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1M1N24016 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2024

MCH1C01 – Quantum Mechanics & 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 linear and non-linear operators?
2) What is the significance of a wave function?
3) What is an orthonormal wave function in quantum mechanics?
4) Explain the term symmetry breaking.
5) What is Space Quantization?
6) What are group orbitals?
7) Why do we need spherical polar coordinates for solving hydrogen atom?
8) What is a projection operator?
9) Differentiate between vanishing and non-vanishing integrals.
10) Explain mutual exclusion principle.
11) What is tunnelling?
12) Differentiate between abelian and cyclic groups.

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

13) How Cartesian coordinates is represented in spherical polar coordinates? Explain.
14) Explain the photoelectric effect using Einstein's equation.
15) Write a short note on black body radiation.
16) What is a well behaved function? Explain.
17) Derive the expression for the energy of a particle in a one-dimensional box?
18) Find commutator for [Lx, Ly].
19) Write a short note on Mulliken symbols.

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

20) Discuss the applications of Great Orthogonality Theorem.

21) Discuss the quantum mechanical treatment of hydrogen atom.

22) Briefly explain the postulates of quantum mechanics.

23) Find the IR and Raman active vibrations of NH_3 and H_2O molecules using group theory.

	E	$2C_3(z)$	$3\sigma_v$	linear, rotations	quadratic
A_1	1	1	1	z	x^2+y^2, z^2
A_2	1	1	-1	R_z	
E	2	-1	0	(x, y) (R_x, R_y)	(x^2-y^2, xy) (xz, yz)

C_{2v}	E	C_2	$\sigma_v(xz)$	$\sigma_v'(yz)$		
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	−1	−1	R_z	xy
B_1	1	−1	1	−1	x, R_y	xz
B_2	1	−1	−1	1	y, R_x	yz

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Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2024

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 is surface acidity? Explain with a suitable example.

2) Explain the structural features of B_4H_{10}.

3) By applying Wade's rule classify the following carboranes into closo, nido and arachno: (i) CB_6H_{12}, (ii) $C_2B_8H_{10}$, and (iii) $C_2B_3H_{11}$.

4) Why zeolites are used as molecular sieves?

5) Why polythiazyl is called a one- dimensional metal?

6) Explain Latimer diagram and its applications.

7) What are transactinide elements? Give two examples.

8) Briefly explain the quenching of orbital contribution to magnetic moment.

9) Differentiate between photo nuclear and thermo nuclear reactions.

10) Define reaction cross section in nuclear reactions?

11) What are radiative capture reactions?

12) Write a note on isopoly anions.

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

13) Explain Usanovich concept of acids and bases. Mention its merits and demerits.

14) Discuss the classification and properties of carbides.

15) Explain the MO approach to the bonding in diborane.

16) Explain the structure and bonding of phosphorous- sulphur compounds.

17) Compare the magnetic properties of 4f and 5f elements.

18) Discuss the significance of Pourbaix diagram with the help of iron in natural water.

19) What are the products of radiolysis of water?

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

20) Write a note on liquid NH_3 as a non-aqueous solvent.

21) Explain the structure, bonding and uses of Phosphorous-Nitrogen compound.

22) Discuss the basis, salient features and merits of the shell model of the nucleus.

23) Explain antiferromagnetism based on Curie- Weiss Law. Discuss the mechanism of anti-ferromagnetic interactions in metal complexes.

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2024

MCH1C03 – Structure and 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. Illustrate a reaction where a hydroxyl group acts as a neighbouring group to produce an epoxide.
2. Depict the molecular orbitals of allyl radical.
3. Differentiate between classical and non-classical carbocations.
4. Compare the acid strength of maleic acid and fumaric acid.
5. Define conformationally biased molecules? Give two examples.
6. Draw the stable conformation of 1,2- and 1,4-cyclohexane diol.
7. Predict the product formed when dl and meso stilbene dihalide undergo dehydrohalogenation.
8. Write a brief note on Bredt's rule.
9. What are chiral auxiliaries? Give an example of one used in asymmetric Diels-Alder reactions.
10. Illustrate Sharpless asymmetric epoxidation reaction and specify the reagents and conditions employed.
11. What are the advantages and disadvantages of chiral pool strategy of asymmetric synthesis?
12. Depict the structures of (2Z, 4Z)-2, 4-hexadiene and (2E, 4Z, 6E)-2, 4, 6-octatriene.

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

13. Discuss the effect of substituents on the acidity of carboxylic acids with examples.
14. Discuss the stability of various cyclic conjugated pi-systems in organic compounds, based on the concepts of aromaticity and anti-aromaticity.
15. State Hammond postulate and apply it to predict the relative rates of solvolysis of 2-bromopropane and 2-methyl-2-bromopropane.

16. Explain the stereochemical outcome in pyrolitic elimination of esters.
17. Discuss the conformations of disubstituted cyclohexane.
18. Specific rotation of a mixture of 2-bromobutanes is –9.2°. (R)-bromobutane has a specific rotation of –23.1°. How much % R and % S enantiomer is there in the mixture?
19. Illustrate the structure of a catalyst which can do asymmetric reductions.

SECTION C - Essay

Answer 2 Questions out of 4.

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

20. (i). Write a detailed note on the application of isotope effects in the study of reactions mechanisms.

    (ii). Discuss Hammet and Taft equation for polar effects and Taft's steric substituent constant for steric effect.
21. What are the factors affecting the conformational stability of molecule
22. (i) Explain the concept of asymmetric induction and illustrate the prediction of stereochemical outcome with Felkin-Ahn model, in an appropriate example.

    (ii) Write a note on asymmetric hydroboration reactions.
23. Differentiate between chiral reagent controlled and chiral catalyst controlled asymmetric synthesis. Give examples. Discuss the advantages and disadvantages of each.

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2024

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) Explain the linear phenomenological relations and Onsager reciprocal relations. .
2) Explain residual entropy. How is it different from thermal entropy?
3) Rationalize thermal diffusion using irreversible thermodynamics.
4) Write and explain the Glansdorf-Pregogine equation.
5) Explain Nernst heat theorem.
6) What is London equation? Explain its significance.
7) Explain the effect of pressure on the explosion limits with $H_2 - O_2$ reaction as example.
8) Explain the RRK model for unimolecular reactions.
9) What are the assumptions of Langmuir theory of adsorption?
10) Discuss the preparation of zeolites.
11) Explain any method for the determination of surface acidity.
12) What is Michaelis-Menten constant? Explain its significance.

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

13) Explain chemical potential. Deduce the relation between chemical potential with temperature and pressure.
14) Derive Duhem-Margules equation and explain its significance.
15) Obtain the expression for entropy production in an irreversible process involving heat flow only.
16) Differentiate by illustrating attractive and repulsive potential energy surfaces.
17) Discuss the kinetics of decomposition of acetaldehyde.

18) Differentiate primary and secondary salt effects.

19) What is meant by oscillating reactions? Explain the Brusselator and Oregonator systems.

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

20) Define (i) fugacity ii)partial molar volume. Explain one method each to determine them.

21) Explain the principle of branching chain reactions and significance of net branching factor.

22) Derive the BET equation and discuss its significance.

23) Distinguish between Langmuir-Hinshelwood and Eley-Rideal models for bimolecular gas phase reactions on solid surfaces.