Sample Question Paper

Class XII (2020-21)

Biotechnology (045) Theory

Time: 3 Hours **Maximum Marks: 70**

General Instructions:

(i) All questions are compulsory.

(ii) The question paper has four sections: Section A, Section B, Section C and Section. There are 33 questions. All questions are compulsory.

(iii) Section A has 14 questions of 1 marks each and two case –based questions, Section B has 9 questions of 2 marks each, Section C has 5 questions of 3 marks each, and Section D has 3 questions of 5 marks each.

(iv) There is no overall choice. However, internal choices have been provided in few questions. A student has to attempt only one of the alternatives in such questions.

(v) Wherever necessary, neatly labeled diagrams should be drawn.

SECTION A		
1.	What is a shuttle vector?	1
2.	Name the amino acids involved in the catalytic triad that regulates charge -relay system in the enzyme Chymotrypsin?	1
3.	Specify one advantage of developing vectors based on M13.	1
4.	On which chromosome in humans, is the genetic defect for the Huntington disease located?	1
5.	Name the red algae from which agar is obtained.	1
6.	What is RFLP?	1
7.	What are nutraceutical proteins?	1
8.	What is the disadvantage of using primary animal culture as compared to secondary culture?	1
9.	Counting genes and predicting their presence have proved to be laden with inaccuracies. Give reasons.	1
10.	Which technique is used to confirm the detection of Sickle cell anaemia? Who developed this technique?	1
11.	**(i) Assertion** – Native enzyme subtilisin is easily inactivated by bleach **Reason**- Site directed mutagenesis at codon position 222 to replace methionine with alanine is found best in terms of activity and stability (a) Both Assertion and Reason are true and the reason is the correct	1

	explanation of the assertion (b) Both Assertion and Reason are true but the reason is not the correct explanation of the assertion (c) Assertion is true but Reason is false (d) Both Assertion and Reason are false **OR** **(ii) Assertion**- OKT-3 is used to prevent graft rejection following kidney transplantation **Reason**- OKT-3 blocks immune cells which attack foreign grafts. (a) Both Assertion and Reason are true, and the reason is the correct explanation of the assertion (b) Both Assertion and Reason are true, but the reason is not the correct explanation of the assertion (c) Assertion is true but Reason is false (d) Both Assertion and Reason are false	
12.	Composition of minerals like calcium and phosphorus in mg/ml is highest in- (a) Cow milk (b) Buffalo milk (c) Human milk (d) Goat milk	1`
13.	RefSeq is a curated database of: (a) mRNA and proteins (b) DNA and proteins (c) DNA and m RNA (d) DNA and t RNA	1
14.	During isolation of streptomycin, clear broth is- (a) discarded (b) subjected to liquid-liquid extraction chromatography (c) subjected to ultra filtration (d) subjected to solubilization of proteins	1
15.	Read the following and answer any **four** questions from 15 (i) to 15 (v) **Testing for COVID-19 using PCR** The objective of COVID-19 testing is to identify part of the corona viral genome in the patient sample. As, there is insufficient viral RNA to detect directly in the patient sample, a process called reverse transcription polymerase chain reaction (RT-PCR) is used for amplification. Short single stranded pieces of DNA called primers recognize unique RNA sequences within the viral genome. When double-stranded DNA copy of the target region of the viral RNA is produced, it undergoes successive rounds of amplification during which the DNA undergoes denaturation. Two	4

	primers anneal to their target sequences and then Taq polymerase extends a new strand. The number of copies of the target region of the viral genome doubles with each cycle. In practice, the virus is typically detected in 35 cycles of PCR, after which the number of DNA copies produced will be 2^{35}. PCR based diagnosis is faster, safer and more specific because it does not use live pathogens.	
(i)	The sequence of steps in PCR is- (a) Denaturation, annealing, extension (b) Annealing, denaturation, extension (c) Extension, annealing, denaturation (d) Denaturation, extension, annealing	
(ii)	A primer is- (a) short ss piece of DNA (b) short ds piece of DNA (c) short ds piece of RNA (d) Either (b) or (c)	
(iii)	After n cycles, the number of DNA copies produced are- (a) n^2 (b) 2^n (c) nx2 (d) n÷2	
(iv)	Taq DNA polymerase synthesizes DNA at a temperature of around 70^0C as it is- (a) thermophilic (b) thermostable (c) thermoregulator (d) thermolabile	
(v)	Culture based approaches for detecting pathogens, as compared to PCR based assays are- a) Faster, safer but less specific b) Slower but safer and more specific c) Slower, less safer and less specific d) Slower, less safer but more specific.	
16.	Read the following and answer any **four** questions from 16 (i) to 16 (v) **Tissue Culture in Rose Propagation** In January 2014, an experiment was conducted to explore the intricacies of in vitro propagation of *Rosa hybrida* from explants. The purpose was to determine the proper basal medium and growth regulators for these tissue culture techniques. Plant hormones play a pivotal role in growth and differentiation of cultured cells and tissues. An acidic pH is also very important. There are several types of media like	4

	MS, LS, B5 and Nitsch's medium, and the choice of media is dictated by the plant species, variety or plant part. However, the most extensively used nutrient medium is MS medium, which was developed by Murashige and Skoog in 1962. *Rosa hybrida L.* species are propagated around the world, using seed propagation, micropropagation, stem cuttings, budding, grafting, and even tissue culture. To increase the productivity of roses, somatic hybridization is also thought of.	
(i)	To enhance the productivity through micropropagation, which medium is generally used. (a) MS medium (b) LS (c) B5 (d) Nitsch's medium	
(ii)	An optimum pH is very important in plant cell tissue culture. It is usually: (a) 8.7 (b) 7.7 (c) 9.7 (d) 5.7	
(iii)	In order to enhance the productivity of rose plants, which of the following could be an effective strategy? (a) Somatic hybridization (b) Generation of haploids (c) Embryo rescue (d) Generation of triploids	
(iv)	Which technique is not included in vegetative propagation? (a) Layering propagation (b) Transgenic (c) Budding (d) Grafting	
(v)	The term explant used in the passage is … (a) any part of the plant (b) only shoot (c) only root (d) only leaf	
	SECTION B	
17	A given protein with a molecular weight of 20,000 daltons containing 5,4,3,2, and 1charges, is subjected to mass spectrometry. Find the sequence of protein ions detected by the mass spectrometer. **OR** Thalassemic patients produce excess alpha or beta subunits of haemoglobin leading	2

	to impaired oxygen-binding capacity by their erythrocytes. How can the subunit produced in excess be determined?	
18	Which information can be retrieved from the following databases? i) EMBL ii) PDB	2
19	Name any two diseases showing gene polymorphism with complex inheritance. **OR** (a) Which database was created to manage the redundancy in EST data? (b) What is the role of the curator in Bio-informatics.	2
20	Name any two medical conditions for which stem cells can be used.	2
21	Differentiate between somaclones and gametoclones. Who proposed the term somaclones?	2
22	The laboratory scale design cannot be scaled up to industrial scale directly. Write any two points that need to be considered while going for industrial scale production.	2
23	a) Animal cells in a culture medium were placed in a regular incubator used for growing bacterial cells. Do you expect the animal cells to grow in it? b) What are Interferons?	2
24	How does the metagenomics approach help to identify novel genes present in the environment? Explain the process.	2
25	Specify two advantages of animal cell culture.	2
SECTION C		
26	Which functional property of *whey protein* is exploited in the following food systems: (i) Eggless cakes; (ii) Soups; (iii) Coffee whiteners Also, state their mode of action.	3
27	Listed below are four different single strands of DNA. Which of these would you expect to be cleaved by a restriction endonuclease? Give reason. (a) ACTCCAGAATTCACTCCG (b) ACTCCACTCCCGACTCCG (c) GCCTCATTCGAAGCCTGA (d) GAGCGGTTTATCTGAGCAG **OR** Students of Class XII visited Microbial Type Culture Collection, Chandigarh and observed microbial cultures of *Providencia stuartii, Streptomyces albus* and *Haemophilus aegyptus*. Name the restriction enzymes obtained from them and also specify their restriction sites	3
28	With the help of a diagram, show the cultivation of adult stem cells from bone marrow and their differentiation into specialized cells.	3

	Name two scientists who established the field of stem cell research	
29	Considering the impact of Biotechnology in our lives, write any three applications of plant genetic engineering.	3
30	What kinds of analysis can be undertaken using various bioinformatics tools? State any three.	3
SECTION D		
31	What are BCAA? Name any two BCAA. State any two functions of BCAA. Also, explain Biological Value. **OR** Explain any five protein based products.	5
32	Explain the method for the selection of recombinants that makes use of insertional inactivation, with the help of suitable diagram. **OR** Explain various steps involved in a recombinant DNA technology experiment. Name any two molecular biologists who helped to create the first r-DNA molecule.	5
33	Write the steps involved in microbial strain isolation. How can the presence of a particular strain be confirmed? **OR** Differentiate between Fed Batch and Continuous microbial culture, along with well-defined graphs for them.	5

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Marking Scheme
Class XII (2020-21)
Biotechnology

Q. No	SECTION A	Marks
1.	Vectors used in eukaryotic cells which are constructed in such a way so that they can exist both in eukaryotic cells and *E. coli.*	1
2.	His-57, Asp-102 and Ser-195	1
3.	Genes cloned can be obtained in the form of single stranded DNA. Since genome is less than 10 kb in size, RF can be purified and manipulated exactly like a plasmid.	1
4.	Chromosome 4	1
5.	*Gelidium amansii*	1
6.	Restriction Fragment Length Polymorphism	1
7.	The proteins which have both nutritional and pharmaceutical values.	1
8.	Primary culture is time consuming and requires the use of live animals or fresh tissue. There can also be considerable variation from one preparation to another, particularly, if prepared by different people.	1
9.	Due to the existence of splice variants and overlapping genes.	1
10.	Peptide mapping/ Protein fingerprinting, V.M Ingram	1
11.	(i) (b) Both Assertion and Reason are true, but the reason is not the correct explanation of the assertion **OR** (ii) (a) Both Assertion and Reason are true, and the reason is the correct explanation of the assertion	1
12.	(b) Buffalo milk	1
13.	(a) mRNA and Proteins	1
14.	(b) subjected to liquid-liquid extraction chromatography	1
15. (i)	(a) Denaturation, annealing, extension	1
(ii)	(a) short ss piece of DNA	1
(iii)	(b) 2^n	1
(iv)	(a) thermostable	1

(v)	(c) Slower, less safer and less specific	1
16. (i)	a) MS medium	1
(ii)	d) 5.7	1
(iii)	a) Somatic hybridisation	1
(iv)	b) transgenic	1
(v)	a) any part of the plant	1
	SECTION B	
17	m/z= M+ nH + /n m/z=20,005/5=4001 m/z=20,004/4= 5001 m/z=20,003/3=6668 m/z=20,002/2=10,001 m/z=20,001/1=20,001 Sequence—It detects protein ions at m/z=4001, 5001, 6668, 10001 and 20,001respectively **OR** Normal and thallasaemic erythrocytes obtained and their lysates analysed Protein fingerprinting/2-D gel electrophoresis/MALDI-TOF/SDS-PAGE can identify if α or β chain is absent. *(Any one technique can be described)*	2
18	(i) Nucleotide Sequence (ii) Three dimensional structure of proteins	1 1
19	Two diseases showing gene polymorphism with complex inheritance • Common late-onset Alzheimer's disease • Migraine **OR** a) Unigene b) The curator reviews and checks newly submitted data to ensure that biological features are adequately described and the conceptual translations of any coding regions obey known rules.	1 1 1 1
20	Leukemia (Cancerous blood cells), Heart disease, Heart attack (cardiac tissue damage). Paralysis (spinal cord injury), Alzheimer's, Parkinson's, Huntington's (dead brain cells) and Burns (damaged skin cells) *(Any two)*.	2

<table>
<tr><td>21</td><td>While somaclones are plant variants obtained from tissue cultures of somatic tissues, gametoclones are plant variants with gametophytic origin obtained from tissue such as pollen or egg cell.

Larkin and Scowcroft (1981) proposed the term 'somaclones'</td><td>1

1</td></tr>
<tr><td>22</td><td>Bulk purchase of chemicals and other raw materials would bring down costs.
The labour cost decreases sharply with increase in production.</td><td>1

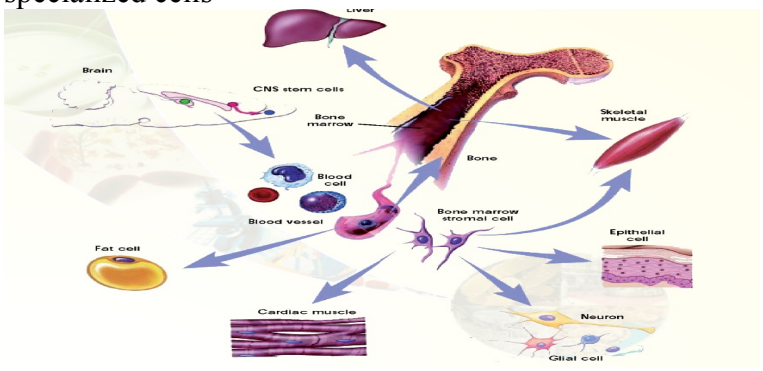
1</td></tr>
<tr><td>23</td><td>a) No, animal cells need a CO_2 incubator.

b) Interferons are proteins secreted by virally infected cells and interfere with viral propagation.</td><td>1

1</td></tr>
<tr><td>24</td><td>Metagenomics approach has been developed to identify and select microbial genes synthesizing novel molecules.

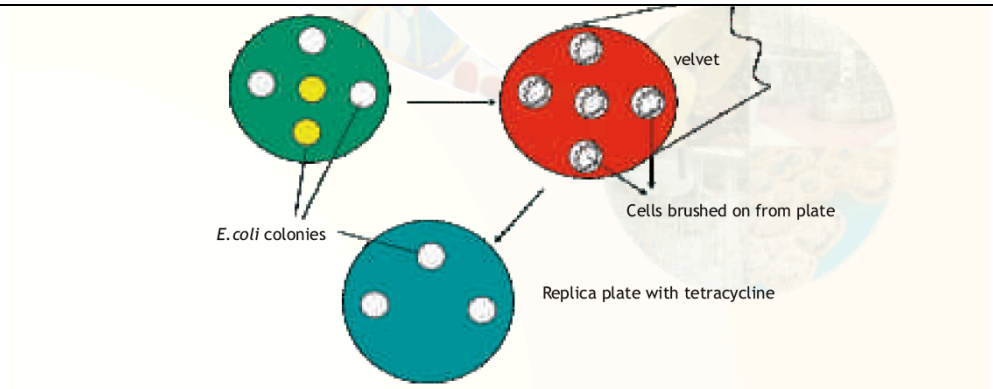
This approach utilizes the large number of microbial genomes present in an environmental niche (eg. in soil, in water such as ocean or in human gut). These genomes are contributed by both the culturable and the nonculturable variety of microbes and together constitute metagenome.</td><td>2</td></tr>
<tr><td>25</td><td>Advantages :

Homogenous genetic population//Controlled physico-chemical environment// Easy to add genes (Transfection) // regulate protein levels (RNAi). Available in adequate numbers to do chemical study//Easy production of biopharmaceuticals. //No ethical clearance required. //Cost effective screening assays.
(Any two)</td><td>2</td></tr>
<tr><td colspan="3">SECTION C</td></tr>
<tr><td>26</td><td><table>
<tr><th>Food systems</th><th>Functional Property</th><th>Mode of action</th></tr>
<tr><td>(i) Eggless cakes</td><td>Whipping/ foaming</td><td>Forms Stable film</td></tr>
<tr><td>(ii) Soups</td><td>Viscosity</td><td>Thickening/ water binding</td></tr>
<tr><td>(iii) Coffee whiteners</td><td>Emulsification</td><td>Formation and stabilization of fat emulsions</td></tr>
</table></td><td>3</td></tr>
</table>

27	(a) ACTCCAGAATTCACTCCG (c) GCCTCATTCGAAGCCTGA Restriction enzymes recognize palindromic sequences. **OR** *Haemophilus Aegyptus* *HaeIII* 5'G-G-C-C 3' 3'C-C-G-G 5' *Providencia stuartii* *Pst I* 5'C-T-G-C-A-G 3' 3'G-A-C-G-T-C 5' *Streptomyces albus* *Sal I* 5'G-T-C-G-A-C 3' 3'C-A-G-C-T-G 5'	1 1 1 3
28.	Cultivation of adult stem cells from bone marrow and their differentiation into specialized cells  Ernest McCulloch and James Till	2 1
29	• Production of healthy oils with altered fatty acid profiles. • Modification of starch properties for specific uses. • Favourable change of grain storage products and their chemical composition to improve the processing of bread making with wheat flour, malting of barley and brewing of beer.	3

	• Removal of undesirable toxic compounds in certain plants. • Development of blue roses/ blue coloured cotton which is otherwise not possible by conventional plant breeding because of the absence of blue pigment in roses/ cotton • Development of tear-less onions, caffeine-free coffee and low nicotine tobacco. *(Any three)*	
30	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. Genes: Gene prediction can be done by using computer programs like GeneMark for bacterial genomes and GENSCAN for eukaryotes. Proteins: Protein sequences can be inferred from the predicted genes by using simple computer programs. Regulatory sequences: Regulatory sequences can also be identified and analysed by using bioinformatics tools. Inferring phylogenetic relationships: Information regarding the relationships between organisms can be obtained by aligning multiple sequences, calculating evolutionary distance and constructing phylogenetic trees. Making a Discovery: Using the bioinformatics tools and databases, the functions of unknown genes can be predicted. *(Any three)*	3
	SECTION D	
31	BCAA are Branched chain amino acids BCAA: ile, leu,val, lys, trp *(Any two)* They- • are essential for the biosynthesis of muscle protein • help in increasing the bio-availability of high complex carbohydrates • 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. *(Any 2 points)* Biological value- It measures the amount of protein nitrogen that is retained by the body from a given amount of protein nitrogen that has been consumed	2 2 1

	OR (i) Blood products and vaccines e.g. Factor IX for treating hemophilia (ii) Therapeutic antibodies and enzymes e.g. Monoclonal antibodies OKT3 for preventing graftness. (iii) Therapeutic hormones and growth factors e.g. Insulin to treat diabetes. (iv) Regulatory factors e.eg. Interferons for antiviral properties. (v) Analytical applications e.g. Horse radish peroxidase for ELISA. (vi) Industrial enzymes e.g. Papain for meat tenderization. (vii) Fuctional non catalytic proteins e.g. Kappa casein for milk protein stabilization. (viii) Nutraceutical proteins eg. Infant food formulation to provide adequate nutrition for infant. These products are of commercial value to the Biotechnology industry. *(Any 5)*	5
32	Principle of Insertional Inactivation- When cloned DNA is inserted into a gene it inactivates its functioning. Sequence/ insert cloned into vectors within genes of antibiotic resistance, leads to loss of function. Steps 1. Host cells (E. coli cells) with recombinant pBR322 plasmid are first plated on solid media (agarose containing) with the antibiotic ampicillin (assume that the insert has been ligated within the tetracycline resistance gene). Colonies from every single cell plate having the plasmid will develop overnight 2. A petri plate containing solid media with antibiotic tetracycline is kept carefully under aseptic conditions(Laminar flow hood) 3. A circular piece of velvet or velvet paper is aligned and pressed onto the colony containing ampicillin plate (master plate).With the same alignment it is pressed onto the tetracycline plate. Overnight only colonies not containing the insert will grow while due to insertional inactivation no colonies will grow which have the insert.The colonies which have the insert can easily be scored off by comparing the two plates.	1 3

	 **Fig. 7.** Replica plating (note only colonies marked yellow have insert). **OR** Steps involved: 1. Isolation of a DNA fragment containing a gene of interest that needs to be cloned (called as insert). 2. Generation of a recombinant DNA (rDNA) molecule by insertion of the DNA fragment into a carrier DNAmolecule called vector (e.g. plasmid) that can self replicate within a host cell. 3. Transfer of the rDNAinto an E. coli host cell (process called transformation). 4. Selection of only those host cells carrying the rDNA and allowing them to multiply thereby multiplying the rDNA molecules. Paul Berg, Herbert Boyer, Annie Chang and Stanley Cohen. *(Any two)*	1 (diagram) 4 1
33	a) The sample containing the microbes (e.g. soil) is put in a nutritive medium and allowed to grow in shake cultures. The growth conditions (e.g. temperature, nutrients) in the medium are provided and these favour the growth of microbes of our interest. b) Screening is done using a method where the organism will show its desired properties. For example, if we are looking for a microorganism, which produces an antibiotic, we may detect it by growing the culture on an agar plate in the presence of that bacterium against which antimicrobial activity is desired. Immunological methods are also available in which the microbes producing products are detected using specific antibodies. Use of probes, which enable the detection of organisms capable of producing specific products. **OR**	5

S.No	Fed Batch Culture	Continuous Microbial Culture
1.	Nutrients added without removal of culture	Nutrients added with removal of culture
2.	Volume increases	Volume constant
3.	Used for high cell density	Used for Biomass or metabolite production

5

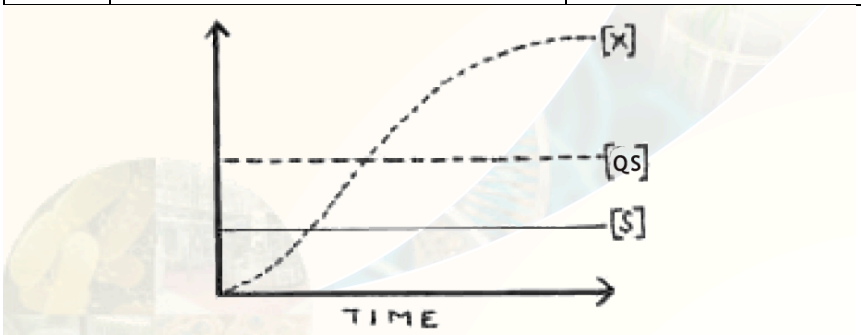


Fig. 6. Characteristic features of a fed-batch culture.

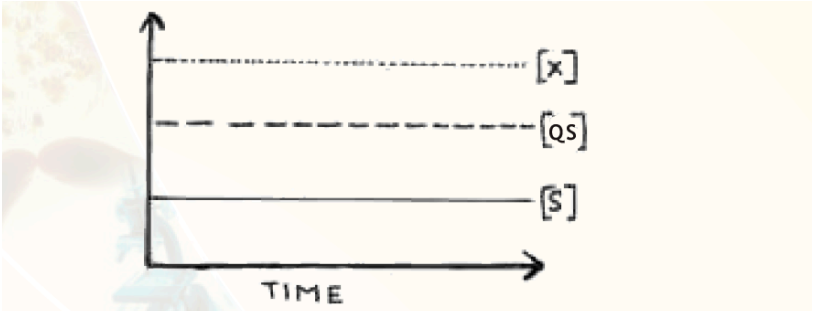


Fig. 7. Characteristic features of a continuous culture at steady state.

(X)- Cell density

(S) – Substrate concentration

(QS)- Cell Specific substrate turn over rate