2021

Full Marks - 60

Time - 2 hours

The figures in the right-hand margin indicate marks

Answer ***all*** questions

SECTION-A

1. Answer any ***three*** of the following within 50 words each : 4 × 3

   a) Write down the method of preparation and structure of Zeise's salt.

   b) Explain EAN rule.

   c) Write about the acetylation and alkylation reaction of ferrocene.

   d) What is the role of Ziegler-Natta catalyst ?

   e) Write short notes on Fischer Tropsch Reaction.

   f) Explain Borax bead test.

   g) What is trans effect ? Write the preparation of Cis-Platin from $[PtCl_4]^{2-}$.

   h) What is Kurnakov test ?

SECTION-B

2. Answer any ***three*** of the following within 200 words each : 16 × 3

   a) Discuss the nature of bonding in metal carbonyls. How does infrared spectroscopy help in Structure elucidation, describe with suitable examples ?

   b) What are organometallic compounds and describe the classification of organometallic compounds on the basis of their bond type ?

   c) Discuss the structural features of Methyl lithium. Explain the multicenter bonding in Methyl lithium (tetramer) and trialkyl aluminum (dimer).

   d) Write down the method of preparation of Ferrocence. Discuss its structure and aromaticity.

   e) What is hydroformylation reaction ? Discuss the mechanism for hydroformylation by Cobalt complex with suitable examples.

   f) Explain the Principle of Common ion effect and solubility products in inorganic qualitative analysis.

g) Explain in detail the mechanism of substitution reaction in Octahedral Complex.

h) Discuss the mechanism of nucleophilic substitution in square planner complexes. Explain its thermohynamic and kinetic stability.

2019

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

1. a) Discuss the various types of electronic transitions in organic molecules when energy is absorbed in UV region by complex organic molecules. 9

   b) Mention characteristic absorption bands of the Carbonyl group in the IR spectra of (i) CH_3COCH_3 (ii) CH_3CHO and (iii) $C_6H_5CO_2H$. 3

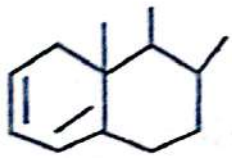
   c) Distinguish between Acetone and acetylene using IR spectra. 3

   OR

   d) Discuss the effect of H-bonding, Resonance and ring size on IR absorptions with suitable examples. 9

e) Name the electronic transitions possible when UV light is absorbed by (i) HCHO (ii) CH_4 and (iii) CH_3Cl. 3

f) Calculate the absorption maximum for the following compound using Woodward rules : 3



2. a) Discuss the basic principles of proton magnetic resonance. What is chemical shift, explain. 9

b) State the splitting pattern in case of ethyl bromide, CH_3–CH_2 Br. 3

c) Discuss the Fragmentation Pattern of neo-pentane. 3

OR

d) Discuss the basic principle of mass spectrometry with a diagram of instrumentation. 9

e) Write a note on anisotropic effect. 3

f) Discuss the Fragmentation Pattern of n-butane. 3

3. a) What is Kiliani-Fisher Synthesis ? What products are finally formed if you carry out two consecutive Kiliani-Fischer Synthesis on D-glyceraldehyde ? 9

b) Write short notes on the following : 3 + 3

i) Mutarotation

ii) Azodyes.

OR

c) Elucidate the structure of Maltose. 9

d) Write short notes on the following : 3 + 3

i) Triphenyl methane dyes

ii) Natural dyes.

4. a) Discuss Metallocene-based Ziegler-Natta polymerization of alkenes. 9

b) Write short notes on the following : 3 + 3

i) Biodegradable polymers

ii) Buna-S.

OR

c) Compare and explain the steps involved in cationic and anionic polymerization. Explain why cationic polymerization is an effective method of polymerizing

$CH_2 = C(CH_3)_2$ but not $CH_2 = CH_2$. 6 + 3

d) Write short notes on the following : 3 + 3

i) Thermo setting Plastics

ii) Conducting Polymers.

2021

Full Marks - 60

Time - 2 hours

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Answer ***all*** questions

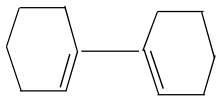
SECTION-A

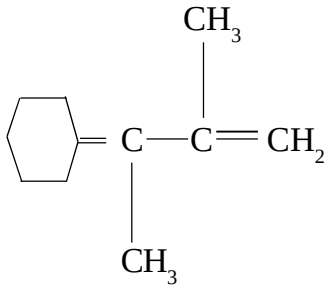
1. Answer any ***three*** of the following within 50 words each : 4 × 3

   a) i) Bathochromic effect

      ii) Hypochromic effect

   b) Applying Woodward rule to calculate the absorption maximum for the compounds :

      i) 

      ii) 

   c) Write about molecular ion and its features

   d) Write the fragmentation pattern of n-Butane

   e) Mutarotation

   f) Azodyes

   g) Conducting polymer

   h) Polyurethanes.

SECTION-B

2. Answer any ***three*** of the following within 200 words each : 16 × 3

   a) Define electronic spectroscopy. Discuss various type of electronic transition and explain the effect of solvent on electromic transition.

   b) What is Infrared spectroscopy ? Write a note on different modes of vibration in diatomic and polyatomic molecules.

   c) Discuss the basic principles of NMR spectroscopy. What information can be obtained from the NMR absorption peaks ? Explain with examples.

d) Illustrate the Basic principle of mass spectrosocpy. What do you mean metastable ions or peaks ? How metastable peaks are recognized in mass spectrum and discuss their importance.

e) Elucidate the structure Maltose.

f) What is Kiliani-Fisher Synthesis ? What products are finally formed if you carry out two consecutive Kiliani-Fisher Synthesis on D-glyceraldehyde ?

g) Discuss Metallocene-based Ziegler-Natta Polymerization of alkene.

h) Discuss the mechanism of free radical, Cationic and anionic polymerization.

2021

Full Marks - 60

Time - 2 hours

The figures in the right-hand margin indicate marks

Answer ***all*** questions

SECTION-A

1. Answer any ***three*** of the following within 50 words each : 4 × 3

   a) How hydrogen is manufactured by electrolytic process.

   b) Discuss the uses of helium, neon and argon.

   c) What is meant by smog ? Discuss the two types of smog, their causes and effects.

   d) How is stratospheric ozone layer formed in nature ?

   e) What do you understand by coagulation and flocculation ? Why are they necessary and what is their effect ?

   f) Emuerate the types of water pollutants.

   g) What are the alternative sources of energy.

   h) Write short notes on tidal energy.

SECTION-B

2. Answer any ***three*** of the following within 200 words each : 16 × 3

   a) Describe the manufacture, storage and uses of acetylene.

   b) Discuss the preparation of ultra-pure metals for semiconductor technology.

   c) What are the biotic and abiotic components of an ecosystem ? Discuss the models of energy flow in an ecosystem.

   d) What do you understand by the term air pollution ? What are the various health effects of air pollution on human beings ?

   e) What is hydrosphere ? Explain the hydrological cycle with a neat sketch.

f) Discuss the effluents that generates from textile industry. How these effluents are treated ?

g) "Nuclear power is the important source of energy", comment on the statement.

h) How geothermal energy used for generation of electrical power ? Discuss its advantages and disadvantages.

2020

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

1. a) Discuss the general methods of preparation of some mono-and binuclear carbonyls. 9

   b) What is synergic effect ? Explain with an example. 3

   c) Explain with example of any two six carbon bonded ligands. 3

OR

   d) Give the MO diagram of CO, Write the structures of Chromium Mononuclear Carbonyl and binuclear iron Carbonyl. 9

   e) Explain EAN rule. 3

   f) Define organometallic compounds and give two examples. 3

2. a) Describe the preparation, reactions and structure of ferrocene. 9

   b) Show the bonding structure in $(C_5H_5)_2$ Fe. 3

   c) What is the role of Ziegler-Natta Catalyst. 3

OR

   d) Discuss the role of trimethyl aluminium in polymerisation of ethene. 9

   e) What is Friedel-Crafts reaction. 3

   f) What is multicentre bonding is metal alkyls. 3

3. a) Describe the principles involved in the analysis of cations and anions. 9

   b) Explain borax bead test. 3

   c) What is catalyst ? Give the role of Wilkinson's catalyst. 3

OR

   d) Describe the application of solubility product principle in Quantitative analysis. 9

   e) What is the essence of Wacker process. 3

   f) Define common ion effect with an example. 3

4. a) Give an account of the mechanism of nucleophilic substitution in square planar complexes. 9

b) What is liabilizing effect. 3

c) What is D-mechanism ? Explain with example. 3

OR

d) What is trans effect and discuss its theories. Give the application of trans effect. 9

e) Explain the thermodynamic stability of an octahedral complex. 3

f) How do the SN^1 and SN^2 reaction differ. 3

2022

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

Part-I

1. Answer the following : 1×8

   a) Write the formula of Zeise's salt.

   b) Calculate the effective atomic number (EAN) of $Ni(CO)_4$.

   c) Write the structure of Grignard reagent in ether solution.

   d) Write the Zieglar-Natta catalyst used for preparation of polyethylene.

   e) Name the group reagent used to analyze various cations of Group-IIA.

   f) Write the formula of water gas.

   g) What is the incoming ligand in aquation reaction of octahedral complexes ?

   h) Write down the relation between stepwise and overall formation constants of metal complexes.

Part-II

2. Answer any ***eight*** of the following : $1\frac{1}{2} \times 8$

a) What do you mean by organometallic compounds ? Out of $Fe(C_6H_5)_2$ and NaCN, which one is not an organometallic compound.

b) Write the types of CO groups shown by the infrared (IR) spectra of $Fe_2(CO)_9$.

c) Explain the meaning of hapticity of organic ligand with one example.

d) What do you mean by Mannich condensation ?

e) What is the role of Ziegler-Natta catalyst ?

f) Draw the structure of Wilkinson's catalyst.

g) What is *trans* effect in square planar complexes ?

h) Comment on the effect of strength of metal-ligand bond in metal complexes on the rate of reaction and equilibrium constant value.

i) Write down the structure of *cis*-and *trans*-platin.

j) Find out the solubility product of Ag_2CrO_4 at 85°C, if the solubility of Ag_2CrO_4 is 8.0×10^{-5} moles/litre at 85°C.

Part-III

3. Answer any ***eight*** of the following : 2×8

a) The metal-metal bond distance in $Mn_2(CO)_{10}$ is longer than that in $Fe_2(CO)_9$. Explain.

b) Write the balanced chemical equation to prepare acetaldehyde through Wacker process.

c) Describe the π-acceptor behaviour of CO.

d) Write the chemical reactions involved for preparation of ferrocene in laboratory.

e) Write the structure of $Al_2(CH_3)_6$.

f) Calculate the solubility of $BaSO_4$ in 0.10M $BaCl_2$, if the solubility product of $BaSO_4$ is 1.5×10^{-9}.

g) What do you mean by kinetic stability and thermodynamic stability of metal complexes ?

h) Describe the effect of chelate ring on the stability of metal complexes.

j) Discuss the importance of Kurnakov test in square planar complexes with example.

i) Write the preparation of *cis*-platin from $[PtCl_4]^{2-}$.

Part-IV

4. a) Explain 18 electron rule in metal carbonyls with one suitable example. 2

b) Write down the method of preparation and structure of Zeise's salt. 4

OR

c) How can you prepare $Cr(CO)_6$ from $CrCl_3$? 2

d) Describe the structure of $Cr(CO)_6$ using VBT. 4

5. a) Write down the chemical reactions involved in iodination of ferrocene. 2

b) Discuss the acetylation and alkylation reactions of Ferrocene. 4

OR

c) Discuss the structural aspects of $(CH_3Li)_4$ in details. 6

6. a) Explain common ion effect with one suitable example. 2

b) Discuss the role of Wilkinson's catalyst in homogeneous hydrogenation of alkenes. 4

OR

c) Mention the role of NH_4OH solution for the analysis of group-V cations. 2

d) Describe the mechanism of Fischer Tropsch reaction. 4

7. a) Describe how the size and charge of the ligand influence the stability in metal complexes. 2

b) Discuss the details about π-bonding theory of *trans*-effect. 4

OR

c) Discuss the effect of metal ions on the stability of metal complexes. 2

d) Explain the associative and dissociative reaction mechanism for substitution reaction in octahedral complexes. 4

□□

2022

Full Marks - 60

Time - 3 hours

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Answer *all* questions

Part-I

1. Fill in the blanks with appropriate answer : 1×8

   a) The molecular formula of baking soda is ___.

   b) ___ acid is mostly found in acid rain.

   c) ___ is the topmost region of the atmosphere.

   d) Photchemical smog is generally formed in ___ season.

   e) ___ poisonous gas can bind faster with haemoglobin than oxygen.

   f) Coal, petroleum and natural gas are ___ fuels.

   g) Byproducts of radioactive materials that generates at nuclear power stations are called as ___.

   h) ___ are biocatalysts that increases rate of biochemical reactions in a living-system.

Part-II

2. Answer any ***eight*** of the following : $1\frac{1}{2} \times 8$

a) How is industrial oxygen separated from the air ?

b) Find product for the equation :
$Ca(OH)_2 + Cl_2 \rightarrow$

c) What is poling process in matuallurgy ?

d) What is the biogeochemical cycle in an ecosystem ?

e) Which oxides of nitrogen are responsible for air pollution ?

f) What does the conductivity test of drinking water indicate ?

g) What are the effluents from the electroplating industry ?

h) What are different clean sources of energy ?

i) What are the general characteristics of biocatalyst ?

j) What are the hazards in the fertilizer industry ?

Part-III

3. Answer any ***eight*** of the following : 2×8

a) What is Van Arkel method of obtaining ultra-pure metals ?

b) What is the enhanced greenhouse effect ?

c) How is hydrogen used as an energy source ?

d) What is the reverse osmosis-based water purification technique ?

e) How do biocatalysts help chemical industries in manufacturing ?

f) How is petroleom better than coal as a source of fuel ?

g) Define calorific values of fuels.

h) What are the applications and hazards of H_2O_2 ?

i) What is acid rain ? What are its consequences ?

j) How do nuclear accidents affect our environment ?

Part-IV

4 a) Write notes on industrial production, application, and uses of acetylene gas and highlight possible environmental hazards related to it. 6

OR

b) Give an account of preparation of various non-ferrous ultrapure metals and its uses for semiconductor technology.

5. a) What is biogeochemical cycles ? Explain biogeochemical cycle of nitrogen. 6

OR

b) Discuss the sources, sizes and chemical nature of various air pollutants. How air pollution due to SO_2 and NO_x can be controlled ?

6. a) What do you mean by water quality parameters of domestic water ? Write a short note on the ion-exchange method of water purification. 6

OR

b) What is hydrological cycle ? Discuss various processes and the impacts of water pollution on hydrologic cycle.

7. a) Explain conventional and non-conventional sources of energy. Discuss the advantages/ disadvantages of getting energy from hydrogen and geothermal souces of energy. 6

OR

b) What is biocatalysis ? Explain, how use of the biocatalysts in various industrial processes become revolutionary and one of the major components of green chemistry ?