

2015

19 MAY 2015

BIOCHEMISTRY**Paper – BCO – 404****(Structural Biology)****Full Marks – 25***The figures in the margin indicate full marks**Candidates are required to give their answers in their own words as far as practicable***Group – A**

1. (a) Which one of the following thermodynamic parameter is not a state function and why ?
- (i) Enthalpy change, (ii) Heat change, (iii) Entropy change, (iv) Free energy change. 1
- (b) "ATP synthesis in mitochondria is coupled with hydrogen ion transport and membrane potential" — Discuss the energetic of the process. 2
- (c) (i) In anaerobic glycolysis process, thermodynamic parameters are
 $\text{Glucose} + 2\text{Pi} + 2\text{ADP} \rightleftharpoons 2\text{Lactate} + 2\text{ATP} + 2\text{H}_2\text{O}$
 $\Delta G^0 = -124 \text{ KJ/mol}$, $\Delta H^0 = -63 \text{ KJ/mol}$, and $\Delta S^0 = 220 \text{ J/mol-K}$
- (ii) In direct oxidation of glucose, thermodynamic parameters are
 $\text{Glucose} + 6 \text{O}_2 \rightleftharpoons 6\text{CO}_2 + 6\text{H}_2\text{O}$
 $\Delta G^0 = -2878 \text{ KJ/mol}$, $\Delta H^0 = -2801 \text{ KJ/mol}$ and $\Delta S^0 = -259 \text{ J/mol-K}$.
- Between the two processes, (i) is more useful physiological system — Explain why. 2
- (d) The equilibrium constant under standard conditions for the reaction :
 $\text{Fumarate} + \text{H}_2\text{O} \rightleftharpoons \text{L-malate}$ is 4.00. At 310 K, the equilibrium constant is 8.00. What is the standard enthalpy change ΔH^0 , for the reaction, assuming the standard enthalpy change is independent of temperature ? Show the calculation. 2
- (i) 5.23 kcal/mol; (ii) 10.56 kcal/mol; (iii) 21.12 kcal/mol; (iv) 42.24 kcal/mol.

Or

2. (a) For determination spontaneity of a process, which one would be the best Parameter ? (Need brief explanation). 1
- (i) ΔH^0 ; (ii) ΔS^0 ; (iii) ΔG^0 ; (iv) ΔG .
- (b) Free energy changes for transferring amino acids from ethanol to water at 298 K are as follow :
- | Amino Acid | ΔG_t (kcal/mol) |
|------------|-------------------------|
| Glycine | -4.63 |
| Alanine | -3.90 |
| Valine | -2.94 |
| Isoleucine | -1.69 |
- Calculate ΔG_t for side chain of each amino acid and interpret those data. 2
- (c) "Hydrophobic interactions are entropy driven process" — Explain. 2

[Turn Over]

(d) Standard free energies of formation at 298 K and steady state concentration of the following glycolytic intermediates are :

Substance	ΔG^0 (kJ/mol)	Concentration (mM)
Glucose	-426.71	5.0
Glucose-6-phosphate	-1318.92	0.083
ATP	-2097.89	1.85
ADP	-1230.12	0.14

Calculate ΔG^0 and ΔG values for the following reaction :



Group - B

3. (a) Cytochrome c is a heme protein. The protein has a quenched tryptophan fluorescence intensity. Upon unfolding with urea, the fluorescence intensity goes up significantly. Explain. 3

(b) Which of the following techniques can be used to monitor the secondary structure of a protein ? 2

Far UV CD, Steady state tryptophan fluorescence, dynamic light scattering.

Or

4. (a) Which of the following techniques can be used to measure the size of a protein ? 2

Dynamic light scattering, gravitational force measurements, Near UV CD.

(b) What is a molten globule intermediate ? 3

Group - C

5. (a) Draw and explain all the backbone torsion angles in a protein.

(b) Considering Ramachandran Plot, mention what type of protein secondary structure you expect for amino acids with positive values of torsion angle phi and negative values of torsion angle psi.

(c) Explain the significance of the name given to the CATH database. 3+1+2

Or

6. (a) Name the different components in threading approach for the prediction of protein tertiary structure. What is the task of the objective function ?

(b) How are interface residues in a protein-protein interaction identified ?

(c) What are the two main *in silico* strategies for drug designing ? 3+2+1

Group - D

7. (a) What do you mean by a G-quadruplex DNA structure ? Discuss with example.

(b) You have synthesised two polypyridine ligands. Present an experimental design to analyse the selectivity of the complexes for G-quadruplex structure. 3+4

Or

8. (a) Interaction of Kaempferol (Kaemp) with HSA needs to be investigated, since the cardioprotective activity of this natural flavonoid has raised great interest in biomedical science. Design an experiment to find the distance between kaemp and tryptophan residue of HSA using FRET.

(b) How can you estimate whether there is any unfolding in the confirmation of HSA upon binding with kaemp ? 3+4