

**FOURTH SEMESTER M.Sc. DEGREE (REGULAR) EXAMINATION
MARCH 2021**

(CBCSS)

Chemistry

CHE 4E 08—ORGANOMETALLIC CHEMISTRY

(2019 Admissions)

Time : Three Hours

Maximum : 30 Weightage

General Instructions

1. *In cases where choices are provided, students can attend all questions in each section.*
2. *The minimum number of questions to be attended from the Section / Part shall remain the same.*
3. *There will be an overall ceiling for each Section / Part that is equivalent to the maximum weightage of the Section / Part.*

Section A

Answer any eight questions.

Each question carries a weightage of 1.

1. Is it possible for a ligand to show different hapticities in one metal complex ? Substantiate your answer.
2. What is Collman's reagent ? Give any one of its synthetic applications.
3. How is methyl lithium prepared ? Comment on its structural features.
4. Generally transition metal carbonyls are stable at high temperature, but lanthanide carbonyls exist only at very low temperature. Give reasons.
5. What is meant by agostic interaction ? Explain with an example.
6. Explain σ -bond metathesis reaction with suitable example.
7. What is hydrosilation ? Give one example.
8. How an organometallic polymer can be prepared by ring opening polymerization ?
9. Explain the role of a co-catalyst in Wacker process.
10. State and explain 18-electron rule as applied to organometallic compounds.

(8 × 1 = 8 weightage)

Section B

Answer any six questions.

Each question carries a weight of 2.

11. How is Zeise's salt synthesized? Account for the changes in olefinic bond on forming Zeise's salt.
12. Explain reductive carbonylation and transmetallation reactions with suitable examples.
13. Sketch the different bonding modes of NO towards a metal ion. How IR spectroscopy can be used to identify these bonding modes?
14. What are fluxional organometallics? How ^1H NMR spectroscopy is useful in the structural investigation of such compounds?
15. Discuss the mechanism of the reactions involved in hydroformylation of alkenes.
16. How 'CO insertion' occurs into $[\text{CH}_3\text{Mn}(\text{CO})_5]$? Support your explanation with experimental evidences.
17. What is Fischer-Tropsch reaction? Explain.
18. Write briefly on organometallic dendrimers.

(6 × 2 = 12 weightage)

Section C

Answer any two questions.

Each question carries a weight of 5.

19. Distinguish between carbene and carbyne organometallics. Give an account of the synthesis, structure and reactivity of Fischer and Schrock carbenes.
20. How is ferrocene synthesized? Give an account of its structure and important reactions.
21. Discuss the catalytic cycle and mechanism of the reactions involved in Zeigler-Natta catalysis. Why it is called stereo-regular polymerization? Do you find any difference in the polythene produced by Zeigler-Natta catalysis and that formed by free radical polymerization?
22. Write briefly on :
 - (a) Microwave assisted substitution reactions of metal carbonyls.
 - (b) Nucleophilic and electrophilic attack on coordinated ligands.
 - (c) Water-gas shift reaction.

(2 × 5 = 10 weightage)

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CHE 4E 07—MATERIAL SCIENCE

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General Instructions

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Section A

Answer any eight questions.

Each questions carries a weightage of 1.

1. Differentiate between metallic and non-metallic materials.
2. What are the main differences between traditional ceramics and new ceramics ?
3. What are the applications of sol-gel process ?
4. What is the theory of ferroelectricity ?
5. What is Meissner Effect ?
6. What are photoconductive polymers ? Give two examples.
7. What are engineering plastics ? What are their uses ?
8. What are thermosetting polymers ? What are their properties ?
9. Discuss the various applications of composites.
10. Discuss the applications of fatigue testing.

(8 × 1 = 8 weightage)

Turn over

Section B

Answer any six questions.

Each question carries a weightage of 2.

11. How will you carry out the bend test ? What is its importance ?
12. Discuss the various physical properties of ceramics.
13. How will you carry out the chemical modifications of surface of a nanomaterial ? What is its significance ?
14. What are piezoelectric materials ? What are their applications ?
15. Distinguish between the properties of ferri and ferro magnetic materials.
16. Describe the production and main properties of polyamides.
17. Briefly discuss the nanostructural characteristics of composite materials.
18. Explain the Weibull statistics for failure.

(6 × 2 = 12 weightage)

Section C

Answer any two questions.

Each question carries a weightage of 5.

19. a) Explain the various types of classifications of materials.
b) By taking an example, discuss the phase equilibrium in ceramics system.
20. a) Briefly explain the various methods of synthesis of nanomaterials.
b) What are metallic glasses ? Discuss one method of preparation of metallic glass. What are its applications ?
21. a) Describe the structure and applications of high temperature superconductors.
b) What are the main polymers used as commodity plastics ? Explain one of its methods of production and properties.
22. a) Explain the various methods of processing techniques for ceramic - matrix composites.
b) Briefly explain the microstructural features of fracture in ceramics.

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CHE 4E 05—INDUSTRIAL CATALYSIS

(2019 Admissions)

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Section A

Answer any eight questions.

Each question carries a weightage of 1.

1. Define isosteric heat of adsorption. How is it measured ?
2. Distinguish between activated and non-activated adsorption.
3. Unimolecular surface catalysed gas phase reactions follow first order kinetics at low pressures and zero order kinetics at high pressures. Why ?
4. Distinguish between reactant selectivity and product selectivity.
5. How do you determine pore size distribution of a catalyst ?
6. Explain 'Coking' of catalyst.
7. Explain with example 'immobilized biocatalysts'.
8. Quarternary ammonium salts are used as phase transfer catalysts. Why ?
9. Name two cracking catalysts in petroleum industry. Justify your answer.
10. What is MAO ? How does it function as catalyst ?

(8 × 1 = 8 weightage)

Turn over

Section B

Answer any six questions.

Each question carries a weightage of 2.

11. Draw potential energy curves for physisorption and chemisorption. Discuss.
12. Discuss mechanism of diffusion controlled reactions.
13. Briefly discuss shape selective catalysis by zeolites.
14. What are the mechanisms of catalyst poisoning ? Discuss.
15. Discuss application of PEG in phase transfer catalysis.
16. Write a brief account of the specific catalytic groups in enzyme catalysis.
17. Briefly discuss Mobil process for conversion of methanol to hydrocarbons.
18. Name one catalyst employed for hydroformylation. How does it function ?

(6 × 2 = 12 weightage)

Section C

Answer any two questions.

Each question carries a weightage of 5.

19. Briefly discuss Absolute Rate Theory as applied to chemisorption.
20. Briefly discuss electronic factors in catalysis by metals.
21. Write a brief account of the various methods for determination of surface acidity.
22. What are the methods for the determination of surface area of a solid ?

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CHE 4E 04—PETROCHEMICALS AND COSMETICS

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Section A*Answer any eight questions.**Each questions carries a weightage of 1.*

1. What is Cetane Number and what is its significance ?
2. What is natural gas and what are its components ?
3. Explain the terms: rectified spirit, methylated spirit, absolute alcohol and proof number of spirit.
4. Which are the sulfur compound present in crude petroleum ?
5. What are electric desalting plants ? What is their function ?
6. Which are the thinners and lacquers that are manufactured as petroleum products ?
7. Describe the alkaline purification method used in petroleum product industry.
8. What is aniline point and how is it determined ?
9. What are ionones ? Write the structure of two examples.
10. What is meant by 'fixing' of delicate odours in perfume preparation?

(8 × 1 = 8 weightage)

Section B*Answer any six questions.**Each question carries a weightage of 2.*

11. Describe the constituents of crude oil and the products that arise from its refining.

Turn over

12. Describe the source, composition and applications of natural gas. How can natural gas be liquefied ?
13. Write an account of the raw materials used in industrial organic manufacture.
14. Describe the methods used to determine the viscosity of petroleum.
15. Discuss the various types of columns used in petroleum distillation.
16. Describe the nature and composition of fuel and boiler oils. What are their uses ?
17. Explain the purification methods : (i) hydrorefining and (ii) demercaptanisation of petroleum product.
18. Describe the composition of a typical toothpaste formulation.

(6 × 2 = 12 weightage)

Section C

Answer any two questions.

Each question carries a weightage of 5.

19. Describe in detail the processes of : (i) cracking and (ii) reforming of petroleum.
20. Discuss the major chemical processes used in industrial organic synthesis.
21. Write short notes on : (i) Distillation curves of petroleum and (ii) heaters, boilers, condensers and heat exchangers used in crude petroleum distillation.
22. (a) Illustrate the structure and use of flowery and fruity odours in perfume preparation. How are these obtained ?
(b) What are skin chemicals ? Describe their ingredients.

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CHE 4C 12—INSTRUMENTAL METHODS OF ANALYSIS

(2019 Admissions)

Time : Three Hours

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Section A*Answer any eight questions.**Each question carries a weight of 1.*

1. Distinguish between accuracy and precision.
2. What is a metallochromic indicator ? Give two examples.
3. What is 'polarographic maxima' ? How it can be suppressed ?
4. Explain the principle of chronopotentiometry.
5. A solution exhibited an absorbance one ($A = 1$) at 520nm. Calculate the percentage of radiation absorbed by the solution.
6. Distinguish between SEM and TEM.
7. Comment on the complementary nature of TG and DTA.
8. Explain the significance of R_f -value in chromatography. How it is related to R_m -value.
9. Distinguish between co-precipitation and post-precipitation with suitable examples.
10. Calculate the standard deviation and coefficient of variation for the following set of analytical data for the estimation of Cu in a sample

Amount of copper : 35.46, 35.48, 35.49, 35.41, 35.47 mg.

(8 × 1 = 8 weightage)

Turn over

Section B

Answer any six questions.

Each question carries a weight of 2.

11. Discuss the application of the method of least squares for the evaluation of analytical data.
12. What are the essential requirements for a substance which can be used as an indicator in complexometric titrations? Explain.
13. Describe the advantages and disadvantages of dropping mercury electrode in polarography.
14. Give a brief account of the different types of amperometric titrations. Why this is a better method than polarographic method for quantitative analysis?
15. How does nephelometry differ from turbidimetry. Explain.
16. Briefly discuss the principle and applications of AFM.
17. Write a note on thermometric titrations.
18. What are the important detectors used in GC? Describe the working of any two such detectors.

(6 × 2 = 12 weightage)

Section C

Answer any two questions.

Each question carries a weight of 5.

19. What are the advantages and disadvantages of using organic precipitants in gravimetric analysis? Explain the application of oxine and cupferron in the gravimetric estimation of metal ions.
20. Outline the principle involved in polarography. Discuss the applications of this technique in qualitative and quantitative analysis.
21. Discuss the principle and important applications of atomic absorption spectrometry. What are the main differences between atomic absorption spectrometry and atomic emission spectrometry?
22. Write notes on :
 - (a) Auger electron spectroscopy.
 - (b) Neutron activation analysis.
 - (c) Thin layer chromatography.

(2 × 5 = 10 weightage)