



Attempt questions first; check the separate key afterward. Use labelled diagrams where asked. Give scientific reasons; answer key covers closed questions.

A. Very short answers - 1 mark each

1. Name the bacterium supplying Bt insecticidal genes.
2. Why is the Bt toxin initially termed a protoxin?
3. Name the enzyme deficient in the classic ADA gene-therapy example.
4. Name the connecting peptide removed from proinsulin.
5. Expand RNAi.
6. Name the root-knot nematode discussed in the RNAi example.
7. What is a transgenic animal?
8. Define biopiracy.

B. Short answers / practice - 2 marks each

9. Explain why Bt protoxin becomes active in a susceptible insect gut.
10. Describe the specificity of different cry genes.
11. Explain how Bt cotton can reduce damage by target insects.
12. Why does pest resistance management remain necessary for Bt crops?
13. Describe RNAi-mediated gene silencing.
14. Explain nematode resistance in engineered tobacco using RNAi.
15. Compare mature insulin with proinsulin.
16. Explain recombinant human insulin production conceptually.
17. Why was separately producing insulin chains a useful early strategy?
18. Describe gene therapy using the ADA-deficiency example.
19. Distinguish somatic gene therapy from heritable germline alteration.

20. Why may treated lymphocytes need repeated administration in some early gene-therapy approaches?

C. Application / reasoning - 3 marks each

21. Explain PCR-based early detection of a pathogen.
22. Describe antigen-antibody specificity in ELISA.
23. Compare a diagnostic test with treatment of disease.
24. Explain recombinant vaccine production at a basic level.
25. Define stem-cell self-renewal and differentiation.
26. Compare embryonic and adult stem cells conceptually.
27. Describe three uses of transgenic animals in research.
28. Explain why animal-model results need careful interpretation before human use.
29. Does insertion of a gene guarantee identical expression in every organism?
30. Distinguish a patent from ownership of all traditional knowledge about a resource.
31. Explain biosafety assessment of a genetically modified crop.

D. Extended practice - 5 marks each

32. Describe Bt-crop action and RNAi-based resistance with labelled mechanisms.
33. Compare recombinant insulin, gene therapy and molecular diagnosis as medical applications.
34. Discuss transgenic animals and stem-cell technology, including potential benefits and ethical issues.
35. Explain biosafety, patents and biopiracy using a balanced example of biological-resource use.

ANSWER KEY - Numerical / closed questions

- 1) *Bacillus thuringiensis*. 3) Adenosine deaminase.
4) C-peptide. 5) RNA interference. 6) *Meloidogyne incognita*. 29) No.