Hello everyone, myself Ms. Unnati Ulhas Sinari, Assistant Professor of Chemistry from Government College of Arts, Science and Commerce Khandola - Marcela Goa,
I'm going to take module entitled as Stereo-isomerism: Geometric isomerism under the topic coordination chemistry

The outline of the module goes as stereoisomerism under Geometrical isomerism we are going to see Geometrical isomerism in square planar complexes and Geometrical isomerism in octahedral complexes

The learning outcomes of this module, .i.e. after this module students will be able to understand the geometrical isomerism for square planar and octahedral coordination compounds.
They will also be able to deduce the geometrical isomers of different coordination compounds.
They start with the module. Before starting with the Geometrical isomerism, we must know what you mean by stereoisomerism.
Stereoisomerism is a phenomena shown stereoisomers and it nothing but the Compounds which have the same position of atoms or groups i.e. same connectivity but differ in 3 dimensional arrangements around the central atom which gives 2 types of stereoisomerism which are geometrical isomerism and optical isomerism.

In this module we are going to see geometrical isomerism in coordination compounds. As I earlier said geometrical isomerism is observed because of ligands occupying the different positions around a central metal ion.

Complexes in which same two ligands occupy positions adjacent to each other i.e. nothing but if the ligands are 90° apart, those compounds are termed as cis-isomers.
Whereas the complexes in which like ligands occupy the position opposite to each other that is 180 degree apart are termed as trans isomers.

Geometrical isomerism is not shown by complexes having coordination number 2, 3 and tetrahedral complexes because in these arrangements all the positions are adjacent to each other.
Geometrical isomerism commonly occur in for coordinated square planar complexes and six coordinated octahedral complexes.

Now we will see geometrical isomerism in square planar complexes.
The square planar complexes having the general formula MA_4, MA_3B and MAB_3 where M stands for metal ion and A and B stands for Monodentate ligands doesn't show geometrical isomerism as all arrangement for any of these complexes are equivalent again.

However, we will see which are the square planar complexes, what type of square planar complexes are showing the geometrical isomer.
MA_2B_2 Type complexes have a tendency to show to show cis and trans isomer.
Here you can see the all A type of ligands lie adjacent to each other.

Where in trans isomer A type of ligands opposite to each other. Here are the some of the examples of MA_2B_2 type compounds.
Second type is MA_2BC Type this type of complex is also shows cis and trans isomer with respect to like ligands
If like ligands are adjacent to each other, the isomer is termed as cis isomer whereas in trans isomer like ligands lie opposite to each other. Here is the one of the example of such type.

The third type of square planar complexes is MABCD where all four ligands are of different types.
This type of complexes show total three types of different geometrical isomer.
Which can be found out by placing the fixed position for one ligand and place remaining with respect to it.
If we fix the position of A ligand and then place the remaining three with respect to that we can get all three geometrical isomers for this type of complexes. Here is the one of the example of it.

The next is $M(ab)_2$ type of complexes where ab stands for unsymmetrical bidentate ligand.
Here is one of the example of platinum complex. So this type of complexes also show two isomers i.e. ci and trans isomer. In cis isomer you can see the oxygen of the glycine are adjacent to each other as well as nitrogen of both the molecules are adjacent to each other.
Whereas over here in trans isomer the Nitrogens are opposite to each other as well as oxygens opposite to each other.

The next type is square planar complexes having bridged ligands for example $M_2A_2X_4$ type where X is a Monodentate ligands and it also have a tendency to act as a bridging ligand. For example halogens.
So this type of complexes show total three types of geometrical isomer termed cis isomer, trans isomer, and unsymmetric isomer where isomers are named with respect to ligand A which is a simple Monodentate ligands.
So in the cis isomer, like ligands are placed adjacent and in trans isomer they are opposite, whereas in unsymmetric isomer ligand A are attached to only one metal. One of the example of this type of complexes is given over here.

Now we will see geometrical isomerism in octahedral complexes.
The complex is having MA_6, MA_5B and MAB_5 doesn't show geometrical isomerism as all possible arrangement for any these complexes are equivalent.

The octahedral complexes having the formula such as MA_4B_2 MA_2B_4 and MA_4BC type of complexes shows two types of geometrical isomer that is cis isomer and trans isomer.
Here in cis form is labeled by saying the two different types of isomer are adjacent or if they are trans to each other in the trans isomer.
Over here ligand B and C are adjacent to each other as this one is the cis isomer. Whereas in these two structure you can see that these are opposite to see has these two structures are trans isomers.

Here is her other two examples of them.
The second type is MA_3B_3 type of octahedral complexes, so this type of complexes will also show

two isomers that is cis and trans.

In Cis form, like ligands occupy the corners of one of the triangular faces of the octahedron hence it is also termed as fac or facial isomer. Whereas in Trans form, like ligands are at the corners of the square plane hence it is termed as meridional or mer isomer.

So here are the structures of MA_3B_3 type or geometrical isomer for this type of complex.

In Cis isomer over here can see the liagnds B form's one of the triangular plane of the octahedral where in trans or mer form only form the triangular plane of the octahedron.

Here are some of the examples of this.

Next, type of the octahedral complexes is MABCDEF where all the ligands are different and all are monodentate ligands. This type of complexes have a tendency to show around 15 geometrical isomers.

Since till date only one complex of this type is recorded. This is the example of that complex and of this complex, only three different isomers can be isolated. Practically, all 15 is almost cannot be isolated. Out of 15 only three different isomers of this complex can be practically isolated.

The next type of the complexes is $[M(ab)_2CD]$, $[M(ab)_2C_2]$, $[M(ab)_3]$ type. Where ab stands for unsymmetrical bidentate ligand. For example glycine complex of Chromium.

And the same rule can be applied for remaining two types of complexes. These type of complexes will also show two types of geometrical isomers i.e. cis isomers and trans isomers.

Here you can see this nitrogen and this nitrogen are adjacent to each other. Hence this is a cis isomer. whereas over here a nitrogen and nitrogen are opposite to each other as they are in trans isomer.

OK,

Here are the some of the references of the module you can read are Principles of inorganic chemistry by Puri Sharma and Chemistry for degree students by RL Madan.

Thank you.