Sample Question Paper 2023-24
Class XII
Biotechnology (Subject Code-045)

Maximum Marks: 70 **Time: 3 hours**

General Instructions:

(i) The question paper has five Sections. All questions are compulsory.

(ii) Section–A contains 12 Multiple choice questions and 4 Assertion-Reasoning based questions of 1 mark each; Section–B has 5 short answer questions of 2 marks each; Section –C has 7 short answer questions of 3 marks each; Section-D has 2 case based question of 4 marks; Section-E has three long answer questions of 5 marks each.

(iii) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.

Section - A

Q. No.	Question	Marks
1	Type II Restriction Enzymes are employed and not type I and type III, in Recombinant DNA technology because : (a) They recognise a palindromic recognition sequence. (b) They lyse specifically within the restriction site. (c) They cleave 1 bp away from the 5' end. (d) They cleave both the DNA strands simultaneously.	1
2	A bull has trouble walking and getting up, He is nervous and violent. This condition is getting worse with time. The causative agent responsible for these symptoms could be : (a) Bacillus anthracis (b) Virion (c) Mycobacterium bovis (d) Prion	1
3	Turbidity measurement method for ascertaining the number of microbial cells in a liquid culture is not accurate. Choose the correct explanation. (a) It measures both live and dead cells. (b) It measures low amount of cells too. (c) It is difficult and non sensitive technique. (d) It destroys the sample solution.	1

4	To increase the efficiency of picking of insert by a vector, Dr. Kumar decided to make use of _____ in the genetic engineering protocol. Identify the tool. (a) DNA Ligase (b) DNA Phosphatase (c) Alkaline Phosphatase (d) DNA Polymerase	1
5	Example of Single Cell Protein (a) Yeast (b) Bacteria (c) Algae (d) All of these	1
6	The first human cell line established by George Gay in 1950s from cervix cancer is called _____ (a) CHO cell line (b) Cos-1 cell line (c) HeLa cell line (d) Fibroblast cell line	1
7	In 1603, Baricelli reported that a spectrum of diseases like jaundice, skin lesions etc can be treated by administration of : (a) Curd (b) Honey (c) Milk (d) Whey	1
8	An important plant secondary metabolite produced through tissue culture which has found use in antifertility drugs is _____ (a) Berberine (b) Quinine (c) Shikonin (d) Diosgenin	1
9	One of the important purpose of Functional Proteomics is : (a) To obtain 3D structure of all the proteins (b) To identify protein networks in nuclear pore complex (c) To characterise all protein-protein interactions (d) To identify disease specific proteins	1

10	The vector that was used in the first cloning experiment involving mammalian host cells was _____ (a) Adenovirus (b) Papillomavirus (c) Retrovirus (d) SV 40 virus	1
11	Name the autosomal recessive disorder that follows mendelian inheritance and occurs due to deletion of 3 base pairs resulting in loss of codon 508 which codes for phenylalanine. (a) Huntington disease (b) Migraine (c) Cystic fibrosis (d) Alzheimer	1
12	*Leuconostoc mesenteroides* is used for the commercial production of: (a) Dextran (b) Ethanol (c) Penicillin (d) Amylases	1
Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below: (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true and R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.		
13	Assertion - It is very difficult to produce hybrids in inter-generic crosses. Reason - The abnormal development of endosperm leads to death of hybrid embryo.	1
14	Assertion– Humulin acts in 15 minutes whereas classical insulin takes 3 hours. Reason –Hybridoma technology can facilitate the development of faster acting proteins like Humulin.	1
15	Assertion - Animal cells in vitro divide till they fill the surface of the culture vessel and then stop growing. Reason - Animal cells can be grown upto only limited generations.	1
16	Assertion - The number of proteins easily outnumber the number of genes. Reason - It is estimated that proteins can undergo approximately 200 different types of post transcriptional modifications.	1

Section – B		
17	An enzyme **X** is used to remove stains from fabrics. Mala added bleach and a detergent that contained enzyme **X** to wash her white school uniform. However, she did not get the desired result. Identify the enzyme **X** and provide an explanation for the inefficiency of the detergent that contains **X**. Suggest a solution to her problem giving proper explanation.	2
18	List four possible challenges associated with the public acceptance of transgenic crops.	2
19	What are the disadvantages of primary cell culture? Why is trypsin required in the preparation of primary cell culture? **OR** Differentiate between finite and continuous cell lines.	2
20	Compare Fluorescence in situ hybridisation technique with Karyotyping for identification of chromosomal translocations.	2
21	Set up below is an IEF gel for the separation of four proteins A, B, C and D obtained in a cell extract. The pH of the proteins A to D is 5.5, 6, 7 and 8 respectively. Study the set up and answer the questions that follow:  (a) Which proteins A to D can be separated using the above setup? (b) What change in the above set up is required in order to separate all the proteins?	2

Section – C		
22	Selection is an important step in genetic engineering. You are given ampicillin and tetracycline antibiotics. Using these antibiotics, which selection technique could be used to differentiate between recombinant and non-recombinant cells?	3
23	What is *in-situ activation*? How does the charge -relay system operate in the enzyme Chymotrypsin?	3
24	Give reasons for the following (a) Most media that are used for culturing microbes in laboratories are not used for large scale cultivation. (b) Aeration is important for microbial growth. (c) Foaming caused during fermentation process can be harmful to the process. **OR** An extract of common Jasmine (*Jasminum officinale*) has potential activity and it has shown positive results in clinical trials against human bacterial pathogens. However, the active compound is present in very low concentration. Suggest any two ways to increase its production. Also suggest a strategy to ensure that the production of recombinant protein does not occur until required	3
25	Protoplasts from two different sources are isolated and allowed to randomly fuse with each other. Name this process and indicate how this fusion can be done. Give its agricultural importance.	3
26	What are the genetic engineering strategies used to create transgenic crops with the following traits- (a) Herbicide tolerance (b) Insect resistance (c) Virus resistance	3
27	Embryonic stem cells could potentially be used to treat a variety of diseases associated with cell and tissue damage. Defend this statement by giving three examples of ES therapeutics.	3
28	State one therapeutic application each of r-HuEPO , t-PA and OKT-3 , which is due to the following properties of these proteins. (a) r-HuEPO stimulates RBC production without the risk involved in blood transfusion (b) t-PA catalyzes the conversion of plasminogen to plasmin responsible for dissolving blood clots. (c) OKT3 binds and blocks the function of CD3 in T cells	3

Section – D

Q. No. 29 and 30 are case based questions. Each question has subparts with internal choice in one subpart.

29 (4)

Polymerase Chain Reaction is an important tool to amplify rapidly a small sample of DNA to generate millions of copies because significant amounts are necessary for molecular and genetic analysis. Once amplified, the DNA produced by PCR can be used in many different laboratory procedures. A scientist deposited hundred double stranded molecules with the following sequence for multiplication by PCR to Pennysylvania Molecular Biology Lab. The sequence consist of coding region from nucleotide position 11 to 40.

5'CAGTTCATGTCAAATTGCGAGTCTCGCAAAGGCTGGACTTAATCGA3'

(i) How many molecules of DNA will be generated after four cycles of PCR?

(ii) Which strand will act as template in this reaction?

(iii) Design two primers that are five nucleotides long to specifically allow amplification of the coding area from the given sequence.

OR

(iii) Explain how PCR can help with solving disputed paternity claims.

30 (4)

Production of recombinant proteins involves culturing microbial cells in fermenter. The whole cells and cellular debris are removed. The resulting fermentation broth will contain the extracellular proteins. Consider the case study involving the downstream processing of the antibiotic streptomycin from large scale fermentation. A table featuring the purification steps that were used is as follows :

Sl. No.	Purification Steps	Total Proteins (mg)
1.	Crude Extract	50,000
2.	Ion Exchange Chromatography	27,000
3.	Solvent Extraction	6,000
4.	Salt Precipitation	565

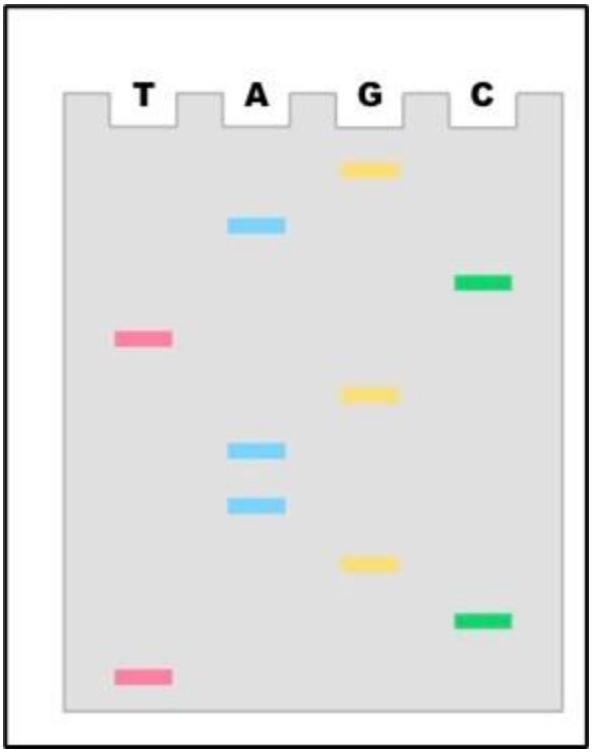
(i) Name two metabolite specific methods that have been employed in the given protocol.

(ii) Apart from sedimentation, which other techniques can be used to separate microbial cells from fermentation broth?

(iii) Why is it preferable to perform the purification of a metabolite in lesser number of steps?

OR

(iii) State two ways which can help in detection and confirmation of a microbial strain.

Section – E		
31	Few restriction enzymes break the phosphodiester bond in such a manner that single stranded overhang ends are generated in the DNA strand. EcoRI is one such a restriction enzyme. (a) Write the sequence for restriction site for enzyme EcoRI. Give a name to the type of ends generated here. Are all the restriction sequences palindromic in nature? (b) Explain about any two vectorless methods that allow DNA to enter host cells. (c) Why is small size desirable in a cloning vehicles? **OR** Given below is the diagram of Sanger's method of DNA sequencing. Based on this answer the following questions. (a) Read and write the original DNA sequence from the autoradiogram below.  (b) Define the principle and steps of this technique.	5
32	How was it be proved that sickle cell anaemia results from an amino acid substitution in Hemoglobin? Elaborate it. **OR** (a) Illustrate the important parts of a mass spectrometer with the help of a suitable diagram. (b) Explain how proteins are volatilised as well as analysed by a mass	5

	spectrometer. (c) What is the major attraction for using this technique as a characterization tool for proteins.	
33	An investigator is interested in studying the level of mRNA production from every gene in an eukaryotic organism. Name a technique he would use for completing his research work. Describe this technique with the help of a suitable diagram. **OR** (a) List three database retrieval tools available from the NCBI. Also mention about the possible use of each. (b) Which information can be retrieved from the following databases? (i) EMBL (ii) PDB	5

MARKING SCHEME (2023-24)

Class XII

Biotechnology (Subject Code-045)

Q. No.	Answer	Marks
	Section - A	
1	(b) They lyse specifically within the restriction site.	1
2	(d) Prion	1
3	(a) It measures both live and dead cells.	1
4	(c) Alkaline Phosphatase	1
5	(d) All of these	1
6	(c) HeLa cell line	1
7	(d) Whey	1
8	(d) Diosgenin	1
9	(b) To identify protein networks in nuclear pore complex.	1
10	(d) SV40	1
11	(c) Cystic Fibrosis	1
12	(a) Dextran	1
13	(a) Both Assertion and Reason are true and reason is the correct explanation of the assertion.	1
14	(c) Assertion is true but the reason is false.	1
15	(b) Both the Assertion and reason are true but reason is not the correct explanation of the assertion.	1
16	(c) The assertion is true but the reason is false.	1
	Section – B	
17	**X** is Subtilisin. The native enzyme subtilisin is easily inactivated by bleach (up to 90%). Solution to the problem is to use the detergent that contains Subtilisin that is modified by Site directed mutagenesis which is not affected by bleach. (1/2x4=2)	2
18	Safety for human or animal consumption/ Effect on Biodiversity/Effect on beneficial insects or microbes Gene pollution/Development of superweeds/Change in fundamental vegetable nature of plants/ Antibiotic resistance in humans or animal pathogens/Changes in evolutionary pattern. (Any 4 for ½ mark each)	2

19	Preparation is time consuming/Requires use of live animal or fresh tissue/ Variations in one preparation to another. (Any two for ½ mark each) Trypsin is used to dissociate the adhered animal cells during sub culturing. (1 mark) **OR** (Any two points of difference with 1 mark each)	2

Finite Cell Lines	Continuous Cell Lines
grow upto a limited number of generations	Grow continuously
Finite cell lines show contact inhibition, density limitation and anchorage dependence	No contact inhibition and anchorage dependence. Density limitation lost or reduced.
/ Finite cell lines show slow growth rate or doubling time as 24-96 hours	continuous cell lines show rapid growth with doubling time as 12 to 24 hours.

20	FISH	Karyotyping	2
	Interphase chromosomes can be used	Metaphase chromosomes are needed	(1 Mark)
	Easy Technique as it gives colour to the chromosome	No such specific colour	(1 Mark)

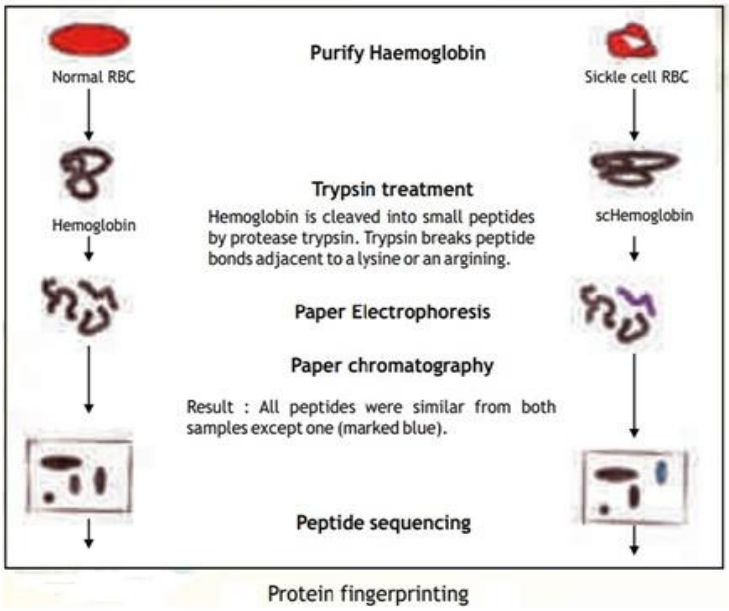
21	(a) Protein samples A and B will get separated using this set up. (1 Mark) (b) Using ampholytes with broader range covering pH value range from 3 to 11 will be able to isolate all the four proteins. (1Mark)	2

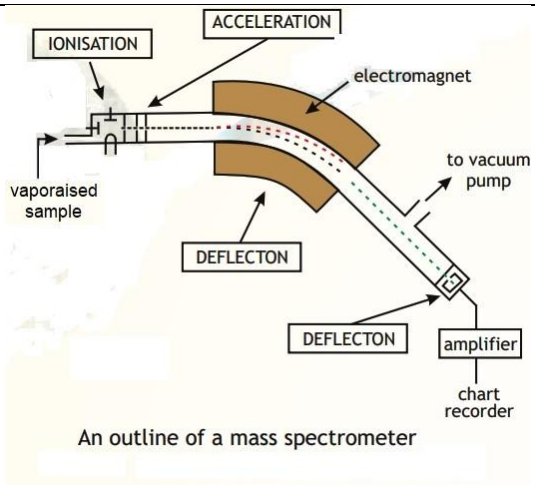
Section – C

22	Replica plating. Plasmid pBR322 carrying the insert in tet^r gene in Multiple Cloning Sites (MCS) is used to transform the host cells which are first plated on solid media containing ampicillin. Overnight colonies from every single cell plated will develop which all have the plasmid. Replica plating is next performed to select colonies from this plate which are tetracycline sensitive due to insertional inactivation. The non recombinant colonies will grow on media with tetracycline and thus differentiate between recombinant and non recombinant cells.	3
23	In Situ Activation means activation of zymogens at their site of activity in the presence of their biological target by alteration in its shape. (1 Mark) Due to constellation of three amino acids because of unique folding of chymotrypsin, the asp 102 is able to hydrogen bond with the adjacent his 57 by borrowing a hydrogen ion. The his 57 in turn attracts a hydrogen ion from the adjacent ser 195 which allows its negatively charged oxygen anion to be able to make a nucleophilic attack on the peptide bond of the substrate. (2 Marks)	3
24	(a) Lab media contain highly purified and costly chemical constituents which can't be economically used for large scale production. (b) Provides uniform mixing of the medium and avoids development of anaerobic pockets thus ensuring optimum oxygen availability for growth. (c) Foaming denatures the proteins so it is undesirable. (1 x 3 marks)	3

	OR Somaclones through tissue culture, Mutant selection where mutants are produced using a mutagen like UV light, or Genetic Engineering can improve the production of the active compound. (Any 2 for 1 Mark each) The gene can be put under the control of a regulatory switch such that the production of recombinant protein does not occur until required. (1 Mark)	
25	The name of the technique is Protoplast Fusion and chemicals fusion like PEG can be used to fuse protoplasts from two different plants/ Electro-fusion. (1 Mark) Somatic hybrids and Cybrids can be produced using this method. (1 Mark) Example: Intergeneric somatic hybrid between potato and tomato called Pomato/Topato or inter specifc somatic hybrid between two species of Nicotiana (any one, 1Mark)	3
26	(a) Introduction of modified gene that encodes for overproduction herbicide target enzyme into crop plant making it insensitive to herbicide. (b) Introduction of gene that encodes for Bt toxin into the crop plant. (c) Introduction of gene that encodes for viral coat protein into the crop plant. (1 x 3Marks)	3
27	Leukemia, Heart disease/Heart attack, Paralysis/Spinal cord injury, Alzheimer's disease, Parkinson's disease, Huntington's disease, Burns (Any 6 for ½ mark each)	3
28	(a) rHuEPO is used to treat anemia due to kidney failure/cancer treatment/treatment of AIDS/ blood loss during surgery. (Any one for 1 Mark) (b) tPA is used for dissolution of blood clots during a heart attack or stroke. (1 Mark) (c) OKT3 binds to CD3 receptors of T lymphocytes causing immuno-suppression thus preventing rejection of kidney transplant. (1 Mark)	3
Section – D		
29	(i) 16 DNA molecules would be generated after 4 cycles. (1 Mark) (ii) Both the strands will act as the template in this case. (1 Mark) (iii) 5' CTGAA 3' and 5' CAATT 3' (2 Marks) **OR** (iii) PCR can amplify the genome sequence from parents and offspring and DNA fingerprinting can match the pattern obtained. (2 Marks)	4
30	(i) Metabolite specific purification methods used are solvent extraction/ ion exchange chromatography/ salt precipitation. (Any two for ½ Mark each) (ii) Flocculation/ Centrifugation/Ultrafiltration. (Any two for ½ Mark each) (iii) For higher yields/higher stability of proteins/ cost reduction. (Any two for 1 Mark each) **OR** (iii) Using specific Antibodies and probes which enable the detection of the organism capable of producing specific products. (2 Marks)	4

Section-E

31	(a) Restriction site of EcoRI is 5'-GAATTC-3' (1 Mark) The ends generated will be called sticky. (½ Mark) No, all the Restriction sequences may not be palindromic. (½ Mark) (b)Microinjection can inject foreign DNA into plant and animal cells Biolistics makes use of particle gun to bombard gold coated DNA Into cells, (c)Small size of vector facilitates entry of recombinant molecules into the host cells. (1 Mark) (Any two, 1 Mark each) **OR** (a)3' AGCTTCAGTC 3' (1 Mark) (b)Principle – When a ddNTP gets incorporated in the growing chain, the reaction stops due to non availability of 3'hydroxyl group. (1 Mark) Steps- Each test tube out of four carries single stranded DNA templates, dNTPs and DNA polymerase. Small amount of four ddNTPs are added separately into the four test tubes. For example in test tube containing ddATP, all chains will terminate at ddA but at different positions of T present in the template. The prematurely terminated fragments are resolved and read with agarose gel electrophoresis. (3 Marks)	5
32	Steps of Protein Fingerprinting (5 Marks)  Protein fingerprinting **OR** (a) Mass Spectrometer (2 Marks)	5



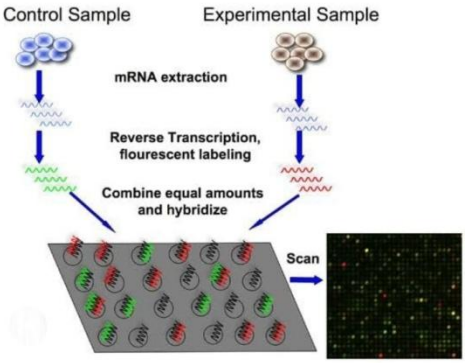
An outline of a mass spectrometer

(b) The protein molecules can be vaporized by using the method called matrix assisted laser desorption ionisation where a pulsed laser beam is directed onto sample suspended in a matrix. (1 Mark)

The protein molecules can be analysed by separating and directing the charged ions by electrostatic lenses from ionisation source to the mass analyses. (1 Mark)

(a) It can provide information about molecular weight of unknown molecules/ structural information/Pico moles of protein samples can be analyzed too. (Any one for 1 Mark)

33 MICROARRAY (1 Mark) 5



(4 Marks)

OR

(a) Database retrieval tools – ENTREZ gives access to literature, sequences and structures. TAXONOMY BROWSER provides information on taxonomic classification of over 79000 organisms. LOCUS LINK carries information on official gene names and other description. (3 Marks)

(b) EMBL–nucleotide sequences (1 Mark)
PDB - 3D structure of proteins (1 Mark)