THE OPEN UNIVERSITY OF SRI LANKA
B. Sc. & B. Ed. DEGREE/STAND ALONE
COURSES IN SCIENCE 2008/2009 – Level 5
ASSIGNMENT TEST I (NBT)
CHU3127/CHE5127 – Organometallic Chemistry

DURATION : 1.5 hours

DATE : 9th September 2008 TIME : 3.30 p.m. to 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 and 1/5th of the mark will be deducted for each **incorrect** answer.

PART A (60 marks)

1. The possible **coordination mode(s)** of cyclobutene (C_4H_6) is/are?
   1) η^1 only. 2) η^2 only.
   3) η^4 only. 4) η^2 and η^4 only.

2. Consider the following organic ligands,
   (i) ethyl (ii) π–allyl (iii) $=CH_2$
   The possible ***monohapto*** ligands are
   1) (i) and (ii) only. 2) (i) and (iii) only.
   3) (ii) and (iii) only. 4) (i), (ii) and (iii).

3. The IUPAC name of $[NiCl(\eta^2\text{-}C_2H_4)(\eta^3\text{-}C_3H_5)]$ is
   1) Nickel chloroethyleneallyl
   2) Chloro(η^2-ethene)(η^3-allyl)nickel
   3) Trihaptoallylchlorodihaptoethenenickel
   4) (η^3-Allyl)chloro(η^2-ethene)nickelate

4. The **strongest** σ-donor ligand among the following ligands is
   1) PEt_3 2) PCl_3 3) PPh_3 4) PF_3

5. According to ionic model, which one of the following is **not** a 4e-donor ligand?
   1) η^3-$C_3H_5^-$ 2) η^5–Cp^- 3) η^4-cyclobutadiene (C_4H_4) 4) η^3-cyclopropenyl

6. What is the **Valence Electron Count (VEC)** of Ni in $[NiCl(\eta^2\text{–}C_2H_4)(\eta^3\text{–}C_3H_5)]$?
   (Atomic number of Ni is 28)
   1) 14 2) 16 3) 18 4) 33

7. An L_2X type ligand is
   1) η^3-$C_3H_3^-$ 2) cyclopentadiene (C_5H_6) 3) η^4-C_4H_4 4) η^5-$C_5H_5^-$

8. The **coordination number** of Ni in $[NiCl(\eta^2\text{-}C_2H_4)(\eta^3\text{-}C_3H_5)]$ is
1) 3 2) 4 3) 5 4) 6

9. Consider the following statements about carbenes.
(i) Carbene ligand is a *monohapto* ligand.
(ii) In Schrock carbenes, the carbene carbon is nucleophilic.
(iii) Carbene ligand is a 2e-donor.
The **correct** statements are
1) (i) & (ii) only. 2) (i) & (iii) only.
3) (ii) & (iii) only. 4) (i), (ii) & (iii).

10. According to the ionic model, the **d^n electron configuration** and the **oxidation number** of nickel in $[NiCl(\eta^3\text{-}C_3H_5)(PPh_3)]$ (atomic number of Ni is 28) are
1) d^{10}, +1 2) d^8, +1
3) d^8, +2 4) d^{10}, +2

11. Consider the following statements about $[PdCl(\eta^3\text{-}C_3H_5)(PPh_3)]$ (Group number of Pd is 10),
(i) It shows the square-planar geometry.
(ii) It gives geometrical isomers.
(iii) It is a coordinatively unsaturated compound.
The **correct** statements are
1) (i) & (ii) only. 2) (i) & (iii) only.
3) (ii) & (iii) only. 4) (i), (ii) & (iii).

12. Which one of the following ligands is **not isoelectronic** with CN^-.
1) HC≡CH 2) C≡O 3) NO 4) NO^+

13. Consider the following statements.
(i) CO stabilises metal centres in higher oxidation states.
(ii) CO is a good π-acceptor ligand.
(iii) The back bonding increases the M–CO bond strength.
The **correct** statement/s is/are
1) (ii) only. 2) (i) & (iii) only.
3) (ii) & (iii) only. 4) (i), (ii) & (iii).

14. What is **not true** about **PMe_3**?
1) It is a good σ-donor.
2) It is a 2e donor.
3) It is a better π-acceptor than PF_3.
4) It stabilises the metal centres in higher oxidation states.

15. Which one of the following statements is **not true** about **Fischer carbenes?**
1) Hetero-atoms are attached to the carbene carbon.
2) Carbene carbon contains a -δ charge.
3) Carbene carbon is readily attacked by nucleophiles.
4) Metal is in a low oxidation state.

16. What is **not true** about the **dinitrogen** ligand?
    1) It is isolectronic with CN^-.
    2) It can act as a terminal ligand
    3) It can act as a bridging ligand
    4) It cannot act as a *dihapto* ligand

17. Consider the following statements,
    (i) Isocyanides (RN≡C) are stronger π-acceptors than CO.
    (ii) CO is a stronger π-acceptor than PMe_3.
    (iii) PF_3 is stronger π-acceptor than PMe_3.

    The correct statement/s is/are
    1) (i) only.
    2) (i) & (ii) only.
    3) (ii) & (iii) only.
    4) (i) (ii) & (iii) only.

18. Due to **back donation** in metal carbonyls,
    1) the bond strength of C≡O is increased.
    2) M–CO bond order is decreased.
    3) the M–CO bond length is decreased.
    4) the σ–character of the M–CO bond is increased.

19. According to the **Ionic Model**, what is the **oxidation number** of Co in $[CoCl(\eta^1\text{-}C_3H_5)(\eta^2\text{-}C_2H_4)(\eta^5\text{-}C_5H_5)]$ (atomic number of Co is 27) ?
    1) 1 2) 2 3) 3 4) 4.

20. $[(\eta^5\text{-}C_5H_5)_4Cr_2(\mu\text{-}CO)_2]$ is a **coordinatively saturated** complex. Which one of the following statements is **true** about the above complex? (Group number of Cr is 6)
    1) Each chromium centre has 16 valence electrons.
    2) This is not a symmetrical molecule.
    3) There is a no Cr–Cr bond.
    4) Each chromium centre has one bridging carbonyl ligands.

THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME 2008/2009
CHU3127/CHE5127 – ORGANOMETALLIC CHEMISTRY- LEVEL 5
ASSIGNMENT TEST I - MCQ TEST

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

Name:- .....

Reg.No/Index No.

	Marks
Part A	
Part B	
Total %	

FOR EXAMINER'S USE	
Unanswered	
Correct Answers	
Wrong Answers	
Total	

1.	1	2	3	4	2.	1	2	3	4	3.	1	2	3	4
4.	1	2	3	4	5.	1	2	3	4	6.	1	2	3	4
7.	1	2	3	4	8.	1	2	3	4	9.	1	2	3	4
10.	1	2	3	4	11.	1	2	3	4	12.	1	2	3	4
13.	1	2	3	4	14.	1	2	3	4	15.	1	2	3	4
16.	1	2	3	4	17.	1	2	3	4	18.	1	2	3	4
19.	1	2	3	4	20.	1	2	3	4					

Part B (40 marks)
Answer all the questions in the space provided. Attached sheets will not be graded.

1. (a) Give IUPAC names for the following complexes.

i. $[CoCl(\eta^1\text{-}C_3H_5)(\eta^2\text{-}C_4H_4)(\eta^2\text{-}C_2H_4)]$ .....
.....

ii. $[FeBr_2(\eta^5\text{-}C_5H_5)(PPh_3)(CO)]$ .....
.....

(b) Draw the structures of the following complexes.

i. $[CoCl(\eta^1\text{-}C_3H_5)(\eta^2\text{-}C_4H_4)(\eta^2\text{-}C_2H_4)]$

ii. (η^3-Allyl) (η^5-cyclopentadienyl)(η^2-ethene)molybdenum

(c) (i) Determine the **VEC** of cobalt in $[CoCl(\eta^3\text{-}C_3H_5)(\eta^2\text{-}C_2H_4)]$ using **ionic model**.
(Indicate your break down; Group number of Co is 9)

(ii) Determine the **VEC** of iron in $[FeBr(\eta^5\text{-}C_5H_5)(PPh_3)(CO)]$ using **covalent model**.
(Indicate your break down; Group number of Fe is 8)

(d) Draw the **structure** of the following **coordinatively saturated** complex
$[(\eta^6\text{-}C_6H_6)_2Co_2(\mu\text{-}CO)_2]$.

2. (a) Determine the **coordination number** of Mn in $[(\eta^5\text{-}C_5H_5)Mn(CO)_3]$.

(b) What is meant by "**α-agostic interaction**"? Draw the **structure** of $[TiCl(=CH_2)(\eta^5\text{-}C_5H_5)_2]$, indicating the α-agostic interaction.

(c) Arrange NO^+, CN^- and CO in the order of increasing π-acceptability.

.....

(d) (i) Give the relationship between the shape of the **M-NO** fragment and the number of electrons donated by the NO ligand.

(ii) Deduce the **coordination geometry** of the **Mn-NO fragment** in the 18e-complex $[Mn(NO)(CO)_4(PPh_3)]$.

(e) Draw and identify the two **geometrical isomers** of $[FeBr_3(PPh_3)_3]$.

ASSIGNMENT TEST 1 (NBT) – ANSWER GUIDE
CHU 3127 / CHE 5127

PART (A)

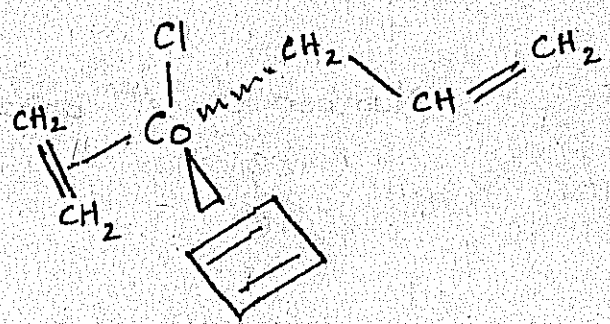
1. (2) 2. (2) 3. (3) 4. (1) 5. (2) 6. (2)
7. (4) 8. (2) 9. (4) 10. (3) 11. (2) 12. (3)
13. (3) 14. (3) 15. (2) 16. (4) 17. (3) 18. (3)
19. (3) 20. (3)

PART (B)

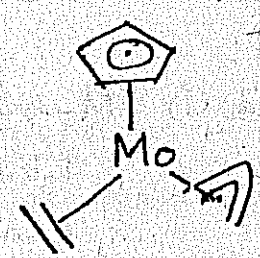
1) (a) (i) (η^1-allyl)chloro(η^4-cyclobutadiene)(η^2-ethene)cobalt

(ii) dibromocarbonyl(η^5-cyclopentadienyl)triphenylphosphineiron

(b) (i)



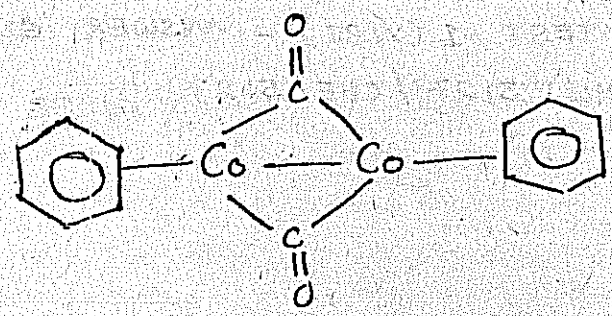
(ii)



(c) (i) Co^{2+} – 7e
Cl^- – 2e
$\eta^3-C_3H_5^-$ – 4e
$\eta^2-C_2H_4$ – 2e
15e

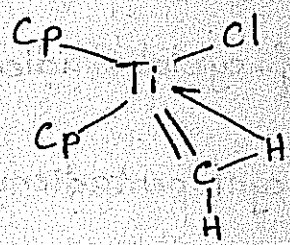
(ii) Fe – 8e
$Br^\bullet$ – 1e
$\eta^5-C_2H_5$ – 5e
PPh_3 – 2e
CO – 2e
18 e

(d)



(2) (a) Mn^{2+} receives 12 electrons or 6 electron pairs fro the ligands; therefore the coordination number = 6

(b) Weak interaction between a metal centre and a bonding electron pair of a C–H bond of an α-carb



(c) $CN^- < CO < NO^+$

(d) (i)

M–NO fragment	Number of e^{ns} donated by NO
Linear	3e
Bent	1e

(ii) If x = no. of electrons donated by NO

Mn = 7e

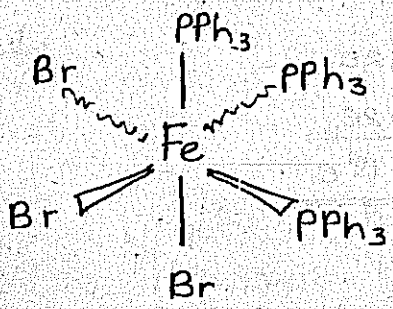
NO = xe

4 x CO = 8e

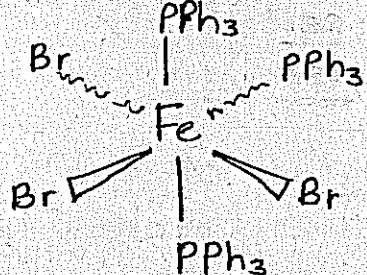
PPh_3 = 2e

$17 + x = 18 \Rightarrow x = 1 \Rightarrow$ bent

(e)



fac–isomer



mer–isomer