Bihar Board 12 Biology Set F 2024 Question Paper with Solutions

Time Allowed :3 Hours 15 mins	**Maximum Marks :**70	**Total questions :**96

General Instructions

Instructions to the candidates:

1. **Candidate must enter his/her Question Booklet Serial No. (10 Digits) in the OMR Answer Sheet.**
2. Candidates are required to give their answers in their own words as far as practicable.
3. Figures in the right-hand margin indicate full marks.
4. An extra time of 15 minutes has been allotted for the candidates to read the questions carefully.
5. This question booklet is divided into two sections — **Section-A** and **Section-B**.

1. What is the use of alpha-1-antitrypsin?

(A) In treatment of emphysema

(B) In treatment of asthma

(C) As insecticidal protein

(D) In treatment of diabetes

Correct Answer: (A) In treatment of emphysema

Solution:

Step 1: Understanding alpha-1-antitrypsin.

Alpha-1-antitrypsin is a glycoprotein that protects tissues from enzymes of inflammatory cells, especially elastase. A deficiency of this protein causes damage to lung tissues, leading to emphysema.

Step 2: Analyzing the options.

(A) In treatment of emphysema: Correct — Patients with alpha-1-antitrypsin deficiency are treated with this protein to prevent lung damage.

(B) In treatment of asthma: Incorrect — Asthma is unrelated to this protein therapy.

(C) As insecticidal protein: Incorrect — Insecticidal proteins are derived from Bacillus thuringiensis, not alpha-1-antitrypsin.

(D) In treatment of diabetes: Incorrect — Diabetes treatment does not involve this protein.

Step 3: Conclusion.

Thus, alpha-1-antitrypsin is used in the treatment of **emphysema**.

Quick Tip

Alpha-1-antitrypsin deficiency can cause lung damage; supplementing it helps in emphysema management.

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2. Which of the following methods is used for the amplification of nucleic acid?

(A) Transformation

(B) Transfection

(C) PCR

(D) Micropropagation

Correct Answer: (C) PCR

Solution:

Step 1: Understanding amplification of nucleic acid.

Amplification means producing multiple copies of a specific DNA sequence. The most widely used method for this is Polymerase Chain Reaction (PCR).

Step 2: Analyzing the options.

(A) Transformation: Incorrect — It introduces foreign DNA into a host, not amplification.

(B) Transfection: Incorrect — This refers to introducing nucleic acids into eukaryotic cells, not amplification.

(C) PCR: Correct — PCR is the standard technique for amplifying DNA in vitro, producing millions of copies.

(D) Micropropagation: Incorrect — It is a plant tissue culture technique, unrelated to nucleic acid amplification.

Step 3: Conclusion.

The correct method for amplification of nucleic acid is **PCR**.

Quick Tip

PCR (Polymerase Chain Reaction) is the most efficient technique for amplifying DNA sequences.

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3. At what pH insecticidal protein synthesized by Bacillus thuringiensis becomes active?

(A) Acidic pH

(B) Alkaline pH

(C) Neutral pH

(D) First acidic then alkaline pH

Correct Answer: (B) Alkaline pH

Solution:

Step 1: Understanding Bt toxin.

Bacillus thuringiensis (Bt) produces insecticidal proteins known as Cry proteins. These proteins act as biopesticides against insect pests.

Step 2: Mechanism of action.

When ingested by insect larvae, the Cry protein crystals dissolve in the insect midgut, which has an **alkaline pH**. The protein is then activated and binds to the gut epithelial cells, causing lysis and ultimately the death of the insect.

Step 3: Analyzing options.

(A) Acidic pH: Incorrect — The crystals do not activate in acidic conditions.

(B) Alkaline pH: Correct — Activation of Cry proteins occurs in the alkaline medium of insect midgut.

(C) Neutral pH: Incorrect — The activation requires alkalinity.

(D) First acidic then alkaline pH: Incorrect — Only alkaline pH is essential.

Step 4: Conclusion.

Bt insecticidal protein becomes active at an **alkaline pH**.

Quick Tip

Bt toxin is widely used in genetically modified crops like Bt cotton to resist insect pests.

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4. RNA interference is utilized to prevent nematode infestation in tobacco plants. By which vector are nematode specific genes introduced?

(A) Bacteriophage

(B) Retrovirus

(C) Escherichia coli

(D) Agrobacterium

Correct Answer: (D) Agrobacterium

Solution:

Step 1: Understanding RNA interference (RNAi).

RNA interference is a biological process where RNA molecules inhibit gene expression by neutralizing targeted mRNA molecules. It is used in biotechnology to silence specific genes.

Step 2: Application in plants.

To protect tobacco plants from nematode infestation, double-stranded RNA specific to nematode genes is introduced. This triggers RNAi in the nematode, silencing essential genes and preventing infestation.

Step 3: Role of vector.

The dsRNA is introduced into plants through **Agrobacterium tumefaciens**, which is commonly used as a vector for plant genetic engineering.

Step 4: Analyzing options.

(A) Bacteriophage: Incorrect — Works in bacteria, not in plants.

(B) Retrovirus: Incorrect — Used in animals, not in plants.

(C) Escherichia coli: Incorrect — A bacterial host, not a vector for plant transformation.

(D) Agrobacterium: Correct — This vector is widely used to transfer foreign genes into plant genomes.

Step 5: Conclusion.

The nematode-specific genes are introduced via **Agrobacterium**.

Quick Tip

Agrobacterium tumefaciens is the most widely used vector in plant biotechnology for genetic transformation.

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5. How many varieties of Basmati rice are grown in India?

(A) 20

(B) 15

(C) 27

(D) 5

Correct Answer: (C) 27

Solution:

Step 1: Understanding Basmati rice.

Basmati rice is a special variety of long-grain aromatic rice traditionally grown in India. It is well-known for its fragrance, flavor, and cooking quality.

Step 2: Fact about varieties.

In India, **27 varieties of Basmati rice** have been officially notified and approved for cultivation. This includes both traditional and improved varieties developed through breeding.

Step 3: Conclusion.

Thus, the correct answer is **27 varieties**.

Quick Tip

Basmati rice is exported globally, and India is the largest producer and exporter of Basmati varieties.

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6. Which of the following organizations makes decision regarding the validity of GM research and the safety of introducing GM organisms?

(A) Department of Science and Technology

(B) Department of Biotechnology

(C) GEAC

(D) Indian Patent Office

Correct Answer: (C) GEAC

Solution:

Step 1: Understanding GM research regulation.

Genetically Modified (GM) crops and organisms require strict regulation to ensure their safety for humans, animals, and the environment.

Step 2: Role of GEAC.

The **Genetic Engineering Appraisal Committee (GEAC)** under the Ministry of

Environment, Forest and Climate Change is the apex body that approves large-scale use, release, and commercial introduction of GM organisms in India.

Step 3: Analyzing options.

(A) Department of Science and Technology: Incorrect — This promotes science research but does not regulate GM organisms.

(B) Department of Biotechnology: Incorrect — It promotes biotech research but approval lies with GEAC.

(C) GEAC: Correct — Responsible for decisions about GM research validity and safety.

(D) Indian Patent Office: Incorrect — It deals with intellectual property rights, not biosafety.

Step 4: Conclusion.

Hence, the correct answer is **GEAC**.

Quick Tip

GEAC ensures biosafety while approving GM organisms before they are released for field use or commercialization.

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7. Name of Ramdeo Mishra is associated with which field of research?

(A) Ecology

(B) Biotechnology

(C) Green revolution

(D) Genetics

Correct Answer: (A) Ecology

Solution:

Step 1: About Ramdeo Mishra.

Ramdeo Mishra is regarded as the **father of Indian Ecology**. He made pioneering contributions in the field of plant ecology and ecosystem dynamics.

Step 2: His contributions.

He worked extensively on grassland and forest ecosystems, energy flow in ecosystems, and ecological succession. His research established ecology as a recognized discipline in India.

Step 3: Analyzing options.

(A) Ecology: Correct — Mishra is most prominently associated with ecology.

(B) Biotechnology: Incorrect — He did not work in biotechnology.

(C) Green revolution: Incorrect — That is linked to M.S. Swaminathan.

(D) Genetics: Incorrect — Genetics research was not his specialization.

Step 4: Conclusion.

Thus, the name of Ramdeo Mishra is associated with **Ecology**.

Quick Tip

Remember: M.S. Swaminathan → Green Revolution, Ramdeo Mishra → Ecology.

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8. HIV attacks on which of the following cells?

(A) B-cells

(B) T-cells

(C) Epithelial cell

(D) T-helper cell

Correct Answer: (D) T-helper cell

Solution:

Step 1: Understanding HIV.

HIV (Human Immunodeficiency Virus) is a retrovirus that primarily attacks the immune system. It targets cells that play a crucial role in immunity.

Step 2: Target cells.

HIV specifically infects **CD4+ T-helper cells**. By destroying these cells, HIV weakens the immune response, leading to AIDS.

Step 3: Analyzing options.

(A) B-cells: Incorrect — B-cells produce antibodies but are not the main HIV target.

(B) T-cells: Incomplete — Refers to all T-cells, but HIV specifically targets T-helper (CD4+) cells.

(C) Epithelial cell: Incorrect — These are not the site of HIV attack.

(D) T-helper cell: Correct — HIV targets and destroys CD4+ T-helper cells.

Step 4: Conclusion.

Thus, HIV attacks **T-helper cells**.

Quick Tip

HIV weakens the immune system by reducing CD4+ T-helper cells, making patients vulnerable to infections.

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9. Going down of inorganic water soluble nutrients into the soil nutrients is called as

(A) Fragmentation

(B) Leaching

(C) Catabolism

(D) Humification

Correct Answer: (B) Leaching

Solution:

Step 1: Understanding the process.

Leaching is the process by which water percolates through the soil and carries soluble inorganic nutrients downward, away from the root zone.

Step 2: Analyzing the options.

(A) Fragmentation: Incorrect — It is the breakdown of detritus into smaller pieces by detritivores.

(B) Leaching: Correct — The downward movement of soluble nutrients is called leaching.

(C) Catabolism: Incorrect — It is the breakdown of organic molecules inside cells.

(D) Humification: Incorrect — It refers to the formation of humus from decomposed organic matter.

Step 3: Conclusion.

The correct term for downward movement of soluble nutrients is **Leaching**.

Quick Tip

Leaching reduces soil fertility as it washes away essential minerals and nutrients.

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10. According to Robert May, how much is the global species diversity?

(A) 7 million

(B) 1–5 million

(C) 20–25 million

(D) 2 million

Correct Answer: (A) 7 million

Solution:

Step 1: Understanding global diversity estimates.

Robert May, an ecologist, estimated that the global species diversity on Earth is around **7 million species**. This includes both known and unknown species.

Step 2: Analyzing options.

(A) 7 million: Correct — Matches Robert May's estimate.

(B) 1–5 million: Incorrect — This is lower than the actual estimate.

(C) 20–25 million: Incorrect — This is a higher estimate not supported by Robert May.

(D) 2 million: Incorrect — Much lower than accepted diversity estimates.

Step 3: Conclusion.

Therefore, according to Robert May, global species diversity is approximately **7 million**.

Quick Tip

Robert May's estimate of 7 million species is widely cited in biodiversity studies.

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11. Biodiversity of India is what percentage of the total global species diversity?

(A) 2–4%

(B) 8–1%

(C) 5%

(D) 9%

Correct Answer: (A) 2–4%

Solution:

Step 1: Understanding biodiversity distribution.

India is one of the 17 megadiverse countries in the world. Although it occupies only 2.4% of the world's land area, it harbors a rich biodiversity.

Step 2: Percentage contribution.

India contributes about **2–4% of the world's total species diversity**. This highlights India's ecological richness.

Step 3: Conclusion.

Therefore, the biodiversity of India is approximately **2–4% of global diversity**.

Quick Tip

India is part of the "megadiverse nations," rich in both flora and fauna.

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12. What was the reason for extinction of more than 200 species of Cichlid fish in Lake Victoria?

(A) Co-extinction

(B) Alien species invasion

(C) Overexploitation

(D) Habitat loss

Correct Answer: (B) Alien species invasion

Solution:

Step 1: Background.

Lake Victoria, one of the largest lakes in Africa, was once home to hundreds of endemic Cichlid fish species.

Step 2: Cause of extinction.

The introduction of the alien species **Nile Perch** in Lake Victoria led to the extinction of more than 200 species of Cichlids. The Nile Perch acted as a predator and outcompeted the native fish.

Step 3: Analyzing options.

(A) Co-extinction: Incorrect — No evidence of linked species extinction here.

(B) Alien species invasion: Correct — Nile Perch invasion was the main cause.

(C) Overexploitation: Incorrect — Though fishing occurs, it wasn't the major cause.

(D) Habitat loss: Incorrect — The environment remained largely intact.

Step 4: Conclusion.

Hence, the extinction of Cichlid fishes was due to **alien species invasion**.

Quick Tip

Alien species introduction is one of the major threats to biodiversity worldwide.

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13. Which of the following is not the reason for global warming?

(A) Use of fossil fuels

(B) Deforestation

(C) Population explosion

(D) Improvement in the efficiency of energy use

Correct Answer: (D) Improvement in the efficiency of energy use

Solution:

Step 1: Causes of global warming.

Global warming is caused mainly by human-induced activities such as burning fossil fuels, deforestation, and rapid population growth.

Step 2: Analysis of options.

(A) Use of fossil fuels: Correct cause — Releases CO_2.

(B) Deforestation: Correct cause — Reduces carbon sinks.

(C) Population explosion: Correct cause — Increases resource use and emissions.

(D) Improvement in the efficiency of energy use: Not a cause — In fact, this helps reduce global warming.

Step 3: Conclusion.

Thus, the option **Improvement in efficiency of energy use** is not a cause of global warming.

Quick Tip

Global warming is mainly linked to human activities that increase greenhouse gases in the atmosphere.

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14. Which of the following statements is incorrect about organic farming?

(A) It is cyclic

(B) Zero waste is generated

(C) Maximum utilization of resources

(D) Use of chemical fertilizers

Correct Answer: (D) Use of chemical fertilizers

Solution:

Step 1: Understanding organic farming.

Organic farming is an agricultural method that avoids the use of synthetic chemicals and instead relies on natural processes for soil fertility and pest management.

Step 2: Analyzing the statements.

(A) It is cyclic: Correct — Organic farming follows natural nutrient cycles.

(B) Zero waste is generated: Correct — Waste is recycled back into the system.

(C) Maximum utilization of resources: Correct — Resources are efficiently used in organic farming.

(D) Use of chemical fertilizers: Incorrect — Organic farming strictly avoids chemical fertilizers.

Step 3: Conclusion.

Hence, the incorrect statement is **Use of chemical fertilizers**.

Quick Tip

Organic farming is based on eco-friendly practices and avoids chemicals entirely.

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15. Which of the following statements is incorrect about temperature?

(A) Temperature is the most important environmental factor

(B) Temperature decreases from the equator towards the pole

(C) Temperature increases with increase in height

(D) Temperature is low at the summit of a mountain

Correct Answer: (C) Temperature increases with increase in height

Solution:

Step 1: General effect of temperature.

Temperature plays a major role in determining the distribution of organisms and ecosystems.

Step 2: Analyzing statements.

(A) Correct — Temperature is indeed one of the most important environmental factors influencing organisms.

(B) Correct — Temperature decreases as we move from the equator to the poles.

(C) Incorrect — Actually, temperature **decreases** with increase in altitude/height, not increases.

(D) Correct — At the summit of a mountain, the temperature is low due to high altitude.

Step 3: Conclusion.

Thus, the incorrect statement is **Temperature increases with increase in height**.

Quick Tip

Remember: With altitude, temperature decreases at an average lapse rate of 6.5°C per km.

16. At which level is natural selection operated to evolve the desired traits?

(A) Individual level

(B) Population level

(C) Community level

(D) Ecosystem level

Correct Answer: (B) Population level

Solution:

Step 1: Concept of natural selection.

Natural selection acts on variations within populations and results in differential survival and reproduction.

Step 2: Analyzing options.

(A) Individual level: Incorrect — Selection acts on individuals, but evolution is seen at the population level.

(B) Population level: Correct — Evolution occurs through changes in allele frequencies across generations in a population.

(C) Community level: Incorrect — Communities involve multiple species, not the unit of evolution.

(D) Ecosystem level: Incorrect — Too broad; natural selection doesn't directly act at this level.

Step 3: Conclusion.

Natural selection operates at the **population level** to evolve traits.

Quick Tip

Evolution = change in allele frequency across populations, not individuals.

17. When percentage of individuals of pre-reproductive, reproductive and post-reproductive phase is in decreasing order in the age pyramid of human population, it shows that population is

(A) Expanding

(B) Decreasing

(C) Stable

(D) Unstable

Correct Answer: (A) Expanding

Solution:

Step 1: Understanding age pyramids.

An age pyramid represents the distribution of individuals in different age groups of a population.

Step 2: Case of decreasing order.

When the proportion is highest in the pre-reproductive phase, followed by reproductive, and lowest in post-reproductive, it indicates more young individuals, ensuring future population growth.

Step 3: Analyzing options.

(A) Expanding: Correct — More young individuals mean the population is expanding.

(B) Decreasing: Incorrect — Would show fewer young and more old.

(C) Stable: Incorrect — All three groups would be nearly equal in proportion.

(D) Unstable: Incorrect — Not the correct ecological term in this context.

Step 4: Conclusion.

Hence, the population pyramid in decreasing order of age groups indicates an **expanding population**.

Quick Tip

Expanding populations have broad-based pyramids due to a higher percentage of young individuals.

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18. Which of the following reproduces once in a lifetime?

(A) Pacific salmon fish and bamboo

(B) Mammals

(C) Birds and mammals

(D) Litchi and mango

Correct Answer: (A) Pacific salmon fish and bamboo

Solution:

Step 1: Understanding reproductive strategies.

Organisms may reproduce once (semelparous) or multiple times (iteroparous) in their lifetime.

Step 2: Examples.

- Pacific salmon fish reproduce only once, after which they die.

- Bamboo flowers once in its lifetime after long intervals and then dies.

Step 3: Analyzing options.

(A) Pacific salmon fish and bamboo: Correct — Both are semelparous.

(B) Mammals: Incorrect — They reproduce many times (iteroparous).

(C) Birds and mammals: Incorrect — Also reproduce multiple times.

(D) Litchi and mango: Incorrect — These reproduce seasonally every year.

Step 4: Conclusion.

Thus, Pacific salmon fish and bamboo reproduce once in a lifetime.

Quick Tip

Semelparous organisms reproduce once and then die; iteroparous reproduce multiple times.

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19. What was the reason for co-existence of five closely related species of warblers?

(A) Competitive exclusion

(B) Resource partitioning

(C) Parasitism

(D) Commensalism

Correct Answer: (B) Resource partitioning

Solution:

Step 1: Concept of species co-existence.

Closely related species often compete for similar resources. However, they can coexist if they use resources differently.

Step 2: Case of warblers.

MacArthur studied warblers in spruce trees and found that five species coexisted because they utilized different parts of the same tree, thus minimizing competition.

Step 3: Conclusion.

This phenomenon is called **resource partitioning**, allowing species to coexist.

Quick Tip

Resource partitioning reduces competition and allows species with similar needs to co-exist.

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20. Which of the following plants produces poisonous cardiac glycoside?

(A) Cactus

(B) Calotropis

(C) Coffee plant

(D) Tobacco

Correct Answer: (B) Calotropis

Solution:

Step 1: Understanding cardiac glycosides.

Cardiac glycosides are toxic compounds that affect the heart by altering cardiac muscle contractions.

Step 2: Source plants.

Calotropis (milkweed) produces poisonous cardiac glycosides, which are harmful if ingested.

Step 3: Analyzing options.

(A) Cactus: Incorrect — No cardiac glycosides.

(B) Calotropis: Correct — Produces toxic glycosides.

(C) Coffee plant: Incorrect — Contains caffeine, not glycosides.

(D) Tobacco: Incorrect — Contains nicotine, not glycosides.

Step 4: Conclusion.

Thus, Calotropis is the plant producing cardiac glycosides.

Quick Tip

Calotropis is poisonous due to cardiac glycosides in its latex.

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21. Which of the following are decomposers?

(A) Fungi and algae

(B) Fungi and virus

(C) Fungi and bacteria

(D) Fungi, bacteria and virus

Correct Answer: (C) Fungi and bacteria

Solution:

Step 1: Definition.

Decomposers are organisms that break down dead organic matter into simpler substances, recycling nutrients back to the ecosystem.

Step 2: Identifying decomposers.

Fungi and bacteria are the primary decomposers in ecosystems, converting organic matter into inorganic nutrients.

Step 3: Analyzing options.

(A) Fungi and algae: Incorrect — Algae are autotrophs, not decomposers.

(B) Fungi and virus: Incorrect — Viruses are obligate parasites, not decomposers.

(C) Fungi and bacteria: Correct — Major decomposers.

(D) Fungi, bacteria and virus: Incorrect — Virus is not a decomposer.

Step 4: Conclusion.

Hence, **Fungi and bacteria** are decomposers.

Quick Tip

Decomposers recycle nutrients, making them available for producers in ecosystems.

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22. Which of the following is not a cloning vector for bacteria?

(A) Bacteriophage

(B) Plasmid

(C) pBR322

(D) T-DNA

Correct Answer: (D) T-DNA

Solution:

Step 1: Understanding cloning vectors.

Cloning vectors are DNA molecules used to carry foreign DNA into host cells for replication and expression.

Step 2: Examples.

- Plasmids and bacteriophages are common bacterial cloning vectors.

- pBR322 is a widely used plasmid vector in bacteria.

- T-DNA, however, is a part of Agrobacterium's Ti plasmid, used for gene transfer in plants, not bacteria.

Step 3: Conclusion.

Thus, **T-DNA is not a cloning vector for bacteria**.

Quick Tip

Remember: T-DNA is used for plant transformation via Agrobacterium, not bacterial cloning.

23. Which of the following methods is used to inject recombinant DNA into nucleus of animal cell directly?

(A) Transfection

(B) Transformation

(C) Gene gun

(D) Microinjection

Correct Answer: (D) Microinjection

Solution:

Step 1: Methods of DNA introduction.

Different methods are used to introduce recombinant DNA into host cells — transformation, transfection, gene gun, and microinjection.

Step 2: Direct introduction into nucleus.

Microinjection involves directly injecting recombinant DNA into the nucleus of an animal cell using fine needles under a microscope.

Step 3: Conclusion.

Therefore, the correct method is **Microinjection**.

Quick Tip

Microinjection is widely used in animal biotechnology for creating transgenic animals.

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24. For isolation of DNA a fungus is treated with which enzyme?

(A) Lysozyme

(B) Cellulase

(C) DNase

(D) Chitinase

Correct Answer: (D) Chitinase

Solution:

Step 1: Cell wall composition.

Fungal cell walls are mainly composed of **chitin**. To break open fungal cells for DNA isolation, the enzyme chitinase is used.

Step 2: Analyzing options.

(A) Lysozyme: Correct for bacteria (acts on peptidoglycan).

(B) Cellulase: Correct for plant cells (acts on cellulose).

(C) DNase: Incorrect — It degrades DNA, not used for extraction.

(D) Chitinase: Correct — Breaks down fungal cell walls.

Step 3: Conclusion.

Thus, **Chitinase** is used for DNA isolation from fungi.

Quick Tip

Always match enzyme with cell wall component: Lysozyme → bacteria, Cellulase → plants, Chitinase → fungi.

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25. Which of the following is absent in pBR322?

(A) Origin of replication

(B) Restriction site

(C) T-DNA

(D) Antibiotic resistant genes

Correct Answer: (C) T-DNA

Solution:

Step 1: Features of pBR322.

pBR322 is a commonly used cloning vector in bacteria. It contains:

- Origin of replication (ori).

- Restriction sites for cloning.

- Antibiotic resistance genes (ampicillin, tetracycline).

Step 2: Absent component.

T-DNA is specific to Agrobacterium Ti plasmid, used for plant transformation, not bacterial cloning vectors like pBR322.

Step 3: Conclusion.

Hence, **T-DNA is absent in pBR322**.

Quick Tip

Remember: pBR322 → Bacterial cloning vector; Ti plasmid (T-DNA) → Plant transformation.

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26. If a foreign DNA is inserted in tetracycline resistant gene, the recombinant plasmid

(A) Will lose ampicillin resistance

(B) Will lose tetracycline resistance

(C) Cloning would become easier

(D) Ampicillin resistance will become stronger

Correct Answer: (B) Will lose tetracycline resistance

Solution:

Step 1: Double antibiotic resistance marker in pBR322.

pBR322 has resistance genes for both ampicillin and tetracycline. If a foreign gene is inserted into one of these, that resistance is lost.

Step 2: Insertion in tetracycline resistance gene.

If foreign DNA is inserted into the tetracycline resistance gene, the bacteria carrying recombinant plasmid will not be resistant to tetracycline.

Step 3: Conclusion.

Thus, insertion leads to loss of **tetracycline resistance**.

Quick Tip

Recombinant selection uses insertional inactivation of resistance genes.

27. From which of the following bacteria, thermostable DNA polymerase is isolated?

(A) Agrobacterium

(B) Thermus aquaticus

(C) Methanobacterium

(D) Archaebacteria

Correct Answer: (B) Thermus aquaticus

Solution:

Step 1: Importance of thermostable polymerase.

PCR requires DNA polymerase that can withstand high temperatures of denaturation cycles.

Step 2: Source organism.

Taq polymerase, the thermostable DNA polymerase used in PCR, is isolated from **Thermus aquaticus**, a thermophilic bacterium living in hot springs.

Step 3: Conclusion.

Thus, thermostable DNA polymerase is obtained from **Thermus aquaticus**.

Quick Tip

PCR revolutionized molecular biology using Taq polymerase from Thermus aquaticus.

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28. Which of the following bacteria synthesizes insecticidal protein?

(A) Agrobacterium

(B) Bacillus thuringiensis

(C) Escherichia coli

(D) Archaebacteria

Correct Answer: (B) Bacillus thuringiensis

Solution:

Step 1: Understanding Bt bacteria.

Bacillus thuringiensis (Bt) is a soil bacterium that produces insecticidal crystal proteins (Cry proteins) toxic to insect larvae.

Step 2: Application.

These proteins are used in genetically modified crops (Bt cotton, Bt corn) to provide resistance against pests.

Step 3: Analyzing options.

(A) Agrobacterium: Incorrect — Used as a gene transfer vector in plants.

(B) Bacillus thuringiensis: Correct — Synthesizes insecticidal Cry proteins.

(C) Escherichia coli: Incorrect — Model organism, not insecticidal.

(D) Archaebacteria: Incorrect — Extremophiles, not related to insecticidal protein.

Step 4: Conclusion.

Thus, insecticidal protein is produced by **Bacillus thuringiensis**.

Quick Tip

Bt crops reduce pesticide use by producing their own insecticidal proteins.

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29. Which of the following statements is incorrect about DNA replication?

(A) DNA replication is semi-conservative

(B) Main enzyme for DNA replication is DNA polymerase

(C) Mutation appears due to error in replication

(D) Replication on both strands of DNA is continuous

Correct Answer: (D) Replication on both strands of DNA is continuous

Solution:

Step 1: Nature of DNA replication.

DNA replication is semi-conservative — each new DNA has one old and one new strand. DNA polymerase is the key enzyme.

Step 2: Leading and lagging strands.

Replication is continuous on the leading strand but discontinuous on the lagging strand (Okazaki fragments).

Step 3: Analyzing options.

(A) Correct — DNA replication is semi-conservative.

(B) Correct — DNA polymerase is the main enzyme.

(C) Correct — Errors during replication can cause mutations.

(D) Incorrect — Only leading strand is continuous; lagging is discontinuous.

Step 4: Conclusion.

Thus, the incorrect statement is **Replication on both strands of DNA is continuous**.

Quick Tip

Remember: Leading strand → continuous, Lagging strand → Okazaki fragments (discontinuous).

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30. Which of the following enzymes is responsible for transcription of ribosomal RNA?

(A) RNA polymerase

(B) RNA polymerase I

(C) RNA polymerase II

(D) RNA polymerase III

Correct Answer: (B) RNA polymerase I

Solution:

Step 1: Functions of RNA polymerases in eukaryotes.

- RNA polymerase I: Transcribes rRNA (except 5S rRNA).

- RNA polymerase II: Transcribes mRNA, snRNA, some miRNAs.

- RNA polymerase III: Transcribes tRNA and 5S rRNA.

Step 2: Analyzing options.

(A) RNA polymerase: General term, not specific.

(B) RNA polymerase I: Correct — Transcribes most ribosomal RNA.

(C) RNA polymerase II: Incorrect — Responsible for mRNA synthesis.

(D) RNA polymerase III: Incorrect — Transcribes tRNA and 5S rRNA.

Step 3: Conclusion.

Hence, **RNA polymerase I** is responsible for transcription of rRNA.

Quick Tip

Remember: RNA polymerase I $\rightarrow$ rRNA, RNA polymerase II $\rightarrow$ mRNA, RNA polymerase III $\rightarrow$ tRNA.

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31. Some amino acids are coded by more than one codon. Such code is known as

(A) unambiguous

(B) degenerate/redundant

(C) universal

(D) specific

Correct Answer: (B) degenerate/redundant

Solution:

Step 1: Nature of genetic code.

The genetic code has redundancy — multiple codons can code for the same amino acid. This is called degeneracy of the genetic code.

Step 2: Example.

Leucine is coded by six different codons.

Step 3: Analyzing options.

(A) Unambiguous: Incorrect — Each codon specifies only one amino acid.

(B) Degenerate/redundant: Correct — More than one codon codes for same amino acid.

(C) Universal: Incorrect — The code is nearly universal across organisms.

(D) Specific: Incorrect — Misleading, as redundancy is the point here.

Step 4: Conclusion.

Hence, such a code is called **degenerate/redundant**.

Quick Tip

Remember: One amino acid can be coded by multiple codons → degeneracy.

---

32. What is the role of y gene in lac operon?

(A) Codes for -galactosidase

(B) Codes for permease

(C) Codes for repressor gene

(D) Codes for transacetylase

Correct Answer: (B) Codes for permease

Solution:

Step 1: Genes in lac operon.

The lac operon in E. coli has three structural genes:

- lac Z → -galactosidase

- lac Y → Permease

- lac A → Transacetylase

Step 2: Function of lac Y.

The lac Y gene codes for **permease**, which facilitates lactose entry into the bacterial cell.

Step 3: Conclusion.

Thus, the y gene in lac operon codes for **permease**.

Quick Tip

lac Z → -galactosidase, lac Y → Permease, lac A → Transacetylase.

---

33. Paleontological evidence is based on the study of

(A) embryological development

(B) comparative anatomy

(C) fossils

(D) divergent evolution

Correct Answer: (C) fossils

Solution:

Step 1: Understanding paleontology.

Paleontology is the study of ancient life forms preserved as fossils. Fossils provide direct evidence of evolution.

Step 2: Analyzing options.

(A) Embryological development: Incorrect — Supports evolution but not paleontological.

(B) Comparative anatomy: Incorrect — Deals with homology/analogy in structures.

(C) Fossils: Correct — Fossils form the basis of paleontology.

(D) Divergent evolution: Incorrect — A concept, not direct evidence.

Step 3: Conclusion.

Hence, paleontological evidence is based on **fossils**.

Quick Tip

Fossils provide direct historical records of evolution.

---

34. What do analogous structures show?

(A) Divergent evolution

(B) Convergent evolution

(C) Parallel evolution

(D) Saltation

Correct Answer: (B) Convergent evolution

Solution:

Step 1: Understanding analogous structures.

Analogous structures are organs with similar functions but different origins.

Step 2: Example.

Wings of insects and wings of birds both serve for flying but evolved independently.

Step 3: Analyzing options.

(A) Divergent evolution: Incorrect — Produces homologous structures.

(B) Convergent evolution: Correct — Analogous structures are due to convergence.

(C) Parallel evolution: Incorrect — Evolution of related species along similar paths.

(D) Saltation: Incorrect — Sudden mutations, not relevant.

Step 4: Conclusion.

Thus, analogous structures show **convergent evolution**.

Quick Tip

Homologous → Divergent evolution; Analogous → Convergent evolution.

---

35. When did prehistoric cave art develop?

(A) 18,000 years ago

(B) 10,000 years ago

(C) 75,000 years ago

(D) 40,000 years ago

Correct Answer: (D) 40,000 years ago

Solution:

Step 1: Historical evidence.

Archaeological studies suggest that prehistoric humans created cave paintings about **40,000 years ago**.

Step 2: Significance.

These paintings reflected human creativity, rituals, and interaction with nature.

Step 3: Analyzing options.

(A) 18,000 years ago: Incorrect — Too recent.

(B) 10,000 years ago: Incorrect — Marks Neolithic transition, not early art.

(C) 75,000 years ago: Incorrect — Older than known art discoveries.

(D) 40,000 years ago: Correct — True timeline of cave art.

Step 4: Conclusion.

Thus, prehistoric cave art developed about **40,000 years ago**.

Quick Tip

Cave art is a sign of symbolic thought and cultural evolution in early humans.

---

36. Amount of which vitamin increases after conversion of milk into curd?

(A) Vitamin B_{12}

(B) Vitamin A

(C) Vitamin C

(D) Vitamin B_6

Correct Answer: (A) Vitamin B_{12}

Solution:

Step 1: Conversion of milk into curd.

When milk is converted into curd by lactic acid bacteria (Lactobacillus), there is an increase in certain vitamins.

Step 2: Vitamin synthesis.

The process enhances the amount of **Vitamin B_{12}** due to microbial activity.

Step 3: Conclusion.

Thus, the vitamin content that increases is **Vitamin B_{12}**.

Quick Tip

Fermentation by microbes often increases vitamin levels, especially B-group vitamins.

---

37. Alexander Fleming discovered penicillin while working on which of the following bacteria?

(A) Streptococcus

(B) Acetobacter

(C) Staphylococcus

(D) Lactobacillus

Correct Answer: (C) Staphylococcus

Solution:

Step 1: Discovery of penicillin.

Alexander Fleming observed that the fungus *Penicillium notatum* released a substance that inhibited the growth of bacteria.

Step 2: Bacterial target.

The bacterium used in Fleming's experiments was **Staphylococcus**.

Step 3: Conclusion.

Thus, penicillin was discovered while working on **Staphylococcus**.

Quick Tip

Penicillin was the first antibiotic discovered, marking the beginning of the antibiotic era.

---

38. Which of the following inhibits synthesis of cholesterol?

(A) Protease

(B) Streptokinase

(C) Penicillin

(D) Statin

Correct Answer: (D) Statin

Solution:

Step 1: Function of statins.

Statins are a group of drugs that inhibit the enzyme HMG-CoA reductase, a key enzyme in cholesterol biosynthesis.

Step 2: Role.

By blocking cholesterol synthesis, statins lower blood cholesterol levels and reduce cardiovascular risks.

Step 3: Conclusion.

Thus, the inhibitor of cholesterol synthesis is **Statin**.

Quick Tip

Statins are widely prescribed drugs for lowering blood cholesterol.

---

39. Capacity to generate a whole plant from a plant cell is called as

(A) Tissue culture

(B) Pluripotency

(C) Totipotency

(D) Micropropagation

Correct Answer: (C) Totipotency

Solution:

Step 1: Plant cell capability.

Totipotency refers to the genetic potential of a single cell to develop into an entire organism.

Step 2: Importance in biotechnology.

In plants, this property is used in tissue culture to regenerate full plants from single cells.

Step 3: Conclusion.

Thus, the capacity to generate a whole plant is called **Totipotency**.

Quick Tip

Totipotency is the foundation of plant tissue culture techniques.

40. Hisardale is a breed of which of the following animals?

(A) Cow

(B) Buffalo

(C) Sheep

(D) Chicken

Correct Answer: (C) Sheep

Solution:

Step 1: Understanding Hisardale.

Hisardale is a synthetic breed of sheep developed in India.

Step 2: Origin.

It was developed by crossing Bikaneri ewes with exotic Merino rams to improve wool quality.

Step 3: Conclusion.

Thus, Hisardale is a breed of **Sheep**.

Quick Tip

Hisardale sheep are known for high wool yield and better quality fleece.

41. Which of the following techniques was used to get yellow mosaic virus resistant mung lentil?

(A) Mutation breeding

(B) Introduction

(C) Hybridisation

(D) Tissue culture

Correct Answer: (A) Mutation breeding

Solution:

Step 1: Understanding resistance breeding.

Yellow mosaic virus is a major disease in pulses like mung lentil. To develop resistant varieties, mutation breeding was applied.

Step 2: Mutation breeding.

Mutation breeding involves exposing seeds to chemicals or radiations to create mutations, and selecting resistant plants.

Step 3: Conclusion.

Thus, yellow mosaic resistant mung lentil was developed by **mutation breeding**.

Quick Tip

Mutation breeding is commonly used in pulses to develop disease resistant varieties.

---

42. Reason for movement of DNA fragments towards anode in electrophoresis is DNA fragments being

(A) Negatively charged

(B) Positively charged

(C) Charged

(D) Charged with charges of both types

Correct Answer: (A) Negatively charged

Solution:

Step 1: Property of DNA.

DNA molecules carry a **negative charge** due to the phosphate groups in their sugar-phosphate backbone.

Step 2: Principle of electrophoresis.

In gel electrophoresis, negatively charged DNA fragments migrate towards the positive electrode (anode) when an electric current is applied.

Step 3: Conclusion.

Therefore, DNA moves towards the anode because it is **negatively charged**.

Quick Tip

Remember: DNA is negatively charged and always migrates to the positive pole in electrophoresis.

---

43. Which of the following is not responsible for vegetative propagation of plants?

(A) Offset

(B) Bulb

(C) Rhizome

(D) Gemmule

Correct Answer: (D) Gemmule

Solution:

Step 1: Vegetative propagation in plants.

Vegetative propagation involves formation of new plants from vegetative parts like stems, roots, and leaves. Structures such as offset, bulb, and rhizome are examples.

Step 2: Special case of gemmules.

Gemmules are internal buds found in sponges (Porifera), not plants. They help in asexual reproduction in animals, not vegetative propagation in plants.

Step 3: Conclusion.

Thus, **gemmules** are not responsible for vegetative propagation of plants.

Quick Tip

Vegetative propagation in plants uses structures like rhizomes, bulbs, tubers, and offsets.

---

44. Which of the following statements is incorrect?

(A) Antheridia are present on antheridiophore of female thallus of *Marchantia*

(B) *Chara* is monoecious

(C) Diploid gene forms gamete after meiosis

(D) Zoospores are formed in *Chlamydomonas*

Correct Answer: (A) Antheridia are present on antheridiophore of female thallus of *Marchantia*

Solution:

Step 1: Understanding Marchantia.

In *Marchantia*, antheridiophores (male sex organs) are borne on the **male thallus**, not on the female thallus. Archegoniophores (female sex organs) are found on female thallus.

Step 2: Analyzing other statements.

(B) Correct — *Chara* is monoecious, i.e., both sex organs are present on the same thallus.

(C) Correct — Gametes are always haploid, formed after meiosis from diploid cells.

(D) Correct — Zoospores are formed in *Chlamydomonas*.

Step 3: Conclusion.

The incorrect statement is (A), because antheridia are not present on female thallus in *Marchantia*.

Quick Tip

Remember: Antheridiophore → male thallus (Marchantia), Archegoniophore → female thallus.

---

45. Which of the following plants is referred to as 'Terror of Bengal'?

(A) Water hyacinth

(B) Bamboo

(C) Lantana

(D) Parthenium

Correct Answer: (A) Water hyacinth

Solution:

Step 1: Understanding 'Terror of Bengal'.

Water hyacinth (*Eichhornia crassipes*) is an invasive aquatic weed. It clogs water bodies, depletes oxygen, and hampers aquatic biodiversity.

Step 2: Reason for the name.

It spreads rapidly in Bengal's water bodies, causing serious ecological and economic problems, hence called the "Terror of Bengal".

Step 3: Conclusion.

Thus, the correct plant is **Water hyacinth**.

Quick Tip

Water hyacinth is one of the fastest-growing aquatic weeds and a global invasive species.

---

46. Which of the following is not a part of microsporangium?

(A) Endothecium

(B) Tapetum

(C) Epidermis

(D) Micropyle

Correct Answer: (D) Micropyle

Solution:

Step 1: Structure of microsporangium.

A microsporangium has 4 wall layers: Epidermis, Endothecium, Middle layers, and Tapetum. These surround pollen mother cells.

Step 2: Understanding micropyle.

Micropyle is a small opening in the ovule, not a part of microsporangium.

Step 3: Conclusion.

Therefore, the part not belonging to microsporangium is **Micropyle**.

Quick Tip

Microsporangium → Epidermis, Endothecium, Middle layers, Tapetum. Micropyle → part of ovule.

---

47. Which of the following cells divides to form two male gametes in angiospermic plant?

(A) Vegetative cell

(B) Generative cell

(C) Microspore mother cell

(D) Microspore

Correct Answer: (B) Generative cell

Solution:

Step 1: Male gametophyte development.

The pollen grain (microspore) has two cells: the vegetative cell and the generative cell.

Step 2: Division of generative cell.

The generative cell undergoes mitotic division to form two male gametes (sperms), which take part in double fertilization.

Step 3: Conclusion.

Thus, the cell that divides to form two male gametes is the **Generative cell**.

Quick Tip

Remember: Vegetative cell → tube formation, Generative cell → gamete formation.

---

48. Which of the following is not associated with egg apparatus?

(A) Synergid

(B) Egg

(C) Antipodal cells

(D) Filiform apparatus

Correct Answer: (C) Antipodal cells

Solution:

Step 1: Structure of egg apparatus.

The egg apparatus in embryo sac consists of one egg cell and two synergids, along with filiform apparatus present in synergids.

Step 2: Antipodal cells.

Antipodal cells are present at the chalazal end of the embryo sac and are not part of the egg apparatus.

Step 3: Conclusion.

Therefore, the part not associated with egg apparatus is **Antipodal cells**.

Quick Tip

Egg apparatus = 1 egg cell + 2 synergids + filiform apparatus (support structure).

---

49. Scutellum present in the seeds of grass is called

(A) Endosperm

(B) Cotyledon

(C) Seed coat

(D) Embryonal axis

Correct Answer: (B) Cotyledon

Solution:

Step 1: Structure of grass seed.

Grass seeds (monocot seeds) have a single cotyledon called the **scutellum**.

Step 2: Function.

Scutellum helps in absorption of nutrients from the endosperm during germination.

Step 3: Conclusion.

Hence, scutellum in grass seeds is the **cotyledon**.

Quick Tip

In monocots → scutellum = single cotyledon. In dicots → two cotyledons.

---

50. In a cross between true breeding red flowered and true breeding white flowered plants of Antirrhinum the F_1 generation was pink flowered, which is an example of

(A) Dominance

(B) Codominance

(C) Incomplete dominance

(D) Blending of contrasting forms of a character

Correct Answer: (C) Incomplete dominance

Solution:

Step 1: Concept of incomplete dominance.

In incomplete dominance, neither allele is completely dominant. The heterozygous condition shows an intermediate phenotype.

Step 2: Example in Antirrhinum.

Crossing red (RR) and white (rr) flowers produces pink (Rr) in F_1, showing incomplete dominance.

Step 3: Conclusion.

Thus, the phenomenon is an example of **Incomplete dominance**.

Quick Tip

Incomplete dominance → intermediate phenotype (e.g., Antirrhinum, Snapdragon flowers).

---

51. Which of the following statements is incorrect?

(A) Characters are controlled by factors

(B) Factors are discrete

(C) In pea, factors are in pairs

(D) Alleles blend with each other

Correct Answer: (D) Alleles blend with each other

Solution:

Step 1: Mendel's principles.

Mendel proposed that characters are controlled by discrete units called factors (now known as genes). These occur in pairs in organisms.

Step 2: Blending inheritance concept.

Mendel disproved blending theory. Alleles do not mix permanently but segregate and retain their identity.

Step 3: Analyzing options.

(A) Correct — Characters are controlled by factors.

(B) Correct — Factors are discrete.

(C) Correct — In peas, factors are in pairs.

(D) Incorrect — Alleles do not blend but segregate independently.

Step 4: Conclusion.

Thus, the incorrect statement is **Alleles blend with each other**.

Quick Tip

Mendel's experiments rejected blending inheritance and supported particulate inheritance.

---

52. What is the cytological basis of law of independent assortment?

(A) There is no blending of alleles

(B) Alleles of a pair separate during gamete formation

(C) Alleles may be dominant or recessive

(D) Pair of chromosomes arrange themselves in line independently in metaphase I

Correct Answer: (D) Pair of chromosomes arrange themselves in line independently in metaphase I

Solution:

Step 1: Understanding law of independent assortment.

This law states that alleles of different gene pairs assort independently of one another during gamete formation.

Step 2: Cytological explanation.

During metaphase I of meiosis, homologous chromosomes align at the equatorial plate randomly. This independent alignment results in independent assortment of alleles.

Step 3: Analyzing options.

(A) Incorrect — No blending of alleles is true but not the cytological basis.

(B) Incorrect — Separation of alleles explains segregation, not independent assortment.

(C) Incorrect — Dominance/recessiveness is unrelated to independent assortment.

(D) Correct — Random orientation of homologous chromosomes in metaphase I is the true basis.

Step 4: Conclusion.

Thus, the cytological basis of law of independent assortment is **independent alignment of chromosomes in metaphase I**.

Quick Tip

Segregation → separation of alleles. Independent assortment → random alignment of homologous chromosomes in meiosis I.

---

53. Who propounded the chromosomal theory of inheritance?

(A) Mendel

(B) Sutton and Boveri

(C) Morgan

(D) Henking

Correct Answer: (B) Sutton and Boveri

Solution:

Step 1: Background.

Mendel proposed the basic principles of inheritance, but the chromosomal basis was established later.

Step 2: Sutton and Boveri's contribution.

In 1902–1903, **Sutton and Boveri** independently proposed that chromosomes carry Mendel's factors (genes) and thus form the basis of inheritance.

Step 3: Conclusion.

Hence, the chromosomal theory of inheritance was propounded by **Sutton and Boveri**.

Quick Tip

Mendel $\rightarrow$ Laws of inheritance; Sutton and Boveri $\rightarrow$ Chromosomal theory; Morgan $\rightarrow$ Experimental proof.

---

54. Which of the following is not a chromosomal disorder?

(A) Down's syndrome

(B) Klinefelter's syndrome

(C) Turner's syndrome

(D) Haemophilia

Correct Answer: (D) Haemophilia

Solution:

Step 1: Chromosomal disorders.

Disorders caused due to numerical or structural abnormalities in chromosomes include Down's syndrome (trisomy 21), Klinefelter's syndrome (XXY), and Turner's syndrome (XO).

Step 2: Haemophilia.

Haemophilia is a genetic disorder caused by a mutation in a single gene located on the X-chromosome, not due to chromosomal number abnormalities.

Step 3: Conclusion.

Thus, the disorder that is not chromosomal is **Haemophilia**.

Quick Tip

Chromosomal disorders = abnormal chromosome number/structure; Mendelian disorders = single gene mutation (e.g., Haemophilia).

---

55. Who provided X-ray diffraction data of DNA?

(A) Maurice Wilkins & Rosalind Franklin

(B) Chargaff

(C) Watson and Crick

(D) Holley

Correct Answer: (A) Maurice Wilkins & Rosalind Franklin

Solution:

Step 1: Discovery of DNA structure.

The double helical structure of DNA was proposed by Watson and Crick in 1953.

Step 2: X-ray diffraction.

The crucial experimental X-ray diffraction data came from **Rosalind Franklin and Maurice Wilkins**, which revealed DNA's helical nature.

Step 3: Conclusion.

Hence, the X-ray diffraction data of DNA was provided by **Maurice Wilkins and Rosalind Franklin**.

Quick Tip

Franklin's Photo 51 was the key evidence that confirmed the helical structure of DNA.

56. What was the conclusion of Hershey and Chase experiment?

(A) Genetic material of bacteria is DNA

(B) Genetic material of virus is DNA

(C) Genetic material of bacteria is RNA

(D) Genetic material of virus is RNA

Correct Answer: (B) Genetic material of virus is DNA

Solution:

Step 1: Experiment details.

Hershey and Chase (1952) performed experiments using bacteriophage (virus) and bacteria. They labeled viral DNA with radioactive phosphorus (^{32}P) and viral protein coat with radioactive sulfur (^{35}S).

Step 2: Observation.

After infection, only the ^{32}P-labeled DNA entered the bacterial cells, while the protein coat remained outside.

Step 3: Conclusion.

This proved that **DNA is the genetic material in viruses**, not proteins.

Quick Tip

Hershey and Chase experiment confirmed DNA as the hereditary material in viruses.

---

57. Which of the following is not a termination codon?

(A) UAG

(B) UGA

(C) AUG

(D) UAA

Correct Answer: (C) AUG

Solution:

Step 1: Recall stop codons.

There are three termination (stop) codons in the genetic code: UAG, UAA, and UGA.

Step 2: Function of AUG.

AUG is not a termination codon. It is the initiation/start codon, which codes for Methionine and signals the beginning of protein synthesis.

Step 3: Conclusion.

Thus, the codon which is not a termination codon is **AUG**.

Quick Tip

Remember: **UAA, UAG, UGA** = Stop codons; **AUG** = Start codon.

---

58. What is the meaning of charging of t-RNA?

(1) Linking of amino acid with cognate t-RNA

(2) Attachment of t-RNA with ribosome

(3) Translation of RNA

(4) Modification of RNA

Correct Answer: (1) Linking of amino acid with cognate t-RNA

Solution:

Step 1: Concept of charging of t-RNA.

Charging of t-RNA refers to the process where an amino acid is chemically linked to its corresponding t-RNA by an enzyme called aminoacyl-tRNA synthetase. This prepares the t-RNA for protein synthesis.

Step 2: Analysis of options.

(1) Correct — This is the definition of charging of t-RNA.

(2) Incorrect, this occurs during translation, not charging.

(3) Incorrect, translation is the entire process of protein synthesis.

(4) Incorrect, charging is not modification but amino acid attachment.

Step 3: Conclusion.

Therefore, the correct answer is (1) Linking of amino acid with cognate t-RNA.

Quick Tip

Charging of t-RNA is the first step in translation where t-RNA is loaded with its specific amino acid.

---

59. Which of the following is a non-infectious disease?

(1) AIDS

(2) Malaria

(3) Cancer

(4) Typhoid

Correct Answer: (3) Cancer

Solution:

Step 1: Understanding disease classification.

Infectious diseases are caused by pathogens such as bacteria, viruses, protozoa, or fungi. Non-infectious diseases are not caused by pathogens but result from genetic, environmental, or lifestyle factors.

Step 2: Analysis of options.

(1) AIDS: Infectious, caused by HIV virus.

(2) Malaria: Infectious, caused by Plasmodium protozoa.

(3) Cancer: Non-infectious, caused by uncontrolled cell growth.

(4) Typhoid: Infectious, caused by Salmonella typhi bacteria.

Step 3: Conclusion.

Hence, the correct answer is (3) Cancer.

Quick Tip

Remember: Cancer, diabetes, and hypertension are examples of non-infectious diseases.

60. Which of the following blood cells is known as PMNL (Polymorphonuclear leukocyte)?

(1) Lymphocyte

(2) Monocyte

(3) Neutrophil

(4) Platelets

Correct Answer: (3) Neutrophil

Solution:

Step 1: Understanding PMNL.

PMNL stands for Polymorphonuclear leukocytes, which are a type of white blood cell characterized by a nucleus with multiple lobes.

Step 2: Role of neutrophils.

Neutrophils are the most abundant PMNLs and play a major role in the innate immune system by engulfing pathogens through phagocytosis.

Step 3: Elimination of wrong options.

(1) Lymphocytes: Mononuclear, not PMNL.

(2) Monocytes: Also mononuclear, not PMNL.

(3) Neutrophils: Correct, they are polymorphonuclear.

(4) Platelets: Not cells but fragments, hence not PMNL.

Step 4: Conclusion.

Thus, the correct answer is (3) Neutrophil.

Quick Tip

PMNLs mainly refer to neutrophils, the first line of defense in our immune system.

61. Which of the following is abundantly found in colostrum?

(1) IgA

(2) IgG

(3) IgM

(4) IgD

Correct Answer: (1) IgA

Solution:

Step 1: Understanding colostrum.

Colostrum is the first secretion from the mammary glands after childbirth, rich in antibodies that protect the newborn.

Step 2: Key antibody.

IgA is the main immunoglobulin present in colostrum, which protects mucous membranes of infants from infections.

Step 3: Option analysis.

(1) IgA – Correct, abundantly present in colostrum.

(2) IgG – Present but not in high concentration.

(3) IgM – Found in trace amounts.

(4) IgD – Rarely present in colostrum.

Step 4: Conclusion.

Thus, the correct answer is (1) IgA.

Quick Tip

IgA in colostrum provides passive immunity to infants against respiratory and gastrointestinal infections.

---

62. What is diacetyl morphine?

(1) Codeine

(2) Heroin

(3) Cannabinoid

(4) Coke

Correct Answer: (2) Heroin

Solution:

Step 1: Understanding diacetyl morphine.

Diacetyl morphine is a semi-synthetic derivative of morphine. It is commonly known as heroin, a highly addictive opioid drug.

Step 2: Analysis of options.

(1) Codeine – Another opiate but not diacetyl morphine.

(2) Heroin – Correct, diacetyl morphine is the chemical name of heroin.

(3) Cannabinoid – Different psychoactive compounds derived from cannabis.

(4) Coke – Common name for cocaine, not diacetyl morphine.

Step 3: Conclusion.

Thus, diacetyl morphine is (2) Heroin.

Quick Tip

Always remember: Diacetyl morphine = Heroin, a banned narcotic drug due to its addictive nature.

---

63. Which fever is confirmed by Widal test?

(1) Malaria

(2) Typhoid

(3) AIDS

(4) Pneumonia

Correct Answer: (2) Typhoid

Solution:

Step 1: About Widal test.

The Widal test is a diagnostic test used to detect the presence of antibodies against Salmonella typhi, the bacterium causing typhoid fever.

Step 2: Analysis of options.

(1) Malaria – Confirmed by blood smear or antigen tests, not Widal.

(2) Typhoid – Correct, confirmed by Widal test.

(3) AIDS – Diagnosed using ELISA and Western blot, not Widal.

(4) Pneumonia – Confirmed by chest X-ray or sputum analysis.

Step 3: Conclusion.

Thus, the Widal test confirms (2) Typhoid fever.

Quick Tip

Remember: Widal test $\rightarrow$ Typhoid fever caused by Salmonella typhi.

---

64. After how many months of pregnancy, do limbs and digits of embryo develop?

(1) 2 months

(2) 3 months

(3) 1 month

(4) 6 months

Correct Answer: (1) 2 months

Solution:

Step 1: Development timeline.

Embryonic development occurs in stages. Limbs and digits begin to form around the second month of pregnancy (approximately 8 weeks).

Step 2: Analysis of options.

(1) Correct — limb buds and digits appear.

(2) Too late, further development occurs.

(3) Too early, only organ primordia seen.

(4) Too late, fetus already well-formed.

Step 3: Conclusion.

Correct answer is (1) 2 months.

Quick Tip

Limb and digit development begins in the 2nd month of pregnancy.

---

65. Which of the following secretes large amount of progesterone?

(1) Graafian follicle

(2) Corpus albicans

(3) Corpus luteum

(4) Primary follicle

Correct Answer: (3) Corpus luteum

Solution:

Step 1: Role of corpus luteum.

After ovulation, the ruptured follicle transforms into corpus luteum, secreting progesterone for maintaining endometrium.

Step 2: Analysis of options.

(1) Graafian follicle – Produces estrogen.

(2) Corpus albicans – Degenerated luteum, inactive.

(3) Corpus luteum – Correct, main source of progesterone.

(4) Primary follicle – Early stage, no progesterone.

Step 3: Conclusion.

Correct answer is (3) Corpus luteum.

Quick Tip

Progesterone = pregnancy hormone, secreted mainly by corpus luteum.

---

66. After ovulation the ovum is surrounded by a group of cells called?

(1) Corona radiata

(2) Zona pellucida

(3) Granulosa cells

(4) Theca layer

Correct Answer: (1) Corona radiata

Solution:

Step 1: Structure of ovum.

After ovulation, the ovum is surrounded by corona radiata, which nourishes and protects it.

Step 2: Analysis of options.

(1) Corona radiata – Correct.

(2) Zona pellucida – Glycoprotein layer below corona radiata.

(3) Granulosa cells – Present in follicle, not around ovum post-ovulation.

(4) Theca layer – Surrounds follicle, not ovum.

Step 3: Conclusion.

Correct answer is (1) Corona radiata.

Quick Tip

Ovum post-ovulation is covered by corona radiata cells.

---

67. Which of the following cells is haploid?

(1) Oogonia

(2) Primary oocyte

(3) Secondary oocyte

(4) Zygote

Correct Answer: (3) Secondary oocyte

Solution:

Step 1: Chromosome number.

Oogonia and primary oocytes are diploid (2n). Secondary oocyte, formed after meiosis I, is haploid (n). Zygote is diploid again.

Step 2: Option analysis.

(1) Oogonia – Diploid.

(2) Primary oocyte – Diploid.

(3) Secondary oocyte – Haploid, correct.

(4) Zygote – Diploid.

Step 3: Conclusion.

Correct answer is (3) Secondary oocyte.

Quick Tip

Secondary oocyte is haploid (n), ready for fertilization.

---

68. A new contraceptive pill which is non-steroidal is referred as

(1) LNG 20

(2) Progestaset

(3) Saheli

(4) Lippes loop

Correct Answer: (3) Saheli

Solution:

Step 1: About Saheli.

Saheli is the world's first non-steroidal oral contraceptive pill developed in India. It contains Centchroman (ormeloxifene), a selective estrogen receptor modulator.

Step 2: Analysis of options.

(1) LNG 20 – A hormonal IUD (Levonorgestrel), not a non-steroidal pill.

(2) Progestaset – Contains progestin hormone, hence steroidal.

(3) Saheli – Correct, non-steroidal contraceptive pill.

(4) Lippes loop – An intrauterine device (IUD), not a pill.

Step 3: Conclusion.

Thus, the correct answer is (3) Saheli.

Quick Tip

Saheli = first non-steroidal contraceptive pill, safe and widely used in India.

---

69. What is the population growth rate of India as per 2001 census?

(1) 1-1%

(2) 3-7%

(3) Approximately 2%

(4) 3%

Correct Answer: (3) Approximately 2%

Solution:

Step 1: Census 2001 data.

According to Census 2001, India's annual population growth rate was around 1.97%, i.e., approximately 2%.

Step 2: Analysis of options.

(1) 1-1% – Incorrect, too low compared to actual.

(2) 3-7% – Incorrect, exaggerated figure.

(3) Approximately 2% – Correct, matches official Census data.

(4) 3% – Slightly higher than actual value.

Step 3: Conclusion.

Thus, the correct answer is (3) Approximately 2%.

Quick Tip

India's population growth rate (2001 census) 2%, declined further in 2011 census.

---

70. Which of the following IUDs is hormone releasing?

(1) Multiload 375

(2) LNG-20

(3) Lippes loop

(4) Cu-T

Correct Answer: (2) LNG-20

Solution:

Step 1: Types of IUDs.

IUDs are classified into non-medicated, copper-releasing, and hormone-releasing devices. LNG-20 (Levonorgestrel 20) is a hormone-releasing IUD.

Step 2: Analysis of options.

(1) Multiload 375 – Copper-releasing IUD.

(2) LNG-20 – Correct, hormone-releasing IUD.

(3) Lippes loop – Non-medicated plastic IUD.

(4) Cu-T – Copper-releasing IUD.

Step 3: Conclusion.

Thus, the correct answer is (2) LNG-20.

Quick Tip

LNG-20 is a hormone-releasing IUD, while Cu-T and Multiload are copper-based.

Section B

1. What is incomplete dominance?

Solution:

Step 1: Definition.

Incomplete dominance is a type of inheritance where the phenotype of the heterozygote is an intermediate form between the two homozygotes. Neither allele is completely dominant over the other.

Step 2: Example.

In Mirabilis jalapa (4 o'clock plant), when red-flowered (RR) and white-flowered (rr) plants are crossed, the F_1 hybrid (Rr) has pink flowers, which is intermediate.

Step 3: Conclusion.

Thus, incomplete dominance shows blending of traits in heterozygotes.

Quick Tip

Incomplete dominance is different from co-dominance — in co-dominance, both traits are fully expressed, while in incomplete dominance, an intermediate form appears.

---

2. What would be the blood group of offspring, if the blood group of mother is AB and blood group of father is O?

Solution:

Step 1: Parental genotypes.

Mother's blood group = AB $\rightarrow$ genotype = $I^A I^B$

Father's blood group = O $\rightarrow$ genotype = ii

Step 2: Cross.

$$I^A I^B \times ii \quad \Rightarrow \quad \text{Possible offspring: } I^A i,\ I^B i$$

Step 3: Blood groups of offspring.

- $I^A i \rightarrow$ Blood group A

- $I^B i \rightarrow$ Blood group B

Step 4: Conclusion.

The offspring will have either blood group A or B, but not AB or O.

Quick Tip

Cross between AB and O parents gives 50% A group and 50% B group children.

---

3. Draw the symbols used for male, female, mating and consanguineous mating in human pedigree analysis.

Solution:

Step 1: Pedigree symbols.

- Male → Square ()

- Female → Circle ()

- Mating → Horizontal line connecting male and female

- Consanguineous mating → Double horizontal line connecting male and female

Step 2: Importance.

Pedigree analysis helps in tracing inheritance of traits and genetic disorders across generations.

Quick Tip

Always remember: Square = Male, Circle = Female, Single line = Marriage, Double line = Consanguineous marriage.

---

4. What are the goals of Human Genome Project?

Solution:

Step 1: Main aim.

The Human Genome Project (HGP) was an international research program to map and sequence the entire human genome.

Step 2: Specific goals.

1. Identify all genes present in human DNA (around 20,000–25,000).
2. Determine the sequence of 3 billion DNA base pairs.
3. Store genetic information in databases.
4. Improve tools for data analysis.
5. Transfer related technologies to the private sector.
6. Address ethical, legal, and social issues (ELSI).

Step 3: Conclusion.

HGP created a foundation for modern genomics and personalized medicine.

Quick Tip

HGP was completed in 2003; it revolutionized biology and medicine by mapping the human genome.

---

5. What is the relationship between thorns of Bougainvillea and tendrils of Cucurbita?

Solution:

Step 1: Concept of homology.

Thorns of Bougainvillea and tendrils of Cucurbita are examples of homologous organs. They are derived from modification of stems but perform different functions.

Step 2: Explanation.

- Bougainvillea thorns = protective function.

- Cucurbita tendrils = climbing support.

Step 3: Conclusion.

Both are homologous organs showing divergent evolution.

Quick Tip

Homologous organs $\rightarrow$ Same origin, different function. Analogous organs $\rightarrow$ Different origin, same function.

---

6. Name the different species of Plasmodium. Which species is responsible for malignant malaria?

Solution:

Step 1: Species of Plasmodium infecting humans.

1. Plasmodium vivax
2. Plasmodium malariae
3. Plasmodium ovale
4. Plasmodium falciparum

Step 2: Malignant malaria.

Plasmodium falciparum causes malignant malaria (cerebral malaria), the most dangerous form with high fatality.

Step 3: Conclusion.

Thus, Plasmodium falciparum is responsible for malignant malaria.

Quick Tip

Plasmodium falciparum = Deadliest species → malignant malaria. P. vivax = relapsing malaria.

---

7. What are the factors which affect population growth?

Solution:

Step 1: Basic understanding.

Population growth depends on the balance between natality (birth rate), mortality (death rate), immigration (inflow), and emigration (outflow).

Step 2: Major factors.

1. Birth rate (Natality): Higher birth rate increases population.
2. Death rate (Mortality): Lower death rate increases population growth.
3. Migration: Immigration increases population, emigration decreases it.
4. Socio-economic factors: Education, healthcare, and awareness influence growth rate.
5. Government policies: Family planning, incentives, and awareness programs regulate growth.

Step 3: Conclusion.

Population growth is affected by demographic (birth & death rate), social, and economic factors.

Quick Tip

Population growth rate = (Births + Immigration) – (Deaths + Emigration).

---

8. Explain parasitic adaptations.

Solution:

Step 1: General idea.

Parasites are organisms that live on or inside a host and derive nutrition at the host's expense. To survive, they evolve specific adaptations.

Step 2: Morphological adaptations.

1. Loss of unnecessary organs (e.g., digestive system in tapeworm).
2. Presence of adhesive structures such as hooks and suckers.
3. Thick resistant cuticle to resist host enzymes.

Step 3: Physiological adaptations.

1. Secretion of anti-enzymes to neutralize host digestive juices.
2. Anaerobic respiration in intestinal parasites.

Step 4: Reproductive adaptations.

1. High reproductive capacity (e.g., tapeworm produces thousands of eggs).
2. Complex life cycles involving multiple hosts to ensure survival.

Step 5: Conclusion.

Parasites exhibit structural, physiological, and reproductive adaptations for survival inside host organisms.

Quick Tip

Remember: Hooks, suckers, high fecundity, and resistant cysts are common parasitic adaptations.

---

9. What is cell mediated immunity?

Solution:

Step 1: Definition.

Cell-mediated immunity (CMI) is an immune response that does not involve antibodies but instead uses T-lymphocytes to destroy infected or abnormal cells.

Step 2: Mechanism.

1. Antigen-presenting cells present antigens to T-helper cells.

2. Cytotoxic T-cells are activated.

3. These T-cells destroy virus-infected cells, tumor cells, or transplanted tissues.

Step 3: Importance.

CMI provides defense against intracellular pathogens (viruses, some bacteria) and cancer cells.

Step 4: Conclusion.

CMI is an essential defense mechanism mediated by T-cells rather than antibodies.

Quick Tip

Antibody-based defense = Humoral immunity. T-cell based defense = Cell mediated immunity.

---

10. What is cyclosporin-A and what is its use?

Solution:

Step 1: Definition.

Cyclosporin-A is an immunosuppressive drug obtained from the fungus *Trichoderma polysporum*.

Step 2: Mode of action.

It inhibits activation of T-lymphocytes, thereby suppressing cell-mediated immune responses.

Step 3: Use.

It is mainly used in organ transplantation to prevent graft rejection. It helps the body accept transplanted organs like kidney, liver, and heart.

Step 4: Conclusion.

Cyclosporin-A is an immunosuppressant drug widely used in transplantation medicine.

Quick Tip

Cyclosporin-A prevents organ transplant rejection by suppressing immunity.

11. What are the primary and secondary productivities?

Solution:

Step 1: Primary productivity.

It is the rate at which energy is captured by producers (plants, algae) through photosynthesis per unit area per unit time.

- Gross Primary Productivity (GPP): Total energy fixed.

- Net Primary Productivity (NPP): Energy available to consumers (GPP – respiration losses).

Step 2: Secondary productivity.

It is the rate at which energy is assimilated at the consumer level (herbivores, carnivores). It represents biomass gained by consumers per unit area per unit time.

Step 3: Conclusion.

Primary productivity $\rightarrow$ producers; Secondary productivity $\rightarrow$ consumers.

Quick Tip

Remember: NPP = GPP – R (respiration).

---

12. What is Dobson unit?

Solution:

Step 1: Definition.

Dobson Unit (DU) is a unit used to measure the thickness of the ozone layer in the atmosphere.

Step 2: Explanation.

1 DU corresponds to a 0.01 mm thick layer of pure ozone at standard temperature and pressure (STP).

Step 3: Normal values.

Average ozone concentration is about 300 DU. Values below 220 DU indicate an ozone hole.

Step 4: Conclusion.

Dobson unit measures ozone layer thickness and is important for studying ozone depletion.

Quick Tip

Normal ozone = 300 DU, Ozone hole = ¡ 220 DU.

---

13. How are DNA fragments separated and isolated?

Solution:

Step 1: Separation method.

DNA fragments are separated by a technique called gel electrophoresis. Agarose gel acts as a medium.

Step 2: Principle.

DNA is negatively charged (due to phosphate groups). When an electric field is applied, DNA fragments move towards the positive electrode. Smaller fragments move faster than larger ones.

Step 3: Visualization.

DNA fragments are stained with ethidium bromide or other dyes and visualized under UV light.

Step 4: Isolation.

The specific DNA fragment is cut out from the gel and extracted for further use.

Step 5: Conclusion.

Gel electrophoresis allows both separation and isolation of DNA fragments.

Quick Tip

Gel electrophoresis separates DNA based on size; smaller fragments travel faster.

---

14. What is ELISA?

Solution:

Step 1: Full form.

ELISA = Enzyme Linked Immunosorbent Assay.

Step 2: Definition.

It is a biochemical test used to detect the presence of antigens or antibodies in a sample using enzyme-linked reactions.

Step 3: Working principle.

- Antigen or antibody is fixed to a solid surface.

- A complementary antibody or antigen linked to an enzyme is added.

- Substrate is added $\rightarrow$ color change indicates positive reaction.

Step 4: Applications.

- Diagnosis of diseases like HIV, hepatitis, etc.

- Detection of hormones, allergens, and toxins.

Step 5: Conclusion.

ELISA is a highly sensitive diagnostic test for antigen-antibody interactions.

Quick Tip

ELISA is commonly used in HIV detection tests.

---

15. What is MOET?

Solution:

Step 1: Full form.

MOET = Multiple Ovulation and Embryo Transfer.

Step 2: Definition.

It is a modern reproductive technology used in cattle breeding to improve herd quality.

Step 3: Process.

1. A high milk-yielding cow is hormonally treated to induce super-ovulation.

2. The cow produces multiple eggs.

3. Eggs are fertilized artificially.

4. Embryos are collected and transferred into surrogate mothers.

Step 4: Importance.

This increases the number of offspring from a single superior female, improving genetic

quality of livestock.

Step 5: Conclusion.

MOET is a biotechnology tool to increase cattle productivity and improve breeds.

Quick Tip

MOET helps in producing more calves from elite cows in a short time.

---

16. How is the name given to restriction endonucleases?

Solution:

Step 1: Basis of naming.

Restriction endonucleases are named according to the bacterium from which they are isolated.

Step 2: Rules.

1. The first letter → genus (capital).

2. Next two letters → species (small letters).

3. Strain of bacterium may be mentioned.

4. Roman numeral indicates the order of discovery.

Step 3: Example.

EcoRI:

- **E** → Escherichia (genus)

- **co** → coli (species)

- **R** → strain RY13

- **I** → First enzyme isolated from this strain.

Step 4: Conclusion.

Thus, restriction enzymes are named scientifically using genus, species, strain, and discovery order.

Quick Tip

EcoRI is one of the most widely used restriction enzymes in genetic engineering.

17. Describe the structure of microsporangium.

Solution:

Step 1: Location.

Microsporangia are pollen sacs present in the anther of a flower. Each anther has four microsporangia.

Step 2: Structure.

1. Wall layers (from outside to inside):

- Epidermis
- Endothecium
- Middle layers
- Tapetum (nourishes pollen grains)

2. Inside → Microspore mother cells (diploid) undergo meiosis.

3. They form haploid microspores, which develop into pollen grains.

Step 3: Conclusion.

Thus, microsporangium is the pollen sac that produces pollen grains through meiosis of microspore mother cells.

Quick Tip

Tapetum is the innermost nutritive layer of microsporangium, crucial for pollen development.

---

18. Explain double fertilization.

Solution:

Step 1: Definition.

Double fertilization is a unique feature of angiosperms in which two fusions occur inside the embryo sac.

Step 2: Process.

1. One male gamete fuses with the egg cell → forms diploid zygote (syngamy).

2. Second male gamete fuses with two polar nuclei $\rightarrow$ forms triploid primary endosperm nucleus (PEN).

Step 3: Significance.

- Zygote develops into embryo.

- PEN develops into endosperm, which nourishes the embryo.

Step 4: Conclusion.

Double fertilization ensures formation of both embryo and nutritive endosperm in angiosperms.

Quick Tip

Double fertilization = Syngamy (zygote) + Triple fusion (endosperm).

---

19. What are spermatogonia, primary spermatocytes and secondary spermatocytes?

Solution:

Step 1: Spermatogonia (2n).

Basal lamina par seminiferous tubules ke andar paaye jaane wale mitotically active stem cells hote hain.

Type A (stem pool maintain karte) aur Type B (meiotic pathway par commit) milte hain. Sab diploid (2n) hote hain.

Step 2: Primary spermatocytes (2n, 4C DNA).

Type B spermatogonia ke growth & S-phase ke baad bante hain. Inka chromosome number diploid (2n) rehta hai par DNA content duplicate ho kar 4C ho jata hai.

Yeh blood–testis barrier cross karke adluminal compartment me enter karte hain aur **Meiosis I** start karte hain.

Step 3: Secondary spermatocytes (n, 2C DNA).

Primary spermatocyte ke **Meiosis I** complete karne par bane cells hain. Chromosome number haploid (n) hota hai, lekin har chromosome abhi do chromatids wala hota hai (2C DNA).

Yeh short-lived hote hain aur turant **Meiosis II** karke haploid spermatids (n, 1C) banate hain.

Step 4: Flow yaad rakho.

Spermatogonia (2n) → Primary spermatocyte (2n, 4C) → Secondary spermatocyte (n, 2C) → Spermatid (n, 1C) → Spermatozoa.

Quick Tip

Exam line: **Meiosis I** makes the cell *haploid*; **Meiosis II** halves the DNA per chromosome. Bas is sequence ko yaad rakho.

---

20. What are contraceptive pills? How do they function?

Solution:

Step 1: Definition & types.

Contraceptive pills oral medicines hoti hain jo pregnancy ko prevent karti hain. Aam taur par:

(i) **Combined pill** — low-dose estrogen + progestin.

(ii) **Progestin-only "mini-pill"**.

(iii) **Non-steroidal pill** (e.g., Centchroman/"Saheli").

Step 2: Primary mechanism (No ovulation).

Estrogen–progestin hypothalamus/pituitary par negative feedback dete hain ⇒ LH surge suppress hota hai ⇒ ovulation nahi hoti.

Step 3: Additional mechanisms.

(a) **Cervical mucus thickening** — sperm penetration mushkil.

(b) **Endometrium ko less receptive** banana — implantation ke chances kam.

(c) **Tubal motility me change** — gamete transport affected.

Step 4: Use (typical regimens).

Combined pills: cycle ke Day-5 se 21 din tak daily; 7-day pill-free/placebo interval, phir next pack.

Emergency pills (high-dose levonorgestrel) intercourse ke 72 ghante ke andar — mainly **ovulation delay/inhibition**.

Step 5: Conclusion.

Oral pills ka core action ovulation ko rokhna hai; saath hi mucus thicken karke aur endometrium ko hostile bana kar fertilization/implantation ko bhi reduce karti hain.

Quick Tip

Mnemonic: **O.M.E.** = Ovulation off, Mucus thick, Endometrium hostile. Yeh teen points likh do — full marks!

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21. Explain the causes of biodiversity loss.

Solution:

Step 1: Human Activities.

Human activities are the primary cause of biodiversity loss. These include: 1. Deforestation: Cutting down forests destroys habitats for many species, leading to a loss of biodiversity. 2. Pollution: Pollution from industrial, agricultural, and urban sources harms ecosystems and can lead to species extinction. 3. Overexploitation: Overhunting, overfishing, and excessive harvesting of natural resources deplete species populations. 4. Climate Change: Human-induced climate change alters habitats, affecting species' ability to survive. 5. Habitat Destruction: Urbanization and agricultural expansion destroy ecosystems that are crucial for biodiversity.

Step 2: Natural Factors.

In addition to human activities, natural factors such as invasive species, diseases, and natural disasters also contribute to biodiversity loss. Invasive species can outcompete native species, leading to their decline.

Step 3: Conclusion.

Biodiversity loss is mainly caused by human activities like deforestation, pollution, overexploitation, and climate change, though natural factors can also play a role.

Quick Tip

Preserving biodiversity requires sustainable practices, protecting natural habitats, and mitigating climate change.

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22. Write short notes on the following:

- **(A) Phosphorus cycle**
- **(B) Primary immunity**

Solution:

Step 1: Phosphorus Cycle.

The phosphorus cycle is the process by which phosphorus moves through the environment, including the soil, water, and living organisms. Unlike other biogeochemical cycles, the phosphorus cycle does not involve the atmosphere. The main stages are: 1. Weathering of rocks: Phosphorus is released from rocks through weathering. 2. Absorption by plants: Phosphorus is absorbed by plants in the form of phosphate. 3. Consumption by animals: Herbivores consume plants, and carnivores eat herbivores, thus transferring phosphorus. 4. Decomposition: When organisms die, decomposers break down organic matter, returning phosphorus to the soil. 5. Leaching: Phosphorus may be washed into water bodies, where it can contribute to aquatic life.

Step 2: Primary Immunity.

Primary immunity, also known as innate immunity, is the first line of defense against pathogens. It is a nonspecific response, meaning it does not target specific pathogens but acts against any foreign invader. The components of primary immunity include: 1. Physical barriers: The skin, mucous membranes, and cilia prevent the entry of pathogens. 2. Chemical barriers: Enzymes, stomach acid, and antimicrobial peptides help kill or neutralize harmful invaders. 3. Cellular defenses: White blood cells like neutrophils and macrophages engulf and destroy pathogens through phagocytosis.

Step 3: Conclusion.

The phosphorus cycle is vital for ecosystem productivity, while primary immunity provides immediate, nonspecific protection from infections.

Quick Tip

Understanding the phosphorus cycle helps in ecosystem management, and primary immunity is crucial in the body's first defense against diseases.

23. Write short notes on the following:

- **(A) Allergy**
- **(B) Chemical composition of DNA.**

Solution:

Step 1: Allergy.

Allergy is an immune system reaction to foreign substances known as allergens. These substances may include pollen, dust mites, mold, certain foods, and insect venom. When a person with an allergy encounters an allergen, the immune system overreacts, producing symptoms such as: 1. Sneezing 2. Itchy eyes 3. Runny nose 4. Swelling 5. Anaphylaxis in severe cases.

The immune system produces IgE antibodies against allergens, which trigger the release of histamine and other chemicals that cause inflammation. Treatment options include antihistamines and immunotherapy.

Step 2: Chemical Composition of DNA.

DNA (Deoxyribonucleic acid) is the molecule that carries the genetic information in living organisms. Its chemical composition includes: 1. Nucleotides: The building blocks of DNA, consisting of: - Sugar: Deoxyribose in DNA. - Phosphate group: Forms the backbone of the DNA structure. - Nitrogenous bases: Adenine (A), Thymine (T), Cytosine (C), and Guanine (G). 2. Double Helix Structure: DNA forms a double helix with two complementary strands held together by hydrogen bonds between the bases. Adenine pairs with thymine, and cytosine pairs with guanine. 3. Chromatin: DNA in the nucleus is wrapped around histone proteins, forming structures called nucleosomes, which make up chromatin.

Step 3: Conclusion.

Allergy involves an overreaction of the immune system to harmless substances, while DNA is made up of nucleotides with a specific structure that encodes genetic information.

Quick Tip

Understanding allergies can help manage reactions, and knowledge of DNA composition is essential for studying genetics and molecular biology.

24. How is gene of interest amplified by using PCR?

Solution:

Step 1: Understanding PCR (Polymerase Chain Reaction).

Polymerase Chain Reaction (PCR) is a laboratory technique used to amplify specific segments of DNA. It enables researchers to create millions of copies of a gene of interest from a small amount of DNA. The process involves several key steps: 1. Denaturation: The double-stranded DNA is heated to 94-98°C, causing the DNA to separate into two single strands. 2. Annealing: The temperature is lowered to 50-65°C, allowing the primers (short single-stranded sequences) to bind to the target DNA sequences at the beginning and end of the gene of interest. 3. Extension: The temperature is raised to 75-80°C, and DNA polymerase synthesizes new DNA strands starting from the primers, copying the gene of interest. This process is repeated multiple times to generate millions of copies.

Step 2: Conclusion.

PCR amplifies a gene of interest by repeatedly denaturing, annealing, and extending DNA, resulting in the production of large quantities of the target gene.

Quick Tip

PCR is a powerful tool in molecular biology, allowing for the amplification of specific DNA regions, facilitating gene cloning, sequencing, and diagnostic tests.

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25. Answer the following questions:

- **(A) Stability of DNA is higher than that of RNA. How?**
- **(B) What are the roles of the three parts of the transcription unit?**

Solution:

Step 1: Stability of DNA compared to RNA.

DNA is more stable than RNA due to the following reasons: 1. Double-stranded structure: DNA exists as a double-stranded helix, which provides greater stability. The double-strand

structure helps in protecting the genetic information against damage. 2. Deoxyribose sugar: DNA contains deoxyribose, which lacks a hydroxyl group at the 2' position (compared to RNA, which contains ribose with a hydroxyl group at the 2' position). The absence of this hydroxyl group makes DNA less reactive and more stable. 3. Longer lifespan: DNA is designed to store genetic information for long periods, whereas RNA is more transient and involved in protein synthesis.

Step 2: The roles of the three parts of the transcription unit.

The transcription unit consists of three main parts: 1. Promoter: The promoter is a region of DNA that initiates transcription. It is recognized by RNA polymerase, which binds to it and begins the transcription process. 2. Coding Region: The coding region is the part of the DNA that contains the gene to be transcribed into RNA. This is the portion that is ultimately used to synthesize proteins. 3. Terminator: The terminator is a sequence that signals the end of transcription. When RNA polymerase reaches this sequence, it stops synthesizing RNA and releases the RNA transcript.

Step 3: Conclusion.

DNA is more stable than RNA due to its structural properties, while the three parts of the transcription unit (promoter, coding region, and terminator) play crucial roles in the process of gene transcription.

Quick Tip

Understanding the stability of DNA and RNA, and the transcription process, is crucial for molecular biology, particularly in gene expression and regulation.

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26. Write brief notes on the following:

- **(A) Implantation**
- **(B) Autogamy**

Solution:

Step 1: Implantation.

Implantation is the process by which the embryo embeds itself into the lining of the uterus after fertilization. This is a critical step in pregnancy. The steps involved are: 1. Blastocyst formation: After fertilization, the zygote divides into a ball of cells, known as a blastocyst. 2. Attachment: The blastocyst attaches to the endometrial lining of the uterus. 3. Invasion: The trophoblast cells of the blastocyst secrete enzymes that allow it to burrow into the uterine wall. 4. Nutrient supply: Once implanted, the embryo receives nutrients from the mother via the placenta, which forms during implantation.

Step 2: Autogamy.

Autogamy is a form of self-fertilization in which an organism fertilizes its own eggs with its own sperm. It is common in certain plants and hermaphroditic animals. For example: 1. Plants: Some plants are capable of self-pollination, where the pollen from a flower fertilizes the same flower or another flower of the same plant. 2. Hermaphroditic Animals: Certain animals, like earthworms, can mate with themselves, as they possess both male and female reproductive organs.

Step 3: Conclusion.

Implantation is a vital process in pregnancy, ensuring the embryo receives nutrients from the mother, while autogamy allows for reproduction without a mate, ensuring species survival in specific conditions.

Quick Tip

Implantation is a crucial process for the continuation of pregnancy, and autogamy helps organisms reproduce in isolated environments.
