

General Instructions

Read the following instructions very carefully and strictly follow them:

1. All questions are compulsory.
2. Illustrate your answers with labeled diagrams, wherever necessary.
3. Marks allotted to each question are mentioned against it.

Multiple Choice Type Questions

1. Choose the correct option and write in your answer-book:

(a) Genetic engineering is useful in:

- (i) Agriculture
- (ii) Medical treatment
- (iii) Formation of vaccine
- (iv) All of these

Correct Answer: (iv) All of these

Solution:

Genetic engineering has applications in various fields such as:

- **Agriculture:** Developing genetically modified crops with improved yield and resistance to pests.
- **Medical treatment:** Producing insulin, growth hormones, and gene therapy.
- **Formation of vaccines:** Development of recombinant vaccines such as the Hepatitis B vaccine.

💡 Quick Tip

Genetic engineering = Agriculture + Medicine + Vaccines.

(b) Which one of the following is not a false fruit?

- (i) Apple
- (ii) Strawberry
- (iii) Cashew
- (iv) Mango

Correct Answer: (iv) Mango

Solution:

A false fruit is one that develops from parts of the flower other than the ovary, such as the receptacle. Examples include apple, strawberry, and cashew. Mango, however, is a true fruit as it develops solely from the ovary.

💡 Quick Tip

False fruits = Apple, Strawberry, Cashew (develop from parts other than ovary).
Mango = True fruit.

(c) The vector of Dengue (Break bone) fever is:

- (i) Culex
- (ii) Aedes
- (iii) Anopheles
- (iv) None of these

Correct Answer: (ii) Aedes

Solution:

Dengue fever, also known as "breakbone fever," is transmitted by the bite of *Aedes aegypti* mosquitoes, which are active during the daytime and breed in stagnant water.

💡 Quick Tip

Dengue = Spread by *Aedes aegypti*, breeds in clean stagnant water, active in the day-time.

(d) The name of the plant pollinated by water is:

- (i) Hydrilla
- (ii) Pea
- (iii) Citrus
- (iv) None of these

Correct Answer: (i) Hydrilla

Solution:

Hydrophily is pollination that occurs through water. Plants like *Hydrilla* and *Vallisneria* are adapted to water pollination, whereas pea and citrus rely on insect or wind pollination.

💡 Quick Tip

Water pollinated plants = Hydrilla, Vallisneria (Hydrophily).

Very Short Answer Type Questions

2. Answer the following questions briefly:

(a) Write the full form of IUD.

Solution:

IUDs are contraceptive devices inserted into the uterus to prevent pregnancy. They can be hormonal or non-hormonal (copper-based).

💡 Quick Tip

IUD = Intrauterine Device, used for long-term contraception.

(b) Who proposed the Chromosomal theory of Inheritance?

Solution:

Sutton and Boveri suggested that genes are located on chromosomes, and their behavior during meiosis explains Mendel's laws of inheritance.

💡 Quick Tip

Sutton and Boveri linked genes to chromosomes, explaining Mendelian inheritance.

(c) How many pairs of contrasting traits were studied by Mendel in pea plants?

Solution:

The seven pairs of contrasting traits included characteristics such as seed shape (round/wrinkled), plant height (tall/dwarf), and flower color (purple/white).

💡 Quick Tip

Mendel studied 7 contrasting traits in pea plants like height, seed shape, and color.

(d) What are parthenocarpic fruits?

Solution:

These fruits develop without the formation of seeds. Examples include bananas and seedless grapes. Parthenocarpy can occur naturally or be induced artificially using hormones.

💡 Quick Tip

Parthenocarpic fruits = Seedless fruits (e.g., banana, seedless watermelon).

(e) What do you understand by patent?

Solution:

A patent provides protection to inventors against unauthorized use of their inventions and promotes innovation by granting commercial rights for a specified duration, usually 20 years.

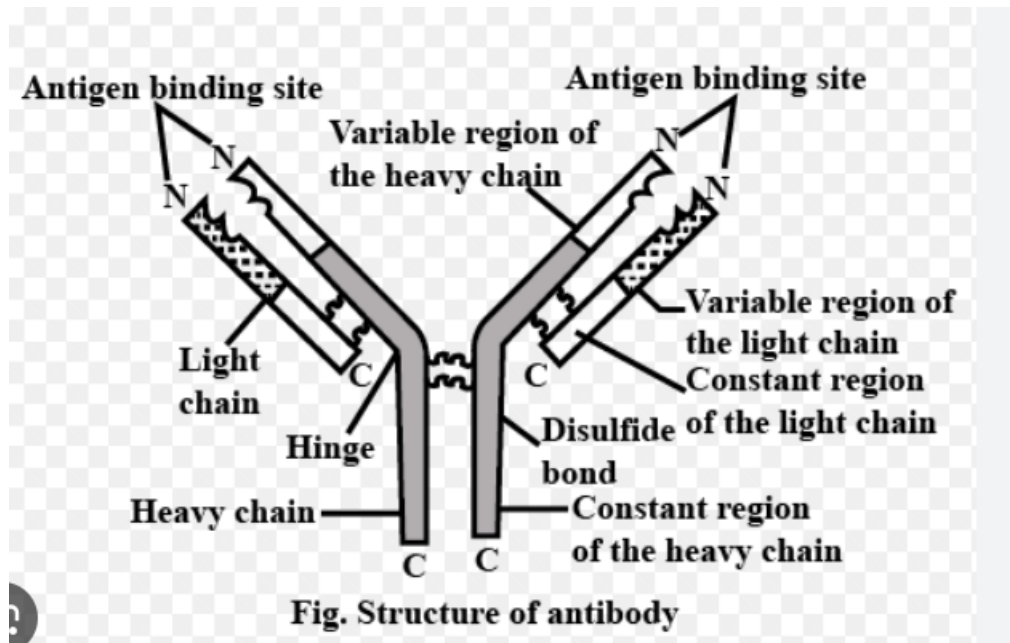
💡 Quick Tip

Patent = Legal right to protect an invention, prevents unauthorized use.

Short Answer Type Questions I

3. Answer the following questions briefly:

(a) Draw only the diagram of the structure of an Antibody molecule.



💡 Quick Tip

Antibody = Y-shaped protein with heavy and light chains, binds to antigens.

(b) Differentiate between homozygosity and heterozygosity.

Solution:

Homozygosity	Heterozygosity
Both alleles of a gene are identical	The alleles of a gene are different
Example: TT (Tall), tt (Dwarf)	Example: Tt (Tall)

💡 Quick Tip

Homozygous = Identical alleles (TT, tt), Heterozygous = Different alleles (Tt).

(c) Write a short note on productivity.

Solution:

Productivity refers to the rate at which energy is accumulated in the form of biomass by producers in an ecosystem. Productivity is of two types:

- **Primary Productivity:** The rate at which autotrophs convert solar energy into chemical energy.
- **Secondary Productivity:** The rate at which consumers assimilate energy from the organic matter they consume.

 Quick Tip

Productivity = Energy accumulation in biomass; Primary (plants), Secondary (herbivores).

(d) Explain Mendelian law of segregation.

Solution:

The law of segregation states that during gamete formation, the two alleles of a gene segregate independently, with each gamete receiving only one allele. According to Mendel's first law, each parent contributes one allele to the offspring. In heterozygous individuals (Tt), the two alleles segregate during gamete formation, resulting in 50% T and 50% t in the gametes.

 Quick Tip

Law of segregation = Alleles separate during gamete formation; each gamete gets one allele.

(e) Describe natural selection in brief.

Solution:

Natural selection is the process by which organisms with favorable traits survive and reproduce, while those with less favorable traits are eliminated. Natural selection acts on variation within a population, leading to the survival of the fittest. Over generations, advantageous traits become more common, contributing to evolution. Example: Peppered moth adaptation during industrial revolution.

 Quick Tip

Natural selection = "Survival of the fittest," traits that help survival get passed on.

Short Answer Type Questions II

4. Answer the following questions briefly:

(a) Explain the back cross and test cross.

Solution:

Back Cross: A cross of an offspring with one of its parents to achieve desired traits. It helps in maintaining desirable characteristics in subsequent generations.

Test Cross: A cross between an individual with an unknown genotype and a homozygous recessive individual to determine the unknown genotype. **Solution:**

Back Cross:

- Ensures the inheritance of a desired trait.
- Example: Crossing a hybrid pea plant (Tt) with its parent (TT or tt).

Test Cross:

- Used to determine whether an individual is homozygous dominant or heterozygous.
- Example: Crossing Tt (unknown) with tt (recessive).

💡 Quick Tip

Back cross = Offspring $\times$ Parent, ensures traits.

Test cross = Unknown genotype $\times$ Recessive, reveals genotype.

(b) Describe the structure of seminiferous tubule.

Solution:

Seminiferous tubules are coiled structures in the testes where spermatogenesis occurs.

- Lined with germinal epithelium, which contains spermatogenic cells that develop into sperm.
- Sertoli cells provide nutrition and support to developing sperm.
- Interstitial cells (Leydig cells) present between the tubules secrete testosterone.

💡 Quick Tip

Seminiferous tubule = Sperm production site, contains spermatogenic and Sertoli cells.

(c) Describe infectious diseases with examples.

Solution:

Infectious diseases are caused by pathogenic microorganisms such as bacteria, viruses, fungi, and parasites. Infectious diseases are caused by pathogenic microorganisms such as bacteria, viruses, fungi, and parasites. Examples of infectious diseases:

- **Bacterial:** Tuberculosis (caused by *Mycobacterium tuberculosis*).
- **Viral:** Influenza (caused by the influenza virus).
- **Fungal:** Athlete's foot (caused by fungi).
- **Parasitic:** Malaria (caused by *Plasmodium* parasite).

💡 Quick Tip

Infectious diseases = Caused by microbes, spread through contact, air, or vectors.

(d) Describe the importance of seed and fruit development.

Solution:

Seeds and fruits play a crucial role in plant reproduction, dispersal, and survival

- **Seed Importance:**
 - Ensures the continuation of plant species.
 - Stores food for embryo development.

- Facilitates dispersal to new locations.

- **Fruit Importance:**

- Protects the developing seeds.
- Aids in seed dispersal through wind, water, and animals.
- Provides food for humans and animals.

💡 Quick Tip

Seeds ensure survival; fruits protect and aid in dispersal.

5. Answer the following questions briefly:

(a) Describe the contribution of biotechnology in agriculture.

Solution:

Biotechnology has revolutionized agriculture by enhancing crop yield, improving resistance to pests, and reducing dependency on chemical inputs.

Contributions of biotechnology in agriculture include:

- **Genetically Modified Crops (GMOs):** Crops such as Bt cotton and Golden Rice provide resistance to pests and improved nutrition.
- **Tissue Culture:** Allows the production of disease-free plants and rapid multiplication.
- **Bio-fertilizers:** Use of beneficial microbes to improve soil fertility and reduce chemical fertilizers.
- **Pest and Disease Resistance:** Genetic engineering enables crops to resist harmful insects and pathogens.
- **Drought and Salinity Tolerance:** Development of crops that can withstand environmental stress conditions.

💡 Quick Tip

Biotechnology in agriculture = GMOs + Tissue culture + Pest resistance + Bio-fertilizers.

(b) Write a short note on Mendelism.

Solution:

Mendelism refers to the principles of inheritance proposed by Gregor Mendel based on his experiments with pea plants.

Mendel formulated three laws of inheritance:

- **Law of Dominance:** In a heterozygous individual, the dominant allele is expressed while the recessive allele remains hidden.
- **Law of Segregation:** Alleles separate during gamete formation, ensuring each gamete carries only one allele.

- **Law of Independent Assortment:** Genes for different traits assort independently during gamete formation.

His work laid the foundation for modern genetics.

💡 Quick Tip

Mendel's laws: Dominance, Segregation, Independent Assortment.

(c) Write notes on the following:

(i) Ringworm

Solution:

Ringworm appears as red, itchy, circular rashes on the skin. It spreads through direct contact with infected individuals, animals, or contaminated surfaces. Treatment involves antifungal medications such as creams and oral drugs.

💡 Quick Tip

Ringworm = Fungal skin infection, circular itchy rash, spreads by contact.

(ii) Amoebiasis

Solution:

It spreads through contaminated food and water, causing symptoms like diarrhea, abdominal pain, and fatigue. In severe cases, it may lead to liver abscesses. Prevention includes proper sanitation and hygiene.

💡 Quick Tip

Amoebiasis = Caused by *E. histolytica*, spreads via contaminated water, causes diarrhea.

(d) Explain symbiosis with suitable examples.

Solution:

Symbiosis is a close and long-term biological interaction between two different species. The term "symbiosis" encompasses a variety of relationships, which can be beneficial, harmful, or neutral to the organisms involved. Based on the nature of the interaction, symbiotic relationships are classified into three main types: mutualism, commensalism, and parasitism. Types of symbiosis with examples:

- **Mutualism:** Both species benefit. Example: Lichen (fungus and algae), where algae provide food, and fungi offer support.
- **Commensalism:** One species benefits while the other is neither harmed nor benefited. Example: Barnacles on whales.
- **Parasitism:** One species benefits at the expense of the other. Example: Tapeworm in the human intestine.

💡 Quick Tip

Symbiosis types: Mutualism = Both benefit.
Commensalism = One benefits, other unaffected.
Parasitism = One benefits, other harmed.

6. Answer the following questions briefly:

(a) Explain competition and parasitism with examples.

Solution:

Competition:

- Occurs in populations of the same species (intraspecific) or different species (interspecific).
- Leads to reduced availability of resources for both organisms.

Parasitism:

- Parasites may cause harm but usually do not kill the host.
- Examples include lice on humans and mistletoe on trees.

💡 Quick Tip

Competition = Struggle for resources.
Parasitism = Parasite benefits, host suffers.

(b) When a cross is made between a tall plant with yellow seed (TtYy) and a tall plant with green seed (Tt yy), in what proportion of the following phenotypes could be expected?

Solution:

$$TtYy \times Tt yy$$

Phenotypes:

1. Tall and green:

$$T-Yy, T-yy = \frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$$

2. Dwarf and green:

$$ttYy, ttyy = \frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$$

💡 Quick Tip

Use the forked line method or Punnett square to determine phenotype ratios.

(c) Write a note on National Park.

Solution:

- National Parks prohibit activities such as hunting, grazing, and deforestation.
- They serve as tourist attractions and educational sites.
- Examples in India: Jim Corbett National Park (Uttarakhand), Kaziranga National Park (Assam).

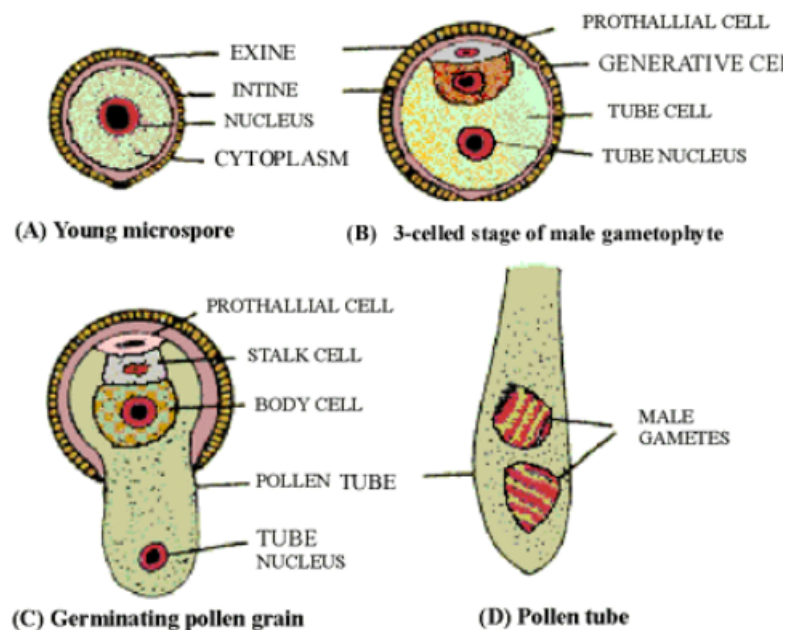
💡 Quick Tip

National Park = Protected area, no human interference, aims at wildlife conservation.

(d) Describe the development of the male gametophyte of an angiospermic plant with a suitable diagram.

Solution:

- The microspore mother cell undergoes meiosis to form haploid microspores.
- Each microspore undergoes mitosis to form a pollen grain with two cells:
 1. **Vegetative cell:** Responsible for pollen tube formation.
 2. **Generative cell:** Divides to form two male gametes.
- The mature pollen grain is released for pollination.



💡 Quick Tip

Male gametophyte = Microspore → Pollen grain → Pollen tube + 2 male gametes.

Long Answer Type Questions

7. How does fertilization take place in an angiospermic plant? Describe post-fertilization structures and events.

Solution:

Fertilization Process:

- The pollen grain lands on the stigma and germinates, forming a pollen tube.
- The pollen tube grows through the style and reaches the ovule in the ovary.
- The generative cell divides to form two male gametes.
- One male gamete fuses with the egg cell to form the diploid zygote (syngamy).
- The other male gamete fuses with the two polar nuclei to form the triploid endosperm (triple fusion).

Post-fertilization structures and events:

- **Zygote formation:** The fertilized egg develops into an embryo.
- **Endosperm development:** Provides nourishment to the developing embryo.
- **Ovule transformation:** The ovule develops into a seed.
- **Ovary transformation:** The ovary matures into a fruit.
- **Other floral parts:** Sepals, petals, and stamens usually wither away.

💡 Quick Tip

Fertilization in angiosperms = Pollen tube growth → Syngamy (zygote) + Triple fusion (endosperm) → Seed and fruit formation.

OR

Write an essay on human evolution.

Solution:

Stages of human evolution:

- **Australopithecus (4–2 million years ago):** Early bipedal hominins with small brain capacity.
- **Homo habilis (2.4–1.4 million years ago):** First tool users, known as "handy man."
- **Homo erectus (1.9 million–110,000 years ago):** First to use fire and migrate out of Africa.
- **Neanderthals (400,000–40,000 years ago):** Lived in Europe and Asia, skilled hunters with complex social behavior.
- **Homo sapiens (300,000 years ago–present):** Modern humans with advanced language, culture, and technological development.

Key evolutionary concepts:

- **Bipedalism:** Walking on two legs, allowing hands to be free for tool use.
- **Brain development:** Increased brain size leading to higher intelligence and social organization.
- **Cultural evolution:** Development of language, agriculture, and civilization.

💡 Quick Tip

Human evolution = Australopithecus → Homo habilis → Homo erectus → Neanderthals → Homo sapiens.

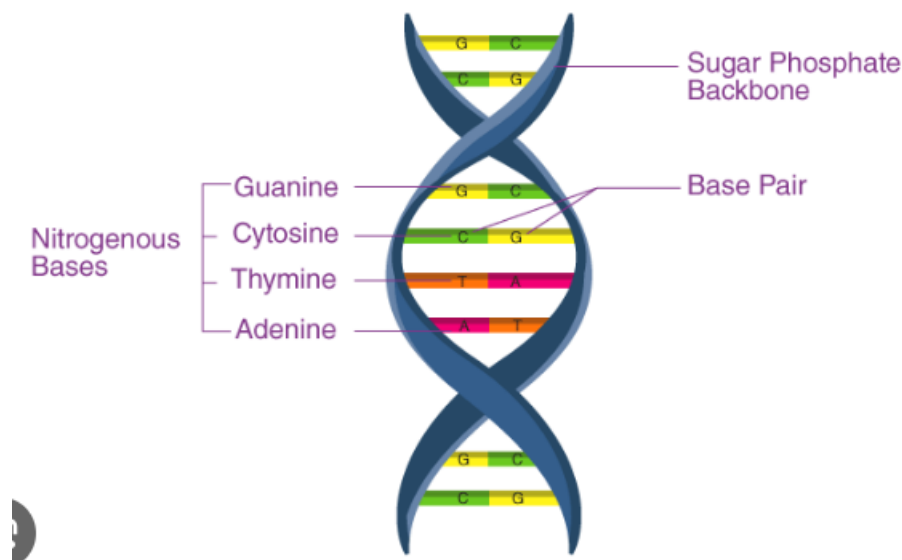
8. Answer the following question in detail:

(i) Characteristic features of the structure of double-stranded DNA.

Solution:

The key features of the DNA double helix are:

- **Double helix structure:** Two strands of nucleotides run in opposite directions (antiparallel).
- **Sugar-phosphate backbone:** Provides structural support and is composed of deoxyribose sugar and phosphate groups.
- **Base pairing:** Adenine (A) pairs with Thymine (T), and Guanine (G) pairs with Cytosine (C) via hydrogen bonds.
- **Helical structure:** The two strands coil around an axis with a right-handed twist.
- **Uniform diameter:** The structure has a constant diameter of 2 nm due to base-pair complementarity.



💡 Quick Tip

DNA = Double helix, antiparallel strands, A-T and G-C base pairing.

(ii) **Components of an ecosystem.**

Solution:

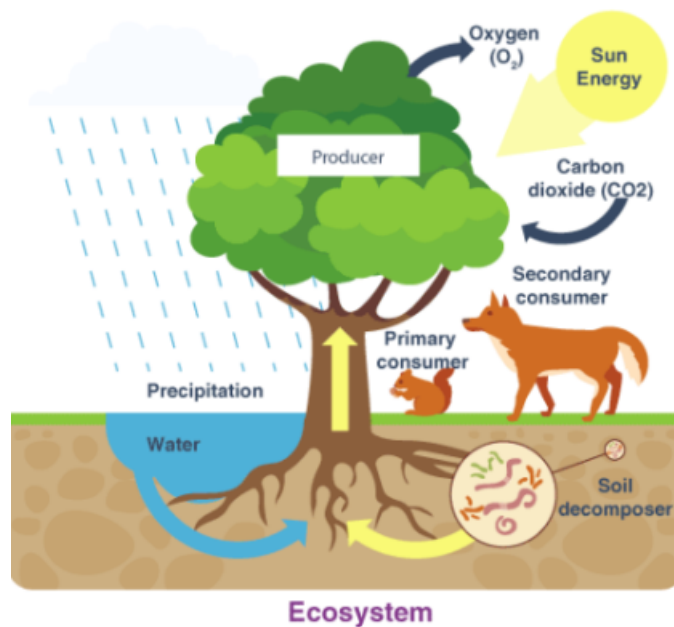
The components of an ecosystem include:

Biotic Components (Living):

- **Producers:** Autotrophs like plants that convert solar energy into food.
- **Consumers:** Heterotrophs that consume producers (herbivores) or other consumers (carnivores).
- **Decomposers:** Microorganisms like fungi and bacteria that break down organic matter.

Abiotic Components (Non-living):

- Physical factors: Light, temperature, humidity, water, and soil.
- Chemical factors: Nutrients such as nitrogen, phosphorus, and oxygen.



💡 Quick Tip

Ecosystem = Biotic (producers, consumers, decomposers) + Abiotic (air, water, soil).

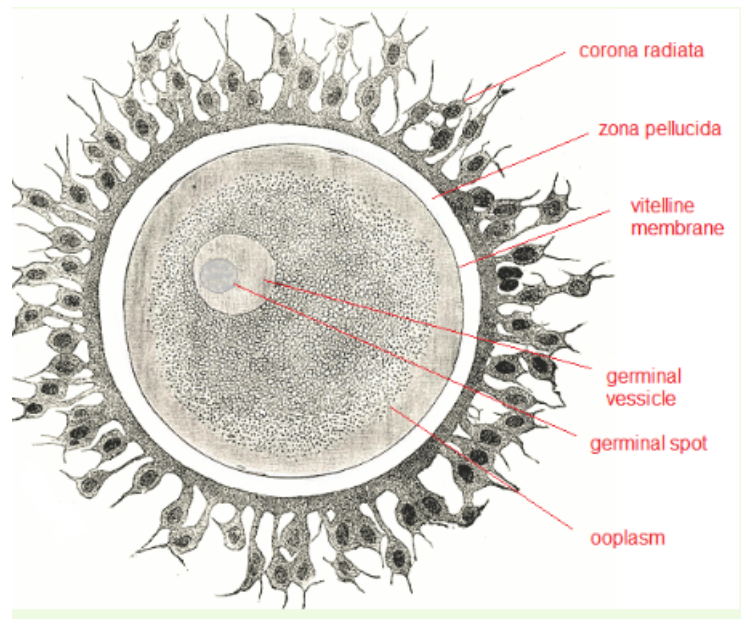
(iii) **Human ovum.**

Solution:

Key features of the human ovum:

- **Size:** The ovum is one of the largest cells in the human body (about 0.1 mm in diameter).
- **Structure:** It has a nucleus, cytoplasm, and protective layers such as the zona pellucida and corona radiata.

- **Function:** Carries genetic material and nutrients for the early development of the embryo after fertilization.



💡 Quick Tip

Human ovum = Large, contains zona pellucida, corona radiata, supports early embryo development.

OR

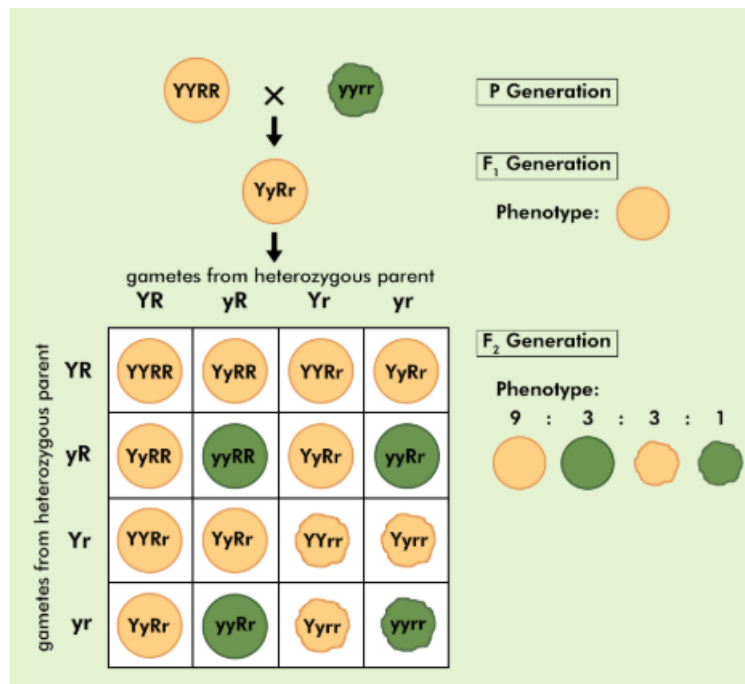
Describe the dihybrid cross with a diagram.

Solution:

Mendel's dihybrid cross involved pea plants with contrasting traits of seed shape (round/wrinkled) and seed color (yellow/green).

Steps in the dihybrid cross:

- Parental generation (P): RRYy (round yellow) $\times$ rryy (wrinkled green).
- First filial generation (F1): All RrYy (round yellow).
- F2 generation (self-cross): Produces a phenotypic ratio of 9:3:3:1 (round yellow, round green, wrinkled yellow, wrinkled green).



💡 Quick Tip

Dihybrid cross ratio = 9:3:3:1 (round yellow, round green, wrinkled yellow, wrinkled green).

9. Answer the following questions briefly:

(i) Genetically Modified (GM) Crops

Solution:

Key characteristics of GM crops:

- **Increased Yield:** GM crops produce higher yields compared to traditional crops.
- **Pest Resistance:** Crops like Bt cotton produce their own insecticidal proteins.
- **Herbicide Tolerance:** GM crops can survive the application of herbicides without damage.
- **Improved Nutritional Value:** Crops like Golden Rice are enriched with essential vitamins.

💡 Quick Tip

GM crops = Higher yield, pest resistance, herbicide tolerance, improved nutrition.

(ii) Components of a Nucleotide

Solution:

Each nucleotide consists of three components:

- **Sugar:** A five-carbon sugar (deoxyribose in DNA, ribose in RNA).
- **Phosphate Group:** Provides a negative charge and links nucleotides together.

- **Nitrogenous Base:** Includes adenine (A), thymine (T), guanine (G), cytosine (C), and uracil (U in RNA).

💡 Quick Tip

Nucleotide = Sugar + Phosphate + Nitrogenous base.

(iii) In-situ Conservation

Solution:

In-situ conservation methods include:

- **Biosphere Reserves:** Large protected areas for conservation of biodiversity.
- **National Parks and Wildlife Sanctuaries:** Areas designated to protect specific species.
- **Sacred Groves:** Traditionally protected forest patches preserved by local communities.

This method allows organisms to continue evolving in their natural surroundings.

💡 Quick Tip

In-situ conservation = Protecting species in their natural habitat (e.g., national parks).

OR

What is addiction? Write a note on its ill effects on the young generation and its control measures.

Solution:

Ill effects of addiction:

- **Physical health issues:** Chronic diseases, weakened immunity, and neurological damage.
- **Mental health disorders:** Anxiety, depression, and impaired cognitive function.
- **Social problems:** Decline in academic performance, strained relationships, and financial loss.
- **Legal issues:** Involvement in criminal activities and legal penalties.

Control measures for addiction:

- **Awareness programs:** Educating youth on the dangers of addiction.
- **Rehabilitation centers:** Providing medical and psychological support.
- **Parental guidance:** Encouraging healthy habits and monitoring behavior.
- **Counseling services:** Professional help to cope with addiction.

💡 Quick Tip

Addiction = Physical + Mental + Social issues; Prevent with awareness, counseling, rehab.
