

Question Paper

Conducted by the Central Board of Secondary Education (CBSE)



Time Allowed: 3 Hours

Maximum Marks: 70

General Instructions

- (i) This Question paper contains 33 questions. All questions are compulsory.
- (ii) Question paper is divided into five sections – Section A, B, C, D and E.
- (iii) Section A : Questions number 1 to 16 are Multiple Choice Type Questions (MCQs). Each question carries 1 mark.
- (iv) Section B : Questions number 17 to 21 are Very Short Answer (VSA) Type Questions. Each question carries 2 marks.
- (v) Section C : Questions number 22 to 28 are Short Answer (SA) Type Questions. Each question carries 3 marks.
- (vi) Section D : Questions number 29 and 30 are Case Study-based Questions, carrying 4 marks each. Each question has sub-parts with internal choice in one sub-part.
- (vii) Section E : Questions number 31 to 33 are Long Answer (LA) Type Questions. Each question carries 5 marks.
- (viii) There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the Sections except Section – A.

Section A

1. The formation of inclusion bodies in microbial cell culture is associated with :

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| (A) Incorrect folding and intracellular accumulation of recombinant proteins. | (B) Incorrect folding and extracellular secretion of recombinant proteins. |
| (C) Enhanced cell growth. | (D) Lack of nutrients in the medium |

2. The incubators used to culture mammalian cells are maintained at :

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|---------------------------|----------------------------|
| (A) 30% CO ₂ | (B) 2% CO ₂ |
| (C) 5-10% CO ₂ | (D) 15-20% CO ₂ |

3. The most common molecule used to spot on a DNA microarray is :

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| (A) cDNA | (B) Peptide |
| (C) mRNA | (D) Antibody |

4. Plant organ culture involves the *in vitro* growth of isolated _____.

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|----------------|----------------|
| (A) Protoplast | (B) Plant cell |
| (C) Anther | (D) Callus |

5. For *E. coli*, the dry cell weight of one billion cells is approximately :

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|------------|------------|
| (A) 250 mg | (B) 150 mg |
| (C) 350 mg | (D) 450 mg |

6. The natural defence mechanism of bacteria occurs for :

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| (A) Destruction of bacteria's own DNA during replication. | (B) Facilitating efficient cloning process. |
| (C) Destruction of invading viral DNA | (D) Destruction of invading bacterial DNA |

7. The technique of Nick Translation was developed by :

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|---------------------------------|---------------------------------|
| (A) Rigby and Paul Berg in 1877 | (B) Rigby and Paul Berg in 1977 |
| (C) Linus Pauling in 1985 | (D) Paul Berg in 1973 |

8. Locus link was primarily developed to :

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| (A) Provide three dimensional structures of proteins. | (B) Store taxonomic information of species. |
| (C) Provide information on official gene names. | (D) Provide information on metabolic pathways. |

9. Which of the following is a function of collagen in human body ?

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|--------------------------------------|------------------------------------|
| (A) Providing strength to our bones. | (B) Production of hormones. |
| (C) Transport of oxygen to tissues | (D) Secretion of digestive enzymes |

10. Which of the following statements is correct for use in diagnostics and therapeutics ?

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| (A) Monoclonal antibodies are preferred over polyclonal antibodies. | (B) Antibiotics are preferred over antibodies. |
| (C) Antibodies are not used at all. | (D) Only polyclonal antibodies are used. |

11. Single Nucleotide Polymorphisms can occur :

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| (A) only in the coding regions of a genome. | (B) only in the non-coding regions of a genome. |
| (C) in both coding and non-coding regions of a genome. | (D) in mitochondrial DNA only |

12. SCID (Severe Combined Immuno Deficiency) is caused due to deficiency of which enzyme ?

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|-------------------------|---------------------------|
| (A) Adenosine deaminase | (B) Amylase |
| (C) Lipase | (D) Reverse Transcriptase |

13. Assertion (A): The human embryonic stem cells can be derived from the inner cell mass of blastocyst and cultured in a suitable nutrient medium.

Reason (R): It is possible to selectively remove a gene and make precise genetic modification in mouse embryonic stem cells.

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

14. Assertion (A): Mutation selection technique identifies micro organisms that have been improved by induced mutations.

Reason (R): Mutations cannot be induced by irradiations in micro-organisms.

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

15. Assertion (A): M13 bacteriophage uses rolling circle mechanism for DNA replication.

Reason (R): During rolling circle mechanism, double stranded replicative form of DNA is formed which replicates until there are about its hundred copies in the host bacterial cell.

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

16. Assertion (A): The gene that encodes for Barnase is used to induce male sterility in transgenic plants.

Reason (R): Barnase is a RNA hydrolyzing enzyme that inhibits pollen formation in the tapetal cells of anther.

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

Section B

17(a). On which plasmid are Bacterial Artificial Chromosome (BAC) vectors based ? Enlist the important sequences present in these vectors.

OR

17(b). Given below is a single stranded sequence of DNA : 5' ACTAGAATTCGCCA 3'. Which restriction enzyme would cleave this sequence in double stranded form ? Illustrate the fragments that will be generated upon digestion by this restriction enzyme.

18. Although not required for cell growth, antibiotics are one of the most essential components of animal cell culture medium. Why ? Give examples of two such antibiotics often used in animal cell culture medium.

19. What is meant by 'Gene knock out' ? How is it useful in developing mouse models for studying human diseases ?

19-VI. For visually impaired candidates only, in lieu of Question 19.

Why is an inverted microscope required to observe animal cell cultures ?

20. How is chymotrypsinogen converted to chymotrypsin in the duodenum ? What is the name of this process ?

21. Even if we know where the genes are present in a genome, it is not entirely clear how to count them. Give two reasons for this problem.

Section C

22. Briefly explain the process of sickling of Red Blood Cells (RBCs) during sickle cell anaemia. Why does sickle celled RBCs lead to anaemic conditions in patients ?

23. How does the metagenomics approach helps to identify novel genes present in an environment ? Explain the process.

24. What is the use of introducing the property of delayed fruit ripening in some plants ? Explain the methods used for delaying fruit ripening.

25. Mention the catalytic traid (along with diagram) which contributes to the enzymatic activity of native subtilisin. Why was this enzyme improved by protein engineering ? Write the method used in this process.

25-VI. For visually impaired candidates only, in lieu of Question 25.

Since many centuries, whey has been used for the treatment of numerous ailments. Briefly elaborate upon the scientific relevance of it.

26. Selection methods are based on the expression or non-expression of certain traits in recombinant microbial cells. Enlist such any three traits.

27(a). Explain briefly the procedures of the following techniques used in recombinant DNA Technology : (i) Transfection (ii) Electroporation (iii) Biolistics

OR

27(b). Describe the Blue-White selection method of screening for the presence of recombinant plasmids.

28. How can you differentiate between cancerous and non-cancerous cells in culture by microscopic examination ? Give one example of each of such cell types.

Section D

29. In human beings, Chronic Myelogenous Leukemia (CML) is caused due to the reciprocal translocation between chromosome 9 and chromosome 22. This translocation is detected by Fluorescence in-situ hybridisation (FISH) technique in such patients, and severity of the disease is observed.

29(i). Name the genes which fuse during translocation in Philadelphia chromosome.

29(ii). During FISH technique, is any fluorescence detected in the der 9 chromosome ? Why ?

29(iii)(a). Briefly describe Nick Translation technique.

OR

29(iii)(b). How is CML detected by FISH techniques ?

30. Microbial culture works are classified based on how nutrients are supplied and culture is maintained during the fermentation process as :
(A) Batch Culture : This is a closed system with fixed amount of nutrient medium.
(B) Fed-Batch culture : In this system, fresh nutrients are added during growth, but culture is not removed.
(C) Continuous culture : This is a culture system where fresh medium containing a limited nutrient is added when required and an equal volume of the culture is removed.

30(i). Enlist any two limitations of batch culture.

30(ii). What does the term 'fed' in fed-batch culture refer to ?

30(iii)(a). Write the significance of using a turbidostat and a chemostat in continuous culture system.

OR

30(iii)(b). Draw labelled graphical representations of Batch and continuous culture systems.

Section E

31(a). State the principle of mass spectrometry. Describe the procedure of Matrix Assisted Laser Desorption Ionisation (MALDI), explaining the significance of the matrix in this technique.

OR

31(b). Why do cereals and legumes have limited nutritional quality ? Describe two genetic engineering approaches used to improve protein quality in seeds.

32(a). (i) How are virus-free plants produced from virus-infected plants ? State any two advantages of virus-free plants. (ii) Elaborate on the production of artificial seed and illustrate its structure with a well-labelled diagram.

OR

32(b). Explain the steps involved in the development of Golden Rice through genetic engineering and mention its advantages in providing nutrition. How was Golden Rice further engineered ?

33(a). (i) Describe the steps involved in a Polymerase Chain Reaction (PCR) technique. (ii) If a researcher starts with three double stranded DNA molecules, how many such molecules will be produced after 10 PCR cycles ? Explain briefly.

OR

33(b). What is the full form of RFLP ? State its basic principle and mention any two important applications.

- End of Question Paper -