DPP-03

SOLUTIONS

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1. $[Fe(H_2O)_5NO]^{2+}$

Brown ring is formed when NO_3^- containing solution is treated with $FeSO_4$ followed by addition of conc. H_2SO_4.

$$NO \rightarrow NO^+ + e^-$$
$$Fe^{2+} + e^- \rightarrow Fe^+$$

Thus, EAN of Fe $=$ Z $-$ oxidation state $+2 \times$ (coordination number)

$$= 26 - 1 + 12 = 37$$

Hence, Complex has Fe – N linkage

2. The nearest inert gas of Pt is Rn, the total electrons in Rn is 86 . By calculating the EAN of Pt in the complex, $[Pt(ox)(py_2)(O_2)(H_2O)]$. EAN $=$ Z $-$ ON $+ (2 \times$ L) Where, Z is atomic number, ON is oxidation state on central metal, and L is ligand.

$$Pt = Z - ON + (2 \times L)$$
$$= 78 - 4 + (2 \times 6)$$
$$= 86$$

Ox is a bidentate complex with an octahedral structure in this complex and all

other are monodented. So, option D is correct.

3. The value of EAN for $Fe(\eta^5 - C_5H_5)_2]$ is 36 . Hence, it follows the EAN rule. Hence, the correct option is A.

4. Each Mn have 25 electrons so two Mn will have 50 e-. 1CO - 2e- so 10 CO will have

20 e-. Total electrons will be 50 + 20 = 70e-.

Statement 1 is correct.

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In statement 2, $Mn_2(CO)_{10}$

For $2Mn = 2 \times 25 - 0 + (11 \times 2) = 72$

C.N. $= 11 \rightarrow$ (10 from C 0) and (1 for Mn-Mn sigma bond)

For $1Mn \rightarrow \frac{72}{2} = 36$, stable complex

Statement 2 is incorrect.

5. (1)$Mn(CO)_5$ acts as an oxidizing agent. it accepts an electron to form $[Mn(CO)_5]^-$ which acquires EAN of 36 (electronic configuration of Kr) and is stable.

$$\underset{\text{less stable (OA.)}}{Mn(CO_5)} + \bar{e} \rightarrow \underset{\text{more stable, as EAN of Mn=36(Kr)}}{[Mn(CO)_5]^-}$$

$$EAN = z - 0.S. + 2C \cdot N$$

C.N. = coordination number

$Mn(CO)_5 = 25 - 0 + (2 \times 5) = 35$

It need one electron to form a stable complex

$\therefore$ It will undergo reduction i.e. gain of electron

Hence behave as oxidising agent

(2) $Fe(CO)_5 = 26 - 0 + (2 \times 5) = 36$

Stable complex

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

For $2Mn = 2 \times 25 - 0 + (11 \times 2) = 72$

C.N. $= 11 \rightarrow$ (10 from C 0) and (1 for Mn-Mn sigma bond)

For $1Mn \rightarrow \frac{72}{2} = 36$, stable complex

(4) $Fe_2(CO)_9$

For $2Fe = (26 \times 2) - 0 + (2 \times 10) = 72$

C.N. $= 11 \rightarrow$ (10 for CO) and (1 for Fe $-$Fe bond)

For $1Fe = \frac{72}{2} = 36$ stable complex

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6. $[Ni(CO)_4]$

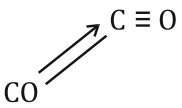
Oxidation state of Ni $= 0$

Electronic Configuration of Ni $= [Ar]3d^8 4s^2$

$Na[Co(CO)_4] \longrightarrow [Co(CO)_4]^-$

Oxidation state of Co $= -1$

$\Rightarrow$Electonic Configulation of $Co^{-1} = [Ar]3d^8 4s^2$



Co will donate e- density into antibonding MO of CO group. Hence, the bond order of CO decreases, and the bond length increases.

$[Fe(CO)4]^{2-}$ has longest C–O bond length. Since in the complex metal atom is carrying maximum negative charge therefore it would show maximum synergistic bonding due to which C–O bond length would be maximum.

7. $\begin{bmatrix} Mn(CO)_6 \\ EAN = 37 \end{bmatrix} \rightarrow \underset{EAN=36}{Mn(CO)_6^+} + e^-$

8. (a) $[Ag(S_2O_3)_2]^{3-} \Rightarrow 47 - 1 + 4 = 50$

(b) $48 - 2 + 8 = 54$

(c) $78 - 2 + 8 = 84$

(d) $42 - 2 + 8 = 48$

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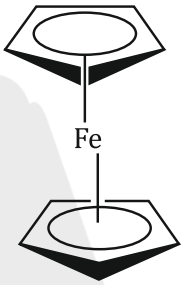
9. The EAN number is a representation of the overall number of electrons that surround a metal atom's nucleus in a metal complex. the EAN value of central atom of ferrocene $[Fe(\pi - C_5H_5)_2]$ is 0036 .

$$26 - 2 + 12 = 36$$

Ferrocene



10. Correct Answer - A → r; B → p; C → s; D → q

(A) $K_3[Fe(CN)_5(CO)]$

→ Due to +2 oxidation state of Fe extent of $d\pi(Fe^{II}) \rightarrow \pi^*(CO)$ is poor , hence

$C - O$ bond length is not increased considerably as in $[Co(CO)_4]^-$and $[V(CO)_6]$

→ EAN of Fe $= 26 - 2 + 5 \times 2 + 2 = 36(Kr)$

$Fe^{II} \underset{\sigma}{\overset{\pi}{\Longleftrightarrow}} CO$, hence synergic bonding is present.

(B) $K[PtCl_3(CH_2 = CH_2)]$

EAN of Pt $= 78 - 2 + 3 \times 2 + 2 = 84$, (At. no. of Rn $= 86$)

$Pt^{II} \overset{\pi}{\Longleftrightarrow} (CH_2 = CH_2)$, synergic bonding is present

$Pt \overset{\pi}{\longleftarrow} (CH_2 = CH_2)$

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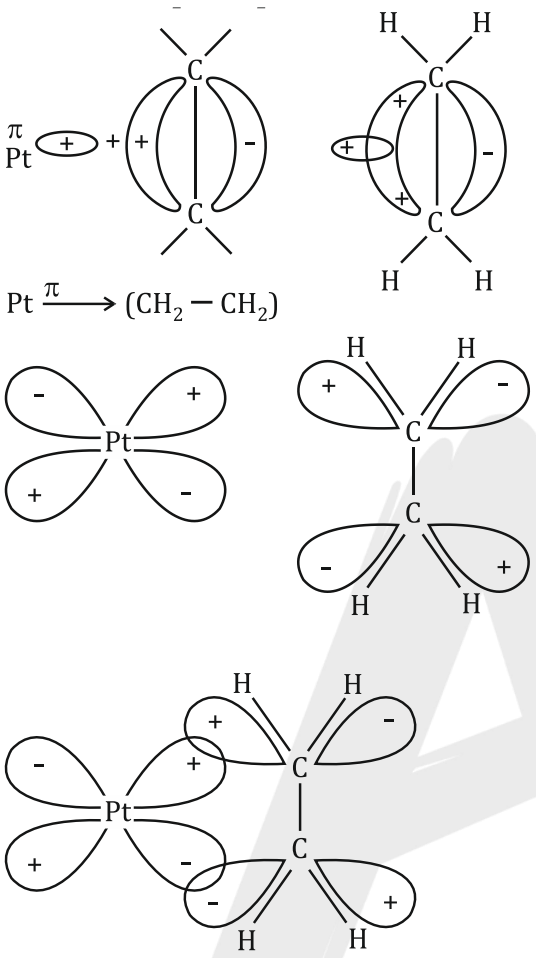

$Na[Co(CO)_4]$

(C) $Na[Co(CO)_4]$

EAN of $Co = 27 + 1 + 4 \times 2 = 36(Kr)$

$Co \overset{\pi}{\Longleftrightarrow} CO$, synergic bonding takes place

$Co \overset{\sigma}{\longleftarrow} CO$

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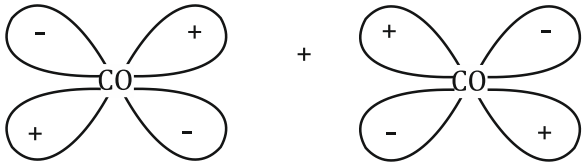
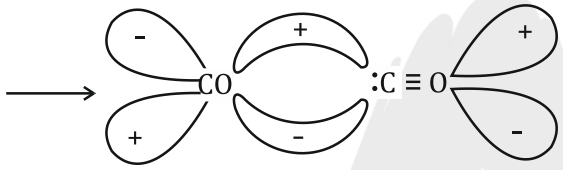
$CO \underset{\sigma}{\overset{\pi}{\rightleftharpoons}} CO$ synergic bonding takes place

$CO \xleftarrow{\sigma} CO$

$CO \xrightarrow{\pi} CO$





(D) $[V(CO)_6]$

$EAN = 23 - 0 + 6 \times 2 = 35$

11. $[Pd(NH_3)_6]^{4t}$

$EAN = Z - O.S + 2(C.N_{-})$

$O.S = x + 0 \times 6 = +4$

$x = +4$

At. no. $(Pd = 46)$

$C.N. = 6$

$EAN = 46 - 4 + 2 \times 6$

$= 42 + 12$

$= 54$