ENTRANCE EXAMINATIONS – 2020

4.72

Ph.D. Biotechnology

Time: 2 hours | Maximum Marks: 70

HALL TICKET NUMBER:

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. There is no negative marking for wrong answer.
3. Answers are to be marked on the OMR answer sheet following the instructions provided there upon.
4. Hand over the OMR answer sheet at the end of the examination to the invigilator.
5. The question paper contains 70 questions of multiple choices, printed in 16 pages including this page. No additional sheets will be provided. Rough work can be done in the question paper itself /space provided at the end of the booklet.
6. All questions carry one mark each.
7. In case the candidates have equal marks, preference will be given towards the candidate who has obtained higher marks in Part-A.
8. Non-programmable scientific calculators are permitted.
9. Cell/Mobile Phones are strictly prohibited in the examination hall.

Part-A

1. Which position of a codon evolves at the highest rate?
   A. All positions
   B. First position
   C. Second position
   D. Third position

2. There are 8 boys and 12 girls in a classroom. If a team of three students is formed by random selection, what is the probability that the team consists of one boy and two girls.
   A. 0.15
   B. 0.33
   C. 0.46
   D. 0.50

3. The degeneration of dopaminergic neurons is the cause of which neurological disorder?
   A. Parkinson's Disease
   B. Alzheimer's Disease
   C. Huntington's Disease
   D. Degeneration of dopaminergic neurons does NOT cause neurological impairment

4. An average value of blood urea nitrogen measured for 32 individuals was 16 mg/dl. If the standard deviation was 2 mg/dl, what will be the variance of the samples?
   A. 1.4 mg/dl
   B. 2 mg/dl
   C. 4 mg/dl
   D. 8 mg/dl

5. When you make ice cubes, what happens to the entropy of water?
   A. Increases
   B. Decreases
   C. Does not change
   D. May increase or decrease depending on process used

6. Arrange the following sequences of phylogenetic analysis in the correct order.
   I. Performing multiple sequence alignment:
   II. Choose model of evolution
   III. Assessing tree reliability
   IV. Tree-building
   V. Choosing molecular markers or sequences
   A. I, II, III, IV, V
   B. I, V, III, IV, II
   C. IV, III, II, V, I
   D. V, I, II, IV, III

7. Among the compounds listed below, which one is expected to be most soluble in water?
   A. CH_3-CH_2-OH
   B. CH_3-CH_2-CH_2-OH
   C. CH_3-CH_2-CH_2-CH_2-OH
   D. CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-OH

8. In infrared spectroscopy, the amide-I band of α-helix appears at
   A. 1595 cm^{-1}
   B. 1620 cm^{-1}
   C. 1650 cm^{-1}
   D. 1680 cm^{-1}

9. Which of the following is *not* an aspect of cerebellar function?
   A. Monitoring movement intention
   B. Monitoring actual movement
   C. Comparing intent with actual performance
   D. Directing sensory input to effectors

10. Match the following list

	List I	List II
I.	Alexa 568	1. Stain the protein bands
II.	Coomassie blue	2. Reactive oxygen species
III.	Bromophenol blue	3. Tracking dye
IV.	Hydrogen peroxide	4. Fluorescent probe

Which of the pairs given above are correctly matched?

	I	II	III	IV
A.	2	3	1	4
B.	1	4	3	2
C.	4	1	3	2
D.	4	2	1	3

11. In a cylinder, if radius and height are increased by 2 and 4 fold respectively, what would be the change in volume of cylinder?
   A. Remains same
   B. Halves
   C. Doubles
   D. Quadruples

12. In a reversible adiabatic process, _____ of the system is constant.
   A. Volume
   B. Pressure
   C. Temperature
   D. Entropy

13. Which of the following molecule has centre of symmetry?
    A. O_3
    B. CO_2
    C. H_2O
    D. N_2O

14. The expression values for two genes were measured across N samples. Which of the following value of correlation between the genes represent the strongest relationship?
    A. -0.93
    B. 0.56
    C. -0.85
    D. 0.02

15. If half of one-fourth of a number is 10 then, what is the one-tenth of the number?
    A. 10
    B. 8
    C. 6
    D. 4

16. If a person drives a car at 100 km/h instead of 80 km/h, he will cover 50 km more. If he had driven at 80 km/h, what would have been the distance covered?
    A. 20 km
    B. 150 km
    C. 200 km
    D. 250 km

17. Match the following pairs

I.	Red gram	1. *Vigna mungo*
II.	Black gram	2. *Cajanus cajan*
III.	Horse gram	3. *Vigna radiata*
IV.	Green gram	4. *Macrotyloma uniflorum*

Which of the pairs given above are correctly matched?

	I	II	III	IV
A.	4	3	1	2
B.	2	1	3	4
C.	3	4	2	1
D.	2	1	4	3

18. In a culture flask 10 ml solution is found. Each ml contains $5x10^3$ bacterial cells. After one hour through binary fission, number of bacteria in each ml is (doubling time 20 minutes):
    A. 20×10^3
    B. 40×10^3
    C. 80×10^3
    D. 10×10^3

19. Which of the following equations can be used to derive the distance calculated from a known wavelength of the source and measured angle?
    A. Debye equation
    B. Scherrer equation
    C. Coolidge equation
    D. Bragg's equation

20. A chronic pathogen's pursuit within its host unfolds in the following step by step manner:
    A. Invade – gain niche – adopt to carbon source – avoid clearance by immune system
    B. Adhesion – invasion – adaptation – immune evasion – persistence – sustained transmission
    C. Invade – multiply – consume all carbon source – cause host death – hop to new host
    D. Invade – overwhelm immune system – cause cytokine storm – cause host death

21. Which of the following cell types is NOT involved in an antibody mediated response?
    A. T-Cytotoxic cells
    B. Plasma cells
    C. B lymphocytes
    D. T-helper cells

22. Which of the following is the main application of the BLAST.

    A. Global alignment to align two nucleotide sequences using appropriate databases.
    B. Retrieving the optimum alignment of two DNA sequences.
    C. Identifying sequences that are similar to a protein or nucleotide sequence in a biological database.
    D. Searching the desired structure of a molecule.

23. How much water must be added to 300 ml of 0.2 M solution of acetic acid for the degree of dissociation of the acid to double? K_a for acetic acid is 1.8×10^{-5}.
    A. 900 mL
    B. 1000 mL
    C. 500 mL
    D. 300 Ml

24. Which of the following is the most widely used program for multiple sequence alignment.
    A. AUTODOCK
    B. FASTA
    C. CLUSTAL
    D. CHIME

25. Which one of the following statement in NOT correct
    A. Pitch of a helix in A-DNA is shorter than B-DNA
    B. A-DNA has deeper major groove and shallow minor groove compared to B-DNA
    C. Helix width (diameter) in A-DNA is shorter than B-DNA
    D. Glycosidic bond in both A- and B-DNA has *anti* conformation

26. Match the correct definitions of the following terms entailing energy forms

I.	Nuclear Energy	1. Total potential and kinetic energy of the particles
II.	Thermal Energy	2. Potential energy stored in the core of an atom
III.	Electromagnetic Energy	3. A form of energy that is stored in atomic bonds
IV.	Chemical Energy	4. Energy of light/radiation traveling as waves

	I	II	III	IV
A.	2	1	4	3
B.	1	4	3	2
C.	3	1	4	2
D.	4	2	1	3

27. Which of the following enzyme function as the substrate recognition modules of the ubiquitination?
    A. E1
    B. E2
    C. E3
    D. E4

28. Match the given pathogens with the diseases they cause

	List I	List II
I.	Human papilloma virus	1. Childhood diarrhea
II.	H1N1 virus	2. Cervical cancer
III.	SARS Cov-2	3. Spanish Flu-1918
IV.	Rotavirus	4. Covid-19

	I	II	III	IV
A.	2	3	4	1
B.	3	1	2	4
C.	4	3	1	2
D.	2	4	3	1

29. Which of the following are NOT Antigen presenting cells?
    A. B cells
    B. Macrophages
    C. $CD11c^+$ Dendritic cells
    D. Follicular Dendritic cells

30. Which one of the following is a citric acid cycle enzyme?
    A. Succinate dehydrogenase
    B. NADH oxidoreductase
    C. Cytochrome C oxidase
    D. Pyruvate dehydrogenase

31. Match the given enzymes with their function /involvement

	List I	List II
I.	Helicase	1. Cross linking of peptidoglycans in cell wall synthesis
II.	Transaminase	2. Unwinding of nucleic acids
III.	Peptidyl transferase	3. Amino acid biosynthesis
IV.	Transpeptidase	4. Peptide bond formation during protein synthesis

	I	II	III	IV
A.	4	1	2	3
B.	3	4	1	2
C.	2	3	4	1
D.	2	4	1	3

32. Which of the following is the volume of mobile phase that passes through the column between the point of injection and the peak maximum?
    A. Retention volume
    B. Void volume
    C. Dead volume
    D. Adjusted retention volume

33. When Nicotinamide adenine dinucleotide undergoes oxidation-reduction in a living cell
    I. Oxidized form carries a positive charge
    II. Phosphorylation contribute to positive charge in oxidized form
    III. Oxidized form accept two electrons and two hydrogen
    IV. reduced form is denoted as $NADH + H^+$

    Identify the correct combination of statements
    A. I and III
    B. II and IV
    C. II and III
    D. I and IV

34. Day night cycle is influenced by
    A. Acetyl choline
    B. Serotonin
    C. Glutamate
    D. Dopamine

35. The secondary structure appearing in the first-quadrant of Ramachandran plot is
    A. Left-handed α-helix
    B. β-sheet
    C. Right-handed α-helix
    D. 3_{10} helix

Part-B

36. While performing the sequence search to a database using BLAST if one expects 2 matches with the same score for the query sequence by chance then what is the E-value?

A. 0.5
B. 1
C. $1/2^{10}$
D. 2

37. Which of the following statements are true in the field of drug design?

I. The term "lead" is used for the molecule which has all the desirable properties to become a drug.
II. The term "lead" is used for the molecule which has the ability to bind any protein.
III. Ligand-based drug design depends on knowledge of other molecules that bind to the biological target of interest.
IV. QSAR is computational method to predict the bioavailability of a drug molecule.

A. I and III
B. II and III
C. II and IV
D. I and IV

38. Identify correct combination of statements

I. Pseudocount is added while computing PSSM
II. The top hit of a query gets highest expect value in blast search
III. PSI-BLAST is most suitable blast search tool for finding distantly related proteins to your query, because its strategy of using a PSSM is likely to be more sensitive
IV. Tryptophan occurs more frequently than glycine in protein

A. I and II
B. II and III
C. I and III
D. III and IV

39. Calculate and assign the score in '*ij*' cell using dynamic programming algorithm of Needleman and Wunch, consider match score +1 and mismatch score -2

		G	C
	0	-2	-4
G	-2		
A	-4		

A. -4
B. +1
C. -2
D. -1

40. Match the enzyme in list-I with its function in list-II.

	List-I	List-II
I.	Kinase	1. Cleaves a peptide bond at N-terminus of protein
II.	Phosphatase	2. Cleaves a peptide bond at C-terminus of protein
III.	Aminopeptidase	3. Attaches a phosphate group to a protein
IV.	Carboxypeptidase	4. Removes a phosphate group from a protein

	I	II	III	IV
A.	2	1	4	3
B.	2	4	3	1
C.	3	4	1	2
D.	2	3	4	1

41. Plants protect themselves from herbivores by synthesizing unusual amino acids with a structure that mimic protein building amino acids. The false amino acid 'Canavanine' mimics
   A. Valine
   B. Arginine
   C. Cysteine
   D. Asparagine

42. Which of the following is NOT considered an advantage of synchrotron radiation in comparison with *in house* X-ray sources?
   A. Cost
   B. Intensity
   C. Selection of wavelength
   D. Speed of data collection

43. Align the given antibiotics in list-I on the basis of their mechanism of action in list-II

	List-I	List-II
I.	Aminoglycosides	1. Cell wall synthesis inhibition
II.	Rifampin	2. Folic acid synthesis inhibition
III.	Vancomycin	3. Protein synthesis inhibition
IV.	Sulfonamides	4. Nucleic acid synthesis inhibition

	I	II	III	IV
A.	2	4	1	3
B.	4	3	1	2
C.	3	1	4	2
D.	3	4	1	2

44. Histone posttranslational modifications are key components of diverse processes that modulate chromatin structure. Which of the following is NOT a common mode of histone modification in eukaryotes?
    A. Acetylation
    B. Methylation
    C. Sulphonation
    D. Phosphorylation

45. Identify the secondary structure contents α-helix, β-sheet and coil from the following ellipticity signatures:
    I. 212 nm (+) & 195 nm (-)
    II. 222 nm (-) & 208 nm (-)
    III. 218 nm (-) & 196 nm (+)

	I	II	III
A.	α-helix	β-sheet	coil
B.	β-sheet	α-helix	coil
C.	coil	β-sheet	α-helix
D.	coil	α-helix	β-sheet

46. Consider the following pairs related to the biological database and the information they host.

I.	ClinVar	1. Human genes and genetic phenotype
II.	OMIM	2. Vocabulary to index articles in PubMed
III.	MeSH	3. Bibliographic data
IV.	NLM	4. Genomic changes related to human health

Which of the pairs are correctly matched?

	I	II	III	IV
A.	4	1	3	2
B.	4	1	2	3
C.	1	2	4	3
D.	3	1	2	4

47. Aspartic acid is substituted to leucine in a protein. Both the unmutated and mutated proteins are electrophoresed at pH 8.0. The mobility will be :
    A. mutated protein remains at the point of application
    B. mutated protein moves to negative pole and unmutated protein to positive pole
    C. mutated protein moves slower than unmutated protein towards positive pole
    D. mutated protein moves faster than unmutated protein towards positive pole

48. After isolating a protein of 10 kDa with 100% purity from grown bacterial culture, you are confused as to whether you grew wild-type bacteria or its mutant strain that carry alanine at the position of 80 instead of glycine. Which one of the following technique is suitable to differentiate the wild-type and mutant versions of the protein?
    A. SDS-PAGE
    B. Mass Spectrometry
    C. Ion Exchange Chromatography
    D. High Performance Liquid Chromatography

49. Identify the order in which the following enzymes appear in carbon oxidation cycle :
    I. Succinate dehydrogenase
    II. Succinate thiokinase
    III. Aconitase
    IV. Isocitrate dehydrogenase

    A. II, I, III and IV
    B. III, II, IV and I
    C. III, IV, II and I
    D. I, III, IV and II

50. An eukaryotic cell is fractioned and subjected to ultra- centrifugation. One of the fractions is found to be rich in 'cardiolipin' during metabolite analysis. Identify the organelle that is separated into this fraction.
    A. Endoplasmic reticulum
    B. Mitochondria
    C. Nucleus
    D. Chloroplast

51. Match the following pairs

I.	Antihemophilic factor	1. Factor X
II.	Stuart Factor	2. Factor XIII
III.	Fibrin Stabilizing factor	3. Factor III
IV.	Tissue Factor	4. Factor VIII

Which of the pairs given above are correctly matched?

	I	II	III	IV
A.	4	1	2	3
B.	3	1	4	2
C.	3	4	2	1
D.	1	3	4	2

52. Identify the correct combination of statements related to chromatography :
    I. In reversed-phase liquid chromatography the stationary phase is polar and the mobile phase relatively non-polar
    II. Octyl (C_8) and octadecyl (C_{18}) silane groups are commonly used column material in reverse phase liquid chromatography
    III. The mobile phase is generally an organic solvent such as hexane in reversed-phase liquid chromatography
    IV. Stationary phase is non-polar and the mobile phase is relatively polar in reversed phase liquid chromatography

    A. I and II
    B. II and III
    C. II and IV
    D. I, II, and III

53. In an experiment you do a chi-square test comparing observed and expected progeny. Your calculated chi square is 0.375. With 1 degree of freedom, this corresponds to a probability between 0.9 and 0.5. What does this mean?
    A. There is between a 50% and 90% chance that you did the experiment correctly.
    B. There is greater than a 50% chance that the difference between expected and observed progeny is due to something other than chance.
    C. You probably made an error in calculating your expected progeny to obtain this probability.
    D. There is between a 50% and 90% chance that the difference between expected and observed progeny is due to chance.

54. If glucose labeled with ^{14}C in position 1 is added to a bacterial culture under anaerobic conditions, which carbon atom of lactic acid would be labelled?
    A. The methyl carbon
    B. The carboxyl carbon
    C. The chiral carbon
    D. All three carbons

55. Following are the elements of a genome sequencing and analysis workflow. Arrange them in a step by step order and identify the correct sequence of workflow.
    I. DNA quantitation
    II. DNA extraction
    III. Assembly of reads
    IV. Genomic Library preparation
    V. Comparative genomics and analysis
    VI. Sequencing reaction and run

    A. I, II, III, V, IV, VI
    B. II, VI, I, III, V, IV
    C. II, I, III, V, VI, IV
    D. II, I, IV, VI, III, V

56. Which of the following next-generation sequencing approach uses an instrument system that detects the release of hydrogen ions, a by-product of nucleotide incorporation, as quantitated changes in pH through a coupled silicon detector?
    A. Ion Torrent technology
    B. Illumina HiSeq 2000 technology
    C. Applied biosystems SOLiD 2.0 technology
    D. 454 genome Sequencer from Roche applied science

57. New genes with new functions can arise in a genome via all of the following EXCEPT :
    A. Gene duplication and subsequent divergence
    B. Pseudogene formation and duplication
    C. Exon duplication and subsequent divergence
    D. Exon shuffling

58. Consider the following steps involved in a DNA Microarray based differential gene expression profiling experiment and arrange them in correct order :
    I. RIN check and estimation of concentration
    II. Isolation of mRNA from matched samples
    III. Hybridization
    IV. Data normalization and calculation of fold changes
    V. Reverse transcription and labeling with Cy3 and Cy5 fluorescent dyes
    VI. Scanning and image processing

    A. II, I, III, V, IV, and VI
    B. II, III, I, V, VI, and IV
    C. I, II, III, V, VI and IV
    D. II, I, V, III, VI, and IV

59. If you were interested in identifying genes expressed in cancer cells, why you might choose to construct and screen a cDNA library instead of a genomic DNA library?
    A. A cDNA library is larger (in quantity) than a genomic library.
    B. A cDNA library is enriched for genes that are actively transcribed in your cell of interest.
    C. A cDNA library includes all protein-coding genes as well as the regulatory sequences for those genes.
    D. A cDNA library is enriched for genes that are expressed at low frequency.

60. Small interfering RNA (siRNA) molecules block expression of target genes by degrading the mRNA or inhibiting transcription. siRNAs specifically target:
    A. The genes from which they were transcribed
    B. Genes other than those they were transcribed from
    C. Random genes in the genome
    D. Transposon genes

61. Circle the right statement (s):
    I. Epigenetics means alteration of both genotype and phenotype upon environmental changes
    II. Epigenetics does not involve a change in DNA sequence
    III. Epigenetics involves mutation in DNA sequence
    IV. Gregor Mendel coined the term 'Epigenetics'

A. I and II
B. I, II and III
C. III
D. II

62. Match the techniques of the left panel to the ones in the right panel

I. Southern Hybridization	1. To detect interaction between DNA replication and DNA repair protein
II. Northern Hybridization	2. Beta marcaptoethanol is used to denature the sample
III. Western Hybridization	3. Formamide is used to denature the sample
IV. Far Western Hybridization	4. Technique that depends on specific DNA-DNA duplex
	5. Technique that depends on specific RNA-DNA duplex

	I	II	III	IV
A.	4	5	3	2
B.	4	3	2	1
C.	5	4	1	3
D.	5	3	1	2

63. You are studying a bacterial virus and found its base composition to be A=22%, T = 28%, G= 20% and C=30%. What is your conclusion regarding its genetic material?
A. single stranded RNA
B. double stranded RNA
C. single stranded DNA
D. double stranded DNA

64. Identify correct combination of statements related to polyacrylamide gels :
    I. The polymerization of acrylamide is an example of free-radical catalysis, and is initiated by the addition of ammonium persulphate and the base TEMED
    II. TEMED decomposition releases a free radical which initiates polymerization of acrylamide
    III. Bis-acrylamide is two acrylamide molecules linked by a methylene group and is used as a cross-linking agent
    IV. Ammonium persulphate catalyses the decomposition of TEMED to give a free radical for acrylamide polymerization.

A. I and II
B. II and III
C. I, III and IV
D. I and III

65. Positional cloning of a gene of interest requires that
    A. Its protein product is known
    B. Its map position on a chromosome is known
    C. Part of its DNA sequence is known
    D. Its biochemical function in the organism is known

66. Following are the pairs of computational methods/tools and their applications. Match the correct pairs.

I.	Rosetta stone	1. Genome assembly
II.	Scaffolding	2. Sequence alignment
III.	MEGA	3. Protein-protein interaction prediction
IV.	GLIMMER	4. Gene prediction

Which of the pairs are correctly matched?

	I	II	III	IV
A.	3	1	2	4
B.	4	3	1	2
C.	3	1	4	2
D.	2	3	1	4

67. Which human protein is responsible for mediating infection by interacting with the spike glycoprotein of human SARS-CoV-2, the causative agent for recent pandemic coronavirus disease?
    A. ACE
    B. ACE-1
    C. ACE-2
    D. ACE-3

68. The activity of sucrose phosphate synthase (SPS) is regulated by covalent modification of the following residue in its structure.
    A. Threonine
    B. Serine
    C. Asparagine
    D. Glutamine

69. Which of the following is considered as a strong anion exchanger in ion exchange chromatography?
    A. Primary amine
    B. Secondary amine
    C. Tertiary amine
    D. Quaternary amine

70. A complex network of circular DNA which contain several copies of genome in mitochondrion of the member of trypanosomatidae is called as_____.
    A. Kinetocyst
    B. Kinetoplast
    C. Kinetosome
    D. Kinetochore

* * *