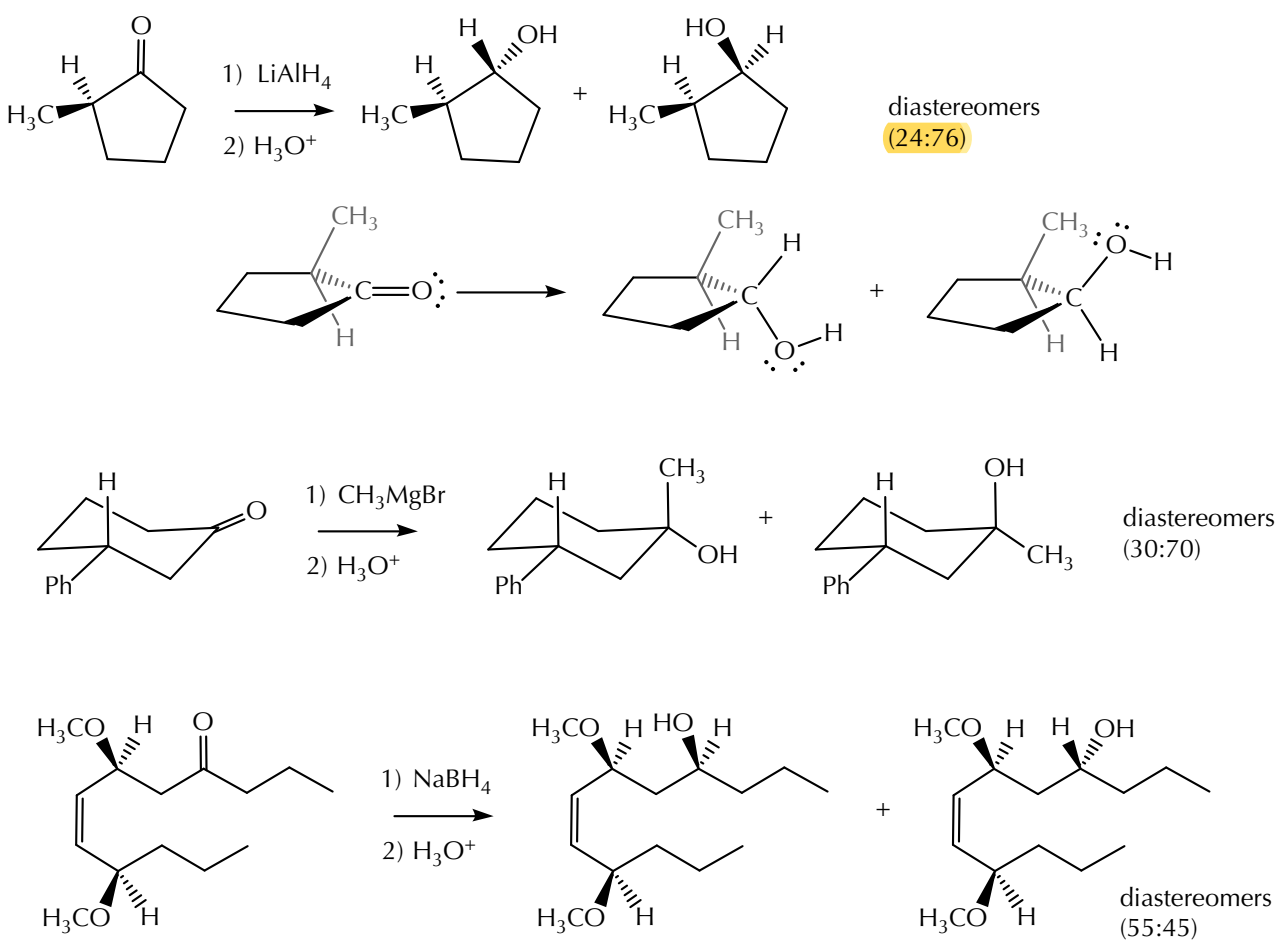


When a molecule is chiral, creating an additional stereocenter will result in diastereomers (Figure 1222). The ratio of diastereomers is not predictable, and unlikely to be 50:50. If the ratio was 50:50, then the reaction would be classified as nondiastereoselective; any other ratio is an example of diastereoselectivity, through a 100:0 ratio, which would be classified as a completely diastereoselective reaction. The ratios shown in Figure 1222 are experimental results.

Figure 1222

Carbonyl addition reaction outcome: diastereomers from chiral molecules.



Chemists are curious to understand the diastereoselectivity in these reactions, and they create models to explain the results.

One of the examples from Figure 1222 is the lithium aluminum hydride reduction of (2*R*)-2-methylcyclopentan-1-one to give (1*R*,2*R*)-2-methylcyclopentan-1-ol and (1*S*,2*R*)-2-methylcyclopentan-1-ol in a 1:3 ratio. In this case, the stereocenter is on the adjacent carbon to the site where the new bond is forming, and so we imagine that the trajectory for forming the new C-H bond, using lithium aluminum hydride, would require the hydride reagent to potentially collide with the methyl group on the way to forming the (1*S*,2*R*)-isomer of the product, versus only needing to pass by a hydrogen atom on the way to forming the (1*R*,2*R*)-isomer (Figure 1123). The proposition is that the diastereoselectivity is based upon the difference in steric energy in the transition states, between passing by (and colliding with) the methyl group relative to the hydrogen atom, as shown on the energy diagram.