TDC (CBCS) Even Semester Exam., 2024

CHEMISTRY

(6th Semester)

Course No. : CHMHCC-601T

**[Organometallic Chemistry
(Inorganic Chemistry)]**

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

UNIT—I

1. Answer any *two* questions from the following : 2×2=4

(a) Define organometallic compounds. Identify the nature of metal-ligand bond in the following organometallic compounds : 1+1=2

(i) $(C_2H_5)_4Zn$

(ii) $(\eta^6\text{-}C_6H_6)_2Cr$

(b) What is the hapticity of the ligand in the given complex? Mention the maximum hapticity possible with this ligand : 1+1=2

(c) Using $18e^-$ rule as guide, determine the values of n in the following complexes : 1+1=2

(i) $(\eta^5\text{-}C_p)Co(C_nH_n)$

(ii) $[(\eta^5\text{-}C_p)Fe(CO)_n]_2$ having one Fe—Fe single bond

2. Answer any *one* question from the following : 6

(a) (i) What is meant by π-acidity? 1

(ii) Is CO a stronger π-acid ligand as compared to NO^+? Justify your answer. ½+½=1

(iii) What is synergic effect? How does it account for the formation of carbonyls with transition metals in low oxidation states? 1+3=4

(b) (i) Draw the structures of the following complexes following EAN rule : 1×2=2

(1) $Mn_2(CO)_{10}$

(2) $(\eta^4\text{-}C_4H_4)Fe(CO)_3$

(ii) Why is direct nitration of ferrocene not possible? How can you get the nitro derivative of ferrocene? 1+1=2

(iii) Draw the structures of ferrocene in solid and gaseous states. 2

UNIT—II

3. Answer any *two* questions from the following : 2×2=4

(a) Draw the structure of methyl lithium. What are the coordination numbers of Li and C in methyl lithium? 1+1=2

(b) Write the composition of Ziegler-Natta catalyst. Mention its use. 1+1=2

(c) Write the synthesis of the cobalt catalyst used in the hydroformylation reaction. 2

4. Answer any *one* question from the following : 6

(a) (i) What is Grignard reagent? Why is diethylether an especially good solvent for the preparation of Grignard reagent? 1+2=3

(ii) What is Schlenk equilibrium? Explain. 2

(iii) Write the limitations of Grignard reaction. 1

(b) Both $AlEt_3$ and $AlCl_3$ dimerize but the nature of alkyl bridging and halide bridging in the dimers are different. Justify. 6

UNIT—III

5. Answer any *two* questions from the following : 2×2=4

(a) Show the stereochemistry of substitution in the following reaction :

$$[PtCl_4]^{2-} \xrightarrow{NO_2^-} ? \xrightarrow{NH_3} ?$$

(b) Define thermodynamic and kinetic stabilities of complexes.

(c) Define electrophilic substitution reaction in octahedral complexes. Give a suitable example. 1+1=2

6. Answer any *one* question from the following : 6

(a) (i) What is *trans*-effect? Explain *trans*-effect in the light of electrostatic polarization theory. 1+3=4

(ii) What do you mean by aquation and anation reaction in octahedral complexes? Give suitable examples. 2

(b) Discuss the mechanism of nucleophilic substitution reactions in octahedral complexes and also mention the stereochemistry of the intermediates. 6

UNIT—IV

7. Answer any *two* questions from the following : 2×2=4

(a) Draw and explain the structure of Wilkinson catalyst.

(b) Define oxidative addition reaction. Give example. 1+1=2

(c) Write the limitations of cobalt catalysts mediated hydroformylation reaction.

8. Answer any *one* question from the following : 6

(a) (i) What is synthesis gas? Mention a few sources of synthesis gas. 1+1=2

(ii) Discuss the mechanistic pathway involved in the production of synthesis gas using metal carbonyl complexes. 4

(b) (i) What is Fischer-Tropsch process? Mention the catalysts used in this process. 1+1=2

(ii) Explain the most plausible mechanism for this process. 4

UNIT—V

9. Answer any *two* questions from the following : 2×2=4

(a) Define common ion effect.

(b) Write the chemistry of removal of BO_3^{3-} from the solution during qualitative analysis of a salt mixture.

(c) What happens to the solubility of Ag_2CO_3 in water on addition of $AgNO_3$? Explain. 1+1=2

10. Answer any *one* question from the following : 6

(a) *(i)* Explain how common ion effect helps in precipitation of Group–III hydroxides. 2

(ii) When 0·01 *M* HCl solution is added to a 0·01 *M* $Pb(NO_3)_2$ solution, will a precipitate of $PbCl_2$ be formed or not? Given, K_{sp} for $PbCl_2 = 1{\cdot}6\times10^{-5}$. 3

(iii) Mention the group reagents used for analyzing the following cations : 1

(1) Zn^{2+}

(2) Mg^{2+}

(b) *(i)* Explain how a buffer solution resists change in pH. 3

(ii) (1) Write the difference between ionic product and solubility product. 1

(2) Discuss the cause of interference of some acid radicals in inorganic qualitative analysis. 2

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