

2012

(November)

CHEMISTRY

(Major)

Course : 301

(Inorganic Chemistry—I)

Full Marks : 48

Pass Marks : 19

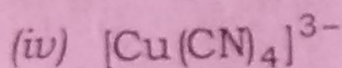
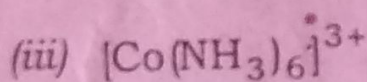
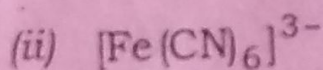
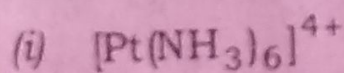
Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Select the correct answer :

1×5=5

(a) The complex which does not obey EAN rule is



(b) The example of a tridentate ligand is

- (i) triethylene tetramine
- (ii) dimethyl glyoximate anion
- (iii) iminodiacetate anion
- (iv) acetylacetonate anion

(c) In the complex $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$, the metal ion has

- (i) d^1 -configuration
- (ii) d^2 -configuration
- (iii) d^3 -configuration
- (iv) d^5 -configuration

(d) Which of the following has the highest liability?

- ~~(i)~~ SF_6
- (ii) $[\text{PF}_6]^-$
- (iii) $[\text{SiF}_6]^{2-}$
- (iv) $[\text{AlF}_6]^{3-}$

(e) The number of $4f$ -electron in lanthanum is

- ~~(i)~~ 0
- (ii) 1
- (iii) 2
- (iv) 5

2. Answer the following :

2×5=10

(a) Write the name and formula of each of the following types of ligand :

(i) A bidentate ligand with one acidic and one neutral donor

(ii) A tridentate ligand with three neutral donors

(b) What is spectrochemical series?

(c) Explain inert and labile complexes with example.

(d) What are the L and S values of 3P , 1D , 3F and 2G ?

(e) What do you mean by diamagnetism and paramagnetism?

3. (a) Write the IUPAC name of the following :

1×2=2

(i) $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2][\text{Cr}(\text{NH}_3)_2\text{Cl}_4]$

(ii) $[(\text{NH}_3)_5\text{Co}-\text{NH}_2-\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})]\text{Cl}_5$

(b) Write the formula of the following compounds :

1×2=2

(i) Sodium ethylenediaminetetraacetatonickelate(II)

(ii) μ -Hydroxo- μ -imidotetrakis(ethylene diamine) dicobalt(III) ion

- (c) What are macrocyclic ligands? Give the meaning of the numbers 18 and 6 in the complex $[\text{Na}(18\text{ crown-}6)]^+$. 1+1=2

4. Answer either (a) or (b) :

- (a) (i) On the basis of crystal field theory, explain the splitting of d -orbitals in an octahedral complex. 3

(ii) What do you mean by crystal field stabilization energy (CFSE)? Calculate CFSE for each of the following octahedral systems : 1+2=3

1. d^5 high-spin

2. d^6 low-spin

- (b) (i) Discuss briefly why the d -orbital splitting is larger in octahedral complexes than in tetrahedral one. Mention the factors on which splitting depends. 2+2=4

(ii) Explain what you mean by Russell-Saunders coupling. 2

5. Answer either (a) or (b) :

- (a) (i) How does valence bond theory account for the following? 2+2=4

1. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ ion is more paramagnetic than $[\text{Fe}(\text{CN})_6]^{3-}$ ion.

2. $\text{Ni}(\text{CO})_4$ is tetrahedral while $[\text{Ni}(\text{CN})_4]^{2-}$ ion is square planar.

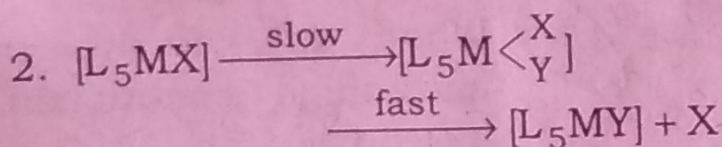
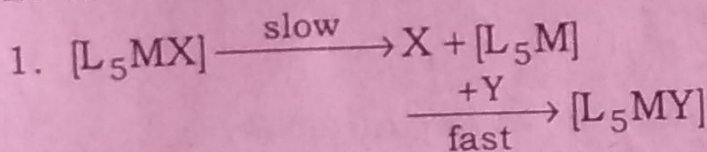
(ii) Draw and explain the Orgel diagram for a d^1 -system. 3

(b) (i) Discuss the geometrical isomerism of $[\text{Ma}_2\text{X}_2]^{n\pm}$ and $[\text{MA}_4\text{X}_2]^{n\pm}$ type complexes. 3

(ii) What are inner complexes? Give the characteristics of inner complexes. Mention one of its uses with example. 1+2+1=4

6. Answer either (a) or (b) :

(a) (i) Explain the mechanism of reaction in the following : 2+2=4



(ii) Write a note on acid hydrolysis of cobalt(III) compounds with suitable example. 3

(iii) Discuss the following factors on the rate of aquation of a hexa-coordinated complex (any one) :

1. Charge on the complex
2. Steric effect

(b) (i) The rate of hydrolysis of a cobalt complex is expressed by the following rate :

$$\text{Rate} = k[\text{CoL}_5\text{X}^{n+}][\text{OH}^-]$$

What type of hydrolysis is it called? Explain the mechanism of such hydrolysis.

(ii) Explain what you mean by A , D , I_d and I_a mechanism in ligand substitution reaction.

(iii) What is *trans*-effect?

7. Answer either (a) or (b) :

(a) (i) What do you understand by lanthanide contraction? Discuss its causes.

1+2=3

(ii) What are the problems in the separation of lanthanides from one another?

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(b) Give reasons for the following :

$$2+1\frac{1}{2}+1\frac{1}{2}=5$$

(i) Common oxidation states of the first transition series elements increase up to manganese and then decrease.

(ii) Ti^{4+} ion is more stable than Ti^{3+} ion.

(iii) d-Block elements show variable oxidation state.
