

Entrance Examinations – 2021
Ph.D. Biochemistry

Hall Ticket No.

Time : 2 hours

Max. Marks : 70

Please read the following instructions carefully before answering:

1. Enter Hall Ticket number in the space provided above and also on OMR sheet.
2. Paper contains two sections: Part A and Part B together with 60 questions for 70 marks. **Part A contains 25 questions. Questions 1 to 15 carries one mark each. Questions 16 to 25 carries 2 mark each. Part B contains 35 questions; each question carries one mark.**
3. Answers have to be marked on the OMR sheet as per the instructions provided.
4. Apart from OMR sheet, the question paper contains 11 (Eleven) pages including the instructions.
5. **Please return the OMR answer sheet at the end of examination.**
6. No additional sheet will be provided.
7. Rough work can be carried out in the question paper itself in the space provided at the end of the booklet.
8. Non programmable calculators are allowed.

Part A

1. If the length and breadth of a rectangle are increased by 30% and 20% respectively, what net % increase in its area will be observed?
A. 60%
B. 56%
C. 50%
D. 44%
2. At 6 pm, Sheetal kept her wrist watch on the table and noticed that the hour hand of the watch is pointing towards the North. In which direction the minute hand will point at 2.45 pm?
A. South-West
B. South
C. East
D. West
3. Complete the series, 173, 118, 73, 38, ?
A. 18
B. 8
C. 23
D. 13
4. The number A and B are 30% and 50% more respectively than the third number C. Find the ratio between A and B.
A. 13:15
B. 3:5
C. 5:7
D. 3:8

5. Three train tickets from city A to B and two tickets from city A to C cost Rs. 770, but two tickets from city A to B and three tickets from city A to C cost Rs. 730. What are the fares between the cities A to B and A to C respectively?
- Rs 150 and Rs 140
 - Rs 170 and Rs 130
 - Rs 230 and Rs 170
 - Rs 130 and Rs 170
6. A protein migrates on a native gel as a single band and if the same protein is subjected to a SDS-PAGE, you observe three bands at 20 kDa, 30 kDa and 50 kDa. What is the inference of the observation from two gels?
- Protein is homodimer
 - Protein is homotrimer
 - Protein has three subunits linked by disulfide bond
 - Protein has three equal subunits
7. Affinity chromatography is a technique to separate the macromolecules on the basis of
- Reversible binding of macromolecule with ligand
 - Irreversible binding of macromolecule with ligand
 - With both reversible and irreversible binding with ligand
 - None of the above
8. Anti-bovine albumin antibodies raised in BALB/c mice were injected into a goat, a C1 mouse and another BALB/c mouse. Given below are the antibodies produced in the three cases against different types of antigenic determinants. Select the correct option.
- In goat – allotypic antibodies
 - In C1 mouse – idiotypic antibodies
 - BALB/c – Isotypic antibodies
 - In C1 mouse – allotypic antibodies
9. Working on the allosteric regulation of an enzyme, a research scholar noted that addition of X increased the allosteric constant L from 100 to 1000, while addition of Y decreased L from 100 to 10. Which of the following inference can be made on the basis of these observations?
- X is a positive regulator
 - Y is a negative regulator
 - X is a negative regulator
 - Y has no regulatory impact
10. How does a graphical representation of enzyme kinetics data according to the equations of Lineweaver and Burk modified in the presence of a non-competitive inhibitor of having a $K_i < K_{esi}$ ($K\alpha < \alpha'$).
- The X intercept would not change
 - The X intercept would move left (away from the origin)
 - The Y intercept would move down (toward the origin)
 - The X intercept would move right (toward to origin)
11. A cross is performed with genotype $AB/a b \times a b/a b$. The two genes, A and B are 10 map units apart. In an ideal situation what would be the frequency of ab/ab genotype?
- 50%
 - 10%
 - 45%
 - 75%

12. For investigating interaction between two proteins, which techniques would you use?
- Immunoprecipitation and fluorescence anisotropy
 - Protein profiling
 - Protein profiling and sequencing
 - Transcriptomics and protein profiling with mass spectroscopy
13. You need to purify a DNA binding protein from three other proteins whose isoelectric points (pI) are in range of 6.8 to 7.5. Which purification method would you like to use to separate the DNA binding protein from other proteins? Note that the DNA binding protein binds through strong electrostatic interactions.
- Gel filtration chromatography
 - Combination of gel filtration and spectroscopy
 - Cation exchange chromatography
 - Anion exchange chromatography
14. Which of the statements is not correct about point mutation
- It can be induced by chemicals.
 - It can be responsible for a genetic disease.
 - It can be mapped by a technique similar to Maxim-Gilbert sequencing.
 - It can be detected easily by Southern blotting.
15. If you want to separately resolve a 100 bp long DNA from a 110 bp long DNA. Which of the following gel electrophoresis would you chose?
- 0.5% agarose gel
 - 1% agarose gel
 - 3.5% agarose gel
 - 35% agarose gel
16. A protein solution in a cuvette of length 1 cm is subjected to absorbance measurement at 280nm, using a spectrometer. The measured value is 1.2. If protein solution is diluted 3 times, what would be the final concentration of protein in mg/ml? (Molecular weight: 66.5 kDa; Extinction Coefficient: $43,824 \text{ M}^{-1} \text{ cm}^{-1}$ at 25°C ; and PI: 4.7)
- 6 mg/mL
 - 0.06 mg/mL
 - 0.6 mg/mL
 - 0.9×10^{-5} mg/mL
17. In order to find which residues are important for the activity of an enzyme, site directed mutagenesis was performed and the following information on the biochemical parameter of each was obtained.

Enzyme	k_{cat}	K_M
Wild Type	77 s^{-1}	20 μM
Mutant: 1	70 s^{-1}	17 μM
Mutant: 2	0.15 s^{-1}	20 μM
Mutant: 3	0.001 s^{-1}	18 μM

Comparing all, which one has the highest catalytic efficiency?

- Wild-type enzyme
- Mutant 1
- Mutant 2
- Mutant 3

18. In hilly areas, what is the efficiency of oxygen delivery by hemoglobin to the tissues where PO_2 in the lungs = 50 torr and in tissues = 25 torr?

- A. 0.30
- B. 0.40
- C. 0.50
- D. 0.60

19. You plan to clone your favourite gene (YFG) in a bacterial expression vector pE at the Bam HI site. The size of YFG and pE are 0.5 kb and 4.5 kb respectively. Your advisor suggested you to keep the vector: insert ratio at around 1:3 in the ligation mixture. Which of the following will give you the desired stoichiometry?

- A. Vector 100 ng and insert 30 ng.
- B. Vector 100 ng and insert 100 ng.
- C. Vector 100 ng and insert 300 ng.
- D. Vector 100 ng and insert 900 ng.

20. P1 transduction was done to determine the order of the *leu*, *pur* and *pro* genes relative to each other. The donor was *leu- purR pro-* and the recipient was *leu+ purS pro+*. *purR* transductants were selected. The coinherance of the non-selected markers is shown in the table below.

- leu+pro+* were 97
- leu-pro-* were 56
- leu+pro-* were 18
- leu- pro+* were 10

The following statements are made about these observations:

- i) the order of genes is *leu pro pur*
- ii) the order of genes is *pro leu pur*
- iii) the coinherance of *leu-* is less than *pro-*
- iv) the coinherance of *pro-* is less than *leu-*

Choose the option that represents all the correct statements.

- A. i and iii
- B. i and iv
- C. ii and iii
- D. ii and iv

21. Match the following statements written in the left column to the electron transport chain complex of mitochondria (right side)

1. Not involved in pumping protons directly	a. Complex I
2. Uncoupler inhibits its activity	b. Complex II
3. Moves electrons from a lipid-soluble mobile electron carrier to a water soluble mobile electron carrier	c. Complex III
4. Contain "a" type cytochrome	d. Complex IV
	e. Complex V

- A. 1-b; 2-e; 3-c; 4-d
- B. 1-e; 2-d; 3-a; 4-c
- C. 1-d; 2-d; 3-c; 4-b
- D. 1-c; 2-c; 3-b ; 4-d

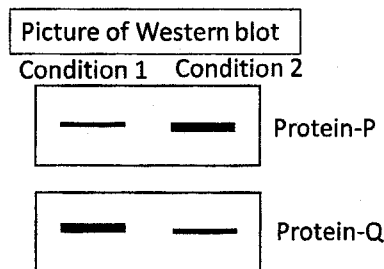
22. In a cross sectional study conducted at a clinic, the researcher is interested to know what proportion of the patients are having tuberculosis and corona. The results are tabulated below:

Covid-19	Tuberculosis		Total
	Yes	No	
+ ve	16	4	20
- ve	24	456	480
Total	40	460	500

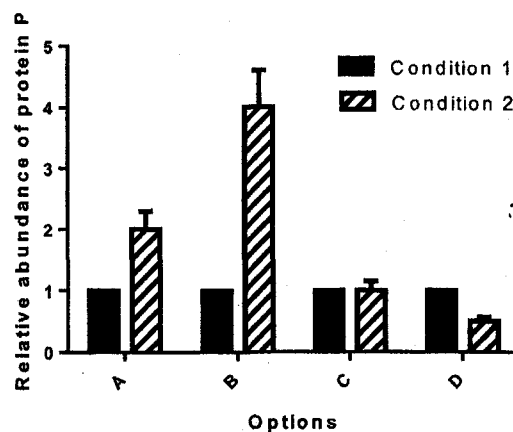
In the above study sample, what is the probability that a selected person will have tuberculosis given that the person is Covid-19 positive?

- A. Cannot be estimated
- B. 0.2
- C. 0.4
- D. 0.8

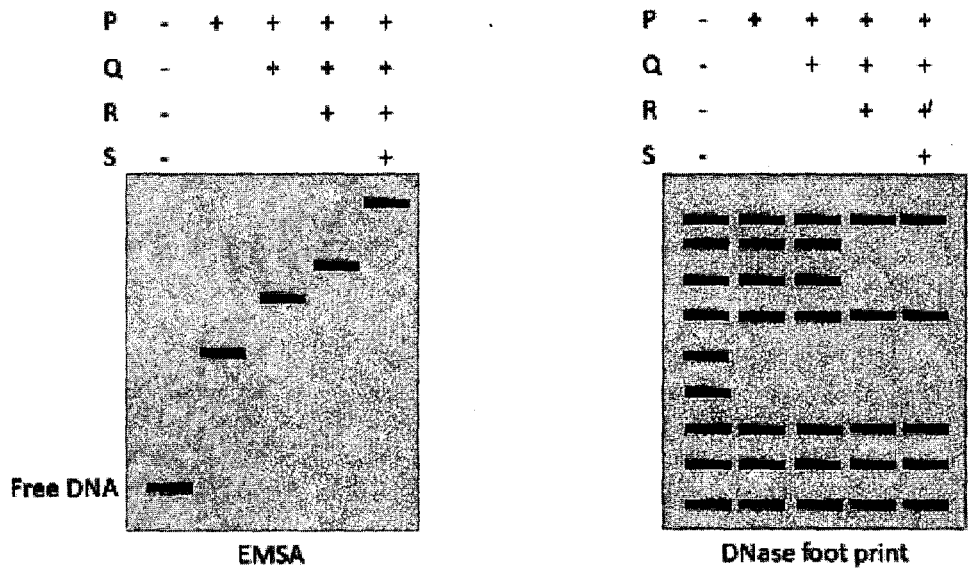
23. The steady-state levels of a protein P are investigated under conditions 1 and 2. The accompanying western blot represents the result of one such experiment, where the protein Q is the product of a housekeeping gene, whose level is invariant under these two conditions. The total proteins isolated from cells grown under these two conditions were subjected to a western blot analysis, where the same membrane was probed with the antibodies against protein P and protein Q.



Indicate which one of the graphs (A to D) accurately represent the experimental finding?



24. In order to study the DNA- protein complex formation of four transcription factors (P, Q, R, and S) you have performed electrophoresis mobility shift assay (EMSA) and DNase foot print assay. The results of such experiments are given in the accompanying figures.



Six conclusions were made based on the results:

- I) P, Q, R, S all bind to the DNA
- II) P, Q, and R bind to the DNA
- III) P, and R bind to the DNA
- IV) P interacts with Q
- V) Q does not interact with R
- VI) S interacts with one or more proteins of the PQR complex

Chose the option that represents all the correct conclusions.

- A. I, IV, and VI
- B. II, V, and VI
- C. II, IV, and V
- D. III, IV, and VI

25. Which of the following statements are true about the *trp*-mRNA and the *trp*-leader RNA?

- Statement 1: The *trp* mRNA would hybridize to *trp*-promoter, *trp*-operator, *trp*-E gene
- Statement 2: The *trp* mRNA would hybridize to *trp*-promoter, *trp*-operator, *trp*-A gene
- Statement 3: The *trp* mRNA would hybridize to *trp*-operator, *trp*-E gene
- Statement 4: The *trp* mRNA would hybridize to *trp*-operator, *trp*-A gene
- Statement 5: The leader RNA would hybridize to *trp*-promoter, *trp*-operator, *trp*-E gene
- Statement 6: The leader RNA would hybridize to *trp*-promoter, *trp*-operator
- Statement 7: The leader RNA would hybridize to *trp*-operator

- A. Statements 1, 2, and 5 are correct
- B. Statements 3, 4, and 6 are correct
- C. Statements 1, 3, and 7 are correct
- D. Statements 3, 4, and 7 are correct

PART B

26. Aldose sugar to keto sugar conversion occurs through
- Ene-diol intermediate
 - Reduction of aldose
 - Oxidation of ketose
 - Phosphorylation
27. The composition of the core oligosaccharide that is anchored to Dolichol pyrophosphate in glycan biosynthesis is
- 2-GlcNAc-7-Man-3-Glc
 - 2-GlcNAc-9-Man-3-Glc
 - 2-GlcNAc-5-Man-3-Glc
 - 2-GlcNAc-7-Man-2-Glc
28. Which of the following enzymes is more active
- Deadenylated glutamine synthetase
 - Adenylated glutamine synthetase
 - Phosphorylated glycogen synthase
 - Phosphodiesterase that promotes glycogenolysis
29. Which of the following enzymes contain Biotin
- Pyruvate decarboxylase
 - Pyruvate dehydrogenase
 - Pyruvate Carboxylase
 - Pyruvate Kinase
30. If the equilibrium constant is greater than one, what can be said about the change in the Gibbs energy?
- Gibbs energy is negative
 - Gibbs energy is positive
 - Gibbs energy is zero
 - None of the above
31. The enzymatic steps involved in the first stage of saturated fatty acid oxidation are in the order of
- Acyl CoA Dehydrogenase → Enoyl CoA hydratase → Hydroxyacyl CoA dehydrogenase → thiolase
 - Enoyl CoA hydratase → Acyl CoA Dehydrogenase → Hydroxy acyl CoA dehydrogenase → thiolase
 - Hydroxyacyl CoA dehydrogenase → thiolase → Acyl CoA Dehydrogenase → Enoyl CoA hydratase
 - Acyl CoA Dehydrogenase → Hydroxyacyl CoA dehydrogenase → Enoyl CoA hydratase → thiolase
32. Mutation in which of the following gene results in hyperuricemia, gouty arthritis and formation of stones in the urinary tract.
- Uricase
 - HGPRT
 - Xanthine oxidase
 - Adenosine deaminase
33. Protein molecules that differ in a few amino acid residues are called
- Isoforms

- B. Glycoforms
C. Heterotypes
D. Isotypes
34. Which of the following amino acids are rarely present in alpha helix
A. Proline and tryptophan
B. Glycine and proline
C. Tryptophan and glycine
D. Proline only
35. Which of the following are essential amino acids
A. Methionine and Tryptophan
B. Serine and Tyrosine
C. Aspartic acid and Asparagine
D. Alanine and Glycine
36. Chloroplast and mitochondrial F_0F_1 -ATP synthases use the free energy derived from a transmembrane proton transport to synthesize ATP from ADP and inorganic phosphate. The H^+/ATP ratio of chloroplast and mitochondrial F_0F_1 -ATP synthases would be approximately in the order of
A. 4.7 and 3.3
B. 3.3 and 3.3
C. 3.3 and 4.7
D. 3.0 and 3.0
37. Which one of the following is a balanced equation for the Q cycle catalysed by the cytochrome *b6f* complex of chloroplasts?
A. $PQH_2 + 2H^+ \text{ Stroma} + 2 PC (Cu^{2+}) \rightarrow PQ + 2 PC (Cu^+) + 4 H^+ \text{ Thylakoid}$
B. $PQH_2 + 2H^+ \text{ Stroma} + 2 PC (Cu^{2+}) \rightarrow PQ + 2 PC (Cu^+) + 2 H^+ \text{ Thylakoid}$
C. $PQH_2 + 2H^+ \text{ Thylakoid} + 2 PC (Cu^{2+}) \rightarrow PQ + 2 PC (Cu^+) + 2 H^+ \text{ Stroma}$
D. $PQH_2 + 2H^+ \text{ Thylakoid} + 2 PC (Cu^{2+}) \rightarrow PQ + 2 PC (Cu^+) + 4 H^+ \text{ Stroma}$
38. Which of the following is true about enzymes?
A. All enzymes have cofactors or coenzymes at their active site
B. Every enzyme catalysis involves an intermediate formation before it produces the product
C. Enzyme structure is rigid
D. Catalytic efficiency of an enzyme can be predicted from its kinetic studies
39. The coenzyme that participates in the transamination reaction is
A. Flavin adenine dinucleotide
B. Thiamine pyrophosphate
C. Coenzyme B_{12}
D. Pyridoxal phosphate
40. Which option represents all the right pairs?
P. Eukaryotic genome
Q. Bacterial genome
R. Chloroplast genome
S. Viral genome
I) 10^4 bp
II) 10^5 bp
III) 10^6 bp
IV) 10^8 bp
- A. P-I, Q-II, R-III, S-IV
B. P-IV, Q-III, R-II, S-I
C. P-IV, Q-II, R-III, S-I
D. P-IV, Q-III, R-I, S-II

41. Tri-Methylation at which of the following sites on histones is a repressive mark for transcription:
- A. H3K4
 - B. H3K36
 - C. H3K27
 - D. H3K79
42. DNA exists in which of the following organizational forms in the eukaryotic metaphase nucleus:
- A. Beads on string structure
 - B. Condensed chromosomes
 - C. 30 nm fibre
 - D. Protein free DNA
43. Which of the following is the most common modification on mRNA molecules?
- A. N6-methyladenosine (m6A)
 - B. 8-Oxo-7,8-dihydroguanosine (8-oxoG)
 - C. Pseudouridine (Ψ)
 - D. m5C, 5-hydroxymethylcytosine (hm5C)
44. Which of the following genomic elements do NOT have tandem repeat sequences?
- A. Minisatellites and microsatellites
 - B. Centromeres
 - C. Telomeres
 - D. LINEs and SINEs
45. Which of the statements about telomeres is not true?
- A. Telomeres contain regions with a high G content.
 - B. Telomeres solve end-replication problem.
 - C. Telomeres contain short repetitive sequences, which are invariant among different organisms.
 - D. Telomeres contain non-Watson-Crick base pairing.
46. In male meiosis I, X-chromosome non-disjunction occurs. Which one of the following represents the most likely sperm genotype in this male. Assume autosomes segregate normally.
- A. X and Y sperm
 - B. No X chromosome; Y
 - C. XY only
 - D. XX and Y
47. A plant heterozygous for both seed shape (round (R) or wrinkled (r)) and seed color (Yellow(Y) or green (y)). A self-cross of these plants is performed. The progeny plants homozygous for both traits would be about
- A. 50%
 - B. 25%
 - C. 1/16
 - D. 2/16
48. Which of the following can be considered as the earliest evidence of epigenetic transgenerational inheritance for any trait?
- A. Transmission of acquired traits from mother to daughter.
 - B. Transmission of acquired traits from father to son.

- C. Transmission of acquired traits from father to son and grandson.
D. Transmission of acquired traits from mother to daughter and granddaughter.
49. Which one of the following processes is not necessary for chromosome separation in mitosis?
A. Attachment of kinetochores to kinetochore microtubules
B. Polyubiquitination of Securin
C. Degradation of mitotic cyclinB
D. Increased dynamic instability of microtubules
50. Which of the following are endocytic receptors?
A. LDL receptor and Cation independent Mannose 6-phosphate receptor
B. Asialoglycoprotein receptor and Cation dependent Mannose 6-phosphate receptor
C. Epinephrine receptors
D. Receptor for urea
51. Which of the following is true about the plasma membrane?
A. The plasma membrane largely stays intact in both apoptosis and necrotic cell death
B. The plasma membrane ruptures in both necrosis and apoptosis
C. In apoptosis the plasma membrane stays intact while ruptures in necrosis
D. The plasma membrane ruptures in apoptosis but stays intact in necrosis
52. An antigenic determinant is about the size of
A. 1 amino acid residue
B. 5 amino acid residues
C. 20 amino acid residues
D. 50 amino acid residues
53. Bacteria are cleared from the bloodstream mainly by
A. Lung capillaries
B. Spleen and liver macrophages
C. Circulating neutrophils
D. Marginating neutrophils
54. Class I MHC molecules are found on
A. B cells and macrophages only
B. Erythrocytes, B cells and T cells only
C. T cells only
D. All nucleated cells
55. The major disadvantage of active immunization is that it
A. Causes prolonged immunity
B. Induces rapid onset of immunity
C. Induces slow onset of immunity
D. Causes serum sickness
56. Which of the following statements about the activation of T-cells is not correct? Select the most appropriate answer.
A. Interaction of B7 and CD28 provides the essential positive co-stimulatory signals required for T-cell Activation
B. T cells can be stimulated only when peptide-bound MHC molecule interact with the T-cell receptor
C. Agents other than peptides bound to MHC class II, such as superantigens can activate CD4+ T cells
D. Activated T cells undergo proliferation and differentiation due to specific cytokines.

57. Which of the following is a mismatch?
- A. Follicle stimulating hormone-Gonadotroph
 - B. Thyroid stimulating hormone-Corticotroph
 - C. Prolactin-Lactotroph
 - D. Growth hormone-Somatotroph
58. Unlike normal cells, cancer cells prefer anaerobic glycolysis (Warburg Effect) for the following reasons:
- i) To avoid negative feedback effect posed by ATP, the end product of oxidative phosphorylation.
 - ii) To support the biosynthesis of macromolecules such as DNA, RNA protein and FAs, by diverting the glycolysis intermediates.
 - iii) Aerobic glycolysis generates more energy to support the uncontrolled proliferation of cancer cells

Find the correct option:

- A. i only
 - B. ii & iii only
 - C. i & ii only
 - D. i & iii only
59. Which one of the following statements about iron uptake by cells is not true?
- A. In low pH Fe^{3+} dissociates from transferrin
 - B. Transferrin dissociates from the receptor in the late endosomes
 - C. Iron bound transferrin binds to receptor at neutral pH
 - D. Fe^{3+} bound transferrin receptor complex is endocytosed
60. Pyknosis is characterized by the following features
- A. Mitochondrial collapse into small pieces
 - B. Nuclear collapse into dense structures
 - C. Plasma membrane break down
 - D. Pigment release from damaged cells

ROUGH WORK

University of Hyderabad
Entrance Examinations - 2021

School/Department/Centre : Life Sciences, Biochemistry

Course/Subject : PhD Biochemistry

Code No: A-55

1	B	21	A	41	C
2	C	22	D	42	B
3	D	23	B	43	A
4	A	24	D	44	D
5	B	25	D	45	C
6	C	26	A	46	C
7	A	27	B	47	B
8	D	28	A	48	C
9	C	29	C	49	C
10	D	30	A	50	A
11	C	31	A	51	C
12	A	32	B	52	B
13	C	33	A	53	B
14	D	34	B	54	D
15	C	35	A	55	C
16	C	36	A	56	B
17	B	37	A	57	B
18	B	38	D	58	C
19	A	39	D	59	B
20	A	40	B	60	B