

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

Time Allowed :3 hours

Maximum Marks :70

Total questions :33

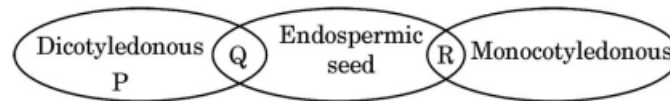
General Instructions

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**: Sections **A, B, C, D, and E**.
3. **Section A** – questions number 1 to 16 are **multiple-choice type questions**. Each question carries 1 mark.
4. **Section B** – questions number 17 to 21 are **very short answer type questions**. Each question carries 2 marks.
5. **Section C** – questions number 22 to 28 are **short answer type questions**. Each question carries 3 marks.
6. **Section D** – questions number 29 and 30 are **case-based questions**. Each question carries 4 marks. Each question has subparts with **internal choice** in one of the subparts.
7. **Section E** – questions number 31 to 33 are **long answer type questions**. Each question carries 5 marks.
8. There is **no overall choice**. However, an internal choice has been provided in Sections **B, C, and D** of the question paper. A candidate has to write the answer for **only one of the alternatives** in such questions.
9. Kindly note that there is a separate question paper for **Visually Impaired candidates**.
10. Wherever necessary, **neat and properly labelled diagrams** should be drawn.

SECTION A

1. 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: Step 1: Analyze the Venn diagram and categories.

The Venn diagram categorizes seeds into Dicotyledonous (P), Endospermic (Q), and Monocotyledonous (R).

Dicotyledonous seeds have two cotyledons (e.g., Bean).

Endospermic seeds contain stored food in the form of an endosperm (e.g., Castor).

Monocotyledonous seeds have one cotyledon (e.g., Maize).

Step 2: Match the examples with the categories.

(P) Dicotyledonous: Bean fits into this category as it is a dicotyledon.

(Q) Endospermic: Castor belongs to this group due to the presence of endosperm.

(R) Monocotyledonous: Maize fits into this category as it is a monocotyledon.

Step 3: Evaluate all options.

(1) Castor, Onion, Wheat: Incorrect as Onion is not a dicotyledon.

(3) Pea, Gram, Barley: Incorrect as Barley is not a monocotyledon.

(4) Coconut, Rubber, Groundnut: Incorrect as Rubber is not an endospermic seed.

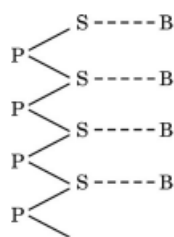
Hence, the correct option is (B) Bean, Castor, Maize.

Final Answer: The correct option is (2) Bean, Castor, Maize.

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 ('—') signifies the bond between the nitrogenous base (B) and the sugar (S). This bond is referred to as an N-glycosidic linkage, which connects the 1' carbon of the pentose sugar to the nitrogen atom of the nitrogenous base. Other bonds in the polynucleotide structure include:

Phosphodiester bond: This bond links the sugar molecules of adjacent nucleotides.

Hydrogen bond: It forms between complementary nitrogenous bases in double-stranded DNA.

Peptide bond: This bond is present 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.

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 type of heterotrophic bacterium commonly found in the fermentation of dairy products. These bacteria thrive in environments where organic compounds, such as lactose, are available as a source of energy. In the case of milk, *Lactobacillus* ferments the sugar lactose present in the milk.

During this process, the bacterium breaks down lactose into simpler sugars, which are then converted into lactic acid through a series of biochemical reactions. The accumulation of lactic acid lowers the pH of the milk, causing the proteins in the milk, particularly casein, to coagulate. This results in the formation of curds, which are the solid components of curd. The process of fermentation is essential for the production of various dairy products like yogurt and cheese. In yogurt, for instance, *Lactobacillus* and other bacteria contribute to both the sour taste and the thick consistency of the product, as well as provide beneficial probiotics that aid in digestion.

Quick Tip

Heterotrophic bacteria derive their energy from organic compounds. In dairy fermentation, they are crucial for converting lactose into lactic acid, which is responsible for curdling the milk and contributing to the development of the final product.

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 frequently used in biomedical research, particularly for testing the safety and efficacy of vaccines, such as the polio vaccine. These mice can be genetically modified to carry specific genes or mutations that make them more susceptible to diseases that affect humans. In the case of the polio vaccine, transgenic mice can be engineered to replicate the human immune response and mimic human susceptibility to the poliovirus. This allows researchers to observe how the vaccine interacts with the immune system, how it triggers protective immunity, and whether any adverse reactions occur. By using transgenic mice, scientists can ensure that vaccines are both safe and effective before they are administered to humans.

Quick Tip
Transgenic animals are widely used in biomedical research for vaccine testing, studying genetic disorders, and understanding disease mechanisms by modeling human conditions.

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: The "Biogenetic Law" was proposed by German biologist Ernst Haeckel in the 19th century. This law suggests that the development of an individual organism (ontogeny) mirrors, or "recapitulates," the evolutionary history of its species (phylogeny). In other words, during the embryonic development of an organism, certain stages of its development reflect the stages of its evolutionary ancestors. Haeckel's idea was based on the observation that early stages of development in embryos of different species often appear strikingly similar. For example, vertebrate embryos initially look alike during early stages, suggesting a common ancestry.

Haeckel's law was an important step in the development of evolutionary theory as it provided evidence for the idea of common descent. However, it is important to note that modern biology has refined this theory, and while there are similarities across species in embryonic stages, the law does not strictly hold in all cases. Some developmental processes are more complex and do not necessarily mirror phylogeny in a straightforward manner.

Quick Tip

Haeckel's Biogenetic Law highlights the similarities found in early embryonic stages of different species, supporting the concept of common ancestry. However, modern biology recognizes that embryonic development can be influenced by various factors and does not always follow a simple recapitulation of evolutionary history.

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 a hormone secreted by the placenta during pregnancy. Its primary function is to maintain the pregnancy by supporting the corpus

luteum, a temporary endocrine structure in the ovaries that produces progesterone in the early stages of pregnancy. Progesterone is essential for maintaining the uterine lining, which is crucial for embryo implantation and the continuation of pregnancy. By ensuring the ongoing production of progesterone, hCG plays a vital role in preventing the degradation of the uterine lining and allowing the pregnancy to be sustained.

Additionally, the presence of hCG in the bloodstream is used as a reliable marker for pregnancy. The hormone's levels increase significantly in the early stages of pregnancy, and this rise forms the basis of most pregnancy tests, which detect hCG in urine or blood to confirm pregnancy.

Quick Tip
hCG is a key hormone used in pregnancy tests due to its significant rise in levels during early pregnancy. It helps maintain pregnancy by supporting progesterone production.

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: In response to an allergic trigger, the immune system activates specific cells called mast cells and basophils. These cells release a chemical called histamine into the bloodstream. Histamine plays a crucial role in the allergic response by binding to receptors on nearby blood vessels and tissues. This binding causes the blood vessels to dilate and become more permeable, leading to the common symptoms of an allergic reaction, such as swelling, itching, and inflammation. The inflammatory response is a result of increased fluid leakage from blood vessels into surrounding tissues, contributing to the swelling and discomfort associated with allergic reactions.

Quick Tip

Histamine is a central mediator in allergic reactions, contributing to common symptoms such as itching, swelling, and inflammation by affecting blood vessels and surrounding tissues.

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: Klinefelter syndrome (44 + XXY) is a chromosomal condition where an individual has an extra X chromosome, resulting in a total of 47 chromosomes instead of the typical 46. While individuals with Klinefelter syndrome are typically male, they may exhibit some characteristics commonly associated with females. These can include reduced fertility, which may result in infertility, and mild developmental issues, such as delayed speech or motor development. However, despite these features, individuals with Klinefelter syndrome do not generally develop full feminine physical characteristics, such as breast development or female reproductive organs. Instead, the syndrome may cause subtle changes like mild gynecomastia (enlarged breast tissue) and a taller-than-average stature.

It's important to note that Klinefelter syndrome varies widely in its expression, with some individuals experiencing only mild symptoms, while others may have more pronounced features.

Quick Tip

Klinefelter syndrome (XXY) results in individuals with male characteristics who may have some feminized features, such as reduced fertility and mild gynecomastia, but without full feminine development.

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 type of restriction enzyme, which is an enzyme that recognizes and cuts DNA at specific sites. In the case of Hind II, it identifies a particular palindromic sequence of six base pairs: 5'-AAGCTT-3'. This sequence is recognized as a mirror image when read in opposite directions, which is why it is called palindromic. Once the enzyme binds to this sequence, it cleaves the DNA between the adenine (A) and guanine (G) bases, resulting in two separate DNA fragments. This precise cutting ability is fundamental in molecular biology for manipulating and analyzing DNA.

Quick Tip

Restriction enzymes, such as Hind II, are highly specific and cut DNA at designated recognition sites defined by particular base pair sequences, which are essential tools in genetic research and biotechnology.

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: Ovulation typically occurs between days 10 to 17 of the menstrual cycle, depending on the length of the cycle. During this phase, a mature egg is released from the ovary and is available for fertilization. This period is considered the most fertile window of the menstrual cycle because the egg can be fertilized for about 12 to 24 hours after its

release. Sperm can survive in the female reproductive tract for up to five days, meaning that intercourse during this time increases the likelihood of conception. If a woman wishes to avoid pregnancy, this is the high-risk period for conception if abstinence or other contraceptive methods are not used.

Understanding the timing of ovulation and the fertile window can be helpful for both those trying to conceive and those practicing natural family planning. By tracking ovulation, individuals can better identify the fertile period and make informed decisions about contraception or conception.

Quick Tip

Understanding the menstrual cycle is crucial for natural family planning, as it helps identify the fertile window, the time of highest risk for conception.

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 renowned for their pioneering contributions to molecular genetics, particularly for the development of recombinant DNA (rDNA) technology. In their groundbreaking experiment, they utilized the bacterium *Salmonella typhimurium* as a key part of their work.

The method they used involved extracting DNA from two distinct sources and combining them to create a single recombinant DNA molecule. This recombinant DNA was then introduced into *Salmonella typhimurium*, allowing for the transfer and expression of the recombinant genetic material.

Here is a breakdown of the options:

Option (A) *Agrobacterium tumefaciens*: Although *Agrobacterium tumefaciens* is commonly

used in genetic engineering, particularly for gene transfer in plants, it was not involved in Cohen and Boyer's creation of the first rDNA.

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 recombinant DNA research.

Option (C) *E. coli*: While *Escherichia coli* (*E. coli*) is often used in contemporary recombinant DNA technology as a host for cloning, Cohen and Boyer initially utilized *Salmonella typhimurium* for their early rDNA work.

Option (D) *Salmonella typhimurium*: Correct. Cohen and Boyer used *Salmonella typhimurium* in their landmark experiment to develop the first recombinant DNA molecule. This bacterium was crucial for cloning the recombinant DNA in their research. Therefore, the correct answer is (D) *Salmonella typhimurium*.

Quick Tip
Stanley Cohen and Herbert Boyer's pioneering work in recombinant DNA technology laid the foundation for modern genetic engineering. They used <i>Salmonella typhimurium</i> to successfully create the first recombinant DNA molecule.

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: In aquatic ecosystems, fish can occupy more than one trophic level depending on their feeding habits. Many fish species are considered secondary consumers because they feed on zooplankton, which are primary consumers that feed on phytoplankton. At the same time, fish can also act as primary consumers when they feed directly on phytoplankton. This dual role means that fish are able to occupy multiple trophic levels within the food chain,

depending on their diet. For instance, small herbivorous fish that feed on phytoplankton are primary consumers, while larger fish that prey on zooplankton or smaller fish are secondary consumers.

The ability of some organisms, like fish, to occupy multiple trophic levels is known as being omnivorous or trophic omnivores. This flexibility in their feeding behavior allows them to adapt to different ecological niches and can affect the stability of the ecosystem.

Quick Tip

Some organisms, like fish, can occupy multiple trophic levels in an ecosystem by being both primary and secondary consumers, depending on their feeding habits.

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 partially correct in that the Genetic Engineering Approval Committee (GEAC) is responsible for evaluating the safety and environmental impact of genetically modified (GM) crops in India. The GEAC reviews scientific data regarding the potential risks of GM crops, such as their effects on human health, biodiversity, and the environment. However, the reason provided in the assertion is false because genetic modification can indeed have significant ecological consequences. These may include unintended crossbreeding between GM crops and wild relatives, the development of resistant pests, or changes in the local ecosystem, such as disruption of pollination or soil health.

Therefore, while GEAC ensures that GM crops undergo thorough evaluation, genetic modifications can still lead to unpredictable ecological changes that must be carefully monitored.

Quick Tip

The GEAC evaluates the safety and environmental impact of GM crops, ensuring responsible use, but it is important to recognize that genetic modification can still have unintended ecological effects, such as crossbreeding or disruptions in local ecosystems.

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: The assertion is partially correct in that the Genetic Engineering Approval Committee (GEAC) is responsible for evaluating the safety and environmental impact of genetically modified (GM) crops in India. The GEAC reviews scientific data regarding the potential risks of GM crops, such as their effects on human health, biodiversity, and the environment. However, the reason provided in the assertion is false because genetic modification can indeed have significant ecological consequences. These may include unintended crossbreeding between GM crops and wild relatives, the development of resistant pests, or changes in the local ecosystem, such as disruption of pollination or soil health. Therefore, while GEAC ensures that GM crops undergo thorough evaluation, genetic

modifications can still lead to unpredictable ecological changes that must be carefully monitored.

Quick Tip

The GEAC evaluates the safety and environmental impact of GM crops, ensuring responsible use, but it is important to recognize that genetic modification can still have unintended ecological effects, such as crossbreeding or disruptions in local ecosystems.

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, the trophic levels are organized based on the biomass present at each level in the food chain:

Level 'A': This level is typically occupied by Producers (PC), such as plants, which form the base of most ecosystems. Producers usually have the highest biomass since they harness solar energy and convert it into chemical energy through photosynthesis. In terrestrial

ecosystems, this level usually represents plants and trees. Level 'B': This level is typically occupied by Primary Consumers (PP), such as herbivores, which feed on the producers. These organisms usually have a lower biomass compared to producers since energy is lost at each trophic level due to metabolic processes and inefficiencies in energy transfer.

In some ecosystems, such as aquatic ecosystems, this pyramid of biomass can be inverted. In such systems, producers like phytoplankton, which are microscopic organisms, have a lower total biomass compared to the primary consumers that feed on them, such as zooplankton or small fish. Despite their small size, phytoplankton reproduce very rapidly, and their biomass can be quickly turned over, leading to a lower standing biomass at any given time compared to the consumers.

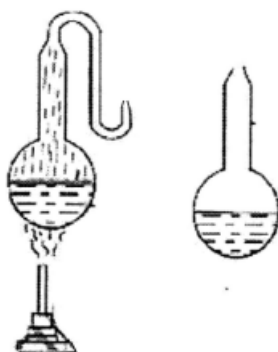
This phenomenon of an Inverted Pyramid of Biomass is a characteristic feature of Aquatic Ecosystems where the turnover rate of producers is very high, and their biomass is often much smaller than that of primary consumers.

Quick Tip

In aquatic ecosystems, producers like phytoplankton have a short life cycle and reproduce rapidly, leading to a smaller standing biomass compared to the consumers, even though they form the base of the food chain.

18. Given below is an illustration of the experiment performed by Louis Pasteur.

Explain the experiment and its conclusion.



Solution: Louis Pasteur's famous "swan-neck flask experiment" was designed to refute the theory of spontaneous generation, which suggested that life could arise from non-living matter. In his experiment, Pasteur used a flask with a long, curved neck (resembling a swan's

neck), which allowed air to enter but prevented dust and other contaminants from getting inside.

Pasteur first boiled the nutrient broth in the flask to sterilize it and kill any existing microorganisms. The unique shape of the swan-neck flask blocked dust and microbes from entering, and as a result, no microbial growth occurred in the broth. However, when the neck of the flask was broken, allowing dust and microorganisms to enter, microbial growth quickly appeared.

Conclusion: This experiment provided strong evidence against spontaneous generation, supporting the idea that microorganisms originate from other living organisms in the environment. It firmly endorsed the theory of biogenesis, which states that life arises only from pre-existing life.

Quick Tip

Pasteur's experiment was crucial in demonstrating that life arises from pre-existing life, laying the foundation for 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 are largely determined by the microorganisms involved in the fermentation process, which influence the texture, flavor, and overall characteristics of the cheese. The types of bacteria and fungi used in the fermentation process are critical in shaping the final product. Some examples include:

- **Swiss Cheese:** The bacterium *Propionibacterium shermanii* plays a key role in Swiss cheese production by producing carbon dioxide during fermentation. This gas forms characteristic holes in the cheese, while also contributing to its signature nutty flavor. The bacterium also helps in the development of the cheese's smooth texture.
- **Blue Cheese:** In blue cheese, the mold *Penicillium roqueforti* is introduced to the cheese, resulting in the formation of blue veins throughout the cheese. This mold also contributes to the sharp, tangy flavor that blue cheese is known for. The mold breaks down fats and proteins in the cheese, enhancing its rich and bold taste.

The unique combination of microorganisms used in different cheese types determines not only the taste and texture but also the aroma, color, and appearance of the cheese.

Quick Tip

Microorganisms play an essential role in the fermentation process of cheese production. The specific bacteria and molds used can influence the flavor, texture, and overall characteristics of different cheeses. Understanding these microbes can help in identifying and appreciating cheese varieties.

OR

20(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/slows down body functions
2.	<i>Cannabis sativa</i>	B	C
3.	<i>Erythroxylum coca</i>	Cocaine	D

Solution: Several plants produce compounds that have significant effects on the human body, especially through their interactions with the central nervous system. These compounds can have therapeutic effects but also pose risks, including addiction and other health issues. Here are a few examples:

- **Papaver somniferum (Opium poppy):** The plant produces **Morphine**, a powerful depressant that slows down body functions. Morphine is commonly used as a painkiller, especially for severe pain, but it can also lead to addiction and respiratory depression if misused.
- **Cannabis sativa (Cannabis):** This plant contains **THC (Tetrahydrocannabinol)**, which affects the nervous system, causing altered perception, euphoria, and impaired coordination. While cannabis has medicinal uses, particularly for pain and nausea, it can also impair cognitive functions and cause long-term psychological effects in heavy users.
- **Erythroxylum coca (Coca plant):** The plant produces **Cocaine**, a powerful stimulant that stimulates the central nervous system. Cocaine causes intense euphoria and energy, but it is highly addictive and can lead to serious health issues, including heart problems, high blood pressure, and psychological disorders.

These plant-derived substances have profound impacts on the human body, and while they may have medicinal uses, their misuse or overuse can lead to dangerous side effects.

Quick Tip

Plant-derived drugs like morphine, THC, and cocaine can have significant and sometimes dangerous effects on the body. Understanding how they affect the central nervous system and other organs is crucial for both medical use and abuse prevention.

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 Assisted Reproductive Technologies (ART) program, commonly known as the "test tube baby program," involves several critical steps to help couples conceive when natural conception is not possible. These steps are as follows:

- **Step 1: Hormonal Stimulation**

The female is given hormonal treatments to stimulate the ovaries to produce multiple eggs (ova) rather than the single egg that is typically produced each cycle. This increases the chances of successful fertilization.

- **Step 2: Egg Retrieval and Fertilization**

Once the eggs have matured, they are carefully retrieved from the ovaries through a minor surgical procedure. The eggs are then fertilized with sperm from the male partner (or a donor) in a laboratory setting, where conditions are carefully controlled to optimize fertilization.

- **Step 3: Embryonic Development**

The fertilized eggs (zygotes) begin to divide and develop into embryos in vitro, or outside the body, in a controlled laboratory environment. The embryos are monitored for development and quality.

- **Step 4: Embryo Transfer**

Once the embryos reach a suitable stage of development, one or more healthy embryos are selected and transferred into the female's uterus for further growth and implantation. If successful, the embryo will implant in the uterine lining, and pregnancy will begin.

This process is commonly referred to as the **test tube baby program** because fertilization and early embryonic development take place outside the female's body, typically in a petri dish or test tube.

Quick Tip

Assisted Reproductive Technology (ART) techniques like in vitro fertilization (IVF) allow for the fertilization of an egg outside the body, after which healthy embryos are transferred into the uterus for potential pregnancy.

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 landmark experiment was crucial because it recreated the environmental conditions of early Earth and demonstrated that organic molecules, including amino acids, could be synthesized from inorganic compounds under these primitive conditions. This experiment provided substantial support for the theory of abiogenesis, which proposes that life originated from non-living matter.

The hypothesis behind Miller's experiment was first proposed by **Alexander Oparin** and **J.B.S. Haldane**, who suggested that life emerged from simple molecules in a reducing environment, which was conducive to the formation of complex organic compounds.

Quick Tip

Miller's experiment was a major breakthrough in understanding the origin of life, showing how basic compounds could evolve into the building blocks of life under suitable conditions.

22(B). How does meteorite analysis favour this hypothesis?

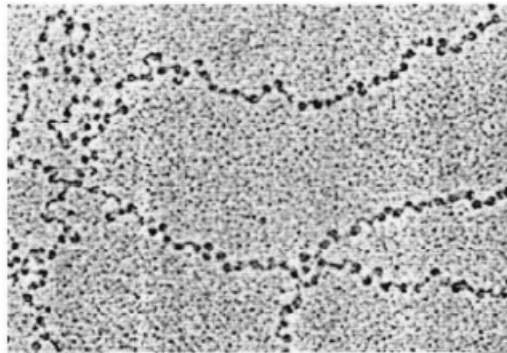
Solution: Meteorite analysis has shown that many organic compounds, including amino acids, are present in meteorites. This supports the hypothesis that organic molecules could

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 image provided shows a detailed view of a **cellular structure** magnified at a very high level. Based on the clarity and resolution of the image, it is most likely a **microscopic image** captured using a **Transmission Electron Microscope (TEM)**. TEM is a powerful tool that allows scientists to observe the fine details of cellular components, such as organelles, membranes, and macromolecular structures, by passing electrons through thin slices of the sample. This method provides much higher resolution than conventional light microscopes, enabling the visualization of structures at the nanometer scale.

Quick Tip

A Transmission Electron Microscope (TEM) is crucial for studying the fine details of cell structures at very high resolution, providing insights into cellular components and functions.

23(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.

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):

$$X^cY$$

Mother (normal vision):

$$X^N X^N$$

When the alleles are crossed:

$$\text{Father: } X^cY \quad \text{Mother: } X^N X^N$$

Possible offspring:

$$\text{Daughter: } X^N X^c \quad (\text{Carrier, not color blind})$$

$$\text{Son: } X^cY \quad (\text{Color blind})$$

Thus, the daughter is a carrier

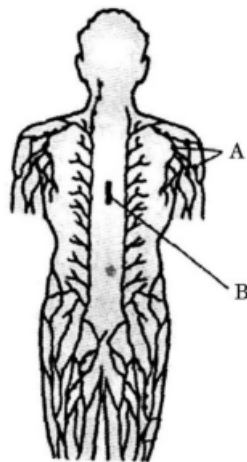
$(X^N X^c)$ and does not have the disease, while the son inherits color blindness from his mother (X^cY) , not from his father.

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**, and **B** represents the **Lymphatic vessels**.

Each of these components plays a crucial role in the body's immune system:

- **Lymph nodes (A):** Lymph nodes are small, bean-shaped structures distributed throughout the body. They act as filters for the lymph, a fluid that circulates in the lymphatic system. Lymph nodes trap foreign particles such as bacteria, viruses, and even cancer cells, preventing them from spreading to other parts of the body. They are populated with immune cells, particularly lymphocytes (T cells and B cells), that play a key role in recognizing and attacking harmful pathogens. When pathogens are detected, the lymph nodes become swollen as the immune system mounts a defense.

- **Lymphatic vessels (B):** The lymphatic vessels are part of the extensive network that makes up the lymphatic system. These vessels transport lymph, immune cells, and waste products from tissues back into the bloodstream. The vessels also help to maintain the body's fluid balance by ensuring that excess fluid is removed from tissues and returned to the circulatory system. Importantly, the lymphatic vessels facilitate immune surveillance by delivering immune cells to lymph nodes for pathogen detection and response.

Thus, both lymph nodes and lymphatic vessels work in tandem to maintain the immune system's ability to recognize and defend against infections and other harmful invaders.

Quick Tip

Lymph nodes act as checkpoints in the immune system by filtering out pathogens, while lymphatic vessels transport immune cells and waste products, supporting the body's immune surveillance and defense.

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.

26(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, commonly known as birth control pills, work through several mechanisms to prevent pregnancy:

- **Inhibiting Ovulation:** The primary function of the hormones in contraceptive pills (usually a combination of estrogen and progestin) is to prevent the ovaries from releasing eggs. Without ovulation, there is no egg available for fertilization, reducing the chances of pregnancy.
- **Thickening Cervical Mucus:** The hormones in the pill also alter the consistency of the cervical mucus, making it thicker. This makes it more difficult for sperm to swim through the cervix and enter the uterus, preventing sperm from reaching any egg that may be released.
- **Changing the Uterine Lining:** The pill also affects the lining of the uterus, making it less receptive to a fertilized egg. This change in the uterine lining reduces the likelihood of successful implantation if fertilization were to occur.

Schedule: Contraceptive pills are typically taken daily for 21 days. After completing a 21-day course, there is a 7-day break during which menstruation occurs. A new pack of pills is started after this 7-day break. The daily intake of the pill ensures consistent hormone levels in the body, maximizing the effectiveness of contraception.

Quick Tip

Taking contraceptive pills at the same time every day ensures a consistent hormone level in the body, increasing their effectiveness in preventing pregnancy.

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.

28(a) (i). 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

28(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.

28(b) (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

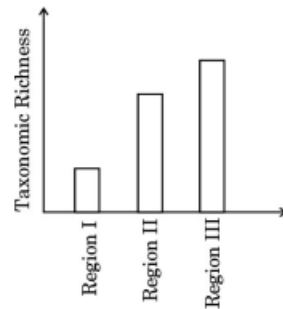
EcoRI is widely used in molecular biology for cutting DNA into smaller fragments, useful for cloning and sequencing.

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.

OR

29(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.

29(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: Step 1: Understand the concept.

The uneven distribution of species diversity across the world is referred to as **beta diversity** or the variation in species composition between ecosystems or regions.

Final Answer: This uneven distribution of diversity is referred to as beta diversity.

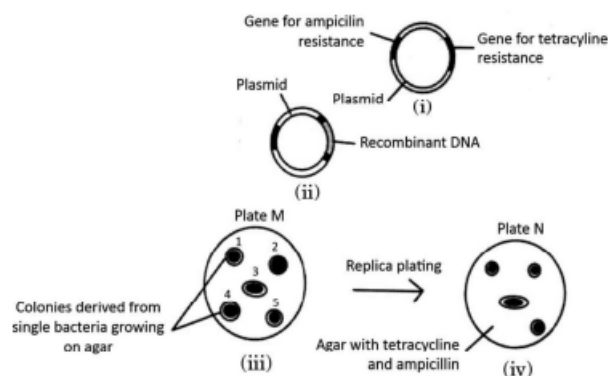
Quick Tip
Key point: Alpha diversity: Within a specific habitat. Beta diversity: Between different habitats. Gamma diversity: Across large geographic scales.

29(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 in this experiment is the one that grows on Plate M (which contains ampicillin) but does not grow on Plate N (which contains both ampicillin and tetracycline).

Justification: The recombinant DNA introduced into the bacteria disrupts the tetracycline resistance gene, making the bacteria sensitive to tetracycline. However, the ampicillin resistance gene remains intact, allowing the bacteria to survive and grow on Plate M, which contains ampicillin. Since the tetracycline resistance gene is disrupted, the bacteria cannot grow on Plate N, which contains both ampicillin and tetracycline, as they are now sensitive to tetracycline.

Thus, the ability to grow on Plate M but not Plate N indicates successful transformation where the bacteria retain ampicillin resistance but lose tetracycline resistance due to the disruption of the corresponding gene.

Quick Tip

In transformation experiments: Disruption of the resistance gene leads to the loss of resistance (e.g., tetracycline resistance is lost). Growth on selective plates indicates retained resistance (e.g., ampicillin resistance remains intact).

30(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 identify-

ing 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.

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

Solution: In genetic engineering and molecular biology, certain enzymes play crucial roles in manipulating DNA to study its functions or create recombinant DNA. Here are the key enzymes involved:

- **Restriction Endonucleases:** These are enzymes that cut DNA at specific, recognized sequences known as "restriction sites." They act as molecular scissors, making cuts at precise locations within the DNA strand. The recognition sites are usually palindromic sequences (where the sequence reads the same forward and backward on opposite strands). Restriction endonucleases are used to fragment DNA into smaller pieces, which is useful for cloning, DNA sequencing, and other applications in genetic research. For example, the restriction enzyme EcoRI cuts DNA at the sequence GAATTC, leaving sticky ends that can be used for further DNA manipulation.
- **DNA Ligase:** This enzyme facilitates the joining of DNA fragments by forming phosphodiester bonds between the sugar-phosphate backbones of adjacent nucleotides. DNA ligase is essential for creating recombinant DNA by linking the ends of DNA fragments that have been cut by restriction enzymes. This process is critical for applications like cloning, where a gene of interest needs to be inserted into a plasmid or other vector for further study or manipulation. The enzyme ensures that the DNA strands are correctly joined, which is vital for the stability of the recombinant DNA.

Together, restriction endonucleases and DNA ligase are fundamental tools in the creation of recombinant DNA, enabling the modification and transfer of genetic material between organisms.

Quick Tip

In molecular biology:

Restriction endonucleases act as molecular scissors, cutting DNA at specific sequences.

DNA ligase acts as "molecular glue," joining DNA fragments to form recombinant DNA.

OR

30(c). State the role of β -galactosidase in insertional inactivation.

Solution: Insertional inactivation of the β -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

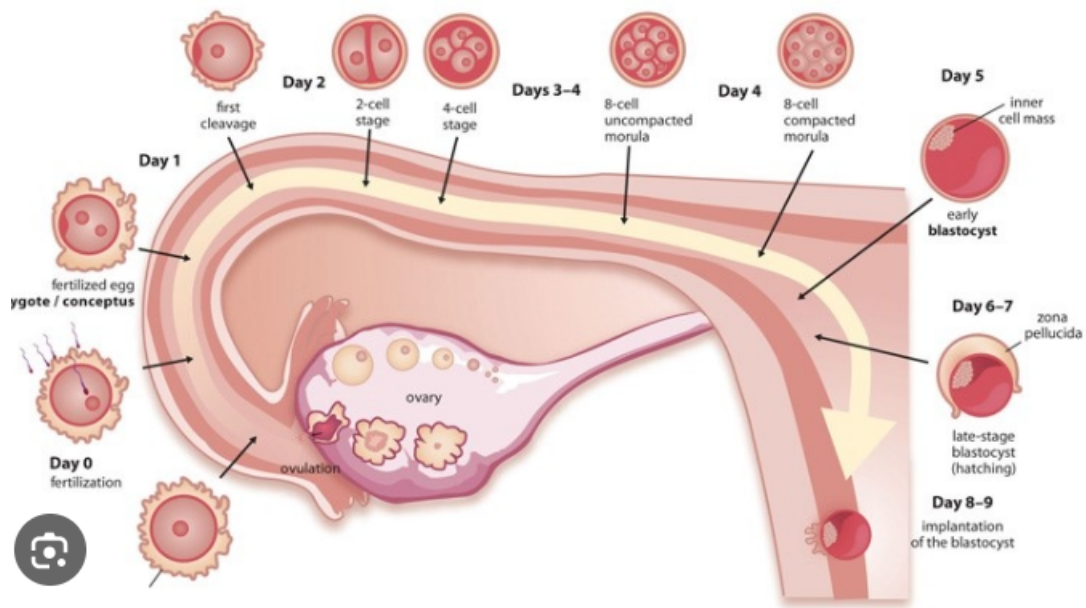
Restriction enzymes cut, and DNA ligase joins DNA.

β -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.

31(a) (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 the embryo successfully implants into the uterine lining, it undergoes several crucial developmental stages to establish the foundation for all future growth and organ development:

1. **Placenta Formation:** Following implantation, the trophoblast layer of the blastocyst (the early stage embryo) begins to grow and invade the uterine lining. This process leads to the formation of the placenta, an essential organ that facilitates nutrient and gas exchange between the mother and the embryo. The placenta serves as a conduit for oxygen and nutrients from the mother to the developing embryo, while also removing waste products from the embryo's blood. This exchange is vital for the continued development of the embryo.

2. **Formation of Three Germ Layers:** The next key event is gastrulation, during which the inner cell mass of the blastocyst differentiates into three distinct germ layers, each of which will give rise to specific tissues and organs in the body:

Ectoderm: The outermost layer, which forms the skin, hair, nails, and nervous system (including the brain and spinal cord).

Mesoderm: The middle layer, which gives rise to muscles, bones, the circulatory system, and other connective tissues.

Endoderm: The innermost layer, which forms the lining of the digestive and respiratory systems, as well as organs like the liver and pancreas.

These three germ layers are foundational to the formation of all major organs and tissues in the developing embryo. The differentiation of these layers is a critical step in ensuring the proper development of the body.

Quick Tip

Gastrulation is a pivotal process in embryonic development where the three germ layers are established, setting the stage for the formation of all the body's tissues and organs.

31(a) (iii). Mention the role of the following:

Solution: 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

31(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.

31(b)(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.

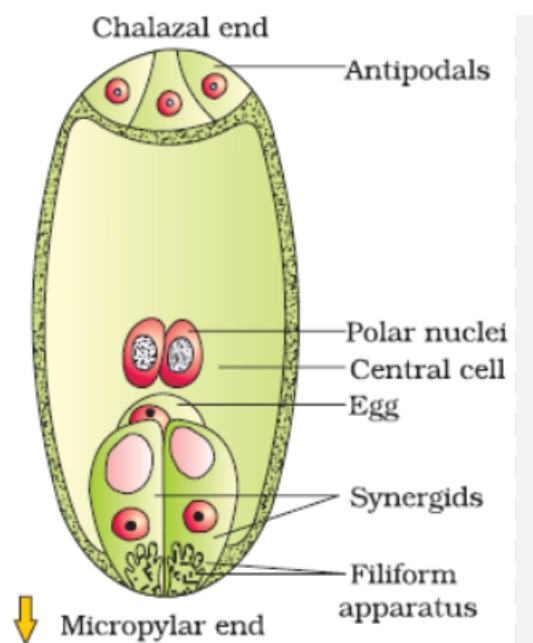
3. **Dormancy:** Seeds can remain dormant for long periods, allowing them to germinate when conditions are favorable.

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.

31(b)(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.

32(a) (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.

32(a) (iii). State the role of the following techniques in detection and diagnosis of cancer:

Solution:

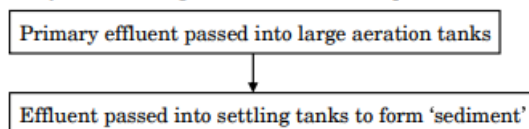
- (1) **Biopsy and Histopathology:** A biopsy involves taking a tissue sample from the suspected area to examine under a microscope. Histopathology helps in identifying abnormal or cancerous cells in the tissue.
- (2) **Magnetic Resonance Imaging (MRI):** MRI uses magnetic fields and radio waves to create 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.

32(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 :



32(b)(i)(i). 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.

32(b)(i)(ii). 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.

32(b)(i)(iii). 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.

32(b)(ii)(i). 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

33(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.
