



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 enzymes cutting DNA at specific recognition sequences.
2. Name the enzyme joining DNA fragments.
3. Expand PCR.
4. Name the thermostable polymerase commonly used in PCR.
5. Name the organism originally supplying Taq polymerase.
6. What is a cloning vector?
7. What is the role of an origin of replication?
8. Toward which electrode does DNA move during agarose electrophoresis?

B. Short answers / practice - 2 marks each

9. Distinguish genetic engineering from conventional selection.
10. Explain restriction-enzyme naming with EcoRI.
11. Describe palindromic recognition sequences using an example.
12. Compare sticky and blunt ends.
13. Explain why matching restriction cuts aid recombinant-DNA formation.
14. State essential properties of a good cloning vector.
15. Describe selectable markers and insertional inactivation.
16. Explain how pBR322 can distinguish recombinants from non-recombinants.
17. Why must a host cell be made competent for DNA uptake?
18. Describe heat-shock-mediated transformation conceptually.
19. Compare microinjection, biolistics and disarmed pathogen vectors.
20. Explain agarose gel separation by fragment size.

C. Application / reasoning - 3 marks each

21. Why do smaller DNA fragments usually migrate farther?
22. What is elution of a DNA fragment?
23. Describe cell lysis and removal of proteins/RNA during DNA isolation.
24. Explain the three PCR steps and the purpose of primers.
25. From one double-stranded molecule, find ideal copies after 10 PCR cycles.
26. From five templates, find ideal copies after 6 cycles.
27. A linear DNA has three internal restriction sites. How many fragments result after complete digestion?
28. A circular plasmid has three sites for an enzyme. How many fragments result after complete digestion?
29. Distinguish cloning from expression of an inserted gene.
30. Explain the role of a stirred-tank bioreactor.
31. What does downstream processing include?

D. Extended practice - 5 marks each

32. Describe recombinant-DNA technology from isolation to product purification.
33. Draw and explain a cloning vector, marking ori, marker and cloning site.
34. Explain PCR and gel electrophoresis with diagrams and practical applications.
35. Describe bioreactor design, process control and downstream quality checks.

ANSWER KEY - Numerical / closed questions

- 1) Restriction endonucleases. 2) DNA ligase. 3) Polymerase chain reaction. 4) Taq polymerase. 5) *Thermus aquaticus*. 6) DNA carrier delivering/replicating an inserted sequence in a host. 7) Initiates replication and influences copy number. 8) Positive electrode/anode. 25) 1024. 26) 320. 27) Four. 28) Three.