BSEH MARKING SCHEME

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

- **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.	d) None of these	1
2.	a) Brain	1
3.	b) Nucleotide sequence	1
4.	b) *Saccharomyces cerevisiae*	1
5.	d) sugars	1
6.	d) 37 °C	1
7.	epitopes	1
8.	Mau (U.P.)	1
9.	Molecular scissors	1
10.	The branched chain amino acids (BCAA) are essential for the biosynthesis of muscle proteins.	1
11.	Basic Local Alignment Search Tool	1
12.	Product of fusion of enucleated and nucleated protoplasts is known as cytoplasmic hybrids (Cybrids).	1
13.	c) A is true but R is false	1

<table>
<tr><td>14.</td><td>a) Both A and R are true, and R is the correct explanation of A.</td><td>1</td></tr>
<tr><td>15.</td><td>d) A is false but R is true.</td><td>1</td></tr>
<tr><td>16.</td><td>The polymerase chain reaction or PCR is selective artificial amplification of a specific region of a DNA molecule.
(1 mark)
A major application of this technique is pathogen diagnosis/ forensic science.
(Any one,1 mark)</td><td>2</td></tr>
<tr><td>17.</td><td><table><tr><th>Chymotrypsinogen</th><th>Chymotrypsin</th></tr><tr><td>• It is inactive /precursor enzyme.</td><td>• It is active enzyme.</td></tr><tr><td>• It do not proteolyses the proteins and polypeptides.</td><td>• It proteolyses the proteins and polypeptides.</td></tr></table>(1 mark each)</td><td>2</td></tr>
<tr><td>18.</td><td><table><tr><td>Factor</td><td>Chemostat</td><td>turbidostat</td></tr><tr><td>constant factor</td><td>chemical composition of the medium is constant</td><td>turbidity of the medium is constant</td></tr><tr><td>process</td><td>Fresh medium is continuously added</td><td>Fresh medium is added automatically</td></tr><tr><td>dilution rate</td><td>It is constant</td><td>It varies</td></tr><tr><td>limiting nutrient</td><td>required</td><td>not required</td></tr></table>(any two, 1 mark each)
Or</td><td>2</td></tr>
</table>

	Microbial cultures are prepared for production of biomass and metabolites. In this culture, nutrient medium is designed in such way that one of the nutrient is limited. (½ mark) In this method before the nutrient medium is exhausted fresh medium is added. New biomass balances the loss of culture. During the process nutrient is fed at such a rate that the culture should achieve the steady rate. (1 mark) In this state, cell concentration, metabolites and nutrient concentration in the reactor remain same (½ mark)	
19.	By placing foreign gene under regulatory controls (1 mark) recognized by the host microorganism. (1 mark)	2
20.	• Optimal pH and constant temperature is maintained. • Humidity is maintained. • Sterility of chamber is maintained.	2

	(Any two, 1 mark each) Or • It is the source of minerals, amino acids, calcium, chloride, hormones, vitamins, etc. • Various peptide hormone, growth like hormone are derived from the serum. • It regulates the cell permeability. • They also provide binding and transport proteins. (½ mark each)	
21.	Steps involved in production of erythropoietin in animal cell culture are: 1. Isolation of gene from human and Selection of vector system 2. Ligation of vector and target gene to get recombinant product. 3. Selection of host cell in CHO cell line and Hyper secretion of therapeutic proteins by CHO cells 4. Isolation, purification and stable formulation formation (½ mark each)	2
22.	Two important products from Animal Cell Culture Technology are: 1. Vaccine:	3

	(½ mark) Preparation of vaccine is done by introducing dead or attenuated pathogens into an individual. Production of antibody will start as result of the antigen in the body. The introduction of dead or inactivated stage of pathogens into a healthy individual against a particular disease is called immunization or vaccination. (1 mark) 2. Recombinant protein: (½ mark) Specific genes are transferred to host cells leads to the production of the recombinant protein. For e.g. Human growth hormone, erythropoietin, and blood clotting factor VIII. (1 mark) (1 mark each)	
23.	This technique of identifying and locating specific sequences in DNA gels using probes was invented in 1975 by Edward Southern and is named Southern Hybridisation technique in his honor. (½ mark) The principle of the technique is based on the ability of a probe to seek out and bind to its complementary sequence. (½ mark)	3

	The procedure involves isolation and digestion of total genomic DNA with one or more restriction enzymes. The DNA fragments thus generated are separated in agarose gels using the technique of electrophoresis. (½ mark) Following separation of the DNA fragments due to size differences, they are transferred from the gel to a nylon or nitrocellulose membrane in a technique called blotting. (½ mark) The membrane is then treated with the single stranded labelled probe for an appropriate period after which the membrane is washed and either photographed under UV light (if probe label is fluorescent) or overlaid with a photographic film (if probe is radioactive). (½ mark) The location of the probe is determined leading to the identification of a gene or specific DNA fragment obtained from that given genomic DNA. (½ mark) Or Bacteriophages are viruses that infect bacterial cells by injecting their DNA into them and consequently	

	take over the machinery of the bacterial cells to multiply themselves. (½ mark) The injected DNA hence is selectively replicated and expressed in the host bacterial cell resulting in a number of phages which eventually extrude out of the cell (lytic pathway) and infect neighbouring cells. (½ mark) This ability to transfer DNA from the phage genome to specific bacterial hosts during the process of viral infection gave scientists the idea that specifically designed phage-based vectors would be useful tools for gene cloning experiments. (1 mark) Two phages that have been extensively modified for the development of cloning vectors are lambda (λ) and M13 phages. (1 mark)	
24.	MALDI-TOF is matrix assisted laser desorption ionization-time of flight mass spectrometry. (½ mark) In this ionization, method samples are fixed in a crystalline matrix and are bombarded by a laser. The sample molecules vaporize into the vacuum while	3

	being ionized at the same time without fragmenting or decomposing. (1 mark) TOF stands for Time of Flight, a mass spectrometry method that separates ions by their mass to charge ratio and determines that mass to charge ratio by the time it takes for the ions to reach a detector. (1 mark) It is a commonly used technique for the rapid and precise detection of bacteria, mycobacteria, and some fungal pathogens. (½ mark)	
25.	Alanine: A Glycine: G Tryptophan: W Tyrosine: Y Serine: S Methionine: M (½ mark each)	3
26.	Plant growth and productivity are greatly affected by various environmental stresses/ abiotic stresses like high salinity and drought. Plant breeding efforts to produce abiotic stress tolerant plants while retaining high production is not very successful. (½ mark)	3

	Plants have evolved many types of adaptations to cope with abiotic stress conditions like the production of the stress-related osmolytes like sugars (e.g. trihalose and fructans), sugar alcohols (e.g. mannitol) and amino acids (e.g. proline), glycine betaine, and certain proteins (e.g. antifreeze proteins). (1½ mark) Transgenic plants have been developed which over-express the genes for one or more of the above-mentioned compounds. Such plants have shown increased tolerance to environmental stresses. (1 mark) Or • Golden rice is genetically modified rice that is enriched with pro-vitamin A. It is developed by introducing three genes involved in the biosynthesis pathway of carotenoids (pro-vitamin A). • Normal rice has an extremely low level of vitamin A while golden rice is enriched with pro-vitamin A. • Normal rice is white in colour while golden rice is yellow in colour. (1 mark each)	

27.	Given: t = 4 hours = 240 minutes (½ mark) $N_0 = 10^4$ $N_t = 10^7$ As $n = 3.3 \log N_0 - \log N_t$ (½ mark) or $n = 3.3 \times 3 = 10$ (½ mark) now $t_d = t/n$ (½ mark) or $t_d = 240/10$ = 24 minutes (½ mark for unit, ½ mark for correct answer)	3
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:	5

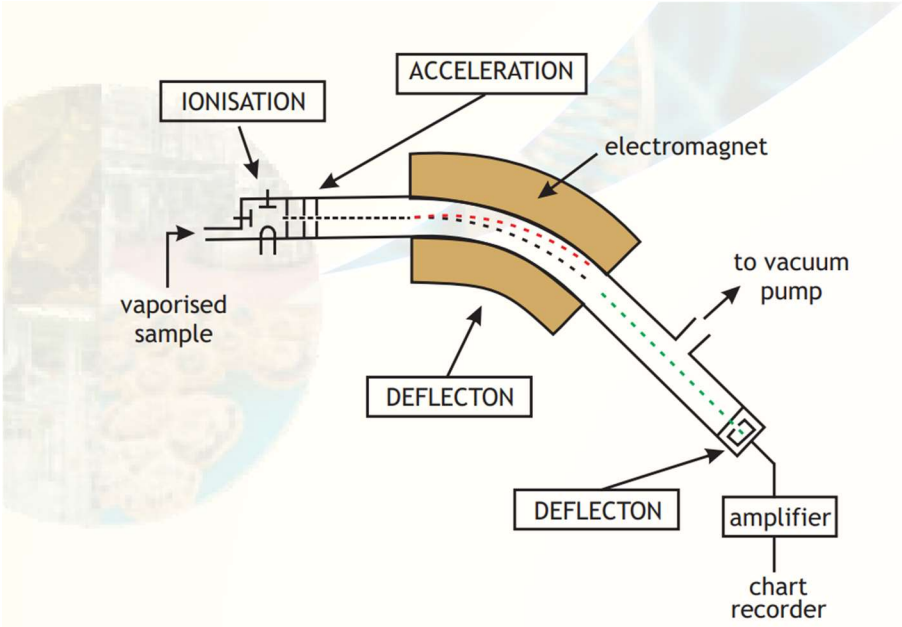
	1. Pure Hb and scHb are taken separately into test tubes. (½ mark) 2. The Hb and scHb are digested with the proteolytic enzyme trypsin which cleaves the protein after basic amino acid residues Arg and Lys. (½ mark) 3. Two separate strips of Whatman filter paper are spotted with Hb and scHb tryptic peptides 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 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 A mass spectrometer is an analytical device that determines the molecular weight of chemical compounds by separating molecular ions according to their mass/charge ratio (m/z) ratios. (½ mark) The molecular ions are generated either by a loss or gain of a charge (e.g. electron ejection, protonation or deprotonation). (½ mark) Proteins/peptides have many suitable sites for protonation as all the backbone amide nitrogen atoms could be protonated theoretically as well as certain	

amino acid side chains such as lysine and arginine which contain primary amine functional groups.

(½ mark)

A schematic diagram of the various parts of a mass spectrometer is indicated in Figure.



(2 marks)

Basically a vapourised sample of a protein or peptide is introduced into the instrument wherein it undergoes ionisation.

(½ mark)

The charged molecules are then electrostatically propelled into a mass analyser (filter) which separates the ions according to their m/z ratio.

(½ mark)

	The signal received upon detection of the ions at the detector is transferred to a computer which stores and processes the information. (½ mark)	
29.	Proteomics refers to the large scale characterization of the entire protein complement of cells, tissues and even whole organisms. (½ mark) Types of Proteomics: Expression proteomics: (½ mark) The quantitative study of protein expression between samples that differ by some variable is known as expression proteomics. Using this approach, protein expression of the entire proteome or of subproteomes between samples can be compared. This could be useful in identification of disease specific proteins. (1 mark) Structural proteomics: (½ mark) Structural proteomics are directed to map out the structure and nature of protein complexes present specifically in a particular cellular organelle. The aim is to identify all proteins present in a complex and to	5

	characterize all protein-protein interactions occurring between these proteins. (1 mark) Functional proteomics: (½ mark) Functional proteomics is a very broad term for many specific, directed proteomics approaches. It can be defined as the use of proteomics methods to analyze the properties of molecular networks involved in a living cell. One of the major objectives is to identify molecules that participate in these networks. (1 mark) Or Microarray Technology: This technology promises to monitor the whole genome on a single chip so that researchers can have a better picture of the interactions among thousands of genes simultaneously. (½ mark) Principle: Microarrays consist of large numbers of DNA molecules spotted in a systematic order on a solid substrate, usually a slide. The base pairing or hybridization is the underlying principle of DNA microarray. Microarray exploit the preferential binding of complementary single-stranded nucleic acids.	

	(1 mark) Microarrays are made from a collection of purified DNA molecules typically using an arraying machine. The choice of DNA to be used in the spots on a microarray determines which genes can be detected in a comparative hybridization assay. (½ mark) This microarray technology promises to monitor the whole genome on a single chip so that researchers can have a better picture of the interactions among thousands of genes simultaneously. In the case of gene chips, the substrate for immobilization is a silicon wafer and the probes are oligonucleotides spotted through photolithographic etching. (1 mark) This technique has been used to study the following: 1. Tissue specific genes 2. Regulatory gene defects in a disease 3. Cellular responses to environment 4. Cell cycle variations. (½ mark each)	
30.	The basic technique of plant tissue culture involves the following steps:	5

	1. Selection of suitable explants like shoot tip, leaf, cotyledon and hypocotyls. (½ mark) 2. Surface sterilization of the explants by disinfectants (e.g. sodium hypochlorite) and then washing the explants with sterile distilled water. (1 mark) 3. Inoculation (transfer) of the explants onto the suitable nutrient medium (shoot regeneration medium, which is sterilized by autoclaving or filter-sterilized to avoid microbial contamination) in culture vessels under sterile conditions (i.e., in laminar flow cabinet). (1 mark) 4. Growing the cultures in the growth chamber or plant tissue culture room having the appropriate physical conditions [i.e., artificial light photoperiod), temperature and relative humidity]. (1 mark) 5. Regeneration of shoots from cultured plant tissues and their elongation. (½ mark) 6. Rooting of regenerated shoots on rooting medium. (½ mark)	

	7. Transfer of plants to the transgenic green-house or field conditions following the acclimatization (tissue hardening) of the regenerated plants. (½ mark) Or The constraints associated with public acceptance of transgenic crops continue to be important challenges facing the global community. The following are the major concerns about GM crops and GM foods: (½ mark) 1. The safety of GM food for human and animal consumption (e.g. GM food may cause allergenicity). 2. The effect of GM crops on biodiversity and environment. 3. The effect of GM crops on non-target and beneficial insects/microbes. 4. Transgenes may escape through pollen to related plant species (gene pollution) and may lead to the development of super weeds. 5. The GM crops may change the fundamental vegetable nature of plants as the genes from animals (e.g. fish or mouse) are being introduced into crop plants.	

	6. The antibiotic resistance marker genes used to produce transgenic crops may horizontally transfer into microbes and thus exacerbate problem of antibiotic resistance in human and animal pathogens (i.e. transgenes may move from plants to gut microflora of humans and animals). 7. The GM crops may lead to the change in the evolutionary pattern. (½ mark each) The thorough assessment of the risks associated with transgenics for plants, animals and humans is important before they are released. (½ mark) Foods or food ingredients derived from GMOs must be shown to be as safe as or safer than their traditional counterpart before they can be recommended for public use. (½ mark)	