v) Describe Phosphoketolase pathway

vi) Discuss the steps of glycolysis that could not be reversed during gluconeogenesis ? How are they by passed ?

vii) Compare the properties of Hexokinase and glucokinase.

M. Sc. Bio-Technology Part I Examination, 2019

Molecular Biophysics & Chemistry of Biomolecules

Paper - 1/5

Time : Four hours Full Marks : 100

PART - I

1. a) Name the experiments (two) which demonstrates wave–particle duality ? 2

b) The de Broglie wavelength of a particle that has kinetic energy K is λ . The wavelength is proportional to -----. 3

c) Calculate Wavelength of a 65 kg person running at a speed of 3m s-1 through an opening of width 0.80. (3.4×10-36m) 3

d) Name the pair of physical entities that can be determined precisely and simultaneously only with a minimum tolerance of the order of $h/2\pi$. 3

e) A free particle of mass m and energy E is travelling in the +x direction in region of constant, zero potential—write down the time dependent Schrödinger equation and show that $\psi(x.t) = A \exp\left(i[kx - \omega t]\right)$ is a solution to the Schrödinger equation for this free particle. 5

OR

2. a) Using de broglie's hypothesis how can you explain Bohr quantization condition for hydrogen atom : total angular momentum L=n h 3

b) For a particle in a box of size a, normalize the ground-state wave function. 4

c) Draw the wave function and probability distribution for a particle in a box at the n=3 energy level. 6

d) Which of the follwing are eigen function of the momentum operator p=ih d/dx 3

i) $\psi(x) = A\sin(kx) - A\cos(kx)$

ii) $\psi(x) = A\cos(kx) + iA\sin(kx)$

iii) $\psi(x) = A\,e\,ik(x-a)$

3. a) Define Numerical Aperture of a microscope objective. What are the advantages of a High NA objective ? What advantages might a Low-NA objective have ? 1+2+2

b) What would you see using a dark-field microscope on bacteria that transmit light without reflecting it into the objective lens? 2

c) What do phase-contrast and dark-field microscopes have in common ? 2

d) Describe the working principle of an atomic force microscope (AFM). What are the main modes of AFM operation ? 4+3

14. a) A protein form dimer spontaneously at 300K, pH 7.4, 1 atm. Enthaply change of the above reaction is 2Kcal/mole. Entropy change of the reaction is —10/k.mole. Number of moles of water released of dimer formation is twenty. Solvent entropy increase per mole released water is 2cal/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 ?

b) Discuss the generation and utilization ΔP by living organisms.

c) Discuss the role of ATP in a coupled reaction.

[4+4+2=10]

15. Write Short notes ***(any two)*** : 5×2=10

i) How different organisms get rid of their toxic nitrogenous waste ?

ii) What is the biochemical role of pyridoxal phosphate ?

iii) How muscle dump waste product of both carbon and nitrogen metabolism elsewhare?

iv) What are the respiratory chain inhibitors

b) What is FRET ? What is the effcienct of energy transfer when $r=R_0$ Where r denotes donor-acceptor distance and R_o denotes Förster distance. 1+3

7. a) What are the different types of stretching and bending motions of atoms in a molecule that can be excited by IR radiation ?

5

b) How does Raman and Rayleigh lines originate ? Explain with an equation. 4

8. a) Chemical shift in NMR spectroscopy is given in ppm. Explain the term chemical shift and ppm with an equation.

4

b) What is meant by equilibrum magnetization and how does precessional motion come into being ? 3

c) What are longitudinal and transverse relaxations ? 2

PART - III

Answer any ***five*** questions : 5×10=50

9. a) How organic enzymes are different from inorganic catalyst?

b) How specific activity measurements could be used in monitoring the course of enzyme purification.

c) Mention different ways to stop an ongoing enzymatic reaction.

d) How protein estimations are done ? How would the method change when the amount of protein is too high or too low [2+2+2+(2+2)=10]

10. a) What are the role of the enzymes (i) Phosphotransacetylase and acetate kinase in anaerobic metabolism ? Are those enzyme pairs present in aerobic organisms ? Explain.

b) Mention how acetyl CoA is generated and utilized under anaerobic condition.

c) Mention two anaerobic electron acceptors.

[(4+1)+4+1=10]

11. a) Mention the diseases that are caused by the malfunction of the respiratory chain

b) Oxygen to toxic even in aerobic organisms—Explain Why

c) Discuss the role of the different agents that are proecting human from oxidative stress.

d) Why pregnant women are often prescribed with iron and folic acid ?

e) What are the ligands of hemoglobin ? [2+2+3+1+2=10]

12. a) Discuss the role of isocitrate lyase and malate synthase in bacteria and plants.

b) Why glycolysis is the preferred mode of glucose metabolism in human during emergency ?

c) What is a futile cycle ?

d) Discuss the spin off products of TCA cycle ?

[3+3+1+3=10]

13. a) What is the rate limiting step in mitrogen cycle ?

b) How nitrogenase enzyme activity could be assayed ?

c) How organisms utilize ammonia when it is in excess and/ or it is in limiting amount.

d) Calculate the weight of ATP that could be produced from complete beta-oxidation of one femto mole of strearic acid. [1+2+2+5=10]

OR

4. a) Describe the methodology to prepare sample for FACS for cell cycle analysis. 4

b) Compare the Practical Uses of Scanning Electron Microcopes (SEM) and Transmission electron microscope (TEM) 4

c) Provide the electron trajectory of a TEM. 5

d) State the basic working principle of Dynamic light scattering. 3

PART - II

5. Answer any two questions : 9×2=18

a) Explain Internal conversion, intersystem crossing and phosphorescence from Jablonski Diagram. 6

b) What are the difference between static and dynamic quenching? 3

6. a) Given $r = \left(I_{parallel} - I_{perpendicular}\right) / \left(I_{parallel} + 2I_{perpendicular}\right)$

where $I_{parallel}(\theta, \phi) = \cos^2 \theta$

and $I_{perpendicular}(\theta, \phi) = \sin^2 \theta \sin^2 \phi$ probability that a fluorophore is oriented between θ and $\theta + d\theta$ prove that $-0.2 \le r \le 0.4$ 5