SMART SKILLS

2020-21

CLASS XII

BIOTECHNOLOGY

Table of Contents

Chapter 1

RECOMBINANT DNA TECHNOLOGY

1 mark each

1) Give the full form of BAC and YAC.
2) Define Palindrome.
3) Name the source of EcoRI. What type of ends does it create?
4) What is meant by a recombinant DNA?
5) Give the meaning of Cosmids.

2 marks each

1) Describe Restriction Modification System.
2) Differentiate between blunt and sticky ends.
3) What are restriction enzymes? Give their types and use in genetic engineering.
4) Discuss the importance of expression and shuttle vectors.
5) Discuss the commonly used hOst cells in the area of rDNA technology. What are the advantages of using Yeast as host cells?

3 marks each

1) Differentiate between a Genomic and cDNA library.
2) Explain briefly the use of M13 as a vector.
3) All vectors are plasmids but not all plasmids are vectors. Discuss highlighting the desirable features of a vector.
4) Discuss the method and importance of RFLP.
5) Describe Insertional inactivation as a method of selection of transformed cells.

5 marks each

1) Describe the various steps and applications of PCR.
2) Discuss briefly the various methods of introducing rDNA into the host cell.
3) Explain the method and applications of Southern Hybridization.
4) Describe Sanger's method of DNA sequencing. Why is it that the sequence we read is not the sequence of the original strand?
5) Make a flow chart of construction of an rDNA molecule *in vitro*.

Chapter 2

PROTEIN STRUCTURE AND ENGINEERING

1 mark each

1) Give the full form of SCID and GRAS.
2) What are Interferons? Where are they used?
3) Define intra cellular and extra cellular proteins.
4) Name the proteins involved in breathing and protection from antigens.
5) Give 1 functional property and its application of whey proteins.

2 marks each

1) Describe briefly BV and PER.
2) Differentiate between essential and non essential amino acid giving 2 examples under each category.
3) What are Neutraceutical proteins?
4) Number of genes and number of proteins share a nonlinear relationship. Explain.
5) Write a short note on Prions.

3 marks each

1) What is meant by molecular pharming? What are the advantages?
2) Discuss the technique of aquas two phase partition.
3) Describe the cause and method of detection of a molecular disease.
4) Differentiate between MALDI and ESI.
5) Discuss taking an example, designing proteins by protein engineering
6) Make a flow chart of the downstream processing of an Intracellular metabolite.

5 marks each

1) Describe in detail the structure function relationship in proteins.
2) Discuss any five areas of applications of protein based products.
3) a) A bacterium produces a protein of interest (Mol.Wt. =6000D) at the rate of 2000 molecules /cell. To purify 4 Gms of protein how many cells would be needed?

   (b) Assuming that the bacterium is a cylinder (d=2µm, h=6µm) calculate the packed cell volume for the production of 6 Gms of protein, and the volume of the fermentor if the maximum cell concentration is 6%.

Chapter 3

GENOMICS AND BIOINFORMATICS

1 mark each

1) What is PAM?
2) Define and give 1 example of a data retrieval tool.
3) Name the scientist who sequenced the human genome.
4) What is meant by genome?
5) Give the full form and location of TIGR.
6) What is Philadelphia chromosome?

2 marks each

1) Differentiate between structural and functional genomics.
2) Give the 2 properties of biological data that played a key role in the development of Bioinformatics.
3) Describe the method of directed sequencing of BAC contigs.
4) What is random shotgun sequencing?
5) In Bioinformatics, how do we determine whether a given sequence is DNA, RNA or protein?

3 marks each

1) Discuss the principle, procedure and applications of SNP analysis.
2) Explain BLAST family of search tools.
3) Give the location and importance of EMBL and EBI.
4) Describe the concept of directionality in bioinformatics. Add a note on the importance of NCBI.

5 marks each

1) Describe taking an example the use of comparative cDNA Microarray.
2) Discuss in detail the various types of sequences that you can come across in the area of Bioinformatics.
3) Give any 5 kinds of analysis that is possible using the tools of Bioinformatics.

Chapter 4

MICROBIAL CULTURE AND APPLICATIONS

1 mark each

1) What is antifoam? Give 1 example.
2) Give the full forms of TSB and BHI.
3) Name the metabolic process of Yeast which is responsible for production of alcohol.
4) What is *in situ* sterilization? How is it done?

2 marks each

1) What are the carbon sources and growth factors for microbial cultures? What is their importance?
2) What is the importance of measuring and knowing the kinetics of microbial growth?
3) What is the importance of culture collection centers?
4) Explain briefly the method and importance of strain isolation.

3 marks each

1) Describe along with a diagram the structure and working of a fermentor.
2) Explain the types of microbial cultures.
3) How is microbial growth measured?
4) Discuss the methods and importance of strain improvement.
5) Make a flow chart of downstream processing of an intracellular metabolite.

5 marks each

1) Describe the applications of microbial cell culture technology.
2) Describe the various ethical issues related to microbial culture technology.
3) Taking an example, describe the various equations used to calculate the specific growth rate.

   Recombinant insulin is produced at the rate of 100mg/L by *E.coli* at a cell concentration of 1g/L. Calculate the size of fermentor needed to produce 2 Kg of insulin when the cell concentration is 50mg/L and insulin production is 100mg/gm of cells.

Chapter 5

PLANT CELL CULTURE AND APPLICATIONS

1 mark each

1) What is a Callus?
2) Define Totipotency.
3) Give the full form and importance of Ti plasmid.
4) What is micropropogation?
5) Give the source and use of Vincristine.
6) What is a gene gun?
7) Give the full form and importance of PHB.
8) What are antifreeze proteins? How are they useful?

2 marks each

1) What are somaclonal variations? How are they different from gametoclonal variations?
2) Differentiate between somatic hybrids and cybrids.
3) Discuss briefly artificial seeds and embryo rescue.
4) Explain the 2 plant regeneration pathways.
5) Write a short note on the types of plant cultures.

3 marks each

1) Discuss the various steps of plant tissue culture technique.
2) Taking an example discuss the concept and importance of inducing and restoring male sterility in plants.
3) Discuss briefly : Golden rice ,Flavr Savr Tomato , Pomato
4) Define germplasm.Explain the 2 methods of germplasm conservation.
5) Describe molecular breeding. What are the 3 types of markers used in the area?

5 marks each

1) Describe in detail the commonly used vector mediated gene transfer method in plants. What is meant by disarming of the vector?
2) Explain the various ethical issues in the area of plant biotechnology.
3) Discuss any 5 beneficial traits for which transgenic plants have been created.

Chapter 6

ANIMAL CELL CULTURE AND APPLICATIONS

1 mark each

1) What are Interferons?
2) Define contact inhibition.
3) Give the full form and use of DMSO.
4) Define Pluripotent.
5) Give the full form and importance of PGDF.

2 marks each

1) Differentiate between monoclonal and polyclonal antibodies.
2) What are the two characteristic properties of stem cells?
3) Briefly explain microcarrier beads and roller bottle.
4) What is t-PA? What is its use?
5) Differentiate between anchorage dependent and anchorage independent cell cultures.

3 marks each

1) Discuss the Hybridoma technology.
2) Explain the importance of OKT3.
3) Describe long term marrow culture.
4) What is CFU-S? Describe the principle and procedure of the method.
5) What is a cell line? Briefly describe the two types of cell lines.

5 marks

1) What are ICM cells? Describe their properties and importance.
2) Discuss the ethical issues in the area of animal cell culture technology.
3) Discuss in detail the principle, method and importance of characterization of cell lines.

Sample Question Paper
Class: XII
Biotechnology (Theory) (2017-18)
Sub Code: 045

Time: 3 Hours Max. Marks:70

General Instructions:
- All questions are compulsory
- Question paper consists of 4 sections A,B,C and D
- Question numbers 1 to 6 are very short answer questions each carrying one mark
- Question numbers 7 to 14 are short answer questions each carrying two marks
- Question numbers 15 to 25 are also short answer questions each carrying three marks
- Question numbers 26 to 28 are long answer questions each carrying five marks
- 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.
- Use of calculators is not permitted .However, you may use log tables, if necessary.

	SECTION A	
1.	Specify the role of "cos" sites in bacteriophage lambda.	1
2.	Expand and define PER.	1
3.	What would be the effect of an aqueous environment on the bond strength of ionic bonds between amino acid residues in a protein?	1
4.	How is lipofection used to deliver genes into cells?	1
5.	Name the scientists who were first to introduce trypsin for the sub culturing of adherent cells.	1
6.	Write any one distinguishing feature of pBR 322 and pUC19 vectors.	1
	SECTION B	
7.	What is meant by tissue engineering?	2
8.	How does the metagenomics approach help to identify novel genes present in the environment? Explain the process.	2
9.	Explain various plant regeneration pathways.	2

10.	A researcher wants to introduce a desired gene into a specific host cell .Write any two methods that can be used for the same.	2
11.	Differentiate between somaclonal variations and gametoclonal variations. Who proposed the term "Somaclones" for plant variants?	2
12.	*C.elegans* a eukaryotic organism with a genome of 97 Mb and about 20,000 genes. Why does organizational features of this genome are unusual when compared to the genomes of other eukaryotes, such as yeast and *Drosophila*?	2
13.	Highlight graphically the differences between culturing microbes in the school laboratory and a bioreactor which allow cells to grow in a continuous culture system.	2
14.	How can you maximize protein stability during purification? Write any two parameters for the same.	2
	SECTION C	
15.	Discuss the various types of shapes & structures that a protein takes to make a functional protein .Write various forces responsible for these structures.	3
16.	Outline the process of creation of chimeric mouse by embryonic stem cell culture.	3
17.	What is a DNA probe? Explain the principle of Sanger's method of DNA sequencing.	3
18	Expand BLAST. Differentiate between Homologues and Paralogs.	3
19.	You have succeeded in purifying a protein from yeast .Name a technique you would use and the principle behind it for determining the molecular mass of this protein .	3
20.	Explain the methods which can be used for the scaling up of animal culture.	3
21.	State any three advantages of using *Pichia pastoris* as a eukaryotic expression host.	3
22.	How would you detect a specific microbial contamination from a given water sample using PCR. Give a brief explanation of the process.	3

23.	Following are few transgenic crops approved by U.S.F.D.A .Identify 'a' , 'b' and 'c' and complete the table.	3

Crop	Gene(s) introduced	New/Improved Character	Developer
Canola	a	High laurate oil	Calgene
Corn	EPSP synthase	b	Monsanto
Cotton	Acetolactate synthase	Weed Control	c

24.	Rohan cultured *streptococcus* bacteria in his lab to check whether it is gram positive or negative and then he threw the culture directly in dustbin. Is this method of disposal ethically and ecologically safe?	3
25.	What are edible vaccines? How are they better than conventional vaccines? Give any two points. OR What are somatic hybrids? How are they produced?	3
	SECTION D	
26.	What are type II restriction endonucleases ? Give an example of a type II restriction endonucleases that generates flush ends and the sequence recognized by it. Explain how are they named. Name any other enzyme and its utility in cloning experiment.	5
27.	Name the technique developed by O' farrel. Schematically depict key steps in the separation of proteins using the technique. Highlight the basis of separation at each step. OR Classify protein based products. Give one example under each category along with its application. How are these useful to the biotechnology industry?	5
28.	Explain how cDNA microarray technique can be used to study cellular response to the environment? Support your answer with a flowchart for the same. OR a)Which information can be retrieved from the following databases? i)EMBL ii)PDB iii)PALI b)Give two reasons for completely sequencing a genome.	5

Marking Scheme of Sample Question Paper
Class: XII Biotechnology (Theory)
(2017-18) Sub Code: 045

<table>
<tr><td></td><td>SECTION A</td><td></td></tr>
<tr><td>1.</td><td>“cos” sites are important for packaging DNA into phage head.</td><td>1</td></tr>
<tr><td>2.</td><td>Protein Efficiency Ratio

PER is used as a measure of growth expressed in terms of weight gain of an adult by consuming1g of food protein.</td><td>½

½</td></tr>
<tr><td>3.</td><td>The bond strength decreases due to the insulating properties / dielectric strength of water.</td><td>1</td></tr>
<tr><td>4.</td><td>Gene is transferred with the help of tiny vesicles of bipolar phospholipids that fuse with the cell membrane, releasing the DNA into the cytoplasm.</td><td>1</td></tr>
<tr><td>5.</td><td>Rous and Jones.</td><td>1</td></tr>
<tr><td>6.</td><td>BAC YAC
<table><tr><td>Effective in Bacteria</td><td>Effective in Yeast</td></tr><tr><td>It has genes for maintenance and replication of F-factor

Can accommodate up to 300kb of DNA</td><td>It has telomere, centromere and ARS from yeast chromosome

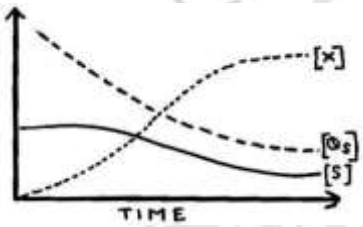
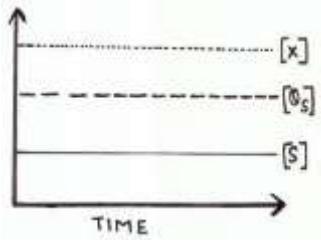
can be used for cloning DNA upto 1 MB in size.</td></tr></table>(Any two)</td><td>½

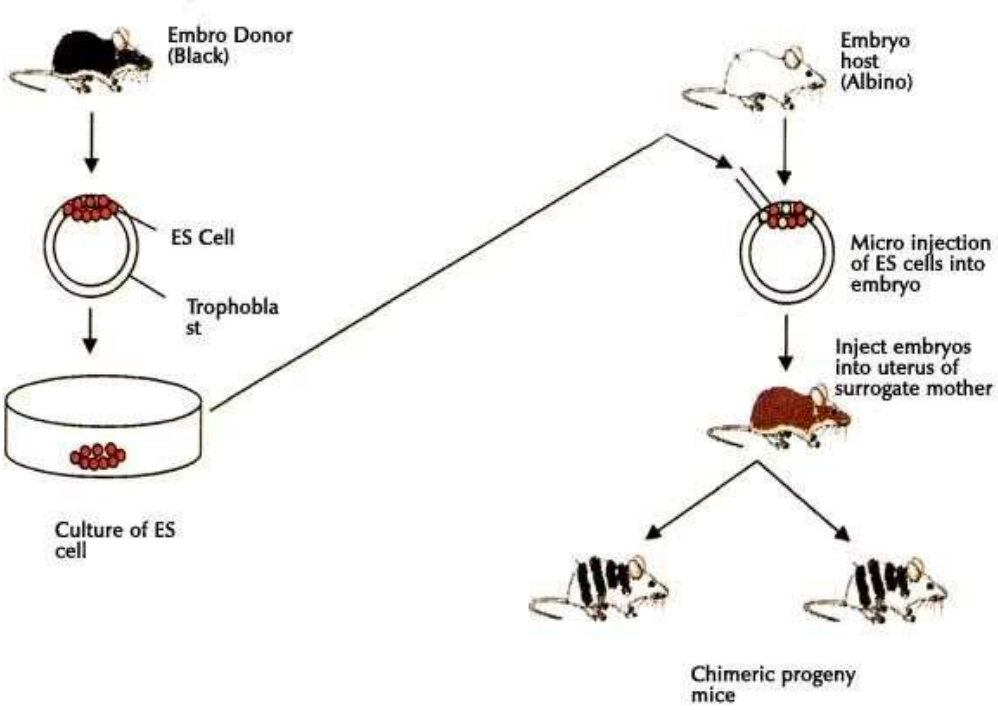
½</td></tr>
<tr><td></td><td>SECTION B</td><td></td></tr>
<tr><td>7.</td><td>Tissue engineering :Naturally derived or synthetic materials may be engineered into "scaffolds" that when implanted in the body could provide a template that allows the body’s own cells to grow and form new tissues
Such implants could function without triggering immune responses.
Genetically-modified animals may also provide a source of cells, tissues, and organs for xenografts</td><td>1

½

½</td></tr>
</table>

8.	Metagenomics approach has been developed to identify and select microbial genes synthesizing novel molecules. This approach directly utilizes the large number of microbial genomes present in an environmental niche, for example in soil, in water such as ocean or in human gut. These genomes are contributed by both the culturable and the non-culturable variety of microbes and together constitute what has been termed as metagenome The collective DNA is extracted from a sample of soil, water or any other environmental niche. It is subjected to restriction digestion using restriction endonucleases and the fragments are cloned into suitable vectors. The clones are then screened for presence of a variety of molecules.	1 1
9.	**Plant regeneration pathways** The plants can be regenerated by either **organogenesis** and **somatic embryogenesis**. **Organogenesis** means formation of organs like shoots from the cultured explants .Miller and Skoog experimentally proved that formation of shoot or root first on the cultured tissue depends on the relative concentration of auxin and cytokinin. If auxins are high in the medium, then it promotes rooting while if cytokinins are high, shoot formation is promoted. In **somatic embryogenesis**, the totipotent cells may undergo embryogenic pathway to form somatic embryos ,which can be grown to regenerate into complete plants. Generally, somatic embryos resemble the zygotic embryos (seed embryos) except in their place of origin and larger size. For the first time, Steward in 1958 and Reinert in 1959 independently reported the somatic embryogenesis from carrot cultures.	1 1
10.	1. Transformation : In this technique. we put the recombinant DNA in the medium having host cells .Host cells will uptake the desired DNA provided the host cells are competent . If they are not competent , we make them competent by treating it with the cold calcium chloride. Mandel and Higa proposed the technique in 1970. 2.Trasfection : The desired DNA is mixed with the cationic liposome's or dextran and layered on the host cells and is then taken inside by the host cells. 3.Electroporation :We pass electricity of desired voltage through the culture of the cells resulting in transient (temporary) pores in the cell membrane and through these pores DNA enters.	1 1

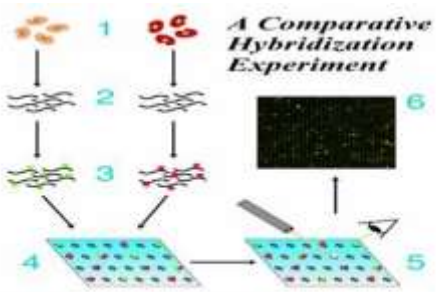
	4.Biolistics (Use of gene gun) : We use gold or tungsten particles and layer the DNA on them and bombard these bullets into the culture of the cells. 5.Use of modified bacteriophages to deliver the desired gene in the bacterial cell Use of modified *Agrobacterium tumefaciens* to deliver the desired gene in the plant cell (ANY TWO)	
11	Plants regenerated from long-term callus and cell suspension culture are often associated with chromosomal variations known as **somaclonal variation**. If the tissue from which the variants have been obtained is having gametophytic origin such as pollen or egg cell, **such variation is called Gamaetoclonal variation.** Larkin and Scowcroft (1981) proposed the term '**somaclones**' for plant variants obtained from tissue cultures of somatic tissues	½ ½ 1
12	It shows inaccuracy in gene prediction There is no correlation between the intuitive complexity of an organism with that of other eukaryotes Yeast encodes 70 percent of proteins whereas worm and fruit fly encode 20- 25%	½ ½ 1
13	Graph of batch culture Fig.5.Pg No.91 C.B.S.E  Graph of continuous culture Fig.7. Pg No.92 C.B.S.E  	1 1

14.	i)Maintenance of pH ii)Maintenance of physiological conditions (%CO_2, temperature) iii)Use of inhibitors to prevent the action of proteolytic enzymes iv)Avoidance of agitation or addition of chemicals which may denature the protein v)Minimize processing time (Any two)	1 1
	SECTION C	
15.	The non-covalent interaction involved in organizing the structure of a protein molecule. Proteins fold into secondary structure, α – helix, β- pleats. Secondary Structure undergo further folding into domains, motifs called tertiary structures. Multimeric proteins organized as Quaternary structures. Various forces responsible for these structures. Hydrophobic interactions , electrostatic interactions., Hydrogen bonding , van der waals forces are the non-covalent forces . (Any two)	2 1
16.	 	1 1 1
17.	DNA Probe: It is a small sequence of DNA that recognizes and blinds to its complementary sequence.	1

	Sanger's Method : Whenever ddNTP comes in the DNA synthesis , further synthesis of DNA stops. It must indicate the following reagents: - Single strand DNA which needs to be sequenced. -A primer with a free 3'-OH. -DNA polymerase -dNTPs -ddNTPs -Primer extension in 4 different tubes each containing a specific ddNTP at low concentration. -Termination at the point where ddNTP is incorporated. -Gel electrophoresis	2
18	BLAST :Basic Local Alignment Search Tool Homologues represent the similarity due to common ancestory and they will have same function Paralogs represent similarities due to random chance and may differ in function	1 1 1
19	Mass spectrometry. 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 .	1 1 1
20.	*Roller bottles* In roller bottles, the cells adhere to the total curved surface area of the micro carrier beads, thereby markedly increasing the available space for growth. These tissue culture bottles can be used in specialized CO_2 incubators with attachments that rotate the bottles along the long axis. After each complete rotation of the bottle, the entire cell monolayer has transiently been exposed to the medium. The volume of medium need only be sufficient to provide a shallow covering over the monolayer . *Micro carrier beads* These beads are used to increase the number of adherent cells per flask and are either dextran or glass-based and come in a range of densities and sizes. The beads are	1 1

	buoyant and therefore can be used with spinner culture flasks. The surface area available for cell growth on these beads is huge Microcarrier beads when re-suspended at the recommended concentration provide 0.24 m^2 for every 100 ml of culture flasks. Under these conditions adherent cells can be grown to very high densities before crowding becomes a problem. Cells growing at such high densities will rapidly exhaust the medium, which may need replacing during culture. *Spinner cultures* Spinner cultures are used for scaling up the production of suspension cells. They consist of a flat surface glass flask with a suspended central teflon paddle that turns and agitates the medium when placed on a magnetic stirrer. Commercial versions incorporate one or more side arms for sampling and/or decantation. The cells are not allowed to settle to the bottom of the flask and thus cell crowding occurs only at very high densities. Stirring the medium improves gas exchange .	1
21	Advantages of *Pichia pastoris* as a eukaryotic expression host: a)Has strong inducible promoters b) Is capable of making posttranslational modifications c) Downstream processing is simpler as *Pichia* does not secrete its own proteins into the fermentation medium	 1 1 1
22	Selective amplification of microbial gene (in test water sample) using microbe specific primers by PCR. Principle of PCR: Selective Amplification by designing suitable primers to include the sequence which is to be amplified. It was invented by Kary Mullis. Basic steps should include Denaturation: It involves the heating of DNA above 80 degree Celsius which results in the breaking of hydrogen bonds present between two strands , resulting in two different individual strands. Annealing: It involves the hybrization of two primers at 3' region of each strand. Extension/Polymerization – It involves the addition of ddNTP to the 3' region of each strand with the help of Taq polymerase(DNA Polymerase) resulting in complete DNA molecule.	 1 1 1
23	a)Thioesterase b)Weed control c)DuPont	1 1 1
24	No It may cause infections leading to health problems Mutations may convert even harmless strains to potentially dangerous ones	1 1 1

25.	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. Edible vaccines offer following advantages over conventional vaccines. (Any two) 1. Low cost 2.Alleviation of storage problems 3.Easy delivery system by feeding (any other relevant point) OR Plants raised by tissue culture of somatic hybrid cells formed by fusion of plant cell protoplasts are called as somatic hybrids. Procedure: Isolation of plant cell protoplasts and their fusion. Selection of hybrid cells and raising by plant tissue culture	1 1 1 1 2
	SECTION D	
26.	R.E. type II recognize a specific DNA sequence and cut within the sequence generating sticky/flush ends. In recombinant DNA technology , we use type II RE as they are highly specific in their action. Alu I with the restriction site 5' - AGCT'-3 (Make it double stranded) Nomenclature: Eco R I with the restriction site 5'-GAATTC-3' (Make it double stranded) Nomenclature with one example The first letter indicates the genus of the organism The second two letter indicates the species name. The next letter indicates the strain name The next roman letter indicates the order of discovery. Eco R I - E indicates the genus" Escherichia" The second two letter indicates the species "coli" name. The next letter indicates the strain "Rd " name The next roman letter i.e. I indicates the order of discovery The functions of a) Alkaline phosphatase/ b) DNA ligase. The role of alkaline phosphatase is to prevent self re-ligation of the vector /The role of DNA ligase is to make 3'-5' phosphodiester bond. (Any one)	 1 1 2 1

27.	2D – Gel electrophoresis As two components (IEF and SDS –PAGE) are carried at right angle to each other , thereby increasing the resolution . Principle of IEF- Separation of the proteins is on the basis of their pIs. Ampholytes (Polyamino-Polycarboxylic acids) are used in generating the pH gradient. SDS-PAGE- Separation of the proteins is on the basis of their molecular mass Silver stain is used as a staining dye 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 five) 1x5	1 1 1 ½ 1 ½ 5
28.	Cellular response to the environment can be studied by comparing the amounts of many different mRNA in normal and affected cells(eg. Cancerous cells) (Explanation of preparation of microarray and cDNA microarray technique)  	2

3	Major steps involved in comparative microarray hybridization experiments between normal and affected (for example cancerous cells) :Indicate through diagram and label it and explain in points (Steps should include) 1. Choosing cell population and extracting m RNA. 2. Reverse transcribing the m RNA to get c DNA . 3. Flourescent labelling of c DNA. 4. Hybridization to a DNA microarray . 5. Scanning the hybridized array . 6. Interpretation of scanned image. ½ x 6(For steps) OR	
3	a) i) EMBL-Nucleotide sequence ii) PDB -3D structure of proteins iii)PALI -Phylogenetic analysis and alignment of proteins	
2	b) Provides a means of discovery of all the genes/ shows relationship between genes/ tools for future experimentation/ organizes all genetic information about organisms (Any two points)	

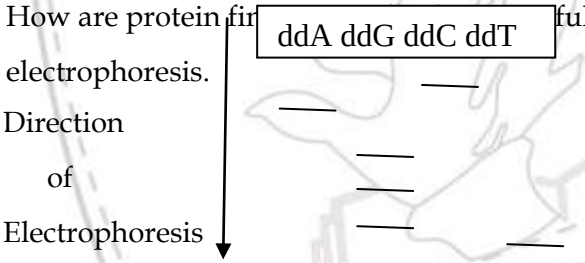
QUESTION BANK

RECOMBINANT DNA TECHNOLOGY

PROTEIN STRRUCTURE AND ENGINEERING

1. Protein chemists prefer to monitor absorbance of protein fractions eluting from a chromatographic column at 280 nm. Why?
2. Name any two naturally occurring enzymes which have a reactive serine at active site.
2. What is polylinker?
3. How are hydrogen bonds formed in proteins?
3. What decides the length of DNA strand in Sanger's chain termination method?
4. Indicate tow ways by which sickle cell anemia can be diagnosed. What is the molecular defect in these patients?
4. For recombinant DNA work, why are both cDNA and genomic DNA libraries used?
5. What are essential amino acids? Which among the casein, egg protein, soya protein, rice protein, wheat protein and whey protein is a better nutritional protein and why?
5. Why is it necessary to use high voltage in electroporation process?
6. An autoradiogram of a sequencing gel containing four lanes of DNA fragments is shown in the figure below. In the order ATCG
7. Give the sequence of the two primers (5-nucleotides long) required to amplify the following DNA sequence by PCR

5'- GCACCTAGATCGATCC-3'.



How are protein fingerprinting useful? Briefly indicate the principle of 2-D gel electrophoresis.

(i)Read the sequence from the autoradiogram.

(ii)Explain, why the sequence read from the autoradiogram is complementary to the original sequence?

8. Who first developed the protein sequencing method? Name the protein which was sequence first.

9. . Listed below are four different single strands of DNA. Which of these in their double stranded form would you expect to be cleaved by a restriction endonuclease and why?

i) ACTCCAGAATTCACTCCG ii)ACTCCACTCCCGACTCCG

iii) GCCTCATTCGAAGCCTGA iv)GAGCGGTTTATCTGAGCAG

10. In a recombinant DNA experiment, the transformed cells are sensitive to one antibiotic A and resistant to another antibiotic B. With a suitable diagram, explain how this can happen?

GENOMICS AND BIOINFORMATICS

1. Genome analysis has the potential to identify patients with disease susceptibilities. Explain.
2. In storing data related to protein and DNA sequences, why are single letter codes used? Mention the single letter code for G or T or C and A or C or T
3. Schematically depict the steps involved in Fluorescence in situ Hybridisation (FISH).
4. Why are sequence databases important? Name atleast three such databases and their uses.
5. Do you think 'in silico' based prediction techniques are accurate in genomics? Support your answer with reasoning.

विद्यया च विमुच्यते
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MICROBIAL CELL CULTURE AND APPLICATIONS

1. In large scale microbial culture media, olive oil or sunflower oil is an additive. What purpose does this serve?
2. With an equation, show that doubling time of microbes and their specific growth rate are inversely proportional.
3. Growth media for microbial growth is not always adjusted to pH 7. Why?
4. Why are mutagens used for microbial strains? Name any one mutagen.
5. A given Microbial species grows slowly. Of the two; specific growth rate (u) or doubling time (t_d), which one would be lower?
6. Why should selected microbial strains be preserved? Name any centre located in India which can be used as a repository for microbial cultures.

PLANT CELL CLUTURE AND APPLICATIONS

1 What is the main feature of suspension cultures? Give an example.

2 Which Plant is taxol derived from and what is its use?

3 To a stationary phase cell culture, a dose of hormone was added. No change in growth of cells resulted .Explain why?

4 Name the bacterium toxin, which is used to engineer crops resistant to bollworms.

5 What is the main feature of suspension cultures? Give an example.

6 Why is 'golden rice' nutritionally superior to normal rice?

7. What is meant by golden rice? In what why, it is different from normal rice?

8. 1. Fill in the blanks

(i) Rapid multiplication of plants by tissue culture techniques in referred to as…….

(ii) Gottlieb Haberlandt is known as father of ……

(iii) The most commonly employed gene transfer method in plants is ……(transfer through Agrobacterium tumefacians).

ANIMAL CELL CULTURE AND APPLICATIONS

1. In heart bypass surgery, blood vessels from other parts of patient are used to replace blocked coronary arteries instead of a donor. Explain.
2. What is main buffer system used in animal cell culture?
3. 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 or not?
4. In heart bypass surgery, blood vessels from other parts of patient are used to replace blocked coronary arteries instead of a donor. Explain.
5. What is gene knock out? How is this useful in generating genetic models of human disease?
6. What is meant by tissue engineering? Discuss some medical applications of tissue engineering.

MULTIPLE CHOICE QUESTIONS

1. A recombinant DNA molecule is produced by joining together
   1. one mRNA with a DNA segment 2. one mRNA with a tRNA segment

2. A gene produced for recombinant DNA technology contains a gene from one organism joined to the regulatory sequence of another gene. Such a gene is called
   1. oncogene 2. junk gene 3. chimeric gene 4. None

3. A group of genetically similar organisms obtained by a sexual reproduction is called
   1. Clone 2. Population 3. Assembly 4. None

4. To be useful in the preparation of recombinant DNA, a plasmid must have
   1. No origin of replication
   2. An origin of replication
   3. The ability to alternate between the linear and circular forms
   4. Restriction endonuclease activity

5. Restriction endonucleases have the ability of cutting
   1. DNA at random sites 2. DNA at specific sites
   3. Both a and b 4. DNA and RNA at random sites

6. Endonucleases, a group of enzymes cleave DNA
   1. Externally 2. Internally 3. Both 1 and 2 4. Neither a nor b

7. The extra chromosomal, self replicating, double stranded, closed, circular DNA molecules are called
   1. Plasmids 2. Phages 3. Viruses 4. Chloroplasts

8. A plasmid consisting of its own DNA with a foreign DNA inserted into it is called
   1. recombinant DNA 2. non-coding DNA
   3. junk DNA 4. none of the above

9. Insulin, a protein, consisting of
   1. 2 Polypeptide chains 2. 3 Polypeptide chains
   3. 4 Polypeptide chains 4. more than 4 Polypeptides chains

10. The first human protein produced through recombinant DNA technology is
    1. insulin 2. erythropoitin 3. interferon 4. somatostatin

11. Humulin, a genetically engineered insulin was produced for the first time by
    1. Biocon India Limited 2. Glaxo 3. Elililly and Company 4. Cipla

12. The first licenced drug produced through genetic engineering is
    1. interferon 2. insulin 3. penicillin 4. somatotropin

13. Before the production of recombinant insulin, insulin for the treatment of diabetes in human was obtained from
    1. healthy humans 2. dead human body
    3. cows and pigs 4. dogs and cats

14. The plasmid generally used for the production of recombinant insulin is

1. RK 646 2. Ti plasmid 3. ACY 17 4. pUC 18

15. In one of the techniques of recombinant insulin production the genes for α and β polypeptides were inserted into the plasmid by the side of
1. ori 2. β - galactosidase gene
3. antibiotic resistant gene 4. restriction endonuclease gen

16. During recombinant insulin synthesis, the bond between insulin polypeptide and galactosidase can be removed by using
1. cyanogen bromide 2. chymotrypsin
3. carboxy peptidase 4. amylase

17. Prior to the production of recombinant insulin, insulin obtained from cows and pigs were given to patients. Some of the problems faced by this treatment was
1. the insulin was not active
2. in some humans it induced antibody production
3. it reduces the weight of patients
4. loss of memory power

18. A plant called *Rauolfia serpentina* is under the threat of extinction. To save this plant, which technique is highly useful?
1. genetic engineering 2. DNA finger printing
3. hybridoma technology 4. in vitro culture

19. Which group of enzymes are popularly called "Molecular stichers"
1. restriction Endonuclease 2. ligases
3. RNA polymerase 4. DNA polymerase

20. A clone is a group of organisms produced by
1. asexual method and genetically similar
2. asexual method and genetically dissimilar
3. sexual method and genetically similar
4. sexual method and genetically dissimilar

21. Match the following:

1. Restriction endonuclease	p. Kary Mullis
2. DNA Finger printing	q. Kohler and
3. Polymerase chain reaction	r. Alec Jaffreys
4. Monoclonal antibodies	s. Arber

1. 1-s, 2-r, 3-p, 4-q 2. 1-s, 2-r, 3-q, 4-p
3. 1-q, 2-r, 3-p, 4-s 4. 1-s, 2-p, 3-q, 4-r

22. Some of the steps involved in Gene Cloning are given below i) Insertion of isolated gene to the vector
ii) Introduction of recombinant vector to the host iii) Isolation of desired gene
iv) Expression of recombinant gene in host v) Extraction of recombinant gene product

The correct sequence of steps involved are
1. iii, i, iv, ii, v 2. iii, i, ii, iv, v 3. i, ii, iii, iv, v 4. ii, i, iii, iv, v

23. A gene for insulin has been inserted into a vector for the purpose of obtaining its protein product only. Such a vector is called
1. expression vector
2. suppression vector
3. storage vector for genomic library
4. none of the above

24. Expression vectors are those
1. produce protein products
2. used for genomic libraries
3. used for chromosome synthesis
4. used for finger printing

25. *E. coli* is generally used for gene cloning because
1. it supports the replication of recombinant DNA
2. it is easy to transfor
3. it is free from elements that interferes with replication and recombination of DNA
4. all of these

26. An ideal plasmid to be used for recombinant DNA technology must have
1. minimum amount of DNA
2. relaxed replication control
3. one recognition site for one restriction endonuclease
4. all of these

27. Transgenic organisms are
1. produced by gene transfer technology
2. extinct organisms
3. naturally occurring and endemic
4. produced by traditional plant breeding technique

28. Transfer of recombinant plasmid into *E. Coli* cells needs
1. heat treatment 2. UV rays treatment 3. $CaCl_2$ treatment 4. lysis

29.
1. all vectors are plasmids only
2. plasmids, phages can be used as vectors
3. fungi can also be used as vectors
4. cyanobacteria can also be used as vectors

30. Which of the following statement about plasmids is correct?
1. plasmids are present in bacteria only
2. plasmids are present in all organisms
3. plasmids present in bacteria and phages
4. plasmids present in plants and animals

31. Which one of the following statement are <u>not</u> attributed to plasmids
1. they are circular DNA molecule
2. they have antibiotic resistant genes
3. they have the ability of autonomous replication
4. they have DNA that is as long as chromosomal DNA

32. Which one of the following statements about Restriction Endonuclease is true
1. all restriction endonucleases cut DNA at specific sites
2. all restriction endonucleases cut DNA at random sites
3. all restriction endonucleases join DNA segments at specific sites
4. all restriction endonucleases join DNA at random sites

33. Restriction endonucleases cut DNA at a specific site called
1. ligation site 2. ori 3. recognition sequence 4. replication site

34. Restriction endonucleases, when present in a host cell act on foreign DNA molecule and cleave them, but they do not act on host DNA molecule. It happens because
1. Restriction endonuclease cannot act on host DNA
2. Host DNA is packed into chromosomes
3. Host DNA is methylated hence restriction endonucleases can't act.
5. Restriction endonucleases become inactive when they reach host DNA

35. The presence of Restriction endonucleases were postulated in 1960 by
1. Khorana 2. Watson 3. Crick 4. Arber

36. The scientists who won nobel prize for physiology for their discovery of restriction endonucleases are:
1.Jacob and Monad 2. Smith, Nathans and Arber
3. Watson and Crick 4. Alec Jaffreys and Milstein

37. Restriction endo nucleases are also known as:
1. molecular scissors 2. molecular glue
3. buffer 4. molecular polymer

38. In restriction endonuclease EcoR1, "E" stands for
1. extraction 2. the first letter of the genus in which it is present
3. endonuclese 4. endangered

39. EcoR1 cleaves DNA at
a) $^{5/}G\ AATTC^{3/}$
b) $^{5/}GTT\downarrow AAC^{3/}$ $^{3/}CTTAA\ G^{5/}$
$^{3/}CAA\uparrow TTG^{5/}$
c) $^{5/}C\downarrow AATTG^{3/}$
d) $^{5/}GGGCC\downarrow T^{3/}$
$^{3/}GTTAA\uparrow C^{5/}$
$^{3/}CCCGG\uparrow A^{5/}$

40. Restriction endonucleases recognize specific sequences on DNA called
1. non-coding sequences 2. satellites
3. palindromes with rotational symmetry 4. tandem repeats

41. Main tools required for recombinant DNA technology are
1. vector, desired gene
2. vector, desired gene, mRNA of desired gene, host, restriction enzymes, ligases
3. desired gene, host, vector
4. vector, desired gene, mRNA of desired gene, host

42. An example for autonomously replicating mini chromosome is
1. virus 2. phage 3. plasmid 4. lichen

43. Which one of the following statements about plasmids is correct
1. plasmids are mobile
2. plasmids are made up of RNA and proteins
3. plasmids are present in eukaryotes
4. plasmids are present in fungi

44. DNA Ligase, used in recombinant DNA technology is obtained from
1. *E.coli* only
2. *E.coli* and also Ligase encoded by T_4 phage
3. *Saccharomyces*
4. retroviruses

45. DNA finger printing was first developed by
1. David Suzuki 2. Khorana 3. Alec Jaffreys 4. Gilbert

46. Using genetic technique in forensic science is also called
1. genetic finger printing 2. *In vitro* culture
3. hybridoma technology 4. gene therapy

47. A technique called southern blotting is used in
1. monoclonal antibody production 2. *In vitro* culture
3. genetic finger printing 4. polymerase chain reaction

48. Genetic finger printing is useful in
1. identifying the criminals involved in rape, murder etc.,
2. establishing the parentage of a disputed child
3. identifying illegal immigrants
4. all of these

49. RFLP is
1. restriction fragment length polymorphism
2. repeated fragment length polymorphism
3. renewed fragment length polymorphism
4. required fragment length polymorphism

50. VNTR is
1. variable nucleotide triplet 2.variable nucleoside tandem
3. variable nucleoside triplet 4.variable number of tandem repeat repeats

51. A small, 15-30 bases long nucleotide sequences used to detect the presence of complementary sequences in DNA sample during DNA finger printing is called
1. RFLP 2. Probe 3. VNTR 4. reporter gene

52. A radio active probe used in DNA finger printing contains
1. 32 p 2. 14 C 3. 12 N 4. pUC18

53. Electrophoresis, a technique used in DNA fingerprinting helps to separate

1. DNA segments 2. cells from DNA 3. Tissues 4. RNA from DNA

54. In DNA finger printing, even a smallest amount of DNA obtained from samples collected at crime place, can be multiplied into millions of copies by using a technique called
1. autoradiography 2. southern blotting
3. polymerase chain reaction 4. electrophoresis

55. In DNA finger printing, the DNA from the gel is transferred to for hybridization
1. nitrocellulose membrane 2. agarose 3. autoradiogram 4. PCR

56. Southern blotting is a technique used in genetic finger printing is called so because,
1. the blotting is done from the south side
2. it was discovered by a scientist, E.M. Southern
3. it was popular in South America 4. it was popular in sourthern countries

57. During DNA finger printing, DNA nucleotides hybridized with probe can be detected through
1. electrophoresis 2. polymerase chain reaction
3. autoradiography 4. hybridoma

58. DNA finger printing helps in
1. identifying illegal immigrants 2. detecting the real parent of child
3. detecting the suspect involved in crime 4. all of these

59. RFLP, VNTR, Probe are some of the terminologies associated with
1. hybridoma technology 2. tissue culture
3. DNA finger printing 3. none

60. Dolly, the first animal produced through cloning is
1. camel 2. rat 3. cow 4. sheep

61. Some of the steps involved in DNA finger printing are listed below
I. Extraction of DNA II. Collecting the sample
III. Treating DNA with REN IV. GEL Electrophoresis
V. Transfer segments of DNA to nitrocellulose membrane
VI. Hybridize with probe
VII. Autoradiography.

The correct sequence is __

1. ii, iii, iv, vi, v, i, vii 2. ii, i, iii, vi, v, vi, vii
2. iv, i, ii, v, iii, vi, vii 4. i, iv, v, ii, iii, vi, vii

62. An aged person is suffering from Atherosclerosis. Since conducting a surgery is very difficult due to his old age, which of the therapies can be adviced to him to overcome the problem?

1. gene therapy for Anticoagulent
2. gene therapy for the formation of angiogenic factors
3. both 1 and 2
4. genetics and finger printing

63. Gene therapy can be made highly effective by conducting
1. gene therapy for each and every tissue
2. gene therapy through injecting modified cells
3. gene therapy for stem cells and bone marrow cells
4. genetics and finger printing

64. Gene therapy, a technique that helps in
1. saving endangered species 2. curing genetic disorders
3. clonal propagation 4. producing monoclonal antibodies

65. In 1990, the first gene-therapy was conducted on a 4 year old girl in US. The girl was suffering
1. AIDS 2. CANCER 3. SCID 4. Malaria

66. SCID, a disease can be cured by Gene therapy is due to the deficiency of
1. ADA enzyme 2. Insulin 3. Glucagon 4. Dystrophin

67. Gene therapy, a technique to cure inherited diseases by
1. repairing the faulty gene
2. introducing the correct copy of the gene
3. adding new cells to the body
4. polymerase chain reaction

68. During gene therapy, the possible ways through which the genes can be introduced into the cell are
1. micro injection 2. some viruses 3. both 1 and 2 4. erythrocytes

69. In one type of gene therapy, functional genes are introduced into the sperm or the egg. This is called
1. somatic cell gene therapy 2. germline gene therapy
3. vegetative cell gene therapy 4. gametic gene therapy

70. In somatic cell gene therapy, the functional genes can be introduced into
1. sperm 2. egg 3. any body cells 4. germinal cells

71. The genes introduced through somatic cell gene therapy are
1. heritable 2. non-heritable 3. partially heritable 4.none of these

72. During the recent tsunami disaster a child was separated from its parents in Srilanka. Later with the help of technique the child was made to reunite with its true parents. The technique is
1. DNA finger printing 2. gene therapy
3. tissue culture 3. hybridoma technology

73. Fearing that the child to be born may have a genetic disorder, a couple goes to a doctor. Which one of the techniques will be suggested by the doctor cure genetic disorder?
1. hybridoma technology 2. gene therapy
3. ELISA 4. DNA finger printing

74. The work 'Hybridization' in DNA finger printing means
1. pairing between the nucleotides of DNA sample with probe
2. pairing between the nucleotides of DNA and mRNA
3. pairing between the nucleotides of probe with mRNA
4. pairing between the nucleosides with mRNA

75. The main aim of human genome project is
1. to identify and sequence of all the genes present in the human body
2. to introduce new genes to human beings
3. to remove disease causing genes from humans
4. to improve techniques of finger printing

76. Bt cotton is a
1. a cotton variety obtained by crossing two different cotton plants
2. a cotton variety brought from South America
3. an insecticide sprayed on cotton plant
4. a transgenic cotton variety

77. In biotechnology, mass culturing of cells / microbes can be achieved by using
1. Test tube culture 2. Bioreactor 3. Autoclave 4. electrophoresis

78. A device in which a substrate of low value is utilized by living cells or enzymes to generate a product of higher value is called
1. bioreactor 2. test tube culture 3. electrophoresis 4. chromotography

79. A bioreactor known for mass culturing of cells / microbes must have
1. agitation for mixing of cells and medium
2. sterile conditions
3. regulation of temperature, aeration, etc.,
4. all of these

80. Bioreactors are used for
1. large scale production of desired substances by using cells / micro bes
2. kill bacteria 3. to store viruses 4. to get chemicals

81. The basic components of tissue culture media are
1. micro and macro nutrients, glucose
2. micro and macro nutrients, vitamins, agar
3. micro and macro nutrients and growth regulators, glucose
4. micro and macro nutrients, growth regulators, agar, vitamins, glucose

82. Agar agar is added to tissue culture media as
1. carbon source 2. a growth regulator
3. nitrogen source 4. solidifying agent

83. Agar agar, used in plant tissue culture is extracted from,
1. a fungi 2. a bacteria 3. an algae 4. a virus

84. Glucose is added to the tissue culture media as
1. growth regulator 2. carbon source
3. solidifying agent 4. an antibiotic

85. Explant is
1. any cut part of the plant used in tissue culture
2. a plant extract used in tissue culture
3. a source of growth regulators added to media
4. solidifying agent

86. Totipotency refers to
1. the ability of a plant cell to arrest the growth of a plant
2. the ability of a plant cell to develop disease in plant
3. the ability of a plant cell to develop into a complete plant
4. the ability of a plant cell to develop into a callus

87. Somatic embryos are
1. embryos developed from zygote after fertilization
2. embryos developed from egg without fertilization
3. embryo like structure developed from the cells of callus
4. embryo developed by ovules

88. In vitro culture of plant parts need
2. aseptic
3. maintenance of pH
4. all of these

89. An amorphous mass of loosely arranged thin walled parenchyma cells developing from explant is called
1. thallus 2. callus 3. callose 4. embryoids

90. The unique feature of callus is
1. it gives rise to cells only
2. it can give rise to zygotic embryos
3. it can give rise to root, shoot and embryoids
4. it can give rise to flowers directly

91. Meristem culture helps in
1. hybrid plants
2. virus free
3. disease resistant plants
3. tall plants

92. Genetic variation observed in callus obtained from tissue culture is called
1. morphogenesis
2. rhizogenesis
3. callogenesis
3. somaclonal variation

93. The name "Golden rice" is given to a rice variety because
1. it contains traces of gold
2. it is obtained from areas where gold mining is done
3. the seeds are golden yellow in colour because of the presence of β – carotene
4. it is made of gold

94. Golden rice is
1. hybrid rice developed by traditional plant breeding
2. a rice variety obtained by plant tissue culture
3. a rice variety obtained by recombinant DNA technology
4. hybrid rice developed by DNA finger printing

95. Golden rice a rice variety was developed by

1. Ingo Potricus and Peter Beyer 2. Alec Jaffreys and Kary Mullis
3. Jacob and Monad 4. Landsteiner and Weiner

96. Genes required to transfer a rice plant into "Golden rice" were obtained from
1. carrot
2. a plant called Daffodil and a bacterium called *Erwinia*
3. *E.coli* and Daffodil
4. sunflower and cotton

97. The golden rice is produced to help people suffering from
1. beri beri 2. scurvy 3. xerophthalmia 4. AIDS

98. A transgenic plant "Golden rice" consists of foreign genes that produces
1. β - Carotene 2. niacin 3. 4. nicotinic

99. The "Golden rice", aimed at
curing
2. vitamin a
3. vitamin k deficiency
4. zinc deficiency

100. The vector used to transfer gene to produce "Golden rice" is
1. pBR322 2. pUC18 3. Ti plasmid 4. Phage

101. A variety of rice plant, into which genes were transferred to produce "Golden rice" is

1. IR-22 2. Basmathi 3. Taipe-30 a 4. Sona

102. The objections raised by people against the introduction of Golden rice is
1. consumption of Golden rice may cause hypervitaminoses
2. it is not a natural variety hence it may disturb the genotype of local varieties
3. the transgenic rice may cause allergy
4. all of these

103. Fruit juice or coconut milk is added to plant tissue culture media because
1. it is a source of micronutrients
2. it is a source of macronutrients
3. it is a source of growth regulators
4. it helps in maintaining pH of the media

104. Which one of the following statements about plant tissue culture is correct?
1. the culturing of root is not possible
2. any cell that is totipotent can be cultured
3. the pH of the media need not be maintained
4. fruit juices are added to media as carbon source

105. The plasmid used to transfer genes in plants is
C 18

106. The bacterium used for gene transfer in plants is
4. *Agrobacterium*

107. Match the following

Scientists	Associated with
1. Murashige and Skoog	p. Restriction
2. Milstein and Kohler	q. Golden rice
3. Potricus and beyer	r. Tissue culture media

4. Arber and Nathan s. Hybridoma

1. 1-p, 2-q, 3-r, 4-s 2. 1-s, 2-p, 3-r, 4-q
3. 1-r, 2-s, 3-q, 4-p 4. 1-s, 2-r, 3-p, 4-q

108. Al the cells in a callus
1. are genetically 2. genetically
3. similar in size 4. inefficient to grow organs

109. Which one of the following statements about plant tissue culture is correct
1. cells can be cultured only on solid medium
2. cells can be cultured both on solid and liquid medium
3. callus do not need hormones
4. the cells of the callus cannot be subcultured

110. POMATO, is
1. a transgenic plant
2. a plant obtained through protoplast hybridization
3. a plant obtained by organ culture
4. a plant developed by plant breeding method

111. The production of a large number of genetically similar plants through plant tissue culture is called
1. hybridoma technology 2. recombinant DNA technology
3. gene therapy 4. micropropagation

112. cDNA, a term used in recombinant DNA technology means
1. competetive DNA 2. chemical DNA
3. complex DNA 4. complementary DNA

113. The process of introduction of foreign DNA into an animal cells is called
1. transversion 2. conversion 3. inversion 4. transfection

114. Genes have been transferred into animals with a view to obtain a large scale production of the proteins encoded by these genes in the milk, blood etc. This approach is also referred generally as
1. *In vitro* culture 2. molecular farming
3. gene therapy 4. hybridoma technology

115. With reference to biotechnology, microinjection is a method of
1. injecting a solution of DNA into the nucleus of a cell
2. injecting nutrients into a cell culture media
3. injecting microbes into a cell culture media
4. injecting medicine to human beings

116. Pluripotent cells derived from the early pre implantation of an embryo in mice are called
1. stem cells 2.organ culture 3. somatic cell hybridization 4. Hybridoma

117. The advantage with embryonic stem cells in producing transgenic animals is
1. these cells are immortal

2. these cells can be maintained and multiplied *in vitro* long enough to permit various manipulations for gene transfer.
3. both 1 and 2
4. neither 1 nor 2

118. The development of transgenic animals like cattle which aims at the production of recoverable quantities of pharmaceutically or biologically important proteins. Hence such transgenic animals can also be called
1. hybrids 2. cybrids 3. bioreactors 4. special varieties

119. Match the following

1. Restriction endonucleases	p. Small DNA segments used in DNA finger prints
2. Ligases	q. Molecular scissors
3. Probe	r. Virus free plants
4. Meristem culture	s. Molecular stichers

1. 1-q, 2-s, 3-p, 4-r 2. 1-p, 2-q, 3-r, 4-s
3. 1-q, 2-s, 3-r, 4-p 4. 1-p, 2-s, 3-q, 4-r

120. Match the following

1. Electrophoresis	p. Gene transfer in plants
2. Probe	q. Breaks bond between insulin and –galactosidase
3. Cyanogen bromide	r. Small DNA segment used for hybridization
4. Ti plasmid	s. Separation of DNA segments

1. 1-r, 2-s, 3-q, 4-p 2. 1-s, 2-r, 3-q, 4-p
3. 1-p, 2-r, 3-q, 4-s 4. 1-q, 2-p, 3-s, 4-r

121. Match the following

1. Explant	p. Structures developed from callus
2. Embryoids	q. Plant part for tissue culture
3. Glucose	r. Source of growth regulators
4. Fruit juice	s. Carbon source

1. 1-q, 2-s, 3-p, 4-r 2. 1-p, 2-q, 3-r, 4-s 3. 1-q, 2-p, 3-r, 4-s 4. 1-q, 2-p, 3-s, 4-r

122. Match the following:

1. PCR	p. for hybridization
2. Probe	q. for gene amplification
3. Electrophoresis	r. for monoclonal antibody production
4. Hybridoma	s. for DNA segments separation

1. 1-p, 2-q, 3-r, 4-s 2. 1-q, 2-s, 3-p, 4-r 3. 1-q 2-p 3-s, 4-r 4. 1-p, 2-q, 3-s, 4-r

123. In plant tissue culture, induction of roots and shoots is accomplished by
1. using a tissue of certain minimum size

2. using a particular auxin cytokinin ratio
3. using a specific concentration of sucrose in the medium
4. manipulating physical factors such as light, pH, temperature

124. A part of nucleic acid used to find a gene by hybridization is called
1. vector 2. clone 3. probe 4. cybrid

125. The cloned sheep "Dolly" had a genotype which is
1. haploid and identical to that of the mothers egg cell
2. diploid and identical to that of the mothers somatic cells
3. diploid with the haploid set of chromosomes from the father and other from the mother
4. diploid and identical to that of the donors somatic cells

126. A segment of DNA that reads from the same forward and backward is called
1. palindromic DNA 2. complementary DNA
3. plasmid DNA 4. copy DNA

127. Stem cells found in umbilical cord blood is
1. totipotent 2. pluripotent 3. omnipotent 4. multipotent

128. Which of the following is associated with DNA finger printing?
1. hybridoma 2. site specific mutagenesis 2. shotgun cloning 4. RFLP

129. Which technique would most likely to be used to produce a large number of genetically identical offspring
1. cloning and in vitro culture 2. polymerase chain reaction
3. chromatography 4. electrophoresis

130. The restriction Endonucleases are called so because
1. they have a very restrictive or site specific endonuclease activity
2. they cut DNA at a few restricted sites
3. they restrict the entry of foreign DNA into the cell by cleaving the DNA due to their endonuclease activity
4. their distribution is restricted to only some bacterial cells

131. Which one of the following organism is used for the large scale production of recombinant insulin?
1. *Plasmodium* 2. *Agrobacterium* 3. *Rhizobium* 4. *E.coli*

132. 'T
1. enzyme linked immuno sorbant assay
2. ligation reaction
3. polymerase chain reaction
4. immobilization reaction

133. Construction of a recombinant DNA involves
1. cleaving DNA with restriction endonuclease and joining with ligase
2. cleaving DNA with ligase and joining with endonuclease
3. cleaving and joining DNA with restriction endonuclease
4. cleaving DNA with restriction endonuclease and joining with polymerase

134. Haploid plants can be obtained through
1. meristem culture 2. embryo culture
3. endosperm culture 4. pollen culture

135. Which one of the following statements about genetic energy is NOT correct
1. this is the process of producing transgenic organisms
2. through this technology, one can produce recombinant insulin
3. this process involves transfer of genes from one organism to another
4. through this process chromosomes can be added or deleted from the cell

136. Which one of the following statements about human genome project is NOT correct
1. it helps in identifying the exact location of genes on chromosomes
2. the information gathered from this project helps in curing genetic diseases
3. this helps in developing artificial organs
4. it helps in determining the sequence of 3 billion base pairs that makes up human genome

137. Which one of the following techniques is successfully used to compare two DNA samples
1. hybridoma technology 2. ELISA
3. genetic finger printing 4. gene therapy

138. The chemical nature of 'humulin' produced by recombinant DNA technology is
1. lipid 2. protein 3. monosaccharide 4. vitamin

139. pUC 18 is a
1. phage used as a vector 2. bacteria used for transformation
3. restriction endonuclease 4. a plasmid

140. ECOR1 is a
1. DNA ligase enzyme 2. restriction endonuclease
3. a vector used for insulin synthesis 4. a plasmid used as a vector

141. The unique feature of pluripotent stem cells is
1. they can develop into any tissue of the body
2. they can develop into whole individuals
3. they help in the production of monoclonal antibodies
4. none of these

142. Stem cells can be obtained from
1. embryo only
2. any part of the body
3. blood only
4. embryo, bone marrow, umbilical cord blood etc

143. Which one of the following therapies can be suggested to cure a person who is suffering from spinal cord injuries
1. hybridoma 2. gene therapy
3. stem cell therapy 4. recombinant DNA technology

144. A hybridoma is

1. a hybrid cell obtained by fusing a β–lymphocyte with a myeloma cell in vitro
2. a hybrid cell obtained by fusing a β–lymphocyte with a myeloma cell in vivo
3. a hybrid cell obtained by fusing 2 β–lymphocyte cells in vitro
4. a hybrid cell obtained by fusing any 2 body cells in vitro

145. A hybridoma cell
1. produces different types of antibodies against different types of antigens
2. produces only specific antibodies only against a specific antigen
3. produces different types of antibodies but only one type of antigen
4. none of the above

146. A cancerous / myeloma cell in hybridoma helps in
1. continuous growth of hybridomas 2. production of antibodies
3. both 1 and 2 4. neither 1 nor 3

147. All the antibodies produced through hybridoma are
1. polyclonal 2. monoclonal 3. non active 4. over active

148. A type of β–lymphocyte that produces antibody is
1. plasma cell 2. memory cell 3. adipocyte 4. erythrocyte

149. The unique feature of monoclonal antibody is that
1. it is specific to a single antigenic determinant of a single antigen
2. it is non specific
3. it is specific to a few antigenic determinants
4. restricted growth

150. Monoclonal antibodies are nowadays used in
1. disease diagnosis
2. detection of specific type of pathogen
3. very early and accurate detection of cancer
4. all of these

151. Monoclonal antibodies are usually produced from
1. myeloma cells 2. hybridoma cells 3. monocytes 4. adipocytes

152. To produce monoclonal antibodies in large scale, the techniques that
1. can be used are in vivo in the peritoneal cavity of mice
2. in vitro in large scale culture vessels
3. both 1 and 2
4. neither 1 nor 2

153. To produce monoclonal antibodies in
1. large scale stirred bioreactors can be
2. air lift fermenters can be used
3. vessels based on immobilized cells can be used
4. all of these