

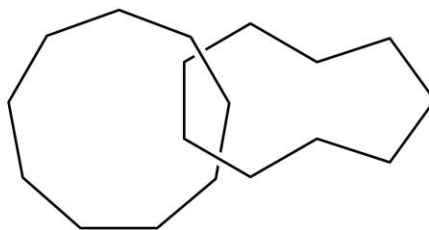
❖ Catenanes and Rotaxanes

Besides the addition compounds, some compounds contain two or more sovereign parts which are linked but without any valence forces. A more general discussion on these two types of organic compounds is given below.

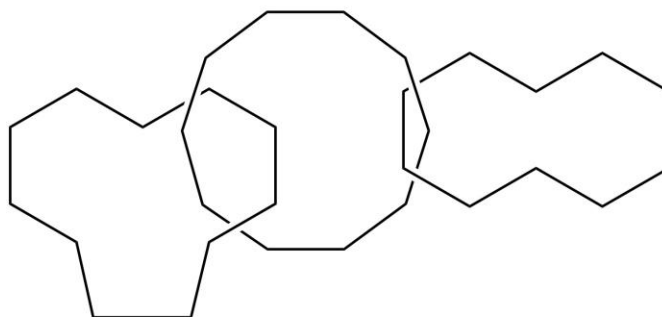
➤ Catenanes

A catenane may simply be defined as a mechanically interlocked molecular construction that is consisted of two or more macrocycles, i.e. a molecular assembly having two or more intertwined cycles.

These interlocked cycles cannot be parted without the cleavage of covalent bonds of one of the macrocycles. These compounds are obtained their name from the Latin word 'catena' which literally means 'the chain'. Catenanes can be abstractly associated with other mechanically interlocked molecular constructions, like rotaxanes, molecular Borromean rings, or molecular knots.



A [2]-Catenane



A [3]-Catenane

In recent years, the term "mechanical bond" has been devised that defines the correlation between the macrocycles of a single catenane.

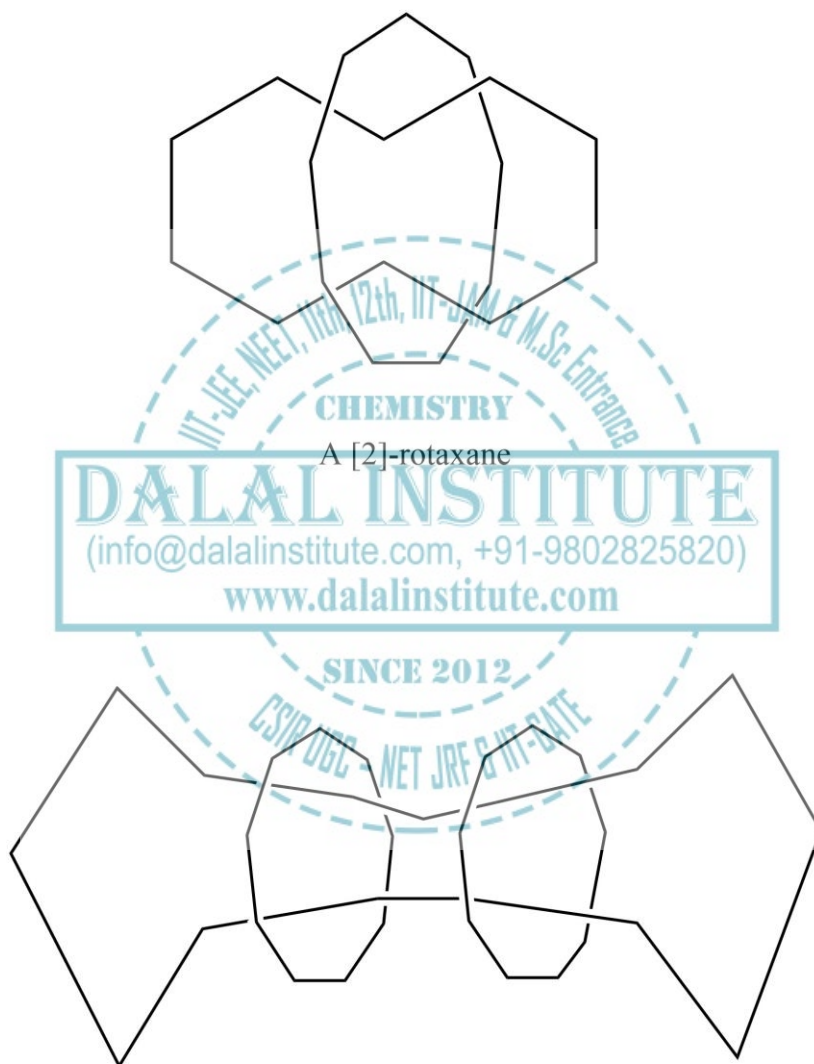
Catenanes can be synthesized via two different routes; the first one is the statistical synthesis, whereas the second one is called as the template-directed method. The first approach is to simply carry out a ring-closing reaction and hoping that some of the reactant will be generated around other cyclic system yielding the required catenane product. This approach is very inefficient, needing high dilution of the closing ring and a huge excess of the pre-formed ring, and therefore, this method is used in rare cases.



The 2nd approach depends upon the supramolecular preorganization of the macrocyclic reactants by employing properties like metal coordination, hydrogen bonding, coulombic interactions, or hydrophobic effect.

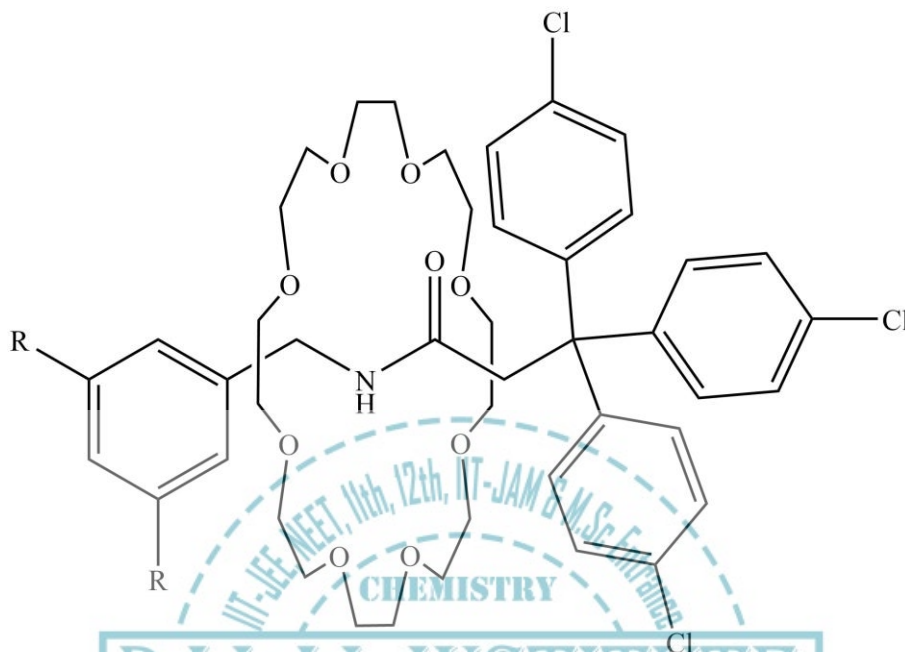
➤ **Rotaxanes**

A rotaxane may simply be defined as a mechanically interlocked molecular assembly that is consisted of a dumbbell-shaped molecule, which is threaded through a macrocycle. These compounds got their name from the Latin word wheel (rota) and axle (axis). Rotaxane's two components are kinetically trapped because the dumbbell's ends are bigger than the internal diameter of the cycle, and therefore, forbid the dissociation of the components as it would need a huge magnitude of distortion of the covalent interactions.



Also, most of the research about rotaxanes has been focused on their efficient preparation or their use as artificial machines at the molecular level.

Nevertheless, many rotaxane examples have been found in naturally occurring substances like peptides (i.e. cyclotides or lasso-peptides and cystine knot peptides).



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A [2]-rotaxane formed by
crown ether

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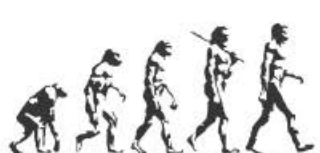
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A TEXTBOOK OF ORGANIC CHEMISTRY

Volume I

MANDEEP DALAL



First Edition

DALAL INSTITUTE

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