

Hall Ticket No.

Entrance Examination, June 2012
Ph.D. Biotechnology

Time : 2 hours

Maximum Marks : 75

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE ANSWERING:

1. Enter your hall ticket number on this sheet and the answer (OMR) Sheet.
2. Answers have to be marked on the OMR answer sheet with BLACK/BLUE Ball point/ Sketch pen following the instructions provided there upon.
3. Hand over both the question paper booklet and OMR answer sheet at the end of the examination.
4. All questions carry one mark each.
5. 0.33 mark will be deducted for every wrong answer.
6. There are total 14 pages (excluding 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.

DEPARTMENT OF BIOTECHNOLOGY
SCHOOL OF LIFE SCIENCES

Ph.D ENTRANCE EXAMINATION – 2012

MAXIMUM MARKS: 75

PART A

1. Which one of the following techniques is used for studying genome wide differential gene expression
 - A. Western blotting
 - B. Northern blotting
 - C. DNA microarray
 - D. Pyro-sequencing of genomes
2. Which of the following BLAST programs is used for protein query against a translated nucleotide sequence database
 - A. Blastp
 - B. Blastn
 - C. tblastx
 - D. Tblastn
3. Which of the following amino acids is least mutable according to the PAM scoring matrix?
 - A. Alanine
 - B. Glutamine
 - C. Methionine
 - D. Cysteine
4. If the ratio A_{260}/A_{280} nm of a DNA solution is 1.4, it indicates contamination of DNA preparation with
 - A. Carbohydrate
 - B. RNA
 - C. Protein
 - D. Salt

5. The methods used for locating transcription start site are
- A. Gel retardation and foot printing
 - B. Northern analysis and RT-PCR
 - C. Primer extension and S1 nuclease mapping
 - D. Cloning of 5' UTRs and DNA Sequencing
6. Which one of the following is a M13 based vector
- A. pBR322
 - B. pT7blue
 - C. pUC18
 - D. Cosmid
7. DNA fragment size suitable to cloning in a λ replacement vector
- A. 30 kb
 - B. 35 kb
 - C. 18 kb
 - D. 53 kb
8. In a yeast two hybrid assay if two test proteins (bait and prey) are interacting with each other, then
- A. LacZ reporter gene will be strongly repressed
 - B. LacZ reporter gene will be expressed
 - C. LacZ reporter gene expression is repressed by *LacI*
 - D. LacZ reporter gene expression is unaffected
9. RNA is susceptible to alkaline hydrolysis, but not DNA because
- A. RNA is single stranded and nitrogenous bases are exposed to alkali
 - B. RNA can form intra base-pairing, but not DNA
 - C. RNA has 2'-OH group
 - D. RNA is smaller than DNA
10. Which one of the following has high gene density
- A. Human
 - B. Arabidopsis
 - C. Drosophila
 - D. *E. coli*
11. Processivity of DNA polymerase is enhanced by
- A. DNA helicase

- B. Sliding clamp
C. Topoisomerase
D. RNA helicase
12. Which form of the following plasmid DNA migrates faster during agarose gel electrophoresis
- A. highly super-coiled plasmid DNA
B. relaxed plasmid DNA
C. linear plasmid DNA
D. nicked circular plasmid DNA
13. Which one of the following *E.coli* sigma subunit is required for transcription of heat inducible genes
- A. Sigma 70
B. Sigma 32
C. Sigma54
D. Sigma28
14. Which one of the following is NOT a state function?
- A. Internal energy
B. Heat
C. Enthalpy
D. Entropy
15. Number of vibrational degrees of freedom for ethylene molecule is
- A. 18
B. 15
C. 12
D. 11
16. Symmetry elements of ammonia molecule contain
- A. C_3 -axis of symmetry and one centre of symmetry
B. C_3 -axis of symmetry and three planes of symmetry
C. C_2 -axis of symmetry and one centre of symmetry
D. C_2 -axis of symmetry and two planes of symmetry
17. Volume of a balloon filled with an ideal gas is 5 L, at 1 atm and 25 °C; what will be the volume of the balloon if temperature increases to 35°C?
- A. 3.57 L
B. 4.84 L

- C. 5.17 L
D. 7.0 L
18. Which of the following sequence is correct, if the molecules are arranged according to their bond energies?
- A. $H_2 > F_2 > Cl_2 > Br_2$
 - B. $H_2 > Cl_2 > F_2 > Br_2$
 - C. $F_2 > Cl_2 > Br_2 > H_2$
 - D. $Cl_2 > F_2 > Br_2 > H_2$
19. Addition of an inhibitor does not change K_m/V_{max} value, if the mechanism of inhibition is
- A. Competitive
 - B. Uncompetitive
 - C. Noncompetitive
 - D. All the above
20. Generally, in a fluorescent experiment, moving the excitation wavelength to higher wavelength,
- A. does not affect the emission wavelength
 - B. blue shifts emission wavelength
 - C. red shifts emission wavelength
 - D. depends on the solvent and temperature
21. The chloroplast genome of higher plants contain
- A. Twelve genes
 - B. Hundred and twenty genes
 - C. Twelve hundred genes
 - D. Twelve thousand genes
22. The metabolite that causes internal bleeding in mammals
- A. Stilbenes
 - B. Coumarins
 - C. Ferulic acid
 - D. Chalcones
23. Denaturation of a protein involves
- A. Partial loss of amino acid sequence
 - B. Loss of α -helices

- C. Loss of β -sheets
 - D. Loss of 3-D shape and catalytic activity
24. A particle moves with a constant velocity parallel to the X-axis. Its angular momentum with respect to the origin,
- A. Is zero
 - B. Remains constant
 - C. Goes on decreasing
 - D. Goes on increasing
25. The secondary pacemaker of the heart is known as the:
- A. AV node
 - B. SA node
 - C. Purkinje Bundle
 - D. None of the above

PART B

26. The resting potential of a neuron is dependent on what two ions?
- A. lead and calcium ions
 - B. calcium and phosphate ions
 - C. sodium and potassium ions
 - D. potassium and phosphate ions
27. A double stranded DNA showed a positive peak around 260 nm followed by a negative trough - what form of DNA it is?
- A. A form
 - B. B form
 - C. C form
 - D. Z form
28. Alpha helix of a protein can be estimated at the following wavelength in CD spectrum
- A. 217 nm
 - B. 190 nm
 - C. 222 nm
 - D. 280nm

29. DNA

- A. is more susceptible than RNA to degradation at high pH
- B. can hybridize with other DNA molecules but not with RNA
- C. has fewer hydroxyl groups than RNA
- D. has catalytic activity

30. Which one of the following radiolabeled compounds is most commonly used for studying DNA synthesis in cultures of *Escherichia coli*?

- A. [³H] thymidine
- B. [¹⁴C] uridine
- C. [γ -³²P] dATP
- D. [α -³²P] dATP

31. The *lac* repressor

- A. Is induced by exposure of a bacterial cell to lactose
- B. Uses the same promoter as the *lacZ* gene
- C. Changes the shape in the presence of inducer
- D. Can form alternate stem-loop structures

32. Following is not a characteristic of the mRNA 5' cap

- A. 7-methylguanosine triphosphate
- B. 2'-OH methylation
- C. 3' → 5' linkage
- D. 5' → 5' linkage

33. How (eukaryotic) viruses acquire lipid membranes?

- A. The lipids are synthesized by proteins coded by viral genes.
- B. The viral capsid acquires the membrane when it leaves the host cell.
- C. The viral capsid acquires the membrane when it is assembled inside the host cell.
- D. The viral capsid acquires the membrane when it first binds to a host cell.

34. Which of the following is NOT a type of histone modification?

- A. Acetylation
- B. ADP-ribosylation
- C. Methylation
- D. Phosphorylation

35. Enzyme which incorporate oxygen into a substrate are called

- A. Oxidases

- B. Dehydrogenases
 - C. Oxygenases
 - D. Hydroperoxidases
36. The bonds that are important in the secondary structure of protein are
- A. Hydrophobic interactions
 - B. Peptide bonds
 - C. Hydrogen bonds
 - D. Disulphide bonds
37. The cell wall component of Gram negative bacteria which is mostly associated with the induction of septic shock.
- A. Capsular protein
 - B. Endotoxin
 - C. Peptidoglycan
 - D. Phospholipid
38. Select the principal means by which antigenic shift occurs in influenza A virus.
- A. Low fidelity of DNA dependent DNA polymerase
 - B. Low fidelity of RNA dependent RNA polymerase
 - C. Low fidelity of reverse transcriptase
 - D. Reassortment of fragments of the RNA genome
39. Which of the statement about hemoglobin is NOT correct?
- A. Number of contacts between two α chains are less than the contacts between α and β chains
 - B. Increasing pH increases the percentage of oxygen saturation at a given oxygen partial pressure
 - C. During deoxygenation, hemes of α chains are slightly separated apart and β chains come closer
 - D. In sickle cell hemoglobin glutamic acid is replaced with valine in the sixth position of β chain
40. By adding SDS (sodium dodecyl sulfate) during the electrophoresis of proteins, it is possible to:
- A. determine an enzyme's specific activity
 - B. determine the amino acid composition of the protein
 - C. preserve a protein's native structure and biological activity
 - D. separate proteins exclusively on the basis of molecular weight

41. One round of Edman degradation of the peptide: $\text{H}_2\text{N}-\text{Gly}-\text{Arg}-\text{Lys}-\text{Phe}-\text{Asp}-\text{COOH}$ would result in which of the following structures or their phenyl isothiocyanate derivatives?
- A. $\text{H}_2\text{N}-\text{Gly}-\text{Arg}-\text{COOH} + \text{H}_2\text{N}-\text{Lys}-\text{Phe}-\text{Asp}-\text{COOH}$
 - B. $\text{H}_2\text{N}-\text{Gly}-\text{Arg}-\text{Lys}-\text{Phe}-\text{COOH} + \text{Asp}$
 - C. $\text{H}_2\text{N}-\text{Arg}-\text{Lys}-\text{Phe}-\text{Asp}-\text{COOH} + \text{Gly}$
 - D. $\text{H}_2\text{N}-\text{Gly}-\text{Arg}-\text{Lys}-\text{COOH} + \text{H}_2\text{N}-\text{Phe}-\text{Asp}-\text{COOH}$
42. Aromatic amino acids can be detected by
- A. Sakaguchi reaction.
 - B. Millon-Nasse reaction
 - C. Hopkins-Cole reaction
 - D. Xanthoproteic reaction
43. Death of T cells in negative selection occurs because of
- A. Low affinity receptors for self MHC
 - B. High affinity receptors for self MHC
 - C. Both
 - D. None
44. The primary activities of complement system DO NOT include
- A. Opsonization
 - B. Cell Lysis
 - C. Clearance of immune complexes
 - D. Tissue regeneration
45. Which of the following is used to search protein database using a translated nucleotide query?
- A. BLASTp
 - B. BLASTx
 - C. tBLASTn
 - D. tBLASTx
46. Which of the following is the distance based method for phylogenetic analysis?
- A. Neighbor-Joining method
 - B. Maximum Parsimony method
 - C. Maximum Likelihood method
 - D. all above methods
47. BLOSUM is an acronym for

- A. Basic subtraction matrix
 - B. Basic local summation matrix
 - C. Blocks substitution matrix
 - D. Blocks substituted mutation
48. Which of the following tool is used for molecular structure file conversion?
- A. BABEL
 - B. PHYLIP
 - C. CLUSTAL
 - D. MSFC
49. Which of the following is SMILE code for 2-Propanol?
- A. CCOC-2
 - B. CC(O)C
 - C. CCC-2OH
 - D. CCCO
50. Glutathione and Glutathione conjugates originate from
- A. Methionine
 - B. S-adenosyl methionine
 - C. Cysteine
 - D. Cystine
51. Bioactive endogenous gibberellic acids are rendered inactive by
- A. 2 β -hydroxylation
 - B. 3 β -hydroxylation
 - C. 2,3 β -hydroxylation
 - D. 2 α -hydroxylation
52. One of the following organisms that produces carbapenemase enzyme and termed as a 'superbug'
- A. MRSA
 - B. *Clostridium difficile*
 - C. NDM-1 positive *E. coli*
 - D. *Yersinia pestis*
53. Bacterial pathogen that has co-evolved with its human host

- C. C- reactive proteins
 - D. All of the above
60. Method(s) used to validate protein-protein interaction
- A. Immuno-coprecipitation and pull down
 - B. Biacore analysis
 - C. Yeast two hybrid assay
 - D. All of the above
61. Which of the following is NOT a virulence factor
- A. Invasins
 - B. Adhesins
 - C. Collectins
 - D. Flagellins
62. The following DNA sequence assembly tool is used to assemble short reads data.
- A. Velvet
 - B. Mummer
 - C. VectorNTI
 - D. Artemis
63. The following is an online genome annotation tool
- A. RAST
 - B. Mg-RAST
 - C. Annotate – it
 - D. GeneScan
64. Which of the following techniques is useful in determining the movement of proteins within a nucleus?
- A. Electron microscopy
 - B. Fluorescence recovery after photobleaching (FRAP)
 - C. Fluorescent *in situ* hybridization (FISH)
 - D. Confocal light microscopy
65. Nonsense-mediated RNA decay (NMD) is a system for the degradation of eukaryotic mRNA molecules with what features?
- A. NMD degrades mRNA molecules with stop codons at incorrect positions.
 - B. NMD degrades mRNA molecules that encode nonfunctional proteins.
 - C. NMD degrades mRNA molecules that lack a start codon.
 - D. NMD degrades mRNA molecules that lack a stop codon.

66. Which one of the following antiviral drugs effective against pandemic influenza targets neuraminidase enzyme of the influenza viruses?
- A. Oseltamivir
 - B. Pleconaril
 - C. Amantadine
 - D. None of the above
67. A bacterium that can grow by using arsenic instead of phosphorus in its nucleic acids
- A. *Halomonas* strain GFAJ-1
 - B. *Zymomonas mobilis*
 - C. *Pseudoalteromonas atlantica*
 - D. *Psuedomonas fluorescens*
68. How do you represent C-alpha atom in PDB format?
- A. CA
 - B. C
 - C. C-alpha
 - D. α
69. Genomic analysis of unculturable organisms in a habitat within an ecosystem is called
- A. Metagenomics
 - B. Microbiome analysis
 - C. Phylogenomics
 - D. Epigenomics
70. A sequencing technique that is used to identify binding sites of DNA associated proteins
- A. Solexa sequencing
 - B. ChIP-sequencing
 - C. Pyrosequencing
 - D. SoLiD sequencing
71. The following transcription factor is said to be 'at the cross-roads of life and death' as it operates upstream to both the proliferative and apoptotic signaling pathways
- A. P53
 - B. NFAT
 - C. NF κ B
 - D. None of the above
72. Amount of phosphoric acid needed to neutralize 100 g of magnesium hydroxide is

- A. *Salmonella paratyphi*
 - B. *Yersinia enterocolitica*
 - C. *Helicobacter pylori*
 - D. *Corynebacterium diphtheriae*
54. The new science of systems biology aims at?
- A. Generation of multi-omics data
 - B. Making sense out of next generation sequencing data
 - C. Integration of multi-omics data and mathematical approaches to propose testable biological models relevant in discovery
 - D. To deliver designer therapeutics and vaccines
55. Which one of the following is connecting link between Photosystem I and Photosystem II
- A. plastocyanin
 - B. ferredoxin
 - C. cytochrome *c*
 - D. cytochrome *b6f* complex
56. Which of the following global profiles is relevant in the development of sero-diagnostic markers?
- A. Transcriptome
 - B. Secretome
 - C. Virulome
 - D. Interactome
57. Arbuscular mycorrhiza are formed by fungi of the division
- A. Basidiomycota
 - B. Ascomycota
 - C. Zygomycota
 - D. Glomeromycota
58. Which one of the following immunoglobulins can readily cross placenta
- A. IgM
 - B. IgG
 - C. IgA
 - D. IgE
59. Which of the following is/are NOT a component of plant immune system?
- A. Pattern recognition receptors (PRR)
 - B. NB-LRR

- A. 112 g
- B. 168 g
- C. 252 g
- D. 66.7 g

73. One of the following is NOT a DNA fingerprinting technique

- A. Variable number of tandem repeat analysis
- B. Restriction fragment length polymorphism analysis
- C. Differential display
- D. Pulsed Field Gel Electrophoresis

74. Sickle cell anemia provides genetic resistance towards one of the following diseases

- A. Diabetes
- B. Malaria
- C. Tuberculosis
- D. Coronary artery diseases

75. Neuronal cell death in Alzheimer's disease is induced by the following factor(s)

- A. Amyloid - β
- B. Reactive oxygen species
- C. Nitric oxide and ER-stress
- D. All of the above