

MHT-CET Biology Sample Paper-9

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. Identify the correct sequence of steps involved in the development of a typical monosporic embryo sac in angiosperms:

- (A) Megaspore Mother Cell → Meiosis → 4 Functional Megaspores → 3 Mitosis
- (B) Megaspore Mother Cell → Meiosis → 1 Functional Megaspore → 3 Mitosis
- (C) Megaspore Mother Cell → Mitosis → 1 Functional Megaspore → 3 Meiosis
- (D) Nucellus → 3 Mitosis → 1 Functional Megaspore → Meiosis

Q2. Statement I: The process of guttation is observed when root pressure is high and transpiration is low.

Statement II: Guttation occurs through specialized pores called hydathodes found at the vein endings.

- (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.

Q3. Match the following plant hormones in Column I with their specific precursors in Column II:



Column I (Hormone)	Column II (Precursor)
i. Auxin (IAA)	p. Methionine
ii. Gibberellic Acid	q. Tryptophan
iii. Ethylene	r. Acetyl CoA / Mevalonic Acid
iv. Abscisic Acid	s. Violaxanthin / Carotenoids

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

Q4. In the context of DNA replication, the enzyme _____ is responsible for relieving the torsional strain (supercoiling) ahead of the replication fork.

- (A) Helicase
 (B) Primase
 (C) DNA Topoisomerase (DNA Gyrase)
 (D) DNA Ligase

Q5. A person with blood group AB positive (AB^+) is considered a universal recipient because their blood contains:

- (A) Both A and B antigens on RBCs and both anti-A and anti-B antibodies in plasma.
 (B) Both A and B antigens on RBCs but no anti-A or anti-B antibodies in plasma.
 (C) No antigens on RBCs but both anti-A and anti-B antibodies in plasma.
 (D) A, B, and Rh antigens on RBCs and only anti-Rh antibodies in plasma.

Q6. Identify the INCORRECT statement regarding the C_4 pathway:

- (A) The primary CO_2 fixation occurs in the mesophyll cells.
 (B) The bundle sheath cells contain a high concentration of RuBisCO.
 (C) PEPcase is absent in the mesophyll cells.



(D) C4 plants lack photorespiration, leading to higher productivity.

Q7. The price of a bio-pesticide is ₹ 1200 per liter. If a farmer uses a 10% more concentrated solution to increase efficiency, what is the new cost per hectare if the original usage was 2 liters?

(A) ₹ 2400

(B) ₹ 2640

(C) ₹ 1320

(D) ₹ 3000

Q8. The volume of air inspired or expired during a normal respiration is called _____ and its value is approximately _____ mL.

(A) Vital Capacity; 3500

(B) Residual Volume; 1200

(C) Tidal Volume; 500

(D) Inspiratory Reserve Volume; 2500

Q9. Assertion (A): In a dihybrid cross, the Law of Independent Assortment is not followed if the genes are linked.

Reason (R): Linked genes are located very close to each other on the same chromosome and tend to be inherited together.

(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.

Q10. Select the correct match for the type of joint and its location:

(A) Hinge joint — Between Atlas and Axis

(B) Gliding joint — Between the Carpals

(C) Pivot joint — Between Humerus and Pectoral girdle



(D) Saddle joint — Between Phalanges

Q11. The process of charging of tRNA or aminoacylation requires _____ and _____.

(A) ATP; Aminoacyl tRNA synthetase

(B) GTP; Ribosomes

(C) ATP; Peptidyl transferase

(D) mRNA; DNA Polymerase

Q12. Which of the following is a "Living Fossil" in the Phylum Arthropoda?

(A) Apis

(B) Laccifer

(C) Limulus

(D) Locusta

Q13. The "Evil Quartet" refers to the four major causes of _____.

(A) Global Warming

(B) Biodiversity Loss

(C) Population Explosion

(D) Ozone Depletion

Q14. In human evolution, the hominid with a cranial capacity of 1400 cc who used hides to protect their body and buried their dead was:

(A) Homo habilis

(B) Homo erectus

(C) Neanderthal man

(D) Australopithecus

Q15. Identify the hormone that is NOT a protein hormone:



- (A) Insulin
- (B) Glucagon
- (C) Cortisol
- (D) Pituitary hormones

Q16. A population has 400 individuals. 40 individuals die in a year. The death rate is _____ individuals per capita per year.

- (A) 0.01
- (B) 0.1
- (C) 10
- (D) 1.0

Q17. Which of the following describes the correctly matched pair of the ecosystem pyramid?

- (A) Pyramid of Biomass in Sea — Upright
- (B) Pyramid of Energy — Always Upright
- (C) Pyramid of Number in Grassland — Inverted
- (D) Pyramid of Biomass in Forest — Inverted

Q18. The enzyme _____ is used in PCR to extend the primers using nucleotides.

- (A) DNA Ligase
- (B) Restriction Endonuclease
- (C) Taq Polymerase
- (D) Reverse Transcriptase

Q19. Which part of the brain is the main center for equilibrium and posture?

- (A) Cerebrum
- (B) Cerebellum
- (C) Hypothalamus



(D) Medulla oblongata

Q20. Match the following microbial products with their uses:

Microbe/Product	Use
i. Cyclosporin A	p. Blood cholesterol lowering agent
ii. Statins	q. Immunosuppressive agent
iii. Streptokinase	r. Digestion of oil spills
iv. Lipase	s. Removal of clots from blood vessels

- (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-r, ii-s, iii-p, iv-q

Q21. The secondary xylem and secondary phloem are produced by _____ in a dicot stem.

- (A) Phellogen
 (B) Vascular cambium
 (C) Apical meristem
 (D) Axillary meristem

Q22. Identify the correct floral formula for the family Solanaceae:

- (A) $\oplus \subsetneq K_{(5)}C_{(5)}A_5\underline{G}_{(2)}$
 (B) $\% \subsetneq K_{(5)}C_{1+2+(2)}A_{(9)+1}\underline{G}_1$
 (C) $\oplus \subsetneq K_{(5)}C_{(5)}A_{(5)}\underline{G}_{(2)}$
 (D) $\oplus \subsetneq P_{(3+3)}A_{3+3}\underline{G}_{(3)}$

Q23. Statement I: The tapetum is the innermost layer of the microsporangium.
 Statement II: Cells of tapetum are generally binucleate or multinucleate.

- (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.
- (E)

Q24. The structural and functional unit of the liver is _____.

- (A) Nephron
- (B) Hepatic lobule
- (C) Alveoli
- (D) Glisson's capsule

Q25. Identify the correct sequence of stages in the development of a human embryo:

- (A) Zygote → Morula → Blastocyst → Gastrula
- (B) Zygote → Blastocyst → Morula → Gastrula
- (C) Zygote → Gastrula → Blastocyst → Morula
- (D) Zygote → Morula → Gastrula → Blastocyst

Q26. Match the following disorders with their chromosomal constitution:

Disorder	Constitution
i. Down's syndrome	p. 44 + XXY
ii. Klinefelter's syndrome	q. 44 + X0
iii. Turner's syndrome	r. 44 + XY (Trisomy 21)

- (A) i-r, ii-p, iii-q
- (B) i-p, ii-q, iii-r
- (C) i-q, ii-r, iii-p
- (D) i-r, ii-q, iii-p

Q27. The hormone _____ triggers the LH surge in human females.

- (A) Progesterone



- (B) FSH
- (C) Estrogen
- (D) Oxytocin

Q28. Which of the following is NOT an In-situ conservation strategy?

- (A) National Park
- (B) Wildlife Sanctuary
- (C) Botanical Garden
- (D) Biosphere Reserve

Q29. The net gain of ATP molecules from one molecule of glucose in aerobic respiration is:

- (A) 2
- (B) 38
- (C) 36
- (D) 4

Q30. Identify the correctly matched pair regarding respiratory organs:

- (A) Prawn — Gills
- (B) Earthworm — Tracheal tubes
- (C) Cockroach — Moist skin
- (D) Scorpion — Lungs

Q31. Which of the following represents the correct path of water movement in the root according to the Apoplast pathway?

- (A) Cell wall → Intercellular spaces → Casparian strips → Pericycle
- (B) Cytoplasm → Plasmodesmata → Endodermis → Xylem
- (C) Cell wall → Intercellular spaces → Endodermis (upto Casparian strips) → Symplast



(D) Vacuole → Tonoplast → Cytoplasm → Xylem

Q32. Statement I: In a Monohybrid cross, the F_2 phenotypic and genotypic ratios are identical in the case of Incomplete Dominance.

Statement II: This deviation from Mendel's law is due to the blending of alleles in the F_1 hybrid.

- (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.

Q33. Identify the correct combination of the organism and its unique excretory organ:

Organism	Excretory Organ
i. Rotifers	p. Green Glands
ii. Amphioxus	q. Flame cells (Protonephridia)
iii. Prawn	r. Solenocytes
iv. Earthworm	s. Nephridia

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

Q34. In the LAC Operon, the sequence of structural genes is _____ and the gene 'i' codes for _____.

- (A) z-y-a; Inducer
 (B) a-y-z; Repressor
 (C) z-y-a; Repressor protein
 (D) y-z-a; β -galactosidase



- Q35.** Calculate the number of nucleosomes present in a diploid human cell containing 6.6×10^9 bp of DNA.
- (A) 3.3×10^7
(B) 6.6×10^7
(C) 2.2×10^7
(D) 4.4×10^7
- Q36.** Identify the correct sequence of events in the Cardiac Cycle:
- (A) Atrial Systole → Ventricular Systole → Joint Diastole
(B) Ventricular Systole → Atrial Systole → Joint Diastole
(C) Joint Diastole → Atrial Systole → Ventricular Systole
(D) Atrial Diastole → Joint Systole → Ventricular Diastole
- Q37.** Which of the following enzymes is used to remove the "phloem sap" from the aphid's stylet for chemical analysis?
- (A) Cellulase
(B) Pectinase
(C) Protease
(D) No enzyme, it is collected via the pressure of the sap itself.
- Q38.** The process of formation of mRNA from DNA is called _____ and it is catalyzed by _____.
- (A) Replication; DNA Polymerase
(B) Transcription; RNA Polymerase II
(C) Translation; Ribozyme
(D) Transcription; RNA Polymerase I
- Q39.** Assertion (A): The pyramid of biomass in a pond ecosystem is typically inverted.
Reason (R): The biomass of phytoplanktons is smaller than that of the herbivorous fish and zooplanktons at any given time.



- (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.

Q40. A recombinant DNA molecule is produced by joining the foreign DNA to the vector DNA using the enzyme:

- (A) EcoRI
- (B) DNA Polymerase
- (C) DNA Ligase
- (D) Taq Polymerase

Q41. In a test cross involving F_1 dihybrid flies, more parental-type offspring were produced than recombinant-type offspring. This indicates that:

- (A) The two genes are located on different chromosomes.
- (B) The two genes are linked on the same chromosome.
- (C) There is a high frequency of crossing over.
- (D) The genes follow the Law of Independent Assortment.

Q42. The volume of blood pumped out by each ventricle per minute is called _____ and is approximately _____ liters in a healthy adult.

- (A) Stroke Volume; 0.07
- (B) Cardiac Output; 5.0
- (C) Tidal Volume; 0.5
- (D) Vital Capacity; 4.5

Q43. Identify the hormone secreted by the G-cells of the stomach that stimulates gastric juice secretion:

- (A) Secretin



- (B) Gastrin
- (C) Cholecystokinin (CCK)
- (D) Gastric Inhibitory Peptide (GIP)

Q44. The term 'Humus' refers to the _____ and _____ substance formed during decomposition.

- (A) Light colored; Crystalline
- (B) Dark colored; Amorphous
- (C) Green colored; Fibrous
- (D) Yellow colored; Colloidal

Q45. The value of Biogenetic Law (Recapitulation Theory) was proposed by:

- (A) Charles Darwin
- (B) Ernst Haeckel
- (C) Hugo de Vries
- (D) Lamarck

Q46. Which of the following is a symptom of Down's Syndrome?

- (A) Gynaecomastia
- (B) Rudimentary ovaries
- (C) Furrowed tongue and partially open mouth
- (D) Sterile male

Q47. During DNA fingerprinting, the DNA fragments are separated based on their size using:

- (A) Polymerase Chain Reaction
- (B) Gel Electrophoresis
- (C) Southern Blotting
- (D) Autoradiography



Q48. Identify the correct match for the secondary metabolites and their categories:

Category	Example
i. Alkaloids	p. Anthocyanins
ii. Terpenoids	q. Morphine
iii. Pigments	r. Monoterpenes
iv. Lectins	s. Concanavalin A

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

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

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

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

Q49. The concentration of the essential element below which plant growth is retarded is termed as _____.

(A) Toxicity level

(B) Critical concentration

(C) Optimum concentration

(D) Deficiency level

Q50. What is the total number of biodiversity hotspots identified in the world?

(A) 25

(B) 34

(C) 40

(D) 17

Q51. Which cell organelle is known as the "Packaging center" of the cell?

(A) Mitochondria

(B) Endoplasmic Reticulum

(C) Golgi apparatus

(D) Lysosome



Q52. Statement I: RuBisCO is the most abundant protein in the whole of the biosphere.
Statement II: It has an affinity for both CO_2 and O_2 .

- (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.

Q53. The function of filiform apparatus in the embryo sac is to:

- (A) Recognize the suitable pollen at the stigma.
- (B) Guide the entry of pollen tube into the synergid.
- (C) Prevent polyspermy.
- (D) Stimulate division of the generative cell.

Q54. Match the following terms in Column I with their descriptions in Column II:

Column I	Column II
i. Euryhaline	p. Organisms restricted to a narrow range of salinity
ii. Stenohaline	q. Organisms tolerant to a wide range of salinity
iii. Eurythermal	r. Organisms restricted to a narrow range of temperature
iv. Stenothermal	s. Organisms tolerant to a wide range of temperature

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

Q55. The first human-like hominid was called _____.

- (A) Homo erectus
- (B) Homo habilis
- (C) Dryopithecus
- (D) Ramapithecus



- Q56.** Which of the following molecules acts as an inducer in the LAC operon?
- (A) Glucose
 - (B) Galactose
 - (C) Lactose
 - (D) Tryptophan
- Q57.** In human females, the first polar body is formed during _____ at the stage of _____.
- (A) Oogenesis; Meiosis I
 - (B) Spermatogenesis; Meiosis II
 - (C) Oogenesis; Mitosis
 - (D) Gastrulation; Meiosis I
- Q58.** The interaction where one species is harmed and the other is unaffected is called:
- (A) Commensalism
 - (B) Amensalism
 - (C) Mutualism
 - (D) Parasitism
- Q59.** A person suffers from a condition where the immune system starts attacking its own body cells. This is known as:
- (A) Allergy
 - (B) Auto-immunity
 - (C) Immunodeficiency
 - (D) Active immunity
- Q60.** The restriction enzyme HindII cuts DNA at a specific sequence of _____ base pairs.



- (A) 4
- (B) 8
- (C) 6
- (D) 5

Q61. In the context of biodiversity, "Z" in the species-area relationship curve represents _____.

- (A) Species richness
- (B) Area
- (C) Regression coefficient (slope of the line)
- (D) Y-intercept

Q62. Match the following biomes with their characteristic vegetation/features:

Biome	Feature
i. Tropical Rainforest	p. Permafrost
ii. Coniferous Forest	q. Maximum biodiversity
iii. Tundra	r. Sclerophyllous leaves
iv. Chaparral	s. Needle-like leaves

- (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-r, ii-s, iii-q, iv-p

Q63. The cost of a high-yield genetically modified seed is ₹ 4500 per bag. If a government subsidy reduces the price by 15%, what is the cost of 5 bags for a farmer?

- (A) ₹ 22500
- (B) ₹ 19125
- (C) ₹ 3825
- (D) ₹ 20000



Q64. Which of the following is the correct order of phases in a sigmoid growth curve?

- (A) Lag → Log → Stationary
- (B) Log → Lag → Stationary
- (C) Stationary → Lag → Log
- (D) Lag → Stationary → Log

Q65. The DNA-dependent DNA polymerase catalyzes polymerization only in one direction, which is:

- (A) 3' → 5'
- (B) 5' → 3'
- (C) 5' → 5'
- (D) 3' → 3'

Q66. Which of the following parts of the human brain is responsible for the regulation of body temperature and the urge for eating?

- (A) Thalamus
- (B) Corpus callosum
- (C) Hypothalamus
- (D) Hippocampus

Q67. The first clinical gene therapy was given in 1990 to a 4-year-old girl with _____ deficiency.

- (A) Tyrosinase
- (B) Adenosine deaminase (ADA)
- (C) Insulin
- (D) Glucokinase

Q68. Match the following terms with their definitions:



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Term	Definition
i. Standing Crop	p. Rate of biomass production
ii. Productivity	q. Mass of living material at a particular time
iii. Decomposition	r. Breakdown of complex organic matter
iv. Stratification	s. Vertical distribution of different species

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

Q69. In the DNA double helix, the plane of one base pair stacks over the other. This provides _____ to the helical structure.

- (A) Flexibility
- (B) Stability
- (C) Mutability
- (D) Permeability

Q70. Identify the correct statement about the Juxtaglomerular Apparatus (JGA):

- (A) A fall in GFR activates JG cells to release Renin.
- (B) An increase in GFR activates JG cells to release Renin.
- (C) Renin converts Angiotensinogen to Angiotensin II directly.
- (D) JGA is located in the Medulla of the kidney.

Q71. The hormone _____ is responsible for the "Milk-Ejection Reflex" during breastfeeding.

- (A) Prolactin
- (B) Estrogen
- (C) Oxytocin
- (D) Progesterone



Q72. Select the correct floral formula for the family Liliaceae:

- (A) $\oplus \underline{\subset} K_{(5)}C_{(5)}A_5\underline{G}_{(2)}$
- (B) $Br\oplus \underline{\subset} P_{(3+3)}A_{3+3}\underline{G}_{(3)}$
- (C) $\% \underline{\subset} K_{(5)}C_{1+2+(2)}A_{(9)+1}\underline{G}_1$
- (D) $\oplus \underline{\subset} K_{(5)}C_5A_\infty\underline{G}_{(5)}$

Q73. Which type of natural selection occurs when the environment favors average individuals in a population?

- (A) Directional Selection
- (B) Disruptive Selection
- (C) Stabilizing Selection
- (D) Cyclic Selection

Q74. The most common substrate used for the production of ethanol in distilleries is _____.

- (A) Corn
- (B) Molasses
- (C) Bamboo
- (D) Soya bean

Q75. Identify the mismatched pair:

- (A) Streptococcus — Streptokinase
- (B) Aspergillus niger — Citric acid
- (C) Trichoderma polysporum — Statins
- (D) Clostridium butylicum — Butyric acid

Q76. In a sea-shore ecosystem, the interaction between sea anemone and hermit crab is an example of:

- (A) Parasitism



- (B) Commensalism
- (C) Proto cooperation
- (D) Amensalism

Q77. A patient is diagnosed with an autoimmune disorder where the neuromuscular junction is affected, leading to fatigue and paralysis of skeletal muscles. This is:

- (A) Muscular dystrophy
- (B) Myasthenia gravis
- (C) Tetany
- (D) Arthritis

Q78. The DNA sequences that are repeated many times in the human genome are known as _____ DNA.

- (A) Coding
- (B) Repetitive
- (C) Unique
- (D) Functional

Q79. If the sequence of nitrogen bases in the coding strand of DNA is 5'-ATGAATT-3', what will be the sequence of the corresponding mRNA?

- (A) 5'-UACUAAA-3'
- (B) 5'-AUGAAUU-3'
- (C) 3'-UACUAAA-5'
- (D) 5'-TACTTAA-3'

Q80. Which of the following is a "biodiversity-rich" region often described as the "Lungs of the Planet"?

- (A) Western Ghats
- (B) Amazon Rain Forest



- (C) Himalayan Region
- (D) Sahara Desert

Q81. The functional residual capacity (FRC) in human lungs is equal to:

- (A) $TV + ERV$
- (B) $ERV + RV$
- (C) $TV + IRV$
- (D) $VC + RV$

Q82. In the context of population growth, the 'Carrying Capacity' is represented by the symbol _____.

- (A) r
- (B) N
- (C) K
- (D) t

Q83. The structural gene in a transcription unit that codes for a polypeptide is called _____.

- (A) Muton
- (B) Recon
- (C) Cistron
- (D) Intron

Q84. Identify the correct order of layers of the alimentary canal from outer to inner:

- (A) Serosa \rightarrow Muscularis \rightarrow Sub-mucosa \rightarrow Mucosa
- (B) Mucosa \rightarrow Sub-mucosa \rightarrow Muscularis \rightarrow Serosa
- (C) Serosa \rightarrow Sub-mucosa \rightarrow Muscularis \rightarrow Mucosa
- (D) Muscularis \rightarrow Serosa \rightarrow Sub-mucosa \rightarrow Mucosa

Q85. Which of the following was the first transgenic cow, produced in 1997?



- (A) Dolly
- (B) Rosie
- (C) Tracy
- (D) Polly

Q86. The value of ₹ 850 is the cost of one unit of a recombinant protein. If a clinic requires 12 units per patient per month, what is the annual cost for 5 patients?

- (A) ₹ 10200
- (B) ₹ 51000
- (C) ₹ 612000
- (D) ₹ 122400

Q87. The trigger for activation of Bt-toxin in the gut of the bollworm is _____.

- (A) Acidic pH
- (B) Alkaline pH
- (C) High temperature
- (D) Mechanical pressure

Q88. Match the Column I (Vitamins) with Column II (Deficiency Disease):

Vitamin	Disease
i. Vitamin A	p. Beri-beri
ii. Vitamin B1	q. Nyctalopia
iii. Vitamin C	r. Rickets
iv. Vitamin D	s. Scurvy

- (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-r, ii-s, iii-p, iv-q

Q89. Which of the following is NOT an example of a secondary pollutant?



- (A) PAN (Peroxyacyl nitrate)
- (B) Ozone (O_3)
- (C) Carbon monoxide (CO)
- (D) Nitric acid (HNO_3)

Q90. The stage of the Plasmodium parasite that is infectious to humans is _____.

- (A) Trophozoite
- (B) Sporozoite
- (C) Gametocyte
- (D) Merozoite

Q91. The process of formation of mature seeds without fertilization is called:

- (A) Parthenocarpy
- (B) Apomixis
- (C) Polyembryony
- (D) Amphimixis

Q92. Identify the cell that is responsible for producing antibodies in the human body:

- (A) T-cytotoxic cell
- (B) B-lymphocyte (Plasma cell)
- (C) Natural Killer cell
- (D) Neutrophil

Q93. Statement I: Montreal Protocol was signed to control the emission of ozone-depleting substances.

Statement II: It was signed in 1987 and became effective in 1989.

- (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.

Q94. The presence of _____ in the urine is an indicative symptom of Diabetes Mellitus.

- (A) Urea and Uric acid
(B) Glucose and Ketone bodies
(C) Albumin and Creatinine
(D) Sodium and Potassium

Q95. Match the following terms in the context of PCR:

Step	Temperature
i. Denaturation	p. 54°C
ii. Annealing	q. 72°C
iii. Extension	r. 94°C

- (A) i-r, ii-p, iii-q
(B) i-p, ii-q, iii-r
(C) i-q, ii-r, iii-p
(D) i-r, ii-q, iii-p

Q96. Which of the following is a "stop codon" during translation?

- (A) AUG
(B) UGG
(C) UAA
(D) GUG

Q97. The "Test-tube baby" program involves which of the following techniques?

- (A) GIFT
(B) ZIFT



- (C) AI
- (D) IUI

Q98. The primary consumers in a pond ecosystem are _____.

- (A) Phytoplanktons
- (B) Zooplanktons
- (C) Small fish
- (D) Benthic organisms

Q99. Which of the following is the largest gland in the human body?

- (A) Pancreas
- (B) Thyroid
- (C) Liver
- (D) Pituitary

Q100. The most commonly used vector for cloning genes into higher plants is:

- (A) pBR322
- (B) *Agrobacterium tumefaciens* (Ti plasmid)
- (C) Phagemid
- (D) *Salmonella typhimurium*



Detailed Solutions

Q1.

Solution

Concept: The development of the female gametophyte (embryo sac) from a megaspore mother cell is called megasporogenesis and megagametogenesis. In about 80% of angiosperms, only one megaspore out of the four produced participates in the formation of the embryo sac, a process termed monosporic development.

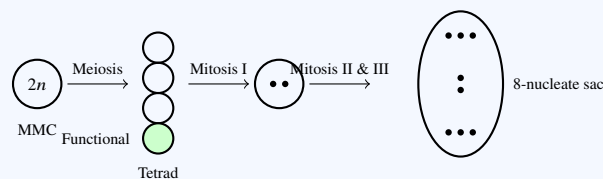
Solution: Step 1: A single diploid ($2n$) Megaspore Mother Cell (MMC) differentiates in the nucellus of the ovule.

Step 2: The MMC undergoes meiosis to produce a linear tetrad of four haploid (n) megaspores.

Step 3: In monosporic development, three megaspores (usually at the micropylar end) degenerate, while one remains functional (usually at the chalazal end).

Step 4: The nucleus of the functional megaspore undergoes three successive mitotic divisions. The first mitosis produces 2 nuclei, the second produces 4, and the third produces 8 nuclei.

Step 5: These 8 nuclei are eventually organized into cells: 3 form the egg apparatus (egg cell and two synergids), 3 form antipodal cells, and 2 (polar nuclei) reside in the large central cell.



Final Answer: (B) Megaspore Mother Cell \rightarrow Meiosis \rightarrow 1 Functional Megaspore \rightarrow 3 Mitosis

Answer: (B)

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Q2.

Solution**Concept:**

Guttation is the exudation of liquid water from the leaves of plants. It is distinct from transpiration, which is the loss of water as vapor.

Solution:

Step 1: Evaluate Statement I. Guttation occurs when the rate of water absorption by roots is high (root pressure) and the rate of water loss via transpiration is low (e.g., at night or early morning in high humidity). This matches the statement.

Step 2: Evaluate Statement II. The liquid droplets are released through specialized structures called hydathodes. These are permanent openings located at the margins or tips of the leaves where veins terminate. This statement is also correct.

Step 3: Both statements are factual and accurately describe the physiological and anatomical requirements for guttation.

Final Answer:

Answer: (A)

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Q3.

Solution**Concept:**

Plant Growth Regulators (PGRs) are synthesized from specific chemical precursors. Matching the hormone to its biosynthetic origin is a common "Hard" level MHT-CET question.

Solution:

Step 1: Auxin (Indole-3-acetic acid) is chemically related to the amino acid Tryptophan, which serves as its primary precursor (i-q).

Step 2: Gibberellins are terpenes synthesized via the mevalonic acid pathway, starting from Acetyl CoA (ii-r).

Step 3: Ethylene is a gaseous hormone derived from the sulfur-containing amino acid Methionine (iii-p).

Step 4: Abscisic Acid (ABA) is a sesquiterpene often synthesized from carotenoid pigments like violaxanthin (iv-s).

Step 5: Comparing the matches: i-q, ii-r, iii-p, iv-s leads to Option A.

Final Answer:

Answer: (A)

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Q4.

Solution**Concept:**

DNA replication involves multiple enzymes working in a coordinated manner. As Helicase unwinds the double helix, it creates tension in the form of supercoils ahead of the fork.

Solution:

Step 1: Helicase acts as the "zipper" to separate strands, but it doesn't solve the problem of overwinding.

Step 2: Primase synthesizes RNA primers to provide a starting point for DNA Polymerase.

Step 3: DNA Topoisomerase (specifically DNA Gyrase in prokaryotes) works ahead of the replication fork. It cuts the DNA strands, allows them to rotate to release the torsional strain, and then reseals them.

Step 4: DNA Ligase is used later to join Okazaki fragments on the lagging strand.

Step 5: Therefore, the enzyme responsible for relieving supercoiling is Topoisomerase.

Final Answer:

Answer: (C)

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Q5.

Solution**Concept:**

Blood grouping (ABO and Rh) is determined by antigens present on the surface of RBCs and naturally occurring antibodies in the plasma.

Solution:

Step 1: Blood group AB has both A and B antigens on the RBC surface.

Step 2: Because it has both antigens, the plasma does not contain anti-A or anti-B antibodies (otherwise, the blood would clump/agglutinate).

Step 3: The '+' sign indicates the presence of the Rh antigen (Rhesus factor) on the RBCs.

Step 4: Being a "universal recipient" means this person can receive any blood type (A, B, AB, O) because their plasma lacks the antibodies that would attack incoming RBC antigens.

Step 5: Specifically, AB^+ has A, B, and Rh antigens and no antibodies against them in the plasma.

Final Answer:

Answer: (B)

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Q6.

Solution**Concept:**

C4 plants have evolved a specialized anatomy called Kranz anatomy to minimize photorespiration and maximize CO_2 fixation efficiency in high temperature and light conditions.

Solution:

Step 1: In C4 plants, the primary CO_2 fixation occurs in the mesophyll cells where PEPcase (Phosphoenolpyruvate carboxylase) fixes CO_2 into Oxaloacetic acid.

Step 2: The mesophyll cells contain PEPcase but lack RuBisCO to prevent the oxygenase activity of RuBisCO.

Step 3: The C4 acids are transported to bundle sheath cells, where they are decarboxylated to release CO_2 .

Step 4: The bundle sheath cells are rich in RuBisCO, allowing the Calvin cycle (C_3 cycle) to proceed in a CO_2 -rich environment, effectively eliminating photorespiration.

Step 5: Statement C is incorrect because PEPcase is actually present in mesophyll cells, not absent. It is RuBisCO that is absent in mesophyll cells.

Final Answer: C

Answer: (C)

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Q7.

Solution**Concept:**

This problem involves basic arithmetic applied to a biological application (bio-pesticide usage) to determine the total expenditure per hectare.

Solution:

Step 1: Calculate the original cost per hectare. The farmer uses 2 liters per hectare at a rate of ₹ 1200 per liter. Original Cost = $2 \times 1200 = ₹ 2400$.

Step 2: Calculate the cost of the more concentrated solution. The solution is 10% increase in cost = 10%

Step 3: Calculate the new total cost. New Cost = Original Cost + Increase = $2400 + 240 = ₹ 2640$.

Step 4: Alternatively, New rate per liter = $1200 + (0.10 \times 1200) = ₹ 1320$. Total cost for 2 liters = $2 \times 1320 = ₹ 2640$.

Final Answer: B

Answer: (B)

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Q8.

Solution**Concept:**

Respiratory volumes and capacities are essential parameters used to assess pulmonary function. Each volume represents a specific quantity of air moved under different conditions.

Solution:

Step 1: Tidal Volume (TV) is the volume of air inspired or expired during a normal, quiet respiration.

Step 2: In a healthy adult human, the average value of Tidal Volume is approximately 500 mL.

Step 3: Vital Capacity is the maximum volume of air a person can breathe in after a forced expiration (approx. 3500-4500 mL).

Step 4: Residual Volume is the volume of air remaining in the lungs even after a forcible expiration (approx. 1100-1200 mL).

Step 5: Comparing the definitions and values, the "volume of air inspired or expired during normal respiration" is Tidal Volume, and its value is 500 mL.

Final Answer: C

Answer: (C)

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Q9.

Solution**Concept:**

Mendel's Law of Independent Assortment states that the alleles of two (or more) different genes get sorted into gametes independently of one another. However, Linkage is an exception to this law.

Solution:

Step 1: Analyze the Assertion (A). The Law of Independent Assortment applies only to genes located on different chromosomes or very far apart on the same chromosome. If genes are "linked," they do not assort independently. Thus, A is true.

Step 2: Analyze the Reason (R). Linkage refers to the physical association of genes on a chromosome. Linked genes are situated close to each other and tend to stay together during meiosis (crossing over is less likely). Thus, R is true.

Step 3: Determine the relationship. Because the physical proximity (Linkage) prevents the genes from separating, they cannot assort independently. Therefore, R is the correct explanation for why the law is not followed in this specific case.

Final Answer: A

Answer: (A)

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Q10.

Solution**Concept:**

Synovial joints are characterized by the presence of a fluid-filled synovial cavity and are classified based on the type of movement they allow.

Solution:

Step 1: Hinge joint allows movement in one plane (like a door). Example: Knee or Elbow. The joint between Atlas and Axis is a Pivot joint.

Step 2: Gliding joint allows bones to glide over each other. Example: Between the carpals (wrist bones) and between the tarsals. This is a correct match.

Step 3: Pivot joint allows rotation. Example: Atlas and Axis. The joint between the Humerus and Pectoral girdle is a Ball and Socket joint.

Step 4: Saddle joint is a specialized joint. Example: Between the Carpal and Metacarpal of the thumb. The joints between phalanges are hinge joints.

Step 5: Only Option B provides a correct anatomical match for the joint type.

Final Answer:

Answer: (B)

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Q11.

Solution**Concept:**

Translation is the process of protein synthesis. Before amino acids can be joined to form a polypeptide chain, they must be activated and attached to their specific tRNA molecules. This two-step process is called "charging of tRNA" or aminoacylation.

Solution:

Step 1: The amino acid is first activated by reacting with ATP (Adenosine Triphosphate) in the presence of a specific enzyme. This forms an aminoacyl-adenylate complex.

Step 2: The enzyme responsible for this specific reaction is Aminoacyl tRNA synthetase. There is a specific synthetase for each of the 20 amino acids.

Step 3: The activated amino acid is then transferred to the 3' end (CCA tail) of its cognate tRNA, releasing AMP.

Step 4: Therefore, the two essential components required for this process are ATP (as the energy source) and the enzyme Aminoacyl tRNA synthetase.

Step 5: Ribosomes and Peptidyl transferase are involved later during the elongation phase of translation, not during the initial charging of tRNA.

Final Answer:

Answer: (A)

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Q12.

Solution**Concept:**

A "Living Fossil" is an organism that has remained essentially unchanged from earlier geologic times and whose close relatives are usually extinct.

Solution:

Step 1: Analyze the options provided within the Phylum Arthropoda.

Step 2: *Apis* (Honey bee) and *Laccifer* (Lac insect) are modern, highly evolved insects.

Step 3: *Locusta* (Locust) is a gregarious pest, also a modern insect.

Step 4: *Limulus*, commonly known as the King Crab or Horseshoe Crab, is a marine arthropod. It has survived for over 450 million years with very little morphological change.

Step 5: Because it represents a lineage that has persisted while many of its contemporaries went extinct, it is classified as a living fossil.

Final Answer: C

Answer: (C)

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Q13.

Solution**Concept:**

The "Evil Quartet" is a term used by ecologists to describe the four major anthropogenic (human-caused) drivers that lead to the extinction of species.

Solution:

Step 1: The four components of the Evil Quartet are:

1. Habitat loss and fragmentation (the most important cause). 2. Over-exploitation (e.g., Stellar's sea cow, passenger pigeon). 3. Alien species invasions (e.g., Nile perch in Lake Victoria). 4. Co-extinctions (when a host species goes extinct, its dependent parasites/mutualists also perish).

Step 2: These four factors combined are the primary reasons for the current accelerated rates of species extinction across the globe.

Step 3: Therefore, the term refers specifically to Biodiversity Loss.

Step 4: While Global Warming and Population Explosion contribute to environmental stress, they are not the specific four "arms" defined in the ecological concept of the Evil Quartet.

Final Answer: B

Answer: (B)

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Q14.

Solution**Concept:**

Human evolution is traced through various hominid stages, characterized by changes in cranial capacity, tool use, and social behaviors.

Solution:

Step 1: *Homo habilis* had a cranial capacity of 650–800 cc and was the first tool-maker.

Step 2: *Homo erectus* had a larger brain (around 900 cc) and likely used fire.

Step 3: *Neanderthal man (Homo neanderthalensis)* lived in near East and central Asia between 100,000 to 40,000 years ago.

Step 4: Neanderthals had a brain size of approximately 1400 cc. They were the first to show cultural behaviors such as using animal hides to protect their bodies and performing ritualistic burials for their dead.

Step 5: *Australopithecus* had a much smaller cranial capacity (approx. 450–600 cc), similar to modern apes.

Final Answer: C

Answer: (C)

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Q15.

Solution**Concept:**

Hormones are chemically classified into several groups: Proteins/Peptides, Steroids, Iodothyronines (thyroid hormones), and Amino-acid derivatives.

Solution:

Step 1: Insulin and Glucagon are pancreatic hormones composed of polypeptide chains; hence they are protein hormones.

Step 2: Pituitary hormones (like GH, TSH, LH, FSH) are also proteinaceous or glycoproteinaceous in nature.

Step 3: Cortisol is produced by the adrenal cortex. The adrenal cortex produces "corticoids," which are all steroid hormones derived from cholesterol.

Step 4: Other steroid hormones include Testosterone, Progesterone, and Estrogen.

Step 5: Since Cortisol is a steroid, it is the correct answer as it is "NOT a protein hormone."

Final Answer: C

Answer: (C)

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Q16.

Solution**Concept:**

The death rate (mortality) in a population is calculated as the number of individuals dying per unit of time relative to the initial population size. It is expressed as per capita.

Solution:

Step 1: Identify the given values. Initial population size (N) = 400 individuals. Number of deaths (d) = 40 individuals.

Step 2: Use the formula for death rate:

$$\text{Death Rate} = \frac{\text{Number of deaths}}{\text{Total population}}$$

Step 3: Substitute the values into the formula:

$$\text{Death Rate} = \frac{40}{400}$$

Step 4: Perform the division:

$$\frac{40}{400} = \frac{4}{40} = 0.1$$

Step 5: The unit is "individuals per capita per year." Option A is too low, and Option C/D are whole numbers not representing the ratio.

Final Answer:

Answer: (B)

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Q17.

Solution**Concept:**

Ecological pyramids represent the trophic structure of an ecosystem. While most pyramids are upright, some can be inverted depending on the ecosystem type and the parameter being measured (number, biomass, or energy).

Solution:

Step 1: Evaluate the Pyramid of Energy. Energy is lost as heat at each trophic level (10

Step 2: Evaluate the Pyramid of Biomass in the sea. The biomass of phytoplanktons (producers) is much less than that of the fishes (consumers) at any given time because of high turnover rates. This pyramid is actually inverted, so "Upright" is a wrong match.

Step 3: Evaluate the Pyramid of Number in Grassland. Usually, there are many grasses supporting fewer herbivores, which support even fewer carnivores. This is typically upright.

Step 4: Evaluate the Pyramid of Biomass in Forest. This is generally upright as the biomass of large trees exceeds that of the herbivores and carnivores.

Final Answer: B

Answer: (B)

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Q18.

Solution**Concept:**

The Polymerase Chain Reaction (PCR) is used to amplify DNA. It requires a thermostable DNA polymerase because the process involves high-temperature denaturation steps.

Solution:

Step 1: PCR consists of three steps: Denaturation (94°C), Annealing (54°C), and Extension (72°C).

Step 2: During the extension phase, an enzyme adds dNTPs to the 3' end of the primers.

Step 3: Standard DNA polymerases denature at high temperatures. Therefore, a thermostable enzyme called Taq Polymerase, isolated from the bacterium *Thermus aquaticus*, is used.

Step 4: Restriction Endonucleases are used for cutting DNA, not extending it. DNA Ligase is used for joining fragments. Reverse Transcriptase is used to make cDNA from RNA.

Step 5: Taq Polymerase remains active throughout the heating cycles, making it the essential enzyme for PCR extension.

Final Answer: C

Answer: (C)

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Q19.

Solution**Concept:**

The human brain is divided into the forebrain, midbrain, and hindbrain, each with specific regulatory functions regarding motor control and sensory processing.

Solution:

Step 1: The Cerebrum (Forebrain) is responsible for intelligence, memory, and voluntary muscle control, but not primarily for unconscious balance.

Step 2: The Cerebellum (Hindbrain) has a very convoluted surface to provide additional space for many more neurons. Its primary function is to coordinate complex muscular movements and maintain equilibrium, posture, and balance of the body.

Step 3: The Hypothalamus regulates body temperature, hunger, and thirst.

Step 4: The Medulla oblongata contains centers that control respiration, cardiovascular reflexes, and gastric secretions.

Step 5: For any question regarding "balance," "posture," or "equilibrium," the Cerebellum is the key regulatory center.

Final Answer:

Answer: (B)

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Q20.

Solution**Concept:**

Microbes are used industrially to produce various bioactive molecules and enzymes that have significant medical and environmental applications.

Solution:

Step 1: Cyclosporin A is produced by the fungus *Trichoderma polysporum*. It is used as an immunosuppressive agent in organ-transplant patients to prevent graft rejection (i-q).

Step 2: Statins are produced by the yeast *Monascus purpureus*. They inhibit the enzyme responsible for cholesterol synthesis, thus acting as blood cholesterol lowering agents (ii-p).

Step 3: Streptokinase is produced by the bacterium *Streptococcus*. It is used as a "clot buster" to remove clots from the blood vessels of patients who have undergone myocardial infarction (iii-s).

Step 4: Lipases are used in detergent formulations and are helpful in removing oily stains from laundry (iv-r).

Step 5: Matching the pairs: i-q, ii-p, iii-s, iv-r. This corresponds to Option A.

Final Answer:

Answer: (A)

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Q21.

Solution**Concept:**

Secondary growth in dicotyledonous stems is responsible for the increase in girth (thickness). This process is driven by lateral meristems, primarily the vascular cambium and the cork cambium.

Solution:

Step 1: The vascular cambium is a strip of meristematic tissue located between the primary xylem and primary phloem (intrafascicular cambium) and between vascular bundles (interfascicular cambium).

Step 2: During secondary growth, the vascular cambium becomes active and begins to cut off new cells on both its inner and outer sides.

Step 3: The cells cut off towards the pith (inner side) mature into secondary xylem, which eventually forms the wood of the tree.

Step 4: The cells cut off towards the periphery (outer side) mature into secondary phloem.

Step 5: Phellogen (cork cambium) produces phellem (cork) and phelloderm (secondary cortex), not the vascular tissues. Apical and axillary meristems are responsible for primary growth (height).

Final Answer:

Answer: (B)

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Q22.

Solution**Concept:**

A floral formula is a symbolic representation of the different parts of a flower, their numbers, arrangements, and relationships. The family Solanaceae (Potato family) has specific diagnostic features.

Solution:

Step 1: Analyze the symmetry. Solanaceae flowers are typically actinomorphic (radial symmetry), represented by the symbol \oplus .

Step 2: Analyze the sexuality. They are bisexual (hermaphrodite), represented by $\underline{\subseteq}$.

Step 3: Calyx (K). There are 5 sepals, which are fused (gamosepalous), represented by $K_{(5)}$.

Step 4: Corolla (C). There are 5 petals, which are also fused (gamopetalous), represented by $C_{(5)}$.

Step 5: Androecium (A). There are 5 stamens that are epipetalous (attached to petals), shown by a line above C and A, though often simplified to A_5 in list format.

Step 6: Gynoecium (G). It is bicarpellary, syncarpous, and superior, represented by $\underline{G}_{(2)}$.

Step 7: Option A correctly matches all these parameters. Option B describes Fabaceae. Option D describes Liliaceae.

Final Answer:

Answer: (A)

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Q23.

Solution**Concept:**

The microsporangium (pollen sac) is surrounded by four wall layers: the epidermis, endothecium, middle layers, and the tapetum.

Solution:

Step 1: Evaluate Statement I. The tapetum is indeed the innermost wall layer surrounding the sporogenous tissue. Its primary function is to provide nourishment to the developing pollen grains (microspores). Thus, Statement I is correct.

Step 2: Evaluate Statement II. The cells of the tapetum possess dense cytoplasm and generally have more than one nucleus. This polyploidy or multinucleate condition arises due to endomitosis or nuclear division without cytokinesis. Thus, Statement II is also correct.

Step 3: Since both statements are scientifically accurate regarding the anatomy and cytology of the anther wall, the correct option is A.

Final Answer:

Answer: (A)

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Q24.

Solution**Concept:**

The liver is the largest gland in the human body. Its internal structure is organized into specific functional units that perform metabolic and secretory duties.

Solution:

Step 1: The Nephron is the structural and functional unit of the kidney.

Step 2: Alveoli are the structural and functional units of the lungs where gas exchange occurs.

Step 3: The liver is composed of many Hepatic Lobules. These are the structural and functional units of the liver.

Step 4: Each hepatic lobule contains hepatic cells (hepatocytes) arranged in the form of cords around a central vein.

Step 5: Glisson's capsule is a thin connective tissue sheath that covers each hepatic lobule, but it is a covering, not the functional unit itself.

Final Answer:

Answer: (B)

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Q25.

Solution**Concept:**

Embryogenesis in humans follows a specific chronological order of morphological changes following the fertilization of the ovum by the sperm.

Solution:

Step 1: Fertilization results in a single-celled diploid Zygote.

Step 2: The zygote undergoes cleavage (mitotic divisions). When it reaches the 8 to 16 cell stage, it is a solid ball called a Morula.

Step 3: As divisions continue, a fluid-filled cavity (blastocoel) forms, and the embryo becomes a Blastocyst. It is at this stage that implantation into the uterine wall occurs.

Step 4: After implantation, the inner cell mass of the blastocyst undergoes morphogenetic movements to form the three germ layers (ectoderm, mesoderm, and endoderm). This stage is the Gastrula.

Step 5: Therefore, the correct sequence is: Zygote → Morula → Blastocyst → Gastrula.

Final Answer:

Answer: (A)

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Q26.

Solution**Concept:**

Chromosomal disorders are caused by the absence, excess, or abnormal arrangement of one or more chromosomes. These are often categorized as aneuploidy (gain or loss of a chromosome).

Solution:

Step 1: Down's syndrome is caused by the presence of an additional copy of chromosome number 21. This is known as trisomy 21. The total chromosome count is 47 (45 autosomes + XY or XX). Thus, i-r.

Step 2: Klinefelter's syndrome is caused by the presence of an additional X chromosome in a male, resulting in a karyotype of 47 chromosomes (44 autosomes + XXY). Thus, ii-p.

Step 3: Turner's syndrome is caused by the absence of one of the X chromosomes in a female, resulting in a karyotype of 45 chromosomes (44 autosomes + X0). Thus, iii-q.

Step 4: Mapping the pairs correctly: i-r, ii-p, iii-q.

Step 5: This matching sequence corresponds exactly to Option A.

Final Answer:

Answer: (A)

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Q27.

Solution**Concept:**

The menstrual cycle is regulated by a complex feedback mechanism involving pituitary hormones (FSH and LH) and ovarian hormones (Estrogen and Progesterone).

Solution:

Step 1: During the follicular phase, the growing follicles secrete increasing amounts of Estrogen.

Step 2: Rapid secretion of Estrogen during the mid-cycle leads to a positive feedback effect on the anterior pituitary.

Step 3: This high level of Estrogen triggers a sudden, massive release of Luteinizing Hormone (LH), a phenomenon known as the "LH surge."

Step 4: The LH surge is the direct trigger for ovulation (the rupture of the Graafian follicle and release of the ovum).

Step 5: While FSH also peaks at mid-cycle, it is the peak in Estrogen that specifically mediates the positive feedback loop for the LH surge.

Final Answer:

Answer: (C)

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Q28.

Solution**Concept:**

Biodiversity conservation is classified into two types: In-situ (on-site) and Ex-situ (off-site). In-situ involves protecting the species in its natural habitat, while Ex-situ involves moving it to a special setting.

Solution:

Step 1: National Parks, Wildlife Sanctuaries, and Biosphere Reserves are areas where the entire ecosystem is protected in its natural state. These are classic examples of In-situ conservation.

Step 2: Botanical Gardens are man-made facilities where specific plant species are collected, grown, and maintained outside their natural environment for research and conservation. This is an Ex-situ method.

Step 3: Other Ex-situ examples include Zoological parks (Zoos), Wildlife Safari parks, Seed banks, and Cryopreservation.

Step 4: Therefore, the Botanical Garden is the option that does NOT belong to the In-situ category.

Final Answer:

Answer: (C)

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Q29.

Solution**Concept:**

Aerobic respiration involves Glycolysis, the Link Reaction, the Krebs Cycle, and the Electron Transport System (ETS). The total ATP yield varies depending on the shuttle system used for NADH.

Solution:

Step 1: Glycolysis produces 2 net ATP (direct) and 2 NADH.

Step 2: The conversion of 2 Pyruvate to 2 Acetyl CoA produces 2 NADH.

Step 3: The Krebs Cycle (two turns per glucose) produces 2 GTP (ATP equivalent), 6 NADH, and 2 $FADH_2$.

Step 4: Using the standard ETS conversion (1 NADH = 3 ATP, 1 $FADH_2$ = 2 ATP):

* From Glycolysis: 2 ATP + 6 ATP (from 2 NADH) = 8 ATP * From Link Reaction: 6 ATP (from 2 NADH) = 6 ATP * From Krebs Cycle: 2 ATP + 18 ATP (from 6 NADH) + 4 ATP (from 2 $FADH_2$) = 24 ATP

Step 5: Total = 8 + 6 + 24 = 38 ATP. In some eukaryotic tissues, the shuttle costs 2 ATP, resulting in 36, but 38 is the theoretical maximum generally used in standard biology texts for total yield.

Final Answer:

Answer: (B)

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Q30.

Solution**Concept:**

Different animals have evolved various organs for the exchange of gases depending on their habitats and complexity of organization.

Solution:

Step 1: Prawns are aquatic crustaceans that use Gills for respiration. This is a correct match.

Step 2: Earthworms use their moist cuticle (skin) for gas exchange. Tracheal tubes are found in insects like cockroaches.

Step 3: Cockroaches use a network of Tracheal tubes. Moist skin is characteristic of earthworms and amphibians.

Step 4: Scorpions (Arachnids) use Book Lungs, not standard mammalian-style lungs.

Step 5: Comparing the options, only the Prawn—Gills pair is accurately matched.

Final Answer:

Answer: (A)

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Q31.

Solution**Concept:**

Water absorption in roots occurs via two main pathways: the Apoplast and the Symplast. The Apoplast pathway involves the movement of water through the non-living parts of the plant.

Solution:

Step 1: The Apoplast pathway consists of the system of adjacent cell walls and intercellular spaces that is continuous throughout the plant, except at the Casparian strips of the endodermis.

Step 2: Water enters the root hair and moves through the cell walls of the cortex and the spaces between those cells.

Step 3: However, when water reaches the endodermis, it encounters the Casparian strip, which is made of suberin (a water-impermeable waxy material).

Step 4: This blockage forces the water to cross the cell membrane and enter the Symplast pathway (living cytoplasm) to pass through the endodermis and reach the xylem.

Step 5: Therefore, the correct path involves cell walls and intercellular spaces until it hits the Casparian strips, where it must switch to the Symplast.

Final Answer: C

Answer: (C)

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Q32.

Solution**Concept:**

Incomplete dominance is a form of intermediate inheritance in which one allele for a specific trait is not completely expressed over its paired allele.

Solution:

Step 1: Analyze Statement I. In incomplete dominance (e.g., *Mirabilis jalapa*), the F_1 hybrid (Rr) is pink. When F_1 is selfed, the F_2 generation shows 1 Red (RR) : 2 Pink (Rr) : 1 White (rr). Both the phenotypic ratio (1:2:1) and the genotypic ratio (1:2:1) are the same. Thus, Statement I is correct.

Step 2: Analyze Statement II. The concept of "blending" was an old theory that Mendel disproved. In Incomplete Dominance, alleles do not blend or merge; they remain discrete. This is proven because the original parental phenotypes (Red and White) reappear in the F_2 generation. If they had blended, the white and red traits would never be recovered in their pure form.

Step 3: Therefore, Statement I is correct, but Statement II is incorrect because it uses the scientifically inaccurate term "blending."

Final Answer: C

Answer: (C)

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Q33.

Solution**Concept:**

Excretory structures vary across the animal kingdom, evolving from simple tubular structures to complex kidneys.

Solution:

Step 1: Rotifers and Platyhelminthes (like Planaria) use Flame cells (also called protonephridia) for osmoregulation and excretion (i-q).

Step 2: Cephalochordates like *Amphioxus* possess specialized cells called Solenocytes (also a type of protonephridia) (ii-r).

Step 3: Crustaceans like Prawns have Antennal glands, also known as Green Glands, located near their antennae (iii-p).

Step 4: Annelids like Earthworms have tubular structures called Nephridia (iv-s).

Step 5: Matching these pairs: i-q, ii-r, iii-p, iv-s. This sequence is found in Option A.

Final Answer:

Answer: (A)

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Q34.

Solution**Concept:**

The Lac Operon (Lactose Operon) is a classic model for gene regulation in prokaryotes, consisting of regulatory genes and structural genes.

Solution:

Step 1: The Lac Operon contains three structural genes that are transcribed together: *lac z*, *lac y*, and *lac a*. Their order is z-y-a.

Step 2: The 'i' gene is the regulatory gene. The term 'i' stands for "inhibitor," not inducer.

Step 3: The 'i' gene constitutively (all the time) codes for the Repressor protein. This repressor binds to the operator to turn the operon "off."

Step 4: Lactose (or allolactose) acts as the inducer by binding to the repressor and preventing it from binding to the operator.

Step 5: Thus, the sequence is z-y-a and the 'i' gene codes for the Repressor protein.

Final Answer:

Answer: (C)

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Q35.

Solution**Concept:**

A nucleosome is the basic unit of DNA packaging in eukaryotes, consisting of DNA wrapped around a histone octamer.

Solution:

Step 1: Recall that a single nucleosome contains approximately 200 base pairs (bp) of DNA.

Step 2: Identify the total DNA content in a diploid human cell: 6.6×10^9 bp.

Step 3: To find the number of nucleosomes, divide the total number of base pairs by the number of base pairs per nucleosome:

$$\text{Number of nucleosomes} = \frac{6.6 \times 10^9}{200}$$

Step 4: Simplify the calculation:

$$\frac{6.6 \times 10^9}{2 \times 10^2} = 3.3 \times 10^{(9-2)} = 3.3 \times 10^7$$

Step 5: This calculation gives the total count of nucleosomes required to package the human genome.

Final Answer:

Answer: (A)

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Q36.

Solution**Concept:**

The cardiac cycle refers to the sequence of events that occurs from the beginning of one heartbeat to the beginning of the next. It involves phases of contraction (systole) and relaxation (diastole) of both the atria and ventricles.

Solution:

Step 1: Consider the state of the heart when all four chambers are in a relaxed state. This is known as Joint Diastole. During this phase, blood from the pulmonary veins and vena cava flows into the left and right atria respectively, and then into the ventricles.

Step 2: The SAN (Sino-Atrial Node) then generates an action potential which stimulates both the atria to undergo a simultaneous contraction—this is Atrial Systole. This increases the flow of blood into the ventricles by about 30 percent.

Step 3: The action potential is conducted to the ventricular side, causing the ventricles to contract (Ventricular Systole). During this time, the atria undergo relaxation (diastole). Ventricular systole increases the ventricular pressure causing the closure of tricuspid and bicuspid valves, and the opening of semilunar valves.

Step 4: The ventricles then relax (Ventricular Diastole), the semilunar valves close, and the heart returns to the state of Joint Diastole.

Step 5: Thus, the logical starting sequence for a single cycle description is Joint Diastole → Atrial Systole → Ventricular Systole.

Final Answer:

Answer: (C)

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Q37.

Solution**Concept:**

Phloem transport studies often use organisms that naturally feed on plant sap. Aphids (plant lice) are insects that insert their needle-like mouthparts, called stylets, into the phloem sieve tubes to extract sugar-rich sap.

Solution:

Step 1: When an aphid is feeding, its stylet is precisely positioned within a single sieve tube member.

Step 2: To analyze the contents of the phloem without contaminating it with cellular debris from the plant, researchers allow the aphid to begin feeding.

Step 3: The aphid is then anesthetized or killed, and its body is carefully severed, leaving the stylet embedded in the plant.

Step 4: Because the phloem sap is under significant positive hydrostatic pressure (turgor pressure), the sap continues to exude from the cut end of the stylet.

Step 5: No chemical enzymes like cellulase or pectinase are required to "remove" the sap; it is collected purely through the natural pressure gradient maintained by the plant's physiological processes.

Final Answer:

Answer: (D)

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Q38.

Solution**Concept:**

Transcription is the process by which genetic information from a strand of DNA is copied into a new molecule of messenger RNA (mRNA). In eukaryotes, different types of RNA polymerases handle different types of RNA.

Solution:

Step 1: The process of copying DNA to RNA is called Transcription.

Step 2: In eukaryotic cells, there are three distinct RNA polymerases:

* RNA Polymerase I: Transcribes rRNAs (28S, 18S, and 5.8S). * RNA Polymerase II: Transcribes the precursors of mRNA (heterogeneous nuclear RNA or hnRNA). * RNA Polymerase III: Transcribes tRNA, 5S rRNA, and snRNAs.

Step 3: Since the question specifically asks for the formation of mRNA, the catalyst is RNA Polymerase II.

Step 4: Replication is the process of DNA from DNA, and Translation is the process of Protein from RNA.

Step 5: Therefore, Option B is the only correct match for both the process name and the specific enzyme subtype.

Final Answer:

Answer: (B)

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Q39.

Solution

Concept: The pyramid of biomass shows the relationship between the total living organic matter (biomass) at different trophic levels. While most pyramids of biomass are upright, aquatic ecosystems often exhibit an inverted pattern due to the high turnover rate of primary producers.

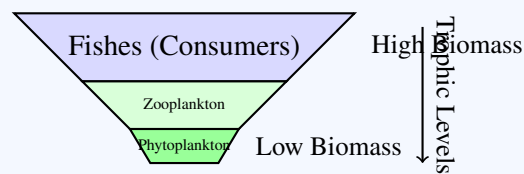
Solution: Step 1: In a pond ecosystem, the primary producers are phytoplankton. These are microscopic organisms that reproduce extremely rapidly but have a very short life cycle.

Step 2: Because they are consumed almost immediately by zooplankton and small fishes, their "standing crop" biomass (the amount present at any given moment) is relatively low.

Step 3: The consumers at higher trophic levels, such as herbivorous and carnivorous fishes, have much longer lifespans and larger body sizes, allowing them to accumulate and maintain a larger total biomass.

Step 4: Consequently, the base of the pyramid (producers) is smaller than the higher levels (consumers), leading to an inverted shape.

Step 5: Therefore, Assertion (A) is true, and Reason (R) correctly explains why the biomass distribution creates this inverted shape.



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

Answer: (A)

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Q40.

Solution**Concept:**

Recombinant DNA (rDNA) technology involves combining DNA from two different sources. This requires "molecular scissors" to cut DNA and "molecular glue" to join them.

Solution:

Step 1: Restriction endonucleases like *EcoRI* are used to cut the DNA at specific palindromic sequences, creating "sticky ends."

Step 2: To create the recombinant molecule, the foreign DNA fragment and the cut vector DNA (like a plasmid) must be physically linked.

Step 3: DNA Ligase is the enzyme that facilitates the joining of DNA strands together by catalyzing the formation of a phosphodiester bond. It acts as the "molecular glue."

Step 4: DNA Polymerase is used for synthesizing new DNA strands, and Taq Polymerase is a specific heat-stable version used in PCR.

Step 5: For the specific task of "joining" two DNA molecules to produce a recombinant one, DNA Ligase is the required tool.

Final Answer:

Answer: (C)

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Q41.

Solution**Concept:**

Linkage and Recombination are phenomena that deviate from Mendel's Law of Independent Assortment. When two genes are physically close on the same chromosome, they tend to be inherited together.

Solution:

Step 1: In a test cross of a dihybrid ($AaBb \times aabb$), Mendel expected a 1:1:1:1 ratio, meaning 50

Step 2: If the result shows a significantly higher frequency of parental types (e.g., 80

Step 3: This physical association of genes on the same chromosome is called Linkage.

Step 4: The closer the genes are on the chromosome, the stronger the linkage and the lower the frequency of recombination (crossing over).

Step 5: Therefore, the production of more parental-type offspring in this specific dihybrid test cross is a direct indicator of linkage.

Final Answer:

Answer: (B)

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Q42.

Solution**Concept:**

Cardiac Output is a primary measure of heart efficiency, representing the total volume of blood the heart pumps into the systemic and pulmonary circuits per unit time.

Solution:

Step 1: Stroke Volume (SV) is the volume of blood pumped out by one ventricle during one contraction (systole), which is approximately 70 mL (0.07 L).

Step 2: Heart Rate (HR) is the number of beats per minute, averaging 72 beats/min in a healthy adult.

Step 3: Cardiac Output (CO) is calculated by the formula:

$$CO = SV \times HR$$

Step 4: Calculation:

$$CO = 70 \text{ mL} \times 72 \approx 5040 \text{ mL} \approx 5 \text{ Liters}$$

Step 5: Thus, the volume pumped per minute is Cardiac Output, and its value is roughly 5.0 Liters.

Final Answer:

Answer: (B)

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Q43.

Solution**Concept:**

Gastrointestinal hormones regulate the secretion of digestive juices and the motility of the digestive tract. These are secreted by endocrine cells present in the mucosal epithelium.

Solution:

Step 1: Gastrin is secreted by G-cells located in the antrum of the stomach. Its primary role is to stimulate the gastric glands to secrete hydrochloric acid (HCl) and pepsinogen.

Step 2: Secretin is secreted by the duodenal mucosa. It stimulates the pancreas to release bicarbonate ions to neutralize stomach acid.

Step 3: Cholecystokinin (CCK) is also duodenal. It triggers the release of digestive enzymes from the pancreas and bile from the gallbladder.

Step 4: GIP (Gastric Inhibitory Peptide) inhibits gastric secretion and motility.

Step 5: Therefore, the hormone from G-cells that stimulates gastric juice is Gastrin.

Final Answer:

Answer: (B)

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Q44.

Solution**Concept:**

Humification is a stage of decomposition where organic matter is converted into a highly stable form called humus.

Solution:

Step 1: Decomposition involves fragmentation, leaching, catabolism, humification, and mineralization.

Step 2: During humification, a substance is formed that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate.

Step 3: This substance, Humus, is characterized as being dark-colored and amorphous (non-crystalline).

Step 4: Humus serves as a reservoir of nutrients and improves soil texture due to its colloidal nature.

Step 5: Comparing with the options, "Dark colored" and "Amorphous" correctly define the physical characteristics of humus.

Final Answer:

Answer: (B)

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Q45.

Solution**Concept:**

The Biogenetic Law, often summarized as "Ontogeny recapitulates Phylogeny," suggests that the stages of an organism's embryonic development (ontogeny) repeat the evolutionary history of its species (phylogeny).

Solution:

Step 1: Charles Darwin proposed Natural Selection as the mechanism for evolution.

Step 2: Ernst Haeckel proposed the Biogenetic Law based on observations that embryos of different vertebrates (like fish, salamanders, and humans) look very similar in early stages.

Step 3: Hugo de Vries proposed the Mutation Theory of evolution.

Step 4: Lamarck proposed the theory of "Inheritance of Acquired Characters."

Step 5: Although later largely disproven by Karl Ernst von Baer (who noted that embryos do not pass through the adult stages of other animals), the historical proposal of the Recapitulation Theory is attributed to Ernst Haeckel.

Final Answer:

Answer: (B)

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Q46.

Solution**Concept:**

Down's Syndrome is a genetic disorder caused by the presence of all or part of a third copy of chromosome 21 (Trisomy 21). This aneuploidy results in specific physical and mental developmental delays.

Solution:

Step 1: Identify the characteristics of Down's Syndrome. Affected individuals typically have a short stature, a small round head, and a characteristic facial appearance.

Step 2: Notable physical symptoms include a furrowed tongue and a mouth that is often kept partially open. These are diagnostic physical traits described in standard medical biology.

Step 3: Gynaecomastia (development of breast tissue in males) and being a sterile male are characteristic symptoms of Klinefelter's Syndrome (44 + XXY).

Step 4: Rudimentary ovaries and being a sterile female are characteristic symptoms of Turner's Syndrome (44 + X0).

Step 5: Therefore, among the given options, the furrowed tongue and partially open mouth are the unique identifiers for Down's Syndrome.

Final Answer:

Answer: (C)

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Q47.

Solution**Concept:**

DNA fingerprinting relies on identifying variations in DNA sequences. A critical step in this process is the physical separation of DNA fragments of varying lengths.

Solution:

Step 1: After DNA is isolated and digested by restriction endonucleases, the resulting fragments are of different sizes.

Step 2: Gel Electrophoresis is the technique used to separate these fragments. DNA is negatively charged, so when an electric field is applied, the fragments move through an agarose gel toward the positive anode.

Step 3: The gel acts as a sieve; smaller fragments move faster and further, while larger fragments move slower and stay closer to the wells.

Step 4: Southern Blotting is the subsequent transfer of these separated fragments to a synthetic membrane. PCR is used for amplification, and Autoradiography is used for detection.

Step 5: For the specific task of "separation based on size," Gel Electrophoresis is the correct technical answer.

Final Answer:

Answer: (B)

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Q48.

Solution**Concept:**

Secondary metabolites are organic compounds produced by bacteria, fungi, or plants which are not directly involved in the normal growth, development, or reproduction of the organism.

Solution:

Step 1: Alkaloids are nitrogenous organic compounds. Common examples include Morphine and Codeine (i-q).

Step 2: Terpenoids are a large class of organic chemicals derived from the 5-carbon compound isoprene. Examples include Monoterpenes and Diterpenes (ii-r).

Step 3: Pigments give color to plant parts. Anthocyanins and Carotenoids are primary examples (iii-p).

Step 4: Lectins are carbohydrate-binding proteins. Concanavalin A is a well-known lectin used in biochemical research (iv-s).

Step 5: Assembling the matches: i-q, ii-r, iii-p, iv-s. This corresponds to the sequence provided in Option A.

Final Answer:

Answer: (A)

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Q49.

Solution**Concept:**

Plants require specific essential elements in certain quantities. The relationship between the concentration of an element and the growth of the plant is used to define metabolic thresholds.

Solution:

Step 1: When an essential element is present in a concentration that allows for maximum growth, it is at an optimum level.

Step 2: If the concentration drops below a certain point, the plant starts showing morphological changes known as "deficiency symptoms."

Step 3: This specific threshold, below which plant growth is retarded and symptoms appear, is scientifically termed the "Critical Concentration."

Step 4: Toxicity level refers to a concentration that is too high and causes tissue damage (often defined as a 10 percent reduction in dry weight).

Step 5: Therefore, the specific term for the concentration below which growth is hindered is Critical Concentration.

Final Answer:

Answer: (B)

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Q50.

Solution**Concept:**

Biodiversity Hotspots are regions that contain very high levels of species richness and high degrees of endemism, but are also under significant threat of habitat loss.

Solution:

Step 1: The concept of biodiversity hotspots was originally developed by Norman Myers.

Step 2: Initially, 25 biodiversity hotspots were identified globally.

Step 3: Over time, with further research and ecological assessment, nine more hotspots were added to the official list.

Step 4: This brought the total number of recognized biodiversity hotspots in the world to 34.

Step 5: These 34 hotspots together cover less than 2 percent of the Earth's land area but harbor an extremely high percentage of the world's plant and animal species.

Final Answer: B

Answer: (B)

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Q51.

Solution**Concept:**

Cell organelles perform specialized functions. The Golgi apparatus (or Golgi complex) is a membrane-bound organelle found in most eukaryotic cells that acts as the factory of the cell.

Solution:

Step 1: Proteins and lipids are synthesized in the Endoplasmic Reticulum (ER).

Step 2: These substances are then transported in vesicles to the *cis* face (forming face) of the Golgi apparatus.

Step 3: Inside the Golgi cisternae, the materials undergo modifications (such as glycosylation to form glycoproteins and glycolipids).

Step 4: Finally, the Golgi apparatus sorts and "packages" these processed materials into secretory vesicles at its *trans* face (maturing face) to be delivered to their intracellular or extracellular targets.

Step 5: Because of this essential role in processing and distribution, it is aptly called the "Packaging center" or "Post office" of the cell.

Final Answer: C

Answer: (C)

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Q52.

Solution**Concept:**

RuBisCO (Ribulose-1,5-bisphosphate carboxylase/oxygenase) is the enzyme responsible for the first major step of carbon fixation in the Calvin cycle.

Solution:

Step 1: Evaluate Statement I. RuBisCO is indeed the most abundant protein on Earth (biosphere) because it is present in every green plant and photosynthetic bacteria to facilitate CO_2 fixation. Thus, Statement I is correct.

Step 2: Evaluate Statement II. The name "carboxylase-oxygenase" indicates its dual nature. It has an active site that can bind to both Carbon dioxide (CO_2) and Oxygen (O_2).

Step 3: The binding is competitive and depends on the relative concentrations of CO_2 and O_2 . When O_2 binds instead of CO_2 , it leads to a wasteful process called photorespiration. Thus, Statement II is also correct.

Step 4: Since both statements are scientifically accurate, the correct option is A.

Final Answer:

Answer: (A)

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Q53.

Solution

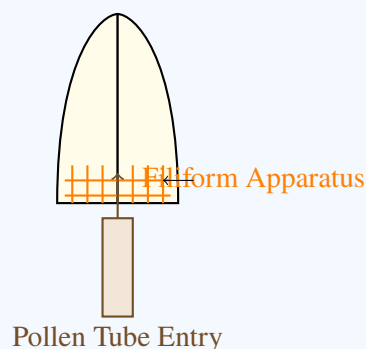
Concept: In the mature angiosperm embryo sac (female gametophyte), the egg apparatus is situated at the micropylar end. It consists of two synergids and one egg cell. The synergids possess a specialized structure known as the filiform apparatus.

Solution: Step 1: The filiform apparatus is a mass of finger-like projections of the wall into the cytoplasm of the synergid cells, specifically at the micropylar end.

Step 2: Its primary role is to guide the pollen tube as it enters the ovule. It secretes certain chemical signaling molecules (chemotropic substances) that direct the growth of the pollen tube.

Step 3: Once the pollen tube reaches the synergid, the filiform apparatus facilitates its entry, allowing the tube to release the two male gametes into the cytoplasm of the synergid.

Step 4: Other options are incorrect because: (A) Recognition of pollen occurs on the stigma via pollen-pistil interaction; (C) Prevention of polyspermy in plants is typically achieved by the degeneration of synergids and the formation of a fertilization membrane; (D) The generative cell usually divides in the pollen grain or pollen tube before reaching the embryo sac.

Egg Apparatus (Micropylar End)

Final Answer: (B) Guide the entry of pollen tube into the synergid.

Answer: (B)

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Q54.

Solution**Concept:**

Organisms are classified based on their tolerance to environmental variations like temperature (thermal) and salinity (haline).

Solution:

Step 1: "Eury-" refers to a wide range. Thus, Euryhaline organisms can tolerate a wide range of salinities (i-q), and Eurythermal organisms can tolerate a wide range of temperatures (iii-s).

Step 2: "Steno-" refers to a narrow range. Thus, Stenohaline organisms are restricted to a narrow range of salinity (ii-p), and Stenothermal organisms are restricted to a narrow range of temperature (iv-r).

Step 3: Most organisms are stenothermal, whereas only a few can handle large fluctuations (eurythermal).

Step 4: Matching the pairs: i-q, ii-p, iii-s, iv-r.

Step 5: This matching corresponds to Option A.

Final Answer:

Answer: (A)

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Q55.

Solution**Concept:**

Human evolution involves a transition from ape-like ancestors to modern humans, marked by changes in posture and brain size.

Solution:

Step 1: *Dryopithecus* and *Ramapithecus* were early primates (about 15 mya). *Ramapithecus* was more man-like, but still largely considered an ancestral primate.

Step 2: *Australopithecus* lived in East African grasslands and hunted with stone weapons but essentially ate fruit.

Step 3: *Homo habilis* is considered the first "human-like" hominid (the first being in the genus *Homo*).

Step 4: It had a cranial capacity between 650-800 cc and was the first to exhibit tool-making capabilities, which is why the name "habilis" (handy man) was given.

Step 5: *Homo erectus* came later with a larger brain capacity of about 900 cc.

Final Answer:

Answer: (B)

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Q56.

Solution**Concept:**

An inducer is a molecule that regulates gene expression. In inducible operons like the LAC operon, the presence of a specific substrate triggers the transcription of the structural genes.

Solution:

Step 1: The LAC operon is naturally in an "off" state because the repressor protein (coded by the *i* gene) is bound to the operator region, blocking RNA polymerase.

Step 2: When Lactose is added to the medium, a small amount enters the cell via the action of permease.

Step 3: Lactose (or its isomer allolactose) acts as the inducer. It binds to the repressor protein, causing a conformational change that makes the repressor lose its affinity for the operator.

Step 4: Once the operator is free, RNA polymerase can move forward to transcribe *lac z*, *lac y*, and *lac a*.

Step 5: Glucose and Galactose are the products of lactose hydrolysis, not the inducers. Tryptophan is an amino acid associated with the repressible TRP operon.

Final Answer:

Answer: (C)

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Q57.

Solution**Concept:**

Oogenesis is the process of formation of a mature female gamete. Unlike spermatogenesis, it is an unequal division process that results in one functional cell and small polar bodies.

Solution:

Step 1: The primary oocyte (diploid) undergoes the first meiotic division (Meiosis I) shortly before ovulation.

Step 2: This division is unequal, resulting in a large haploid "secondary oocyte" and a very small haploid "first polar body."

Step 3: The first polar body contains very little cytoplasm but carries a complete set of chromosomes to ensure the secondary oocyte remains haploid.

Step 4: The second polar body is formed only after fertilization, during the completion of Meiosis II.

Step 5: Therefore, the first polar body is a product of Oogenesis during the Meiosis I stage.

Final Answer:

Answer: (A)

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Q58.

Solution**Concept:**

Population interactions are classified based on whether the effect on each species is beneficial (+), harmful (-), or neutral (0).

Solution:

Step 1: Commensalism is an interaction where one species benefits (+) and the other is unaffected (0).

Step 2: Amensalism is an interaction where one species is harmed (-) and the other species remains unaffected (0). An example is the mold *Penicillium* secreting penicillin which kills bacteria without benefiting the mold directly.

Step 3: Mutualism involves both species benefiting (+/+).

Step 4: Parasitism involves one species benefiting at the expense of another (+/-).

Step 5: The question asks for (Harmed / Unaffected), which matches the (- / 0) definition of Amensalism.

Final Answer:

Answer: (B)

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Q59.

Solution**Concept:**

The immune system's primary characteristic is its ability to distinguish between "self" and "non-self" (foreign) molecules.

Solution:

Step 1: Sometimes, due to genetic reasons or environmental triggers, the body loses the ability to differentiate between its own cells and foreign pathogens.

Step 2: When this happens, the immune system produces antibodies or T-cells that attack the body's own tissues and organs.

Step 3: This condition is called Auto-immunity. Examples include Rheumatoid arthritis, Myasthenia gravis, and Insulin-dependent diabetes mellitus.

Step 4: Allergy is an exaggerated immune response to common environmental substances (pollen, dust). Immunodeficiency (like AIDS) is a failure of the immune system to protect the body.

Step 5: Active immunity refers to the body's own production of antibodies after exposure to an antigen.

Final Answer:

Answer: (B)

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Q60.

Solution**Concept:**

Restriction endonucleases recognize specific palindromic sequences in DNA. *HindIII* was the first restriction endonuclease to be isolated and characterized.

Solution:

Step 1: Every restriction enzyme has a specific recognition sequence where it binds and cuts the DNA.

Step 2: Scientists discovered that *HindIII* always cuts DNA at a particular point by recognizing a specific sequence of base pairs.

Step 3: This recognition sequence for *HindIII* is exactly 6 base pairs long.

Step 4: Although thousands of restriction enzymes have been isolated since then, most of the commonly used ones in biotechnology (like *EcoRI* or *BamHI*) also recognize 6-bp sequences.

Step 5: Therefore, the specific length for *HindIII* is 6 base pairs.

Final Answer:

Answer: (C)

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Q61.

Solution

Concept: Alexander von Humboldt observed that within a region, species richness increases with increasing explored area, but only up to a limit. On a normal graph, this relationship is a rectangular hyperbola, but on a log-log scale, it is a linear relationship.

Solution: Step 1: The mathematical formula for the species-area relationship is given by:

$$S = CA^Z$$

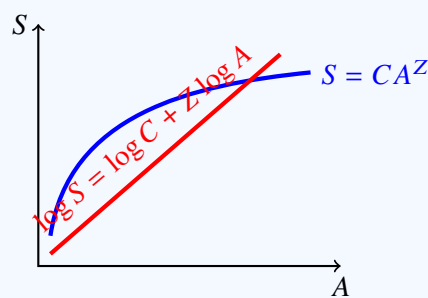
Step 2: To make this relationship easier to analyze, it is converted to a logarithmic scale:

$$\log S = \log C + Z \log A$$

Step 3: In this linear equation (which follows the $y = mx + c$ format):

- S = Species richness
- A = Area
- Z = **Slope of the line (regression coefficient)**
- C = Y-intercept

Step 4: The value of Z is remarkably similar (typically 0.1 to 0.2) regardless of the taxonomic group or region when looking at small areas. However, for very large areas like entire continents, the slope is much steeper (Z values of 0.6 to 1.2).



Species-Area Relationship

Final Answer: (C) Regression coefficient (slope of the line)

Answer: (C)

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Q62.

Solution**Concept:**

Biomes are large ecological areas on the Earth's surface, with fauna and flora adapting to their specific climate (temperature and precipitation).

Solution:

Step 1: Tropical Rainforests are characterized by high rainfall and warm temperatures year-round, resulting in the maximum biodiversity of any terrestrial biome (i-q).

Step 2: Coniferous Forests (Taiga) are dominated by gymnosperms like pines and firs, which have needle-like leaves to survive cold winters and reduce water loss (ii-s).

Step 3: The Tundra is a cold, treeless biome characterized by a permanently frozen layer of subsoil called permafrost (iii-p).

Step 4: The Chaparral is a Mediterranean biome characterized by hot, dry summers and mild, rainy winters. Its vegetation consists of shrubs with thick, leathery, "sclerophyllous" leaves (iv-r).

Step 5: Matching the pairs: i-q, ii-s, iii-p, iv-r. This corresponds to Option A.

Final Answer:

Answer: (A)

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Q63.

Solution**Concept:**

This calculation determines the net cost of agricultural inputs after applying a percentage-based government subsidy.

Solution:

Step 1: Determine the original price of one bag: ₹ 4500.

Step 2: Calculate the value of the 15

$$\text{Subsidy} = \frac{15}{100} \times 4500 = 15 \times 45 = | 675$$

Step 3: Calculate the discounted price for one bag:

$$\text{Discounted Price} = 4500 - 675 = | 3825$$

Step 4: Calculate the total cost for 5 bags:

$$\text{Total Cost} = 3825 \times 5 = | 19125$$

Step 5: Alternatively, total original cost = $4500 \times 5 = ₹ 22500$. Applying a 15

Final Answer:

Answer: (B)

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Q64.

Solution**Concept:**

The sigmoid (S-shaped) growth curve is characteristic of living organisms growing in a natural environment with limited resources.

Solution:

Step 1: The initial phase is the Lag phase, where the organism adapts to the environment and growth is very slow.

Step 2: This is followed by the Log phase (also called the Exponential phase), where resources are abundant and the population or size increases rapidly at an exponential rate.

Step 3: As resources become limited and waste products accumulate, the growth rate slows down.

Step 4: Eventually, the growth reaches a plateau where the rate becomes zero. This is the Stationary phase.

Step 5: Therefore, the correct chronological order of growth phases is Lag → Log → Stationary.

Final Answer:

Answer: (A)

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Q65.

Solution**Concept:**

DNA replication is semi-conservative and highly directional. The enzyme DNA polymerase is restricted by its biochemical structure in how it adds new nucleotides.

Solution:

Step 1: DNA polymerase can only add a new deoxyribonucleotide to the 3'-OH group of an existing sugar-phosphate backbone.

Step 2: This means the new strand must grow by adding to its 3' end.

Step 3: Consequently, the chemical synthesis or "polymerization" of the new DNA strand always proceeds in the 5' → 3' direction.

Step 4: Because the two strands of DNA are antiparallel, this directionality causes one strand (leading strand) to be synthesized continuously and the other (lagging strand) to be synthesized in fragments.

Step 5: Regardless of the strand, the enzymatic activity of the polymerase is strictly 5' → 3'.

Final Answer:

Answer: (B)

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Q66.

Solution**Concept:**

The forebrain contains the cerebrum, thalamus, and hypothalamus. Each structure governs specific physiological and behavioral functions.

Solution:

Step 1: The Thalamus acts as a major relay center for sensory and motor signaling.

Step 2: The Hypothalamus lies at the base of the thalamus. It contains several centers which control body temperature, urge for eating (hunger), and drinking (thirst).

Step 3: It also contains several groups of neurosecretory cells which secrete hormones that regulate the pituitary gland.

Step 4: The Hippocampus is part of the limbic system involved in memory formation. The Corpus callosum is a tract of nerve fibers connecting the two cerebral hemispheres.

Step 5: Therefore, the regulation of internal temperature (homeostasis) and basic biological drives like hunger is the specific domain of the hypothalamus.

Final Answer: C

Answer: (C)

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Q67.

Solution**Concept:**

Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child or embryo.

Solution:

Step 1: In 1990, the first clinical gene therapy was conducted to treat a four-year-old girl.

Step 2: She was suffering from a deficiency of the enzyme Adenosine Deaminase (ADA).

Step 3: This enzyme is crucial for the immune system to function. Its absence leads to SCID (Severe Combined Immunodeficiency).

Step 4: The treatment involved using a retroviral vector to introduce a functional ADA cDNA into the patient's lymphocytes, which were then returned to her body.

Step 5: While other genetic conditions like insulin deficiency (Diabetes) exist, the historical "first" clinical application was specifically for ADA deficiency.

Final Answer: B

Answer: (B)

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Q68.

Solution**Concept:**

Ecosystem dynamics are described using specific ecological parameters that measure biomass, energy flow, and physical structure.

Solution:

Step 1: Standing Crop is the total mass of living material (biomass) in a unit area at a particular time (i-q).

Step 2: Productivity refers to the rate at which biomass or organic matter is produced per unit area by plants during photosynthesis (ii-p).

Step 3: Decomposition is the process where decomposers breakdown complex organic matter into inorganic substances like CO_2 , water, and nutrients (iii-r).

Step 4: Stratification is the vertical distribution of different species occupying different levels in an ecosystem (e.g., trees in top layer, shrubs in middle, grasses at bottom) (iv-s).

Step 5: Matching the pairs: i-q, ii-p, iii-r, iv-s. This corresponds to Option A.

Final Answer:

Answer: (A)

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Q69.

Solution**Concept:**

The structure of the DNA double helix is stabilized by several chemical forces, including hydrogen bonds between base pairs and hydrophobic interactions.

Solution:

Step 1: In DNA, the nitrogenous bases are stacked on top of each other like the rungs of a ladder or steps of a spiral staircase.

Step 2: This arrangement means that the flat, hydrophobic surfaces of the base pairs are in close contact.

Step 3: This stacking arrangement, in addition to the *H*-bonds, provides significant chemical and physical stability to the helical structure.

Step 4: Stability is crucial for maintaining genetic integrity over time and preventing spontaneous degradation of the molecule.

Step 5: Flexibility and permeability are physical properties, but the primary evolutionary "goal" of stacking in the double helix is stability.

Final Answer:

Answer: (B)

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Q70.

Solution**Concept:**

The Juxtaglomerular Apparatus (JGA) is a specialized sensitive region formed by cellular modifications in the distal convoluted tubule and the afferent arteriole.

Solution:

Step 1: The JGA acts as a feedback mechanism to regulate the Glomerular Filtration Rate (GFR).

Step 2: When there is a fall in GFR (or glomerular blood pressure/flow), the specialized JG cells are activated to release the enzyme Renin into the blood.

Step 3: Renin converts Angiotensinogen in the blood into Angiotensin I, which is further converted to Angiotensin II by ACE.

Step 4: Angiotensin II is a powerful vasoconstrictor that increases glomerular blood pressure and GFR, while also stimulating aldosterone release.

Step 5: Statement A is correct. Statement B is the opposite of the truth. Statement C skips a step (Angiotensin I). Statement D is incorrect as JGA is located where the DCT touches the afferent arteriole in the cortex.

Final Answer:

Answer: (A)

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Q71.

Solution**Concept:**

Parturition and lactation are complex neuroendocrine processes involving several hormones. The movement of milk from the alveoli of the mammary glands into the ducts is a mechanical response to a hormonal signal.

Solution:

Step 1: Prolactin is the primary hormone responsible for the synthesis of milk within the mammary glands.

Step 2: When a baby 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 alveoli.

Step 4: This contraction forces the milk into the ducts so it can be extracted by the infant. This is specifically known as the "Milk-Ejection Reflex" or "Let-down reflex."

Step 5: Estrogen and Progesterone are involved in the development of mammary tissues during pregnancy but actually inhibit milk secretion until after birth.

Final Answer:

Answer: (C)

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Q72.

Solution**Concept:**

Liliaceae is a characteristic family of monocotyledonous plants. Their floral parts are usually arranged in multiples of three (trimerous).

Solution:

Step 1: Symmetry. Liliaceae flowers are actinomorphic (radial symmetry), represented by \oplus .

Step 2: Sexuality. They are bisexual, represented by \subseteq .

Step 3: Perianth (P). In monocots, sepals and petals are often not distinct and are called tepals. There are 6 tepals arranged in two whorls (3 + 3), often fused (3 + 3).

Step 4: Androecium (A). There are 6 stamens in two whorls (3 + 3), which are epitepalous (attached to the perianth).

Step 5: Gynoecium (G). It is tricarpeal, syncarpous, and the ovary is superior, represented by $\underline{G}_{(3)}$.

Step 6: Many members like Onion also have bracts (*Br*).

Step 7: Option B matches these monocot-specific characteristics perfectly.

Final Answer:

Answer: (B)

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Q73.

Solution**Concept:**

Natural selection can produce different outcomes depending on which phenotypes in a population are favored by the environment.

Solution:

Step 1: Directional Selection occurs when the environment favors one extreme phenotype over the others, shifting the mean of the population in one direction.

Step 2: Disruptive Selection occurs when both extreme phenotypes are favored over the intermediate or average ones, often leading to the formation of two distinct groups.

Step 3: Stabilizing Selection occurs when the environment favors the average (intermediate) individuals.

Step 4: In stabilizing selection, individuals at both extremes of the distribution are eliminated, which reduces variation and maintains the status quo for a particular trait.

Step 5: An example is human birth weight; babies of average weight have higher survival rates than those who are very small or very large.

Final Answer:

Answer: (C)

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Q74.

Solution**Concept:**

Microbes, specifically yeast (*Saccharomyces cerevisiae*), are used to ferment sugars into ethanol. The choice of substrate depends on the availability of fermentable carbohydrates.

Solution:

Step 1: To produce ethanol efficiently, a high-sugar or high-starch starting material is needed.

Step 2: Molasses is the dark, viscous byproduct of the sugar refining process (from sugarcane or sugar beets). It contains high amounts of residual sucrose, glucose, and fructose.

Step 3: Because it is a byproduct, it is very cost-effective for large-scale industrial fermentation in distilleries.

Step 4: While corn is used (especially in the US for biofuel), molasses remains the most common substrate globally for industrial and beverage ethanol production.

Step 5: Bamboo and Soya bean are not primary sources for high-yield ethanol fermentation.

Final Answer:

Answer: (B)

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Q75.

Solution**Concept:**

Industrial microbiology involves using specific species of fungi and bacteria to produce organic acids, enzymes, and bioactive molecules.

Solution:

Step 1: *Streptococcus* is used to produce Streptokinase, which acts as a clot-buster. This is a correct match.

Step 2: *Aspergillus niger* (a fungus) is used for the commercial production of Citric acid. This is a correct match.

Step 3: *Clostridium butylicum* (a bacterium) is used to produce Butyric acid. This is a correct match.

Step 4: Statins are blood-cholesterol lowering agents. They are produced by the yeast *Monascus purpureus*, not *Trichoderma polysporum*.

Step 5: *Trichoderma polysporum* is actually the source of Cyclosporin A (an immunosuppressant).

Therefore, Option C is the mismatched pair.

Final Answer:

Answer: (C)

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Q76.

Solution**Concept:**

Protocooperation is a non-obligatory positive interspecific interaction where both species benefit from the association but can also live separately.

Solution:

Step 1: In the sea-shore ecosystem, the sea anemone often attaches itself to the shell inhabited by a hermit crab.

Step 2: The sea anemone provides protection to the hermit crab from predators using its stinging tentacles (nematocysts) and also provides camouflage.

Step 3: In return, the hermit crab provides mobility to the stationary sea anemone, carrying it to new feeding grounds. The anemone also feeds on the scraps of food left over by the crab.

Step 4: Unlike mutualism (which is obligatory), both the sea anemone and the hermit crab can survive without each other. This mutually beneficial but non-essential interaction is called Protocooperation.

Step 5: Commensalism would imply only one benefits, and Amensalism would imply one is harmed, which does not fit this scenario.

Final Answer:

Answer: (C)

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Q77.

Solution**Concept:**

Myasthenia gravis is a chronic autoimmune neuromuscular disease that causes weakness in the skeletal muscles, which are responsible for breathing and moving parts of the body.

Solution:

Step 1: In this disorder, the body's immune system produces antibodies that block or destroy the nicotinic acetylcholine receptors at the neuromuscular junction.

Step 2: This prevents the nerve impulses from triggering muscle contractions, leading to muscle weakness and rapid fatigue.

Step 3: Common symptoms include drooping eyelids (ptosis), difficulty in swallowing, and eventual paralysis of skeletal muscles.

Step 4: Muscular dystrophy is a genetic disorder (progressive degeneration), not autoimmune. Tetany is caused by low calcium levels. Arthritis is the inflammation of joints.

Step 5: Therefore, the description of an autoimmune attack on the neuromuscular junction specifically identifies Myasthenia gravis.

Final Answer:

Answer: (B)

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Q78.

Solution**Concept:**

The human genome consists of coding and non-coding sequences. A large portion of the genome is made up of sequences that do not code for proteins but are repeated many times.

Solution:

Step 1: Repetitive DNA consists of nucleotide sequences that are repeated hundreds or thousands of times in the genome.

Step 2: These sequences are thought to have no direct coding function (non-coding), but they are important for chromosome structure, dynamics, and evolution.

Step 3: They can be categorized into satellite DNA (like micro-satellites and mini-satellites) based on their base composition and length of segment.

Step 4: These repetitive sequences are the basis of DNA fingerprinting because the number of repeats varies between individuals (polymorphism).

Step 5: Coding and functional DNA represent only a small fraction (less than 2 percent) of the total human genome.

Final Answer:

Answer: (B)

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Q79.

Solution**Concept:**

In transcription, the DNA strand with the 3' → 5' polarity acts as the template. The other strand (5' → 3') is called the coding strand, which has the same sequence as the mRNA except for the substitution of Thymine with Uracil.

Solution:

Step 1: Note the given sequence of the coding strand: 5'-ATGAATT-3'.

Step 2: Recall the rule of transcription: The mRNA sequence is identical to the coding strand sequence, but all Thymine (T) bases are replaced by Uracil (U).

Step 3: Replace 'T' with 'U' in the given sequence:

* A → A * T → U * G → G * A → A * A → A * T → U * T → U

Step 4: The resulting mRNA sequence is 5'-AUGAAUU-3'.

Step 5: Option A is the complement of the template (anti-parallel), but the coding strand shortcut is the most efficient way to solve this.

Final Answer:

Answer: (B)

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Q80.

Solution**Concept:**

Tropical rainforests are the most biodiverse terrestrial ecosystems. The Amazon rainforest is so massive and productive that it significantly impacts the global atmosphere.

Solution:

Step 1: The Amazon rain forest in South America is the largest tropical rainforest in the world.

Step 2: It is estimated to harbor millions of species of plants, insects, birds, and mammals, many of which are still undiscovered.

Step 3: Through the process of photosynthesis, this vast forest is estimated to produce approximately 20 percent of the total oxygen in the Earth's atmosphere.

Step 4: Because of this massive oxygen contribution and its role in carbon sequestration, it is widely referred to as the "Lungs of the Planet."

Step 5: While the Western Ghats and Himalayas are biodiversity hotspots, they do not produce oxygen on the same global scale as the Amazon.

Final Answer:

Answer: (B)

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Q81.

Solution**Concept:**

Lung capacities are combinations of two or more respiratory volumes. Functional Residual Capacity (FRC) represents the amount of air that remains in the lungs after a normal, quiet expiration.

Solution:

Step 1: Identify the volumes involved. Expiratory Reserve Volume (ERV) is the additional volume of air a person can expire by a forcible expiration (1000 mL to 1100 mL).

Step 2: Residual Volume (RV) is the volume of air remaining in the lungs even after a forcible expiration (1100 mL to 1200 mL).

Step 3: When you breathe out normally (tidal expiration), you do not empty your lungs of all the air you could potentially push out. You leave behind both the ERV and the RV.

Step 4: Therefore, the mathematical formula for Functional Residual Capacity is $FRC = ERV + RV$.

Step 5: This air is crucial as it allows for continuous gas exchange between breaths and prevents the alveoli from collapsing.

Final Answer:

Answer: (B)

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Q82.

Solution**Concept:**

In population ecology, the Verhulst-Pearl Logistic Growth model describes how a population grows when resources are finite.

Solution:

Step 1: The logistic growth equation is $dN/dt = rN[(K - N)/K]$.

Step 2: In this model, ' r ' represents the intrinsic rate of natural increase, and ' N ' represents the population density at time ' t '.

Step 3: The environment has limited resources to support a maximum possible number of individuals. This limit is called the 'Carrying Capacity'.

Step 4: The symbol ' K ' is used to represent this Carrying Capacity. When N reaches K , the growth rate (dN/dt) becomes zero, and the population enters the stationary phase.

Step 5: This results in the characteristic sigmoid or S-shaped growth curve.

Final Answer:

Answer: (C)

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Q83.

Solution**Concept:**

The definition of a "gene" has evolved with molecular biology. A cistron is a segment of DNA that contains the genetic code for a single functional unit.

Solution:

Step 1: In a transcription unit, the structural gene is the region that actually gets transcribed into RNA.

Step 2: A segment of DNA coding for a polypeptide is specifically called a Cistron.

Step 3: Eukaryotic structural genes are usually "monocistronic" (one mRNA codes for one protein), whereas prokaryotic structural genes are often "polycistronic" (one mRNA codes for multiple proteins).

Step 4: A Muton is the smallest unit of DNA capable of undergoing mutation. A Recon is the smallest unit capable of recombination.

Step 5: An Intron is a non-coding sequence within a gene that is removed during splicing. Therefore, the coding unit is the Cistron.

Final Answer:

Answer: (C)

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Q84.

Solution**Concept:**

The wall of the alimentary canal from the esophagus to the rectum possesses four distinct tissue layers. Understanding their anatomical arrangement is fundamental to histology.

Solution:

Step 1: The outermost layer is the Serosa. It is made of a thin mesothelium with some connective tissues.

Step 2: Just inside the serosa is the Muscularis layer, usually consisting of inner circular and outer longitudinal smooth muscles.

Step 3: The next layer toward the center is the Sub-mucosa, which contains loose connective tissues, nerves, blood, and lymph vessels.

Step 4: The innermost layer lining the lumen of the alimentary canal is the Mucosa. This layer is responsible for absorption and secretion.

Step 5: Therefore, the correct sequence from the outside (peripheral) to the inside (lumen) is Serosa → Muscularis → Sub-mucosa → Mucosa.

Final Answer:

Answer: (A)

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Q85.

Solution**Concept:**

Transgenic animals are created to produce useful biological products, such as human proteins, in their milk or blood.

Solution:

Step 1: In 1997, the first transgenic cow was successfully created.

Step 2: This cow was named Rosie.

Step 3: Rosie was genetically engineered to produce human protein-enriched milk. The milk contained the human protein alpha-lactalbumin.

Step 4: This milk was nutritionally more balanced for human babies than natural cow milk, containing 2.4 grams of the human protein per liter.

Step 5: Dolly was the first cloned sheep (1996), Tracy was a transgenic sheep producing alpha-1-antitrypsin, and Polly was the first transgenic cloned sheep. Rosie is the specific answer for the first transgenic cow.

Final Answer:

Answer: (B)

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Q86.

Solution**Concept:**

This calculation involves multi-step arithmetic to determine the annual cost of a medical treatment involving recombinant proteins for a group of patients.

Solution:

Step 1: Calculate the monthly cost for one patient. Cost per unit = ₹ 850 Units per month = 12
Monthly cost per patient = $850 \times 12 = ₹ 10200$.

Step 2: Calculate the monthly cost for all 5 patients. Total monthly cost = $10200 \times 5 = ₹ 51000$.

Step 3: Calculate the total annual cost (12 months). Annual cost = $51000 \times 12 = ₹ 612000$.

Step 4: Alternatively, total units per year for 5 patients = $12 \times 5 \times 12 = 720$ units. Total cost = $720 \times 850 = ₹ 612000$.

Step 5: Therefore, the total expenditure for the clinic for these 5 patients annually is ₹ 6,12,000.

Final Answer: C

Answer: (C)

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Q87.

Solution**Concept:**

Bt-toxin is a biological insecticide produced by the bacterium *Bacillus thuringiensis*. It is produced as an inactive protoxin and requires specific conditions to become active.

Solution:

Step 1: The Bt-toxin exists as inactive crystalline protein inclusions in the bacterium.

Step 2: When an insect (like the cotton bollworm) ingests the transgenic plant tissue containing this protoxin, the crystals are dissolved in the insect's gut.

Step 3: The gut of these insects is characterized by an alkaline pH.

Step 4: This alkaline pH facilitates the solubilization of the crystals and the proteolytic conversion of the inactive protoxin into an active toxin.

Step 5: The active toxin binds to the surface of midgut epithelial cells, creating pores that cause cell swelling and lysis, eventually leading to the death of the insect.

Final Answer: B

Answer: (B)

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Q88.

Solution**Concept:**

Vitamins are essential micronutrients that the body needs in small amounts. A deficiency in any specific vitamin leads to characteristic clinical symptoms or diseases.

Solution:

Step 1: Vitamin A (Retinol) is essential for vision. Its deficiency causes Nyctalopia, commonly known as night blindness (i-q).

Step 2: Vitamin B1 (Thiamine) deficiency affects the nervous and cardiovascular systems, leading to the disease Beri-beri (ii-p).

Step 3: Vitamin C (Ascorbic acid) is necessary for collagen synthesis. Its deficiency causes Scurvy, characterized by bleeding gums (iii-s).

Step 4: Vitamin D (Calciferol) is required for calcium absorption. Its deficiency in children leads to Rickets, characterized by soft and deformed bones (iv-r).

Step 5: Matching the pairs: i-q, ii-p, iii-s, iv-r. This corresponds to Option A.

Final Answer:

Answer: (A)

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Q89.

Solution**Concept:**

Air pollutants are classified into primary and secondary. Primary pollutants are emitted directly from a source, whereas secondary pollutants form in the atmosphere through chemical reactions.

Solution:

Step 1: Carbon monoxide (CO) is a primary pollutant because it is released directly from the incomplete combustion of fossil fuels in vehicle exhausts and factories.

Step 2: Ozone (O_3) in the troposphere is a secondary pollutant, formed by the reaction of NO_x and VOCs in the presence of sunlight.

Step 3: PAN (Peroxyacyl nitrate) is a secondary pollutant and a component of photochemical smog, formed from other precursor pollutants.

Step 4: Nitric acid (HNO_3) is a secondary pollutant formed when nitrogen oxides react with water vapor in the air (leading to acid rain).

Step 5: Since Carbon monoxide is emitted directly, it is NOT a secondary pollutant.

Final Answer:

Answer: (C)

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Q90.

Solution**Concept:**

The life cycle of *Plasmodium* (the malaria parasite) involves two hosts: the female *Anopheles* mosquito and the human.

Solution:

Step 1: When an infected female *Anopheles* mosquito bites a human, it injects the parasite into the human bloodstream along with its saliva.

Step 2: The specific stage of the parasite present in the mosquito's salivary glands is the Sporozoite.

Step 3: Sporozoites are minute, sickle-shaped, infectious forms that travel to the human liver to begin the asexual phase of the life cycle.

Step 4: Trophozoites and Merozoites are stages found within the human body during the erythrocytic (RBC) cycle. Gametocytes are the stages that must be taken up by a mosquito to continue the cycle.

Step 5: Therefore, the Sporozoite is the stage that initiates the infection in humans.

Final Answer:

Answer: (B)

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Q91.

Solution**Concept:**

Usually, seeds are the product of fertilization (amphimixis). However, some plants have evolved a mechanism to produce seeds without the fusion of male and female gametes.

Solution:

Step 1: Parthenocarpy is the formation of fruit without fertilization, which typically results in seedless fruits (e.g., banana).

Step 2: Apomixis is a form of asexual reproduction that mimics sexual reproduction, where seeds are formed without fertilization.

Step 3: This can occur through various methods, such as a diploid nucellar cell developing into an embryo or the formation of a diploid egg cell that develops into an embryo without being fertilized.

Step 4: Polyembryony is the occurrence of more than one embryo in a seed, which is often seen in citrus fruits and can be a result of apomixis.

Step 5: Since the question specifically asks for the process of "seed formation without fertilization," Apomixis is the correct biological term.

Final Answer:

Answer: (B)

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Q92.

Solution**Concept:**

The humoral immune response is mediated by antibodies found in the blood and lymph. These antibodies are specialized proteins produced by a specific type of lymphocyte.

Solution:

Step 1: Lymphocytes are of two types: B-lymphocytes (B-cells) and T-lymphocytes (T-cells).

Step 2: When B-cells encounter an antigen, they proliferate and differentiate into Plasma cells and Memory cells.

Step 3: Plasma cells are the actual "antibody factories" of the body. They secrete large volumes of antibodies (immunoglobulins) into the blood plasma to neutralize pathogens.

Step 4: T-cytotoxic cells are involved in cell-mediated immunity (killing infected cells directly). Natural Killer cells and Neutrophils are part of the innate immune system and do not produce specific antibodies.

Step 5: Therefore, the B-lymphocyte (specifically the differentiated plasma cell) is responsible for antibody production.

Final Answer:

Answer: (B)

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Q93.

Solution**Concept:**

International treaties are essential for addressing global environmental issues. The Montreal Protocol is one of the most successful environmental agreements in history.

Solution:

Step 1: Evaluate Statement I. The Montreal Protocol is an international treaty designed to protect the ozone layer by phasing out the production and consumption of numerous substances that are responsible for ozone depletion (like CFCs). Thus, Statement I is correct.

Step 2: Evaluate Statement II. The protocol was opened for signature on September 16, 1987, in Montreal, Canada. It subsequently became effective on January 1, 1989. Thus, Statement II is also correct.

Step 3: Both statements provide accurate historical and functional facts regarding the protocol.

Final Answer:

Answer: (A)

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Q94.

Solution**Concept:**

Diabetes Mellitus is a metabolic disorder characterized by high blood sugar levels (hyperglycemia) due to insulin deficiency or resistance.

Solution:

Step 1: When blood glucose levels exceed the renal threshold (approx. 180 mg/dL), the kidneys cannot reabsorb all the glucose from the filtrate.

Step 2: This results in the excretion of glucose in the urine, a condition known as Glycosuria.

Step 3: Additionally, because the body cannot effectively use glucose for energy, it starts breaking down fats at an accelerated rate, leading to the production of Ketone bodies.

Step 4: The presence of these Ketone bodies in the urine is called Ketonuria.

Step 5: Therefore, the presence of both Glucose and Ketone bodies in urine is a classic diagnostic indicator for Diabetes Mellitus.

Final Answer:

Answer: (B)

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Q95.

Solution**Concept:**

PCR (Polymerase Chain Reaction) utilizes a thermal cycler to rapidly change temperatures, allowing different biochemical reactions to occur in a specific order.

Solution:

Step 1: Denaturation (i) involves heating the DNA to separate the double strands into single strands. This requires a high temperature, typically 94°C (i-r).

Step 2: Annealing (ii) involves cooling the reaction so that primers can bind (hybridize) to their complementary sequences on the single-stranded DNA. This occurs at a lower temperature, around 54°C (ii-p).

Step 3: Extension (iii) is the phase where Taq polymerase synthesizes the new DNA strand. The optimum temperature for this enzyme's activity is 72°C (iii-q).

Step 4: Matching the sequence: i-r, ii-p, iii-q.

Step 5: This corresponds to Option A.

Final Answer:

Answer: (A)

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Q96.

Solution**Concept:**

Translation (protein synthesis) involves the reading of mRNA codons by ribosomes. Specific codons signal the start and the end of the polypeptide chain synthesis.

Solution:

Step 1: The genetic code is a triplet code. Out of the 64 possible codons, 61 code for amino acids and 3 do not code for any amino acid.

Step 2: The three codons that do not code for amino acids are UAA (Ochre), UAG (Amber), and UGA (Opal).

Step 3: These are called "Stop Codons" or "Termination Codons" because when a ribosome encounters them, the translation process stops and the newly formed polypeptide is released.

Step 4: AUG is the "Start Codon" (Initiation codon) which also codes for Methionine. GUG can occasionally act as a start codon. UGG codes for Tryptophan.

Step 5: Among the given options, UAA is the only stop codon.

Final Answer:

Answer: (C)

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Q97.

Solution**Concept:**

In vitro fertilization (IVF) is a process where the egg is fertilized by sperm outside the body, in a laboratory setting. This is popularly known as the "Test-tube baby" program.

Solution:

Step 1: In the IVF program, the zygote or early embryo (up to 8 blastomeres) can be transferred into the fallopian tube. This specific technique is called ZIFT (Zygote Intra-Fallopian Transfer).

Step 2: If the embryo is older than 8 blastomeres, it is transferred into the uterus, a technique called IUT (Intra-Uterine Transfer).

Step 3: GIFT (Gamete Intra-Fallopian Transfer) involves transferring unfertilized gametes into the fallopian tube, which is an in vivo (inside the body) fertilization method.

Step 4: AI (Artificial Insemination) and IUI (Intra-Uterine Insemination) involve the transfer of sperm, not embryos.

Step 5: Therefore, ZIFT is the technique directly associated with the embryo transfer phase of a test-tube baby program.

Final Answer:

Answer: (B)

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Q98.

Solution**Concept:**

A food chain represents the flow of energy from one trophic level to another. In an aquatic ecosystem, the producers are usually microscopic photosynthetic organisms.

Solution:

Step 1: Producers (First Trophic Level): In a pond, these are Phytoplanktons, algae, and floating/submerged plants.

Step 2: Primary Consumers (Second Trophic Level): These are herbivores that feed directly on the producers.

Step 3: In a typical pond food chain, Zooplanktons (tiny aquatic animals) feed on the phytoplanktons.

Step 4: Small fish and benthic organisms (like certain insect larvae) may also act as primary consumers, but zooplanktons are the dominant primary consumers in the open water (limnetic) zone.

Step 5: Small fish that eat zooplanktons are considered secondary consumers. Therefore, Zooplanktons are the correct primary consumers.

Final Answer: B

Answer: (B)

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Q99.

Solution**Concept:**

Glands in the human body are specialized organs that secrete substances. They are categorized based on their size, location, and the nature of their secretion (exocrine or endocrine).

Solution:

Step 1: The Liver is the largest gland in the human body, weighing about 1.2 to 1.5 kg in an adult human. It performs hundreds of functions, including bile production and detoxification.

Step 2: The Pancreas is the second largest gland and is a heterocrine gland (both exocrine and endocrine).

Step 3: The Thyroid is the largest purely endocrine gland, located in the neck.

Step 4: The Pituitary is a very small gland (about the size of a pea) located at the base of the brain, often called the "Master Gland" despite its small size.

Step 5: In terms of total mass and volume, the Liver is unrivaled as the largest gland.

Final Answer: C

Answer: (C)

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Q100.

Solution**Concept:**

In plant biotechnology, vectors are used to deliver desirable genes into the host plant genome. Certain soil bacteria have a natural ability to transform plant cells.

Solution:

Step 1: *Agrobacterium tumefaciens* is a soil bacterium known as a "natural genetic engineer" of plants.

Step 2: It contains a large plasmid called the Ti (Tumor-inducing) plasmid.

Step 3: In nature, it uses a segment of this plasmid (T-DNA) to infect plant cells and integrate its DNA into the host genome, causing crown gall disease.

Step 4: Scientists have modified the Ti plasmid by removing the disease-causing genes while keeping the ability to transfer DNA. This "disarmed" Ti plasmid is the most widely used vector for cloning genes into dicot plants.

Step 5: pBR322 is primarily used for *E. coli*. *Salmonella* was used in the first recombinant DNA experiment but is not a standard plant vector.

Final Answer:

Answer: (B)

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Answer Key

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

