7.13
Chemical Reactions That Produce Diastereomers
In order to know understand stereochemistry of product, you need to know two things:

(1) stereochemistry of alkene (cis or trans; Z or E)
(2) stereochemistry of mechanism (syn or anti)
Bromine Addition to trans-2-Butene

Fig. 7.14 (p 284)

anti addition to trans-2-butene gives meso diastereomer
Bromine Addition to cis-2-Butene

Fig. 7.15 (p 285)

anti addition to cis-2-butene gives racemic mixture of chiral diastereomer

anti addition to cis-2-butene gives racemic mixture of chiral diastereomer
Epoxidation of trans-2-Butene
Problem 7.17 (p 285)

syn addition to trans-2-butene gives racemic mixture of chiral diastereomer

50% 50% 50%
Epoxidation of cis-2-Butene

Problem 7.17 (p 285)

syn addition to \( \text{cis-2-butene} \) gives meso diastereomer
of two stereoisomers of a particular starting material, each one gives different stereoisomeric forms of the product related to mechanism: terms such as syn addition and anti addition refer to stereospecificity
cis-2-butene bromination anti $2R,3R + 2S,3S$

trans-2-butene bromination anti meso

Stereospecific reaction

cis-2-butene epoxidation syn meso

trans-2-butene epoxidation syn $2R,3R + 2S,3S$
a single starting material can give two or more stereoisomeric products, but gives one of them in greater amounts than any other.

\[
\begin{align*}
\text{Stereoselective reaction} & \\
\begin{array}{c}
H \quad \text{CH}_3 \\
\text{CH}_2 \quad \text{H}_2 \\
\text{Pt}
\end{array} & \rightarrow \\
\begin{array}{c}
\text{H} \\
\text{CH}_3 \\
\text{H}
\end{array} & + \\
\begin{array}{c}
\text{H} \\
\text{CH}_3 \\
\text{CH}_3
\end{array}
\end{align*}
\]
7.14
Resolution of Enantiomers

separation of a racemic mixture into its two enantiomeric forms
enantiomers

\[
\begin{array}{cc}
C(+) & C(-) \\
\end{array}
\]
enantiomers

\[
\begin{array}{c}
\text{C}(+) \\
\text{C}(-)
\end{array}
\]

\[
\begin{array}{c}
\text{2P}(+)
\end{array}
\]

\[
\begin{array}{c}
\text{C}(+) \text{P}(+) \\
\text{C}(-) \text{P}(+)
\end{array}
\]

diastereomers

Strategy
enantiomers

\[
\begin{align*}
C(+) & \quad C(-) \\
2P(+) & \\
C(+)P(+) & \quad C(-)P(+) \\
\end{align*}
\]

diastereomers

\[
\begin{align*}
C(+)P(+) & \quad C(-)P(+)
\end{align*}
\]
enantiomers

C(+) P(+)

C(+) C(+) P(+)

C(C(--)) P(+)

C(+) P(+)

C(+) C(+) P(+)

C(-) P(+)

C(C(--)) P(+)

C(-) P(+)

P(+)

C(+) P(+)

C(-) P(+)

P(+)

C(-)

diastereomers

2P(+)

C(+) C(+) 2P(+)

C(+) C(-)

Strategy
7.15
Stereoregular Polymers
atactic
isotactic
syndiotactic
Atactic Polypropylene

random stereochemistry of methyl groups attached to main chain (stereorandom)
properties not very useful for fibers etc.
formed by free-radical polymerization
Isotactic Polypropylene

stereoregular polymer; all methyl groups on same side of main chain

useful properties

prepared by coordination polymerization
under Ziegler-Natta conditions
Syndiotactic Polypropylene

stereoregular polymer; methyl groups alternate side-to-side on main chain

useful properties

prepared by coordination polymerization

under Ziegler-Natta conditions
7.16
Stereogenic Centers
Other Than Carbon
silicon, like carbon, forms four bonds in its stable compounds and many chiral silicon compounds have been resolved
Nitrogen in amines

Pyramidal geometry at nitrogen can produce a chiral structure, but enantiomers equilibrate too rapidly to be resolved.

\[
\begin{array}{c}
\text{N} \\
\text{a} \\
\text{b} \\
\text{c}
\end{array}
\leftrightarrow
\begin{array}{c}
\text{N} \\
\text{a} \\
\text{b} \\
\text{c}
\end{array}
\]

Very fast
Phosphorus in phosphines

Pyramidal geometry at phosphorus can produce a chiral structure; pyramidal inversion slower than for amines and compounds of the type shown have been resolved.
Sulfur in sulfoxides

Pyramidal geometry at sulfur can produce a chiral structure; pyramidal inversion is slow and compounds of the type shown have been resolved.