# ENTRANCE EXAMINATIONS – 2020

## (Ph.D. Admissions - January 2021 Session)

Y-72

**Ph.D. Biotechnology**

**Time: 2 hours** **Maximum Marks: 70**

**HALL TICKET NUMBER:**

**BOOKLET: I**

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**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.
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. OMR answer sheet provided separately.
5. All questions carry one mark each.
6. There is no negative marking for wrong answer.
7. If there is a tie, the marks obtained in Part A will be used to dissolve the tie.
8. Non-programmable scientific calculators are permitted.
9. Cell/Mobile Phones are strictly prohibited in the examination hall.
10. There are total 16 pages including the instructions page

## PART A

1. If $5^{(x-y)}= 125$ and $5^{(x+y)}= 3125$, then x is equal to:

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

2. One morning after sunrise Minu while going to school met Shanti at road crossing. Shanti's shadow was exactly to the right of Minu. If they were face to face, which direction was Minu facing?

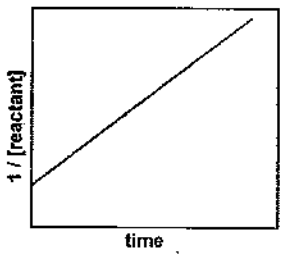
A. South
B. North
C. East
D. West

3. A single stranded DNA fragment of length 200 nucleotides has 40% GC content and the total count of C is 50 and the number of A is twice than the number of T. The count of A and G are

A. 40 and 30 respectively
B. 40 and 50 respectively
C. 80 and 30 respectively
D. 30 and 50 respectively

4. The given kinetic plot represents

A. Zeroth-order reaction
B. First order reaction
C. Pseudo first order reaction
D. Second order reaction




5. Which of the below mentioned solid exhibits covalent bond?

A. NaCl
B. Diamond
C. Sodium Metal
D. An Inert gas-solid

6. If a coin is tossed and a dice is rolled what is the probability of observing a tail in the coin or number 4 in the dice?

A. 1/12
B. 7/8
C. 2/3
D. 1/6

7. $_{11}Na^{24} \rightarrow X + \beta$-particles; In this equation X =
A. $_{11}Na^{23}$
B. $_{10}Ne^{23}$
C. $_{12}Mg^{23}$
D. $_{12}Mg^{24}$

8. Reductases are enzymes involved in
A. Transfer of phosphate from ATP
B. Transfer of amino group from one substrate to another
C. Add Hydrogen to substrate
D. Transfer Hydrogen from the substrate

9. Which one of the following is considered as the Father of modern neuroscience?
A. Sir Neil Harphan
B. Sir Alexander Graham Bell
C. Sir Otto Rohm
D. Sir Santiago Ramon y Cajal

10. If there exist an X-linked recessive disorder in man who marries a normal woman, then which of the following statement (s) is/are true?
I. All male children of the couple would have no risk to the disease.
II. 50% of the male children of the couple would have no risk to the disease.
III. All female children will be diseased.
IV. All female children will be carrier.
A. Only I
B. I and III
C. I and IV
D. Only III

11. Put the following compounds synthesized during Citric acid cycle in the correct order.
I. Oxaloacetate
II. Fumarate
III. Malate
IV. Succinate
A. III, I, II, IV
B. IV, III, I, II
C. IV, II, III, I
D. IV, I, III, II

12. Match the following:

| Exchange type | Ion exchange group |
|---|---|
| I. Strong anion | 1. Sulfonic acid |
| II. Weak anion | 2. Carboxylic acid |
| III. Strong cation | 3. Tertiary amine |
| IV. Weak cation | 4. Quaternary amine |

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

13. DNA from organism A, labeled with $^{14}N$ is hybridized with an equal concentration of DNA from organism J, labeled with $^{15}N$ and then centrifuged to equilibrium in CsCl. Five percent of the total renatured DNA has a hybrid density. What fraction of the base sequences is common to the two organisms?

A. 25%
B. 50%
C. 10%
D. 20%

14. A typical gene utilizes a segment of DNA whose molecular weight is one million. How many turns of the helix do this represent?

A. 300
B. 150
C. 15
D. 1500

15. Which of the following statement is not correct for components used in SDS-PAGE?

A. DTT is used as reducing agent
B. SDS is used as cationic detergent
C. Bromophenol blue is used as tracking dye
D. Coomassie brilliant blue is used for protein staining

16. The phenomenon which shows lack of correlation of genome size and the complexity of an organism?

A. B-value paradox
B. C-value paradox
C. G-value paradox
D. H-value paradox

17. Which of the following technique uses immobilization strategy?

A. Isothermal titration calorimetry
B. Microscale thermophoresis
C. Surface Plasmon resonance
D. Differential scanning calorimetry

18. A molecule has more covalent character, if

A. The cation is larger in size
B. The anion is smaller in size
C. The cation and anion are of same size
D. Charge on either of the ion is high

19. *E. coli* chromosome completes the entire cycle of DNA replication in 40 minutes. If the molecular weight of the bacteria is $2.6 \times 10^9$, find the average rate (expressed in nucleotides per second) of the replication forks that progress along the chromosome.

A. 7200 nucleotides/second
B. 1800 nucleotides/second
C. 3600 nulceotides/second
D. 900 nucleotides/second

20. Match the following

| | | | |
|---|---|---|---|
| I. | Affinity chromatography | 1. | DEAE cellulose |
| II. | Anion exchange chromatography | 2. | CM cellulose |
| III. | Cation exchange chromatography | 3. | Sephadex G50 |
| IV. | Gel filtration chromatography | 4. | Trypsin-sepharose 4B |

Find the correct answer

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

21. Which of the following recognize a specific amino acid and its cognate t-RNA molecule?

A. r-RNA
B. Ribososme
C. Topoisomerase
D. t-RNA synthetase

22. The scientists H.J. Alter, M. Houghton and C.M. Rice were awarded Nobel prize in the year 2020 for their contributions on the following virus

A. Covid
B. Dengue
C. Hepatitis C
D. Chickungunya

23. The pH of a solution of HCl is 4. What is the molarity of the solution?

A. 4.0 M
B. 0.4 M
C. 0.0001 M
D. 0.001 M

24. One of the following gives us a measure of the irreversibility of a given process; meaning also that it is a measure of disorder of a system

A. Entropy
B. Enthalpy
C. Mass-charge ratio
D. Plasticity

25. Among the different cell-based expression systems, which one is not free from the contamination of endotoxin?

A. Yeast cell
B. Insect cell
C. Bacterial cell
D. Mammalian cell

26. The following constitute important mechanisms of genome evolution in bacterial lineages

I. Horizontal gene transfer (HGT)
II. Genome reduction
III. Pseudogenization
IV. Codon usage bias (CUB)

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

27. Match the following

| List I | List II |
|---|---|
| I. ZMWs on the SMRT cell | 1. NGS by pH change monitoring |
| II. Ion Chip, a specialized silicon chip | 2. Pyrophosphate detection |
| III. Illumina Hiseq 2000 | 3. Single molecule Next-generation sequencing |
| IV. 454 Genome Sequencer | 4. Cluster generation and bridge amplification and sequencing by synthesis with reversible dye terminators |

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

28. The hydrogen bond formed by a polypeptide chain in π-helix can be represented as
   A. $i \rightarrow i+4$
   B. $i+4 \rightarrow i$
   C. $i \rightarrow i+5$
   D. $i+5 \rightarrow i$

29. Transient interactions of proteins are expected to control the majority of cellular processes and are best studied by
   A. Pull-down assay
   B. Far-western method
   C. Cross-linking reagents
   D. Co-immunoprecipitation

30. The instrument used to measure the light intensity is
   A. Spectrophotometer
   B. Photometer
   C. Photomultiplier
   D. Radiometer

31. If the lines given by $2x + ky = 1$ and $3x - 5y = 7$ are parallel, then the value of k is
   A. -10/3
   B. 10/3
   C. -13
   D. -7

32. Louis Pasteur worked on
   A. Smallpox
   B. Typhoid
   C. Malaria
   D. Anthrax

33. The basic unit for Baltimore system of virus classification is
   A. Genome
   B. mRNA formation
   C. Transmission
   D. Replication

34. The factor which does not affect $pK_a$ value of an amino acid is
   A. The loss of charge in the α-carboxyl and α-amino groups
   B. The interactions with other peptide R groups
   C. Other environmental factors
   D. Molecular weight

35. The following is a cell line used in *in vitro* experiments to serve as an experimental model for human monocytes
   A. THP1
   B. Caco-2
   C. HepG2
   D. MC/9

## PART B

36. What best defines the genomic islands occurring in bacterial chromosomes?

I. They have a different G+C composition than the chromosome as a whole
II. They are the reminiscent of retroviruses
III. Usually inserting in t-RNA genes and are flanked by mobilizable elements
IV. They are almost always associated with imparting a fitness advantage to bacteria

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

37. Match the viruses based on the genetic material they carry.

| | |
|---|---|
| I. HIV | 1. ssDNA |
| II. Reovirus | 2. dsDNA |
| III. Parvovirus | 3. ssRNA |
| IV. Lambda phage | 4. dsRNA |

Which of the pairs are correctly matched?

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

38. Match the following.

| | |
|---|---|
| I. PDB | 1. A database of the Drosophila genome |
| II. OMIM | 2. A substitution matrix |
| III. PAM | 3. Genetic information of human diseases |
| IV. FlyBase | 4. A resource of the 3D structures of biological molecules |

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

39. The word 'fulminant' refers to

A. Short and severe
B. Lingering
C. Hardening
D. Quick and high mortality

40. You are setting up an in-vitro experiment to study DNA replication at the replication fork. In each of following tubes you have set a series of reactions by adding the enzymes and/or reagents that are required for DNA replication, however omitted only one of the components as mentioned below.

I. No ligase was added II. No primase was added
III. Only dNTPs were added (no NTPs) IV. No DNA polymerase was added
Indicate in which case DNA replication will be affected

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

41. For the statistical validation of a phylogenetic tree which of the following could be used for the resampling of a multiple sequence alignment.

A. Bootstrap analysis
B. Joining analysis
C. Cluster analysis
D. Docking analysis

42. What is the CORRECT order of events during DNA replication on the lagging strand?

(1) Formation of a new phosphodiester bond by DNA polymerase.
(2) Binding of single-strand DNA binding proteins.
(3) Separation of double-stranded DNA by helicase.
(4) Exonucleolytic proofreading by DNA polymerase.
(5) RNA primer synthesized by DNA primase.

A. 1, 3, 2, 5, 4
B. 3, 5, 2, 1, 4
C. 3, 1, 5, 2, 4
D. 3, 2, 1, 4, 5

43. An action potential involves $Na^+$ moving _____ the cell and $K^+$ moving _____ the cell.

A. inside; outside
B. outside; inside
C. inside; inside
D. outside; outside

44. Acetylcholine is a neurotransmitter that provides for communication between muscles and nerves. When there is a problem with the interaction between acetylcholine and the acetylcholine receptor sites on the muscles, which condition(s) can occur?

A. Myasthenia gravis
B. Botulism
C. Multiple sclerosis
D. A and B

45. Dopamine is an important neurotransmitter. Which disease or disorder results when the neurons in the brain that produce dopamine die?
A. Multiple sclerosis
B. Lou Gehrig's disease (amyotrophic lateral sclerosis)
C. Parkinson's disease
D. Seizure disorder

46. Consider the following statements
I. *EcoRI* is from *Escherichia coli* recognizes 5'GAATTC 3'
II. In a dideoxy chain termination sequencing reaction only one primer is used.
III. Northern blotting technique is used for DNA transfer and detection
IV. In DNA microarray analysis probe is labeled with fluorescent dye
Which of the following statements is / are correct?
A. I and II
B. II and III
C. II, III and IV
D. III and IV

47. Addition of an inhibitor to an enzyme-substrate reaction following Michaelis-Menten mechanism, increases the $Km$ value, but does not affect the $Vmax$ value. Then, the inhibitor could be
A. Competitive inhibitor
B. Uncompetitive inhibitor
C. Non-competitive inhibitor
D. Irreversible inhibitor

48. The enzymes actively involved in scavenging of reactive oxygen species are
I. Alternative oxidase
II. Superoxide dismutase
III. Cytochrome oxidase
IV. NADPH oxidase
A. I and IV
B. I and III
C. II and IV
D. I and II

49. Down's syndrome results from
A. The absence of one chromosome in position 21
B. The presence of an extra chromosome in position 21
C. The absence of both the chromosomes in position 21
D. Crossing over on the chromosomes in position 21

50. Which of the following statement is not correct about the NMR?
A. It stands for Nuclear Magnetic Resonance
B. Protein samples are labelled with radioisotopes such as $^{13}C$ and $^{15}N$
C. NMR spectroscopy detects spinning patterns of atomic nuclei in a magnetic field
D. NMR spectroscopy detects spinning patterns of atomic nuclei in an electric field

51. Which of the following prezygotic reproductive isolating mechanisms best explains why salamanders that live in trees do not successfully mate with salamanders that live in soil by rivers?
A. Mechanical isolation
B. Temporal isolation
C. Ecological isolation
D. Behavioral isolation

52. In DNA sequencing by the Sanger (dideoxy) method:
A. Specific enzymes are used to cut the newly synthesized DNA into small pieces, which are then separated by electrophoresis
B. The dideoxynucleotides must be present at high levels to obtain long stretches of DNA sequence.
C. The role of the dideoxy CTP is to occasionally terminate enzymatic synthesis of DNA where Gs occur in the template strands
D. The template DNA strand is radioactive

53. Consider the following steps involved in PSI-Blast and arrange them in correct order
I. The PSSM is used as a query to search database
II. BLASTP search using a scoring matrix such as BLOSUM62 to perform pairwise alignments of query sequence against database
III. Construction of a multiple sequence alignment from BLASTP search and creation of a profile.
IV. Continuation of search process iteratively, typically about five times.
V. Estimation of the statistical significance of the database matches.
A: II, III, I, V and IV
B. II, I, III, IV, and V
C. III, V, I, II, and IV
D. II, III, V, I, and IV

54. Which statement is NOT true of sterols?
A. Sterols are commonly found in bacterial membranes.
B. Sterols are more common in plasma membranes than in intracellular membranes (mitochondria, lysosomes, etc.).
C. Sterols are precursors of steroid hormones.
D. Sterols have a structure that includes four fused rings.

55. The following could be the causes or etiological factors responsible for the development and or progression of type – 1diabetes

I. Genetic susceptibility and environmental triggers
II. Allergy to wheat gluten
III. Certain antigens causing autoimmunity
IV. Lactose intolerance

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

56. One of the significant objectives or outcomes of systems biology could be

A. Generation of multi-*omics* data
B. Making sense out of next generation sequencing data
C. Data driven, testable models relevant in discovery
D. To deliver designer therapeutics and vaccines

57. If you perform Dot plot analysis of a DNA sequence with itself having direct repeats. It will produce

A. horizontal lines
B. parallel vertical lines
C. crossed line to the diagonal line
D. lines parallel to the diagonal line

58. In a zymographic assay aimed to identify the protease inhibitors, the following statement is correct.

A. Protease is mixed with the components of the polyacrylamide gel before PAGE
B. Gelatin is mixed with the components of the polyacrylamide gel before PAGE
C. Protease is mixed with the components of the polyacrylamide gel before PAGE followed by the incubation of the gel with the Gelatin
D. Gelatin is mixed with the components of the polyacrylamide gel before PAGE followed by the incubation of the gel with the protease

59. Multiple sclerosis involves a breakdown of the _____.

A. soma
B. myelin sheath
C. synaptic vesicles
D. dendrites

60. A 30-year-old man is a heterozygote for a disease that is prevalent in the population. If the population is in Hardy-Weinberg equilibrium, then $p^2 + 2pq + q^2 = 1$ and $p + q = 1$. Which of the following in this equation indicates the prevalence of heterozygotes?

A. $p^2$
B. $q^2$
C. 2pq
D. $p^2 + q2$

61. Non-steroidal anti-inflammatory drugs (NSAIDS) like aspirin and ibuprofen act by blocking production of:

A. Prostaglandins
B. Sphingolipids
C. Vitamin D
D. Biological waxes

62. The _____ is a sensory relay station where all sensory information, except for smell, goes before being sent to other areas of the brain for further processing.

A. amygdala
B. hippocampus
C. hypothalamus
D. thalamus

63. Which of the following methods can be used to interpret protein-protein interaction.

I. FASTA
II. Domain fusion method (Rosetta Stone)
III. Gene Neighborhood method
IV. Chou–Fasman method

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

64. Match the following

| | |
|---|---|
| I. ExPASy | 1. Resource of protein–protein interactions |
| II. BLOSUM | 2. Bioinformatics Resource Portal |
| III. STRING | 3. Information retrieval tool of NCBI |
| IV. Entrez | 4. A substitution matrix |

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

65. Which of the following is a genetic disease that causes neurons in the brain to waste away and die?
A. Multiple sclerosis
B. Polio
C. Encephalitis
D. Huntington's disease

66. The following statements are correct with reference to Jasmonic acid
I. It is essential during pathogen resistance
II. It is synthesized from arachidonic acid
III. Ricin, a bacterial toxin activates jasmonate signalling
IV. Jasmonoyl-isoleucine is the active hormone in the jasmonate signalling pathway
A. I and II
B. II and III
C. I and IV
D. II and IV

67. Identify the correct sequence in the passage of electrons to the Alternative oxidase pathway of mitochondrial electron transport chain
A. complex I, ubiquinone
B. complex III, ubiquinone
C. complex III, complex IV, ubiquinone
D. ubiquinone, complex III, complex IV

68. Match the following group-specific ligands with their compounds with affinity, commonly used in affinity chromatography

| List I | List II |
|---|---|
| I. Avidin | 1. Immunoglobulins |
| II. Proteins A and G | 2. Biotin containing enzymes |
| III. Phenylboronate | 3. rRNA |
| IV. Lysine | 4. Glycoproteins |
| | 5. RNA containing poly(U) sequences |

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

69. The amino acid cysteine is synthesized from a precursor of glycolytic pathway in the following sequence of reactions
A. 3-phosphoglycerate, serine, O-acetylserine
B. PEP, serine, O-acetylserine
C. OAA, serine, O-acetylserine
D. Fructose-1,6-bisphosphate, serine, O-acetylserine

70. The specific carotenoids implicated in non-photochemical quenching of photosynthesis
    A. Violaxanthin and lutein
    B. Zeaxanthin and lutein
    C. Isoprene and zeaxanthin
    D. Antheraxanthin and neoxanthin

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| Question No. | Answer | Question No. | Answer |
|---|---|---|---|
| 1 | C | 36 | D |
| 2 | A | 37 | C |
| 3 | C | 38 | B |
| 4 | D | 39 | D |
| 5 | B | 40 | A |
| 6 | C | 41 | A |
| 7 | D | 42 | B |
| 8 | C | 43 | A |
| 9 | D | 44 | A |
| 10 | C | 45 | C |
| 11 | C | 46 | A |
| 12 | D | 47 | A |
| 13 | C | 48 | D |
| 14 | B | 49 | B |
| 15 | B | 50 | D |
| 16 | B | 51 | C |
| 17 | C | 52 | C |
| 18 | D | 53 | A |
| 19 | C | 54 | A |
| 20 | C | 55 | C |
| 21 | D | 56 | C |
| 22 | C | 57 | D |
| 23 | C | 58 | D |
| 24 | A | 59 | B |
| 25 | C | 60 | C |
| 26 | B | 61 | A |
| 27 | D | 62 | D |
| 28 | D | 63 | D |
| 29 | C | 64 | B |
| 30 | B | 65 | D |
| 31 | A | 66 | C |
| 32 | D | 67 | A |
| 33 | B | 68 | C |
| 34 | D | 69 | A |
| 35 | A | 70 | B |

25/01/2021