

SAMPLE QUESTION PAPER

BIOTECHNOLOGY (045)

Class XII (2021-22)

Max. Marks 35

Time allowed: 2 hours

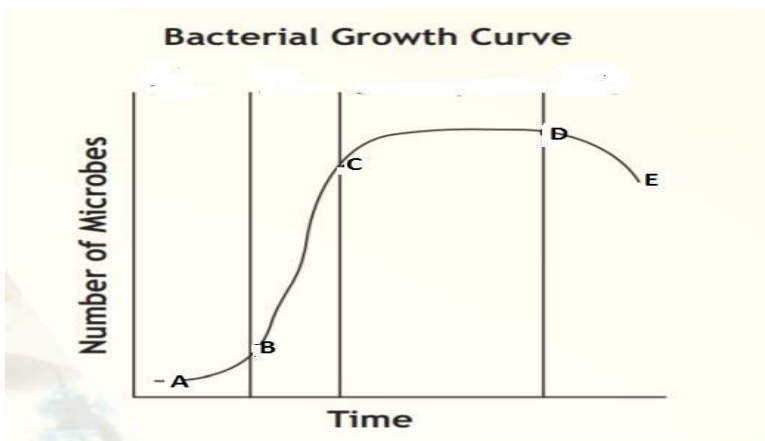
General Instructions:

- i) All questions are compulsory.
- ii) The question paper has three sections. All questions are compulsory.
- iii) Section–A contains 6 questions of 2 marks each; Section–B has 6 questions of 3 marks each; and Section–C has case-based question of 5 marks.
- iv) 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		
1	Why is r-HUEPO preferred over blood transfusion in such cases where a person has excessive blood loss due to accidents? OR Differentiate between primary and secondary animal cell cultures.	2
2	Sterile seeds may be formed during crosses between distantly related plants. What could be the reason for this and how can it be overcome?	2
3	<i>Pichia pastoris</i> has many advantages as a eukaryotic expression host. Justify giving two reasons.	2
4	Name any two databases important in bioinformatics. Mention the type of information which may be obtained from these databases. OR Suggest two possible ways for analyzing a given sequence using bioinformatics.	2
5	State any two applications of <i>protoplast culture</i> in plant biotechnology.	2
6	Patients who are administered OKT3 do not suffer from an acute renal allograft rejection. Why?	2
SECTION B		
7	a. What do you mean by gene knock out? (1) b. Give any two advantages of the preparation of mouse models using gene knockouts useful? (2)	3

8	a. How are artificial seeds produced? (1) b. State two ways in which artificial seeds are different from embryonic seeds. (2)	3
9	Write the steps of BLAST involved in comparison of DNA sequences.	3
10	a. How can microbial cultures be used for the production of different metabolites? (1) b. A recently discovered microbial strain gives us the desired metabolite in nanomolar concentration. Suggest two ways of improving the production of the desired metabolite. (2)	3
11	a. What are edible vaccines? (1) b. How are edible vaccines advantageous over recombinant vaccines produced by bacterial fermentation? (2) OR How can one obtain virus-free sugarcane plants from virus-infected plants? Are these plants virus-resistant? Give reason for your response.	3
12	a. How are the hybridoma cells selected from the culture of B-cells and Myeloma cells while fusing them in hybridoma technology? (1) b. Which monoclonal antibody is used to treat early stages of breast cancer and how does it work? (2)	3

SECTION C

13	<p><u>Microbial growth kinetics</u></p> <p>Cell growth includes increase in its number. A typical bacterial growth curve is shown in the figure below-</p>  <p style="text-align: center;"><i>Diagram 1</i></p> <p>Growth kinetics is an autocatalytic reaction which implies that the rate of growth is directly proportional to the concentration of cell.</p>	5
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As the cell divides, we shall have:

No. of cell division	0	1	2	3	n
No. of cells	1	2	4	8	2^n
Mathematically	N_0	$N_0 \times 2$ $N_0 2^1$	$N_0 \times 2 \times 2$ $N_0 2^2$	$N_0 \times 2 \times 2 \times 2$ $N_0 2^3$	- $N_0 2^n$

TABLE 1

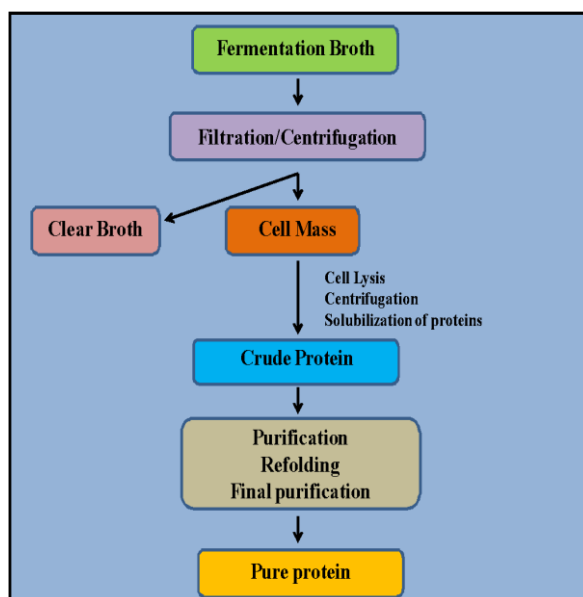
Doubling time which is the time taken by the population to double through one round of cell division is inversely related to specific growth rate.

- In the microbial growth curve depicted above (Diagram 1), in which phase is the microbial cell specific growth rate calculated (from phases AB/BC/CD/DE)? What is this phase called? (2)
- Refer to Table 1 and calculate the generation time and specific growth rate constant of a bacterial population in which the number of bacteria increases from 10^4 cells /ml to 10^7 cells /ml during four hours of exponential growth. (3)

OR

Management of Diabetes

Insulin delivery is still the most effective method of pharmacotherapy in cases of extremely high hyperglycemia. The production process has been divided into several stages as depicted below in the flow chart:



At each stage of insulin production, qualitative and quantitative analyses were performed to confirm identity and purity of the desired protein. (1X5)

	<p>a. In a fermentation medium depicted above, few workers processed clear broth for the production of desired protein, but were unable to get any yield. What could be the possible reason for this?</p> <p>b. How is the outcome of the process affected if the number of processing steps are reduced while obtaining pure protein from the fermentation medium?</p> <p>c. Which type (recombinant insulin or cattle derived insulin) will be produced in the above depicted flow chart?</p> <p>d. Name a metabolite which is produced using clear broth rather than cell mass.</p> <p>e. How is crude protein different from the desired protein?</p>	
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MARKING SCHEME
BIOTECHNOLOGY (045)
TERM 2 (2021-22)

SECTION A														
1	<p>No donor is required for transfusion, no transfusion facilities, no risk of transfusion related infection (any two)</p> <p>OR</p> <p>The maintenance of growth of cells under laboratory conditions in suitable culture medium is known as primary cell culture.</p> <p>The primary cell culture is sub-cultured in fresh growth media to develop secondary cultures.</p>	2												
2	<p>a. Abnormal development of the endosperm causes premature death of the hybrid embryo and leads to sterile seeds.</p> <p>b. The embryo from such sterile hybrid seeds can be excised at an appropriate time and cultured on a suitable nutrient medium to produce novel hybrid.</p>	1 1												
3	<p>a. It has strong inducible promoters.</p> <p>b. It is capable of making post-translational modifications similar to those performed by human cells.</p> <p>c. Downstream processing is simpler as Pichia does not secrete its own proteins into the fermentation medium.</p> <p>(Any two)</p>	2												
4	<table><tr><th>Database</th><th>Information Available</th></tr><tr><td>EMBL(European Molecular Biology Laboratory)</td><td>Nucleotide sequence</td></tr><tr><td>Nucleotide sequence</td><td>Annotated protein sequence</td></tr><tr><td>PDB (Protein Database)</td><td>Three dimensional structure of proteins</td></tr><tr><td>Ribosomal RNAdatabase</td><td>rRNAsubunit sequences</td></tr><tr><td>PALI database</td><td>Phylogenetic analysis and alignment of proteins</td></tr></table> <p>(Any two)</p>	Database	Information Available	EMBL(European Molecular Biology Laboratory)	Nucleotide sequence	Nucleotide sequence	Annotated protein sequence	PDB (Protein Database)	Three dimensional structure of proteins	Ribosomal RNAdatabase	rRNAsubunit sequences	PALI database	Phylogenetic analysis and alignment of proteins	2
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	<p>OR</p> <ol style="list-style-type: none"> 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 Gene Mark 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 Two) 	
5	<ol style="list-style-type: none"> a. Somatic Hybrids b. Cybrids (Cytoplasmic hybrids) c. Genetic transformations d. Metabolic studies 	2
6	<p>T-cells play a major role in rejection of foreign grafts and hence they are responsible for the kidney transplant rejection.</p> <p>OKT3 is a monoclonal antibody that targets CD3 surface markers (antigens) present on mature T- cells and remove them from circulation and hence prevent acute renal allograft rejection.</p>	1 1
SECTION B		
7	<ol style="list-style-type: none"> a. Gene knock out- selectively remove a gene. b. Used to understand genetic basis of diseases, new diagnostic and therapeutic modalities. (Any two) 	1 2
8	<ol style="list-style-type: none"> a. Use of certain hormones can convert somatic cells into state similar to embryos which are encapsulated to produce artificial seeds. b. Artificial seeds are bigger in size/ long term storage/potential for automation. (Any two) 	1 2
9	<ul style="list-style-type: none"> • The given sequence is compared with sequences in the database using substitution matrices that specify scores to either 'reward' a match or 'penalize' a mismatch. • 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. • True matches are further examined thoroughly with other details accessible through Entrez and other tools available at NCBI. 	1 1 1

10	<p>a. Production of food, vaccines/ Production of primary metabolites; acids, alcohol/ Production of secondary metabolites: antibiotics/ Biotransformation reactions: enzymatic, steroids (Any one)</p> <p>b. Strain improvement is done in order to maximize metabolite production by:</p> <ul style="list-style-type: none"> • Mutant selection : There are two methods - Physical method; Chemical Method • Genetic engineering 	<p>1</p> <p>1</p> <p>1</p>
11	<p>a. The genes encoding antigenic proteins can be isolated from pathogens and expressed in plants. Such transgenic plants or their tissues producing antigens can be eaten for vaccination / immunization. These are called edible vaccines.</p> <p>b. Edible vaccines offer following advantages over conventional vaccines.</p> <ul style="list-style-type: none"> • Low cost • Alleviation of storage problems • Easy delivery system by feeding (any other relevant point) <p>(Any Two)</p> <p>OR</p> <p>Micropropagation using meristems.</p> <p>No, these are not virus resistant.</p> <p>Because meristems are virus-free but do not have resistance genes.</p>	3
12	<p>a. Using HAT medium</p> <p>b. Monoclonal antibody which is used to treat early stages of breast cancer is Herceptin (trastuzumab).</p> <p>It works by attaching itself to HER2 receptors by blocking them from receiving the growth signals.</p>	<p>1</p> <p>1</p> <p>1</p>
SECTION C		
13	<p>a. The phase in which microbial cell specific growth rate is calculated is BC. Log phase</p> <p>b. $n = 3.3 (\log 10^7 - \log 10^4)$ $3.3(3) = 10$ $t = 240/10 = 24 \text{ min}$ Specific Growth rate constant = $0.693/1440 = 4.8 \times 10^{-4} /s$</p> <p>OR</p> <p>a. The recombinant insulin is intracellular and to isolate it , we need to rupture the cells as broth will be lacking the recombinant insulin.</p> <p>b. Minimizing steps: Cost effective/ less denaturation of protein /higher yield.</p> <p>c. Recombinant insulin</p> <p>d. Antibiotics(term) /any example of antibiotics</p> <p>e. Crude protein will have number of unwanted proteins which needs to purified.</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>