

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 spectroscopic free ion ground term
for d^2 configuration is

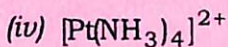
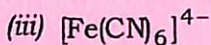
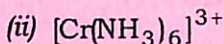
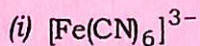
(i) 1S

(ii) 3P

(iii) 2D

(iv) 3F

(b) The complex ion which obeys the EAN rule is



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

(i) $4 Dq$

(ii) $8 Dq$

(iii) $12 Dq$

(iv) $16 Dq$

(d) Which of the following is not a member of actinoids?

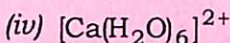
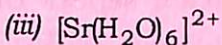
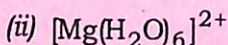
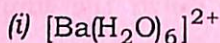
(i) Nobelium

(ii) Uranium

(iii) Californium

(iv) Europium

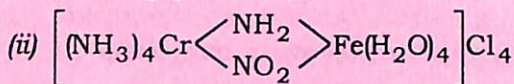
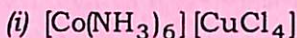
(e) Which of the following is least labile?



2. Answer any five of the following questions :

3×5=15

(a) Give IUPAC names of the following : 1×3=3



(b) Write down the formulae of the following complexes :

1×3=3

(i) Tetrahydroxonickelate(II)

(ii) Ammonium tetrathiocyanato-

5 chromate(II)

(iii) μ -amidodecamminedicobalt (III)

chloride

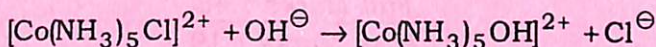
(c) Write down the conditions required to determine the ground term of a configuration. Find out the free ion ground term for d^7 configuration. 2+1=3

- (d) What is EAN? Find the EAN for $[\text{Co}_4(\text{Co})_{12}]$. Write down the limitations of EAN rule (any two). $1+1+1=3$
- (e) What is Irving-William series? Discuss briefly. $1+2=3$
- (f) Give reasons of the following : $1\frac{1}{2}\times 2=3$
- (i) Ti^{4+} ion is more stable than Ti^{3+} ion.
- (ii) D-block elements show variable oxidation state.

3. Answer the following questions :

- (a) What is CFSE in octahedral complexes? Calculate CFSE for the following : $1+1+1=3$
- (i) $[\text{FeF}_6]^{3-}$ ion
- (ii) $[\text{Fe}(\text{CN})_6]^{3-}$ ion
- (b) Explain the Orgel diagram of a metal complex with d^9 configuration. 3
- (c) Draw the splitting and energy level diagrams of metal d -orbitals in octahedral, tetragonal and square planar complexes. Why is crystal field splitting Δ_{sp} greater than Δ_0 ? $3+1=4$

4. (a) Explain the mechanism of the reaction in terms of S_N1 -CB mechanism : 5



- (b) Give an account of 'trans-effect'. 2

5. (a) Discuss the stereoisomerism exhibited by the complex $[\text{Cr}(\text{gly})_3]$. 2

- (b) Define macrocyclic ligands. Give the meaning of the numbers 18 and 6 in the complex $[\text{Na}(18\text{-crown-}6)]^+$. 2

- (c) A solution containing 2.674 g of $\text{CoCl}_3 \cdot 6\text{NH}_3$ was passed through a cation exchanger. The solution obtained gave 4.305 g of AgCl precipitate with AgNO_3 solution. Determine the formula of the complex.

(Given,

molar masses of $\text{CoCl}_3 \cdot 6\text{NH}_3 = 267.4$
and $\text{AgCl} = 143.45$) 4

6. Answer any one question : 3

- (a) Explain the fact that the most common oxidation state of the three elements La (57), Gd (64) and Ln (71) is +3.

- (b) What are the consequences of lanthanide contraction?

(6)

(Old Course)

Full Marks : 48

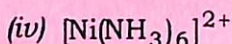
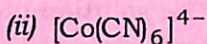
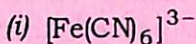
Pass Marks : 19

Time : 3 hours

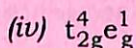
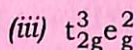
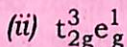
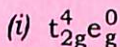
*The figures in the margin indicate full marks
for the questions*

1. Select the correct answer : 1×5=5

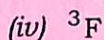
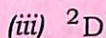
(a) Which of the following complexes obeys EAN rule?



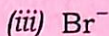
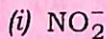
(b) The high-spin configuration of Cr(II) ion is octahedral. Crystal field is



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



(d) Which of the following has the minimum *trans*-effect?



(e) Common oxidation state of lanthanides is



(iv) None of the above

2. Answer any *five* of the following questions :

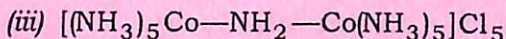
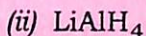
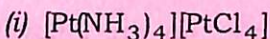
2×5=10

- (a) What is ambidentate ligand? Give an example.
- (b) What are the L and S values of 3F , 1D , 3P and 2G ?
- (c) What are inert and labile complexes?
- (d) Draw the structures of all possible stereo-isomers of $[\text{Co}(\text{en})_2\text{Cl}_2]^+$.
- (e) Give the electronic configurations of europium and neodymium.
- (f) What do you mean by diamagnetism and paramagnetism?
- (g) Write down the chemical formulae of the following compounds :
- (i) Chloronitro bis(ethylenediamine)
cobalt(III) ion
- (ii) Decaamine- μ -hydroxodichromium(III)
bromide

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

3×3=9

(a) Write the IUPAC names of the following compounds :



(b) What is chelation? Why are chelate complexes highly stable?

(c) On the basis of crystal field theory, explain that $[\text{CoF}_6]^{3-}$ is paramagnetic but $[\text{Co}(\text{NH}_3)_6]^{3+}$ is diamagnetic.

(d) Draw and explain Orgel diagram of a metal complex with d^1 configuration.

(e) On the basis of valence bond theory, discuss the structures of $[\text{Ni}(\text{CO})_4]$ and $[\text{Ni}(\text{CN})_4]^{2-}$.

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

4×3=12

(a) Discuss briefly the splitting and energy level diagrams of metal d -orbitals in octahedral and tetrahedral complexes.

Why is crystal field splitting Δ_t less than Δ_o ?

3+1=4

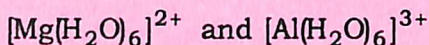
- (b) Calculate the number of unpaired electrons (n), spin only magnetic moments (μ_s) and CFSE in terms of Δ_o for the complex $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$. $1+(1\frac{1}{2}\times 2)=4$
- (c) Write short notes on the following : $2\times 2=4$
- (i) Colour of complexes in the light of crystal field theory
 - (ii) Nephelauxetic effect
- (d) What is spectro-chemical series? Write the spectro-chemical series of the common ligands. Calculate CFSE for an octahedral complex with d^7 metal ion under strong and weak field conditions. 4

5. Answer any *three* of the following questions :

$3\times 3=9$

- (a) Explain the associative and dissociative mechanisms in ligand substitution reaction.
- (b) Discuss the kinetics of acid hydrolysis of Co(III) compounds with suitable example.
- (c) What is *trans*-effect? Starting from $[\text{PtCl}_4]^{2-}$ and other ligands, outline the synthesis of *cis*- and *trans*- $[\text{PtCl}_2(\text{NH}_3)(\text{NO}_2)]$. $1+2=3$

- (d) Discuss inert and labile complexes with examples. Which one of the following is more labile? 1½×2=3



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

- (a) Give three points of differences between lanthanides and actinides.
- (b) What do you mean by lanthanide contraction? What are the causes of lanthanide contraction?
