

(SOT)

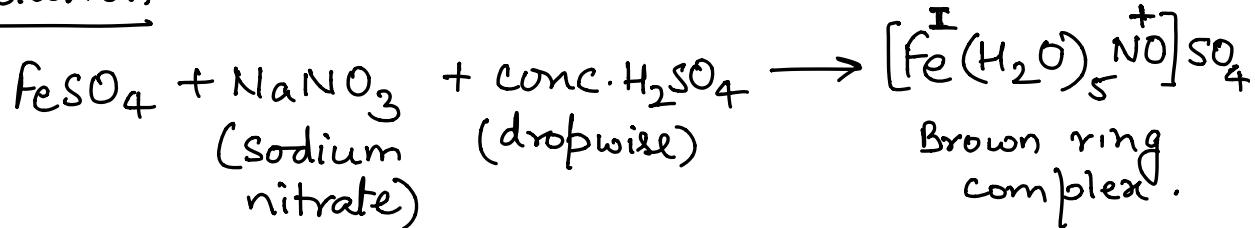
- When freshly prepared  $\text{FeSO}_4$  is added to the sodium nitrate solution followed by the addition of concentrated  $\text{H}_2\text{SO}_4$  dropwise then brown ring complex is formed. Which of the following property is correct for the formed complex
 

<b>(A)</b> EAN value of complex is 36	<b>(B)</b> Complex have cyclic ring in structure
<b>(C)</b> Complex has Fe – N linkage	<b>(D)</b> None of these
- जब ताजा बने  $\text{FeSO}_4$  विलयन को सोडियम नाइट्रेट विलयन में मिलाने के बाद बूंद-बूंद कर के सान्द्र  $\text{H}_2\text{SO}_4$  मिलाया जाता है तो भूरी बल; संकुल बनता है। निम्न में से कौनसा गुण] निर्मित संकुल के लिये सही है&
 

<b>(A)</b> संकुल का EAN मान 36 है	<b>(B)</b> संकुल की संरचना में चक्री; बल; उपस्थित है
<b>(C)</b> संकुल में Fe–N बन्धन उपस्थित है	<b>(D)</b> इनमें से कोई नहीं

1. Ans. **(C)**

Solution



$$\text{EAN} = 26 - 1 + 2 \times 6 = 37.$$

There is no cyclic ring in the structure.

Since  $\text{NO}^+$  ligand is present, it has Fe-N linkage.

Ans C.



Select correct statement about this complex

(A) Oxidation state of  $\text{O}_2$  is -1

(B) EAN of Pt is 86

(C) Mono dentate as well as bidentate ligands are present in complex

(D) Both (B) and (C)



इस संकुल के सन्दर्भ में सही कथन चुनिये।

(A)  $\text{O}_2$  की ऑक्सीकरण अवस्था] -1 है

(B) Pt का EAN, 86 है

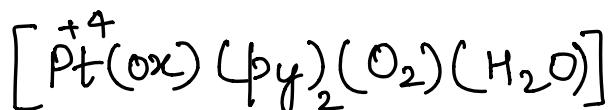
(C) संकुल में , क दन्तुक लिगेण्ड के साथ-साथ }&दन्तुक लिगेण्ड भी उपस्थित हैं

(D) दोनों (B) तथा (C)

2. Ans. (D)

Solution

All  $\text{Pt}^{+4}$  compounds have coordination number = 6.



$$4 - 2 + 0 + x + 0 = 0$$

$$x = -2.$$

Oxidation state of  $\text{O}_2$  is -2.

$$\text{EAN} = 78 - 4 + 2 \times 6 = 86.$$

$\text{ox} \rightarrow \text{C}_2\text{O}_4^{2-}$  is a bidentate ligand.

rest all ligands are monodentate ligands

Ans  $\underline{\underline{D}}$

3. Which of the following complexes follow Sidgwick EAN rule ?
- (A)  $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2]$       (B)  $\text{K}[\text{PtCl}_3(\eta^2\text{-C}_2\text{H}_4)]$   
 (C)  $[\text{V}(\text{CO})_6]$       (D)  $[\text{Mn}(\text{CO})_6]$
3. निम्न में से कौनसा संकुल सिडविक के EAN नियम का पालन करता है &
- (A)  $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2]$       (B)  $\text{K}[\text{PtCl}_3(\eta^2\text{-C}_2\text{H}_4)]$   
 (C)  $[\text{V}(\text{CO})_6]$       (D)  $[\text{Mn}(\text{CO})_6]$
3. Ans. (A)

### Solution

$$(A) \left[ \text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2 \right] \Rightarrow \text{EAN} = 26 - 2 + 6 \times 2 \\ = 36$$

Follows Sidgwick's rule.

$$(B) \left[ \text{PtCl}_3(\eta^2\text{-C}_2\text{H}_4) \right] \Rightarrow \text{EAN} = 78 - 2 + 2 \times 4 \\ = 84$$

Does not follow Sidgwick's rule.

$$(C) \left[ \text{V}(\text{CO})_6 \right] \Rightarrow \text{EAN} = 23 - 0 + 2 \times 6 \\ = 35$$

Does not follow Sidgwick's rule

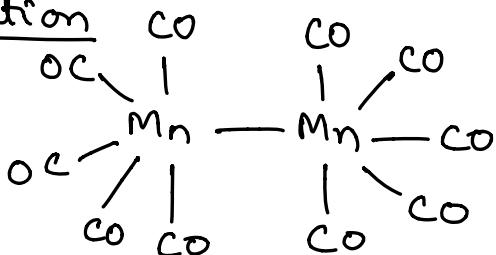
$$(D) \left[ \text{Mn}(\text{CO})_6 \right] \Rightarrow \text{EAN} = 25 - 0 + 2 \times 6 \\ = 37$$

Does not follow Sidgwick's rule.

4. Statement-1 : In  $Mn_2(CO)_{10}$  molecule, there are total 70 electrons in both Mn atoms.[3]  
 Statement-2 :  $Mn_2(CO)_{10}$  molecule acts as oxidising agent.  
 (A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.  
 (B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.  
 (C\*) Statement-1 is true, statement-2 is false.  
 (D) Statement-1 is false, statement-2 is true.

4. Ans. (C)

Solution



Electrons in one Mn atom =  $25 + 2 \times 5^- = 35^-$ .  
 — " — two Mn atoms =  $35 \times 2 = 70 \text{ e}^-$ .

$$\text{EAN of } Mn_2(CO)_{10} = \frac{25 \times 2 + 0 + 2 \times 10 + 2}{2} = 36.$$

It follows Sidgwick's EAN rule hence will neither require electron nor will release  $e^-$ .  
 Hence not an oxidizing agent.

Ans C.

**(MCQ)**

5. Which of the following do not act as an oxidizing agent?  
 (A)  $\text{Mn}(\text{CO})_5$       (B\*)  $\text{Fe}(\text{CO})_5$       (C\*)  $\text{Mn}_2(\text{CO})_{10}$       (D\*)  $\text{Fe}_2(\text{CO})_9$
5. निम्न में से कौन, क आक्सीकारक के : प के कार्य नहीं करता है ?  
 (A)  $\text{Mn}(\text{CO})_5$       (B)  $\text{Fe}(\text{CO})_5$       (C)  $\text{Mn}_2(\text{CO})_{10}$       (D)  $\text{Fe}_2(\text{CO})_9$
5. **Ans. (B,C,D)**

Solution

$$\text{EAN of } \text{Mn}(\text{CO})_5 = 25 + 0 + 2 \times 5 = 35.$$

It can accept an  $e^-$  to follow Sidgwick's rule to become stable, hence will get reduced itself and will oxidize other.  
 Hence acts as oxidizing agent.

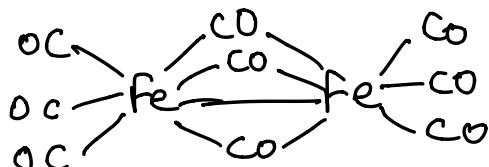
$$\text{EAN of } \text{Fe}(\text{CO})_5 = 26 + 0 + 2 \times 5 = 36.$$

Neither accept nor release  $e^-$ . Not an oxidizing agent.

$$\text{EAN of } \text{Mn}_2(\text{CO})_{10} = \frac{25 \times 2 + 0 + 2 \times 10 + 2}{2} = 36.$$

Not an oxidizing agent.

$$\text{EAN of } \text{Fe}_2(\text{CO})_9 = \frac{26 \times 2 + 0 + 2 \times 9 + 2}{2} = 36.$$

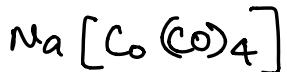


Not an oxidizing agent.

Ans BCD

6. Which of the following species has/have more C – O bond length than CO ?  
 (A)  $\text{Na}[\text{Co}(\text{CO})_4]$     (B)  $[\text{Fe}(\text{CO})_4]^{2-}$     (C)  $[\text{Ni}(\text{CO})_4]$     (D)  $\text{CO}^+$
6. निम्न में से कौन से स्पीशीज में C – O बंध लम्बाई] CO की तुलना में अधिक है ?  
 (A)  $\text{Na}[\text{Co}(\text{CO})_4]$     (B)  $[\text{Fe}(\text{CO})_4]^{2-}$     (C)  $[\text{Ni}(\text{CO})_4]$     (D)  $\text{CO}^+$
6. Ans.(A, B, C)

Solution



Due to synergic Bond , Metal carbon bond becomes strong, hence C-O Bond becomes weak & Bond length increases and is more than CO.  
 Same is observed in  $[\text{Fe}(\text{CO})_4]^{2-}$  &  $[\text{Ni}(\text{CO})_4]$  .

$\text{CO}^+$  bond order is between 3-3.5. Hence Bond length is less than CO.

Ans (A, B, C).

**Paragraph for question nos. 8 to 10**

Sidwick EAN rule says that complex compound has the tendency to achieve the EAN of 36, 54 and 86 for first, second and third transition series elements. [9]

सिडविक का EAN नियम बताता है कि प्रथम] द्विती; और तृती; संक्रमण श्रेणी तत्वों के संकुल , ऐसिको में क्रमशः 36, 54 और 86, EAN प्राप्त करने की प्रवृत्ति होती है। [9]

7. Which of the following complex acts as reducing agent based on Sidwick EAN rule.  
 (A)  $\text{Mn}(\text{CO})_5$       (B)  $\text{Mn}_2(\text{CO})_{10}$       (C\*)  $\text{Mn}(\text{CO})_6$       (D)  $[\text{V}(\text{CO})_6]^-$
7. सिडविक के EAN नियम के आधार पर] निम्न में से कौनसा संकुल अपचायक की तरह कार्य करता है।  
 (A)  $\text{Mn}(\text{CO})_5$       (B)  $\text{Mn}_2(\text{CO})_{10}$       (C)  $\text{Mn}(\text{CO})_6$       (D)  $[\text{V}(\text{CO})_6]^-$
7. Ans. (C)
8. Which of the following complex is following sidwick EAN rule.  
 (A)  $[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}$  (when only 'S' atom is the donor atom)  
 (B\*)  $[\text{Cd}(\text{CN})_4]^{2-}$   
 (C)  $[\text{Pt}(\text{en})_2]^{2+}$   
 (D)  $[\text{Mo}(\sigma-\text{C}_3\text{H}_5)\text{Br}(\text{NH}_3)_2]^0$

Ans. (B)

Solution

$$(7) \quad \text{Mn}(\text{CO})_5 \Rightarrow \text{EAN} = 25 - 0 + 2 \times 5 = 35$$

It will accept an electron hence will act as oxidizing agent.

$$\text{Mn}_2(\text{CO})_{10} \Rightarrow \text{EAN} = \frac{2 \times 25 - 0 + 2 \times 10 + 2}{2} = 36 .$$

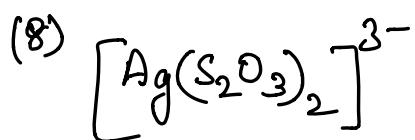
Neither oxidizing nor reducing agent

$$\text{Mn}(\text{CO})_6 \Rightarrow \text{EAN} = 25 - 0 + 2 \times 6 = 37 .$$

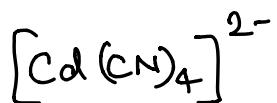
It will lose an electron hence will act as reducing agent.

$$[\text{V}(\text{CO})_6]^- \Rightarrow \text{EAN} = 23 - (-1) + 2 \times 6 = 36 .$$

Neither oxidizing nor reducing agent.

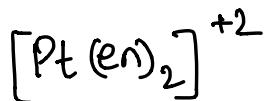


$EAN = 47 - 1 + 2 \times 2 = 50$ . ( $\text{S}_2\text{O}_3^{2-}$  acts as monodentate)  
Does not follow Sidgwick's Rule.



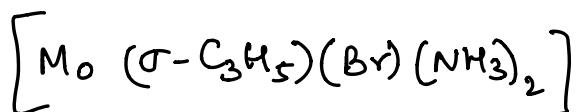
$$EAN = 48 - 2 + 2 \times 4 = 54$$

Follow Sidgwick's Rule.



$$EAN = 78 - 2 + 4 \times 2 = 84$$

Does not follow Sidgwick's Rule.

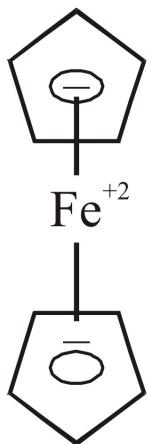


$$EAN = 42 - 2 + 2 \times 4 = 48$$

Does not follow Sidgwick's Rule.

9. Which of following statement is not correct regarding complex "Ferrocene".
- (A\*) EAN of central atom in ferrocene is not equal to its nearest noble gas  
 (B) Molecule is having aromatic character  
 (C) It has sandwich like structure  
 (D) Two rings act as  $\pi$ -donor ligand.
9. "फेरोसीन" संकुल के सन्दर्भ में निम्न में से कौन सा कथन सही नहीं है।
- (A) फेरोसीन में केन्द्री; परमाणु का EAN ] इसके निकटतम उत्कृष्ट गैस के बराबर नहीं है।  
 (B) अणु में, रोमेटिक लक्षण है।  
 (C) इसकी संरचना "सैंडविच" की तरह है।  
 (D) दो वल;  $\pi$ -दाता लिगेण्ड की तरह कार्य करती हैं।
9. Ans. (A)

### Solution



$$\text{EAN} = 26 - 2 + 6 \times 2 = 36.$$

EAN is close to nearest noble gas.

Both cyclopentadienyl rings are aromatic.  
 It is called sandwich structure since  $\text{Fe}^{+2}$  is sandwiched between two cyclopentadienyl rings.

Two rings acts as  $\pi$ -donor ligand.

A is incorrect.

(Matrix Match)

10.      Column I	Column II	[12]
(A) $K_3[Fe(CN)_5(CO)]$	(P) Complex having lowest bond length of CO ligand	
(B) $K[PtCl_3(C_2H_4)]$	(Q) Follow Sidgwick's rule of EAN	
(C) $Na[Co(CO)_4]$	(R) Complex involved in synergic bonding	
(D) $V(CO)_6$	(S) Complex having highest bond length of CO ligand	
10.      स्तम्भ - I	स्तम्भ - II	[12]
(A) $K_3[Fe(CN)_5(CO)]$	(P) संकुल में, CO लिगेण्ड की बंध लम्बाई न्यूनतम है।	
(B) $K[PtCl_3(C_2H_4)]$	(Q) सिड्विक के EAN नियम का पालन करता है।	
(C) $Na[Co(CO)_4]$	(R) संकुल में सहक्रियाशीलता बंधन (synergic bonding) है।	
(D) $V(CO)_6$	(S) संकुल में CO लिगेण्ड की बंध लम्बाई अधिकतम है।	
10. Ans. (A) → P, Q, R ; (B) → R ; (C) → Q, R, S ; (D) → R		

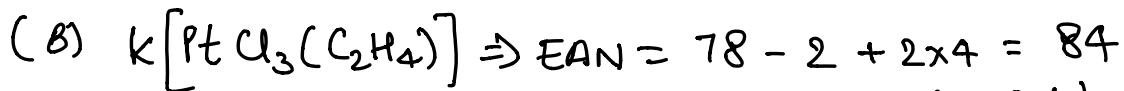
Solution



Follow Sidgwick Rule.

Synergic Bonding is present.

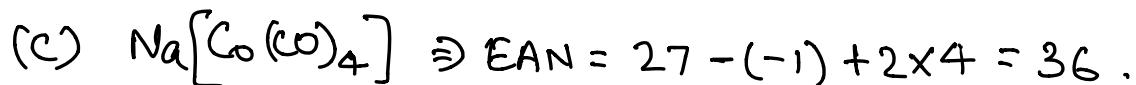
Since Fe has +2 charge, synergic bonding is weak, hence C-O bond strength will be highest & CO bond length will be minimum. (P&R)



Does not follow Sidgwick's Rule.

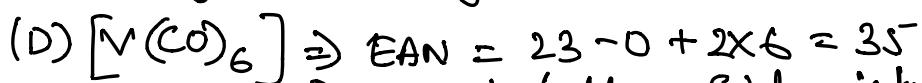
Synergic Bonding with  $C_2H_4$ .

No CO present. (R)



Follow Sidgwick Rule,

Highest CO Bond length since synergic Bonding is maximum. (QRS)



Does not follow Sidgwick Rule (R)

,