

# ENTRANCE EXAMINATIONS – 2020

(Ph.D. Admissions - January 2021 Session)

4-68

## 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 9 (nine) 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. In a certain code language,  
'speak nicely to all' is coded as "ka cu ma he"  
'all are like us' is coded as " si fo he to"  
'teach us lesson nicely' is coded as " po ma fo re"  
'lesson like all humans' is coded as "he re gu si"  
What would be the code for "lesson"?  
A) he                      B) re                      C) si                      D) fo
2. There are seven friends A,B,C,D,E,F and G in a seven-floor building. The ground floor is no. 1, the floor above it is no.2 and so on. E does not live on an even numbered floor. G does not live on the topmost floor. Only one person lives between E and G. A does not live on even numbered floor and does not live below F. D does not live immediately above or immediately below G. There are two floors between D and E. Both B and C live on even-numbered floor. G and C live in between the two floors. F lives on floor number 5.  
From the given options find the person who lives on 3rd floor.  
A) B                      B) C                      C) D                      D) E
3. Look at this series: 8, 11, 9, 12, 10, 13, ... What number should come next?  
A) 7                      B) 12                      C) 11                      D) 9
4. Given that out of the 42 students, 18 opted for Biology and 26 opted for Mathematics. If 5 students opted for both the subjects, then how many opted neither subjects?  
A) 5                      B) 4                      C) 3                      D) 0

5. Determine the number of bacterial cells per ml in the original culture given that when 100 $\mu$ l from 1/1000 dilution of the original sample was plated onto an agar plate gave 92 colonies.
- A)  $92 \times 10^3$  / ml  
 B)  $9.2 \times 10^5$  / ml  
 C)  $9.2 \times 10^4$  / ml  
 D)  $92 \times 10^6$  / ml
6. A lipase purified from 6000 gm of bacterial pellet involved multiple steps. In the 3rd step, a total of 100 ml carrying 300 mg of protein showed 72,000 units of activity. What is the specific activity of the lipase in this purification step?
- A) 720 U/mg  
 B) 240 U/mg  
 C) 20000 U/mg  
 D) 12 U/mg
7. DNA density on cesium chloride gradient is
- A) Higher than RNA and Lower than protein  
 B) Higher than protein and lower than RNA  
 C) Equal to protein and RNA  
 D) Highest compared to RNA or protein
8. Identify right statement
- A) Cycloheximide inhibits mRNA synthesis while chloramphenicol inhibits protein synthesis in eukaryotes  
 B) Cycloheximide inhibits prokaryotic protein synthesis while Actinomycin D inhibits ribosome elongation  
 C) Cycloheximide inhibits eukaryotic protein synthesis while chloramphenicol inhibits prokaryotic protein synthesis  
 D) Cycloheximide inhibits prokaryotic DNA replication while Actinomycin D inhibits ribosome elongation
9. A protein migrates on SDS-PAGE as a single band and if same protein is subjected to native gel electrophoresis, you observe three bands at 20 KDa, 30 KDa and 50kDa. What is the inference of the observation from two gels?
- A) Protein is homodimer  
 B) Protein is homotrimer  
 C) Protein has three subunits linked by disulfide bond  
 D) Protein has three equal subunits
10. An acidic solution of unknown concentration of 37 ml is titrated with 55 ml of 0.5 M NaOH to achieve a pH 7. What is the original concentration of the acid used?
- A) 0.74 M  
 B) 0.6  
 C) 0.84 M  
 D) 0.55 M
11. The pKa of a weak acid (HA) is 4.5. The pOH of an aqueous buffer solution of HA in which 50% of the acid is ionized is
- A) 7.0  
 B) 4.5  
 C) 9.5  
 D) 8.5
12. A substance absorbs visible light of wavelength  $\lambda = 550$  nm. How much energy is absorbed by 1 mole of the substance? (Plank's constant =  $6 \times 10^{-34}$  J.s)
- A) 200 J  
 B) 315kJ  
 C) 90kJ  
 D) 196k
13. A cross between two homozygous recessive results in non-mutant progeny. This indicates that
- A) Alleles are mutations on different genes

- B) Alleles are mutations in the same gene
- C) No conclusion can be made with respect to the genes that carry these mutation
- D) Mutations were lost during the breeding process

14. Given below are a few statements about the Golgi complex.

1. It synthesizes proteins
2. It does protein sorting to organelles
3. It does covalent modifications on certain proteins
4. It has ribosomes on the surface of its membrane
5. It does packaging of proteins into vesicles

Choose the combination that correctly represents the golgi function

- A) 1,2,3 only
- B) 2,4,5 only
- C) 2,3,5 only
- D) 1,2,3,5 only

15. What are the three basic steps of conventional PCR?

- A) Denature, anneal, & strand displacement
- B) Denature, anneal & extension
- C) Strand displacement, synthesis & release
- D) Reverse-transcription, anneal & extend

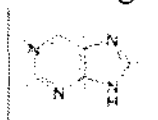
16. Which one of the following dilution(s) can yield 52% sucrose solution when you are diluting 70% stock solution?

- A) 10.4 ml stock+ 3.6ml water
- B) 11.2 ml stock + 3.8ml water
- C) 52 ml stock+ 48ml water
- D) 2.8 ml stock + 0.95 ml water

17. Thymus and lymph node tissues from normal and RAG-1/2 knockout mice were extracted and subjected to FACS analysis to identify the population of double negatives (CD8-CD4-), double positives (CD8+ CD4+) or single positive (CD8+ or CD4+) T cells using fluorescein labeled anti-CD4 and rhodamine-labeled anti-CD8 antibodies. Which of the following statements regarding the FACS observations will be correct?

- A) Thymus from normal mice will show all categories of T cells, but thymus from RAG-1/2 KO mice will not have single positive T cells
- B) Thymus from RAG-1/2 KO will not have double negative and double positive T cells, but will have single positive T cells
- C) Lymph node tissue from normal mice will not have double positive T cells and Lymph node tissue from RAG-1/2 KO mice will have only double negative T cells
- D) Both A and C statements are correct

18. N1 and N3 atoms of purine ring are contributed by which of the following?



- A) N1- Glutamine & N3-Aspartate
- B) N1- HCO<sub>3</sub> & N3-Glutamine
- C) N1-Aspartate & N3-HCO<sub>3</sub>
- D) N1-Aspartate & N3-Glutamine

19. A mixture of compounds X and Y were separated by paper chromatography. During separation X has travelled a distance of 6.8 cm. The compound Y moved 3.5 cm and is 5 cm away from the distance travelled by the solvent. What is the R<sub>f</sub> value of X?  
 A) 0.68                      B) 0.8                      C) 0.85                      D) 0.118

20. Match the contents between Set I (cell cycle proteins) and Set II (its functions)

Set I	Set II
i) APC/Cyclosome	I) controls metaphase to anaphase transition by, inhibiting separase
ii) pRb	II) E3 Ub ligase that is active during mitosis
iii) p27	III) cyclin dependent kinase inhibitor
iv) Securin	IV) Cellular gate keeper

The correct match is

- A) i-I, ii-III, iii-IV, iv-II                      B) i-II, ii-IV, iii-III, iv-I  
 C) i-II, ii-III, iii-IV, iv-I                      D) i-IV, ii-II, iii-I, iv-III
21. In a family, one parent has a dominant phenotype and the other has a recessive phenotype and the 2 offspring have dominant phenotype. Which one of the following genotypes for the parent with the dominant phenotype can be deduced with certainty?  
 A) Homozygous dominant only  
 B) Heterozygous dominant only  
 C) Either heterozygous or homozygous dominant  
 D) Genotype cannot be deduced from the information provided

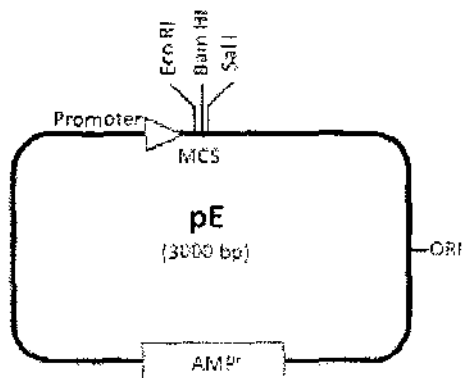
22. In ion-exchange chromatography, often a salt gradient is used to elute the bound proteins. This is because:  
 A) As salts are neutral, they keep the protein active  
 B) A salt gradient allows the protein to ionise and bind specifically  
 C) At a certain ionic strength, the salt will compete with the protein for binding to the column  
 D) Salt gradients are used to equilibrate the column

23. The mechanisms regulating the decision between lysis and lysogeny for bacteriophage has been described as a genetic switch. The following five statements are made of this system:  
 a. The cI and cro are transcribed in opposite directions.  
 b. The mRNA encoding cI and Cro protein are synthesized using the same strand of DNA as template.  
 c. Of the three O<sub>R</sub> sites in genome, Cro has greatest affinity for O<sub>R</sub>3.  
 d. Of the three O<sub>R</sub> sites in genome, cI has greatest affinity for O<sub>R</sub>1.  
 e. Synthesis of cI is stimulated by its binding to O<sub>R</sub>1 and O<sub>R</sub>2.  
 A) Only a and e are correct                      B) Only a, b and e are correct  
 C) Only a, c and d are correct                      D) Only a, c, d and e are correct

24. You have amplified your favourite gene (YFG) of 0.5 kb in size using a forward primer containing a Bam HI site followed by a Kpn I site (in 5' to 3' direction) and a

reverse primer harbouring a Bam HI site followed by a Sal I site (in 5' to 3' direction). You performed a non-directional cloning of the Bam HI digested amplified product at the Bam HI site of the expression vector pE (3 kb). At the multiple-cloning-sites (MCS) of the vector there are Eco RI and Sal I unique sites flanking the Bam HI site as shown in the figure. After cloning of YFG in the pE vector you have performed few restriction digestions and made the following observations:

- 1) Digestion with Bam HI yielded a 3 kb and a 0.5 kb bands.
- 2) Digestion with Kpn I yielded a 3.5 kb band.
- 3) Digestion with Sal I yielded a 3.5 kb band.
- 4) A double digestion with Kpn I and Sal I yielded a 3.5 kb band.



Which of the following statements best explains these observations?

- A) The YFG insert did not get inserted into the vector.
- B) The YFG insert got inserted into the vector in such a manner that the Sal I site of the insert and the Sal I site of the vector were next to each other.
- C) The Kpn I site of the insert got mutated.
- D) The Sal I site of the insert got mutated.

25. Match the column I statements with best fit column II electron transport chain complexes

Column I	Column II
i) Moves electrons from lipid soluble mobile electron carrier to a water-soluble mobile electron carrier	a) Complex I
ii) Moves electrons from substrate directly into the electron transport chain	b) Complex II
iii) Contains two copper sites	c) Complex III
iv) Irreversible inhibition in the presence of Piericidin A	d) Complex IV

- A) i-b; ii-c; iii-a; iv-d
- C) i-c; ii-a; iii-d; iv-c

- B) i-d; ii-b; iii-a; iv-b
- D) i-c; ii-b; iii-d; iv-a

## PART B

26. A synthetic mRNA with the sequence 5' AACUAACUAACUAACUAACUAACU 3', is translated in cell-free translational system. It will produce
- Single polypeptide, Di and Tripeptides
  - will not be translated in an invitro translation system
  - an octapeptide
  - Pentapeptide only
27. Which one of the nucleotides mentioned below existed possibly early in evolution?
- GTP
  - ATP
  - TTP
  - UTP
28. Fusidic acid inhibits
- Delivery of fMET-tRNA<sub>i</sub> to 30S ribosome subunits
  - EF.TU/TS
  - Inhibits the translocase activity of EF-G
  - Inhibits Cap binding protein eIF4E
29. How many supercoils can you see in the linear DNA carrying 360 base pairs when it is unwound by 42 bases pairs
- Two Negative supercoils
  - Four Positive Supercoils
  - Four Negative Supercoils
  - None
30. Which one of the radioactive labels do you use to study DNA synthesis in cells?
- Gamma -dCTP
  - Beta - dGTP
  - Alpha- dTTP
  - Gamma-dATP
31. Which of the following structural features is NOT associated with all isotypes of antibodies?
- Presence of a proline rich hinge region
  - Presence of carbohydrate groups on heavy chain
  - Antiparallel beta-pleated strands
  - Region of hypervariability within the variable region of a light chain
32. Which of the following statements is INCORRECT about oxygen-dependent microbicidal mechanisms used by activated neutrophils and macrophages?
- TNF $\alpha$  induces expression of inducible nitric oxide synthase (iNOS) in macrophages
  - Myeloperoxidases generate hypochlorous acid in neutrophils for antimicrobial activity
  - Superoxide dismutase generates reactive oxygen species (ROS) to kill bacteria.
  - Activation of pattern receptors on neutrophils and macrophages induces respiratory burst.
33. What general pathway(s) can a eukaryotic cells use to synthesize nucleotides?
- Catabolic and de novo pathways
  - Salvage and de novo pathways
  - Anabolic pathways
  - Anabolic and amphibolic pathways

34. Which one of the following statements is true regarding the regulation of purine nucleotide biosynthesis?
- Adenylosuccinate synthase is inhibited by AMP only
  - Adenylosuccinate synthase is inhibited by AMP & ADP, but not ATP
  - Adenylosuccinate synthase is inhibited by AMP, ADP, and ATP
  - Adenylosuccinate synthase is inhibited by ATP only
35. Which of the following amino acids are purely ketogenic?
- Leucine and Isoleucine
  - Isoleucine and Lysine
  - Leucine and Lysine
  - Lysine and Arginine
36. Synthesis of 1 mole of cholesterol requires .....&.....?
- 18 moles Acetyl-CoA and 18 moles NADPH
  - 16 moles Acetyl-CoA and 16 moles NADPH
  - 18 moles Acetyl-CoA and 16 moles NADPH
  - 16 moles Acetyl-CoA and 18 moles NADPH
37. Histones are present in the nucleosome as:
- 4 copies of each of 2 histones
  - 2 copies of each of 4 histones
  - 8 copies of 1 histone
  - 6 copies of 1 histone and 2 copies of 1 histone
38. The basic unit of chromatin organization is
- Histone
  - Nucleosome
  - DNA
  - Nucleolus
39. In which of the following organizational forms is the DNA present in an eukaryotic metaphase nucleus:
- Beads on string structure
  - 30 nm fiber
  - Condensed chromosomes
  - Protein free DNA
40. Which of the following RNA types has highest number of RNA modifications per 100 base pairs:
- tRNA
  - mRNA
  - rRNA
  - piRNA
41. Which of the following best describes the process of genomic imprinting?
- X-chromosome inactivation in human female.
  - Maternal inheritance of mitochondrial genes
  - Paternal inheritance of Y-linked genes.
  - Differential expression of alleles depending on its parent of origin.
42. An enzyme catalyzed reaction was investigated in the presence and absence of an inhibitor. Michaelis—Menten plot of the data showed that the maximum velocity did not change significantly when different concentration of inhibitors was used. Which type of inhibition is this?
- Competitive
  - uncompetitive
  - noncompetitive
  - mixed
43. Which of the following amino acid side chains can act as a nucleophile in enzyme catalysis?
- Arginine
  - Histidine
  - Aspartamine
  - Glutamine

44. Which of the following is not correct about the function of the corresponding cofactor?
- Biotin helps in carboxylation
  - NAD<sup>+</sup> as an oxidizing agent
  - Tetrahydrofolate transfers a one carbon unit
  - Pyridoxal phosphate helps in transfer of alkyl group
45. Which of the following transcription and translational mechanisms are wrongly paired with its location?
- Translation- cytoplasm
  - Post-transcriptional modifications-ER
  - Transcription- nucleus
  - Post-translational mechanism-ER
46. In an experiment, alpha amanitin was added with increasing concentrations. Which below mentioned sequences correctly represents the sensitivity of RNA polymerases?
- Pol I -> pol III , pol II unaffected
  - pol II -> pol III , pol I unaffected
  - pol III->pol II -> pol I
  - pol I->pol I ->pol III
47. Which one of the below mentioned processes involves metabolite-sensing in noncoding portions of mRNAs to control gene expression?
- Alternative polyadenylation
  - Short-peptide translation
  - Adenosine methylation
  - Riboswitching
48. Which one of the statements below best describes the function of helicase in RNA transcription?
- Annealing of two separated DNA strands
  - Separation of two DNA strands giving access to polymerase enzyme
  - Cleaving of methyl groups from DNA strands
  - Catalyzing the interaction between transcription factors and the DNA strand
49. Sickle Cell Anemia is caused by a point mutation in hemoglobin beta chain at position 6. The point mutation is
- Glu to Val
  - Glu to Phe
  - His to Arg
  - Val to Tyr
50. Which of the following cellular process is characterized by inflammatory form of lytic programmed cell death that occurs most frequently upon infection with intracellular pathogens and is likely to form part of the antimicrobial response.
- Apoptosis
  - Auophagy
  - Pyroptosis
  - Necrosis
51. Which of the following is a ketohexose containing 3 asymmetric carbon atoms
- Fructose
  - Ribulose
  - Stachyose
  - Erythrose
52. Hemolytic anemia is caused due to the deficiency of
- Glucose 6-phosphate dehydrogenase
  - Pyruvate Kinase
  - Glutathione synthetase
  - Hydratase



53. Addition of inducer would not greatly affect the synthesis of  $\beta$ -galactosidase in bacteria having the genotype

- Z<sup>-</sup> Y<sup>+</sup> A<sup>+</sup>.
- I<sup>+</sup> O<sup>c</sup> Z<sup>+</sup>.
- I<sup>-</sup> O<sup>c</sup> Z<sup>+</sup>.
- I<sup>+</sup> O<sup>+</sup> Z<sup>+</sup> (in the presence of glucose).
- I<sup>-</sup> O<sup>c</sup> Z<sup>+</sup> / I<sup>+</sup> O<sup>+</sup> Z<sup>+</sup>.

Mark the correct answer:

- Only a, b and c are correct
- Only b, c and d are correct
- Only a, b, c and d are correct
- Only a, b, c and e are correct

54. Indicate the false statement. Gene-knockout experiments

- involve replacement of wild-type genes with mutant genes.
- Can be carried out across species boundaries.
- Are most interesting when they show no effect.
- May be helpful in determining whether open reading frames (ORFs) with no homology to other known genes encode functionally important proteins.

55. How much more acidic is a solution of pH 2 compared to a solution of pH 4.

- 10 times
- 2 times
- 100 times
- 1/100 times

56. Given below are a few statements about F<sub>2</sub> progeny in a monohybrid cross. Identify the INCORRECT statement

- 3:1 is the expected phenotype ratio with one dominant and one recessive allele
- 1:2:1 is the expected genotype ratio
- 2:1 is the expected ratio of heterozygous to homozygous recessive
- 1:2 is the expected ratio of heterozygous to homozygous dominant

57. Which if the following statements is TRUE for a quantitative trait (e.g. crop yield)?

- They are not amenable to molecular analysis
- They cannot be inherited
- They are multifactorial
- They are linked genes

58. The first electron acceptor of NADH dehydrogenase complex (Complex I) of electron transport chain

- 2Fe-2S
- CoQ
- FMN
- FAD

59. Highest positive redox potential containing biological molecule

- Cytb<sub>6</sub>f complex
- Oxygen evolving complex
- Photosystem I
- Photosystem II

60. A receptor that has enzymatic activity other than ligand binding is

- G-Protein Coupled Receptor
- Epinephrine Receptors
- Insulin Receptor
- T cell receptor

PhD Biochemistry : Answer Key (Q paper Code No – Y-68 )

PART A	Question no.	Answer	PART B	Question	Answer	Question	Answer
	1	B		26	A	51	A
	2	D		27	B	52	A
	3	C		28	C	53	C
	4	C		29	D	54	C
	5	B		30	C	55	C
	6	B		31	A	56	D
	7	B		32	C	57	C
	8	C		33	B	58	C
	9	C		34	A	59	C
	10	A		35	C	60	C
	11	C		36	C		
	12	D		37	B		
	13	A		38	B		
	14	D		39	C		
	15	B		40	A		
	16	A		41	D		
	17	D		42	A		
	18	D		43	B		
	19	B		44	D		
	20	B		45	B		
	21	C		46	B		
	22	C		47	D		
	23	D		48	B		
	24	D		49	A		
	25	D		50	C		

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28/1/2021