

Cr / Mn / Mo / Co / Ni / V

Total No. of Printed Pages—7

2 TDC CHM M 1

2013

CHEMISTRY
(Major)

Paper : 20100

(Inorganic Chemistry)

Full Marks : 60 → 18

Time : 3 hours

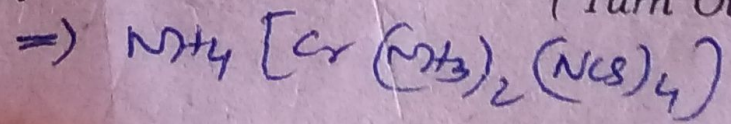
The figures in the margin indicate full marks for the questions

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

- (i) $[\text{Co}(\text{ONO})(\text{NH}_3)_5] \text{SO}_4 \Rightarrow$ Pentamine nitrito-
-cobalt (III) sulphate
- (ii) $[(\text{NH}_3)_5\text{Cr}-\text{OH}-\text{Cr}(\text{NH}_3)_5] \text{Cl}_5 \Rightarrow$ μ -hydroxo-
-bis-(pentaamminechromium)
-(III) chloride
- (iii) $\text{K}[\text{PtCl}_3(\text{C}_2\text{H}_4)] \Rightarrow$ Potassium trichloro(ethylene)platinate

(b) Give the structural formulae of the following compounds : 1×3=3

- (i) Ammoniumdiamminetetakis
(isothiocyanato)chromate(III)



(ii) Pentaammineazidocobalt(III)
⇒ $[Co(NH_3)_5(N_3)]SO_4$ sulphate

(iii) Potassiumpentachloronitrido-
⇒ $K_2[OsCl_5N]$ osmate(VI)

(c) Choose the correct answer : $\frac{1}{2} \times 3 = 1\frac{1}{2}$

(i) Which of the following compounds obeys EAN rule?

- ✗ (1) $[Cr(NH_3)_6]^{3+}$ → $(24 - 3) = 21$
 - ✗ (2) $[Ni(NH_3)_6]^{2+}$ → $(28 - 2) = 26$
 - ✓ (3) $[Co(NH_3)_6]^{3+}$ → $(27 - 3) = 24$
- $\frac{(+12)}{3} = 4$

(ii) The brown-ring test for nitrate is due to the formation of complex ion with formula

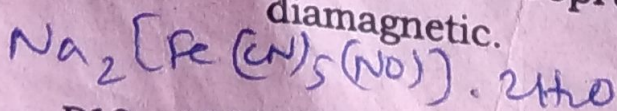
- (1) $[Fe(H_2O)_4(NO)_2]^{2+}$
- (2) $[Fe(NO)(CN)_5]^{2-}$
- ✓ (3) $[Fe(H_2O)_5NO]^{2+}$

(iii) For d^8 , the CFSE in an octahedral complex is

- ✓ (1) $12 Dq$
- (2) $6 Dq$
- (3) $4 Dq$

out in sen

✗ (d) Predict the oxidation states of iron atom, cyano and nitrosyl ligands in sodium nitroprusside which is diamagnetic.



$\frac{1}{2} \times 3 = 1\frac{1}{2}$

Fe = +2
CN = -1
NO = +1

2. Answer the following (any four) :

(a) Each of the compounds $[\text{Pt}(\text{NH}_3)_6]\text{Cl}_4$, $\text{K}_2[\text{PtCl}_6]$, $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$ and $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$ has been dissolved in water to make its 0.001 M solution. Rank them in order of their increasing conductivity in solution. 2

(b) $\text{Ni}(\text{CO})_4$ and $[\text{Ni}(\text{CN})_4]^{2-}$ have different geometries but same magnetic property. Explain. 1+1=2

(c) What is nephelauxetic effect? Arrange the following ligands in order of their nephelauxetic effects : 1+1=2

$\text{NH}_3, \text{H}_2\text{O}, \text{F}^-, \text{CN}^-$

$\Rightarrow \text{F}^- > \text{H}_2\text{O} > \text{NH}_3 > \text{CN}^-$

(d) What are the limitations of valence-bond theory? 2

(e) Draw the structures of all the possible isomers of $[\text{Co}(\text{en})_3]^{3+}$ ion. 2

3. Answer any three questions :

(a) How can you explain the stabilization of the following metal ions by complex formation? 2+2=4

$\text{Cu}(\text{I})$ and $\text{Ag}(\text{II})$

Mulliken Symbols: The symbols which are used to identify irreducible representations of group.

→ 1) A → singly degenerate state which is symmetric w.r.t. rotation about C_n-axis.

→ 2) B → singly degenerate state which is antisymmetric w.r.t. rotation about principal C_n-axis.

(b) On the basis of crystal field theory, discuss the hybridization and magnetic behaviour of $[\text{Fe}(\text{CN})_6]^{3-}$ and $[\text{FeF}_6]^{3-}$. 4

(c) What are chelates? Give the structure of two metal chelates that are prepared in inorganic qualitative analysis. Mention also which membered ring they are of. 1+2+1=4

(i) What is ambidentate ligand? Give an example. 1+1=2

(ii) Write a note on coordination isomerism with suitable examples. 2

(i) Define Mulliken symbols (A, B, E, T). 2

(ii) For Mn^{3+} ion, the electron pairing energy (P) is 28000 cm^{-1} . Δ_0 values for the complexes $[\text{Mn}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Mn}(\text{CN})_6]^{3-}$ are 21000 cm^{-1} and 38500 cm^{-1} , respectively. Do these complexes have high-spin or low-spin configuration? 2

4. (a) What is base hydrolysis reaction? Discuss the kinetics of the base hydrolysis reaction of an octahedral cobalt complex. 1+3=4

(b) Give the meaning of the following terms applied in inorganic substitution reactions : $\frac{1}{2} \times 4 = 2$

- (i) Associative, A
- (ii) Dissociative, D
- (iii) Interchange associative, I_a
- (iv) Interchange dissociative, I_d

Or

Explain the application of *trans*-effect with the help of a suitable example. 2

~~(c)~~ What is the importance of Irving-William series? Write the series. 1+1=2

1) 30 predict the inherent acidity of diff. molecules.

(d) Explain S_N1 and S_N2 mechanisms briefly for ligand replacement reactions. 2

2) 30 predict the hard-soft factor of diff. molecules
Irving-William series of stability $\Rightarrow Mn^{2+} < Fe^{2+} < Co^{2+}$

5. (a) Write short notes on (any three) : $2 \times 3 = 6$

- (i) Carbon dating
- (ii) Nuclear fission
- (iii) Geiger-Muller counter
- (iv) Packing fraction and binding energy

$< Ni^{2+} < Cu^{2+} >$
 Zn^{2+}

(b) Answer any one of the following : 3

- (i) Calculate the binding energy per nucleon in helium atom, ${}^4_2\text{He}$ which has a mass of 4.00260 a.m.u., mass of neutron = 1.008665 a.m.u. and mass of hydrogen atom = 1.007825 a.m.u.
- (ii) Give a short account on nuclear reactor.

6. (a) What are the oxidation states exhibited by the first five elements of the first transition series? 2½

(b) What are main causes of exhibiting variable oxidation states by these elements? 1½

7. (a) Give the structure of the products formed by the reaction of the following organic reagents with metal ions : $1 \times 3 = 3$

- (i) Thiourea forms a complex with Cu(II) ion
- (ii) 1-Nitroso-2-naphthol forms a complex with Co(II) ion
- (iii) Cupferron forms a complex with Cu(II) ion

(b) How do you prepare solutions of the following compounds for use as reagents in inorganic analysis? $1 \times 3 = 3$

(i) Magneson

(ii) 1-Nitroso-2-naphthol

(iii) Salicylaldoxime

(c) Write a note on the advantages of organic reagents over inorganic reagents in inorganic analysis.

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