

THE OPEN UNIVERSITY OF SRI LANKA
B. Sc. & B. Ed. DEGREE/STAND ALONE
COURSES IN SCIENCE Level 5
ASSIGNMENT TEST I (NBT)
CMU3122/CME5122 – Organometallic Chemistry



DURATION : 1.5 hours

Date: 23rd January 2013

TIME : 4.00 – 5.30 p.m.

ANSWER ALL QUESTIONS

Select 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.

PART A (60 marks)

- The coordination mode(s) of the π -allyl group is/are
1) η^1 only. 2) η^2 only 3) η^3 only
4) η^1 and η^3 only. 5) η^1 , η^2 and η^3 only.
- Consider the following organic ligands,
(i) σ -allyl (ii) ethyl (iii) carbene
The possible *monohapto* ligand/s is/are
1) (ii) only. 2) (i) and (ii) only. 3) (i) and (iii) only.
4) (ii) and (iii) only. 5) (i), (ii) and (iii).
- The IUPAC name of $[\text{CoF}(\eta^2\text{-C}_2\text{H}_4)_2(\text{CO})]$ is
1) Carbonyldi(η^2 -ethene)fluorocobaltate
2) Carbonyldi(η^2 -ethene)fluorocobalt(II)
3) Carbonyldi(η^2 -ethene)fluorocobalt
4) Fluorodi(η^2 -ethene)carbonylcobalt
5) Carbonylfluoro(η^2 -ethene)cobalt(I)
- What is the Valence Electron Count (VEC) of Cr in $[\text{CrF}(\text{CO})_2(\eta^5\text{-C}_5\text{H}_5)]$?
(Group number of Cr is 6)
1) 16 2) 17 3) 18 4) 19 5) 20
- According to ionic model, which one of the following is not a 2e-donor ligand?
1) $\eta^1\text{-C}_3\text{H}_5^-$ 2) $\eta^3\text{-C}_3\text{H}_5^-$ 3) $\text{C}\equiv\text{O}$ 4) Cl^- 5) $\eta^2\text{-C}_4\text{H}_6$
- An L_2 type ligand is
1) $\eta^5\text{-C}_5\text{H}_5^-$ 2) $\eta^2\text{-C}_4\text{H}_6$ 3) cyclobutene 4) $\eta^6\text{-C}_6\text{H}_6$ 5) η^4 -cyclobutadiene
- The weakest σ -donor ligand among the following ligands is
1) $\text{C}\equiv\text{S}$ 2) MeCN 3) $\text{N}\equiv\text{N}$ 4) CN^- 5) $\text{C}=\text{O}$

8. The **coordination number** of Co in $[\text{CoF}(\eta^2\text{-C}_2\text{H}_4)_2(\text{CO})]$ is
 1) 4 2) 5 3) 6 4) +1 5) Answer is not given
9. The **dⁿ electron configuration** and the **oxidation number** of Cr in $[\text{Cr}(\eta^6\text{-C}_6\text{H}_6)_2]$ (Group number of Cr is 6) are
 1) d⁶, +2 2) d⁶, 0 3) d⁶, +1 4) d⁵, +1 5) d⁴, 0
10. Consider the following statements
 (i) Carbene ligand is a two-electron donor.
 (ii) The M≡C bond is shorter than the M=C bond.
 (iii) Carbyne carbon is sp hybridised.
 The **correct statement/s is/are**
 1) (i) only 2) (i) & (ii) only 3) (i) & (iii) only
 4) (ii) & (iii) only 5) (i), (ii) & (iii)
11. What is **not true** about cyclopentadienyl ligand?
 1) It is a mono-anionic ligand.
 2) It is a good σ-donor.
 3) It is a good π-acceptor.
 4) According to ionic model, it is a 6e donor.
 5) According to LX classification, it is a L₂X type ligand.
12. Which one of the following statements is **true** about **Schock carbenes**?
 1) Metal is in a low lower state.
 2) Carbene carbon is electrophilic.
 3) Carbenes are formed with late transition metal.
 4) Carbene carbon contains a +δ charge.
 5) None of the above statements is true.
13. In metal carbonyls, what is **true** about **back donation**?
 1) the M–CO bond length increases as back donation increases.
 2) the M–CO bond order increases as back donation decreases.
 3) the carbonyl frequency increases as back donation decreases.
 4) the bond strength of C≡O decreases as back donation decreases.
 5) None of the above statements is true.
14. Consider the following statements about $[\text{Co}_2(\text{CO})_8]$.
 (Group number of Co is 9),
 (i) In the solid state, it has two bridging ligands.
 (ii) The C–O bond strength of a bridging ligand is weaker than that of a terminal ligand.
 (iii) It is an 18e-compound.
 The **correct statement/s is/are**
 1) (ii) only. 2) (i) and (ii) only. 3) (i) and (iii) only.
 4) (ii) and (iii) only. 5) (i), (ii) and (iii).

15. According to the **Ionic Model**, what is the **oxidation number** of Co in $[\text{Co}(\eta^2\text{-CH}_2=\text{CH}_2)_2(\text{CO})]$ (Group number of Co is 9)?
 1) 0 2) +1 3) +2 4) 4 5) Answer is not given
16. Which one of the following is **isoelectronic** with NH_3 ?
 1) BH_3 2) PH_3 3) CH_3^+ 4) BH_4^- 5) None of the above
17. Consider the following statements,
 (i) NH_3 is a stronger σ -donor than NMe_3 .
 (ii) NO is a weaker π -acceptor than NO^+ .
 (iii) CS is a stronger σ -donor than CO .
 The **correct** statement/s is/are
 1) (i) only. 2) (i) and (ii) only. 3) (i) and (iii) only.
 4) (ii) and (iii) only. 5) (i), (ii) and (iii).
18. Consider the following statements about Ziese's salt, $\text{K}[\text{PtCl}_3(\eta^2\text{-CH}_2=\text{CH}_2)]$.
 (i) Ethene is bonded to Pt in a side-on fashion.
 (ii) The C–C bond distance of the salt is shorter than that of free ethene.
 (iii) According to ionic model, the oxidation number of Pt is +2.
 The **correct** statement/s is/are
 1) (i) only 2) (i) & (ii) only 3) (i) & (iii) only
 4) (ii) & (iii) only 5) (i), (ii) & (iii)
19. What is **true** about CO ?
 1) It stabilises the metal centres in higher oxidation states.
 2) In the free ligand, CO bond order is 2.
 3) It is a weak π -acceptor.
 4) Carbon and oxygen atoms are sp^2 -hybridised.
 5) None of the above is true
20. Consider the complex $[\text{RhCl}(\eta^2\text{-CH}_2=\text{CH}_2)_3]$. Which one of the following statements is **not true** about the above complex? (Group number of Rh is 9)
 1) Rh centre has 16 valence electrons.
 2) It has the square planar geometry.
 3) According to ionic model, the oxidation number of Rh is +1.
 4) It is an unsymmetrical molecule.
 5) The coordination number of Rh is 4.

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 B. Sc DEGREE PROGRAMME 2012/2013
 CMU3122/CME5122 – ORGANOMETALLIC CHEMISTRY- LEVEL 5

ASSIGNMENT TEST-I (Part A)

MCQ ANSWER SHEET: Mark a cross (X) over the most suitable answer.

For Examiners Use

Reg.No.

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Part A	
Part B	
Total %	

Marks

Correct Answers		
Wrong Answers		
Total		

- | | | | | | | | | | | | | | | | | | |
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| 1. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 | 2. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 | 3. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 |
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| 7. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 | 8. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 | 9. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 |
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| 1 | 2 | 3 | 4 | 5 | | | | | | | | | | | | | |
| 13. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 | 14. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 | 15. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 |
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| 19. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 | 20. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 | | | | | | |
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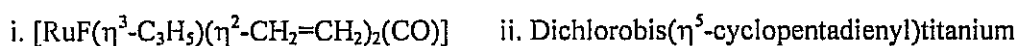
Part B (40 marks)

Answer all the questions in the space provided. Attached sheets will not be graded.

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



(b) Draw the structures of the following complexes.



(c) (i) Determine the **VEC** of Ru in $[\text{RuF}(\eta^3\text{-C}_3\text{H}_5)(\eta^2\text{-CH}_2\text{=CH}_2)_2(\text{CO})]$ using **ionic model**. (Indicate your break down; Group number of Ru is 8)

(ii) Determine the **VEC** of Ru in $[\text{RuBr}_2(\eta^6\text{-C}_6\text{H}_6)(\text{PPh}_3)]$ using **covalent model**. (Indicate your break down; Group number of Ru is 8)

(d) Determine the **coordination number** of Re in $[\text{ReCl}(\eta^3\text{-C}_3\text{H}_5)(\eta^4\text{-C}_4\text{H}_4)(\text{CO})]$

2. (a) Draw the structure of $K[PtCl_3(PPh_3)]$ indicating the possible agostic interaction. Identify the type of agostic interaction present in the above complex?

(b) Draw the orbital diagram between a metal (M) and a $C\equiv O$ ligand, indicating the σ - and π -overlap.

(c) (i) Arrange $MeCH=CHMe$, $FCH=CHF$, $H_2C=CH_2$ in the order of increasing π -acceptability.
.....

(ii) Arrange NH_3 , NF_3 and $H_2NCH_2CH_2NH_2$ (en) in the order of increasing σ -donor ability.
.....

(d) (i) Name the possible geometries for a metal centre with four coordinated ligands?
.....

(ii) What is the main geometry shown by Pd(II) centres?

(iii) Draw the structures of the three geometrical isomers of the Pd(II) complex $[PdCl(Me)(C\equiv S)(NF_3)]$.

(e) $[RuCl(NO)(\eta^3-C_3H_5)(C\equiv O)]$ has a linear Ru-NO fragment. Determine the VEC of Ru. Ru is a Group 8 metal.

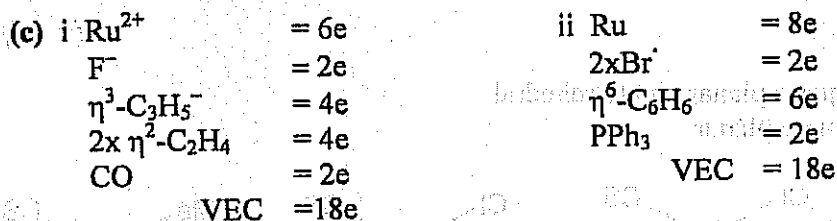
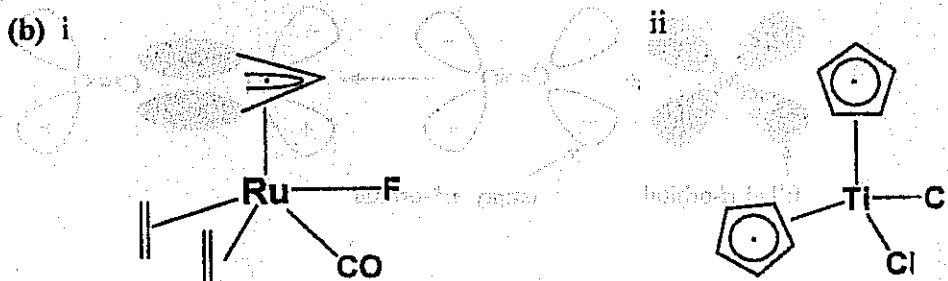
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 Assignment Test - I Answer Guide

Part A – MCQ ANSWERS

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

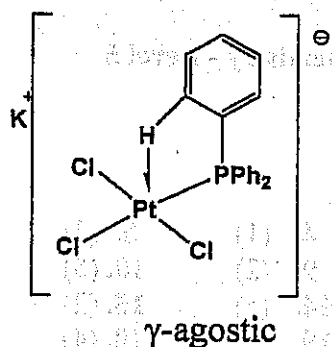
Part B

1. (a) i $(\eta^3\text{-allyl})\text{carbonyldi}(\eta^2\text{-ethene})\text{fluororuthenium}$
 ii $(\eta^6\text{-benzene})\text{dibromo}(\text{triphenylphosphine})\text{ruthenium}$

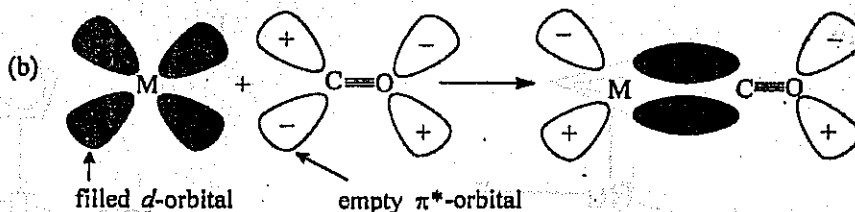


- (d) No. of electrons donated by $\text{Cl}^- = 2$
 No. of electrons donated by $(\eta^3\text{-C}_3\text{H}_5^-) = 4$
 No. of electrons donated by $(\eta^4\text{-C}_4\text{H}_4) = 4$
 No. of electrons donated by $\text{CO} = 2$
 Total no. of electrons = 12
 Number of electron pairs = Coordination Number = 6

2. (a)

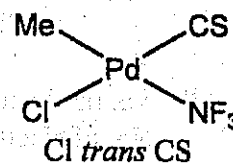
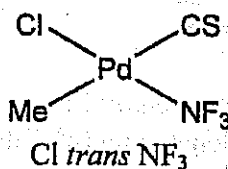
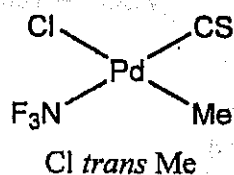


(b) σ -overlap and π -overlap are given below.



- (c) i $\text{MeCH=CHMe} < \text{CH}_2=\text{CH}_2 < \text{FHC=CHF}$
 ii $\text{NF}_3 < \text{NH}_3 < \text{en}$

- (d) i Square planar and tetrahedral
 ii Square planar



(e) NO (linear) gives 3e to the metal centre.

Ru^{2+}	= 6e
Cl^-	= 2e
NO	= 3e
$\eta^3\text{-C}_3\text{H}_5^-$	= 4e
CO	= 2e
VEC	= 17e