MHT-CET Biology Sample Paper-12

Duration: 90 Minutes **Maximum Marks: 100**

Instructions

- This paper contains a total of **100** Multiple Choice Questions.
- Each correct answer carries **+1 marks**.
- No negative marking for incorrect questions.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.
- No marks will be deducted for questions that are left unattempted.

Q1. Select the INCORRECT statement regarding the regulation of cardiac activity:

(A) The sympathetic nerves can increase the rate of heartbeat and the strength of ventricular contraction.

(B) Parasympathetic neural signals decrease the rate of heartbeat and the speed of conduction of action potential.

(C) Adrenal medullary hormones can increase the cardiac output.

(D) The neural center that can moderate cardiac function is located in the Cerebellum.

Q2. Match the following stages of Prophase I with their key events:

Column I	**Column II**
i. Zygotene	p. Dissolution of synaptonemal complex
ii. Pachytene	q. Formation of synaptonemal complex
iii. Diplotene	r. Terminalisation of chiasmata
iv. Diakinesis	s. Appearance of recombination nodules

(A) i-q, ii-s, iii-p, iv-r

(B) i-p, ii-q, iii-r, iv-s

(C) i-q, ii-p, iii-s, iv-r

(D) i-s, ii-q, iii-p, iv-r

Q3. Assertion (A): In C_4 plants, the bundle sheath cells are rich in RuBisCO but lack PEPcase. Reason (R): C_4 plants have a mechanism that increases the concentration of CO_2 at the enzyme site to minimize photorespiration.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is NOT the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

Q4. Identify the correct sequence of electron transport in the light reaction (Z-scheme):

(A) PS II $\rightarrow$ $Pheophytin \rightarrow Plastoquinone \rightarrow Cytochrome\, b_6f \rightarrow Plastocyanin \rightarrow PS\ I$

(A) PS I $\rightarrow$ $Plastocyanin \rightarrow Cytochrome\ b_6f \rightarrow Plastoquinone \rightarrow Pheophytin \rightarrow PS\ II$

(A) PS II $\rightarrow$ $Plastoquinone \rightarrow Cytochrome\, b_6f \rightarrow Pheophytin \rightarrow Plastocyanin \rightarrow PS\ I$

(A) PS II $\rightarrow$ $Plastocyanin \rightarrow Plastoquinone \rightarrow Cytochrome\ b_6f \rightarrow PS\ I \rightarrow Pheophytin$

Q5. Which of the following describes the condition of "Emphysema"?

(A) Inflammation of bronchi and bronchioles.

(B) Alveolar walls are damaged, resulting in decreased respiratory surface.

(C) Spasm of bronchial muscles leading to wheezing.

(D) Proliferation of fibrous tissue in the upper part of lungs.

Q6. Statement I: The endosperm in gymnosperms is formed after fertilization and is triploid (3n). Statement II: In angiosperms, the endosperm is a pre-fertilization tissue and is haploid (n).

(A) Both Statement I and Statement II are correct.

(B) Both Statement I and Statement II are incorrect.

(C) Statement I is correct but Statement II is incorrect.

(D) Statement I is incorrect but Statement II is correct.

Q7. Calculate the number of double bonds in a molecule of Arachidonic acid:

(A) 1

(B) 2

(C) 3

(D) 4

Q8. The term "Stenohaline" refers to organisms that:

(A) Can tolerate a wide range of salinities.

(B) Are restricted to a narrow range of salinities.

(C) Can tolerate a wide range of temperatures.

(D) Are restricted to a narrow range of temperatures.

Q9. In the LAC operon of E. coli, the 'i' gene codes for _____ and its product binds to _____ in the absence of an inducer.

(A) Repressor protein; Promoter

(B) Repressor protein; Operator

(C) Permease; Structural gene

(D) β-galactosidase; Operator

Q10. Which of the following represents the correct floral formula of the family Solanaceae?

(A) $\oplus \subsetneq K_{(5)}C_{(5)}A_5\underline{G}_{(2)}$

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

(A) $\oplus \subsetneq P_{(3+3)}A_{3+3}\underline{G}_{(3)}$

(A) $\oplus \subsetneq K_{(5)}C_5A_5\underline{G}_{(2)}$

Q11. Identify the "Natural Genetic Engineer" used for transforming dicot plants:

(A) Bacillus thuringiensis

(B) Agrobacterium tumefaciens

(C) Thermus aquaticus

(D) Salmonella typhimurium

Q12. During DNA replication, the Okazaki fragments are joined by the enzyme:

(A) DNA Polymerase I

(B) DNA Helicase

(C) DNA Ligase

(D) DNA Primase

Q13. Which of the following is a symptom of "Addison's disease"?

(A) High blood pressure and hyperglycemia.

(B) Low blood sugar, low plasma sodium, and high plasma potassium.

(C) Excessive hair growth and obesity.

(D) Bulging eyeballs and increased metabolic rate.

Q14. The price of a life-saving hormone injection is ₹ 4500. Due to a 15% increase in logistics cost, what is the new price if the base price remains the same?

(A) ₹ 5175

(B) ₹ 5000

(C) ₹ 4650

(D) ₹ 5250

Q15. Match the following biocontrol agents with their targets:

Agent	Target
i. Ladybird	p. Mosquitoes
ii. Dragonflies	q. Aphids
iii. Bacillus thuringiensis	r. Plant pathogens
iv. Trichoderma	s. Butterfly caterpillars

(A) i-q, ii-p, iii-s, iv-r

(B) i-p, ii-q, iii-r, iv-s

(C) i-q, ii-r, iii-p, iv-s

(D) i-s, ii-q, iii-p, iv-r

Q16. In the context of Human Evolution, which hominid first used fire?

(A) Homo habilis

(B) Homo erectus

(C) Neanderthal man

(D) Australopithecus

Q17. Select the CORRECT sequence of layers in the wall of the alimentary canal from outer to inner:

(A) Serosa → Muscularis → Sub-mucosa → Mucosa

(B) Mucosa → Sub-mucosa → Muscularis → Serosa

(C) Serosa → Sub-mucosa → Muscularis → Mucosa

(D) Muscularis → Serosa → Sub-mucosa → Mucosa

Q18. Statement I: The hormone atrial natriuretic factor (ANF) can cause vasodilation and decrease blood pressure. Statement II: ANF mechanism acts as a check on the Renin-Angiotensin mechanism.

(A) Both statements are correct.

(B) Both statements are incorrect.

(C) Statement I is correct, Statement II is incorrect.

(D) Statement I is incorrect, Statement II is correct.

Q19. The specific region in the hypothalamus that regulates body temperature is:

(A) Pons

(B) Thalamus

(C) Thermoregulatory center

(D) Medulla

Q20. Identify the incorrect match for the respiratory volume and its value:

(A) Tidal Volume (TV) - 500 mL

(B) Inspiratory Reserve Volume (IRV) - 2500 to 3000 mL

(C) Residual Volume (RV) - 1100 to 1200 mL

(D) Vital Capacity (VC) - 1000 to 1100 mL

Q21. Which of the following is an example of an In-situ conservation strategy?

(A) Botanical Garden

(B) Wildlife Safari Park

(C) Biosphere Reserve

(D) Seed Bank

Q22. A population of 500 individuals has a birth rate of 0.2 and a death rate of 0.08 per capita per year. The net increase in population after one year will be:

(A) 60

(B) 40

(C) 100

(D) 140

Q23. The "Human Genome Project" was a 13-year project coordinated by:

(A) US Department of Energy and National Institute of Health

(B) Welcome Trust (UK)

(C) Both A and B

(D) UNESCO

Q24. Identify the hormone that is a derivative of amino acid tyrosine:

(A) Insulin

(B) Epinephrine

(C) Estrogen

(D) Cortisol

Q25. Assertion (A): Human females have more chances of being carrier for hemophilia than being hemophilic. Reason (R): Hemophilia is a sex-linked recessive disorder and requires two copies of the defective gene in females to express the disease.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is NOT the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

Q26. Which of the following enzymes is used in PCR to synthesize new DNA strands at high temperatures?

(A) DNA Polymerase III

(B) Taq Polymerase

(C) RNA Polymerase

(D) Helicase

Q27. The symmetry found in adult Echinoderms is _____ while in their larvae it is _____.

(A) Radial; Bilateral

(B) Bilateral; Radial

(C) Asymmetric; Radial

(D) Radial; Radial

Q28. Match the following terms in Column I with their descriptions in Column II:

Column I	Column II
i. Apomixis	p. Development of fruit without fertilization
ii. Parthenocarpy	q. Production of seeds without fertilization
iii. Polyembryony	r. Occurrence of more than one embryo in a seed
iv. Parthenogenesis	s. Development of an organism from unfertilized egg

(A) i-q, ii-p, iii-r, iv-s

(B) i-p, ii-q, iii-r, iv-s

(C) i-q, ii-r, iii-p, iv-s

(D) i-s, ii-q, iii-p, iv-r

Q29. Identify the condition where the concentration of O_2 is low in tissues:

(A) Hyperoxia

(B) Hypoxia

(C) Apnea

(D) Dyspnea

Q30. The structural and functional unit of the human kidney is:

(A) Neuron

(B) Nephron

(C) Nephridia

(D) Ommatidia

Q31. Which of the following is NOT a part of the "Evil Quartet"?

(A) Habitat loss and fragmentation

(B) Over-exploitation

(C) Alien species invasion

(D) Greenhouse effect

Q32. In a DNA molecule, the ratio of $(A + G)/(T + C)$ is always:

(A) 1

(B) 2

(C) 0.5

(D) Variable

Q33. The enzyme Recombinase is required at which stage of Meiosis?

(A) Pachytene

(B) Zygotene

(C) Diplotene

(D) Diakinesis

Q34. Statement I: Down's syndrome is caused by the trisomy of chromosome 21.
Statement II: It results due to the non-disjunction of chromosomes during gamete formation.

(A) Both statements are correct.

(B) Both statements are incorrect.

(C) Statement I is correct, Statement II is incorrect.

(D) Statement I is incorrect, Statement II is correct.

Q35. Which of the following is a character of wind-pollinated flowers?

(A) Small, inconspicuous and often packed into inflorescences.

(B) Large, colorful and fragrant.

(C) Produce nectar and have sticky pollen.

(D) Pollen grains are heavy and covered with pollen kitt.

Q36. The cranial capacity of Neanderthal man was:

(A) 650-800 cc

(B) 900 cc

(C) 1400 cc

(D) 1650 cc

Q37. Match the following vitamins with their deficiency diseases:

Vitamin	Disease
i. Vitamin A	p. Beri-beri
ii. Vitamin B_1	q. Scurvy
iii. Vitamin C	r. Night blindness
iv. Vitamin D	s. Rickets

(A) i-r, ii-p, iii-q, iv-s

(B) i-p, ii-r, iii-q, iv-s

(C) i-r, ii-q, iii-p, iv-s

(D) i-s, ii-p, iii-q, iv-r

Q38. Identify the correctly matched pair:

(A) Fibrous joint - Between phalanges

(B) Cartilaginous joint - Between adjacent vertebrae

(C) Synovial joint - Skull bones

(D) Pivot joint - Between humerus and pectoral girdle

Q39. Which hormone triggers the "Milk Ejection Reflex"?

(A) Prolactin

(B) Oxytocin

(C) Estrogen

(D) Progesterone

Q40. A farmer sprays a hormone to induce parthenocarpy in tomatoes. The hormone is most likely:

(A) Abscisic acid

(B) Auxin

(C) Ethylene

(D) Cytokinin

Q41. Select the INCORRECT statement regarding the structure of DNA:

(A) The two chains have anti-parallel polarity.

(B) The bases in two strands are paired through hydrogen bonds.

(C) The pitch of the helix is 3.4 nm.

(D) There are roughly 12 base pairs in each turn.

Q42. In which of the following groups are all animals "Ureotelic"?

(A) Bony fishes, Aquatic amphibians, Aquatic insects.

(B) Mammals, Terrestrial amphibians, Marine fishes.

(C) Reptiles, Birds, Land snails.

(D) Insects, Earthworms, Birds.

Q43. Statement I: In human females, the first polar body is formed during oogenesis in the fetal stage. Statement II: The secondary oocyte completes meiosis II only upon fertilization.

(A) Both statements are correct.

(B) Both statements are incorrect.

(C) Statement I is incorrect, Statement II is correct.

(D) Statement I is correct, Statement II is incorrect.

Q44. Which part of the brain is responsible for the regulation of sexual behavior and expression of emotional reactions?

(A) Thalamus

(B) Limbic system and Hypothalamus

(C) Corpus callosum

(D) Cerebral cortex

Q45. Identify the hormone that inhibits gastric secretion and motility:

(A) Gastrin

(B) Secretin

(C) Gastric Inhibitory Peptide (GIP)

(D) Cholecystokinin (CCK)

Q46. Match the following microbes with their commercial products:

Microbe	**Product**
i. Aspergillus niger	p. Butyric acid
ii. Acetobacter aceti	q. Citric acid
iii. Clostridium butylicum	r. Acetic acid
iv. Lactobacillus	s. Lactic acid

(A) i-q, ii-r, iii-p, iv-s

(B) i-r, ii-q, iii-p, iv-s

(C) i-q, ii-p, iii-r, iv-s

(D) i-p, ii-r, iii-q, iv-s

Q47. The Net Primary Productivity (NPP) is defined as:

(A) Rate of production of organic matter during photosynthesis.

(B) GPP minus Respiration losses (R).

(C) Rate of formation of new organic matter by consumers.

(D) Total biomass in an ecosystem at a given time.

Q48. Which of the following is a non-reducing sugar?

(A) Glucose

(B) Fructose

(C) Lactose

(D) Sucrose

Q49. Assertion (A): Most mammals are "Eurythermal". Reason (R): They can thrive in a wide range of temperatures because they are homeothermic.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is NOT the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

Q50. Identify the incorrectly matched pair of organism and its characteristic:

(A) Pila - Radula

(B) Bombyx - Malpighian tubules

(C) Pleurobrachia - Comb plates

(D) Asterias - Statocysts

Q51. In "Bt Cotton", the Bt toxin exists as an inactive protoxin in the bacterium, but is converted into an active form in the insect gut due to:

(A) Acidic pH of the gut

(B) Alkaline pH of the gut

(C) Presence of specific enzymes

(D) Action of gut microflora

Q52. The process of "Mineralization" in decomposition involves:

(A) Conversion of organic matter into humus.

(B) Release of inorganic nutrients by microbial action.

(C) Breaking down of detritus into smaller particles.

(D) Precipitation of water-soluble nutrients.

Q53. Identify the hormone that stimulates the production of RBCs (Erythropoiesis):

(A) Erythropoietin

(B) Cortisol

(C) Both A and B

(D) Thyroxine

Q54. The term "Biodiversity" was popularized by:

(A) Robert May

(B) Edward Wilson

(C) Paul Ehrlich

(D) Alexander von Humboldt

Q55. Which of the following describes "Eustele"?

(A) Vascular bundles scattered in the ground tissue.

(B) Vascular bundles arranged in a ring.

(C) Xylem and phloem arranged in a solid core.

(D) Presence of a central pith surrounded by xylem.

Q56. In the PCR process, the temperature required for "Denaturation" is approximately:

(A) $94°C$

(A) $54°C$

(A) $72°C$

(A) $40°C$

Q57. Match the following plant groups with their dominant life cycle phase:

Plant Group	**Dominant Phase**
i. Bryophytes	p. Sporophyte (2n)
ii. Pteridophytes	q. Gametophyte (n)
iii. Gymnosperms	r. Highly reduced gametophyte
iv. Angiosperms	s. Independent sporophyte and gametophyte

(A) i-q, ii-p, iii-p, iv-p

(B) i-p, ii-q, iii-r, iv-s

(C) i-q, ii-s, iii-p, iv-p

(D) i-s, ii-q, iii-r, iv-p

Q58. The gene 'a' in the LAC operon codes for:

(A) Permease

(B) β-galactosidase

(C) Transacetylase

(D) Repressor

Q59. A person suffers from "Gout". This is due to the accumulation of _____ in the joints.

(A) Calcium carbonate

(B) Uric acid crystals

(C) Synovial fluid

(D) Lactic acid

Q60. Identify the incorrectly matched pair of hormone and its function:

(A) Glucagon - Hypoglycemic hormone

(B) Insulin - Hyperglycemic hormone

(C) Both A and B

(D) PTH - Hypercalcemic hormone

Q61. Which of the following is a "Physical Barrier" of the innate immune system?

(A) Skin

(B) Mucus coating of epithelium

(C) Both A and B

(D) Interferons

Q62. The process of "Capping" in mRNA processing involves adding _____ to the 5' end.

(A) Adenylate residues

(B) Methyl guanosine triphosphate

(C) Uracil

(D) Cytosine

Q63. In human lungs, the branching of bronchioles ends in very thin, irregular-walled vascularised bag-like structures called:

(A) Bronchi

(B) Alveoli

(C) Trachea

(D) Pleura

Q64. Identify the hormone that is NOT secreted by the Anterior Pituitary:

(A) Growth Hormone (GH)

(B) Prolactin (PRL)

(C) Oxytocin

(D) Thyroid Stimulating Hormone (TSH)

Q65. The "Rivet Popper Hypothesis" regarding biodiversity was proposed by:

(A) Paul Ehrlich

(B) Robert May

(C) David Tilman

(D) Edward Wilson

Q66. The process by which the genetic code is read from mRNA to synthesize a protein is called:

(A) Transcription

(B) Translation

(C) Replication

(D) Transformation

Q67. Identify the correct match for the type of placentation and its example:

(A) Marginal - Mustard

(B) Axile - Tomato

(C) Parietal - Pea

(D) Free central - Argemone

Q68. Which of the following hormones is often called the "Stress Hormone" in plants?

(A) Auxin

(B) Gibberellin

(C) Abscisic acid

(D) Cytokinin

Q69. The "Global Species Diversity" estimate given by Robert May is approximately:

(A) 1.7 million

(B) 20 to 50 million

(C) 7 million

(D) 1.5 million

Q70. In a longitudinal section of a kidney, the "Columns of Bertini" represent the extension of:

(A) Medulla into Cortex

(B) Cortex into Medulla

(C) Pelvis into Ureter

(D) Cortex into Pelvis

Q71. Which of the following is a structural and functional unit of the liver?

(A) Kupffer cells

(B) Glisson's capsule

(C) Hepatic lobules

(D) Sinusoids

Q72. The volume of air that will remain in the lungs after a normal expiration is called:

(A) Vital Capacity

(B) Functional Residual Capacity

(C) Inspiratory Capacity

(D) Total Lung Capacity

Q73. Identify the correctly matched pair regarding Biomes and their mean annual temperature:

(A) Tropical Forest: $20 - 25°C$

(B) Coniferous Forest: $15 - 20°C$

(C) Desert: $5 - 10°C$

(D) Arctic and Alpine Tundra: $10 - 20°C$

Q74. Which of the following is NOT an autoimmune disease?

(A) Rheumatoid arthritis

(B) Myasthenia gravis

(C) Alzheimer's disease

(D) Insulin-dependent Diabetes Mellitus

Q75. In DNA fingerprinting, the probe used for hybridization is:

(A) cDNA

(B) snRNA

(C) VNTR

(D) scDNA

Q76. The hormone that maintains the Corpus Luteum during the early stages of pregnancy is:

(A) LH

(B) hCG

(C) Estrogen

(D) Progesterone

Q77. Which cell organelle is responsible for the formation of acrosome in a sperm?

(A) Mitochondria

(B) Golgi complex

(C) Ribosome

(D) Lysosome

Q78. Match the following organisms with their life spans:

Organism	**Life Span**
i. Butterfly	p. 1-2 weeks
ii. Crow	q. 15 years
iii. Parrot	r. 140 years
iv. Crocodile	s. 60 years

(A) i-p, ii-q, iii-r, iv-s

(B) i-q, ii-p, iii-s, iv-r

(C) i-p, ii-r, iii-q, iv-s

(D) i-s, ii-q, iii-p, iv-r

Q79. In "Gene Therapy" for SCID, the missing enzyme is:

(A) Adenosine deaminase

(B) DNA polymerase

(C) Reverse transcriptase

(D) Restriction endonuclease

Q80. The first human-like hominid was called:

(A) Homo erectus

(B) Homo habilis

(C) Australopithecus

(D) Neanderthal man

Q81. Select the INCORRECT statement regarding 'In situ' conservation:

(A) It includes Biosphere Reserves and National Parks.

(B) It involves the protection of a species in its natural habitat.

(C) Zoological parks are a major component of this strategy.

(D) Hotspots are identified based on high levels of species richness.

Q82. The movement of chloride ions into the RBCs to maintain ionic balance during CO_2 transport is called:

(A) Bohr's effect

(B) Haldane effect

(C) Chloride shift (Hamburger's phenomenon)

(D) Root effect

Q83. Assertion (A): Interstitial cells or Leydig cells secrete androgens. Reason (R): LH (Luteinizing Hormone) stimulates Leydig cells to produce testosterone.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is NOT the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

Q84. Which type of epithelium is found in the inner lining of Fallopian tubes to move the ovum?

(A) Squamous epithelium

(B) Cuboidal epithelium

(C) Ciliated epithelium

(D) Glandular epithelium

Q85. Identify the hormone that is a gaseous PGR:

(A) ABA

(B) Ethylene

(C) Gibberellic acid

(D) Zeatin

Q86. The percentage of urea reabsorbed in the proximal convoluted tubule (PCT) is approximately:

(A) 0%

(B) 50%

(C) 100%

(D) 10%

Q87. Which of the following is a "Stop Codon" in the genetic code?

(A) AUG

(B) GUG

(C) UAA

(D) UUU

Q88. The sum of $TV + IRV + ERV$ is known as:

(A) Inspiratory Capacity

(B) Vital Capacity

(C) Total Lung Capacity

(D) Functional Residual Capacity

Q89. Identify the secondary metabolite used as a drug for treating cancer:

(A) Morphine

(B) Vinblastine

(C) Abrin

(D) Ricin

Q90. Statement I: The first clinical gene therapy was given in 1990 to a 4-year-old girl with ADA deficiency. Statement II: This deficiency occurs due to the deletion of the gene for Adenosine Deaminase.

(A) Both statements are correct.

(B) Both statements are incorrect.

(C) Statement I is correct, Statement II is incorrect.

(D) Statement I is incorrect, Statement II is correct.

Q91. The "P" wave in a standard ECG represents:

(A) Depolarization of atria

(B) Depolarization of ventricles

(C) Repolarization of atria

(D) Repolarization of ventricles

Q92. In recombinant DNA technology, the "Molecular Scissors" refers to:

(A) DNA Ligase

(B) Restriction Endonucleases

(C) DNA Polymerase

(D) Reverse Transcriptase

Q93. Which of the following is an example of a "True Fruit"?

(A) Apple

(B) Strawberry

(C) Mango

(D) Cashew

Q94. The cost of a DNA sequencing kit is ₹ 12000. If there is a discount of 10%, the selling price is:

(A) ₹ 10800

(B) ₹ 11000

(C) ₹ 11800

(D) ₹ 10000

Q95. Match the following disorders with their chromosomal status:

Disorder	**Status**
i. Klinefelter's Syndrome	p. 45, XO
ii. Turner's Syndrome	q. 47, XXY
iii. Down's Syndrome	r. Trisomy of 21
iv. Patau's Syndrome	s. Trisomy of 13

(A) i-q, ii-p, iii-r, iv-s

(B) i-p, ii-q, iii-s, iv-r

(C) i-r, ii-p, iii-q, iv-s

(D) i-q, ii-s, iii-p, iv-r

Q96. The primary CO_2 acceptor in C_3 plants is:

(A) PEP

(B) $RuBP$

(C) OAA

(D) PGA

Q97. Which of the following is a "Living Fossil" among Arthropods?

(A) Apis

(B) Laccifer

(C) Limulus

(D) Locusta

Q98. Identify the hormone responsible for apical dominance in plants:

(A) Gibberellin

(B) Auxin

(C) Cytokinin

(D) Ethylene

Q99. The "Montreal Protocol" was signed to control the emission of:

(A) Greenhouse gases

(B) Ozone depleting substances

(C) Toxic wastes

(D) Nuclear wastes

Q100. The final electron acceptor in the Mitochondrial Electron Transport System (ETS) is:

(A) NAD^+

(A) FAD

(B) Oxygen

(C) Cytochrome c

Detailed Solutions

Q1.

Solution

Concept:

The human heart is myogenic, but its function is regulated by the autonomic nervous system (ANS) and hormones. The primary neural center for cardiovascular regulation is located in the medulla oblongata of the brainstem, not the cerebellum.

Solution:

Step 1: The medulla oblongata contains the cardiovascular center which receives inputs from various receptors (baroreceptors and chemoreceptors).

Step 2: Sympathetic stimulation via the cardiac nerves increases both the rate of the SA node firing (heart rate) and the force of contraction of the myocardium.

Step 3: Parasympathetic stimulation via the Vagus nerve (CN X) releases acetylcholine, which slows the heart rate and decreases the speed of conduction.

Step 4: Hormones like Adrenaline (Epinephrine) and Noradrenaline from the adrenal medulla further enhance cardiac output during stress.

The statement in Option D is incorrect because the cerebellum is primarily involved in motor coordination and balance, not autonomic regulation of the heart.

Final Answer: $\boxed{D}$

Answer: (D)

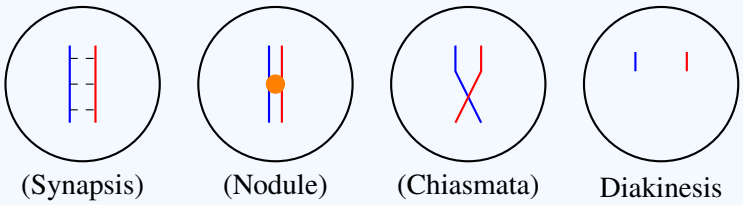
Go Back to Question 1

Q2.

Solution

Concept: Prophase I is the longest phase of meiosis and is subdivided into five stages: Leptotene, Zygotene, Pachytene, Diplotene, and Diakinesis. These stages involve the pairing, recombination, and eventual separation of homologous chromosomes.

Solution: Step 1: **Zygotene (i-q)** – Homologous chromosomes start pairing up (synapsis). This process is accompanied by the formation of a complex structure called the **synaptonemal complex**.
Step 2: **Pachytene (ii-s)** – The bivalent chromosomes (now tetrads) are clearly visible. This stage is characterized by the appearance of **recombination nodules**, the sites where crossing over occurs between non-sister chromatids.
Step 3: **Diplotene (iii-p)** – Crossing over is completed. The homologous chromosomes begin to separate from each other, which is initiated by the **dissolution of the synaptonemal complex**. The X-shaped structures remaining are called chiasmata.
Step 4: **Diakinesis (iv-r)** – This is the final stage of prophase I. It is marked by the **terminalisation of chiasmata**. The chromosomes are fully condensed and the meiotic spindle is assembled.



Final Answer: (A) i-q, ii-s, iii-p, iv-r

Answer: (A)

Go Back to Question 2

Q3.

Solution

Concept:

C_4 plants (like Maize and Sugarcane) have evolved "Kranz anatomy" to bypass the oxygenase activity of RuBisCO, which leads to wasteful photorespiration. This is achieved by spatial separation of CO_2 fixation.

Solution:

Step 1: In the mesophyll cells, CO_2 is initially fixed by PEPcase (which has no oxygenase activity) to form a 4-carbon acid.

Step 2: This 4-carbon acid is transported to the bundle sheath cells.

Step 3: Inside the bundle sheath cells, the 4-carbon acid is decarboxylated to release CO_2. This creates a high local concentration of CO_2 around RuBisCO.

Step 4: RuBisCO then functions purely as a carboxylase, ensuring high photosynthetic efficiency and zero photorespiration.

Both the Assertion and Reason are true, and the Reason correctly explains how C_4 plants overcome the limitations of C_3 photosynthesis.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 3

Q4.

Solution

Concept:

The light-dependent reactions of photosynthesis involve the non-cyclic flow of electrons from water to NADP+, known as the Z-scheme. This requires a specific sequence of electron carriers located in the thylakoid membrane.

Solution:

Step 1: Light energy excites PS II (P680). Electrons are kicked out and first accepted by Pheophytin (a chlorophyll-like molecule without Magnesium).

Step 2: From Pheophytin, electrons move to Plastoquinone (PQ) and then through the Cytochrome b_6f complex.

Step 3: The electrons are then transferred to Plastocyanin (PC), a small copper-containing protein.

Step 4: Plastocyanin delivers the electrons to the reaction center of PS I (P700), which has been oxidized by light.

The correct chronological sequence is PS II $\rightarrow$ Pheophytin $\rightarrow$ PQ $\rightarrow$ Cyt b_6f $\rightarrow$ PC $\rightarrow$ PS I.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 4

Q5.

Solution

Concept:

Emphysema is a chronic obstructive pulmonary disease (COPD) typically caused by long-term smoking or exposure to air pollutants. It involves permanent structural changes in the lungs.

Solution:

Step 1: Chronic exposure to irritants causes inflammation and the release of enzymes (like elastase) that break down the connective tissue of the lungs.

Step 2: This leads to the destruction of the alveolar walls (septa).

Step 3: As walls break, small alveoli merge into larger, irregular sacs. This drastically reduces the total surface area available for gas exchange.

Step 4: Consequently, the lungs lose elasticity, making expiration difficult and leading to a "barrel chest" appearance.

Option A refers to Bronchitis, Option C to Asthma, and Option D to Occupational Lung Diseases like Silicosis.

Final Answer: B

Answer: (B)

Go Back to Question 5

Q6.

Solution

Concept:

The ploidy and timing of endosperm formation vary significantly between Gymnosperms and Angiosperms, reflecting their different reproductive strategies (non-double fertilization vs. double fertilization).

Solution:

Step 1: In Gymnosperms, the endosperm (female gametophyte) is formed before fertilization. Since it develops directly from the functional megaspore through mitotic divisions, it is haploid (n).

Step 2: In Angiosperms, the endosperm is formed after fertilization as a result of "Triple Fusion" (the fusion of one male gamete with two polar nuclei/secondary nucleus).

Step 3: Because it involves the fusion of three haploid nuclei, the angiosperm endosperm is triploid (3n).

Step 4: Reviewing the statements: Statement I says gymnosperm endosperm is formed after fertilization and is 3n (Incorrect). Statement II says angiosperm endosperm is pre-fertilization and is n (Incorrect).

Both statements are swapped and therefore incorrect.

Final Answer: B

Answer: (B)

Go Back to Question 6

Q7.

Solution

Concept:

Fatty acids are categorized as saturated (no double bonds) or unsaturated (one or more double bonds). Arachidonic acid is a polyunsaturated fatty acid (PUFA) essential for the synthesis of prostaglandins.

Solution:

Step 1: Arachidonic acid is a 20-carbon chain fatty acid (including the carboxyl carbon).

Step 2: Its chemical formula is $C_{20}H_{32}O_2$.

Step 3: It is an omega-6 fatty acid with double bonds located at positions 5, 8, 11, and 14.

Step 4: Specifically, it contains 4 double bonds. In contrast, Palmitic acid has 0 (saturated), Oleic acid has 1, and Linoleic acid has 2.

Final Answer: $\boxed{4}$

Answer: (D)

Go Back to Question 7

Q8.

Solution

Concept:

Organisms have different levels of tolerance towards environmental gradients like salinity (salt concentration) and temperature. The prefix "steno-" implies narrow, while "eury-" implies wide.

Solution:

Step 1: Salinity is a major limiting factor for aquatic organisms.

Step 2: Organisms that can tolerate only a narrow range of salinity are called "Stenohaline." Examples include most freshwater fish that cannot survive in the ocean.

Step 3: Organisms that can tolerate a wide range of salinity are called "Euryhaline" (e.g., salmon or migratory eels).

Step 4: Similarly, for temperature, "Stenothermal" refers to a narrow range and "Eurythermal" refers to a wide range.

The question specifically asks for "Stenohaline," which matches the restriction to a narrow range of salinities.

Final Answer: $\boxed{B}$

Answer: (B)

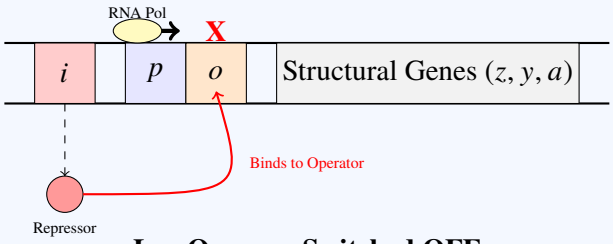
Go Back to Question 8

Q9.

Solution

Concept: The *Lac* operon is a polycistronic structural gene regulated by a common promoter and regulatory genes. It functions to control the metabolism of lactose in *E. coli*. The regulation is primarily negative, involving a repressor protein that prevents transcription unless an inducer is present.

Solution: Step 1: The *Lac* operon consists of one regulatory gene (the *i* gene) and three structural genes (z, y, a).
Step 2: The term 'i' in the *i* gene is derived from the word **inhibitor**. It constitutively (all the time) codes for the **repressor protein**.
Step 3: In the absence of an inducer (such as lactose or allolactose), the repressor protein has a high affinity for the **operator** region (o) of the operon.
Step 4: When the repressor binds to the operator, it creates a physical roadblock that prevents RNA polymerase (which binds at the promoter) from transcribing the structural genes.
Step 5: Therefore, the *i* gene codes for the repressor protein, which binds to the operator to "switch off" the operon.



Lac Operon: Switched OFF
(No Inducer Present)

Final Answer: (B) Repressor protein; Operator

Answer: (B)

Go Back to Question 9

Q10.

Solution

Concept:

A floral formula is a symbolic representation of the structure of a flower. Solanaceae (the Potato family) has specific characteristics: actinomorphic symmetry, bisexual flowers, 5 united sepals, 5 united petals, 5 epipetalous stamens, and a bicarpellary syncarpous superior ovary.

Solution:

Step 1: $\oplus$ represents actinomorphic (radial) symmetry.

Step 2: $\subsetneq$ (or the circle with an arrow and cross) represents a bisexual flower.

Step 3: $K_{(5)}$ indicates 5 fused sepals (gamosepalous). $C_{(5)}$ indicates 5 fused petals (gamopetalous).

Step 4: A_5 with an arc over C (or A placed after C) represents epipetalous stamens (stamens attached to petals).

Step 5: $\underline{G}_{(2)}$ represents a superior ovary (line below G) that is bicarpellary and syncarpous (parentheses around 2).

Option A matches all these criteria perfectly. Option B describes Fabaceae, and Option C describes Liliaceae.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 10

Q11.

Solution

Concept:

In biotechnology, specific microbes or biological agents are used to transfer desired genes into host organisms. A "Natural Genetic Engineer" refers to an organism that has the innate ability to integrate its own DNA into a host's genome.

Solution:

Step 1: *Agrobacterium tumefaciens* is a soil-dwelling bacterium that naturally infects many dicotyledonous plants.

Step 2: It contains a large extrachromosomal DNA called the Ti (Tumor-inducing) plasmid. A specific segment of this plasmid, known as T-DNA, is transferred into the plant cell.

Step 3: Once inside, the T-DNA integrates into the plant's nuclear genome, forcing the plant to produce chemicals (opines) for the bacteria and causing "Crown Gall" disease (tumors).

Step 4: Biotechnologists have "disarmed" this plasmid by removing the tumor-causing genes while retaining the T-DNA transfer mechanism, making it a perfect vector for delivering useful genes into plants.

Other options like *B. thuringiensis* (toxin producer) or *T. aquaticus* (DNA polymerase source) do not have this natural gene-integration property.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 11

Q12.

Solution

Concept:

DNA replication is semi-discontinuous. While the leading strand is synthesized continuously, the lagging strand is synthesized in short fragments called Okazaki fragments because DNA polymerase can only add nucleotides in the 5' to 3' direction.

Solution:

Step 1: During replication, the replication fork moves in one direction. The template strand with 3' to 5' orientation allows continuous 5' to 3' synthesis.

Step 2: The other template strand (5' to 3') requires the polymerase to work backwards in small stretches as the fork opens, resulting in discontinuous Okazaki fragments.

Step 3: These fragments are initially separated by RNA primers. After primers are replaced by DNA, gaps remain between the sugar-phosphate backbones.

Step 4: The enzyme DNA Ligase acts as "molecular glue." It catalyzes the formation of a phosphodiester bond between the 3'-OH of one fragment and the 5'-phosphate of the next, creating a continuous strand.

Final Answer: C

Answer: (C)

Go Back to Question 12

Q13.

Solution

Concept:

Addison's disease is a primary adrenal insufficiency. It occurs when the adrenal cortex is damaged and fails to produce sufficient amounts of steroid hormones, primarily cortisol and aldosterone.

Solution:

Step 1: Aldosterone is responsible for sodium reabsorption and potassium excretion in the kidneys. Its deficiency leads to "hyponatremia" (low sodium) and "hyperkalemia" (high potassium).

Step 2: Cortisol is essential for maintaining blood glucose levels through gluconeogenesis. Lack of cortisol leads to "hypoglycemia" (low blood sugar).

Step 3: These hormonal imbalances result in extreme fatigue, weight loss, and low blood pressure (hypotension).

Step 4: A characteristic sign is also hyperpigmentation of the skin. Option B correctly identifies the electrolyte and glucose imbalances typical of this condition.

Option A and D describe Cushing's syndrome and Graves' disease (Hyperthyroidism) respectively.

Final Answer: B

Answer: (B)

Go Back to Question 13

Q14.

Solution

Concept:

This is a practical arithmetic problem applied to medical logistics. To find the new price, we must calculate the percentage increase and add it to the original base price.

Solution:

Step 1: Identify the original price and the percentage increase. Original Price = ₹ 4500. Increase = 15

Step 2: Calculate the value of the increase:

$$\text{Increase Amount} = \frac{15}{100} \times 4500$$

$$\text{Increase Amount} = 15 \times 45 = ₹\ 675$$

Step 3: Add the increase amount to the original base price to find the final price:

$$\text{New Price} = 4500 + 675 = ₹\ 5175$$

Step 4: Ensure all symbols are correctly formatted. The final calculated value is ₹ 5175.

Final Answer: 5175

Answer: (A)

Go Back to Question 14

Q15.

Solution

Concept:

Biological control involves the use of living organisms to manage pests and pathogens, reducing the reliance on chemical pesticides. Each agent has a specific target or niche.

Solution:

Step 1: Ladybird beetles (Ladybugs) are well-known predators that feed extensively on Aphids, which are common plant-sucking pests (i-q).

Step 2: Dragonflies are aerial predators that catch and eat small insects, particularly Mosquitoes, near water bodies (ii-p).

Step 3: *Bacillus thuringiensis* (Bt) produces a toxic protein crystal. When eaten by butterfly caterpillars, it becomes active in their gut and kills them (iii-s).

Step 4: *Trichoderma* species are free-living fungi very common in the root ecosystem (rhizosphere). They are effective biocontrol agents against several soil-borne plant pathogens (iv-r).

Matching the pairs: i-q, ii-p, iii-s, iv-r.

Final Answer: *A*

Answer: (A)

Go Back to Question 15

Q16.

Solution

Concept:

Human evolution is characterized by a progressive increase in brain capacity, tool usage, and the mastery of environmental elements. *Homo erectus* is a pivotal species in this lineage, appearing approximately 1.5 million years ago.

Solution:

Step 1: *Homo habilis*, the "handy man," was the first hominid to make tools but there is no definitive evidence of them using fire.

Step 2: *Homo erectus* had a larger brain (around 900 cc) and migrated out of Africa. Archaeological evidence suggests they were the first to control and use fire for cooking and protection.

Step 3: Neanderthal man lived much later and used fire extensively, even burying their dead, but they were not the "first" to discover its use.

Step 4: Australopithecus was more ape-like and did not possess the cognitive or technical ability to manage fire.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 16

Q17.

Solution

Concept:

The wall of the human alimentary canal, from the esophagus to the rectum, possesses four distinct histological layers. Understanding their order is crucial for studying digestive anatomy and physiology.

Solution:

Step 1: The outermost layer is the **Serosa**, which is a thin mesothelium with some connective tissues (except in the esophagus).

Step 2: Beneath the serosa is the **Muscularis** layer, usually composed of inner circular and outer longitudinal smooth muscles.

Step 3: The next layer is the **Sub-mucosa**, consisting of loose connective tissues containing nerves, blood vessels, and lymph vessels.

Step 4: The innermost layer lining the lumen is the **Mucosa**, responsible for secretion and absorption.

The correct sequence from outer to inner is Serosa $\rightarrow$ Muscularis $\rightarrow$ Sub-mucosa $\rightarrow$ Mucosa.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 17

Q18.

Solution

Concept:

Blood pressure and volume are regulated by two opposing systems: the Renin-Angiotensin-Aldosterone System (RAAS), which increases blood pressure, and the Atrial Natriuretic Factor (ANF), which decreases it.

Solution:

Step 1: An increase in blood flow to the atria of the heart causes the release of Atrial Natriuretic Factor (ANF).

Step 2: ANF is a potent vasodilator, meaning it relaxes the smooth muscles of blood vessels, which leads to a decrease in blood pressure.

Step 3: ANF also inhibits the release of Renin from the juxtaglomerular cells, thereby checking the RAAS mechanism and preventing excessive sodium and water retention.

Step 4: Since both statements correctly describe the physiological role and inhibitory nature of ANF, they are both correct.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 18

Q19.

Solution

Concept:

The hypothalamus is a small but vital part of the forebrain that acts as the body's master control center for homeostasis, linking the nervous system to the endocrine system.

Solution:

Step 1: The hypothalamus contains several centers that control autonomic functions like hunger, thirst, and body temperature.

Step 2: The "thermoregulatory center" in the hypothalamus acts as a thermostat, sensing the blood temperature and receiving signals from skin receptors.

Step 3: If the body is too hot, it triggers sweating and vasodilation; if too cold, it triggers shivering and vasoconstriction.

Step 4: While the Thalamus is a relay station and the Medulla controls respiratory/cardiovascular functions, the specific regulation of temperature is a hypothalamic function.

Final Answer: $\boxed{C}$

Answer: (C)

Go Back to Question 19

Q20.

Solution

Concept:

Respiratory volumes and capacities are measurable parameters that indicate the functional status of the lungs. They vary based on age, gender, and physical fitness.

Solution:

Step 1: Tidal Volume (TV) is the volume of air inspired or expired during a normal breath, which is approximately 500 mL.

Step 2: Inspiratory Reserve Volume (IRV) is the additional volume of air a person can inspire by a forcible inspiration (2500 to 3000 mL).

Step 3: Residual Volume (RV) is the volume of air remaining in the lungs even after a forcible expiration (1100 to 1200 mL).

Step 4: Vital Capacity (VC) is the maximum volume of air a person can breathe in after a forced expiration (or breathe out after a forced inspiration). It is calculated as $ERV + TV + IRV$, which typically ranges from 3500 mL to 4500 mL.

Option D states VC is 1000 to 1100 mL, which is incorrect as that value actually represents the Expiratory Reserve Volume (ERV).

Final Answer: D

Answer: (D)

Go Back to Question 20

Q21.

Solution

Concept:

Biodiversity conservation is categorized into two main types: In-situ (on-site) and Ex-situ (off-site). In-situ conservation focuses on protecting the entire ecosystem and its natural habitat so that the species is protected in its natural environment.

Solution:

Step 1: In-situ conservation includes protected areas like National Parks, Sanctuaries, Biosphere Reserves, and Sacred Groves.

Step 2: Biosphere Reserves are large areas of protected land for the conservation of wildlife, plant and animal resources, and the traditional life of the tribals living in the area.

Step 3: Ex-situ conservation involves taking the organism out of its natural habitat and placing it in a special setting where it can be protected and given care. Examples include Botanical Gardens, Zoological Parks (Wildlife Safari Parks), Seed Banks, and Cryopreservation.

Step 4: Looking at the options, Botanical Garden, Wildlife Safari Park, and Seed Bank are all Ex-situ. Only Biosphere Reserve is an In-situ strategy.

Final Answer: C

Answer: (C)

Go Back to Question 21

Q22.

Solution

Concept:

The change in population size over a specific period is determined by the intrinsic rate of natural increase (r). The formula for the net increase in a population is Net Increase $= (b - d) \times N$, where b is birth rate, d is death rate, and N is the initial population.

Solution:

Step 1: Identify the given values. Initial population (N) = 500. Birth rate (b) = 0.2 per capita. Death rate (d) = 0.08 per capita.

Step 2: Calculate the per capita growth rate (r):

$$r = b - d = 0.2 - 0.08 = 0.12$$

Step 3: Calculate the total increase in individuals for the year:

$$\text{Increase} = r \times N = 0.12 \times 500$$

Step 4: Perform the multiplication:

$$12 \times 5 = 60$$

The net increase in the population after one year will be 60 individuals.

Final Answer: $\boxed{60}$

Answer: (A)

Go Back to Question 22

Q23.

Solution

Concept:

The Human Genome Project (HGP) was an international scientific research project with the goal of determining the base pairs that make up human DNA. It is often referred to as a "Mega Project" due to its scale and cost.

Solution:

Step 1: The HGP was launched in 1990 and completed in 2003.

Step 2: It was primarily coordinated by the U.S. Department of Energy (DOE) and the National Institute of Health (NIH).

Step 3: During the early years of the project, the Wellcome Trust (UK) became a major partner, providing significant funding and research support.

Step 4: Additional contributions came from countries like Japan, France, Germany, and China. Therefore, both the US departments and the Wellcome Trust played leading roles.

Final Answer: $\boxed{C}$

Answer: (C)

Go Back to Question 23

Q24.

Solution

Concept:

Hormones are chemically diverse and can be classified into groups: Peptide/Protein hormones, Steroids, Iodothyronines, and Amino-acid derivatives.

Solution:

Step 1: Insulin is a peptide hormone consisting of two polypeptide chains.

Step 2: Estrogen and Cortisol are steroid hormones derived from cholesterol.

Step 3: Epinephrine (Adrenaline) and Nor-epinephrine are catecholamines. These are synthesized by the modification of the amino acid Tyrosine.

Step 4: Thyroid hormones (T_3 and T_4) are also derived from Tyrosine but are specifically categorized as iodothyronines because they contain iodine.

Step 5: Epinephrine is the classic example of a simple amino-acid derivative.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 24

Q25.

Solution

Concept:

Hemophilia is an X-linked recessive genetic disorder. This means the gene responsible for the condition is located on the X chromosome. Males have one X and one Y chromosome (XY), while females have two X chromosomes (XX).

Solution:

Step 1: For a female to be hemophilic, she must inherit two defective X chromosomes (X^hX^h). This is very rare as it requires the father to be hemophilic and the mother to be at least a carrier.

Step 2: A female with only one defective X chromosome (XX^h) is a "carrier." She does not show the disease because the normal X chromosome is dominant over the recessive hemophilic gene.

Step 3: In contrast, a male will express the disease even with a single defective X chromosome (X^hY) because there is no corresponding gene on the Y chromosome to mask it.

Step 4: Thus, the assertion that females are more likely to be carriers than sufferers is true, and the reason regarding the requirement of two copies for expression in females is the correct explanation.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 25

Q26.

Solution

Concept:

Polymerase Chain Reaction (PCR) is a technique used to amplify a specific DNA segment. It involves repeated cycles of heating and cooling. A critical component is the use of a thermostable DNA polymerase that remains functional at high temperatures.

Solution:

Step 1: In the first step of PCR (Denaturation), the double-stranded DNA is heated to about $94^{\circ}C$ to break the hydrogen bonds and separate the strands.

Step 2: Most DNA polymerases, like the one found in humans or *E. coli*, would denature and lose activity at such high temperatures.

Step 3: To solve this, scientists use **Taq Polymerase**, which is isolated from the thermophilic bacterium *Thermus aquaticus*.

Step 4: This bacterium lives in hot springs; therefore, its enzymes are naturally evolved to be stable and active at temperatures above $70^{\circ}C$. This allows the PCR process to be automated without adding new enzyme in every cycle.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 26

Q27.

Solution

Concept:

Animal symmetry often changes during the life cycle of certain phyla. Echinodermata (e.g., Starfish) is a unique phylum where the larval stage and the adult stage show completely different body plans.

Solution:

Step 1: The larvae of echinoderms (like the bipinnaria or brachiolaria) are free-swimming and exhibit **Bilateral symmetry**, meaning the body can be divided into identical left and right halves in only one plane.

Step 2: As the animal undergoes metamorphosis into an adult, it adopts a sedentary or slow-moving lifestyle on the ocean floor.

Step 3: The adult echinoderm develops **Radial symmetry** (specifically pentamerous radial symmetry), where the body parts are arranged around a central axis.

Step 4: This transition from bilateral larvae to radial adults is a defining characteristic of this phylum.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 27

Q28.

Solution

Concept:

Plant reproduction includes several unconventional methods that bypass typical fertilization or involve multiple embryos. These terms are often confused but have distinct biological definitions.

Solution:

Step 1: **Apomixis** is a form of asexual reproduction that mimics sexual reproduction; it is the production of seeds without fertilization (i-q).

Step 2: **Parthenocarpy** is the development of a fruit without fertilization. Such fruits are typically seedless, like bananas or seedless grapes (ii-p).

Step 3: **Polyembryony** refers to the occurrence of more than one embryo in a single seed, common in *Citrus* and Mango (iii-r).

Step 4: **Parthenogenesis** is a broader biological term where an unfertilized egg develops into a complete individual (iv-s), seen in some insects (like rotifers and honeybees).

Matching: i-q, ii-p, iii-r, iv-s.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 28

Q29.

Solution

Concept:

Respiratory terminology describes various states of breathing and oxygenation levels in the body. Understanding these medical terms is essential for diagnosing respiratory distress.

Solution:

Step 1: **Hypoxia** is the condition in which the body or a region of the body is deprived of adequate oxygen supply at the tissue level.

Step 2: **Hyperoxia** is the opposite, referring to an excess of oxygen in the tissues.

Step 3: **Apnea** refers to the temporary cessation of breathing, often occurring during sleep.

Step 4: **Dyspnea** is the medical term for shortness of breath or "air hunger," often described as labored breathing.

The question specifically asks for the condition of low O_2 concentration in tissues, which is Hypoxia.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 29

Q30.

Solution

Concept:

Every organ system has a microscopic unit that performs the primary function of that organ. In the excretory system, the kidney is composed of millions of tiny filtering structures.

Solution:

Step 1: The **Nephron** is the structural and functional unit of the kidney. Each human kidney contains about one million nephrons.

Step 2: The nephron is responsible for the removal of waste products from the blood and the regulation of water and electrolyte balance through filtration, reabsorption, and secretion.

Step 3: **Neurons** are the functional units of the nervous system.

Step 4: **Nephridia** are excretory organs found in annelids (like earthworms), and **Ommatidia** are the units that make up the compound eyes of insects.

Final Answer: B

Answer: (B)

Go Back to Question 30

Q31.

Solution

Concept:

Biodiversity loss is summarized by ecologists through the "Evil Quartet," which describes the four major causes of species extinction resulting from human activities.

Solution:

Step 1: The first and most important cause is **Habitat Loss and Fragmentation**, where natural forests are cut down for agriculture or urban development.

Step 2: The second is **Over-exploitation**, where humans harvest a species beyond its capacity to regenerate (e.g., Steller's sea cow, passenger pigeon).

Step 3: The third is **Alien Species Invasions**, where non-native species are introduced (intentionally or accidentally) and cause the decline of indigenous species (e.g., Nile perch in Lake Victoria).

Step 4: The fourth is **Co-extinctions**, where the extinction of one species lead to the extinction of another obligate partner (e.g., plant-pollinator mutualism).

The "Greenhouse effect" is a cause of global warming, which may indirectly lead to biodiversity loss, but it is not traditionally listed as one of the "Evil Quartet."

Final Answer: D

Answer: (D)

Go Back to Question 31

Q32.

Solution

Concept:

Erwin Chargaff proposed rules for DNA structure based on the base composition of double-stranded DNA. These rules are fundamental to understanding the stability and pairing of the DNA double helix.

Solution:

Step 1: Chargaff's rule states that in a double-stranded DNA, the total amount of purines is equal to the total amount of pyrimidines.

Step 2: Purines are Adenine (A) and Guanine (G). Pyrimidines are Thymine (T) and Cytosine (C).

Step 3: Therefore, $A + G = T + C$.

Step 4: Dividing both sides by $(T + C)$, we get the ratio $(A + G)/(T + C) = 1$. This ratio is constant for a species and is always equal to unity in double-stranded DNA.

Final Answer: $\boxed{A}$

Answer: (A)

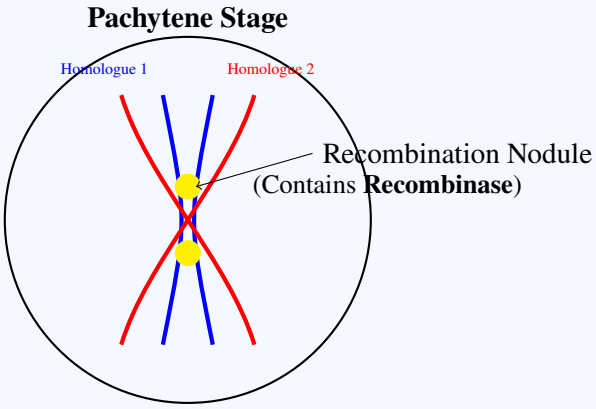
Go Back to Question 32

Q33.

Solution

Concept: Meiosis I is characterized by a long and complex Prophase I, subdivided into five stages. One of the most critical events for genetic variation is crossing over, which involves the physical breakage and reunion of DNA strands, catalyzed by specific enzymes.

Solution: Step 1: During the Zygotene stage, homologous chromosomes pair up (synapsis) to form bivalents.
Step 2: Following Zygotene is the Pachytene stage. In this stage, the bivalent chromosomes become clearly visible as tetrads.
Step 3: Pachytene is marked by the appearance of recombination nodules, which are the sites where crossing over occurs between non-sister chromatids.
Step 4: Crossing over is an enzyme-mediated process. The enzyme responsible for facilitating the exchange of genetic material is called **recombinase**.
Step 5: After crossing over is complete, the chromosomes remain linked at the sites of exchange (chiasmata) as they move into the Diplotene stage.



Final Answer: (A) Pachytene

Answer: (A)

Go Back to Question 33

Q34.

Solution

Concept:

Mendelian disorders are caused by single-gene mutations, whereas Chromosomal disorders are caused by the absence, excess, or abnormal arrangement of one or more chromosomes (Aneuploidy).

Solution:

Step 1: Down's syndrome is a genetic disorder caused by the presence of an additional copy of chromosome number 21 (Trisomy 21).

Step 2: This means the affected individual has 47 chromosomes instead of 46.

Step 3: The cause of this trisomy is usually "non-disjunction," which is the failure of homologous chromosomes or chromatids to separate properly during meiosis in the parent (usually the mother).

Step 4: As a result, one gamete receives two copies of chromosome 21, and after fertilization with a normal gamete, the zygote has three copies. Both statements accurately describe the condition and its etiology.

Final Answer: A

Answer: (A)

Go Back to Question 34

Q35.

Solution

Concept:

Anemophily (wind pollination) is common in grasses. Since wind is a non-directional abiotic agent, plants have evolved specific adaptations to maximize the chance of pollen reaching a stigma.

Solution:

Step 1: Flowers do not need to attract animals, so they are generally small, colorless, and lack nectar or scent.

Step 2: Numerous flowers are often packed into an inflorescence to increase the chance of pollination.

Step 3: Pollen grains are produced in massive quantities and are light, non-sticky, and sometimes winged so they can be easily carried by air currents.

Step 4: The stigmas are often large and feathery to "trap" the wind-borne pollen grains. Options B, C, and D describe entomophilous (insect-pollinated) or zoophilous flowers.

Final Answer: A

Answer: (A)

Go Back to Question 35

Q36.

Solution

Concept:

Human evolution is characterized by a progressive increase in brain capacity (cranial capacity), tool usage, and the mastery of environmental elements. *Homo erectus* is a pivotal species in this lineage, appearing approximately 1.5 million years ago.

Solution:

Step 1: *Homo habilis*, often called the "handy man," was the first hominid to make and use stone tools, but there is no definitive archaeological evidence of them using fire. Their cranial capacity was about 650–800 cc.

Step 2: *Homo erectus* had a significantly larger brain (around 900 cc) and was the first to migrate out of Africa. Extensive archaeological evidence (such as charred bones and hearths) suggests they were the first to control and use fire for cooking, warmth, and protection.

Step 3: Neanderthal man lived much later (100,000 to 40,000 years ago) and used fire extensively, even burying their dead, but they were not the "first" species in the lineage to discover its use.

Step 4: Australopithecus was more ape-like with a smaller cranial capacity and did not possess the cognitive or technical ability to manage fire.

Final Answer: B

Answer: (B)

Go Back to Question 36

Q37.

Solution

Concept:

Vitamins are essential organic compounds that the body requires in small amounts for various metabolic processes. Deficiency in these vitamins leads to specific clinical conditions or diseases.

Solution:

Step 1: Vitamin A (Retinol) is essential for the formation of rhodopsin in the retina. Its deficiency causes Nyctalopia, commonly known as Night blindness (i-r).

Step 2: Vitamin B_1 (Thiamine) acts as a coenzyme in carbohydrate metabolism. Severe deficiency leads to Beri-beri, characterized by nerve inflammation and heart failure (ii-p).

Step 3: Vitamin C (Ascorbic acid) is crucial for collagen synthesis and tissue repair. Deficiency leads to Scurvy, which involves bleeding gums and delayed wound healing (iii-q).

Step 4: Vitamin D (Calciferol) is required for calcium absorption from the gut. In children, its deficiency causes Rickets, leading to soft and deformed bones (iv-s).

The matching sequence is i-r, ii-p, iii-q, iv-s.

Final Answer: A

Answer: (A)

Go Back to Question 37

Q38.

Solution

Concept:

Joints are the points of contact between bones or between bones and cartilages. They are classified into three major structural types: Fibrous, Cartilaginous, and Synovial.

Solution:

Step 1: **Fibrous joints** do not allow any movement. Examples include the sutures between skull bones. Option A is incorrect because phalanges have synovial hinge joints.

Step 2: **Cartilaginous joints** involve bones joined by cushions of cartilage, allowing limited movement. This is exactly what is found between adjacent vertebrae in the vertebral column, allowing for slight flexibility.

Step 3: **Synovial joints** are characterized by a fluid-filled synovial cavity, allowing significant movement. Skull bones (Option C) have fibrous joints, not synovial.

Step 4: **Pivot joints** allow rotation around an axis (e.g., between Atlas and Axis). The joint between the humerus and pectoral girdle is a "Ball and Socket" joint, making Option D incorrect.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 38

Q39.

Solution

Concept:

Lactation and milk release are governed by a complex neuroendocrine reflex involving the pituitary gland. Two main hormones are involved: one for production and one for ejection.

Solution:

Step 1: **Prolactin**, secreted by the anterior pituitary, is responsible for the synthesis and secretion of milk within the mammary alveoli.

Step 2: When the infant suckles at the breast, sensory impulses are sent to the hypothalamus, which triggers the posterior pituitary to release **Oxytocin**.

Step 3: Oxytocin causes the contraction of the myoepithelial cells surrounding the mammary alveoli, forcing milk into the ducts. This is known as the "Milk Ejection Reflex" or "Let-down reflex."

Step 4: Estrogen and Progesterone are involved in the development of mammary glands during pregnancy but actually inhibit milk secretion until after birth.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 39

Q40.

Solution

Concept:

Parthenocarpy is the production of fruit without the fertilization of ovules, resulting in seedless fruits. Plant Growth Regulators (PGRs) can be applied exogenously to induce this process in certain crops.

Solution:

Step 1: **Auxins** (such as IAA or IBA) and **Gibberellins** are the primary hormones used to induce parthenocarpy.

Step 2: In tomatoes, applying dilute solutions of Auxin to the flowers can trigger the ovary to develop into a fruit even if pollination and fertilization fail to occur.

Step 3: **Ethylene** is primarily used for fruit ripening and abscission. **Abscisic acid** (ABA) is a growth inhibitor involved in dormancy and stress response.

Step 4: **Cytokinins** promote cell division and delay senescence but are not the standard choice for inducing seedless fruit development in tomatoes.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 40

Q41.

Solution

Concept:

The Watson-Crick model of B-DNA describes the double helix structure. Its dimensions and base pairing rules are highly specific and determine the stability of the genetic material.

Solution:

Step 1: The DNA molecule consists of two polynucleotide chains where the backbone is constituted by sugar-phosphate and the bases project inside.

Step 2: The two chains have anti-parallel polarity, meaning if one chain has the polarity 5' $\rightarrow$ 3', the other has 3' $\rightarrow$ 5'.

Step 3: The bases in two strands are paired through Hydrogen bonds ($A = T$ with two bonds, $G \equiv C$ with three bonds).

Step 4: The pitch of the helix is 3.4 nm (34 Angstroms) and there are 10 base pairs in each turn, not 12. The distance between a base pair in a helix is approximately 0.34 nm.

Option D is incorrect because B-DNA typically has 10 base pairs per turn of the helix.

Final Answer: $\boxed{D}$

Answer: (D)

Go Back to Question 41

Q42.

Solution

Concept:

Animals are categorized based on the primary nitrogenous waste they excrete: Ammonotelic (Ammonia), Ureotelic (Urea), and Uricotelic (Uric acid). This is largely an adaptation to water availability.

Solution:

Step 1: **Ammonotelic** animals excrete ammonia, which is highly toxic and requires large amounts of water (e.g., aquatic invertebrates, bony fishes, aquatic amphibians).

Step 2: **Ureotelic** animals convert ammonia into urea in the liver and excrete it. This is an adaptation for water conservation. This group includes Mammals, terrestrial amphibians (like frogs), and marine fishes (which must conserve water due to the salty environment).

Step 3: **Uricotelic** animals excrete uric acid in the form of pellets or paste with minimum loss of water. This includes reptiles, birds, and land snails.

Step 4: Checking the groups: Option B lists Mammals, Terrestrial amphibians, and Marine fishes, all of which are primarily ureotelic.

Final Answer: B

Answer: (B)

Go Back to Question 42

Q43.

Solution

Concept:

Oogenesis is the process of formation of a mature female gamete. Unlike spermatogenesis, it is a discontinuous process that begins during the embryonic development stage.

Solution:

Step 1: Primary oocytes are formed during fetal development and are arrested at Prophase I.

Step 2: Just before ovulation (after puberty), the primary oocyte completes Meiosis I, resulting in a large haploid **secondary oocyte** and a tiny **first polar body**. Thus, the first polar body is formed in the adult ovary, not the fetal stage.

Step 3: The secondary oocyte begins Meiosis II but is arrested at Metaphase II.

Step 4: Meiosis II is completed only if a sperm enters the egg. This trigger causes the secondary oocyte to divide into an ootid (ovum) and a second polar body.

Statement I is incorrect because the first polar body forms at puberty. Statement II is correct regarding the completion of Meiosis II.

Final Answer: C

Answer: (C)

Go Back to Question 43

Q44.

Solution

Concept:

The forebrain consists of the cerebrum, thalamus, and hypothalamus. The inner parts of cerebral hemispheres and a group of associated deep structures like the amygdala and hippocampus form a complex functional unit.

Solution:

Step 1: The **Limbic system** is often referred to as the "emotional brain." It includes the amygdala (involved in memory and emotion) and hippocampus.

Step 2: Along with the **Hypothalamus**, the limbic system regulates sexual behavior, expression of emotional reactions (such as excitement, pleasure, rage, and fear), and motivation.

Step 3: The Hypothalamus specifically handles homeostatic functions and hormonal control, but its interaction with the limbic system is what governs complex behaviors.

Step 4: The Thalamus is a relay center, and the Corpus callosum is a fiber tract connecting the two hemispheres.

Final Answer: B

Answer: (B)

Go Back to Question 44

Q45.

Solution

Concept:

Digestion is regulated by both neural and hormonal mechanisms. Several hormones are secreted by the gastrointestinal mucosa to coordinate the movement of food and the release of enzymes.

Solution:

Step 1: Gastrin stimulates the secretion of HCl and pepsinogen in the stomach.

Step 2: Secretin acts on the exocrine pancreas to stimulate the secretion of water and bicarbonate ions.

Step 3: Cholecystokinin (CCK) acts on both the pancreas and gallbladder to stimulate the secretion of pancreatic enzymes and bile juice, respectively.

Step 4: Gastric Inhibitory Peptide (GIP), as the name suggests, inhibits gastric secretion and motility. This ensures that the stomach does not empty too quickly into the duodenum and slows down acid production when not needed.

Final Answer: C

Answer: (C)

Go Back to Question 45

Q46.

Solution

Concept:

Microbes play a vital role in industrial production by acting as biological factories for organic acids, enzymes, and alcohols. Different species of fungi and bacteria are utilized based on their specific metabolic pathways.

Solution:

Step 1: Aspergillus niger is a filamentous fungus used for the large-scale industrial production of **Citric acid**, which is used in food preservation and flavoring (i-q).

Step 2: Acetobacter aceti is a bacterium that oxidizes ethanol into **Acetic acid** (vinegar) under aerobic conditions (ii-r).

Step 3: Clostridium butylicum is an anaerobic bacterium used for the production of **Butyric acid** (iii-p).

Step 4: Lactobacillus species are bacteria that convert lactose (milk sugar) into **Lactic acid**, used in the curdling of milk and food processing (iv-s).

The correct matching sequence according to industrial applications is i-q, ii-r, iii-p, iv-s.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 46

Q47.

Solution

Concept:

Primary productivity is the rate at which solar energy is captured by producers to synthesize organic compounds. It is measured in terms of weight (g/m^2) or energy ($kcal/m^2$).

Solution:

Step 1: Gross Primary Productivity (GPP) is the total rate of production of organic matter during photosynthesis in an ecosystem.

Step 2: Plants use a considerable amount of GPP for their own metabolic needs, primarily for cellular respiration. This is denoted as Respiration losses (R).

Step 3: **Net Primary Productivity (NPP)** is the remaining biomass available for the consumption of heterotrophs (herbivores and decomposers).

Step 4: The mathematical relationship is expressed as: $NPP = GPP - R$.

Option C refers to Secondary Productivity, which is the rate of formation of new organic matter by consumers.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 47

Q48.

Solution

Concept:

Sugars are classified as reducing or non-reducing based on their ability to reduce Benedict's or Fehling's solution. This depends on the presence of a free (unbound) functional group (aldehyde or ketone).

Solution:

Step 1: All monosaccharides, whether aldoses (Glucose) or ketoses (Fructose), are reducing sugars because they have a free active group.

Step 2: Disaccharides like Lactose and Maltose are also reducing because one of the two units has a free hemiacetal group.

Step 3: **Sucrose** (table sugar) consists of glucose and fructose. The linkage (glycosidic bond) occurs between the reducing groups of both molecules ($C1$ of glucose and $C2$ of fructose).

Step 4: Since both functional groups are involved in the bond, no free reducing group is available. Thus, Sucrose is a non-reducing sugar.

Final Answer: $\boxed{D}$

Answer: (D)

Go Back to Question 48

Q49.

Solution

Concept:

Thermal tolerance determines the geographical distribution of species. Animals that maintain a constant internal body temperature regardless of environmental changes are called Homeotherms or Regulators.

Solution:

Step 1: **Eurythermal** organisms can tolerate and thrive in a wide range of temperatures.

Step 2: Most mammals and birds are eurythermal because they have physiological mechanisms (homeostasis) to regulate their internal temperature.

Step 3: These organisms are "Homeothermic" (warm-blooded), allowing them to remain active in diverse climates ranging from the Arctic to the Sahara.

Step 4: The assertion is true because mammals are generally eurythermal, and the reason is the correct explanation because their ability to regulate temperature (homeothermy) is what allows them that wide thermal tolerance.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 49

Q50.

Solution

Concept:

Each animal phylum possesses unique anatomical or physiological features that serve as diagnostic characteristics for classification.

Solution:

Step 1: *Pila* (Apple snail) belongs to Mollusca and possesses a rasping organ for feeding called the **Radula**.

Step 2: *Bombyx* (Silkworm) belongs to Arthropoda and uses **Malpighian tubules** for excretion.

Step 3: *Pleurobrachia* belongs to Ctenophora and possesses eight external rows of ciliated **Comb plates** for locomotion.

Step 4: *Asterias* (Starfish) belongs to Echinodermata. They do NOT possess **Statocysts** (balance organs). Statocysts are common in some arthropods and mollusks, but echinoderms primarily rely on their water vascular system for coordination.

Final Answer: $\boxed{D}$

Answer: (D)

Go Back to Question 50

Q51.

Solution

Concept:

Biotechnology uses specific genes from soil bacteria to provide pest resistance to plants. The "Bt" in Bt cotton stands for the bacterium *Bacillus thuringiensis*, which naturally produces insecticidal proteins.

Solution:

Step 1: *Bacillus thuringiensis* forms protein crystals during a particular phase of their growth. These crystals contain a toxic "insecticidal protein."

Step 2: In the bacterium, the toxin exists as inactive "protoxins." It does not kill the bacterium itself because it is in an inactive state.

Step 3: However, once an insect (like a bollworm) ingests the inactive toxin, it is converted into an active form of toxin due to the **Alkaline pH** of the insect's gut, which solubilizes the crystals.

Step 4: The activated toxin binds to the surface of midgut epithelial cells and creates pores that cause cell swelling and lysis, eventually leading to the death of the insect.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 51

Q52.

Solution

Concept:

Decomposition is a complex process where detritus is broken down into simpler inorganic substances. It involves several steps: fragmentation, leaching, catabolism, humification, and mineralization.

Solution:

Step 1: Humification leads to the accumulation of a dark-colored amorphous substance called humus, which is highly resistant to microbial action.

Step 2: Humus further serves as a reservoir of nutrients.

Step 3: The process of **Mineralization** occurs when the humus is further degraded by some microbes.

Step 4: This degradation results in the release of inorganic nutrients (such as CO_2, H_2O, and nutrients like Ca^{2+}, Mg^{2+}, K^{+}, etc.) back into the soil.

Step 5: Thus, mineralization is the final step that returns essential elements to the abiotic environment.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 52

Q53.

Solution

Concept:

Erythropoiesis is the process of red blood cell (RBC) formation. In adults, this occurs primarily in the red bone marrow and is regulated by various hormones.

Solution:

Step 1: The primary hormone regulating RBC production is **Erythropoietin** (EPO), which is produced by the juxtaglomerular cells of the kidney in response to low oxygen levels (hypoxia).

Step 2: However, other hormones also play a significant role. **Thyroxine** from the thyroid gland stimulates metabolism and supports erythropoiesis.

Step 3: **Cortisol** (Glucocorticoids) from the adrenal cortex also stimulates RBC production. This is why patients with Cushing's syndrome (excess cortisol) often have high RBC counts.

Step 4: Since both A and B are involved in stimulating the bone marrow to produce more RBCs, Option C is the most comprehensive answer.

Final Answer: $\boxed{C}$

Answer: (C)

Go Back to Question 53

Q54.

Solution

Concept:

While many scientists have contributed to the study of biological variety, specific individuals are credited with coining or popularizing the terminology we use today in ecology.

Solution:

Step 1: The term "Biological Diversity" was originally used by scientists like Raymond Dasmann, but the combined and popular term "Biodiversity" was popularized by the sociobiologist **Edward Wilson**.

Step 2: Wilson used the term to describe the combined diversity at all levels of biological organization, from genes to ecosystems.

Step 3: Robert May is known for his global species estimates (approx. 7 million).

Step 4: Paul Ehrlich proposed the Rivet Popper hypothesis, and Alexander von Humboldt described the species-area relationship.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 54

Q55.

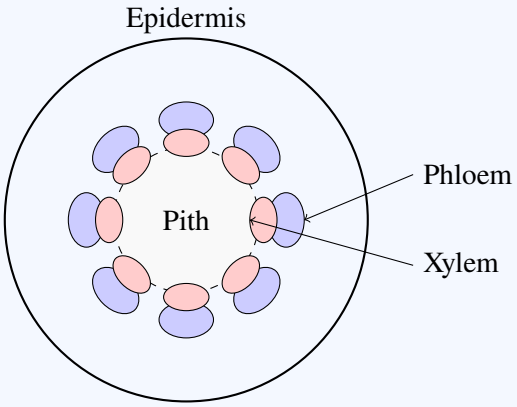
Solution

Concept: The stele is the central part of the root or stem containing the tissues derived from the procambium. These include vascular tissues (xylem and phloem), and in some cases, ground tissue (pith) and a pericycle. Different plants exhibit different patterns of vascular tissue arrangement.

Solution: Step 1: A 'Eustele' is a type of siphonostele where the primary vascular tissue consists of longitudinal strands (vascular bundles) arranged in a circle or ring around the central pith.
Step 2: This arrangement is typical of the stems of dicotyledonous plants and gymnosperms.
Step 3: In this configuration, each vascular bundle is usually conjoint and collateral (xylem on the inner side, phloem on the outer side).
Step 4: Looking at the other options:

- (A) describes an **Atactostele**, which is characteristic of monocot stems.
- (C) describes a **Protostele**, the most primitive type where there is no pith.
- (D) describes a general **Siphonostele**, of which eustele is a specific subtype.

Step 5: Therefore, the defining feature of a Eustele is the ring-like arrangement of vascular bundles.



Eustele (Dicot Stem)

Final Answer: (B) Vascular bundles arranged in a ring.

Answer: (B)

Go Back to Question 55

Q56.

Solution

Concept:

Polymerase Chain Reaction (PCR) consists of three main steps: Denaturation, Annealing, and Extension. Each step occurs at a specific temperature to ensure the proper separation of strands, binding of primers, and synthesis of new DNA.

Solution:

Step 1: **Denaturation** is the first step where the target DNA is heated to a high temperature, typically around **$94^\circ C$**. This high heat breaks the hydrogen bonds between the two strands, separating them into single templates.

Step 2: **Annealing** occurs at a lower temperature ($40^\circ C$ to $60^\circ C$, commonly around $54^\circ C$), allowing DNA primers to bind to their complementary sequences on the single-stranded templates.

Step 3: **Extension** (or Polymerization) happens at approximately $72^\circ C$, which is the optimum temperature for Taq Polymerase to add dNTPs and extend the primers.

Step 4: Since the question specifically asks for the temperature of the "Denaturation" phase, $94^\circ C$ is the correct choice.

Final Answer: $94^\circ C$

Answer: (A)

Go Back to Question 56

Q57.

Solution

Concept:

The plant kingdom is characterized by "Alternation of Generations" between a haploid gametophyte and a diploid sporophyte. The dominance and independence of these phases evolved as plants moved from aquatic to terrestrial environments.

Solution:

Step 1: **Bryophytes** (Mosses/Liverworts) are unique because their dominant, independent, and photosynthetic phase is the **Gametophyte (n)**. The sporophyte is physically attached to and dependent on the gametophyte (i-q).

Step 2: **Pteridophytes** (Ferns) were the first vascular plants. Their dominant phase is the **Sporophyte (2n)**, but they have a distinct, small, independent gametophyte called a prothallus (ii-s).

Step 3: **Gymnosperms** and **Angiosperms** both have a dominant Sporophyte (2n). In these groups, the gametophyte is highly reduced and never independent; it is retained within the sporophyte tissues (iii-p, iv-p).

Step 4: Matching the dominant phases: i-q, ii-s, iii-p, iv-p.

Final Answer: C

Answer: (C)

Go Back to Question 57

Q58.

Solution

Concept:

The structural genes of the Lac Operon (z, y, and a) are transcribed together as a polycistronic mRNA. Each gene produces a specific enzyme required for the metabolism of lactose.

Solution:

Step 1: The **'z' gene** codes for β-galactosidase, which hydrolyzes lactose into glucose and galactose.

Step 2: The **'y' gene** codes for permease, which increases the permeability of the cell to β-galactosides (lactose).

Step 3: The **'a' gene** codes for **Transacetylase**, an enzyme that transfers an acetyl group from acetyl-CoA to β-galactosides. While its exact physiological necessity in lactose metabolism is less critical than the others, it is a required part of the operon structure.

Step 4: The 'i' gene codes for the repressor. Therefore, the 'a' gene specifically corresponds to Transacetylase.

Final Answer: $\boxed{C}$

Answer: (C)

Go Back to Question 58

Q59.

Solution

Concept:

Gout is a type of metabolic arthritis. It results from a disturbance in purine metabolism, leading to elevated levels of a specific metabolic byproduct in the blood (hyperuricemia).

Solution:

Step 1: When the concentration of **Uric acid** in the blood becomes too high, it can no longer remain dissolved.

Step 2: The excess uric acid precipitates out of the blood and forms sharp, needle-like **monosodium urate crystals**.

Step 3: These crystals preferentially accumulate in the joints (often the big toe) and surrounding tissues.

Step 4: The presence of these crystals triggers an immune response, causing intense inflammation, redness, and excruciating pain.

Step 5: Lactic acid accumulation causes muscle fatigue, not gout. Synovial fluid is a normal lubricant; its excess is known as effusion or "water on the joint."

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 59

Q60.

Solution

Concept:

Endocrine regulation involves antagonistic pairs of hormones to maintain homeostasis. Insulin and Glucagon regulate blood glucose, while Parathyroid Hormone (PTH) and Calcitonin regulate blood calcium.

Solution:

Step 1: **Glucagon** is secreted by alpha cells of the pancreas. It acts to increase blood sugar by promoting glycogenolysis and gluconeogenesis. Therefore, it is a **Hyperglycemic** hormone, not hypoglycemic. (Incorrect match)

Step 2: **Insulin** is secreted by beta cells. It enhances cellular glucose uptake and utilization, thereby lowering blood sugar. Thus, it is a **Hypoglycemic** hormone, not hyperglycemic. (Incorrect match)

Step 3: **PTH** (Parathyroid Hormone) increases blood calcium levels by stimulating bone resorption and calcium reabsorption in the kidneys. It is correctly called a Hypercalcemic hormone.

Step 4: Since both A and B are incorrectly described in the options (their functions are swapped), Option C is the correct choice to identify the errors.

Final Answer: C

Answer: (C)

Go Back to Question 60

Q61.

Solution

Concept:

Innate immunity consists of four types of barriers that provide a non-specific defense against pathogens from the time of birth. Physical barriers are the first line of defense that physically prevent entry of microorganisms into the body.

Solution:

Step 1: The **Skin** (stratum corneum) is the primary physical barrier that prevents the entry of bacteria and viruses into the body.

Step 2: The **Mucus coating** of the epithelium lining the respiratory, gastrointestinal, and urogenital tracts also acts as a physical barrier by trapping microbes attempting to enter the body.

Step 3: Together, the skin and the mucosal surfaces form the "Physical Barriers" category of innate immunity.

Step 4: Physiological barriers (like stomach acid or tears), Cellular barriers (like WBCs), and Cytokine barriers (like Interferons) represent different categories of the innate immune system.

Since both A and B are physical barriers, Option C is the correct choice.

Final Answer: C

Answer: (C)

Go Back to Question 1

Q62.

Solution

Concept:

Post-transcriptional modification (processing) is required to convert primary transcript (hnRNA) into functional mRNA in eukaryotes. This involves three steps: Splicing, Capping, and Tailing.

Solution:

Step 1: **Capping** occurs at the 5' end of the hnRNA.

Step 2: During this process, an unusual nucleotide, **methyl guanosine triphosphate** (m^7Gppp), is added to the 5' end.

Step 3: This cap is essential for the recognition of mRNA by the ribosome during translation and protects the mRNA from degradation by exonucleases.

Step 4: **Tailing** (Polyadenylation) involves the addition of about 200–300 adenylate residues at the 3' end. Uracil and Cytosine addition are not standard part of the capping process.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 62

Q63.

Solution

Concept:

The human respiratory system follows a branching pattern of air passages that increases the surface area for gas exchange. The transition from conducting zones to respiratory zones involves specific structural changes.

Solution:

Step 1: The trachea divides into primary, secondary, and tertiary bronchi, which further branch into smaller bronchioles.

Step 2: The terminal bronchioles give rise to a number of very thin, irregular-walled, and highly vascularised bag-like structures.

Step 3: These structures are called **Alveoli**. They are the primary sites of actual gas exchange between the air and the blood.

Step 4: The Alveoli and their ducts form the respiratory or exchange part of the respiratory system, while the trachea and bronchi represent the conducting part.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 63

Q64.

Solution

Concept:

The pituitary gland (hypophysis) is divided into the adenohypophysis (anterior) and neurohypophysis (posterior). While the anterior pituitary synthesizes its own hormones, the posterior pituitary only stores and releases hormones produced by the hypothalamus.

Solution:

Step 1: The **Anterior Pituitary** (Adenohypophysis) secretes several hormones, including Growth Hormone (GH), Prolactin (PRL), TSH, ACTH, LH, and FSH.

Step 2: **Oxytocin** and Vasopressin (ADH) are synthesized by the neurosecretory cells of the Hypothalamus.

Step 3: These hormones are transported axonally to the **Posterior Pituitary** (Neurohypophysis), where they are stored and released into the bloodstream when needed.

Step 4: Therefore, Oxytocin is not a secretion of the anterior pituitary.

Final Answer: C

Answer: (C)

Go Back to Question 64

Q65.

Solution

Concept:

To explain the significance of biodiversity to an ecosystem, ecologists often use analogies. The Rivet Popper hypothesis compares the species of an ecosystem to the rivets of an airplane.

Solution:

Step 1: The **Rivet Popper Hypothesis** was proposed by Stanford ecologist **Paul Ehrlich**.

Step 2: In this analogy, the ecosystem is the airplane and the species are the rivets holding its parts together.

Step 3: If every passenger starts popping a rivet (extinction of a species), the plane may not become dangerous immediately, but as more rivets are removed, the plane becomes dangerously weak.

Step 4: Furthermore, the loss of "key rivets" (keystone species that drive major ecosystem functions) poses a more serious threat to flight safety (ecosystem stability) than the loss of less critical rivets.

Final Answer: A

Answer: (A)

Go Back to Question 65

Q66.

Solution

Concept:

The flow of genetic information, known as the Central Dogma, moves from DNA to RNA (Transcription) and then from RNA to Protein. The latter stage is where the nucleotide sequence is converted into an amino acid sequence.

Solution:

Step 1: **Replication** is the process where DNA makes a copy of itself.

Step 2: **Transcription** is the process where the information in a strand of DNA is copied into a new molecule of messenger RNA (mRNA).

Step 3: **Translation** is the biochemical process in which the ribosome "reads" the genetic code carried by the mRNA and, with the help of tRNA, assembles amino acids in a specific order to synthesize a polypeptide chain (protein).

Step 4: **Transformation** refers to the genetic alteration of a cell resulting from the direct uptake and incorporation of exogenous genetic material.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 66

Q67.

Solution

Concept:

Placentation refers to the arrangement of ovules within the ovary. It is a key diagnostic feature used in the classification of flowering plants.

Solution:

Step 1: **Marginal Placentation** occurs in the Fabaceae family, where the placenta forms a ridge along the ventral suture of the ovary (e.g., Pea). Mustard has parietal placentation.

Step 2: **Axile Placentation** occurs when the placenta is axial and the ovules are attached to it in a multilocular ovary (e.g., Tomato, Lemon, China rose).

Step 3: **Parietal Placentation** is when ovules develop on the inner wall of the ovary or on peripheral parts (e.g., Mustard, Argemone).

Step 4: **Free Central Placentation** occurs when ovules are borne on a central axis and septa are absent (e.g., Dianthus, Primrose).

Option B is the correct match as Tomato exhibits axile placentation.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 67

Q68.

Solution

Concept:

Plant Growth Regulators (PGRs) can be growth promoters or growth inhibitors. Inhibitors typically help the plant survive unfavorable environmental conditions.

Solution:

Step 1: **Abscisic acid (ABA)** acts as a general plant growth inhibitor and an inhibitor of plant metabolism.

Step 2: It stimulates the closure of stomata in the epidermis and increases the tolerance of plants to various kinds of stresses.

Step 3: Because of its role in helping plants cope with environmental challenges like drought or salinity, it is specifically referred to as the **Stress Hormone**.

Step 4: Auxins, Gibberellins, and Cytokinins are primarily growth promoters.

Final Answer: C

Answer: (C)

Go Back to Question 68

Q69.

Solution

Concept:

Estimating the total number of species on Earth is a challenge for ecologists. While some estimates are extreme, others are based on rigorous statistical comparisons between tropical and temperate regions.

Solution:

Step 1: The IUCN (2004) states that the total number of plant and animal species described so far is slightly more than 1.5 million.

Step 2: Some researchers estimate the total number to be between 20 and 50 million.

Step 3: However, a more conservative and scientifically sound estimate was provided by **Robert May**.

Step 4: Robert May placed the global species diversity at about **7 million**. This estimate is widely accepted in the scientific community as a realistic benchmark.

Final Answer: C

Answer: (C)

Go Back to Question 69

Q70.

Solution

Concept:

The mammalian kidney consists of an outer cortex and an inner medulla. The medulla is divided into several conical masses called medullary pyramids.

Solution:

Step 1: The outer layer of the kidney is the **Cortex**, and the inner part is the **Medulla**.

Step 2: The medullary pyramids project into the calyces.

Step 3: The cortex extends in between the medullary pyramids as renal columns.

Step 4: These cortical extensions are specifically named the **Columns of Bertini**. Thus, they represent the extension of the **Cortex into the Medulla**.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 70

Q71.

Solution

Concept:

The liver is the largest gland in the human body and performs diverse metabolic and secretory functions. Its internal structure is organized into specific units that facilitate the processing of blood from the digestive tract.

Solution:

Step 1: The liver is covered by a thin connective tissue sheath called **Glisson's capsule**.

Step 2: Each lobe of the liver is made up of many tiny functional units called **Hepatic lobules**. These lobules consist of hepatic cells (hepatocytes) arranged in the form of cords.

Step 3: **Kupffer cells** are specialized macrophages located within the liver that clear bacteria and damaged red blood cells from the blood.

Step 4: **Sinusoids** are the small, porous blood vessels that run between the cords of hepatocytes.

Step 5: Since the hepatic lobules are the actual sites where the liver's physiological functions are carried out, they are considered the structural and functional units.

Final Answer: $\boxed{C}$

Answer: (C)

Go Back to Question 71

Q72.

Solution

Concept:

Lung capacities are combinations of two or more respiratory volumes. Understanding the air remaining in the lungs after various phases of the breathing cycle is crucial for assessing pulmonary health.

Solution:

Step 1: After a normal expiration, the lungs are not empty. They still contain a certain volume of air.

Step 2: This volume includes the air that could still be forcibly exhaled (Expiratory Reserve Volume or ERV) and the air that can never be exhaled (Residual Volume or RV).

Step 3: The sum of $ERV + RV$ is defined as the **Functional Residual Capacity (FRC)**.

Step 4: **Inspiratory Capacity** is $TV + IRV$, and **Total Lung Capacity** is the total volume of air the lungs can hold after a maximum forced inspiration ($VC + RV$).

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 72

Q73.

Solution

Concept:

Biomes are characterized by specific climate patterns, primarily defined by their mean annual temperature and mean annual precipitation. These factors determine the type of vegetation and animal life present.

Solution:

Step 1: **Tropical Forests** are located near the equator and maintain a relatively high and constant temperature, typically ranging between **$20 - 25^{\circ}C$**.

Step 2: **Coniferous Forests** (Taiga) are found in cooler regions with mean annual temperatures often between $0 - 15^{\circ}C$.

Step 3: **Deserts** can be hot or cold, but hot deserts often have mean annual temperatures exceeding $25^{\circ}C$, while the value in Option C is too low for a general desert biome mean.

Step 4: **Arctic and Alpine Tundra** are characterized by extremely low temperatures, often well below $0^{\circ}C$ for most of the year.

Option A represents the most accurate pairing for a major biome's temperature range.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 73

Q74.

Solution

Concept:

Autoimmune diseases occur when the body's immune system loses its ability to distinguish between "self" and "non-self," leading it to attack the body's own cells and tissues.

Solution:

Step 1: **Rheumatoid arthritis** is an autoimmune disorder where the immune system attacks the synovial membrane of the joints.

Step 2: **Myasthenia gravis** is an autoimmune condition where antibodies block or destroy acetylcholine receptors at the neuromuscular junction.

Step 3: **Insulin-dependent Diabetes Mellitus (Type 1)** involves the immune-mediated destruction of insulin-producing beta cells in the pancreas.

Step 4: **Alzheimer's disease** is a progressive neurodegenerative disease characterized by the accumulation of amyloid plaques and tau tangles in the brain. While inflammation is involved, it is not primarily classified as an autoimmune disease.

Final Answer: C

Answer: (C)

Go Back to Question 74

Q75.

Solution

Concept:

DNA fingerprinting (DNA profiling) relies on identifying variations in specific regions of DNA that are unique to individuals. These regions consist of repeating sequences.

Solution:

Step 1: The human genome contains many regions of repetitive DNA sequences called satellite DNA.

Step 2: A specific class of satellite DNA is called **VNTR (Variable Number of Tandem Repeats)**.

Step 3: In DNA fingerprinting, a radiolabeled VNTR sequence is used as a **probe**.

Step 4: This probe hybridizes (binds) to its complementary sequences in the DNA sample during the Southern Blotting process, allowing the unique pattern of repeats to be visualized via autoradiography.

Final Answer: C

Answer: (C)

Go Back to Question 75

Q76.

Solution

Concept:

The corpus luteum is a temporary endocrine structure in the ovary that secretes progesterone, which is essential for maintaining the uterine lining (endometrium) for pregnancy. If fertilization occurs, the corpus luteum must be prevented from degenerating.

Solution:

Step 1: In a normal menstrual cycle, the corpus luteum degenerates after about 10–14 days due to the withdrawal of LH (Luteinizing Hormone).

Step 2: If pregnancy occurs, the developing trophoblast cells of the embryo (later the placenta) secrete a hormone called **hCG (human Chorionic Gonadotropin)**.

Step 3: hCG mimics the action of LH and signals the corpus luteum to continue functioning and secreting progesterone throughout the first trimester.

Step 4: This prevents menstruation and ensures the pregnancy is maintained until the placenta is fully developed enough to take over progesterone production.

Final Answer: B

Answer: (B)

Go Back to Question 76

Q77.

Solution

Concept:

The sperm is a highly specialized cell designed for motility and fertilization. Each part of the sperm is derived from specific organelles of the spermatid during the process of spermiogenesis.

Solution:

Step 1: The head of the sperm contains the nucleus and is capped by a structure called the **acrosome**.

Step 2: The acrosome is filled with proteolytic enzymes (like hyaluronidase and acrosin) that help the sperm penetrate the protective layers of the ovum (zona pellucida).

Step 3: This acrosome is formed from the **Golgi complex** of the spermatid, which packages these enzymes into a large vesicle at the anterior end of the nucleus.

Step 4: Other organelles also have specific roles: Mitochondria cluster in the middle piece to provide energy (ATP) for movement, and the centriole forms the axial filament of the tail.

Final Answer: B

Answer: (B)

Go Back to Question 77

Q78.

Solution

Concept:

Life span is the period from birth to the natural death of an organism. It is important to note that life span is not necessarily correlated with the size of the organism; for example, a crow and a parrot are similar in size but have vastly different life spans.

Solution:

Step 1: A **Butterfly** has a very short life span, typically ranging from **1-2 weeks** (i-p).

Step 2: A **Crow** has a life span of approximately **15 years** (ii-q).

Step 3: A **Parrot**, despite being similar in size to a crow, lives for a remarkably long time, up to **140 years** (iii-r).

Step 4: A **Crocodile** has a life span of about **60 years**, which is similar to that of a horse (iv-s).

Matching the organisms to their life spans: i-p, ii-q, iii-r, iv-s.

Final Answer: A

Answer: (A)

Go Back to Question 78

Q79.

Solution

Concept:

Severe Combined Immunodeficiency (SCID) is a genetic disorder that leaves the individual without a functional immune system. One form of SCID is caused by a single gene defect that affects lymphocyte maturation.

Solution:

Step 1: The most common target for the first successful gene therapy trials was a deficiency in the enzyme **Adenosine deaminase (ADA)**.

Step 2: This enzyme is crucial for the breakdown of metabolic byproducts that are toxic to T-lymphocytes. Without ADA, these cells die, leading to total immune failure.

Step 3: Gene therapy involves introducing a functional copy of the ADA gene into the patient's cells (usually bone marrow cells or lymphocytes) to restore enzyme production.

Step 4: Reverse transcriptase and Restriction endonucleases are tools used in molecular biology but are not the "missing enzymes" that cause the disease itself.

Final Answer: A

Answer: (A)

Go Back to Question 79

Q80.

Solution

Concept:

In the lineage of human evolution, there is a transition from ape-like ancestors to the genus *Homo*. The term "human-like" specifically refers to the first species that exhibited characteristics like making tools and a larger brain than previous hominids.

Solution:

Step 1: **Australopithecus** (around 2-4 million years ago) lived in East African grasslands and was more ape-like, though they walked upright.

Step 2: **Homo habilis** (around 2 million years ago) is considered the first "human-like" hominid (hominid). They had a brain capacity between 650–800 cc and were the first known to make stone tools.

Step 3: **Homo erectus** appeared later (1.5 million years ago) with a larger brain and fire usage.

Step 4: **Neanderthal man** was a much later and more advanced species.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 80

Q81.

Solution

Concept:

Biodiversity conservation is classified into 'In situ' (on-site) and 'Ex situ' (off-site). In situ conservation focuses on protecting the species within its natural ecosystem to maintain the ecological community.

Solution:

Step 1: **In situ conservation** includes Biosphere Reserves, National Parks, Wildlife Sanctuaries, and Sacred Groves. These areas protect the entire habitat.

Step 2: **Hotspots** are regions with very high levels of species richness and high degree of endemism. They are priority areas for In situ conservation.

Step 3: **Ex situ conservation** involves removing threatened animals and plants from their natural habitat and placing them in special settings like **Zoological Parks**, Botanical Gardens, and Wildlife Safari Parks for protection and care.

Step 4: Therefore, Statement C is incorrect because Zoological parks are an Ex situ strategy, not an In situ one.

Final Answer: $\boxed{C}$

Answer: (C)

Go Back to Question 81

Q82.

Solution

Concept:

The transport of CO_2 in the blood involves complex biochemical shifts to maintain the electrical neutrality and pH of the red blood cells (RBCs).

Solution:

Step 1: Inside RBCs, CO_2 reacts with water to form bicarbonate (HCO_3^-) and hydrogen ions (H^+).

Step 2: As bicarbonate ions diffuse out of the RBC into the plasma, the inside of the cell becomes relatively more positive.

Step 3: To maintain ionic balance and electrical neutrality, chloride ions (Cl^-) diffuse from the plasma into the RBCs.

Step 4: This phenomenon is known as the **Chloride Shift** or **Hamburger's phenomenon**.

Step 5: Bohr's effect refers to the effect of CO_2 on hemoglobin's affinity for O_2, and Haldane effect refers to the effect of O_2 on hemoglobin's affinity for CO_2.

Final Answer: $\boxed{C}$

Answer: (C)

Go Back to Question 82

Q83.

Solution

Concept:

Male reproductive functions are regulated by the Hypothalamic-Pituitary-Gonadal (HPG) axis. Hormones from the anterior pituitary directly control the endocrine and gametogenic functions of the testes.

Solution:

Step 1: **Leydig cells** (also called interstitial cells) are located in the connective tissue between the seminiferous tubules in the testes.

Step 2: These cells are responsible for the synthesis and secretion of testicular hormones called **Androgens**, mainly testosterone.

Step 3: The secretion of these androgens is stimulated by **LH (Luteinizing Hormone)** from the anterior pituitary. In males, LH is sometimes called Interstitial Cell Stimulating Hormone (ICSH).

Step 4: Since LH directly stimulates Leydig cells to produce testosterone, the reason correctly explains how and why these cells function.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 83

Q84.

Solution

Concept:

Epithelial tissues are specialized based on their location and function. In certain tubular organs, the epithelium possesses hair-like projections to facilitate the movement of particles or fluids in a specific direction.

Solution:

Step 1: The **Fallopian tubes** (oviducts) need to transport the non-motile ovum (egg) from the ovary toward the uterus.

Step 2: To achieve this, the inner lining consists of **Ciliated epithelium**. The rhythmic beating of the cilia creates a current that moves the ovum.

Step 3: Similarly, ciliated epithelium is found in the respiratory tract (bronchioles) to move mucus and trapped particles toward the pharynx.

Step 4: Squamous epithelium is for diffusion (alveoli), and cuboidal is for secretion/absorption (nephrons).

Final Answer: C

Answer: (C)

Go Back to Question 84

Q85.

Solution

Concept:

Plant Growth Regulators (PGRs) exist in various chemical forms. While most are solids or liquids at room temperature, one major PGR exists naturally in a gaseous state.

Solution:

Step 1: **Ethylene** (C_2H_4) is a simple gaseous PGR.

Step 2: It is primarily synthesized by tissues undergoing senescence and by ripening fruits.

Step 3: Ethylene is famous for its role in horizontal growth of seedlings, swelling of the axis, and apical hook formation in dicot seedlings. It also promotes fruit ripening.

Step 4: ABA, Gibberellic acid, and Zeatin (a cytokinin) are non-gaseous organic compounds.

Final Answer: B

Answer: (B)

Go Back to Question 85

Q86.

Solution

Concept:

The Proximal Convoluted Tubule (PCT) is the primary site for the reabsorption of essential nutrients and water from the glomerular filtrate. While most "waste" is meant to be excreted, some small molecules like urea are partially reabsorbed to maintain osmotic gradients.

Solution:

Step 1: In the PCT, nearly all essential nutrients (glucose, amino acids) and $70-80\%$ of electrolytes and water are reabsorbed.

Step 2: Urea is a small, uncharged molecule. As water is reabsorbed in the PCT, the concentration of urea in the remaining filtrate increases.

Step 3: This concentration gradient causes urea to diffuse passively back into the peritubular capillaries.

Step 4: Approximately **50%** of the filtered urea is reabsorbed in the PCT. This urea is later partially secreted back into the thin ascending limb of the Henle's loop as part of the "urea recycling" mechanism to maintain medullary osmolarity.

Final Answer: 50%

Answer: (B)

Go Back to Question 86

Q87.

Solution

Concept:

The genetic code is a set of rules used by living cells to translate information encoded within genetic material into proteins. Out of 64 codons, 61 code for amino acids and 3 serve as signals to end protein synthesis.

Solution:

Step 1: **Start Codon**: AUG (coding for Methionine) is the most common start signal. Sometimes GUG can act as a start codon in specific contexts.

Step 2: **Sense Codons**: These are the 61 codons that specify one of the 20 standard amino acids (e.g., UUU codes for Phenylalanine).

Step 3: **Stop Codons (Nonsense Codons)**: These do not code for any amino acid. When a ribosome encounters them, the translation process terminates.

Step 4: The three stop codons are:

- **UAA** (Ochre)
- **UAG** (Amber)
- **UGA** (Opal)

Step 5: Among the options, UAA is a recognized stop codon.

Final Answer: $\boxed{C}$

Answer: (C)

Go Back to Question 87

Q88.

Solution

Concept:

Lung capacities are derived by adding specific respiratory volumes. Vital Capacity (VC) represents the maximum volume of air a person can breathe out after a forced inspiration.

Solution:

Step 1: **Tidal Volume (TV)**: Air inspired/expired during normal breath ($\approx$ 500 mL).

Step 2: **Inspiratory Reserve Volume (IRV)**: Additional air inspired forcibly ($\approx 2500 - 3000$ mL).

Step 3: **Expiratory Reserve Volume (ERV)**: Additional air expired forcibly ($\approx 1000 - 1100$ mL).

Step 4: **Vital Capacity (VC)** is the sum of these three volumes: $VC = TV + IRV + ERV$. It is an important clinical measure of lung power.

Step 5: Total Lung Capacity would further include the Residual Volume ($VC + RV$).

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 88

Q89.

Solution

Concept:

Plants and other organisms produce chemicals that are not directly involved in growth or development but have significant ecological or medicinal roles. These are called secondary metabolites.

Solution:

Step 1: **Morphine** (from *Papaver somniferum*) is a secondary metabolite (alkaloid) used primarily as a potent analgesic (painkiller).

Step 2: **Abrin** and **Ricin** are highly toxic proteins (lectins) found in seeds; they are toxins rather than therapeutic drugs.

Step 3: **Vinblastine** and **Vincristine** are alkaloids derived from the Madagascar Periwinkle (*Catharanthus roseus*).

Step 4: These compounds are widely used as chemotherapy **drugs** to treat various types of cancers, including leukemia and lymphoma, because they inhibit microtubule formation during mitosis.

Final Answer: B

Answer: (B)

Go Back to Question 89

Q90.

Solution

Concept:

Gene therapy is a technique used to correct a hereditary disease by providing a functional gene to replace a defective one. Adenosine Deaminase (ADA) deficiency was the first disorder to be treated this way.

Solution:

Step 1: The first clinical trial of gene therapy took place in **1990** at the NIH (USA) on a four-year-old girl suffering from SCID (Severe Combined Immunodeficiency).

Step 2: This specific form of SCID is caused by a deficiency of the enzyme **Adenosine Deaminase (ADA)**, which is essential for the immune system to function.

Step 3: The biochemical cause is a genetic mutation leading to the **deletion** of the gene that codes for this enzyme.

Step 4: Treatment involved extracting the patient's lymphocytes, growing them in culture, inserting a functional ADA cDNA using a retroviral vector, and returning them to the patient.

Step 5: Both Statement I and Statement II accurately describe the history and the genetic basis of the disease.

Final Answer: A

Answer: (A)

Go Back to Question 90

Q91.

Solution

Concept:

Electrocardiogram (ECG) is a graphical representation of the electrical activity of the heart during a cardiac cycle. To obtain a standard ECG, a patient is connected to the machine with three electrical leads (one to each wrist and to the left ankle).

Solution:

Step 1: The **P-wave** is the first small upward deflection. It represents the electrical excitation or **depolarization of the atria**, which leads to the contraction of both the atria.

Step 2: The **QRS complex** represents the depolarization of the ventricles, which initiates the ventricular contraction. The contraction starts shortly after Q and marks the beginning of the systole.

Step 3: The **T-wave** represents the return of the ventricles from excited to normal state (**repolarization**). The end of the T-wave marks the end of systole.

Step 4: Repolarization of the atria also occurs, but it is masked by the much stronger QRS complex and is not usually visible on a standard ECG.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 91

Q92.

Solution

Concept:

Recombinant DNA technology requires specific tools to manipulate DNA. Just as a tailor needs scissors and glue, a molecular biologist needs enzymes to cut and join DNA strands at precise locations.

Solution:

Step 1: **Restriction Endonucleases** are enzymes that cut DNA at specific base sequences called palindromic recognition sequences. Because they cut DNA internally at specific points, they are popularly called **"Molecular Scissors"**.

Step 2: **DNA Ligase** is the "Molecular Glue" used to join two DNA fragments together by forming phosphodiester bonds.

Step 3: **DNA Polymerase** is used to synthesize new DNA strands by adding nucleotides to a template.

Step 4: **Reverse Transcriptase** is used to synthesize $cDNA$ from an RNA template.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 92

Q93.

Solution

Concept:

Fruits are classified based on which part of the flower develops into the fruit. In most plants, the fruit develops only from the ovary, and other floral parts degenerate and fall off.

Solution:

Step 1: **True Fruits** are those that develop exclusively from the mature ovary after fertilization (e.g., **Mango**, Watermelon, Pea).

Step 2: **False Fruits** (Pseudocarps) are those in which other floral parts, such as the thalamus or receptacle, also contribute to fruit formation.

Step 3: Examples of false fruits include **Apple**, **Strawberry**, and **Cashew**, where the fleshy part we eat is actually the enlarged thalamus.

Step 4: Since Mango develops solely from the ovary, it is a true fruit.

Final Answer: $\boxed{C}$

Answer: (C)

Go Back to Question 93

Q94.

Solution

Concept:

This is a mathematical calculation regarding the pricing of laboratory equipment. A discount is a reduction in the marked price or list price of an item.

Solution:

Step 1: Identify the original cost and the discount percentage. Cost = ₹ 12000. Discount = 10

Step 2: Calculate the discount amount:

$$\text{Discount Amount} = \frac{10}{100} \times 12000 = ₹\ 1200$$

Step 3: Subtract the discount amount from the original price to find the selling price:

$$\text{Selling Price} = 12000 - 1200 = ₹\ 10800$$

Step 4: Ensure the currency symbol is correctly applied as per LaTeX standards. The final amount is ₹ 10800.

Final Answer: $\boxed{10800}$

Answer: (A)

Go Back to Question 94

Q95.

Solution

Concept:

Chromosomal disorders are caused by the addition or loss of chromosomes. Trisomy refers to the presence of an extra chromosome ($2n + 1$), and Monosomy refers to the absence of a chromosome ($2n - 1$).

Solution:

Step 1: **Klinefelter's Syndrome** is caused by the presence of an additional X chromosome in males, resulting in a karyotype of **47, XXY** (i-q).

Step 2: **Turner's Syndrome** is caused by the absence of one of the X chromosomes in females, resulting in a karyotype of **45, XO** (ii-p).

Step 3: **Down's Syndrome** is an autosomal disorder caused by the **Trisomy of chromosome 21** (iii-r).

Step 4: **Patau's Syndrome** is another autosomal trisomy, specifically the presence of an extra **chromosome 13** (iv-s).

The matching sequence is i-q, ii-p, iii-r, iv-s.

Final Answer: $\boxed{A}$

Answer: (A)

Go Back to Question 95

Q96.

Solution

Concept:

Photosynthesis in C_3 plants (like wheat and rice) follows the Calvin Cycle. The first step involves the fixation of CO_2 into a stable organic intermediate.

Solution:

Step 1: In the Calvin cycle, the primary CO_2 acceptor is a 5-carbon ketose sugar called **Ribulose-1,5-bisphosphate (RuBP)**.

Step 2: The enzyme RuBisCO catalyzes the carboxylation of RuBP with CO_2 to form a highly unstable 6-carbon intermediate.

Step 3: This intermediate immediately breaks down into two molecules of **3-phosphoglyceric acid (PGA)**, which is a 3-carbon acid.

Step 4: Because the first stable product is a 3-carbon compound, the pathway is named the C_3 pathway.

Step 5: PEP and OAA are associated with the C_4 pathway, where PEP is the primary acceptor and OAA is the first stable product.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 96

Q97.

Solution

Concept:

A "Living Fossil" is an extant (living) species that closely resembles organisms otherwise known only from the fossil record and has remained relatively unchanged over millions of years.

Solution:

Step 1: Within the Phylum Arthropoda, most groups have evolved significantly or gone extinct.

Step 2: **Limulus** (the King Crab or Horseshoe Crab) is a classic example of a living fossil. It has maintained its anatomical form for over 450 million years.

Step 3: *Apis* (Honey bee) and *Laccifer* (Lac insect) are economically important insects that have evolved significantly within their respective orders.

Step 4: *Locusta* (Gregarious pest) is a modern insect.

Step 5: Limulus is often grouped under the class Merostomata and is more closely related to arachnids than to true crabs.

Final Answer: C

Answer: (C)

Go Back to Question 97

Q98.

Solution

Concept:

Apical dominance is a phenomenon where the terminal (apical) bud of a plant grows more vigorously than the lateral (axillary) buds, inhibiting their growth. This is regulated by specific plant hormones.

Solution:

Step 1: **Auxins** (like IAA) are synthesized in the shoot apex. They move basipetally (downward) and inhibit the growth of axillary buds.

Step 2: This process ensures the plant grows vertically rather than bushier. If the shoot tip is removed (decapitation), the source of auxin is gone, and lateral buds start growing.

Step 3: **Cytokinins** are antagonistic to auxins in this regard; they promote the growth of lateral buds and can overcome apical dominance.

Step 4: **Gibberellins** primarily promote internodal elongation, and **Ethylene** is involved in fruit ripening.

Final Answer: B

Answer: (B)

Go Back to Question 98

Q99.

Solution

Concept:

Environmental protection involves international treaties aimed at solving global ecological crises. The thinning of the ozone layer in the stratosphere required a global commitment to reduce chemical pollutants.

Solution:

Step 1: The Montreal Protocol is an international treaty that was signed in 1987 (and became effective in 1989).

Step 2: Its primary objective was to protect the ozone layer by phasing out the production and consumption of Ozone Depleting Substances (ODS).

Step 3: The most prominent ODS addressed were Chlorofluorocarbons (CFCs), which release chlorine atoms that destroy ozone molecules.

Step 4: The Kyoto Protocol, on the other hand, was designed to control the emission of Greenhouse gases like CO_2 to combat global warming.

Final Answer: $\boxed{B}$

Answer: (B)

Go Back to Question 99

Q100.

Solution

Concept:

Aerobic respiration involves the transfer of electrons through a series of carriers in the inner mitochondrial membrane. This Electron Transport System (ETS) eventually transfers electrons to a final acceptor to form water.

Solution:

Step 1: Electrons from $NADH$ and $FADH_2$ are passed through Complexes I-IV.

Step 2: Complex IV (Cytochrome c oxidase) contains Cytochromes a and a_3 and two copper centers.

Step 3: At the very end of the chain, the electrons are passed to **Molecular Oxygen** (O_2).

Step 4: Oxygen acts as the final hydrogen acceptor, combining with protons (H^+) and electrons to form water (H_2O).

Step 5: Oxygen is essential because it effectively "pulls" electrons through the chain, allowing the proton gradient to be maintained for ATP synthesis.

Final Answer: $\boxed{C}$

Answer: (C)

Go Back to Question 100

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	D	2	A	3	A	4	A	5	B
6	B	7	D	8	B	9	B	10	A
11	B	12	C	13	B	14	A	15	A
16	B	17	A	18	A	19	C	20	D
21	C	22	A	23	C	24	B	25	A
26	B	27	A	28	A	29	B	30	B
31	D	32	A	33	A	34	A	35	A
36	B	37	A	38	B	39	B	40	B
41	D	42	B	43	C	44	B	45	C
46	A	47	B	48	D	49	A	50	D
51	B	52	B	53	C	54	B	55	B
56	A	57	C	58	C	59	B	60	C
61	C	62	B	63	B	64	C	65	A
66	B	67	B	68	C	69	C	70	B
71	C	72	B	73	A	74	C	75	C
76	B	77	B	78	A	79	A	80	B
81	C	82	C	83	A	84	C	85	B
86	B	87	C	88	B	89	B	90	A
91	A	92	B	93	C	94	A	95	A
96	B	97	C	98	B	99	B	100	C