

Maharashtra 12 Biology 2023 Question Paper with Solutions

Time Allowed :3 Hours	Maximum Marks :80	Total questions :96
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General Instructions

Important instructions:

1. Each activity has to be answered in complete sentence/s. One word answers will **not** be given complete credit. Just the correct activity number written in case of options will **not** be given credit.
2. Web diagrams, flow charts, tables etc. are to be presented exactly as they are with answers.
3. In point 2 above, just words without the presentation of the activity format/design, will **not** be given credit.
4. Use of colour pencils/pens etc. is **not** allowed. (Only blue/black pens are allowed.)
5. Multiple answers to the same activity will be treated as wrong and will **not** be given any credit.
6. Maintain the sequence of the Sections/ Question Nos./ Activities throughout the activity sheet.

1.i. Histones are rich in

- (1) Lysine and Arginine
- (2) Serine and Leucine
- (3) Leucine and Methionine
- (4) Phenylalanine and Lysine

Correct Answer: (1) Lysine and Arginine

Solution:

Step 1: Understanding histones.

Histones are proteins that play a key role in DNA packaging and gene expression. They are rich in basic amino acids like lysine and arginine, which help them bind to the negatively charged DNA.

Step 2: Analyzing the options.

- (1) Lysine and Arginine:** This is the correct answer. These amino acids are abundant in histones, aiding in DNA binding.
- (2) Serine and Leucine:** This is incorrect. These amino acids are not significantly present in histones.
- (3) Leucine and Methionine:** This is incorrect. Histones do not primarily contain leucine and methionine.
- (4) Phenylalanine and Lysine:** Incorrect. While lysine is present, phenylalanine is not abundant in histones.

Step 3: Conclusion.

The correct answer is **(1) Lysine and Arginine** as these are the amino acids most abundant in histones.

Quick Tip

Histones are rich in basic amino acids, particularly lysine and arginine, which are key for DNA binding.

ii. How many mitotic divisions take place during the formation of a female gametophyte from a functional megaspore?

- (1) One
- (2) Two
- (3) Three
- (4) Four

Correct Answer: (2) Two

Solution:

Step 1: Understanding the formation of female gametophyte.

In flowering plants, the female gametophyte (embryo sac) is formed from a single functional megaspore. This process involves two mitotic divisions: one to form the dyad (two cells) and another to form the tetrad (four cells).

Step 2: Analyzing the options.

- (1) One:** This is incorrect. One mitotic division is not sufficient to form the full gametophyte.
- (2) Two:** Correct. Two mitotic divisions are involved in the formation of the female gametophyte.
- (3) Three:** This is incorrect. The process involves only two mitotic divisions.
- (4) Four:** Incorrect. Four mitotic divisions do not occur during gametophyte formation.

Step 3: Conclusion.

The correct answer is **(2) Two** mitotic divisions are involved in the formation of a female gametophyte from a functional megaspore.

Quick Tip

Two mitotic divisions are key in the formation of a female gametophyte from a single functional megaspore in flowering plants.

iii. Which of the following is the only gaseous plant growth regulator?

- (1) ABA

- (2) Cytokinin
- (3) Ethylene
- (4) Gibberellin

Correct Answer: (3) Ethylene

Solution:

Step 1: Understanding plant growth regulators.

Plant growth regulators (PGRs) include various hormones that regulate plant growth.

Ethylene is the only gaseous plant growth regulator among the options provided.

Step 2: Analyzing the options.

- (1) **ABA:** Incorrect. Absciscic acid (ABA) is a plant hormone but is not gaseous.
- (2) **Cytokinin:** Incorrect. Cytokinins are plant hormones but are not gaseous.
- (3) **Ethylene:** Correct. Ethylene is a gaseous plant hormone that regulates processes like fruit ripening and stress responses.
- (4) **Gibberellin:** Incorrect. Gibberellins are plant hormones but are not gaseous.

Step 3: Conclusion.

The correct answer is **(3) Ethylene**, as it is the only gaseous plant growth regulator among the listed options.

Quick Tip

Ethylene is the only gaseous plant growth regulator and plays a crucial role in processes such as fruit ripening and leaf abscission.

iv. The pH of nutrient medium for plant tissue culture is in the range of

- (1) 2 to 4.2
- (2) 5 to 5.8
- (3) 7 to 7.5
- (4) 8 to 9.5

Correct Answer: (2) 5 to 5.8

Solution:

Step 1: Understanding the pH range for plant tissue culture.

For successful plant tissue culture, the nutrient medium's pH typically needs to be within a slightly acidic range to encourage cell growth and development.

Step 2: Analyzing the options.

- (1) **2 to 4.2:** Incorrect. This pH range is too acidic for most plant tissue cultures.
- (2) **5 to 5.8:** Correct. This is the optimal pH range for many plant tissue cultures.
- (3) **7 to 7.5:** Incorrect. This is more neutral but not ideal for tissue culture.
- (4) **8 to 9.5:** Incorrect. This pH range is too alkaline for most plant tissue cultures.

Step 3: Conclusion.

The correct answer is **(2) 5 to 5.8**, as this pH range is ideal for plant tissue culture.

Quick Tip

Most plant tissue cultures thrive in a slightly acidic pH range of 5 to 5.8 for optimal growth.

v. Rivet Popper Hypothesis is an analogy to explain the significance of

- (1) Biodiversity
- (2) sex-ratio
- (3) natality
- (4) age distribution ratio

Correct Answer: (1) Biodiversity

Solution:

Step 1: Understanding Rivet Popper Hypothesis.

The Rivet Popper Hypothesis compares the loss of species in an ecosystem to rivets in an airplane. Each rivet represents a species, and their loss weakens the ecosystem. It highlights the importance of biodiversity.

Step 2: Analyzing the options.

(1) **Biodiversity:** Correct. The Rivet Popper Hypothesis emphasizes the role of biodiversity in maintaining the integrity of ecosystems.

(2) **sex-ratio:** Incorrect. The hypothesis does not address the significance of sex-ratio.

(3) **natality:** Incorrect. The hypothesis does not focus on natality.

(4) **age distribution ratio:** Incorrect. The hypothesis deals with species loss and not age distribution.

Step 3: Conclusion.

The correct answer is (1) **Biodiversity**, as the Rivet Popper Hypothesis focuses on the loss of species and its impact on ecosystems.

Quick Tip

Biodiversity is critical for ecosystem stability, as described by the Rivet Popper Hypothesis.

vi. Which of the following group shows ZW-ZZ type of sex determination?

(1) Pigeon, Parrot, Sparrow

(2) Parrot, Bat, Fowl

(3) Bat, Fowl, Crow

(4) Sparrow, Fowl, Cat

Correct Answer: (3) Bat, Fowl, Crow

Solution:

Step 1: Understanding ZW-ZZ sex determination.

In ZW-ZZ type of sex determination, females have a ZW chromosome pair, while males have a ZZ pair. This system is found in some birds and reptiles.

Step 2: Analyzing the options.

(1) **Pigeon, Parrot, Sparrow:** Incorrect. This group does not follow the ZW-ZZ system.

(2) **Parrot, Bat, Fowl:** Incorrect. Although parrots and fowls follow the ZW-ZZ system, bats follow XY sex determination.

(3) Bat, Fowl, Crow: Correct. This group includes species that follow the ZW-ZZ sex determination system.

(4) Sparrow, Fowl, Cat: Incorrect. This group includes species that do not all follow the ZW-ZZ system.

Step 3: Conclusion.

The correct answer is **(3) Bat, Fowl, Crow**, as these species exhibit ZW-ZZ type of sex determination.

Quick Tip

The ZW-ZZ system is typically found in birds and some reptiles. Females have ZW chromosomes, and males have ZZ chromosomes.

vii. In Hamburger's phenomenon,.....

- (1) Cl diffuse into WBCs
- (2) Cl diffuse into RBCs
- (3) Na diffuse into RBCs
- (4) Na diffuse into WBCs

Correct Answer: (2) Cl diffuse into RBCs

Solution:

Step 1: Understanding Hamburger's phenomenon.

Hamburger's phenomenon refers to the exchange of ions between red blood cells (RBCs) and the surrounding plasma. Specifically, chloride ions (Cl) diffuse into RBCs while bicarbonate ions diffuse out to maintain ionic balance.

Step 2: Analyzing the options.

- (1) Cl diffuse into WBCs:** Incorrect. Cl diffuses into RBCs, not WBCs.
- (2) Cl diffuse into RBCs:** Correct. This is the correct description of Hamburger's phenomenon.
- (3) Na diffuse into RBCs:** Incorrect. Sodium ions (Na) do not play a major role in Hamburger's phenomenon.

(4) Na diffuse into WBCs: Incorrect. Sodium ions do not diffuse into WBCs in this context.

Step 3: Conclusion.

The correct answer is **(2) Cl diffuse into RBCs**, as this is the essence of Hamburger's phenomenon.

Quick Tip

In Hamburger's phenomenon, chloride ions (Cl) enter red blood cells to maintain ionic balance.

viii. Calcium and Phosphate ions are balanced between blood and other tissues by

.....

- (1) Thymosin and Parathormone
- (2) Calcitonin and Somatostatin
- (3) Collip's hormone and Calcitonin
- (4) Calcitonin and Thymosin

Correct Answer: (2) Calcitonin and Somatostatin

Solution:

Step 1: Understanding the role of hormones.

Calcitonin helps lower calcium levels in blood by promoting calcium deposition in bones, while somatostatin inhibits the release of growth hormone and insulin, contributing to calcium regulation.

Step 2: Analyzing the options.

- (1) Thymosin and Parathormone:** Incorrect. Thymosin is involved in immune function, while parathormone regulates calcium but not in conjunction with thymosin.
- (2) Calcitonin and Somatostatin:** Correct. These hormones are involved in regulating calcium and phosphate balance.
- (3) Collip's hormone and Calcitonin:** Incorrect. Collip's hormone is not directly involved in calcium-phosphate regulation.

(4) Calcitonin and Thymosin: Incorrect. Thymosin is not involved in calcium regulation.

Step 3: Conclusion.

The correct answer is **(2) Calcitonin and Somatostatin** for the regulation of calcium and phosphate balance.

Quick Tip

Calcitonin and somatostatin play key roles in maintaining calcium and phosphate balance in the body.

ix. Identify the INCORRECT statement.

- (1) In a flaccid cell, T.P. is zero
- (2) In a turgid cell, DPD is zero
- (3) In a fully turgid cell, $TP = OP$
- (4) Water potential of pure water is negative

Correct Answer: (4) Water potential of pure water is negative

Solution:

Step 1: Understanding water potential.

Water potential is the potential energy of water in a system. In pure water, the water potential is zero because it has no solute or pressure gradient.

Step 2: Analyzing the options.

- (1) In a flaccid cell, T.P. is zero:** Correct. Turgor pressure (T.P.) is zero in a flaccid cell.
- (2) In a turgid cell, DPD is zero:** Correct. In a turgid cell, the pressure potential (DPD) is zero.
- (3) In a fully turgid cell, $TP = OP$:** Correct. In a fully turgid cell, turgor pressure equals osmotic pressure.
- (4) Water potential of pure water is negative:** Incorrect. The water potential of pure water is zero, not negative.

Step 3: Conclusion.

The correct answer is **(4) Water potential of pure water is negative**, which is incorrect.
The water potential of pure water is zero.

Quick Tip

The water potential of pure water is zero, not negative. It's important to remember this when calculating water potential in cells.

x. Which of the following is a hormone releasing contraceptive?

- (1) Cu-T
- (2) Cu-7
- (3) Multiload-375
- (4) LNG-20

Correct Answer: (4) LNG-20

Solution:

Step 1: Understanding hormone releasing contraceptives.

LNG-20 is a type of intrauterine device (IUD) that releases hormones to prevent pregnancy. The other options are IUDs that primarily function with copper ions.

Step 2: Analyzing the options.

- (1) Cu-T:** Incorrect. Cu-T is a copper-based IUD, not a hormone-releasing one.
- (2) Cu-7:** Incorrect. Cu-7 is also a copper IUD, not a hormone-releasing one.
- (3) Multiload-375:** Incorrect. This is a copper IUD as well.
- (4) LNG-20:** Correct. LNG-20 is a hormone-releasing IUD.

Step 3: Conclusion.

The correct answer is **(4) LNG-20**, as it is a hormone-releasing contraceptive.

Quick Tip

LNG-20 is a hormone-releasing IUD that is effective in preventing pregnancy.

2.i. Which disease is caused by HPV?

Solution:

Step 1: Understanding HPV (Human Papillomavirus).

HPV is a group of more than 200 related viruses that are commonly transmitted through sexual contact. Some strains of HPV can lead to the development of certain cancers and genital warts.

Step 2: Diseases caused by HPV.

HPV is responsible for causing several diseases, including cervical cancer, genital warts, and other cancers such as throat, anal, and penile cancer.

Step 3: Conclusion.

The most common diseases caused by HPV include cervical cancer and genital warts, with certain high-risk strains leading to other forms of cancer.

Quick Tip

HPV vaccination is available and can help prevent many types of HPV-related diseases, including cervical cancer and genital warts.

ii. Which device is used to clean both dust and gases from polluted air?

Solution:

Step 1: Understanding air pollution control devices.

To clean both dust and gases from polluted air, a device called an "electrostatic precipitator" is commonly used. It uses electric fields to remove dust particles and some gases from the air.

Step 2: Conclusion.

The device used to clean both dust and gases from polluted air is an "electrostatic precipitator."

Quick Tip

Electrostatic precipitators are highly effective in removing particles and gases from industrial exhaust systems.

iii. Mention the name of sterile animal produced by intergeneric hybridisation.

Solution:

Step 1: Understanding intergeneric hybridization.

In intergeneric hybridization, two different species or genera are crossbred to produce a hybrid. One example is the mule, a sterile animal produced by crossing a horse and a donkey.

Step 2: Conclusion.

The name of a sterile animal produced by intergeneric hybridization is a "mule."

Quick Tip

Mules are sterile hybrids and cannot reproduce due to the genetic differences between horses and donkeys.

iv. Give the name of the first transgenic plant.

Solution:

Step 1: Understanding transgenic plants.

A transgenic plant is a plant that has been genetically modified to carry a gene from another species. The first transgenic plant was a tobacco plant. It was genetically modified to resist antibiotics.

Step 2: Conclusion.

The name of the first transgenic plant is "tobacco."

Quick Tip

The development of transgenic plants has revolutionized agriculture by introducing traits such as disease resistance and higher yields.

v. A child has low BMR, delayed puberty and mental retardation. Identify the disease.

Solution:

Step 1: Understanding the symptoms.

The combination of low BMR (basal metabolic rate), delayed puberty, and mental retardation is indicative of a disease related to thyroid function. One such disease is "hypothyroidism," a condition in which the thyroid gland does not produce enough thyroid hormones.

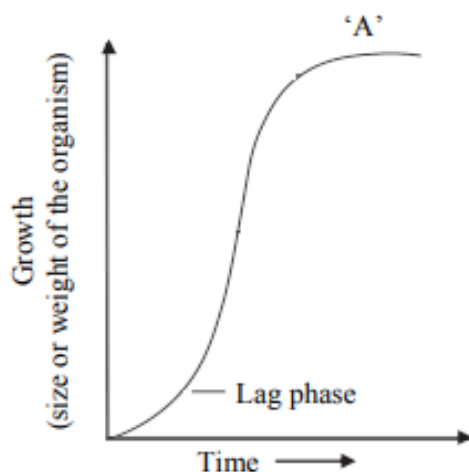
Step 2: Conclusion.

The disease associated with low BMR, delayed puberty, and mental retardation is "hypothyroidism."

Quick Tip

Hypothyroidism can be treated with thyroid hormone replacement therapy to help manage the symptoms and improve quality of life.

vi. Identify 'A' in the given graph of population growth:



Solution:**Step 1: Understanding the graph of population growth.**

The graph represents typical population growth, with different phases of growth. The 'lag phase' refers to the initial phase where the population is adjusting to the environment, and growth is slow. 'A' typically represents the exponential growth phase, where the population grows at a rapid rate.

Step 2: Conclusion.

The point 'A' in the graph represents the "exponential growth phase," where the population increases rapidly after overcoming the lag phase.

Quick Tip

In population growth graphs, the exponential phase follows the lag phase, where the population grows rapidly due to favorable conditions.

vii. Complete the following box with reference to symptoms of mineral deficiency:

Symptom	Mineral Deficiency
Pre-mature fall of flowers, fruits and leaves	Abscission
Appearance of green and non-green patches on leaves	Chlorosis

Solution:**Step 1: Understanding the symptoms.**

Abscission refers to the premature shedding of flowers, fruits, and leaves, often due to mineral deficiencies such as a lack of potassium. Chlorosis, on the other hand, is a condition where leaves turn yellow due to a lack of essential minerals, like nitrogen or magnesium.

Step 2: Conclusion.

The mineral deficiencies related to the symptoms are potassium for abscission and nitrogen or magnesium for chlorosis.

Quick Tip

Mineral deficiencies can lead to several symptoms in plants, such as abscission and chlorosis. Understanding these can help in diagnosing plant health.

viii. Give an example of a plant having both kidney and dumb-bell shaped guard cells in stomata.

Solution:

Step 1: Understanding the structure of guard cells.

Guard cells control the opening and closing of stomata, with different shapes depending on the plant species. Some plants, such as grasses, have kidney-shaped guard cells, while others, such as dicots, can have dumb-bell shaped guard cells.

Step 2: Example.

An example of a plant with both kidney and dumb-bell shaped guard cells in its stomata is "wheat," which exhibits both types of guard cells depending on environmental factors and the plant's developmental stage.

Step 3: Conclusion.

Wheat (*Triticum aestivum*) is an example of a plant that has both kidney-shaped and dumb-bell shaped guard cells.

Quick Tip

Guard cells can vary in shape between different plant species. Understanding these shapes can help identify plant types and their adaptations.

3. Define the terms:

a. Gross Primary Productivity

Solution:

Step 1: Understanding Gross Primary Productivity (GPP).

Gross Primary Productivity refers to the total amount of solar energy captured by plants through photosynthesis in a given area and time period. It represents the total energy input into the ecosystem.

Step 2: Conclusion.

Gross Primary Productivity is the total energy captured by plants before subtracting the energy used for plant respiration.

b. Net Primary Productivity

Solution:

Step 1: Understanding Net Primary Productivity (NPP).

Net Primary Productivity refers to the amount of energy or biomass produced by plants after accounting for the energy used in plant respiration. It represents the energy available for primary consumers (herbivores).

Step 2: Conclusion.

Net Primary Productivity is calculated as:

$$\text{NPP} = \text{GPP} - \text{Respiration.}$$

Quick Tip

Net Primary Productivity is a key measure of an ecosystem's ability to support life, as it represents the energy available to consumers.

4. Draw a neat diagram of the thyroid gland and label thyroid follicle, follicular cells, and blood capillaries.

Solution:

Unfortunately, I cannot draw diagrams directly in this format. However, I can describe the process for drawing the thyroid gland diagram:

Step 1: Drawing the thyroid gland.

Draw a butterfly-shaped structure, which is the thyroid gland. It consists of two lobes connected by a narrow region called the isthmus.

Step 2: Labeling the components.

- Label the outer layer as "Thyroid Follicle." - The inner region of the follicle is filled with colloid, where thyroid hormones are stored. - Label the outer cells of the follicle as "Follicular Cells." - Blood capillaries surround the follicles for hormone transport.

Quick Tip

The thyroid gland plays a vital role in regulating metabolism through the release of thyroid hormones.

5. i. Give reason - ABA is also known as an antitranspirant.**Solution:****Step 1: Understanding ABA.**

Absciscic acid (ABA) is a plant hormone that plays a significant role in stress responses. It is often called an antitranspirant because it helps to reduce water loss by closing stomata, preventing excessive transpiration under drought conditions.

Step 2: Conclusion.

ABA helps to minimize water loss in plants, making it an antitranspirant during times of water stress.

ii. Explain the role of chlorophyllase enzyme in banana.**Solution:****Step 1: Understanding the role of chlorophyllase.**

Chlorophyllase is an enzyme that plays a crucial role in the degradation of chlorophyll. In bananas, this enzyme is involved in the breakdown of chlorophyll during the ripening process. As chlorophyll is broken down, the banana changes from green to yellow, indicating ripening.

Step 2: Conclusion.

Chlorophyllase facilitates the breakdown of chlorophyll, contributing to the color change in bananas as they ripen.

Quick Tip

Chlorophyllase is crucial for the ripening process in fruits like bananas, leading to the breakdown of chlorophyll and the appearance of yellow color.

6. Complete the chart showing human proteins produced by rDNA technology to treat human diseases and re-write.

Disorders/Diseases	Recombinant Proteins
Anemia	Erythropoietin
Asthma	Monoclonal antibodies
Emphysema	Alpha-1-antitrypsin

Solution:

Step 1: Recombinant proteins used for treating diseases.

Recombinant DNA (rDNA) technology has allowed for the production of several human proteins to treat specific diseases. Some examples include:

- For anemia, erythropoietin is produced to stimulate red blood cell production.
- For asthma, monoclonal antibodies such as omalizumab are used to treat allergic asthma.
- For emphysema, alpha-1-antitrypsin is produced to prevent the breakdown of lung tissue.

Step 2: Conclusion.

Recombinant proteins play a vital role in the treatment of various human diseases by providing proteins that are lacking or malfunctioning in the body.

Quick Tip

Recombinant proteins are important for treating diseases where natural proteins are deficient or dysfunctional.

7. i. Define – Imbibition

Solution:

Step 1: Definition of Imbibition.

Imbibition is the process in which water is absorbed by solid or porous materials, such as seeds or dry wood, causing them to swell. It is a passive process and occurs due to the affinity of the substance for water.

Step 2: Conclusion.

Imbibition is the absorption of water by materials, particularly in seeds, leading to their rehydration and germination.

ii. Explain how imbibition helps root hairs in the adsorption of water.**Solution:****Step 1: Role of Imbibition in Root Hairs.**

Imbibition is essential for root hairs as they absorb water from the soil. The root hairs are in contact with water in the soil, and imbibition allows them to absorb the water efficiently. The swelling of the root hair cells facilitates the movement of water into the plant.

Step 2: Conclusion.

Imbibition helps root hairs by enabling them to absorb water from the soil, facilitating plant growth and nutrient uptake.

Quick Tip

Imbibition is critical for the initial absorption of water in seeds and root hairs, allowing for plant growth.

8. Draw a neat diagram of the conducting system of human heart and label AV node, Bundle of His, and Purkinje fibres.**Solution:**

Unfortunately, I cannot directly draw diagrams in this text format. However, you can follow these steps to draw the diagram of the human heart's conducting system:

Step 1: Drawing the human heart.

Start by drawing a simple outline of the heart with the right and left atria, and ventricles.

Step 2: Labeling the conducting system.

- Label the Sinoatrial (SA) node at the top of the right atrium.
- Label the Atrioventricular (AV) node near the junction of the atria and ventricles.
- Draw the Bundle of His coming from the AV node, and label it.
- Label the Purkinje fibres extending into the walls of the ventricles.

Step 3: Conclusion.

The conducting system of the heart allows electrical signals to coordinate the heartbeat.

Quick Tip

The conduction system ensures that the heart beats in a synchronized manner, maintaining efficient blood circulation.

9. Distinguish between heterochromatin and euchromatin with reference to staining property and activity.**Solution:****Step 1: Understanding Heterochromatin and Euchromatin.**

Heterochromatin and euchromatin are two types of chromatin found in the nucleus.

- **Heterochromatin:** - It is densely packed and stains darker. - It is transcriptionally inactive and contains genes that are not being actively transcribed.
- **Euchromatin:** - It is loosely packed and stains lighter. - It is transcriptionally active and contains genes that are being transcribed.

Step 2: Conclusion.

Heterochromatin is dense and inactive, while euchromatin is less dense and active in gene expression.

Quick Tip

Euchromatin is associated with active gene expression, while heterochromatin is associated with inactive genes.

10. Complete the following chart regarding energy flow in an Ecosystem and re-write:

?	Herbivores
Primary Producer	Grass
?	Man, Lion
Secondary Consumer	Tiger

Solution:

Step 1: Understanding the chart for energy flow.

In an ecosystem, energy flows from primary producers (plants) to herbivores (primary consumers) and then to secondary consumers (carnivores). The missing terms are:

- Primary Producers: Plants, such as grass, which produce energy through photosynthesis.
- Secondary Consumers: Carnivores like tigers, which consume herbivores such as deer.

Step 2: Conclusion.

The chart is completed as follows: - Primary Producers: Grass - Herbivores: Deer - Secondary Consumers: Tiger

Quick Tip

Energy flows in an ecosystem starting from producers (plants) to herbivores, and then to carnivores or secondary consumers.

11. i. What is biofortification?

Solution:

Step 1: Understanding Biofortification.

Biofortification refers to the process of increasing the nutritional content of food crops through conventional breeding or genetic modification. This is done to improve the nutrient value of crops, especially in regions where deficiencies are common.

Step 2: Conclusion.

Biofortification improves the nutrient profile of plants, such as increasing the content of vitamins and minerals.

ii. Mention one example each of fortification with reference to –

a. Amino acid content

Solution:

Step 1: Example for Amino Acid Content.

An example of fortification to increase amino acid content is the fortification of maize with lysine and tryptophan.

Step 2: Conclusion.

Fortification of maize with lysine improves the nutritional content by enhancing the amino acid profile.

b. Vitamin-C content

Solution:

Step 1: Example for Vitamin-C Content.

An example of fortification for Vitamin-C content is the enhancement of potatoes with increased Vitamin-C levels.

Step 2: Conclusion.

Biofortification of potatoes increases Vitamin-C content, helping to combat deficiencies in certain populations.

Quick Tip

Biofortification helps improve the nutritional quality of crops, making them more beneficial for populations with specific deficiencies.

12. Differentiate between X-chromosome and Y-chromosome with reference to –

i. Length of non-homologous regions

Solution:

Step 1: Understanding X and Y chromosomes.

X and Y chromosomes are sex chromosomes that determine the biological sex of an individual.

- The X chromosome is larger and has more non-homologous regions.
- The Y chromosome is smaller and has relatively fewer non-homologous regions compared to the X chromosome.

Step 2: Conclusion.

The X chromosome has a greater length of non-homologous regions compared to the Y chromosome.

ii. Type as per position of centromere.

Solution:

Step 1: Position of Centromere.

The centromere is the region where the two chromatids are held together.

- The X chromosome has a centromere located closer to the middle, making it a metacentric chromosome.
- The Y chromosome has a centromere located towards one end, making it a submetacentric chromosome.

Step 2: Conclusion.

The X chromosome is metacentric, while the Y chromosome is submetacentric.

Quick Tip

The position of the centromere helps in classifying chromosomes and determining their behavior during cell division.

13. Define the terms:

i. Genetic drift

Solution:

Step 1: Understanding Genetic Drift.

Genetic drift refers to the random changes in allele frequencies in a population due to chance events. It is more prominent in smaller populations.

Step 2: Conclusion.

Genetic drift can lead to the loss or fixation of alleles in a population without the influence of natural selection.

ii. Homologous organs

Solution:

Step 1: Understanding Homologous Organs.

Homologous organs are those that have a similar structure but may perform different functions. They arise from a common evolutionary origin. Examples include the forelimbs of humans, bats, and whales.

Step 2: Conclusion.

Homologous organs provide evidence for common ancestry and divergent evolution.

Quick Tip

Genetic drift and homologous organs are fundamental concepts in evolution, showing how random events and evolutionary history shape organisms.

14. i. What is ex-situ conservation?

Solution:

Step 1: Understanding Ex-Situ Conservation.

Ex-situ conservation refers to the conservation of species outside their natural habitats, such as in zoos, botanical gardens, or seed banks.

Step 2: Conclusion.

Ex-situ conservation helps protect species at risk of extinction by providing controlled environments for their survival.

ii. Mention any two places where ex-situ conservation is undertaken.

Solution:

Step 1: Examples of Ex-Situ Conservation.

Two examples of places where ex-situ conservation is undertaken are:

- Zoological Parks (Zoos)
- Botanical Gardens

Step 2: Conclusion.

These institutions play a key role in conserving endangered species through controlled breeding programs and habitat recreation.

Quick Tip

Ex-situ conservation helps ensure the survival of species that are endangered in the wild by providing them with a safe environment for breeding and research.

15. i. Define – Incomplete Dominance.

Solution:

Step 1: Understanding Incomplete Dominance.

Incomplete dominance occurs when the heterozygous genotype produces an intermediate phenotype that is a blend of the two homozygous phenotypes. In this case, neither allele is completely dominant over the other.

Step 2: Example.

For example, in the case of flower color in *Mirabilis jalapa*, where red (R) is incompletely dominant over white (W), the F1 generation from a cross between red and white flowers would have pink flowers (RW).

Step 3: Conclusion.

Incomplete dominance results in a blending of traits in the heterozygous individuals, rather than one allele completely masking the effect of the other.

ii. If a red-flowered *Mirabilis jalapa* plant is crossed with a white-flowered plant, what will be the phenotypic ratio in F2 generation? Show it by a chart.

Solution:

Step 1: Understanding the genetic basis.

In the case of incomplete dominance, the red-flowered plant (RR) is crossed with a white-flowered plant (WW). The F1 generation will all be heterozygous (RW), resulting in

pink flowers. In the F₂ generation, the offspring will inherit alleles from both parents. The cross for F₂ will be:

$$\text{F1 Cross: } RW \times RW$$

Step 2: Punnett square for F₂ generation.

	<i>R</i>	<i>W</i>
<i>R</i>	<i>RR</i>	<i>RW</i>
<i>W</i>	<i>RW</i>	<i>WW</i>

Step 3: Phenotypic Ratio.

- Red flowers (RR): 1
- Pink flowers (RW): 2
- White flowers (WW): 1

Step 4: Conclusion.

The phenotypic ratio in the F₂ generation is 1 red: 2 pink: 1 white.

Quick Tip

In incomplete dominance, the heterozygous offspring exhibit an intermediate phenotype, which results in a 1:2:1 phenotypic ratio in the F₂ generation.

16. i. Differentiate between sympathetic and parasympathetic nervous system with reference to the following:

a. Pre and post ganglionic nerve fibres.

Solution:

Step 1: Understanding the Nervous Systems.

The sympathetic and parasympathetic nervous systems are part of the autonomic nervous system, which controls involuntary functions. Both systems have pre- and post-ganglionic fibres that transmit signals from the central nervous system to various organs.

- Sympathetic Nervous System: The pre-ganglionic fibres are short, and the post-ganglionic fibres are long. The ganglia are located near the spinal cord.

- Parasympathetic Nervous System: The pre-ganglionic fibres are long, and the post-ganglionic fibres are short. The ganglia are located near or within the target organs.

Step 2: Conclusion.

The main difference lies in the length of the pre- and post-ganglionic fibres and the location of the ganglia. The sympathetic system has short pre-ganglionic and long post-ganglionic fibres, whereas the parasympathetic system has long pre-ganglionic and short post-ganglionic fibres.

b. Effect on heart beat.

Solution:

Step 1: Effect on Heartbeat.

The sympathetic and parasympathetic nervous systems have opposite effects on the heart.

- Sympathetic Nervous System: It increases the heart rate by releasing norepinephrine, which stimulates the heart.

- Parasympathetic Nervous System: It decreases the heart rate by releasing acetylcholine, which slows down the heart.

Step 2: Conclusion.

The sympathetic nervous system increases heart rate, while the parasympathetic nervous system decreases heart rate.

Quick Tip

The sympathetic system prepares the body for 'fight or flight' by increasing heart rate, whereas the parasympathetic system promotes 'rest and digest' by decreasing heart rate.

ii. Give reason – All spinal nerves are of mixed type.

Solution:

Step 1: Understanding the Spinal Nerves.

Spinal nerves are mixed nerves because they contain both sensory (afferent) and motor (efferent) fibres. These nerves emerge from the spinal cord and are responsible for transmitting sensory information to the brain and motor commands to muscles.

Step 2: Conclusion.

All spinal nerves are of mixed type as they carry both sensory and motor information, which is essential for the functioning of the nervous system.

Quick Tip

Spinal nerves are called mixed because they contain both sensory and motor fibres, enabling them to serve both afferent and efferent functions.

17. i. Draw a suitable diagram of replication of eukaryotic DNA and label any three parts.

Solution:

Unfortunately, I cannot directly draw diagrams in this text format. However, you can follow these steps to draw the diagram of eukaryotic DNA replication:

Step 1: Drawing the Replication Fork.

Draw the double helix of the DNA strand. At the replication fork, you will have the two separated strands with helicase unwinding the DNA.

Step 2: Labeling Parts.

- Label the leading strand (the strand that is synthesized continuously).
- Label the lagging strand (the strand synthesized discontinuously in Okazaki fragments).
- Label the DNA polymerase enzyme responsible for adding nucleotides.

Step 3: Conclusion.

The replication process involves the synthesis of new DNA strands, with key enzymes such as helicase and DNA polymerase playing crucial roles.

ii. How many amino acids will be there in the polypeptide chain formed on the following mRNA?

5' GCCACAUGGGAGGACAAAAAUUUCUAGAAA3'

Solution:

Step 1: Understanding the mRNA sequence.

Each set of three nucleotides (codon) in the mRNA corresponds to an amino acid. The start codon (AUG) indicates the beginning of translation.

Step 2: Counting Codons.

The given mRNA sequence is: 5' GCCACAUGGGAGGACAAAAAUUUCUAGAAA3'

The translation begins at the first "AUG" codon. Counting the codons after the "AUG" start codon:

AUG (Start) – GAG – GAC – AAA – AAU – UCU – UAG(Stop)

There are 6 amino acids in the polypeptide chain.

Step 3: Conclusion.

The polypeptide chain formed will consist of 6 amino acids.

Quick Tip

The number of amino acids in a polypeptide chain is determined by counting the codons in the mRNA, excluding the start and stop codons.

18. Describe the steps in breathing.

Solution:

Breathing, also known as respiration, is the process of taking in oxygen and expelling carbon dioxide. The steps in breathing can be broken down as follows:

Step 1: Inhalation (Inspiration)

- The diaphragm contracts and moves downwards.
- The intercostal muscles contract, causing the ribcage to expand.
- This creates a decrease in pressure within the lungs, causing air to flow in through the nose or mouth and fill the lungs.

Step 2: Gas Exchange

- Oxygen from the inhaled air moves from the alveoli (tiny air sacs in the lungs) into the blood.
- Carbon dioxide from the blood moves into the alveoli to be expelled during exhalation.

Step 3: Exhalation (Expiration)

- The diaphragm relaxes and moves upwards.
- The intercostal muscles relax, causing the ribcage to move downwards and inward.
- This increases the pressure inside the lungs, forcing air (containing carbon dioxide) out of the body.

Step 4: Conclusion

Breathing is a continuous cycle of inhalation and exhalation, which is essential for providing oxygen to the body and removing carbon dioxide.

Quick Tip

Breathing is a rhythmic process that allows oxygen to enter the body and carbon dioxide to be expelled, facilitating cellular respiration.

19. i. What is spermatogenesis?

Solution:

Step 1: Definition of Spermatogenesis.

Spermatogenesis is the process of sperm cell development in the testes. It begins with the division of spermatogonia (germ cells) and results in the formation of mature sperm cells (spermatozoa). This process involves several stages: mitosis, meiosis, and spermiogenesis.

Step 2: Conclusion.

Spermatogenesis produces haploid sperm cells that are essential for sexual reproduction in males.

ii. Draw a neat and labelled diagram of spermatogenesis.

Solution:

Unfortunately, I cannot directly draw diagrams in this text format. However, you can follow these steps to draw the diagram of spermatogenesis:

Step 1: Diagram Components.

- Start by drawing the seminiferous tubules in the testes.

- Label the spermatogonia at the outermost layer. These undergo mitosis to form primary spermatocytes.
- Show primary spermatocytes undergoing meiosis to form secondary spermatocytes and later spermatids.
- Spermatids undergo spermiogenesis, transforming into mature sperm cells (spermatozoa).
- Label the parts of a sperm: head (with nucleus), midpiece (with mitochondria), and tail (flagellum).

Step 2: Conclusion.

The diagram should show the stages from spermatogonia to spermatozoa, illustrating the entire process of spermatogenesis.

Quick Tip

Spermatogenesis is a highly regulated process that ensures the production of sperm with the correct number of chromosomes for fertilization.

20. i. What is a connecting link?

Solution:

Step 1: Definition of Connecting Link.

A connecting link refers to an organism or fossil that shows characteristics of two different groups, indicating an evolutionary transition. These organisms exhibit features from both ancestral and descendant groups.

Step 2: Conclusion.

Connecting links help trace the evolutionary process by showing the intermediate stages between different groups.

ii. Which fossil animal is considered as the connecting link between reptiles and birds?

Give any one character of each class found in it.

Solution:

Step 1: The Connecting Link Between Reptiles and Birds.

The fossil animal considered as the connecting link between reptiles and birds is Archaeopteryx. Archaeopteryx had both reptilian and avian features, making it an important transitional fossil.

Step 2: Features of Archaeopteryx.

- Reptilian feature: It had teeth, which is characteristic of reptiles.
- Avian feature: It had feathers, similar to modern birds, used for flight.

Step 3: Conclusion.

Archaeopteryx is considered the connecting link between reptiles and birds due to its mixture of features from both groups.

Quick Tip

Archaeopteryx provides evidence of the evolutionary transition between reptiles and birds, showing a combination of traits from both groups.

21. Complete the following chart regarding population interaction and re-write:

Sr. No. Interaction Between	Name of Interaction
1 Parasitism	Plasmodium and Man
2 Competition	Leopard and Lion
3 Mutualism	Clown fish and Sea-anemone

Solution:

Step 1: Identifying the type of interaction.

The chart shows different types of interactions between species:

- Plasmodium and Man: This is an example of parasitism, where Plasmodium (the malaria parasite) benefits at the expense of the human host.

- Leopard and Lion: This is a case of competition, as both species may compete for the same resources (prey) in the same habitat.
- Clown fish and Sea-anemone: This is mutualism, where both the clown fish and sea-anemone benefit. The clown fish gets protection, while the sea-anemone gets cleaned by the fish.

Step 2: Conclusion.

The interactions are classified as parasitism, competition, and mutualism based on the relationship between the organisms.

Quick Tip

In ecology, understanding the types of interactions between species helps explain how organisms coexist and compete for resources in an ecosystem.

22. i. What is composition of bio-gas?

Solution:

Step 1: Understanding Bio-Gas Composition.

Bio-gas is a renewable energy source produced through the anaerobic digestion of organic matter. The main components of bio-gas are:

- Methane (CH₄): 50-70% – The primary component that provides energy.
- Carbon Dioxide (CO₂): 30-40% – The second largest component, which is non-combustible.
- Nitrogen (N₂): 0-5% – A minor component.
- Hydrogen Sulfide (H₂S): Small amounts – Often present in trace amounts and can be corrosive.
- Water Vapor (H₂O): Trace amounts – Present as vapor in the gas.

Step 2: Conclusion.

The primary components of bio-gas are methane and carbon dioxide, with smaller amounts of nitrogen, hydrogen sulfide, and water vapor.

ii. Mention any four benefits of bio-gas.

Solution:

Step 1: Benefits of Bio-Gas.

- Renewable energy source: Bio-gas is a renewable source of energy that can be used for cooking, lighting, and generating electricity.
- Reduces greenhouse gas emissions: By utilizing organic waste, bio-gas production helps in reducing harmful greenhouse gases such as methane from landfills.
- Fertilizer by-product: The digestate (leftover residue) from bio-gas production is a nutrient-rich fertilizer.
- Waste management: Bio-gas production helps manage organic waste by converting it into energy, reducing waste accumulation.

Step 2: Conclusion.

Bio-gas offers numerous benefits, including being a renewable energy source, reducing greenhouse gases, providing organic fertilizer, and managing waste.

Quick Tip

Bio-gas is a sustainable solution for both energy production and waste management, making it environmentally friendly.

23. i. Give reason – Water acts as thermal buffer.**Solution:****Step 1: Understanding Water's Role as a Thermal Buffer.**

Water has a high specific heat capacity, meaning it can absorb or release a large amount of heat with a small change in temperature. This property allows water to regulate temperature and act as a thermal buffer, stabilizing temperature in both living organisms and the environment.

Step 2: Conclusion.

Water's high specific heat capacity helps in maintaining temperature stability, making it an effective thermal buffer.

ii. Draw a neat and proportionate diagram of root hair and label mitochondria, nucleus, and vacuole.

Solution:

Unfortunately, I cannot directly draw diagrams in this text format. However, you can follow these steps to draw the diagram of a root hair:

Step 1: Diagram Components.

- Draw an elongated structure to represent the root hair.
- Label the cell wall surrounding the root hair.
- Draw a central large vacuole and label it.
- Draw a small oval-shaped structure to represent the nucleus and label it.
- Label the mitochondria, which are scattered in the cytoplasm, responsible for energy production.

Step 2: Conclusion.

The diagram should clearly show the root hair structure with labels for the mitochondria, nucleus, and vacuole.

Quick Tip

Root hairs are specialized for water absorption, and their structure is optimized for this function with organelles like mitochondria for energy production.

24. Explain three main functions of free antibodies produced by B-lymphocytes.**Solution:****Step 1: Understanding Antibodies and B-lymphocytes.**

B-lymphocytes are a type of white blood cell that produce antibodies as part of the immune response. These antibodies play a crucial role in identifying and neutralizing foreign pathogens such as bacteria, viruses, and toxins.

Step 2: Functions of Free Antibodies.

- Neutralization of pathogens: Antibodies bind to the surface of pathogens, preventing them from entering or damaging host cells.
- Opsonization: Antibodies tag pathogens, marking them for destruction by phagocytes, such as macrophages.

- Activation of complement system: Antibodies activate the complement system, leading to the destruction of pathogens by lysis or phagocytosis.

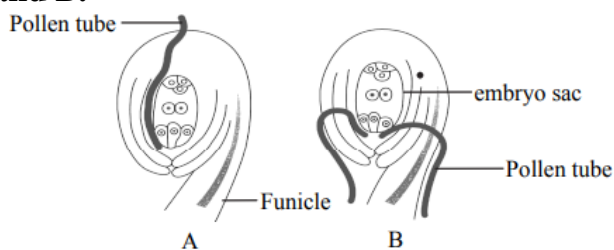
Step 3: Conclusion.

Free antibodies produced by B-lymphocytes perform essential functions in protecting the body from infections by neutralizing pathogens, marking them for destruction, and activating the immune response.

Quick Tip

Antibodies are vital for the adaptive immune response, and they help protect the body by targeting and neutralizing harmful pathogens.

25. i. Following are the diagrams of entry of pollen tube into ovule. Identify the type A and B.



Solution:

Step 1: Understanding the diagrams.

The diagrams represent the process of pollen tube entry into the ovule, which is an essential part of fertilization in flowering plants.

- Diagram A: This represents the Monosporic type of embryo sac where the pollen tube enters the ovule through the micropyle and directly reaches the embryo sac for fertilization.
- Diagram B: This represents the Bisporic type of embryo sac where the pollen tube enters through the micropyle and interacts with the two synergid cells before reaching the egg cell for fertilization.

Step 2: Conclusion.

- A represents the monosporic embryo sac. - B represents the bisporic embryo sac.

ii. Give any four points of significance of double fertilization.

Solution:**Step 1: Understanding Double Fertilization.**

Double fertilization is a unique process in angiosperms where two fertilization events occur within the ovule. The two sperm cells from the pollen tube fuse with different cells in the embryo sac.

Step 2: Significance of Double Fertilization.

1. Formation of Zygote and Endosperm: One sperm cell fertilizes the egg cell to form the zygote, while the other sperm cell fuses with the central cell to form the endosperm, which nourishes the developing embryo.
2. Efficient Use of Resources: Double fertilization ensures that the endosperm is only formed when fertilization occurs, saving energy and resources.
3. Prevention of Unnecessary Development: It prevents the unnecessary development of endosperm in the absence of fertilization, ensuring better resource allocation.
4. Formation of Seeds: Double fertilization leads to the formation of seeds that are capable of germination, ensuring plant propagation.

Step 3: Conclusion.

Double fertilization is crucial for the development of seeds, ensuring both the formation of the embryo and the nourishing endosperm.

Quick Tip

Double fertilization is a hallmark of angiosperms, ensuring the efficient use of resources and proper seed development.

26. i. Name the hormone which is responsible for apical dominance.**Solution:****Step 1: Understanding Apical Dominance.**

Apical dominance is the phenomenon where the growth of lateral buds is inhibited by the presence of the apical bud. This is controlled by a plant hormone called Auxin.

Step 2: Conclusion.

Auxin is the hormone responsible for apical dominance, and it prevents the growth of lateral buds, ensuring the plant grows taller.

ii. A farmer wants to remove broad-leaved weeds from the jowar plantation in his field. Suggest any plant hormone to remove such weeds.

Solution:

Step 1: Understanding the Role of Plant Hormones in Weed Control.

To remove broad-leaved weeds, the farmer can use 2,4-D (a synthetic auxin). It is selective in its action, promoting uncontrolled growth in dicot weeds, which leads to their death.

Step 2: Conclusion.

2,4-D is an effective herbicide that targets broad-leaved weeds without harming monocot crops like jowar.

iii. Mention any two applications of cytokinin.

Solution:

Step 1: Understanding Cytokinins.

Cytokinins are plant hormones that promote cell division and growth. They have several applications in agriculture and plant tissue culture.

Step 2: Applications of Cytokinins.

1. Promotion of Shoot Growth: Cytokinins are used in tissue culture to promote the growth of shoots and buds from plant explants.
2. Delay of Senescence: Cytokinins can delay leaf senescence, extending the shelf life of cut flowers and fruits by preventing premature aging.

Step 3: Conclusion.

Cytokinins are widely used in plant growth and agricultural practices, particularly in tissue culture and extending the shelf life of plants.

Quick Tip

Cytokinins play a crucial role in regulating plant growth and development, particularly in shoot growth and delaying aging in plants.

27. i. What is blood pressure?

Solution:

Step 1: Understanding Blood Pressure.

Blood pressure refers to the force exerted by circulating blood on the walls of blood vessels, particularly the arteries. It is essential for the proper circulation of blood throughout the body and the delivery of oxygen and nutrients to tissues.

Step 2: Measurement.

Blood pressure is typically measured in millimeters of mercury (mmHg) and is recorded as two values: systolic pressure (when the heart beats) and diastolic pressure (when the heart rests between beats).

Step 3: Conclusion.

Blood pressure is the force of blood against vessel walls, vital for blood circulation and organ function.

ii. Give the name of the instrument which is used to measure the blood pressure.

Solution:

Step 1: Understanding the Instrument.

The instrument used to measure blood pressure is called a Sphygmomanometer. It consists of an inflatable cuff, a pressure gauge, and a stethoscope.

Step 2: Conclusion.

The sphygmomanometer is the standard tool used to measure both systolic and diastolic blood pressure.

iii. Differentiate between an artery and a vein with reference to lumen and thickness of the wall.

Solution:

Step 1: Arteries vs. Veins.

- Arteries: - Have a narrow lumen. - The walls are thicker and contain more smooth muscle and elastic tissue to withstand high pressure from the heart's pumping action. - Arteries carry oxygenated blood (except for the pulmonary artery).

- Veins: - Have a wider lumen. - The walls are thinner with less muscle and elastic tissue because the blood pressure is lower. - Veins carry deoxygenated blood (except for the pulmonary vein).

Step 2: Conclusion.

Arteries have thicker walls and a smaller lumen to handle high-pressure blood flow, while veins have thinner walls and a larger lumen as they carry blood at lower pressure.

Quick Tip

Arteries carry blood away from the heart under high pressure, while veins carry blood back to the heart under low pressure.

28. i. Describe any three adaptations in anemophilous flowers.

Solution:

Step 1: Understanding Anemophilous Flowers.

Anemophilous flowers are those that are pollinated by the wind. They have several adaptations to enhance wind pollination.

Step 2: Adaptations in Anemophilous Flowers.

1. Light, non-fragrant flowers: These flowers are typically small, pale, and lack fragrance, which helps reduce the attraction of insects and allows wind to carry the pollen.
2. Exposed anthers and large stigmas: The anthers are often long and hang outside the flower to release pollen into the air. The stigma is large, feathery, and sticky to capture the pollen carried by the wind.
3. Abundant, lightweight pollen: The pollen grains are small, light, and produced in large quantities to increase the chances of successful pollination.

Step 3: Conclusion.

Anemophilous flowers are well adapted to wind pollination by having light flowers, exposed reproductive organs, and abundant pollen.

ii. Mention any one example of the anemophilous flower.

Solution:

Step 1: Example of Anemophilous Flower.

An example of an anemophilous flower is corn (*Zea mays*).

Step 2: Conclusion.

Corn is an anemophilous plant that uses wind for pollination.

iii. Describe any three adaptations in hydrophilous flowers.**Solution:****Step 1: Understanding Hydrophilous Flowers.**

Hydrophilous flowers are pollinated by water, usually found in aquatic plants. These flowers have adaptations that allow them to float or interact with water for pollination.

Step 2: Adaptations in Hydrophilous Flowers.

1. Floating flowers or long stalks: Many hydrophilous flowers are adapted to float on the surface of water or have long stalks to keep the flower above the water.
2. Sticky, large, and buoyant pollen: The pollen grains are large, sticky, and often buoyant, which allows them to float on water and adhere to the stigma of another flower.
3. Open flowers: The flowers are often large and open, allowing easy access to water for pollination.

Step 3: Conclusion.

Hydrophilous flowers are specially adapted to the water environment with floating structures, sticky pollen, and open flowers for easy pollination.

iv. Mention any one example of the hydrophilous flower.**Solution:****Step 1: Example of Hydrophilous Flower.**

An example of a hydrophilous flower is water lily (*Nymphaea*).

Step 2: Conclusion.

The water lily is a hydrophilous plant that uses water for pollination.

Quick Tip

Hydrophilous flowers are adapted to pollination by water, with structures that facilitate the movement of pollen in aquatic environments.

29. i. What is polymerase chain reaction (PCR)?**Solution:****Step 1: Understanding PCR.**

Polymerase Chain Reaction (PCR) is a molecular biology technique used to amplify a specific segment of DNA. It allows the production of millions of copies of a particular DNA sequence from a small initial sample. PCR is widely used in various applications such as cloning, gene analysis, and diagnostic testing.

Step 2: Conclusion.

PCR enables the rapid and specific amplification of DNA, making it a powerful tool for genetic analysis and research.

ii. Describe three steps involved in the mechanism of PCR.**Solution:****Step 1: The Three Key Steps of PCR.**

The PCR process involves three main steps that are repeated for several cycles:

1. Denaturation: The DNA sample is heated to around 94-98°C to separate the two strands of the DNA template. This results in single-stranded DNA.
2. Annealing: The reaction temperature is lowered to around 50-65°C, allowing short primers to bind to the complementary sequences on the single-stranded DNA.
3. Extension (Elongation): The temperature is raised to 72°C, and a heat-stable DNA polymerase (such as Taq polymerase) synthesizes the new DNA strand by adding nucleotides to the primer.

Step 2: Conclusion.

These three steps – denaturation, annealing, and extension – are repeated in multiple cycles to exponentially amplify the target DNA.

Quick Tip

PCR is an essential technique for amplifying DNA sequences and is widely used in diagnostics, genetic testing, and forensic science.

30. i. Give any four significances of fertilization in human.

Solution:

Step 1: Understanding Fertilization.

Fertilization is the process in which the male sperm fuses with the female ovum to form a zygote. This is a crucial step in human reproduction.

Step 2: Significances of Fertilization.

1. Restoration of Chromosome Number: Fertilization restores the diploid number of chromosomes by combining the haploid sets from the sperm and egg.
2. Genetic Variation: Fertilization introduces genetic diversity by combining genetic material from both parents.
3. Development of Zygote: The fertilized egg (zygote) starts to divide and differentiate, leading to the development of a new individual.
4. Sex Determination: The fertilization of an egg by a sperm carrying either an X or Y chromosome determines the sex of the offspring.

Step 3: Conclusion.

Fertilization is essential for genetic diversity, development, and the restoration of the chromosome number in humans.

ii. Mention the names of any two organs each derived from ectoderm and mesoderm.

Solution:

Step 1: Understanding Germ Layers.

The ectoderm, mesoderm, and endoderm are the three primary germ layers formed during embryonic development. Different organs are derived from each of these layers.

Step 2: Organs Derived from Ectoderm and Mesoderm.

- Ectoderm-derived organs: 1. Skin 2. Nervous system (brain and spinal cord)
- Mesoderm-derived organs: 1. Muscles 2. Kidneys

Step 3: Conclusion.

The ectoderm gives rise to the skin and nervous system, while the mesoderm forms the muscles and kidneys.

Quick Tip

The three germ layers – ectoderm, mesoderm, and endoderm – give rise to all the organs and tissues in the body during development.

31. i. Give any two functions of cerebellum.

Solution:

Step 1: Understanding the Function of the Cerebellum.

The cerebellum is a part of the brain that is responsible for coordinating voluntary movements and maintaining balance.

Step 2: Functions of the Cerebellum.

1. Coordination of Voluntary Movements: The cerebellum helps to coordinate and fine-tune voluntary movements, ensuring smooth and accurate actions.
2. Balance and Posture Control: It plays a crucial role in maintaining balance and posture by regulating muscle tone and coordinating movements.

Step 3: Conclusion.

The cerebellum is essential for motor control, including movement coordination and balance.

ii. Write the names of any four motor cranial nerves with their appropriate serial number.

Solution:

Step 1: Understanding Motor Cranial Nerves.

Motor cranial nerves are responsible for carrying motor information from the brain to the muscles. Here are four motor cranial nerves with their serial numbers:

1. Oculomotor nerve (III) – Controls eye movements and pupil constriction.
2. Trochlear nerve (IV) – Controls eye movement (superior oblique muscle).
3. Abducens nerve (VI) – Controls lateral movement of the eye.
4. Accessory nerve (XI) – Controls the movement of neck and shoulder muscles.

Step 2: Conclusion.

These cranial nerves are essential for motor control in the head and neck region.

iii. Which hormones stimulate liver for glycogenesis and gluconeogenesis?

Solution:

Step 1: Understanding Glycogenesis and Gluconeogenesis.

Glycogenesis is the process of converting glucose into glycogen for storage, while gluconeogenesis is the process of producing glucose from non-carbohydrate precursors.

Step 2: Hormones Involved.

1. Insulin: Stimulates glycogenesis (storage of glucose as glycogen) and inhibits gluconeogenesis.
2. Glucagon: Stimulates gluconeogenesis (production of glucose) and promotes the breakdown of glycogen (glycogenolysis).

Step 3: Conclusion.

Insulin promotes glycogenesis, while glucagon stimulates gluconeogenesis in the liver.

Quick Tip

The balance between insulin and glucagon is essential for maintaining blood glucose levels in the body.