

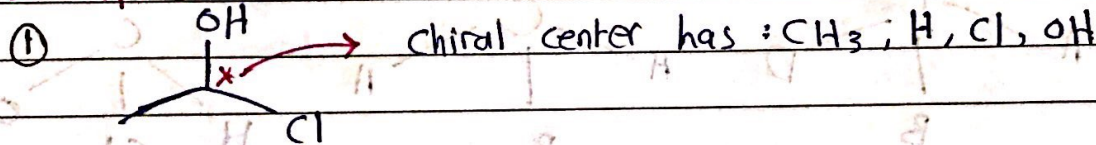
Chapter "5": Stereoisomerism

* Stereochemistry = branch of chemistry that deals with arrangements of atoms in the space.

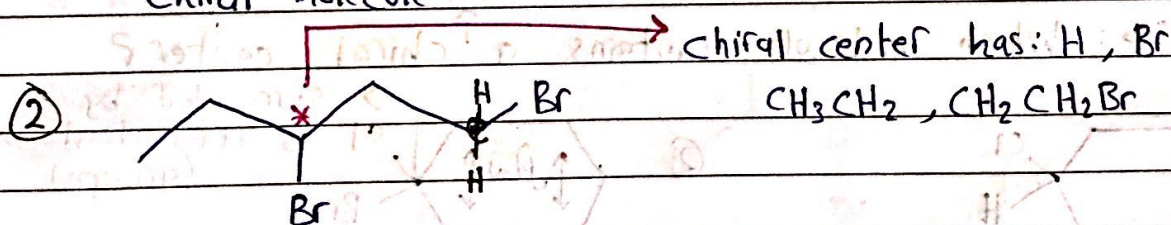
5.1 + 5.2:

* Chiral molecule: is defined as a molecule that contains at least one chiral center, but what is the chiral center? It is a sp^3 carbon that has 4 different atoms (or groups)

Examples:



Chiral molecule



→ Don't look just on adjacent atoms, look on the whole chain.

→ The molecule is chiral since it has 1 chiral center (also called stereogenic center)

* Chiral molecule can be defined as :

a molecule that has no plane of symmetry

* لا يمكن أن نقسم المركب إلى جزئين متماثلين ، ولأنه من السهولة
أن نجد المركب (chiral) من خلال العتق عن (chiral center)

no space

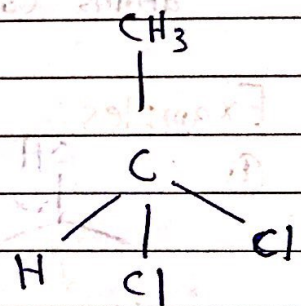
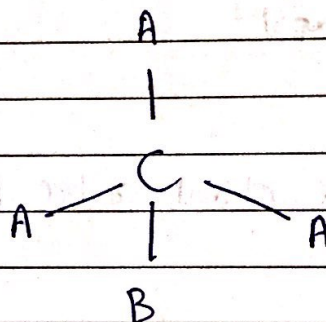
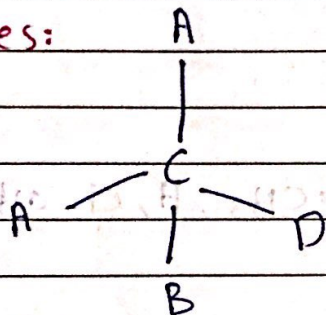
* achiral molecule can be defined as :

a molecule that has no chiral center

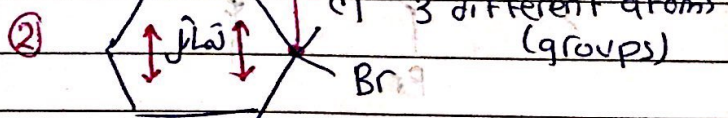
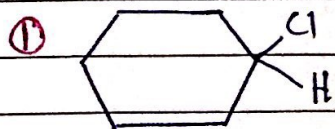
(No sp^3 carbon that has 4 different atoms (groups)).

OR molecule that contains plane of symmetry.

Examples:

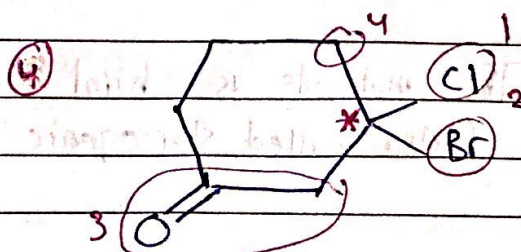
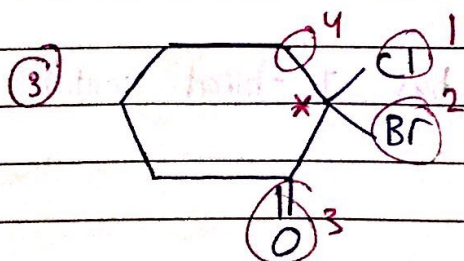


Exercise: Which molecule contains a ^{space} chiral center?



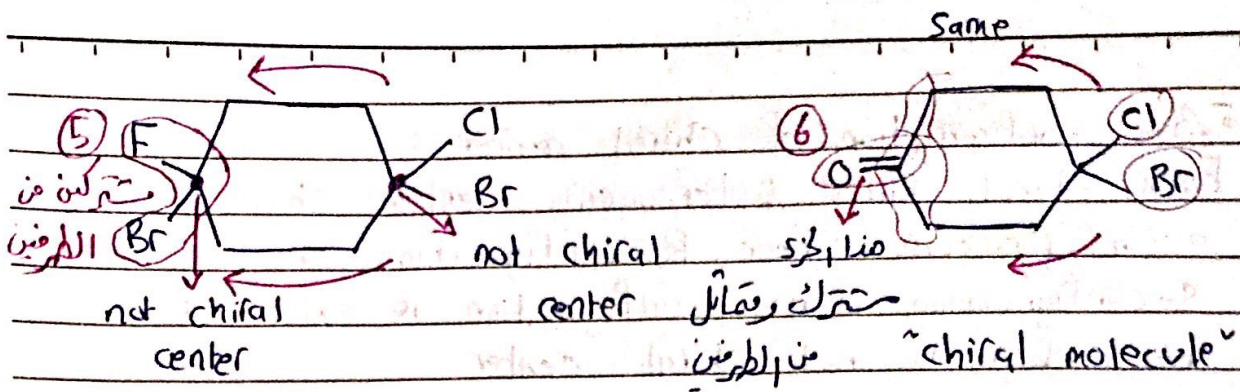
~ no chiral center
achiral molecule ~

~ no chiral center
achiral molecule ~

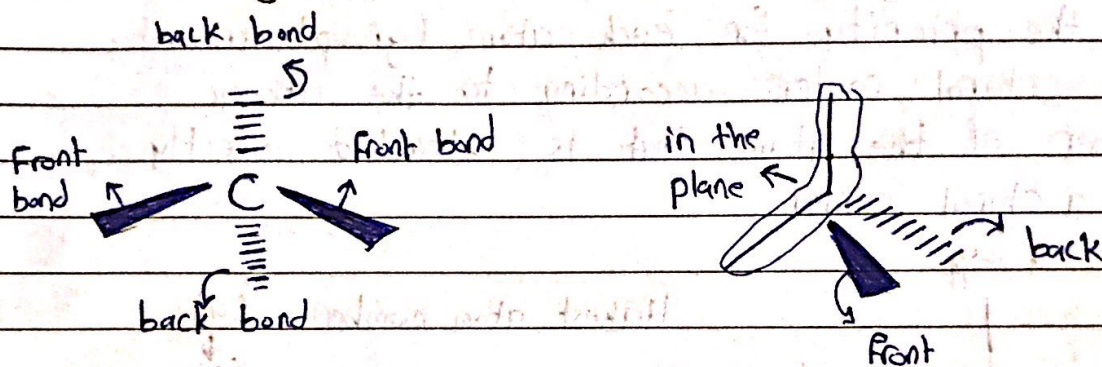


~ chiral molecule ~

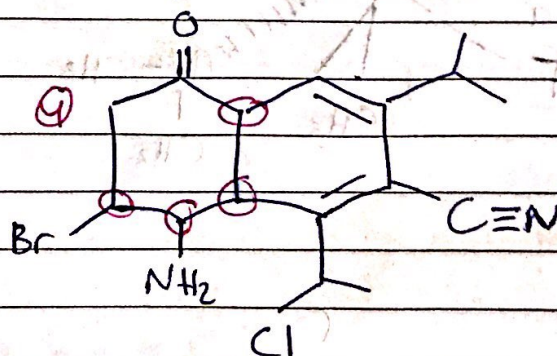
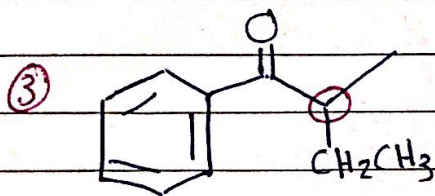
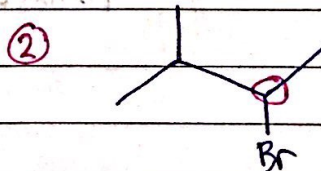
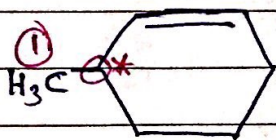
~ chiral molecule ~



Notes: Drawing of σ -bonds in the space of 3-Dimension



* Assign chiral center (s) in the following :



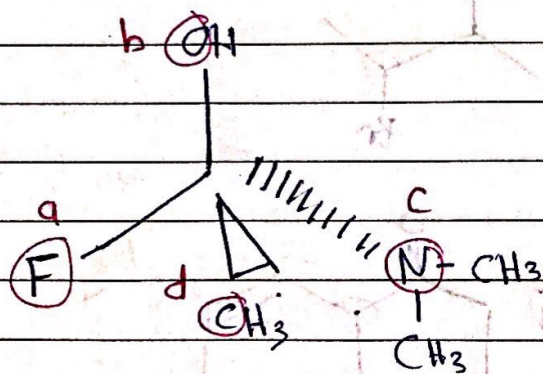
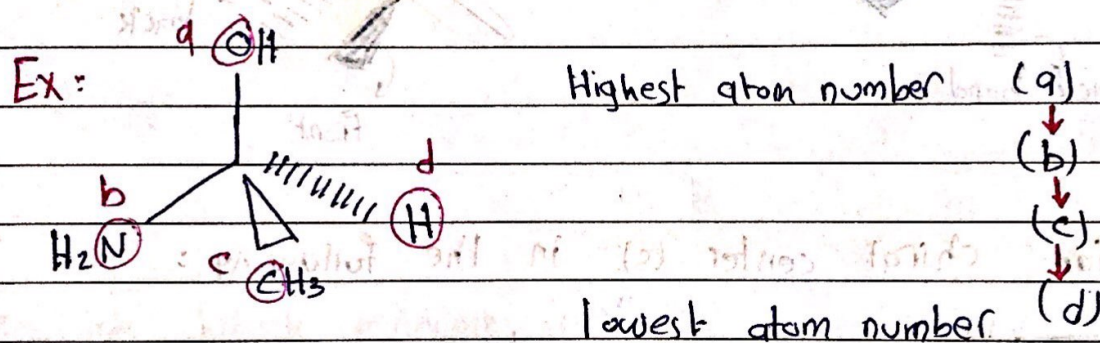
All of these molecules are chiral molecules.

5.3: Configuration of chiral center:

Each chiral center (stereogenic center) should have a configuration either R-configuration or S-configuration, no configuration is exist if the carbon is not chiral center.

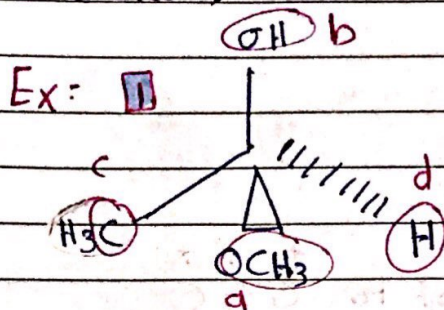
- Rules to assign the configuration:

- ① Give the priority for each atom (group) around the chiral center according to the atomic number of the atom that is attached directly to a chiral center

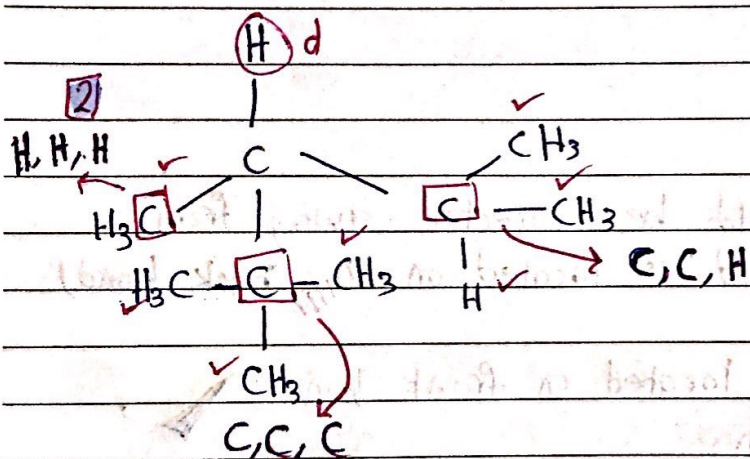
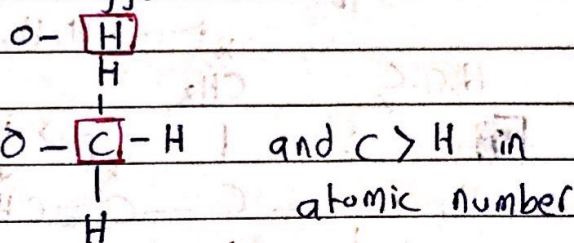


Rule

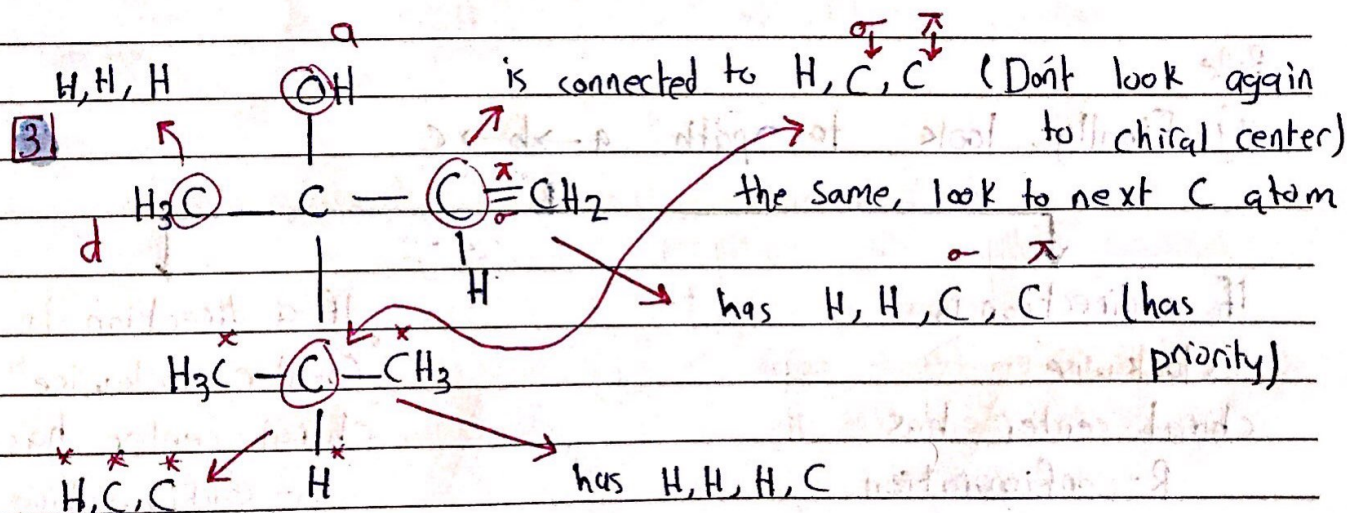
② IF 2 atoms that attached directly to a stereogenic center are identical $\Rightarrow$ observe the 1st point of difference.

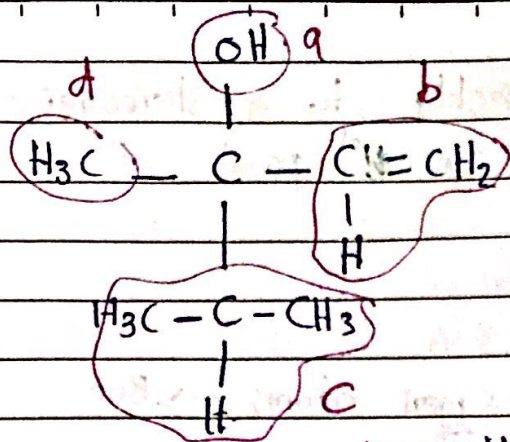


Some oxygen atoms $\Rightarrow$ But

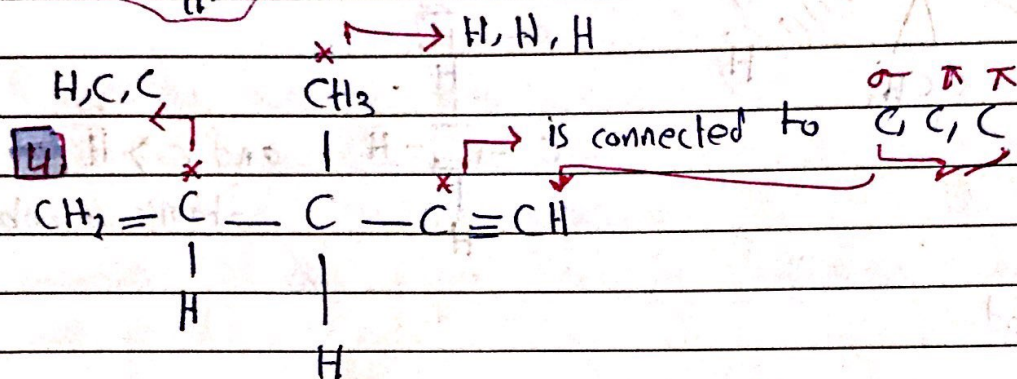


all carbons are identical $\Rightarrow$ go to adjacent atoms





You can check page 155.



③ The group (d) should be directed away from us (it means group (d) is located on "back bond")

But, if group (d) is located on front bond, invert the configuration

Rule

④ Finally, look to path $a \rightarrow b \rightarrow c$

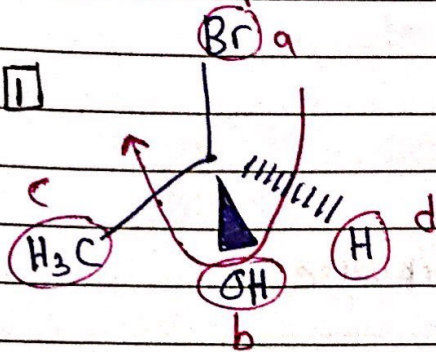
If a direction is "clock wise"
 chiral center has
 R-configuration.

If a direction is "counter clock wise"
 chiral center has
 S-configuration

* These rules are called Cahn-Ingold-Prelog.

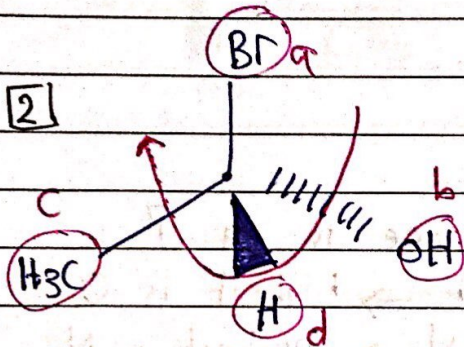
More Examples:

[1]



clockwise $\Rightarrow$ R-configuration

[2]



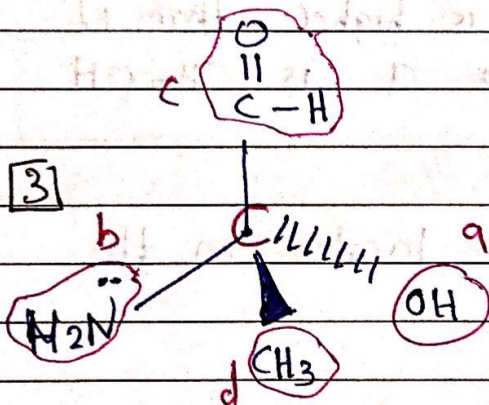
clockwise $\Rightarrow$ R-configuration

but (d) is located on front bond

$\Downarrow$
The final configuration is
S-configuration

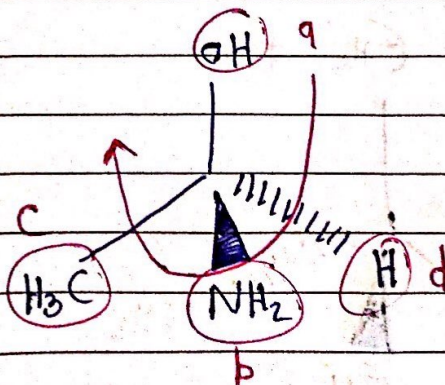
Final answer $\leftarrow$

[3]



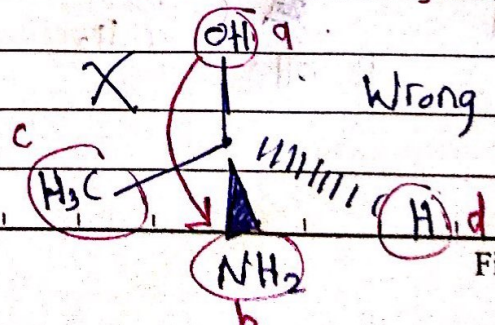
clockwise $\Rightarrow$ R-configuration
of chiral center

[4]

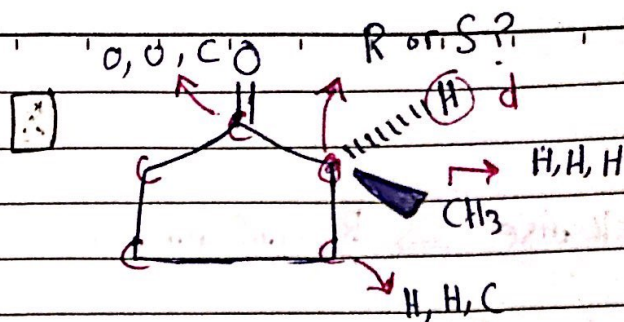


clockwise $\Rightarrow$ R-configuration

Important note: You can go
from $a \rightarrow b \rightarrow c$ "through
d but not through c"

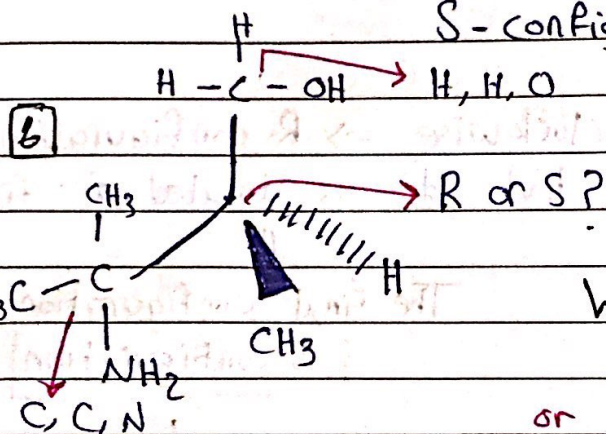


Five Apple



$a \rightarrow b \rightarrow c \Rightarrow$ counter clockwise

S-configuration



Which one is a?

$H, H, O \Rightarrow$ highest is O

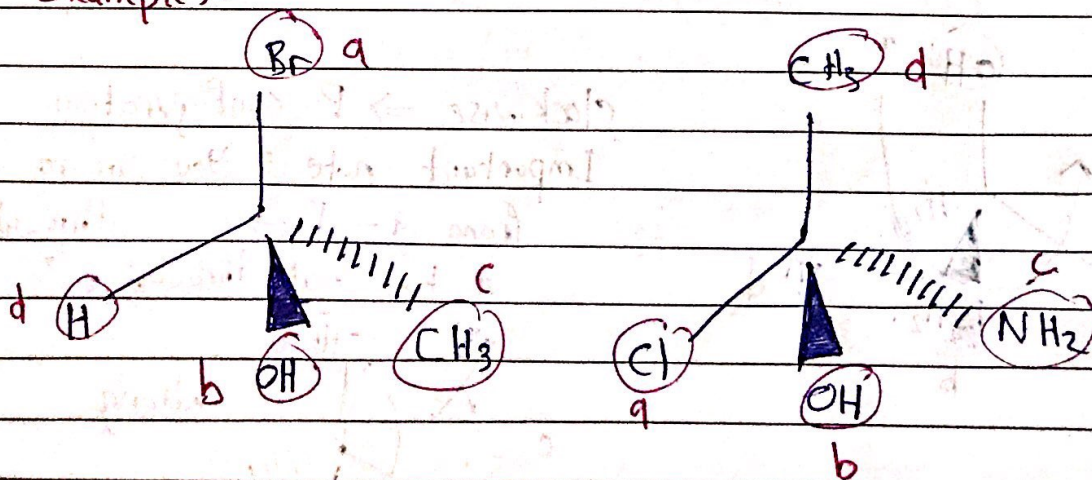
or $C, C, N \Rightarrow$ highest is N

O is higher than N

So a is CH_2OH

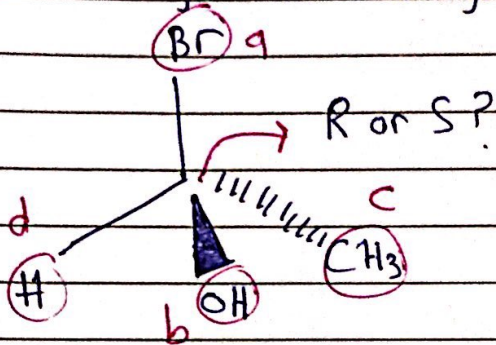
* Special case: If group "d" is located on the plane

Examples:

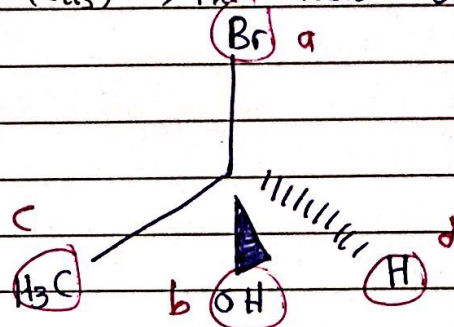


How can we determine the configuration?
let's explain this point on this example.

Assign the configuration for this molecule:

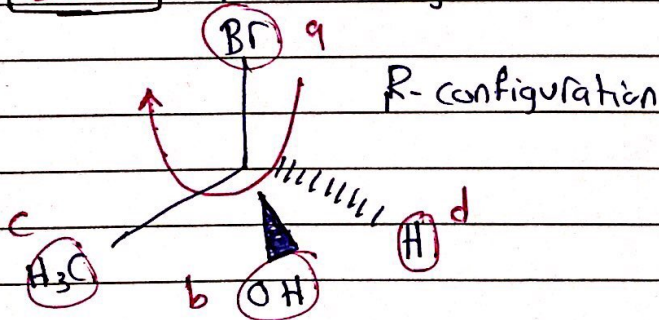


Step 1: Exchange between group "d" (H) and group "c" (CH₃), the new drawing is



We select CH₃ group since it locates on back bond

Step 2: Find configuration for new drawing



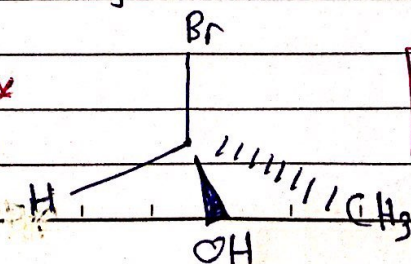
Step 3: invert the configuration that observed in step 2 to get an original configuration of a given molecule

إذا لم يقيم الطالب دونه

الخطوات يكتب أنه وجد

الخطوات configuration مباشرة

يكون ذلك بالسهولة



Final configuration
S