NEET BIOLOGY

AND ITS APPLICATIONS

1. The bacterium, *Bacillus thuringiensis* is widely used in contemporary biology as
   a) Insecticide
   b) Agent for the production of dairy products
   c) Source of industrial enzyme
   d) Indicator of water pollution
2. The technique of DNA fingerprinting was initially developed by
   a) Ian wilmut b) Har Gobind Khurana
   c) Jacque Monod d) Alex Jeffreys
3. Consider the following statements
   I. Specific *Bt* toxin gene have been isolated from *Bacillus thuringiensis*
   II. *Bt* toxin is coded by a gene named *cry*
   III. *Bt* toxin protein exists as inactive protoxins
   Which of the statements given above are correct?
   a) I, II and III b) I and II c) I and III d) II and III
4. Silencing of a gene could be achieved by the use of
   a) RNAi b) Antisense RNA c) Both (a) and (b) d) None of these
5. In callus culture, roots can be induced by the supply of
   a) Auxin b) Cytokinin c) Gibberellin d) Ethylene
6. Golden rice
   I. It is a transgenic variety of rice
   II. It contains a goods quality of β-carotene (provitamin-A)
   III. β-carotene is a principal source of vitamin-A
   IV. The grains of the rice are yellow in colour due to β-carotene. The rice is commonly called golden rice
   Which of the statements given above are correct?
   a) I, II and III b) II, III and IV c) I, III and IV d) I, II, III and IV
7. GEAC stands for
   a) Genetic and Biotechnique Approval Committee b) Gene Environment Action Committee
   c) Genetic Engineering Approval Committee d) Genome Engineering Action Committee
8. The linking of antibiotic resistance gene with the plasmid vector became possible with
   a) DNA ligase b) Endonucleases c) DNA polymerase d) Exonucleases
9. Genetically modified plants have been useful in increasing
   a) Crop yield b) Nutritional value of food
   c) Tolerance against abiotic stresses d) All of the above
10. Transgenic crops are modified through genetic engineering to develop natural resistance to insect pests. Which one is a transgenic plant?
    a) Tobacco and cotton b) Tomato and rice c) Maize and sugarcane d) Tomato and wheat
11. Golden rice was created by transforming rice with two beta=carotene biosynthesis genes, namely,
    a) *Psy* and *Cry 1* genes b) *LCY-e* c) *CHY-1* d) *CHY-2*
12. Which of the following is used in genetic engineering?
    a) Plastid b) Plasmid c) Mitochondria d) ER
13. Explants before organogenesis, is
    a) Photosynthetic b) Autotrophic c) Heteromorphic d) Heterotrophic
14. In RNAi, genes are silenced using

a) *ds*DNA b) *ds*RNA c) *ss*DNA d) *ss*RNA

15. GAATTC is the recognition site for the restriction endonuclease
    a) *Eco* RI b) *Hind* II c) *Eco* RII d) *Bam* HI
16. Consider the following statements about transgenic tobacco plant
    I. Transgenic tobacco plants contains a gene from a bacterium, *Bacillus thuringiensis*
    II. *Bt* gene is an insecticidal protein which damages the inner lining of the insects and kills it (insect)
    III. The tobacco plants having *Bt* gene produces their own insecticide
    Which of the statements given above are correct?
    a) I and II b) I and III c) II and III d) I, II and III
17. Which gene was introduced in the first transgenic cow?
    a) Human α-lactalbumin b) α-1-antitrypsin c) β-1-antitrypsin d) *cry*-IAc
18. Which bacteria was the first to be used as biopesticide on the commercial scale in the world?
    a) *Bacillus thuringiensis* b) *E. coli*
    c) *Pseudomonas aeruginosa* d) *Agrobacterium tumefaciens*
19. Silk is produced by
    a) Egg of silkworm b) Pupa of silkworm c) Lara of silkworm d) Insect itself
20. Most widely used bioweapon is
    a) *Bacillus subtilis* b) *Pseudomonas putida*
    c) *Bacillus anthracis* d) None of these
21. *Bt* toxin kills insects by
    a) Inhibiting protein synthesis
    b) Generating excessive heat
    c) Creating pores in the midgut epithelial cells, leading to cell swelling and lysis
    d) Obstructing a biosynthetic pathway
22. GM brinjal in India has been developed for resistance against
    a) Virus b) Bacteria c) Fungi d) Insects
23. Which of the following is used as a best genetic vector in plants?
    a) *Bacillus thuringiensis* b) *Agrobacterium tumefaciens*
    c) *Pseudomonas putida* d) None of the above
24. Somaclonal variation appears in plants
    a) Growing in polluted soil or water b) Exposed to gamma rays
    c) Raised in tissue culture d) Transformed by recombinant DNA technology
25. Which of the following cells cannot be grown under tissue which of culture condition?
    a) Hela cells b) Leucocytes c) Kidney cells d) Nerve cells
26. Use of biological resources of other countries without any legal authorization of the countries concerned is called
    a) Biopatent b) Biopiracy c) Bioethics d) All of these
27. Genetic modification has
    I. reduced reliance on chemical pesticides
    II. reduced post-harvest losses
    III. increased efficiency of minerals used by the plants
    IV. enhanced nutritional value of the food
    Which of the statements given above are correct?
    a) I, II, III and IV b) I, II and III c) II, III and IV d) III and IV
28. The function of polymerase chain reaction is
    a) Transduction b) DNA amplification c) Translation d) None of these
29. Gene amplification using primers can be done by
    a) Microinjection b) ELISA
    c) Polymerase chain reaction d) Gene gun
30. A technique, which involves deliberate manipulation of genes within or between species is

a) Gene therapy b) Hybridoma technology
c) Tissue culture d) Genetic engineering

31. 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
32. Which of the following statement is not true for a clone?
    a) Clones are descended from a single parent b) Identical twins are not clones
    c) Clone is a result of sexual reproduction d) Both (a) and (c)
33. Which of the following companies started selling humulin in 1983?
    a) Baxter international b) Eli Lilly c) Roche d) Bayer healthcare
34. More advancement in genetic engineering is due to
    a) Restriction endonuclease b) Reverse transcriptase
    c) Protease d) Zymase
35. An organisation aiming to regulate biotechnological activities was established by Indian Government named
    a) Genetic Engineering Approval Committee
    b) Society of Applied Biotechnology
    c) Society of Industrial Microbiology and Biotechnology
    d) National Biotechnology Development Society
36. *Bt* toxin is obtained from
    a) Prokaryotes b) Eukaryotes c) Both (a) and (b) d) None of these
37. Which of the following transgenic human protein product has been used to treat emphysema?
    a) α-1 antitrypsin b) α-1 globulin c) Cry I Ab protein d) Cry II Ac protein
38. Biopiracy is
    a) The use of biological patent
    b) Thefts of plants and animal
    c) The use of bioresources of a country without proper authorisation
    d) Stealing of biological resources
39. Meristem culture is practised in horticulture to get
    a) Somaclonal variation b) Haplods c) Virus-free plants d) Slow-growing callus
40. Use of biology in industrial process and for improving quality of life is called
    a) Genetic engineering b) Eugenics c) Microbiology d) Biotechnology
41. *Bacillus thuringiensis* forms the protein crystals which contains a toxic insecticidal protein. This protein
    I. is activated by alkaline pH of the gut of the insect pest
    II. binds with the epithelial cells of the midgut of the insect pest ultimately killing it
    III. does not kill the carrier bacterium which is itself resistance to this toxin
    Which of the statement given above are correct?
    a) I and II b) I and III c) II and III d) I, II and III
42. Treatment of a genetic disorder by manipulating genes is called
    a) Gene therapy b) Gene replacement therapy
    c) Bone marrow transplantation d) Enzyme replacement therapy
43. PCR proceeds in three distinct steps governed by temperature, they are in order of
    a) Denaturation, annealing, synthesis b) Synthesis, annealing, denaturation
    c) Annealing, synthesis, denaturation d) Denaturation, synthesis, annealing
44. Lymphocytes are
    a) A kind of white blood cells b) A kind of red blood cells
    c) Blood platelets d) Plasma cells
45. Blindness can be prevented by use of which crop in poor contries?

a) Golden rice b) Wheat c) Gram d) Pea

46. Variable number of tandem repeats (VNTRs) in the DNA molecule are highly useful in
    a) Recombinant DNA technology b) DNA fingerprinting
    c) Monoclonal antibody production d) Stem cell culture
47. Why is *Bt* toxin not toxic to human beings?
    a) The toxin recognises only insect specific targets
    b) *Bt* toxin activation requires temperature above the human body temperature
    c) *Bt* toxin formation froms pro *Bt* state which requires pH lower than one present in human stomach
    d) Conversion of pro *Bt* to *Bt* state takes place only in highly alkaline condition
48. A clone is
    a) Heterozygote obtained asexually b) Homozygote obtained asexually
    c) Heterozygote produced by sexual methods d) Homozygote produced by sexual reproduction
49. Humulin is
    a) Human insulin b) Animal insulin c) Bacterial insulin d) Fungi insulin
50. In *Bt* cotton, transgenic plant, *Bt* refers to
    a) Botanical b) Beta
    c) Biotechnology d) Bacillus thuringiensis
51. The first time in 1990, M Blease and WF Andresco of National Institute of Health, attempted gene therapy on a 4 year old girl with which of the following enzyme deficiency?
    a) Cytosine deaminase (CDA)
    b) Adenosine deaminase (ADA)
    c) Tyrosine oxidase
    d) Glutamate trihydrogenase
52. Secondary cells can't divide because
    a) They lose the ability to divide
    b) They do not have nucleus
    c) They undergo certain irreversible changes during differentiation
    d) All of the above
53. Undifferentiated mass of plant cells grown on nutrient medium, is called
    a) Callus b) Bud c) Clone d) Scion
54. The first case of IVF-ET technique success, was reported by
    a) Louis Joy Brown and Banting Best b) Patrick Steptoe and Robert Edward
    c) Robert Steptoe and Gilbert Brown d) Baylis and Starling Taylor
55. Today, transgenic models have been developed for many human diseases, which includes
    I. rheumatoid arthritis II. Alzheimer's disease
    III. cancer IV. Cystic fibrosis
    Choose the correct option
    a) I and II b) II and IV c) I, II and IV d) I, II, III and IV
56. Probes, used in DNA fingerprinting, are initially
    a) Single stranded RNA b) Mini satellite
    c) 19 base long oligonucleotide d) All of the above
57. The decisions regarding the validity of GMO (Genetic Modification of Organism) research and the safety of introducing GM for the public services in India is taken by
    a) Genetic Engineering Approval Committee
    b) Department of Recombinant DNA Technology
    c) Department of Science and Biotechnology
    d) National Biotechnology Board
58. Some strains of *Bacillus thuringiensis* produces proteins that kills insects like
    a) Lepidopterans b) Coleopterans c) Dipterans d) All of these
59. Golden rice is

a) A type of rice grown along the yellow river in China
b) A transgenic rice having gene for β-carotene (pro-vitamin-A)
c) Normal variety of rice with golden coloured grains
d) Wild and long sized rice having golden tint

60. In order to obtain virus-free plants through tissue culture, the best method is
a) Protoplast culture b) Embryo rescue c) Anther culture d) Meristem culture

61. Which of the following genes were introduced in cotton to protect it from cotton bollworms?
a) *Cry* Ac and *cry* Ab
b) *Bt* Ac and *Bt* Ab
c) *Cry* I Ac and *cry* II Ab
d) *Nif* genes

62. Which of the following techniques are related with gene therapy?
I. Bone marrow transplantation
II. Enzyme replacement therapy
III. Gel electrophoresis technique
IV. Hybridoma technique
Choose the correct option
a) I and II b) II and III c) I, II and III d) II, III and IV

63. The SCID patient has a defective gene for the enzyme Adenosine Deaminase (ADA). He/She lacks functional …… and therefore, fails to fight the infecting pathogens
a) B-lymphocytes b) Phagocytes c) T-lymphocytes d) Both (a) and (b)

64. The bacterium *Bacillus thuringiensis* is widely used in contemporary biology as a/an
a) Indicator of water pollution
b) Insecticide
c) Agent for production of dairy products
d) Source of industrial enzyme

65. The enzymes, commonly used in genetic engineering, are
a) Restriction endonuclease and polymerase
b) Endonuclease and ligase
c) Restriction endonclease and ligase
d) Ligase and polymerase

66. In plant biotechnology, PEG is used in
a) Protoplast isolation
b) Cell culture preparation
c) Protoplast fusion
d) Hardening

67. Differentiation of shoot is controlled by
a) High gibberellin – auxin ratio
b) High gibberellin – cytokinin ratio
c) High auxin – cytokinin ratio
d) High cytokinin – auxin ratio

68. Which one of the following is used as vector for cloning genes into higher organisms?
a) Baculovirus
b) Salmonella typhimurium
c) Rhizopus nigricans
d) Retrovirus

69. Main objective of production/use of herbicide resistant GM crops is to
a) Eliminate weeds from the field without the use of manual labour
b) Eliminate weeds from the field without the use of herbicides
c) Encourage eco-friendly herbicides
d) Reduce herbicide accumulation in food articles for health safety

70. Golden rice is a transgenic crop of the future with which of the following improved trait?
a) High lysine (essential amino acid) content
b) Insect resistance
c) High protein content
d) High vitamin-A content

71. 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*

72. Molecular scissors are
a) Restriction endonucleases
b) DNA polymerase

c) DNA ligase d) RNA polymerase

73. Producing a giant mouse in the laboratory was possible through
a) Gene manipulation b) Gene mutation c) Gene synthesis d) Gene duplication

74. Which of the following nematode infects the roots of the tobacco plants which reduce the production of tobacco?
a) *Wuchereria* b) *Manduca sexta*
c) *Meloidegyne incognitia* d) *Enterbius*

75. 'Roise' cow known to produce a type of milk which has all the following characteristics
I. protein content of 2.4 g/L
II. human α-lactalbumin
III. more nutritionally balanced for human babies than natural cow milk
Which of the above statements are correct?
a) I and II b) I and III c) II and III d) I, II and III

76. The protein toxin producing bacteria, used to control biological pest, is
a) *E. coli* b) *Agrobacterium* c) *Mycobacterium sp.* d) *B. thuringiensis*

77. Which one of the following is correct explanation for autobiography?
a) It is used for the detection of mutated genes b) Clone which have mutated genes will no appear on the photographic film
c) The probe used will have only complementary genes with unmuted protein of DNA d) All of the above

78. A kind of biotechnology involving manipulation of DNA is
a) DNA replication b) Genetic engineering c) Denaturation d) Renaturation

79. Which one of the following can help in the diagnosis of a genetical disorder?
a) ELISA b) ABO blood group c) PCR d) NMR

80. A …..... infects the roots of tobacco plants which reduce the production of tobacco
a) Nematode (*Meloidegyne incognitia*) b) Coleopterans (beetles)
c) Lepidopterans (armyworm) d) Dipterans (mosquitoes)

81. *Bt* toxins are initially inactive protoxins but after ingestion by the insects their inactive toxin becomes active due to the
a) Alkaline pH of the gut b) Acidic pH of the gut
c) Temperature of the gut d) Hormone present in the gut

82. The term 'totipotency' refers to
a) The capability of organism to regenerate its lost parts
b) Capability of somatic cells to produce complete organism
c) The introduction of foreign gene in a cell's DNA
d) The technique of growing immature embryos

83. Mixture of biogas contains
a) Carbon dioxide, nitrogen and methane b) Nitrogen, methane and hydrogen
c) Methane, carbon dioxide and carbon monoxide d) Hydrogen, butane and carbon dioxide

84. An efficient oil eating 'Super bug' developed through genetic engineering used in cleaning of oil-spill polluted sites is a species of
a) *Arthrobacter* b) *Citrobacter* c) *Pseudomonas* d) *Thiobacillus*

85. Consider the following statements
I. *Flavr savr* is a genetically modified tomato, which remains fresh and retains its flavour much longer than the normal tomato due to blocking of synthesis of fruit softening enzyme polygalacturonase
II. Recently, the US Government has patented the Indian 'basmati' rice as Rice-tec
III. Viruses, bacteria and some other harmful organisms can be used as bioweapons in biological warfare
Which of the statements given above are correct?
a) I and II b) I and III c) II and III d) I, II and III

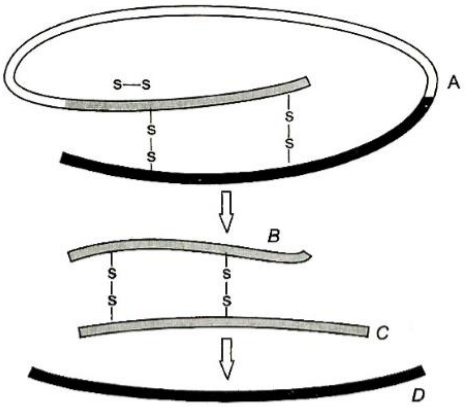
86. DNA fingerprinting refers to

a) Molecular analysis of profiles of DNA samples
b) Analysis of DNA samples using imprinting device
c) Techniques used for molecular analysis of different specimens of DNA
d) Techniques used for identification of fingerprints of individuals

87. Insect resistant transgenic cotton has been produced by inserting a piece of DNA from
a) An insect
b) A bacterium
c) A wild relative of cotton
d) A virus

88. Somatic hybrids are produced by
a) Protoplast fusion
b) Tissue culture
c) Pollen culture
d) Hybridoma process

89. The below diagram show a diagrammatic sketch of maturation of insulin. Select the correct set of the names labelled A, B, C and D



a) A-A-peptide, B-B-peptide, C-Proinsulin, D-Free C-Peptide
b) A-Proinsulin, B-A peptide, C-B peptide D-free C-Peptide
c) A-Free C-Peptide, B-A-peptide, C-B-peptide, D-Proinsulin
d) A-A-peptide, B-B-peptide, C-Free C-peptide, D-Proinsulin

90. A technology, which has found immense use in solving cases of disputed parentage, is
a) Polymerase chain reaction
b) DNA fingerprinting
c) Monoclonal antibody production
d) Recombinant DNA technology

91. Emasculation is related to
a) Pureline
b) Mass selection
c) Clonal selection
d) Hybridization

92. An extrachromosomal DNA, which can be used as vector in gene cloning is called
a) Transposon
b) Intron
c) Exon
d) Plasmid

93. The protein products of the following Bt toxin genes *cry* I *Ac* and *cry* II *Ab* are responsible for controlling
a) Bollworm
b) Roundworm
c) Moth
d) Fruit fly

94. Biopiracy is related to which of the following?
a) Traditional knowledge
b) Biomolecules and regarding bioresources
c) Bioresources
d) All of the above

95. A suitable vector for gene cloning in higher organisms is
a) Baculovirus
b) Retrovirus
c) *Salmonella typhimurium*
d) *Neurospora crassa*

96. A correct pair of characteristic of molecular probe is
I. a single-stranded DNA or RNA tagged with a radioactive molecule
II. a double-stranded DNA tagged with a radioactive molecule
III. complementary to part of desired gene
IV. small molecule
Which of the above statements are correct?
a) I and II
b) I and III
c) II and III
d) III and IV

97. The crops having *cry* genes needs
a) No insecticide
b) Small amount of insecticide

c) Large amount of insecticide d) None of the above

98. In the initial stages of protoplast culture, sorbitol/mannitol is added
    a) As an additional source of carbon b) As an additional source of energy
    c) To keep cells alive after the removal of cell wall d) As a osmotic stabilizer
99. Important objectives of biotechnology in agriculture section are
    a) To produce pest resistant varieties of plants b) To increase the nitrogen content
    c) To decrease the seed number d) To increase the plant weight
100. Which of the following is/are considered as application (s) of biotechnology?
    I. Waste treatment
    II. Energy production
    III. Bioremediation
    IV. Processed food
    V. Genetically modified crops for agriculture
    VI. Diagnostics
    VII. Therapeutics
    Choose the correct option
    a) I, II, III, IV and V b) III, V, VI and VII c) I, II, III, V and VII d) All of these
101. The organism, which is used for gene transfer in higher organisms is
    a) *Agrobacterium tumefaciens* b) *E. coli*
    c) *Acetobacter aceti* d) *Bacillus thuringiensis*
102. Which of the following statements are false?
    I. Insulin for curing diabetes, used to be extracted from the pancreas of slaughtered pig and cattle
    II. Animal insulin is slighty different from the human insulin
    III. Animal insulin causes some undesirable side effects such as allergy
    IV. Bacteria cannot be made to synthesise insulin from its gene because of the presence of introns
    Choose the correct option
    a) I, II and III b) I, III and IV c) II, III and IV d) None of these
103. Which of the following ways are suitable for increasing food production?
    I. Agrochemical based agriculture
    II. Organic agriculture
    III. Genetically engineered crop-based agriculture
    Choose the correct option
    a) I and II b) I and III c) II and III d) I, II and III
104. Green revolution is related to the increase in production of
    a) Better irrigation, fertilizers and pesticides facilities
    b) Exploitation of high yielding varieties
    c) Intensive cultivation
    d) All of the above
105. Tobacco plant resistant to a nematode have been developed by the introduction of DNA that produces (in the host cells)
    a) An antifeedent b) Both sense and antisense RNA
    c) A particular hormone d) Toxic protein
106. Which one of the following pairs of term/names means one and the same thing?
    a) Gene pool – Genome b) Codon – Gene
    c) Cistron – Triplet d) DNA fingerprinting – DNA profiling
107. At what temperature milk gets pasteurized?
    a) 58°C b) 60°C c) 62°C d) 68°C
108. Continuous addition of sugars in 'fed batch' fermentation is done to
    a) Obtain antibiotics b) Purify enzymes c) Degrade sewage d) Produce methane
109. Genetic engineering has been successfully used for producing

a) Transgenic mice for testing safety of polio vaccine before use in humans
b) Transgenic models for studying new treatments for certain cardiac diseases
c) Transgenic cow-Rosie, which produces high fat milk for making ghee
d) Animals like bulls for farm work as they have super power

110. Who discovered recombinant DNA (*r*DNA) technology?
a) Har Gobind Khurana
b) James D Watson
c) Stanley Cohen and Herbert Boyer
d) Walter Sutton and Avery

111. In which of the following method, a probe is allowed to hybridise to its complementary DNA in the clone of cells?
a) Gene therapy
b) Recombinant DNA technology
c) Polymerase chain reaction
d) Enzyme Linked Immuno-Sorbent Assay (ELISA)

112. Which of the following is/are correct about Adenosine Deaminase (ADA) deficiency?
I. In the absence of adenosine deaminase enzyme, purine metabolism is disturbed and T-lymphocytes fails to function
II. ADA deficiency is caused by the deletion of the gene for ADA
III. In some cases, it can be cured by bone marrow transplantation and enzyme replacement therapy. But in both approaches, the patients are not completely cured
IV. For permanent cure, genes isolated from the bone marrow cells producing ADA at early embryonic stages can be a possible cure
Which of the above statements are correct?
a) I, II and III
b) II, III and IV
c) I, III and IV
d) I, II, III and IV

113. Which variety of rice was patented by a US company even through the highest number of varieties of this rice is found in India?
a) Basmati
b) Parmal
c) Lerma Roja
d) CO-668

114. DNA fingerprinting technique was first developed by
a) Jeffreys, Wilson and Thien
b) Boysen and Jensen
c) Schleiden and Schwann
d) Edward and Steptoe

115. Both in callus and suspension cultures commonly used auxin is
a) Napthalene acetic acid
b) Indole-3 butyric acid
c) 2, 4, 5- trichlorophenoxy acetic acid
d) Dichlorophenoxy acetic acid (2, 4,-D)

116. A drug obtained through genetic engineering and useful for treating infertility is
a) Calcitonin
b) Chorionic gonadotropin
c) Interleukin
d) Tissue plasminogen activator

117. According to NCERT text which Indian plants have either been patented or attempts have been made to patent them by Western nations for their commercial use?
I. Basmati rice II. Neem
III. Turmic IV. Tulsi
a) I and II
b) I and III
c) I, II and III
d) I, II, III and IV

118. Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called
a) Genetically modified organisms
b) Hybrid organisms
c) Pest resistant organisms
d) Insect resistant organisms

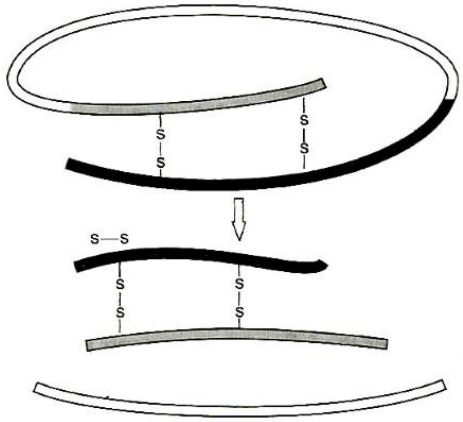
119. *Bt* toxin gene have been expressed in plant in order to provide resistance against
I. tobacco budworm and armyworm
II. beetles
III. flies and mosquitoes
Choose the correct option
a) I and II
b) I and III
c) II and III
d) I, II and III

120. Somaclonal variation is seen in
a) Tissue culture grown plants
b) Apomicts
c) Polyploids
d) Vegetatively propagated plants

121. 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' – CGTTCG – 3' 3' – ATCGTA – 5'
    b) 5' – GATATG – 3' 3' – CTACTA – 5'
    c) 5' – GAATTC – 3' 3' – CTTAAG – 5'
    d) 5' – CACGTA – 3' 3' – CTCAGT – 5'
122. Crop plants grown in monoculture are
    a) Low in yield
    b) Free from intraspecific competition
    c) Characterized by poor root system
    d) Highly prone to pests
123. Agrochemical based agriculture includes
    a) Fertilisers and pesticides
    b) Genetically modified crops
    c) RNA interference
    d) DNA interference
124. An improved variety of transgenic basmati rice
    a) Does not require chemical fertilizers and growth hormones
    b) Gives high yield and is rich in vitamin-A
    c) Is completely resistant to all insect pests and diseases of paddy
    d) Gives high yield but has no characteristic aroma
125. Plants are more rapidly manipulated by genetic engineering than animals due to
    a) Single somatic cell, which can regenerate a whole plant body
    b) A group of somatic cells, which can regenerate a whole plant body
    c) May be (a) or (b)
    d) None of the above
126. Test tube baby means, a baby born when
    a) The ovum is fertilized externally and thereafter implanted in the uterus
    b) It develops from a non-fertilized egg
    c) It is developed in a test-tube
    d) It is developed through tissue culture method
127. 'Silencing of *m*RNA molecule' in order to control the production of a harmful protein has been used in the protection of plants from
    a) Bettles
    b) Armyworm
    c) Budworm
    d) Nematodes
128. *Bt* corn the been made resistant from corn borer disease by the introduction of the gene
    a) *Cry* I Ac
    b) *Cry* II Ab
    c) *Cry* I Ab
    d) *Cry* II Ac
129. Genetically engineered bovine (bSI), sometimes called rbST (recombinant bovine somatotropin) or rbGH (recombinant bovine growth hormone) are used in the
    a) Therapeutic drugs
    b) Agriculture
    c) Dairy industry
    d) DNA fingerprinting
130. Which one of the following is a correct statement?
    a) '*Bt*' in '*Bt* cotton' indicates that it is a genetically modified organism produced through biotechnology
    b) Somatic hybridization involves fusion of two complete plant cells carrying desired genes
    c) The anticoagulant hirudin is being produced from transgenic *Brassica napus* seeds
    d) '*Flavr savr*' variety of tomato has enhanced the production of ethylene, which improves its taste
131. Biopatents means
    a) Right to use an invention
    b) Right to use biological resources
    c) Right to use applications
    d) Right to use processes
132. A USA patent was taken for
    a) Basmati rice
    b) Lerma Roja
    c) CO-668
    d) Sharbati Sonara
133. Fined the incorrect statement.
    a) Gene therapy is a genetic engineering technique used to treat disease at molecular level by replacing defective genes with normal genes
    b) Calcitonin is a medically useful recombinant product in the treatment of infertility
    c) Bt toxin is biodegradable insecticide obtained from *bacillus*
    d) *Trichoderma* sp. Is a biocontrol agent for fungal diseases of plants
134. Some of the characteristics of *Bt* cotton are

a) Long fibre and resistance to aphids
b) Medium yield, long fibre and resistance to beetle pests
c) High yield and production of toxic protein crystals which kill dipteran pests
d) High yield and resistance to bollworms

135. The below diagram shows



a) Maturation of pro-insulin into insulin
b) Method of pro-insulin formation
c) Gene therapy
d) Enzyme replacement therapy

136. Solution of polyethylene glycol (PEG) or a very brief high voltage electric current is used in fusion of
a) Protoplasms b) Protoplasts c) Somatic cells d) Germinal cells

137. Transgenic animals are developed by
a) Introducing foreign genes
b) Introducing gene mutations
c) Deleting certain chromosomes parts
d) Stopping spindle formation

138. Correct chronological order of the steps occurring during gene therapy are
I. Lymphocytes are obtained from the patients
II. Lymphocytes are transferred to the culture dishes
III. Lymphocytes are transfected with the normal ADA genes
IV. The transfected cell are returned to the patients
The chronological order should be
a) I, II, III and IV b) II, I, III and IV c) I, III, II and IV d) III, II, IV and I

139. Maximum application of animal cell culture technology today is in the production of
a) Vaccines b) Edible proteins c) Insulin d) Interferons

140. Manipulation of DNA in genetic engineering become easy due to invention of
a) Polymerase chain reaction
b) Dot blot
c) Enzyme linked immune sorbent assay
d) Eastern blotting

141. *Cry* II *Ab* and *cry* I *Ab* produce toxins that control
a) Cotton bollworms and corn borer respectively
b) Corn borer and cotton bollworms respectively
c) Tobacco budworms and nematodes respectively
d) Nematodes and tobacco budworms respectively

142. Genetically engineered bacteria are being employed for production of
a) Thyroxine b) Human insulin c) Cortisol d) Epinephrine

143. Micropropagation is a technique for production of
a) True type plants b) Haploid plants c) Somatic hybrids d) Somaclonal plants

144. Which of the following radioisotope is not suitable for DNA labeling based studies?
a) H^3 b) P^{32} c) N^{15} d) S^{35}

145. Gene therapy in humans was first practiced by Blease and Andresco to cure
a) Cystic fibrosis
b) Haemophilia
c) Thalassaemia

d) Severe Combined Immuno Deficiency Disease

146. For production of haploids, we culture
a) Shoot tip b) Anther c) Root tip d) None of these

147. Differentiation of organs and tissues in a developing organism, is associated with
a) Developmental mutations b) Differential expression of genes
c) Lethal mutations d) Deletion of genes

148. How many varieties of rice has been estimated to be present in India?
a) 2200 b) 20000 c) 200000 d) 2000000

149. Who discovered that restriction enzymes have the capability of cutting DNA strands in a particular fashion, which left what has became known as 'sticky ends' on the strads?
a) Ramdeo Mishra b) Stanley Cohen c) Herbert Boyer d) James D Watson

150. A cybrid is hybrid carrying
a) Genomes and cytoplasms of two different plants
b) Cytoplasms of two different plants
c) Cytoplasms of two different plants but genome of one plant
d) Genomes of two different plants

151. Which of the following is correctly matched?
a) *Agrobacterium tumefaciens* – Tumour b) *Thermos aquaticus* – *Bt-gene*
c) pBR322 – Enzyme d) Ligase – Molecular scissors

152. Which of the following shows correct chronological order of the events occurring during callus culture?
a) Callus → Cell division → Explant → Addition of cytokinin → Cells acquire merstematic property
b) Explant → Callus → Cell division → Addition of cytokinin → Cells acquire meristematic property
c) Explants → Cell division → Callus → Addition of cytokinin → Cells acquire meristematic property
d) Callus → Explant → Cell division → Addition of cytokinin → Cells acquire meristematic property

153. *Bt* toxin is
a) Intracellular crystalline protein b) Extracellular crystalline protein
c) Intracellular monosaccharide d) Extracellular polysaccharide

154. A major use of embryo culture is in
a) Production of alkaloids b) Clonal propagation
c) Induction of somaclonal variations d) Overcoming hybridization barriers

155. Which one of the following hydrolyses internal phosphodiester bonds in a polynucleotide chain?
a) Lipase b) Exonuclease c) Endonuclease d) Protease

156. White revolution is related to the increase in production
a) Egg b) Milk c) Meat d) Wool

157. What is true about *Bt* toxin?
a) The inactive protoxin gets converted into active form in the insect gut
b) *Bt* protein exists as active toxin in the *Bacillus*
c) The activated toxin enters the ovaries of the pest to sterilize it and thus, prevent its multiplication
d) The concerned Bacillus has antitoxins

158. In recombinant DNA technique, the term vector refers to
a) Donor DNA, is identified and picked up through electrophoresis
b) Plasmid, transfers DNA into living cell
c) Collection of entire genome in form of plasmid
d) Enzyme, cuts the DNA at specific sites

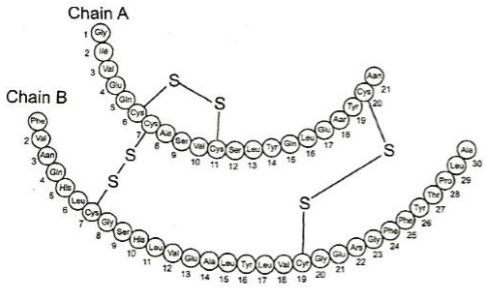
159. A plant species which has been exploited for the production of hirudin is
a) *Brassica napus* b) *Zea mays* c) *Solanun nigrum* d) *Oryza sativa*

160. The aims and objectives of Genetic Engineering Approval Committee are
I. To permit the use of genetically modified organisms and their product for commercial applications
II. To adopt the procedures for restriction, production and application of GM organisms
III. approval to conduct large scale field trails and release of transgenic crops in the environment

Which of the statements are given above are correct?

a) I and II b) I and III c) II and III d) I, II and III

161. Identify the figure given below



a) Glyphosphatase b) Insulin c) TPA d) Erythropoietin

162. *Bt* cotton is not

a) a GM plant b) Insect resistant

c) A bacterial gene expressing system d) Resistant to all pesticides

163. Which of the following is/are true?

I. Biowar is the use of biological weapons against humans and/or their crops and animals.

II. Bioethics is the unauthorized use of bioresources and traditional knowledge related to bioresources for commercial benefits.

III. Biopatent is exploitation of bioresources of other nations without proper authorization.

a) II only b) I only c) I and II d) I and III

164. Alec Jeffreys developed the DNA fingerprinting technique. The probe he used was

a) Ribozyme b) Sex chromosomes c) SNP d) VNTR

165. ADA is an enzyme, which is found lacking in a genetic disorder SCID. What is the full form of ADA?

a) Adenosine Deoxyaminase b) Adenosine Deaminase

c) Aspartate Deaminase d) Arginine Deaminase

166. Cellular totipotency is demonstrated by

a) All eukaryotic cells b) Only bacterial cells

c) Only gymnosperm cells d) All plant cells

167. The problem of blindness in poor countries can be taken care of by using which of the following?

a) Golden rice b) Transgenic tomato c) Transgenic maize d) *Bt* brinjal

168. Consider the following statements about the responsibility of GEAC (set-up by the Indian Government)

I. GEAC make decisions regarding the validity of the GM research

II. It checks the safety of introducing GM organisms for the public services for their large scale use

Which of the statements given above is/are correct?

a) Only I b) Only II c) I and II d) None of these

169. All are the biotechnological application in order to increase food production, except

a) Pisciculture b) Agro-chemical based agriculture

c) Organic-agriculture d) Genetically engineered crop-based agriculture

170. Which of the following is false for Bt transgenic plant?

a) Disease resistance b) Prepared by *Bacillus thuringiensis*

c) It is recombinant type d) No such plant is known

171. DNA fingerprinting technique was discovered by

a) Wilmut b) A Jeffreys c) Ethoven d) Kary Mullis

172. C-peptide of human insulin is

a) A part of mature insulin molecule b) Responsible for the formation of disulphide bridges

c) Removed during the maturation of pro-insulin to insulin d) Responsible for its biological activity

173. Consider the following statements about therapeutic drugs

I. The recombinant DNA technology is used for production of therapeutic drugs which are safe and effective
II. It avoid unwanted immunological responses, commonly observed with similar products isolated from non-human sources
III. About thirty recombinant therapeutics have been approved for human use in the world including India
Which of the statements given above are correct?
a) I and II b) I and III c) II and III d) I, II and III

174. Choose a correct option for the uses of PCR technique in diagnosis
I. It is used to detect HIV in suspected AIDS patients
II. It is used to detect mutations in the genes in suspected cancer patients
III. It is used to detect swine flu in human beings
IV. It is used to detect different common diseases in pigs, sheep and cow
V. It is a good technique to identify many other genetic disorders
Which of the above statements are correct?
a) I and II b) III and IV c) I, II and V d) II, III and IV

175. What might be an advantage of beginning gene therapy prior to birth?
a) This would give the body plenty of time
b) The body would not reject it as it has not yet recognised 'self'
c) The cells being extremely young are more receptive of gene therapy
d) There probably is not any advantage

176. Which of the following transgenic animals are used in testing safety of polio vaccine before they are used on human?
a) Transgenic cow b) Transgenic monkey c) Transgenic mice d) Transgenic sheep

177. Which Indian plants have either been patented or attempts have been made to patent them by Western nations for their use?
a) Basmati rice b) Turmeric c) Neem d) All of these

178. The T_i – plasmid, is often used for making transgenic plants. This plasmid is found in
a) *Azotobacter* b) *Rhizobium* of the roots of leguminous plants
c) *Agrobacterium* d) Yeast as a 2 μm plasmid

179. Which step was proved to be the main challenge in the production of human insulin by recombinant DNA technology?
a) Splitting A and B-peptide chain b) Addition of C-peptide to proinsulin
c) Getting insulin assembled into mature form d) Removal of C-peptide from active insulin

180. A nutritionally wild type organism, which does not required any additional growth supplement is known as
a) Phenotype b) Holotype c) Auxotroph d) Prototroph

181. PCR is used to
a) Detect HIV in suspended AIDS patients
b) Detect mutations in the genes in suspended cancer patients
c) Diagnose many genetic disorders
d) All of the above

182. The technique that was employed to produce haploids of *Datura* was
a) Meristem culture b) Anther culture c) Embryo culture d) Protoplast culture

183. Find out the wrong statement.
a) Mobile genetic elements, transposons were visualized by Barbara McClintock
b) Udder cell, a somatic cell is used to produce the cloned sheep by nuclear transplantation method
c) In pedigree analysis, a person immediately affected by an action is called propositus
d) DNA ligases are used to cleave a DNA molecule

184. Phytotron is
a) A controlled condition chamber for tissue culture

b) Leaf culture process
c) Special culture of plants
d) Root culture process

185. Which of the following bio-engineered bacteria is utilized for cleaning of marine oil slicks?
a) *Escherichia coli* b) *Pseudomonas syringae*
c) *Pseudomonas putida* d) *Rhizoctonia solani*

186. The RNAi stands for
a) RNA interference b) RNA interferon c) RNA inactivation d) RNA initiation

187. Which of the following peptide chain is removed during the maturation of proinsulin into insulin?
a) A-chain (21 amino acid) b) B-chain (30 amino acid)
c) C-chain (33 amino acid) d) A and B chain

188. Which of the following is obtained from genetic engineering?
a) Haemoglobin b) Glucose c) Golden rice d) None of these

189. The enzyme employed for amplification of DNA during PCR is commercially obtained from
a) *Streptococcus pyogenes* b) *Bacillus licheniformis*
c) *Trichoderma reesi* d) *Thermos aquaticus*

190. A genetically engineered microorganism used successfully in bioremediation of oil spills, is a species of
a) *Pseudomonas* b) *Trichoderma* c) *Xanthomonas* d) *Bacillus*

191. The vector for T-DNA is
a) *Thermos aquaticus* b) *Salmonella typhimurium*
c) *Agrobacterium tumefaciens* d) *Escherichia coli*

192. What is true for plasmid?
a) Found in viruses b) Contains genes for vital activities
c) Part of nuclear chromosome d) Widely used in gene transfer

193. β-carotene is a principal source of
a) Vitamin-A b) Vitamin-B c) Vitamin-C d) Vitamin-D

194. Consider the following statements
I. Earlier, insulin was extracted from pancreas of slaughtered cattle and pigs which was more efficient than the genetically engineered insulin
II. PCR technique is being used for the detection of HIV in suspected AIDS patients and genetic mutations in suspected cancer patients
III. Cystic fibrosis, haemophilia, cancer, Parkinon's etc., are treated by gene therapy
Which of the statements given above are correct?
a) I and II b) I and III c) II and III d) I, II and III

195. A single strand of nucleic acid tagged with a radioactive molecule is called
a) Plasmid b) Vector c) Probe d) Selectable marker

196. Product of biotechnology is
a) Transgenic crops (GM crops) b) Humulin
c) Biofertilizer d) All of the above

197. Cultivation of *Bt* cotton has been much in the news. The prefix *Bt* means
a) Barium-treated cotton seeds
b) Bigger thread variety of cotton with better tensile strength
c) Produced by biotechnology using restriction enzymes and ligases
d) Carrying an endotoxin gene from *Bacillus thuringiensis*

198. Enzyme that is used in PCR technology is
a) *Taq polymerase* b) Polymerase c) Helicase d) Reverse transcriptase

199. Transgenic animals are those which have foreign
a) DNA in some of its cells b) DNA in all its cells
c) RNA in all of its cells d) RNA in some of its cells

200. The application of biotechnology includes all except

a) Waste treatment
b) Energy production
c) Genetically modified crops
d) Conventional hybridization

201. A strain of golden rice contains high contents of
a) Vitamin-A b) Vitamin-K c) Vitamin-E d) Vitamin-C

202. Restriction endonucleases are enzymes which
a) Make cuts at specific positions within the DNA molecule
b) Recognize a specific nucleotide sequence for binding of DNA ligase
c) Restrict the action of the enzyme DNA polymerase
d) Remove nucleotides from the ends of the DNA molecule

203. Which one of the following is the most suitable, medium for culture of *Drosophila melanogaster?*
a) Moist bread b) Agar agar c) Ripe banana d) Cow dung

204. Technique used to detect the DNA in a clone is called
a) Gel electrophoresis b) Polymerase chain reaction
c) Gene therapy d) Autoradiography

205. Genetic engineering is related with
a) Eugenics b) Euphenics c) Euthenics d) All of these

206. In 1983, Eli Lilly an American company, first prepared two DNA sequences corresponding to A and B-chains of the human insulin and introduced them in the plasmids of *Escherchia coli* to produce insulin chains. Chains A and B were prepared separately, extracted and combined by creating
a) Hydrogen bond b) Disulphide bond c) Covalent bond d) Peptide bond

207. The nucellar embryos were first produced by tissue culture technique in
a) *Citrus mexima* b) *Citrus reticulate* c) *Citrus microcarpa* d) Citrus limon

208. Restriction endonucleases are
a) Present in mammalian cells for degradation of DNA when the cell dies
b) Used in genetic engineering for ligating two DNA molecules
c) Used for in *vitro DNA* synthesis
d) Synthesized by bacteria as part of their defence mechanism

209. The method of growing micro-organisms as a thin layer on nutrient medium is known as
a) Suspended growth system b) Support growth system
c) Thin layer growth system d) All of the above

210. Kohler and Milstein developed a method in biotechnology for the production of
a) Myelomas b) Steroid conversion
c) Monoclonal antibodies d) immobilised enzymes

211. Maximum utilization of biotechnological techniques has been made in the field of
a) Industries b) Medicines c) Agriculture d) Biogas production

212. The haploid content of human DNA is
a) 3.3×10^6 bp b) 3.3×10^9 bp c) 4.6×10^6 bp d) 6.6×10^9 bp

213. A novel strategy was adopted to prevent *Meloidegyne incognitia* infection in tobacco plants that was based on the process of
a) DNA interference b) RNA interference c) RNA initiation d) DNA initiation

214. The term "Test Tube Baby" implies that
a) Fertilization of ovum takes place in the uterus but develops in the test-tube
b) Fertilization of ovum takes place in the test-tube but it develops in test-tube itself
c) Fertilization of ovum takes place in the test-tube but it develops in the uterus
d) Fertilization of ovum takes place in the uterus and embryo develops I the uterus

215. Human insulin is being commercially produced from a transgenic species of
a) *Escherichia coli* b) *Mycobacterium* c) *Rhizobium* d) *saccharomyces*

216. The process of RNA interference has been used in the development of plants resistance to

a) Armyworm b) *Meloidegyne incognitia*
c) *Enterobius* d) Beetles

217. *Bacillus thuringiensis* (*Bt*) strains have been used for designing novel
a) Biofertilisers b) Bio-metallurgical techniques
c) Bio-mineralisation processes d) Bio-insecticidal plants

218. *Bacillus thuringiensis* is a bacterium of
a) Dirty water b) Skin of cat c) Soil d) Surface of midgut

219. Which one of the following techniques has helped to solve many mysteries involving murders, robberies and rapes?
a) Gene splicing b) Computer technology
c) DNA fingerprinting d) Gene cloning

220. Which one of the following bacterium is used for production of transgenic plants?
a) *Escherichia coli* b) *Bacillus thuringiensis*
c) *Staphylococcus aureus* d) *Agrobacterium tumefaciens*

221. Agarose extracted from sea weeds finds use in
a) Tissue culture b) PCR c) Gel electrophoresis d) Spectrophotometry

222. The inherent capacity of a cell to regenerate a new whole organism is called
a) Ontogeny b) Totipotency c) Phylogeny d) Proliferation

223. Axenic culture is
a) Pure culture of a microbe without any nutrient b) Pure culture without any contamination
c) Culture of tissue d) Culture of gene

224. Golden rice is a transgenic variety of rice which contains good quantities of
a) β-carotene (pro-vitamin-A) b) α-carotene (pro-vitamin-A)
c) γ-carotene (pro-vitamin-B) d) All of the above

225. An institution, where valuable plant material likely to become irretrievably lost in the wild or in cultivation is preserved in viable condition is known as
a) Genome b) Gene library c) Gene bank d) Herbarium

226. Which of the following technique is based on the principle of antigen-antibody interaction?
a) PCR
b) ELISA
c) Recombinant DNA technology
d) Gene therapy

227. Basmati is unique for its aroma and flavour, whose A… varieties are cultivated in B….
Here A and B refers to
a) A-27; B-America b) A-30; B-America c) A-27; B-India d) A-30; B-India

228. Which one of the following bacteria has found extensive use in genetic engineering work in plants?
a) *Bacillus coagulans* b) *Xanthomonas citri*
c) *Clostridium septicum* d) *Agrobacterium tumefaciens*

229. Through which method more number of female plants can be produced in papaya?
a) Spraying ethephon b) Genetic engineering c) Polyploidy breeding d) Tissue culture

230. Which one of the following gene is defective in patients suffering from Severe Combined Immunodeficiency Disease (SCID)?
a) Adenosine deaminase b) Glutamate dehydrogenase
c) DNAase d) Tyrosine oxidase

231. A transgenic food crop, which may help in solving the problem of night blindness in developing countries is
a) *Flavr savr tomatoes* b) Starlink maize c) *Bt soybean* d) Golden rice

232. Blood stains are found at the site of a murder. If DNA profiling technique is to be used for identifying the criminal, which of the following is ideal for use?
a) Serum b) Erythrocytes c) Leucocytes d) Platelets

233. A probe which is a molecule used to locate specific sequences in a mixture of DNA or RNA molecules could be
a) A single-stranded RNA
b) A single-stranded DNA
c) Either RNA or DNA
d) Can be ssDNA but not ssRNA

234. Which of the following pairs are correctly matched?
a) Central dogma – Codon
b) Okazaki fragments – RNA primer
c) RNA polymerase – RNA primer
d) Restriction enzyme – Genetic engineering

235. Which one of the following is commonly used in transfer of foreign DNA into crop plants?
a) *Trichoderma harzianum*
b) *Meloidogyne incognita*
c) *Agrobacterium tumefaciens*
d) *Penicillium expansum*

236. Production of value added products like nutrition supplements, pharmaceuticals, fuels, etc., using transgenic crop is called
a) Genetic farming b) Molecular farming c) Biotech farming d) All of these

237. Multicellular organisms that carries a specific genetic change in each cell because of an intervention at the fertilized egg stage is a
a) Transversion b) Transition c) Transgenic d) Transformant

238. Polyethylene glycol method is used for
a) Gene transfer without a vector
b) Biodiesel production
c) Seedless fruit production
d) Energy production from sewage

239. The site of the production of ADA in the body is
a) Bone marrow b) Lymphocytes c) Blood plasma d) Monocytes

240. First genetically modified plants commercially released in India is
a) Golden rice
b) Slow ripening tomato
c) *Bt* brinjal
d) *Bt* cotton

241. Which one of the following molecular diagnostic technique is used to detect the presence of a pathogen in its early stage of infection?
a) Angiography
b) Radiography
c) Enzyme replacement technique
d) Polymerase Chain Reaction (PCR)

242. First hormone prepared by genetic engineering is
a) Oxytocin b) Somatotropin c) Adrenaline d) Insulin

243. First hormone produced artificially by culture bacteria, is
a) Insulin b) Thyroxine c) Testosterone d) Adrenaline

244. In transgenics, expression of transgene in target tissue is determined by
a) Enhancer b) Transgene c) Promoter d) Reporter

245. Genomic DNA library means
a) A collection of literature about DNA
b) A collection of organisms for extracting DNA
c) Packing of donor DNA in a collection of vectors
d) A collection of gene vectors

246. The characteristics of a molecular probe are
I. Very long molecule
II. Double-stranded
III. DNA or RNA
IV. Complementary to a part of desired gene
The correct pair is
a) I and II b) II and III c) III and IV d) IV and I

247. A monopoly granted to a person who has either invented a new and useful article, made improvement in an existing article or invented a new process of making an article is called
a) Bioethics
b) Patent
c) Biopiracy
d) Genetic recombination

248. Choose the correct option about agrochemicals
    a) These are expensive for farmers in developing countries
    b) Also have harmful effects on environment
    c) Genetically modified crops are less expensive than agrochemicals
    d) All of the above
249. Some organisations and multinational companies patent biological resources of other nations without proper authorization from the countries concerned, this is called
    a) Bioweapon b) Biopiracy c) Bioethics d) Bio patient
250. Which one of the following is a 'man made cereal' not found in nature?
    a) *Triticale* b) Hybrid maize c) Dwarf wheat d) Soyabean
251. What is the demerit of using bovine insulin (from cow) and porcine insulin (from pig) in diabetic patients?
    a) It leads to hypercalcemia
    b) It is expensive
    c) It may cause allergic reactions
    d) It may lead to mutations in human genome
252. The tumour inducing capacity of *Agrobacterium tumefaciens* is located in large extra chromosomal plasmids called
    a) R_i − plasmid b) Lambda phage c) pBR 322 d) T_i − plasmid
253. Choose the correct options about Basmati rice
    I. In 1997, an American company got patent rights for Basmati rice through the US Patent and Trademark office and was allowed to sell a 'new variety' in US and abroad
    II. This new variety of Basmati was derived from Chinese farmer's varieties
    III. Indian Basmati was crossed with semidwarf varieties and claimed as an invention or a novelty
    Which of the above statements are correct?
    a) I and II b) I and III c) II and III d) I, II and III
254. Genetically engineered human insulin, humulin was launched by American drug company on
    a) 5th July 1998 b) 5th July 1993 c) 5th July 1973 d) 5th July 1983
255. Which of the following is not a restriction endonuclease?
    a) *Eco* RI b) *Hind* III c) *Pst* I d) DNAse I
256. The totipotency of a cell refers to the
    a) Flowering in a culture medium
    b) Development of fruit from a flower in a culture medium
    c) Development of an organ from a cell in culture medium
    d) Development of all tissues of all kinds from a cell in a culture medium
257. The anticoagulant hirudin is obtained from
    a) Ti plasmid of *Agrobacterium* b) Bt toxin produced by cry gene
    c) Seeds of *Brassica napus* d) None of the above
258. Restriction enzymes are used to cut
    a) Single stranded RNA b) Double stranded DNA
    c) Single stranded DNA d) Double stranded RNA
259. When a person with defective Adenosine Deaminase (ADA) was treated, which of the following steps were performing for gene therapy?
    I. Lymphocytes were extracted from the bone marrow of the patient
    II. Lymphocytes were grown in a culture out side the body
    III. Lymphocytes were transfected with the normal ADA genes
    IV. The transfected cells were returned to the patients
    a) I, II and III b) I, III and IV c) II, III and IV d) I, II, III and IV
260. DNA or RNA segment tagged with a radioactive molecule is called
    a) Vector b) Probe c) Clone d) Plasmid
261. Consider the following statements

I. *Bt* toxin gene has been cloned from the bacteria
II. Genetic engineering works only on animals and has not yet been successfully used on plants
III. Strains of *Bacillus thuringiensis* are used in producing bioinsecticidal plants
Which of the statements given above are correct?
a) I and II b) I and III c) II and III d) I, II and III

262. There is a restriction endonuclease called Eco RI. What does '*co*' part in it stand for?
a) Coelom b) Coenzyme c) *Coli* d) Colon

263. Animals whose DNA is manipulated to possess and express an extra (foreign) gene are known as
a) Transgenic animal b) Hybrid animal c) Transversion animal d) All of these

264. Which of the following terms is used to describe the component isolated from a plant, for in vitro culturing in the specific medium?
a) Callus b) Embryoid c) Synthetic seeds d) Explant

265. Which of the following is a transgenic plant?
a) Hirudin b) *Flavr savr* c) *Triticale* d) All of these

266. *Bt* cotton is resistant to
a) Herbicides b) Drought c) Cold d) Insects

267. A doctor, while operating on an HIV^+ patient accidently cut himself with a scalpel. He comes to you, suspecting himself to have contacted the virus. Which test will you advise him to rule out/confirm his suspicion?
a) PCR
b) Routine urine examination
c) TLC
d) DLC

268. Golden rice is a promising transgenic crop. When released for cultivation, it will help in
a) Producing a petrol like fuel from rice b) Alleviation of vitamin-A deficiency
c) Pest resistance d) Herbicide tolerance

269. Natural genetic engineer is
a) *Bacillus subtilis* b) *Pseudomonas sp*
c) *Escherichia coli* d) *Agrobacterium tumefaciens*

270. Consider the following statements about 'Rosie'
I. Rosie is a first transgenic cow
II. Rosie produced human protein enriched milk
III. The milk contained the human α-lactalbumin and scientist behind the research believes that the milk from the cow could provide an alternative to human breast milk
Which of the statements given above are correct?
a) I and II b) I and III c) II and III d) I, II and III

271. An example of gene therapy is
a) Production of injectible hepatitis-A vaccine b) Introduction of the genes for adenosine deaminase in a person suffering from SCID
c) Production of test-tube babies by artificial insemination d) All of the above

272. The process, in which mature differentiated cells reverse to meristematic activity to form callus is called
a) De-differentiation b) Differentiation c) Cyto-differentiation d) Re-differentiation

273. The first human drug made by using genetic engineering technique was
a) Insulin b) Paracetamol c) Streptomycin d) None of these

274. In tissue culture, roots can be induced by
a) Lower concentration of cytokinin and higher concentration of auxins
b) Only cytokinin and no auxins
c) No cytokinin and only auxins
d) Higher concentration of cytokinin and lower concentration of auxins

275. Consider the following statements about insulin
I. Human insulin is made-up of 51 amino acids arranged in two polypeptide chains
II. The two polypeptide chains are interconnected by two disulphide bridges
III. In mammals including humans, insulin is synthesized as a pro-hormone, which contains an extra stretch called the C-peptide
IV. C-peptide is not present in the mature insulin
Which of the statements given above are correct?
a) I, II and III b) I, III and IV c) II, III and IV d) I, II, III and IV

276. The basis of DNA fingerprinting is
a) The double helix b) Errors in base sequence
c) Polymorphism in sequence d) DNA replication

277. Which of the following enzymes are used to join bits of DNA?
a) Ligase b) Primase c) DNA polymerase d) Endonuclease

278. Consider the following statements
I. Transgenic animals are more sensitive to the toxic substance than non-transgenic animals
II. Useful biological products can be produced by introducing into transgenic animals the portion of DNA which codes for a particular product
III. Brazzein is a protein produced by a west African plant, *Pentadiplandra brazzeana* which is approximately 2000 time as sweet as sugar
Which of the statements are given above are correct?
a) I, II and III b) I and II c) I and III d) None of these

279. The construction of the first recombinant DNA was done by using the native plasmid of
a) *E. coli* b) *Salmonella typhirmurium*
c) *Bacillus thuringiensis* d) Yeast

280. Satellite DNA is useful tool in
a) Organ transplantation b) Sex determination
c) Forensic science d) Genetic engineering

281. *Bt* tobacoo was first cultured to kill
a) Hornworm b) Bollworm c) Stem borer d) Tobacco budworm

282. Rules of conduct that may be used to regulate our activities in relation to the biological world is called
a) Bioethics b) Biowar c) Biopiracy d) Biopatent

283. Murashige and Skoog's medium is used for
a) Isolation of fungal strains
b) Culture of bacteria
c) Raising plants through micropropagation
d) Culture of protein rich cyanobacterium *spirulina*

284. Organic farming is the technique of raising crops by the use of
a) Manures b) Biofertilisers c) Resistant varieties d) All of these

285. In crop improvement programmes, virus-free clones can be obtained through
a) Grafting b) Hybridization c) Embryo culture d) Shoot apex culture

286. Plasmids are suitable vectors for gene cloning because
a) These are small circular DNA molecules, which can integrate with host chromosomal DNA
b) These are small circular DNA molecules with their own replication origin site
c) These can shuttle between prokaryotic and eukaryotic cells
d) These often carry antibiotic resistance genes

287. ……. is a collection of methods that allows correction of gene defects diagnosed in a child or embryo
a) Genetic therapy b) Gene therapy c) Molecular diagnosis d) ELISA

288. *Bt* toxin protein crystals present in bacterium *Bacillus thuringiensis*, do not kill the bacteria themselves because
a) Bacteria are resistant to the toxin b) Bacteria enclose toxins in a special sac

c) Toxins occur an inactive protoxins in bacteria d) None of the above

289. Out of the following which is a genetically engineered anti-viral protein?
a) Humulin b) Interferon c) Fumagillin d) Griseofulvin

290. Consumption of which one of the following foods can prevent the kind of blindness associated with vitamin-A deficiency?
a) *Flavr savr* tomato b) Canolla c) Golden rice d) *Bt* brinjal

291. Which of the following statements are considered as the advantages of biotechnology?
I. Creation of fermented food
II. Production of pestresistant crops
III. Plants yielding more nutritious and tastier fruits
IV. Production of new types of medicine to fight dangerous disease
Choose the correct option
a) Only IV b) I and III c) I, II and III d) I, II, III and IV

292. The name of first cloned sheep is
a) Dolly b) Polly c) Molley d) Holly

293. Palaeontologists unearthed a human skull during excavation. A small fragment of the scalp tissue was still attached to it. Only little DNA could be extracted from it. If the genes of the ancient man need to be analysed, the best way of getting sufficient amount of DNA from this extract is
a) By hybridizing the DNA with a DNA probe b) By subjection the DNA to polymerase chain reaction
c) By subjecting the DNA to gel electrophoresis d) By treating the DNA with restriction endonucleases

294. Applications, like bioremediation, processed food, therapeutics and diagnostics are related with
a) Biochemistry b) Microbiology c) Biotechnology d) Medical science

295. *Cry* I endotoxins obtained from *Bacillus thuringiensis* are effective against
a) Flies b) Mosquitoes c) Worms d) Nematodes

296. The critical research areas of biotechnology are
I. providing best catalyst as improved organism, usually a microbes or pure enzyme
II. creating optimal conditions by engineering for a catalyst to act
III. down stream processing technologies
IV. Multiple Ovulation Transfer Technology (MOET)
Which of the statements given above the correct?
a) I and II b) I, II and III c) II, III and IV d) I, II, III and IV

297. *Bacillus thuringiensis* is used to control
a) Insect pests b) Bacterial pathogen c) Fungal pathogen d) Nematodes

298. This method of finding a gene is used when researchers know very little about the gene they are trying to find. This process results in a complete gene library: a collection of copies of DNA fragments that represent the entire genome of an organism. Identify the method.
a) Cloning b) Shotgun cloning
c) Gene synthesis cloning d) PCR

299. Part of the plant, which is cultured to obtain virus free clones, is
a) Leaf b) Root tip c) Shoot tip d) Embryo

300. Which of the following is a plasmid?
a) pBR322 b) *Bam* HI c) Sal I d) *Eco* RI

301. *Bt* toxin is produced by
a) *Bacillus subtitis* b) *Bacillus thuringiensis*
c) *Bacillus anthracis* d) *Bacillus coccus*

302. Transgenic plants are
a) Produced by a somatic embryo in artificial medium
b) Generated by introducing foreign DNA into a cell and regenerating a plant from that cell

c) Produced after protoplast fusion in artificial medium
d) Grown in artificial medium after hybridization in the field

303. Which of the following key factors, makes the plasmid, the vector in genetic engineering?
a) It is resistant to antibiotics
b) It is resistant to restriction enzymes
c) Its ability to carry a foreign gene
d) Its ability to cause infection in the host

304. The genetic defect-Adenosine Deaminase (ADA) deficiency may be cured permanently by
a) Periodic infusion of genetically engineered lymphocytes having functional ADA C-DNA
b) Administering adenosine deaminase activators
c) Introducing bone marrow cells producing ADA into
d) Enzyme replacement therapy

305. …… animals are made to carry genes which make them more sensitive to the toxic substance than other normal animals
a) Transgenic b) Transversion c) Transition d) Transformant

306. Nucleic acid segment tagged wit5h a radioactive molecule is called
a) Clone b) Probe c) Plasmid d) Vector

307. Who discovered the super bug?
a) H G Khurana
b) Dilip sah
c) Anand Mohan Chakraborty
d) Robert Hooke

308. Automated DNA sequencers, work on the principle of the method developed by
a) Erwin Chargaff b) Maurice Wilkins c) Frederick Sanger d) Francis Crick

309. Biotechnology mainly deals with
a) Industrial scale production of biopharmaceutical
b) Biological use of genetically modified microbes, fungi, plants and animals
c) Both (a) and (b)
d) None of the above

310. Restriction enzyme was discovered by
a) Alexander Fleming
b) Waksman
c) Berg
d) Smith, Nathan and Arber

311. Which of the following techniques serves the purpose of early diagnosis of AIDS, cancer, etc?
I. Polymerase chain reaction
II. Recombinant DNA technology
III. Enzyme linked immune-sorbant assay
Choose the correct option
a) I and II b) I and III c) II and III d) I, II and III

312. Adenosine Deaminase (ADA) deficiency can be cured by …A… and …B… but it is not fully curative. Here A and B can be
a) A-gene therapy, B-radiation therapy
b) A-bone marrow transplantation, B-enzyme replacement therapy
c) A-organ transplantation, B-hormone replacement therapy
d) A-radiation therapy, B-enzyme replacement therapy

313. Which step has been taken by Government of India to cater to the requirements of patent terms and other emergency provisions in this regards
a) Biopiracy act b) Indian patents bill c) Biowar act d) Bioethics act

314. A regulatory body working under MoEF for the release of transgenic crops is
a) NBPGR b) GEAC c) NSC d) NIPGR

315. A functional ADA *c*DNA can be introduced into the cells of the patients receiving gene therapy by using vector constituted by
a) *E. coli*
b) Retrovirus
c) *Bacillus thuringiensis*
d) *Agrobacterium*

316. Gene therapy is

a) A method aim to cure the genetic disorders
b) A method to provide correct version of the defective gene
c) A method to replace a defective gene with a healthy gene
d) All of the above

317. Which of the following could be a permanent cure for treatment of Severe Combined Immuno Deficiency (SCID)?
a) Gene therapy
b) Bone marrow transplant
c) Enzyme replacement therapy
d) All of the above

318. Hybridomas are result of the fusion of
a) Normal antibody producing cell with myeloma
b) Abnormal antibody producing cell with myeloma
c) Male reproductive cell with myeloma
d) Female reproductive cell with myeloma

319. The first clinical gene therapy was done for the treatment of
a) AIDS
b) Cancer
c) Cystic fibrosis
d) SCID (Servere Combined Immuno Deficiency) resulting from deficiency of ADA

320. Transfer of any gene into a completely different organism can be done through
a) Genetic engineering b) Tissue culture c) Transformation d) None of these

321. Somaclones are obtained by
a) Tissue culture b) Plant breeding c) Irradiation d) Genetic engineering

322. Restriction endonucleases are most widely used in recombinant DNA technology. They are obtained from
a) Bacteriophages b) Bacterial cells c) Plasmids d) All prokaryotic cells

323. T_i plasmids used in genetic engineering is obtained from
a) *Bacillus thuringiensis*
b) *Agrobacterium rhizogenes*
c) *Agrobacterium tumefaciens*
d) *Pseudomonas syringae*

324. Sterilization of tissue culture medium is done by
a) Autoclaving of medium at 120° for 15 min
b) Filtering the medium through fine sieve
c) Mixing the medium with antifungal agents
d) Keeping the medium at $-20°C$

325. In cloning of cattle, a fertilized egg is taken out of the mother's womb and
a) The egg is divided into four pairs of cells, which are implanted into the womb of other cows
b) In the eight cell stage, cells are separated and cultured until small embryos are formed, which are implanted into the womb of other cows
c) In the eight cell stage, the individual cells are separated under electrical field for further development in culture media
d) From this upto eight identical twins can be produced

326. Which of these is used as vector in gene therapy for SCID?
a) Arbovirus b) Rotavirus c) Enterovirus d) Retrovirus

327. About …A… recombinant therapeutics have been approved for human use the world over. In India, …B… of these are presently being marketed
Here A and B can be
a) A-30, B-20 b) A-30, B-12 c) A-20, B-10 d) A-25, B-10

328. The mobile genetic element is
a) Transposon b) Mutation c) Endonuclease d) Variation

329. *Bacillus thuringiensis* forms protein crystals which contains a
a) Toxic insecticidal protein
b) Non-toxic insecticidal protein
c) Simple protein
d) Simple lipids

330. Hardening in tissue culture is
    a) Keeping at $30 - 50°C$ temperature for about 30 minutes
    b) Acclimatization tissue culture plants slowly before growing in the field
    c) Plunging the vials into water at $37 - 40°C$
    d) None of the above
331. Pollen grains of a plant, whose $2n = 28$, are cultured to get callus by tissue culture method. What would be the number of chromosomes in the cells of the callus?
    a) 28 b) 21 c) 14 d) 56
332. Transgenic animals are produced for which of the following purposes?
    I. To study the normal physiology and development
    II. To study diseases
    III. To obtain useful biological products
    IV. To test the vaccine safety
    V. To test the chemical safety
    Which of the above statements are correct?
    a) I, II and III b) II, III and IV c) I, II, III and V d) I, II, III, IV and V
333. Choose the correct statement with reference to 'Dolly'
    a) She was created by taking nucleus from unfertilized eggs and cytoplasm from fertilized eggs
    b) She was created by taking nucleus from udder cells and cytoplasm from unfertilized egg
    c) She was created by taking cytoplasm from udder cell and nucleus from unfertilized egg
    d) She was created by taking cytoplasm from udder cell and nucleus from fertilized egg
334. The callus is not formed in
    a) Tissue culture b) Suspension culture c) Clonal propagation d) Sexual reproduction
335. The green revolution succeeded in increasing the yield of crops mainly due to the use of
    I. improved varieties of the crops
    II. agro-chemicals
    III. better management practices
    Choose the correct option
    a) I and II b) I and III c) II and III d) I, II and III
336. ELISA is based on
    a) Antigen – antibody interaction b) Antigen – protein interaction
    c) Lectin – antibody interaction d) All of the above
337. Manipulation of DNA in genetic engineering became possible due to the discovery of
    a) Restriction endonuclease b) DNA ligase
    c) Transcriptase d) Primase
338. Which of the following is used in recombinant DNA technique?
    a) Cell wall of virus b) Gene which produces capsid of virus
    c) Virus d) Capsid of virus
339. Which one is regarded as a molecular scissor in biotechnology?
    a) Reverse transcriptase b) Restriction endonuclease
    c) *Taq* polymerase d) Topoisomerase
340. In 1997, the first transgenic cow, Rosie produced
    a) Human protein enriched milk (2.4 g/L)
    b) Human protein enriched milk (2.8 g/L)
    c) Human calcium enriched milk (2.4 g/L)
    d) Human calcium enriched milk (2.8 g/L)

NEET BIOLOGY

BIOTECHNOLOGY AND ITS APPLICATIONS

: ANSWER KEY :

1)	a	2)	d	3)	a	4)	c	169)	a	170)	a	171)	b	172)	c
5)	a	6)	d	7)	c	8)	a	173)	d	174)	c	175)	b	176)	c
9)	d	10)	a	11)	b	12)	b	177)	d	178)	c	179)	c	180)	d
13)	d	14)	b	15)	a	16)	d	181)	d	182)	b	183)	d	184)	a
17)	a	18)	a	19)	c	20)	c	185)	c	186)	a	187)	c	188)	c
21)	c	22)	d	23)	b	24)	c	189)	d	190)	a	191)	c	192)	d
25)	d	26)	b	27)	a	28)	b	193)	a	194)	c	195)	c	196)	d
29)	c	30)	d	31)	d	32)	c	197)	d	198)	a	199)	b	200)	d
33)	b	34)	c	35)	a	36)	a	201)	a	202)	a	203)	c	204)	d
37)	a	38)	c	39)	c	40)	d	205)	b	206)	b	207)	c	208)	d
41)	a	42)	a	43)	a	44)	a	209)	b	210)	c	211)	b	212)	b
45)	a	46)	b	47)	d	48)	b	213)	b	214)	c	215)	a	216)	b
49)	a	50)	d	51)	b	52)	b	217)	d	218)	c	219)	c	220)	d
53)	a	54)	b	55)	d	56)	b	221)	c	222)	b	223)	b	224)	b
57)	a	58)	d	59)	b	60)	d	225)	c	226)	b	227)	c	228)	d
61)	c	62)	a	63)	c	64)	b	229)	d	230)	a	231)	d	232)	c
65)	c	66)	c	67)	d	68)	d	233)	c	234)	d	235)	c	236)	b
69)	d	70)	a	71)	a	72)	a	237)	c	238)	a	239)	b	240)	a
73)	a	74)	c	75)	d	76)	d	241)	d	242)	d	243)	a	244)	d
77)	d	78)	b	79)	c	80)	a	245)	c	246)	c	247)	b	248)	d
81)	a	82)	b	83)	a	84)	c	249)	b	250)	a	251)	c	252)	d
85)	d	86)	a	87)	b	88)	a	253)	b	254)	d	255)	d	256)	c
89)	b	90)	b	91)	d	92)	d	257)	c	258)	b	259)	d	260)	b
93)	c	94)	c	95)	b	96)	b	261)	b	262)	c	263)	a	264)	d
97)	a	98)	d	99)	a	100)	d	265)	b	266)	d	267)	a	268)	b
101)	a	102)	d	103)	d	104)	d	269)	d	270)	d	271)	b	272)	a
105)	b	106)	d	107)	c	108)	b	273)	a	274)	a	275)	d	276)	c
109)	a	110)	c	111)	b	112)	d	277)	a	278)	a	279)	a	280)	c
113)	a	114)	b	115)	d	116)	b	281)	a	282)	a	283)	c	284)	d
117)	c	118)	a	119)	d	120)	c	285)	d	286)	b	287)	b	288)	c
121)	c	122)	d	123)	a	124)	b	289)	d	290)	c	291)	d	292)	a
125)	a	126)	a	127)	d	128)	c	293)	b	294)	c	295)	c	296)	b
129)	c	130)	c	131)	b	132)	a	297)	a	298)	b	299)	c	300)	a
133)	b	134)	d	135)	a	136)	b	301)	b	302)	b	303)	c	304)	a
137)	a	138)	a	139)	a	140)	b	305)	a	306)	b	307)	a	308)	c
141)	a	142)	b	143)	d	144)	d	309)	c	310)	d	311)	d	312)	b
145)	d	146)	b	147)	b	148)	c	313)	b	314)	b	315)	b	316)	d
149)	c	150)	c	151)	a	152)	c	317)	a	318)	a	319)	d	320)	a
153)	a	154)	d	155)	c	156)	b	321)	a	322)	b	323)	c	324)	a
157)	a	158)	b	159)	a	160)	d	325)	b	326)	d	327)	b	328)	a
161)	b	162)	d	163)	b	164)	d	329)	a	330)	b	331)	c	332)	d
165)	b	166)	d	167)	a	168)	c	333)	b	334)	d	335)	d	336)	a

337) a 338) c 339) b 340) a

NEET BIOLOGY

BIOTECHNOLOGY AND ITS APPLICATIONS

: HINTS AND SOLUTIONS :

1 **(a)**
The bacterium *Bacillus thuringiensis* is widely used in contemporary biology as insecticide

2 **(d)**
DNA fingerprinting is a technique to identify a person on the basis of persons DNA specificity. The technique was developed by **Sir Alec Jeffreys** (1964) at Leicester University, UK.

3 **(a)**
Specific *Bt* toxin genes obtained from bacteria *Bacillus thuringiensis* are used in several crop plants. The toxin is coded by a gene called *cry*, which is of various types. For example, proteins encoded by the genes *cry* I Ac and *cry* II Ab controls the cotton bollworms and that of *cry* I Ab controls corn borer. *Bt* toxin are initially inactive protoxins but after ingestion by the insects their inactive toxins become active due to the alkaline pH of the gut, which solublise the crystals

4 **(c)**
Silencing of a gene could be achieved through the use of RNAi and antisense RNA

5 **(a)**
In callus culture, shoot and root regenerations are controlled, generally, by auxin-cytokinin balance. Usually, the excess of auxin (such as naphthalene acetic acid or NAA), promotes root regeneration, whereas that of cytokinin (like BAP) promotes shoot regeneration.

6 **(d)**
Golden rice is developed of Swiss Federal Institute of Technology. The rice grains are golden yellow in colour due to the presence of β-carotene. It contains 'beta carotene' gene from daffodil plants and also genes from some bacteria. Golden rice will prevents child blindness caused due to deficiency of vitamin-A

7 **(c)**
Genetic Engineering Approval Committee – Government of India formed the organisation like GEAC (Genetic Engineering Approval Committee) to decides the validity and safety of GM organisms for public safety

8 **(a)**
DNA ligase is used to seal the nicks that remain in recombinant DNA molecule. In fact DNA ligase joins together the neighbouring nucleotides flanking a discontinuity in a DNA strand by forming a phosphodiester bond.

9 **(d)**
Genetic modification of crops have resulted in
(i) Increased tolerance against abiotic stresses (cold, drought, salt and heat)
(ii) Reduced reliance on chemical pesticides (pest-resistant crops)
(iii) Reduced post-harvest losses
(iv) Enhanced nutritional value of food, *e*. *g*., vitamin-A enriched (golden rice)
(v) Increased efficiency of minerals used by the plants (this prevents early exhaustion of fertility of soil)

10 **(a)**
Insect resistant transgenic plants contain either a gene from the bacterium *Bacillus thuringiensis* or some other gene. In Bt cotton and Bt tobacco the insect resistant gene is transferred from *Bacillus thuringiensis*.

11 **(b)**
Transgenic golden rice was created by transforming rice with the genes *Psy* (phytoene synthase) from daffodil (*Narcissus pseudonarcissus*) and *Cry* 1 from the soil bacterium *Erwinia uredovora*.

12 **(b)**
Plasmids are used in genetic engineering.

13 **(d)**
An explant is the excised piece of tissue or organ used for culture. An explant before organogenesis is heterotrophic which grows on a synthetic

medium and sucrose is the most commonly used carbon source.

14 **(b)**
A nematode *Meloidegyne incognitia* infects the roots of tobacco plants, which reduces the production of tobacco. It can be prevented by using RNA interference (RNAi) process, which is checked by the silencing of specific *m*RNA due to a complementary *ds*RNA. *ds*RNA binds and prevents the translation of the *m*RNA (silencing)

15 **(a)**
The restriction endonuclease *Eco* RI is obtained from *Escherichia coli* Ry 13. The recognition sequence for this is G/AATTC, CTTAA/G.

16 **(d)**
Transgenic tobacco plants containing a gene (*cry*) from a bacterium, *Bacillus thuringiensis* have been produced.
This bacterial gene specifies an insecticidal protein that destroys the stomach lining of the insects and kills them. The tobacco plants with this gene produces their own insecticide

17 **(a)**
Gene for human alpha lactalbumin was introduced into the genes of first transgenic cow, which made the milk nutritionally richer

18 **(a)**
Bacillus thuringiensis was the first to be used as biopesticides on the commercial scale in the world

19 **(c)**
Silk is obtained from cocoon (pupa) of silk moth. The salivary glands are modified and forming silk glands of larva. Silk is secreted by silk glands.

20 **(c)**
Bacillus anthracis (anthrax) and *B. mallei* (glanders, the most common biological weapon) were used in WW-I by Germany, to infect livestock and animal feed exported to Allies.

21 **(c)**
Bt toxins are initially inactive protoxins but after ingestion by the insects, their inactive toxins becomes active due to the alkaline pH of the gut which solublise the crystals. The activated toxin binds to the surface of the midgut epithelial cells thus, creating pores which causes cell swelling and lysis, further leading to death of the insects

22 **(d)**
Bt brinjal is a transgenic plant with insect resistance which contains Bt gene encoding Bt toxin derived from *Bacillus thuringiensis*.

23 **(b)**
Agrobacterium tumefaciens is used as a best genetic vector in plants.

24 **(c)**
Somaclonal variation is a variation that occurs in cell and tissue cultures, which may be genetic or epigenetic.

25 **(d)**
Polyethylene glycol (PEG) is a hydrocarbon solvent that attacks cell membranes and is widely used in the induction of cell fusion between plant protoplasts and in the production of animal cell hybridoma. It is used for gene transfer without a vector.

26 **(b)**
Biopiracy.
Indian Basmati was crossed with semi dwarf variety and was claimed as a new variety for which the patent was filled by a USA company

27 **(a)**
Genetic modification of crops have resulted in
(i) increased tolerance against abiotic stresses (cold, drought, salt, heat)
(ii) reduced reliance on chemical pesitcides (pest-resistant crops)
(iii) reduced post-harvest losses
(iv) increased efficiency of minerals used by the plants (this prevents early exhaustion of fertility of soil)
(v) enhanced nutritional value of the food
(vi) creation of tailor-made plants to supply alternative resources such as starches, fuels and pharmaceuticals to industries

28 **(b)**
PCR was discovered by **Karry Mullis**. In polymerase chain reaction (PCR), a segment of DNA is amplified. Taq DNA polymerase enzyme is used in PCR, this enzyme is temperature resistant.

29 **(c)**
Gene amplification using primers can be done by polymerase chain reaction (PCR). In this reaction, multiple copies of the gene of interest is synthesized in vitro using two sets of primers and

the enzyme DNA polymerase. Primers are small chemically synthesized oligonucleotides that are complementary to the regions of DNA.

30 **(d)**
Genetic engineering is defined as the manipulation of genes by man. It refers to the artificial synthesis, modification, isolation, addition, combination and repair of genetic material (DNA) to get desired and useful phenotype. In this technique, the DNA or gene of different origins are joined to produce hybrid DNA called recombinant DNA.

32 **(c)**
A clone consists of asexual progeny of a single individual or cell. The process of producing a clone is called cloning. All the individual of a clone have the same genotype, which is also identical with that of the individual from which the clone was derived.

33 **(b)**
Eli Lilly.
The company that developed genetically engineered *E. coli* to make human insulin was Genetech. They developed it in 1978. This technique was purchased by another American company Eli Lilly in September 1982. On 5th July, 1983 Eli Lilly company launched the first genetically engineered human insulin by the name humulin

34 **(c)**
Endonucleases are enzymes that produce internal cuts called cleavage in DNA molecule. A class of endonucleases cleavage DNA only within or near those sites which have specific base sequences, such endonucleases are known as restriction endonucleases and sites recongnised by them are called recognition sites. Restriction endonucleases have major role in genetic engineering.

35 **(a)**
Government of India formed the organisations like GEAC (Genetic Engineering Approval Committee) to decide the validity and the safety of GM organisms for public safety

36 **(a)**
Bt toxin is obtained from Bacillus thuringiensis, a prokaryote.

37 **(a)**
Useful biological products can be produced by introducing into transgenic animals the portion of DNA (or genes), which codes for a particular product.
For example, Human protein (4-1-antitrypsin) is used to treat emphysema

38 **(c)**
Biopiracy is a theft or robbery of biological and genetic resources indigenous to a country. The biological resources have many uses in agriculture health care and chemical industries. The process of biopiracy involves the collection of the samples of biological sources, which can be done unnoticed

39 **(c)**
Cultivation of axillary or apical shoot meristem is known as meristem culture. It involves the development of an already existing shoot meristem and subsequently the regeneration of adventitious roots from the developed shoots. Meristem culture can be used for rapid clonal multiplication, production of virus free plants, germplasm conservation and production of transgenic plants.

41 **(a)**
Bacillus thuringiensis froms the protein crystals, which contains a toxic insecticidal protein. *Bt* toxins are initially inactive protoxins but after ingestion by the insects their inactive toxin becomes active due to the alkaline pH of the gut, which solubilise the crystals. The activated toxin binds to the surface of the midgut epithelial cells thus creating pores, which causes cell swelling and lysis, further leading to death of the insect

42 **(a)**
Genetic engineering may one day enable the medical scientists to replace the defective genes responsible for heredity diseases (haemophilia, phenylketonuria) with the normal genes.
The improved techniques for gene manipulation and deeper understanding of gene function in the body, may some day enable the medical biotechnologists to correct gene disorders in humans. Treatment of a genetic disorder by manipulating genes is called **gene therapy**

43 **(a)**
Polymerase Chain Reaction (PCR) was developed by **Kary Mullis**. It is composed of denaturation of

DNA at high temperature, annealing of primers at the ends of DNA strands and synthesis/polymerization by polymerase.

44 **(a)**
A lymphocyte is a kind of WBCs in the vertebrate immune system. The three major types of lymphocyte are T-cells, B-cells and Natured Killer (NK) cells

46 **(b)**
Variable Number Tandem Repeats (VNTRs) are short nucleotide repeats that vary in number from person to person but are inherited. These can be recognized only through molecular analyses of DNA samples and are important for DNA fingerprinting.

47 **(d)**
Bt toxin is not toxin to human being because conversion of pro *Bt* to *Bt* state takes place only in highly alkaline conditions

48 **(b)**
A clone is a homozygote obtained asexually or a clone is a group of individuals or cells derived from a single parent or cell through asexual reproduction. All the cells in the clone have the same genetic material and are exact copies of the original.

49 **(a)**
The company that developed genetically engineered *E. coli* to make human insulin was Genetech. They developed it in 1978. This technique was purchased by another American company Eli Lilly in September 1982. On 5th July, 1983 Eli Lilly company launched the first genetically engineered human insulin by the name humulin

50 **(d)**
Bt cotton is a transgenic plant with insect resistance, which contain *Bt* gene encoding *Bt* toxin derived from *Bacillus thuringiensis*.

51 **(b)**
For the first time in 1990, M Blease and WF Andresco of National Institute of Health, attempted gene therapy on a 4 year old girl Adenosine Deaminate (ADA) deficiency ADA is caused due to the deletion of gene for adenosine deaminase

52 **(b)**
Secondary cells are formed from divisions in primary meristematic cells. These newly formed secondary cells become lose the ability to divide due to irreversible changes during differentiation or due to loss of nucleus at the maturation.

53 **(a)**
Callus is an unorganized and undifferentiated mass of actively dividing plant cells grown on culture medium from an explants. In 1939 **White, Gautheret** and **Nobecour**t independently succeeded in raising callus.

54 **(b)**
Test tube baby is the result of IVF-ET technique (in vitro Fertilization-Embryo Transfer). The first case of IVF-ET technique success was reported by **Dr. Patrick Steptoe** (England) and **Dr. Robert Edward** (England) when first test tube baby Louis Joy Brown was born to Lesley and Gilbert Brown on July 1978, in Oldham, Lancashire (England).

55 **(d)**
Transgenic models have been developed for many human disease like cancer cystic fibrosis, rheumatoid arthritis and Alzheimer's disease

56 **(b)**
The probes used for DNA fingerprinting are usually prepared from **minisatellite** or microsatellite DNA.

57 **(a)**
The decisions regarding the validity of GM (Genetically Modification of Organism) research and the safety of introducing GM for public services in India is taken by Genetic Engineering Approval Committee

58 **(d)**
Some strains of *Bacillus thuringiensis* produce that kills insect like lipidoptreans, coleopterans and dipterans

59 **(b)**
Transgenic rice having gene for β-carotene. Golden rice a variety of *Oryza sativa* is produced through the genetic engineering of biosynthesis beta-carotene, a precursor of provitamin-A in the edible parts of rice. The research that led to golden rice was conducted with the goal of helping children who suffer from vitamin-A deficiency and blindness in poor countries.

Golden rice has been breed to be especially disease-resistant, resulting in better crop yield

60 **(d)**
In meristem culture, the shoot apical meristem along with some surrounding tissue is grown in vitro. It is used for clonal propagation and recovery of **virus free plants**. It is also potentially useful in germplasm exchange and long term storage of germplasm through freeze preservation

61 **(c)**
Bt toxin is coded by a gene named *cry*. There are number of such genes, *e*. *g*., the proteins encoded by the genes *cry* IAc and *cry* IIAb control the cotton bollworms, that of *cry* IAb controls corn borer

62 **(a)**
Bone marrow transplantation and enzyme replacement therapy.
Adenosine deaminase enzyme is very important for the immune system to function. In the absence of adenosine deaminase enzyme, purine metabolism is disturbed and T-lymphocytes fails to function. ADA deficiency can lead to Severe combiuned Immune Deficiency (SCID)
SCID is caused due to defect in the genes for the enzyme adenosine deaminase. The genetic diseases that are being investigated for gene therapy ranges from sickle-cell anaemia to Severe Combined Immuno Deficiency (SCID). In some children, ADA deficiency can be cured by bone marrow transplantation
However, in others it can be treated by the enzyme replacement therapy, in which functional ADA is given to the patient by injection. But in both approaches, the patients are not completely cured. For permanent cure, gene isolated from the bone marrow cells producing ADA at early embryonic stage can be a possible cure

63 **(c)**
The SCID patient has a defective gene for the enzyme Adenosine Deaminase (ADA). He/she lacks functional T-lymphocytes and therefore, fails to fight the infecting pathogens

64 **(b)**
Bacillus thuringiensis is a Gram positive, soil dwelling bacterium, also occurs naturally in the gut of caterpillars of various types of moths and butterflies.
During sporulation, B. thuringiensis forms crystals of proteinaceous insecticidal δ − endotoxins (cry toxins), which are encoded by cry genes. It was determined that the cry genes are harbored in the plasmids of B. thuringiensis strains. Cry toxins have specific activities against species of the order-Lepidoptera (moths and butterflies), Diptera (flies and mosquitoes) and Coleoptera (beetles). Thus, B. thuringiensis serves as an important reservoir of cry toxins and cry genes for the production of biological insecticides and insect resistant genetically modified crops.

65 **(c)**
Restriction endonucleases and ligase are commonly used enzymes in genetic engineering.

66 **(c)**
Somatic hybridization involves the fusion of protoplasts of two defferent species which resulted in hybrid. Naked protoplasts are obtained by dessolution of their cell walls by the mecerating enzymes such as pectinase and cellulas. Fusion of protoplasts from two defferent varieties can be enhanced by treating with polyethylene glycol (PEG) in presence of high voltage electric current.

67 **(d)**
Ratio of cytokinins to auxins controls differentiation. If both of these are present in equal quantities, the cells divide but fail to differentiate. If there is more cytokinin than auxin, shoot buds develop. If there is more auxin than cytokinin, roots develop.

68 **(d)**
'Retroviruses' have been disarmed and are now used to deliver desirable genes into animal cells.

69 **(d)**
Main objective of production/use of herbicide resistant genetically modified crops is to reduce herbicide accumulation in food articles for health safety.

70 **(a)**
Generally, seeds of rice do not have vitamin-A, but golden rice, which is developed through genetic engineering has the high vitamin-A content.

71 **(a)**
Escherichia coli and *Agrobacterium tumefaciens* are microbes found to be very useful in genetic engineering. E. coli is motile, Gram negative, rod shaped bacterium which is a normal inhabitant of human colon. It is most extensively used in bacterial genetics and molecular biology.
Agrobacterium tumefaciens is a soil bacterium. It has T_i plasmid (Tumour inducing plasmid) and it can be used for the transfer of a desired gene in dicot plants.

72 **(a)**
Restriction endonuclease is the enzyme which recognizes a specific DNA base sequence and cleavages both the strands of a DNA at a particular site called restriction site having palindromic sequence. So, restriction endonuclease are also called molecular scissors.

73 **(a)**
Production of 'giant mouse' in the laboratory was made possible through gene manipulation.

74 **(c)**
Nematodes is a group of organisms, which parasites a large number of plants and animals including human being. One of the common nematodes *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great loss by causing reduction in yield.
This infestation was prevented by using a novel strategy, which was based on the process of RNA interference (RNAi). RNA is powerful reverse genetic tool to study gene function

75 **(d)**
In 1997, the first transgenic cow, Rosie produced human protein – enriched milk (2.4 g/L). The milk contained the human α-lactalbumin and was nutritionally balanced for human babies than natural cow milk

76 **(d)**
Bacillus thuringiensis bacterium carries a gene, which codes for toxic crystals (*Bt* toxin proteins) that are produced during endospore formation. *Bt* toxin is active against larvae of more than 140 species of insects including cabbage worm and bag worm.

77 **(d)**
All of the above.
In recombinant DNA technology, a probe is allowed to hybridise to its complementary DNA in the clone of cells. The cells are then detected by autoradiography. The cells with mutated genes will not be observed on the photographic film because the probe was not complementary to the mutated genes

78 **(b)**
In genetic engineering rDNA technology is applied to several biotechnological processes for obtaining particular biochemical improvement of genetic makeup of an organism and fighting genetic defects.

79 **(c)**
PCR is a technique, in which a small fragment of DNA is rapidly cloned or duplicated to produce multiple DNA copies. Thus, it helps in the diagnosis of a genetical disorder. This technique was conceived by American biochemist **Kary B Mullis.**

80 **(a)**
A nematode *Meloidegyne incognitia* infects the roots of tobacco plants, which reduce the production of tobacco

81 **(a)**
Alkaline pH of the gut.
Bt toxin is an intracellular crystalline protein. Specific *Bt* toxin genes obtained from *Bacillus thuringiensis* are used in several crop plants like cotton. *Bt* toxins are initially inactive protoxins but after ingestion by the insects their inactive toxin becomes active due to the alkaline pH of the gut which dissolves the crystals

82 **(b)**
Morgan (1901) coined the term 'totipotency'
Cellular totipotency is the capability of a somatic cell to produce the complete organisms.

83 **(a)**
Biogas is a methane rich fuel gas produced by anaerobic breakdown or biomass with the help of methanogenic bacteria. It is composed of methane (50-70%), CO_2 (30-40%) and traces of hydrogen, nitrogen and hydrogen sulphide.

84 **(c)**
Prof. **Anand Mohan Chakravorty** has developed a new strain of oil eating bacteria called super bug

by using species of *Pseudomonas* through recombinant DNA technology.

85 **(d)**

(i) Fruit softening is promoted by an enzyme polygalacturonase, which degrades pectin. In the transgenic tomato variety *Flavr savr*, production of polygalacturonase was blocked hence fruit of this tomato variety remains fresh and retains their flavour much longer then do the fruit of normal tomato varieties

(i) Recently the US government has patented the India Basmati rice as 'Rice tec'. The Government of India challenged on April 28.2001. Consequently, USPTO served a notice to M/s Rice Tec., Inc., for the amendments in claims restricting to only three strains developed by it

(ii) The war, which is fought by bioweapons (biological weapons) against humans or their crops and animals is called as biowar. Viruses, bacteria and some other harmful organisms can be used as bioweapons in biological warfare

86 **(a)**

Important for DNA fingerprinting are short nucleotide repeats that ary in number from person to person but are inherited. These are Variable Number Tandem Repeats or VNTRs and these can be recognized only through molecular analysis of DNA SAMPLES. **Alec Jeffreys** (1985, 86) discovered this technique for the first time.

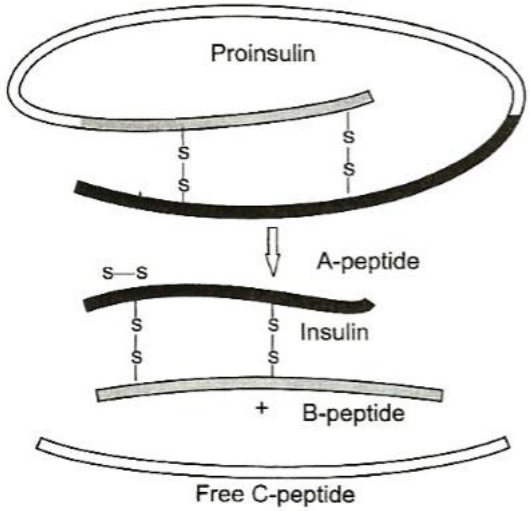
87 **(b)**

Insect resistant transgenic cotton was produced through genetic engineering by inserting a piece of DNA from the bacterium *Bacillus thuringiensis*. Hence, this cotton is called transgenic cotton or *Bt* **cotton**. It provides resistance against the ballworm of cotton.

89 **(b)**

A-Proinsulin, B-A peptide, C-B peptide D-free C-Peptide.

Maturation of proinsulin into insulin after removal of C-peptide



90 **(b)**

DNA fingerprinting technique is very useful in solving disputed parentage cases and forensic cases, DNA fingerprints are obtained from **RFLP** or VNTR (satellite DNA) analysis of blood, hair or other materials found at the place of crimes.

92 **(d)**

Plasmids are extrachromosomal molecules of DNA that replicate independently of the bacterial chromosomes. They are normally closed, circular, super coiled. They are used as a vector for cloning and genetic engineering.

93 **(c)**

The *cry* gene of *Bacillus thuringiensis* produces a protein which forms crystalline inclusions in the bacterial spores. These crystal proteins are responsible for the insecticidal activities of bacterial strain. *Cry* I *Ac* and *cry* II *Ab* gene are responsible for controlling the insects of Lepidoptera (moth).

94 **(c)**

Biopiracy (or biocolonialism) is the appropriation of another's knowledge of use of biological resources.

95 **(b)**

Vector is a DNA molecule that has the ability to replicate autonomously in and appropriate host cell and into which the DNA fragment to be cloned is integrated for cloning. In higher organism retroviruses vectors are used, while Baculovirus vectors used for production of transgenic proteins in silk worm.

96 **(b)**

A single-stranded DNA or RNA tagged with a radioactive molecule (such as ^{32}P) is called probe. In this method, a probe is allowed to hybridise to its complementary DNA in the clone of cells

97 **(a)**
Bacillus thuringiensis is a natural insecticide with unusual properties that makes it useful for pest control in certain situations. *Bacillus thuringiensis* forms protein crystals (*Cry* protein or *cry* gene) which contains a toxic insecticidal protein

98 **(d)**
In the initial stages of protoplast culture, sorbitol/mannitol is added as an osmotic stabilizer.

99 **(a)**
Important objectives of biotechnology in agriculture section is to produce pest resistant varieties of the plants

100 **(d)**
All of these.
The application of biotechnology includes
(i) therapeutics
(ii) diagnostics
(iii) genetically modified crops for agriculture
(iv) processed food
(v) bioremediation
(vi) waste treatment and
(vii) energy production

101 **(a)**
T_i – plasmid of the bacterium *Agrobacterium tumefaciens* is used to carry DNA into plant cells.

102 **(d)**
Earlier, insulin was extracted from the pancreas of slaughtered cattle and pigs but some patients began developing allergies. Bacteria can not be made to synthesise insulin from its gene because of the presence of introns. Bacteria do not possess enzymes for removing intron mediated transcription

103 **(d)**
Food production can be increased by applying biotechnology in the following ways
(i) Agrochemical – based agriculture
(ii) Organic agriculture
(iii) Genetically engineered crop-based agriculture

104 **(d)**
The term green revolution leads to the very substantial yield increase obtained by plants resulted from the development of new crop varieties under intensive programme of fertilizers, water and pesticide management. The high yielding varieties of wheat and rice have been the key element in the green revolution.

105 **(b)**
A nematode *Meloidegyne incognitia* infects the roots of tobacco plants, which reduces the production of tobacco. It can be prevented by using RNA interference process. In this process, by using *Agrobacterium* vector, nematode specific genes were introduced into the host plants, which produced both sense and antisense RNA in the host cells

106 **(d)**
DNA fingerprinting (= DNA typing = DNA profiling = genetic fingerprinting) was invented by Sir Alec Jeffreys of UK in 1985. It is a technique to identify a person on the basis of his or her DNA specificity. During this technique, the dark bands on X-ray film present the DNA fingerprint (= DNA profiles). It is very helpful in identifying criminals of rape/murder (using blood/semen/hair) as well as for settling matters related to parentage and paternity.

107 **(c)**
Pasteurization is the heating of milk at 62°C for 30 minutes or at 73°C for 15 seconds. It kills all the microorganisms of milk.

111 **(b)**
In recombinant DNA technology, a probe is allowed to hybridise to its complementary DNA in the clone of cells. The cells are then detected by autoradiography. The cells with mutated genes will not be observed on the photographic film because the probe was not complementary to the mutated genes

112 **(d)**
Adenosine deaminase enzyme is very important for the immune system to function. In the absence of adenosine deaminase enzyme, purine metabolism is disturbed and T-lymphocytes fails to function. ADA deficiency can lead to Severe combiuned Immune Deficiency (SCID)
SCID is caused due to defect in the genes for the enzyme adenosine deaminase. The genetic

diseases that are being investigated for gene therapy ranges from sickle-cell anaemia to Severe Combined Immuno Deficiency (SCID). In some children, ADA deficiency can be cured by bone marrow transplantation

However, in others it can be treated by the enzyme replacement therapy, in which functional ADA is given to the patient by injection. But in both approaches, the patients are not completely cured. For permanent cure, gene isolated from the bone marrow cells producing ADA at early embryonic stage can be a possible cure

113 **(a)**

The diversity of rice in India is one of the richest in the world. Basmati rice is distinct for its aroma and flavour and 27 documented varieties of Basmati are grown in India. There is reference to Basmati in ancient books as it has been grown for centuries.

In 1997, an American company got patent rights on Basmati rice through the US patent and Trademark office. This allowed the company to sell a new variety of Basmati, in the US and abroad. This new variety of basmati had actually been derived from Indian farmer's varieties. Indian Basmati was crossed with semi dwarf varieties and claimed as an invention or a novelty

114 **(b)**

The technique of DNA fingerprinting was developed for the first time by **Alec Jeffreys** (1985, 86) and his colleagues at Leicester University in UK.

115 **(d)**

Callus culture and suspension culture are two types of plant tissue cultures differentiated on the basis of in vitro growth of the explant, which is higher is case of suspension culture than in callus culture. Usually, the medium contains the auxin 2, 4-D (dichlorophenoxy acetic acid) and BAP.

116 **(b)**

The drug chorionic gonadotropin is obtained through genetic engineering and is useful for treating infertility.

117 **(c)**

India is a country rich in traditions, communal knowledge and expertise in natural medicines spices, food preparation, biological pesticides and diverse agriculture. That's why, it is under the surge from biopirates.

The patents have been taken out on the plants such as Basmati rice (*Oryza sativa*), black pepper (*piper nigrum*), pomegranate (*Punica granantum*), Indian mustard (*Brassica compestris*), turmeric (*Curcuma/longa*) and neem (*Azadirachta indica*). US, Japanese and German companies are the principal patenting pirates

118 **(a)**

Genes of plants, bacteria, fungi and animals have been changed by manipulations therefore, these organisms are called Genetically Modified Organisms (GMOs). The behavior of a GMOs depends on the nature of genes transferred, nature of host plants, bacterium and animals

119 **(d)**

Some strains of *Bacillus thuringiensis* produces proteins that kills some insects like lepidopteran (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes)

120 **(c)**

The genetic variability present among cultured cells or plants derived from such cells or progeny of such plants is called **somaclonal variation**. Generally, the term somaclonal variation is used for genetic variability present among all kinds of cells/plants obtained from cells cultured in vitro.

121 **(c)**

Out of the given options

5' – GAATTC – 3'

3' – CTTAAG – 5'

Is a palindromic sequence that can be cut at about the middle by particular restriction enzyme.

122 **(d)**

Monoculture involves the exclusive cultivation of a single crop over wide areas. It is an efficient way to use certain kinds of soils but the crop plants grown in monoculture are highly prone to pests and thus, it carries the risk of an entire crop being destroyed with the appearance of a single pest species or disease.

123 **(a)**

Agrochemical based agriculture includes fertilisers and pesticides. Agrochemicals are

expensive for farmers in developing countries and also have harmful effects on environment

124 **(b)**
Golden rice a variety of *Oryza sativa* is produced through genetic engineering to biosynthesize' beta-carotene, a precursor of pro-vitamin-A in the edible parts of rice. The research that led to golden rice was conducted with the goal of helping children who suffer from vitamin-A deficiency in poor countries. Golden rice has been bred to be especially disease-resistant, resulting in better crop yields.

125 **(a)**
Plants are more rapidly manipulated by genetic engineering than animals because single somatic cell can regenerate a whole plant body.

127 **(d)**
Silencing of *m*RNA molecule' in order to control the production of a harmful protein has been used in the protection of plants from nematodes

128 **(c)**
Cry I Ab.
β-Carotene pro vitamin-A.
Golden rice a variety of *Oryza sativa* is produced through the genetic engineering of biosynthesis beta-carotene, a precursor of provitamin-A in the edible parts of rice. The research that led to golden rice was conducted with the goal of helping children who suffer from vitamin-A deficiency and blindness in poor countries. Golden rice has been breed to be especially disease-resistant, resulting in better crop yield

129 **(c)**
These hormones are used in the dairy industry, when injected into cows would increase their milk production.

130 **(c)**
'Bt' in 'Bt' cotton stands for Bacillus thuringiensis, a soil bacterium from which Bt gene (encoding Bt toxin) is obtained. Somatic hybridization involves the fusion of protoplast (i.e, cell minus cell wall) of two cells. Flavr savr is a transgenic tomato with hard skin and improved flavor and recombinant hirudin is obtained from the seeds of transgenic Brassica napas at commercial scale.

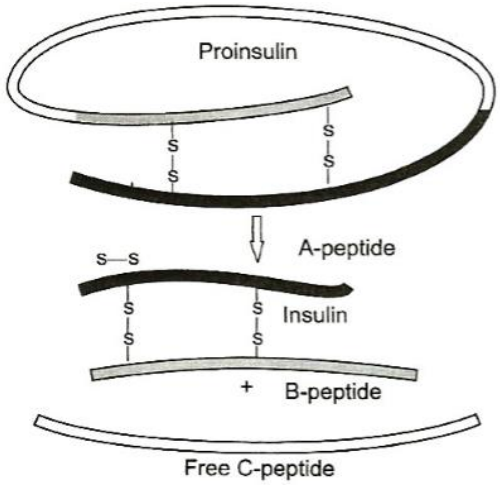
131 **(b)**
Biopatent is a government protection to an inventor of a biological material, securing to him for a specific time the exclusive right of manufacturing, exploiting, using and selling an invention

132 **(a)**
Indian Basmati was crossed with semi dwarf variety and was claimed as a new variety for which the patent was filled by a USA company

133 **(b)**
Calcitonin is a hormone secreted from parafollicular cell of thyroid gland. It is chorionic gonadotrohin hormone which is medically useful recombinant product in the treatment of infertility.

134 **(d)**
Characteristic of *Bt* cotton are high yield and resistance to boll worms.

135 **(a)**
Maturation of proinsulin into insulin after removal of C-peptide



136 **(b)**
Protoplasts are naked cells from which cell wall has been removed. Fusion of protoplast is done with solution of PEG or a very brief high voltage current.

137 **(a)**
Introducing foreign genes.
Animals whose DNA is manipulated to possess and express an extra (foreign) gene are known as transgenic animals. Transgenic rats, rabbits, pigs, sheep and cows have been produced

138 **(a)**
(i) → (ii) → (iii) → (iv).

Adenosine deaminase enzyme is very important for the immune system to function. In the absence of adenosine deaminase enzyme, purine metabolism is disturbed and T-lymphocytes fails to function. ADA deficiency can lead to Severe combiuned Immune Deficiency (SCID)
SCID is caused due to defect in the genes for the enzyme adenosine deaminase. The genetic diseases that are being investigated for gene therapy ranges from sickle-cell anaemia to Severe Combined Immuno Deficiency (SCID). In some children, ADA deficiency can be cured by bone marrow transplantation
However, in others it can be treated by the enzyme replacement therapy, in which functional ADA is given to the patient by injection. But in both approaches, the patients are not completely cured. For permanent cure, gene isolated from the bone marrow cells producing ADA at early embryonic stage can be a possible cure

140 **(b)**
Manipulation of DNA becomes easy due to invention of polymerase chain reaction developed by **Karry Mullis**. It generates microgram quantities of DNA copies of the desired DNA segment, present even as a single copy.

141 **(a)**
Bt toxin is coded by a gene named *Cry*. There are a number of them, *e.g.*, the proteins encoded by the genes *Cry* I *Ac* and *Cry* II *Ab* control the cotton bollworms, that of *Cry* I *Ab* controls corn borer.

142 **(b)**
In 1983, an American company Eli Lilly synthesized artificial insulin with the help of plasmids of *Escherichia coli.* It was named as humulin. Since then, genetically engineered E. coli bacteria are being used to produce human insulin.

143 **(d)**
Micropropagation is the practice of rapidly multiplying stock plant material to produce a large number of progeny plants, using modern plant tissue culture methods. It is used to provide a sufficient number of plantlets for planting from a stock plant, which does not produce seeds or does not respond well to vegetative reproduction.

144 **(d)**
S^{35} radioisotope is not suitable for DNA labeling based studies as DNA does not contain sulphur. S^{35} radioisotope is suitable for protein labeling based studies because protein contains sulphur.

145 **(d)**
For the first time in 1990, M Blease and WF Andresco of National Institute of Health attempted gene therapy on a 4 year old girl with Adenosine Deaminase (ADA) deficiency. The SCID patient has a defective gene for the enzyme Adenosine Deaminase (ADA)

146 **(b)**
Haploids hae a single genome as found in the gametes of the species. A haploid has only one copy of each chromosome and is highly sterile. **Guha** and **Maheshwari** (1964), developed a culture techniquee to produce haploid plants. It is called androgenic haploid culture, in which very young unopened sterilised flowers are opened to remove young anthers. **Anthers** are introduced over **culture medium** for 4-6 weeks, to give rise to large number of **embryoids** (haploids).

147 **(b)**
Differentiation of organs and tissues in a developing organism, is associated with differential expression of genes. In regulation of gene expression, the chromosomal proteins play important role. The chromosomal proteins are of two types-histones and non-histones. The regulation of gene expression involves an interaction between histones and non-histones.

148 **(c)**
Rice is being used since thousands of years in Asia's agricultural history of which 200,000 varieties are in India alone

150 **(c)**
A cybrid is a hybrid carrying cytoplasms of two different plants but genome of only one plant.

151 **(a)**
Agrobacterium tumefaciens (updated scientific name: Rizobium radiobacte) is the causal agent of crown gall desease (the formation of tumour) in over 140 species of dicot. It is a rod-shaped, Gram negative soil bacterium (Smith, et. al, 1907). Symptoms are caused by the insertion of a small segment of DNA, known as T-DNA (transfer DNA)

into the plant cell, which is incorporated at a semi-random location into the plant genome.

152 **(c)**
In callus culture, cell division in explant forms a callus. Callus is irregular unorganized and undifferentiated mass of actively dividing cells. Darkness and solid medium gelled by agar stimulates callus formation. The culture medium contains growth regulators auxin 2, 4-D and often a cytokinin like BAP. Both of these growth regulators stimulate meristematic property in callus.

153 **(a)**
Bt toxin is an intracellular crystalline protein. Specific *Bt* toxin genes obtained from *Bacillus thuringiensis* are used in several crop plants like cotton. *Bt* toxins are initially inactive protoxins but after ingestion by the insects their inactive toxin becomes active due to the alkaline pH of the gut which dissolves the crystals

155 **(c)**
Endonuclease hydrolyses internal phosphodiester bonds in a polynucleotide chain.

156 **(b)**
White revolution – Milk production

Golden revolution – Egg production

Blue revolution – Fish production

157 **(a)**
Bacillus thuringiesis toxin is an inactive protoxin, which gets converted into active form in the insect gut. It works as an insecticide.

159 **(a)**
Hirudin is an anticoagulant protein found in leech (*Hirudinaria).* It is now produced through genetic engineering from seeds of a plant Brassica napus. The hirudin accumulates in seeds and it is purified as medicine.

160 **(d)**
GEAC was set up by the ministry of environment and forests to regulate research, testing and commercial release of GM crops, food and organisms
The aim and objectives of GEAC are
(i) to permit the use of GM organisms and their products for the commercial applications
(ii) to adopt the procedures for restriction, production a scale, import, export and application of GM organisms
(iii) approval to conduct a large scale field trails and release of transgenic crops in the environment
(iv) to authorise agencies or persons to have large scale production and the release of GM organisms into the environment or curb and take **punitive** action against them

161 **(b)**
Insulin

162 **(d)**
Bt cotton is not resistant to all pesticides

163 **(b)**
Biowar or biological war or **bioterrorism** is the development of biological weapons against people, their crops and animals.

164 **(d)**
The technique of fingerprinting was initially developed by **Alec Jeffreys**. He used a satellite DNA as probe that shows very high degree of polymorphisms. It was called as Variable Number of Tandem Repeats (VNTR).

165 **(b)**
ADA – Adenosine Deaminase

166 **(d)**
Professor **F C Steward** of Cornell University (USA) demonstrated that mature cells removed from a carrot and placed in a suitable culture solution could be stimulated to start dividing again and to provide new carrot plants (totipotency). Totipotency is inherent capability of a single cell, which provides the genetic programme required to direct the development of an entire individual.

167 **(a)**
Golden rice is transgenic rice having carotene and iron. Carotene is precursor of vitamin-A *Flavr savr* (transgenic tomato) remains fresh and retain their flavor much longer than normal tomato. *Bt brinjal* is insect resistance brinjal.

168 **(c)**
Both statements are corrects.
GEAC was set up by the ministry of environment and forests to regulate research, testing and

commercial release of GM crops, food and organisms

The aim and objectives of GEAC are

(i) to permit the use of GM organisms and their products for the commercial applications

(ii) to adopt the procedures for restriction, production a scale, import, export and application of GM organisms

(iii) approval to conduct a large scale field trails and release of transgenic crops in the environment

(iv) to authorise agencies or persons to have large scale production and the release of GM organisms into the environment or curb and take **punitive** action against them

169 **(a)**

Food production can be increased by applying biotechnology is the following ways

(i) Agrochemicals based agriculture

(ii) Organic agriculture

(iii) Genetically engineered crop base agriculture

Fish farming in isolated water bodies is called pisciculture

170 **(a)**

All the statements given are correct for Bt transgenic plant except option (d).

171 **(b)**

DDNA fingerprinting technique was discovered by **A Jeffreys**. It is a modern technique that compares sets of DNA by locating identical sequences of nucleotides. It is oftenly used in forensic matters.

172 **(c)**

Removed during the maturation of proinsulin to insulin.

Insulin contains two short polypeptide chains, chain A and B-chain linked by disulphide bridge. In mammals, insulin is synthesised as prohormone (that needs to be processed to become mature and functional hormone). It contains an extra stretch called-peptide. C-peptide is absent in mature insulin and is removed during the maturation into insulin

173 **(d)**

The recombinant DNA technology process have made great impact in the area of healthcare by the mass production of safe and more effective therapeutics drugs. Further, the recombinant therapeutics do not induces unwanted immunological responses. Now, about 30 recombinant therapeutics have been approved for human use all over the world. In India, 12 of these are presently being marketed

174 **(c)**

PCR can detect very low amount of DNA. PCR is now usually used to detect HIV in suspected AIDS patients. It is also used to detect mutations in the genes in suspected cancer patients. It is a good technology to detect many other genetic disorders. Option III and IV are incorrect

175 **(b)**

The body would not reject it as it has not yet recognised self

176 **(c)**

Transgenic mice are developed to tests the safety of polio vaccine before being used on human

177 **(d)**

The patents have been taken out on the plants such as Basmati rice (*Oryza sativa*), black pepper (*piper nigrum*), pomegranate (*Punica granantum*), Indian mustard (*Brassica compestris*), turmeric (*Curcuma/longa*) and neem (*Azadirachta indica*). US, Japanese and German companies are the principal patenting pirates

178 **(c)**

T_i – plasmid, used for making transgenic plants is found in the bacterium *Agrobacterium tumefaciens*. Ti-plasmid is used as a vector for gene transfer to plant cells. T_i – plasmid has a vir region responsible for irulence towards host and a *t*DNA region, which is transferred to the host.

179 **(c)**

The main challenge for the production of insulin using RiDNA technique was getting insulin assembled into a mature form. In 1983, Eli Lilly an American company, first prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them into the plasmids of *Escherichia coli* to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulphide bonds to form human insulin (humulin)

180 **(d)**

An organism (such as bacterium) that will grow on a minimal medium (means having no specific nutritional requirement) is called a prototroph, while a 'mutant' of it that will not grow on a minimal medium but requires the addition of

some compound like an amino acid or vitamin is called **auxotroph.**

181 **(d)**
PCR can detect very low amounts of DNA. PCR is now usually used to detect HIV in suspected AIDS patients. It is also used to detect mutations the in genes in suspected cancer patients. It is a good technique to identify many other genetic disorders

182 **(b)**
Anther culture is the technique of 'tissue culture' developed by **Guha** and **Maheshwari** (1964). It is the culturing of anthers over suitable culture medium.

183 **(d)**
Restriction endonucleases cleave DNA molecules only at specific nucleotide sequence called **restriction sites. DNA Ligase** enzyme is used to join bits of DNA.

184 **(a)**
Phytotron is a chamber, in which plants can be grown in controlled condition for the study of effect of environmental condition on their growth.

185 **(c)**
Pseudomonas Putida is a genetically engineered bacterium with many different plasmids to degrade the pollutants. It is developed by **Dr. Anand Mohan Chakravorty** and is known as superbug or oil eating bug or Chakraborty's superbug. Now-a-days, this genetically engineered bacterium is utilized for cleaning of marine oil slicks.

186 **(a)**
RNA interference.
Nematodes is a group of organisms, which parasites a large number of plants and animals including human being. One of the common nematodes *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great loss by causing reduction in yield.
This infestation was prevented by using a novel strategy, which was based on the process of RNA interference (RNAi). RNA is powerful reverse genetic tool to study gene function

187 **(c)**
Insulin contains two short polypeptide chains, chain A and B-chain linked by disulphide bridge. In mammals, insulin is synthesised as prohormone (that needs to be processed to become mature and functional hormone). It contains an extra stretch called-peptide. C-peptide is absent in mature insulin and is removed during the maturation into insulin

189 **(d)**
The enzyme used in PCR is commercially obtained from *Thermus aquaticus.*

190 **(a)**
Genetically engineered microorganism called *Pseudomonas putida* is used in bioremediation of oil spills. It is also known as 'Chakravorty's super bug or oil eating super bug.

191 **(c)**
Vector is used to introduce genes into a host cell, where the genes may be amplified or otherwise manipulated, e.g., *A. tumefaciens.*

192 **(d)**
Plasmid is an exrtachromosomal genetic element of DNA that is capable of replicating independently of host chromosome. It forms the basis of many cloning vectors used in genetic engineering.

193 **(a)**
β-carotene is principal source of vitamin-A generally, seeds of rice do not have vitamin-A but golden rice, which is developed through genetic engineering has the high vitamin-A content

194 **(c)**
Earlier, insulin was extracted from the pancreas of slaughtered cattle and pigs but some patients began developing allergies. The injection of this insulin into patients occasionally produces sensitivity reaction and side effects

195 **(c)**
The molecular probes are usually single stranded pieces of DNAs (sometimes RNAs), labelled with radio-isotopes such as P^{32}. Molecular probes are available for many genetic disorders such as, Duchenne muscular dystrophy, cystic fibrosis, Tay-Sachs disease

196 **(d)**
Biotechnology may be, simply defined as the use of micro-organisms animals or plant's cells, or thin components to generate products and services useful to human beings. Now-a-days,

biotechnology is very helpful in producing transgenic crops or genetically modified (GM) crops, transgenic animals, biofertilizers, antibodies, hormones like humulin (genetically engineered human insulin), antibodies and various other useful products.

197 **(d)**
Bt cotton, *Bt* tobacco, *Bt* tomato, etc are transgenic plants having *Bt*-2 gene encoding *Bt* toxin, (e.g., thurioside). *Bt* toxin gene has been isolated from a bacterium *Bacillus thuringiensis* therefore, called *Bt* (*i.e., Bacillus thuringiensis*). These plants are resistant for more than 140 species of insects including common cabbage worm, caterpillars, bag worms, canker worms, gypsy worm, etc.

198 **(a)**
The polymerase chain reaction (PCR) is a technique by which small samples of DNA can be quickly amplified. The repeated amplification is achieved by the use of thermostable DNA polymerase, *i.e., (Taq*-polymerase isolated from a bacterium, *Thermus aquaticus*) which remain active during the high temperature induced denaturation of double-stranded DNA.

199 **(b)**
Transgenic animals are those, which have foreign DNA in all of its cells

200 **(d)**
The application of biotechnology includes
(i) therapeutics
(ii) diagnostics
(iii) genetically modified crops for agriculture
(iv) processed food
(v) bioremediation
(vi) waste treatment and
(vii) energy production

201 **(a)**
Vitamin-A.
Bt toxin protein crystals present in bacterium *Bacillus thuringiensis*, do not kill the bacteria themselves because toxins occur as inactive protoxin in bacteria

202 **(a)**
Restriction endonuclease recognizes a specific DNA base sequence (recognition sequence, recognizion site, restriction sequence or restriction site having palindromic sequence) and cleaves both the strands of DNA at or near that site. The enzyme cuts the DNA, generating restriction fragments with overhanging ends or blunt ends.

203 **(c)**
Drosophila melanogaster commonly called as fruitfly and is often used in genetic and development biology researches. The ripe banana is the most suitable medium to culture this fly.

204 **(d)**
A single-stranded DNA or RNA joined with a radioactive molecule (probe) is allowed to hybridise to its complementary DNA in a clone of the cells. It is followed by the detection using autoradiography

205 **(b)**
Genetic engineering is related with euphenics. **Euphenics** is the study of improvement of human race by altering the protein synthesis (by *m*RNA) process in cell. It is also called **medical engineering**.

206 **(b)**
Production of insulin by recombinant DNA techniques was achieved by an American company, Eli Lilly, in 1983. They prepared two DNA sequences corresponding to A and B-chains of the human insulin and introduction them into the plasmids of *E. coli* for production. The A and B chains produced were separated, extracted and combined by creating disulphide bonds to form human insulin

207 **(c)**
Rangaswami (1961) of Delhi University was the first to develop nucellar embryos of Citrus microcarpa. The nucellar embryos are used for producing disease free clones.

208 **(d)**
Restriction enzymes are degradative enzymes, which recognize and cut up DNA that is foreign to a cell. These enzymes protect bacteria against intruding DNA from other organisms such as virus or other bacterial cells.

210 **(c)**
In 1984, Caesar Milstein of England and George Kohler of Switzerland were awarded Nobel Prize for engineering the monoclonal antibodies. Monoclonal antibodies have been used in genetic engineering for identifying the levels of gene

product which is not detectable by other methods. These bodies are also used in pregnancy testing diagnosis of diseases, treatment of disease, preventing rejection of transplants and tissue typing for transplant

212 **(b)**
The haploid content of human DNA is 3.3×10^9 bp.

213 **(b)**
RNA interference.
Nematodes is a group of organisms, which parasites a large number of plants and animals including human being. One of the common nematodes *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great loss by causing reduction in yield.
This infestation was prevented by using a novel strategy, which was based on the process of RNA interference (RNAi). RNA is powerful reverse genetic tool to study gene function

215 **(a)**
The two DNA sequences or genes were made to fuse with plasmids of *Escherichia coli* and later allowed to form insulin chains.

216 **(b)**
Meloidegyne incognitia.
Alleviation of vitamin-A deficiency.
Golden rice a variety of *Oryza sativa* is produced through the genetic engineering of biosynthesis beta-carotene, a precursor of provitamin-A in the edible parts of rice. The research that led to golden rice was conducted with the goal of helping children who suffer from vitamin-A deficiency and blindness in poor countries. Golden rice has been breed to be especially disease-resistant, resulting in better crop yield

217 **(d)**
Bio-insecticidal plants.
Meloidegyne incognitia.
Alleviation of vitamin-A deficiency.
Golden rice a variety of *Oryza sativa* is produced through the genetic engineering of biosynthesis beta-carotene, a precursor of provitamin-A in the edible parts of rice. The research that led to golden rice was conducted with the goal of helping children who suffer from vitamin-A deficiency and blindness in poor countries. Golden rice has been breed to be especially disease-resistant, resulting in better crop yield

218 **(c)**
The bacterium *Bacillus thuringiensis* is a common soil bacteria, which produces a protein toxin that kills certain insects. The toxin is a crystal (Cry) protein. There are several kinds of cry toxin which are toxic to different groups of insects. The gene encoding Cry protein is called by gene

219 **(c)**
DNA fingerprinting is a modern technique that compares sets of DNA by locating identical sequences of nucleotides. It is oftening used to solve many mysteries involving murders, robberies and rapes.

220 **(d)**
Plant cells do not have endogeneous plasmids. The plasmid vectors used for plant cell transformation are mostly based on *Agrobacterium tumefaciens*-Ti plasmid. These are plant pathogenic Gram–ve soil bacteria which cause crown gall disease of dicot plants.

221 **(c)**
Gel electrophoresis is a technique to separate fragments of DNA. Since, DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix. Now-a-days the most commonly used matrix is agarose which is a natural polymer extracted from seaweeds (e.g., *Gelidium, Gracilaria, Gigartina*, etc.)

222 **(b)**
Totipotency is the inherent capability of a single cell to provide the genetic programme required to direct the development of an entire individual.

223 **(b)**
Pure culture without any contamination is called axenic culture.

224 **(b)**
Golden rice a variety of *Oryza sativa* is produced through the genetic engineering of biosynthesis beta-carotene, a precursor of provitamin-A in the edible parts of rice. The research that led to golden rice was conducted with the goal of helping children who suffer from vitamin-A deficiency and blindness in poor countries. Golden rice has been breed to be especially disease-resistant, resulting in better crop yield

225 **(c)**
Herbarium is a collection of preserved plant material. **Genome** refers to total genetic material within a cell of individual. **Gene library** is the collection of DNA fragments. **Gene bank** (= world collections) are large collections of germplasm (in the viable condition) representing materials from various parts of the world.

226 **(b)**
ELISA is based on the principle of antigen-antibody interactions. It can detect very small amount of proteins (antibody or antigen) with the help of enzymes (*e*. *g*., peroxidase or alkaline phosphatase)

227 **(c)**
Basmati is unique for its aroma and flavor, whose 27 varieties are cultivated in India

228 **(d)**
Agrobacterium tumefaciens is a widespread naturally occurring soil bacterium that causes crown gall and has the ability to introduce new genetic material into the plant cell

230 **(a)**
Adenosine deaminase.
SCID is caused due to defect in the genes for the enzyme adenosine deaminase. In some children, ADA deficiency can be cured by bone marrow transplantation. However, in others it can be treated by the enzyme replacement therapy in which functional ADA is given to patient by injection. But in both approaches, the patients by are not completely cured. For permanent cure, genes isolated from the bone marrow cells producing ADA at early embryonic stage can be a possible cure

231 **(d)**
Vitamin-A deficiency causes nightblindness among children. Vitamin-A deficiency often occurs where rice is the staple food since, rice grain does not contain β − carotene.

232 **(c)**
DNA fingerprinting is a technique to identify a person on the basis of person's DNA specificity. The technique is based upon the fact that the DNA constitution of an individual carries some specific sequence of nucleotides, which do not carry any information for protein synthesis.
From the given options, leucocytes are to be used for identifying the criminal because they are nucleated, whereas erythrocytes are enucleated.

233 **(c)**
A single-stranded DNA or RNA joined with a radioactive molecule (probe) is allowed to hybridise to its complementary DNA in a clone of cells. It is followed by the detection using autoradiography

234 **(d)**
Restriction enzyme is used in genetic engineering. Restriction enzyme is an endonuclease, that recognizes a specific DNA base sequence and cleaves both the strands of a DNA at or near that site.

235 **(c)**
The uptake of foreign DNA or transgenes by plant cells is called transformation. A variety of techniques have been used to introduce transgenes into plant cells, these can be grouped into the following two categories – (i) *Agrobacterium – mediated* and (ii) direct gene transfers. *Agrobacterium tumefacies* mediated transformation eliminates the need for regeneration from tissue explants.

236 **(b)**
Production of value added products like nutrition supplements, pharmaceuticals, fuels, etc., using transgenic crop is called molecular farming

237 **(c)**
A multicellular organism that carries a specific genetic change in each cell because of an intervention at the fertilised egg stage is a transgenic

238 **(a)**
Polyethylene glycol (PEG) is a hydrocarbon solvent that attachs cell membranes and is widely used in the induction of cell fusion between plant protoplast and in the production of animal cell hybridoma. It is used for are transfer without a vector.

239 **(b)**
The site of production of adenosine deaminase in the body is lymphocytes

240 **(a)**
Bt cotton is first genetically modified plant commercially released in India.

241 **(d)**
Presence of a pathogen (bacteria, viruses, etc.) is usually suspected only when the pathogen has produced a diseased symptom. By that time the number of pathogens is already very high in the body but very low count of a bacteria or virus (when the symptoms of the disease are not yet visible) can be detected by multiplication of their nucleic acid by **PCR**

242 **(d)**
Insulin was the first hormone prepared by genetic engineering within the *E. coli* bacterium. Insulin is made up of two 20 and 30 chains of amino acid residues. Two different *E. coli* bacterial cultures were used to produced each of the insulin chain, these were then recovered from the bacterial and separated by β-galactosidase and finally, chemically joined to make human insulin.

243 **(a)**
Insulin is the first hormone produced by culturing *E.coli* bacteria, in which insulin producing genes have been transferred from human beings.

244 **(d)**
Reporter genes are used to determine a particular DNA construct has been successfully introduced into a cell, organ or tissue. Enhancer is a DNA sequence present within the control regions of many eukaryotic genes that can enhance transcription. A transgenic organism contains in its genome a gene or genes introduced by one or the other technique of transfection. The gene introduced by transfection is called **transgen**.
Promoter is a cis-acting nucleotide sequence on a DNA molecule, which promotes the initiation of transcriptin.

245 **(c)**
Genomic DNA library means packing of donor DNA in a collection of vectors.

246 **(c)**
A probe is radioactively labeled (P^{32}) nucleic acid (20-40 nucleotide long) with a short sequence complementary to at least one part of the desired DNA/gene.

247 **(b)**
A monopoly granted to a person who has either invented a new and useful article, made improvement in an existing article or invented a new process of making an article is called **patent**

248 **(d)**
Agrochemicals are expensive for farmers. In developing countries and also they have harmful effects on the environment. Therefore, genetically modified crops were developed to overcome such problems

249 **(b)**
Biopiracy is defined as the use of bioresources by multinational companies and other organisations without proper authorisation from the countries and concerned people without complementary payment

250 **(a)**
Triticale is a man made cereal obtained by intergeneric cross between bread wheat (*Triticum* = 422) and rye (Secale = 14) followed by colchicines treatment.

251 **(c)**
Insulin obtained from the pancreas of cattle and pigs slightly differ from the human insulin in their amino acid sequence. Moreover, the insulin production from pig and cattle is not sufficient to cater the needs of growing number of diabetic patients.
Also, the injection of insulin into the patients, occasionally produces sensitivity reaction and side effects. These factors led researches to look for some alternative source of human insulin. The search for new source was soon fulfilled by recombinant DNA technology

252 **(d)**
T_i – plasmid is found in *Agrobacterium tumefaciens,* which produces crown gall (tumour) in a large number of dicot species. *A tumefaciens* is a Gram negative soil bacterium that infects a wide range of plants and cause crown galls.

253 **(b)**
All option are correct except (ii) new variety of Basmati rice was derived from Indian farmer's varieties

254 **(d)**
By using genetic engineering or recombinant DNA technology, insulin producing genes from human beings have been transferred into E. coli bacteria, which produced insulin called 'humulin' for clinical use. This type of synthetic insulin was

produced by an American pharmaceutical firm Eli Lily on 5th July 1983.

255 **(d)**
Restriction endonucleases are the enzymes, which cut a DNA molecule within certain specific sites that have specific base sequence, e.g., *Hae* III, *Eco* RI, *Bam* II, *Hind* II, *Pst* I, etc. DNAse-I is not a restriction endonuclease enzyme. DNA polymerase-III synthesizes DNA, while DNA polymerase-I erases printer and fills gaps during DNA replication.

256 **(c)**
The term 'totipotency' refers to the development of an organ from a cell in culture medium.

257 **(c)**
Hirudin is an anticoagulant protein found in leech (*Hirudinaria).* It is now produced through genetic engineering from seeds of *Brassica napus*. The gene encoding hirudin was transferred into *Brassica napus*, where hirudin accumulated in seeds which is purified and used medicinally.

258 **(b)**
Restriction enzymes cut double stranded DNA molecues at specific sites called recognition site that have specific base sequence. The restriction enzyme *Eco* RI, *Bam* II and *Hind* III are used in recombinant DNA technology to produce cuts in vector and other DNA molecules to obtain chimeric DNA.

259 **(d)**
As a first step towards the gene therapy, lymphocytes a kind of white blood cells, are extracted from the bone marrow of the patient and are grown in a culture outside the body. A functional ADA, cDNA *is then introduced into these lymphocytes, which the reinjected to the patients bone marrow but as these cells do not always remain alive, the patient requires periodic infusion or such genetically engineered lymphocytes*

260 **(b)**
Probe is a defined nucleic acid molecule that can be used in molecular hybridization procedures to identify specific nucleic acid sequences that are complementary to it, by virtue of a label carried by the probe. The label may be radio active or non-radioactive.

261 **(b)**
Specific *Bt* toxin genes obtained from bacteria *Bacillus thuringiensis* are used in several crop plants like cotton. It is easier to produce transgenic plants than animals. A single cell in most plant species can regenerate a whole plant. Thus, a single genetically engineered cell can produce a new plant with new traits. *Bacillus thuringiensis* forms the protein crystals which contains a toxic insecticidal protein

262 **(c)**
Restriction endonuclease recognizes a particular palindromic sequence and degrades the same. It was so, called because it restricted the growth of bacteriophage in the bacterium *(e.g., E. coli).* The convention for naming these enzymes is the first latter of the name comes from the bacterial genus; the second two letters come from the species, and the fourth letter from strain, e.g., Eco RI comes from *Escherichia coli* RY 13. Roman numbers following the names indicate the order in which the enzymes were isolated.

263 **(a)**
Animals whose DNA is manipulated to possess and express an extra (foreign) gene are known as transgenic animals. Transgenic rats, rabbits, pigs, sheep and cows have been produced

264 **(d)**
The plant tissue or organ excised and used for in vitro culture is known as **explant**. Any plant part such as shoot tip, root tip, leaf tip, pollen grains, etc, may be used as an explant. The choice of explant depends mainly on the objective of the culture and the regeneration potential of the different organs of a plant species.

265 **(b)**
A transgenic crop is a crop which contains and expresses a transgene. A popular term for transgenic crop is genetically modified crops or GM crops. *Flavr savr* tomato was the first commercially grown genetically engineered food to be granted a license for human consumption. These tomato can be fresh for long time than other varieties of tomato.

266 **(d)**

Bt cotton is resistant to insects. Insect resistant transgenic cotton was produced through genetic engineering by inserting a piece of DNA from the bacterium *Bacillus thuringiensis*. Hence, this cotton is called transgenic cotton or *Bt* cotton. It provides resistance against the bollworm of cotton

267 **(a)**
PCR is now, used to detect HIV in suspected AIDS patients

268 **(b)**
Alleviation of vitamin-A deficiency.
Golden rice a variety of *Oryza sativa* is produced through the genetic engineering of biosynthesis beta-carotene, a precursor of provitamin-A in the edible parts of rice. The research that led to golden rice was conducted with the goal of helping children who suffer from vitamin-A deficiency and blindness in poor countries. Golden rice has been breed to be especially disease-resistant, resulting in better crop yield

269 **(d)**
In genetic engineering, a desired part of DNA is taken and then inserted into another suitable organism for their expression. Thus, genetic engineering is an artificial process. But in nature, *Agrobacterium tumefaciens* (a bacterium) does this process normally. This bacterium has a plasmid, which contains a 23 base pair direct repeat sequences, called as T-DNA. This T-DNA has the ability to transfer itself from *A. tumefaciens* to an infected plant chromosome.

270 **(d)**
In 1997, the first transgenic cow, Rosie produced human protein – enriched milk (2.4 g/L). The milk contained the human α-lactalbumin and was nutritionally balanced for human babies than natural cow milk

271 **(b)**
Example of gene therapy Introduction of gene for adenosine deaminase in person suffering from Severe Combined Immune Deficiency (SCID)

272 **(a)**
In callus culture, cell division in explant (differentiated mass of mature cells) forms callus. Callus is an irregular unorganized and undifferentiated mass of actively dividing cells. Callus is obtained within 2-3 weeks. The process is called **de-differentiation.**

273 **(a)**
The first human drug made by using genetic engineering technique was insulin. Insulin is an important life saving drug for diabetic patients

274 **(a)**
In tissue culture, shoot regeneration is promoted by cytokinin, and root generation is promoted by auxin like NAA (Naphthalene Acetic Acid). An excess of auxin promotes root regeneration, whereas that of cytokinin promotes shoot regeneration. Roots regenerate from the lower end of these shoots to give complete plantlets.

275 **(d)**
Human insulin is made up of 51 amino acids arranged in two polypeptide chains. A having 21 amino acids and B with 30 amino acids. The two polypeptide chains are interconnected by two disulphide bridges or S-S linkages. S-S linkage also occurs in A-chain. The hormone develops from the storage product is called proinsulin. Proinsulin has three chains, A, B and C. C chain with 33 amino acids is removed prior to insulin formation

276 **(c)**
Polymorphism in sequence is the basis of DNA fingerprinting.

277 **(a)**
Ligase enzyme catalyses condensation of ATP or any other such triphosphate. DNA ligase is used to join bits of DNA.

278 **(a)**
Transgenic animals are made to carry genes which makes them more sensitive to the toxic substance then non-transgenic animals
(i) Useful biological products can be produced by introducing into transgenic animals the portion of DNA (or genes) which codes for a particular product, *e*. *g*., human protein (α-1-antitrypsin) is used to treat emphysema
(ii) Brazzein is protein produced by a west African plant, *Pentadiplandra brazzeana*, which is approximately 2000 times as sweet as sugar. It is used as a low calorie sweetener. Local people have been using the super sweet berries of this plant for centuries. But the protein brazzein was patented in USA

279 **(a)**

Recombinant DNA molecule is a vector (e.g., plasmid, phage or virus) into which the desired DNA fragment has been inserted to enable its cloning in an appropriate host. pBr 322 of E. coli was the first most widely used plasmid for construction of recombinant DNA.

281 **(a)**
Bt tobacco was first cultured to kill hornworm. Tobacco plants containing a gene from a bacterium, *Bacillus thruinginesis* have been produced. This bacterial gene specifies an insecticidal protein that destroys the stomach lining of insects and kills them. The tobacco plants with this gene produces their own insecticide

282 **(a)**
Rules of conduct that may be used to regulate our activities in relation to the biological world is called bioethics

283 **(c)**
Murashige and Skoog's medium is used for raising plants through micropropagation.

284 **(d)**
In organic farming, farmers use resistant varieties, manure, biofertilisers, biopesticides and biocontrols to increase the crop production instead of using artificial fertilisers and pesticides

285 **(d)**
Tissue culture technique can be utilized for the production of virus-free plants either by meristem culture chemotherapy or selective chemotherapy of larger explants from donor plants. Shoot apex consists of meristematic cells, thus, shoot apex culture is successful to obtain virus-free clones in crop improvement programmes.

287 **(b)**
Gene therapy is a collection of methods that allows the correction of gene defects diagnosed in a child or embryo. By insertion of normal gene, the defective mutant allele of the genes are replaced and non-functional gene is compensated

288 **(c)**
Bt toxin protein crystals present in bacterium *Bacillus thuringiensis*, do not kill the bacteria themselves because toxins occur as inactive protoxin in bacteria

290 **(c)**
Golden rice.
Golden rice a variety of *Oryza sativa* is produced through the genetic engineering of biosynthesis beta-carotene, a precursor of provitamin-A in the edible parts of rice. The research that led to golden rice was conducted with the goal of helping children who suffer from vitamin-A deficiency and blindness in poor countries. Golden rice has been breed to be especially disease-resistant, resulting in better crop yield

291 **(d)**
Biotechnology is essentially the use of technology to make biological processes beneficial to the mankind
Advantages
(i) Genetic engineering techniques to improve food crops
(ii) Molecular biology method to help understand the nature of diseases
(iii) Creation of genetically modified foods to feed the ever growing world population
(iv) Use of stem cells to treat diseases
(v) Creation of processed food
(vi) Plants yielding more nutritious and tastier fruits
(vii) Production of new types of medicine to fight dangerous disease

292 **(a)**
'Dolly' is the name of sheep, which was produced from the udder cell of sheep in England by cloning.

293 **(b)**
The Polymerase Chain Reaction (PCR) is a technique by which small samples of DNA can be quickly amplified. Starting with only one gene sized piece of DNA, this technique is used to make literally billions of copies in only a few hours.

294 **(c)**
Biotechnology.
The application of biotechnology includes
(i) therapeutics
(ii) diagnostics
(iii) genetically modified crops for agriculture
(iv) processed food
(v) bioremediation
(vi) waste treatment and
(vii) energy production

295 **(c)**
The toxin is coded by a gene called '*cry*'. *Bt* toxin gene has been isolated from a bacterium *Bacillus*

thuringiensis, e. g., proteins encoded by the genes *cry* I Ac and *cry* II Ab control the cotton bollworms and that of *cry* I Ab control corn borer

296 **(b)**

There are three critical research areas of biotechnology

(i) Providing best catalyst as improved organism, usually a microbe or pure enzyme

(ii) Creating optimal conditions by engineering for a catalyst to act

(iii) Downstream processing technologies to purify the proteins/organic compounds

Multiple Ovulation Embryo Transfer Technology (MOET) has successfully increased the herd size of cattle

297 **(a)**

Some strains of *Bacillus thuringiensis* produces proteins that kills some insects like lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies and mosquitoes)

299 **(c)**

Seeds from virus infected plants generally do not contain the virus. Therefore, sexual progeny are usually virus free, except for new-infections. But this belief is not entirely correct. In case of asexually reproducing crops virus infections spread rapidly. This is because of vegetative propagules from virus infected plants contain virus particle, hence in vegetatively propagated plants the virus gets transmitted through propagule (rhizome/bulb/tubers/root). But the growing bud is not infected (i.e., shoot tips are virus free)

300 **(a)**

Plasmid is an extrachromosomal genetic element of DNA or RNA that is capable of replicating independently of the host chromosome, *e.g., E. coli* plasmid pBR322.

301 **(b)**

Bacillus thuringiensis.

Bt toxin is an intracellular crystalline protein. Specific *Bt* toxin genes obtained from *Bacillus thuringiensis* are used in several crop plants like cotton. *Bt* toxins are initially inactive protoxins but after ingestion by the insects their inactive toxin becomes active due to the alkaline pH of the gut which dissolves the crystals

302 **(b)**

The plants obtained through genetic engineering contain a gene or genes usually from an unrelated organism, such genes are called transgenes and the plants containing transenes are known as transgenic plants. These plants are often called as genetically modified or GM crops, e.g., Flavr savr tomatoes, golden rice. Plants are made transgenic for identification, expressing the gene activity in time, to produce several chemicals like fatty acids, sugars, cellulose, rubber, etc.

303 **(c)**

Plasmids, cosmids or bacteriophages can be used as vector in genetic engineering. Plasmids are most widely used circular, extrachromosomal DNA segments seen in the bacterial cells. They carry a foreign gene or desired gene to the host. The size of plasmids ranges from 1×10^6 to 200×10^6 daltons. Among other vector plasmids are pBR 322, those of pUG series and T_i, R_i plasmids of *Agrobacterium.*

305 **(a)**

Transgenic animals are made to carry the genes, which makes them more sensitive to the toxic substance then other normal animals

306 **(b)**

Probe are 15-30 bases long radioactively labelled oligonucleotieds (RNA or DNA) used to detect complementary nucleotide sequences, used for disease diagnosis, etc.

307 **(a)**

Dr. Anand Mohan Chakravorty introduced plasmids from different strains into a single cell of *Pseudomonas putida*. The result was new genetically engineered bacterium, which would degrade octane, hexane, decane, xylene, toluene, etc. Hence, called **super bug** (oil eating bug).

308 **(c)**

Automated DNA sequencers, which sequence DNA fragments, work on the principle of a method developed by **Frederick Sanger.**

309 **(c)**

Biotechnology deals with industrial scale production of biopharmaceuticals and biological use of genetically modified microbes, fungi, plants and animals

310 **(d)**

Restriction enzyme are known as molecular knives or molecular scissors and are used to cut DNA at specific sites of DNA. These were first discovered by **Smith, Nathan** and **Arber**.

311 **(d)**
Early detection of a disease is not possible by the conventional diagnosis methods. *Some technique used for early diagnosis are*
(i) Polymerase chain reaction
(ii) Recombinant DNA technology
(iii) Enzyme Linked Immuno Sorbent Assay (ELISA)

312 **(b)**
In some cases, adenosine deaminase deficiency can be cured by bone marrow transplantation and enzyme replacement therapy, but it is not fully curative

313 **(b)**
Some nations are developing laws to prevent such unauthorised exploitation of their bioresearch and traditional knowledge. To check these problems, India parliament has recently cleared the second amendment of the **Indian Patents Bill**, that takes such issues into consideration

314 **(b)**
GEAC is the regulatory body working under MoEF for the release of transgenic crops.

315 **(b)**
A functional ADA CDNA can be introduced into cells of the patients receiving gene therapy by using vector constituted by retrovirus. The SCID patient has a defective gene for the enzyme Adenosine Deaminase (ADA). He/she lacks functional T-lymphocytes and, therefore fails to fight the infecting pathogen. Lymphocytes are extracted from the patient's bone marrow and a normal functional copy of human gene coding for ADA is introduced into these lymphocytes with the help of retrovirus

316 **(d)**
Gene therapy is a collection of methods that allows the correction of gene, defects diagnosed in a child or embryo. By the insertion of normal genes, the defective mutant allele of the genes are replaced and the non-functional gene is compensated

317 **(a)**
SCID is caused due to defect in the genes for the enzyme adenosine deaminase. In some children, ADA deficiency can be cured by bone marrow transplantation. However, in others it can be treated by the enzyme replacement therapy in which functional ADA is given to patient by injection. But in both approaches, the patients by are not completely cured. For permanent cure, genes isolated from the bone marrow cells producing ADA at early embryonic stage can be a possible cure

318 **(a)**
Monoclonal antibodies are produced by fusing normal antibody-producing cells with myelomas (cells from cancerous tumour). The resulting hybrid cells are called hybridomas.

319 **(d)**
The first clinical gene therapy was done for the treatment of SCID (Severe Combined Immune Deficiency). SCID is caused due to the defect in the gene for the enzyme adenosine deaminase

320 **(a)**
Genetic engineering is defined as the modification of genetic information of living organisms by direct manipulation of their DNA. Thus, a gene of known function (or economic importance) can be transferred from its normal location into a cell via a suitable mobile genetic element called **vector** such as plasmid, phage, etc.

321 **(a)**
Somaclones are obtained by **tissue culture**. The plant regenerated from cell and tissue cultures shows heritable variation for both qualitative and quantitative traits.

Plant breeding is the branch of biology, which is concerned with developing varieties superior to existing ones.

Irradiation means exposure to any form of radiation. Genetic engineering is the technique by which genetically modified organisms are obtained.

322 **(b)**
Restriction endonucleases are enzymes that produce internal cuts called cleavage in DNA molecules only within or near those sites which have specific base sequences (recognition site). These are obtained from the bacterial cells. Restriction enzymes were obtained from the bacterial cells. Restriction enzymes were

discovered due to and named after the phenomenon of host restriction of bacterial phages.

323 **(c)**
Ti plasmid is a plasmid present in *Agrobacterium tumefacies.* It is used in genetic engineering in plants, e.g., as a vector in gene transfer to dicot plants.

324 **(a)**
Autoclaving is commonly done at the temperature 121°C for 15 min or at 134°C for 3 min. The time required for sterilization depend upon the volume of medium in vessel

325 **(b)**
In cloning of cattle, a fertilized egg divides in 2, then in 4 and then in 8. This embryo is carefully removed from the womb.

326 **(d)**
SCID (Severe Combined Immuno Deficiency) is caused due to the defect in the gene synthesizing ADA. For the treatment of SCID, stem cell therapy is used in which bone marrow cells are taken from the patients and correct ADA gene is introduced using retroviruses as vectors.

327 **(b)**
About 30 recombinant therapeutics have been approved for human use in the world including India. In India, 12 of these are presently being marketed

328 **(a)**
Mobile genetic element is broadly any genetic element capable of moving itself, with or without duplication, from one site in a genome to another. Mobile genetic elements include plasmids, viruses, transposable genetic elements (transposons), short interspread elements, pathogenicity islands and so on. The term 'transposon' was introduced by **R W Hedges** and **A E Jacob** in 1974, to 'controlling' elements' or jumping genes, discovered by **Barbara McClintock** (1950) in maize.

329 **(a)**
Bacillus thuringiensis froms protein crystals which contains a toxic insecticidal proteins (*Bt* toxin). *Bt* toxin genes are used in several crop plants like cotton. The toxin is coded by a gene called *cry* which is of various types
For example *cry* IAc and *cry* IIAb control the cotton boll worms IAb control corn borer

331 **(c)**
Haploid plants may be obtained from pollen grains by placing anthers or isolated pollen grains on a suitable culture medium. Thus, the number of the chromosomes in the cells of the callus for the given case will be **14.**

332 **(d)**
Animals whose DNA is manipulated to process and express an extra (Foreign) gene are known as transgenic animals. Following are the common reasons for developing transgenic animals
(i) Study of normal physiology and development *e*. *g*., study of complex growth factors like insulin like growth factor
(ii) Study of disease Transgenic model have been developed for many human diseases like cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's disease
(iii) Obtain useful biological products, *e*. *g*., human protein (α-1-antitrypsin) is used to treat emphysema
(iv) Vaccine safety-Transgenic mice are developed to test the safety of vaccine before being used on humans. For example polio vaccine
(v) Chemical safety testing; Transgenic animals are made to carry genes, which makes them more sensitive to the toxic substances than non-transgenic animals

333 **(b)**
'Dolly' was the name given to a clone of adult lamb by **Ian Wilmut** of Roslin Institute, Edinburgh, UK (Feb. 1997). Dolly was created by the scientists by extracting the genetic material (or nucleus) from udder cells and cytoplasm from unfertilized eggs. In fact, the genetic material from the udder cells of one sheep was implanted into another sheep's egg after removing its genetic material. The fused cell developed into an embryo which was planted into the uterus of another sheep which acted as surrogate mother. Thus, Dolly had two genetic mothers as confirmed by the analysis of her mitochondria by **Eric Schon** and **Ian Wilmut** in 1999.

334 **(d)**

A callus is an amorphous mass of loosely arranged thin walled parenchyma cells developing from proliferation cells of parent tissue. An explants excised from a stem, tuber or root is used for callus formation.

335 **(d)**
The green revolution succeeded in increasing food supply because of
(i) Use of improved crop varieties
(ii) Use of agrochemicals (fertilisers and pesticides)
(iii) Use of better management practices

336 **(a)**
Antigen – antibody interaction.
ELISA is based on the principle of antigen-antibody interactions. It can detect very small amount of proteins (antibody or antigen) with the help of enzymes (*e*. *g*., peroxidase or alkaline phosphatase)

337 **(a)**
Isolation of restriction endonucleases by **Nathans** and **Smith** (1970) made it possible to cut DNA at specific sites. Restriction enzyme can cut both strands of DNA when foreign nucleotides are introduced in the cell. They cleave DNA to generate a nick with a 5' phosphoryl and 3' hydroxyl terminus.

338 **(c)**
In recombinant DNA technology, a desired segment of DNA or a gene is made to combine with the DNA of an organism where it will multiply and produce its copies. Plasmids and viruses are the most commonly used cloning vectors in recombinant DNA technology.

339 **(b)**
Restriction enzymes are the enzymes that can cleave or cut a DNA molecule within certain specific sites that have specific base sequence. These are used in recombinant DNA technology to produce cuts in vector and other DNA molecules to obtain chimeric DNA. Hence, these are also known as molecular scissors.

340 **(a)**
In 1997, the first transgenic cow, Rosie produced human protein enriched milk (2.4 g/L). The milk contained the human alpha-Lactalbumin and was more nutritionally balanced for the human babies than natural cow milk