BIOTECHNOLOGY – Code No. 045
SAMPLE QUESTION PAPER*
Class-XII (2025-26)

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

General Instructions:

(i) *All questions are compulsory.*
(ii) *The question paper has five sections and 33 questions.*
(iii) *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 two case-based question of 4 marks; Section-E has three long answer questions of 5 marks each.*
(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.*
(v) *Wherever necessary, neat and properly labeled diagrams should be drawn.*

	Section - A **Q. No. 1 to 12 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.**	
1	In which phase of growth, specific growth rate of microbial culture is calculated? (a) Lag phase (b) Exponential phase (c) Stationary phase (d) Intense metabolic activity phase	1
2	Name the type of animal cell culture which is prepared by inoculating directly from the parental tissue to nutrient media? (a) Primary cell culture (b) Secondary cell culture (c) Spinner culture (d) Transformed cell culture	1
3	Relationship between the number of genes and proteins is not linear because of- (i) Alternative splicing of genes (ii) Overlapping genes (iii) Post translational modification (iv) Amplified DNA templates (a) (i) (ii) and (iii) only (b) (ii) and (iv) only (c) (i) and (iv) only (d) (ii), (iii) and (iv) only	1

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4	Which of the following statement is incorrect about Agar? (a) It is a polysaccharide . (b) It is obtained from a red algae. (c) It is present in both liquid and solid medium (d) Solidifying agent	1
5	An example of secondary metabolites produced by microbial cells is: (a) Vitamins (b) Alcohol (c) Amino Acids (d) Antibiotics	1
6	YEp contains a gene coding for: (a) X-Gal (b) B-galactosidase (c) Leucine (d) GFP	1
7	Reciprocal translocation between chromosome 9 and chromosome 22 forms- (a) an extra-short chromosome 9 (der9) (b) an extra-long Philadelphia chromosome (Ph1) (c) Philadelphia chromosome (Ph1) with fused abl-bcr gene (d) der 9 chromosome with fused abl-bcr gene	1
8	Which of the following statement on differences between homologues and paralogs are correct? (i) Homologues have the same function whereas paralogs may differ in function. (ii) Paralogs have the same function whereas homologues may differ in function. (iii) Homologues are the sequences descended from a common ancestor whereas paralogs are duplicated genes within a genome. (iv) Paralogs are the sequences descended from a common ancestor whereas homologues are duplicated genes within a genome. (a) (i) and (iii) (b) (ii) and (iv) (c) (i) and (iv) (d) (ii) and (iii)	1
9	Severe combined immunodeficiency disease is caused due to the absence of: (a) Adenosine diphosphate (b) Adenosine deaminase (c) Adenosine cyclase (d) Guanidine nitrate	1

10	A protein ion with a molecular weight of 10,000 Daltons carried a charge of 5+ and was subjected to mass spectrometric analysis. Calculate its mass to charge ratio. (a) 2001 (b) 2000 (c) 2501 (d) 5001	1
11	Single nucleotide polymorphisms usually occur in _____ regions. (a) Mini-satellite only (b) Non-coding only (c) Regulatory only (d) Both Coding and non-coding	1
12	Which of the following is not a function of serum? (a) Cell proliferation (b) Promote healthy growth of cells (c) Enhance cell attachment (d) Provide sterile environment to cell culture	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 **Assertion** (A) and **Reason** (R) are the true and Reason (R) is the correct explanation of Assertion (A).
(b) Both **Assertion** (A) and **Reason** (R) are the true but **Reason** (R) is not the correct explanation of **Assertion** (A).
(c) **Assertion** (A) is true and **Reason** (R) is false.
(d) **Assertion** (A) is false and **Reason** (R) is true.

13	**Assertion (A)** – OKT-3 can prevent graft rejection following kidney transplantation. **Reason (R)** – OKT-3 helps immune cells which attack foreign grafts.	1
14	**Assertion (A)** – If batch culture is continuously fed with fresh medium without removing the growing culture, it is called Continuous culture. **Reason (R)** – Continuous culture is widely used for production of biomass or metabolites.	1
15	**Assertion (A)** – Most of the commonly used cloning vectors contain multiple cloning sites. **Reason (R)** – *MCS provide flexibility in the choice and use of restriction enzymes.*	1

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<table>
<tr><td>16</td><td>ASSERTION (A) - Protoplast can be isolated by using cellulases, hemicellulases and pectinases.
REASON (R) - Protoplasts are plant cells without cell wall</td><td>1</td></tr>
</table>

<table>
<tr><th colspan="3">Section - B</th></tr>
<tr><td>17</td><td>A. State the role of selectable marker gene in a cloning vector.
B. Why is small sized cloning vector a desirable feature?</td><td>2</td></tr>
<tr><td>18</td><td>A technician in a tissue culture laboratory accidentally removed the identification tag of a petridish containing cells from a cancerous biopsy. How can he identify this petridish among other petridishes containing normal cells.</td><td>2</td></tr>
<tr><td>19</td><td><u>Attempt either option A or B</u>
A. Why are CO_2 incubators used to culture animal cells in lab?
OR
B. How are inverted microscopes ideal to visualize growth of cells in animal cell culture?</td><td>2</td></tr>
<tr><td>20</td><td>Name two components of 2 D gel electrophoresis. Highlight the basis of separation of each part.</td><td>2</td></tr>
<tr><td>21</td><td>Given below is a table of number of genes and chromosomes, and size of genome of two different organisms:
<table>
<tr><td>Organism</td><td>No of chromosomes</td><td>Genome size (bp)</td><td>Predicted genes</td></tr>
<tr><td>Arabidopsis</td><td>5</td><td>157,000,000</td><td>25,498</td></tr>
<tr><td>Homo sapiens</td><td>46</td><td>3,000,000,000</td><td>25,000</td></tr>
</table>
Draw two inferences from the table above

For Visually Impaired Students:
Why are computational methods of gene counting of genomes inaccurate? Give two reasons.</td><td>2</td></tr>
</table>

<table>
<tr><th colspan="3">Section - C</th></tr>
<tr><td>22</td><td>A. What do you mean by In-situ activation?

B. Write various applications of protein engineering.</td><td>3</td></tr>
</table>

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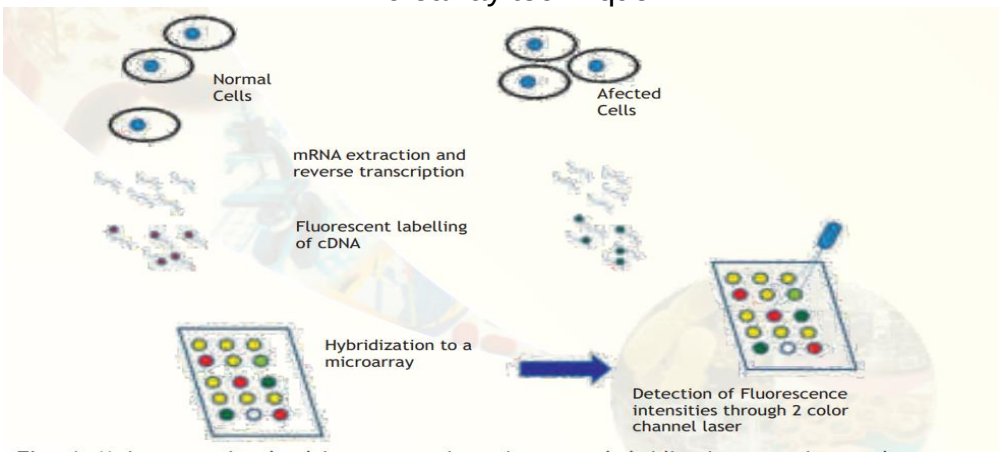
23	A. Why are fermenters provided with baffles? (1) B. Write the principle behind using spectrophotometer for measuring microbial cell growth. (2)	3
24	What are artificial seeds? Why and how are they produced ?	3
25	Suggest two ways by which sickle cell anaemia can be diagnosed. Why is it called a molecular disease?	3
26	With an example of each, show Blunt and Sticky end cleavage by restriction enzymes. Which one of these is better for recombinant DNA technology and why?	3
27	A. Differentiate between monoclonal and polyclonal antibodies. B. How has Hybridoma Technology revolutionized the area of diagnostics and therapeutics?	3
28	*Attempt either option A or B.* A. How are recombinant cells selected if the vector used is pUC19? **OR** B. Give any three advantages that E.coli offers as a host cell.	3

Section - D		
29	Gene expression of a normal cell and a cancer cell was studied with microarray technique. Cancer cell cDNA was labelled red and normal cell cDNA was labelled green. Microarray technique  A. Why are some spots depicted above seen as Yellow dots? B. How are DNA chips useful in functional genomics? *Attempt either option C or D.* C. Comparative hybridization experiments depicted above compare the amounts of many different mRNA in two cell populations. Why are such comparative studies important? **OR** D. Why is cDNA used to check the gene expression of both cell types though we have isolated mRNA from the cell populations in the first step?	4

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	For Visually Impaired Students: Gene expression of a normal cell and cancer was studied with microarray technique. The end product of a comparative hybridization experiment is a scanned array image. Cancer cell cDNA was labelled red and normal cell cDNA was labelled green. A. Why are some spots seen as Yellow dots in the scanned array image? B. How are DNA chips useful in functional genomics? *Attempt either option C or D.* C. Comparative hybridization experiments described above compare the amounts of many different mRNAs in two cell populations. Why are such comparative studies important? **OR** D. Why is cDNA used to check the gene expression of both cell types though we have isolated mRNA from the cell populations ?	
30	Downstream processing is an essential aspect of Biotechnology, particularly in the production of Biopharmaceuticals. It includes the purification, isolation and characterization of the target product from complex biological matrices to ensure the final product is safe, effective and high-quality. A. Name two methods which can be used to obtain microbial metabolite from clarified fermented liquor. (1) B. When is cell disruption process used in downstream processing? (1) *Attempt either subpart C or D* (2) C. Write the steps involved in isolation of the desired microbial product for an intracellular product. **OR** D. Why are lesser number of steps advised in downstream processing?	4

Section - E		
31	*Attempt either option A or B.* A. Explain how proteins are volatilized as well as analyzed by a mass spectrometer. Draw a well labelled Diagram of mass spectrometer. **OR** B. Classify any five proteins based products. Give one example under each category along with its application.	5
32	*Attempt either option A or B.* A. Give any two examples of genetically modified crops and the strategy behind developing them. **OR** B. Write any five biosafety concerns regarding transgenic plants.	5

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33	*Attempt either option A or B.* A. (i) In the diagnosis of tuberculosis, the older methods depended on culturing the causative Bacillus from sputum. Newer methods include PCR-based assays. With the help of a diagram, explain the principle of PCR. How is it more effective than culturing methods? (ii) If four copies of ds DNA are subjected to polymerase chain reaction, how many copies would be obtained after 20 cycles? **OR** B. (i) How is ddNTP different from dNTP? (ii) A DNA strand 3'TACGTACG 5' is sequenced on a gel. Draw the autoradiogram that would be obtained after sequencing. (iii) How is Single lane automated sequencing better than Sanger's method of DNA sequencing?	5