

MH 12 BIOLOGY Question and Solutions

Time Allowed :3 Hours	Maximum Marks :70	Total questions :31
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General Instructions

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1. Section A:

(a) Q. No. 1 contains Ten multiple choice type of questions carrying one mark each. Evaluation will be done for the first attempt only.

(b) Q. No. 2 Contains Eight very short answer type of questions carrying one mark each.

2. Section B: Q. No. 3 to 14 are short answer type of questions carrying two marks each. (Attempt any Eight)

3. Section C: Q. No. 15 to 26 are short answer type of questions carrying three marks each. (Attempt any Eight)

4. Section D: Q. No. 27 to 31 are long answer type of questions carrying four marks each. (Attempt any Three)

5. Begin the answer of each section on a new page.

SECTION – A

Q. 1. Select the correct alternatives and write the answers :

(i) Identify the growth hormone in plants which causes inhibitory effect.

- (A) Cytokinins
- (B) Absciscic acid
- (C) Gibberellin
- (D) Ethylene

Correct Answer: (B)

Solution: Absciscic acid (ABA) is a plant hormone that functions in many plant developmental processes, including bud dormancy. It is also known as the "stress hormone" because it is involved in the response to environmental stresses like drought. A primary function of ABA is to inhibit growth, acting as an antagonist to growth-promoting hormones like auxins and gibberellins. It promotes stomatal closure, inhibits shoot growth, and induces seed dormancy.

Quick Tip

Remember the main roles of plant hormones: Auxins (growth), Gibberellins (stem elongation, germination), Cytokinins (cell division), Ethylene (ripening), and Absciscic acid (inhibition, stress response).

(ii) Which one of the following is not a part of lac operon?

- (A) Promoter
- (B) Regulator
- (C) Inducer
- (D) Operator

Correct Answer: (C)

Solution: The lac operon consists of several components on the DNA: a promoter (where RNA polymerase binds), an operator (where the repressor protein binds), and three structural genes (lacZ, lacY, lacA). The regulator gene (lacI) codes for the repressor protein but is typically located upstream and is not considered part of the operon itself. The inducer (allolactose) is a molecule that binds to the repressor protein, inactivating it. It is a signaling molecule, not a physical part of the operon's DNA sequence.

Quick Tip

Distinguish between gene components (promoter, operator, structural genes) and regulatory molecules (repressor protein, inducer). An operon refers specifically to the set of genes transcribed together.

(iii) In absence of fertilization, corpus luteum degenerates into -----.

- (A) tunica albugenia
- (B) membrana granulosa
- (C) zona pellucida
- (D) corpus albicans

Correct Answer: (D)

Solution: After ovulation, the remnant of the ovarian follicle develops into the corpus luteum, which secretes progesterone. If fertilization does not occur, the corpus luteum begins to break down about 10-12 days after ovulation. This degeneration process involves apoptosis of the luteal cells, and the structure is replaced by a mass of fibrous scar tissue called the corpus albicans (Latin for "white body").

Quick Tip

Follow the sequence in the ovarian cycle: Follicle → Ovulation → Corpus Luteum. If no fertilization: Corpus Luteum → Corpus Albicans. If fertilization: Corpus Luteum is maintained.

(iv) Which of the following divides nasal cavity?

- (A) Hyaline cartilage
- (B) Mesethmoid cartilage
- (C) Ligamentum arteriosum
- (D) Laryngopharynx

Correct Answer: (B)

Solution: The nasal cavity is divided into two halves by the nasal septum. The anterior part of the nasal septum is made of cartilage, specifically the septal cartilage, which is part of the mesethmoid cartilage complex (derived from the ethmoid bone). The posterior part is bony. Mesethmoid cartilage is the correct term for the cartilaginous structure that forms a significant part of the nasal septum.

Quick Tip

The nasal septum has both bony and cartilaginous parts. The mesethmoid cartilage is the primary cartilaginous component dividing the nasal cavity.

(v) Which of the following is caused by unsterilized needle?

- (A) Elephantiasis
- (B) AIDS
- (C) Malaria
- (D) Dengue

Correct Answer: (B)

Solution: AIDS (Acquired Immunodeficiency Syndrome) is caused by the Human Immunodeficiency Virus (HIV). HIV is a blood-borne pathogen. One of the primary modes of transmission is through the sharing of contaminated needles and syringes, which can transfer infected blood from one person to another. Elephantiasis, Malaria, and Dengue are all vector-borne diseases, transmitted by insects (mosquitoes).

Quick Tip

Categorize diseases by their mode of transmission: blood-borne (HIV, Hepatitis B/C), vector-borne (Malaria, Dengue), water-borne (Cholera), etc. This helps in identifying the cause based on the transmission method mentioned.

(vi) Recognition sequence of restriction enzymes are generally ----- nucleotides long.

- (A) 2 to 4
- (B) 4 to 8
- (C) 8 to 10
- (D) 14 to 18

Correct Answer: (B)

Solution: Restriction enzymes, or restriction endonucleases, are proteins that cut DNA at specific recognition sites. These recognition sequences are typically palindromic (reading the same forwards and backward on opposite strands). The length of these sites is a key characteristic of the enzyme. Most commonly used restriction enzymes recognize sequences that are 4, 6, or 8 base pairs (nucleotides) long. Therefore, the range of 4 to 8 is the correct answer.

Quick Tip

The length of the recognition site determines how frequently the enzyme will cut a given DNA sequence. A shorter sequence (e.g., 4 bp) will occur more frequently by chance than a longer sequence (e.g., 8 bp).

(vii) Which of the following types require pollinator but result is genetically similar to autogamy?

- (A) Geitonogamy
- (B) Xenogamy
- (C) Apogamy

(D) Cleistogamy

Correct Answer: (A)

Solution: **Autogamy** is self-pollination within the same flower. **Geitonogamy** is the transfer of pollen from the anther of one flower to the stigma of another flower on the *same plant*. Ecologically, this is cross-pollination because it involves a pollinating agent (like an insect or wind). However, genetically it is equivalent to autogamy because the pollen and the ovule come from the same parent plant. **Xenogamy** is cross-pollination between flowers on different plants. **Cleistogamy** refers to flowers that never open and are self-pollinated, not requiring a pollinator.

Quick Tip

Break down the terms: 'Geitono-' means neighbor, '-gamy' means marriage. So, pollination with a "neighbor" flower on the same plant. It's functionally cross-pollination but genetically self-pollination.

(viii) Which one of the following does not evolve further?

- (A) Climax community
- (B) Primary Succession
- (C) Pioneer Species
- (D) Seral Community

Correct Answer: (A)

Solution: Ecological succession is the process of change in the species structure of an ecological community over time. It involves several stages: **Pioneer species** are the first to colonize a barren environment. **Seral communities** are the intermediate stages of succession. **Primary succession** is the entire process starting from a barren site. A **climax community** is the final, stable, and mature stage of succession. It is in equilibrium with its environment and has a high level of species diversity and biomass. By definition, it is considered the endpoint of succession and does not undergo further directional evolution.

Quick Tip

Think of succession as a journey. Pioneer species are the starting travelers, seral communities are the stops along the way, and the climax community is the final destination where the ecosystem settles down.

(ix) Identify the appropriate term for the number of births under ideal conditions :

- (A) Absolute mortality
- (B) Realized natality
- (C) Realized mortality
- (D) Absolute natality

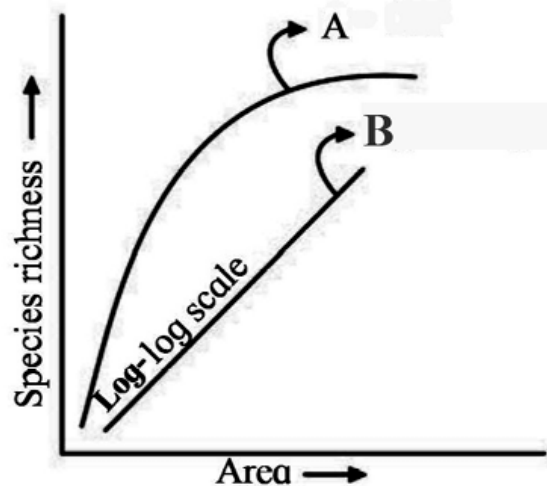
Correct Answer: (D)

Solution: In population ecology, natality refers to the birth rate. **Absolute natality** (or potential natality) is the theoretical maximum production of new individuals under ideal, unlimited environmental conditions, with no limiting factors like competition or resource scarcity. **Realized natality** is the actual number of births observed under the existing environmental conditions, which are often limiting. Mortality refers to the death rate.

Quick Tip

Remember the distinction: 'Absolute' or 'Potential' refers to ideal, theoretical maximums. 'Realized' or 'Ecological' refers to the actual, observed rates under real-world conditions.

(x) Observe the graph and select correct option :



- (A) Line 'A' represents $S = CA^2$
- (B) Line 'B' represents $\log C = \log A + Z \log S$
- (C) Line A represents $S = CA^Z$
- (D) Line B represents $\log S = \log Z + C \log A$

Correct Answer: (C)

Solution: The graph shows the species-area relationship, which describes how the number of species (S) found in an area (A) increases with the size of that area. The relationship was described by the naturalist Alexander von Humboldt with the equation:

$$S = CA^Z$$

where S = Species richness, A = Area, C = Y-intercept, and Z = slope of the line. When plotted on normal axes, this equation gives a rectangular hyperbola, which is represented by Line A. When plotted on a log-log scale, the equation becomes linear:

$$\log S = \log C + Z \log A$$

This linear relationship is represented by Line B. Option (C) correctly identifies the equation for the curve shown as Line A. The other options misrepresent the equations.

Quick Tip

The species-area relationship is a fundamental concept in ecology. Remember its standard form ($S = CA^Z$) and its logarithmic form ($\log S = \log C + Z \log A$), and be able to recognize both on a graph. The curve is the standard form; the straight line is the log-log form.

Q. 2. Answer the following questions :

(i) What are vestigial organs?

Solution: Vestigial organs are organs, tissues, or bones in a body that are no longer functional in the way they were in the organism's ancestors. They are remnants of evolutionary history, indicating structures that were critical for survival in the past but have since lost their primary function. Examples in humans include the appendix, wisdom teeth, and the coccyx (tailbone).

(ii) Expand the term ZIFT.

Solution: ZIFT stands for **Zygote Intrafallopian Transfer**. It is an assisted reproductive technology (ART) where an egg is fertilized in a laboratory (in vitro fertilization), creating a zygote. This zygote is then surgically placed into the fallopian tube of the mother.

(iii) Give the name of endocrine gland which is prominent at birth but gets gradually atrophied in adult stage.

Solution: The **thymus gland**. The thymus is a crucial part of the immune system, responsible for the maturation of T-lymphocytes (T cells). It is largest and most active during the neonatal and pre-adolescent periods. After puberty, it begins to shrink (atrophy) and is gradually replaced by fat tissue.

(iv) What is the full form of IAA?

Solution: IAA stands for **Indole-3-Acetic Acid**. It is the most common, naturally occurring plant hormone of the auxin class. It plays a major role in controlling plant growth and development, including cell elongation and division, fruit development, and root formation.

(v) Give the name of microbial source of antibiotic chloromycetin.

Solution: The microbial source of chloromycetin (also known as chloramphenicol) is the bacterium *Streptomyces venezuelae*. It was originally isolated from a soil sample collected in Venezuela.

(vi) Which cells of islets of Langerhans produce a hormone insulin?

Solution: The **Beta cells** (β -cells) within the islets of Langerhans in the pancreas produce and secrete the hormone insulin. Insulin is responsible for regulating blood glucose levels by promoting the absorption of glucose from the blood into liver, fat, and skeletal muscle cells.

(vii) How many meiotic divisions are required for the formation of 300 seeds in angiosperm?

Solution: To form one seed, one male gamete (from a pollen grain) and one female gamete (from an ovule) are required.

- **For 300 male gametes (pollen grains):** One meiotic division of a microspore mother cell produces 4 microspores (pollen grains). Thus, to get 300 pollen grains, $300/4 = 75$ meiotic divisions are needed.
- **For 300 female gametes (ovules):** One meiotic division of a megaspore mother cell produces 1 functional megaspore (ovule) and 3 polar bodies that degenerate. Thus, to get 300 ovules, 300 meiotic divisions are needed.

Total meiotic divisions = Divisions for pollen + Divisions for ovules = $75 + 300 = 375$.

Therefore, **375** meiotic divisions are required.

(viii) Explain the term Emigration.

Solution: Emigration is one of the four primary factors of population change. It refers to the one-way movement of individuals *out of* a particular population or geographical area to settle in another. It leads to a decrease in the size of the original population. It is the opposite of immigration.

SECTION – B

Attempt any EIGHT of the following questions :

Q. 3. What are the reasons for the success of Mendel?

Solution: Gregor Mendel's success in discovering the principles of inheritance can be attributed to several key factors:

- (a) **Choice of experimental material:** He chose the pea plant (*Pisum sativum*), which was ideal because it is easy to cultivate, has a short life cycle, and produces many offspring.
- (b) **Selection of contrasting characters:** He studied seven pairs of clearly distinguishable, contrasting traits (e.g., tall vs. dwarf, round vs. wrinkled seeds).
- (c) **Controlled pollination:** Pea plants are naturally self-pollinating, but Mendel performed cross-pollination manually and prevented accidental cross-pollination by emasculation (removing anthers).
- (d) **Quantitative approach:** For the first time in biology, he applied statistical and mathematical principles to analyze his results. He maintained accurate and detailed records of all his experiments.
- (e) **Studying one character at a time:** He initially focused on the inheritance of a single trait before moving on to study two traits simultaneously (dihybrid cross).
- (f) **Careful experimentation:** He started with pure-breeding parent plants and studied inheritance patterns over several generations (F1, F2, F3).

Quick Tip

Mendel's success wasn't just luck. It was his methodical, scientific, and quantitative approach—treating biology like a physical science—that set his work apart and led to his groundbreaking discoveries.

Q. 4. Arrange the following steps of DNA fingerprinting in correct sequence :

- (a) Gel electrophoresis
- (b) Isolation of DNA
- (c) Southern blotting
- (d) Restriction digestion

Solution: The correct sequence for the steps of DNA fingerprinting is:

1. **Isolation of DNA (b):** DNA is extracted from the cells of a biological sample (like blood, saliva, or hair).
2. **Restriction digestion (d):** The isolated DNA is cut into smaller fragments using restriction enzymes.
3. **Gel electrophoresis (a):** The DNA fragments are separated according to their size by running them through an agarose gel. Smaller fragments move faster and further.
4. **Southern blotting (c):** The separated DNA fragments are transferred (blotted) from the gel onto a nylon membrane.

The correct sequence is **(b) → (d) → (a) → (c)**.

Quick Tip

A mnemonic to remember the core steps: **Ice Drink Every Summer**. (**I**solation, **D**igestion, **E**lectrophoresis, **S**outhern blotting).

Q. 5. Distinguish between human sperm and ovum.

Solution:

Feature	Human Sperm	Human Ovum (Egg)
Size	Microscopic, about 50 μm long. One of the smallest cells in the body.	Large, about 120 μm in diameter. The largest cell in the body.
Motility	Motile, possesses a tail (flagellum) for swimming.	Non-motile, cannot move on its own.
Shape	Tadpole-shaped with a distinct head, middle piece, and tail.	Spherical or oval in shape.
Cytoplasm	Contains very little cytoplasm.	Contains a large amount of cytoplasm (ooplasm) rich in nutrients (yolk).
Mitochondria	Located in the middle piece to provide energy for movement.	Scattered throughout the cytoplasm.
Production	Produced in very large numbers (millions) continuously after puberty.	Typically, one is produced per menstrual cycle.
Genetic Makeup	Contains either an X or a Y chromosome, determining the sex of the offspring.	Contains only an X chromosome.

Quick Tip

Think of their roles: the sperm is designed for a long, competitive journey (small, motile, high numbers), while the ovum is designed to be a nutrient-rich target that provides for the early embryo (large, non-motile, resource-heavy).

Q. 6. Enlist the uses of gene therapy.

Solution: Gene therapy is a technique used to treat or prevent diseases by correcting the underlying genetic problem. Its uses include:

- **Treating single-gene disorders:** It is used to treat inherited diseases caused by a single faulty gene, such as severe combined immunodeficiency (SCID), cystic fibrosis, hemophilia, and sickle cell anemia.
- **Cancer treatment:** It can be used to modify immune cells (like T-cells in CAR-T therapy) to better recognize and kill cancer cells, or to introduce "suicide genes" into cancer cells.
- **Treating viral infections:** Research is ongoing to use gene therapy to treat infections like HIV by modifying cells to be resistant to the virus.
- **Treating degenerative diseases:** It holds potential for treating conditions like Parkinson's disease, Huntington's disease, and muscular dystrophy by replacing or repairing the defective genes.
- **Vaccine development:** DNA vaccines, a form of gene therapy, can be used to stimulate a strong and long-lasting immune response.

Quick Tip

The core principle of gene therapy is simple: "replace a bad gene with a good gene." It aims to fix the root cause of a disease at the DNA level rather than just treating the symptoms.

Q. 7. Define the following terms : (a) Gene flow (b) Chromosomal aberrations

Solution:

- (a) **Gene flow:** Also known as gene migration, gene flow is the transfer of genetic material from one population to another. When individuals from different populations interbreed, they introduce new alleles into the recipient population and can change the frequency of existing alleles. Gene flow tends to reduce genetic differences between populations.

(b) **Chromosomal aberrations:** These are changes in the normal structure or number of chromosomes, which can lead to genetic disorders. They can be:

- **Numerical aberrations:** A change in the number of chromosomes, such as aneuploidy (e.g., Trisomy 21 causing Down syndrome) or polyploidy.
- **Structural aberrations:** A change in the structure of a chromosome, such as deletion (loss of a segment), duplication (repetition of a segment), inversion (reversal of a segment), or translocation (movement of a segment to a non-homologous chromosome).

Quick Tip

Remember the difference: **Gene flow** is like people moving between towns, mixing up the local populations. **Genetic drift** is a random change in a population, like if a certain family in a small town happens to have more children by chance. Gene flow makes populations more similar, while genetic drift can make them different.

Q. 8. What are the significances of double fertilization?

Solution: Double fertilization is a unique process in angiosperms (flowering plants) that has several significances:

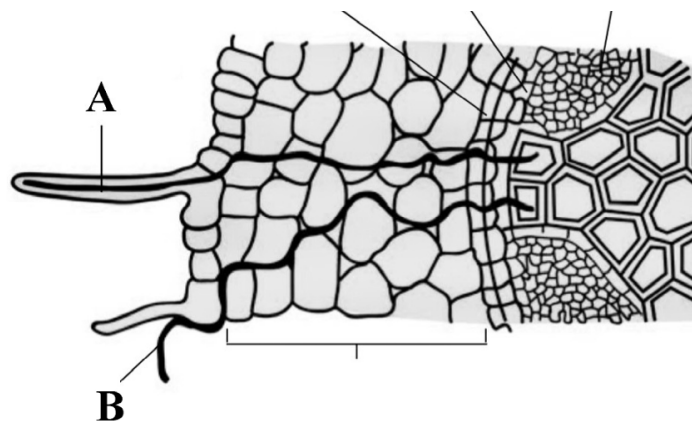
1. **Formation of Embryo and Endosperm:** It ensures that both the embryo (from syngamy, the fusion of one male gamete with the egg) and the nutritive tissue, the endosperm (from triple fusion, the fusion of the second male gamete with the central cell), are formed simultaneously.
2. **Efficient Nutrient Use:** The endosperm, which provides nourishment to the developing embryo, is only formed when fertilization is successful. This prevents the plant from wasting energy and resources on an unfertilized ovule.
3. **Triploid Endosperm:** The formation of a triploid ($3n$) endosperm provides a unique genetic makeup that is highly efficient at providing nutrients for the diploid ($2n$) embryo.

4. **Increased Seed Viability:** The nourishment provided by the endosperm increases the chances of the embryo surviving and developing into a healthy seedling, thus enhancing the viability of the seeds.
5. **Basis for Angiosperm Dominance:** This efficient reproductive mechanism is considered one of the key reasons for the evolutionary success and dominance of angiosperms in most terrestrial ecosystems.

Quick Tip

Double fertilization = Two fusions. First fusion (male gamete + egg) makes the baby (embryo). Second fusion (male gamete + central cell) makes the baby's food (endosperm).

Q. 9. Identify and define 'A' and 'B' in relation to uptake of water by the root :



Solution: The image shows two pathways for water uptake by a plant root.

- **A is the Apoplast Pathway:** This is the pathway where water moves from the root hair to the xylem through the non-living parts of the root—the intercellular spaces and the cell walls. This pathway is blocked by the Casparian strip in the endodermis, forcing water to enter the symplast.
- **B is the Symplast Pathway:** This is the pathway where water moves through the living parts of the cells—the cytoplasm and plasmodesmata (cytoplasmic channels connecting

adjacent cells). Water enters the cytoplasm of a root hair cell and moves from cell to cell through the plasmodesmata, crossing the cortex and endodermis to reach the xylem.

Quick Tip

A simple way to remember: **A**poplast = **A**way from the cytoplasm (in the cell walls).
Symplast = **S**haring cytoplasm (through plasmodesmata).

Q. 10. Describe mutualism.

Solution: Mutualism is a type of symbiotic interaction between two different species where both species benefit from the relationship. It is often denoted as a (+/+) interaction. The association can be obligate, where neither species can survive without the other, or facultative, where they can survive independently but benefit from living together. Examples include:

- **Lichens:** A composite organism arising from algae or cyanobacteria living among filaments of multiple fungi in a mutualistic relationship. The fungus provides shelter and absorbs water/nutrients, while the alga/cyanobacterium provides food through photosynthesis.
- **Mycorrhiza:** A relationship between a fungus and the roots of a vascular plant. The fungus colonizes the root system, increasing the plant's water and nutrient absorption capabilities, while the plant provides the fungus with carbohydrates.
- **Pollination:** Insects, birds, or bats get nectar (food) from flowers while transferring pollen, which is essential for the plant's reproduction.

Quick Tip

Think of mutualism as a "win-win" situation in nature. Both partners in the relationship get something positive out of the deal.

Q. 11. Explain factors affecting water absorption.

Solution: The rate of water absorption by plant roots is affected by several external and internal factors:

1. **Available Soil Water:** The primary source of water for plants is capillary water in the soil. If the soil has too little water (below the wilting point) or is waterlogged (displacing soil oxygen), absorption rates will be low.
2. **Soil Temperature:** The optimal temperature for water absorption is typically between 20°C and 30°C. Low temperatures decrease the permeability of the root cell membranes and increase the viscosity of water, slowing down absorption.
3. **Soil Aeration:** Root cells need oxygen for respiration to provide the energy needed for active transport of minerals, which in turn facilitates water absorption by osmosis. Poorly aerated or waterlogged soils lack sufficient oxygen, thus hindering water uptake.
4. **Concentration of Soil Solution:** If the soil solution is highly concentrated with salts (hypertonic), the water potential gradient between the soil and the root cells is reduced or even reversed, making it difficult for the roots to absorb water.
5. **Rate of Transpiration:** A high rate of transpiration creates a strong tension or "pull" on the water column in the xylem (transpirational pull). This is the main driving force for passive water absorption by the roots.

Quick Tip

For a plant to "drink" water efficiently, it needs four things: 1) Water must be available, 2) The soil must be warm enough, 3) The roots need to breathe (oxygen), and 4) The leaves must be "sweating" (transpiring) to create a pull.

Q. 12. What is differentiation and redifferentiation?

Solution: Differentiation is the process by which cells derived from meristems (apical, intercalary, and lateral) mature and undergo structural and physiological changes to perform

specific functions. During this process, the cells lose their ability to divide and form permanent tissues like parenchyma, xylem, and phloem.

Redifferentiation is the process where cells that have already undergone dedifferentiation (i.e., differentiated cells that have regained the ability to divide) once again lose their ability to divide and mature to form new, specialized permanent tissues. For example, the cells of the secondary meristems, like the cork cambium, divide and then redifferentiate to form cork (phellem) on the outer side and secondary cortex (phelloderm) on the inner side.

Quick Tip

Think of it as a career path for a plant cell: **Meristem** (Student) → **Differentiation** (Gets a specific job, e.g., becomes a skin cell) → **Dedifferentiation** (Goes back to school to get a new degree) → **Redifferentiation** (Gets a new, more specialized job, e.g., becomes a cork cell).

Q. 13. Select and rewrite appropriate disorder of respiratory system with the given symptoms : [sinusitis, emphysema, silicosis and asbestosis, laryngitis]

Solution:

- (a) **Breakdown of alveoli, shortness of breath. → Emphysema**
- (b) **Inflammation of the sinuses, mucous discharge. → Sinusitis**
- (c) **Inflammation of larynx, vocal cord, sore throat, hoarseness of voice, mucous build up and cough. → Laryngitis**
- (d) **Inflammation of fibrosis, lung damage. → Silicosis and Asbestosis**

Quick Tip

Look for keywords: Alveoli damage points to emphysema. "-itis" means inflammation, so inflammation of the sinuses is sinusitis, and inflammation of the larynx is laryngitis. Fibrosis (scarring) in the lungs is characteristic of occupational diseases like silicosis and asbestosis.

Q. 14. Explain the steps involved in preliminary treatment of sewage.

Solution: The preliminary (or primary) treatment of sewage is a physical process designed to remove large solid materials. It involves the following steps:

1. **Screening:** Raw sewage first passes through screens or bar racks. These are meshes of varying sizes that physically block and remove large floating objects like plastic bags, cans, sticks, and rags.
2. **Grit Removal:** After screening, the sewage enters a grit chamber. Here, the speed of the sewage flow is slowed down significantly. This allows heavy, inorganic particles like sand, grit, and small stones to settle at the bottom through sedimentation, while the lighter organic solids remain suspended.
3. **Primary Sedimentation:** The sewage then flows into a large tank called a primary settling tank or clarifier. In this tank, the flow is very slow, and it is held for a period of several hours. This allows most of the suspended organic solids to settle to the bottom by gravity, forming a mass called primary sludge. Lighter materials like grease and oil float to the top, forming a layer called scum, which is skimmed off. The remaining liquid, now called the primary effluent, is then sent for secondary treatment.

Quick Tip

Think of preliminary treatment as a 3-step physical clean-up: 1. **Screen** out the big trash. 2. **Settle** out the heavy sand/grit. 3. **Settle** out the lighter organic solids. No chemistry or biology involved yet!

SECTION – C

Attempt any EIGHT of the following questions :

Q. 15. Give the different steps involved in formation of m-RNA from hn-RNA.

Solution: The formation of a mature messenger RNA (m-RNA) from the primary transcript, heterogeneous nuclear RNA (hn-RNA), in eukaryotes is called post-transcriptional processing. It involves three main steps:

1. **Capping:** A modified nucleotide, methyl guanosine triphosphate, is added to the 5' end of the hn-RNA. This "cap" is essential for protecting the m-RNA from degradation by ribonucleases, and it also helps in the binding of the ribosome to the m-RNA during translation.
2. **Splicing:** The hn-RNA contains both coding sequences, called exons, and non-coding sequences, called introns. In splicing, the introns are precisely removed, and the exons are joined together in the correct sequence. This process is carried out by a complex of proteins and RNA called the spliceosome.
3. **Tailing (Polyadenylation):** A tail of about 200-300 adenylate residues (poly-A tail) is added to the 3' end of the hn-RNA. This tail also protects the m-RNA from degradation, helps in its transport from the nucleus to the cytoplasm, and plays a role in initiating translation.

After these modifications, the hn-RNA is now considered a mature and functional m-RNA, ready for translation.

Quick Tip

Remember the processing with the mnemonic **C-S-T**: **C**apping at the 5' head, **S**plicing the introns out from the middle, and **T**ailing at the 3' end.

Q. 16. What is reproductive isolation? Describe any two types each of pre-mating and post-mating isolating mechanism.

Solution: Reproductive isolation refers to the collection of evolutionary mechanisms, behaviors, and physiological processes that prevent members of different species from producing viable, fertile offspring. These mechanisms are crucial for maintaining the integrity of distinct species.

Two types of Pre-mating (or Pre-zygotic) isolating mechanisms: These prevent mating or fertilization from occurring.

1. **Temporal Isolation:** This occurs when two species have different mating or flowering seasons or times of day. For example, two species of frogs might live in the same pond but breed at different times of the year, one in early summer and the other in late summer, so they never have the opportunity to interbreed.
2. **Behavioral Isolation:** This mechanism operates when species have different and specific courtship rituals, mating calls, or pheromones. If one species' courtship display is not recognized by another, mating will not occur. For instance, the specific song of a male bird will only attract females of the same species.

Two types of Post-mating (or Post-zygotic) isolating mechanisms: These act after mating has occurred, preventing the formation of a fertile hybrid.

1. **Hybrid Inviability:** In this case, a zygote is formed by the fusion of gametes from two different species, but it fails to develop or dies before reaching maturity. The genetic incompatibility between the two species prevents normal embryonic development.
2. **Hybrid Sterility:** The hybrid offspring is successfully born and develops into a mature adult, but it is sterile and cannot produce functional gametes. The classic example is the mule, which is the sterile offspring of a male donkey and a female horse.

Quick Tip

Think of it this way: **Pre-mating** barriers are like a "locked door" that prevents two species from getting together. **Post-mating** barriers are what happens when they manage to get through the door, but the "offspring" either doesn't survive or can't have its own children.

Q. 17. Explain unique features of acquired immunity.

Solution: Acquired (or adaptive) immunity is a specific type of defense that the body develops after exposure to an antigen (a foreign substance, typically from a pathogen). Its four unique features are:

1. **Specificity:** Acquired immunity is highly specific. The immune response generated against a particular pathogen (like the measles virus) is effective only against that pathogen. Antibodies or T-cells produced in response to one antigen will not recognize or react to a different antigen.
2. **Diversity:** The immune system is capable of recognizing and responding to an almost infinite variety of different antigens. This is due to the vast repertoire of B-lymphocytes and T-lymphocytes, each with unique receptors for a specific antigen.
3. **Memory:** A hallmark of acquired immunity is its ability to "remember" past infections. After an initial encounter with an antigen, the immune system produces memory B-cells and T-cells. If the same antigen is encountered again, these memory cells mount a secondary (anamnestic) response that is much faster, stronger, and more effective than the primary response, often preventing the disease from developing. This is the principle behind vaccination.
4. **Discrimination between Self and Non-self:** The immune system has the remarkable ability to distinguish between the body's own cells and molecules ("self") and foreign substances ("non-self"). This prevents the immune system from attacking and destroying the body's own tissues, a condition known as autoimmunity.

Quick Tip

Remember the features with the acronym **S-D-M-S**: **S**pecificity (a sniper, not a bomb), **D**iversity (a huge library of targets), **M**emory (never forgets a face), and **S**elf/Non-self Recognition (knows friend from foe).

Q. 18. Name and describe hormones secreted by ovaries.

Solution: The ovaries are the female gonads that secrete two main groups of steroid hormones: estrogens and progesterone.

1. **Estrogen:**

- **Source:** It is primarily synthesized and secreted by the growing ovarian follicles (granulosa cells).
- **Functions:** Estrogen is responsible for a wide range of functions, including:
 - Stimulating the growth, maturation, and maintenance of female reproductive organs like the uterus and vagina.
 - Development of female secondary sexual characteristics at puberty, such as the growth of breasts and pubic hair, and the characteristic female body shape.
 - Regulating the menstrual cycle, specifically by causing the proliferation (thickening) of the uterine lining (endometrium) during the follicular phase.

2. Progesterone:

- **Source:** It is mainly secreted by the corpus luteum, which forms from the ruptured follicle after ovulation.
- **Functions:** Progesterone is often called the "pregnancy hormone" because its primary role is to prepare the body for and support pregnancy. Its functions include:
 - Preparing the endometrium for the implantation of a fertilized egg by making it more glandular and vascular (secretory phase).
 - Inhibiting uterine contractions to maintain pregnancy.
 - Promoting the development of the mammary glands (alveoli) in preparation for milk production.

Ovaries also produce smaller amounts of hormones like inhibin (which inhibits FSH secretion) and relaxin (which relaxes pelvic ligaments during childbirth).

Quick Tip

A simple way to remember their roles in the menstrual cycle: **Estrogen** is the "builder" that makes the uterine lining thick. **Progesterone** is the "maintainer" that keeps the lining ready for a potential pregnancy.

Q. 19. Explain different steps involved in PCR technique.

Solution: PCR, or Polymerase Chain Reaction, is a laboratory technique used to make millions of copies of a specific segment of DNA. Each cycle of PCR involves three main steps:

1. Denaturation:

- The reaction mixture, containing the target DNA, primers, nucleotides, and DNA polymerase, is heated to a high temperature, typically 94-96°C.
- This high heat breaks the hydrogen bonds holding the two strands of the DNA double helix together, causing the DNA to separate into two single strands. Each single strand can now serve as a template for the synthesis of a new strand.

2. Annealing:

- The temperature of the reaction is lowered to about 50-65°C. The exact temperature depends on the sequence of the primers.
- At this temperature, short, single-stranded DNA sequences called primers bind (anneal) to their complementary sequences on the single-stranded template DNA. Primers are necessary as they provide a starting point for the DNA polymerase.

3. Extension (or Elongation):

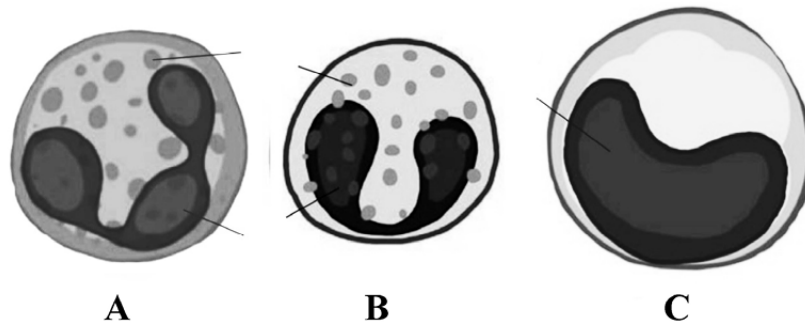
- The temperature is raised again to around 72°C, which is the optimal temperature for the heat-stable DNA polymerase enzyme (like Taq polymerase) to function.
- The DNA polymerase attaches to the primers and moves along the template strand, adding complementary nucleotides (A, T, C, G) to synthesize a new DNA strand. This results in two new double-stranded DNA molecules.

This three-step cycle is repeated 25-35 times, leading to an exponential amplification of the target DNA sequence.

Quick Tip

Remember the PCR cycle as a simple 3-step recipe: **1. Heat** to separate (Denature). **2. Cool** to prime (Anneal). **3. Warm** to copy (Extend).

Q. 20. Identify A, B, and C from the above diagrams and give their functions.



Solution: The diagrams show three different types of white blood cells (leukocytes).

- **A is a Neutrophil:**

- **Identification:** It is identified by its multi-lobed nucleus (typically 3-5 lobes connected by thin strands) and fine, granular cytoplasm.
- **Function:** Neutrophils are highly phagocytic cells. They are the most abundant type of WBC and act as the first line of defense against bacterial infections by engulfing and destroying pathogens.

- **B is an Eosinophil:**

- **Identification:** It is characterized by its bilobed nucleus (resembling headphones or spectacles) and large, coarse cytoplasmic granules that stain reddish-pink with acidic dyes like eosin.
- **Function:** Eosinophils are primarily involved in combating parasitic infections (especially helminths or worms) and also play a significant role in modulating allergic inflammatory responses.

- **C is a Monocyte:**

- **Identification:** It is the largest of all WBCs and is identified by its large, kidney-bean or C-shaped nucleus and abundant, non-granular (agranular) cytoplasm.

- **Function:** Monocytes are also phagocytic. They circulate in the blood for a few days before migrating into tissues, where they differentiate into macrophages. Macrophages are powerful phagocytes that engulf pathogens, dead cells, and cellular debris.

Quick Tip

Identify them by their nucleus: Neutrophil has a "Numerous-lobed" nucleus. Eosinophil has an "Ear-muff" (bilobed) nucleus. Monocyte has a "Massive" kidney-shaped nucleus.

Q. 21. What are the limitations of root pressure theory?

Solution: The root pressure theory suggests that a positive hydrostatic pressure generated in the roots can push water up the xylem. While root pressure does exist, it has several limitations as the primary mechanism for water transport in plants:

1. **Insufficient Force:** The magnitude of root pressure is typically low (around 1-2 atmospheres), which is only enough to push water up a few meters. It cannot account for the ascent of sap in tall trees, which can exceed 100 meters in height.
2. **Not a Universal Phenomenon:** Root pressure is not observed in all plants. For example, gymnosperms and many other tall trees do not generate any significant root pressure.
3. **Absent During Active Transpiration:** Root pressure is highest at night or in conditions of high humidity when transpiration is low. During the day, when water demand is highest due to active transpiration, the water column in the xylem is under tension (negative pressure), not positive pressure.
4. **Slow Rate:** The rate of water movement attributed to root pressure is much slower than the actual rates measured in the stems of actively transpiring plants.

Therefore, while root pressure can explain guttation (exudation of water droplets from leaf margins) in small herbaceous plants, the main driving force for water movement over long

distances is the cohesion-tension or transpiration pull theory.

Quick Tip

Think of root pressure as a "small push from below" and transpiration pull as a "powerful pull from above." For a small plant, a push might be enough, but for a tall tree, you need the strong pull.

Q. 22. Explain green house effect with reference to gases responsible for it and their sources.

Solution: The greenhouse effect is a natural process that warms the Earth's surface. Solar radiation reaches the atmosphere, and some is reflected back into space. The rest is absorbed by the land and oceans, heating the Earth. This heat is then radiated back from the Earth's surface as infrared radiation. Greenhouse gases (GHGs) in the atmosphere trap some of this outgoing heat, preventing it from escaping into space and thus keeping the Earth's average temperature stable and suitable for life.

The primary greenhouse gases and their sources are:

- **Carbon Dioxide (CO₂):** The main contributor to the enhanced greenhouse effect.
 - **Sources:** Burning of fossil fuels (coal, oil, and natural gas) for electricity and transportation, industrial processes like cement manufacturing, and deforestation (which reduces the absorption of CO₂ by forests).
- **Methane (CH₄):** A potent GHG, though less abundant than CO₂.
 - **Sources:** Agricultural activities (livestock digestion, rice cultivation), decomposition of organic waste in landfills, and the production and transport of coal, natural gas, and oil.
- **Nitrous Oxide (N₂O):** A long-lasting GHG.
 - **Sources:** Agricultural practices (use of nitrogen fertilizers), industrial processes, combustion of fossil fuels, and treatment of wastewater.

- **Chlorofluorocarbons (CFCs):** Synthetic compounds that are very effective at trapping heat.
 - **Sources:** Previously used in refrigerants, air conditioners, aerosol sprays, and cleaning solvents. Their use has been phased out under the Montreal Protocol due to their role in ozone depletion, but they persist in the atmosphere.

While the natural greenhouse effect is essential for life, human activities have significantly increased the concentration of these gases, leading to an enhanced greenhouse effect and global warming.

Quick Tip

Imagine the atmosphere as a blanket. Greenhouse gases make the blanket thicker, trapping more heat and making the planet warmer than it would be otherwise.

Q. 23. Describe physiological effects and applications of ethylene.

Solution: Ethylene is a simple gaseous plant growth regulator with a wide range of effects on plant physiology.

Physiological Effects:

- **Fruit Ripening:** It is the most widely known effect. Ethylene initiates and promotes the ripening process in climacteric fruits (e.g., bananas, apples, tomatoes), leading to changes in color, texture, and aroma.
- **Senescence and Abscission:** It accelerates the aging (senescence) of leaves and flowers and promotes the formation of an abscission layer, leading to the shedding of leaves, flowers, and fruits.
- **Breaking Dormancy:** It can break seed and bud dormancy in certain plants.
- **Flowering:** While it generally inhibits flowering, it induces it in some plants like pineapples and mangoes.

- **Triple Response:** In seedlings growing in the dark, ethylene causes a 'triple response' to mechanical stress: inhibition of stem elongation, promotion of radial swelling of the stem, and horizontal growth (diageotropism).

Applications:

- **Artificial Ripening:** Ethylene is used commercially to ripen fruits that are harvested when green. A compound called Ethephon is often used, which releases ethylene when sprayed on plants. This allows for controlled ripening of fruits like tomatoes and bananas.
- **Inducing Flowering:** It is used to synchronize flowering and fruit set in pineapple plantations.
- **Promoting Sprouting:** Used to promote the sprouting of potato tubers.
- **Thinning Agent:** It can be used as a thinning agent to reduce the number of fruits in crops like cotton, cherry, and walnut, leading to larger remaining fruits.

Quick Tip

Remember ethylene as the "ripening and rotting" hormone. It makes fruits ready to eat but also causes leaves and flowers to age and fall off.

Q. 24. Give the name and type of I, IV and VII cranial nerves.

Solution: The cranial nerves are a set of 12 paired nerves that emerge directly from the brain. The name and type of the requested nerves are:

- **Cranial Nerve I:**
 - **Name:** Olfactory Nerve
 - **Type:** Sensory (Specifically, special visceral sensory). It is responsible for the sense of smell.
- **Cranial Nerve IV:**

- **Name:** Trochlear Nerve
 - **Type:** Motor (Somatic motor). It controls a single extrinsic eye muscle, the superior oblique, which helps in eye movement.
- **Cranial Nerve VII:**
- **Name:** Facial Nerve
 - **Type:** Mixed (both Sensory and Motor).
 - * Its motor functions include controlling the muscles of facial expression.
 - * Its sensory functions include carrying taste sensations from the anterior two-thirds of the tongue.
 - * It also has parasympathetic motor functions to stimulate salivary and lacrimal (tear) glands.

Quick Tip

A mnemonic to remember the nerve types (Sensory, Motor, or Both): "Some Say Marry Money, But My Brother Says Big Brains Matter More." The type for nerve I is the 1st word (Some=Sensory), IV is the 4th (Money=Motor), and VII is the 7th (Brother=Both).

Q. 25. Describe pyramid of energy with the help of diagram.

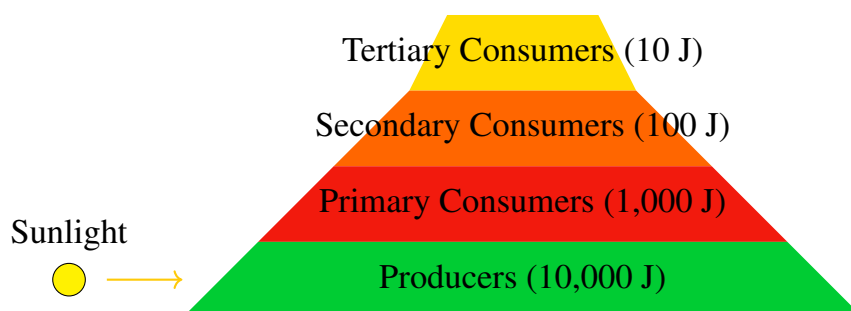
Solution: The pyramid of energy is a graphical representation of the energy flow at each successive trophic level in an ecosystem. It illustrates that the amount of energy decreases as it is transferred from lower to higher trophic levels.

Description:

- The base of the pyramid is always the producers (e.g., plants), which have the largest amount of energy captured from the sun through photosynthesis.
- The next level consists of primary consumers (herbivores) that feed on producers.
- Above them are secondary consumers (carnivores or omnivores), followed by tertiary consumers.

- The pyramid of energy is always upright and can never be inverted. This is because the transfer of energy from one trophic level to the next is highly inefficient, following the 10% Law.
- According to the 10% Law, only about 10% of the energy stored at a particular trophic level is incorporated into the biomass of the next higher trophic level. The remaining 90% is lost, mainly as heat during metabolic activities, or is unavailable (e.g., not consumed).

Diagram:



Quick Tip

The pyramid of energy can never be upside down because you can't have more energy in the consumers than in what they consume. Energy is always lost, never gained, as you move up the food chain.

Q. 26. What is lac? Enlist economic importance of Lac.

Solution: **Lac** is a natural, resinous substance secreted by a tiny scale insect, *Kerria lacca* (or *Laccifer lacca*). The insect produces this resin as a protective coating around itself on the twigs of specific host trees (like Ber, Palas, and Kusum). The twigs covered with this encrustation are known as sticklac, which is the raw material harvested.

Economic Importance of Lac: Lac is a versatile product with numerous commercial applications, primarily after being processed into shellac.

- **Varnishes and Polishes:** Shellac is used to make high-quality varnishes and polishes for furniture and musical instruments, providing a durable and glossy finish.

- **Food Industry:** Food-grade shellac is used as a glazing agent on candies, pills, apples, and coffee beans to make them shiny and increase their shelf life.
- **Electrical Industry:** Due to its excellent insulating properties, it is used as an insulator in electrical components and cables.
- **Adhesives and Cements:** It is a key ingredient in manufacturing sealing wax and special cements used for fixing lenses and mirrors in optical instruments.
- **Cosmetics Industry:** It is used in products like nail polishes, hair sprays, and mascara.
- **Printing and Inks:** It is used in making printing inks, lithographic ink, and for waterproofing.
- **Lac Dye:** Historically, a scarlet dye extracted during the washing of sticklac was a valuable product for dyeing textiles like silk and wool.

Quick Tip

Think of lac as "insect armor" that humans have found countless uses for, from making furniture shiny to glazing candies and insulating electrical wires.

SECTION – D

Attempt any THREE of the following questions :

Q. 27. Describe histological structure of Testis with well labelled diagram.

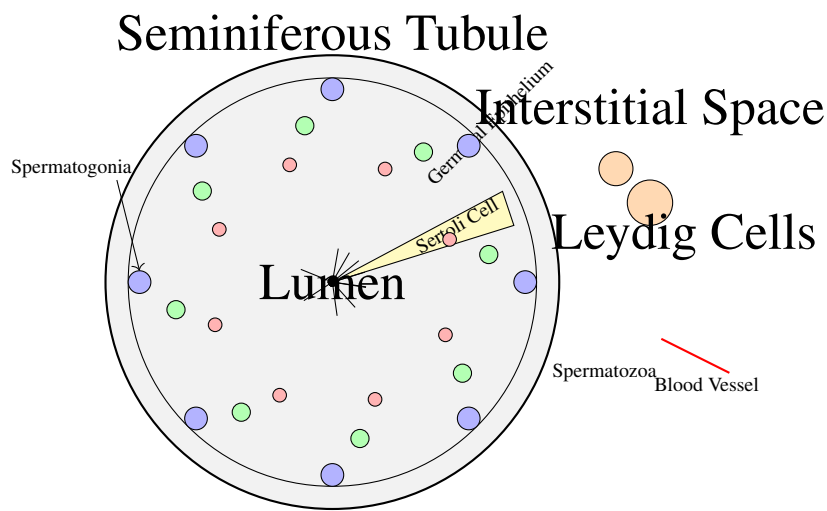
Solution: The testis is the primary male reproductive organ, responsible for producing sperm and male hormones. Its histological structure is highly organized for these functions.

Histological Structure:

- **Coverings:** The testis is enclosed by three layers. The outermost is the **Tunica vaginalis** (a peritoneal covering), followed by a dense, fibrous capsule called the **Tunica albuginea**. The innermost layer is the **Tunica vasculosa**, which is rich in blood vessels.

- **Testicular Lobules:** The Tunica albuginea extends inwards to form septa that divide the testis into about 250 conical compartments called testicular lobules.
- **Seminiferous Tubules:** Each lobule contains one to three highly coiled tubes known as seminiferous tubules. These are the functional units of the testes where spermatogenesis (sperm production) occurs.
- **Germinal Epithelium:** The wall of each seminiferous tubule is lined by a complex stratified epithelium called the germinal epithelium. This epithelium consists of two main types of cells:
 1. **Spermatogenic Cells:** These are the male germ cells at various stages of development, from the outermost **spermatogonia** to **primary spermatocytes**, **secondary spermatocytes**, **spermatids**, and finally **spermatozoa** (sperm) near the lumen.
 2. **Sertoli Cells (Sustentacular Cells):** These are large, supportive cells that extend from the basement membrane to the lumen of the tubule. They nourish and support the developing sperm cells, form the blood-testis barrier, and secrete hormones like inhibin.
- **Interstitial Space:** The space between the seminiferous tubules is called the interstitial space. It is filled with connective tissue, blood vessels, and specialized endocrine cells.
- **Leydig Cells (Interstitial Cells):** Located in the interstitial space, these cells are responsible for synthesizing and secreting male sex hormones (androgens), primarily testosterone, which is crucial for spermatogenesis and the development of male secondary sexual characteristics.

Diagram (T.S. of Testis):



Quick Tip

Think of the testis as a factory. The seminiferous tubules are the "assembly lines" where sperm are made, Sertoli cells are the "workers" providing support, and Leydig cells in the "office" (interstitial space) produce the hormone (testosterone) that runs the factory.

Q. 28. What are chromosomal disorders? Describe Turner's syndrome and Klinefelter's syndrome.

Solution: Chromosomal disorders are genetic conditions caused by an abnormality in the number or structure of an individual's chromosomes. These abnormalities, known as chromosomal aberrations, arise from errors during gamete formation (meiosis), such as the failure of chromosomes to separate properly (non-disjunction). This results in a zygote with an abnormal number of chromosomes (aneuploidy) or structurally altered chromosomes, leading to a range of physical and developmental problems.

Turner's Syndrome:

- **Cause:** It is a chromosomal disorder caused by the absence of one of the X chromosomes in females. It is a monosomy of the sex chromosome, resulting in a karyotype of **45, XO** instead of the normal 46, XX.
- **Symptoms:** Individuals with Turner's syndrome are females with the following characteristics:

- They are sterile because their ovaries are rudimentary and non-functional.
- They have a short stature.
- Physical features often include a broad, "shield-like" chest with widely spaced nipples, a webbed neck, and a low hairline at the back of the neck.
- They lack secondary sexual characteristics at puberty.
- Intelligence is generally normal, though some may have learning difficulties, particularly with spatial visualization.

Klinefelter's Syndrome:

- **Cause:** This disorder is caused by the presence of an extra X chromosome in males. It is a trisomy of the sex chromosome, resulting in a karyotype of **47, XXY** instead of the normal 46, XY.
- **Symptoms:** Individuals with Klinefelter's syndrome are males who may exhibit the following characteristics:
 - They are sterile due to underdeveloped, small testes (testicular atrophy) and no sperm production (azoospermia).
 - They are often tall with disproportionately long arms and legs.
 - They have overall masculine development but also show some feminine characteristics, most notably the development of breast tissue (**gynaecomastia**).
 - They have sparse body and facial hair.
 - Testosterone levels are low, and they may have learning disabilities or delayed speech development.

Quick Tip

Remember the key difference by the chromosome count: **Turner's (XO)** is a loss (45 total), leading to underdeveloped female traits. **Klinefelter's (XXY)** is a gain (47 total), leading to a male with extra female traits.

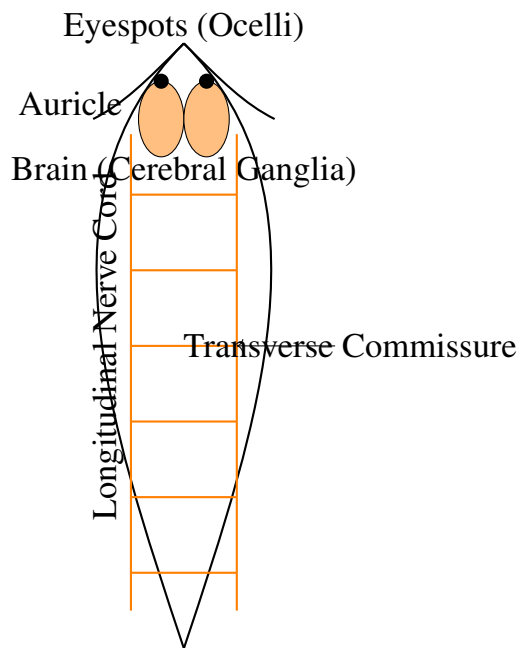
Q. 29. Describe nervous system in planaria with well labelled diagram.

Solution: The nervous system of a Planarian (a type of flatworm) is a primitive centralized nervous system that is more advanced than the diffuse nerve net found in cnidarians. It is often described as a "ladder-like" nervous system due to its structure.

Structure:

- **Brain (Cerebral Ganglia):** At the anterior (head) end of the planarian, there is a bilobed, mass of nerve cells called the cerebral ganglia. This structure functions as a simple brain, coordinating nerve signals and responses.
- **Longitudinal Nerve Cords:** Extending posteriorly from the brain are two main, parallel ventral longitudinal nerve cords that run the length of the body.
- **Transverse Commissures:** The two longitudinal nerve cords are connected to each other at regular intervals by a series of transverse nerve cords called commissures. This arrangement of longitudinal cords and transverse commissures gives the nervous system its characteristic ladder-like appearance.
- **Peripheral Nerves:** Numerous smaller peripheral nerves branch out from the longitudinal cords and the brain to innervate the muscles and sensory cells throughout the body, forming a peripheral nerve plexus.
- **Sensory Organs:** Planaria exhibit cephalization, with sensory organs concentrated at the anterior end. These include:
 - **Eyespots (Ocelli):** Two cup-shaped eyespots are located on the dorsal side of the head. They are photoreceptive and can detect light intensity and direction, but they cannot form images.
 - **Auricles:** These are chemosensory lobes on the sides of the head that help the planarian locate food.

Diagram (Nervous System of Planaria):



Quick Tip

The key phrase for the planarian nervous system is "**ladder-like**." It represents a major evolutionary step: a centralized system with a primitive brain at one end for processing information.

Q. 30. Explain following terms : (a) Grafting (b) Apomixis (c) Polyembryony (d) Parthenocarpy

Solution:

- (a) **Grafting:** It is a horticultural technique of asexual propagation where parts of two plants are joined together so they will grow as one. The upper part (the **scion**) of one plant grows on the root system (the **stock**) of another plant. This method is used to combine the desirable characteristics of both plants, such as the good fruit quality of the scion with the disease-resistant roots of the stock.
- (b) **Apomixis:** This is a type of asexual reproduction in plants that mimics sexual reproduction by producing seeds without fertilization. The embryo develops from a diploid cell in the ovule, bypassing the usual process of meiosis and fusion of gametes.

The resulting seeds are genetically identical to the parent plant. It is common in grasses and citrus fruits.

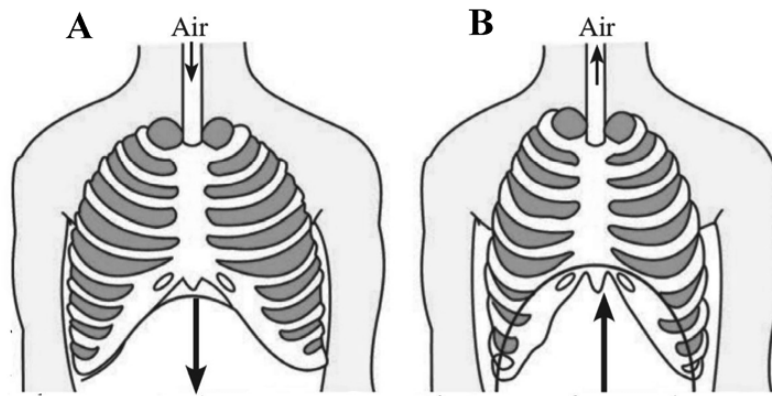
- (c) **Polyembryony:** This is the phenomenon of having more than one embryo in a seed, which then results in the emergence of multiple seedlings. It can occur when multiple embryo sacs form within an ovule, or when cells of the nucellus or integuments surrounding the embryo sac develop into additional embryos. It is commonly seen in citrus fruits and mango.
- (d) **Parthenocarpy:** This is the natural or artificial induction of fruit development without prior fertilization of ovules. Because no fertilization occurs, the resulting fruit is seedless. Examples of naturally parthenocarpic fruits include bananas and some varieties of pineapple and grapes. It can also be induced by applying growth hormones like auxins.

Quick Tip

Remember these terms by their outcome:

- **Grafting:** Two plants become one.
- **Apomixis:** Seeds without sex (clones).
- **Polyembryony:** Many embryos in one seed.
- **Parthenocarpy:** Fruit without seeds.

Q. 31. Interpret the given diagrams A and B. Enlist the changes occurring during inspiration and expiration.



Solution: Interpretation of Diagrams:

- **Diagram A represents Inspiration (Inhalation):** This is shown by the arrows indicating air moving into the lungs, the diaphragm moving down (contracting and flattening), and the rib cage moving upwards and outwards. This increases the volume of the thoracic cavity.
- **Diagram B represents Expiration (Exhalation):** This is shown by the arrows indicating air moving out of the lungs, the diaphragm moving up (relaxing and arching), and the rib cage moving downwards and inwards. This decreases the volume of the thoracic cavity.

Changes during Inspiration and Expiration:

Feature	Inspiration (Active Process)	Expiration (Passive Process)
Diaphragm	Contracts and flattens.	Relaxes and arches upwards.
External Intercostal Muscles	Contract.	Relax.
Ribs and Sternum	Move upwards and outwards.	Move downwards and inwards.
Volume of Thoracic Cavity	Increases.	Decreases.
Pressure in Lungs	Decreases (becomes negative compared to atmosphere).	Increases (becomes positive compared to atmosphere).
Movement of Air	Air rushes into the lungs.	Air is forced out of the lungs.

Quick Tip

Remember: **Inspiration** is for **I**ncreasing volume. When the chest cavity gets bigger, the pressure inside drops, and air is sucked **in**. Expiration is the opposite.
