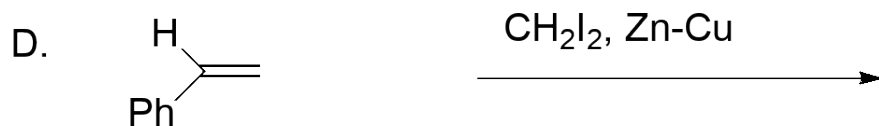
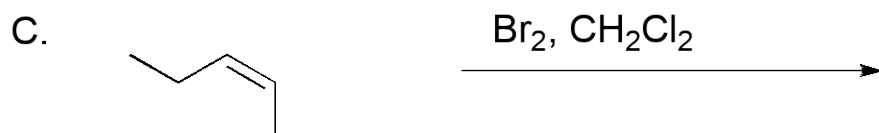
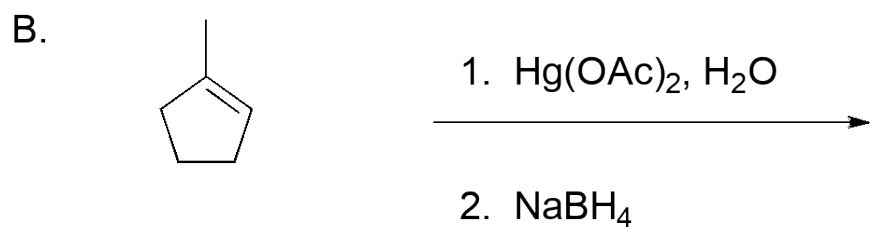
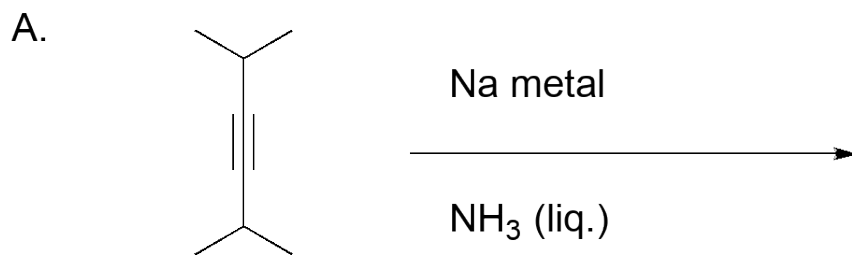
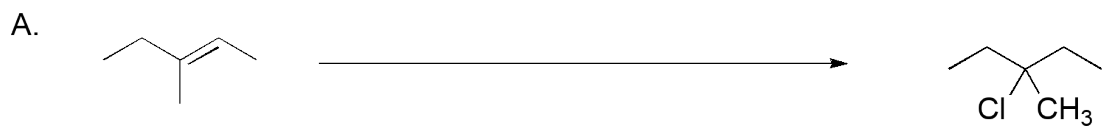


1. (30 points) Write the expected products for each of the following reactions. Specify stereochemistry where appropriate (you may write "racemic" in place of drawing a second enantiomer).

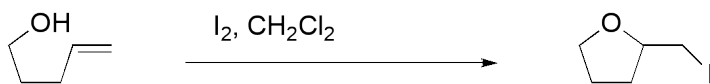


2. (25 points) Write (over the arrow) the reagents needed to accomplish the following transformations.

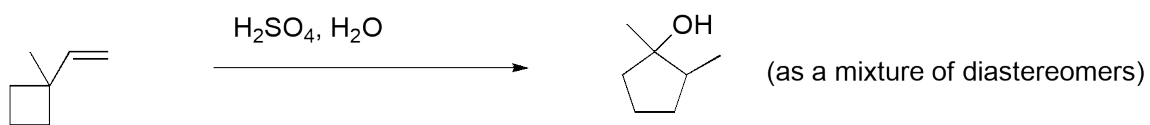


3. (20 points) Write mechanisms (using the correct electron-pushing formalism, and as many steps as needed) for each of the following transformations.

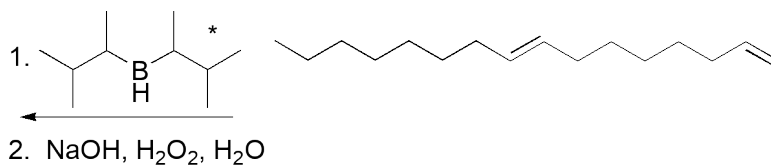
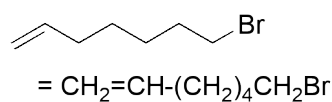
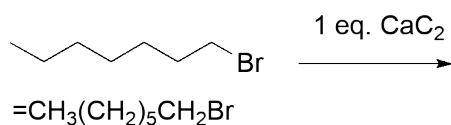
A.



B.

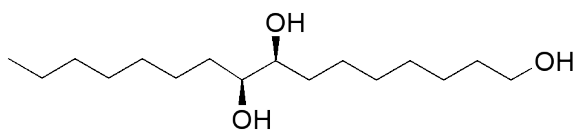


4. (16 points) Long-chain fatty alcohols are often observed to be chemical signaling agents in insect biochemistry. Fill in the boxes for intermediate structures or reagents in the following synthesis of (8S, 9S)-1,8,9-hexadecanetriol. (You may abbreviate using the $(\text{CH}_2)_n$ formalism.)



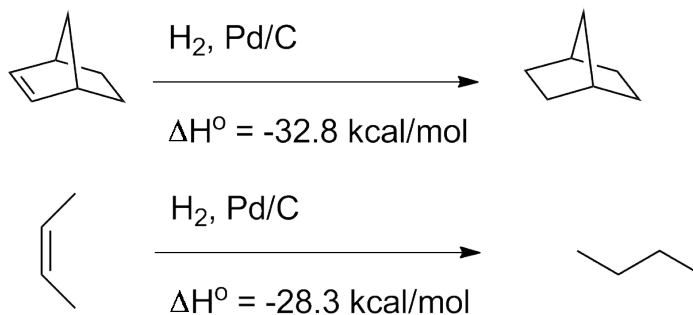
* This reagent reacts selectively with monosubstituted alkenes in the presence of more highly substituted alkenes

1. OsO_4
 2. NaHSO_3



5. (9 points) The heat of hydrogenation for norbornene ([2.2.1]-bicyclo-hept-2-ene, shown at the right) is -32.8 kcal/mol.

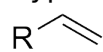

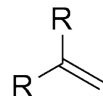

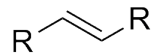
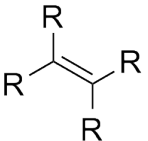
Explain why this is different from that for Z-2-butene (-28.3 kcal/mol).



Bond strengths (kcal/mol):

F-F	38
Cl-Cl	58
Br-Br	46
I-I	36
H-F	136
H-Cl	103
H-Br	87
H-I	71
CH ₃ -H	105
CH ₃ CH ₂ -H	101
(CH ₃) ₂ CH-H	98.5
(CH ₃) ₃ C-H	96.5
CH ₃ -F	110
CH ₃ -Cl	85
CH ₃ -Br	70
CH ₃ -I	57
CH ₃ CH ₂ -F	111
CH ₃ CH ₂ -Cl	84
CH ₃ CH ₂ -Br	70
CH ₃ CH ₂ -I	56
(CH ₃) ₂ CH-F	111
(CH ₃) ₂ CH-Cl	84
(CH ₃) ₂ CH-Br	71
(CH ₃) ₂ CH-I	56
(CH ₃) ₃ C-F	110
(CH ₃) ₃ C-Cl	85
(CH ₃) ₃ C-Br	71
(CH ₃) ₃ C-I	55

Typical Heats of Hydrogenation

	-30 kcal/mol		-28.2 kcal/mol
	-27.9 kcal/mol		-26.5 kcal/mol
	-27.4 kcal/mol		-26.3 kcal/mol