MHT-CET Biology Sample Paper-2

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. A segment of DNA has 120 Adenine and 120 Cytosine bases. The total number of nucleotides present in this segment is:

(A) 240

(B) 480

(C) 360

(D) 120

Q2. Identify the correct sequence of the stages in the catalytic cycle of an enzyme action: i. The substrate binds to the active site. ii. The enzyme releases the products. iii. The active site of the enzyme is in close proximity to the substrate and breaks chemical bonds. iv. Binding of the substrate induces the enzyme to alter its shape.

(A) i $\rightarrow$ ii $\rightarrow$ iii $\rightarrow$ iv

(B) i $\rightarrow$ iv $\rightarrow$ iii $\rightarrow$ ii

(C) iv $\rightarrow$ iii $\rightarrow$ ii $\rightarrow$ i

(D) i $\rightarrow$ iii $\rightarrow$ iv $\rightarrow$ ii

Q3. In a typical Mendelian dihybrid cross, if the F_2 generation shows a phenotypic ratio of 9:3:3:1, what is the probability of obtaining a plant with at least one dominant allele for both traits?

(A) 1/16

(B) 3/16

(C) 9/16

(D) 15/16

Q4. Which of the following hormones is a potent vasodilator and is secreted by the atrial wall of the heart to reduce blood pressure?

(A) Erythropoietin

(B) Atrial Natriuretic Factor

(C) Aldosterone

(D) Renin

Q5. In the double-blind fold experiment of photosynthesis, if a plant is provided with $H_2^{18}O$ and CO_2, the evolved oxygen will be:

(A) $^{18}O_2$

(B) O_2 (normal)

(C) Mixture of $^{18}O_2$ and O_2

(D) No oxygen will be evolved

Q6. During the process of oogenesis, the first polar body is formed after the completion of:

(A) Mitosis

(B) Meiosis-I

(C) Meiosis-II

(D) Differentiation

Q7. The volume of air that remains in the lungs even after a forcible expiration is known as:

(A) Tidal Volume

(B) Residual Volume

(C) Inspiratory Reserve Volume

(D) Vital Capacity

Q8. Select the mismatch pair from the following regarding secondary metabolites:

(A) Alkaloids - Morphine

(B) Terpenoids - Monoterpenes

(C) Lectins - Concanavalin A

(D) Drugs - Ricin

Q9. In an ecosystem, the rate of production of organic matter during photosynthesis is termed as:

(A) Net Primary Productivity

(B) Gross Primary Productivity

(C) Secondary Productivity

(D) Net Productivity

Q10. The transition zone between two distinct communities or ecosystems is referred to as:

(A) Ecotone

(B) Edge effect

(C) Ecological niche

(D) Biome

Q11. Which of the following is an example of an autosomal recessive disorder?

(A) Haemophilia

(B) Sickle Cell Anaemia

(C) Colour blindness

(D) Myotonic dystrophy

Q12. In plants, the hormone primarily responsible for the "triple response" (inhibiting elongation, thickening the stem, and horizontal growth) is:

(A) Auxin

(B) Gibberellin

(C) Ethylene

(D) Cytokinin

Q13. The semi-conservative nature of DNA replication was first experimentally proven in:

(A) Streptococcus pneumoniae

(B) Escherichia coli

(C) Drosophila melanogaster

(D) Vicia faba

Q14. Match Column I with Column II and select the correct option: Column I: (A) Amoebiasis, (B) Filariasis, (C) Typhoid, (D) Ringworm Column II: (i) Wuchereria bancrofti, (ii) Entamoeba histolytica, (iii) Microsporum, (iv) Salmonella typhi

(A) A-ii, B-i, C-iv, D-iii

(B) A-i, B-ii, C-iii, D-iv

(C) A-ii, B-i, C-iii, D-iv

(D) A-iv, B-iii, C-ii, D-i

Q15. Which part of the human brain is responsible for the regulation of body temperature and the urge for eating?

(A) Cerebellum

(B) Corpus callosum

(C) Hypothalamus

(D) Medulla oblongata

Q16. The primary CO_2 acceptor in C_4 plants is:

(A) RuBP

(B) PEP

(C) PGA

(D) OAA

Q17. In the human heart, the "Pacemaker" is located in:

(A) Left atrium

(B) Right atrium

(C) Interventricular septum

(D) Purkinje fibres

Q18. Which of the following is NOT a characteristic of wind-pollinated flowers?

(A) Light and non-sticky pollen grains

(B) Well-exposed stamens

(C) Feathery stigma

(D) Large, brightly coloured petals

Q19. According to the "Lock and Key" hypothesis, the _____ represents the lock and the _____ represents the key.

(A) Enzyme, Substrate

(B) Substrate, Enzyme

(C) Product, Enzyme

(D) Co-factor, Enzyme

Q20. Restriction endonucleases are also known as:

(A) Molecular glue

(B) Molecular scissors

(C) Vector DNA

(D) DNA polymerase

Q21. The term 'Linkage' was coined by which of the following scientists while working on Drosophila melanogaster?

(A) Gregor Mendel

(B) T.H. Morgan

(C) Hugo de Vries

(D) Bateson and Punnett

Q22. Identify the correct match regarding the location and type of epithelial tissue:

(A) Inner lining of salivary ducts - Ciliated epithelium

(B) Moist surface of buccal cavity - Glandular epithelium

(C) Tubular parts of nephrons - Cuboidal epithelium

(D) Inner surface of bronchioles - Squamous epithelium

Q23. The process of formation of RNA from DNA is known as _____ and is catalyzed by the enzyme _____.

(A) Replication, DNA polymerase

(B) Translation, Ribozyme

(C) Transcription, RNA polymerase

(D) Reverse transcription, Transcriptase

Q24. In a longitudinal section of a typical flower, the megasporangium is represented by the:

(A) Ovule

(B) Ovary

(C) Embryo sac

(D) Nucellus

Q25. Which of the following is a 'Stop Codon' during the process of translation?

(A) AUG

(B) GUG

(C) UUU

(D) UAG

Q26. The pyramid of energy in any ecosystem is always:

(A) Upright

(B) Inverted

(C) Spindle shaped

(D) Irregular

Q27. In the human male reproductive system, the correct path of sperm transport is:

(A) Rete testis → Efferent ductules → Epididymis → Vas deferens

(B) Efferent ductules → Rete testis → Vas deferens → Epididymis

(C) Rete testis → Epididymis → Efferent ductules → Vas deferens

(D) Vas deferens → Epididymis → Efferent ductules → Rete testis

Q28. The movement of water through the cell wall and intercellular spaces without crossing any membrane is called:

(A) Symplast pathway

(B) Apoplast pathway

(C) Vacuolar pathway

(D) Transpiration pull

Q29. The 'Double Fertilization' is a characteristic feature of:

(A) Algae

(B) Gymnosperms

(C) Angiosperms

(D) Pteridophytes

Q30. Which of the following is NOT an application of PCR (Polymerase Chain Reaction)?

(A) DNA fingerprinting

(B) Detection of pathogens

(C) Purification of isolated protein

(D) Gene amplification

Q31. The pH of human arterial blood is approximately:

(A) 6.8

(B) 7.4

(C) 8.2

(D) 5.5

Q32. In the context of evolution, the wings of a butterfly and the wings of a bird are examples of:

(A) Homologous organs

(B) Analogous organs

(C) Vestigial organs

(D) Atavistic organs

Q33. The 'Grafting' method is successful in Dicots but fails in Monocots because Dicots have:

(A) Vascular bundles arranged in a ring

(B) Cambium for secondary growth

(C) Closed vascular bundles

(D) Parallel venation

Q34. Which immunoglobulin is most abundant in human colostrum?

(A) IgG

(B) IgM

(C) IgE

(D) IgA

Q35. The function of 'Filiform apparatus' in an embryo sac is to:

(A) Recognize the suitable pollen at the stigma

(B) Guide the entry of pollen tube into the synergid

(C) Prevent entry of more than one pollen tube

(D) Help in the formation of endosperm

Q36. The breakdown of Glucose to Pyruvic acid in the cytoplasm is called:

(A) Krebs cycle

(B) Glycolysis

(C) Link reaction

(D) ETS

Q37. A person with blood group 'O' has _____ on their RBCs and _____ in their plasma.

(A) No antigens; anti-A and anti-B antibodies

(B) Antigen A and B; no antibodies

(C) Antigen O; anti-O antibodies

(D) Antigen A; anti-B antibodies

Q38. The structure in a human kidney that acts as a dialyzing unit is the:

(A) Renal pelvis

(B) Nephron

(C) Ureter

(D) Medullary pyramid

Q39. The production of 'Bt-cotton' involves the use of a toxin produced by:

(A) Agrobacterium tumefaciens

(B) Bacillus thuringiensis

(C) Escherichia coli

(D) Thermus aquaticus

Q40. In the process of digestion, the enzyme 'Pepsin' converts:

(A) Fats into Diglycerides

(B) Starch into Maltose

(C) Proteins into Proteoses and Peptones

(D) Nucleotides into Nucleosides

Q41. The functional unit of contraction in a muscle fiber is:

(A) Myofibril

(B) Sarcomere

(C) Fascia

(D) Sarcoplasm

Q42. Identify the hormone that stimulates the gallbladder to release bile:

(A) Gastrin

(B) Secretin

(C) Cholecystokinin (CCK)

(D) Enterogastrone

Q43. The 'Montreal Protocol' is associated with:

(A) Control of global warming

(B) Conservation of biodiversity

(C) Protection of the ozone layer

(D) Control of water pollution

Q44. In humans, the sex-determining region Y (SRY gene) is located on:

(A) X chromosome

(B) Y chromosome

(C) Autosome 21

(D) Mitochondrial DNA

Q45. The conversion of Ammonia to Nitrates in soil is carried out by:

(A) Nitrosomonas and Nitrobacter

(B) Rhizobium

(C) Azotobacter

(D) Pseudomonas

Q46. Which of the following is a primary lymphoid organ?

(A) Spleen

(B) Payer's patches

(C) Bone marrow

(D) Lymph nodes

Q47. The 'Kranz anatomy' is a characteristic feature of the leaves of:

(A) C_3 plants

(B) C_4 plants

(C) CAM plants

(D) Insectivorous plants

Q48. In the respiratory system, the gaseous exchange occurs in the:

(A) Trachea

(B) Bronchi

(C) Alveoli

(D) Pharynx

Q49. The interaction where one species is benefited and the other is neither harmed nor benefited is called:

(A) Mutualism

(B) Parasitism

(C) Commensalism

(D) Amensalism

Q50. Which part of the sperm contains the enzymes that help in penetrating the egg membrane?

(A) Nucleus

(B) Middle piece

(C) Acrosome

(D) Tail

Q51. During DNA replication, the Okazaki fragments are joined together by:

(A) DNA polymerase I

(B) DNA ligase

(C) Helicase

(D) Primase

Q52. Which phase of the menstrual cycle is also known as the Proliferative phase?

(A) Luteal phase

(B) Follicular phase

(C) Secretory phase

(D) Ovulatory phase

Q53. In a test cross, an individual with an unknown genotype is crossed with:

(A) Homozygous dominant parent

(B) Heterozygous parent

(C) Homozygous recessive parent

(D) F_1 hybrid

Q54. The movement of ions against the concentration gradient with the expenditure of ATP is called:

(A) Simple diffusion

(B) Facilitated diffusion

(C) Active transport

(D) Osmosis

Q55. The structural and functional unit of the liver is:

(A) Hepatocyte

(B) Hepatic lobule

(C) Kupffer cell

(D) Glisson's capsule

Q56. Which set of symptoms is characteristic of Pneumonia?

(A) Constipation, abdominal pain, cramps

(B) Nasal congestion, sore throat, cough

(C) Fever, chills, cough, headache, greyish-blue lips

(D) High fever, weakness, stomach pain, loss of appetite

Q57. The technique used for the amplification of a specific DNA sequence in vitro is:

(A) Western blotting

(B) Northern blotting

(C) Polymerase Chain Reaction

(D) Chromatography

Q58. The target organ for the hormone 'Oxytocin' in females is:

(A) Ovary

(B) Uterus and Mammary glands

(C) Pituitary gland

(D) Kidney

Q59. Identify the correct match for the Mendelian disorders:

(A) Thalassemia - X-linked recessive

(B) Phenylketonuria - Autosomal recessive

(C) Down's syndrome - Gene mutation

(D) Turner's syndrome - Autosomal trisomy

Q60. The 'Lesser Glands' or 'Cowper's Glands' in males are also known as:

(A) Prostate gland

(B) Seminal vesicles

(C) Bulbourethral glands

(D) Bartholin's glands

Q61. In which part of the chloroplast do the 'Light Reactions' occur?

(A) Stroma

(B) Grana/Thylakoid

(C) Outer membrane

(D) Inner membrane

Q62. The pioneer species in a primary succession on rocks are:

(A) Mosses

(B) Lichens

(C) Ferns

(D) Grasses

Q63. The deficiency of which hormone causes 'Diabetes Insipidus'?

(A) Insulin

(B) Glucagon

(C) ADH (Vasopressin)

(D) Aldosterone

Q64. Which of the following serves as the 'Biological clock' in humans?

(A) Thymus gland

(B) Pineal gland

(C) Thyroid gland

(D) Adrenal gland

Q65. In a DNA molecule, the distance between two adjacent base pairs is:

(A) 3.4 nm

(B) 0.34 nm

(C) 2.0 nm

(D) 34 nm

Q66. The 'Red Data Book' is maintained by:

(A) WWF

(B) IUCN

(C) CITES

(D) IBWL

Q67. Which of the following is a gaseous phytohormone?

(A) ABA

(B) Ethylene

(C) IAA

(D) GA_3

Q68. The inner layer of the human eye that contains photoreceptor cells is the:

(A) Sclera

(B) Choroid

(C) Retina

(D) Cornea

Q69. The production of 'Humulin' (human insulin) by Eli Lilly company was done using:

(A) Saccharomyces

(B) E. coli

(C) Agrobacterium

(D) Bacillus

Q70. In the respiratory system, 'Vital Capacity' is calculated as:

(A) TV + IRV

(B) TV + ERV

(C) TV + IRV + ERV

(D) TV + IRV + ERV + RV

Q71. The 'Corpus Luteum' secretes high amounts of:

(A) Estrogen

(B) Progesterone

(C) LH

(D) FSH

Q72. The genetic material in 'Tobacco Mosaic Virus' (TMV) is:

(A) Double-stranded DNA

(B) Single-stranded DNA

(C) Double-stranded RNA

(D) Single-stranded RNA

Q73. The process by which nutrient-rich water bodies lead to excessive growth of algae and depletion of oxygen is called:

(A) Biomagnification

(B) Eutrophication

(C) Bioremediation

(D) Stratification

Q74. Identify the hormone that is called the 'Stress Hormone' in plants:

(A) Cytokinin

(B) Abscisic acid (ABA)

(C) Gibberellin

(D) Auxin

Q75. The largest gland in the human body is:

(A) Pancreas

(B) Thyroid

(C) Liver

(D) Adrenal

Q76. In DNA, Adenine pairs with Thymine through _____ hydrogen bonds.

(A) One

(B) Two

(C) Three

(D) Four

Q77. The syndrome caused by the presence of an extra X chromosome in males (XXY) is:

(A) Turner's syndrome

(B) Klinefelter's syndrome

(C) Down's syndrome

(D) Edward's syndrome

Q78. Which part of the brain controls involuntary activities like heart rate and respiration?

(A) Cerebrum

(B) Medulla oblongata

(C) Thalamus

(D) Cerebellum

Q79. The nitrogenous waste excreted by humans is primarily:

(A) Ammonia

(B) Uric acid

(C) Urea

(D) Guanine

Q80. Which of the following is a non-medicated IUD?

(A) Lippes loop

(B) Multiload 375

(C) Cu7

(D) LNG-20

Q81. In C_4 plants, the bundle sheath cells are rich in the enzyme:

(A) PEP carboxylase

(B) RuBisCO

(C) Carbonic anhydrase

(D) Hexokinase

Q82. The major function of 'Stomata' is:

(A) Support

(B) Transpiration and gas exchange

(C) Protection

(D) Absorption of water

Q83. Which stage of Meiosis is characterized by the 'Crossing over' of genetic material?

(A) Leptotene

(B) Zygotene

(C) Pachytene

(D) Diplotene

Q84. The first human-like hominid was:

(A) Homo erectus

(B) Homo habilis

(C) Australopithecus

(D) Neanderthal man

Q85. In which type of natural selection do more individuals acquire peripheral character values at both ends of the distribution curve?

(A) Stabilizing selection

(B) Directional selection

(C) Disruptive selection

(D) Normalizing selection

Q86. The cells that produce antibodies in the human body are:

(A) T-cells

(B) B-cells (Plasma cells)

(C) Neutrophils

(D) Macrophages

Q87. The 'Sacred Groves' are an example of:

(A) Ex-situ conservation

(B) In-situ conservation

(C) Cryopreservation

(D) Seed bank

Q88. The hormone that helps in the maintenance of pregnancy by inhibiting uterine contractions is:

(A) Relaxin

(B) Progesterone

(C) Oxytocin

(D) Prolactin

Q89. The small finger-like projections in the small intestine that increase surface area for absorption are:

(A) Cilia

(B) Flagella

(C) Villi

(D) Rugae

Q90. Which of the following is a connecting link between reptiles and birds?

(A) Ornithorhynchus

(B) Archaeopteryx

(C) Peripatus

(D) Neopilina

Q91. The removal of anthers from the flower bud before it dehisces is called:

(A) Bagging

(B) Emasculation

(C) Tagging

(D) Hybridization

Q92. In 'DNA Fingerprinting', the small DNA sequences that vary in number from person to person are called:

(A) SNPs

(B) VNTRs

(C) RFLPs

(D) Exons

Q93. The function of 'Sertoli cells' in the testis is to:

(A) Produce testosterone

(B) Provide nutrition to germ cells

(C) Form the blood-testis barrier

(D) Both (B) and (C)

Q94. Which ecological pyramid can never be inverted in a stable ecosystem?

(A) Pyramid of Number

(B) Pyramid of Biomass

(C) Pyramid of Energy

(D) None of the above

Q95. The vector used for transferring gene into a 'Dicot' plant is:

(A) pBR322

(B) Ti-plasmid

(C) Lambda phage

(D) SV40

Q96. The disease caused by the deficiency of 'Thyroxine' in adults is:

(A) Cretinism

(B) Myxedema

(C) Grave's disease

(D) Exophthalmic goitre

Q97. The term 'Biodiversity' was popularized by:

(A) Edward Wilson

(B) Robert May

(C) Paul Ehrlich

(D) Alexander von Humboldt

Q98. In double-stranded DNA, if Cytosine is 18%, the percentage of Adenine will be:

(A) 18%

(B) 32%

(C) 36%

(D) 64%

Q99. The 'Hardy-Weinberg equilibrium' is affected by:

(A) Gene flow

(B) Genetic drift

(C) Mutation

(D) All of the above

Q100. Which of the following is a Copper-releasing IUD?

(A) LNG-20

(B) Progestasert

(C) Multiload 375

(D) Lippes loop

Detailed Solutions

Q1.

Solution

Concept: The structure of DNA is governed by Chargaff's rules, which state that in a double-stranded DNA molecule, the amount of purines is always equal to the amount of pyrimidines. Specifically, the number of Adenine (A) bases equals the number of Thymine (T) bases, and the number of Cytosine (C) bases equals the number of Guanine (G) bases. This base-pairing rule is fundamental to understanding the quantitative composition of any DNA segment.

Solution: 1: Let's identify the given values from the question. We are told that the DNA segment contains 120 Adenine (A) bases and 120 Cytosine (C) bases.
2: According to Chargaff's base-pairing rules ($A = T$ and $G = C$):
Since A is 120, then the number of Thymine (T) must also be 120.
Since C is 120, then the number of Guanine (G) must also be 120.
3: To find the total number of nucleotides in the DNA segment, we must sum all four types of nitrogenous bases present in the double helix. The calculation is as follows:
Total Nucleotides = A + T + G + C
Total Nucleotides = 120 (A) + 120 (T) + 120 (G) + 120 (C)
Total Nucleotides = 480.
4: Each nucleotide consists of a nitrogenous base, a pentose sugar, and a phosphate group. Therefore, the total number of bases corresponds exactly to the total number of nucleotides in that segment of the DNA molecule. This illustrates the stoichiometric balance required for the stability of the double helix structure.

Final Answer: 480

Answer: (B)

Go Back to Question 1

Q2.

Solution

Concept: Enzymes are biological catalysts that speed up chemical reactions by lowering the activation energy. The catalytic cycle describes the sequence of events that occur at the molecular level when an enzyme interacts with its substrate to produce a specific product. This process is often explained by the Induced Fit model, which suggests a dynamic interaction between the enzyme and the substrate.

Solution: 1: The first step in the catalytic cycle is the recognition phase. The substrate must collide with and bind to the specific active site of the enzyme, forming an Enzyme-Substrate (ES) complex. This corresponds to statement (i).
2: Once the substrate is bound, the binding itself triggers a conformational change in the enzyme. The enzyme wraps more tightly around the substrate, ensuring a perfect fit. This is the "induced fit" stage. This corresponds to statement (iv).
3: In this tightly bound state, the active site is in extremely close proximity to the chemical bonds of the substrate. The enzyme then exerts physical or chemical stress to break the old bonds and facilitate the formation of new ones, creating the Enzyme-Product (EP) complex. This corresponds to statement (iii).
4: Finally, once the chemical transformation is complete, the enzyme loses its affinity for the newly formed products. The products are released into the surrounding medium, and the enzyme returns to its original state, ready to catalyze another reaction. This corresponds to statement (ii).
5: Therefore, the logical and biological sequence of the catalytic cycle is i $\rightarrow$ iv $\rightarrow$ iii $\rightarrow$ ii.

Final Answer: i $\rightarrow$ iv $\rightarrow$ iii $\rightarrow$ ii

Answer: (B)

Go Back to Question 2

Q3.

Solution

Concept: In Mendelian genetics, a dihybrid cross involves the study of two pairs of contrasting traits simultaneously. Mendel's Law of Independent Assortment states that the alleles of two (or more) different genes get sorted into gametes independently of one another. For a standard dihybrid cross (e.g., RrYy x RrYy), the F_2 phenotypic ratio is 9:3:3:1.

Solution: 1: The total number of possible combinations in a dihybrid Punnett square is 16 (4×4). The ratio 9:3:3:1 represents these 16 parts.
2: Let's break down the 9:3:3:1 ratio based on dominant and recessive phenotypes:
9/16: Dominant for both traits (e.g., Round and Yellow). These individuals have at least one dominant allele for the first trait (R_) and one for the second (Y_).
3/16: Dominant for the first trait, recessive for the second (e.g., Round and green). (R_yy).
3/16: Recessive for the first trait, dominant for the second (e.g., wrinkled and Yellow). (rrY_).
1/16: Recessive for both traits (e.g., wrinkled and green). (rryy).
3: The question asks for the probability of obtaining a plant with at least one dominant allele for BOTH traits. This refers specifically to the first category in the ratio (the "Double Dominant" phenotype).
4: By looking at the Punnett square results, exactly 9 out of the 16 offspring will possess at least one dominant allele for trait 1 and at least one dominant allele for trait 2. Thus, the probability is 9/16.

Final Answer: 9/16

Answer: (C)

Go Back to Question 3

Q4.

Solution

Concept: The regulation of blood pressure and kidney function involves a complex interplay between the heart, the kidneys, and the adrenal glands. While the Renin-Angiotensin-Aldosterone System (RAAS) works to increase blood pressure, the heart produces a counter-regulatory hormone to prevent the pressure from becoming excessively high.

Solution: 1: When blood flow or blood pressure in the atria of the heart increases (often due to increased blood volume), the muscular walls of the atria are stretched.
2: In response to this stretching, the atrial walls secrete a peptide hormone called Atrial Natriuretic Factor (ANF).
3: The primary physiological role of ANF is to act as a powerful vasodilator. Vasodilation refers to the widening of blood vessels, which immediately results in a decrease in peripheral resistance and a subsequent drop in blood pressure.
4: Additionally, ANF inhibits the release of Renin from the juxtaglomerular apparatus and inhibits the secretion of Aldosterone from the adrenal cortex. By doing so, it promotes the excretion of sodium (natriuresis) and water in the urine, further reducing blood volume and pressure.
5: Let's look at the other options: Erythropoietin stimulates RBC production; Aldosterone increases blood pressure by retaining sodium; Renin initiates the RAAS pathway to increase pressure. Therefore, ANF is the correct vasodilator mentioned.

Final Answer: Atrial Natriuretic Factor

Answer: (B)

Go Back to Question 4

Q5.

Solution

Concept: Photosynthesis is a process where light energy is converted into chemical energy. A long-standing debate in biology was whether the oxygen evolved during photosynthesis came from Carbon Dioxide (CO_2) or from Water (H_2O). This was eventually resolved using heavy isotopes of oxygen (^{18}O) in experiments conducted by Ruben, Hassid, and Kamen.

Solution: 1: The overall equation for photosynthesis is: $6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$.
2: During the Light-Dependent Reactions (specifically non-cyclic photophosphorylation), water molecules undergo a process called photolysis. The water-splitting complex associated with Photosystem II breaks down water into protons (H^+), electrons (e^-), and oxygen (O_2).
3: In the scenario provided, the plant is given water labeled with the heavy isotope of oxygen ($H_2^{18}O$) and normal carbon dioxide (CO_2).
4: Since the oxygen released as gas comes exclusively from the splitting of water molecules and not from the carbon dioxide, the isotopic label (^{18}O) present in the water will be transferred directly to the oxygen gas evolved.
5: Therefore, if the oxygen in the water is ^{18}O, the evolved oxygen gas will be $^{18}O_2$. This experiment proves that water is the source of oxygen in photosynthesis, while the oxygen in CO_2 ends up in the glucose and the newly formed water molecules.

Final Answer: $^{18}O_2$

Answer: (A)

Go Back to Question 5

Q6.

Solution

Concept: Oogenesis is the process of formation of a mature female gamete. Unlike spermatogenesis, oogenesis is a discontinuous process that begins during the embryonic developmental stage. It involves several rounds of cell division, including both mitosis and meiosis, and is characterized by unequal cytoplasmic division to ensure the ovum receives maximum nutrients for potential embryo development.

Solution: 1: During fetal development, millions of oogonia are formed in the fetal ovary. These cells enter the Prophase-I of meiosis but get suspended at that stage. These are known as primary oocytes.
2: At puberty, a primary oocyte completes its first meiotic division (Meiosis-I). This division is highly unequal, resulting in the formation of a large haploid secondary oocyte and a tiny haploid cell called the first polar body.
3: The first polar body contains very little cytoplasm and serves as a means to discard half of the chromosomes while retaining the bulk of the nutrient-rich cytoplasm within the secondary oocyte.
4: The secondary oocyte then begins Meiosis-II but is arrested at the metaphase stage, completing it only if fertilization by a sperm occurs. If fertilization happens, a second polar body is formed.
5: Therefore, the first polar body is strictly the product of the completion of Meiosis-I. This marks the transition from a diploid primary oocyte to a haploid secondary oocyte.

Final Answer: Meiosis-I

Answer: (B)

Go Back to Question 6

Q7.

Solution

Concept: Pulmonary volumes and capacities are essential parameters used to measure the functional status of the respiratory system. These measurements vary based on physical activity, health status, and age. Understanding these volumes helps in diagnosing restrictive and obstructive lung disorders. The residual volume is a unique component because it cannot be measured using a simple spirometer.

Solution: 1: During normal breathing, the volume of air inspired or expired is called the Tidal Volume (TV), which is roughly 500 mL in a healthy adult.
2: Even after the most forceful expiration, the lungs are never completely empty of air. This specific volume that stays within the alveoli and respiratory passages to prevent the lungs from collapsing is called the Residual Volume (RV).
3: Residual Volume averages about 1100 mL to 1200 mL. Its presence is vital because it allows for continuous gas exchange to occur even between breaths and during expiration.
4: Other related capacities include: Vital Capacity (VC), which is the maximum volume of air a person can breathe out after a forced inspiration; and Inspiratory Reserve Volume (IRV), which is the extra volume of air one can inspire beyond the tidal volume.
5: Since the question specifically asks for the air remaining after "forcible expiration," the only correct physiological term is Residual Volume.

Final Answer: Residual Volume

Answer: (B)

Go Back to Question 7

Q8.

Solution

Concept: Plants, fungi, and microbes produce thousands of organic compounds. While primary metabolites (like sugars and amino acids) have identifiable functions in physiological processes, secondary metabolites are often produced as defense mechanisms, attractants, or by-products. They are classified into groups such as alkaloids, terpenoids, lectins, and toxins based on their chemical nature.

Solution: 1: Let's evaluate each pair based on the standard classification of secondary metabolites:
Option A: Alkaloids - Morphine and Codeine. This is a correct match. Morphine is a well-known alkaloid derived from the opium poppy.
Option B: Terpenoids - Monoterpenes and Diterpenes. This is also a correct match, representing a large class of lipid-soluble compounds.
Option C: Lectins - Concanavalin A. This is correct. Lectins are proteins that bind to carbohydrates, and Concanavalin A is the most studied example.
Option D: Drugs - Ricin. This is the mismatch. Ricin (along with Abrin) is classified as a "Toxin," not a "Drug." Common examples of secondary metabolites used as drugs include Vinblastine and Curcumin.
2: Ricin is a highly potent toxin produced in the seeds of the castor oil plant. While it has biochemical significance, it is not categorized under the "Drugs" group in the standard biological classification of metabolites.
3: Therefore, the pair "Drugs - Ricin" is the incorrect association among the provided choices.

Final Answer: Drugs - Ricin

Answer: (D)

Go Back to Question 8

Q9.

Solution

Concept: Productivity in an ecosystem refers to the rate of biomass production. It is a fundamental measure of the energy flow through different trophic levels. Primary productivity is the production at the producer (plant) level, while secondary productivity refers to the rate of formation of new organic matter by consumers.

Solution: 1: Total solar energy captured by the producers through the process of photosynthesis to create organic matter per unit area over a given time period is known as the Gross Primary Productivity (GPP).
2: However, plants themselves use a significant portion of this captured energy for their own metabolic needs and cellular respiration (R).
3: The amount of energy/biomass that remains after accounting for these respiratory losses is called the Net Primary Productivity (NPP). The relationship is expressed as: $NPP = GPP - R$.
4: The question specifically asks for the "rate of production of organic matter during photosynthesis," which refers to the total or "gross" amount before any respiration occurs.
5: Therefore, the correct term is Gross Primary Productivity. This value represents the total "income" of energy into the biotic component of the ecosystem.

Final Answer: Gross Primary Productivity

Answer: (B)

Go Back to Question 9

Q10.

Solution

Concept: In ecology, ecosystems are rarely isolated; they often overlap at their boundaries. These boundary areas are highly dynamic and exhibit unique biological characteristics. The transition between two different biomes or communities involves a gradual change in environmental conditions and species composition.

Solution: 1: The specific geographical area where two different communities meet and integrate is called an Ecotone. A classic example of an ecotone is a marshland, which exists between a dry terrestrial ecosystem and a purely aquatic ecosystem.
2: Ecotones are often characterized by a phenomenon called the "Edge Effect," where the diversity and density of some species are higher in the transition zone than in either of the flanking communities.
3: Other terms in the options have different meanings:
Ecological niche: The functional role or "profession" of a species within its habitat.
Biome: A large regional unit characterized by a major vegetation type and associated fauna in a specific climate zone.
Edge effect: The specific biological result (increased diversity) found within an ecotone, rather than the zone itself.
4: Thus, the physical "transition zone" itself is termed the Ecotone. It acts as a buffer and a bridge between distinct ecological systems.

Final Answer: Ecotone

Answer: (A)

Go Back to Question 10

Q11.

Solution

Concept: Genetic disorders in humans are broadly classified into Mendelian disorders and Chromosomal disorders. Mendelian disorders are mainly determined by alteration or mutation in a single gene. These are further categorized based on their inheritance pattern: Autosomal Dominant, Autosomal Recessive, X-linked Dominant, or X-linked Recessive.

Solution: 1: Let us analyze each disorder listed in the options to determine its mode of inheritance.
2: Haemophilia and Colour blindness are both classic examples of X-linked recessive disorders. This means the defective gene is located on the X chromosome, and the condition is more commonly expressed in males.
3: Myotonic dystrophy is an example of an Autosomal dominant disorder. In this case, a single copy of the mutated gene in every cell is sufficient to cause the disorder.
4: Sickle Cell Anaemia is an Autosomal recessive disorder. It is caused by the substitution of Glutamic acid by Valine at the sixth position of the beta-globin chain of the haemoglobin molecule. This substitution is controlled by a single pair of alleles, Hb^A and Hb^S.
5: For an individual to manifest Sickle Cell Anaemia, they must inherit two copies of the recessive allele ($Hb^S Hb^S$). Heterozygous individuals ($Hb^A Hb^S$) are carriers but usually remain unaffected.
6: Since the gene is located on an autosome (specifically chromosome 11) and requires two copies for expression, it is strictly an autosomal recessive trait.

Final Answer: Sickle Cell Anaemia

Answer: (B)

Go Back to Question 11

Q12.

Solution

Concept: Plant Growth Regulators (PGRs) or phytohormones are small, simple molecules of diverse chemical composition that control various physiological processes. One of the most unique hormones is Ethylene, which is the only gaseous PGR. It plays a significant role in fruit ripening and stress responses, particularly the specific growth pattern known as the "triple response."

Solution: 1: The "triple response" is a classic biological assay used to detect the presence and effect of ethylene on plant seedlings, particularly in dicots.
2: When a seedling is exposed to ethylene (often when it encounters an obstruction in the soil), it undergoes three distinct morphological changes:
a) Inhibition of hypocotyl/epicotyl elongation (shorter stature).
b) Promotion of lateral expansion or swelling of the seedling axis (thickening of the stem).
c) Horizontal or exaggerated apical hook formation (causing the plant to grow sideways).
3: This response allows the seedling to bypass obstacles like stones or hard soil crusts during germination.
4: While Auxins are involved in apical dominance and Gibberellins in internodal elongation, they do not produce this specific trio of effects. Ethylene is the primary coordinator of this mechanical stress response.
5: Therefore, Ethylene is the hormone responsible for inhibiting vertical growth while promoting thickness and horizontal orientation in the triple response.

Final Answer: Ethylene

Answer: (C)

Go Back to Question 12

Q13.

Solution

Concept: The semi-conservative model of DNA replication suggests that during the synthesis of a new DNA molecule, the two strands of the parent DNA separate, and each serves as a template for a new complementary strand. Consequently, each daughter DNA molecule consists of one "old" (parental) strand and one "newly synthesized" strand.

Solution: 1: This model was first experimentally proven by Matthew Meselson and Franklin Stahl in 1958.
2: They utilized the bacterium Escherichia coli (E. coli) for their experiments. They grew the bacteria in a medium containing a heavy isotope of nitrogen, $^{15}NH_4Cl$, as the only nitrogen source for many generations.
3: The ^{15}N was incorporated into the newly synthesized DNA. This "heavy" DNA could be distinguished from normal DNA (^{14}N) by centrifugation in a cesium chloride ($CsCl$) density gradient.
4: When they transferred the cells into a medium with normal $^{14}NH_4Cl$, they observed that after one generation (20 minutes), the DNA was of an intermediate or "hybrid" density. After two generations, there were equal amounts of hybrid DNA and light DNA.
5: This distribution of densities confirmed that DNA replicates semi-conservatively. While Vicia faba was later used by Taylor to prove the same in chromosomes, the very first proof was established in E. coli.

Final Answer: Escherichia coli

Answer: (B)

Go Back to Question 13

Q14.

Solution

Concept: Human health and diseases involve the study of various pathogens, including protozoans, helminthes (worms), bacteria, and fungi. Each disease is characterized by a specific causative agent and distinct clinical symptoms. Matching the disease to its correct pathogen is a fundamental requirement in clinical biology and MHT-CET examinations.

Solution: 1: Let's analyze the pairs provided in the columns:
(A) Amoebiasis: This is a protozoan disease of the large intestine. It is caused by Entamoeba histolytica. Symptoms include constipation, abdominal pain, and stools with excess mucus. (Matches with ii).
(B) Filariasis: Also known as Elephantiasis, this is a helminthic disease affecting the lymphatic vessels. It is caused by the filarial worms Wuchereria bancrofti and Wuchereria malayi. (Matches with i).
(C) Typhoid: This is a bacterial infection of the small intestine. It is caused by the pathogenic bacterium Salmonella typhi. It is characterized by sustained high fever and intestinal perforation in severe cases. (Matches with iv).
(D) Ringworm: This is one of the most common infectious fungal diseases in humans. It is caused by fungi belonging to the genera Microsporum, Trichophyton, and Epidermophyton. (Matches with iii).
2: Combining these matches: A-ii, B-i, C-iv, and D-iii.
3: This sequence aligns perfectly with option (A). Understanding these associations helps in identifying the nature of the pathogen (protozoan vs. bacteria vs. fungus) for effective treatment.

Final Answer: A-ii, B-i, C-iv, D-iii

Answer: (A)

Go Back to Question 14

Q15.

Solution

Concept: The human brain is the central information processing organ of our body. It is divided into the forebrain, midbrain, and hindbrain. The forebrain consists of the cerebrum, thalamus, and hypothalamus. Each region has specialized functions related to sensory processing, motor control, and homeostatic regulation.

Solution: 1: The Hypothalamus is a small but vital part of the forebrain located at the base of the thalamus.
2: It contains several centers which control body temperature, urge for eating (hunger), and drinking (thirst). It acts as the body's thermostat, ensuring that internal temperature remains within a narrow, healthy range.
3: In addition to these physiological drives, the hypothalamus also contains several groups of neurosecretory cells, which secrete hormones called hypothalamic hormones that regulate the synthesis and secretion of pituitary hormones.
4: Let's briefly look at other options for clarity:
Cerebellum: Primarily responsible for maintaining balance, posture, and coordinating voluntary muscle movements.
Corpus callosum: A tract of nerve fibers that connects the left and right cerebral hemispheres.
Medulla oblongata: Contains centers that control respiration, cardiovascular reflexes, and gastric secretions.
5: Since the question specifically targets thermoregulation and hunger, the Hypothalamus is the undisputed center for these functions.

Final Answer: Hypothalamus

Answer: (C)

Go Back to Question 15

Q16.

Solution

Concept: Plants have evolved different pathways for carbon fixation to adapt to varying environmental conditions. C_4 plants (like maize and sorghum) possess a specialized leaf anatomy called Kranz anatomy. This allows them to minimize photorespiration and maximize photosynthetic efficiency in hot, dry climates. The fixation of carbon dioxide in these plants occurs in two different cell types: mesophyll cells and bundle sheath cells.

Solution: 1: In C_4 plants, the initial fixation of CO_2 occurs in the cytoplasm of the mesophyll cells.
2: Unlike C_3 plants where RuBP is the first acceptor, C_4 plants utilize a 3-carbon molecule called Phosphoenolpyruvate (PEP) as the primary CO_2 acceptor.
3: The reaction is catalyzed by the enzyme PEP carboxylase (PEPcase). It is important to note that mesophyll cells of C_4 plants lack the RuBisCO enzyme.
4: The CO_2 reacts with PEP to form a 4-carbon compound called Oxaloacetic acid (OAA), which is why these plants are named C_4 plants.
5: OAA is then converted into other 4-carbon compounds like malic acid or aspartic acid, which are transported to the bundle sheath cells for the Calvin cycle.
6: Therefore, the primary acceptor is PEP. RuBP acts as the secondary acceptor within the bundle sheath cells where the actual C3 cycle takes place.

Final Answer: PEP

Answer: (B)

Go Back to Question 16

Q17.

Solution

Concept: The human heart is myogenic, meaning the impulse for heartbeat originates within the muscular tissue itself rather than from external nerve stimulation. This is made possible by a specialized nodal tissue distributed throughout the heart. This tissue is responsible for initiating and maintaining the rhythmic contractile activity of the heart.

Solution: 1: The primary component of this nodal system is the Sino-atrial node (SAN). It is a small patch of specialized cardiac muscle fibers.
2: The SAN is located in the upper right corner of the right atrium, close to the opening of the superior vena cava.
3: The SAN has the unique ability to generate action potentials spontaneously without any external stimuli. It generates the maximum number of action potentials (70–75 per minute) compared to other parts of the nodal system.
4: Because it initiates the rhythmic heartbeat and sets the pace for the entire heart, it is popularly known as the "Pacemaker."
5: The impulse generated by the SAN then spreads to the Atrio-ventricular node (AVN), then to the Bundle of His, and finally through the Purkinje fibers to cause ventricular contraction.
6: Thus, the physical location of the pacemaker (SAN) is the right atrium.

Final Answer: Right atrium

Answer: (B)

Go Back to Question 17

Q18.

Solution

Concept: Pollination is the transfer of pollen grains from the anther to the stigma. Plants use various biotic (animals, insects) and abiotic (wind, water) agents for this process. Flowers show specific morphological adaptations (contrivances) depending on their primary pollinating agent. Wind pollination is also known as Anemophily.

Solution: 1: Wind-pollinated flowers do not need to attract insects. Therefore, they lack features like bright colors, nectar, or pleasant fragrances. Having large, brightly colored petals would be an unnecessary expenditure of energy for such plants.
2: Instead, they produce an enormous amount of pollen grains because the chances of a single grain hitting a stigma are very low. These pollen grains are light and non-sticky so they can be easily carried by wind currents.
3: The stamens are typically well-exposed (exerted) so that the pollen is easily dispersed into the wind.
4: The stigma is often large and feathery to increase the surface area and effectively "trap" the wind-borne pollen grains.
5: Common examples include grasses, corn (tassels), and many types of trees.
6: Since "large, brightly colored petals" are meant for biotic pollination (like insects or birds), they are NOT a characteristic of wind-pollinated flowers.

Final Answer: Large, brightly coloured petals

Answer: (D)

Go Back to Question 18

Q19.

Solution

Concept: The mechanism of enzyme action is often explained through various models that illustrate the specificity of enzymes. One of the earliest models is the "Lock and Key" hypothesis, proposed by Emil Fischer in 1894. This model emphasizes that the enzyme and substrate have rigid, complementary geometric shapes.

Solution: 1: In this analogy, the enzyme is compared to a lock, and the substrate is compared to a key.
2: Just as a specific lock can only be opened by a unique key with a matching shape, a specific enzyme can only catalyze a reaction with a particular substrate that fits perfectly into its active site.
3: The active site of the enzyme possesses a fixed, rigid three-dimensional structure. The substrate molecule has a configuration that is complementary to this active site.
4: When the substrate (key) enters the active site of the enzyme (lock), an intermediate enzyme-substrate complex is formed. This proximity allows the chemical reaction to occur with very low activation energy.
5: After the reaction, the products are released, and the enzyme remains unchanged, ready to "unlock" another substrate molecule.
6: Therefore, in this specific model, the Enzyme is the lock and the Substrate is the key.

Final Answer: Enzyme, Substrate

Answer: (A)

Go Back to Question 19

Q20.

Solution

Concept: Biotechnology and genetic engineering rely on specific "tools" to manipulate DNA. One of the most critical groups of tools is a class of enzymes found in bacteria that can cut DNA at specific nucleotide sequences. These are called Restriction Endonucleases. Their discovery was a turning point in modern biology.

Solution: 1: Restriction enzymes belong to a larger class of enzymes called nucleases. They are called "restriction" enzymes because, in nature, they restrict the growth of bacteriophages (viruses) by cutting up the viral DNA.
2: These enzymes do not cut DNA randomly. They recognize a specific palindromic nucleotide sequence (recognition site) and cut the DNA at a precise point within or near that site.
3: Because they act as biological tools to cut DNA into fragments that can then be used for cloning or analysis, they are metaphorically referred to as "Molecular Scissors" or "Chemical Scalpels."
4: Other tools in the biotech "toolbox" include DNA Ligase, which acts as "Molecular Glue" to join DNA fragments together, and DNA Polymerase, which synthesizes new DNA strands.
5: Since the question specifically asks for the identity of Restriction Endonucleases, the correct term is Molecular Scissors.

Final Answer: Molecular scissors

Answer: (B)

Go Back to Question 20

Q21.

Solution

Concept: Linkage refers to the physical association of genes on a chromosome. According to the law of independent assortment, genes for different traits should segregate independently. However, if genes are located close to each other on the same chromosome, they tend to be inherited together. This phenomenon was a significant discovery that refined our understanding of Mendelian genetics.

Solution: 1: While the term and phenomenon of "coupling and repulsion" were initially observed by Bateson and Punnett, the formal term 'Linkage' and its underlying chromosomal basis were established by Thomas Hunt Morgan.
2: Morgan conducted extensive hybridization experiments on the fruit fly, Drosophila melanogaster, to study genes that were sex-linked.
3: He observed that when two genes in a dihybrid cross were situated on the same chromosome, the proportion of parental gene combinations was much higher than the non-parental or recombinant type.
4: Morgan attributed this to the physical linkage of the two genes and coined the term 'linkage' to describe this physical association. He also coined the term 'recombination' to describe the generation of non-parental gene combinations.
5: His work proved that the frequency of linkage is inversely proportional to the distance between genes on a chromosome, a concept that laid the foundation for genetic mapping.

Final Answer: T.H. Morgan

Answer: (B)

Go Back to Question 21

Q22.

Solution

Concept: Epithelial tissues are categorized based on the number of cell layers and the shape of the cells. Their structure is intimately linked to their function, whether it be protection, secretion, or absorption. In the human body, specific organs require specific types of lining to perform their physiological roles effectively.

Solution: 1: Let's evaluate the options to identify the correct physiological match:
Option A: Inner lining of salivary ducts. These are typically lined by compound (stratified) cuboidal epithelium or simple columnar epithelium, not ciliated epithelium. Ciliated epithelium is found in the respiratory tract.
Option B: Moist surface of buccal cavity. This is lined by non-keratinized stratified squamous epithelium for protection against abrasion, not glandular epithelium.
Option C: Tubular parts of nephrons (specifically the PCT). These are lined by simple cuboidal epithelium. In the PCT, these cells also possess microvilli (brush border) to increase the surface area for reabsorption. This is a correct match.
Option D: Inner surface of bronchioles. These are lined by ciliated columnar or cuboidal epithelium to move mucus, not squamous epithelium. Squamous epithelium is found in the alveoli for gas exchange.
2: Therefore, the association between the tubular parts of nephrons and cuboidal epithelium is the only accurate match provided.

Final Answer: Tubular parts of nephrons - Cuboidal epithelium

Answer: (C)

Go Back to Question 22

Q23.

Solution

Concept: The 'Central Dogma' of molecular biology, proposed by Francis Crick, describes the unidirectional flow of genetic information. Information coded in DNA is transferred to RNA, which is then used to synthesize proteins. Each of these steps is mediated by specific enzymes and occurs in distinct cellular compartments.

Solution: 1: The process by which the genetic information present in one strand of the DNA is copied into a complementary strand of RNA is called Transcription.
2: During this process, only a segment of DNA and only one of the strands is copied into RNA. This ensures that the message is specific and functional.
3: The primary enzyme responsible for this process in all organisms is RNA polymerase. In eukaryotes, there are three types: RNA Pol I, II, and III, which specialize in different types of RNA (rRNA, mRNA, and tRNA respectively).
4: RNA polymerase binds to a specific region of the DNA called the promoter, unwinds the double helix, and adds ribonucleotides in a $5' \rightarrow 3'$ direction using the DNA template strand.
5: Let's clarify the other terms: Replication is DNA to DNA (DNA polymerase); Translation is RNA to Protein (Ribosomes); Reverse transcription is RNA to DNA (Reverse Transcriptase).

Final Answer: Transcription, RNA polymerase

Answer: (C)

Go Back to Question 23

Q24.

Solution

Concept: In angiosperms, the female reproductive unit is the gynoecium, consisting of one or more pistils. To understand plant reproduction, one must differentiate between the macroscopic floral organs and the microscopic reproductive structures contained within them. These terms are often analogous to structures found in animal reproduction.

Solution: 1: The ovule is a small structure attached to the placenta by means of a stalk called a funicle. In botanical terminology, the ovule is technically referred to as the Integumented Megasporangium.
2: It is called a megasporangium because it is the structure within which megaspores are produced through meiosis.
3: Let's distinguish between the other parts:
Ovary: The basal swollen part of the pistil that contains one or more ovules.
Embryo sac: This is the female gametophyte, which develops inside the megasporangium (ovule) after functional megaspores are formed.
Nucellus: The mass of parenchymatous cells enclosed within the integuments of the ovule that provides nutrition to the developing embryo sac.
4: Therefore, the megasporangium specifically refers to the ovule as a whole.

Final Answer: Ovule

Answer: (A)

Go Back to Question 24

Q25.

Solution

Concept: The genetic code is a set of rules used by living cells to translate information encoded within genetic material into proteins. The code consists of 64 codons (triplets of nucleotides). Out of these, 61 codons code for amino acids, while the remaining 3 act as signals to stop the process of translation. These are called Stop Codons or Termination Codons.

Solution: 1: Translation begins at an initiation codon (usually AUG, which codes for Methionine) and continues until the ribosome encounters a stop codon on the mRNA.
2: There are three specific stop codons in the standard genetic code:
- UAA (Ochre)
- UAG (Amber)
- UGA (Opal)

3: These codons do not code for any amino acid. Instead, when a ribosome reaches one of these sequences, release factors bind to the site, causing the newly synthesized polypeptide chain to be released and the ribosomal subunits to dissociate.
4: Let's check the options:
AUG: Initiation codon.
GUG: Occasionally acts as an initiator, codes for Valine.
UUU: Codes for Phenylalanine (the first codon discovered).
UAG: One of the three recognized stop codons.
5: Therefore, UAG is the correct "Stop Codon" among the choices provided.

Final Answer: UAG

Answer: (D)

Go Back to Question 25

Q26.

Solution

Concept: Ecological pyramids represent the trophic structure and function of an ecosystem. They can be based on number, biomass, or energy. While pyramids of number and biomass can sometimes be inverted (e.g., in a parasitic food chain or a marine ecosystem), the pyramid of energy is governed by the laws of thermodynamics, specifically the 10% law.

Solution: 1: The pyramid of energy represents the total amount of energy utilized by organisms at each trophic level over a specific area and time.
2: According to the 10% law of energy transfer proposed by Lindeman, only about 10% of the energy available at one trophic level is transferred to the next higher trophic level. The remaining 90% is lost as heat during respiration and other metabolic activities.
3: Because energy is invariably lost as heat at every step of the food chain, the energy available to a higher trophic level is always significantly less than the energy available at the lower level.
4: Consequently, the base of the energy pyramid (producers) is always the widest, and it narrows progressively toward the top (carnivores).
5: There are no exceptions to this rule in a stable, functioning ecosystem. Therefore, the pyramid of energy is always upright.

Final Answer: Upright

Answer: (A)

Go Back to Question 26

Q27.

Solution

Concept:

Path of sperm transport in the human male reproductive system.

Solution:

Step 1: Sperms are produced inside the seminiferous tubules of testes.

Step 2: From seminiferous tubules, sperms enter the **rete testis**.

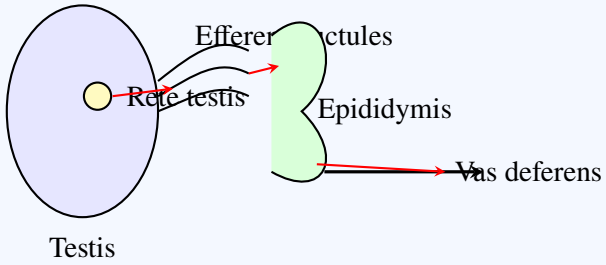
Step 3: From rete testis, sperms pass through the **efferent ductules**.

Step 4: Efferent ductules open into the **epididymis**, where sperms mature and are stored.

Step 5: Finally, sperms move into the **vas deferens** for transport.

Therefore, the correct sequence is:

Rete testis → Efferent ductules → Epididymis → Vas deferens



Final Answer:

(A) Rete testis → Efferent ductules → Epididymis → Vas deferens

Answer: (A)

Go Back to Question 27

Q28.

Solution

Concept: The movement of water and minerals in plants occurs through different pathways in the root cortex before reaching the xylem. These pathways are categorized based on whether the water travels through living cellular components or through the non-living parts of the plant tissue.

Solution: 1: There are two main pathways for water transport: the Apoplast and the Symplast.
2: The Apoplast pathway refers to the system of adjacent cell walls and intercellular spaces that is continuous throughout the plant, except at the casparian strips of the endodermis in the roots.
3: In the apoplast pathway, water moves exclusively through the "non-living" parts. Since it does not involve crossing any semi-permeable cell membrane, the movement is relatively fast and occurs through mass flow.
4: In contrast, the Symplast pathway involves the movement of water through the interconnected cytoplasm of cells, linked by plasmodesmata. This requires crossing cell membranes and is therefore slower.
5: The question specifically identifies movement through the "cell wall and intercellular spaces without crossing any membrane," which perfectly describes the Apoplast pathway.

Final Answer: Apoplast pathway

Answer: (B)

Go Back to Question 28

Q29.

Solution

Concept: Plant reproduction varies significantly across different groups. Angiosperms (flowering plants) have developed a highly specialized and unique fertilization mechanism that involves two distinct fusion events within the embryo sac. This process ensures the simultaneous development of the embryo and its nutritive tissue.

Solution: 1: In Angiosperms, when the pollen tube enters the embryo sac, it releases two male gametes.
2: The first fusion occurs when one male gamete fuses with the egg cell (Syngamy) to form a diploid Zygote ($2n$), which eventually develops into the embryo.
3: The second fusion occurs when the other male gamete fuses with the two polar nuclei (or the secondary nucleus) in the center of the embryo sac. This is called Triple Fusion, and it results in the formation of a triploid Primary Endosperm Nucleus (PEN, $3n$).
4: Because two types of fusion (Syngamy and Triple Fusion) take place in the same embryo sac, the phenomenon is termed "Double Fertilization."
5: This process was first discovered by Nawaschin in Fritillaria and Lilium. It is a defining and unique characteristic of Angiosperms and is not found in Algae, Bryophytes, Pteridophytes, or Gymnosperms.

Final Answer: Angiosperms

Answer: (C)

Go Back to Question 29

Q30.

Solution

Concept: The Polymerase Chain Reaction (PCR) is a revolutionary technique in molecular biology that allows for the in vitro synthesis of millions of copies of a specific DNA segment. It relies on thermal cycling, consisting of denaturation, annealing, and extension, using a thermostable DNA polymerase like Taq polymerase.

Solution: 1: PCR is primarily a tool for DNA amplification. Let's look at its practical applications:
DNA fingerprinting: PCR is essential to amplify small samples of DNA found at crime scenes so they can be analyzed.
Detection of pathogens: PCR is used to detect the genetic material of viruses (like HIV or SARS-CoV-2) or bacteria even at very low concentrations.
Gene amplification: This is the core function of PCR—producing many copies of a gene of interest for cloning or research.
2: Now, consider option C: Purification of isolated protein. PCR acts on nucleic acids (DNA), not proteins. The purification of proteins involves techniques like chromatography (ion-exchange, affinity, etc.) or electrophoresis, but not PCR.
3: Therefore, while PCR helps in identifying the gene that codes for a protein, it cannot be used to purify the protein itself.

Final Answer: Purification of isolated protein

Answer: (C)

Go Back to Question 30

Q31.

Solution

Concept: The pH of blood is a critical physiological constant that must be maintained within a very narrow range to ensure the proper functioning of enzymes and overall cellular metabolism. This homeostasis is primarily managed by the bicarbonate buffer system, as well as the respiratory and renal systems.

Solution: 1: Human arterial blood is slightly basic or alkaline. The normal physiological range for arterial blood pH is typically between 7.35 and 7.45.
2: An average value of 7.4 is generally cited as the standard for healthy human blood.
3: If the pH drops below 7.35, the condition is known as acidosis, which can lead to central nervous system depression and coma. If the pH rises above 7.45, it is known as alkalosis, which can cause neuromuscular hyperexcitability and tetany.
4: The other options provided are:
6.8: This is significantly acidic and would be fatal if it were the pH of systemic blood.
8.2: This is highly alkaline and also not compatible with human life.
5.5: This is acidic, similar to the pH of some bodily secretions like urine or the surface of the skin, but never blood.
5: Therefore, 7.4 is the correct representative value for the pH of human arterial blood.

Final Answer: 7.4

Answer: (B)

Go Back to Question 31

Q32.

Solution

Concept: Comparative anatomy provides significant evidence for evolution through the study of homologous and analogous organs. These structures help scientists understand whether different species share a common ancestor or have evolved similar adaptations independently due to similar environmental pressures.

Solution: 1: Analogous organs are structures that are different in their fundamental anatomical structure and embryonic origin but perform similar functions. This phenomenon is known as Convergent Evolution.
2: Let's analyze the wings of a butterfly and a bird:
Structure: A butterfly's wing is an extension of the integument (chitinous exoskeleton), whereas a bird's wing is a modified forelimb with a bony internal skeleton, muscles, and feathers.
Function: Both structures are used for flight.
3: Because they have different origins but serve the same purpose, they are Analogous organs.
4: Homologous organs, by contrast, share a common anatomical blueprint but may have different functions (e.g., the flipper of a whale and the wing of a bat). Vestigial organs are non-functional remnants of organs that were functional in ancestors.
5: Thus, the wings of butterflies and birds are classic examples of analogy resulting from similar selection pressures for flight.

Final Answer: Analogous organs

Answer: (B)

Go Back to Question 32

Q33.

Solution

Concept: Grafting is an artificial vegetative propagation technique where parts of two different plants (the scion and the stock) are joined so that they continue to grow as a single plant. The success of this union depends entirely on the ability of the plants to produce new vascular tissue that can bridge the gap between the two segments.

Solution: 1: For grafting to be successful, there must be a continuous contact between the cambium layers of the scion and the stock. The cambium is a layer of meristematic tissue responsible for secondary growth.
2: Dicots possess "open" vascular bundles, meaning they have a layer of cambium between the xylem and phloem. When a graft is made, the cambium cells divide rapidly to form a callus, which eventually differentiates into new xylem and phloem, establishing a vascular connection.
3: Monocots, however, possess "closed" vascular bundles. They lack a vascular cambium. Their vascular bundles are also scattered throughout the ground tissue rather than arranged in a ring.
4: Because monocots lack this meristematic cambium tissue, they cannot form the necessary vascular union required for a successful graft.
5: Therefore, the presence of cambium is the primary reason why grafting is successful in dicots but not in monocots.

Final Answer: Cambium for secondary growth

Answer: (B)

Go Back to Question 33

Q34.

Solution

Concept: Immunity can be categorized as active or passive. Passive immunity involves the transfer of ready-made antibodies from one individual to another. A natural example of this occurs during the first few days of lactation when a mother produces a specialized form of milk called colostrum.

Solution: 1: Colostrum is the yellowish fluid secreted by the mother during the initial days of lactation. It is exceptionally rich in nutrients and, more importantly, in antibodies that provide immediate protection to the newborn.
2: The primary immunoglobulin (antibody) found in colostrum is IgA (specifically secretory IgA).
3: IgA is crucial for protecting the infant's mucosal surfaces, such as the gastrointestinal tract, from pathogens. Since the infant's own immune system is not yet fully developed, these antibodies provide essential "passive immunity."
4: Let's briefly distinguish other Igs:
IgG: The only antibody that can cross the placenta.
IgM: The first antibody produced during a primary immune response.
IgE: Associated with allergic reactions and parasitic infections.
5: Therefore, IgA is the correct and most abundant immunoglobulin associated with colostrum and mucosal protection in infants.

Final Answer: IgA

Answer: (D)

Go Back to Question 34

Q35.

Solution

Concept:

The filiform apparatus is a finger-like thickening present in synergids of the embryo sac. Its main role is to guide the pollen tube toward the egg apparatus for fertilization.

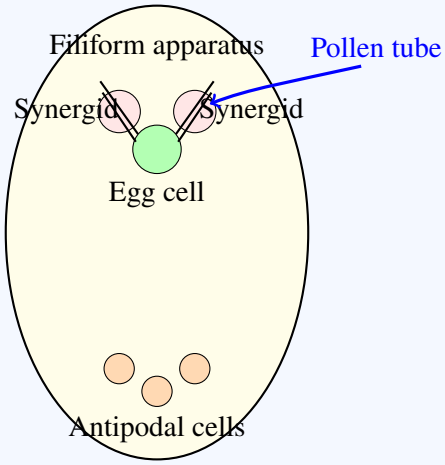
Solution:

Step 1: In the embryo sac, two synergids are present near the micropylar end.

Step 2: Each synergid contains a special structure called the *filiform apparatus*.

Step 3: The filiform apparatus helps in attracting and guiding the pollen tube into one of the synergids.

Step 4: Therefore, its main function is to guide the entry of the pollen tube into the synergid.



Final Answer: The filiform apparatus guides the entry of pollen tube into the synergid.

Answer: (B)

Go Back to Question 35

Q36.

Solution

Concept: Respiration is the process by which organic molecules like glucose are oxidized to release energy in the form of ATP. The first major pathway in this oxidation is Glycolysis, also known as the EMP pathway (named after Embden, Meyerhof, and Parnas). This pathway is universal, occurring in the cytoplasm of both aerobic and anaerobic organisms.

Solution: 1: Glycolysis is a sequence of ten enzymatic reactions that convert one molecule of glucose (a 6-carbon sugar) into two molecules of pyruvic acid (a 3-carbon compound).
2: The process occurs entirely in the cytosol and does not require oxygen, making it the common phase for both aerobic and anaerobic respiration.
3: During this process, there is a net gain of 2 ATP molecules and 2 $NADH + H^+$ molecules.
4: Let's differentiate the other options:
Krebs cycle: Occurs in the mitochondrial matrix and oxidizes Acetyl-CoA to CO_2.
Link reaction: The conversion of Pyruvic acid to Acetyl-CoA within the mitochondria.
ETS (Electron Transport System): Occurs on the inner mitochondrial membrane to generate ATP from NADH and $FADH_2$.
5: Since the question describes the breakdown of glucose to pyruvic acid in the cytoplasm, Glycolysis is the correct term.

Final Answer: Glycolysis

Answer: (B)

Go Back to Question 36

Q37.

Solution

Concept: The ABO blood grouping system is based on the presence or absence of specific surface antigens (glycoproteins) on the Red Blood Cells (RBCs) and naturally occurring antibodies in the plasma. This system is genetically determined and is vital for safe blood transfusions.

Solution: 1: There are two main antigens (A and B) and two main antibodies (anti-A and anti-B).
2: An individual with blood group 'O' is characterized by the total absence of both A and B antigens on the surface of their RBCs.
3: Because these antigens are absent, the immune system of a person with group 'O' blood perceives both A and B antigens as foreign. Therefore, their plasma naturally contains both anti-A and anti-B antibodies.
4: This lack of surface antigens is why group 'O' (specifically O negative) is considered the universal donor—there are no A or B antigens for a recipient's antibodies to attack.
5: Conversely, a person with blood group 'AB' has both antigens on RBCs but no antibodies in the plasma.
6: Therefore, a person with group 'O' has no antigens on RBCs and both anti-A and anti-B antibodies in the plasma.

Final Answer: No antigens; anti-A and anti-B antibodies

Answer: (A)

Go Back to Question 37

Q38.

Solution

Concept: The human excretory system is responsible for removing nitrogenous wastes and maintaining osmoregulation. The kidney is the primary organ for this task, and its internal structure is highly specialized to filter blood and form urine through the processes of filtration, reabsorption, and secretion.

Solution: 1: Each human kidney contains approximately one million complex tubular structures called Nephrons.
2: The nephron is the structural and functional unit of the kidney. It is essentially the "dialyzing unit" or filtration unit where the actual cleaning of the blood occurs.
3: A nephron consists of two main parts: the Glomerulus (a tuft of capillaries) and the Renal Tubule.
4: The process of hemodialysis in a clinical setting is essentially an artificial mimicry of the natural function performed by the nephrons in a healthy kidney.
5: Let's look at the other options:
Renal pelvis: A funnel-shaped space that collects urine before it enters the ureter.
Ureter: A tube that carries urine from the kidney to the bladder.
Medullary pyramids: Conical masses in the kidney medulla that contain the collecting ducts and loops of Henle.
6: Thus, the individual microscopic unit that performs the function of filtration and dialysis is the Nephron.

Final Answer: Nephron

Answer: (B)

Go Back to Question 38

Q39.

Solution

Concept: Biotechnology has revolutionized agriculture through the development of Genetically Modified (GM) crops. One of the most famous examples is Bt-cotton, which is engineered to be resistant to certain insect pests, specifically bollworms. This resistance is achieved by introducing a specific gene from a soil bacterium.

Solution: 1: The acronym 'Bt' stands for Bacillus thuringiensis, a common soil bacterium.
2: Certain strains of this bacterium produce protein crystals during a particular phase of their growth. These crystals contain a toxic insecticidal protein called 'Cry' protein.
3: The toxin exists as an inactive protoxin in the bacterium, but once ingested by an insect, it is converted into an active form due to the alkaline pH of the insect's gut. The active toxin creates pores in the midgut, leading to cell swelling, lysis, and eventually the death of the insect.
4: Scientists isolated the Cry genes (like cryIAc and cryIIAb) from Bacillus thuringiensis and incorporated them into the cotton plant genome.
5: This allows the cotton plant to produce its own insecticide, reducing the need for chemical sprays.

Final Answer: Bacillus thuringiensis

Answer: (B)

Go Back to Question 39

Q40.

Solution

Concept: Digestion is the mechanical and biochemical breakdown of complex food substances into simple, absorbable forms. Protein digestion begins in the stomach and is completed in the small intestine. The stomach provides a highly acidic environment ($pH \approx 1.8$) which is necessary for the activation of certain proteolytic enzymes.

Solution: 1: The gastric glands in the stomach secrete a proenzyme called Pepsinogen.
2: Upon exposure to Hydrochloric acid (HCl), the inactive pepsinogen is converted into the active proteolytic enzyme called Pepsin.
3: Pepsin's primary role is to act on proteins. It breaks down long polypeptide chains of proteins into smaller fragments known as proteoses and peptones (peptides).
4: This is the first major step of protein digestion in the human alimentary canal. Further digestion into individual amino acids is carried out later in the small intestine by enzymes like trypsin, chymotrypsin, and carboxypeptidases.
5: Let's check other options: Lipase handles fats; Salivary amylase handles starch; Nucleases handle nucleotides. Pepsin is strictly a protein-digesting enzyme.

Final Answer: Proteins into Proteoses and Peptones

Answer: (C)

Go Back to Question 40

Q41.

Solution

Concept:

The sarcomere is the basic structural and functional unit of muscle contraction in a muscle fiber.

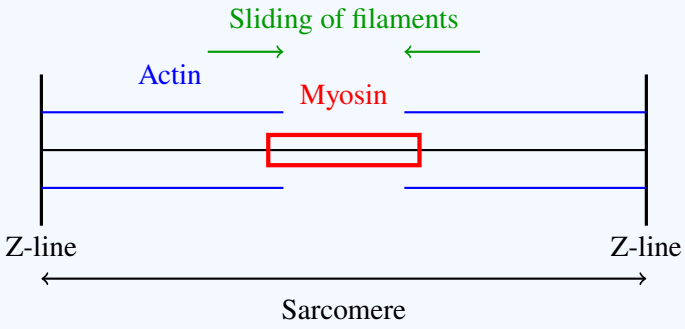
Solution:

Step 1: A muscle fiber contains many thread-like structures called myofibrils.

Step 2: Each myofibril is made up of repeating units called sarcomeres.

Step 3: During muscle contraction, the actin and myosin filaments slide within the sarcomere.

Step 4: Therefore, the sarcomere is considered the functional unit of contraction.



Final Answer: Sarcomere is the functional unit of contraction in a muscle fiber.

Answer: (B)

Go Back to Question 41

Q42.

Solution

Concept: The process of digestion is not only regulated by the nervous system but also by several local hormones secreted by the gastrointestinal mucosa. these hormones coordinate the release of digestive juices with the presence of food in different parts of the alimentary canal to ensure efficient breakdown and absorption.

Solution: 1: When partially digested food (chyme), particularly food rich in fats and proteins, enters the duodenum (the first part of the small intestine), it triggers the release of certain hormones.
2: One of the primary hormones released by the duodenal mucosa is Cholecystokinin (CCK).
3: CCK travels through the bloodstream and acts on two main targets: the gallbladder and the pancreas.
4: Its effect on the gallbladder is to stimulate contraction, which forces stored bile into the common bile duct and then into the duodenum to emulsify fats.
5: Simultaneously, CCK stimulates the secretion of pancreatic enzymes from the acinar cells of the pancreas.
6: In contrast, Gastrin stimulates gastric acid secretion, and Secretin primarily stimulates the release of bicarbonate ions from the pancreas. Therefore, CCK is the specific hormone responsible for gallbladder contraction.

Final Answer: Cholecystokinin (CCK)

Answer: (C)

Go Back to Question 42

Q43.

Solution

Concept: International cooperation is essential for addressing global environmental issues. Over the decades, various protocols and treaties have been signed to mitigate human impact on the biosphere. Distinguishing between these protocols (such as Kyoto vs. Montreal) is a common requirement in biology and environmental science exams.

Solution: 1: The Montreal Protocol is an international treaty that was signed in Montreal, Canada, in 1987 (and became effective in 1989).
2: Its primary objective was to regulate and phase out the production and consumption of Ozone Depleting Substances (ODS), such as Chlorofluorocarbons (CFCs).
3: These substances are responsible for the thinning of the ozone layer in the stratosphere, which protects the Earth from harmful ultraviolet (UV) radiation.
4: To differentiate:
Control of global warming: Associated with the Kyoto Protocol and the Paris Agreement.
Conservation of biodiversity: Associated with the Earth Summit (Rio de Janeiro).
Control of water pollution: Usually governed by national acts (like the Water Act in India).
5: Thus, the Montreal Protocol remains the most successful environmental treaty specifically targeting the protection of the ozone layer.

Final Answer: Protection of the ozone layer

Answer: (C)

Go Back to Question 43

Q44.

Solution

Concept: In humans, sex is determined by the presence of specific sex chromosomes (allosomes). Females have two X chromosomes (XX), while males have one X and one Y chromosome (XY). The biological "switch" that triggers male development is a specific gene found on the sex chromosomes.

Solution: 1: The SRY gene stands for "Sex-determining Region Y" gene.
2: As the name implies, this gene is located exclusively on the Y chromosome. It is situated on the short arm (p-arm) of the Y chromosome.
3: The SRY gene provides instructions for making a protein called the sex-determining region Y protein (or Testis-determining factor - TDF).
4: This protein acts as a transcription factor that initiates the development of undifferentiated gonads into testes. Once testes are formed, they secrete testosterone, which leads to the development of other male reproductive structures.
5: If the SRY gene is absent (as in typical females) or non-functional, the gonads develop into ovaries.
6: Therefore, the Y chromosome is the unique carrier of this specific gene that dictates male sex determination in humans.

Final Answer: Y chromosome

Answer: (B)

Go Back to Question 44

Q45.

Solution

Concept: Nitrogen is an essential element for all life forms, but most organisms cannot use atmospheric nitrogen (N_2) directly. The nitrogen cycle involves several biochemical steps to convert nitrogen into usable forms like nitrates. One critical step is Nitrification, which is carried out by specialized chemoautotrophic bacteria in the soil.

Solution: 1: Nitrification is a two-step process that converts toxic ammonia into nitrates that plants can easily absorb.
2: In the first step, Ammonia (NH_3) is oxidized to Nitrite (NO_2^-). This step is primarily carried out by bacteria such as Nitrosomonas and Nitrococcus.
3: In the second step, the Nitrite is further oxidized to Nitrate (NO_3^-). This step is carried out by the bacterium Nitrobacter.
4: Together, these nitrifying bacteria ensure that nitrogen remains available in the soil in a non-toxic, oxidized form.
5: Let's look at the other bacteria mentioned:
Rhizobium and Azotobacter: Responsible for Nitrogen Fixation (converting N_2 to NH_3).
Pseudomonas: Often involved in Denitrification (converting nitrates back to N_2).
6: Therefore, Nitrosomonas and Nitrobacter are the specific agents of the nitrification process.

Final Answer: Nitrosomonas and Nitrobacter

Answer: (A)

Go Back to Question 45

Q46.

Solution

Concept: The immune system consists of various organs, cells, and soluble molecules that work together to protect the body. Lymphoid organs are categorized into primary and secondary types based on their role in the life cycle of a lymphocyte. Understanding this distinction is vital for understanding how the body develops and deploys its immune defenses.

Solution: 1: Primary lymphoid organs are the sites where immature lymphocytes differentiate into antigen-sensitive lymphocytes. These are the "nurseries" where lymphocytes are produced and undergo maturation.
2: In humans, the two primary lymphoid organs are the Bone Marrow and the Thymus. In the bone marrow, all blood cells (including B and T lymphocytes) are produced. B-cells also mature here, while T-cells migrate to the thymus for their maturation and "education."
3: Secondary lymphoid organs, on the other hand, are the sites where matured lymphocytes migrate to interact with antigens and undergo proliferation to become effector cells. Examples include the Spleen, Lymph nodes, Tonsils, and Peyer's patches of the small intestine.
4: The spleen acts as a filter for the blood, while lymph nodes trap microorganisms from the lymph.
5: Since the question specifically asks for a primary lymphoid organ, Bone Marrow is the correct answer among the given options.

Final Answer: Bone marrow

Answer: (C)

Go Back to Question 46

Q47.

Solution

Concept: C_4 plants have developed a specialized internal leaf structure to adapt to high temperatures and high light intensities. This anatomy is essential for the spatial separation of initial CO_2 fixation and the Calvin cycle, which effectively eliminates the wasteful process of photorespiration. This structural adaptation is known as Kranz anatomy.

Solution: 1: The word "Kranz" means "wreath" or "halo" in German, referring to the characteristic arrangement of cells.
2: In Kranz anatomy, the vascular bundles are surrounded by a layer of large, thick-walled cells called bundle sheath cells. These, in turn, are surrounded by mesophyll cells. This creates a ring-like or wreath-like appearance in a leaf cross-section.
3: The bundle sheath cells in C_4 plants contain a large number of chloroplasts, lack intercellular spaces, and have thick walls impervious to gaseous exchange.
4: This arrangement allows C_4 plants (like sugarcane, maize, and sorghum) to pump CO_2 into the bundle sheath cells, maintaining a high concentration of CO_2 at the enzyme RuBisCO's site, ensuring it acts as a carboxylase and not an oxygenase.
5: Therefore, Kranz anatomy is a definitive diagnostic feature of C_4 plants.

Final Answer: C_4 plants

Answer: (B)

Go Back to Question 47

Q48.

Solution

Concept: The human respiratory system is designed to facilitate the exchange of oxygen and carbon dioxide between the atmosphere and the blood. While most of the system (trachea, bronchi, bronchioles) acts as a "conducting zone" to transport and clean the air, the actual "respiratory zone" is where the diffusion of gases takes place.

Solution: 1: The conducting part of the respiratory system starts from the external nostrils and goes up to the terminal bronchioles. Its role is to transport atmospheric air, clear it from foreign particles, and humidify it.
2: The actual site of diffusion (exchange) of O_2 and CO_2 between the blood and atmospheric air is the Alveoli and their ducts.
3: The alveoli are very thin, irregular-walled, vascularized bag-like structures. They provide a massive surface area (approximately 70-100 square meters) for gas exchange.
4: The exchange occurs across the "respiratory membrane," which is made of the thin squamous epithelium of the alveoli, the endothelium of the alveolar capillaries, and the basement substance between them.
5: Pharynx, trachea, and bronchi are merely passageways; they do not have the specialized thin membranes required for efficient gas exchange.

Final Answer: Alveoli

Answer: (C)

Go Back to Question 48

Q49.

Solution

Concept: Population interactions in an ecosystem can be interspecific (between different species) or intraspecific (within the same species). These interactions are categorized as positive (beneficial), negative (harmful), or neutral, based on how they affect the survival and reproduction of the involved species.

Solution: 1: Commensalism is an interaction where one species benefits (the commensal) and the other species (the host) is neither significantly harmed nor benefited. It is represented as (+, 0).
2: A classic example is the orchid growing as an epiphyte on a mango branch. The orchid gets a place to grow and better access to light (benefit), while the mango tree is unaffected. Another example is the cattle egret and grazing cattle.
3: Let's compare this with the other options:
Mutualism (+, +): Both species benefit from the interaction (e.g., lichens).
Parasitism (+, -): One species benefits at the expense of the other (e.g., liver fluke in humans).
Amensalism (-, 0): One species is harmed while the other is unaffected (e.g., Penicillium inhibiting bacteria).
4: Since the scenario specifies one benefited and one unaffected, Commensalism is the correct ecological term.

Final Answer: Commensalism

Answer: (C)

Go Back to Question 49

Q50.

Solution

Concept: A mature human sperm (spermatozoon) is a microscopic, motile cell composed of a head, neck, middle piece, and a tail. Each part is highly specialized to ensure that the sperm can reach and successfully fertilize the ovum. The head contains the genetic material and the chemical tools necessary for egg penetration.

Solution: 1: The head of the sperm contains an elongated haploid nucleus. The anterior (front) portion of this head is covered by a cap-like structure known as the Acrosome.
2: The acrosome is derived from the Golgi complex during the process of spermiogenesis. It is filled with powerful proteolytic enzymes, collectively called sperm lysins.
3: The most prominent enzyme in the acrosome is hyaluronidase, which digests the hyaluronic acid holding the follicular cells (corona radiata) together. Other enzymes like acrosin help the sperm penetrate the zona pellucida layer of the ovum.
4: To clarify other parts: The nucleus carries DNA; the middle piece contains mitochondria for energy/motility; the tail provides the lashing movement for swimming.
5: Therefore, the acrosome is the specific structure containing the enzymes required for penetrating the egg's protective membranes.

Final Answer: Acrosome

Answer: (C)

Go Back to Question 50

Q51.

Solution

Concept: DNA replication is a semi-discontinuous process due to the antiparallel nature of the DNA double helix and the fact that DNA polymerase can only synthesize DNA in the $5' \rightarrow 3'$ direction. On the lagging strand, DNA is synthesized in short, discrete segments known as Okazaki fragments. These fragments must eventually be joined to form a continuous strand.

Solution: 1: During replication, the replication fork moves along the parental DNA. On the leading strand, synthesis is continuous. However, on the lagging strand, synthesis occurs in small stretches called Okazaki fragments.
2: Once these fragments are synthesized and the RNA primers are removed (and replaced with DNA by DNA polymerase I), there remain "nicks" or gaps in the sugar-phosphate backbone between the fragments.
3: The enzyme responsible for sealing these nicks is DNA ligase. It catalyzes the formation of a phosphodiester bond between the $3'$-OH end of one fragment and the $5'$-phosphate end of the adjacent fragment.
4: Because of its role in "stitching" DNA strands together, DNA ligase is often referred to as molecular glue.
5: Helicase unwinds the DNA, Primase creates RNA primers, and DNA polymerase III is the main enzyme for elongation. Therefore, DNA ligase is the specific enzyme for joining Okazaki fragments.

Final Answer: DNA ligase

Answer: (B)

Go Back to Question 51

Q52.

Solution

Concept: The menstrual cycle is a series of natural changes in the production of hormones and the structures of the uterus and ovaries of the female reproductive system. It is divided into several phases based on the state of the endometrium and the development of ovarian follicles.

Solution: 1: The follicular phase follows the menstrual phase. During this time, the primary follicles in the ovary grow to become fully mature Graafian follicles.
2: Simultaneously, the endometrium of the uterus regenerates through a process of cell division (proliferation). Because the primary characteristic of the uterine lining during this time is rapid growth and thickening, this stage is also called the Proliferative phase.
3: These changes in both the ovary and the uterus are induced by changes in the levels of pituitary hormones (FSH and LH) and ovarian hormones (Estrogen).
4: To clarify other phases:
Luteal/Secretory phase: Follows ovulation; the endometrium becomes glandular and prepares for implantation.
Ovulatory phase: The brief period (around day 14) when the egg is released.
5: Thus, the Follicular phase and the Proliferative phase are synonymous terms referring to the pre-ovulatory stage of the cycle.

Final Answer: Follicular phase

Answer: (B)

Go Back to Question 52

Q53.

Solution

Concept: A test cross is a specific type of genetic cross used by researchers to determine the genotype of an individual expressing a dominant phenotype. Since both homozygous dominant (AA) and heterozygous (Aa) individuals look identical, a cross with a specific known genotype is required to reveal the hidden allele.

Solution: 1: In a test cross, the individual with the unknown genotype is crossed with an individual that is homozygous recessive (aa) for the trait in question.
2: The homozygous recessive parent can only contribute recessive alleles to the offspring. This allows the alleles of the unknown parent to be expressed clearly in the phenotypes of the F_1 generation.
3: If the unknown parent is homozygous dominant ($AA \times aa$), 100% of the offspring will show the dominant phenotype.
4: If the unknown parent is heterozygous ($Aa \times aa$), the resulting phenotypic ratio will be 1:1 (50% dominant, 50% recessive).
5: This simple ratio allows the geneticist to conclude the genotype of the parent with absolute certainty. Crossing with a dominant parent or a hybrid would not provide this clear diagnostic result.

Final Answer: Homozygous recessive parent

Answer: (C)

Go Back to Question 53

Q54.

Solution

Concept: The cell membrane is selectively permeable, and substances move across it through various mechanisms. These mechanisms are classified as passive or active based on whether they require the cell to spend metabolic energy (ATP) to facilitate the movement.

Solution: 1: Passive transport (diffusion, osmosis, facilitated diffusion) involves the movement of molecules along a concentration gradient (from high to low concentration) and does not require ATP.
2: Active transport is the movement of molecules or ions against their concentration gradient (from a region of lower concentration to a region of higher concentration).
3: Because this movement is "uphill," it requires a significant input of energy, which is provided by the hydrolysis of ATP.
4: This process is typically mediated by specific transmembrane proteins called carrier proteins or "pumps" (e.g., the Sodium-Potassium pump).
5: Since the question specifies movement "against the concentration gradient" with the "expenditure of ATP," Active transport is the only correct biological process.

Final Answer: Active transport

Answer: (C)

Go Back to Question 54

Q55.

Solution

Concept: The liver is the largest gland in the human body and performs over 500 vital functions, including bile production, detoxification, and protein synthesis. To understand its complex physiology, one must look at its microscopic organization, where cells are arranged into distinct geometric units.

Solution: 1: The liver is composed of many small, hexagonal functional units called Hepatic lobules.
2: Each lobule consists of plates of liver cells (hepatocytes) radiating from a central vein. The lobules are covered by a thin connective tissue sheath called Glisson's capsule.
3: While Hepatocytes are the individual "workers" or cells of the liver, the Hepatic lobule is considered the "structural and functional unit" because it represents the smallest complete organized assembly capable of performing liver functions.
4: To clarify other terms:
Kupffer cells: Specialized macrophages in the liver that destroy pathogens and old RBCs.
Glisson's capsule: The connective tissue covering of the lobules.
5: Therefore, in anatomical and physiological terms, the hepatic lobule is the defined unit of the liver.

Final Answer: Hepatic lobule

Answer: (B)

Go Back to Question 55

Q56.

Solution

Concept: Pneumonia is an infection that inflames the air sacs in one or both lungs. It can be caused by bacteria (such as *Streptococcus pneumoniae* and *Haemophilus influenzae*), viruses, or fungi. Identifying the specific symptoms of respiratory infections is critical for differentiating them from common colds or intestinal infections.

Solution: 1: In pneumonia, the alveoli (air sacs) of the lungs become filled with fluid and dead white blood cells, which leads to severe problems in gaseous exchange.
2: The characteristic symptoms include high fever, chills, a productive cough (often with mucus), and a persistent headache.
3: In severe cases, because the oxygen intake is compromised, the lips and finger nails may turn greyish to bluish in color—a condition known as cyanosis.
4: Let's evaluate the other options:
Option A: Describes Amoebiasis or general intestinal distress.
Option B: Describes the Common Cold (limited to the upper respiratory tract).
Option D: Describes Typhoid (sustained high fever and stomach pain).
5: Thus, the combination of fever, chills, cough, and bluish tint to the extremities is the definitive clinical profile for Pneumonia.

Final Answer: Fever, chills, cough, headache, greyish-blue lips

Answer: (C)

Go Back to Question 56

Q57.

Solution

Concept: The ability to manipulate and study DNA requires large quantities of specific sequences. In the past, this was done only through cloning in bacteria, which was time-consuming. Modern biotechnology relies on a faster, automated method of DNA amplification called the Polymerase Chain Reaction (PCR).

Solution: 1: PCR is a biochemical technology used to amplify a single or a few copies of a piece of DNA across several orders of magnitude, generating thousands to millions of copies of a particular DNA sequence.
2: It is performed "in vitro," meaning in a test tube or a thermal cycler, rather than inside a living cell.
3: The process involves three main steps:
a) Denaturation: Heating the DNA to separate the strands.
b) Annealing: Primers binding to the target sequence.
c) Extension: Taq polymerase synthesizing new DNA strands.
4: Let's look at the other options:
Blotting techniques (Western/Northern): Used for detecting specific proteins or RNA, not for amplification.
Chromatography: A technique for separating mixtures, not for synthesizing DNA.
5: Therefore, PCR is the definitive technique for the rapid, in vitro amplification of DNA.

Final Answer: Polymerase Chain Reaction

Answer: (C)

Go Back to Question 57

Q58.

Solution

Concept: Oxytocin is a peptide hormone produced by the hypothalamus and released by the posterior pituitary gland. It is often referred to as the "birth hormone" or the "milk-ejection hormone" because of its critical roles during and after childbirth. Hormones typically act on specific target organs that possess the necessary receptors.

Solution: 1: Oxytocin acts on the smooth muscles of the body and stimulates their contraction.
2: In pregnant females, it acts on the myometrium (smooth muscle layer) of the uterus to induce vigorous contractions during parturition (childbirth). This is a positive feedback mechanism that facilitates the delivery of the baby.
3: After birth, oxytocin acts on the myoepithelial cells of the mammary glands. This causes the "let-down reflex," which is the ejection of milk from the mammary alveoli into the ducts so the infant can feed.
4: While other hormones like FSH and LH act on the ovaries, and ADH acts on the kidneys, Oxytocin is specifically focused on uterine and mammary smooth muscle tissues.
5: Thus, the uterus and mammary glands are the primary target organs for this hormone.

Final Answer: Uterus and Mammary glands

Answer: (B)

Go Back to Question 58

Q59.

Solution

Concept: Genetic disorders are classified as Mendelian (gene-level mutations) or Chromosomal (changes in chromosome number or structure). Mendelian disorders follow predictable inheritance patterns such as autosomal recessive, autosomal dominant, or sex-linked.

Solution: 1: Let's evaluate each pair to find the correct match:
Option A: Thalassemia is an autosomal recessive disorder, not X-linked. It involves reduced synthesis of globin chains.
Option B: Phenylketonuria (PKU) is an inborn error of metabolism inherited as an autosomal recessive trait. The affected individual lacks an enzyme that converts the amino acid phenylalanine into tyrosine. This is a correct match.
Option C: Down's syndrome is a chromosomal disorder (Trisomy 21), not a simple gene mutation.
Option D: Turner's syndrome is a chromosomal disorder (monosomy, 45,XO), not an autosomal trisomy.
2: Therefore, Phenylketonuria correctly describes an autosomal recessive Mendelian disorder.

Final Answer: Phenylketonuria - Autosomal recessive

Answer: (B)

Go Back to Question 59

Q60.

Solution

Concept: The male accessory glands include the paired seminal vesicles, a single prostate gland, and paired bulbourethral glands. These glands secrete fluids that make up the seminal plasma, which is essential for sperm motility, nutrition, and protection within the female reproductive tract.

Solution: 1: The Bulbourethral glands are small, pea-sized glands located below the prostate gland on either side of the urethra.
2: They are also commonly known as Cowper's glands.
3: Their primary function is to secrete an alkaline, mucus-like fluid during sexual arousal. This fluid serves two purposes:
a) It lubricates the end of the penis (glans penis).
b) It neutralizes the acidity of any residual urine in the urethra, protecting the sperm as they pass through.
4: To clarify other terms:
Bartholin's glands: The female equivalent, located near the vaginal opening.
Prostate and Seminal vesicles: Other male accessory glands, but they are not called Cowper's glands.
5: Thus, Cowper's gland is simply the alternative clinical name for the bulbourethral gland.

Final Answer: Bulbourethral glands

Answer: (C)

Go Back to Question 60

Q61.

Solution

Concept: Photosynthesis is divided into two main stages: the Light-Dependent Reactions and the Light-Independent Reactions (Calvin Cycle). These stages are spatially separated within the chloroplast to optimize the conversion of solar energy into chemical energy.

Solution: 1: The Light-Dependent Reactions (or simply 'Light Reactions') are the first stage of photosynthesis. These reactions require direct sunlight to produce ATP and NADPH. 2: These reactions take place in the membranous system of the chloroplast, specifically within the Thylakoids. The thylakoids are stacked like coins to form structures called Grana. 3: The thylakoid membranes contain the photosystems (PS I and PS II), chlorophyll pigments, and the electron transport chain necessary to capture light and split water molecules (photolysis). 4: In contrast, the 'Dark Reactions' or the Calvin Cycle take place in the Stroma, which is the fluid-filled matrix of the chloroplast. The stroma contains the enzymes (like RuBisCO) required to fix CO_2 into sugar. 5: Therefore, the grana/thylakoid is the specific site for the light-driven synthesis of energy carriers.

Final Answer: Grana/Thylakoid

Answer: (B)

Go Back to Question 61

Q62.

Solution

Concept: Ecological succession is the process of change in the species structure of an ecological community over time. Primary succession occurs in newly formed areas where no soil or life previously existed, such as bare rock, a newly cooled lava flow, or a retreated glacier. The first species to colonize these harsh environments are called pioneer species.

Solution: 1: On bare rock, the environment is extremely dry and lacks nutrients. The pioneer species must be able to withstand these conditions and initiate soil formation. 2: Lichens are the primary pioneer species on rocks. They are a symbiotic association between a fungus and an alga. 3: Lichens secrete organic acids (like oxalic acid) that chemically weather and corrode the rock surface. This process breaks down the rock into small particles, which, combined with decaying organic matter from the lichens, begins the formation of a thin layer of soil. 4: Once a small amount of soil is established, other plants like mosses can take hold. Mosses further trap dust and organic debris, leading to deeper soil that can eventually support grasses, shrubs, and finally trees. 5: Therefore, in a lithosere (succession on rock), lichens are the essential starting point of the biotic community.

Final Answer: Lichens

Answer: (B)

Go Back to Question 62

Q63.

Solution

Concept: The kidneys' ability to conserve water is regulated by the hypothalamus and the posterior pituitary gland. The hormone responsible for this is Anti-Diuretic Hormone (ADH), also known as Vasopressin. A failure in this hormonal system leads to significant imbalances in water excretion.

Solution: 1: ADH acts on the distal convoluted tubules (DCT) and collecting ducts of the nephron to increase their permeability to water, allowing more water to be reabsorbed into the blood. 2: When there is a deficiency of ADH (or if the kidneys fail to respond to it), the body cannot reabsorb sufficient water. This results in the production of large volumes of very dilute urine, a condition called polyuria. 3: This specific clinical disorder is known as Diabetes Insipidus. Unlike Diabetes Mellitus (which involves insulin and high blood sugar), Diabetes Insipidus is strictly a "water" diabetes characterized by extreme thirst (polydipsia) and frequent urination. 4: To clarify: Insulin deficiency causes Diabetes Mellitus; Glucagon regulates blood sugar; Aldosterone regulates sodium/potassium balance. 5: Thus, the loss of water-regulating ability due to low ADH levels is the hallmark of Diabetes Insipidus.

Final Answer: ADH (Vasopressin)

Answer: (C)

Go Back to Question 63

Q64.

Solution

Concept: Biological rhythms, such as the 24-hour sleep-wake cycle, are essential for synchronizing the body's internal environment with the external world. These rhythms are managed by a specialized endocrine gland that responds to light and dark signals received through the eyes.

Solution: 1: The Pineal gland is a small, pinecone-shaped gland located on the dorsal side of the forebrain. 2: It secretes a hormone called Melatonin. The production of melatonin is inhibited by light and stimulated by darkness. 3: Melatonin plays a very important role in the regulation of a 24-hour (diurnal) rhythm of our body. It helps in maintaining the normal rhythms of the sleep-wake cycle and body temperature. 4: Additionally, melatonin also influences metabolism, pigmentation, the menstrual cycle, and our defense capability. 5: Because of its role in timing these daily cycles, the pineal gland is frequently referred to as the "Biological Clock" of the human body. The Thymus is involved in immunity, and the Thyroid in metabolism.

Final Answer: Pineal gland

Answer: (B)

Go Back to Question 64

Q65.

Solution

Concept: The double helix structure of DNA, proposed by Watson and Crick, is characterized by very specific and constant physical dimensions. These dimensions are crucial for the stability of the molecule and the precise packing of genetic information within the cell nucleus.

Solution: 1: In a B-DNA molecule (the most common form), the helix makes a complete turn every 3.4 nm (34 Å) along its length. 2: There are typically 10 base pairs (bp) in each complete turn of the helix. 3: To find the distance between two adjacent (consecutive) base pairs, we divide the length of one full turn by the number of base pairs in that turn:

$$3.4 \text{ nm}/10 = 0.34 \text{ nm}$$

(or 3.4 Å). 4: Other key dimensions include: the diameter of the helix, which is 2.0 nm; and the pitch of the helix, which is 3.4 nm. 5: It is important not to confuse the distance between base pairs (0.34 nm) with the length of a full turn (3.4 nm). The question specifically asks for the distance between two adjacent base pairs.

Final Answer: 0.34 nm

Answer: (B)

Go Back to Question 65

Q66.

Solution

Concept: Meiosis is a specialized form of cell division that reduces the chromosome number by half, resulting in the production of haploid gametes. It consists of two rounds of division: Meiosis I and Meiosis II. Prophase I of Meiosis I is the most complex and long-lasting phase, further divided into five distinct substages based on chromosomal behavior.

Solution: 1: During the third substage of Prophase I, known as Pachytene, the bivalent chromosomes (pairs of homologous chromosomes) appear clearly as tetrads. 2: This stage is characterized by the appearance of recombination nodules, which are the sites where "crossing over" occurs between non-sister chromatids of homologous chromosomes. 3: Crossing over is an enzyme-mediated process involving the exchange of genetic material between homologous chromosomes. This leads to genetic recombination, which is the primary source of variation in sexually reproducing populations. 4: The enzyme involved in this process is called Recombinase. 5: To clarify other stages: Zygotene: Synapsis (pairing) occurs. Diplotene: Dissolution of the synaptonemal complex; chiasmata become visible. Diakinesis: Terminalization of chiasmata. 6: Therefore, Pachytene is the specific stage where the physical exchange of DNA segments (crossing over) takes place.

Final Answer: Pachytene

Answer: (B)

Go Back to Question 66

Q67.

Solution

Concept: The study of human evolution involves tracing the lineage of *Homo sapiens* through various ancestral forms. These ancestors are categorized based on their cranial capacity (brain size), skeletal structure, and tool-making abilities. The transition from ape-like ancestors to modern humans shows a steady increase in brain size.

Solution: 1: *Homo habilis* is considered one of the earliest members of the genus *Homo*. They lived about 2 million years ago and are famously known as the "handy man" because they were the first to make and use stone tools. 2: The cranial capacity of *Homo habilis* was relatively small, ranging between 650–800 cubic centimeters (cc). 3: Comparing this with other ancestors: *Homo erectus*: Had a larger brain, around 900 cc. *Neanderthal man*: Had a brain size of about 1400 cc, similar to modern humans. *Homo sapiens*: Modern human brain size averages around 1350–1450 cc. 4: Because *Homo habilis* represents an early transitional stage, its cranial capacity is the lowest among the options provided, specifically within the 650–800 cc range.

Final Answer: 650–800 cc

Answer: (A)

Go Back to Question 67

Q68.

Solution

Concept: The Lac Operon is a classic model of gene regulation in prokaryotes (specifically *E. coli*), proposed by Jacob and Monod. It consists of structural genes that code for enzymes involved in lactose metabolism and regulatory elements that control when these genes are expressed.

Solution: 1: The Lac Operon contains three structural genes: a) 'z' gene: Codes for beta-galactosidase (β-gal), which hydrolyzes lactose into glucose and galactose. b) 'y' gene: Codes for Permease, which increases the cell's permeability to β-galactosides (lactose). c) 'a' gene: Codes for Transacetylase. 2: The regulation of the operon depends on the presence of an inducer (lactose/allolactose). 3: The 'i' gene (inhibitor gene) codes for a repressor protein. In the absence of an inducer, this repressor binds to the Operator (o) region, physically blocking RNA polymerase from transcribing the structural genes. 4: When the inducer is present, it binds to the repressor, changing its shape so it can no longer bind to the operator. This "turns on" the operon. 5: Thus, the repressor protein's specific target to stop transcription is the Operator.

Final Answer: Operator

Answer: (C)

Go Back to Question 68

Q69.

Solution

Concept: Down's Syndrome is a well-known chromosomal disorder caused by an abnormality in the number of chromosomes (aneuploidy). This condition arises due to a failure in the segregation of chromatids during gamete formation, a process known as non-disjunction.

Solution: 1: A normal human cell contains 46 chromosomes (23 pairs). Down's Syndrome occurs when an individual has an extra copy of chromosome number 21. 2: This condition is specifically called "Trisomy 21." Therefore, the total chromosome count in the cells of an affected person is 47 (46 + 1). 3: The disorder was first described by Langdon Down in 1866. 4: Characteristic clinical features include: - Short stature with a small round head. - Furrowed tongue and partially open mouth. - Broad palm with a characteristic palm crease. - Physical, psychomotor, and mental development is retarded. 5: It is not related to sex chromosomes (like Turner's or Klinefelter's syndromes) but is purely an autosomal aneuploidy.

Final Answer: Trisomy of 21st chromosome

Answer: (A)

Go Back to Question 69

Q70.

Solution

Concept: Agarose gel electrophoresis is a fundamental technique in biotechnology used to separate DNA fragments based on their size. Since DNA is negatively charged due to the phosphate groups in its backbone, it will migrate toward a positive electrode when placed in an electric field.

Solution: 1: In this technique, DNA fragments are loaded into wells in an agarose gel. An electric current is then applied across the gel. 2: The DNA fragments move toward the Anode (positive electrode). 3: The gel acts as a sieve or a matrix. Smaller DNA fragments move more easily through the pores of the gel and thus travel a greater distance in a given amount of time. 4: Larger DNA fragments encounter more resistance and stay closer to the wells (the cathode/starting point). 5: Therefore, the fragments are separated solely according to their size (length in base pairs). 6: Once separated, the DNA fragments are visualized by staining them with Ethidium Bromide (EtBr) and exposing them to Ultraviolet (UV) light, appearing as bright orange bands.

Final Answer: Size

Answer: (C)

Go Back to Question 70

Q71.

Solution

Concept: Plant classification is based on the complexity of the plant body and the presence of specialized structures for reproduction and vascular transport. One of the most significant evolutionary milestones in the plant kingdom is the development of vascular tissues (xylem and phloem) and the production of seeds.

Solution: 1: Plants are broadly divided into Cryptogams (non-seed bearing) and Phanerogams (seed-bearing). 2: Gymnosperms and Angiosperms are both Phanerogams. They possess vascular tissues and produce seeds. 3: The term "Gymnosperm" is derived from the Greek words *gymnos* (naked) and *sperma* (seed). These plants are characterized by the fact that their ovules are not enclosed by any ovary wall and remain exposed, both before and after fertilization. 4: Consequently, the seeds that develop from these ovules are not covered by a fruit wall; they are "naked." 5: In Angiosperms, however, the ovules are enclosed within an ovary, which develops into a fruit. Therefore, angiosperm seeds are enclosed. 6: Algae, Bryophytes, and Pteridophytes do not produce seeds at all. Thus, the characteristic of having "naked seeds" is exclusive to Gymnosperms.

Final Answer: Gymnosperms

Answer: (B)

Go Back to Question 71

Q72.

Solution

Concept: The cardiac cycle is 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 the ventricles. One of the most important metrics of heart health is the volume of blood pumped per unit of time.

Solution: 1: During each cardiac cycle, the ventricles pump out a specific volume of blood. This is known as the Stroke Volume. 2: In a normal, healthy adult at rest, the stroke volume is approximately 70 mL. 3: The Cardiac Output is defined as the volume of blood pumped by each ventricle per minute. It is calculated by multiplying the stroke volume by the heart rate (number of beats per minute).

$$\text{Cardiac Output} = \text{Stroke Volume} \times \text{Heart Rate}$$

4: For a typical heart rate of 72 beats per minute:

$$\text{Cardiac Output} = 70 \text{ mL} \times 72 \approx 5000 \text{ mL or } 5 \text{ Litres.}$$

5: The heart has the ability to alter the stroke volume and heart rate based on the body's needs (e.g., during exercise), thereby significantly increasing the cardiac output.

Final Answer: 5000 mL

Answer: (B)

Go Back to Question 72

Q73.

Solution

Concept: In genetic engineering, a vector is a DNA molecule used as a vehicle to artificially carry foreign genetic material into another cell. Plasmids, which are small, circular, extra-chromosomal DNA molecules found in bacteria, are the most commonly used vectors. To be effective, a vector must possess several specific features.

Solution: 1: The most critical feature of any vector is the Origin of Replication (ori). This is a specific DNA sequence where replication begins. Any piece of DNA linked to this sequence can be made to replicate within the host cells. 2: The 'ori' also controls the copy number of the linked DNA. 3: Another essential feature is a Selectable Marker. This is a gene that helps researchers distinguish between "transformants" (cells that have taken up the vector) and "non-transformants." 4: Common selectable markers in bacterial vectors include genes that provide resistance to antibiotics like ampicillin, chloramphenicol, tetracycline, or kanamycin. 5: Normal E. coli cells do not naturally carry resistance to these antibiotics. Therefore, if a plasmid containing an ampicillin-resistance gene is successfully inserted into a cell, that cell will be able to grow on a medium containing ampicillin, while others will die. 6: Thus, antibiotic resistance genes serve as the primary selectable markers in cloning experiments.

Final Answer: Selectable marker

Answer: (B)

Go Back to Question 73

Q74.

Solution

Concept: The structural units of DNA and RNA are nucleotides. Each nucleotide is composed of three distinct chemical components: a nitrogenous base, a five-carbon sugar (pentose), and a phosphate group. While the phosphate group is constant, the sugar and bases vary between DNA and RNA.

Solution: 1: The nitrogenous bases are categorized into two groups: Purines (Adenine and Guanine) and Pyrimidines (Cytosine, Thymine, and Uracil). 2: In DNA, the four bases are Adenine (A), Guanine (G), Cytosine (C), and Thymine (T). 3: In RNA, Thymine is absent. Instead, it is replaced by a different pyrimidine called Uracil (U). 4: Therefore, the bases in RNA are Adenine, Guanine, Cytosine, and Uracil. 5: Additionally, the sugar in DNA is deoxyribose, whereas the sugar in RNA is ribose. 6: This substitution of Uracil for Thymine is one of the key chemical differences that allows the cell to distinguish between its long-term genetic storage (DNA) and its short-term messaging molecules (RNA).

Final Answer: Uracil

Answer: (B)

Go Back to Question 74

Q75.

Solution

Concept: Mendel's Law of Segregation (the First Law of Inheritance) states that the two alleles for a heritable character segregate (separate) during gamete formation and end up in different gametes. This ensures that a gamete receives only one of the two alleles present in the somatic cells of the organism.

Solution: 1: An individual organism (diploid) carries two alleles for each gene (e.g., Tt). 2: When the organism produces gametes through the process of meiosis, the homologous chromosomes separate. 3: As a result, each gamete (sperm or egg) receives only one allele (either T or t). 4: Because the gamete carries only one version of the gene, it is always "pure" for that trait. It cannot be a hybrid. 5: This is why the Law of Segregation is also known as the Law of Purity of Gametes. 6: This principle is universal for all sexually reproducing organisms and explains why the recessive trait can reappear in the F_2 generation even if it was hidden in the F_1 hybrid—the alleles never "blend," they only temporarily associate and then separate cleanly.

Final Answer: Law of purity of gametes

Answer: (B)

Go Back to Question 75

Q76.

Solution

Concept: The ascent of sap in tall trees is a remarkable physical feat that cannot be explained by simple capillary action or root pressure alone. The most widely accepted explanation is the Transpiration Pull theory, also known as the Cohesion-Tension theory, proposed by Dixon and Joly.

Solution: 1: Transpiration is the loss of water vapor from the leaves through stomata. As water evaporates from the leaf cells into the atmosphere, it creates a negative pressure or "pull" (tension) in the xylem vessels. 2: Because of the strong cohesive forces (attraction between water molecules) and adhesive forces (attraction between water and xylem walls), a continuous, unbroken column of water is maintained from the roots to the leaves. 3: The transpiration pull acts like a suction straw, drawing water upward through the xylem. 4: This pull is strong enough to move water to the tops of even the tallest trees, like *Sequoia*, which can reach heights of over 100 meters. 5: While root pressure helps in small plants or during the night (leading to guttation), it is not sufficient for long-distance transport in tall trees. Therefore, transpiration pull is the primary driving force.

Final Answer: Transpiration pull

Answer: (C)

Go Back to Question 76

Q77.

Solution

Concept: Cancer is characterized by the uncontrolled growth and division of cells. Tumors are classified into two types: Benign and Malignant. Benign tumors remain localized, while Malignant tumors are cancerous and have the ability to invade surrounding tissues and spread to distant organs.

Solution: 1: The most feared and characteristic property of malignant tumors is Metastasis. 2: During this process, cancerous cells slough off from the primary tumor and reach distant sites through the blood or lymph. 3: Wherever these cells get lodged in the body, they start a new tumor, essentially "seeding" the cancer in other organs. 4: This makes malignant tumors much more dangerous and difficult to treat than benign tumors. 5: Let's look at the other terms: Contact inhibition: A normal property where cells stop growing when they touch each other; cancer cells lose this. Apoptosis: Programmed cell death; cancer cells often evade this. Infiltration: The local spread into adjacent tissues. 6: Thus, the specific term for the spread to "distant" sites is Metastasis.

Final Answer: Metastasis

Answer: (A)

Go Back to Question 77

Q78.

Solution

Concept: Photosynthesis consists of two stages: the light-dependent reactions and the light-independent reactions (Calvin cycle). The Calvin cycle is responsible for fixing carbon dioxide into organic molecules (sugars). This cycle is named after Melvin Calvin, who mapped the pathway using radioactive isotopes.

Solution: 1: To identify the first stable product of the Calvin cycle, Calvin and his colleagues used the radioactive isotope ^{14}C in algal photosynthesis studies. 2: They discovered that the first stable intermediate formed after CO_2 fixation is a 3-carbon organic acid. 3: This compound is 3-phosphoglyceric acid (3-PGA). 4: Because the first stable product has three carbon atoms, the pathway is also called the C3 pathway. 5: In contrast, C_4 plants initially produce a 4-carbon compound called Oxaloacetic acid (OAA). 6: Therefore, for the standard Calvin cycle (C3 cycle), 3-PGA is the definitive first stable product.

Final Answer: 3-phosphoglyceric acid (PGA)

Answer: (B)

Go Back to Question 78

Q79.

Solution

Concept: The respiratory volume that can be inspired or expired varies based on the effort applied. While Tidal Volume covers normal breathing, additional air can be moved during forceful breathing. These volumes are measured using a spirometer.

Solution: 1: Tidal Volume (TV) is the volume of air inspired or expired during a normal breath (500 mL). 2: The additional volume of air that a person can inspire by a "forcible" inspiration is called the Inspiratory Reserve Volume (IRV). 3: In a healthy adult, the IRV averages between 2500 mL to 3000 mL. 4: Similarly, the extra volume of air that can be expired forcibly is the Expiratory Reserve Volume (ERV), which is about 1000–1100 mL. 5: Vital Capacity (VC) is the sum of TV + IRV + ERV. 6: Since the question specifically asks for the "additional" air inspired "forcibly," IRV is the correct physiological term.

Final Answer: Inspiratory Reserve Volume (IRV)

Answer: (A)

Go Back to Question 79

Q80.

Solution

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

Solution: 1: Let's categorize the provided options: Option A: Wildlife Safari Parks - These are man-made enclosures where animals are kept; this is Ex-situ. Option B: Botanical Gardens - These are facilities where plants are grown for display and research outside their natural habitats; this is Ex-situ. Option C: Biosphere Reserves - These are large areas of protected land designed to conserve biodiversity, where local communities also live and work in harmony with nature in the buffer/transition zones. This is In-situ. Option D: Seed Banks - These are facilities that store seeds of various plants to preserve genetic diversity; this is Ex-situ. 2: Other examples of in-situ conservation include National Parks, Sanctuaries, and Sacred Groves. 3: Therefore, the Biosphere Reserve is the only in-situ conservation method among the choices.

Final Answer: Biosphere Reserve

Answer: (C)

Go Back to Question 80

Q81.

Solution

Concept: The growth of plants is a complex process influenced by internal and external factors. When plotting the growth of a plant organ or the entire plant against time, a characteristic curve is obtained. This curve represents the different phases of growth that biological organisms typically undergo.

Solution: 1: Most living organisms in a natural environment exhibit a growth pattern described as a Sigmoid (S-shaped) curve. 2: This curve is divided into three distinct phases: a) Lag phase: The initial period of slow growth as the organism adapts to its environment. b) Log (Exponential) phase: A period of rapid, maximum growth where resources are abundant. c) Stationary phase: As resources become limited or the organism reaches maturity, the growth rate slows down and eventually levels off. 3: Mathematically, this is expressed by the equation: $W_1 = W_0 e^{rt}$, where W_1 is the final size, W_0 is the initial size, r is the growth rate, and t is time. 4: Linear growth, on the other hand, occurs when only one daughter cell continues to divide (e.g., in root elongation), resulting in a straight-line graph. 5: Since the question refers to the "characteristic" curve for most living organisms under natural conditions, the Sigmoid curve is the correct answer.

Final Answer: Sigmoid curve

Answer: (B)

Go Back to Question 81

Q82.

Solution

Concept: The process of protein synthesis (translation) involves the collaboration of three types of RNA: mRNA, rRNA, and tRNA. tRNA (transfer RNA) serves as the "adapter molecule" that bridges the gap between the nucleotide sequence of the mRNA and the amino acid sequence of the protein.

Solution: 1: To function as an adapter, tRNA must have a specific structure. The two-dimensional "cloverleaf" model of tRNA highlights its key functional regions. 2: The end of the tRNA molecule that binds to a specific amino acid is called the Amino Acid Acceptor End. This is always located at the 3′ end of the tRNA molecule and typically ends with the sequence CCA. 3: On the opposite side of the molecule is the Anticodon Loop. This loop contains a triplet of bases that are complementary to the codon found on the mRNA. 4: For example, if the mRNA codon is AUG (Methionine), the tRNA anticodon would be UAC. 5: By matching its anticodon to the mRNA codon, the tRNA ensures that the correct amino acid is brought to the ribosome. 6: Thus, the Anticodon loop is the specific site that "reads" the genetic code on the messenger RNA.

Final Answer: Anticodon loop

Answer: (B)

Go Back to Question 82

[Image of the tRNA cloverleaf structure]

Q83.

Solution

Concept: The human ear is a sophisticated organ responsible for two primary functions: hearing and the maintenance of body balance (equilibrium). The inner ear, or labyrinth, contains specialized structures for both functions.

Solution: 1: The inner ear consists of two main parts: the Cochlea and the Vestibular Apparatus. 2: The Cochlea is the coiled, snail-like structure responsible for hearing. It contains the Organ of Corti, which converts sound vibrations into nerve impulses. 3: The Vestibular Apparatus is responsible for maintaining balance and posture. It consists of the three Semi-circular canals and the Otolith organs (Saccule and Utricle). 4: The semi-circular canals detect rotational movements of the head (dynamic equilibrium), while the saccule and utricle detect linear acceleration and the position of the head relative to gravity (static equilibrium). 5: Together, these structures send continuous signals to the brain (cerebellum) about the body's orientation in space. 6: Therefore, the Vestibular apparatus is the specific region of the ear dedicated to equilibrium.

Final Answer: Vestibular apparatus

Answer: (C)

Go Back to Question 83

Q84.

Solution

Concept: Sex-linked inheritance refers to the transmission of genes located on the sex chromosomes. In humans, the most common sex-linked traits are X-linked recessive disorders. Because males have only one X chromosome (hemizygous), they are more likely to express these traits than females, who have two.

Solution: 1: Let's analyze the disorders listed in the options: Option A: Night blindness - Usually caused by Vitamin A deficiency or autosomal mutations. Option B: Colour blindness - A classic X-linked recessive disorder where the individual cannot distinguish between certain colors (usually red and green). Option C: Albinism - An autosomal recessive disorder resulting in the lack of melanin pigment. Option D: Myxedema - A condition resulting from severe hypothyroidism in adults. 2: Haemophilia is another well-known X-linked recessive disorder where the blood fails to clot properly. 3: Both Colour blindness and Haemophilia follow a "criss-cross" inheritance pattern, where the trait is passed from a carrier mother to her son. 4: Therefore, Colour blindness is the correct example of a sex-linked (X-linked) inheritance provided here.

Final Answer: Colour blindness

Answer: (B)

Go Back to Question 84

Q85.

Solution

Concept: The human vertebral column is composed of 33 vertebrae (which fuse into 26 bones in adults). These vertebrae are categorized into five regions based on their location and structural characteristics: Cervical, Thoracic, Lumbar, Sacral, and Coccygeal.

Solution: 1: The Cervical vertebrae are located in the neck region. 2: A unique feature of mammals is that almost all of them, regardless of the length of their neck (from a tiny shrew to a tall giraffe), have exactly seven cervical vertebrae. 3: The first cervical vertebra is called the Atlas, which supports the skull and allows for "nodding" movements. The second is called the Axis, which allows for "pivoting" or side-to-side movements. 4: To review the other regions in a human: - Thoracic: 12 (attached to ribs) - Lumbar: 5 (lower back) - Sacral: 5 fused into 1 - Coccygeal: 4 fused into 1 5: Thus, the number of cervical vertebrae in the human skeletal system is 7.

Final Answer: 7

Answer: (C)

Go Back to Question 85

Q86.

Solution

Concept: The regulation of calcium levels in the blood is a vital homeostatic process. Calcium is essential for muscle contraction, nerve impulse transmission, and blood clotting. Two antagonistic hormones, produced by the thyroid and parathyroid glands, work together to maintain calcium balance.

Solution: 1: When blood calcium levels fall below normal, the Parathyroid glands (four small glands located on the posterior surface of the thyroid) secrete Parathyroid Hormone (PTH). 2: PTH is a hypercalcemic hormone, meaning it increases blood Ca^{2+} levels through three main actions: a) Stimulating osteoclasts to dissolve bone matrix (resorption), releasing calcium into the blood. b) Increasing calcium reabsorption by the renal tubules. c) Increasing calcium absorption from digested food in the intestines. 3: Conversely, the thyroid gland secretes Thyrocalcitonin (TCT), which lowers blood calcium levels by promoting its deposition in bones. 4: Since the question asks for the hormone that "increases" blood calcium levels, Parathyroid hormone is the correct answer.

Final Answer: Parathyroid hormone (PTH)

Answer: (B)

Go Back to Question 86

Q87.

Solution

Concept: Respiratory capacities are derived by adding two or more respiratory volumes. These capacities are used to assess the functional limits of the lungs. Vital Capacity is one of the most important clinical measurements, as it represents the maximum amount of air a person can move in a single respiratory cycle.

Solution: 1: Vital Capacity (VC) is defined as the maximum volume of air a person can breathe out after a forced inspiration. 2: Alternatively, it is the maximum volume of air a person can breathe in after a forced expiration. 3: It is calculated by summing three specific volumes: - Tidal Volume (TV): Normal breath (500 mL). - Inspiratory Reserve Volume (IRV): Extra air inspired forcibly (2500–3000 mL). - Expiratory Reserve Volume (ERV): Extra air expired forcibly (1000–1100 mL). 4: Therefore, the formula is: $VC = TV + IRV + ERV$. 5: It differs from Total Lung Capacity (TLC) because VC excludes the Residual Volume (RV), which can never be exhaled.

Final Answer: $TV + IRV + ERV$

Answer: (C)

Go Back to Question 87

Q88.

Solution

Concept: Population growth can be modeled based on the availability of resources (food and space). In an environment where resources are finite—which is true for almost all natural habitats—population growth follows a logistic pattern, reflecting the "carrying capacity" of the environment.

Solution: 1: In logistic growth, a population initially grows slowly (lag phase), then rapidly (acceleration/log phase), and then slows down as it approaches the carrying capacity (K). 2: The carrying capacity (K) is the maximum number of individuals of a particular species that a specific environment can support sustainably. 3: When the population reaches K, the growth rate becomes zero, resulting in a plateau (stationary phase). This creates a Sigmoid or S-shaped curve. 4: The mathematical Verhulst-Pearl Logistic Growth equation is:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

where N is population density, r is the intrinsic rate of natural increase, and t is time. 5: Exponential growth (J-shaped curve) only occurs when resources are unlimited, which is rare in nature.

Final Answer: Logistic growth

Answer: (A)

Go Back to Question 88

Q89.

Solution

Concept: The female reproductive unit of a flower, the pistil, consists of the stigma, style, and ovary. Within the ovary are the ovules. The arrangement of these ovules within the ovary is called placentation. Different plant families exhibit distinct types of placentation.

Solution: 1: In Basal placentation, the placenta develops at the base of the ovary. 2: Typically, a single ovule is attached to this basal placenta within a unilocular ovary. 3: This type of placentation is a characteristic feature of the family Asteraceae (Compositae), which includes sunflowers and marigolds. 4: To review other types: - Marginal: Ovules along the ventral suture (e.g., Pea). - Axile: Ovules on a central axis in a multilocular ovary (e.g., China rose, Tomato). - Parietal: Ovules on the inner wall of the ovary (e.g., Mustard). 5: Therefore, Sunflower is the classic example of basal placentation.

Final Answer: Sunflower

Answer: (B)

Go Back to Question 89

Q90.

Solution

Concept: Genetic material must be able to replicate itself, store information, and undergo occasional mutations to allow for evolution. While DNA is the genetic material in most organisms, some viruses use RNA. The classic experiment that proved DNA is the genetic material was performed by Hershey and Chase.

Solution: 1: Alfred Hershey and Martha Chase (1952) worked with bacteriophages—viruses that infect bacteria. 2: They used radioactive isotopes to label the two components of the virus: ^{35}S (Radioactive Sulfur) to label the protein coat and ^{34}P (Radioactive Phosphorus) to label the DNA. 3: They allowed these labeled viruses to infect E. coli bacteria. After agitation and centrifugation, they found that only the radioactive DNA (^{34}P) had entered the bacterial cells. 4: The radioactive protein (^{35}S) remained in the surrounding medium (supernatant). 5: This unequivocally proved that DNA, not protein, is the genetic material passed from the virus to the bacteria. 6: Griffith (Transformation) and Avery-MacLeod-McCarty provided earlier evidence, but the Hershey-Chase experiment is considered the "unequivocal" or final proof.

Final Answer: Hershey and Chase

Answer: (C)

Go Back to Question 90

Q91.

Solution

Concept: The Adrenal gland, located atop the kidneys, consists of two parts: the outer cortex and the inner medulla. The adrenal medulla secretes two hormones, Adrenaline (Epinephrine) and Noradrenaline (Norepinephrine), which are chemically classified as catecholamines.

Solution: 1: Adrenaline and Noradrenaline are rapidly secreted in response to stress of any kind or during emergency situations. 2: Because they prepare the body to either face a threat or run away from it, they are famously called "Emergency hormones" or "Hormones of Fight or Flight." 3: Their physiological effects include: a) Increased alertness and pupil dilation. b) Increased heart rate and strength of heart contraction. c) Increased rate of respiration. d) Breakdown of glycogen into glucose to provide immediate energy. 4: These actions ensure that the brain and muscles have a surge of oxygen and fuel to handle high-pressure scenarios. 5: Therefore, the adrenal medulla is the specific source of these life-saving emergency responses.

Final Answer: Adrenal medulla

Answer: (B)

Go Back to Question 91

Q92.

Solution

Concept: Spermatogenesis is the process of sperm production in the testes. It involves a sequence of cell divisions and transformations. The most significant transition occurs when diploid germ cells undergo meiosis to become haploid cells.

Solution: 1: The process begins with the diploid Spermatogonia ($2n$) located on the inner wall of the seminiferous tubules. 2: Some spermatogonia grow into Primary spermatocytes ($2n$), which then undergo the first meiotic division (Meiosis I). 3: This division results in the formation of two equal, haploid cells called Secondary spermatocytes (n). 4: The secondary spermatocytes then undergo the second meiotic division (Meiosis II) to produce four equal, haploid Spermatids (n). 5: Finally, the spermatids undergo a transformation process called spermiogenesis to become mature, motile Spermatozoa (sperm). 6: Since the question asks for the cells produced specifically by the second meiotic division of the secondary spermatocytes, Spermatids is the correct answer.

Final Answer: Spermatids

Answer: (C)

Go Back to Question 92

Q93.

Solution

Concept: Transpiration is the loss of water in the form of vapor from the aerial parts of the plant. While most transpiration occurs through the stomata on leaves, a small amount occurs through other openings. The total amount of water lost through transpiration is immense, with plants often losing over 95

Solution: 1: Stomatal transpiration: This is the most significant type, occurring through the stomatal pores. It accounts for about 80–902: Cuticular transpiration: Water vapor escapes directly through the waxy cuticle covering the leaf surface. This accounts for about 5–103: Lenticular transpiration: This occurs through lenticels, which are small openings in the bark of woody stems and some fruits. 4: Lenticular transpiration is the least significant path, accounting for only about 0.15: Guttation is the loss of liquid water from hydathodes, which is a different physiological process altogether and not a type of transpiration. 6: Thus, Lenticular transpiration is the pathway with the minimum contribution to overall water loss.

Final Answer: Lenticular transpiration

Answer: (B)

Go Back to Question 93

Q94.

Solution

Concept: Double fertilization is a unique event in Angiosperms where two male gametes fuse with different components of the embryo sac. The result of one of these fusions is the formation of the endosperm, a tissue that provides nourishment to the developing embryo.

Solution: 1: One male gamete (n) fuses with the egg cell (n) to form the diploid Zygote ($2n$). 2: The second male gamete (n) moves toward the center of the embryo sac and fuses with the two haploid polar nuclei (or the single diploid secondary nucleus, $2n$). 3: This fusion involving three nuclei is called Triple Fusion. 4: The result of triple fusion is the formation of the Primary Endosperm Nucleus (PEN). 5: Since it is the product of three haploid sets ($n + n + n$), the PEN is triploid ($3n$). 6: This triploid nature is a characteristic feature of angiosperm endosperm, distinguishing it from the haploid endosperm found in gymnosperms.

Final Answer: Triploid ($3n$)

Answer: (C)

Go Back to Question 94

Q95.

Solution

Concept: The thyroid gland is an H-shaped gland located in the neck, consisting of two lobes connected by an isthmus. It is composed of many spherical structures called thyroid follicles. These follicles are the functional units responsible for the synthesis and storage of thyroid hormones.

Solution: 1: Each thyroid follicle is lined by a single layer of cuboidal epithelial cells called Follicular cells. 2: These cells synthesize and secrete the hormones Tetraiodothyronine (T_4 or Thyroxine) and Triiodothyronine (T_3). 3: These hormones are crucial for regulating the Basal Metabolic Rate (BMR), growth, and development. 4: The space inside the follicle is filled with a sticky, protein-rich fluid called Colloid, which mainly consists of thyroglobulin—a storage form of the hormones. 5: Between the follicles, there are other cells called Parafollicular cells (or C-cells), which secrete Thyrocalcitonin (TCT). 6: Since the question focuses on the source of T_3 and T_4, the Follicular cells are the correct anatomical source.

Final Answer: Follicular cells

Answer: (A)

Go Back to Question 95

Q96.

Solution

Concept: Transcription is the process of copying genetic information from DNA to RNA. A transcription unit in DNA is defined by three main regions: a Promoter, a Structural gene, and a Terminator. The orientation of the DNA strands determines which strand will serve as the template.

Solution: 1: DNA-dependent RNA polymerase catalyzes the polymerization in only one direction: $5' \rightarrow 3'$. 2: Consequently, the strand that has the polarity $3' \rightarrow 5'$ acts as a template and is referred to as the Template strand. 3: The other strand, which has the polarity $5' \rightarrow 3'$ and the same sequence as the RNA being formed (except for Thymine instead of Uracil), is called the Coding strand. 4: The Promoter is a DNA sequence that provides the binding site for RNA polymerase. By convention, the position of the promoter is defined in relation to the coding strand. 5: The promoter is located toward the $5'$ end (upstream) of the structural gene (with respect to the coding strand). 6: Conversely, the Terminator is located toward the $3'$ end (downstream) of the coding strand and usually defines the end of the transcription process.

Final Answer: $5'$ end of coding strand

Answer: (A)

Go Back to Question 96

Q97.

Solution

Concept: Plant Growth Regulators (PGRs) are small, simple molecules that control various physiological processes. One of the most diverse groups is the Gibberellins (GAs). There are more than 100 gibberellins identified from various organisms, and they have profound effects on stem elongation and developmental transitions.

Solution: 1: Gibberellins are known to cause an extraordinary increase in the length of the axis (stem). This property is used commercially to increase the length of grape stalks. 2: They also promote "Bolting." Bolting is the sudden, rapid elongation of the internodes just prior to flowering in plants with a rosette habit (like cabbage and beet). 3: In the brewing industry, GA_3 is used to speed up the malting process. 4: They can also delay senescence, allowing fruits like apples to be left on the tree longer to improve their market period. 5: Cytokinins, in contrast, promote cell division and delay leaf senescence, while Auxins are involved in apical dominance and rooting. 6: Thus, Bolting is the specific physiological response associated with gibberellin treatment.

Final Answer: Gibberellins

Answer: (B)

Go Back to Question 97

Q98.

Solution

Concept: Ecosystems are composed of biotic (living) and abiotic (non-living) components. To understand the structure and function of an ecosystem, it is essential to look at the distribution of different species and how energy and matter flow between these components.

Solution: 1: Different species in a community often occupy different vertical layers based on their size, resource needs, and environmental tolerances. 2: This vertical distribution of different species occupying different levels is called Stratification. 3: For example, in a tropical forest: - Trees occupy the top vertical strata or layer. - Shrubs occupy the second layer. - Herbs and grasses occupy the bottom layers. 4: Fragmentation refers to the breakdown of detritus into smaller particles. 5: Eutrophication is the natural aging of a lake by nutrient enrichment. 6: Scarification is the weakening of a seed coat to encourage germination. 7: Therefore, Stratification is the correct term for the "vertical" layering seen in biological communities.

Final Answer: Stratification

Answer: (D)

Go Back to Question 98

[Image of forest stratification layers]

Q99.

Solution

Concept: The digestion of carbohydrates begins in the mouth and is completed in the small intestine. Enzymes called carbohydrases or amylases break down complex polysaccharides like starch into simpler disaccharides and finally into monosaccharides like glucose.

Solution: 1: Saliva contains an enzyme called Salivary Amylase (formerly known as Ptyalin). 2: The chemical process of digestion is initiated in the oral cavity by the hydrolytic action of this enzyme. 3: About 304: This enzyme requires an optimum pH of 6.8 and the presence of chloride ions for its activity. 5: Once the food reaches the stomach, the high acidity ($pH \approx 1.8$) inactivates the salivary amylase, and carbohydrate digestion pauses until the food enters the small intestine, where pancreatic amylase takes over. 6: Thus, Maltose is the primary product of starch digestion in the oral cavity.

Final Answer: Maltose

Answer: (B)

Go Back to Question 99

Q100.

Solution

Concept: Human teeth are characterized by three main features: they are thecodont (embedded in sockets), diphyodont (two sets of teeth: deciduous and permanent), and heterodont (different types of teeth). The dental formula is a shorthand representation of the number and types of teeth in one half of each jaw.

Solution: 1: An adult human has 32 permanent teeth. These are of four different types: - Incisors (I): For cutting. - Canines (C): For tearing. - Premolars (PM): For grinding. - Molars (M): For grinding. 2: The arrangement of these teeth in each half of the upper and lower jaw, in the order I, C, PM, M, is represented by the dental formula:

$$\frac{2123}{2123}$$

3: This means in one-half of the upper jaw, there are 2 Incisors, 1 Canine, 2 Premolars, and 3 Molars (2 + 1 + 2 + 3 = 8 teeth). 4: Total teeth: 8 (upper half) $\times$ 2 + 8 (lower half) $\times$ 2 = 32. 5: In contrast, the dental formula for a child (milk teeth) is 2102/2102, as they lack premolars and the third molar (wisdom tooth).

Final Answer: $\frac{2123}{2123}$

Answer: (B)

Go Back to Question 100

Answer Key

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