

Isomerism in Coordination Compounds

Two or more compounds having same molecular formula but different arrangement of atoms/molecules due to which they differ in one or more physical properties/chemical properties.

Such compounds are called isomers & this phenomenon is isomerism.

1 Structural Isomerism :-

- (i) Coordination Isomerism
- (ii) Hydrate Isomerism
- (iii) Linkage Isomerism
- (iv) Ligand Isomerism

2 Stereoisomerism :-

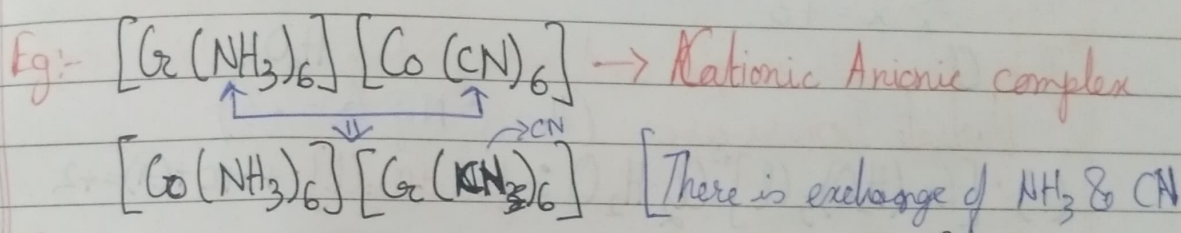
- (i) Geometrical isomerism [For $C.N = 4, 6$]
- (ii) Optical isomerism [" " "]

Structural Isomerism:

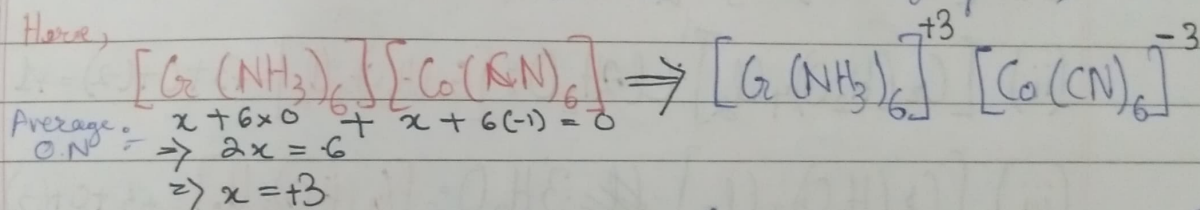
Compounds having same molecular formula but different structural formula.

1. Coordination Isomerism

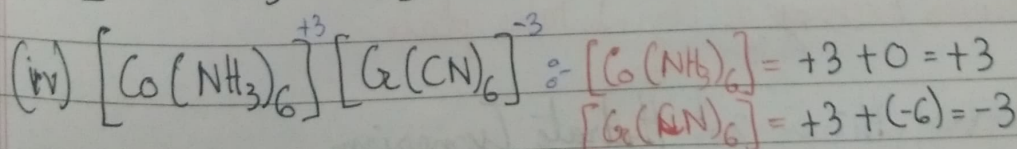
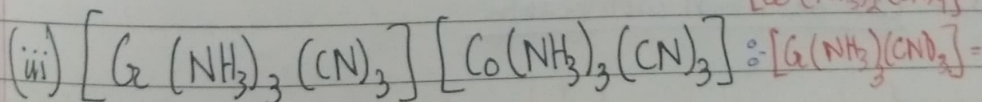
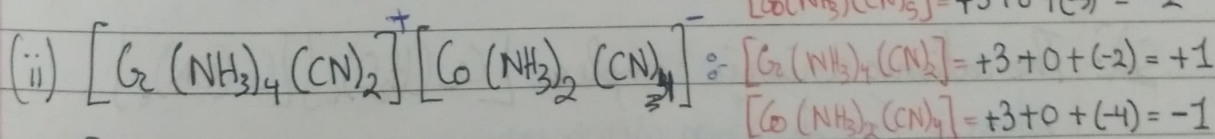
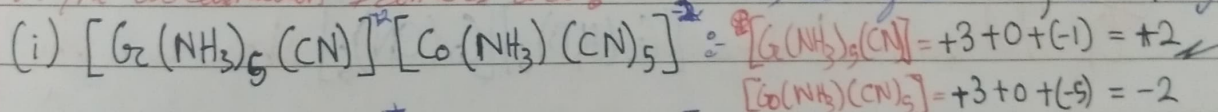
In this isomerism, there is exchange of ligands completely/partially betⁿ cationic & anionic complexes.



Here,



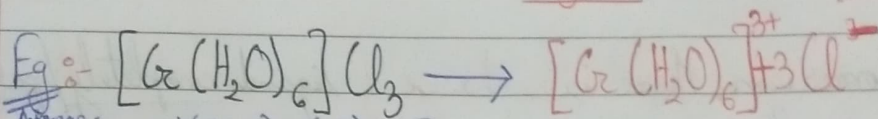
\therefore The Coordination Isomers are:- (Here, $\circ.N$ of $Cr = +3$, $Co = +3$)



2. Solvate/Hydrate Isomerism

When H_2O is used ~~as~~, then it is called Hydrate isomerism.

In this isomerism, $\text{H}_2\text{O} \rightarrow$ act as ligand as well as water of crystallization.

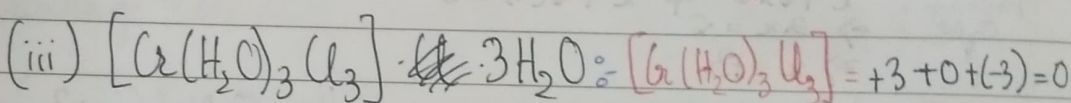
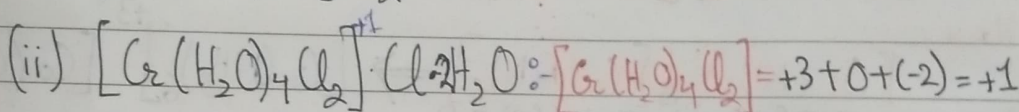
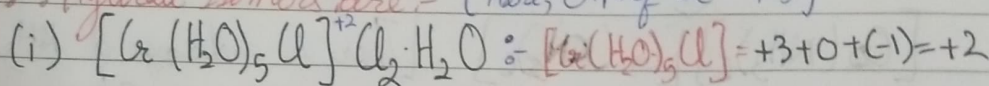


Average O.N. = $x + (0 \times 6) + (-3) = 0$

$\Rightarrow x = +3$

* Take Cl inside complex and corresponding H_2O outside complex

Hydrate Isomers are:- (Here, O.N of $\text{Cr} = +3$)



Q. What isomerism does $[\text{Cr}(\text{H}_2\text{O})_6][\text{Co}(\text{CN})_6]$ show and why?

Sol:- The cationic anionic complex $[\text{Cr}(\text{H}_2\text{O})_6][\text{Co}(\text{CN})_6]$ shows Coordination isomerism.

Because Exchange of ligands take place

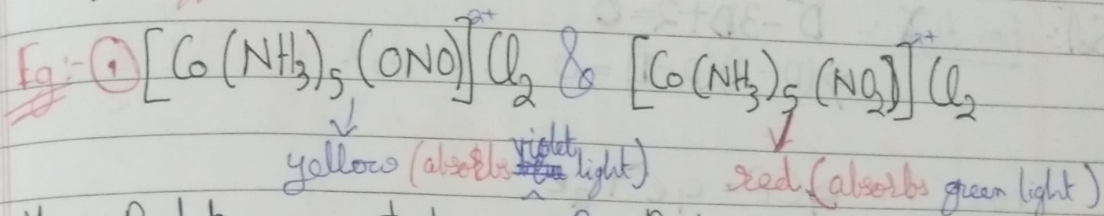
However, this is not Hydrate Isomerism.

Because ~~this~~ this type of isomerism is more focused on the ligand exchange within the complex's cationic/anionic ~~rather~~ individually rather than bet two ~~com~~ ~~for~~ components.

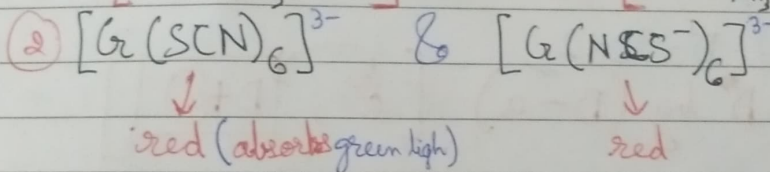
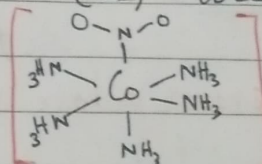
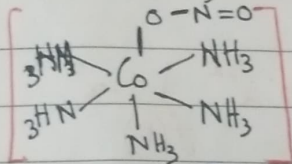
Hydrate isomerism applies to scenarios involving hydrate state of a single entity rather than interaction across cation-anion pair.

3 Linkage Isomerism

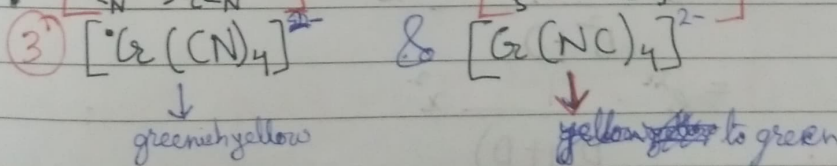
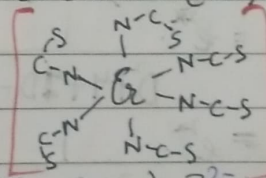
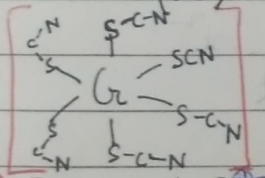
This isomerism occurs when there is ambidentate ligand & links to CMA through different sites



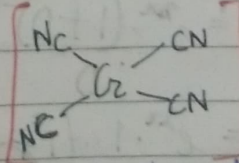
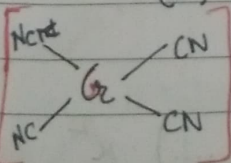
Here, Pentammine nitrito - O cobalt (III) chloride & Pentammine nitrito - N cobalt (III) chloride



Here, Hexa thiocyanato chromium (IV) & Hexa cyanato chromium (III)



Here, Tetra cyanato chromium (II) & Tetra cyanato chromium (II)



* Why ③ → greenish yellow and not red?

Sol: $[\text{Cr}(\text{CN})_4]^{2-}$ is a tetra complex $[\Delta_t = \frac{4}{9}\Delta_o]$
 ∴ Splitting of d-orbitals is weakened but due to strong field nature of CN
 The overall color of this complex becomes greenish yellow