

Code No. B-11

ENTRANCE EXAMINATION - 2022

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. Write your Hall ticket number in the OMR answer sheet given to you. Also write the Hall ticket number in the space provided above.
2. Answers are to be marked on the OMR answer sheet following the instructions provided there upon.
3. Hand over the OMR answer sheet at the end of the examination to the invigilator.
4. The question paper contains 70 questions of multiple choices, printed in 17 pages (last three blank pages to be used for rough work), including this page. No additional sheets will be provided.
5. OMR answer sheet provided separately.
6. All questions carry **one mark** each.
7. **There is no negative marking.**
8. Non-programmable scientific calculators are permitted.
9. Cells, Mobile Phones are strictly prohibited in the examination hall.

**PART-A**

1. Two trains proceeding towards each other from 2 stations 200 km apart, cross each other at 120 km from one of the stations. What is the ratio of their speeds?
  - A. 10:9
  - B. 12:8
  - C. 15:4
  - D. 20:12
  
2. A solution contains water and alcohol in 3:4 ratios. If 5 liters of water is added to the solution the ratio becomes 5:4. What is the quantity (liters) of alcohol in the solution?
  - A. 10
  - B. 12
  - C. 15
  - D. 18
  
3. A tank can be filled by a pipe X in 10 hrs, pipe Y in 5 hrs and pipe Z in 30 hrs. What is the time taken to fill the tank if all the pipes are ON simultaneously?
  - A. 12
  - B. 5
  - C. 3
  - D. 20
  
4. If p exceeds q by 25%, then q is less than p by?
  - A. 15%
  - B. 20 %
  - C. 25 %
  - D. 30 %
  
5. If  $E[x^2] - (E[x])^2 = R$ , where  $E$  is expectation and  $x$  is random variable, then?
  - A.  $R=0$
  - B.  $R<0$
  - C.  $R>0$
  - D.  $R\geq 0$
  
6. Let  $H_0$  be the Null hypothesis. Type 1 error occurs when
  - A.  $H_0$  is rejected if it is True
  - B.  $H_0$  is rejected if it is False
  - C.  $H_0$  is accepted if it is True
  - D.  $H_0$  is accepted if it is False

7. If  $n$  items are selected from a population  $p$  with replacement, what is the probability of the each sample being selected?
- A.  $1/p$
  - B.  $1/n^p$
  - C.  $1/pC_n$
  - D.  $1/p^n$
8. A die is rolled once. What is the probability that a number less than 4 is obtained?
- A. 0.17
  - B. 0.33
  - C. 0.50
  - D. 0.71
9. Jennifer Doudna And Emmanuelle Charpentier received the Noble prize for the year 2020 for \_\_\_\_\_
- A. Developing the CRISPER gene editing technology
  - B. Discovering molecular mechanisms governing the circadian rhythm
  - C. Developing molecular modelling tools
  - D. Discovering receptors for temperature and touch.
10. For the following set of three linear equations
- $$\begin{aligned}y + z &= 2 \\2x + 3z &= 5 \\x + y + z &= 3\end{aligned}$$
- Solution for  $x$ ,  $y$  and  $z$  is hidden in which of the following options?
- A.  $(2, \tan \pi/6, \sin \pi/4)$
  - B.  $(2^0, \tan \pi/4, \sin \pi/2)$
  - C.  $(0.8, \cos \pi/6, \sin \pi/6)$
  - D.  $(0.9, \sin \pi/6, \cos \pi/6)$
11. Let the coordinates  $(x,y)$  of three vertices of a triangle be  $(-1, 0)$ ,  $(1, 0)$ , and  $(0, 2)$ . The equations of the three sides of the triangle will be
- A.  $x = 0, y = -2x + 3, y = 2x + 2$
  - B.  $y = 1, y = -2x + 2, y = x + 2$
  - C.  $y = 0, y = -2x + 2, y = 2x + 2$
  - D.  $y = 2, y = -4x + 5, y = 7x$

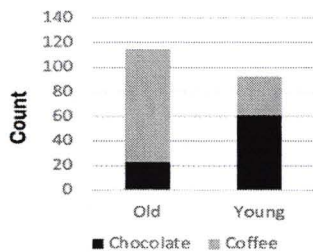
12. \_\_\_\_\_ compound has hexagonal structure.
- A. Graphite
  - B. Diamond
  - C. Silver
  - D. Platinum
13. If the velocity and mass are doubled the kinetic energy will \_\_\_\_\_
- A. Remain the same
  - B. Increase twice
  - C. Increase 8 times
  - D. Increase 6 times
14. Value of  $x$  in equation  $\log_2(1 + \sqrt{x}) = 6$  is
- A.  $63^2$
  - B.  $5^2$
  - C.  $66^2$
  - D.  $64^2$
15. Which of the following is false \_\_\_\_\_
- A.  $(1.13)^x$  represents an exponential growth function
  - B.  $(0.9)^x$  represents an exponential decay function
  - C.  $x^2 + x + 2$  represents a polynomial of degree 1
  - D.  $x^2$  represents a polynomial of degree 2
16. Given the mean and the standard deviation of 100 and 10 respectively, the z-score corresponding to a random variable  $X$  whose value is 90, is \_\_\_\_\_
- A. 1
  - B. -3.0
  - C. 2.0
  - D. -1.0
17. A small spherical drop of mercury is due to its
- A. Surface tension
  - B. Viscosity
  - C. Gravity
  - D. Elasticity

18. The leakage of \_\_\_\_\_ gas was responsible for the Bhopal gas tragedy in 1984.
- A. Methyl isocyanide
  - B. Methyl isocyanate
  - C. Methyl isochloride
  - D. Methyl isochlorate
19. Which of the following statements is *INCORRECT*?
- A. Proteins are the polymers of amino acids
  - B. Surface residues in the globular proteins are mostly polar in nature
  - C. Buried amino acid residues in the protein core are always polar in nature
  - D. Always you find at least one or two polar residues among the catalytic residues
20. The standard error is given by \_\_\_\_ (Note:  $\sigma$  and  $n$  are the standard deviation and the sample size respectively)
- A.  $\sigma * \sqrt{n}$
  - B.  $\sigma * n$
  - C.  $\sigma * \sqrt{n}$
  - D.  $\sigma/\sqrt{n}$
21. Degree distribution in a random graph follows \_\_\_\_
- A. Poisson distribution
  - B. Beta distribution
  - C. Gama distribution
  - D. Power-law
22. Among the isotopes  $^{12}\text{C}$ ,  $^{13}\text{C}$  and  $^{14}\text{C}$  \_\_\_\_\_ is different.
- A. number of protons
  - B. atomic mass
  - C. number of neutrons
  - D. number of electrons
23. Which one of the following statements is *CORRECT*? \_\_\_\_
- A. The  $\alpha$  – helices in proteins are stabilized by 5 $\rightarrow$ 1 H-bonds
  - B. The  $\alpha$  – helices in proteins are stabilized by 4 $\rightarrow$ 1 H-bonds
  - C. The  $\alpha$  – helices in proteins are stabilized by 3 $\rightarrow$ 1 H-bonds
  - D. The  $\alpha$  – helices in proteins are stabilized by 2 $\rightarrow$ 3 H-bonds

24. A mother is twice as old as her son. If 20 years ago, the age of the mother was 10 times the age of the son, what is the present age of the mother?
- 38 years
  - 40 years
  - 43 years
  - 45 years

25. The range of a sample gives an indication of the
- way in which the values cluster about a particular point
  - number of observations bearing the same value
  - maximum variation in the sample
  - degree to which the mean value differs from its expected value.

26. The stacked barplot shown below represents counts of old and young individuals' preference of chocolate and coffee. Which of the following statements is *CORRECT*?



- I. Old people prefer chocolate more than coffee
  - II. Young people prefer chocolate more than coffee
  - III. Old people prefer coffee more than young people
  - IV. Young people prefer coffee more than old people
- I and IV
  - II and IV
  - II and III
  - III and IV

27. If all the six Cysteine residues in a protein take part in making disulfide bond then the possible number of ways the three S-S bonds can be formed is
- ${}^6C_2$
  - ${}^6P_2$
  - 6!
  - 3!

28. The standard deviation of 10 values is 4. If each value is increased by 3, then find the variance of the new set of values
- A. 49
  - B. 19
  - C. 16
  - D. 7
29. If in a given DNA molecule the number of Adenine, Guanine and Cytosine are 40, 40 and 40, respectively, then the length of its sequence would be
- A. 40
  - B. 80
  - C. 120
  - D. 160
30. A cathode and an anode are the most common components of an electrochemical cell. Which of the following claims about the cathode is *CORRECT*?
- A. Oxidation occurs at the cathode
  - B. Electrons move into the cathode
  - C. Usually denoted by a negative sign
  - D. Is usually made up of insulating material
31. In a fuel cell, which of the following can be utilized as a fuel?
- A. Nitrogen
  - B. Argon
  - C. Hydrogen
  - D. Xenon
32. Let  $f(x) = x^2 + ax - 3$  has a tangent at  $x = 4$ . If this line is parallel to x-axis, then  $a = ?$
- A. -8
  - B. -16
  - C. -4
  - D. 16
33. If  $f(x) = \begin{cases} 2x - 3, & \text{for } x < 1 \\ 2x, & \text{for } x \geq 1 \end{cases}$  then the function is discontinuous at
- A.  $x = -1$
  - B.  $x = 1$
  - C.  $x = 3/2$
  - D.  $x = -3/2$



34. The forces acting on two charges placed at a distance in a medium are governed by \_\_\_\_
- Zeroth law of thermodynamics
  - Coulomb's law
  - Pauli's exclusion principle
  - Maxwell's equations
35. The number of bond angles in the Methane structure is equal to \_\_\_\_
- 3
  - 4
  - 5
  - 6

**PART-B**

36. Which of the following is not a numerical method to solve ODEs
- Range-Kutta method
  - Euler method
  - Adams-Moulten method
  - Gauss-Seidel method
37. A signaling circuit can show ultrasensitive response due to the presence of
- Positive feedback loop
  - Negative feedback loop
  - Coherent Feed forward loop
  - Incoherent feed forward loop
38. What is the order of reaction if the rate of reaction is equal to the rate constant?
- Zero order
  - First order
  - Second order
  - Third order
39. For a reaction  $A \rightarrow B$  with rate  $k$ , the ODEs can be written as
- $\dot{A} = k * A - B$ ;  $\dot{B} = -k * A + B$
  - $\dot{A} = -k * A + B$ ;  $\dot{B} = k * A - B$
  - $\dot{A} = -k * A$ ;  $\dot{B} = k * A$
  - $\dot{A} = k * A$ ;  $\dot{B} = -k * A$



40. What does the following equation represent?

$$\frac{S}{V} = \frac{K_m}{V_{max}} + \frac{S}{V_{max}}$$

- A. Eadie-Hofstee plot equation
  - B. Lineweaver Burk equation
  - C. Michaelis Menten equation
  - D. Hanes plot equation
41. The steepest descent method uses \_\_\_\_\_ of the energy function which is a function of \_\_\_\_\_ of all the atoms in a molecule
- A. First derivative/gradient; positional coordinates
  - B. Second derivative; positional coordinates
  - C. First derivative; Momentum
  - D. Second derivative; Momentum
42. What is the fractional rate ( $v/V_{max}$ ) of an enzymatic reaction if  $S = 5 * K_m$ ?
- A. 10/5
  - B. 5/6
  - C. 5/10
  - D. 6/5
43. \_\_\_\_\_ is called as the basic repetitive structural unit of a crystal
- A. Monomer
  - B. Molecule
  - C. Unit cell
  - D. Atom
44. A disaccharide is formed when two monosaccharides are bonded together by a \_\_\_\_\_ bond.
- A. Glycosidic
  - B. Peptide
  - C. Ionic
  - D. Phosphodiester

45. Similarity search for biological sequence in a local database by computer programs such as BLAST,
- A. can be split into sub-tasks and run in parallel on multiple cores
  - B. is a serial task so can't be run on multiple cores of a processor
  - C. will take same time irrespective of being run in serial or parallel
  - D. is a serial task so can be run on multiple cores of a processor
46. Fill in the blanks with the *CORRECT* answer.  
Molecular dynamics is primarily based on \_\_\_\_\_
- A. Newton's first law of motion
  - B. Newton's law of gravity
  - C. Newton's second law of motion
  - D. Newton's third law of motion
47. The number of distinct transfer RNA molecules (tRNA) required for protein synthesis process is
- A. 64 (one each for the 64 codons)
  - B. 20 (one each for 20 amino acids)
  - C. 21 (one each for the 20 amino acids, and one for all 3 stop codons)
  - D. 23 (one each for the 20 amino acids, and one each for the 3 stop codons)
48. The mitochondrial genome is comprised of
- A. DNA
  - B. RNA
  - C. contains both DNA and RNA
  - D. organelles do not have genome other than nucleus
49. If the frequency of two alleles ( $A$  and  $a$ ) in a population in Hardy-Weinberg equilibrium are  $p$  and  $q$ , respectively, then the frequency of heterozygous genotypes will be
- A.  $p$
  - B.  $q$
  - C.  $p*q$
  - D.  $2*p*q$

50. The scores of High Scoring Pairs (HSPs) in BLAST follow \_\_\_\_ distribution
- A. Normal distribution
  - B. Extreme Value Distribution
  - C. Poisson distribution
  - D. Power-law distribution
51. Smith-Waterman algorithm for local sequence alignments is an implementation of \_\_\_\_
- A. BLAST heuristics
  - B. Linear programming
  - C. Decision tree method
  - D. Dynamic programming
52. In a substitution scoring matrix Alanine (A) has a score of 2 whereas Tryptophan (W) has a score of 14. These scores indicate that \_\_\_\_ during the evolution of protein sequences
- A. A is often substituted by another amino acid than W
  - B. W is often substituted by another amino acid than A
  - C. A can be substituted by any 2 of the amino acids
  - D. W can be substituted by any 14 of the amino acids
53. The amino acid Proline has been referred to as “helix breaker”. One of the following is not associated to this property of Proline \_\_\_\_
- A. It lacks the amide group in the main chain
  - B. It is rarely found in the helices and often found in loops and turns
  - C. It does not offer H-bond donor for the helix hydrogen bonds
  - D. Its main chain Phi angle is restricted to value  $\sim -60$  degrees
54. If a peptide ARRPPPTT undergoes amino acid residue substitutions R2D and T6G the total charge on the peptide changes from \_\_\_\_ (wild-type) to \_\_\_\_ (mutant)
- A. +2, +1
  - B. 0, 0
  - C. -2, -1
  - D. 0, 1
55. The PROSITE expression G-[T,S]-X-X-X-{W} does not apply to \_\_\_\_
- A. G-T-G-F-Q-R
  - B. G-S-F-F-Q-N
  - C. G-R-G-G-Q-W
  - D. G-T-G-G-G-G

56. Clustering co-efficient of a node in a network is defined as the ratio of \_\_\_\_
- A. the number of connections that node makes, to the number of connections made by its neighboring nodes
  - B. the number of connections, to the expected number of connections made by the neighboring nodes
  - C. the number of times that node comes in between, to the number of times its neighboring nodes come in between the nodes of the network.
  - D. the number of connections that node makes, to the number of connections made by the other nodes in the network
57. In a network hubs and bottlenecks are identified using the \_\_\_\_ and \_\_\_\_ centrality values, respectively
- A. degree and betweenness
  - B. betweenness and degree
  - C. degree and clustering coefficient
  - D. Eigen vector and degree
58. The Power-law is given by the following function \_\_\_\_  
(Note:  $P(k)$  = probability of a node having a degree value  $k$  and  $k$  = degree centrality)
- A.  $P(k) = e^{-k}$
  - B.  $P(k) = k^{-2}$
  - C.  $P(k) = e^{-2}$
  - D.  $P(k) = 2^k$
59. The E-value in BLAST is a function of \_\_\_\_\_
- A. Percentage sequence identity
  - B. Alignment score, lengths of the query and the database used
  - C. Only alignment score
  - D. Only lengths of the query and the database used
60. Which among the following centrality measures tells how many times a particular node comes in the shortest paths between two other nodes.
- A. Degree centrality
  - B. Betweenness centrality
  - C. Closeness centrality
  - D. Clustering coefficient

61. The table below indicates the presence or absence of traits X, Y and Z in species I, II and III. The number 1 indicates that a character is present; a 0 indicates that it is absent.

Species	Trait		
	X	Y	Z
I	1	1	0
II	1	1	1
III	1	0	0
Outgroup	0	0	0

With respect to traits X, Y and Z, which of the following is true? Species II is most closely related to

- A. Species I
  - B. Species III
  - C. Outgroup
  - D. Both species I and III equally
62. Which of the following is *INCORRECT* about CLUSTAL ?
- A. It is a tool for multiple sequence alignment
  - B. It involves both local and global alignments
  - C. It is based on progressive alignment method
  - D. It is available both as a stand-alone and on-line program
63. BLAST search of a DNA sequence gave significant hits only with exons, then the query is a
- A. Transcribed sequence of a gene
  - B. Regulatory sequence of a gene
  - C. Non-coding sequence of a gene
  - D. Genomic sequence of a gene
64. In the Sanger sequencing method for DNA sequencing, which statement is *INCORRECT* about the CHAIN TERMINATION step?
- A. it occurs due to the use of only one of the di-dexoy NTPs
  - B. it occurs due to the use of all types of the di-dexoy NTPs
  - C. it occurs typically at all positions in the template molecule
  - D. separate reactions are carried out for each of the di-dexoy NTPs



65. Which statement is *CORRECT* about polymerase chain reaction?
- A. It requires only one type of primer sequence
  - B. It requires DNA polymerase enzyme active at 37° C
  - C. If target region is present, then amplified sequences are double-stranded DNA
  - D. If target region is present, then amplified sequences are single-stranded DNA
66. Which statement is *CORRECT* about density of genes in genomes
- A. density is same in prokaryotes and eukaryotes
  - B. bacterial genomes have higher density than eukaryotes
  - C. eukaryotic genomes have higher density than prokaryotes
  - D. eukaryotic genomes have higher density than viral genomes
67. Which statement is *INCORRECT* about heterochromatin?
- A. it is condensed chromatin
  - B. it is not accessible for transcriptional machinery
  - C. it's state is fixed throughout life
  - D. centromeric region is rich in heterochromatic DNA
68. Which nucleic acid is *UNLIKELY* to form a secondary structure?
- A. single stranded DNA
  - B. transfer RNA
  - C. precursor micro-RNA
  - D. double stranded DNA
69. The orthologous and paralogous genes
- A. originate from common ancestors and duplication events, respectively
  - B. originate from duplication events and common ancestors, respectively
  - C. both originate from common ancestors
  - D. both originate from duplication events
70. Which statement is *INCORRECT* about forward genetics?
- A. mutagenesis is a commonly used in such studies
  - B. the gene underlying a trait of interest is discovered
  - C. function of a known gene sequence is characterized
  - D. next-generation sequencing has found application in such studies

## University of Hyderabad

### Entrance Examinations - 2022

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

Course/Subject **PhD** : Systems and Computational Biology Code: B-11

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

अध्यक्ष / HEAD  
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