

Entrance Examination – 2020
(Ph.D. Admissions - January 2021 Session)

Ph.D. Microbiology

Time: 2 hours

Maximum Marks: 70

HALL TICKET NO.

INSTRUCTIONS

Please read carefully before answering the questions:

1. Enter your Hall Ticket number both on the top of this page and on the OMR answer sheet.
2. Answers are to be marked only on the **OMR answer sheet** following the instructions provided there upon.
3. Hand over the OMR answer sheet to the Invigilator before leaving the examination hall.
4. The question paper contains **70** questions. **Part-A:** Question Nos. **1-35** and **Part-B:** Questions Nos. **36-70** of multiple-choice printed in **12** pages, including this page. **One OMR answer sheet** is provided separately. **Please check.**
5. The marks obtained in **Part-A** will be used for resolving the tie cases.
6. Each question carries one mark.
7. Calculators and mobile phones are NOT allowed.

PART-A

1. In which direction do the sodium (Na^+) and potassium (K^+) ions move in the sodium/potassium pump?
 - A. Na^+ into the cell, K^+ out
 - B. K^+ into the cell, Na^+ out
 - C. Na^+ into the cell, K^+ in
 - D. K^+ out of the cell, Na^+ out

2. Which of the following is the **correct** full form of MEGA?
 - A. Minimum Evolutionary Genome Analysis
 - B. Minimum Evolutionary Genetics Analysis
 - C. Molecular Evolutionary Genetics Analysis
 - D. Molecular Evolutionary Genome Analysis

3. Which of the following enzyme is involved in siRNA-directed DNA methylation pathway in plants?
 - A. RNA polymerase I
 - B. NA polymerase II
 - C. RNA polymerase III
 - D. RNA polymerase V

4. Kyte-Doolittle hydropathy plots are used for predicting the following_____.
 - A. Transmembrane regions in a protein
 - B. Active site of enzymes
 - C. Amino acid sequence similarity between proteins
 - D. Cofactor-binding domain of a protein

5. Noble prize (2020) in chemistry was given away to Jennifer Doudna and Emmanuelle Charpentier for developing a technique which is used extensively as a tool in molecular biology.
 - A. CRISPR-CAS9
 - B. Atomic force microscopy
 - C. Quelling
 - D. Super resolution microscopy

6. To prepare 1L of buffer of 50 mM Tris base (121.14 g/mol), 200 mM glycine (75.07 g/mol) and 1% SDS, the following amounts are nearest to the correct weighed amounts to be taken
 - A. 6.006 g of Tris Base; 1.5 g of glycine 10 g of SDS
 - B. 6.06 g of Tris Base; 15 g of glycine 10 g of SDS
 - C. 3.03 g of Tris Base; 15 g of glycine 1 g of SDS
 - D. 30.3 g of Tris Base; 15 g of glycine 1 g of SDS

7. One of the following concepts emerged out of PaJaMo experiment, conducted by AB Pardee, F. Jacob and J. Monod, is _____

- A. DNA as the "transforming principle"
- B. proteins are always synthesized from N-terminus to C-terminus
- C. development of the concept of messenger RNA
- D. genetic codon

8. Match the genetic notation (A) with the correct description (B).

A	B
a. ::	(i) truncation
b. Φ	(ii) insertion
c. '	(iii) deletion
d. Δ	(iv) fusion

- A. a(i), b(iv), c(ii), d(iii)
- B. a(iv), b(ii), c(iii), d(i)
- C. a(ii), b(iv), c(i), d(iii)
- D. a(iii), b(ii), c(i), d(iv)

9. GC skew of a given genome is calculated by the formula _____.

- | | |
|----------------------|----------------------|
| A. $(G - C)/(G + C)$ | B. $(G + C)/(G - C)$ |
| C. $(G - C)*(G + C)$ | D. $(G + C)*(G - C)$ |

10. A bacterial strain can grow on a medium supplemented with Arg, Trp, and Leu. It fails to grow on media containing Arg and Trp or Leu and Trp; however, it shows growth on agar with Arg and Leu. What is the genotype of the bacterium with respect to these three amino acids?

- | | |
|------------------|------------------|
| A. $arg^+ leu^-$ | B. $arg^- leu^-$ |
| C. $arg^+ leu^+$ | D. $arg^- leu^+$ |

11. Prenatal screening of babies for gross chromosomal aberrations as well as sex prediction is possible based on the fluid surrounding the fetus by the process known as:

- | | |
|------------------|---|
| A. Amniocentesis | B. Widal agglutination test |
| C. Aminocentesis | D. Albumin to Creatinine Ratio (ACR) test |

12. The Shine-Dalgarno sequence is a part of:

- A. Trailer sequence of a polycistronic mRNA
- B. 16S ribosomal RNA
- C. Leader of an mRNA molecule
- D. Transfer RNA (tRNA) gene

13. Amino acids are attached to the correct tRNA molecules by a set of activating enzymes called:
- A. Aminoacyl tRNA synthetases B. Peptidyl tRNA synthetases
C. Peptidyl transferases D. Deformylase
14. Induction of beta-galactosidase activity by IPTG is the result of
- A. Stimulation of the *lac* repressor function
B. IPTG binding to *lac* operon and inducing transcription
C. IPTG binding to *lac I* gene product and inhibiting its activity
D. Inhibition of beta-galactosidase degradation
15. Which of the following amino acid has the greatest number of codons?
- A. Proline B. Leucine C. Tryptophan D. Aspartic acid
16. DNA of a bacterium is not cleaved by its own restriction enzymes because the recognition DNA sequences are
- A. Methylated B. Deleted
C. Bound by inhibitory proteins D. Not accessible to restriction enzymes.
17. The cell walls of gram-stain-positive bacteria contain two modified sugars, *N*-acetylglucosamine and *N*-acetylmuramic acid. They are covalently linked by
- A. α -1,4-glycosidic bond B. β -1,6-glycosidic bond
C. α -1,6-glycosidic bond D. β -1,4-glycosidic bond
18. Acid fast staining of gram-stain-positive mycobacterium is due to
- A. presence of dipicolinic acid in cell wall
B. presence of mycolic acid in cell wall
C. presence of teichoic acid in cell wall
D. presence of diaminopimelic acid in cell wall
19. A bacterial culture had an initial cell density of 10^3 cells/ml. In 6 hours, the cell density reached 10^6 cells/ml. Given the formula for the number of generations, $n = (\log_{10}N_t - \log_{10}N_0)/0.301$; the number of generations (n) the cells have undergone is
- A. 3 B. 10 C. 15 D. 20
20. Exposure of a photographic film to DNA labeled with a radioactive isotope is:
- A. DNA Cross-linking B. Electrophoresis
C. Autoradiography D. Radiotherapy

21. In pBeloBAC11 cloning vector, the BAC cloning site is flanked by
- A. Only SP6 promoter sequence
 - B. Only T7 promoter sequence
 - C. Both SP6 and T7 promoter sequence
 - D. Both SacB and T7 promoter sequence
22. Which frequency range is known as the fingerprint region in infrared spectroscopy?
- A. 400 - 1400 cm^{-1} B. 1400 - 900 cm^{-1} C. 900 - 600 cm^{-1} D. 600 - 250 cm^{-1}
23. Oxidation of protein leads to
- A. Misfolding
 - B. Denaturation
 - C. Renaturation
 - D. Hydrophobic effect
24. In which method the substrate and inhibitor cannot bind to the enzyme at the same time
- A. Competitive inhibition
 - B. Uncompetitive inhibition
 - C. Non- Competitive inhibition
 - D. Allosteric inhibition
25. Various bacterial photosynthetic organisms like green sulfur bacteria, purple sulfur bacteria, and purple nonsulfur bacteria are different in their light absorption, pigments, structure but they also have common similarities. Can you identify the similarity among them from the following answers?
- A. They are all mixotrophic
 - B. They are all aerobic
 - C. They all have Reaction Centre
 - D. Thylakoid
26. Incidence of Beriberi, a neurological disorder is due to deficiency of which of the following?
- A. Cyanocobalamin
 - B. Pyridoxal phosphate
 - C. Riboflavin
 - D. Thiamine
27. Cyclo-oxygenase catalyzes the formation of prostaglandins from which of the following precursor?
- A. Cholesterol
 - B. Palmitic acid
 - C. Glycerol
 - D. Arachidonic acid
28. In proteins, N-linked oligosaccharides are attached to:
- A. Glutamine
 - B. Arginine
 - C. Lysine
 - D. Asparagine

29. If the average molecular weight of one amino acid is 110 Daltons, the molecular weight of a peptide made up of 10 amino acids is expressed to be
- A. 1100 B. 938 C. 876 D. 744
30. Which one of the following combinations of amino acids in a protein is likely to be phosphorylated by protein kinases?
- A. Arg, Leu, Ala, Ile B. Tyr, Ser, Thr, His
C. Val, Glu, Phe, Lys D. Met, Trp, Asp, Pro
31. Consider the following peptide sequence in which the amino acids are depicted in the one letter code: D-W-V-R-M-S-M-F-K-Q-G-P-R-M. When this peptide is treated with trypsin the fragments generated would be
- A. D-W-V-R; M-S-M-F-K; D-W-V-R-M-S-M-F-K; D-W-V-R-M-S-M-F-K-Q-G-P-R; M-S-M-F-K-Q-G-P-R-M
B. V-R-M-S-F; C-Q-G-P-K; M; D-W-V-R; M-S-F-C-Q-G-P-R-M; D-W-V-R-M; S-F-C-R-M
C. V-R-M-S-F; D-W-V; R-M-S-F-C-Q-G-P-Y-M; M-S-F-C-Q-G-P-Y-M; F-M-R-Y-M
D. V-R-M-S-F; C-Q-G-P-Y; R-M-S-F-C-Q-G-P-Y-M; F-C-Q-G-P; S-F-C-Q-G-P-Y-M;
32. DNA was extracted and analysed for base composition from the cells of *Staphylococcus afermentans*. It was found that 37% of the bases are cytosine. Using this information, predict what percentage of the bases is adenine?
- A. 20% B. 13% C. 53% D. 30%
33. If a virus particle contains double stranded DNA with 200,000 base pairs, how many complete spirals would occur on each strand?
- A. 20,000 complete spirals B. 40,000 complete spirals
C. 100,000 complete spirals D. 60,000 complete spirals
34. Calvin Bridges discovered rare exceptions in the expected pattern of inheritance in crosses with several X-linked genes. In the crosses between white-eyed (X^wX^w) *Drosophila* females with red-eyed ($X^{w+}Y$) males, the rare primary exceptional progeny he recovered were:
- A. Red eyed sterile females with the genotype, $X^{w+}0$
B. White eyed fertile females with the genotype, $X^wX^w Y$
C. Red eyed sterile males with the genotype, $X^{w+}Y$
D. White eyed fertile males with the genotype, X^w0

35. If two loci A/a and B/b are 14 map units apart and an Ab/aB individual is testcrossed, there will be
- | | |
|-------------------------|--------------------------------|
| A. 14% AaBb individuals | B. 14% aaBb individuals |
| C. 7% aabb individuals | D. 28% recombinant individuals |

PART-B

36. A man produces the following kinds of sperm in equal proportions: *EF*, *Ef*, *eF* and *ef*. What is his genotype with reference to the genes specified?
- | | | | |
|----------------|----------------|----------------|----------------|
| A. <i>EEFF</i> | B. <i>EeFf</i> | C. <i>EEFf</i> | D. <i>eeff</i> |
|----------------|----------------|----------------|----------------|
37. Transposable elements like *bobo* mediates intrachromosomal recombination in *Drosophila* such that two *bobo* elements on the same chromosome pair and recombine with each other. What would be the result of such recombination if the *bobo* elements were oriented in the Opposite direction on the chromosome?
- | | | | |
|--------------|-------------|----------------|--------------|
| A. insertion | B. deletion | C. duplication | D. inversion |
|--------------|-------------|----------------|--------------|
38. The nitrogen-fixing nodules of a bean plant carries a variant of hemoglobin molecule which scavenges oxygen is
- | | |
|------------------------|------------------|
| A. Carbaminohemoglobin | B. Leghemoglobin |
| C. Myeloglobin | D. Oxyhemoglobin |
39. Harvey J. Alter, Michael Houghton and Charles M. Rice were awarded noble prize (2020) for medicine and physiology for their seminal work on this virus
- | | |
|---------------------------------|-----------------------------|
| A. <i>Human Papilloma virus</i> | B. <i>Hepatitis C virus</i> |
| C. <i>Sars Corona virus</i> | D. <i>Ebola virus</i> |
40. Consider the following statements and choose the **correct** answer.

Statement 1: Retting is a process where the action of water, fungi and bacteria entering the leaf via the stomata, decompose the mainly parenchymatous matter surrounding the fiber bundles and thereby free the fibers from the other tissues.

Statement 2: Bast fibers are usually separated by this means except flax fibers, which are not extracted by retting

- | |
|---|
| A. Both statements are correct. |
| B. Both statements are false. |
| C. Statement 1 is correct and statement 2 is false. |
| D. Statement 2 is correct and statement 1 is false. |

41. Which of the following does NOT act as a secondary messenger during cell signaling?
A. c-AMP B. IP₃ C. Ca²⁺ D. PLC
42. Which of the following fruit and vegetable has the least amount of sucrose?
A. Tomato B. Banana C. Mangoes D. Sugar beet
43. Which of the bacterial enzymes is involved in Glyphosate resistance?
A. 5-enolpyruylshikimate-3-phosphate synthase
B. Phosphoenol Pyruvate Carboxylase
C. Phosphinothricin N-Acetyltransferase
D. Hexokinase
44. Which of the following modified dihybrid ratio is obtained in F₂ generation in case of dominant epistasis?
A. 12: 3: 1 B. 13: 3 C. 9: 6: 1 D. 5: 7
45. Garrod studied a number of inborn errors of metabolism in which the patients excreted abnormal substances in the urine. In the individuals affected by the hereditary disease alkaptonuria, the abnormal substance excreted is called as
A. 4-Hydroxyphenylpyruvic acid B. 4-Maleylacetoacetic acid
C. Homogentisic acid D. Fumarylacetoacetic acid
46. The purpose of a quantitative genetic analysis of a trait is
A. To determine the nature of gene interactions controlling the trait in a given population
B. To determine the genotypes of the individuals of a population
C. To determine the number of genes controlling a specific trait in the population
D. To determine how much of the phenotypic variation associated for a trait in a population is due to genetic variation and how much is due to environmental variation
47. The stage of meiotic prophase 1 during which the chromosomes become visible in the light microscope as unpaired thread-like structures is
A. Leptotene B. Zygotene C. Pachytene D. Diplotene
48. Which of the following present exclusively in outer layer of plasmamembrane?
A. Phospolipids B. Sterols C. Glycolipids D. Extrinsic proteins

49. Victorin is a host-specific toxin produced by *Helminthosporium victoriae* is a
- A. Linear polyketols varying C₃₅-C₄₅ in length
 B. Cyclic tetradepsipeptide
 C. Cyclic pentapeptide
 D. Polyketide coronafacic acid
50. George Beadle and Edward Tatum proposed one gene-one enzyme hypothesis through experiments conducted with the following organism
- A. *Neurospora crassa*
 B. *Drosophila melanogaster*
 C. *Saccharomyces cerevisiae*
 D. *Mus musculus*
51. The antibacterial effect of 'oxazolidinones' is by _____.
- A. Inhibiting bacterial transcription
 B. Inhibiting binding of N-formylmethionyl-tRNA to the ribosome
 C. Inhibiting ATP synthesis
 D. Inhibiting nucleotide metabolism
52. Preservation of the order of genes or genomic regions along the chromosomes is called ____.
- A. Parsimony
 B. Synteny
 C. Paralogy
 D. Ontology
53. The enzyme commission number is a numerical classification of enzymes based on ____.
- A. Chemical reactions they catalyze
 B. Tertiary structure of amino acids
 C. Physicochemical properties
 D. Distribution of α -helix and the β -strand
54. Which of the following is not a gene knockdown approach?
- A. RNAi
 B. VIGS
 C. TALEN
 D. miRNA
55. The gene *npvIII* imparts resistance to the antibiotic ____.
- A. Hygromycin
 B. Ampicillin
 C. Kanamycin
 D. Chloramphenicol
56. The non-homologous recombination in higher organisms may arise due to one of the following:
- A. Inversions
 B. Transposons
 C. Duplications
 D. Deletions

57. Match the definitions (A) with their correct terminologies (B).

- | A | B |
|---|-----------------------|
| a. Conversion of chemical compounds to different forms by the biological system | (i) Biosimulation |
| b. Supplementing nutrients and other factors that promote the growth and activity of microbes | (ii) Biosorption |
| c. Biological process of reducing complex contaminants to non-toxic levels | (iii) Bioformulation |
| d. Introducing microbes into the environment/process to aid in remediation | (iv) Bioremediation |
| e. Passive concentration of contaminants into the cellular structure | (v) Biotransformation |
| | (vi) Bioaugmentation |
| | (vii) Biostimulation |
- A. a(ii), b(iii), c(iv), d(v), e(vi)
 B. a(vi), b(v), c(ii), d(iv), e(i)
 C. a(iii), b(i), c(vi), d(ii), e(iv)
 D. a(v), b(vii), c(iv), d(v), e(ii)

58. Match the mutagens (A) with the type of mutation they induce (B).

- | A | B |
|---------------------------|---|
| a. 5-bromouracil | (i) intercalating and buckling DNA |
| b. Ethyl ethane sulfonate | (ii) purine analogue |
| c. Proflavine | (iii) conversion of adenine to hypoxanthine |
| d. 2-aminopurine | (iv) removal of purine ring |
| e. nitrous acid | (v) pyrimidine analogue |
- A. a(v), b(iv), c(i), d(ii), e(iii)
 B. a(i), b(v), c(ii), d(iv), e(iii)
 C. a(v), b(ii), c(i), d(iii), e(iv)
 D. a(iii), b(iv), c(v), d(ii), e(i)

59. Which among the following is an intermediate in steroid biosynthesis?

- A. Chorismate B. 2, 4-Dihydroxybenzoate C. Squalene D. Phytoene

60. Gnotobiotic refers to

- A. A biological system in which certain microbial communities are introduced to understand their function.
- B. A biological system which is germ-free with known microbial communities.
- C. A biological system in which certain microbial communities are excluded to understand their function.
- D. A complete biological system which includes macro and micro life.

61. Which among the following is **not** a Proteobacterium

- A. *Rhizobium*
- B. *Rhodospirillum*
- C. *Leptospira*
- D. *Agrobacterium*

62. Q fever is caused by a member belonging to the genus

- A. *Mixobacteria*
- B. *Coxiella*
- C. *Mycobacterium*
- D. *Leptospira*

63. Leukopenia is one of the abnormal conditions related to immune system. This condition is known for

- A. Low RBC count in the blood
- B. High level of eosinophils in the blood
- C. High level of LDL cholesterol
- D. Low WBC count in the blood

64. Gliding motility is common among

- A. Filamentous cyanobacteria
- B. Pseudo mycelia of yeast
- C. *Paramecium*
- D. *Hydrilla*

65. One of the following is used in the treatment of Parkinson's disease

- A. 2, 4-Dihydroxyphenylalanine
- B. 1, 2-Dihydroxybenzoate
- C. 2, 4-Dihydroxybenzoate
- D. 1, 2-Diamino-4-hydroxyphenylalanine

66. Which of the following cells in peripheral nervous system produces the myelin sheath around neural axons?

- A. Schwann cells
- B. Microglial cells
- C. Astrocyte
- D. Ependymal cells

67. Identify the mismatch

- A. *Rhodobacter* – Alphaproteobacteria
- B. *Chromatium* – Gammaproteobacteria
- C. *Bdellovibrio* – Gammaproteobacteria
- D. *Campalobacter* – Epsilonproteobacteria

68. "Cercariae" is an infective stage of which of the following disease?

- A. Lymphatic filariasis
- B. Trichomoniasis
- C. Cysticercosis
- D. Schistosomiasis

69. Match the following diseases in group A with their causative agent in group B.

Group A

- K. Histoplasmosis
- L. Encephalitis
- M. Cysticercosis
- N. Leishmaniasis

Group B

- 1. Virus
- 2. Tapeworm
- 3. Fungi
- 4. Bacteria
- 5. Protozoa

- A. K-4; L-1; M-2; N-5
- B. K-2; L-4; M-1; N-5
- C. K-3; L-1; M-2; N-5
- D. K-3; L-1; M-5; N-2

70. Which of the following disease is also known as Hansen's disease?

- A. Plague
- B. Leprosy
- C. Histoplasmosis
- D. Gonorrhoea

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1. B
2. C
3. D
4. A
5. A
6. B
7. C
8. C
9. A
10. B
11. A
12. C
13. A
14. C
15. B
16. A
17. D
18. B
19. B
20. C
21. C
22. B
23. A
24. A
25. C
26. D
27. D
28. D
29. B
30. B
31. A
32. B
33. A
34. B
35. C
36. B
37. D
38. B
39. B
40. C
41. D
42. A
43. A
44. A

Gil

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