Semester-I (Hons)

Organic chemistry Notes

STEREOCHEMISTRY

by
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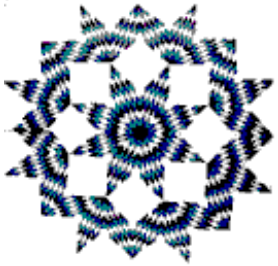
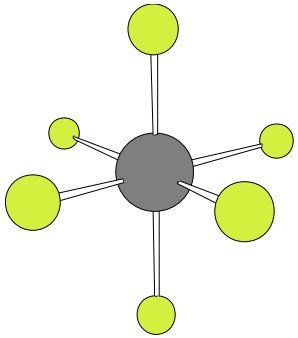
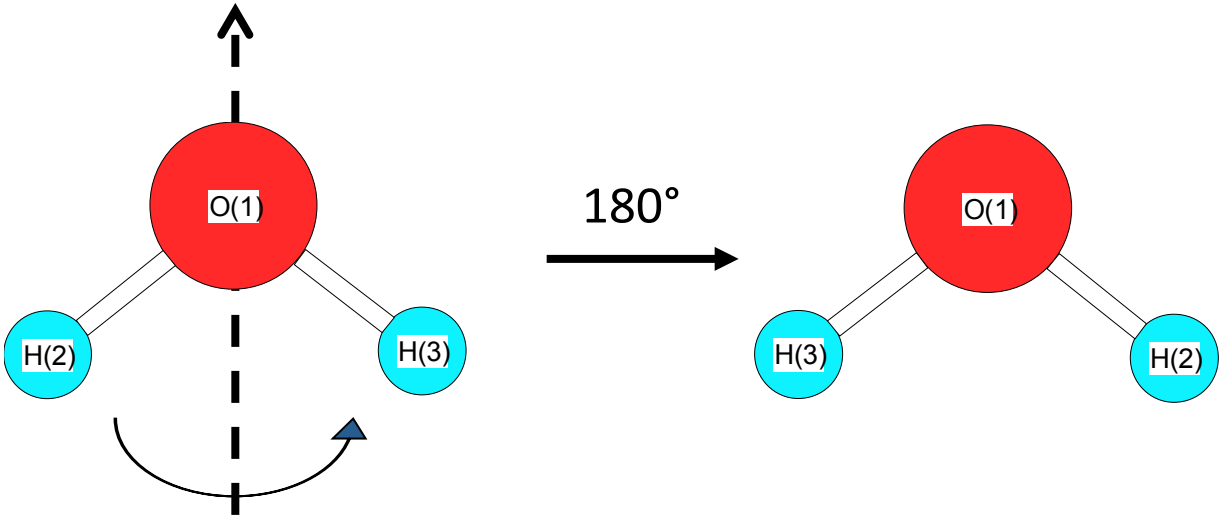
NATURE prefers SYMMETRY

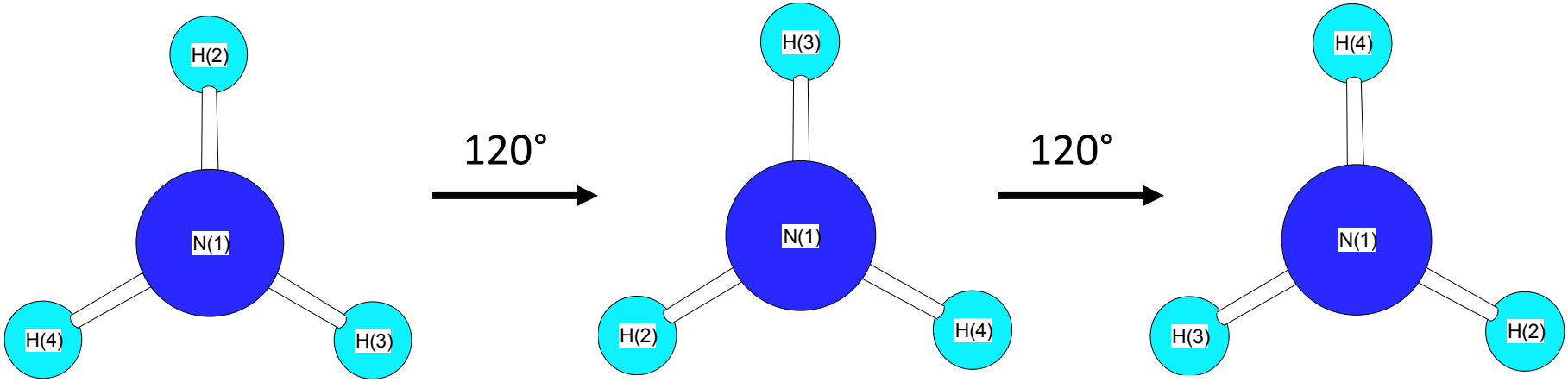



Element	Operation
Rotation axis, C_n	n-fold rotation
Improper rotation axis, S_n	n-fold improper rotation
Plane of symmetry, σ	Reflection
Center of symmetry, i	Inversion
	Identity, E

n-fold rotation - a rotation of 360°/n about the C_n axis (n = 1 to ∞)

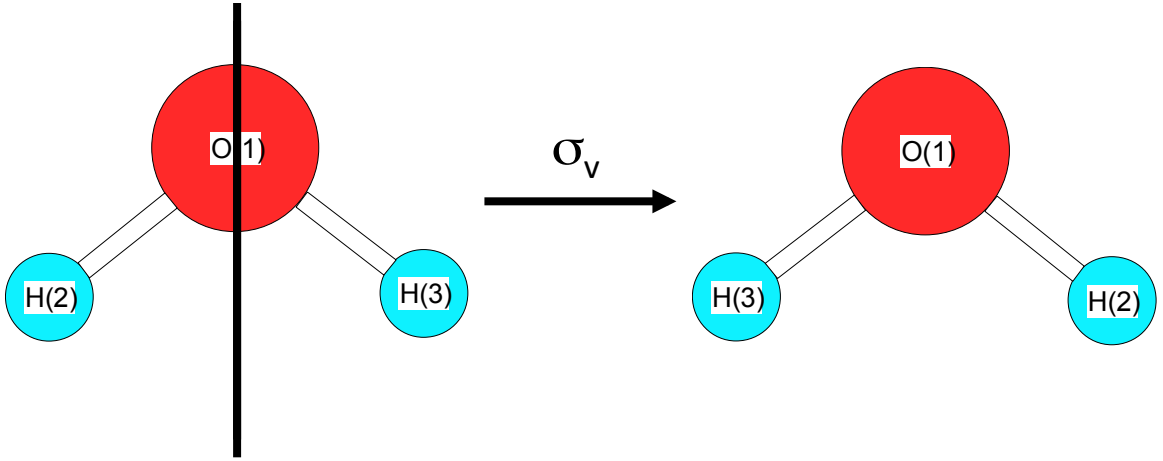


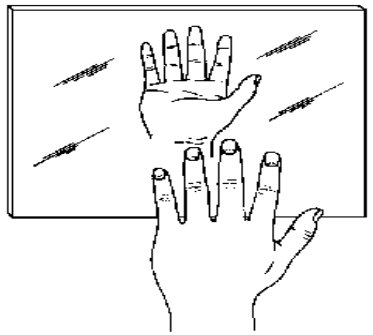
In water there is a C_2 axis so we can perform a 2-fold (180°) rotation to get the identical arrangement of atoms.



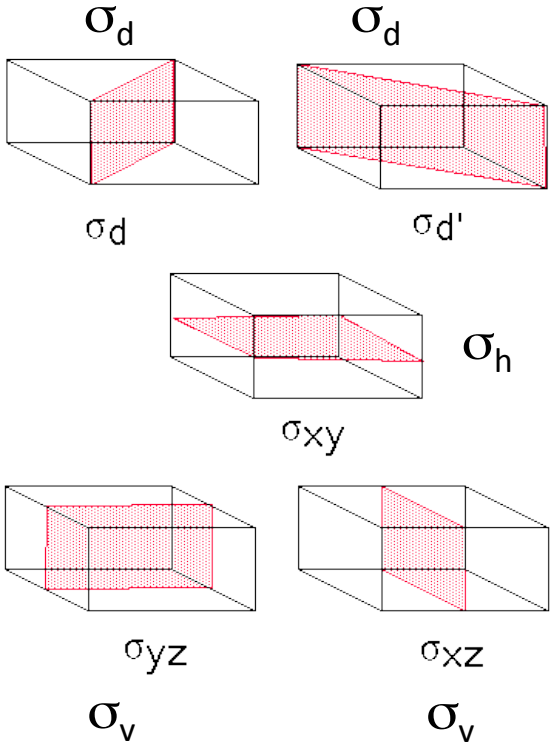
In ammonia there is a C_3 axis so we can perform 3-fold (120°) rotations to get identical arrangement of atoms.

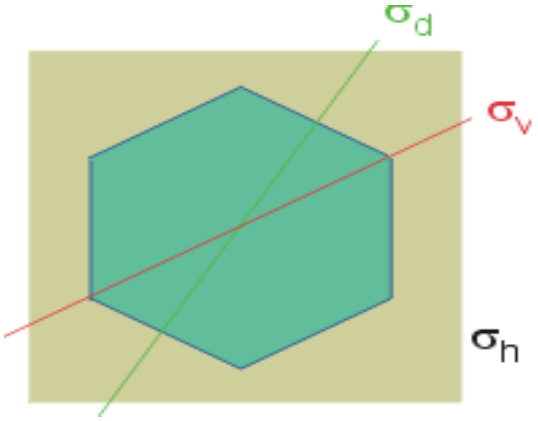
Reflection across a plane of symmetry, σ (mirror plane)

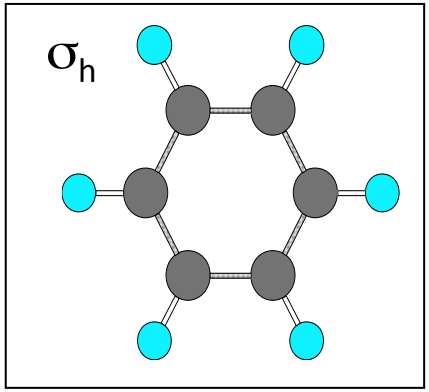


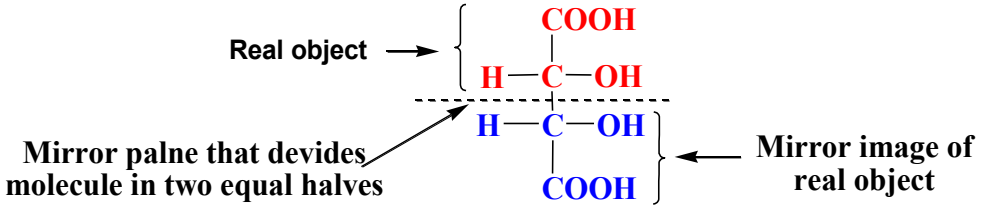


Reflection planes may be vertical, horizontal or dihedral (more on σ_d later)





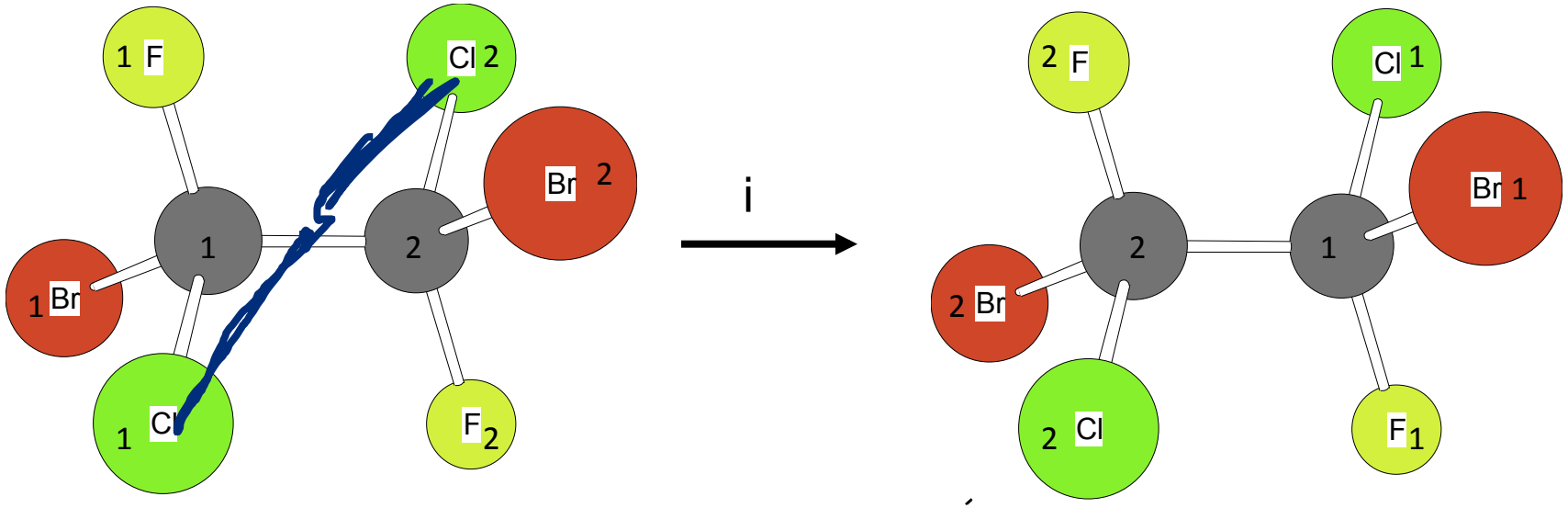


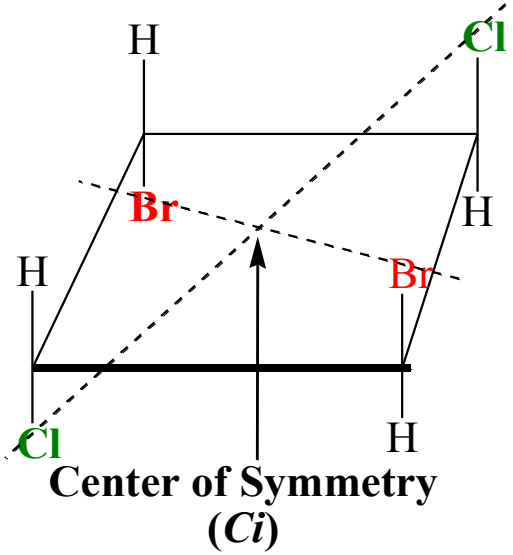


2,3-dihydroxysuccinic acid
(Tartaric acid)

Inversion and centers of symmetry, i (inversion centers)

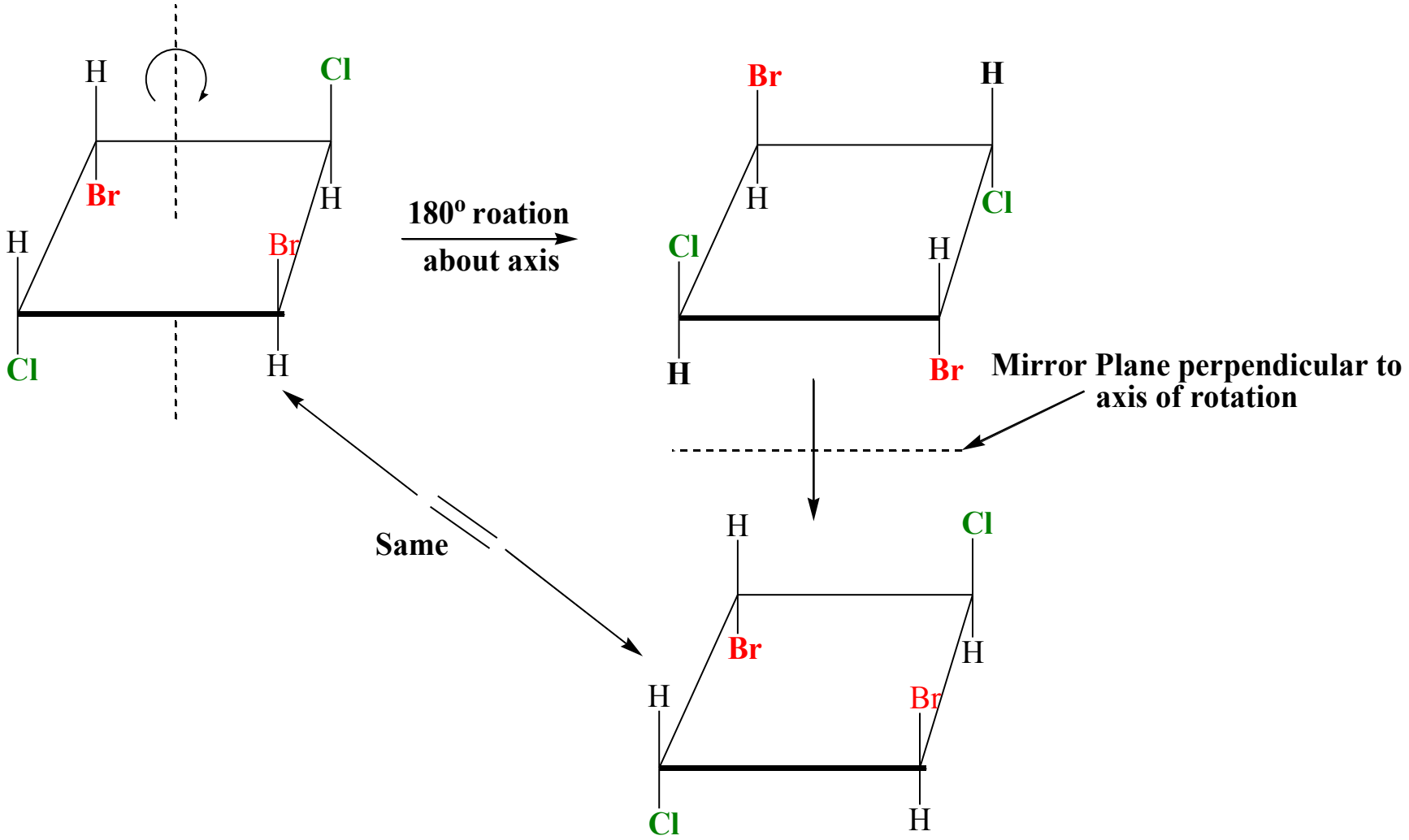
In this operation, every part of the object is reflected through the inversion center, which must be at the center of mass of the object.





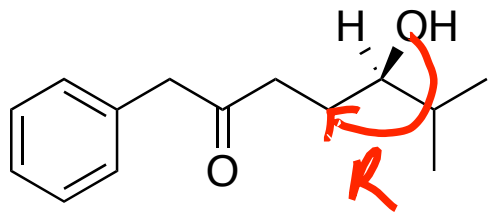
n-fold improper rotation, S_n (associated with an improper rotation axis or a rotation-reflection axis) This operation involves a rotation of 360°/n followed by a reflection perpendicular to the axis.

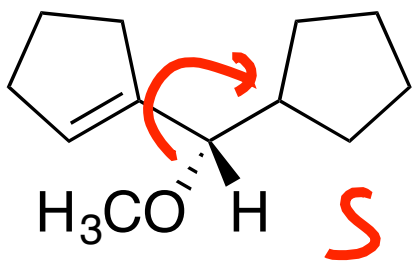
Alternating axis of symmetry Cn+Sigma v

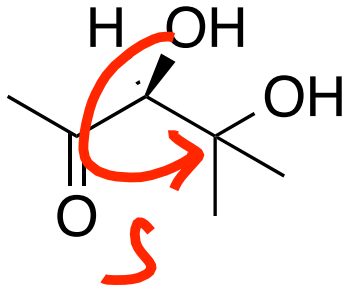


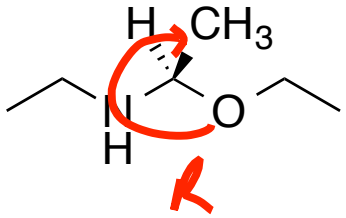
Problems-Answers

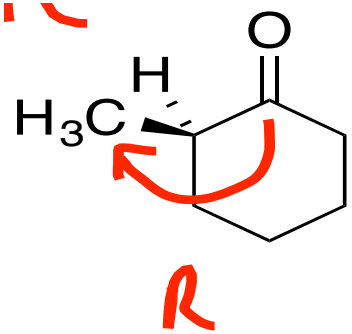
Designate the R/S configuration for any chiral centers in the following molecules

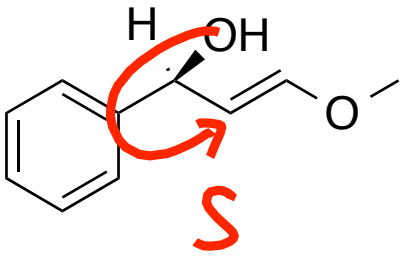


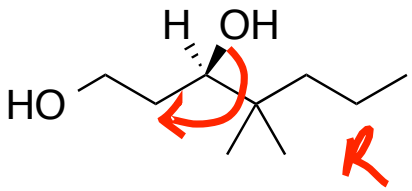


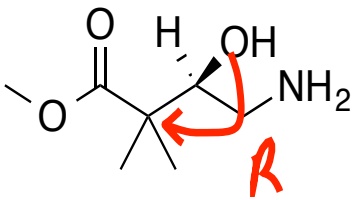




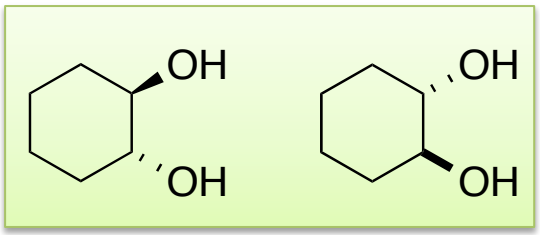




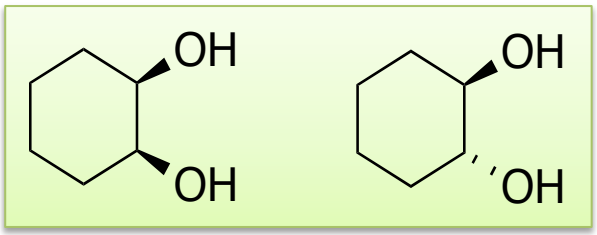




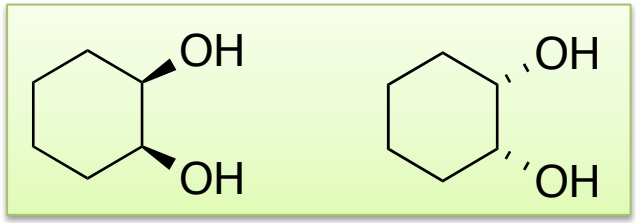
Mark the relationships between the following structures as either "same", "enantiomers", or "diastereomers"



Mirror/ Enantiomers



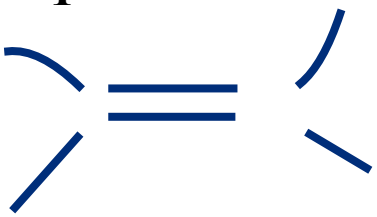
Diastereomers

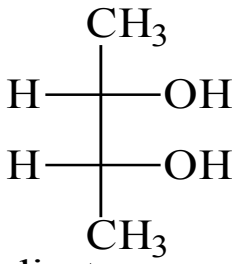


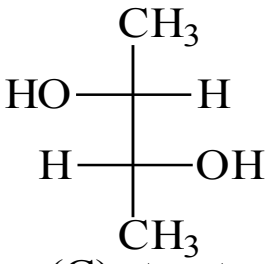
Mirror but Same/ Meso

The relationship between the following two structures is:

1







(A) enantiomers (B) diastereomers (C) structural isomers
(D) identical (E) none of the above

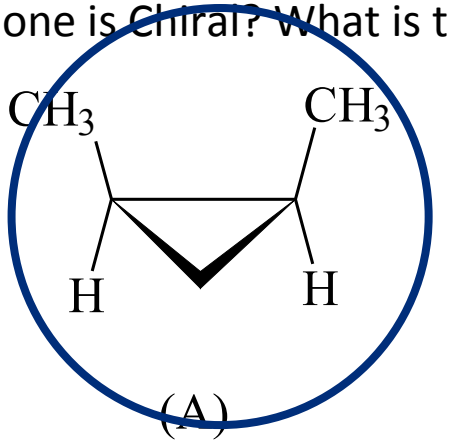
The specific rotation of pure (R)-2-butanol is -13.5°. What % of a mixture of the two enantiomeric forms is (S)-2-butanol if the specific rotation of this mixture is –5.4° ?

2

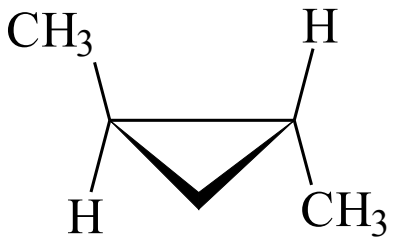
(A) 40% (B) 30% (C) 60% (D) 70% (E) None of the above

Which one is Chiral? What is the relationship between (A) and (B?)

3



(A)



(B)