This is for the students studying chemistry at the third year Bachelor of Science Semester 6. The course is Inorganic Chemistry, Section B, and the Course Code is CHC109.

I am Isabel de Noronha from St Xavier's College, Mapusa Goa. I am going to take up two factors,
Steric Effect and ***Forced Configuration*** in the module, **Factors Affecting the Stability of Metal Complexes** under the unit “Reaction Kinetics and Mechanism”.

Under ***Steric Effect*** we will see what is meant by steric hindrance and how it affects the stability of a complex.

Under the factor ***Forced Configuration*** we will see how ligands impose configurations upon the metal ion
that affects the stability of a complex.

At the end of this module, the students will be able to account for steric effect in a complex; explain how steric effect can lessen the stability of complexes from the examples cited; and explain how ligands can impose configurations, other than the expected ones, on metal ions that weaken the stability of the complex.

So to begin with, ***the factors affecting the stability of metal complexes***… Let us first take up the factor **Steric Effect**: When a bulky group is either attached to or is present near a donor atom, it causes mutual repulsions among the ligands, resulting in weakening of the metal-ligand bond. This strain to the molecule because of bulky ligands is known as steric hindrance and the effect is known as **steric effect.**

We can see this in the nickel complex with 8-hydroxyquinoline and its derivatives, namely, 2-methyl-8- hydroxyquinoline, and 4-methyl-8- hydroxyquinoline.

When Ni^{2+}complexes with these ligands it is seen that the complex formed with 2-methyl-8-hydroxyquinoline is the least stable as compared to that formed with 8-hydroxyquinoline or 4-methyl-8- hydroxyquinoline. This is because in 2-methyl-8-hydroxyquinoline, the bulky methyl group is present near the nitrogen atom which is the donor site for bonding with the metal ion. Now, compared to 2-methyl-8-hydroxyquinoline, the 4-methyl derivative also contains a methyl group. But this methyl group is far away from the donor nitrogen site and hence does not interfere in the complexation of the ligand with the metal. Hence, the complex of 4-methyl-8-hydroxyquinoline is most stable as compared to the complex formed with 2-methyl-8-hydroxyquinoline.

Another example is that of ethylene diamine which forms more stable complexes than that of its tetramethyl derivative, namely, tetramethyl ethylene diamine. This is so because in tetramethyl ethylene diamine, the two hydrogen atoms on either side of nitrogen are replaced by the bulky methyl groups,
which makes complexes with tetramethyl ethylenediamine less stable.

The strain in the complexes with large ligands is sometimes due to the geometry of the ligand coupled with the stereochemistry of the complex.
For example, triethylene tetraamine, also known as trien, forms more stable complexes as compared
to triamino triethylenamine, also known as tren. This is so because trien is a straight chain amine and can
coordinate through its four nitrogen atoms at the corners of the square, whereas trien is a branched
chain amine which is unable to assume the preferred square planar geometry. Hence, trien forms more stable complexes with Cu^{2+} than trien. And here is the complex that it forms because of the nature of the ligand.

The next factor is F**orced configuration.**

We have ligands like porphyrin and phthalocyanine, which have completely fused planar ring system and they form very stable complexes with metal ions that tend to give planar complexes.

For example, the Cu^{2+}complex with phthalocyanine is a very stable complex formed. Similarly, we have just seen under steric effect, how trien also forms very stable complexes with Cu^{2+}.

Now there are certain stereochemical requirements of the ligand that sometimes impose certain configurations on the metal ion, and this may, in some cases, lead to a stable complex formation or in other cases a less stable or an unstable complex formation.

So, these polydentate ligands impose certain planar configurations even on metal ions that have no tendency to form planar complexes with unidentate ligands.

For example, Beryllium and zinc ions, we know, form tetrahedral complexes with monodentate ligands. But with polydentate ligands they are forced to assume a square planar configuration.

If we see in this example… when beryllium complexes with ammonia, it forms the tetrahedral complex. But with a polydentate ligand like trien, it is forced to assume a square planar configuration, and this square planar configuration makes this entire complex less stable because it induces certain strain on the beryllium atom.

Hence, to summarize:

We have seen two factors in this module, namely Steric Effect and Forced Configuration:

Under ***steric effect*** we have seen what is meant by steric hindrance and how steric hindrance caused due to bulky ligands weakens the metal ligand bond, making the complex unstable.

We have also seen that the strain in the complexes with large ligands is sometimes due to the geometry of the ligand coupled with the stereochemistry of the complexes.

Under the factor ***Forced configuration***, we have seen how polydentate ligands can force configurations
upon metal ions other than the expected configurations that decrease the stability of the complex.

Here are some references for you.

Happy learning. Thank you.