

Time allowed: 3 hours

Maximum Marks: 70

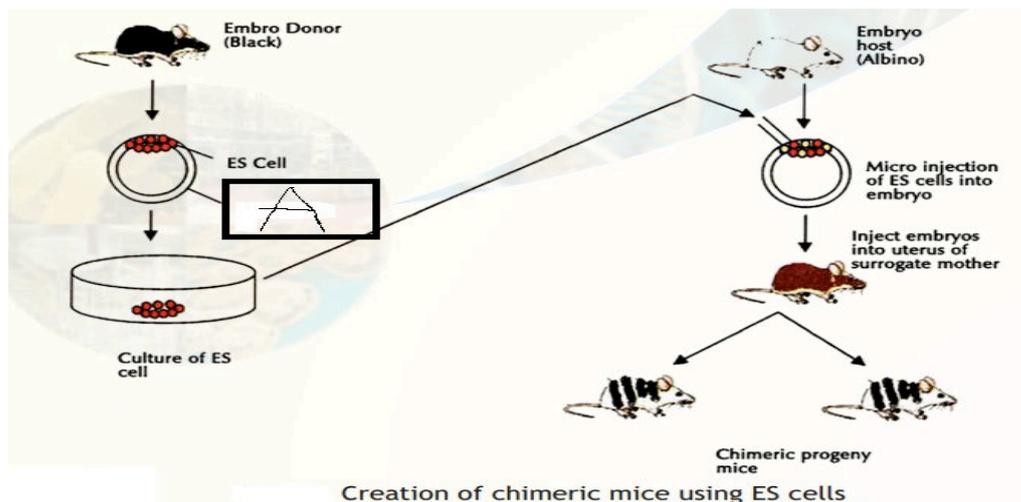
General Instructions:

- (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



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
- X-ray crystallography
 - NMR
 - Sanger’s method of protein sequencing
 - Edman’s method of protein sequencing

9. Optimum pH for plant tissue culture medium is- 1
- 7.5
 - 5.7
 - 8
 - 8.5

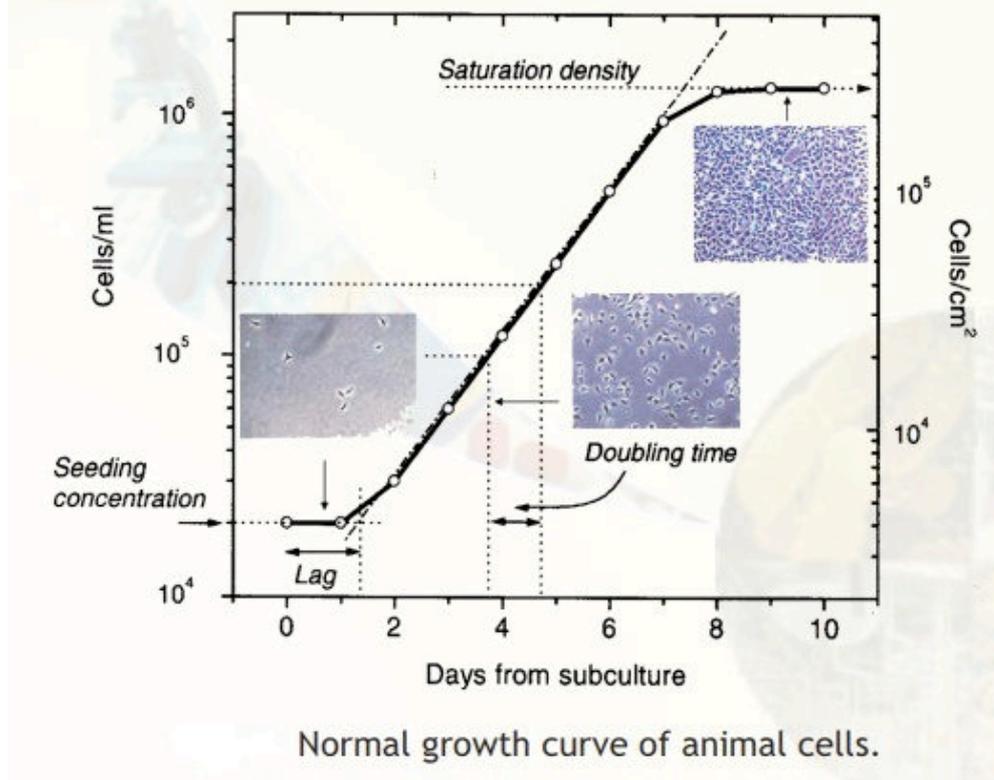
10. The single letter codes for Tyrosine and Asparagine are 1
- N and Y
 - A and T
 - T and A
 - Y and N

11. The disease due to the deficiency of an enzyme Adenosine Deaminase (ADA) is 1
- SCID
 - Thallasemia
 - Haemophilia
 - 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.



- (i). Beyond what cell concentration, saturation density is achieved? 1
- $> 10^4$ cells /ml
 - 10^4 to 10^5 cells /ml
 - $> 10^5$ cells /ml
 - $> 10^6$ cells /ml
- (ii). There is no increase in the cell concentration in the lag phase due to the following reasons: 1
- Exhaustion of the medium.
 - Space constraint
 - Both "a" and "b"
 - Acclimatization to the new environment.
- (iii). In which phase of growth is the specific growth rate of animal cell calculated? 1
- Log phase
 - Lag phase
 - Stationary phase
 - 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
- Antibiotics add growth factors and hormones in the medium
 - Antibiotics provide serum for the growth of animal cells.
 - Antibiotics enhance the nutrient content of the medium.
 - 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 <i>Caenorhabditis elegans</i>	6	100,000,000	19,000	27%
Human <i>Homo sapiens</i>	23	3,000,000,000	20,000-25,000	<5%
Fly <i>Drosophila melanogaster</i>	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?
b) How can the stability of protein be changed? 2
- 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

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