33 Biotechnology: Principles and Processes

Conceptual MCQs

1. The primary reason why the same basic techniques can be used to analyse the DNA from species as diverse as bacteria and humans is that
(a) all cells are identical.
(b) every organism has the same amount of DNA.
(c) the DNA sequences of all organisms are the same.
(d) DNA has a consistent structure in all organisms.

2. Which of the following is a critically important tool used in experiments involving DNA hybridization?
(a) DNA sequencing machines
(b) Ligases
(c) DNA probes
(d) Vectors

3. Introduction of one or more genes into an organism which normally does not possess them or their deletion by using artificial means (not by breeding) comes under
(a) molecular biology (b) cytogenetics
(c) genetic hybridization (d) genetic engineering

4. Cloning means that
(a) all of the cells are derived from one cell and are genetically identical.
(b) a gene from one organism has been inserted into a vector and successfully introduced into a host cell.
(c) all of the cells in a particular organism are identical.
(d) All of the above

5. A genetic marker is a
(a) place where a restriction enzyme cuts DNA.
(b) chart that traces the family history of a genetic trait.
(c) nucleotide sequence near a particular gene.
(d) radioactive probe used to find a gene.

6. Electrophoresis is used to
(a) separate fragments of DNA.
(b) clone genes.
(c) cut DNA into fragments.
(d) match a gene with its function.

7. DNA ligases are enzymes that can be used to
(a) cut a large DNA molecule into small fragments.
(b) copy DNA fragments.
(c) insert the DNA from one species into the DNA of another species.
(d) separate DNA fragments based on their size.

8. Which of the following is not necessary to execute a polymerase chain reaction successfully?
(a) All four DNA bases (b) Short DNA base primers
(c) DNA polymerase (d) DNA library

9. Which of the following is/are used in recombinant DNA technology?
(1) agarose gel
(2) ethidium bromide
(3) plasmid vector
(4) restriction endonuclease
(a) (1) and (2) (b) (2) and (3)
(c) (3) and (4) (d) (1), (2), (3) and (4)

10. A device in which large volume of living cells are cultured in order to get a specific product is called
(a) PCR (b) assimilator
(c) bioreactor (d) None of these

11. Restriction fragment length polymorphism (RELP) is
(a) the technique used to over-exploit genetic errors
(b) the difference in the restriction maps between the two alleles in a diploid cell
(c) the difference in the restriction maps between two individuals of one species
(d) the differece in the restriction maps between two individuals of two species

12. Which of the following features cannot be associated with Ti plasmid of *Agrobacterium tumefaciens*, which is modified into a cloning vector?
(a) Ti plasmid of *Agrobacterium* is a natural genetic engineer
(b) Modified into cloning vector as it can transfer a piece of T-DNA into plant cells
(c) Pathogenic to the plants
(d) None of these

13. A restriction endonuclease breaks bonds between the
(a) base pair of DNA molecule
(b) base pair of a DNA-RNA hybrid molecule
(c) sugar and phosphate components of a nucleic acid molecule
(d) exons and introns of a DNA molecule.

14. Identify the palindromic sequence in the following.
(a) $\frac{\text{GAATTC}}{\text{CTTUUG}}$ (b) $\frac{\text{GGATCC}}{\text{CCTAGG}}$
(c) $\frac{\text{CCTGG}}{\text{GGACC}}$ (d) $\frac{\text{CGATA}}{\text{GCTAA}}$

15. Micro-injection is a method used to
(a) produce sticky ends of DNA
(b) provide protection against pathogen
(c) purify the DNA
(d) inject recombinant DNA into the nucleus of an animal cell.

16. pBR322 was the first artificial cloning vector to be constructed. What does "BR" stands for?
(a) Bacteriophage and Recombinant
(b) Boliver and Rodriguez
(c) Boyer and Replicative
(d) None of these

17. The sticky ends of a fragmented DNA molecule are made of
(a) calcium salts (b) endonuclease enzyme
(c) unpaired bases (d) methyl groups.

18. A correct pair of characteristics of molecular probe is
(A) very long molecule (B) double stranded
(C) single stranded DNA or RNA
(D) complementary to part of desired gene
(a) A and B (b) B and C
(c) C and D (d) A and D

19. Primers are
(a) chemically synthesized oligonucleotides that are complementary to the regions of DNA
(b) chemically synthesized oligonucleotides that are not complementary to the regions of DNA
(c) chemically synthesized, autonomously replicating circular DNA molecules
(d) specific sequences present on recombinant DNA.

20. Enzyme '*Taq* polymerase' used in PCR, has been isolated from bacterium
(a) *Agrobacterium tumefaciens*
(b) *Thermus aquaticus*
(c) *Streptomyces albus*
(d) *Escherichia coil*

21. Which of the following are the types of bioreactors?
(i) Simple stirred-tank bioreactor
(ii) Complex stirred-tank bioreactor
(iii) Sparged stirred-tank bioreactor
(iv) Agitator stirred-tan bioreactor
(a) (i) and (iii) (b) Only (iii)
(c) (i) and (ii) (d) (i), (ii) and (iv)

Application Based MCQs

22. A gene is said to be cloned if
(a) the DNA sequence of the gene is known.
(b) the function of the gene is known.
(c) there is a DNA probe for the gene.
(d) the gene has been isolated and copied.

23. An enzyme that joins the ends of two strands of nucleic acid is a
(a) polymerase (b) synthetase
(c) helicase (d) ligase

24. DNA fragments are separated using gel electrophoresis
(a) because DNA is pulled through the gel toward the negative end of the field.
(b) because larger DNA fragments move faster through the gel than smaller DNA fragments.
(c) to identify and isolate DNA fragments.
(d) to synthesize DNA for cloning.

25. Complementary base pairing is important for
(a) ligation reactions with blunt-end DNA molecules.
(b) hybridization between DNA and transcription factors.
(c) restriction endonucleases to cut cell walls.
(d) synthesizing cDNA molecules from mRNA templates.

26. In order for a prokaryotic vector to be propagated in a host bacterial cell, the vector needs
(a) telomeres (b) centromeres
(c) drug resistant genes (d) an origin of replication

27. Recombinant DNA can be transferred into host cell by
(a) growing the host cell in growth medium containing ampicillin.
(b) coating the DNA with carbohydrates so that the cells will engulf the DNA.
(c) treating cells with calcium ions or electrical pulses to increase cell permeability.
(d) injecting proteins into host cells to make them more permeable.

28. Expression vectors are different from other vectors because they
(a) contain drug resistance markers.
(b) contain telomeres.
(c) contain regulatory regions that permit the cloned DNA to produce a gene product.
(d) contain origin of DNA replication.

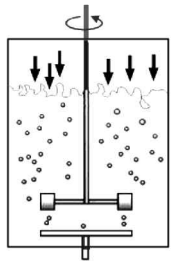
29. Which of the following statements about restriction enzymes is false?
(a) They work on DNA extracted from all types of organisms.
(b) They are used to glue together short segments of DNA.
(c) They come in many varieties, each with its own DNA target sequence.
(d) They are highly specific for their DNA target sequences.

30. Imagine a gel through which DNA fragments have moved in response to an applied electrical current. The band on this gel that is farthest from the top (that is, from the place where the DNA fragments were added to the "well") represents the
(a) shortest fragments of DNA.
(b) longest fragments of DNA.
(c) restriction enzyme used to cut the DNA into fragments.
(d) ligase used to bind the DNA fragments together.

31. A biologist intends to use a polymerase chain reaction to perform a genetic task. The biologist probably is trying to
(a) discover new genes.
(b) clone a gene.
(c) cut DNA into many small fragments.
(d) isolate DNA from a living cell.

32. In genetic engineering, genes can be inserted from one organism into another or back into the original organism using which of the following techniques?
(a) Polymerase chain reaction
(b) Gene gun
(c) DNA hybridization
(d) Gel electrophoresis

33. Identify the correct match for the given apparatus.



	Apparatus	Function
(a)	Gene gun	Vectorless direct gene transfer
(b)	Column chromatography	Separation of chlorophyll pigments
(c)	Sparged tank bioreactor	Carry out fermentation process
(d)	Respirometer	Finding out rate of respiration

34. Molecular probes used for identification of recombinant clone carrying the desired DNA insert can be
(1) denatured double stranded DNA probes
(2) double stranded RNA probes
(3) protein probes
(4) single stranded DNA probes
(a) (1) and (2) (b) (2) and (3)
(c) (1) and (4) (d) (1), (2), (3) and (4)

35. DNA of a bacterium is not cleaved by its own restriction enzymes because the recognition DNA sequences are
(a) methylated
(b) unmethylated
(c) bound by inhibitory protein
(d) not accessible to restriction enzymes

36. Restriction endonucleases are enzymes that
(P) Require Mg^{2+} and co-factor
(Q) make sequence-specific cuts in both strands of duplex DNA molecules
(R) promote circularisation of the duplex DNA molecule by removal of the 5' terminal nucleotides
(S) generate 3'-hydroxyl and 5'-phosphate ends in the cut DNA strands
(a) P, Q (b) P, R (c) Q, S (d) P, Q, R, S

37. Which of the following statements is not correct regarding *EcoRI* restriction endonuclease enzyme?
(a) It is isolated from *Escherichia coli* RY 13
(b) Its recognition sequence is 5'-GAATTC-3'
3'-CTTAAG-5'
(c) It produces complimentary blunt ends
(d) None of these

38. Which of the following correctly depicts the recognition site for *EcoRI*?

(a) G–A–A–T–T–C / C–T–T–A–A–G (↓ after G, ↑ after A)
(b) G–T–C–G–A–C / C–A–G–C–T–G (↓ after G, ↑ after C)
(c) G–T–C–G–A–C / C–A–G–C–T–G (↓ after G, ↑ after G)
(d) G–A–A–T–T–C / C–T–T–A–A–G (↓ after G, ↑ after G)

39. If a plasmid vector is digested with *EcoRI* at a single site, then
(a) one sticky end will be produced
(b) two stick ends will be produced
(c) four sticky ends will be produced
(d) six sticky ends will be produced.

40. Stirred-tank bioreactors have advantages over shake flasks because they
(a) provide high temperature and pH
(b) provide better aeration and mixing properties
(c) do not allow the entry of CO_2
(d) are easy to operate.

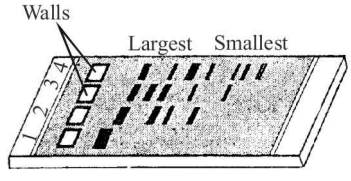
41. Which of the following is required to perform polymerase chain reaction?
(a) Primers, dNTPs and DNA polymerase
(b) DNA, $CaCl_2$ and nuclease
(c) Mg^{+2}, DNA
(d) Both (a) and (c)

Skill Based MCQs

42. To study the genetic basis of the inherited human disease sickle-cell anemia, a biologist must first isolate DNA from an affected individual's cells. The next step is to use
(a) restriction enzymes that break the DNA into small pieces at known points.
(b) gel electrophoresis to separate the DNA from other cell fragments.
(c) ligases that make the DNA stick together.
(d) DNA polymerase to make new copies of the DNA.

43. Which one of the following pairs is not correctly matched?
(a) Plasmid – Small piece of extrachromosomal DNA in bacteria
(b) Interferon – An enzyme that interferes with DNA replication
(c) Cosmid – A vector for carrying large DNA fragments into host cells
(d) Myeloma – Antibody-producing tumour cells

44. Identify the correct match for the given figure.



(a)	Electrophoresis	Differential migration of DNA fragments
(b)	Column chromatography	Separation of chlorophyll pigments
(c)	Gene cloning	Technique of obtaining identical copies of a particular DNA segment or a gene
(d)	Microinjection	Technique of introducing foreign genes into a host cell

45. Match column-I with column-II and select the correct answer using the codes given below.

	Column I		Column II
A.	Primers	1.	PCR
B.	Separation and purification of products	2.	C_2H_5OH
C.	Precipitation of DNA	3.	Uptake of foreign DNA by bacterium
D.	Transformation	4.	Downstream processing

(a) A → (4); B → (1); C → (2); D → (3)
(b) A → (2); B → (1); C → (4); D → (3)
(c) A → (4); B → (1); C → (3); D → (2)
(d) A → (1); B → (4); C → (2); D → (3)

46. Given flow chart depicts the steps to transfer a desirable gene of interest into a plant.
Identify the missing steps (A, B and C) with regard to following statements and select the correct option.
(i) Joining of desirable gene to a suitable cloning vector using ligase to create a recombinant DNA molecule.
(ii) Selection of transformed cells.
(iii) Transferring the recombinant DNA molecules to target cells.

Isolation of desirable gene using restriction endonucleases and gel electrophoresis
↓
A
↓
B
Screening of cell for transformation
↓
C
↓
Regeneration of plants from the transformed cells to get transgenic plant

	A	B	C
(a)	(i)	(ii)	(iii)
(b)	(i)	(iii)	(ii)
(c)	(ii)	(iii)	(i)
(d)	(iii)	(i)	(ii)

47. X technique is now routinely used to detect HIV in suspected AIDS patients. It is being used to detect mutations in genes in suspected cancer patients too. It is a powerful technique to identify many other genetic disorders. Identify X.
(a) X = PCR
(b) X = DNA fingerprinting
(c) X = Pathogen
(d) X = X-ray diffraction

48. In order to identify the person who committed a crime, forensic experts will need to extract DNA from the tissue sample collected at the crime scene and conduct one of the following procedures for DNA fingerprinting analysis.
(a) Cut the DNA and hybridize with specific micro-satellite probes
(b) Cut the DNA and subclone the fragments
(c) Cut DNA of victim to transfer in other individual
(d) (b) followed by (c)

49. If a recombinant DNA bearing gene for resistance to antibiotic ampicillin is transferred to *E.coli* cells, the host cells become transformed into ampicillin resistant cells. If such bacteria are transferred on agar plates containing ampicillin, only transformants will grow and the untransformed recipient cells will die. The ampicillin resistant gene in the case is called as
(a) selectable marker
(b) recombinant protein
(c) cloning site
(d) chemical scalpels.

50. Having become an expert on gel electrophoresis, you are asked to examine a gel for a colleague. Where would you find the smallest segments of DNA?
(a) Near the positive electrode, farthest away from the wells
(b) Near the negative electrode close to the wells
(c) Near the negative electrode, farthest away from the wells
(d) Near the middle, they tend to slow down after the first few minutes.

51. **(A):** The cloning vector is required to have very few, preferably single, recognition sites for the commonly used restriction enzymes.
(B): Presence of more than one recognition sites within a cloning vector will generate several fragments, which will complicate the process of gene cloning.
(a) Both (A) and (B) are true.
(b) (A) is true and (B) is false.
(c) Both (A) and (B) are false.
(d) (A) is false and (B) is true.

ANSWER KEY

Conceptual MCQs																			
1	(d)	**4**	(d)	**7**	(c)	**10**	(c)	**13**	(c)	**16**	(b)	**19**	(a)						
2	(c)	**5**	(c)	**8**	(d)	**11**	(c)	**14**	(b)	**17**	(c)	**20**	(b)						
3	(d)	**6**	(a)	**9**	(d)	**12**	(c)	**15**	(d)	**18**	(c)	**21**	(a)						
Application Based MCQs																			
22	(d)	**24**	(c)	**26**	(d)	**28**	(c)	**30**	(a)	**32**	(b)	**34**	(c)	**36**	(c)	**38**	(d)	**40**	(b)
23	(d)	**25**	(d)	**27**	(c)	**29**	(b)	**31**	(b)	**33**	(c)	**35**	(a)	**37**	(c)	**39**	(b)	**41**	(d)
Skill Based MCQs																			
42	(a)	**43**	(b)	**44**	(a)	**45**	(d)	**46**	(b)	**47**	(a)	**48**	(a)	**49**	(a)	**50**	(b)	**51**	(a)