BIOTECHNOLOGY - Code No. 045

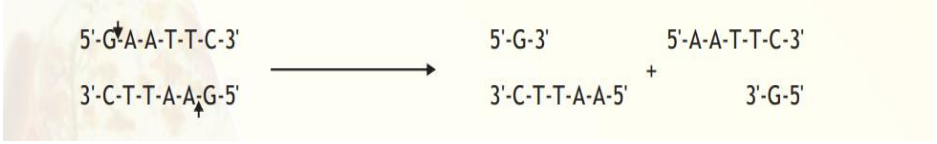
MARKING SCHEME

Class-XII (2025-26)

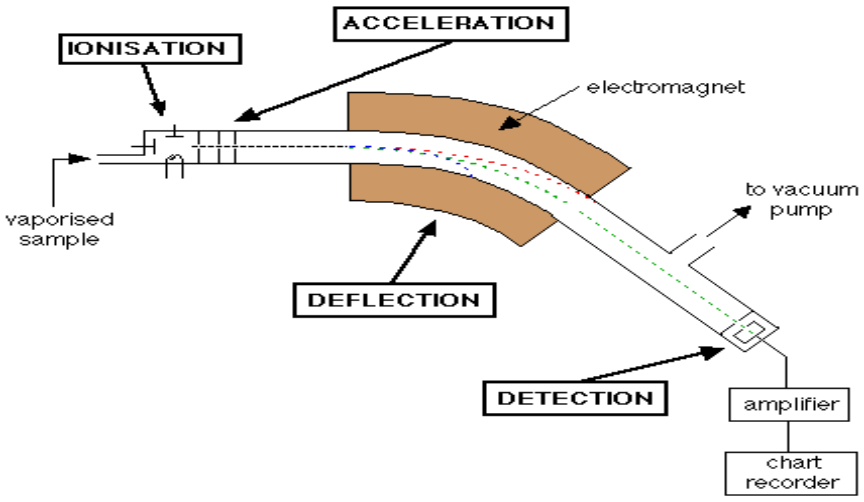
Time Allowed: 3 hours **Maximum Marks: 70**

S. No.	Section - A	Marks
1	(b) Exponential phase	1
2	(a) Primary cell culture	1
3	(a) (i) (ii) and (iii) only	1
4	(c) It is present in both liquid and solid medium	1
5	(d) Antibiotics	1
6	(c) Leucine	1
7	(c) Philadelphia chromosome (Ph1) with fused abl-bcr gene	1
8	(a) (i) and (iii)	1
9	(b) Adenosine deaminase	1
10	(a) 2001	1
11	(b) Non-coding only	1
12	(d) Provide sterile environment to cell culture	1
13	(c) **Assertion** (A) is true and **Reason** (R) is false.	1
14	(d) **Assertion** (A) is false and **Reason** (R) is true	1
15	(a) Both **Assertion** (A) and **Reason** (R) are the true and Reason (R) is the correct explanation of Assertion (A).	1
16	(b) Both **Assertion** (A) and **Reason** (R) are the true but **Reason** (R) is not the correct explanation of **Assertion** (A).	1

Section - B		
17.	A. A gene whose product can identify the host cells containing the vector. This will help in selection of transformed cells for growth. B. Small sized cloning vector is easy to manipulate, to facilitate entry/transfer into host cells.	1 1
18	Cancerous cell cultures appear different from normal cells. i) They are more rounded in shape. ii) They pile on each other showing no contact inhibition.	1 1
19	*Student to attempt either option A or B.* A. Sterile environment/a constant temperature/an atmosphere with fixed level of CO_2 / high relative humidity. (Any two) **OR** B. In animal cell culture, the cells are present at the bottom with the culture medium above. Inverted microscope allows the cells at bottom to be visualized as optical system is on top.	1x2 2
20	2D – Gel electrophoresis has two components: (IEF and SDS –PAGE) Principle of IEF- Separation of the proteins is on the basis of their pl values. SDS-PAGE- Separation of the proteins is on the basis of their molecular mass/size	1 ½ ½
21	(i) No simple correlation between the intuitive complexity of an organism and the number of genes in its genome. (ii) Relatively small number of genes in a human genome in comparison to Arabidopsis may be due to unreliability of the computational method. **For Visually Impaired Students:** (i) Errors arise due to overlapping genes and splice variants (ii) Algorithm based on known genes are used as training data sets, which is inaccurate, hence becomes a limitation (iii) Gap between genomes (iv) Existence of repeated sequences (v) Unreliability of in silico (computational) gene prediction (vi) No clarity about the method of counting genes (Any 2)	1 1 2

Section - C		
22	A. Alteration in the structure of Zymogen to make it functional. B. To improve the stability of protein. To design the protein subtilisin, for increasing its efficiency in laundry detergents To design novel vaccines. To improve the nutritional values of cereals and legumes	1 ½ x 4
23	A. Aeration /to improve oxygen transfer/mixing B. When light passes through a suspension of bacteria, there is a reduction in light transmitted as a consequence of scattering. With different cell concentration , absorbance at a particular wavelength will be proportional to the cell concentration, which can be calculated by plotting graph with absorbance versus cell concentration.	1 1 1
24	Artificial seeds are artificially encapsulated somatic embryos (Torpedo stage) in a protective coating like calcium alginate They can be utilized for the rapid and mass propagation of elite plant species as well as hybrid varieties in short period of time.	2 1
25	Microscopic observation of RBC morphology and Peptide mapping / protein finger printing of hemoglobin and compare it with normal hemoglobin. It is due to the substitution of Glutamic acid with Valine at 6th position of beta subunit of the hemoglobin.	2 1
26	Blunt end cutter- Alu 1  Sticky end cutter- Eco R I  Sticky ends are better because only compatible ends can base pair and join.	1 1 1

27	A. Monoclonal antibodies are raised against specific epitope of an antigen whereas Polyclonal antibodies are a heterologous population of antibodies released by different populations of B – lymphocytes. B. Due to hybridism technology, large scale production of monoclonal antibodies was achieved which has helped in early detection of many infectious diseases/therapeutics and also helps in providing passive immunity in case of many diseases.	1 2
28	*Student to attempt either option A or B.* A. The method is blue-white selection which is based on the insertional inactivation of the LacZ gene. This gene expresses the enzyme Beta Galatosidase whose activity can cleave a colorless substrate X-Gal into a blue colored product. If LacZ gene is inactivated due to presence of the insert, then the enzyme is not expressed. Hence when the host cells are plated on X-Gal Agar and ampicillin containing media white colonies are the ones which contain the rDNA. **OR** B. i) E. coli is a preferred host due to the detailed knowledge of its nucleic acid and can accept a variety of vectors. i) Genetically defined strains available. iii) Standard doubling period of 20 minutes iv) Easy to use v) Extensively studied for safety (Any three)	1 1 1 1x3
Section - D		
29	A. Yellow spot specifies that particular gene is being expressed in both normal and cancerous cells at that time. B. DNA microarrays or gene chips are useful in functional genomics because they enable scientists to study the interaction among thousands of genes simultaneously. *Student to attempt either subpart C or D.* C. By such comparisons, we can understand the altered gene expression patterns in cancerous cells and make attempts to develop cures. **OR** D. Since free RNA is quickly degraded, to prevent the experimental samples from being lost, they are reverse transcribed into complementary (cDNA) whose sequences are the complements of the original mRNA sequence. **For Visually Impaired Students: Same answer as above**	1 1 2

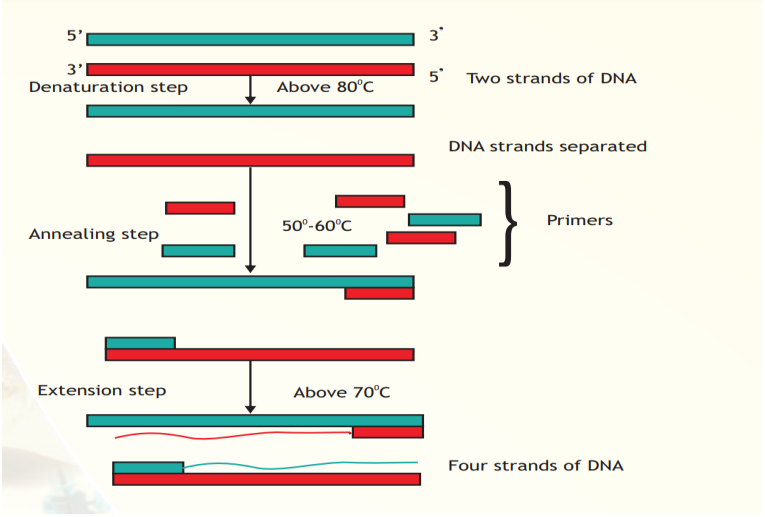
30	A. Solvent extraction/Chromatography /Membrane filtration /Precipitation (Any two) B. For intracellular metabolite *Student to attempt either subpart C or D.* C. i) Separation of cells from fermented broth ii) Cell disruption iii) Concentration of broth iv) Initial purification. v) Metabolite specific purification vi) Polishing of metabolite **OR** *D.* Lesser steps to decrease cost , more will be yield of the metabolite.	1 1 2
Section - E		
31	*Student to attempt either option A or B.* A. Principle of Mass spectrometer: It determines the molecular weight of chemical compounds by separating molecular ions according to mass/charge ratio (m/z). MALDI – Matrix Assisted Laser Desorption Ionization. Protein sample is dissolved in matrix and then laser beam is applied which results in the ionization of the proteins which are then analyzed. Charged protein accelerated through evacuated tubes and separated by m/z ratio. The signal received upon detection at the detector is transferred to a computer for processing of information. Detection and recording Well defined Diagram (It should include) Diagram: Ionisation chamber, electromagnet, vaccum pump, detector and chart recorder.  (Any two labeling) **OR**	1 2 2

	B. i) Blood products and vaccines e.g. Factor IX for treating hemophilia ii) Therapeutic antibodies and enzymes e.g. Monoclonal antibodies OKT3 for preventing rejection following organ transplant. iii) Therapeutic hormones and growth factors, e.g. Insulin to treat diabetes. iv) Regulatory factors, e.g. 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, e.g. Infant food formulation to provide adequate nutrition for infants. These products are of commercial value to the Biotechnology industry. (Any five with relevant example. Any other examples as in book should also be assessed at par)	1x5
32	*Student to attempt either option A or B.* A. Two examples are: Golden rice - Enriched in provitamin A (beta carotenoids) Strategy: By introducing three genes for involved in biosynthesis pathway for carotenoid under the control of endosperm specific promoter. Seeds are yellow in colour, contain provitamin A which gets converted to vitamin A in body. Flavr savr tomato: Strategy: Delayed fruit ripening, ripening is slowed down by blocking or reducing ethylene production, introducing ethylene forming genes in a way to suppress its own expression. (Any other examples may also be assessed) **OR** B. 1. Allergenecity 2. Toxicity 3. Effect on beneficial insects and microbes 4. Develop superweeds-pollen escape 5. Create antibiotic resistant microbes 6. Change evolutionary pattern 7. Effects on biodiversity and environment. (Any 5 points)	½ 1 1 ½ 1 1 1x5

33

Student to attempt either option A or B.

A. (i) Amplification of DNA sequences specific to Mycobacterium tuberculosis



3

PCR can amplify the specific DNA segment into millions of copies. Three steps are:

1. Denaturation – Seperates DNA into two single strands
2. Annealing – Primers attach to complementary sequences of DNA
3. Extension – Taq polymerase extends each primer using dNTPs and the DNA strand as template

- Technique is more rapid safer and sensitive. 1

(ii) 4×2^{20} 1

OR

B.

(i) Absence of –OH at 3' carbon position of sugar moiety. 1

(ii) * indicates nested fragments.

A	T	G	C
			*
		*	
	*		
*			
			*
		*	
	*		
*			

1

Sequence read from the autoradiogram is : 5' ATGCATGC 3' 1

(iii) In automated sequencing to avoid using radioisotopes and their consequent danger, dideoxynucleotides are conjugated with florescent molecules which on excitation give a different colour each. Hence each band on the gel (read from anode to cathode) indicates the particular base as its terminal dideoxy nucleotide fluoresces with a given colour. 1

This avoids the use of a four lane gel, a single lane gel electrophoresis is instead conducted and the gels are then laser scanned and the data fed into a computer. 1