IIT-JAM CHEMISTRY 2023

TEST : ORGANOMETALLIC COMPOUNDS

Time 00 : 60 Hour **Date : 11-09-2022**

M.M. : 35

INSTRUCTION:

1. **Attempt all the questions.**
2. **PART-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. **PART-B contains 04 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. **PART-C contains 08 Numerical Answer Type (NAT) questions. Q.16 to Q.17 carry 1 Mark and Q.18 to Q.21 carries 2 Marks each. The answer of each (NAT) is a real number.**
5. **In all sections, questions not attempted will result in zero mark. In PART–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 PART–B (MSQ), there is no negative and no partial marking provisions. There is no negative marking in PART–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) $Ni\left(\eta^5-C_5H_5\right)$ (B) $Cr(CO)_2\left(\eta^6-C_6H_6\right)$ (C) $\left[Fe(CO)_2(PPh_3)\right]^-$

(a) A-CH, B-CH_3, C-CH (b) A-CH, B-CH_2^+, C-CH

(c) A-CH, B-CH_3^+, C-CH (d) A-CH_2, B-CH_3^+, C-CH

2. Match the following

List-A	**List-B**
(1) $\left[PtCl_3(C_2H_4)\right]^-$	(i) Wacker process
(2) $Ir(PPh_3)_2(CO)Cl$	(ii) Wilkinsons catalyst
(3) $\left[Rh(PPh_3)_3Cl\right]$	(iii) Vaska's complex
(4) $\left[PdCl_4\right]^{2-}$, $CuCl_2$	(iv) Zeise's salt

(a) A-IV, B-III, C-II, D-I (b) A-IV, B-III, C-I, D-II

(c) A-I, B-II, C-III, D-IV (d) A-I, B-II, C-IV, D-III

3. 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) $d_{yz}, d_{xz} < d_{x^2-y^2}, d_{xy} < d_{z^2}$

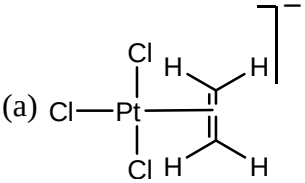
4. The species $GeC_2B_9H_{11}$ can be classified as
(a) Closo (b) Nido (c) Arachno (d) Hypho

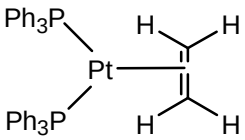
5. Which of the following is the correct order for donor ability?
(a) $PF_3 > P(OAr)_3 > P(OR)_3 > PAr_3$ (b) $PF_3 > P(OR)_3 > P(OAr)_3 > PAr_3$
(c) $PAr_3 > P(OR)_3 > P(OAr)_3 > PF_3$ (d) $PAr_3 > P(OAr)_3 > P(OR)_3 > PF_3$

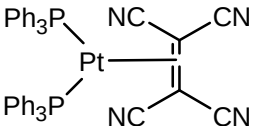
Q.6 to Q.10: Carry 2 Marks each.

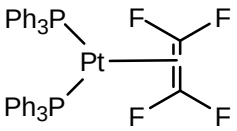
6. The structure of $Rh_6(CO)_{16}$ and $B_{12}H_{14}$ are respectively.
(a) closo, nido (b) closo, arachno (c) closo, closo (d) nido, arachno

7. Which of the following complex having highest C–C bond length.

(a) 

(b) 

(c) 

(d) 

8. Following the 18-electron rule as guide, determine x, y, z in the following complexes
(i) $\left[\eta^5 CpOs(CO)_x\right]_2$ has an Os–Os single bond

(ii) $\left[\eta^6-(C_6H_6)Mn(CO)_2CH_3\right]^y$ (iii) $\left[\eta^5 Cp(CO)_2 Fe(PhC\equiv CH)\right]^z$
(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. The correct order of rate of oxidative addition is
(a) Fe (0) > Co(+1) > Ni(+2) (b) Ru(0) > Pd(+2) > Rh(+1)
(c) Pt(+2) > Ir (+1) > Os(0) (d) Rh(+1) > Ir (+1) > Co (+1)

10. The structure corresponding to the compound $Ru_6(CO)_{17}C$ is:
(a) Square pyramidal (b) TBP
(c) Octahedral (d) Butterfly

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

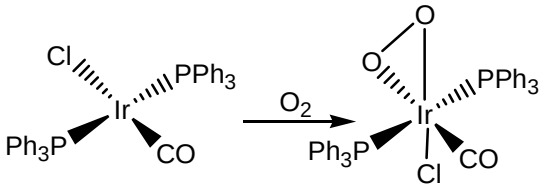
12. Select the correct order regarding ν_{C-O} value of carbonyl complexes

(a) $Ni(CO)_4 < \left[Fe(CO)_4\right]^{2-} > \left[Co(CO)_4\right]^-$

(b) $\left[Cr(CO)_6\right] > CO > \left[V(CO)_6\right]^- > \left[Ti(CO)_6\right]^{2-}$

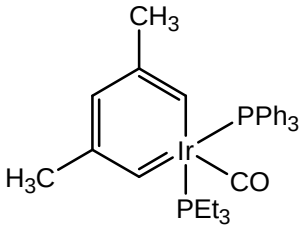
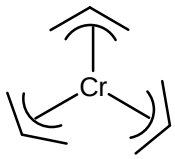
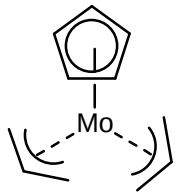
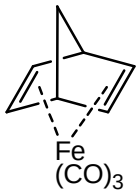
(c) $CO > \left[Cr(CO)_6\right] > \left[V(CO)_6\right]^- > \left[Ti(CO)_6\right]^{2-}$

(d) $Ni(CO)_4 > Ni(CO)_3\left[P(OMe)_3\right] > Ni(CO)_2\left[P(OMe)_3\right]_2$

13. 

Which of the following statement is/are **true** regarding above reaction
(a) Metal oxidation state changes from Ir(+1) to Ir(+3)
(b) Electron count changes from $16\,e^- \rightarrow 18\,e^-$
(c) Both reactant and product are diamagnetic
(d) O_2 converted into superoxide

14. Which of the following complexes follows 18 electron rule

(a) 
(b) 
(c) 
(d) 

15. Which of the following sequences is/are correct for mentioned properties?

(a) $HCo(CO)_3(PMe_3) < HCo(CO)_3(PPh_3) < HCo(CO)_3(PF_3)$ [acidity order]

(b) $HMn(CO)_5 < HTe(CO)_5 < HRe(CO)_5$ [thermal stablility order]

(c) $NO^+ < CS < CO < CN^-$ [order of π-accepting ability]

(d) $BH_3 \cdot CO <$ free $CO < CO^+$ [order of $\bar{\nu}_{C-O}$]

PART-C

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

16. Number of bridging carbonyl in $[Fe_3(CO)_{12}]$ is _____

17. If the cluster $[Co_3(CH)(CO)_9]$ obeying 18-electron rule, number of bridging ligand is _____

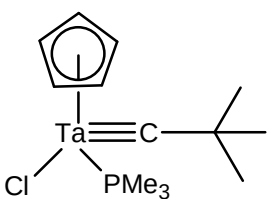
Q.18 to Q.21: Carry 2 Marks each.

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

19. Bond order in cluster $[Mo_2(SO_4)_4]^{4-}$ is _____

20. The number of metal-metal bonds per metal in the following complex $Ir_4(CO)_{12}$ is _____

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



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PART - A

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

PART - B

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

PART - C

16. (2)	17. (1)	18. (2)	19. (4)
20. (3)	21. (16)		