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Reg. No:.....

Name:

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2021

MCH3C09 – Molecular Spectroscopy

(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. Find the rotational quantum number corresponding to the maximum intensity in the microwave spectrum of HCl. Rotational constant $B=10.5 \text{ cm}^{-1}$.
2. Write the number of fundamental vibrational frequencies in the IR spectrum of CO_2 and H_2O molecules.
3. What do you mean by resonance Raman spectrum? Explain.
4. Discuss Franck-Condon principle.
5. Briefly discuss T_1 and T_2 relaxation.
6. How many ESR lines are possible for NH_2D radical.
7. How will you differentiate the following two compounds by IR spectroscopy.
 $\text{C}_6\text{H}_5\text{-CO-OCH}_3$ and $\text{CH}_3\text{-CO-OC}_6\text{H}_5$
8. Trans stilbene has higher λ_{max} and E_{max} than cis stilbene. Account for this?
9. Based on ^1H NMR how we will be able to differentiate o-hydroxyacetophenone from p-hydroxyacetophenone.
10. How will you differentiate isomeric xylenes by proton decoupled ^{13}C NMR spectroscopy.
11. Differentiate between 3-methylcyclohexene and 4-methylcyclohexene by using mass spectrometry.
12. State and explain axial haloketone rule.

(8 x 1 = 8 weightage)

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

13. (a) Derive the expression for the rotational energy of a symmetric top molecule and explain the selection rules. (2 weightage)
(b) How are IR and Raman spectroscopies are complimentary to each other? (1 weightage)
14. (a) HCl shows IR absorption at 2990 cm^{-1} . Find the force constant. (2 weightage)
(b) Explain the concept of dissociation with illustration. (1 weightage)
15. (a) Explain electronic spectra of conjugated molecules. (2 weightage)
(b) Differentiate between fundamental and overtone bands. (1 weightage)
16. (a) Discuss Nuclear Overhauser Effect using suitable example and illustrate its application. Explain NOE difference spectrum. (2 weightage)
(b) Write McConnell equation. Explain the terms (1 weightage)
17. (a) An organic compound with molecular formula C_7H_8 shows the following absorption bands in the IR spectrum in cm^{-1} . $3060, 3040, 2918, 1500, 750\text{ cm}^{-1}$. Deduce the structure of the compound. (2 weightage)
(b) How solvent polarity determine the position and intensity of electronic absorption bands. (1 weightage)
18. (a) Deduce the molecular structure from the following data
(i) Mol. Formula- $\text{C}_9\text{H}_{10}\text{O}_2$
(ii) IR- (i) 1720 cm^{-1} , 1602 cm^{-1} , 1581 cm^{-1} , 1270 cm^{-1} , 1105 cm^{-1}
(iii) $^1\text{H NMR}$ (i) δ -1.29, 3H, t, $J=8\text{ Hz}$ (ii) 4.35, 2H, q, $J=8\text{ Hz}$, (iii) 7.40, 3H, m
(iv) 8.81, 2H, m. (2 weightage)
(b) Discuss the effect of chemical exchange in NMR pattern with examples. (1 weightage)
19. (a) How can we differentiate isomeric compounds with molecular formula $\text{C}_5\text{H}_{10}\text{O}$ by mass spectrometry (2 weightage)
(b) Discuss HMBC spectroscopy. (1 weightage)

(4 x 3 = 12 weightage)

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

- 20) (a) Deduce the structure and stereochemistry of the compound from the following spectral data. Explain the pattern of each and every signals with suitable explanation.
- (i) IR- 1650 cm^{-1}
 - (ii) ^1H NMR - δ (ppm)- 2.4 (s, 3H), 6.8 (d, $J=16\text{ Hz}$, 1H), 7.5 (m, 5H), 7.6 (d, $J=16\text{ Hz}$, 1H, overlapping)
 - (iii) ^{13}C NMR- δ (ppm) - 27.1, 127.1, 128.2, 129.0, 130.0, 135.0, 144.2, 198.0.
 - (iv) Mass- m/z - 146, 131, 103 (3 weightage)
- (b) Explain off-resonance and noise decoupled spectra with examples (2 weightage)
- 21 (a) Outline the relative advantages of ORD and CD in solving organic chemical problems. (2 weightage)
- (b) Discuss McLafferty rearrangement in MS with suitable examples. (2 weightage)
- (c) Briefly discuss Woodward Fieser rules for calculating absorption maxima of enones (1 weightage)
22. (a) Explain the theory and applications of electron spin resonance spectroscopy in detail by selecting different compounds. (3 weightage)
- (b) Discuss the quantum theory of Raman effect in detail (2 weightage)
23. (a) Explain P, Q and R branches of rotation vibration spectrum (2 weightage)
- (b) Discuss electric, quadrupole and magnetic hyperfine interactions in Mössbauer Spectroscopy. (2 weightage)
- (c) Explain the determination of bond length using microwave spectral data. (1 weightage)
- (2 x 5 = 10 weightage)**

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE
Third Semester M.Sc Degree Examination, November 2021
MCH3C10 – Organometallic & Bioinorganic Chemistry
(2019 Admission onwards)

Time: 3 hours

Max. weightage : 30

Section A: Short Answer
Answer any 8 questions out of 12.
Each question carries a weightage of 1

1. Draw the structure of $\text{Fe}(\text{CO})_5$ and $\text{Fe}_2(\text{CO})_9$
2. Give the preparation and structure of Ziese's salt.
3. What is hapticity? What hapticities are possible for allyl group with transition metal atom?
4. Write a note on fullerene complexes.
5. What is Collman's reagent? What is its application?
6. What are higher carbonyl clusters?
7. What are 'naked' clusters? Discuss their structures.
8. What is meant by isolobal analogy?
9. What is the significance of Hill constant?
10. Explain the activity of hemocyanin.
11. Define active and passive transport of ions across membranes.
12. Define entatic state. What is its necessity in metalloenzymes?

(8 x 1 = 8 weightage)

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

13. Compare the characteristics of Fischer type and Shrock type carbene complexes with examples.
14. Describe the molecular orbital representation of the structure of ferrocene.
15. Discuss the bonding in alkyne complexes.
16. Explain Monsanto acetic acid process using catalytic cycle.

17. Explain the rules for predicting the skeletal structures of high nuclearity and low nuclearity carbonyl clusters.
18. Discuss the structure of $[\text{Re}_2\text{Cl}_8]^{2-}$ on the basis of molecular orbital theory.
19. Explain the role of Mg in chlorophyll molecule.

(4 x 3 = 12 weightage)

Section C: Essay

Answer any 2 questions out of 4.
Each question carries a weightage of 5

20. Discuss the preparation and bonding of metal- dihydrogen and metal- dinitrogen complexes.
21. With suitable examples, discuss the oxidative addition and reductive elimination reactions involving organometallic compounds.
22. Explain the structure of myoglobin and haemoglobin. Discuss the role and mechanism of action of these molecules in biological system.
23. What are metalloenzymes and metal- activated enzymes? Describe the function of following metalloenzymes in biological system
(i) cytochrome P-450, and (ii) carboxypeptidase

(2 x 5 = 10 weightage)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2021

MCH3C11 – Reagents and Transformations in organic chemistry

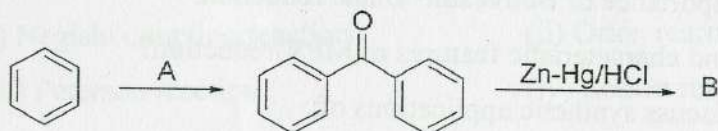
(2019 Admission onwards)

Time: 3 hours

Max. weightage : 30

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

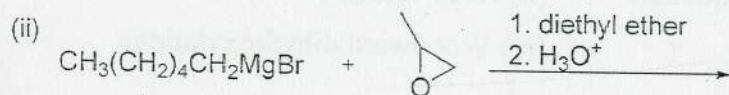
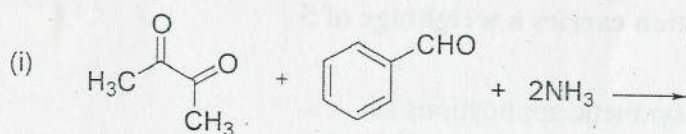
1. What is Sharpless asymmetric dihydroxylation reaction?
2. Emphasising mechanism, explain briefly how Noyori asymmetric hydrogenation becomes useful in enantioselective reduction of ketones.
3. Complete the following reaction sequence. Identify each reaction and draw the mechanisms.



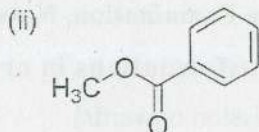
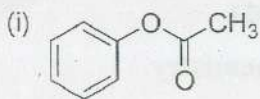
4. What is McMurry coupling?
5. What are β -cyclodextrins? Mention its important synthetic applications.
6. What is Ziegler-Natta polymerisation? Mention their advantages.
7. Give a synthetic route for the dipeptide, glycylvaline.



8. Write the structure of following polymers and the corresponding monomer units involved.
 (i) PVC (ii) Teflon (iii) Buna-S (iv) Bakelite (v) Nylon-6,6
9. What are molecular receptors? Give any two examples.
10. Write all the possible products of the following reactions. Among the products, which one is obtained as the major product and why?



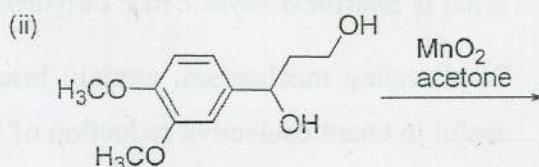
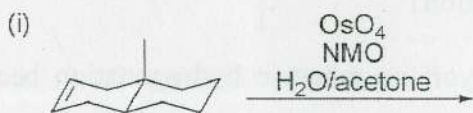
11. Illustrate supramolecular catalysis using an example.
12. Which of the following compounds will give you Fries rearrangement product? Justify your answer by giving the mechanism.



(8 x 1 = 8 weightage)

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

13. Illustrating mechanism, predict the major product of the following reactions. Indicate the stereochemistry in each case.



14. State and explain the synthetic importance of Bouveault- Blanc reduction.
15. Explain in brief the mechanism and characteristic features of MPV reduction?
16. Emphasising typical examples, discuss synthetic applications of:
- (i) Crown ethers (ii) Diborane.
17. How do starch and cellulose differ in their structures? Explain.
18. A heptapeptide on reaction with DNFB followed by hydrolysis produces N-DNP valine. The hydrolysis of peptide by carboxypeptidase enzyme releases glutamic acid. The partial hydrolysis of peptide gives the following fragments:
- (i) Pro – Keu – Val (ii) Ala – Tyr – Pro (iii) Keu – Val – Glu
 (iv) Val – Ala (v) Val – Glu.

Identify the sequence of amino acids in the heptapeptide.

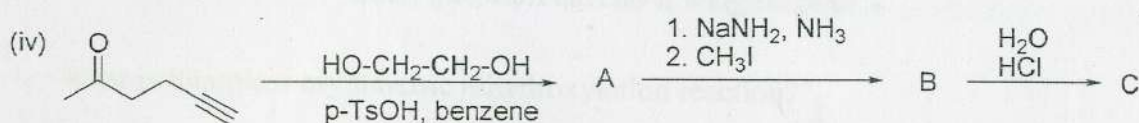
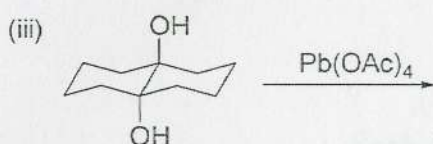
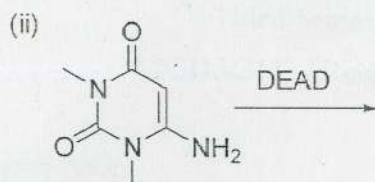
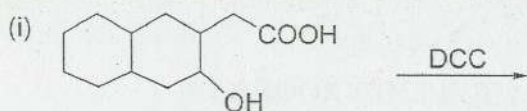
19. Explain the mechanisms of:
- (a) Benzil-benzilic acid rearrangement reaction (b) Bayer-Villiger oxidation reaction.

(4 x 3 = 12 weightage)

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

20. (a) Describe the mechanism and synthetic applications of:
- (i) Sharpless asymmetric epoxidation (ii) Riley reaction
 (iii) Swern oxidation reaction (iv) Woodward dihydroxylations
 (v) Dess- Martin oxidation.

21. Giving mechanism, complete the following reactions.



22. Explain any two synthetic methods for the following.

- (i) Adenine (ii) Guanine (iii) Uracil (iv) Thymine (v) Aziridine.

23. Explain the mechanism and synthetic applications of:

- (i) Negishi coupling reaction (ii) Orton rearrangement reaction
(iii) Peterson reaction (iv) Lossen rearrangement reaction
(v) Demjanov rearrangement reaction.

(2 x 5 = 10 weightage)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2021

MCH3E01 – Synthetic Organic Chemistry

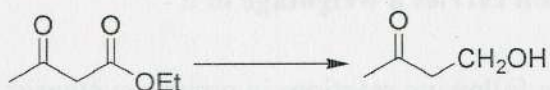
(2019 Admission onwards)

Time: 3 hours

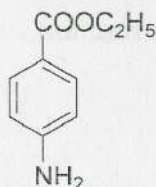
Max. weightage : 30

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

1. Give examples of chromium based oxidants for selective oxidation of alcohols to aldehydes?
2. Write down the mechanism of Wacker oxidation of alkenes to ketones.
3. Highlight the synthetic utility of Tri-n-butyl tin hydride reagent.
4. Give an example for Pd-catalyzed amine arylation reaction.
5. Chlorobenzene is normally unreactive towards methoxide ion, whereas the tricarbonyl chromium complex of chlorobenzene undergoes substitution of chlorine by methoxide. Explain.
6. Give the application of SeO_2 reagent in organic synthesis.
7. How will you bring about the following conversion successfully using a suitable protecting group?



8. What are Synthons? Suggest synthetic equivalents for the synthons R^- and $^+\text{CH}_2\text{OH}$.
9. Using disconnection approach, design a suitable synthesis for the following molecule:



10. Write a brief note on the applications of Wilkinson's catalyst.
11. Suggest a method for the synthesis of Quinoline.
12. How will you establish that enolate anions are involved as intermediates in conjugate additions of lithium alkylcuprates?

(8 x 1 = 8 weightage)

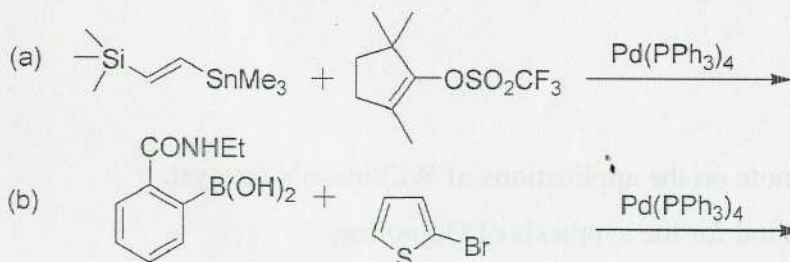
Section B: Short Essay
Answer 4 Questions out of 7.
Each question carries a weightage of 3

13. Write a descriptive note on chemoselectivity in metal hydride reductions.
14. What is Umpolung strategy in organic synthesis? Give examples of organic syntheses employing various umpolung reagents.
15. Write a descriptive note on the preparation and synthetic applications of organo silicon and boron reagents.
16. Explain the importance of protecting groups in organic syntheses. What are the major strategies of protection and regeneration of amino and alcohol functional groups?
17. (a) Explain two group C-C disconnections with respect to Diels-Alder reaction and 1,3-Difunctionalised compounds. (2 weightage)
 (b) Discuss one-group C-X disconnections with suitable examples. (1 weightage)
18. Give general methods for the synthesis of the following heterocycles:
 (a) Indoles (b) Azepines (c) Triazoles
19. Outline the Corey's synthesis of longifolene. Which step do you consider as the key step in this synthesis? Justify.

(4 x 3 = 12 weightage)

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

20. Discuss the importance of the following reactions in organic synthesis:-
 (a) Woodward and Prevost hydroxylation reactions (2 weightage)
 (b) Sharpless asymmetric epoxidation (2 weightage)
 (c) Dissolving metal reductions of aromatic and conjugated systems. (1 weightage)
21. Draw the structures of the products formed in the following reactions. Give the name of the reaction and explain the general mechanism of the reaction.



22. Highlight the synthetic applications of the following:-

- (a) Dieckmann reaction
- (b) Mannich reaction
- (c) Stork-enamine reactions
- (d) Phosphorous Ylides
- (e) Phase transfer catalysts

23. (a) Discuss two-group C-C disconnections with reference to Michael addition and Robinson annulation. (3 weightage)

(a) Discuss the guidelines for choosing suitable disconnections in retrosynthetic analysis. (2 weightage)

(2 x 5 = 10 weightage)