Code No. V-71

ENTRANCE EXAMINATION - 2019

Ph.D. Systems and Computational Biology

HALL TICKET NUMBER _____

Maximum Marks: 70 Time: 2 hours

INSTRUCTIONS: Please read the instructions carefully before answering the questions

1. Answers are to be marked on the OMR answer sheet.
2. Hand over the OMR answer sheet at the end of the examination to the invigilator.
3. The question paper contains 70 questions of multiple choices, printed in 14 pages (last three pages to be used for rough work), including this page.
4. OMR answer sheet provided separately.
5. All questions carry one mark each.
6. In case the candidates have equal marks, preference will be given towards the candidate who has obtained higher marks in Part-A.
7. **There is negative marking for wrong answer. Each wrong answer carries -0.33 mark.**
8. Non-programmable scientific calculators are permitted.
9. Cell,Mobile Phones are strictly prohibited in the examination hall.

V-74

PART-A

1. If $N = \{ Ni: 1 \leq Ni \leq 10\}$ is a set of integers and P is a set of prime numbers then the set $X = P \cap N$ is:

   A. {1, 2, 3, 4, 5, 6, 10}
   B. {1, 2, 3, 5, 7}
   C. {2, 4, 6, 8, 10}
   D. {3, 5, 7}

2. A survey conducted in the beginning of 1980 revealed that a Tiger-reserve forest near Hyderabad had 100 tigers and another survey conducted in the year 1987 revealed that the Tiger population has doubled. If this is so, at what rate (approximately), in terms of %, the population of the Tigers was growing every year?

   A. 5%
   B. 25%
   C. 20%
   D. 10%

3. "X" and "Y" bought two pieces of adjacent lands whose total area is 1000 mt^2. If the piece of land bought by "X" is ¼ the total area of the two pieces of lands, what is the area of the land bought by "Y?

   A. 750 mt^2
   B. 500 mt^2
   C. 450 mt^2
   D. 300 mt^2

4. Let us say yesterday you bought "X" number of Mangoes by paying Rs.700/- (Rupees Seven Hundred Only). After eating two, you gave 1/3 of the remaining Mangoes to your friend. After eating another Mango, you gave one third of the remaining Mangoes to another friend and were left with 14 Mangoes. Given these data, calculate at what rate (i.e, price/Mango) you bought the Mangoes.

   A. Rs. 23
   B. Rs. 15
   C. Rs. 20
   D. Rs. 25

5. If you travel 4 kms north, then 3 kms north-east, then 4 kms south- east finally 4 kms south. How many kms would you be from your starting place, considering the least distance?

   A. one
   B. two
   C. three
   D. five

6. _____ is a property of matter by which it continues in its existing state of rest or uniform motion in a straight line, unless that state is changed by an external force.

   A. Inertia
   B. Potential
   C. Friction
   D. Reaction

7. The energy possessed by a physical body by virtue of its position or its configuration is referred to as _____ energy

   A. Kinetic
   B. Sound
   C. Thermal
   D. Potential

8. The units of distances used typically for describing separation of atoms and separation of the astronomical bodies such as stars are ____ and _____ respectively

   A. Nanometers and light years
   B. Meters and kilometres
   C. Light years and nanometers
   D. Nanometers and kilometres

9. In a lamp oil raises up the wick due to ___

   A. The viscosity of the oil
   B. Capillary effect
   C. Hydrophobic nature of the oil
   D. Volatile nature of the oil

10. The colors exhibited by thin oil layers formed on a water when a bright light is flashed is due to ____

    A. Diffraction
    B. Interference
    C. Dispersion
    D. Polarization

11. When a drop of water placed on a glass spreads out to form a thin film whereas a drop of mercury when placed on the same glass does not spread out like water because

    A. Cohesion of mercury is greater than its adhesion with glass
    B. Mercury is metal whereas water is liquid
    C. Density of mercury is greater than water
    D. Cohesion of water is greater than mercury

12. When an iron rod is heated up to its red-hot temperature and allowed to cool, it is observed that the rate of initial cooling is _____ to its temperature

    A. Directly proportional
    B. Indirectly proportional
    C. Not related
    D. Equal

13. When fighter airplane is flying from one end of the horizon to the other end in the sky you hear thundering sound and this varying pitch of sound is explained by

    A. The Newton's laws of motion
    B. The Archimedes principle
    C. The Raman effect
    D. The Doppler effect

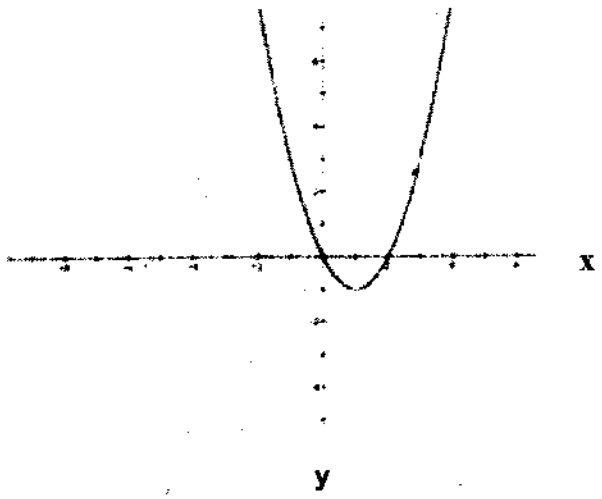
14. Srijani was four year old girl when her brother's age was half her age. What would be Srijani's age when she is 1.25 times the age of her brother?

    A. 9
    B. 7
    C. 10
    D. 11

15. How many integers satisfy $|x-3| \leq 5$?

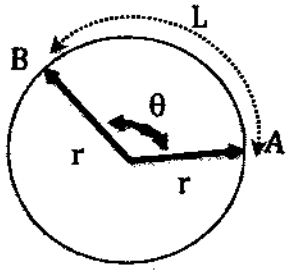
    A. 11
    B. 0
    C. An infinite number
    D. 9

16. How many roots exist for a function $y = f(x)$ as described by the following graph?



    A. 0
    B. 1
    C. 2
    D. 3

17. The value of the angle θ if L = 2r is ___ radians



A. 3
B. 1
C. 4
D. 2

18. A mammalian cell double stranded DNA of 2.4 meters duplicates in 4 hrs. If it duplicates at the rate of 10 micrometer/min, how many origins of replication are there in that DNA?

A. 1000
B. 100
C. 10
D. 1

19. What is the expected incidence of affected homozygous females given the following data: a) a X-linked recessive disorder is in Hardy-Weinberg equilibrium and b) the incidence in males is 1 in 100?

A. 1 in 1000
B. 1 in 4000
C. 1 in 10000
D. 1 in 40000

20. The alternative hypothesis in a statistical test is that more than 10% of a population is left-handed. The *p-value* for the test is calculated to be 0.25. Which statement is correct?

A. We can accept that more than 10% of the population is left-handed.
B. We can reject that more than 25% of the population is left-handed.
C. We can accept that exactly 25% of the population is left-handed.
D. We can reject that more than 10% of the population is left-handed.

21. Range of correlation coefficient is

A. 0 to +1
B. -1 to +1
C. -1 to 0
D. None of the above

22. Given the four letters alphabet of DNA (i.e., the four nucleotides A, T, C and G), if you are asked to generate oligomers of size five, how many oligomers would you generate?

A. 1024
B. 20
C. 625
D. 120

23. For measurement of central tendency of a skewed data (with non-parametric distribution), which measure should be preferred when some outliers are present in the data?

A. median
B. mean
C. mode
D. (maximum_value - minimum _value) / 2

24. The gloves size of 12 cricket players of a class are 7, 8, 6, 8, 9, 6, 7, 8, 6, 9, 7, 8. Out of the following, which glove size will fit the most number of people?

A. 7
B. 6
C. 8
D. 9

25. If today is Tuesday, after 62 days it will be?

A. Sunday
B. Monday
C. Tuesday
D. Friday

26. Complete the series 2, 5, 9, 19, 37, ___

A. 76
B. 74
C. 75
D. None of these

27. A candidate who scores 30% fails by 5 marks, while another candidate who scores 40% marks gets 10 more than minimum passing marks. The minimum marks required to pass are:

A. 50
B. 100
C. 45
D. 150

28. Worker A can do a job in 12 days and worker B can do the same job in 10 days. With the help of worker C they can do the same job in 4 days. In how many days C alone can do this job?

A. 15 days
B. 14 days
C. 13 days
D. 12 days

29.The base thymine of the DNA of the fungus *Agaricus aff.* Augustus forms 20% of its composition. Which of the following is the most likely base composition of the genome?

A. A = 30 %, G = 30 % and C=20%
B. A = 20 %, G = 20 % and C=30%
C. A = 20%, G = 30 % and C = 30%
D. A = 30 %, G = 20 % and C=30%

30. A population of cells grown in adherent culture contains 0.4 mg protein per 10^6 cells. Actin comprises 4.5 % of the total protein. Given the M_r of actin is 42,000 and Avogadro's number is 6.02×10^{23}, which of the following equals the mean number of actin molecules per cell?

A. 2.58×10^{14} actin molecules
B. 2.58×10^{11} actin molecules
C. 2.58×10^{8} actin molecules
D. 2.58×10^{10} actin molecules

31. If $pK_1 = 2.34$ and $pK_2 = 9.60$, then the isoelectric point pI is

A. 5.87
B. 5.97
C. 3.67
D. 11.94

32. In 2019 Nobel prize was given to two scientists for their discovery of cancer therapy by inhibition of negative immune regulation. The scientists are

A. James P. Allison and Tasuku Honjo
B. Michael W. Young, Michael Rosbash
C. Yoshinori Ohsumi and Susumu Tonegawa
D. William C. Campbell, Satoshi Ōmura

33. In an ideal gas equation pV = nRT, n stands for

A. Number of gas molecules.
B. Avagadro number of gas molecules.
C. Equilibrium constant of the reaction.
D. Number of moles of the gas in question.

34. Phenol is acidic and corrosive while alcohol is not, despite both having an O-H group because ____

A. phenol has a very high pKa compared to alcohol
B. alcohol has a very high pka compared to phenol
C. pka for both are approximately same it's the pH which is different for the two
D. Alcohol is equally corrosive just that we don't see the corrosive effect obviously

35. Which of the following is **TRUE** ?

A. Reversible reactions are always reversible on their own
B. Reversible reaction must be forced to undergo the forward reaction
C. In a reversible reaction, products can react to form reactants
D. A reversible reaction always goes to completion

V-71

PART-B

36. "Once a gap, always a gap" in the alignment is observed in ___

A. Progressive multiple sequence alignment method
B. Needleman & Wunsch method
C. Smith & Watermann method
D. Heuristic method such as BLAST

37. The approach that can be used to predict the 3D structure of a protein with no template is

A. homology modeling
B. comparative modeling
C. fold recognition
D. ab initio modeling

38. In Ramachandran plot for L-residues, which is quadrant is completely disallowed?

A. $-180° \leq \phi \leq 0°$; $+180° \leq \psi \leq 0°$
B. $-180° \leq \phi \leq 0°$; $-180° \leq \psi \leq 0°$
C. $+180° \leq \phi \leq 0°$; $+180° \leq \psi \leq 0°$
D. $+180° \leq \phi \leq 0°$; $-180° \leq \psi \leq 0°$

39. Your lab partner is using BLAST, and the E value of the best hit is 10. This means that

A. he has found 10 proteins in the database that have the same sequence as his protein.
B. the chance that these similarities arose due to chance is one in 10^10.
C. there would be 10 matches with same alignment score in a database by chance alone.
D. the match in amino acid sequences is perfect, except for the amino acids at 10 positions.

40. "Six degrees of separation" in Network Biology means

A. There are few nodes with less than six degree and many nodes with degree greater than six
B. The average degree of nodes in a network is six
C. Any node can be reached from any other node with a six or less than six intermediate nodes
D. Any node can be reached from any other node with a six or more than six intermediate nodes

41. tBLAST X program is used for searching ___

A. translated DNA sequence against DNA database
B. translated DNA sequence against translated DNA database
C. Protein sequences against protein database
D. DNA sequence against translated DNA database

42. Dendrogram shows

A. Pair-wise alignment
B. Phylogenetic relationship
C. DNA Barcoding
D. Structure database

43. Overfitting in Machine learning

A. Model works well with training dataset but doesn't work with test set
B. Occurs because of too many parameters
C. Occurs because of imbalanced training dataset
D. All of the above

44. Which of the following is **NOT** a Machine learning method

A. Neural Networks
B. Receiver Operating Characteristics
C. Decision Trees
D. Support Vector Machine

45. Semi-independent folding units in proteins are referred to as ___

A. Oligomers
B. Domains
C. Active site
D. Subunits

46. Approximately, _____ amino acid residues are there in one turn of an α helix

A. 1
B. 2
C. 4
D. 5

47. The length of the largest of all the shortest paths of a network is

A. Clustering Coefficient
B. Network Diameter
C. Network Radius
D. Betweenness

48. One PAM distance between two protein homologs is

A. 1 accepted mutation per residue
B. 1 accepted mutation per 10 residues
C. 1 accepted mutation per 100 residues
D. 1 accepted mutation per 1000 residues

49. Which of the following is **TRUE** regarding Energy minimization?

A. Energy minimization is a random search process
B. Energy minimization uses gradient based methods
C. Energy minimization is nothing but a grid-search method
D. All of the above

50. Stable interaction between a drug and its receptor is characterized by all the interactions given below. However, of these ____ is the strongest.

A. Ionic bonding
B. Hydrogen bonding
C. hydrophobic contact
D. Van der Waals' interaction

51. Of the following statements about docking algorithms ____ is **FALSE**

A. Docking methods provide one unique solution.
B. Docking methods incorporating ligand flexibility are common.
C. Exploring search space is a major computational overhead.
D. Crystal structures of complexes are still the best validation methods for docking methods.

52. Which agent acts directly on the cell membrane of the microorganisms affecting its permeability

A. Penicillin
B. Nystatin
C. Tetracycline
D. Erythromycin

53. Monte Carlo Simulation is a

A. Systamatic search method
B. Random/Stochoistic search Method
C. Deterministic search method
D. Tabu Local Search method

54. How many protein coding genes constitute the human genome?

A. More than 1 million
B. Approximately 60,000
C. Approximately 24,000
D. Approximately 1,00,000

55. The protein folds having only one experimentally determined structure are referred to as ____

A. Orphan folds
B. Single folds
C. Special folds
D. Super folds

56. Total energy calculated for a homology model using a force-field is -1000Kcal/mole. Does this mean that the homology model is correct, given that the template total energy is also of the same value.

A. No. Empirical energy values are not at all the indicators of quality of structures without the knowledge of the energy surface of that molecule
B. Yes. Because the energy value is so low
C. Yes. This energy is same as that of the template
D. No. Total energy of the homology model should be less that of the template

57. In *pyrosequencing* the DNA templates to be sequenced are immobilized in the microwells, and in each cycle the four dNTPs are incubated one at a time for polymerisation, followed by detection of release of pyrophosphate from one of the incorporated dNTPs. Such technology can have a problem with

A. Sequencing DNA fragments longer than 200 bases
B. Sequencing of interspersed repeats
C. Correct detection of incorporated purines due the triple hydrogen bond
D. Sequencing of tandem repeat of single nucleotide

58. RNAseq is used for

A. Finding differentially expressed genes between two conditions
B. To obtain profile of gene activity across the life cycle (gene expression atlas)
C. Improving structural annotation (location of genes/isoforms) of respective genome
D. All of the above

59. Use of clustering techniques in a gene expression analysis involving multiple samples is typically used for finding genes that are

A. Upregulated
B. Downregulated
C. Coexpressed
D. Highly expressed

60. A type of DNA repeat used in molecular genetics for mapping traits is

A. Simple sequence repeats (SSR)
B. Macrosatellites
C. Long terminal repeats (LTR)
D. *Alu* repeats

V-71

61. Metagenomics is study of

A. Genomes available in public databases
B. Mixture of genomes of a community
C. Genomes for discovery of metabolites
D. Variation in genomes across a population

62. A low resolution map having information about the spacing between specific, short segments of DNA, on top of which the sequence-level information can be assembled is known as

A. Genetic map of genome
B. Chromosome map of genome
C. Physical map of genome
D. Optical map of genome

63. Genes, arising due to speciation, and performing same function, are

A. Orthologs
B. Paralogs
C. Analogs
D. Conserved gene

64. Proteins destined to be secreted move through the secretory pathway in the following order: The correct order of transport of protein in a secretory pathway is

A. cytoplasm-SER lumen-RER lumen-cis Golgi-median Golgi-trans Golgi-vesicles-fusion of vesicles with plasma membrane-exocytosis
B. cytoplasm-RER lumen-cis Golgi-median Golgi-trans Golgi-vesicles-fusion of vesicles with plasma membrane-exocytosis
C. cytoplasm- vesicles -SER lumen-RER lumen-cis Golgi-median Golgi-trans Golgi-fusion of vesicles with plasma membrane-exocytosis
D. cytoplasm- RER lumen-trans Golgi -median Golgi-cis Golgi -vesicles-fusion of vesicles with plasma membrane-exocytosis

65. Yamanaka factors are highly expressed in embryonic stem (ES) cells, and their over-expression can induce pluripotency in both mouse and human somatic cells. What are those four factors?

A. Oct3/4, Sox2, nanog, c-Myc
B. fox3, Sox2, Klf4, c-Myc
C. Oct3/4, Sox2, Klf4, c-Myc
D. Oct3/4, Sox2, Klf4, ascorbic acid

66. Retinoblastoma (Rb) acts as tumour suppressor and it is dysfunctional in several cancers. Which of the following is correct regarding Rb tumor suppressor protein?

    A. It interacts E2F transcription factor and prevents cell from entering S phase until a mitogenic signal is received
    B. Its activation phosphorylated by Cdk
    C. It is a transcription factor
    D. When a mitogenic signal is received, it binds the transcription factor E2F and thus stimulates the cell to enter S phase

67. Which of the following plays a major role in extrinsic cell death pathway?

    A. G protein coupled receptor signalling
    B. TRADD
    C. IRS-1
    D. Protein-kinase C

68. Changing three amino acids in a particular enzyme increases its catalytic efficiency. Which of the following methods can be used to change those three amino acids?

    A. PCR
    B. Gene knockout
    C. Site directed mutagenesis
    D. Knock in particular protein

69. A protein X is synthesized and is degraded. The ODE for modeling this system is given by ___ (where, [X] = concentration of X, Nx = number of X molecules, t= time, X' = dX/dt, k1 and k2 = rate constants for synthesis and degradation of the protein respectively)

    A. X' = k1 - k2*Nx
    B. X' = k1+ k2*[X]
    C. X' = k1 - k2*[X]
    D. X' = -k1 – k2*[X]

70. An enzyme E is processing a substrate S at a rate v1; the ODE describing this biochemical reaction comprises of ____as state variable and ____ as parameter

    A. Enzyme concentration; substrate concentration
    B. Substrate concentration; enzyme concentration
    C. Number of substrate molecules; enzyme concentration
    D. Substrate concentration; number of enzyme molecules

University of Hyderabad

Entrance Examinations - 2019

School/Department/Centre: **School of Life Sciences, Department of Systems and Computational Biology**

Course/Subject : **PhD in Systems and Computational Biology (Code No. V-71)**

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
1	B	26	C	51	A	76	
2	D	27	A	52	A	77	
3	A	28	A	53	B	78	
4	C	29	C	54	C	79	
5	D	30	C	55	A	80	
6	A	31	B	56	A	81	
7	D	32	A	57	D	82	
8	A	33	D	58	D	83	
9	B	34	B	59	C	84	
10	B	35	C	60	A	85	
11	A	36	A	61	B	86	
12	A	37	D	62	C	87	
13	D	38	D	63	A	88	
14	C	39	C	64	B	89	
15	A	40	C	65	C	90	
16	C	41	B	66	A	91	
17	D	42	B	67	B	92	
18	A	43	D	68	C	93	
19	C	44	B	69	C	94	
20	D	45	B	70	B	95	
21	B	46	C	71		96	
22	A	47	B	72		97	
23	A	48	C	73		98	
24	C	49	B	74		99	
25	B	50	A	75		100	

Note/Remarks : None

Signature Prof. H.A. NAGARAJARAM
Head
School/Department/Centre utational Biology