



Post Graduate School  
Indian Agricultural Research Institute, New Delhi  
Examination for Admission to Ph.D. Programme 2011-2012

Discipline : Molecular Biology and Biotechnology

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Roll No

**Please Note:**

- (i) This question paper contains 14 pages. **Please check whether all the pages are printed in this set.** Report discrepancy, if any, **immediately** to the invigilator.
- (ii) *There shall be **NEGATIVE** marking for **WRONG** answers in the Multiple Choice type questions (No. 1 to 130) which carry one mark each. For every wrong answer 0.25 mark will be deducted.*

**PART – I (General Agriculture)**

**Multiple choice questions (No. 1 to 30). Choose the correct answer (a, b, c or d) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.**

1. Which of the following crops have been approved for commercial cultivation in India?
  - a) Bt cotton and Bt brinjal
  - b) Bt cotton and Golden Rice
  - c) Bt maize and Bt cotton
  - d) Bt cotton only
2. This year (2010-11) the expected food grain production in India is
  - a) 212 million tonnes
  - b) 220 million tonnes
  - c) 235 million tonnes
  - d) 250 million tonnes
3. The genome of which of the following crops is still not completely sequenced?
  - a) Rice
  - b) Soybean
  - c) Sorghum
  - d) Wheat
4. According to the Approach Paper to the 12<sup>th</sup> Five Year Plan, the basic objective of the 12<sup>th</sup> Plan is
  - a) Inclusive growth
  - b) Sustainable growth
  - c) Faster, more inclusive and sustainable growth
  - d) Inclusive and sustainable growth
5. To address the problems of sustainable and holistic development of rainfed areas, including appropriate farming and livelihood system approaches, the Government of India has set up the
  - a) National Rainfed Area Authority
  - b) National Watershed Development Project for Rainfed Areas
  - c) National Mission on Rainfed Areas
  - d) Command Area Development and Water Management Authority
6. Which of the following sub-schemes are not covered under the Rashtriya Krishi Vikas Yojana?
  - a) Extending the Green Revolution to eastern India
  - b) Development of 60,000 pulses and oilseeds villages in identified watersheds
  - c) National Mission on Saffron
  - d) National Mission on Bamboo
7. The minimum support price for the common variety of paddy announced by the Government of India for the year 2010-11 was
  - a) ₹ 1030
  - b) ₹ 1000
  - c) ₹ 980
  - d) ₹ 950
8. According to the Human Development Report 2010 of the United Nations, India's rank in terms of the human development index is
  - a) 119
  - b) 134
  - c) 169
  - d) 182

9. Which of the following does not apply to SRI method of paddy cultivation?
- Reduced water application
  - Reduced plant density
  - Increased application of chemical fertilizers
  - Reduced age of seedlings
10. Which organic acid, often used as a preservative, occurs naturally in cranberries, prunes, cinnamon and cloves?
- Citric acid
  - Benzoic acid
  - Tartaric acid
  - Lactic acid
11. Cotton belongs to the family
- Cruciferae
  - Anacardiaceae
  - Malvaceae
  - Solanaceae
12. Photoperiodism is
- Bending of shoot towards source of light
  - Effect of light/dark durations on physiological processes
  - Movement of chloroplast in cell in response to light
  - Effect of light on chlorophyll synthesis
13. Ergot disease is caused by which pathogen on which host?
- Claviceps purpurea* on rye
  - Puccinia recondita* on wheat
  - Drechlera sorokiniana* on wheat
  - Albugo candida* on mustard
14. Rocks are the chief sources of parent materials over which soils are developed. Granite, an important rock, is classified as
- Igneous rock
  - Metamorphic rock
  - Sedimentary rock
  - Hybrid rock
15. Which one of the following is a *Kharif* crop?
- Pearl millet
  - Lentil
  - Mustard
  - Wheat
16. The coefficient of variation (C.V.) is calculated by the formula
- $(\text{Mean}/\text{S.D.}) \times 100$
  - $(\text{S.D.}/\text{Mean}) \times 100$
  - $\text{S.D.}/\text{Mean}$
  - $\text{Mean}/\text{S.D.}$
17. Which of the following is commonly referred to as muriate of potash?
- Potassium nitrate
  - Potassium chloride
  - Potassium sulphate
  - Potassium silicate
18. Inbred lines that have same genetic constitution but differ only at one locus are called
- Multi lines
  - Monohybrid
  - Isogenic lines
  - Pure lines
19. For applying 100 kg of nitrogen, how much urea would one use?
- 45 kg
  - 111 kg
  - 222 kg
  - 333 kg
20. The devastating impact of plant disease on human suffering and survival was first realized by epidemic of
- Brown spot of rice in Bengal
  - Late blight of potato in USA
  - Late blight of potato in Europe
  - Rust of wheat in India
21. The species of rice (*Oryza*) other than *O. sativa* that is cultivated is
- O. rufipugon*
  - O. longisteminata*
  - O. glaberrima*
  - O. nivara*
22. The enzyme responsible for the fixation of  $\text{CO}_2$  in mesophyll cells of C-4 plants is
- Malic enzyme
  - Phosphoenol pyruvate carboxylase
  - Phosphoenol pyruvate carboxykinase
  - RuBP carboxylase
23. Which one of the following is a 'Vertisol'?
- Black cotton soil
  - Red sandy loam soil
  - Sandy loam sodic soil
  - Submontane (Tarai) soil
24. What is the most visible physical characteristic of cells in metaphase?
- Elongated chromosomes
  - Nucleus visible but chromosomes not
  - Fragile double stranded loose chromosomes
  - Condensed paired chromosomes on the cell plate
25. All weather phenomena like rain, fog and mist occur in
- Troposphere
  - Mesosphere
  - Ionosphere
  - Ozonosphere

26. Which of the following elements is common to all proteins and nucleic acids?
- Sulphur
  - Magnesium
  - Nitrogen
  - Phosphorous
27. Silt has intermediate characteristics between
- Sand and loam
  - Clay and loam
  - Loam and gravel
  - Sand and clay
28. Certified seed is produced from
- Nucleus seed
  - Breeder seed
  - Foundation seed
  - Truthful seed
29. Seedless banana is an
- Autotriploid
  - Autotetraploid
  - Allotriploid
  - Allotetraploid
30. Which one of the following is used to test the goodness-of-fit of a distribution?
- Normal test
  - t-test
  - Chi-square test
  - F-test

**PART – II (Subject Paper)**

**Multiple choice questions (No. 31 to 130). Choose the correct answer (a, b, c or d) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.**

31. Cellulose is a polymer of glucose with \_\_\_\_\_ linkage.
- $\alpha$ -1-4
  - $\beta$ -1-4
  - $\alpha$ -1-6
  - $\beta$ -1-6
32. Centrioles are found in cells of
- Animals
  - Plants
  - Fungi
  - Bacteria
33. Overlapping genes are more often found in
- Viruses
  - Bacteria
  - Fungi
  - Human beings

34. A wild-type allele usually refers to
- Dominant allele
  - Recessive allele
  - Allele found in high frequency
  - Allele found in wild-related species
35. Which of the following is a case of reverse genetics?
- Cloning of a gene by transposon mutagenesis
  - Map-based cloning of a gene for disease resistance
  - Identification of gene function by over expression or silencing
  - Isolation of a gene based on natural variation
36. A gene that originates through duplication within a species is called
- Paralogous
  - Heterologous
  - Orthologous
  - Homologous
37. For plants, which of the following is not an immortal population for genetic studies?
- NILs
  - RILs
  - Doubled haploids
  - BC<sub>1</sub>F<sub>1</sub>
38. A mis-sense mutation leads to
- Loss of transcription
  - Loss of protein production
  - Production of modified protein
  - No change in the primary structure of protein
39. A repressor mutation is
- Mutation occurring in another gene leading to appearance of wild-type phenotype from a mutant
  - Mutation in the same gene but at a different site leading to restoration of wild-type phenotype
  - Mutation at the same site leading to restoration of original gene function
  - A mutation in the same gene that prevents expression of another gene
40. The number of clones required for a true representative genomic DNA library is dependent on many factors. Choose the right combination of factors from the following:
- Size of the genome
  - No. of genes in the organism
  - Mean size of the clones
  - Confidence level (i.e. probability of having at least one copy of any DNA sequence present in the organism)
- i, ii and iii
  - i, ii and iv
  - i, iii and iv
  - ii, iii and iv

41. For a given organism, the number of c-DNA libraries that can be constructed is
- Equal to the number of genes
  - Directly proportional to the life-span of the organism
  - Equal to the genomic content
  - Unlimited
42. In garden pea, Mendel found that yellow seed colour was dominant to green and round seed shape was dominant to shrunken. What are the expected ratios of yellow:green and round:shrunken phenotypes in the F<sub>2</sub> of a cross of a pure yellow, round X green, shrunken?
- 3:1 and 4:1
  - 2:1 and 3:1
  - Both 3:1
  - Both 2:1
43. A bacterial protein-coding gene acquired a termination codon in the middle of coding region, yet a functional protein was produced. Which of the following could be responsible for translation of the gene?
- Excision of an intron
  - mRNA without any secondary structure
  - Ribosome lacking ssRNA
  - A suppressor tRNA
44. Who of the following carried out recombination experiments on rII locus of phage T4 and introduced the term 'Cistron'?
- Seymour Benzer
  - Sydney Brenner
  - Daniel Nathans
  - Paul Berg
45. The recognition site of the restriction endonuclease *Ava*I is CPyCGPuG, where Py is any pyrimidine and Pu is any purine. Which of the following would be the expected average distance in nucleotide pairs between *Ava*I specific site in a random DNA sequence?
- 64
  - 512
  - 1024
  - 4096
46. A mutation in a bacterial aminoacyl tRNA synthetase led to charging of entire tRNA<sup>Ser</sup> population with Alanine. Which of the following will occur upon using these aminoacyl tRNAs for protein synthesis in a bacterial cell?
- Protein synthesized will contain either Alanine or serine
  - Protein synthesized will contain Alanine where serine should normally occur
  - Protein synthesized will contain serine where Alanine should normally occur
  - The alanyl-tRNA<sup>Ser</sup> will not function in protein synthesis
47. Which of the following causes frameshift mutations?
- Proflavin
  - 2-Aminopurine
  - 5-Bromouracil
  - Nitrous acid
48. Which of the following is not involved in recombination in eukaryotes?
- Rad 51
  - Rho
  - Dmc 1
  - Spo 11
49. The binding and assembly of Rec A, the central protein in recombination in *E. coli*, is much more rapid on which of the following?
- Single stranded DNA
  - Double stranded DNA
  - Binds with equal rapidity to both single and double stranded DNA
  - Rec A does not bind to DNA
50. Which of the following are found only in organisms containing polycistronic mRNA?
- Alternative splice sites
  - Temperature sensitive mutations
  - Polar mutations
  - Missense mutations
51. Frederick Griffith injected mice with samples from virulent S strain and/or nonvirulent R strain of *Streptococcus pneumoniae*. Which of the following observations is not consistent with his experiment?
- Mouse lived upon injection with R strain
  - Mouse lived upon injection with a mixture of heat killed S strain and live R strain
  - Mouse died upon injection with S strain
  - Mouse lived upon injection with heat killed S strain
52. Transfer of F' (F prime) factor to F<sup>-</sup> cells is known as
- Conjugation
  - Transduction
  - Sexduction
  - Transformation
53. Which of the following products of genetic manipulation will not qualify to be called a transgenic?
- Obtained by micro-injection of DNA
  - Obtained via direct DNA uptake by protoplasts
  - Derived by somatic hybridization between cultivated and wild-related species
  - Gene transferred by backcross breeding with a transgenic

54. A circular double stranded DNA genome is determined by chemical method to contain 22 percent Guanosine nucleotide. The percentage of adenosine nucleotide in the DNA is
- 11
  - 22
  - 28
  - Cannot be computed with the available information
55. Which of the following conditions is likely to interfere with the conjugation process in bacteria?
- Pretreatment of recipient cells with cycloheximide
  - Pretreatment of recipient cells with DNase
  - Treatment of mating cell pairs with RNase
  - Application of strong shearing forces on the mating cell pairs
56. A yeast artificial chromosome contains all these except
- Centromere
  - Telomeres
  - Satellite DNA
  - ARS
57. Which of the following does not contain introns?
- 5S and 5.8S rRNA
  - Genes of mitochondrial genome
  - Genes of nucleolus genome
  - Genes of chloroplast genome
58. The cytoplasmic substrate for fatty acid synthesis, acetyl CoA is synthesized in mitochondria. Which of the following is the form in which the carbon of acetyl CoA is transported to the cytoplasm since the inner mitochondrial membrane is impermeable to acetyl CoA?
- Pyruvate
  - Citrate
  - Acetate
  - Malate
59. In a cell-free protein synthesizing system, a synthetic mRNA of the following sequence 5' CACACACACACACAC 3' was used. Assuming that protein synthesis could begin without the requirement of an initiator codon, which of the following products will be synthesized?
- One protein with an alternating sequence of 3 amino acids
  - One protein with an alternating sequence of 2 different amino acids
  - One protein consisting of a single type of amino acid
  - Two proteins each with an alternating sequence of 2 different amino acids
60. Which of the following is the first metabolic product which is common to the aerobic metabolism of fatty acids and glucose?
- Glyceraldehyde 3-phosphate
  - Pyruvate
  - Acetyl CoA
  - Citrate
61. The glyoxylate cycle is present in plants and bacteria but is not found in animals. The lack of glyoxylate cycle in animals results in their inability to
- Perform gluconeogenesis from amino acids
  - Perform gluconeogenesis from fatty acids
  - Synthesize oxaloacetate from isocitrate
  - Synthesize glutamate from malate
62. Attenuation, a regulatory mechanism in trp operon to overcome termination of transcription occurs
- When tryptophan concentration is limiting
  - When tryptophan concentration is high
  - When c-AMP is low
  - When c-AMP is high
63. Which of the following amino acids are specified by single codons?
- Tryptophan and histidine
  - Methionine and proline
  - Methionine and histidine
  - Methionine and tryptophan
64. The restriction enzymes that recognize a specific target DNA sequence which is symmetrical and cleave within that sequence are known as
- Type I
  - Type II
  - Type III
  - Type IV
65. Which of the following can act as a substrate for nitrogenase?
- Nitrite
  - Ethylene
  - Nitrate
  - Ammonia
66. The short single stranded 5' projections which are complementary in sequence and by which  $\lambda$  bacteriophage DNA adopts a circular structure when it is injected into its host cell are called
- att site
  - int site
  - cro site
  - cos site

67. The electron transport chain is located predominantly in which of the following in mitochondria?
- Inner membrane
  - Outer membrane
  - Inter membrane space
  - Matrix
68. Two formulations containing different growth regulators are to be tested for tissue culture response. Which of the following treatments will be appropriate for a proper comparison?
- Pairs of treatments with equal quantity (mg/l) of the samples
  - Pairs of treatments with equal quantity (mg/l) of active ingredients present in the sample
  - Pairs of treatments with equimolar quantity of active ingredients
  - Pairs of treatments with equal quantity (in%) of active ingredients
69. The initial product of photosynthetic CO<sub>2</sub> fixation in C<sub>3</sub> plants is
- Phosphoenol pyruvate
  - Glyceraldehyde-3-phosphate
  - 3-phosphoglycerate
  - 1,3-bisphosphoglycerate
70. The fused hybridoma cells in monoclonal antibody production are selected on a medium containing which of the following
- Hypoxanthine, aminopterin, ampicillin
  - Hypoxanthine, thymidine, aminopterin
  - Hypoxanthine, ampicillin, thymidine
  - Aminopterin, ampicillin, thymidine
71. Which of the following amino acids causes disruption in helical structure in proteins?
- Alanine
  - Valine
  - Proline
  - Tryptophan
72. The linkage number of a covalently closed circular DNA of 21,000 bp which is free of supercoiling and corresponds to B form of DNA is
- +2000
  - +1000
  - +2100
  - 2100
73. Which of the following is the common lesions found in DNA after exposure to ultraviolet light?
- Base deletions
  - Purine dimers
  - Pyrimidine dimers
  - Single strand breaks
74. The separation of two strands of duplex DNA at the replication fork is catalyzed by
- Gyrase
  - DNA helicase
  - Topoisomerase
  - Single strand binding protein
75. The primary enzyme involved in replication of *E.coli* chromosome is
- DNA polymerase I
  - DNA polymerase II
  - DNA polymerase III
  - DNA polymerase IV
76. Which of the following is the strategy employed by some viruses to increase the coding potential of their genome?
- Use of a degenerate triplet code
  - Use of alternative splicing sites
  - Use of host ribosomes for translation
  - Integration into the host genome
77. The percentage of G-C base pairs in a DNA molecule is related to the T<sub>m</sub> because
- A-T base pairs require a higher temperature for denaturation
  - The stability of G-C and A-T base pairs is intrinsically different
  - The triple bonds of G-C base pairs are less stable than the double bonds of A-T base pairs
  - The G-C content equals the A-T content
78. Which of the following statements is true for an enzyme catalysed reaction?
- Competitive inhibition can be overcome by increasing the concentration of substrate
  - Competitive inhibition can be overcome by decreasing the concentration of substrate
  - Noncompetitive inhibition can be overcome by increasing the concentration of substrate
  - Noncompetitive inhibition can be overcome by decreasing the concentration of substrate
79. Cholesterol is a precursor for the synthesis of all of the following except
- Bile salt
  - Estrogen
  - Corticosteroids
  - Isoprene
80. During signal transduction, regulation of the kinase cascades requires the activity of an enzyme that
- Removes phosphates
  - Cleaves proteins into peptides
  - Adds sugar groups to proteins
  - Makes disulfide bonds

81. The antibiotic streptomycin acts by
- Blocking protein elongation
  - Preventing initiation of protein synthesis
  - Interfering with peptidyl transferase activity
  - Interfering decoding by 16S rRNA, thus preventing protein synthesis
82. Which of the following statement is not correct?
- Prototrophs can grow on minimal media
  - Prototrophs can grow on complete media
  - Auxotrophs can grow on minimal media
  - Auxotrophs can grow on supplement media
83. Clues about the function of a plant gene responsible for a disease can be obtained by
- Carrying out the structural features of the isolated protein encoded by the gene
  - Analyzing the expression pattern of the gene
  - Expressing the gene in a bacterial system
  - Comparing the sequence of the putative gene causing the disease with sequences of other genes stored in a database
84. An error has been made in the concentration of ddGTP used in dideoxy sequencing reactions: the solution is 100  $\mu\text{M}$  rather than 1  $\mu\text{M}$ . Examination of the autoradiogram resulting from using this concentration of compound would show
- Increased spacing between all bands
  - Decreased spacing between all bands
  - A large blank area at the bottom
  - A decreased number of bands in the lane from the reaction with ddGTP
85. Which of the following is not true for allosteric proteins?
- They obey Michaelis-Menten kinetics
  - They show sigmoidal relationship between reaction velocity and substrate concentration
  - Activity of these enzymes may be altered by regulatory molecules which is bound to sites other than the catalytic sites
  - Binding of oxygen to hemoglobin is an example of allosteric protein
86. Which histone is not a part of nucleosome core particle?
- H2A
  - H1
  - H3
  - H4
87. Which of the following radioactive molecules is used for end-labeling of oligonucleotides?
- $\alpha^{32}\text{P-ATP}$
  - $\alpha^{32}\text{P-CTP}$
  - $\gamma^{32}\text{P-ATP}$
  - $\gamma^{33}\text{P-ATP}$
88. Commonly used software for multiple protein sequence alignment is
- NCBI
  - CLUSTAL W
  - PHYLLIP
  - PAUP
89. Depending on the criteria such as quality and content of information, reproducibility and speed of different DNA marker systems, identify the most suitable arrangement in the descending order
- AFLP – SSR – RFLP – RAPD
  - RFLP – AFLP – SSR – RAPD
  - SSR – RFLP – AFLP – RAPD
  - RAPD – SSR – RFLP – AFLP
90. For construction of a linkage map, both AFLP and RAPD markers were used. Which of the following mapping population would be most suitable and equally informative as that of co-dominant markers for map construction?
- $F_2$  of a cross between two inbred parents
  - $F_1$  of a cross between two out-bred parents
  - DH and RILS derived from a cross between two inbred parents
  - None of the above
91. During the recurrent backcrossing, the population of the donor genome is reduced by the relationship
- $1/2$
  - $1/2^m$
  - $1/2^{m-1}$
  - $1/2^{m+1}$
- where m is the number of generation of backcrossing
92. In human, the haploid number of chromosomes is 23. How many different types of gametes can arise by independent assortment?
- $2^{23}$
  - $4^{23}$
  - $23^2$
  - $23^4$
93. Gene conversion refers to
- A DNA segment being reversed in a chromosome
  - Insertion of a transposons that alters the reading frame
  - Single nucleotide substitution caused by a base analogue mispairing
  - Alterations in homologues as mismatch pair errors are corrected

94. Okazaki fragments are used to elongate
- The leading strand towards the replication fork
  - The lagging strand towards the replication fork
  - The leading strand away from the replication fork
  - The lagging strand away from the replication fork
95. Sickle cell anaemia is due to a mutant gene, Hbs. The nature of this mutation is
- Frameshift
  - Transversion
  - Transition
  - Translocation
96. The number of introns in cDNA having 7 exons are
- 0
  - 6
  - 7
  - 8
97. Two protoplasts from distantly related plant species can be fused by
- Polyethylene glycol
  - Spermidine
  - Cellulase
  - Pectinase
98. Male sterility systems are used for commercial hybrid seed production in plants. In a plant species where seed is not the economic product, most suitable male sterility system for hybrid seed production could be
- Recessive nuclear male sterility
  - Cytoplasmic male sterility
  - Cytoplasmic genetic male sterility
  - Dominant nuclear male sterility
99. Which one of the following anonymous DNA marker systems could be regarded as single locus, multi-allelic and co-dominant marker?
- RAPD
  - SNP
  - SSR
  - AFLP
100. Which one of the following is not a feature of eukaryotic gene expression?
- Polycistronic mRNA are very rare
  - Many genes are interrupted by non-coding DNA sequences
  - RNA synthesis and protein synthesis are coupled as in prokaryotes
  - mRNA is often extensively modified before translation
101. Which one of the following is not involved in regulating the synthesis of RNA in the eukaryotic nucleus?
- Active genes in euchromatin and genes in heterochromatin
  - Use of different RNA polymerases to transcribe different classes of RNA
  - Spliceosomes that stimulates synthesis of intron-containing hnRNA
  - Enhancers that can stimulate specific promoters
102. How can you distinguish a solution containing RNA from the one containing DNA?
- Heating the solution to 85°C and then measuring the absorbance at 260 nm
  - Measuring the absorbance at room temperature at 260 nm
  - Measuring the absorbance at 280 nm at 37°C
  - Monitoring the change in absorbance at 260 nm while elevating the temperature
103. Which of the following chemicals is added in the agarose gels during RNA electrophoresis?
- SDS
  - Formaldehyde
  - Bromophenol blue
  - Urea
104. PEP carboxylase is the main enzyme to fix CO<sub>2</sub> in
- C<sub>3</sub> plants
  - C<sub>4</sub> plants
  - CAM plants
  - Both C<sub>3</sub> and C<sub>4</sub> plants
105. Which of the following enzymes in prokaryotes has a function opposite to that of topoisomerase?
- Helicase
  - Gyrase
  - RNA polymerase
  - Recombinase
106. Who proposed chemiosmotic theory of ATP generation during oxidative phosphorylation?
- Peter Mitchell
  - Robert Emmerson
  - Albert Lehninger
  - James Summer
107. The eukaryotic RNA polymerase I, II and III have been so named based on
- Genes transcribed by them
  - Order of elution from a column
  - Order of their discovery
  - An arbitrary nomenclature



108. Prediction of conformation of a protein can be attempted from its
- Molecular weight
  - Amino acid sequence
  - Number of amino acids
  - Isoelectric pH
109. The term 'BLAST' is an abbreviation for
- Biological Linkage Analysis Statistical Tool
  - Basic Local Alignment Search Tool
  - Basic Localized Arrangement Tool
  - Best Local Arrangement of Sequence Tags
110. One dalton is equal to
- $10^{-9}$  gm
  - $3.32 \times 10^{-24}$  gm
  - $10^{-12}$  gm
  - $3.32 \times 10^{-12}$  gm
111. Starch is a polymer of glucose with linkages of
- $\alpha(1 \rightarrow 6)$  and  $\beta(1 \rightarrow 4)$
  - $\alpha(1 \rightarrow 4)$  and  $\beta(1 \rightarrow 6)$
  - $\alpha(1 \rightarrow 6)$  and  $\alpha(1 \rightarrow 4)$
  - $\beta(1 \rightarrow 4)$  and  $\beta(1 \rightarrow 6)$
112. A gene is 10 map units away from each of the two morphological markers flanking the gene on either side. In a test cross progeny, what is the probability that a segregant carrying the target gene cannot be correctly identified by the linked markers?
- 0.10
  - Zero
  - 0.001
  - 0.01
113. The half-life of  $^{32}\text{P}$  phosphate is approximately 14 days. 42 days after purchase of a batch of  $^{32}\text{P}$  the radioactivity present was 1.25 mCi. The radioactivity on the date of purchase would be
- 5 mCi
  - 0.625 mCi
  - 2.5 mCi
  - 10 mCi
114. The number of linkage groups found in an organism is equal to the number of chromosomes in its.
- Haploid
  - Diploid
  - Triploid
  - Tetraploid
115. If there are 10 DNA molecules at start, how many DNA molecules will be present after five cycles of replication?
- $10^5$
  - $10 \times 2^5$
  - $10 \times 5^2$
  - $2 \times 10^5$
116. Which of the following enzymes can introduce negative supercoiling?
- Helicase
  - Micrococcal DNase
  - DNA gyrase
  - Exonuclease III
117. Histamines are released from
- B-cells
  - T-cells
  - Mast cells
  - Phagocytes
118. 100  $\mu\text{l}$  of 100 mM stock of each dNTP was mixed to constitute a master stock. For a PCR reaction requiring 200  $\mu\text{M}$  of each dNTP in a 25  $\mu\text{l}$  reaction volume, how much of the master stock is required?
- 1  $\mu\text{l}$
  - 0.1  $\mu\text{l}$
  - 0.2  $\mu\text{l}$
  - 0.5  $\mu\text{l}$
119. Lysogeny of *E. coli* cells by  $\lambda$  phage is maintained by continuous expression of the following  $\lambda$  gene
- N gene
  - Cro gene
  - $C_i$  gene
  - gam genes
120. In an insertional cloning vector for identifying clones by immunological methods, a cDNA is inserted into *EcoRI* site of the vector, what is the probability that the ligation would lead to an in-frame fusion?
- 1/6
  - 1/2
  - 1/3
  - 1/4
121. If a virus particle contains double stranded DNA of 120,000 base pairs, how many phosphorus atoms would be present
- 120,000
  - 240,000
  - 360,000
  - 480,000
122.  $\beta$ -oxidation of fatty acid yields
- Glucose
  - Acetyl CoA
  - Glycerol
  - Triglyceride
123. To isolate plant DNA, EDTA is used for
- Chelating cesium chloride
  - Inhibiting nuclease activities
  - Removing ethidium bromide
  - Removing excessive NaCl

124. The relationship among linking number (Lk), Twist (Tw) and Writhe (Wr) for a DNA molecule can be represented as
- Lk + Tw = Wr
  - Lk + Wr = Tw
  - Tw + Wr = Lk
  - Tw - Wr = Lk
125. Which of the following functions is not shared between *E. coli* DNA polymerase I and DNA polymerase III?
- 5'-3' DNA synthesis
  - Proof-reading
  - 5'-3' exonuclease activity
  - 3'-5' exonuclease activity
126. What will be the maximum number of changes necessary to convert a seven nucleotide-long DNA sequence into a palindrome?
- 2
  - 3
  - 4
  - 5
127. Which of the following tests is not based on antibodies?
- Western blotting
  - ELISA-test
  - Northern blotting
  - Bt-strip assay
128.  $C_0t_{1/2}$  of DNA is defined as
- Time taken by the denatured DNA molecule to reanneal
  - Concentration of DNA in a cell at a particular time
  - Initial concentration of DNA multiplied by time taken for 50 per cent of DNA to reanneal
  - Concentration of cytosine bases in a single stranded DNA molecule
129. The two technical developments that led to the discovery of path of carbon during  $CO_2$  fixation in  $C_3$  cycle
- Autoradiography and gel electrophoresis
  - Autoradiography and paper chromatography
  - Ultra-centrifugation and autoradiography
  - X-ray crystallography and capillary electrophoresis
130. From the following recognition sequences of restriction enzymes, which one upon digestion of DNA is expected to produce the 3' recessed and 5' overhang termini
- G↓GATCC
  - GGGCC↓C
  - GGG↓CCC
  - CAGC↓TG
- Matching type questions (No. 131 to 140); all questions carry equal marks. Choose the correct answer (a, b, c, d or e) for each sub-question (i, ii, iii, iv and v) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.**
131. Match the name of the scientists with their discoveries
- |                                    |                                   |
|------------------------------------|-----------------------------------|
| i) Charles Yanofsky                | a) Colony hybridization           |
| ii) Grunstein and Hogness          | b) Hybridoma technology           |
| iii) Beadle and Tatum              | c) Attenuation                    |
| iv) Kohler and Milstein            | d) Restriction enzymes            |
| v) Warner Arber, Nathans and Smith | e) One Gene One Enzyme hypothesis |
132. Match the following antibiotics with their mode of action
- |                   |  |
|-------------------|--|
| i) Tetracycline   | a) Prevents release of EF-G-GDP from the ribosome                                |
| ii) Puromycin     | b) Inhibits amino-acyl tRNA binding to A site                                    |
| iii) Fusidic acid | c) Blocks exit of growing polypeptide chain from ribosome and assets translation |
| iv) Erythromycin  | d) Inhibits peptidyl transferase activity in eukaryotic cells                    |
| v) Cycloheximide  | e) Mimics the 3' end of aa-tRNA in A site and causes chain termination           |
133. Match the following types of lipids with their function in higher plants
- |                                 |  |
|---------------------------------|--|
| i) Glycerolipids, sphingolipids | a) Water proofing and surface protection                     |
| ii) Triacylglycerol, waxes      | b) Defense and antifeeding compounds                         |
| iii) Tocopherols                | c) Membrane structural components                            |
| iv) Cutin, suberin              | d) Protection of membranes against damage from free radicals |
| v) Essential oils               | e) Storage compounds   |
- 134.
- | Technique              | Application                        |
|------------------------|------------------------------------|
| i) Chromosome walking  | a) Secondary metabolite production |
| ii) Hairy root culture | b) Screening genomic libraries     |
| iii) Southern blotting | c) Map based cloning               |
| iv) 2D-electrophoresis | d) Gene transfer                   |
| v) Electroporation     | e) Proteomics                      |

135.

| <u>Transgenic organism</u> | <u>Application</u>                |
|----------------------------|-----------------------------------|
| i) Transgenic pig          | a) Rapeseed                       |
| ii) Golden rice            | b) Milk with therapeutic proteins |
| iii) Flavr Savr            | c) Organ transplantation          |
| iv) Transgenic cow         | d) Delayed ripening               |
| v) Barnase-barstar         | e) Vitamin A - rich               |

136.

|                           |                            |
|---------------------------|----------------------------|
| i) DNA methylation        | a) Insertional mutagenesis |
| ii) Reverse genetics      | b) Selection marker        |
| iii) BAC                  | c) Epigenetic mechanism    |
| iv) Antibiotic resistance | d) Gene knockout           |
| v) Ac-Ds system           | e) Positional cloning      |

137.

|              |               |
|--------------|---------------|
| i) Thiamine  | a) Hormone    |
| ii) Tyrosine | b) Base       |
| iii) Renin   | c) Protease   |
| iv) Thymine  | d) Vitamin    |
| v) Insulin   | e) Amino acid |

138.

|                   |  |
|-------------------|--|
| i) A.Z. Fire      | a) <i>Caenorhabditis elegans</i> development |
| ii) S. Brenner    | b) Recombination in bacteria                 |
| iii) J. Lederberg | c) Structure of globular proteins            |
| iv) H.G. Khorana  | d) RNA interference                          |
| v) M.F. Perutz    | e) t-RNA synthesis                           |

139.

|                 |                     |
|-----------------|---------------------|
| i) Gyrase       | a) Okazaki fragment |
| ii) dsDNA       | b) SSb              |
| iii) RNA primer | c) Anti-parallel    |
| iv) ssDNA       | d) dnaB             |
| v) Helicase     | e) Topoisomerase    |

140.

|                           |                    |
|---------------------------|--------------------|
| i) Pyruvate kinase        | a) Peroxisomes     |
| ii) Catalase              | b) Glyoxysomes     |
| iii) Pyruvate carboxylase | c) Antiporter      |
| iv) Malate synthase       | d) Glycolysis      |
| v) ATP-ADP translocase    | e) Gluconeogenesis |

Short questions (No. 141 to 146); each question carries FIVE marks. Write answers, including computation / mathematical calculations if any, in the space provided for each question on the question paper itself.

141. Given below is the Southern hybridization pattern obtained using DNA from leaves and flower buds of a plant after restriction digestion with HpaII or MspI. The probe used for hybridization is a cDNA clone. Interpret the results.

| HpaII |            | MspI   |            |
|-------|------------|--------|------------|
| Leaf  | Flower bud | Leaf   | Flower bud |
| 1     | 2          | 3      | 4          |
| ■     | —<br>—     | —<br>— | —<br>—     |

142. List the methods used for cloning a gene which is known only by its phenotype.

143. List atleast six possible modifications that can be carried out in a prokaryotic gene so that its expression in transgenic plant is enhanced.

144. List atleast six advantages of using plants as bioreactors for pharmaceutically relevant proteins.

145. How can one determine the copy number of a transgene in a transgenic plant?

146. Describe in brief the principle underlying 454 method of DNA sequencing.