4-73

ENTRANCE EXAMINATIONS – 2020

(Ph.D. Admissions - January 2021 Session)

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 15 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 NO negative marking for wrong answers.**
8. Non-programmable scientific calculators are permitted.
9. Cell, Mobile Phones are strictly prohibited in the examination hall.

Part A

1. A train moves with a speed of 200 km/hr, its speed in meter/second is

   A. 45.55
   B. 40.55
   C. 50.55
   D. 55.55

2. Pipe X can fill a tank in 4 hours, pipe Y in 8 hours. If both the pipes are open, in how many hours will the tank be filled?

   A. 2 hours
   B. 2.67 hours
   C. 3 hours
   D. 2.25 hours

3. The central limit theorem states that ___

   A. If the sample size increases sampling distribution approaches normal distribution
   B. If the sample size decreases sample distribution approaches normal distribution
   C. If the sample size increases sampling distribution approaches exponential distribution
   D. If the sample size decreases sampling distribution approaches exponential distribution

4. Type 1 error means ___

   A. Rejection of null hypothesis even if it is True
   B. Rejection of null hypothesis even if it is False
   C. Acceptance of null hypothesis even if it is True
   D. Acceptance of null hypothesis even if it is False

5. Confidence coefficient of alternative hypothesis is represented by ____

   A. α
   B. β
   C. $1-\beta$
   D. $1-\alpha$

6. If one litre solution contains 60% concentration of solute, what is the amount of solvent required to dilute the solution such that the solute concentration reaches 20%?

   A. 1000 ml
   B. 2000 ml
   C. 3000 ml
   D. 5000 ml

7. In an enzyme catalytic reaction, the mode of enzyme catalysis is through

   A. Increase in activation energy of intermediate state and for product formation
   B. Decrease in activation energy of intermediate state and for product formation
   C. Increase in activation energy of intermediate state and decrease in activation energy for product formation
   D. Decrease in activation energy of intermediate state and increase in activation energy for product formation

8. The overall order for the reaction A+ 2B —> 3C with rate equation rate $=k[A][B]^2$ is?

   A. Zero
   B. First
   C. Second
   D. Third

9. For a population with 0.1 minor allele frequency, the frequency of heterozygotes will be

   A. 0.01
   B. 0.18
   C. 0.81
   D. 0.1

10. In 2013, ___ , ____ and _____ received Nobel Prize in Computational Chemistry for developing computer-based methods to model complex systems.

    A. François Englert, Martin Karplus and Peter W
    B. Alice Munro, Michael Levitt and Arieh Warshel
    C. Martin Karplus, Michael Levitt, and Arieh Warshel
    D. James E. Rothman, Randy W. Schekman and Thomas C. Südhof

11. The concentration of carbon monoxide, CO, in the air near a busy road is a function of distance from the road. The concentration decays exponentially at a continuous rate of 3.3% per meter. At what distance from the road, the concentration of CO becomes half?

    A. 21 m
    B. 31 m
    C. 41 m
    D. 51 m

12. sinh(x) =

A. $(e^x - e^{-x})/2$

B. $(e^x + e^{-x})/2$

C. $(e^x - e^{-x})/(e^x + e^{-x})$

D. $(e^x + e^{-x})/(e^x - e^{-x})$

13. If the positional coordinates of two points A and B are (x_A, y_A, z_A) and (x_B, y_B, z_B), respectively, the distance between these points is

A. $(x_A - x_B) + (y_A - y_B) + (z_A - z_B)$

B. $\sqrt{(x_A - x_B)^2 + (y_A - y_B)^2 + (z_A - z_B)^2}$

C. $(x_A + x_B) + (y_A + y_B) + (z_A + z_B)$

D. $\sqrt{(x_A + x_B)^2 + (y_A + y_B)^2 + (z_A + z_B)^2}$

14. A company employs a total of 16 workers. The employees have decided to select 2 workers randomly. How many ways selections can be made considering that the order of selection is important?

A. 240
B. 120
C. 16!
D. 8!

15. Consider that a fair coin is tossed ten times. What is the probability of getting four '*heads*'?

A. $\frac{10!}{4!}(0.5)^4(0.5)^6$

B. $\frac{10!}{6!}(0.5)^4(0.5)^6$

C. $\frac{10!}{4!\,6!}(0.5)^4$

D. $\frac{10!}{4!\,6!}(0.5)^4(0.5)^6$

16. Which among the following is the main constituent of Biogas?

A. Methane
B. Propane
C. Butane
D. Ethane

17. A bacterial genome is 60% GC rich. The probability of finding the subsequence GCGCGC anywhere in the genome is ___

A. 6 X 0.3
B. 6 X 0.2
C. $(0.3)^6$
D. $(0.2)^6$

18. The algebraic function that satisfies the following statement "Oscillates between the values +3 and +1 with an amplitude of 1 and the roots of this function are at $\frac{n\pi}{2}$ where $n \in Z$ (where Z is the set of integers)" is ___

A. 3sin2x
B. cosx + 2
C. sinx + 2
D. 3cos2x

19. $\lim_{x\to 0} \frac{1-cosx}{x} = ?$

A. 1
B. 0
C. 2
D. ∞

20. In a typical normal distribution, the z-score << -3 indicates that the probability (p) of finding the value of a random variable X is ____

A. << 0.01
B. >> 0.01
C. 0.05 > p > 0.01
D. >>0.05

21. Of the following hexapeptides ___ corresponds to the sequence of only polar and charged residues

A. PPPPPP
B. RTSKKR
C. CTCCAA
D. HYWILP

22. The bond order of all the covalent bonds in a methane molecule is ___

A. Double
B. Triple
C. A mix of double and single
D. Single

23. $\int_a^b \frac{1}{x} dx = ?$

A. Cannot be calculated
B. $\ln(b) - \ln(a)$
C. $e^b - e^a$
D. $\ln(a) - \ln(b)$

24. In a protein structure the amino acid residues Lys and Glu are found to form a salt-bridge interaction. The most appropriate explanation is ___

A. The side chains are oppositely charged and are involved in ionic interactions with each other
B. The side chains are involved in covalent interactions
C. The side chains are involved in H-bond interactions with each other
D. Both the amino acid residues are involved in main chain-main chain ionic interactions

25. What is the radius of the sphere whose center is at (0,0,0) and passes through (2,1,3)?

A. 3.99
B. 6.00
C. 3.74
D. 2.73

26. How many integers are there in the solution set of $|x-2| > 1$ if $x \in$ {set of integers} ?

A. 100
B. 1000
C. 10000
D. an infinite number

27. The book entitled "The Man Who Knew Infinity" is a biographical sketch of –

A. S. Hawking
B. S. Ramanujan
C. C.V. Raman
D. A. Einstein

28. How many copies of a gene are present in a diploid cell?

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

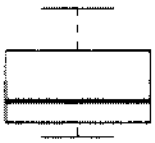
29. What is 'Single Nucleotide Polymorphism'?

A. A disease-causing mutation
B. A substitution mutation occurring in $\geq 1\%$ of population
C. A substitution mutation occurring in $< 1\%$ of population
D. An indel mutation

30. If a table of 10 rows and 20 columns needs to be populated using a computer program, then a minimum of how many for loops would be needed?

A. 10+20
B. 1
C. 2
D. 1+2

31. What does the box represent in the boxplot?

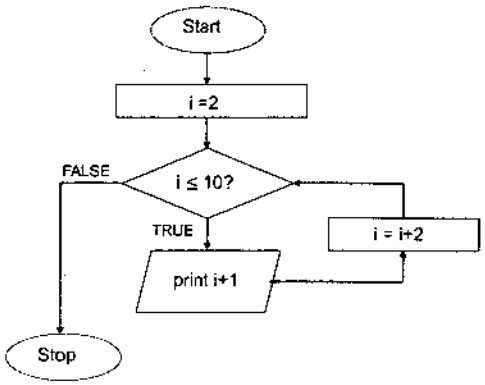


A. Region between 3rd and 4th quartile
B. Region between 1st and 2nd quartile
C. Region between 1st and 3rd quartile
D. Region between 2nd and 3rd quartile

32. For $f(x) = e^x$ and $g(x)=x^2$, the value of $g(f(1))$ is

A. 1
B. 0
C. e
D. e^2

33. What will be the output of an algorithm represented by the following flowchart?



A. 3, 6, 8,10
B. 3, 5, 7, 9
C. 3, 4, 6, 8
D. 3, 5, 8, 9

34. If a population, *P(t)*, is a function of time (in months) and is defined as,

$$P(t) = e^{kt}$$

if $P(12) = 100$ then the value of k should be

A. 0.13
B. 0.38
C. 0.54
D. 0.71

35. A newly formulated antidiabetic drug was tested on 10000 volunteers. The fasting blood sugar values were measured before and after medication and their mean values were found to be 150 and 110. A statistical significance test was performed and the corresponding p-value was found to be << 0.05. If the null hypothesis is "drug is not effective", what would be your interpretation on this clinical trial ____

A. the statement "drug is not effective" is rejected given the sample size
B. the drug is ineffective given the sample size
C. one cannot say anything about the efficacy of the drug.
D. the p-value is so low which indicates that the dosage needs to altered and the clinical trial has to be repeated

Part B

36. A nucleotide sequence encodes for a protein is identified by

A. six frame translation of both sense and anti-sense strand followed by finding open reading frame
B. three frame translation of sense strand followed by finding open reading frame
C. finding if methionine is present
D. finding if promoter sequence is present upstream

37. Differentially expressed genes _____

A. show statistically significant higher or lower expression values in test samples as compared with control samples
B. always show statistically significant higher expression in test samples as compared with control samples
C. always show statistically significant lower expression in test samples as compared with control samples.
D. cannot be identified based on expression data of just test and control samples.

38. Gene ontology ____

A. is about establishing evolutionary relationship among genes
B. uses controlled vocabulary to describe the function of genes and gene products
C. involves curation of genes involved in oncology
D. is a method of gene prediction

39. microRNAs are generally 18-24 nucleotides long ____

A. RNA duplexes
B. non coding RNAs
C. protein coding RNAs
D. protein bound RNAs

40. The mitochondrial genome sequence of a eukaryotic species is likely to show higher similarity with

A. nuclear genome sequences of evolutionary closer eukaryotic species
B. nuclear genome sequences of same species
C. genome sequences of bacteria
D. viral genome sequences

41. A negative (purifying) selection is indicated by
    A. Higher rates of synonymous mutations as compared with non-synonymous mutations
    B. Lower rates of synonymous mutations as compared with non-synonymous mutations
    C. Similar rates of synonymous and non-synonymous mutations
    D. None of the Above

42. 'Hash' in PERL and 'Dictionary' in PYTHON languages are data structures suitable for storing multiple paired information in the form of key-value pairs, such that the keys must be unique. These may be suitable for storing

    A. codons as keys and respective amino-acids as values
    B. amino-acids as keys and respective codons as values
    C. each nucleotide of a DNA sequence as keys and corresponding positions as values
    D. gene function as keys and gene-ID as values

43. Coverage (*n*X) is the number of times a genome has been sequenced. Assume that a sample of human genome (3 billion bases) is to be sequenced such that 90 billion bases of data is generated. What will be its average coverage?

    A. 90X
    B. 87X
    C. 270X
    D. 30X

44. Hierarchical clustering of a multi-dimensional data set is an example of

    A. supervised learning
    B. semi-supervised learning
    C. unsupervised learning
    D. pseudo-supervised learning

45. Select the most appropriate answer.
    Functions or subroutines in the programming languages are created for

    A. Storing a value
    B. reusing the code
    C. debugging the program
    D. exiting the program

46. Which substitution matrices one should prefer to find closely related orthologs through BLAST search?

    A. BLOSUM 40 and PAM 250
    B. BLOSUM 40 and PAM 120
    C. BLOSUM 62 and PAM 250
    D. BLOSUM 62 and PAM 120

47. Match the items in Group 1 with an appropriate description in Group 2

Group 1	Group 2
P. Neighbor-joining	1. Protein sequence database
Q. CLUSTALW	2. Phylogenetic Analysis
R. SWISS-PROT	3. Search Engine
S. Entrez	4. Multiple Sequence Alignment

A. P-2, Q-1, R-4, S-3
B. P-2, Q-4, R-1, S-3
C. P-4, Q-1, R-2, S-3
D. P-4, Q-4, R-4, S-3

48. The basic unit of chromatin organization is

A. Histone
B. Nucleosome
C. DNA
D. Nucleolus

49. If A inhibits B and B inhibits C and C inhibits A, then the system represents

A. Actuator-inhibitor
B. Accelerator
C. Repressilator
D. Toggle-switch

50. The unit of rate constant for the first order biochemical reaction is given by

A. $time^{-1}$
B. concentration/time
C. $concentration/time^2$
D. time/concentration

51. Ordinary differential equations model

A. Change in species/reactant concentration
B. Rate of change in reactant concentration per unit change in time
C. Rate of change in reactant concentration per unit change in space and time
D. Rate of change of parameters per unit change in time

52. In a reaction where A converts to B with rate k,

A. A and B are parameters and k is a variable
B. A and k are variables and B is a parameter
C. A and B are variables and k is a parameter
D. A and B are parameters and k is a variable

53. In the Hills kinetics the Hill coefficient of greater than 1 represents

A. Fast response
B. Ultra-sensitive response
C. Delayed response
D. Sub-sensitive response

54. The network motif with an incoherent feed forward loop produces a

A. Graded response
B. Pulse response
C. Oscillations
D. Delayed response

55. If the degradation of a biomolecule follows a Michaelis-Menten rate kinetics, at what concentration of biomolecule the degradation rate is independent of substrate concentration? (Assume degradation rate is given by S/(S+Km))

A. S<<Km
B. S=Km
C. S>>Km
D. S= Km^2

56. In an oscillator, if the frequency of the oscillations is doubled, what happens to the period of the oscillation

A. Period is doubled
B. Period is reduced to half
C. Period increases four-fold
D. Period doesn't change

57. Hybridization of carbon in CO_2 is

A. sp^3
B. sp^2
C. sp
D. sp^2d

58. Total number of fundamental vibrational modes of H_2O is

A. 5
B. 4
C. 2
D. 3

59. Choose the *CORRECT* statement from the following statements (assume neutral pH)

A. The oligo peptide AAARTT is charged and the total charge is +1
B. The oligo peptide RRRTT is neutral
C. The oligo peptide CCPPTT is charged and the total charge is -2
D. The oligo peptide KKKTRR is neutral

60. Proline is rarely found in helices because

A. It is a hydrophobic residue
B. It doesn't have a polar side chain
C. The backbone φ angle is highly restricted to -60^0
D. It lacks amide hydrogen to take part in the intrahelical H-bond that stabilizes helices

61. In the Ramachandran Map the (φ, ψ) angles of (0,0) are _____ because _____

A. Allowed, there no steric clashes
B. Disallowed, of steric clashes of backbone atoms
C. Disallowed, no stabilizing interactions are possible within the peptide backbone
D. Allowed, there are stabilizing interactions within the peptide backbone

62. Soluble globular proteins are typically characterized by ____

A. Mostly a hydrophobic core and hydrophilic surface
B. Hydrophilic core and hydrophobic surface
C. Buried charged residues and exposed hydrophobic residues
D. Buried bulky amino acids and exposed small amino acids

63. A molecule of Methane is in ____ geometry

A. trigonal
B. icosahedral
C. tetrahedral
D. planar

64. Hydrogen bonds are _____ and, essentially _____ interactions.

A. weak, covalent
B. weak, electrostatic
C. strong, electrostatic
D. strong, covalent

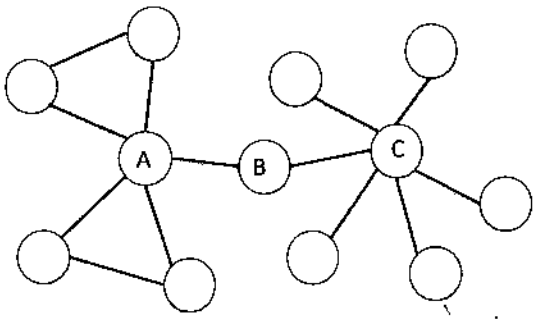
65. A protein 3D structure is composed of just one domain and you find that about 85% of the amino acid residues are in helices and remaining are in loops. What structural class do you assign this protein to?

A. α-Class
B. β-Class
C. α+β- Class
D. α/β- Class

66. Expect (E) value in BLAST is dependent _____

A. Only on % similarity between query and subject
B. on length of the query and % similarity between query and subject
C. only on the local alignment score
D. on product of length of query and size of database that is being searched

67. Which statement is *CORRECT* about the nodes A, B and C (assume any node with degree > 2 as hub)



A. Nodes A and B are hubs
B. Nodes A and C are hubs
C. Only node B is hub
D. Only node A is hub

68. In a eukaryotic cell cycle, the order of cell cycle phases for a newly formed daughter cell is

A. Gap 1, Mitotic phase, Gap 2, Synthetic phase
B. Mitotic phase, Gap 1, Synthetic phase, Gap 2
C. Gap 1, Synthetic phase, Gap 2, Mitotic phase
D. Synthetic phase, G1, Mitotic phase, Gap 2

69. Which of the following is not a common type of receptor?

A. Ion channel
B. Protein kinase
C. Adenylyl cyclase
D. G protein–linked receptor

70. The length of the largest shortest path of the network gives

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

University of Hyderabad

Entrance Examinations - 2021

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

Course/Subject : **Systems and Computational Biology**

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

Note/Remarks :

Signature

School/Department/Centre

Head
School of Life Sciences
University of Hyderabad
Hyderabad-500 046.