Sample Question paper
CLASS- XII
BIO-TECHNOLOGY (045)
SESSION 2019-20

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

General Instructions:

(i) The question paper comprises four Sections – A, B, C and D. Attempt all the Sections.

*(ii) **All** questions are compulsory.*

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

*(iv) Question numbers **1** to **7** are very short answer questions carrying **1** mark each. Question numbers **8** to **12** are multiple choice questions carrying **1** mark each*

*(v) Question numbers **13** to **19** are short answer questions, carrying **2** marks each.*

*(vi) Question numbers **20** to **26** are also short answer questions, carrying **3** marks each.*

*(vii) Question numbers **27** to **30** are long answer questions, carrying **5** marks each.*

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

SECTION A

1 Name any two scientists involved in designing the first recombinant DNA molecule. 1

2 Write any two properties which can be improved through protein engineering 1

3 Transgenic plants have been developed to survive in saline habitat. Which technique might have been used to develop such plants? 1

4 Which vector was used in the first cloning experiment involving mammalian cell? 1

OR

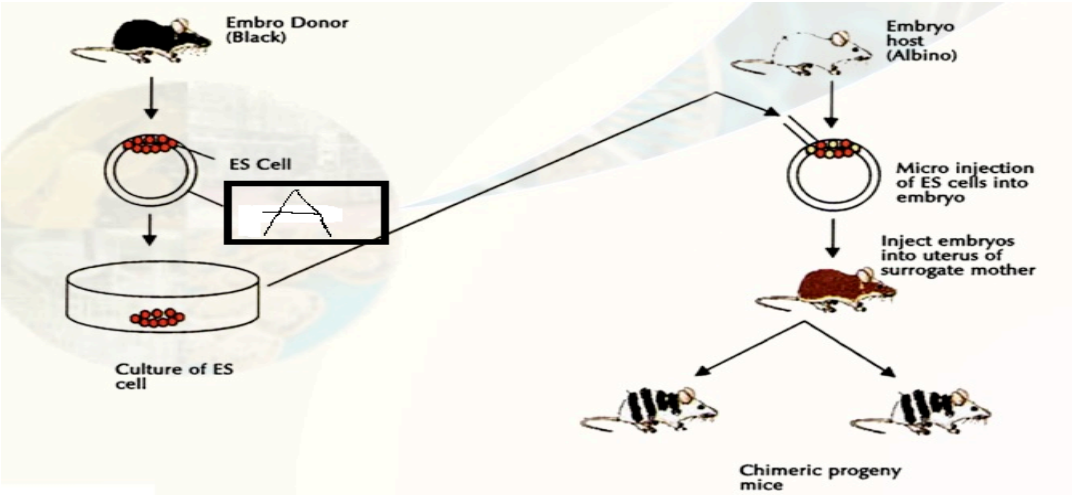
How does a modification enzyme protect its own DNA from digestion?

5 What was the strategy behind *Human Genome Project*? 1

6. An enriched medium containing salts, glucose, proteins and vitamins was made and a commercially available animal cell line was introduced. However, the cells began dying. What could be the reason behind it? 1

OR

What is A in the flow chart?



Creation of chimeric mice using ES cells

7. Margaret Dayhoff observed that protein sequences undergo variation according to certain patterns. Write any one such pattern. 1

OR

What is the underlying principle of "Molecular evolution"?

8. Crystallisation is not required due to the advent of which of the following new technique. 1
   a) X-ray crystallography
   b) NMR
   c) Sanger's method of protein sequencing
   d) Edman's method of protein sequencing

9. Optimum pH for plant tissue culture medium is- 1
   a) 7.5 c) 8
   b) 5.7 d) 8.5

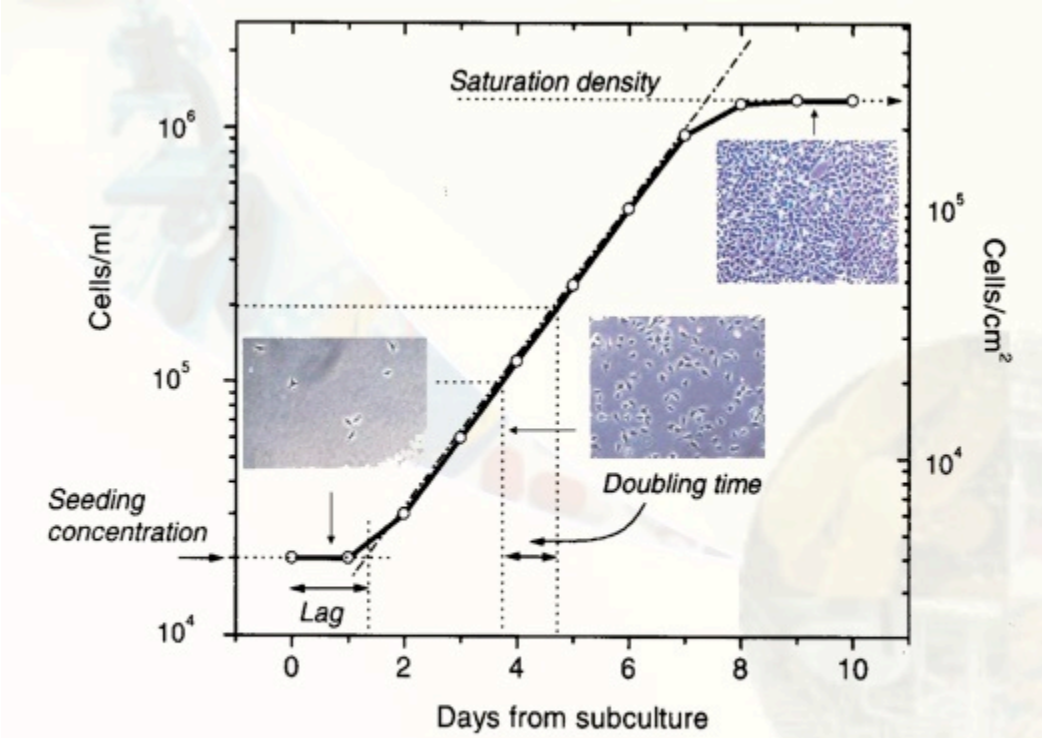
10. The single letter codes for Tyrosine and Asparagine are 1
    a) N and Y
    b) A and T
    c) T and A
    d) Y and N

11. The disease due to the deficiency of an enzyme Adenosine Deaminase (ADA) is 1
    a) SCID
    b) Thallasemia
    c) Haemophilia
    d) Mad cow disease

12 **Question numbers 12(i) to 12(iv) are based on the following text on characterization of Cell Lines:**

In order to analyze the growth characteristics of a particular cell type or cell line, a growth curve can be established from which one can obtain a population doubling time, a lag time, and a saturation density. A growth curve generally will show the cell population's lag phase, that is, the time it takes for the cells to recover from subculture, attach, and spread; the log phase, in which the cell

number begins to increase exponentially and a plateau phase, in which the growth rate slows or stops due to depletion of growth factors and nutrients.



Normal growth curve of animal cells.

(i). Beyond what cell concentration , saturation density is achieved ? 1
a) > 10^4 cells /ml
b) 10^4 to 10^5 cells /ml
c) > 10^5 cells /ml
d) > 10^6 cells /ml

(ii). There is no increase in the cell concentration in the lag phase due to the following reasons: 1
a) Exhaustion of the medium.
b) Space constraint
c) Both “a” and “b”
d) Acclimatization to the new environment.

(iii). In which phase of growth is the specific growth rate of animal cell calculated? 1
a) Log phase
b) Lag phase
c) Stationary phase
d) Decline phase.

(iv) A student adds antibiotic to the animal cell culture medium and still obtains the same growth curve .The probable explanation for it will be: 1
a) Antibiotics add growth factors and hormones in the medium
b) Antibiotics provide serum for the growth of animal cells.
c) Antibiotics enhance the nutrient content of the medium.
d) Antibiotics don’t have any affect on animal cells

SECTION B

13 Differentiate between synthetic and complex medium used for microbial culture. 2

14 How can LEU 2 gene be used as a selectable marker? 2

15 On the basis of the table given below, state your observations pertaining to the organisation features of the organism. 2

ORGANISM	No. of chromosomes	Genome size in base pairs	The number of predicted genes	Part of the genome that encodes for proteins
Worm *Caenorhabditis elegans*	6	100,000,000	19,000	27%
Human *Homo sapiens*	23	3,000,000,000	20,000-25,000	<5%
Fly *Drosophila melanogaster*	4	175,000,000-196,000,000	13600	20%

16 Differentiate between somaclones and gametoclones. Who proposed the term somaclones? 2

17 a) What are the various interactions that stabilize a folded protein? 2
b) How can the stability of protein be changed?

18 What are various biosafety issues in microbial technology? 2

OR

The laboratory scale design cannot be scaled up to industrial scale directly. Write any two points that need to be considered while going for industrial scale production.

19 In a variant of chymotrypsin, Asp 102 is replaced by Glu 102. Do you expect the enzyme to retain activity? Schematically indicate the role of amino acid residues participating in catalysis. 2

OR

Thalassemic patients produce excess alpha or beta subunits of haemoglobin leading to impaired oxygen-binding capacity by their erythrocytes. How can it be determined as to which subunit is produced in excess?

SECTION C

20 Recombinant insulin is produced at 100 mg/l by *E. coli* at a cell concentration of 1 g/l. Calculate the volume of reactor (size of the fermentor) needed to produce 1 kilogram of insulin in the following conditions: 3

(a) When the cell concentration is 1 g/l and insulin production is 100 mg /l.
(b) When the cell concentration is 50 g/l and insulin production is 100 mg /l.
(c) When the cell concentration is 50 g/l and insulin production is 500 mg /l

21 Schematically explain the formation of recombinant plasmid. 3

OR

Students of Class XII visited Microbial Type Culture Collection, Chandigarh and observed microbial cultures of *Providencia stuartii, Streptomyces albus* and *Haemophilus aegyptus.* Name the restriction enzymes obtained from them and also specify their restriction sites.

22 Complete the table by filling the mode of action / functional properties indicated as A, B, C, D, E and F 3

Functional Property	**Mode of action**
Whipping/Foaming	A
B	Formation and stabilization of fat emulsions
C	Protein matrix formation and setting
Viscosity	D
E	Hydrogen bonding of water; entrapment of water
Solubility	F

23 Selection is an important step in genetic engineering. You are given ampicillin and tetracycline antibiotics. Using these antibiotics, which selection technique could be used to differentiate between recombinant and non-recombinant cells? 3

24 Write any six applications of plant genetic engineering. 3

25 How does the metagenomics approach help to identify novel genes present in the environment? Explain the process. 3

OR

What is a pilot plant? Why is it necessary to validate a process in a pilot plant before commercial scale production in a bioprocess industry?

26 Given below are few transgenic crops approved by US food and drug administration along with the improved character. Name the genes A to F introduced for the improved character. 3

Crop	Gene	Improved character
Canola	A	Hybrid production
Corn	B	Insect resistance
Cotton	C	Insect resistance
Papaya	D	Virus resistance
Potato	E	Insect and virus control
Soyabean	F	Weed Control

SECTION D

27 Mutation is an alteration in any of the base of a DNA sequence sometimes leading to a defective protein or prematurely terminated non-functional protein. It can be spontaneous or induced. Diagrammatically explain how mutation can be induced in a gene. 5

OR

A bacteriophage is known to infect *E.coli* with pili. How can it be modified to serve as a suitable vector?

What are the major advantages of developing vectors based on such bacteriophages?

28 Explain the non-covalent interactions involved in organizing the structure of protein molecules. 5

29 Which two main methodologies are used for genome sequencing? Explain. 5

OR

Explain the diseases caused by single gene mutations following mendelian inheritance specifying the genomic location, inheritance pattern and mutation.

Name any two diseases showing gene polymorphism with complex inheritance.

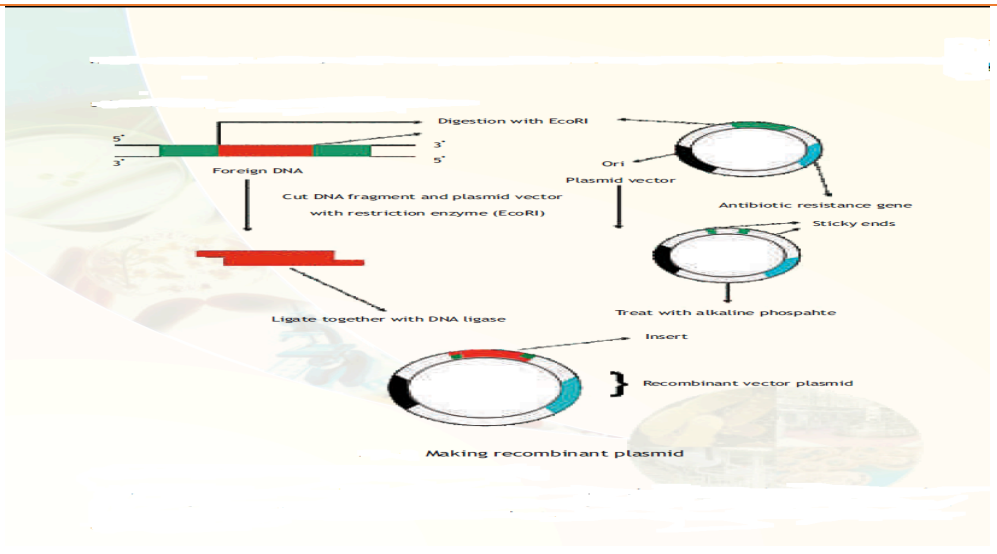
30 Diagrammatically show the cultivation of adult stem cells from bone marrow and their differentiation into specialized cells. Name two scientists who established the field of stem cell research. For which medical conditions, stem cells can be used (Write any two)? 5

Sample Question paper 02
CLASS- XII
BIO-TECHNOLOGY 2019-20

MARKING SCHEME

	SECTION A	
1	Paul Berg, Herbert Boyer, Annie Chang and Stanley Cohen. *(Any two)*	½ *2
2	Properties for thermal and pH stability/ solvent tolerance and solubility/ catalytic potency etc. *(Any two)*	½ *2
3	By the production of stress-related osmolytes like sugars (e.g. trihalose and fructans)/ sugar alcohols (e.g. mannitol) / amino acids (e.g. proline), glycine betaine/ certain proteins (e.g. antifreeze proteins). *(Any one)*	1
4	Simian Virus 40 **OR** Methylation	1
5.	To make series of maps of each human chromosome at increasingly finer resolutions.	1
6.	Serum/FCS, an essential component of animal cell culture media was missing. **OR** Trophoblast	1
7	Amino acids were not replaced at random but were altered with specific preferences./ Some amino acids such as tryptophan, was generally not replaced by any other amino acid / Based on several homologous sequences, a point accepted mutation (PAM) matrix could be developed. *(Any one)* **OR** Functionally related or homologous protein sequences are similar.	1
8	b) NMR	1
9	b) 5.7	1
10	d) Y and N	1

11.	a) SCID	1
12	(i) d) > 10^6 cells /ml	1
	(ii) d) Acclimatization to the new environment.	1
	(iii) a) Log phase	1
	(iv) d) Antibiotics don't have any affect on animal cells	1
	SECTION B	
13	**Synthetic media** - Full composition of the medium is known. **Semi-synthetic media** - These media contain highly complex components such as peptone, beef extract, yeast extract or casein digest. Nutrient broth/ Typticase soya broth (TSB) / Brain heart infusion (BHI) broth	1 1
14	*LEU2* gene codes for an enzyme required for the synthesis of amino acid leucine. Yeast cells having this plasmid can grow on a medium lacking leucine and hence can be selected. e.g. Yep	1 ½ ½
15	No simple correlation between the intuitive complexity of an organism and the number of genes in its genome. Relatively small number of genes in a human genome in comparison to worm /*Drosophila melanogaster*.	1 1
16	While somaclones are plant variants obtained from tissue cultures of somatic tissues, gametoclones are plant variants with gametophytic origin obtained from tissue such as pollen or egg cell. Larkin and Scowcroft (1981) proposed the term 'somaclones'	1 1
17	A balance between the stabilizing (mainly hydrophobic) interactions and destabilization interactions. By substituting amino acids that either favour stabilizing interactions in a folded protein or destabilizing interactions in an inactive protein.	1 1
18	Potential of genetically modified organisms (GMO) or recombinant strains to infect other organisms./Toxicity and allergy associated with the use of recombinant molecules./ Increasing the environmental pool of antibiotic resistant microorganisms or transfer of antibiotic resistant genes./Problems associated with the disposal of spent microbial biomass./Safety aspects associated with contamination, infection or mutation of process strains.	1*2

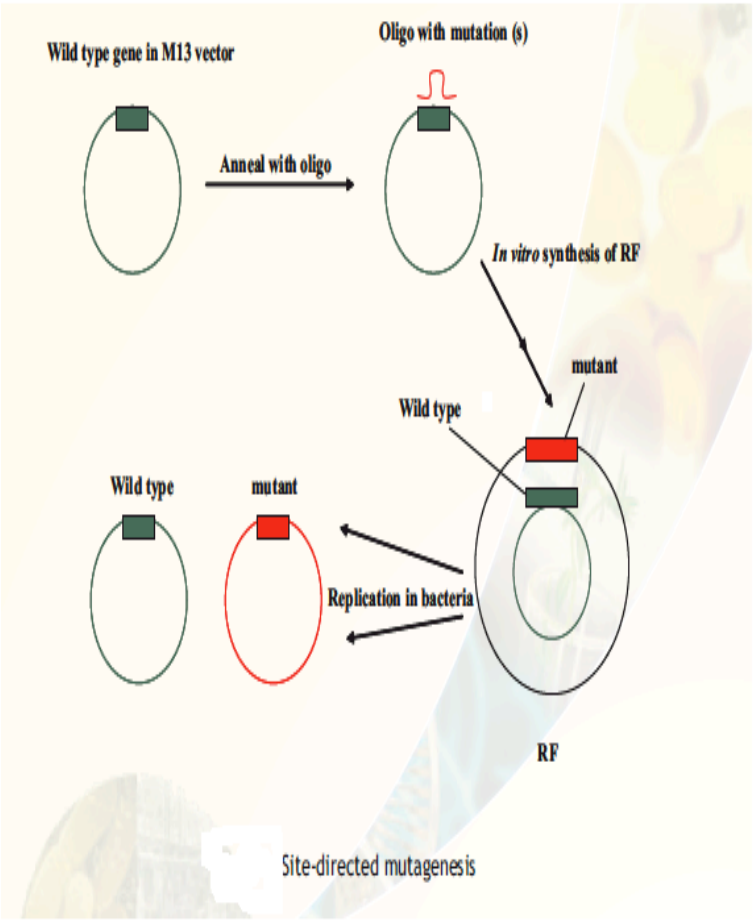
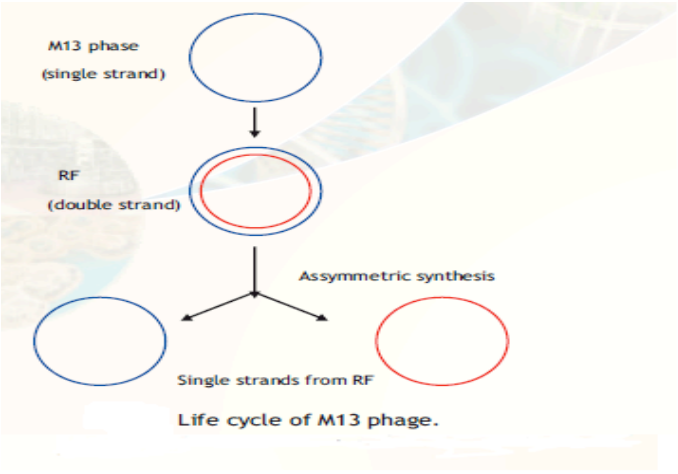
	(Any two) **OR** • Bulk purchase of chemicals and other raw materials would bring down costs. • The labour cost decreases sharply with increase in production.	
19.	Negatively charged Asp 102 partially borrow hydrogen ion from His-57. His-57 attracts hydrogen ion from adjacent Ser 195 Serine 195 gets negative charge. Serine 195 makes a nucleophilic attack on the protein substrate. **OR** Normal and thallasaemic erythrocytes obtained and their lysates analysed Protein fingerprinting/ 2-D gel electrophoresis/ MALDI/ SDS-PAGE can identify if alpha or beta chain is absent Protein fingerprinting: • Trypsin digestion of Purified haemoglobin • Paper electrophoresis followed by paper chromatography. • Spray with ninhydrin. (Student should be awarded marks if he/she describes any of the above mentioned technique.)	½ ½ ½ ½ ½ ½*3
	SECTION C	
20.	(a) Insulin production is 100 mg/L; so fermentor volume needed for 1 Kg of insulin is 1 Kg /100mg = 1000, 000mg/100,g = 10,000mg = 10,000L. (b) Cell concentration is increased 50 times, we need 200 L reactor. (c) Insulin yield per litre of culture is 500 X 50 = 25, 000 mg / L which is 25 gram/L. We need a 40 L reactor (1000g/25g) .	1 1 1
21		3

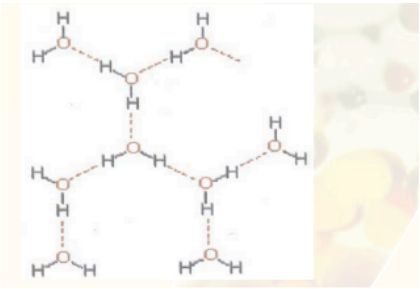
	OR	
	Haemophilus Aegyptus *HaeIII* 5'G-G-C-C 3' 3'C-C-G-G 5' *Providencia stuartii* *Pst*I 5'C-T-G-C-A-G 3' 3'G-A-C-G-T-C 5' *Streptomyces albus* *Sal*I 5'G-T-C-G-A-C 3' 3'C-A-G-C-T-G 5'	1 1 1
22	<table><tr><td>Functional Property</td><td>Mode of action</td></tr><tr><td>Whipping/Foaming</td><td>Forms stable film (A)</td></tr><tr><td>Emulsification (B)</td><td>Formation and stabilization of fat emulsions</td></tr><tr><td>Gelation(C)</td><td>Protein matrix formation and setting</td></tr><tr><td>Viscosity</td><td>Thickening, water binding(D)</td></tr><tr><td>Water binding(E)</td><td>Hydrogen bonding of water; entrapment of water</td></tr><tr><td>Solubility</td><td>Protein salvation(F)</td></tr></table>	3
23	**Replica plating.** • Host cells are first plated (master plate) on solid media with the desired antibiotic overnight. • Velvet paper is aligned, pressed on master plate. • With the same alignment it is pressed onto the replica plate. • Keep it overnight ,transformed colonies will not grow in replica plate • The colonies having insert can easily be scored off from master plate by comparing the two plates.	½ ½*5
24	• Production of healthy oils with altered fatty acid profiles. • Modification of starch properties for specific uses. • Favourable change of grain storage products and their chemical composition to improve the processing of bread making with wheat flour, malting of barley and brewing of beer. • Removal of undesirable toxic compounds in certain plants. • Development of blue roses/ blue coloured cotton which is otherwise not possible by conventional plant breeding because of the absence of blue pigment in roses/ cotton • Development of tear-less onions, caffeine-free coffee and low nicotine tobacco. *(Any three)*	½ * 6
25	The collective DNA(from various environmental niche) is subjected to restriction digestion using restriction endonucleases and the fragments are	1

	cloned into suitable vectors. The clones are then screened for presence of a variety of molecules. The clones expressing novel molecules or molecules with improved characteristics are used for large-scale production by fermentation techniques. **OR** Pilot plant: Mini version of the commercial plant. Direct production of microbes on a large or commercial scale has the risk of not only large investments, but also producing products, which may not be of appropriate quality so that there are problems in their commercialization.	1 1 1 2
26		½ * 6

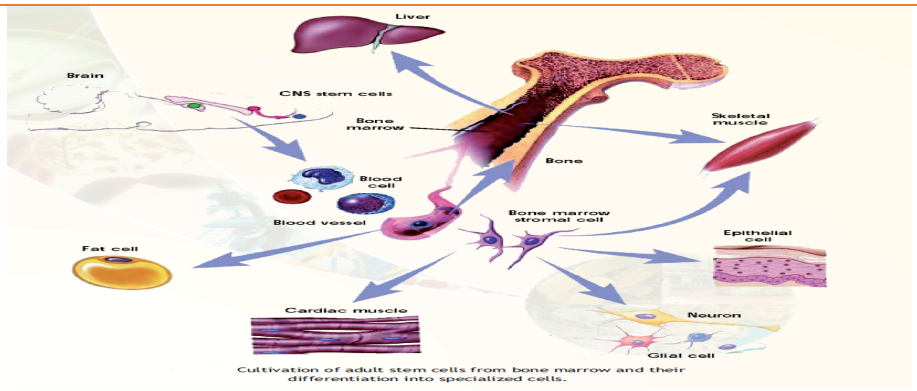
Crop	Gene	Improved character
Canola	**(A)** Thioesterase EPSP *synthase/ Any relevant gene*	Hybrid production
Corn	**(B)**Bt cry I Ac /any other	Insect resistance
Cotton	**(C)** Acetolactate synthase Nitrilase EPSP synthase Bt CryIA(c)	Insect resistance
Papaya	**(D)**Coat protein/ Any relevant gene	Virus resistance
Potato	**(E)**Bt CryIIIA and coat protein/ Any relevant gene	Insect and Virus control
Soyabean	**(F)**EPSP synthase/ Any relevant gene	Weed control

SECTION D

27		5
	OR	
	Foreign DNA can be inserted into bacteriophage single stranded, circular DNA of 6407 bp without disrupting any of the essential genes.	1
		1

	Its genome is less than 10 kb in size. RF can be purified and manipulated exactly like a plasmid. Genes cloned into M13 based vectors can be obtained in the form of single stranded DNA.	1 1 1
28	Ionic bonds: Interactions between the oppositely charged groups also known as **salt bridges** Hydrogen bonds: Hydrogen bonds are formed by "sharing" of a hydrogen atom between two electronegative atoms such as Nitrogen and Oxygen.  Hydrogen Bonding Van der Waals forces: The Van der Waals types of forces are essentially contact forces, proportional to the surface areas in contact. Hydrophobic interactions:	1 1 1 1 1

	The hydrophobic interaction is a manifestation of hydrogen bonding network in water. In water, each molecule is potentially bonded to four other molecules through H-bonds	
29	**Directed sequencing of Bacterial Artificial Chromosome (BAC) contigs**	½
	Bacterial Artificial Chromosome (BAC) vectors are used to make genomic libraries in which the insert size is 80-100 kb, library is then screened by finding common restriction fragments.	1
	BAC clones are then mapped to find overlapping arrays of contiguous clones called contigs. The mapped contigs are sequenced by breaking large DNA fragments into small pieces.	1
	Random shotgun sequencing In random shotgun sequencing, big genomic DNA molecules are cloned in small (2.0 kb) and medium (10 kb) plasmid vectors and a library is constructed	½ 1
	Picking many clones, sequencing them and feeding all these data into a computer program, these sequences are joined by finding overlapping parts. The result is, we get long pieces of DNA sequences.	1
	OR	
	Cystic Fibrosis (Cystic Fibrosis Trans membrane Conductance Regulator CFTR gene)	½
	1. Inheritance: autosomal recessive disease 2. Genomic location: Chromosome 7 (7q31.2) 3. Mutation: The most common mutation is a deletion of 3 bps resulting in the loss of codon no. 508, which codes for phenylalanine	½*3
	Huntington disease (Hunting tin gene HTT)	½
	1. Inheritance: autosomal dominant 2. Location: Chrosome 4 (4p16.3) 3. Mutation: increased number of CAG repeats more than 35 times	½*3
	Two diseases showing gene polymorphism with complex inheritance Common late-onset Alzheimer's disease Migraine	½ ½
30	Cultivation of adult stem cells from bone marrow and their differentiation into specialized cells	3



Cultivation of adult stem cells from bone marrow and their differentiation into specialized cells.

1

Ernest McCulloch and James Till

½*2

Leukemia (Cancerous blood cells), Heart disease, heart attack (cardiac tissue damage). Paralysis (spinal cord injury). Alzheimer's, Parkinson's, Huntington's (dead brain cells).and Burns (damaged skin cells) *(Any two)*