DESIGN OF THE QUESTION PAPER
BIOTECHNOLOGY CLASS XII

Hrs : 3 Hrs. **Max. Marks : 70**

The weightage of the distribution of marks over different dimensions of the question paper shall be as follows:

1. Weigthtage to content/subject units

S.No.	OBJECTIVES	MARKS	PERCENTAGE
1.	Knowledge (K)	21	30
2.	Understanding (U)	35	50
3.	Application (A)	14	20
	TOTAL	**70**	**100**

2. Weightage Unit wise

	UNIT	MARKS
1.	Protein Structure and Engineering	15
2.	Recombinant DNA Technology	15
3.	Genomics and Bioinformatics	10
4.	Microbial Culture and Applications	10
5.	Plant Cell Culture and Applications	10
6.	Animal Cell Culture and Application	10

2. Weightage to different form of questions

S.No.	Form of questions	Marks for each question	No.of questions	Total Marks
1.	Long Answer Type Qs.(LA)	5	3	15
2.	Short Answer Qs. I (SAI)	3	10	30
3.	Short Answer Qs. II (SAII)	2	10	30
4.	Very Short Answer Qs. (VSA)	1	5	5
	Total	_	28	70

Note : Although the weightage to different content areas and forms of questions has been assigned and the paper setters will adhere to the weightage but there can be slight variation in distribution of marks over different units/forms of questions in the Board Examination depending upon the situation.

Note : The expected time required for attempting forms of questions would be as follows:

S.No.	Form of Questions	Expected time for each question
1.	Long Answer Type (LA)	12 Minutes
2.	Short Answer Type (SA I/II)	8 Minutes / 4 Minutes
3.	Very Short Answer Type (VSA)	2 Minutes

This is only an approximation. The total time is calculated on the basis of the number of questions required to be answered and the lenghts of their anticipated answers. It would be advisable for the candidates to manage their time properly by avoiding unnecessary details.

4. Scheme of Options

(i) There will be no overall choice

(ii) Internal choice (either/or type) on a very selective basis has been provided. This choice has been given in any one question of 3 marks and any two questions of 5 marks weightage.

5. A question may vary in difficulty level from individual to individual. As such, the approximation in respect of each question will be made by the paper setter on the basis of general expectation from the group as a whole. This provision is only to make the paper balanced in nature than to determine the pattern of marking at any stage.

BLUE PRINT I

BIOTECHNOLOGY

CLASS XII

Units	Knowledge				Understanding				Application				Total
	VSA	SAI	SAII	LA	VSA	SAI	SAII	LA	VSA	SAI	SAII	LA	
Chapter I Protein structure and Engg		2(1)	3(1)	5(1)			3(1)			2(1)			15(5)
Chapter II Recombinant DNA Technology			3(1)			2(1)	3(1)	5(1)		2(1)			15(5)
Chapter III Genomics and Bioinformatics		2(1)						5(1)			3(1)		10(3)
Chapter IV Cell culture Technology			3(1)		1(1)	2(1)	3(1)		1(1)				10(3)
Chapter V Plant cell culture and applications		2(1)			1(1)	2(1)	3(1)			2(1)			10(5)
Chapter VI Animal cell culture and applications	1(1)					2(1)	3(1)		1(1)		3(1)		10(5)
Total	1(1)	6(3)	9(3)	5(1)	2(2)	8(4)	15(5)	10(2)	2(2)	6(3)	6(2)		70(28)

SAMPLE QUESTION PAPER - 1

BIOTECHNOLOGY

CLASS-XII

Time : 3 Hrs **MM: 70**

General Instructions :

(i) All questions are compulsory.

(ii) There is no overall choice. However, an internal choice has been provided in one question of three marks and two questions of five marks. You have to attempt only one of the choices in such questions. Question paper contains four sections-A, B, C, and D.

(iii) Question number 1 to 5 are very short answer questions, carrying 1 mark each.

(iv) Question number 6 to 15 are short answer questions, carring 2 marks each.

(v) Question number 16 to 25 are also short answer questions, carring 3 marks each.

(vi) Question number 26 to 28 are long answer questions, carrying 5 marks each.

(vii) Use of calculators is not permitted. However, you may use log tables, if necessary.

Section - A

1. Why is nutrient medium autoclaved for 15 - 20 minutes before using for culturing microbes?
2. Name two components unique to animal cell culture media.
3. Maize and Rice plants were crossed but no hybrids were obtained. Why? Justify giving two reasons.
4. Why is r-HuEPO used in the treatment of surgery associated anaemia?
5. Why cannot E. Coli be used to overproduce penicillin?

Section - B

6. Why are animal cells grown in CO_2 incubators and not in regular incubators?
7. How does the charge relay system operate in chymotrypsin?
8. Give the sequence of the two primers (5 nucleotides long) required to amplify the following DNA sequence by PCR.

   5' ATGCCTAGGATCATGC 3'
9. Explain why children eating golden rice are unlikely to suffer from 'night blindness'?
10. List four reasons for sequencing a genome.
11. The composition of buffalo milk is 7% fat and 3% casein. How will you separate fat from casein in milk? How many grams of fat and casein can be obtained from 1 lakh litres of milk.
12. If the genes involved in fruit ripening are selectively mutated, what commercial importance can this serve?
13. If you want to clone a gene that is expressed by yeast only under starvation conditions, which kind of library will you use and why?
14. Why is foaming caused in microbiological processes? How can this be harmful to the process?
15. Enumerate the different steps in micro propagation methods.

Section - C

16. Explain the basic steps of protein finger printing and its use.
17. A child suffering from acute lymphocytic Leukaemia underwent a bone marrow replacement therapy wherein her bone marrow was destroyed and replaced by bone marrow obtained from a sibling who was normal. Why was the bone marrow destroyed during therapy? Do you expect the child to recover? Explain.
18. What are the main areas of consideration for safety aspects specific to biotechnology?
19. Study the following enzyme (protein) purification table and answer the question that follow:

Procedure		Total Protein (mg).	Activity (units)
Step 1 :	Crude extract	1000	2000
Step 2 :	Precipitation (Salt)	200	1890
Step 3 :	Ion-exchange chromatography	100	1500
Step 4 :	Gel chromatography	90	1400
Step 5 :	Affinity chromatography	2	1000

(i) What is the yield of active protein from crude extract?

(ii) Which step in the purification is most effective and why ?

(iii) Which step in the purification is least effective and why?

20. Bioinformatics database provide many different types of sequences, such as cDNA, genomic, EST, peptide, etc. Which of these would you use as the most suitable starting point for indentifying:

(a) Promotor

(b) Open Reading Frame

(c) Intron

21. A human gene codes for a protein which is unstable at room temperature. This protein can be made more stable by changing the amino acid residue Met 115 to Trp. Can you suggest the steps and the technique you would use.
22. Differentiate between primary and secondary cell cultures. Why are secondary cell cultures perferred for experimental work?
23. Define Vector. What are the characteristic features of a vector?

OR

What are the various methods by which foreign DNA can be introduced into E.coli cells? Define any three.

24. Why is aeration important for microbial growth? How can proper aeration be achieved in the microbial cultures grown in the laboratory?
25. What is the importance of regeneration in plant tissue culture and how are plant hormones used to aid this process?

Section - D

26. Describe important parts of a mass spectrometer with the help of a suitable diagram. Explain how proteins are volatilized as well as analyzed by the mass spectrometer.

OR

Discuss the various types of shapes and structures that a protein can take to make a functional protein. Discuss the non-covalent interaction involved in organizing the structure of a protein molecule.

27. You know the amino acid sequence of a polypeptide made by a gene. Expain a strategy by which you can clone this gene?

OR

How will you use the technique of PCR to amplify a DNA fragment? What would happen if you add only one primer to the PCR reaction?

28. Breast cancer cells often exhibit abnormal expression of certain genes which are too many to study individually. Describe a method that you would use to compare the gene expression in the breast cancer cell and a normal cell.

MARKING SCHEME
SAMPLE QUESTION PAPER-I
XII - BIOTECHNOLOGY

Time : 3 Hrs **MM: 70**

Q.No.	Value Point	Marks	T.Marks
1.	To sterilize medium. Autoclave achieves temperature of 120°C which kills bacterial and fungal spores.	1	1
2.	(i) Serum (ii) Bicarbonate buffer	½x2	1
3.	Such crosses results in (i) abnormal development of endosperm (ii) formation of sterile seeds	½x2	1
4.	r-Hu EPO (erythropoietin) stimulates the formation of erythrocytes which are depleted due to blood loss during surgery.	1	1
5.	Penicillin will kill the antibiotic sensitive E. coli cells	1x2	2
6.	The pH of animal culture media depends on a HCO_3/CO_2 buffer system. Hence CO_2 is required. Humidity conditions in the incubator maintain osmolality of medium.	1x2	2
7.	Chymotrypsin folds bringing together Asp 102, His 57, Ser 195 in this sequence in space	1x2	2
8.	PRIMER (1) 5' ATGCC 3' PRIMER (2) 5' GCATG 3'	1x2	2
9.	Golden rice is genetically engineered with V it A precursor carotenoids. Lack of vit A causes night blindness.	1x2	2
10.	(i) Indentification of genes and making an inventory (ii) Determine relationships between genes (iii) Sequences can be used as tools (iv) Complete genetic information available for that organism.	4x½	2
11.	Fat is less dense than water and can be separated by centrifugation . 7000 kg. fat and 3000 kg casein.	1x2	2
12.	Fruits do not ripen thereby preventing rotting during transportation. Before sale ethylene gas can be used to ripen.	1x2	2
13.	cDNA library. This represents mRNA being expressed under starvation condition.	2	2

Q.No.	Value Point	Marks	T.Marks
14.	Foaming is caused by metabolites, proteins and media components Foaming denatures proteins.	1x2	2
15.	(i) Initiation of culture (ii) Shoot formation (iii) Rooting of shoots (iv) Transplantation	½x4	2
16.	Protein hydrolysed by trypsin Electrophoresis on paper strips Chromatolgraphy at 90° 1—— D peptide map visualized by spraying with reagent (ninhydrin) Use.....	½ ½ ½ ½ 1	3
17.	Bone marrow destroyed to remove leukaemic cells. Yes. Replacement of normal bone marrow from sibling. Use of sibling bone marrow prevents transplant rejection.	1 1 1	3
18.	Pathogenicity, Toxicity & Allergy, Other medically relevant effects, Disposal of spent microbial biomass, safety aspects associated with contamination, infection or mutation of process strain.	½x6	3
19.	(i) Yield is 2 mg (ii) Affinity chromatography step gets rid of most non enzyme (iii) Gel chromatography step. Not much change in protein or activity units.	1x3	3
20.	(a) Genomic sequence (b) cDNA sequence (c) Genomic sequence	1x3	3
21.	Use site directed mutagenesis to alter Met 115 codon to Trp codon. Design a primer whose sequence is complementary partly and includes the sequence of Trp codon (U in RNA is replaced with A in primer for codon)	1 1	
22.	Growth of cells obtained from parental tissue such as liver, kidney etc is Primary Culture. Sub culturing of Primary cell cultures leads to Secondary cell culture. Preferred as they are less time consuming , do not require fresh animal tissue and do not show variation from one preparation to another.	1x2 1	2
23.	Definition of Vector..... Should contain (i) origin of replication (ii) Selectable marker (iii) restriction site (iv) small in size.	1 ½x4	3

Q.No.	Value Point	Marks	T. Marks
	CHOICE (i) transformation (ii) Electroporation (iii) infection with bacteriophages. Define any three	1x3	3
24.	Aeration provides oxygen for generation of ATP as well as mixing.	1	3
	Shakers.	1x2	
	Baffle flasks		
25.	A whole plant can be raised from cultured plant tissue by regeneration.	1	3
	Regeneration by somatic embryogenesis or organogenesis.	1	
	Auxins promote rooting. cytokinins promote shooting.	1	
26.	Diagram: Ionisation chamber, electromagnet, vaccum pump, detector and chart recorder.	2	5
	Proteins dissolved in matrix; laser beam applied; proteinionizes.	1	
	Charged protein accelerated through evacuated tubes and separated by m/c ratio.	1	
	Detection and recording.	1	5
	CHOICE Proteins fold into secondary structure α helix, β pleats.	3	
	Secondary structures undergo further folding into domains, motifs called tertiary structures. Multimeric proteins organized as Quaternary structures.		
	Hydrophobic interaction, electrostatic interactions, Hydrogen	1	5
	bonding, vander waals forces are the non-covalent forces.	1	
27.	The aminoacid sequence used to compute the DNA sequence.	2	
	Probes (oligenucleotides) designed on the basis of DNA sequence.	2	
	Screen genomic or DNA libraries.	1	
	CHOICE	1	
	Design primers which are complementary to flanking sequences of the DNA fragment.	3	
	Steps of PCR; denaturation, primer annealing, chain elongation.	1	5
	Only one strand of the DNA fragment will be amplified	1	
28.	Microarray technique used to compare the cancerous and normal cells.	1	
	Procedure; Thousands of genes robotically placed in order on two glass sliders.	5	
	mRNA isolated from cancerous and normal cells.	1	
	Fluorescent labeled cDNA prepared and hybridized on slides.	1	
	Using laser, colours on the two slides compared.	1	

BLUE PRINT II

BIOTECHNOLOGY

CLASS XII

Units	Knowledge				Understanding				Application				Total
	VSA	SAI	SAII	LA	VSA	SAI	SAII	LA	VSA	SAI	SAII	LA	
Chapter I Protein structure and Engg			3(1)	5(1)		2(1)	3(I)			2(1)			15(5)
Chapter II Recombinant DNA Technology			3(1)	5(1)		2(1)	3(1)			2(1)			15(5)
Chapter III Genomics and Bioinformatics		2(1)				2(1)	3(1)				3(1)		10(4)
Chapter IV Cell culture Technology	1(1)						3(1)	5(1)	1(1)				10(4)
Chapter V Plant cell culture and applications		2(1)				2(1)	3(1)		1(1)	2(1)			10(5)
Chapter VI Animal culture and applications					2(2)	2(1)	3(1)				3(1)		10(5)
Total	1(1)	4(2)	6(2)	10(2)	2(2)	10(5)	18(6)	5(1)	2(2)	6(3)	6(2)		70(28)

Sample Question Paper II
XII- BIOTECHNOLOGY

Time : 3 Hours **Max. Marks : 70**

GENERAL INSTRUCTIONS :

1. *All questions are compulsory.*
2. *There is no overall choice. However, an internal choice has been provided in one question of three marks and two questions of five marks. You have to attempt only one of the choices in such questions. Question paper contains for section A,B,C, and D.*
3. *Question numbers 1 to 5 are very short answer questions, carrying 1 mark each.*
4. *Question numbers 6 to 15 are very short answer questions, carrying 2 marks each.*
5. *Question numbers 16 to 25 are also short answer questions, carrying 3 marks each.*
6. *Question numbers 26 to 28 are long answer questions, carrying 5 marks each.*
7. *Use of calculators is not permitted. However, you may use log tables, if necessary.*

Q.1 Write a general chemical equation for the formation of products from reactants.

Q.2 Discuss how the maintenance of approprate pH and osmolality is essential for maintaing animal cells in culture? Briefy comment on both the factors.

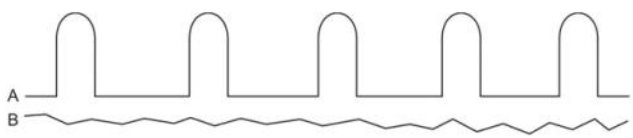
Q.3 Unless fresh medium is added to a microbial cell culture, the cells will eventually die. Explain why?

Q.4 When substance A was added to a plant tissue culture medium, it promoted rooting, whereas when substance B was added, it promoted shooting Identify substances A and B.

Q.5 Why are CO_2 incubators necessary for culturing animal cells?

Q.6 The relationship between number of genes and number of proteins is non linear. Why?

Q.7 An experimental technique allows purified mRNA from a eukaryotic cell to be hybridized (paired up) with the DNA which codes for it. Under the electron microscope the following structure is observed.



(i) Indicate DNA and mRNA strands in the picture (A.B).

(ii) If prokaryotic mRNA was hybridized with prokaryotic DNA would the structure alter and how?

Q.8 What is SNP? What are its uses?

Q.9 Explain why Bt cotton flowers undergo pollination by butterflies and bees inspite of being insect pest resistant.

Q.10 Animal cells are cryopreserved at low temperature using liquid nitrogen in the presence of a cryopreservant like glycerol. Why?

Q.11 Assume one milliliter of curd has $1x\ 10^7$ cells of Lactococci (spherical in shape) of diameter 0.5 micrometers each. Calculate.

(i) The number of lactococci in 500 ml of curd.

(ii) The packed cell volume occupied by these Lactococci.

Q.12 An autoradiaogram sequence reads as follows from the anodic to the cathodic end. CATCCGATAGC

(i) What is the directionality of this strand?

(ii) What is the sequence of the original strand which was sequenced?

Q.13 Explain why secondary metabolites are best produced by cell and root cultures, whereas many other products need genetically engineered plants?

Q.14 One of the major uses of genome sequence is to develop tool for further experiments. Given the sequence of a ribonuclease gene from the model plant Arabidopsis, how would you design a tool for isolating the ribonuclease gene from a tea plant.

Q.15 Distinguish between organogenesis and somatic embryogenesis.

Q.16 Canadian scientists have developed a formulation based on whey proteins for reducing the viral load in HIV patients. What could be the possible scientific explanation for this therapeutic effect?

Q.17 Explain the principle of insertional inactivation by giving a suitable example.

Q.18 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 pertridishes containing normal cells?

Q.19 a) State two ways by which protoplast fusion can be achieved.

b) Suggest a method for selection of the resulting hybrid cells.

Q.20 What are the three main enzymes and their role in rDNA technology.

Q.21 What are Database retrieval tools ? Name and explain the use of the tool used to classify a newly discovered species.

Q.22 Differentiate between monoclonal and polyclonal antibodies. Why are monoclonal antibodies selectively used in the detection of infectious diseases such as AIDS?

OR

Antibodies generated from hybridoma technology differ in their specificity from antibodies raised in animals against antigen immunization. Explain.

Q.23 A bactrial culture contains 10^8 cells/mL in the beginning. Two hours later it was found to contain 10^{12} cells/mL. Calculate.

(i) Specific growth rate of the culture.

(ii) Doubling time

Q.24 You have the gene sequence of a protein which has proteolytic activity. How will you establish through tools of Bioinformatics that this protein.

(i) has homologues in other organisms

(ii) belongs to the chymotrypsim family

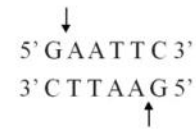
Q.25 A plasmid vector has restriction sites for only Bam HI and Eco RI.

Bam HI recognizes the sequence below and cleaves at

5' G↓G A T C C 3'

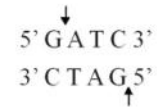
3' C C T A G↑G 5'

the positions indicated by the arrows. Eco RI recognizes and cleaves the following sequence



Explain with the help of a diagram which of these two restriction enzymes you would use to cut the plasmid vector in order to join a DNA fragment that has been digested with Sau 3 A.

Sau 3A recognizes and cleaves the sequence



Q.26 Explain the principle and the steps involved in the Sanger's method of DNA sequencing

OR

Explain why the Sanger's method requires a single stranded DNA and how this is produced. Also discuss why this method is also known as chain termination method.

Q.27 What do you understand by the term GRAS? Give atleast 4 examples of organisms under GRAS. Describe how Streptomycin can be commercialy prepared from S.gresius.

OR

a) Discuss how you will go about discovering a strain for production of penicillin.

b) Comment on how strain improvement can be achieved.

c) How can a high - yield strain be preserved for future use?

Q28. State any five categories of protein Based products. Give one example under each category along with its application.

Marking Scheme

Sample Paper II

BIOTECHNOLOGY

CLASS - XII

Q. No.	Value Points	Marks	T. Marks
1.	$CwHxOyNz+aO_2 + bHgOhNi \rightarrow cCH\alpha O\beta Ny + dCO_2+eH_2O$	1	1
2.	(i) pH (ii) Osmolality	½x2	1
3.	Fresh medium replenishes growth nutrients and dilutes waste products in old media that inhibit growth.	½x2	1
4.	A auxin, B cytokinin	½x2	1
5.	CO_2 in the incubator is essential for maintaining pH of animal tissue culture media. HCO_3/CO_2 buffer system.	1	1
6.	(i)mRNA transcript of a single gene can vary in sequence due to splicing & editing. (ii)Translated proteins can undergo various modifications.	1x2	2
7.	(i)A is DNA, B is mRNA (ii)Yes; No loops in DNA will be seen because prokaryotic genes have no introns.	1x2	2
8.	SNP or single nucleotide polymorphism indicates a nucleotide position in a gene that may be represented by any other nucleotide even in closely related individuals or in a population. SNPs can be used to track criminal, or identifying patients responding to a particular medicine.	1x2	2
9.	Bt cotton is genetically engineered to produce a toxin which kills insect pests which eat the plant. Bees and butterflies only forage for nectar in flowers and do not eat any part of the plant. So, do not die. OR Bt being species specific so non target organisms are not affected	1x2	2
10.	Liquid nitrogen provides low temperatures of - 170°C to inhibit all metabolism in cells and preserve them as they were. Glycerol enters the cells preventing damaging ice crystal formation.	1x2	2
11.	(i) 5×10^9 cells. (ii) 2.5×10^{-9}m3 or 2.5×10^{-3} mL or 2.5 µL	1x2	2

12. (i) Sequences anode to cathode is 5'–3' 1x2 2

(ii) 5' G C T A T C G G A T G 3'

13. Most secondary metabolites such as alkaloids, resins, tannins, etc are non-proteinaceous and often require more than one gene/ enzyme for their synthesis. Therefore it is easier to culture the tissues that naturally overproduce these products *in vitro*. 1x2 2

14. Use the sequence from ribonuclease gene of Arabidopsis to make a synthetic labeled probe. 1x2 2

The probe is used to identify the ribonuclease gene containing clone from a tea plant library.

15. Organogenesis: formation of organs from cultured explants. 1x2 2

Somatic embryogenesis : totipotent cells may undergo embryonic pathway to form somatic embryos leading to complete plants.

16. Whey proteins elevate the tripeptide glutathione levels in cells. 1 3

Glutathione is a reducing compound, inhibits HIV from multiplying there by reducing viral load. 2

17. Insert foreign gene by recombinant technology into lac Z gene. 1 3

Plate cells including transformants onto x-gal agar. 1

Transformants will contain interrupted Lac Z gene which will not produce B-galactosidase. So, transformed colonies appear white. 1

18. Cancerous cell cultures appear different from normal cells.

(i) The are more rounded. 1x3 3

(ii) They pile on each other showing no contact inhibition.

(iii) They multiply faster.

19. (a) Use of fusogenic agents like PEG (polythylene glycol) (ii) by electro-fusion 1x2 3

(b) Use of different antibiotic markes of fluorescent dyes for two different protoplasts.

or

morphology and moleculas analysis (e.q.) RAPD) (1)

20. Restriction enzymes cut DNA specifically; DNA ligase joins DNA fragments; Alkaline phosphatase removes 5' phosphate from the vector to prevent its self ligation. 1x3 3

21. Allow access to literature (abstracts) sequences and structures. 1 3

ENTREZ is a useful retrieval tool which provides information on taxonomic classification 1x2

22. Monoclonal antibodies bind to specific epitopes or domains on antigens and are produced by a single clone of hybridoma cells. Polyclonal antibodies recognize several domains and are found in serum of animals immunized with the antigen. 2 3

A monoclonal antibody against a unique domain of a AIDS viral protein would specifically detect AIDS patients. 1

CHOICE

Animal sera contain polyclonal antibodies. Hybridoma technique generates monoclonal antibodies. Polyclonal antibodies bind several different domains in an antigen whereas monoclonal antibodies bind only to one domain and hence are more specific. 2 3 1

23. (i) 4.606 h^{-1}
(ii) 0.150 h 1½x2 3

24. (i) Gene Sequence of given proteolytic enzyme → BLAST search → Find out → Homologous sequences in other organism 1½

(ii) Look for Conserved catalytic Find Whether belongs to domain of chymotrypsin or to chymotrypsin family ½ 3

25. Bam HI will cut the plasmid vector to generate staggered ends which can base pair with the staggered ends generated in the DNA fragment cut with Sau 3A due to complementary base pairing and hence ligation occurs. 1x5 5

Explained with diagram - 3

without diagram - 1½

correct choice - ½

26. (i) The DNA fragment to be sequenced is denatured and single strands are separately sequenced.

(ii) Four tubes containing small amounts of dd TTP, dd ATP, ddCTP dd GTP respectively in each tube are set up. The DNA strand, polymerase, primers and dNTPs are added to each tube.

(iii) Fragments of various length are generated in each tube depending on point of dd NTP incorporations. These are electrophoresed separately after which an autoradiogram is prepared.

(iv) The sequence is read off from the autoradiogram from anode to cathode (5'-3')

(v) Complementory sequence is deduced and then reversed end to end to obtain 5'-3' sequence of original strand. 1 x 5

CHOICE

(i) Sangers method involves elongating a primer annealed to a single parental strand. 1

(ii) Alkaline denaturation and electrophoresis will give single strands. 1
Also cloning using M 13 phage provides single strand. (Any one)

(iii) dd NTPs being low in concentration are incorporated randomly at the complementary nucleotide position. dd NTPs have no-OH at the 3'(1½x2) position for further elongation. The elongating chain terminates. Hence method known as chain termination method: 5

27. Generally regarded as safe. 1

E.coli, S.cerevisase, Lactobacillus, B. subtilis 1

To prepare streptomycin : Fermentation → Drum filter → Clear broth 1½ 5

liquid extraction → purification → Crystallization. 1½

CHOICE

i) Microbes present in natural habitats such as aquatic environment, soil etc have to be isolated and screened for penicillin production. 2
Microarray methods also used if genes involved are known. ½

ii) Strain improvement achieved using classical gentics and genetic engineering (1½)

iii) Cryopreservation defined 1

28. (i) Blood products and vaccines, e.g. Factor IX for treating haemophilia □½x8 5

(ii) Therapeutic antibodies and enzymes eg Monoclonal antibodies
OKT-3 for preventing graft rejection

(iii) Therapeutic hormones and growth factors e.g. Insulin to treat diabetes.

(iv) Regulatory factors. eg Interferons for antiviral properties.

(v) Analytical applications. e.g. Horse.radish peroxidase for ELISA

(vi) Industrial enzymes. e.g. Papain for meat tenderisation.

(vii) Functional non catalytic proteins. e.g. Kappa casein for milk protein stablization.

(viii) Nutraceutical proteins. eg Infant food formulation to provide adequate nutrition for infant.

(Any Five)

Naming with example 2½ 5

Stating the applications 2½