PG Odd Semester (CBCS) Exam., December—2017

CHEMISTRY

(3rd Semester)

Course No. : CHMCC–301

(Inorganic Chemistry—III)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

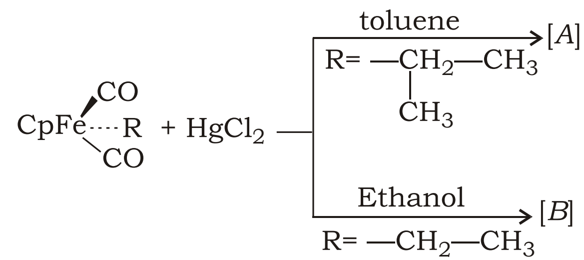
Answer **five** questions, selecting **one** from each Unit

UNIT—I

1. *(a)* Furnish four different synthetic routes to obtain metal-carbon sigma bonded organometallic compounds. 1×4=4

(b) Explain agostic interaction of a transition metal complex (d^0) citing suitable example. Why does -elimination not occur in this complex? 2+1=3

(c) Write down the products for the following reactions (give structure) : 1×3=3

(i) 

(ii) $Mn(CO)_4CH_3 + C_6H_5N{=}NC_6H_5$ 100 C ?

(iii) $Pt_2(dmpm)Me_4 + 2MeI$?

(d) Illustrate the application of alkylidene complexes in—

(i) ring-opening metathesis polymerization (ROMP);

(ii) synthesis of metallacyclobutene. 2+2=4

2. *(a)* $Pb(C_2H_5)_4$ is stable up to 200 °C while $Ti(C_2H_5)_4$ is unstable and decomposes at – 80 °C despite the fact that Pb—C bond energy (~ 170 kJ/mol) is lower than Ti—C bond energy (~ 260 kJ/mol). Explain. 3

(b) "Indenyl complexes are more reactive than cyclopentadienyl analogue." Explain with suitable examples. 2

(c) Find out the second row transition metal elements (*M*) following a suitable valence electron count : 1×3=3

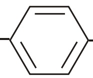
(i) $[M(CO)_5PF_3]$

(ii) $[M_2(CO)_2(\ —Cl)_2Cl_2]$

(iii) $[M_3(CO)_{12}]$ (three *M*—*M* bonds)

(d) Write the product and give explanation for the following reactions : 2+2=4

(i) $Cp_2Ti(PMe_3)_2$ +  $\xrightarrow{—PMe_3}$?

(ii) $Cp(CO)_2W{\equiv}C—$  —Me + Me—C≡C—Me $\xrightarrow{\text{1 bar CO}}$?

(e) Explain the *M*—*M* bonding in

$$[Mo_2(SO_4)_4]^4$$

using *d*-orbital overlap. 2

UNIT—II

3. (a) Write the advantages of homogeneous catalyst over heterogeneous catalyst. 2

(b) Explain the mechanism of this oxidative addition reaction of $IrCl(CO)(PPh_3)_2$ with HCl in polar and non-polar solvents. 3

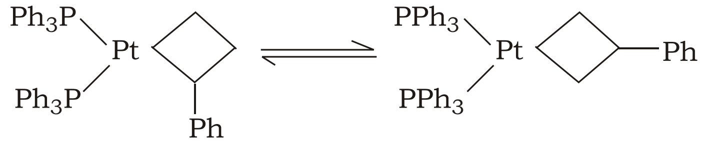
(c) Identify the following reactions by type and predict the products : 2×3=6

(i) $CH_3Mn(CO)_5$ SO_2 ?

(ii) $HIrCl_2(PPh_3)_2$?

(iii) $CpMo(CO)_3Me$ + CN ?

(d) Suggest a plausible mechanism for the following reaction : 3



4. (a) Propose a mechanism for the stoichiometric decarbonylation of $C_6H_5CH_2C(O)Cl$ by Rh $(PPh_3)_3Cl$ giving benzyl chloride. 5

(b) Write the product and give explanation of the following reactions : 2+2=4

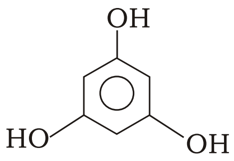
(i) $^5\text{-}C_5H_5—(CO)_2Fe—CHRCH_2R \underset{BH_4^-}{\overset{Ph_3C^+BF_4^-}{\rightleftharpoons}}$

(ii) $Pt(PPh_3)_3 + CF_3I \longrightarrow$

(c) Describe the mechanism of hydrogenation of alkenes using Wilkinson's catalyst. What is the advantage of Wilkinson's catalyst over other catalyst used for hydrogenation? 5

UNIT—III

5. *(a)* Deduce the point group of the following species : 2×3=6

(i) 

(ii) $Co_4(Cp)_4$

(iii) PF_3Cl_2 (one Cl axial and one Cl equatorial)

(b) Work out all the associated symmetry operations that can be generated from S_3. 3

(c) Using $POCl_3$ as an example, develop the reducible representation of its point group. 5

6. *(a)* Define 'similarity transformation'. Taking the case of a C_{3v} point group, show that $C_3^1 \quad {}_v \, C_3^2 \qquad {}_v$. 5

(b) Work out the point group of—

(i) ClF_2;

(ii) IF_5. 2

(c) Work out the character representation of hybrid orbitals of H_2O and then deduce the irreducible representations (IR). From this, comment on the type of hybrid orbitals involved. 7

UNIT—IV

7. *(a)* Briefly discuss the principle of proportional counter. 3

(b) Draw the variation of pulse size with applied voltage for and particles and explain. 5

(c) Discuss the prospects and limitations of nuclear fusion as a source of energy. 6

8. *(a)* What do you mean by *Q*-value of a nuclear reaction? Explain the significance of a positive and a negative *Q*-value. Find out the threshold energy for the reaction $^{11}B(d, p)^{12}B$ where Q 1 136 MeV. 1+2+2=5

(b) Briefly discuss the scintillation methods for radiation detection and counting. 6

(c) Write a short note on any *one* of the following : 3

(i) Nuclear cross-section

(ii) Spallation reaction

UNIT—V

9. *(a)* What is carrier mediated trasport? Point out the specific factors required to design a carrier molecule. Explain by taking a suitable example 'proton-coupled transport in a pH gradient'. 1+3+3=7

(b) What is co-catalysis? Explain co-catalysis process by taking a suitable example. 1+3=4

(c) Briefly explain the light conversion molecular devices by using a suitable example. 3

10. *(a)* What are switching devices? Write down the main components of switching devices and their roles. Explain photoelectro switching process. 1+4+4=9

(b) Define self-assembly in supramolecular chemistry. Explain metal directed self-assembly process by taking a suitable example. 5

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