



Post Graduate School
Indian Agricultural Research Institute, New Delhi
Examination for Admission to Ph.D. Programme 2013-2014

Discipline : Molecular Biology and Biotechnology

Discipline Code : 15

Roll No.

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Please Note:

- (i) This question paper contains **13** 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. Who is the present Chairman of Protection of Plant Varieties and Farmers' Right Authority (PPV&FRA)?
 - a) Dr. R.R. Hanchinal
 - b) Dr. P.L. Gautam
 - c) Dr. S. Nagarajan
 - d) Dr. Swapan K. Datta
2. Which among the following is another name for vitamin B₁₂?
 - a) Niacin
 - b) Pyridoxal phosphate
 - c) Cobalamin
 - d) Riboflavin
3. The largest share in India's farm export earning in the year 2011-12 was from
 - a) Basmati rice
 - b) Non-basmati rice
 - c) Sugar
 - d) Guar gum
4. The National Bureau of Agriculturally Important Insects was established by ICAR in _____, was earlier known as _____.
 - a) Bangalore; PDBC
 - b) New Delhi; National Pusa Collection
 - c) Ranchi; Indian Lac Research Institute
 - d) New Delhi; NCIPM
5. The most important sucking pests of cotton and rice are respectively
 - a) *Nilaparvata lugens* and *Aphis gossypii*
 - b) *Aphis gossypii* and *Thrips oryzae*
 - c) *Amrasca biguttula biguttula* and *Scirtothrips dorsalis*
 - d) *Thrips gossypii* and *Orseolia oryzae*
6. Which of the following microorganism causes fatal poisoning in canned fruits and vegetables?
 - a) *Aspergillus flavus*
 - b) *Penicillium digitatum*
 - c) *Clostridium botulinum*
 - d) *Rhizoctonia solani*
7. The cause of the great Bengal Famine was
 - a) Blast of rice
 - b) Brown spot of rice
 - c) Rust of wheat
 - d) Karnal bunt of wheat
8. Actinomycetes belong to
 - a) The fungi
 - b) Eukaryote
 - c) *Mycelia sterilia*
 - d) None of the above
9. A virus-free clone from a virus infected plant can be obtained by
 - a) Cotyledonary leaf culture
 - b) Axenic culture
 - c) Stem culture
 - d) Meristem tip culture
10. Which of the following is not an objective of the National Food Security Mission?
 - a) Sustainable increase in production of rice, wheat and pulses
 - b) Restoring soil fertility and productivity at individual farm level
 - c) Promoting use of bio-pesticides and organic fertilizers
 - d) Creation of employment opportunities

11. Agmarknet, a portal for the dissemination of agricultural marketing information, is a joint endeavour of
 - a) DMI and NIC
 - b) DMI and Ministry of Agriculture
 - c) NIC and Ministry of Agriculture
 - d) DMI and Directorate of Economics and Statistics
12. The share of agriculture and allied activities in India's GDP at constant prices in 2011-12 was
 - a) 14.1%
 - b) 14.7%
 - c) 15.6%
 - d) 17.0%
13. The average size of land holding in India according to Agricultural Census 2005-06 is
 - a) 0.38 ha
 - b) 1.23 ha
 - c) 1.49 ha
 - d) 1.70 ha
14. 'Farmers First' concept was proposed by
 - a) Paul Leagans
 - b) Neils Rolling
 - c) Robert Chamber
 - d) Indira Gandhi
15. In the year 2012, GM crops were cultivated in an area of
 - a) 150 million hectare in 18 countries
 - b) 170 million hectare in 28 countries
 - c) 200 million hectare in 18 countries
 - d) 1.70 million hectare in 28 countries
16. The broad-spectrum systematic herbicide glyphosate kills the weeds by inhibiting the biosynthesis of
 - a) Phenylalanine
 - b) Alanine
 - c) Glutamine
 - d) Cysteine
17. At harvest, the above ground straw (leaf, sheath and stem) weight and grain weight of paddy crop are 5.5 and 4.5 tonnes per hectare, respectively. What is the harvest index of paddy?
 - a) 45%
 - b) 50%
 - c) 55%
 - d) 100%
18. Crossing over between non-sister chromatids of homologous chromosomes takes place during
 - a) Leptotene
 - b) Pachytene
 - c) Diplotene
 - d) Zygotene
19. The term 'Heterosis' was coined by
 - a) G.H. Shull
 - b) W. Bateson
 - c) T.H. Morgan
 - d) E.M. East
20. When a transgenic plant is crossed with a non-transgenic, what would be the zygosity status of the F_1 plant?
 - a) Homozygous
 - b) Heterozygous
 - c) Hemizygous
 - d) Nullizygous
21. The highest per capita consumption of flowers in the world is in
 - a) The USA
 - b) India
 - c) Switzerland
 - d) The Netherlands
22. Which of the following is a very rich source of betalain pigment?
 - a) Radish
 - b) Beet root
 - c) Carrot
 - d) Red cabbage
23. Dog ridge is
 - a) Salt tolerant rootstocks of mango
 - b) Salt tolerant rootstocks of guava
 - c) Salt tolerant rootstocks of grape
 - d) Salt tolerant rootstocks of citrus
24. Which of the following micronutrients are most widely deficient in Indian soils?
 - a) Zinc and boron
 - b) Zinc and iron
 - c) Zinc and manganese
 - d) Zinc and copper
25. Which of the following fertilizers is not produced in India?
 - a) DAP
 - b) Urea
 - c) Muriate of potash
 - d) TSP
26. What is the estimated extent of salt affected soils in India?
 - a) 5.42 mha
 - b) 7.42 mha
 - c) 11.42 mha
 - d) 17.42 mha
27. Which of the following is not a feature of watershed?
 - a) Hydrological unit
 - b) Biophysical unit
 - c) Socio-economic unit
 - d) Production unit

28. Correlation coefficient 'r' lies between
 a) 0 and 1
 b) -1 and 1
 c) -1 and 0
 d) 0 and ∞
29. For the data 1, -2, 4, geometric mean is
 a) 2
 b) 4
 c) $-\frac{7}{3}$
 d) -2
30. The relationship between Arithmetic mean (A), Harmonic mean (H) and Geometric mean (G) is
 a) $G^2=AH$
 b) $G=\sqrt{A+H}$
 c) $H^2=GA$
 d) $A^2=GH$

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. Bacterial artificial chromosomes are plasmids designed for cloning DNA fragments of ____ size.
 a) 1-3 kb
 b) 100-300 kb
 c) 550-750 kb
 d) 750-900 kb
32. Genes possessing similar sequence and functional relationship within a single species are
 a) Orthologs
 b) Paralogs
 c) Pseudogenes
 d) Nested genes
33. Which of the following is a naturally totipotent cell?
 a) Ovule
 b) Zygote
 c) Egg cell
 d) Sperm cell
34. The chief source of nitrogen for green plants is
 a) Atmospheric nitrogen
 b) Ammonium salts
 c) Nitrate
 d) Low molecular weight-organic nitrogenous compound
35. A quantitative trait locus (QTL)
 a) Always carries a known gene which affects a polygenic trait
 b) Contains multiple genes, all controlling the same trait
 c) Contains a single unknown gene which affects a polygenic trait
 d) Contains at least one gene that is associated with a polygenic trait
36. The shortest of mitotic phases is the
 a) Telophase
 b) Anaphase
 c) Interphase
 d) Metaphase
37. pUC 19 is a
 a) Phage used as a vector
 b) Bacteria used for transformation
 c) DNA ligase
 d) A plasmid
38. What is the metal ligand in chlorophylls?
 a) Copper (Cu)
 b) Magnesium (Mg)
 c) Manganese (Mn)
 d) Iron (Fe)
39. Common outbreaks of food poisoning are due to
 a) *Clostridium nigrificans*
 b) *Salmonella typhimurium*
 c) *Pseudomonas fragi*
 d) *Aspergillus glaucus*
40. First effect of ionizing radiation on a cell is
 a) Formation of highly reactive ions
 b) Bonding between adjacent thymines
 c) Base substitutions
 d) Breaks in DNA molecule
41. Hfr cells
 a) Show high frequency of division
 b) Exhibit high frequency of recombination
 c) Show high frequency of transformation
 d) Show high frequency of conjugation
42. Salivary gland chromosome is an example of
 a) β -chromosome
 b) Polytene chromosome
 c) Lampbrush chromosome
 d) Acentric chromosome
43. Penicillin destroys bacteria by inhibiting
 a) Protein synthesis
 b) DNA replication
 c) Cell wall formation
 d) RNA synthesis

44. Functions of ER are
- Protein synthesis
 - Lipid synthesis
 - Glycogen synthesis
 - Cholesterol synthesis
 - ATP synthesis
 - Detoxification
- ii, iii, iv, v
 - iii, iv, v, vi
 - i, ii, iv, v
 - i, ii, iii, iv, vi
45. Amino acids with longest side chains are
- Arginine and Lysine
 - Lysine and Leucine
 - Asparagine and Glycine
 - Arginine and Glycine
46. Role of Topoisomerase is to
- Initiate transcription
 - Initiate translation
 - Induce negative supercoiling
 - Induce positive supercoiling
47. Most common mode of reproduction in bacteria is
- Sexual reproduction
 - Budding
 - Binary fusion
 - Binary fission
48. The delayed ripening tomato Flavr Savr was created by gene
- Conversion
 - Replacement
 - Silencing
 - Mutation
49. Which of the following organelles is not present in prokaryotes?
- DNA
 - Chromosomes
 - Ribosomes
 - Endoplasmic reticulum
50. 'Mad cow' disease is caused by
- Virus
 - Bacterium
 - Misfolded protein - prion
 - Mycoplasma
51. Which of the following represents an example of epigenetics?
- Deletion of a DNA fragment
 - SNP
 - Altered methylation pattern of DNA
 - Transposition
52. Deamination of adenine results in the formation of
- Uracil
 - Cytosine
 - Hypoxanthine
 - Guanine
53. In secondary metabolism two distinct phases-trophophase and idiophase refer respectively to
- Growth and production phase
 - Early and late phase
 - Primary and secondary metabolism
 - Lag phase and log phase
54. Abzymes are
- Enzymes that are highly specific like antibodies
 - Antibodies that have catalytic activities
 - Also referred to as zymogens
 - Enzymes which hydrolyze antibodies
55. *Escherichia coli* utilizes glucose first, even if other sugars are present, through a mechanism called
- Operon repression
 - Enzyme repression
 - Catabolite repression
 - Glucose utilization
56. In *E. coli*, which of the following repair systems is not error-prone?
- Photoactivation
 - Excision repair
 - Recombinational repair
 - SOS repair
57. Which of the following combination of statements are correct?
- Allosteric enzymes need not necessarily obey Michaelis-Menten kinetics
 - Some regulatory enzymes are modulated by reversible covalent modification
 - Allosteric enzymes undergo reversible covalent modification
 - Phosphorylation of regulatory enzymes is most common type of reversible covalent modification
- P and Q
 - P, Q and R
 - P, Q and S
 - P, Q, R and S
58. Three of the four eukaryotic rRNAs are synthesized from a single transcription unit consisting of rDNA. Which one of the following does not belong to this group?
- 5 S
 - 5.8 S
 - 18 S
 - 28 S

59. There are five classes of antibodies (IgM, IgD, IgG, IgE, IgA). What determines the class to which an antibody belongs?
- Structure of the light chain
 - Variable region of the antibody
 - Structure of the heavy chain constant region
 - Stage of the infection
60. In an immunoglobulin molecule, the region determining complementarity is present in
- Variable domain of heavy chain
 - Variable domain of light chain
 - Variable domain of heavy and light chains
 - Variable and constant domains of heavy chain
61. Most CO₂ from catabolism of glucose is released during
- Glycolysis
 - Krebs cycle
 - Lactate fermentation
 - Oxidative phosphorylation
62. Two restriction enzymes A and B have eight and four base pairs as their recognition sites, respectively. The ratio of the number of fragments that they will generate on restriction digestion of a genomic DNA of *E. coli* is approximately
- 1:64
 - 1:256
 - 4:8
 - 8:4
63. In the Meselson and Stahl experiment, *E. coli* cells grown on heavy nitrogen were transferred to light nitrogen. What % of DNA can be expected to be constituted of light nitrogen after 3 generations of multiplication?
- 25
 - 50
 - 75
 - 100
64. Which of the following properties is not associated with DNA polymerase I?
- 5'→3' exonuclease activity
 - 3'→5' exonuclease activity
 - 5'→3' endonuclease activity
 - 3'→5' endonuclease activity
65. Action of topoisomerase leads to change in
- Linking number of single-stranded linear DNA
 - Linking number of double-stranded linear DNA
 - Linking number of closed circular single-stranded DNA
 - Linking number of closed circular double-stranded DNA
66. Which of the following features of transcription is similar to that of replication?
- No primer is required for polymerization
 - Polymerization does not have proof reading activity
 - Newly synthesized strand starts falling off the template before complete RNA is synthesized
 - RNA synthesis requires DNA topoisomerase action
67. What will be the proportion of Resistant (R) to susceptible (S) plants in the progeny of a T₀ tobacco plant carrying kanamycin resistance gene when selfed and when crossed with an untransformed plant separately?
- 1:1 and 3:1
 - 1:1 and 1:3
 - 3:1 and 1:3
 - 3:1 and 1:1
68. The DNase footprinting assay can be used to
- Map the position of nucleosomes in chromatin
 - Determine the level of expression of a specific transcript
 - Determine the DNA-binding site for a transcription factor
 - Map the ends of a transcript
69. Induction of β-galactosidase activity by IPTG is the result of
- Simulation of lac repressor function
 - IPTG binding to lac operon and inducing transcription
 - IPTG binding to lac I gene product and inhibiting its activity
 - Inhibition of β-galactosidase degradation
70. A linear DNA is 100% labeled at one end and has 3 restriction sites for *EcoRI*. If it is partially digested by *EcoRI* so that all possible fragments are produced, how many of these fragments will be labeled and how many will not be labeled?
- 4 labeled; 6 unlabeled
 - 4 labeled; 4 unlabeled
 - 3 labeled; 5 unlabeled
 - 3 labeled; 3 unlabeled
71. What clones would a eukaryotic cDNA library contain?
- Clones that represent every fragment of a DNA in approximately equal frequencies
 - Clones that represent one copy of every coding region
 - Clone representing transcribed DNA in approximately equal frequencies
 - Clones representing transcribed DNA in frequencies that reflect their level of expression

72. The two photosystems I and II during non-cyclic photophosphorylation act in
- Parallel
 - Series only
 - Parallel and series only
 - Parallel and series alternatively
73. The mechanism of ATP formation both in chloroplast and mitochondria is explained by
- Relay pump theory of Godlewski
 - Cholodny Went's model
 - Chemiosmotic theory
 - Munch's pressure/mass flow model
74. In photorespiration, glycolate and glyoxylate are produced sequentially in the following organelles. Choose the correct sequence.
- Chloroplast and mitochondria
 - Chloroplast and peroxisome
 - Peroxisome and mitochondria
 - Peroxisome and chloroplast
75. Consider three polypeptides of 15 residues each. They adopt distinct conformations corresponding to right handed α -helical structure and single strand of a β -sheet structure. Considering the shortest distance between the first and the last residues as the length of the structure, which one of the following statements is true?
- Right handed α -helical structure is longest
 - Left handed α -helical structure is longest
 - β -strand structure is longest
 - All the three polypeptides have identical length
76. Melting temperature of DNA is the temperature at which
- DNA melts completely
 - 30% of the DNA is denatured
 - 50% of the DNA is denatured
 - 80% of the DNA is denatured
77. The stability of DNA to alkaline hydrolysis relative to RNA, is due to
- The greater stability of ribose over deoxyribose
 - DNA having β -glycosidic bonds and RNA having α -glycosidic bonds
 - DNA being more insoluble in water than RNA
 - The absence of 2'-hydroxyl to assist in the hydrolysis
78. Streaming of protoplasm is absent in
- Parenchyma and collenchyma cells
 - Bacterial cells and vessels
 - Cells of higher plants
 - Cells of hydrilla
79. Somatic embryo from cotyledon explant would develop in which of the following sequential stages?
- Cotyledonary \rightarrow heart \rightarrow globular \rightarrow torpedo
 - Globular \rightarrow torpedo \rightarrow heart \rightarrow cotyledonary
 - Globular \rightarrow heart \rightarrow torpedo \rightarrow cotyledonary
 - Cotyledonary \rightarrow globular \rightarrow heart \rightarrow torpedo
80. The DNA transfer is specific for the DNA left of the RB (the T-DNA), rather than for the DNA left of the LB because
- The sequence context at the RB defines the direction of transfer
 - The sequence context at the LB defines the direction of transfer
 - The sequence present within the T-DNA region
 - The endonuclease activity of VirD2 protein allows nicking at RB
81. Consider two linked loci, labeled A and B. Each locus has two alleles, labeled 1 and 2. The frequencies of the alleles in a population are : $A_1=0.6$, $A_2=0.4$, $B_1=0.7$, $B_2=0.3$. If there is linkage equilibrium between these two loci in the population, what is the expected frequency of chromosomes carrying a combination of the A_1 and B_2 alleles?
- 0.12
 - 0.18
 - 0.24
 - 1.0
82. In prokaryotes, the synthesis and breakdown of mRNA occurs from
- 5' to 3' end
 - 5' to 3' and 3' to 5' end, respectively
 - 3' to 5' end
 - 3' to 5' and 5' to 3' end, respectively
83. The number of introns in a c-DNA consisting of 5 exons will be
- 6
 - 5
 - 4
 - 0
84. The DNA content of a diploid cell in G1 stage is x. After meiosis I, the DNA content of the daughter cells produced will be
- x
 - 2x
 - x/2
 - x/4
85. Which among the following statements is absurd?
- L-proline is optically active
 - D-alanine is optically active
 - L-glycine is optically active
 - Racemic mixture of histidine is optically inactive

86. Which of the following statements about C₃ and C₄ plants is incorrect?
- CO₂ is finally fixed by Rubisco in both types
 - C₄ plants do not fix CO₂ but release oxygen at night
 - C₃ plants fix CO₂ and release oxygen in presence of light
 - CO₂ fixation is more efficient in C₄ plants
87. In a bacterial cell, a mutation in an aminoacyl-tRNA synthetase leads to charging of the entire tRNA^{Ser} population with alanine. Which of the following describes the result of using these aminoacyl-tRNAs for protein syntheses in the cell?
- The alanyl-tRNA^{Ser} will not function in protein synthesis
 - Proteins synthesized using alanyl-tRNA^{Ser} will contain neither alanine nor serine
 - Proteins synthesized using alanyl-tRNA^{Ser} will contain only serine where alanine would normally occur
 - Proteins synthesized using alanyl-tRNA^{Ser} will contain alanine where serine would normally occur
88. Molar absorption coefficient of NADH at 340 nm is 6220 per mole per litre per cm whereas that of NAD at 340 nm is zero. What absorbance will be observed when light at 340 nm passes through a 1 cm cuvette containing 10 μM NADH and 10 μM NAD?
- 0.031
 - 0.062
 - 0.124
 - 0.62
89. The resistance of the peptidoglycons to proteases can be attributed to
- L-amino acids
 - D-amino acids
 - β(1→4) linkage between N-acetylglucosamine and N-acetylmuramic acid
 - Isopeptide bonds between the amino acids
90. The 3'-terminal trinucleotide "CCA" of an eukaryotic t-RNA precursor is
- Added during processing
 - Present in the primary transcript
 - Added by the enzyme t-RNA nucleotidyl transferase
 - Created without being dependent on a DNA or RNA template
91. Klenow fragment generated by proteolytic cleavage of DNA polymerase I has
- Both polymerase as well as 3'-5' exonuclease activities
 - Only polymerase activity
 - Both 3'-5' exonuclease as well as 5'-3' exonuclease activities
 - Both polymerase as well as 5'-3' exonuclease activities
92. Type-I topoisomerase catalyse the relaxation of
- vely super coiled DNA by increasing the DNA's linking number
 - +vely super coiled DNA by decreasing the DNA's linking number
 - +vely super coiled DNA by increasing the DNA's linkage number
 - vely super coiled DNA by decreasing the DNA's linkage number
93. Which of the following statements about ABC model of flower development in plants is correct?
- Activity of both A and B specifies sepals
 - Activity of both A and B are required for the formation of petals
 - Activity of B and C are required for stomata
 - Activity of C alone specifies carpals
94. In case of 'P element dysgenesis' in *Drosophila*, sterile phenotype would be obtained in
- P female × P male
 - M female × P male
 - M female × M male
 - Progeny of (a) × P male
95. In a biosynthetic pathway within a cell, the substrate and product are generally in
- Equilibrium
 - Steady state
 - Intermediate state
 - None of the above
96. Most common form of chemical modification involving an estimated 80% of all proteins is
- Glucosylation
 - Acetylation
 - Phosphorylation
 - Methylation
97. Characteristic of a protein to bind one molecule in preference to other molecules is known as
- Affinity
 - Selectivity
 - Sensitivity
 - Specificity

98. Molecular basis of disease sickle-cell anemia provides evidence in support of
- One gene-one enzyme hypothesis
 - One gene-many enzyme hypothesis
 - One gene-one polypeptide hypothesis
 - One gene-many polypeptide hypothesis
99. The central ion in the process of signal transduction is
- Magnesium
 - Manganese
 - Calcium
 - Zinc
100. Which amino acid is unable to form a proper peptide bond?
- Valine
 - Serine
 - Proline
 - Arginine
101. In a nucleic acid molecule, carbon atoms of the deoxyribose which bear a phosphate, a hydroxyl group, and a base, are
- 1', phosphate; 2', OH; 5', base
 - 1', base; 3', OH; 5', phosphate
 - 2', base; 4', OH; 6', phosphate
 - 2', phosphate; 4', OH; 6', base
102. Which of the property is essential for the functioning of an aminoacyl synthetase?
- Recognition of a codon
 - Recognition of the anticodon of a tRNA molecule
 - Recognition of the amino acid loop of a tRNA molecule
 - Ability to distinguish ribosome subunits
103. β -glucuronidase (GUS) is a screenable marker derived from
- E. coli*
 - Fungi
 - Yeast
 - Plants
104. Which of the following is not surrounded by a double membrane in eukaryotes?
- The cell
 - The nucleus
 - Mitochondria
 - Chloroplasts
105. A gene present in only one copy in a genome which usually is diploid is described as
- Haploid
 - Homozygous
 - Hemizygous
 - Homologous
106. The DNA strand that bears the same sequence as the mRNA is called the
- Coding strand
 - Non-coding strand
 - Template DNA
 - Complimentary strand
107. Citrate synthase, an enzyme of TCA cycle belongs to class
- Ligase
 - Isomerase
 - Lyase
 - Hydrolase
108. Immunoglobulins are
- Stimulated by haptens
 - Nucleoproteins
 - Glycoproteins
 - Lipoproteins
109. The half-life of ^{32}P phosphate is approximately 14 days. 42 days after purchase of a batch of ^{32}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
110. Which of the following is a heteropolysaccharide?
- Starch
 - Cellulose
 - Hyaluronic acid
 - Urogluconic acid
111. Generalized transducing particles are formed during
- Lysis
 - Lysogeny
 - Prophage formation
 - Phage infection
112. Portion of molecule responsible for antigenic function is known as
- Antigen
 - Immunogen
 - Adjuvant
 - Epitope
113. Resistance to the herbicide atrazine is shown to be associated with
- Mitochondria
 - Ribosomes
 - Chloroplasts
 - Endoplasmic reticulum

114. In hybrid arrested translation method, identification of recombinant clone is done on the basis of
- Presence of RNA sequences
 - Presence of DNA sequences
 - Absence of RNA sequences
 - Absence of polypeptide
115. Which of the following enzymes can introduce negative supercoiling?
- Helicase
 - Micrococcal DNase
 - DNA gyrase
 - Exonuclease III
116. How many sites are present in a ribosome for binding to tRNA?
- One
 - Two
 - Three
 - Four
117. How many types of tRNA present in the chloroplasts?
- 1
 - 3
 - 5
 - ≥ 20
118. An antibody that is an image of the antigen is termed as
- Monoclonal antibody
 - Polyclonal antibody
 - Single chain antibody
 - Anti-ideotypic antibody
119. Which of the following antibiotics inhibits transcription?
- Streptomycin
 - Mitomycin
 - Rifampicin
 - Puromycin
120. The herbicide atrazine inhibits
- Photosystem I
 - Photosystem II
 - Amino acid biosynthesis
 - Glutathione transferase
121. Which of the following processes in protein synthesis requires hydrolysis of GTP?
- Initiation
 - Elongation
 - Termination
 - Polyadenylation
122. Homopolymer tailing of cDNA can be achieved with
- Ligase
 - Reverse transcriptase
 - Terminal deoxynucleotidyl transferase
 - Klenow fragment
123. Puromycin acts by binding to
- 'A' site on the ribosomes
 - 'P' site on the ribosomes
 - rho factor
 - sigma factor
124. Gene responsible for the synthesis of repressor protein in λ -phage is
- P gene
 - N gene
 - Cio gene
 - CI gene
125. Leg-hemoglobin is a/an
- Hemoglobin substitute
 - Red coloured protein of a ripe fruit
 - Member of a group of protein called nodulin
 - A hemoglobin in insect legs
126. Eukaryotic synthesis on the leading strand is accomplished by DNA polymerases
- ϵ and α
 - α and δ
 - δ and ϵ
 - γ and α
127. A gene is said to be annotated if it is
- Cloned
 - Tagged with a molecular marker
 - Sequenced and at least partially characterized
 - Experimentally demonstrated to code for a protein extensively employed in plant breeding
128. Which of the following is not true for a candidate gene?
- Shows association with the trait
 - Located on both the flanking markers linked to the trait
 - Shows high expression in all tissues
 - May not show Mendelian inheritance
129. A high LOD score value indicates that
- The two genes are linked
 - The two genes are duplicates
 - The two genes are involved in the same pathway
 - The two genes are antagonistic
130. Nod factors are
- Proteins produced by rhizobium in the nodules
 - Proteins produced by the plants in the nodules
 - Lipopolysaccharide molecular produced by the rhizobium
 - Lipopolysaccharide molecular produced by the plants

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.

- | | |
|-------------------------------------|---|
| i) Isocitrate lyase | a) Conversion of amino acids into glucose |
| ii) PEP carboxylase | b) Biotin |
| iii) Pyruvate dehydrogenase complex | c) Synthesis of glucose from acetate |
| iv) Phosphofructokinase | d) Lipoic acid |
| v) Pyruvate carboxylase | e) An allosteric enzyme |

132.

- | | |
|------------------------------|--|
| i) Transformation | a) Cell to cell contact required |
| ii) Generalized transduction | b) Occurs during the lysogenic cycle of temperate phage |
| iii) Conjugation | c) Naked DNA transferred |
| iv) Specialized transduction | d) Conjugation between different Hfr and F ⁻ strains |
| v) Gene mapping | e) Occurs during the lytic cycle of virulent and temperate phage |

133.

- | | |
|---|--|
| i) Homologous recombination | a) Spread of antibiotic resistance |
| ii) Non-homologous end joining | b) Expansion or contraction of repeat motifs |
| iii) Unequal crossing over and replication slippage | c) Chloroplast transformation |
| iv) Horizontal gene flow | d) Nuclear transformation |
| v) Transformation | e) Transgene escape |

134.

- | | |
|----------|---------------------------|
| i) RAPD | a) Metaphor (3-4%) |
| ii) RFLP | b) Agarose (1.2%) |
| iii) SSR | c) Denaturing PAGE (6-8%) |
| iv) AFLP | d) Denaturing HPLC (6-8%) |
| v) SNP | e) Agarose (0.8%) |

135.

- | | |
|--|--|
| i) Andrew Z. Fire and Craig C. Mello | a) Nobel prize for Ubiquitin-mediated protein degradation |
| ii) Max Perutz | b) Nobel prize for studies on ribosome |
| iii) Venkatraman Ramakrishnan | c) Nobel prize for discovery of RNA interference |
| iv) E.H. Fischer and E.G. Krebs | d) Nobel prize for 3-D structure of hemoglobin |
| v) Aaron Ciechanover, Avram Hershko and Irwin Rose | e) Nobel prize for discovery of irreversible protein phosphorylation as a regulatory mechanism |

136.

- | | |
|-----------------------------|-----------------------------|
| i) Z-DNA | a) Transcription initiation |
| ii) T-DNA | b) Chromatin structure |
| iii) Solenoid | c) Left handed helix |
| iv) Shine-Delgarno sequence | d) Opine synthesis |
| v) Pribnow-box | e) mRNA binding to ribosome |

137.

- | | |
|--------------------|----------------------------------|
| i) Chloramphenicol | a) Bacterial cell wall |
| ii) Ampicillin | b) Initiation of transcription |
| iii) Streptomycin | c) DNA synthesis |
| iv) Rifampicin | d) Peptidyl transferase |
| v) Mitomycin D | e) Protein synthesis of bacteria |

138.

- | <u>Biochemical reactions</u> | <u>Parts of the cell</u> |
|--|--------------------------|
| i) Photolysis of water | a) Chloroplast |
| ii) Glycolysis | b) Mitochondria |
| iii) Polyadenylation of mRNA | c) Golgi bodies |
| iv) Glycosylation of proteins | d) Endoplasmic reticulum |
| v) Disulphide bond formation in storage proteins | e) Nucleus |

139.

- | | |
|-----------------------------|-------------------------------------|
| i) Alkaline phosphatase | a) cDNA synthesis |
| ii) S ₁ nuclease | b) Protein sequencing |
| iii) Reverse transcriptase | c) End labeling |
| iv) Protease | d) Preventing self ligation |
| v) Polynucleotide kinase | e) Transcription start site mapping |

140.

- | | |
|------------------------------|------------------------------|
| i) Isolation of organelle | a) Centrifugation |
| ii) Isolation of plasmid DNA | b) Gel filtration |
| iii) Isolation of proteins | c) HPLC |
| iv) Isolation of Vitamin E | d) Solvent extraction |
| v) Isolation of lipids | e) Adsorption chromatography |

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. Two amphidiploid interspecific hybrids involving species A and B have been generated. One of the hybrids is of sexual origin (i.e. $A \times B$) whereas the other one is obtained through protoplast fusion. Unfortunately, their labels are missing. Could the true identities of the hybrids be established? If yes, explain how? If not, explain why not?
142. A gene encoding an important protein of economic value has been isolated. It is proposed to mass produce this protein in yeast and obtain pure protein. However, there is no information on its immunological properties or biological activity. Describe in clear steps, how will you proceed to obtain pure form of this protein?

143. A transgenic female papaya plant is produced via Agrobacterium-mediated transformation. The T-DNA insertion site and flanking plant sequence information has been determined and the plant is hemizygous and single copy for the transgene. Will it be possible to obtain a female homozygous transgenic plant? Explain your response with suitable justification.

144. In glycolysis there are two reactions that require one ATP each and two reactions that produce one ATP each. This being the case, how can glycolysis of glucose to lactate lead to the net production of two ATP molecules per glucose?

145. Briefly describe the experimental strategy that was used to demonstrate for the first time that a bacterial chromosome is circular.

146. Briefly describe, what do you understand by the following:

- a) Haplotype
- b) Doubled haploid and polyhaploid
- c) Iso-schizomers
- d) Plantibodies
- e) Paired-end sequencing