

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

1. A single gene that controls the expression of more than one trait is said to show:

- (A) Multiple allelism
- (B) Polygenic inheritance
- (C) Incomplete dominance
- (D) Pleiotropism

Correct Answer: (D) Pleiotropism.

Solution: Pleiotropism refers to the phenomenon where a single gene influences multiple phenotypic traits. For example, the gene responsible for sickle-cell anaemia affects both the shape of red blood cells and oxygen transport efficiency.

💡 Quick Tip

Pleiotropic genes demonstrate how a single mutation can have widespread effects on an organism's phenotype.

2. A person with trisomy of 21st chromosome shows:

- (i) Furrowed tongue
- (ii) Characteristic palm crease
- (iii) Rudimentary ovaries
- (iv) Gynaecomastia

Select the correct option from the choices given below:

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

Correct Answer: (D) (i) and (ii).

Solution: Trisomy of the 21st chromosome, also known as Down syndrome, is characterized by features such as:

- Furrowed tongue (i).
- Characteristic palm crease (ii).

Gynaecomastia (iv) and rudimentary ovaries (iii) are not commonly associated with Down syndrome.

💡 Quick Tip

Down syndrome is a genetic disorder caused by an extra copy of chromosome 21, leading to unique physical traits and intellectual development challenges.

3.

Identify the most appropriate technique depicted in the above diagram. **Observe the schematic representation of assisted reproductive technology given below:**

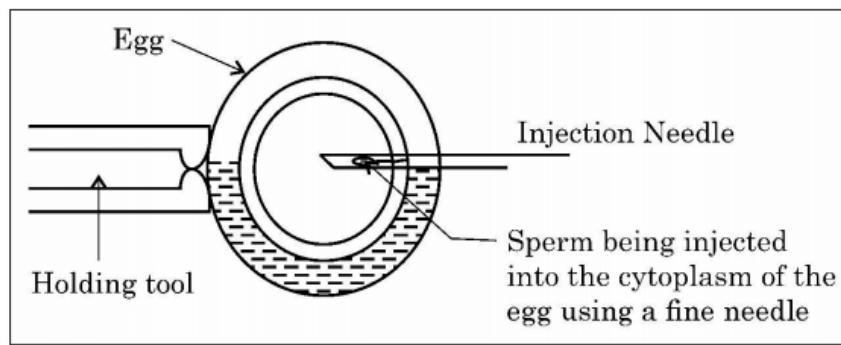


Figure 1: Sperm being injected into the cytoplasm of the egg using a fine needle. The diagram highlights the injection needle, the egg, and the holding tool.

Identify the most appropriate technique depicted in the above diagram.

- (A) IUT
- (B) IUI
- (C) ICSI
- (D) ZIFT

Correct Answer: (C) ICSI.

Solution: The diagram shows Intracytoplasmic Sperm Injection (ICSI), where a single sperm is directly injected into the cytoplasm of an egg using a fine needle. This technique is used in cases of severe male infertility.

💡 Quick Tip

ICSI is a specialized in vitro fertilization technique that helps overcome male infertility by directly injecting sperm into the egg.

4. Interferons are proteins secreted by:

- (A) RBC
- (B) WBC
- (C) Bacteria infected cell

Correct Answer: (D) Virus infected cell.

Solution: Interferons are proteins secreted by virus-infected cells as part of the immune response. They help inhibit viral replication and activate immune cells to fight infection.

💡 Quick Tip

Interferons are crucial in the body's defense against viral infections by signaling neighboring cells to heighten their antiviral defenses.

5. During biological treatment of sewage, the masses of bacteria held together by fungal filaments to form mesh-like structures are called:

- (A) Primary sludge
- (B) Flocs
- (C) Activated sludge
- (D) Anaerobic sludge

Correct Answer: (B) Flocs.

Solution: Flocs are masses of bacteria and fungi that aggregate during the secondary treatment of sewage. These flocs help in the breakdown of organic matter in wastewater, significantly reducing BOD (Biochemical Oxygen Demand).

 Quick Tip

Flocs are an essential component of the biological treatment process in sewage treatment plants, enabling the efficient removal of organic pollutants.

6. Which one of the following statements is correct in the context of observing DNA separation by agarose gel electrophoresis?

- (A) DNA can be seen in visible light.
- (B) DNA can be seen without staining in visible light.
- (C) Ethidium bromide stained DNA can be seen in visible light.
- (D) Ethidium bromide stained DNA can be seen under UV light.

Correct Answer: (D) Ethidium bromide stained DNA can be seen under UV light.

Solution: Ethidium bromide is a fluorescent dye that binds to DNA. When exposed to UV light, it fluoresces, making the DNA bands visible after separation by agarose gel electrophoresis.

 Quick Tip

Ethidium bromide is a commonly used dye in molecular biology for visualizing DNA under UV light during electrophoresis.

7. A phenomenon where a male insect mistakenly identified the patterns of an orchid flower as the female insect partner, and tries to copulate and thereby pollinates the flower is said to be:

- (A) Pseudocopulation
- (B) Pseudopollination
- (C) Pseudoparthenocarpy
- (D) Pseudofertilisation

Correct Answer: (A) Pseudocopulation.

Solution: Pseudocopulation refers to the process where a male insect is attracted to the flower's patterns, mistaking them for a female insect. The male attempts to copulate, inadvertently transferring pollen and pollinating the flower.

💡 Quick Tip

Pseudocopulation is an evolutionary adaptation in some orchids to ensure pollination by mimicking the appearance of female insects.

8. Identify the correct labellings in the figure of a fertilised embryo sac of an angiosperm given below:

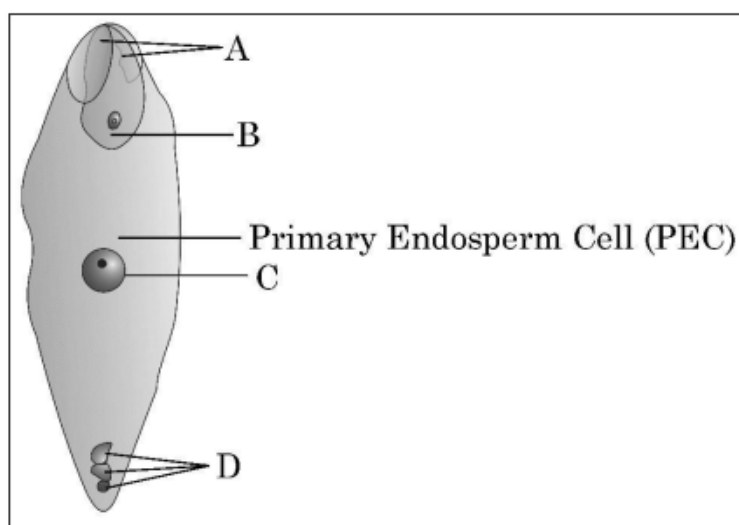


Figure 2: Labeled diagram showing the Primary Endosperm Cell (PEC) and parts A, B, C, and D.

- (A) A – zygote, B – degenerating synergids, C – degenerating antipodals, D – PEN
(B) A – degenerating synergids, B – zygote, C – PEN, D – degenerating antipodals
(C) A – degenerating antipodals, B – PEN, C – degenerating synergids, D – zygote
(D) A – degenerating synergids, B – zygote, C – degenerating antipodals, D – PEN

Correct Answer: (B) A – degenerating synergids, B – zygote, C – PEN, D – degenerating antipodals.

Solution: In the fertilised embryo sac of an angiosperm:

- **A:** Degenerating synergids – Synergids disintegrate after fertilization.
- **B:** Zygote – Formed by the fusion of the male gamete and the egg cell.
- **C:** Primary Endosperm Nucleus (PEN) – Formed by the fusion of the second male gamete with two polar nuclei.
- **D:** Degenerating antipodals – Antipodals disintegrate after fertilization.

💡 Quick Tip

The fertilised embryo sac represents the beginning of seed development, with the zygote developing into the embryo and the PEN forming the endosperm.

9. Study the pedigree chart of a family showing the inheritance pattern of a certain disorder. Select the option that correctly identifies the nature of the trait depicted in the pedigree chart.

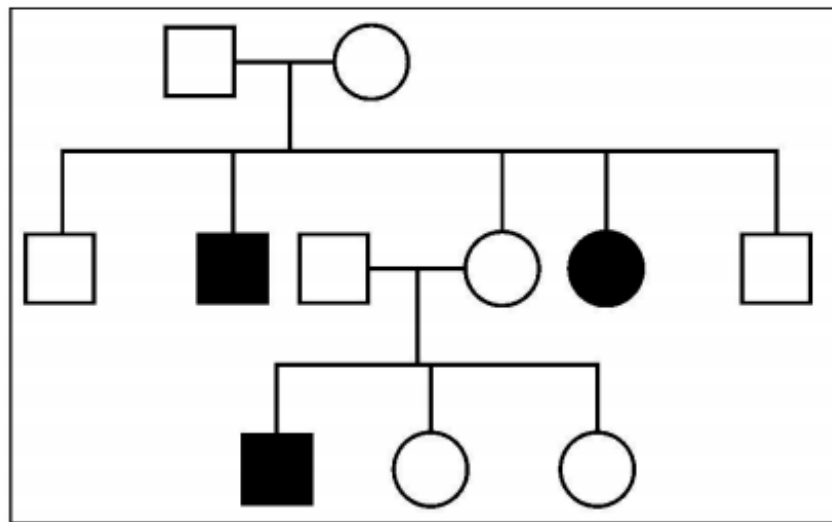


Figure 3: A pedigree chart showing the inheritance pattern of a genetic trait. Squares represent males, circles represent females, shaded shapes indicate affected individuals, and unshaded shapes indicate unaffected individuals.

- (A) Dominant X-linked
- (B) Recessive X-linked
- (C) Autosomal dominant
- (D) Autosomal recessive

Correct Answer: (D) Autosomal recessive.

Solution: The pedigree shows characteristics of an autosomal recessive inheritance:

- The disorder skips generations, indicating it is recessive.
- Both males and females are equally affected, suggesting it is autosomal.
- Affected individuals inherit two recessive alleles (one from each parent).

💡 Quick Tip

In autosomal recessive inheritance, carriers are unaffected but can pass the trait to offspring if both parents are carriers.

10. Match the following genes of the lac operon listed in column 'A' with their respective products listed in column 'B':

Column A (Gene)	Column B (Product)
a. 'i' gene	(i) β -galactosidase
b. 'z' gene	(ii) Lac permease
c. 'a' gene	(iii) Repressor
d. 'y' gene	(iv) Transacetylase

Select the correct option:

- (A) a–(i), b–(iii), c–(ii), d–(iv)
(B) a–(iii), b–(i), c–(iv), d–(ii)
(C) a–(iii), b–(i), c–(ii), d–(iv)
(D) a–(iii), b–(ii), c–(iv), d–(i)

Correct Answer: (B) a–(iii), b–(i), c–(iv), d–(ii).

Solution:

- 'i' gene: Codes for the repressor protein, which inhibits transcription of the operon in the absence of lactose.
- 'z' gene: Codes for β -galactosidase, an enzyme that hydrolyses lactose into glucose and galactose.
- 'a' gene: Codes for transacetylase, which transfers an acetyl group to β -galactosides.
- 'y' gene: Codes for lac permease, which facilitates lactose transport into the cell.

 Quick Tip

The lac operon is a classic example of gene regulation in prokaryotes, controlled by the presence or absence of lactose in the environment.

11. If both the parents are carriers for thalassaemia, the chances of an afflicted child to be born to them is:

- (A) 25%
(B) 50%
(C) 75%
(D) 100%

Correct Answer: (A) 25%.

Solution: Thalassaemia is an autosomal recessive disorder. If both parents are carriers (Tt):

Punnett Square:

	T	t
T	TT	Tt
t	Tt	tt

The possible genotypes are:

- TT : Normal (25%)
- Tt : Carrier (50%)
- tt : Afflicted (25%)

💡 Quick Tip

In autosomal recessive disorders, both parents must contribute a defective allele for the child to be affected.

12. If the sequence of nitrogen bases of the coding strand in a transcription unit is 5'–ATGAATG–3', the sequence of bases in its RNA transcript would be:

- (A) 5'–AUGAAUG–3'
 (B) 5'–UACUUAC–3'
 (C) 5'–CAUUCAU–3'
 (D) 5'–GUAAGUA–3'

Correct Answer: (A) 5'–AUGAAUG–3'.

Solution: The RNA transcript is complementary to the template strand of DNA and identical to the coding strand (except uracil replaces thymine).

Coding strand: 5'–ATGAATG–3'/RNA transcript: 5'–AUGAAUG–3'

💡 Quick Tip

During transcription, RNA is synthesized using the DNA template strand, but its sequence matches the coding strand with uracil substituted for thymine.

13. The question 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, but (R) is not the correct explanation of (A).
 (C) (A) is true, but (R) is false.
 (D) (A) is false, but (R) is true.

Assertion (A): AIDS is a syndrome caused by HIV.

Reason (R): HIV is a virus that damages the immune system with DNA as its

genetic material.

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

Solution: HIV is a virus that causes AIDS by destroying helper T-cells, leading to immune system failure. However, HIV is an RNA virus, not a DNA virus.

 Quick Tip

HIV is a retrovirus with RNA as its genetic material, and it uses reverse transcriptase to convert RNA into DNA within the host cell.

14. The question 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, but (R) is not the correct explanation of (A).
- (C) (A) is true, but (R) is false.
- (D) (A) is false, but (R) is true.

Assertion (A): In molecular diagnosis, single-stranded DNA or RNA tagged with a radioactive molecule is called a probe.

Reason (R): A probe always searches and hybridises with its complementary DNA in a clone of cells.

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

Solution: Probes are single-stranded DNA or RNA molecules tagged with a radioactive or fluorescent label. They hybridise with complementary sequences in target DNA during molecular diagnosis, making them highly specific for detecting genetic abnormalities.

 Quick Tip

Probes are crucial in techniques like Southern blotting and in situ hybridisation for detecting specific DNA or RNA sequences.

15. The question 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, but (R) is not the correct explanation of (A).
- (C) (A) is true, but (R) is false.
- (D) (A) is false, but (R) is true.

Assertion (A): In birds, the sex of the offspring is determined by males.

Reason (R): Males are homogametic while females are heterogametic.

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

Solution: In birds, females are the heterogametic sex (ZW), and males are homogametic (ZZ). Therefore, the sex of the offspring is determined by the female, not the male.

 Quick Tip

The sex determination system in birds is opposite to that of humans, where males determine the sex of the offspring.

16. The question 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, but (R) is not the correct explanation of (A).
- (C) (A) is true, but (R) is false.
- (D) (A) is false, but (R) is true.

Assertion (A): Communities that comprise of more species tend to be more stable.

Reason (R): A higher number of species results in less year-to-year variation in total biomass.

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

Solution: Communities with higher species diversity are more resilient to environmental changes, ensuring greater stability in total biomass over time.

 Quick Tip

Biodiversity ensures ecosystem stability by providing functional redundancy, where multiple species perform similar ecological roles.

SECTION – B

17.(a) “Farmers prefer apomictic seeds to hybrid seeds.” Justify giving two reasons.

Correct Answer: Farmers prefer apomictic seeds because:

- Apomictic seeds do not require repeated hybridisation every year, saving costs.
- They maintain genetic uniformity, ensuring stable yields.

💡 Quick Tip

Apomixis is an asexual reproduction process that produces seeds without fertilisation, retaining the parent's genetic traits.

OR

(b) Mention one advantage and one disadvantage of amniocentesis.

Correct Answer:

- Advantage: Helps detect genetic disorders like Down syndrome and other chromosomal abnormalities in the fetus.
- Disadvantage: It carries a small risk of miscarriage or harm to the fetus.

💡 Quick Tip

Amniocentesis is a prenatal diagnostic procedure that analyses amniotic fluid for genetic testing.

18. 5'–G↓AATTC–3'
3'–CTTAA↑G–5'

(a) Name the restriction enzyme that recognises the given specific sequence of bases. What are such sequences of bases referred to as?

(b) What are the arrows in the given figure indicating? Write the result obtained thereafter.

Correct Answer:

(a)

- Restriction enzyme: EcoRI.
- The sequences are referred to as palindromic sequences.

(b)

- The arrows indicate the site where the restriction enzyme EcoRI cuts the DNA.
- Result: The DNA is cleaved into fragments with sticky ends, enabling the insertion of foreign DNA during genetic engineering.

💡 Quick Tip

Palindromic sequences are unique DNA sequences that read the same in both directions, enabling precise enzymatic cuts.

19. Observe the population growth curve and answer the questions given below:

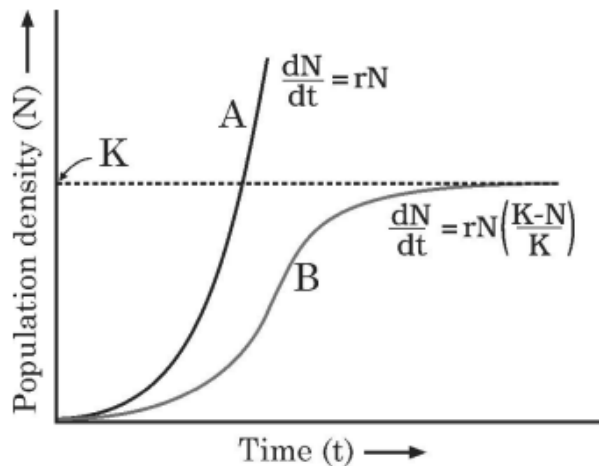


Figure 4: Population growth curves showing exponential growth (A) and logistic growth (B).

State the conditions under which growth curve 'A' and growth curve 'B' plotted in the graph are possible.

Correct Answer:

- Growth curve 'A' (Exponential growth): Possible when resources are unlimited and there are no environmental constraints.
- Growth curve 'B' (Logistic growth): Possible when resources are limited, and environmental resistance impacts population growth.

💡 Quick Tip

Exponential growth occurs under ideal conditions, while logistic growth reflects real-world scenarios with environmental limitations and carrying capacity.

19. Observe the population growth curve and answer the questions given below: Mention what does 'K' in the graph represent.

Correct Answer: 'K' represents the carrying capacity of the environment, which is the maximum population size that the environment can sustain with the available resources.

💡 Quick Tip

Carrying capacity is determined by factors like food availability, habitat space, and environmental conditions.

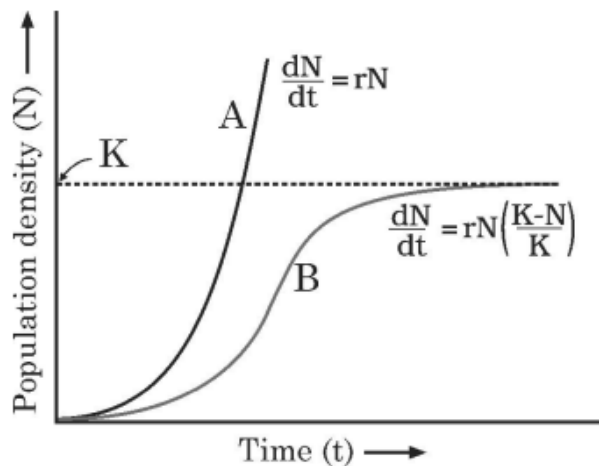


Figure 5: Population growth curves showing exponential growth (A) and logistic growth (B).

20. Explain how are plants benefitted by their association with “*Glomus* species.”

Correct Answer:

- *Glomus* species form mycorrhizal associations with plant roots.
- These fungi enhance the absorption of nutrients, particularly phosphorus, and improve water uptake.
- They also provide resistance to root pathogens and increase the plant’s tolerance to drought and salinity.

💡 Quick Tip

Mycorrhizal fungi establish a symbiotic relationship with plants, offering nutrient exchange and protection in return for carbohydrates.

21. If the base adenine constitutes 31% of an isolated DNA fragment, then write what will be the expected percentage of the base cytosine in it. Explain how did you arrive at the answer given.

Correct Answer:

- Adenine (A) pairs with Thymine (T), so $A + T = 31\% + 31\% = 62\%$.
- Cytosine (C) pairs with Guanine (G), and since $C + G = 100\% - (A + T) = 38\%$, the percentage of cytosine is $C = 19\%$.

💡 Quick Tip

The Chargaff’s rule states that in DNA, the percentage of $A = T$ and $C = G$, with the total equalling 100%.

SECTION – C

22. Identify a, b, c, d, e, and f in the table given below:

Sl. No.	Organism	Bioactive Molecule	Use
1	<i>Monascus purpureus</i>	a	b
2	c	d	Antibiotic
3	e	Cyclosporin A	f

Correct Answer:

Sl. No.	Organism	Bioactive Molecule	Use
1	<i>Monascus purpureus</i>	Statins	Lowers cholesterol
2	<i>Streptomyces</i>	Streptomycin	Antibiotic
3	<i>Trichoderma polysporum</i>	Cyclosporin A	Immunosuppressant

💡 Quick Tip

Bioactive molecules derived from microorganisms play a crucial role in medicine, such as antibiotics, cholesterol-lowering agents, and immunosuppressants.

23. Tropical regions harbour more species than the temperate regions. How have biologists tried to explain this in their own ways? Explain.

Correct Answer: Biologists explain the higher species richness in tropical regions due to:

- Favourable climate: The warm and stable climate supports year-round plant growth and species survival.
- Longer evolutionary time: Tropical regions remained undisturbed during glaciation periods, providing longer periods for species diversification.
- Higher productivity: Abundant sunlight and rainfall result in high primary productivity, supporting diverse food webs.

💡 Quick Tip

The stability and resource availability in tropical regions make them biodiversity hotspots with numerous endemic species.

OR

(b) What does an ecological pyramid represent?

Correct Answer: An ecological pyramid represents the trophic structure and functional levels in an ecosystem, such as energy, biomass, or number of organisms at each trophic level.

💡 Quick Tip

Ecological pyramids provide a visual representation of energy flow and resource distribution across trophic levels in an ecosystem.

(ii) The ecological pyramids may have an ‘upright’ or an ‘inverted’ shape. Justify with the help of suitable examples.

Correct Answer:

- Upright pyramid: Found in most ecosystems, such as grasslands, where producers have the highest energy or biomass, followed by primary and secondary consumers.
- Inverted pyramid: Found in aquatic ecosystems, where phytoplankton (producers) have a smaller biomass than zooplankton and higher trophic levels.

💡 Quick Tip

The shape of the pyramid depends on the ecosystem type and the parameter being measured (energy, biomass, or numbers).

24. (a) What are transgenic animals?

Correct Answer: Transgenic animals are organisms that have had foreign genes inserted into their genome using recombinant DNA technology.

💡 Quick Tip

Transgenic animals are valuable in research, agriculture, and medicine, helping to study diseases, improve productivity, and develop therapeutic proteins.

(b) Name the transgenic animal having the largest number amongst all the existing transgenic animals.

Correct Answer: Mice.

💡 Quick Tip

Transgenic mice are extensively used in research to study human diseases, drug development, and gene functions due to their genetic similarity to humans.

(c) State any 3 reasons for which these types of animals are being produced.

Correct Answer: Transgenic animals are produced for:

- Studying the effects of genes and their role in development and disease.
- Producing biologically important proteins like insulin and vaccines.
- Testing the safety of drugs and chemicals before human use.

💡 Quick Tip

Transgenic animals are valuable tools in medical research, biotechnology, and drug development.

25. If the cells in the leaves of a maize plant contain 10 chromosomes each, write the number of chromosomes in its endosperm and zygote. Name and explain the process by which an endosperm and a zygote are formed in maize.

Correct Answer:

- Chromosomes in zygote: 10 (diploid).
- Chromosomes in endosperm: 15 (triploid).

Process:

- Zygote formation: One male gamete fuses with the egg cell (syngamy) to form the zygote.
- Endosperm formation: The second male gamete fuses with two polar nuclei in the central cell (triple fusion), forming the triploid endosperm.

💡 Quick Tip

Double fertilisation is a characteristic feature of angiosperms, resulting in the formation of both zygote and endosperm.

26. (a) Why does DNA replication occur within a replication fork and not in its entire length simultaneously?

Correct Answer: DNA replication occurs within a replication fork because:

- The fork structure allows helicase to unwind the DNA strand gradually.
- Polymerases can synthesise the new strand step by step in the 5' to 3' direction.

💡 Quick Tip

The replication fork ensures accurate DNA synthesis by coordinating unwinding, priming, and elongation processes step by step.

(b) “DNA replication is continuous and discontinuous on the two strands within the replication fork.” Explain with the help of a schematic representation.

Correct Answer:

- Leading strand: Synthesised continuously in the 5' to 3' direction.
- Lagging strand: Synthesised discontinuously in short fragments (Okazaki fragments) and later joined by DNA ligase.

Diagrammatic representation should include the fork, helicase, and synthesis direction.

💡 Quick Tip

The antiparallel nature of DNA strands necessitates continuous and discontinuous replication in the fork structure.

27. Explain the processing of heterogeneous nuclear RNA (hnRNA) into a fully functional mRNA in eukaryotes. Where does this processing occur in the cell?

Correct Answer: Steps of Processing:

- Capping: Addition of a 5' methyl guanosine cap.
- Splicing: Removal of introns and joining of exons.
- Polyadenylation: Addition of a poly-A tail at the 3' end.

Location: The processing occurs in the nucleus of eukaryotic cells.

💡 Quick Tip

RNA processing ensures the stability and translatability of mRNA before it moves to the cytoplasm for translation.

28. The world is facing accelerated rates of species extinction largely due to human activities. Explain any three human activities responsible for accelerated rates of species extinction.

Correct Answer: Human activities responsible for accelerated species extinction include:

- **Habitat destruction:** Clearing forests for agriculture, urbanisation, and infrastructure development destroys natural habitats, leading to the loss of biodiversity.
- **Overexploitation:** Overhunting, overfishing, and overharvesting of natural resources deplete populations of species beyond recovery.
- **Pollution:** Release of pollutants into the air, water, and soil disrupts ecosystems, making them uninhabitable for many species.

💡 Quick Tip

Conserving habitats, sustainable resource use, and reducing pollution are critical measures to mitigate species extinction caused by human activities.

SECTION – D

Q. No. 29 and 30 are case-based questions. Each question has 3 sub-questions with internal choice in one sub-question.

29. In a human female, the reproductive phase starts on the onset of puberty and ceases around middle age of the female. Study the graph given below regarding menstrual cycle and answer the questions that follow:

Name the hormones and their source organ, which are responsible for menstrual cycle at puberty.

Correct Answer:

- **Hormones:** Follicle Stimulating Hormone (FSH) and Luteinising Hormone (LH).
- **Source organ:** Anterior pituitary gland.

💡 Quick Tip

FSH and LH are vital pituitary hormones that regulate follicle maturation and ovulation during the menstrual cycle.

In a human female, the reproductive phase starts on the onset of puberty and ceases around middle age of the female. Study the graph given below regarding menstrual cycle and answer the questions that follow:

For successful pregnancy, at what phase of the menstrual cycle can an early embryo (up to 3 blastomeres) be implanted in the uterus (IUT) of a human female who has opted for Assisted Reproductive Technology (ART)? Support your answer with a reason.

Correct Answer:

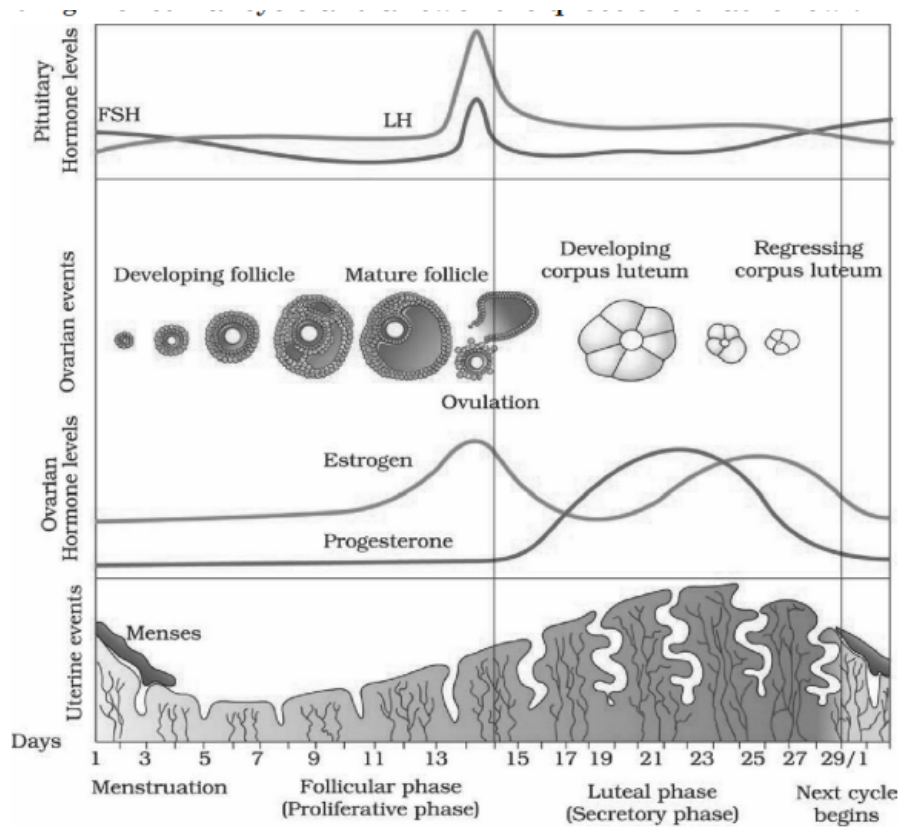


Figure 6: Graph showing the hormonal regulation and events during the menstrual cycle.

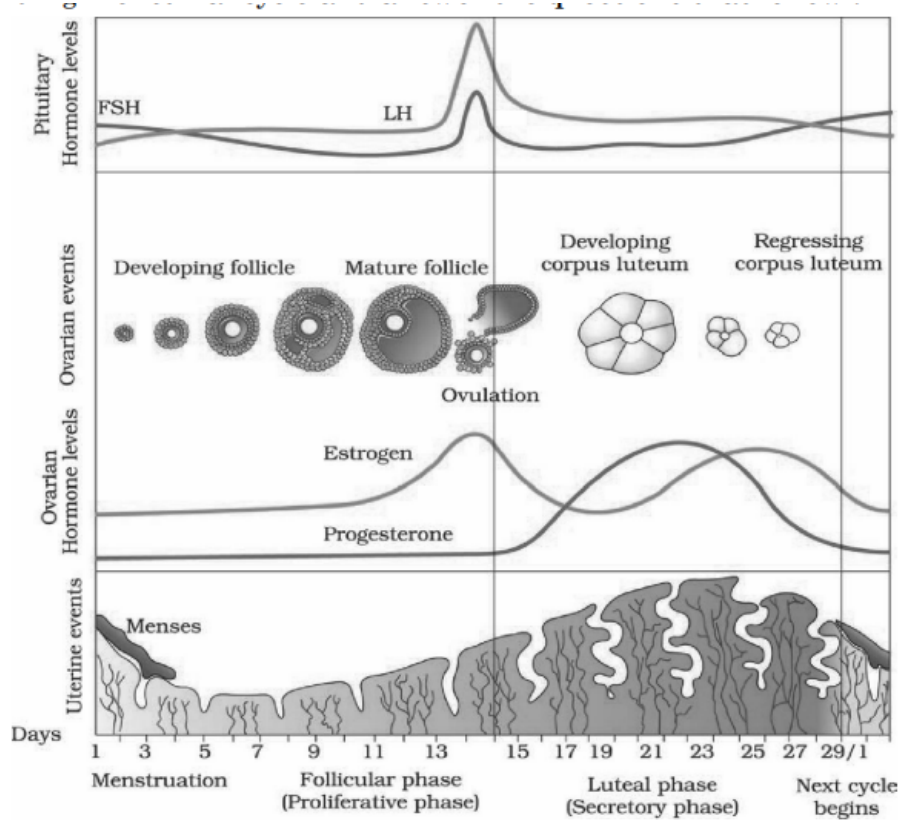


Figure 7: Graph showing the hormonal regulation and events during the menstrual cycle.

- Implantation should occur during the luteal phase (days 15–28) of the menstrual cycle.
- Reason: The uterine lining (endometrium) is thick and vascularised during the luteal phase, providing optimal conditions for embryo implantation and development.

💡 Quick Tip

The luteal phase provides a supportive environment for implantation due to high progesterone levels.

In a human female, the reproductive phase starts on the onset of puberty and ceases around middle age of the female. Study the graph given below regarding menstrual cycle and answer the questions that follow:

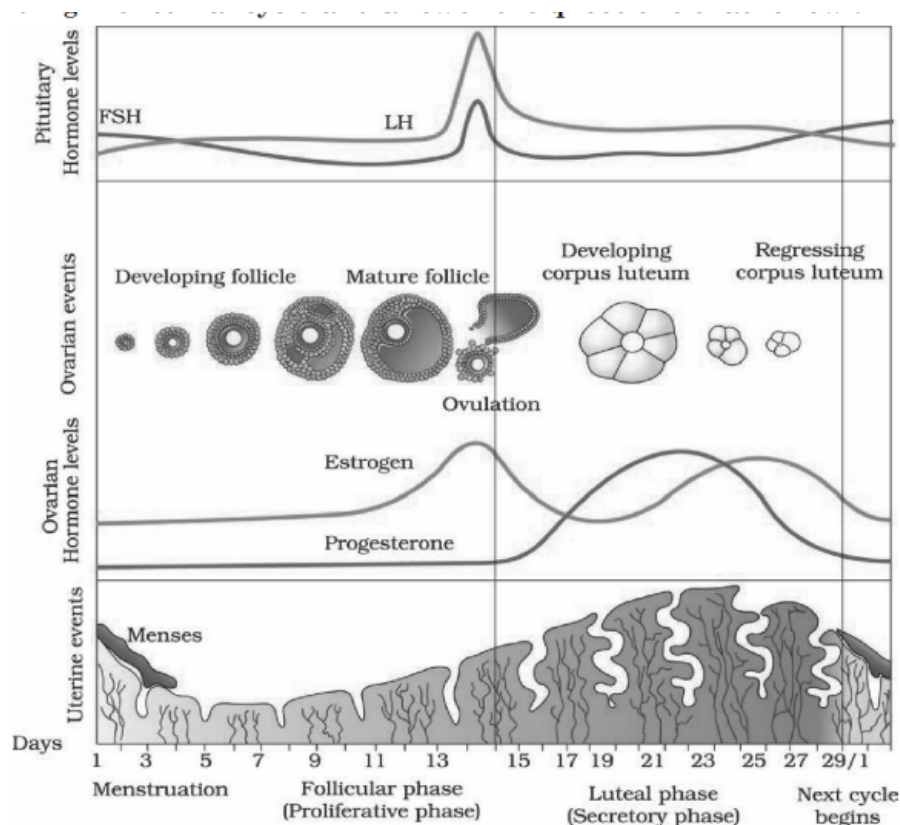


Figure 8: Graph showing the hormonal regulation and events during the menstrual cycle.

Name the hormone and its source organ responsible for the events occurring during proliferative phase of menstrual cycle. Explain the event.

Correct Answer:

- Hormone: Oestrogen.
- Source organ: Ovaries (developing follicles).
- Event: Oestrogen stimulates the proliferation of the endometrial lining of the uterus, preparing it for possible implantation of a fertilised egg.

💡 Quick Tip

Oestrogen plays a crucial role in regenerating the uterine lining during the proliferative phase of the menstrual cycle.

OR

In a human female, the reproductive phase starts on the onset of puberty and ceases around middle age of the female. Study the graph given below regarding menstrual cycle and answer the questions that follow:

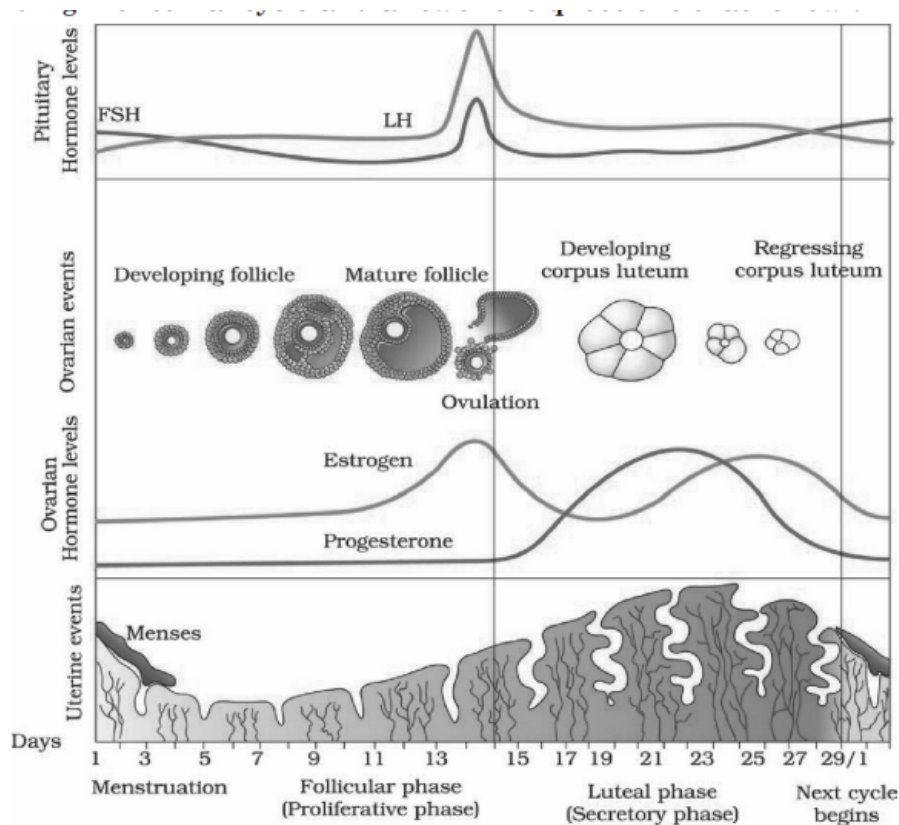


Figure 9: Graph showing the hormonal regulation and events during the menstrual cycle.

In a normal human female, why does menstruation only occur if the released ovum is not fertilised? Explain.

Correct Answer:

- If the ovum is not fertilised, the corpus luteum degenerates, leading to a decline in progesterone levels.
- Low progesterone levels cause the breakdown of the endometrial lining, resulting in menstruation.

💡 Quick Tip

Menstruation occurs due to the absence of fertilisation, leading to hormonal changes and shedding of the uterine lining.

30.

“Mosquitoes are drastically affecting the human health in almost all the developing tropical countries. Different species of mosquitoes cause very fatal diseases so much so that many humans lose their life and if they survive, are unable to put in productive hours to sustain their life. With the result, the health index of the country goes down.” Read the following passage and answer the questions that follow:

“Mosquitoes are drastically affecting the human health in almost all the developing tropical countries. Different species of mosquitoes cause very fatal diseases so much so that many humans lose their life and if they survive, are unable to put in productive hours to sustain their life. With the result, the health index of the country goes down.”

Name the form in which *Plasmodium* gains entry into

- (i) human body
- (ii) the female *Anopheles* body.

Correct Answer:

- (i) *Plasmodium* enters the human body as sporozoites through the bite of an infected female *Anopheles* mosquito.
- (ii) It enters the female *Anopheles* body as gametocytes from the blood of an infected human host.

💡 Quick Tip

Sporozoites are the infective stage of *Plasmodium*, while gametocytes are responsible for transmission back to the mosquito.

“Mosquitoes are drastically affecting the human health in almost all the developing tropical countries. Different species of mosquitoes cause very fatal diseases so much so that many humans lose their life and if they survive, are unable to put in productive hours to sustain their life. With the result, the health index of the country goes down.” Read the following passage and answer the questions that follow:

“Mosquitoes are drastically affecting the human health in almost all the developing tropical countries. Different species of mosquitoes cause very fatal diseases so much so that many humans lose their life and if they survive, are unable to put in productive hours to sustain their life. With the result, the health index of the country goes down.”

Why do the symptoms of malaria not appear in a person immediately after being bitten by an infected female *Anopheles*? Give one reason. Explain when and how the symptoms of the disease would appear.

Correct Answer:

- The symptoms of malaria do not appear immediately because the parasite undergoes an incubation period within the human liver and red blood cells before multiplying.
- Symptoms appear after 10–14 days, once the merozoites are released into the bloodstream, causing fever, chills, and other symptoms.

💡 Quick Tip

The incubation period allows the parasite to multiply in the liver and red blood cells, causing a delay in the onset of symptoms.

OR

“Mosquitoes are drastically affecting the human health in almost all the developing tropical countries. Different species of mosquitoes cause very fatal diseases so much so that many humans lose their life and if they survive, are unable to put in productive hours to sustain their life. With the result, the health index of the country goes down.” Read the following passage and answer the questions that follow:

“Mosquitoes are drastically affecting the human health in almost all the developing tropical countries. Different species of mosquitoes cause very fatal diseases so much so that many humans lose their life and if they survive, are unable to put in productive hours to sustain their life. With the result, the health index of the country goes down.”

Explain the events which occur within a female *Anopheles* mosquito after it has sucked blood from a malaria patient.

Correct Answer:

- The gametocytes of *Plasmodium* ingested with human blood develop into gametes in the mosquito's gut.
- Fertilisation occurs, forming a zygote which develops into an ookinete and then into an oocyst.
- The oocyst releases sporozoites which migrate to the mosquito's salivary glands, ready to infect another human.

💡 Quick Tip

The life cycle of *Plasmodium* involves complex stages within the mosquito's gut, leading to the formation of infectious sporozoites.

“Mosquitoes are drastically affecting the human health in almost all the developing tropical countries. Different species of mosquitoes cause very fatal diseases so

much so that many humans lose their life and if they survive, are unable to put in productive hours to sustain their life. With the result, the health index of the country goes down.” Read the following passage and answer the questions that follow:

“Mosquitoes are drastically affecting the human health in almost all the developing tropical countries. Different species of mosquitoes cause very fatal diseases so much so that many humans lose their life and if they survive, are unable to put in productive hours to sustain their life. With the result, the health index of the country goes down.”

Name a species of mosquito other than female *Anopheles* and the disease, for which it carries the pathogen.

Correct Answer:

- Species: *Aedes aegypti*.
- Disease: Dengue fever.

💡 Quick Tip

Aedes aegypti is responsible for spreading diseases like Dengue, Chikungunya, and Zika virus.

SECTION – E

31. (a)

(i) Draw a schematic diagram of the cloning vector pBR 322 and label

- (1) Bam HI site
- (2) gene for ampicillin resistance
- (3) ‘ori’
- (4) ‘rop’ gene.

Correct Answer:

A schematic diagram of pBR 322 must include:

- The origin of replication (‘ori’).
- Ampicillin resistance gene.
- Restriction site for Bam HI.
- ‘rop’ gene regulating plasmid copy number.

💡 Quick Tip

The pBR 322 vector is a widely used cloning vector in genetic engineering due to its multiple cloning sites and selectable markers.

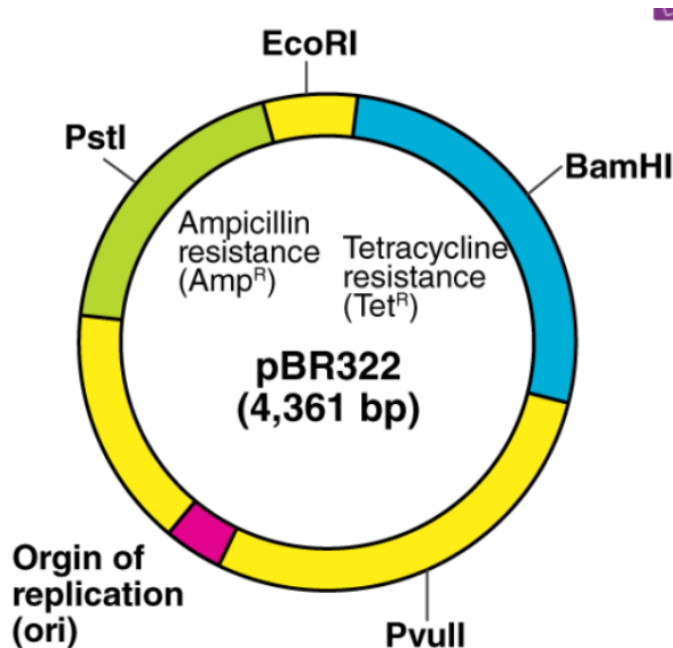


Figure 10: Schematic representation of pBR322 cloning vector, highlighting important sites such as BamHI, EcoRI, origin of replication (ori), ampicillin resistance gene, and tetracycline resistance gene.

(ii) State the role of 'rop' gene.

Correct Answer: The 'rop' gene regulates the plasmid copy number by controlling the replication of the plasmid within the host cell.

💡 Quick Tip

The 'rop' gene ensures stable replication of plasmids, maintaining a controlled number of plasmids per host cell.

(iii) A cloning vector does not have a selectable marker. How will it affect the process of cloning?

Correct Answer: Without a selectable marker, it becomes difficult to identify and isolate transformed cells, as there is no way to distinguish between transformed and non-transformed cells.

💡 Quick Tip

Selectable markers, such as antibiotic resistance genes, help in identifying and isolating transformed cells in genetic engineering.

(iv) Why is insertional inactivation preferred over the use of selectable markers in cloning vectors?

Correct Answer: Insertional inactivation ensures that the cloned DNA disrupts the marker gene, providing a visual or functional confirmation of successful transformation (e.g., loss of antibiotic resistance or colour change).

💡 Quick Tip

Insertional inactivation reduces dependency on antibiotics and provides a safer alternative for identifying recombinant colonies.

OR

(b) (i) Name the nematode (scientific name) that infects the roots of tobacco plant and reduces its yield.

Correct Answer: *Meloidogyne incognita*.

💡 Quick Tip

Root-knot nematodes like *Meloidogyne incognita* cause significant agricultural losses by affecting crop yields.

(ii) Name the vector that is used to introduce nematode-specific genes into the host plant (tobacco).

Correct Answer: *Agrobacterium tumefaciens*.

💡 Quick Tip

Agrobacterium tumefaciens is a natural genetic engineer widely used for transferring foreign genes into plants.

(iii) How does an anti-sense RNA function?

Correct Answer: Anti-sense RNA binds to the complementary mRNA sequence, blocking its translation and silencing the expression of the target gene.

💡 Quick Tip

Anti-sense RNA technology is an effective tool in gene silencing, used for studying gene functions and controlling diseases.

32. (a) (i)

Draw a diagram of a human sperm. Label any four parts and write their functions.

Correct Answer:

A diagram of a human sperm should include the following parts:

SPERM CELL

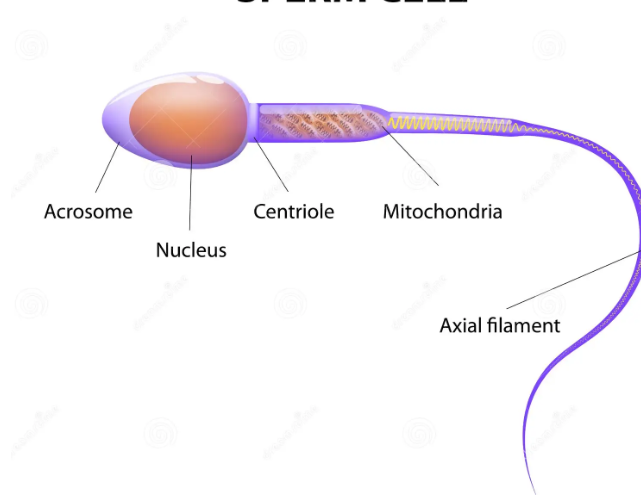


Figure 11: Labeled diagram of a human sperm cell showing the head, middle piece, and tail along with their respective components.

- **Head:** Contains the nucleus with genetic material and is covered by the acrosome, which has enzymes to penetrate the egg.
- **Midpiece:** Contains mitochondria to provide energy for motility.
- **Tail:** Propels the sperm towards the egg.
- **Acrosome:** Helps in breaking the egg membrane during fertilisation.

(ii) In a human female, the probability of an ovum to get fertilised by more than one sperm is impossible. Give reason.

Correct Answer: After the entry of one sperm into the egg, a fertilisation membrane develops around the egg, preventing the entry of additional sperms. This ensures monospermy.

💡 Quick Tip

The fertilisation membrane acts as a protective barrier, ensuring only one sperm fertilises the ovum, maintaining genetic stability.

OR

(b) (i) With the help of labelled diagram only, show the different stages of embryo development in a dicot plant.

Correct Answer: A labelled diagram of embryo development in a dicot plant should include:

- Zygote.

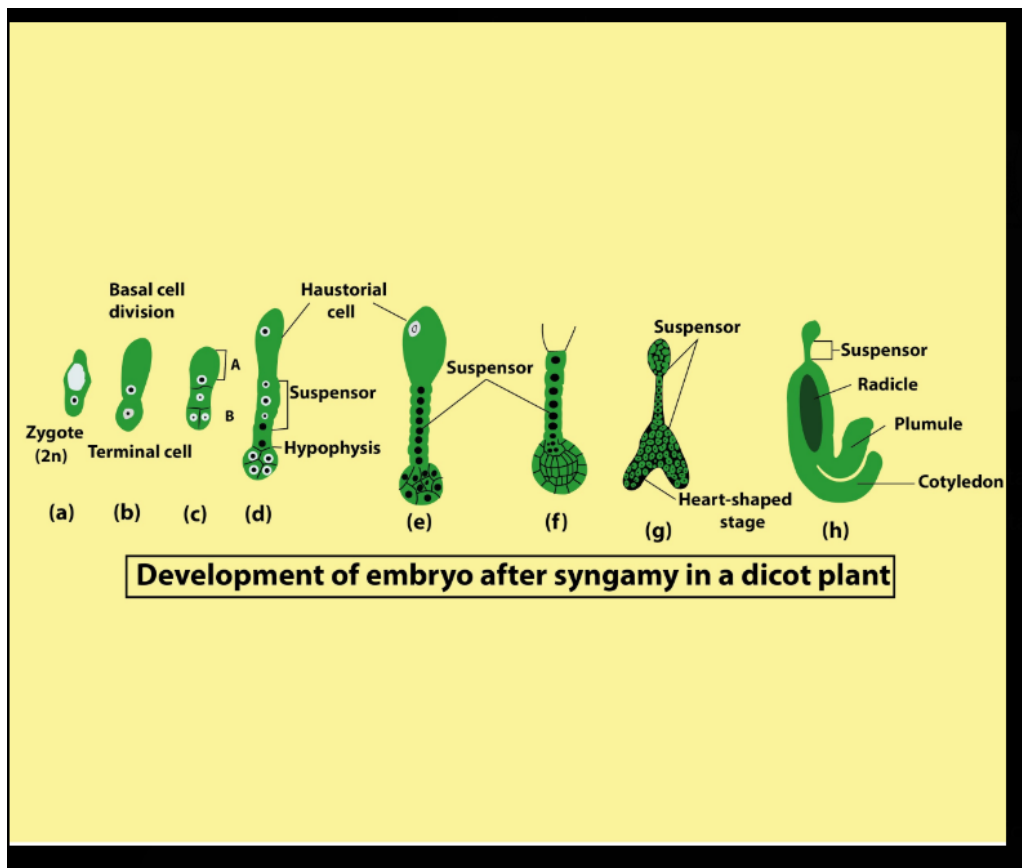


Figure 12: Development of embryo after syngamy in a dicot plant.

- Globular stage.
- Heart-shaped stage.
- Mature embryo.

(ii) Endosperm development precedes embryo development. Justify.

Correct Answer: Endosperm development provides the necessary nutrients for the developing embryo, ensuring its proper growth and maturation.

💡 Quick Tip

Endosperm is formed from the fusion of a sperm cell with the polar nuclei and acts as a nutritive tissue for the embryo in angiosperms.

33. (a) Natural selection operates in different ways in nature.

33(a). Natural selection operates in different ways in nature.

Identify the type of natural selection depicted in the graph above.

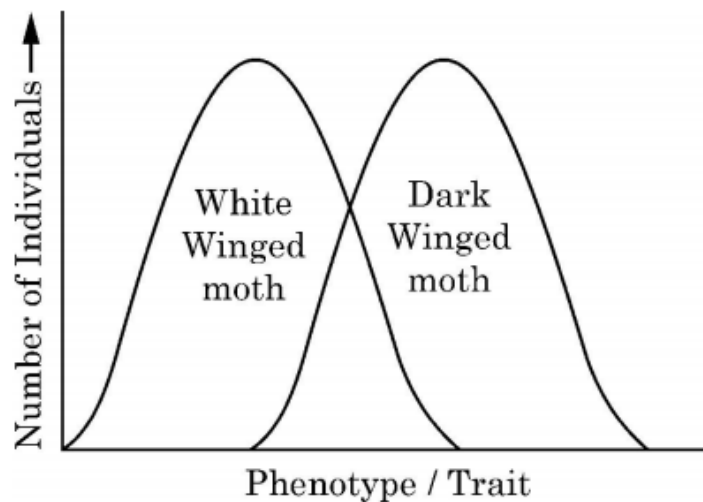


Figure 13: Phenotype distribution of White Winged and Dark Winged Moths.

Correct Answer: The graph depicts directional selection, where one phenotype is favoured over another, shifting the population mean.

💡 Quick Tip

Directional selection leads to a gradual shift in the population's traits due to environmental pressures favouring one extreme.

(ii) In England after industrialisation, the population of dark winged moths were more favoured than white winged moths. Explain.

Correct Answer: During industrialisation, trees were covered in soot, making dark-winged moths less visible to predators compared to white-winged moths. This gave dark-winged moths a survival advantage, increasing their population.

💡 Quick Tip

Camouflage is an important evolutionary trait that enhances survival in changing environments.

(iii) Anthropogenic action can enhance the rate of evolution. Explain with the help of an example.

Correct Answer: Anthropogenic actions like pesticide use have led to the evolution of pesticide-resistant insect populations. For example, mosquitoes have developed resistance to DDT due to its widespread use.

💡 Quick Tip

Human activities like pollution and overuse of chemicals create selection pressures, driving rapid evolutionary changes.

33(b).

(i) Why did Hershey and Chase use ^{35}S and ^{32}P in their experiment? Explain.

Correct Answer:

- ^{35}S : Used to label proteins as sulphur is present in proteins but not in DNA.
- ^{32}P : Used to label DNA as phosphorus is present in DNA but not in proteins.

This helped to determine whether DNA or proteins are the genetic material.

 Quick Tip

Radioactive isotopes are valuable tools for tracing molecules in biological experiments.

(ii) State the importance of (1) blending and (2) centrifugation in their experiment.

Correct Answer:

- Blending: Separated the phage protein coats from the bacterial cells.
- Centrifugation: Allowed the heavier bacterial cells to settle, separating them from the lighter phage protein coats.

 Quick Tip

Blending and centrifugation techniques are essential for separating biological components during experiments.

(iii) Write the conclusion they arrived at the end of their experiment.

Correct Answer: Hershey and Chase concluded that DNA is the genetic material as only ^{32}P -labelled DNA was found inside the bacterial cells, while ^{35}S -labelled protein remained outside.

 Quick Tip

Hershey and Chase demonstrated that DNA, not proteins, carries hereditary information in living organisms.