

## CBSE 12 Biology (57/1/3) Question Paper with Solutions

Time Allowed :3 hours

Maximum Marks :70

Total questions :33

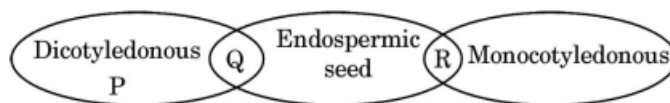
### General Instructions

**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.

## SECTION A

1. Refer to the Venn diagram given below. Select the option with correct examples P, Q, and R:



	P	Q	R
(A)	Castor	Onion	Wheat
(B)	Bean	Castor	Maize
(C)	Pea	Gram	Barley
(D)	Coconut	Rubber	Groundnut

**Correct Answer:** (B) P: Bean, Q: Castor, R: Maize

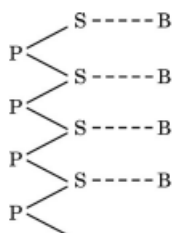
**Solution:** The Venn diagram illustrates the classification of seeds into dicotyledonous (P), endospermic (Q), and monocotyledonous (R). Based on the characteristics:

- **P (Dicotyledonous):** Bean is a dicot seed, which has two cotyledons.
- **Q (Endospermic seed):** Castor seed is an endospermic dicot seed, where the endosperm persists in the mature seed.
- **R (Monocotyledonous):** Maize is a monocot seed, having only one cotyledon.

### Quick Tip

To solve Venn diagram-based questions, identify each group and classify the options based on key seed characteristics such as cotyledon number and the presence of endosperm.

2. The type of bond represented by the dotted line '—' in a schematic polynucleotide chain is:



- (A) Hydrogen bond
- (B) Peptide bond
- (C) N-glycosidic linkage
- (D) Phosphodiester bond

**Correct Answer:** (C) N-glycosidic linkage

**Solution:** In a polynucleotide chain, the dotted line (‘—’) represents the bond between the nitrogenous base (B) and the sugar (S). This bond is known as an N-glycosidic linkage. It connects the 1’ carbon of the pentose sugar to the nitrogen atom of the nitrogenous base.

Other bonds in the polynucleotide structure: Phosphodiester bond: Links the sugar molecules of adjacent nucleotides. Hydrogen bond: Occurs between complementary nitrogenous bases in double-stranded DNA. Peptide bond: Found in proteins, not in polynucleotides.

#### Quick Tip

Identify bonds in biomolecules: N-glycosidic linkage: Between sugar and base in nucleotides. Phosphodiester bond: Backbone of DNA/RNA. Hydrogen bond: Holds DNA strands together. Peptide bond: Found in proteins.

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### 3. *Lactobacillus* that sets milk into curd is categorised as:

- (A) Cyanobacteria
- (B) Archaeobacteria
- (C) Chemosynthetic bacteria
- (D) Heterotrophic bacteria

**Correct Answer:** (D) Heterotrophic bacteria

**Solution:** *Lactobacillus* is a heterotrophic bacterium that converts lactose in milk into lactic acid, setting the milk into curd.

#### Quick Tip

Heterotrophic bacteria obtain their energy from organic compounds, making them important in fermentation processes like curd formation.

**4. Which one of the following transgenic animals is being used to test the safety of the polio vaccine?**

- (A) Sheep
- (B) Goat
- (C) Pig
- (D) Mice

**Correct Answer:** (D) Mice

**Solution:** Transgenic mice are used to test the safety of the polio vaccine because they can be genetically modified to mimic human susceptibility to the polio virus.

**Quick Tip**

Transgenic animals are widely used in biomedical research for vaccine testing and studying genetic disorders.

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**5. The scientist who proposed that "embryos of all vertebrates including humans develop a row of vestigial gill slits behind the head but it is a functional organ only in fish and replaced by lungs in all other vertebrates" is:**

- (A) Darwin
- (B) Lamarck
- (C) Ernst Haeckel
- (D) Mendel

**Correct Answer:** (C) Ernst Haeckel

**Solution:** Ernst Haeckel proposed the "Biogenetic Law," which states that embryonic development (ontogeny) recapitulates the evolutionary history (phylogeny) of an organism.

**Quick Tip**

Haeckel's Biogenetic Law highlights similarities in embryonic stages across species, supporting the concept of common ancestry.

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**6. Which one of the following hormones is secreted by the human placenta that helps in**

**the maintenance of pregnancy?**

- (A) Relaxin
- (B) Human Chorionic Gonadotropin
- (C) Oxytocin
- (D) Human Placental Lactogen

**Correct Answer:** (B) Human Chorionic Gonadotropin

**Solution:** Human Chorionic Gonadotropin (hCG) is secreted by the placenta and maintains pregnancy by supporting the corpus luteum, ensuring the continuous production of progesterone.

**Quick Tip**

hCG is a key hormone in pregnancy tests, as its levels rise significantly in early pregnancy.

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**7. During an allergic reaction, the binding of antigen to IgE antibodies initiates release of:**

- (A) Interferon
- (B) Histamine
- (C) Heparin
- (D) Acetylamine

**Correct Answer:** (B) Histamine

**Solution:** During an allergic reaction, histamine is released by mast cells and basophils, causing symptoms like swelling, itching, and inflammation.

**Quick Tip**

Histamine is a key mediator in allergic reactions and contributes to symptoms such as itching and swelling.

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**8. Select the incorrect match from the following:**

- (A) 45 + XX - Broad palm with characteristic palm crease

- (B) 44 + XXY - Overall feminine development  
(C) 44 + XO - Sterile females as ovaries are rudimentary  
(D) 44 + XY - Normal male

**Correct Answer:** (B) 44 + XXY - Overall feminine development

**Solution:** In the case of 44 + XXY (Klinefelter syndrome), the individual is typically male but may have some characteristics of females, such as reduced fertility and mild developmental issues, but not overall feminine development.

#### Quick Tip

Klinefelter syndrome (XXY) results in male characteristics with some feminized features like reduced fertility.

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**9. Restriction Endonuclease - Hind II always cuts DNA molecules at a particular point by recognising a specific sequence of:**

- (A) Six base pairs  
(B) Four base pairs  
(C) Seven base pairs  
(D) Three base pairs

**Correct Answer:** (A) Six base pairs

**Solution:** Hind II is a restriction enzyme that recognizes the palindromic sequence of six base pairs (5'-AAGCTT-3') and cuts between the A and the G.

#### Quick Tip

Restriction enzymes like Hind II are highly specific and cut DNA at recognition sites of particular base pair sequences.

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**10. The periodic abstinence by a couple for family planning should be from:**

- (A) Day 5 to 10 of menstrual cycle  
(B) Day 13 to 15 of menstrual cycle  
(C) Day 10 to 17 of menstrual cycle

(D) Day 16 to 20 of menstrual cycle

**Correct Answer:** (C) Day 10 to 17 of menstrual cycle

**Solution:** During days 10 to 17 of the menstrual cycle, ovulation occurs and the woman is most fertile, making it the period of high risk for conception if abstinence is not followed.

#### Quick Tip

Understanding the menstrual cycle helps in natural family planning, identifying the fertile window for avoiding conception.

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**11. Which one of the following bacteria was used by Stanley Cohen and Herbert Boyer to accomplish the construction of the first rDNA?**

(A) *Agrobacterium tumefaciens*

(B) *Mycobacterium* sp.

(C) *E. coli*

(D) *Salmonella typhimurium*

**Correct Answer:** (D) *Salmonella typhimurium*

**Solution:** Stanley Cohen and Herbert Boyer are famous for their pioneering work in molecular genetics, particularly for the development of the first recombinant DNA (rDNA) technology. In their landmark experiment, they used the bacterium **Salmonella typhimurium** as part of their work.

The process involved taking DNA from two different sources and combining them into a single molecule of recombinant DNA. The genetic material was introduced into **Salmonella typhimurium**, allowing for the transfer and expression of the recombinant DNA.

Here is a breakdown of the options:

- Option (A) *Agrobacterium tumefaciens*: While *Agrobacterium tumefaciens* is widely used in genetic engineering, particularly for introducing genes into plant cells, it was not involved in the construction of the first rDNA by Cohen and Boyer.

- Option (B) *Mycobacterium* sp.: *Mycobacterium* species, such as *Mycobacterium tuberculosis*, are known for causing diseases like tuberculosis. These bacteria were not used by Cohen and Boyer in their rDNA work.

- Option (C) *E. coli*: Although *Escherichia coli* (*E. coli*) is commonly used in modern recombinant DNA technology as a host for cloning, Cohen and Boyer initially worked with *Salmonella typhimurium* for their rDNA construction.

- Option (D) *Salmonella typhimurium*: Correct. Stanley Cohen and Herbert Boyer used *Salmonella typhimurium* to carry out their groundbreaking work in the creation of the first recombinant DNA. This bacterium was used to clone recombinant DNA molecules in their experiments.

Thus, the correct answer is (D) *Salmonella typhimurium*.

#### Quick Tip

Stanley Cohen and Herbert Boyer's work in recombinant DNA technology laid the foundation for modern genetic engineering. They used *Salmonella typhimurium* to successfully create the first rDNA molecule.

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**12. The organism that occupies more than one trophic level in a pond ecosystem is:**

- (A) Fish
- (B) Frog
- (C) Zooplankton
- (D) Phytoplankton

**Correct Answer:** (A) Fish

**Solution:** Fish are often secondary consumers (feeding on zooplankton) and primary consumers (feeding on phytoplankton), occupying more than one trophic level.

#### Quick Tip

Some organisms like fish can occupy multiple trophic levels by being both primary and secondary consumers in an ecosystem.

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**13. Assertion (A):** Indian Government has set up an organisation known as GEAC to decide the validity of GM research.

**Reason (R):** Genetic modification of organisms has no effect when such organisms are introduced in the ecosystem.

(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:** The assertion is correct as GEAC (Genetic Engineering Approval Committee) evaluates the safety and environmental impact of GM crops in India. However, the reason is false because genetic modification can affect ecosystems in various ways, including unintended crossbreeding and ecological changes.

#### Quick Tip

GEAC ensures the safe use of GM organisms by assessing their environmental impact, unlike the incorrect assertion that such modifications have no effect.

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**14. Assertion (A):** Gene flow increases genetic variations.

**Reason (R):** The random introduction of new alleles into a recipient population and their removal from donor populations affects allele frequency.

(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:** Gene flow introduces new genetic variations by mixing alleles between populations. The random introduction and removal of alleles do indeed affect allele

frequencies, supporting the assertion.

#### Quick Tip

Gene flow is essential for increasing genetic diversity by allowing allele exchange between populations, affecting evolutionary processes.

**15. Assertion (A):** The laws of our country permit legal adoption and it is as yet one of the best methods for childless couples looking for parenthood.

**Reason (R):** Emotional, religious, and social factors are no deterrents to the legal adoption of orphaned and destitute children in India.

(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:** The assertion is true as adoption is legally permitted in India. However, the reason is false because emotional, religious, and social factors can often act as barriers in adoption processes.

#### Quick Tip

While adoption laws are supportive, emotional and social factors can still play a significant role in the decision-making process.

**16. Assertion (A):** *Agrobacterium tumefaciens* is a pathogen of several monocot plants.

**Reason (R):** It is able to deliver a piece of DNA known as 'T-DNA' to transform normal plant cells into a tumor.

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

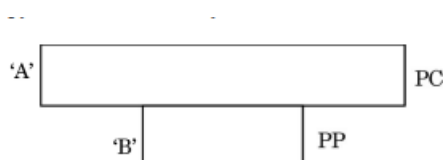
**Solution:** *Agrobacterium tumefaciens* is not a pathogen of monocot plants but primarily infects dicot plants. The reason is correct as it delivers T-DNA, causing tumor formation in infected plants.

#### Quick Tip

*Agrobacterium tumefaciens* is a model organism used in genetic engineering to transfer genes into plants, particularly dicots.

## SECTION B

**17. Study the diagram of a pyramid of biomass given below. Name the two standing crops that could be occupying level 'A' and level 'B' in it. Name this type of pyramid and the ecosystem in which it is found.**



**Solution:** In the given pyramid of biomass:

- Level 'A' could be occupied by **Producers (PC)** such as plants, which have the highest biomass in most ecosystems.

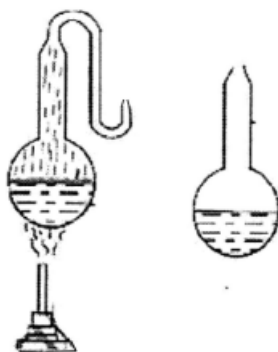
- Level 'B' could be occupied by **Primary Consumers (PP)** like herbivores, which feed on plants.

This type of pyramid is known as an **Inverted Pyramid of Biomass**, and it is typically found in **Aquatic Ecosystems** where the biomass of producers (like phytoplankton) is lower than that of primary consumers (like zooplankton or small fish).

### Quick Tip

In aquatic ecosystems, producers like phytoplankton have a short life cycle and reproduce rapidly, which leads to a smaller biomass compared to the consumers.

**18. Given below is an illustration of the experiment performed by Louis Pasteur. Explain the experiment and its conclusion.**



**Solution:** Louis Pasteur's experiment, known as the "swan-neck flask experiment," was conducted to disprove the theory of spontaneous generation. In this experiment, Pasteur used a flask with a long curved neck (swan-neck) to allow air but prevent contaminants from entering the flask.

He boiled the nutrient broth in the flask to kill any existing microorganisms. The swan neck prevented dust and microbes from entering, and no microbial growth was observed in the broth. However, if the neck was broken, allowing dust and microorganisms to enter, microbial growth occurred.

**Conclusion:** This experiment concluded that microorganisms do not spontaneously arise from non-living matter but are introduced from the environment. It supported the theory of biogenesis.

### Quick Tip

Pasteur's experiment was pivotal in proving that life comes from pre-existing life, which helped establish the foundation of microbiology and the theory of biogenesis.

**19. Identify A, B, C, and D in the table given below:**

<i>Terms</i>	<i>Part of the plant it represents</i>
Pericarp	'A'
'B'	Cotyledon in seed of grass family
Embryonal axis	'C'
'D'	Remains of nucellus in a seed

### Solution:

- **A: Pericarp** – The outer covering of the fruit, often referred to as the fruit wall.
- **B: Cotyledon in seed of grass family** – The seed leaves, which are important in providing energy during germination.
- **C: Embryonal axis** – The region of the seed that connects the embryo with the seed and helps in the development of the plant.
- **D: Remains of nucellus in a seed** – The remnant of the tissue that provides nutrition to the developing embryo in the seed.

### Quick Tip

Understanding seed structure is essential for studying plant development. Focus on the parts like pericarp, cotyledon, and nucellus for better comprehension of seed biology.

**20. (a) "Different varieties of cheese are known by their characteristic texture, flavour and taste, the specificity coming from the microbes used." Support this statement with the help of two suitable examples.**

**Solution:** Cheese varieties differ due to the microorganisms used in their fermentation, affecting the texture, flavor, and taste. Examples include:

- **Swiss Cheese:** The bacterium *Propionibacterium shermanii* produces holes and imparts a nutty flavor to Swiss cheese.
- **Blue Cheese:** Bacteria such as *Penicillium roqueforti* cause the blue veins in blue cheese and contribute to its distinct, sharp flavor.

### Quick Tip

Microorganisms are essential for the fermentation process in cheese production, influencing both the flavor and texture. Understanding the specific microbes used can help in identifying different cheese types.

OR

(b) Identify A, B, C, and D in the following table:

	Scientific name of source plant	Drug	Harmful effects / Body part affected
1.	<i>Papaver somniferum</i>	A	Depressant/slow down body functions
2.	<i>Cannabis sativa</i>	B	C
3.	<i>Erythroxylum coca</i>	Cocaine	D

**Solution:** - *Papaver somniferum*: A: **Morphine**, which is a depressant and slows down body functions.

- *Cannabis sativa*: B: **THC (Tetrahydrocannabinol)**, which affects the nervous system and causes altered perception.

- *Erythroxylum coca*: C: **Cocaine**, which stimulates the central nervous system, causes addiction, and can lead to heart issues.

### Quick Tip

Plant-derived drugs, like morphine, THC, and cocaine, can have significant effects on the body. It is important to understand their impact on the central nervous system and other organs.

**21. Write the basic steps followed in the Assisted Reproductive Technologies (ART) programme to help childless couples. Why is it also known as the test tube baby programme?**

**Solution:** The basic steps followed in the Assisted Reproductive Technologies (ART) programme are:

- **Step 1:** Hormonal stimulation is provided to the female to induce the production of

multiple ova.

- **Step 2:** The eggs (ova) are retrieved from the ovaries and fertilized with sperm in a laboratory setting.
- **Step 3:** The fertilized egg (zygote) undergoes early embryonic development in vitro (outside the body).
- **Step 4:** The resulting embryo is then implanted into the uterus for further development.

It is known as the **test tube baby programme** because fertilization and early embryonic development occur outside the female body in a laboratory setting, commonly in a petri dish or test tube.

#### Quick Tip

Assisted Reproductive Technology (ART) techniques like IVF help couples conceive by fertilizing the egg outside the body, and successful embryos are transferred back into the uterus.

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## SECTION C

**22. (a) Explain the significance of the experiment carried out by S.L. Miller. Name the scientists whose hypothesis prompted him to carry out this experiment.**

**Solution:** S.L. Miller's experiment was significant because it simulated the conditions of early Earth and demonstrated that organic molecules, including amino acids, could be synthesized from inorganic compounds under primitive conditions. This experiment supported the idea of abiogenesis, the origin of life from non-living matter.

The hypothesis prompting the experiment was proposed by **Alexander Oparin** and **J.B.S. Haldane**, who suggested that life originated from simple molecules under reducing conditions.

### Quick Tip

Miller's experiment was a breakthrough in understanding the origin of life, showing how simple compounds could form the building blocks of life under the right conditions.

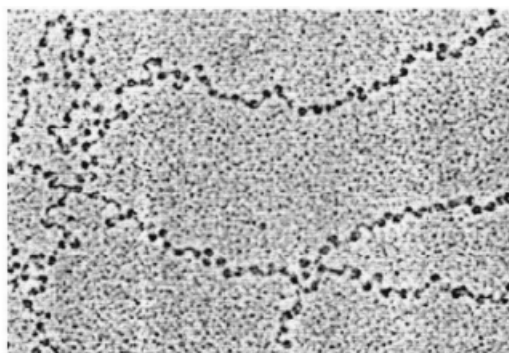
### (b) How does meteorite analysis favour this hypothesis?

**Solution:** Meteorite analysis has shown that many organic compounds, including amino acids, are present in meteorites. This supports the hypothesis that organic molecules could have formed in space and later arrived on Earth, potentially aiding in the origin of life.

### Quick Tip

Meteorites provide evidence that organic compounds can form in outer space, supporting theories of extraterrestrial origins of life on Earth.

### 23. (a) Identify the picture given below and name the tool under which it was viewed.



**Solution:** The picture shows a **cellular structure** at a very high magnification. It is likely a **microscopic image** viewed under a **Transmission Electron Microscope (TEM)**.

### Quick Tip

TEM is used for observing very fine details of cell structures at a high resolution.

### (b) What do the dark spots represent in the picture? Explain how and why they are formed.

**Solution:** The dark spots in the image represent **ribosomes** or **dense areas** of the cell that are involved in protein synthesis. These structures appear darker in electron microscopy because they absorb more electrons due to their dense, compact structure.

#### Quick Tip

Dark spots in TEM images usually correspond to dense structures such as ribosomes, which are crucial for protein synthesis in cells.

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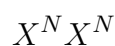
**24. In a family, the father, the daughter and the son are colour blind, whereas the mother has normal vision. Do you think the son and the daughter have inherited the disease from their father? Work out a cross to justify your answer.**

**Solution:** In humans, color blindness is a sex-linked recessive trait carried on the X chromosome. For a male to be color blind, he must inherit the X chromosome carrying the color blindness allele from his mother (because males have only one X chromosome). A female would need to inherit two copies of the color blindness allele (one from each parent) to be color blind.

**Cross:** - Father (color blind):



- Mother (normal vision):



When the alleles are crossed:



Possible offspring:

Daughter:  $X^N X^c$  (Carrier, not color blind)

Son:  $X^cY$  (Color blind)

Thus, the daughter is a carrier

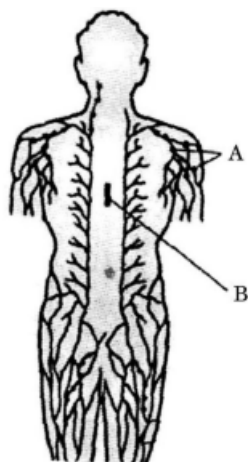
( $X^N X^c$ ) and does not have the disease, while the son inherits color blindness from his mother ( $X^cY$ ), not from his

**Conclusion:** The son inherited the disease from the mother, not the father. The daughter, being a carrier, did not inherit the disease from the father but can pass the gene on to her offspring.

### Quick Tip

In sex-linked recessive inheritance, males inherit traits from their mothers (X chromosome), while females require two copies of the allele (one from each parent) to express the trait.

**25. Identify A and B in the diagram below. Explain their role in the immune system of the body.**



**Solution:** In the diagram, - **A** represents the **Lymph nodes**. - **B** represents the **Lymphatic vessels**.

The role of each in the immune system is as follows:

- **Lymph nodes (A):** Lymph nodes are small, bean-shaped structures that filter lymph (a fluid that circulates in the lymphatic system) and trap foreign particles like bacteria, viruses, and cancer cells. They contain immune cells, such as lymphocytes, that help in recognizing and attacking harmful pathogens.

- **Lymphatic vessels (B):** These vessels are part of the lymphatic system, which transports lymph, immune cells, and waste products throughout the body. The lymphatic vessels also transport the filtered lymph back to the bloodstream, thus playing an important role in immune surveillance and response.

### Quick Tip

Lymph nodes act as checkpoints in the immune system, filtering pathogens, while lymphatic vessels transport immune cells to maintain body defenses.

**26. (a) Explain how it is ensured that the orchid *Ophrys* is pollinated by a specific species of bee.**

**Solution:** The orchid *Ophrys* ensures pollination by a specific species of bee through a mechanism called **sexual deception**. The flower of *Ophrys* mimics the appearance, scent, and texture of a female bee, attracting the male bee of a particular species. When the male bee attempts to mate with the flower, it brushes against the flower's anthers and picks up pollen, which is transferred to another flower, facilitating pollination.

### Quick Tip

Sexual deception in orchids ensures pollination by mimicking the behavior of pollinators, promoting cross-pollination in specific species.

**(b) Describe co-evolution with the help of this example.**

**Solution:** Co-evolution refers to the reciprocal evolutionary change in interacting species. In the case of *Ophrys* and the specific bee species, both the orchid and the bee have evolved in response to each other. The orchid has evolved to mimic the female bee, attracting the male for pollination, while the male bee evolves to recognize the orchid as a mate, thus ensuring pollination. This mutual evolution benefits both species.

### Quick Tip

Co-evolution demonstrates how species evolve in tandem, shaping each other's behavior, physiology, or appearance over time.

**27. Explain the mode of action of contraceptive pills taken by human females. Mention the schedule to be followed for effective outcome.**

**Solution:** Contraceptive pills work primarily by:

- **Inhibiting ovulation:** The hormones in the pill prevent the release of eggs from the ovaries.
- **Thickening cervical mucus:** This makes it more difficult for sperm to enter the uterus.
- **Changing the uterine lining:** This prevents implantation of a fertilized egg.

**Schedule:** The pill is typically taken daily for 21 days, followed by a 7-day break during which menstruation occurs. A new pack is started after the break.

#### Quick Tip

Taking contraceptive pills at the same time every day increases their effectiveness in preventing pregnancy.

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### 28. (a) (i) What are transgenic animals?

**Solution:** Transgenic animals are animals that have been genetically modified to carry a foreign gene, which is incorporated into their DNA. These genes can be from different species and are typically inserted to study gene function or to produce useful substances like pharmaceuticals.

#### Quick Tip

Transgenic animals are used in research and biotechnology to understand genetic diseases or produce proteins for medical purposes.

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### (ii) Name the first transgenic cow and state its importance.

**Solution:** The first transgenic cow was **Rosie**, genetically engineered to produce milk containing human protein. This was an important breakthrough for biopharmaceuticals, as it demonstrated the potential of animals to produce therapeutic proteins.

### Quick Tip

Transgenic cows like Rosie show the potential for genetically engineered animals to be used in medicine, particularly for producing human proteins.

**OR**

**(b) (i) Explain the convention for naming EcoRI.**

**Solution:** EcoRI is named using the following convention: - **E** is the first letter of the genus *Escherichia*. - **co** refers to the species *coli*. - **R** indicates that it was isolated from strain R of *Escherichia coli*. - **I** denotes that it is the first enzyme identified from this strain.

### Quick Tip

The naming convention for restriction enzymes helps identify their origin and order of discovery.

**(ii) With the help of an illustration only, show the action of EcoRI on a DNA polynucleotide.**

**Solution:** EcoRI cuts DNA at the specific recognition site 5'-GAATTC-3', producing sticky ends. The enzyme cuts between the G and the A on both strands of the DNA molecule, resulting in overhanging ends that can be used for further recombination or ligation.

DNA sequence: 5' GAATTC 3'

EcoRI cuts between G and A:

5' G | AATTC 3'

Sticky ends:

5' G    AATTC 3'

### Quick Tip

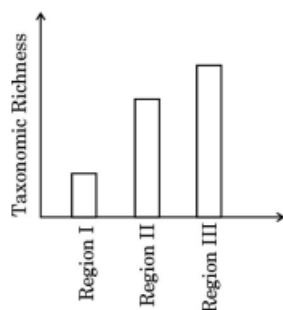
EcoRI is widely used in molecular biology for cutting DNA into smaller fragments, useful for cloning and sequencing.

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29. Read the following passage and answer the questions that follow.

Isn't it incredible that India's land area is only 2.4 percent of the world's total land area whereas its share of the global species diversity is an impressive 8-1 percent! However, in these estimates of species, prokaryotes do not figure anywhere.

Biologists are always keen on collecting data with respect to species diversity observed in different regions of the world. The data collected based on the survey conducted for species richness of groups of mammals in three different regions of the world is shown in the bar graph below.



(a) Why is the species richness maximum in Region III in the bar graph?

**Solution:** - Region III has maximum species richness due to: 1. Favourable climatic conditions such as tropical climate with high rainfall and temperature. 2. High resource availability and ecological niches supporting a large number of species.

**Quick Tip**

Species richness depends on: - Climatic conditions (tropical regions have higher richness). - Resource availability and niche diversity.

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**OR**

(a) Why is the species richness minimum in Region I in the bar graph?

**Solution:** - Region I has minimum species richness because: 1. It likely represents a cold or arid climate, which is less suitable for supporting diverse life forms. 2. Limited resource availability and harsh environmental conditions restrict the number of species.

#### Quick Tip

Extreme climates (cold or arid) limit species richness due to low resources and survival challenges.

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**(b) Plants and animals do not have uniform diversity in the world but show rather uneven distribution. Mention what this kind of diversity is referred to as.**

**Solution:** - This uneven distribution of species diversity is referred to as Beta Diversity. It reflects the variation in species composition between different ecosystems or regions.

#### Quick Tip

Remember: - Alpha diversity: Within a specific habitat. - Beta diversity: Between different habitats. - Gamma diversity: Across large geographic scales.

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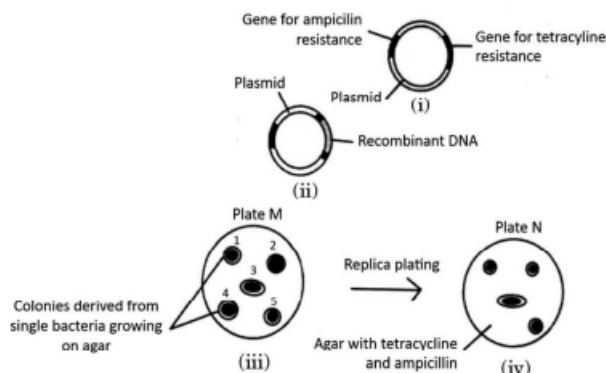
**(c) Why is it that prokaryotes do not have an estimated number of their species diversity as seen in plants and animals? Explain.**

**Solution:** 1. Prokaryotes lack morphological diversity, making species identification challenging. 2. Many prokaryotic species cannot be cultured in laboratories, limiting data collection. 3. Molecular techniques like DNA sequencing are required to identify them, which is time-consuming and resource-intensive.

#### Quick Tip

Challenges in estimating prokaryotic diversity: - Lack of culture techniques for most species. - Dependence on advanced molecular methods for identification.

**30. Study the diagram given below that shows the steps involved in the procedure of selecting transformed bacteria and answer the questions that follow:**



**(a) Identify the colony that has got transformed. Justify your answer.**

**Solution:** - The transformed colony is the one that grows on Plate M (with ampicillin) but does not grow on Plate N (with both ampicillin and tetracycline). - Justification: The recombinant DNA disrupts the tetracycline resistance gene, making the bacteria sensitive to tetracycline, but retains ampicillin resistance, allowing growth on Plate M.

#### Quick Tip

In transformation experiments: - Disrupted resistance gene = Loss of resistance. - Growth indicates retained resistance (e.g., ampicillin resistance).

**(b) What are the sites in a plasmid called where ampicillin and tetracycline resistance genes are inserted? State their role in genetic engineering.**

**Solution:** - The sites are called selectable marker sites. - Role: These genes help in identifying and selecting transformed cells: - Ampicillin resistance gene ensures growth on ampicillin-containing media. - Tetracycline resistance gene helps distinguish recombinant bacteria (tetracycline-sensitive) from non-recombinant ones.

#### Quick Tip

Selectable markers: - Aid in distinguishing transformed cells by their growth or lack thereof on specific media.

**(c) Name two enzymes playing an important role in genetic engineering.**

**Solution:** 1. Restriction endonucleases: Cut DNA at specific sequences. 2. DNA ligase: Joins DNA fragments to form recombinant DNA.

**OR**

**(c) State the role of  $\beta$ -galactosidase in insertional inactivation.**

**Solution:** - Insertional inactivation of the  $\beta$ -galactosidase gene prevents the production of the enzyme, resulting in white colonies (instead of blue) on media with X-gal. This helps identify recombinant bacteria.

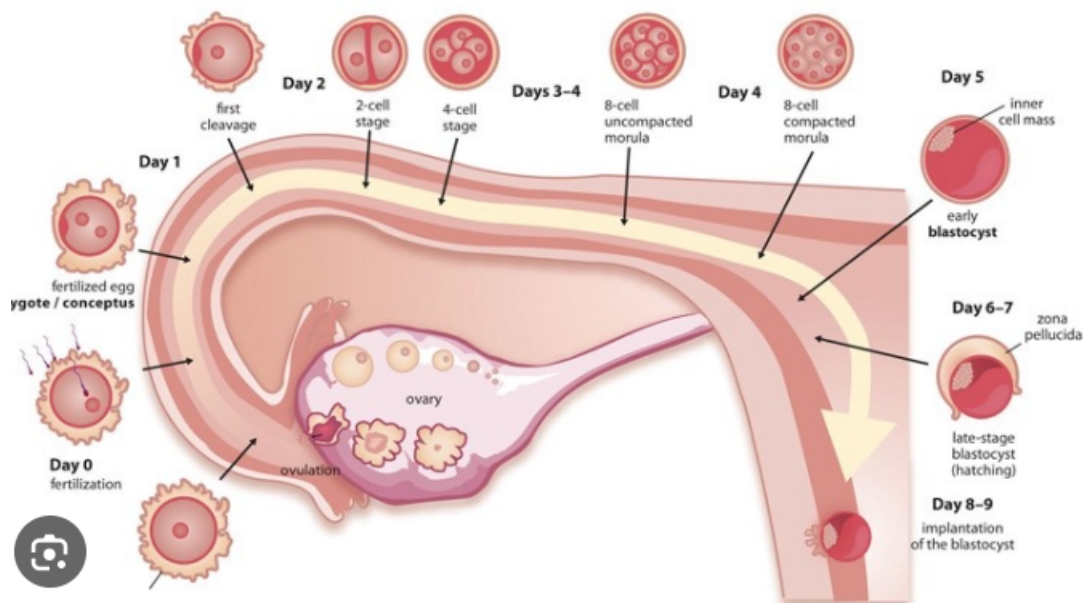
### Quick Tip

- Restriction enzymes cut, and DNA ligase joins DNA. -  $\beta$ -galactosidase inactivation indicates recombinant colonies (white on X-gal media).

**31. (a) (i) Draw a labelled diagram of the embryonic stage that gets implanted in the human female leading to pregnancy.**

**Solution:** The diagram shows the blastocyst, which is the stage of the embryo that gets implanted in the uterine lining during pregnancy. The blastocyst has the following structure: - Inner cell mass (which will develop into the embryo). - Trophoblast (outer layer that forms the placenta). - Blastocoel (fluid-filled cavity).

**Labelled Diagram:**



### Quick Tip

The blastocyst stage is crucial for implantation and the beginning of pregnancy, with the trophoblast eventually forming the placenta.

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**(ii) Explain the changes that the different parts of the embryo undergo after implantation up till (1) Placenta formation and (2) Formation of three germ layers.**

**Solution:** After implantation, the embryo undergoes several developmental stages:

1. **Placenta Formation:** The trophoblast layer of the blastocyst grows and invades the uterine lining, forming the placenta, which allows nutrient and gas exchange between mother and embryo.

2. **Formation of Three Germ Layers:** The inner cell mass undergoes gastrulation, forming three germ layers:

- **Ectoderm:** Forms the skin and nervous system.
- **Mesoderm:** Forms muscles, bones, and the circulatory system.
- **Endoderm:** Forms the digestive and respiratory systems.

### Quick Tip

Gastrulation is a key process where the three germ layers are formed, leading to the differentiation of tissues and organs in the embryo.

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**(iii) Mention the role of the following:**

1. **Placenta:** The placenta provides nutrients and oxygen to the developing fetus, removes waste products, and produces hormones to support pregnancy.

2. **Three Germ Layers:** These layers give rise to all the organs and tissues of the body, forming the basis for the development of the fetus.

### Quick Tip

The placenta is vital for fetal development, while the three germ layers form the foundation for all tissues and organs.

**OR**

**(b) (i) Why do plants like *Viola* and *Oxalis* give assured seed sets even in the absence of pollinators?**

**Solution:** *Viola* and *Oxalis* are examples of plants that exhibit **self-pollination**, which ensures that seeds are formed even without pollinators. These plants have both male and female reproductive organs in the same flower, and pollen can fertilize the ovule within the same flower or between flowers of the same plant.

### Quick Tip

Self-pollination ensures seed production even in the absence of external pollinators, contributing to the plant's reproductive success.

**(ii) Mention four advantages of seed formation to angiosperms.**

**Solution:** 1. **Protection of the embryo:** Seeds protect the embryo from harsh environmental conditions.

2. **Dispersal:** Seeds can be dispersed to new areas, helping the plant species spread.

3. **Dormancy:** Seeds can remain dormant for long periods, allowing them to germinate when conditions are favorable.

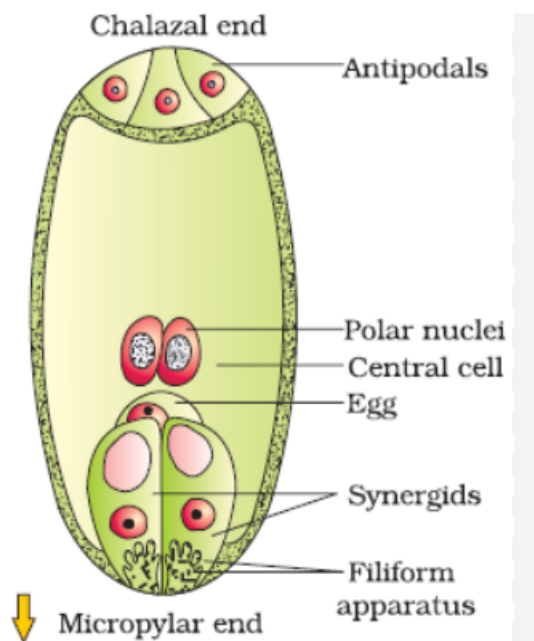
4. **Genetic variation:** Seeds result from fertilization, leading to genetic variation, which is important for evolution and adaptation.

### Quick Tip

Seeds ensure survival and spread of plant species, allowing for genetic diversity and the ability to withstand adverse conditions.

(iii) Draw a diagram of a fertilized embryo sac of an angiosperm and label any four parts.

**Solution:**



A fertilized embryo sac in an angiosperm consists of the following parts: 1. **Zygote:** The fertilized egg cell that develops into the embryo.

2. **Endosperm:** Provides nourishment to the developing embryo.

3. **Integuments:** Surround the embryo sac and later form the seed coat.

4. **Micropyle:** The opening through which the pollen tube enters to deliver sperm to the ovule.

#### Quick Tip

The embryo sac of angiosperms undergoes fertilization, forming the embryo and endosperm that will later develop into a seed.

32. (a) (i) Name and explain the property present in normal cells but is lost in cancer cells.

**Solution:** The property that is present in normal cells but is lost in cancer cells is **contact inhibition**. In normal cells, when they come into contact with each other, they stop dividing.

This prevents uncontrolled cell growth and maintains tissue structure. In cancer cells, contact inhibition is lost, leading to uncontrolled cell division and tumor formation.

#### Quick Tip

Contact inhibition helps maintain healthy cell growth and tissue organization. Its loss leads to the uncontrolled proliferation characteristic of cancer cells.

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**(ii) All normal human cells have genes that may become cancerous under certain conditions. Name them and explain how.**

**Solution:** The genes that may become cancerous under certain conditions are called **oncogenes** and **tumor suppressor genes**. - **Oncogenes:** These are mutated forms of proto-oncogenes (normal genes that regulate cell growth). When they mutate, they cause excessive cell growth and division. - **Tumor suppressor genes:** These genes regulate the repair of damaged DNA and control cell division. When these genes are inactivated or mutated, they fail to stop uncontrolled cell division, leading to cancer.

#### Quick Tip

Oncogenes promote cancerous growth, while tumor suppressor genes normally inhibit it. Mutations in either can lead to cancer.

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**(iii) State the role of the following techniques in detection and diagnosis of cancer:**

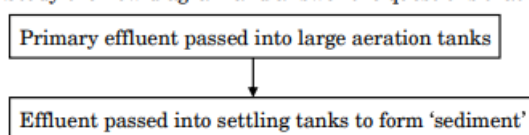
- (1) **Biopsy and Histopathology:** A biopsy involves taking a tissue sample from the suspected area to examine under a microscope. Histopathology helps in identifying abnormal or cancerous cells in the tissue.
- (2) **Magnetic Resonance Imaging (MRI):** MRI uses magnetic fields and radio waves to create detailed images of internal organs. It is used to detect tumors, their size, and location, helping in cancer diagnosis.

### Quick Tip

Biopsy and histopathology are essential for confirming cancer, while MRI is important for detecting and assessing the extent of the disease.

(b) Large quantities of sewage are generated every day in cities as well as in towns and are treated in Sewage Treatment Plants (STPs) to make them less polluting. Given below is the flow diagram of stages of STP. Study the flow diagram and answer the questions that follow:

Study the flow diagram and answer the questions that follow :



(i)

(1) **Why is primary effluent passed into large aeration tanks?**

**Solution:** The primary effluent is passed into large aeration tanks to introduce oxygen into the water. The oxygen promotes the growth of aerobic microorganisms that decompose organic matter, reducing the pollution load of the effluent.

(2) **What is the 'sediment' formed, referred to as? Mention its significance.**

**Solution:** The 'sediment' formed in the settling tanks is called **sludge**. It consists of organic matter, microorganisms, and debris that settle down after the aeration process. Sludge is important because it can be further processed to recover valuable materials or treated for safe disposal.

(3) **Explain the final step in the settling tank before the treated effluent is released into water bodies.**

**Solution:** In the final step, the effluent in the settling tank undergoes a process where it is allowed to settle, and the remaining solid particles (sludge) are removed. The treated effluent is then passed through filtration to remove any remaining impurities before being released into water bodies.

### Quick Tip

Aeration tanks are key to promoting the breakdown of organic waste by microorganisms, while settling tanks help remove solids, ensuring cleaner water for disposal.

(ii)

(1) **Name any two organisms commonly used as biofertilisers, belonging to different kingdoms. Write how each one acts as a biofertiliser.**

**Solution:** Two organisms commonly used as biofertilizers are:

- **Rhizobium (Kingdom: Bacteria):** Rhizobium bacteria form symbiotic relationships with leguminous plants by fixing atmospheric nitrogen into a form that plants can use for growth.
- **Mycorrhiza (Kingdom: Fungi):** Mycorrhiza fungi form symbiotic relationships with plant roots, enhancing nutrient uptake, especially phosphorus, and improving plant growth.

### Quick Tip

Biofertilizers like Rhizobium and Mycorrhiza enhance plant growth by improving nutrient availability, reducing the need for chemical fertilizers.

**33. (a) Stability, as one of the properties of genetic material, was very evident in one of the very early experiments in genetics. Name the scientist and describe his experiment. State the conclusion he arrived at.**

**Solution:** The scientist who demonstrated the stability of genetic material through early experiments was **Gregor Mendel**. His famous experiments involved crossing pea plants to study inheritance patterns.

**Experiment:** Mendel performed monohybrid and dihybrid crosses using pea plants, focusing on traits such as plant height and flower color. In his monohybrid cross, he crossed a tall plant (T) with a short plant (t) and observed that the F1 generation had all tall plants. When F1 plants were self-pollinated, the F2 generation exhibited a 3:1 ratio of tall to short

plants.

**Conclusion:** Mendel concluded that inheritance follows specific ratios (such as 3:1 for a monohybrid cross), and that genetic material is inherited in a stable manner, maintaining the ratio generation after generation. This laid the foundation for the laws of inheritance (Mendel's Laws).

#### Quick Tip

Mendel's laws of inheritance, particularly the Law of Segregation and the Law of Independent Assortment, explain how genetic traits are inherited in stable patterns.

**OR**

**(b) A tall pea plant bearing violet flowers with unknown genotype is given. Find the genotype by working out different crosses only by selfing the plants. Write the genotypic and phenotypic ratios of each cross shown by you.**

**Solution:** Let the tallness (T) be dominant over shortness (t), and violet color (V) be dominant over white color (v). The given pea plant is tall with violet flowers, but its genotype is unknown.

**Cross 1: Selfing Tall Violet (T? V?)** - Assume the genotype of the plant is heterozygous for both traits: TtVv.

Parental Cross:  $TtVv \times TtVv$

The Punnett square for this cross gives the following genotypic ratio:

Genotypic ratio: 1 TTVV : 2 TtVV : 2 TTVv : 4 TtVv : 1 ttVV : 2 ttVv : 1 Ttvv : 1 ttvv

Phenotypic ratio:

Tall, Violet: 15 : Short, Violet: 3

#### Quick Tip

By selfing plants, we can determine the genotype of the parent based on the offspring's ratios. Mendelian inheritance patterns help predict possible outcomes of crosses.

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