



THE OPEN UNIVERSITY OF SRI LANKA
B. Sc. DEGREE PROGRAMME 2017/2018
CYU5300 – ORGANOMETALLIC CHEMISTRY
ASSIGNMENT TEST-I (NBT)

DATE : 16th June 2018

Duration = 1 hour

TIME : 9.00 am to 10.00 am

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 (45 marks)

1. Consider the following organic ligands.

(i) $-\text{CH}=\text{CH}_2$ (ii) ethenyl (iii) ethynylThe *monohapto* ligand/s is/are

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

2. The possible **coordination mode(s)** of 1,3-butadiene (*in a mononuclear complex*) is/are?

- 1) η^4 only. 2) η^2 and η^4 only. 3) η^1 and η^3 only.
 4) η^1 , η^2 and η^4 only. 5) η^1 , η^2 , η^3 and η^4 only.

3. Consider the following statements.

- (i) Carbene ligand is a *monohapto* ligand.
 (ii) Carbyne ligand is a 2e-donor.
 (iii) In Fischer carbenes, the $\text{M}=\text{C}$ carbon is electrophilic.

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)

4. Which one of the following ligands is **not isoelectronic** with CO.

- 1) $\text{HC}\equiv\text{CH}$ 2) N_2 3) NO^+ 4) CN^- 5) $\text{CH}_2=\text{CH}_2$

5. A L_2 type ligand is

- 1) $\eta^4\text{-C}_4\text{H}_4$ 2) $\eta^2\text{-CH}_2=\text{CH}_2$ 3) $\eta^6\text{-C}_6\text{H}_6$ 4) $\eta^3\text{-C}_3\text{H}_3^-$ 5) $\text{HC}\equiv\text{CH}$

6. The IUPAC name of $[\text{W}(\text{O}_2)(\text{CO})_2(\eta^6\text{-C}_6\text{H}_6)]$ is

- 1) Diperoxodicarbonyl(η^6 -benzene)tungsten
 2) (η^6 -benzene)dicarbonyl(oxygen)tungsten
 3) (η^6 -Benzene)dioxodicarbonyltungsten
 4) (η^6 -Benzene)dicarbonyl(dioxygen)tungsten
 5) Dicarbonyl(dioxygen)(η^6 -benzene)tungstate

7. According to **ionic model**, which one of the following is a 6e-donor ligand?

- 1) $\eta^7\text{-C}_7\text{H}_7^-$ 2) 1,3-cyclobutadiene 3) cyclopentadiene (C_5H_5)
 4) $\eta^5\text{-Cp}^-$ 5) 1,3-cyclohexadiene (C_6H_8)

8. The coordination number of **each** Pd centre in the dimer $[(\eta^3\text{-C}_3\text{H}_5)\text{Pd}(\mu\text{-Cl})]_2$ is

- 1) 3 2) 4 3) 5 4) 6 5) 2

9. Consider the following statements about $[\text{Pd}(\text{CN})(\text{Br})(\text{PPh}_3)(\text{CO})]$. Group no. of Pd is 10.

- (i) It shows the tetrahedral geometry.
- (ii) It gives optical isomers.
- (iii) It is a coordinatively unsaturated compound.

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. Consider the following statements about metal carbonyls.

- (i) Back bonding weakens the CO bond strength.
- (ii) Back bonding increases the M–C bond strength.
- (iii) The CO stretching frequency $\nu(\text{CO})$, is inversely proportional to the carbon-oxygen bond strength.

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. Which one of the following statements is **not true** about **Fischer carbenes**?

- 1) Metal is in a low oxidation state.
- 2) Carbene carbon contains a $-\delta$ charge.
- 3) Carbene carbon is readily attacked by nucleophiles.
- 4) Carbenes are formed with late transition metal.
- 5) Carbene carbon is electrophilic.

12. Consider the following statements,

- (i) Isocyanides are stronger σ -donors than $\text{C}\equiv\text{O}$.
- (ii) $\text{F}_3\text{CN}\equiv\text{C}$ is a stronger π -acceptor than $\text{MeN}\equiv\text{C}$.
- (iii) Isocyanides are weaker π -acceptors than $\text{C}\equiv\text{O}$.

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)

13. Example for an **oxidative-addition** reaction is

- 1) $[\text{Fe}(\text{CO})_5] + 2 \text{CF}_2=\text{CF}_2 \rightarrow [(\text{OC})_4\text{Fe}(\text{C}_4\text{F}_8)] + \text{CO}$
- 2) $[\text{Pt}(\text{PEt}_3)_3] + \text{PhI} \rightarrow [\text{Pt}(\text{Ph})(\text{I})(\text{PEt}_3)_2] + \text{PEt}_3$
- 3) $[\text{MeMn}(\text{CO})_5] + \text{CO} \rightarrow [\text{Me}(\text{COMe})(\text{CO})_5]$
- 4) $[\text{Ni}(\text{CO})_3] + \text{CO} \rightarrow [\text{Ni}(\text{CO})_4]$
- 5) $[\text{Mn}_2(\text{CO})_{10}] + 2 \text{Na} \rightarrow 2 \text{Na}[\text{Mn}(\text{CO})_5]$

14. $[(\eta^5\text{-C}_5\text{H}_5)_4\text{Mo}_2(\mu\text{-CO})_2]$ is a **coordinatively saturated** complex. Which one of the following statements is **not true** about the above complex? (Group no. of Mo is 6)

- 1) W and Mo belong to the same Group.
- 2) The complex has two bridging carbonyl ligands.
- 3) Each molybdenum centre has 18 valence electrons.
- 4) There is a Mo–Mo bond.
- 5) Each molybdenum centre is coordinated to two Cp ligands.

15. Consider the following statements regarding reductive elimination reactions.

- (i) The two groups (to be eliminated) must be in the *trans* position before elimination can occur.
- (ii) Coordination number of the metal is decreased by two units.
- (iii) It proceeds *via* 3-center transition state.

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

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

THE OPEN UNIVERSITY OF SRI LANKA
B. Sc. DEGREE PROGRAMME 2017/2018
CYU5300 – ORGANOMETALLIC CHEMISTRY - LEVEL 5
ASSIGNMENT TEST-I (Part A)

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

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For Examiners Use

Part A	
Part B	
Total %	

Marks

Correct Answers		
Wrong Answers		
Total		

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Part B (55 marks)

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

1. (a) Give the IUPAC name for $[\text{CoF}(\eta^1\text{-C}_3\text{H}_5)(\eta^2\text{-C}_4\text{H}_4)(\eta^2\text{-C}_2\text{H}_4)]$.

- (b) Draw the **structure** of $(\eta^4\text{-Butadiene})\text{carbonyl}(\eta^2\text{-ethyne})\text{diiodotungsten}$

- (c) Determine the **coordination number** of Ru in $[\text{RuCl}(\eta^2\text{-C}_2\text{H}_4)(\eta^5\text{-C}_5\text{H}_5)(\text{CO})]$.

- (d) $[\text{FeF}(\text{NO})(\eta^5\text{-C}_5\text{H}_5)(\text{CO})]$ has a **bent** Fe–NO fragment. Determine the **VEC** of Fe. (Fe is a Group 8 metal)

- (e) Draw the structures of the **three** isomers of $[\text{Ru}(\text{CO})_2(\text{PPh}_3)_3]$ with the **tetragonal pyramidal** geometry.

- (f) What is meant by the **β -agostic alkyl group**? Explain using an appropriate **structure**.

- (g) Arrange NMe_3 , MeCN and N_2 in the order of increasing **σ -donor ability**.

- (h) Arrange CF_3CN , MeCN , and CS in the order of increasing **π -acceptability**.

Name:

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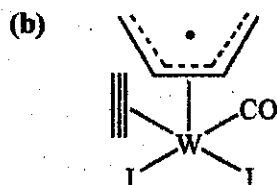
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CYU5300/CMU3122 – ORGANOMETALLIC CHEMISTRY
ANSWER GUIDE FOR ASSIGNMENT TEST-I

Part A

- (1) 5 (2) 2 (3) 3 (4) 5 (5) 1 (6) 4 (7) 4 (8) 2 (9) 1
 (10) 2 (11) 2 (12) 5 (13) 2 (14) 4 (15) 3

Part B

1. (a) η^1 -allyl(η^2 -cyclobutadiene)(η^2 -ethene)fluorocobalt



- (c) Coordination number = No. of electron pairs donated by the ligands
 $= 1 (\text{Cl}^-) + 1 (\eta^2\text{-C}_2\text{H}_4) + 3 (\eta^5\text{-C}_5\text{H}_5^-) + 1 (\text{CO}) = 6$

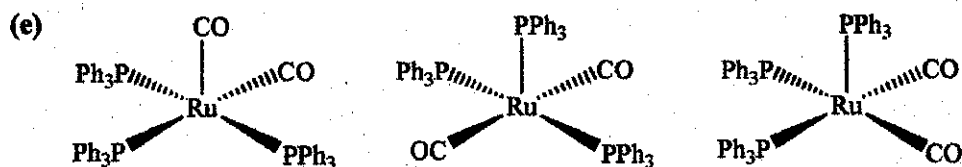
- (d) NO of a bent Fe-NO fragment donates 1e.

Ionic Model

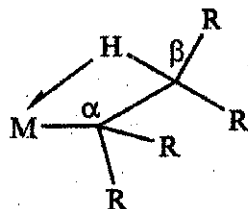
$$\text{VEC} = [(\text{Fe}^{2+}; 6e) + (\text{F}^-; 2e) + (\text{NO}; 1e) + (\eta^5\text{-C}_5\text{H}_5^-; 6e) + (\text{CO}; 2e)] = 17e$$

Covalent Model

$$\text{VEC} = [(\text{Fe}^0; 8e) + (\text{F}; 1e) + (\text{NO}; 1e) + (\eta^5\text{-C}_5\text{H}_5; 5e) + (\text{CO}; 2e)] = 17e$$



- (f) It is a weak interaction between a metal (M) and a C-H bond. It is believed that the two bonding electrons of the C-H bond are involved. If the interacting H is attached to the β -carbon it is a β -agostic interaction.



- (g) $\text{N}_2 < \text{MeCN} < \text{NMe}_3$

- (h) $\text{MeCN} < \text{CF}_3\text{CN} < \text{CS}$