ENTRANCE EXAMINATION, 2015

Integrated MSc-PhD Biotechnology

Time: 2 hours   **Maximum Marks: 75**

HALL TICKET NO. [   ]

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. Enter your hall ticket number on this sheet and the answer (OMR) sheet.

2. Answers are to be marked only on the OMR answer sheet with BLACK/BLUE ball point/Sketch pen following the instructions provided there upon.

3. Hand over OMR answer sheet at the end of examination.

4. All questions carry one mark each.

5. 0.33 mark will be deducted for every wrong answer.

6. There are total 13 pages (including this page) in this question paper. Check this before you start answering.

7. The question paper consists of **Part "A"** and **Part "B"**. The marks obtained in **Part "A"** will be taken into consideration in case of a tie, when more than one student gets equal marks, to prepare the merit list.

8. Non-programmable scientific calculators are permitted.

9. Cell/Mobile phones are strictly prohibited in the examination hall.

Part A

1. A rover on Mars crawls 100 meters south then 120 meters west, and 20 meters south again. It then moves 40 meters east before crawling 60 meters north. How far is the rover from its initial start point?
   A) 170 meters
   B) 85 meters
   C) 100 meters
   D) 120 meters

2. The length of a rectangle is increased by 60%. By what percentage the width be decreased to maintain the same area?
   A) 37%
   B) 50%
   C) 120%
   D) 75%

3. A fabric needed to make 3 curtains, sells for $8.00 per yard, and can be purchased only by the full yard. If the length of fabric required for each curtain is 1.6 yards and all of the fabric purchased as a single length, what is the total cost of the fabric that needs to be purchased for the 3 curtains
   A) $40.00
   B) $38.40
   C) $24.00
   D) $16.00

4. Which of the following samples has the largest mass
   A) $1.42 cm^3$ diamond (density - $2.84 gm/cm^3$)
   B) $0.75 cm^3$ opal (density- $2.20 gm/cm^3$)
   C) $1.00 cm^3$ ivory (density-$1.9 gm/cm^3$)
   D) $0.65 cm^3$ coal (density- $2.7 gm/cm^3$)

5. What is the least positive integer that is not a factor of 25! and is not a prime number?
   A) 26
   B) 28
   C) 56
   D) 58

6. If $x<y<0$, which of the following inequalities must be true?
   A) $y+1<x$
   B) $y-1<x$
   C) $xy<y^2$
   D) $xy<x^2$

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7. Consider following system of equations

$$2yz + zx - 5xy = 2$$
$$yz - zx + 2xy = 1$$
$$yz - 2zx + 6xy = 3.$$

What is the correct answer?

A) xyz=±6 and x=2, y=1, z=3 ; x=-2, y=-1, z=-3

B) xyz=±6 and x=1, y=2, z=3; x=-1, y=-2, z=-3

C) xyz=−6 and x=1, y=-2, z=3

D) xyz=6 and x=2, y=1, z=3

8. What is the perimeter, in meters, of a rectangular playground which is 24 meters wide and has same area as a rectangular playground 64 meters long and 48 meters wide
A) 112
B) 152
C) 312
D) 304

9. $f(x) = ax - \dfrac{x^3}{1+x^2}$ where **a** is a constant. What should be the value of **a** such that $f^1(x) \geq 0$ for all x?

A) $a \geq \dfrac{11}{8}$

B) $a \geq 1$

C) $a \geq \dfrac{10}{8}$

D) $a \geq \dfrac{9}{8}$

10. List K consists of numbers -10, -5, 0, 5 and 10. Which of the following lists of numbers have the same range as the numbers in list K
A) -15,-1,0,1,15
B) -7,-4,-2,1,13
C) 0,1,2,5,8,10
D) 4, 6, 8, 24

11. Nuclear sizes are expressed in a unit called:
A) Fermi
B) Tesla
C) Newton
D) Angstrom

12. Sequence coverage in whole genome sequencing is dependent on:
    A) Read length
    B) Number of reads
    C) Genome size
    D) All of the above

13. Which of the following can be used to determine an alpha helical conformation of a protein in a solution
    A) UV absorbance spectroscopy
    B) Circular dichroism
    C) Ultracentrifugation
    D) Electrophoresis

14. Consider the following pattern. Identify the missing number that should replace '?'

```
          5    6    7
       11   3   11   6    2
     7    8   5   15   7   1   2
       3    4   ?    8   3
          4    4    4
```
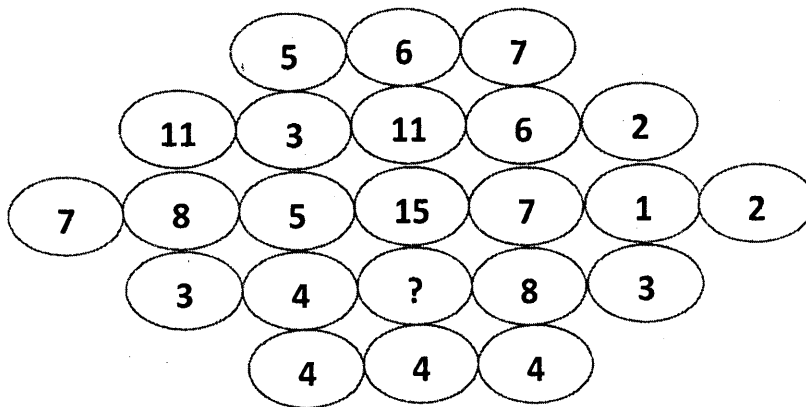
    A) 4
    B) 8
    C) 9
    D) 12

15. Sound produced at a point is heard by a person after 5 second, while the same sound is heard by another person after 6 seconds. If the speed of sound is 300 m/s, what could be the maximum and minimum distances between the two persons?
    A) 1.8 km, 0.15 km
    B) 2.2 km, 0.20 km
    C) 2.8 km, 0.25 km
    D) 3.3 km, 0.30 km

16. A bag contains 4 white, 5 red and 6 blue balls. Three balls are drawn at random from the bag. The probability that all of them are red, is:
    A) 1/22
    B) 3/22
    C) 2/91
    D) 2/77

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17. In the xy-plane, line k is a line that does not pass through the origin. Which of the following statements individually provide(s) sufficient additional information to determine whether the slope of the line k is negative:
    A) The intercept of line k is half the y-intercept of line k
    B) The product of the x-intercept and the y-intercept of line k is negative
    C) Line k passes through the points (a, b) and (r, s), where (a-r)(b-s) < 0
    D) Line k does not pass through the points (a, b) and (r, s), where (a-r)(b-s) < 0

18. The base adenine (A) of the DNA of an organism is 21.3 % of its total DNA composition; which of the following statement is correct for the base composition of the genome, given C is cytosine, G guanine and T thymine?
    A) A = T = 21.3 % and G = C = 28.7 %
    B) A = C = 28.7 % and G = T = 28.7 %
    C) A = T = 21.3 % and G = C = 21.3 %
    D) A = T = 28.7 % and G = C = 21.3 %

19. Phosphorus comes in different allotrophic forms in various colors. Which one is the standard state?
    A) White
    B) Admixture of red and black
    C) Black
    D) Red

20. The standard state of bromine is:
    A) solid
    B) liquid
    C) gas
    D) vapor

21. Which one of the following statements is more correct about oxygen:
    A) It exists as O_2 (g) under normal state, not as liquid or oxygen atoms
    B) It can naturally exist as O_3 (ozone) which is an allotrope of oxygen
    C) The O_2 form is energetically more stable than O_3
    D) All of the above

22. A bike started from a point X is ridden with a constant velocity of 60 km/hr. When will another bike ridden with a constant velocity of 90 km/hr started from the same point X, but after two hours, could meet the first bike?
    A) 1 hrs. after the second bike was started
    B) 2 hrs. after the second bike was started
    C) 4 hrs. after the second bike was started
    D) 6 hrs. after the second bike was started

23. Sensitive dependence of a system on initial conditions leads to large-scale effects elsewhere owing to small changes at one place. This phenomenon is called as:
   A) Butterfly effect
   B) Time travel effect
   C) Chaos theory
   D) Boyle's law

24. Bottle opener, see-saw, and stapler are the levers of, respectively,
   A) class-I, class-II, and class-III
   B) class-I, class-III, and class-II
   C) class-II, class-I, and class-III
   D) class-III, class-I, and class-II

25. Which one of the following is correct with respect to the energy of electromagnetic radiations?
   A) Radio waves < Ultraviolet < Infrared < X-ray
   B) Radio waves < Infrared < Ultraviolet < X-ray
   C) Infrared < Ultraviolet < X-ray < Radio waves
   D) Infrared < Ultraviolet < Radio waves < X-ray

PART - B

26. Which of the following technique is most suitable for detecting the presence of a gene product
   A) Dot blotting
   B) Plaque blotting
   C) Western blotting
   D) Southern blotting

27. A vector able to replicate into two different hosts is called
   A) Cloning vector
   B) Expression vector
   C) Secretion vector
   D) Shuttle vector

28. An amino acid that has a secondary amine and disrupts alpha-helix formation is
   A) Threonine
   B) Glycine
   C) Phenyl alanine
   D) Proline

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29. The following is a Y-linked phenomenon
    A) Holandric inheritance
    B) Occurrence of amelogenin loci
    C) SRY genes
    D) Genomic imprinting

30. 2, 4-D is a structural analogue of
    A) Auxin
    B) Cytokinin
    C) Abscisic acid
    D) Brassinolide

31. Which one of the following is true
    A) Epigenetics means alteration of both genotype and phenotype upon environmental changes
    B) Epigenetics does not involve a change in DNA sequence
    C) Epigenetics involves mutation in DNA sequence
    D) Gregor Mendel coined the term 'Epigenetics'

32. Which of the following enzyme uses RNA as template to make DNA
    A) RNA polymerase
    B) Telomerase
    C) DNA polymerase III
    D) DNA polymerase alpha

33. Reverse transcriptase enzyme is involved in
    A) Synthesis of complementary DNA from mRNA
    B) Synthesis of complementary mRNA from DNA
    C) To digest DNA-RNA complex
    D) To join to DNA fragments

34. A technique that can be used to study protein location in cells
    A) MALDI-TOF
    B) Fluorescent microscopy
    C) NMR spectroscopy
    D) X-ray crystallography

35. The oxidized form of glutathione is represented as
    A) GSH
    B) FAD
    C) NAD
    D) GSSG

36. You engineered a bacteriophage that had the protein coat of T4 phage and the DNA of T2 phage. The composite bacteriophage was allowed to infect bacteria. What would be the composition of the new phages produced in the bacterial cells

   A) New phages would have the protein coat of T2 and the DNA of T4
   B) New phages would have the protein coat and DNA of T4
   C) New phages would have the protein coat and DNA of T2
   D) New phages would have a mixture of the DNA and proteins of both phages

37. What is the chemical basis of gene imprinting
   A) Phosphorylation of DNA
   B) Methylation of DNA
   C) Oxidation of DNA
   D) Glycosylation of DNA

38. Which one of the following *E.coli* sigma subunit is required for transcription of heat inducible genes
   A) Sigma 70
   B) Sigma 32
   C) Sigma54
   D) Sigma28

39. The substance that is the general biosynthetic precursor of sex hormones and hormones of adrenal cortex is
   A) Lecithin
   B) Sphingomyelin
   C) Phosphatidyl choline
   D) Cholesterol

40. Anaplerotic reaction involves the conversion of pyruvate to
   A) α-ketoglutarate
   B) Acetyl-CoA
   C) Oxaloacetate
   D) Succinate

41. Molecular chaperones
   A) Are expressed only when cells are exposed to various stressful condition
   B) Are present in nucleus and help in folding of DNA
   C) degrade proteins that have folded incorrectly
   D) Help new proteins fold correctly and repair incorrectly folded proteins

42. Classification of bacteria into Gram positive and Gram negative categories is based upon:
   A) Shape
   B) Size
   C) Staining
   D) Flagella

43. With reference to the bacterial cell wall, which of the following statements is correct?
    A) Gram +ve bacteria lack peptidoglycan
    B) Gram –ve bacteria lack peptidoglycan
    C) Both Gram +ve and Gram –ve bacteria possess peptidoglycan and the outer membrane
    D) Both Gram +ve and Gram-ve bacteria possess peptidoglycan but the Gram +ve bacteria lack outer membrane

44. An example of peptide phytohormone
    A) Jasmonic acid
    B) Systemin
    C) Salicylic acid
    D) Oxylipin

45. A hydrocarbon is said to be saturated if
    A) It has one or more double bonds between carbon atoms
    B) It contains more than one functional group
    C) Each internal carbon atom is covalently bonded to two hydrogen atoms
    D) It should have at least one aromatic ring

46. In enzyme kinetics, K_{cat}/K_m indicates
    i) turnover number of an enzyme
    ii) efficiency of an enzyme
    iii) affinity of an enzyme

    A) (i) only
    B) (ii) only
    C) (i) and (ii) only
    D) (iii) only

47. Rapid but non-antigen specific immune responses are produced by the
    A) Adaptive immune response
    B) Innate immune system
    C) Leukocytes
    D) Lymphatic system

48. LYS2 is a selectable marker for
    A) Bacteriophase λ
    B) *E.coli*
    C) Yeast
    D) Protozoa

49. The size of the viruses will be maximum in
    A) nm
    B) μm

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C) mm

D) cm

50. Which of the following are true with regard to interferons
   A) Activates B cells to make virus specific antibodies
   B) Are Th2 cytokines
   C) Are virus proteins that interfere with activation of cytotoxic T cells
   D) Inhibits virus replication by infected cells

51. Which of the following disease is not an autoimmune disease
   A) Type-1 diabetes
   B) Celiac disease
   C) Alzheimer's disease
   D) Hashimoto's thyroidosis

52. Mitosis produces a different number of cells than meiosis. Which of the following statements is true
   A) Mitosis produces two cells while meiosis produces four.
   B) Mitosis produces one-tenth the amount of cells as meiosis
   C) Meiosis produces two cells while mitosis produces four
   D) Meiosis produces one fifth the amount of cells as mitosis

53. 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

54. Which of the following is not the part of a virus
   A) Capsid
   B) Plastid
   C) Envelop
   D) Capsomere

55. Alternative oxidase pathway is associated with
   A) Mitochondrial electron transport chain
   B) Chloroplastic electron transport chain
   C) Plasma membrane
   D) Nuclear membrane

56. Antigen-presenting cells that activate helper T cells must express which one of the following on their surfaces
   A) IgE
   B) gamma interferon
   C) class I MHC antigens

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D) class II MHC antigens

57. Which of the following organisms would not undergo meiosis?
    A) Bacteria
    B) Fungi
    C) Plant
    D) Humans

58. The following phenomenon in plants influences their genome size determination:
    A) Ploidy
    B) Gene duplication
    C) Transposition
    D) Mutations and reversions

59. Which of the following genetic elements in bacteria are acquired from an external donor
    A) Multiple CDS
    B) Shine-Dalgarno sequences
    C) Plasmids
    D) Core metabolic genes

60. Which of the following can digest protein
    A) Lipase and trypsin
    B) Trypsin and pepsin
    C) Amylase and chymotrypsin
    D) Pepsin and lipase

61. Restriction enzymes, enzymes which cut the DNA molecules, were discovered by
    A) Boyer and Cohen
    B) Jacob and Monad
    C) Watson and Crick
    D) Nathan, Arber and Smith

62. A light receptor in certain bacteria resembles that found in the eyes of animals. What is the bacterial light receptor called
    A) Photochrome
    B) Chlorophyll
    C) Bacteriorhodopsin
    D) Rhodopsin

63. Polynucleotide phosphorylase (PNPase) polymerizes following substrates when they are available in excess
    A) dNDPs
    B) dNTPs
    C) polydATPs
    D) NTPs

64. An origin of replication is
   A) A particular sequence in eukaryotic or prokaryotic DNA at which replication starts
   B) A sequence to which single stranded binding proteins flock first to start replication
   C) A sequence found in autonomously replicating plasmids
   D) A DNA sequence responsible for making theta coils in a plasmid as a hallmark of replication

65. Which of the following enzyme was firstly isolated in pure crystalline form
   A) Urease
   B) Zymase
   C) Oxygenase
   D) Hexokinase

66. Which of the following amino acids absorb maximum UV light at 280nm
   A) Thr and Pro
   B) Trp and Tyr
   C) Phe and His
   D) Cys and Met

67. Which one of the following is a M13 based vector
   A) pBR322
   B) pT7blue
   C) pUC18
   D) Cosmid

68. The Maxam-Gilbert method of nucleotide sequencing is based on
   A) dideoxy nucleotide triphosphates
   B) chemical modifications of DNA
   C) PCR
   D) RT-PCR

69. Which of the following is used for Global sequence alignment?
   A) Needleman and Wunsch algorithm
   B) Smith and Waterman algorithm
   C) Dot matrix algorithm
   D) ClusalW algorithm

70. Unidirectional transmission of a nerve impulse through nerve fibre is due to the fact that
   A) Nerve fibre is insulated by a medullary sheath
   B) sodium pump starts operating only at the cyton and then continues into the nerve fibre
   C) Neurotransmitters are released by dendrites and not by axon endings
   D) Neurotransmitters are released by the axon endings and not by dendrites

71. Which one of the following is a DNA binding protein

A) light chain proteins
B) C-lectin type receptors
C) TNF Alpha
D) Nf-Kappa-B

72. The primary thermodynamic factor that favors the formation of a lipid bilayer in aqueous surrounding is
A) Hydrogen bond
B) Hydrophobic force
C) Ionic interaction
D) Covalent bonds

73. The enzyme which converts palmitic acid (C16:0) to palmitoleicacid (C16:1) is
A) Hydrogenase
B) Desaturase
C) Hydrolase
D) Catasase

74. Gel electrophoresis is used
A) To size-separate DNA molecules
B) To digest DNA molecules based on their molecular weight
C) To ligate different DNA molecules
D) For amplification of DNA

75. Raw honey is more wholesome than processed honey because:
A) It contains honey bees' probiotic bacteria and pollens
B) It contains color and aroma corresponding to the floral source of the nectar
C) It rarely contains harmful bacterial spores
D) All of the above

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