

ROLL NO.

- Please check that this question paper contains 5 printed pages.
- Code number given on the right-hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains 33 questions.

**BIOLOGY (Theory)****CHAPTER: BIOTECHNOLOGY AND ITS APPLICATIONS****Time allowed: 3 hours****Maximum Marks: 70****General Instructions:**

- There are total 33 questions and five sections in the question paper. All questions are compulsory.
- Section A contains questions number 1 to 16, multiple choice type questions of one mark each.
- Section B contains questions number 17 to 21, very short answer type-I questions of two marks each.
- Section C contains questions number 22 to 28, short answer type-II questions of three marks each.
- Section D contains question number 29 to 30, case-based questions of four marks each. Each question has subparts with internal choice in one subpart.
- Section E contains question number 31 to 33, long answer type questions of five marks each.
- There is no overall choice in the question paper, however, an internal choice is provided in one question of two marks, one questions of three marks and all the three questions of five marks. In these questions, an examinee is to attempt any one of the two given alternatives.
- Wherever necessary, the diagram drawn should be neat and properly labelled.

**SECTION A**

Questions no. 1 to 16 are Multiple choice (MCQ) type Questions, carrying 1 mark each. **16 × 1 = 16**

- Nematode specific genes were introduced into the tobacco host plant using a vector
  - pBR 322
  - Plasmid
  - Bacteriophage
  - Agrobacterium
- 'Cry genes' that code for insecticidal toxins are present in:
  - Cotton bollworms
  - Nematodes
  - Corn borer
  - Bacillus thuringiensis*
- Transposons can be used during which one of the following?
  - Gene sequencing
  - Polymerase Chain Reaction
  - Gene silencing
  - Autoradiography
- In gene therapy of Adenosine Deaminase (ADA) deficiency, the patient requires periodic infusion of genetically engineered lymphocytes because:
  - Genetically engineered lymphocytes are not immortal cells.
  - Retroviral vector is introduced into these lymphocytes.

3. Gene isolated from marrow cells producing ADA is introduced into cells at embryonic stages
4. Lymphocytes from patient's blood are grown in culture, outside the body.
5. When gene targeting involving gene amplification is attempted in an individual's tissue to treat disease, it is known as:
  1. Molecular diagnosis
  2. Safety testing
  3. Biopiracy
  4. Gene therapy
6. For effective treatment of the disease, early diagnosis and understanding its pathophysiology is very important. Which of the following molecular diagnostic techniques is very useful for early detection?
  1. ELISA Technique
  2. Hybridization Technique
  3. Western Blotting Technique
  4. Southern Blotting Technique
7. The Adenosine deaminase deficiency results into:
  1. Digestive disorder
  2. Addison's disease
  3. Dysfunction of Immune system
  4. Parkinson's disease
8. The process of RNA interference has been used in the development of plants resistant to
  1. Fungi
  2. Viruses
  3. Insects
  4. Nematodes
9. The first human hormone produced by recombinant DNA technology is
  1. Insulin
  2. Growth Hormone
  3. Thyroxine
  4. Progesterone
10. Which body of the Government of India regulates GM research and safety of introducing GM organism for public services?
  1. Bio-safety committee
  2. Indian Council of Agricultural Research
  3. Genetic Engineering Approval Committee
  4. Research Committee on Genetic manipulation
11. The introduction of t-DNA into plants involves
  1. Altering the pH of soil, then heat-shocking the plants.
  2. Exposing the plants to cold for a brief period.
  3. Allowing the plant roots to stand in water.
  4. Infection of the plant by Agrobacterium tumefaciens.
12. In Bt-cotton the Bt-toxin present in plant tissue as pro-toxin is converted into active toxin due to
  1. Alkaline pH of the insect gut
  2. Acidic pH of the insect gut
  3. Action of gut microorganisms
  4. Presence of conversion factors in insect gut

**For Questions No. 13 to 16, two statements are given – one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer these questions from the codes a), b), c) and d) as given below:**

- a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
  - b) Both Assertion (A) and Reason (R) are true and Reason (R) is **not** the correct explanation of Assertion (A).
  - c) Assertion (A) is true but Reason (R) is false.
  - d) Assertion (A) is False but Reason (R) is true.
13. **Assertion (A):** In human beings, insulin is synthesized as a pro-hormone which needs to be processed before it becomes fully mature and functional.  
**Reason (R):** The extra stretch of C-peptide is to be removed from A-peptide and B-peptide chain of insulin.

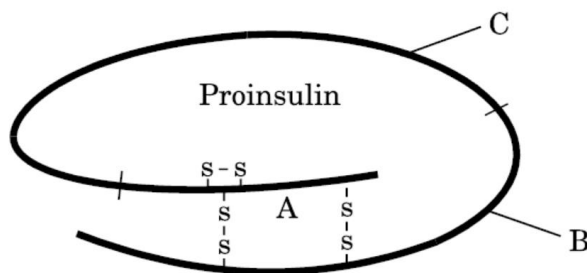
14. **Assertion (A):** The nematode cannot survive in a transgenic host which expresses specific interfering RNA.  
**Reason (R):** Nematode specific gene introduced in the host produces both sense and antisense complementary RNA which initiate RNA interference in the host cell.
15. **Assertion (A):** A double stranded DNA or RNA tagged with radioactive molecule is used as probe.  
**Reason (R):** Because double stranded DNA or RNA is easily hybridised with single stranded DNA.
16. **Assertion (A):** PCR is now routinely used to detect HIV in suspected AIDS patient.  
**Reason (R):** Very low concentration of Virus can be detected by the amplification of the nucleic acid by PCR.

### SECTION B

17. Why does the toxin produced by *B. thuringiensis* not kill the *Bacillus*? 2
18. Name the Indian crop variety for which in 1997 an American company got patent right through the US Patent and Trademark Office. Why did the company claim it to be an invention or a novelty? 2
19. How is "Rosie" considered different from a normal cow? Explain 2
20. Highlight any four advantages of genetically modified organisms (GMOs). 2
21. Write full form of ELISA. Give an example of the clinical application of 'ELISA' test. 2

### SECTION C

22. Insulin in the human body is secreted by pancreas as prohormone/proinsulin. The schematic polypeptide structure of proinsulin is given below. This proinsulin needs to undergo processing before it becomes functional in the body. Answer the questions that follow: 3



- i. State the change the proinsulin undergoes at the time of its processing to become functional.
- ii. Name the technique the American company Eli Lilly used for the commercial production of human insulin.
- iii. How are the two polypeptides of a functional insulin chemically held together?
23. What are transgenic animals? How are they being used for vaccine safety and chemical safety testing? Explain. 3
24. One of the potential uses of genetic engineering is in correction of a gene defect that has been diagnosed in a child/embryo. Explain how gene therapy is of help in ADA deficiency. 3
25. Name two naturally occurring sources, one that transfers pathogenic genes into a plant cell and the other into an animal cell respectively, for their benefit. Write how have these naturally occurring sources been used for the benefit of human race by the biotechnologists 3

26. i. State the role of a selectable marker in r-DNA technology. 3  
 ii. Name one such selectable marker which is considered to be useful for E.coli.  
 iii. Give one reason why is it considered to be a useful marker.
27. Two children, A and B aged 4 and 5 years respectively visited a hospital with a similar genetic disorder. The girl A was provided enzyme-replacement therapy and was advised to revisit periodically for further treatment. The girl, B was, however, given a therapy that did not require revisit for further treatment. 3  
 i. Name the ailments the two girls were suffering from?  
 ii. Why did the treatment provided to girl A required repeated visits?  
 iii. How was the girl B cured permanently?
28. A multinational company outside India tried to sell new varieties of turmeric without proper patent rights. What is such an act referred to? Explain. Why this act is required? 3

### SECTION D

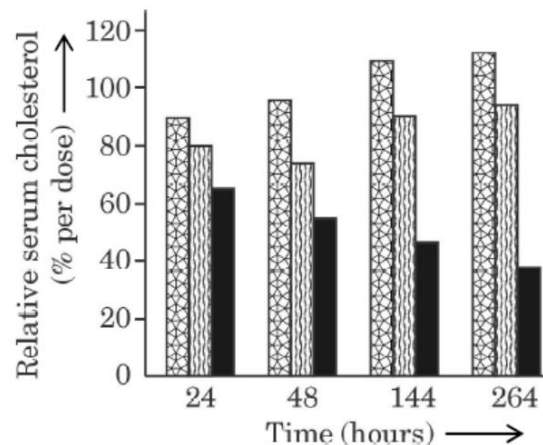
29. RNA interference (RNAi) holds great potential as a therapeutic agent for the treatment of human diseases and as a biocontrol agent for controlling pests in the field of agriculture. 4

The graph given below illustrate the use of RNAi for the potential treatment of disorders of cholesterol metabolism. Some people posse's genetic mutation with elevated levels of "ApoB" gene which predisposes them to coronary artery diseases. Lowering the amount of "ApoB" can reduce the number of lipoprotein and lower the blood cholesterol.

Tracy Zimmerman and her colleagues used RNAi in 2006 to reduce the level of "ApoB" in Non-human primates Cynomolgus monkeys.

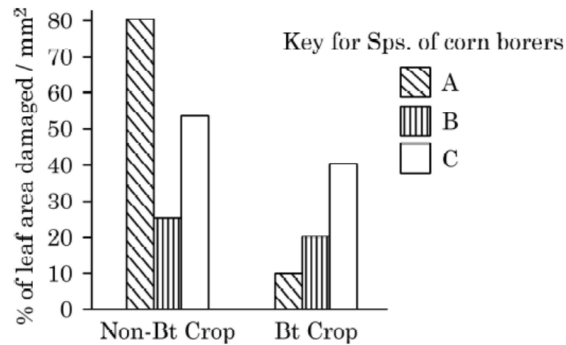
One group of monkeys were given RNAi treatment (Small interfering RNAs, SiRNAs) (doses 1 mg/kg SiRNAs), a second group of monkeys were given RNAi treatment (doses 2.5 mg/kg SiRNAs) and a third group of monkeys were injected with saline as control.

The results of the experiments are illustrated in the graph given below:



- Legend:  Saline X     1 mg/kg Y     2.5 mg/kg Z
- i. Write your interpretation from the bars X and Z obtained after 264 hours of treatment of monkeys with saline and 2.5 mg/kg SiRNAs treatment respectively, in comparison to the bars obtained after 24 hours of treatment with saline and 2.5 mg/kg SiRNAs.
- ii. A tobacco plant made transgenic using RNA interference is protected from the parasite *Meloidogyne incognita*. How is the transgenic tobacco plant able to prevent itself from infestation by the nematode? Explain briefly.
30. To save the crop plant from the attack of various insect pests the biotechnologists have developed many pests resistant plants. One such example is Bt corn plant. In this plant 'cry' genes were introduced which produces cry proteins in the plant that has toxic effect on the pest (corn borer). Thus saves the corn plant from the attack

of the corn borer. An experimental field study was conducted by the scientists to see the efficacy of the Bt corn plant against the attack of corn borers. Three different species of corn borers namely 'A', 'B', 'C' was collected and were independently fed on non Bt corn plants and Bt corn plants separately for the same period. The extent of the damage caused to the leaf area of the plant was observed and noted down. With the help of the observations and data collected the following bar graph was plotted. Study the graph and answer the questions that follow.



- Identify the species of the corn borer that was most successfully controlled by Bt corn plant. Give appropriate reason for your inference
- Identify the species of the corn borers which shows least impact of toxin produced by Bt genes.
- What would be your advice as a Scientist, to the farmers for growing this particular Bt corn variety in the area which is infested by species—'B' of corn borers?
- Name one Bt gene that encodes protein in corn plants to control corn borers.

### SECTION E

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|-----|-----|--|---|
| 31. | i.  | What is plasmid?   | 5 |
|     | ii. | What is meant by ADA deficiency? How is gene therapy a solution to this problem? Why is it not a permanent cure?                     |   |
| 32. |     | You have identified a useful gene in bacteria. Make a flow chart of the steps that you would follow to transfer this gene to a plant | 5 |
| 33. |     | Highlight five areas where biotechnology has influenced our lives.   | 5 |