

QP Code : 77174

( 2½ Hours)

[ Total Marks : 75

- N.B.: (1) All questions are compulsory.  
(2) Figures to the right indicate full marks.  
(3) Use of log table/non-programmable calculator is allowed.

1. Answer any three of the following :-
- (A) On the basis of crystal field theory explain magnetic properties of  $[\text{CoF}_6]^{3-}$  and  $[\text{Co}(\text{NH}_3)_6]^{3+}$  5
  - (B) Draw neat labelled molecular orbital diagram of hexafluoroferrate (III) ion, considering only sigma bonding. Comment on its magnetic property. 5
  - (C) Define 'Crystal field stabilization energy'. Calculate C.F.S.E for  $d^4$  and  $d^7$  configurations in octahedral complexes of metal with strong field ligands. 5
  - (D) (a) State the rules to determine the ground state term. 3  
(b) Calculate number of microstates for  $p^3$  configuration. 2
  - (E) Write a short note on 'nephelauxetic effect' 5
  - (F) Explain the effect of  $\pi$  bonding on 10Dq values in octahedral complexes with ligands having empty  $\pi$  orbitals. 5
2. Answer any three of the following :-
- (A) Justify the following
    - (a)  $[\text{Zn}(\text{NH}_3)_4]^{2+}$  is less stable than  $[\text{Zn}(\text{en})_2]^{2+}$  3
    - (b) E.D.T.A forms stable complexes with most of the metal ions. 2
  - (B) Explain the role of the following factors on the stability of complexes.
    - (a) size and charge on the central metal atom / ion. 3
    - (b) steric effect. 2
  - (C) Give an account of anation reactions. 5
  - (D) Write a note on 'dissociative mechanism'. 5
  - (E) Explain in brief the selection rules which govern the electronic transitions. 5
  - (F) Give an account of the following :- 5
    - (a) Intra ligand transitions
    - (b) d-d transitions
3. Answer any three of the following:-
- (A) Explain the following reactions of organometallic compounds of main group elements. 5
    - (a) alkylation
    - (b) complex formation reactions

[ TURN OVER

JD-Con.322-17.



-2-

- (B) What are organometallic compounds? Discuss the methods of synthesis of organometallics of main group elements with respect to  
 (a) oxidative addition reactions. 5  
 (b) methylenation reactions. 5
- (C) What are metal clusters? Discuss the structure of  $[Re_2Cl_8]^{2-}$  5
- (D) Explain the following reactions with reference to ferrocene.  
 (a) metalation (b) acylation 5
- (E) What are metallocenes? Discuss the bonding in ferrocene on the basis of Valence bond theory. 2
- (F) Answer the following :- 3  
 (a) preparation of ferrocene using Grignard's reagent.  
 (b) physical properties of ferrocene.
4. Answer any three of the following:- 5  
 (A) Explain the bonding in borazine. 5  
 (B) Write notes on 'COD' and 'TOC'.  
 (C) Give an account of the following with respect to effluent treatment. 2  
 (a) principle involved in aerobic process. 3  
 (b) steps involved in primary treatment. 5
- (D) With reference to nanomaterials explain -  
 (a) mechanical properties (b) optical properties
- (E) What are Carbon nanotubes? How are they prepared? Give any two applications of carbon nanotubes. 5
- (F) Give an account of calamine and  $KMnO_4$  as pharmaceuticals. 5
5. Answer the following :-  
 (A) Select and write the most appropriate answer. 4  
 (a) The number of microstates for  $d^1$  configuration is \_\_\_\_\_  
 (i) 10 (ii) 15 (iii) 20  
 (b) The ground state term for \_\_\_\_\_ configuration is  $^2D$ .  
 (i)  $d^1$  (ii)  $d^2$  (iii)  $d^3$

[ TURN OVER

JD-Con.322-17.



- 3 -

- (c) Only \_\_\_\_\_ of the  $d^5sp^3$  orbitals of a metal ion can form sigma bonds in octahedral complexes.
- (i) three                      (ii) six                      (iii) five
- (d) In square planar complexes, due to crystal field splitting, orbital with maximum energy is \_\_\_\_\_.
- (i)  $d_{z^2}$                       (ii)  $d_{yz}$                       (iii)  $d_{x^2-y^2}$

OR

4

- (A) State whether the following statements are true or false.
- (p) The value of  $10Dq$  in octahedral complexes increases as the charge on the metal ion decreases.
- (q) ESR spectrum of  $[\text{IrCl}_6]^{2-}$  consists of double humped curve with two peaks.
- (r) For a given value of 'S' the spin multiplicity is given by the formula  $2S+1$ .
- (s) In  $d^2$  configuration two electrons can be arranged in 45 ways in the five 'd' orbitals.

4

(B) Select and write the most appropriate answer :-

- (a) Which of the following metal ions form stable complexes with phthalocyanin ligand?
- (i)  $\text{Cu}^{+2}$                       (ii)  $\text{Zn}^{+2}$                       (iii)  $\text{Be}^{+2}$
- (b) Blue coloured  $[\text{Co}(\text{SCN})_4]^{2-}$  complex on dilution with  $\text{H}_2\text{O}$  changes to \_\_\_\_\_ color.
- (i) green                      (ii) yellow                      (iii) pink
- (c)  $\text{SN}^1\text{CB}$  mechanism is applied only to complexes in which one or more ionisable \_\_\_\_\_ atoms, are present.
- (i) F                      (ii) Cl                      (iii) H
- (d) In  $\text{L} \rightarrow \text{M}$  transitions \_\_\_\_\_
- (i) ligand gets oxidised                      (ii) metal gets oxidised
- (iii) ligand gets reduced

OR

[TURN OVER]

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(B) State whether the following statements are true or false.

- (p) Stability of chelate complex increases with increase in size of the chelating ligand.
- (q) Higher the base strength of ligand, greater is the stability of the complex.
- (r) Overall formation constant is given by the product of stepwise stability constants.
- (s) Generally tetrahedral and square planar complexes are more labile than octahedral complexes.

(C) Select and Write the most appropriate answer:-

(a) In ----- reactions one metal replaces the other metal to form new organometallic compound.

- i) redistribution      ii) transmetalation      iii) metalation

(b) Exchange of formal carbanion  $R^-$  with halide anion may be regarded as----- reaction.

- i) halogenation      ii) metathesis      iii) hydrometallation

(c) During nitration ferrocene undergoes -----

- i) oxidation      ii) reduction      iii) substitution

(d) Condensation of ferrocene rings with formaldehyde and amine is called ----- reaction.

- i) hydrolysis      ii) Mannich      iii) alkylation

OR

(C) State whether the following statements are true or false:-

- (p) Many organometallics of first few main group elements are pyrophobic.
- (q) Addition of metal or non-metal hydrides to an alkene is called hydrometallation reaction.
- (r) Cyclopentadiene rings in ferrocene are aliphatic in nature.
- (s) Ferrocene molecule is an example of sandwich compounds.

[ TURN OVER

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(D) Select and write the most appropriate answer:-

3

- (a) One of the end products of aerobic degradation is \_\_\_\_\_  
(i)  $\text{CH}_4$  (ii)  $\text{N}_2$  (iii)  $\text{CO}_2$
- (b) Oxygen demanding waste in water leads to \_\_\_\_\_ in the concentration of dissolved  $\text{O}_2$ .  
(i) decrease (ii) increase (iii) No change
- (c) Borazine on hydrolysis gives \_\_\_\_\_  
(i)  $\text{N}_2$  (ii)  $\text{N}_2\text{H}_4$  (iii)  $\text{H}_3\text{BO}_3$

OR

3

(D) State whether the following statements are true or false:-

- (p) Borazine is isoelectronic with naphthalene.  
(q) Antimicrobials cause suppression of growth of micro organisms.  
(r) For nano particles, with decrease in particle size melting point decreases.

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