

THE OPEN UNIVERSITY OF SRI LANKA
 B. Sc. & B. Ed. DEGREE/STAND ALONE
 COURSES IN SCIENCE Level 5 – 2014/2015
 ASSIGNMENT TEST I (NBT)
 CMU3122/CME5122 – Organometallic Chemistry



DURATION : 1 hour

DATE: 1st February 2015 (Sunday)

TIME : 4.00 p. m. – 5.00 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)

- The possible **hapticity** or **hapticities** of cyclopentadienyl ligand is/are?
 - η^2 only.
 - η^2 and η^5 only
 - η^1 and η^3 only
 - η^2 and η^4 only.
 - η^1 , η^3 and η^5 only.
- Consider the following organic ligands.
 - $\eta^3\text{-C}_3\text{H}_5^-$
 - σ -allyl
 - vinyl
 The **monohapto** ligand/s is/are
 - (ii) only.
 - (i) and (ii) only.
 - (i) and (iii) only.
 - (ii) and (iii) only.
 - (i), (ii) and (iii).
- Consider the following statements
 - $\text{CH}_2=\text{CH}_2$ and $\text{CH}\equiv\text{CH}$ are not isoelectronic.
 - CO and CS are isoelectronic.
 - CN^- and N_2 are isoelectronic.
 The **correct** statement/s is/are
 - (iii) only
 - (i) & (ii) only
 - (i) & (iii) only
 - (ii) & (iii) only
 - (i), (ii) & (iii)
- An L_2X type ligand is
 - σ -allyl
 - $\eta^5\text{-C}_5\text{H}_5^-$
 - cyclopropenyl
 - vinyl
 - $\eta^3\text{-C}_3\text{H}_5^-$
- The IUPAC name of $[\text{FeI}_2(\eta^2\text{-CH}_2=\text{CH}_2)(\text{CO})_3]$ is
 - Diiodo(dihaptoethene)tricarbonyliron
 - Tricarbonyl(η^2 -ehene)diiodoferrate
 - Tricarbonyldiiodo(η^2 -vinyl)iron
 - Tricarbonyl(η^2 -ehene)diiodoiron
 - Diiodotricarbonyl(η^2 -ehene)ferrus(II)
- The strongest σ -donor ligand is
 - PPh_3
 - NO^+
 - BF_3
 - NMe_3
 - CO

7. The **coordination number** of Fe in $[\text{FeCl}(\eta^3\text{-C}_3\text{H}_5)(\eta^1\text{-CH=CH}_2)(\text{CO})_2]$ is

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

8. Consider the following statements.

- (i) $\text{CF}_2=\text{CF}_2$ is a better π -acceptor than $\text{CH}_2=\text{CH}_2$.
(ii) NO^+ is a better π -acceptor than CO.
(iii) PH_3 is a better σ -donor than NH_3 .

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)

9. According to **ionic model**, which one of the following is a 4e-donor ligand?

- 1) $\eta^2\text{-C}_4\text{H}_4$ 2) σ -allyl 3) $\eta^3\text{-C}_3\text{H}_5^-$ 4) $\eta^5\text{-C}_5\text{H}_5^-$ 5) $\text{CH}_2=\text{CHCl}$

10. What is **true** about N_2 ?

- 1) It is a good π -acceptor. 2) It is a good σ -donor.
3) It is a better σ -donor than NH_3 . 4) It can bridge two metal centres.
5) It can stabilise metal centres in lower oxidation states.

11. What is the **Valence Electron Count (VEC)** of Fe in $[\text{FeCl}(\eta^3\text{-C}_3\text{H}_5)(\eta^1\text{-CH=CH}_2)(\text{CO})_2]$?

(Group number of Fe is 8)

- 1) 16 2) 17 3) 18 4) 19 5) 20

12. Which one of the following statements is **true** about oxidative-addition reactions?

- 1) Normally oxidative addition of X-Y to M results in **trans-MX(Y)** arrangement.
2) Coordination number of the metal is **always** increased by two units.
3) Coordinatively saturated compounds **cannot** undergo oxidative addition.
4) Metal centre should **always** be coordinatively unsaturated.
5) None of the above statements is true.

13. Consider the following statements about **Fischer-carbenes**.

- (i) Carbene ligand is a 3e-donor.
(ii) Carbene carbon contains a $-\delta$ charge.
(iii) $\text{M}=\text{C}$ is attacked by nucleophiles.

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

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

14. Due to **back donation** in metal carbonyls,

- 1) the π -character of the $\text{M}-\text{CO}$ bond is decreased.
2) the $\text{M}-\text{CO}$ bond length is increased.
3) the bond strength of $\text{C}\equiv\text{O}$ is increased.
4) $\text{M}-\text{CO}$ bond order is decreased.
5) None of the above is correct.

15. The d^n and the oxidation number of Fe in $[\text{Fe}(\text{CS})_2(\text{PF}_3)(\text{CO})_2]$ is (Z of Fe is 26)

- 1) d^4 , zero 2) d^6 , +2 3) d^8 , zero 4) d^7 , zero 5) d^6 , 5

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B. Sc DEGREE PROGRAMME 2014/2015
CMU3122/CME5122 – ORGANOMETALLIC CHEMISTRY- LEVEL 5
ASSIGNMENT TEST-I (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		

- | | | | | | | | | | | | | | | | | | |
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| 1. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 | 2. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 | 3. <table border="1" style="display: inline-table; text-align: center;"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table> | 1 | 2 | 3 | 4 | 5 |
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| 1 | 2 | 3 | 4 | 5 | | | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | | | | | | | | | | | | | |

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 $[\text{Fe}(\eta^1\text{-CH=CH}_2)(\eta^1\text{-C}_3\text{H}_5)(\eta^4\text{-C}_4\text{H}_4)]$.

(b) Draw the **structure** of $[\text{Fe}(\eta^1\text{-CH=CH}_2)(\eta^1\text{-C}_3\text{H}_5)(\eta^4\text{-C}_4\text{H}_4)]$.

(c) Determine the VEC of Ru in $[\text{RuBr}_2(\text{CN})(\eta^2\text{-C}_4\text{H}_4)(\text{CO})_2]$ using **ionic model**.
(Indicate your break down; Group number of Ru is 8)

(d) What is the **coordination number** of Mo in $[\text{MoCN}(\eta^5\text{-C}_5\text{H}_5)(\text{CO})_2(\eta^2\text{-C}_4\text{H}_4)]$

(e) Draw the **structures** of the **FOUR** isomers of $[\text{Fe}(\text{CS})_2(\text{PF}_3)(\text{CO})_2]$ with the **trigonal bipyramidal** geometry.

(f) Draw an **orbital diagram** to show the **π -overlap** between Fe and CO in $[\text{Fe}(\text{CO})_5]$.

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Answer Guide to CAT-I held on 01-02-2015

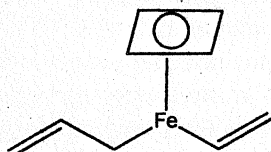
Part A – MCQ ANSWERS

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

Part B

(1)(a) $(\eta^1\text{-allyl})(\eta^4\text{-cyclobutadiene})(\eta^1\text{-vinyl})\text{iron}$ or
 $(\eta^1\text{-allyl})(\eta^4\text{-cyclobutadiene})(\eta^1\text{-ethenyl})\text{iron}$

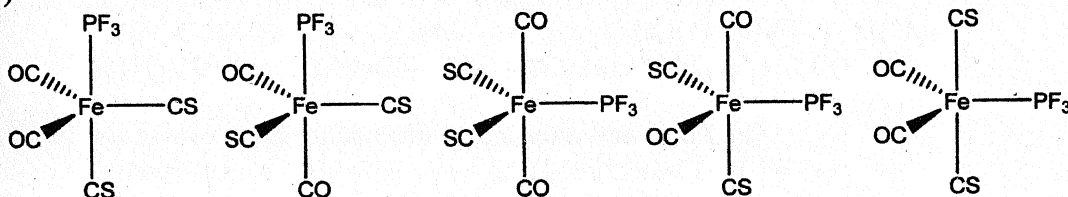
(b)



(c) $\text{VEC} = [(\text{Ru}^{3+}; 5e) + (2\text{Br}^-; 4e) + (\text{CN}^-; 2e) + (\eta^2\text{-C}_4\text{H}_4; 2e) + (2\text{CO}; 4e)] = 17e$

(d) Coordination number = No. of electron pairs
 $= 1 (\text{CN}) + 3 (\eta^5\text{-C}_5\text{H}_5) + 2 (2 \times \text{CO}) + 1 (\eta^2\text{-C}_4\text{H}_4) = 7$

(e)



(f)) $[\text{M} = \text{Fe}]$

