

Entrance Test for
Ph.D. (BIOCHEMISTRY) Programme - 2016

Time : 3 hours

Maximum Marks : 100

Note :

- (i) *The test booklet consists of 2 parts. Part - A Biochemistry and Part - B Research Methodology.*
 - (ii) *All questions are compulsory.*
 - (iii) *Q. No. 1 - 75 are multiple choice questions (MCQs). Each question carries 1 mark. Answer these questions in OMR sheet. Read the instructions carefully given in the OMR sheet.*
 - (iv) *There will be no negative marking.*
 - (v) *Q. No. 76 - 85 are descriptive in nature. Answer these questions in the answer sheet provided separately.*
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11. Enzyme parameters of four isoenzymes are given below :

Isoenzyme	K_m (μM)	V_{max}
A	0.1	15
B	0.5	45
C	4.0	100
D	0.01	10

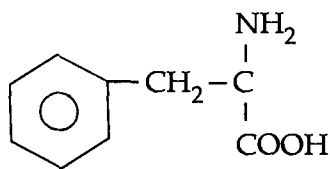
These enzymes are localized in different tissues. In muscle, the substrate concentration is $1.0 \mu\text{M}$. Which of the following isoenzymes is present in muscle ?

- (1) A (2) B (3) C (4) D

12. Protein X from *E.Coli* contains 170 aminoacids. The number of nucleotides present in the gene coding the protein will be :

- (1) 340 (2) 250 (3) 510 (4) 170

13. An aminoacid with structure is :



- (1) Acidic (2) Basic (3) Aromatic (4) Imino acid

14. The limit of resolution of a light microscope using visible light is about :

- (1) 200 nm (2) 50 nm (3) 100 nm (4) 400 nm

15. Which of the following is **not** a deficiency disease ?

- (1) Scurvy (2) Rickets (3) Poliomyelitis (4) Beri beri

16. ATP synthase (also known as complex V) consists of two domains ; F_1 and F_0 . Which of the following statements is **correct** ?

- (1) F_1 and F_0 are both integral membrane protein complexes of the outer membrane.
(2) F_0 domain provides a channel for translocation of protons across the membrane.
(3) F_0 domain catalyses the synthesis of ATP.
(4) Only the F_0 domain contains more than one sub-unit.

17. The first step in fructose metabolism in liver is :

- (1) Isomerization to glucose
(2) Phosphorylation to Fructose - 1, 6 - bisphosphate by ATP
(3) Phosphorylation to Fructose - 1 - phosphate by ATP
(4) Phosphorylation to Fructose - 6 - phosphate by ATP

18. The reaction velocity (V) *vs.* substrate concentration $[S]$ profile was performed for enzyme (X) using $1\ \mu\text{g}$ enzyme per assay. Similar assay was carried out under identical conditions except that concentration of enzyme used was $2\ \mu\text{g}/\text{assay}$. Under these conditions, the kinetic parameters :
- (1) K_m and V_{\max} will remain unchanged
 - (2) K_m will change while V_{\max} will remain same
 - (3) K_m will remain same but V_{\max} will increase
 - (4) K_m and V_{\max} will increase
19. In diabetes ketoacidosis, increase in which of the following would cause elevated production of ketone bodies ?
- (1) proteolysis
 - (2) urea production
 - (3) insulin release
 - (4) lipolysis
20. Ramachandran plot is used to determine _____ structure of proteins.
- (1) 1° (primary)
 - (2) 2° (secondary)
 - (3) 3° (tertiary)
 - (4) 4° (quarternary)
21. Antibodies are produced by :
- (1) T - cells
 - (2) B - cells
 - (3) Mast cells
 - (4) Neutrophils
22. Pinocytosis is also known as :
- (1) cell eating
 - (2) cell death
 - (3) cell drinking
 - (4) cell lysis
23. Photophosphorylation is :
- (1) Synthesis of NADH
 - (2) Synthesis of ATP
 - (3) Synthesis of ATP in sunlight
 - (4) Phosphorylation of protein in sunlight
24. Synthesis of urea takes place in :
- (1) Liver
 - (2) Kidney
 - (3) Brain
 - (4) Spleen
25. LDL binds with the cell surface receptor and gets internalized via clathrin mediated endocytosis. This process helps in maintaining the cholesterol - LDL level in plasma. However, in a disease known as Familial Hypercholesterolemia (FH), a very high level of plasma cholesterol is found. This could be due to mutation in which of the following genes ?
- (1) Clathrin
 - (2) LDL
 - (3) LDL - receptor
 - (4) Adaptor
26. Type of complex obtained in 'Direct ELISA' is :
- (1) Secondary antibody - antigen - primary antibody
 - (2) Antigen - primary antibody
 - (3) Primary antibody - antigen - secondary antibody
 - (4) Antigen - primary antibody - secondary antibody

27. During muscle contraction, troponin binds to :
- (1) Mg^{2+} (2) Ca^{2+} (3) K^+ (4) Na^+
28. Coenzyme form of vitamin B₅ is :
- (1) Tetrahydrofolate (2) Coenzyme A
(3) NADP (4) Thymine pyrophosphate
29. The plasmid cloning vector P^{BR322} contains amp^R and tet^R genes that confer resistance to ampicillin and tetracycline, respectively. The tet^R gene contains site for restriction enzyme BAMH1. P^{BR322} is first cleaved with BAMH1, DNA is added to this restriction fragment and treated with ligase used to transform *E.coli* cells. Under these conditions, which of the following statements is true ?
- (1) Tetracyclin can be used to select for transformed *E.coli* carrying recombinant plasmids.
(2) Tetracyclin can be used to select for transformed *E.coli* carrying non-recombinant plasmids.
(3) *E.coli* cells with recombinant plasmids will grow on both tetracyclin and ampicillin.
(4) None of the above
30. The peptide bond is rigid because it is a :
- (1) single bond (2) partial double bond
(3) double bond (4) triple bond
31. Southern blotting technique is used for :
- (1) detection of RNA fragments on membrane by specific radioactive antibodies
(2) detection of proteins on membrane using radioactive DNA probe
(3) detection of DNA fragments on membrane using a radioactive DNA probe
(4) detection of DNA fragments on membrane using specific radioactive antibodies
32. Which of the following sugars can't be detected by Fehling's solution ?
- (1) sucrose (2) maltose (3) glucose (4) lactose
33. How many peptide bonds are present in a protein containing 200 amino acids ?
- (1) 200 (2) 201 (3) 199 (4) 210
34. DNA is more stable than RNA as it is not hydrolyzed by alkali, whereas RNA is readily hydrolyzed. This is due to :
- (1) double helical structure of DNA (2) uracil is present in RNA
(3) stem loop structure in RNA (4) presence of 2' - OH in RNA

35. Nucleosome consists of :
- (1) DNA and histones (2) RNA and histones
 (3) Histone octamers only (4) DNA and RNA
36. Which of the following is a purine base ?
- (1) Adenine (2) Cytosine (3) Uracil (4) Thiamine
37. Binding of oxygen to hemoglobin is :
- (1) Co-operative (2) Non-cooperative
 (3) Both (1) and (2) (4) None of the above
38. Denaturation of double stranded DNA results in more absorption of UV light. This effect is known as :
- (1) Hypsochromic (2) Hypochromic (3) Hyperchromic (4) Hygroscopic
39. Protein A has a binding site for ligand X with $K_d = 10^{-6}$ M. Protein B has a binding site for the same ligand with $K_d = 10^{-9}$ M. Which of the two proteins has higher affinity for the ligand X ?
- (1) A (2) B
 (3) Both has equal affinity (4) None of the above
40. In the Cori cycle :
- (1) Only tissues with aerobic metabolism i.e. mitochondria and oxygen are involved.
 (2) A 4 - carbon compound arising from glycolysis is converted to glucose at the expense of energy from fatty acid oxidation.
 (3) Glucose is converted to lactate in anaerobic tissues and this lactate goes to liver where it is converted to glucose.
 (4) Nitrogen from alanine must be converted to urea increasing the amount of energy required to drive the process.
41. Which of the following is achiral molecule ?
- (1) Glucose (2) Alanine (3) Glycine (4) Valine
42. Klinefelter's syndrome is due to :
- (1) XO (2) XXY (3) XXX (4) XYY
43. Sickle cell anemia is an example of Single Nucleotide Polymorphism (SNP) of :
- (1) A to T mutation (2) G to C mutation
 (3) T to A mutation (4) C to G mutation

44. Which of the following is **not** correct pair of a metabolic pathway and its subcellular location ?
- (1) Fatty acid synthesis occurs in mitochondria
 - (2) Oxidative phosphorylation occurs in mitochondria
 - (3) Glycolysis occurs in mitochondria
 - (4) Ganglioside degradation occurs in lysosomes
45. Mutations which occur in vegetative parts during growth which do not go on to form gametes can be classified as :
- (1) auxotrophic mutation
 - (2) somatic mutations
 - (3) morphological mutations
 - (4) oncogenes
46. Which of the following pairs are epimers ?
- (1) D - glucose and L - glucose
 - (2) D - glucose and D - galactose
 - (3) D - glucose and D - fructose
 - (4) D - glucose and L - galactose
47. Which of the following statements is **not** correct ?
- (1) Gene Amino acids are coded by triplet codon
 - (2) One triplet codon can code for more than one amino acid
 - (3) Genetic code is continuous
 - (4) Genetic code is degenerate
48. Gout is caused by excess of :
- (1) glycogen
 - (2) starch
 - (3) albumin
 - (4) uric acid
49. Glutathione is a tripeptide which is involved in detoxification. Its constituent amino acids are :
- (1) alanine - valine - glycine
 - (2) glutamic acid - cysteine - glycine
 - (3) glutamine - aspartate - glycine
 - (4) valine - glutamine - cysteine
50. Which of the following is a precursor of steroid hormones and bile salts ?
- (1) phosphatidyl choline
 - (2) triacyl glycerol
 - (3) cholesterol
 - (4) ceramide

PART - B
(Research Methodology)

51. One of the essential characteristics of research is :
- (1) Generalizability (2) Usability
(3) Objectivity (4) Replicability
52. Which of the following is **not** a part of basic principles of experimental designs ?
- (1) Replication (2) Randomization (3) Local control (4) Reduction
53. What do you understand by hypothesis ?
- (1) Drawing some conclusion
(2) Getting proof for some activity
(3) Assumptions about relations between variables
(4) Assumption regarding one activity
54. For better accuracy in research which of the following should be taken care of ?
- (1) Increase the sampling (2) Unbiased data collection
(3) Both (1) and (2) (4) None of the above
55. While conducting experimental research one should control the :
- (1) Dependent variables (2) Extraneous variables
(3) No variables (4) Independent variables
56. Which of the following is **not** true ?
- (1) Research simply means a search for facts.
(2) Research is purposive investigation.
(3) Research is disorganised detailed enquiry.
(4) Research includes solutions to problems.
57. Which of the following criteria is to be met for a scientifically justified hypothesis ?
- (1) The statements should describe multiple issues.
(2) It should be empirically testable.
(3) Statements in the hypothesis should be subjective.
(4) It should be objective.
58. What do you understand by research design ?
- (1) It is a illogical and systematic plan prepared for directing a research study.
(2) It is an overview how the research will be undertaken.
(3) It is a logical and systematic plan prepared for directing a research study.
(4) It is one of many ways to conduct research.

59. Which of the following represents data ?
- (1) a single value (2) only two values in a set
 (3) group of values in a set (4) all of the above
60. In a grouped data, the number of classes preferred are :
- (1) minimum possible (2) adequate
 (3) maximum possible (4) any arbitrary chosen number
61. Charts and graphs are the presentation of numerical facts by means of :
- (1) points and lines (2) area and other geometrical forms
 (3) symbols (4) all of the above
62. In a column chart bars are :
- (1) Horizontal (2) Vertical
 (3) Slanting (4) None of the above
63. Which of the following can be used for data collection ?
- (1) Interview (2) Questionnaire
 (3) Observation (4) All of the above
64. The subject of cybernetics deals with the science of :
- (1) Genetics (2) Control and Communication
 (3) Molecular Biology (4) Biochemistry
65. Word length of a computer is measured in :
- (1) Bits (2) Millimeter (3) Meters (4) Per second
66. A hemophilic man marries a normal woman. They have a daughter who does not show symptoms of hemophilia. If she marries a hemophilic man, what will be the probability of their sons displaying symptoms of hemophilia ?
- (1) Zero percent (2) 25% (3) 50% (4) 100%
67. What is the pH of 10^{-8} M solution of HCl ?
- (1) 8.12 (2) 6.95 (3) 5.87 (4) 6.36
68. What is PROSITE ?
- (1) Database of protein structures (2) Database of interacting proteins
 (3) Database of protein motifs (4) A search tool
69. DNA - foot printing is a suitable technique for identifying which of the following ?
- (1) Particular mRNA in mixture (2) Particular tRNA in mixture
 (3) Introns within DNA (4) Protein binding site within DNA

70. Organelles of a cell in homogenate can be separated through :
- (1) Chromatography
 - (2) X-ray diffraction
 - (3) Differential/Density gradient centrifugation
 - (4) Autoradiography
71. The order for the construction of a cDNA fragment from mRNA is to :
- (1) treat with reverse transcriptase, digest with RNase, add G residues to the 3' end, bind digo-dC, treat with DNA polymerase and bind oligo-dT.
 - (2) bind digo-dT, treat with reverse transcriptase, digest with RNase, add G residues to the 3' end, bind oligo-dC, treat with DNA polymerase.
 - (3) digest with RNase, add G residues to the 3' end, treat with reverse transcriptase, add G residues to the 3' end, and treat with DNA polymerase.
 - (4) bind oligo-dC, treat with reverse transcriptase, digest with RNase, add G residues to the 3' end, bind oligo-dT and treat with DNA polymerase.
72. The technique most suitable to study the metaphasic behavior of chromosomes in a living cell is :
- (1) Phase contrast microscope
 - (2) X-ray microscope
 - (3) Cell fractionation
 - (4) Scanning electron microscope
73. Data taken from report published by WHO will be considered as :
- (1) primary data
 - (2) secondary data
 - (3) primary and secondary data
 - (4) neither primary nor secondary data
74. Whether classification is done first or tabulation ?
- (1) Classification follows tabulation
 - (2) Classification precedes tabulation
 - (3) Both are done simultaneously
 - (4) No criterion
75. Statistical error refers to :
- (1) $\frac{\text{Actual value} - \text{Estimated value}}{\text{Estimated value}}$
 - (2) $\frac{\text{Actual value} - \text{Estimated value}}{\text{Actual value}}$
 - (3) Original value - Approx. value
 - (4) Actual value - Estimated value

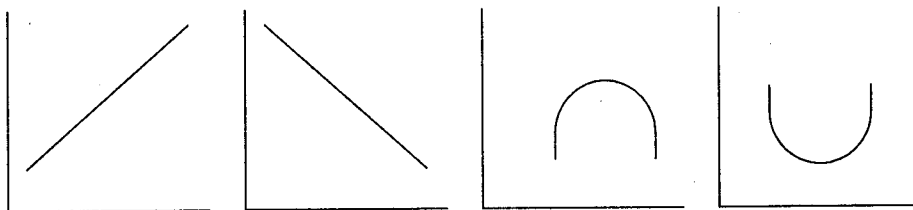
Note : Question Nos. 76 - 80 are descriptive. Each question carries two marks.

2x5=10

76. One ml of NADH solution gave absorbance of 0.31 OD at 340 nm wavelength with 1 cm cuvette pathlength. Calculate the molarity of NADH in this solution.
($\epsilon_{340} = 6220 \text{ M}^{-1} \text{ cm}^{-1}$, MW of NADH = 663Da)
77. A protocol calls for using a working concentration of $1.5 \times 10^{-4} \text{ M}$ boric acid. You decide to make up a 20 \times stock solution. What will be the molarity of that stock solution ?
78. In an enzyme catalysed reaction $K_m = 4 \times 10^{-5} \text{ } \mu\text{mol/L}$ and the rate of reaction (V) at substrate concentration $[S] = 1.2 \times 10^{-2} \text{ M}$ is $80 \text{ } \mu\text{mol/L min}$. Assuming no inhibitor is present, find V_{max} .
79. A protein solution consisting of different proteins ranging from 80, 100, 200 and 250 kDa in size is separated through sephadex G-25 gel loaded column. Discuss which size of protein will elute first and why ?
80. The data represents respiratory rate vs. CO_2 concentration.

Respiratory rate (Breaths/min)	CO_2 concentration (mmHg)
10	43
11	40
12	35
13	32
14	28

- (a) What type of relation exists between the two data ?
Direct/Reverse/Logarithmic/Exponential/No relationship.
- (b) Also which graph expresses it best ?



Note : Question Nos. 81 - 85 are descriptive. Each question carries three marks.

3x5=15

81. "Researcher should not be in a hurry in deciding of the research topic nor in defining its scope". Discuss.
 82. In a class of 60 students 25% of the students like apples, 25% like oranges and the remaining ones like banana. Amongst banana lovers there are 10% students who like pears as well. Represent this data with the help of a pie chart.
 83. How would you prepare 750 mL of 0.35 M Na_2PO_4 solution ?
(MW of Na_2PO_4 = 141.96 g/mole)
 84. A molecular biologist isolated total RNA from liver tissue using Trizol method. Later he intended to purify mRNA alone from the RNA pool. In this process he came to know that affinity chromatography is the best suited technique to achieve single step purification of mRNA. Discuss why and how this technique is suitable ?
 85. Distinguish between Research Methods and Research Methodology.
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