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3 (Sem-6/CBCS) CHE HC 1

2024

CHEMISTRY

(Honours Core)

Paper : CHE-HC-6016

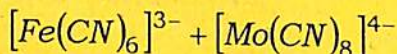
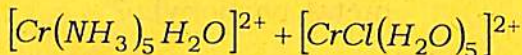
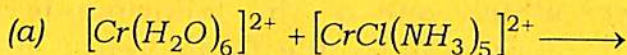
(Inorganic Chemistry-IV)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Choose the correct answer 1×7=7



Which one of the following is correct statement ?

(i) Both involve inner sphere mechanism

Contd.

- (ii) Both involve outer sphere mechanism
- (iii) Reaction I follows inner sphere mechanism and reaction II follows outer sphere mechanism
- (iv) Reaction I follows outer sphere mechanism and reaction II follows inner sphere mechanism
- (b) Wilkinson's catalyst is
- (i) $[RhCl_3(PPh_3)_3]$
- (ii) $[RhCl_3(PPh_3)]$
- (iii) $[RhCl(PPh_3)_3]$
- (iv) $[RhCl_2(PPh_3)_2]$
- (c) Which one of the following is not important for the formation of stable metal carbonyls?
- (i) Metals with low oxidation states
- (ii) Metals with small size
- (iii) Lowering of carbon-oxygen bond order
- (iv) EAN is obeyed

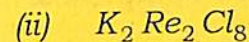
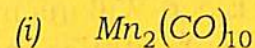
- (d) Which of the following is a wrong statement about industrially important catalytic processes?
- (i) The proportion of H_2 gas in water-gas mixtures can be increased.
- (ii) All metals in Fischer-Tropsch catalytic processes have ability to chemically absorb carbon monoxide.
- (iii) Nickel is best surface for methanation in Fischer-Tropsch processes,
- (iv) Water gas cannot be obtained from natural gas.
- (e) Which of the following precipitates cannot be observed by use of group V reagents?
- (i) $BaCO_3$
- (ii) $SrCO_3$
- (iii) $CuCO_3$
- (iv) $CaCO_3$
- (f) Which is true about $Mn(CO)_4NO$?
- (i) The complex is paramagnetic and follows $18e^-$ rule
- (ii) The complex is diamagnetic and follows $18e^-$ rule

- (iii) The complex is paramagnetic and does not follow $18e^-$ rule
- (iv) The complex is diamagnetic and does not follow $18e^-$ rule
- (g) The n in symbol for hapticity (η^n) represents :
- (i) number of ligands attached to the metal
- (ii) number of atoms of the ligand within a bonding distance to the metal
- (iii) charge on the ligand
- (iv) co-ordination number of the metal

2. Answer the following : $2 \times 4 = 8$

- (a) Draw the structure of $Fe_2(CO)_9$ and $Co_2(CO)_8$
- (b) Common ion effect plays an important role in qualitative analysis. Explain.
- (c) Define ground state trans-effect with an example.

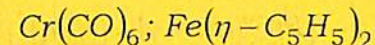
(d) What is the number of metal-metal bond in the following compounds?



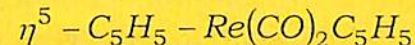
3. Answer **any three** of the following :

$5 \times 3 = 15$

- (a) Explain the mechanism of nucleophilic substitution reaction in square planar complexes.
- (b) Explain EAN rule. Which of the following obey this rule :



Draw the structure of



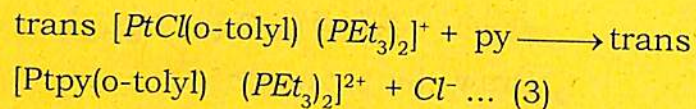
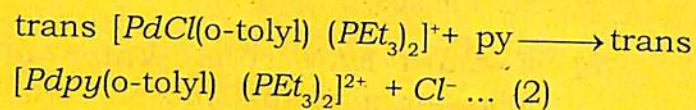
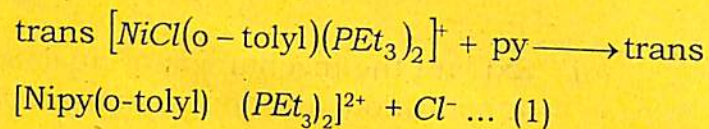
- (c) Discuss the methods of removal of oxalate and phosphate ions during the qualitative analysis of salt mixture.
- (d) Draw the catalytic cycle of the hydroformylation of alkene. Discuss the reactions involved in various steps.
- (e) Explain the mechanism of outer sphere redox reaction of co-ordination compounds. $2+2+1=5$

4. Answer **any three** of the following :

10×3=30

(a) (i) Discuss Eigen-Wilkins mechanism of ligand substitution reactions in octahedral complexes. 4

(ii) For the following substitution reactions :



The observed rates of reaction (1) is 50 times faster than reaction (2) which, in turn, is about 100,000 times faster than reaction (3). Explain. 2

(iii) Define kinetically labile and inert complexes. The high spin complex ion $[Cr(H_2O)_6]^{2+}$ is labile but the low spin complex ion $[Cr(CN)]^+$ is inert. Explain. 2+2=4

(b) Discuss synthesis, chemical properties of $(\eta-C_5H_5)_2Fe$ and give a description of bonding in this important organometallic compound. 2+2+6=10

(c) Discuss the role of organometallic compounds in catalysis with special reference to

(i) Synthesis gas by metal carbonyl complexes

(ii) Alkene hydrogenation by Wilkinson's catalyst. 5+5=10

(d) Explain the preparation, structure and bonding of Zeise's salt. The IR stretching frequency of C=C bond in metal ethylene complex is found to be 1576 cm^{-1} whereas the corresponding frequency for free C_2H_4 is 1625 cm^{-1} . Explain.

1+2+5+2=10

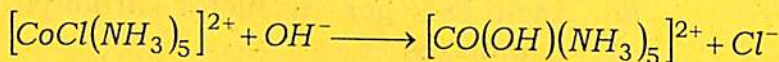
(e) (i) What is Zeigler-Natta catalyst? How is it prepared? Explain its major application. 2+2+1=5

(ii) What is Wacker process? Give one example. Mention the main three catalytic reaction sequence involved in it. 1+1+3=5

(f) (i) Explain with suitable example how steric crowding at the reaction center influence the rate of substitution reactions in square planar and octahedral complexes.

3+3=6

(ii) Discuss the mechanism of the following substitution reaction :



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