

**THIRD SEMESTER M.A./M.Sc./M.Com. DEGREE (REGULAR)  
EXAMINATION, NOVEMBER 2020**

(CBCSS)

Chemistry

CHE 3E 03—GREEN CHEMISTRY AND NANOCHEMISTRY

(2019 Admissions)

Time : Three Hours

Maximum : 30 Weightage

**Section A**

*Answer at least six questions.  
Each question carries 1 weightage.  
All questions can be attended.  
Overall Ceiling 6.*

1. What are atom-economical reactions ? Explain with an example, how is atom economy of a reaction estimated ?
2. Explain the term “Microwave Assisted Organic Reactions-MAOS” ? Write examples.
3. Which types of cation or anion moieties are chosen so as to prepare an ionic liquid ? Write examples.
4. What are quantum dots ? How are these made ? Write examples.
5. Write an example of a nanomaterial synthesis using a micro-organism.
6. What is Atomic Force Microscopy AFM ? Explain its principle and instrumentation.
7. Illustrate with examples organic nanomaterials. What are their structure and applications ?
8. What is the principle and instrumentation of Tunnelling Electron Microscopy TEM ?
9. Write examples of organic nanomaterials. What are these used for ?
10. What is C60 ? How can it be doped with an alkali metal atom ?

(6 × 1 = 6 weightage)

**Turn over**

**Section B**

*Answer at least four questions.*

*Each question carries 3 weightage.*

*All questions can be attended.*

*Overall Ceiling 12.*

11. Write a note on the (i) Alternative starting material ; and (ii) Alternative reagents advocated by green chemistry.
12. Explain the “specific effects” observed in certain microwave promoted reactions. Write examples.
13. Write examples of the use of MeO-CO-OMe and supercritical CO<sub>2</sub> in green chemistry.
14. Describe any *three* of the general methods available for obtaining nanomaterials.
15. Describe the principle, instrumentation, and applications of Scanning Tunnelling Microscopy STM.
16. Explain the use of ultrasound as an alternative energy input method for conducting chemical reactions.
17. Write a note on phase transfer catalysis PTC.
18. Explain briefly the methods for functionalisation of carbon nanotubes CNTs. What are the uses of such functionalised CNTs ?

(4 × 3 = 12 weightage)

**Section C**

*Answer at least two questions.*

*Each question carries 6 weightage.*

*All questions can be attended.*

*Overall Ceiling 12.*

19. What are the principles underlying green chemistry ? Describe each briefly.
20. Write an account of microwave assisted (i) Functional group transformations ; (ii) Redox reactions ; (iii) Condensation reactions ; and (iv) Multi-component reactions.
21. Describe in brief (i) Green oxidation reagents ; (ii) Reactions using ionic liquids as green solvent ; (iii) Synthesis and applications of inorganic nanomaterials ; and (iv) Surface plasmon spectroscopy.
22. Describe the preparation, characterization, structure and properties of single-walled carbon nanotubes.

(2 × 6 = 12 weightage)

THIRD SEMESTER M.A./M.Sc./M.Com. DEGREE (REGULAR) EXAMINATION  
NOVEMBER 2020

(CBCSS)

Chemistry

CHE 3E 01—SYNTHETIC ORGANIC CHEMISTRY

(2019 Admissions)

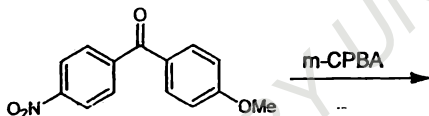
Time : Three Hours

Maximum : 30 Weightage

## Section A

Answer at least six questions.  
Each question carries 1 weightage.  
All questions can be attended.  
Overall Ceiling 6.

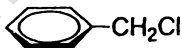
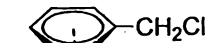
1. Suggest appropriate reagents for selective conversion of an alkene to the corresponding *cis*- and *trans*- diols.
2. Predict the product in the following reaction :



3. How will you effect the following conversion ?



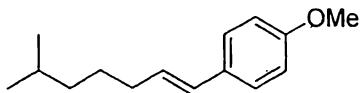
4. Explain the relative rates of solvolysis exhibited by the following compounds :

 $k_{rel} = 1$  $k_{rel} = 10^5$ 

5. Suggest a protecting group for carbonyl compounds and give the reagents and conditions for introduction and removal of it.

Turn over

- Illustrate Claisen condensation with an appropriate example.
- How will you effect the synthesis of the following compound by Suzuki coupling strategy ?



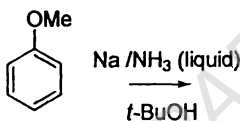
- How will introduce a protecting group onto a hydroxyl group which will survive in both acidic and basic conditions ?
- What are donor and acceptor synthons ? Give examples.
- Why is Corey lactone considered as a key compound in the synthesis of prostaglandins ?

(6 × 1 = 6 weightage)

### Section B

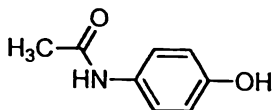
*Answer at least four questions.  
Each question carries 3 weightage.  
All questions can be attended.  
Overall Ceiling 12.*

- Illustrate the application of Swern oxidation. Indicate the mechanism involved.
- Predict the product and explain the selectivity observed in the transformation.



- What is 9-BBN ? Illustrate its application in organic synthesis with an example.
- Illustrate the synthetic applications of Stork-enamine reaction with an appropriate example.
- What are crossed aldol condensation reactions ? Explain its significance in synthesis.
- Write down the catalytic cycle for Heck reaction.

17. Suggest a logical disconnection for the following compound. Write down the structure of all the synthons and corresponding compounds to be used in synthesis.



18. Suggest a name reaction for the synthesis of indole. Give the steps involved.

(4 × 3 = 12 weightage)

### Section C

*Answer at least two questions.  
Each question carries 6 weightage.  
All questions can be attended.*

*Overall Ceiling 12.*

19. Write a note on the mechanism and application of hydroboration reaction with special reference to the stereochemical outcome.
20. Give a short account of the major applications of phosphorous and sulfur ylides in organic synthesis.
21. Explain the mechanism of Sonogashira cross coupling and discuss its applications in cyclic peptide synthesis.
22. Discuss salient features of retrosynthetic analysis using benzocaine as a target molecule.

(2 × 6 = 12 weightage)

**THIRD SEMESTER M.A./M.Sc./M.Com. DEGREE (REGULAR)  
EXAMINATION, NOVEMBER 2020**

(CBCSS)

Chemistry

CHE 3C 11—REAGENTS AND TRANSFORMATIONS IN ORGANIC CHEMISTRY,  
(2019 Admissions)

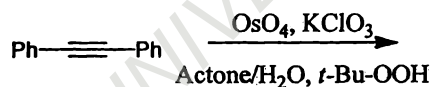
Time : Three Hours

Maximum : 30 Weightage

**Section A**

*Answer at least six questions.  
Each question carries 1 weightage.  
All questions can be attended.  
Overall Ceiling 6.*

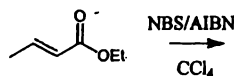
1. Predict the product in the following reaction :



2. Suggest reagents and conditions to effect the following conversion with high enantiomeric excess.

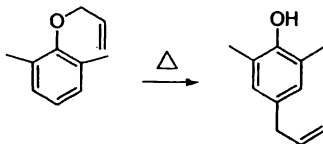


3. Name two reagents and reaction conditions that are useful for the selective reduction of nitriles and esters to aldehydes.
4. What is Lindlar catalyst? Give the applications in organic synthesis.
5. Predict the major product in the following reaction. What is the role of AIBN in the reaction?

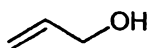


**Turn over**

- Illustrate the use of 18-crown-6 as a phase transfer catalyst with an appropriate example.
- Differentiate between thermosets and thermoplastics.
- Write down the structure of : a) Aziridine ; b) Imidazole.
- Indicate the mechanism of the following transformation.



- Predict the major product obtained in the Heck reaction of the following compound with bromobenzene.

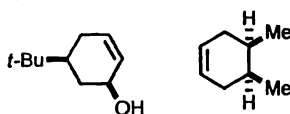


(6 × 1 = 6 weightage)

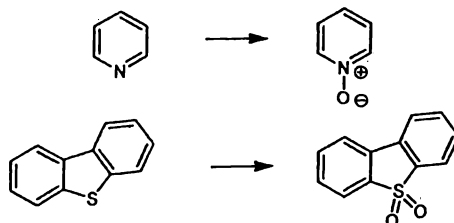
### Section B

*Answer at least four questions.  
Each question carries 3 weightage.  
All questions can be attended.  
Overall Ceiling 12.*

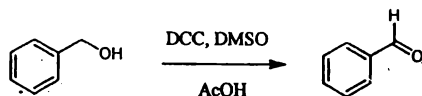
- Write down the structure of the major products obtained when each of the following alkene is treated with *m*-chloroperbenzoic acid.



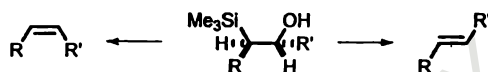
- Suggest suitable reagents to effect the following conversions in single step with appreciable yields.



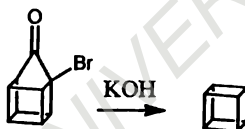
13. Explain the regioselectivity in Birch reduction with suitable examples.
14. Discuss McMurry coupling reaction with reference to its mechanism and applications.
15. Rationalize the following reaction. Suggest a plausible mechanism.



16. Outline a synthesis of uracil starting with urea as one of the substrates.
17. How will you effect the following conversions ? Indicate the mechanism involved.



18. Suggest a plausible mechanism for the following base catalyzed transformation.



(4 × 3 = 12 weightage)

### Section C

Answer at least **two** questions.

Each question carries 6 weightage.

All questions can be attended.

Overall Ceiling 12.

19. Discuss the mechanism and applications of Swern oxidation. What are its advantages over other oxidation methods ? Give examples.
20. Write notes on : a) Noyori asymmetric hydrogenation, ; and b) Shapiro reaction.
21. Write short notes on : a) Role of DEAD in Mitsunobu reaction ; b) Role of DBU as a base.
22. Outline a total synthesis of 8-hydroxy quinoline.

(2 × 6 = 12 weightage)



**THIRD SEMESTER M.A./M.Sc./M.Com. DEGREE (REGULAR) EXAMINATION  
NOVEMBER 2020**

(CBCSS)

Chemistry

CHE 3C 10—ORGANOMETALLIC AND BIO-INORGANIC CHEMISTRY

(2019 Admissions)

Time : Three Hours

Maximum : 30 Weightage

**Section A**

*Answer at least six questions.  
Each question carries 1 weightage.  
All questions can be attended.  
Overall Ceiling 6.*

1. What do you mean by agostic interaction ? Illustrate with an example.
2. Distinguish between carbene and carbyne organometallics.
3. Draw the possible structures of  $\text{Cp}_2\text{Fe}_2(\text{CO})_4$ .
4. Which is more basic ; aniline or ferrocene ? Substantiate your answer.
5. Explain the role of a co-catalyst in Wacker process.
6. What are 'naked clusters' ? Give two examples.
7. What are isolobal fragments ? Explain with an example.
8. Hemocyanin is colourless, but in the oxy form it is coloured ; why ?
9. How does nature protect iron (II) in hemoglobin from its irreversible oxidation in presence of oxygen ?
10. How does vanadate ion interfere with  $\text{Na}^+ - \text{K}^+$  pump in biological system ?

(6 × 1 = 6 weightage)

**Section B**

*Answer at least four questions.  
Each question carries 3 weightage.  
All questions can be attended.  
Overall Ceiling 12.*

11. How is Zeise's salt synthesized ? Account for the changes in olefinic bond on forming this compound.
12. Discuss the structure and bonding in metal carbonyls.

**Turn over**

13. What is Collman's reagent ? Give any *two* of its synthetic applications.
14. Write a note on Chevrel phases.
15. Explain the structure and functions of hemerythrin.
16. Differentiate between metalloenzymes and metal activated enzymes, giving examples.
17. Discuss the structure and functions of catalase and peroxidase.
18. Explain the changes that generally occur in a ligand system when it gets co-ordinated to a metal ion.

(4 × 3 = 12 weightage)

### Section C

*Answer at least two questions.  
Each question carries 6 weightage.  
All questions can be attended.  
Overall Ceiling 12.*

19. How metal nitrosyls are prepared ? Give an account of the structure and bonding in metal nitrosyl complexes. How linear and bent metal nitrosyls can be distinguished by using IR spectroscopy ?
20. What are the pre-requisites for the formation of metal-metal bonds ? Discuss the structure and bonding in  $[\text{Re}_2\text{Cl}_8]^{2-}$ .
21. Describe the photosynthetic process in plants bringing out the functions of PS-I and PS-II. What do you mean by 'red-drop' in photosynthesis ?
22. Write notes on :
  - (a) Role of calcium in blood clotting.
  - (b) Siderophores.
  - (c) Fullerene complexes.

(2 × 6 = 12 weightage)

**THIRD SEMESTER M.A./M.Sc./M.Com. DEGREE (REGULAR) EXAMINATION  
NOVEMBER 2020**

(CBCSS)

Chemistry

CHE 3C 09—MOLECULAR SPECTROSCOPY

(2019 Admissions)

Time : Three Hours

Maximum : 30 Weightage

**Section A**

*Answer at least six questions.  
Each question carries 1 weightage.  
All questions can be attended.  
Overall Ceiling 6.*

1. The lifetime of a pulse of radiation is 100 microseconds. Calculate the band width in Hz.
2. Distinguish between prolate and oblate type of molecules with examples.
3. Explain the term 'Resonance Raman'.
4. What is predissociation spectrum ?
5. What are the drawbacks of  $^{13}\text{C}$  in NMR ?
6. State and explain Kramer's theorem.
7. What is Octant rule ? Explain.
8. Distinguish : Enantiotopic, diastereotopic and homotopic protons in NMR.
9. Explain Spin decoupling.
10. What is time of flight mass spectrometry ?

(6 × 1 = 6 weightage)

**Section B**

*Answer at least four questions.  
Each question carries 3 weightage.  
All questions can be attended.  
Overall Ceiling 12.*

11. How would you determine C=O and C=S bondlengths in COS by microwave spectroscopy ? Discuss.
12. Find the lowest energy electronic transition in *nm* for Octatetraene. The length of the  $\pi(\text{pi})$ , bond system is 9.3 Å. Use particle in a box model.

**Turn over**

13. How would you determine spin-lattice relaxation time  $T_1$  in NMRL ?
14. How many lines do you expect in the EPR spectrum of  $\text{ND}_3$  radical. What is the relative intensity ? Discuss.
15. How would you distinguish the following pairs by IR Spectroscopy ?
  - (a)  $\text{Ph CH}_2\text{NH}_2$  and  $\text{Ph CO NH}_2$ .
  - (b)  $\text{MeO} - \text{C}_6\text{H}_4 - \text{COMe}$  and  $\text{Me} - \text{C}_6\text{H}_4 \text{COOMe}$ .
16. Draw NMR spectrum of 4-vinyl pyridine and assign the peaks.
17. Briefly discuss correlation spectroscopy.
18. Write a brief account of the various ionization techniques in MS.

(4 × 3 = 12 weightage)

### Section C

*Answer at least two questions.  
Each question carries 6 weightage.  
All questions can be attended.  
Overall Ceiling 12.*

19. Discuss theory, applications and instrumentation in Raman spectroscopy.
20. Briefly discuss FT NMR.
21. Discuss the applications of ORD in structural elucidation.
22. The spectral data of a compound is given below :

IR :  $1620 \text{ cm}^{-1}(\text{m}), 1695 \text{ cm}^{-1}(\text{s})$ .

NMR :  $1.9 \delta(3\text{H}, \text{singlet}), 2.1 \delta(6\text{H}, \text{singlet})$ .

UV :  $\lambda_{\text{max}} - 238 \text{ nm}(\epsilon = 11700)$ .

MS :  $\frac{m}{z}$  55(100), 83(90), 43(78), 98(49)  
29(46), 39(43), 27(42), 53(13)  
41(13), 28(8).

Deduce the structure of the compound and assign the peaks.

(2 × 6 = 12 weightage)

THIRD SEMESTER M.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION  
NOVEMBER 2020

(CUCSS)

Chemistry

CH 3E 01—SYNTHETIC ORGANIC CHEMISTRY

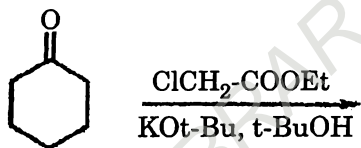
(2015 Admissions)

Time : Three Hours

Maximum : 36 Weightage

**Section A***Answer all questions.**Each question has 1 weightage.*

1. Write a note on Stille carbonylative cross coupling reaction.
2. What is Birch reduction ?
3. Give the names and structures of any *two* protecting groups for the carboxyl group.
4. Write a note on tri-n-butyl tinhydride.
5. Give an account of palladium catalysed amine arylation.
6. Predict the product and explain the mechanism of the reaction :



7. What are phase transfer catalysts ?
8. Write a note on phosphorous and sulphur ylides.
9. Explain Umpolung equivalent with suitable example.
10. Explain one group C-C disconnections used in retrosynthetic analysis with suitable examples.
11. Draw the structures of azepines and oxepines.
12. Give a chemical reaction in which PCC as an oxidizing agent.

(12 × 1 = 12 weightage)

**Turn over**

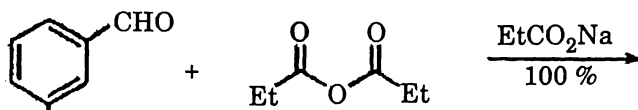
## Section B

Answer any **eight** questions.

Each question carries 2 weightage.

13. Differentiate between homogenous and heterogenous catalytic hydrogenation.

14. Give the name of the following reaction and write its mechanism :



15. Write the mechanism of reactions :

(a) Michael addition ; and (b) Robinson annulation.

16. Write down the protection and deprotection of hydroxyl group with suitable examples.

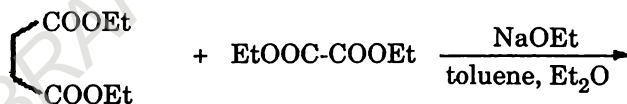
17. Explain the enantioselective synthesis of :

(a) Corey lactone ; and (b) Longifolene.

18. Give an account of the application of IBX and Oxone.

19. Explain two group C-X and C-C disconnections used in retrosynthesis.

20. Write down the mechanism of the following reaction :



21. Discuss in detail :

(a) Sharpless asymmetric epoxidation ; and (b) TEMPO oxidation.

22. Write down the retrosynthetic analysis of :

(a) Propranolol from 1-Naphthol ; and (b) Benzocain from toluene.

23. Discuss the synthesis and reactions of Benzofuran.

24. What are the important strategies of functional group interconversion and functional group transposition ?

(8 × 2 = 16 weightage)

**Section C**

*Answer any two questions.*

*Each question carries 4 weightage.*

25. Discuss the basic principles of retrosynthetic analysis and explain one group and two group C-C disconnections in detail.
26. Write down the mechanism of following reactions :
- |                |                    |
|----------------|--------------------|
| (a) Dieckmann. | (b) Stork enamine. |
| (c) Perkin.    | (d) Darzen.        |
27. Give an account of the application of following reagents in organic synthesis :
- |                           |                       |
|---------------------------|-----------------------|
| (a) Rhuthenium tetroxide. | (b) Osmium tetroxide. |
| (c) Lead tetra acetate.   | (d) Periodic acid.    |
28. Explain the mechanism of the following coupling reactions :
- |                     |             |
|---------------------|-------------|
| (a) Suzuki-Miyaura. | (b) Hiyama. |
| (c) Sonogashira.    | (d) Kumada. |

(2 × 4 = 8 weightage)

**THIRD SEMESTER M.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION  
NOVEMBER 2020**

(CUCSS)

Chemistry

CH 3C 11—REAGENTS AND TRANSFORMATIONS IN ORGANIC CHEMISTRY

(2015 Admissions)

Time : Three Hours

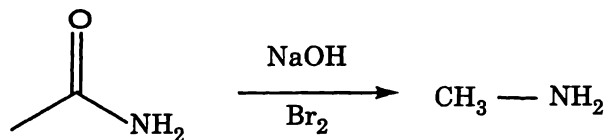
Maximum : 36 Weightage

**Section A**

*Answer all twelve questions.*

*Each question carries 1 weightage.*

1. What is the advantage of using propanone as solvent during Jones Oxidation ?
2. Illustrate the structures of PCC and PDC.
3. What is MPV reduction ? Give one application.
4. What is hydrogenolysis ? Give an example.
5. How does Baker's yeast work ?
6. Give the structures of : a) DABCO ; b) DEAD.
7. What are the bases present in DNA ? Give their structure.
8. What are the reagents available for C- Terminal Analysis of peptides ?
9. Explain electrophilic substitution in Pyrrole.
10. What is Chichibabin reaction ?
11. Sketch the mechanism of :



12. "Of the following four related reactions : Hoffmann, Schmidt, Lossen and Curtius, the Lossen rearrangement is the least useful in Organic Chemistry". Why ?

(12 × 1 = 12 weightage)

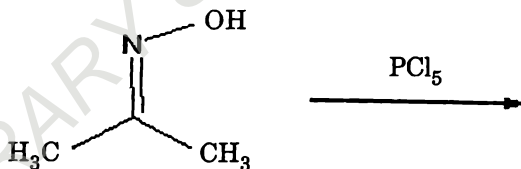
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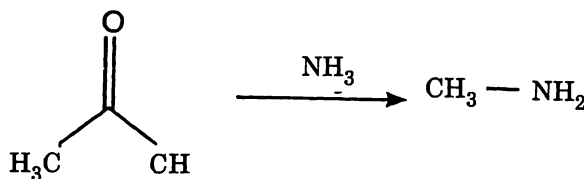
### Section B

Answer any **eight** questions.  
Each question carries 2 weightage.

13. Peroxycarboxylic acids act as oxidising agents for carbonyl compounds. Name the reaction and illustrate the mechanism.
14. Comment on  $\text{SeO}_2$  oxidation. Give mechanism.
15. Explain with mechanism : a) Clemmensen Reduction ; b) Bouveault - Blanc reduction.
16. Give an account of dissolving metal reduction.
17. Give one example for Manganese based oxidation of alkenes to carbonyl compounds. Suggest mechanism.
18. Give the structure of NBS and DCC. Suggest one important use for each.
19. Explain the synthesis of any two synthetic rubbers.
20. Write short notes on : a) thermosets and thermoplastics ; b) network polymers.
21. Give one method for the synthesis of (a) Imidazole ; (b) Furan.
22. How is uric acid synthesised ?
23. Predict the product(s) and write down the mechanism of :



24. Discuss the mechanism and application of :



(8 × 2 = 16 weightage)

**Section C**

*Answer any two questions.*

*Each question carries 4 weightage.*

25. Compare the Prevost and Woodward hydroxylations. Give mechanisms, (b) Briefly discuss the synthetic utility of Wacker process in organic synthesis.
26. Give an account of the application of hydride transfer reagents in organic synthesis with special reference to (a)  $\text{LiAlH}_4$  ; (b) DIBAL-H ; (c)  $\text{NaBH}_4$  ; and (d) Red-Al.
27. Explain with suitable example and mechanism the activity of : a) Lead tetra acetate ; b) Diborane ; c) t-Butoxy carbonyl chloride ; d) ceric ammonium nitrate.
28. Explain Solid Phase Peptide Synthesis. Explain the synthesis of the peptide Gly-Ala-Gly-Tyr using SPPS.

(2 × 4 = 8 weightage)

**THIRD SEMESTER M.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION  
NOVEMBER 2020**

(CUCSS)

Chemistry

CH 3C 10—ORGANOMETALLIC AND BIO-INORGANIC CHEMISTRY

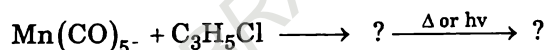
(2015 Admissions)

Time : Three Hours

Maximum : 36 Weightage

**Part A***Answer all questions.**Each question carries a weightage of 1.*

1. Differentiate between 18 and 16 electron rule by taking suitable organometallic compounds as examples.
2. Replacement of some of the carbonyls in  $\text{Cr}(\text{CO})_5\text{N}_2$  by phosphine ligands will enhance the stability of the complex ? Why ?
3. What is hapticity of an organic ligand ? Predict the hapticity of cyclopentadienyl ligand in ferrocene.
4. What are the different types of Fullerene metal complexes ? What are the significant properties of these compounds ?
5. Complete the reaction and explain the mechanism of the following reaction :



6. Which of the two,  $\text{Ir}(\text{dppe})\text{Cl}(\text{CO})$  and  $\text{Ir}(\text{dmpe})\text{Cl}(\text{CO})$ , will react faster with methyl iodide ? Why ?  
(dppe is 1,2-Bis(diphenylphosphino)ethane and dmpe is 1,2-Bis (dimethyl phosphino) ethane)
7. What is Zeigler- Natta catalyst ? Early transition metal halides can function as good Zeigler - Natta catalyst along with aluminium alkyls, but not late transition metal halides. Why ?
8. What is water gas shift reaction ? What is the significance of this reaction ?
9. What is superoxide dismutase ? Which is the active site ? Give its function.

**Turn over**

10. The metal-ligand bonds in  $[\text{Co}(\eta^5\text{-Cp})_2]^+$  is stronger and shorter than in the neutral molecule. Explain based on MO concept.
11. Oxy form of hemocyanin is blue and deoxy form is colourless. Why ?
12. What is Transferrin ? How does it function ?

(12 × 1 = 12 weightage)

### Part B

*Answer any eight questions.*

*Each question carries a weightage of 2.*

13. What is fluxionality in metal complexes ? Explain the fluxional behaviour of  $\text{Ti}(\text{Cp})_4$ .
14. Briefly discuss olefin metathesis with examples.
15. What are different types of carbene metal complexes ? Give a brief account of the bonding in different carbene metal complexes.
16. What is Dewar-Chatt- Duncanson model of bonding in organometallic compounds ? Explain with suitable examples. How the presence of substituent in alkenes and alkynes affect the C - C bond and stability of the complex ?
17. Give the structure, function and mechanism of action of the enzyme carboxypeptidase.
18. What are low and high nuclearity carbonyl clusters ? With suitable examples explain their structure and bonding.
19. What is Wacker Process ? Which is catalyst used and explain the mechanism of the process ?
20. Give the structural and functional differences between Haemoglobin and Myoglobin. Explain, how oxygen is transported and stored in living organism ?
21. What is Monsanto process ? Which is the catalyst used in the reaction ? Illustrate the mechanism of the reaction.
22. Write a note on substitution reactions in organometallic complexes. Differentiate between associative and dissociative substitution reactions.
23. What is  $\text{Na}^+/\text{K}^+$  pump ? Explain the mechanism of its function.
24. Briefly discuss the structure, function and mechanism of action of Cytochrome P-450.

(8 × 2 = 16 weightage)

**Part C**

*Answer any two questions.*

*Each question carries a weightage of 4.*

25. What is Wilkinson catalyst ? Give the industrial importance of this catalyst. Briefly discuss the mechanism of the process. Explain with an example how enantioselective hydrogenation is achieved in this process ?
26. Explain hydroformylation reaction with mechanism. Discuss how CO concentration influence the rate of the reaction ? How the selectivity of the process can be increased to get linear aldehyde as major product than branched isomer ? Explain.
27. Which is the photosynthetic pigment present in plants ? Give its structure. What is Photosystem I and II ? Explain the Z scheme in photosynthesis.
28. Give the method of preparation and important reactions of Ferrocene. Discuss the bonding and give the MO diagram of Ferrocene. Compare the reactivity of ferrocene, with Cp complexes of Co, Ni, V and Cr. If any difference explain the reason on the basis MO diagram.

(2 × 4 = 8 weightage)

**THIRD SEMESTER M.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION  
NOVEMBER 2020**

(CUCSS)

Chemistry

CH 3C 09—MOLECULAR SPECTROSCOPY

(2015 Admissions)

Time : Three Hours

Maximum : 36 Weightage

**Section A**

*Answer all questions.*

*Each questions carries 1 weightage.*

1. Explain three factors affecting intensity of spectral lines ?
2. Vibrational frequency in the excited state of a molecule is smaller than that in the ground state. Why ?
3. Explain the term “resonance” in Nuclear Magnetic Resonance Spectroscopy ?
4. Explain why in a triplet of  $^1\text{H}$  NMR spectrum the relative peak areas are in the ratio of 1 : 2 : 1 ?
5. What is hyperfine interaction in EPR ?
6. Explain Collision broadening in spectral transitions ?
7. What is meant by rigid rotor ?
8. Give examples for symmetric top molecules and give the symmetric criteria ?
9. Why homonuclear diatomic molecule does not give any vibrational spectra ?
10. Explain isomer shift in Mossbauer Spectroscopy ?
11.  $^{13}\text{C}$  NMR does not show any splitting. Why ?
12. Explain nitrogen rule in mass spectrometry ?

(12 × 1 = 12 weightage)

**Turn over**

### Section B

Answer any **eight** questions.

Each question carries 2 weightage.

13. Explain the principle of EPR spectrum ? What is "g" factor ?
14. What is haloketone rule ? Illustrate with an example ?
15. Write notes on (i) circular birefringence ; (ii) Fermi resonance.
16. a) The magnitude of the nuclear spin angular momentum of a nuclei is  $\frac{\sqrt{15}}{2} \hbar$ . The value of I is ?  
b) Toluene show two peaks corresponding to methyl and aromatic protons when the NMR spectrum is recoded at 60 MHz and 1.41T. Given that, what would be the magnetic field at 300 MHz ?
17. What are the empirical rules for calculating  $\lambda_{\max}$  in UV-Vis Spectroscopy ?
18. Detail electronic spectra of poly atomic molecules ?
19. Write a note on McLafferty rearrangement ?
20. Draw a diagram showing the allowed rotational energies of a rigid diatomic molecule and explain ?
21. For the linear molecule nitrous oxide,  $N_2O$ , predict which rotational energy level which is most populated for a temperature of 300K ? The rotational constant of nitrous oxide is  $0.419 \text{ cm}^{-1}$  ?
22. The rotational constant for  $H^{35}Cl$  is observed to be  $10.5909 \text{ cm}^{-1}$ . What are the values of B for  $H^{37}Cl$  and for  $^2D^{35}Cl$  ? (Given Atomic mass  $^1H = 1.673 \times 10^{-27} \text{ kg}$ ,  $^{35}Cl = 58.066 \times 10^{-27} \text{ kg}$ ,  $^2D = 3.344 \times 10^{-27}$ ,  $^{37}Cl = 61.38 \times 10^{-27}$ ).
23. Explain the microwave spectrum of a nonlinear polyatomic molecule ?
24. Give a detailed account of the pure rotational Raman spectra in Linear molecules ?

(8 × 2 = 16 weightage)

### Section C

Answer any **two** questions.

Each question carries 4 weightage.

25. a) Write note on Chemical Shift reagent with example ?  
b) Explain the theory of spin-spin splitting in NMR spectrum of trans-cinnamic acid ?

26. a) What is Raman effect ?  
b) Explain the origin of Stokes and anti-Stokes lines ?
27. a) Why is that in the excited state of a molecule the vibrational frequency is smaller than that in the ground state ?  
b) What are the merits of Fourier Transform spectra over conventional spectra in IR ?
28. a) Explain Transition probabilities using Ladder operators EPR Spectroscopy ?  
b) What is Zero field splitting in EPR ?

(2 × 4 = 8 weightage)

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