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**THE OPEN UNIVERSITY OF SRI LANKA**  
**B.Sc & B. Ed DEGREE / STAND ALONG COURSES IN SCIENCE**  
**LEVEL 5 – ASSESSMENT TEST 1 (NBT) 2006/2007**  
**CHU 3127/ CHE 5127 ORGANOMETALLIC CHEMISTRY**  
**TIME 1 ½ HOURS**

Date : 30<sup>th</sup> July 2006

Time : 3.30 – 5.00 pm

**Answer all questions**

Choose the most correct answer to each question given below. Mark a cross(X) over the most suitable answer on the given answer script. Any answer with more than one cross will not be counted and 1/5<sup>th</sup> of the mark will be deducted for each incorrect answer.

**Part A (60 marks)**

1. The coordination number of W in  $[W\equiv CPh](CO)_4$  is  
1) 2                      2) 4                      3) 6                      4) 3
2. What is the group number of Cr? (Cr atomic number is 24)  
1) 5                      2) 7                      3) 6                      4) 3
3. What is the  $d^n$  for  $Mn^{2+}$ ? (Mn atomic number is 25)  
1)  $d^5$                       2)  $d^2$                       3)  $d^4$                       4)  $d^1$
4. Number of valence electrons in  $[MnBr(CO)_5]$  is  
1) 18                      2) 10                      3) 17                      4) 12
5. What is the VEC of Rh in  $[Rh_2(\mu_2-Br)_2(CO)_4]$ ? (Rh atomic number is 45)  
1) 18                      2) 16                      3) 17                      4) 12
6. The IUPAC name of  $[Ni(\eta^2-C_2H_4)_3]$  is  
1. Di(trihaptoethene)nickel                      2. Tri(dihaptoethene)nickel  
3. Nickeldi(trihaptoethene)                      4. Nickeltri(dihaptoethene)

7. Number of electrons donated by  $SMe_2$  is

- 1) 1                      2) 2                      3) 3                      4) 4

8. Select the correct statement.

1.  $\sigma$ - donor ability  $PF_3 < PPh_3 < PMe_3$                       2.  $\sigma$ - donor ability  $PMe_3 < PPh_3 < PF_3$   
3.  $\sigma$ - donor ability  $PMe_3 < PF_3 < PPh_3$                       4.  $\sigma$ - donor ability  $PPh_3 < PF_3 < PMe_3$

9. The strongest  $\Pi$ -acceptor ligand is

- 1)  $PMe_3$                       2)  $PF_3$                       3)  $PCl_3$                       4)  $PPh_3$

10. Which ligand is isoelectronic with CO?

- 1) NO                      2)  $NO_2$                       3)  $PCl_3$                       4) CN

11. Consider the following statements about dinitrogen.

- (a) It is isoelectronic with O.                      (b) It is a weaker  $\sigma$ -donor than CO.  
(c) It is a stronger  $\pi$ -acceptor than CO.

Which statement/s is/are true for dinitrogen?

- 1) (a) only                      2) (a) and (b) only                      3) (c) only                      4) (a) and (c) only

12. Nitrosyl ligand (NO) can act as a

- (a) 1 e donor                      (b) 2 e donor                      (c) 3 e donor

The correct statement/s is/are

- 1) (a) only                      2) (a) and (b) only                      3) (c) only                      4) (a) and (c) only

13. Consider the following statement/s about Fischer-carbenes?

- (a) Metal of Fischer-carbenes is in a high oxidation state  
(b) Metal is a late transition metal.  
(c) Metal is in a low oxidation state

The correct statement/s is/are

- 1) (a) only      2) (a) and (c) only      3) (b) only      4) (a) and (b) only

14. Consider following statement/s about metal-alkyne complexes

- (a) They have stronger back donations than metal-alkene complexes  
(b) Alkyne acts as a dihapto 2e donor  
(c) Alkyne acts as a trihapto 3e donor

The correct statement/s is/are

- 1) (a) only      2) (a) and (c) only      3) (b) only      4) (a) and (b) only

15. What is the VEC of Re in compound  $[\text{ReO}_3(\eta^5\text{-C}_5\text{H}_5)]$ ? (Re is in the same group as Mn)

- 1) 10      2) 17      3) 18      4) 12

16. Consider following statement/s regarding a compound having VEC of metal is 18

- (a) These complexes are unstable  
(b) These complexes are stable  
(c) They are coordinatively saturated

The correct statement/s is/are

- 1) (a) only      2) (a) and (c) only      3) (b) and (c) only      4) (a) and (b) only

17. Which statement is true about metal carbonyls

- 1)  $\sigma$  bond removes electron density from C  
2) Back bonding decreases electron density at C  
3) They have higher IR stretching frequency than free CO  
4) They are very unstable

18. Back bonding in metal carbonyls

- (a) Decreases metal-carbon bond strength  
(b) Increases metal-carbon bond strength

(c) Decreases carbon-oxygen bond strength

The correct statement/s is/are

- 1) (a) only      2) (a) and (c) only      3) (b) and (c) only      4) (a) and (b) only

19. The  $\nu_{CO}$  value of metal carbonyl

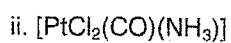
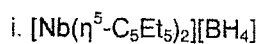
- 1) is same as free CO      2) is higher than free CO  
3) is lower than free CO      4) can not compare with free CO

20. Carbyne ligand is a

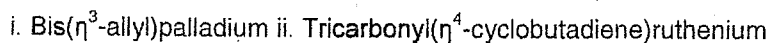
- 1) 1 e donor      2) 2 e donor      3) 3 e donor      4) 4 e donor

**Part B (40 marks)**

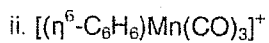
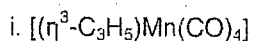
1. (a) Give IUPAC names for the following complexes



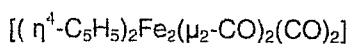
(b) Draw the structures of following complexes



(c) Determine the VEC of the metals in following complexes. You **must specify** the model you are going to use.



(d) Draw the structure of following coordinatively saturated complex



2. (a) Metal carbonyls have less IR stretching frequencies than free CO. Explain?

(b) What do you mean by agnostic alkyls? Explain using an appropriate structure.

(c) What are the important features of Fischer-carbenes?

(d)  $\nu(\text{C}=\text{C})$  value for  $[\text{Ag}(\eta^2\text{-CH}_2=\text{CH}_2)_2]\text{BF}_4$  is  $1584\text{ cm}^{-1}$  where as  $\nu(\text{C}=\text{C})$  value for free C=C is  $1623\text{ cm}^{-1}$ . Discuss?

**Answer guide for CHU 3127 Assignment test (I)  
2006/2007 (30<sup>th</sup> July 2006)**

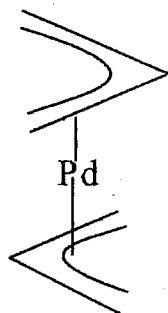
**Answers for MCO's (Part A)**

- |       |       |
|-------|-------|
| 1. -  | 11. - |
| 2. 3  | 12. 4 |
| 3. 1  | 13. - |
| 4. 1  | 14. 4 |
| 5. 2  | 15. 3 |
| 6. 2  | 16. 3 |
| 7. 2  | 17. 1 |
| 8. 1  | 18. 3 |
| 9. 2  | 19. 3 |
| 10. - | 20. 3 |

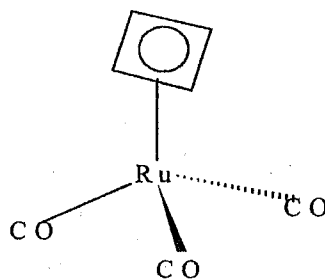
**Answers for Part B**

- 1.** (a) (i) Bis ( $\eta^5$ -Pentaethylcyclopentadienyl) niobium tetrahydroborate.  
(ii) Amminecarbonyldichloroplatinum

(b) (i)



(ii)



(c) (i) For compound (1)

**Covalent Model**

$$\begin{aligned}
 4 * \text{CO} &= 8e \\
 \eta^3 \text{C}_3\text{H}_5 &= 3e \\
 1 * \text{Mn}^0 &= \underline{7e} \\
 &= \underline{18e}
 \end{aligned}$$

(ii) For compound (2)

**Covalent Model**

$$\begin{aligned}
 3 * \text{CO} &= 6e \\
 \eta^6 \text{C}_6\text{H}_6 &= 6e \\
 1 * \text{Mn}^0 &= 7e \\
 + \text{charge} &= \underline{-1e} \\
 &= \underline{18e}
 \end{aligned}$$

**Ionic Model**

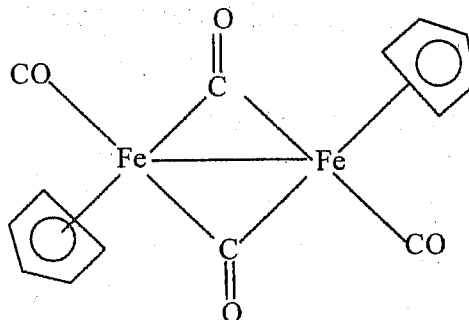
$$\begin{aligned}
 4 * \text{CO} &= 8e \\
 1 * \text{C}_3\text{H}_5^- &= 4e \\
 1 * \text{Mn}^+ &= \underline{6e} \\
 &= \underline{18e}
 \end{aligned}$$

**Ionic Model**

$$\begin{aligned}
 3 * \text{CO} &= 6e \\
 1 * \text{C}_6\text{H}_6 &= 6e \\
 1 * \text{Mn}^+ &= \underline{6e} \\
 &= \underline{18e}
 \end{aligned}$$



(d) The structure should be  $[(\eta^5\text{-C}_5\text{H}_5)_2\text{Fe}_2(\mu_2\text{-CO})_2(\text{CO})_2]$

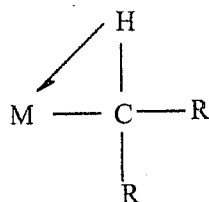


2.

(a) Increasing electron density on metal leads to increasing ~~transfer~~ of electrons in filled metal d-orbitals to low-lying vacant  $\pi^*$ -antibonding orbitals of CO called as Back Donation, which leads to decrease in the carbon oxygen bond strength. Therefore IR frequency of C-O in Metal Carbonyls decreases.

(b) Agostic Alkyls

From X-ray data, it was shown that there were weak interactions between Metal and C-H bonds. These interactions are known as Agostic interactions.



- (c)
- \* Metal is in Low Oxidation state
  - \* Metal is a Late Transition metal
  - \* Coordinated ligands are good  $\pi$ -acceptors

(d) Due to Back donation from Ag to ethene  $\nu$  (C=C double bond) in  $[\text{Ag}(\eta^2\text{-CH}_2\text{=CH}_2)_2]\text{BF}_4$  decreases compared to free C=C double bond.

Bond order after forming M-C=C bond will decrease due to increasing electron in  $\pi^*$  orbital.

$$\text{Bond Order} = \frac{e(\pi) - e(\pi^*)}{2}$$

$e(\pi^*)$  increases so, Bond order Decreases