BSEH MARKING SCHEME

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

- **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) Tobacco mosaic virus	1
2.	a) Primary	1
3.	c) W	1
4.	d) none of these	1
5.	c) *Alcaligenes eutrophus*	1
6.	c) Lipofection	1
7.	Colony formation	1
8.	The explants can be any part of the plant like the piece of stem, leaf, cotyledon, hypocotyls, etc. used to induce callus or plant regeneration in artificial conditions.	1
9.	Three-dimensional structure of proteins	1
10.	*Aspergillus oryzae*	1
11.	protein efficiency ratio (PER). PER is used as a measure of growth expressed in terms of weight gain of an adult by consuming 1g of food protein.	1

12.	phosphodiester	1
13.	d) A is false but R is true.	1
14.	d) A is false but R is true.	1
15.	a) Both A and R are true, and R is the correct explanation of A.	1
16.	DNA ligase (1 mark) Alkaline phosphatase (1 mark)	2
17.	It is called a molecular disease because of formation of abnormal haemoglobin Hb-s due to defective gene. (1 mark) Haemoglobin electrophoresis using High performance liquid chromatography (HPLC) and Deoxyribonucleic acid (DNA) testing. (1 mark)	2
18.	Lyophilization or freeze-drying involves freezing of a culture followed by drying under vacuum. (1 mark) This results in sublimation of cell water. Lyophilised culture may remain viable for 5-10 years or more. (1 mark) Or The air used in the fermentation process should also be sterilized. This is done by filter sterilization.	2

	(1 mark) The filtration sterilization process uses porous membrane filters. The pores in the membranes prevent any substance larger than the size of the pore from passing through. (1 mark)	
19.	GMP (good microbiological practices) are important during the preparation of microbial culture. It ensures biosafety while handling microbes. (1 mark) GRAS: It is known as generally regarded as safe. This is the category of microbes or substance that are screened by properly trained quality experts. They are safe for use after the approval. (1 mark)	2
20.	**Normal cells** shows the phenomenon of contact inhibition which means when cells grow till the surface they stop growing further. They show adherence to the wall of the vessels. Their rate of growth and proliferation also in control. (Any two, ½ mark each)	2

	Transformed cells does not show the phenomenon of contact inhibition. They are rounded in shape and don't show adherence to the wall of the vessels. The rate of growth and proliferation is high. Hence they can be detected as cancerous cell. (Any two, ½ mark each) Or The importance of pH while culturing animal cells: 1. To maintain ion balance 2. For survival of the cells 3. for optimal functioning of enzymes 4. Binding of hormone, growth factor to the cell surface receptor. (Any three, ½ mark each) The pH in culture media is maintained by using buffering system for e.g. bicarbonate-CO_2 buffering system. (½ mark)	

21.	Primary Cell Culture	Secondary Cell Culture	2

	They are used to develop vaccines.	They are used in manufacturing hormones, antibodies and anticancer agents.	
	They have a high risk of contamination.	No risk of contamination	
	They have a finite life span.	Life span is indefinite due to mutations and viral transformations.	
	(Any two, 1 mark each)		
22.	Embryo rescue refers to the in-vitro technique where an immature or weak embryo is developed into a viable plant. (½ mark) This technique is particularly used to produce many interspecific and intergeneric hybrids (½ mark) where the embryo from the sterile seeds is excised at an appropriate time and (½ mark) cultured on an artificial nutrient medium (½ mark) which acts as the replacement of endosperms. (½ mark)		3

	In this way, embryo rescue can be used to produce novel hybrids. (½ mark) Or biodegradable plastics is PHB (polyhydroxybutyrate). (1 mark) Its benefits are: • PHB is biodegradable hence, it is a safe and environmentally friendly alternative to traditional plastics. • PHB is a renewable source. • It is a natural product and hence it is non-toxic. • It has better physical properties than polypropylene (½ mark each)	
23.	Tissue engineering is the field that is focused on the development of tissue or organ in controlled physiological and biological factors. (1 mark) The aim of tissue engineering is to supply body parts for repair of damaged tissue and organs, without causing an immune response or infection or mutilating other parts of the body. (1 mark)	3

	Tissue engineering potentially offers dramatic improvements in low-cost medical care. (1 mark)	
24.	Microbial growth is defined as an orderly increase in all chemical components in the presence of suitable medium and environment. (½ mark) The parameter that characterises microbial growth is the doubling time. It is the time required for the cell mass or number to double its original value during the balanced growth of the organism. (½ mark) Measurement of cell mass or number is one of the easiest ways to measure microbial growth. It is carried out by measuring the dry weight of the cell material in a fixed volume of the culture by removing the cells from the medium and drying them till constant weight is obtained. (1 mark) Cell growth is also measured by measuring the absorbance of cell suspensions in a spectrophotometer. This principle is based on the fact that small molecules scatter light proportionate to their concentration. (1 mark)	3

25.	A single gene mutation (monogenic disorder) or multiple gene mutations (polygenic disorder) may trigger genetic abnormalities. (½ mark) Mutated genes inherited by one's mother and/or father are believed to be the cause of over 4,000 diseases. (½ mark) Example: Cystic Fibrosis is an autosomal recessive disease which is due to mutation as deletion of 3 bps resulting in the loss of codon no. 508, which codes for phenylalanine. (1 mark) Common late-onset Alzheimer's disease caused by epsilon4 allele of the gene coding for apolipoproteinE (APOE). (1 mark)	3
26.	Plasmids are extrachromosomal, self-replicating, usually circular, double-stranded DNA molecules found naturally in many bacteria and also in some yeasts. (1 mark) Shuttle vectors contain two types of origin of replication and selectable marker genes, one set which functions in the eukaryotic cells (e.g. yeast) and another in E. coli.	3

	(1 mark) An example of a shuttle vector is the yeast plasmid Yep, (½ mark) Yeast cells having this plasmid can grow on a medium lacking leucine and hence can be selected over cells not containing the plasmid. (½ mark) Or 1. **Transformation**: In rDNA technology, the most common method to introduce rDNA into living cells is called transformation. In this procedure, bacterial cells take up DNA from the surrounding environment. 2. **Transfection**: Another method to transfer rDNA into host cells involves mixing the foreign DNA with charged substances like calcium phosphate, cationic liposomes or DEAE dextran and overlaying on recipient host cells. 3. **Electroporation**: An electric current is used to create transient microscopic pores in the recipient host cell membrane allowing rDNA to enter. 4. **Microinjection**: Exogenous DNA can also be introduced directly into animal and plant cells without the use of eukaryotic vectors. In the procedure of microinjection, foreign DNA is directly injected into	

	recipient cells using a fine micro syringe under a phase contrast microscope to aid vision. 5. **Biolistics:** A remarkable method that has been developed to introduce foreign DNA into mainly plant cells is by using a gene or particle gun. Microscopic particles of gold or tungsten are coated with the DNA of interest and bombarded onto cells with a device much like a particle gun. (Any three, 1 mark each)	

27.	**Isoelectric Focusing** or IEF is a method of separating proteins according to their Isoelectric points in a pH gradient. Isoelectric point denoted as pI is defined as the pH at which protein carry no net charge, or pH at which protein become immobile in an electric field. (1 mark) **SDS PAGE** is the technique which uses an anionic detergent namely Sodium Dodecyl Sulfate, which provides the uniform negative charge on protein molecules. The electrophoretic separation to be brought about only on the basis of the molecular weight of the proteins. (1 mark)	3

	2-D electrophoresis better than single dimension electrophoresis because analytes are more effectively separated in 2-D electrophoresis than in 1-D electrophoresis, because it is less likely that two analytes will be the same in two than in one property. (1 mark)	
28.	The cereal grains and seeds of legumes constitute a major chunk of dietary protein requirement. The seed storage proteins are synthesised and accumulated throughout seed development to serve as source of amino acid reserves at the time of seed germination. (1 mark) High levels of such proteins in seeds would provide an enriched amino acid source for human consumption. However, deficiencies in seeds of certain essential amino acids render cereal grains or legumes unsuitable for a balanced diet. (½ mark) Supplementation of diet with essential amino acids from other sources therefore becomes essential. Essential amino acids are those which have to be obtained from food and cannot be made in our cells. (½ mark)	5

	From the data it is apparent that whey protein is superior to other sources especially with regard to branched amino acids- ile, leu, val, lys and trp. The branched chain amino acids (BCAA) are essential for the biosynthesis of muscle proteins. (1 mark) BCAAs reduce muscle breakdown and act as an energy source before and after exercise. Hence while maintaining exercise performance and delaying exhaustion BCAAs are very important for muscle growth. (1 mark) Nowadays an entire new area of sports medicine and nutrition prepare and recommend special nutrient drinks etc. which incorporate these principles. plant cereals have been genetically engineered for higher nutrient value in terms of proteins, vitamins etc. (1 mark) Or Chymotrypsin, a proteolytic enzyme: Chymotrypsin, which hydrolyses peptide bonds following bulky aromatic amino acid residues in polypeptides is actually synthesised in the pancreas and through the pancreatic duct released into the duodenum.	

	(½ mark) This enzyme being a powerful proteolytic enzyme does not end up cutting cellular proteins within the pancreas itself. (½ mark) Nature has ensured that chymotrypsin and other proteolytic enzymes are synthesised as inactive harmless precursors known as zymogens which are then activated when required only in the duodenum, their site of activity, a process called in-situ activation. (½ mark) This activation in molecular terms results in an alteration in its shape so that it may now be able to interact with its substrate. The inactive precursor enzyme is termed chymotrypsinogen and the fully active enzyme is called chymotrypsin. (½ mark) The enzyme chymotrypsin is made up of a linear chain of 245 amino acids interrupted into three peptides A, B, C. (½ mark) The protein folds into a globular structure. In the 3-D structure of the enzyme three important amino acid residues, his57, asp102 and ser195 come close	

	together in space which allows a "charge relay system" to operate. (½ mark) The negatively charged asp102 is able to hydrogen bond with the adjacent his57 partially borrowing the hydrogen ion from the latter. The his57 makes good its partial hydrogen ion loss to aspartate by attracting a hydrogen ion from the adjacent ser195 through the his57 residue much like a relay race where the baton is passed from one member to another, the difference here being that the baton is a charge. (½ mark) Normally the hydroxyl group of a serine residue is not acidic (pKa 12) and this is true for all other serine residues of chymotrypsin; only ser195 becomes acidic due to the unique constellation of the three amino acid residues because the protein has folded uniquely in space. (½ mark) The specific site of chymotrypsin is a large space created within the enzyme active site and lined by hydrophobic residues which therefore only allow bulky aromatic, hydrophobic amino acids to bind. This binding brings the susceptible peptide bond close to the attacking ser195 residue. In chymotrypsinogen,	

	the substrate binding site is blocked and hence the enzyme is inactive. (½ mark) In-situ activation of trypsin involves a proteolytic cut in chymotrypsinogen which results in a conformational change, exposing the substrate binding pocket. (½ mark)	
29.	BLAST (Basic Local Alignment Search Tool) (½ mark) is a similarity search program to analyze sequence information. (½ mark) These tools are designed to answer the question "Which sequences in the database are similar (or homologous) to my sequence?" (1 mark) The principles involved are- (a) A given sequence is compared with sequences in the database using substitution matrices that specify scores to either 'reward' a match or 'penalize' a mismatch. (b) Top scoring matches are ranked according to set criteria that serve to distinguish between a similarity due to ancestral relationship or due to random chance. In most analysis these criteria are not	5

changed. However, if the user wishes, criteria can be changed.

(c) True matches are further examined thoroughly with other details accessible through Entrez and other tools available at NCBI.

(1 mark each)

Or

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 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)	
30.	The basic technique of plant tissue culture involves the following steps: 1. Selection of suitable explants like shoot tip, leaf, cotyledon and hypocotyls. (½ mark)	5

	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

Genetic engineering is defined as the deliberated modification of the genetic makeup of the organism by inserting or removing part of the genetic material thereby changing the phenotype or characteristics of the organism.

(1 mark)

- Isolation of the desired gene or target gene from the donor organism.
- Selection of vector that can carry the desired gene extracted from the donor. The vector is cut open using the same restriction endonuclease enzyme that was used to cut the target gene from the donor genome.
- The gene of interest is ligated to the Vector to give what is known as recombinant DNA or chimeric DNA.
- Then a vector along with target DNA is inserted into the organism. Now this organism that carries endogenous DNA is called a Genetically modified organism.

(1 mark each)