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Biotechnology and its Applications — CBSE Class 12 Biology Chapter Test

FREE CHAPTER TEST · CLASS XII · BIOLOGY (044) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	37	17 (A 8 · B 3 · C 3 · D 1 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 17 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. Section A (Q1–8) contains 6 multiple choice questions and 2 assertion-reason based questions of 1 mark each.
4. Section B (Q9–11) contains short answer questions of 2 marks each.
5. Section C (Q12–14) contains short answer questions of 3 marks each.
6. Section D (Q15) contains case-based questions of 4 marks each, with sub-parts of 1, 2 and 1 marks.
7. Section E (Q16–17) contains long answer questions of 5 marks each.
8. There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 1 question in Section D, 2 questions in Section E. Attempt only one of the alternatives in such questions.
9. Draw neat, labelled diagrams wherever necessary.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Biology (044) Sample Question Paper 2026-27, at about half the length of the 70-mark board paper: 37 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Biotechnology and its Applications · **Topics:** Applications in agriculture: GM crops, Bt cotton · RNA interference · Applications in medicine: insulin, gene therapy · Molecular diagnosis · Transgenic animals · Ethical issues and biopiracy

SECTION A

This section comprises 8 questions of 1 mark each: 6 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. The cry genes in Bt cotton that control cotton bollworms are 1

(A) cryIAb only
(B) cryIIAc and cryIIIAb
(C) cryIAc and cryIIAb
(D) cryIAb and cryIIIAb

2. The genes for the Bt toxin were obtained from the bacterium 1

(A) Bacillus thuringiensis
(B) Agrobacterium tumefaciens
(C) Escherichia coli
(D) Thermus aquaticus

3. RNA interference (RNAi) was used to make tobacco plants resistant to 1

(A) the cotton bollworm
(B) the nematode Meloidogyne incognita
(C) aphids
(D) a fungal pathogen

4. The first clinical gene therapy, in 1990, was given to a four-year-old girl with 1

(A) haemophilia
(B) sickle-cell anaemia
(C) cystic fibrosis
(D) adenosine deaminase (ADA) deficiency

5. The transgenic cow Rosie (1997) produced 1

(A) milk containing human alpha-lactalbumin (2.4 g per litre)
(B) human insulin in its blood
(C) alpha-1-antitrypsin in its milk
(D) milk without lactose

6. Over 95 per cent of all existing transgenic animals are 1

(A) cows
(B) sheep
(C) mice
(D) pigs

7. **Assertion (A):** All Bt toxins kill the same kinds of insects. 1
Reason (R): Different Bt toxin proteins are coded by different cry genes.

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

8. **Assertion (A):** The transgenic cow Rosie produced milk that was nutritionally more balanced for human babies than natural cow milk. 1
Reason (R): The nematode Meloidogyne incognita infects the roots of tobacco plants.

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

SECTION B

This section comprises 3 short answer questions of 2 marks each.

9. (a) Give four advantages of genetically modified (GM) crops. 2

OR

(b) What is golden rice? What does it show about GM crops?

10. (a) Name the three options for increasing food production. Why is GM-crop-based agriculture considered among them? 2

OR

(b) How did the Green Revolution increase food supply, and why is it not enough on its own?

11. What are genetically modified organisms (GMOs)? Give one example each of a GM plant and a GM animal from this chapter. 2

SECTION C

This section comprises 3 short answer questions of 3 marks each.

12. Describe how human insulin was produced by recombinant DNA technology. Why was this an improvement over insulin from animals? 3

13. Explain how RNA interference was used to protect tobacco plants from a nematode. 3

14. Why are recombinant therapeutics preferred to drugs of non-human origin? About how many have been approved for human use in the world, and how many of them are marketed in India? Name one example. 3

SECTION D

This section comprises 1 case-based question of 4 marks, with sub-parts of 1, 2 and 1 marks.

15. A four-year-old child suffers repeated serious infections. Tests show that she has ADA deficiency: the gene for the enzyme adenosine deaminase is deleted, so her immune system cannot work properly. Her doctors consider bone marrow transplantation, enzyme replacement therapy and gene therapy.

(I) Why is adenosine deaminase important for the body? [1]

(II) Describe how gene therapy is used to treat ADA deficiency. [2]

(III) Why does this treatment have to be repeated periodically? [1]

OR

(III) How could ADA deficiency be cured permanently? [1]

SECTION E

This section comprises 2 long answer questions of 5 marks each.

16. (a) Explain why early diagnosis of diseases is important, and describe how PCR, ELISA and labelled probes are used in molecular diagnosis. 5

OR

(b) Describe five uses of transgenic animals, with an example of each where possible.

17. (a) What ethical issues are raised by biotechnology? What is biopiracy? Explain with the example of basmati rice, and state how India has responded. 5

OR

(b) (i) Explain how the Bt toxin kills an insect that eats a Bt cotton plant.

(ii) Why does the Bt toxin not kill the bacterium that makes it? Why do Bt crops reduce the need for chemical insecticides?

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
(C)	(A)	(B)	(D)	(A)	(C)	(D)	(B)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (C). cryIAc and cryIIAb control cotton bollworms; cryIAb controls the corn borer.

Q2. Answer (A). Bt stands for Bacillus thuringiensis, a soil bacterium that makes insecticidal proteins.

Q3. Answer (B). Nematode-specific genes introduced into the host produce dsRNA that silences the nematode's mRNA.

Q4. Answer (D). ADA deficiency, an immune-system disorder caused by deletion of the gene for adenosine deaminase.

Q5. Answer (A). Human protein-enriched milk (2.4 g per litre), nutritionally more balanced for human babies than natural cow milk.

Q6. Answer (C). Transgenic rats, rabbits, pigs, sheep, cows and fish have been produced, but over 95 % of transgenic animals are mice.

Q7. Answer (D). Each toxin is specific: the proteins coded by cryIAc and cryIIAb control cotton bollworms, while that of cryIAb controls the corn borer. A is false, R is true. Answer D.

Q8. Answer (B). Both are true, but the nematode has nothing to do with Rosie's milk, which contained a human protein (alpha-lactalbumin). Answer B.

Q9. (2 marks) Answer: (a) any four advantages; (b) vitamin A enriched rice.
(a) Any four [2]: more tolerant to abiotic stresses (cold, drought, salt, heat); less reliance on chemical pesticides (pest-resistant crops); reduced post-harvest losses; increased efficiency of mineral usage by plants (prevents early exhaustion of soil fertility); enhanced nutritional value of food (e.g. vitamin A enriched rice); tailor-made plants supplying alternative resources such as starches, fuels and pharmaceuticals to industry.
OR (b) Golden rice is a genetically modified variety of rice enriched in vitamin A. [1] It shows how genetic modification can increase the nutritional value of food. [1]

Q10. (2 marks) Answer: (a) agrochemical, organic, GM; (b) yields rose, but not enough; agrochemicals costly and harmful.
(a) Agrochemical-based agriculture, organic agriculture and genetically engineered crop-based agriculture. [1] The Green Revolution increased yields with agrochemicals, but these are costly and harmful; GM crops can raise yields while reducing the use of fertilisers and chemicals. [1]
OR (b) The Green Revolution, using improved crop varieties together with agrochemicals (fertilisers and pesticides), increased food supply greatly. [1] It is still not enough for the growing population, and the agrochemicals are often too expensive for farmers in the developing world and harmful to the environment. [1]

Q11. (2 marks) Answer: organisms with genes altered by manipulation; Bt cotton; Rosie.
Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called genetically modified organisms. [1] GM plant: Bt cotton (or golden rice, or RNAi tobacco); GM animal: the transgenic cow Rosie (or transgenic mice). [1]

Q12. (3 marks) Answer: A and B chains made separately in E. coli and joined; no C-peptide problem; no allergy.
Insulin has two short polypeptide chains, A and B, linked by disulphide bridges; in the body it is made as proinsulin, which has an extra stretch, the C-peptide, removed during maturation. [1]
In 1983 Eli Lilly, an American company, prepared two DNA sequences corresponding to the A and B chains, introduced them into plasmids of E. coli to produce the chains separately, then extracted the chains and combined them by creating disulphide bonds to form human insulin. [1]
Insulin from slaughtered cattle and pigs caused allergy or other reactions in some patients; human insulin made this way avoids that, and can be produced in large amounts. [1]

Q13. (3 marks) Answer: Meloidogyne incognita; sense + antisense RNA → dsRNA → silencing.
The nematode Meloidogyne incognita infects the roots of tobacco plants and greatly reduces yield. [1]
Using Agrobacterium vectors, nematode-specific genes were introduced into the host plant in such a way that they produced both sense and anti-sense RNA in the host cells; these two complementary RNAs formed double-stranded RNA (dsRNA). [1]
The dsRNA initiated RNAi, silencing the specific mRNA of the nematode; the parasite could not survive in a transgenic host expressing this RNA, so the plant was protected. [1]

Q14. (3 marks) Answer: no unwanted immune response; about 30, 12 in India; human insulin.
Recombinant DNA technology makes it possible to produce safe and more effective therapeutic drugs; recombinant therapeutics do not cause unwanted immunological responses, as similar products isolated from non-human sources do. [1]
About 30 recombinant therapeutics have been approved for human use the world over [½]; 12 of them are being marketed in India. [½]
Example: human insulin made in E. coli. [1]

Q15. (4 marks) Answer: (I) needed for immunity; (II) lymphocytes + ADA cDNA (retroviral vector) returned; (III) lymphocytes not immortal, or gene into early embryonic cells.
(I) The enzyme is crucial for the immune system to function. [1]
(II) Lymphocytes from the patient's blood are grown in a culture outside the body; a functional ADA cDNA is introduced into them using a retroviral vector. [1] The genetically engineered lymphocytes are then returned to the patient. [1]
(III) The engineered lymphocytes are not immortal, so the patient needs periodic infusions of them. [1]
OR (III) By introducing the gene isolated from marrow cells producing ADA into cells at early embryonic stages. [1]

Q16. (5 marks) Answer: (a) PCR, ELISA, probes and autoradiography; (b) five uses of transgenic animals.
(a) Early diagnosis allows effective treatment; conventional methods (serum and urine analysis) cannot detect a pathogen until its concentration is high, when symptoms have appeared. [1] PCR amplifies even a very low amount of a pathogen's nucleic acid, so it can detect infections such as HIV in suspected AIDS patients, and mutations in genes in suspected cancer patients; it is also used to detect many other genetic disorders. [1½] ELISA is based on antigen-antibody interaction: infection can be detected by the presence of antigens (proteins, glycoproteins) of the pathogen or by antibodies made against it. [1½] A single-stranded DNA or RNA tagged with a radioactive molecule (probe) hybridises to its complementary DNA in a clone of cells; detection by autoradiography — a clone with a mutated gene does not show up on the photographic film, because the probe is not complementary to it. [1]
OR (b) Normal physiology and development: to study how genes are regulated and how they affect body functions (e.g. insulin-like growth factor). [1] Study of disease: models for human diseases such as cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's, so that new treatments can be investigated. [1] Biological products: e.g. alpha-1-antitrypsin, used to treat emphysema; the cow Rosie produced human protein-enriched milk (2.4 g per litre). [1] Vaccine safety: transgenic mice are used to test the safety of the polio vaccine before it is used on humans. [1] Chemical safety (toxicity) testing: transgenic animals carrying genes that make them more sensitive to toxic substances give results faster. [1]

Q17. (5 marks) Answer: (a) GEAC, patents, biopiracy, basmati, Patents Bill amendment; (b) protoxin activated in alkaline gut, pores in midgut cells; less insecticide.

(a) Genetic modification of organisms can have unpredictable results when they are introduced into the ecosystem, so the Indian Government set up the GEAC to decide on the validity of GM research and the safety of GM organisms for public services. [1] Patents are being granted for products and technologies that use genetic materials, plants and other biological resources long identified, developed and used by farmers and indigenous people. [1] Biopiracy is the use of bio-resources by multinational companies and other organisations without proper authorisation from the countries and people concerned, or without compensatory payment. [1] Basmati: India has about 27 documented varieties of basmati, with unique flavour and aroma; in 1997 an American company got patent rights on basmati rice through the US Patent and Trademark Office, for a 'new' variety derived from Indian farmers' varieties crossed with semi-dwarf varieties. [1] India's Parliament has cleared the second amendment of the Indian Patents Bill, which takes such issues into consideration, including emergency provisions and research and development initiatives. [1]

OR (b) (i) Bacillus thuringiensis forms protein crystals during a phase of its growth, containing a toxic insecticidal protein. [1] The toxin exists as an inactive protoxin; when an insect eats it, the alkaline pH of the gut solubilises the crystals and converts it into the active toxin. [1] The active toxin binds to the surface of the midgut epithelial cells and creates pores, causing the cells to swell and lyse, so the insect dies. [1]

(ii) Because the toxin is stored as an inactive protoxin, it does not harm the bacterium itself. [1] A Bt crop makes the toxin in its own tissues, so insects that feed on it are killed and much less chemical insecticide needs to be sprayed. [1]

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