

Biology Question Paper with Solutions

Time Allowed :3 hours	Maximum Marks :70	Total Questions :33
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General Instructions

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 33 questions. **All questions are compulsory.**
2. The question paper is divided into **five sections**: Sections **A, B, C, D, and E.**
3. **Section A** – questions number 1 to 16 are **multiple-choice type questions.** Each question carries 1 mark.
4. **Section B** – questions number 17 to 21 are **very short answer type questions.** Each question carries 2 marks.
5. **Section C** – questions number 22 to 28 are **short answer type questions.** Each question carries 3 marks.
6. **Section D** – questions number 29 and 30 are **case-based questions.** Each question carries 4 marks. Each question has subparts with **internal choice** in one of the subparts.
7. **Section E** – questions number 31 to 33 are **long answer type questions.** Each question carries 5 marks.
8. There is **no overall choice.** However, an internal choice has been provided in Sections **B, C, and D** of the question paper. A candidate has to write the answer for **only one of the alternatives** in such questions.
9. Kindly note that there is a separate question paper for **Visually Impaired candidates.**
10. Wherever necessary, **neat and properly labelled diagrams** should be drawn.

SECTION A

$$16 \times 1 = 16$$

1. In a fertilized ovule of an angiosperm, the cells in which n , $2n$, and $3n$ conditions respectively occur are:

- (A) antipodal, zygote, and endosperm
- (B) zygote, nucellus, and endosperm
- (C) endosperm, nucellus, and zygote
- (D) antipodals, synergids, and integuments

Correct Answer: (A) antipodal, zygote, and endosperm.

Solution: In an angiosperm, the cells with n , $2n$, and $3n$ ploidy levels are:

- n (haploid): Antipodals, synergids, and egg cells.
- $2n$ (diploid): Zygote, formed by the fusion of one sperm cell with the egg.
- $3n$ (triploid): Endosperm, formed by the fusion of the second sperm cell with two polar nuclei in the embryo sac.

💡 Quick Tip

Remember, the zygote is diploid ($2n$), while the endosperm is triploid ($3n$), specific to angiosperms.

2. Study the following diagram of Transverse Section of a young anther of an angiosperm:

(Refer to the provided diagram)

Select the option where parts 'A', 'B', and 'C' are correctly identified.

- (A) A – Connective, B – Endothecium, C – Pollen grain.
- (B) A – Endothecium, B – Connective, C – Pollen grain.
- (C) A – Pollen grain, B – Connective, C – Endothecium.
- (D) A – Endothecium, B – Pollen grain, C – Connective.

Correct Answer: (A) A – Connective, B – Endothecium, C – Pollen grain.

Solution: The labeled structures in the transverse section of a young anther are:

- A: Connective – The central tissue connecting the two anther lobes.
- B: Endothecium – The outermost layer of the anther wall, involved in pollen release.
- C: Pollen grain – The microspores that develop into male gametophytes.

Quick Tip

The anther structure includes layers: epidermis, endothecium, middle layer, tapetum, and pollen grains inside pollen sacs.

3. Identify the category of genetic disorder depicted in the pedigree chart given below:

- (A) X-Linked recessive
- (B) X-Linked dominant
- (C) Autosomal recessive
- (D) Autosomal dominant

Correct Answer: (C) Autosomal recessive.

Solution: The pedigree chart shows the following characteristics of autosomal recessive inheritance:

- Affected individuals appear in both males and females.
- The disorder skips generations, indicating recessive inheritance.
- Both parents of an affected child are carriers (heterozygous).

💡 Quick Tip

In autosomal recessive inheritance, carriers do not show symptoms, but two carriers can pass the trait to offspring.

4. Which of the options has correct identification of ‘P’, ‘Q’, and ‘R’ in the illustration of ‘Central Dogma’ given below?

- (A) *P* – Replication, *Q* – mRNA, *R* – Transcription
- (B) *P* – Translation, *Q* – mRNA, *R* – Transcription
- (C) *P* – Replication, *Q* – mRNA, *R* – Translation
- (D) *P* – Transcription, *Q* – mRNA, *R* – Translation

Correct Answer: (D) *P* – Transcription, *Q* – mRNA, *R* – Translation.

Solution: The central dogma of molecular biology describes the flow of genetic information from DNA to RNA to protein:

- *P*: Transcription – DNA is transcribed into mRNA.
- *Q*: mRNA – Messenger RNA is synthesized during transcription.
- *R*: Translation – mRNA is translated into a protein sequence.

💡 Quick Tip

The central dogma highlights the processes of transcription and translation, with mRNA acting as the intermediary between DNA and protein synthesis.

5. Hugo de Vries proposed the mutation theory of organic evolution after his experiments on:

- (A) Garden pea
- (B) Evening primrose
- (C) Fruit fly
- (D) Four O’clock plant

Correct Answer: (B) Evening primrose.

Solution: Hugo de Vries observed sudden heritable changes (mutations) while working with the evening primrose plant (*Oenothera lamarckiana*). His mutation theory proposed that these sudden changes serve as the basis for evolution, introducing new traits into populations.

 Quick Tip

Mutations are the raw material for evolution, introducing new variations upon which natural selection can act.

6. A list of organisms is given in column 'R', whereas in column 'S' a list of products produced by them:

Column 'R' (Organisms)	Column 'S' (Products)
<i>Lactobacillus</i>	Cheese
<i>Saccharomyces cerevisiae</i>	Curd
<i>Aspergillus niger</i>	Citric acid
<i>Acetobacter aceti</i>	Acetic acid

Select the option where the organisms are correctly matched with the product:

- (A) (ii) (iii) (iv) (i)
(B) (ii) (iv) (iii) (i)
(C) (iii) (ii) (iv) (i)
(D) (iii) (iv) (i) (ii)

Correct Answer: (C) (iii) (ii) (iv) (i).

Solution: The correct matches between the organisms and the products they produce are:

- *Lactobacillus* – Cheese.
- *Saccharomyces cerevisiae* – Curd.
- *Aspergillus niger* – Citric acid.
- *Acetobacter aceti* – Acetic acid.

 Quick Tip

Microorganisms play a vital role in the production of various industrial products, including dairy products, acids, and fermented foods.

7. Study the table given below:

Contraceptive	Mode of Action
A. The pill	I. Prevent sperm reaching cervix
B. Condom	II. Prevent implantation
C. Vasectomy	III. Inhibits ovulation
D. Copper-T	IV. Semen contains no sperm

Select the option where contraceptive/contraceptive method are correctly matched with their mode of action:

- (A) A – III, B – I, C – I, D – IV

- (B) A – III, B – I, C – IV, D – II
(C) A – III, B – I, C – IV, D – III
(D) A – IV, B – III, C – II, D – I

Correct Answer: (C) A – III, B – I, C – IV, D – III.

Solution: The contraceptives and their corresponding modes of action are:

- A. The pill – III. Inhibits ovulation.
- B. Condom – I. Prevents sperm from reaching the cervix.
- C. Vasectomy – IV. Semen contains no sperm.
- D. Copper-T – III. Prevents implantation.

💡 Quick Tip

Contraceptive methods have different modes of action: hormonal methods inhibit ovulation, mechanical barriers block sperm, and surgical methods like vasectomy prevent sperm in semen.

8. Select the option that gives the correct identification of ovum, morula, and blastocyst in a human female reproduction system as shown in the following diagram:
(Refer to the provided diagram.)

- (A) Ovum – B, Morula – D, Blastocyst – F
(B) Ovum – A, Morula – B, Blastocyst – G
(C) Ovum – A, Morula – E, Blastocyst – G
(D) Ovum – B, Morula – D, Blastocyst – G

Correct Answer: (C) Ovum – A, Morula – E, Blastocyst – G.

Solution: Based on the stages of development in the female reproductive system:

- Ovum (A): The unfertilized egg.
- Morula (E): The solid mass of cells resulting from cleavage of the fertilized egg.
- Blastocyst (G): The structure that implants into the uterine wall for further development.

💡 Quick Tip

The ovum is released during ovulation. After fertilization, it progresses through the morula stage to form the blastocyst before implantation.

9. The commonly used vector for human genome sequencing was/were:

- (A) Retrovirus
(B) T-DNA

- (C) BAC and YAC
- (D) Plasmid Vector

Correct Answer: (C) BAC and YAC.

Solution: BAC (Bacterial Artificial Chromosome) and YAC (Yeast Artificial Chromosome) were used as vectors in the Human Genome Project due to their capacity to clone large fragments of DNA efficiently.

 Quick Tip

BAC and YAC are preferred in genome sequencing due to their ability to accommodate large DNA fragments, enabling efficient mapping and analysis.

10. Turner's syndrome in humans occurs due to:

- (A) Aneuploidy
- (B) Euploidy
- (C) Polyploidy
- (D) Autosomal abnormality

Correct Answer: (A) Aneuploidy.

Solution: Turner's syndrome is a chromosomal disorder caused by the presence of only one X chromosome in females (45, X). This is an example of aneuploidy, which refers to the presence of an abnormal number of chromosomes.

 Quick Tip

Aneuploidy refers to a deviation from the normal chromosomal number, often leading to genetic disorders such as Turner's syndrome and Down syndrome.

11. ELISA technique is based on the principle of:

- (A) DNA replication
- (B) Antigen-antibody interaction
- (C) Pathogen-antigen interaction
- (D) Antigen-protein interaction

Correct Answer: (B) Antigen-antibody interaction.

Solution: ELISA (Enzyme-Linked Immunosorbent Assay) detects and quantifies antigens or antibodies using the principle of antigen-antibody interaction. This method is widely used for diagnostic purposes in medical and research fields.

 Quick Tip

ELISA is an effective tool for detecting specific proteins or antibodies in a sample using enzymatic reactions to produce measurable results.

12. The ‘molecular scissors’ fall in the category of:

- (A) Cleaving enzyme
- (B) Endonuclease
- (C) Exonuclease
- (D) Restriction enzymes

Correct Answer: (D) Restriction enzymes.

Solution: Restriction enzymes, also known as molecular scissors, cut DNA at specific sequences called recognition sites. These enzymes are essential tools in genetic engineering and molecular biology.

 Quick Tip

Restriction enzymes are widely used in genetic engineering for cutting DNA at precise locations, enabling DNA manipulation and analysis.

Question Nos. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

- (A) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (B) Both (A) and (R) are true and (R) is not the correct explanation of (A).
- (C) (A) is true, but (R) is false.
- (D) (A) is false, but (R) is true.

13. Assertion (A): Plasmids are autonomously replicating circular extra-chromosomal DNA.
Reason (R): Plasmids are usually present in eukaryotic cells.

Correct Answer: (C) (A) is true, but (R) is false.

Solution: Plasmids are autonomously replicating circular DNA molecules found in prokaryotic cells, not eukaryotic cells. These plasmids are widely used as vectors in genetic engineering.

 Quick Tip

Plasmids are essential tools in molecular biology for gene cloning and expression studies due to their ability to replicate independently.

14. Assertion (A): A given fig species can be pollinated only by its partner wasp.

Reason (R): The wasp pollinates the fig inflorescence while searching for suitable egg-laying sites.

Correct Answer: (A) Both (A) and (R) are true and (R) is the correct explanation of (A).

Solution: The mutualistic relationship between figs and fig wasps involves the wasp pollinating the fig flowers while depositing eggs. This ensures species-specific pollination.

 Quick Tip

Fig-wasp mutualism is a classic example of co-evolution, where both species depend on each other for survival and reproduction.

15. Assertion (A): Some aquatic ecosystems have inverted biomass pyramids.

Reason (R): More energy is required by the organisms occupying higher trophic levels.

Correct Answer: (B) Both (A) and (R) are true and (R) is not the correct explanation of (A).

Solution: Inverted biomass pyramids occur in aquatic ecosystems because the biomass of primary producers (phytoplankton) is smaller but reproduces rapidly, supporting higher trophic levels. The reason provided is true, but it is not the correct explanation for inverted biomass pyramids. Energy typically decreases with increasing trophic levels, but rapid reproduction of primary producers compensates for their low biomass.

 Quick Tip

Biomass pyramids in aquatic ecosystems are often inverted due to the high turnover rate of primary producers like phytoplankton.

16. Assertion (A): Patents are granted by the government to an inventor.

Reason (R): Patents prevent others from commercial use of an invention.

Correct Answer: (A) Both (A) and (R) are true and (R) is the correct explanation of (A).

Solution: Patents are legal rights granted to inventors to protect their innovations, preventing unauthorized commercial use by others. The reason correctly explains the assertion.

 Quick Tip

Patents encourage innovation by granting exclusive rights to inventors while ensuring their ideas are protected.

SECTION B

17. (a) Name the first developed transgenic cow.

Correct Answer: Rosie.

Solution: Rosie was the first transgenic cow developed in 1997. It produced milk enriched with human protein (alpha-lactalbumin), making it more nutritionally suitable for infants.

💡 Quick Tip

Transgenic animals like Rosie are engineered to produce biologically important substances, contributing to advancements in medicine and nutrition.

(b) Explain the improvement in the quality of the milk produced by it.

Correct Answer: The milk contained human alpha-lactalbumin.

Solution: Rosie's milk was enriched with human alpha-lactalbumin, making it nutritionally superior. This milk provided essential proteins required for infant growth and development.

💡 Quick Tip

The modification in Rosie aimed to enhance the nutritional quality of milk, aligning it closer to human milk.

18. Study the graph given below that represents the changes in the thickening of the uterine wall in women 'X' and women 'Y' over a period of one month: (*Refer to the provided graph.*)

What does the graph with respect to woman 'X' and woman 'Y' indicate? Give a suitable reason.

Correct Answer: Woman 'X' indicates pregnancy; Woman 'Y' indicates no pregnancy.

Solution: The graph shows:

- In woman 'X,' the uterine wall continues to thicken after ovulation, indicating successful implantation and pregnancy.
- In woman 'Y,' the uterine wall thickness reduces after ovulation, indicating no fertilization, leading to menstruation.

💡 Quick Tip

The uterine wall thickens during the menstrual cycle in preparation for pregnancy and sheds if fertilization does not occur.

19. (a) Mention any two ways by which HIV and Hepatitis-B can be transmitted to a healthy person.

Correct Answer: 1. Unprotected sexual contact.
2. Sharing of contaminated needles.

 Quick Tip

HIV and Hepatitis-B are both bloodborne and sexually transmitted infections. Safe practices, such as using condoms and avoiding needle sharing, can significantly reduce the risk of transmission.

(b) Why is an early detection of these diseases essential?

Correct Answer: Early detection helps in timely treatment and prevents disease progression.

Solution:

- HIV and Hepatitis-B can spread through unprotected sexual contact, blood transfusion, or contaminated syringes.
- Early detection helps in timely management, reduces transmission risk, and improves patient outcomes.

 Quick Tip

Adopting safe practices and undergoing regular health screenings can significantly reduce the transmission of these diseases.

20. (a) Biodiversity hotspots cover less than 2% of Earth's land area. Strict protection of these areas can reduce the rate of ongoing extinctions. Explain.

Correct Answer: Biodiversity hotspots have high species richness and endemic species. Protecting these areas prevents habitat destruction and species extinction.

Solution:

- Biodiversity hotspots are regions with a high level of species richness and endemic species under threat due to human activities.
- Protection efforts such as habitat restoration, creating reserves, and sustainable practices help in preserving these species.

 Quick Tip

Biodiversity hotspots are critical for ecological balance and must be preserved to ensure the survival of numerous species.

(b) Name any two hotspots in India.

Correct Answer: 1. Western Ghats.
2. Indo-Burma region.

💡 Quick Tip

Hotspots in India are areas of high biodiversity and endemism, which are also under threat from human activities. Protecting these areas is crucial for conservation.

21. (a) Differentiate between grazing food chain and detritus food chain.

Correct Answer:

- **Grazing food chain:**

- Starts with living plants (producers) that are consumed by herbivores (primary consumers).
- Example: Grass → Grasshopper → Frog → Snake.

- **Detritus food chain:**

- Begins with dead organic matter (detritus) that is consumed by decomposers (detritivores) like fungi and bacteria.
- Example: Dead leaves → Earthworm → Bird.

💡 Quick Tip

Grazing food chains involve the flow of energy through living organisms, while detritus food chains primarily deal with the decomposition of dead matter, playing a vital role in nutrient recycling in ecosystems.

OR

(b) Explain brood parasitism with the help of a suitable example.

Correct Answer: Brood parasitism is when a bird lays its eggs in the nest of another bird species, letting the host bird incubate and raise its young. Example: Cuckoo lays eggs in the crow's nest.

Solution: Brood parasitism involves one species, like the cuckoo, exploiting another species (e.g., crow) to raise its offspring. The parasitic bird's eggs mimic the host's eggs to avoid detection.

💡 Quick Tip

Brood parasitism is an evolutionary strategy where parasitic birds reduce parental investment by outsourcing the care of their young to other species.

SECTION C

22. Draw a schematic diagram of the *E. coli* vector pBR 322 and mark the following in it:

- (a) ori
- (b) rop
- (c) ampicillin resistant gene
- (d) tetracycline-resistant gene
- (e) restriction site Bam HI
- (f) restriction site EcoRI

Correct Answer: The diagram of the *E. coli* vector pBR322 should include:

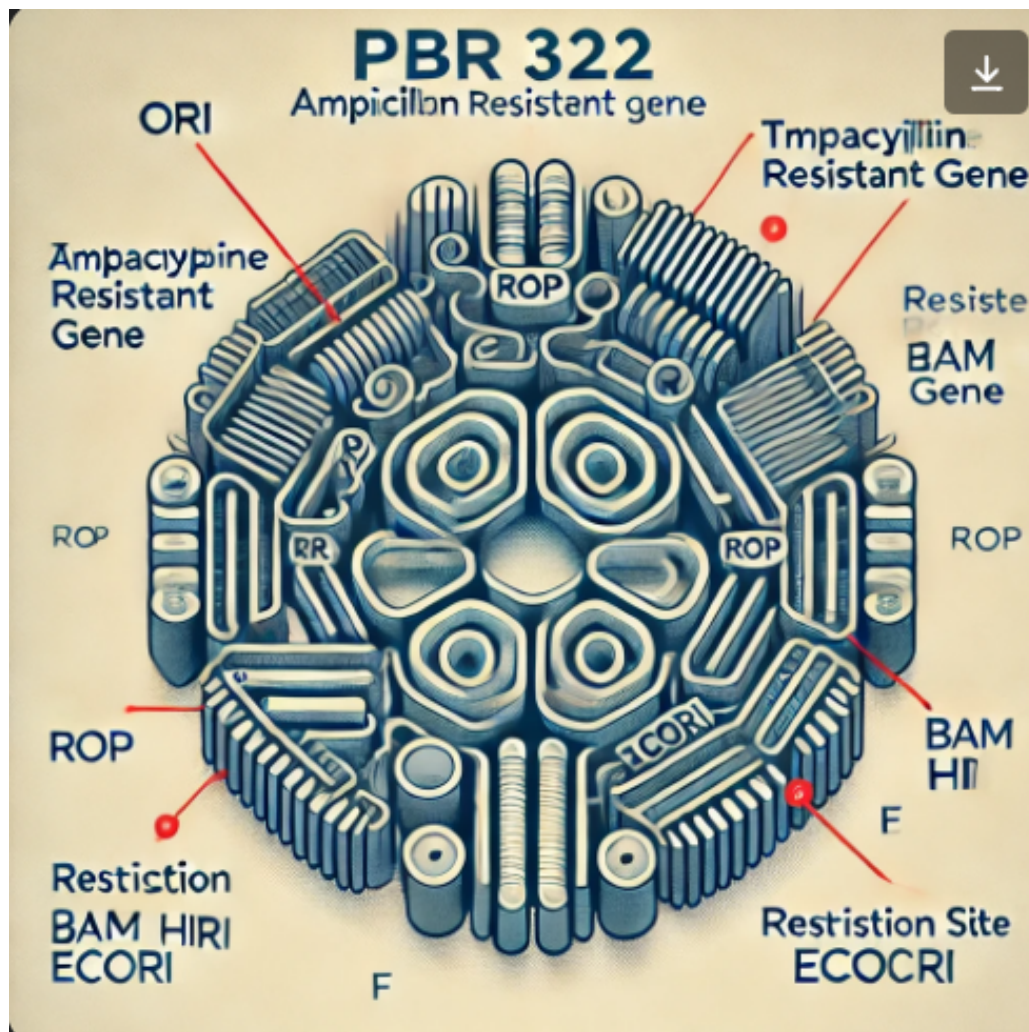


Figure 1: Schematic diagram of the *E. coli* vector pBR 322 with marked features

- ori: Origin of replication.
- rop: Codes for proteins to regulate plasmid replication.
- Antibiotic resistance genes for ampicillin and tetracycline.
- Restriction sites: BamHI and EcoRI at specific locations.

💡 Quick Tip

Plasmid pBR322 is a widely used cloning vector in genetic engineering, containing genes for antibiotic resistance and multiple restriction sites for DNA insertion.

23. How has the use of *Agrobacterium* as vector helped in controlling *Meloidogyne incognita* infestation in tobacco plants? Explain in correct sequence.

Correct Answer: *Agrobacterium tumefaciens* is used to transfer nematode-specific genes into tobacco plants, producing RNA interference (RNAi) that silences the gene responsible for infestation.

Solution:

- A nematode-specific gene is introduced into the tobacco plant using *Agrobacterium tumefaciens*.
- The plant produces double-stranded RNA (dsRNA), initiating RNA interference (RNAi).
- RNAi silences the vital genes of *Meloidogyne incognita*, reducing infestation and damage.

💡 Quick Tip

RNA interference (RNAi) is a biotechnological tool that uses double-stranded RNA to silence specific genes, providing resistance against pests like nematodes.

24. Explain the role of the following during the sewage treatment:

(a) Flocs

Correct Answer: (a) Flocs: Aggregates of bacteria and fungi that degrade organic matter during the secondary treatment of sewage.

Solution:

- **Flocs:** These are masses of aerobic bacteria and fungi that degrade organic matter, reducing BOD (Biochemical Oxygen Demand) in sewage water.

💡 Quick Tip

Flocs help reduce the biochemical oxygen demand (BOD) in wastewater by breaking down organic matter during the secondary treatment process.

(b) Anaerobic sludge digester

Correct Answer: (b) Anaerobic sludge digester: Breaks down organic matter in sludge into biogas and stabilizes waste.

Solution:

- **Anaerobic sludge digester:** It processes the settled sludge from the primary treatment under anaerobic conditions, producing biogas (methane, carbon dioxide) as a by-product.

💡 Quick Tip

Anaerobic sludge digesters play a key role in treating sewage by breaking down organic matter and producing valuable biogas for energy use.

25. Whose skulls 'A', 'B', and 'C' are shown below? Which of the two are more similar to each other?

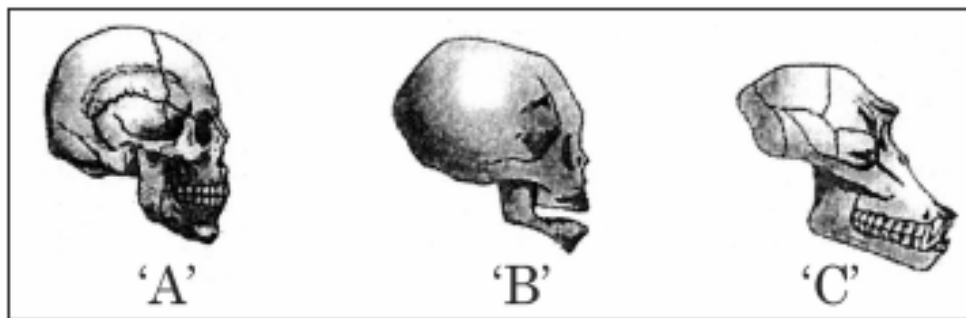


Figure 2: Skull

Correct Answer:

- (A) Ape-like.
- (B) Man-like.
- (C) Similar to humans.
- Skulls (B) and (C) are more similar to each other.

💡 Quick Tip

The skulls of ancient hominids reveal the evolution of human traits, with changes in brain size and facial structure over time.

(b) Name the (i) ape-like (ii) man-like primates that existed 1.5 million years ago.

Correct Answer:

- (i) Ape-like: Australopithecus.

- (ii) Man-like: Homo erectus.

💡 Quick Tip

Fossil evidence of species like Australopithecus and Homo erectus provides critical insights into the evolutionary steps leading to modern humans.

26. (a) Name the group of drugs whose skeletal molecule is shown below:

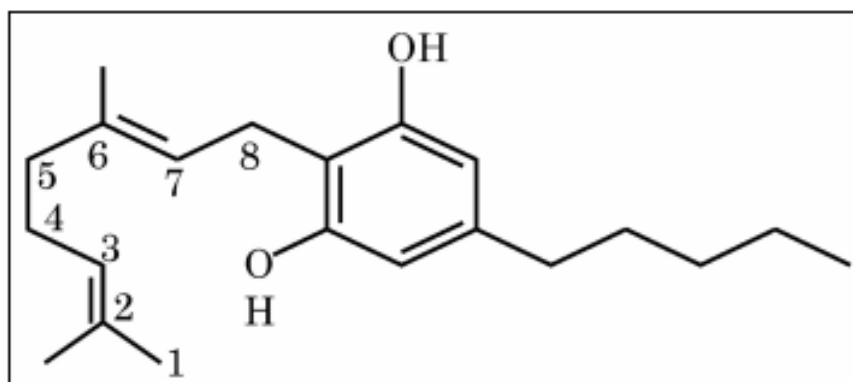


Figure 3: Drug

Correct Answer: Steroids.

Solution: Steroids are a group of lipophilic compounds with a characteristic four-ring structure, widely used in medicine as anti-inflammatory and hormonal drugs.

💡 Quick Tip

Steroids, such as corticosteroids, are crucial in treating inflammatory and autoimmune diseases due to their ability to suppress immune responses.

(ii) How are such drugs consumed?

Correct Answer: Steroids are usually consumed orally, injected, or applied topically, depending on their type and purpose.

💡 Quick Tip

Steroids can be taken in various forms such as pills, injections, or creams, depending on the medical condition being treated.

(iii) Name the human body organ affected by the consumption of these drugs.

Correct Answer: Liver.

💡 Quick Tip

The liver metabolizes steroids. Long-term or excessive use can damage the liver and other organs.

OR

Draw a schematic diagram of an antibody molecule and label any 4 parts. Mention their chemical nature. Name the cells which produce them.

Correct Answer:

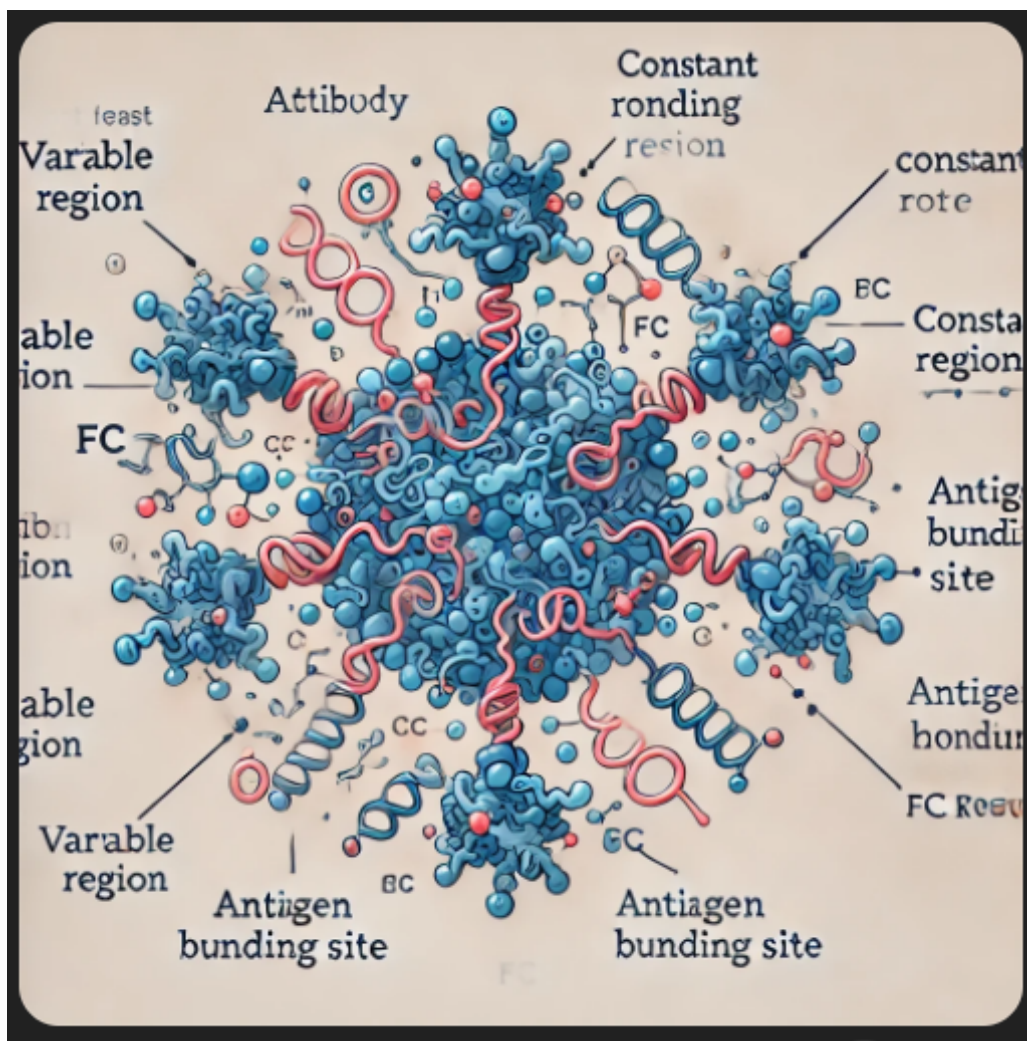


Figure 4: Antibody

- Diagram: Antibody structure with labeled parts (e.g., heavy chain, light chain, antigen-binding site, disulfide bonds).
- Chemical nature: Antibodies are glycoproteins.

- Produced by: B-lymphocytes.

💡 Quick Tip

Antibodies are part of the immune system and help neutralize pathogens by binding specifically to antigens.

27. A pea plant with purple flowers, when crossed with a plant with white, produced 50 plants with only purple flowers. On selfing these plants produced 482 plants with purple flower and 162 with white flowers. Explain the pattern of inheritance with the help of Punnett square.

Correct Answer: This represents a monohybrid cross, where the purple flower trait is dominant over the white flower trait.

Solution: The first generation (F1) produced only purple-flowered plants because purple is dominant. In the second generation (F2), the ratio of purple to white flowers is approximately 3:1.

$$P : PP(\text{purple}) \times pp(\text{white}) \quad \text{F1: All Pp (purple)}$$

F2 generation cross:

$$Pp \times Pp \quad \text{gives: PP, Pp, Pp, pp.}$$

Phenotypic ratio: 3 (purple):1 (white).

💡 Quick Tip

Punnett squares are useful tools for predicting the inheritance patterns of genetic traits in offspring.

28. Draw a well-labeled diagram of sectional view of male gametophyte/microspore of an angiosperm and write the functions of any two parts labelled. (Any four labels).

Correct Answer:

Generally, in eukaryotic cells, the average length of a transcription unit along a DNA molecule is about 8,000 nucleotides, so the RNA product of the transcription is also that long. But it only takes about 1200 nucleotides from the above RNA product to translate an average-sized polypeptide of 400 amino acids.

29. (a) Name this RNA product transcribed from the DNA that subsequently translates into a polypeptide of 400 amino acids. Mention the enzyme responsible for transcribing this type of RNA from the DNA.

Correct Answer:

- RNA product: mRNA.
- Enzyme: RNA polymerase II.

💡 Quick Tip

mRNA is transcribed from DNA and carries the genetic information for protein synthesis. RNA polymerase II is responsible for transcribing protein-coding genes in eukaryotes.

(b) Name and explain the process the RNA molecule transcribed from 8000 nucleotides long DNA undergoes to be able to translate a polypeptide of 400 amino acids.

Correct Answer: RNA splicing.

Solution:

- Introns (non-coding regions) are removed, and exons (coding regions) are joined to form a mature mRNA strand.
- This process reduces the RNA length to 1200 nucleotides, ready for translation.

💡 Quick Tip

RNA splicing is essential in eukaryotes to produce functional mRNA for protein synthesis by removing non-coding sequences.

(c) Write the number of RNA polymerases involved in the transcription of DNA in a prokaryote and eukaryotes.

Correct Answer:

- Prokaryotes: One RNA polymerase.
- Eukaryotes: Three RNA polymerases (RNA polymerase I, II, and III).

💡 Quick Tip

Prokaryotes use a single RNA polymerase for all types of RNA synthesis, while eukaryotes use three distinct RNA polymerases for different types of RNA transcription (I for rRNA, II for mRNA, and III for tRNA).

OR

(c) Mention the difference in the site of transcription in a prokaryote and eukaryote cell.

Correct Answer:

- Prokaryotes: Transcription occurs in the cytoplasm.
- Eukaryotes: Transcription occurs in the nucleus.

💡 Quick Tip

The separation of transcription and translation in eukaryotes allows for RNA processing, which is absent in prokaryotes.

30. Read the following passage:

Populations evolve to maximise their reproductive fitness in the habitat in which they live. Ecologists suggest, the life history of organisms have evolved in relations to the constraints imposed by the biotic and abiotic components of the habitat in which they live. This gets reflected in the population growth pattern of all organisms including humans.

Study the population growth curves shown in the given graph and answer the questions that follow:

(a) Identify the growth curves 'A' and 'B'.

Correct Answer:

- Curve A: Exponential growth curve ($\frac{dN}{dt} = rN$).
- Curve B: Logistic growth curve ($\frac{dN}{dt} = rN \left(\frac{K-N}{K} \right)$).

💡 Quick Tip

The exponential growth curve represents unchecked growth, whereas the logistic growth curve accounts for environmental resistance and carrying capacity.

(b) Mention what does the dotted line in the graph indicate and state its importance also.

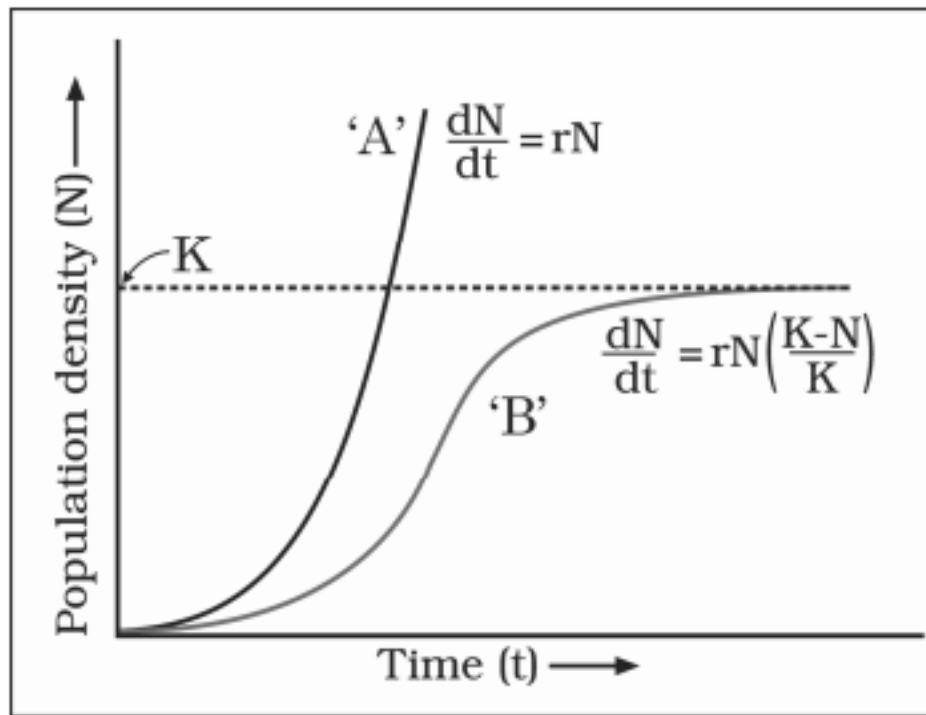


Figure 6: Population Growth Curves

Correct Answer: The dotted line indicates the carrying capacity (K) of the environment. It represents the maximum population size that the environment can sustain with available resources.

💡 Quick Tip

The carrying capacity limits population growth due to resource constraints like food, space, and environmental resistance.

OR

(c) (i) Growth curve 'B' shows a different pattern from that of growth curve 'A'. Justify giving one reason.

Correct Answer: Growth curve 'B' considers environmental resistance (e.g., resource availability, competition), which limits population growth, unlike curve 'A'.

💡 Quick Tip

Growth curve 'B' accounts for realistic environmental factors that limit the unchecked growth seen in curve 'A'.

(ii) Which one of the two curves is more “realistic” and why?

Correct Answer: Curve ‘B’ is more realistic as it incorporates carrying capacity and the limiting factors that affect population growth in a natural environment.

 Quick Tip

Curve ‘B’ better reflects real-world conditions where resources and space limit population growth, making it more realistic than curve ‘A’.

(iii) Which one of the two curves is relevant in present days with respect to human population in our country and why?

Correct Answer: Curve ‘B’ is relevant as it reflects the limiting effects of resource availability, environmental resistance, and carrying capacity on population growth in densely populated regions like India.

 Quick Tip

Human population growth is constrained by resource availability, space, and environmental factors, making the logistic growth curve more relevant to current demographic trends.

SECTION E

31. (a) Study the schematic diagram given below and answer the questions that follow: (*Refer to the provided diagram.*)

(i) Identify the polarity from ‘X’ to ‘X’ in the mRNA segment shown. Mention how many more amino acids can be added to the polypeptide that is being translated and why.

Correct Answer:

- Polarity: 5' to 3'.
- Number of amino acids: 4 amino acids.
- Reason: Translation proceeds in the 5' to 3' direction, and the remaining codons in the segment can accommodate 4 amino acids.

 Quick Tip

In protein synthesis, translation occurs in the 5' to 3' direction, and the number of amino acids is determined by the number of codons available for translation.

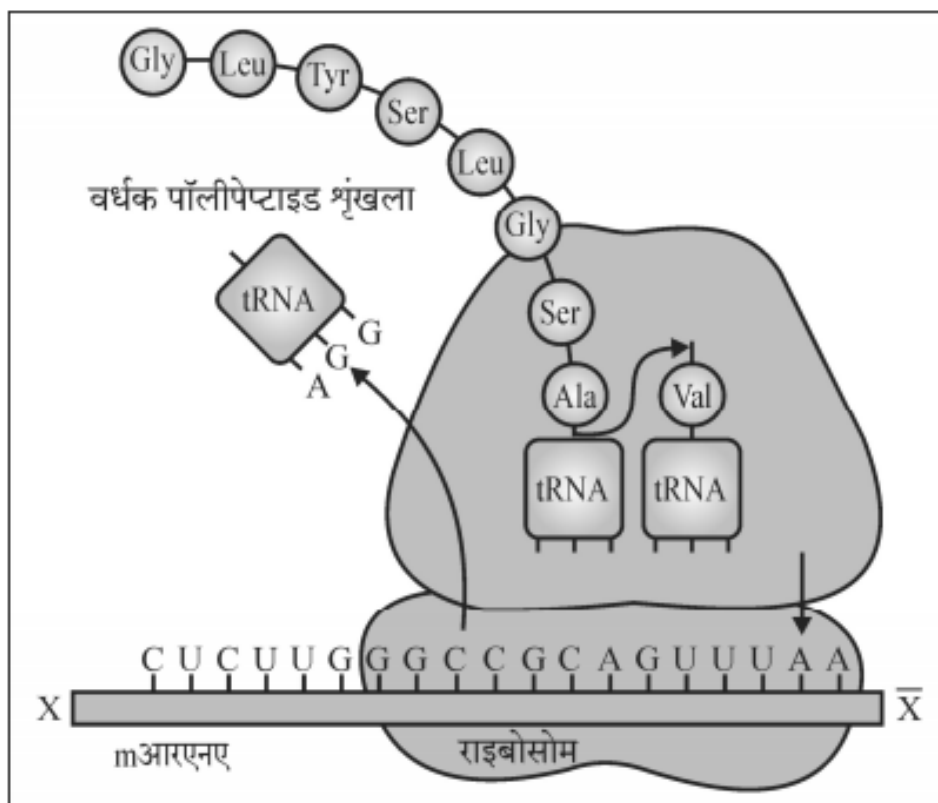


Figure 7: Diagram

(ii) Write the initiating codon for translation, its anticodon, and the amino acid it codes for.

Correct Answer:

- Initiating codon: AUG.
- Anticodon: UAC (on tRNA).
- Amino acid: Methionine.

💡 Quick Tip

The initiating codon (AUG) starts the process of translation and codes for methionine, which is the first amino acid in most proteins.

(iii) Explain the charging of an adaptor molecule. Why does this molecule need to be charged?

Correct Answer:

- Charging of tRNA (adaptor molecule): The process involves attaching a specific amino acid to its corresponding tRNA with the help of the enzyme aminoacyl-tRNA synthetase and ATP.

- Need for charging: Charged tRNA delivers the correct amino acid to the ribosome during protein synthesis.

💡 Quick Tip

Charged tRNA ensures the fidelity of translation by accurately matching amino acids to their corresponding codons on the mRNA strand.

OR

(i) Why is sickle-cell anaemia, a human blood disorder, so named?

Correct Answer: Sickle-cell anaemia is named after the sickle-shaped red blood cells observed in affected individuals, caused by abnormal haemoglobin.

💡 Quick Tip

Sickle-cell anaemia is caused by a mutation in the haemoglobin gene, resulting in sickle-shaped red blood cells that can block blood flow and cause pain.

(ii) Explain the genetic basis that results in the expression of this disorder.

Correct Answer: The disorder is caused by a point mutation in the β -globin gene, resulting in the substitution of glutamic acid with valine at the sixth position of the haemoglobin molecule. This mutation causes haemoglobin molecules to polymerize under low oxygen conditions, leading to the characteristic sickle shape of red blood cells.

💡 Quick Tip

Sickle-cell anaemia is an autosomal recessive disorder caused by a single-point mutation in the hemoglobin gene, which affects the structure of red blood cells.

(iii) Work out a cross to explain how normal parents may have a sickle-cell anaemic child.

Correct Answer:

Parental genotype: Both parents are carriers ($Hb^A Hb^S$).

Punnett Square:

	Hb^A	Hb^S
Hb^A	$Hb^A Hb^A$	$Hb^A Hb^S$
Hb^S	$Hb^A Hb^S$	$Hb^S Hb^S$

Results:

- 25% normal ($Hb^A Hb^A$).
- 50% carriers ($Hb^A Hb^S$).
- 25% sickle-cell anaemic ($Hb^S Hb^S$).

💡 Quick Tip

Sickle-cell anaemia is an autosomal recessive disorder. Carriers are usually asymptomatic but can pass the defective allele to offspring.

32. (a) Describe the life cycle of HIV from the time of its entry into the human body till full-blown AIDS sets in.

Correct Answer: The HIV life cycle can be summarized as follows:

- **Entry and Integration:** The virus enters the host body and attaches to CD4 receptors on helper T-cells. It injects its RNA and viral enzymes into the host cell.
- **Reverse Transcription:** Viral RNA is converted into DNA by reverse transcriptase.
- **Integration:** The viral DNA integrates into the host genome with the help of integrase enzyme.
- **Replication and Assembly:** The host cell machinery is used to produce viral RNA and proteins. New viruses are assembled.
- **Release and Maturation:** Newly formed viruses bud off from the host cell, ready to infect other cells. Over time, the number of helper T-cells decreases, leading to immune system failure (AIDS).

💡 Quick Tip

The progression from HIV infection to AIDS can take years and depends on the viral load and immune system strength.

OR

(i) Write the symptoms of malaria in human and explain what causes these symptoms.

Correct Answer:

- **Symptoms:** Fever, chills, sweating, headache, muscle pain, and fatigue.
- **Cause:** Malaria is caused by *Plasmodium* parasites. These parasites infect red blood cells, causing their rupture and the release of toxins into the bloodstream.

 Quick Tip

Malaria symptoms are caused by the rupture of red blood cells infected by *Plasmodium* parasites, releasing toxins that trigger fever and other symptoms.

(ii) Describe the different steps in the sexual mode of reproduction in the life cycle of a malarial parasite from the time of its initiation till where it is completed and ready to start a fresh cycle.

Correct Answer:

- **Gametocytes:** Male and female gametocytes are ingested by a mosquito during a blood meal.
- **Fertilization:** Gametocytes fuse in the mosquito's gut to form a zygote.
- **Development:** The zygote develops into an ookinete, which penetrates the gut wall and forms an oocyst.
- **Sporozoites:** The oocyst releases sporozoites that migrate to the mosquito's salivary glands, ready to infect a new host.

 Quick Tip

The sexual reproduction phase of *Plasmodium* occurs in mosquitoes, making them the definitive hosts of the parasite.

33. (a) (i) State the objective of adopting artificial hybridisation programme in plants.

Correct Answer: To obtain desired traits such as disease resistance, higher yield, or improved quality in plants by crossing two genetically different plants.

 Quick Tip

Artificial hybridisation is used in plant breeding to combine the best traits from different plant varieties, improving crop quality and yield.

(ii) Describe the steps followed in this technique.

Correct Answer: The steps in artificial hybridisation are:

- **Emasculation:** Removal of stamens from the bisexual flowers of the female parent to prevent self-pollination.
- **Bagging:** Covering the emasculated flower with a bag to prevent contamination from unwanted pollen.

- **Pollination:** Dusting pollen from the male parent onto the stigma of the female parent.
- **Re-bagging:** Re-covering the flower to ensure fertilization occurs without external interference.

 Quick Tip

Artificial hybridisation is a critical step in plant breeding programs to enhance crop varieties.

OR

(i) Describe the development of placenta during pregnancy in a human female.

Correct Answer: The placenta develops from the chorionic villi of the embryo and the uterine tissue of the mother. It establishes a structural and functional connection between the fetus and the mother.

 Quick Tip

The placenta forms a crucial link between mother and fetus, enabling nutrient exchange and waste removal during pregnancy.

(ii) Explain its role.

Correct Answer: The placenta performs the following functions:

- Facilitates exchange of nutrients, gases, and waste products between the mother and fetus.
- Produces hormones such as hCG, progesterone, and estrogens to maintain pregnancy.
- Acts as a barrier to certain harmful substances while allowing essential nutrients to pass through.

 Quick Tip

The placenta is a vital organ that ensures the proper growth and development of the fetus by providing nutrition and protection.