

NEET UG 2024 Zoology T2 Question Paper With Solutions

Time Allowed :3 Hours 20 min	Maximum Marks :720	Total Questions :200
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151. Match List I with List II.

List I		List II	
A.	Fibrous joints	I.	Adjacent vertebrae, limited movement
B.	Cartilaginous joints	II.	Humerus and Pectoral girdle, rotational movement
C.	Hinge joints	III.	Skull, don't allow any movement
D.	Ball and socket joints	IV.	Knee, help in locomotion

Choose the correct answer from the options given below :

- (1) A-I, B-III, C-I, D-IV
- (2) A-II, B-I, C-IV, D-II
- (3) A-IV, B-II, C-III, D-I
- (4) A-I, B-III, C-II, D-IV

Correct Answer: (2) A-III, B-I, C-IV, D-II

Solution: Fibrous joints (A-III): These joints are also known as fixed or immovable joints because they do not permit movement. The bones in fibrous joints are connected by dense connective tissue. The sutures of the skull are the prime examples where the bones are tightly locked together, allowing for very minimal movement, primarily for shock absorption and protection of the brain.

Cartilaginous joints (B-I): These joints are slightly movable (amphiarthroses) or immovable and are connected entirely by cartilage. An example of this type of joint is the joints between the vertebrae in the spine, where the connection is made through intervertebral discs of fibrocartilage. This allows for flexibility and slight movement, which facilitates bending and twisting of the torso.

Hinge joints (C-IV): Characterized by their cylindrical projections fitting into a trough-shaped structure of another bone, hinge joints are primarily found in the elbow and knee. These joints allow movement along one axis to produce an opening and closing action, much like a door hinge, supporting activities such as walking, running, and bending.

Ball and socket joints (D-II): These are the most mobile type of joints, allowing rotational movement in almost every direction. The shoulder and hip joints are examples, where the spherical end of one bone lodges into the cup-like cavity of another bone. This design allows for movements such as rotation, swinging, and circumduction, essential for complex activities involving the arms and legs.

Quick Tip

Understanding joint types is crucial for studying skeletal biomechanics, which has applications in fields ranging from orthopedics to robotics.

152. Match List I with List II.

List I		List II	
A.	Typhoid	I.	Fungus
B.	Leishmaniasis	II.	Nematode
C.	Ringworm	III.	Protozoa
D.	Filariasis	IV.	Bacteria

Choose the correct answer from the options given below:

- (1) A-III, B-I, C-IV, D-II
- (2) A-II, B-IV, C-III, D-I
- (3) A-I, B-III, C-II, D-IV
- (4) A-IV, B-III, C-I, D-II

Correct Answer: (4) A-IV, B-III, C-I, D-II

Solution: Step 1: Analyzing Each Disease and Its Pathogen

Typhoid (A): Caused by *Salmonella typhi*, which is a bacterium. Thus, A matches with **IV. Bacteria**.

Leishmaniasis (B): This disease is caused by protozoans of the genus *Leishmania*. Therefore, B corresponds to **III. Protozoa**.

Ringworm (C): Despite its name, ringworm is not caused by a worm. It is a fungal infection of the skin, and hence, C aligns with **I. Fungus**.

Filariasis (D): This disease is caused by nematodes (roundworms) such as *Wuchereria bancrofti* and *Brugia malayi*. Hence, D matches with **II. Nematode**.

Step 2: Confirming the Correct Combination

- Each disease is correctly paired with its causative agent, affirming the answer as:
- A-IV, B-III, C-I, D-II

Quick Tip

Knowing the causative agents of diseases is essential for diagnosis and treatment, particularly in tropical medicine.

153. In both sexes of cockroach, a pair of jointed filamentous structures called anal cerci are present on the segment:

- (1) 8th and 9th segment
- (2) 11th segment
- (3) 5th segment
- (4) 10th segment

Correct Answer: (4) 10th segment

Solution: Understanding Anal Cerci:

Anal cerci are paired appendages located at the posterior end of many insects, including cockroaches. These structures serve as sensory organs and are highly sensitive to air movements, helping the insect detect predators and other threats from behind.

Cockroach Anatomy:

Cockroaches, like other insects, have segmented bodies comprising three main parts: the head, thorax, and abdomen. The abdomen itself is segmented, typically consisting of ten segments in cockroaches.

Location of Anal Cerci:

The anal cerci are located on the last segment of the cockroach's abdomen. In terms of numerical designation, this is the 10th segment. These cerci extend outward from the tip of the abdomen, giving them a strategic position to detect changes in the environment from a defensive standpoint.

Function and Importance:

Besides serving a sensory function, anal cerci are involved in mating behaviors and can also aid in locomotion to some extent. Their primary role, however, is to enhance the cockroach's

ability to react to threats, contributing to their survival and evolutionary success.

Quick Tip

Studying the anatomy of common insects like cockroaches can provide insights into their survival strategies and sensory adaptations.

154. Which of the following is not a component of Fallopian tube?

- (1) Infundibulum
- (2) Ampulla
- (3) Uterine fundus
- (4) Isthmus

Correct Answer: (3) Uterine fundus

Solution: Overview of the Fallopian Tube:

The Fallopian tubes, also known as oviducts or uterine tubes, are part of the female reproductive system. They play a critical role in transporting eggs from the ovaries to the uterus. Each Fallopian tube can be divided into several sections, each with distinct anatomical and functional characteristics.

Components of the Fallopian Tube:

Infundibulum: This is the funnel-shaped portion of the Fallopian tube closest to the ovary. It has finger-like projections called fimbriae that help capture the egg released from the ovary.

Ampulla: This is the widest section of the Fallopian tube, where fertilization typically occurs. The ampulla's large diameter provides a suitable environment for the egg and sperm to meet.

Isthmus: This is the narrower part of the tube that links the ampulla to the uterus. It is typically thicker and more muscular than the ampulla, helping to move the fertilized egg towards the uterus.

Incorrect Component:

Uterine Fundus: The uterine fundus is not part of the Fallopian tube. It refers to the top portion of the uterus, which is opposite the cervical opening into the vagina. The fundus of the uterus is the site where the Fallopian tubes connect to the uterus, but it is not a component of the tubes themselves.

Quick Tip

Understanding the anatomy of the female reproductive system is crucial for both medical studies and understanding reproductive health.

155. Given below are two statements:

Statement I: The presence or absence of hymen is not a reliable indicator of virginity.

Statement II: The hymen is torn during the first coitus only.

In the light of the above statements, choose the correct answer from the options given below :

- (1) Statement I is true but Statement II is false
- (2) Statement I is false but Statement II is true
- (3) Both Statement I and Statement II are true
- (4) Both Statement I and Statement II are false

Correct Answer: (1) Statement I is true but Statement II is false

Solution: Analysis of Statement I:

The hymen is a thin membrane that partially covers the external vaginal opening. It varies widely in shape and size among females.

The condition of the hymen is not a definitive marker of sexual activity. It can be stretched or torn due to various non-sexual activities such as sports, tampon use, or medical examinations. Moreover, some girls are born without a hymen. Therefore, the state of the hymen should not be used as a criterion to determine virginity. This makes **Statement I true**.

Analysis of Statement II: It is a common misconception that the hymen is only torn during the first vaginal intercourse. As mentioned earlier, the hymen can tear or change due to various reasons unrelated to sexual activity.

Additionally, not all sexual activities result in the tearing of the hymen, and the hymen does not always tear during first-time intercourse. Some women may not experience significant tearing at all.

Thus, this statement is overly simplistic and misleading, making **Statement II false**.

Quick Tip

Medical myths about the hymen and virginity can lead to misunderstandings and stigma; accurate education helps to dispel these myths.

156. Which of the following are Autoimmune disorders?

- A. Myasthenia gravis
- B. Rheumatoid arthritis
- C. Gout
- D. Muscular dystrophy
- E. Systemic Lupus Erythematosus (SLE)

Choose the most appropriate answer from the options given below

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

Correct Answer: (4) A, B & E only

Solution: Understanding Autoimmune Disorders:

Autoimmune disorders occur when the immune system mistakenly attacks the body's own cells, leading to inflammation and damage to various tissues.

Analysis of Each Condition:

Myasthenia Gravis (A): An autoimmune disorder where antibodies attack the neuromuscular junctions, impairing the ability of the muscles to contract. This condition is characterized by muscle weakness and fatigue.

Rheumatoid Arthritis (B): This is an autoimmune disease where the immune system primarily targets the lining of the joints. This leads to chronic inflammation that can result in joint damage and pain.

Gout (C): Not an autoimmune disorder but a form of arthritis caused by the deposition of uric acid crystals in joints, leading to inflammation. It is related to metabolic processes, not an autoimmune response.

Muscular Dystrophy (D): A group of genetic diseases characterized by progressive

weakness and degeneration of the skeletal muscles. It is not autoimmune but rather due to genetic mutations affecting muscle fibers.

Systemic Lupus Erythematosus (SLE) (E): A complex autoimmune disease affecting multiple organ systems including skin, kidneys, and the nervous system, where the immune system attacks its own tissues, leading to widespread inflammation and tissue damage.

Identifying Autoimmune Disorders from the List:

Based on the descriptions, conditions A (Myasthenia Gravis), B (Rheumatoid Arthritis), and E (Systemic Lupus Erythematosus) are autoimmune disorders.

Quick Tip

Autoimmune disorders often require management that includes suppressing the immune response to reduce symptoms.

157. Match List I with List II.

List I (Sub Phases of Prophase I)		List II (Specific Characters)	
A.	Diakinesis	I.	Synaptonemal complex formation
B.	Pachytene	II.	Completion of terminalisation of chiasmata
C.	Zygotene	III.	Chromosomes look like thin threads
D.	Leptotene	IV.	Appearance of recombination nodules

Choose the correct answer from the options given below

- (1) A-II, B-IV, C-I, D-III
- (2) A-IV, B-III, C-II, D-I
- (3) A-IV, B-I, C-III, D-II
- (4) A-I, B-II, C-IV, D-III

Correct Answer: (1) A-II, B-IV, C-I, D-III

Solution: Overview of Prophase I:

Prophase I is a crucial phase in meiosis where chromosomes undergo various processes critical for genetic recombination and proper segregation. This phase is subdivided into several distinct stages, each characterized by unique chromosomal behaviors and structural changes.

Detailed Analysis:

Leptotene (D): During this initial stage, chromosomes begin to condense, becoming visible under the microscope as thin threads, aligning with **III. Chromosomes look like thin threads.**

Zygotene (C): This stage is marked by the pairing (synapsis) of homologous chromosomes. The formation of the synaptonemal complex between homologs is essential for subsequent recombination, corresponding to **I. Synaptonemal complex formation.**

Pachytene (B): As synapsis completes, recombination nodules appear and crossing over (recombination) between homologous chromosomes occurs. This stage is defined by the **IV. Appearance of recombination nodules.**

Diakinesis (A): The final stage of Prophase I involves the further condensation of chromosomes and the clear visualization of chiasmata (sites of crossing over). The chiasmata move toward the ends of the chromosomes in a process known as terminalisation, which matches **II. Completion of terminalisation of chiasmata.**

Quick Tip

Understanding the stages of meiosis is crucial for genetics and helps explain how genetic diversity is achieved through sexual reproduction.

158. Given below are some stages of human evolution.

- A. *Homo habilis*
- B. *Homo sapiens*
- C. *Homo neanderthalensis*
- D. *Homo erectus*

Arrange them in correct sequence. (Past to Recent)

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

Correct Answer: (2) A-D-C-B

Solution: Understanding the Evolutionary Timeline:

The stages listed represent significant points in the evolution of Homo, the genus that includes modern humans and their close relatives.

Analysis of Each Stage:

Homo habilis (A): Known as the "handy man," this species is one of the earliest members of the genus Homo, appearing around 2.4 million years ago. It is noted for its use of stone tools.

Homo erectus (D): Emerging around 1.9 million years ago, this species was highly successful and versatile, surviving for over a million years. Homo erectus is known for its upright posture and is considered a direct ancestor of modern humans.

Homo neanderthalensis (C): Often known simply as Neanderthals, this species arose around 400,000 years ago and lived until about 40,000 years ago. They are known for their robust build and adaptation to cold climates.

Homo sapiens (B): Modern humans, appearing around 300,000 years ago, with sophisticated tools, art, and technology. Our species is characterized by a high level of cognitive ability and complex social structures.

Correct Sequence:

Starting with **Homo habilis (A)**, as one of the earliest, moving to **Homo erectus (D)**, who spread out of Africa and adapted to various environments. Following this is **Homo neanderthalensis (C)**, known to have overlapped and interacted with early Homo sapiens, and finally **Homo sapiens (B)**, the most recent.

Quick Tip

Understanding the timeline of human evolution helps in grasping the complexity and the adaptive strategies that characterized early human survival and development.

159. Match List I with List II:

List I		List II	
A.	Expiratory capacity	I.	Expiratory reserve volume + Tidal volume + Inspiratory reserve volume
B.	Functional residual capacity	II.	Tidal volume + Expiratory reserve volume
C.	Vital capacity	III.	Tidal volume + Inspiratory reserve volume
D.	Inspiratory capacity	IV.	Expiratory reserve volume + Residual volume

Choose the correct answer from the options given below :

- (1) A-II, B-I, C-IV, D-III
- (2) A-I, B-III, C-II, D-IV
- (3) A-II, B-IV, C-I, D-III
- (4) A-III, B-II, C-IV, D-I

Correct Answer: (3) A-II, B-IV, C-I, D-III

Solution: Understanding Lung Volumes and Capacities:

Expiratory capacity (A): This is the maximum volume of air that can be exhaled from the lung after normal expiration. It is the sum of the tidal volume (the amount of air inhaled and exhaled during normal breathing) and the expiratory reserve volume (the additional amount of air that can be forcibly exhaled after normal exhalation). Hence, **A matches with II (Tidal volume + Expiratory reserve volume).**

Functional residual capacity (B): This is the volume of air remaining in the lungs after a normal expiration. It includes the expiratory reserve volume and the residual volume (the volume of air remaining in the lungs after a maximal exhalation). Therefore, **B corresponds with IV (Expiratory reserve volume + Residual volume).**

Vital capacity (C): The total amount of air that can be forcibly exhaled after a maximal inhalation, which includes the tidal volume, inspiratory reserve volume (the additional air that can be forcibly inhaled after normal inhalation), and the expiratory reserve volume. This makes **C align with I (Expiratory reserve volume + Tidal volume + Inspiratory reserve volume).**

Inspiratory capacity (D): The total volume of air that can be inhaled after a normal

expiration, including the tidal volume and the inspiratory reserve volume. Thus, **D matches with III (Tidal volume + Inspiratory reserve volume).**

Quick Tip

Understanding different lung volumes and capacities is essential for assessing respiratory health and function.

160. Match List I with List II:

List I		List II	
A.	Pons	I.	Provides additional space for Neurons, regulates posture and balance.
B.	Hypothalamus	II.	Controls respiration and gastric secretions.
C.	Medulla	III.	Connects different regions of the brain.
D.	Cerebellum	IV.	Neuro secretory cells

Choose the correct answer from the options given below :

- (1) A-I, B-III, C-II, D-IV
- (2) A-II, B-I, C-III, D-IV
- (3) A-III, B-II, C-I, D-IV
- (4) A-III, B-IV, C-II, D-I

Correct Answer: (4) A-III, B-IV, C-II, D-I

Solution: Detailed Analysis of Each Brain Part:

Pons (A): The pons is a critical structure located above the medulla in the brainstem. It contains nuclei that relay signals from the forebrain to the cerebellum, along with nuclei that deal primarily with sleep, respiration, swallowing, bladder control, hearing, equilibrium, taste, eye movement, facial expressions, and posture. As a major structure of the brainstem, it is pivotal in the communication between different parts of the brain. Therefore, A matches with **III. Connects different regions of the brain.**

Hypothalamus (B): The hypothalamus is a small region of the brain located below the

thalamus and above the brainstem. It plays a crucial role in hormone production and the regulation of essential bodily functions including emotions, autonomic functions, and homeostasis. It links the nervous system to the endocrine system via the pituitary gland, containing neurosecretory cells that synthesize and secrete neurohormones, sometimes referred to as hypothalamic-releasing hormones. These hormones control and regulate the secretion of pituitary hormones. Thus, B aligns with **IV. Neuro secretory cells.**

Medulla (C): The medulla oblongata is the lower half of the brainstem. It controls autonomic functions and connects the higher levels of the brain to the spinal cord. It is crucial for the regulation of several vital functions, including heart rate, breathing, blood pressure, and digestion. Known for its role in autonomic (involuntary) functions, it is vital for life-sustaining functions such as breathing and heart rate. Therefore, C matches with **II. Controls respiration and gastric secretions.**

Cerebellum (D): Located at the back of the skull, the cerebellum is vital for motor control. It does not initiate movement, but it contributes to coordination, precision, and accurate timing of movements. It also regulates motor movements, such as posture, balance, coordination, and speech, resulting in smooth and balanced muscular activity. It is also important for learning motor behaviors. It is not involved directly in psychological functions but in the coordination of voluntary movements such as posture, balance, coordination, and speech, thus D corresponds with **I. Provides additional space for Neurons, regulates posture and balance.**

Quick Tip

The brain's complex structure functions include multiple overlapping roles; each area can have multiple roles affecting different body systems.

161. Given below are two statements:

Statement I: In the nephron, the descending limb of loop of Henle is impermeable to water and permeable to electrolytes.

Statement II: The proximal convoluted tubule is lined by simple columnar brush border epithelium and increases the surface area for reabsorption.

In the light of the above statements, choose the correct answer from the option given

below :

- (1) Statement I is true but Statement II is false
- (2) Statement I is false but Statement II is true
- (3) Both Statement I and Statement II are true
- (4) Both Statement I and Statement II are false

Correct Answer: (4) Both Statement I and Statement II are false

Solution: Analysis of Statement I:

The descending limb of the loop of Henle is primarily permeable to water but not to electrolytes. This segment of the nephron is crucial for concentrating the urine as water is reabsorbed into the surrounding hypertonic medullary interstitium, driven by osmotic gradients. The ascending limb, in contrast, is impermeable to water and actively transports salts out of the tubular fluid. Therefore, **Statement I is false.**

Analysis of Statement II:

The proximal convoluted tubule (PCT) is indeed critical for reabsorption, but it is lined with simple cuboidal epithelium, not columnar. The epithelium of the PCT has a brush border, which significantly increases the surface area for reabsorption of water, ions, and nutrients from the filtrate. Thus, while the statement correctly notes the presence of a brush border and its function, it incorrectly describes the type of epithelium. Therefore, **Statement II is false.**

Quick Tip

Understanding the specific functions and cellular structures of different parts of the nephron is crucial for grasping kidney function and its role in homeostasis.

162. Which of the following is not a steroid hormone?

- (1) Progesterone
- (2) Glucagon
- (3) Cortisol
- (4) Testosterone

Correct Answer: (2) Glucagon

Solution: Understanding Steroid Hormones:

Steroid hormones are derived from cholesterol and share a characteristic structure involving

four carbon rings. These hormones are lipid-soluble and can pass through cell membranes to interact with intracellular receptors, influencing gene expression directly.

Analysis of Each Option:

Progesterone (1): A steroid hormone involved in the menstrual cycle, pregnancy, and embryogenesis of humans and other species. Progesterone is produced in the ovaries, the placenta (when pregnant), and the adrenal glands.

Glucagon (2): This is a peptide hormone, produced by the alpha cells of the pancreas. It works to raise the concentration of glucose and fatty acids in the bloodstream and is not a steroid hormone. Its primary function is to raise blood glucose levels by promoting gluconeogenesis and glycogenolysis in the liver.

Cortisol (3): Known as the "stress hormone," cortisol is a steroid hormone produced by the adrenal cortex. It is involved in the response to stress and low blood-glucose concentration.

Testosterone (4): A steroid hormone from the androgen group, testosterone is primarily secreted in the testes of males and the ovaries of females, although small amounts are also secreted by the adrenal glands. It is the principal male sex hormone and an anabolic steroid.

Conclusion:

Among the options listed, **Glucagon** is the only compound that is not a steroid hormone. It is a peptide hormone, which differentiates it from the others that are all based on the steroid nucleus structure. Therefore, the correct answer is **(2) Glucagon**.

Quick Tip

Differentiating between steroid and peptide hormones is essential for understanding their mechanisms of action and implications for drug development.

163. Match List I with List II:

List I		List II	
A.	<i>Pterophyllum</i>	I.	Hag fish
B.	<i>Myxine</i>	II.	Saw fish
C.	<i>Pristis</i>	III.	Angel fish
D.	<i>Exocoetus</i>	IV.	Flying fish

Choose the correct answer from the options given below :

(1) A-IV, B-I, C-II, D-III

(2) A-III, B-II, C-I, D-IV

(3) A-II, B-I, C-III, D-IV

(4) A-III, B-I, C-II, D-IV

Correct Answer: (4) A-III, B-I, C-II, D-IV

Solution: Pterophyllum (A) is commonly known as the **Angel fish** (III). It is an ornamental freshwater fish with distinctive triangular fins. The name "Pterophyllum" is derived from Greek, meaning "wing-shaped leaf," referring to its wing-like dorsal and pectoral fins. These fish are typically found in the Amazon River basin, and are popular in aquariums due to their vibrant color and graceful appearance. The angel fish is peaceful and thrives in well-planted aquariums, making it one of the most recognized aquarium fish.

Myxine (B) is commonly known as the **Hag fish** (I). The hag fish is a primitive, jawless fish that is famous for producing slime, which it uses as a defense mechanism. These slime-producing abilities are also used to suffocate and deter predators. Hagfish are scavengers that feed on dead and decaying matter, making them important for marine ecosystems as they help clean up organic waste. They are primarily found in cold, deep-sea environments and can reach lengths of about 1 meter.

Pristis (C) refers to the **Saw fish** (II), known for its distinctive saw-like rostrum (snout). The sawfish uses its long, flattened snout to slash through schools of fish, stunning them or causing injury for easy feeding. It is a type of ray-finned fish found in warm coastal waters. Sawfish can be found in the tropics and subtropics of the Atlantic, Indian, and Pacific oceans. Their saw-like snout is used in both predation and defense, and sawfish are critically endangered due to habitat loss and fishing practices.

Exocoetus (D) is commonly known as the **Flying fish** (IV). This species is renowned for its ability to leap out of the water and glide for significant distances, aided by their enlarged pectoral fins. Flying fish can glide for over 100 meters in one leap, using their tail to propel themselves above the surface. This ability helps them evade predators such as tuna and other larger fish. Flying fish are found in warm tropical and subtropical waters and are often seen leaping from the ocean surface in schools. They are also an important part of the food chain for many predatory fish, birds, and even humans in some regions.

Quick Tip

Studying the common names and characteristics of various fish species aids in biological classification and ecological studies.

164. Which one is the correct product of DNA dependent RNA polymerase to the given template?

Template DNA: 3'TACTGCGAAATCATTCAG5'

- (1) 5' AUGUACCGUUUAAGGAGAAGU3'
- (2) 5' ATGACCGTTAATAGGAGAAGT3'
- (3) 5' AUGUACCGUUUAAGGAGAAGU3'
- (4) 5' AUGUAAAGUUUAAGGUAAGU3'

Correct Answer: (3) 5' AUGUACCGUUUAAGGAGAAGU3'

Solution: Process of Transcription:

DNA-dependent RNA polymerase synthesizes RNA by reading the template strand of DNA from 3' to 5'. The RNA polymerase adds RNA nucleotides that are complementary to the DNA template strand, resulting in an RNA strand that grows from 5' to 3'.

Transcription Steps:

For the given DNA template 3'-TACATGGCAAATATCCATTCA-5', the RNA polymerase will synthesize an RNA strand using the following base pairing rules:

- Adenine (A) pairs with Uracil (U) in RNA.
- Thymine (T) pairs with Adenine (A) in RNA.
- Cytosine (C) pairs with Guanine (G) in RNA.
- Guanine (G) pairs with Cytosine (C) in RNA.

Transcribing the Given DNA Template:

Reading the DNA template from 3' to 5', the complementary RNA sequence will be synthesized from 5' to 3' as follows:

- DNA 3'-T A C A T G G C A A A T A T C C A T T C A-5'
- RNA 5'-A U G U A C C G U U U A U A G G U A A G U-3'

Matching with Options:

- Comparing the calculated RNA sequence with the provided options, option (3)

5'-AUGUACCGUUUAUAGGUAAGU-3' correctly represents the RNA sequence transcribed from the given DNA template.

Quick Tip

Understanding transcription involves recognizing the anti-parallel nature of DNA-RNA synthesis and the base pairing rules that govern nucleic acid structures.

165. Which of the following statements is incorrect?

- (1) Bio-reactors are used to produce small scale bacterial cultures
- (2) Bio-reactors have an agitator system, an oxygen delivery system and foam control system
- (3) A bio-reactor provides optimal growth conditions for achieving the desired product
- (4) Most commonly used bio-reactors are of stirring type

Correct Answer: (1) Bio-reactors are used to produce small scale bacterial cultures

Solution: Evaluating Each Statement:

Statement (1): This statement is **incorrect** because bio-reactors, while versatile, are typically used for large-scale production of microbial, plant, animal cells, and their products. They are designed to handle large volumes and maintain optimal conditions over extensive periods, which is crucial for commercial and industrial applications rather than just small scale bacterial cultures.

Statement (2): This statement is **correct**. Bio-reactors are equipped with various systems to ensure the efficient growth of cultures:

Agitator system ensures uniform mixing and distribution of nutrients and heat.

Oxygen delivery system is crucial for aerobic cultures to supply sufficient oxygen.

Foam control system prevents foam formation that can inhibit microbial activity and affect gas exchange.

Statement (3): This statement is **correct**. One of the primary functions of a bio-reactor is to provide controlled environments (temperature, pH, oxygen levels, etc.) tailored to maximize the yield and potency of the desired bioproduct, such as pharmaceuticals, antibodies, or biopolymers.

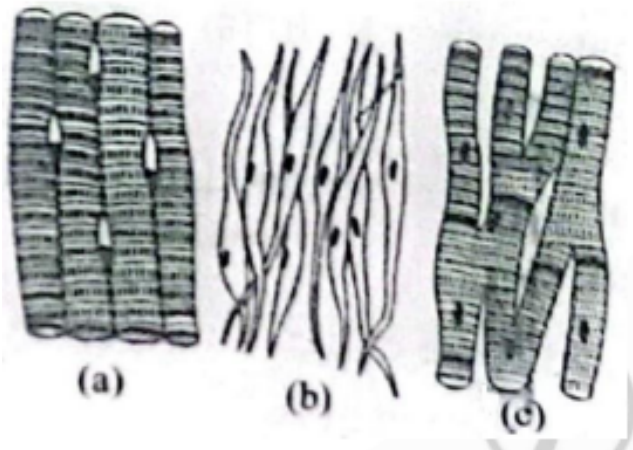
Statement (4): This statement is also **correct**. Stirred-tank reactors are the most common type of bio-reactor because they are suitable for a variety of microbial and cell culture

processes. Their design allows for efficient mixing, oxygen transfer, and scale-up capabilities.

Quick Tip

Bio-reactors are versatile tools in biotechnology used for scaling up from laboratory to industrial production, accommodating various organisms and products.

166. Three types of muscles are given as a, b, and c. Identify the correct matching pair along with their location in the human body:



Name of Muscle/Location.

- (1) (a) Skeletal - Biceps, (b) Involuntary - Intestine, (c) Smooth - Heart
- (2) (a) Involuntary - Nose tip, (b) Skeletal - Bone, (c) Cardiac - Heart
- (3) (a) Smooth - Toes, (b) Skeletal - Legs, (c) Cardiac - Heart
- (4) (a) Skeletal - Triceps, (b) Smooth - Stomach, (c) Cardiac - Heart

Correct Answer: (4) (a) Skeletal - Triceps, (b) Smooth - Stomach, (c) Cardiac - Heart

Solution: Analysis of Muscle Types and Locations:

(a) Skeletal Muscle: Characterized by striations and voluntary control. Common examples include muscles such as the biceps and triceps which are used for movement of bones.

Correct identification: Triceps, a large muscle on the back of the upper limb of many vertebrates. It is responsible for extension of the elbow joint.

(b) Smooth Muscle: Lacks striations and is under involuntary control. It is found in walls of hollow organs like intestines and stomach.

Correct identification: Stomach, which extensively uses smooth muscle for the process of

digestion through peristalsis.

(c) Cardiac Muscle: Striated like skeletal muscle but operates under involuntary control, found only in the heart.

Correct identification: Heart, the primary location of cardiac muscle which is specialized for continuous contractions to pump blood throughout the body.

Conclusion:

Each muscle type is correctly identified in option (4) with its location, matching the unique structural and functional characteristics necessary for their respective roles in the human body.

Quick Tip

Distinguishing muscle types is key in anatomy and helps in understanding the physiological roles of different muscle tissues in the body.

167. Which one of the following factors will not affect the Hardy-Weinberg equilibrium?

- (1) Gene migration
- (2) Constant gene pool
- (3) Genetic recombination
- (4) Genetic drift

Correct Answer: (2) Constant gene pool

Solution: Understanding Hardy-Weinberg Equilibrium:

The Hardy-Weinberg principle provides a mathematical model that predicts how gene frequencies are transmitted from one generation to the next, under the assumption that the population is large, mating is random, and there are no forces (like selection, mutation, migration, or genetic drift) altering the gene frequencies.

Factors Affecting Hardy-Weinberg Equilibrium:

Gene Migration: Also known as gene flow, it involves the transfer of alleles from one population to another, introducing new alleles into the gene pool and altering allele frequencies. Hence, it affects the equilibrium.

Constant Gene Pool: This condition implies that the allele frequencies in the population

remain constant and no evolutionary forces (like selection, mutation, or migration) are acting on the population. This scenario is actually a requirement for the Hardy-Weinberg equilibrium to be maintained, rather than a factor that would disrupt it.

Genetic Recombination: Occurs during sexual reproduction where alleles are shuffled and new combinations can form. While genetic recombination changes the combination of genes, it does not change the overall frequency of alleles in the population; however, in real-world scenarios, it can introduce variation that selection acts upon, thus potentially affecting equilibrium.

Genetic Drift: Refers to random changes in allele frequencies that can occur in small populations due to chance events. It leads to a decrease in genetic variation and can cause significant deviations from Hardy-Weinberg equilibrium.

Conclusion: The only option that does not affect Hardy-Weinberg equilibrium is a **constant gene pool** (Option 2), as it describes a scenario where evolutionary forces are absent, thus maintaining equilibrium rather than disrupting it.

Quick Tip

The Hardy-Weinberg principle serves as a fundamental model in population genetics to study how genetic variation is maintained or changed.

168. Which of the following is not a natural/traditional contraceptive method?

- (1) Lactational amenorrhea
- (2) Vaults
- (3) Coitus interruptus
- (4) Periodic abstinence

Correct Answer: (2) Vaults

Solution: Understanding Natural/Traditional Contraceptive Methods:

Natural or traditional contraceptive methods rely on observations about the woman's body and menstrual cycle or behaviors that prevent sperm from reaching the egg. They do not involve the use of chemical or physical barriers.

Analysis of Each Option:

Lactational Amenorrhea (1): This is a natural method of contraception. It is based on the

natural postpartum infertility that occurs when a woman is amenorrheic (not menstruating) and fully breastfeeding. This method relies on the hormonal changes that occur during lactation which suppress ovulation.

Vaults (2): This refers to the contraceptive method using cervical caps or diaphragms, which are barrier methods of contraception. These devices are inserted into the vagina to cover the cervix and prevent sperm from entering the uterus. They are not natural methods as they involve the use of manufactured devices.

Coitus Interruptus (3): Also known as withdrawal method, it involves the male partner withdrawing his penis from the vagina prior to ejaculation to avoid depositing sperm in the female reproductive tract. This is considered a traditional and natural method as it only involves behavioral change and no chemical or physical barriers.

Periodic Abstinence (4): This involves abstaining from sexual intercourse during the days of a woman's menstrual cycle when she is most likely to conceive. This method is also known as the rhythm method or fertility awareness and is considered natural because it only requires observation and timing, without the use of physical or chemical aids.

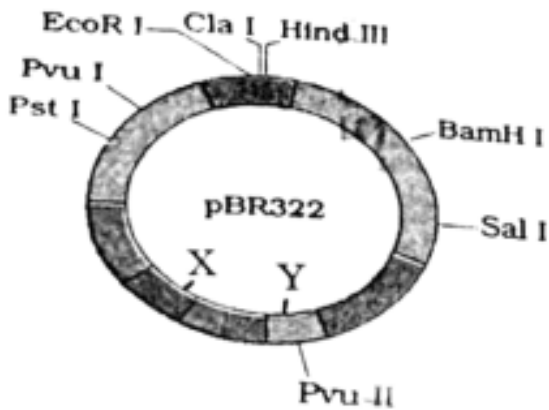
Conclusion: The only option listed that is not a natural/traditional method of contraception is **Vaults** (Option 2), as it involves the use of a physical barrier, unlike the other methods which are based on natural physiological phenomena or behavioral modifications.

Quick Tip

Understanding different contraceptive methods is crucial for reproductive health and family planning.

169. The following diagram showing restriction sites in *E. coli* cloning vector pBR322.

Find the role of 'X' and 'Y' genes:



- (1) The gene 'X' is for protein involved in replication of Plasmid and 'Y' for resistance to antibiotics.
- (2) Gene 'X' is responsible for recognitions sites and 'Y' is responsible for antibiotic resistance.
- (3) The gene 'X' is responsible for resistance to antibiotics and 'Y' for protein involved in the replication of Plasmid.
- (4) The gene 'X' is responsible for controlling the copy number of the linked DNA and 'Y' for protein involved in the replication of Plasmid.

Correct Answer: (4) The gene 'X' is responsible for controlling the copy number of the linked DNA and 'Y' for protein involved in the replication of Plasmid.

Solution: Analyze the function of genes in pBR322.

The gene 'X' in pBR322, often referred to as the 'copA' gene, controls the copy number of the plasmid, regulating how many copies of the plasmid exist per cell. Gene 'Y', typically the 'rop' gene, helps in the stabilization and efficient replication of the plasmid.

Quick Tip

Understanding plasmid functions such as replication, antibiotic resistance, and copy number control is fundamental in genetic engineering and biotechnology.

170. Match List I with List II:

List-I		List-II	
A.	Lipase	I.	Peptide bond
B.	Nuclease	II.	Ester bond
C.	Protease	III.	Glycosidic bond
D.	Amylase	IV.	Phosphodiester bond

Choose the correct answer from the options given below :

- (1) A-II, B-IV, C-I, D-III
- (2) A-IV, B-I, C-III, D-II
- (3) A-IV, B-II, C-III, D-I
- (4) A-III, B-II, C-I, D-IV

Choose the correct answer from the options given below :

Correct Answer: (1) A-II, B-IV, C-I, D-III

Solution: Understanding the Function of Each Enzyme: - **Lipase (A):** Enzymes that break down lipids, specifically by hydrolyzing the ester bonds in lipids, releasing fatty acids and glycerol. Thus, Lipase acts on **Ester bonds (II)**.

- **Nuclease (B):** Enzymes that cleave the chains of nucleotides in nucleic acids. They break phosphodiester bonds within DNA and RNA, which link the nucleotide subunits together. Hence, Nuclease targets **Phosphodiester bonds (IV)**.

- **Protease (C):** Also known as peptidases, these enzymes hydrolyze peptide bonds between amino acids in proteins. Proteases thereby act on **Peptide bonds (I)**.

- **Amylase (D):** Enzymes that catalyze the hydrolysis of starch into sugars. Amylase acts on the glycosidic bonds linking glucose monomers in starch. Therefore, Amylase is associated with **Glycosidic bonds (III)**.

Correct Matching: - The appropriate pairings, based on the functional activity of each enzyme with the type of bond it acts upon, are: - A-II, B-IV, C-I, D-III

Quick Tip

Each enzyme is specialized to act on specific chemical bonds; understanding these specificities is crucial in biochemistry and molecular biology.

171. Which of the following factors are favourable for the formation of oxyhaemoglobin

in alveoli?

- (1) Low $p\text{CO}_2$ and High H^+ concentration
- (2) Low $p\text{CO}_2$ and High temperature
- (3) High $p\text{O}_2$ and High $p\text{CO}_2$
- (4) High $p\text{O}_2$ and Lesser H^+ concentration

Correct Answer: (4) High $p\text{O}_2$ and Lesser H^+ concentration

Solution: Understanding the Factors Influencing Oxyhaemoglobin Formation:

The formation of oxyhaemoglobin, the complex of oxygen and hemoglobin, is influenced by several physiological factors. This process is essential for transporting oxygen from the lungs to the tissues.

Analysis of Each Factor:

Partial Pressure of Oxygen $p\text{O}_2$: Higher $p\text{O}_2$ increases the affinity of hemoglobin for oxygen, facilitating the formation of oxyhaemoglobin. In the alveoli, where oxygen concentration is high due to fresh air intake, the $p\text{O}_2$ is naturally higher, promoting this binding.

Partial Pressure of Carbon Dioxide $p\text{CO}_2$: Lower $p\text{CO}_2$ reduces the competition between carbon dioxide and oxygen for binding sites on hemoglobin, further enhancing oxygen binding.

Hydrogen Ion Concentration H^+ : Lower H^+ concentration, or a higher pH, shifts the oxygen-hemoglobin dissociation curve to the left (known as the Bohr effect). This shift increases hemoglobin's affinity for oxygen, facilitating the formation of oxyhaemoglobin.

Detailed Analysis of Options: Option (1) Low $p\text{CO}_2$ and High H^+ concentration is not favorable because high H^+ concentration (or low pH) would decrease hemoglobin's oxygen affinity.

Option (2) Low $p\text{CO}_2$ and High temperature: While lower $p\text{CO}_2$ is favorable, higher temperatures actually decrease the affinity of hemoglobin for oxygen, promoting oxygen release rather than uptake in tissues.

Option (3) High $p\text{O}_2$ and High $p\text{CO}_2$: While high $p\text{O}_2$ is favorable, high $p\text{CO}_2$ would lower hemoglobin's oxygen affinity due to competitive inhibition and a shift in pH.

Option (4) High $p\text{O}_2$ and Lesser H^+ concentration: This is the most favorable condition in the alveoli for oxyhaemoglobin formation. High $p\text{O}_2$ enhances oxygen loading, and lesser

H⁺ concentration increases hemoglobin's affinity for oxygen, facilitating efficient oxygen transport.

Quick Tip

The Bohr effect describes how pH levels and CO₂ concentrations influence hemoglobin's oxygen-binding capacity, crucial for understanding respiratory physiology.

172. Match List I with List II:

List I		List II	
A.	Common cold	I.	Plasmodium
B.	Haemozoin	II.	Typhoid
C.	Widal test	III.	Rhinoviruses
D.	Allergy	IV.	Dust mites

Choose the correct answer from the options given below :

- (1) A-III, B-I, C-II, D-IV
- (2) A-IV, B-II, C-III, D-I
- (3) A-II, B-IV, C-III, D-I
- (4) A-I, B-III, C-II, D-IV

Correct Answer: (1) A-III, B-I, C-II, D-IV

Solution: Detailed Analysis of Each Match:

Common cold (A): The common cold is primarily caused by rhinoviruses, which are a group of infectious agents responsible for upper respiratory infections. This makes the correct match **A-III**.

Haemozoin (B): Haemozoin is a byproduct formed from the digestion of blood by certain parasites, including Plasmodium species, which cause malaria. Therefore, the correct match is **B-I**.

Widal test (C): The Widal test is a diagnostic test for typhoid fever, which detects the presence of serum agglutinins (H and O) in a patient with suspected typhoid fever caused by the bacterium *Salmonella typhi*. Thus, the correct pairing is **C-II**.

Allergy (D): Allergies can be triggered by various environmental agents, including dust

mites, which are a common cause of allergic reactions such as asthma and allergic rhinitis. This leads to the correct association **D-IV**.

Quick Tip

Connecting diseases with their causative agents or associated tests helps in clinical diagnosis and understanding pathology.

173. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: Breast-feeding during initial period of infant growth is recommended by doctors for bringing a healthy baby.

Reason R: Colostrum contains several antibodies absolutely essential to develop resistance for the new born baby.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (1) A is correct but R is not correct
- (2) A is not correct but R is correct
- (3) Both A and R are correct and R is the correct explanation of A
- (4) Both A and R are correct but R is NOT the correct explanation of A

Correct Answer: (3) Both A and R are correct and R is the correct explanation of A

Solution: Detailed Analysis:

Assertion A (Breast-feeding during the initial period of infant growth is recommended by doctors for bringing a healthy baby): This statement is **correct**. Breast-feeding is universally recommended by health professionals because it provides the best source of nutrition for most infants, including essential nutrients and immunological protection against many diseases and infections.

Reason R (Colostrum contains several antibodies absolutely essential to develop resistance for the newborn baby): This statement is also **correct**. Colostrum, the first form of milk produced by the mammary glands immediately following delivery, is rich in antibodies, particularly immunoglobulin A (IgA). IgA protects the newborn's gastrointestinal tract from infection and helps in the overall development of the immune system.

Correlation of A and R:

Correct Explanation: The Reason (R) provides a strong scientific basis for the Assertion (A). The presence of antibodies in colostrum is a critical factor that underlines the importance of breast-feeding during the initial days after birth. These antibodies are crucial for the development of the infant's immune system, contributing significantly to the health of the baby, which is precisely what the Assertion suggests. Thus, R correctly explains A, confirming that both statements are accurate and R is indeed the correct explanation for A.

Quick Tip

Colostrum, the first form of milk produced immediately following delivery, is rich in antibodies and is crucial for passive immunity in the newborn.

174. Match List I with List II:

List I		List II	
A.	Non-medicated IUD	I.	Multiload 375
B.	Copper releasing IUD	II.	Progestogens
C.	Hormone releasing IUD	III.	Lippes loop
D.	Implants	IV.	LNG-20

Choose the correct answer from the options given below:

- (1) A-IV, B-I, C-II, D-III
- (2) A-III, B-I, C-IV, D-II
- (3) A-II, B-I, C-III, D-IV
- (4) A-I, B-III, C-II, D-IV

Correct Answer: (2) A-III, B-I, C-IV, D-II

Solution: Detailed Analysis of Each Match:

Non-medicated IUD (A): These types of IUDs do not release any hormones or copper. They work by creating a physical barrier and possibly by creating a local inflammatory response that is toxic to sperm and ova. **Lippes Loop** is a type of non-medicated IUD, which is a plastic device that sits in the uterus to prevent pregnancy. Thus, **A matches with III.**

Copper releasing IUD (B): These IUDs release a small amount of copper into the uterus, which is toxic to sperm. **Multiload 375** is a specific brand of copper-releasing IUD known

for its effectiveness in preventing pregnancy. Therefore, **B matches with I.**

Hormone releasing IUD (C): This type of IUD releases hormones (typically progestogens) to prevent pregnancy. **LNG-20 (Levonorgestrel releasing intrauterine system)** is a well-known example that releases levonorgestrel, a hormone, to prevent fertilization. Hence, **C matches with IV.**

Implants (D): These are typically small, flexible rods implanted under the skin of the upper arm, which release hormones to prevent pregnancy. They commonly release **progestogens**, which inhibit ovulation and increase cervical mucus viscosity, thus preventing sperm from reaching an egg. Consequently, **D matches with II.**

Quick Tip

Understanding the mechanism of different contraceptive methods can aid in choosing the most appropriate method for reproductive health.

175. Following are the stages of cell division:

- A. Gap 2 phase
- B. Cytokinesis
- C. Synthesis phase
- D. Karyokinesis
- E. Gap 1 phase

Choose the correct sequence of stages from the options given below:

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

Correct Answer: (2) E-C-A-D-B

Solution: Understanding the Cell Cycle:

The cell cycle is divided into interphase and the mitotic (M) phase. Interphase includes the Gap 1 (G1), Synthesis (S), and Gap 2 (G2) phases. The mitotic phase includes mitosis (karyokinesis) and is followed by cytokinesis.

Detailed Sequence of the Cell Cycle:

Gap 1 Phase (E): This is the first part of interphase, where the cell grows physically larger, copies organelles, and makes the molecular building blocks it will need in later steps.

Synthesis Phase (C): During the S phase, the cell synthesizes a complete copy of the DNA in its nucleus. It also duplicates a microtubule-organizing structure called the centrosome, which helps separate DNA during M phase.

Gap 2 Phase (A): In the G2 phase, the cell grows more, makes proteins and organelles, and begins to reorganize its contents in preparation for mitosis. G2 ends when mitosis begins.

Karyokinesis (D): Also known as mitosis, this phase involves the division of a cell's nucleus into two nuclei, each with the same number of chromosomes. Mitosis is subdivided into stages: prophase, metaphase, anaphase, and telophase.

Cytokinesis (B): This is the final stage of cell division, where the cell cytoplasm divides, creating two daughter cells. Cytokinesis typically overlaps with the telophase stage of mitosis.

Correct Sequence:

The sequence provided in option (2), E-C-A-D-B, accurately follows the order of the cell cycle, beginning with the initial growth phase (Gap 1), followed by DNA synthesis, preparation for mitosis (Gap 2), the division of the nucleus (karyokinesis), and finally, the division of the cytoplasm (cytokinesis).

Quick Tip

Remember the order of the cell cycle as G1 (growth), S (synthesis), G2 (second growth), and M (mitosis), which includes karyokinesis followed by cytokinesis.

176. Match List I with List II:

List I		List II	
A.	Pleurobrachia	I.	Mollusca
B.	Radula	II.	Ctenophora
C.	Stomochord	III.	Osteichthyes
D.	Air bladder	IV.	Hemichordata

Choose the correct answer from the options given below:

- (1) A-II, B-IV, C-I, D-III
- (2) A-IV, B-III, C-II, D-I
- (3) A-IV, B-II, C-III, D-I
- (4) A-II, B-I, C-IV, D-III

Correct Answer: (4) A-II, B-I, C-IV, D-III

Solution: Detailed Analysis of Each Match:

Pleurobrachia (A): This is a species found in the phylum **Ctenophora**, commonly known as comb jellies. These marine organisms are characterized by their gelatinous bodies and distinctive combs, which are rows of cilia used for swimming. Therefore, **A matches with II.**

Radula (B): The radula is a unique anatomical feature found in most mollusks (**Mollusca**). It functions as a file-like structure used by these animals to scrape or cut food before ingestion. Thus, **B matches with I.**

Stomochord (C): The stomochord is a flexible, rod-like structure in the collar region of **Hemichordata**, which was once thought to be homologous to the notochord of chordates. Hemichordata includes animals like acorn worms. Hence, **C matches with IV.**

Air bladder (D): Also known as the swim bladder, it is an internal gas-filled organ that contributes to the ability of a fish to control its buoyancy, and is found in most **Osteichthyes** (bony fish). This feature helps the fish maintain its depth without floating upward or sinking. Therefore, **D matches with III.**

Quick Tip

Learning to associate specific structures or organisms with their respective phyla can significantly enhance understanding in comparative anatomy and evolutionary biology.

177. The flippers of the Penguins and Dolphins are the example of:

- (1) Convergent evolution
- (2) Divergent evolution
- (3) Adaptive radiation
- (4) Natural selection

Correct Answer: (1) Convergent evolution

Solution: Understanding Convergent Evolution:

Convergent evolution occurs when different species evolve similar traits independently, often because they adapt to similar environments or ecological niches. This process does not imply a common ancestry for the structures concerned but rather a similar pattern of natural selection.

Flippers of Penguins and Dolphins:

Penguins: Birds that have evolved to become highly proficient swimmers. Their flippers, which are modified wings, are streamlined for swimming rather than flying. This adaptation allows penguins to navigate effectively through water.

Dolphins: Mammals that are part of the cetacean family, which includes whales and dolphins. Their flippers evolved from the forelimbs of terrestrial mammals, reshaping into paddles that provide stability and steering capabilities in the aquatic environment.

Why This is Convergent Evolution:

Despite their different evolutionary histories and being part of distinct taxonomic groups (birds and mammals), both penguins and dolphins have developed flippers. This similarity arises not from shared ancestry but because both have adapted to life in marine environments. The streamlined, flat shape of flippers is an effective adaptation for swimming and maneuvering in water, thus these similar structures have evolved due to similar selective pressures in a marine environment, rather than because of a recent common ancestor.

Conclusion:

- The evolution of flippers in both penguins and dolphins is a classic example of convergent evolution, where unrelated species develop similar traits due to having to adapt to similar conditions or niches. This is distinct from divergent evolution or adaptive radiation where traits evolve from a common ancestor into diverse forms.

Quick Tip

Convergent evolution is an important concept in evolution, demonstrating how different lineages can develop similar adaptations independently when exposed to similar challenges.

178. Match List I with List II:

List I		List II	
A.	Axoneme	I.	Centriole
B.	Cartwheel pattern	II.	Cilia and flagella
C.	Crista	III.	Chromosome
D.	Satellite	IV.	Mitochondria

Choose the correct answer from the options given below:

- (1) A-II, B-IV, C-I, D-III
- (2) A-II, B-I, C-IV, D-III
- (3) A-IV, B-III, C-II, D-I
- (4) A-IV, B-II, C-III, D-I

Correct Answer: (2) A-II, B-I, C-IV, D-III

Solution: Detailed Analysis of Each Match:

Axoneme (A): The axoneme is the central shaft found within cilia and flagella, consisting of microtubules arranged in a characteristic "9+2" pattern. It is essential for the beating motion of these organelles. Thus, **A matches with II.**

Cartwheel pattern (B): This refers to the structural appearance of the centriole when viewed in cross-section, particularly evident in the early stages of centriole formation. The cartwheel structure is key in microtubule organization. Hence, **B matches with I.**

Crista (C): Cristae are the inner foldings of the mitochondrial membrane and are sites where the electron transport chain components are located. They increase the surface area for ATP production activities within mitochondria. Therefore, **C matches with IV.**

Satellite (D): Satellites are segments of DNA located at the end of chromosomes, important for the stability and integrity of chromosomes. They are often involved in the formation of telomeres. Consequently, **D matches with III.**

Quick Tip

Recognizing cellular structures and their functions is fundamental in cell biology, enhancing understanding of cell structure and function.

179. Following are the stages of pathway for conduction of an action potential through the heart:

- A. AV bundle
- B. Purkinje fibres
- C. AV node
- D. Bundle branches
- E. SA node

Choose the correct sequence of pathway from the options given below:

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

Correct Answer: (3) E-C-A-D-B

Solution: Understanding the Cardiac Conduction System:

The cardiac conduction system controls the heart rate and coordinates the contraction of cardiac muscle. The electrical impulses that initiate cardiac contraction follow a specific pathway through the heart, ensuring that blood is pumped efficiently.

Detailed Analysis of the Correct Sequence (E-C-A-D-B):

SA node (E): The sinoatrial (SA) node, located in the right atrium, is the natural pacemaker of the heart. It generates the electrical impulses that initiate each heartbeat. This is where the conduction pathway begins.

AV node (C): After the impulse spreads over the atria, it arrives at the atrioventricular (AV) node. Located at the junction of the atria and ventricles, the AV node briefly delays the impulse, allowing the atria to complete their contraction before the ventricles contract.

AV bundle (A): The impulse travels from the AV node to the atrioventricular bundle (bundle of His). This bundle is the only electrical connection between the atria and the ventricles.

Bundle branches (D): The AV bundle splits into the right and left bundle branches which conduct the impulses down either side of the interventricular septum.

Purkinje fibres (B): The bundle branches terminate in the Purkinje fibres, which spread throughout the ventricular myocardium. The Purkinje fibres transmit the impulse rapidly and ensure coordinated contraction of both ventricles.

Conclusion:

The sequence E-C-A-D-B correctly represents the progression of an action potential through the heart's conduction system, starting from the initiation at the SA node and ending with the transmission through the Purkinje fibers, leading to ventricular contraction.

Quick Tip

The pathway of electrical signals in the heart is critical for understanding cardiac physiology and the basis of electrocardiogram (ECG) patterns.

180. The "Ti plasmid" of *Agrobacterium tumefaciens* stands for:

- (1) Tumor inducing plasmid
- (2) Temperature independent plasmid
- (3) Tumour inhibiting plasmid
- (4) Tumor independent plasmid

Correct Answer: (1) Tumor inducing plasmid

Solution: Understanding the Ti Plasmid:

The Ti plasmid, or Tumor inducing plasmid, is a type of plasmid (a small circular DNA molecule that is separate from chromosomal DNA) found in *Agrobacterium tumefaciens*, a bacterium that causes crown gall disease in plants. This disease is characterized by the formation of tumors (galls) at the infection site.

Mechanism of Action:

When *Agrobacterium tumefaciens* infects a plant, the Ti plasmid transfers part of its DNA, specifically the T-DNA (transfer DNA) region, into the plant cell. This integration of bacterial DNA into the plant genome occurs at wound sites where the plant tissue has been damaged.

The T-DNA carries genes that are expressed in the plant cells, leading to the production of proteins that stimulate plant cells to produce opines, which are nitrogen and carbon compounds that the bacteria use as nutrients. Additionally, some genes in the T-DNA encode enzymes that cause the plant cells to proliferate uncontrollably, leading to tumor formation.

Importance in Biotechnology:

The ability of the Ti plasmid to transfer genes into plant cells has been harnessed in

biotechnology to create genetically modified plants. By modifying the T-DNA region of the Ti plasmid to carry desirable genes instead of tumor-inducing genes, researchers can introduce new traits into plants, such as resistance to pests, diseases, or environmental conditions.

Quick Tip

Ti plasmid has been exploited in genetic engineering for the introduction of new genes into plant cells, showcasing an application of molecular biology in agriculture.

181. Match List I with List II:

List I		List II	
A.	Cocaine	I.	Effective sedative in surgery
B.	Heroin	II.	Cannabis sativa
C.	Morphine	III.	Erythroxyllum
D.	Marijuana	IV.	Papaver somniferum

Choose the correct answer from the options given below:

- (1) A-I, B-I, C-III, D-IV
- (2) A-III, B-IV, C-I, D-II
- (3) A-IV, B-III, C-I, D-II
- (4) A-I, B-III, C-II, D-IV

Correct Answer: (2) A-III, B-IV, C-I, D-II

Solution: Detailed Analysis of Each Match:

Cocaine (A): Cocaine is derived from the coca plant, specifically from the leaves of **Erythroxyllum coca**. Therefore, A matches with **III**.

Heroin (B): Heroin is synthesized from morphine, a natural product extracted from the seed pod of the various opium poppy plants, notably **Papaver somniferum**. Thus, B matches with **IV**.

Morphine (C): Morphine is an alkaloid found naturally in the opium poppy, **Papaver somniferum**, and is used medically as a powerful painkiller and sedative, particularly in surgical settings. Hence, C matches with **I**.

Marijuana (D): Marijuana, commonly referred to as cannabis, is derived from the plant

Cannabis sativa. Therefore, D matches with **II**.

Quick Tip

Knowing the sources and primary uses of different narcotics can aid in their identification and understanding of their pharmacological impacts.

182. Match List I with List II:

List I		List II	
A.	Down's syndrome	I.	11 th chromosome
B.	α -Thalassemia	II.	'X' chromosome
C.	β -Thalassemia	III.	21 st chromosome
D.	Klinefelter's syndrome	IV.	16 th chromosome

Choose the correct answer from the options given below:

- (1) A-III, B-IV, C-I, D-II
- (2) A-IV, B-I, C-III, D-II
- (3) A-I, B-III, C-II, D-IV
- (4) A-II, B-III, C-IV, D-I

Correct Answer: (1) A-III, B-IV, C-I, D-II

Solution: Detailed Analysis of Each Match:

Down's syndrome (A): Down's syndrome is caused by the presence of an extra copy of chromosome 21. This genetic disorder is characterized by intellectual disability, distinctive facial features, and other health issues. Therefore, A matches with **III (21st chromosome)**.

α -Thalassemia (B): α -Thalassemia is a blood disorder caused by mutations that reduce the production of hemoglobin, which is needed to carry oxygen in the blood. This condition is associated with deletions or mutations in the genes located on chromosome 16. Thus, B matches with **IV (16th chromosome)**.

β -Thalassemia (C): β -Thalassemia is another hemoglobinopathy involving insufficient production of the beta chains of hemoglobin. The genes affected in β -Thalassemia are located on chromosome 11. Hence, C matches with **I (11th chromosome)**.

Klinefelter's syndrome (D): Klinefelter's syndrome is a genetic condition affecting males that results from having one or more extra X chromosomes. Males with this condition

typically have a chromosome pattern of XXY. Therefore, D matches with **II** ('X' chromosome).

Quick Tip

Linking genetic disorders to their chromosomal bases is crucial for understanding their etiology and for genetic counseling.

183. Match List I with List II:

List I		List II	
A.	α -1 antitrypsin	I.	Cotton bollworm
B.	Cry IAb	II.	ADA deficiency
C.	Cry IAc	III.	Emphysema
D.	Enzyme replacement therapy	IV.	Corn borer

Choose the correct answer from the options given below:

- (1) A-III, B-IV, C-I, D-II
- (2) A-II, B-IV, C-I, D-III
- (3) A-II, B-I, C-IV, D-III
- (4) A-III, B-I, C-II, D-IV

Correct Answer: (1) A-III, B-IV, C-I, D-II

Solution: Detailed Analysis of Each Match:

α -1 Antitrypsin (A): This is a protein that protects tissues from enzymes of inflammatory cells, especially elastase. Deficiency in α -1 antitrypsin can lead to diseases like emphysema due to uncontrolled enzyme activity degrading lung tissue. Thus, A matches with **III (Emphysema)**.

Cry IAb (B): Cry IAb is a gene from the bacterium *Bacillus thuringiensis* (Bt) that codes for a protein toxic to certain insects, including the corn borer. This gene is used in genetically modified crops to provide resistance against this pest. Therefore, B matches with **IV (Corn borer)**.

Cry IAc (C): Similar to Cry IAb, Cry IAc is another variant of the Bt toxin protein targeting different pests, such as the cotton bollworm. This makes crops like cotton resistant to such insects. Hence, C matches with **I (Cotton bollworm)**.

Enzyme replacement therapy (D): This is a medical treatment used to replace a deficient or absent enzyme in patients with enzyme deficiencies. A common example is the treatment of ADA (adenosine deaminase) deficiency, which can lead to severe combined immunodeficiency (SCID). Thus, D matches with **II (ADA deficiency)**.

Quick Tip

Understanding the application of biotechnology in medicine and agriculture highlights the practical importance of genetic engineering.

184. Consider the following statements:

- A. Annelids are true coelomates.
- B. Poriferans are pseudocoelomates.
- C. Aschelminthes are acoelomates.
- D. Platyhelminthes are pseudocoelomates.

Choose the correct answer from the options given below:

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

Correct Answer: (4) A only

Solution: Analysis of Each Statement:

Statement A (Annelids are true coelomates): This statement is **correct**. Annelids, which include earthworms, leeches, and polychaetes, possess a true coelom, which is a fluid-filled body cavity completely lined with mesoderm tissue. This coelom serves various functions, including acting as a hydrostatic skeleton.

Statement B (Poriferans are pseudocoelomates): This statement is **incorrect**. Poriferans, or sponges, do not have a true coelom nor a pseudocoelom; they are instead classified as parazoans, lacking true tissues and organs, and certainly lacking any type of body cavity.

Statement C (Aschelminthes are acoelomates): This statement is **incorrect**.

Aschelminthes, more commonly referred to as nematodes or roundworms, are actually

pseudocoelomates, not acoelomates. They have a body cavity, known as a pseudocoel, which is only partially lined with mesoderm tissue.

Statement D (Platyhelminthes are pseudocoelomates): This statement is **incorrect**.

Platyhelminthes, which are flatworms, are acoelomates, meaning they lack a coelom entirely. Their bodies are solid between the digestive tract and the outer body wall.

Conclusion:

Only statement A is correct, as annelids are indeed true coelomates, having a well-developed, completely mesoderm-lined coelom. The other statements incorrectly categorize the other groups of animals regarding their body cavity status.

Quick Tip

Understanding the differences between coelomates, pseudocoelomates, and acoelomates is crucial in comparative anatomy and taxonomy.

185. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: FSH acts upon ovarian follicles in female and Leydig cells in male.

Reason R: Growing ovarian follicles secrete estrogen in female while interstitial cells secrete androgen in male human being.

In the light of the above statements, choose the correct answer from the options given below:

- (1) A is true but R is false.
- (2) A is false but R is true.
- (3) Both A and R are true and R is the correct explanation of A.
- (4) Both A and R are true but R is NOT the correct explanation of A.

Correct Answer: (2) A is false but R is true.

Evaluation of Assertion A:

FSH and Ovarian Follicles: FSH (Follicle-Stimulating Hormone) indeed acts on ovarian follicles in females to stimulate follicular growth and maturation, as well as the production of estrogen by the granulosa cells of the follicles.

FSH and Leydig Cells: However, in males, FSH does not act on Leydig cells but rather on the Sertoli cells of the seminiferous tubules. Leydig cells, which produce testosterone in the presence of LH (Luteinizing Hormone), are not stimulated by FSH. Thus, this part of the assertion is incorrect.

Evaluation of Reason R:

Estrogen Secretion by Ovarian Follicles: This part of the statement is correct as growing ovarian follicles indeed secrete estrogen, which is vital for the regulation of the female reproductive cycle.

Androgen Secretion by Interstitial Cells: Also known as Leydig cells, interstitial cells are indeed responsible for the secretion of androgens (e.g., testosterone) in male humans. This function is critical for male sexual development and reproduction.

Conclusion:

Assertion A is false because FSH does not act upon Leydig cells in males; it acts on Sertoli cells.

Reason R is true as it correctly describes the hormones secreted by the ovarian follicles and interstitial (Leydig) cells in females and males, respectively.

Quick Tip

Understanding hormone interactions is critical for comprehending endocrine functions and their implications in physiological processes.

SECTION-B

186. Given below are two statements:

Statement I: Mitochondria and chloroplasts both double membranes bound organelles.

Statement II: Inner membrane of mitochondria is relatively less permeable, as compared chloroplast.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (1) Statement I is correct but Statement II is incorrect.
- (2) Statement I is incorrect but Statement II is correct.
- (3) Both Statement I and Statement II are correct.

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

Correct Answer: (1) Statement I is correct but Statement II is incorrect.

Solution: Evaluation of Statement I:

Mitochondria and chloroplasts as double-membrane organelles: This statement is **correct**. Both mitochondria and chloroplasts are organelles that possess two membranes—an outer membrane that encapsulates the organelle, and an inner membrane that contains many of the biochemical mechanisms vital to their function. The presence of these double membranes is key to their roles in cellular metabolism and photosynthesis, respectively.

Evaluation of Statement II:

Comparative permeability of inner membranes: This statement is **incorrect**. The inner membrane of the mitochondria is indeed relatively impermeable, which is crucial for maintaining the proton gradient essential for ATP synthesis through oxidative phosphorylation. However, the inner membrane of chloroplasts, particularly the thylakoid membrane, must also maintain a proton gradient to facilitate ATP synthesis during the light reactions of photosynthesis. Thus, it is also selectively permeable and designed to regulate ion and protein movement strictly. The assertion that the mitochondrial inner membrane is "less permeable" compared to that of chloroplasts lacks context, as both membranes have evolved to tightly regulate ion gradients critical for their energy-transforming functions.

Quick Tip

The structural features of mitochondria and chloroplasts are key to their functions in cellular respiration and photosynthesis, respectively.

187. Regarding catalytic cycle of an enzyme action, select the correct sequential steps:

- A. Substrate-enzyme complex formation.
- B. Free enzyme ready to bind with another substrate.
- C. Release of products.
- D. Chemical bonds of the substrate broken.
- E. Substrate binding to active site.

Choose the correct answer from the options given below:

(1) B, A, C, D, E

(2) E, D, C, B, A

(3) E, A, D, C, B

(4) A, E, B, D, C

Correct Answer: (3) E, A, D, C, B

Solution: Analysis of the Correct Sequence (E, A, D, C, B):

Step E (Substrate binding to active site): This is the first step in the catalytic cycle of enzyme action. The substrate approaches and binds to the specific active site of the enzyme, forming a stable complex. This step is crucial as it ensures specificity and the correct alignment of the substrate for the chemical reaction.

Step A (Substrate-enzyme complex formation): Following substrate binding, the enzyme-substrate complex is fully formed. This complex is typically stabilized by multiple interactions between the substrate and specific amino acid residues within the active site.

Step D (Chemical bonds of the substrate broken): Within the complex, the enzyme catalyzes the conversion of the substrate into the product(s) by breaking the chemical bonds. This transformation often involves rearrangement of electrons and breaking/formation of new bonds.

Step C (Release of products): After the reaction, the newly formed product(s) are released from the enzyme's active site. The enzyme's active site returns to its original state, ready to interact with a new substrate molecule.

Step B (Free enzyme ready to bind with another substrate): With the active site cleared of the product, the enzyme is now free again and can bind another substrate molecule, repeating the catalytic cycle.

Quick Tip

Understanding the enzyme catalysis process is fundamental in biochemistry, aiding in the comprehension of metabolic pathways and drug design.

188. Given below are two statements:

Statement I: Gause's competitive exclusion principle states that two closely related species competing for different resources cannot exist indefinitely.

Statement II: According to Gause's principle, during competition, the inferior will be

eliminated. This may be true if resources are limiting.

In the light of the above statements, choose the correct answer from the options given below:

- (1) Statement I is true but Statement II is false.
- (2) Statement I is false but Statement II is true.
- (3) Both Statement I and Statement II are true.
- (4) Both Statement I and Statement II are false.

Correct Answer: (2) Statement I is false but Statement II is true

Solution: Step 1: Understanding Gause's competitive exclusion principle.

Gause's principle states that two species competing for the same limited resources cannot coexist at constant population values if other ecological factors remain constant. Thus, when the resources are limited, one species will outcompete the other.

Step 2: Analyzing the statements.

Statement I is false because it incorrectly states that the species compete for different resources; the principle actually involves the same resource. Statement II correctly interprets the principle in the context of limited resources.

Quick Tip

Understanding Gause's principle can help clarify many ecological and environmental management practices.

189. Match List I with List II:

List I		List II	
A.	Exophthalmic goiter	I.	Excess secretion of cortisol, moon face & hyperglycemia
B.	Acromegaly	II.	Hypo-secretion of thyroid hormone and stunted growth
C.	Cushing's syndrome	III.	Hyper secretion of thyroid hormone & protruding eye balls
D.	Cretinism	IV.	Excessive secretion of growth hormone

Choose the correct answer from the options given below :

- (1) A-III, B-IV, C-II, D-I
- (2) A-III, B-IV, C-I, D-II
- (3) A-IV, B-III, C-II, D-I

(4) A-IV, B-II, C-I, D-III

Correct Answer: (2) A-III, B-IV, C-I, D-II

Solution: Matching diseases with their descriptions.

A correct match involves associating the disease with its primary clinical presentation based on hormone imbalance or characteristic symptoms:

A (Exophthalmic goiter) is associated with III (Hyper secretion of thyroid hormone & protruding eyes), commonly seen in conditions like Graves' disease.

B (Acromegaly) results from IV (Excessive secretion of growth hormone), typically leading to enlarged features and extremities.

C (Cushing's syndrome) is characterized by I (Excess secretion of cortisol, moon face & hyperglycemia), a hallmark of excessive adrenal cortex activity.

D (Cretinism) involves II (Hypo-secretion of thyroid hormone and stunted growth), a developmental issue due to insufficient thyroid hormone production.

Quick Tip

Linking symptoms with hormonal imbalances provides insights into diagnosing and treating endocrine disorders.

190. Per ABO blood grouping system, the blood group of father is B+, mother is A+ and child is O+. Their respective genotype can be:

A. $I^B i / I^A i / ii$

B. $I^B I^B / I^A I^A / ii$

C. $I^A I^B / i I^A / I^B i$

D. $I^A i / I^B i / I^A i$

E. $i I^B / i I^A / I^A I^B$

Choose the most appropriate answer from the options given below:

(1) C & B only

(2) D & E only

(3) A only

(4) B only

Correct Answer: (3) A only

Solution: Analysis of Blood Groups and Genotypes:

- The ABO blood group system is determined by a single gene with three alleles: I^A , I^B , and i . I^A and I^B are codominant, and i is recessive.

Father (Blood Group B+):

- To have a B blood type, the father can be either $I^B I^B$ or $I^B i$.

Mother (Blood Group A+):

- To have an A blood type, the mother can be either $I^A I^A$ or $I^A i$.

Child (Blood Group O+):

- To have an O blood type, the child must be ii . This means each parent must contribute an i allele.

Evaluating Options:

Option A ($I^B i / I^A i / ii$): This is the only scenario that can produce a child with blood type O (ii) from parents with blood types B ($I^B i$) and A ($I^A i$). Both parents possess one i allele, which they can pass to their child, resulting in the child having ii genotype. **Other Options:** They either lack the necessary i alleles or specify impossible combinations for the given blood types (e.g., parents with both dominant alleles cannot produce a child with an O blood type).

Quick Tip

Remember, the presence of I^A or I^B alone does not determine phenotype without considering the second allele because of the recessive nature of i .

191. The following are the statements about non-chordates:

- A. Pharynx is perforated by gill slits.
- B. Notochord is absent.
- C. Central nervous system is dorsal.
- D. Heart is dorsal if present.
- E. Post anal tail is absent.

Choose the most appropriate answer from the options given below:

- (1) B, D & E only
- (2) B, C & D only

(3) A & C only

(4) A, B & D only

Correct Answer: (1) B, D & E only

Solution: Evaluation of Each Statement:

Statement A (Pharynx is perforated by gill slits): This is incorrect for non-chordates. Pharyngeal gill slits are a characteristic of chordates, specifically seen in some stages of development or certain adult forms.

Statement B (Notochord is absent): This is correct. Non-chordates do not possess a notochord at any stage of their development, distinguishing them from chordates.

Statement C (Central nervous system is dorsal): This statement is generally incorrect for non-chordates. Most non-chordates have a ventral nerve cord rather than a dorsal one, which is characteristic of chordates.

Statement D (Heart is dorsal if present): This is correct. In the few non-chordates where a heart-like structure is present, it tends to be located dorsally. This contrasts with chordates, where the heart is typically ventral.

Statement E (Post anal tail is absent): This is correct for non-chordates. A post-anal tail, another characteristic of chordates, is absent in non-chordates.

Correct Combination Based on Evaluation:

The correct statements for non-chordates are B (Notochord is absent), D (Heart is dorsal if present), and E (Post anal tail is absent), matching with option (1).

Quick Tip

Recognize that notochords and post-anal tails are distinctive characteristics of chordates, helping differentiate them from non-chordates in classification.

192. Match List I with List II related to digestive system of cockroach:

List I		List II	
A.	The structures used for storing of food	I.	Gizzard
B.	Ring of 6-8 blind tubules at junction of foregut and midgut	II.	Gastric Caeca
C.	Ring of 100-150 yellow coloured thin filaments at junction of midgut and hindgut	III.	Malpighian tubules
D.	The structures used for grinding the food	IV.	Crop

Choose the correct answer from the options given below:

- (1) A-I, B-II, C-III, D-IV
- (2) A-III, B-II, C-IV, D-I
- (3) A-IV, B-II, C-III, D-I
- (4) A-I, B-III, C-II, D-IV

Correct Answer: (3) A-IV, B-II, C-III, D-I

Solution: Step 1: Matching anatomical structures with their functions.

A (The structures used for storing of food) matches with IV (Crop), used for storage.

B (Ring of 6-8 blind tubules at junction of foregut and midgut) matches with II (Gastric Caeca), involved in enzymatic secretion.

C (Ring of 100-150 yellow coloured thin filaments at junction of midgut and hindgut) matches with III (Malpighian tubules), part of the excretory system.

D (The structures used for grinding the food) matches with I (Gizzard), which mechanically breaks down food.

Quick Tip

Understanding the specialized structures of a cockroach's digestive system can provide insights into their survival strategies and dietary habits.

193. Choose the correct statement given below regarding juxta medullary nephron:

- (1) Loop of Henle of juxta medullary nephron runs deep into medulla.
- (2) Juxta medullary nephrons outnumber the cortical nephrons.
- (3) Juxta medullary nephrons are located in the columns of Bertini.
- (4) Renal corpuscle of juxta medullary nephron lies in the outer portion of the renal medulla.

Correct Answer: (1) Loop of Henle of juxta medullary nephron runs deep into medulla

Solution: Analysis of Each Statement:

Statement 1: This statement is **correct**. Juxta medullary nephrons have their renal corpuscles located near the medulla, and their loops of Henle extend deeply into the renal medulla. This deep extension is crucial for the process of concentrating urine, as it allows for the creation of a significant osmotic gradient along the loop, facilitating efficient water and solute reabsorption.

Statement 2: This statement is **incorrect**. Juxta medullary nephrons do not outnumber cortical nephrons. In fact, cortical nephrons make up the majority of nephrons in the kidney.

Statement 3: This statement is **incorrect**. Juxta medullary nephrons are not located in the columns of Bertini, but their renal corpuscles are located at the boundary of the cortex and the medulla, hence the name "juxta medullary."

Statement 4: This statement is **incorrect**. The renal corpuscle of the juxta medullary nephron is located at the cortex-medulla junction, not in the outer portion of the renal medulla.

Significance of Juxta Medullary Nephrons:

Juxta medullary nephrons play a critical role in the kidney's ability to produce concentrated urine, which is essential for water conservation in the body. Their deep loops of Henle and the associated vasa recta create and maintain a high osmolarity in the surrounding interstitial fluid, enabling effective water reabsorption from the collecting ducts.

Quick Tip

The deep penetration of the loop of Henle in juxta medullary nephrons is key to their role in producing concentrated urine, a vital adaptation in land animals for water conservation.

194. Match List I with List II:

List I		List II	
A.	P wave	I.	Heart muscles are electrically silent.
B.	QRS complex	II.	Depolarisation of ventricles.
C.	T wave	III.	Depolarisation of atria.
D.	T-P gap	IV.	Repolarisation of ventricles.

Choose the correct answer from the options given below :

- (1) A-I, B-III, C-IV, D-II
- (2) A-IV, B-II, C-I, D-III
- (3) A-I, B-II, C-IV, D-III
- (4) A-III, B-II, C-IV, D-I

Correct Answer: (4) A-III, B-II, C-IV, D-I

Solution: Detailed Analysis of Each Match:

P wave (A): The P wave represents the depolarization of the atria in response to the SA node triggering. It precedes the atrial contraction. Therefore, A matches with **III (Depolarisation of atria)**.

QRS complex (B): The QRS complex represents the rapid depolarization of the right and left ventricles. Since the ventricles are much larger than the atria, the QRS complex is much larger in amplitude than the P wave. Thus, B matches with **II (Depolarisation of ventricles)**.

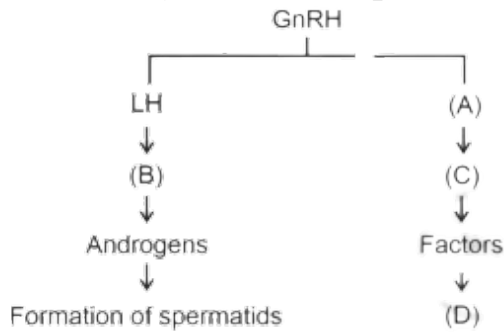
T wave (C): The T wave represents the repolarization (recovery) of the ventricles. The ventricles begin to relax after the contraction, coinciding with the start of the ventricular repolarization. Hence, C matches with **IV (Repolarisation of ventricles)**.

T-P gap (D): The T-P segment (gap) reflects the period when the heart muscle is electrically silent between heartbeats. It occurs when the ventricles are completely depolarized and are preparing for the next cycle. This phase is crucial for the heart to fill with blood and prepare for the next contraction. Therefore, D matches with **I (Heart muscles are electrically silent)**.

Quick Tip

ECG components like P wave, QRS complex, and T wave are crucial for diagnosing heart rhythms and conditions, reflecting different phases of cardiac electrical activity.

195. Identify the correct option (A), (B), (C), (D) with respect to spermatogenesis:



- (1) FSH, Sertoli cells, Leydig cells, spermatogenesis.
- (2) ICSH, Leydig cells, Sertoli cells, spermatogenesis.
- (3) FSH, Leydig cells, Sertoli cells, spermiogenesis.
- (4) ICSH, Interstitial cells, Leydig cells, spermiogenesis.

Correct Answer: (3) FSH, Leydig cells, Sertoli cells, spermiogenesis

Solution: Detailed Analysis of the Correct Match:

FSH (A): Follicle Stimulating Hormone influences Sertoli cells which are crucial for nourishing developing sperm cells and are instrumental in the process termed spermatogenesis.

Leydig cells (B): Stimulated by LH, Leydig cells are responsible for producing testosterone (Androgens), which is essential for the development of male secondary sexual characteristics and influencing spermatogenesis.

Sertoli cells (C): Act under the influence of FSH and testosterone to support the maturation of sperm cells, particularly during the phase called spermiogenesis, where spermatids are transformed into mature spermatozoa.

Spermiogenesis (D): This is the final stage of spermatogenesis where spermatids are converted into spermatozoa (mature sperm cells). This step involves significant morphological changes which are supported by Sertoli cells.

Conclusion: The diagram and associated hormonal pathways correctly identify the process involving FSH affecting Sertoli cells, Leydig cells producing androgens under the influence of LH, and the involvement of Sertoli cells in the final transformation during spermiogenesis. Option (3) accurately captures these interactions and the respective roles.

Quick Tip

The hormonal control of spermatogenesis involves a finely tuned interaction between GnRH, LH, FSH, androgens, and Sertoli cells, highlighting the complexity of reproductive physiology.

196. Match List I with List II:

List I		List II	
A.	Unicellular glandular epithelium	I.	Salivary glands
B.	Compound epithelium	II.	Pancreas
C.	Multicellular glandular epithelium	III.	Goblet cells of alimentary canal
D.	Endocrine glandular epithelium	IV.	Moist surface of buccal cavity

Choose the correct answer from the options given below:

- (1) A-III, B-IV, C-I, D-II
- (2) A-II, B-I, C-IV, D-III
- (3) A-II, B-I, C-III, D-IV
- (4) A-IV, B-III, C-I, D-II

Correct Answer: (1) A-III, B-IV, C-I, D-II

Solution: Expanded Analysis of Each Match:

A. Unicellular glandular epithelium (III): Goblet cells are a prime example of unicellular glandular epithelium. Located throughout the respiratory and gastrointestinal tracts, these cells secrete mucus that lubricates and protects the lining surfaces. Their widespread presence in the alimentary canal aids in facilitating the smooth passage of food while protecting the mucosal layer.

B. Compound epithelium (IV): Compound epithelium is structured in multiple layers to protect against chemical and mechanical stresses. In the buccal cavity, this type of epithelium provides a barrier against pathogens, mechanical injury due to food particles, and the corrosive effects of enzymes and acidic food substances.

C. Multicellular glandular epithelium (I): The salivary glands are composed of multicellular glandular epithelium and play a crucial role in the digestion process. They produce and secrete saliva that begins the digestion of starches. Moreover, saliva contains antibacterial compounds that help maintain oral hygiene.

D. Endocrine glandular epithelium (II): The pancreas functions as both an endocrine and exocrine gland. The endocrine part, through the Islets of Langerhans, secretes important hormones such as insulin and glucagon directly into the bloodstream, regulating blood glucose levels. This glandular structure is vital for metabolic homeostasis.

Quick Tip

Differentiating between unicellular and multicellular glandular structures is key to understanding their specific functions in secretion and absorption in various body systems.

197. Given below are two statements:

Statement I: The cerebral hemispheres are connected by nerve tract known as corpus callosum.

Statement II: The brain stem consists of the medulla oblongata, pons and cerebrum.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (1) Statement I is correct but Statement II is incorrect.
- (2) Statement I is incorrect but Statement II is correct.
- (3) Both Statement I and Statement II are true.
- (4) Both Statement I and Statement II are incorrect.

Correct Answer: (1) Statement I is correct but Statement II is incorrect.

Solution: Step 1: Verifying Statement I.

The corpus callosum is indeed the nerve tract that connects the two cerebral hemispheres, making Statement I correct.

Step 2: Verifying Statement II.

The brain stem is composed of the medulla oblongata, pons, and midbrain, not the cerebrum, making Statement II incorrect.

Quick Tip

The corpus callosum plays a critical role in enabling communication between the left and right hemispheres of the brain.

198. Match List I with List II:

List I		List II	
A.	Mesozoic Era	I.	Lower invertebrates
B.	Proterozoic Era	II.	Fish & Amphibia
C.	Cenozoic Era	III.	Birds & Reptiles
D.	Paleozoic Era	IV.	Mammals

Choose the correct answer from the options given below :

(1) A-I, B-II, C-IV, D-III

(2) A-III, B-I, C-IV, D-II

(3) A-II, B-I, C-III, D-IV

(4) A-III, B-I, C-II, D-IV

Correct Answer: (2) A-III, B-I, C-IV, D-II

Solution: Detailed Analysis of Each Match:

A. Mesozoic Era (III): The Mesozoic Era, often referred to as the "Age of Reptiles," is notable for the dominance and diversification of reptiles, including the dinosaurs, as well as the early evolution of birds. Hence, A matches with **III (Birds & Reptiles)**.

B. Proterozoic Era (I): The Proterozoic Era spans from 2.5 billion to 540 million years ago and is characterized by the emergence of the first complex life forms, including the first multicellular organisms, which were predominantly lower invertebrates. Thus, B matches with **I (Lower invertebrates)**.

C. Cenozoic Era (IV): Known as the "Age of Mammals," the Cenozoic Era follows the Mesozoic and features the extensive diversification and dominance of mammals following the extinction of the non-avian dinosaurs. Therefore, C matches with **IV (Mammals)**.

D. Paleozoic Era (II): The Paleozoic Era is known for the "Cambrian Explosion," leading to the appearance and evolution of a wide variety of life forms, including the first fish and later amphibians. Hence, D is correctly paired with **II (Fish & Amphibia)**.

Quick Tip

Each geological era is characterized by the dominance of certain life forms which can be used as a timeline to understand evolutionary history.

199. Match List I with List II:

List I		List II	
A.	RNA polymerase III	I.	snRNPs
B.	Termination of transcription	II.	Promotor
C.	Splicing of Exons	III.	Rho factor
D.	TATA box	IV.	SnRNAs, tRNA

Choose the correct answer from the options given below :

- (1) A-III, B-IV, C-I, D-II
- (2) A-IV, B-III, C-I, D-II
- (3) A-II, B-IV, C-I, D-III
- (4) A-IV, B-II, C-IV, D-I

Correct Answer: (2) A-IV, B-III, C-I, D-II

Solution: Detailed Analysis of Each Match:

A. RNA polymerase III (IV): RNA polymerase III is responsible for transcribing DNA to synthesize ribosomal 5S rRNA, tRNA, and other small RNAs. The correct match here is **IV (SnRNAs, tRNA)**, as it includes tRNA which is a primary product of RNA polymerase III.

B. Termination of transcription (III): Termination of transcription in prokaryotes often involves the rho factor, a protein that facilitates the termination of RNA synthesis by RNA polymerase at specific sites. This makes B correctly paired with **III (Rho factor)**.

C. Splicing of Exons (I): Splicing of exons during mRNA processing involves snRNPs (small nuclear ribonucleoproteins), which play a crucial role in recognizing and excising introns, making C correctly matched with **I (snRNPs)**.

D. TATA box (II): The TATA box is a DNA sequence that indicates where a genetic sequence can be read and decoded. It is a component of the promotor region of genes, typically found in the core promoter area and is crucial for forming the transcription initiation complex. Thus, D is accurately matched with **II (Promotor)**.

Quick Tip

The TATA box is a crucial promoter element in many eukaryotic genes, playing a key role in the initiation of transcription.

200. Given below are two statements:

Statement I: Bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.

Statement II: Both bone marrow and thymus provide micro environments for the development and maturation of T-lymphocytes.

In the light of above statements, choose the most appropriate answer from the options given below :

- (1) Statement I is correct but Statement II is incorrect.
- (2) Statement I is incorrect but Statement II is correct.
- (3) Both Statement I and Statement II are correct.
- (4) Both Statement I and Statement II are incorrect.

Correct Answer: (3) Both Statement I and Statement II are correct.

Solution: Step 1: Verifying Statement I.

Bone marrow is indeed the primary site for the production of all types of blood cells, including lymphocytes, making Statement I correct.

Step 2: Verifying Statement II.

Both bone marrow and thymus are critical for the development and maturation of T-lymphocytes, with bone marrow producing the cells and the thymus providing the environment for their maturation, making Statement II correct.

Quick Tip

Understanding the roles of bone marrow and thymus in immune system development is crucial for comprehending how adaptive immunity is structured and functions.