BSEH MARKING SCHEME

CLASS- XII Biotechnology (March-2024) Code: D

- **The answer points given in the marking scheme are not final. These are suggestive and indicative. If the examinee has given different, but appropriate answers, then he should be given appropriate marks.**

Q. No.	Answers	Marks
1.	b) Southern Hybridisation	1
2.	d) All of the above	1
3.	b) ApoE	1
4.	c) Both of the above	1
5.	c) Haberlandt	1
6.	b) Epitopes	1
7.	Finite	1
8.	polyhydroxybutyrate	1
9.	antifoams	1
10.	A curator is one who reviews and checks newly submitted data ensuring all mandatory information has been provided.	1
11.	Ionic bonds	1
12.	Lambda or λ	1
13.	c) A is true but R is false	1

14.	b) Both A and R are true, and R is not the correct explanation of A.	1
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16.	The dideoxynucleotide chain termination method (1 mark) Chemical degradation method (1 mark)	2
17.	1. Electrophoretic techniques, SDS/PAGE. 2. Fingerprinting. 3. Two-dimensional gel electrophoresis. 4. Protein sequencing. 5. Mass spectrometry. (Any four,1 mark each)	2
18.	In Metagenomic, the large number of microbial genomes is collected from the different environmental niche like water, air soil etc. This is called as metagenomes. (1 mark) The collected DNA is processed for restriction digestion by the enzymes restriction endonucleases and then fragments are cloned. The cloned fragments are screened for presence of variety of molecules. These novel molecules are used for large scale production.	2

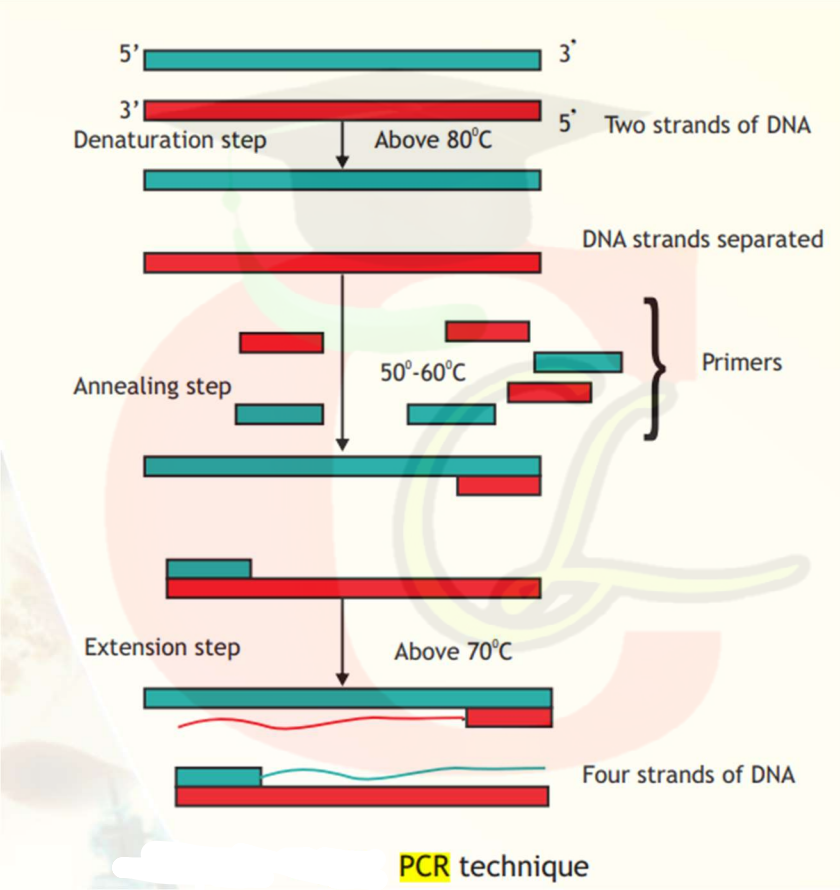
	(1 mark) Or • Presence of strong inducible promoter • It make post translational modifications • Downstream processing is simple as it does not secrete its own protein in fermentation medium (any two, 1 mark each)	
19.	• Their function is to collect and maintain important and useful microbial cultures. • They function to preserve and safeguard microbial diversity. • It acts as a reliable source for culture as they preserve the authenticity of the culture. • The cultures are available for taxonomical studies, industrial research, and academic purpose. • Another main function of culture collection centers is the preparation of informative documents regarding the culture maintained by them. (Any four, ½ mark each)	2
20.	1. They can be grown in glass or plastic vessels in the presence of nutrient media.	2

	2. Cell can be grown till limited generation only in nutrient media. (1 mark each) Or When the cells are cultured from the primary cell, then it is called secondary culture or cell lines. (1 mark) The growth characteristics of cell lines is determined by their doubling time, life span and formation of the layer. (1 mark)	
21.	Gene knock outs are defined as the removal of a gene to create the precise genetic modification of mouse embryonic cells. (½ mark) Genes Knock out are created in animal and they are carried to the next generation by breeding. Embryonic stem cells are used in this technology. Knock out genes make the mouse model of the human diseases by making the genetic modification in the mouse embryonic stem cells. This is helpful for	2

	various genetic diseases and their therapeutic modalities. (1½ mark each)	
22.	Stem cells are the cell which have capability to renew themselves by mitotic division and can be differentiated into diverse cell types. (1 mark) Application of embryonic stem cell technology are widely in medicinal field. 1. Tissue repair 2. Gene therapy 3. Toxicological studies. (Any two, ½ mark each)	3
23.	Single cells can be isolated from either callus or any other part of the plant (e.g. leaf) and cultured in liquid medium. (½ mark) Both mechanical and enzymatic methods can be used for isolation of plant cells. (½ mark) Once the cells have been isolated, they may be cultured by batch cultures or continuous cultures. (½ mark) The cell suspension cultures can be used for: i) induction of somatic embryos/shoots.	3

	ii) in vitro mutagenesis and mutant selection. iii) genetic transformation. iv) production of secondary metabolites. (any three, ½ mark each) Or Plant regeneration can be defined as the regeneration of a whole new plant by cultivating plant cells or explant on an artificial nutrient medium. This regeneration is possible because of the unique totipotency properties of the plant. (1 mark) There are two methods for plant regeneration which are as follow: 1. Organogenesis - It is defined as the techniques where plant organs like shoot, roots, etc. are directly developed from the explant or callus culture. (1 mark) 2. Somatic embryogenesis - It is a technique where totipotent somatic cells embark on the path of embryonic development to give somatic embryos which undergo regeneration to develop into a new plant. (1 mark)	

24.	Batch culture is a closed culture system, which contains an initial limited amount of nutrients. After the medium is inoculated with the bacterial inoculum, the organism will grow and show usual growth phases. (1 mark) Growth results in the consumption of nutrients and excretion of microbial products. (½ mark) At stationary phase, the growth is zero. This means, that in such a culture, growing cells are exposed to continually changing environment due to gradual consumption of nutrients and the accumulation of metabolites. (1 mark) Culturing microbes in the laboratory, in an ordinary flask, is nothing but an example of batch culture. (½ mark)	3
25.	The usual approach taken by standard computer programs like sequence search programs scan the first 20 symbols. (1 mark) If the symbols encountered switch between any of the 4 bases only, then the sequence at hand is taken as a DNA sequence.	3

	(½ mark) Instead of T if U is encountered, then it is a RNA sequence. (½ mark) But if the symbols switch between any of the 20 (greater than 4), then it is taken as protein sequence. (1 mark)	
26.	 PCR technique (proper diagram 1½ marks, ½ mark each for correct labeling of name of step) Or In the technique of site-directed mutagenesis a Biotechnologist is able to create mutation selectively, rather than that which occurs randomly in nature.	3

	The principle involves cloning the target gene into an M13 vector wherein it is presented as a single stranded part of the phage genome. (1 mark) A small oligonucleotide is added containing a complementary sequence to the gene but with one or more altered nucleotides. This allows the oligonucleotide to bind to a complementary portion in the target gene. This then acts like a primer in vitro to synthesise a double stranded replicative form. (1 mark) The duplex DNA molecule is then introduced into bacterial cells by transformation. Subsequent replication inside bacterial cells will produce either wild type or mutant gene containing plasmids. If appropriate expression signals are present altered protein can be expressed and studied. (1 mark)	

27.	Misfolded proteins denature easily and lose their structure and function. Incorrect protein folding can lead to many human diseases. (½ mark)	3

	Alzheimer's disease is an example of a neurodegenerative condition caused by protein misfolding. (½ mark) Protein folding occurs in a cellular compartment called the endoplasmic reticulum. (½ mark) This is a vital cellular process because proteins must be correctly folded into specific, three-dimensional shapes in order to function correctly. (½ mark) Unfolded or misfolded proteins contribute to the pathology of many diseases. (½ mark) Protein misfolding is the primary cause of Alzheimer's disease, Parkinson's disease, Huntington's disease, Creutzfeldt-Jakob disease, cystic fibrosis, Gaucher's disease and many other degenerative and neurodegenerative disorders. (½ mark)	

28.	This technique involves the generation and 2-D analysis of peptides from a protein. (½ mark) Each protein has a unique peptide map (2-D analysis) and hence serves as a fingerprint for the protein. (½ mark) The steps involved in generating a peptide map/fingerprint are as follows: 1. Pure Hb and scHb are taken separately into test tubes. (½ mark) 2. The Hb and scHb are digested with the proteolytic enzyme trypsin which cleaves the protein after basic amino acid residues Arg and Lys. (½ mark) 3. Two separate strips of Whatman filter paper are spotted with Hb and scHb tryptic peptides and the peptides allowed to separate using the technique of paper electrophoresis at pH 2.0. Highly charged peptides will migrate more towards the anode/cathode. (½ mark) 4. The paper strips are dried, attached to larger squares of Whatman paper and chromatographed at right angles to the electrophoretic direction using a solvent system Butanol:Water:Acetic acid. In such a	5

	system peptides will separate based on their partition coefficient between the solvent and paper which is dependant on the relative hydrophobicity of the peptides. More hydrophobic peptides will move with the solvent to longer distances. (1 mark) 5. The chromatograms are dried and stained with a suitable visualisation reagent like Ninhydrin wherein peptide containing regions appear as orange yellow spots. (½ mark) 6. The peptide map for Hb and scHb are compared and it was found that one peptide was differently placed in the scHb map. (½ mark) 7. On examining this peptide and determining its amino acid sequence, Ingram found that it had a valine substitution for glutamic acid in the peptide. (½ mark) Or From the commercial point of view, proteins may be classified into the following categories: 1. Blood products and vaccines. 2. Therapeutic antibodies and enzymes. 3. Therapeutic hormones and growth factors.	

	4. Regulatory factors. 5. Analytical application. 6. Industrial enzymes. 7. Functional non-catalytic proteins. 8. Nutraceutical proteins. (Any four, ½ mark each) **1. Blood products and vaccines:** A better understanding of haematapoiesis (formation of blood cells) as well as factors responsible for blood coagulation has led to the discovery of several useful proteins. Several proteins from blood and plasma have been commercially available for decades. While these products have traditionally been obtained from blood donated by human volunteers, some are now produced by recombinant DNA technology. For example Factor VIII for treatment of Haemophilia A, Factor IX for treatment of Haemophlia B, Hepatitis B vaccine for prevention of hepatitis etc. (1½ marks) 2. **Therapeutic antibodies and enzymes**: Polyclonal antibodies have been used for more than a century for therapeutic purposes. More recently monoclonal antibody preparations as well as antibody fragments produced by recombinant DNA technology have found therapeutic use. For example tissue	

	plasminogen activator (t-PA) is a proteolytic enzyme used to digest blocks in arteries following myocardial infarctions. (1½ marks) Or explanation of any other categories.	
29.	Database retrieval tools include ENTREZ, TAXONOMY BROWSER, and LOCUS Link. (½ mark each) Entrez is an integrated database retrieval system. Through this system one can access literature (in the form of abstracts), sequences and structures. Entrez is an excellent system for obtaining comprehensive information on a given biological question. (1½ marks) Locus link carries information on the official gene names and other descriptive information about genes. Additionally, through Locus link one can access information on homologous genes. For example, it is very convenient to obtain information on the mouse homologue of a given human gene. Homologues from other organisms are also available. (1½ marks) Or explanation of any other categories. Or	5

	Many kinds of analysis can be made using various bioinformatics tools. These include: 1. Processing raw information: The experimentally determined sequence (raw information) is processed using bioinformatics tools into genes, the proteins encoded and their function, the regulatory sequences, and inferring phylogenetic relationships. 2. Genes: Gene prediction can be done by using computer programs like GeneMark for bacterial genomes and GENSCAN for eukaryotes. 3. Proteins: Protein sequences can be inferred from the predicted genes by using simple computer programs. 4. Regulatory sequences: Regulatory sequences can also be identified and analysed by using bioinformatics tools. 5. Inferring phylogenetic relationships: Information regarding the relationships between organisms can be obtained by aligning multiple sequences, calculating evolutionary distance and constructing phylogenetic trees. 6. Making a Discovery: Using the bioinformatics tools and databases, the functions of unknown genes can be predicted.	

	(Any five, 1 mark each)	
30.	1. Micropropagation 2. Virus-free plants 3. Artificial seeds 4. Embryo rescue 5. Haploids and triploids 6. Somatic hybrids and cybrids 7. Production of secondary metabolites 8. Somaclonal variation 9. In vitro plant germplasm conservation 10. Gametoclonal variation (½ mark each) Or • Social implication - There are several issues that are raised against genetic engineering. One major concern is the acceptance of genetic engineering and GMOs. In most country products obtained through the use of GMOs are labeled. (1½ marks) • Economical implication - It is of great concern that the economic benefits from GMOs and genetic engineering will be derived by the giant multinational company only. Mainly GMOs are greatly influenced by commercial interest rather	5

	than the balance between social, environmental, and economic. (1½ marks) • Environmental implication - There is great concern that GMOs developed can turn invasive and thereby causing loss of biodiversity. It can lead to environmental pollution as the use of insecticides and herbicides is increased. It can also lead to the development of resistance in insects and weed due to excessive use of insecticides and herbicides. (2 marks)	