Use separate answer scripts for each group

B.Sc. (Honours) Examination, 2025

Semester-VI (CBCS)

Chemistry (Honours)

CC-13

(Inorganic and Organic Chemistry- Theory)

Time: Three Hours **Full Marks: 60**

Questions are of value as indicated in the margin

Group-A (Marks: 30)

(Inorganic Chemistry)

Answer **any three** questions.

1. (a) What is organometallic compound? Is Wilkinson catalyst an organometallic compound? Justify.

(b) Give the chemical identity of the given organometallic compounds and mention their utilities: (i) Ziegler-Natta catalyst, (ii) Grub's first generation catalyst.

(c) Count the electron using oxidation number method of the compounds: (i) Bis(trihapto-allyl)di(μ-bromo)palladium, (ii) Dibromobis(μ-dimethyldimethylenephohonium)gold, (iii) Tricarbonyl(η^7-tropylium)molybdenum(1+).

(d) Write the IUPAC name of the compounds: (i) $K[\eta^2\text{-}C_2H_4)Cl_3]$, (ii) $Na_4[Fe(CN)_5(NOS)]$, and (iii) $[Fe(NO)(H_2O)_5]SO_4$.

2 + 2+3+3 = 10

2. (a) Define eighteen electron rule and why it is called EAN rule also?

(b) What are the suitable conditions to satisfy the eighteen electron rule?

(c) Find the metal-metal bond order in $[CpFe(CO)(NO)]_2$ and $[W(Cp)(\mu\text{-}Cl)(CO)_2]_2$.

(d) Deduce the structure of $Fe_2(CO)_9$, $Fe_3(CO)_{12}$, and $Co_4(CO)_{12}$.

2+3+2+3 = 10

3. (a) Differentiate hapticity and denticity?

(b) Calculate the hapticity and denticity of the underlined ligands. [CpFe(CO)(allyl)], TiCp$_4$

(c) What is ligand bound number (LBN)? Calculate LBN of involved metal in FeCp$_2$ and $(Fe(CN)_5(NO)]^{2-}$.

(d) Mention the nature of metal-ligand bond in ferrocene and draw the d-orbital splitting of iron in it.

2+ 4+2+2 = 10

4. (a) What is isolobal analogy? Write the extended statements of isolobal analogy.

(b) Find the followings: (i) isolobal borane of $Ru_6(CO)_{17}C$, (ii) hydrocarbon having analogous structure to that of P_4O_6, (iii) parallel organic compound of $Pt(PMe_3)_2\{CH=W(CO)_2Cp\}$.

(c) Among the species given bellow find the isolobal to CH_2.

$CpCr(CO)_2$, CpCu, $Ni(CO)_2$, $Cr(CO)_4$, $Fe(CO)_4$, $Ni(CO)_3$.

(d) Justify the isolobality between H & $Au(PR_3)$.

(1+2) + 3 + 2 + 2 = 10

5.(a) Calculate the Mn-C and C-O bond orders in the compounds $[Mn(CO)_6]^+$ and $[Mn(CO)_3(dien)]^+$ and compare CO stretching frequency. (dien = diethylenetriamine)

(b) What is Collman's reagent? How do you prepare it? Mention its importance.

(c) Differentiate linear and bent nitrosyls.

(d) State and explain Enemark-Feltham notation regarding nitrosyl chemistry with examples.

2.5x4 = 10

Group-B (Marks: 30)

(Organic Chemistry)

Answer **any three** questions.

1. (a) Outline the process of TCA cycle indicating the enzymes associated with the process. (b) What are the coenzymes associated with the enzyme complex 'pyruvate dehydrogenase? How do they function in conversion of pyruvate to acetyl coenzyme-A?

5+(2+3) = 10

2. Write short notes on (any four)

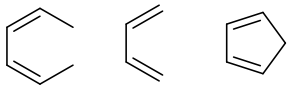
(a) Hydrogenation of oil. (b) Chloroquine. (c) Chloramphenicol. (d) Competitive inhibitor. (e) Alcoholic fermentation

2.5 x 4 = 10

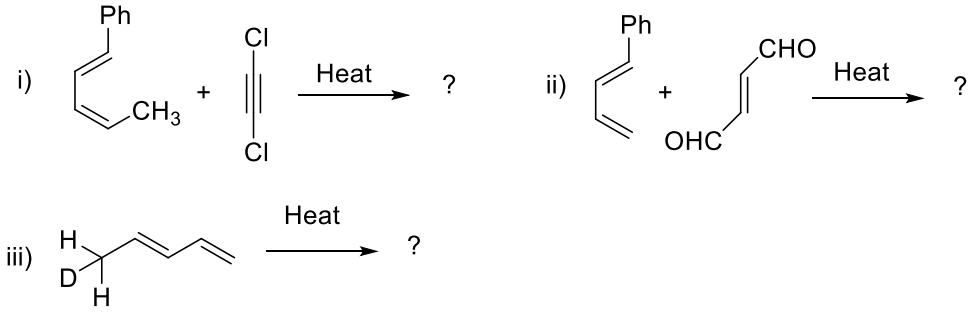
3. (a) Outline the processes that occur in Urea Cycle. (b) Sketch the pi molecular orbitals of the allyl system. Give electron occupancy in allyl cation, radical and ally anion.

5+5=10

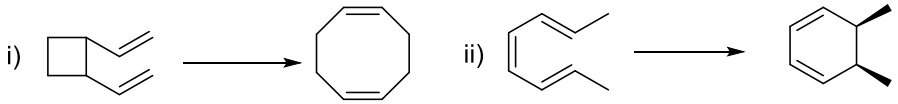
4.(a) Give the order of the rate of the following Diels-Alder reaction with for the following Dienes.



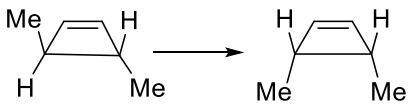
(b) Predict the product of the following reactions with proper stereochemistry where applicable.



(c) Write the reaction condition and type (with proper nomenclature) of the following reactions. How can you carry out the following conversion

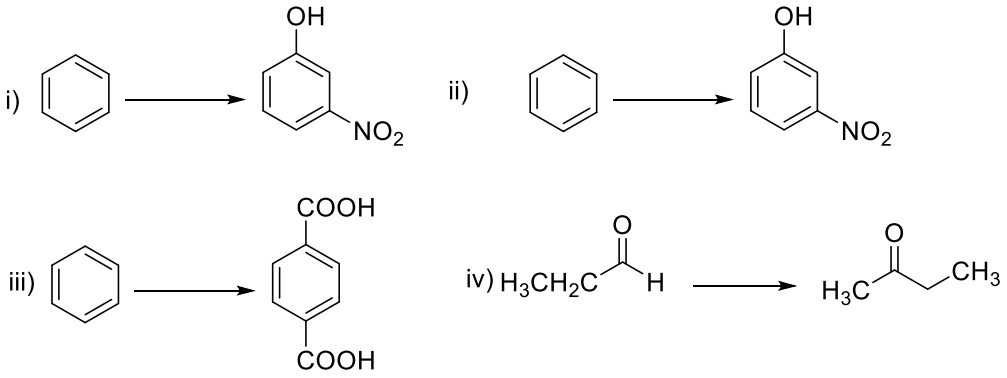


(d) How can you carry out the following conversion.



1+(1.5+1.5+1)+(1.5+1.5)+2=10

5.(a) What do you mean by Illogical disconnection in retrosynthesis? (b) Outline the synthesis with proper retrosynthesis analysis for the following conversion.



2+(2.5x4)=10

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B. Sc. Examination, 2025
Semester-VI
Chemistry
Course: DSE-Instrumental Methods of Chemical Analysis
Paper: DSE-12, Gr-A

Time: Three Hours **Full Marks: 40**

Questions are of value as indicated in the margin.
Answer *any four* questions

1. (a) Discuss the energy terms involved in PXRD, FT-IR, NMR spectroscopy.

   (b) How can you distinguish geometric isomers of N,O-donating organic ligand-directed Co(III)-complex through proton NMR spectroscopy ?

   (5+5)

2. (a) Write a brief comparative discussion on spectrophotometer and spectrometer.

   (b) How can you perform qualitative and quantitative analyses by the help of UV-Vis spectroscopy?

   (5+5)

3. (a) Write a short note on the basic aspect of EPR spectroscopy.

   (b) Briefly discuss about EPR spectroscopic outcome of $H^{\bullet}$ radical.

   (5+5)

4. (a) Discuss about atomic absorption spectroscopy (AAS).

   (b) Write the significance of Hollow Cathode Lamp in atomic absorption spectroscopy.

   (6+4)

5. (a) Write about ^{1}H, ^{31}P, ^{19}F NMR spectroscopic outcomes of HPF_2 molecules.

   (b) How can you find out the possibility of forming M(II)-complex of acetylacetone through NMR Spectroscopy?

   (6+4)

6. (a) How can you identify the crystalline and amorphous features of testing-samples through instrumental technique?

   (b) "Proton NMR spectral data shows that the hydride signal of $[Rh(PPh_3)_2(TPy)(H)]^+$ is found at -6.3 ppm (triplet)." Explore the structure.

   (c) What do you mean by 'A' and 'g' terms of EPR spectroscopy?

   (2+5+3)