THE OPEN UNIVERSITY OF SRI LANKA
B. Sc. DEGREE PROGRAMME 2016/2017
CMU3122/CME5122 – ORGANOMETALLIC CHEMISTRY
ASSIGNMENT TEST-I (NBT)

DATE : 21st April 2017 Duration = 1 h TIME : 4.15 p.m. to 5.15 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 (45 marks)

1. Consider the following organometallic ligands,
   (i) ethyl (ii) σ-allyl (iii) ≡CPh
   The *monohapto* ligands is/are
   1) (i) only 2) (i) & (ii) only 3) (i) & (iii) only
   4) (ii) & (iii) only 5) (i), (ii) & (iii)

2. The possible coordination mode(s) of the cyclopentadienyl ion, (*in a mononuclear complex*) is/are?
   1) η^5 only. 2) η^3 only. 3) $\eta^1$and η^5 only.
   4) η^1 and η^3 only. 5) η^1, $\eta^3$and η^5 only.

3. 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) In Fischer carbenes, the M=C carbon is nucleophilic whereas in Schrock carbenes it 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. According to the **covalent model**, which one of the following is **not** a 3e-donor ligand?
   1) Nitrosyl 2) N≡N 3) ≡CR 4) π-allyl 5) NO

5. A LX type ligand is
   1) η^3-$C_3H_3^-$ 2) ≡CR 3) vinyl 4) =CHCl 5) η^5-$C_5H_5^-$

6. The IUPAC name of [Ti(η^4-C_4H_4)Cl(COMe)(CO)] is
   1) Titanium(η^4-cyclobutadiene)chloroacetylcarbonyl
   2) Chloroacetylcarbonyl(η^4-cyclobutene)titanium
   3) Acetylcarbonylchloro(η^4-cyclobutadiene)titanium
   4) Acetylcarbonylchloro(η^4-cyclobutene)titanate(II)
   5) Chloroacetylcarbonyl(η^4-cyclobutene)titanate

7. The **weakest π-acceptor** ligand among the following ligands is
   1) PF_3 2) CO 3) NO^+ 4) CN^- 5) CS

8. The coordination number of Pt in [(η^2-C_4H_4)PtBr(COMe)(PMe_3)] is
   1) 4 2) 5 3) 6 4) 7 5) 8

9. In metal carbonyls, what is **true** about **back donation**?
   1) the M–CO bond order increases as back donation decreases.
   2) the carbonyl frequency increases as back donation decreases.
   3) the bond strength of C≡O decreases as back donation decreases.
   4) the M–CO bond length decreases as back donation decreases.
   5) the bond strength of C≡O increases as back donation increases.

10. Consider the following statement/s about metal-alkyne complexes.
   (i) They have stronger back donations than metal-alkene complexes.
   (ii) Alkyne acts as a dihapto 2e donor.
   (iii) Alkyne acts as a trihapto 3e donor.
   The **correct** statement/s is/are
   1) (i) only 2) (i) and (iii) only 3) (ii) and (iii) only
   4) (i) and (ii) only 5) (i), (ii) and (iii)

11. What is **not true** about NO ligand?
   1) It is isolectronic with CO 2) It is a 1e donor
   3) It is a 3e-donor 4) It forms complexes with a bent M-NO group.
   5) It is paramagnetic.

12. According to the **Ionic Model**, what is the **oxidation number** of Ti in $[(\eta^3C_5H_5)TiCl(COMe)(CN)(CO)]$ (Atomic number of Ti is 22).
   1) 1 2) 2 3) 3 4) 4 5) 5

13. Which one of the following statements is **true** about oxidative-addition reactions?
   1) Oxidative addition of X-Y to M always results in *cis*-MX(Y) arrangement.
   2) Coordination number of the metal is always increased by two units.
   3) Coordinatively saturated compounds can undergo oxidative addition reactions by prior dissociation.
   4) Electron withdrawing ligands promote oxidative addition reactions
   5) Metal centre should always be coordinatively saturated.

14. $[(\eta^5\text{-}Cp)_2Fe_2(CO)_4]$ is a **coordinatively saturated** complex. Which one of the following statements is **not true** about the above complex?
   1) Fe belongs to the Group 8.
   2) It has two bridging carbonyl ligands.
   3) Each iron centre has 18 valence electrons.
   4) There is a Fe–Fe bond.
   5) Each metal centre has two terminal carbonyl ligand.

15. Example for an **insertion** reaction is
   1) $[Fe(CO)_5] + CF_2{=}CF_2 \rightarrow [(OC)_4Fe(\eta^2\text{-}CF_2{=}CF_2)] + CO$
   2) $[Ni(PEt_3)_3] + PhCl \rightarrow [Ni(Ph)(Cl)(PEt_3)_2] + PEt_3$
   3) $[MeMn(CO)_5] + CO \rightarrow [Mn(COMe)(CO)_5]$
   4) $[MeMn(CO)_5] + CF_2{=}CF_2 \rightarrow [Mn(CFMeCF_2Me)(CO)_5]$
   5) $[Ni(PEt_3)_3] + CH_2{=}CHCH_2Br \rightarrow [(\eta^3\text{-}C_3H_5)Ni(Br)(PEt_3)] + 2\ PEt_3$

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 [RuHCl(CO)(η^2-CH_2=CH_2)(η^3-C_5H_5)].

(b) Draw the **structure** of [RuHCl(CO)(η^2-CH_2=CH_2)(η^3-C_5H_5)].

(c) [RuCl(NO)(η^3-C_3H_5)(C≡O)] has a linear Ru–NO fragment. Determine the **VEC** of Ru. Ru is a Group 8 metal.

(d) Determine the **coordination number** of Ru in [RuHCl(CO)(η^2-CH_2=CH_2)(η^3-C_5H_5)]

(e) Draw the **structures** of **geometrical** and **optical** isomers of [Fe(ox)(dppe)$(CO)_2$]. dppe = $PPh_2CH_2CH_2PPh_2$ is a bidentate ligand; ox = oxalate ion.

(f) Draw the **orbital diagram** between a metal (M) and a C≡O ligand, indicating the σ- and π-overlap.

(g) List **three** ligands which are isoelectronic with NO^+. .....

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CMU3122/CME5122 – ORGANOMETALLIC CHEMISTRY - LEVEL 5
ASSIGNMENT TEST-I (Part A)

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

Part A	
Part B	
Total %	

Reg. No. | | For Examiners Use

Marks

Correct Answers		
Wrong Answers		
Total		

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

CMU3122

ORGANOMETALLIC CHEMISTRY

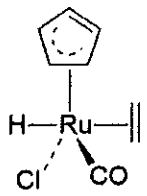
CAT 01 (Answer Guide)

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

Part B

1. a) Carbonylchloro(η^3-cyclopentadienyl)(η^2-ethene)hydroruthenium

b)



c) Covalent Model VEC = 8e (Ru) + 3e (NO) + 1e (Cl) + 3e (η^3-C_3H_5) + 2e (CO)
= 17e

Ionic Model VEC = 6e (Ru) + 3e (NO) + 2e (Cl^-) + 4e (η^3-C_3H_5) + 2e (CO)

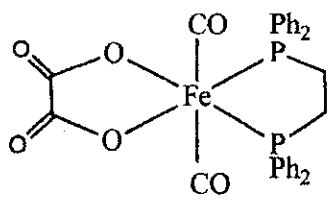
= 17e

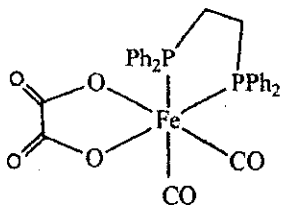
d) Coordination number (CN) = Number of electron pairs donated to the metal

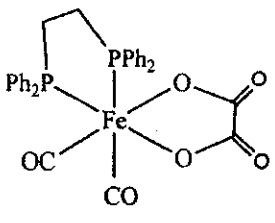
= 1+1+1+1+2 = 6 pairs

<u>CN = 6</u>

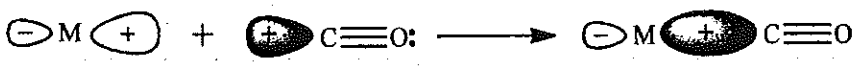
e)



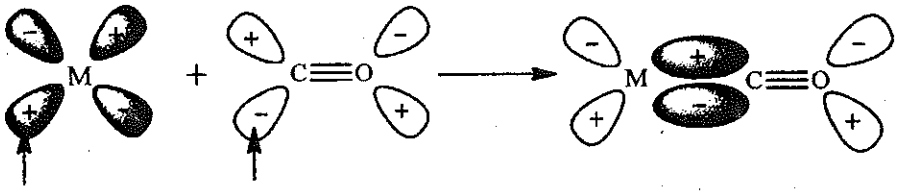




f) a)



b)



filled *d*-orbital empty π^*– orbital

g) CO, N_2, CN^-