Thwani

Seat No.	

SL-36

Total No. of Pages : 3

M.Sc. (Part - I) (Semester - II) (NEP 1.0) Examination, December - 2023

CHEMISTRY

Physical Chemistry - II (Paper - VII)

Sub. Code : 90165/90075

Day and Date : Saturday, 02 - 12 - 2023 Total Marks : 80

Time : 02.30 p.m. to 05.30 p.m.

Instructions :
1) Question one is compulsory.
2) Solve any two questions from Section I and Section II.
3) All questions carry equal marks.
4) Figures to the right indicates marks.
5) Use of log-tables/non programmable scientific calculator is allowed.
6) Neat diagrams and sketches should be drawn wherever necessary.

Q1) Answer the following : [16]

a) Write the expression for the kinetic energy operator.

b) Write the commutator of position and momentum.

c) Set of functions that are normalised and mutually orthogonal are _____.

d) Define Ladder operator. increase or decrease of eginvalues by a quantum

e) A plot of surface tension verses applied potential is _____.

f) A movement of solid charged particles in a stationary electrolyte solution is Dynamic electrophoresis or AC

g) What is electric double layer? surrounded by dispersed phase including the ions absorbed on the particle surface and a film of the counter charged dispersion medium

h) Which model of electrified interface is called as diffused charged model? Gouy-Chapman model.

i) State the Frank Condon principle.

j) Complete the equation $\tau_0 = \frac{\phi f}{?}$.

k) What is pre-dissociation phenomenon?

l) Write the rate equation for fluorescence.

i) el- rearrangement occurs so rapidly that nuclei can be considered as stationary until re arrangement is complete. B.T.O.

d)

k) discrete energy level structure disappears already for energies which are below the dissociation limit but reappears again at some higher energies.

m) Write the steps and expression for rate involved in the reaction between NO_2 and F_2.

n) Give mechanism of ozone decomposition.

o) Give names of any two methods experimental investigation of rate of reaction.

p) What is primary salt effect?

influence of electrolyte conc. or more precisely ionic strength on the activity coefficient where the rate of reactn.

SECTION - I

Q2) a) Describe commutator operator. Determine the commutators $\left[x, \frac{\partial}{\partial x}\right], \left[y, \frac{\partial}{\partial x}\right]$ and $\left[\frac{\partial}{\partial x}, \frac{\partial}{\partial x^2}\right]$ using wave function (Ψ). [8]

b) Give the condition of normalization of wave function, write the wave function for particle in one dimensional box and calculate the energy difference between the energy level E_5 and E_4 in cm^{-1} for an electron in one dimensional box of length 10 A°. (Given : $h = 6.62 \times 10^{-34}$ J s, mass of electron = 9.1×10^{-31} kg, $c = 3 \times 10^{10}$ cm s^{-1}, 1J = 6.24×10^{18} eV, 1eV = 8.06×10^3 cm^{-1}.) [8]

Q3) a) Define the quantum yield of fluorescence. The quantum yield and observed fluorescence lifetime of aqueous tryptophan are 0.2 and 2.6ns, respectively. Calculate fluorescence rate constant (k_f). [8]

b) What is fluorescence quenching? Write the mechanism of decay of excited singlet states. Derive the Stern-Volmer equation. [8]

Q4) a) Show that the product of two hermitian operators is hermitian if they commute. [6]

b) What is Photophysical phenomenon? Describe the phenomenon of phosphorescence. [6]

c) Give the physical significance of wave function. [4]

SECTION - II

Q5) a) Discuss in brief effect of the ionic strength on the rate of reaction. **[6]**

b) Describe any one method for estimating the rate of reaction experimentally. **[6]**

c) For a First order reaction, k_1 is found 7×10^{-7} s^{-1} at 7°C and 9×10^{-4} at 57°C calculate the activation energy (E_a) of a reaction. **[4]**

Q6) a) How will you determine the charge and capacitance from the electro-capillarity curve. **[6]**

b) Derive an expression for capacitance by Gouy-Chapmann model. **[6]**

c) In an electro-capillary measurement, mercury is in contact with a solution. If the height of the column is 2 cm, the inner diameter of the capillary tube is 0.5 mm, and the density of the mercury at 25 °C is 13.5457 g cm^{-3} and at 0°C is 13.5951 g cm^{-3}. Calculate the surface tension values at these two temperatures. **[4]**

Q7) Write short notes on any three of the following : **[16]**

a) Eigen function and Eigen values

b) Jablonski diagram

c) Michaelis-Menten enzyme catalysis

d) Electro-capillarity curve

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$$\log \frac{K_2}{K_1} = \frac{E_a}{2.303 R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$