NEET-UG Biology Sample Paper - 6

Duration: 1 Hour **Maximum Marks: 360**

Instructions

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

Q1. Which of the following represents the correct hierarchical arrangement of taxonomic categories in ascending order for the organism *Musca domestica*?

(A) Species < Genus < Family < Order < Class < Phylum

(B) Species < Genus < Order < Family < Class < Phylum

(C) Species < Genus < Family < Order < Class < Division

(D) Genus < Species < Family < Order < Class < Phylum

Q2. [Image-Based] Observe the diagram of the floral formula components. Identify the correct aestivation shown in the image below representing the 'Standard', 'Wings', and 'Keel' of a Fabaceae flower.

(A) Valvate

(B) Twisted

(C) Vexillary

(D) Imbricate

Q3. During the G_2 phase of the cell cycle, if the initial amount of DNA is $2C$, what will be the amount of DNA and the number of chromosomes if the initial number of chromosomes in G_1 was $2n$?

(A) $4C$ and $4n$

(B) $4C$ and $2n$

(C) $2C$ and $2n$

(D) $2C$ and $4n$

Q4. [Image-Based] Identify the stage of Prophase-I in the provided micrograph where the dissolution of the synaptonemal complex occurs and chiasmata become visible.

(A) Pachytene

(B) Zygotene

(C) Diplotene

(D) Diakinesis

Q5. Match the following with respect to the "Species-Area Relationship" proposed by Alexander von Humboldt:
(i) $\log S = \log C + Z \log A$
(ii) Value of Z for frugivorous birds in tropical forests
(iii) Value of Z for entire continents

(A) (i)-Equation, (ii)-1.15, (iii)-0.6 to 1.2

(B) (i)-Equation, (ii)-0.6 to 1.2, (iii)-1.15

(C) (i)-Equation, (ii)-0.1 to 0.2, (iii)-1.15

(D) (i)-Equation, (ii)-1.15, (iii)-0.1 to 0.2

Q6. [Image-Based] Look at the diagram of the Lac Operon. If a mutation occurs in the 'i' gene such that the repressor cannot bind to the inducer, what will be the status of the operon in the presence of lactose?

(A) Continuously Switched On

(B) Permanently Switched Off

(C) Switched On briefly then Off

(D) No effect on transcription

Q7. In a dihybrid cross, if the recombination frequency between gene A and B is 15%, and between B and C is 10%, and between A and C is 5%, what is the sequence of genes on the chromosome?

(A) A-B-C

(B) A-C-B

(C) C-A-B

(D) B-C-A

Q8. [Image-Based] Identify the molecule 'X' in the following diagram of the Transcription Unit. What is the polarity of the template strand?

(A) $5' \rightarrow 3'$

(B) $3' \rightarrow 5'$

(C) $3' \rightarrow 3'$

(D) $5' \rightarrow 5'$

Q9. Select the incorrect statement regarding the human heart:

(A) The SAN can generate the maximum number of action potentials (70 – 75 min^{-1}).

(B) The bicuspid valve is situated between the left atrium and the left ventricle.

(C) The duration of a cardiac cycle is 0.8 seconds.

(D) The second heart sound (Dub) is associated with the opening of semilunar valves.

Q10. [Image-Based] In the provided diagram of the Biogas Plant, identify the component labeled 'A' where the anaerobic digestion by methanogens takes place.

(A) Slurry tank

(B) Gas holder

(C) Digester

(D) Charge pit

Q11. In *Mangifera indica* Linn, what does 'Linn' indicate?

(A) The name was first published in Latin.

(B) The species was first described by Linnaeus.

(C) It is a binomial nomenclature variation.

(D) The organism is a hybrid.

Q12. Which taxonomic category contains organisms with the least number of similar characters?

(A) Species

(B) Genus

(C) Kingdom

(D) Family

Q13. Choose the correct statement regarding Viroids:

(A) They have a protein coat.

(B) They have free RNA of high molecular weight.

(C) They were discovered by T.O. Diener.

(D) They cause Tobacco Mosaic Disease.

Q14. [Image-Based] Identify the type of life cycle shown in the diagram where the diploid sporophyte is dominant and the gametophyte is highly reduced.

(A) Haplontic

(B) Diplontic

(C) Haplo-diplontic

(D) Haplontic-diplontic

Q15. Which of the following is an example of an "imperfect fungus"?

(A) *Ustilago*

(B) *Alternaria*

(C) *Agaricus*

(D) *Albugo*

Q16. Select the correct matching of Animal and its level of organization:

(A) *Spongilla* - Tissue level

(B) *Hydra* - Cellular level

(C) *Fasciola* - Organ level

(D) *Pheretima* - Organ system

Q17. Floridean starch has a structure very similar to:

(A) Amylopectin and Glycogen

(B) Mannitol and Algin

(C) Starch and Cellulose

(D) Chitin

Q18. The presence of a water vascular system is a characteristic feature of:

(A) Porifera

(B) Echinodermata

(C) Mollusca

(D) Coelenterata

Q19. [Image-Based] Identify the type of simple epithelium shown in the image that is found in the lining of the stomach and intestine.

(A) Squamous

(B) Cuboidal

(C) Columnar

(D) Ciliated

Q20. In a dicot root, the vascular cambium is:

(A) Primary in origin

(B) Completely secondary in origin

(C) Partly primary, partly secondary

(D) Absent

Q21. Which of the following is correct regarding the mouthparts of a cockroach?

(A) Labrum - Lower lip

(B) Labium - Upper lip

(C) Mandibles - Grinding region

(D) Hypopharynx - Mandible

Q22. Bulliform cells are found in:

(A) Dicot leaves

(B) Grasses

(C) Dicot stems

(D) Monocot roots

Q23. Heartwood differs from sapwood in:

(A) Being lighter in color

(B) Having non-functional xylem

(C) Conducting water and minerals

(D) Being soft

Q24. The concept of "Omnis cellula-e cellula" was proposed by:

(A) Aristotle

(B) Rudolf Virchow

(C) Schleiden

(D) Schwann

Q25. [Image-Based] Identify the stage of mitosis where chromosomes move to the spindle equator and get aligned along the metaphase plate.

(A) Prophase

(B) Metaphase

(C) Anaphase

(D) Telophase

Q26. Which organelle is known as the "Protein Factory" of the cell?

(A) Lysosome

(B) Ribosome

(C) Vacuole

(D) Golgi body

Q27. Crossing over occurs during which stage of Meiosis?

(A) Leptotene

(B) Zygotene

(C) Pachytene

(D) Diplotene

Q28. Secondary metabolites like Ricin and Abrin are:

(A) Alkaloids

(B) Toxins

(C) Lectins

(D) Drugs

Q29. If a cell has 24 chromosomes at G_1, how many will it have after S phase?

(A) 12

(B) 24

(C) 48

(D) 36

Q30. The fluid nature of the membrane is important for:

(A) Cell growth

(B) Secretion

(C) Endocytosis

(D) All of these

Q31. Which of the following is not a part of the endomembrane system?

(A) ER

(B) Golgi

(C) Mitochondria

(D) Lysosomes

Q32. Chitin is a polymer of:

(A) N-acetyl glucosamine

(B) Glucose

(C) Fructose

(D) Glycogen

Q33. Select the mis-match:

(A) Gas vacuoles - Green bacteria

(B) Large central vacuoles - Animal cells

(C) Protists - Eukaryotes

(D) Methanogens - Prokaryotes

Q34. Stomata open when:

(A) Guard cells lose water

(B) Turgor pressure of guard cells increases

(C) CO_2 concentration increases

(D) pH decreases

Q35. [Image-Based] Look at the Z-scheme of light reaction. What is 'X' which transfers electrons from PS-II to PS-I?

(A) Cytochrome b_6f

(B) Plastocyanin

(C) Ferredoxin

(D) Pheophytin

Q36. Which element is required for the photolysis of water?

(A) Mg

(B) Mn

(C) Mo

(D) Zn

Q37. The primary CO_2 acceptor in C_3 plants is:

(A) PEP

(B) RuBP

(C) OAA

(D) PGA

Q38. Respiratory Quotient (RQ) of Tripalmitin is:

(A) 1.0

(B) 0.9

(C) 0.7

(D) 1.4

Q39. Which hormone promotes "bolting" in plants?

(A) Auxin

(B) Cytokinin

(C) Gibberellin

(D) Ethylene

Q40. Photorespiration is a characteristic of:

(A) C_4 plants

(B) CAM plants

(C) C_3 plants

(D) All of these

Q41. Net gain of ATP in Glycolysis is:

(A) 2

(B) 4

(C) 8

(D) 38

Q42. Tidal Volume in a healthy human is approximately:

(A) 1000 mL

(B) 500 mL

(C) 2500 mL

(D) 6000 mL

Q43. [Image-Based] Identify the structure in the Nephron where maximum reabsorption of electrolytes and water (70 – 80%) takes place.

(A) Bowman's capsule

(B) PCT

(C) Loop of Henle

(D) DCT

Q44. Which hormone is known as the "Emergency Hormone"?

(A) Insulin

(B) Thyroxine

(C) Adrenaline

(D) Estrogen

Q45. The "QRS complex" in a standard ECG represents:

(A) Atrial depolarization

(B) Ventricular depolarization

(C) Ventricular repolarization

(D) Atrial repolarization

Q46. Osteoporosis is caused by:

(A) High Calcium

(B) Low Estrogen

(C) High Vitamin D

(D) Low Uric acid

Q47. Which cranial nerve is responsible for hearing?

(A) Optic

(B) Auditory

(C) Olfactory

(D) Vagus

Q48. The junction between a motor neuron and the sarcolemma of the muscle fiber is called:

(A) Synapse

(B) Neuromuscular junction

(C) Node of Ranvier

(D) Gap junction

Q49. Bilirubin and Biliverdin are found in:

(A) Pancreatic juice

(B) Saliva

(C) Bile

(D) Intestinal juice

Q50. Diabetes Insipidus is caused by the deficiency of:

(A) Insulin

(B) ADH

(C) Glucagon

(D) Oxytocin

Q51. Which cells of the Pancreas secrete Glucagon?

(A) α cells

(B) β cells

(C) δ cells

(D) F cells

Q52. The ionic gradient across the resting membrane is maintained by:

(A) Na-K pump

(B) Passive diffusion

(C) Osmosis

(D) Active transport of Cl^-

Q53. The middle ear contains three tiny bones: Malleus, Incus and:

(A) Cochlea

(B) Stapes

(C) Utricle

(D) Saccule

Q54. Emphysema is a chronic disorder caused mainly by:

(A) Coal dust

(B) Cigarette smoking

(C) Viral infection

(D) High altitude

Q55. In a typical angiosperm embryo sac, the number of nuclei is:

(A) 8

(B) 7

(C) 6

(D) 5

Q56. The structural and functional unit between the developing embryo and maternal body is:

(A) Umbilical cord

(B) Placenta

(C) Amnion

(D) Yolk sac

Q57. Capacitation occurs in:

(A) Epididymis

(B) Vas deferens

(C) Female reproductive tract

(D) Rete testis

Q58. What is the ploidy of the Endosperm in angiosperms?

(A) n

(B) $2n$

(C) $3n$

(D) $4n$

Q59. Withdrawal of which hormone is the immediate cause of menstruation?

(A) Estrogen

(B) FSH

(C) Progesterone

(D) LH

Q60. Saheli, a new oral contraceptive, was developed at:

(A) AIIMS

(B) CDRI

(C) IARI

(D) WHO

Q61. The process of formation of a mature female gamete is:

(A) Spermatogenesis

(B) Oogenesis

(C) Parthenogenesis

(D) Gametogenesis

Q62. Which of the following is a "Copper releasing IUD"?

(A) Lippes loop

(B) Multiload 375

(C) Progestasert

(D) LNG-20

Q63. Transfer of an ovum collected from a donor into the fallopian tube is:

(A) ZIFT

(B) GIFT

(C) ICSI

(D) IUI

Q64. Triple fusion in angiosperms involves the fusion of:

(A) Two polar nuclei and one male gamete

(B) One polar nucleus and two male gametes

(C) Egg and two male gametes

(D) Synergid and male gamete

Q65. The genotype of a "Test Cross" is:

(A) $F_1\times$ Dominant Parent

(B) $F_1\times$ Recessive Parent

(C) $F_1 \times F_1$

(D) $F_2 \times F_2$

Q66. Down's syndrome is caused by an extra copy of chromosome number:

(A) 13

(B) 18

(C) 21

(D) 22

Q67. In DNA, the distance between two consecutive base pairs is:

(A) 0.34 nm

(B) 3.4 nm

(C) 34 nm

(D) 0.034 nm

Q68. The "Experimental proof of semi-conservative replication" was given by:

(A) Hershey and Chase
(B) Meselson and Stahl
(C) Watson and Crick
(D) Griffith

Q69. Homologous organs indicate:

(A) Convergent evolution
(B) Divergent evolution
(C) Common ancestry
(D) Both B and C

Q70. The "Urey-Miller experiment" used which gases?

(A) CH_4, NH_3, H_2, H_2O
(B) CO_2, NH_3, O_2, H_2
(C) CH_4, N_2, H_2, O_2
(D) CH_4, H_2, CO_2, NH_3

Q71. Who proposed the "Chromosomal theory of inheritance"?

(A) Mendel
(B) Sutton and Boveri
(C) Morgan
(D) Bateson

Q72. A man with blood group A marries a woman with blood group B. What are the possible blood groups of their children?

(A) A and B only

(B) A, B and AB only

(C) A, B, AB and O

(D) O only

Q73. Thalassemia is a:

(A) Qualitative problem

(B) Quantitative problem

(C) Chromosomal problem

(D) Non-hereditary problem

Q74. The amino acid sequence is determined by the sequence of bases on:

(A) tRNA

(B) mRNA

(C) rRNA

(D) DNA

Q75. In a population, if the frequency of recessive allele 'q' is 0.4, what is the frequency of heterozygotes?

(A) 0.16

(B) 0.36

(C) 0.48

(D) 0.6

Q76. "Inheritance of acquired characters" was given by:

(A) Darwin

(B) Lamarck

(C) Wallace

(D) Weismann

Q77. The "Human Genome Project" was completed in:

(A) 1990

(B) 2000

(C) 2003

(D) 2010

Q78. Spliceosomes are not found in cells of:

(A) Plants

(B) Animals

(C) Fungi

(D) Bacteria

Q79. Satellite DNA is useful in:

(A) Organ transplantation

(B) DNA fingerprinting

(C) Sex determination

(D) Genetic engineering

Q80. "Amanita muscaria" is a:

(A) Bio-fertilizer

(B) Hallucinogen

(C) Antibiotic

(D) Vitamin source

Q81. The "Large holes in Swiss cheese" are due to:

(A) Bacteria producing CH_4

(B) Bacteria producing CO_2

(C) Fungi producing O_2

(D) Fungi producing CO_2

Q82. Which of the following is an "autoimmune disease"?

(A) Cancer

(B) AIDS

(C) Rheumatoid arthritis

(D) Allergy

Q83. MALT constitutes about 50 percent of lymphoid tissue in the human body.

(A) 20%

(B) 50%

(C) 10%

(D) 70%

Q84. Treatment of snake bite by antivenom is an example of:

(A) Artificial acquired active immunity

(B) Artificial acquired passive immunity

(C) Natural passive immunity

(D) Specific natural immunity

Q85. "Cyclosporin A" is produced by:

(A) *Trichoderma polysporum*

(B) *Monascus purpureus*

(C) *Saccharomyces cerevisiae*

(D) *Aspergillus niger*

Q86. The "Restriction enzymes" were discovered by:

(A) Alexander Fleming

(B) Smith and Nathans

(C) Watson and Crick

(D) Boyer and Cohen

Q87. "PCR" stands for:

(A) Polymerase Chain Reaction

(B) Protein Chain Reaction

(C) Polypeptide Chain Reaction

(D) None of these

Q88. The first transgenic cow was:

(A) Dolly

(B) Rosie

(C) Tracy

(D) Polly

Q89. [Image-Based] Identify the cloning vector pBR322 component 'rop' which codes for:

(A) Resistance to Ampicillin

(B) Resistance to Tetracycline

(C) Proteins involved in replication

(D) Restriction site for EcoRI

Q90. "BT Cotton" is resistant to:

(A) Insects

(B) Fungi

(C) Viruses

(D) Bacteria

Detailed Solutions

Q1.

Solution

Concept:

Taxonomic hierarchy refers to the process of arranging various organisms into successive levels of biological classification either in a decreasing or an increasing order from kingdom to species or vice versa. Each level of the hierarchy is called a taxonomic category or rank. For the Housefly (*Musca domestica*), the classification must follow the animal kingdom rules.

Solution:

1. The biological classification of the Housefly is as follows:
- Kingdom: Animalia
- Phylum: Arthropoda
- Class: Insecta
- Order: Diptera
- Family: Muscidae
- Genus: *Musca*
- Species: *domestica* 2. Ascending order means moving from the most specific (lowest) rank to the most general (highest) rank. 3. Therefore, the sequence starts at Species and moves upward: Species → Genus → Family → Order → Class → Phylum. 4. Option (A) correctly identifies this sequence for an animal species.

Final Answer: The correct hierarchical arrangement in ascending order is Species < Genus < Family < Order < Class < Phylum.

Answer: (A)

Q2.

Solution

Concept:

Aestivation is the arrangement of sepals or petals in a floral bud. In the Fabaceae family, the corolla consists of five petals with a unique arrangement known as papilionaceous or vexillary aestivation. This is a crucial diagnostic feature used in plant identification.

Solution:

1. Vexillary aestivation consists of three distinct types of petals:
- Standard (Vexillum): The largest, posterior petal that overlaps the others.
- Wings (Alae): Two lateral petals overlapped by the standard.
- Keel (Carina): Two smallest, anterior petals that are fused together, forming a boat-like structure.
2. This specific 1 + 2 + (2) arrangement is designed to facilitate pollination by specific insects.
3. The image description provided in the question (Standard, Wings, and Keel) matches this definition perfectly.

Final Answer: The aestivation described is Vexillary.

Answer: (C)

Q3.

Solution

Concept:

The cell cycle involves distinct phases of growth and DNA replication. Interphase consists of G_1, S, and G_2 phases.

- G_1 (Gap 1): Cell growth and normal metabolic roles.
- S (Synthesis): DNA replication occurs.
- G_2 (Gap 2): Preparation for mitosis.

Solution:

1. Let the initial number of chromosomes be $2n$ and DNA content be $2C$ in G_1. 2. During the S phase, DNA replication doubles the amount of DNA. Thus, $2C$ becomes $4C$. 3. However, the chromosome number does not change during the S phase because the sister chromatids remain attached at the single centromere. So, chromosomes remain $2n$. 4. By the time the cell enters the G_2 phase, the DNA replication is complete. 5. Therefore, in G_2:

- DNA amount = $4C$
- Chromosome number = $2n$

Final Answer: The DNA amount is $4C$ and the chromosome number is $2n$.

Answer: (B)

Q4.

Solution

Concept:

Prophase-I of Meiosis is a prolonged phase divided into five stages: Leptotene, Zygotene, Pachytene, Diplotene, and Diakinesis. Each stage is characterized by specific chromosomal activities related to recombination and separation.

Solution:

1. During Zygotene, chromosomes pair up (synapsis) and the synaptonemal complex forms. 2. During Pachytene, crossing over occurs between non-sister chromatids. 3. The Diplotene stage is marked by the dissolution of the synaptonemal complex. 4. As the complex dissolves, the recombined homologous chromosomes start to separate from each other except at the points of crossing over. 5. These remaining points of attachment are called chiasmata, which become clearly visible as X-shaped structures during this stage.

Final Answer: The stage described is Diplotene.

Answer: (C)

Q5.

Solution

Concept:

The Species-Area relationship, established by Alexander von Humboldt, describes how species richness increases with the explored area. This relationship is typically represented as a rectangular hyperbola on a normal scale and a straight line on a logarithmic scale.

Solution:

1. The logarithmic equation is: $\log S = \log C + Z \log A$. 2. The value of Z (the slope of the regression) indicates the sensitivity of species richness to area. 3. For very large areas like entire continents, the slope Z is much steeper, ranging from 0.6 to 1.2. 4. For specific groups like frugivorous birds and mammals in tropical forests across different continents, the Z value is specifically observed to be 1.15. 5. Mapping the items:

- (i) Equation: $\log S = \log C + Z \log A$
- (ii) Frugivorous birds: 1.15
- (iii) Entire continents: 0.6 to 1.2

Final Answer: The correct match is (i)-Equation, (ii)-1.15, (iii)-0.6 to 1.2.

Answer: (A)

Q6.

Solution

Concept:

The Lac Operon is a classic model for gene regulation in prokaryotes (*E. coli*). It consists of structural genes (z, y, a) and regulatory elements. The regulatory gene 'i' produces a repressor protein. In the absence of an inducer (lactose), the repressor binds to the operator, blocking RNA polymerase. When lactose is present, it binds to the repressor, inactivating it and allowing transcription.

Solution:

1. The 'i' gene (inhibitor) constitutively synthesizes the repressor protein. 2. Under normal conditions, the repressor has a binding site for the operator and a binding site for the inducer (lactose/allolactose). 3. The question states a mutation occurs where the repressor **cannot bind** to the inducer. 4. This means that even if lactose is present in the medium, it cannot "pull" the repressor away from the operator. 5. Consequently, the repressor remains permanently bound to the operator region. 6. This blocks RNA polymerase from transcribing the structural genes indefinitely. 7. Thus, the operon remains in a "Switched Off" state regardless of the presence of the inducer.

Final Answer: The operon will be permanently Switched Off.

Answer: (B)

Q7.

Solution

Concept:

Recombination frequency is a measure of genetic linkage and is used to create genetic maps. The distance between genes on a chromosome is measured in centiMorgans (cM), where 1% recombination frequency equals 1 cM. By comparing the distances between three genes, we can determine their linear arrangement.

Solution:

1. We are given the following recombination frequencies (distances):
- Distance between A and B = 15 cM
- Distance between B and C = 10 cM
- Distance between A and C = 5 cM 2. To find the sequence, identify the two genes that are furthest apart. Here, A and B are furthest (15 cM). This suggests A and B are the flanking (end) genes. 3. Now, check if the distance between A-C (5 cM) and C-B (10 cM) adds up to the total distance A-B (15 cM). 4. Calculation: 5 cM (A to C) + 10 cM (C to B) = 15 cM. 5. This confirms that gene C is located between gene A and gene B. 6. Therefore, the linear sequence on the chromosome is A-C-B (or B-C-A).

Final Answer: The sequence of genes is A-C-B.

Answer: (B)

Q8.

Solution

Concept:

Transcription is the process of copying genetic information from one strand of DNA into RNA. A transcription unit in DNA is defined by three regions: a Promoter, a Structural gene, and a Terminator. RNA synthesis always proceeds in the $5' \rightarrow 3'$ direction.

Solution:

1. Because RNA polymerase can only catalyze polymerization in the $5' \rightarrow 3'$ direction, it must use a DNA template that runs in the opposite direction. 2. The DNA strand that serves as the template must have a polarity of $3' \rightarrow 5'$. 3. This strand is called the "Template Strand." 4. The other strand (which has the same sequence as the newly formed RNA, except for Thymine instead of Uracil) has a polarity of $5' \rightarrow 3'$ and is called the "Coding Strand." 5. In a standard diagram of a transcription unit, the template strand is identified by its $3' \rightarrow 5'$ orientation relative to the direction of transcription.

Final Answer: The polarity of the template strand is $3' \rightarrow 5'$.

Answer: (B)

Q9.

Solution

Concept:

The cardiac cycle involves the rhythmic contraction (systole) and relaxation (diastole) of the heart chambers. Heart sounds are produced by the closure of heart valves.

- The first sound ('Lubb') is caused by the closure of AV valves (tricuspid and bicuspid).
- The second sound ('Dub') is caused by the closure of semilunar valves.

Solution:

1. Let us evaluate the statements:

- (A) The Sino-atrial Node (SAN) is the pacemaker and generates $70 - 75$ action potentials per minute. (Correct)
- (B) The bicuspid (mitral) valve is located between the left atrium and left ventricle. (Correct)
- (C) One cardiac cycle takes 0.8 seconds. (Correct)
- (D) The second heart sound (Dub) is associated with the **closure** of the semilunar valves at the end of ventricular systole, not their opening. 2. When semilunar valves open, blood flows silently into the arteries. It is the sudden snapping shut to prevent backflow that creates the sound. 3. Therefore, statement (D) is incorrect.

Final Answer: Statement (D) is incorrect because 'Dub' is associated with the closure of semilunar valves.

Answer: (D)

Q10.

Solution

Concept:

A biogas plant (Gobar gas plant) utilizes anaerobic bacteria to break down organic waste (manure/slurry) into methane, carbon dioxide, and other gases. The main components are a concrete tank, a floating cover, and an outlet for the gas.

Solution:

1. The organic waste (slurry) is fed into the plant via a charge pit. 2. This slurry moves into a large central tank called the Digester. 3. The Digester is an airtight chamber where methanogens (*Methanobacterium*) carry out anaerobic fermentation. 4. This is the specific site where biogas is generated. 5. The produced gas collects in a gas holder (floating cover) which rises as gas accumulates. 6. The spent slurry is removed through another outlet to be used as fertilizer. 7. Therefore, the component where digestion and gas production occur is the Digester.

Final Answer: The component where anaerobic digestion takes place is the Digester.

Answer: (C)

Q11.

Solution

Concept:

Scientific nomenclature follows the Binomial system introduced by Carolus Linnaeus. According to the International Code for Botanical Nomenclature (ICBN), the scientific name of a species consists of two parts: the Genus and the Specific Epithet. Often, the name of the author who first described the species is appended at the end in an abbreviated form.

Solution:

1. In the scientific name *Mangifera indica* Linn., *Mangifera* represents the Genus.
2. *indica* represents the specific epithet.
3. 'Linn.' is the abbreviation for Linnaeus.
4. The presence of 'Linn.' indicates that this particular species was first described, named, and published by Carolus Linnaeus.
5. This author citation is written in Roman (upright) font, even though the biological name is written in Italics.

Final Answer: 'Linn' indicates that the species was first described by Linnaeus.

Answer: (B)

Q12.

Solution

Concept:

The taxonomic hierarchy consists of various levels: Kingdom, Phylum/Division, Class, Order, Family, Genus, and Species. As we move from Species to Kingdom (ascending order), the number of shared characteristics between the members of a category decreases, while the diversity increases.

Solution:

1. Species is the most specific category where organisms share the maximum number of common characteristics.
2. As we go higher in the hierarchy (Species → Genus → Family → Order → Class → Phylum → Kingdom), organisms become more diverse.
3. Kingdom is the highest and most inclusive category.
4. Therefore, members within a Kingdom (like Kingdom Animalia) share the fewest similar characters compared to members within a Family or Genus.
5. Among the given options, Kingdom represents the highest rank, thus containing organisms with the least number of similar characters.

Final Answer: The taxonomic category with the least number of similar characters is Kingdom.

Answer: (C)

Q13.

Solution

Concept:

Viroids are infectious agents that are even smaller than viruses. They were discovered by T.O. Diener in 1971. Unlike viruses, viroids lack a protein coat (capsid) and consist solely of a short strand of circular, single-stranded RNA.

Solution:

1. Let us examine the characteristics of Viroids:

- They lack the protein coat that is present in all viruses.
- Their RNA is of low molecular weight, not high.
- They are known to cause diseases such as Potato Spindle Tuber disease.

2. They were indeed discovered and named "viroid" by T.O. Diener.

3. Therefore, statement (C) is the only scientifically accurate description among the choices provided.

Final Answer: Viroids were discovered by T.O. Diener.

Answer: (C)

Q14.

Solution

Concept:

Plants exhibit different types of life cycles based on the alternation of generations between a haploid gametophyte (n) and a diploid sporophyte ($2n$).

- Haplontic: Gametophyte is dominant; zygote is the only diploid cell.
- Diplontic: Sporophyte is dominant; gametes are the only haploid cells.
- Haplo-diplontic: Both phases are multicellular and often free-living.

Solution:

1. In the Diplontic life cycle, the diploid sporophyte is the dominant, photosynthetic, and independent phase of the plant.
2. The haploid phase is represented only by the single to few-celled gametophyte.
3. This type of life cycle is characteristic of all seed-bearing plants, namely Gymnosperms and Angiosperms.
4. It is also found in certain algae like *Fucus*.
5. The description of a dominant sporophyte and highly reduced gametophyte corresponds perfectly to the Diplontic pattern.

Final Answer: The type of life cycle shown is Diplontic.

Answer: (B)

Q15.

Solution

Concept:

Fungi are classified based on the morphology of the mycelium, mode of spore formation, and fruiting bodies. The four main classes are Phycomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes. Deuteromycetes are famously known as "Fungi Imperfecti."

Solution:

1. Deuteromycetes are called "imperfect" because only their asexual or vegetative phases are known.
2. Once a sexual stage is discovered for a member of this group, it is usually moved to Ascomycetes or Basidiomycetes.
3. Common examples of Deuteromycetes include *Alternaria*, *Colletotrichum*, and *Trichoderma*.
4. *Ustilago* and *Agaricus* belong to Basidiomycetes, while *Albugo* belongs to Phycomycetes.
5. Therefore, *Alternaria* is the correct example of an imperfect fungus.

Final Answer: *Alternaria* is an example of an "imperfect fungus."

Answer: (B)

Q16.

Solution

Concept:

The animal kingdom is classified into different levels of organization based on the complexity of the body structure. These levels range from cellular (aggregates of cells) to tissue, organ, and organ system levels.

Solution:

1. Let us analyze the provided examples:

- *Spongilla* (Sponge): Belongs to Phylum Porifera. These exhibit a cellular level of organization, not tissue level.
- *Hydra*: Belongs to Phylum Coelenterata. These exhibit a tissue level of organization, not just cellular.
- *Fasciola* (Liver fluke): Belongs to Phylum Platyhelminthes. These are the first to exhibit an organ level of organization.
- *Pheretima* (Earthworm): Belongs to Phylum Annelida. These exhibit a complete organ system level of organization. 2. Comparing the options, *Fasciola* correctly matches the "Organ level" of organization described in taxonomic standards.

Final Answer: The correct match is *Fasciola* - Organ level.

Answer: (C)

Q17.

Solution

Concept:

Algae are classified into three main classes based on their pigments and stored food: Chlorophyceae (Green), Phaeophyceae (Brown), and Rhodophyceae (Red). Each class has a unique chemical structure for its storage starch.

Solution:

1. Rhodophyceae (Red algae) store food in the form of Floridean starch.
2. Chemically, Floridean starch is a complex carbohydrate.
3. Scientific analysis shows that its branched structure is very similar to the structure of amylopectin and glycogen found in animals.
4. Amylopectin is a branched component of starch, and glycogen is the storage polysaccharide in animals and fungi.
5. This similarity is a significant biochemical characteristic of Red Algae.

Final Answer: Floridean starch is structurally similar to amylopectin and glycogen.

Answer: (A)

Q18.

Solution

Concept:

The water vascular system is a unique and specialized system of canals used for locomotion, food and waste transportation, and respiration. It is a defining anatomical feature of a specific phylum in the animal kingdom.

Solution:

1. Let us distinguish between two often confused systems:

- Canal System (Water Transport System): Found in Phylum Porifera (Sponges).
- Water Vascular System (Ambulacral System): Found in Phylum Echinodermata. 2. In Echinoderms like starfish and sea urchins, this system operates through hydraulic pressure, powering the tube feet. 3. Phylum Mollusca and Coelenterata do not possess such a system. 4. Therefore, the water vascular system is the diagnostic characteristic of Echinodermata.

Final Answer: The water vascular system is a characteristic feature of Echinodermata.

Answer: (B)

Q19.

Solution

Concept:

Simple epithelium consists of a single layer of cells and is classified based on cell shape. Columnar epithelium consists of tall and slender cells with nuclei usually located at the base. Its primary functions are secretion and absorption.

Solution:

1. Columnar epithelium is specifically adapted for surfaces where high levels of absorption and secretion occur.
2. It forms the inner lining of the stomach and the small and large intestines.
3. In the intestine, the free surface of these cells may have microvilli to increase the surface area for absorption.
4. Squamous epithelium is found in air sacs of lungs, while cuboidal is found in ducts of glands and nephrons.
5. Based on the location mentioned (stomach and intestine), the tissue is columnar.

Final Answer: The type of simple epithelium is Columnar.

Answer: (C)

Q20.

Solution

Concept:

The vascular cambium is the meristematic tissue responsible for the secondary growth (increase in girth) of plants. Its origin can be primary (present from the start) or secondary (derived from permanent tissues later).

Solution:

1. In dicot stems, the vascular cambium is partly primary (intrafascicular cambium) and partly secondary (interfascicular cambium).
2. However, in dicot roots, the vascular cambium is completely secondary in origin.
3. It originates from the tissue located just below the phloem bundles and a portion of pericycle tissue above the protoxylem.
4. These tissues are initially permanent but become meristematic later in the life of the root to initiate secondary thickening.
5. Therefore, the cambium in a dicot root is entirely secondary.

Final Answer: In a dicot root, the vascular cambium is completely secondary in origin.

Answer: (B)

Q21.

Solution

Concept:

The mouthparts of a cockroach (*Periplaneta americana*) are of the biting and chewing type. They consist of a labrum (upper lip), a pair of mandibles, a pair of maxillae, a labium (lower lip), and a median flexible lobe acting as a tongue, known as the hypopharynx.

Solution:

1. Let us verify the functions and positions of each part:

- Labrum: Acts as the upper lip.
- Labium: Acts as the lower lip.
- Mandibles: Located on the sides, they have incisor (cutting) and molar (grinding) regions to crush food.
- Maxillae: Help in picking up and feeding the food to the mandibles.
- Hypopharynx: Acts as the tongue, situated within the cavity enclosed by the mouthparts. 2. Comparing the options:
- Option (A) incorrectly identifies Labrum as the lower lip.
- Option (B) incorrectly identifies Labium as the upper lip.
- Option (C) correctly states that Mandibles possess a grinding region.
- Option (D) incorrectly relates Hypopharynx solely to the mandible.

Final Answer: The correct statement is Mandibles - Grinding region.

Answer: (C)

Q22.

Solution

Concept:

Bulliform cells, also known as motor cells, are large, bubble-shaped epidermal cells that occur in groups on the upper surface of the leaves of many monocots. They play a vital role in the rolling and unrolling of leaves to control water loss.

Solution:

1. Bulliform cells are a characteristic feature of monocot leaves, particularly grasses.
2. When these cells are turgid (full of water), the leaf surface is exposed and flat.
3. When the plant faces water stress, these cells lose turgidity and become flaccid.
4. This causes the leaves to roll inwards to minimize the exposed surface area, thereby reducing transpiration.
5. These cells are not found in dicot leaves, stems, or roots.

Final Answer: Bulliform cells are found in Grasses (Monocot leaves).

Answer: (B)

Q23.

Solution

Concept:

In old trees, the greater part of secondary xylem is dark brown due to the deposition of organic compounds like tannins, resins, oils, gums, and aromatic substances. This region is called Heartwood (Duramen), while the outer, lighter region is called Sapwood (Alburnum).

Solution:

1. Heartwood is the central, non-functional part of the secondary xylem.
2. Because of the deposition of various organic substances, the vessels of heartwood are blocked by tyloses, making them highly durable and resistant to microbes.
3. Consequently, heartwood does not conduct water or minerals; its primary function is to provide mechanical support.
4. Sapwood, on the other hand, is the peripheral region that remains functional and is responsible for the conduction of water and minerals from roots to leaves.
5. Therefore, the main functional difference is that heartwood consists of non-functional xylem.

Final Answer: Heartwood differs from sapwood in having non-functional xylem.

Answer: (B)

Q24.

Solution

Concept:

The Cell Theory was initially formulated by Schleiden and Schwann. However, they did not explain how new cells were formed. This gap was filled by Rudolf Virchow in 1855, who expanded the theory with a crucial biological principle.

Solution:

1. Rudolf Virchow was the first to explain that cells divide and new cells are formed from pre-existing cells.
2. He phrased this concept in Latin as: *"Omnis cellula-e cellula"*.
3. This statement became one of the two fundamental pillars of the modern cell theory.
4. Aristotle was a Greek philosopher, and Schleiden/Schwann focused on the composition of plants and animals but missed the origin of new cells.

Final Answer: The concept "Omnis cellula-e cellula" was proposed by Rudolf Virchow.

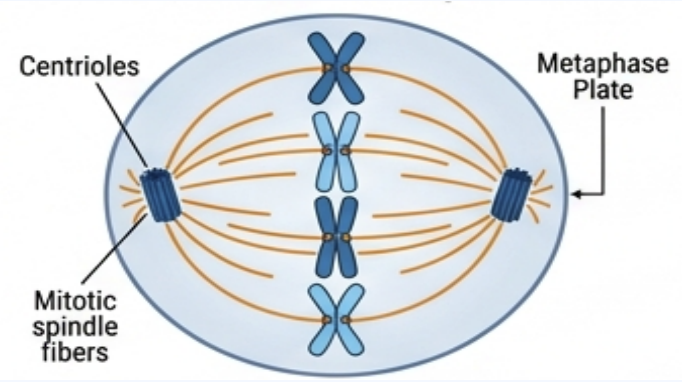
Answer: (B)

Q25.

Solution

Concept:

Mitosis is divided into four main stages: Prophase, Metaphase, Anaphase, and Telophase. Each stage involves specific movements of chromosomes guided by the spindle apparatus.



Solution:

1. During Prophase, chromosomal material condenses and the nuclear envelope disappears.
2. During Metaphase, the spindle fibers attach to the kinetochores of the chromosomes.
3. The chromosomes are then pulled to the center of the cell.
4. They align themselves along a plane called the "metaphase plate" or the "spindle equator."
5. This alignment is the defining characteristic of Metaphase, ensuring that each daughter cell will receive an equal number of chromosomes.

Final Answer: The stage described is Metaphase.

Answer: (B)

Q26.

Solution

Concept:

Ribosomes are granular structures first observed under the electron microscope as dense particles by George Palade (1953). They are composed of ribonucleic acid (RNA) and proteins and are not surrounded by any membrane. They are found in both prokaryotic (70S) and eukaryotic (80S) cells.

Solution:

1. Ribosomes serve as the primary site for biological protein synthesis (translation).
2. They facilitate the joining of amino acids in a specific sequence dictated by the messenger RNA (mRNA).
3. Because of their central role in the assembly of polypeptides, they are universally referred to as the "Protein Factories" of the cell.
4. Lysosomes are involved in digestion (suicidal bags), Vacuoles in storage, and Golgi bodies in packaging and secretion.
5. Therefore, the ribosome is the organelle responsible for protein production.

Final Answer: The "Protein Factory" of the cell is the Ribosome.

Answer: (B)

Q27.

Solution

Concept:

Meiosis is a specialized form of cell division that reduces the chromosome number by half. Prophase I of Meiosis I is particularly complex and includes the critical process of "crossing over," which leads to genetic variation.

Solution:

1. Crossing over is the exchange of genetic material between non-sister chromatids of homologous chromosomes.
2. This process is mediated by an enzyme called recombinase.
3. It occurs during the Pachytene stage of Prophase I.
4. Prior to this, in Zygotene, the chromosomes pair up (synapsis).
5. After Pachytene, the chromosomes begin to separate in Diplotene, making the chiasmata visible.
6. Thus, Pachytene is the specific stage dedicated to genetic recombination.

Final Answer: Crossing over occurs during the Pachytene stage.

Answer: (C)

Q28.

Solution

Concept:

Plants and animals produce a wide variety of chemical compounds. Primary metabolites (like sugars and amino acids) have identifiable functions in physiological processes. Secondary metabolites are compounds that do not have direct roles in growth or development but are often used for defense or ecological interactions.

Solution:

1. Secondary metabolites are classified into various groups:
- Alkaloids: Morphine, Codeine.
- Toxins: Ricin, Abrin.
- Lectins: Concanavalin A.
- Drugs: Vinblastine, Curcumin. 2. Ricin (extracted from castor beans) and Abrin (from Jequirity seeds) are extremely potent protein-inhibiting toxins. 3. They are specifically categorized under the "Toxins" group of secondary metabolites. 4. Therefore, Ricin and Abrin are Toxins.

Final Answer: Ricin and Abrin are Toxins.

Answer: (B)

Q29.

Solution

Concept:

The S phase (Synthesis phase) of the interphase is the period during which DNA content doubles. However, it is a crucial rule of biology that the chromosome number remains unchanged during this replication process in a typical mitotic cycle.

Solution:

1. In the G_1 phase, the cell has 24 chromosomes.
2. During the S phase, DNA replication occurs. While the amount of DNA doubles (from $2C$ to $4C$), the chromosomes merely form an identical sister chromatid attached at the same centromere.
3. Since the number of chromosomes is determined by the number of centromeres, the count remains 24.
4. The separation of these chromatids into individual chromosomes only happens later during the Anaphase of the M phase.
5. Therefore, even after the S phase, the chromosome number remains 24.

Final Answer: The chromosome number remains 24.

Answer: (B)

Q30.

Solution

Concept:

The "Fluid Mosaic Model" proposed by Singer and Nicolson (1972) describes the structure of the plasma membrane. The "fluidity" of the membrane refers to the ability of proteins and lipids to move laterally within the bilayer.

Solution:

1. The quasi-fluid nature of lipids enables the lateral movement of proteins within the overall bilayer.

2. This fluidity is essential for several vital cellular functions, including:

- Cell growth and formation of intercellular junctions.
- Secretion of substances.
- Endocytosis (engulfing food or foreign particles).
- Cell division. 3. Without a fluid membrane, the cell would be a rigid structure unable to perform these dynamic physiological processes. 4. Thus, all the given options are facilitated by the fluid nature of the membrane.

Final Answer: The fluid nature is important for all of these (Cell growth, Secretion, Endocytosis).

Answer: (D)

Q31.

Solution

Concept:

The endomembrane system includes those organelles whose functions are coordinated and integrated. These include the Endoplasmic Reticulum (ER), Golgi complex, Lysosomes, and Vacuoles. Organelles like Mitochondria, Chloroplasts, and Peroxisomes are not considered part of the endomembrane system because their functions are not coordinated with the former.

Solution:

1. The endomembrane system works as a functional unit for the synthesis, packaging, and distribution of cellular materials.

2. Mitochondria and Chloroplasts are semi-autonomous organelles with their own DNA and ribosomes.

3. Their activities and metabolic pathways (like ATP production and photosynthesis) are independent of the ER-Golgi-Lysosome pathway.

4. Therefore, while Mitochondria are vital to the cell, they do not belong to the endomembrane system.

Final Answer: Mitochondria is not a part of the endomembrane system.

Answer: (C)

Q32.

Solution

Concept:

Polysaccharides are long chains of sugars. Some are homopolymers (made of one type of monosaccharide), while others are heteropolymers. Chitin is a complex polysaccharide found in the exoskeletons of arthropods and the cell walls of fungi.

Solution:

1. Chitin is the second most abundant polysaccharide in nature after cellulose.
2. It is a homopolymer of a modified sugar called N-acetyl glucosamine (NAG).
3. The individual units of N-acetyl glucosamine are linked by $\beta - 1, 4$-glycosidic bonds.
4. Unlike glycogen or starch which are polymers of glucose, chitin's nitrogen-containing monomer gives it high structural strength and resistance to decay.

Final Answer: Chitin is a polymer of N-acetyl glucosamine.

Answer: (A)

Q33.

Solution

Concept:

Cell organelles and structures vary significantly between prokaryotic and eukaryotic cells, and even between different types of eukaryotes (plants vs. animals). Vacuoles, in particular, show distinct differences in size and function.

Solution:

1. Let us analyze the pairs:

- Gas vacuoles: Found in certain prokaryotes like blue-green and purple/green photosynthetic bacteria to provide buoyancy. (Correct)
- Large central vacuoles: These are the defining feature of plant cells, occupying up to 90% of the cell volume. Animal cells generally have very small, temporary vacuoles or none at all. (Mismatch)
- Protists: These are single-celled eukaryotes. (Correct)
- Methanogens: These are a group of Archaebacteria, which are prokaryotic. (Correct) 2. Therefore, the statement pairing large central vacuoles with animal cells is a mismatch.

Final Answer: Large central vacuoles - Animal cells is the mismatch.

Answer: (B)

Q34.

Solution

Concept:

The opening and closing of stomata is a turgor-operated mechanism. Stomata are pores surrounded by two specialized epidermal cells called guard cells. In dicots, these are bean-shaped; in monocots (grasses), they are dumbbell-shaped.

Solution:

1. The inner wall of guard cells (towards the pore) is thick and elastic, while the outer wall is thin.
2. When water enters the guard cells from surrounding epidermal cells, the turgor pressure inside the guard cells increases.
3. This causes the thin outer walls to bulge outwards, forcing the thick inner walls into a crescent or kidney shape.
4. This movement pulls the stomatal aperture open.
5. Conversely, when guard cells lose water and turgor pressure drops, the elastic inner walls regain their original shape, closing the pore.

Final Answer: Stomata open when the turgor pressure of guard cells increases.

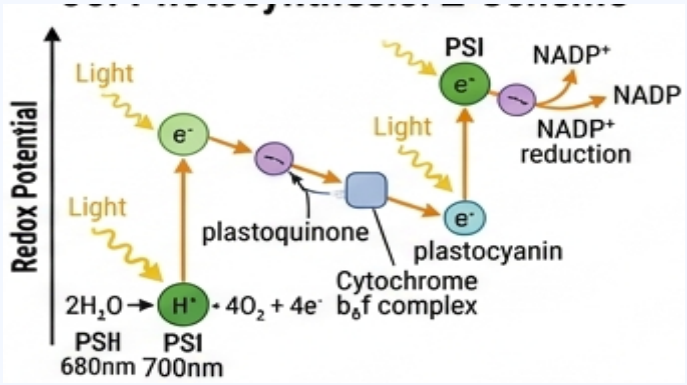
Answer: (B)

Q35.

Solution

Concept:

The Z-scheme of light reaction describes the flow of electrons during non-cyclic photophosphorylation. Electrons move from Photosystem II (PS-II) to Photosystem I (PS-I) through a series of electron carriers located in the thylakoid membrane.



Solution:

1. When PS-II absorbs light, electrons are excited and picked up by a primary electron acceptor.
2. These electrons are then passed down an Electron Transport System (ETS) consisting of cytochromes.
3. Specifically, the electrons move from PS-II $\rightarrow$ Plastoquinone $\rightarrow$ Cytochrome b_6f complex $\rightarrow$ Plastocyanin $\rightarrow$ PS-I.
4. Plastocyanin is a small, water-soluble, copper-containing protein that acts as a mobile electron carrier on the inner surface of the thylakoid membrane.
5. It is the final link that transfers the electron directly to the reaction center of PS-I (P_{700}).

Final Answer: The molecule 'X' that transfers electrons to PS-I is Plastocyanin.

Answer: (B)

Q36.

Solution

Concept:

The photolysis of water (water splitting) is a crucial step in the light-dependent reactions of photosynthesis. It occurs on the inner side of the thylakoid membrane and provides electrons to Photosystem II (PS-II) to replace those lost during excitation.

Solution:

1. The reaction for water splitting is: $2H_2O \rightarrow 4H^+ + O_2 + 4e^-$.
2. This process is catalyzed by the Oxygen Evolving Complex (OEC).
3. Certain inorganic mineral ions act as essential cofactors for this enzyme complex.
4. Manganese (Mn^{2+}) is the primary element involved, as it can exist in multiple oxidation states to facilitate the removal of electrons from water.
5. Chlorine (Cl^-) and Calcium (Ca^{2+}) also play supportive roles in this process.
6. Therefore, Manganese is the key element required for the photolysis of water.

Final Answer: The element required for the photolysis of water is Mn (Manganese).

Answer: (B)

Q37.

Solution

Concept:

Photosynthesis in higher plants involves the fixation of CO_2. Depending on the first stable product formed, plants are classified as C_3 (3-phosphoglyceric acid) or C_4 (oxaloacetic acid) plants. The fixation process requires a specific acceptor molecule and an enzyme.

Solution:

1. In C_3 plants (like wheat and rice), the primary carboxylation reaction occurs in the mesophyll cells.
2. The CO_2 acceptor is a 5-carbon ketose sugar called Ribulose 1,5-bisphosphate (RuBP).
3. This reaction is catalyzed by the enzyme RuBisCO.
4. The combination of 1 molecule of CO_2 and 1 molecule of RuBP results in two molecules of 3-PGA (3-carbon).
5. In C_4 plants, the acceptor is Phosphoenolpyruvate (PEP), which is a 3-carbon molecule.

Final Answer: The primary CO_2 acceptor in C_3 plants is RuBP.

Answer: (B)

Q38.

Solution

Concept:

The Respiratory Quotient (RQ) is the ratio of the volume of CO_2 evolved to the volume of O_2 consumed during respiration. The value of RQ depends on the type of respiratory substrate being oxidized.

- Carbohydrates: $RQ = 1.0$
- Fats: $RQ < 1.0$
- Proteins: $RQ \approx 0.9$

Solution:

1. Tripalmitin is a common fatty acid (fat).
2. The balanced chemical equation for the oxidation of Tripalmitin is:

$2(C_{51}H_{98}O_6) + 145O_2 \rightarrow 102CO_2 + 98H_2O + \text{Energy}$

3. Calculation: $RQ = \frac{\text{Volume of } CO_2}{\text{Volume of } O_2} = \frac{102}{145} = 0.703.$
4. Since fats are relatively oxygen-poor compared to carbohydrates, they require more external oxygen for complete oxidation, leading to an RQ value less than 1.

Final Answer: The Respiratory Quotient (RQ) of Tripalmitin is 0.7.

Answer: (C)

Q39.

Solution

Concept:

Plant growth regulators (hormones) control various physiological processes. Gibberellins (GA) are a group of hormones known for their ability to cause stem elongation and influence developmental transitions.

Solution:

1. "Bolting" is the sudden elongation of internodes just prior to flowering in plants with a rosette habit (e.g., cabbage, beet).
2. Under normal conditions, these plants have shortened internodes and leaves clustered together.
3. Application of Gibberellic acid (GA_3) induces rapid cell division and elongation in the sub-apical meristem.
4. This results in a tall flowering stalk, a process essential for seed production in these species.
5. Auxins are involved in apical dominance, while Ethylene is primarily for fruit ripening.

Final Answer: The hormone that promotes bolting is Gibberellin.

Answer: (C)

Q40.

Solution

Concept:

Photorespiration (C_2 cycle) is a wasteful process where the enzyme RuBisCO binds with O_2 instead of CO_2. This process does not produce ATP or NADPH and leads to a loss of fixed carbon.

Solution:

1. Photorespiration occurs when CO_2 levels are low and O_2 levels are high, usually in high-temperature environments.
2. C_3 plants lack a mechanism to concentrate CO_2 at the enzyme site, making them highly susceptible to photorespiration.
3. C_4 plants have evolved a specialized anatomy (Kranz anatomy) and a CO_2 pump (PEP carboxylase) that ensures RuBisCO is always surrounded by high CO_2, thus avoiding photorespiration.
4. CAM plants also avoid this process by temporal separation of CO_2 fixation.
5. Therefore, photorespiration is a distinct characteristic of C_3 plants.

Final Answer: Photorespiration is a characteristic of C_3 plants.

Answer: (C)

Q41.

Solution

Concept:

Glycolysis (EMP pathway) occurs in the cytoplasm and involves the partial oxidation of one molecule of glucose into two molecules of pyruvic acid. During this process, energy is both consumed and generated in the form of ATP and NADH.

Solution:

1. In the preparatory phase of Glycolysis, 2 molecules of ATP are consumed (during the phosphorylation of glucose and fructose-6-phosphate).
2. In the pay-off phase, 4 molecules of ATP are produced directly through substrate-level phosphorylation.
3. Calculation of Net Gain:

Total ATP produced (4) − Total ATP consumed (2) = 2 ATP.

4. Additionally, 2 molecules of $NADH + H^+$ are produced, which can yield more ATP via the electron transport chain, but the direct net gain of ATP molecules remains 2.

Final Answer: The net gain of ATP in Glycolysis is 2.

Answer: (A)

Q42.

Solution

Concept:

Pulmonary volumes are the quantities of air that a person can breathe in, out, or retain in the lungs under different conditions. Tidal Volume (TV) is the most basic measure of ventilation.

Solution:

1. Tidal Volume is defined as the volume of air inspired or expired during a normal, effortless breath.
2. In a healthy adult human, this volume is approximately 500 mL per breath.
3. This means a healthy person can inspire or expire approximately 6000 to 8000 mL of air per minute (calculating 500 mL $\times 12 - 16$ breaths/minute).
4. Higher volumes like 1000 mL or 2500 mL correspond to Inspiratory or Expiratory Reserve Volumes.

Final Answer: Tidal Volume in a healthy human is approximately 500 mL.

Answer: (B)

Q43.

Solution

Concept:

The Nephron is the functional unit of the kidney. Different segments of the nephron (Proximal Convoluted Tubule, Loop of Henle, Distal Convoluted Tubule) are specialized for the reabsorption of specific substances and the maintenance of ionic balance.

Solution:

1. The Proximal Convoluted Tubule (PCT) is lined by simple cuboidal brush border epithelium which increases the surface area for reabsorption.
2. Nearly all of the essential nutrients, and $70 - 80\%$ of electrolytes and water, are reabsorbed by this segment.
3. The Loop of Henle is primarily involved in maintaining high osmolarity of medullary interstitial fluid, while the DCT is involved in conditional reabsorption of sodium and water.
4. Therefore, the PCT is the site of maximum reabsorption.

Final Answer: Maximum reabsorption takes place in the PCT.

Answer: (B)

Q44.

Solution

Concept:

Hormones released during acute stress prepare the body for "fight or flight" responses. These hormones are secreted by the adrenal medulla in response to signals from the sympathetic nervous system.

Solution:

1. Adrenaline (Epinephrine) and Noradrenaline (Norepinephrine) are rapidly secreted during emergency situations.
2. These hormones increase alertness, pupilary dilation, piloerection (raising of hairs), and sweating.
3. Most importantly, they increase the heart rate, the strength of heart contraction, and the rate of respiration.
4. They also stimulate the breakdown of glycogen, resulting in an increased concentration of glucose in the blood.
5. Due to these immediate life-saving responses, Adrenaline is called the Emergency Hormone.

Final Answer: Adrenaline is known as the "Emergency Hormone."

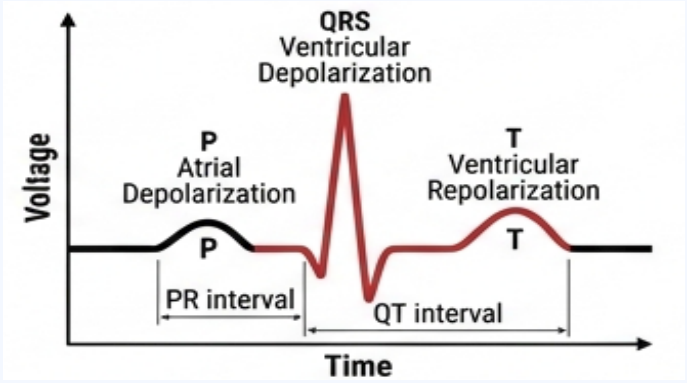
Answer: (C)

Q45.

Solution

Concept:

An Electrocardiogram (ECG) is a graphical representation of the electrical activity of the heart during a cardiac cycle. A standard ECG consists of a P-wave, a QRS complex, and a T-wave.



Solution:

1. P-wave: Represents the electrical excitation (or depolarization) of the atria, which leads to atrial contraction.
2. QRS complex: Represents the depolarization of the ventricles, which initiates the ventricular contraction. The contraction starts shortly after Q and marks the beginning of the systole.
3. T-wave: Represents the return of the ventricles from excited to normal state (repolarization).
4. By counting the number of QRS complexes that occur in a given time period, one can determine the heart rate of an individual.

Final Answer: The "QRS complex" represents Ventricular depolarization.

Answer: (B)

Q46.

Solution

Concept:

Bone health is maintained by a delicate balance between bone formation by osteoblasts and bone resorption by osteoclasts. This balance is heavily influenced by hormonal levels, particularly in aging individuals.

Solution:

1. Osteoporosis is an age-related systemic skeletal disorder characterized by low bone mass and micro-architectural deterioration of bone tissue.
2. It leads to increased bone fragility and a consequent increase in fracture risk.
3. In post-menopausal women, the level of Estrogen drops significantly.
4. Estrogen plays a protective role in maintaining bone density by inhibiting bone resorption.
5. Therefore, a common cause of osteoporosis is decreased levels of estrogen.
6. Uric acid accumulation leads to Gout, not osteoporosis.

Final Answer: Osteoporosis is caused by Low Estrogen.

Answer: (B)

Q47.

Solution

Concept:

The human body has 12 pairs of cranial nerves that emerge directly from the brain. Each pair has a specific function: sensory, motor, or mixed.

Solution:

1. The nerves are categorized by their primary function:

- Optic nerve (II): Responsible for vision.
- Olfactory nerve (I): Responsible for the sense of smell.
- Auditory nerve (VIII): Also known as the Vestibulocochlear nerve; it is responsible for hearing and equilibrium.
- Vagus nerve (X): Responsible for various autonomic functions in the thoracic and abdominal cavities. 2. The auditory nerve carries electrical impulses from the cochlea (inner ear) to the brain's auditory cortex. 3. Therefore, the VIIIth cranial nerve is the one responsible for hearing.

Final Answer: The Auditory nerve is responsible for hearing.

Answer: (B)

Q48.

Solution

Concept:

Muscle contraction is initiated by a signal sent by the central nervous system (CNS) via a motor neuron. The communication between the nervous system and the skeletal muscle occurs at a specialized synapse.

Solution:

1. A motor neuron along with the muscle fibers it innervates constitutes a motor unit.
2. The specific point of contact where the axon terminal of a motor neuron meets the sarcolemma (plasma membrane) of a muscle fiber is the Neuromuscular Junction (NMJ) or motor-end plate.
3. When a nerve impulse reaches this junction, a neurotransmitter (Acetylcholine) is released.
4. This generates an action potential in the sarcolemma, which ultimately leads to the release of calcium ions and muscle contraction.
5. A general "synapse" occurs between two neurons, whereas the NMJ is specific to muscle interaction.

Final Answer: The junction is called the Neuromuscular junction.

Answer: (B)

Q49.

Solution

Concept:

The liver secretes bile, which is stored and concentrated in the gallbladder. Bile plays a significant role in the digestion and emulsification of fats. It contains several organic and inorganic substances but lacks digestive enzymes.

Solution:

1. Bile consists of bile salts, cholesterol, phospholipids, and bile pigments.
2. The primary bile pigments are Bilirubin (yellow) and Biliverdin (green).
3. These pigments are metabolic breakdown products of hemoglobin from aged or damaged red blood cells.
4. They are excreted from the body via the digestive tract, giving feces its characteristic color.
5. Saliva, pancreatic juice, and intestinal juice do not contain these waste pigments.

Final Answer: Bilirubin and Biliverdin are found in Bile.

Answer: (C)

Q50.

Solution

Concept:

Water balance in the body is regulated by the kidneys under the influence of the Hypothalamus. The posterior pituitary releases hormones that act on the kidney tubules to prevent excessive water loss.

Solution:

1. Antidiuretic Hormone (ADH), also known as Vasopressin, facilitates water reabsorption from the distal parts of the kidney tubules (DCT and Collecting Duct).
2. If there is a deficiency of ADH or the kidneys fail to respond to it, the body cannot reabsorb water effectively.
3. This leads to the excretion of large volumes of dilute urine and persistent thirst.
4. This clinical condition is known as Diabetes Insipidus.
5. Note that Diabetes Mellitus is related to Insulin deficiency and blood sugar levels, which is a different disorder.

Final Answer: Diabetes Insipidus is caused by the deficiency of ADH.

Answer: (B)

Q51.

Solution

Concept:

The Pancreas is a composite gland that acts as both an exocrine and an endocrine gland. The endocrine part consists of "Islets of Langerhans." There are about 1 to 2 million Islets of Langerhans in a normal human pancreas, representing only 1 to 2 percent of the pancreatic tissue.

Solution:

1. The two main types of cells in the Islet of Langerhans are α-cells and β-cells.
2. α-cells (Alpha cells) are responsible for secreting the hormone Glucagon.
3. Glucagon is a hyperglycemic hormone; it increases blood glucose levels by stimulating glycogenolysis and gluconeogenesis in the liver.
4. β-cells (Beta cells) secrete Insulin, which lowers blood glucose levels.
5. δ-cells (Delta cells) secrete Somatostatin, which inhibits the release of both insulin and glucagon.

Final Answer: The α cells of the Pancreas secrete Glucagon.

Answer: (A)

Q52.

Solution

Concept:

The resting membrane potential of a neuron is maintained by the differential distribution of ions across the axolemma. This state of polarization is not static but is actively managed by membrane proteins.

Solution:

1. The axonal membrane is more permeable to potassium ions (K^+) and nearly impermeable to sodium ions (Na^+) at rest.
2. To maintain this concentration gradient, the cell uses the Sodium-Potassium (Na^+-K^+) Pump.
3. This pump is an active transport mechanism that uses ATP to transport 3 Na^+ ions outwards for every 2 K^+ ions brought into the cell.
4. This electrogenic pump ensures that the inside of the neuron remains negatively charged relative to the outside, maintaining the resting potential.
5. Passive diffusion and osmosis do not maintain specific ionic gradients against their concentration profiles.

Final Answer: The ionic gradient is maintained by the Na-K pump.

Answer: (A)

Q53.

Solution

Concept:

The middle ear is an air-filled cavity that contains three tiny interconnected bones called ear ossicles. Their primary function is to increase the efficiency of transmission of sound waves to the inner ear.

Solution:

1. The three ear ossicles are:

- Malleus (Hammer-shaped): Attached to the tympanic membrane (eardrum).
- Incus (Anvil-shaped): The middle bone.
- Stapes (Stirrup-shaped): Attached to the oval window of the cochlea. 2. The Stapes is the smallest bone in the human body. 3. Cochlea is a part of the inner ear, while Utricle and Saccule are parts of the vestibular apparatus responsible for balance. 4. Therefore, the third bone in the sequence is the Stapes.

Final Answer: The third bone is the Stapes.

Answer: (B)

Q54.

Solution

Concept:

Respiratory disorders can be acute or chronic, often caused by environmental factors or lifestyle habits. Emphysema is a condition where the alveolar walls are damaged, leading to a permanent decrease in the respiratory surface area.

Solution:

1. Emphysema is primarily a result of long-term exposure to irritants.
2. Cigarette smoking is the major cause of this disorder as it triggers the release of enzymes that break down the elastic fibers in the lungs.
3. As the alveolar walls break down, the air sacs lose their shape, and air becomes trapped in the lungs, making it difficult to exhale.
4. Coal dust usually causes Occupational Respiratory Disorders like Silicosis or Asbestosis.
5. High altitude leads to altitude sickness due to low pO_2, but does not directly cause emphysema.

Final Answer: Emphysema is caused mainly by Cigarette smoking.

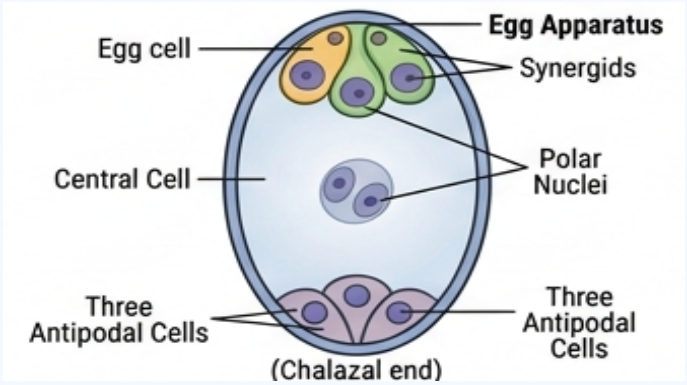
Answer: (B)

Q55.

Solution

Concept:

The female gametophyte of angiosperms is called the embryo sac. It develops within the ovule through the process of megasporogenesis and megagametogenesis. The most common type is the monosporic, Polygonum-type embryo sac.



Solution:

1. A typical mature embryo sac of angiosperms is 7-celled but 8-nucleated.
2. The distribution of nuclei is as follows:

- 3 nuclei at the micropylar end (within the Egg apparatus: 2 synergids + 1 egg cell).
- 3 nuclei at the chalazal end (within the 3 antipodal cells).
- 2 nuclei in the large central cell (called polar nuclei). 3. Although there are only 7 cells (because the polar nuclei share one central cell), the total number of individual nuclei is 8.

Final Answer: In a typical embryo sac, the number of nuclei is 8.

Answer: (A)

Q56.

Solution

Concept:

During pregnancy, the developing embryo requires a constant supply of nutrients and oxygen, as well as a mechanism to remove metabolic wastes and carbon dioxide. This exchange is facilitated by a specialized tissue that connects the fetus to the mother.

Solution:

1. After implantation, finger-like projections called chorionic villi appear on the trophoblast.
2. These villi are surrounded by the uterine tissue and maternal blood.
3. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between the developing embryo (fetus) and maternal body.
4. This unit is called the Placenta.
5. The placenta also acts as an endocrine tissue, producing hormones like hCG, hPL, estrogens, and progesterones.
6. The umbilical cord connects the placenta to the embryo, but the placenta itself is the interface unit.

Final Answer: The structural and functional unit is the Placenta.

Answer: (B)

Q57.

Solution

Concept:

Spermatozoa, though morphologically mature when they leave the testes, are not immediately capable of fertilizing an ovum. They must undergo a series of physiological changes while traveling through the female reproductive tract.

Solution:

1. Capacitation is the final stage of sperm maturation that occurs after ejaculation.
2. This process takes place in the female reproductive tract (specifically in the uterus and fallopian tubes).
3. During capacitation, the cholesterol cover on the sperm head is removed, and the membrane becomes more permeable to calcium ions.
4. This increases sperm motility (hyperactivation) and prepares the acrosome for the release of enzymes necessary to penetrate the egg's layers.
5. Sperm in the epididymis or vas deferens are mature but not yet "capacitated."

Final Answer: Capacitation occurs in the Female reproductive tract.

Answer: (C)

Q58.

Solution

Concept:

Double fertilization is a unique characteristic of angiosperms. It involves two fusion events: syngamy (fusion of egg and male gamete) and triple fusion (fusion of the second male gamete with polar nuclei).

Solution:

1. Syngamy results in the formation of a diploid Zygote ($2n$).
2. Triple fusion involves the fusion of one haploid male gamete (n) with the two haploid polar nuclei ($n + n$) or the diploid secondary nucleus ($2n$) located in the central cell.
3. This results in the formation of the Primary Endosperm Nucleus (PEN).
4. Because three haploid nuclei are involved in the fusion, the resulting endosperm tissue is Triploid ($3n$).
5. This tissue provides nourishment to the developing embryo.

Final Answer: The ploidy of the Endosperm in angiosperms is 3n.

Answer: (C)

Q59.

Solution

Concept:

The menstrual cycle is regulated by the complex interplay of pituitary hormones (FSH, LH) and ovarian hormones (Estrogen, Progesterone). Each phase of the cycle corresponds to the rise or fall of these specific chemicals.

Solution:

1. After ovulation, the ruptured Graafian follicle transforms into the Corpus Luteum.
2. The Corpus Luteum secretes large amounts of Progesterone, which is essential for maintaining the endometrium (lining of the uterus).
3. In the absence of fertilization, the Corpus Luteum degenerates, leading to a sharp decline in Progesterone levels.
4. The withdrawal of Progesterone causes the disintegration of the endometrium.
5. This breakdown leads to menstruation, marking the start of a new cycle.

Final Answer: The immediate cause of menstruation is the withdrawal of Progesterone.

Answer: (C)

Q60.

Solution

Concept:

Family planning and reproductive health initiatives in India have led to the development of various contraceptive methods. Scientists in India aimed to create an effective, non-steroidal oral contraceptive with minimal side effects.

Solution:

1. Saheli is a "once-a-week" oral contraceptive pill.
2. It is unique because it is non-steroidal (contains Centchroman) and has very few side effects compared to traditional hormonal pills.
3. It was developed by scientists at the Central Drug Research Institute (CDRI).
4. CDRI is located in Lucknow, India.
5. AIIMS (medical institute) and IARI (agricultural institute) were not the primary developers of this specific contraceptive.

Final Answer: Saheli was developed at CDRI.

Answer: (B)

Q61.

Solution

Concept:

Gametogenesis is the biological process by which diploid or haploid precursor cells undergo cell division and differentiation to form mature haploid gametes. In females, this specific process is highly regulated and begins even before birth.

Solution:

1. The formation of gametes in males is called spermatogenesis, which leads to the production of sperm.
2. The formation of a mature female gamete (ovum) is called Oogenesis.
3. Oogenesis is markedly different from spermatogenesis as it is initiated during the embryonic development stage when a couple of million gamete mother cells (oogonia) are formed within each fetal ovary.
4. Parthenogenesis is a form of reproduction where an egg develops into an embryo without fertilization.
5. Gametogenesis is the general term for both male and female gamete formation.

Final Answer: The process of formation of a mature female gamete is Oogenesis.

Answer: (B)

Q62.

Solution

Concept:

Intrauterine Devices (IUDs) are self-inserted or doctor-inserted devices used for contraception. They are classified based on their mechanism of action: non-medicated, copper-releasing, and hormone-releasing.

Solution:

1. Non-medicated IUDs: Example is Lippes loop. These increase phagocytosis of sperm.
2. Copper-releasing IUDs: Examples include CuT, Cu7, and Multiload 375. These release copper ions (Cu^{2+}) which suppress sperm motility and the fertilizing capacity of sperms.
3. Hormone-releasing IUDs: Examples include Progestasert and LNG-20. These make the uterus unsuitable for implantation and the cervix hostile to the sperm.
4. Based on this classification, Multiload 375 is a copper-releasing device.

Final Answer: Multiload 375 is a "Copper releasing IUD."

Answer: (B)

Q63.

Solution

Concept:

Assisted Reproductive Technologies (ART) are special techniques used to help couples conceive when natural methods are not successful. Each technique is designed to bypass a specific physiological barrier to fertility.

Solution:

1. GIFT stands for Gamete Intra Fallopian Transfer.
2. This procedure involves the collection of an ovum from a donor (or the mother herself) and transferring it directly into the fallopian tube of another female who cannot produce one but can provide a suitable environment for fertilization and further development.
3. ZIFT (Zygote Intra Fallopian Transfer) involves transferring the zygote, not the ovum.
4. ICSI (Intracytoplasmic Sperm Injection) involves injecting a sperm directly into the ovum in a lab setting.
5. IUI (Intrauterine Insemination) involves introducing sperm into the uterus.

Final Answer: Transfer of an ovum into the fallopian tube is GIFT.

Answer: (B)

Q64.

Solution

Concept:

Double fertilization is a complex fertilization mechanism of flowering plants (angiosperms). It involves the joining of a female gametophyte (embryo sac) with two male gametes. One of these fusions is called Triple Fusion.

Solution:

1. Upon entering the embryo sac, the pollen tube releases two male gametes.
2. One male gamete fuses with the egg cell to form a zygote (Syngamy).
3. The second male gamete moves towards the two polar nuclei located in the central cell and fuses with them.
4. Because this involves the fusion of three haploid nuclei (one male gamete + two polar nuclei), it is termed Triple Fusion.
5. This results in the formation of the triploid Primary Endosperm Nucleus (PEN).

Final Answer: Triple fusion involves the fusion of two polar nuclei and one male gamete.

Answer: (A)

Q65.

Solution

Concept:

In genetics, a Test Cross is a method used to determine the genotype of an individual expressing a dominant phenotype. Since a dominant phenotype could be either homozygous (AA) or heterozygous (Aa), crossing it with a specific known genotype reveals its true nature.

Solution:

1. A Test Cross always involves crossing the individual in question (usually the F_1 hybrid) with the homozygous recessive parent.
2. If the F_1 is heterozygous (Aa), the offspring will show a $1:1$ ratio of dominant to recessive traits.
3. If the F_1 is homozygous dominant (AA), all offspring will show the dominant trait.
4. Crossing F_1 with the dominant parent is known as a Back Cross (specifically an Out Cross), which does not help in identifying the unknown genotype as effectively as a test cross.
5. Therefore, the standard genotype for a Test Cross is $F_1\times$ Recessive Parent.

Final Answer: The genotype of a "Test Cross" is $F_1\times$ Recessive Parent.

Answer: (B)

Q66.

Solution

Concept:

Aneuploidy is a condition where there is an abnormal number of chromosomes in a cell, caused by the failure of chromatids to segregate during cell division. Down's syndrome is a well-known genetic disorder caused by the presence of an additional autosome.

Solution:

1. Down's syndrome was first described by Langdon Down in 1866.
2. The affected individual has an extra copy of chromosome number 21.
3. Instead of the normal pair, there are three copies of this chromosome, a condition known as trisomy.
4. Therefore, the total chromosome count in such individuals becomes 47 (45 + XX or 45 + XY).
5. Trisomy 18 causes Edwards syndrome, and Trisomy 13 causes Patau syndrome.

Final Answer: Down's syndrome is caused by an extra copy of chromosome number 21.

Answer: (C)

Q67.

Solution

Concept:

The Double Helix model of DNA, proposed by Watson and Crick, provides specific dimensions for the structure of B-DNA. The structure is characterized by a constant width and a regular twisting pattern.

Solution:

1. In B-DNA, the pitch of the helix is 3.4 nm (or 34 Å).
2. There are roughly 10 base pairs (bp) in each turn of the helix.
3. To find the distance between two consecutive base pairs, we divide the pitch by the number of base pairs per turn.
4. Calculation: $\frac{3.4\text{ nm}}{10} = 0.34$ nm.
5. In Angstroms, this value is 3.4 Å.

Final Answer: The distance between two consecutive base pairs is 0.34 nm.

Answer: (A)

Q68.

Solution

Concept:

DNA replication is "semi-conservative," meaning that each of the two new DNA molecules contains one strand from the original molecule and one newly synthesized strand. This was a theoretical prediction that required experimental verification.

Solution:

1. While Watson and Crick suggested the semi-conservative scheme, the experimental proof was provided later.
2. Matthew Meselson and Franklin Stahl performed the definitive experiment in 1958 using *E. coli*.
3. They used heavy nitrogen (^{15}N) and normal nitrogen (^{14}N) isotopes to label the DNA and utilized cesium chloride ($CsCl$) density gradient centrifugation to separate the DNA molecules.
4. Hershey and Chase proved that DNA is the genetic material, while Griffith discovered the "Transforming Principle."

Final Answer: Experimental proof of semi-conservative replication was given by Meselson and Stahl.

Answer: (B)

Q69.

Solution

Concept:

Evidence for evolution comes from various sources, including comparative anatomy. Homologous organs and analogous organs provide different insights into how species have changed over time.

Solution:

1. Homologous organs are those that have a similar fundamental structure and origin but perform different functions (e.g., the forelimbs of a man, cheetah, whale, and bat).
2. Homology indicates "Divergent Evolution," where the same basic structure evolved along different directions due to adaptations to different needs.
3. The existence of homology suggests that these organisms share a "Common Ancestry."
4. Convergent evolution, on the other hand, is represented by analogous organs (different origin, similar function).
5. Therefore, homologous organs indicate both divergent evolution and common ancestry.

Final Answer: Homologous organs indicate both divergent evolution and common ancestry.

Answer: (D)

Q70.

Solution

Concept:

The chemical evolution theory suggests that life originated from non-living organic molecules. S.L. Miller and H.C. Urey provided experimental evidence by creating conditions similar to those thought to exist on primitive Earth.

Solution:

1. In 1953, Miller created electric discharges in a closed flask at 800°C.
2. The flask contained a specific mixture of gases representing the reducing atmosphere of early Earth.
3. The gases used were Methane (CH_4), Ammonia (NH_3), Hydrogen (H_2), and Water vapor (H_2O).
4. Note that Oxygen (O_2) was absent because the primitive atmosphere was reducing, not oxidizing.
5. The experiment resulted in the formation of amino acids, supporting the idea of chemical evolution.

Final Answer: The gases used were CH_4, NH_3, H_2, H_2O.

Answer: (A)

Q71.

Solution

Concept:

The Chromosomal Theory of Inheritance sought to unite the principles of Mendelian genetics with the physical behavior of chromosomes during cell division (meiosis). It identified chromosomes as the carriers of genetic material.

Solution:

1. Gregor Mendel established the laws of inheritance, but he was unaware of the physical nature of "factors."
2. In 1902, Walter Sutton and Theodore Boveri independently noted that the behavior of chromosomes was parallel to the behavior of genes.
3. They used chromosomal movement to explain Mendel's laws.
4. Sutton united the knowledge of chromosomal segregation with Mendelian principles and called it the Chromosomal Theory of Inheritance.
5. Thomas Hunt Morgan later provided experimental verification of this theory using *Drosophila melanogaster*.

Final Answer: Sutton and Boveri proposed the Chromosomal theory of inheritance.

Answer: (B)

Q72.

Solution

Concept:

The ABO blood grouping system in humans is controlled by the I gene, which has three alleles: I^A, I^B, and i. This is an example of multiple allelism and codominance.

Solution:

1. A man with blood group A could have the genotype I^AI^A or I^Ai.
2. A woman with blood group B could have the genotype I^BI^B or I^Bi.
3. If both parents are heterozygous (I^Ai and I^Bi), the possible combinations for the children are:

- I^AI^B (Blood group AB)
- I^Ai (Blood group A)
- I^Bi (Blood group B)
- ii (Blood group O)

4. Therefore, it is possible for the children to have any of the four blood groups.

Final Answer: The possible blood groups are A, B, AB, and O.

Answer: (C)

Q73.

Solution

Concept:

Genetic disorders are often classified into Mendelian disorders (caused by a mutation in a single gene) and Chromosomal disorders. Mendelian disorders can further be characterized as qualitative or quantitative defects.

Solution:

1. Thalassemia is an autosome-linked recessive blood disease.
2. It is characterized by the reduced rate of synthesis of one of the globin chains (α or β) that make up hemoglobin.
3. Because the problem lies in the "amount" of globin chains synthesized, it is classified as a quantitative problem.
4. In contrast, Sickle-cell anemia is a qualitative problem because it involves the synthesis of an "incorrectly functioning" (mutant) globin chain, though the amount may be normal.

Final Answer: Thalassemia is a quantitative problem.

Answer: (B)

Q74.

Solution

Concept:

The "Central Dogma" of molecular biology explains the flow of genetic information. DNA acts as the master blueprint, but the actual assembly of amino acids into proteins occurs in the cytoplasm based on a portable copy of the code.

Solution:

1. DNA contains the genetic information, but it is sequestered in the nucleus.
2. Transcription produces Messenger RNA (mRNA), which carries the genetic code from the DNA to the ribosomes.
3. The sequence of nitrogenous bases on the mRNA is read in triplets (codons).
4. Each codon corresponds to a specific amino acid.
5. Therefore, the direct template that determines the amino acid sequence during translation is the mRNA.
6. tRNA acts as an adapter, and rRNA provides the structural/catalytic site.

Final Answer: The amino acid sequence is determined by the sequence of bases on mRNA.

Answer: (B)

Q75.

Solution

Concept:

The Hardy-Weinberg principle states that allele frequencies in a population are stable and remain constant from generation to generation in the absence of evolutionary influences. The equation is: $p^2 + 2pq + q^2 = 1$, where p is the frequency of the dominant allele and q is the frequency of the recessive allele.

Solution:

1. Given: Frequency of recessive allele $(q) = 0.4$.
2. Since $p + q = 1$, the frequency of the dominant allele $(p) = 1 - 0.4 = 0.6$.
3. The frequency of heterozygotes in the population is represented by the term $2pq$.
4. Calculation:

$2 \times (p) \times (q)$

$2 \times 0.6 \times 0.4 = 0.48$.

5. Thus, 48% of the population consists of heterozygotes.

Final Answer: The frequency of heterozygotes is 0.48.

Answer: (C)

Q76.

Solution

Concept:

Evolutionary theories attempt to explain how species change over time. Before Charles Darwin proposed natural selection, other scientists suggested mechanisms for evolutionary change based on the interaction between organisms and their environment.

Solution:

1. Jean-Baptiste Lamarck, a French naturalist, was one of the first to propose a formal theory of evolution.
2. His theory, often called "Lamarckism," suggested that organisms could pass on traits acquired during their lifetime to their offspring.
3. This was based on the "Use and Disuse" of organs; for example, he famously argued that giraffes developed long necks by stretching to reach high leaves, and this acquired trait was inherited.
4. While this specific mechanism was later proven incorrect by modern genetics, Lamarck was a pioneer in suggesting that life evolves.
5. August Weismann later disproved this by showing that only changes in germ cells (not somatic cells) are inherited.

Final Answer: "Inheritance of acquired characters" was given by Lamarck.

Answer: (B)

Q77.

Solution

Concept:

The Human Genome Project (HGP) was a massive international scientific research effort aimed at determining the sequence of the human genome and identifying all human genes from both a physical and functional standpoint.

Solution:

1. The Human Genome Project was launched in the year 1990.
2. It was planned as a 13-year project, coordinated by the U.S. Department of Energy and the National Institutes of Health.
3. The project was successfully completed in 2003.
4. It revealed that the human genome contains approximately 3×10^9 base pairs.
5. Although the main project ended in 2003, the sequencing of the final chromosome (Chromosome 1) was actually completed in May 2006, but the official project completion is recognized as 2003.

Final Answer: The Human Genome Project was completed in 2003.

Answer: (C)

Q78.

Solution

Concept:

Spliceosomes are large molecular complexes found in eukaryotic nuclei. They are responsible for "splicing," the process of removing non-coding regions (introns) from a primary RNA transcript (pre-mRNA) and joining the coding regions (exons) together.

Solution:

1. Splicing is a post-transcriptional modification that occurs in Eukaryotes.
2. Prokaryotes (Bacteria) have a simpler gene structure where the coding sequence is continuous and not interrupted by introns.
3. Therefore, bacteria do not require spliceosomes because their mRNA is translated directly as it is transcribed.
4. Plants, Animals, and Fungi are all eukaryotes and contain introns in many of their genes, thus requiring spliceosomes for mRNA processing.
5. Consequently, spliceosomes are absent in Bacteria.

Final Answer: Spliceosomes are not found in cells of Bacteria.

Answer: (D)

Q79.

Solution

Concept:

The human genome contains many repetitive DNA sequences. A small portion of this DNA, known as Satellite DNA, shows a high degree of polymorphism (variation) and does not code for any proteins.

Solution:

1. Satellite DNA is classified into categories like micro-satellites and mini-satellites (VNTRs) based on the number of repetitive units.
2. Because these sequences are highly specific to an individual and are inherited from parents, they serve as the basis for DNA Fingerprinting.
3. DNA fingerprinting is used in forensic science to identify individuals, in paternity testing, and in studying genetic diversity.
4. While it involves genetic material, its primary routine application among the choices is the identification process involved in fingerprinting.

Final Answer: Satellite DNA is useful in DNA fingerprinting.

Answer: (B)

Q80.

Solution

Concept:

Fungi produce various secondary metabolites that can affect the human nervous system. Some of these substances are used in medicine, while others are notorious for their psychoactive properties.

Solution:

1. *Amanita muscaria*, commonly known as the fly agaric, is a mushroom characterized by its bright red cap with white spots.
2. It contains psychoactive alkaloids such as muscimol and ibotenic acid.
3. These compounds act on the brain to produce altered states of perception, vivid dreams, and hallucinations.
4. Therefore, it is classified as a hallucinogen.
5. It is not used as a bio-fertilizer or a primary source of vitamins in a traditional sense.

Final Answer: *Amanita muscaria* is a Hallucinogen.

Answer: (B)

Q81.

Solution

Concept:

The immune system uses various types of cells to defend the body against pathogens. When a pathogen enters the bloodstream, certain white blood cells (leukocytes) act as the first line of cellular defense by physically engulfing and destroying the invaders.

Solution:

1. Phagocytosis is the process by which a cell uses its plasma membrane to enclose and "eat" a foreign particle or microorganism.
2. In the human body, the primary phagocytic cells are Neutrophils and Monocytes.
3. Monocytes are the largest type of white blood cell; when they move into tissues, they differentiate into even more powerful phagocytes called Macrophages.
4. Lymphocytes are primarily involved in the adaptive immune response (producing antibodies or killing infected cells directly), rather than simple phagocytosis.
5. Therefore, Monocytes are the correct answer among the given options.

Final Answer: Monocytes are phagocytic cells.

Answer: (B)

Q82.

Solution

Concept:

Immunity can be classified into Active and Passive. Active immunity involves the body's own immune system producing antibodies. Passive immunity involves the direct transfer of pre-formed antibodies from one individual to another to provide immediate protection.

Solution:

1. Colostrum is the yellowish fluid secreted by the mother during the initial days of lactation.
2. It is exceptionally rich in antibodies, specifically of the IgA type.
3. These antibodies are essential to protect the newborn infant against various infections while its own immune system is still developing.
4. Since the infant is receiving ready-made antibodies rather than producing them in response to an infection, this is a classic example of Passive Immunity.
5. Active immunity would require the infant to be exposed to a pathogen or a vaccine.

Final Answer: The immunity provided by colostrum is an example of Passive immunity.

Answer: (B)

Q83.

Solution

Concept:

Cancer is characterized by the uncontrolled division of cells. One of the most important properties of normal cells is "contact inhibition," which prevents them from growing uncontrollably when they come into contact with other cells.

Solution:

1. Normal cells show a property called contact inhibition by virtue of which contact with other cells inhibits their uncontrolled growth.
2. Cancer cells appear to have lost this property.
3. As a result, they continue to divide even when surrounded by other cells, eventually piling up to form masses of cells called tumors.
4. Benign tumors stay confined to their original location, while malignant tumors (cancers) can spread to other parts of the body (metastasis).
5. Therefore, the loss of contact inhibition is a hallmark of cancerous transformation.

Final Answer: Cancer cells have lost the property of "Contact inhibition."

Answer: (B)

Q84.

Solution

Concept:

When the body is injured or invaded by pathogens, it triggers an inflammatory response. This localized reaction is mediated by chemicals released by certain immune cells found in the connective tissues.

Solution:

1. Mast cells are specialized cells found in various tissues, especially near blood vessels.
2. During an allergic reaction or in response to injury, mast cells undergo degranulation.
3. This process releases potent chemicals, primarily Histamine and Serotonin.
4. Histamine causes vasodilation (widening of blood vessels) and increases capillary permeability, leading to the redness and swelling associated with inflammation.
5. Heparin is also released by mast cells but functions mainly as an anticoagulant.

Final Answer: Mast cells secrete Histamine and Serotonin.

Answer: (B)

Q85.

Solution

Concept:

Recombinant DNA technology involves cutting DNA at specific locations using molecular scissors known as restriction enzymes. These enzymes look for specific sequences in the DNA to make their cuts.

Solution:

1. Restriction enzymes belong to a larger class of enzymes called nucleases.
2. Each restriction enzyme functions by inspecting the length of a DNA sequence and binding to a specific recognition sequence.
3. These recognition sequences are usually Palindromic—meaning the sequence of base pairs reads the same on both strands when the orientation of reading is kept the same (e.g., $5' \rightarrow 3'$).
4. An example is the sequence for $EcoRI$: $5'-GAATTC-3'$ on one strand and $3'-CTTAAG-5'$ on the other.
5. Therefore, the enzymes recognize palindromic nucleotide sequences.

Final Answer: Restriction enzymes recognize Palindromic nucleotide sequences.

Answer: (B)

Q86.

Solution

Concept:

The Polymerase Chain Reaction (PCR) is a technique used to amplify a specific segment of DNA into millions of copies. It involves three fundamental steps that are repeated for many cycles. Each step requires a specific temperature to facilitate different biochemical processes.

Solution:

1. **Denaturation:** The double-stranded DNA is heated (approx. 94–96°C) to separate it into two single strands. 2. **Annealing:** The temperature is lowered (approx. 50–65°C) to allow DNA primers to bind to the complementary sequences on the single-stranded DNA templates. 3. **Extension (or Elongation):** The temperature is raised (approx. 72°C), and a heat-stable DNA polymerase (like *Taq* polymerase) adds nucleotides to the primers, synthesizing new DNA strands. 4. Therefore, the correct sequence is Denaturation, followed by Annealing, and finally Extension.

Final Answer: The correct order is Denaturation, Annealing, Extension.

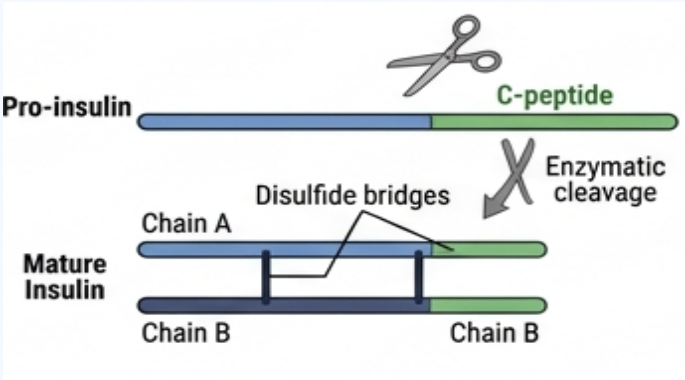
Answer: (B)

Q87.

Solution

Concept:

Biotechnology has revolutionized the production of therapeutic proteins. In 1983, Eli Lilly, an American company, used recombinant DNA technology to produce human insulin, which they marketed under the name "Humulin."



Solution:

1. Human insulin consists of two short polypeptide chains: Chain A and Chain B, linked by disulfide bridges. 2. In humans, insulin is synthesized as a pro-hormone containing an extra stretch called the C-peptide, which is removed during maturation. 3. The primary challenge in using bacteria to produce insulin was assembling the mature form without the C-peptide. 4. Eli Lilly solved this by preparing two DNA sequences corresponding to the A and B chains of human insulin and introducing them into separate *E. coli* plasmids. 5. The chains were produced separately, extracted, and then combined by creating disulfide bonds to form mature human insulin.

Final Answer: The A and B chains were produced separately and then combined by creating disulfide bonds.

Answer: (D)

Q88.

Solution

Concept:

Organisms adapt to their environments through various morphological, physiological, or behavioral mechanisms. In hot, arid climates like the Sahara Desert, mammals face extreme water scarcity and high heat.

Solution:

1. The Kangaroo rat (*Dipodomys*) in North American deserts is a master of water conservation. 2. It meets its entire water requirement through "internal fat oxidation," where water is produced as a metabolic byproduct. 3. Furthermore, its kidneys are highly specialized to concentrate urine to a level where minimal water is lost during the excretion of nitrogenous wastes. 4. Seals use a thick layer of fat (blubber) for insulation in cold climates, and polar bears hibernate to survive winters.

Final Answer: The Kangaroo rat meets its water requirement through internal fat oxidation.

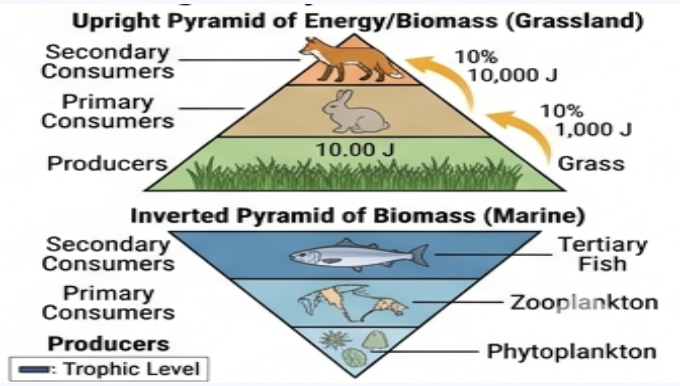
Answer: (C)

Q89.

Solution

Concept:

An ecological pyramid represents the relationship between organisms at different trophic levels in terms of number, biomass, or energy. While most pyramids are upright, certain exceptions exist depending on the ecosystem structure.



Solution:

1. **Pyramid of Energy:** Always upright because energy is lost as heat at each trophic level (10% law). 2. **Pyramid of Number in a Grassland:** Usually upright as there are more grasses than herbivores. 3. **Pyramid of Biomass in a Sea:** Typically inverted. The biomass of the primary producers (phytoplankton) is much less than that of the consumers (zooplankton and fish) because phytoplankton have a very short lifespan and high turnover rate. 4. **Pyramid of Number on a Tree:** Often inverted (one large tree supporting many insects). 5. Thus, the pyramid of biomass in a sea is the most common example of an inverted pyramid.

Final Answer: The Pyramid of biomass in a sea is generally inverted.

Answer: (C)

Q90.

Solution

Concept:

The "Evil Quartet" refers to the four major causes of biodiversity loss driven by human activities. Understanding these factors is critical for conservation biology.

Solution:

1. The four components of the Evil Quartet are:

- **Habitat loss and fragmentation:** The most important cause (e.g., deforestation of the Amazon).
- **Over-exploitation:** When humans harvest a species faster than it can regenerate (e.g., Steller's sea cow).
- **Alien species invasion:** Introduction of non-native species that outcompete locals (e.g., Nile perch in Lake Victoria).
- **Co-extinctions:** When the extinction of one species leads to the extinction of another that depends on it. 2. "Pollution" and "Reforestation" are not part of the traditionally defined "Evil Quartet." 3. Among the options, Alien species invasion is the correct component.

Final Answer: Alien species invasion is a part of the "Evil Quartet."

Answer: (A)

Answer Key

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