

This question paper contains 5 printed pages.

5952

Your Roll No.

B.Sc. (Hons.) Bio-Chemistry / I Sem.

B

Paper— BCHT-102 : Biophysics

Time : 3 hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt five questions in all. Question No. 1 is compulsory.

Use of scientific calculator / log tables may be allowed.

Q1. (a) Explain the following

- (i) Two different light sources are used in a UV-Vis spectrophotometer
- (ii) The brightness of an image increases as the magnification decreases
- (iii) A denser particle will have a higher sedimentation coefficient
- (iv) The origin of homochirality during chemical evolution
- (v) X-ray crystallography is a form of elastic scattering
- (vi) The optics in CD are purged with nitrogen flow

(b) Define the following terms

- (i) Unit of radioactivity
- (ii) Relative viscosity
- (iii) Quantum yield
- (iv) Resolution

(c) The ionic product of water at 100°C is 55 times than that at 25°C.

Calculate the value of pH of water at 100°C.

(d) Which of the following electromagnetic waves has the lowest energy and the longest wavelength?

- (i) Ultraviolet waves
 - (ii) Radio waves
 - (iii) Gamma waves
 - (iv) Infrared waves
- (12, 4, 2, 1)**

Turn over

Q2. (a) Give reasons for the following

- (i) Emitted light has a longer wavelength than the excitation light
- (ii) IR spectroscopy is not used to study protein dynamics in aqueous solutions
- (iii) Radioisotopes that decay by alpha emission are not used in biological work

(b) What is the role of the following

- (i) Photomultiplier in a spectrophotometer
- (ii) Nicoll prism in a polarimeter

(c) What do you understand by the following terms

- (i) Hyperchromicity
- (ii) Optical activity
- (iii) Chemical shift

(d) Which of the following nuclei will have a magnetic moment

- (i) ${}^1_1\text{D}^2$
- (ii) ${}^8_8\text{O}^{16}$
- (iii) ${}^{12}_6\text{C}^{12}$
- (iv) ${}^{32}_{16}\text{S}^{32}$

(6, 4, 3, 1)

Q3. (a) What are intrinsic and extrinsic flours. Explain with the help of examples

(b) A solution containing 2g/litre of a light absorbing substance in a 1 cm cuvette transmits 75% of the incident light of a certain wavelength. Calculate

- (i) Transmittance of a solution containing 4g/litre
- (ii) If the molecular weight of the compound is 250, calculate the molar extinction coefficient

(a) How will you distinguish between the following using spectral measurements

- (i) Tryptophan and Isoleucine
- (ii) DNA and protein

(iii) DNA and RNA

(iv) NADH and NAD⁺

(d) DNA bands on an agarose gel are not visible unless they are stained with ethidium bromide and seen under UV light. Explain

(4, 4, 4, 2)

Q4. (a) What is sedimentation velocity. What are the factors affecting the sedimentation velocity of a particle. Why are centrifugation techniques not very useful for separating amino acids

(b) Reverse osmosis is most commonly known for its use in drinking water purification, removing the salts and other impurities from the water molecules. What is the principle of reverse osmosis

(c) A sample is spinning at speed of 12,000 rpm in a fixed angle rotor. The rotor dimensions are $r_{\min} = 4.8$ cm and $r_{\max} = 8$ cm. Calculate the average RCF generated by the spinning rotor

(d) State Fick's first law of diffusion. What are the factors affecting the diffusion coefficient of a molecule.

(e) Name two substances that are used to form a density gradient for density gradient centrifugation

(4, 3, 3, 3, 1)

Q5. (a) What are the nuclei that can be used to study protein conformation by NMR. Why is it important to label the protein for NMR. Name a few isotopes used for labeling proteins for NMR studies

(b) What is the principle of ORD. What kind of information is provided by this technique

(c) If two substances are found whose absorption spectra are identical and whose CD curves are identical except that one curve is positive and the other is negative. What can probably be said about the structural relation between the two substances

(d) Arrange the following bonds in the order of increasing wave number in IR

C-H, O-H, C=C, C-C

(5, 4, 3, 2)

Q6. (a) Explain the principle of dark field microscopy. Name one advantage and one disadvantage of dark field microscopy

(b) What is the function of

(i) Emission filter in a fluorescence microscope

(ii) POPOP in a scintillation cocktail.

(c) Give two applications of radioisotopes in medicine

(d) Explain why live samples cannot be viewed by electron microscopy

(e) What atom is produced if ${}_{53}\text{I}^{131}$ undergoes beta decay

(i) ${}_{52}\text{Te}^{131}$

(ii) ${}_{54}\text{Xe}^{131}$

(iii) ${}_{51}\text{Sb}^{128}$

(iv) ${}_{55}\text{Cs}^{135}$

(4, 4, 3, 2, 1)

Q7. (a) X-rays are the “sweet spot” for wavelength when determining atomic resolution structures from the scattering of electromagnetic radiation. Justify the statement giving reasons why ultraviolet radiation and gamma rays are not suitable.

(b) Explain the “RNA world” hypothesis for the origin of life

(c) What do you understand by the solubility product of a salt. Will a precipitate of AgCl form if 20 ml of 0.01 M AgNO₃ and 20 ml of 0.0004 M NaCl are mixed. (Solubility product of AgCl = 1.7×10^{-10})

OR

State the Ostwald's dilution law for weak electrolytes. The dissociation constant for HCN is 4.9×10^{-10} at 25°C . Calculate the degree of dissociation of HCN if its concentration is 0.1 M

(d) Define conductance. How is electrolytic conductance different from metallic conductance

(5, 4, 3, 2)

Q8. Explain the principle involved in the following techniques

- (a) Scintillation counter
- (b) Flow cytometer
- (b) Differential centrifugation
- (d) Chemical actinometry

(4, 4, 3, 3)