WEST BENGAL STATE UNIVERSITY

B.Sc. Honours PART-I Examinations, 2018

MICROBIOLOGY-HONOURS

PAPER-MCBA-IA

Time Allotted: 4 Hours | Full Marks: 100

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Use separate answer books for each Group.

Group-A

Questions No. 1 is compulsory and answer any *four* questions from the rest

1. Answer any ***five*** questions from the following: 2×5 = 10

(a) Hydrogenation of unsaturated fats elevates their melting temperature. – Justify the statement.

(b) Write down the Fisher projection formula of D-glyceraldehyde and give its R-S configurational nomenclature.

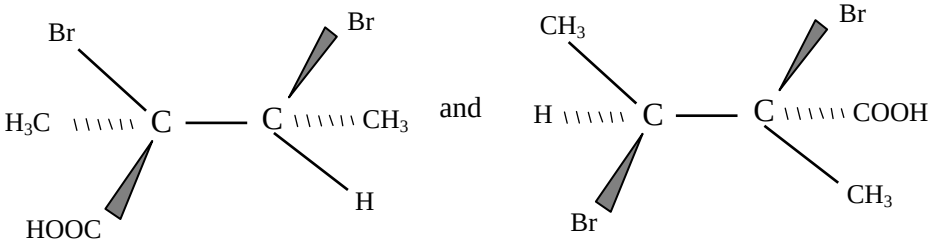
(c) What will happen if glyceraldehyde is subjected to oxidation by bromine water?

(d) Why the two strands of DNA are antiparallel in nature?

(e) Why would you use a gradient of buffer during ion exchange chromatography?

(f) "Peptide bonds are planer"– Justify.

(g) Identify whether the following pairs of compound represents enantiomer, diastereoisomer or monomer



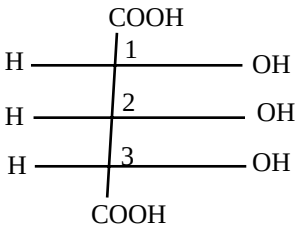
(h) Explain why RNA is hyperchromic compared to DNA.

2. (a) How the size of the ring in sugars can be determined by oxidation methods? 2

(b) Write the Haworth projection formula of sucrose. Is sucrose a reducing sugar? – Explain. 2+1

(c) Explain plane of symmetry with an example. 2

(d) Write the RS-nomenclature of the carbon atoms in the following diagram (designated as 1, 2, 3). 3



3. (a) Mention the basic features of Z-form of DNA. 2
   (b) A diploid organism with a 45,000 kb haploid genome contains 21% G residues. Calculate the number of A, C, G and T residues in the DNA of each cell in this organism. 2
   (c) Draw the structural formula and give the name of 1+1
   (i) a purine deoxyribose
   (ii) a pyrimidine 3′–5′ diphosphate.
   (d) What will be your interpretation regarding a DNA sample with the following observation: "Reannealing of DNA sample is very slow and occurs only at high C_0t values". 2
   (e) The energy required to break C–C bond of ethane is 90 kCal/mol, whereas for cyclohexane it is 65 kCal/mol. Explain. 2

4. (a) What is meant by rancidity of fat? Why do some cooking oils, such as canolla oil and olive oil, become rancid sooner than solid fats? 1+2
   (b) Calculate the Saponification number of Palmitodisterain. 3
   (c) Explain why soaps in aqueous solution assemble into micellar structures. 2
   (d) Why do animals that live in cold climates generally have polyunsaturated fatty acyl residue in their fats than do animals that have in warm climate. 1
   (e) Define ω-3 fatty acids with example. 1

5. (a) How many amino acids residues are there in a protein of μw 55,000? 1
   (b) Why is proline and glycine rarely found in an α-helix? 2
   (c) Describe Edman's degradation. What is the advantage of Edmann's method over Dansylchloride method? 2+2
   (d) Write the name and structures of amino acids: 1+1
   (i) having 'R' group with pk′ ≃12, Making it positively charged at all physiological pH and
   (ii) having 'R' group which is negatively charged at pH = 7
   (e) What is the purpose of adding formaldehyde in formal titration of amino acids? 1

6. (a) What is Mutarotation? How did it help in postulating cyclic structure of glucose? 2
   (b) About how many glucose unit may be present in an amylopectin molecule having average molecular weight of 275000? 2
   (c) Name the factors which can regulate the oxygen binding to hemoglobin. 3
   (d) What is optical purity of a compound? 1
   (e) What is meant by ammonium sulfate precipitation in Protein chemistry? 2

7. (a) What is meant by "mobile" and "stationary" phase in chromatography? 2
   (b) A mixture of Glutamine and glycine is subjected to 3
   (i) anion exchange chromatography and
   (ii) Gel filtration chromatography.
   State with reasons which amino acid will come out first in each type of chromatography?
   (c) Proline gives yellow product instead of Ruheman's purple when treated with excess ninhydrin. Explain the statement. 2
   (d) Differentiate between parallax and anti-parallel β-stands in terms of 1.5+1.5
   (i) direction and
   (ii) distinctive pattern of H-bonding

8. (a) Indicate whether the following statements are true or false — 1×3 = 3
   (i) All diastereomers are optically active.
   (ii) (2R, 3S)-pentane-2, 3-diol is the enantiomer of (2S, 3S)-pentane-2, 3-diol.

(iii) A meso compound must contain an even number of asymmetric centres and/or axes of chirality.

(b) Looking down the C3 – C4 bond, write Newman projections for all three staggered conformations of 2, 2-dimethyl pentane. Select the most stable conformation. 3

(c) Name one natural peptide which can act as a reducing agent write down its primary structure at pI and its chemical name. 2

(d) What happens when the following peptide is cleared by CNBr: 2

Thr – Cys – Gly – Met – Asn

9. (a) Draw the structure of an oligopeptide generated by the disulfide linkage of the two peptides given below: Nal–Cys, Ser–Cys–Pro. 2

(b) Explain why lipids with high acid number have higher tendency to undergo rancidification. 2

(c) What are the structural features that cause cellulose to be a structural polysaccharide and glycogen to be a storage polysaccharide? 4

(d) Briefly explain why most globular proteins in solution of a given ionic strength show minimum solubility at their isoelectric point. 2

Group-B

Answer Question Number 10 compulsorily and any *four* from the rest

10. Answer any ***five*** questions from the following: 2×5 = 10

(a) What types of transitions are observed in UV spectra? Give a relevant clear diagram.

(b) Distinguish between open and closed systems with examples.

(c) Mention two differences between α rays and β rays.

(d) What do you mean by K-electron capture?

(e) What are isotones and isobars? Give examples.

(f) Define specific absorption co-efficient.

(g) What is meant by specific viscosity of a solution?

(h) What is polyprotic acid? Give an example.

11.(a) Why is DNA electrophoresis carried out horizontally whereas electrophoresis of proteins carried out vertically? 2

(b) State the zeroth law of thermodynamics. 2

(c) Why is establishment of Donnan equilibrium harmful for animal cell? How does cell avoid this situation? 1.5+1.5

(d) Mn^{54} has a half-life of 314 days. Calculate the percent of initial radioactivity remaining in the sample after 80 days. 3

12.(a) State van't Hoff's Laws of Osmotic pressure. 3

(b) A solution containing 1g urea per litre exerts an osmotic pressure equal to 304 mm Hg at 15°C. Calculate the MW of Urea. 3

(c) Write down the important differences between Bonding and Anti-Bonding orbitals. 2

(d) Why are glass cuvettes not suitable for spectrophotometric studies in the UV region? State the unit of molar extinction coefficient. 1+1

13.(a) Under physiological conditions in red blood cells, the concentrations of fructose 1, 6 bisphosphates (FBP) is 35 μM, dihydroxyacetone phosphate (DHAP) is 120 μM and glyceraldehyde 3-phosphate (G 3 P) is 15 μM. Will the conversion of fructose 1, 6 bisphosphates to dihydroxyacetone phosphate and glyceraldehyde 3-phosphate occur spontaneously under these conditions? Given the standard free energy change for the reaction 3

FBP$\rightarrow$ DHAP + G 3 P $\Delta G^{\circ\prime}$ = 23.8 kJ at 25°C

(b) Explain the phenomenon of Raman spectroscopy. 3

(c) What are the necessary conditions to be satisfied for fluorescence resonance energy transfer to occur? 2

(d) Define isoelectric point of an amino acid with an example. 2

14.(a) Bring out the points of differences between SEM and TEM. 3

(b) Define rad and rem. 2

(c) When 2 moles of HCl are added to 1 litre of an acidic buffer, its pH changes from 3.4 to 2.9. What is the buffer capacity of the buffer solution? 3

(d) Mention two disadvantage of Infrared spectrophotometry when applied to biological samples. 2

15.(a) Discuss the principle of fluorescence with the help of a Jablonski diagram. 3

(b) For a fluorescent molecule, the emission peak wavelength is always higher than the excitation peak wavelength — explain with the help of energy-level diagram. 2

(c) What is Donnan membrane potential? Explain. 2

(d) A solution containing 10^{-5} M ATP has a transmission of 70.2% at 260 nm in a 1 cm cuvette. Calculate the absorbance and transmittance of 5×10^{-5}M ATP. 3

16.(a) Elucidate the working principle of Ostwald viscometer. 3

(b) An ultracentrifuge operates at 58000 rpm. Calculate 3

(i) angular momentum (ω) in radians

(ii) the radiative centrifugal force at a point 6.2 cm from the centre of rotation.

(c) What is plasmolysis? 2

(d) Differentiate between state and path functions. 2

17.(a) Calculate the resolving power of a light microscope when wavelength of light used is 500 nm and numerical aperture of the objective is 1.5. 2

(b) (i) What type of precautions should be taken during handling of radioisotopes in the laboratory? 2.5

(ii) What is surface tension? What are the factors that affect surface tension? 1+2.5

(iii) Describe the circumstance when Beer-Lambert law is no more valid. 2

18.(a) Write short notes on any ***two*** of the following: 2.5×2 = 5

(i) Gieger Muller counter

(ii) Linear energy transfer

(iii) Ultracentrifugation

(iv) Absorption spectrum of a substance.

(b) Distinguish between any ***two*** of the following: 2.5×2 = 5

(i) Active Transport and Facilitated diffusion

(ii) Spectrophotometer and spectroflurometer

(iii) Fluorophore and chromophore

(iv) Exergonic and endergonic reactions.

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