

THE OPEN UNIVERSITY OF SRI LANKA
 B. Sc. DEGREE PROGRAMME 2019/2020
 CYU5300/CMU3122 – ORGANOMETALLIC CHEMISTRY
 ASSIGNMENT TEST-I (NBT)



DATE: 10th August 2019

Duration = 1 h

TIME : 9.00 a.m.- 10.00 a.m.

ANSWER ALL QUESTIONS

Mark a cross (X) over the **English letter** that corresponds to **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) cyclobutene (ii) vinyl (iii) ethyne

The *dihapto* ligand/s is/are

- a) (iii) only. b) (i) and (ii) only. c) (i) and (iii) only.
 d) (ii) and (iii) only. e) Answer is not given.

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

- a) $[(\eta^1\text{-C}_3\text{H}_5)\text{Mn}(\text{CO})_5] \rightarrow [(\eta^3\text{-C}_3\text{H}_5)\text{Mn}(\text{CO})_4] + \text{CO}$
 b) $[\text{Ni}(\text{PET}_3)_3] + \text{PhI} \rightarrow [\text{Ni}(\text{Ph})(\text{I})(\text{PET}_3)_2] + \text{PET}_3$
 c) $[\text{Os}(\text{CO})_5] + \text{I}_2 \rightarrow [\text{OsI}_2(\text{CO})_4] + \text{CO}$
 d) $[\text{HMn}(\text{CO})_5] + \text{CF}_2=\text{CF}_2 \rightarrow [\text{Mn}(\text{CF}_2\text{CF}_2\text{H})(\text{CO})_5]$
 e) $[\text{Ni}(\text{PET}_3)_3] + \text{IFC}=\text{CF}_2 \rightarrow [\text{NiI}(\text{PET}_3)_2(\text{CF}=\text{CF}_2)] + \text{PET}_3$

3. Consider the following statements

- (i) MeCHO and MeNO are not isoelectronic.
 (ii) Ar and HCl are isoelectronic.
 (iii) NO⁺ and N₂ are isoelectronic.

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

- a) (iii) only b) (i) & (ii) only c) (i) & (iii) only
 d) (ii) & (iii) only e) (i), (ii) & (iii)

4. An L₃ type ligand is

- a) $\eta^4\text{-C}_6\text{H}_6$ b) $\eta^2\text{-C}_6\text{H}_6$ c) cyclopentadienyl d) $\eta^6\text{-C}_7\text{H}_8$ e) $\eta^3\text{-C}_3\text{H}_5^-$

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

- a) (η^6 -benzene)carbonylfluorocobaltate
 b) Carbonylfluorophenylcobalt
 c) (η^6 -Benzene)carbonylfluorocobalt
 d) (Hexahaptobenzene)carbonylcobalt fluoride
 e) Fluorocarbonyl(η^6 -benzene)cobalt

6. What is the **Valence Electron Count (VEC)** of Rh in $[\text{RhI}(\eta^1\text{-C}_3\text{H}_5)(\eta^6\text{-C}_6\text{H}_6)]$?

(Group number of Rh is 9)

- a) 16 b) 17 c) 18 d) 21 e) 15

7. According to the **covalent model**, a stable 4e-donor ligand is

- a) σ -allyl b) benzene c) C \equiv O d) π -allyl e) C₄H₄

8. According to the ionic model, the **coordination number** and the **oxidation number** of Co in $[\text{CoCl}(\eta^5\text{-C}_5\text{H}_5)(\eta^3\text{-C}_5\text{H}_5)]$ (Group number of Co is 9) are
 a) 6, +2 b) 6, +3 c) 7, +1 d) 7, +2 e) 7, +3
9. Consider the following statements about $[\text{FeI}_2(\text{CO})_3(\text{PMe}_3)]$ (Group no. of Fe = 8).
 (i) It has 3 geometrical isomers.
 (ii) It does not show optical isomerism.
 (iii) It is a coordinatively saturated compound.
 The **correct** statement/s is/are
 a) (iii) only. b) (i) & (ii) only. c) (i) & (iii) only.
 d) (ii) & (iii) only. e) (i), (ii) & (iii).
10. Consider the following statements,
 (i) Reductive elimination is enhanced by electron donating ligands.
 (ii) The two groups to be eliminated must always be in the *cis*-positions before elimination takes place.
 (iii) $[\text{PdMe}_2(\text{dppe})]$ eliminates ethane slower than $[\text{PdMe}_2(\text{PPh}_3)_2]$.
 (dppe = $\text{PPh}_2\text{CH}_2\text{CH}_2\text{PPh}_2$ is a bidentate ligand)
 The **correct** statement/s is/are
 a) (ii) only b) (i) & (ii) only c) (i) & (iii) only
 d) (ii) & (iii) only e) (i), (ii) & (iii)
11. The strongest σ -donor ligand is
 a) NMe_3 b) CO c) BMe_3 d) CHCl_3 e) PF_3
12. What is **not true** about **dinitrogen**?
 a) It can act as a *dihapto* ligand. b) It can act as a 4e-donor.
 c) It can act as a bridging ligand. d) It is a better σ -donor than CO .
 e) It is a weak π -acceptor than NO .
13. Consider the complex ion $[\text{PtBr}_3(\eta^2\text{-CF}_2=\text{CF}_2)]^-$. Which one of the following statements is **true** about the above complex? (Group number of Pt is 10)
 a) It is a tetrahedral complex.
 b) The oxidation number of Pt is +3.
 c) The plane of $\text{CF}_2=\text{CF}_2$ is perpendicular to the PtBr_3 plane.
 d) It is not symmetrical.
 e) All the above statements are false.
14. What is **not true** about the **carbene** ligand?
 a) It can act as a monodentate ligand.
 b) It cannot act as a 3e-donor.
 c) Carbene carbon is sp^2 hybridized.
 d) It can form a metal carbon double bond.
 e) It can form Fischer carbenes with Group 4 metals.
15. Which is **not an oxidative addition/coupling** reaction
 a) $[\text{Fe}(\text{CO})_5] + 2 \text{CF}_2=\text{CF}_2 \rightarrow [(\text{OC})_4\text{Fe}(\text{C}_4\text{F}_8)] + \text{CO}$
 b) $[\text{Pt}(\text{PEt}_3)_3] + \text{PhI} \rightarrow [\text{Pt}(\text{Ph})(\text{I})(\text{PEt}_3)_2] + \text{PEt}_3$
 c) $[\text{MeMn}(\text{CO})_5] + \text{CO} \rightarrow [\text{Me}(\text{COMe})(\text{CO})_5]$
 d) $[\text{Ni}(\text{PEt}_3)_3] + \text{IFC}=\text{CF}_2 \rightarrow [\text{NiI}(\text{PEt}_3)_2(\text{CF}=\text{CF}_2)] + \text{PEt}_3$
 e) $2[\text{Co}(\text{CN})_5]^{3-} + \text{H}_2 \rightarrow 2[\text{HCo}(\text{CN})_5]^{3-}$

THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. Degree Programme - Level 5

Assignment Test I - 2019/2020
CYU5300/CMU3122 - Organometallic Chemistry

MCQ Answer Sheet: Mark a cross (×) over the English Letter that corresponds to the most suitable answer.

Reg. No.

FOR EXAMINER'S USE ONLY		
Answers	No.	Marks
Correct		
Wrong		
Total		

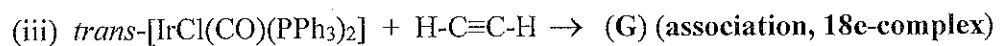
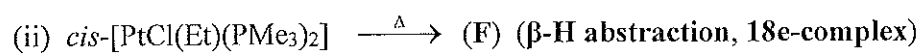
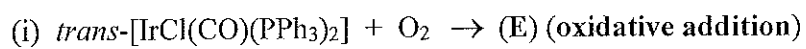
1	a	b	c	d	e	2	a	b	c	d	e	3	a	b	c	d	e	4	a	b	c	d	e
5	a	b	c	d	e	6	a	b	c	d	e	7	a	b	c	d	e	8	a	b	c	d	e
9	a	b	c	d	e	10	a	b	c	d	e	11	a	b	c	d	e	12	a	b	c	d	e
13	a	b	c	d	e	14	a	b	c	d	e	15	a	b	c	d	e						

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 $[\text{CoH}(\text{Br})(\text{CH}=\text{CH}_2)(\eta^5\text{-C}_5\text{H}_5)]$.
- (b) Draw the **structure** of $[\text{ReH}(\text{Br})(\eta^1\text{-CH}_2\text{CH}=\text{CH}_2)(\eta^5\text{-C}_5\text{H}_5)]$.
- (c) Determine the **VEC** of Re in $[\text{ReBr}_2(\text{Me})(\eta^1\text{-CH}_2\text{CH}=\text{CH}_2)(\eta^5\text{-C}_5\text{H}_5)]$ (A) using **ionic model**. (Indicate your break down; Group number of Re is 7)
- (d) Determine the **coordination number** of Re in (A).
- (e) **Draw the structures** of the three **geometrical** isomers of $[\text{RuBr}_2(\text{dppe})(\text{CO})_2]$ (B). dppe = $\text{PPh}_2\text{CH}_2\text{CH}_2\text{PPh}_2$ is a bidentate ligand.
- (f) Oxidative addition of MeI is **more facile** to $[\text{RhCl}_2(\text{PEt}_3)_2]^-$ (C) than $[\text{RhCl}_2(\text{CO})_2]^-$ (D). Briefly explain.

(g) Write the **molecular formulae** or draw the structures of the **major product** of the following reactions using **the hint given in brackets**.



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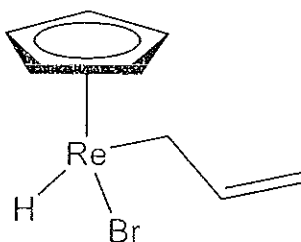
Answer Guide
ORGANOMETALLIC CHEMISTRY CYU5300
CAT-1 – 2019/2020

Part A – MCQ Answers

1. c 2. a 3. d 4. d 5. c 6. b 7. e 8. b
 9. e 10. d 11. a 12. d 13. c 14. e 15. c

Part B

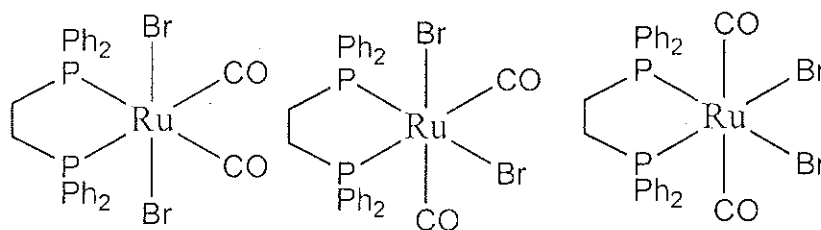
1. a) Bromo(η^5 -cyclopentadienyl)(ethenyl)hydrocobalt or
 bromo(η^5 -cyclopentadienyl)hydrovinylcobalt
 b)



c) $2e (\text{Re}^{5+}) + 4e (2 \times \text{Br}^-) + 2e (\text{Me}^-) + 2e (\eta^1\text{-allyl}) + 6e (\text{Cp}^-) = 16e$

d) C.N = number of electron pairs donated
 $2 (2 \times \text{Br}^-) + 1 (\text{Me}^-) + 1 (\eta^1\text{-allyl}) + 3 (\eta^5\text{-Cp}^-) = 7$

e)



- f) Both compounds are Rh(I) and square-planar;
 Electron donor ability $\text{PEt}_3 > \text{CO}$;
 Therefore, Rh(I) centre in (C) is electron richer than that of (D);
 thus, ability to undergo oxidative addition is (C) > (D).

g)

- I. (E) = $[\text{IrCl}(\text{CO})(\eta^2\text{-O}_2)(\text{PPh}_3)_2]$
 II. (F) = $[\text{PtCl}(\text{H})(\eta^2\text{-CH}_2=\text{CH}_2)(\text{PMe}_3)_2]$
 III. (G) = $[\text{IrCl}(\text{CO})(\eta^2\text{-HC}\equiv\text{CH})(\text{PPh}_3)_2]$

