



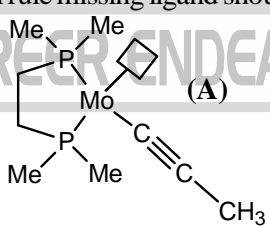
Time 00 : 45 Hour

Date : 31-10-2017
M.M. : 60

INSTRUCTION :

- There are Two Parts. **Part-A** contains 10 objective type questions, each question carry 2 marks and **Part-B** contains 10 objective type questions, each question carry 4 marks.
- There is negative marking, @ 25% will be deducted for each wrong answer.
- Attempt all the questions, use of calculator is not allowed.

PART - A

- The carbonyl resonance in ^{13}C NMR spectrum of $[\eta^5\text{CpRh}(\text{CO})]_3$ (^{103}Rh , $I = \frac{1}{2}$, 100%). Shows a triplet at -65°C owing to the presence of
(a) Terminal CO (b) $\mu^2 - \text{CO}$ (c) $\mu^3 - \text{CO}$ (d) $\eta^5\text{Cp}$
- $\text{Cr}(\text{CO})_6 + \text{NO} \xrightarrow{h\nu} \text{P}[\text{Cr}(\text{NO})_x]$
The complex 'P' is homoleptic complex and follows 18 electron the value of 'x' will be
(a) 3 (b) 4 (c) 0 (d) 5
- The cluster $[\text{Co}_6(\text{CO})_{15}]^{2-}$, $[\text{Fe}_5(\text{CO})_{15}\text{C}]$ and $[\text{Ni}_5(\text{CO})_{10}]^{6-}$ having the structure respectively.
(a) closo, arachno, nido (b) nido, arachno, closo
(c) closo, nido, arachno (d) closo, closo, nido
- For complex (A) to follow 18 electron rule missing ligand should be
 (A)
(a) $\eta^6 - \text{C}_7\text{H}_8$ (b) $\eta^8 - \text{C}_8\text{H}_8$ (c) $\eta^7 - \text{C}_7\text{H}_7$ (d) $\eta^4 - \text{C}_4\text{H}_4$
- Arrange the following in order of their increasing $\nu_{\text{M-C}}$ stretching frequency
(A) $[\text{Hf}(\text{CO})_6]^{2-}$ (B) $[\text{Ta}(\text{CO})_6]^-$ (C) $[\text{W}(\text{CO})_6]$ (D) $[\text{Re}(\text{CO})_6]^+$
(E) $[\text{Os}(\text{CO})_6]^{2+}$ (F) $[\text{Ir}(\text{CO})_6]^{3+}$
(a) $\text{A} < \text{B} < \text{C} < \text{D} < \text{E} < \text{F}$ (b) $\text{F} < \text{E} < \text{D} < \text{C} < \text{B} < \text{A}$
(c) $\text{A} < \text{B} < \text{C} < \text{E} < \text{D} < \text{F}$ (d) $\text{F} < \text{E} < \text{D} < \text{C} < \text{A} < \text{B}$



6. In the complex $\text{Me}_4\text{Al}_2(\mu\text{-Me})_2$, the two alkyl acts as a bridging ligands. This seems to happens by 2e, three centre bond involving between metal and alkyl carbon. The hapticity of terminal and bridging alkyl groups are respectively.

- (a) η^1, η^2 (b) η^2, η^1 (c) η^3, η^1 (d) η^1, η^1

7. Consider the metal carbonyl complex (A)



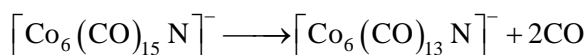
The strongest $\nu_{\text{C-O}}$ band in IR spectrum can be observed when the value of q will be

- (a) -2 (b) -1 (c) 0 (d) +1

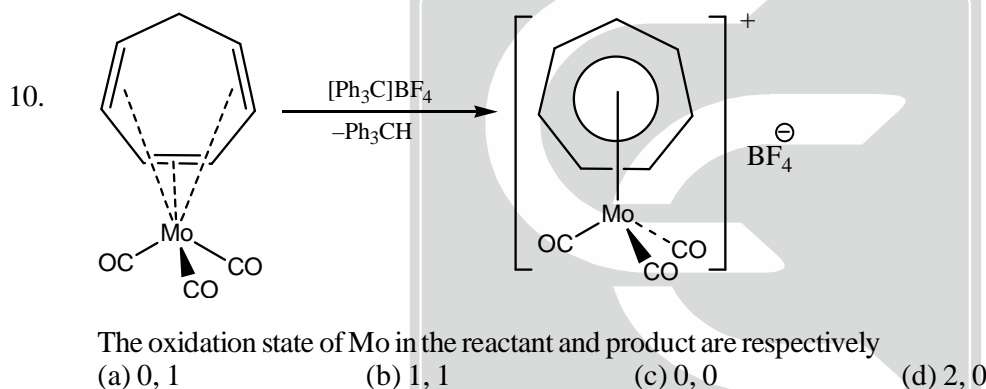
8. $[\text{Ru}_6(\text{CO})_{18}]^{2-}$ is isolobal with

- (a) $[\text{B}_6\text{H}_6]^{2-}$ (b) $[\text{B}_5\text{H}_5]^{4-}$ (c) $\text{Ir}_4(\text{CO})_{12}$ (d) $[\text{Fe}_4(\text{CO})_{13}]^{2-}$

9. Suggest what changes in cluster structure might accompany the reaction:



- (a) Octahedron to trigonal prism (b) Square pyramid to trigonal bipyramid
(c) Tetrahedron to octahedron (d) Trigonal prism to octahedron



PART-B

11. $[\eta^5\text{CpFe}(\text{CO})]_4$ (A) is a dark green solid compound. The IR spectrum shows a single CO stretching band at 1640 cm^{-1} . The $^1\text{H NMR}$ spectrum shows a single line even at low temperature. Which of the following statement is not true on the basis of given data about the structure of $[\eta^5\text{CpFe}(\text{CO})]_4$

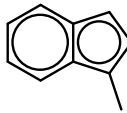
- (a) The complex (A) follows the 18 electron rule.
(b) The total number of M-M bonds in complex are six.
(c) All CO's are present μ^3 -mode.
(d) Two CO's are present in μ^2 -mode where as another two CO's are present at μ^3 modes.

12. Which of the following Molybdenum complex having highest $\nu_{\text{C-O}}$ carbonyl stretching frequency

- (a) $[\text{Mo}(\text{CO})_3(\text{PF}_3)_3]$ (b) $[\text{Mo}(\text{CO})_3(\text{PCl}_3)_3]$
(c) $[\text{Mo}(\text{CO})_3(\text{PClPh}_2)_3]$ (d) $[\text{Mo}(\text{CO})_3(\text{PMe}_3)_3]$



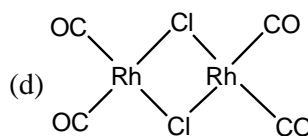
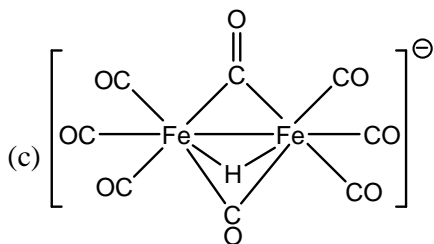
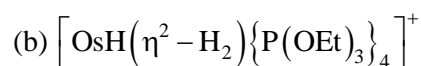
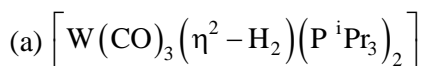
13. Match **List-A** (organometallic compound) with **List-B** (^1H NMR chemical-shift for marked proton)
- | List-A | List-B |
|--|----------------|
| (A) $\text{Mn}(\text{CO})_5\text{H}$ | (I) 10.22 ppm |
| (B) $\text{Ni}(\eta^2-\text{C}_2\text{H}_4)_3$ | (II) 3.06 ppm |
| (C) $(\eta^6-\text{C}_6\text{H}_6)_2\text{Cr}$ | (III) -7.5 ppm |
| (D) $\left[(\eta^5-\text{C}_5\text{H}_5)_2\text{Ta} \begin{array}{l} \text{CH}_3 \\ \diagup \\ \text{CH}_2 \end{array} \right]$ | (IV) 4.12 ppm |
- (a) A-III, B-IV, C-II, D-I (b) A-III, B-II, C-IV, D-I
(c) A-I, B-II, C-III, D-IV (d) A-II, B-III, C-I, D-IV
14. The cluster having arachno type structure is
- (a) $[\text{Ir}_4(\text{CO})_{12}]$ (b) $[\text{Rh}_6(\text{CO})_{16}]$ (c) $[\text{Os}_6(\text{CO})_{18}]^{2-}$ (d) $[\text{Ru}_5\text{C}(\text{CO})_{16}]$
15. A compound **A** having the composition $\text{FeC}_9\text{H}_8\text{O}_3$ shows one signal at 2.5 ppm and another one around 5.0 ppm in its ^1H NMR spectrum. The IR spectrum of this compound shows two bands around 1900 and 1680 cm^{-1} . The compound follows the 18 electron rule of the following statements for A, the correct one is/are
- (A) It has $\eta^5-\text{Cp}$ group. (B) It has a terminal CO ligand.
(C) It has a CH_3 ligand (D) It has Fe-H bond.
(a) (A) and (B) only (b) (C) only (c) (A) and (C) only (d) (B) and (D) only.
16. Complexes of general formula, $\text{fac-}[\text{Mo}(\text{CO})_3(\text{phosphine})_3]$ have the C—O stretching bands as given below.
- Phosphines: PF_3 (A); PCl_3 (B); $\text{P}(\text{Cl})\text{Ph}_2$ (C); PMe_3 (D)
 $\nu(\text{CO}), \text{cm}^{-1}$: 2090(i); 2040(ii); 1977(iii); 1945(iv)
- The correct combination of the phosphine and the stretching frequency is,
- (a) (A-i), (B-ii), (C-iii), (D-iv) (b) (A-ii), (B-i), (C-iv), (D-iii)
(c) (A-iv), (B-iii), (C-ii), (D-i) (d) (A-iii), (B-iv), (C-i), (D-ii)
17. Find the best possible combination of metal ligand and charge. So, that the complex (X) follows 18 electron rule.
- $$[\text{M}(\text{L})_x]^{z-}$$
- (a) $M = \text{Co}, L = \text{CO}, x = 4, z = 3$ (b) $M = \text{Fe}, L = \text{CN}, x = 4, z = 2$
(c) $M = \text{Fe}, L = \text{CO}, x = 4, z = 2$ (d) $M = \text{Mn}, L = \text{PPh}_3, x = 5, z = 2$
18. Ti^{4+} seldom forms stable carbonyl complexes because
- (a) Antibonding orbitals of $\text{CO}(\pi^*)$ are high in energy.
(b) CO increases electron density on the metal Ti^{4+}
(c) The $d\pi$ set of metal (t_{2g}) orbital find no match with the $\text{CO}(\sigma)$
(d) Absence of back bonding as the metal present in highest oxidation state.

19. Indenyl is a well known organometallic ligand the structure of indenyl ligand is  the haptacity and

electron contribution for the indenyl complex $[(\text{Indenyl})\text{Fe}(\text{Cp})(\text{CO})_2]$ are respectively.

- (a) 1, 1 (b) 3, 1 (c) 1, 3 (d) 1, 0

20. Which of the following complex does not obey 18 electron rule.





CAREER ENDEAVOUR

Best Institute for IIT-JAM, NET & GATE

CSIR-UGC-NET/JRF | GATE CHEMISTRY
TEST : ORGANOMETALLIC COMPOUNDS

Date : 31-10-2017

[ANSWERS]

PART-A

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

PART-B

- | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| 11. (d) | 12. (a) | 13. (b) | 14. (d) | 15. (a) | 16. (a) | 17. (c) |
| 18. (d) | 19. (a) | 20. (d) | | | | |



South Delhi : 28-A/11, Jia Sarai, Near-IIT Hauz Khas, New Delhi-16, Ph : 011-26851008, 26861009

North Delhi : 33-35, Mall Road, G.T.B. Nagar (Opp. Metro Gate No. 3), Delhi-09, Ph: 011-65462244, 65662255