



IIT-JAM CHEMISTRY

TEST : ORGANOMETALLIC COMPOUNDS

Time 00 : 50 Hour

Date : 27-08-2017

M.M. : 35

INSTRUCTION:

1. Attempt all the questions.
2. Section-A contains 10 Multiple Choice Questions (MCQ). Each question has 4 choices (a), (b), (c) and (d), for its answer, out of which ONLY ONE is correct. From Q.1 to Q.5 carries 1 Marks and Q.6 to Q.10 carries 2 Marks each.
3. Section-B contains 05 Multiple Select Questions (MSQ). Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which ONE or MORE than ONE is/are correct. For each correct answer you will be awarded 2 marks.
4. Section-C contains 06 Numerical Answer Type (NAT) questions. Q.16 to Q.17 carry 1 Mark and Q.18 to Q.21 carries 2 Marks each. For each NAT type question, the value of answer in between 0 to 9.
5. In all sections, questions not attempted will result in zero mark. In Section-A (MCQ), wrong answer will result in negative marks. For all 1 mark questions, 1/3 marks will be deducted for each wrong answer. For all 2 marks questions, 2/3 marks will be deducted for each wrong answer. In Section-B (MSQ), there is no negative and no partial marking provisions. There is no negative marking in Section-C (NAT) as well.

PART-A

Q.1 to Q.05: Carry 1 Mark each.

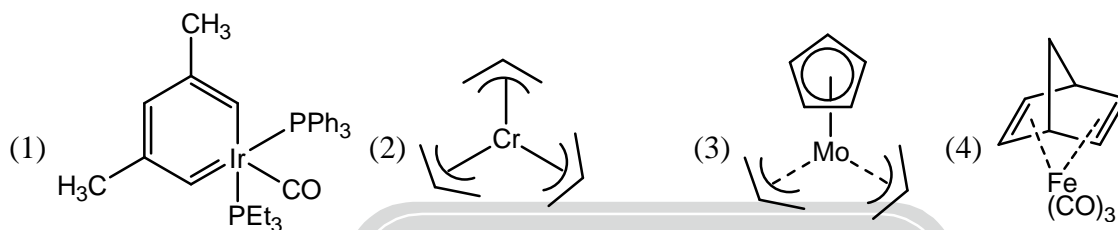
1. Find organic fragment isolobal with each of the following
(A) $Ni(\eta^5-C_5H_5)$ (B) $Cr(CO)_2(\eta^6-C_6H_6)$ (C) $[Fe(CO)_2(PPh_3)]$
(a) A-CH, B-CH₃, C-CH (b) A-CH, B-CH₂⁺, C-CH
(c) A-CH, B-CH₃⁺, C-CH (d) A-CH₂, B-CH₃⁺, C-CH
2. The sandwich complex $\eta^5-CpCoC_nH_n$ is an 18 electron species, where 'n' is
(a) 6 (b) 4 (c) 3 (d) 5
3. Intense band at 1, 5000 cm⁻¹ in the UV-visible spectrum of $[Re_2Cl_8]^{2-}$ is due to the transition
(a) $\pi-\pi^*$ (b) $\delta-\delta^*$ (c) $\delta-\pi^*$ (d) $\pi-\delta^*$
4. The correct order of energy level of d-orbital of ferrocene is
(a) $d_{x^2-y^2}, d_{xy} < d_{z^2} < d_{xy}, d_{yz}$ (b) $d_{z^2} < d_{xz}, d_{yz} < d_{x^2-y^2}, d_{xy}$
(c) $d_{x^2-y^2}, d_{xy} < d_{xz}, d_{yz} < d_{z^2}$ (d) $d_{yz}, d_{xz} < d_{x^2-y^2}, d_{xy} < d_{z^2}$



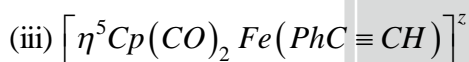
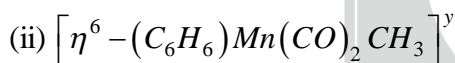
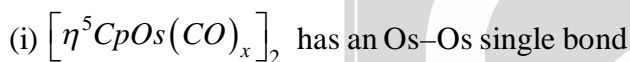
5. The reaction between $[\text{PdCl}_4]^{2-}$ and C_2H_4 produces a new compound. Compared to free C_2H_4 . The C–C bond order of the product is
 (a) between 1 and 2 (b) less than 1 (c) unaltered (d) greater than 2

Q.6 to Q.10: Carry 2 Marks each.

6. For the metal-olefin complex (i) $[\text{PtCl}_3(\text{C}_2\text{H}_4)]^-$ and (ii) $[\text{PtCl}_3(\text{C}_2\text{F}_4)]^-$. The correct statement is that
 (a) C–C bond length is same both in (i) and (ii)
 (b) C–C bond length in (i) is smaller compared to that of (ii)
 (c) C–C bond length in (i) is larger compared to that of (ii)
 (d) A metallocycle is formed in each complex.
7. Which of the following complexes follows 18 electron rule



- (a) 1 and 2 (b) 1, 2 and 4 (c) 1 and 4 (d) 2, 3 and 4
8. Following the 18-electron rule as guide, determine x, y, z in the following complexes



- (a) $x = 2, y = 1, z = +1$ (b) $x = 1, y = 0, z = +1$
 (c) $x = 1, y = 1, z = +1$ (d) $x = 2, y = 0, z = +1$
9. Match the following

Column-I

- (I) Fischer carbene
 (II) Shrocks carbene

Column-II

- (A) It behave like phosphorous ylide in some of its reaction
 (B) The carbene carbon is nucleophilic in nature
 (C) The metal atom is relatively electron rich
 (D) The Grubb's first generation catalyst is typical example for this
 (E) It quite often does not obey the 18-electron rule
 (F) The metal-carbon bond has relatively low rotational barrier

- (a) I-C,F; II-B,D,E (b) I-C,D; II-A,B,E (c) I-C,F; II-A,B,E (d) I-C,F; II-A,B,C,D

10. The metal cluster $(\text{Cp}^*\text{Co})_3(\text{CO})_2$ have $\nu_{\text{C-O}}$ stretching frequencies in the range of $1600\text{--}1730\text{ cm}^{-1}$. The bonding mode of CO ligand is
 (a) $\mu^2\text{--CO}$ (b) $\mu^3\text{--CO}$ (c) $\mu^4\text{--CO}$ (d) Terminal CO

PART-B

Q.11 to Q.15: Carry 2 Marks each.

11. Correct statement regarding ferrocene is
 (a) it obey 18-electron rule
 (b) it is more reactive towards electrophilic substitution reaction than benzene
 (c) it is diamagnetic in nature
 (d) it exist in eclipsed confirmation in gaseous state
12. Select the correct order regarding ν_{C-O} value of carbonyl complexes
 (a) $Ni(CO)_4 < [Fe(CO)_4]^{2-} > [Co(CO)_4]^-$
 (b) $[Cr(CO)_6] > CO > [V(CO)_6]^- > [Ti(CO)_6]^{2-}$
 (c) $CO > [Cr(CO)_6] > [V(CO)_6]^- > [Ti(CO)_6]^{2-}$
 (d) $Ni(CO)_4 > Ni(CO)_3[P(OMe)_3] > Ni(CO)_2[P(OMe)_3]_2$
13. The correct statement regarding $Co_4(CO)_{12}$ is/are
 (a) it has 3 bridging CO
 (b) it has six-M-M bond
 (c) it has 9-terminal CO
 (d) it has No-bridging CO
14. Select the correct statement regarding metal-alkene complexes
 (a) C-C bond length in free alkene is more than alkene bonded to metal
 (b) Metal-bonded alkene undergo nucleophilic addition reaction
 (c) electron withdrawing group on alkene bonded to metal leads to increase in C-C bond length of alkene
 (d) ν_{C-C} value of free alkene is higher than metal-bonded alkene
15. (A) $[Cp_2Zr(CO)(Cl)]^+$ (B) $[Cp_2Zr(CO)_2]$
 Which of the following statements is/are correct.
 (a) the back π -bonding is more in B than in A
 (b) ν_{C-O} of B is greater than that of A
 (c) ν_{C-O} of A is greater than that of B
 (d) ν_{M-C} of B is greater than that of A

PART-C

Q.16 to Q.17: Carry 1 Mark each.

16. Number of bridging carbonyl in $[Fe_3(CO)_{12}]$ is _____
17. In the cluster $[Co_3(CH)(CO)_9]$ obeying 18-electron rule, number of bridging ligand is _____

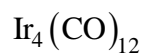


Q.18 to Q.21: Carry 2 Marks each.

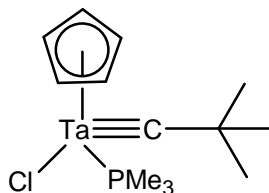
18. Number of framework electron in the fragment $\text{Ru}(\text{CO})_3$ involve in cluster formation is _____

19. Bond order in cluster $[\text{Mo}_2(\text{SO}_4)_4]^{4-}$ is _____

20. The number of metal-metal bonds in the following complex is/are _____



21. The total valence electrons in the following complex is _____





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Part - A

- | | | | | | | |
|--------|--------|---------|--------|--------|--------|--------|
| 1. (c) | 2. (b) | 3. (b) | 4. (a) | 5. (a) | 6. (b) | 7. (c) |
| 8. (d) | 9. (c) | 10. (b) | | | | |

Part - B

- | | | | | |
|---------------|-----------|-------------|-------------|-------------|
| 11. (a,b,c,d) | 12. (c,d) | 13. (a,b,c) | 14. (b,c,d) | 15. (a,c,d) |
|---------------|-----------|-------------|-------------|-------------|

Part - C

- | | | | | |
|----------|---------|---------|---------|---------|
| 16. (2) | 17. (1) | 18. (2) | 19. (4) | 20. (6) |
| 21. (16) | | | | |

