CBSE 12 Biology (57/5/1) 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**: Section A, B, C, D, and E.
3. **Section A:** Questions 1 to 16 are multiple-choice type questions. Each question carries 1 mark.
4. **Section B:** Questions 17 to 21 are very short answer-type questions. Each question carries 2 marks.
5. **Section C:** Questions 22 to 28 are short answer-type questions. Each question carries 3 marks.
6. **Section D:** Questions 29 and 30 are case-based questions. Each question carries 4 marks and has subparts with internal choice in one of the subparts.
7. **Section E:** Questions 31 to 33 are long answer-type questions. Each question carries 5 marks.
8. There is no overall choice. However, **internal choice** has been provided in some questions in Section B, Section C, and Section D. A candidate has to attempt only one of the alternatives in such questions.
9. A separate question paper is available for **Visually Impaired candidates**.
10. Wherever necessary, neat and properly labeled diagrams should be drawn.

collegedunia

SECTION – A

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

---

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:

When a single gene can exhibit multiple phenotypic expressions, such a gene is called a pleiotropic gene. For example, the gene responsible for phenylketonuria in humans affects multiple traits, such as hair color, skin pigmentation, and mental ability.

Quick Tip

A pleiotropic gene influences multiple traits. Remember, pleiotropism = "one gene, many effects."

---

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)

collegedunia

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

Solution:

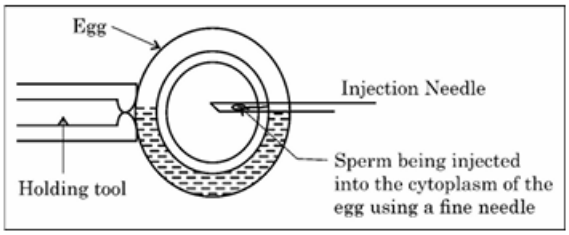
A person with trisomy of 21st chromosome will be afflicted with Down's syndrome. This condition is characterized by a small round head, furrowed tongue, partially open mouth, and characteristic palm crease.

Quick Tip

For conditions like Down's syndrome, remember that trisomy 21 leads to physical and developmental traits such as furrowed tongue and palm crease.

---

3. Observe the schematic representation of assisted reproductive technology given below:



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 represents Intracytoplasmic Sperm Injection (ICSI), where a single sperm is directly injected into the cytoplasm of the egg using a fine needle. This technique is used in cases of severe male infertility or failed fertilization in conventional IVF.

Quick Tip

Remember: In ICSI, a single sperm is injected directly into the egg's cytoplasm using a fine needle.

collegedunia

4. Interferons are proteins secreted by:

(A) RBC

(B) WBC

(C) Bacteria-infected cell

(D) Virus-infected cell

Correct Answer: (D) Virus-infected cell

Solution:

Interferons are signaling proteins secreted by virus-infected cells to protect nearby uninfected cells. They play a crucial role in the immune response by interfering with viral replication.

Quick Tip

Interferons are secreted in response to viral infections to protect uninfected cells.

---

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:

In the biological treatment of sewage, flocs are masses of bacteria held together by fungal filaments, forming mesh-like structures. These flocs help in the breakdown of organic matter during secondary treatment.

Quick Tip

Remember: Flocs are bacterial masses held together by fungal filaments, essential in sewage treatment.

---

collegedunia

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:

In agarose gel electrophoresis, DNA is separated based on size. Staining with ethidium bromide allows the DNA bands to be visualized under UV light. Ethidium bromide binds to DNA and fluoresces under UV light, making the bands visible.

Quick Tip

Always use UV light to observe ethidium bromide-stained DNA during gel electrophoresis.

---

7. A phenomenon where a male insect mistakenly identifies 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 occurs when a male insect is deceived by the patterns or structures of a flower that resemble a female insect. The male attempts to copulate with the flower, leading to its pollination. This is a pollination strategy employed by certain orchids.

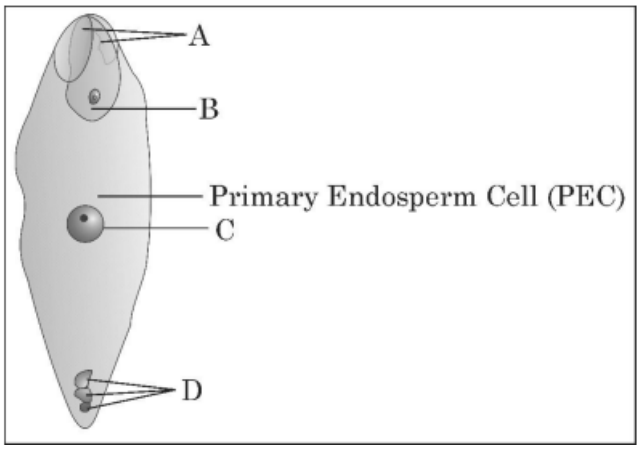
collegedunia

Quick Tip

Pseudocopulation: ”Male insect fooled by flower resembling female partner, leading to pollination.”

---

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



(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:

The correct labellings in the figure are:

- A represents degenerating synergids as they are no longer needed after fertilization.

- B is the zygote formed after the fusion of the male and female gametes.

- C is the primary endosperm nucleus (PEN) formed by the fusion of a sperm with two polar nuclei.

- D represents degenerating antipodals as their function is complete.

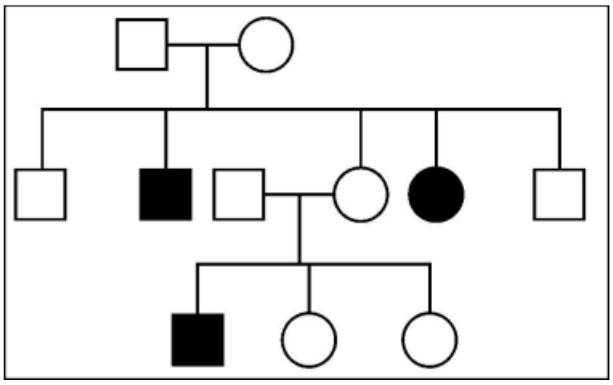
collegedunia

Quick Tip

In a fertilised embryo sac: - Zygote forms at the center of the sac. - Degenerating synergids and antipodals are found at opposite poles. - PEN results from the fusion of a sperm with two polar nuclei.

---

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:



(A) Dominant X-linked

(B) Recessive X-linked

(C) Autosomal dominant

(D) Autosomal recessive

Correct Answer: (D) Autosomal recessive

Solution:

The disorder depicted in the pedigree chart follows an autosomal recessive inheritance pattern. This can be inferred from the following observations:

1. The trait skips generations, which is typical for recessive traits.

2. Both males and females are equally affected, indicating an autosomal pattern.

3. The trait is expressed only when an individual inherits two copies of the recessive allele, one from each parent.

collegedunia

Quick Tip

In pedigree analysis: - Recessive traits often skip generations. - Autosomal traits affect males and females equally. - X-linked traits show gender bias (males more affected in recessive traits, females more affected in dominant traits).

---

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

A (Gene)	B (Products)
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) (i), (iii), (ii), (iv)

(B) (iii), (i), (iv), (ii)

(C) (iii), (i), (ii), (iv)

(D) (iii), (iv), (i), (ii)

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

Solution:

In the lac operon: - The 'i' gene codes for the repressor protein, which inhibits the operon when lactose is absent.

- The 'z' gene produces β-galactosidase, which breaks down lactose into glucose and galactose.

- The 'a' gene encodes transacetylase, which helps in lactose metabolism.

- The 'y' gene produces lac permease, which facilitates the entry of lactose into the cell.

Quick Tip

Remember the lac operon genes: - 'i' gene $\rightarrow$ Repressor - 'z' gene $\rightarrow$ β-galactosidase - 'y' gene $\rightarrow$ Lac permease - 'a' gene $\rightarrow$ Transacetylase

collegedunia

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:

When both parents are carriers for thalassaemia (heterozygous), the genetic cross shows: - 25% chance of an unaffected child (homozygous dominant).

- 50% chance of a carrier child (heterozygous).

- 25% chance of an afflicted child (homozygous recessive).

Thus, there is a 25% chance that the child will be afflicted with thalassaemia.

Quick Tip

For autosomal recessive disorders like thalassaemia, a carrier cross (Aa × Aa) always results in a 25% chance of an afflicted child.

---

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 and identical to the coding strand (except that uracil (U) replaces thymine (T) in RNA). Therefore, the RNA transcript of the sequence 5' – ATGAATG – 3' is 5' – AUGAAUG – 3'.

collegedunia

Quick Tip

Remember: RNA is complementary to the template strand and identical to the coding strand, except that U replaces T.

---

13. 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.

(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.

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

Solution:

HIV (Human Immunodeficiency Virus) causes AIDS (Acquired Immunodeficiency Syndrome) by damaging the immune system. However, HIV is an RNA virus, not a DNA virus. Therefore, Assertion (A) is true, but Reason (R) is false.

Quick Tip

HIV is an RNA virus that causes AIDS by targeting and destroying the immune system's CD4 cells.

---

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

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

(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.

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

collegedunia

Solution:

A probe is a single-stranded DNA or RNA tagged with a radioactive or fluorescent molecule, used to identify complementary sequences by hybridization. The probe searches and hybridizes with its complementary DNA in a clone of cells, making both (A) and (R) correct, with (R) explaining (A).

Quick Tip

Remember: Probes are tagged single-stranded DNA or RNA molecules used to locate complementary sequences via hybridization.

---

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

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

(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.

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

Solution:

In birds, the sex of the offspring is determined by females, not males, as females are heterogametic (ZW), while males are homogametic (ZZ). Therefore, Assertion (A) is false, but Reason (R) is true.

Quick Tip

In birds: - Males: Homogametic (ZZ) - Females: Heterogametic (ZW) Sex determination is based on the female's gamete.

---

16. 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.

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

collegedunia

(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.

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

Solution:

Communities with more species are more stable due to the complementary roles of species, reducing year-to-year variation in total biomass and ensuring ecological stability. Both (A) and (R) are true, and (R) correctly explains (A).

Quick Tip

Ecological stability increases with biodiversity because different species complement each other and buffer environmental changes.

SECTION – B

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

Solution:

Farmers prefer apomictic seeds because:

- They do not require repeated hybridization, saving time and cost.
- They maintain the hybrid vigor (heterosis) over generations, as apomixis produces genetically identical offspring.

Quick Tip

Remember: Apomictic seeds are cost-effective and maintain hybrid vigor across generations, making them favorable for farmers.

OR

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

Solution:

collegedunia

Advantage:

Amniocentesis can detect genetic abnormalities and chromosomal disorders in the fetus, aiding in early diagnosis and management.

Disadvantage:

It carries a small risk of complications such as miscarriage or infection.

Quick Tip

Amniocentesis: Think of "genetic diagnosis" (advantage) vs. "risk of miscarriage" (disadvantage).

---

18. 5' – G↓AATTC – 3'

3' – CTTAA↑G – 5'

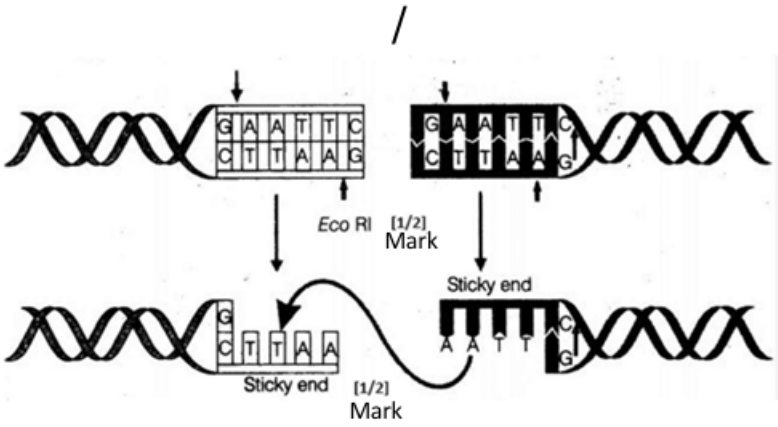
(a) Name the restriction enzyme that recognizes the given specific sequence of bases. What are such sequences of bases referred to as?

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

Solution (a):

The restriction enzyme that recognizes the given sequence is EcoRI. Such sequences are referred to as palindromic sequences, which read the same forward and backward on complementary strands.

Solution (b):



The arrows indicate the sites where the restriction enzyme EcoRI cuts the DNA. The result obtained thereafter is the formation of sticky ends, which are single-stranded overhangs that

collegedunia

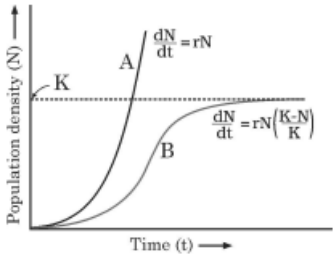
facilitate the joining of DNA fragments during genetic engineering.

Quick Tip

Remember: - EcoRI recognizes the sequence 5' – GAATTC – 3'. - Palindromic sequences are the same on complementary strands when read in opposite directions. - Sticky ends are crucial for recombination in genetic engineering.

---

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



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

(b) Mention what does 'K' in the graph represent.

Solution (a):

- Growth curve 'A' represents exponential growth, which is possible when resources are unlimited, and there are no environmental constraints.

- Growth curve 'B' represents logistic growth, which occurs when resources are limited, and the population stabilizes after reaching the carrying capacity.

Solution (b):

'K' in the graph represents the carrying capacity, which is the maximum population size that the environment can sustain indefinitely, given the available resources.

Quick Tip

- Exponential growth: Unlimited resources, no constraints. - Logistic growth: Limited resources, stabilizes at carrying capacity (K).

---

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

collegedunia

Solution:

Plants form symbiotic associations with *Glomus* species, a type of mycorrhiza. These fungi help the plants in:

- Efficient absorption of water and minerals, especially phosphorus.
- Enhancing resistance to pathogens and tolerance to salinity and drought.

Quick Tip

Think of mycorrhiza as ”fungal helpers” that improve plant nutrient uptake and enhance resistance to stress and pathogens.

---

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.

Solution:

DNA follows Chargaff’s rule, which states:

- The percentage of adenine (A) equals the percentage of thymine (T), and the percentage of cytosine (C) equals the percentage of guanine (G).
- Since adenine constitutes 31%, thymine also constitutes 31%. Together, A + T = 62%.
- The remaining 38% is divided equally between cytosine and guanine. Thus, cytosine constitutes 19%.

Quick Tip

Chargaff’s Rule: A = T and C = G. Use this to calculate the percentage of any base in DNA when the percentage of one base is known.

SECTION – C

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

collegedunia

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

Solution:

The completed table is as follows:

Sl. No.	Organism	Bioactive Molecule	Use
1	*Monascus purpureus*	Statins	Lowers blood cholesterol
2	*Streptomyces*	Streptomycin	Antibiotic
3	*Trichoderma polysporum*	Cyclosporin A	Immunosuppressant

Quick Tip

- *Monascus purpureus* produces statins that lower blood cholesterol.
- *Streptomyces* is a source of antibiotics like streptomycin.
- Cyclosporin A from *Trichoderma polysporum* is used as an immunosuppressant.

---

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

Solution:

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

- **Favourable Climate:** Stable climatic conditions in tropical regions support year-round growth and reproduction.
- **Long Evolutionary Time:** Tropical regions have remained undisturbed for millions of years, allowing species to diversify.
- **Higher Productivity:** High temperature and sunlight lead to higher productivity, supporting a larger variety of organisms.

OR

(b) (i) What does an ecological pyramid represent?

collegedunia

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

Solution:

(i) An ecological pyramid represents the trophic structure and function of an ecosystem, depicting energy, biomass, or numbers at each trophic level.

(ii)

- **Upright Pyramid:** In most ecosystems, energy pyramids are upright because energy decreases with each trophic level. Example: Grassland ecosystem.
- **Inverted Pyramid:** Some aquatic ecosystems have an inverted biomass pyramid. Example: Phytoplankton (low biomass) support a higher biomass of zooplankton.

Quick Tip

- Tropical regions: High species diversity due to stable climate, evolutionary time, and productivity.
- Ecological pyramids: Energy is always upright, but biomass may invert in aquatic systems.

---

24. (a) What are transgenic animals?

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

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

Solution:

(a) Transgenic animals are animals whose genomes have been altered by introducing foreign DNA, enabling them to express desired traits.

(b) The transgenic animal with the largest number is mice.

(c) Transgenic animals are produced for:

- **Studying Diseases:** Used as models for studying human genetic diseases.
- **Producing Medicines:** Engineered to produce proteins or medicines like insulin and human growth hormone.

collegedunia

- **Improving Livestock:** Modified to enhance productivity and disease resistance.

Quick Tip

- Transgenic animals are used in medicine, research, and agriculture.
- Mice are the most common transgenic animals.

---

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.

Solution:

- The number of chromosomes in:

- Zygote: 10 chromosomes (formed by fusion of haploid male and female gametes, each with 10 chromosomes).
- Endosperm: 30 chromosomes (formed by triple fusion, involving two polar nuclei (10 + 10) and one male gamete (10)).

- Process:

- Zygote Formation: Syngamy, where a male gamete fuses with an egg cell to form a diploid zygote.
- Endosperm Formation: Double fertilization, where one male gamete fuses with two polar nuclei to form a triploid endosperm.

Quick Tip

Remember: - Zygote = Fusion of 2 gametes (haploid). - Endosperm = Fusion of 2 polar nuclei + 1 male gamete (triploid, only in angiosperms).

---

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

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

collegedunia

Solution:

(a) DNA replication occurs within a replication fork because DNA polymerase synthesizes new strands only in the 5' to 3' direction. This restricts replication to occur progressively as the fork unwinds.

(b)

- The leading strand is synthesized continuously in the 5' to 3' direction.
- The lagging strand is synthesized discontinuously in small fragments (Okazaki fragments), which are later joined by DNA ligase.

Quick Tip

- DNA replication is semi-discontinuous. - Leading strand = continuous. - Lagging strand = Okazaki fragments (discontinuous).

---

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

Solution:

Processing of hnRNA into mRNA involves:

- Capping: Addition of a 5' methyl guanosine cap for stability and ribosome attachment.
- Splicing: Removal of introns (non-coding regions) and joining of exons (coding regions).
- Tailing: Addition of a poly-A tail at the 3' end for stability and nuclear export.

- This processing occurs in the nucleus of the eukaryotic cell.

Quick Tip

Remember the steps of hnRNA processing: 1. Capping (5' end), 2. Splicing (introns removed), 3. Tailing (poly-A at 3' end).

---

collegedunia

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.

Solution:

Three human activities causing species extinction:

- Deforestation: Destruction of natural habitats reduces biodiversity.
- Pollution: Air, water, and soil pollution harm ecosystems and species survival.
- Overexploitation: Overfishing, hunting, and poaching lead to the depletion of species populations.

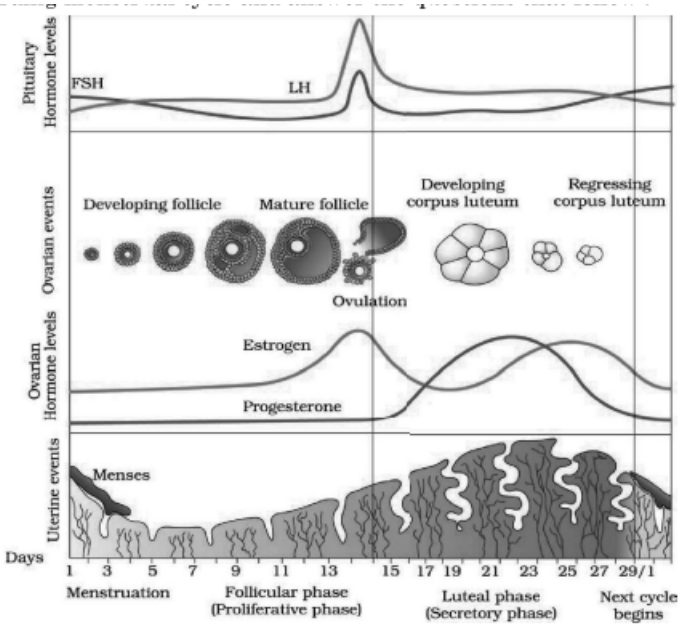
Quick Tip

Key threats to biodiversity: - Habitat loss, pollution, and overexploitation are major drivers of extinction.

SECTION – D

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

collegedunia



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

(b) 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.

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

OR

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

Solution:

(a) The hormones responsible for the menstrual cycle at puberty are:

- **FSH (Follicle Stimulating Hormone)**: Secreted by the anterior pituitary gland, stimulates follicle development.
- **LH (Luteinizing Hormone)**: Secreted by the anterior pituitary gland, triggers ovulation and corpus luteum formation.
- **Estrogen and Progesterone**: Secreted by the ovaries, regulate the uterine lining during the cycle.

collegedunia

(b) Implantation should occur during the secretory phase (days 15-28) of the menstrual cycle. During this phase, the uterine lining (endometrium) is thick and vascularized due to the action of progesterone, creating a suitable environment for embryo implantation.
(c) The hormone responsible for the proliferative phase is Estrogen, secreted by the developing ovarian follicles. It stimulates the regeneration and thickening of the uterine lining (endometrium) after menstruation.

OR

If the released ovum is not fertilized, the corpus luteum degenerates, leading to a drop in progesterone levels. This causes the uterine lining (endometrium) to break down and shed, resulting in menstruation.

Quick Tip

- Menstrual cycle phases: Menses, Proliferative, Secretory. - Implantation occurs in the secretory phase due to high progesterone levels. - Progesterone = Maintains endometrium; Estrogen = Builds endometrium.

---

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

"Mosquitoes are drastically affecting 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."

(a) Name the form in which *Plasmodium* gains entry into (i) human body (ii) the female *Anopheles* body.

(b) 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 do the symptoms of the disease appear.

OR

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

(c) Name a species of mosquito other than female *Anopheles* and the disease for which it

collegedunia

carries the pathogen.

Solution:

(a)

- (i) In humans, *Plasmodium* enters in the form of sporozoites, which are injected by the female *Anopheles* mosquito during a bite.
- (ii) In the female *Anopheles* body, *Plasmodium* enters in the form of gametocytes, which are taken up with the blood meal from an infected person.

(b) The symptoms of malaria do not appear immediately after the bite because the parasite undergoes an incubation period inside the human liver and blood cells. Symptoms appear 10–14 days later when the parasite multiplies and ruptures red blood cells, releasing toxins. This results in fever, chills, and sweating.

OR

In the female *Anopheles* mosquito, after sucking blood from an infected person:

- The gametocytes of *Plasmodium* develop into sporozoites in the mosquito's gut.
- The sporozoites migrate to the salivary glands of the mosquito, making it ready to infect another human during its next bite.

(c) A mosquito species other than *Anopheles* is *Aedes aegypti*, which carries the pathogen for dengue fever.

Quick Tip

- *Plasmodium* stages: Sporozoites enter humans; gametocytes enter mosquitoes.
- *Aedes aegypti*: Carries pathogens for dengue and chikungunya. - Malaria symptoms appear after the incubation period (10–14 days).

SECTION – E

31. (a)

collegedunia

1. **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.**
2. **State the role of 'rop' gene.**
3. **A cloning vector does not have a selectable marker. How will it affect the process of cloning?**
4. **Why is insertional inactivation preferred over the use of selectable markers in cloning vectors?**

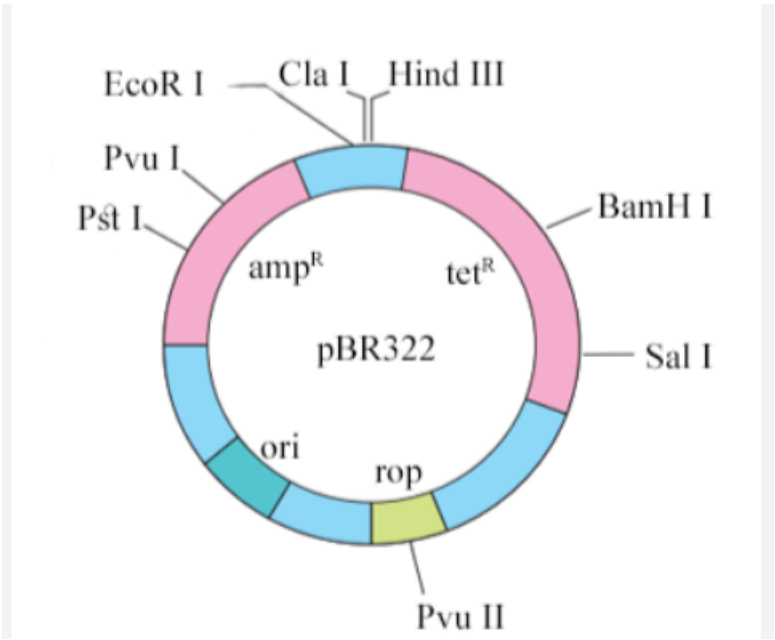
OR

(b)

1. **Name the nematode (scientific name) that infects the roots of tobacco plant and reduces its yield.**
2. **Name the vector that is used to introduce nematode-specific genes into the host plant (tobacco).**
3. **How do sense and anti-sense RNAs function?**
4. **Why could the parasite not survive in a transgenic tobacco plant?**

Solution (a):

(i) A schematic diagram of the cloning vector pBR 322 is shown below:



collegedunia

(ii) The 'rop' gene in pBR 322 encodes proteins involved in maintaining the copy number of the plasmid.

(iii) If a cloning vector does not have a selectable marker, it would be difficult to differentiate between transformed and non-transformed cells, complicating the identification of successful clones.

(iv) Insertional inactivation is preferred because it allows direct identification of recombinant colonies. It inactivates a selectable marker gene (e.g., antibiotic resistance), so only recombinant cells are easily identified.

Solution (b):

(i) The nematode that infects the roots of tobacco plants is Meloidogyne incognita.

(ii) The vector used to introduce nematode-specific genes into the host plant is Agrobacterium tumefaciens.

(iii) Sense and anti-sense RNAs are complementary RNA strands. When expressed together, they form a double-stranded RNA that silences the target nematode gene through RNA interference (RNAi).

(iv) The parasite could not survive in the transgenic tobacco plant because the RNAi mechanism silences the nematode-specific genes, preventing its growth and reproduction.

Quick Tip

- Cloning vectors: pBR 322 has ori (replication origin), selectable markers, and restriction sites.
- RNAi: Silences specific genes by degrading their mRNA using double-stranded RNA.
- *Agrobacterium tumefaciens* is commonly used for plant genetic transformation.

---

32. (a)

1. **Draw a diagram of a human sperm. Label any four parts and write their functions.**
2. **In a human female, the probability of an ovum getting fertilized by more than one sperm is impossible. Give a reason.**

OR

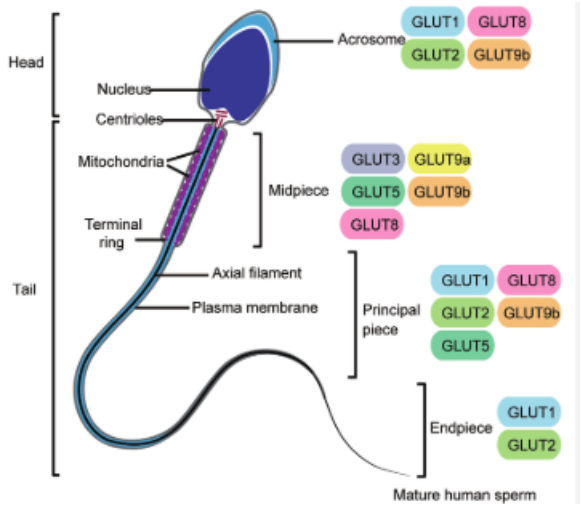
(b)

collegedunia

1. **With the help of a labelled diagram only, show the different stages of embryo development in a dicot plant.**
2. **Endosperm development precedes embryo development. Justify.**

Solution (a):

(i) Diagram of a human sperm:



Functions of labelled parts:

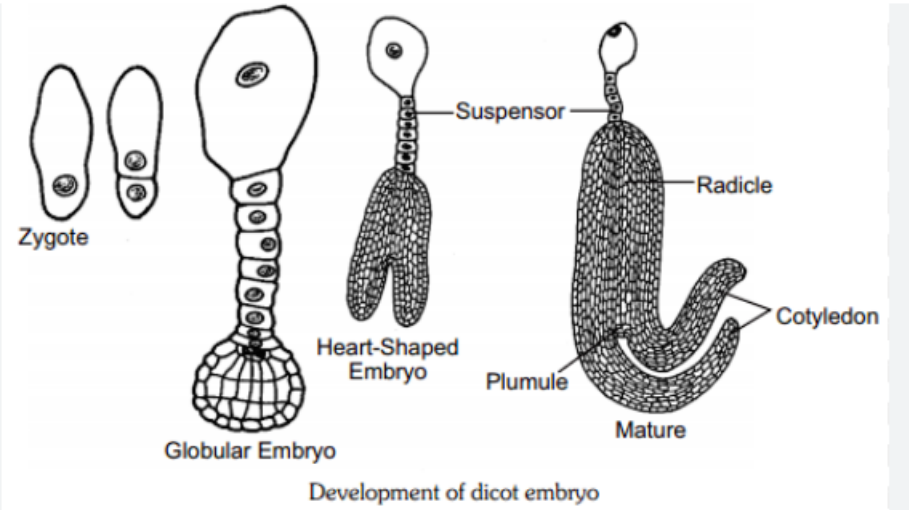
- **Head**: Contains the nucleus with genetic material and acrosome for penetrating the egg.
- **Middle Piece**: Contains mitochondria that provide energy for motility.
- **Tail**: Facilitates movement of the sperm towards the egg.
- **Plasma Membrane**: Encloses the sperm and maintains its structural integrity.

(ii) The probability of an ovum being fertilized by more than one sperm is impossible due to a phenomenon called cortical reaction, where the egg membrane changes after the first sperm enters, preventing entry of additional sperms.

Solution (b):

(i) Diagram showing stages of embryo development in a dicot plant:

collegedunia



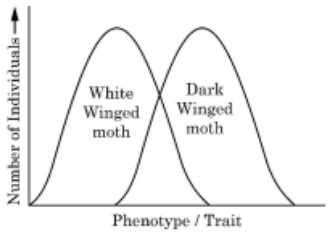
Development of dicot embryo

(ii) Endosperm development precedes embryo development because the endosperm provides nutrients to the developing embryo. It supports early stages of growth until the plant can photosynthesize independently.

Quick Tip

- Human sperm: Acrosome helps penetrate the egg; mitochondria in the middle piece generate energy.
- Cortical reaction prevents polyspermy in humans.
- Dicot embryos develop after endosperm formation, ensuring nutrient availability.

33.



(a)

1. **Natural selection operates in different ways in nature. Identify the type of natural selection depicted in the graph above.**
2. **In England after industrialisation, the population of dark-winged moths was more favoured than white-winged moths. Explain.**

collegedunia

3. **Anthropogenic action can enhance the rate of evolution. Explain with the help of an example.**

OR

(b)

1. **Why did Hershey and Chase use ^{35}S and ^{32}P in their experiment? Explain.**
2. **State the importance of (1) blending and (2) centrifugation in their experiment.**
3. **Write the conclusion they arrived at the end of their experiment.**

Solution (a):

(i) The type of natural selection depicted is directional selection, as one extreme phenotype (dark-winged moth) is favoured over the other (white-winged moth).

(ii) After industrialisation, soot darkened tree trunks. Dark-winged moths were camouflaged and escaped predation, while white-winged moths were easily spotted by predators. This is an example of natural selection.

(iii) Anthropogenic actions like pesticide usage or antibiotic resistance drive evolution. Example: Overuse of antibiotics has led to the evolution of drug-resistant bacteria.

Solution (b):

(i) Hershey and Chase used ^{35}S to label protein and ^{32}P to label DNA to distinguish which molecule entered bacterial cells during viral infection.

(ii)

- Blending: Removed phage particles attached to the bacterial surface.
- Centrifugation: Separated heavier infected bacterial cells from lighter viral components.

(iii) The conclusion was that DNA is the genetic material, as only ^{32}P (DNA) was found inside the bacterial cells.

Quick Tip

- Natural selection: Directional selection favours one phenotype.
- Industrial melanism: Dark-winged moths camouflaged better on soot-covered trees.
- Hershey-Chase: DNA, not protein, is the genetic material.

collegedunia