

Hall Ticket Number

ENTRANCE EXAMINATION, June 2011

Ph.D Biotechnology

Time: 2 hours

Maximum Marks: 75

INSTRUCTIONS: PLEASE READ BEFORE ANSWERING

1. Enter your hall ticket number on this sheet and the answer (OMR) sheet
2. Answers have to be marked on the OMR answer sheet with ball-point pen following the instructions provided there upon.
3. Hand over both the question paper booklet and OMR answer sheet at the end of the examination.
4. All questions carry one mark each.
5. 0.33 mark will be deducted for every wrong answer.
6. There are total 18 pages ((excluding 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 phones are not allowed

X-61

Ph.D ENTRANCE EXAMINATION – 2011

PhD Program – Biotechnology

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PART – A

1. Match the coefficients in group 1 with their corresponding downstream processing steps given in group 2.

Group 1	Group 2
P. sedimentation coefficient	1. aqueous two-phase extraction
Q. partition coefficient	2. ultrafiltration
R. rejection coefficient	3. dialysis
S. activity coefficient	4. centrifugation

- A. P-3, Q-1, R-4, S-2
B. P-2, Q-1, R-4, S-3
C. P-4, Q-3, R-1, S-2
D. P-4, Q-1, R-2, S-3
2. Separation of two proteins, present in a solution, having 10kDa and 20kDa molecular weight with similar properties can be achieved by-
- A. Hydrophobic interaction chromatography
B. Gel filtration chromatography
C. Ion exchange chromatography
D. Affinity chromatography
3. Sea- water purification for drinking purpose can be done with-
- A. Filtration
B. Reverse osmosis
C. Sedimentation

D. Flocculation

4. Sephadex is a brand named Dextran, used in gel filtration columns. Chemically, Sephadex is poly (what?) linked (how?).
- A. Galactose, α -1,4
 - B. Galactose, α -1,6
 - C. Glucose, α -1,4
 - D. Glucose, α -1,6
5. The isoelectric point, or pI, of an amino acid or a protein is
- A. zero at pH 7.0
 - B. pH at which the amino acid or protein has no net charge
 - C. pI at which the amino acid or protein is neither hydrophobic nor hydrophilic
 - D. measure of the hydrophathy of an amino acid or protein
6. Which of the following is true about the Edman degradation system of sequencing polypeptides? -
- i. The Edman degradation system is carried out on a machine called an Edmanator.
 - ii. The Edman degradation system will work on any size polypeptide.
 - iii. In the Edman degradation system the amino-terminal residue is labeled with fluoro dinitrobenzene and the polypeptide is hydrolyzed with 6M HCl to its constituent amino acids.
 - iv. In the Edman degradation system the amino-terminal residue is labeled with phenylisothiocyanate, cleaved with trifluoroacetic acid, purified and identified in each successive cycle.
- A. I and II
 - B. II and IV
 - C. I, II and III
 - D. IV only
7. In the α -helix the hydrogen bonds:

- A. are roughly parallel to the axis of the helix
- B. are roughly perpendicular to the axis of the helix
- C. occur mainly between electronegative atoms of the R groups
- D. occur only between some of the amino acids of the helix

8. Protein phosphorylation is commonly involved with all of the following except

- A. regulation of transcription by extracellular signal molecules
- B. activation of G-protein linked receptors
- C. activation of receptor tyrosine kinases
- D. activation of protein kinase molecules

9. Signal transduction pathways benefit cells for all of the following reasons except

- A. they help cells respond to signal molecules that are too large or too polar to cross the plasma membrane
- B. they enable different cells to respond appropriately to the same signal
- C. they help cells use up phosphate generated by ATP breakdown
- D. variations in the signal transduction pathways can enhance response specificity

10 Below is a list of biochemical functions of amino acids determined by the possible biochemical pathways:

- i. Substrates for protein synthesis
- ii. Regulator of mRNA translation
- iii. Transport of nitrogen
- iv. Synthesis for fatty acid synthesis

Which of the above statements is wrong?

- A. i
- B. ii
- C. iii
- D. None

11. You have a mixture of proteins with following properties:

Protein 1: Mr 12 kD pI=10

Protein 2: Mr 62 kD pI=4

Protein 3: Mr 28 kD pI=8

Protein 4: Mr 09 kD pI=5

Predict the emergence of these proteins when a mixture of the four is chromatographed in DEAE-cellulose at pH 7.0

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

12. Consider a molecule having one n -fold rotation axis and n two-fold rotation axes perpendicular to it. Choose from the following the appropriate point group symmetry.

- A. C_{2v}
- B. C_{3v}
- C. D_n
- D. C_{1v}

13. Which of the following molecules could be classified as a prolate symmetric top?

- A. cyclobutane
- B. benzene
- C. methyl bromide
- D. phthalocyanine

14. Which of the following ratios define the nuclear gyromagnetic ratio?

- A. angular momentum to magnetic moment
- B. magnetic moment to angular momentum
- C. angular momentum to Planck's constant
- D. Planck's constant to angular momentum

15. Which of the following refer to splitting of nuclear energy levels in the presence of a magnetic field?
- A. Stark effect
 - B. Photoelectric effect
 - C. Zeeman effect
 - D. Ring current effect
16. Choose the appropriate scattering type from the following choices that could explain why the color of the sky is blue.
- A. Stokes Raman scattering
 - B. Antistokes Raman scattering
 - C. Brillouin scattering
 - D. Rayleigh scattering
17. Generally, an induced dipole is created when light interacts with a molecule. The induced dipole is proportional to the electric field vector of the light wave. Which of the following correctly describe the proportionality constant?
- A. magnetic anisotropy
 - B. polarizability
 - C. electrical conductivity
 - D. permittivity
18. In quantum mechanics, the probability of finding an electron at some point within an atom is given by
- A. the Hamiltonian operator
 - B. the wavefunction
 - C. the modulus of the wavefunction
 - D. the square of the modulus of the wavefunction

19. Consider the isothermal compression of an ideal gas by a force of 1.0 Newton acting through 0.5 meter. Choose the correct answer from the following for the heat change involved in the compression process.

- A. -0.1 Joule
- B. -0.2 Joule
- C. -0.3 Joule
- D. -0.5 Joule

20. Which of the following qualitatively describes the change of the Helmholtz free energy of a system at constant temperature and pressure in a spontaneous process?

- A. increase
- B. decrease
- C. invariant
- D. infinity

21. In condensed phase, molecules constantly move one position to another. Which of the following describes the average time a molecule spends at a defined position before it makes a move to another position?

- A. Spin-lattice relaxation time
- B. Correlation time
- C. Spin-spin relaxation time
- D. Free-flight time

22. Features of genomic islands in a bacterial chromosome include -

- A. (Because of their foreign origin) they have a different G+C composition than the chromosome as a whole
- B. They usually insert in t-RNA genes and are flanked by mobilizable elements
- C. They are always associated with imparting survival advantage or improve fitness
- D. a and b above

23. Which one of the following statements is true?

- A. Alleles can not admix so hybrid alleles do not usually occur in a population
- B. A particular gene can have only two alleles.
- C. A single trait or phenotype can be affected by many different genes
- D. Pseudogenes occur frequently in viral genomes.

24. What is the cause of type – 1 diabetes?

- A. An interplay of genetic susceptibility and environmental triggers
- B. Early exposure in life to certain antigen.
- C. Molecular mimicry resulting in autoimmunity and loss of insulin secreting cells
- D. All of the above

25. A successful pathogen's pursuit within its host is not aimed at:

- A. Easy access to a preferred carbon source within the host
- B. Gaining niche to ensure long term infection
- C. Avoid clearance by the host immune system
- D. Shut down all essential processes within the host resulting in host demise and early transmission opportunity

PART - B

26. Which of the following is not a source of variation in a population?

- A. Inherited genetic differences
- B. Differences due to health
- C. Differences due to age
- D. None of the above

27. What is the relationship between the wing of a bird and the wing of a bat?

- A. They are homologous because they represent modified forms of a trait present in a common ancestor (forelimbs)
- B. They are analogous because while each carries out the same function (flight), this trait has arisen independently as a result of convergence (i.e. the common ancestor of both did not have a forelimb that allowed it to fly)

- C. A and B.
- D. They represent derived homologies

28. Which one of the following is not a pathogen encoded player in infection biology?

- A. Adhesins
- B. LPS
- C. Flagellins
- D. NF-Kappa-B

29. Which of the following techniques are useful in genetic profiling, tracking and analyzing the spread of bacterial pathogen populations?

- A. Immuno-electrophoresis
- B. Multi-locus variable number of tandem repeats analysis (MLVA)
- C. Pulsed field gel-electrophoresis
- D. b and c

30. Which pathogens below are linked to cancer?

- A. Epstein-Barr Virus
- B. HIV
- C. Human papilloma virus
- D. All of the above

31. Which of the following is not a genome evolution mechanism in bacteria?

- A. Horizontal gene acquisition
- B. Vertical genome reduction
- C. *In situ* gene duplication
- D. None of the above

32. Molecular mimicry is an important strategy used by pathogens to fool the host immune system, which can be defined as:

- A. Confusion of the tolerance system due to similarities of the epitopes of the pathogen and those of the host
- B. Non-self discrimination by the normal immune system to recognize foreign antigens
- C. Generation of an immune response against self-tissue and cells
- D. All of the above

33. The following are very important markers for the diagnostic development against bacterial pathogens:

- A. Secreted antigens
- B. House keeping enzymes
- C. Transposases
- D. Heat shock proteins

34. Which one of the following are correct

- A. Hepatitis A and B viruses contains RNA as the genome where as Hepatitis C virus contains DNA
- B. Hepatitis A and C viruses contains RNA as genome where as Hepatitis B virus contains DNA
- C. Hepatitis A and B viruses contains DNA as the genome where as Hepatitis C virus contains RNA
- D. Hepatitis A and C viruses contains DNA as genome where as Hepatitis B virus contains RNA

35. Vaccinia virus belongs to the family

- A. Herpesviridae
- B. Poxviridae
- C. Adenoviridae
- D. None

36. Which one of the following is a para-retrovirus

- A. Human immunodeficiency virus (HIV)
- B. Hepatitis C virus (HCV)
- C. Hepatitis B virus (HBV)
- D. None

37. The RNA virus having DNA as an intermediate in the life cycle is

- A. Human immunodeficiency virus (HIV)
- B. Hepatitis C virus (HCV)
- C. Hepatitis B virus (HBV)
- D. None

38. The target cells for HIV are

- A. Plasma cells
- B. Effector B cells
- C. Helper T cells
- D. None of the above

39. The inclusion bodies called Negribodies are found in which of the following virus infected nerve cells

- A. Poliovirus
- B. Rhabdovirus
- C. Reovirus
- D. Retrovirus

40. Replication of an Adenovirus occurs in

- A. Cytoplasm
- B. Endoplasmic reticulum
- C. Nucleus
- D. Golgicomplex

41. Internal ribosome entry site (IRES) mediated type of translation is present in

- A. Hepatitis A virus
- B. Hepatitis C virus
- C. Poliovirus
- D. All

42. Which of the following viruses is NOT a DNA virus?

- A. Papova virus
- B. Toga virus
- C. Adeno virus
- D. Herpes virus

43. Sabin polio vaccine is made by

- A. Formaldehyde fixing
- B. Passage in monkey kidney cell lines
- C. Reverse genetics
- D. Heat inactivation

44. All of the following antibiotics bind bacterial ribosome except

- A. Streptomycin
- B. Tetracycline
- C. Erythromycin
- D. Penicillin

45. The end stage cells are

- A. Plasma cells
- B. Naïve cells
- C. Activated B cells
- D. None of the above

46. Most efficient APCs are

- A. Macrophages

- B. B cells
- C. Dendritic cells
- D. All

47. The activities of complement system include

- A. Opsonization
- B. Lysis
- C. Clearance of Immune complexes
- D. All the above

48. Which one of the following is not a nonspecific defense mechanism?

- A. Skin
- B. Mucous membrane
- C. Cell mediated immunity
- D. All of the above

49. During acute, nonspecific inflammation, the first leucocytes to arrive at the site of tissue damage are

- A. Monocytes
- B. Eosinophils
- C. Macrophages
- D. Neutrophils

50. Which of the following cells contain or release histamine?

- A. Mast cells
- B. Basophils
- C. Both
- D. None

51. The cells that produce and secrete antibodies are

- A. T cells

- B. B cells
- C. Plasma cells
- D. Dendritic cells

52. A person does not normally produce antibodies or activated T cells to self antigen due to the presence of
- A. Haptens
 - B. Immunoglobulins
 - C. Human leucocyte antigen
 - D. Non-self antigen
53. The process of photorespiration is catalyzed by the enzymes
- A. Sucrosephosphate synthase and RuBP oxygenase
 - B. RuBP oxygenase and nitrate reductase
 - C. Pyruvate kinase and RuBP oxygenase
 - D. RuBP oxygenase and hydroxypyruvate reductase
54. The tough, water insoluble protein present in the outer portion of the epidermis of the skin is
- A. Epidermin
 - B. Carotene
 - C. Keratin
 - D. Impenetrin
55. According to classical genetics which of the following statements is true?
- A. Recessive alleles are detected by the phenotype of the F_1 generation
 - B. The closer two genes are the more frequently they recombine
 - C. Genes on different autosomes segregate independently
 - D. Genes on sex chromosomes segregate with the same pattern as autosomal genes
56. Mating type switching in yeast

- A. Occurs in G₁ phase of the cell cycle
- B. Occurs in S phase of the cell cycle
- C. Can be induced by placing cells in rich medium
- D. Requires binding of a pheromone to a cell surface receptor on the cell that produced it

57. The pectins and hyaluronic acid are both

- A. Secreted by animal cells
- B. Very negatively charged
- C. Proteins
- D. Intracellular substance

58. Drugs such as colchicine or vinblastine arrest cells division for hours or even days.

Which phase of the cell cycle is blocked by these drugs?

- A. S
- B. G₂
- C. M
- D. G₁

59. In eukaryotes, the lagging strand DNA is synthesized by DNA polymerase _ _____

- A. α
- B. β
- C. γ
- D. δ

60. Which of the following is normally associated with the production of hybridomas secreting a desired monoclonal antibody?

- A. mutant mouse myeloma cells producing antibodies
- B. plasma cells from bone marrow of an immunized mouse
- C. aminopterin blockage of nucleotide salvage pathway
- D. mitogen-induced antibody diversity

61. Expression vectors contain a sequence, *not normally found* in other vectors that is known as
- A. a ribosome-binding site.
 - B. an *ori* site
 - C. a multiple-cloning site
 - D. an antibody-resistant marker
62. Which of the following is *not* a mechanism whereby B cells or antibodies contribute to immunity?
- A. presentation of antigen to T cells
 - B. opsonization
 - C. direct cell killing
 - D. agglutination
63. Which of the following approach is *NOT* associated to the prediction of Protein– Protein Interactions?
- A. Domain fusion (Rosetta stone)
 - B. Protein phylogenic profiles
 - C. Position-Specific Iterated BLAST
 - D. Conservation of gene order
64. Which of the following method is associated with orthologous protein identification?
- A. Reciprocal Best BLAST Hit
 - B. tBLASTn
 - C. Dot Pot
 - D. Pattern Hit Initiated BLAST
65. Which of the following approach can be used to predict the 3D structure of a protein if it has no detectable sequence similarity with the available templates?

- A. homology modeling
- B. *ab initio* modeling
- C. fold recognition
- D. Domain recognition

66. Which of the following sequences contains the pattern |AG|-x(4)-G-H-[ST].

- A. VAGWGHIST
- B. GVLKRGHS
- C. AGVLKGRT
- D. AGVGKSTP

67. In order to calculate the affine gap penalty, one need to know only

- A. Gap open penalty and the gap length
- B. B .Terminal gap penalty and gap length
- C. Gap open penalty, gap extension penalty and the gap length
- D. Gap open penalty, terminal gap penalty and the gap length

68. Hybridization of single stranded RNA or DNA is facilitated by

- A. High temperature
- B. The presence of an unrelated DNA
- C. High salt
- D. Low salt

69. Which of the following lipids have a net negative charge?

- A. Phosphatidylcholine
- B. Cholesterol
- C. Phosphatidylserine
- D. Phosphatidylethanolamine

70. Which of the following events could lead to the evolution of a new gene that contains exons from two or more other genes?

- A. Domain duplication
- B. Domain shuffling
- C. Gene conversion
- D. Gene duplication

71. The smallest bacterial genome is several hundred thousand base pairs in length while the human mitochondrial genome is less than 17,000 base pairs. The smaller size of the mitochondrial genome is due to which of the following?
- A. The human mitochondrial genome has lost its protein coding genes
 - B. The human mitochondrial genome has lost its functional RNA genes
 - C. The human mitochondrial genome is non-functional and is an evolutionary relic
 - D. Genes from the human mitochondrial genome have been transferred to the nucleus
72. Which of the following is NOT a mechanism by which a signalling compound is known to influence genome expression after being imported into a cell?
- A. Some signalling molecules methylate DNA sequences to silence specific genes
 - B. Some signalling molecules are proteins that function as regulators of genome expression
 - C. Some signalling molecules directly influence the activity of regulatory proteins within the cell
 - D. Some signalling molecules influence the activity of regulatory proteins in the cell indirectly through intermediate molecules
73. Which algorithm is used for global alignments between sequences?
- A. Needleman-Wunsch algorithm
 - B. Smith-Waterman algorithm
 - C. Markov algorithm
 - D. Genetic algorithm
74. The traceback of the sequence alignment as per Needleman-Wunsch algorithm begins from

- A. any cell having the highest score
- B. the last cell
- C. any cell having the positive score
- D. The cell having zero score

75. Dot matrix approach to sequence comparisons was introduced by

- A. Needleman Wunsch
- B. Gibbs and McIntyre
- C. Dayhoff
- D. Smith Waterman
