

MHT-CET Biology Sample Paper- 4

Duration: 90 Minutes

Maximum Marks: 100

Instructions

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

Q1. A botanist discovers a new species that possesses a dominant gametophytic phase, multicellular rhizoids, and a sporophyte that is partially dependent on the gametophyte but contains chlorophyllous cells. This plant most likely belongs to:

- (A) Hepaticopsida
- (B) Bryopsida
- (C) Pteropsida
- (D) Lycopsidea

Q2. In the context of the life cycle of *Gymnosperms*, which of the following statements regarding the "pollen drop" mechanism is most accurate?

- (A) It is a sugary secretion from the microsporangium to attract insect vectors.
- (B) It is a pollination liquid secreted by the micropyle to pull pollen into the pollen chamber.
- (C) It is a hydrostatic mechanism used for the dehiscence of the microsporophyll.
- (D) It acts as a nutritional medium for the development of the male gamete in the archegonium.

Q3. Which of the following phylogenetic arrangements correctly represents the evolution of the stellar system from primitive to advanced?



- (A) Protosteles → Siphonosteles → Solenosteles → Dictyosteles
- (B) Siphonosteles → Protosteles → Dictyosteles → Atactosteles
- (C) Protosteles → Dictyosteles → Siphonosteles → Eusteles
- (D) Solenosteles → Siphonosteles → Protosteles → Dictyosteles

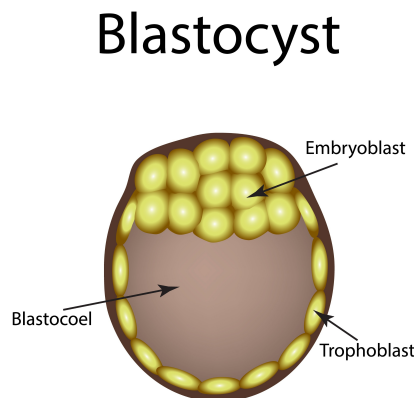
Q4. In Rhodophyceae, the complex post-fertilization development involves the formation of a structure called:

- (A) Cystocarp
- (B) Oogonium
- (C) Trichogyne
- (D) Carpogonium

Q5. The presence of "Amphiphloic Siphonostele" is a characteristic feature of the rhizome of which plant?

- (A) *Selaginella*
- (B) *Marsilea*
- (C) *Equisetum*
- (D) *Adiantum*

Q6. In the diagram of a human blastocyst, identify the fate of the 'Inner Cell Mass' and the 'Trophoblast' respectively:



- (A) Becomes the placenta; becomes the embryo proper.
- (B) Becomes the embryo proper; becomes the extra-embryonic membranes (chorion).
- (C) Becomes the umbilical cord; becomes the amniotic fluid.
- (D) Becomes the ectoderm; becomes the endoderm and mesoderm.

Q7. In a mature dicot stem, the sequence of tissues from the exterior to the interior is:

- (A) Phellem → Phelloderm → Phellogen → Pericycle
- (B) Phellem → Phellogen → Phelloderm → Secondary Phloem
- (C) Phellogen → Phellem → Phelloderm → Secondary Xylem
- (D) Phelloderm → Phellogen → Phellem → Endoderms

Q8. During secondary growth in extrastelar regions, the phellogen cuts off cells on both sides. The cells produced on the inner side differentiate into:

- (A) Cork
- (B) Complementary cells
- (C) Secondary cortex
- (D) Rhytidome

Q9. A transverse section of a leaf shows "Kranz anatomy" and large, thin-walled, empty cells on the upper epidermis. These specific epidermal cells are:

- (A) Subsidiary cells
- (B) Bulliform cells
- (C) Passage cells
- (D) Guard cells

Q10. Which of the following is an example of a "lateral meristem" that is secondary in origin but primary in function?

- (A) Intrafascicular cambium



- (B) Interfascicular cambium
- (C) Vascular cambium in roots
- (D) Cork cambium

Q11. In the xylem of certain Angiosperms, tyloses are formed. These represent:

- (A) Secretory glands in the primary xylem.
- (B) Outgrowths of parenchyma cells into the lumen of vessels through pits.
- (C) Lignified thickenings on the walls of tracheids.
- (D) Specialized fungal hyphae in the heartwood.

Q12. The fluidity of the plasma membrane is maintained at low temperatures by the presence of:

- (A) Saturated fatty acids
- (B) Cholesterol and unsaturated phospholipids
- (C) Peripheral proteins
- (D) Glycocalyx

Q13. During the S-phase of the cell cycle, while DNA replicates in the nucleus, which of the following occurs in the cytoplasm of animal cells?

- (A) Histone protein synthesis
- (B) Centriole duplication
- (C) Tubulin synthesis
- (D) Mitochondria division

Q14. If a cell has a chromosome number of $2n = 24$ and a DNA content of $2C$ at G_1 , what will be the chromosome number and DNA content after Meiosis I?

- (A) $n = 12, 2C$
- (B) $2n = 24, 4C$
- (C) $n = 12, C$



(D) $2n = 12, 2C$

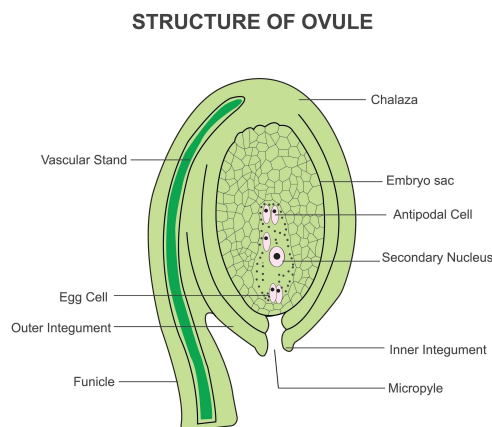
Q15. The enzyme "recombinase," required for crossing over during meiosis, is functionally active during:

- (A) Zygotene
- (B) Pachytene
- (C) Diplotene
- (D) Diakinesis

Q16. Which organelle is responsible for the "Photorespiratory" pathway, specifically for the conversion of glycolate to glyoxylate?

- (A) Chloroplast
- (B) Peroxisome
- (C) Mitochondrion
- (D) Glyoxysome

Q17. In the diagram of an 'Anatropous Ovule', the point where the body of the ovule fuses with the funicle is labeled as the:



- (A) Micropyle
- (B) Chalaza
- (C) Hilum



(D) Nucellus

Q18. In the C_4 pathway, the primary CO_2 fixation occurs in the mesophyll cells, but the final Calvin cycle takes place in the bundle sheath cells. The transport of which molecule connects these two?

(A) Phosphoenolpyruvate (PEP)

(B) Malate or Aspartate

(C) Oxaloacetate (OAA)

(D) Pyruvate

Q19. During non-cyclic photophosphorylation, the primary electron acceptor from Photosystem II is:

(A) Phaeophytin

(B) Plastoquinone

(C) Plastocyanin

(D) Ferridoxin

Q20. The 'Warburg effect' refers to the:

(A) Inhibition of photosynthesis by high O_2 levels.

(B) Acceleration of respiration by high CO_2 levels.

(C) Decoupling of ATP synthesis from electron transport.

(D) Saturation of light harvesting complexes.

Q21. In the Krebs cycle, the only step involving the reduction of FAD^+ to $FADH_2$ is the conversion of:

(A) Isocitrate to α -ketoglutarate

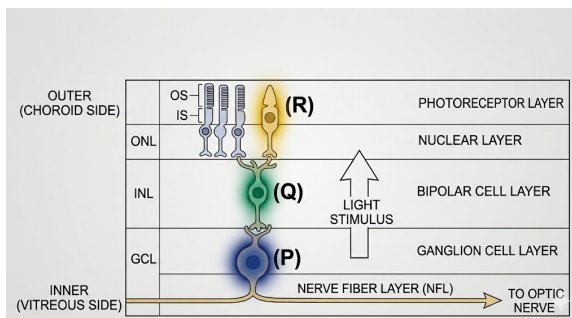
(B) Succinyl-CoA to Succinate

(C) Succinate to Fumarate

(D) Fumarate to Malate



- Q22.** Examine the high-magnification diagram of the human retinal layers below. Identify the cells labeled (P), (Q), and (R) and determine the correct path of an action potential generated by light stimulus.



- (A) (P) Amacrine cell, (Q) Rods, (R) Bipolar cell; Path: $R \rightarrow Q \rightarrow P$
 (B) (P) Ganglion cell, (Q) Bipolar cell, (R) Photoreceptor; Path: $R \rightarrow Q \rightarrow P$
 (C) (P) Photoreceptor, (Q) Ganglion cell, (R) Bipolar cell; Path: $P \rightarrow R \rightarrow Q$
 (D) (P) Bipolar cell, (Q) Photoreceptor, (R) Ganglion cell; Path: $Q \rightarrow P \rightarrow R$

- Q23.** A plant hormone that acts as a "stress hormone" and induces the closure of stomata during water deficit is:

- (A) Ethylene
 (B) Cytokinin
 (C) Abscisic acid
 (D) Gibberellic acid

- Q24.** The phenomenon of "Guttation" is primarily driven by:

- (A) High transpiration pull
 (B) Positive root pressure
 (C) Low humidity in the atmosphere
 (D) Capillary action in xylem vessels

- Q25.** Which of the following elements is a structural component of the chlorophyll molecule and is also required for the activation of enzymes in respiration?

- (A) Fe



- (B) Mn
- (C) Mg
- (D) Mo

Q26. The critical period of light duration for a Short-Day Plant (SDP) is 10 hours. In which of the following conditions will the plant fail to flower?

- (A) 8 hours light / 16 hours dark
- (B) 9 hours light / 15 hours dark (with a flash of red light in the middle of the dark period)
- (C) 9 hours light / 15 hours dark
- (D) 7 hours light / 17 hours dark

Q27. In glycolysis, the "pay-off phase" begins with the conversion of:

- (A) Glucose to Glucose-6-Phosphate
- (B) Fructose-1,6-bisphosphate to DHAP and G-3-P
- (C) Glyceraldehyde-3-phosphate to 1,3-bisphosphoglycerate
- (D) 3-phosphoglycerate to 2-phosphoglycerate

Q28. According to the "Munch Pressure Flow Hypothesis," the translocation of solutes in the phloem occurs due to:

- (A) Active transport of water into the sieve tube.
- (B) A turgor pressure gradient between source and sink.
- (C) Cytoplasmic streaming within sieve elements.
- (D) The suction force created by transpiration.

Q29. In an angiosperm, if the haploid number of chromosomes is 12, what would be the number of chromosomes in the cells of the nucellus, the primary endosperm nucleus, and the synergids respectively?

- (A) 24, 36, 12
- (B) 12, 24, 36



(C) 24, 24, 12

(D) 36, 36, 12

Q30. While studying pollen-pistil interaction, a student observes that pollen tubes of a certain species fail to germinate on the stigma of the same plant but grow normally on the stigma of a different individual of the same species. This physiological mechanism is known as:

(A) Herkogamy

(B) Dicliny

(C) Self-incompatibility

(D) Protandry

Q31. Which of the following represents the correct developmental sequence of the male gametophyte in Angiosperms?

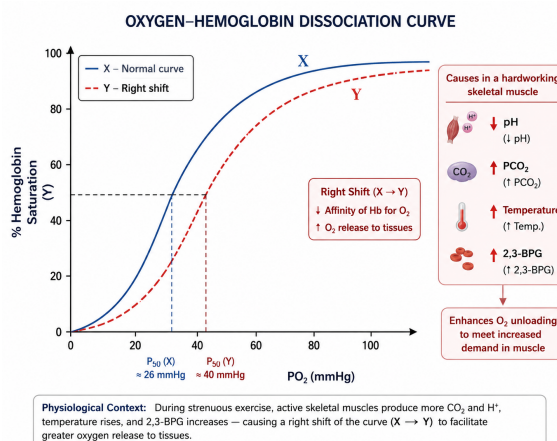
(A) Pollen grain → Generative cell → Pollen tube → Two male gametes

(B) Microspore mother cell → Microspore tetrad → Pollen grain → Vegetative cell

(C) Archegonium → Sporogenous tissue → Microspore → Male gamete

(D) Pollen grain → Vegetative cell → Generative cell → Microspore

Q32. Examine the provided diagram of the **Oxygen-Dissociation Curve**. If the curve shifts from position 'X' to position 'Y' as shown, identify the physiological condition responsible for this change in a hardworking skeletal muscle.



- (A) Increased pH , Decreased PCO_2 , Decreased Temperature
- (B) Decreased pH , Increased PCO_2 , Increased Temperature
- (C) Increased PO_2 , Decreased 2, 3 – BPG , Increased pH
- (D) Decreased Temperature, Decreased PCO_2 , High Altitude

Q33. In a typical *Polygonum* type embryo sac, the distribution of nuclei at the micropylar end, chalazal end, and the center is:

- (A) 3, 2, 3
- (B) 2, 3, 3
- (C) 3, 3, 2
- (D) 1, 3, 4

Q34. A plant produces chasmogamous flowers but also ensures successful seed set even in the absence of pollinators through:

- (A) Geitonogamy
- (B) Cleistogamy
- (C) Xenogamy
- (D) Apomixis

Q35. The formation of an embryo directly from the diploid nucellar or integumentary cells without fertilization is an example of:

- (A) Parthenogenesis
- (B) Adventive embryony
- (C) Apospory
- (D) Diplospory

Q36. If the endosperm of a gymnosperm has 15 chromosomes, how many chromosomes will be present in its root tip cells?

- (A) 15



- (B) 30
- (C) 45
- (D) 10

Q37. The 'filiform apparatus' is a characteristic feature of which cell in the embryo sac?

- (A) Egg cell
- (B) Central cell
- (C) Synergid
- (D) Antipodal cell

Q38. In a dihybrid cross ($AaBb \times AaBb$), what is the probability of obtaining an offspring with the genotype $aaBb$?

- (A) 1/16
- (B) 2/16
- (C) 4/16
- (D) 9/16

Q39. Which Mendelian idea is depicted by a cross in which the F_1 generation resembles both parents simultaneously?

- (A) Incomplete dominance
- (B) Law of dominance
- (C) Co-dominance
- (D) Inheritance of one gene

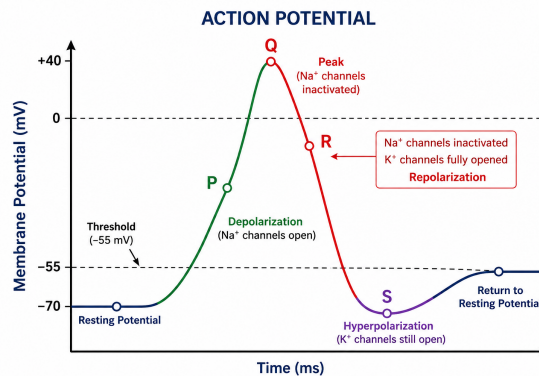
Q40. A man with blood group 'A' marries a woman with blood group 'B'. What are all the possible blood groups of their offspring if both parents are heterozygous?

- (A) A and B only
- (B) A, B, and AB only



- (C) A, B, AB, and O
 (D) AB only

Q41. The graph below shows the changes in membrane potential during an action potential. At which labeled point are the Na^+ channels inactivated and K^+ channels fully opened?



- (A) P (Depolarization)
 (B) Q (Peak)
 (C) R (Repolarization)
 (D) S (Hyperpolarization)

Q42. The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes was first explained by:

- (A) Gregor Mendel
 (B) Alfred Sturtevant
 (C) T.H. Morgan
 (D) Sutton and Boveri

Q43. In a test cross involving F_1 dihybrid flies, more parental-type offspring were produced than recombinant-type offspring. This indicates:

- (A) The two genes are located on different chromosomes.
 (B) The two genes are linked and present on the same chromosome.
 (C) Both of the characters are controlled by more than one gene.



(D) The genes are exhibiting independent assortment.

Q44. Which of the following is an example of 'Pleiotropy'?

- (A) Haemophilia
- (B) Thalassemia
- (C) Phenylketonuria
- (D) Color blindness

Q45. The DNA polymerase enzyme used in PCR (Polymerase Chain Reaction) is preferred over human DNA polymerase because:

- (A) It is faster at DNA replication.
- (B) It remains active at very high temperatures.
- (C) It does not require a primer to start.
- (D) It can replicate RNA into DNA.

Q46. While using pBR322 as a cloning vector, the insertion of a foreign DNA at the *BamHI* site results in the loss of resistance to:

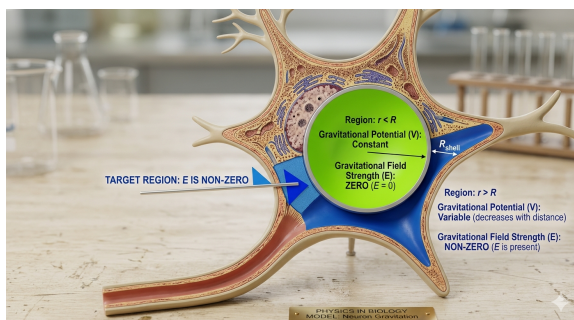
- (A) Ampicillin
- (B) Tetracycline
- (C) Kanamycin
- (D) Streptomycin

Q47. What is the primary role of 'Ethidium Bromide' in the process of Gel Electrophoresis?

- (A) To help the DNA fragments move faster towards the anode.
- (B) To make the DNA fragments visible under UV light.
- (C) To denature the double-stranded DNA into single strands.
- (D) To act as a buffer for maintaining pH.



- Q48.** A small block of mass m slides along a track with a loop-the-loop of radius R . If the block is released from rest at a height $h = 3R$, what is the normal force exerted by the track on the block at the highest point of the loop?



- (A) mg
- (B) $2mg$
- (C) zero
- (D) $3mg$
- Q49.** In 'Blue-White screening', the white colonies represent:
- (A) Non-transformants
- (B) Transformants with non-recombinant DNA
- (C) Transformants with recombinant DNA
- (D) Host cells without any plasmid
- Q50.** The first clinical gene therapy was given in 1990 to a 4-year-old girl with which enzyme deficiency?
- (A) Tyrosinase
- (B) Adenosine deaminase (ADA)
- (C) Phenylalanine hydroxylase
- (D) Glutamate dehydrogenase
- Q51.** RNA interference (RNAi) involves the silencing of a specific mRNA due to:
- (A) Single-stranded RNA
- (B) Double-stranded RNA



- (C) Double-stranded DNA
- (D) Single-stranded DNA

Q52. According to Allen's Rule, mammals from colder climates generally have:

- (A) Shorter ears and shorter limbs
- (B) Longer ears and longer limbs
- (C) Larger body size and thick fur
- (D) Lower metabolic rate

Q53. In a population of 1000 individuals, 100 births and 50 deaths were recorded in a year. What is the intrinsic rate of natural increase (r) for this population?

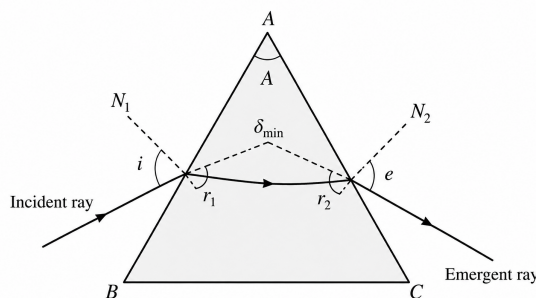
- (A) 0.1
- (B) 0.05
- (C) 0.5
- (D) 0.15

Q54. Which of the following curves represents the 'Verhulst-Pearl Logistic Growth' in a resource-limited environment?

- (A) J-shaped curve
- (B) S-shaped (Sigmoid) curve
- (C) Linear curve
- (D) Bell-shaped curve

Q55. A ray of light passes through a prism as shown. If the prism is in minimum deviation condition, the path is:





- (A) Asymmetric inside prism
- (B) Symmetric with $i = e$
- (C) No refraction occurs
- (D) Emergent ray parallel to incident ray

Q56. The interaction between an orchid growing on a mango branch and the mango tree is an example of:

- (A) Parasitism
- (B) Mutualism
- (C) Commensalism
- (D) Amensalism

Q57. In an ecosystem, the rate of production of organic matter during photosynthesis is called:

- (A) Net Primary Productivity
- (B) Gross Primary Productivity
- (C) Secondary Productivity
- (D) Net Community Productivity

Q58. Which of the following pyramid types is ALWAYS upright in any stable ecosystem?

- (A) Pyramid of Biomass
- (B) Pyramid of Number



- (C) Pyramid of Energy
- (D) All of the above

Q59. The 'Evil Quartet' is a term used to describe the four major causes of:

- (A) Air pollution
- (B) Population explosion
- (C) Biodiversity loss
- (D) Global warming

Q60. The process by which nutrient enrichment of a water body leads to the depletion of dissolved oxygen is known as:

- (A) Biomagnification
- (B) Eutrophication
- (C) Stratification
- (D) Succession

Q61. If the pH of the duodenal contents remains acidic due to a failure in secretin release, which of the following will be the most direct consequence?

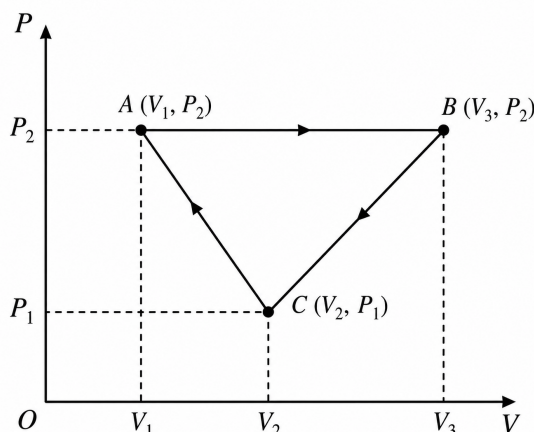
- (A) Impaired emulsification of fats by bile.
- (B) Inactivation of pancreatic enzymes like trypsinogen.
- (C) Increased gastric motility and emptying.
- (D) Failure of Brunner's glands to secrete mucus.

Q62. During strenuous exercise, the hemoglobin-oxygen dissociation curve shifts to the right. This "Bohr Effect" is primarily driven by:

- (A) Decreased pCO_2 and increased pH.
- (B) Increased pCO_2 , increased H^+ , and increased temperature.
- (C) Decreased temperature and increased pO_2 .
- (D) Increased 2, 3 - DPG levels and increased pH.



Q63. A gas undergoes a cyclic process shown in the P - V diagram. The net work done is:

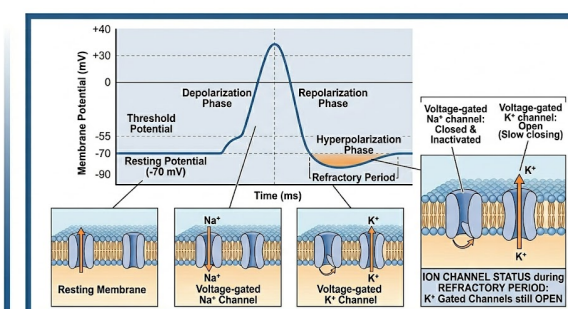


- (A) Zero
- (B) Equal to area enclosed by cycle
- (C) Maximum at isobaric path only
- (D) Depends only on temperature

Q64. A person has a cardiac output of 5 L/min and a heart rate of 72 beats/min. If the end-diastolic volume is 110 ml, what is the end-systolic volume?

- (A) 40 ml
- (B) 70 ml
- (C) 30 ml
- (D) 50 ml

Q65. The graph below represents the changes in membrane potential during the conduction of a nerve impulse (Action Potential) across a localized patch of an axonal membrane.



During the phase marked as '**Refractory Period**' (specifically the hyperpolarization phase), which of the following ion-channel statuses is responsible for the membrane potential dropping below -70 mV?

- (A) Rapid influx of Na^+ ions through voltage-gated channels while K^+ channels remain closed.
- (B) Closure of Na^+ voltage-gated channels and the slow, prolonged opening of K^+ voltage-gated channels.
- (C) Active transport of $3Na^+$ out and $2K^+$ in via the Na^+/K^+ pump against the concentration gradient.
- (D) Opening of ligand-gated chloride (Cl^-) channels causing an immediate increase in internal negativity.

Q66. Which of the following would happen if the stretch receptors of the urinary bladder wall were totally removed?

- (A) Micturition will continue normally.
- (B) Urine will continue to collect normally in the bladder.
- (C) There will be no micturition.
- (D) Urine will not collect in the bladder.

Q67. The sensation of "fatigue" in muscles is caused by the accumulation of lactic acid, which specifically leads to:

- (A) Permanent bonding of Myosin to Actin.
- (B) Inhibition of Calcium release from the sarcoplasmic reticulum.
- (C) Inhibition of the enzyme Acetylcholinesterase.
- (D) Rapid breakdown of ATP in the H-zone.

Q68. In the human eye, the "Blind Spot" is the region where:

- (A) Only cones are densely packed.
- (B) The optic nerve leaves the eye and retinal blood vessels enter.
- (C) Only rods are present for scotopic vision.

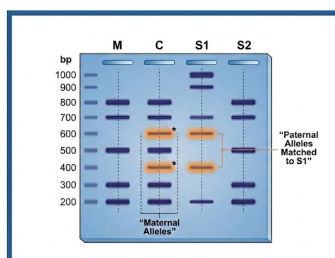


(D) The image is formed with the highest resolution.

Q69. Which specific hormone acts on the exocrine part of the pancreas to stimulate the secretion of water and bicarbonate ions?

- (A) Gastrin
- (B) Cholecystokinin (CCK)
- (C) Secretin
- (D) Insulin

Q70. The diagram below shows the results of an agarose gel electrophoresis used in a paternity dispute. "M" represents the Mother, "C" represents the Child, and "S1" and "S2" represent two suspected fathers. Based on the DNA banding patterns, determine the biological father and the reason.



- (A) S1; because all bands in C that do not match M must match S1.
- (B) S2; because C shares more bands with S2 than with the Mother.
- (C) S1; because S1 has the highest molecular weight DNA fragments.
- (D) S2; because the thickest band in C matches the thickest band in S2.

Q71. The physiological process of 'deamination' primarily occurs in the:

- (A) Nephrons
- (B) Hepatocytes
- (C) Alveoli
- (D) Pancreatic Acini



- Q72.** A drop in blood pressure stimulates the release of Aldosterone. What is the specific site of action for Aldosterone to increase Na^+ reabsorption?
- (A) Proximal Convoluted Tubule
 - (B) Descending limb of Henle's loop
 - (C) Distal Convoluted Tubule and Collecting Duct
 - (D) Bowman's Capsule
- Q73.** The 'Resting Membrane Potential' is primarily maintained by the leakage of which ion across the axonal membrane?
- (A) Na^+
 - (B) K^+
 - (C) Cl^-
 - (D) Ca^{2+}
- Q74.** In the absence of fertilization, the corpus luteum degenerates. This causes a sudden drop in progesterone, which leads to:
- (A) Repair of endometrium
 - (B) Disintegration of endometrium
 - (C) Thickening of cervical mucus
 - (D) Ovulation
- Q75.** The 'Fast Block' to polyspermy in humans is achieved by:
- (A) The cortical reaction and formation of the fertilization envelope.
 - (B) Depolarization of the oocyte plasma membrane.
 - (C) The release of enzymes from the acrosome.
 - (D) The hardening of the Zona Pellucida.
- Q76.** What is the correct ploidy sequence: Spermatogonia, Primary Spermatocyte, Secondary Spermatocyte, Spermatid?



- (A) $2n, 2n, n, n$
- (B) $n, 2n, n, n$
- (C) $2n, n, n, n$
- (D) $2n, 2n, 2n, n$

Q77. The hormone 'Inhibin' is produced by which cells in the male reproductive system to provide negative feedback to the anterior pituitary?

- (A) Leydig cells
- (B) Interstitial cells
- (C) Sertoli cells
- (D) Spermatogonia

Q78. Identify the correct match regarding the fetal membranes and their function:

- (A) Yolk Sac: Provides nourishment in humans.
- (B) Amnion: Acts as a shock absorber.
- (C) Allantois: Forms the major part of the placenta.
- (D) Chorion: Stores nitrogenous waste.

Q79. The 'Silvering' of the head of the sperm (Acrosome) consists of enzymes like Hyaluronidase. Its primary function is to:

- (A) Dissolve the cells of Corona Radiata.
- (B) Neutralize the acidity of the vagina.
- (C) Provide energy for motility.
- (D) Bind to the receptor on the Fallopian tube.

Q80. Darwin's Finches are an excellent example of Adaptive Radiation. However, at a broader scale, they also illustrate:

- (A) Parallel evolution
- (B) Divergent evolution



- (C) Convergent evolution
- (D) Saltation

Q81. In a population, if the frequency of a dominant phenotype is 0.19, what is the frequency of the recessive allele, assuming Hardy-Weinberg equilibrium?

- (A) 0.9
- (B) 0.81
- (C) 0.1
- (D) 0.43

Q82. The 'Bottle-neck effect' usually results in:

- (A) Increased genetic diversity.
- (B) Random change in allele frequency due to a sudden reduction in population size.
- (C) Selection of the most fit individuals.
- (D) Increased gene flow from neighboring populations.

Q83. Homology indicates common ancestry, whereas analogy indicates similar adaptation. Which of the following is a pair of homologous organs?

- (A) Wings of a bird and wings of a butterfly.
- (B) Flippers of a penguin and flippers of a dolphin.
- (C) Thorns of *Bougainvillea* and tendrils of *Cucurbita*.
- (D) Eyes of an octopus and eyes of a mammal.

Q84. Which of the following Phylum is characterized by 'pseudocoelom' and 'syncytial epidermis'?

- (A) Platyhelminthes
- (B) Aschelminthes
- (C) Annelida



(D) Arthropoda

Q85. The presence of 'Choanocytes' (collar cells) is a unique diagnostic feature of:

(A) Coelenterata

(B) Porifera

(C) Ctenophora

(D) Mollusca

Q86. A 'Hemocoel' (blood-filled cavity) is found in:

(A) *Pheretima* and *Hirudinaria*

(B) *Periplaneta* and *Pila*

(C) *Hydra* and *Aurelia*

(D) *Taenia* and *Fasciola*

Q87. Identify the 'Urochordate' among the following:

(A) *Branchiostoma*

(B) *Herdmania*

(C) *Petromyzon*

(D) *Myxine*

Q88. The 'Haversian canals' in the histology of mammalian bone are connected to each other by transverse canals called:

(A) Bidder's canals

(B) Volkmann's canals

(C) Inguinal canals

(D) Canaliculi

Q89. In the cockroach (*Periplaneta americana*), the respiratory system consists of a network of trachea that open through 10 pairs of small holes called spiracles. Where are these spiracles located?



- (A) Dorsal side of the body
- (B) Ventral side of the body
- (C) Lateral side of the body
- (D) Only on the thoracic segments

Q90. Which type of cell junction acts as a 'barrier' to prevent the leakage of extracellular fluid between epithelial cells?

- (A) Adhering junctions
- (B) Gap junctions
- (C) Tight junctions
- (D) Desmosomes

Q91. If a segment of DNA has 120 adenine and 120 cytosine bases, what is the total number of nucleotides in that segment?

- (A) 240
- (B) 480
- (C) 120
- (D) 60

Q92. The 'rRNA' that acts as a structural component as well as a ribozyme in bacteria is:

- (A) 5S rRNA
- (B) 18S rRNA
- (C) 23S rRNA
- (D) 28S rRNA

Q93. A man with color blindness marries a woman who is a carrier for the same trait. What is the probability that their first son will be color blind?

- (A) 25%



- (B) 50%
- (C) 75%
- (D) 100%

Q94. During the process of Translation, the 'UAC' anticodon on tRNA will bind with which codon on mRNA?

- (A) AUG
- (B) GUA
- (C) ATG
- (D) UAC

Q95. In 'Gene Therapy' for ADA deficiency, the lymphocytes are used because:

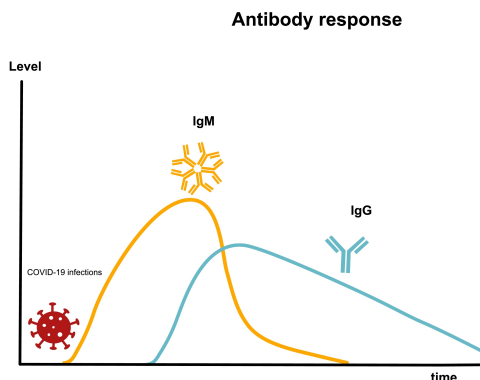
- (A) They are immortal cells.
- (B) They can be easily cultured and returned to the patient.
- (C) They are the only cells that express the ADA gene.
- (D) They do not require a viral vector.

Q96. The 'CryIAb' gene is specifically used to control:

- (A) Cotton bollworms
- (B) Corn borer
- (C) Root-knot nematode
- (D) Tobacco budworm

Q97. In a graph representing the "Primary and Secondary Immune Response," the 'Secondary Response' is significantly faster and more intense (Anamnestic). This is visually characterized by the rapid rise of which specific class of antibody in the blood?





- (A) IgM
- (B) IgA
- (C) IgG
- (D) IgD

Q98. Which of the following is a 'passive' immunity?

- (A) Immunity developed after a natural infection.
- (B) Immunity provided by a vaccine like BCG.
- (C) Transfer of antibodies through the placenta to the fetus.
- (D) Immunity generated by a toxoid.

Q99. A researcher is measuring the thickness of a plasma membrane using an electron microscope. If the average thickness is found to be 75 \AA , what is this value expressed in nanometers (nm) and micrometers (μm) respectively?

- (A) 7.5 nm and $0.0075 \mu\text{m}$
- (B) 0.75 nm and $0.075 \mu\text{m}$
- (C) 750 nm and $0.75 \mu\text{m}$
- (D) 7.5 nm and $0.75 \mu\text{m}$

Q100. In modern "Lab-on-a-chip" (LOC) technology used for rapid DNA sequencing, Field-Effect Transistors (FETs) made of semiconductor materials are often



utilized as biosensors. Which of the following statements best describes the principle of communication between the biological sample and the semiconductor device?

- (A) The semiconductor measures the mechanical pressure exerted by DNA strands during hybridization.
- (B) The change in surface potential due to the binding of charged biomolecules (like DNA) modulates the conductance of the semiconductor channel.
- (C) The semiconductor acts as a simple thermal resistor that detects the heat released during ATP hydrolysis.
- (D) The device uses electromagnetic induction to detect the magnetic moment of nitrogenous bases in the DNA.



Detailed Solutions

Q1.

Solution

Concept: Bryophytes possess a dominant gametophytic generation and a dependent sporophyte. In mosses, the sporophyte contains chlorophyll and can photosynthesize partially, though it remains attached to the gametophyte for nutrition. Multicellular rhizoids are also characteristic of Bryopsida, distinguishing them from liverworts which possess unicellular rhizoids.

Solution: The plant described has a dominant gametophytic phase, indicating it belongs to bryophytes rather than pteridophytes like Pteropsida or Lycopsida, where the sporophyte is dominant. The sporophyte is partially dependent but chlorophyllous, which is a characteristic feature of mosses. Furthermore, the presence of multicellular rhizoids strongly supports Bryopsida because liverworts (Hepaticopsida) possess unicellular rhizoids. Pteropsida and Lycopsida are vascular plants with independent sporophytes and true roots instead of rhizoids. Therefore, the combination of dominant gametophyte, multicellular rhizoids, and photosynthetic sporophyte clearly identifies the plant as belonging to Bryopsida.

Final Answer: Bryopsida

Answer: (B)

[Go Back to Question 1](#)

Q2.

Solution

Concept: In gymnosperms, pollination commonly occurs through a “pollen drop” mechanism. A sticky liquid secreted through the micropyle captures pollen grains and retracts them into the ovule’s pollen chamber. This adaptation ensures successful pollination, especially in wind-pollinated gymnosperms lacking flowers and stigmas.

Solution: The pollen drop mechanism is a specialized pollination adaptation found in gymnosperms. During pollination, the ovule secretes a liquid drop through the micropyle. Wind-borne pollen grains become trapped in this fluid. As the liquid retracts or dries, the pollen grains are pulled into the pollen chamber near the nucellus, enabling fertilization later. Option (A) is incorrect because the secretion is not produced by the microsporangium and is not primarily for insect attraction. Option (C) incorrectly relates the mechanism to dehiscence of microsporophylls. Option (D) is also wrong because the pollen drop does not nourish male gametes in the archegonium. Hence, the pollen drop is specifically a pollination liquid secreted by the micropyle for transporting pollen into the ovule.

Final Answer: Micropylar pollination drop that draws pollen into the pollen chamber

Answer: (B)

[Go Back to Question 2](#)



Q3.

Solution

Concept: The stellar system in vascular plants evolved gradually from simple to more complex arrangements to improve conduction and support.

- **Protosteles** is the most primitive type with solid vascular tissue.
- **Siphonosteles** evolved with a central pith.
- **Solenosteles** is a type of siphonostele with leaf gaps not overlapping.
- **Dictyosteles** is more advanced, having overlapping leaf gaps forming a network.

Evolutionary Sequence:

Protosteles → Siphonosteles → Solenosteles → Dictyosteles

Visual Representation:



Explanation:

- Option (A) correctly follows the accepted evolutionary trend.
- Other options place advanced forms before primitive ones.

Final Answer: Protosteles → Siphonosteles → Solenosteles → Dictyosteles

Answer: (A)

[Go Back to Question 3](#)



Q4.

Solution

Concept: Rhodophyceae exhibit a highly specialized post-fertilization development. After fertilization, the zygote develops into a carposporophyte enclosed within a protective structure called the cystocarp. This structure is characteristic of many red algae and aids in reproductive success.

Solution: In red algae, fertilization occurs within the carpogonium, the female reproductive organ. Following fertilization, a complex post-fertilization process leads to the formation of gonimoblast filaments and carpospores. These structures become enclosed by sterile tissue, collectively forming the cystocarp. The cystocarp protects developing carpospores and is an important reproductive adaptation in Rhodophyceae. Option (B), oogonium, is a female reproductive structure found in some algae and fungi but not the post-fertilization structure here. Option (C), trichogyne, is merely the receptive part of the carpogonium. Option (D), carpogonium, is the female gametangium itself. Hence, the correct answer is cystocarp.

Final Answer:

Answer: (A)

[Go Back to Question 4](#)

Q5.

Solution

Concept: Amphiphloic siphonostele is a vascular arrangement in which phloem occurs on both outer and inner sides of the xylem. This advanced stelar condition is commonly observed in the rhizomes of certain ferns, especially *Adiantum*, reflecting efficient vascular conduction.

Solution: Amphiphloic siphonostele consists of a central pith surrounded by xylem, with phloem present both externally and internally. This type of stele is characteristic of many fern rhizomes. Among the given options, *Adiantum*, a true fern, exhibits amphiphloic siphonostele in its rhizome. *Selaginella* typically possesses protostele, while *Equisetum* has a modified siphonostele with vallecular canals. *Marsilea* also shows specialized vascular organization but not the classic amphiphloic siphonostele associated with *Adiantum*. Therefore, the presence of amphiphloic siphonostele most accurately identifies *Adiantum*.

Final Answer:

Answer: (D)

[Go Back to Question 5](#)



Q6.

Solution

Concept: In a human blastocyst, the inner cell mass develops into the embryo proper, while the trophoblast contributes to extra-embryonic structures such as the chorion and placenta. This differentiation is crucial for embryonic development, implantation, and formation of supporting membranes required for nourishment and protection of the embryo.

Solution: The blastocyst is an early embryonic stage composed mainly of two important cellular components: the inner cell mass and the trophoblast. The inner cell mass forms the embryo proper, which later differentiates into all tissues and organs of the developing body. The trophoblast forms the outer protective layer and contributes to extra-embryonic membranes, especially the chorion, which later participates in placenta formation. Option (A) reverses these functions and is incorrect. Option (C) incorrectly associates the structures with the umbilical cord and amniotic fluid. Option (D) inaccurately limits the developmental roles of these structures. Therefore, the correct relationship is that the inner cell mass forms the embryo proper while the trophoblast forms extra-embryonic membranes such as the chorion.

Final Answer: Becomes the embryo proper; becomes the extra-embryonic membranes (chorion)

Answer: (B)

[Go Back to Question 6](#)

Q7.

Solution

Concept: During secondary growth in dicot stems, the periderm replaces the epidermis. From outer to inner side, the tissues are arranged as phellem, phellogen, phelloderm, and secondary phloem. This orderly arrangement provides protection and support while maintaining vascular conduction in mature stems.

Solution: In mature dicot stems undergoing secondary growth, the epidermis is replaced by periderm. The outermost tissue is phellem or cork, composed of dead protective cells. Beneath it lies the phellogen or cork cambium, a lateral meristem responsible for producing new cells. Towards the inner side, phellogen produces phelloderm, also called secondary cortex. Further inward lies the secondary phloem, which conducts food materials. Option (B) correctly presents this sequence from exterior to interior. Option (A) incorrectly places phelloderm before phellogen. Option (C) begins with phellogen externally, which is anatomically incorrect. Option (D) also misarranges the tissues and incorrectly mentions endodermis. Hence, the correct sequence is phellem, phellogen, phelloderm, followed by secondary phloem.

Final Answer: Phellem → Phellogen → Phelloderm → Secondary Phloem

Answer: (B)

[Go Back to Question 7](#)



Q8.

Solution

Concept: During secondary growth, phellogen or cork cambium produces tissues on both sides. Cells formed outward become cork or phellem, while cells produced inward differentiate into phelloderm, also called secondary cortex. These tissues together constitute the protective periderm of mature stems and roots.

Solution: Phellogen is a lateral meristem that develops during secondary growth in extrastelar regions. It actively divides to produce cells on both outer and inner sides. The outer cells become cork or phellem, which are dead and suberized for protection. The inner cells remain living and differentiate into phelloderm, commonly known as secondary cortex. Option (A) is incorrect because cork is produced outwardly, not inwardly. Option (B), complementary cells, are associated with lenticels rather than normal inward growth. Option (D), rhytidome, refers to dead outer bark tissues formed later during extensive secondary growth. Therefore, the cells produced on the inner side of phellogen differentiate into secondary cortex or phelloderm.

Final Answer: Secondary cortex

Answer: (C)

[Go Back to Question 8](#)

Q9.

Solution

Concept: Kranz anatomy is characteristic of C_4 plants and is often associated with specialized epidermal adaptations. Large, thin-walled, empty-looking cells present in the upper epidermis of many monocot leaves are called bulliform cells. They help in rolling and unrolling of leaves during water stress conditions.

Solution: The question describes a leaf with Kranz anatomy, indicating a C_4 plant. In such leaves, large, thin-walled cells are often present on the upper epidermis. These are bulliform cells, also called motor cells. They lose water during dry conditions, causing the leaf to roll inward and thereby reducing transpiration. When water becomes available, they regain turgidity and the leaf unrolls. Option (A), subsidiary cells, are associated with stomata. Option (C), passage cells, occur in roots and aid transport. Option (D), guard cells, regulate stomatal opening but do not match the description of large empty epidermal cells. Therefore, the cells described are bulliform cells.

Final Answer: Bulliform cells

Answer: (B)

[Go Back to Question 9](#)



Q10.

Solution

Concept: Interfascicular cambium originates from mature parenchymatous cells between vascular bundles, making it secondary in origin. However, after formation it functions as a normal cambium by producing secondary vascular tissues, thereby acting like a primary meristem in functional significance during secondary growth.

Solution: Lateral meristems are responsible for secondary growth in plants. Among them, interfascicular cambium arises secondarily from medullary ray cells situated between vascular bundles. Since it develops from mature permanent tissue, it is secondary in origin. However, once formed, it actively divides and contributes to secondary xylem and phloem formation along with intrafascicular cambium. Thus, functionally it behaves like a primary cambial meristem. Intrafascicular cambium is primary in origin because it develops directly from procambium. Cork cambium forms protective tissues rather than vascular tissues. Vascular cambium in roots is not generally described as secondary in origin but primary in function. Therefore, interfascicular cambium best fits the given description.

Final Answer: Interfascicular cambium

Answer: (B)

[Go Back to Question 10](#)

Q11.

Solution

Concept: Tyloses are balloon-like outgrowths formed by adjacent xylem parenchyma cells that protrude into vessel lumens through pits. They commonly develop in aging xylem and heartwood, helping block vessels and prevent pathogen spread or water loss in certain angiosperms.

Solution: In many angiosperms, tyloses develop during heartwood formation or in response to injury. Living xylem parenchyma cells adjacent to vessels expand through pit membranes into the vessel lumen, forming sac-like structures called tyloses. These outgrowths block the vessel cavity and reduce conduction, but they also help protect the plant from pathogen invasion and excessive water loss. Option (A) is incorrect because tyloses are not secretory glands. Option (C) incorrectly describes wall thickenings of tracheids. Option (D) refers to fungal hyphae, which are unrelated to tyloses. Therefore, tyloses are correctly identified as outgrowths of parenchyma cells extending into vessel lumens through pits.

Final Answer: Outgrowths of parenchyma cells into the lumen of vessels through pits

Answer: (B)

[Go Back to Question 11](#)



Q12.

Solution

Concept: Plasma membrane fluidity depends on lipid composition. At low temperatures, cholesterol prevents tight packing of phospholipids, while unsaturated fatty acids maintain flexibility due to kinks in their hydrocarbon chains. Together they ensure membrane stability and proper cellular functioning under varying thermal conditions.

Solution: The plasma membrane follows the fluid mosaic model, where membrane fluidity is essential for transport, signaling, and enzyme activity. At low temperatures, phospholipids tend to pack tightly, making the membrane rigid. Cholesterol acts as a buffer by preventing excessive packing of lipid molecules. Unsaturated phospholipids also contribute to fluidity because their double bonds create bends that reduce close packing. Option (A), saturated fatty acids, would increase rigidity instead of fluidity. Peripheral proteins and glycocalyx do not primarily regulate membrane fluidity. Therefore, the combined presence of cholesterol and unsaturated phospholipids helps maintain proper membrane fluidity at low temperatures.

Final Answer: Cholesterol and unsaturated phospholipids

Answer: (B)

[Go Back to Question 12](#)

Q13.

Solution

Concept: During the S-phase of the cell cycle, DNA replication occurs in the nucleus. Simultaneously, animal cells duplicate their centrioles in the cytoplasm. This ensures that two centrosomes are available later for spindle formation during mitosis and proper chromosome segregation.

Solution: The S-phase is primarily known for DNA replication, where chromosomes duplicate to form sister chromatids. In animal cells, another important event occurring simultaneously in the cytoplasm is centriole duplication. Each centriole gives rise to a new centriole, resulting in two centrosomes required for spindle organization during mitosis. Option (A), histone synthesis, does occur but is mainly associated with chromatin assembly rather than a distinct cytoplasmic event. Option (C), tubulin synthesis, is not specifically restricted to S-phase. Option (D), mitochondrial division, may occur independently throughout the cell cycle. Therefore, the characteristic cytoplasmic event associated with S-phase in animal cells is centriole duplication.

Final Answer: Centriole duplication

Answer: (B)

[Go Back to Question 13](#)



Q14.

Solution

Concept: Meiosis I is a reductional division in which homologous chromosomes separate, reducing the chromosome number to half.

- Initial condition at G_1 :

$$2n = 24, \quad 2C$$

- During S-phase, DNA replicates:

$$2n = 24, \quad 4C$$

- After Meiosis I:

- Homologous chromosomes separate.
- Chromosome number becomes haploid:

$$n = 12$$

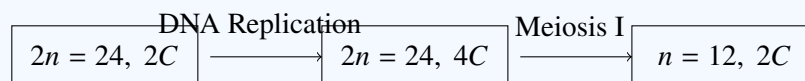
- Each chromosome still has two chromatids, so DNA content remains:

$$2C$$

Sequence of Changes:

$$2n, 2C \rightarrow 2n, 4C \rightarrow n, 2C$$

Visual Representation:



Final Answer: $n = 12, 2C$

Answer: (A)

[Go Back to Question 14](#)



Q15.

Solution

Concept: Crossing over during meiosis occurs in Prophase I and involves exchange of genetic material between homologous chromosomes. The enzyme recombinase facilitates this process by promoting breakage and reunion of DNA strands. Its functional activity is most prominent during the pachytene stage of meiosis.

Solution: Prophase I of meiosis is divided into leptotene, zygotene, pachytene, diplotene, and diakinesis. During zygotene, homologous chromosomes pair through synapsis and form bivalents. However, actual crossing over occurs during pachytene. At this stage, the enzyme recombinase becomes active and catalyzes the exchange of genetic material between non-sister chromatids of homologous chromosomes. This process produces genetic recombination and variation among offspring. During diplotene, the homologous chromosomes begin separating while remaining attached at chiasmata. Diakinesis represents terminalization of chiasmata. Therefore, recombinase is functionally active during pachytene when crossing over is actively taking place.

Final Answer: Pachytene

Answer: (B)

[Go Back to Question 15](#)

Q16.

Solution

Concept: Photorespiration is a metabolic pathway involving chloroplasts, peroxisomes, and mitochondria. In this pathway, glycolate produced in chloroplasts is transported to peroxisomes, where it is oxidized into glyoxylate. This step is catalyzed by glycolate oxidase and is characteristic of photorespiratory metabolism.

Solution: Photorespiration begins when RuBisCO oxygenates RuBP instead of carboxylating it, producing phosphoglycolate. This compound is converted into glycolate inside chloroplasts. The glycolate is then transported to peroxisomes, where the enzyme glycolate oxidase converts it into glyoxylate. Peroxisomes therefore play a major role in the photorespiratory pathway. Chloroplasts initiate the process but do not perform this specific conversion. Mitochondria participate later in glycine metabolism, while glyoxysomes are specialized organelles involved mainly in fat metabolism during seed germination. Hence, the organelle responsible for converting glycolate into glyoxylate is the peroxisome.

Final Answer: Peroxisome

Answer: (B)

[Go Back to Question 16](#)



Q17.

Solution

Concept: In an anatropous ovule, the ovule becomes inverted during development, bringing the micropyle close to the funicle. The junction where the body of the ovule attaches and fuses with the funicle is known as the hilum, an important identifying feature of ovule structure.

Solution: The anatropous ovule is the most common type of ovule found in angiosperms. In this condition, the ovule bends completely so that the micropyle lies close to the funicle. The point where the ovule body remains attached to the funicle is called the hilum. Option (A), micropyle, refers to the small opening through which the pollen tube enters. Option (B), chalaza, is the basal region opposite the micropyle where integuments and nucellus meet. Option (D), nucellus, is the nutritive tissue surrounding the embryo sac. Therefore, the point of fusion between the body of the ovule and the funicle is correctly identified as the hilum.

Final Answer: Hilum

Answer: (C)

[Go Back to Question 17](#)

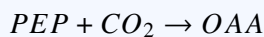


Q18.

Solution

Concept: In the C_4 pathway, carbon dioxide is first fixed in the mesophyll cells and then transported to the bundle sheath cells where the Calvin cycle occurs.

- In mesophyll cells:



- Oxaloacetate (OAA) is converted into:

Malate or Aspartate

- These compounds are transported to the bundle sheath cells.
- There, they release CO_2 for the Calvin cycle.

Flow of Carbon Transport:**Visual Representation:****Explanation:**

- PEP acts as the initial acceptor of CO_2 .
- OAA is the first stable product.
- Malate or Aspartate are the transport molecules carrying carbon to bundle sheath cells.
- Pyruvate returns back to mesophyll cells after decarboxylation.

Final Answer: Malate or Aspartate

Answer: (B)

[Go Back to Question 18](#)



Q19.

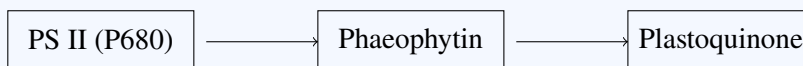
Solution

Concept: In non-cyclic photophosphorylation, light energy excites electrons in Photosystem II (PS II). These excited electrons are first transferred to a primary electron acceptor.

- In PS II, the reaction center is **P680**.
- The excited electron from P680 is initially accepted by:

Phaeophytin

- From phaeophytin, electrons move to plastoquinone and then through the electron transport chain.

Electron Flow:
$$P680 \rightarrow \text{Phaeophytin} \rightarrow \text{Plastoquinone}$$
Visual Representation:**Explanation:**

- Phaeophytin acts as the primary electron acceptor of PS II.
- Plastoquinone receives electrons after phaeophytin.
- Plastocyanin transfers electrons between cytochrome complex and PS I.
- Ferredoxin functions near PS I.

Final Answer:

Answer: (A)

[Go Back to Question 19](#)



Q20.

Solution

Concept: The Warburg effect in plant physiology refers to the inhibition of photosynthesis at high oxygen concentration. Elevated oxygen levels enhance photorespiration because RuBisCO acts as an oxygenase instead of a carboxylase, thereby reducing the efficiency of carbon fixation and overall photosynthetic productivity.

Solution: Otto Warburg observed that high concentrations of oxygen suppress the rate of photosynthesis in many plants. This phenomenon occurs because RuBisCO can bind both carbon dioxide and oxygen. At elevated oxygen levels, oxygenation of RuBP increases, initiating photorespiration instead of the Calvin cycle. Photorespiration consumes energy and releases previously fixed carbon dioxide, reducing net photosynthetic efficiency. Option (B) incorrectly links the effect to respiration and high carbon dioxide levels. Option (C) refers to uncoupling of oxidative phosphorylation, which is unrelated. Option (D) concerns light harvesting saturation rather than oxygen inhibition. Therefore, the Warburg effect specifically describes inhibition of photosynthesis due to high oxygen concentration.

Final Answer: Inhibition of photosynthesis by high O_2 levels

Answer: (A)

[Go Back to Question 20](#)

Q21.

Solution

Concept: In the Krebs cycle, most oxidation reactions reduce NAD^+ to NADH. However, only one step involves the reduction of FAD to $FADH_2$. This occurs during oxidation of succinate into fumarate by the enzyme succinate dehydrogenase located on the inner mitochondrial membrane.

Solution: The Krebs cycle includes several oxidation-reduction reactions that generate reducing equivalents for ATP production. Among these reactions, isocitrate to α -ketoglutarate produces NADH, while succinyl-CoA to succinate generates GTP through substrate-level phosphorylation. The conversion of succinate into fumarate is unique because the enzyme succinate dehydrogenase uses FAD as the hydrogen acceptor instead of NAD^+ . During this process, FAD is reduced to $FADH_2$. The fumarate to malate step involves hydration rather than oxidation-reduction. Therefore, the only Krebs cycle reaction that directly forms $FADH_2$ is the oxidation of succinate to fumarate. This step also links the Krebs cycle with the electron transport chain because succinate dehydrogenase functions as Complex II.

Final Answer: Succinate to Fumarate

Answer: (C)

[Go Back to Question 21](#)



Q22.

Solution

Concept: The retina contains photoreceptors, bipolar cells, and ganglion cells arranged in sequential layers. Light stimulates photoreceptors first, generating signals that pass to bipolar cells and then to ganglion cells. Axons of ganglion cells form the optic nerve carrying impulses to the brain for visual perception.

Solution: In the retina, photoreceptors such as rods and cones detect light and convert it into electrical signals. These impulses are transmitted to bipolar cells, which act as interneurons connecting photoreceptors with ganglion cells. Ganglion cells generate action potentials whose axons collectively form the optic nerve. In the diagram, the deepest sensory layer corresponds to photoreceptors, the middle layer to bipolar cells, and the innermost layer to ganglion cells. Thus, label (R) represents photoreceptors, (Q) represents bipolar cells, and (P) represents ganglion cells. The correct direction of impulse transmission is from photoreceptors to bipolar cells and then to ganglion cells. Therefore, the path of action potential is represented as $R \rightarrow Q \rightarrow P$.

Final Answer: (P) Ganglion cell, (Q) Bipolar cell, (R) Photoreceptor; Path: $R \rightarrow Q \rightarrow P$

Answer: (B)

[Go Back to Question 22](#)

Q23.

Solution

Concept: Abscisic acid is commonly called the stress hormone of plants. It helps plants survive unfavorable environmental conditions by inducing stomatal closure during water deficiency, thereby reducing transpiration and conserving water essential for cellular activities and growth.

Solution: Plants respond to drought and water stress through hormonal regulation. Abscisic acid accumulates in leaves when water availability decreases. This hormone triggers the movement of ions out of guard cells, causing them to lose turgor and close the stomata. Stomatal closure reduces transpiration and minimizes water loss from the plant body. Ethylene mainly regulates fruit ripening and senescence, while cytokinins promote cell division and delay aging. Gibberellic acid stimulates stem elongation and seed germination rather than stress responses. Therefore, the hormone specifically associated with stress response and stomatal closure during water deficit is abscisic acid.

Final Answer: Abscisic acid

Answer: (C)

[Go Back to Question 23](#)



Q24.

Solution

Concept: Guttation is the exudation of liquid water droplets from leaf margins through specialized structures called hydathodes. It usually occurs at night or early morning when transpiration is low and root pressure becomes sufficiently high to force water outward.

Solution: Guttation mainly occurs under conditions of high soil moisture and low transpiration, such as during humid nights. Since transpiration pull is weak at this time, water absorbed by roots accumulates within the xylem, generating positive root pressure. This pressure pushes liquid water upward and out through hydathodes located at leaf tips or margins. Option (A) is incorrect because high transpiration pull is associated with water vapor loss rather than guttation. Option (C), low humidity, generally increases transpiration instead of guttation. Option (D), capillary action, contributes slightly to water movement but is not the primary cause. Hence, guttation is primarily driven by positive root pressure.

Final Answer: Positive root pressure

Answer: (B)

[Go Back to Question 24](#)



Q25.

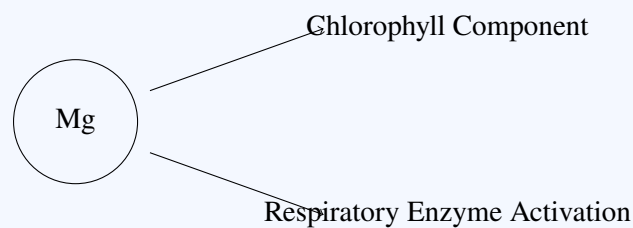
Solution

Concept: Mineral elements perform important structural and metabolic functions in plants.

- **Magnesium (Mg)** is the central atom present in the chlorophyll molecule.
- It also acts as an activator for many enzymes involved in:
 - Respiration
 - Photosynthesis
 - DNA and RNA synthesis

Role of Magnesium:

Chlorophyll Structure + Enzyme Activation

Visual Representation:**Explanation:**

- Fe is important for electron transport but not the central chlorophyll atom.
- Mn is involved in photolysis of water.
- Mo is associated with nitrogen metabolism.

Final Answer: Mg

Answer: (C)

[Go Back to Question 25](#)



Q26.

Solution

Concept: Short-day plants flower only when the dark period exceeds a critical duration. Interruption of the dark period by red light prevents flowering because phytochrome-mediated responses interpret the interruption as a shorter night, thereby inhibiting floral induction in these plants.

Solution: In short-day plants, flowering depends on receiving an uninterrupted dark period longer than the critical duration. If the critical light duration is 10 hours, flowering occurs when the plant experiences less than 10 hours of light and a sufficiently long continuous night. Options (A), (C), and (D) provide long uninterrupted dark periods, so flowering occurs. However, in option (B), although the light period is only 9 hours, the dark period is interrupted by a flash of red light. This interruption breaks the continuity of darkness and prevents floral induction. Red light converts phytochrome into its active form, making the plant physiologically interpret the night as shorter. Consequently, the short-day plant fails to flower under this condition.

Final Answer: Red light interruption during the dark period prevents flowering

Answer: (B)

[Go Back to Question 26](#)

Q27.

Solution

Concept: Glycolysis consists of an energy investment phase and a pay-off phase. The pay-off phase begins when glyceraldehyde-3-phosphate is oxidized to 1,3-bisphosphoglycerate, producing NADH and enabling subsequent ATP generation through substrate-level phosphorylation reactions.

Solution: During glycolysis, the initial reactions consume ATP and prepare glucose for breakdown. This portion is called the investment phase. Fructose-1,6-bisphosphate is split into DHAP and glyceraldehyde-3-phosphate, but ATP production has not yet started. The pay-off phase begins specifically when glyceraldehyde-3-phosphate is oxidized into 1,3-bisphosphoglycerate by glyceraldehyde-3-phosphate dehydrogenase. This reaction generates NADH and introduces a high-energy phosphate bond. Subsequent reactions then produce ATP by substrate-level phosphorylation. Option (A) belongs to the investment stage, while option (D) occurs later in glycolysis. Therefore, the pay-off phase starts with the conversion of glyceraldehyde-3-phosphate into 1,3-bisphosphoglycerate.

Final Answer: Glyceraldehyde-3-phosphate to 1,3-bisphosphoglycerate

Answer: (C)

[Go Back to Question 27](#)



Q28.

Solution

Concept: According to the Munch pressure flow hypothesis, translocation in phloem occurs through mass flow driven by differences in turgor pressure between source and sink regions. Sugars loaded into sieve tubes draw water osmotically, creating pressure that moves solutes through the phloem.

Solution: The Munch pressure flow hypothesis explains long-distance transport of organic solutes in plants. At the source region, usually leaves, sugars are actively loaded into sieve tubes. This lowers water potential and causes water to enter from adjacent xylem by osmosis, generating high turgor pressure. At the sink region, such as roots or developing fruits, sugars are removed, leading to lower pressure. The resulting pressure gradient drives bulk flow of phloem sap from source to sink. Option (A) incorrectly suggests active water transport, while option (C) refers to cytoplasmic streaming, which is insufficient for long-distance translocation. Option (D) relates to transpiration-driven xylem transport. Therefore, phloem translocation occurs due to a turgor pressure gradient between source and sink regions.

Final Answer: A turgor pressure gradient between source and sink

Answer: (B)

[Go Back to Question 28](#)

Q29.

Solution

Concept: In angiosperms, somatic tissues such as nucellus are diploid, gametophytic cells like synergids are haploid, and the primary endosperm nucleus is typically triploid due to triple fusion. Chromosome numbers in these structures can therefore be determined directly from the haploid chromosome number of the species.

Solution: The haploid chromosome number of the plant is given as $n = 12$. The nucellus is a sporophytic tissue and therefore diploid, containing $2n = 24$ chromosomes. The primary endosperm nucleus forms after triple fusion between one male gamete and two polar nuclei. Since each nucleus contributes $n = 12$ chromosomes, the endosperm nucleus becomes triploid with $3n = 36$ chromosomes. Synergids are part of the female gametophyte and remain haploid, so they contain $n = 12$ chromosomes. Thus, the chromosome numbers in the nucellus, primary endosperm nucleus, and synergids are 24, 36, and 12 respectively. Therefore, option (A) correctly represents the required chromosome numbers.

Final Answer: 24, 36, 12

Answer: (A)

[Go Back to Question 29](#)



Q30.

Solution

Concept: Self-incompatibility is a genetically controlled physiological mechanism that prevents self-pollen from germinating or fertilizing ovules of the same plant. It promotes cross-pollination and genetic variation by allowing pollen from genetically different individuals of the same species to function normally.

Solution: In the given situation, pollen grains fail to germinate on the stigma of the same plant but grow successfully on another individual of the same species. This indicates a recognition mechanism between pollen and pistil that rejects genetically similar pollen. Such a mechanism is called self-incompatibility. It is controlled by specific genes and prevents self-fertilization, thereby encouraging cross-pollination and maintaining genetic diversity. Herkogamy refers to spatial separation of anthers and stigma, dicliny refers to unisexual flowers, and protandry refers to earlier maturation of anthers than stigma. None of these directly involve physiological rejection of self-pollen. Therefore, the phenomenon described is self-incompatibility.

Final Answer: Self-incompatibility

Answer: (C)

[Go Back to Question 30](#)

Q31.

Solution

Concept: The male gametophyte of angiosperms develops through microsporogenesis followed by microgametogenesis. The pollen grain contains vegetative and generative cells, and during pollen tube growth the generative cell divides mitotically to form two male gametes required for double fertilization.

Solution: The mature pollen grain represents the immature male gametophyte. After pollination, the vegetative cell forms the pollen tube while the generative cell enters the tube and divides mitotically to produce two male gametes. Thus, the developmental sequence involves pollen grain formation first, followed by the presence of the generative cell, development of the pollen tube, and finally formation of two male gametes. Option (B) describes stages mainly associated with microsporogenesis rather than complete male gametophyte development. Option (C) includes sporophyte-level structures and omits essential stages. Option (D) incorrectly reverses the order and ends with microspore formation. Therefore, the correct developmental sequence is pollen grain to generative cell to pollen tube to two male gametes.

Final Answer: Pollen grain → Generative cell → Pollen tube → Two male gametes

Answer: (A)

[Go Back to Question 31](#)



Q32.

Solution

Concept: In hardworking skeletal muscles, increased metabolic activity produces more carbon dioxide, heat, and acidic products. These factors shift the oxygen dissociation curve to the right, reducing hemoglobin affinity for oxygen and facilitating greater oxygen release to actively respiring tissues.

Solution: A shift of the oxygen dissociation curve from position X to Y represents a rightward shift. This occurs under conditions where hemoglobin releases oxygen more readily. In actively working skeletal muscles, respiration increases carbon dioxide concentration and lowers pH due to lactic acid accumulation. Muscle activity also raises local temperature. These combined factors decrease the affinity of hemoglobin for oxygen, promoting efficient oxygen unloading to tissues. Option (A) would shift the curve left by increasing oxygen affinity. Option (C) also favors left shift due to higher pH and reduced 2,3-BPG. Option (D) does not represent conditions typical of hardworking muscles. Therefore, decreased pH, increased PCO_2 , and increased temperature cause the observed rightward shift.

Final Answer: Decreased pH , Increased PCO_2 , Increased Temperature

Answer: (B)

[Go Back to Question 32](#)

Q33.

Solution

Concept: The Polygonum type embryo sac is the most common type in angiosperms and is eight-nucleate, seven-celled. It contains three cells at the micropylar end, three antipodal cells at the chalazal end, and two polar nuclei located centrally in the large central cell.

Solution: In a mature Polygonum type embryo sac, the micropylar end contains the egg apparatus composed of one egg cell and two synergids, making a total of three nuclei. At the chalazal end, there are three antipodal cells, contributing another three nuclei. In the center lies the large central cell containing two polar nuclei before fusion. Thus, the distribution of nuclei from micropylar end to chalazal end and center is 3, 3, and 2 respectively. Option (A) incorrectly places two nuclei at the chalazal end. Option (B) reverses the arrangement, while option (D) gives an incorrect nuclear distribution. Therefore, the correct arrangement is 3, 3, and 2.

Final Answer: 3, 3, 2

Answer: (C)

[Go Back to Question 33](#)



Q34.

Solution

Concept: Cleistogamy is the production of closed flowers that never open and undergo self-pollination. Plants with chasmogamous flowers may also produce cleistogamous flowers to ensure seed formation even in the absence of pollinators, thereby guaranteeing reproductive success under unfavorable conditions.

Solution: Chasmogamous flowers are open flowers that depend on pollinating agents for fertilization. However, some plants also produce cleistogamous flowers that remain closed and self-pollinate internally. This adaptation ensures successful seed set even when pollinators are absent. Geitonogamy refers to transfer of pollen between flowers of the same plant, while xenogamy involves cross-pollination between different plants. Apomixis produces seeds without fertilization and is unrelated to the presence of chasmogamous flowers. Therefore, the mechanism enabling assured seed formation in the absence of pollinators is cleistogamy.

Final Answer: Cleistogamy

Answer: (B)

[Go Back to Question 34](#)

Q35.

Solution

Concept: Adventive embryony is a form of apomixis in which embryos develop directly from diploid somatic tissues such as nucellus or integuments without fertilization. These embryos are genetically identical to the parent plant and often occur alongside sexually produced embryos.

Solution: In adventive embryony, embryos arise directly from diploid cells of the nucellus or integuments rather than from the fertilized egg. Since fertilization is absent, the resulting embryos are genetically identical to the maternal parent. Parthenogenesis specifically refers to embryo development from an unfertilized egg cell. Apospory involves development of an embryo sac from somatic cells without meiosis, while diplospory involves embryo sac formation directly from the megaspore mother cell without reduction division. The process described in the question clearly involves direct embryo formation from nucellar or integumentary tissues, which is characteristic of adventive embryony.

Final Answer: Adventive embryony

Answer: (B)

[Go Back to Question 35](#)



Q36.

Solution

Concept: In gymnosperms, the endosperm represents the haploid female gametophyte formed before fertilization. Therefore, its chromosome number equals the haploid number of the species, while root tip cells are diploid and contain twice the chromosome number present in the endosperm.

Solution: The gymnosperm endosperm differs from that of angiosperms because it develops from the female gametophyte before fertilization and remains haploid. If the endosperm contains 15 chromosomes, then the haploid number of the species is $n = 15$. Root tip cells are somatic tissues and therefore diploid. Their chromosome number will be twice the haploid number. Thus, the chromosome number in root tip cells becomes $2n = 30$. Option (A) incorrectly gives the haploid number, while option (C) gives a triploid condition not found in gymnosperm roots. Option (D) is unrelated to the given data. Therefore, the correct chromosome number in root tip cells is 30.

Final Answer:

Answer: (B)

[Go Back to Question 36](#)



Q37.

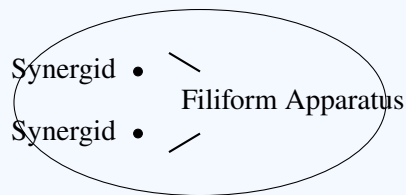
Solution

Concept: The embryo sac of angiosperms contains different specialized cells involved in fertilization.

- The two **synergid cells** possess a special thickening called the **filiform apparatus**.
- It is located near the micropylar end.
- The filiform apparatus helps:
 - Guide the pollen tube
 - Facilitate nutrient transfer

Structure of Embryo Sac:

Synergids → Filiform Apparatus

Visual Representation:**Explanation:**

- Egg cell does not contain filiform apparatus.
- Central cell contains polar nuclei.
- Antipodal cells are located at the chalazal end.

Final Answer: Synergid**Answer: (C)**[Go Back to Question 37](#)

Q38.

Solution

Concept: In a dihybrid cross, genes assort independently according to Mendel's law of independent assortment. The probability of obtaining a specific genotype is calculated by multiplying the individual genotype probabilities for each gene pair derived from the parental cross.

Solution: The cross given is $AaBb \times AaBb$. To obtain genotype $aaBb$, probabilities for each gene must be calculated separately. For the A-gene cross, $Aa \times Aa$ produces genotype aa with probability $1/4$. For the B-gene cross, $Bb \times Bb$ produces genotype Bb with probability $1/2$. Since the two genes assort independently, the combined probability is obtained by multiplication:

$$\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$$

Expressed in terms of sixteenths:

$$\frac{1}{8} = \frac{2}{16}$$

Therefore, the probability of obtaining an offspring with genotype $aaBb$ is $2/16$.

Final Answer:

Answer: (B)

[Go Back to Question 38](#)

Q39.

Solution

Concept: Co-dominance occurs when both alleles of a gene express themselves fully and simultaneously in the heterozygous condition. As a result, the offspring displays characteristics of both parents together rather than showing blending or dominance of only one parental trait.

Solution: The question asks for the Mendelian idea where the F_1 generation resembles both parents simultaneously. This is characteristic of co-dominance. In co-dominance, neither allele suppresses the expression of the other, and both are equally expressed in the heterozygote. A common example is the human ABO blood group system where genotype $I^A I^B$ expresses both A and B antigens together. Incomplete dominance differs because traits blend to form an intermediate phenotype. The law of dominance states that one allele masks another, which is not occurring here. Therefore, simultaneous resemblance to both parents in the F_1 generation demonstrates co-dominance.

Final Answer:

Answer: (C)

[Go Back to Question 39](#)



Q40.

Solution**Concept:** In the ABO blood group system:

- Blood group A (heterozygous) genotype:

$$I^A i$$

- Blood group B (heterozygous) genotype:

$$I^B i$$

Cross:

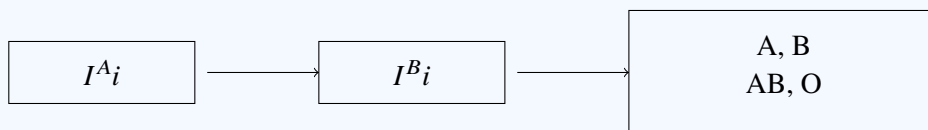
$$I^A i \times I^B i$$

Punnett Combination:

	I^B	i
I^A	$I^A I^B$	$I^A i$
i	$I^B i$	ii

Possible Blood Groups:

- $I^A I^B \rightarrow AB$
- $I^A i \rightarrow A$
- $I^B i \rightarrow B$
- $ii \rightarrow O$

Visual Representation:**Final Answer:** A, B, AB, and O**Answer:** (C)[Go Back to Question 40](#)

Q41.

Solution

Concept: During an action potential, sodium channels open first causing depolarization. At the peak, sodium channels become inactivated while potassium channels open fully, initiating repolarization. This coordinated ion movement restores the resting membrane potential of the neuron after excitation.

Solution: In an action potential, depolarization occurs when voltage-gated sodium channels open and sodium ions rapidly enter the neuron. As the membrane potential approaches its peak, sodium channels become inactivated, preventing further sodium entry. Simultaneously, voltage-gated potassium channels open completely, allowing potassium ions to move out of the cell. This outward movement initiates repolarization. On the graph, point P represents depolarization, Q represents the peak of the action potential, R represents repolarization, and S represents hyperpolarization. Since sodium channel inactivation and full potassium channel opening occur at the peak just before repolarization begins, the correct point is Q.

Final Answer:

Answer:

[Go Back to Question 41](#)

Q42.

Solution

Concept: Alfred Sturtevant developed the concept of genetic mapping by correlating recombination frequency with the physical distance between genes on chromosomes. He showed that genes farther apart undergo more recombination, forming the basis of linkage maps in genetics.

Solution: While studying linkage in fruit flies, Alfred Sturtevant, a student of T.H. Morgan, observed that recombination frequency between genes varied depending on their relative positions on chromosomes. He proposed that genes arranged farther apart on the same chromosome are more likely to undergo crossing over during meiosis. Using this idea, he prepared the first genetic linkage map. Gregor Mendel established the laws of inheritance but did not explain linkage or recombination. T.H. Morgan discovered linkage, while Sutton and Boveri proposed the chromosomal theory of inheritance. Therefore, the scientist who first explained recombination frequency as a measure of gene distance was Alfred Sturtevant.

Final Answer:

Answer:

[Go Back to Question 42](#)



Q43.

Solution

Concept: Linked genes are located on the same chromosome and tend to be inherited together. In linkage studies, parental-type offspring occur more frequently than recombinant types because crossing over between closely linked genes occurs less often during meiosis.

Solution: In a test cross involving dihybrid flies, independent assortment would produce parental and recombinant offspring in equal numbers. However, the observation of more parental-type offspring indicates that the genes do not assort independently. Instead, they are physically associated on the same chromosome and therefore inherited together more frequently. Recombinant offspring arise only when crossing over occurs between linked genes during meiosis. Since crossing over frequency is relatively low for closely linked genes, recombinant types are fewer in number. Thus, the predominance of parental combinations demonstrates genetic linkage. Therefore, the two genes are linked and present on the same chromosome.

Final Answer: The two genes are linked and present on the same chromosome

Answer: (B)

[Go Back to Question 43](#)

Q44.

Solution

Concept: Pleiotropy occurs when a single gene influences multiple phenotypic traits. A mutation in such a gene produces several effects in the organism simultaneously. Phenylketonuria is a classic example where one defective gene affects metabolism, skin pigmentation, and mental development.

Solution: Phenylketonuria is caused by mutation in the gene coding for phenylalanine hydroxylase. This single genetic defect leads to accumulation of phenylalanine and affects multiple body systems. Individuals may show intellectual disability, reduced pigmentation of skin and hair, and metabolic abnormalities. Thus, one gene influences several phenotypic characters, demonstrating pleiotropy. Haemophilia and color blindness are sex-linked disorders mainly affecting specific physiological functions, while thalassemia primarily affects hemoglobin synthesis. Although these disorders have important consequences, they are not standard examples used to explain pleiotropy. Therefore, phenylketonuria best represents pleiotropic gene action.

Final Answer: Phenylketonuria

Answer: (C)

[Go Back to Question 44](#)



Q45.

Solution

Concept: PCR requires repeated heating cycles to separate DNA strands. Therefore, a thermostable DNA polymerase is essential. The commonly used enzyme, Taq polymerase, remains active even after exposure to high temperatures that would denature ordinary human DNA polymerase enzymes.

Solution: During PCR, DNA strands are separated by heating the reaction mixture to temperatures around 94°C . Ordinary human DNA polymerase would denature and lose activity at such high temperatures. Taq polymerase, isolated from the thermophilic bacterium *Thermus aquaticus*, is thermostable and remains functional throughout repeated heating cycles. This allows efficient amplification of DNA without replacing the enzyme after each cycle. Option (A) is not the primary reason for its use. Option (C) is incorrect because DNA polymerase still requires primers. Option (D) describes reverse transcriptase rather than Taq polymerase. Therefore, PCR uses this enzyme mainly because it remains active at very high temperatures.

Final Answer: It remains active at very high temperatures

Answer: (B)

[Go Back to Question 45](#)



Q46.

Solution

Concept: The plasmid **pBR322** is a commonly used cloning vector containing two antibiotic resistance genes:

- **amp^R** — Ampicillin resistance
- **tet^R** — Tetracycline resistance

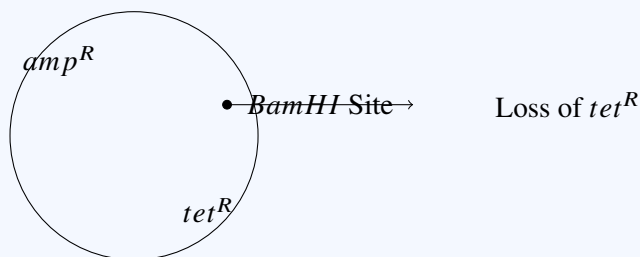
Important Feature:

- The *Bam*HI restriction site is located within the **tetracycline resistance gene**.
- Insertion of foreign DNA at this site disrupts the tet^R gene.
- As a result, recombinant bacteria lose resistance to tetracycline.

Representation:

Insertion at *Bam*HI → Disruption of tet^R

Visual Representation:



Explanation:

- Ampicillin resistance remains unaffected.
- pBR322 does not carry kanamycin or streptomycin resistance genes.

Final Answer: Tetracycline

Answer: (B)

[Go Back to Question 46](#)



Q47.

Solution

Concept: Ethidium bromide is a fluorescent dye used in gel electrophoresis to visualize DNA fragments. It intercalates between DNA base pairs and fluoresces under ultraviolet light, allowing separated DNA bands in the gel to be observed clearly after electrophoresis.

Solution: During gel electrophoresis, DNA fragments migrate through agarose gel according to their size. Since DNA itself is colorless, visualization requires a staining agent. Ethidium bromide binds between adjacent base pairs of DNA molecules. When exposed to ultraviolet light, the dye fluoresces, making the DNA bands visible. This enables identification and analysis of separated DNA fragments. Ethidium bromide does not increase migration speed, denature DNA, or act as a buffering agent. Therefore, its primary role is to make DNA fragments visible under UV light after electrophoresis.

Final Answer: To make the DNA fragments visible under UV light

Answer: (B)

[Go Back to Question 47](#)



Q48.

Solution

Concept: In loop-the-loop motion, conservation of mechanical energy determines the speed at the highest point, while centripetal force conditions determine the normal force. At the top of the loop, both gravity and normal reaction contribute toward providing the required centripetal force.

Solution: The block starts from rest at height $h = 3R$. Using conservation of energy between the starting point and the top of the loop:

$$mgh = mg(2R) + \frac{1}{2}mv^2$$

Substituting $h = 3R$:

$$mg(3R) = mg(2R) + \frac{1}{2}mv^2$$

$$mgR = \frac{1}{2}mv^2$$

$$v^2 = 2gR$$

At the highest point of the loop, centripetal force requirement is:

$$mg + N = \frac{mv^2}{R}$$

Substituting $v^2 = 2gR$:

$$mg + N = 2mg$$

$$N = mg$$

Thus, the normal force exerted by the track at the highest point is equal to the weight of the block.

Final Answer: mg

Answer: (A)

[Go Back to Question 48](#)



Q49.

Solution

Concept: Blue-white screening identifies recombinant bacteria using disruption of the *lacZ* gene. Colonies with recombinant plasmids fail to produce functional β -galactosidase and appear white, while non-recombinant transformants produce the enzyme and form blue colonies on indicator medium.

Solution: In blue-white screening, the cloning vector contains a functional *lacZ* gene encoding β -galactosidase. When foreign DNA inserts into this gene, its function becomes disrupted. Bacteria containing recombinant plasmids therefore cannot produce functional β -galactosidase. On medium containing X-gal, such colonies remain white. In contrast, bacteria with non-recombinant plasmids possess an intact *lacZ* gene and produce blue colonies. Non-transformants generally fail to grow due to absence of antibiotic resistance. Hence, white colonies specifically represent transformants carrying recombinant DNA molecules.

Final Answer: Transformants with recombinant DNA

Answer: (C)

[Go Back to Question 49](#)

Q50.

Solution

Concept: The first successful clinical gene therapy was performed in 1990 for Severe Combined Immunodeficiency caused by deficiency of the enzyme adenosine deaminase. Functional ADA genes were introduced into the patient's lymphocytes to restore immune system activity and improve health.

Solution: In 1990, scientists carried out the first approved clinical gene therapy on a four-year-old girl suffering from ADA deficiency, a form of Severe Combined Immunodeficiency Disease (SCID). Because of defective adenosine deaminase enzyme, the child lacked proper immune function and was highly susceptible to infections. Functional ADA genes were inserted into the patient's lymphocytes using retroviral vectors, and these modified cells were reintroduced into the body. This partially restored immune function and demonstrated the therapeutic potential of gene therapy. Tyrosinase deficiency causes albinism, phenylalanine hydroxylase deficiency causes phenylketonuria, and glutamate dehydrogenase deficiency is unrelated to the first gene therapy trial. Therefore, the enzyme deficiency involved was adenosine deaminase deficiency.

Final Answer: Adenosine deaminase (ADA)

Answer: (B)

[Go Back to Question 50](#)



Q51.

Solution

Concept: RNA interference (RNAi) is a biological mechanism in which double-stranded RNA triggers the degradation or silencing of complementary messenger RNA. This process prevents translation of specific proteins and serves as an important regulatory and defense mechanism in many organisms.

Solution: RNA interference is initiated when double-stranded RNA enters a cell. Specialized enzymes such as Dicer cut this dsRNA into small interfering RNAs (siRNAs). These siRNAs associate with the RNA-induced silencing complex (RISC), which recognizes complementary messenger RNA molecules. The target mRNA is then cleaved or blocked from translation, effectively silencing gene expression. Single-stranded RNA or DNA molecules alone do not initiate the classical RNAi pathway. Double-stranded DNA is involved in genetic storage rather than post-transcriptional silencing. Therefore, the molecule responsible for triggering RNA interference is double-stranded RNA.

Final Answer: Double-stranded RNA

Answer: (B)

[Go Back to Question 51](#)

Q52.

Solution

Concept: Allen's Rule states that animals living in colder climates tend to have shorter body appendages such as ears, tails, and limbs. Reduced surface area minimizes heat loss and helps conserve body warmth, providing an adaptive advantage in low-temperature environments.

Solution: According to Allen's Rule, endothermic animals from cold climates evolve shorter appendages to reduce surface area relative to body volume. This adaptation decreases heat loss and improves thermal conservation. For example, Arctic foxes have shorter ears and limbs compared to desert foxes, which possess larger appendages for heat dissipation. Option (B) describes characteristics typical of animals in warmer regions. Option (C) relates more closely to Bergmann's Rule, which concerns body size. Option (D) is not a defining feature of Allen's Rule. Therefore, mammals from colder climates generally possess shorter ears and shorter limbs.

Final Answer: Shorter ears and shorter limbs

Answer: (A)

[Go Back to Question 52](#)



Q53.

Solution

Concept: The intrinsic rate of natural increase (r) measures population growth under ideal conditions. It is calculated as the difference between birth rate and death rate relative to the total population size, representing the net per capita increase in population over time.

Solution: The population contains 1000 individuals. During one year, 100 births and 50 deaths occurred. The net increase in population is therefore:

$$100 - 50 = 50$$

The intrinsic rate of increase is calculated as:

$$r = \frac{\text{Births} - \text{Deaths}}{\text{Total population}}$$

Substituting the given values:

$$r = \frac{50}{1000} = 0.05$$

This indicates that the population increased by 5% during the year under the given conditions. Option (A) would represent only the birth rate, while options (C) and (D) are mathematically incorrect for the given data. Therefore, the intrinsic rate of natural increase is 0.05.

Final Answer:

Answer: (B)

[Go Back to Question 53](#)

Q54.

Solution

Concept: Verhulst-Pearl logistic growth describes population growth under limited resources. Initially, growth is rapid and exponential, but it slows as environmental resistance increases. Eventually, the population stabilizes near carrying capacity, producing a characteristic sigmoid or S-shaped growth curve.

Solution: In natural environments, resources such as food, water, and space are limited. Therefore, populations cannot grow exponentially forever. The logistic growth model proposed by Verhulst and Pearl explains that population growth begins rapidly when resources are abundant, resembling exponential growth. As population size approaches the carrying capacity of the environment, competition and resource limitation reduce growth rate. Finally, growth stabilizes around the carrying capacity, creating an S-shaped or sigmoid curve. A J-shaped curve instead represents unrestricted exponential growth. Linear and bell-shaped curves do not accurately describe logistic population growth. Hence, the Verhulst-Pearl logistic growth curve is sigmoid in shape.

Final Answer:

Answer: (B)

[Go Back to Question 54](#)



Q55.

Solution

Concept: Minimum deviation in a prism occurs when the path of light inside the prism becomes symmetrical. Under this condition, the angle of incidence equals the angle of emergence, and the refracted ray inside the prism travels parallel to the prism base.

Solution: When a prism is adjusted to the condition of minimum deviation, the light ray follows a symmetric path through the prism. This means the angle of incidence equals the angle of emergence:

$$i = e$$

At this stage, the refraction angles inside the prism are also equal, and the ray inside the prism travels symmetrically relative to the prism faces. Option (A) is incorrect because asymmetry does not correspond to minimum deviation. Option (C) is impossible because refraction necessarily occurs in a prism. Option (D) describes behavior through a parallel-sided glass slab rather than a prism. Therefore, the correct condition for minimum deviation is a symmetric path with equal incident and emergent angles.

Final Answer: Symmetric with $i = e$

Answer: (B)

[Go Back to Question 55](#)

Q56.

Solution

Concept: Commensalism is an ecological interaction in which one organism benefits while the other remains neither harmed nor benefited. Epiphytic orchids growing on mango trees gain support and better access to sunlight without affecting the host tree significantly.

Solution: Orchids commonly grow as epiphytes on tree branches. In this relationship, the orchid gains physical support and better exposure to sunlight for photosynthesis. The mango tree, however, neither gains any benefit nor suffers significant harm from the orchid's presence. Therefore, the interaction is classified as commensalism. In parasitism, one organism benefits while harming the host, which does not occur here. Mutualism involves benefit to both organisms, and amensalism involves harm to one organism without affecting the other. Hence, the relationship between an orchid and a mango tree is an example of commensalism.

Final Answer: Commensalism

Answer: (C)

[Go Back to Question 56](#)



Q57.

Solution

Concept: Gross Primary Productivity (GPP) refers to the total rate at which producers synthesize organic matter through photosynthesis in an ecosystem. It represents the total energy captured before subtracting the energy lost through respiration by the producers themselves.

Solution: Primary productivity measures the rate of organic matter formation by autotrophs. Gross Primary Productivity includes the entire amount of organic matter produced through photosynthesis. A portion of this energy is later utilized by plants for respiration. The remaining productivity after respiratory loss is called Net Primary Productivity (NPP). Secondary productivity refers to biomass production by consumers, while net community productivity concerns overall ecosystem productivity after considering respiration by all organisms. Since the question specifically asks for the total rate of organic matter production during photosynthesis, the correct term is Gross Primary Productivity.

Final Answer: Gross Primary Productivity

Answer: (B)

[Go Back to Question 57](#)

Q58.

Solution

Concept: The pyramid of energy is always upright because energy flow in ecosystems is unidirectional and decreases at successive trophic levels according to the second law of thermodynamics. Energy loss through respiration and heat prevents inversion of this ecological pyramid.

Solution: Ecological pyramids represent relationships among trophic levels. Pyramids of number and biomass may be upright or inverted depending on ecosystem structure. For example, tree ecosystems may show inverted pyramids of number, while aquatic ecosystems can exhibit inverted biomass pyramids. However, the pyramid of energy is always upright because energy transfer between trophic levels is inefficient. Only a small fraction of energy, usually around 10%, passes from one trophic level to the next, while the rest is lost as heat during metabolic activities. Consequently, higher trophic levels always contain less energy than lower ones. Therefore, the pyramid of energy remains upright in every stable ecosystem.

Final Answer: Pyramid of Energy

Answer: (C)

[Go Back to Question 58](#)



Q59.

Solution

Concept: The “Evil Quartet” refers to the four major causes responsible for biodiversity loss worldwide. These include habitat loss and fragmentation, over-exploitation, alien species invasion, and co-extinctions, all of which significantly reduce species richness and ecological stability.

Solution: Biodiversity loss has become a major environmental concern. Ecologists use the term “Evil Quartet” to describe the four primary factors driving species extinction and ecological imbalance. These are habitat loss and fragmentation, over-exploitation of organisms, invasion by alien species, and co-extinctions where dependent species disappear together. Although pollution and climate change also affect ecosystems, the Evil Quartet specifically refers to major causes of biodiversity decline. Therefore, the correct answer is biodiversity loss.

Final Answer: Biodiversity loss

Answer: (C)

[Go Back to Question 59](#)

Q60.

Solution

Concept: Eutrophication is the enrichment of water bodies with nutrients such as nitrates and phosphates. Excessive nutrient input stimulates algal blooms, and decomposition of these organisms consumes dissolved oxygen, causing oxygen depletion and harming aquatic life.

Solution: When large quantities of nutrients enter lakes or ponds from fertilizers or sewage, rapid growth of algae and aquatic plants occurs. This process is called eutrophication. Initially, algal blooms increase productivity, but when algae die, decomposer microorganisms break them down using dissolved oxygen from the water. As oxygen levels decline, aquatic organisms such as fish may suffocate and die. Biomagnification refers to increasing concentration of toxins in food chains, stratification relates to water layering, and succession describes gradual ecosystem development. Therefore, nutrient enrichment leading to oxygen depletion is known as eutrophication.

Final Answer: Eutrophication

Answer: (B)

[Go Back to Question 60](#)



Q61.

Solution

Concept: Secretin is released from the duodenum in response to acidic chyme. It stimulates the pancreas to secrete bicarbonate-rich fluid, which neutralizes acidity and creates an alkaline medium necessary for proper activation and functioning of pancreatic digestive enzymes in the intestine.

Solution: When acidic chyme enters the duodenum, secretin is normally released by the intestinal mucosa. Secretin acts on the exocrine pancreas and stimulates secretion of bicarbonate ions, which neutralize the acidic contents. If secretin release fails, the duodenal contents remain acidic. Pancreatic enzymes such as trypsinogen require an alkaline medium for proper activation and function. In highly acidic conditions, these enzymes become ineffective or inactivated, severely impairing digestion. Although bile action may also be affected indirectly, the most direct consequence is loss of pancreatic enzyme activity. Gastric motility and Brunner's gland secretion are not the primary effects of secretin deficiency. Therefore, acidic duodenal contents mainly lead to inactivation of pancreatic enzymes.

Final Answer: Inactivation of pancreatic enzymes like trypsinogen

Answer: (B)

[Go Back to Question 61](#)



Q62.

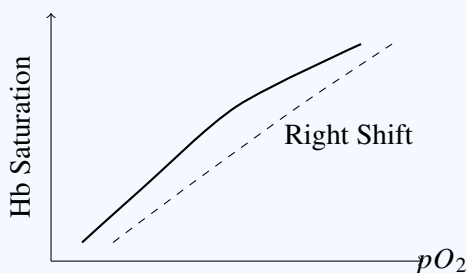
Solution

Concept: The **Bohr Effect** refers to the reduced affinity of hemoglobin for oxygen under conditions of increased metabolic activity.

- During strenuous exercise:
 - pCO_2 increases
 - H^+ concentration increases (pH decreases)
 - Temperature increases
- These factors shift the hemoglobin–oxygen dissociation curve to the **right**.
- A right shift promotes greater release of oxygen to actively respiring tissues.

Key Relationship:

$\uparrow pCO_2, \uparrow H^+, \uparrow \text{Temperature} \Rightarrow \text{Right Shift}$

Visual Representation:**Explanation:**

- Increased CO_2 and acidity reduce oxygen affinity.
- Higher temperature also favors oxygen unloading.
- Decreased pCO_2 or increased pH would shift the curve left.

Final Answer: Increased pCO_2 , increased H^+ , and increased temperature

Answer: (B)

[Go Back to Question 62](#)



Q63.

Solution

Concept: In thermodynamics, the work done during a cyclic process on a P - V diagram equals the area enclosed by the closed path. Since the system returns to its initial state after one complete cycle, the net work depends only on the enclosed area.

Solution: A cyclic process means the gas ultimately returns to its original thermodynamic state. On a pressure-volume diagram, the work done by the gas during expansion and compression is represented by the area under the process curve. For a complete cycle, the algebraic sum of all work interactions equals the area enclosed within the loop. If the cycle proceeds clockwise, the net work done by the gas is positive; if anticlockwise, it is negative. The work is not necessarily zero because expansion and compression may occur at different pressures. It also does not depend solely on temperature or only on an isobaric process. Therefore, the net work done in a cyclic process equals the area enclosed by the cycle.

Final Answer: Equal to area enclosed by cycle

Answer: (B)

[Go Back to Question 63](#)



Q64.

Solution

Concept: Cardiac output equals the product of heart rate and stroke volume. Stroke volume itself is the difference between end-diastolic volume and end-systolic volume. These relationships help determine ventricular pumping efficiency during each cardiac cycle.

Solution: Cardiac output is given as:

$$5 \text{ L/min} = 5000 \text{ ml/min}$$

Heart rate:

$$72 \text{ beats/min}$$

Stroke volume is therefore:

$$SV = \frac{5000}{72} \approx 69.4 \text{ ml}$$

Stroke volume is also expressed as:

$$SV = EDV - ESV$$

Given:

$$EDV = 110 \text{ ml}$$

Thus,

$$69.4 = 110 - ESV$$

$$ESV = 110 - 69.4 \approx 40 \text{ ml}$$

Hence, the end-systolic volume is approximately 40 ml. This indicates that about 70 ml of blood is pumped out during each ventricular contraction.

Final Answer: 40 ml

Answer: (A)

[Go Back to Question 64](#)



Q65.

Solution

Concept: During an action potential, the membrane potential changes due to the opening and closing of voltage-gated ion channels.

- **Depolarization** occurs due to rapid influx of Na^+ ions.
- **Repolarization** occurs when Na^+ channels close and K^+ channels open.
- During the **hyperpolarization phase** (refractory period), the membrane potential becomes more negative than the resting potential (-70 mV).

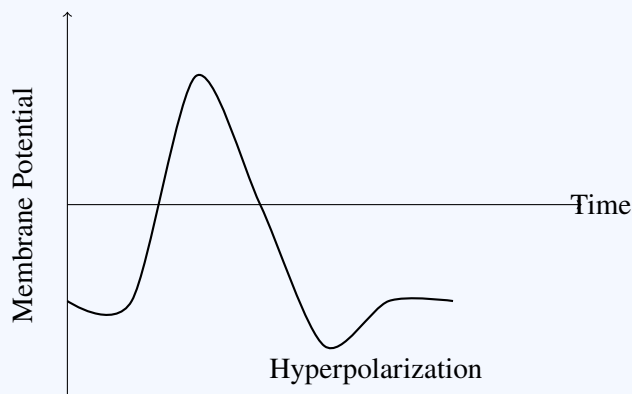
Reason for Hyperpolarization:

- Voltage-gated Na^+ channels are closed.
- Voltage-gated K^+ channels remain open for a longer duration.
- Continued outward movement of K^+ ions causes excess loss of positive charge.

Key Process:

Prolonged K^+ efflux \Rightarrow Membrane potential below -70 mV

Visual Representation:



Explanation:

- Option (A): causes depolarization, not hyperpolarization.
- Option (B): correct mechanism for refractory hyperpolarization.
- Option (C): Na^+/K^+ pump maintains gradients but is not the immediate cause.
- Option (D): chloride channels are not primarily responsible in axonal action potentials.

Final Answer: Closure of Na^+ channels and prolonged opening of K^+ channels

Answer: (A)

[Go Back to Question 65](#)



Q66.

Solution

Concept: Stretch receptors in the urinary bladder wall detect bladder filling and initiate the micturition reflex. Sensory impulses generated by these receptors activate neural pathways that coordinate contraction of the bladder and relaxation of sphincters during urination.

Solution: As urine accumulates in the bladder, the bladder wall stretches. Stretch receptors present in the wall detect this distension and send sensory impulses to the spinal cord. These impulses trigger the micturition reflex, leading to contraction of the detrusor muscle and relaxation of the urethral sphincters. If the stretch receptors are completely removed, the nervous system cannot detect bladder filling, and the reflex pathway fails to initiate urination. Urine may still collect in the bladder because kidney function continues normally, but micturition will not occur reflexively. Therefore, absence of stretch receptors would result in failure of micturition.

Final Answer:

Answer: (C)

[Go Back to Question 66](#)

Q67.

Solution

Concept: During intense muscular activity, oxygen supply may become insufficient, leading to anaerobic respiration and lactic acid accumulation. Increased acidity interferes with muscle contraction mechanisms, contributing to muscle fatigue and reduced contractile efficiency.

Solution: In strenuous exercise, muscles may temporarily rely on anaerobic glycolysis, producing lactic acid. Accumulation of lactic acid lowers intracellular pH and interferes with normal muscle contraction. One important effect is inhibition of calcium ion release from the sarcoplasmic reticulum. Since calcium is essential for interaction between actin and myosin filaments, reduced calcium availability decreases muscle contraction efficiency and produces fatigue. Permanent actin-myosin bonding occurs mainly in rigor mortis due to ATP absence. Acetylcholinesterase inhibition affects neuromuscular transmission rather than lactic acid accumulation. ATP breakdown occurs throughout active muscle fibers and is not confined specifically to the H-zone. Therefore, fatigue due to lactic acid accumulation primarily results from inhibition of calcium release.

Final Answer:

Answer: (B)

[Go Back to Question 67](#)



Q68.

Solution

Concept: The blind spot, or optic disc, is the point on the retina where the optic nerve exits the eye. Since this region lacks rods and cones, it cannot detect light and therefore produces a natural blind area in vision.

Solution: The retina contains photoreceptor cells called rods and cones that detect light. However, at the point where the optic nerve leaves the eye and retinal blood vessels enter, photoreceptors are absent. This region is known as the blind spot or optic disc. Because rods and cones are missing there, no image can be detected when light falls directly on this area. The fovea centralis, not the blind spot, contains densely packed cones and provides highest visual acuity. Rods dominate peripheral regions rather than the blind spot. Therefore, the blind spot corresponds to the region where the optic nerve exits and blood vessels enter the eye.

Final Answer:

Answer: (B)

[Go Back to Question 68](#)

Q69.

Solution

Concept: Secretin is a gastrointestinal hormone released by the duodenum in response to acidic chyme. It stimulates the exocrine pancreas to secrete bicarbonate-rich fluid and water, helping neutralize acidity and create optimal conditions for digestive enzyme activity.

Solution: When acidic food enters the duodenum from the stomach, specialized intestinal cells release secretin into the bloodstream. Secretin acts mainly on the duct cells of the exocrine pancreas, stimulating secretion of water and bicarbonate ions. The bicarbonate neutralizes acidic chyme and protects the intestinal lining while providing a suitable alkaline medium for pancreatic enzymes. Gastrin mainly stimulates gastric acid secretion, while cholecystokinin promotes enzyme-rich pancreatic secretion and gallbladder contraction. Insulin regulates blood glucose levels and does not control pancreatic bicarbonate secretion. Therefore, the hormone responsible for stimulating bicarbonate-rich pancreatic secretion is secretin.

Final Answer:

Answer: (C)

[Go Back to Question 69](#)



Q70.

Solution

Concept: In DNA fingerprinting for paternity testing, every DNA band in the child must originate from either the mother or the biological father. Bands present in the child but absent in the mother must therefore match the true father.

Solution: During paternity analysis using agarose gel electrophoresis, the DNA banding pattern of the child is compared with those of the mother and suspected fathers. Any DNA band in the child that is not inherited from the mother must be inherited from the biological father. In the diagram, the unmatched bands in the child correspond with the banding pattern of S1 rather than S2. Therefore, S1 is identified as the biological father. The conclusion is based on inheritance of matching DNA fragments, not on molecular weight, thickness of bands, or overall number of shared bands. Hence, the correct interpretation is that all non-maternal bands in the child match S1.

Final Answer: S1; because all bands in C that do not match M must match S1

Answer: (A)

[Go Back to Question 70](#)

Q71.

Solution

Concept: Deamination is the metabolic process in which the amino group is removed from amino acids. This process mainly occurs in liver cells and produces ammonia, which is later converted into urea through the ornithine cycle for safe excretion.

Solution: Proteins are broken down into amino acids during digestion. Excess amino acids cannot be stored in the body and therefore undergo deamination. In this process, the amino group is removed, producing ammonia and a keto acid. The liver is the primary organ responsible for this reaction, and the process mainly occurs in hepatocytes. The toxic ammonia formed is rapidly converted into urea by the urea cycle and later excreted by the kidneys. Nephrons mainly excrete nitrogenous waste rather than perform deamination. Alveoli participate in gas exchange, while pancreatic acini secrete digestive enzymes. Therefore, deamination primarily occurs in hepatocytes of the liver.

Final Answer: Hepatocytes

Answer: (B)

[Go Back to Question 71](#)



Q72.

Solution

Concept: Aldosterone is a mineralocorticoid hormone secreted by the adrenal cortex. It acts mainly on the distal convoluted tubule and collecting duct of nephrons to increase sodium reabsorption and potassium excretion, thereby helping maintain blood pressure and fluid balance.

Solution: When blood pressure falls, the renin-angiotensin-aldosterone system becomes activated. Aldosterone released from the adrenal cortex acts specifically on the distal convoluted tubule and collecting duct of the nephron. It stimulates synthesis of sodium channels and sodium-potassium pumps, increasing sodium reabsorption into the blood. Water follows sodium osmotically, increasing blood volume and pressure. The proximal convoluted tubule reabsorbs sodium independently of aldosterone to a large extent. The descending limb mainly handles water reabsorption, while Bowman's capsule performs filtration. Therefore, aldosterone primarily acts on the distal convoluted tubule and collecting duct.

Final Answer: Distal Convoluted Tubule and Collecting Duct

Answer: (C)

[Go Back to Question 72](#)

Q73.

Solution

Concept: The resting membrane potential of neurons is mainly produced by selective permeability of the plasma membrane to potassium ions. Continuous leakage of K^+ ions out of the axon leaves the inside relatively negative compared to the outside environment.

Solution: In a resting neuron, the membrane is far more permeable to potassium ions than to sodium ions because numerous potassium leakage channels remain open. Potassium ions diffuse outward down their concentration gradient, causing loss of positive charges from the cell interior. This creates a negative resting membrane potential, typically around -70 mV . Although the sodium-potassium pump helps maintain ion gradients, the immediate cause of resting potential is potassium leakage. Sodium permeability is comparatively low at rest, while chloride and calcium ions play smaller roles. Therefore, the resting membrane potential is primarily maintained by leakage of potassium ions across the axonal membrane.

Final Answer: K^+

Answer: (B)

[Go Back to Question 73](#)



Q74.

Solution

Concept: The corpus luteum secretes progesterone after ovulation. If fertilization does not occur, the corpus luteum degenerates, causing progesterone levels to fall. This hormonal decline leads to breakdown and shedding of the uterine endometrium during menstruation.

Solution: Progesterone maintains the thickened endometrium prepared for implantation of an embryo. In the absence of fertilization, the corpus luteum degenerates into the corpus albicans and progesterone secretion declines sharply. Without progesterone support, the endometrial lining cannot be maintained. Blood vessels supplying the endometrium constrict, tissue degenerates, and the uterine lining is shed as menstrual flow. Repair of the endometrium occurs later under the influence of estrogen. Thickening of cervical mucus and ovulation are unrelated to progesterone decline after corpus luteum degeneration. Therefore, the sudden fall in progesterone results in disintegration of the endometrium.

Final Answer: Disintegration of endometrium

Answer: (B)

[Go Back to Question 74](#)

Q75.

Solution

Concept: The fast block to polyspermy prevents entry of multiple sperms into the ovum immediately after fertilization. In humans and many animals, this rapid mechanism involves depolarization of the oocyte plasma membrane, temporarily preventing additional sperm fusion.

Solution: When the first sperm fuses with the oocyte membrane, rapid ionic changes occur across the oocyte plasma membrane. Sodium ions enter the egg, causing membrane depolarization. This immediate electrical change acts as the fast block to polyspermy and prevents other sperms from fusing with the membrane. A slower but permanent block follows later through cortical reactions and hardening of the zona pellucida. Acrosomal enzymes assist sperm penetration before fertilization and are not responsible for blocking polyspermy. Therefore, the fast block specifically occurs through depolarization of the oocyte plasma membrane.

Final Answer: Depolarization of the oocyte plasma membrane

Answer: (B)

[Go Back to Question 75](#)



Q76.

Solution

Concept: During spermatogenesis, spermatogonia and primary spermatocytes are diploid ($2n$), while meiosis reduces chromosome number in secondary spermatocytes and spermatids, making them haploid (n). This ensures formation of haploid male gametes for sexual reproduction.

Solution: Spermatogenesis begins with diploid spermatogonia having chromosome number $2n$. These cells divide mitotically and form primary spermatocytes, which also remain diploid ($2n$). The primary spermatocyte undergoes meiosis I, reducing chromosome number by half and producing haploid secondary spermatocytes (n). Meiosis II then produces spermatids, which also remain haploid (n). Later, spermatids differentiate into spermatozoa without further chromosome change. Therefore, the correct ploidy sequence is:

$$2n, 2n, n, n$$

Final Answer:

Answer: (A)

[Go Back to Question 76](#)

Q77.

Solution

Concept: Sertoli cells are supporting cells present inside seminiferous tubules. They nourish developing sperm cells and secrete the hormone inhibin, which provides negative feedback to the anterior pituitary to regulate secretion of follicle-stimulating hormone (FSH).

Solution: In the male reproductive system, Sertoli cells play an essential role in spermatogenesis. These cells support and nourish developing germ cells and maintain the microenvironment required for sperm production. Sertoli cells also secrete inhibin, a hormone that specifically inhibits secretion of follicle-stimulating hormone from the anterior pituitary through negative feedback. Leydig or interstitial cells mainly produce testosterone rather than inhibin. Spermatogonia are germ cells that eventually form spermatozoa. Therefore, the hormone inhibin is produced by Sertoli cells.

Final Answer:

Answer: (C)

[Go Back to Question 77](#)



Q78.

Solution

Concept: Fetal membranes protect and support the developing embryo. The amnion forms a fluid-filled sac around the embryo, and the amniotic fluid acts as a cushion or shock absorber, protecting the fetus from mechanical injury during development.

Solution: The amnion is the innermost fetal membrane surrounding the embryo. It encloses amniotic fluid, which cushions the fetus against physical shocks and prevents dehydration. The yolk sac has only a minor nutritional role in humans and mainly participates in early blood formation. The chorion contributes to placenta formation, while the allantois assists in formation of blood vessels and the umbilical cord rather than nitrogenous waste storage in humans. Therefore, the correct match is that the amnion acts as a shock absorber.

Final Answer: Amnion: Acts as a shock absorber

Answer: (B)

[Go Back to Question 78](#)

Q79.

Solution

Concept: The acrosome of the sperm contains hydrolytic enzymes such as hyaluronidase. These enzymes help the sperm penetrate the outer coverings of the ovum, especially the corona radiata and zona pellucida, during fertilization.

Solution: During fertilization, the sperm must pass through several protective layers surrounding the ovum. The acrosome at the head of the sperm contains enzymes including hyaluronidase and acrosin. Hyaluronidase helps dissolve the cells of the corona radiata, allowing the sperm to move closer to the zona pellucida. Acrosomal enzymes then aid penetration through the zona pellucida for successful fertilization. Neutralization of vaginal acidity is mainly achieved by seminal fluid, while ATP production for motility occurs in mitochondria of the middle piece. Therefore, the primary function of acrosomal enzymes is dissolution of the corona radiata cells.

Final Answer: Dissolve the cells of Corona Radiata

Answer: (A)

[Go Back to Question 79](#)



Q80.

Solution

Concept: Divergent evolution occurs when related organisms evolve different adaptations from a common ancestor in response to different environmental conditions. Darwin's finches demonstrate this process through diversification of beak shapes adapted to distinct ecological niches.

Solution: Darwin observed several finch species on the Galápagos Islands that shared a common ancestral origin but evolved different feeding habits and beak structures. Natural selection acted differently in separate ecological niches, causing diversification into multiple species. This phenomenon is known as adaptive radiation. At a broader evolutionary level, adaptive radiation represents divergent evolution because many species arise from a common ancestor and become increasingly dissimilar over time. Parallel evolution involves similar changes in related groups, while convergent evolution produces similar traits in unrelated organisms. Saltation refers to sudden large evolutionary changes. Therefore, Darwin's finches best illustrate divergent evolution.

Final Answer:

Answer: (B)

[Go Back to Question 80](#)

Q81.

Solution

Concept: Under Hardy-Weinberg equilibrium, allele frequencies remain constant across generations. If the recessive phenotype frequency is known as q^2 , then the recessive allele frequency is obtained by taking its square root, while dominant allele frequency equals $1 - q$.

Solution: The question states that the frequency of the dominant phenotype is 0.19. Therefore, the recessive phenotype frequency is:

$$1 - 0.19 = 0.81$$

Under Hardy-Weinberg equilibrium:

$$q^2 = 0.81$$

Taking the square root:

$$q = \sqrt{0.81} = 0.9$$

Thus, the frequency of the recessive allele is 0.9. The dominant allele frequency would therefore be:

$$p = 1 - q = 0.1$$

Hence, the correct answer is 0.9.

Final Answer:

Answer: (A)

[Go Back to Question 81](#)



Q82.

Solution

Concept: The bottleneck effect is a form of genetic drift that occurs when a population suddenly decreases drastically in size due to disasters or environmental changes. The surviving individuals carry only a small fraction of the original genetic variation.

Solution: In the bottleneck effect, a large population undergoes sudden reduction because of events such as disease outbreaks, natural disasters, or habitat destruction. Since only a few individuals survive, allele frequencies in the remaining population may differ greatly from the original population purely by chance. This random sampling causes loss of genetic diversity and unpredictable changes in allele frequencies. It is not a process of natural selection favoring the fittest individuals directly, nor does it increase gene flow or diversity. The reduced population may later expand, but with altered genetic composition. Therefore, the bottleneck effect mainly results in random changes in allele frequency due to sudden reduction in population size.

Final Answer: Random change in allele frequency due to a sudden reduction in population size

Answer: (B)

[Go Back to Question 82](#)

Q83.

Solution

Concept: Homologous organs share a common evolutionary origin but may perform different functions, whereas analogous organs perform similar functions despite different evolutionary origins. Homology is strong evidence for divergent evolution from a common ancestor.

Solution: Thorns of *Bougainvillea* and tendrils of *Cucurbita* are both modifications of the stem and therefore arise from the same basic structural origin. Although they perform different functions, one for protection and the other for climbing, they are homologous organs. Wings of birds and butterflies are analogous because they perform the same function of flight but originate differently. Flippers of penguins and dolphins are also analogous adaptations for swimming. Eyes of octopus and mammals evolved independently and are examples of convergent evolution. Therefore, the correct pair of homologous organs is the thorns of *Bougainvillea* and tendrils of *Cucurbita*.

Final Answer: Thorns of *Bougainvillea* and tendrils of *Cucurbita*

Answer: (C)

[Go Back to Question 83](#)



Q84.

Solution

Concept: Aschelminthes, or Nematoda, are triploblastic pseudocoelomates with an unsegmented cylindrical body. A characteristic feature of this phylum is the presence of a pseudocoelom and a syncytial epidermis covered by a resistant cuticle.

Solution: Members of the phylum Aschelminthes possess a body cavity called pseudocoelom, which is not completely lined by mesoderm. Their epidermis is syncytial, meaning it contains multinucleated cytoplasm without distinct cellular boundaries. This layer secretes a thick cuticle that provides protection. Platyhelminthes are acoelomate, while annelids and arthropods possess a true coelom. Therefore, the combination of pseudocoelom and syncytial epidermis is characteristic of Aschelminthes.

Final Answer:

Answer: (B)

[Go Back to Question 84](#)

Q85.

Solution

Concept: Choanocytes, also called collar cells, are specialized flagellated cells unique to sponges. They generate water currents for feeding and gas exchange and help capture food particles from water entering the sponge body.

Solution: Poriferans possess a simple body organization with numerous pores and canals. The inner lining contains choanocytes, which have a collar-like arrangement surrounding a flagellum. Continuous beating of the flagella creates water currents that bring food and oxygen into the sponge body. Choanocytes also trap microscopic food particles for intracellular digestion. These collar cells are absent in coelenterates, ctenophores, and molluscs. Hence, the presence of choanocytes is a diagnostic feature of Porifera.

Final Answer:

Answer: (B)

[Go Back to Question 85](#)



Q86.

Solution

Concept: A hemocoel is a blood-filled body cavity characteristic of animals with an open circulatory system. Arthropods and most molluscs possess a hemocoel where blood directly bathes tissues and organs instead of remaining confined to vessels.

Solution: *Periplaneta* (cockroach) belongs to Arthropoda and *Pila* belongs to Mollusca. Both groups possess an open circulatory system in which blood flows through sinuses and body cavities collectively called hemocoel. In annelids such as *Pheretima* and *Hirudinaria*, blood circulates within closed vessels. Coelenterates lack a true circulatory system, while flatworms like *Taenia* and *Fasciola* are acoelomates. Therefore, hemocoel is found in *Periplaneta* and *Pila*.

Final Answer: *Periplaneta* and *Pila*

Answer: (B)

[Go Back to Question 86](#)

Q87.

Solution

Concept: Urochordates are marine chordates in which the notochord is present only in the larval tail region. Adult forms are usually sessile and enclosed within a protective tunic composed of tunicin.

Solution: *Herdmania*, commonly called sea squirt, belongs to the subphylum Urochordata. In its larval stage, the notochord is restricted to the tail region, which is a defining feature of urochordates. *Branchiostoma* belongs to Cephalochordata, while *Petromyzon* and *Myxine* are jawless vertebrates grouped under Cyclostomata. Therefore, the correct urochordate among the given organisms is *Herdmania*.

Final Answer: *Herdmania*

Answer: (B)

[Go Back to Question 87](#)



Q88.

Solution

Concept: Compact mammalian bone contains Haversian canals carrying blood vessels and nerves. These longitudinal canals are interconnected by transverse or oblique channels called Volkmann's canals, which facilitate communication between neighboring osteons.

Solution: The Haversian system or osteon is the structural unit of compact bone. Each osteon contains a central Haversian canal surrounded by concentric lamellae. Adjacent Haversian canals communicate through transverse canals known as Volkmann's canals. These canals allow blood vessels and nerves to pass between osteons and connect with the periosteum. Canaliculi are tiny channels connecting lacunae containing osteocytes, not Haversian canals. Therefore, the transverse canals joining Haversian canals are called Volkmann's canals.

Final Answer: Volkmann's canals

Answer: (B)

[Go Back to Question 88](#)

Q89.

Solution

Concept: Cockroaches respire through a tracheal system that opens externally through spiracles. These spiracles are arranged along the lateral sides of the thoracic and abdominal segments, allowing exchange of respiratory gases.

Solution: In *Periplaneta americana*, respiration occurs through a network of tracheae connected to the exterior by spiracles. There are ten pairs of spiracles, two pairs in the thorax and eight pairs in the abdomen. These openings are situated laterally on the body segments. Air enters and leaves through these spiracles and travels through tracheae directly to tissues. Spiracles are neither confined only to thoracic segments nor located dorsally or ventrally. Therefore, they are present on the lateral sides of the body.

Final Answer: Lateral side of the body

Answer: (C)

[Go Back to Question 89](#)



Q90.

Solution

Concept: Tight junctions are specialized intercellular junctions that seal adjacent epithelial cells closely together. They prevent leakage of extracellular fluid between cells and maintain compartmentalization in epithelial tissues.

Solution: Epithelial tissues require controlled movement of substances across cell layers. Tight junctions form a continuous seal between neighboring cells, preventing passage of fluids and dissolved substances through intercellular spaces. Adhering junctions and desmosomes mainly provide mechanical attachment between cells, while gap junctions permit communication through exchange of ions and small molecules. Therefore, the junction type acting as a barrier against extracellular leakage is the tight junction.

Final Answer:

Answer: (C)

[Go Back to Question 90](#)

Q91.

Solution

Concept: According to Chargaff's rule in double-stranded DNA, adenine pairs with thymine and cytosine pairs with guanine. Therefore, the number of adenine equals thymine, and the number of cytosine equals guanine in the DNA segment.

Solution: The DNA segment contains:

120 adenine bases

and

120 cytosine bases

Since adenine pairs with thymine:

$$T = 120$$

and cytosine pairs with guanine:

$$G = 120$$

Thus, the total number of nucleotides is:

$$\begin{aligned} A + T + C + G \\ = 120 + 120 + 120 + 120 \\ = 480 \end{aligned}$$

Therefore, the DNA segment contains a total of 480 nucleotides.

Final Answer:

Answer: (B)

[Go Back to Question 91](#)



Q92.

Solution

Concept: Ribosomal RNA not only provides structural support to ribosomes but can also function as a ribozyme. In prokaryotes, the 23S rRNA of the large ribosomal subunit catalyzes peptide bond formation during protein synthesis.

Solution: Bacterial ribosomes are composed of a small 30S subunit and a large 50S subunit. The 50S subunit contains 23S rRNA and 5S rRNA. Among these, 23S rRNA plays a catalytic role by acting as peptidyl transferase, which forms peptide bonds between amino acids during translation. Because it possesses enzymatic activity along with structural function, it is considered a ribozyme. The 18S and 28S rRNAs are found in eukaryotic ribosomes rather than bacteria. Therefore, the bacterial rRNA functioning both structurally and catalytically is 23S rRNA.

Final Answer: 23S rRNA

Answer: (C)

[Go Back to Question 92](#)

Q93.

Solution

Concept: Color blindness is an X-linked recessive trait. Sons inherit the Y chromosome from the father and the X chromosome from the mother. Therefore, the probability of a son being color blind depends entirely on the maternal X chromosome inherited.

Solution: Let the normal allele be X^C and the color blind allele be X^c . The man is color blind:



The woman is a carrier:



Possible sons receive the Y chromosome from the father and one X chromosome from the mother:



Thus, among all sons, half are expected to be color blind. Therefore, the probability that their first son will be color blind is:

$$\frac{1}{2} = 50\%$$

Final Answer: 50%

Answer: (B)

[Go Back to Question 93](#)



Q94.

Solution

Concept: During translation, the anticodon present on tRNA pairs complementarily with the codon on mRNA according to base-pairing rules. Adenine pairs with uracil, and cytosine pairs with guanine in RNA molecules.

Solution: The anticodon given is:



To determine the complementary mRNA codon, RNA base-pairing rules are applied:



Thus, the corresponding codon is:



This codon is also important biologically because it functions as the initiation codon for protein synthesis and codes for methionine. Option (C) contains thymine, which is absent in RNA. Therefore, the anticodon *UAC* binds with the codon *AUG*.

Final Answer:

Answer: (A)

[Go Back to Question 94](#)

Q95.

Solution

Concept: In gene therapy for ADA deficiency, patient lymphocytes are commonly used because they can be isolated, genetically modified in culture, and then reintroduced into the patient to restore enzyme production temporarily.

Solution: ADA deficiency is a genetic disorder caused by absence of adenosine deaminase activity. In one form of gene therapy, lymphocytes are removed from the patient and cultured outside the body. A functional ADA gene is introduced into these cells using a suitable vector, after which the corrected lymphocytes are returned to the patient. Lymphocytes are preferred because they are relatively easy to isolate, culture, and reintroduce into circulation. They are not immortal cells, and viral vectors are usually required for gene transfer. Other body cells can also express ADA. Therefore, lymphocytes are used mainly because they can be easily cultured and returned to the patient.

Final Answer:

Answer: (B)

[Go Back to Question 95](#)



Q96.

Solution

Concept: Different cry genes from *Bacillus thuringiensis* produce toxins effective against specific insect pests. The CryIAb gene is particularly effective against the corn borer insect that damages maize crops.

Solution: *Bacillus thuringiensis* produces crystal proteins encoded by cry genes. Each cry gene targets specific insect groups. The CryIAb gene produces a toxin highly effective against the corn borer, an important pest of maize crops. CryIAc is mainly effective against cotton bollworms, while other genes target different insects or nematodes. Genetic engineering allows insertion of these cry genes into crop plants to provide pest resistance and reduce dependence on chemical pesticides. Therefore, the CryIAb gene is specifically used to control corn borer infestation.

Final Answer:

Answer: (B)

[Go Back to Question 96](#)

Q97.

Solution

Concept: The secondary immune response is faster and stronger due to the presence of memory cells formed during primary exposure. This response is characterized mainly by rapid and abundant production of IgG antibodies in the bloodstream.

Solution: During the primary immune response, antigen exposure activates naïve B lymphocytes, producing antibodies slowly with IgM appearing first. Some activated cells become memory B cells. Upon second exposure to the same antigen, these memory cells respond rapidly and produce a much stronger immune reaction called the secondary or anamnestic response. The antibody level rises quickly and is dominated mainly by IgG antibodies, which persist longer and provide effective protection. IgA is associated with mucosal immunity, while IgD mainly functions as a receptor on B cells. Therefore, the rapid rise in IgG antibodies characterizes the secondary immune response.

Final Answer:

Answer: (C)

[Go Back to Question 97](#)



Q98.

Solution

Concept: Passive immunity occurs when ready-made antibodies are transferred from one individual to another. The recipient gains immediate but temporary protection because their own immune system does not actively produce the antibodies.

Solution: Immunity transferred from mother to fetus through the placenta is a classic example of naturally acquired passive immunity. Maternal antibodies, especially IgG, cross the placenta and provide temporary protection to the newborn. In contrast, immunity following infection or vaccination is active immunity because the individual's immune system actively produces antibodies and memory cells. Toxoids and vaccines stimulate active immune responses rather than direct antibody transfer. Therefore, passive immunity is represented by transfer of antibodies through the placenta.

Final Answer: Transfer of antibodies through the placenta to the fetus

Answer: (C)

[Go Back to Question 98](#)

Q99.

Solution

Concept: The angstrom (\AA) is a very small unit of length used in molecular biology. Conversion relationships are:

$$1 \text{ nm} = 10$$

and

$$1 \mu\text{m} = 1000 \text{ nm}$$

Solution: The plasma membrane thickness is:

$$75$$

Converting to nanometers:

$$75 = \frac{75}{10} = 7.5 \text{ nm}$$

Now converting nanometers into micrometers:

$$7.5 \text{ nm} = \frac{7.5}{1000} = 0.0075 \mu\text{m}$$

Thus, the membrane thickness expressed in nanometers and micrometers respectively is:

$$7.5 \text{ nm} \quad \text{and} \quad 0.0075 \mu\text{m}$$

Final Answer: 7.5 nm and 0.0075 μm

Answer: (A)

[Go Back to Question 99](#)



Q100.

Solution

Concept: Field-Effect Transistor biosensors detect biological molecules through electrical changes at the semiconductor surface. Charged biomolecules such as DNA alter the surface potential, which changes the conductivity of the semiconductor channel and generates measurable electronic signals.

Solution: In Lab-on-a-chip technology, FET biosensors are designed so that biological molecules interact directly with the semiconductor surface. DNA molecules possess negatively charged phosphate groups. When DNA hybridization or binding occurs near the semiconductor channel, the local electric field and surface potential change. This modulates the conductance of the semiconductor, allowing highly sensitive detection of biomolecular interactions. The device does not primarily measure mechanical pressure, thermal resistance, or magnetic properties of nitrogenous bases. Instead, signal generation is based on electrostatic interaction between charged biomolecules and the semiconductor surface. Therefore, the correct principle involves modulation of semiconductor conductance by changes in surface potential caused by biomolecule binding.

Final Answer: Binding of charged biomolecules changes semiconductor conductance

Answer: (B)

[Go Back to Question 100](#)



Answer Key

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

