

5.8: Meso Compounds

A meso compound is an achiral compound that has chiral centers. It is superimposed on its mirror image and is optically **inactive** although it contains two or more stereocenters.

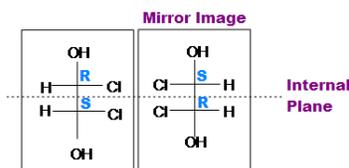
Introduction

In general, a meso compound should contain two or more identical substituted stereocenters. Also, it has an internal symmetry plane that divides the compound in half. These two halves reflect each other by the internal mirror. The stereochemistry of stereocenters should "cancel out". What it means here is that when we have an internal plane that splits the compound into two symmetrical sides, the stereochemistry of both left and right side should be opposite to each other, and therefore, result in **optically inactive**. Cyclic compounds may also be meso.

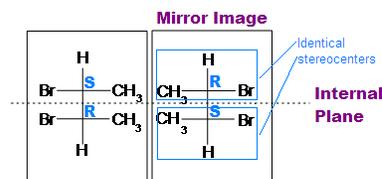
Identification

If A is a meso compound, it should have two or more stereocenters, an internal plane, and the stereochemistry should be **R and S**.

1. Look for an internal plane, or internal mirror, that lies between the compound.
2. The stereochemistry (e.g. R or S) is very crucial in determining whether it is a meso compound or not. As mentioned above, a meso compound is optically inactive, so their stereochemistry should cancel out. For instance, R cancels S out in a meso compound with two stereocenters.

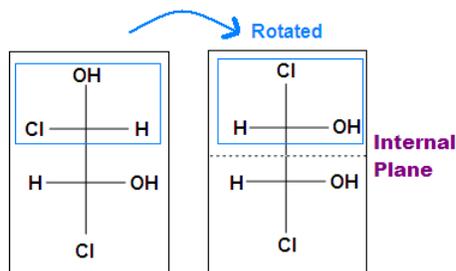


trans-1,2-dichloro-1,2-ethanediol

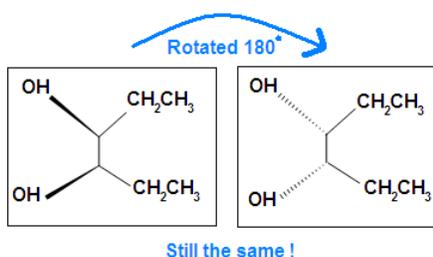


(*meso*)-2,3-dibromobutane

Tips: An interesting thing about single bonds or sp^3 -orbitals is that we can rotate the substituted groups that attached to a stereocenter around to recognize the internal plane. As the molecule is rotated, its stereochemistry does not change. For example:

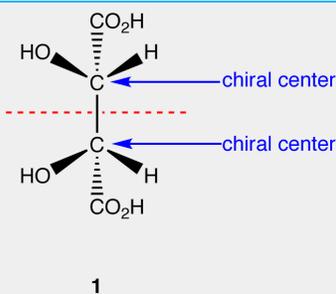


Another case is when we rotate the whole molecule by 180 degree. Both molecules below are still meso.



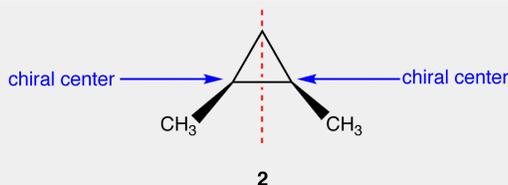
Remember the internal plane here is depicted on two dimensions. However, in reality, it is three dimensions, so be aware of it when we identify the internal mirror.

Example 1



1 has a plane of symmetry (the horizontal plane going through the red broken line) and, therefore, is achiral; 1 has chiral centers. Thus, 1 is a meso compound.

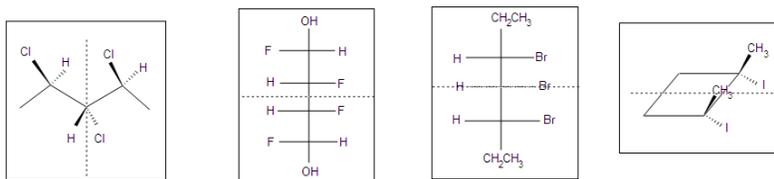
Example 2

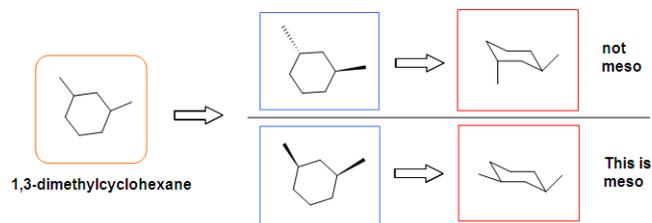


This molecule has a plane of symmetry (the vertical plane going through the red broken line perpendicular to the plane of the ring) and, therefore, is achiral, but has two chiral centers. Thus, it is a meso compound.

Other Examples of meso compounds

Meso compounds can exist in many different forms such as pentane, butane, heptane, and even cyclobutane. They do not necessarily have to be two stereocenters, but can have more.



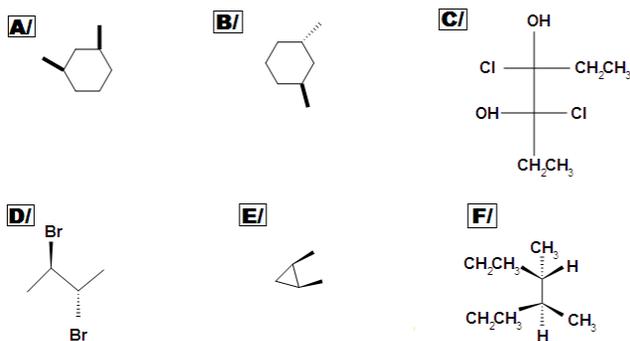


Optical Activity Analysis

When the **optical activity** of a meso compound is attempted to be determined with a polarimeter, the indicator will not show (+) or (-). It simply means there is no certain direction of rotation of the polarized light, neither levorotatory (-) and dextrorotatory (+).

Problems

Beside meso, there are also other types of molecules: enantiomer, **diastereomer**, and identical. Determine if the following molecules are meso.



Answer key: A C, D, E are meso compounds.

Contributors

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