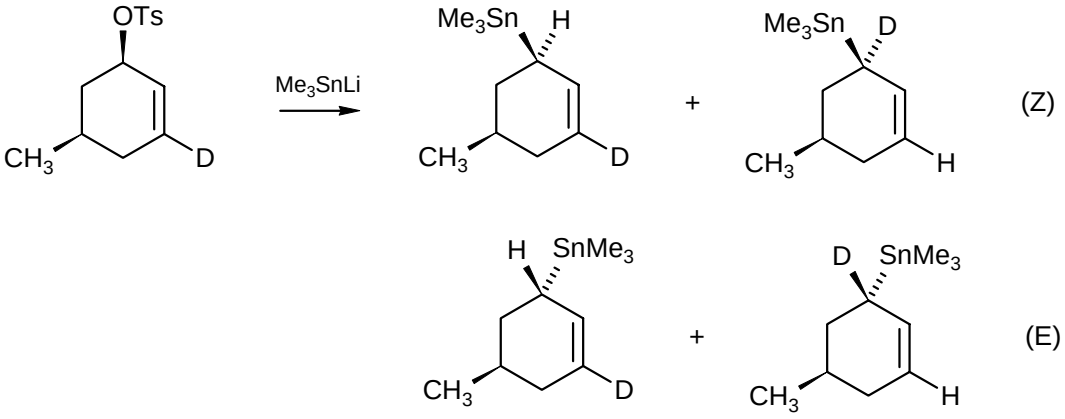
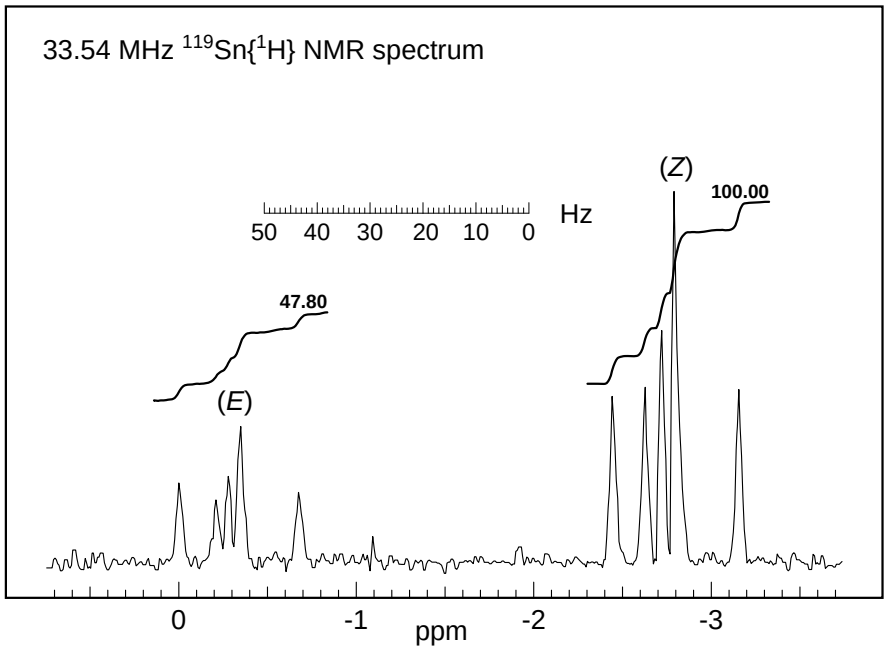
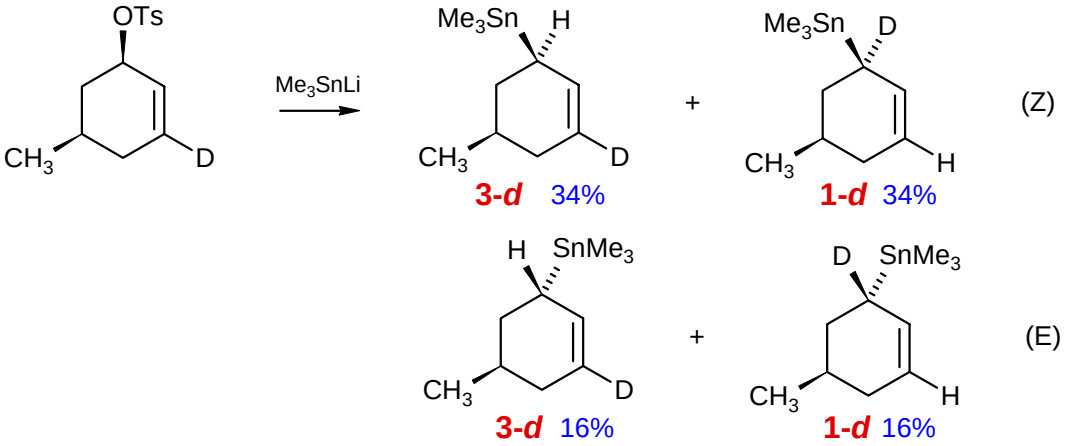
Problem R-306 ($C_{10}H_{20}Sn$). Below is the 33.54 MHz $^{119}Sn\{^1H\}$ NMR spectrum of a reaction product from the reaction shown (Quintard, J.-P.; Degueil-Castaing, M.; Dumartin, G.; Barbe, B.; Petraud, M. *J. Orgmet. Chem.* ***1982****, 234*, 36):



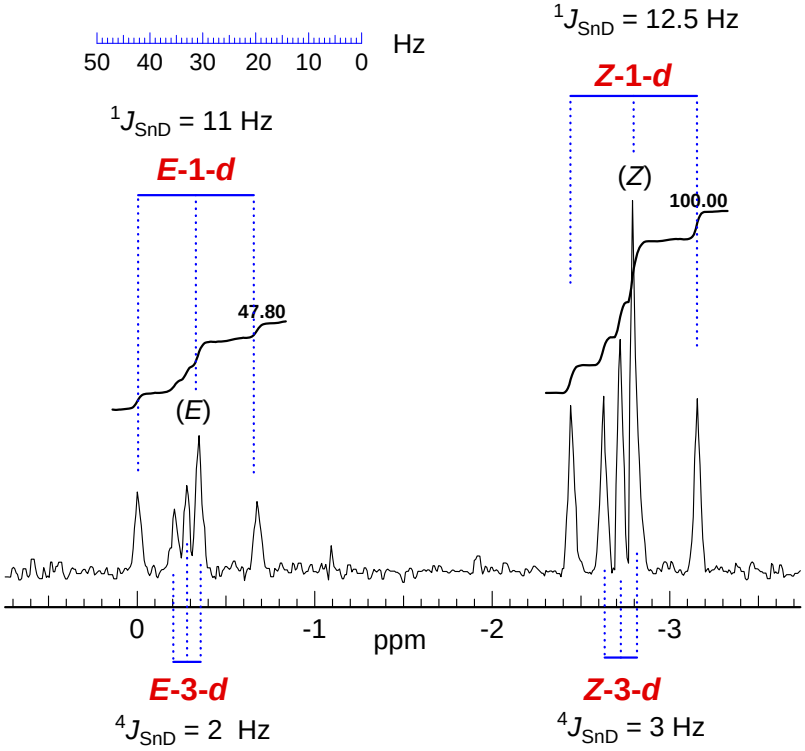
Estimate the ratio of the four isomeric products from the NMR spectrum. All materials are racemic.



Problem R-306 ($C_{10}H_{20}Sn$). Below is the 33.54 MHz $^{119}Sn\{^1H\}$ NMR spectrum of a reaction product from the reaction shown (Quintard, J.-P.; Degueil-Castaing, M.; Dumartin, G.; Barbe, B.; Petraud, M. *J. Orgmet. Chem.* ***1982**, 234*, 36):



Estimate the ratio of the four isomeric products from the NMR spectrum. All materials are racemic.



Each of the ^{119}Sn signals is coupled to the deuterium, to give overlapping 1:1:1 triplets

We would expect the $^2J_{SnD}$ (1-*d*) to be larger than $^4J_{SnD}$ (3-*d*).

The ratio of 3-*d* to 1-*d* is 1:1

The *E* to *Z* ratio is 48/100 (32/68)

Note the small isotope shift of about 2 Hz, with the 1-*d* signals upfield of the 3-*d* ones

This experiment was carried out to determine the mechanism of the nucleophilic substitution at carbon. A direct S_N2 substitution would have given ony the *E*-3-*d* isomer (inversion at carbon), so either a carbonium ion (S_N1 through the allyl cation) or, more likely, a radical mechanism ($S_{RN}1$ through the allyl radical) is involved.