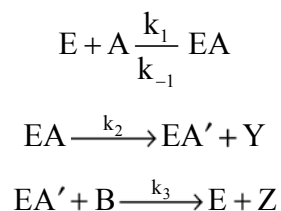


[4]

- (d) Derive the rate equation for the following special case of the ping-pong bi-bi mechanism :



Where Y and Z are the reaction products. A and B are the substrates and E is an enzyme.

- (e) Write a short note on irreversible inhibition with examples. Discuss briefly about applications of enzymatic analysis in industry.
- (f) What do you mean by micellar catalysis? Describe such catalysis in aqueous and non-aqueous solvents.

Ex/SC/CHEM/PG/CORE/TH/XII-P/2023

M. Sc. CHEMISTRY EXAMINATION, 2023

(3rd Semester, CBCS)

PAPER: XII P

[PHYSICAL CHEMISTRY SPECIAL]

Time : Two Hours

Full Marks : 40

(20 Marks for each unit)

Use a separate answer script for each unit.

UNIT - P - 3121

1. Answer any **one** of the following :
- (a) Describe the Classical Limit condition and show that under that condition both the quantum statistics becomes classical Boltzmann statistics.
- (b) Starting from the definition of a microstate and a macrostate and suitable constrains: derive the form of the thermodynamic probability of a macrostate for an isolated system following Fermi-Dirac statistics, in terms of the total number of particles (N), the degeneracy of a particular “*i*th” energy level (g_i) and the number of particles in a particular “*i*th” energy level (n_i).

5

[Turn over

[2]

2. Answer any **one** of the following :
- (a) Describe briefly the pair correlation function, $g(r)$ and derive an expression for internal energy of a monatomic liquid involving $g(r)$. 5
- (b) (i) For a system composed of electrons in a metallic conductor, determine the number of electron waves between energy range of E and $E+dE$. 3
- (ii) Graphically depict the variation of the ratio of occupancy of a particular energy level and degeneracy of that level i.e. $\left(\frac{n_i}{g_i}\right)$ versus $\frac{(\epsilon_i - \mu)}{k_B T}$ (where the symbols used have their usual meaning), for a system obeying Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac and Classical statistics. 2

3. Answer any **one** of the following : 4
- (a) Describe how second virial coefficient, $B_2(T)$ for an imperfect gas can be determined experimentally and obtain its theoretical expression for a gas with intermolecular interactions following Square-Well potential.
- (b) Derive the form of the Bose-Einstein transition temperature T_c starting from a suitable form for the number density of an ideal Bose gas $\left(\rho = \frac{N}{V}\right)$.

[3]

4. Answer any **two** questions : 2x3=6
- (a) Write a short note on Percus-Yevick equation and comment on its importance.
- (b) Using the form of the spectral radiance of a black body as $\rho\lambda = \frac{8\pi hc}{\lambda^5} \times \frac{1}{e^{hc/\lambda k_B T} - 1} d\lambda$, justify the Wien's Displacement Law and determine the Wien's displacement constant.
- (c) Use a suitable form of the density matrix to represent the statistical average of an observable and show that it is basis independent.

UNIT - P - 3122

5. Answer any **four** questions : 4x5
- (a) Write a brief note on the Shock-tube method in the study of fast reactions.
- (b) What is meant by ionic polymerization? How many types are there? Discuss the steps involved in the 'polar bond mechanism' for cationic polymerization and deduce the rate law.
- (c) What is microscopic diffusion controlled reaction? Discuss about full microscopic diffusion controlled reaction.

[Turn over