



THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. & B. Ed. DEGREE / STAND ALONG COURSE IN SCIENCE - LEVEL 5
ASSIGNMENT TEST II (NBT) 2016/2017
CMU3122/CME5122 – Organometallic Chemistry

15th May 2017 (Monday)

4.15 – 5.15 p.m.

ANSWER ALL QUESTIONS

Select the most correct answer/choice 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 (45 marks)

1. Which one is the most likely **substitution** reaction?

- 1) $[\text{Pd}(\text{PPh}_3)_4] + \text{CH}_2=\text{CHI} \rightarrow [\text{PdI}(\text{CH}=\text{CH}_2)(\text{PPh}_3)_2] + 2\text{PPh}_3$
- 2) $[\text{Ni}(\text{PEt}_3)_3] + \text{PhI} \rightarrow [\text{Ni}(\text{Ph})(\text{I})(\text{PEt}_3)_2] + \text{PEt}_3$
- 3) $[\text{Os}(\text{CO})_5] + \text{I}_2 \rightarrow [\text{OsI}_2(\text{CO})_4] + \text{CO}$
- 4) $[(\text{OC})_4\text{Fe}(\text{C}_4\text{F}_8)] \rightarrow [\text{Fe}(\text{CO})_4] + \text{C}_4\text{F}_8$
- 5) $[(\eta^1\text{-C}_3\text{H}_5)\text{Mn}(\text{CO})_5] \rightarrow [(\eta^3\text{-C}_3\text{H}_5)\text{Mn}(\text{CO})_4] + \text{CO}$

2. Which one of the following reactions would **not** take place?

- 1) $\text{Na}_2[\text{Fe}(\text{CO})_4] + \text{HCl} \rightarrow \text{Na}[\text{HFe}(\text{CO})_4] + \text{NaCl}$
- 2) $[\text{Pt}(\text{PPh}_3)_3] + \text{HCN} \rightarrow [\text{PtH}(\text{CN})(\text{PPh}_3)_2] + \text{PPh}_3$
- 3) $[\text{Cp}_2\text{TiCl}_2] + \text{AlMe}_3 \rightarrow [\text{Cp}_2\text{TiMe}_2] + \text{AlMeCl}_2$
- 4) $[\text{Pd}(\text{PPh}_3)_4] + \text{CH}_2=\text{CHI} \rightarrow [\text{PdI}(\text{CH}=\text{CH}_2)(\text{PPh}_3)_2] + 2\text{PPh}_3$
- 5) $[\text{Pt}(\text{PPh}_3)_3] + \text{I}_2 \rightarrow [\text{PtI}_2(\text{PPh}_3)_2] + \text{PPh}_3$

3. Consider the following statements regarding **reductive elimination**.

- (i) Coordinatively unsaturated compounds prefer to undergo reductive elimination.
- (ii) Reductive elimination is facile if the metal center is positively charged.
- (iii) Coordination number of the metal is reduced by two units during reductive elimination.

The **correct** statement/s is/are

- 1) (ii) only
- 2) (i) & (ii) only
- 3) (ii) & (iii) only
- 4) (i) & (iii) only.
- 5) (i), (ii) & (iii).

4. Which one of the following statements is **not true** about $[\text{W}(\eta^2\text{-H}_2)(\text{CO})_3(\text{PPr}^f_3)_2]$ (A)?

- 1) (A) is a divalent complex.
- 2) (A) has the octahedral geometry.
- 3) In (A), H–H bond distance is larger than that of free H_2 .
- 4) In (A), H_2 can be replaced by N_2 by bubbling nitrogen.
- 5) (A) has the *mer,trans* arrangement.

5. What is the **product** of the reaction, $[\text{PtCl}_2(\text{PMe}_3)_2] + \text{excess LiMe} \rightarrow ?$

- 1) $\text{Li}_2[\text{PtCl}_2\text{Me}_2(\text{PMe}_3)_2]$
- 2) $[\text{PtMe}_2(\text{PMe}_3)_2]$
- 3) $[\text{PtCl}(\text{Me})(\text{PMe}_3)_2] + \text{LiCl}$
- 4) $\text{Li}[\text{PtCl}_2\text{Me}(\text{PMe}_3)_2]$
- 5) $[\text{PtCl}_2\text{Me}_2(\text{PMe}_3)_2]$

6. Which one of the following metal carbonyls has **not** got a bridging carbonyl ligand?

- 1) $[\text{Fe}_2(\text{CO})_9]$
- 2) $[\text{Fe}_3(\text{CO})_{12}]$
- 3) $[(\eta^5\text{-C}_5\text{H}_5)_2\text{Fe}_2(\text{CO})_4]$
- 4) $[\text{Ir}_4(\text{CO})_{12}]$
- 5) $[\text{Co}_2(\text{CO})_8]$

7. Which one is an example for **one-electron** oxidative-addition reaction?
- 1) $[\text{Os}(\text{CO})_5] + \text{I}_2 \rightarrow [\text{OsI}_2(\text{CO})_4] + \text{CO}$
 - 2) $2[\text{Co}(\text{CN})_5]^{3-} + \text{H}_2 \rightarrow 2[\text{HCo}(\text{CN})_5]^{3-}$
 - 3) $\text{trans-}[\text{Ir}(\text{CO})(\text{PPh}_3)_2] + \text{MeI} \rightarrow [\text{IrMeI}_2(\text{CO})(\text{PPh}_3)_2]$
 - 4) $[\text{Os}(\text{CO})_5] + \text{I}_2 \rightarrow [\text{OsI}(\text{CO})_5]\text{I}$
 - 5) $\text{Pt}(\text{PPh}_3)_4 + \text{Br}_2 \rightarrow [\text{PtBr}_2(\text{PPh}_3)_2] + 2\text{PPh}_3$
8. Consider the following statements.
- (i) Oxidative addition of MeI to $[\text{IrCl}(\text{CO})(\text{PPh}_3)_2]$ is normally *trans*.
 - (ii) $[\text{Os}(\text{CO})_5]$ is coordinatively saturated and it does **not** undergo oxidative addition reaction with I_2 to form $[\text{OsI}(\text{CO})_5]\text{I}$.
 - (iii) Oxidative addition of O_2 to $[\text{IrCl}(\text{CO})(\text{PPh}_3)_2]$ is always *cis*.
- 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).
9. Consider the following statements.
- (i) Dihydrogen can act as a good π -acceptor.
 - (ii) The oxidative addition of coordinated H_2 depends on the strength of the back donation.
 - (iii) Oxidative addition of H_2 to $[\text{IrCl}(\text{CO})(\text{PPh}_3)_2]$ gives *cis*-dihydrides.
- The **correct** statement/s is/are
- 1) (iii) only
 - 2) (i) & (ii) only
 - 3) (i) & (iii) only
 - 4) (ii) & (iii) only
 - 5) (i), (ii) & (iii).
10. β -Agostic interaction could be seen in
- 1) $[\text{Pt}(\text{PPh}_3)_3]$
 - 2) $[\text{Ni}(\text{PEt}_3)_3]$
 - 3) $[\text{MeCo}(\text{CO})_3]$
 - 4) $[(\eta^5\text{-C}_5\text{H}_5)\text{Rh}(\text{Me})(\text{PPh}_3)\text{I}]$
 - 5) $[\text{PhCH}_2\text{Co}(\text{CO})_3]$
11. Nucleophilic attack on a coordinated ligand is **not** facilitated if
- 1) The metal is coordinatively saturated.
 - 2) the metal is coordinated to good σ -donor ligands.
 - 3) the metal carries a positive charge.
 - 4) electron withdrawing groups are on coordinated ligands
 - 5) the metal is coordinated to good π -acceptor ligands.
12. Consider the following statements about metal carbonyls.
- (i) The carbonyl stretching frequencies of doubly bridging metal carbonyls are higher than those of triply bridging ones.
 - (ii) CO stabilizes the metal centres in lower oxidation states.
 - (iii) The back bonding increases the M-C bond strength.
- The **correct** statement/s is/are
- 1) (ii) only
 - 2) (i) & (ii) only
 - 3) (i) & (iii) only
 - 4) (ii) & (iii) only
 - 5) (i), (ii) & (iii)
13. Consider the olefins propene (A), *trans*-2-butene (B) and *cis*-2-butene (C).
The ease of hydrogenation of the above olefins is
- 1) (A) > (B) > (C)
 - 2) (A) > (C) > (B)
 - 3) (C) > (A) > (B)
 - 4) (B) > (C) > (A)
 - 5) (B) > (A) > (C)
14. Some metals react directly with alkyl halides to form M-C σ -bonds.
The order of reactivity of organic halide is,
- 1) $\text{RCl} > \text{RBr} > \text{RI}$
 - 2) $\text{RI} > \text{RBr} > \text{RCl}$
 - 3) $\text{RBr} > \text{RCl} > \text{RI}$
 - 4) $\text{RBr} > \text{RI} > \text{RCl}$
 - 5) $\text{RI} > \text{RCl} > \text{RBr}$

15. Consider the following statements.

(i) Metal hydrides cannot act as H^+ donors.

(ii) $[HCo(CO)_3(PPh_3)]$ is a stronger acid than $[HCo(CO)_4]$.

(iii) $\nu(M-H) = \nu(M-D) \times \sqrt{2}$.

The correct statement/s is/are

1) (iii) only

2) (i) & (ii) only

3) (i) & (iii) only

4) (ii) & (iii) only

5) (i), (ii) & (iii)

THE OPEN UNIVERSITY OF SRI LANKA

B. Sc DEGREE PROGRAMME 2016/2017

CMU3122/CME5122 – ORGANOMETALLIC CHEMISTRY- LEVEL 5

ASSIGNMENT TEST-II (Part A)

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

Reg. No.

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For Examiners Use

Part A	
Part B	
Total %	

Marks

Correct Answers		
Wrong Answers		
Total		

1.

1	2	3	4	5
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2.

1	2	3	4	5
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3.

1	2	3	4	5
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4.

1	2	3	4	5
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5.

1	2	3	4	5
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6.

1	2	3	4	5
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7.

1	2	3	4	5
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8.

1	2	3	4	5
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9.

1	2	3	4	5
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10.

1	2	3	4	5
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11.

1	2	3	4	5
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12.

1	2	3	4	5
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13.

1	2	3	4	5
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14.

1	2	3	4	5
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15.

1	2	3	4	5
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Part B (55 marks)

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

1. (a) (i) What is the **molecular formula** of the product (**A**) formed due to oxidative addition of HCl to $[\text{CoH}(\text{CO})_3]$?

(ii) Draw the structures of the **three** isomers of (**A**).

(b) $[\text{IrCl}_3(\text{PPh}_3)_3]$ reacts with an excess of MeLi to give the 18e-complex (**P**). (**P**) reductive eliminates an alkane (**Q**) to give the 16e-complex (**R**). Under pressure, (**R**) reacts with CO to give another 16e-complex (**S**). Identify (**P**), (**Q**), (**R**) and (**S**).

(**P**) (**Q**)

(**R**) (**S**)

(c) Arrange PF_3 , PMe_3 , $\text{P}(\text{OMe})_3$, and NMe_3 , in the order of increasing π -acceptability.

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(d) Identify the product(s) of the following reactions using the hint given in the brackets.

(i) $[(\eta^5\text{-Cp})(\text{Ph}_3\text{P})_2\text{FeC}\equiv\text{CPh}] + \text{Me}_3\text{O}^+ \rightarrow$ 18e-complex (**K**) (electrophilic attack)

(ii) $[\text{Fe}(\text{PMe}_3)_4] \rightarrow$ 18e-complex (**L**) (cyclometallation)

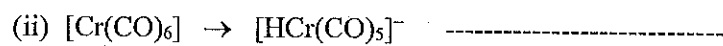
(iii) $\text{cis-}[\text{PtCl}(\text{Et})(\text{PPh}_3)_2] \xrightarrow{\Delta}$ 16e-complex (**M**) (β -H abstraction)

(**K**)

(**L**)

(**M**)

(e) Write on the dotted line, the **compound/reagent(s)** which can be used to carry out the following conversions.



(f) $[\text{Mo}(\text{CO})_6]$ reacts with two moles of PPh_3 to give a molybdenum(0) complex (**Z**). (**Z**) shows only one IR band in the carbonyl region, draw the structure of (**Z**).

Registration No:

Name & Address:

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CMU 3122
ORGANOMETALLIC CHEMISTRY
CAT 02 (ANSWER GUIDE)

Part A (45 marks)

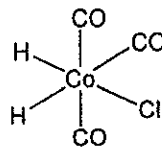
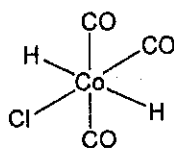
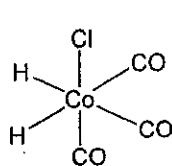
1. 5	2. 3	3. 3	4. 1	5. 2
6. 4	7. 2	8. 3	9. 4	10. 2
11. 2	12. 4	13. 2	14. 2	15. 1

Part B (55 marks)

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

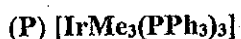
1. (a) (i) What is the **molecular formula** of the product (A) formed due to oxidative addition of HCl to $[\text{CoH}(\text{CO})_3]$? $[\text{CoH}_2\text{Cl}(\text{CO})_3]$

(ii) Draw the structures of the **three isomers** of (A).

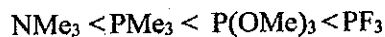


fac- $[\text{CoH}_2\text{Cl}(\text{CO})_3]$ *mer,trans*- $[\text{CoH}_2\text{Cl}(\text{CO})_3]$ *mer,cis*- $[\text{CoH}_2\text{Cl}(\text{CO})_3]$

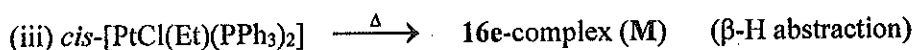
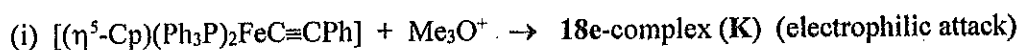
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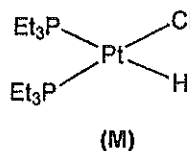
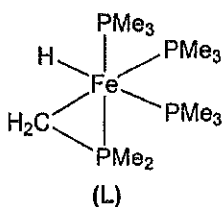
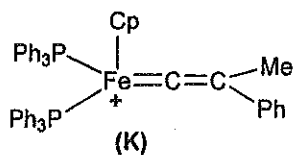


- (c) Arrange PF_3 , PMe_3 , $\text{P}(\text{OMe})_3$, and NMe_3 , in the order of increasing π -acceptability.

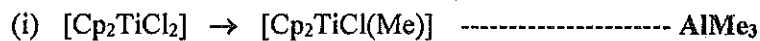


- (d) Identify the product(s) of the following reactions using the hint given in the brackets.

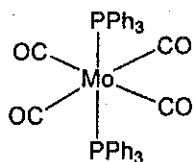




(e) Write on the dotted line, the **compound/reagent(s)** which can be used to carry out the following conversions.



(f) $[\text{Mo}(\text{CO})_6]$ reacts with two moles of PPh_3 to give a molybdenum(0) complex (**Z**). (**Z**) shows only one IR band in the carbonyl region, draw the structure of (**Z**).



trans- $[\text{Mo}(\text{PPh}_3)_2(\text{CO})_4]$ (**Z**)