

Total No. of Printed Pages—11

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(November)

CHEMISTRY

(Major)

Course : 301

(Inorganic Chemistry—I)

(New Course)

Full Marks : 48

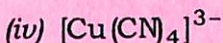
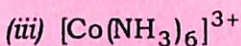
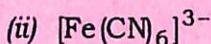
Pass Marks : 14

Time : 2 hours

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

1. Select the correct answer : 1×5=5

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



(b) 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

(c) The free ion ground term for Ni^{2+} ion is

- (i) 4F
- (ii) 2D
- (iii) 3F
- (iv) 3D

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

- (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 questions : 2×8=16

(a) What is spectrochemical series? Write one application of the spectrochemical series. 1+1=2

(b) Find out the values of L and S for $3P$, $1D$, $3F$ and $2G$. $\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = 2$

(c) Write the name and formula of each of the following types of ligand : 1×2=2

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

(ii) A tridentate ligand with three neutral donors

(d) Write the IUPAC names of the following compounds : 1+1=2

(i) $\text{Na}_3[\text{Co}(\text{CN})_5\text{NO}]$

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

(e) Write the formulas of the following complexes : 1+1=2

(i) Dichloro-*bis*-(triphenyl phosphine) palladium (II)

(ii) Pentaamine (dinitrogen) ruthenium (II) chloride

(f) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ is labile but $[\text{Fe}(\text{CN})_6]^{4-}$ is inert. Explain. 2

(g) Explain inert and labile complexes with examples. 2

(h) What are the problems in the separation of lanthanides from one another? 2

3. Answer any *three* questions : 3×3=9

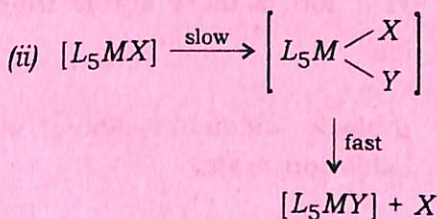
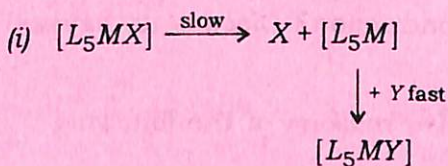
(a) What do you mean by crystal field stabilization energy (CFSE)? Calculate CFSE for each of the following octahedral systems :

(i) d^5 -high spin

(ii) d^6 -low spin

1+2=3

- (b) Discuss the geometrical isomerism of $[Ma_2X_2]^{n\pm}$ and $[MA_4X_2]^{n\pm}$ type complexes. $1\frac{1}{2}+1\frac{1}{2}=3$
- (c) $Ni(CO)_4$ is tetrahedral while $[Ni(CN)_4]^{2-}$ ion is square planar. Explain in the light of valence bond theory. $1\frac{1}{2}+1\frac{1}{2}=3$
- (d) Draw and explain the Orgel diagram for a d^1 -system. 3
- (e) What are inner complexes? Give the characteristics of inner complexes. $1+2=3$
4. (a) Write a note on acid hydrolysis of cobalt (III) compounds with suitable example. 3
- (b) Explain the mechanisms of reactions in the following : $2+2=4$



5. (a) State and explain the following with suitable examples : 2+2=4

(i) Laporte selection rule

(ii) Spin selection rule

- (b) The complex ion $[\text{Co}(\text{NH}_3)_6]^{3+}$ is octahedral and diamagnetic and $[\text{CoF}_6]^{3-}$ is also octahedral but paramagnetic. How does valence bond theory account for this observation?

2+2=4

6. Answer either (a) or (b) : 3

(a) What do you understand by lanthanide contraction? Discuss its causes. 1+2=3

(b) Give reasons of the following :

(i) Ti^{4+} ion is more stable than Ti^{3+} ion. 1½

(ii) *d*-block elements show variable oxidation state. 1½

(7)

(Old Course)

Full Marks : 48

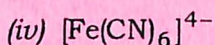
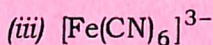
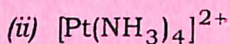
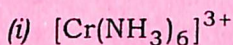
Pass Marks : 19

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 ion which obeys the EAN rule is



(b) The CFSE for the d^3 -ion in strong crystal field is

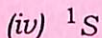
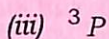
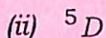
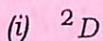
(i) 4 Dq

(ii) 8 Dq

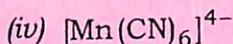
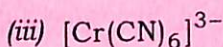
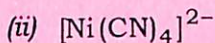
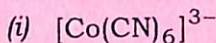
(iii) 12 Dq

(iv) 16 Dq

(c) The spectroscopic free ion ground term for d^1 is



(d) The complex which reacts most rapidly is



(e) Which of the following elements has the electronic configuration $[\text{Xe}]4f^65d^16s^2$?

(i) Americium

(ii) Californium

(iii) Europium

(iv) Fermium

2. Answer the following questions : 2×8=16
- (a) Write the IUPAC names of the following compounds : 1+1=2
- (i) $[\text{Co}(\text{ONO})(\text{NH}_3)_5] \text{SO}_4$
- (ii) $\text{K}_3[\text{Fe}(\text{CN})_5\text{NO}]$
- (b) Write the formulas of the following : 1+1=2
- (i) Dichloro-*bis*-(triphenyl phosphine) palladium (II)
- (ii) Potassium pentachloronitrito-osmate (VI)
- (c) What is spectrochemical series? Write the spectrochemical series of the common ligands. 1+1=2
- (d) $\text{Ni}(\text{CO})_4$ and $[\text{Ni}(\text{CN})_4]^{2-}$ have different geometries but same magnetic property. Explain. 1+1=2
- (e) Draw the structures of all the possible isomers of $[\text{Co}(\text{en})_3]^{3+}$ ion. 2
- (f) Explain briefly $\text{S}_{\text{N}}1$ - and $\text{S}_{\text{N}}2$ -mechanisms for ligand replacement reactions. 2
- (g) Write a note on *trans*-effect. 2
- (h) Discuss the causes of lanthanide contraction. 2

3. Answer any three questions : 3×3=9

(a) Calculate the CFSE for each of the following : 1+1+1=3

(i) d^5 -high spin

(ii) d^6 -low spin

(iii) d^4 -low spin

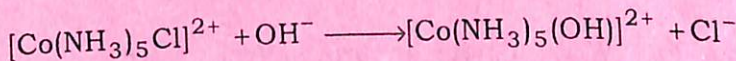
(b) Discuss the geometrical isomerisms of $[Ma_2X_2]^{n\pm}$ and $[MA_4X_2]^{n\pm}$ type complexes. 1½+1½=3

(c) Draw and explain the Orgel diagram for the complex $[Cu(H_2O)_6]^{2+}$ ion. 1+2=3

(d) Explain the term "Russell-Saunders coupling". 3

(e) What are inner complexes? Give the characteristics of inner complexes. 1+2=3

4. (a) Explain the mechanism of the following reaction in terms of S_N1 -CB-mechanism : 4



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

5. (a) State and explain with suitable examples : 2+2=4

(i) Laporte selection rule

(ii) Spin selection rule

(b) What is the basis of crystal field theory? Draw the splitting patterns for octahedral and tetrahedral complexes in a crystal field. 2+1+1=4

6. (a) What do you understand by lanthanide contraction? Discuss its causes. 1+2=3

Or

(b) Cerium is the only lanthanide which is stable in (+4) oxidation state. Justify the statement. 3
