

Entrance Examinations – 2026

Ph.D. Biochemistry

Hall Ticket No. _____

Time : 2 hours

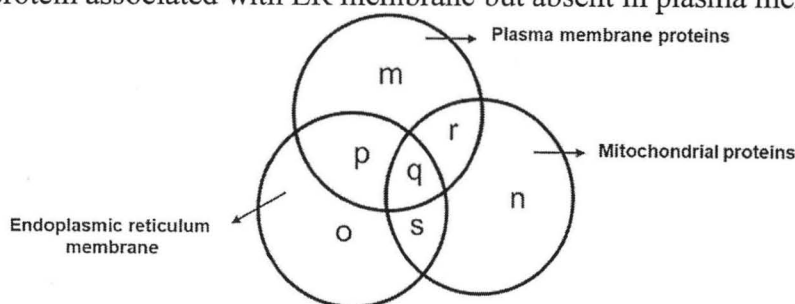
Max. Marks : 70

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 50 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 25 questions. Questions 26 to 40 carries one mark each. Questions 41 to 50 carries 2 mark each.** Answers have to be marked on the OMR sheet as per the instructions provided.
3. There is no negative marking.
4. Apart from OMR sheet, the question paper contains 14 (Fourteen) pages including the instructions and rough work.
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. **Assertion (A):** Predation helps maintain species diversity in a community.
Reason (R): Predators eliminate weak individuals from prey populations.
A) Both A and R are true, and R is the correct explanation of A
B) Both A and R are true, but R is not the correct explanation of A
C) A is true, but R is false
D) A is false, but R is true
2. Which of the options has the correct combination of letters representing proteins common to plasma membrane and endoplasmic reticulum (ER) membrane but absent in mitochondria, and mitochondrial protein associated with ER membrane but absent in plasma membrane?



- A) p and q respectively
 - B) q and r respectively
 - C) p and s respectively
 - D) r and s respectively
3. **Assertion (A):** Glycolysis can occur in the absence of oxygen.
Reason (R): Glycolysis takes place in the cytoplasm of the cell.
A) A is true, but R is false
B) A is false, but R is true

- C) Both A and R are true, and R is the correct explanation of A
 D) Both A and R are true, but R is not the correct explanation of A
4. Three plant cells X, Y, and Z have osmotic potentials as follows; Cell X = -2 bars, Cell Y = -5 bars, and Cell Z = -9 bars. Which of the following correctly shows the direction of net water movement?
 A) X to Y to Z
 B) Z to Y to X
 C) X to Z to Y
 D) There is no net water movement
5. A box contains 5 pink cards, 3 yellow cards, and 2 brown cards. If you pick one card at random, what is the probability that you will draw an either pink or brown card?
 A) $\frac{3}{7}$
 B) $\frac{10}{5}$
 C) $\frac{7}{10}$
 D) $\frac{5}{2}$
6. Considering that the data provided to you are not normally distributed, which of the following correlation analysis will be correct to use? Select the most suitable option.
 A) Pearson correlation coefficient
 B) Spearman correlation coefficient
 C) Neither Pearson correlation coefficient nor Spearman correlation coefficient
 D) Both Pearson correlation coefficient and Spearman correlation coefficient
7. How is the fluorescence spectrum of a molecule related to the absorption spectrum?
 A) The fluorescent spectrum is always red-shifted relative to the absorption spectrum
 B) Absorption spectrum is red-shifted to the fluorescence spectrum
 C) The fluorescent spectrum is always blue-shifted relative to the absorption spectrum
 D) Fluorescence spectrum overlaps with the absorption spectrum
8. In SDS-PAGE, chloride ions act as leading ions while glycine acts as trailing ions in the stacking gel. Which of the following statements is the correct explanation?
 A) Glycine remains mostly neutral in the stacking gel and hence moves slower than chloride ion in the electric field
 B) Glycine attains strong positive charge in the stacking gel and hence moves slower than chloride ion in the electric field
 C) Glycine binds strongly to proteins that prevents its movement, while the chloride ions remain free to move faster
 D) Negatively charged chloride ions bind to proteins to move with them, while glycine cannot bind to proteins hence moves slower
9. An electron microscope achieves higher resolution than a light microscope because
 A) the electron microscopes use better quality of lens and objectives
 B) measurements are done in vacuum which improves resolution
 C) electrons have a shorter wavelength than visible light
 D) the sample preparation methods improve the resolution

10. In a randomly mating population that is in Hardy-Weinberg equilibrium, the frequency of green-eyes trait, which is homozygous recessive is about 4%. What is the expected frequency of heterozygotes in this population?
- A) 0.68
 - B) 0.32
 - C) 0.45
 - D) 0.80
11. CRISPR-dCas9 system which lacks the endonuclease activity, CANNOT be used for which of the following purpose?
- A) CRISPR gene knockout
 - B) CRISPR epigenetic editing
 - C) CRISPR gene silencing
 - D) Live cell imaging
12. Plasmids that are capable of replicating in two different organisms, namely, Prokaryotes (*Escherichia coli*) and Eukaryotes (Yeast), are called:
- A) Chimeric vectors
 - B) Shuttle vectors
 - C) Viral vectors
 - D) Bacterial Artificial Chromosomes
13. A comparative genomics study finds that two species share 85% nucleotide identity across their coding sequences, but their gene order (synteny) is almost completely scrambled. A third species shares only 70% nucleotide identity with species 1 but shows near-perfect synteny conservation. Which of the following conclusions is most justified?
- A) The third species is more closely related to species 1 than species 2 is.
 - B) Species 2 has undergone extensive chromosomal rearrangements after diverging from species 1.
 - C) Species 2 and species 1 share a more recent common ancestor because sequence identity is a more reliable phylogenetic marker than synteny.
 - D) The scrambled synteny in species 2 indicates it has a larger genome with more repetitive elements.
14. Gram-positive bacteria retain the crystal violet stain during Gram staining because of which structural feature?
- A) Presence of an outer membrane rich in lipopolysaccharide
 - B) Presence of teichoic acids that chemically bind crystal violet
 - C) Thick peptidoglycan layer that traps the crystal violet-iodine complex after alcohol decolourisation
 - D) Absence of porin proteins that would otherwise allow dye to leak out
15. Which of the following activities is performed by Cas9 of the CRISPR-Cas9 system?
- A) 3' exonuclease that breaks double-stranded DNA
 - B) Endonuclease that breaks double-stranded DNA
 - C) Endonuclease that cleaves single-stranded DNA only
 - D) Ribonuclease (RNase) that cleaves single-stranded RNA

16. When X-rays of wavelength $0.955\text{\AA}$ are scattered from a protein crystal lattice, peaks of scattered intensity are observed if the following conditions are met
1. The angle of incidence is half the angle of scattering.
 2. The path length difference between two scattered lights is equal $0.955\text{\AA}$
 3. If the grazing angle and angle of scattering are equal
 4. If the incident light and diffracting plane are parallel

Which one of the following options represents the combination of the correct statements?

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

17. A small molecule is added to a protein solution, and the Far-UV and near-UV CD spectra are reordered. Only a change in the near-UV spectrum of the protein was observed. The following conclusions were drawn
1. The protein binds to a small molecule and undergoes certain environmental perturbations
 2. The binding of small molecules brings about a change in secondary structure
 3. Shows a change in the backbone amide groups
 4. Binding brings about a change in the tertiary structure

Which one of the following options represents the combination of the correct statements?

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

18. A solution of a protein with a concentration of $30\text{ }\mu\text{g/ml}$ and a molecular weight of 600 has an absorbance of 0.5 at 540 nm when measured in a 1 cm path cuvette. The molar absorption coefficient at 540 nm is

- A) $10000\text{ M}^{-1}\text{ cm}^{-1}$
- B) $1 \times 10^3\text{ M}^{-1}\text{ cm}^{-1}$
- C) $5500\text{ M}^{-1}\text{ cm}^{-1}$
- D) $1000\text{ M}^{-1}\text{ cm}^{-1}$

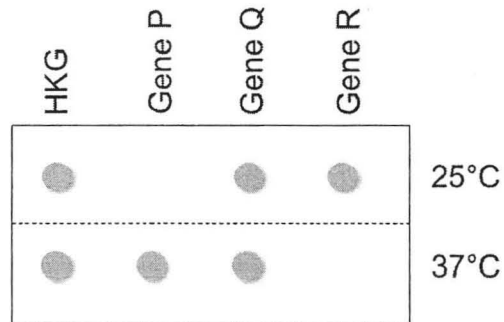
19. When 30 curly-winged flies were crossed to 30 normal flies, out of 800 progenies, 600 were curly-winged, and 200 were normal. Assume that curly-wing phenotype is dominant. If the curly-winged flies are selfed, what would be the frequency of curly-winged individuals in this population?

- A) 0
- B) 25%
- C) 50%
- D) 75%

20. Yeast cultures grown at 25°C were divided into two parts: one part was continued to grow at 25°C for two hours and the other part was shifted to 37°C for two hours, followed by RNA isolation and real-time-RT-PCR analysis. In a parallel experiment ^3H -UTP pulse labeling were done during the last two hours of growth, and labeled RNA were collected for nuclear-run-on assay. The results of these experiments are shown below:

Gene	C_T value (25°C)	C_T value (37°C)
House keeping gene (HKG)	20	22
Gene P	28	29
Gene Q	22	24
Gene R	27	28

Results of real-time RT-PCR



Dot blot showing results of nuclear-run-on assays

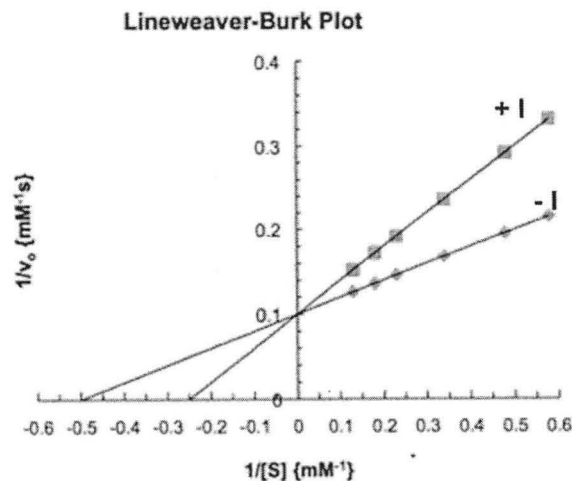
The following statements were made:

1. Synthesis of new P-RNA took place at 37°C
2. Synthesis of new Q-RNA took place at 37°C
3. Synthesis of new R-RNA took place at 37°C
4. There was a 2-fold up-regulation of R-gene expression at 37°C

Which of the option represents the right combination?

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

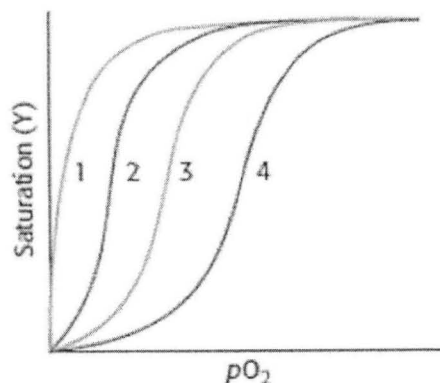
21. Given below are the double-reciprocal plots for the kinetic data obtained for an enzyme with (+I) and without inhibitor (-I).



Where does the inhibitor, most likely, bind on the enzyme?

- A) At an allosteric site, different from substrate binding site
- B) At both substrate binding site and allosteric site
- C) At substrate binding site
- D) The inhibitor binding site cannot be inferred from the plot

22. Several oxygen-dissociation curves for haemoglobin are shown below. Curve 3 represents the oxygen dissociation under normal physiological pH and typical concentrations of CO₂ and 2,3-BPG. Choose the correct statement based on this information.



- A) Plot 1 illustrates the oxygen-dissociation curve without 2,3-BPG, while Plot 4 shows the curve in the presence of elevated 2,3-BPG levels.
- B) Plot 1 demonstrates the oxygen-dissociation curve at increased CO₂ concentrations, whereas Plot 4 shows the curve under reduced CO₂ conditions.
- C) Plot 2 depicts the oxygen-dissociation curve at a lower pH, and Plot 1 represents the curve when haemoglobin has lost its quaternary structure.
- D) Plot 2 illustrates the oxygen-dissociation curve under high 2,3-BPG conditions, while Plot 4 represents the curve at physiological pH.
23. A restriction enzyme, *Eco* RI, recognizes 5'-GAATTC-3' sequence as the cut site. In theory, upon digestion of a genomic DNA of length "n" bp with *Eco* RI, what would be the average size of the fragment generated and the number of fragments generated after complete digestion?
- A) Average fragment size: 6⁴ bp; number of fragments: n / 6⁴
- B) Average fragment size: 4⁴ bp; number of fragments: n / 4⁴
- C) Average fragment size: 4⁶ bp; number of fragments: n / 4⁶
- D) Average fragment size: 3⁶ bp; number of fragments: n / 3⁶
24. A researcher is planning to do a proteomics experiment to determine the proteome of a cancer cell line. The student found the list of reagents required for sample preparation. However, the student does not know the purpose of each reagent. Help the student match the reagents in part A to their corresponding uses/purposes in part B.

Part A	Part B
1) Trypsin	(i) Reduces inter- or intra-molecular disulfide (S-S) bonds.
2) Dithiothreitol (DTT)	(ii) Denaturation of a protein
3) Urea	(iii) Alkylates free sulphydryl (-SH) groups
4 Iodoacetamide (IAA)	(iv) Hydrolysis of peptide bonds on the carboxyl side of lysine and arginine residues.

- A) 1-(i); 2-(iii); 3-(iv); 4(ii)
- B) 1-(iv); 2-(iii); 3-(ii); 4(i)
- C) 1-(ii); 2-(iii); 3-(i); 4(iv)
- D) 1-(iv); 2-(i); 3-(ii); 4(iii)

25. Four researchers were tasked with measuring a very low concentration of the IL-4 cytokine in human serum, which contains many unrelated proteins. To obtain accurate results, they needed to maximise both specificity and sensitivity. Below are the methods each researcher used. Select the researcher using the most suitable method to quantify cytokine levels from the options below.

A) Researcher 1 used an 'antigen-first' ELISA, coating the serum directly onto the ELISA plate and then applying labelled primary anti-human IL-4 antibodies.

B) Researcher 2 used a sandwich ELISA, employing the same monoclonal antibody against human IL-4 as both the capture and detection antibody.

C) Researcher 3 used a sandwich ELISA, employing two different monoclonal antibodies against human IL-4, one as the capture and the other as the detection antibody.

D) Researcher 4 used an 'antigen-first' ELISA, coating the ELISA plate with serum and using anti-human IL-4 as the primary antibody and anti-human IgG as the secondary antibody.

PART -B

26. For a nucleus with nuclear spin quantum number, $I = \frac{1}{2}$, what are the values of spin angular momentum, m_i

- A) $+1/2, 0$
- B) $+1/2, 1$
- C) $0, +1/2$
- D) $+1/2, -1/2$

27. Mammalian cells that have just crossed the restriction point (R-point) of cell cycle are likely to

- A) High levels of unphosphorylated retinoblastoma protein
- B) An active anaphase promoting complex
- C) Low levels of mitotic cyclin B
- D) Nuclear envelope breakdown

28. A protein has a mutation that leads to loss of signal sequence KDEL. The protein is likely to be found in:

- A) peroxisome
- B) Golgi
- C) Lysosome
- D) Cytosol

29. α -amanitin is a fungal toxin which inhibits eukaryotic RNA polymerase. The three eukaryotic RNA polymerases show differential sensitivity to this toxin. Which one of the following orders (higher to lower) is correct in respect of sensitivity towards α -amanitin?
- RNA pol III > RNA pol II > RNA pol I
 - RNA Pol II > RNA pol III > RNA Pol I
 - RNA Pol I > RNA Pol III > RNA Pol II
 - RNA Pol II > RNA Pol I > RNA Pol III
30. Which of the following metabolite is the signal for the depletion of energy in the cell?
- ADP
 - cAMP
 - AMP
 - ATP
31. Many enzymes undergo phosphorylation to regulate their activity. Phosphorylation of enzymes may lead to:
- Activation of enzyme activity only
 - Inhibition of enzyme activity only
 - Activation or inhibition of enzyme activity
 - No change in the activity
32. If glycolytic NADPH (or NADH equivalents) are considered, which of the following statements are correct
- ATP yield from glycolytic NADH in eukaryotes can be lower than in bacteria
 - ATP yield from glycolytic NADH in eukaryotes is always higher than in bacteria
 - ATP yield from glycolytic NADH in eukaryotes and in bacteria are always equal
 - None of the above, because NADPH cannot be used for ATP production
33. **Assertion (A):** At its isoelectric point, an amino acid has minimum solubility and does not migrate in an electric field.
Reason (R): At the isoelectric point, the net charge on the amino acid is zero due to formation of a zwitterion.
- A is true, R is false
 - A is false, R is true
 - Both A and R are true, and R is the correct explanation
 - Both A and R are true, but R is not the correct explanation
34. Which domain shares histone-like proteins with Eukarya?
- Bacteria
 - Archaea
 - Cyanobacteria
 - Fungi
35. Which of the following features contributes to terrestrial adaptation in insects compared to annelids?

- A) Closed circulatory system
- B) Exoskeleton and tracheal respiration
- C) Nephridia
- D) Gills for respiration

36. Birds and mammals both possess four-chambered hearts. This is considered an example of:

- A) Divergent evolution
- B) Adaptive radiation
- C) Convergent evolution
- D) Parallel mutation

37. The following statements are made about the *gray crescent* in amphibian development:

1. It forms opposite to the site of sperm entry.
2. It determines the dorsal axis of the embryo.
3. It is essential for proper gastrulation.
4. It represents the blastopore lip.

Which one of the following options represents the combination of all correct statements?

- A) 1 and 2
- B) 2 and 3
- C) 3 and 4
- D) 1, 2 and 3

38. There are four events during skeletal muscle contraction.

- (i) Binding of calcium ions
- (ii) Power stroke
- (iii) Cross bridge formation
- (iv) ATP hydrolysis

The correct of sequence of events is?

- A) i - ii - iii - iv
- B) i - iv - iii - ii
- C) iv - iii - i - ii
- D) ii - i - iv - iii

39. Two functionally similar genes exist in the same organism - one on chromosome 3 and one on chromosome 11. Sequence analysis reveals they share 65% amino acid identity, conserved catalytic domains, and arose from a gene duplication event approximately 200 million years ago. These genes are best described as:

- A) Alleles
- B) Orthologs
- C) Paralogs
- D) Pseudogenes

40. Aspirin (Acetylsalicylic Acid) works by transferring an acetyl group to a serine residue at the active site of Cyclooxygenase (COX-1 and COX-2) enzymes. This covalent modification prevents the synthesis of prostaglandins. Therefore, Aspirin is which type of inhibitor?

- A) Competitive Reversible Inhibitor

- B) Non-competitive Reversible Inhibitor
- C) Irreversible Inhibitor
- D) Allosteric Feedback Inhibitor

41. Number of chiral centres in alpha-D-glucose and beta-D-fructose are ____ and ____, respectively.
- A) 6 and 6
 - B) 6 and 5
 - C) 5 and 4
 - D) 5 and 5

42. Given below are two columns.

Column I (Concepts / Processes)	Column II (Thermodynamic Features)
1. Exergonic reaction	$\Delta H > 0$ and $\Delta S > 0$
2. Endergonic reaction	$\Delta S > 0$
3. Spontaneity at high temperature	$\Delta G > 0$
4. Increase in system entropy	$\Delta G < 0$

Select the option with all correct matches.

- A) 1a; 2b; 3c; 4d
 - B) 1d; 2b; 3a; 4c
 - C) 1d; 2c; 3a; 4b
 - D) 1d; 2c; 3b; 4a
43. Some errors occur during DNA replication that are not corrected by proof reading activity of DNA polymerase. These are corrected by specialized repair pathways. Given below are some enzymes:
- 1. DNA polymerase III and DNA ligase
 - 2. AP endonuclease and DNA glycosidase
 - 3. Mut S and Mut L
 - 4. Rec A and Rec F

Select the options that has the correct combination of enzymes that participate in the above-mentioned repair pathways.

- (A) 1, 2 and 3
 - (B) 4 and 2
 - (C) 1 and 4
 - (D) 1 and 3
44. Mark the correct option.
- A) In a cell, membrane phospholipids, peripheral membrane proteins and integral membrane proteins including G-coupled protein receptors diffuse freely in all directions (x, y and z).
 - B) In a cell, membrane phospholipids, peripheral membrane proteins and integral membrane proteins including receptors do not diffuse at all since membranes are extremely crowded.
 - C) In a cell, membrane phospholipids, peripheral membrane proteins as well as integral membrane proteins including receptors diffuse freely in the 2-D (x-y) plane of the membrane

D) In a cell, phospholipids and peripheral membrane proteins diffuse freely in the 2-D (x-y) plane of the membrane but integral membrane proteins including receptors always remain fixed at specific locations due to their large size and constraints

45. In *E. coli*, four Hfr strains denote the genetic markers shown in the order:

Strain 1: F A B C Z

Strain 2: H Y X Z C

Strain 3: P D W H Y

Strain 4: P F A B C

All the Hfr strains are derived from the same F⁺ strain. What is the order of these markers on the circular chromosome of the original *E. coli* F⁺ strain?

A) B C Z P D F A W H Y X B

B) F A B C Z P D W H Y X F

C) F A B C Z X Y H W D P F

D) F A B C Y X Z H W D P F

46. Group I and II introns are self-splicing introns. Listed below are few statements about them.

1. They do not require energy source in the form of ATP

2. Nucleophilic attack first take place at the 5' splice site of the intron and the free OH formed at 5' site now attacks the 3' splice site of the intron

3. Nucleophilic attack first takes place at the 3' end splice site of the intron and the free OH formed at 5' site now attacks the 5' splice site of the intron

4. There is formation of spliceosome

5. Lariat formation take place in group II introns

Choose the correct ones

A) 1 & 2

B) 3, 4 & 5

C) 1, 2 & 5

D) 2, 4 & 5

47. Addition of rotenone to the mammalian cells leads to the inhibition of mitochondrial complex I activity and an increase in the production of reactive oxygen species. Interestingly, a noticeable change in the expression of nuclear genes in response to the mitochondrial complex I inhibition. The process can be best explained by one or more of the options below.

1. Anterograde signaling

2. Retrograde signaling

3. Inter-organellar communication

4. Independent signaling events

Choose the option that represents all correct combinations.

A) 1 & 2 only

B) 2 & 3 only

C) 2 & 4 only

D) 1 & 3 only

48. Fossil evidence suggests transition from lobe-finned fishes to tetrapods. Which of the following features are considered most significant in this transition?

- I. Presence of scales
- II. Operculum development
- III. Limb bones homologous to tetrapod appendages

Select the option that represents all correct combinations.

- A) I only
- B) II & III
- C) I & III
- D) III only

49. Which one of the following options represents all correct matches between vertebrate embryonic structures and their developmental outcomes?

Column X (Structure)	Column Y (Outcome)
a. Neural crest	i. Peripheral nervous system
b. Notochord	ii. Induces neural tube formation
c. Somites	iii. Skeletal muscle and vertebrae
d. Endoderm	iv. Gut lining and associated organs

Which one of the following options represents all correct matches?

- A) a (i) b (ii) c (iii) d (iv)
- B) a (ii) b (i) c (iii) d (iv)
- C) a (i) b (iii) c (ii) d (iv)
- D) a (iv) b (ii) c (iii) d (i)

50. During prolonged fasting acetoacetate is used as fuel for extrahepatic tissues such as the brain and heart. What is the net yield of ATP generated from the complete aerobic oxidation of one molecule of acetoacetate to CO_2 and H_2O ? (Note: Use $\text{NADH} = 2.5 \text{ ATP}$ and $\text{FADH}_2 = 1.5 \text{ ATP}$)

- A) 12.0 ATP
- B) 19.0 ATP
- C) 21.5 ATP
- D) 24.0 ATP

F-3

ROUGH WORK:

F-3

University of Hyderabad
Entrance Examinations - 2026
Ph.D. Admissions – July Session

School/Department/Centre : Biochemistry
 Course: Ph.D. Subject: BC (F3)

Q. No.	Answer	Q. No.	Answer
1	B ✓	26	D ✓
2	C ✓	27	C ✓
3	D ✓	28	B ✓
4	A ✓	29	B ✓
5	C ✓	30	C ✓
6	B ✓	31	C ✓
7	A ✓	32	A ✓
8	A ✓	33	C ✓
9	C ✓	34	B ✓
10	B ✓	35	B ✓
11	A ✓	36	C ✓
12	B ✓	37	D ✓
13	B ✓	38	B ✓
14	C ✓	39	C ✓
15	B ✓	40	C ✓
16	B ✓	41	C ✓
17	D ✓	42	C ✓
18	A ✓	43	D ✓
19	D ✓	44	C ✓
20	D ✓	45	C ✓
21	C ✓	46	C ✓
22	A ✓	47	B ✓
23	C ✓	48	D ✓
24	D ✓	49	A ✓
25	C ✓	50	B ✓

Note/Remarks: Questions 1 to 15 carries one mark each. Questions 16 to 25 carries 2 mark each.
 Questions 26 to 40 carries one mark each. Questions 41 to 50 carries 2 mark each.


 9/8/26
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