ENTRANCE EXAMINATION, 2015
Ph.D. Biotechnology

Time: 2 hours

Maximum Marks: 75

HALL TICKET NO. ________________________

INSTRUCTIONS

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE ANSWERING:

1. Enter your hall ticket number on this sheet and the answer (OMR) sheet.

2. Answers are to be marked only on the OMR answer sheet with BLACK/BLUE ball point/Sketch pen following the instructions provided there upon.

3. Hand over OMR answer sheet at the end of examination.

4. All questions carry one mark each.

5. 0.33 mark will be deducted for every wrong answer.

6. There are total 13 pages (including this page) in this question paper. Check this before you start answering.

7. The question paper consists of Part “A” and Part “B”. The marks obtained in Part “A” will be taken into consideration in case of a tie, when more than one student gets equal marks, to prepare the merit list.

8. Non-programmable scientific calculators are permitted.

9. Cell/Mobile phones are strictly prohibited in the examination hall.
Part A

1. Tesla is the unit of:
   A) Magnetic flux density
   B) Resonance
   C) Photon flux
   D) Mass charge

2. If two linear single stranded DNA molecules are heated to 368 K followed by cooling to 278 K, the product formed is
   A) Double stranded DNA with blunt ends
   B) Double stranded DNA with overhangs
   C) Single stranded circular DNA
   D) Linear single stranded DNA

3. A fires 7 shots to B's 5, but A kills only once in 4 shots while B kills once in 2 shots. When B has missed 20 times, A has killed:
   A) 90 birds
   B) 14 birds
   C) 25 birds
   D) 20 birds

4. The calculated bond order in O$_2^-$ ion is
   A) 1.0
   B) 1.5
   C) 2
   D) 2.5

5. Protein A and B have similar migration on native page; while Protein A shows two times higher molecular weight than protein B on SDS PAGE, which of the following is true:
   A) A and B are monomeric
   B) A and B are dimeric
   C) A is monomeric and B is dimeric
   D) A is dimeric and B is monomeric

6. LED - television works on the following principle
   A) Luminescence
   B) Phosphorescence
   C) Electro Luminescence
   D) Fluorescence
7. The reaction of 2-chloropyridine with sodium ethoxide is
   A) Elimination followed by addition
   B) Electrophilic aromatic substitution
   C) Addition followed by substitution
   D) Nucleophilic aromatic substitution

8. When it is 8.30 A.M. on Wednesday of Greenwich, then:
   A) It is 10.30 P.M. on Wednesday at New Delhi
   B) It is 6.15 A.M. on Tuesday at New York
   C) It is 3.30 P.M. on Wednesday at Sydney
   D) It is 5.30 P.M. on Wednesday at Tokyo

9. Example of fermions are
   A) Electron and proton
   B) Photon and proton
   C) Electron and proton
   D) Photon

10. What is the number of triangles in the given figure?

   ![](triangle.png)
   A) 12
   B) 20
   C) 8
   D) 14

11. Which of the following is the least dense metals?
   A) Mercury
   B) Lithium
   C) Germanium
   D) Platinum

12. Which of the following are the ingredients of gun metal?
   A) Iron, zinc and sodium
   B) Iron, copper and brass
   C) Copper and Tin
   D) Aluminum and Uranium

13. The minimum calculated distance of Mars from Earth is:
   A) 54.6 Million Km
   B) 401 Million Km
   C) 225 Million Km
D) 95.5 Million Km

14. Which statement is incorrect about the Z-DNA form:
   A) It entails a left handed double helix winding to the left in a zig-zag pattern
   B) The major and minor grooves show little difference in width
   C) Certain conditions such as high salt and negative supercoiling induce it
   D) Once induced, it usually persists longer and remains stable

15. The difference between the molecular weight of sucrose and that of the sum of the molecular weights of its components (glucose and fructose) is:
   A) 0
   B) 2
   C) 18
   D) 16

16. Different isotopes of an element are physically separated by the process of:
   A) Ultracentrifugation
   B) Filtration
   C) Evaporation
   D) Distillation

17. Proteogenomics is an approach of identification of proteins and peptides wherein:
   A) Mass spectrometry based data are used for identification of novel peptides
   B) Novel peptides are mined from customized genomic and transcriptomic databases
   C) Mass spectrometry data are searched and compared against genomic and transcriptomics databases for the identification of novel peptides
   D) Novel peptides are identified at the interface of proteomics and genomics approaches

18. The following is a potent alkylating mutagen that is used as a tool in genetic screens:
   A) Nitrosoamine
   B) N-methyl formamide
   C) Acridine orange
   D) Nitroso-ethyl urea

19. Internal ribosome entry site (IRES) elements are present in the genome of
   A) Rabies virus
   B) Smallpox virus
   C) Vaccinia virus
   D) Poliovirus

20. The following are the reservoirs/vectors for Ebola and Marburg viruses:
   A) Fruit Bats
   B) Mosquitoes
   C) Rodents
   D) Migratory Birds
21. Mate pair information is not retained in this sequencing technique:
   A) Solexa sequencing
   B) Sanger sequencing
   C) 454 sequencing
   D) SoLiD sequencing

22. There are 3 non-graduated gallons A B C:
   Gallon A having max capacity of 7 litres is currently filled with 4 litres of water
   Gallon B having max capacity of 5 litres is currently filled with 3 litres of water
   Gallon C having max capacity of 3 litres is currently filled with 2 litres of water
   How can you measure 1 liter of water in minimum number of steps?
   A) Pour 1 litre of water from gallon A to gallon C
   B) Pour water from gallon C to completely fill gallon B and leftover is one litre water
   C) Step A followed by step B
   D) Pour exactly 1 litre water from gallon C to gallon A

23. \((+) + (+) + (+) + (+) = 30\). This is what you have for an equation. The following are the numbers that you can use to fill in the brackets, if required with the use of a (-) sign: 1, 3, 5, 7, 9, 11, 13 & 15. Your correctly filled brackets should be:
   A) \((15 - 9) + (13 - 7) + (7 - 1) + (9 - 1) + (13 - 9)\)
   B) \((11 - 5) + (15 - 11) + (5 - 1) + (15 - 1) + (3 - 1)\)
   C) \((7 - 5) + (13 - 1) + (9 - 1) + (1) + (3 - 1)\)
   D) A or B

24. What function the transformer performs at a power station?
   A) regulates heating of electric lines by stepping up the voltage
   B) decreases heating of electric lines by stepping up the current
   C) increases heating of electric lines by stepping up the voltage
   D) decreases heating of electric lines by stepping down the voltage

25. The following type of chart is used to display the work breakdown structure of a project:
   A) Doughnut chart
   B) Gantt chart
   C) Bubble chart
   D) Radar chart

Part B

26. Which of the following programs does not take PDB file as an input:
   A) RasMol
B) Chime  
C) BLAST  
D) PyMol

27. Beta-amyloid Plaques are associated with  
A) Huntington disease  
B) Alzheimer's disease  
C) ALS  
D) Parkinson's disease

28. The development of pollen in tapetum cells is prevented by the expression of an enzyme from *Bacillus amyloliquefaciens*  
A) Hexokinase  
B) ATPase  
C) Cytochrome oxidase  
D) Ribonuclease

29. You are studying DNA replication in an *E. coli* mutant, which has a partially defective DNA polymerase. In vitro experiments using the mutant DNA polymerase gives an error rate of $10^{-3}$, as compared to the expected error rate of $10^{-6}$. Which of the following activities is the mutant polymerase likely to be missing, as compared to the normal polymerase  
A) 5'-3' exonuclease  
B) 3'-5' exonuclease  
C) 3'-5' recombinase  
D) 5'-3' polymerase

30. Biodegradable nanoparticles have following features  
A) Kill cells  
B) Escape from immune system  
C) Accumulate in the Gut  
D) Unstable

31. Which of the following genetic elements insert at tRNA genes in their host chromosome  
A) Genomic islands  
B) IS elements  
C) Plasmids  
D) Prophages

32. Which of the following is the most common and stable confirmation for a polypeptide chain  
A) Alpha helix  
B) Beta pleated sheets  
C) Anti-parallel beta pleated sheets  
D) Tertiary structure
33. Which of the following statements is/are true regarding the distribution of ions during the resting membrane potential of a neuron
   a) K+ is more concentrated inside the cell
   b) Na+ is more concentrated inside the cell
   c) Ca+2 is concentrated more outside the cell
   d) Na+ is concentrated more outside the cell
   
   A) Only (a) and (b) are true
   B) Only (a), (c), and (d) are true
   C) Only (c) and (d) are true
   D) Only (b) and (c) are true

34. Inactivation of a gene that codes for a repressor protein which is involved in regulation of genes X, Y and Z leads to
   A) Inhibition of X, Y and Z transcription
   B) Constitutive expression of X, Y and Z genes
   C) Rapid degradation of X, Y and Z mRNA
   D) Disappearance of X, Y and Z proteins

35. Structures that have the same evolutionary origin although they may have different structures or functions are said to be
   A) alogous
   B) analogous
   C) homologous
   D) Non-homologous

36. In a mixture of proteins listed below, which should elute second in size-exclusion chromatography
   A) cytochrome c Mr = 13,000
   B) immunoglobulin G Mr = 145,000
   C) ribonuclease A Mr = 13,700
   D) RNA polymerase Mr = 450,000

37. Programmed cell death or apoptosis is
   A) a genetically coded and regulated process
   B) not associated with ischemia
   C) inflammatory response
   D) a result of multiple random events

38. The bacterial effector protein that induces hummingbird phenotype in cultured epithelial cells
   A) Botulinum toxin
   B) CagA
   C) Staphylococcal protein A
   D) LPS
39. Sickle cell anemia is a disease resulting from missense mutation. What amino acid is substituted at the original glutamic acid? This mutation affects which protein chain in the hemoglobin
A) Valine; beta hemoglobin
B) Valine; alpha hemoglobin
C) Methionine; alpha hemoglobin
D) Cysteine; beta hemoglobin

40. Which of the following is NOT a feature of a typical bacterial operon?
A) The genes are translated into a single polypeptide
B) The genes in the operon are transcribed into a single mRNA molecule
C) The genes frequently encode proteins that are involved in a single biochemical pathway
D) The genes are under the control of a single promoter

41. Which of the following amino acids will be the site of enzyme modification by phosphorylation?
A) Arginine
B) Cysteine
C) Phenylalanine
D) Serine

42. Ebola virus genome is
A) +ve ssRNA
B) -ve ss RNA
C) ds RNA
D) ss DNA

43. Which of the following drug inhibits DNA replication
A) Rifampicin
B) Puromycin
C) Oligomycin
D) 5-Fluorouracil

44. Which of the following is a mobile electron carrier protein in the photosynthetic electron transport
A) Plastoquinone
B) Plastocyanin
C) Phycocyanin
D) D1 protein

45. The following gene/locus when deleted from the X or Y-chromosome can lead to misidentification of gender in forensic or prenatal analysis
A) a Holandric gene
B) Amelogenin
C) SRY gene
52. A famous biological sample repository based in the US is
A) ATCC
B) NCBI
C) NTTC
D) NIST

53. Thin layer chromatography can be used to distinguish between different amino acids. If a particular amino acid has low solubility in the mobile phase used, then the amino acid
A) will have a low Rf value
B) will spend more time dissolved in the mobile phase than attached to the stationary phase
C) must have a high molecular mass
D) will move at a speed close to that of the solvent

54. Calcium channels in Endoplasmic reticulum of plants and animals are controlled by
A) cAMP
B) Inositol 1,4,5-triphosphate
C) cGMP
D) G-Proteins

55. In isoelectric-focusing the following substances are used to give a pH gradient
A) Veronal
B) Tris
C) Polyaminopolycarboxylic acids
D) Phosphate buffer

56. Graft and tumor rejection are mediated primarily by
A) non-complement-fixing antibodies
B) phagocytic cells
C) helper T cells
D) cytotoxic T cells

57. Eukaryotic cells with DNA damage often cease progression through the cell cycle until the damage is repaired. This type of control over the cell cycle is referred to as
A) Proteosome control
B) Damage control
C) Anticyclin control
D) Checkpoint control

58. Area of the brain associated with speech is called:
A) Broca's area
B) Wernicke's area
C) Angular gyrus
D) Ventricles
59. Pharmacophore is a
   A) Receptor
   B) Molecular structure feature
   C) Drug effect
   D) Substrate effect

60. United Nations Educational, Scientific and Cultural Organization (UNESCO) celebrated the year 2014 as:
   A) International Year of Bioinformatics
   B) International Year of Crystallography
   C) International Year of Molecular Biology
   D) International Year of Structural Biology

61. Peroxiredoxins do not reduce
   A) H₂O₂
   B) Paraquat
   C) Alkylperoxides
   D) Peroxinitrites

62. Two-dimensional electrophoresis is a combination of which two techniques?
   A) Isoelectric focusing and affinity chromatography
   B) Ion-exchange chromatography and SDS-PAGE
   C) Isoelectric focusing and SDS-PAGE
   D) Isoelectric focusing and ion-exchange chromatography

63. Following labelled ATP can be used to label DNA or protein using a kinase
   A) α-32P-ATP
   B) P-32-inorganic phosphate
   C) γ-32P ATP
   D) B-32P ATP

64. The mechanism that permits immunoglobulins to be synthesized in either a membrane-bound or secreted form is
   A) allelic exclusion
   B) codominant expression
   C) the one-turn/two-turn joining rule
   D) differential RNA processing

65. Polynucleotide ligase joins two DNA molecules together by forming a covalent bond between
   A) Two OH groups of adjacent strands
   B) A 3′OH group and a 5′PO₄ group
   C) A 3′PO₄ group and a 5′OH group
   D) Two carbon atoms of adjacent nucleotides on the same strand
66. Which of the following separates molecule according to their size
   A) Gel-Filtration chromatography
   B) Affinity chromatography
   C) Isoelectric focusing
   D) Ion exchange chromatography

67. Which of the following describes RNA interference
   A) Antisense RNA molecules block the translation of mRNA molecules
   B) Double-stranded RNA molecules are bound by proteins that block their translation
   C) Double-stranded RNA molecules are cleaved by a nuclease into short interfering RNA molecules
   D) Short interfering RNA molecules bind to the ribosome to prevent the translation of viral mRNAs

68. Which statement is scientifically correct about raw honey?
   A) It retains footprints of all the components of the eco-social system of the beehive
   B) It holistically entails benefits of pure honey, pollen, wax and other unknown biotic components and enzymes/peptides added by the bees and by their farmed microbiota
   C) It contains probiotic bacteria from the honey crop of bees
   D) All of the above

69. One of the following is a regulatory protein
   A) Gp120
   B) integrase
   C) Reverse transcriptase
   D) Tat

70. The frequency of somatic mutation in Ig genes is greatest during
   A) differentiation of pre-B cells into mature B cells
   B) differentiation of pre-T cells into mature T cells
   C) generation of memory B cells
   D) antibody secretion by plasma cells

71. The methods used for locating transcription start site are
   A) Gel retardation and footprinting
   B) Northern analysis and RT-PCR
   C) Primer extension and S1 nuclease mapping
   D) Cloning of 5’ UTRs and DNA Sequencing

72. A person with lactose intolerance is most likely deficient in breaking the following chemical bond:
   A) An ester linkage
   B) A phosphodiester bond
   C) An amide bond
   D) A glycosidic bond
73. Severe Acute Respiratory Syndrome (SARS) virus belongs to the family
   A) Picornaviridae
   B) Coronaviridae
   C) Adenoviridae
   D) Abolaviridae

74. Which of the following processes is thought to underlie concerted evolution
   A) Gene conversion
   B) Lateral gene transfer
   C) Programmed cell death
   D) Transposition

75. Based on the time dependent changes in the fatty acid composition of a bacterial membrane
    as shown in the following figure, identify the abiotic stress treatment given to the bacterial
    culture

   ![Graph showing fatty acid composition over time](image)

   A) Heat stress
   B) Salt stress
   C) Cold stress
   D) Oxidative stress