CBSE EXAMINATION PAPER-2022

BIOLOGY

(Solved)

Time allowed : 3 hours | Maximum Marks : 65

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **29 questions.** All questions are **compulsory.**

ii. This question paper is divided into **5 sections.**

iii. **Section A** – questions number **1 to 1** are case based questions

iv. **Section B** – questions number **2 to 11** are multiple choice questions

v. **Section C** – questions number **12 to 18** are very short answer

vi. **Section D** – questions number **19 to 25** are short answer

vii. **Section E** – questions number **26 to 29** are long answer

viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

ix. Use of calculator is NOT allowed.

Section A

Question 1.

Section B

Question 2.

The primary source of energy for Earth's climate system is:

[1 Marks]

(A) Nuclear energy

(B) Geothermal energy

(C) Solar energy

(D) Wind energy

Explanation: The correct answer is 'Solar energy' because it is the main energy source that drives the Earth's climate system, influencing weather patterns and supporting life through the process of photosynthesis.

Question 3.

Which of the following statements is true about genes?

[1 Marks]

(A) None of the above.

(B) Genes do not play a role in inheritance.

(C) Genes are segments of DNA that code for proteins.

(D) All genes are expressed at all times.

Explanation: The correct answer is 'Genes are segments of DNA that code for proteins.' This statement is true because genes are defined as specific sequences of DNA that contain the instructions for building proteins, which play crucial roles in the body's structure and function.

Question 4.

The process by which organisms maintain a stable internal environment is called:

[1 Marks]

(A) Respiration

(B) Photosynthesis

(C) Homeostasis

(D) Metabolism

Explanation: The correct answer is 'Homeostasis' because it refers to the mechanisms that organisms use to maintain a stable internal environment despite changes in external conditions. This is crucial for the survival and proper functioning of living organisms.

Question 5.

What is the main function of the ribosome?

[1 Marks]

(A) Cell division

(B) Energy production

(C) DNA replication

(D) Protein synthesis

Explanation: The main function of the ribosome is protein synthesis, which is the process of translating messenger RNA (mRNA) into a polypeptide chain or protein. Ribosomes are the cellular structures where this translation occurs, making them essential for the production of proteins needed for various cellular functions.

Question 6.

Which of the following structures is involved in photosynthesis?

[1 Marks]

(A) Endoplasmic reticulum

(B) Nucleus

(C) Chloroplasts

(D) Mitochondria

Explanation: The correct option is 'Chloroplasts' because chloroplasts contain the green pigment chlorophyll, which is essential for absorbing light energy used in the process of photosynthesis to convert carbon dioxide and water into glucose and oxygen.

Question 7.

Which molecule is known as the energy currency of the cell?

[1 Marks]

(A) DNA

(B) RNA

(C) NADPH

(D) ATP

Explanation: The correct answer is ATP (Adenosine Triphosphate). ATP is known as the energy currency of the cell because it stores and provides energy for many cellular processes, such as muscle contraction and biochemical reactions.

Question 8.

Which of the following is the start codon for protein synthesis?

[1 Marks]

(A) UAA

(B) UAG

(C) UGA

(D) AUG

Explanation: The correct answer is AUG, which serves as the start codon for protein synthesis. It not only codes for the amino acid Methionine but also marks the initiation point for translation in mRNA. The other options (UGA, UAG, UAA) are stop codons that signal the end of protein synthesis.

Question 9.

In the Meselson and Stahl experiment, the DNA extracted after one generation of replication in ^{15}N medium showed:

[1 Marks]

(A) One heavy band

(B) Two distinct bands

(C) One light band

(D) One intermediate band

Explanation: Lenders often require collateral to mitigate the risk of loan default. When borrowers provide collateral, it serves as security for the loan, ensuring that lenders can recover some value in case the borrower fails to repay. This reduces the overall risk associated with lending.

Question 10.

Bt-cotton is resistant to:

[1 Marks]

(A) Aphids

(B) Bollworms

(C) Bacterial blight

(D) Fungal infections

Explanation: Bt-cotton is engineered to produce a toxin from the bacterium Bacillus thuringiensis, which is effective against certain insect pests, specifically bollworms. The context highlights that Bt-cotton is designed to provide resistance to insect pests, which aligns with the option 'Bollworms' as the correct answer.

Question 11.

Which of the following is a vector used to transfer genes into plant cells?

[1 Marks]

(A) Plasmid

(B) Cosmid

(C) Agrobacterium tumefaciens

(D) Bacteriophage

Explanation: The correct answer is 'Agrobacterium tumefaciens' because it is specifically mentioned in the context as a modified vector that can transfer genes into plant cells using its tumor-inducing plasmid (Ti plasmid). The other options do not serve this specific role in gene transfer to plants.

Section C

Question 12.

Mention the parts of human body that get affected by Pneumonia and common cold infections. Write the causative agents of the two diseases.

[2 Marks]

Answer: Pneumonia primarily affects the lungs, leading to inflammation and fluid accumulation in the alveoli, which impairs breathing. The common cold affects the upper respiratory tract, particularly the nose and throat, causing symptoms like nasal congestion and sore throat. The causative agent of pneumonia is often bacteria such as Streptococcus pneumoniae or viruses like influenza. The common cold is mainly caused by rhinoviruses and coronaviruses.

Key Points: Pneumonia affects lungs; common cold affects upper respiratory tract; pneumonia agents: bacteria (Streptococcus pneumoniae), viruses; common cold agents: rhinoviruses, coronaviruses

Question 13.

State the impact of constant mechanical agitation and pumping of air in the aeration tank on the sewage during the biological treatment.

[2 Marks]

Answer: Constant mechanical agitation and pumping of air in the aeration tank enhance the biological treatment of sewage by promoting the growth of aerobic bacteria. These bacteria require oxygen for the breakdown of organic matter in sewage, leading to effective degradation and stabilization of pollutants. The agitation also helps in mixing the sewage, ensuring uniform distribution of oxygen and nutrients, which ultimately accelerates the treatment process and improves the overall efficiency of the treatment.

Key Points: Enhances aerobic bacterial growth-Oxygen requirement for organic matter breakdown-Effective degradation of pollutants-Uniform distribution of oxygen and nutrients-Accelerates treatment process

Question 14.

(a) Give an example of viral biocontrol agent.

(b) Why are they considered to be desirable when an ecologically sensitive area is being treated?

[2 Marks]

Answer: An example of a viral biocontrol agent is the Baculovirus, specifically used to control pest populations like the cotton bollworm. Baculoviruses target and are lethal to specific insect pests, reducing their numbers without harming non-target organisms. They are desirable in ecologically sensitive areas as they minimize environmental impact and chemical residue, enhancing biodiversity by preserving beneficial insects and maintaining ecosystem balance.

Key Points: Baculovirus is a viral biocontrol agent-pest control example-limited to specific insects-environmentally friendly-no chemical residues-preserves biodiversity-enhances ecosystem balance

Question 15.

What is the importance of female *Anopheles* mosquitoes m the life of a malarial Parasite *Plasmodium* ?

[2 Marks]

Answer: Female Anopheles mosquitoes play a crucial role in the life cycle of the malarial parasite Plasmodium. They are the primary vectors responsible for transmitting the parasite from one host to another. When a female mosquito feeds on the blood of an infected host, it ingests the Plasmodium gametes, which then develop into sporozoites within the mosquito. These sporozoites migrate to the salivary glands and are transmitted to another host during a subsequent blood meal, facilitating the spread of malaria.

Key Points: female Anopheles as primary vector - transmission of Plasmodium - ingestion of gametes - development into sporozoites - migration to salivary glands

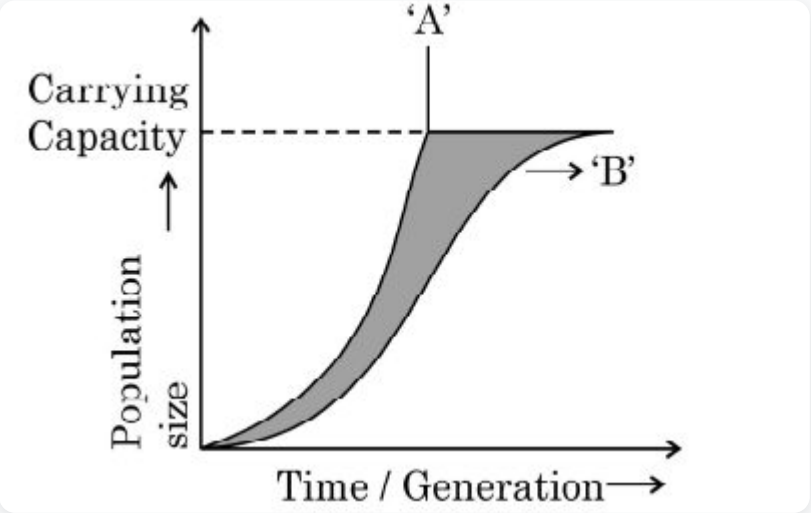
Question 16.

Study the graph given below, showing the population growth curves 'A' and 'B' respectively. Answer the following questions:

(a) What is 'Carrying Capacity' in respect of Curve 'B' indicative of?

(b) Mention the action of possible natural forces that could have lead to curve 'B'.

[2 Marks]



Answer: The 'Carrying Capacity' in respect of Curve 'B' reflects the maximum population size that the environment can sustain indefinitely without degrading the ecosystem. It is indicative of the balance between resources available and the population's needs. Possible natural forces that could have influenced Curve 'B' include climatic changes, availability of food, disease outbreaks, and predator-prey dynamics which could alter the population growth and lead to a decline in numbers as they approach the carrying capacity.

Key Points: Carrying Capacity indicates the maximum sustainable population-resource balance; Natural forces affecting Curve 'B' include climate change, resource availability, and ecological interactions.

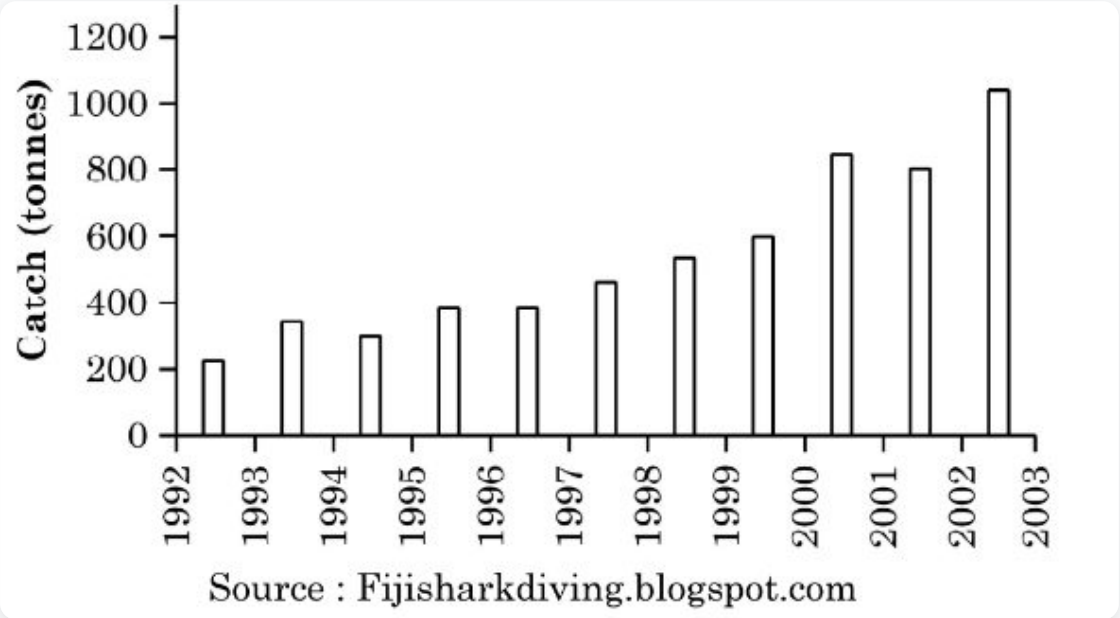
Question 17.

The histogram given below representing the data for annual shark harvest in the great barrier reef / coral reef located on the east coast of Queensland, Australia. Study the histogram and answer the questions that follow.

(a) Write your interpretation of the data given.

(b) Write the impact on the biodiversity of the area that you can interpret on the basis of given data.

[2 Marks]



Answer: The histogram indicates variations in the annual shark harvest from the Great Barrier Reef over a specified period. There appears to be peaks in certain years suggesting increased fishing activity or population changes. A decline in shark numbers, if observed, could indicate overfishing. Such changes in shark populations can have significant repercussions on the reef's ecosystem, as sharks play a critical role in maintaining the balance of marine biodiversity.

Key Points: trends in shark harvest-overfishing impacts-ecosystem balance

Question 18.

(i) cattle excreta is important source for producing a domestic fuel . Name the fuel and write its main components.

(ii) Write the biological process that responsible for the production of this fuel.

[2 Marks]

Answer: The fuel produced from cattle excreta is biogas, which is primarily composed of methane, carbon dioxide, and trace amounts of other gases. This biogas is generated through a biological process known as anaerobic digestion, where specific microorganisms decompose organic matter, such as cattle dung, in the absence of oxygen, releasing gases as by-products.

> **Key Points: biogas-methane-carbon dioxide-anaerobic digestion-microbial activity-decomposition-cattle dung**

Section D

Question 19.

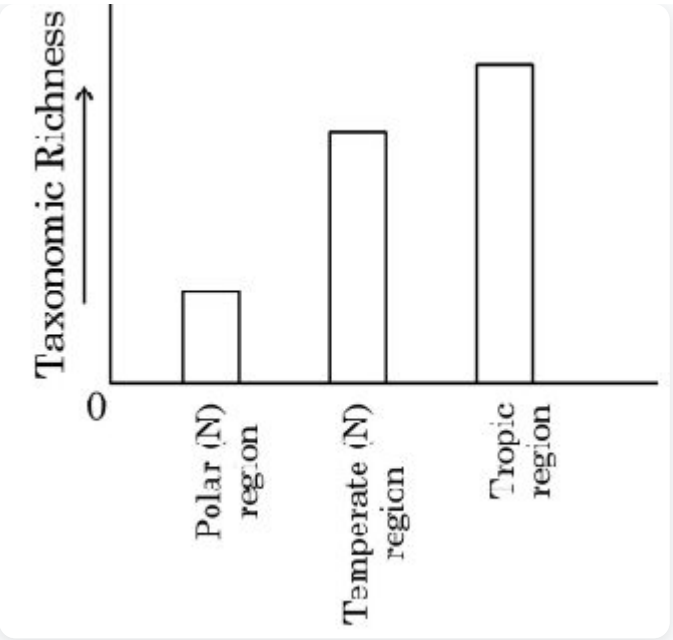
The data collected based on the survey conducted for species richness of group of mammals, in three different climatic regions of the world is shown in the bar graph given below.

Panama has nearly 560 species of mammals, Canada has nearly 301 species of mammals and Denmark has 67 species of mammals.

(i) Based on the species, richness, identify the location of these countries in the respective climatic regions given.

(ii) Plantsand animalsdonothaveauniformdiversityintheworld.Write the term given to this pattern of diversity and why?

[3 Marks]



Answer: Based on the survey, Panama, which has approximately 560 species of mammals, is situated in a tropical rainforest climate, known for its rich biodiversity. Canada, with around 301 species, is characterized by temperate forests and boreal forests, while Denmark, with only 67 species, is in a temperate maritime climate. The lack of uniformity in species diversity is often referred to as 'biogeographical patterns.' This term highlights how biodiversity is influenced by various ecological factors, including climate, habitat, and geography, leading to regions like Panama exhibiting much higher mammal diversity compared to Denmark.

Key Points: Panama's biodiversity is due to its tropical rainforest climate; Canada has temperate forests; Denmark's lower diversity stems from its temperate maritime climate; term 'biogeographical patterns' refers to uneven biodiversity influenced by ecological factors.

Question 20.

5. Bio-diversification of life started to occur almost 3 billion years ago. Since then new species have been evolving and then disappearing en masse from earth.

(a) How many episodes of mass extinctions of species have already taken place and which one is in progress in the current era?

(b) How is current episode in progress different from the previous episodes and why ? Explain.

[3 Marks]

Answer: There have been five major episodes of mass extinction in Earth's history: the Ordovician, Late Devonian, Permian-Triassic, Late Triassic, and Cretaceous-Paleogene extinctions. Currently, we are experiencing the sixth mass extinction, often referred to as the Holocene extinction, primarily driven by human activities such as habitat destruction, pollution, climate change, and over-exploitation of species. Unlike previous mass extinctions, which occurred due to natural events like volcanic

eruptions or asteroid impacts, the current extinction is uniquely anthropogenic, occurring at an accelerated pace due to human influence on the planet's ecosystems.

Key Points: Five major mass extinctions occurred; current one is the Holocene extinction; human activities driving current extinction; previous extinctions were natural; accelerated extinction rate due to human impact

Question 21.

Name two naturally occurring sources, one that transfers pathogenic genes into a plant cells and the other into an animal cell respectively, for their benefit. Write how have these naturally occurring sources been used for the benefit of human race by the biotechnologists.

[3 Marks]

Answer: Two naturally occurring sources of gene transfer are Agrobacterium tumefaciens for plants and retroviruses for animals. Agrobacterium tumefaciens is a bacterium that can transfer its T-DNA into the plant cells, causing the plant to produce unique compounds beneficial for bioremediation or enhanced nutritional value. Retroviruses, on the other hand, can integrate their genetic material into animal cells, allowing for gene therapy applications to correct genetic disorders. In biotechnology, these organisms have been harnessed to improve crop resilience and develop new treatments for previously incurable diseases, enabling significant advancements in agriculture and medicine.

Key Points: Agrobacterium tumefaciens, gene transfer in plants, retroviruses for animals, crop enhancement, gene therapy, biotechnological applications

Question 22.

Enumerate the main sources of bio-fertilisers giving one example of each.

[3 Marks]

Answer: Bio-fertilisers are natural substances that enhance soil fertility by promoting the growth of beneficial microorganisms. The main sources of bio-fertilisers include nitrogen-fixing bacteria, mycorrhizal fungi, and organic matter. 1. Nitrogen-fixing bacteria: An example is Rhizobium, which forms symbiotic relationships with leguminous plants, converting atmospheric nitrogen into a usable form for plants. 2. Mycorrhizal fungi: An example is Glomus species, which enhance nutrient uptake, especially phosphorus, by expanding the root surface area. 3. Organic matter: Compost is a key example, improving soil structure and providing essential nutrients. These sources significantly contribute to sustainable agriculture by reducing the need for chemical fertilisers.

Key Points: 1. Definition of bio-fertilisers 2. Sources: nitrogen-fixing bacteria, mycorrhizal fungi, organic matter 3. Example: Rhizobium, Glomus species, Compost 4.

Role in enhancing soil fertility and sustainable agriculture

Question 23.

Explain giving reason the action plan followed by organic farmers that support their key belief "biodiversity furthers health of crop lands".

[3 Marks]

Answer: Organic farmers adopt a holistic approach towards agriculture that emphasizes biodiversity to enhance the health and resilience of crop lands. Their action plan involves crop rotation, intercropping, and the use of cover crops. Crop rotation ensures different nutrients are utilized and replenished, reducing pest and disease cycles. Intercropping, where multiple crops are grown together, improves pollination and reduces the need for chemical inputs. Cover crops prevent soil erosion and promote soil health by adding organic matter. By maintaining diverse ecosystems, organic farmers can foster natural pest control, enhance soil fertility, and promote crop resilience against environmental stress. Ultimately, these practices lead to healthier crops and ecosystems, aligning with the belief that biodiversity is crucial for sustainable farming.

Key Points: Crop rotation improves nutrient management and reduces pests- Intercropping enhances pollination and decreases chemical reliance- Cover crops prevent soil erosion and add organic matter- Diverse ecosystems support natural pest control- Practices lead to healthier crops and sustainable agriculture

Question 24.

(i) State the role of a selectable marker in r-DNA technology.

(ii) Name one such selectable marker which is considered to be useful for E.coli.

(iii)Give one reason why is it considered to be a useful marker.

[3 Marks]

Answer: Selectable markers are essential in recombinant DNA (r-DNA) technology as they help scientists identify and isolate cells that have successfully taken up the recombinant DNA. By providing a means to discriminate between transformed and non-transformed cells, these markers facilitate the selection process. One commonly used selectable marker in E.coli is the antibiotic resistance gene, such as the ampicillin resistance (bla) gene. This marker is useful because it allows for the growth of only those bacteria that possess the plasmid containing the gene, ensuring that the desired recombinant bacteria are maintained while inhibiting those without the plasmid.

Key Points: role of selectable marker in r-DNA technology; help in identifying transformed cells; enable selection of recombinant bacteria; E.coli selectable marker;

ampicillin resistance gene; allows only transformed cells to grow;

Question 25.

What are plasminds ? How they different from cloning vectors ? give one example each for a viral and bacterial cloning vector ?

[3 Marks]

Answer: Plasmids are small, circular pieces of DNA that can replicate independently within bacterial cells, separate from chromosomal DNA. They serve as important vectors in genetic engineering, allowing for the insertion of foreign DNA to study gene function, express proteins, or confer new traits, such as antibiotic resistance. Cloning vectors, on the other hand, include plasmids but are specifically designed to facilitate the cloning process, featuring selectable markers and multiple cloning sites. An example of a viral cloning vector is the bacteriophage, while a common bacterial cloning vector is pUC19, a plasmid with features that ease the cloning process.

Key Points: Definition of plasmids-Difference between plasmids and cloning vectors-Example of a viral cloning vector (bacteriophage)-Example of a bacterial cloning vector (pUC19)

Section E

Question 26.

Explain the process of DNA replication in eukaryotes. Why is it called semiconservative?

[5 Marks]

Answer: DNA replication in eukaryotes occurs in several well-coordinated steps and is termed semiconservative due to the way it produces new DNA strands. Initially, the double helix unwinds and the hydrogen bonds between complementary base pairs break, leading to the separation of the two parental strands. Each strand then serves as a template for the synthesis of a new complementary strand. This replication is facilitated by enzymes, primarily DNA-dependent DNA polymerase, which catalyze the polymerization of deoxynucleotides, matching them based on base-pairing rules (A with T, C with G). When replication is complete, each new DNA molecule consists of one original (parental) strand and one newly synthesized strand. This property is termed semiconservative because half of the parental molecule is conserved in each of the daughter DNA molecules formed, ensuring genetic continuity. This concept was first established through experiments in Escherichia coli and has since been confirmed in more complex organisms, including plants and animals. The semiconservative nature of DNA replication is crucial for accurate replication and preservation of genetic information across generations.

Key Points: Involves unwinding of the double helix - Enzymes catalyze strand synthesis - Parental and new strands combine in daughter DNA - Critical for genetic fidelity - Proven through experiments in E. coli and eukaryotes

Question 27.

Describe the structure of a human male reproductive system.

[5 Marks]

Answer: The human male reproductive system is located primarily in the pelvic region and consists of several key components: a pair of testes, accessory ducts, glands, and the external genitalia. The testes, which produce sperm and hormones, are housed in the scrotum, ensuring they are kept at a temperature ideal for sperm production. Each testis contains approximately 250 compartments known as testicular lobules, housing one to three coiled seminiferous tubules where spermatogenesis occurs. The sperm travels through the epididymis, ductus deferens, ejaculatory duct, and urethra as it moves towards the external environment. Accessory glands, including the seminal vesicles and prostate gland, contribute fluids to seminal fluid, nourishing the sperm. This entire system works cohesively to facilitate reproduction.

Key Points: Location in pelvis; testes in scrotum; testicular lobules; seminiferous tubules; epididymis; ductus deferens; accessory glands (seminal vesicles, prostate); urethra functions.

Question 28.

Explain Mendel's laws of inheritance with suitable examples.

[5 Marks]

Answer: Mendel's laws of inheritance are fundamental principles that govern genetic inheritance. The first law, known as the Law of Dominance, states that in a heterozygous organism, one allele can mask the expression of another. For example, in pea plants, the tall trait (T) is dominant over the short trait (t). Thus, a plant with genotype Tt will display the tall phenotype. The second law, the Law of Segregation, postulates that allele pairs separate during gamete formation, ensuring that offspring inherit one allele from each parent. For instance, when a homozygous dominant (TT) is crossed with a homozygous recessive (tt) pea plant, all offspring will be heterozygous (Tt), demonstrating the segregation of alleles. Mendel’s principles laid the groundwork for modern genetics, highlighting how traits are passed from parents to offspring through discrete units of heredity.

Key Points: Law of Dominance - dominant and recessive traits; example of tall and short pea plants - Law of Segregation - allele separation during gamete formation; example of

TT x tt cross resulting in all Tt offspring - Importance of Mendel's work in modern genetics.

Question 29.

Describe the steps involved in recombinant DNA technology.

[5 Marks]

Answer: Recombinant DNA technology is a meticulous process that involves several critical steps. The first step is the isolation of the DNA that contains the gene of interest. This is followed by fragmentation of the DNA using restriction endonucleases, which cut the DNA at specific sequences, allowing for the isolation of the desired DNA fragment. The next step is the ligation of this fragment into a suitable vector, often a plasmid or viral vector, using DNA ligase. Once the recombinant DNA is constructed, it is introduced into a host organism through a process called transformation. After successful incorporation, the host cells are cultured in a suitable growth medium, allowing them to multiply and express the foreign gene. The final steps involve extracting and purifying the desired product, usually a protein encoded by the inserted gene, and preparing it for therapeutic use. This entire process is known as genetic engineering and has revolutionized fields like medicine by enabling the mass production of therapeutics that are safer and more effective than those derived from non-human sources.

Key Points: Isolation of DNA-Fragmentation by restriction endonucleases-Isolation of the DNA fragment-Ligation into a vector-Transformation into host-Culturing host cells-Extraction of the desired product