

2022

( February )

## BIOCHEMISTRY

( Honours )

## ( Biomolecules and Biophysical Techniques )

[ BCHEM-101 ]

Marks : 56

Time : 3 hours

*The figures in the margin indicate full marks for the questions*

Answer **four** questions, taking at least **one** from each Part

## PART—A

1. (a) What kind of intramolecular chemical bond holds the hydrogen atoms to the oxygen in water molecules? 4
- (b) Explain why ethanol ( $\text{CH}_3\text{CH}_2\text{OH}$ ) is more soluble in water than ethane ( $\text{CH}_3\text{CH}_3$ ). 2

- (c) Calculate the pH of a solution that has an  $\text{H}^+$  concentration of the following : 3
- (i)  $1.75 \times 10^{-5} \text{ mol/L}$
- (ii)  $6.50 \times 10^{-10} \text{ mol/L}$
- (iii)  $1.0 \times 10^{-4} \text{ mol/L}$
- (d) Calculate the concentration of  $\text{H}^+$  in a solution of 0.1 M NaOH. 2
- (e) Define the following :  $1\frac{1}{2} \times 2 = 3$
- (i) pH
- (ii) Buffer

2. (a) How do epimers differ from anomers? 3
- (b) Name the epimers of D-ribose at C-2 and C-3. 3
- (c) Draw the Haworth perspective formulas of the  $\alpha$ - and  $\beta$ -form of D-glucose. What feature distinguishes the two forms?  $3+1=4$
- (d) Describe the common structural features and differences for each pair of the following : 3
- (i) Cellulose and Glycogen
- (ii) D-glucose and D-fructose

( 3 )

- (e) Cellulose could provide a widely available and cheap source of glucose, but human cannot digest it. Why? 1
3. (a) What chemical properties the peptide bonds have? How do you define the primary structure of proteins? 2+2=4
- (b) Why are  $\alpha$ -amino acids so called? Explain with the help of a general structure. 3
- (c) What is protein conformation? Why is protein conformation important? 2+2=4
- (d) What is the length of a polypeptide with 80 amino acid residues in a single contiguous  $\alpha$ -helix? 2
- (e) In the context of protein structure, define the term 'stability'. 1
4. (a) Explain the differences between saturated and unsaturated fats. 4
- (b) Explain why the absorption of UV light by double-stranded DNA increases when the DNA is denatured. 3

( 4 )

- (c) One strand of a double-helical DNA has the sequence  
(5) GCGCAATATTTCTCAAAATATTGCGC (3)  
Write the base sequence of the complementary strand. 2
- (d) What is the difference between mono-unsaturated and polyunsaturated fatty acids (PUFAs)? 3
- (e) What are polyunsaturated fatty acids (PUFAs) with a double bond between C-3 and C-4; C-6 and C-7 known as? 2

PART—B

5. (a) A protein  $x$  was found to have molecular mass of 40 kDa using Native-PAGE. However, when the same protein was separated using SDS-PAGE, it was found that two bands were formed corresponding to 10 kDa and 5 kDa. Using this information, discuss the possible number of subunit combinations of the protein  $x$ . 6
- (b) You take 2 kg of beef heart and homogenize in a high-speed blender in a medium containing 0.2 M sucrose,

( 5 )

buffered to a pH of 7.2. Then you subject the resulting heart homogenate to a series of differential centrifugation steps. Answer the following :  $2+3+3=8$

- (i) Why was the tissue suspended in 0.2 M sucrose?
- (ii) What happened to the tissue when it was homogenized?
- (iii) What did differential centrifugation accomplish?

6. Explain the uses of the following for determining the three-dimensional structure of a protein :  $7 \times 2 = 14$

- (a) X-ray Crystallography
- (b) Nuclear Magnetic Resonance (NMR)

7. (a) State the characteristics of  $\alpha$  ,  $\beta$  and  $\gamma$  radiations. 6

- (b) Describe scintillation counting method for detection of radioactivity. 8

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