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Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Degree Examination, March/April 2020

### MCH2C07 – Reaction Mechanisms in Organic chemistry

(2019 Admission onwards)

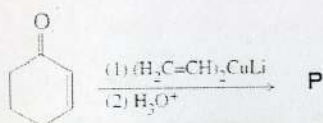Time: 3 hours   Max. Weightage :30

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

1. Using S_N^2 reactions how will you convert 1-chlorobutane into

   a) 1-Hexyne   b) Pentane nitrile

2. Discuss E1cB mechanism.

3. Predict the product of the following reactions

   (i) + HBr   (ii) + Pb(OAc)₄
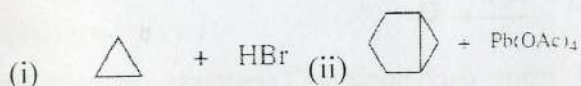
4. Identify the product and explain the reason of formation.

5. What are the possible products that would be formed by the reaction of 3,3-dimethyl-2-butanol and phosphoric acid at 80 °C.

6. Discuss $A_{AC}1$ mechanism of ester hydrolysis by citing an example.

7. Identify the product A and B in the following reaction.
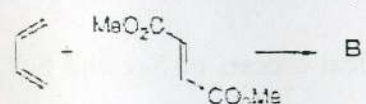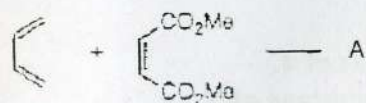
8. Illustrate that the antarafacial thermal [1,3] migrations are allowed by Woodward-Hoffmann rule. However, such rearrangements are rare. Account for the observation.

9. Complete the given reaction and predict the mechanism

 $CH_3COCH_2CH_2CH_3 + h\nu \longrightarrow$
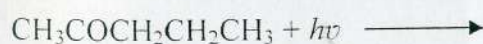
10. Write a short note on Jablonsky diagram.

11. What are the possible products that would form on irradiation of cycloprop ketone with light?

12. Write a brief account on Emde degradation.

Section B Short Essay
Answer 4 Questions out of 7.
Each question carries a weightage of 3

13. Predict Structural and solvent effect on reactivity in S_N1 and S_N2 reactions.

14. Write a brief note on Extrusion reactions.

15. Describe the formation of singlet and triplet carbene intermediate. How do the differ in structure and reactivity?

16. Identify the product A and B and write the mechanism of the reaction.

$$NC\text{-}(CH_2)_4\text{-}CN \xrightarrow{\text{Base}} A \xrightarrow{H_2O} B$$
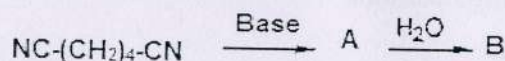
17. Draw the product formed from each pair of reactants in a thermal [4+2 cycloaddition reaction. Predict the stereochemistry.

a. [structure] + $CH_2=CH_2$

b. [structure] + [structure with CN groups]

18. Derive the selection rules for [4n] and [4n+2] electrons by FMO method ir thermal and photochemical electrocylisation.

19. Discuss the isolation methods and classification of alkaloids (based on ring structure).

Section B Essay
Answer 2 Questions out of 4.
Each question carries a weightage of 5

20. (a) Discuss the mechanism and stereochemical aspects of S_E1 and S_E2 reactions.

(b) Write the mechanism of S_NAr reaction

(c) Write the synthetic steps involved in the preparation of *m*-bromonitrobenzene and *p*-bromonitrobenzene starting from Benzene.
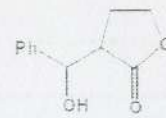
21. (a) How would you employ reformatsky reaction to prepare and suggest the mechanism of reaction,

(b) Using Mannich reaction as guide, propose the mechanism of this reaction

(c) Explain the mechanism of

(i) Stobbe condensation (ii) Knoevenagel reaction, (iii) Claisen condensation.

$(1+1+3)$

22. Write the example and mechanism of the following reactions:

(a) Photo –Fries rearrangement (b) di-π- methane rearrangement,

(c) Barton reaction. (d) Hoffmann-Loeffler-Freytag reaction and

(e) Paterno buchi reaction. $(1+1+1+1+1)$

23. (a) Write the salient steps in conversion of cholesterol to testosterone.

(b) Discuss in brief

(i) Anthocynine and (ii) Flavonoids $(3+2)$

$(2 \times 5 = 10 \text{ weightage})$

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE
Second Semester M.Sc Degree Examination, March/April 2020
MCH2C08 – Electrochemistry, Solid State Chemistry & Statistical TD
(2019 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

1. Define Half cell potential.

2. Write down the advantages of dropping mercury electrode.

3. Write down the Butler-Volmer equation and define the terms.

4. Define decomposition potential.

5. Differentiate point symmetry and space symmetry with appropriate example.

6. How cooper pair formation causes super conductivity.

7. What is meant by exciton and its role in photoconductivity.

8. Define Brillouin zone.

9. What is meant by ensemble and how grand canonical ensemble is different from micro canonical ensemble.

10. Write down the equation for translational partition function and define the terms.

11. Write down the temperature independent equation for entropy and discuss its significance.

12. What is meant by Bose-Einstein condensation?

(8 x 1 = 8 weightage)

Section B Short Essay
Answer 4 Questions out of 7.
Each question carries a weightage of 3

13. Discuss briefly about the efficiency of electrochemical cell and heat engine.

14. Derive Tafel equation. Discuss the significance of Tafel plot.

15. Discuss briefly about overvoltage and its significance.

16. (a) What is the advantage of miller indices over direct lattice parameter? (b) Find 'd" of unit cell having direct lattices of (i) a/3, b/2, c, (ii) ∞a, b, c/2.

17. Comment on Meisner effect and how it changes with temperature.

18. What is meant by Hall effect? how it can be used to measure the mobility of electron / hole.

19. Bosons and fermions obeys Maxwell Boltzmann distribution at dilute conditions, how?

(4 x 3 = 12 weightage)

Section C Essay
Answer 2 Questions out of 4.
Each question carries a weightage of 5

20. Discuss the working principle, advantages and limitations of (a) Methanol Fuel cell (b) Ni-Cd cell.

21. Comment on the following

    (a)plausibility of existence of fivefold symmetry in solids.   (b) Screw axis

    (c) Applications of Braggs Law

22. Derive Vibrational partition function, Rotational partition function and its temperature effects.

23. Explain Einstein theory of heat capacity of solids, failure and Debye modifications.

(2 x 5 = 10 weightage)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester MSc Degree Examination, March/April 2020

MCH2C06 – Coordination Chemistry

(2019 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

1. Explain how Cu(I) and Fe(II) can be stabilised.

2. How Sidgwick's electronic theory explains the formation of $[Cu(NH_3)_4]^{2+}$ and $[Fe(CN)_6]^{2-}$?

3. Give any two limitations of Valence bond theory.

4. Explain the reason behind Electron cloud expansion in complexes.

5. How magnetic susceptibility of a paramagnetic substance is related with temperature?

6. Nickel forms a complex with Schiff base (formed by the condensation between Salicylaldehyde and ethylene diamine). How infrared spectroscopy helps in explaining the formation of Ni Schiff base complex.

7. Explain the Effect of complex formation on the symmetry of the ligand.

8. With the help of NMR spectroscopy, explain the structure of a diamagnetic complex.

9. What are labile and inert complexes?

10. Give any two evidences for dissociative mechanism in ligand substitution reactions in complexes.

11. Write down the Eigen-Fuoss equation and explain the terms.

12. What are metal complex sensitizers?

(8 x 1 = 8 weightage)

Section B Short Essay
Answer 4 Questions out of 7.
Each question carries a weightage of 3

13. Discuss on Chelate effect and Macrocyclic effect with examples. Is porphyrin a chelating ligand or macrocyclic ligand or both?

14. Explain in detail the splitting of d-orbitals in octahedral and square planar complexes according to crystal field theory.

15. What is Jahn Teller effect? Explain the theories related with Jahn Teller effect.

16. Explain Temperature independent paramagnetism with examples.

17. What is ESR spectra? Explain its application in copper complexes.

18. Explain Mossbauer Spectroscopy with examples.

19. Explain Inner and outer sphere electron transfer mechanisms.

(4 x 3 = 12 weightage)

Section B Essay
Answer 2 Questions out of 4.
Each question carries a weightage of 5

20. What is stability constant of a complex? Discuss the thermodynamic aspects of stability constant. Explain how pH metric method and spectrophotometric method can be used to calculate the stability constant of a complex.

21. What are Orgel diagrams? Explain with example. What are the merits and demerits of Orgel diagram? Discuss the importance of Tanabe Sugano diagrams over Orgel diagram.

22. What is trans effect? Explain the theories and applications of trans effect. Starting from $PtCl_4^{2-}$, explain how cis-platin can be synthesised.

23. Explain in detail the photochemical reaction of metal complexes.

(2 x 5 = 10 weightage)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc. Degree Examination, March/April 2020

MCH2C05 – Group Theory and Chemical Bonding

(2019 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

1. What is meant by block factorization of a matrix? Explain with an example

2. How reduction formula can be derived using great orthogonality theorem.

3. Explain the nomenclature of irreducible representations

4. What are the consequences of great orthogonality theorem?

5. Explain the term transition moment integral. How it helps to find the probability of spectral transitions

6. How atomic orbitals are classified into different symmetry species?

7. How inverse transformation is important in group theory. Explain with an example

8. Why symmetry should be maintained during the formation of bonding molecular orbitals from atomic orbitals?

9. Draw the MO diagram for CO and find its bond order

10. Electronic wave function of Hydrogen molecule should be antisymmetric. Why?

11. Obtain the molecular term symbol for (i) O_2, (iii) O_2^+,(iii) O_2^{2-} and (iv) O_2^-

12. Find whether the given molecules are are aromatic or not using Frost -Hückel circle mnemonic device.

    (i) Cyclobutadiene   (ii) cyclooctatetrene

    (iii) benzene   (iv) cyclopentadienylanion

                                                           (8 x 1 = 8 weightage)

Section B
Short Essay
Answer 4 Questions out of 7.
Each question carries a weightage of 3

13. Explain the methods direct product and direct sum of square matrices and how these methods help in group theory.

14. How irreducible representation can be obtained by block diagonalization? Explain with an example.

15. Construct character tables for C_2V and C_2h point groups

16. How group theory can be used to explain the mutual exclusion principle of CO_2

17. Obtain the hybridized orbitals for BF_3 molecules using SALC

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)

18. Construct MO diagram for H_2O (C_2V point group) and find the possible electronic transitions

19. Obtain the delocalization energy of allylic cation, allylic radical and allylic anion using HMO method

(4 x 3 = 12 weightage

Section C
Essay
Answer 2 Questions out of 4.
Each question carries a weightage of 5

20. a. Explain briefly on (i) finite, (ii) infinite groups, (iii) Abelian and (iv) cyclic mathematical groups

    b. How basic symmetry operations are represented by using matrices

21. Obtain the Raman and IR activities of normal vibrational modes of NH_3 and H_2O molecules

C_{2v}	E	C_2	$\sigma_v(xz)$	$\sigma_v'(yz)$				C_{3v}	E	$2C_3$	$3\sigma_v$		
A_1	1	1	1	1	z	x^2, y^2, z^2		A_1	1	1	1	z	$x^2 + y^2, z^2$
A_2	1	1	−1	−1	R_z	xy		A_2	1	1	−1	R_z	
B_1	1	−1	1	−1	x, R_y	xz		E	2	−1	0	$(x, y)(R_x, R_y)$	$(x^2 − y^2, xy)(xz, yz)$
B_2	1	−1	−1	1	y, R_x	yz							

22. Derive the solution for the Schrodinger equation for H_2 molecule using molecular orbital theory

23. Obtain the π molecular orbitals of 1,3-butadiene using Hückel Molecular Orbitals. Find the free valence of each carbon atoms and explain the reactivity of each carbon atoms towards addition reactions.

(2 x 5 = 10 weightage