

Biotechnology: Principles and Processes — NEET Biology PYQ (2005-2021)

Class 12 Biology · 55 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2021

1. DNA strands on a gel stained with ethidium bromide when viewed under UV radiation, appear as :

- (A) Yellow bands
- (B) Bright orange bands
- (C) Dark red bands
- (D) Bright blue bands

NEET 2021

2. During the purification process for recombinant DNA technology, addition of chilled ethanol precipitates out :

- (A) RNA
- (B) DNA
- (C) Histones
- (D) Polysaccharides

NEET 2021

3. Which of the following is a correct sequence of steps in a PCR (Polymerase Chain Reaction) ?

- (A) Denaturation, Annealing, Extension
- (B) Denaturation, Extension, Annealing
- (C) Extension, Denaturation, Annealing
- (D) Annealing, Denaturation, Extension

NEET 2021

4. Plasmid pBR322 has PstI restriction enzyme site within gene amp^R that confers ampicillin resistance. If this enzyme is used for inserting a gene for β-galactoside production and the recombinant plasmid is inserted in an E.coli strain

- (A) it will not be able to confer ampicillin resistance to the host cell.
- (B) the transformed cells will have the ability to resist ampicillin as well as produce β-galactoside.
- (C) it will lead to lysis of host cell.
- (D) it will be able to produce a novel protein with dual ability.

NEET 2021

5. A specific recognition sequence identified by endonucleases to make cuts at specific positions within the DNA is :

- (A) Degenerate primer sequence
- (B) Okazaki sequences
- (C) Palindromic Nucleotide sequences
- (D) Poly(A) tail sequences

NEET 2021

6. During the process of gene amplification using PCR, if very high temperature is not maintained in the beginning, then which of the following steps of PCR will be affected first ?

- (A) Annealing
- (B) Extension
- (C) Denaturation
- (D) Ligation

NEET 2020 · Q7

7. Choose the correct pair from the following:

- (A) Ligases - Join the two DNA molecules
- (B) Polymerases - Break the DNA into fragments
- (C) Nucleases - Separate the two strands of DNA
- (D) Exonucleases - Make cuts at specific positions within DNA

NEET 2020 · Q18

8. In gel electrophoresis, separated DNA fragments can be visualized with the help of:

- (A) Acetocarmine in bright blue light
- (B) Ethidium bromide in UV radiation
- (C) Acetocarmine in UV radiation
- (D) Ethidium bromide in infrared radiation

NEET 2020 · Q21

9. The specific palindromic sequence which is recognized by EcoRI is:

- (A) 5'-GAATTC-3' / 3'-CTTAAG-5'
- (B) 5'-GGAACC-3' / 3'-CCTTGG-5'
- (C) 5'-CTTAAG-3' / 3'-GAATTC-5'
- (D) 5'-GGATCC-3' / 3'-CCTAGG-5'

NEET 2020 · Q27

10. Match the organism with its use in biotechnology.

- (a) *Bacillus thuringiensis* | (i) Cloning vector**
- (b) *Thermus aquaticus* | (ii) Construction of first rDNA molecule**
- (c) *Agrobacterium tumefaciens* | (iii) DNA polymerase**
- (d) *Salmonella typhimurium* | (iv) Cry proteins**

Select the correct option from the following:

- (A) (a)-ii, (b)-iv, (c)-iii, (d)-i
- (B) (a)-iv, (b)-iii, (c)-i, (d)-ii
- (C) (a)-iii, (b)-ii, (c)-iv, (d)-i
- (D) (a)-iii, (b)-iv, (c)-i, (d)-ii

NEET 2020 · Q78

11. The sequence that controls the copy number of the linked DNA in the vector, is termed:

- (A) Selectable marker
- (B) Ori site
- (C) Palindromic sequence
- (D) Recognition site

NEET 2019 · Q113

12. Which one of the following equipments is essentially required for growing microbes on a large scale, for industrial production of enzymes ?

- (A) BOD incubator
- (B) Sludge digester
- (C) Industrial oven
- (D) Bioreactor

NEET 2019 · Q122

13. DNA precipitation out of a mixture of biomolecules can be achieved by treatment with :

- (A) Isopropanol
- (B) Chilled ethanol
- (C) Methanol at room temperature
- (D) Chilled chloroform

NEET 2019 · Q145

14. Following statements describe the characteristics of the enzyme Restriction Endonuclease. Identify the incorrect statement.

- (A) The enzyme cuts DNA molecule at identified position within the DNA.
- (B) The enzyme binds DNA at specific sites and cuts only one of the two strands.
- (C) The enzyme cuts the sugar-phosphate backbone at specific sites on each strand.
- (D) The enzyme recognizes a specific palindromic nucleotide sequence in the DNA.

NEET 2018 · Q101

15. The correct order of steps in Polymerase Chain Reaction (PCR) is

- (A) Denaturation, Extension, Annealing
- (B) Annealing, Extension, Denaturation
- (C) Extension, Denaturation, Annealing
- (D) Denaturation, Annealing, Extension

NEET 2017 · Q56

16. A gene whose expression helps to identify transformed cell is known as:

- (A) Selectable marker
- (B) Vector
- (C) Plasmid
- (D) Structural gene

NEET 2017 · Q80

17. DNA fragments are:

- (A) Positively charged
- (B) Negatively charged
- (C) Neutral
- (D) Either positively or negatively charged depending on their size

NEET 2017 · Q84

18. The process of separation and purification of expressed protein before marketing is called:

- (A) Upstream processing
- (B) Downstream processing
- (C) Bioprocessing
- (D) Postproduction processing

NEET 2017 · Q105

19. The DNA fragments separated on an agarose gel can be visualised after staining with:

- (A) Bromophenol blue
- (B) Acetocarmine
- (C) Aniline blue
- (D) Ethidium bromide

NEET 2017 (Gujarati paper) · Q123

20. Restriction endonucleases are:

- (A) Used for in vitro DNA synthesis
- (B) Synthesized by bacteria as part of their defense mechanism
- (C) Present in mammalian cell for degradation of DNA when the cell dies
- (D) Used in genetic engineering for ligating two DNA molecules

NEET 2016 Phase 2 · Q125

21. Stirred-tank bioreactors have been designed for

- (A) purification of product
- (B) addition of preservatives to the product
- (C) availability of oxygen throughout the process
- (D) ensuring anaerobic conditions in the culture vessel

NEET 2016 Phase 2 · Q126

22. A foreign DNA and plasmid cut by the same restriction endonuclease can be joined to form a recombinant plasmid using

- (A) Eco RI
- (B) Taq polymerase
- (C) polymerase III
- (D) ligase

NEET 2016 Phase 2 · Q127

23. Which of the following is not a component of downstream processing?

- (A) Separation
- (B) Purification
- (C) Preservation
- (D) Expression

NEET 2016 Phase 2 · Q128

24. Which of the following restriction enzymes produces blunt ends?

- (A) Sal I
- (B) Eco RV
- (C) Xho I
- (D) Hind III

NEET 2016 Phase 1 · Q123

25. Which of the following is not a feature of the plasmids?

- (A) Independent replication
- (B) Circular structure
- (C) Transferable
- (D) Single - stranded

NEET 2016 Phase 1 · Q132

26. The taq polymerase enzyme is obtained from:

- (A) Thermus aquaticus
- (B) Thiobacillus ferrooxidans
- (C) Bacillus subtilis
- (D) Pseudomonas putida

NEET 2016 Phase 1 · Q151

27. Which of the following is a restriction endonuclease?

- (A) Hind II
- (B) Protease
- (C) DNase I
- (D) RNase

AIPMT 2014

28. Which vector can clone only a small fragment of DNA?

- (A) Yeast artificial chromosome
- (B) Plasmid
- (C) Cosmid
- (D) Bacterial artificial chromosome

NEET 2013

29. DNA fragments generated by the restriction endonucleases in a chemical reaction can be separated by

- (A) Centrifugation
- (B) Polymerase chain reaction
- (C) Electrophoresis
- (D) Restriction mapping

NEET 2013

30. Which of the following is not correctly matched for the organism and its cell wall degrading enzyme?

- (A) Bacteria – Lysozyme
- (B) Plant cells – Cellulase
- (C) Algae – Methylase
- (D) Fungi – Chitinase

AIPMT 2012 Mains

31. Biolistics (gene-gun) is suitable for

- (A) Disarming pathogen vectors
- (B) Transformation of plant cells
- (C) Constructing recombinant DNA by joining with vectors
- (D) DNA finger printing

AIPMT 2012 Mains

32. In genetic engineering, the antibiotics are used

- (A) as selectable markers
- (B) to select healthy vectors
- (C) as sequences from where replication starts
- (D) to keep the cultures free of infection

AIPMT 2012 Mains

33. Which one of the following represents a palindromic sequence in DNA ?

- (A) 5'-GAATTC-3' / 3'-CTTAAG-5'
- (B) 5'-CCAATG-3' / 3'-GAATCC-5'
- (C) 5'-CATTAG-3' / 3'-GATAAC-5'
- (D) 5'-GATACC-3' / 3'-CCTAAG-5'

AIPMT 2012 Prelims

34. Which one of the following is a case of wrong matching ?

- (A) Callus - Unorganised mass of cells produced in tissue culture
- (B) Somatic hybridization - Fusion of two diverse cells
- (C) Vector DNA - Site for t-RNA synthesis
- (D) Micropropagation - In vitro production of plants in large numbers

AIPMT 2012 Prelims

35. A single strand of nucleic acid tagged with a radioactive molecule is called

- (A) Probe
- (B) Vector
- (C) Selectable marker
- (D) Plasmid

AIPMT 2012 Prelims

36. For transformation, micro-particles coated with DNA to be bombarded with gene gun are made up of

- (A) Gold or Tungsten
- (B) Silver or Platinum
- (C) Platinum or Zinc
- (D) Silicon or Platinum

AIPMT 2012 Prelims

37. Which one is a true statement regarding DNA polymerase used in PCR ?

- (A) It remains active at high temperature
- (B) It is used to ligate introduced DNA in recipient cells
- (C) It serves as a selectable marker
- (D) It is isolated from a virus

38. Which one of the following techniques made it possible to genetically engineer living organisms?

- (A) Heavier isotope labelling
- (B) Hybridization
- (C) Recombinant DNA techniques
- (D) X-ray diffraction

39. Agarose extracted from sea weeds finds use in

- (A) Gel electrophoresis
- (B) Spectrophotometry
- (C) Tissue culture
- (D) PCR

40. Given below is a sample of a portion of DNA strand giving the base sequence on the opposite strands. What is so special shown in it?

5' ____ GAATTC ____ 3'
3' ____ CTTAAG ____ 5'

- (A) Palindromic sequence of base pairs
- (B) Replication completed
- (C) Deletion mutation
- (D) Start codon at the 5' end

41. There is a restriction endonuclease called EcoRI. What does "co" part in it stand for?

- (A) coli
- (B) colon
- (C) coelom
- (D) coenzyme

42. Which of the following are used in gene cloning?

- (A) Nucleoids
- (B) Lomasomes
- (C) Mesosomes
- (D) Plasmids

43. In genetic engineering, a DNA segment (gene) of interest, is transferred to the host cell through a vector. Consider the following four agents (A-D) in this regard and select the correct option about which one or more of these can be used as a vector/vectors

Statements

(A) A bacterium

(B) Plasmid

(C) Plasmodium

(D) Bacteriophage

- (A) (A), (B) and (D) only
- (B) (A) only
- (C) (A) and (C) only
- (D) (B) and (D) only

AIPMT 2010 Prelims · Q191

44. Stirred-tank bioreactors have been designed for

- (A) Availability of oxygen throughout the process
- (B) Addition of preservatives to the product
- (C) Purification of the product
- (D) Ensuring anaerobic conditions in the culture vessel

AIPMT 2010 Prelims · Q194

45. Which one of the following is used as vector for cloning genes into higher organisms?

- (A) Retrovirus
- (B) Baculovirus
- (C) Salmonella typhimurium
- (D) Rhizopus nigricans

AIPMT 2010 Prelims · Q197

46. Restriction endonucleases are enzymes which

- (A) Remove nucleotides from the ends of the DNA molecule
- (B) Make cuts at specific positions within the DNA molecule
- (C) Recognize a specific nucleotide sequence for binding of DNA ligase
- (D) Restrict the action of the enzyme DNA polymerase

AIPMT 2010 Prelims · Q200

47. Which one of the following palindromic base sequences in DNA can be easily cut at about the middle by some particular restriction enzyme?

- (A) 5' CACGTA 3'; 3' CTCAGT 5'
- (B) 5' CGTTCG 3'; 3' ATGGTA 5'
- (C) 5' GATATG 3'; 3' CTAATA 5'
- (D) 5' GAATTC 3'; 3' CTTAAG 5'

AIPMT 2009 Prelims · Q55

48. Polyethylene glycol method is used for:

- (A) Biodiesel production
- (B) Seedless fruit production
- (C) Energy production from sewage
- (D) Gene transfer without a vector

AIPMT 2009 Prelims · Q58

49. Which one of the following is commonly used in transfer of foreign DNA into crop plants?

- (A) Meloidogyne incognita
- (B) Agrobacterium tumefaciens
- (C) Penicillium expansum
- (D) Trichoderma harzianum

AIPMT 2008 Prelims · Q185

50. Gel electrophoresis is used for

- (A) Isolation of DNA molecule
- (B) Cutting of DNA into fragments
- (C) Separation of DNA fragments according to their size
- (D) Construction of recombinant DNA by joining with cloning vectors

AIPMT 2008 Prelims · Q193

51. The linking of antibiotic resistance gene with the plasmid vector became possible with

- (A) Exonucleases
- (B) DNA ligase
- (C) Endonucleases
- (D) DNA polymerase

52. Microbes found to be very useful in genetic engineering are :

- (A) Escherichia coli and Agrobacterium tumefaciens
- (B) Vibrio cholerae and a tailed bacteriophage
- (C) Diplococcus sp. and Pseudomonas sp.
- (D) Crown gall bacterium and Caenorhabditis elegans

53. Restriction endonuclease :

- (A) cuts the DNA molecule randomly
- (B) cuts the DNA molecule at specific sites
- (C) restricts the synthesis of DNA inside the nucleus
- (D) synthesizes DNA

54. Which one of the following hydrolyses internal phosphodiester bonds in a polynucleotide chain ?

- (A) Lipase
- (B) Exonuclease
- (C) Endonuclease
- (D) Protease

55. Production of a human protein in bacteria by genetic engineering is possible because :

- (A) bacterial cell can carry out the RNA splicing reactions
- (B) the human chromosome can replicate in bacterial cell
- (C) the mechanism of gene regulation is identical in humans and bacteria
- (D) the genetic code is universal

Answer key and explanations

1. Answer: (B) Bright orange bands

Ethidium bromide intercalates into DNA and fluoresces under UV light, so the separated DNA fragments are seen as bright orange bands. They are not visible as bands without the stain and UV exposure.

2. Answer: (B) DNA

After the cell is lysed and RNA, proteins and other molecules are removed with enzymes, adding chilled ethanol makes the purified DNA come out of solution as fine threads. RNA is removed earlier by ribonuclease, not precipitated at this step.

3. Answer: (A) Denaturation, Annealing, Extension

Each PCR cycle first denatures the double-stranded DNA by heat, then lets the primers anneal to the single strands, and finally extends the primers using a thermostable DNA polymerase. Extension cannot come before annealing because the polymerase needs a primer to start.

4. Answer: (A) it will not be able to confer ampicillin resistance to the host cell.

PstI cuts inside the ampicillin resistance gene, so inserting a foreign gene there disrupts it by insertional inactivation and the recombinant plasmid can no longer make the host resistant to ampicillin. The transformed cells therefore cannot both resist ampicillin and express the new gene.

5. Answer: (C) Palindromic Nucleotide sequences

Restriction endonucleases recognise palindromic nucleotide sequences, which read the same on both strands in the 5'→3' direction, and cut at specific positions within them. Okazaki fragments and poly-A tails are unrelated to restriction sites.

6. Answer: (C) Denaturation

The first step of PCR, denaturation, needs a very high temperature (about 94 °C) to separate the two DNA strands, so it is affected first if that temperature is not reached. Ligation is not a PCR step at all.

7. Answer: (A) Ligases - Join the two DNA molecules

DNA ligase joins DNA fragments, for example sealing a gene into a vector. Polymerases synthesise DNA rather than break it, nucleases break phosphodiester bonds rather than separate strands, and it is endonucleases, not exonucleases, that cut at specific positions within the DNA.

8. Answer: (B) Ethidium bromide in UV radiation

After gel electrophoresis the DNA is stained with ethidium bromide and seen as bright orange bands under UV light. Acetocarmine is a chromosome stain used in light microscopy, and ethidium bromide does not fluoresce usefully under infrared.

9. Answer: (A) 5'-GAATTC-3' / 3'-CTTAAG-5'

EcoRI recognises the palindrome 5'-GAATTC-3' paired with 3'-CTTAAG-5', which reads the same on both strands in the 5'→3' direction. GGATCC is the BamHI site, and writing CTTAAG as the top 5'→3' strand is not the EcoRI site.

10. Answer: (B) (a)-iv, (b)-iii, (c)-i, (d)-ii

Bacillus thuringiensis gives cry proteins, Thermus aquaticus gives the thermostable Taq DNA polymerase, Agrobacterium tumefaciens (Ti plasmid) is used as a cloning vector, and a plasmid of Salmonella typhimurium was used to make the first rDNA molecule. Hence cry proteins, DNA polymerase, cloning vector, first rDNA is the correct order.

11. Answer: (B) Ori site

The origin of replication (ori) is where replication starts, and it also controls the copy number of the linked DNA in the vector. Selectable markers help pick transformants, and palindromic and recognition sequences are restriction enzyme sites.

12. Answer: (D) Bioreactor

Large volumes (100–1000 litres) of culture are grown in bioreactors, which provide optimal temperature, pH, aeration and mixing. A sludge digester is used in sewage treatment, not enzyme production.

13. Answer: (B) Chilled ethanol

In the NCERT protocol, purified DNA is precipitated by adding chilled ethanol and appears as fine threads. Chloroform is used to remove proteins, not to precipitate DNA.

14. Answer: (B) The enzyme binds DNA at specific sites and cuts only one of the two strands.

A restriction endonuclease recognises a specific palindromic sequence and cuts the sugar-phosphate backbone of both strands at specific positions, so the claim that it cuts only one of the two strands is the incorrect statement. Cutting at an identified position within the DNA is exactly what an endonuclease does, so that statement is correct.

15. Answer: (D) Denaturation, Annealing, Extension

Each PCR cycle first denatures double-stranded DNA by heat, then lets the primers anneal to the single strands at a lower temperature, and finally Taq polymerase extends the primers. Extension cannot happen before annealing because the polymerase needs a primer to start from.

16. Answer: (A) Selectable marker

A selectable marker, such as a gene for ampicillin or tetracycline resistance, lets transformants be picked out because only they survive on the selective medium. A vector or plasmid is the carrier of the DNA, not the identifying gene.

17. Answer: (B) Negatively charged

The phosphate groups of the sugar-phosphate backbone carry negative charges, so all DNA fragments are negatively charged and move towards the anode in electrophoresis. Size changes how fast they move, not the sign of their charge.

18. Answer: (B) Downstream processing

After biosynthesis in the bioreactor, the product is separated, purified, formulated with preservatives and put through quality control; these steps together are downstream processing. Upstream processing is the earlier stage of preparing the organism and growing it.

19. Answer: (D) Ethidium bromide

DNA in the gel is stained with ethidium bromide and seen as bright orange bands under UV light. Bromophenol blue is only a tracking dye that shows how far the run has gone, and does not stain DNA bands.

20. Answer: (B) Synthesized by bacteria as part of their defense mechanism

Restriction endonucleases are made by bacteria to cut the DNA of invading bacteriophages, restricting their growth, which is a defence mechanism. Joining DNA molecules is done by DNA ligase, and DNA synthesis in vitro needs DNA polymerase.

21. Answer: (C) availability of oxygen throughout the process

The stirrer in a stirred-tank bioreactor mixes the contents and spreads sterile air bubbles evenly, so oxygen is available throughout the culture. Purification and preservation belong to downstream processing, and the design supplies air rather than keeping conditions anaerobic.

22. Answer: (D) ligase

DNA ligase seals the sugar-phosphate backbone between the matching sticky ends of the vector and insert, forming the recombinant plasmid. EcoRI only cuts DNA, and Taq polymerase and polymerase III synthesise new strands rather than join fragments.

23. Answer: (D) Expression

Downstream processing starts after the product is made and includes separation, purification and formulation with preservatives. Expression of the gene in the host happens earlier, during the bioreactor stage, so it is not part of downstream processing.

24. Answer: (B) Eco RV

EcoRV cuts both strands at the same point in the middle of its recognition site GATATC, giving blunt ends. Sall, XhoI and HindIII make staggered cuts and leave sticky single-stranded overhangs.

25. Answer: (D) Single - stranded

Plasmids are extrachromosomal, circular, double-stranded DNA molecules that replicate independently of the chromosome and can be transferred between cells. They are not single-stranded.

26. Answer: (A) Thermus aquaticus

Taq polymerase is a heat-stable DNA polymerase isolated from the thermophilic bacterium *Thermus aquaticus*, which lets it survive the high denaturation temperature in PCR. The other bacteria are not its source.

27. Answer: (A) Hind II

Hind II, from *Haemophilus influenzae*, was the first restriction endonuclease isolated and cuts DNA at a specific recognition sequence. DNase I cuts DNA non-specifically, while proteases and RNases do not act on DNA.

28. Answer: (B) Plasmid

Plasmids can accept only small inserts (roughly up to 10 kb). Cosmids carry about 40–45 kb, BACs about 100–300 kb and YACs even larger fragments, which is why they are used for big genomic DNA pieces.

29. Answer: (C) Electrophoresis

DNA fragments, being negatively charged, move towards the anode through an agarose gel and are separated by size in gel electrophoresis. PCR amplifies DNA and does not separate fragments.

30. Answer: (C) Algae - Methylase

Methylase adds methyl groups to DNA and does not break down cell walls, so pairing it with algae is the wrong match. Lysozyme breaks bacterial walls, cellulase plant walls and chitinase fungal walls.

31. Answer: (B) Transformation of plant cells

In biolistics, gold or tungsten microparticles coated with DNA are shot into cells, a method suited to transforming plant cells. Disarming pathogens and joining DNA to vectors are done with enzymes, not a gene gun.

32. Answer: (A) as selectable markers

Antibiotic-resistance genes on a vector act as selectable markers: only transformed cells survive on medium containing the antibiotic. The replication start site is the ori, not an antibiotic sequence.

33. Answer: (A) 5'-GAATTC-3' / 3'-CTTAAG-5'

5'-GAATTC-3' reads the same 5'→3' on both strands (the EcoRI site), which makes it a palindrome. In the other options the second strand does not read the same as the first in the 5'→3' direction.

34. Answer: (C) Vector DNA - Site for t-RNA synthesis

A vector DNA (such as a plasmid) carries the foreign gene into the host cell and lets it replicate; it is not a site of tRNA synthesis. Callus, somatic hybridisation and micropropagation are all correctly described.

35. Answer: (A) Probe

A probe is a single-stranded DNA or RNA tagged with a radioactive (or fluorescent) molecule that hybridises with its complementary sequence and is detected by autoradiography. Vectors and plasmids carry genes into hosts, and selectable markers identify transformants.

36. Answer: (A) Gold or Tungsten

In biolistics (gene gun), DNA is coated onto high-velocity microparticles of gold or tungsten and fired into plant cells. Silver, platinum, zinc and silicon are not used.

37. Answer: (A) It remains active at high temperature

The DNA polymerase used in PCR is Taq polymerase from the bacterium *Thermus aquaticus*, which stays active at the high temperatures used to denature DNA. It is isolated from a bacterium, not a virus, and it does not ligate DNA or act as a selectable marker.

38. Answer: (C) Recombinant DNA techniques

Recombinant DNA technology, cutting and joining DNA with restriction enzymes and ligase and inserting it into a host, made it possible to genetically engineer organisms. Isotope labelling and X-ray diffraction were tools for studying DNA, and hybridization is conventional breeding.

39. Answer: (A) Gel electrophoresis

Agarose, a polysaccharide extracted from seaweeds, forms the gel matrix used in gel electrophoresis to separate DNA fragments by size. It plays no matrix role in spectrophotometry or PCR.

40. Answer: (A) Palindromic sequence of base pairs

The sequence 5'-GAATTC-3' reads the same on the opposite strand when both are read 5'→3', so it is a palindromic sequence. This is the recognition site of EcoRI. Nothing in it indicates deletion or a start codon (AUG/ATG).

41. Answer: (A) coli

Restriction enzymes are named after their source: in EcoRI, 'E' is the genus *Escherichia*, 'co' is the species *coli*, 'R' is the strain RY13 and 'I' the order of isolation.

42. Answer: (D) Plasmids

Plasmids are small, autonomously replicating, extrachromosomal circular DNA molecules of bacteria and are the commonest cloning vectors (e.g. pBR322). Mesosomes and nucleoids are bacterial cell structures and lomasomes are fungal membrane bodies; none of them carry foreign DNA.

43. Answer: (D) (B) and (D) only

The standard cloning vectors are plasmids and bacteriophages, because both replicate inside bacteria and can carry inserted DNA. Plasmodium is a protozoan parasite and is never used as a vector.

44. Answer: (A) Availability of oxygen throughout the process

A stirred-tank bioreactor uses a stirrer and a sparging system to mix the contents evenly and keep oxygen available throughout the culture. Purification and adding preservatives belong to downstream processing, not to the bioreactor.

45. Answer: (A) Retrovirus

Retroviruses can turn normal animal cells cancerous, but when disarmed they are used as vectors to deliver genes into animal cells. Baculoviruses are used as biocontrol agents against insects, and *Salmonella* and *Rhizopus* are not cloning vectors.

46. Answer: (B) Make cuts at specific positions within the DNA molecule

Restriction endonucleases recognise a specific palindromic sequence and cut the DNA at specific positions within the molecule. Removing nucleotides from the ends is what exonucleases do.

47. Answer: (D) 5' GAATTC 3'; 3' CTTAAG 5'

5'-GAATTC-3' / 3'-CTTAAG-5' reads the same 5'→3' on both strands, which makes it a true palindrome. It is the EcoRI recognition site, which is cut between G and A. The other pairs are not even complementary strands, let alone palindromes.

48. Answer: (D) Gene transfer without a vector

Polyethylene glycol (PEG) makes plant protoplast membranes permeable or fuse, so naked DNA can be taken up directly; it is a vectorless (direct) gene transfer method. It has nothing to do with biodiesel or seedless fruits.

49. Answer: (B) *Agrobacterium tumefaciens*

Agrobacterium tumefaciens naturally transfers a piece of its Ti plasmid (T-DNA) into dicot plant cells, and the disarmed Ti plasmid is used as a vector to deliver genes into crop plants. *Meloidogyne incognita* is a nematode pest and *Trichoderma* is a biocontrol fungus, not a vector.

50. Answer: (C) Separation of DNA fragments according to their size

In agarose gel electrophoresis negatively charged DNA fragments move toward the anode, and the gel's sieving effect separates them by size, smaller ones travelling farther. Cutting DNA is done by restriction enzymes and joining by ligase.

51. Answer: (B) DNA ligase

Cohen and Boyer joined the antibiotic resistance gene to the plasmid using DNA ligase, which seals the sugar-phosphate backbone between the cut ends. Restriction endonucleases only cut DNA; they do not join fragments.

52. Answer: (A) Escherichia coli and Agrobacterium tumefaciens

E. coli is the main host for cloning vectors, and Agrobacterium tumefaciens is used to transfer genes into plants through its Ti plasmid. Caenorhabditis elegans is a nematode, not a microbe.

53. Answer: (B) cuts the DNA molecule at specific sites

A restriction endonuclease recognises a specific palindromic base sequence and cuts DNA at or near that site. It does not cut randomly or make DNA.

54. Answer: (C) Endonuclease

Endonucleases cut phosphodiester bonds within a DNA or RNA chain; restriction enzymes are an example. Exonucleases remove nucleotides only from the ends. Lipases and proteases act on fats and proteins.

55. Answer: (D) the genetic code is universal

Because the genetic code is universal, bacterial ribosomes read a human gene's codons as the same amino acids and so make the human protein. Bacteria cannot splice introns (cDNA is used for that reason), and gene regulation differs between bacteria and humans.

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