# CBSE 12 Biology (57/4/3) Question Paper with Solutions

| **Time Allowed :**3 hours | **Maximum Marks :**100 | **Total questions :**65 |
|---|---|---|

## 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

**Question Nos. 1 to 16 are Multiple Choice type Questions, carrying 1 mark each.**

**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:**

- **n (haploid):** Present in the antipodal cells.
- **2n (diploid):** Present in the zygote formed during fertilization.
- **3n (triploid):** Present in the endosperm formed through double fertilization.
- This specific distribution of ploidy levels is a distinctive feature of the reproductive process in angiosperms.

**Quick Tip**

Double fertilization is a unique feature of angiosperms, resulting in the formation of both a zygote and triploid endosperm.

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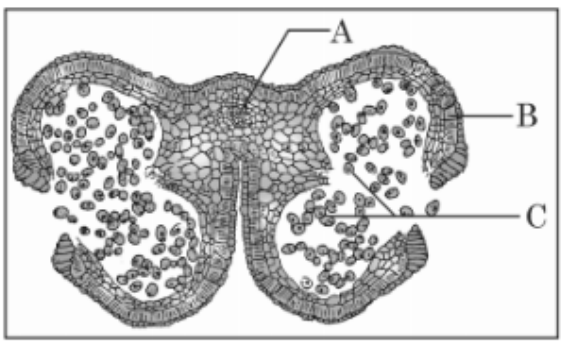
**2. Study the following diagram of Transverse Section of a young anther of an angiosperm:**



**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:**

- **A – Connective:** Tissue that connects the two lobes of the anther.
- **B – Endothecium:** The outer layer of the pollen sac that provides structural support.
- **C – Pollen grain:** The male gametophyte developed within the pollen sac.

Quick Tip

The anther is a bilobed structure that contains microsporangia, which develop into pollen sacs, housing pollen grains.

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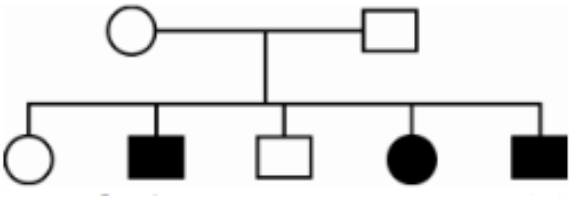
**3. Identify the category of genetic disorder depicted in the pedigree chart given below:**



(A) X-Linked recessive

(B) X-Linked dominant

(C) Autosomal recessive

(D) Autosomal dominant

**Correct Answer:** (C) Autosomal recessive

**Solution:**

- The disorder is seen in both males and females, indicating autosomal inheritance.
- It skips generations, suggesting recessive inheritance.
- The affected offspring have parents who are carriers of the recessive allele.

Quick Tip

Autosomal recessive disorders often require both parents to contribute the recessive allele for the disorder to manifest in offspring.

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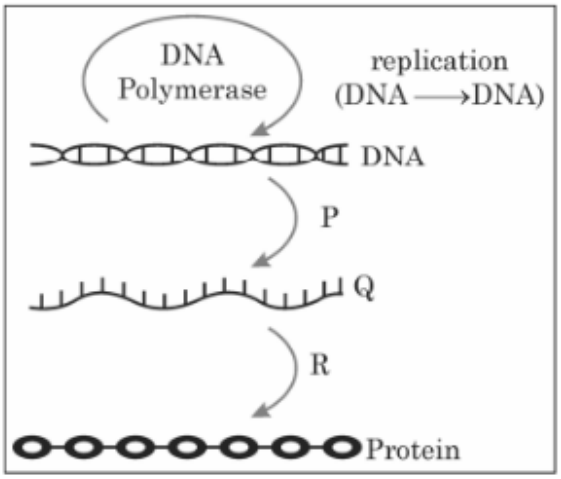
**4. Which of the options has correct identification of 'P', 'Q', and 'R' in the illustration of 'Central Dogma' given below?**




(A) P – Replication, Q – rRNA, 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:**

- Transcription (P): The process by which mRNA is synthesized from a DNA template.
- mRNA (Q): Acts as a blueprint for the synthesis of proteins.
- Translation (R): The process in which the mRNA sequence is translated into a protein.
- The Central Dogma explains the transfer of genetic information from DNA to RNA and then to protein.

Quick Tip

The Central Dogma of molecular biology illustrates the one-way flow of genetic information in cells.

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**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.

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**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)** |
|---|---|
| *A.Lactobacillus* | (i) Cheese |
| *B.Saccharomyces cerevisiae* | (ii) Curd |
| *C.Aspergillus niger* | (iii) Citric acid |
| *D.Acetobacter aceti* | (iv) Bread |
| | (v) 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.

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**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.

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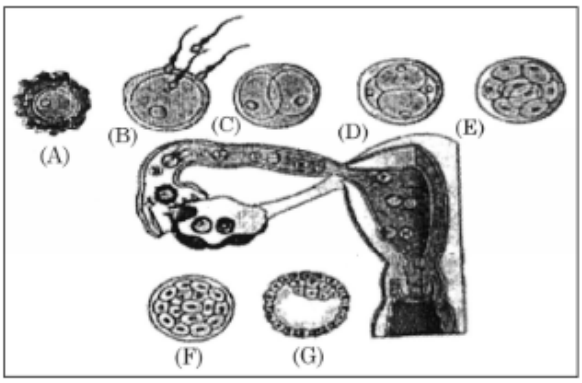
**8. Select the option that gives the correct identification of ovum, morula, and blastocyst in a human female reproduction system as shown in the following diagram:**




(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:**

- **Ovum (A):** The egg cell that has not been fertilized.
- **Morula (E):** A solid cluster of cells formed after several rounds of mitotic division.
- **Blastocyst (G):** A hollow structure formed during early embryonic development that attaches to the uterine wall.

Quick Tip

The blastocyst stage is critical for implantation into the uterine lining, marking the beginning of pregnancy.

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**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.

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**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 caused by the absence of one X chromosome, resulting in a 45, XO chromosomal pattern. This is a type of aneuploidy, which refers to the presence of an abnormal number of chromosomes.

Quick Tip

Turner's syndrome affects females and is characterized by short stature, infertility, and other physical abnormalities.

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**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.

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**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.

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**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.

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**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.

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**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 comes under 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.

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**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.

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## 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.

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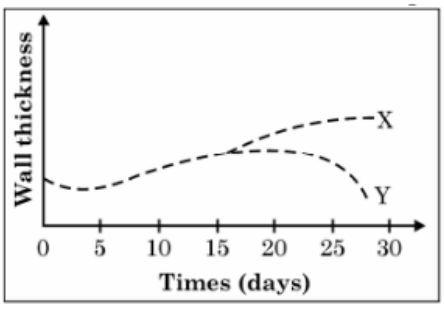
**18. Study the graph given below that represents the changes in the thickening of the uterine wall in women 'X' and women 'Y' over a period of one month: (Refer to the provided graph.)**



**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.

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

**Correct Answer:**

- Through unprotected sexual contact with an infected individual.
- Through sharing needles or other contaminated sharp objects.

**Solution: Step 1: HIV Transmission.**

HIV can be transmitted through sexual contact with an infected person, particularly if there is exposure to infected bodily fluids like semen or blood. Sharing needles used for drug injection can also transmit HIV.

**Step 2: Hepatitis-B Transmission.**

Hepatitis-B can be transmitted in similar ways, including through unprotected sex with an infected person or through contact with contaminated blood, such as sharing needles.

Quick Tip

Both HIV and Hepatitis-B can be prevented by practicing safe sex and avoiding the sharing of needles or any other contaminated materials.

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

**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.

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**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.**

**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.

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**20.(b) Name any two hotspots in India.**

**Correct Answer:** Western Ghats and Indo Burma

**Solution:**

- Western Ghats.
- Indo-Burma region.

Quick Tip

India has four biodiversity hotspots: Himalayas, Western Ghats, Indo-Burma, and Sundaland.

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

**Solution:**

- Grazing food chain: Begins with producers consumed by herbivores. (e.g., Grass → Deer → Lion)
- Detritus food chain: Begins with decomposers breaking down organic matter. (e.g., Dead leaves → Fungi → Earthworm)

Quick Tip

Grazing and Detritus food chain varies according to their functions.

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**21.(b) Explain Brood parasitism with the help of a suitable example.**

**Correct Answer:** Reproductive strategy and Cuckoo.

**Solution:**

- Brood parasitism: A reproductive strategy where one species lays eggs in the nest of another species.
- Example: Cuckoo lays eggs in crow nests; cuckoo chicks outcompete crow chicks for food.

Quick Tip

Brood parasitism benefits the parasitic species by reducing parental investment.

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## 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

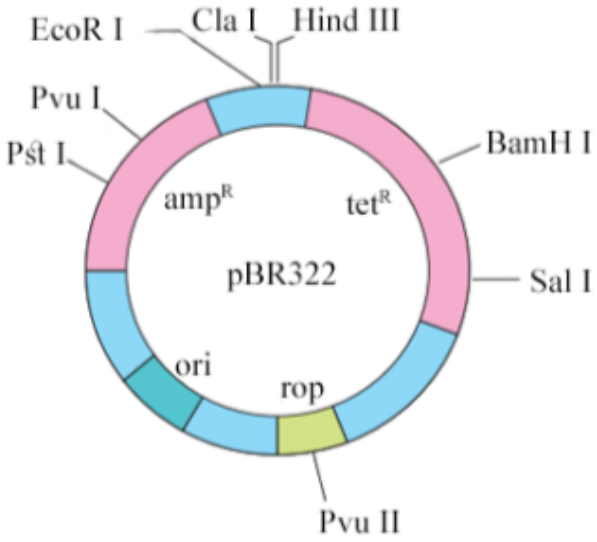
(d) tetracycline-resistant gene

(e) restriction site Bam HI

(f) restriction site EcoRI

**Correct Answer:** Origin, Codes for protein, Antibiotic resistance and restriction sites.

**Solution:** The diagram of the 'E.coli' vector pBR322 should include:




- 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.

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**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.

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**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.

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**(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.

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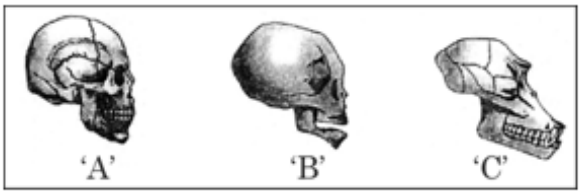
**25. (a) Whose skulls 'A', 'B', and 'C' are shown below? Which of the two are more similar to each other?**




**Correct Answer:** Homo sapiens, Neanderthals, Australopithecus.

**Solution:**

- Skull A: Homo sapiens.
- Skull B: Neanderthals.
- Skull C: Australopithecus.
- Skulls A and B (Homo sapiens and Neanderthals) are more similar to each other.

Quick Tip

Remember the skull A, B, C according to the species.

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

**Correct Answer:** Australopithecus and Homo erectus.

**Solution:**

- (i) Ape-like: Australopithecus.
- (ii) Man-like: Homo erectus.

Quick Tip

Skulls and fossils are vital in understanding the evolutionary lineage of humans and their ancestors.

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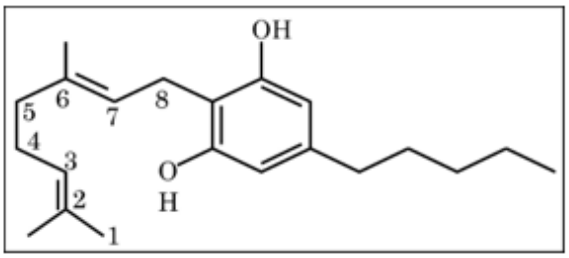
**26. (a) (i) Name the group of drugs whose skeletal molecule is shown below:**




**Correct Answer:** Steroids.

**Solution:** -Steroids are the drugs whose skeletal molecule is given.

-They are characterized by a four-ring carbon structure.

-Steroids can be classified into anabolic steroids, which promote muscle growth, and corticosteroids, which are used to treat inflammation and immune disorders.

Quick Tip

The steroids are drugs which is surrounded by four-ring structure.

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**(ii) How are such drugs consumed?**

**Correct Answer:** These drugs are consumed orally, injected, or applied topically.

**Solution:** -These drugs are consumed orally, injected, or applied topically.

-They can have various therapeutic uses, such as treating inflammation, hormone imbalances, and autoimmune diseases.

-However, prolonged or excessive use can lead to side effects, including liver damage, hormonal imbalances, and increased risk of cardiovascular diseases.

-Steroids should only be used under medical supervision to minimize potential risks.

Quick Tip

The drugs depending on the treatment taken orally, injected or applied topically.

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

**Correct Answer:** Liver.

**Solution:** Liver is affected by the consumption of steroids.

Prolonged use of steroids can lead to liver toxicity, causing conditions like jaundice, liver damage, and in severe cases, liver failure.

Steroids can also increase the risk of developing liver tumors or cysts due to their impact on liver function and metabolism.

Quick Tip

Steroids drugs are classified into different types and injected or orally. Liver is most affected by these drugs.

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**OR**

**(b) 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:** Y-shaped

**Solution:**

- Antibodies are Y-shaped molecules produced by B-lymphocytes.
- Chemical Nature: Proteins made of light and heavy polypeptide chains.

Quick Tip

Antibodies are crucial for immune defense, targeting specific antigens.

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**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.

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

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.

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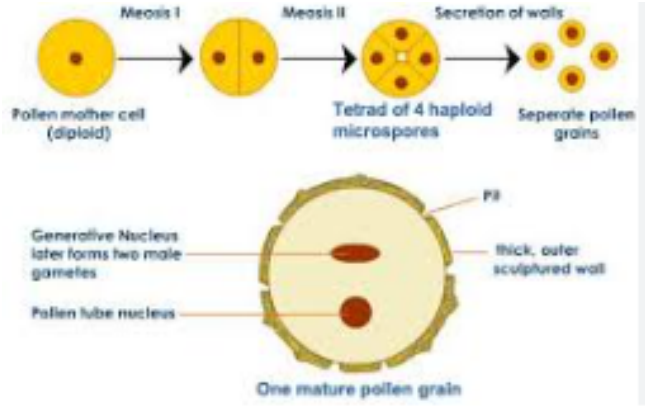
**28. Draw a well-labeled diagram of sectional view of male gametophyte/microspore of an angiosperm and write the functions of any two parts labelled. (Any four labels).**

**Correct Answer:** The diagram should include:




**Solution:**

- Diagram: Microspore with labeled parts (e.g., vegetative nucleus, generative nucleus, exine, intine).
- Functions:
  - Vegetative nucleus: Controls pollen tube growth.
  - Generative nucleus: Divides to form two male gametes for fertilization.

**Quick Tip**

The male gametophyte plays a vital role in sexual reproduction in angiosperms by delivering sperm cells to the ovule.

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## SECTION D

**Case Based Questions**

**29. Read the following passage:**

**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.

**Solution:** 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. This process is called transcription.

Quick Tip

Remember the RNA types and DNA types, both translates from different enzyme.

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**(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 have a single RNA polymerase. - Eukaryotes have three RNA polymerases: RNA polymerase I, II, and III.

**Solution:** - Prokaryotes rely on a single RNA polymerase for synthesizing all types of RNA (mRNA, tRNA, and rRNA).

- Eukaryotes have specialized RNA polymerases:

- RNA polymerase I synthesizes rRNA.

- RNA polymerase II synthesizes mRNA.

- RNA polymerase III synthesizes tRNA and some small RNAs.

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:** - In prokaryotes, transcription occurs in the cytoplasm.

- In eukaryotes, transcription occurs in the nucleus.

**Solution:** - Prokaryotes lack a defined nucleus, so transcription occurs directly in the cytoplasm where translation can occur simultaneously.

- Eukaryotes have a defined nucleus where transcription occurs, separating it from translation which happens in the cytoplasm.

Quick Tip

In eukaryotes, transcription and translation are compartmentalized processes, while in prokaryotes, they occur simultaneously in the cytoplasm.

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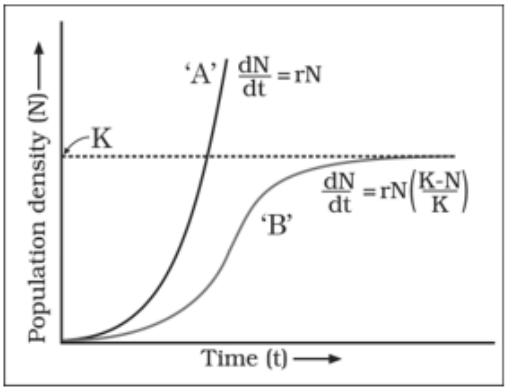
**30. Read the following passage:**

**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 : Exponential growth curve.

- Curve : Logistic growth curve.

**Solution:** Exponential growth occurs under unlimited resources, showing a J-shaped curve. Logistic growth accounts for environmental constraints and levels off at the carrying capacity (K), forming an S-shaped curve.

Quick Tip

Exponential growth cannot sustain indefinitely due to limited resources, whereas logistic growth reflects real-world ecological scenarios.

---

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

**Correct Answer:** Carrying capacity (K)

**Solution:**

- The dotted line represents the carrying capacity (K).
- **Importance:** Carrying capacity is the maximum population size that an environment can sustain indefinitely. It is determined by resource availability and environmental factors.

Quick Tip

The carrying capacity sets a limit on population size to prevent overuse of resources and ecological imbalance.

**OR**

**(b) Growth curve 'B' shows a different pattern from that of growth curve 'A'. Justify giving one reason. Correct Answer:** Logistic curves

**Solution:**

- Curve (logistic growth) differs from curve (exponential growth) because it incorporates the concept of limited resources and environmental resistance.
- Logistic growth considers population stabilization when reaching the carrying capacity, making it more realistic.

Quick Tip

Logistic growth aligns with natural population patterns where resources are limited and competition exists.

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**(c)(i) Which one of the two curves is more realistic and why? Correct Answer:** A and B

**Solution:**

- Curve (logistic growth) is more realistic because populations are subject to resource limitations, predation, and environmental constraints.
- Curve (exponential growth) assumes unlimited resources, which is rarely the case in natural ecosystems.

Quick Tip

Logistic growth reflects real-world dynamics, highlighting the role of environmental resistance in stabilizing populations.

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**(ii) Which one of the two curves is relevant in present days with respect to human population in our country and why? Correct Answer:** Exponential curve

**Solution:**

- The exponential growth curve (Curve 2018-2019) is more relevant because the human population continues to grow at a rapid rate, often exceeding the carrying capacity temporarily.
- However, environmental resistance like resource depletion and climate change will eventually necessitate stabilization, transitioning to a logistic growth model.

**Quick Tip**

Human population trends often reflect exponential growth due to advancements in healthcare and technology, delaying resource exhaustion.

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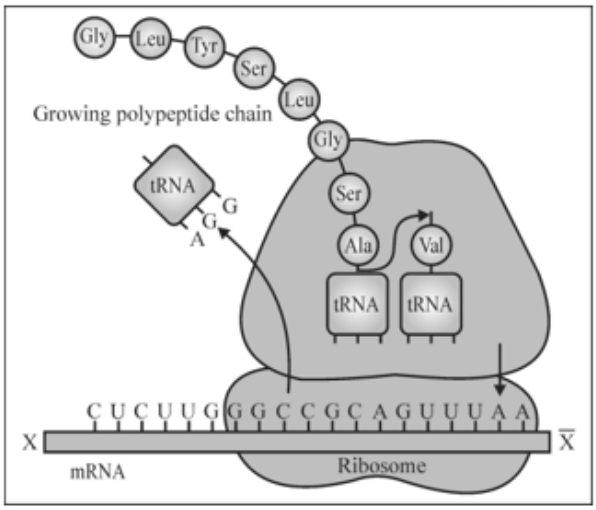
## SECTION E

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




**(i) Identify the polarity from 'X' to 'Y' 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:** 5 to 3

**Solution:**

- Polarity: 5' to 3' direction.
- Number of additional amino acids: Depends on the number of codons left untranslated on the mRNA.

- Reason: Each codon corresponds to one amino acid, and translation stops when a stop codon is encountered.

Quick Tip

mRNA's polarity determines the direction of translation, with the ribosome reading it from 5' to 3'.

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

**Correct Answer:** AUG, UAC and Methionine

**Solution:**

- Initiating codon: AUG.
- Anticodon: UAC.
- Amino acid: Methionine.

Quick Tip

The codon AUG not only initiates translation but also codes for methionine, a crucial amino acid in protein synthesis.

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

**Solution:**

- Charging of tRNA: Aminoacyl-tRNA synthetase attaches a specific amino acid to its corresponding tRNA, forming aminoacyl-tRNA.
- Importance: Charged tRNA ensures accurate addition of amino acids to the growing polypeptide chain during translation.

Quick Tip

Charged tRNA is essential for translating the genetic code into a functional protein.

**OR**

**(b) Answer the following questions on sickle-cell anaemia:**

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

**Correct Answer:** RBCs

**Solution:**

- The disorder causes red blood cells to assume a sickle shape under low oxygen conditions, leading to its name.

Quick Tip

The sickle shape of red blood cells reduces their ability to carry oxygen efficiently, leading to severe health complications.

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

**Solution:**

- It is caused by a point mutation in the heamo-globin gene, where glutamic acid is replaced by valine at the sixth position of the haemoglobin protein.
- The mutated haemoglobin (HbS) polymerizes under low oxygen conditions, leading to cell deformation.

Quick Tip

Sickle-cell anaemia arises due to a single-point mutation, showcasing the profound impact of small genetic changes.

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

**Solution:** When both parents are carriers (HbA HbS), the offspring have a 25% chance of inheriting two sickle-cell alleles (HbS HbS), causing the disorder.

Quick Tip

A Punnett square can effectively illustrate inheritance patterns of sickle-cell anaemia and other genetic disorders.

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

**Solution:** 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.

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**OR**

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

**Solution:**

- 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.

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**(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.**

**Solution:**

- 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.

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

**Solution:** Artificial hybridization is used in plant breeding to combine the best traits from different plant varieties, improving crop quality and yield. To obtain desired traits such as disease resistance, higher yield, or improved quality in plants by crossing two genetically different plants.

Quick Tip

The objective of adopting artificial hybridization is useful in plants for many ways.

**(ii) Describe the steps followed in this technique.**

**Solution:** 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.**

**Solution:** -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.

-The placenta facilitates the exchange of nutrients, gases, and waste products between the maternal and fetal blood.

-It also produces hormones like human chorionic gonadotropin (hCG), progesterone, and estrogen to support pregnancy.

Quick Tip

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

**(ii) Explain its role.**

**Solution:** 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.

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