SH CHE–13

2021

(6th Semester)

Time : 3 hours

Full Marks : 60

Answer from **both** the Sections as per instructions

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(INORGANIC CHEMISTRY)

SECTION – A

1. Answer *all* the bit questions : 2×6

(*a*) Give two examples of preparation of Syngas using metal carbonyl complexes.

(*b*) What is Shlenk equilibrium ?

(*c*) How will you prepare trans $[PtCl_2(NO_2)(NH_3)]^-$ from $[PtCl_4]^{-2}$?

(*d*) Arrange the following ligand in the decreasing order of trans effect :

Cl^-, Py, NH_3, Br^-

(*e*) What is the requirement of removal of interfering agent after group II analysis ?

(*f*) Predict the molecular formula of the carbonyls of Ni and Fe with the help of EAN rule. The oxidation state of Ni and Fe is zero in these carbonyls.

SECTION – B

Answer **all** questions : 12×4

2. (*a*) Discuss the molecular orbital theory for σ and π trans effect in $[PtCl_4]^{-2}$. 6

(*b*) Describe the various factors that influence the formation of complexes. 6

Or

(*a*) What do you understand by inert and labile complexes ? On the basis of valence bond theory explain the inertness and lability of octahedral complexes.

(*b*) What is trans effect ? Which theory of trans effect explains the following order of trans effect of inert ligands $F^- < Cl^- < Br^- < I^-$? 6

3. (*a*) Describe any two method of preparation of Ferrocene. Also describe briefly the structure of ferrocene. 6

(*b*) Briefly explain Mannich reaction. 6

Or

(*a*) What is Grignard reagent ? Describe the species present in ether solution of Grignard reagent and their structure. 6

(*b*) Discuss in detail the reactions of ferrocene (at least three reaction) which establish its aromatic character. 6

4. (*a*) What are organometallic compounds and mixed organometallic compounds ? How are these distinguished ? Give atleast two examples in each case. 6

(*b*) What is meant by hapticity of ligand ? How is it designated ? Show clearly that hapticity of a ligand varies from one organometallic compound to another. 6

Or

(*a*) Discuss the 18-electron rule. Apply this rule to calculate the effective atomic number of the metal in the following complex $(C_2H_4)Fe(CO)_3]$. 6

(*b*) Discuss the structure of $Fe_2(CO)_9$. 6

5. (*a*) Explain hydroformylation by suitable examples with special reference to the concept of selectivity in hydroformylation. 6

(*b*) What do you understand by alkene hydrogenation ? Explain it with suitable example. 6

Or

(*a*) What is Wacker process ? Give the mechanism for the reaction taking place in the process. 6

(*b*) Explain the industrial process, BASF oxo process and Exxom process for the hydroformylation reaction. 6

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(ORGANIC CHEMISTRY - V)

SECTION – A

1. Answer *all* questions : 2×6

(*a*) The UV spectrum of acetone shows absorption maxima at 166, 189 and 279 nm. What type of electronic transition is responsible for each of these ?

(*b*) How will you distinguish o-hydroxybenzaldehyde and m-hydroxy-benzaldehyde with the help of IR spectroscopy ?

(*c*) Arrange the following compounds in increasing order of deshielding of their methyl protons :

CH_3-CH_3, CH_3F, CH_3OCH_3, $(CH_3)_3N$

(*d*) Maltose is a disaccharide consists of

(*i*) Glucose and fructose
(*ii*) Glucose and galactose
(*iii*) Glucose and sucrose
(*iv*) Glucose and glucose

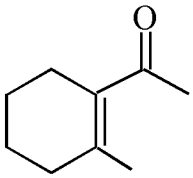
(*e*) Write the structure of Indigo dye.

(*f*) Draw the structure of Neoprene.

SECTION – B

Answer **all** questions : 12×4

2. (*a*) Calculate λ_{max} for the given compounds. 8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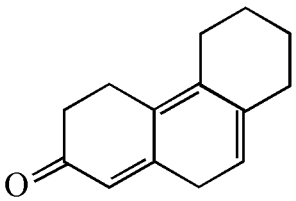
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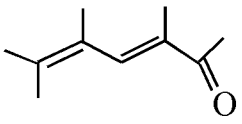
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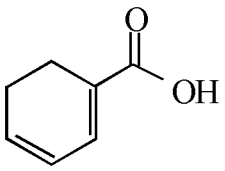

(*iv*)

(*b*) Write a short notes on : 4

Bathochromic shift and Hypsochromic shift.

Or

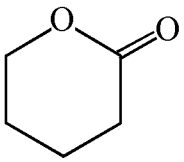
(*a*) Which of the following molecules are IR active and which are IR inactive ? 4

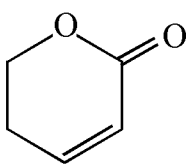
O_2, H_2, HCl, Cl_2, H_2O, C_2H_4, N_2

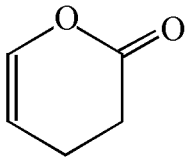
(*b*) Which of the following has the highest carbonyl streching frequency : 4

CH_3COOH, CH_3COCH_3, CH_3CHO, CH_3COCl, CH_3CONH_2

(*c*) The carbonyl stretching absorptions for the following lactones are 4







3. (*a*) Draw the structure of each of the following compounds which meets the given requirements in its PMR spectrum : 8

(*i*) $C_3H_3Cl_5$: one doublet and one triplet

(*ii*) $C_4H_{10}O$: one singlet, one doublet and one septet

(*iii*) C_4H_8O : one singlet, one triplet and one quartet

(*iv*) C_3H_7Cl : one doublet and one septet

(*b*) Write the factors affecting the chemical shifts. 4

Or

(*a*) Protons of a compound exhibit an NMR signal at δ 2.5. What will be the value of chemical shift of these protons in Hz if the spectrum is recorded on a 60 MHz spectrometer ? 4

(*b*) Write notes on : 8

(*i*) Metastable peaks

(*ii*) Molecular ion peak

(*iii*) Relative abundance of the parent and the fragment ions.

4. (*a*) Write the α and β anomer of Glucopyranose. 2

(*b*) Write the conversion of aldopentose to ketohexose. 6

(*c*) Draw the structure of Glucose and Galactose and show the epimeric carbon. 4

Or

Write the synthesis and applications of Methyl Orange and Phenolphthalein. 12

5. (*a*) Describe the Ziegler-Natta polymerisation of alkene in details. 6

(*b*) Give a short notes on Buna-S and Neoprene. 6

Or

(*a*) Write the preparation and applications of polyurethanes, PVC and polythene. 9

(*b*) Give the examples of biodegradable and conducting polymers. 3

SD CHE–03

2021

(6th Semester)

Time : 3 hours

Full Marks : 60

Answer from **both** the Sections as per direction

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(INDUSTRIAL CHEMICALS AND ENVIRONMENT)

SECTION – A

1. Answer *all* questions : 2×6

(*a*) What is calcination ?

(*b*) What will happen when potassium dichromate will react with concentrated sulphuric acid ?

(*c*) What is ozone hole ?

(*d*) What is dechlorination ?

(*e*) Name different methods for the purification of water.

(*f*) What is non-aqueous biocatalyst ?

SECTION – B

Answer **all** questions : 12×4

2. (*a*) Describe the extraction and applications of ultrapure silicon. 7

(*b*) How hydrogen peroxide is manufactured by electrolytic processes ? 5

Or

(*a*) How sulphur dioxide is purified ? Discuss the hazards associated with sulphur dioxide gases. 7

(*b*) How potassium dichromate is prepared from chromite ore ? 5

3. (*a*) How sulphur is separated from coal ? 5

(*b*) Discuss the components of ecosystem. How the ecosystems functions ? 7

Or

(*a*) How carbon dioxide is causing green house effect ? Explain. 5

(*b*) Discuss the effect of air pollution on human health and plants. 7

4. (*a*) Describe sewage treatment methods in details. 7

(*b*) Describe the process of eutrophication. 5

Or

(*a*) What is sludge ? Describe the different methods of sludge disposal. 7

(*b*) How water is purified by ozonisation ? 5

5. (*a*) What are the advantages and disadvantages of solid coal ? 7

(*b*) Describe hydrogen as ecofuel. 5

Or

(*a*) Briefly discuss various methods for enzyme immobilization. 7

(*b*) Discuss prevention and control of nuclear waste. 5

Or

(*a*) How metal carbonyls are prepared by reductive carbonylation and photochemical decomposition ? Give one example in each case. 6

(*b*) How does the presence of π-acceptor ligands increase the stability of octahedral complexes ? 6

5. (*a*) What is a synthesis gas ? How is it synthesized with the help of metal carbonyl complexes ? 6

(*b*) What is Wilkinson's catalyst ? Give the mechanism of alkene hydrogenation with the help of the catalyst ? 6

Or

(*a*) Give the mechanism involved in the Fischer-Tropsch process. How is it used for the manufacture of synthetic gasoline ? 6

(*b*) What are interfering anions ? Discuss the removal of phosphate, borates and fluorides. 6

SH CHE–13

2020

(6th Semester)

Time : 3 hours

Full Marks : 60

Answer from **both** the Sections as per direction

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(INORGANIC CHEMISTRY - IV)

SECTION – A

1. Answer *all* the bit questions : 2 × 6

(*a*) What is Wacker process ?

(*b*) State EAN rule.

(*c*) Describe one method for the preparation of ferrocene.

(*d*) What is the effect of strength of M-L bond on the rate of reaction and equilibrium constant ?

(*e*) What is the function of ammonium hydroxide as group reagent in Gr III analysis ?

(*f*) Draw the structure of $CO_2(CO)_8$ in solid state as well as in solution.

SECTION – B

Answer **all** questions : 12×4

2. (*a*) Describe various factors that affect the rate of substitution. 6

(*b*) Explain the difference between kinetic stability and thermodynamic stability with examples. 6

Or

(*a*) Discuss the mechanism of substitution reaction in octahedral complexes. 6

(*b*) What is trans effect ? How will you prepare cis$[PtCl_2(NH_3)_2]$ from $Pt[Cl_4]^{2-}$? 6

3. (*a*) Give laboratory preparation of ferrocene. Compare the aromaticity of ferrocene with benzene. 6

(*b*) Discuss the multicenter bonding in methyl lithium and trialkyl aluminium. 6

Or

(*a*) How does ferrocene give acylation, alkylation reaction ? Discuss with example. 6

(*b*) Explain the bonding in ferrocene using molecular orbital theory. 6

4. (*a*) How are organometallic compounds classified on the basis of their bond type ? Explain with examples. 6

(*b*) Give the structure and synergic effect of Zeise salt. 6

(*c*) Write the synthesis and applications of Malachite green. 3

Or

(*a*) Draw the cyclic structure of Glucose and Fructose and determine their absolute configuration. 3

(*b*) Write short notes on mutarotation and Ruff degradation. 6

(*c*) Elucidate the synthesis of Fluorescein. 3

5. Write the synthesis and application of one thermo-setting and one thermo softening plastic. 12

Or

Write short notes on : 12

(*i*) Addition polymerisation

(*ii*) Condensation polymerisation

(*iii*) Biodegradable polymer

(*iv*) Conducting polymer.

2020

(6th Semester)

Time : 3 hours

Full Marks : 60

Answer from **both** the Sections as per direction

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(ORGANIC CHEMISTRY-V)

SECTION – A

1. Answer *all* questions : 2 × 6

(*a*) Give two examples of chromophore and auxochrome.

(*b*) Write the C-H and C-C stretching frequency of 1-Butyne and 2-Butyne.

(*c*) Distinguish acetaldehyde and acetone by ^1H NMR spectroscopy.

(*d*) What is epimer and anomer ?

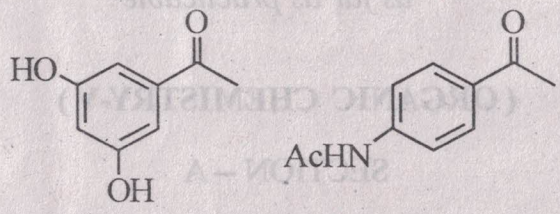
(*e*) Give the examples of edible dyes.

(*f*) Write the structure of Buna-S.

SECTION – B

Answer **all** questions : 12 × 4

2. (*a*) Calculate the absorption maximum for the following compounds : 6



(*b*) Distinguish between the following pairs of compounds with the help of infrared technique : 6

(*i*) Cis and trans cinnamic acid

(*ii*) Ethanol and ethylamine.

Or

(*a*) Discuss various factors influences the vibrational frequency. 6

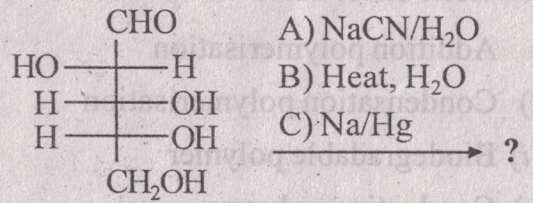
(*b*) Write a detailed account of the various types of transitions involved in the ultra-violet spectrum. What is the effect of hydrogen bonding on UV absorption ? 6

3. Write the anisotropic effects in alkene, alkyne, aldehyde and aromatics. 12

Or

Write the principles and instrumentation of Mass spectrometry. 12

4. (*a*) Give the product in the given reaction : 3



(*b*) Draw the structure of starch and cellulose. 6

(*b*) Describe the management of radioactive waste. 5

Or

(*a*) Describe the working of nuclear reactor. 7

(*b*) Why coal is known as conventional non-renewable source of energy ? 5

SD CHE–0

2020

(6th Semester)

Time : 3 hours

Full Marks : 60

Answer from **both** the Sections as per direction

The figures in the right-hand margin indicate marks

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(INDUSTRIAL CHEMICALS AND ENVIRONMENT)

SECTION – A

1. Answer *all* questions : 2 × 6

(*a*) What is LPG and LNG ?

(*b*) How sulphur dioxide can be prepared from calcium sulphate ?

(*c*) Define ecosystem.

(*d*) What is thermal pollution ?

(*e*) What is synfuel ?

(*f*) How ultrasound purifies water ?

SECTION – B

Answer **all** questions : 12 × 4

2. (*a*) How chlorine is prepared from brine electrolysis ? Describe the hazards associated with chlorine gas ? 7

(*b*) Discuss the manufacture of steel. 5

Or

(*a*) Write different commercial form of iron. Describe the process of manufacture of Cast iron. 7

(*b*) Discuss the problem of storage and handling of acetylene gas. 5

3. (*a*) What do you mean by atmospheric pollutants ? What is particulate matter pollution ? 5

(*b*) Describe major regions of atmosphere and their importance. 7

Or

(*a*) Describe the photochemical reaction of sulphur dioxide. 5

(*b*) Describe the high temperature carbonisation of Coal. 7

4. (*a*) How water is purified by reverse osmosis ? 5

(*b*) Discuss the treatment and disposal of industrial waste. 7

Or

(*a*) How water pollutions are measured by chemical methods ? 7

(*b*) How ion exchange method helps in the purification of water ? 5

5. (*a*) What are the advantages and disadvantages of natural gas ? 7

(*d*) Discuss the structure of $Fe_2(CO)_9$. 6

5. (*a*) What do you mean by alkene hydrogenation ? Explain it by suitable examples. 2 + 4

(*b*) What is Wacker process ? Give the mechanism for the reaction taking place in the process. 2 + 4

Or

(*c*) Explain hydroformylation. Describe the role of steric effect on it. 2 + 4

(*d*) What is Fischer-Tropsch reaction ? Give the mechanism of the various steps involved in the synthesis of gasoline. 2 + 4

SH CHE—13

2019

(6th Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer from **both** the Sections as per direction

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Candidates are required to answer in their own words as far as practicable

(INORGANIC CHEMISTRY-IV)

SECTION–A

1. Answer *all* the bit questions : 2×6

(*a*) What is meant by hapticity ?

(*b*) What do you mean by 18-electron rule ?

(*c*) Describe X-ray structure of ferrocene.

(*d*) How will you explain the three centre bonding in trimethyl aluminium ?

(*e*) What is Wilkinson's catalyst ? How does it work ?

(*f*) What is Thumb's rule ?

SECTION – B

Answer all questions : 12 × 4

2. (*a*) State and explain kinetic stability. 2 + 2

(*b*) Describe various factors that influence the formation of complexes. 4

(*c*) Explain kinetics of octahedral substitution reactions. 4

Or

(*d*) What do you mean by thermodynamic stability ? Explain with example. 2 + 2

(*e*) What is trans effect ? 4

(*f*) Describe the substitution reactions of square planar complexes. 4

3. (*a*) Describe the role of triethyl aluminium in polymerisation of ether by Ziegler-Natta catalyst. 6

(*b*) Describe a method of preparation of ferrocene. How does it give alkylation and acylation ? 2 + 2 + 2

Or

(*c*) Describe Mannich reaction. 6

(*d*) Discuss the structure and aromaticity of ferrocene. 3 + 3

4. (*a*) Give the preparation and structure of Zeise salt. 3 + 3

(*b*) State and explain EAN rule. Calculate the effective atomic number of $CH_3Mn(CO)_5$. 2 + 2 + 2

Or

(*c*) Explain the π-acceptor behaviour of CO with the help of molecular orbital concept. 6

SH CHE–14

2019

(6th Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

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(ORGANIC CHEMISTRY-V)

SECTION – A

1. Answer *all* questions : 2 × 6

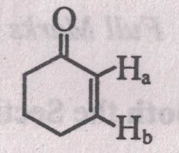
(*a*) Arrange the following electronic transitions in order of their decreasing energy :

$\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$, $\sigma \rightarrow \sigma^*$, $n \rightarrow \sigma^*$

(*b*) Using IR spectroscopy, how will you distinguish the following isomeric compounds :

CH_3CH_2OH and $CH_3 - O - CH_3$

(*c*) In the following compound which proton will absorb at lower field ? Explain.



(*d*) Give evidences to show that D(–)-Fructose is a ketohexose.

(*e*) What are the essentials of a coloured substance to act as dye ?

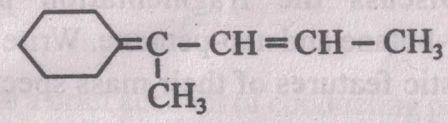
(*f*) What are biodegradable polymers ? Name any two biodegradable polymers.

SECTION – B

Answer **all** questions : 12×4

2. (*a*) Write the various types of electronic transition involved in the ultra-violet spectrum. Discuss the solvent effects on each type of these transitions. $2 + 6$

(*b*) By applying Woodward Rule calculate λ_{max} of the following compound : 4



Or

(*c*) **Discuss the various modes of vibrations in polyatomic molecule.** 8

(*d*) **Describe some characteristic IR absorption bands with their probable region and intensity with respect to the following compounds :** 4

(*i*) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_3$

(*ii*) $C_2H_5NH_2$

3. (*a*) What do you mean by chemical shift ? What is the effect of hydrogen bonding on the chemical shift ? $3 + 4$

(*b*) Write a note on spin-spin coupling. 5

Or

(*c*) Discuss the fragmentation pattern of *n*-butane and neo-pentane. Write characteristic features of their mass spectra. 8

(*d*) Write a note on metastable ions. 4

4. (*a*) Write a note on Mutarotation. $3\frac{1}{2}$

(*b*) How can D(–)-Fructose be converted to D(+)-Glucose ? $3\frac{1}{2}$

(*c*) Discusss the ring size of D(+)-Glucose. 5

Or

(*d*) What are Mordant and Vat dyes ? How are they applied to the fabric ? 4

(*e*) How methyl orange can be prepared ? Explain with mechanism. 4

(*f*) Write a note on edible dye. 4

5. (*a*) Discuss the mechanism of Cationic, Anionic and Free Radical addition polymerisation. 9

(*b*) How is nylon 6, 6 prepared ? 3

Or

(*c*) Give a brief account of conducting polymers. 8

(*d*) Write a note on vulcanization of rubber. 4

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5. (*a*) What are advantage and disadvantages of fossil fuel ? 4

(*b*) Discuss the environmental consequences involved in hydropower generation. 4

(*c*) Discuss the adverse effects of radioactive pollution. 4

Or

(*d*) How solar energy can be used to generate electricity ? 6

(*e*) Biocatalysis is a green process. Explain. 6

SD CHE–03

2019

(6th Semester)

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Full Marks : 60

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(INDUSTRIAL CHEMICALS AND ENVIRONMENT)

SECTION–A

1. Answer *all* questions : 2 × 6

(*a*) What happens when diluted ammonium nitrite is heated ?

(*b*) Write the applications of ultra pure silicon.

(*c*) What is the role of helium in the magnetic resonance imaging machines ?

(*d*) What do you mean by primary and secondary pollutants ?

(*e*) What are the advantages of ozonisation over chlorification in the purification of water ?

(*f*) Explain nuclear fusion.

SECTION – B

Answer **all** questions : 12 × 4

2. (*a*) How nitric acid is manufactured from ammonia ? Discuss the hazards in handling the nitric acid. 6 + 2

(*b*) Discuss the industrial method of preparation of bleaching powder. 4

Or

(*c*) What do you mean by non-ferrous metals ? Discuss the different steps involved in the preparation of non-ferrous metal. 2 + 6

(*d*) Outline the principles involved in manufacture of Wrought iron. 4

3. (*a*) What are different segments of environment ? Describe the photo-chemical reactions involving oxides of nitrogen in the atmosphere. 2 + 6

(*b*) Discuss the chemistry of ozone layer depletion. 4

Or

(*c*) Write a note on Nitrogen cycle. 5

(*d*) How CO_2 is responsible for global warming ? Write briefly the effect of global warming. 3 + 4

4. (*a*) What are major sources of water pollution ? How the effluents of fertilizer industries are treated ? 2 + 6

(*b*) How water is purified by bleaching powder ? 4

Or

(*c*) Write a note on 'Hydrological Cycle'. 5

(*d*) Discuss different methods of sludge disposal. 7