00212

(09)

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) $[(\eta^1\text{-}C_3H_5)Mn(CO)_5] \rightarrow [(\eta^3\text{-}C_3H_5)Mn(CO)_4] + CO$
b) $[Ni(PEt_3)_3] + PhI \rightarrow [Ni(Ph)(I)(PEt_3)_2] + PEt_3$
c) $[Os(CO)_5] + I_2 \rightarrow [OsI_2(CO)_4] + CO$
d) $[HMn(CO)_5] + CF_2{=}CF_2 \rightarrow [Mn(CF_2CF_2H)(CO)_5]$
e) $[Ni(PEt_3)_3] + IFC{=}CF_2 \rightarrow [NiI(PEt_3)_2(CF{=}CF_2)] + PEt_3$

3. Consider the following statements
(i) MeCHO and MeNO are not isoelectronic.
(ii) Ar and HCl are isoelectronic.
(iii) NO^+ and N_2 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 $\mathbf{L_3}$ type ligand is
a) $\eta^4\text{-}C_6H_6$ b) $\eta^2\text{-}C_6H_6$ c) cyclopentadienyl d) $\eta^6\text{-}C_7H_8$ e) $\eta^3\text{-}C_3H_5^-$

5. The IUPAC name of $[CoF(CO)(\eta^6\text{-}C_6H_6)]$ 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 $[RhI(\eta^1\text{-}C_5H_5)(\eta^6\text{-}C_6H_6)]$?
(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≡O d) π–allyl e) C_4H_4

8. According to the ionic model, the **coordination number** and the **oxidation number** of Co in $[CoCl(\eta^5\text{-}C_5H_5)(\eta^3\text{-}C_5H_5)]$ (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 $[FeI_2(CO)_3(PMe_3)]$ (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) $[PdMe_2(dppe)]$ eliminates ethane slower than $[PdMe_2(PPh_3)_2]$. (dppe = $PPh_2CH_2CH_2PPh_2$ 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 $[PtBr_3(\eta^2\text{-}CF_2{=}CF_2)]^-$. 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 $CF_2{=}CF_2$ 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) $[Fe(CO)_5] + 2\ CF_2{=}CF_2 \rightarrow [(OC)_4Fe(C_4F_8)] + CO$
   b) $[Pt(PEt_3)_3] + PhI \rightarrow [Pt(Ph)(I)(PEt_3)_2] + PEt_3$
   c) $[MeMn(CO)_5] + CO \rightarrow [Me(COMe)(CO)_5]$
   d) $[Ni(PEt_3)_3] + IFC{=}CF_2 \rightarrow [NiI(PEt_3)_2(CF{=}CF_2)] + PEt_3$
   e) $2[Co(CN)_5]^{3-} + H_2 \rightarrow 2[HCo(CN)_5]^{3-}$

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 $[CoH(Br)(CH{=}CH_2)(\eta^5\text{-}C_5H_5)]$.

(b) Draw the **structure** of $[ReH(Br)(\eta^1\text{-}CH_2CH{=}CH_2)(\eta^5\text{-}C_5H_5)]$.

(c) Determine the **VEC** of Re in $[ReBr_2(Me)(\eta^1\text{-}CH_2CH{=}CH_2)(\eta^5\text{-}C_5H_5)]$ (**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 $[RuBr_2(dppe)(CO)_2]$ (**B**). dppe = $PPh_2CH_2CH_2PPh_2$ is a bidentate ligand.

(f) Oxidative addition of MeI is **more facile** to $[RhCl_2(PEt_3)_2]^-$ (**C**) than $[RhCl_2(CO)_2]^-$ (**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**.

(i) *trans*-[IrCl(CO)(PPh_3)$_2$] + O_2 $\rightarrow$ **(E) (oxidative addition)**

(ii) *cis*-[PtCl(Et)(PMe_3)$_2$] $\xrightarrow{\Delta}$ **(F) (β-H abstraction, 18e-complex)**

(iii) *trans*-[IrCl(CO)(PPh_3)$_2$] + H-C≡C-H $\rightarrow$ **(G) (association, 18e-complex)**

Name: .....

Registration No: .....

Address: .....

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

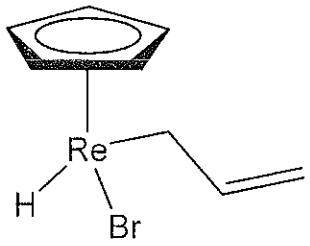
Part A – MCQ Answers

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

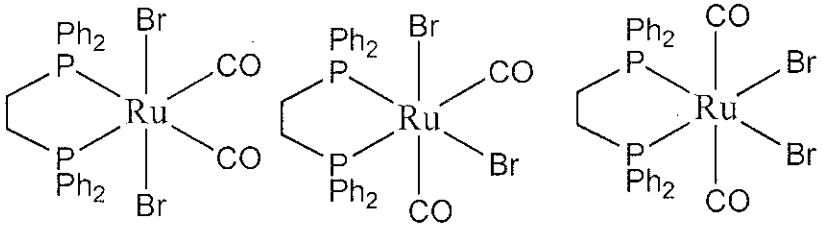
b)



c) 2e (Re^{5+}) + 4e (2×Br^-) + 2e (Me^-) + 2e (η^1-allyl) + 6e (Cp^-) = 16e

d) C.N = number of electron pairs donated
2 (2xBr^-) + 1 (Me^-) + 1 (η^1-allyl) + 3 (η^5-Cp^-) = 7

e)



f) Both compounds are Rh(I) and square-planar;
Electron donor ability PEt_3 > 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**) = [IrCl(CO)(η^2-O_2)(PPh_3)$_2$]

II. (**F**) = [PtCl(H)(η^2-CH_2=CH_2)(PMe_3)$_2$]

III. (**G**) = [IrCl(CO)(η^2-HC≡CH)(PPh_3)$_2$]