Code No. A-60

ENTRANCE EXAMINATIONS 2021

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 18 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 recursive function will be most appropriate for finding

   A. sum of two numbers
   B. factorial of a number
   C. mean of a set of numbers
   D. median of a set of numbers

2. Go through the pseudocode below and choose the output of the code

```
codon='UAA'
if((codon=='UAG') AND (codon=='UGA') AND (codon=='UAA')){
      print "okay"
      }
elseif((codon=='UAG') OR (codon=='UGA') OR(codon=='UAA')){
      print "Not okay"
      }
where '==' means ''equals to'
```

   A. "okay"
   B. "Not okay"
   C. there will be no output of this program
   D. both "okay" and "Not okay" will be printed together

3. If a gene has five exons, and that gene undergoes canonical splicing mechanism that results in different isoforms such that the first and the last exons are present in all isoforms. How many isoforms are possible ?

   A. 3
   B. 4
   C. 5
   D. 8

4. Of the following symbol/name combinations of elements, which one is ***INCORRECT*** ?

   A. C/carbon
   B. B/barium
   C. F/fluorine
   D. N/nitrogen

5. The neutral atoms of all of the isotopes of the same element have

   A. different numbers of protons
   B. equal numbers of neutrons
   C. the same number of electrons
   D. the same mass numbers

6. The Heisenberg Principle states that _____

   A. it is impossible to determine accurately both the position and momentum of an electron simultaneously.
   B. no two electrons in the same atom can have the same set of four quantum numbers.
   C. two atoms of the same element must have the same number of protons.
   D. electrons of atoms in their ground states enter energetically equivalent sets of orbitals singly before they pair up in any orbital of the set.

7. The valence electrons of representative elements are

   A. in s orbitals only
   B. located closest to the nucleus
   C. located in d orbitals
   D. located in the outermost occupied major energy level

8. What is the smallest unit of the information?

   A. A bit
   B. A byte
   C. A block
   D. A band

9. Which of the following natural elements is primarily used in designing of computer chips?

   A. Silicon
   B. Carbon
   C. Iron
   D. Uranium

10. Let two fair dice are thrown at a time. What is the probability of getting two '6's simultaneously?

A. 1/2
B. 1/6
C. 1/12
D. 1/36

11. If the mean of first n natural numbers is $3n/5$, then the value of n is

A. 3
B. 4
C. 5
D. 6

12. The probability of a red marble selected at random from a jar containing p red marbles, q blue marbles and r green marbles is equal to

A. $\frac{p}{p+q+r}$

B. $\frac{q}{p+q+r}$

C. $\frac{p}{p+q}$

D. $\frac{p}{p+r}$

13. For a probability density function f(X) of a continuous random variable X, what is the value of $\int_{-\infty}^{\infty} f(X)$?

A. 0
B. 1
C. Undefined
D. Insufficient data

14. Let E be the expectation of a random variable X, what is the variance of X denoted by?

A. $(E(X))^2$
B. $E(X^2)-(E(X))^2$
C. $E(X^2)$
D. $2E(X)$

15. In a group of 60 members, every member posts a greeting card to every other member of the group. In total how many greeting cards are posted by all ?

A. 1800
B. 3600
C. 3540
D. 1980

16. For a standard normal distribution, the value of median is

A. ∞
B. 1
C. 0
D. not defined

17. The probability of Type 2 error is referred to as

A. $1-\alpha$
B. β
C. α
D. $1-\beta$

18. Which of the following tests is used to perform ANOVA (Analysis of variance)?

A. *t* test
B. z test
C. F test
D. χ^2 test

19. If P(X) = 0.5 and X = 5, then the expectation value E(X) is

A. 2.6
B. 2.8
C. 2.2
D. 2.5

20. In a typical force-field the energy associated with a covalent bond E(Δb) is computed using _____ function of Δb, where Δb= (b-b_o); b and b_o are respectively the calculated and standard bond lengths between two atoms

A. a quadratic
B. a circular trigonometric
C. an exponential
D. a logarithmic

21. In a box plot representation of a certain data distribution with no outliers, the lower and upper whiskers represent the ___ values respectively

A. first and the second quartile values
B. first and the third quartile values
C. extreme low and extreme high values
D. third quartile and the median values

22. If the minimum of a function $y = f(x)$, is -1 then the function is

A. $(x^3 + x)$
B. $(x^2 - 2x)$
C. $(x^2 + 2x)$
D. $(-2x)$

23. The mean of the means of randomly drawn samples of the same size from a normally distributed population is equal to

A. the population mean divided by the sample size
B. the population mean multiplied by the sample size
C. the population variance itself
D. the population mean itself

24. What is the binomial probability for an outcome with two successes ("H") when a coin is tossed three times? (Hint: use the binomial probability mass function)

A. 0.630
B. 0.131
C. 0.375
D. 0.500

25. The mean of a population (μ) with known variance (σ^2) is estimated within a given confidence interval (C.I) using ___

A. $\bar{x} \pm (z * \sigma/\sqrt{n})$
B. $\bar{x}$ alone
C. $\bar{x} \pm z$
D. $\bar{x} \pm (\sigma/\sqrt{n})$

(where, $\bar{x}$ = a sample mean, z = confidence coefficient at a given C.I., n = sample size and σ = population standard deviation)

26. z -score corresponding to a random variable X in a normally distributed population is calculated using ____

A. $z(X) = \frac{(X-\mu)}{\sigma}$
B. $z(X) = \frac{(X-\mu)^2}{\sigma}$
C. $z(X) = \frac{(X-\mu)}{\sigma^2}$
D. $z(X) = \frac{(X-\mu)^2}{\sigma^2}$

(here, μ and σ are the population mean and standard deviation respectively)

27. Nobel prize for "the development of a method for genome editing" was won by Emmanuelle Chapentier and Jennifer A. Doudna in ___

A. Medicine 2020
B. Chemistry 2020
C. Chemistry 2019
D. Medicine 2019

28. Which method is ***NOT*** used for biological sequence alignment?

A. Dot matrix
B. Parsimonious method
C. Dynamic Programming
D. Heuristic Approach

29. What is the output of the following pseudocode?

```
Integer i
Set i = 3
do
Print i + 2
i = i - 1
while(i not equals 0)
end
```

A. 5 5 5
B. 5 4 3
C. 6 5 4
D. 4 4 4

30. Semi-independent folding unit of a protein is called

A. Motif
B. Catalytic site
C. Domain
D. Module

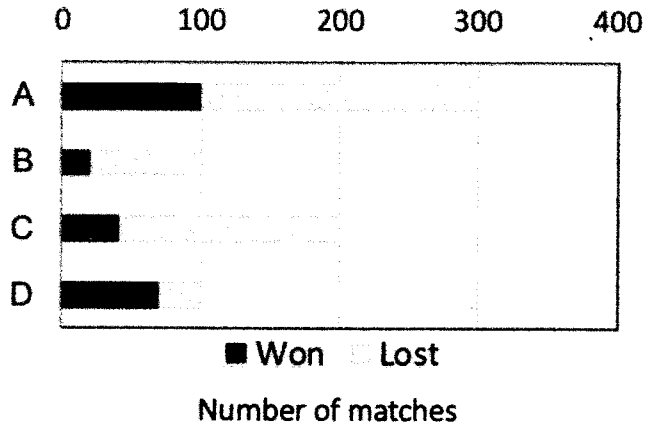
31. 25% of 25% of a quantity is x% of the quantity, where x is

A. 50%
B. 12.5%
C. 6.25%
D. 50%

32. A man starts shopping with X rupees and Y paise, spends Rs. 3.50 and is left with 2Y rupees and 2X paise. What is the amount he started with?

A. Rs. 23.42
B. Rs. 28.64
C. Rs. 48.24
D. Rs. 32.14

33. The bar-chart below shows the number of matches won by four teams A, B, C, D. Which team won the largest proportion of matches it played.



A. A
B. B
C. C
D. D

34. A disease that is present in a community for long time with a constant frequency is referred to as

A. Epidemic
B. Endemic
C. Pandemic
D. Outbreak

35. If a protein encoding sequence (excluding the last codon) has equal frequency of all amino acid encoding codons, the frequency of each codon will be

A. 1/61
B. 1/3
C. 1/20
D. 1/12

Part B

36. 'Statistical ensemble' is a

A. collection of particles
B. collection of molecules
C. collection of groups
D. collection of systems

37. Total kinetic energy of a 3-dimensional harmonic oscillator is

A. $k_x x^2 + k_y y^2 + k_z z^2$

B. $k_x \dot{x}^2 + k_y \dot{y}^2 + k_z \dot{z}^2$

C. $\frac{k_x}{2} x^2 + \frac{k_y}{2} y^2 + \frac{k_z}{2} z^2$

D. $\frac{m}{2} \dot{x}^2 + \frac{m}{2} \dot{y}^2 + \frac{m}{2} \dot{z}^2$

(where, k_i is the spring constant and x,y,z are displacements along the three directions, m is mass)

38. _____ interactions are due to the attraction between temporary dipoles and their induced temporary dipoles

A. Metallic bond
B. London dispersion
C. Hydrogen bond
D. Ionic bond

39. Which of the following primarily drives a protein to adopt its native 3-dimensional structure?

A. Peptide bonds
B. Amino acid sequence
C. Interaction with other polypeptides
D. Interaction with molecular chaperons

40. Which of the following techniques is used for determining protein structures?

A. X-ray crystallography
B. Kryptonics X-ray vision
C. Magnetic resonance imaging (MRI)
D. Scanning Tunneling Microscope (STM)

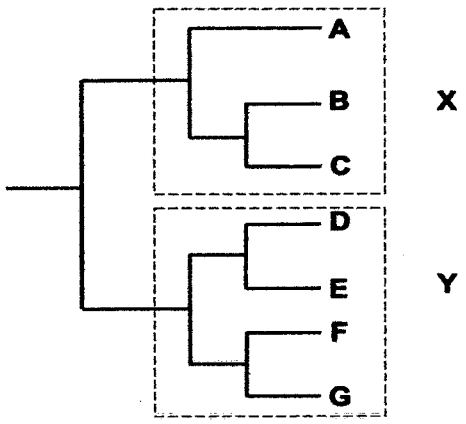
41. Which one of these is a multiple sequence alignment tool?

A. BLAST
B. PYMOL
C. T-COFFEE
D. MODELLER

42. The pairwise alignment of whole sequences is referred to as

A. Local alignment
B. Global alignment
C. Heuristic alignment
D. Progressive alignment

43. Which statement is CORRECT based on the phylogenetic tree given below?

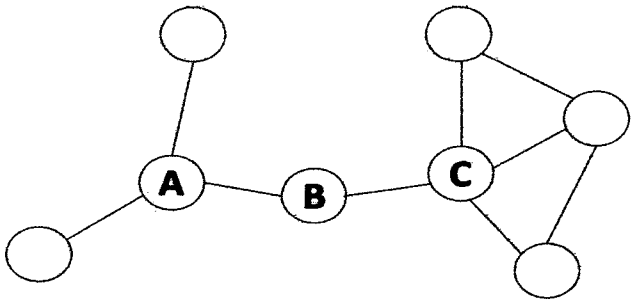


A. Only X is monophyletic
B. Only Y is monophyletic
C. X and Y are paraphyletic
D. X and Y are monophyletic

44. Members of a multigene family show

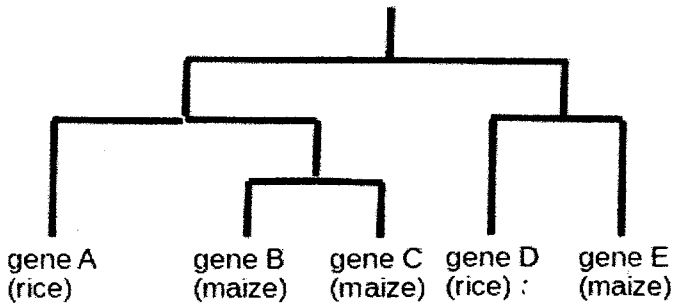
A. one or more conserved domains
B. exactly same length and identical sequence
C. identical coding sequence
D. same nucleotide composition

45. Choose the ***CORRECT*** statement.



A. The clustering coefficient of node A is greater than node C
B. The degree of node B is greater than node C
C. The shortest path between node A and node C is 4
D. The betweenness of node B is greater than node A

46. Given the phylogenetic tree shown below, which statement is ***INCORRECT*** about the relationship among genes from maize and rice?



A. genes B and C are paralogs
B. genes A and E are orthologs
C. gene A is co-orthologs of genes B and C
D. genes B and C are likely to have originated after duplication

47. Comparison of genomes of individuals of a species generally shows groups of linked loci which are inherited together. Such combination of alleles from multiple loci from same homologous region of any chromosome is called

A. genotype
B. haplotype
C. linkage map
D. gamete

48. Which of the following features ***DOES NOT*** distinguish nuclear and organelle genomes of human?

A. Watson-crick base pairing
B. genetic code
C. long interspersed repeats
D. functional categories of the genes present in the genome

49. Which statement is ***INCORRECT*** about microarray?

A. It is a technique for genome-wide transcriptome profiling
B. Expression level of transcripts is estimated from the intensity of the respective dyes
C. It is based on hybridization of probes with labelled cDNA
D. The probes are double stranded

50. Activity of which enzyme has ***NO*** effect on the gene expression?

A. DNA polymerase
B. Histone acetylase
C. Histone methyltransferase
D. DNA methyltransferase

51. Uniprot is a primary database of

A. protein sequences and their functions
B. protist genomes
C. protein families and superfamilies
D. protein structures and interactions

52. Which of the following biological observations is ***likely*** to show Poisson distribution?

A. number of errors during replication of a piece of genomic DNA
B. height of human adults
C. GC composition of fragments of a genome
D. weight of human adults

53. The mass balance equation is given by Accumulation = Input – x + Generation, what is x?

A. Consumption – Output
B. Consumption + Output
C. Output – Consumption
D. None of the above

54. Consider a process with two inputs and one output. Let the input feed rates be 300 kg/sec and 700 kg/sec and the output rate be 800 kg/sec. What is the mass accumulated in the chamber in 5 seconds?

A. 800 kg
B. 500 kg
C. 1000 kg
D. 1500 kg

55. How will you model the following reaction scheme?

A. dA/dt = k1-k2
B. dA/dt = k1*A-k2
C. dA/dt = k1-k2*A
D. dA/dt =(k1-k2)*A

56. A transient parameter perturbation of a short duration in a circadian clock machinery affects the following property of the oscillations

A. Amplitude
B. Period
C. Phase difference
D. Both A and B

57. What is the output of the logic gate A (NAND) B when A= [0 1 0 1] and B= [1 1 0 0] ?

A. 1100
B. 0100
C. 0011
D. 0001

58. The equilibrium constant for a reaction $2A+B \rightarrow 3C$ is given by

A. $K_{eq}= [3C] / ([2A]+[B])$

B. $K_{eq}= [2A][B] / [3C]$

C. $K_{eq}= [C]^3 / ([A]^2+[B])$

D. $K_{eq}= [C]^3 / ([A]^2[B])$

59. In the non-competitive enzyme kinetics, the inhibitor activity affects

A. Km

B. Vmax

C. S

D. Km and Vmax

60. What is the alignment score for pair-wise alignment given below if the score for match = 2, mismatch = 1, gap opening = 0 and gap extension = -1 ?

```
A T G T G T A G
|     | |     |
A - - T G - G G
```

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

61. The dihedral angles described by the peptide backbone atoms C_{i-1}-N_i-C_i^{α}-C_i and N_i-C_i^{α}-C_i-N_{i+1} are

A. ω_i and ψ_i
B. ϕ_i and ψ_{i+1}
C. ϕ_{i-1} and ψ_i
D. ϕ_i and ψ_i

62. Which of the following statements is *INCORRECT*?

A. Chou-Fasman method is used for prediction of secondary structures in proteins using their amino acid sequences
B. Autodock is a protein-ligand docking method
C. PSIPRED is a RNA secondary structure prediction tool
D. MODELLER is a Homology modelling method for proteins

63. Degree in a typical scale-free network follows a ____

A. Power law distribution
B. Poisson distribution
C. Gaussian distribution
D. Boltzman distribution

64. Microsatellites are the DNA sequences comprising of tandemly repeating motifs of the size __ bp

A. 20-50
B. 1-6
C. 100-200
D. 1000-2000

65. In Smith-Waterman algorithm for local alignments the alignment scores matrix can have ___ values

A. both negative and positive
B. only negative
C. both positive and zero
D. both negative and zero

66. A Human Disease Network (HDN) is characterized by ___

A. Diseases as nodes and disease genes common between a pair of nodes as edges
B. Disease genes as nodes and diseases shared by a pair of nodes as edges
C. Diseases as nodes and the shared clinical symptoms between a pair of nodes as edges
D. Disease genes as nodes and the shared disease-causing mutations between a pair of nodes as edges

67. In a protein-protein interaction network, date hubs are the proteins

A. characterized by a well correlated expression values with their interacting partners
B. linking distinct functional modules within the network and hence are intermodular
C. whose deletions do not cause network disintegration
D. of non-essential genes

68. Which of the following scoring matrices is the ***most*** appropriate for aligning two sequences that are the closest homologs?

A. BLOSUM40
B. PAM250
C. PAM120
D. BLOSUM90

69. Which of the following RNA types harbors the highest number of RNA modifications per 100 base pairs?

A. rRNA
B. mRNA
C. tRNA
D. piRNA

70. Which of the following statements is ***CORRECT***?

A. Viral proteins typically interact with only tissue-specific human proteins
B. Viral proteins only interact with the human proteins that are having low centrality values
C. Viral proteins typically interact with the human proteins with high centrality values which are mostly universally expressed
D. Viral proteins only interact with the human proteins that are expressed during the viral infection

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	B	26	A	51	A	76	
2	B	27	B	52	A	77	
3	D	28	B	53	B	78	
4	B	29	B	54	C	79	
5	C	30	C	55	C	80	
6	A	31	C	56	C	81	
7	D	32	D	57	B	82	
8	A	33	D	58	D	83	
9	A	34	B	59	B	84	
10	D	35	A	60	C	85	
11	C	36	D	61	D	86	
12	A	37	D	62	C	87	
13	B	38	B	63	A	88	
14	B	39	B	64	B	89	
15	C	40	A	65	C	90	
16	C	41	C	66	A	91	
17	B	42	B	67	B	92	
18	C	43	D	68	D	93	
19	D	44	A	69	C	94	
20	A	45	D	70	C	95	
21	C	46	B	71		96	
22	C	47	B	72		97	
23	D	48	A	73		98	
24	C	49	D	74		99	
25	A	50	A	75		100	

Note/Remarks :

Signature

अध्यक्ष / HEAD
सिस्टम्स एवं कम्प्यूटेशनल बॉलिजी विभाग