

## NEET 2024 R4 Zoology Question Paper with Solutions

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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-II, D-IV

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

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

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

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

**Solution:**

#### Step 1: Understanding the Different Types of Joints

1. Fibrous Joints (Skull - III):

- These joints have no movement and are held by dense fibrous connective tissue.
- Example: Sutures of the skull.
- Correct Match: III

2. Cartilaginous Joints (Adjacent Vertebrae - I):

- These joints allow limited movement and are connected by cartilage.
- Example: Intervertebral discs between adjacent vertebrae.
- Correct Match: I

3. Hinge Joints (Knee - IV):

- These joints allow movement in one plane only (like the movement of a door hinge).
- Example: Knee joint.
- Correct Match: IV

4. Ball and Socket Joints (Humerus Pectoral Girdle - II):

- These joints allow multi-directional movement and rotation.

- Example: Shoulder joint (Humerus Pectoral girdle).
- Correct Match: II

### Step 2: Conclusion

- The correct matching is A-III, B-I, C-IV, D-II, which corresponds to Option (3).

#### Quick Tip

- Fibrous joints (e.g., Skull) have no movement.
- Cartilaginous joints (e.g., Vertebrae) allow limited movement.
- Hinge joints (e.g., Knee) allow movement in one plane only.
- Ball and Socket joints (e.g., Shoulder) allow rotational and multi-directional movement.

### 152. Match List-I with List-II

| List-I | Disease/Concept | List-II | Associated Pathogen/Factor |
|--------|-----------------|---------|----------------------------|
| 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-I, B-III, C-II, D-IV
- (2) A-III, B-I, C-II, D-IV
- (3) A-IV, B-II, C-III, D-I
- (4) A-II, B-IV, C-III, D-I

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

**Solution:**

#### Step 1: Understanding the Matching Concepts

1. Common Cold (Rhinoviruses - III):

- The common cold is caused by rhinoviruses, which primarily infect the respiratory tract.
- Correct Match: III

2. Haemozoin (*Plasmodium* - I):

- Haemozoin is a malarial pigment released when the malaria parasite (*Plasmodium*) breaks down hemoglobin.

- Correct Match: I

3. Widal Test (Typhoid - II):

- The Widal test is a diagnostic test for typhoid fever, detecting antibodies against *Salmonella typhi*.

- Correct Match: II

4. Allergy (Dust mites - IV):

- Allergies can be triggered by dust mites, which are common allergens in household dust.

- Correct Match: IV

### Step 2: Conclusion

- The correct matching is A-III, B-I, C-II, D-IV, which corresponds to Option (2).

#### Quick Tip

- Common cold is caused by rhinoviruses. - Haemozoin is a malarial pigment produced by *Plasmodium*. - Widal test is used for diagnosing typhoid fever. - Allergies can be triggered by dust mites and other allergens.

### 153. Match List-I with List-II

|    | List I                 |      | List II                     |
|----|------------------------|------|-----------------------------|
| A. | Down's syndrome        | I.   | 11 <sup>th</sup> chromosome |
| B. | $\alpha$ -Thalassemia  | II.  | 'X' chromosome              |
| C. | $\beta$ -Thalassemia   | III. | 21 <sup>st</sup> chromosome |
| D. | Klinefelter's syndrome | IV.  | 16 <sup>th</sup> chromosome |

Choose the correct answer from the options given below:

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

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

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

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

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

## Solution:

### Step 1: Understanding the Genetic Basis of the Disorders

1. Down's Syndrome (21<sup>st</sup> chromosome - III): - Caused by trisomy of chromosome 21 (an extra copy of chromosome 21).  
- Correct Match: III
2.  $\alpha$ -Thalassemia (16<sup>th</sup> chromosome - IV): - Caused by mutations or deletions in the HBA1 and HBA2 genes on chromosome 16.  
- Correct Match: IV
3.  $\beta$ -Thalassemia (11<sup>th</sup> chromosome - I): - Caused by mutations in the HBB gene on chromosome 11, affecting hemoglobin production.  
- Correct Match: I
4. Klinefelter's Syndrome ('X' chromosome - II): - A genetic condition in males due to an extra X chromosome (XXY karyotype).  
- Correct Match: II

### Step 2: Conclusion

- The correct matching is A-III, B-IV, C-I, D-II, which corresponds to Option (2).

#### Quick Tip

- Down's Syndrome is caused by trisomy of chromosome 21. -  $\alpha$ -Thalassemia is linked to mutations in chromosome 16. -  $\beta$ -Thalassemia is caused by mutations in the HBB gene on chromosome 11. - Klinefelter's Syndrome results from an extra X chromosome (XXY karyotype).

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**154. Given below are two statements: one is labeled as Assertion (A) and the other is labeled 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 females, while interstitial cells secrete androgen in male human beings.

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

- (1) Both A and R are true but R is NOT the correct explanation of A

- (2) A is true but R is false
- (3) A is false but R is true
- (4) Both A and R are true and R is the correct explanation of A

**Correct Answer:** (3) A is false but R is true

**Solution:**

**Step 1: Understanding the Functions of FSH and Leydig Cells**

- Follicle-Stimulating Hormone (FSH) is a gonadotropic hormone secreted by the anterior pituitary gland.
- In females, FSH stimulates the growth and maturation of ovarian follicles.
- In males, FSH acts on the Sertoli cells (not Leydig cells) to support spermatogenesis.
- Leydig cells (also called interstitial cells) are stimulated by Luteinizing Hormone (LH), not FSH, to secrete testosterone.

**Step 2: Evaluating the Given Statements**

- Assertion A is false – FSH does not act upon Leydig cells in males; instead, it acts on Sertoli cells.
- Reason R is true – Growing ovarian follicles secrete estrogen, and Leydig (interstitial) cells produce androgens in males.

**Step 3: Conclusion**

- Since Assertion A is false and Reason R is true, the correct answer is Option (3) A is false but R is true.

**Quick Tip**

- FSH stimulates ovarian follicles in females and Sertoli cells in males (not Leydig cells).
- LH stimulates Leydig cells to produce testosterone.
- Ovarian follicles secrete estrogen, while Leydig cells secrete androgens in males.

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**155. The “Ti plasmid” of *Agrobacterium tumefaciens* stands for**

- (1) Tumor independent plasmid
- (2) Tumor inducing plasmid
- (3) Temperature independent plasmid

(4) Tumour inhibiting plasmid

**Correct Answer:** (2) Tumor inducing plasmid

**Solution:**

**Step 1: Understanding the Role of Ti Plasmid**

- The Ti plasmid (Tumor Inducing plasmid) is a virulent plasmid found in *Agrobacterium tumefaciens*, a soil bacterium.
- It is responsible for transferring a segment of DNA (T-DNA) into plant cells, leading to tumor formation (crown gall disease).

**Step 2: Evaluating the Given Options**

- Option (1) is incorrect – The Ti plasmid is not tumor-independent; it actually induces tumors.
- Option (2) is correct – The Ti plasmid is called the Tumor Inducing plasmid.
- Option (3) is incorrect – The plasmid has no relation to temperature independence.
- Option (4) is incorrect – The Ti plasmid does not inhibit tumors; instead, it causes tumor formation.

**Step 3: Conclusion**

- Since Ti plasmid stands for Tumor Inducing plasmid, the correct answer is Option (2).

**Quick Tip**

- The Ti plasmid of *Agrobacterium tumefaciens* is widely used in genetic engineering for introducing foreign genes into plants.
- The T-DNA segment of the Ti plasmid integrates into the plant genome, leading to tumor formation (crown gall disease).

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**156. Given below are two statements:**

**Statement I:** In the nephron, the descending limb of the 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 options given below:

- (1) Both Statement I and Statement II are false

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

**Correct Answer:** (1) Both Statement I and Statement II are false

**Solution:**

**Step 1: Understanding the Function of the Loop of Henle**

- The descending limb of the loop of Henle is permeable to water and impermeable to electrolytes.
- This allows water reabsorption but prevents the movement of ions, concentrating the filtrate.
- Since Statement I incorrectly states that the descending limb is impermeable to water, it is false.

**Step 2: Understanding the Structure of the Proximal Convoluted Tubule (PCT)**

- The PCT is lined by simple cuboidal epithelium with a brush border, not simple columnar epithelium.
- The brush border increases surface area for reabsorption, aiding in the reabsorption of glucose, amino acids, and electrolytes.
- Since Statement II incorrectly states that PCT is lined by simple columnar epithelium, it is false.

**Step 3: Conclusion**

- Since both Statement I and Statement II are incorrect, the correct answer is Option (1).

**Quick Tip**

- The descending limb of Henle's loop is permeable to water and impermeable to electrolytes, allowing water reabsorption.
- The proximal convoluted tubule (PCT) is lined by simple cuboidal epithelium with a brush border, increasing reabsorption efficiency.

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**157. Match List-I with List-II**

|    | <b>List I<br/>(Sub Phases of Prophase I)</b> |      | <b>List II<br/>(Specific Characters)</b>   |
|----|----------------------------------------------|------|--------------------------------------------|
| 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-I, B-II, C-IV, D-III

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

**Solution:**

### **Step 1: Understanding the Sub Phases of Prophase I in Meiosis**

1. Diakinesis (Completion of terminalisation of chiasmata - II):

- The final stage of prophase I where chiasmata completely terminalize and homologous chromosomes separate.

- Correct Match: II

2. Pachytene (Appearance of recombination nodules - IV): - The stage where crossing over occurs due to the appearance of recombination nodules. - Correct Match: IV

3. Zygotene (Synaptonemal complex formation - I):

- Homologous chromosomes start pairing and synapsis occurs, forming the synaptonemal complex.

- Correct Match: I

4. Leptotene (Chromosomes look like thin threads - III):

- Chromosomes appear as thin thread-like structures at the beginning of prophase I.

- Correct Match: III

### **Step 2: Conclusion**

- The correct matching is A-II, B-IV, C-I, D-III, which corresponds to Option (2).



### Quick Tip

- Leptotene: Chromosomes appear as thin threads. - Zygotene: Synapsis begins with synaptonemal complex formation. - Pachytene: Recombination nodules appear, leading to crossing over. - Diakinesis: Terminalization of chiasmata and movement of homologous chromosomes apart.

### 158. 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-I, B-III, C-IV, D-II

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

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

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

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

**Solution:**

#### Step 1: Understanding Different Types of Contraceptives

1. Non-medicated IUD (Lippes loop - III):

- These do not release any medication but create a hostile uterine environment for sperm.
- Example: Lippes loop (a commonly used non-medicated IUD).
- Correct Match: III

2. Copper Releasing IUD (Multiload 375 - I):

- Copper ions released from the IUD increase sperm phagocytosis and prevent fertilization.
- Example: Multiload 375.
- Correct Match: I

3. Hormone Releasing IUD (LNG-20 - IV):

- Releases levonorgestrel (LNG), a hormone that thickens cervical mucus and inhibits sperm

motility.

- Example: LNG-20.

- Correct Match: IV

4. Implants (Progestogens - II):

- Subdermal implants that release progestogens and inhibit ovulation.

- Example: Progestogen-based implants like Norplant.

- Correct Match: II

### Step 2: Conclusion

- The correct matching is A-III, B-I, C-IV, D-II, which corresponds to Option (3).

#### Quick Tip

- Non-medicated IUDs (e.g., Lippes loop) create a hostile uterine environment for sperm. - Copper IUDs (e.g., Multiload 375) release copper ions that prevent fertilization. - Hormone-releasing IUDs (e.g., LNG-20) release levonorgestrel to prevent pregnancy. - Implants (e.g., Progestogens) work by releasing hormones that inhibit ovulation.

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### 159. Which of the following is not a steroid hormone?

(1) Testosterone

(2) Progesterone

(3) Glucagon

(4) Cortisol

**Correct Answer:** (3) Glucagon

**Solution:**

#### Step 1: Understanding Steroid and Non-Steroid Hormones

- Steroid hormones are derived from cholesterol and are lipophilic, allowing them to pass through cell membranes.

- Non-steroid hormones include peptide and protein hormones, which bind to membrane receptors and act via secondary messengers.

#### Step 2: Classifying the Given Hormones

- Testosterone (Steroid Hormone):

- A male sex hormone (androgen) derived from cholesterol.
- Produced by the Leydig cells of testes.
- Progesterone (Steroid Hormone):
- A female reproductive hormone essential for pregnancy.
- Produced by the corpus luteum in ovaries.
- Glucagon (Non-Steroid Hormone - Peptide Hormone):
- A peptide hormone secreted by alpha cells of the pancreas.
- Regulates blood glucose levels by promoting glycogen breakdown in the liver.
- Since it is a peptide hormone, it is **not a steroid hormone**.
- Cortisol (Steroid Hormone):
- A glucocorticoid produced by the adrenal cortex.
- Regulates metabolism and immune response.

### Step 3: Conclusion

- Since Glucagon is a peptide hormone, not a steroid hormone, the correct answer is Option (3).

#### Quick Tip

- Steroid hormones (e.g., Testosterone, Progesterone, Cortisol) are cholesterol-derived and act via intracellular receptors.
- Peptide hormones (e.g., Glucagon) are protein-based and act via membrane receptors.
- Glucagon is secreted by the pancreas and helps regulate blood sugar levels.

**160. Given below are some stages of human evolution.**

**Arrange them in correct sequence (Past to Recent).**

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

Choose the correct sequence of human evolution from the options given below:

- (1) B-A-D-C

(2) C-B-D-A

(3) A-D-C-B

(4) D-A-C-B

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

**Solution:**

### **Step 1: Understanding the Evolutionary Sequence of Humans**

The evolutionary sequence of human ancestors is based on fossil evidence and developmental traits. The correct order from past to recent is:

1. *Homo habilis* (A) (Oldest, 2.4 to 1.4 million years ago):

- Considered the first species in the *Homo* genus.
- Known as "Handy Man", it used primitive tools.

2. *Homo erectus* (D) ( 1.9 million to 110,000 years ago): - First species to walk fully upright and control fire. - It was more advanced in tool-making and survival.

3. *Homo neanderthalensis* (C) ( 400,000 to 40,000 years ago):

- Lived in Europe and Asia and adapted to cold climates.
- Had a larger brain and used complex tools.

4. *Homo sapiens* (B) (Present, 300,000 years ago to now):

- Modern humans with advanced cognitive skills and civilizations.

### **Step 2: Conclusion**

- The correct sequence from past to recent is A-D-C-B, which corresponds to Option (3).

#### **Quick Tip**

- *Homo habilis* was the first tool user. - *Homo erectus* was the first to use fire and walk fully upright. - *Homo neanderthalensis* had advanced hunting and social skills. - *Homo sapiens* are the modern humans with advanced intelligence.

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### **161. Match List-I with List-II**

| List-I | Enzyme   | List-II | Type of Bond Broken |
|--------|----------|---------|---------------------|
| 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-III, B-II, C-I, D-IV

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

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

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

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

**Solution:**

### Step 1: Understanding the Enzymes and Their Functions

1. Lipase (Ester bond - II):

- Lipase is an enzyme that breaks down lipids into glycerol and fatty acids by hydrolyzing ester bonds.

- Correct Match: II

2. Nuclease (Phosphodiester bond - IV):

- Nucleases degrade nucleic acids (DNA and RNA) by hydrolyzing phosphodiester bonds between nucleotides.

- Correct Match: IV

3. Protease (Peptide bond - I):

- Proteases (or peptidases) break down proteins by cleaving peptide bonds between amino acids.

- Correct Match: I

4. Amylase (Glycosidic bond - III):

- Amylase hydrolyzes glycosidic bonds in carbohydrates like starch and glycogen to produce simple sugars.

- Correct Match: III

## Step 2: Conclusion

- The correct matching is A-II, B-IV, C-I, D-III, which corresponds to Option (2).

### Quick Tip

- Lipase breaks down lipids by hydrolyzing ester bonds. - Nuclease degrades DNA/RNA by hydrolyzing phosphodiester bonds. - Protease digests proteins by breaking peptide bonds. - Amylase breaks carbohydrates by cleaving glycosidic bonds.

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## 162. Given below are two statements:

**Statement I:** The presence or absence of the 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) Both Statement I and Statement II are false
- (2) Statement I is true but Statement II is false
- (3) Statement I is false but Statement II is true
- (4) Both Statement I and Statement II are true

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

### Solution:

#### Step 1: Understanding the Hymen and Its Significance

- The hymen is a thin membrane that partially covers the vaginal opening.
- The presence or absence of the hymen is not a reliable indicator of virginity because:
  - It can be torn due to physical activities like cycling, gymnastics, or horseback riding.
  - Some individuals are born with a very elastic or absent hymen. - Hence, Statement I is true.

#### Step 2: Evaluating Statement II

- The belief that the hymen always tears during the first coitus is a misconception.
- The hymen can tear due to multiple reasons other than intercourse, and in some cases, it may remain intact even after intercourse.
- Hence, Statement II is false.

#### Step 3: Conclusion

- Since Statement I is true and Statement II is false, the correct answer is Option (2).

### Quick Tip

- The hymen is not a reliable indicator of virginity since it can tear due to non-sexual activities.
- The hymen does not always tear during first coitus; its elasticity varies among individuals.

### 163. Match List-I with List-II

| List-I | Biological Component       | List-II | Application/Effect |
|--------|----------------------------|---------|--------------------|
| A      | $\alpha$ -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-I, C-II, D-IV
- (2) A-III, B-IV, C-I, D-II
- (3) A-II, B-IV, C-I, D-III
- (4) A-II, B-I, C-IV, D-III

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

**Solution:**

#### Step 1: Understanding the Biological Components and Their Applications

1.  $\alpha$ -1 Antitrypsin (Emphysema - III):

- A protein that protects the lungs from neutrophil elastase.
- Deficiency leads to emphysema (a chronic lung disease).
- Correct Match: III

2. Cry IAb (Corn borer - IV):

- A Bt toxin gene from *Bacillus thuringiensis*.
- Used in genetically modified (GM) crops like Bt corn to kill corn borers.
- Correct Match: IV

3. Cry IAc (Cotton bollworm - I):

- Another Bt toxin gene used in Bt cotton to kill cotton bollworm.

- Correct Match: I

#### 4. Enzyme Replacement Therapy (ADA Deficiency - II):

- Used for Adenosine Deaminase (ADA) deficiency, a genetic disorder affecting the immune system.

- Correct Match: II

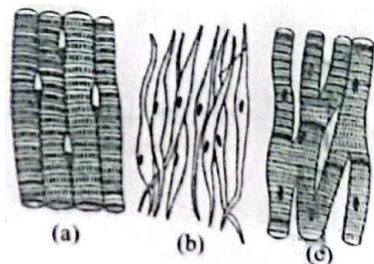
#### Step 2: Conclusion

- The correct matching is A-III, B-IV, C-I, D-II, which corresponds to Option (2).

#### Quick Tip

-  $\alpha$ -1 antitrypsin deficiency causes emphysema. - Cry IAb targets corn borer, while Cry IAc targets cotton bollworm in Bt crops. - Enzyme replacement therapy is used for ADA deficiency.

**164. 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 - Triceps

(b) Smooth - Stomach

(c) Cardiac - Heart

(2) (a) Skeletal - Biceps

(b) Involuntary - Intestine

(c) Smooth - Heart

(3) (a) Involuntary - Nose tip

(b) Skeletal - Bone

(c) Cardiac - Heart



- (4) (a) Smooth - Toes
- (b) Skeletal - Legs
- (c) Cardiac - Heart

**Correct Answer:** (1) (a) Skeletal - Triceps, (b) Smooth - Stomach, (c) Cardiac - Heart

**Solution:**

**Step 1: Identifying the Three Types of Muscles in the Image**

- Figure (a): Skeletal Muscle
- Characterized by striations and multinucleated fibers.
- Found in voluntary muscles like the triceps and biceps.
- Figure (b): Smooth Muscle
- Non-striated with spindle-shaped fibers.
- Found in involuntary organs such as the stomach and intestines.
- Figure (c): Cardiac Muscle
- Striated but involuntary muscle fibers with intercalated discs.
- Found exclusively in the heart.

**Step 2: Evaluating the Given Options**

- Option (1) is correct because:
- Skeletal muscles include triceps and other voluntary muscles.
- Smooth muscles are found in the stomach (involuntary organ).
- Cardiac muscles are found in the heart.
- Options (2), (3), and (4) are incorrect due to incorrect muscle classifications.

**Step 3: Conclusion**

- The correct answer is Option (1):
- (a) Skeletal muscle - Triceps
- (b) Smooth muscle - Stomach
- (c) Cardiac muscle - Heart

### Quick Tip

- Skeletal muscles are voluntary and control body movements (e.g., triceps, biceps).
- Smooth muscles are involuntary and found in internal organs (e.g., stomach, intestines).
- Cardiac muscle is specialized and found only in the heart, enabling rhythmic contraction.

### 165. 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-IV, B-III, C-I, D-II
- (2) A-III, B-I, C-IV, D-II
- (3) A-II, B-IV, C-III, D-I
- (4) A-I, B-III, C-II, D-IV

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

**Solution:**

#### Step 1: Understanding the Causative Agents of the Diseases

1. Typhoid (Bacteria - IV):

- Caused by the bacterium \*Salmonella typhi\*.
- It spreads through contaminated food and water.
- Correct Match: IV

2. Leishmaniasis (Protozoa - III):

- Caused by the protozoan \*Leishmania\*, transmitted by sandflies.
- Correct Match: III

3. Ringworm (Fungus - I):

- Caused by fungal species like \*Trichophyton\*, \*Microsporum\*, and \*Epidermophyton\*.
- Affects the skin, causing circular red patches.
- Correct Match: I

4. Filariasis (Nematode - II):

- Caused by parasitic nematodes like \*Wuchereria bancrofti\* and \*Brugia malayi\*.
- Transmitted by mosquitoes, leading to lymphatic swelling (elephantiasis).
- Correct Match: II

**Step 2: Conclusion**

- The correct matching is A-IV, B-III, C-I, D-II, which corresponds to Option (1).

**Quick Tip**

- Typhoid is caused by \*Salmonella typhi\* (Bacteria). - Leishmaniasis is caused by \*Leishmania\* (Protozoa) via sandflies. - Ringworm is a fungal infection, not caused by worms. - Filariasis is caused by \*Wuchereria bancrofti\* (Nematode) and spread by mosquitoes.

**166. Match List-I with List-II**

| List-I | Cell Structure    | List-II | Associated Organelle/Function |
|--------|-------------------|---------|-------------------------------|
| 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-IV, B-II, C-III, D-I
- (2) A-II, B-IV, C-I, D-III
- (3) A-II, B-I, C-IV, D-III
- (4) A-IV, B-III, C-II, D-I

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

**Solution:**

### Step 1: Understanding the Cell Structures and Their Functions

#### 1. Axoneme (Cilia and Flagella - II):

- The structural core of cilia and flagella, consisting of a 9+2 arrangement of microtubules.
- Correct Match: II

#### 2. Cartwheel Pattern (Centriole - I):

- Centrioles display a cartwheel arrangement of microtubules and play a role in cell division.
- Correct Match: I

#### 3. Crista (Mitochondria - IV):

- Cristae are the folds of the inner mitochondrial membrane where ATP synthesis occurs.
- Correct Match: IV

#### 4. Satellite (Chromosome - III):

- A satellite chromosome has a secondary constriction associated with rRNA synthesis.
- Correct Match: III

### Step 2: Conclusion

- The correct matching is A-II, B-I, C-IV, D-III, which corresponds to Option (3).

#### Quick Tip

- Axoneme is the core structure of cilia and flagella, made of microtubules.
- Cartwheel pattern is found in centrioles, aiding in cell division.
- Cristae are inner membrane folds of mitochondria, where ATP production occurs.
- Satellite DNA is a part of chromosomes, often associated with rRNA synthesis.

---

**167. In both sexes of cockroach, a pair of jointed filamentous structures called anal cerci are present on:**

- (1) 10<sup>th</sup> segment
- (2) 8<sup>th</sup> and 9<sup>th</sup> segment
- (3) 11<sup>th</sup> segment
- (4) 5<sup>th</sup> segment

**Correct Answer:** (1) 10<sup>th</sup> segment

**Solution:**

### Step 1: Understanding the Anal Cerci in Cockroaches

- The anal cerci are a pair of jointed, filamentous sensory structures found at the posterior end of the cockroach's abdomen.
- They are present in both males and females.
- These cerci function as sensory organs, detecting vibrations and aiding in predator avoidance.

### Step 2: Location of Anal Cerci in Cockroach

- The abdomen of a cockroach is divided into 10 segments.
- The anal cerci arise from the 10th abdominal segment in both sexes.
- Males also possess anal styles, but these are absent in females.

### Step 3: Conclusion

- Since the anal cerci are located on the 10th segment, the correct answer is Option (1): 10<sup>th</sup> segment.

#### Quick Tip

- Anal cerci in cockroaches are sensory appendages that detect vibrations and movements.
- They are present on the 10th abdominal segment in both males and females.
- Males have additional anal styles, which are absent in females.

### 168. Match List-I with List-II

| List-I | Organism/Structure   | List-II | Phylum/Class |
|--------|----------------------|---------|--------------|
| A      | <i>Pleurobrachia</i> | 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-I, C-IV, D-III
- (2) A-II, B-IV, C-I, D-III
- (3) A-IV, B-III, C-II, D-I

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

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

**Solution:**

**Step 1: Understanding the Given Terms and Their Classifications**

1. *Pleurobrachia* (Ctenophora - II):

- *Pleurobrachia* belongs to Ctenophora, a group of marine invertebrates known as comb jellies.

- Correct Match: II

2. Radula (Mollusca - I):

- The radula is a specialized feeding structure in mollusks, used to scrape food from surfaces.

- Correct Match: I

3. Stomochord (Hemichordata - IV):

- The stomochord is a structure found in Hemichordates, functionally similar to the notochord.

- Correct Match: IV

4. Air Bladder (Osteichthyes - III):

- The air bladder (swim bladder) is present in bony fishes (Osteichthyes), helping in buoyancy control.

- Correct Match: III

**Step 2: Conclusion**

- The correct matching is A-II, B-I, C-IV, D-III, which corresponds to Option (1).

**Quick Tip**

- *Pleurobrachia* is a comb jelly belonging to Ctenophora. - Radula is a feeding organ found in Mollusca. - Stomochord is a structural component of Hemichordata. - Air bladder is found in Osteichthyes (bony fishes) for buoyancy control.

---

**169. 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) A-E-C-B-D
- (2) B-D-E-C-A
- (3) E-A-D-B-C
- (4) E-C-A-D-B

**Correct Answer:** (4) E-C-A-D-B

**Solution:**

### **Step 1: Understanding the Conduction System of the Heart**

The heart's conduction system consists of specialized cardiac muscle fibers that ensure rhythmic contraction. The correct sequence of electrical conduction is:

1. Sinoatrial (SA) node (E):

- The natural pacemaker of the heart.
- Generates impulses that spread through the atria, causing atrial contraction.

2. Atrioventricular (AV) node (C):

- Located in the lower interatrial septum.
- Delays the impulse before passing it to the ventricles.

3. AV Bundle (Bundle of His) (A):

- Conducts impulses from the AV node to the ventricles.
- Divides into right and left bundle branches.

4. Bundle Branches (D):

- Carry impulses down the interventricular septum toward the apex of the heart.

5. Purkinje Fibers (B):

- Spread the impulse through the ventricular walls, causing ventricular contraction.

### **Step 2: Conclusion**

- The correct conduction pathway is  $E \rightarrow C \rightarrow A \rightarrow D \rightarrow B$ , which corresponds to Option (4).

### Quick Tip

- SA Node (Sinoatrial Node): The heart's pacemaker, initiating electrical impulses. - AV Node (Atrioventricular Node): Delays impulses before sending them to ventricles. - AV Bundle (Bundle of His): Transmits impulses to the ventricles. - Bundle Branches: Carry signals toward the heart's apex. - Purkinje Fibers: Spread electrical signals throughout the ventricles, triggering contraction.

---

### 170. The flippers of Penguins and Dolphins are the example of:

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

**Correct Answer:** (2) Convergent evolution

#### **Solution:**

#### **Step 1: Understanding Convergent Evolution**

- Convergent evolution occurs when unrelated species evolve similar traits due to adaptation to similar environmental conditions.
- Penguins (birds) and dolphins (mammals) have flippers, which serve the same function—swimming—but evolved independently.
- This is an example of analogous structures, which have a similar function but different evolutionary origins.

#### **Step 2: Why Other Options Are Incorrect**

- Natural Selection (Option 1):
- Natural selection drives evolution but does not specifically refer to similar adaptations in unrelated species.
- Divergent Evolution (Option 3):
- This occurs when a common ancestor gives rise to species with different adaptations (e.g., Darwin's finches).
- Adaptive Radiation (Option 4):
- This refers to a single ancestral species evolving into different forms to occupy various



ecological niches.

### Step 3: Conclusion

- Since flippers in dolphins and penguins evolved independently due to similar aquatic environments, this is an example of convergent evolution.
- Hence, the correct answer is Option (2).

#### Quick Tip

- Convergent Evolution: Unrelated species develop similar traits due to similar environmental pressures. - Analogous Structures: Features with similar function but different evolutionary origins (e.g., wings of birds and bats). - Divergent Evolution: A common ancestor gives rise to different species with varying adaptations.

---

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

3' TACATGGCAAATATCCATTCA 5'

- (1) 5'AUGUAAAGUUUAUAGGUAAGU3'
- (2) 5'AUGUACCGUUUAUAGGGAAGU3'
- (3) 5'ATGTACCGTTTATAGGTAAGT3'
- (4) 5'AUGUACCGUUUAUAGGUAAGU3'

**Correct Answer:** (4) 5'AUGUACCGUUUAUAGGUAAGU3'

**Solution:**

#### Step 1: Understanding Transcription and Complementary Base Pairing

- DNA-dependent RNA polymerase synthesizes an mRNA strand complementary to the template DNA strand.
- RNA synthesis follows base-pairing rules, replacing thymine (T) with uracil (U):
- A (Adenine) pairs with U (Uracil)
- T (Thymine) pairs with A (Adenine)
- C (Cytosine) pairs with G (Guanine)
- G (Guanine) pairs with C (Cytosine)

#### Step 2: Deriving the mRNA Sequence from the Given DNA Template

- Given DNA template strand (3' to 5'):

3'TACATGGCAAATATCCATTCA5'

- Complementary mRNA strand (5' to 3'):

5'AUGUACCGUUUAUAGGUAAGU3'

### Step 3: Comparing with the Given Options

- The correct mRNA sequence matches Option (4):

5'AUGUACCGUUUAUAGGUAAGU3'

### Step 4: Conclusion

- The correct answer is Option (4) as it represents the correct mRNA sequence transcribed from the given DNA template.

#### Quick Tip

- Transcription follows base-pairing rules, replacing T with U in RNA.
- mRNA is complementary and antiparallel to the template DNA strand.
- The start codon (AUG) indicates the beginning of translation.

---

**172. Given below are two statements: One is labeled as Assertion A and the other is labeled as Reason R:**

**Assertion A:** Breastfeeding during the 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 newborn baby.

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

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

**Correct Answer:** (4) Both A and R are correct and R is the correct explanation of A

**Solution:**

**Step 1: Understanding the Importance of Breastfeeding**

- Breastfeeding is highly recommended by doctors, especially in the early months after birth, as it provides essential nutrients and immunity-boosting factors to the infant.
- The first milk, called colostrum, is particularly rich in antibodies and immunoglobulins, which help the newborn develop immunity against infections.

**Step 2: Verifying the Statements**

- Assertion A is correct because breastfeeding is advised for healthy growth and immunity development in infants.
- Reason R is also correct because colostrum contains IgA antibodies, which are crucial for the baby's immune defense.
- Furthermore, R correctly explains A since the benefits of breastfeeding are largely due to the presence of colostrum, which provides immunity.

**Step 3: Conclusion**

- Since both statements are correct and R correctly explains A, the correct answer is Option (4).

**Quick Tip**

- Colostrum is the first milk produced by the mother after childbirth, rich in IgA antibodies.
- It provides passive immunity, protecting the infant from infections.
- Breastfeeding ensures optimal nutrition and immune support for newborns.

---

**173. Which of the following factors are favourable for the formation of oxyhaemoglobin in alveoli?**

- (1) High  $pO_2$  and Lesser  $H^+$  concentration
- (2) Low  $pCO_2$  and High  $H^+$  concentration
- (3) Low  $pCO_2$  and High temperature
- (4) High  $pO_2$  and High  $pCO_2$

**Correct Answer:** (1) High  $pO_2$  and Lesser  $H^+$  concentration

**Solution:****Step 1: Understanding the Formation of Oxyhaemoglobin**

- Oxyhaemoglobin ( $HbO_2$ ) is formed in the alveoli of the lungs, where oxygen binds to haemoglobin.
- The binding of oxygen to haemoglobin is influenced by several physiological factors, including oxygen partial pressure ( $pO_2$ ), carbon dioxide partial pressure ( $pCO_2$ ), hydrogen ion concentration ( $H^+$ ), and temperature.

**Step 2: Ideal Conditions for Oxyhaemoglobin Formation****1. High  $pO_2$** 

- In the alveoli, the partial pressure of oxygen ( $pO_2$ ) is high, allowing haemoglobin to efficiently bind oxygen and form oxyhaemoglobin.

**2. Low  $pCO_2$  and Lesser  $H^+$  Concentration**

- A low concentration of carbon dioxide ( $pCO_2$ ) leads to a decrease in  $H^+$  concentration, as  $CO$  combines with water to form carbonic acid, which dissociates into bicarbonate and hydrogen ions.
- This results in a higher pH (less acidic environment), which promotes haemoglobin's affinity for oxygen (Bohr effect).

**3. Lower Temperature**

- Lower temperatures (such as in the lungs) favor the binding of oxygen to haemoglobin, enhancing oxyhaemoglobin formation.

**Step 3: Why Other Options Are Incorrect**

- Option (2): Low  $pCO_2$  is favorable, but high  $H^+$  concentration would lead to oxygen unloading, not binding.
- Option (3): Low  $pCO_2$  is correct, but high temperature promotes oxygen release, not binding.
- Option (4): High  $pCO_2$  leads to oxygen unloading, not oxyhaemoglobin formation.

**Step 4: Conclusion**

- The correct conditions for oxyhaemoglobin formation in alveoli are high  $pO_2$  and lesser  $H^+$  concentration, which matches Option (1).

### Quick Tip

- High  $pO_2$  in alveoli promotes oxygen binding to haemoglobin. - Low  $pCO_2$  leads to lesser  $H^+$  concentration, which enhances haemoglobin's affinity for oxygen (Bohr effect). - Higher temperature and acidic environments favor oxygen release rather than binding.

#### 174. 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) A only
- (2) C only
- (3) D only
- (4) B only

**Correct Answer:** (1) A only

**Solution:**

#### Step 1: Understanding Coelom Types in Different Phyla

##### 1. True Coelomates (Eucoelomates)

- Organisms with a true coelom (fluid-filled body cavity completely lined by mesoderm).
- Example: Annelids (earthworms, leeches).
- Statement A is correct.

##### 2. Pseudocoelomates

- Organisms with a pseudocoelom, where the body cavity is partially lined by mesoderm.
- Example: Aschelminthes (Nematoda).
- Statement B is incorrect because Poriferans (sponges) lack any coelom and have a simple body organization.

##### 3. Acoelomates

- Organisms with no body cavity (solid body).

- Example: Platyhelminthes (flatworms, tapeworms).
- Statement C is incorrect because Aschelminthes (Nematodes) are pseudocoelomates, not acoelomates.

#### 4. Incorrect Classification of Platyhelminthes

- Platyhelminthes are acoelomates, not pseudocoelomates.
- Statement D is incorrect.

#### Step 2: Conclusion

- Only Statement A is correct, which corresponds to Option (1).

#### Quick Tip

- True coelomates (Eucoelomates): Body cavity fully lined with mesoderm (e.g., Annelida, Mollusca, Arthropoda).
- Pseudocoelomates: Body cavity partially lined with mesoderm (e.g., Aschelminthes/Nematoda).
- Acoelomates: No body cavity (e.g., Platyhelminthes).
- Porifera lack a coelom and have a simple cellular organization.

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

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

**Solution:**

#### Step 1: Understanding the Cell Cycle and its Stages

The cell cycle consists of interphase (growth phases) and mitotic phase (division phases).

The correct order of events in the cell cycle is:

1. Gap 1 (G1) Phase (E):

- The first growth phase where the cell grows and prepares for DNA replication.

2. Synthesis (S) Phase (C):

- DNA replication occurs, leading to duplication of chromosomes.

3. Gap 2 (G2) Phase (A):

- The second growth phase where the cell prepares for mitosis by synthesizing proteins and organelles.

4. Karyokinesis (D):

- Nuclear division takes place (mitosis/meiosis).

5. Cytokinesis (B):

- Cytoplasmic division occurs, completing the formation of two daughter cells.

### Step 2: Matching with the Given Options

- The correct sequence of stages is:  $E \rightarrow C \rightarrow A \rightarrow D \rightarrow B$ , which corresponds to Option (3).

### Step 3: Conclusion

- Since the correct order of the cell cycle matches Option (3), the final answer is E-C-A-D-B.

#### Quick Tip

- The cell cycle consists of Interphase (G1, S, G2) and Mitotic phase (Karyokinesis + Cytokinesis).  
- G1 Phase: Growth and preparation for DNA replication.  
- S Phase: DNA replication.  
- G2 Phase: Growth and preparation for mitosis.  
- Karyokinesis: Division of nucleus.  
- Cytokinesis: Division of cytoplasm.

---

### 176. Which of the following statements is incorrect?

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

**Correct Answer:** (2) Bio-reactors are used to produce small scale bacterial cultures

**Solution:**

**Step 1: Understanding Bio-reactors**

- A bio-reactor is a specialized vessel used for large-scale production of biological products like enzymes, vaccines, antibiotics, and recombinant proteins.
- They provide optimal conditions such as temperature, pH, aeration, and nutrient supply for microbial or cell growth.

**Step 2: Evaluating the Statements**

- Statement (1) is correct:
- The most commonly used bio-reactors are of the stirring type, which ensures uniform mixing and distribution of nutrients and oxygen.
- Statement (2) is incorrect:
- Bio-reactors are designed for large-scale production, not small-scale bacterial cultures.
- Small-scale bacterial cultures are typically grown in flasks, test tubes, or petri dishes under controlled laboratory conditions.
- Statement (3) is correct:
- Bio-reactors have essential components such as:
  - Agitator system for mixing
  - Oxygen delivery system for aerobic microbial cultures
  - Foam control system to prevent excessive foam formation
- Statement (4) is correct:
- A bio-reactor provides optimal growth conditions for achieving high yield of the desired biological product.

**Step 3: Conclusion**

- Since Statement (2) is incorrect, the correct answer is Option (2).

**Quick Tip**

- Bio-reactors are used for large-scale production of microbial and biochemical products.
- Small-scale cultures are typically grown in flasks or plates, not in bio-reactors.
- Stirred-tank bio-reactors are the most commonly used type.



---

**177. 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-III, B-IV, C-II, D-I

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

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

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

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

**Solution:**

**Step 1: Understanding the Functions of Brain Structures**

1. Pons (A-III)

- The pons is a part of the brainstem that serves as a bridge connecting different regions of the brain.

2. Hypothalamus (B-IV)

- The hypothalamus contains neurosecretory cells that regulate the endocrine system by releasing hormones.

3. Medulla (C-II)

- The medulla oblongata controls respiration and gastric secretions, as well as other involuntary functions.

4. Cerebellum (D-I)

- The cerebellum helps in maintaining posture, balance, and coordination, and provides additional space for neurons.

**Step 2: Matching with the Given Options**

- The correct matching is A-III, B-IV, C-II, D-I, which corresponds to Option (1).

**Step 3: Conclusion**

- Since the correct answer matches Option (1), the final answer is A-III, B-IV, C-II, D-I.

#### Quick Tip

- Pons connects different regions of the brain. - Hypothalamus contains neurosecretory cells and regulates hormone secretion. - Medulla oblongata controls respiration, gastric secretion, and involuntary reflexes. - Cerebellum maintains balance, posture, and muscle coordination.

---

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

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

**Correct Answer:** (3) Vaults

#### Solution:

#### Step 1: Understanding Natural and Artificial Contraceptive Methods

- Natural or Traditional Contraceptive Methods:
- These do not involve the use of any external device or chemical.
- Examples include:
- Periodic abstinence: Avoiding intercourse during the fertile period.
- Lactational amenorrhea: Natural suppression of ovulation due to breastfeeding.
- Coitus interruptus: Withdrawal method before ejaculation.
- Artificial or Barrier Methods:
- These methods involve physical or chemical barriers to prevent pregnancy.
- Examples include:
- Vaults: These are barrier contraceptives that prevent sperm entry into the uterus.

#### Step 2: Evaluating the Statements

- Statement (1) Periodic abstinence (Correct - Natural method)
- It is a natural method where couples avoid intercourse during the ovulation period.
- Statement (2) Lactational amenorrhea (Correct - Natural method)
- It is a natural postpartum infertility method due to high prolactin levels that suppress

ovulation.

- Statement (3) Vaults (Incorrect - Artificial method)
- Vaults are physical barriers used in artificial contraception, not a natural method.
- They prevent sperm from reaching the cervix.
- Statement (4) Coitus interruptus (Correct - Natural method)
- It is a traditional method where the male withdraws before ejaculation.

### Step 3: Conclusion

- Since Vaults are not a natural method, the correct answer is Option (3).

#### Quick Tip

- Natural contraceptive methods include Periodic abstinence, Lactational amenorrhea, and Coitus interruptus. - Artificial contraceptive methods include Barrier methods (condoms, vaults, diaphragms), Intrauterine devices (IUDs), and Hormonal pills. - Vaults are barrier contraceptives, not a natural method.

---

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

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

**Correct Answer:** (3) Constant gene pool

#### Solution:

##### Step 1: Understanding Hardy-Weinberg Equilibrium

- The Hardy-Weinberg equilibrium states that the allele and genotype frequencies in a population remain constant over generations if no external evolutionary forces act on them.
- The equation is given as:

$$p^2 + 2pq + q^2 = 1$$

where p and q represent the frequency of dominant and recessive alleles, respectively.

##### Step 2: Evaluating the Given Factors

- Statement (1) Genetic drift (Affects equilibrium - Incorrect choice)
- Genetic drift refers to random changes in allele frequency due to chance events.
- It affects Hardy-Weinberg equilibrium by causing random loss or fixation of alleles.
- Statement (2) Gene migration (Affects equilibrium - Incorrect choice)
- Gene migration (also known as gene flow) occurs when individuals move in or out of a population.
- This changes allele frequencies and disturbs Hardy-Weinberg equilibrium.
- Statement (3) Constant gene pool (Does NOT affect equilibrium - Correct choice)
- A constant gene pool means there is no change in allele frequencies.
- This ensures that the population remains in Hardy-Weinberg equilibrium.
- Statement (4) Genetic recombination (Affects equilibrium - Incorrect choice)
- Genetic recombination leads to new allele combinations, which can change genotype frequencies over time.
- This process contributes to variation and affects Hardy-Weinberg equilibrium.

### Step 3: Conclusion

- Since a constant gene pool ensures equilibrium is maintained, the correct answer is Option (3).

#### Quick Tip

- Hardy-Weinberg equilibrium remains stable when no evolutionary forces act on a population.
- Factors that disturb Hardy-Weinberg equilibrium:
  - Genetic drift (random changes)
  - Gene migration (allele movement)
  - Mutations (new allele introduction)
  - Genetic recombination (new combinations of genes)
  - Natural selection (favored allele survival)
- A constant gene pool ensures equilibrium is maintained.

---

### 180. 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 |

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

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

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

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

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

**Solution:**

**Step 1: Understanding the Matching Pairs**

- *Pterophyllum* (Angel fish - III)

- *Pterophyllum* is commonly known as the Angel fish, found in freshwater aquariums.

- *Myxine* (Hag fish - I)

- *Myxine* refers to the Hagfish, which is a jawless marine fish producing slime.

- *Pristis* (Saw fish - II)

- *Pristis*, also known as Sawfish, has a long, toothed snout resembling a saw.

- *Exocoetus* (Flying fish - IV)

- *Exocoetus* refers to Flying fish, which can glide above water surfaces.

**Step 2: Conclusion**

- The correct matching sequence is A-III, B-I, C-II, D-IV, which corresponds to Option (1).

#### Quick Tip

- Angel fish (*Pterophyllum*) is a popular aquarium fish. - Hagfish (*Myxine*) is known for its slime-producing ability. - Sawfish (*Pristis*) has a distinctive saw-like snout. - Flying fish (*Exocoetus*) glides above water using its wing-like fins.

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

(1) Isthmus

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

**Correct Answer:** (4) Uterine fundus

**Solution:**

### **Step 1: Understanding the Structure of the Fallopian Tube**

The Fallopian tube (also known as the uterine tube or oviduct) is an important structure in the female reproductive system that facilitates the transport of the ovum from the ovary to the uterus. It consists of the following parts:

- Infundibulum: Funnel-shaped structure near the ovary with fimbriae that capture the ovum.
- Ampulla: The widest and longest part where fertilization usually occurs.
- Isthmus: A narrow segment that connects the ampulla to the uterus.
- Interstitial (intramural) part: The portion that opens into the uterine cavity.

### **Step 2: Identifying the Incorrect Option**

- Statement (1) Isthmus (Correct component)
- The isthmus is the narrowest part of the Fallopian tube before it joins the uterus.
- Statement (2) Infundibulum (Correct component)
- The infundibulum is the funnel-shaped structure near the ovary.
- Statement (3) Ampulla (Correct component)
- The ampulla is the longest and widest part where fertilization takes place.
- Statement (4) Uterine fundus (Incorrect - Not a part of the Fallopian tube)
- The uterine fundus is the uppermost part of the uterus, not a part of the Fallopian tube.

### **Step 3: Conclusion**

- Since the uterine fundus belongs to the uterus and not the Fallopian tube, the correct answer is Option (4).

#### **Quick Tip**

- The Fallopian tube consists of infundibulum, ampulla, isthmus, and interstitial parts.
- The uterine fundus is the upper rounded part of the uterus, where the Fallopian tubes attach.
- Fertilization usually occurs in the ampulla of the Fallopian tube.

---

**182. Match List I with List II:**

| List I |           | List II |                               |
|--------|-----------|---------|-------------------------------|
| A.     | Cocaine   | I.      | Effective sedative in surgery |
| B.     | Heroin    | II.     | <i>Cannabis sativa</i>        |
| C.     | Morphine  | III.    | <i>Erythroxylum</i>           |
| D.     | Marijuana | IV.     | <i>Papaver somniferum</i>     |

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

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

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

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

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

**Solution:**

**Step 1: Understanding the Matching Pairs**

- Cocaine is derived from the plant *Erythroxylum* (Matching with III).
- Heroin is a derivative of Morphine, which is obtained from *Papaver somniferum* (Matching with IV).
- Morphine is an effective sedative in surgery (Matching with I).
- Marijuana is derived from *Cannabis sativa* (Matching with II).

**Step 2: Verifying the Correct Option**

- Option (3) correctly pairs:
- A → III (Cocaine → *Erythroxylum*)
- B → IV (Heroin → *Papaver somniferum*)
- C → I (Morphine → Effective sedative in surgery)
- D → II (Marijuana → *Cannabis sativa*)

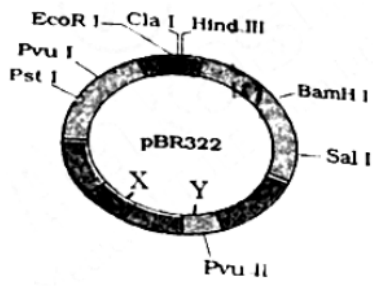
Thus, the correct answer is Option (3).

### Quick Tip

- Cocaine is derived from *Erythroxylum coca* and is a stimulant. - Heroin is synthesized from Morphine obtained from *Papaver somniferum* (Opium Poppy). - Morphine is widely used as a painkiller and sedative. - Marijuana contains THC (Tetrahydrocannabinol) and is obtained from *Cannabis sativa*.

**183. The following diagram shows restriction sites in *E. coli* cloning vector pBR322.**

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



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

**Correct Answer:** (1) 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:**

#### **Step 1: Understanding the Structure of pBR322**

pBR322 is a commonly used plasmid vector in genetic engineering. It contains:

- Antibiotic resistance genes for Ampicillin (Amp<sup>R</sup>) and Tetracycline (Tet<sup>R</sup>).
- Replication origin (ori) which controls plasmid replication.
- Multiple restriction sites (EcoRI, BamHI, HindIII, etc.) for cloning purposes.

#### **Step 2: Identifying the Roles of 'X' and 'Y' Genes**



- The 'X' gene is located at the origin of replication (ori), which plays a crucial role in controlling the copy number of the linked DNA.
- The 'Y' gene is involved in the replication of the plasmid by encoding a necessary replication-associated protein.

### Step 3: Verifying the Correct Option

- Option (1) correctly identifies:
- X → Controls the copy number of linked DNA.
- Y → Protein involved in plasmid replication.

Thus, the correct answer is Option (1).

#### Quick Tip

- pBR322 is a widely used cloning vector in *E. coli*, carrying two antibiotic resistance genes and multiple restriction sites.
- The ori (origin of replication) controls the plasmid copy number inside bacterial cells.
- Restriction sites such as BamHI, HindIII, and EcoRI are used for inserting foreign DNA.

### 184. Which of the following are Autoimmune disorders?

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

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

**Correct Answer:** (1) A, B & E only

**Solution:**

#### Step 1: Understanding Autoimmune Disorders

Autoimmune disorders occur when the immune system mistakenly attacks the body's own

tissues. These include diseases where the body's immune response is hyperactive against its own cells.

### Step 2: Analyzing Each Condition

- Myasthenia gravis (A) → Autoimmune disorder that affects the neuromuscular junction, causing muscle weakness.
- Rheumatoid arthritis (B) → Autoimmune disease where the immune system attacks the joints, leading to inflammation and pain.
- Systemic Lupus Erythematosus (E) → Autoimmune disorder affecting multiple organs, including skin, joints, and kidneys.
- Gout (C) → Metabolic disorder caused by uric acid buildup, not an autoimmune condition.
- Muscular dystrophy (D) → Genetic disorder leading to progressive muscle degeneration, not an autoimmune condition.

### Step 3: Verifying the Correct Option

- The correct autoimmune disorders from the list are A (Myasthenia gravis), B (Rheumatoid arthritis), and E (SLE).
- Option (1) correctly identifies these disorders.

Thus, the correct answer is Option (1).

#### Quick Tip

- Autoimmune disorders arise from an overactive immune response against self-antigens.
- Common examples include Myasthenia gravis, Rheumatoid arthritis, and Systemic Lupus Erythematosus (SLE).
- Gout is due to uric acid buildup, and Muscular dystrophy is a genetic disorder, not autoimmune.

### 185. 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-III, B-II, C-IV, D-I

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

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

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

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

**Solution:**

**Step 1: Understanding Each Respiratory Capacity**

1. Expiratory Capacity (A) = Tidal volume + Expiratory reserve volume. This is the total amount of air a person can expire after a normal inspiration.

- Matches with II.

2. Functional Residual Capacity (B) = Expiratory reserve volume + Residual volume. This represents the air remaining in the lungs after a normal expiration.

- Matches with IV.

3. Vital Capacity (C) = Expiratory reserve volume + Tidal volume + Inspiratory reserve volume. This is the maximum air a person can exhale after maximum inspiration.

- Matches with I.

4. Inspiratory Capacity (D) = Tidal volume + Inspiratory reserve volume. This represents the maximum air that can be inhaled after a normal expiration.

- Matches with III.

**Step 2: Verifying the Correct Option**

- A-II, B-IV, C-I, D-III is the correct matching.

- Option (4) correctly identifies these relationships.

Thus, the correct answer is Option (4).

**Quick Tip**

- Lung capacities are combinations of different lung volumes and are crucial in assessing respiratory function. - Vital capacity (VC) is the sum of expiratory reserve volume, tidal volume, and inspiratory reserve volume. - Functional residual capacity (FRC) includes expiratory reserve volume and residual volume. - Inspiratory capacity (IC) consists of tidal volume and inspiratory reserve volume.

---

**186. Match List I with List II:**

| List I | Description | List II | Explanation                            |
|--------|-------------|---------|----------------------------------------|
| 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-III, B-II, C-IV, D-I

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

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

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

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

**Solution:**

**Step 1: Understanding the ECG Waves**

1. P wave (A): Represents the depolarisation of atria, indicating the electrical impulse from the SA node.

- Matches with III.

2. QRS complex (B): Represents the depolarisation of ventricles, which leads to ventricular contraction.

- Matches with II.

3. T wave (C): Represents the repolarisation of ventricles, meaning the return of ventricles to a resting state.

- Matches with IV.

4. T-P gap (D): Represents the electrical silence of heart muscles, where no depolarisation occurs.

- Matches with I.

**Step 2: Verifying the Correct Option**

- A-III, B-II, C-IV, D-I is the correct matching.

- Option (1) correctly identifies these relationships.

Thus, the correct answer is Option (1).

#### Quick Tip

- P wave signifies atrial depolarisation. - QRS complex represents ventricular depolarisation. - T wave indicates ventricular repolarisation. - T-P gap represents the silent phase where no electrical activity is recorded.

---

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

**Correct Answer:** (2) Statement I is correct but Statement II is incorrect.

#### **Solution:**

##### **Step 1: Understanding Statement I**

- The **cerebral hemispheres** are indeed connected by a large nerve tract known as the corpus callosum.
- This is responsible for communication between the left and right hemispheres of the brain.
- **Thus, Statement I is correct.**

##### **Step 2: Understanding Statement II**

- The brainstem consists of three parts:  
1. Midbrain 2. Pons 3. Medulla oblongata
- However, the cerebrum is **not** a part of the brainstem. It is the largest part of the brain responsible for higher functions like cognition, memory, and voluntary actions.

- **Thus, Statement II is incorrect.**

### Step 3: Verifying the Correct Option

- Since Statement I is correct and Statement II is incorrect, the correct answer is Option (2).

#### Quick Tip

- The corpus callosum is the largest white matter structure connecting both hemispheres of the brain. - The brainstem includes the midbrain, pons, and medulla oblongata but **not** the cerebrum.

---

**188. Given below are two statements:**

**Statement I:** Mitochondria and chloroplasts both are double membrane-bound organelles.

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

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

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

**Correct Answer:** (2) Statement I is correct but Statement II is incorrect.

**Solution:**

#### Step 1: Understanding Statement I

- Both mitochondria and chloroplasts are **double-membrane-bound organelles**.
- The outer membrane provides structure and protection, while the inner membrane contains enzymes and transporters essential for their respective functions.
- **Thus, Statement I is correct.**

#### Step 2: Understanding Statement II

- The inner membrane of mitochondria is highly specialized with cristae and is **highly selective** in transport.
- However, the inner membrane of the chloroplast is also highly selective, and both membranes have their own permeability mechanisms.

- The statement comparing the permeability of mitochondrial and chloroplast inner membranes is misleading.
- **Thus, Statement II is incorrect.**

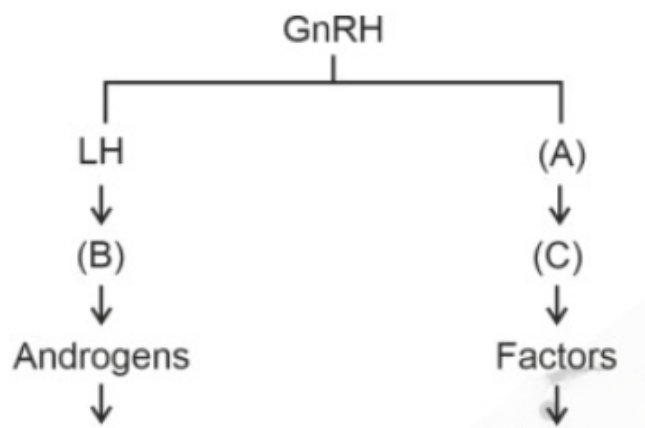
### Step 3: Verifying the Correct Option

- Since Statement I is correct and Statement II is incorrect, the correct answer is Option (2).

#### Quick Tip

- Both mitochondria and chloroplasts are double-membrane-bound organelles.
- The inner membrane of mitochondria contains electron transport chain complexes, making it highly specialized and selective.
- The inner membrane of the chloroplast is also selectively permeable, regulating the movement of ions and metabolites.

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



Choose the correct answer from the options given below:

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

**Correct Answer:** (4) FSH, Leydig cells, Sertoli cells, spermiogenesis.

**Solution:**

### Step 1: Understanding the hormonal regulation of spermatogenesis

- The hypothalamus secretes GnRH (Gonadotropin-releasing hormone), which stimulates the

anterior pituitary to release LH (Luteinizing Hormone) and FSH (Follicle-Stimulating Hormone).

- **LH acts on Leydig cells (B)**, which then produce androgens (mainly testosterone).
- **FSH (A) acts on Sertoli cells (C)**, stimulating the release of factors essential for spermatogenesis.

### Step 2: Matching the correct components

- (A) = FSH (Stimulates Sertoli cells)
- (B) = Leydig cells (Stimulated by LH to release androgens)
- (C) = Sertoli cells (Provide nourishment and factors for spermatogenesis)
- (D) = Spermiogenesis (Final stage where spermatids mature into spermatozoa)

### Step 3: Verifying the Correct Option

- The correct sequence matches Option (4): FSH, Leydig cells, Sertoli cells, spermiogenesis.

#### Quick Tip

- GnRH stimulates the release of LH and FSH. - LH acts on Leydig cells, leading to testosterone production. - FSH acts on Sertoli cells, which provide factors for spermatogenesis and aid in spermiogenesis.

---

### 190. 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 the above statements, choose the most appropriate answer from the options given below:

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

**Correct Answer:** (4) Both Statement I and Statement II are correct.



## **Solution:**

### **Step 1: Understanding the Role of Bone Marrow and Thymus**

- The bone marrow is a primary lymphoid organ responsible for hematopoiesis, the process of blood cell formation, including lymphocytes (B-cells and precursor T-cells).
- The thymus is another primary lymphoid organ that provides a microenvironment for T-cell maturation.
- While B-lymphocytes mature in the bone marrow, T-lymphocytes migrate to the thymus for their maturation.

### **Step 2: Verifying the Statements**

- Statement I is correct because the bone marrow serves as the main site for blood cell production, including lymphocytes.
- Statement II is also correct because both bone marrow and thymus provide environments for the maturation of lymphocytes (B-cells in bone marrow and T-cells in thymus).

### **Step 3: Selecting the Correct Answer**

- Since both statements are correct, the correct option is (4) Both Statement I and Statement II are correct.

#### **Quick Tip**

- Bone marrow is the site of B-cell maturation, whereas T-cells migrate to the thymus for further development.
- The primary lymphoid organs include bone marrow and thymus, while secondary lymphoid organs include the spleen, lymph nodes, and tonsils.

---

**191. As per ABO blood grouping system, the blood group of father is  $B^+$ , mother is  $A^+$ , and the child is  $O^+$ . Their respective genotype can be:**

- (A)  $I^{B_i}/I^{A_i}$
- (B)  $I^B I^B / I^A i$
- (C)  $I^A B / I^A I^B$
- (D)  $I^{A_i} / I^B I^A$
- (E)  $ii / I^A I^B$

**Choose the most appropriate answer from the options given below :**

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

**Correct Answer:** (3) D & E only

**Solution: Step 1: Analyze the genotypes of the parents.** For the child to have the  $O^+$  blood group ( $ii$ ), both parents must carry at least one  $i$  allele. Possible genotypes for the parents include  $I^B i$  and  $I^A i$ .

**Step 2: Eliminate incorrect options based on genotypes.** - Option B includes  $I^B I^B$ ,  $I^A I^A$ , which are not valid for the  $O^+$  child.

- Options D and E correctly represent  $I^A i$  and  $I^B i$ , which can produce  $ii$ .

**Conclusion:** The correct option is (3).

#### Quick Tip

When solving ABO blood group inheritance problems, remember that  $O$  blood group requires two  $i$  alleles (homozygous recessive).

---

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

**Correct Answer:** (3) Statement I is false but Statement II is true.

**Solution:**

**Step 1: Understanding Gause's Competitive Exclusion Principle** Gause's competitive

exclusion principle states that two species competing for the same limiting resources cannot coexist indefinitely. One species will outcompete and eliminate the other if their niches overlap significantly. However, species competing for **different** resources *can* coexist.

**Step 2: Evaluating Statement I** Statement I incorrectly states that the principle applies to species competing for different resources. The principle actually applies when species compete for the **same** resources. Hence, Statement I is **false**.

**Step 3: Evaluating Statement II** Statement II correctly states that during competition, the inferior species will be eliminated, which is a fundamental idea of Gause's principle. This is particularly true when resources are limited. Hence, Statement II is **true**.

**Conclusion:** Since Statement I is false and Statement II is true, the correct answer is **(3)**.

#### Quick Tip

The competitive exclusion principle states that two species competing for the same limiting resources cannot stably coexist. If niches overlap too much, one species will eventually be driven to extinction or forced to adapt.

#### 193. 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-III, B-I, C-II, D-IV

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

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

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

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

**Solution:**

**Step 1: Understanding the evolutionary timeline** Each geological era is characterized by

the emergence and dominance of specific life forms.

- **Mesozoic Era (A):** Known as the "Age of Reptiles," dominated by **Birds & Reptiles (III)**.

- **Proterozoic Era (B):** The early stage of life, where **Lower invertebrates (I)** evolved.

- **Cenozoic Era (C):** Known as the "Age of Mammals," where **Mammals (IV)** became dominant.

- **Paleozoic Era (D):** Characterized by the emergence of **Fish & Amphibia (II)**.

### Step 2: Matching the correct pairs

Thus, the correct matching is:

$A \rightarrow III$  (Birds & Reptiles)

$B \rightarrow I$  (Lower invertebrates)

$C \rightarrow IV$  (Mammals)

$D \rightarrow II$  (Fish & Amphibia)

**Conclusion:** The correct answer is (3) **A-III, B-I, C-IV, D-II**.

#### Quick Tip

Understanding geological time scales helps in remembering which life forms evolved in different eras. The Paleozoic era saw early vertebrates, the Mesozoic era was dominated by reptiles, and the Cenozoic era is known as the Age of Mammals.

### 194. Match List I with List II:

| List I                          |  | List II          |
|---------------------------------|--|------------------|
| A. RNA polymerase III           |  | I. snRNPs        |
| B. Termination of transcription |  | II. Promoter     |
| 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-II, C-IV, D-I

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

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

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

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

**Solution:**

**Step 1: Understanding the functions of each component** - RNA polymerase III is responsible for transcribing small RNA molecules, including **SnRNAs and tRNA** (IV).

- **Termination of transcription** can be influenced by the **Rho factor** (III), which plays a role in terminating RNA synthesis in prokaryotes.

- **Splicing of exons** is carried out by small nuclear ribonucleoproteins (**snRNPs**) (I), which help remove introns.

- The **TATA box** is a **promoter** (II) sequence that helps initiate transcription by recruiting RNA polymerase.

**Step 2: Matching the correct pairs**

$A \rightarrow IV$  (SnRNAs, tRNA)

$B \rightarrow III$  (Rho factor)

$C \rightarrow I$  (snRNPs)

$D \rightarrow II$  (Promoter)

**Conclusion:** The correct answer is (3) **A-IV, B-III, C-I, D-II**.

#### Quick Tip

RNA polymerase III transcribes small RNAs like tRNA. The Rho factor is essential in terminating transcription. The TATA box is a promoter sequence that plays a crucial role in transcription initiation.

---

**195. Regarding the 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) A, E, B, D, C
- (2) B, A, C, D, E
- (3) E, D, C, B, A
- (4) E, A, D, C, B

**Correct Answer:** (4) E, A, D, C, B

**Solution:**

**Step 1: Understanding the catalytic cycle of an enzyme** The catalytic cycle of an enzyme follows a specific sequence of steps:

**1. Substrate binding to the active site (E):**

- The substrate attaches to the enzyme at the active site, forming an enzyme-substrate complex.

**2. Substrate enzyme complex formation (A):**

- The enzyme undergoes conformational changes to properly orient the substrate for catalysis.

**3. Chemical bonds of the substrate broken (D):**

- The enzyme facilitates the breaking of bonds in the substrate, leading to the formation of products.

**4. Release of products (C):**

- The enzyme releases the final reaction products.

**5. Free enzyme ready to bind with another substrate (B):**

- The enzyme returns to its original form and is ready to catalyze another reaction.

**Step 2: Matching the correct sequence**

*E* → Substrate binding to active site

*A* → Substrate enzyme complex formation

*D* → Chemical bonds of the substrate broken

*C* → Release of products

*B* → Free enzyme ready to bind with another substrate

**Conclusion:** The correct answer is **(4) E, A, D, C, B**.

### Quick Tip

The enzyme catalytic cycle follows a defined sequence: binding of the substrate, enzyme-substrate complex formation, breakdown of chemical bonds, product release, and enzyme recycling for the next reaction.

#### 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-IV, B-III, C-I, D-II

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

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

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

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

#### **Solution:**

##### **Step 1: Understanding epithelial tissue types**

- **Unicellular glandular epithelium** includes **goblet cells** that secrete mucus and are found in the alimentary canal. Thus, it matches with **III**.

- **Compound epithelium** serves a protective function and is present in areas like the **moist surface of the buccal cavity**. Thus, it matches with **IV**.

- **Multicellular glandular epithelium** forms exocrine glands like the **salivary glands**. Thus, it matches with **I**.

- **Endocrine glandular epithelium** is found in glands like the **pancreas**, which secretes hormones directly into the blood. Thus, it matches with **II**.

##### **Step 2: Matching the correct pairs**

$A \rightarrow III$  (Goblet cells of alimentary canal)

$B \rightarrow IV$  (Moist surface of buccal cavity)

$C \rightarrow I$  (Salivary glands)

$D \rightarrow II$  (Pancreas)

**Conclusion:** The correct answer is (2) **A-III, B-IV, C-I, D-II.**

#### Quick Tip

Epithelial tissue is classified based on structure and function. Unicellular epithelium consists of single cells (e.g., goblet cells), while multicellular epithelium forms larger glands (e.g., salivary glands). Compound epithelium protects surfaces, and endocrine epithelium secretes hormones.

#### 197. 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-IV, B-II, C-I, D-III

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

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

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

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

**Solution:**

**Step 1: Understanding the endocrine disorders**



- **Exophthalmic goiter** (A) is caused by **hyper-secretion of thyroid hormone**, leading to symptoms such as **protruding eyeballs**. Thus, it matches with **III**.
- **Acromegaly** (B) occurs due to **excessive secretion of growth hormone**, causing abnormal growth in adults. Thus, it matches with **IV**.
- **Cushing's syndrome** (C) is caused by **excess secretion of cortisol**, leading to a characteristic **moon face** and hyperglycemia. Thus, it matches with **I**.
- **Cretinism** (D) is due to **hypo-secretion of thyroid hormone** in children, resulting in **stunted growth and mental retardation**. Thus, it matches with **II**.

**Step 2: Matching the correct pairs**

$A \rightarrow III$  (Hyper-secretion of thyroid hormone & protruding eyeballs)

$B \rightarrow IV$  (Excessive secretion of growth hormone)

$C \rightarrow I$  (Excess secretion of cortisol, moon face & hyperglycemia)

$D \rightarrow II$  (Hypo-secretion of thyroid hormone and stunted growth)

**Conclusion:** The correct answer is (3) **A-III, B-IV, C-I, D-II**.

**Quick Tip**

Endocrine disorders result from hormone imbalances. Exophthalmic goiter is caused by excess thyroid hormone, acromegaly by excess growth hormone, Cushing's syndrome by excess cortisol, and cretinism by thyroid hormone deficiency.

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

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

**Correct Answer:** (2) Loop of Henle of juxta medullary nephron runs deep into medulla.

**Solution:**

**Step 1: Understanding juxta medullary nephrons**

Juxta medullary nephrons are specialized nephrons located at the junction of the cortex and medulla. Their main function is to concentrate urine by creating a high osmolarity gradient

in the medulla.

### Step 2: Evaluating the given options

- Option (1) is incorrect:

The renal corpuscle of juxta medullary nephrons lies **at the junction of the cortex and medulla**, not in the outer portion of the renal medulla.

- Option (2) is correct:

The **Loop of Henle of juxta medullary nephrons extends deep into the medulla**, helping in the formation of concentrated urine.

- Option (3) is incorrect:

Juxta medullary nephrons are **fewer in number** compared to cortical nephrons. Only about **15-20%** of nephrons in the kidney are juxta medullary nephrons.

- Option (4) is incorrect:

Juxta medullary nephrons are located at the **cortico-medullary junction**, while the **columns of Bertini** are extensions of the renal cortex into the medulla, not the location of nephrons.

**Conclusion:** The correct answer is **(2) Loop of Henle of juxta medullary nephron runs deep into medulla.**

#### Quick Tip

Juxta medullary nephrons play a crucial role in urine concentration. Their long loops of Henle extend deep into the medulla, allowing for efficient water reabsorption and osmotic balance.

### 199. Match List I with List II related to the digestive system of a 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-IV, B-III, C-II, D-I

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

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

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

**Solution:**

**Step 1: Understanding the digestive system of a cockroach**

The digestive system of a cockroach consists of three main parts: the foregut, midgut, and hindgut, with various specialized structures performing different functions.

- Crop (A-IV): The crop is a part of the foregut and is responsible for the **storage of food**.
- Gastric Caeca (B-II): The gastric caeca are **6-8 blind tubules** at the junction of the foregut and midgut. They secrete digestive enzymes.
- Malpighian Tubules (C-III): These are **100-150 thin, yellow-colored filaments** located at the junction of the midgut and hindgut, functioning in excretion.
- Gizzard (D-I): The gizzard is a muscular structure used for **grinding food**.

**Step 2: Matching the correct pairs**

$A \rightarrow IV$  (Crop - food storage)

$B \rightarrow II$  (Gastric Caeca - digestive enzymes)

$C \rightarrow III$  (Malpighian Tubules - excretion)

$D \rightarrow I$  (Gizzard - grinding food)

**Conclusion:** The correct answer is **(4) A-IV, B-II, C-III, D-I**.

**Quick Tip**

In cockroaches, the crop stores food, the gastric caeca secrete digestive enzymes, the Malpighian tubules excrete nitrogenous waste, and the gizzard grinds food into smaller particles for digestion.

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**200. 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) A, B & D only

(2) B, D & E only

(3) B, C & D only

(4) A & C only

**Correct Answer:** (2) B, D & E only

**Solution:**

**Step 1: Understanding non-chordates**

Non-chordates are animals that do not possess a notochord at any stage of their development.

They include phyla such as Porifera, Cnidaria, Arthropoda, Mollusca, and Echinodermata.

**Step 2: Evaluating the given statements**

- Statement A is incorrect:

The presence of **pharyngeal gill slits** is a characteristic of chordates, not non-chordates.

- Statement B is correct:

**Notochord is absent** in non-chordates, as they do not possess a rigid rod-like structure in their body.

- Statement C is incorrect:

In non-chordates, the **central nervous system is ventral**, not dorsal. The dorsal CNS is a characteristic feature of chordates.

- Statement D is correct:

If a circulatory system is present in non-chordates, the **heart is usually dorsal**, unlike chordates where it is ventral.

- Statement E is correct:

Non-chordates **lack a post-anal tail**, whereas chordates have this feature.

**Step 3: Selecting the correct answer**

Since statements B, D, and E are correct, the correct answer is **(2) B, D & E only**.

### Quick Tip

Chordates possess a dorsal CNS, a notochord, pharyngeal gill slits, and a post-anal tail. In contrast, non-chordates lack a notochord, have a ventral CNS, and do not have a post-anal tail.

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