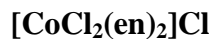


Marks
6

- When cobalt(II) chloride is reacted with ethane-1,2-diamine (en) and the product is oxidised in the air, a purple compound with the empirical formula $\text{CoCl}_3 \cdot 2\text{en}$ is obtained. When reacted with silver nitrate only one chloride ion is released. The compound can be resolved into its enantiomeric forms.

Give the structural formula of the compound.



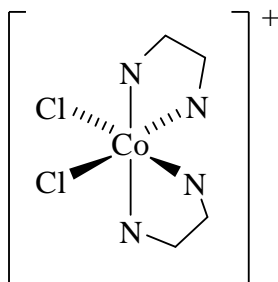
1 chloride ion must be a counter ion as only 1 is released when silver nitrate is added. As en is neutral, it must be coordinate to the metal ion.

Give the name of the compound.

***cis*-dichloridobis(ethane-1,2-diamine)cobalt(III) chloride**

Although the structural formula above gives rise to *cis* and *trans* isomers, only the *cis* form is optically active.

Draw the structure of the metal complex component of the compound.



What is the *d* electron configuration of the Co in this complex?

$[\text{CoCl}_2(\text{en})_2]\text{Cl} = \text{Co}^{3+} + 2\text{en} + 3\text{Cl}^-$. As Co is in group 9, it has 9 valence electrons. Co^{3+} has $(9 - 3) = 6$ electrons: $3d^6$

What types of isomers can be formed by a compound with this empirical formula?

Geometrical (*cis* and *trans*) isomers are possible.

The *cis* isomer can form optical isomers.

Which of the possible isomers has formed? Explain the logic you have used in determining this.

As only the *cis* isomer can form enantiomers, it must have been formed.

The *trans* isomer is superimposable (i.e. identical) to its mirror image.