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M.Sc. (I Semester) Examination,

Dec., 2021

CHEMISTRY

Paper 1.3 : CHEM-513

(Physical Chemistry)

Time Allowed : Three Hours

Maximum Marks : 70

Min. Pass Marks : 28

This question paper will be divided into ***three*** *sections as under :*

Section-A ***Max. Marks-10***

Will carry ***10*** *marks with* ***1*** *compulsory question comprising* ***10*** *short answer type questions (maximum* ***20*** *words answer) taking* ***two*** *questions from each unit. Each question shall be of* ***one*** *mark.*

Section-B ***Max. Marks-25***

Will carry ***25*** *marks with equally divided into five long answer type questions (answer about in* ***250*** *words). Students are instructed to attempt* ***five*** *questions by selecting one question from each unit.*

Section-C ***Max. Marks-35***

Will carry ***35*** *marks with five long answer type* ***questions*** *comprising one compulsory question (Q. No. 7) of* ***15*** *marks and four questions* ***10*** *marks* ***each.*** *Students are instructed to attempt total three* ***questions*** *with one compulsory question (answer about* ***in 500*** *words) and any* ***two*** *more questions (answer* ***about in 400*** *words) out of remaining four questions.*

Section A

1. Answer the following questions :

   (i) Which functions are acceptable in quantum mechanics ?

   (a) $\Psi = \sin x$ for $0 \leq x \pi/2$

   (b) $\Psi = x$ for $x \leq 0$,

(ii) Write down the condition of orthogonality.

(iii) What will be the π electronic energy in Ethylene molecule ?

(iv) If Ψ_1 and Ψ_2 are eigen wave functions of an atom, prove that any linear combination of these wave functions will also be an eigen function of the Schrödinger wave equation.

(v) Define steady state treatment.

(vi) How to relate probability factor with entropy ?

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(vii) What is meant by critical micelle concentration ?

(viii) Write the formula of capillary action when liquid rises in a tube.

(ix) Give the types of polymerization.

(x) Write formula to calculate number average molar mass and mass average molar mass.

SECTION B

UNIT-I

2. What do you understand by angular momentum and generalized angular momentum ?

Or

Derive the time independent Schrödinger equation.

UNIT-II

3. Discuss the eigen values of angular momentum.

Or

Discuss the Huckel theory of conjugated systems

UNIT-III

4. Explain activated complex theory for bimolecular reactions.

Or

For the mechanism

$$A + B \underset{K_2}{\overset{K_1}{\rightleftharpoons}} B\ C$$

$$C \xrightarrow{K_3} D.$$

(*i*) Derive the rate law assuming the steady state approximation to eliminate the concentration of C.

(*ii*) Assuming that $k_3 << k_2$, express the pre-exponential factor A and the overall activation energy E for the formation of D in terms of A_1, A_2 and A_3 and E_1, E_2 and E_3 for the three steps.

UNIT-IV

5. Write B.E.T equation. Explain all terms. Under what condition it is converted to Langmuir equation

Or

Discuss the catalytic activity at surfaces.

UNIT-V

6. Discuss an electrical conducting polymers.

Or

Give the mechanism of polymerization.

SECTION-C

7. (*i*) Give the mechanism of $H_2 + Br_2 \rightarrow 2HBr$ and using the mechanism, derive the rate law for the formation of HBr.

(*ii*) Discuss the kinetics of enzyme catalyzed reaction. 15

8. Discuss the first order time independent perturbation theory and give the correction in wave function and energy for first order to unperturbed wave function and energy. 10

9. Set up and solve the Huckel secular equation for the 1,3-butadiene system and show the results on an M.O. diagram. Also calculate the resonance energy. 10

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10. Derive thermodynamically the Gibbs adsorption isotherm for the adsorption of a solute on the surface of liquid. 10

11. Describe the light scattering method for the determination of molar mass of macromolecules. 10

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