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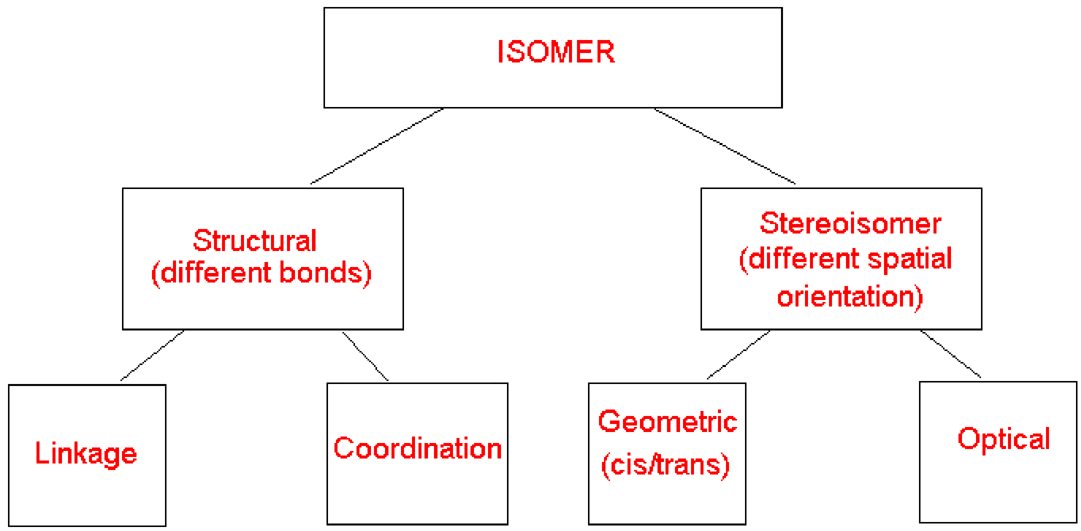
Isomers

1. What is an isomer?

Isomers are compounds with the same formula, but different chemical/physical properties.

2. Complete Isomer Flow Chart



3. Define and give an example of each of the following

a. Coordinate Isomerism

A ligand and a counter ion switch positions.

$[Cr(NH_3)_5Br]SO_4$ and $[Cr(NH_3)_5SO_4]Br$

b. Linkage Isomerism

This occurs when you have a ligand that has 2 or more potential areas of attachment structured in such a way that only one or the other end is able to attach at a time

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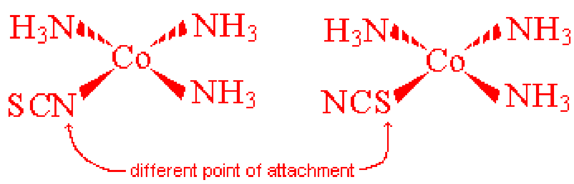
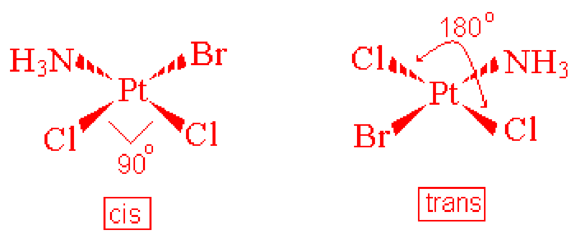


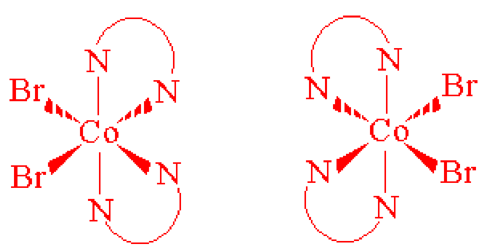
c. Geometric (*cis-trans*) Isomerism

These isomers have two identical ligands that can either be placed 90^{o} (called cis) or 180^{o} (called trans) from each other.



d. Optical Isomerism

This is when you have isomers that are non-super imposable mirror images. These type of isomers rotate plane polarized light in different directions.



I would say that these are the hardest to visualize and if you can get your hands on a molecule model kit, it might be a good idea to make these models and prove to yourself that these are non-super imposable.

4. Draw geometrical isomers of each of the following complex ions.

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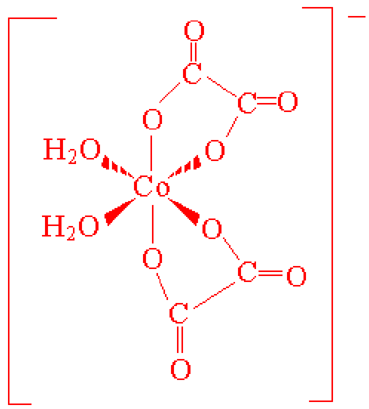
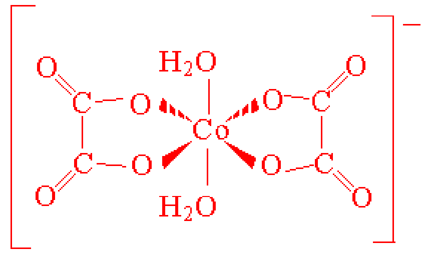
a. $[Co(C_2O_4)_2(H_2O)_2]^-$

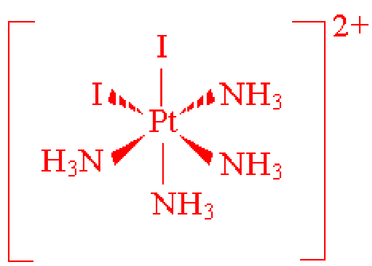


CIS

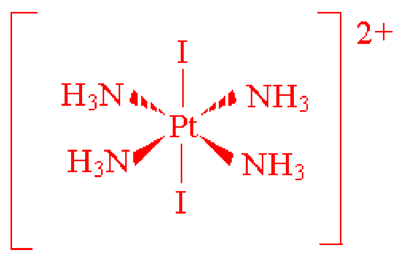


TRANS

b. $[Pt(NH_3)_4I_2]^{2+}$



CIS

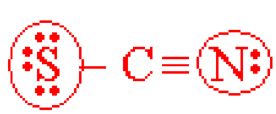


TRANS

5. Which of the following ligands are capable of linkage isomerism?

SCN^-, N_3^-, $NH_2CH_2CH_2NH_2$, OCN^-, I^-

In this problem we are looking to see which of these ligands has two *different* atoms in it with lone pairs that would be too small to form a ring.



Yes. It has two different atoms on it that can act as a Lewis Base (has lone pairs) but it is too small to form a ring.

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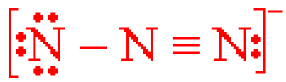
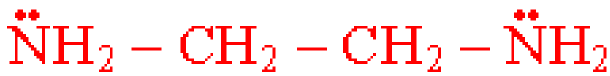
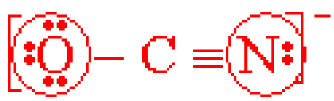


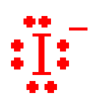
No. it does have more than one atom with lone pairs… but they are both nitrogen, so this would not be able to participate in linkage isomerism.



No. This has two issues, one is that the lone pairs are on two different atoms, but they are both nitrogen. Secondly this is ethylenediamine, which is long enough to form a bidentate ring on the metal.



Yes. Again, two different atoms with lone pairs, but too small to form a ring.



No. It is only made up of one atom.

6. Draw all the geometric isomers of $Pt(CN)_2Br_2(H_2O)_2$. Which of these isomers has an optical isomer? Draw the various optical isomers.

Keep in mind that the isomers that you draw may not look exactly like mine… which is fine. What you do in order to determine if what you drew was actually an isomer and if they relate to the ones illustrated here is to look at the relationships in each.

Examine the relationships in each

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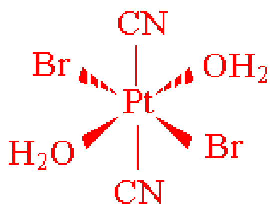
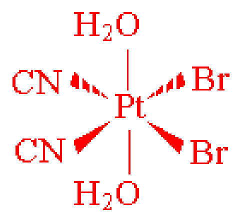
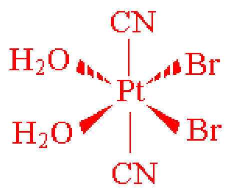


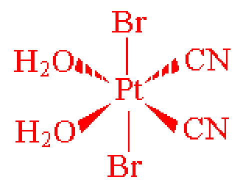
All ligands are trans.



H_2O are trans and
Br and CN are cis

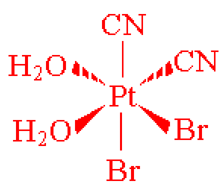


The CN ligands are trans
and the Br and H_2O are cis.

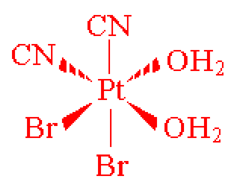


The Br ligands are trans
and the CN and H_2O are cis.

There is only one optically active isomer:



All ligands are cis.



This is the optical isomer
(non-super imposable mirror image.

7. How do you know if a complex ion, with tetrahedral geometry, is optically active?

   The metal has four different ligands attached.

8. In order for a molecule to be optically active it must be chiral.

9. In order to be chiral a molecule must have a non-super imposable mirror images.

10. Chiral isomers are called enantiomers.

11. An isomer that rotates plane polarized light to the left is called levorotary (l).

An isomer that rotates plane polarized light to the right is called dextrorotary (d).

12. What is a racemic mixture?

A 50/50 mixture of d/l enantiomers. This type of mixture results in no rotation of plane polarized light (they negate each other).

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