ENTRANCE EXAMINATION FOR ADMISSION, MAY 2011.

Ph.D. (BIOINFORMATICS)

COURSE CODE : 104

Register Number : [ ]

Signature of the Invigilator
(*with date*)

COURSE CODE : 104

Time : 2 Hours

Max : 400 Marks

Instructions to Candidates :

1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.

2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.

3. Read each question carefully and shade the relevant answer (A) or (B) or (C) or (D) in the relevant box of the ANSWER SHEET using HB pencil.

4. Avoid blind guessing. A wrong answer will fetch you −1 mark and the correct answer will fetch 4 marks.

5. Do not write anything in the question paper. Use the white sheets attached at the end for rough works.

6. Do not open the question paper until the start signal is given.

7. Do not attempt to answer after stop signal is given. Any such attempt will disqualify your candidature.

8. On stop signal, keep the question paper and the answer sheet on your table and wait for the invigilator to collect them.

9. Use of Calculators, Tables, etc. are prohibited.

1. X-ray crystallography is used to study

    (A) structure of lipids

    (B) composition of proteins and nucleic acids

    (C) arrangement of proteins

    (D) three dimensional structure of proteins

2. Electric current may be expressed in which one of the following units?

    (A) coulombs/volt   (B) joules/coulomb

    (C) coulombs/second   (D) ohms/second

3. A constant potential difference is applied across the plates of a parallel-plate capacitor. Neglecting any edge effects, the electric field inside the capacitor is

    (A) constant

    (B) varying as one over r squared

    (C) decreasing as one moves from the positive to the negative plate

    (D) zero

4. When a physical property such as charge exists in discrete "packets" rather than in continuous amounts, the property is said to be

    (A) discontinuous   (B) abrupt

    (C) quantized   (D) noncontinuous

5. The Tesla and the Gauss are units of measure of

    (A) conductance   (B) magnetic field strength

    (C) magnetic flux   (D) electrical current

6. Susan pushes against a 100 kilogram rock with a force of 5 Newtons, but the rock doesn't move. The force the rock exerts on Susan is

    (A) 0 Newtons   (B) 5 Newtons

    (C) 20 Newtons   (D) 100 Newtons

7. A ball is thrown horizontally from the top of a cliff. Assuming no air resistance, the acceleration of the ball while it is in flight is:

    (A) in the vertical direction only

    (B) in the horizontal direction only

    (C) in the vertical and horizontal directions

    (D) zero

8. A wavelength is commonly measured in which one of the following units?

   (A) radians

   (B) angstroms

   (C) electron volts

   (D) seconds

9. Planck's constant was first introduced in order to obtain a correct theoretical prediction of

   (A) the distribution of frequencies occurring in black body radiation.

   (B) the energy produced by the transformation of mass into energy.

   (C) the speed of light.

   (D) lifetime of the neutron

10. Of the following, the most energetic form of NON-IONIZING radiation is:

    (A) ultra-violet light

    (B) infra-red light

    (C) radar

    (D) microwaves

11. Two coal trains, one southbound, the other westbound, reach an over and under crossing at the same instant and each proceed at 40 kilometers per hour on their respective courses. Approximately how far apart are the lead cars two hours later, to the nearest kilometer?

    (A) 80   (B) 113   (C) 136   (D) 160

12. A vehicle is traveling along unbanked curved path. If the friction between the road and tyres suddenly disappears then the vehicle

    (A) moves along tangential direction

    (B) moves along radially outward direction

    (C) moves along a direction between tangential and radially outward direction

    (D) moves along the same curved path

13. Velocity of a projectile in its flight

    (A) remains constant

    (B) first decreases, becomes zero and then increases

    (C) first decreases, reaches minimum and then increases

    (D) first increases, reaches maximum and then decreases

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14. According to the theory of relativity, people who travel at relativistic velocities and then return home will be

   (A) shorter than if they had not made the trip.

   (B) taller than if they had not made the trip.

   (C) younger than if they had not made the trip.

   (D) older than if they had not made the trip.

15. At what point is the temperature the same on the Celsius and Fahrenheit scales?

   (A) Absolute zero   (B) Zero

   (C) Negative 40 degrees   (D) Never

16. A far-sighted person, without optical correction, is typically able to see nearby objects more clearly in bright light. The reason for this phenomena is:

   (A) bright light provides better illumination.

   (B) the pupil of the eye narrows which increases the depth of focus.

   (C) the pupil of the eye widens which increases the depth of focus.

   (D) the bright light causes squinting which flattens the eyeball which tends to correct the far-sighted condition.

17. A typical microwave oven produces microwave radiation with a wavelength of

   (A) 3 meters

   (B) 3×10^{-2} meters (read: 3 times 10 to the minus 2 meters)

   (C) 3×10^{-6} meters (read: 3 times 10 to the minus 6 meters)

   (D) 3×10^{-9} meters (read: 3 times 10 to the minus 9 meters)

18. A sphere which has half the radius but twice the density of another sphere has

   (A) more mass   (B) less mass

   (C) the same mass   (D) the same weight

19. Which of the following is NOT one of the fundamental quantities in physics?

   (A) time   (B) length   (C) weight   (D) mass

20. An element has the following numbers of electrons in its shells: 2-8-8-2. Which of the following is true? The element

   (A) is a non-metal   (B) can accept two electrons

   (C) forms a negative ion   (D) forms an ion with a charge of +2

21. A reaction was found to be second order with respect to the concentration of carbon monoxide. If the concentration of carbon monoxide is doubled, with everything else kept the same, the rate of reaction will

   (A)   remain unchanged   (B)   triple

   (C)   increase by a factor of 4   (D)   double

22. Following statements regarding the periodic trends of chemical reactivity of the alkali metals and the halogens are given. Which of these statements gives the correct picture?

   (A)   The reactivity decreases in the alkali metals but increases in the halogens with increase in atomic number down the group

   (B)   In both the alkali metals and the halogens the chemical reactivity decreases with increase in atomic number down the group

   (C)   Chemical reactivity increases with increase in atomic number down the group in both the alkali metals and halogens

   (D)   In alkali metals the reactivity increases but in the halogens it decreases with increase in atomic number down the group

23. Which one of the following types of drugs reduces fever?

   (A)   Analgesic   (B)   Antipyretic

   (C)   Antibiotic   (D)   Tranquiliser

24. Due to the presence of an unpaired electron, free radicals are

   (A)   Chemically reactive   (B)   Chemically inactive

   (C)   Anions   (D)   Cations

25. The pyrimidine bases present in DNA are

   (A)   cytosine and adenine   (B)   cytosine and guanine

   (C)   cytosine and thymine   (D)   cytosine and uracil

26. A high equivalent weight is desirable for compounds used as primary standards because

   (A)   such compounds are generally easier to purify

   (B)   such compounds are generally hygroscopic

   (C)   such compounds generally react with 1:1 stoichiometry

   (D)   weighing errors are minimized

27. Given that a certain organic compound absorbs light in the visible region, it CANNOT be true that it

    (A)   is aromatic   (B)   is an alkane

    (C)   is colored   (D)   contains a nitro group

28. If the elementary step A → B has a reaction enthalpy of-50 kJ and an activation energy of 10 kJ, the activation energy for the reverse step B -> A is

    (A)   10 kJ   (B)   40 kJ

    (C)   50 kJ   (D)   60 kJ

29. Which of the following hydrogen molecules has the highest vibrational frequency?

    (D - deuterium; T - tritium)

    (A) H_2 (B)   HD

    (C) D_2 (D)   HT

30. A weak acid, HA, has a Ka of 1.00 x 10"5. If 0.100 mole of this acid is dissolved in one liter of water, the percentage of acid dissociated at equilibrium is closest to

    (A)   0.100%   (B)   1.00%

    (C)   99.0 %   (D)   99.9 %

31. An α-helix can be recognized in the 3-dimensional structure of a protein on the basis of

    (A)   hydrogen bonding between consecutive residues

    (B)   φ, ψ angles of alternate residues

    (C)   hydrogen bonding pattern (n to n+4) and φ, ψ angles of a stretch of residues

    (D)   the absence of β – sheet in the structure

32. An expressed sequence tag is a

    (A)   sequence tagged site derived from cDNA

    (B)   sequence tagged site derived from a genomic DNA

    (C)   long strand of DNA which is a part of a cDNA

    (D)   1000-1500 nucleotide sequence that can be used to identify a gene

33. The peptide bond is planar

    (A)   due to restriction caused by rotation around $c_a - N$ bond

    (B)   due to restriction around $c_a - c'$ bond

    (C)   due to delocalization of the lone pair of electrons of the nitrogen onto carbonyl oxygen

    (D)   because amide protons and carbonyl oxygen are involved in hydrogen bonding.

34. The whole-genome shotgun sequencing approach depends primarily on

(A) rapidly sequencing thousands of small randomly cloned fragments

(B) methodical sequencing a few large cloned fragments of DNA

(C) sequencing the bacterial chromosome while it is still intact

(D) use of the gene-gun technology

35. What would be a likely explanation for the existence of pseudogenes?

(A) gene duplication

(B) gene duplication and mutation events

(C) mutation events

(D) unequal crossing over

36. Which type of genomics studies the transcripts and proteins expressed by a genome?

(A) comparative genomics   (B) structural genomics

(C) functional genomics   (D) subtractive genomics

37. Polyphyletic grouping in a phylogenetic tree is

(A) a group in which all members are derived from a unique common ancestor

(B) a group in which all members are derived from a unique common ancestor excluding some of its descendants

(C) a group of distantly related members mixed randomly

(D) a group of closely related members inheriting a set of unique common traits

38. Which of the following method is considered appropriate when the evolutionary rate varies drastically among branches?

(A) Maximum-likelihood

(B) Minimum-evolution

(C) Neighbor-joining

(D) Unweighted Pair Group Method

39. What is the difference between Swiss-Prot and trEMBL?

(A) Swiss-Prot is a computer annotated protein sequence database

(B) trEMBL is an annotated protein sequence database

(C) Swiss-Prot contains all the translations of EMBL nucleotide entries not yet integrated in trEMBL

(D) trEMBL contains all the translations of EMBL nucleotide entries not yet integrated in Swiss-Prot

40. GeneMark, a gene finding tool, uses species specific

  (A) inhomogeneous Markov chain models of protein-coding DNA sequence

  (B) inhomogeneous Markov chain models of non-coding DNA

  (C) homogeneous Markov chain models of protein-coding DNA sequence

  (D) inhomogeneous and homogeneous Markov chain models of non-coding DNA

41. The uncharged polar amino acids are

  (A) Ala, Gln, Val, Ser, Phe   (B) Asn, Gln, Ser, Thr, Tyr

  (C) Phe, Met, Trp, Pro, Asn   (D) Leu, Gln, Ser, Thr, Tyr

42. The genes are tightly packed in

  (A) Bacterial and archeal genome   (B) Plant genome

  (C) *Saccharomyces cerevisiae*   (D) Drosophila genome

43. Kozak consensus is

  (A) the nucleotide sequences surrounding the initiation codon of a eukaryotic mRNA

  (B) the nucleotide sequences surrounding the initiation codon of a prokaryotic mRNA

  (C) located in the promoter region of prokaryotic genomes

  (D) located in the promoter region of eukaryotic genomes

44. A messenger RNA is 339 nucleotide long, including the initiation and termination codons. The number of amino acids in the protein translated from this mRNA is

  (A) 113   (B) 111   (C) 112   (D) 110

45. CpG islands and codon bias are tolls used in eukaryotic genomics to

  (A) find repetitive sequences

  (B) identify open reading frames

  (C) find regulatory sequences

  (D) look for DNA-binding domains

46. Low-complexity regions within protein sequences have

  (A) biased amino-acid composition   (B) transposable elements

  (C) Alu repeats only   (D) regulatory sites only

47. GeneParser is a program that predicts

    (A) promoter region

    (B) miRNA

    (C) tRNA

    (D) exons and introns in a genomic sequence

48. Which one of the following phenomena is not true for lateral gene transfer (LGT)?

    (A) LGT is a process in which an organism incorporates genetic material from another organism

    (B) The mechanisms for LGT are transformation transduction and conjugation

    (C) LGT is common among bacteria, even amongst very distantly-related ones

    (D) There is no evidence for LGT of mitochondrial genes to plant parasites

49. Smith-Waterman process varies from the BLAST method in

    (A) accuracy   (B) speed

    (C) accuracy and speed both   (D) sensitivity

50. Which one of the following statements is not true for Microsatellites

    (A) Repeating sequences of 1-6 base pairs of DNA

    (B) Loci where short sequences of DNA are repeated in tandem arrays

    (C) A polymorphic sequence of DNA consisting of tandemly repeated units of DNA

    (D) Regions are inherently stable and not susceptible to mutations.

51. The orthologous sequences are

    (A) homologous sequences in different species

    (B) homologous sequences within a single species

    (C) the result of gene duplication

    (D) non-homologous sequences in different species

52. Alternative splicing occurs frequently in

    (A) plant   (B) bacteria

    (C) yeast   (D) human

53. Which one of the following statements is not true for Leucine zipper ?

    (A) Protein motif which binds DNA

    (B) Protein motif which binds DNA in which 4-5 Leucines are found

    (C) Protein motif which binds protein in which 4-5 Leucines are found

    (D) Protein motif is present typically in transcription factors that bind DNA.

54. Primary protein structure is formed by

    (A) hydrophobic interactions

    (B) hydrogen bonds

    (C) bonds between amino acids

    (D) covalent linkages between carbon and oxygen

55. In a truly normal frequency distribution

    (A) the mean is never the same as the mode

    (B) the mode is never the same as the median

    (C) the mean always is the same as the median

    (D) the mean always is the same as the standard deviation

56. A letter is taken out from the word STATISTICS and MATHEMATICS. Find the probability that both the letters chosen are Ss.

    (A) 1/55   (B) 1/50   (C) 2/21   (D) 3/21

57. The equation of a circle which passes through (-7,1) and has centre (-4,-3) is

    (A) $x2 + y2 + 8x + 6y = 0$ (B) $x2 + y2 + 4x + 3y = 0$

    (C) $x2 + y2 + 2x + 3y = 0$ (D) $x2 + y2 + 7x + 5y = 0$

58. When two dices are thrown, find the probability of getting equal numbers.

    (A) 1/2   (B) 1/6   (C) 1/12   (D) 1/4

59. What is the probability for a leap year to have 52 Mondays and 53 Sundays?

    (A) 1/7   (B) 1/3   (C) 1/14   (D) 1/21

60. In a protein, hydrophobic amino acids are more likely to be located in the

    (A) protein interior   (B) protein surface

    (C) aqueous environment   (D) transmembrane regions

61. Two amino acids whose R groups contain sulfur atom are

    (A) Cysteine and Methionine   (B) Cysteine and Proline

    (C) Methionine and Histidine   (D) Metheonine and lysine

62. The cosmic ray intensity is minimum at

    (A) South pole   (B) North pole'

    (C) Equator   (D) A height of 20 km

63. Lymphocytes and monocytes are

    (A) Agranulocytes   (B) Granulocytes

    (C) Thrombocytes   (D) Erythrocytes

64. What is the output of following C language statement 7.5 % 3?

    (A) 1.5   (B) 1

    (C) No output   (D) 2

65. A software development strategy that organizes software as a collection of objects that contain both data structure and behaviour

    (A) Software engineering   (B) Object oriented

    (C) Data structure   (D) Program development

66. In C++, by default, the members of a class are

    (A) Public   (B) Private

    (C) Protected   (D) Both public and private

67. In the relational database, the set of values for an attribute or a column is called as

    (A) Tuples   (B) Fields

    (C) Attributes   (D) Domain

68. Authentication mechanisms, which are based on user's behavioral characteristics or physiological characteristics, are known as

    (A) Access matrix technique   (B) Biometric technique

    (C) Artifact technique   (D) Password

69. Which of the following is not a text editor?

    (A) vi   (B) Notepad

    (C) Edit window in DOS   (D) Word 97

70. Which of the following is not a type of processing?

(A) Serial

(B) Network

(C) Batch

(D) Multiprogramming

71. Which of the following hormones initiates biological actions by crossing the plasma membrane and then binding to a receptor?

(A) Glucagon

(B) Estradiol

(C) Insulin

(D) Adrenocorticotropic hormone

72. The major mechanism of turnover of molecular components of the plasma membrane occurs through

(A) endocytosis of patches of membrane

(B) diffusion of individual molecules into the cytoplasm

(C) recovery of specific components by selective receptors

(D) expulsion of integral molecules into the extracellular medium

73. Virus-mediated transfer of cellular genetic material from one bacterial cell to another by means of virus particles is called

(A) Transfection

(B) transformation

(C) transposition

(D) transduction

74. Which of the following is true about a circular double-stranded DNA genome that is determined by chemical means to be 21 percent adenosine?

(A) The genome is 10.5% guanosine

(B) The genome is 21% guanosine

(C) The genome is 29% guanosine

(D) The genome is 58% guanosine

75. "Zinc fingers" are important in cellular regulation because they are:

(A) at the catalytic site of many kinases

(B) a structural motif in many DNA-binding proteins

(C) characteristic of palindromic stretches of unique-sequence DNA

(D) restricted to the cytoplasmic domain of growth-factor receptors

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76. In the cross AaBb × AaBb, Mendel's principle of independent assortment predicts that the ratio of the four possible phenotypes of the offspring will be:

(A) $3:2:2:1$ (B) $4:2:2:1$ (C) $9:3:3:1$ (D) $9:7:3:1$

77. Common lesions found in DNA after exposure to ultraviolet light are

(A) pyrimidine dimers   (B) single strand breaks

(C) base deletions   (D) purine dimers

78. In a first order chemical reaction, if the concentration of the reactant is doubled, the rate of the reaction is

(A) unaltered   (B) halved

(C) changed by a negligible amount   (D) doubled

79. Matrix A is of order 2×3 and B is of order 3×2, then the order of the matrix BA is

(A) 2×3 (B) 3×2 (C) 3×3 (D) 2×2

80. If $nPr = 120 \, nCr$, then the value of r is

(A) 10   (B) 5   (C) 120   (D) 12

81. If a, b, c are in arithmetic progression, then 3^a, 3^b, 3^c are in

(A) arithmetic progression

(B) geometric progression

(C) harmonic progression

(D) arithmetic and geometric progression

82. Equation of two parallel straight lines differ by

(A) x term   (B) y term   (C) constant term   (D) xy term

83. The graph of $xy = 0$ is

(A) a point   (B) a line

(C) a pair of intersecting lines   (D) a pair of parallel lines

84. The function $f(x) = |x|$ is

(A) continuous at $x = 0$ (B) discontinuous at $x = 0$

(C) not continuous from the right at $x=0$ (D) not continuous from the left at $x=0$

85. If A and B are two events such that $P(A) = 0.16$, $P(B) = 0.24$ and $P(A \cap B) = 0.11$, then the probability of obtaining only of the two events is

(A) 0.29   (B) 0.71   (C) 0.82   (D) 0.18

86. X speaks truth in 95 percent of the cases and Y in 80 percent of cases. The percentage of cases they likely to contradict each other in stating same fact is

(A) 14 %   (B) 86 %   (C) 23 %   (D) 85.5 %

87. Which of the following types of bonds or interactions are LEAST likely to be involved in stabilizing the three-dimensional folding of most proteins?

(A) Hydrogen bonds   (B) Hydrophobic interactions

(C) Disulfide bonds   (D) Ester bonds

88. In animals, an enzyme unique to gluconeogenesis is:

(A) phosphoglyceromutase

(B) glyceraldehyde 3-phosphate dehydrogenase

(C) aldolase

(D) fructose 1,6-bisphosphatase

89. Approximately how many moles of ATP will be generated as a result of the oxidation of one mole of FADH2 in an actively respiring mitochondrion?

(A) 0   (B) 2.0   (C) 3.0   (D) 4.5

90. All of the following components of a retrovirus are encoded by the viral genome EXCEPT

(A) matrix proteins   (B) viral RNA's

(C) capsid proteins   (D) envelope lipids

91. Some viruses have increased the coding potential of their genome by

(A) integrating into the host genome   (B) using host ribosomes for translation

(C) using alternative splicing sites   (D) using a degenerate triplet code

92. Which of the following is most likely to lead to a loss of gene function?

    (A)   A missense mutation in the open reading frame

    (B)   A change from a TAA codon to a TAG codon in the coding region

    (C)   A change from T to C in the promoter region

    (D)   A frameshift mutation in the coding region

93. All of the following processes occur in the mitochondria of mammalian cells EXCEPT

    (A)   fatty acid biosynthesis   (B)   protein synthesis

    (C)   DNA synthesis   (D)   beta oxidation of fatty acids

94. Which of the following is meant by the statement that glucose and mannose are epimers?

    (A)   One is an aldose and the other is a ketose.

    (B)   They are mirror images of each other.

    (C)   They rotate the plane of light in opposite directions.

    (D)   They differ only in the configuration about one carbon atom.

95. A solution contains DNA polymerase I, Mg2+ salts of dATP, dGTP, dCTP, and dTTP, and an appropriate buffer. Which of the following DNA molecules would serve as a template for DNA synthesis when added to this solution?

    (A)   A single-stranded closed circle

    (B)   A single-stranded closed circle base-paired to a shorter linear strand with a 3'-terminal hydroxyl

    (C)   A single-stranded closed circle base-paired to a shorter linear strand with a 3'-terminal phosphate

    (D)   A double-stranded closed circle

96. Which of the following enzymes plays a direct role in the biosynthesis of collagen?

    (A)   Prolyl hydroxylase   (B)   Tyrosine hydroxylase

    (C)   Choline oxidase   (D)   Monoamine oxidase

97. Which of the following intermediate compounds is involved when a peptide is hydrolyzed by chymotrypsin?

   (A) An ester between the substrate's acyl carbon and the serine of the active site

   (B) A thioester between the substrate's acyl carbon and the cysteine of the active site

   (C) An amide between the substrate's acyl carbon and the lysine of the active site

   (D) An amide between the substrate's acyl carbon and the asparagine of the active site

98. A mammalian zygote resulted from the fusion of a normal gamete with a gamete that formed after a nondisjunction event in one chromosome during meiosis II. Which of the following best describes the zygote?

   (A) Diploid   (B) Aneuploid   (C) Polyploid   (D) Polysomic

99. The specialized structures located at the ends of eukaryotic chromosomes are called

   (A) terminators   (B) telomeres

   (C) long terminal repeats (LTR's)   (D) centromeres

100. Although multiple disulfide bonds are possible during the formation of the tertiary structure of some secretory proteins, only the "correct" ones are found in the secreted product. This is primarily due to the fact that

   (A) incorrectly folded proteins are degraded by lysosomes

   (B) processing and folding is continued in the endosomes

   (C) a protein facilitates the formation of correct disulfide bonds in the endoplasmic reticulum

   (D) only correctly folded proteins are translated in the endoplasmic reticulum