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1M1N22236 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2022

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) What are conjugate elements ?
2) What is meant by SALC ?
3) Explain tunnelling
4) Prove that $S_2 = i$ (inversion)
5) Show that C_3 and C_3^2 of C_{3v} point group belong to the same class.
6) What is the de Broglie wavelength of an electron with kinetic energy of 100 eV?
7) Write the equation for energy of a rigid rotor.
8) Explain Laporte selection rule for centro-symmetric molecules.
9) Explain well behaved functions.
10) What are eigenfunctions ?
11) Which of the following functions is/are acceptable?

    (a) $\psi = x$ (b) $\psi = x^2$ (c) $\psi = \sin x$ (d) $\psi = e^{-|x|}$

12) Explain spin orbitals.

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

13) Explain Planck's theory of black body radiation.
14) Derive energy expression for particle on a ring.
15) Consider a particle with quantum number n moving in a one-dimensional box of length l.

    (a) Find the probability of finding the particle in the left quarter of the box.

    (b) For what value of n is this probability a maximum?

    (c) What is the limit of this probability for $n \longrightarrow \infty$?

    (d) What principle is illustrated in (c)?

16) Construct C_{3v} character table.

17) Explain Great orthogonality theorem.

18) Write down the C_{2v} character table and reduce the following C_{2v} representation

C_{2v}	E	C 2	$\sigma(xz)$	$\sigma(yz)$
Γ1	3	-1	1	1
Γ1	2	0	0	2

19) Show that the number of IR is equal to the number of classes of operations in that group.

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

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

21) Discuss the harmonic oscillator model and molecular vibrations

22) Obtain the molecular orbitals of HCHO by construction character table.

23) Find out hybridisation in BF_3 using group theory.

D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_3$	$3\sigma_v$		
A_1'	1	1	1	1	1	1		x^2+y^2, z^2
A_2'	1	1	−1	1	1	−1	R_z	
E'	2	−1	0	2	−1	0	(x, y)	(x^2-y^2, xy)
A_1''	1	1	1	−1	−1	−1		
A_2''	1	1	−1	−1	−1	1	z	
E''	2	−1	0	−2	1	0	(R_x, R_y)	(xz, yz)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2022

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) Explain the term surface acidity with suitable example.
2) Classify as closo/ nido/ arachno structures (a) $C_2B_{10}H_{12}$ (b) B_5H_{11} and (c) $C_2B_3H_7$
3) What is styx number? Find out the styx number of B_6H_{10}.
4) Borazine is isoelectronic with benzene but it is more reactive than benzene. Give reason.
5) Polythiazzyl is referred as a one- dimensional metal. Give reason.
6) Discuss the abrupt change in Ellingham diagram.
7) Briefly explain isopolyanions with suitable example.
8) What is a Frost diagram? Explain the informations that can be obtained from this diagram.
9) Explain the effect of temperature on magnetic susceptibility of paramagnetic and diamagnetic substance.
10) Give the ground state term symbol for metal ions Cu in $[Cu(H_2O)_6]^{2+}$ and Ti in $[Ti(H_2O)_6]^{3+}$.
11) Write a note on super heavy elements.
12) Define reaction cross section in nuclear reactions? What is its unit?

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

13) Explain Drago- Wayland equation and its applications.
14) Discuss the MO approach to the bonding in diborane.
15) Give an account on the different types of borides.
16) Explain briefly the structure and uses of P-N compounds.
17) Write a note on Chevrel phases and zintl ions.
18) Explain the significance of Pourbaix diagram using the compounds of iron.
19) Discuss the nuclear fission based on liquid drop model of nucleus.

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

20) Describe the characteristics of hard and soft acids and bases. Explain HSAB principle and its applications.

21) Explain different types of silicates with examples.

22) (a) Discuss the Gouy method for the determination of magnetic moment.
(b) Briefly explain the orbital contribution to magnetic moment and its quenching.

23) Explain the principle and application of neutron activation analysis.

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2022

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) Write a note on residual entropy.
2) State and explain Nernst heat theorem.
3) Write and explain Glansdorf-Pregogine equation.
4) Draw and explain the graph relating surface coverage and temperature in the case of physisorption and chemisorption.
5) Why conventional methods are inadequate in studying the kinetics of fast reactions?
6) How the steady state approximation is useful in deriving the rate equation?
7) Explain activated complex theory.
8) What is molecular beam? Mention its use.
9) Write a short note on the mercury intrusion method for surface area determination of porous solids.
10) Write BET equation and explain the terms.
11) Explain the significance of Michaelis-Menten constant.
12) Explain Sol-gel method for the synthesis of porous catalyst supports.

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

13) What is the significance of heat of adsorption? How is it determined?
14) Write a note on electrokinetic effects.
15) What is meant by an oscillating reaction? Explain the Lotko –Volterra mechanism of an oscillating reaction.
16) Differentiate between attractive and repulsive potential energy surfaces.

17) What is diffusion controlled reaction? Derive the expression for the rate constant for a chemical reaction with partial microscopic diffusion control.

18) Derive Gibbs-Duhem equation. What is its significance?

19) Explain entropy production.

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

20) Explain the Langmuir-Hinshelwood mechanism and Eley-Rideal mechanism for bimolecular reactions.

21) Explain primary and secondary salt effect.

22) Discuss the rate of entropy production for an irreversible process involving heat flow.

23) Explain the Somenoff – Hinshelwood theory of branched chain reaction.

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2022

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) Write resonance structures of azulene.
2) Explain why first ionisation constant of maleic acid is higher than that of fumaric acid.
3) Illustrating examples, explain thermodynamic control and kinetic control in reactions.
4) Explain what are crown ether complexes, cryptates, inclusion compounds.
5) Draw and explain the most stable conformation of cis-1-tert-butyl-4-methylcyclohexane.
6) Draw one example each showing nitrogen and sulphur compounds showing optical isomerism.
7) Discuss the sterochemistry in Ketoximes.
8) Explain Cahn-Ingold-Prelog rule.
9) What is Burgi-Dunitz angle? Illustrate using figure..
10) Illustrate the use of Evans oxazolidinone as chiral auxiliary in alkylation reaction.
11) Discuss the role of BINAL-H as chiral reagent.
12) Illustrate stereo selectivity and stereo specificity.

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

13) With the help of Frost's circle, draw the HMO energy level diagrams for cyclic polyenes with n = 3 to n = 6.
14) Explain Marcus theory and its significance.

15) Discuss the relative rates of esterification of isomeric menthols.

16) Compare the rate of esterification of menthol, isomenthol, neomenthol and neoisomenthol.

17) Write a short note on double-diastereoselective aldol reaction.

18) What is chiral pool? Illustrate with a suitable example.

19) Illustrate the use of SAMP and RAMP as chiral auxiliary in the alkylation reaction.

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

20) Discuss in detail Neighbouring group participation of
(i) carboxylate ion (ii) pi -bond (iii) hydroxyl group
(iv) acetoxy group (v) phenyl group.

21) (i) What do you mean by Linear Free Energy Relationship? Explain what can be learnt from Hammett's parameters about mechanism of a reaction and influence of substituents on it.
(ii) Curtin- Hammet principle and its significance.

22) a) Discuss the stereochemistry of fused, bridged and fused ring systems
b) Draw the different conformations of decalins and explain.

23) (a) Using Felkin –Anh model predict the major product in the reaction of (S)-2-phenyl propanaldehyde with MeMgBr
(b) Using Cram's rule, predict the major product in the reaction of (S)-2-methoxy propanaldehyde with MeMgBr.