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Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2023

MCH1C01 – Quantum Mechanics and Group Theory

(2022 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A Short Answer
Answer 8 Questions out of 12.
Each question carries a weightage of 1 (8 x 1 = 8)

1) Generate matrix representation for S_3
2) What is meant by SALC ?
3) Write down cyclic boundary condition required for a rigid rotor.
4) Explain Uhlenbeck and Goudsmith postulate of spin
5) When are two groups isomorphic? Explain.
6) Find the maximum velocity of photoelectrons ejected by an 80 nm radiation if the work function of photoelectrode is 4.73 eV
7) What are eigen functions ?
8) Write down quantum mechanical operator for L_x.
9) What is degeneracy of the SHO energy level with energy $\frac{9}{2}h\vartheta$?.
10) What are the factors which depend on a quantum mechanical tunnel effect?.
11) Classify the following into even and odd functions: (1) tan(x) (2) (3+x)(3-x)
12) What are stationary states?

Section B Short Essay
Answer 4 Questions out of 7.
Each question carries a weightage of 3 (4 X 3 = 12)

13) Explain
(i) Laplacian operator (ii) Hermitian operator (iii) Non commuting operators.
14) Derive energy expression for particle on a ring.
15) A particle of mass 2.00 $x10^{-26}$ g is in a one-dimensional box of length 4.00 nm. Find the frequency and wavelength of the photon emitted when this particle goes from the n = 3 to the n = 2 level.
16) Write the $\Phi(\phi)$ equation for hydrogenic species and give its general solution.

17) The total representation for C_2v point group is $3A_1 + A_2 + 2B_1$ and $3B_2$. Find the vibrational degrees of freedom

18) Find $[\hat{x}, \hat{p}_x]$

19) Derive C_{4v} character table.

Section B Essay

Answer 2 Questions out of 4.

Each question carries a weightage of 5 (2 X 5 = 10)

20) Deduce time independent Schrödinger wave equation from classical wave equation.

21) Discuss the quantum mechanics of rigid rotor.

22) Describe the applications of direct product of irreducible representations.

23) Find the molecular orbital's of H_2O by constructing C_{2v} character table.

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2023

MCH1C02 – Chemistry of Elements

(2022 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A Short Answer
Answer 8 Questions out of 12.
Each question carries a weightage of 1 (8 X 1 = 8)

1) What are super acids?
2) Give an account on the classification of borides.
3) What are the different types of bonding present in boranes? What are the structural features of B_4H_{10}?
4) Discuss the reaction of diborane with bases.
5) Discuss the structure and thermochromic properties of S_4N_4.
6) What is Ellingham diagram? Discuss the abrupt change in the diagram.
7) Write a note on zintl ions.
8) Explain any two applications of Latimer diagram by taking an example.
9) Write down the ground state term symbols for the metal ions with confiurations: (a) $3d^24s^0$ and (b) $3d^74s^0$.
10) Write the principle of VSM.
11) What is Bethe's notation? Give the Bethe's notation for : ${}^{35}_{17}Cl + {}^{1}_{0}n \rightarrow {}^{1}_{1}H + {}^{35}_{16}S$
12) Explain photonuclear reactions with suitable example.

Section B Short Essay
Answer 4 Questions out of 7.
Each question carries a weightage of 3 (4 X 3 = 12)

13) Explain the solvent system and Usanovich concepts of acids and bases.
14) Discuss the MO approach to the bonding in diborane.
15) Write a note on carboranes and its classification.Classify the following carboranes on the basis of Wade's rule- (i) $C_2B_7H_{18}$, (ii) $C_2B_{10}H_{12}$ and (iii) $C_2B_4H_8$
16) What are silicones? Discuss its structure and applications.
17) Distinguish between isopoly and heteropoly anions? Give examples.
18) Explain the significance of Pourbaix diagram using the compounds of iron.
19) Give an account on the detection and measurement of radiation using scintillation counters.

Section C Essay

Answer 2 Questions out of 4.

Each question carries a weightage of 5 (2 X 5 = 10)

20) Explain the chemistry of liquid NH_3 and SO_2 as non- aqueous solvent.

21) (a)Discuss the preparation, structure, and applications of P- N compounds. (3wt)

(b) Write the structure of (a) P_4S_3 and (b) P_4S_{10} (2 wt)

22) (a)Explain Curie and Curie- Weiss law. (2 wt)

(b) Discuss the orbital contribution to magnetic moment and its quenching (3wt)

23) Write notes on: (a) Liquid drop model and (b) optical model of nucleus. (3 + 2 wt)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2023

MCH1C03 – Structure & Reactivity of Organic Compounds

(2022 Admission onwards)

Time: 3 hours Max.Weightage : 30

Section A Short Answer
Answer 8 Questions out of 12.
Each question carries a weightage of 1 (8 X 1 = 8)

1) Why does tropylium ion exist as an ionic compound?
2) Differentiate between Classical and non classical carbocation.
3) Among 2-phenethyl acetate and propyl acetate, which will readily undergo hydrolysis? Why?
4) Write a note on transition state theory.
5) Discuss the conformation of 2- bromocyclohexanone.
6) Menthyl chloride is less susceptible to elimination reactions than neomenthylchloride.Explain.
7) Identify and sketch the Re-and Si- faces of 2- butanone.
8) Differentiate between homotopic and enantiotopic hydrogens with suitable examples.
9) Distinguish between stereoselectivity and stereospecificity.
10) Write a note on Sharpless Epoxidation
11) Discuss the role of CBS as chiral catalyst.
12) Give examples of compounds containing nitrogen and sulphur showing optical isomerism.

Section B Short Essay
Answer 4 Questions out of 7.
Each question carries a weightage of 3 (4 X 3 = 12)

13) Draw the energy profile diagrams of S_N1 and S_N2 reactions. Explain their significance in understanding the mechanism.
14) Write a note on conformationally biased molecular system. Give some of their applications.
15) Explain the conformations of cyclohexane, and methyl cyclohexane.
16) Predict the different products formed from the four diastereomeric 2-bromo-4-phenylcyclohexanols when treated with base or Ag_2O.

17) Explain Bredt's rule.

18) Discuss the stereochemistry of aldoximes and ketoximes.

19) What is chiral pool? Illustrate with a suitable example. What is its significance in relation to asymmetric synthesis?

Section C Essay
Answer 2 Questions out of 4.
Each question carries a weightage of 5 (2 X 5 = 10)

20) Discuss aromaticity in (i) 8,10 and 14 annulenes and (ii) hetroannulenes.

21) (a) Emphasizing the significances of Hammett parameters, derive & explain Hammett equation.

(b) Explain Taft equation and its advantages over Hammett equation.

22) (i) Discuss optical activity in cis, trans isomers of 1,2-, 1,3-and 1,4-dimethylcycloheaxanes.

(ii) Discuss optical activity in allenes and biphenyls.

23) (a) Discuss the Asymmetric aldol reaction using Zimmermann-Traxler model.

(b) Discuss the double diastereoselection through matched and mismatched aldols.

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2023

MCH1C04 – Thermodynamics, Kinetics & Catalysis

(2022 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A Short Answer
Answer 8 Questions out of 12.
Each question carries a weightage of 1 (8 X 1 = 8)

1) Distinguish between absolute entropy and residual entropy.
2) Why partial molar quantities are important in studying the thermodynamics of open systems?
3) State and explain Onsagar reciprocal relation.
4) Write phenomenological relations.
5) Define explosion limit with an example.
6) What is branched chain reaction? Give an example.
7) What is meant by a diffusion controlled reaction?
8) What is London equation? How is it used?
9) Define isosteric heat of adsorption.
10) What is meant by temperature programmed desorption? What is its use?
11) Arrive at the equation for $\frac{1}{2}V_{max}$ for an enzyme catalyzed reaction starting from Michaelis-Menten equation.
12) What is meant by autocatalysis? Give one example.

Section B Short Essay
Answer 4 Questions out of 7.
Each question carries a weightage of 3 (4 X 3 = 12)

13) Describe the determination of partial molar volume.
14) Show that unimolecular gas phase reactions follow first order kinetics at low pressure and second order kinetics at high pressure.
15) Derive Duhem-Margules equation and mention its applications.
16) Explain the brusselator and oregonator for oscillating chemical reactions

17) What are molecular beams? Explain the stripping and rebound mechanism observed in molecular beam experiments.

18) Explain how non-ideal solution deviates from Raoult's law.

19) Discuss Rice - Herzfeld mechanism using suitable example.

Section B Essay
Answer 2 Questions out of 4.
Each question carries a weightage of 5 (2 X 5 = 10)

20) Explain Excess functions. Illustrate the determination of Excess volume, Excess entropy and Excess free energy.

21) Explain potential energy surfaces. What is the significance of saddle point in a potential energy surface?

22) What are fast reactions? Discuss the flash photolysis and relaxation methods for studying fast reaction.

23) Discuss the BET theory of adsorption and derive the BET equation.