

PART - I (BIO-BOTANY)

SECTION - 1

1. (a)
2. (c)
3. (b)
4. (c)
5. (c)
6. (b)
7. (d)
8. (a)

SECTION - 2

9. Mellitophily refers to pollination by bees.

Explanation: -

- It is a type of entomophily (insect pollination).
- Flowers adapted for mellitophily usually have:
 - (i) Bright colors (especially blue or yellow) to attract bees.
 - (ii) Sweet scent and nectar guides.
 - (iii) Landing platforms for bees to perch on.
 - (iv) Pollen grains that stick to the bee's body for transfer.

10. Terminal ends: -

Exonucleases (e.g., Exonuclease I, Exonuclease III) – remove nucleotides from 3' or 5' ends.

Internal phosphodiester bonds: -

Endonucleases (e.g., Restriction enzymes like EcoRI, HindIII; DNase I) – cut within the DNA strand

11. Myrmecophily is the mutualistic association between plants and ants, where plants provide food or shelter, and ants protect the plants.

Example: Acacia and ants.

12. We are given the number of organisms, so it is a Pyramid of Numbers.

Data: -

- Producers: Plants = 1000
- Primary consumers: Rabbit + Mouse = 250 + 250 = 500
- Secondary consumers: Python + Lizard = 100 + 50 = 150
- Tertiary consumers: Hawks = 50

Pyramid of Numbers (schematic): -

Hawks (50)



Python + Lizard (150)



Rabbit + Mouse (500)



Plants (1000)

Type: Pyramid of Numbers

13. Microbial inoculants are beneficial microorganisms added to soil or seeds to enhance soil fertility.

How they work: -

- (i) Nitrogen-fixing bacteria (e.g., *Rhizobium*, *Azotobacter*) → convert atmospheric nitrogen into forms usable by plants.
- (ii) Phosphate-solubilizing bacteria → make soil phosphorus available to plants.
- (iii) Decomposers → break down organic matter, releasing nutrients.

14. Organic farming is a method of agriculture that avoids synthetic chemicals and emphasizes the use of natural inputs like compost, biofertilizers, and biological pest control to maintain soil fertility and ecological balance.

SECTION - 3

15. The tapetum is the innermost layer of cells in the anther wall of a flower and plays a vital role in pollen development. Its functions are:

- (i) Nourishment of developing pollen grains – supplies proteins, lipids, and carbohydrates.

- (ii) Formation of pollen wall (exine) – provides precursors like sporopollenin.
- (iii) Secretion of enzymes and growth regulators – aids pollen maturation.
- (iv) Contribution to pollen fertility – ensures viable pollen production.

16. (i) Missense Mutation: -

- What it is: A single base pair change in DNA results in a codon that codes for a different amino acid.
- Result: An altered protein with one amino acid substituted for another.
- Effect: Can range from no change (if the new amino acid is similar) to significant loss of function, depending on the location and type of amino acid change (e.g., Sickle Cell Anemia).

(ii) Nonsense Mutation: -

- What it is: A single base pair change creates a premature stop codon (UAA, UAG, UGA) in the mRNA.
- Result: Protein synthesis stops early, leading to a shortened, truncated protein.
- Effect: Usually results in a nonfunctional or severely impaired protein (e.g., Duchenne Muscular Dystrophy, Cystic Fibrosis).

Key Difference Summary: -

- Missense: Amino Acid → Different Amino Acid.
- Nonsense: Amino Acid → Stop Codon.

17. pBR322 is a widely used plasmid vector (~4361 bp) in genetic engineering.

Features: -

- Origin of replication (ori) – for plasmid replication
- Antibiotic resistance genes: amp^R (ampicillin), tet^R (tetracycline)
- Multiple cloning sites – for inserting foreign DNA

Use: -

Gene cloning and recombinant DNA studies.

18. CCS – Cane Crushing Strength / Commercial Cane Sugar / Carbon Capture and Storage

Since you are likely asking in the agriculture/plant biology context:

CCS (Commercial Cane Sugar): -

- It is a measure of sugar content in sugarcane juice.
- Expressed as % of sugar in the cane.
- Used to assess the quality and productivity of sugarcane.

19. Habitat: -

- (i) A specific physical space occupied by an organism (species).
- (ii) The same habitat may be shared by many organisms (species).
- (iii) Habitat specificity is exhibited by organisms.

Niche: -

- (i) a functional space occupied by an organism in the same eco-system
- (ii) A single niche is occupied by a single species
- (iii) Organisms may change their niche with time and season

SECTION - 4

20. (a) Parthenocarpy is the development of fruit without fertilization, producing seedless fruits.

Types: -

- (i) Natural parthenocarpy – occurs naturally (e.g., banana, citrus).
- (ii) Artificial/induced parthenocarpy – achieved by hormones like auxins or gibberellins (e.g., seedless tomato).

Significance: -

- Produces seedless, consumer-friendly fruits.
- Allows fruit formation without pollinators.
- Improves fruit quality and market value.
- Useful for commercial cultivation and food processing.

OR

(b) Incomplete Dominance: -

Phenotype: A new, intermediate (blended) trait appears in the heterozygote.

Allele Interaction: One allele doesn't completely mask the other, leading to a mix

Example: Red (RR) + White (WW) snapdragons produce Pink (RW) flowers.

Codominance: -

- **Phenotype:** Both original parental traits are fully and separately visible.
- **Allele Interaction:** Both alleles are equally expressed; neither is dominant or recessive.

Example: Human AB blood type (both A and B antigens present) or roan cattle (red and white hairs together).

21. (a) Applications of Plant Tissue Culture: -

- (i) Clonal propagation – rapid production of identical plants (e.g., banana, sugarcane).
- (ii) Disease-free plants – produces pathogen-free plants.
- (iii) Germplasm conservation – preserves rare or endangered species.
- (iv) Production of secondary metabolites – medicinal compounds from plant cells.
- (v) Genetic improvement – used in plant breeding and development of transgenic plants.

OR

(b) King of Spices: Black pepper (*Piper nigrum*)

- Uses: Adds flavor, improves digestion, used in medicine for colds, cough, and as antioxidant.

Queen of Spices: Cardamom (*Elettaria cardamomum*)

- Uses: Adds aroma and flavor, used in medicine for stomach disorders, as a breath freshener, and in beverages/desserts.

PART - II (BIO-ZOOLOGY)

SECTION - 1

22.(d)

23.(c)

24.(a)

25.(b)

26. (a)

27.(d)

28.(b)

29.(a)

SECTION - 2

30. Parthenogenesis is the development of an egg into a new individual without fertilization.

Example: -

- Honeybee → unfertilized eggs develop into males (drones).
- Rotifers, some lizards also show parthenogenesis.

31. Surrogacy is a method of assisted reproduction in which a woman (the surrogate mother) carries and delivers a child for another person or couple who cannot conceive naturally.

Types: -

- (i) Traditional surrogacy – surrogate's egg is used.
- (ii) Gestational surrogacy – embryo from intended parents is implanted; surrogate has no genetic relation to the child.

32.

Feature	Template Strand	Coding Strand
Definition	DNA strand used by RNA polymerase to synthesize mRNA.	DNA strand not used for transcription; has same sequence as mRNA (except T → U).
Direction	Read 3' → 5' by RNA polymerase.	Runs 5' → 3'.
Relationship to mRNA	Complementary to mRNA.	Same as mRNA sequence (except T replaced by U).

33. Disproved by: August Weismann

How: -

- Weismann cut off the tails of mice for several generations.
- Offspring still had normal tails, showing that acquired characters are not inherited.

Conclusion: Lamarck's theory of inheritance of acquired characters is incorrect.

34. Symptoms of Filariasis: -

- Fever and chills
- Swelling of limbs (edema) → may lead to elephantiasis
- Swollen lymph nodes
- Pain in joints and muscles
- Thickening of skin in chronic cases

35. Gene therapy is the technique of correcting defective or missing genes in a person's cells to treat or prevent genetic disorders.

Purpose: Treat genetic diseases like cystic fibrosis, hemophilia, and certain cancers.

Method: Introduce a normal copy of the gene using vectors (often viruses).

SECTION - 3

36.

Feature	Foeticide	Infanticide
Definition	Killing of a fetus in the womb	Killing of a newborn baby
Time/Stage	Before birth (during pregnancy)	After birth (after delivery)
Example	Abortion of a female fetus	Killing of an infant soon after birth
Legal Aspect	Often linked to illegal abortion	Considered a criminal act against child

37. Autoimmune disease occurs when the immune system attacks the body's own cells and tissues, mistaking them for foreign invaders.

Justification: -Normally, immunity defends against pathogens, but in autoimmune diseases (e.g., rheumatoid arthritis, type 1 diabetes), the response is misdirected toward self, causing tissue damage.

38. Antibiotic resistance develops when bacteria are exposed to antibiotics repeatedly or improperly, allowing resistant bacteria to survive and multiply.

Causes: -

- Overuse or misuse of antibiotics
- Incomplete antibiotic courses
- Use of antibiotics in livestock feed

Result: -Drugs become less effective or ineffective against infections.

39.

Feature	Natality	Mortality
Definition	Number of births in a population over time	Number of deaths in a population over time
Effect	Increases population size	Decreases population size
Also called	Birth rate	Death rate

40. Dosage compensation in organisms with XY sex determination (like humans) occurs by inactivating one X chromosome in females.

- This forms a Barr body in each female cell.

- As a result, gene expression from X-linked genes is equal in males (XY) and females (XX).

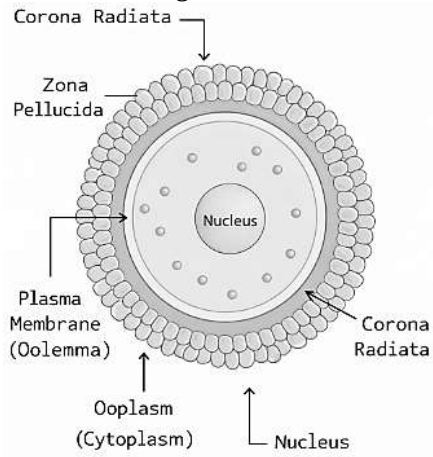
SECTION - 4

41. (a) Human ovum is the female gamete, one of the largest cells in the body.

Key parts:

- (i) Corona Radiata – Outer layer of follicle cells; provides nutrients.
- (ii) Zona Pellucida – Transparent glycoprotein layer; protects ovum and aids sperm binding.
- (iii) Vitelline Membrane – Beneath zona pellucida; regulates sperm entry.
- (iv) Cytoplasm (Ooplasm) – Contains nutrients, mitochondria, and yolk granules.
- (v) Cortical Granules – Prevent polyspermy.
- (vi) Nucleus (Germinal Vesicle) – Haploid nucleus controlling development.

Schematic Diagram: -



OR

(b) (i) Objective: To sequence the entire human DNA and identify all genes (~20,000–25,000 genes).

(ii) Duration: Started in 1990, completed in 2003.

(iii) Techniques used: DNA sequencing, genetic mapping, bioinformatics.

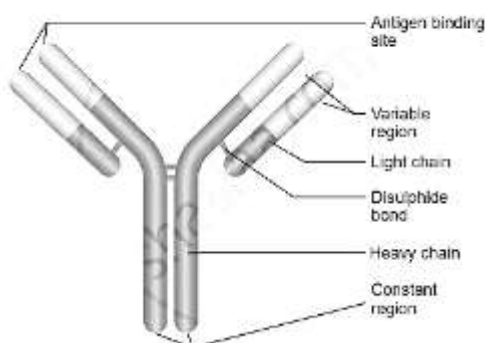
(iv) Outcome: -

- Sequenced 3 billion base pairs of human DNA.
- Identified genes responsible for many diseases.
- Enabled advances in medicine, diagnostics, and gene therapy.

(v) Collaborative effort: Involved international research centers (USA, UK, Japan, France, Germany, China).

Summary: HGP provided a complete reference sequence of human DNA, revolutionizing genetics and medicine.

42. (a) An antibody molecule is a Y-shaped structure that comprises four polypeptide chains, two identical light chains (L) of molecular weight 25,000Da (approximately 214 amino acids), and two identical heavy chains (H) of molecular weight 50,000 Da (approximately 450 amino acids). The polypeptide chains are linked together by disulfide (S-S) bonds. One light chain is attached to each heavy chain and two heavy chains are attached to each other to form a Y-shaped structure. Hence, an antibody is represented by $H_2 L_2$. The heavy chains have a flexible hinge region at their approximate middles. Antigen binding



Structure of immunoglobulin: -

Each chain (L and H) has two terminals. They are C-terminal (Carboxyl) and amino or N-terminal. Each chain (L and H) has two regions. They have a variable (V) region at one end and a much larger constant (C) region at the

other end. Antibodies responding to different antigens have very different (V) regions but their (C) regions are the same in all antibodies. In each arm of the monomer antibody, the (V) regions of the heavy and light chains combine to form an antigen-binding site shaped to 'fit' a specific antigenic determinant. Consequently, each antibody monomer has two such antigen-binding regions. The (C) regions that form the stem of the antibody monomer determine the antibody class and serve common functions in all antibodies.

OR

(b) Radioactive Waste Management

Radioactive waste is produced from nuclear power, medical, and research activities. It is classified as low, intermediate, or high-level based on radioactivity. Management includes collection, segregation, treatment, and disposal. High-level waste is stored in deep geological repositories, while low-level waste is buried in near-surface sites. Methods like solidification and encapsulation prevent leakage. Proper management protects human health and the environment.

