WEST BENGAL STATE UNIVERSITY

B.Sc. Honours PART-I Examinations, 2017

MICROBIOLOGY-HONOURS

PAPER-MCBA-I

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.

**Candidates should use separate Answer Scripts for Group A and Group B.**

Group-A

[Marks: 50]
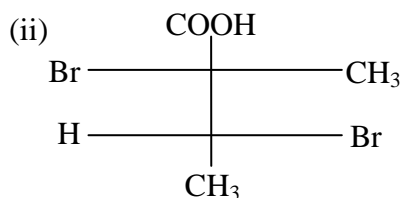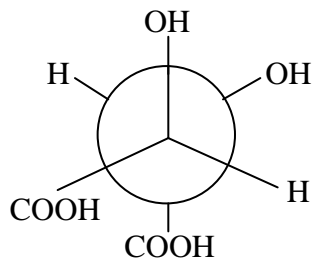
Answer Question No. 1 Compulsorily and any *four* from the rest

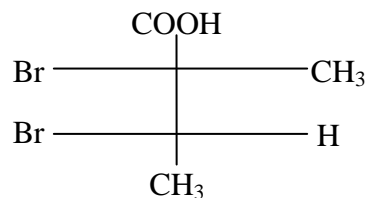1. Answer any *five* questions from the following: 2×5 = 10

(a) Write down all conformations of n-butane with their designation.

(b) Identify whether the following pairs of compounds represent enantiomers, diastereoisomer or monomer.

(i)

and

(ii)

and

                                                                                       Turn Over
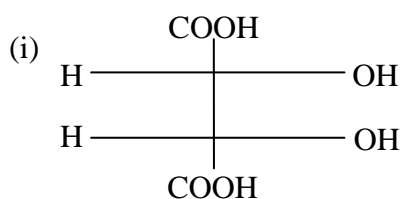
(c) What happens when $_pA_pG_pU_pC_p$ is treated with Sodium hydroxide?

(d) Meso-tartaric acid has two chiral centres, but still it is optically inactive– Justify.

(e) Why table sugar is non reducing, whereas milk sugar is reducing?

(f) Why do cellulose form rod structure whereas glycogen forms coiled helical structure?

(g) Draw the peptide bond between Ile-Met residues indicating both side chains.

(h) An optically active lipid on complete hydrolysis gives two molecules of stearic acid and one molecule each of glycerol, ethanolamine and phosphoric acid. Write down the structure of lipid.

2. (a) What do you mean by the following?   2
   (i) Symmetry element   (ii) Alternating axis of Symmetry.

   (b) Define: 2
   (i) Configurational isomer   (ii) Geometrical isomer

   (c) How can you ascertain a molecule to be asymmetric or dissymmetric?   3

   (d) Write down the RS-nomenclature of the following 3-bromobutane-2-ol.   3
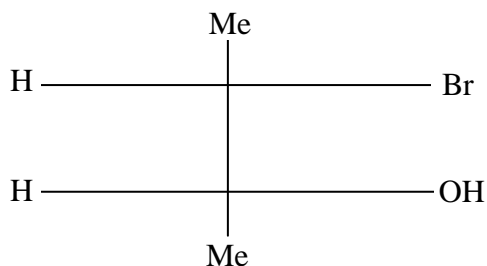
3. (a) Name the products of mild hydrolysis of 1-Palmitoyl-2-oleoyl phosphatidyl-   3
   choline with dilute Sodium hydroxide. What are the products of action of
   hot concentrated Sodium hydroxide on it?

   (b) Draw the structure of sphingomyelin and phosphatidyl-choline, stating the   3
   biological significance of each of these lipids. Propose a method to
   distinguish between them chemically or enzymatically.

   (c) Hydrogenation of unsaturated fats elevates their melting temperature —   2
   Justify the statement.

(d) What are volatile fatty acids? 2

4. (a) Isoelectric point of glutamate is 3.22 whereas isolectirc point of Glycine is 5.97. Explain. 2

(b) What products would you expect if gly-lys is treated with FDNB and then hydrolyzed? 2

(c) For N-terminal determination of a relatively rare peptide which reagent will you prefer among Dansyl chloride and FDNB. Justify your answer. 2

(d) At what pH values Ploylysine is likely to have its most stable α-helical structure? Justify. 2

(e) Explain why α-helix is described as 3.6_{13} helix. 2

5. (a) A sample of DNA purified from *E.Coli* contains 15.1% adenine on a molar bases. What are the percentages of the other bases present? 2

(b) How does the absorbance of dsDNA at 260 nm change with increasing temperature and why? 2

(c) RNA is easily hydrolyzed in the presence of NaOH while DNA is not. Explain. 2

(d) Why the two strands of DNA anti-parallel? 2

(e) Compare A, B and Z DNA with respect to their 1+1

   (i) Number of residues per turn
   (ii) Conformation along N-glycosyl bond.

6. (a) The fructose in honey is mainly in the β-D-pyranose form. It is one of the sweetest carbohydrates known. The β-D-furanose form of fructose is much less sweet. The sweetness of honey gradually decreases at high temperature. How can you explain this? 2

(b) What will happen if glyceraldehyde is subjected to oxidation by bromine water? 2

(c) Although the disaccharide lactose exists in two anomeric forms, no anomeric forms of the disaccharide sucrose have been reported. Why? 3

(d) Explain why an equimolar mixture of D-glucose and D-fructose formed by hydrolysis of sucrose is called invert sugar in the food industry. 3

7. (a) Why is high salt concentration used in eluting buffer during gel filtration? 2

(b) Why will a globular protein move faster than a linear protein during gel filtration? 2

(c) What information would you get from the reaction when an acetylated fat is hydrolyzed and the product is titrated with KOH? 2

(d) What happens when ammonium sulphate added to the globular protein solution from very low to high concentration? Explain. 2

(e) What are Lectins? State one biologically significant process in which they are involved. 2

8. (a) Name one amino acid which has two chiral centres. 1

(b) The pK values of three ionizable groups of Aspartic acid are 1.99, 9.90 and 3.90. What is its isoelectric point? 1

(c) A solution of Glycine shows buffering action in two different pH ranges. Explain. 2

(d) What is the Saponification number of a fat? 2

(e) Describe the principles associated with 2+2
   (i)   Cleavage of Peptide bond by cyanogen bromide
   (ii) Cleavage of disulfide bond is a polypeptide by performic acid.

9. (a) In samples of DNA isolated from two unidentified species of bacteria, adenine makes up 35% and 15% respectively. Which bacterial DNA is more thermostable? 2

(b) Draw the chair conformation of *trans* and *cis*-1, 4-dimethyl cyclohexane. 2

(c) Name the factors that regulate the binding of oxygen to haemoglobin. 2

(d) Give an example each of ω-3 and ω-6 fatty acids. Draw their structures. 2

(e) How the reagent, phenyl isothiocyanate is used in protein chemistry? 2

Group-B

[Marks: 50]

Answer Question No. 10 compulsorily and any *four* from the rest

10.   Answer any *five* questions from the following: $2 \times 5 = 10$

  (a) Define specific activity of a radioactive substance.

  (b) What is reverse osmosis?

  (c) For visualization of living cells which type of microscope is suitable?

  (d) Give examples of two different reactions where water acts as acid and base respectively.

  (e) Define Ionic product of water K_w. Does it vary with temperature? Justify.

  (f) Define Fluorescence quenching.

  (g) What is the pH of 10^{-8} M solution of HCl?

  (h) What is the basic condition for a molecule to IR active?

11.(a) Write down the working principle of phase contrast microscope.   3

  (b) A protein, Bovine Serum Albumin (BSA), causes 1-Anilino-8-Naphthalene Sulfonate (ANS) to fluoresce. Explain with the help of a diagram how the spectral characteristics (intensity and λ_{max}) alter when the increasing concentration of BSA is added to a fixed concentration of ANS kept in a non-polar environment.   3

  (c) How Immersion oil increases the numerical aperture of microscope? Explain diagrammatically.   2

  (d) Find out the limit of resolution of a light microscope under following condition: 2

    (i) $n = 1.5$
    (ii) Angular aperture 70Å
    (iii) Wavelength of light used = 450 nm.

12.(a) Define Buffer capacity. State under what conditions buffer capacity is maximum?   1+2

(b) What are the concentration of HOAC and OAc$^{\ominus}$ in a 0.2 M acetate buffer pH = 5?

(given : K_a of acetic acid = 1.7×10^{-5}; pK_a =4.77)

4

(c) Calculate the volume of 2M NaH_2PO_4, 1M Na_2HPO_4 and distilled water required to prepare 500 ml of 0.2(M) phosphate buffer of pH 7.3.

(Given pK_2 of H_3PO_4 = 6.8)

3

13.(a) State Lambert-Beer Law. Define molar extinction coefficient and state its significance.

1+1+1

(b) Dialysis is molecular filtration– Comment. What are the factors that affect rate of dialysis?

1+2

(c) Why ATP acts as energy yielding molecule?

2

(d) Define membrane potential.

2

14.(a) A suspension of bacteria containing 400 mg dry weight per litre has an absorbance of 1 in 1 cm cuvette at 450 nm. What is the cell density in a suspension that has a transmission of 30% in a 3 cm cuvette?

3

(b) What is osmotic pressure? Discuss the basic principle of osmometer.

1.5+1.5

(c) Differentiate Phosphorescence and Fluorescence using Jablonski diagram.

4

15.(a) (i) Calculate the $\Delta G'$ for the complete oxidation of Lactic acid to CO_2 and H_2O. Given the information below:
Glucose $\rightarrow$ 2 Lactic acid $\Delta G' = -52$ kcal/mole
Glucose + $6O_2 \rightarrow 6CO_2 + 6H_2O$; $\Delta G'_1 = -686$ kcal/mole

2+2

(ii) How many moles of ATP could be synthesized in this process? (Consider 40% efficiency)
ATP $\rightarrow$ ADP + P_i $\Delta G = -7.3$ kcal/mole.

(b) You are supplied with two bacterial DNA of different (G + C) content and each suspended in 0.05 M and 0.50 M phosphate buffers at pH 7.6. Carry out an experiment to determine the melting temperature T_m of four such samples using an UV spectrophotometer. Interpret your observations.

4

(c) Why IR spectra is called as a fingerprint of a compound?

2

16.(a) Write short notes on any *five* of the following: 2×5

       (i)   Common ion effect
       (ii)   Kirchhoff's Law
       (iii)   Second law of thermodynamics
       (iv)   Bathochromic shift
       (v)   Chromatic aberration
       (vi)   Radioimmunoassay
       (vii) Electrophoresis.

17.(a) A protein is known to have a single tryptophan residue. How one can determine its presence on surface or internal region of the protein by absorption spectra.   3

  (b) State the differences between β-rays and γ-rays.   2

  (c) The half life of radioactive element is 2 years. Initial weight of the element is 1 gm. After 6 years what fraction of the element will remain?   3

  (d) What is nuclear fusion? Cite an example.   1+1

18.(a) Cite an example where Donan membrane plays a significant role in human physiology.   2

  (b) Explain the relation $\pi = CRT$.   2

  (c) State the definition of Red shift and Blue shift with diagram.   4

  (d) Draw a schematic diagram of spectroflurimeter.   2

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