FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Chemistry Degree Examination, November 2024

MCH3C09 – Molecular Spectroscopy

(2022 Admission onwards)

Time: 3 hours   Max. Weightage : 30

Section A Short Answer
Answer 8 questions out of 12.
(Each question carries a weight of 1 (8×1 = 8)

1. Write a note on the use of the Karplus equation in the determination of the vicinal coupling constant.

2. Write McConnel equation and explain the terms.

3. How will you classify the molecules based on their moments of inertia? Give one example each.

4. Partial hydrogenation of triene shown below results in two compounds A and B having molecular formula $C_{10}H_{14}$. Compound A shows an absorption maximum at 235 nm and B shows at 275 nm. Assign the structures of A and B compounds.
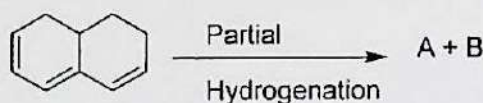
5. How will you distinguish among the following three compounds with the help of ^{13}C NMR spectroscopy?
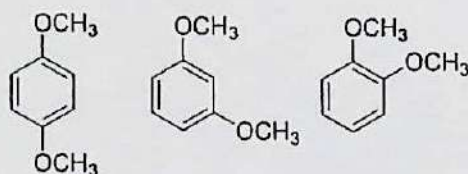
6. Write a short note on isotope effect on rotation spectra.

7. Describe the effect of hydrogen bonding on vibration frequency with a suitable example.

8. State and explain Frank Condon's principle.

9. Pentanoic acid gives m/z 60 as a base peak in a mass spectrum. Explain.

10. In the UV spectrum of the crotonaldehyde, the band due to $\pi-\pi^*$ in hexanes appears at λ_{max} 214 nm but the same band in ethanol appears at 220 nm. Explain.

11. Explain the term g-factor in ESR.

12. Explain chemical and magnetic equivalence in ^1H NMR spectroscopy giving examples.

(8×1=8 weights)

Section B
(Answer any FOUR questions. Each question carries a weight of 3)

13. (i) Derive an expression for the allowed rotational energy levels of a diatomic molecule using a rigid rotor model.

    (ii) Write a note on P, Q, R branches in vibrational spectroscopy

14. Discuss the theory and applications of Mossbauer spectroscopy.

15. Explain dissociation and predissociation.

16. Explain the term non-first order NMR spectrum with a suitable example. Briefly mention any two methods for the simplification of such a spectrum.

17. Discuss the basic principle and application of CD and ORD spectroscopy.

18. Explain how acetophenone, phenol, and benzoic acid can be distinguished by the characteristic bands in their IR spectra.

19. Explain how mass spectrometry is useful to detect halogens in organic compounds.

$$(4 \times 3 = 12 \text{ weights})$$

Section C
(Answer any two questions. Each question carries a weight of 5)

20. (a) Discuss the factors which determine the width and intensity of spectral lines. (3wt)

    (b) Highlight the application of DEPT as a spectroscopic technique to distinguish methyl, methylene and methane protons. (2 wt)

21. (a) Explain briefly the principle and applications of correlated 2D-NMR spectroscopic technique. (3 wt)

    (b) Explain the quantum mechanical description of AX and AB NMR patterns. (2wt)

22. (i) Discuss the classical and quantum theory of the Raman effect. (4 wt)

    (ii) How will you establish the complementary nature of IR and Raman spectroscopies? (1 wt)

23. A compound with molecular formula $C_{10}H_{12}O$ displays the following spectral data:

    IR: 1690, 1600, 1580, 1490, 770, 690 cm^{-1} ^{1}H NMR: δ_{ppm} 1.3 (d, 6H), 2.3 (Septet, 1 H), 7.3 – 7.7 (m, 5 H). ^{13}C NMR: δ_{ppm} 22 (q), 68 (d), 128 (d), 129 (d), 131 (s), 135 (d), 175 (s) Deduce its structure.

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

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Chemistry Degree Examination, November 2024

MCH3C10 – Organometallic & Bio Inorganic Chemistry

(2022 Admission onwards)

Time: 3 hours

Max. Weightage : 30

Section A
Answer any 8 Questions
Each question carries a weightage of 1 (8X1 = 8)

1. Among the two complexes, $Cr(CO)_5[C(OCH_3)C_6H_5]$, $Cr(CO)_5[C(H)C_6H_5]$, which is more stable and why?

2. A complex has an empirical formula $Re(CO)_3Cl$. How could it attain the 18-electron configuration without requiring any additional ligands?

3. What is synergic effect, and how does it relate to metal–carbonyl bonding?

4. What is LNCC? How do they differ from HNCC?

5. Infrared spectra of $[V(CO)_6]^-$ and $[Cr(CO)_6]$ show absorptions at 1859 and 1981 cm^{-1} respectively. Why?

6. What are carbide clusters in organometallic chemistry? How are carbide clusters different from other organometallic compounds?

7. What is Collman's reagent? Give two examples of reactions where the reagent has been successfully employed?

8. Unlike other alkenes, the hydrogenation of ethylene using $(PPh_3)_3RhCl$ is rather slow. Why?

9. How do ion gradients across membranes contribute to cellular processes like action potentials and muscle contraction?

10. What is the role of the iron-molybdenum cofactor in *nitrogenase* activity?

11. Explain cytochromes with examples.

12. *CarboxypeptidaseA* has an influence on protein synthesis. Comment.

13. What do you mean by arene complexes? Discuss the synthesis and properties of arene complexes.

14. The $[Re_2X_8]^{2-}$ exists in an eclipsed conformation rather than staggered. Explain

15. How does the migratory insertion of CO take place in theoxo process? Which kind of complex is formed after insertion? What is the oxidation state attained by the metal ion after insertion?

16. Discuss the fluxional isomerism of allyl and cyclopentadienyl systems.

17. What do you mean by the Bohr effect on oxygen-binding affinity of haemoglobin? Explain the release of O_2 at lower values of pH and ion pairing between the subunits.

18. How does cobalt affect the catalytic activity of cobalt-dependent enzymes? Explain the significance of cobalt in the structure and function of vitamin B_{12}.

19. Explain the structure and functions of Fe-S proteins. What makes them unique?

Section C
Answer any 2 Questions
Each question carries a weightage of 5 (2X5 = 10)

20. What is the Wade-Mingos rule? Using the total electron count, find out the structure and number of M-M bonds and binding modes in $Fe_3(CO)_{12}$, $Co_4(CO)_{12}$ and $Ir_4(CO)_{12}$.

21. How does the Cativa process for acetic acid production differ from the Monsanto process? Mention the catalytic loop for these processes.

22. Discuss in detail condensation polymers based on Ferrocene and on Rigid rod Polyynes.

23. (a) Describe the intrinsic pathways of the blood clotting process.

    (b) Explain the structure and functions of *ferritin* and *transferrin*.

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Chemistry Degree Examination, November 2024

MCH3C11 – Reagents & Transformations in Organic Chemistry
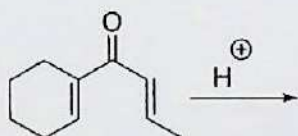
(2022 Admission onwards)

Time: 3 hours   Max. Weightage : 30
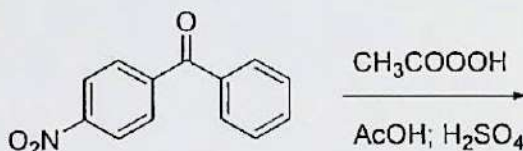
Section A Short Answer
Answer 8 Questions out of 12.
Each question carries a weightage of 1 (8 X 1 = 8)

1) Identify the reaction and predict the product

2) Predict the major product in the following reaction and explain why?

3) How can you convert cyclohexanone to cyclohexane under basic condition

4) Suggest reagent for the following synthetic transformations and the mechanism of the product formation.

5) Illustrate the synthesis of 2-methylpyridine from acetaldehyde

6) Explain the regioselectivity in Birch reduction.

7) Give the structural features of Starch and Cellulose.

8) Suggest the reagent for the following synthetic transformation

9) Predict the major product in each case when But-2-yne is treated with
(i) Lindlar Catalyst and (ii) H_2/Pd

10) Identify the reaction and predict the product in the following reaction
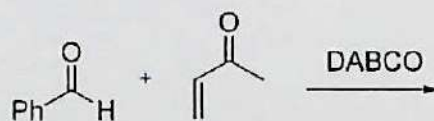
11) What are PTCs? Illustrate their role in organic synthesis with an example

12) What are Umpolung reactions? Illustrate with an example

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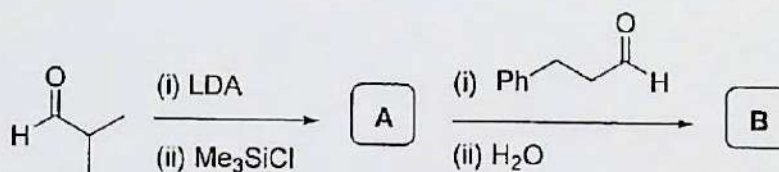Each question carries a weightage of 3 (4 X 3 = 12)

13) Discuss the Noyori asymmetric hydrogenation reaction

14) Explain the salient features of Sharpless asymmetric dihydroxylation

15) Explain in detail the structure of (i) DNA (ii) RNA and (iii) Proteins

16) Predict A and B in the following reaction sequence. Identify the reaction and give a mechanistic explanation for your prediction
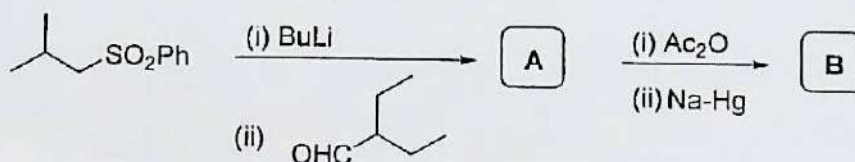
17) Suggest the major product in the following reaction. Identify the reaction and give a mechanistic explanation for your suggestion
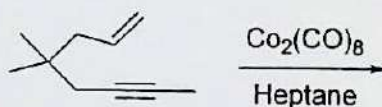

18) Predict A and B in the following reaction sequence. Name the reaction, if any

19) Discuss in detail the heterogeneous catalytic hydrogenation reactions

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

20) Discuss in detail the oxidations using (i) DMSO (ii) Oxoammonum salts and (iii) Chromium based reagents

21) Discuss (i) Different methods for the sequence determination of peptides (ii) Structure and synthesis of Glutathione and (iii) conversion of Cellulose to Rayon

22) Discuss the different methods for the ring synthesis of (i) Indole (ii) Quinoline and (iii) Pyridine

23) (i) Suggest methods for the following conversion and provide their mechanisms
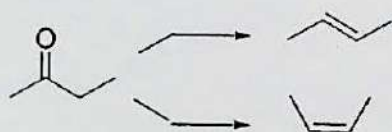
(ii) Illustrate the Peterson olefination reaction

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Chemistry Degree Examination, November 2024

MCH3E01 – Synthetic Organic Chemistry

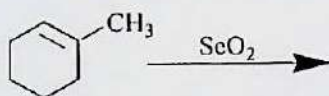(2022 Admission onwards)

Time: 3 hours   Max. Weightage : 30

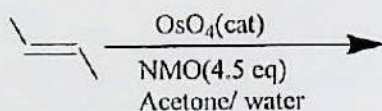### Section A Short Answer
Answer 8 Questions out of 12.
Each question carries a weightage of 1 (8 X 1 = 8)
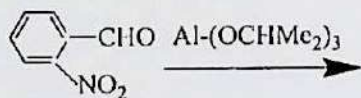
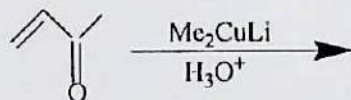1. What is the product of the following reaction


2. Complete the following reaction

3. What is the product in the following reaction

4. Predict the product in the following reaction

5. What are terpenoids and how they are classified?

6. What are the synthetic applications of alkyl boranes ?

7. Explain the function of protective group in organic synthesis taking suitable example

8. Illustrate the disconnection approach in organic synthesis.

9. Explain the use of periodic acid in organic synthesis.

10. Complete the following reaction
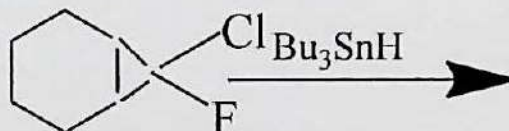
11. Explain hydroboration oxidation reaction.

12. What are prostaglandins? Illustrate its importance.

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

13. Write a note on TEMPO mediated oxidation with mechanism

14. Illustrate the difference between Woodword and Prevost hydroxylation by suitable example

15. Explain Sonogashira coupling reaction.

16. Explain the different types of selectivities with regards to chemo, region and stereoselctive reactions

17. Discuss the general features of retrosynthesis.

18. Discuss the synthetic applications of phase transfer catalyst.

19. Explain the synthesis of reserpine.

Section C
Essay Answer 2 Questions out of 4.
Each question carries a weightage of 5 (2X5 = 10)

20. Explain the different steps involved in the conversion of cholesterol to testosterone and the synthesis of benzodiazepins.

21. Explain the complete synthesis of longifolene.

22. Illustrate the retrosynthetic approach of paracetamol from phenol.

23. Explain Stille, Heck and Suzuki-Miyaura coupling reactions.