

SET-1

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

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:

- In a fertilized ovule of an angiosperm:
 - **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 characteristic of the angiosperm reproductive process.

💡 Quick Tip

The process of double fertilization in angiosperms ensures the formation of both a diploid zygote and a triploid endosperm for nourishment.

2. 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:

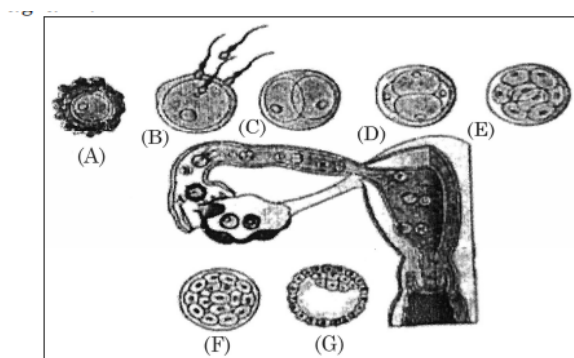


Figure 1: Human Female Reproductive System

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:** The unfertilized egg cell (B) as shown in the diagram.
- **Morula:** A solid ball of cells (D) resulting from the early cleavage stages post-fertilization.

- **Blastocyst:** A hollow structure (G) formed in the early development of mammals, which implants in the uterine wall.

 Quick Tip

The blastocyst stage is crucial for implantation into the uterine lining, marking the start of pregnancy.

3. Study the table given below:

Contraceptive/Contraceptive Method	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.

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 – III, B – I, C – II, D – IV

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

Solution:

- **A – The pill:** Works by inhibiting ovulation (III).
- **B – Condom:** Prevents sperm from reaching the cervix (I).
- **C – Vasectomy:** Involves cutting/tying vas deferens, resulting in semen containing no sperm (IV).
- **D – Copper-T:** Prevents implantation of the fertilized egg in the uterus (II).

 Quick Tip

Contraceptive methods are designed to prevent fertilization or implantation, ensuring effective family planning.

This corrected code reflects the appropriate matches for each contraceptive method and their mode of action:

A – III: The pill inhibits ovulation. B – I: The condom prevents sperm from reaching the cervix. C – IV: Vasectomy results in semen containing no sperm. D – II: Copper-T prevents implantation. Let me know if you need any further adjustments!

4. 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:

Step 1: Analyze the Pedigree Chart.

- Both males and females are affected, indicating autosomal inheritance.
- The disorder appears in siblings but not in the parents, which is characteristic of a recessive trait.

Final Answer: The genetic disorder depicted is **autosomal recessive**.

💡 Quick Tip

Autosomal recessive disorders often skip generations, as carriers do not exhibit symptoms.

5. Which was the last of the 24 human chromosomes to be completely sequenced?

- (A) Chromosome – 1
- (B) Chromosome – 11
- (C) Chromosome – 21
- (D) Chromosome – X

Correct Answer: (A) Chromosome – 1

Solution:

Step 1: Recall the Human Genome Project.

- Chromosome 1 was the last human chromosome to be fully sequenced due to its size and complexity. It contains the largest number of genes and a high number of repetitive sequences, making sequencing particularly challenging.

Final Answer: The last chromosome to be completely sequenced was **Chromosome 1**.

💡 Quick Tip

Chromosome 1 sequencing was challenging due to its large size and complexity, as it carries the most genes among all human chromosomes.

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

- (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.

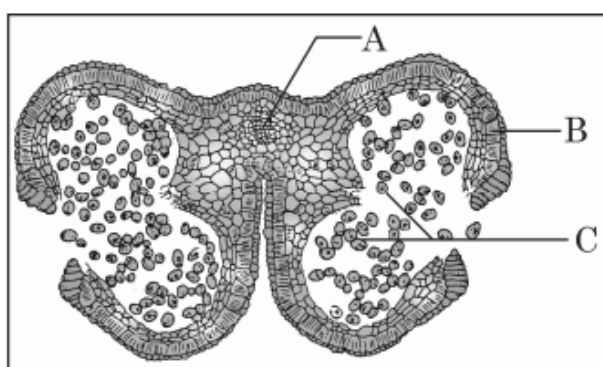


Figure 2: Angiosperm

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

Solution:

Step 1: Interpret the Anther Diagram.

- Connective tissue joins the two lobes of the anther.
- Endothecium forms the outer wall of the pollen sac.
- Pollen grains are present inside the pollen sac.

Final Answer: The correct identification is **A – Connective, B – Endothecium, C – Pollen grain.**

💡 Quick Tip

The anther structure includes connective tissue, endothecium, and pollen grains inside the pollen sacs.

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

- (A) Aneuploidy
(B) Euploidy

- (C) Polyploidy
- (D) Autosomal abnormality

Correct Answer: (A) Aneuploidy

Solution:

Step 1: Understand Turner's Syndrome.

- Turner's syndrome is a chromosomal disorder caused by the presence of a single X chromosome (45, XO) instead of two sex chromosomes.
- This is a form of aneuploidy, which refers to the loss or gain of chromosomes.

Final Answer: Turner's syndrome is caused by **aneuploidy**.

💡 Quick Tip

Turner's syndrome affects females, leading to short stature, infertility, and other physical abnormalities.

8. 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.

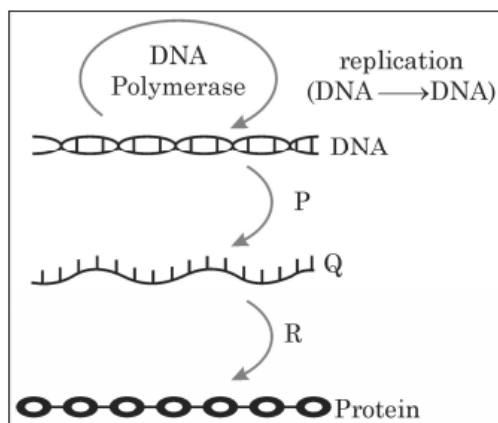


Figure 3: Central Dogma

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

Solution:

Step 1: Recall the Central Dogma.

- Transcription (P): DNA to mRNA.
- mRNA (Q): Carries genetic information.

- Translation (R): mRNA to protein.

Final Answer: P – Transcription, Q – mRNA, R – Translation.

💡 Quick Tip

The central dogma describes the flow of genetic information: DNA → RNA → Protein.

9. Who proposed the mutation theory in favour of organic evolution?

- (A) Weismann
- (B) Louis Pasteur
- (C) Darwin
- (D) Hugo de Vries

Correct Answer: (D) Hugo de Vries

Solution:

Step 1: Recall Evolutionary Theories.

- Hugo de Vries proposed the mutation theory, which states that evolution occurs through sudden, heritable changes in an organism's genetic material.
- These mutations serve as raw material for natural selection.

Final Answer: The mutation theory was proposed by **Hugo de Vries**.

💡 Quick Tip

Mutations are the source of genetic variation, critical for evolution and adaptation.

10. Study the following list of bioactive substances and their action:

Bioactive Substance	Role
Statin	Removal of oil stains
Cyclosporin A	Removal of clots from blood vessels
Streptokinase	Lowering of blood cholesterol
Lipase	Immuno-suppressive agent

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

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

Solution:

Step 1: Match Bioactive Substances to Their Actions.

- Statin: Lowers blood cholesterol (III).
- Cyclosporin A: Acts as an immuno-suppressive agent (IV).
- Streptokinase: Removes clots from blood vessels (II).
- Lipase: Removes oil stains (I).

Final Answer: A – III, B – IV, C – II, D – I.

 Quick Tip

Bioactive substances have diverse roles in medicine, industry, and healthcare.

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

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

Correct Answer: (D) Restriction enzymes

Solution:

Step 1: Understand Restriction Enzymes.

- Restriction enzymes, also known as molecular scissors, cut DNA at specific sequences.
- These enzymes are extensively used in genetic engineering and molecular biology.

Final Answer: Restriction enzymes are referred to as molecular scissors.

 Quick Tip

Restriction enzymes are indispensable in cloning and recombinant DNA technology.

12. 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) works on the principle of antigen-antibody binding to detect specific proteins or antibodies in a sample.
- The reaction between an enzyme-labeled antibody and its antigen is measured through color development, indicating the presence of the antigen.

Quick Tip

ELISA is widely used in diagnostics to detect diseases such as HIV and hepatitis by identifying antibodies or antigens.

13 to 16. Assertion (A) and Reason (R): Select the appropriate answer from the options 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): 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 a mutualistic relationship where each depends on the other for survival and reproduction.
- Wasps pollinate fig flowers while laying eggs, ensuring mutual benefit.

💡 Quick Tip

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

14. 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 indeed circular DNA molecules capable of autonomous replication, but they are commonly found in prokaryotic cells like bacteria, not eukaryotes.

💡 Quick Tip

Plasmids play a vital role in genetic engineering for cloning and gene expression studies.

15. 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.
- The purpose of patents is to prevent unauthorized commercial use and ensure the protection of intellectual property, which directly explains the reason provided.

💡 Quick Tip

Patents encourage innovation by ensuring intellectual property protection.

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, but (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.
- The energy transfer efficiency in trophic levels determines biomass, not the amount of energy required by higher trophic levels, which makes the reason valid but not explanatory for the assertion.

💡 Quick Tip

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

SECTION B

17. 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:

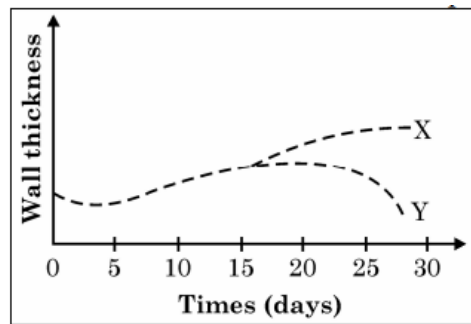


Figure 4: Graph

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

Answer:

- The graph shows:
 - Woman 'X': Normal thickening of the uterine wall due to regular hormonal activity.
 - Woman 'Y': Lack of thickening indicates a hormonal imbalance or insufficient estrogen/progesterone secretion.

Quick Tip

A healthy uterine wall is essential for implantation of the embryo. Hormonal imbalances can disrupt this process.

18.

(a) Intensely lactating mothers generally do not conceive. Why?

Answer:

- Lactational amenorrhea prevents ovulation during intense lactation.
- Prolactin, the hormone responsible for milk production, suppresses gonadotropin release.

(b) Why has our government intentionally imposed strict conditions for MTP (Medical Termination of Pregnancy)?

Answer:

- To prevent misuse and ensure MTP is conducted only for genuine medical or legal reasons.
- Protects the health and rights of women.

💡 Quick Tip

Lactational amenorrhea is a natural contraceptive method but is not completely reliable for preventing pregnancy.

19.

(a) Name the source from which insulin was extracted in earlier times. Why is this insulin no more in use by the diabetic patients?

Answer:

- Source: Pancreas of pigs and cows.
- Reason: Animal insulin caused allergic reactions in some patients due to structural differences from human insulin.

(b) Why does the insulin synthesized in the human body undergo processing whereas the insulin produced by Eli Lilly company does not need to undergo any processing? Explain.

Answer:

- Human insulin is produced as proinsulin and requires processing to remove C-peptide.
- Eli Lilly produces ready-to-use recombinant insulin without requiring further processing.

💡 Quick Tip

Recombinant DNA technology allows the production of human insulin, minimizing allergic reactions.

20.

(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)

OR

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

Answer:

- 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.

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 rich in endemic species but threatened by habitat loss.
- Protecting hotspots helps conserve numerous species, ensuring ecosystem stability and reducing extinction rates.

(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.

SECTION C

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

Answer: The diagram of a male gametophyte/microspore of an angiosperm should include:

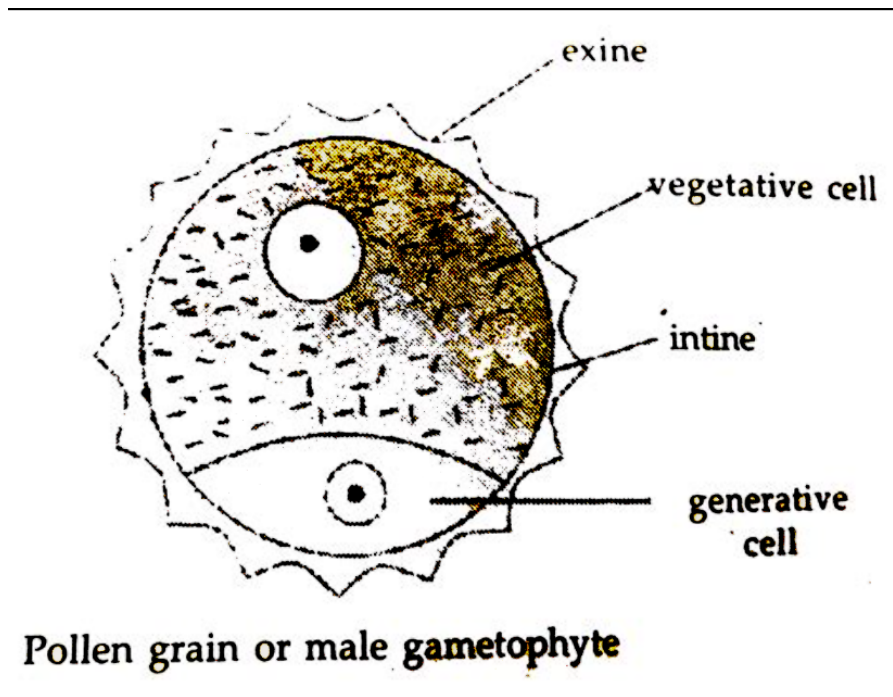


Figure 5: Sectional view of a male gametophyte of an angiosperm. Labelled parts include: Exine, Intine, Vegetative Cell, and Generative Cell.

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 is responsible for the formation of male gametes, crucial for fertilization.

23. (a) A man with blood group 'A' marries a woman with blood group 'AB'. The first child born to them has blood group 'B'. Work out a cross to find the genotype of the father. Give the possible blood groups and their genotypes of the children that could be born to this couple. (Use a Punnett square).

Answer: Father's Genotype: $I^A i$

Mother's Genotype: $I^A I^B$

Punnett Square:

	I^A	I^B
I^A	$I^A I^A$	$I^A I^B$
i	$I^A i$	$I^B i$

Children's Blood Groups:

- Blood Group A: $I^A I^A$, $I^A i$
- Blood Group B: $I^B i$

- Blood Group AB: $I^A I^B$

(b) State the basis of 'ABO' blood grouping in humans.

Answer: The ABO blood grouping is based on:

- The presence or absence of antigens (A and B) on the surface of red blood cells.
- The presence of antibodies (anti-A and anti-B) in the plasma.

Quick Tip

The ABO blood grouping system is crucial for safe blood transfusions and organ transplants.

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

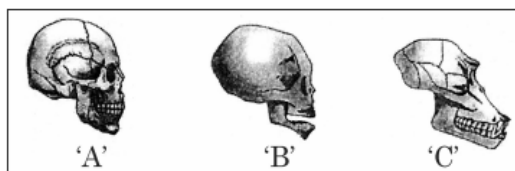


Figure 6: skull

Answer:

- Skull A: Homo sapiens
- Skull B: Neanderthals
- Skull C: Australopithecus
- Skulls A and B 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) Australopithecus (ape-like)
- (ii) Homo erectus (man-like)

Quick Tip

The evolutionary study of skulls provides insights into the development of human and primate features.

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

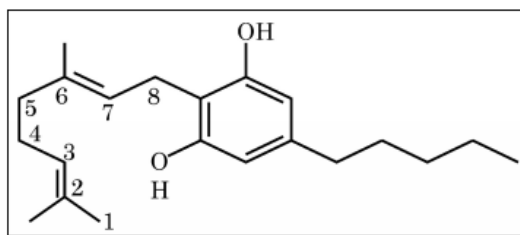


Figure 7: Drug

Answer: Steroids.

(ii) How are such drugs consumed?

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

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

Answer: Liver.

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.

Answer:

- 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.

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

- Flocs
- Anaerobic sludge digester

Answer:

- **Flocs:** Aggregates of bacteria and fungi used in the secondary treatment to degrade organic matter in sewage.
- **Anaerobic sludge digester:** Breaks down organic matter into methane, CO₂, and water during the anaerobic digestion of sludge.

Quick Tip

Sewage treatment plants play a vital role in water purification and waste management.

27. Study the steps shown below, that are carried during a specific technique:

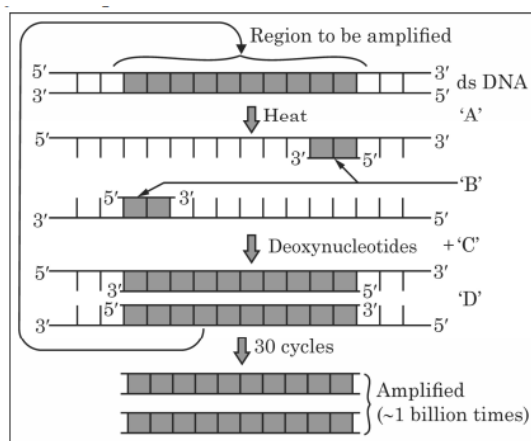


Figure 8: Steps

(a) Identify the steps 'A' and 'D' in the diagram.

Answer:

- **A:** Denaturation of DNA at high temperatures.
- **D:** Amplification of DNA after 30 cycles.

(b) What does 'B' represent?

Answer: Primer annealing.

(c) Write what is 'C'? Name its source organism.

Answer:

- **C:** Taq DNA polymerase.
- **Source:** *Thermus aquaticus*.

(d) Mention the use of this technique in molecular diagnostics.

Answer:

- Used in Polymerase Chain Reaction (PCR) to amplify DNA for genetic testing, disease diagnosis, and forensic analysis.

Quick Tip

PCR is a revolutionary technique for DNA amplification, enabling advancements in molecular biology and medicine.

28. Explain the role of transgenic animals in: (a) Production of Biological Products
Solution:

- Transgenic animals are engineered to produce important biological products like proteins and hormones.
- Example: Transgenic cows producing human lactoferrin, which has therapeutic applications.

💡 Quick Tip

Transgenic technology helps produce safer and more effective biological products for human use.

(b) Studying Diseases Solution:

- Transgenic animals are used as models to study human diseases and their progression.
- Example: Transgenic mice are commonly used to study cancer, diabetes, and Alzheimer's disease.

💡 Quick Tip

Transgenic animal models provide insights into disease mechanisms and potential treatments.

(c) Chemical Safety Testing Solution:

- Transgenic animals are used to test the safety of chemicals and drugs before they are approved for human use.
- Example: Transgenic mice are used to assess the toxicity of new pharmaceutical compounds.

💡 Quick Tip

Transgenic animals ensure that chemicals and drugs are safe for human application by providing reliable test models.

SECTION D

29. Populations evolve to maximise their reproductive fitness in the habitat in which they live. Study the population growth curves shown in the given graph and answer the questions that follow:

(a) Identify the growth curves 2018A2019 and 2018B2019. Solution:

- Curve 2018A2019: Exponential growth curve.

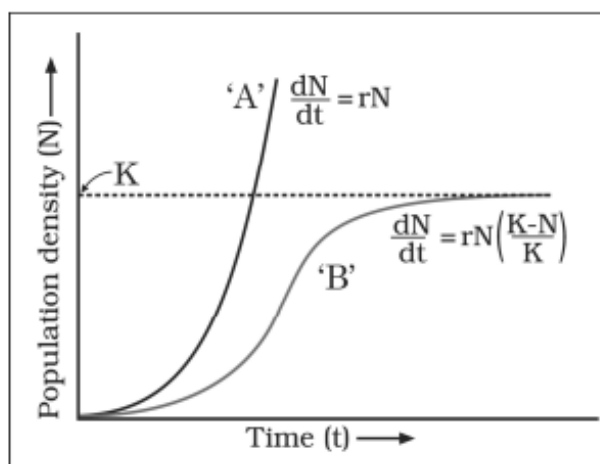


Figure 9: Population Growth Curves

- Curve 2018B2019: Logistic growth curve.
- **Explanation:** 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. **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

Growth curve 2018B2019 shows a different pattern from that of growth curve 2018A2019. Justify giving one reason. **Solution:**

- Curve 2018B2019 (logistic growth) differs from curve 2018A2019 (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.

(c)(i) Which one of the two curves is more realistic and why? Solution:

- Curve B (logistic growth) is more realistic because populations are subject to resource limitations, predation, and environmental constraints.
- Curve A (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.

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

- The exponential growth curve (Curve A) 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.

30. Read the following passage and answer the questions that follow: 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 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. Solution:

- The RNA product is mRNA (messenger RNA).
- Enzyme responsible: RNA polymerase II.

💡 Quick Tip

mRNA is the template for protein synthesis in the process of translation.

(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. **Solution:**

- Process: Splicing.
- Explanation: During splicing, non-coding regions (introns) are removed from the pre-mRNA, leaving only coding regions (exons) to form mature mRNA. This ensures the correct sequence for translating into a 400 amino acid polypeptide.

💡 Quick Tip

Splicing is essential in eukaryotes for producing functional mRNA.

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

Solution:

- **Prokaryotes:** One RNA polymerase is involved in transcription.
- **Eukaryotes:** Three RNA polymerases (RNA polymerase I, II, and III) are involved in transcription.

💡 Quick Tip

Eukaryotic cells use three specialized RNA polymerases for different types of RNA, while prokaryotes rely on a single RNA polymerase.

OR

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

Solution:

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

💡 Quick Tip

In prokaryotes, transcription and translation occur simultaneously in the cytoplasm, while in eukaryotes, transcription is confined to the nucleus and translation occurs in the cytoplasm.

SECTION E

31. (a) The given diagram shows the sectional view of a seminiferous tubule of Human testis.

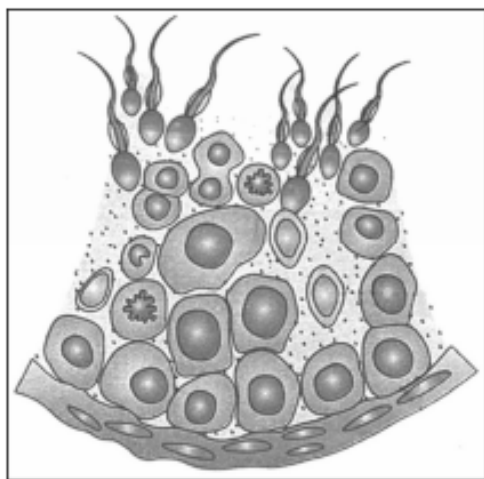


Figure 10: Testis

(i) Name and describe the process depicted in the diagram which results in the development of spermatozoa.

Solution:

- Process: Spermatogenesis.
- Description: Spermatogenesis is the process of formation of sperm cells (spermatozoa) from the spermatogonial cells in the seminiferous tubules of the testes. It includes the following stages:
 - Multiplication Phase: Mitotic division of spermatogonia to produce primary spermatocytes.
 - Growth Phase: Enlargement of primary spermatocytes.
 - Maturation Phase: Meiosis to produce haploid spermatids from secondary spermatocytes.
 - Differentiation Phase: Spermatids transform into spermatozoa.

💡 Quick Tip

Spermatogenesis is regulated by hormones like FSH, LH, and testosterone.

(ii) Identify the cell where you are seeing a cluster of spermatozoa attached in the diagram. Write the function of the cell. Solution:

- The cell is the Sertoli cell.
- Function: Sertoli cells provide nourishment and structural support to the developing sperm cells. They also secrete inhibin, which regulates spermatogenesis.

💡 Quick Tip

Sertoli cells create a microenvironment essential for spermatogenesis.

OR

(b). Observe the picture of Commelina plant bearing two types of flowers:

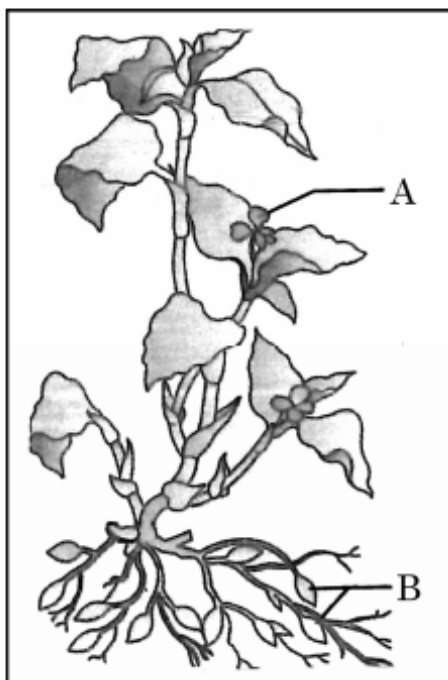


Figure 11: Commelina

(i) Identify the two types of flowers labelled 'A' and 'B' in the picture.

Answer:

- 'A': Chasmogamous flower.

- 'B': Cleistogamous flower.

Quick Tip

Chasmogamous flowers rely on external pollinators, while cleistogamous flowers ensure reproduction even in the absence of pollinators.

(ii) Compare the two types of flowers with reference to:

(1) Characteristic feature

(2) Modes of pollination

Answer:

- Characteristic feature:
 - Chasmogamous flowers: Open flowers, reproductive parts exposed.
 - Cleistogamous flowers: Closed flowers, reproductive parts not exposed.
- Modes of pollination:
 - Chasmogamous flowers: Cross-pollination facilitated by agents like wind, insects, or water.
 - Cleistogamous flowers: Self-pollination occurs as flowers never open.

Quick Tip

Cross-pollination promotes genetic diversity, while self-pollination ensures reproduction in unfavorable conditions.

(iii) List any two 'out breeding devices' in flowering plants. Explain why do plants develop such devices.

Answer:

- Out breeding devices:
 - Self-incompatibility.
 - Production of unisexual flowers.
- Explanation: These devices prevent self-pollination and promote cross-pollination, which enhances genetic diversity and adaptation.

Quick Tip

Out breeding devices ensure genetic recombination, which strengthens plants' adaptability and resilience against environmental changes.

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

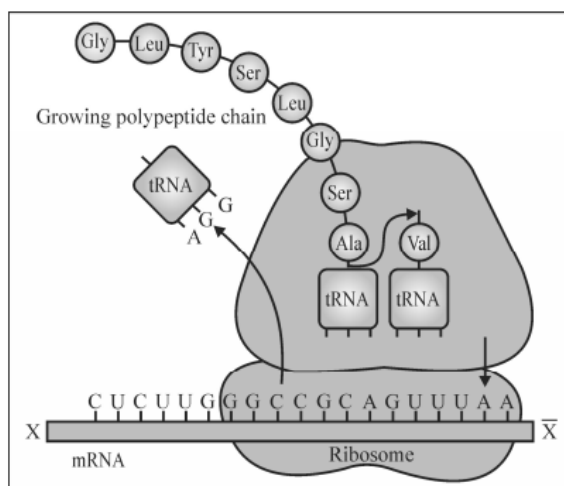


Figure 12: Diagram

(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' direction.
- Number of additional amino acids: Depends on the number of codons left untranscribed 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'.

(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.

Quick Tip

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

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

Answer:

- 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?

Answer:

- 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.

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

Answer:

- It is caused by a point mutation in the β -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.

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

Answer:

- 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.

33. Describe the following:

(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 enters host cells (CD4+ T-cells) via surface receptors.
- Reverse transcription: Viral RNA is converted into DNA by reverse transcriptase.
- Integration: Viral DNA integrates into the host genome via integrase enzyme.
- Replication: Host machinery synthesizes viral components.
- Assembly and release: New viral particles are assembled and released, infecting other cells.
- Progression to AIDS: Gradual destruction of CD4+ cells leads to weakened immunity and opportunistic infections, culminating in AIDS.

Quick Tip

HIV attacks the immune system, specifically CD4+ T-cells, leaving the body vulnerable to infections.

OR

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

Answer:

- Symptoms:
 - High fever with chills.
 - Sweating and headache.
 - Nausea and vomiting.
- Cause: The symptoms are caused by the rupture of red blood cells during the release of merozoites and the immune response to parasitic toxins.

Quick Tip

Preventive measures like using insecticide-treated nets and timely medical intervention can reduce the risk of malaria.

(ii) Describe the different steps in the sexual mode of reproduction in the life cycle of a malarial parasite.

Answer:

- Gametocytes develop in human blood and are taken up by a mosquito during a blood meal.
- Fertilization occurs in the mosquito's gut, forming a zygote.
- The zygote develops into an ookinete and then an oocyst.
- Sporozoites are released from the oocyst and migrate to the salivary glands, ready to infect another human.

Quick Tip

The life cycle of Plasmodium alternates between humans (asexual phase) and mosquitoes (sexual phase).