CUET UG (Biology)

15 May 2024

Question 1

Analogous structures are a result of :

Options:

A. Convergent evolution

B. Divergent evolution

C. Parallel evolution

D. Retrogressive evolution

Answer: A

Solution:

The correct answer is **Convergent evolution**

Explanation:

- **Analogous Organs:**Analogous organs are structures in different species that perform similar functions but have different evolutionary origins and underlying structures.
    - For example, the wings of birds and insects are both used for flying, but they evolved independently in different evolutionary lineages and do not share a common ancestor for the wing structure.
- **Convergent Evolution:**This is the process by which unrelated or distantly related species evolve similar traits due to adaptation to similar environmental pressures or ecological niches.
- In convergent evolution, species from different evolutionary backgrounds develop analogous structures, like the wings of bats and insects, which serve the same function but have different origins.

Other Options:

- **Divergent evolution:** This process occurs when two species that share a common ancestor evolve different traits, leading to increased differences over time.
    - It results in **homologous structures,** which are similar due to shared ancestry but may differ in function.
    - For example, the limbs of humans and the wings of bats are homologous structures.
- **Parallel evolution:** This is when two related species evolve similar traits independently after their evolutionary paths have diverged from a common ancestor.

- **Retrogressive evolution:** Also known as regressive evolution, this is the process where organisms lose complex features and revert to simpler forms.

Question 2

Which of the following does not affect the Hardy-Weinberg equilibrium ?

Options:

A. Natural selection

B. Genetic drift

C. Gene pool

D. Gene migration

Answer: C

Solution:

The correct answer is **Gene pool**

Concept:

- **Hardy-Weinberg Equilibrium:**A principle that states that allele and genotype frequencies in a population will remain constant from generation to generation in the absence of other evolutionary influences.
- Five factors are known to affect Hardy-Weinberg equilibrium.
- These are **gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection.**

Explanation:

- **Natural Selection:** This is a process where organisms with favorable traits are more likely to survive and reproduce, thereby passing these traits to the next generation. It causes changes in allele frequencies, disrupting Hardy-Weinberg equilibrium.
- **Genetic Drift:** This refers to random changes in allele frequencies in a population, especially in small populations. These random changes can lead to significant genetic differences over time, affecting the Hardy-Weinberg equilibrium.
- **Gene Migration:** Also known as gene flow, this is the transfer of alleles or genes from one population to another. This movement of genes can introduce new alleles into a population, altering allele frequencies and disrupting Hardy-Weinberg equilibrium.
- **Gene Pool:** The total set of different alleles in an interbreeding population. The gene pool itself does not affect the Hardy-Weinberg equilibrium directly; it is simply a representation of the genetic diversity within the population.

Question 3

Which of the following primates was more like an ape ?

Options:

A. Homo erectus

B. Dryopithecus

C. Australopithecines

D. Ramapithecus

Answer: B

Solution:

The correct answer is **Dryopithecus**

Explanation:

About 15 mya, primates called Dryopithecus and Ramapithecus were existing. They were hairy and walked like gorillas and chimpanzees. Ramapithecus was more man-like while Dryopithecus was more ape-like.

***Ramapithecus*-**

- They were primates that existed**15 million years ago**(mya).
- They were**hairy and walked like present-day apes**such as gorillas and chimpanzees.
- They existed**alongside*Dryopithecus*,**which were ape-like primates.
- *Ramapithecus*were**more man-like than*Dryopithecus***.

***Homo erectus*-**

- They existed around**1.5 mya**.
- They had a**large brain size of 900cc**.
- They used to**eat meat**.
- Their fossils were**discovered in Java**in 1891.
- As their name suggests, they were the first hominid species to have an**upright posture**.

Australopithecines-

- Two mya, Australopithecines probably lived in East African grasslands.
- Evidence shows they hunted with stone weapons but essentially ate fruit.

Question 4

Nucleosome is associated with _____ molecules of histones.

Options:

A. Four

B. Nine

C. Two

D. Eight

Answer: D

Solution:

The correct answer is **Eight**

Explanation

- The nucleosome is the basic structural unit of chromatin in eukaryotic cells. It plays a critical role in the packaging of DNA into a compact, dense shape, which allows for efficient storage and regulation of genetic information.
- A nucleosome consists of a segment of DNA wound around a core of histone proteins.
- Histones are rich in the basic amino acid residues lysine and arginine. Both the amino acid residues carry positive charges in their side chains.
- Histones are organised to form a unit of eight molecules called **histone octamer.**
- The histone core around which DNA is wrapped is composed of **eight histone molecules:** two each of histone proteins H2A, H2B, H3, and H4.
- The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called **nucleosome**
- A typical nucleosome contains 200 bp of DNA helix.

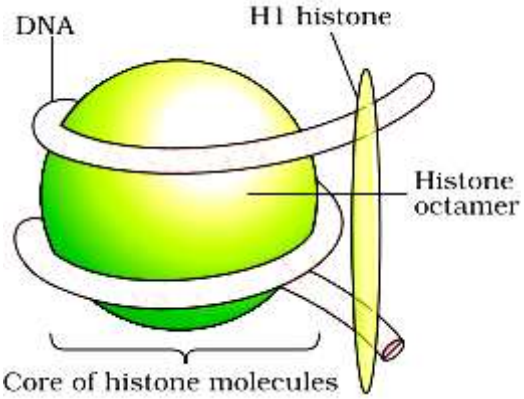

Fig: Nucleosome

Question 5

Select the observations drawn from the human genome project which are correct

(A) The human genome contains 3164.7 million bp.

(B) The average gene consists of 3000 bases.

(C) Total number of genes is estimated at 30,000.

(D) The functions are unknown for over 50% of discovered genes.

(E) Less than 2% of the genome codes for proteins.

Choose the correct answer from the options given below :

Options:

A. (A), (B), (C) and (D) only

B. (A), (C), (D) and (E) only

C. (A), (C) and (E) only

D. (A), (B), (C), (D) and (E)

Answer: D

Solution:

The correct answer is**(A), (B), (C), (D) and (E)**

Concept:

- The**Human Genome Project (HGP)**was an international scientific research project with the primary goal of mapping and understanding all the genes of the human genome. Completed in 2003, the project identified and sequenced the entire genetic code of humans, providing a detailed blueprint of human genes.
- The human genome consists of DNA molecules packaged into 23 pairs of chromosomes within the nucleus of each cell. The HGP revealed that the human genome contains approximately**3 billion DNA**

base pairs.

Explanation:

Some of the salient observations drawn from human genome project are as follows:

1. The human genome contains 3164.7 million bp.
2. The average gene consists of 3000 bases, but sizes vary greatly, with the largest known human gene being dystrophin at 2.4 million bases.
3. The total number of genes is estimated at 30,000–much lower than previous estimates of 80,000 to 1,40,000 genes. Almost all (99.9 per cent) nucleotide bases are exactly the same in all people.
4. The functions are unknown for over 50 per cent of the discovered genes.
5. Less than 2 per cent of the genome codes for proteins.
6. Repeated sequences make up very large portion of the human genome.
7. Repetitive sequences are stretches of DNA sequences that are repeated many times, sometimes hundred to thousand times. They are thought to have no direct coding functions, but they shed light on chromosome structure, dynamics and evolution.
8. Chromosome 1 has most genes (2968), and the Y has the fewest (231).
9. Scientists have identified about 1.4 million locations where single- base DNA differences (SNPs – single nucleotide polymorphism, pronounced as 'snips') occur in humans. This information promises to revolutionise the processes of finding chromosomal locations for disease-associated sequences and tracing human history.

Therefore, all the statements are correct.

Question 6

Match List-I with List-II :

List – I **Placental mammals**		**List - II** **Counterpart Marsupials**	
A.	Anteater	I.	Spotted cuscus
B.	Bobcat	II.	Numbat
C.	Lemur	III.	Flying Phalanger
D.	Flying squirrel	IV.	Tasmanian tiger cat

Choose the correct answer from the options given below :

Options:

A. (A) - (II), (B) - (IV), (C) - (I), (D) - (III)

B. (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

C. (A) - (IV), (B) - (I), (C) - (II), (D) - (III)

D. (A) - (IV), (B) - (I), (C) - (III), (D) - (II)

Answer: A

Solution:

The correct answer is **(A) - (II), (B) - (IV), (C) - (I), (D) - (III)**

Explanation:

- The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called**adaptive radiation.**
- Examples includes Darwin finches and Australian marsupials.
- Placental mammals in Australia also exhibit adaptive radiation in evolving into varieties of such placental mammals each of which appears to be ‘similar’ to a corresponding marsupial.
- **Anteater - Numbat:** The anteater is a placental mammal known for its long snout and tongue, which it uses to eat ants and termites. The numbat, a marsupial, has similar feeding habits and physical adaptations for consuming termites.
- **Bobcat - Tasmanian tiger cat:** The bobcat is a placental mammal that is a medium-sized wildcat with a distinctive spotted fur pattern. The Tasmanian tiger cat, a marsupial, is its ecological counterpart with a similar predatory lifestyle and appearance.
- **Lemur - Spotted cuscus:** Lemurs are placental primates found in Madagascar with diverse diets and arboreal lifestyles. The spotted cuscus, a marsupial, shares similar arboreal habits and dietary preferences.
- **Flying squirrel - Flying phalanger:** The flying squirrel is a placental mammal adapted for gliding between trees using a patagium. The flying phalanger, a marsupial, has developed similar adaptations for gliding.

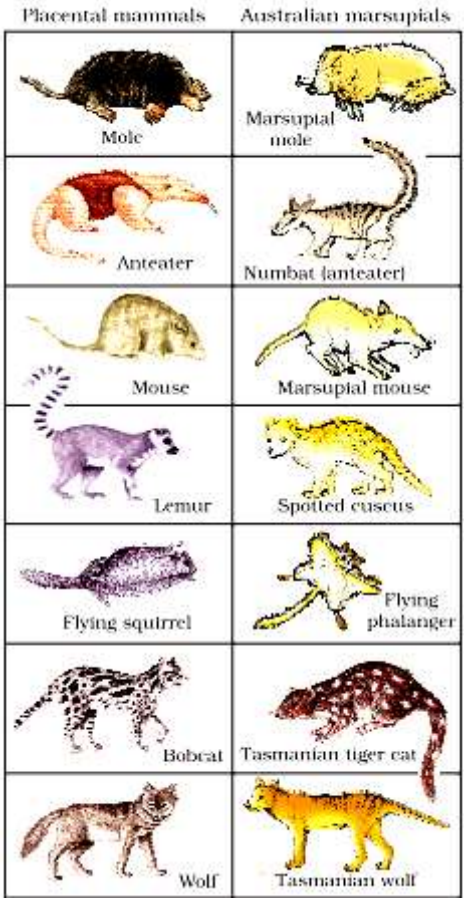

Fig: Picture showing convergent evolution of Australian Marsupials and placental mammals

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Question 7

Identify the incorrect statement/s :

(A) Intestinal perforation and death may occur in severe cases of typhoid infection.

(B) Common cold is caused by Rhinoviruses.

(C) Lips and fingernails may turn grey to bluish colour in severe cases of pneumonia.

(D) Pneumonia is caused by Salmonella.

(E) Typhoid fever could be confirmed by Widal test.

Choose the answer from the options given below :

Options:

A. (A), (C) and (D) only

B. (B) and (E) only

C. (D) only

D. (A) and (D) only

Answer: C

Solution:

The correct answer is **Option 3**

Explanation:

(A) Intestinal perforation and death may occur in severe cases of typhoid infection: This statement is correct.

- *Salmonella typhi* is a pathogenic bacterium which causes typhoid fever in human beings.
- Sustained high fever (39° to 40°C), weakness, stomach pain, constipation, headache and loss of appetite are some of the common symptoms of this disease.
- Intestinal perforation and death may occur in severe cases.

(B) Common cold is caused by Rhinoviruses:

- This statement is correct. The common cold is most commonly caused by rhinoviruses.
- They infect the nose and respiratory passage but not the lungs.

(C) Lips and fingernails may turn grey to bluish colour in severe cases of pneumonia:

- This statement is correct. In severe cases of pneumonia, patients may experience cyanosis, where the lips and fingernails turn a bluish color due to lack of oxygen.

(D) Pneumonia is caused by Salmonella:

- This statement is incorrect. Pneumonia is not caused by *Salmonella.*
- Pneumonia can be caused by various pathogens, including bacteria (e.g., *Streptococcus pneumoniae*) and*Haemophilus influenzae*which infects the alveoli (air filled sacs) of the lungs.

(E) Typhoid fever could be confirmed by Widal test:

- This statement is correct. The Widal test is a serological test used to diagnose typhoid fever by detecting the presence of antibodies against Salmonella antigens in the patient's serum.

Question 8

Match List-I with List-II :

List – I Types of barriers		List - II Examples	
A.	Cytokine barriers	I.	Mucus coating
B.	Physical barriers	II.	Tears from eyes
C.	Cellular barriers	III.	Phagocytosis
D.	Physiological barriers	IV.	Interferons

Choose the correct answer from the options given below :

Options:

A. (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

B. (A) - (II), (B) - (IV), (C) - (III), (D) - (I)

C. (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

D. (A) - (IV), (B) - (I), (C) - (III), (D) - (II)

Answer: D

Solution:

The correct answer is **(A) - (IV), (B) - (I), (C) - (III), (D) - (II)**

Concept:

Innate immunity is non-specific type of defence, that is present at the time of birth. Innate immunity consists of four types of barriers. These are

- Physical barriers
- Physiological barriers
- Cellular barriers
- Cytokine barriers

Explanation:

- **Cytokine barriers (A - IV):** Virus-infected cells secrete proteins called interferons which protect non-infected cells from further viral infection.

- **Physical barriers (B - I):**Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body.
- **Cellular barriers (C - III):**Certain types of leukocytes (WBC) of our body like polymorpho-nuclear leukocytes (PMNL-neutrophils) andmonocytes and natural killer (type of lymphocytes) in the blood as well as macrophages in tissues can phagocytose and destroy microbes.
- **Physiological barriers (D - II):** These barriers involve physiological responses that inhibit pathogen growth or facilitate their removal. Tears from eyes, which contain enzymes that break down bacterial cell walls, are an example of a physiological barrier.

Question 9

Smack is chemically :

Options:

A. Diacetyl morphine

B. Cocaine

C. Benzodiazepine

D. Amphetamine

Answer: A

Solution:

The correct answer is **Diacetyl morphine**

Explanation:

- Smack, also known as heroin, is a highly addictive opioid drug derived from morphine, a substance extracted from the seed pod of the opium poppy plant.
- Heroincommonly called smack is chemically **diacetylmorphine** which is a white, odorless, bitter crystalline compound. This is obtained by acetylation of morphine

Other Options:

- **Cocaine:** This is a powerful stimulant drug made from the leaves of the coca plant native to South America. It is chemically different from heroin and acts primarily on the central nervous system to produce heightened alertness and energy, rather than the depressant effects of opioids.
- Drugs like **barbiturates, amphetamines, benzodiazepines**, and other similar drugs, that are normally used as medicines to help patients cope with mental illnesses like depression and insomnia, are often abused.

Question 10

Antibodies are secreted by :

Options:

A. T-Cells

B. B-Cells

C. α-Cells

D. β-Cells

Answer: B

Solution:

The correct answer is **B-Cells**

Concept:

- The immune system is a complex network of cells, tissues, and organs that work together to defend the body against harmful invaders such as bacteria, viruses, and other pathogens.
- Among the various types of cells in the immune system, lymphocytes play a critical role.
- There are two main types of lymphocytes: B-cells and T-cells.
- Antibodies are specialized proteins produced by B-cells.

Explanation:

B-Cells:

- B-cells, also known as B-lymphocytes, are a type of white blood cell that is essential for the humoral immune response.
- When B-cells encounter a pathogen, they can differentiate into plasma cells, which then secrete antibodies specific to that pathogen.
- These antibodies bind to antigens on the surface of pathogens, marking them for destruction by other immune cells.

T-Cells:

- T-cells, or T-lymphocytes, are another type of white blood cell involved in the immune response.
- They do not secrete antibodies but play a role in directly killing infected cells and regulating the immune response.

Alpha-Cells (α-Cells):

- Alpha-cells are found in the pancreas and are not involved in the immune response.
- They secrete the hormone glucagon, which helps regulate blood sugar levels.

Beta-Cells (β-Cells):

- Beta-cells are also located in the pancreas and are responsible for producing insulin, a hormone that helps lower blood sugar levels.

Question 11

In sewage treatment, flocs are :

Options:

A. the solids that settle during sedimentation.

B. the supernatant that is formed above the primary sludge

C. the masses of bacteria associated with fungal filaments.

D. the bacteria which grow anaerobically and are also called anaerobic sludge digesters.

Answer: C

Solution:

The correct answer is **the masses of bacteria associated with fungal filaments.**

Explanation:

- Sewage treatment involves various processes to remove contaminants from wastewater or sewage, including physical, chemical, and biological treatments.
- Biological treatment is a vital part of sewage treatment where microorganisms are used to decompose organic matter in the sewage.
- Flocs play a crucial role in the biological treatment process, particularly in the **secondary treatment stage.**
- The primary effluent (from primary treatment) is passed into large aeration tanks where it is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh-like structures).
- These flocs are essential in the **activated sludge process**, where they help in the aggregation of bacteria and other microorganisms that break down organic matter in the wastewater.
- The term "**activated sludge**" refers to a key component in the secondary stage of sewage treatment processes. This stage primarily involves biological processes for treating wastewater after the primary treatment has removed large solids and particulate matter.

Other Options:

- "The solids that settle during sedimentation" refers to primary sludge, which consists of settleable solids removed during the primary treatment stage.

- "The supernatant that is formed above the primary sludge" refers to the liquid that remains after the solids have settled in the primary treatment.
- "The bacteria which grow anaerobically and are also called anaerobic sludge digesters" refers to the bacteria involved in anaerobic digestion, a different process used for the treatment of sludge,

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Question 12

Match List-I with List-II :

List – I Products		List - II Organisms	
A.	Statin	I.	Streptococcus
B.	Clot buster	II.	Trichoderma
C.	Swiss cheese	III.	Monascus
D.	Cyclosporin-A	IV.	Propionibacterium

Choose the correct answer from the options given below :

Options:

A. (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

B. (A) - (III), (B) - (I), (C) - (IV), (D) - (II)

C. (A) - (III), (B) - (IV), (C) - (II), (D) - (I)

D. (A) - (II), (B) - (III), (C) - (I), (D) - (IV)

Answer: B

Solution:

The correct answer is**(A) - (III), (B) - (I), (C) - (IV), (D) - (II)**

Explanation:

- **Statins** produced by the yeast***Monascus purpureus***have been commercialised as **blood-cholesterol lowering agents.** It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.
- **Streptokinase**produced by the bacterium**Streptococcus**and modified by genetic engineering is used as a**'clot buster'**for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.

- **Swiss cheese** areformed by the bacterium***Propionibacterium shermanii***.The large holes seen in Swiss cheese are its characteristic feature.They are formed due to CO_2production by the bacterial respiration
- **Cyclosporin A,**that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus***Trichoderma polysporum***.

Question 13

The beetle used as a biocontrol agent for aphids and mosquitoes is :

Options:

A. Trichoderma

B. Dragonflies

C. Ladybird

D. Silver fish

Answer: C

Solution:

The correct answer is **Ladybird**

Explanation:

- Biocontrol agents are organisms that are used to control pests and other harmful organisms in an environmentally friendly way.
- Ladybirds, also known as ladybugs or lady beetles, are a common biocontrol agent used to manage aphid populations.
- Aphids are small sap-sucking insects, and mosquitoes are vectors for many diseases.
- Ladybird and Dragonflies are useful to get rid of aphids and mosquitoes, respectively.

Other Options:

- **Trichoderma:** Trichoderma species are free-living fungi that are very common in the root ecosystems. They are effective biocontrol agents of several plant pathogens.
- **Dragonflies:** Dragonflies are another type of predatory insect that can help control mosquito populations. They are effective biocontrol agents for mosquitoes because their larvae (nymphs) feed on mosquito larvae in water, and adult dragonflies prey on adult mosquitoes.
- **Silverfish:** Silverfish are small, wingless insects that feed on starchy materials like paper, glue, and textiles. They are not biocontrol agents.

Question 14

Downstream processing method involves :

Options:

A. Identification

B. Amplification

C. Fermentation

D. Purification

Answer: D

Solution:

The correct answer is **Purification**

Explanation:

- Downstream processing refers to the recovery and purification of biosynthetic products, particularly pharmaceuticals, from natural sources such as animal or plant tissue or fermentation broth.
- The process involves the separation of the desired product from the mixture, followed by purification to achieve the required quality and concentration.
- The processes include separation and purification, which are collectively referred to as downstream processing.
- The product has to be formulated with suitable preservatives.
- Such formulation has to undergo thorough clinical trials as in case of drugs.
- Strict quality control testing for each product is also required.
- The downstream processing and quality control testing vary from product to product.

Other Options:

- **Identification:** This is the process of determining the presence of the desired product or organism. It is an initial step in research and development but not a part of downstream processing.
- **Amplification:** This refers to the process of increasing the quantity of the desired product, often through techniques like PCR (Polymerase Chain Reaction).
- **Fermentation:** This is the process of culturing microorganisms to produce the desired product. It is part of the upstream processing, not downstream processing.

Question 15

Which of the following is not the correctly matched pair of organism and its respective cell wall degrading enzyme ?

Options:

A. Fungi– Chitinase

B. Algae– Methylase

C. Plant cells – Cellulase

D. Bacteria– Lysozyme

Answer: B

Solution:

The correct answer is **Algae-Methylase**

Explanation:

Organisms such as fungi, algae, plant cells, and bacteria have cell walls that are composed of different materials, and specific enzymes are required to degrade these cell walls.

- **Fungi–Chitinase:** Chitinase is an enzyme that breaks down chitin, which is a major component of the fungal cell wall.
- **Algae–Methylase:** This is the incorrect pair. Algal cell walls are typically composed of cellulose, pectin, and other polysaccharides, and not degraded by methylase.
- **Plant cells–Cellulase:**Cellulase is the enzyme that breaks down cellulose, which is a major component of plant cell walls.
- **Bacteria–Lysozyme:**Lysozyme is an enzyme that breaks down peptidoglycan, which is a major component of bacterial cell walls.

Question 16

Arrange the following steps involved in transformation of bacteria in a sequence from initiation to end.

(A) Incubation of rDNA with bacterial cell on ice

(B) Treatment with divalent cations

(C) Heat shock treatment

(D) Selection on antibiotic containing agar plate

(E) Placed them again on ice

Choose the correct answer from the options given below :

Options:

A. (A), (B), (D), (C), (E)

B. (B), (A), (C), (E), (D)

C. (B), (C), (D), (A), (E)

D. (A), (C), (B), (D), (E)

Answer: B

Solution:

The correct answer is **(B), (A), (C), (E), (D)**

Concept:

- Transformation of bacteria involves the introduction of foreign DNA into a bacterial cell, which can be achieved through several steps.
- The process typically involves preparing the bacterial cells to be receptive to DNA, introducing the DNA, and then selecting for cells that have successfully taken up the DNA.

Explanation:

- **Treatment with divalent cations (B):** The first step in the transformation of bacteria is to treat them with divalent cations (such as Ca^{2+} or Mg^{2+}). This treatment makes the bacterial cell membrane more permeable to DNA.
- **Incubation of rDNA with bacterial cell on ice (A):** After the treatment, the bacterial cells are incubated with the recombinant DNA (rDNA) on ice. This allows the DNA to come into close proximity with the bacterial cells.
- **Heat shock treatment (C):** Following incubation on ice, the cells are subjected to a brief heat shock (usually at 42°C for about 30-45 seconds). This step facilitates the uptake of the DNA into the bacterial cells.
- **Placed them again on ice (E):** After the heat shock, the cells are placed back on ice to stabilize the cell membrane and allow the cells to recover.
- **Selection on antibiotic-containing agar plate (D):** Finally, the transformed cells are plated on agar plates containing an antibiotic. Only the cells that have taken up the rDNA, which includes an antibiotic resistance gene, will grow on these plates. This step selects for successfully transformed cells.

Question 17

Which of the following statements are incorrect ?

(A) Fragments of DNA can be separated by ELISA.

(B) Transformation is a procedure through which a piece of DNA is introduced in a host bacterium.

(C) Recombinant DNA technology does not involve isolation of a desired DNA fragment.

(D) DNA ligases are used for stitching DNA fragments into a vector.

Choose the answer from the options given below

Options:

A. (A) and (C) only

B. (A) and (B) only

C. (B) and (C) only

D. (A), (C) and (D) only

Answer: A

Solution:

The correct answer is **(A) and (C) only**

Explanation:

(A) Fragments of DNA can be separated by ELISA:

- This statement is incorrect.
- ELISA (Enzyme-Linked Immunosorbent Assay) is a technique used for detecting and quantifying proteins, peptides, antibodies, and hormones. It is not used for separating DNA fragments.
- DNA fragments are typically separated using techniques like gel electrophoresis.

(C) Recombinant DNA technology does not involve isolation of a desired DNA fragment:

- This statement is incorrect.

- Recombinant DNA technology involves multiple steps, including the isolation of the desired DNA fragment, its insertion into a vector, and its introduction into a host organism.
- Isolation of the desired DNA fragment is a crucial step in this process.

(B) Transformation is a procedure through which a piece of DNA is introduced in a host bacterium:

- This statement is correct. Transformation is a process by which foreign DNA is introduced into a bacterial cell, allowing the cell to express new genetic information.

(D) DNA ligases are used for stitching DNA fragments into a vector:

- This statement is correct.
- DNA ligases are enzymes that facilitate the joining of DNA strands together by catalyzing the formation of a phosphodiester bond, which is essential for inserting DNA fragments into vectors during cloning.

Question 18

Which of the following statements are true ?

(A) Milk obtained from ‘Rosie’ is nutritionally more balanced for human babies than natural human milk.

(B) Biopiracy refers to the use of bioresources without proper authorisation from MNCs.

(C) GEAC is the decisive body for safety and validity of GMOs and GM research respectively.

(D) Transgenic animals help us to understand the contribution of genes in the development of disease.

Choose the correct answer from the options given below :

Options:

A. (A) and (C) only

B. (C) and (D) only

C. (A) and (D) only

D. (B) and (C) only

Answer: B

Solution:

The correct answer is **(C) and (D) only**

Explanation:

(C) GEAC is the decisive body for safety and validity of GMOs and GM research respectively: This statement is true.

- The Indian Government has set up organisations such as
- GEAC (Genetic Engineering Approval Committee), which will make decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services.

(D) Transgenic animals help us to understand the contribution of genes in the development of disease: This statement is true.

- Transgenic animals are genetically engineered to carry genes from other species, which allows scientists to study the effects of these genes and understand how genetic diseases develop. This can lead to the development of new treatments and therapies for various diseases.

Other Options:

(A) Milk obtained from 'Rosie' is nutritionally more balanced for human babies than natural human milk: This statement is incorrect.

- 'Rosie' was the first transgenic cow, and her milk was modified to contain higher levels of certain proteins, but it is not necessarily more balanced for human babies than natural human milk.

(B) Biopiracy refers to the use of bioresources without proper authorization from MNCs: This statement is incorrect.

- Biopiracy is the term used to refer to the use of bio-resources by multinational companies and other organizations without proper authorisation from the countries and people concerned without compensatory payment.

Question 19

Match List-I with List-II :

List – I Transgene		List - II Used for/Products	
A.	α-1-antitrypsin	I.	Meloidegyne incognitia
B.	cryIAc	II.	Corn borer
C.	Antisense RNA	III.	Treat emphysema
D.	cryIAb	IV.	Cotton bollworms

Choose the correct answer from the options given below :

Options:

A. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

B. (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

C. (A) - (III), (B) - (II), (C) - (I), (D) - (IV)

D. (A) - (I), (B) - (IV), (C) - (III), (D) - (II)

Answer: A

Solution:

The correct answer is **(A) - (III), (B) - (IV), (C) - (I), (D) - (II)**

Explanation:

- **(A) α-1-antitrypsin - (III) Treat emphysema:** α-1-antitrypsin is a human protein used in the treatment of emphysema, a condition that causes shortness of breath.
- **(B) cryIAc - (IV) Cotton bollworms:** The cryIAc gene from *Bacillus thuringiensis* produces a protein that is toxic to certain insects, such as **cotton bollworms**, and is used to protect cotton crops.
- **(C) Antisense RNA - (I)** ***Meloidegyne incognitia:*** Antisense RNA technology is used to inhibit the expression of specific genes. It has been employed in plants to develop resistance against pests like *Meloidegyne incognitia*, a type of nematode.
- **(D) cryIAb - (II) Corn borer:** The cryIAb gene also from *Bacillus thuringiensis* produces a protein that is toxic to the **corn borer,** a pest that affects corn crops.

Question 20

Expand “GEAC” :

Options:

A. Genetic and Environmental Advisory Committee

B. Gene Establisment Approval Committee

C. Genetic Engineering Advisory Committee

D. Genetic Engineering Approval Committee

Answer: D

Solution:

The correct answer is **Genetic Engineering Approval Committee**

Explanation:

- The Genetic Engineering Approval Committee (GEAC) is an apex body responsible for the regulation of the use of genetically modified organisms (GMOs) and their products, including experimental field trials.
- It functions under the Ministry of Environment, Forest and Climate Change in India.
- GEAC (Genetic Engineering Approval Committee)make decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services.

Question 21

When an insect feeds on the Bt plant, the insect dies due to the conversion of inactive protein to active protein in :

Options:

A. Alkaline pH of the gut.

B. Acidic pH of the gut

C. Acidic pH of saliva.

D. Alkaline pH of saliva.

Answer: A

Solution:

The correct answer is **Alkaline pH of the gut**

Explanation:

- *Bacillus thuringiensis*is a bacterium that produces proteins toxic to certain insects. These proteins are used in genetically modified crops to provide resistance against insect pests.
- The Bt toxin is produced in an inactive form (protoxin). When an insect ingests the Bt plant, the protoxin is converted to an active form in the insect's gut, leading to the insect's death.
- The conversion of the protoxin to the active toxin occurs in the alkaline environment of the insect's gut. This active toxin binds to the gut cells, creating pores and causing cell lysis, leading to the insect's death.
- Insects that feed on Bt plants have an alkaline pH in their gut, which activates the Bt protoxin. The active toxin binds to receptors in the gut cells, forming pores and causing cell death. This disrupts the digestive

system of the insect, eventually leading to its death.

Question 22

Match List-I with List-II :

List – I Interspecies Relationships		List - II Features	
A.	Commensalism	I.	One species is benefitted at the expense of the other
B.	Mutualism	II.	One species is harmed and the other is unaffected
C.	Amensalism	III.	Both the species are benefitted
D.	Parasitism	IV.	One species benefits and other remains unaffected

Choose the correct answer from the options given below :

Options:

A. (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

B. (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

C. (A) - (II), (B) - (I), (C) - (III), (D) - (IV)

D. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Answer: B

Solution:

The correct answer is**(A) - (IV), (B) - (III), (C) - (II), (D) - (I)**

Explanation:

- **Commensalism (A - IV):** In this type of relationship, one species benefits while the other remains unaffected.

- **Mutualism (B - III):** Both species involved in the relationship benefit.
- **Amensalism (C - II):** One species is harmed while the other is unaffected.
- **Parasitism (D - I):** One species (the parasite) benefits at the expense of the other (the host).

Table: Population Interactions

Species A	Species B	Name of Interactions	Examples
+	+	Mutualism	Fungi and root of a higher plant in Mycorrtizae
-	-	Competition	A Leopard and a Lion in a forest/grassland
+	-	Predation	In the rocky intertidalcommunities of the American Pacific Coast the starfish Pisaster isan important predator.
+	-	Parasitism	A Cuckoo laying egg in a Crow's nest (Brood Parasitism)
+	0	Commensalism	A cattle egret anda Cattle in a field
-	0	Amensalism	Grazing cattle and insects. When cattle graze in grass, birds eat the insects, but the cattle are unharmed.

Question 23

In a country, at any time, the population has the same number of youngs and mature ones. What type of growth does it reflect ?

Options:

A. Expanding

B. Declining

C. Stable

D. S-shaped

Answer: C

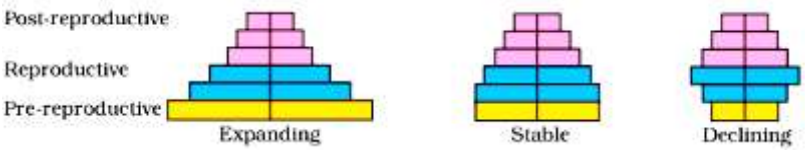
Solution:

The correct answer is **Stable**

Concept:

- Population growth can be categorized into different types based on the age distribution and growth rates of the population.
- Key population growth types include expanding, declining, stable, and S-shaped.
- A stable population is one where the birth rate equals the death rate, leading to no long-term increase or decrease in population size.

- The shape of the pyramids reflects the growth status of the population - (a) whether it is growing, (b) stable or (c) declining.



Explanation:

- **Expanding:** In an expanding population, there are more young individuals compared to older ones. This indicates a higher birth rate leading to population growth over time.
- **Declining:** A declining population has fewer young individuals compared to older ones, indicating a lower birth rate and an eventual decrease in population size.
- **Stable:** A stable population has an equal number of young and mature individuals, indicating that the birth rate is equal to the death rate. This means there is no net change in population size.
- **S-shaped:** S-shaped growth refers to a logistic growth model where the population grows rapidly at first and then stabilizes as it reaches the carrying capacity of the environment. This is a dynamic process and does not describe the given condition of a steady state with equal numbers of young and mature individuals.

Question 24

Two closely related species can co-exist indefinitely and violate the Gause's 'Competitive Exclusion Principle' by :

Options:

A. eliminating the inferior species.

B. resource partitioning.

C. interacting with each other symbiotically

D. changing the area of grazing.

Answer: B

Solution:

The correct answer is **resource partitioning**

Concept:

- Gause's competitive exclusion principle states that two species competing for the same resources cannot coexist indefinitelyand the competitively inferior one will be eliminated eventually.If the resources they are competing for are different, they can coexist.

- When**resources are limited**the competitively superior species will eventually eliminate the other species, but evidence for such competitive exclusion occurring in nature is not always conclusive.
- The Abingdon tortoise in Galapagos Islands became extinct within a decade after goats were introduced on the island, apparently due to the greater browsing efficiency of the goats.

Explanation:

- **Eliminating the inferior species:**It supports the Competitive Exclusion Principle, where one species completely outcompetes and eliminates the other.
- **Resource partitioning:** This is the correct answer because Resource Partitioning promotesco-existence rather than exclusion. If two species compete for the same resource, they could avoid competition by choosing, for instance, different times for feeding or different foraging patterns.
    - MacArthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities.
- **Interacting with each other symbiotically:** While symbiosis refers to a close ecological relationship between the individuals of two (or more) different species, it doesn't necessarily resolve the competition for the same resources. Symbiotic relationships can be mutualistic, commensalistic, or parasitic, and do not inherently violate the Competitive Exclusion Principle.
- **Changing the area of grazing:** This might reduce competition temporarily but does not necessarily lead to stable coexistence.

Question 25

The process of mineralisation by microorganisms helps in the release of :

Options:

A. inorganic nutrients from detritus and formation of humus.

B. organic nutrients from humus.

C. inorganic nutrients from humus

D. organic and inorganic nutrients from detritus.

Answer: C

Solution:

The correct answer is **inorganic nutrients from humus**

Explanation:

- Mineralisation is a process carried out by microorganisms, including bacteria and fungi, which break down organic matter in the soil and release inorganic nutrients.
- Humus is the decomposed organic matter in the soil, rich in nutrients and essential for soil fertility.

- During the mineralisation process, microorganisms decompose the complex organic compounds in humus into **simpler inorganic forms**, such as nitrates, phosphates, and other essential mineral nutrients.
- These inorganic nutrients are then available for uptake by plants, facilitating their growth and development.

Question 26

In which ecosystem is the biomass of primary consumers greater than producers ?

Options:

A. Forests

B. Grassland

C. Desert

D. Sea

Answer: D

Solution:

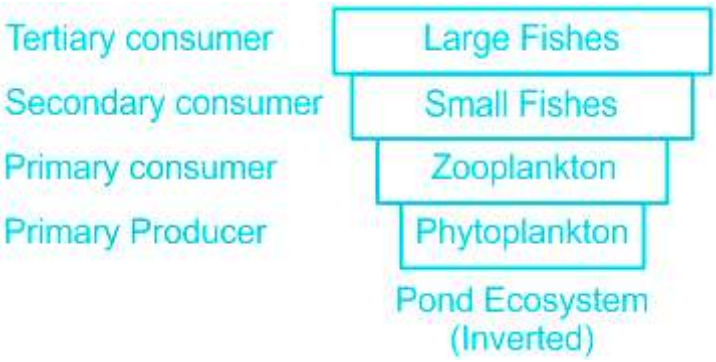
The correct answer is **Sea**

Explanation:

- In an ecosystem, the trophic level starts with a producer and is succeeded by different levels of consumers.
- In an**aquaticecosystem like a lake**, the usual food chain is like:

Phytoplankton → Zooplankton → Small fish → Big fish

Sea: In marine ecosystems, the pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton. This is because phytoplankton have a very high turnover rate; they reproduce and are consumed very quickly, leading to a lower standing biomass even though they have high productivity. Zooplankton, which feed on phytoplankton, accumulate more biomass as they grow and reproduce.



Forests: In forest ecosystems, trees and other vegetation (producers) have a much larger biomass than primary consumers (herbivores). Trees, which are long-lived and large, contribute significantly to the producer biomass.

Grassland: In grasslands, grasses and other producers also have a greater biomass than primary consumers (such as grazing animals).

Desert: In desert ecosystems, producers (like cacti and shrubs) have a greater biomass than primary consumers due to the harsh conditions and scarcity of food and water, which limit the population of herbivores.

Question 27

Choose the correct statements with respect to decomposition from the following :

(A) Decomposition is an anaerobic process.

(B) Decomposition rate of detritus depends upon the chemical nature of it.

(C) Water-soluble organic nutrients go into the soil and get precipitated in the process of leaching.

(D) Humification follows mineralisation.

Choose the correct answer from the options given below :

Options:

A. (B) and (D) only

B. (A) and (C) only

C. (B) and (C) only

D. (A) and (D) only

Answer: C

Solution:

The correct answer is **(B) and (C) only**

Concept:

- Decomposition is the process by which organic substances are broken down into simpler organic or inorganic matter such as carbon dioxide, water, and nutrients.
- Decomposition is largely an oxygen-requiring process.
- The rate of decomposition is controlled by chemical composition of detritus and climatic factors.

Explanation:

- **(B) Decomposition rate of detritus depends upon the chemical nature of it:** This is correct because in a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.
- **(C) Water-soluble organic nutrients go into the soil and get precipitated in the process of leaching:** This is also correct.

  By the process of leaching, water- soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

Incorrect Statements:

- **(A) Decomposition is an anaerobic process:** This is incorrect becauseDecomposition is largely an oxygen-requiring process.
- **(D) Humification follows mineralisation:** This is incorrect.The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralisation.
  - Humification is the process of forming humus from organic matter, while mineralisation is the breakdown of organic matter into its inorganic components.
  - Mineralisation typically follows humification in the decomposition process.

Question 28

Match List-I with List-II :

List – I Concepts		List - II Explanation	
A.	Standing state	I.	Available biomass for the

			consumption of heterotrophs
B.	Secondary productivity	II.	Rate of formation of organic matter by consumers
C.	Standing crop	III.	Mass of living matter in a trophic level at a given time
D.	Net primary productivity	IV.	Amount of mineral nutrients in the soil at a given time

Choose the correct answer from the options given below :

Options:

A. (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

B. (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

C. (A) - (IV), (B) - (II), (C) - (III), (D) - (I)

D. (A) - (I), (B) - (IV), (C) - (II), (D) - (III)

Answer: C

Solution:

The correct answer is **(A) - (IV), (B) - (II), (C) - (III), (D) - (I)**

Explanation:

A. Standing state-

- The**amount of nutrients present in the soil**at any given time in known as the standing state.
- The nutrients include carbon, nitrogen, phosphorus, calcium, etc.

B.Secondary productivity-

- It is defined as the rate of formation of new organic matter by consumers.

C. Standing crop-

- Standing crop refers to the**mass of living material at each trophic level**at a particular time.
- It is measured as the biomass or number of organisms in that area.

D. Net Primary Productivity (NPP) -

- It is the amount of biomass available for the consumption of heterotrophs i.e., organic matter in excess of the respiratory utilization by the plants.
- It can be expressed as: NPP = GPP - R, where GPP is Gross primary productivity and R denotes Respiratory losses.

Question 29

Which of the following is not a Sexually Transmitted Disease ?

Which of the following is not a Sexually Transmitted Disease ?

Options:

A. Chlamydiasis

B. Filariasis

C. Genital herpes

D. Trichomoniasi

Answer: B

Solution:

The correct answer is**Filariasis**

Concept:

- Infections or diseases which are transmitted through sexual intercourse are collectively called sexually transmitted infections (STI) or venereal diseases (VD) or reproductive tract infections (RTI).
- Other STIs can be caused by bacteria, parasites, or fungi.
- Gonorrhoea, syphilis, genital herpes, chlamydiasis, genital warts, trichomoniasis, hepatitis-B are examples of sexually transmitted diseases.

Explanation:

- Filariasis, also known as lymphatic filariasis, is a parasitic disease caused by thread-like filarial worms. These worms are transmitted to humans through the bites of infected mosquitoes.The main causative organisms of lymphatic filariasis are *Wuchereria bancrofti.*This is not an STD
- **Chlamydiasis (Chlamydia)**: This is a common STD caused by the bacterium *Chlamydia trachomatis.* It can infect both men and women and is typically spread through vaginal, anal, or oral sex.
- **Genital herpes:**This is caused by the herpes simplex virus (HSV).

    - There are two types of HSV: HSV-1 and HSV-2. HSV-1 is commonly associated with oral herpes, while HSV-2 is typically responsible for genital herpes.
    - The infection is chronic and remains in the body for life, with periodic outbreaks that can be managed with antiviral medications.
- **Trichomoniasis:** This is a parasitic infection caused by *Trichomonas vaginalis*. It is the most common curable STI.

Question 30

Which of the following statements is incorrect with respect to Medical Termination of Pregnancy ?

Which of the following statements is incorrect with respect to Medical Termination of Pregnancy ?

Options:

A. They are considered safe during the first trimester.

B. It is legalised in India from 1971

C. MTPs can be performed even after 24 weeks, but with the opinion of 2 registered medical practitioners on specific grounds.

D. About 20% of the total number of conceived pregancies undergo MTP in a year globally.

Answer: C

Solution:

The correct answer is **MTPs can be performed even after 24 weeks, but with the opinion of 2 registered medical practitioners on specific grounds.**

Explanation:

- **Medical Termination of Pregnancy (MTP)** refers to the **intentional or voluntary termination of pregnancy** before full term.
- MTP is carried out to avoid unwanted pregnancies as in the case of sexual assault, unprotected coitus, or failure of contraceptives.
- MTP is also employed in cases where pregnancy needs to be terminated if it proves to be harmful or fatal to the mother or fetus.

- MTPs are considered to be**relatively safe**during the**first trimester i.e. up to 12 weeks of pregnancy.**Abortions performed in the second trimester (from 13 to 24 weeks) tend to have higher risks and complications compared to those in the first trimester.
- Government of India legalised **MTP in 1971** with some strict conditions to avoid its misuse.
- MTPs need to be carried out under the supervision of trained professionals like doctors.
- MTP is generally carried out by administering medicines when carried out within the 7-9 weeks of pregnancy.
- MTPs are performed in a year all over the world which accounts to**1/5th (20%) of the total number of conceived pregnancies in a year.**

Question 31

Match List-I with List-II :

List – I **Various Assisted Reproductive Technologies**		**List - II** **Process Involved**	
A.	ZIFT	I.	Formation of embryo in vitro by injecting sperm directly into ovum
B.	ICSI	II.	Transferring of embryo with more than 8 blastomeres into the uterus
C.	IUI	III.	Transferring of fertilised egg up to 8 blastomeres into fallopian tube
D.	IUT	IV.	Transfer of semen from a healthy donor into the uterus artificially

Choose the correct answer from the options given below :

Match List-I with List-II :

List – I **Various Assisted Reproductive Technologies**		**List - II** **Process Involved**	
A.	ZIFT	I.	Formation of embryo in vitro by injecting sperm directly into ovum

B.	ICSI	II.	Transferring of embryo with more than 8 blastomeres into the uterus
C.	IUI	III.	Transferring of fertilised egg up to 8 blastomeres into fallopian tube
D.	IUT	IV.	Transfer of semen from a healthy donor into the uterus artificially

Choose the correct answer from the options given below :

Options:

A. (A) - (III), (B) - (I), (C) - (II), (D) - (IV)

B. (A) - (III), (B) - (I), (C) - (IV), (D) - (II)

C. (A) - (II), (B) - (III), (C) - (IV), (D) - (I)

D. (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

Answer: B

Solution:

The correct answer is**(A) - (III), (B) - (I), (C) - (IV), (D) - (II)**

Explanation:

- **ZIFT (Zygote intra fallopian transfer): The zygote or early embryos (with upto 8 blastomeres) could then be tra**nsferred into the fallopian tube.
- **Intra cytoplasmic sperm injection (ICSI)** is another specialised procedure to form an embryo in the laboratory in which a sperm is directly injected into the ovum.
- **IUI (Intra-uterine insemination):**In this technique,the semen collected either from the husband or a healthy donor is artificiallyintroduced either into the vagina or into the uterusof the female.
- **IUT (Intra uterine transfer):** Embryos with more than 8 blastomeres, into the uterusto complete its further development.

Question 32

Which of the following methods of contraception is not meant for females ?

Which of the following methods of contraception is not meant for females ?

Options:

A. IUDs

B. Lactational amenorrhea

C. Vasectomy

D. Condoms

Answer: C

Solution:

The correct answer is**Vasectomy**

Explanation:

Vasectomyis the surgical method of contraception performed in males. During this procedure, the**vas deferens**(the tubes that carry sperm from the testicles to the urethra) are cut, tied, or sealed. This prevents sperm from mixing with semen that is ejaculated from the penis, thus preventing pregnancy.

Other Options:

- **IUDs (Intrauterine Devices)**: These are small devices inserted into the uterus to prevent pregnancy. They are a form of long-term contraception for females.
- **Lactational amenorrhea:** This is a natural form of contraception that occurs after childbirth when a woman is exclusively breastfeeding and has not started menstruating again. It is specific to females.
- **Condoms:** Condoms are barrier devices used to prevent sperm from entering the uterus. While male condoms are widely used, there are also female condoms. However, male condoms are more commonly used.
- **Tubectomy** is the surgical method of contraception in females, where the fallopian tubes are cut or sealed to prevent eggs from reaching the uterus.

Question 33

‘Saheli’ – an oral contraceptive pill, also known as the ‘Once a week’ pill, was developed by :

‘Saheli’ – an oral contraceptive pill, also known as the ‘Once a week’ pill, was developed by :

Options:

A. AIIMS

B. NBRI

C. CDRI

D. NBPGR

Answer: C

Solution:

The correct answer is **CDRI**

Explanation:

- The Central Drug Research Institute(CDRI) in Lucknow, India, developed an oral contraceptive pill for females called "Saheli."
- Saheli contains non-steroidal contraceptive agents and is known for being a weekly oral contraceptive pill, unlike daily oral contraceptives.
- It is a once a week pill

Question 34

Which of the following is not a characterstic of a stable biological community ?

Which of the following is not a characterstic of a stable biological community ?

Options:

A. It must be resistant to invasions by alien species.

B. It should not show too much variation in productivity from year to year

C. All the species are equally important in a stable community and absence of any one leads to its unstability.

D. It is resilient to occasional disturbances, whether natural or man-made.

Answer: C

Solution:

The correct answer is**All the species are equally important in a stable community and absence of any one leads to its unstability.**

Concept:

- A stable community should not show too much variation in productivity from year to year; it must be either resistant or resilient to occasional disturbances (natural or man-made), and it must also be resistant to invasions by alien species.

Explanation:

- **It must be resistant to invasions by alien species**: A stable biological community typically resists invasions by alien species, as these invasions can disrupt existing interactions and balance.
- **It should not show too much variation in productivity from year to year:** Stability in a biological community usually implies that productivity remains relatively constant over time, indicating resilience to environmental fluctuations.
- **All the species are equally important in a stable community and absence of any one leads to its instability:** This is incorrect because in a stable community, all species hold equal importance and the absence of any one species makes the community unstable. While certain keystone species may play crucial roles, not all species in a community typically hold equal importance; some species may be more pivotal to maintaining stability than others.
- **It is resilient to occasional disturbances, whether natural or man-made:** Resilience to disturbances is a key feature of a stable biological community, as it allows the community to recover from disruptions and maintain its structure and function.

Question 35

In ‘rivet popper hypothesis’ the ‘rivet’ signifies :

In ‘rivet popper hypothesis’ the ‘rivet’ signifies :

Options:

A. Key species

B. Endemic species

C. Community

D. Species

Answer: D

Solution:

The correct answer is**Species**

Explanation:

- The "rivet popper hypothesis" was proposed by ecologist Paul Ehrlich to explain the importance of species in an ecosystem.
- In this hypothesis, the rivets represent different species within an ecosystem.
- The idea is that just like rivets in an airplane, each species plays a critical role in maintaining the structural integrity and functionality of the ecosystem.
- In an airplane (ecosystem) all parts are joined together using thousands of rivets (species).
- Removing or losing species (rivets) can weaken the ecosystem, and the loss of too many species can lead to its collapse.
- Loss of rivets on the wings (key species that drive major ecosystem functions) is obviously a more serious threat to flight safety than loss of a few rivets on the seats or windows inside the plane.

Question 36

The scientist who proved that species richness directly correlates with the stability of a community, was _____.

The scientist who proved that species richness directly correlates with the stability of a community, was _____.

Options:

A. Paul Ehrlich

B. David Tilman

C. Robert May

D. Edward Wilson

Answer: B

Solution:

The correct answer is **David Tilman**

Explanation:

- **David Tilman:**He studied the role of biodiversity in ecosystem stability.He also showed that in his experiments, increased diversity contributed to higher productivity.Tilman found that plots with more species showed less year-to-year variation in total biomass.
    - A stable community should not show too much variation
      in productivity from year to year; it must be either resistant or resilient to occasional disturbances (natural or man-made), and it must also be resistant to invasions by alien species.
- **Paul Ehrlich:**He proposed the "Rivet Popper Hypothesis," which compares species in an ecosystem to rivets in an airplane. The hypothesis suggests that the removal of one species (rivet) may not cause immediate damage, but the ecosystem (airplane) weakens and risks collapse with the loss of more species.
- **Robert May:**He estimated global species diversity to be around 7 million. His work provided significant insights into the complexity and richness of life on Earth.
- **Edward Wilson:**Biodiversity is the term popularised by the sociobiologist Edward Wilson to describe thecombined diversity at all the levels of biological organization.The most important of them are Genetic diversity, Species diversity and Ecological Diversity.

Question 37

Among the vertebrates, which of the following is the most species-rich group ?

Among the vertebrates, which of the following is the most species-rich group ?

Options:

A. Reptiles

B. Fishes

C. Insects

D. Mammals

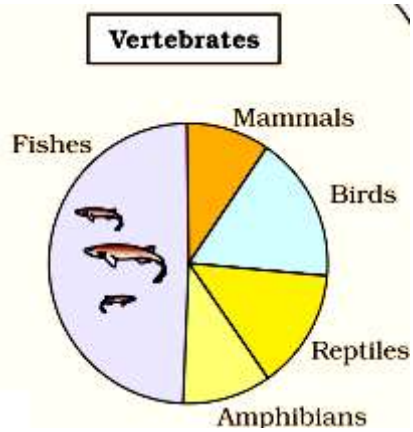
Answer: B

Solution:

The correct answer is**Fishes**

Explanation:

- Fishes are the largest group of vertebrates in terms of species richness. There are more than 33,000 described species of fishes, making them the most diverse group of vertebrates.
- This diversity far exceeds that of the other groups mammals, birds, and reptiles.
- Birds and reptiles also have substantial species diversity, but they do not surpass the species richness found in fishes.



Question 38

The following are the various hypotheses proposed in explaining the greatest biological diversity in tropics except :

The following are the various hypotheses proposed in explaining the greatest biological diversity in tropics except :

Options:

A. Temperate regions are subjected to glaciations, but tropical latitudes have remained relatively undisturbed.

B. Tropical environments have more humidity/moisture which helps the diversity to flourish.

C. Tropical environments are less seasonal and more constant.

D. There is more solar energy available in the tropics which contributes to higher productivity and hence, biodiversity.

Answer: B

Solution:

The correct answer is**Tropical environments have more humidity/moisture which helps the diversity to flourish.**

Explanation:

Biologists have proposed various hypotheses; some important ones are

1. Speciation is generally a function of time, unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a longevolutionary time for species diversification,
2. Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity
3. There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity.

Question 39

Cells present in the mature pollen grains are _____

Options:

A. Central cell and generative cell

B. Antipodal cell and vegetative cell

C. Vegetative cell and generative cell

D. Filiform cell and micropylar cell

Answer: C

Solution:

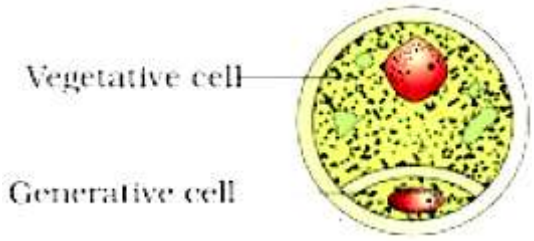
The correct answer is **Vegetative cell and generative cell**

Explanation:

- **Pollen grains**are the male gametophytes of higher plants.
- They develop from microspores that are formed from pollen mother cells by meiosis.
- Thus pollen grains are haploid in nature.
- They are mostly spherical in shape and about 20-25µm in diameter.
- Pollens undergo mitotic divisions to form one vegetative cell and one generative cell.

Pollens are usually shed at this**2-celled stage**.

- **Vegetative cell:**The vegetative cell is bigger, has abundant food reserve and a large irregularly shaped nucleus.
- **Generative cell-**
  - The generative cell divides to form two sperm cells that participate in the fertilization process.
  - It is smaller in size compared to the vegetative cell andfloats in the cytoplasm of the vegetative cell.
  - It is a spindle-shaped cell that undergoes mitosis to form 2 male gametes.



<u>Other Options:</u>

Central cell and generative cell

- The central cell is part of the female gametophyte, not the pollen grain.

Antipodal cell and vegetative cell

- Antipodal cells are part of the female gametophyte in the ovule, not the pollen grain.

Filiform cell and micropylar cell

- Filiform and micropylar cells are terms related to parts of the ovule and embryo sac, not the pollen grain

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Question 40

Match List-I with List-II :

List – I Structures		List - II Functions	
A.	Filiform apparatus	I.	Made up of sporopollenin
B.	Tapetum	II.	Attachment of ovule to the placenta

C.	Exine	III.	Guides pollen tube into the synergid
D.	Funicle	IV.	Nourishes the pollen grain

Choose the correct answer from the options given below :

Options:

A. (A) - (IV), (B) - (I), (C) - (II), (D) - (III)

B. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

C. (A) - (II), (B) - (I), (C) - (III), (D) - (IV)

D. (A) - (I), (B) - (III), (C) - (IV), (D) - (II)

Answer: B

Solution:

The correct answer is**(A) - (III), (B) - (IV), (C) - (I), (D) - (II)**

Explanation:

A. Filiform apparatus - III. Guides pollen tube into the synergid

- The filiform apparatus is a specialized structure located at the micropylar end of the synergid cells in the embryo sac of flowering plants.
- It consists of finger-like projections that assist in directing and guiding the pollen tube towards the synergid cells during fertilization.

B. Tapetum - IV. Nourishes the pollen grain

- The innermost wall layer is the tapetum.
- It nourishes the developing pollen grains.
- Cells of the tapetum possess dense cytoplasm and generally have more than one nucleus.

C. Exine - I. Made up of sporopollenin

- The exine is the outer layer of the pollen grain wall and is primarily composed of a highly resistant substance called sporopollenin.
- Sporopollenin is one of the most chemically stable and durable biological materials, providing protection to the pollen grain from environmental stress, such as ultraviolet radiation, desiccation, and pathogen attacks.

D. Funicle - II. Attachment of ovule to the placenta

- The funicle (or funiculus) is the stalk-like structure that attaches the ovule to the placenta (the tissue within the ovary of the flower).

- It serves as the conduit through which nutrients and signals are transferred between the parent plant and the developing ovule, ensuring proper nourishment and development of the seed.

Question 41

Primary Endosperm Nucleus is the product of :

Options:

A. Double fusion

B. Triple fusion

C. Parthenogenesis

D. Apomixis

Answer: B

Solution:

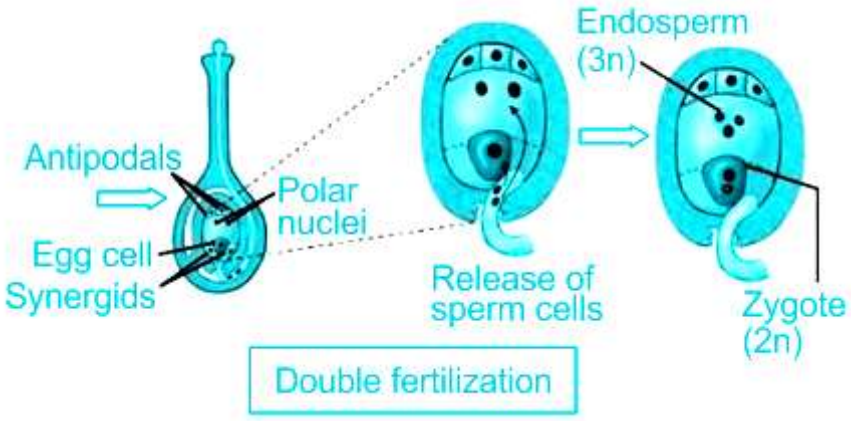
The correct answer is **Triple fusion**

Explanation:

Fertilization Events: Once the pollen tube reaches the embryo sac, it penetrates one of the synergids, which are cells located near the egg cell within the embryo sac.

- **First Fertilization Event (Syngamy):**One of the male gametes fuses with the egg cell (n) to form a diploid zygote (2n). This zygote will eventually develop into the embryo of the seed.
- **Second Fertilization Event (Triple Fusion):**The other male gamete fuses with the central cell, which contains two haploid polar nuclei (each n), resulting in the formation of a triploid (3n) primary endosperm nucleus.
- The central cell with the primary endosperm nucleus will develop into the endosperm, which provides nourishment to the developing embryo.

- This process is known as triple fusion because it involves the fusion of three nuclei.



Other Options:

- **Double fusion:** This term is often used to refer to the fertilization process in flowering plants where one sperm cell fuses with the egg cell to form a zygote, and another sperm cell fuses with the two polar nuclei to form the primary endosperm nucleus.
- **Parthenogenesis:** This is a form of asexual reproduction where an egg develops into an organism without fertilization.
- **Apomixis:** This is a form of asexual reproduction that mimics sexual reproduction but does not involve fertilization. It leads to the formation of seeds without the fusion of gametes.

Question 42

In humans, mammary gland is divided into _____ lobes.

Options:

A. 10 – 12

B. 25 – 30

C. 30 – 35

D. 15 – 20

Answer: D

Solution:

The correct answer is **15 – 20**

Explanation:

- A functional mammary gland is characteristic of all female mammals.

- The**mammary glands**are paired structures (breasts) that containglandular tissue and variable amount of fat.
- The glandular tissue of eachbreast is divided into**15-20 mammary lobes**containing clusters of cellscalled alveoli
- The cells of**alveoli**secrete milk, which is storedin the cavities (lumens) of alveoli.
- The alveoli open into**mammary tubules.**
- The tubules of each lobe join to form a**mammary duct**.
- Several mammaryducts join to form a wider**mammary ampulla**which is connected to**lactiferous duct**through which milk is sucked out.

Question 43

Sex in human embryo is determined by :

Options:

A. ‘X’ chromosome of egg

B. ‘X’ or ‘Y’ chromosome of sperm

C. Only ‘Y’ chromosome of sperm

D. Health of mother

Answer: B

Solution:

The correct answer is **‘X’ or ‘Y’ chromosome of sperm**

Explanation:

- The sex of a human embryo is determined by the combination of sex chromosomes it inherits from its parents.
- Humans have two types of sex chromosomes: X and Y.
- Females have two X chromosomes (XX), while males have one X and one Y chromosome (XY).
- The sperm can contribute either an 'X' or a 'Y' chromosome. If the sperm contributes an 'X' chromosome, the resulting embryo will be female (XX). If the sperm contributes a 'Y' chromosome, the resulting embryo will be male (XY).

Question 44

Arrange the following stages of oogenesis in order of their occurrence.

(A) Ovum

(B) Oogonia

(C) Primary oocyte

(D) Secondary oocyte

Choose the correct answer from the options given below :

Options:

A. (C), (B), (D), (A)

B. (B), (C), (D), (A)

C. (D), (C), (A), (B)

D. (A), (D), (C), (B)

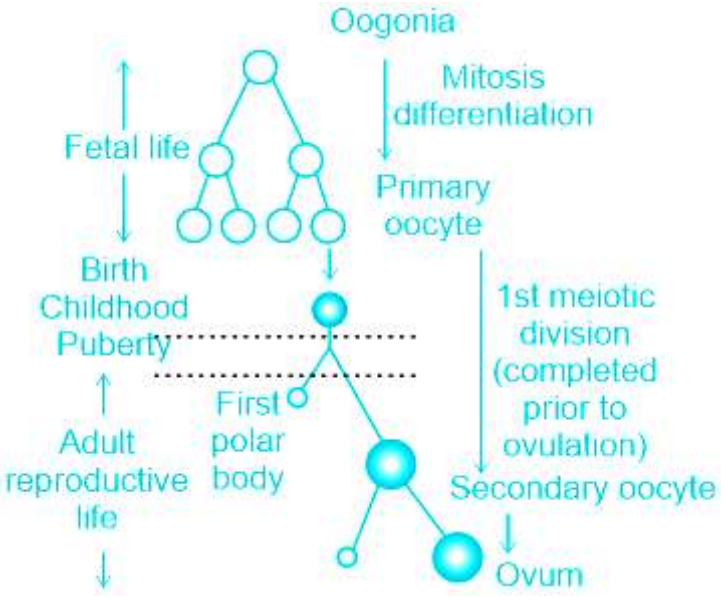
Answer: B

Solution:

The correct answer is **Option 2 (B), (C), (D), (A)**

Explanation:

Oogenesis is the process of formation and development of the ovum (egg cell) in females. This process takes place in the ovaries and involves several stages, starting from the primordial germ cells and ending with a mature ovum.



- **Oogonia (B):** These are the primordial germ cells that divide mitotically to produce more oogonia. This stage occurs during the early fetal development in females.
- **Primary oocyte (C):** Oogonia differentiate into primary oocytes, which enter the first meiotic division but get arrested in prophase I until puberty. Each primary oocyte is surrounded by a layer of granulosa cells, forming a primordial follicle.
- **Secondary oocyte (D):** At puberty, during each menstrual cycle, some primary oocytes complete the first meiotic division to form a secondary oocyte and a small polar body. The secondary oocyte is arrested in metaphase II and is released during ovulation.
- **Ovum (A):** If the secondary oocyte is fertilized by a sperm, it completes the second meiotic division to become a mature ovum. If no fertilization occurs, the secondary oocyte degenerates.

Question 45

Which of the following pair of contrasting traits was not studied by Mendel ?

Options:

A. Pink and white flowers

B. Inflated and constricted pods

C. Axial and terminal flowers

D. Green and yellow pods

Answer: A

Solution:

The correct answer is **Pink and white flowers**

Explanation:

- Gregor Mendel, known as the father of genetics, conducted hybridization experiments on pea plants (*Pisum sativum*) to understand the inheritance of traits.
- Mendel choosepea plants due to their unique characteristics.
- It is bisexual, self-pollinated, easy to grow, has less generation time, and is disease resistant as well.
- Mendel had chosen14 true-breeding pea plant varieties. Mendel selected pairs, which were similar except for one character with contrasting traits.
- These 7 pairs of contrastingcharacters areeasily observable and studied by Mendel.

Pea trait	Dominant rait	Recessive rait
Seeds		
Seed shape	Round	Wrinkled 
Seed colour	Yellow	Green 
Flower colour	Purple 	White 
Flower position	Axial 	Terminal 
Plant height	Tall 	Short 
Pod shape	Inflated 	Constricted 
Pod colour	Green 	Yellow 

Pink and white flowers: Mendel did not study this pair of contrasting traits in his experiments. Mendel's studies focused on traits such as flower color, but the colors he specifically studied were purple and white, not pink and white.

Question 46

Failure of chromatids to segregate during cell division cycle results in :

Options:

A. Polyploidy

B. Euploidy

C. Aneuploidy

D. Autopolyploid

Answer: C

Solution:

The correct answer is **Aneuploidy**

Explanation:

- During cell division, chromosomes must be accurately separated to ensure that each daughter cell receives the correct number of chromosomes. This process is called chromosome segregation.
- Failure of segregation of chromatids during cell division cycle results in the gain or loss of a chromosome(s), called **aneuploidy.**
- Aneuploidy can result in various genetic disorders and is a common feature in many cancers.
- For example, Down's syndrome results in the gain of extra copy of chromosome 21. Similarly, Turner's syndrome results due to loss of an X chromosome in human females.

Other Options:

- **Polyploidy:**Failure of cytokinesis after the telophase stage of cell division results in an increase in a whole set of chromosomes in an organism and, this phenomenon is known as polyploidy. This condition is often seen in **plants.**
- **Euploidy:** This refers to the condition where an organism has one or more complete sets of chromosomes. It indicates a normal, balanced chromosome number and does not involve segregation errors.
- **Autopolyploid:** This condition refers to an organism having more than two sets of chromosomes derived from a single species. It usually involves whole-genome duplication.

Question 47

Select the correctly matched pair about sickle cell anaemia :

Genotype : Phenotype

(A) Hb^A Hb^A : Diseased phenotype

(B) Hb^A Hb^S : Diseased phenotype

(C) Hb^S Hb^S : Diseased phenotype

(D) Hb^S Hb^A : Carrier of disease

Choose the correct answer from the options given below :

Options:

A. (C) and (D) only

B. (A) and (C) only

C. (B), (C) and (D) only

D. (A), (B), and (C) only

Answer: A

Solution:

The correct answer is **(C) and (D) only**

Concept:

- Sickle cell anaemia is a genetic disorder that affects the shape and function of red blood cells.
- It is caused by a mutation in the HBB gene, which provides instructions for making a part of haemoglobin, the protein in red blood cells that carries oxygen.
- The abnormal haemoglobin, known as haemoglobin S, can cause red blood cells to become rigid and shaped like a crescent or sickle.
- The disease is inherited in an autosomal recessive pattern, meaning that a person needs to inherit two copies of the Hb^S gene (one from each parent) to exhibit the disease.
- Individuals with one copy of the normal hemoglobin gene (Hb^A) and one copy of the sickle cell gene (HbS) are carriers of the disease but generally do not show symptoms.

Allele 1	Allele 2	Trait
Hb^A	Hb^A	No sickle cell trait
Hb^A	Hb^S	Sickle cell trait
Hb^S	Hb^S	Sickle cell trait

Explanation:

- **(C) Hb^S Hb^S: Diseased phenotype**: This genotype means the individual has two copies of the sickle cell gene, leading to sickle cell anaemia. These individuals exhibit the diseased phenotype.
- **(D) Hb^S Hb^A: Carrier of disease**: This genotype indicates the individual has one normal hemoglobin gene and one sickle cell gene, making them a carrier. Carriers generally do not exhibit symptoms of the disease.

Question 48

Match List-I with List-II :

List – I Scientists		List - II Discovery	
A.	Sutton and Boveri	I.	X-Body
B.	Sturtevant	II.	Chromosomal Theory of Inheritance
C.	Henking	III.	Transformation in bacteria
D.	Griffith	IV.	Genetic maps

Choose the correct answer from the options given below :

Options:

A. (A) - (II), (B) - (IV), (C) - (I), (D) - (III)

B. (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

C. (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

D. (A) - (IV), (B) - (I), (C) - (III), (D) - (II)

Answer: A

Solution:

The correct answer is **(A) - (II), (B) - (IV), (C) - (I), (D) - (III)**

Explanation:

A. Sutton and Boveri - II. Chromosomal Theory of Inheritance

- Sutton and Boveri independently proposed the Chromosomal Theory of Inheritance, which states that genes are located on chromosomes, and the behavior of chromosomes during meiosis explains Mendel's laws of inheritance.

B. Sturtevant - IV. Genetic maps

- Alfred Sturtevant, a student of Thomas Hunt Morgan, created the first genetic map, demonstrating that genes are arranged linearly on chromosomes and can be mapped based on the frequency of recombination.
- Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and ‘mapped’ their position on the chromosome.

C. Henking - I. X-Body

- Hermann Henking discovered the X-body in the nuclei of male insects, which is now known as the X-chromosome, and he proposed its role in sex determination.

D. Griffith - III. Transformation in bacteria

- Frederick Griffith discovered the phenomenon of transformation in bacteria, showing that a substance from dead bacteria could genetically transform living bacteria, which later led to the identification of DNA as the genetic material.

Question 49

Which of the following statements are incorrect with respect to nucleotides ?

(A) Purines and pyrimidines are nitrogenous bases.

(B) Nucleotides are non-enzymatic molecules.

(C) Phosphate group is linked to – OH of 5°C of a nucleoside through phosphoester linkage.

(D) In RNA, every nucleotide residue has an additional – OH group present at 2'position in the ribose.

(E) Thymine is an example of Pyrimidine.

Choose the correct answer from the options given below :

Options:

A. (B) only

B. (D) and (E) only

C. (B) and (D) only

D. (B) and (E) only

Answer: A

Solution:

The correct answer is **(B) only**

Concept:

- Nucleotides are the building blocks of nucleic acids like DNA and RNA. Each nucleotide consists of a nitrogenous base, a five-carbon sugar, and a phosphate group.
- Nitrogenous bases are classified into two categories: purines (adenine and guanine) and pyrimidines (cytosine, thymine, and uracil).
- In DNA, thymine is present as a pyrimidine, whereas in RNA, uracil replaces thymine.
- Nucleotides are essential for various biological processes and are not merely non-enzymatic molecules; they play a role in enzymatic reactions as well.

Explanation:

(A) Purines and pyrimidines are nitrogenous bases: This statement is correct. Purines include adenine and guanine, while pyrimidines include cytosine, thymine (in DNA), and uracil (in RNA).

(B) Nucleotides are non-enzymatic molecules: This statement is incorrect. Nucleotides can be part of enzymatic reactions and are essential in processes like DNA replication and RNA transcription.

(C) Phosphate group is linked to –OH of 5° C of a nucleoside through phosphoester linkage: This statement is correct. The phosphate group is indeed linked to the 5' carbon of the nucleoside's sugar through a phosphoester bond.

(D) In RNA, every nucleotide residue has an additional –OH group present at 2' position in the ribose: This statement is correct. RNA contains ribose sugar, which has an additional hydroxyl group at the 2' position, unlike deoxyribose in DNA.

(E) Thymine is an example of Pyrimidine: This statement is correct. Thymine is a pyrimidine base found in DNA.

Question 50

Arrange the given steps of DNA fingerprinting in the sequence from initiation to end.

(A) Digestion of DNA by restriction endonuclease

(B) Isolation of DNA

(C) Hybridisationusing labelled VNTR probe

(D) Transferring (blotting) of separated DNA fragments to synthetic membrane

Choose the correct answer from the options given below :

Options:

A. (A), (B), (C), (D)

B. (A), (D), (C), (B)

C. (B), (A), (D), (C)

D. (C), (A), (B), (D)

Answer: C

Solution:

The correct answer is **(B), (A), (D), (C)**

Explanation:

DNA fingerprinting is a technique used to identify individuals based on the unique patterns in their DNA. The technique of DNA Fingerprinting was initially developed by Alec Jeffreys.

He used a satellite DNA as probe that shows very high degree of polymorphism.

This process involves several key steps including isolation, digestion, separation, blotting, and hybridization.

1. Isolation of DNA,
2. Digestion of DNA by restriction endonucleases,
3. Separation of DNA fragments by electrophoresis,
4. Transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon,
5. Hybridisation using labelled VNTR probe,
6. Detection of hybridised DNA fragments by autoradiography.
