Biology Question Paper with Solutions

Time Allowed :3 hours	**Maximum Marks :**70	**Total Questions :**33

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:

Options:
(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):** Found in antipodal cells.
- **2n (diploid):** Found in the zygote formed by fertilization.
- **3n (triploid):** Found in the endosperm formed by double fertilization.
- This distribution of ploidy levels is a characteristic feature of angiosperm reproduction.

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. Turner's syndrome in humans occurs due to:

Options:
(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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3. Which of the options has correct identification of 'P', 'Q', and 'R' in the illustration of 'Central Dogma' given below?

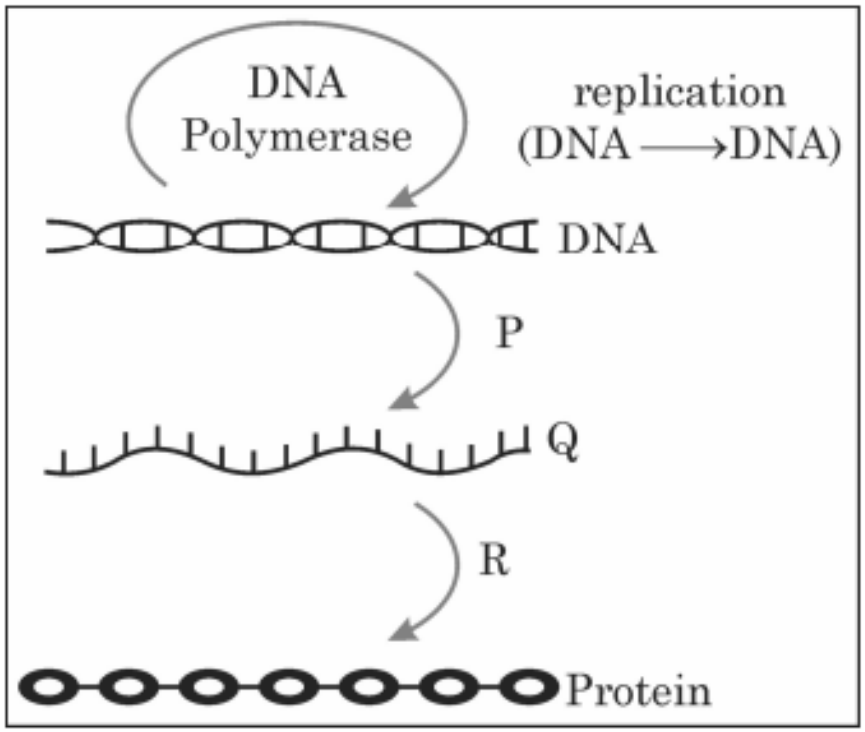

Figure 1: Illustration showing DNA replication, transcription, and translation. Labels P, Q, and R represent the processes leading to protein synthesis.

Options:
(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 of synthesizing mRNA from DNA.
- mRNA (Q): Serves as a template for protein synthesis.
- Translation (R): The process where the mRNA sequence is decoded to synthesize a protein.
- The Central Dogma describes the flow of genetic information from DNA to RNA to Protein.

Quick Tip

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

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

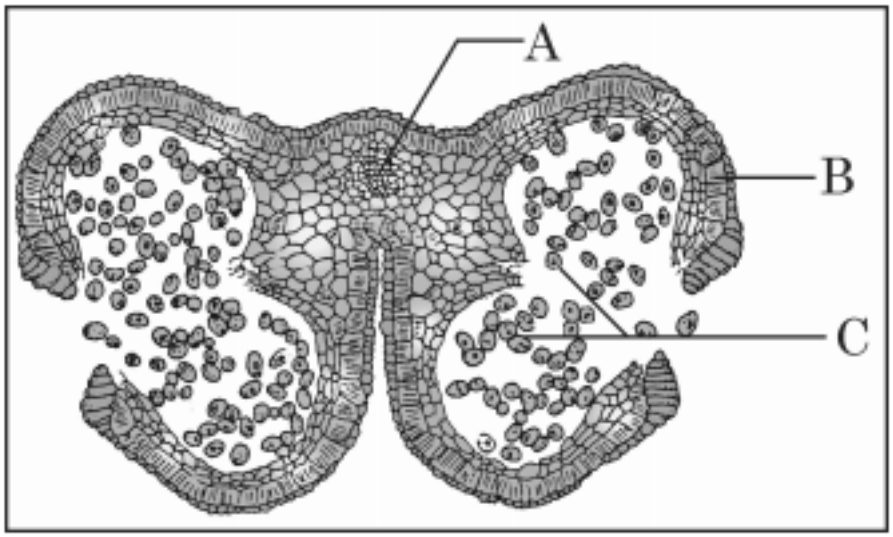

Figure 2: Cross-section of an anther. Labelled parts: A - Epidermis, B - Pollen sacs, C - Connective tissue.

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

Options:
(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 joining the two lobes of the anther.
- **B – Endothecium:** The outer layer of the pollen sac that provides mechanical support.
- **C – Pollen grain:** The male gametophyte formed 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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5. 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:

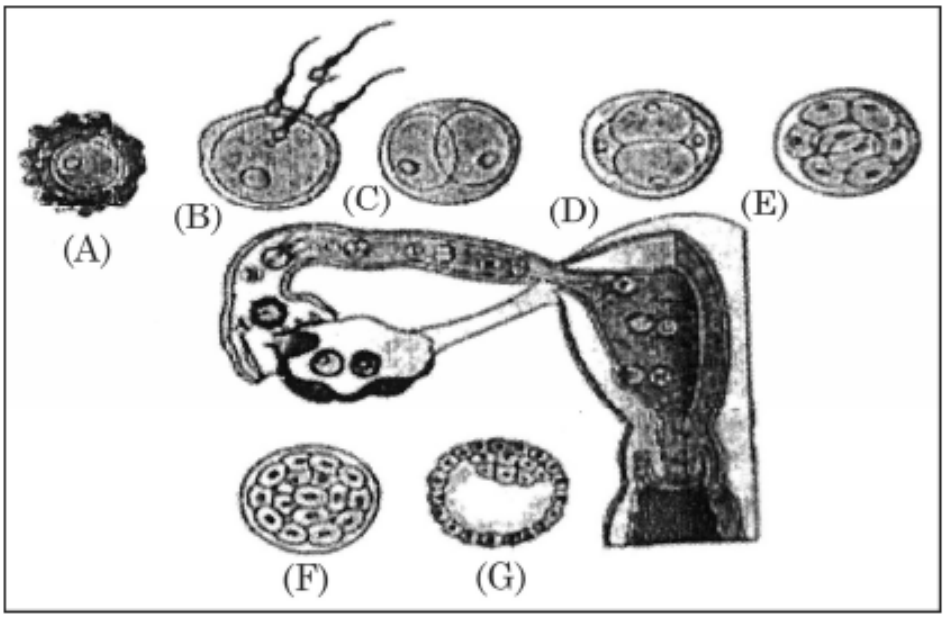

Figure 3: Stages of male gametophyte development in flowering plants. Labels: (A) Pollen mother cell, (B) Microspore tetrad, (C) Uninucleate microspore, (D) Binucleate pollen grain, (E) Mature pollen grain, (F) Pollen tube formation, (G) Pollen tube growth.

Options:
(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: (D) Ovum – B, Morula – D, Blastocyst – G.

Solution:

- **Ovum (B):** The unfertilized egg.
- **Morula (D):** A solid ball of cells formed after a series of mitotic divisions.
- **Blastocyst (G):** A hollow structure in early embryonic development that implants into 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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6. Study the table given below:

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

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

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

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

Solution:

- **A – The pill:** Inhibits ovulation (III).
- **B – Condom:** Prevents sperm from reaching the cervix (I).
- **C – Vasectomy:** Semen contains no sperm after the vas deferens is cut or tied (IV).
- **D – Copper-T:** Prevents implantation of the fertilized egg (II).

Quick Tip

Contraceptive methods are effective tools for family planning, with distinct mechanisms tailored to different needs.

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

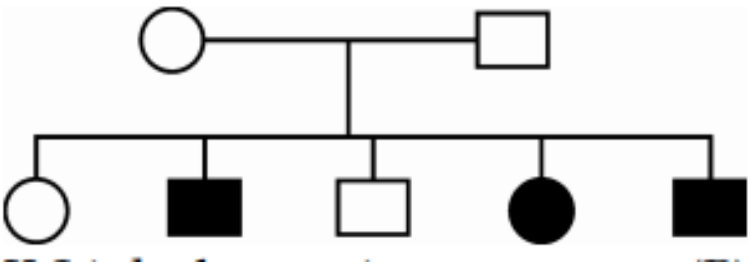

Figure 4: Pedigree diagram representing inheritance patterns.

Options:
(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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8. ELISA technique is based on the principle of:

Options:
(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 specific antigens or antibodies using the principle of antigen-antibody interaction.
- The binding is detected through an enzyme-linked reaction, often resulting in a color change.

Quick Tip

ELISA is extensively used in medical diagnostics, such as detecting infections like HIV and hepatitis.

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9. Homologous organs indicate:

Options:
(A) Convergent evolution
(B) Divergent evolution
(C) Adaptive radiation
(D) Natural selection

Correct Answer: (B) Divergent evolution

Solution:

- Homologous organs have a similar structure but may perform different functions, e.g., human arm and bat wing.
- These similarities suggest a common ancestor and illustrate divergent evolution.

Quick Tip

Divergent evolution demonstrates how species adapt differently to various environments while sharing a common ancestry.

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10. The 'molecular scissors' fall in the category of:

Options:
(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 recognition sequences.
- They are widely used in genetic engineering and molecular biology for cloning and gene editing.

Quick Tip

Restriction enzymes revolutionized molecular biology, enabling precise DNA manipulation for research and therapeutic purposes.

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11. Which of the chromosome in a human possesses the least number of genes?

Options:
(A) 21^{st} chromosome
(B) 16^{th} chromosome
(C) X chromosome
(D) Y chromosome

Correct Answer: (D) Y chromosome

Solution:

- The Y chromosome is the smallest human chromosome and contains the least number of genes.
- It carries genes essential for male sex determination and spermatogenesis.

Quick Tip

The Y chromosome's primary function is determining male sex characteristics, with limited genes compared to other chromosomes.

-12. Given below is a list of some commercially important products in column A, whereas in column B are names of source organisms:

Column A (Bioactive Products)	Column B (Source Organisms)
A. Cyclosporin – A	i. Streptococcus
B. Statins	ii. Trichoderma polysporum
C. Streptokinase	iii. Penicillium notatum
D. Penicillin	iv. Monascus purpureus

Select the option where the product and their source organisms are correctly matched.

Options:
(A) A – (ii), B – (iii), C – (ii), D – (iv)
(B) A – (iii), B – (iv), C – (iv), D – (i)
(C) A – (ii), B – (iv), C – (i), D – (iii)
(D) A – (iv), B – (ii), C – (i), D – (iii)

Correct Answer: (D) A – (iv), B – (ii), C – (i), D – (iii)

Solution:

- **Cyclosporin – A:** Produced by **Monascus purpureus** and used as an immunosuppressant.
- **Statins:** Derived from **Trichoderma polysporum**, these lower blood cholesterol.
- **Streptokinase:** Obtained from **Streptococcus**, used to remove blood clots.
- **Penicillin:** Produced by **Penicillium notatum**, an antibiotic effective against bacterial infections.

Quick Tip

Bioactive products derived from microorganisms have revolutionized medicine, saving millions of lives globally.

Question Nos. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:
Options:
(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 circular DNA molecules capable of autonomous replication.
- They are commonly found in **prokaryotic cells** like bacteria, not in eukaryotic cells.

Quick Tip

Plasmids are essential tools in genetic engineering for cloning and gene expression studies.

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14. Assertion (A): Patents are granted by governments 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 for exclusive use of their inventions.
- Preventing unauthorized use is the primary reason for granting patents, as it ensures that inventors can commercialize their inventions without competition for a limited time.

Quick Tip

Patents encourage innovation by protecting intellectual property rights.

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15. 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:

- Fig and wasp share an obligate mutualistic relationship where each depends on the other for survival and reproduction.
- Wasps pollinate the fig while laying eggs, ensuring mutual benefit.

Quick Tip

The fig-wasp interaction is a classic example of obligate mutualism in nature.

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16. Assertion (A): Some aquatic ecosystems have inverted biomass pyramids.
Reason (R): More energy is required by 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 where the biomass of primary consumers exceeds that of producers.
- More energy is indeed required by organisms occupying higher trophic levels, but this does not explain why inverted biomass pyramids occur in aquatic ecosystems.

Quick Tip

In aquatic ecosystems, phytoplankton reproduce rapidly, sustaining higher consumer biomass despite low producer biomass.

SECTION - B

17. What is artificial insemination in ART? Under what conditions is the person medically advised to go for it?

Answer:

- Artificial insemination is a technique in Assisted Reproductive Technology (ART) where semen is artificially introduced into the female reproductive tract.
- Conditions:
  - When the male partner has low sperm count or motility.
  - In cases of physical or anatomical issues in natural intercourse.

Quick Tip

Artificial insemination is often used as a treatment for infertility in couples unable to conceive naturally.

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18. Why does a patient of ADA-deficiency require repeated infusions of genetically engineered lymphocytes? Suggest a possible permanent remedy.

Answer:

- ADA (Adenosine Deaminase) deficiency leads to severe immune system dysfunction.
- Repeated infusions of genetically engineered lymphocytes temporarily restore immune function.
- Permanent Remedy: Gene therapy to introduce a functional ADA gene into the patient's bone marrow cells, ensuring lifelong enzyme production.

Quick Tip

Gene therapy for ADA deficiency is a promising approach for curing immune disorders.

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19. 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:

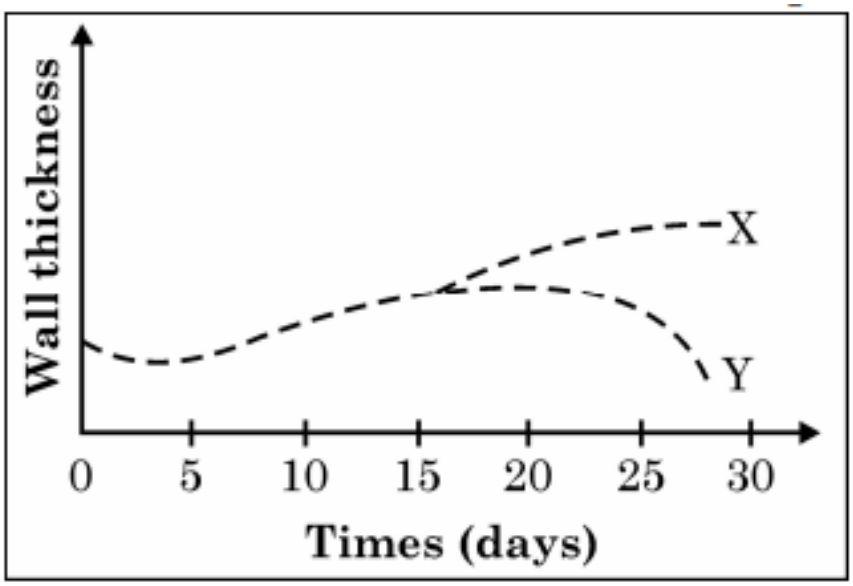

Figure 5: Graph depicting the change in wall thickness over time (days). X and Y represent two different trends observed.

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

Answer:

- **Woman X:** Normal thickening of the uterine wall due to regular hormonal activity.
- **Woman Y:** Lack of thickening indicates hormonal imbalance or insufficient secretion of estrogen and progesterone.

Quick Tip

A healthy uterine wall is crucial for successful implantation of the embryo. Hormonal therapies can address imbalances in woman Y.

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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.

Answer:

- Biodiversity hotspots are regions with a high number of endemic species but face significant habitat destruction.
- Protection ensures the survival of species, maintains ecosystem stability, and preserves genetic resources for future use.

(b) Name any two hotspots in India.
Answer:

- Western Ghats.
- Indo-Burma region.

Quick Tip

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

(a) Differentiate between grazing food chain and detritus food chain.
Answer:

- 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)

(b) Explain Brood parasitism with the help of a suitable example.
Answer:

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

Quick Tip

Brood parasitism benefits the parasitic species by reducing parental investment in offspring care.

21. (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.

Answer:

- Biodiversity hotspots are regions with a high number of endemic species but face significant threats due to habitat loss, deforestation, and human activities.
- Protecting these areas ensures the survival of many species, maintains ecological balance, and safeguards genetic diversity.
- Hotspots are critical for ecosystem services such as water purification, soil fertility, and climate regulation.

(b) Name any two hotspots in India.
Answer:

- Western Ghats.
- Indo-Burma region.

Quick Tip

India is home to four biodiversity hotspots: Himalayas, Western Ghats, Indo-Burma, and Sundaland. These areas are critical for conservation efforts.

(a) Differentiate between grazing food chain and detritus food chain.
Answer:

- Grazing Food Chain:
  - Begins with producers (plants) consumed by herbivores.
  - Example: Grass → Deer → Lion.
- Detritus Food Chain:
  - Begins with dead organic matter broken down by decomposers.
  - Example: Dead leaves → Fungi → Earthworms.

(b) Explain Brood parasitism with the help of a suitable example.
Answer:

- Brood parasitism is a reproductive strategy where one species lays its eggs in the nest of another species.
- Example: The cuckoo lays its eggs in crow nests. Cuckoo chicks often hatch earlier and outcompete the host's chicks for food, ensuring survival.

Quick Tip

Brood parasitism reduces parental investment by the parasitic species while exploiting the host for raising their young.

SECTION - C

22. With reference to flower color, two independent crosses were made, one between true breeding garden pea plants and another between true breeding Antirrhinum plants. Write the phenotypes of their F_1 progeny. Justify your answer giving reasons.

Answer:

- **Garden Pea:** F_1 progeny exhibits complete dominance, showing the dominant flower color.
- **Antirrhinum:** F_1 progeny exhibits incomplete dominance, resulting in an intermediate flower color (e.g., pink when red and white are crossed).

Quick Tip

Inheritance patterns differ between species: Garden pea shows Mendelian dominance, while Antirrhinum shows incomplete dominance.

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

Answer: The diagram should include:

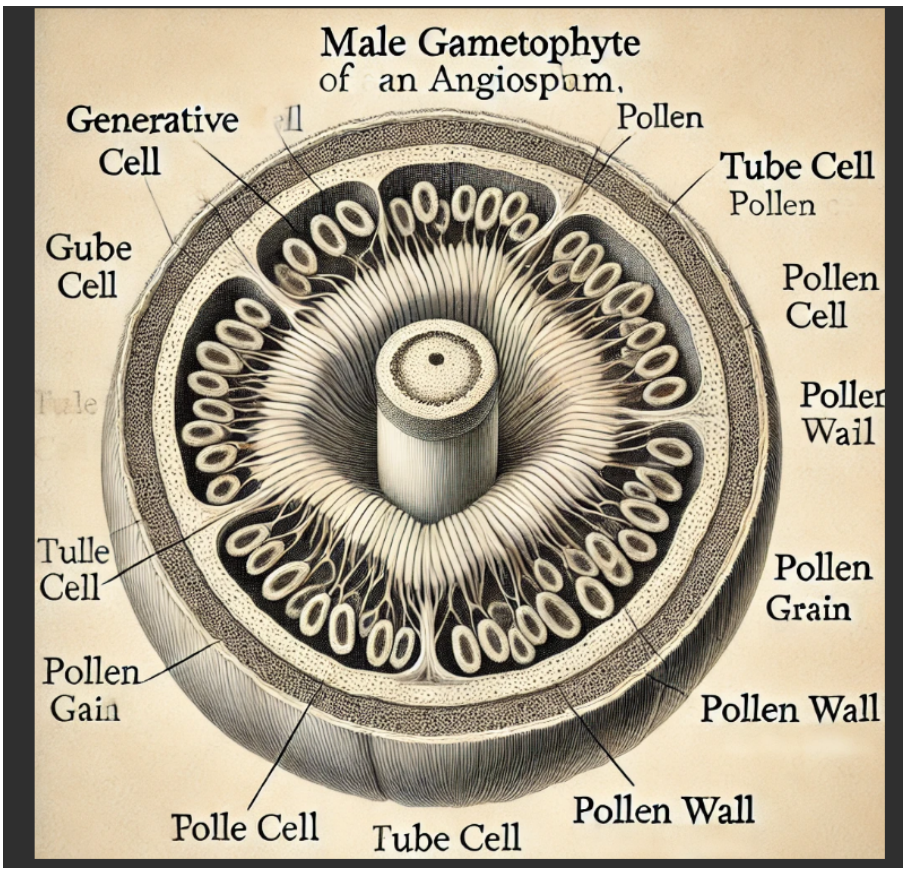

Figure 6: male gametophyte.

- Generative Cell.
- Tube Cell.
- Pollen Wall.
- Pollen Grain.

Functions:

- Generative Cell: Divides to form two male gametes.
- Tube Cell: Grows into a pollen tube to facilitate fertilization.

Quick Tip

The male gametophyte of an angiosperm plays a vital role in reproduction by producing male gametes.

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

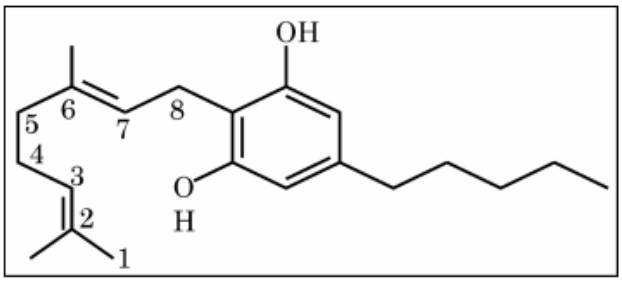

Figure 7: Chemical structure of the given compound.

Answer: Steroids.

(ii) How are such drugs consumed?
Answer: Steroids can be consumed orally, injected, or applied topically depending on their formulation.

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

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

- **Antibody Diagram:** Include the Y-shaped structure showing:
  - Light Chain.
  - Heavy Chain.
  - Antigen Binding Site.
  - Disulfide Bond.
- **Chemical Nature:** Antibodies are glycoproteins composed of polypeptide chains.
- **Producing Cells:** B-Lymphocytes or Plasma Cells.

Quick Tip

Antibodies play a critical role in the immune response by neutralizing pathogens and marking them for destruction.

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25. Explain the role of transgenic animals in:
(a) Production of Biological Products:
Answer:

- Transgenic animals are used to produce important biological substances like proteins, enzymes, and hormones.
- Example: Transgenic goats producing antithrombin, a protein used to treat blood clotting disorders.

(b) Studying Diseases:
Answer:

- They are used as model organisms to study human diseases, their progression, and treatment.
- Example: Transgenic mice are used to study cancer, diabetes, and Alzheimer's disease.

(c) Chemical Safety Testing:
Answer:

- Transgenic animals are used to test the safety and efficacy of chemicals and drugs before human use.
- Example: Toxicity testing using transgenic rodents.

Quick Tip

Transgenic animals have revolutionized medicine and research by enabling the study of diseases and the development of therapeutic solutions.

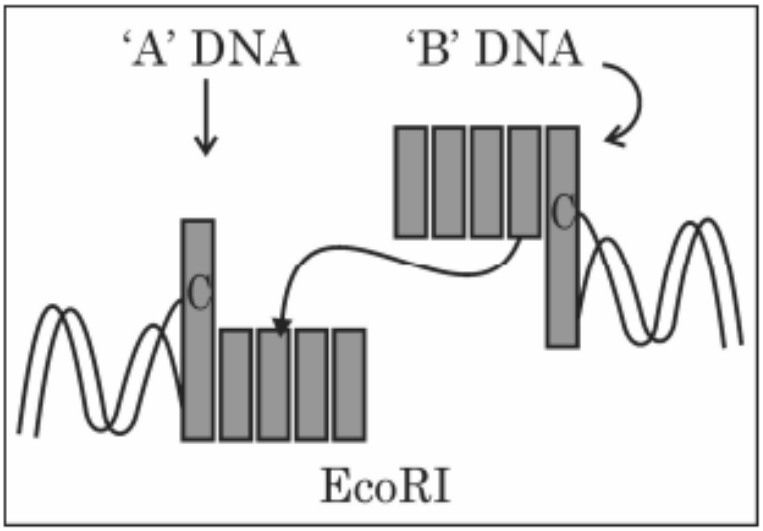

Figure 8: Diagram illustrating the cleavage of DNA by EcoRI enzyme.

26. The schematic representation as above is showing the linking of two DNA fragments.

(a) Name 'A' and 'B' fragments.
Answer:

- A: Vector DNA.
- B: Foreign DNA.

(b) Write the 'palindrome' recognized by EcoRI.
Answer:

- The palindrome sequence recognized by EcoRI is:

$$5' - GAATTC - 3'3' - CTTAAG - 5'$$

(c) Where does EcoRI cut the palindrome? Write the events followed thereafter to form a recombinant DNA.
Answer:

- EcoRI cuts between G and A in the sequence, generating sticky ends.
- Events that follow:
  - The sticky ends of vector DNA and foreign DNA pair through complementary base pairing.
  - DNA ligase seals the nicks, forming recombinant DNA.

Quick Tip

EcoRI is a restriction enzyme widely used in genetic engineering for creating recombinant DNA molecules.

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27. How do the following organisms act as bio-fertilizers? Explain.
(a) *Mycorrhiza*
(b) *Anabaena*
(c) *Rhizobium*

Answer:

- ***Mycorrhiza:***
  - A symbiotic association between fungi and plant roots.
  - Enhances water and nutrient absorption, particularly phosphorus.
- ***Anabaena:***
  - A cyanobacterium capable of nitrogen fixation.
  - Provides nitrogen to plants in a usable form and enhances soil fertility.
- ***Rhizobium:***
  - A bacterium that forms nodules on the roots of leguminous plants.
  - Converts atmospheric nitrogen into ammonia, which is used by the plant.

Quick Tip

Bio-fertilizers enhance soil fertility naturally, reducing dependency on chemical fertilizers.

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

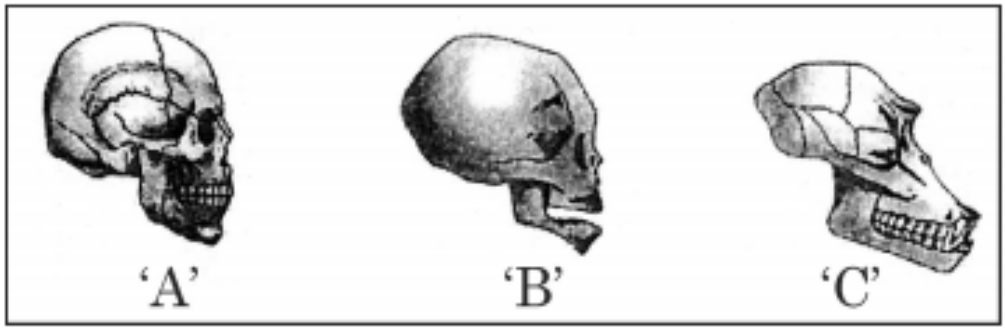

Figure 9: Comparison of skulls labeled as 'A', 'B', and 'C'.

Answer:

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

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

- (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.

SECTION - D

29. 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.

(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.
Answer:

- RNA Product: Messenger RNA (mRNA).
- Enzyme: RNA Polymerase II.

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

- Process: Splicing.
- Explanation:
  - The pre-mRNA transcribed from DNA contains both coding (exons) and non-coding (introns) regions.
  - During splicing, introns are removed, and exons are joined to form a mature mRNA, which is translated into a protein.

Quick Tip

Splicing ensures the formation of functional mRNA by removing non-coding sequences, enabling accurate translation.

(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.
Explanation: - 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

In prokaryotes, a single RNA polymerase performs all RNA synthesis, whereas eukaryotes use three specialized polymerases for different types of RNA.

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.
Explanation: - 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:

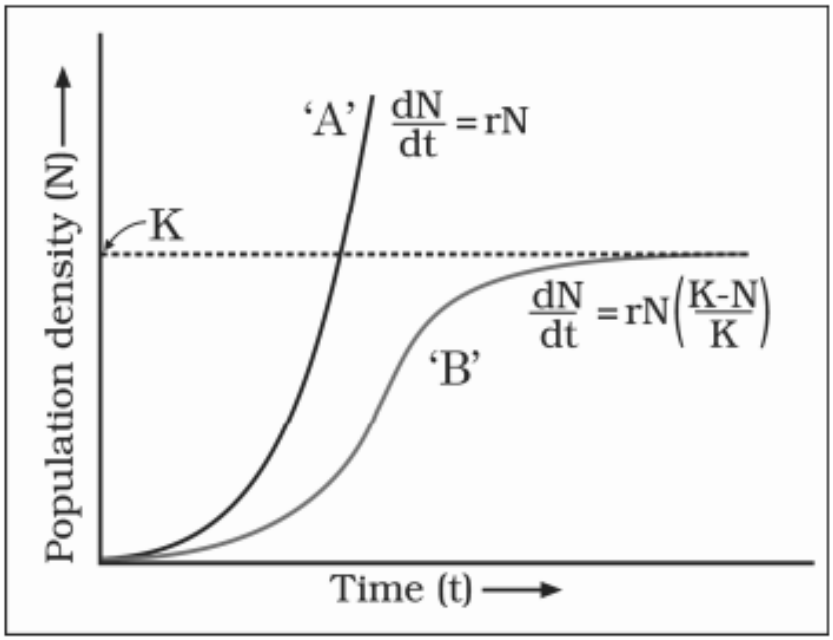

Figure 10: Comparison of exponential growth ('A') and logistic growth ('B') models.

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

- Curve 'A': Exponential growth curve.
- Curve 'B': Logistic growth curve.

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

- The dotted line indicates the carrying capacity (K).

- **Importance:** Carrying capacity represents the maximum population size that an environment can sustain indefinitely. It depends on resource availability and environmental constraints.

Quick Tip

Carrying capacity is crucial for maintaining ecological balance and preventing resource depletion.

OR

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

- Growth curve 'B' (logistic growth) incorporates environmental resistance, which stabilizes population size as it approaches the carrying capacity.
- Exponential growth (curve 'A') assumes unlimited resources, which is unrealistic in natural environments.

(d) Which one of the two curves is more "realistic" and why?
Answer:

- Curve 'B' is more realistic because it reflects real-world conditions, where resources are limited, and competition regulates population size.

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

- The exponential growth curve (curve 'A') is more relevant because the human population continues to grow rapidly due to advancements in healthcare and technology.
- However, environmental challenges may eventually enforce a transition to a logistic growth model.

Quick Tip

Exponential growth reflects the current human population trend, but logistic growth is inevitable due to resource constraints.

SECTION - E

31. (a) Explain the following phases in the menstrual cycle of a human female:

- (1) Menstruation
- (2) Follicular phase

- (3) Luteal phase

Answer:

- **Menstruation:** The uterine lining sheds due to a drop in progesterone levels, resulting in menstrual bleeding.
- **Follicular Phase:** FSH stimulates the development of follicles, and estrogen levels increase, thickening the uterine lining.
- **Luteal Phase:** After ovulation, the ruptured follicle forms the corpus luteum, secreting progesterone to maintain the uterine lining for possible implantation.

(ii) 'A proper understanding of the menstrual cycle can help immensely in family planning.' Do you agree with the statement? Provide reasons for your answer.
Answer: Yes, understanding the menstrual cycle helps in:

- Identifying the fertile window for conception or avoiding pregnancy.
- Monitoring reproductive health and detecting irregularities.

OR

(b) (i) Why does endosperm development precede embryo development in angiosperm seeds? State the role of endosperm in mature albuminous seeds.
Correct Answer:
Endosperm development precedes embryo development in angiosperm seeds to provide the necessary nutrients for the developing embryo. The endosperm stores and supplies food materials to support the initial stages of embryo growth.
Explanation: - Endosperm forms after the fusion of one sperm nucleus with two polar nuclei, ensuring the availability of nutrients for the zygote. - In albuminous seeds, such as wheat and maize, the endosperm persists in the mature seed and acts as a storage tissue for nutrients, including starch, proteins, and oils, required for seed germination and growth.

Quick Tip

The endosperm is crucial in monocots like cereals, where it persists and provides energy during germination.

(b) (ii) Draw a labelled diagram showing the different embryonic stages of a dicot plant, up to a fully mature embryo.
Correct Answer:
Refer to the labelled diagram below for the stages of embryonic development in a dicot plant:

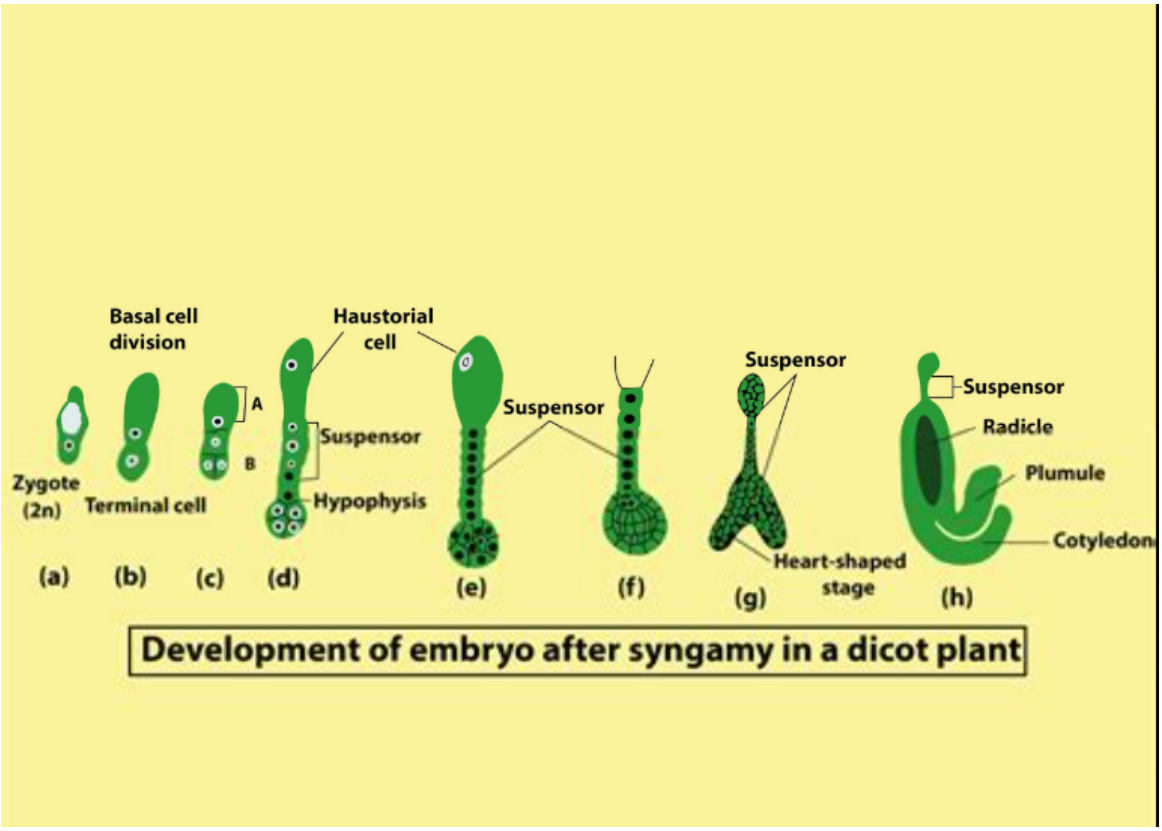

Figure 11: Development of embryo after syngamy in a dicot plant showing different stages from zygote to fully mature embryo.

Explanation: - The embryonic development in dicots progresses through distinct stages: - **Globular stage:** A spherical mass of cells forms. - **Heart-shaped stage:** Cotyledons begin to emerge, giving the embryo a heart shape. - **Torpedo stage:** The cotyledons elongate, and the shoot and root meristems become prominent. - **Mature embryo stage:** The embryo has two cotyledons, a plumule (shoot tip), and a radicle (root tip), ready for germination.

Quick Tip

Understanding embryonic stages helps in studying seed development and propagation techniques in plants.

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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. Answer:

- Entry: HIV attaches to CD4 receptors on T-cells and fuses with the cell membrane.
- Reverse Transcription: Viral RNA is converted to DNA by reverse transcriptase.
- Integration: Viral DNA integrates into the host genome via integrase.
- Replication: Host machinery synthesizes viral proteins and RNA.
- Release: New viruses assemble and exit, destroying T-cells over time.
- Progression: Immune system weakens, leading to opportunistic infections and AIDS.

HIV targets the immune system, making the body vulnerable to infections.

OR

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

Correct Answer:

The symptoms of malaria in humans include:

- Recurring high fever with chills.
- Sweating and shivering.
- Headache and body aches.
- Nausea and vomiting.
- Fatigue and weakness.

.

Explanation: - These symptoms are caused by the release of merozoites into the bloodstream when red blood cells rupture. - The parasite (Plasmodium) infects red blood cells and multiplies within them, leading to their destruction and the release of toxic substances such as haemozoin, which triggers the immune response and causes fever and chills.

Quick Tip

Malaria symptoms typically appear in cycles, reflecting the synchronized bursting of infected red blood cells.

(b) (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:

The steps in the sexual mode of reproduction of the malarial parasite are:

1. **Gamete Formation:**
   - Gametocytes are formed in the human host and are ingested by a female *Anopheles* mosquito during a blood meal.
2. **Fertilization:**
   - Male and female gametocytes fuse in the mosquito's gut to form a zygote.
3. **Ookinete Formation:**
   - The zygote develops into a motile ookinete, which penetrates the mosquito's gut wall.
4. **Oocyst Development:**
   - The ookinete forms an oocyst on the mosquito's gut wall.
5. **Sporozoite Formation:**

- The oocyst undergoes multiple divisions to produce sporozoites, which migrate to the mosquito's salivary glands.

6. **Completion:**

   - The sporozoites are injected into a new human host when the mosquito feeds, completing the cycle.

Explanation: - The sexual reproduction of Plasmodium occurs in the mosquito (definitive host), while asexual reproduction occurs in the human (intermediate host). - The sporozoites introduced into the human bloodstream travel to the liver, initiating the next cycle of asexual reproduction.

Quick Tip

Remember: The mosquito is the definitive host for Plasmodium because sexual reproduction occurs in its body.

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33. (a) Study the schematic diagram given below and answer the questions:

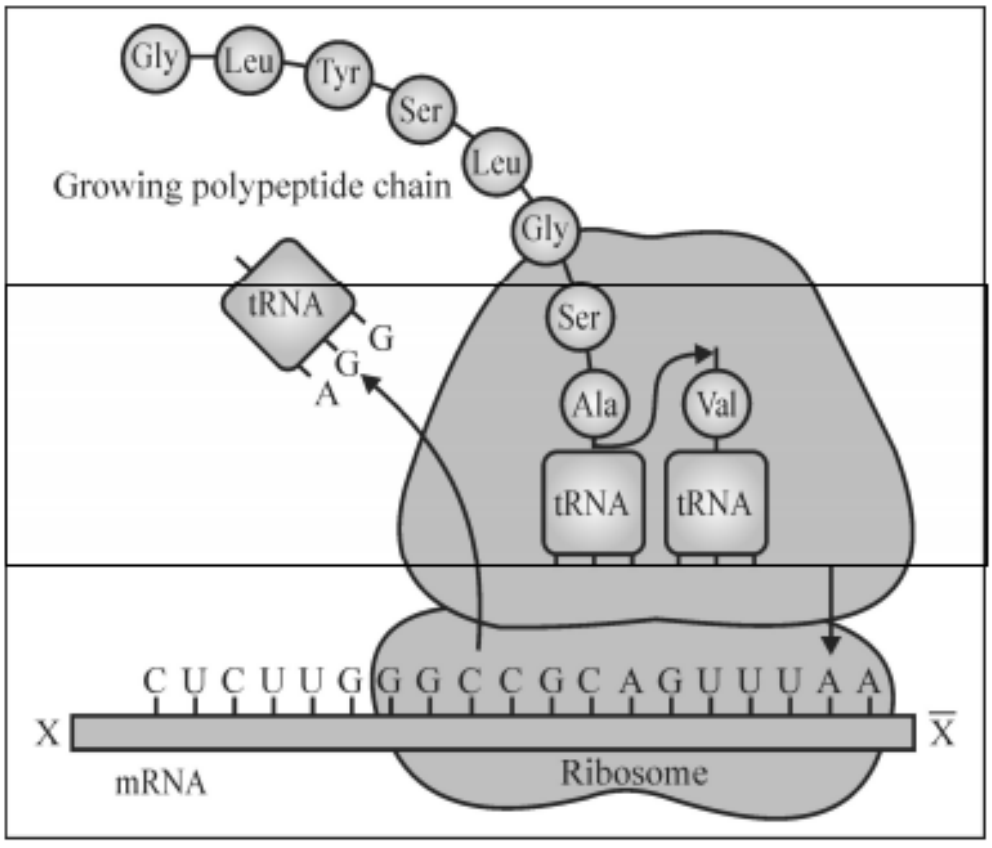

Figure 12: Diagram illustrating the translation process in protein synthesis, showing the ribosome, mRNA, tRNA, and the growing polypeptide chain.

(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. Answer:

- Polarity: 5' to 3'.
- Number of additional amino acids: Determined by the number of codons left untranslated on mRNA.
- Explanation: Each codon codes for one amino acid until a stop codon is reached.

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

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

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

- tRNA is charged by attaching an amino acid via aminoacyl-tRNA synthetase.
- Charged tRNA ensures the correct amino acid is added during translation.

tRNA acts as the adaptor in protein synthesis, translating genetic code into amino acids.

OR

(b) Answer the following questions on sickle-cell anaemia: (i) Why is sickle-cell anaemia, a human blood disorder, so named? Answer:

- Sickle-shaped red blood cells appear under low oxygen levels, leading to the name.

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

- Caused by a point mutation in the -globin gene, replacing glutamic acid with valine.
- Abnormal haemoglobin (HbS) polymerizes, deforming cells.

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

- Genotypes: Parents (HbA HbS), Child (HbS HbS).
- Punnett square demonstrates a 25% chance for an affected child.

Sickle-cell anaemia follows an autosomal recessive inheritance pattern.
