The *d*-Block Elements and Their Compounds

Trends in Atomic Radii

Solution:

Cd (149) > Pb (138) > Mo (136) > Ru (134) > Zn (133)

Note units of atomic radii are in pm

E

The *d*-Block Elements and Their Compounds

Predicting Other Trends

Solution:

Ionization Energy: The minimum energy required to remove an electron from the ground state.

Going across the *d*-block the effective nuclear charge increases therefore it is harder to remove an electron and the ionization energy goes up. However going down a period the effective nuclear charge decreases and the ionization energy also decreases.

Therefore the ionization energy increases from left to right across a period and decreases going down a period

A

Coordination Compounds

Naming Compounds

Solution:

$Na[CoCl_3(NH_3)_3]$

Cation (Na^+)

sodium

Anion ($[CoCl_3(NH_3)_3]^-$)

The ligands are Cl^- and NH_3

Cl^- → chloro → (3) → trichloro

NH_3 → ammine → (3) → triammine

triamminetrichloro

$[CoCl_3(NH_3)_3]^-$ → Therefore Co has charge of +2 → cobaltate(II)

triamminetrichlorocobaltate(II)

Entire Name: sodium triamminetrichlorocobaltate(II)

A

Coordination Compounds

Naming Compounds

Solution:

Potassium hexacyanoferrate(II)

Cation (Potassium)

K^+

Anion (hexacyanoferrate(II))

Hexacyano: cyano = CN^- hexa = 6

Ferrate(II): Fe^{2+}

$[Fe(CN)_6]^{4-}$

To balance charge $4K^+$ are needed

Entire Formula: $K_4[Fe(CN)_6]$

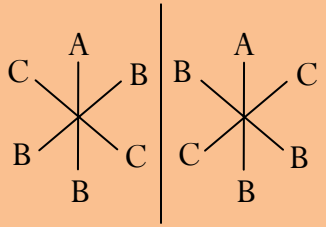
E

Coordination Compounds

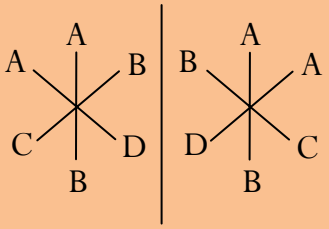
Isomers

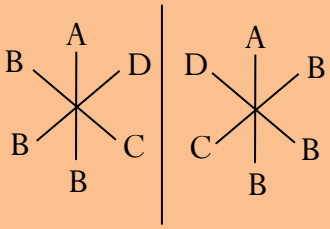
Solution:

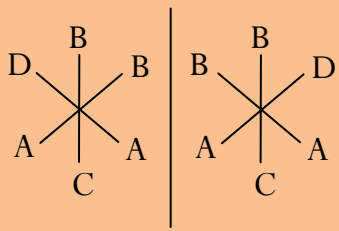
A chiral complex is a complex that is not identical to it mirror image

1 

Rotate mirror image a ¼ of a turn and it is identical to non mirror image

2 

3 

4 

You can not rotate the mirror images of complexes 2, 3, or 4 so that they are identical to their non mirror image

A

5s

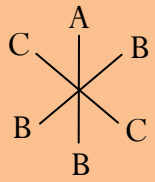
Coordination Compounds

Isomers

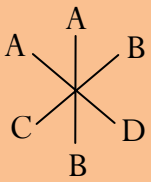
Solution:

Enantiomeric pairs are a chiral complex and its mirror image

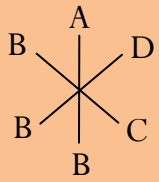
Need to have same number and types of ligands

1 

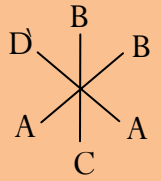
A = 1
B = 3
C = 2

2 

A = 2
B = 2
C = 1
D = 1

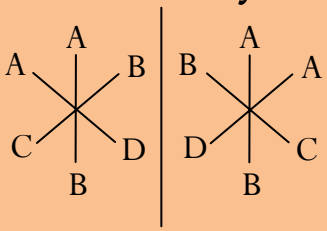
3 

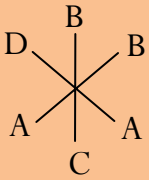
A = 1
B = 3
C = 1
D = 1

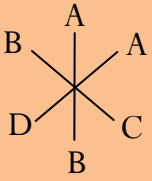
4 

A = 2
B = 2
C = 1
D = 1

Therefore only complexes 2 and 4 can be enantiometic pairs

2 

4 

Rotate → 

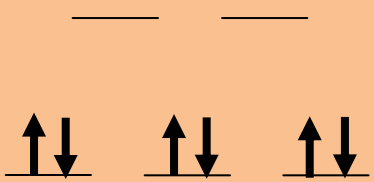
Same as mirror image of complex 2 **E**

The Electronic Structure of Complexes

Crystal Field Theory

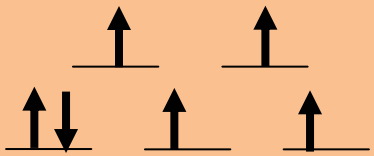
Solution:

(a) Strong Field Ligand



No Unpaired electrons

(b) Weak Field Ligand



4 Unpaired electrons

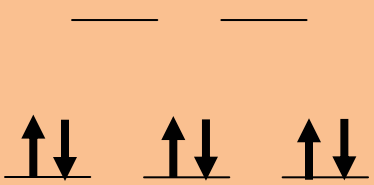
B

The Electronic Structure of Complexes

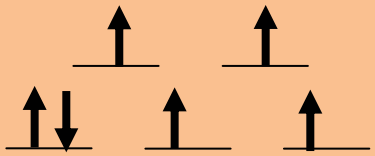
Crystal Field Theory

Solution:

Strong Field Ligand (NO_2^-)



Week Field Ligand (Cl^-)



The complex is originally diamagnetic because does not have any unpaired electrons it then changes to paramagnetic because it now has multiple unpaired electrons

B