) UV light
- (D) Infrared

Q20. Krebs cycle occurs in:

- (A) Cytoplasm
- (B) Mitochondrial matrix
- (C) Inner membrane
- (D) Nucleus

Q21. Pacemaker of heart is:

- (A) AV node
- (B) SA node
- (C) Purkinje fibers
- (D) Bundle of His

Q22. Oxygen dissociation curve is:

- (A) Linear
- (B) Sigmoid
- (C) Parabolic
- (D) Hyperbolic

Q23. Hormone regulating blood calcium:

- (A) Insulin



- (B) Thyroxine
- (C) Parathormone
- (D) Cortisol

Q24. Functional unit of kidney:

- (A) Neuron
- (B) Nephron
- (C) Alveolus
- (D) Glomerulus

Q25. Myelin sheath is formed by:

- (A) Astrocytes
- (B) Schwann cells
- (C) Microglia
- (D) Oligodendrocytes

Q26. Double fertilization is unique to:

- (A) Gymnosperms
- (B) Angiosperms
- (C) Bryophytes
- (D) Pteridophytes

Q27. Acrosome contains enzymes for:

- (A) Fertilization
- (B) Respiration
- (C) Nutrition
- (D) Secretion



Q28. In humans, fertilization occurs in:

- (A) Ovary
- (B) Uterus
- (C) Fallopian tube
- (D) Cervix

Q29. Which hormone maintains pregnancy?

- (A) Estrogen
- (B) Progesterone
- (C) FSH
- (D) LH

Q30. Vegetative propagation occurs in:

- (A) Seeds
- (B) Spores
- (C) Roots/stems/leaves
- (D) Gametes

Q31. Law of segregation was given by:

- (A) Darwin
- (B) Mendel
- (C) Watson
- (D) Crick

Q32. DNA is a:

- (A) Monomer
- (B) Polymer
- (C) Lipid



(D) Protein

Q33. Mutation occurs due to:

(A) Replication error

(B) Radiation

(C) Chemicals

(D) All of these

Q34. Evolution is best defined as:

(A) Individual change

(B) Change in gene frequency

(C) Physical change

(D) Environmental change

Q35. Hardy-Weinberg equilibrium is disturbed by:

(A) Mutation

(B) Migration

(C) Selection

(D) All

Q36. Antibiotics are obtained from:

(A) Plants

(B) Fungi

(C) Bacteria

(D) Both (B) and (C)

Q37. PCR is used for:

(A) Protein synthesis

(B) DNA amplification



- (C) RNA synthesis
- (D) Mutation

Q38. Vector used in genetic engineering:

- (A) Plasmid
- (B) Ribosome
- (C) Lysosome
- (D) Vacuole

Q39. Insulin production using bacteria is an example of:

- (A) Traditional breeding
- (B) Recombinant DNA technology
- (C) Mutation breeding
- (D) Hybridization

Q40. Vaccine works by:

- (A) Killing pathogens
- (B) Stimulating immunity
- (C) Increasing metabolism
- (D) Neutralizing toxins directly

Q41. Pyramid of energy is always:

- (A) Inverted
- (B) Upright
- (C) Both
- (D) None

Q42. Ozone depletion is caused by:

- (A) CO₂



- (B) SO₂
- (C) CFCs
- (D) NO₂

Q43. Primary succession starts on:

- (A) Soil
- (B) Rocks
- (C) Forest
- (D) Grassland

Q44. Keystone species example:

- (A) Tiger
- (B) Lion
- (C) Starfish
- (D) Elephant

Q45. Biomagnification refers to:

- (A) Increase in population
- (B) Increase in toxin concentration in food chain
- (C) Energy flow
- (D) Nutrient cycling

Q46. Which among the following is not a characteristic of living organisms?

- (A) Metabolism
- (B) Consciousness
- (C) Reproduction
- (D) Growth in size only



- Q47.** Five kingdom classification was proposed by:
- (A) Linnaeus
 - (B) Whittaker
 - (C) Haeckel
 - (D) Copeland
- Q48.** Which organism belongs to Archaeobacteria?
- (A) Nostoc
 - (B) Halophiles
 - (C) Amoeba
 - (D) Paramecium
- Q49.** Lichens represent a symbiotic association between:
- (A) Algae and bacteria
 - (B) Algae and fungi
 - (C) Fungi and moss
 - (D) Bacteria and fungi
- Q50.** Which group shows diploblastic organization?
- (A) Platyhelminthes
 - (B) Cnidaria
 - (C) Annelida
 - (D) Arthropoda
- Q51.** Casparian strips are present in:
- (A) Cortex
 - (B) Epidermis
 - (C) Endodermis



(D) Pericycle

Q52. Which connective tissue stores fat?

- (A) Areolar
- (B) Adipose
- (C) Cartilage
- (D) Bone

Q53. The contractile protein of muscle is:

- (A) Tubulin
- (B) Actin
- (C) Keratin
- (D) Collagen

Q54. Which part of neuron receives stimuli?

- (A) Axon
- (B) Dendrite
- (C) Synapse
- (D) Node of Ranvier

Q55. Which cell junction prevents leakage between cells?

- (A) Desmosome
- (B) Tight junction
- (C) Gap junction
- (D) Plasmodesmata

Q56. Which enzyme unwinds DNA helix?

- (A) Ligase
- (B) Helicase



- (C) Polymerase
- (D) Primase

Q57. Golgi apparatus is mainly involved in:

- (A) Respiration
- (B) Packaging and secretion
- (C) Digestion
- (D) Protein synthesis

Q58. Spindle fibers are made up of:

- (A) Actin
- (B) Tubulin
- (C) Myosin
- (D) Keratin

Q59. Which phase involves separation of homologous chromosomes?

- (A) Anaphase I
- (B) Anaphase II
- (C) Metaphase I
- (D) Telophase II

Q60. ATP synthesis in mitochondria occurs at:

- (A) Outer membrane
- (B) Matrix
- (C) Inner membrane
- (D) Cytoplasm

Q61. Which pigment participates directly in photosynthesis?

- (A) Chlorophyll a



- (B) Chlorophyll b
- (C) Carotene
- (D) Xanthophyll

Q62. Water absorption in roots occurs mainly through:

- (A) Osmosis
- (B) Diffusion
- (C) Active transport
- (D) Facilitated diffusion

Q63. Which plant hormone promotes cell elongation?

- (A) Cytokinin
- (B) Auxin
- (C) Ethylene
- (D) ABA

Q64. Which factor limits photosynthesis at high CO₂ concentration?

- (A) Light intensity
- (B) Temperature
- (C) Oxygen
- (D) Water

Q65. Photolysis of water occurs in:

- (A) Photosystem I
- (B) Photosystem II
- (C) Calvin cycle
- (D) Stroma



- Q66.** Which blood cells help in clotting?
- (A) RBCs
 - (B) WBCs
 - (C) Platelets
 - (D) Plasma
- Q67.** Bohr effect is related to:
- (A) Oxygen transport
 - (B) CO₂ transport
 - (C) Blood pressure
 - (D) Heart rate
- Q68.** Which part of brain controls balance?
- (A) Cerebrum
 - (B) Cerebellum
 - (C) Medulla
 - (D) Hypothalamus
- Q69.** Insulin deficiency leads to:
- (A) Hypoglycemia
 - (B) Diabetes mellitus
 - (C) Hyperthyroidism
 - (D) Anemia
- Q70.** Which vitamin is essential for blood clotting?
- (A) Vitamin A
 - (B) Vitamin B
 - (C) Vitamin K



(D) Vitamin D

Q71. Which is the male gametophyte in angiosperms?

(A) Ovule

(B) Pollen grain

(C) Embryo sac

(D) Endosperm

Q72. Which stage is formed after fertilization in plants?

(A) Zygote

(B) Embryo sac

(C) Pollen tube

(D) Ovary

Q73. FSH hormone is secreted by:

(A) Pituitary

(B) Thyroid

(C) Pancreas

(D) Adrenal

Q74. Placenta is formed between:

(A) Embryo and ovary

(B) Foetus and uterus

(C) Ovary and uterus

(D) Cervix and embryo

Q75. Which method prevents ovulation?

(A) Condoms

(B) Oral pills



- (C) IUD
- (D) Vasectomy

Q76. Test cross involves:

- (A) Homozygous dominant
- (B) Homozygous recessive
- (C) Heterozygous
- (D) All

Q77. DNA replication is:

- (A) Conservative
- (B) Semi-conservative
- (C) Dispersive
- (D) Random

Q78. Which codon acts as start codon?

- (A) UAA
- (B) AUG
- (C) UAG
- (D) UGA

Q79. Genetic drift occurs due to:

- (A) Natural selection
- (B) Mutation
- (C) Chance events
- (D) Migration

Q80. Darwin explained evolution by:

- (A) Mutation



- (B) Natural selection
- (C) Isolation
- (D) Genetic drift

Q81. Which microbe is used in curd formation?

- (A) Yeast
- (B) Lactobacillus
- (C) Rhizopus
- (D) Penicillium

Q82. Sewage treatment uses:

- (A) Algae
- (B) Bacteria
- (C) Fungi
- (D) Viruses

Q83. Restriction enzymes cut:

- (A) RNA
- (B) DNA
- (C) Protein
- (D) Lipid

Q84. Gene therapy is used to:

- (A) Treat genetic disorders
- (B) Increase immunity
- (C) Produce vaccines
- (D) Improve crops



- Q85.** Biopiracy refers to:
- (A) Illegal use of bioresources
 - (B) Pollution
 - (C) Overpopulation
 - (D) Deforestation
- Q86.** Which trophic level has maximum energy?
- (A) Producers
 - (B) Primary consumers
 - (C) Secondary consumers
 - (D) Tertiary consumers
- Q87.** Which cycle involves nitrogen fixation?
- (A) Carbon cycle
 - (B) Nitrogen cycle
 - (C) Water cycle
 - (D) Oxygen cycle
- Q88.** Eutrophication is caused by:
- (A) Nutrient enrichment
 - (B) Oxygen depletion
 - (C) Temperature rise
 - (D) Pollution
- Q89.** Which gas contributes most to global warming?
- (A) Oxygen
 - (B) Nitrogen
 - (C) Carbon dioxide



(D) Hydrogen

Q90. Biodiversity hotspots are regions with:

- (A) Low diversity
- (B) High diversity and threat
- (C) High rainfall only
- (D) Desert climate



Detailed Solutions

Q1.

Solution

Concept: Fundamental characteristics of the five kingdoms, specifically Kingdom Protista.

Solution: Kingdom Protista is a diverse group of eukaryotic organisms. They are essentially all eukaryotes that do not fit into the other eukaryotic kingdoms: Plantae, Animalia, or Fungi. Let's analyze the given options:

- (A) Multicellularity: This is not a common feature. Many protists, like *Amoeba* and *Paramecium*, are unicellular. Some, like *Volvox*, are colonial, and others, like kelp (a type of brown algae), are truly multicellular.
- (B) Presence of nucleus: By definition, all protists are eukaryotes. The defining characteristic of a eukaryotic cell is the presence of a membrane-bound nucleus and other membrane-bound organelles. Therefore, every member of Protista possesses a nucleus.
- (C) Autotrophy: This is not a common feature. The kingdom includes autotrophic (plant-like) protists like algae, heterotrophic (animal-like) protists like protozoans, and saprotrophic (fungus-like) protists like slime molds.
- (D) Absence of cell wall: This is not a common feature. Some protists, such as *Amoeba*, lack a cell wall, while others, like diatoms and dinoflagellates, have intricate cell walls.

Thus, the only feature common to all members of Protista is the presence of a nucleus.

Final Answer : “Presence of nucleus”

Answer: (B)



Q2.

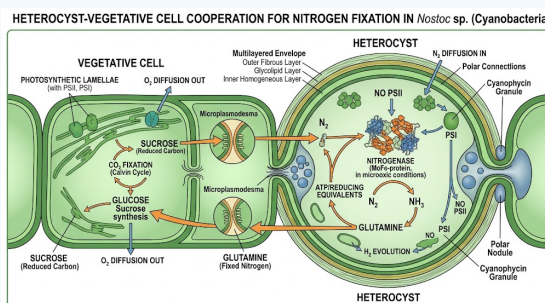
Solution

Concept: Specialized structures for nitrogen fixation in Cyanobacteria.

Solution: Nitrogen fixation is the process of converting atmospheric nitrogen (N_2) into ammonia (NH_3), a form usable by living organisms. This process is carried out by the enzyme nitrogenase, which is highly sensitive to oxygen and gets irreversibly inactivated in its presence.

Many cyanobacteria are photosynthetic and release oxygen during photosynthesis, which creates a challenge for nitrogen fixation. To overcome this, certain filamentous cyanobacteria such as *Nostoc* and *Anabaena* develop specialized cells called heterocysts.

Heterocysts are thick-walled cells that restrict the entry of oxygen and lack Photosystem II, the component responsible for oxygen evolution. This ensures an anaerobic environment suitable for the proper functioning of nitrogenase, thereby enabling efficient nitrogen fixation.



Final Answer: “Heterocyst”

Answer: (B)



Q3.

Solution

Concept: Classification of fungi into different classes.

Solution: This question tests the knowledge of fungal classification. Let's examine each pair:

- (A) Agaricus – Ascomycetes: *Agaricus* (the common mushroom) belongs to the class Basidiomycetes (club fungi), not Ascomycetes (sac fungi). So, this is incorrect.
- (B) Rhizopus – Zygomycetes: *Rhizopus* (the common bread mold) is a classic example of the class Zygomycetes, which are characterized by the formation of zygospores. This match is correct.
- (C) Puccinia – Basidiomycetes: *Puccinia* (the rust fungus) is a pathogenic fungus that belongs to the class Basidiomycetes. This match is also correct.
- (D) Both (B) and (C): Since the matches in both options (B) and (C) are correct, this is the most comprehensive and correct answer.

Final Answer : “Both (B) and (C)”

Answer: (D)



Q4.

Solution

Concept: Distinguishing characteristics of major animal phyla.

Solution: The question asks for the phylum that exhibits both an open circulatory system and jointed appendages.

- An open circulatory system is one in which the circulatory fluid, called hemolymph, is pumped by a heart into a body cavity (hemocoel), where it directly bathes the tissues, rather than being confined within vessels like arteries and veins.
- Jointed appendages are limbs and other body parts that are segmented and connected by flexible joints.

Analyzing the phyla:

- Mollusca: Most have an open circulatory system but lack jointed appendages.
- Annelida: Have a closed circulatory system and lack jointed appendages.
- Arthropoda: This phylum, which includes insects, crustaceans, and spiders, is characterized by a chitinous exoskeleton, a segmented body, and jointed appendages. They also possess an open circulatory system.
- Echinodermata: Have a unique water vascular system and lack jointed appendages.

Therefore, Arthropoda is the correct phylum.

Final Answer : “Arthropoda”

Answer: (C)



Q5.

Solution

Concept: Types of body symmetry in animals.

Solution: Radial symmetry is a body plan in which parts are arranged around a central axis, such that any plane passing through the central axis divides the body into two identical halves. This is common in sessile or sedentary animals. Bilateral symmetry is a body plan where the body can be divided into two equal left and right halves by only one plane (the sagittal plane). Let's analyze the given options:

- (A) *Ascaris* (roundworm) and (C) *Pheretima* (earthworm) and (D) *Periplaneta* (cockroach) all exhibit bilateral symmetry.
- (B) *Hydra*, a member of Phylum Cnidaria, has a cylindrical body with a mouth and tentacles at one end. Its body parts are arranged around the central axis, exhibiting classic radial symmetry.

Final Answer : “Hydra”

Answer: (B)

Q6.

Solution

Concept: Primary and secondary growth in plants.

Solution: Plant growth occurs from meristems, which are regions of undifferentiated, actively dividing cells.

- Primary growth is the increase in length of the shoot and root. It is carried out by apical meristems located at the tips of stems and roots, and by intercalary meristems in some plants like grasses.
- Secondary growth is the increase in the girth or thickness of the plant, primarily in woody dicots and gymnosperms. This type of growth is caused by lateral meristems.

The two types of lateral meristems are the vascular cambium (which produces secondary xylem and phloem) and the cork cambium (which produces the outer bark). Therefore, the tissue responsible for secondary growth is the lateral meristem.

Final Answer : “Lateral meristem”

Answer: (C)



Q7.

Solution

Concept: Regenerative capabilities of different animal tissues.

Solution: Regenerative capacity refers to the ability of a tissue to replace dead or damaged cells with new ones. This capacity varies greatly among the four basic types of animal tissues.

- Nervous tissue has the poorest regenerative capacity; mature neurons generally do not divide.
- Muscle tissue has limited capacity. Cardiac muscle cannot regenerate, while skeletal muscle has some ability to repair itself via satellite cells.
- Connective tissue has a variable capacity; bone regenerates well, but cartilage regenerates very poorly.
- Epithelial tissue, which covers body surfaces and lines cavities (e.g., skin, gut lining), is constantly subjected to wear and tear. As a result, it has a very high rate of cell division and is constantly being renewed. This gives it the maximum regenerative capacity among all animal tissues.

Final Answer : “Epithelial”

Answer: (C)

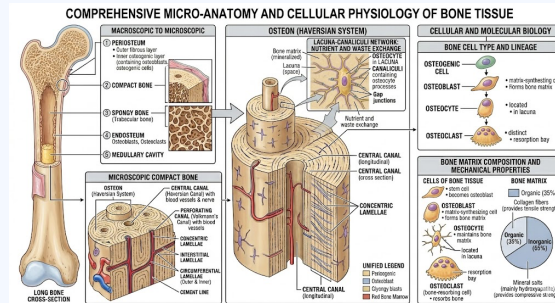


Q8.

Solution

Concept: Microscopic anatomy of bone.

Solution:



Compact bone, the dense outer layer of bones, is organized into repeating structural units called osteons or Haversian systems. Each osteon is a cylindrical structure consisting of concentric layers of calcified matrix called lamellae, arranged around a central Haversian canal. This canal contains the bone’s blood vessels and nerves. The other options are structural units of different organs: a nephron is the functional unit of the kidney, a sarcomere is the contractile unit of muscle, and alveoli are the gas-exchange units of the lungs.

Final Answer : “Osteon”

Answer: (B)

Q9.

Solution

Concept: Comparison of simple permanent tissues in plants.

Solution: Collenchyma and sclerenchyma are both simple supporting tissues in plants. The main differences lie in their cell structure and composition.

- Collenchyma consists of living cells with primary cell walls that are unevenly thickened, particularly at the corners. The thickening is composed of cellulose and pectin, providing flexible support to growing plant parts.
- Sclerenchyma consists of dead cells at maturity with thick, rigid secondary walls that are uniformly thickened with lignin. Lignification provides hardness and strength.

Therefore, the key feature that distinguishes collenchyma from sclerenchyma is the uneven thickening of its cell walls.

Final Answer : “Uneven thickening”

Answer: (B)

Q10.

Solution

Concept: Characteristics of cardiac muscle tissue.

Solution: Cardiac muscle is one of the three types of muscle tissue and is found exclusively in the heart wall. Its key characteristics are:

- **Striated:** It has a striped appearance under the microscope, similar to skeletal muscle.
- **Involuntary:** Its contraction is not under conscious control.
- **Uninucleated:** Each muscle cell (fiber) typically has a single, central nucleus.
- **Branched:** The fibers are branched and interconnected, forming a complex network. This branching pattern is crucial for the coordinated contraction of the heart.
- **Intercalated discs:** Specialized junctions that connect the individual cells, allowing for rapid communication and synchronized contraction.

Based on these features, the correct option is that cardiac muscle fibers are branched and involuntary.

Final Answer : “Branched and involuntary”

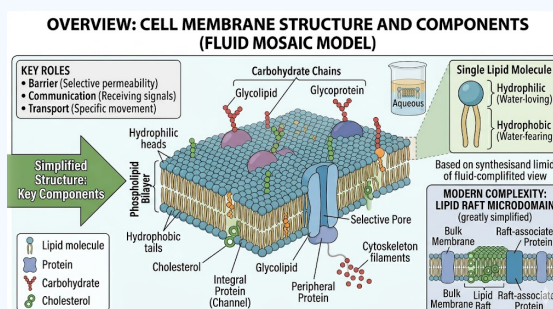
Answer: (C)

Q11.

Solution

Concept: Historical models of the cell membrane.

Solution:



The fluid mosaic model is the currently accepted model for the structure of the plasma membrane. It describes the membrane as a fluid bilayer of phospholipids in which proteins are embedded or attached, much like tiles in a mosaic. This fluidity allows for the lateral movement of both lipids and proteins within the membrane. This influential model was proposed by Seymour J. Singer and Garth L. Nicolson in 1972.

Final Answer : “Singer and Nicolson”

Answer: (B)



Q12.

Solution

Concept: Endosymbiotic theory and semi-autonomous organelles.

Solution: Mitochondria and chloroplasts are referred to as semi-autonomous organelles. According to the endosymbiotic theory, they originated as free-living prokaryotes that were engulfed by an early eukaryotic cell. As a result, they have retained some of their ancestral prokaryotic features, including:

- Their own circular DNA molecule, which codes for some of their proteins.
- Their own ribosomes for protein synthesis. These are 70S ribosomes, the same size as those found in prokaryotes (eukaryotic cytoplasm has larger 80S ribosomes).

Of the options given, only mitochondria possesses its own DNA and 70S ribosomes.

Final Answer : “Mitochondria”

Answer: (B)

Q13.

Solution

Concept: The stages of Prophase I in meiosis.

Solution: Crossing over is the vital process of exchanging genetic material between non-sister chromatids of homologous chromosomes. This creates new combinations of alleles and is a major source of genetic variation. This event occurs during Prophase I of meiosis, which is divided into five sub-stages:

- (a) Leptotene: Chromosomes condense.
- (b) Zygotene: Homologous chromosomes pair up (synapsis).
- (c) **Pachytene:** Synapsis is complete, and the paired chromosomes (bivalents) are clearly visible as tetrads. It is during this stage that crossing over takes place.
- (d) Diplotene: Homologous chromosomes begin to separate but remain attached at points called chiasmata, which are the visible sites of crossing over.
- (e) Diakinesis: Chromosomes are fully condensed, and the nuclear envelope breaks down.

Final Answer : “Pachytene”

Answer: (C)



Q14.

Solution

Concept: Chromosome behavior during the stages of mitosis.

Solution: During the cell cycle, the long threads of chromatin undergo extensive coiling and folding to form compact chromosomes, which are easier to segregate. This condensation process begins in prophase. The chromosomes continue to condense, reaching their maximum state of condensation during metaphase. At this stage, they are most tightly coiled, thickest, and most clearly visible under a light microscope. Their alignment at the metaphase plate during this phase makes it the ideal stage for karyotyping. After metaphase, the separated chromatids remain condensed through anaphase and begin to decondense during telophase.

Final Answer : “Metaphase”

Answer: (B)

Q15.

Solution

Concept: The key enzymes involved in DNA replication.

Solution: DNA replication is a complex process involving a host of enzymes. While several enzymes play crucial roles (e.g., helicase unwinds the DNA, and DNA ligase joins fragments), the primary enzyme responsible for synthesizing the new DNA strands is DNA polymerase. It moves along the template strand and adds complementary nucleotides to the 3' end of the growing new strand. RNA polymerase is involved in transcription (making RNA), not replication.

Final Answer : “DNA polymerase”

Answer: (C)



Q16.

Solution

Concept: Adaptations of C4 plants for photosynthesis.

Solution: C4 plants, such as maize and sugarcane, have a specialized photosynthetic pathway that is an adaptation to hot, dry climates. This pathway minimizes a wasteful process called photorespiration. A key structural adaptation associated with the C4 pathway is a unique leaf anatomy called Kranz anatomy (Kranz means "wreath" in German). In this arrangement, the vascular bundles are surrounded by a sheath of large cells called bundle sheath cells, which are in turn surrounded by mesophyll cells. This spatial separation allows the plant to concentrate CO₂ in the bundle sheath cells, where the Calvin cycle occurs, thus enhancing photosynthetic efficiency and reducing water loss. C4 plants also show very low photorespiration, a low CO₂ compensation point, and high productivity.

Final Answer : "Kranz anatomy"

Answer: (C)

Q17.

Solution

Concept: The mechanism of water transport in plants (ascent of sap).

Solution: The transpiration pull theory, also known as the cohesion-tension theory, is the most widely accepted explanation for the ascent of sap over long distances in plants. It was proposed by Henry Dixon and John Joly in 1894. The theory states that the evaporation of water from the surfaces of leaf cells (transpiration) creates a negative pressure potential or tension. This tension pulls water up through the xylem. The continuous column of water is maintained due to the cohesive forces between water molecules and the adhesive forces between water molecules and the xylem vessel walls.

Final Answer : "Dixon and Joly"

Answer: (A)



Q18.

Solution

Concept: The role of micronutrients in plant metabolism, specifically nitrogen fixation.

Solution: Biological nitrogen fixation is the conversion of atmospheric nitrogen (N_2) into ammonia (NH_3), a process carried out by certain prokaryotes. This reaction is catalyzed by a complex enzyme called nitrogenase. The nitrogenase enzyme is composed of two protein components, one of which is a Molybdenum-Iron (Mo-Fe) protein. Molybdenum is a key cofactor and a structural component of this enzyme, making it absolutely essential for the enzyme to function. Therefore, a deficiency in molybdenum will directly inhibit nitrogen fixation.

Final Answer : “Molybdenum”

Answer: (B)

Q19.

Solution

Concept: Photoreceptors in plants and their role in photomorphogenesis.

Solution: Phytochrome is a crucial photoreceptor protein used by plants to detect light. It is particularly sensitive to light in the red and far-red regions of the visible spectrum. Phytochrome exists in two photo-interconvertible forms: Pr (red-light absorbing form) and Pfr (far-red-light absorbing form). The conversion between these two forms allows the plant to perceive the quality of light (e.g., direct sunlight vs. shade) and regulate various developmental processes like seed germination, stem elongation, leaf expansion, and flowering (photoperiodism).

Final Answer : “Red and far-red light”

Answer: (B)

Q20.

Solution

Concept: Subcellular location of the stages of aerobic cellular respiration.

Solution: The Krebs cycle, also known as the citric acid cycle or the tricarboxylic acid (TCA) cycle, is a key stage of cellular respiration. After glycolysis (which occurs in the cytoplasm) breaks down glucose into pyruvate, the pyruvate is converted to acetyl-CoA and enters the Krebs cycle. All the enzymes, substrates, and coenzymes required for the Krebs cycle are located within the mitochondrial matrix, the innermost compartment of the mitochondria. The final stage, the electron transport chain, occurs on the inner mitochondrial membrane.

Final Answer : “Mitochondrial matrix”

Answer: (B)



Q21.

Solution

Concept: The electrical conduction system of the human heart.

Solution: The pacemaker of the heart is the structure that initiates the electrical impulse for each heartbeat, setting the rhythm of cardiac contractions. This role is performed by the sinoatrial (SA) node, a small mass of specialized cardiac muscle cells located in the upper wall of the right atrium. The SA node has the fastest intrinsic rate of spontaneous depolarization, generating nerve impulses at a rate of about 60-100 times per minute, thereby establishing the normal sinus rhythm of the heart.

Final Answer : “SA node”

Answer: (B)

Q22.

Solution

Concept: The properties of hemoglobin and oxygen transport.

Solution: The oxygen dissociation curve is a graph that plots the proportion of hemoglobin in its oxygen-saturated form (as a percentage) on the y-axis against the prevailing partial pressure of oxygen on the x-axis. The curve has a characteristic S-shape, known as a sigmoid curve. This shape reflects the cooperative binding of oxygen to the hemoglobin molecule. The binding of the first oxygen molecule to one of the four heme groups increases the affinity of the remaining heme groups for oxygen, leading to a steep rise in saturation over a small change in oxygen pressure. This property facilitates efficient oxygen loading in the lungs and unloading in the tissues.

Final Answer : “Sigmoid”

Answer: (B)

Q23.

Solution

Concept: Hormonal regulation of calcium homeostasis.

Solution: The regulation of calcium concentration in the blood is a critical homeostatic mechanism controlled mainly by two hormones. Parathormone, also known as Parathyroid Hormone (PTH), is secreted by the parathyroid glands. Its primary function is to increase blood calcium levels. It does this by stimulating osteoclasts to release calcium from bones, increasing calcium reabsorption in the kidneys, and promoting the synthesis of active vitamin D to enhance calcium absorption from the food in the intestine. Its antagonistic hormone is calcitonin, which lowers blood calcium.

Final Answer : “Parathormone”

Answer: (C)



Q24.

Solution

Concept: The basic structural and functional unit of the excretory system.

Solution: The nephron is the microscopic functional unit of the kidney. Each human kidney contains approximately one million nephrons. The primary function of the nephron is to filter blood, reabsorb essential substances back into the blood, and secrete waste products and excess water to form urine. A nephron consists of a renal corpuscle (which includes the glomerulus and Bowman's capsule) and a renal tubule. The glomerulus is a part of the nephron, but the entire functional unit is the nephron itself.

Final Answer : "Nephron"

Answer: (B)

Q25.

Solution

Concept: The structure and formation of myelinated nerve fibers.

Solution: The myelin sheath is a lipid-rich, insulating layer that surrounds the axons of many neurons, allowing for rapid and efficient transmission of nerve impulses (saltatory conduction). This sheath is formed by specific types of glial cells.

- In the Peripheral Nervous System (PNS), the myelin sheath is formed by **Schwann cells**.
- In the Central Nervous System (CNS), it is formed by **Oligodendrocytes**.

Since both Schwann cells and Oligodendrocytes are listed as options, the question is slightly ambiguous. However, both are correct cell types that form the myelin sheath. Both (B) and (D) are correct answers in different parts of the nervous system.

Final Answer : "Schwann cells"

Answer: (B)



Q26.

Solution

Concept: Unique reproductive strategies in the plant kingdom.

Solution: Double fertilization is a complex fertilization mechanism that is a distinctive feature of Angiosperms (flowering plants). During this process, a pollen tube delivers two male gametes into the ovule. One male gamete fuses with the egg cell to form the diploid (2n) zygote, which will develop into the embryo. The other male gamete fuses with the two polar nuclei within the central cell to form a triploid (3n) primary endosperm nucleus. This nucleus develops into the endosperm, a nutritive tissue that provides nourishment to the developing embryo. This unique "double" event does not occur in gymnosperms, bryophytes, or pteridophytes.

Final Answer : "Angiosperms"

Answer: (B)

Q27.

Solution

Concept: The structure of a sperm cell and the process of fertilization.

Solution: The acrosome is a specialized, cap-like organelle covering the anterior part of the head of a spermatozoon. It is a type of modified lysosome that contains a cocktail of hydrolytic enzymes, including hyaluronidase and acrosin. The primary function of these enzymes is to facilitate fertilization. When a sperm cell reaches an egg, the acrosome releases these enzymes (the acrosome reaction), which digest and break down the protective outer layers of the egg (the corona radiata and zona pellucida), creating a path for the sperm to penetrate and fuse with the egg's plasma membrane.

Final Answer : "Fertilization"

Answer: (A)

Q28.

Solution

Concept: Anatomy of the human female reproductive system and the process of fertilization.

Solution: In humans, after ovulation, the egg (secondary oocyte) travels from the ovary into the Fallopian tube (also called the oviduct). Sperm, after being deposited in the vagina, travel up through the cervix and uterus to reach the Fallopian tubes. Fertilization, the fusion of the sperm and egg, typically occurs in the ampullary region, which is the wider, outer portion of the Fallopian tube. The resulting zygote then travels to the uterus for implantation.

Final Answer : "Fallopian tube"

Answer: (C)



Q29.

Solution

Concept: Endocrine control of pregnancy.

Solution: Progesterone is often called the "hormone of pregnancy" due to its crucial role in maintaining it. Initially produced by the corpus luteum and later by the placenta, progesterone performs several key functions:

- It maintains the endometrium (uterine lining), making it thick and rich in blood vessels to support the developing embryo.
- It inhibits uterine contractions, preventing premature labor.
- It stimulates the development of mammary glands for lactation.

While estrogen is also important, progesterone is the primary hormone responsible for sustaining the pregnancy.

Final Answer : “Progesterone”

Answer: (B)

Q30.

Solution

Concept: Asexual reproduction in plants.

Solution: Vegetative propagation is a type of asexual reproduction in plants where new individuals arise from vegetative parts of the parent plant, rather than from seeds or spores. These vegetative parts include roots (e.g., sweet potato), stems (e.g., potato tubers, strawberry runners), and leaves (e.g., Bryophyllum). The offspring produced are genetically identical to the parent plant, forming a clone. Seeds and gametes are involved in sexual reproduction.

Final Answer : “Roots/stems/leaves”

Answer: (C)



Q31.

Solution

Concept: The foundational principles of classical genetics (Mendelian genetics).

Solution: Gregor Mendel, through his meticulous experiments with pea plants in the 19th century, established the fundamental laws of heredity. One of his key principles is the Law of Segregation (Mendel's First Law). This law states that for any trait, an individual's pair of alleles are separated (segregated) from each other during the formation of gametes (sperm or egg cells). As a result, each gamete carries only one allele for each trait.

Final Answer : "Mendel"

Answer: (B)

Q32.

Solution

Concept: The structure of nucleic acids as biological macromolecules.

Solution: DNA (Deoxyribonucleic acid) is a large biological molecule, or macromolecule. It is composed of a long chain of repeating chemical units called monomers. The monomer unit of DNA is a nucleotide. Since DNA is made up of many of these nucleotide monomers linked together in a long chain, it is classified as a polymer. Specifically, it is a polynucleotide.

Final Answer : "Polymer"

Answer: (B)



Q33.

Solution

Concept: The causes and types of genetic mutations.

Solution: A mutation is a permanent alteration in the nucleotide sequence of DNA. Mutations can arise from various sources:

- **Replication error:** Spontaneous errors can occur during the process of DNA replication that are not corrected by the cell's proofreading and repair mechanisms.
- **Radiation:** Mutagenic agents (mutagens) like ultraviolet (UV) radiation from the sun and ionizing radiation like X-rays can damage DNA.
- **Chemicals:** Certain chemicals, such as those in tobacco smoke or base analogs, can interact with DNA and cause changes in its sequence.

Since all the listed options are well-established causes of mutation, the correct answer is "All of these".

Final Answer : "All of these"

Answer: (D)

Q34.

Solution

Concept: The modern definition of biological evolution.

Solution: From a population genetics perspective, evolution is defined as a change in the frequency of alleles (or genes) in a population's gene pool over successive generations. Individuals do not evolve during their lifetime; rather, populations evolve as the proportions of individuals with different heritable traits change. This change in gene frequency is driven by mechanisms such as natural selection, genetic drift, mutation, and gene flow.

Final Answer : "Change in gene frequency"

Answer: (B)



Q35.

Solution

Concept: Population genetics and the Hardy-Weinberg principle.

Solution: The Hardy-Weinberg equilibrium principle describes a hypothetical, non-evolving population in which allele and genotype frequencies remain constant over generations. This equilibrium is maintained only if five specific conditions are met: no mutation, no gene flow (migration), random mating, no natural selection, and a very large population size. Therefore, any factor that violates these conditions will disturb the equilibrium and cause evolution to occur. This includes:

- **Mutation:** Introduces new alleles.
- **Migration (gene flow):** Adds or removes alleles from the population.
- **Selection (natural selection):** Favors certain alleles over others.

Thus, all of the listed options are evolutionary forces that disturb the Hardy-Weinberg equilibrium.

Final Answer : “All”

Answer: (D)

Q36.

Solution

Concept: Microbial sources of antibiotics.

Solution: Antibiotics are antimicrobial substances that are active against bacteria. The vast majority of clinically useful antibiotics are natural products derived from microorganisms that produce them to compete with other microbes in their environment. The two main sources are:

- **Fungi:** The most famous example is penicillin, discovered by Alexander Fleming, which is produced by the mold *Penicillium chrysogenum*.
- **Bacteria:** Many important antibiotics, including streptomycin, erythromycin, and tetracycline, are produced by soil bacteria, primarily those of the genus *Streptomyces*.

Since both fungi and bacteria are major sources, the correct option is (D).

Final Answer : “Both (B) and (C)”

Answer: (D)



Q37.

Solution

Concept: Applications of the Polymerase Chain Reaction (PCR) in molecular biology.

Solution: PCR (Polymerase Chain Reaction) is a revolutionary laboratory technique used to make many copies of a specific DNA segment. It allows scientists to take a very small amount of DNA and "amplify" it to a large enough quantity to be studied in detail. This process involves a series of heating and cooling cycles using a heat-stable DNA polymerase enzyme. PCR is fundamental to genetic testing, forensics, infectious disease diagnosis, and molecular cloning.

Final Answer : "DNA amplification"

Answer: (B)

Q38.

Solution

Concept: Key tools used in recombinant DNA technology.

Solution: In genetic engineering, a vector is a DNA molecule used as a vehicle to artificially carry a foreign gene of interest into a host cell, where it can be replicated and/or expressed. The most commonly used vectors are plasmids. Plasmids are small, circular, extrachromosomal DNA molecules found naturally in bacteria. They can be easily isolated, cut with restriction enzymes, ligated with a foreign gene, and reintroduced into host bacteria, making them ideal tools for cloning DNA. Ribosomes, lysosomes, and vacuoles are cellular organelles and do not function as genetic vectors.

Final Answer : "Plasmid"

Answer: (A)

Q39.

Solution

Concept: Applications of modern biotechnology.

Solution: The production of human insulin by bacteria is a landmark achievement of genetic engineering. This process involves using recombinant DNA technology. The gene responsible for producing human insulin is isolated and inserted into a bacterial plasmid (which acts as a vector). This "recombinant" plasmid is then introduced into a host bacterium, such as *E. coli*. The bacteria, now carrying the human gene, multiply rapidly and produce large quantities of human insulin, which can then be purified and used to treat diabetes. This method is distinct from traditional breeding or hybridization, which involve crossing whole organisms.

Final Answer : "Recombinant DNA technology"

Answer: (B)



Q40.

Solution

Concept: Principles of active immunity and vaccination.

Solution: A vaccine introduces a weakened or inactivated form of a pathogen, or a component of the pathogen (an antigen), into the body. This does not cause the disease but is sufficient to trigger an immune response. The body's immune system recognizes the antigen as foreign and mounts a primary immune response, producing antibodies and, crucially, memory B and T cells. If the individual is later exposed to the actual pathogen, these memory cells enable a much faster, stronger, and more effective secondary immune response that neutralizes the pathogen before it can cause illness. Therefore, a vaccine works by stimulating the body's own immune system to build long-term protection.

Final Answer : "Stimulating immunity"

Answer: (B)

Q41.

Solution

Concept: Energy flow and trophic levels in an ecosystem.

Solution: An ecological pyramid of energy illustrates the flow of energy from one trophic level to the next. According to the Second Law of Thermodynamics, energy transfer is never 100% efficient; a significant amount of energy is lost as heat at each step. In ecosystems, only about 10% of the energy from one trophic level is incorporated into the biomass of the next level. This means the total energy available at the producer level (the base) is always greater than at the primary consumer level, which is in turn greater than at the secondary consumer level, and so on. This progressive loss of energy at each level means the pyramid of energy can never be inverted; it is always upright.

Final Answer : "Upright"

Answer: (B)



Q42.

Solution

Concept: Causes of stratospheric ozone depletion.

Solution: The stratospheric ozone layer protects life on Earth by absorbing harmful ultraviolet (UV) radiation from the sun. Ozone depletion is primarily caused by man-made chemicals, most notably Chlorofluorocarbons (CFCs). These compounds, formerly used in refrigerants, aerosol sprays, and solvents, are very stable and rise to the stratosphere. There, UV radiation breaks them down, releasing chlorine atoms. A single chlorine atom can act as a catalyst to destroy tens of thousands of ozone (O_3) molecules in a chain reaction. This has led to the formation of the "ozone hole," particularly over Antarctica.

Final Answer : "CFCs"

Answer: (C)

Q43.

Solution

Concept: Ecological succession.

Solution: Ecological succession is the process of change in the species structure of an ecological community over time. There are two main types:

- **Primary succession:** This occurs in an environment that is devoid of vegetation and usually lacking topsoil. It starts on a newly formed or exposed substrate, such as bare rocks after a volcanic eruption, sand dunes, or land exposed by a retreating glacier. Pioneer species, like lichens and mosses, are the first to colonize these areas and begin the process of soil formation.
- **Secondary succession:** This occurs in an area that previously supported life but has undergone a disturbance, such as a fire or logging, that reduced the existing community. Soil is already present.

Therefore, primary succession starts on substrates like rocks.

Final Answer : "Rocks"

Answer: (B)



Q44.

Solution

Concept: The role of keystone species in maintaining ecosystem structure.

Solution: A keystone species is a species that has a disproportionately large effect on its natural environment relative to its abundance. The classic example that helped define this concept is the predatory starfish *Pisaster ochraceus*. In the rocky intertidal ecosystem, *Pisaster* preys on mussels. In its absence, the mussels outcompete and eliminate most other invertebrates and algae, drastically reducing species diversity. By controlling the mussel population, the starfish maintains a high level of biodiversity. While top predators like tigers and lions can also be keystone species, the starfish is the archetypal example.

Final Answer : “Starfish”

Answer: (C)

Q45.

Solution

Concept: The accumulation of toxins in ecological food chains.

Solution: Biomagnification, also known as bioamplification, is the process by which the concentration of a persistent, non-biodegradable toxin increases at successively higher levels in a food chain. When an organism consumes another, it accumulates the toxins present in its prey’s tissues. Because these toxins (like DDT, mercury, or PCBs) are not easily metabolized or excreted, they build up in the organism’s body (bioaccumulation). At the next trophic level, the predator consumes many contaminated prey, leading to an even higher concentration of the toxin. This results in the highest concentrations being found in the top predators of the food chain.

Final Answer : “Increase in toxin concentration in food chain”

Answer: (B)



Q46.

Solution

Concept: The defining and non-defining characteristics of living organisms.

Solution: Living organisms are distinguished from non-living matter by a set of fundamental characteristics. The defining properties, which are found in all living things without exception, are metabolism, consciousness (response to stimuli), and cellular organization. Reproduction is also a key characteristic for the continuation of a species. Growth is another feature, but it needs careful definition.

- **Metabolism (A):** The sum of all chemical reactions (anabolism and catabolism) occurring within a living organism. It is a definitive feature of life.
- **Consciousness (B):** The ability to sense environmental stimuli and respond to them. This is a definitive feature, seen in everything from bacteria moving towards a chemical to complex human responses.
- **Reproduction (C):** The ability to produce new individuals (offspring). While an individual organism can be alive without reproducing (e.g., a sterile mule), it is a fundamental characteristic of living populations.
- **Growth in size only (D):** This is not a defining characteristic. Growth in living organisms is intrinsic (from within) and involves an increase in mass and cell number. Non-living objects like mountains, crystals, or sand dunes can also grow in size, but they do so by accretion (the external addition of material). Therefore, since this type of growth also occurs in non-living things, it cannot be used as a unique characteristic of life.

Final Answer : “Growth in size only”

Answer: (D)



Q47.

Solution

Concept: The historical development of biological classification systems.

Solution: Biological classification has evolved over time. Early systems, like Linnaeus's two-kingdom system (Plantae and Animalia), were insufficient to classify organisms like fungi, protists, and bacteria.

- **Linnaeus (A):** Proposed the two-kingdom classification.
- **Haeckel (C):** Proposed the three-kingdom classification (Protista, Plantae, Animalia), adding a kingdom for unicellular organisms.
- **Copeland (D):** Proposed the four-kingdom classification, creating the kingdom Monera for prokaryotes.
- **Whittaker (B):** In 1969, R.H. Whittaker proposed the widely accepted five-kingdom classification. His system was based on several criteria: cell structure (prokaryotic vs. eukaryotic), body organization (unicellular vs. multicellular), and mode of nutrition (autotrophic vs. heterotrophic). The major contribution of his system was the creation of a separate Kingdom Fungi, recognizing their unique absorptive heterotrophic mode of nutrition and chitinous cell walls, distinguishing them from plants. The five kingdoms are Monera, Protista, Fungi, Plantae, and Animalia.

Final Answer : “Whittaker”

Answer: (B)



Q48.

Solution

Concept: The classification of prokaryotes into Archaeobacteria and Eubacteria.

Solution: The Kingdom Monera includes all prokaryotic organisms. This kingdom is further divided into two major groups: Archaeobacteria and Eubacteria.

- **Archaeobacteria:** These are considered ancient bacteria that live in extreme and harsh environments (extremophiles). Their cell walls lack peptidoglycan and their cell membrane lipids are unique, which allows them to survive these conditions. They are classified into three main groups: methanogens (produce methane), thermoacidophiles (live in hot, acidic conditions), and halophiles.
- **Halophiles (B):** These are a type of archaeobacteria that thrive in environments with very high salt concentrations, such as salt lakes and solar evaporation ponds.
- **Nostoc (A):** This is a cyanobacterium, which is a type of Eubacteria (true bacteria). It is photosynthetic.
- **Amoeba (C) and Paramecium (D):** These are both unicellular, eukaryotic organisms belonging to the Kingdom Protista.

Therefore, Halophiles are the organisms that belong to Archaeobacteria.

Final Answer : “Halophiles”

Answer: (B)



Q49.

Solution

Concept: Symbiosis, specifically the mutualistic relationship in lichens.

Solution: Lichens are composite organisms that are a classic example of a mutualistic symbiotic relationship, where both partners benefit. A lichen consists of two distinct organisms living in an intimate association.

- The fungal partner is called the **mycobiont**.
- The photosynthetic partner is called the **phycobiont**. The phycobiont is typically a green alga or a cyanobacterium.

The roles are divided: The fungus provides the physical structure, anchorage, protection from dehydration and UV radiation, and absorbs water and minerals. In return, the alga or cyanobacterium performs photosynthesis and provides the fungus with carbohydrates (food). This partnership allows lichens to colonize a wide range of harsh environments where neither partner could survive alone. Therefore, the correct association is between algae and fungi.

Final Answer : “Algae and fungi”

Answer: (B)

Q50.

Solution

Concept: Levels of organization in animals based on embryonic germ layers.

Solution: During embryonic development, animals form primary germ layers that give rise to all tissues and organs. The number of these layers determines the level of organization.

- **Diploblastic Organization:** Animals have two germ layers: an outer **ectoderm** and an inner **endoderm**. Between these layers is a non-cellular, jelly-like substance called the mesoglea. This organization is found in simpler multicellular animals. Phylum **Cnidaria (B)** (e.g., jellyfish, sea anemones, corals) and Phylum Ctenophora (comb jellies) are diploblastic.
- **Triploblastic Organization:** Animals have three germ layers: an ectoderm, an endoderm, and a middle layer called the **mesoderm**. The mesoderm gives rise to muscles, the circulatory system, and other complex organs.
- **Platyhelminthes (A), Annelida (C), and Arthropoda (D)** are all more complex, triploblastic animals.

Thus, Cnidaria is the group that shows diploblastic organization.

Final Answer : “Cnidaria”

Answer: (B)



Q51.

Solution

Concept: The internal anatomy of a plant root and pathways of water absorption.

Solution: In a plant root, water moves from the soil to the central vascular cylinder (xylem). It travels through several tissue layers: epidermis, cortex, endodermis, and pericycle. The **endodermis (C)** is the innermost layer of the cortex and acts as a crucial checkpoint. The cells of the endodermis have a specialized waterproof band in their radial and transverse walls called the **Casparian strip**. This strip is made of suberin, a waxy substance.

Its function is to block the apoplastic pathway (water movement through cell walls and intercellular spaces), forcing water and dissolved minerals to pass through the selectively permeable plasma membrane of the endodermal cells (the symplastic pathway). This ensures that the plant has selective control over the uptake of substances into the vascular system and prevents water from leaking back out.

Final Answer : “Endodermis”

Answer: (C)

Q52.

Solution

Concept: Types of connective tissue and their specialized functions.

Solution: Connective tissue is one of the four basic types of animal tissue, providing support, binding other tissues together, and serving various other functions. There are several types of specialized connective tissues.

- **Adipose tissue (B)** is a type of loose connective tissue specialized for the storage of fat. It is primarily composed of cells called adipocytes, which contain large droplets of lipids (triglycerides). Its main functions are to store energy, provide thermal insulation for the body, and cushion vital organs against mechanical shock.
- **Areolar tissue (A)** is another type of loose connective tissue that acts as a packing material, filling the spaces between organs and supporting epithelia.
- **Cartilage (C)** and **Bone (D)** are supportive connective tissues that provide the structural framework of the body.

Final Answer : “Adipose”

Answer: (B)



Q53.

Solution

Concept: The molecular basis of muscle contraction.

Solution: Muscle contraction is an active process powered by ATP and driven by the interaction between two main types of protein filaments within the sarcomeres of muscle cells. These are known as contractile proteins.

- **Myosin:** Forms the thick filaments. Myosin molecules have "heads" that can bind to the thin filaments.
- **Actin (B):** Forms the thin filaments. Actin provides the binding sites for the myosin heads.

According to the sliding filament theory, muscle contraction occurs when myosin heads bind to actin, pivot, and pull the thin filaments past the thick filaments, shortening the sarcomere. Both actin and myosin are therefore considered contractile proteins. Tubulin (A) forms microtubules, Keratin (C) is a structural protein in skin and hair, and Collagen (D) is the main protein in connective tissue.

Final Answer : "Actin"

Answer: (B)

Q54.

Solution

Concept: The structure of a neuron and the function of its parts.

Solution: A neuron, or nerve cell, is specialized for transmitting information. It has three main parts: the cell body (soma), dendrites, and an axon. The flow of information is typically unidirectional.

- **Dendrites (B):** These are short, highly branched extensions that protrude from the cell body. Their primary function is to receive signals (stimuli) from other neurons or from sensory receptors. They provide a large surface area for these connections. The signals received are then transmitted as electrical impulses toward the cell body.
- **Axon (A):** This is a single, long projection that carries the nerve impulse (action potential) away from the cell body to transmit it to other neurons, muscles, or glands.
- **Synapse (C):** This is the specialized junction where a neuron communicates with another cell.
- **Node of Ranvier (D):** These are gaps in the myelin sheath along the axon that help speed up signal transmission.

Final Answer : "Dendrite"

Answer: (B)



Q55.

Solution

Concept: The different types of junctions that connect animal cells.

Solution: Animal cells are connected by several types of intercellular junctions that have different functions.

- **Tight junctions (B):** Also known as occluding junctions, these form a seal between adjacent cells. They consist of a network of transmembrane proteins that fuse the outer surfaces of adjacent plasma membranes together. This creates an impermeable barrier that prevents the leakage of molecules and fluids through the space between cells. They are vital in epithelial tissues like the lining of the intestine and the blood-brain barrier.
- **Desmosomes (A):** These are anchoring junctions that fasten cells together in strong sheets, acting like rivets. They are common in tissues subject to mechanical stress, such as skin and cardiac muscle.
- **Gap junctions (C):** These are communicating junctions that form channels between adjacent cells, allowing for the direct passage of ions and small molecules. They are important for rapid communication between cells, as in the heart.
- **Plasmodesmata (D):** These are channels in plant cells that serve a similar function to gap junctions in animal cells.

Final Answer : “Tight junction”

Answer: (B)



Q56.

Solution

Concept: The roles of key enzymes in the process of DNA replication.

Solution: DNA replication is a complex process requiring the coordinated action of many enzymes. The first step is to separate the two strands of the DNA double helix to make them available as templates.

- **Helicase (B):** This is the enzyme responsible for unwinding the DNA. It moves along the DNA molecule, using energy from ATP hydrolysis to break the hydrogen bonds that hold the complementary base pairs together. This separates the two strands and creates a structure called the replication fork.
- **Ligase (A):** This enzyme joins DNA fragments together by forming phosphodiester bonds, particularly in joining the Okazaki fragments on the lagging strand.
- **Polymerase (C):** This enzyme synthesizes the new DNA strands by adding nucleotides that are complementary to the template strand.
- **Primase (D):** This enzyme synthesizes short RNA primers that provide a starting point for DNA polymerase.

Final Answer : “Helicase”

Answer: (B)



Q57.

Solution

Concept: The structure and function of the Golgi apparatus within the eukaryotic cell.

Solution: The Golgi apparatus (or Golgi complex) is a central organelle in the cell's endomembrane system. It functions like a cellular processing and shipping center. It receives proteins and lipids synthesized in the endoplasmic reticulum (ER). Its main functions are:

- (a) **Modification:** It chemically modifies the proteins and lipids it receives, for example, by adding carbohydrate chains (glycosylation).
- (b) **Sorting and Packaging (B):** After modification, it sorts these macromolecules based on their final destination. It then packages them into membrane-bound vesicles.
- (c) **Secretion:** The vesicles can then be transported to various locations. Some vesicles move to the plasma membrane and release their contents outside the cell (a process called exocytosis or secretion). Other vesicles, like lysosomes, are formed by the Golgi and remain in the cell.

Respiration (A) occurs in mitochondria, Digestion (C) in lysosomes, and Protein synthesis (D) on ribosomes.

Final Answer : "Packaging and secretion"

Answer: (B)

Q58.

Solution

Concept: The composition of the mitotic spindle, a key structure in cell division.

Solution: During mitosis and meiosis, the mitotic spindle is a critical structure that orchestrates the segregation of chromosomes to the daughter cells. The fibers that make up this spindle are composed of microtubules. Microtubules are one of the three main components of the cytoskeleton. They are hollow polymers made of repeating protein subunits called **tubulin (B)**. These tubulin subunits (alpha-tubulin and beta-tubulin) assemble into long filaments that form the spindle fibers. These fibers attach to the chromosomes and pull them apart. Actin (A) and Myosin (C) are proteins involved in muscle contraction and cytokinesis, while Keratin (D) is a protein that forms intermediate filaments, providing structural support to cells.

Final Answer : "Tubulin"

Answer: (B)



Q59.

Solution

Concept: The sequence of events during the stages of meiotic cell division.

Solution: Meiosis is a two-stage cell division process that produces haploid gametes. Meiosis I is the reductional division, and Meiosis II is the equational division. The key distinction lies in what separates at anaphase.

- **Meiosis I:** The primary goal is to separate homologous chromosomes (one chromosome from each parent pair). In Metaphase I, these homologous pairs align at the metaphase plate. In **Anaphase I (A)**, the spindle fibers shorten and pull the homologous chromosomes to opposite poles of the cell. Each chromosome still consists of two sister chromatids.
- **Meiosis II:** This stage is very similar to mitosis. In Metaphase II, individual chromosomes align at the metaphase plate. In **Anaphase II (B)**, the centromeres divide, and the sister chromatids are separated and pulled to opposite poles.

Therefore, the phase involving the separation of homologous chromosomes is Anaphase I.

Final Answer : “Anaphase I”

Answer: (A)

Q60.

Solution

Concept: The process of cellular respiration and the location of ATP synthesis.

Solution: The majority of ATP in aerobic organisms is produced during the final stage of cellular respiration, known as oxidative phosphorylation. This process occurs within the mitochondria. A mitochondrion has an outer membrane, an inner membrane, an intermembrane space, and a central matrix.

The **inner membrane (C)** is the site of oxidative phosphorylation. It is highly folded into cristae to increase its surface area. Embedded within this membrane are the proteins of the electron transport chain (ETC) and the enzyme ATP synthase. The ETC uses energy from electrons (carried by NADH and FADH₂) to pump protons from the matrix into the intermembrane space, creating a proton gradient. The flow of these protons back into the matrix through ATP synthase drives the synthesis of large amounts of ATP. The matrix (B) is the site of the Krebs cycle, while the outer membrane (A) is mainly a permeable barrier.

Final Answer : “Inner membrane”

Answer: (C)



Q61.

Solution

Concept: The roles of different pigments in capturing light energy for photosynthesis.

Solution: Photosynthesis relies on pigments to absorb light energy. These pigments are organized into photosystems. Each photosystem has an antenna complex and a reaction center.

- **Accessory Pigments:** The antenna complex contains various pigments like **Chlorophyll b (B)**, **Carotenes (C)**, and **Xanthophylls (D)**. They absorb light at different wavelengths and transfer the captured energy to the reaction center. This broadens the spectrum of light that can be used.
- **Primary Pigment:** The reaction center contains a special pair of **Chlorophyll a (A)** molecules. This is where the crucial energy conversion step occurs. When Chlorophyll a absorbs the energy from the antenna pigments, it becomes excited and donates an electron to a primary electron acceptor, initiating the flow of electrons.

Because Chlorophyll a is the molecule that actually initiates the photochemical reaction by losing an electron, it is the pigment that participates directly in photosynthesis.

Final Answer : “Chlorophyll a”

Answer: (A)

Q62.

Solution

Concept: The physical mechanism by which plant roots absorb water from the soil.

Solution: Water absorption in plants is a physical process driven by differences in water potential. Water potential is the measure of the potential energy in water, and water always moves from an area of higher water potential to an area of lower water potential.

The water in the soil typically has a high water potential (few solutes). The cytoplasm of root hair cells, however, contains many solutes (sugars, ions, etc.), which gives it a much lower (more negative) water potential. This difference in water potential across the selectively permeable plasma membrane of the root hair cell drives the movement of water from the soil into the root. This specific movement of water across a selectively permeable membrane down a water potential gradient is called **osmosis (A)**. Active transport (C) is used to pump ions into the root, which helps maintain the low water potential, but the movement of water itself is passive osmosis.

Final Answer : “Osmosis”

Answer: (A)



Q63.

Solution

Concept: The major functions of different plant hormones (phytohormones).

Solution: Plant growth and development are regulated by several major classes of hormones.

- **Auxin (B):** One of the most significant roles of auxin is to promote cell elongation, particularly in stems. According to the acid growth hypothesis, auxin stimulates proton pumps in the cell membrane, which acidify the cell wall. This activates enzymes called expansins that loosen the cell wall, allowing the cell to take up water and expand. This is crucial for phenomena like phototropism (bending towards light).
- **Cytokinin (A):** Primarily promotes cell division (cytokinesis) and is involved in shoot growth and delaying senescence.
- **Ethylene (C):** A gaseous hormone that primarily promotes fruit ripening and leaf abscission.
- **ABA (Abscisic Acid) (D):** Generally acts as an inhibitor of growth. It promotes seed dormancy and causes stomatal closure during water stress.

Final Answer : “Auxin”

Answer: (B)

Q64.

Solution

Concept: The principle of limiting factors as it applies to photosynthesis.

Solution: The rate of photosynthesis is affected by several factors, including CO₂ concentration, light intensity, and temperature. According to Blackman’s Law of Limiting Factors, the rate of a process is limited by the factor that is in the shortest supply. Photosynthesis consists of two stages:

- (a) Light-dependent reactions: Use light to produce ATP and NADPH.
- (b) Light-independent reactions (Calvin Cycle): Use CO₂, ATP, and NADPH to make sugar.

In the given scenario, the CO₂ concentration is high, meaning it is not the limiting factor. The Calvin cycle has an abundant supply of its raw material (CO₂), so its rate will now depend on the supply of ATP and NADPH from the light-dependent reactions. The rate of the light-dependent reactions is directly determined by the amount of light energy being captured. Therefore, if light is dim, not enough ATP and NADPH will be produced to utilize the high CO₂ levels, and **light intensity (A)** will become the limiting factor.

Final Answer : “Light intensity”

Answer: (A)



Q65.

Solution

Concept: The details of the light-dependent reactions in photosynthesis.

Solution: Photolysis of water is the light-driven splitting of a water molecule (H_2O) into electrons (e^-), protons (H^+), and oxygen (O_2). This is a fundamental step in the light-dependent reactions.

This process is specifically associated with **Photosystem II (PS II) (B)**. When the reaction center chlorophyll (P680) of PS II absorbs light energy, it loses an electron to the electron transport chain. This leaves the chlorophyll molecule in a highly oxidized, unstable state (P680^+). To become stable again, it must regain an electron. P680^+ is such a powerful oxidizing agent that it can pull electrons from water. An enzyme complex associated with PS II, called the oxygen-evolving complex, catalyzes this water-splitting reaction. The electrons are used to reduce P680^+ , the protons are released into the thylakoid lumen contributing to the ATP synthesis gradient, and oxygen is released as a byproduct. Photosystem I (A) receives electrons from the electron transport chain, not directly from water.

Final Answer : “Photosystem II”

Answer: (B)

Q66.

Solution

Concept: The functions of the different components of blood.

Solution: Blood is composed of plasma and formed elements: red blood cells (RBCs), white blood cells (WBCs), and platelets.

- **RBCs (A):** Erythrocytes; responsible for transporting oxygen.
- **WBCs (B):** Leukocytes; part of the immune system, fighting infection.
- **Platelets (C):** Also known as thrombocytes, these are not complete cells but small cell fragments. They play a critical role in hemostasis (the process of stopping bleeding). When a blood vessel is injured, platelets adhere to the site, aggregate to form a temporary plug, and release chemical factors that initiate the complex coagulation cascade. This cascade results in the formation of a fibrin mesh, which traps blood cells and forms a stable clot.
- **Plasma (D):** The liquid matrix of blood, which contains water, proteins (including clotting factors like fibrinogen), hormones, and nutrients.

Thus, the platelets are the blood cells that help in clotting.

Final Answer : “Platelets”

Answer: (C)

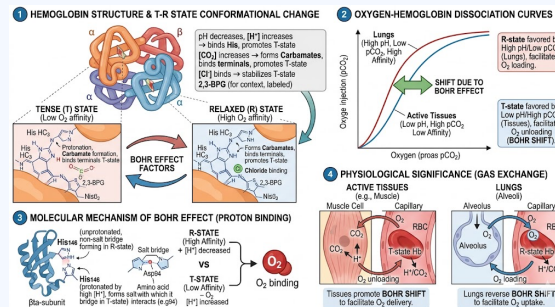


Q67.

Solution

Concept: The Bohr effect and its role in oxygen-hemoglobin binding.

Solution:



The Bohr effect describes the influence of pH and carbon dioxide concentration on the affinity of hemoglobin for oxygen. Hemoglobin's ability to bind oxygen is not fixed; it changes depending on the local environment.

In tissues with high metabolic activity (like exercising muscles), cellular respiration produces high levels of CO₂.

This CO₂ diffuses into the blood and increases the concentration of hydrogen ions (H⁺), thus lowering the blood pH (making it more acidic). The Bohr effect states that a decrease in pH (or an increase in CO₂) reduces hemoglobin's affinity for oxygen. This causes the oxygen-hemoglobin dissociation curve to shift to the right, meaning that for any given partial pressure of oxygen, hemoglobin will release more of its bound oxygen. This is a crucial physiological mechanism that enhances the delivery and release of oxygen to the tissues that need it most. Therefore, the Bohr effect is fundamentally related to the efficiency of **oxygen transport (A)**.

Final Answer : "Oxygen transport"

Answer: (A)



Q68.

Solution

Concept: The specialized functions of the major regions of the human brain.

Solution: The brain is composed of several distinct parts, each controlling different functions.

- **Cerebrum (A):** The largest part of the brain, responsible for higher cognitive functions like thought, reasoning, memory, language, and voluntary control of muscles.
- **Cerebellum (B):** Located at the back of the brain, the cerebellum's primary role is to coordinate voluntary muscle movements, making them smooth and accurate. Crucially, it is also responsible for maintaining posture and balance. It integrates sensory information from the inner ear and muscles to make constant, fine-tuned adjustments to motor activity.
- **Medulla (C):** Part of the brainstem, it controls vital, involuntary functions like heartbeat, breathing rate, and blood pressure.
- **Hypothalamus (D):** Controls the autonomic nervous system and pituitary gland, regulating body temperature, hunger, thirst, and other homeostatic functions.

Therefore, the cerebellum is the part of the brain that controls balance.

Final Answer : "Cerebellum"

Answer: (B)



Q69.

Solution

Concept: The role of the hormone insulin in regulating blood glucose levels.

Solution: Insulin is a hormone produced by the beta cells of the pancreas. Its primary function is to regulate blood glucose levels. After a meal, when blood glucose rises, insulin is secreted and signals the body's cells (primarily in the liver, muscles, and fat tissue) to take up glucose from the bloodstream for use as energy or for storage as glycogen.

- **Insulin deficiency** means that either the pancreas is not producing enough insulin (Type 1 diabetes) or the body's cells are not responding effectively to the insulin produced (Type 2 diabetes).
- In either case, glucose cannot be effectively removed from the blood, leading to a persistently high blood glucose level, a condition called hyperglycemia.
- **Diabetes mellitus (B)** is the medical term for the disease characterized by chronic hyperglycemia due to insulin deficiency or ineffectiveness.
- **Hypoglycemia (A)** is low blood sugar, which would be caused by an excess of insulin, not a deficiency.
- **Hyperthyroidism (C)** is related to the thyroid gland, and **Anemia (D)** is a deficiency of red blood cells. Both are unrelated to insulin.

Final Answer : "Diabetes mellitus"

Answer: (B)



Q70.

Solution

Concept: The function of vitamins in physiological processes, specifically hemostasis.

Solution: Blood clotting, or coagulation, is a complex process involving a cascade of enzymatic reactions that activate a series of proteins called clotting factors.

- **Vitamin K (C)** is a fat-soluble vitamin that is essential for this process. It acts as a cofactor for an enzyme in the liver that modifies several key clotting factors (including Prothrombin (Factor II), Factor VII, Factor IX, and Factor X). This modification (gamma-carboxylation) is necessary to make these proteins functional, allowing them to bind to calcium ions and phospholipid surfaces at the site of injury, which is a critical step in the coagulation cascade.
- A deficiency in Vitamin K leads to the production of inactive clotting factors, impairing the body's ability to form blood clots and resulting in an increased risk of bleeding.
- Vitamin A (A) is for vision, Vitamin B (B) for metabolism, and Vitamin D (D) for calcium absorption.

Final Answer : “Vitamin K”

Answer: (C)

Q71.

Solution

Concept: The life cycle and reproductive structures of angiosperms (flowering plants).

Solution: In the life cycle of plants (alternation of generations), the gametophyte is the haploid (n) phase that produces gametes. In angiosperms, the gametophytes are highly reduced and dependent on the diploid (2n) sporophyte (the main plant body).

- The male gametophyte develops from a microspore within the anther. This structure is the **pollen grain (B)**.
- A mature pollen grain is a two-celled or three-celled structure containing a tube nucleus and one or two male gametes (sperm cells). It is the vehicle for delivering the male gametes to the female gametophyte for fertilization.
- The **embryo sac (C)** is the female gametophyte, which develops inside the **ovule (A)**.
- The **endosperm (D)** is a nutritive tissue formed after fertilization.

Therefore, the pollen grain represents the male gametophyte in angiosperms.

Final Answer : “Pollen grain”

Answer: (B)



Q72.

Solution

Concept: The process of sexual reproduction in flowering plants, focusing on the event of fertilization.

Solution: Fertilization in plants is the fusion of male and female gametes to initiate the development of a new individual.

- In angiosperms, a process called double fertilization occurs. The pollen tube delivers two male gametes to the embryo sac.
- One male gamete fuses with the female gamete (the egg cell). This fusion of two haploid (n) gametes results in the formation of a single diploid ($2n$) cell called the **zygote (A)**.
- The zygote is the first cell of the new sporophyte generation and will develop into the embryo through subsequent cell divisions (mitosis).
- The other male gamete fuses with the two polar nuclei in the central cell to form the triploid ($3n$) primary endosperm nucleus, which develops into the endosperm.

The embryo sac (B) is the structure where fertilization occurs, the pollen tube (C) delivers the gametes, and the ovary (D) is the structure that contains the ovule. The zygote is the direct result of fertilization.

Final Answer : “Zygote”

Answer: (A)



Q73.

Solution

Concept: The human endocrine system and the origin of major hormones.

Solution: Follicle-Stimulating Hormone (FSH) is a gonadotropin, a type of hormone that stimulates the gonads (testes and ovaries).

- FSH is synthesized and secreted by the anterior lobe of the **pituitary gland (A)**, which is a small endocrine gland located at the base of the brain.
- The secretion of FSH is controlled by Gonadotropin-releasing Hormone (GnRH) from the hypothalamus.
- In females, FSH stimulates the growth and maturation of ovarian follicles. In males, FSH acts on the Sertoli cells of the testes to stimulate spermatogenesis (sperm production).
- The Thyroid gland (B) secretes thyroid hormones, the Pancreas (C) secretes insulin and glucagon, and the Adrenal glands (D) secrete corticosteroids and adrenaline.

Final Answer : “Pituitary”

Answer: (A)

Q74.

Solution

Concept: The formation and structure of the placenta during human pregnancy.

Solution: The placenta is a temporary fetomaternal organ that develops during pregnancy and is vital for the support of the developing foetus. It serves as the interface between the mother and foetus for the exchange of nutrients, gases, and waste products.

- It is a composite organ, formed from tissues of both the mother and the foetus.
- The foetal component is derived from the chorion (the outermost embryonic membrane), specifically its finger-like projections called chorionic villi.
- The maternal component is derived from the wall of the **uterus (B)**, specifically the endometrium, which becomes modified during pregnancy (called the decidua).
- The chorionic villi grow and embed into the uterine wall, establishing a close connection with the mother’s blood supply. Therefore, the placenta is formed by the interdigitation of foetal and uterine tissues.

Final Answer : “Foetus and uterus”

Answer: (B)



Q75.

Solution

Concept: Mechanisms of action of different contraceptive methods.

Solution: Ovulation is the release of a mature egg from the ovary, which is a necessary event for fertilization to occur. Different contraceptive methods work in different ways to prevent pregnancy.

- **Oral pills (B):** These are a form of hormonal contraception, typically containing synthetic estrogen and progestin. These hormones disrupt the normal hormonal cycle by providing negative feedback to the hypothalamus and pituitary gland. This suppresses the secretion of FSH and, crucially, prevents the mid-cycle surge of LH. Without the LH surge, the mature follicle does not rupture, and ovulation is prevented.
- **Condoms (A)** are barrier methods that physically block sperm from entering the uterus. They do not affect ovulation.
- **IUDs (C)** work primarily within the uterus, either by creating an inflammatory environment toxic to sperm (copper IUD) or by thickening cervical mucus (hormonal IUD), thus preventing fertilization. They generally do not stop ovulation.
- **Vasectomy (D)** is a male sterilization procedure that prevents sperm from being ejaculated; it has no effect on the female's ovulatory cycle.

Final Answer : "Oral pills"

Answer: (B)



Q76.

Solution

Concept: The principles and application of a test cross in Mendelian genetics.

Solution: A test cross is a specific type of genetic cross used to determine the unknown genotype of an individual that displays a dominant phenotype. An individual showing the dominant trait could be either homozygous dominant (e.g., AA) or heterozygous (e.g., Aa).

- To distinguish between these two possibilities, the individual in question is crossed with an individual that is known to be **homozygous recessive (B)** for the same trait (e.g., aa).
- The phenotypes of the offspring from this cross will reveal the genotype of the unknown parent.
- **Scenario 1:** If the unknown parent is homozygous dominant (AA), all offspring will be heterozygous (Aa) and will show the dominant phenotype. ($AA \times aa \rightarrow \text{all } Aa$)
- **Scenario 2:** If the unknown parent is heterozygous (Aa), there will be a 1:1 ratio of dominant phenotype (Aa) to recessive phenotype (aa) among the offspring. ($Aa \times aa \rightarrow 1 Aa : 1 aa$)

Thus, the key component of a test cross is the use of a homozygous recessive individual.

Final Answer : “Homozygous recessive”

Answer: (B)



Q77.

Solution

Concept: The molecular mechanism of DNA replication.

Solution: When DNA replication was first studied, three models were proposed to explain how a new DNA molecule is synthesized from a parent molecule.

- (a) **Conservative (A):** The two parental strands stay together, and a completely new daughter double helix is synthesized.
- (b) **Dispersive (C):** The parental molecule is broken into fragments, and each daughter molecule is a mix of old and new DNA pieces on both strands.
- (c) **Semi-conservative (B):** The parental double helix unwinds, and each of the two parental strands serves as a template for the synthesis of a new, complementary strand. As a result, each of the two new DNA molecules consists of one "old" (parental) strand and one "new" (daughter) strand.

The landmark experiment by Meselson and Stahl in 1958 provided conclusive evidence that DNA replication in all living organisms follows the semi-conservative model.

Final Answer : "Semi-conservative"

Answer: (B)

Q78.

Solution

Concept: The genetic code and the signals for initiation and termination of protein synthesis (translation).

Solution: The genetic code is read by the ribosome in units of three nucleotides called codons. Each codon on the mRNA molecule specifies either a particular amino acid or a signal to start or stop translation.

- **Start Codon:** The process of translation is initiated at a specific start codon. The most common start codon is **AUG (B)**. It signals the ribosome to begin synthesizing the polypeptide chain. The AUG codon also codes for the amino acid methionine (or N-formylmethionine in prokaryotes). Therefore, methionine is almost always the first amino acid in a new protein.
- **Stop Codons:** Translation is terminated when the ribosome encounters one of three stop codons. These codons do not code for an amino acid but signal for the release of the completed polypeptide chain. The three stop codons are **UAA (A)**, **UAG (C)**, and **UGA (D)**.

Final Answer : "AUG"

Answer: (B)



Q79.

Solution

Concept: Mechanisms of evolutionary change in a population.

Solution: Genetic drift is a mechanism of evolution characterized by random fluctuations in the frequencies of alleles within a population's gene pool. Unlike natural selection, which is driven by the adaptive value of traits, genetic drift is entirely due to **chance events (C)**. It is most pronounced in small populations. For example, if a natural disaster randomly kills a portion of a population, the allele frequencies of the survivors may be very different from the original population, not because certain individuals were more fit, but simply by chance. This can lead to the loss of genetic variation or the fixation of certain alleles, regardless of their adaptive value.

- **Natural selection (A)** is a non-random process where traits that enhance survival and reproduction become more common.
- **Mutation (B)** is the ultimate source of new genetic variation, but it is the random change in allele frequencies that defines drift.
- **Migration (D)**, or gene flow, is the transfer of alleles between populations.

Final Answer : "Chance events"

Answer: (C)

Q80.

Solution

Concept: The Darwinian theory of evolution.

Solution: Charles Darwin, in his seminal work "On the Origin of Species," proposed the primary mechanism by which evolution occurs. He called this mechanism **natural selection (B)**. His theory was based on several key observations and inferences:

- (a) **Variation:** Individuals within a population vary in their traits.
- (b) **Inheritance:** These traits are heritable, passed from parents to offspring.
- (c) **Differential Survival and Reproduction:** Due to limited resources, there is a "struggle for existence." Individuals with traits better suited to their environment are more likely to survive and reproduce, passing on those advantageous traits.

Over generations, this process leads to the accumulation of favourable traits and the adaptation of populations to their environment. Mutation (A) and genetic drift (D) were concepts incorporated later into the Modern Synthesis of evolutionary theory.

Final Answer : "Natural selection"

Answer: (B)



Q81.

Solution

Concept: Application of microbes in the production of household food items.

Solution: Curd is produced from milk through the process of fermentation. This fermentation is carried out by a group of microorganisms known as Lactic Acid Bacteria (LAB).

- The most common bacterium used as a starter for making curd is **Lactobacillus (B)**.
- These bacteria multiply in milk and ferment the milk sugar (lactose) into lactic acid.
- The production of lactic acid lowers the pH of the milk, causing the milk proteins (primarily casein) to coagulate and partially digest, which gives the curd its characteristic thick texture and sour taste. The bacteria also enhance the nutritional value by increasing vitamin B12.
- Yeast (A) is used in baking and brewing. Rhizopus (C) is a bread mold, and Penicillium (D) is used for antibiotics and making certain cheeses.

Final Answer : “Lactobacillus”

Answer: (B)

Q82.

Solution

Concept: The role of microbes in wastewater and sewage treatment.

Solution: Sewage treatment involves several stages, with the secondary (or biological) treatment stage being crucial for removing dissolved organic matter. This stage relies on the metabolic activity of vast populations of microorganisms.

- The primary microbes used are aerobic heterotrophic **bacteria (B)**, often along with fungi.
- In aeration tanks, sewage is vigorously agitated and air is pumped in. This encourages the growth of bacteria and fungi into mesh-like masses called "flocs." These microbes consume the organic pollutants in the sewage as food, converting them into microbial biomass, carbon dioxide, and water. This dramatically reduces the Biochemical Oxygen Demand (BOD) of the wastewater, making it much less polluting. Anaerobic bacteria are also used in a later stage (anaerobic sludge digesters) to digest the "sludge" (the settled flocs).

Final Answer : “Bacteria”

Answer: (B)



Q83.

Solution

Concept: Key tools used in recombinant DNA technology and genetic engineering.

Solution: Restriction enzymes, also known as restriction endonucleases, are enzymes that act as "molecular scissors." They are a fundamental tool in molecular biology.

- Their function is to recognize and bind to specific sequences of nucleotides within a **DNA (B)** molecule. These specific sequences are called recognition sites or restriction sites, which are typically palindromic.
- Upon recognition, the enzyme cuts the phosphodiester backbone of the DNA, usually within the recognition site itself. This cleavage is precise and reproducible.
- This ability to cut DNA at specific locations allows scientists to isolate specific genes and insert them into other DNA molecules (e.g., plasmids) to create recombinant DNA.
- These enzymes do not act on RNA (A), protein (C), or lipids (D); other specific enzymes like RNases, proteases, and lipases act on those molecules.

Final Answer : "DNA"

Answer: (B)



Q84.

Solution

Concept: The principles and applications of gene therapy in medicine.

Solution: Gene therapy is an advanced biotechnological approach aimed at correcting genetic defects at the molecular level.

- The core principle is to introduce a functional, non-mutated copy of a gene into the cells of an individual who has a defective or missing version of that gene.
- This is often done using a modified virus as a vector to deliver the correct gene into the target cells.
- By providing the correct genetic instructions, the cells can then produce the proper protein, thereby alleviating or curing the symptoms of the disease.
- Therefore, the primary goal of gene therapy is to **treat genetic disorders (A)**, such as Severe Combined Immunodeficiency (SCID), cystic fibrosis, and sickle cell disease.
- While it is a form of genetic manipulation, it is distinct from producing vaccines (C) or improving crops (D), which are other applications of biotechnology.

Final Answer : “Treat genetic disorders”

Answer: (A)



Q85.

Solution

Concept: Ethical considerations related to the use of biodiversity and traditional knowledge.

Solution: Biopiracy is a term used to describe the unethical or unlawful appropriation and monopolization of genetic resources and traditional knowledge.

- It refers to the practice of companies or institutions from developed nations exploiting the rich biodiversity of developing nations. This often involves taking genetic material from plants or animals, or documenting traditional knowledge from indigenous communities about their medicinal uses.
- This is done without obtaining proper consent (prior informed consent) from the source country or community and without establishing mutually agreed terms for sharing the resulting commercial profits. It is essentially the **illegal use of bioresources (A)** and the knowledge associated with them.
- Examples include patenting the properties of plants like Neem or Turmeric, which have been known and used in traditional Indian medicine for centuries.

Final Answer : “Illegal use of bioresources”

Answer: (A)



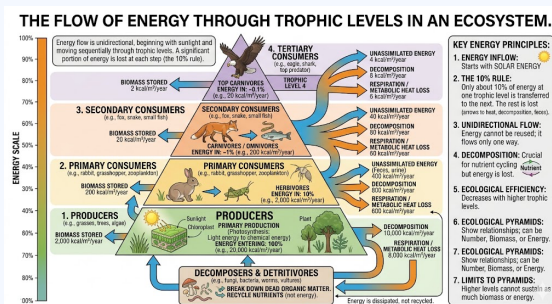
Q86.

Solution

Concept: The flow of energy through trophic levels in an ecosystem.

Solution: An ecosystem’s energy flow is typically depicted as an energy pyramid, with different trophic (feeding) levels.

- The base of the pyramid is formed by the **producers (A)**, which are autotrophs like plants and algae. They capture the initial energy, usually from sunlight, and convert it into chemical energy stored in organic molecules through photosynthesis. This first trophic level contains the largest amount of energy and biomass in the ecosystem.
- **Primary consumers (B)** are herbivores that feed on producers.
- **Secondary (C)** and **tertiary consumers (D)** are carnivores or omnivores that feed on the levels below them.
- According to the Ten Percent Law, only about 10% of the energy is transferred from one trophic level to the next. The remaining 90% is lost as metabolic heat or is not consumed. Therefore, energy decreases significantly at each successive level, making the producers the level with the maximum energy.



Final Answer : “Producers”

Answer: (A)

Q87.

Solution

Concept: The key processes within major biogeochemical cycles.

Solution: Biogeochemical cycles describe the movement of essential elements through the biotic (living) and abiotic (non-living) components of an ecosystem.

- The **Nitrogen cycle (B)** describes how nitrogen moves through the environment. Atmospheric nitrogen (N_2) is abundant but chemically inert and cannot be used by most organisms because of the strong triple bond between the nitrogen atoms.
- **Nitrogen fixation** is the crucial first step of this cycle. It is the process of converting inert N_2 gas into biologically available forms like ammonia (NH_3).
- This conversion is primarily carried out by specialized nitrogen-fixing bacteria, some of which live freely in the soil, while others (like *Rhizobium*) live in a symbiotic relationship in the root nodules of leguminous plants. Lightning also contributes a small amount to nitrogen fixation.
- The other cycles—carbon (A), water (C), and oxygen (D)—do not involve the conversion of atmospheric nitrogen.

Final Answer : “Nitrogen cycle”

Answer: (B)



Q88.

Solution

Concept: The causes and consequences of eutrophication in aquatic ecosystems.

Solution: Eutrophication is the process by which a body of water becomes progressively enriched with minerals and nutrients.

- The primary cause of cultural (human-induced) eutrophication is **nutrient enrichment (A)**. This occurs when excess nutrients, particularly nitrogen and phosphorus, are introduced into an aquatic ecosystem, usually from agricultural fertilizer runoff, sewage, and industrial discharge.
- This overabundance of nutrients stimulates an explosive growth of algae and aquatic plants, a phenomenon known as an algal bloom.
- When these algae die, they sink and are decomposed by aerobic bacteria. This decomposition consumes massive amounts of dissolved oxygen in the water.
- The resulting **oxygen depletion (B)** (hypoxia or anoxia) is a severe consequence, not the initial cause. This lack of oxygen can lead to the death of fish and other aquatic animals, creating a "dead zone." Pollution (D) is a broad term; nutrient enrichment is the specific type of pollution that causes eutrophication.

Final Answer : “Nutrient enrichment”

Answer: (A)



Q89.

Solution

Concept: The composition of the atmosphere and the role of greenhouse gases in global warming.

Solution: Global warming is the long-term increase in Earth's average surface temperature due to the enhanced greenhouse effect. This effect is caused by certain gases in the atmosphere that trap heat (infrared radiation).

- The most abundant gases in the atmosphere, nitrogen (B, 78%) and oxygen (A, 21%), are not significant greenhouse gases.
- The primary greenhouse gases are water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).
- While other gases like methane have a higher warming potential per molecule, **carbon dioxide (C)** is the gas that contributes most to the *current enhanced* global warming. This is due to its vast quantity in the atmosphere and its dramatic increase in concentration since the industrial revolution, primarily from the burning of fossil fuels, deforestation, and industrial processes. Its long atmospheric lifetime means its effects are cumulative and long-lasting.

Final Answer : “Carbon dioxide”

Answer: (C)



Q90.

Solution

Concept: The definition and criteria for identifying biodiversity hotspots for conservation.

Solution: The concept of a "biodiversity hotspot" is a strategy for prioritizing conservation efforts. It identifies regions that are both extraordinarily rich in life and are under immediate and severe threat. A region must meet two strict criteria to be classified as a hotspot:

- (a) **High Species Endemism:** It must contain a high percentage of plant life found nowhere else on the planet. The formal criterion is to have at least 1,500 species of vascular plants as endemics. This represents a high level of irreplaceable biodiversity.
- (b) **High Degree of Threat:** It must have lost at least 70% of its original natural vegetation. This indicates that the region's unique biodiversity is severely threatened by human activities like habitat destruction.

Therefore, a hotspot is not just a region with high diversity, but one where that diversity is under significant threat of being lost forever. The correct option is the one that includes both of these critical components.

Final Answer : "High diversity and threat"

Answer: (B)



Answer Key

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

