

- c) Determine the ratio of S_{80}/S_{20} while S_{80} is the [S] to attain 80% of maximum velocity and S_{20} is the [S] to attain 20% of maximum velocity $4+5+3=12$

10. Answer **any two** questions.[First two answers will be checked] $4 \times 2 = 8$

- i) What are the Euler's criteria of a proper thermodynamic variable ?
- ii) Given, for ideal monoatomic gas $pV=nRT$. Show that P is the thermodynamic variables that follows Euler's criteria
- iii) A protein form dimer spontaneously at 27°C , pH 7.4, 1atm. Enthalpy change of the above reaction is 2Kcal/mole. Entropy change of the reactions is $-10/^{\circ}\text{K.mole}$. Number of moles of water released on dimerisation is ten. Solvent entropy increase per mole released water is 2 cal/ $^{\circ}\text{K.mole}$. Explain the spontaneity of the above dimer formation from thermodynamic points of view, mentioning clearly the role of water molecules in the reaction. What type of interaction you suggest from the above data that might be involved in dimer formation ?
- iv) What is the mathematical representation of first law of thermodynamics of conservation of energy ?
- v) Show that $C_p - C_v = nR$

M. SC. BIO-TECHNOLOGY PART I EXAMINATION, 2018

MOLECULAR BIOPHYSICS & CHEMISTRY OF BIOMOLECULES

PAPER - 1/5

Time : Four hours

Full Marks : 100

[Answer **any three** questions taking at least **one** from

Group A, and Group B]

Neatness carries 2 marks

GROUP - A

1. a) Define Circular Dichroism. 2
- b) What is the essential criterion for a molecule to be CD active ? 1
- c) Why is the term ellipticity used in CD what does it measure ? What is the unit of ellipticity ? 5
- d) Explain the basic functions of quarter wave plate and photo elastic modulator in generation of polarized light. 8
2. a) Derive the equation of stretching vibrations involving two body system from Hooke's Law. 6
- b) Explain with mathematically why lighter atoms would have higher frequency of vibration 2
- c) A dilute solution of alcohol will show up at less broadening Explain the statement. 2
- d) What is the difference between Rayleigh and Raman scattering ? 2

[Turn over

- e) How do Stokes and anti-Stokes lines originate ? 4
3. a) How are the terms Chemical shift (δ) and Frequency (ν) related ? 2
- b) What is Larmor frequency ? 2
- c) Assign the chemical shifts qualitatively for $\text{CH}_3\text{-CH}_2\text{-O-COCH}_3$ a 1D ^1H NMR (you don't need to show the actual shifts but assign the relative positions) 4
- d) Chemical shift (δ) of an atom does not change irrespective of the magnetic field strength of the spectrometer given in MHz. Explain the statement. 4
- e) List the sequence of experiments (names) one needs to perform in order to determine the structure of a protein in a logical fashion. 4
4. a) Explain schematically the essential components of a mass spectrometer with a brief description for each. 6
- b) What are the different modes of ionization in mass spectrometry ? 6
- c) Arrange the following in terms of cation stability CH_3^+ , RCH_2^+ , R_2CH^+ and R_3C^+ 2
- d) What do you understand by molecular ion peak, Base peak and fragment ion peak. Illustrate with a suitable experiment. 2

- viii) Describe how organisms having functional glyoxylate cycle are able to grow on acetate as sole source of carbon.
- ix) Schematically describe the phosphoketolase pathway operating in *Leuconostoc mesenteroids*.
9. Answer **any one** questions. [First answer will be checked] 12
- i) a) What are the major differences the enzymes have compared to the properties of an inorganic catalyst ?
- b) Define activity and specific activity of an enzyme and mention how they help in monitoring the course of enzyme purification.
- c) How to stop an ongoing enzymatic reaction ?
- d) How protein estimations are done ? [3+3+3+3=12]
- ii) a) Deduce the Michaelis Menten equation for enzyme kinetics, clearly mention the approximations used. What is the significance of Michaelis constant ? Does it have a unit ?
- b) Deduce the Hill equation and show that when the number of binding site is one, it becomes equivalent to Michaelis equation.

[6]

- xiii) Biological systems always are far from equilibrium. What happens if it achieves equilibrium ?
8. Answer **any five** questions. [First ten answers will be checked] 5×4=20
- i) How bacteria generate and utilize acetyl CoA under anaerobic condition ?
 - ii) Calculate the weight of ATP that could be produced from complete beta-oxidation of one pico mole of stearic acid.
 - iii) Reductions of NAD^+ for biosynthesis is an energy dependent process in *Nitrobacter winogradskyi* but not in *Alcaligenes eutrophus* – Explain.
 - iv) Compare the respiratory chain of bacteria with that of mitochondria.
 - v) What are the steps of glycolysis that could not be reversed during gluconeogenesis ? How they are bypassed ?
 - vi) Describe, with suitable example, the role of pyridoxal phosphate in transaminase reaction.
 - vii) How different organisms get rid of their toxic nitrogenous waste ? How skeletal muscles dump their toxic nitrogen ? Why urea is toxic ?

[3]

GROUP - B

5. a) Starting from Schrodinger equation Draw the probability distribution for a particle in a box of length L at the $n=3$ energy level.
- b) Also calculate the probability that the particle will be found between 0.1 nm to 0.2 nm from one side of the box in lowest energy state if length of the box is 1nm.
- c) When an electron jumps from an orbit where $n=1$ to $n=4$, what is its energy in terms of the energy of the ground level (E_1) ? 8+5+3

5 or

- a) In a region of space, a particle of mass m and with zero energy has a time independent wave function $\psi(x) = Ax \exp -x^2/L^2$ where A and L are constant. Determine the potential energy of the particle. Also calculate its potential energy at $x=0$.
- b) The position of an electron along the x direction is measured with an uncertainty of $1 \text{ \AA}$. What can you say about the uncertainty in its x momentum ? What, if anything, can you say about the uncertainty in its y momentum ?

[Turn over

[4]

- c) State three types of experimental observations that challenged classical physics. 8+5+3
6. a) Which microscopy technique relies on the specimen interfering with the wave length of light to produce a high contrast image without need for dyes or damage to the specimen. Give the working principle of the microscope. What is the function of Nomarsky prism ?
- b) How does a confocal microscope work ? How you can use confocal microscope for protein protein interaction study. (2+5)+5+4

6 or

- a) Explain the principle of work of an atomic force microscope (AFM). What are the main modes of AFM operation ?
- b) Mention the major differences between Transmission Electron microscopy and Scanning electron microscopy. (6+4)+6

[5]

GROUP - C

Answer **all** questions

7. Answer **any ten** questions. [First ten answers will be checked] 10×1=10
- i) Glycine is unique among the amino acids–Explain
 - ii) Why and how oxygen is toxic to human ?
 - iii) Why glycolysis mode of glucose metabolism is preferred in human during emergency ?
 - iv) What is substrate level phosphorylation ? Give example.
 - v) What are the inhibitors of respiratory chain ?
 - vi) Why TCA cycle is called a metabolic hub ?
 - vii) Mention the major differences between hexokinases and glucokinase.
 - viii) What are the ligands of hemoglobin ?
 - ix) 2,4, DNP is an uncoupler–What does it uncouple ?
 - x) What are the different possible fates of pyruvate produced from glucose metabolism ?
 - xi) What is glutathione ? Does it have any biological role ?
 - xii) What is the role of amino acid in ‘Chinese restaurant syndrome’ ?

[Turn over