BIOT 2101

1.

(BIOT 2101) Time Allotted : 3 hrs

Choose the correct alternative for the following:

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and <u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A (Multiple Choice Type Questions)

 (i) Which of the following is the simplest carbohydrate? (a) Glucose (b) Ribose (c) Erythrose (b) Glyceraldehyde (ii) Coconut oil solidifies in winter but mustard oil does not because (a) coconut oil is more unsaturated (b) coconut oil is more saturated (c) coconut oil contains some water (d) coconut oil is chemically process (iii) A sample of normal double-stranded DNA was found to have a guanine correction of 18%. What is the expected proportion of adenine? (a) 9% (b) 32% (c) 36% (d) 23% (iv) The circular dichroism (CD) is defined as (a) difference in extinction coefficient (b) difference in emission frequency (d) all of the above (v) Amino acids containing aliphatic R groups are (a) Alanine, Valine, Tyrosine (b) Methionine, Serine, Threonine (c) Tryptophan, Leucine, Isoleucine 			
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A tripeptide contains (a) three amino acids and one peptide bond (b) three amino acids and two peptide bonds (c) three amino acids and three peptide bonds (d) three amino acids and four peptide bonds			
 (vii) Structural polysaccharides include (a) cellulose, starch, chitin (b) cellulose, pectin, algininc acid (c) starch, pectin, glycogen (d) cellulose, glycogen, xylan 			

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CHEMISTRY OF BIOMOLECULES

Full Marks: 70

 $10 \times 1 = 10$

- (viii) Loss of three dimensional structure of a protein is termed as(a) denaturation (b) oxidation (c) hydrolysis (d) reduction
- (ix) EMR interact with the matter and different molecular process occurs. Match the names EMR interact (**Group-I**) and the molecular process (**Group-II**)

Group-I	Group-II
(P) X-ray	(1) Molecular rotation
(Q) UV-Vis	(2) Molecular vibration
(R) IR	(3) Electronic transition
(S) Microwave	(4) Bond breaking and ionization

Select the correct match between group-I and group-II

	0	
(a) (P)-1; (Q)-2; (R)-3; (S)-4		(b) (P) -2; (Q)-3; (R) -1; (S)-2,
(c) (P)-4; (Q)-2; (R)-3; (S)-1		(d) (P)-4; (Q)-3; (R)-2; (S)-1

(x) A DNA was isolated from bacteria. That DNA solution shows A₂₆₀ value of 0.2, after 100 times dilution of that DNA solution, in a spectrophotometer. So, the concentration of that DNA solution was

 (a) 10 mg/ml
 (b) 10 μg/ml
 (c) 1000 mg/ml
 (d) 1000 μg/ml

Group-B

- 2. (a) What is solvation? Describe its role in dissolving sodium chloride in water. [(CO1) (Remember, Explain/LOCQ)]
 - (b) The pK values of Asp are as follows. Carboxyl $pK_1=1.88$, $pK_2=9.60$, $pK_R=3.65$. Calculate the charge on Asp at pH 5, 7 and 11. [(CO1) (Evaluate/HOCQ)]
 - (c) Study the following Fischer projection formulas and answer the following.



Are galactose and mannose D sugar or L sugars? Are galactose and mannose enantiomers? Justify your answer. [(CO1) (Analyse/IOCQ)]

$$(1+3)+3+(1+1+3)=12$$

3. (a) State the action of amylase on amylopectin. [(CO1) (Remember/LOCQ)]

(b) (i) Butter is semisolid at room temperature, whereas mustard oil is liquid. Connect their physical states to their physical/chemical properties.
(ii) Distinguish between the behaviour of cellulose and amylose towards the action of amylase. [(CO1) (Analyze/IOCQ)]

(c) You are given three sets of components to make a buffer, (i) sodium acetate and acetic acid, (ii) sodium chloride and hydrochloric acid, (iii) ammonium hydroxide and ammonium chloride. Judge the pairs and suggest the one that will give the best buffer system. [(CO1)(Evaluate/HOCQ)]

$$3 + (3 + 3) + 3 = 12$$

Group - C

- 4. (a) What are parallel and antiparallel beta-sheet? [(CO2) (Remember/LOCQ)]
 - (b) You have a mixture of two different protein molecules of molecular weight 25,000 and 70,000. Illustrate a process by which the two proteins can be separated. [(CO2) (Analyze/IOCQ)]
 - (c) Molecular weight of a protein containing entirely alpha-helical structure is 35,000. Calculate the length of the protein. [(CO2) (Evaluate/HOCQ)]

(2+2)+6+2=12

- 5. (a) Define with example: polar amino acid, modified amino acid. [(CO2) (Remember/LOCQ)]
 - (b) You charged a mixture of amino acids on a paper for paper chromatography using butanol, acetic acid and water (ratio is 80:20:1). It was known that the mixture contains Threonine, Glutamic acid and Valine in solution. After spraying ninhydrin at the end of chromatography, you obtained three purple spots. State the order of movement of the amino acids you expect on the paper. Justify your answer. Suppose you have an amino acid which is not known to you. You did paper chromatography with it and got a spot very close to Valine. What will be your inference? State the logic behind it. [(CO2) (Analyze/IOCQ)]
 - (c) The pK₁, pK₂ and pK_R values of aspartic acid are 2.09, 9.82 1nd 3.86 respectively. Calculate its pI. Predict its movement in an electric field at pH10.
 [(CO2)(Calculate/HOCQ)]

(2+2) + (3+3) + (1+1) = 12

Group - D

- 6. (a) Which experiment confirms that RNA can be genetic material for some virus? Explain the principle and steps of that experiment with labelled diagram. [(CO3)(Explain/LOCQ)]
 - (b) Differentiate between A, B and Z forms of DNA. [(CO3)(Analyze/IOCQ)]
 - (c) Draw the detail chemical structure of ssRNA molecule with three nitrogen bases. [(CO3)(Explain/LOCQ)]
 - (d) The genetic materials of an RNA virus, a ssDNA virus, and a wombat (a mammal) were analyzed by a very disorganized laboratory technician, who lost the identification tags to the samples. Identify the source of the nucleic acid for each sample, giving a reason for each choice.

<u>Sample</u>	<u>Adenine</u>	<u>Cytosine</u>	<u>Guanine</u>	<u>Thymine</u>	<u>Uracil</u>
(X)	28.0	22.0	22.0	0.0	28.0
(Y)	21.0	29.0	29.0	21.0	0.0
(Z)	27.0	24.0	26.0	23.0	0.0
[(CO6)(Solve/	HOCQ)]				

(1+2) + 3 + 3 + 3 = 12

- 7. (a) Explain the experimental principle and steps of the experiment which proved that "the nature of transforming principle is DNA in *Streptococcus pneumoniae*" [(CO3) (Remember/LOCQ)]
 - (b) Write the names of four level structures of DNA. Explain each of the level structural features of DNA with ladled diagram. [(CO3) (Understand/IOCQ)]
 - (c) Assume a 6,000 base pair, closed circular plasmid DNA with 25 negative supercoils in B-DNA form. Calculate *Tw*, *Wr*, *Lk*, and σfor this plasmid DNA.
 [(CO6)(Analyse/HOCQ)]

(1+3)+4+4=12

Group – E

- 8. (a) Explain the differences between absorption and emission spectroscopy with example. A solution of DNA and a solution of protein, separately used to do wavelength scan (from 200 to 310 nm) in spectrophotometer, now you draw and explain the expected nature of the changes of absorption for DNA and protein with increasing wavelength with a labelled diagram. [(CO5) (Explain/IOCQ)]
 - (b) Explain the optical arrangement and working principle of dual beam UV-VIS spectrophotometer.[(CO4) (Analyse/IOCQ)]
 - (c) Explain the principle and steps for structure determination of biomolecules with cryo-electron microscopy with example. [(CO5) (Remember/LOCQ)]
 - (d) Monochromatic light is passed through a 2 cm path length cell containing 0.08 moles/dm³ sample solution. The light intensity reduced to 35% of its value. Evaluate molar extinction co-efficient of the sample. What will be the transmittance if the cell path length is 3 cm? [(CO6) (Evaluate/HOCQ)]

3 + 3 + 3 + 3 = 12

- 9. (a) Explain principle for colorimetric determination of concentration of a unknown protein solution, by chemical reagent and with chemical reaction? [(CO4) (Analyse/IOCQ)]
 - (b) Explain basic working principle and steps of SPR by sensogram. [(CO4) (Analyse/IOCQ)]
 - (c) Describe the principle of STM with a diagram. [(CO5) (Analyse/IOCQ)]
 - (d) Cytosine has a molecular extinction coefficient of 6×10^3 at 270 nm at pH 7. Calculate the absorbance of 1×10^{-4} and 1×10^{-3} M cytosine solutions in a 1 mm cell. [(CO6) (Evaluate/HOCQ)]

(2+2)+3+3+2=12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	29%	46%	25%

Course Outcome (CO):

After the completion of the course students will be able to

- CO1. Calculate the pH of a buffer system, understand weak and forces, identify different stereoisomer's of carbohydrate and lipids and understand the chemistry of carbohydrate and lipids.
- CO2. Explain the different structural components and physiochemical properties of amino acids, proteins.
- CO3. Analyses and explain the different structural components and physiochemical properties of DNA and RNA.
- CO4. Select and apply suitable spectroscopic techniques for estimation biomolecules.
- CO5. Select and apply suitable techniques for and structure determination of biomolecules.
- CO6. Able to solve mathematical problems related to estimation and structural features of biomolecules.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
BT	https://classroom.google.com/c/NDI5ODc2NzQ4MjIy/a/NDc0ODQxODkwMDMw/details