

How to Draw Structures for Accurate NMR Predictions

Advanced Chemistry Development, Inc.

Toronto, ON, Canada

www.acdlabs.com

Introduction

These rules were developed to conform with the algorithmic requirements of ACD/Labs prediction software¹ (ACD/CNMR, ACD/HNMR, ACD/FNMR, ACD/NNMR, ACD/PNMR, and ACD/2D NMR Predictor).

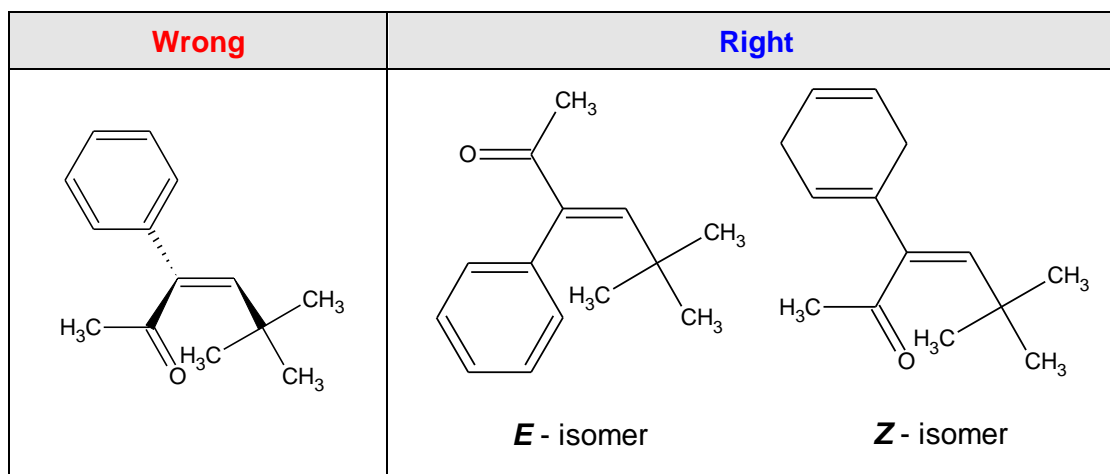
General requirements:

1. ACD/Labs software predicts the spectrum of the actual structure you have drawn. It does not consider the formation of complexes and salts (intramolecular, with the solvent or in case of mixtures).
2. 2D structures with stereochemistry must be used as an input to the predictors. Experimental chemical shifts are produced as a result of the 3D environment, but the database of structure matches for the prediction algorithm is made according to the 2D structure representations. So although the 3D environment is accommodated in the prediction result, the 2D structure with stereochemistry must be used as an input.
3. Coordinates (as drawn) are only used to determine the configuration of double bonds, as well as of isomers of amides, oximes, hydrazones, and nitrosamines.

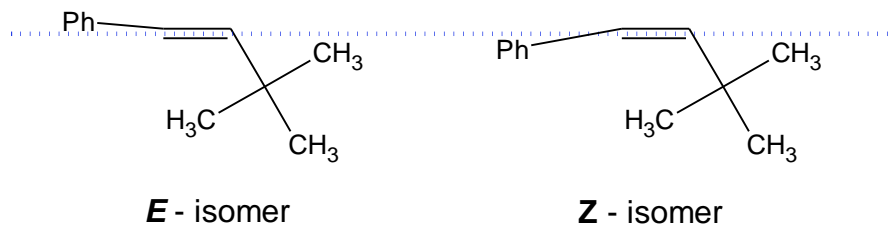
Key Examples

Double Bonds

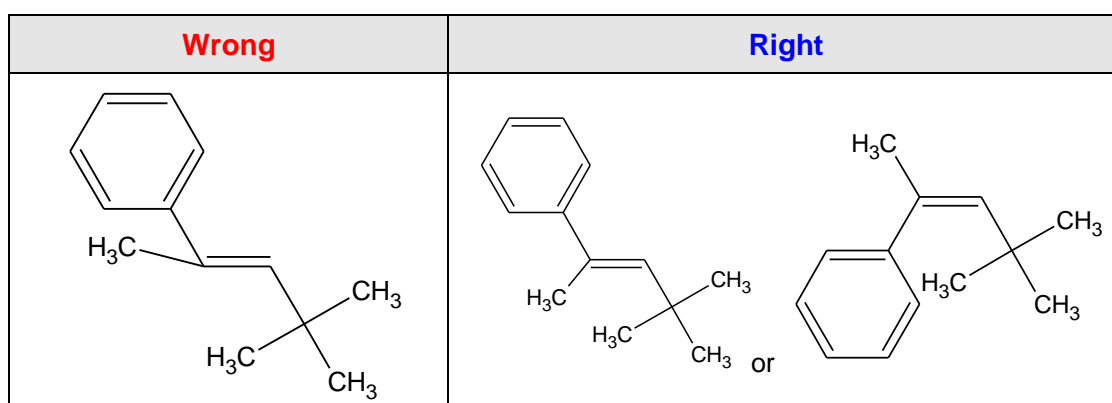
1. Avoid defining the configuration of a double bond using stereo bonds.



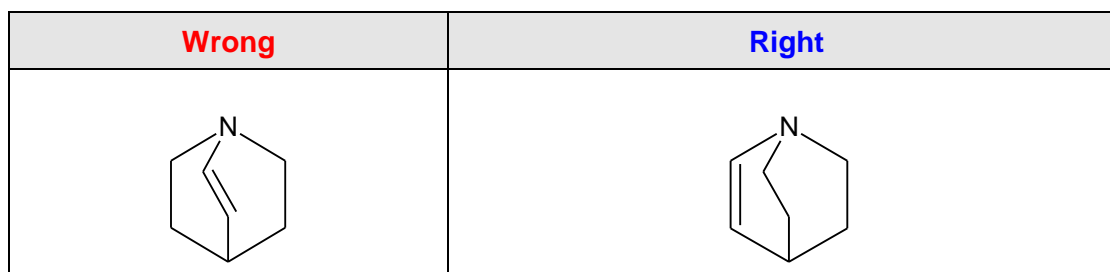
Algorithms within the software determine the configuration of a double bond using the angle between the single bond of a substitute and the line going through the double bond. If this angle is not 0° such a structure is defined as a specific isomer: E or Z:



2. Do not draw two substituents on one side of a double bond.

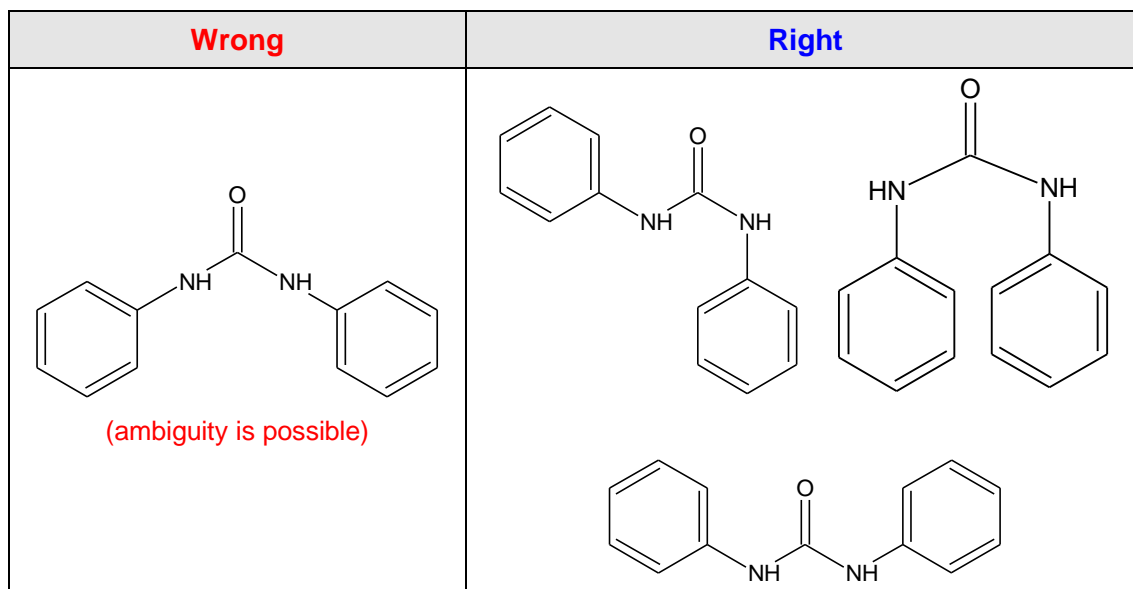


3. The configuration of the double bond in cyclic structures should be as shown, with double bonds drawn with Z-configuration (not E-configuration).



Other Types of Isomerism

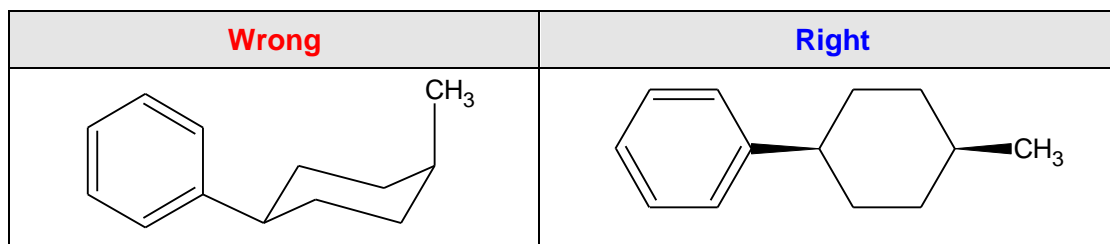
Amide isomers should be drawn with defined substituent positions.



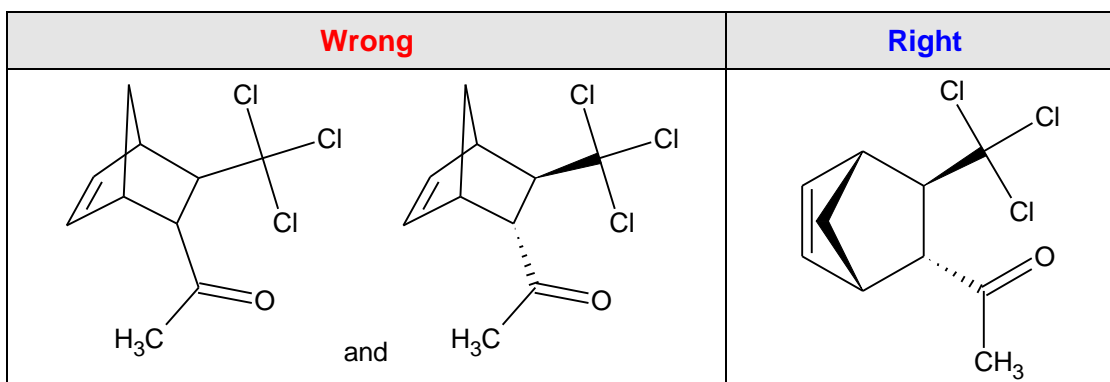
Similar rules should be applied to isomers of oximes, hydrazones, and nitrosamines.

Stereo Bonds and Orientation of Substituents

1. The orientation of substituents should be drawn with the help of stereo bonds.

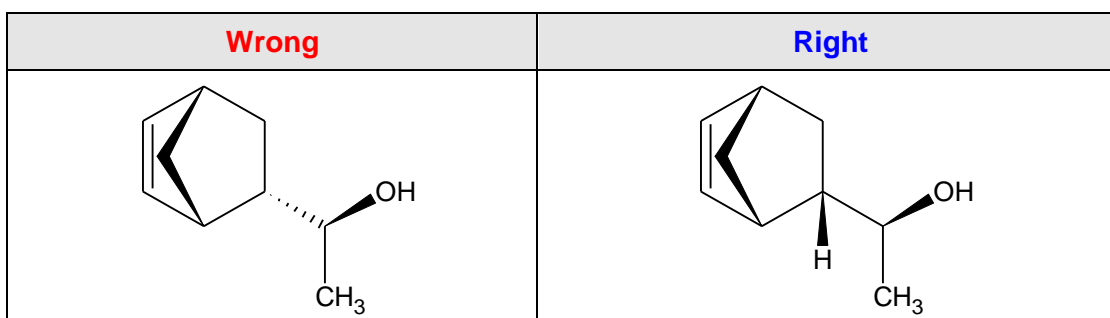


2. Besides the orientation of substituents, in bicyclic structures it is necessary to show the orientation of a bridge.

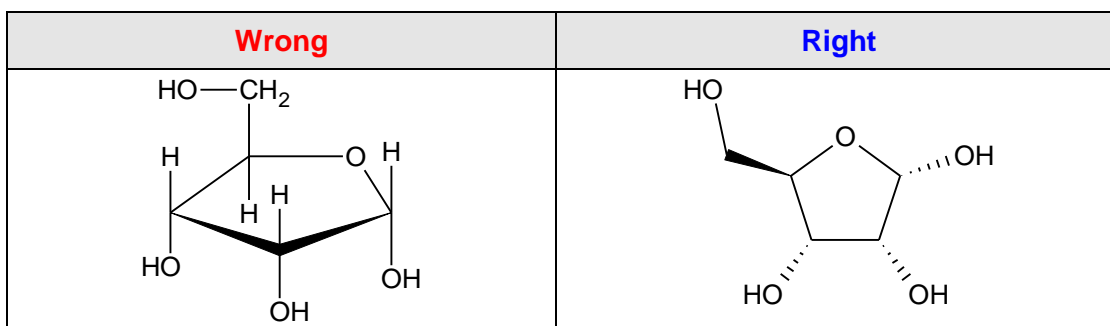


3. Stereo bonds should be designated in such a way that they show the mutual orientation of substituents in a ring, as well as the configuration of all the chiral carbon centers (and, if possible, of phosphorus, sulfur, etc.).

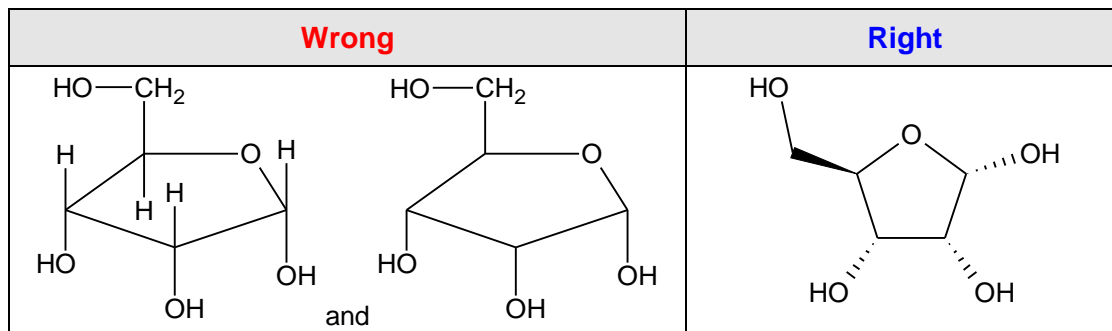
Avoid drawing consecutive stereo bonds (“head” to “tail”). In other words, it’s preferable to draw two neighboring asymmetric centers so that they are connected with a single bond, but the configuration of each is shown differently.



4. Do not use stereo bonds only for the purpose of display.



5. All sugars and their derivatives should be drawn with stereo bonds.

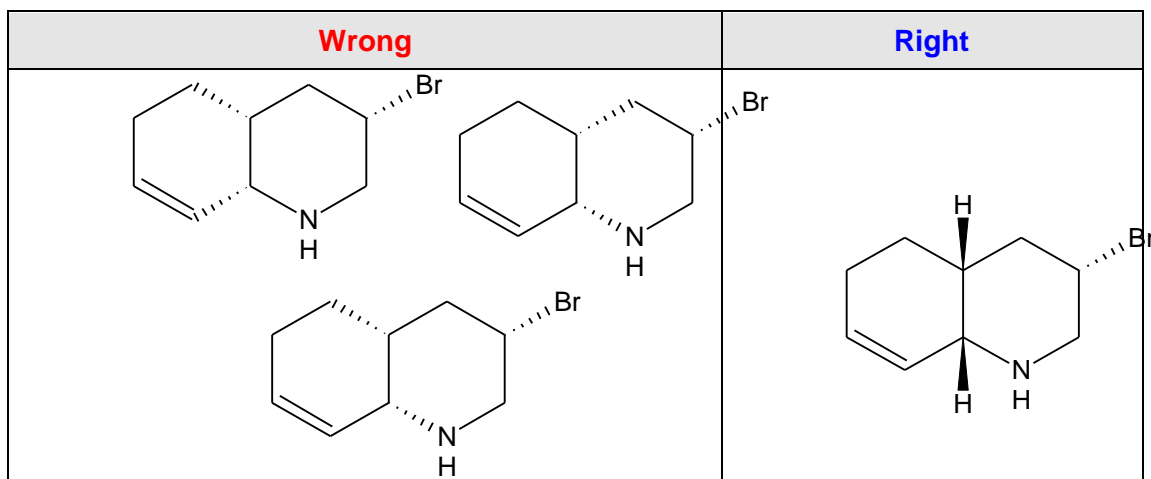


Explicit Hydrogens

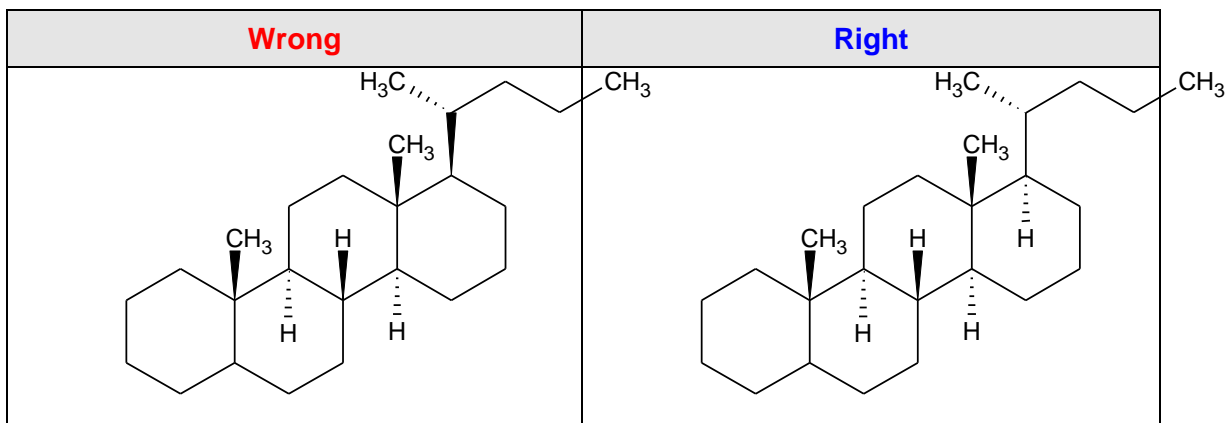
For spectral prediction, do not use the explicitly drawn hydrogens, except in some special cases.

Use explicit hydrogens:

- To define the configuration of fusion atoms in the fused rings:



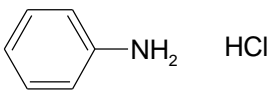
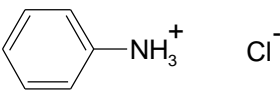
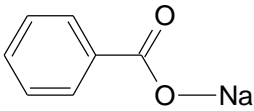
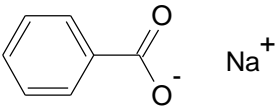
- To avoid drawing stereo bonds directly one after another:



- When using the neural network algorithm in ACD/HNMR or CNMR Predictor.

Salts

To achieve more accurate prediction of spectra for salts, such as aniline hydrochloride or sodium benzoate, the structures must be drawn in ionic form. Structures with the neutral components and covalent bonds between salt components are predicted with lower accuracy.

Wrong	Right
	
	

References

- ACD/Labs NMR Predictors. https://www.acdlabs.com/products/adh/nmr/nmr_pred/ Advanced Chemistry Development, Inc., Toronto, ON, Canada. November 21, 2019.