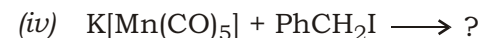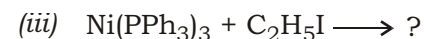CHEMISTRY

(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)* What is meant by organometallic compound? Write down different strategies to obtain kinetically stable organometallic compounds. 1+4=5

(b) Write down the products for the following (give structures) : 1×4=4

   (i) $WCl_6 + LiMe \longrightarrow$?

   (ii) $[CpIrCl_2]_2 \xrightarrow[\ [O]\ ]{AlMe_3}$?

   (iii) $Ni(PPh_3)_3 + C_2H_5I \longrightarrow$?

   (iv) $K[Mn(CO)_5] + PhCH_2I \longrightarrow$?

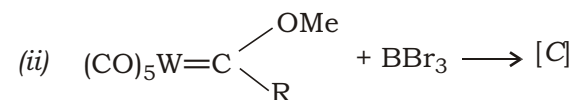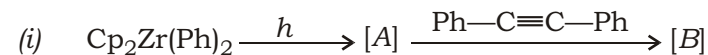*(c)* Illustrate the MO diagram showing d orbital overlap between metal atoms of $[Os_2Cl_8]^2$. Predict the bond order and draw the most stable structure. 3+1+1=5

2. *(a)* Determine the total valence electrons (TVEs) of the following compounds and comment on their isolobal relationship : 1×4=4

   (i) $[(\eta^5\text{-}C_5H_5)Fe(CO)_2]$

   (ii) $[CoH(\eta^8\text{-}C_8H_8)]$

   (iii) $[Pt(Ph)(CO)Cl_2]$

   (iv) $[Mn(CO)_6]$
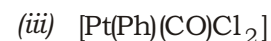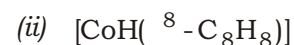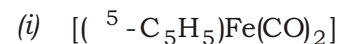
(b) Taking suitable example, show how the change in ligands and metals influence the steric saturation in organometallic compounds. 3

(c) Give products of the following reactions : 1×2=2

   (i) $Cp_2Zr(Ph)_2 \xrightarrow{h} [A] \xrightarrow{Ph—C\equiv C—Ph} [B]$

   (ii) $(CO)_5W{=}C\overset{OMe}{\underset{R}{\diagdown}} + BBr_3 \longrightarrow [C]$
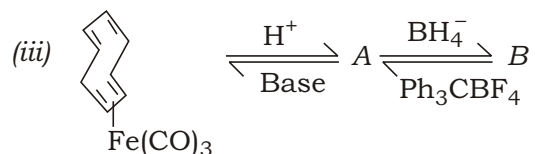
(3)

(d) Give a schematic route to obtain Schrock-alkylidene compound from Fischer-carbene compound. How does Fischer-type compounds differ from Schrock-type compounds? Discuss the bonding in Schrock-type organometallic compounds. $1\frac{1}{2}+2+1\frac{1}{2}=5$

UNIT—II

3. (a) What is meant by 'coordinative unsaturation'? How is it related to catalytic properties of inorganic complexes? Furnish two examples. $1+2+2=5$

(b) Write the products and comment on the following reactions : $2\times3=6$

(i) $Fe(CO)_5 + OH^- \longrightarrow A \xrightarrow{\ OH^-\ } B + C$

(ii) $[Rh(CO)_2Cl_2] + CH_3I \longrightarrow A$

(iii) (structure with $Fe(CO)_3$) $\underset{Base}{\overset{H^+}{\rightleftharpoons}} A \underset{Ph_3CBF_4}{\overset{BH_4^-}{\longrightarrow}} B$

(c) Suggest a plausible mechanism for the oxidative addition of H_2 to metal complexes. 3

(4)

4. (a) The rate of reaction of O_2 with *trans*-$IrX(CO)(PPh_3)_2$ in benzene decreases in the order X I Br Cl N_3 F. Explain the observation. 4

(b) Furnish the products of the following reactions and predict the probable structure : $1\frac{1}{2}\times2=3$

(i) $IrCl(CO)(PR_3)$ H_2S ?

(ii) $CH_3Rh(PPh_3)_2$?

(c) Briefly discuss Ziegler-Natta catalysis for polymerization of alkene. 4

(d) Write a note on insertion reaction. 3

UNIT—III

5. (a) Deduce the symmetry point group notation for a planar *cis*- and *trans*-$PtCl_2X_2$. 4

(b) Develop the matrix for an inversion (i) operation performed on a vector having coordinates (x_1, y_1, z_1). 4

(c) Work out the point group symmetry of the following : 6

PF_3Cl_2, $MnBr(CO)_5$, $S_2O_3^{2-}$

(5)

6. *(a)* Furnish the symmetry point groups of the following (explain with suitable illustrations) : 4

$$S_8, CuCl_4^{2}$$

(b) What is meant by character of a symmetry element? Define dimension of representation. What is the dimension of C_2 in a C_{2v} point group? 3

(c) Show using figurative illustration for C_{3v} point group

$$_vC_3^{1} \quad _v \quad C_3^{2}$$ 3

(d) Show that

$$\sum_{k} \chi_i^{2}(R) \quad h$$

where symbols have their usual significance in relation GOT. 4

UNIT—IV

7. *(a)* Discuss the principle of ionization chamber for radiation measurements. Why is signal amplification needed in this technique? 3+2=5

(b) Discuss the energetics of nuclear fission. 5

(6)

(c) Explain the concept and utility of nuclear reaction cross section. 4

8. *(a)* Explain the photochemical process in an inorganic scintillator. 4

(b) Discuss briefly the principle of Ge (Li) detector. Write down its advantages and disadvantages over NaI (Tl) detector. 4+3=7

(c) Write a short note on any *one* of the following : 3
   (i) GM counter
   (ii) Nuclear fusion

UNIT—V

9. *(a)* What is meant by molecular recognition? Write down the factors for high recognition. How can a spherical macrocyclic cryptand be useful for spherical, tetrahedral and anion recognition? Explain by taking suitable examples.
1+2+4=7

(b) ATP hydrolysis can be catalyzed by the protonated macrocyclic polyamines. Briefly discuss. 3

(7)

(c) Discuss light driven ($2e^-$ $2H^+$) symport across a membrane via quinone carrier molecule, vitamin K_3.　　　4

10. (a) Dithienylethene system bearing two phenol groups shows the dual mode of optical-electrical switching process. Explain.　　　4

(b) Show schematically the processes involved in supramolecular photo-chemistry. Explain A-ET-E process by taking a suitable example.　　2+2=4

(c) Hydrogen bonds have been used to drive the formation of rotaxanes and catenanes. Briefly discuss.　　　6

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