

ENTRANCE EXAMINATION FOR ADMISSION, MAY 2010.

Ph.D. (BIOINFORMATICS)

COURSE CODE : 104

Register Number :



Signature of the Invigilator  
(with date)

COURSE CODE : 104

Time : 2 Hours

Max : 400 Marks

*Instructions to Candidates :*

1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.
2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.
3. Read each question carefully and shade the relevant answer (A) or (B) or (C) or (D) in the relevant box of the ANSWER SHEET using HB pencil.
4. Avoid blind guessing. A wrong answer will fetch you -1 mark and the correct answer will fetch 4 marks.
5. Do not write anything in the question paper. Use the white sheets attached at the end for rough works.
6. Do not open the question paper until the start signal is given.
7. Do not attempt to answer after stop signal is given. Any such attempt will disqualify your candidature.
8. On stop signal, keep the question paper and the answer sheet on your table and wait for the invigilator to collect them.
9. Use of Calculators, Tables, etc. are prohibited.

1. Michaelis-Menten equation describes the rate of the enzymatic reaction as a function of
 

(A) Co-enzyme concentration	(B) Product concentration
(C) Temperature	(D) Substrate concentration
2. In Homology modelling, the region of the protein sequence that needs to be built is
 

(A) Conserved region	(B) Loops
(C) Template	(D) Rotamer
3. The Boolean operators 'AND', 'OR' and 'NOT' are called as
 

(A) Conditional operators	(B) Non-conditional operators
(C) Numeric operators	(D) Non-numeric operators
4. PHYLIP database is used for
 

(A) Sequence analysis and alignment	(B) Phylogenetic analysis
(C) Motif detection	(D) Active site analysis
5. Which of the following is incorrect for homologs?
 

(A) They are similar sequence in two different organisms that have been derived from common ancestor sequence	(B) They are similar sequence in two different organisms that have been arisen due to a speciation event
(C) They are similar sequence within a single organism that has arisen due to a gene duplication event	(D) They are similar sequence that do not share the same evolutionary origin
6. What is the difference between RefSeq and GenBank?
 

(A) RefSeq includes publicly available DNA sequences	(B) GenBank includes non-redundant curated data
(C) GenBank sequences are derived from RefSeq	(D) RefSeq sequences are derived from GenBank
7. Conversion of a chemical structure from \*.mol format to SMILES is "—————" type of file format conversion.
 

(A) 3D to string	(B) 3D to 2D	(C) 2D to 3D	(D) 1D to 3D
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8. Which of the following is not an energy minimization method
- (A) Monte Carlo (B) Conjugate Gradient  
(C) Newton-Raphson (D) Steven-Johnson
9. The null hypothesis is tested by the statistical method ANOVA which, stands for
- (A) Artificial Networks (B) Analysis of Variables  
(C) Analysis of Variance (D) Artificial networks of Variance
10. In regression analysis equation given below, 'Y' stands for
- $$Y_j = \alpha + \beta_1 X_{1j} + \beta_2 X_{2j} + \dots + \beta_m X_{mj}$$
- (A) Independent variable (B) Dependent variable  
(C) Normal variable (D) Regression variable
11. Mean and Variance are equal for a distribution which is
- (A) Asymmetric (B) Normal  
(C) Poisson (D) Skew
12. The various DNA bands in a gel can be stained by
- (A) Planar aromatic cations (B) Non-planar aromatic cations  
(C) Planar aromatic anions (D) Non-planar aromatic anions
13. The main function of release factor, RF-1 in E.coli protein synthesis is
- (A) Recognizes UAA and UAG stop codons  
(B) Recognizes UAA and UGA stop codons  
(C) Displaces GDP from EF-Tu  
(D) GTP hydrolysis
14. What is the symbol  $\pi$  in QSAR stands for
- (A) The hydrophobicity of the molecule  
(B) Electronic effect of the substituent  
(C) Substituent hydrophobicity constant  
(D) A measure of steric property of substituent

15. At which of the following sites is the characteristic triple helical structure of the collagen initially formed?
 

(A) Golgi body	(B) Nucleus
(C) Rough endoplasmic reticulum	(D) Smooth endoplasmic reticulum
16. Which pair of amino acids absorbs the most UV light at 280 nm?
 

(A) Thr and His	(B) Trp and Tyr
(C) Cys and Asp	(D) Phe and Pro
17. A ball is dropped from a height of 1 meter, collision with floor is inelastic and ball loses half the energy after collision. What would be the total vertical distance covered by the ball before it comes to rest?
 

(A) 2 m	(B) 2.5 m	(C) 3 m	(D) 4 m
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18. The required phi and psi angle for the formation of left-handed helices by polyglycine and proline is.
 

(A) 57, 47	(B) -57, -80	(C) -79, 150	(D) -51, 153
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19. A messenger RNA is 669 nucleotides long, including the initiator and termination codons. The number of amino acids in the protein translated from this mRNA is
 

(A) 1998	(B) 222	(C) 223	(D) 333
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20. Which enzyme is activated by phosphorylation?
 

(A) pyruvate kinase	(B) fructose-2,6-bisphosphatase
(C) fructose-1,6-bisphosphatase	(D) acetyl-CoA carboxylase
21. A bag is dropped from an aeroplane flying horizontally at a constant speed. If air resistance is ignored, where will the aeroplane be when the bag hits the ground?
 

(A) ahead of the bag	(B) directly above the bag
(C) far behind the bag	(D) data is not sufficient
22. A bird is in a wire cage which is hanging from a spring balance. In the first case, the bird sits in the cage and in the second case, the bird flies about inside the cage. The reading in the spring balance is
 

(A) more in first case	(B) less in first case
(C) unchanged	(D) zero in second case

23. When horse starts running all of a sudden, the rider on the horse back falls back because
- (A) he is taken aback
  - (B) he is afraid
  - (C) due to inertia of rest, the upper part of his body remains at rest
  - (D) due to inertia of motion, the lower part of his body comes in motion
24. If we place an iron needle on a blotting paper and place the arrangement gently on water, it will be observed that
- (A) both the blotting paper and the iron needle continue to float on water
  - (B) the blotting paper sinks but the iron needle continues to float
  - (C) iron needle begins to execute oscillatory motion
  - (D) the needle tears off the blotting paper
25. An oil drop placed on the surface of water spreads as a thin layer. This is because
- (A) Surface tension of water is greater than that of oil
  - (B) Surface tension of water is less than that of oil
  - (C) viscosity of oil is greater than viscosity of water
  - (D) of large difference in the densities of oil and water
26. When a soap bubble is given an electric charge
- (A) its size increases
  - (B) its size decreases
  - (C) it becomes a drop
  - (D) it bursts
27. A body is detached gently from the outer wall of a satellite circling round earth. This body will
- (A) continue to move along with the satellite
  - (B) fall to the earth
  - (C) fall to the moon
  - (D) follow an irregular path

28. A diesel cycle works at
- (A) constant volume (B) constant pressure  
(C) constant temperature (D) none of the above
29. What happens when the light intensity incident on a photoelectric surface is doubled?
- (A) the frequency of emitted photons is doubled  
(B) the number of photons is doubled  
(C) the number of photons becomes four times  
(D) there is no effect at all
30. The idea of quantum nature of light has been emerged in an attempt to explain
- (A) the thermal radiation of black body (B) radio activity  
(C) fusion (D) interference of light
31. The units of the rate constant for the first order reaction could be:
- (A)  $M^{-1} \text{ min}^{-1}$  (B)  $M$  (C)  $M \text{ min}^{-1}$  (D)  $\text{min}^{-1}$
32. How does the slope of the line on a plot of the Henderson-Hasselbalch equation depend on  $K_{\text{dn}}$ ?
- (A)  $K_{\text{dn}}$  increases the slope decreases  
(B)  $K_{\text{dn}}$  increases the slope is unchanged  
(C)  $K_{\text{dn}}$  increases the slope increases  
(D) There is not enough information to answer this question
33. Hydrophobic molecules are:
- (A) generally nonpolar and relatively insoluble in aqueous solutions  
(B) generally polar and relatively insoluble in aqueous solutions  
(C) generally nonpolar and relatively soluble in aqueous solutions  
(D) generally polar and relatively soluble in aqueous solutions
34. If secreted Immunoglobulin G is resolved on a SDS-PAGE under reducing conditions, how many bands do you expect after staining?
- (A) 1 (B) 2 (C) 4 (D) 7

35. Which is the most common post-translation modification seen in secreted protein?
- (A) Phosphorylation (B) Signal peptide  
(C) Glycosylation (D) Acetylation
36. The molecular weight of a protein is 20 kDa. How many amino acids do you expect in this protein?
- (A) 700-1000 (B) 400-500  
(C) less than 250 (D) less than 99
37. Which of the following chromatography method will be preferred to separate alanine and glutamic acid in a mixture of amino acids?
- (A) Gel filtration chromatography (B) Strong cation exchanger  
(C) Strong anion exchanger (D) Affinity chromatography
38. What is the nature of amino acids present in the transmembrane domains of proteins?
- (A) hydrophobic (B) polar  
(C) amphipatic (D) hydrophilic
39. Which is the most common detergent in shampoos?
- (A) Pentaerythrityl palmitate (B) Lauryl sulphate  
(C) Triton X 100 (D) NP 40
40. Which of the following amino acids have nearly isobaric mass?
- (A) Lysine and Glutamine (B) Aspartic acid and glutamic acid  
(C) Alanine and asparagine (D) Leucine and tyrosine
41. Which chromatography technique is used for molecular weight determination of molecules?
- (A) size exclusion chromatography  
(B) hydrophobic interaction chromatography  
(C) gel permeation chromatography  
(D) affinity chromatography

42. Actual mass of a peptide is 575.2364 (m/z); however, the measured mass of the peptide is 575.2374 (m/z). What is the mass error?
- (A) ~2 ppm                      (B) ~5 ppm                      (C) ~10 ppm                      (D) ~12 ppm
43. At the end of 20 cycles of PCR there are  $10 \times 10^{11}$  molecules. How many DNA molecules would be there at the end of 18 cycles?
- (A)  $25 \times 10^{10}$     (B)  $2.5 \times 10^{12}$   
 (C)  $5 \times 10^{11}$     (D) infinite number
44. Three dice are thrown simultaneously. What is the probability that all three dice would be different?
- (A) 5/9                      (B) 7/9                      (C) 20/216                      (D) 50/216
45. Molecular clock is
- (A) an assumption by which molecular sequences evolve at constant rates  
 (B) an assumption by which molecular sequences evolve at different rates  
 (C) a method for the phylogenetic analysis of organisms  
 (D) standard atomic time keeping device in Geneva
46. Which of the following method is used to reconstruct the metabolic pathway?
- (A) Blotting    (B) DNA Footprinting  
 (C) Genome annotation    (D) EMSA
47. The approximate size of the foreign DNA used for cloning in cosmid
- (A) ~ 50 kb                      (B) ~250 kb                      (C) ~ 500 kb                      (D) ~1000 kb
48. Alternative pathway of glucose metabolism is
- (A) Glycolysis    (B) HMP Shunt  
 (C) TCA Cycle    (D) Gluconeogenesis
49. What step of DNA sequencing is skipped during shotgun sequencing?
- (A) computer analysis    (B) physical mapping  
 (C) primer reactions    (D) cloning of DNA fragment



50. If you utilize a proteomics approach to find the cause of a muscle disorder, which of the following techniques you will be using?
- (A) sequencing the gene responsible for the disorder
  - (B) annotating the gene sequence
  - (C) developing physical maps from genomic clones
  - (D) determining which environmental factors influence the expression of your gene of interest
51. Which of the following does not pertain to B cells?
- (A) have passed through the thymus
  - (B) specific receptors
  - (C) antibody-mediated immunity
  - (D) synthesize and liberate antibodies
52. When a T-cell recognized an antigen, it
- (A) moves from the thymus to the spleen
  - (B) multiplies
  - (C) releases interferons
  - (D) releases antibodies
53. The approaches that can be used to predict the 3D-structure of a protein which has no detectable sequence similarities with the available template is
- (A) Homology modeling
  - (B) Comparative modeling
  - (C) Fold recognition method
  - (D) Ab initio modeling
54. The cell type that would move sugar in a plant is a
- (A) Tracheid
  - (B) Vessel element
  - (C) Fibre
  - (D) Sieve tube
55. Which one of the following tool is used to deposit protein structures into PDB?
- (A) Sequin
  - (B) Sakura
  - (C) ADIT
  - (D) BankIT
56. If E is an event in a sample space S and A1, A2, A3 are mutually disjoint events whose union is S then according to the law of total probability
- (A)  $P(E) = P(A1)P(E/A1) + P(A2)P(E/A2) + P(A3)P(E/A3)$
  - (B)  $P(E) = P(A1) P(E) + P(A2) P(E) + P(A3)P(E)$
  - (C)  $P(S) = P(A1)+P(A2) + P(A3) + P(E)$
  - (D)  $P(S) = P(A1)+P(A2) + P(A3) - P(E)$

57. GeneMark is a gene prediction software that is based on
- (A) Interpolated markov model
  - (B) Fifth order markov model
  - (C) Sixth order markov model
  - (D) Fourth order markov model
58. Rosetta is a web server that
- (A) predicts protein three-dimensional conformations using the extrinsic approach
  - (B) predicts protein three-dimensional conformations using the *ab initio* method
  - (C) predicts protein coding genes using the *ab initio* method
  - (D) predicts promoter regions using the *ab initio* method
59. OMIA is the database containing mutational data of
- (A) human
  - (B) mouse
  - (C) plant
  - (D) animals other than human and mouse
60. The whole-genome shotgun sequencing approach depends primarily on
- (A) methodical sequencing a few large cloned fragments of DNA
  - (B) sequencing the bacterial chromosome while it is still intact
  - (C) rapidly sequencing thousands of small randomly cloned fragments
  - (D) use of the gene-gun technology
61. Particular RNAs that are important for development are located in distinct regions of the *Drosophila* embryo. This is most directly demonstrated by using
- (A) in situ hybridization
  - (B) western blotting
  - (C) northern blotting
  - (D) in vitro translation
62. Twilight zone of protein sequence alignment has
- (A) 20-30% sequence identity
  - (B) above 60% sequence identity
  - (C) less than 20% sequence identity
  - (D) no sequence identity
63. Which one of the following is not a lymphocyte?
- (A) B-cell
  - (B) T-cell
  - (C) NK-cell
  - (D) Mast-cell

64. Which of the following organism does not have a single stranded positive sense RNA genome?
- (A) Influenza virus (B) Polio virus  
(C) C Hepatitis B virus (D) Pox virus
65. Possible combination of gametes which can be formed by genotype AaBbCcDdEeFfGg are
- (A) 16 (B) 32 (C) 64 (D) 128
66. An Expressed sequence tag is
- (A) a part of cDNA sequence  
(B) used as genome marker  
(C) the nucleotide sequence at the junction between exon and intron  
(D) a random genomic sequence
67. Horizontal gene transfer refers to
- (A) vertical transmission of genes from parents to progeny  
(B) transfer of genes from one species to another  
(C) reverse transcription and integration of genes  
(D) none of the above
68. CpG islands are commonly found in
- (A) bacterial genomes (B) fungi genome  
(C) vertebrate genomes (D) archaeal genomes
69. Most microarray consists of a solid support on which is immobilized
- (A) DNA (B) RNA  
(C) Genes (D) Transcripts
70. A self-organizing map
- (A) imposes some structure on the formation of clusters  
(B) is unstructured, like k-means clustering  
(C) has neighboring nodes that represent dissimilar clusters  
(D) cannot be represented as a clustering tree

71. Cn3D is a molecular structure viewer at NCBI. It features
- (A) A menu driven program linked to automated homology modeling
  - (B) A command line interface useful for a variety of structure analyses
  - (C) A structure viewer that is accompanied by a sequence viewer
  - (D) A structure viewer that allows stereoscopic viewing of structure images
72. Which of the following programs does not generate a multiple sequence alignment?
- (A) PSI-BLAST      (B) ClustalW      (C) PileUp      (D) PHYLIP
73. Which of the following is not a homology modeling Tools or software?
- (A) HOMER      (B) MODELLER      (C) WHAT IF      (D) PHYRE
74. The main difference between Pfam-A and Pfam-B is that
- (A) Pfam-A is a manually curated while Pfam-B is automatically curated.
  - (B) Pfam-A uses hidden Markov models while Pfam-B does not
  - (C) Pfam-A provides full-length protein alignments while Pfam-B aligns protein fragments
  - (D) Pfam-A incorporates data from SMART and PROSITE while Pfam-B does not
75. Which one is the best website for gathering literature information?
- (A) OMIM      (B) Entrez      (C) PubMed      (D) PROSITE
76. The DNA from the bacteriophage Phi X174 has a base composition of 25% A, 33% T, 24% G, and 18% C. Which of the following best explains this observation?
- (A) viral genome does not follow Watson-Crick base pairing rule
  - (B) lack of efficient DNA repair machinery in virus
  - (C) the genome of bacteriophage Phi X174 is single-stranded.
  - (D) the genome of bacteriophage is very complex to understand
77. Which of the following is not true about the androgen receptor?
- (A) it belongs to the nuclear receptor family
  - (B) it binds to dehydrotestosterone with more affinity than testosterone
  - (C) it does not have a transmembrane receptor
  - (D) it can transduce a cellular signal even without androgen stimulation

78. Which of the following is NOT true about ribosomes
- (A) They catalyze peptide bond formation
  - (B) They provide site for mRNA binding
  - (C) They are involved in facilitating unwinding mRNA
  - (D) They consist of protein and RNA components
79. The term genome is used for
- (A) haploid set of chromosomes
  - (B) diploid set of chromosomes
  - (C) triploid set of chromosomes
  - (D) whatever is obtained by DNA sequencing
80. Small non-polar molecules can diffuse across the membrane and do not mostly depend on
- (A) Concentration gradient
  - (B) Partition coefficient
  - (C) Size of the molecules
  - (D) Membrane potential
81. Father and mother, both are carriers of sickle cell anemia, have two children who does not suffer from sickle cell anemia. What is the chance that their child in third pregnancy will be suffering from sickle cell anemia?
- (A) 25%
  - (B) 33.3%
  - (C) 50%
  - (D) 100%
82. Gene A is transcribed from the reverse strand .5'ATGCTTTCGTATG 3' is a stretch of sequence from the coding strand. What would be the sequence of mRNA coded by this stretch of gene sequence?
- (A) 5'ATGCTTTCGTATG 3'
  - (B) 5'AUGCUUUCGUAUG 3'
  - (C) 5' UACGAAAGCAUAC 3'
  - (D) 5'CATACGAAAGCAT 3'
83. Mode is true for the following
- (A) Mode = 3 Median - 2 Mean
  - (B) Mode = 2 Median - 2 Mean
  - (C) Mode = Mean + Median
  - (D) Mode = 3 Mean - 2 Median

84. Although multiple disulfide bonds are possible during the formation of the tertiary structure of some secretory proteins, only the correct ones are found in the secreted product. This is primarily due to the fact that
- (A) incorrectly folded proteins are degraded by lysosomes
  - (B) processing and folding is continued in the endosomes
  - (C) protein facilitates the formation of correct disulfide bonds in the endoplasmic reticulum
  - (D) only correctly folded proteins are translated in the endoplasmic reticulum
85. When representing any algebraic expression E which uses only binary operations in a 2-tree,
- (A) the variable in E will appear as external nodes and operations in internal nodes
  - (B) the operations in E will appear as external nodes and variables in internal nodes
  - (C) the variables and operations in E will appear only in internal nodes
  - (D) the variables and operations in E will appear only in external nodes
86. The memory address of fifth element of an array can be calculated by the formula
- (A)  $LOC(Array[5]) = Base(Array) + w(5 - \text{lower bound})$ , where w is the number of words per memory cell for the array
  - (B)  $LOC(Array[5]) = Base(Array[5]) + (5 - \text{lower bound})$ , where w is the number of words per memory cell for the array
  - (C)  $LOC(Array[5]) = Base(Array[4]) + (5 - \text{Upper bound})$ , where w is the number of words per memory cell for the array
  - (D) It is not possible
87. When in-order traversing a tree resulted E A C K F H D B G; the preorder traversal would return
- (A) FAEKCDBHG
  - (B) FAEKCDHGB
  - (C) EAFKHDCBG
  - (D) FEAKDCHBG
88. Which of the following is NOT an assumption of the Binomial distribution?
- (A) The probability of success is equal to 0.5 in all trials
  - (B) The number of successes in the trials is counted
  - (C) All trials must be identical
  - (D) All trials must be independent

89. Suppose that certain bioinformatics software has a mean time between failures of 10,000 hours and has a mean time to repair of 20 hours. If the software is used by 100 customers, what is its availability?
- (A) 80%                      (B) 90%                      (C) 98%                      (D) 99.8%
90. In comparison to other metazoan genomes (such as nematodes, mouse and insects)
- (A) the human genome contains considerably more protein-coding genes
- (B) the human genome has considerably more unique genes that lack identifiable orthologs
- (C) the human genome has somewhat more multidomain proteins, paralagous genes and alternative splicing
- (D) the human genome has a higher GC content
91. The equation of the circle which has its centre at (2,3) and touches the x-axis is the following
- (A)  $x^2+y^2-6x-4y+4=0$                       (B)  $x^2+y^2-4x-6y+4=0$
- (C)  $x^2+y^2+4x-6y+4=0$                       (D)  $x^2+y^2-4x+6y+4=0$
92. If (2,6) is one of the extremities of a diameter of a circle with centre (3,5), then the other point is
- (A) (4,3)                      (B) (2,2)                      (C) (4,4)                      (D) (4,5)
93. M can be used for
- (A) Reconstructing the contents of ROM
- (B) Erasing the contents of ROM
- (C) Erasing and reconstructing the contents of ROM
- (D) Duplicating ROM
94. Choose the correct answer
- (A) exit and return can be used interchangeably
- (B) use of return terminates the program
- (C) use of exit terminates the program
- (D) use of return terminates the loop

95. Semaphores are used to solve the problem of
- (A) race condition
  - (B) dead lock avoidance
  - (C) mutual exclusion
  - (D) context switching
96. Z form of DNA shows
- (A) Right handed helix
  - (B) Right handed turns
  - (C) Left handed helix
  - (D) Sometimes left handed and sometimes right handed
97. Merge sort uses
- (A) divide and conquer strategy
  - (B) backtracking approach
  - (C) heuristic search
  - (D) greedy approach
98. The statement `printf("%c", 100);` in 'c' language
- (A) prints 100
  - (B) prints the ASCII equivalent of 100
  - (C) prints garbage
  - (D) shows error
99. Preorder is same as
- (A) depth-first order
  - (B) breadth-first order
  - (C) topological order
  - (D) linear order
100. The order of the binary search algorithm is
- (A)  $n$
  - (B)  $n^2$
  - (C)  $n \log(n)$
  - (D)  $\log(n)$