Drawing structures is an important part of the vernacular of organic chemistry. You must be able to draw proper structures to fully express your understanding of the subject.

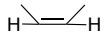
STEREOCHEMICAL REPRESENTATION*:* Stereochemistry is an important aspect of organic chemistry and you must be able to draw structures that unambiguously indicate the stereochemical orientation of the various groups on a molecule. For any given compound there will be a right way and many wrong ways to indicate stereochemistry. This handout gives examples of the correct way to show stereochemistry for alkenes and for cyclic and acyclic alkanes. Some incorrect examples are also given to illustrate common pitfalls and what is not acceptable.

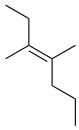
1

ALKENES*:* Alkenes contain a carbon-carbon double bond. The carbons are sp^2 hybridized, therefore the geometry at those carbons is trigonal planar. The three substitutents attached to a carbon of a double bond lie in the same plane and are approximately 120° apart from each other. Substituents are either *cis* (or *Z*, *zusammen* = together) or trans (or *E*, *entgegen* = opposite) to each other. You cannot draw an alkene in a linear form and say the groups are cis or trans - it must be drawn correctly

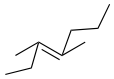
correct ☺ incorrect ☹

trans



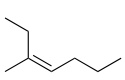


E

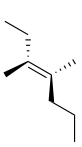


cis

$H_3CHC{=}CHCH_3$ *cis*

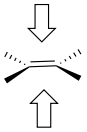


Z



All groups are in the same plane- you don't need to use dashes and wedges on alkenes unless you are making a special point about the faces of the alkene

top face

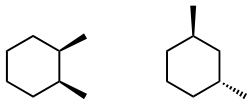


bottom face

2

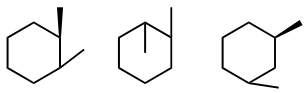
CYCLIC ALKANES: Substituents on a cyclic alkane can be either *cis* (syn) or *trans* (anti) to each other. You should draw the ring in the plane of the paper (solid lines) and use dashes and wedges to show whether the substitutents are above or below the plane of the ring.

correct ☺

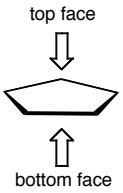


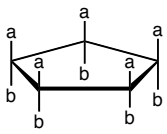
cis **trans**

incorrect ☹



On occasion you may wish to distinguish the faces of a cycloalkane.

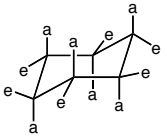




a: above the plane of the ring
b: below the plane of the ring

3

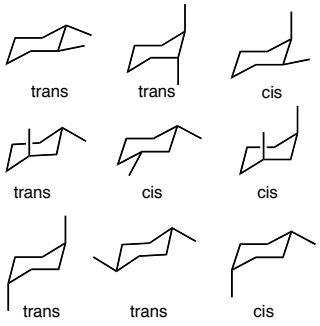
CYCLOHEXANE: You may need to draw a chair comformation of cyclohexane, in which case all substituents must be either axial or equatorial. The following is the correct way to draw chair cyclohexane. Note how the axial and equatorial substituents off each carbon are represented.



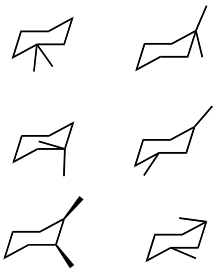
a: axial
e: equitorial

Disubstituted chair cyclohexanes:

correct ☺



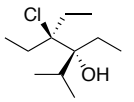
incorrect ☹

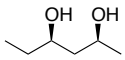


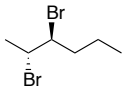
4

LINEAR ALKANES: You should draw the backbone in the plane of the paper, and draw substituents either coming towards you (with wedges) or going away from you (with dashes). Note that each carbon should look like a tetrahedron. Two adjacent position off each tetrahedral carbon should be in the plane of paper; the other two adjacent sites are out of the plane.

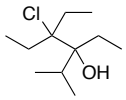
correct ☺

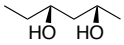


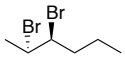




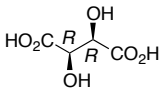
incorrect ☹

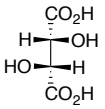


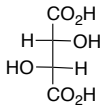




It is also acceptable to represent acyclic structure as Fischer Projections. 2*R*,3*R*-tartaric acid can be drawn in the forms below. Familiarize yourself with these representations.







Fischer Projection

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