

## CBSE Class 12 2025 Biology Question Paper (57/7/1) With Solutions

<b>Time Allowed :3 Hour</b>	<b>Maximum Marks :70</b>	<b>Total questions :33</b>
-----------------------------	--------------------------	----------------------------

### General Instructions

**Read the following instructions very carefully and strictly follow them:**

1. This question paper contains 33 questions. All questions are compulsory.
2. This question paper is divided into five sections Sections A, B, C, D and E.
3. In Section A Questions no. 1 to 16 are Multiple Choice type questions. Each question carries 1 mark.
4. In Section B Questions no. 17 to 21 are Very Short Answer type questions. Each question carries 2 marks.
5. In Section C Questions no. 22 to 28 are Short Answer type questions. Each question carries 3 marks.
6. In Section D Questions no. 29 and 30 are case study based questions. Each question carries 4 marks.
7. In Section E Questions no. 31 to 33 are Long Answer type questions. Each question carries 5 marks.
8. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the Sections except Section A.
9. Kindly note that there is a separate question paper for Visually Impaired candidates.
10. Use of calculators is not allowed.

## SECTION A

Questions no. 1 to 16 are Multiple Choice Type Questions, carrying 1 mark each.

Choose the best option.

1. What are minisatellites?

- (A) 10–40 bp sized small sequences within the genes.
- (B) Short coding repetitive sequences region on the eukaryotic genome.
- (C) Short non-coding repetitive sequences forming a large portion of eukaryotic genome.
- (D) Regions of coding strand of DNA.

**Correct Answer:** (C) Short non-coding repetitive sequences forming a large portion of eukaryotic genome.

**Solution:**

Minisatellites are short, tandemly repeated sequences of DNA, typically 10–60 base pairs in length, located mainly in the non-coding regions of eukaryotic genomes. These sequences are highly variable in the number of repeat units among individuals, making them useful for DNA fingerprinting and genetic diversity studies.

### Quick Tip

Remember — minisatellites are non-coding repetitive DNA sequences used prominently in DNA fingerprinting techniques.

2. Identify the *incorrect* statement regarding PCR.

- (A) Two sets of primers are required during polymerisation.
- (B) The process of replication is repeated multiple times to produce one billion copies.
- (C) Thermostable DNA polymerase is used for extension of primers.
- (D) Annealing is required to separate both the strands of template DNA.

**Correct Answer:** (D) Annealing is required to separate both the strands of template DNA.

**Solution:**

In PCR, denaturation is the step where the double-stranded DNA is heated to separate into two strands. Annealing refers to the cooling phase where primers bind to their

complementary sequences on the template strands. Hence, option (D) is incorrect because separation happens during denaturation, not annealing.

#### Quick Tip

Remember — Denaturation separates DNA strands, Annealing binds primers, and Extension synthesizes new DNA strands.

---

**3. The following information is about drugs and tobacco. Select the correct statement from the options given below.**

- (A) Cocaine is given to patients after surgery as it stimulates recovery.
- (B) Chewing tobacco lowers blood pressure and heart rate.
- (C) Barbiturates when given to criminals makes them tell the truth.
- (D) Morphine is often given to persons who have undergone surgery as a painkiller.

**Correct Answer:** (D) Morphine is often given to persons who have undergone surgery as a painkiller.

#### Solution:

Morphine is a strong opioid analgesic frequently administered to patients after surgery to relieve severe pain. The other statements are incorrect as cocaine is a potent stimulant not used post-surgery, chewing tobacco actually raises blood pressure, and barbiturates are sedatives — they don't make criminals confess the truth.

#### Quick Tip

Opioids like morphine are medically used for pain relief, especially after surgeries.

---

**4. Given below are the events that are observed in an artificial hybridisation programme. Arrange them in the correct sequential order and select the correct option.**

1. Re-bagging
2. Selection of parents

3. Bagging
4. Dusting the pollens on stigma
5. Emasculation
6. Collection of pollens from male parent

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

**Correct Answer:** (B) (ii), (v), (iii), (vi), (iv), (i)

**Solution:**

The correct sequence for artificial hybridisation is:

- **Selection of parents** — Choose desirable plants.
- **Emasculation** — Remove anthers from the female plant to prevent self-pollination.
- **Bagging** — Cover emasculated flowers to avoid unwanted pollination.
- **Collection of pollens from male parent.**
- **Dusting the pollens on stigma.**
- **Re-bagging** — Protect pollinated flowers until fruits develop.

Thus, option (B) correctly arranges these events.

**Quick Tip**

Artificial hybridisation ensures controlled pollination by preventing undesired pollen contact and introducing desired traits.

---

**5. Which of the following conditions correctly describes the manner of determining the sex in the given options?**

- (A) Homozygous sex chromosomes (ZZ) determine female sex in birds.
- (B) XO type of chromosomes determine male sex in grasshoppers.
- (C) XO condition in humans determines female sex.
- (D) Homozygous sex chromosomes (XX) produce male in *Drosophila*.

**Correct Answer:** (B) XO type of chromosomes determine male sex in grasshoppers.

**Solution:**

In grasshoppers, sex is determined by the XO system. Males possess only one X chromosome (XO), while females possess two (XX). The absence of a second sex chromosome (O) in males determines maleness.

**Quick Tip**

XO sex determination is typical in grasshoppers — one X chromosome means male, while XX means female.

---

**6. Choose the option that correctly describes the gynoecium of *Michelia*:**

- (A) Multicarpellary, Apocarpous
- (B) Bicarpellary, Apocarpous
- (C) Multicarpellary, Syncarpous
- (D) Bicarpellary, Syncarpous

**Correct Answer:** (A) Multicarpellary, Apocarpous

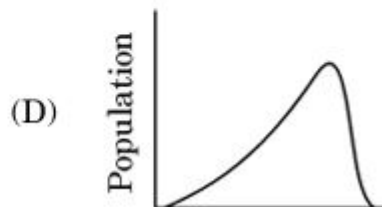
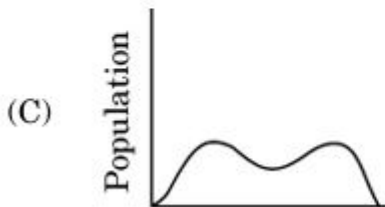
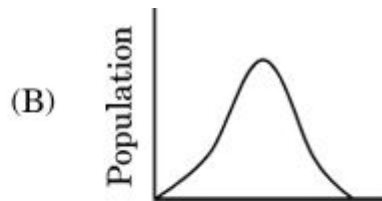
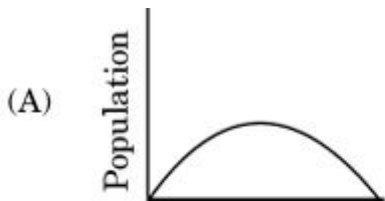
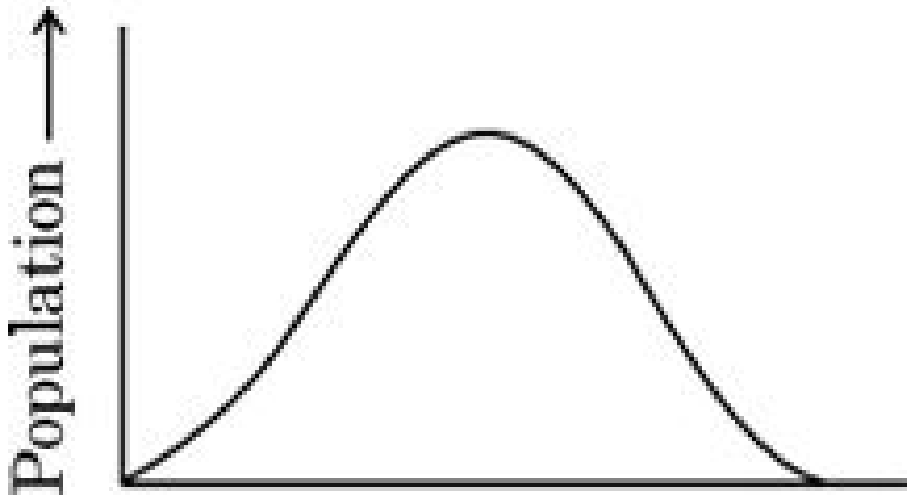
**Solution:**

In *Michelia*, the gynoecium is made up of multiple (multi-) free (apo-) carpels, hence it is termed multicarpellary and apocarpous.

**Quick Tip**

“Apocarpous” means free carpels, and “Multicarpellary” means many carpels.

7. The given graph shows the range of variation among population members, for a trait determined by multiple genes. If this population is subjected to disruptive selection for several generations, which of the following distributions is most likely to result?



**Correct Answer:** (C)

**Solution:**

Disruptive selection favors individuals at both extremes of a trait distribution and selects against the intermediate types. Over several generations, this leads to a bimodal distribution, like the one shown in option (C), where individuals at both ends of the range increase in frequency.

### Quick Tip

Disruptive selection produces two peaks — favoring extremes and reducing intermediates.

**8. Which one of the following immune system components does *not* correctly match with its respective role?**

- (A) Interferons — Secreted by virus-infected cells and protect non-infected cells from further viral infection.
- (B) Macrophages — Mucus-secreting cells that trap microbes entering into the body.
- (C) B-Lymphocytes — Produce antibodies in response to pathogens into blood to fight with them.
- (D) IgA — Present in colostrum in early days of lactation to protect infants from diseases.

**Correct Answer:** (B) Macrophages — Mucus-secreting cells that trap microbes entering into the body.

### Solution:

Macrophages are actually phagocytic cells that engulf and digest pathogens. It is mucus-secreting epithelial cells that trap microbes. Hence, option (B) is incorrectly matched.

### Quick Tip

Macrophages engulf microbes; mucus-secreting cells trap them — don't mix them up!

**9. Which one of the following is *not* the product of transgenic experiments?**

- (A) Pest-resistant crop variety
- (B) High nutritional value in grains
- (C) Drought-resistant crops
- (D) Production of insulin by rDNA technique

**Correct Answer:** (C) Drought-resistant crops

### Solution:

While pest-resistant crops (like Bt cotton), nutritionally enhanced crops (like golden rice), and insulin production by rDNA technology are well-established transgenic products, drought-resistant crops are typically produced via conventional breeding and not predominantly through transgenic methods.

#### Quick Tip

Transgenics excel in pest resistance and nutritional quality, while drought resistance is often achieved by selective breeding.

---

**10. A biologist studied the population of rats in a granary. He found the average natality was 280, average mortality was 200, immigration was 40 and emigration was 50. The net increase in population is:**

- (A) 80
- (B) 70
- (C) 10
- (D) 90

**Correct Answer:** (B) 70

**Solution:**

$$\begin{aligned}\text{Net increase in population} &= (\text{Natality} + \text{Immigration}) - (\text{Mortality} + \text{Emigration}) \\ &= (280 + 40) - (200 + 50) \\ &= 320 - 250 \\ &= 70\end{aligned}$$

#### Quick Tip

Population growth = (Births + Arrivals) - (Deaths + Departures)

---

**11. India has only 2.4% of the world's land area but its share of the global species diversity is:**

- (A) 8.1%
- (B) 12.9%
- (C) 7.3%
- (D) 5.1%

**Correct Answer:** (A) 8.1%

**Solution:**

India, despite having just 2.4% of the world's land area, accounts for approximately 8.1% of the global species diversity, making it one of the richest biodiversity zones on Earth.

**Quick Tip**

Remember — 2.4% land, 8.1% species: India is one of the 12 mega-diversity countries globally.

---

**12. Out of the following, select the correct match:**

- (A) Transgenic cow milk — Human beta-lactalbumin protein
- (B) ELISA — Antigen antibody interaction
- (C) Corn Borer — Cry II Ab gene
- (D) Cotton plant — *Meloidogyne incognitia*

**Correct Answer:** (B) ELISA — Antigen antibody interaction

**Solution:**

ELISA (Enzyme-Linked Immunosorbent Assay) works on the principle of antigen-antibody interaction to detect the presence of antigens (like pathogens) or antibodies in a sample.

**Quick Tip**

ELISA is a diagnostic test based on antigen-antibody binding reactions.

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below:

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

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

**13. Assertion (A):** Swiss cheese is characterized by large holes due to CO<sub>2</sub> production.

**Reason (R):** It is ripened by growing a specific fungi.

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

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is *not* the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

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

**Solution:**

Swiss cheese gets its characteristic holes due to CO<sub>2</sub> production by the bacterium *Propionibacterium shermanii*, not by fungi. Hence, Assertion is true and Reason is false.

Quick Tip

Swiss cheese holes are made by bacteria, not fungi.

---

**14. Assertion (A):** Replication of DNA takes place in S phase of the cell cycle.

**Reason (R):** DNA replication and cell division cycle should be highly coordinated.

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

- (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is *not* the correct explanation of the Assertion (A).
- (C) Assertion (A) is true, but Reason (R) is false.
- (D) Assertion (A) is false, but Reason (R) is true.

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

**Solution:**

DNA replication occurs during the S (Synthesis) phase to ensure each daughter cell gets an identical set of DNA. Both statements are true and Reason appropriately explains Assertion.

**Quick Tip**

S phase is for DNA replication; cell cycle coordination prevents genetic errors.

---

**15. Assertion (A):** A male individual always inherits haemophilia from his mother.

**Reason (R):** The gene for haemophilia lies on X-chromosome.

- (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
- (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is *not* the correct explanation of the Assertion (A).
- (C) Assertion (A) is true, but Reason (R) is false.
- (D) Assertion (A) is false, but Reason (R) is true.

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

**Solution:**

Haemophilia is an X-linked recessive disorder. Males inherit their single X chromosome from their mother, so if she carries the defective gene, it gets expressed in the male child.

### Quick Tip

X-linked traits in males come exclusively from the mother's X chromosome.

---

**16. Assertion (A):** A piece of DNA inserted into an alien organism generally does not replicate, if not inserted into a chromosome.

**Reason (R):** Chromosomes have specific sequences called 'ori' region, where DNA replication is initiated.

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

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is *not* the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

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

### Solution:

For DNA to replicate inside a host organism, it must have an origin of replication (ori). If a foreign DNA lacks this sequence, it won't replicate unless integrated into a chromosome containing an 'ori' site. Thus, both the assertion and reason are true and the reason correctly explains the assertion.

### Quick Tip

'Ori' regions are essential starting points for replication in both plasmids and chromosomes.

---

## SECTION B

**17. Student to attempt either option (A) or (B):**

**(A) Name the Indian crop variety for which, in 1997, an American company got patent rights through the US Patent and Trademark Office. This is considered a case of Biopiracy. Justify.**

**OR**

**(B) State two purposes for which the Indian Government has set up GEAC (Genetic Engineering Approval Committee).**

**Solution:**

**(A) Step 1:** The Indian crop variety involved was **Basmati rice**.

**Step 2:** In 1997, an American company received a patent from the US Patent and Trademark Office for a new variety of Basmati rice lines and grains.

**Step 3:** This was considered **biopiracy** because it involved misappropriating traditional Indian knowledge and resources without consent or benefit-sharing.

**Conclusion:** India opposed this patent on the grounds of protecting its traditional rights and succeeded in revoking it.

**OR**

**(B) Two purposes of setting up GEAC:**

- To regulate the manufacture, use, import, export, and storage of hazardous microorganisms or genetically engineered organisms.
- To ensure environmental safety and human health in connection with research, manufacture, and use of genetically modified organisms (GMOs).

#### Quick Tip

Biopiracy is exploiting traditional knowledge/resources without consent. GEAC regulates GMO use for safety.

---

**18. Student to attempt either option (A) or (B):**

**(A) “A fully developed foetus initiates its delivery from the mother’s womb.” Explain.**

**OR**

**(B) Give reasons for the following:**

1. Why can a woman generally not conceive a child after 50 years of age?
2. Polar bodies are formed during oogenesis and not during spermatogenesis.

**Solution:**

**(A) Step 1:** A fully developed foetus sends signals to the maternal system through hormones.

**Step 2:** Foetal ejection reflex is triggered by mild uterine contractions.

**Step 3:** This stimulates the release of oxytocin from the maternal pituitary.

**Step 4:** Oxytocin enhances uterine contractions in a positive feedback loop until delivery occurs.

**OR**

**(B) (i)** After 50 years of age, a woman usually undergoes **menopause**, where the ovaries stop releasing eggs and hormonal support for conception ceases.

**(ii)** During **oogenesis**, unequal cytoplasmic division occurs to preserve maximum cytoplasm in the ovum. The small, non-functional cells produced alongside are called **polar bodies**. In **spermatogenesis**, equal division produces four functional sperms, hence no polar bodies form.

**Quick Tip**

Delivery is triggered by oxytocin via foetal signals. Polar bodies form in oogenesis due to unequal divisions, unlike spermatogenesis.

---

**19. A few stages and their respective time period in the evolutionary history of human beings are mentioned in the flowchart given below:**

- **15 mya** — Primates walking like gorillas and chimpanzees existed.
- **3–4 mya** — Man-like primates walked in Eastern Africa. Fossils of their bones were discovered.

- **2 mya** — This ancestor lived in the East African grasslands and ate fruits.
- **1.5 mya** — This hominid had a brain size of 900 cc and probably ate meat.

**Based on the above information, answer the following questions:**

- (a) Name one primate about 15 mya.
- (b) Name one place where fossils of primates were discovered in Eastern Africa.
- (c) Name the ancestor that lived in the East African grasslands about 2 mya.
- (d) Name the hominid that was found around 1.5 mya.

**Solution:**

- (a) Dryopithecus or Ramapithecus.
- (b) Ethiopia or Tanzania.
- (c) Australopithecus.
- (d) Homo erectus.

#### Quick Tip

Dryopithecus and Ramapithecus are ancient primates from 15 mya. Homo erectus had a 900 cc brain and used tools.

---

**20. Student to attempt either option (A) or (B):**

**(A) How does a human body respond when vaccine is introduced into it? It is said that vaccinations are a must for a healthy society. Justify.**

**OR**

**(B) Humans have innate immunity for protection against pathogens that may enter the gut along with food. What are the two barriers in our body that protect it from such pathogens?**

**Solution:**

**(A) Step 1:** A vaccine introduces weakened or inactivated pathogens or their antigens into the body.

**Step 2:** The immune system recognises these as foreign and activates B-lymphocytes to produce antibodies.

**Step 3:** Memory cells are also formed for long-lasting immunity.

**Step 4:** This ensures quicker and stronger response upon future exposure to the same pathogen.

**Conclusion:** Vaccination prevents the spread of infectious diseases, protecting both individuals and society (herd immunity).

**OR**

**(B) Two barriers protecting the gut:**

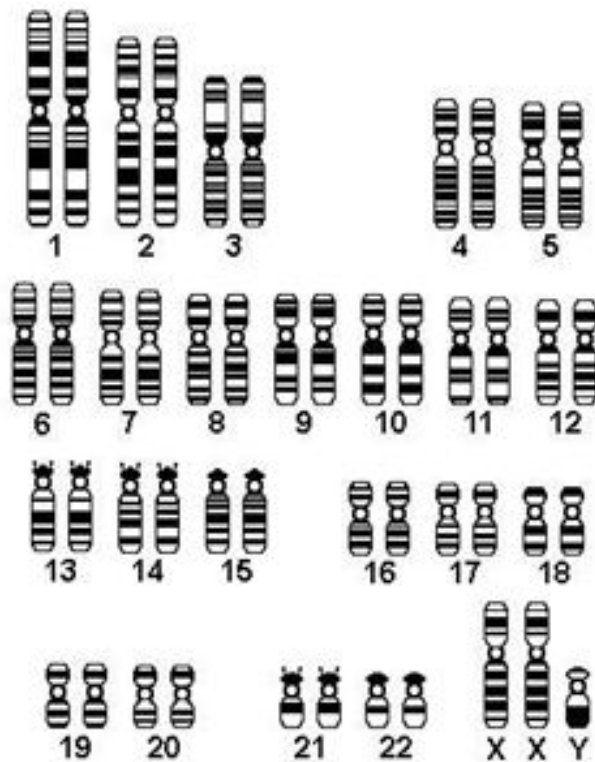
1. **Physical barrier:** Mucus lining in the gut that traps microbes and prevents their entry.
2. **Physiological barrier:** Hydrochloric acid in the stomach that kills most microbes entering with food.

**Quick Tip**

Vaccines build immunity and memory cells. Mucus and stomach acid guard the gut against pathogens.

---

**21. A karyotype of a human suffering from a certain disorder is given below:**



**Answer the following:**

- (a) Identify the disorder.
- (b) Write the symptoms of the disorder.
- (c) Give reason for such a disorder.

**Solution:**

- (a) The disorder is **Down's syndrome (Trisomy 21)**.
- (b) Symptoms include:
  - Mental retardation.
  - Short stature.
  - Broad face.
  - Furrowed tongue.
  - Physical growth delay.

- (c) The disorder occurs due to **trisomy of chromosome 21**, caused by non-disjunction during gamete formation, leading to an extra chromosome 21.

#### Quick Tip

Down's syndrome results from an extra chromosome 21. It's a chromosomal numerical abnormality.

---

### SECTION C

**22. A village health worker was taking a session with women. She tells them that one has to be careful while using oral pills as a method of birth control. Wrong usage can actually promote conception.**

**(A) Analyse the statement — oral pills need careful usage, as wrong usage can promote conception. Compare merits and demerits of using oral pills and surgical methods of birth control.**

**(B) Village women are confused as to how a thin metallic copper loop can prevent pregnancy. Explain the mode of action of IUDs. Give two points.**

**Solution:**

**(A) Analysis:**

- Oral pills should be taken regularly and at the prescribed time. Missed doses reduce effectiveness, increasing chances of conception.

**Merits of oral pills:**

- Easy to administer.
- Reversible contraceptive method.

**Demerits:**

- Must be taken regularly without fail.
- Possible side effects like nausea and hormonal imbalances.

**Merits of surgical methods:**

- Permanent and highly effective.
- No need for daily management.

**Demerits:**

- Irreversible in most cases.
- Requires hospitalization and medical procedure.

**(B) Mode of action of copper IUDs:**

- Release of copper ions reduces sperm motility and viability, preventing fertilisation.
- Induces changes in the uterine lining, making it unsuitable for implantation.

**Quick Tip**

Regularity is key for oral pills. IUDs work by affecting sperm and uterine lining to prevent pregnancy.

---

**23. (a) "The process of evolution of different species in a given geographical area starts from a point and literally radiates to other geographical areas." Explain it with an example.**

**(b) Cite an example where more than one adaptive radiation has occurred in an isolated geographical area. Name the type of evolution your example depicts.**

**Solution:**

(a) The given statement explains **adaptive radiation**, where organisms diversify rapidly into new forms to adapt to different ecological niches.

- **Example:** Darwin's finches on the Galápagos Islands. From a single ancestral species, many species evolved with different types of beaks suited to different kinds of food.

- (b) An example is the **marsupials in Australia**, where many species evolved from a common ancestor in isolated geographical areas.
- This depicts **convergent evolution**, where organisms evolve similar adaptations independently.

#### Quick Tip

Adaptive radiation leads to diversification from a common ancestor. Australia's marsupials are a textbook example.

---

**24. A segment of DNA, 'TTG AGG GGG ATG' was translated into an oligopeptide with the amino acids, Lysine - Serine - Proline - Tyrosine.**

- (a) Write the codons in correct sequence for the four amino acids.
- (b) If first adenine in DNA is substituted by guanine, what will be the sequence of amino acids in the new oligopeptide?
- (c) Write the anticodons for these amino acids.

#### **Solution:**

- (a) Codons for:
- Lysine: AAA / AAG
  - Serine: UCU / UCC / UCA / UCG / AGU / AGC
  - Proline: CCU / CCC / CCA / CCG
  - Tyrosine: UAU / UAC
- (b) If the first adenine (A) is replaced by guanine (G) in DNA, it will alter the corresponding mRNA codon and amino acid sequence.
- New amino acid sequence: It would depend on the resulting codons, which might code for different amino acids, possibly altering the peptide chain.

(c) Anticodons for:

- Lysine: UUU / UUC
- Serine: AGA / AGG / AGU / AGC / UCA / UCG
- Proline: GGA / GGG / GGU / GGC
- Tyrosine: AUA / AUG

#### Quick Tip

A single base substitution can change the amino acid sequence, affecting protein structure and function.

---

**25. A person is suffering from high grade fever. Which symptoms will help to identify if he/she is suffering from Typhoid, Pneumonia or Malaria?**

**Solution:**

- **Typhoid:**
  - Sustained high fever.
  - Weakness.
  - Stomach pain and constipation.
- **Pneumonia:**
  - Fever with chills.
  - Cough.
  - Difficulty in breathing and chest pain.
- **Malaria:**
  - Recurrent high fever with chills.
  - Headache.
  - Muscle pain.

- Sweating after fever subsides.

#### Quick Tip

Pattern of fever and associated symptoms are important clues in diagnosing infectious diseases like Typhoid, Pneumonia, and Malaria.

**26. (a) Why are transgenic animals so called?**

**(b) With the help of an example each, explain the role of transgenic animals in the following:**

- (i) Vaccine safety
- (ii) Biological products

**Solution:**

- (a) Animals that have had their DNA manipulated to possess and express an extra (foreign) gene are called **transgenic animals**.
- (b) (i) **Vaccine safety:** Transgenic mice are used to test the safety of vaccines before human use. Example: Transgenic mice used in the testing of polio vaccine.  
(ii) **Biological products:** Transgenic animals can produce valuable therapeutic proteins. Example: Rosie, the transgenic cow, produced human protein-enriched milk containing *alpha-lactalbumin*.

#### Quick Tip

Transgenic animals carry foreign genes and are vital tools in biomedical research, vaccine testing, and drug production.

**27. (a) Mention any two advantages of micropropagation techniques.**

**(b) Write in brief how the process is carried out in the laboratory.**

**(c) Name any two important food plants grown commercially by this method.**

**Solution:**

- (a) – Large number of genetically identical plants can be produced rapidly.
  - Disease-free plants can be developed.
- (b) – Explants (small plant tissue pieces) are cultured in nutrient medium under sterile conditions.
  - Plant hormones stimulate cell division to form callus.
  - Callus differentiates into plantlets, which are later transferred to soil.
- (c) – Banana
  - Sugarcane

#### Quick Tip

Micropropagation is a tissue culture technique useful for mass-producing uniform, disease-free plants.

---

**28. Name the type of food chains responsible for the flow of larger fraction of energy in an aquatic ecosystem and a terrestrial ecosystem, respectively. Mention any two differences between the two food chains.**

**Solution:**

- **In aquatic ecosystems:** Grazing food chain.
- **In terrestrial ecosystems:** Detritus food chain.
- **Differences:**
  - In the grazing food chain, energy flow begins from producers (phytoplankton or plants), while in detritus food chain, it begins from dead organic matter.
  - The grazing food chain is the major energy flow route in aquatic systems, whereas detritus food chain dominates in terrestrial systems.

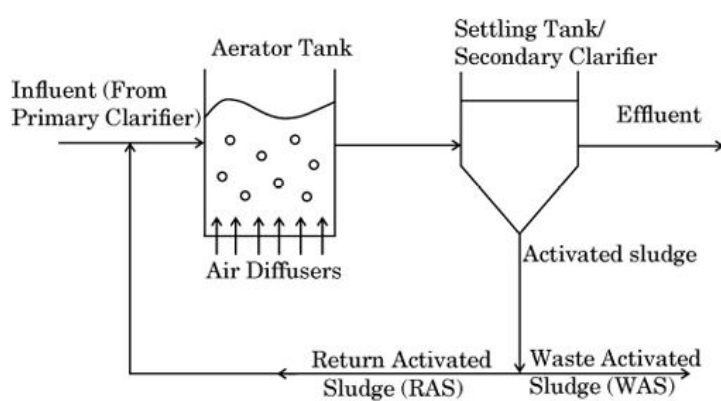
### Quick Tip

Energy in aquatic ecosystems flows mainly through grazing food chains, while detritus chains dominate terrestrial ecosystems.

## SECTION D

**Question Nos.29 and 30 are case based questions.Each question has 3 sub-questions with internal choice in one sub-question.**

**29. Study the figure given below and answer the questions that follow.**



- Identify the figure and state its importance.
- Why is air diffused into the aerator tank? Explain.
- What changes take place in the settling tank?

**OR**

- How is BOD related to organic matter present in the water?

**Solution:**

- The figure represents the **Secondary Treatment or Biological Treatment in a Sewage Treatment Plant.**

*Importance:* This stage helps in removing the biodegradable organic matter from the wastewater using aerobic microorganisms.

(b) Air is diffused into the aerator tank to provide **oxygen** to aerobic bacteria and microbes. These microbes utilize the oxygen to break down organic matter in the sewage efficiently, reducing the Biochemical Oxygen Demand (BOD) of the water.

(c) (i) In the settling tank, the **activated sludge settles down** at the bottom due to gravity. The clear water or effluent is then separated from the top. A portion of the activated sludge is returned to the aeration tank (Return Activated Sludge - RAS), while the rest is removed as Waste Activated Sludge (WAS).

**OR**

(ii) BOD (Biochemical Oxygen Demand) is **directly proportional** to the amount of organic matter present in water. The more the organic content, the more oxygen is required by aerobic bacteria to break it down, leading to a higher BOD value.

#### Quick Tip

The secondary treatment in sewage involves aerobic microbes that degrade organic waste. High BOD means more organic pollution in water.

**30. The following question is based on pollination. Study the figures carefully and answer the questions that follow.**

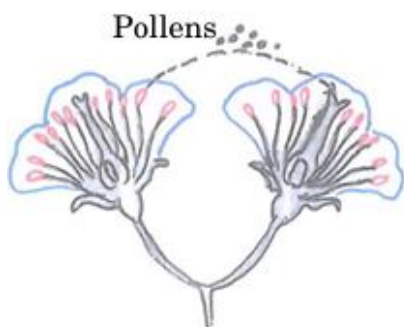


Figure A



Figure B

- (a) Give the scientific terms for the processes taking place in Figures A and B respectively.
- (b) Mention two conditions necessary for the process occurring in Figure B.
- (c) (i) State one advantage and one disadvantage of the process occurring in Figure B.

**OR**

- (ii) Name one plant where, in some flowers only, the process in Figure B takes place and give the reason responsible for it.

**Solution:**

(a) The scientific terms are:

- Figure A — **Cross-pollination**
- Figure B — **Autogamy** (a type of self-pollination)

(b) Two conditions necessary for autogamy:

- (i) Anther and stigma must mature simultaneously (synchronous maturation).
- (ii) Anther and stigma must be positioned closely to facilitate transfer of pollen grains.

(c) (i) **Advantage:** Maintains genetic purity of the species.

**Disadvantage:** Leads to reduced genetic variation, which may limit adaptability.

**OR**

(ii) One such plant is **Viola** (commonly known as pansy).

*Reason:* It shows cleistogamy, where some flowers do not open and ensure autogamy as the only mode of pollination.

#### Quick Tip

Cross-pollination promotes genetic diversity, while autogamy ensures reproductive assurance, especially in isolated environments.

---

## SECTION E

**31. Student to attempt either option-(A) or (B):**

(A) Write the features a molecule should have to act as a genetic material. In the light of the above features, evaluate and justify the suitability of the molecule that is preferred as an ideal genetic material.

**OR**

(B) Differentiate between the following:

- (i) Polygenic Inheritance and Pleiotropy
- (ii) Dominance, Codominance and Incomplete dominance

**Solution:**

(A) Features of an ideal genetic material:

- Should be able to replicate accurately.
- Must store all genetic information.
- Should express the information as phenotypes.
- Should permit occasional mutations for variation and evolution.
- Must be chemically and structurally stable.

*Justification:* DNA is considered the most suitable genetic material because it meets all the above criteria. It replicates semi-conservatively, is stable under physiological conditions, and carries information through sequences of nitrogenous bases. It also undergoes mutations at a low rate, allowing genetic variation without compromising integrity.

**OR**

(B)

	<b>Polygenic Inheritance</b>	<b>Pleiotropy</b>
(i)	A single trait is controlled by multiple genes.	A single gene influences multiple traits.
	Example: Skin color in humans.	Example: Sickle cell anemia gene affects multiple organs.

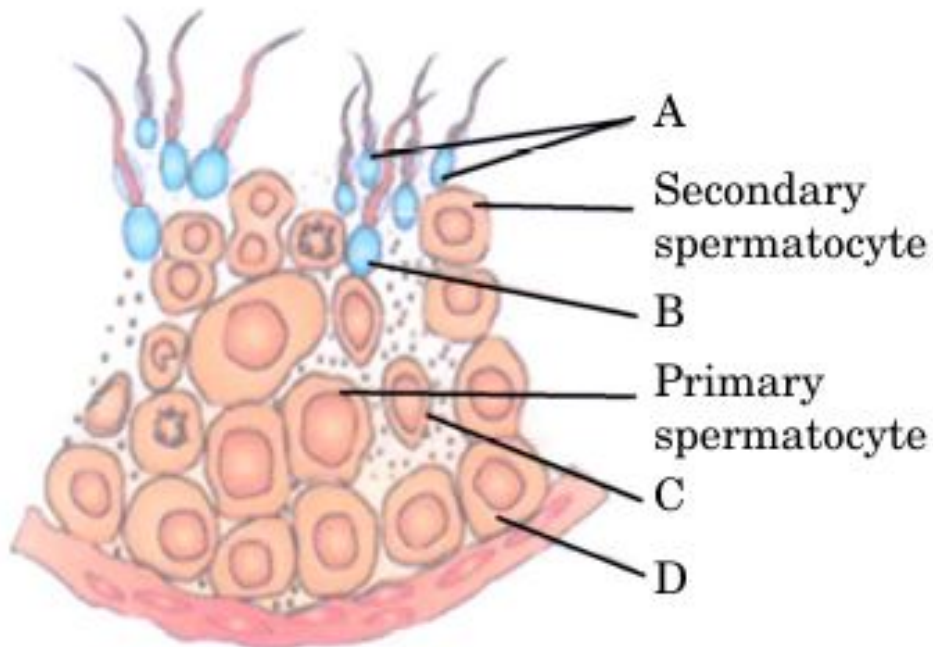
	<b>Dominance</b>	<b>Codominance</b>	<b>Incomplete Dominance</b>
(ii)	One allele masks the effect of another.	Both alleles express equally in the heterozygote.	The heterozygote shows an intermediate phenotype.
	Example: Tall (T) dominant over dwarf (t) in pea.	Example: AB blood group.	Example: Flower color in snapdragon.

### Quick Tip

DNA is preferred as genetic material because of its stability, ability to replicate, and storage of vast genetic information. Understanding dominance types helps decode trait expression patterns.

### 32. Student to attempt either option-(A) or (B):

(A) Study the given diagram showing the sectional view of a seminiferous tubule.



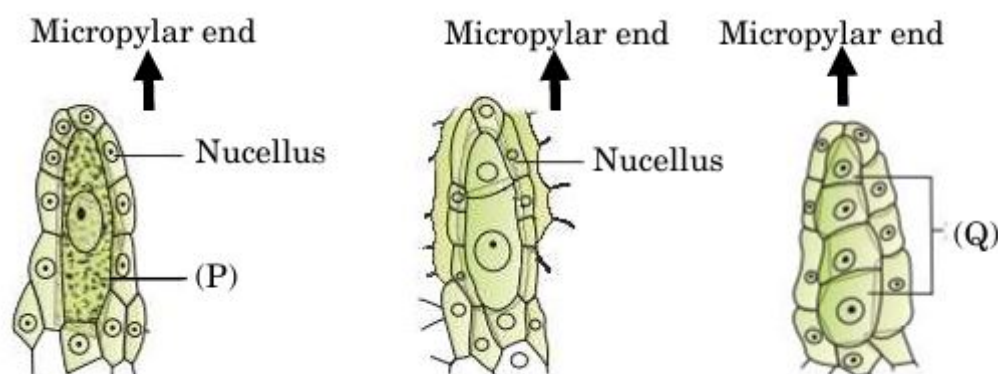
Answer the following questions:

(i) Label A, B, C and D in the figure.

- (ii) What will be the number of chromosomes in secondary spermatocyte and spermatid respectively?
- (iii) Explain the terms — Spermiogenesis and Spermiation.

**OR**

**(B)** Study the figures given below showing initial stages in the formation of female gametophyte and answer the questions that follow.



- (i) Identify (P) and (Q).
- (ii) I. What kind of division does cell (P) undergo to form (Q)?
- II. How many (Q) cells form the embryo sac? What is the name given to such kind of development?
- III. How many free nuclear mitotic divisions will the functional megaspore undergo to form the embryo sac?
- IV. Describe the structure of a mature female gametophyte.

**Solution:**

**(A)**

(i) Labels:

- A — Spermatozoa
- B — Secondary spermatocyte
- C — Primary spermatocyte

- D — Spermatogonia
- (ii) Secondary spermatocyte: **n = 23 chromosomes**, Spermatid: **n = 23 chromosomes**
- (iii) • **Spermiogenesis:** Process by which spermatids transform into mature spermatozoa.
- **Spermiation:** Release of mature spermatozoa from Sertoli cells into the lumen of seminiferous tubules.

**OR**

**(B)**

- (i) • (P) — Megaspore mother cell
- (Q) — Functional megaspore
- (ii) I. Cell (P) undergoes **meiosis** to form cell (Q).
- II. Only **one functional (Q)** cell develops into the embryo sac. This is called **monosporic development**.
- III. The functional megaspore undergoes **three free nuclear mitotic divisions**.
- IV. The mature female gametophyte (embryo sac) is 7-celled and 8-nucleated, consisting of:
- 1 egg cell and 2 synergids at the micropylar end,
  - 3 antipodal cells at the chalazal end,
  - 1 central cell with 2 polar nuclei.

#### Quick Tip

Spermiogenesis transforms spermatids into sperm, while spermiation releases them. In female gametophyte development, monosporic development forms the embryo sac from one megaspore.

**33. Student to attempt either option-(A) or (B):**

**(A)**

(i) How does alien species invasion cause a decline in biodiversity? Explain.

How have the following contributed to biodiversity loss?

- I. *Nile Perch*
- II. *Lantana* and *Eichhornia*
- III. *Clarias gariepinus*

(ii) Why have certain regions been declared as biodiversity hotspots by environmentalists of the world? Name any two such regions in India.

**OR**

**(B)**

(i) Write an equation for Verhulst-Pearl Logistic Growth Curve where:

$N$  = Population density at time 't'

$r$  = Intrinsic rate of natural increase

(ii) Draw a graph for a population whose population density has reached carrying capacity.

(iii) Draw a growth curve where resources are non-limiting to growth of population.

(iv) Which growth curve is considered more realistic and why? Explain.

**Solution:**

**(A)**

(i) **Alien species invasion** causes biodiversity loss by outcompeting native species for resources, altering habitats, or introducing new diseases.

- *Nile Perch*: Introduced in Lake Victoria, it caused the extinction of over 200 native cichlid fish species.
- *Lantana* and *Eichhornia*: These invasive plants choke native vegetation and water bodies, respectively, altering ecosystem structure.
- *Clarias gariepinus*: An exotic African catfish introduced in Indian waters that threatens indigenous fish diversity by predation and competition.

- (ii) Regions rich in endemic species and facing severe threats are declared as biodiversity hotspots. These areas are prioritized for conservation.

**Two biodiversity hotspots in India:**

- Western Ghats
- Indo-Burma region

**OR**

**(B)**

- (i) The equation for Verhulst-Pearl Logistic Growth is:

$$\frac{dN}{dt} = rN \left( \frac{K - N}{K} \right)$$

Where:

- $N$  = Population density at time  $t$
- $r$  = Intrinsic rate of natural increase
- $K$  = Carrying capacity

- (ii) *(Draw an S-shaped sigmoid curve showing slow start, exponential growth, and leveling off at  $K$ )*

(iii) *(Draw a J-shaped curve showing continuous rise in population size)*

- (iv) The logistic growth curve is considered more realistic because:

- It takes into account limited resources and environmental resistance.
- It reflects the natural population growth trend where growth slows as resources become scarce and population approaches carrying capacity.

**Quick Tip**

Invasive species disrupt native ecosystems. Logistic growth models real-world population trends, considering environmental limits.