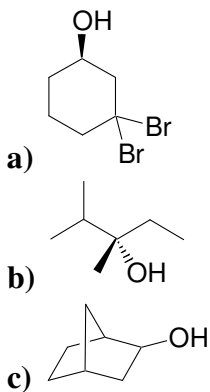


Solutions

13.1.

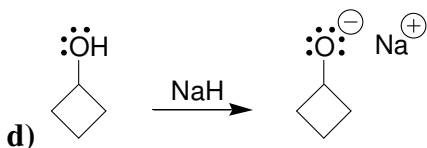
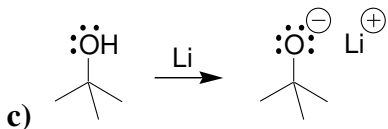
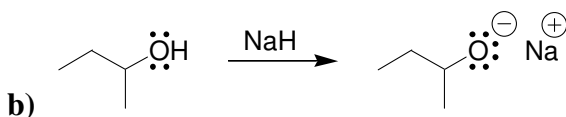
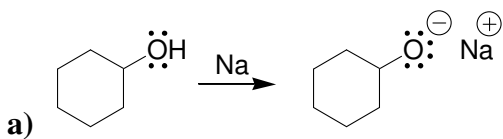
- 5,5-dibromo-2-methylhexan-2-ol
- (2*S*,3*R*)-2,3,4-trimethylpentan-1-ol
- 2,2,5,5-tetramethylcyclopentanol
- 2,6-diethylphenol
- (*S*)-2,2,4,4-tetramethylcyclohexanol

13.2.

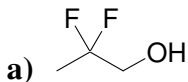


13.3. Nonyl mandelate has a longer alkyl chain than octyl mandelate and is therefore more effective at penetrating cell membranes, rendering it a more potent agent. Nonyl mandelate has a shorter alkyl chain than decyl mandelate and is therefore more water-soluble, enabling it to be transported through aqueous media and to reach its target destination more effectively.

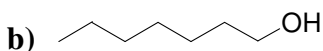
13.4.



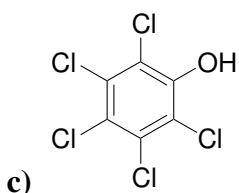
13.5.



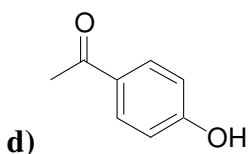
The electron-withdrawing effects of the fluorine atoms stabilize the conjugate base.



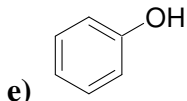
The conjugate base of a primary alcohol will be more easily solvated than the conjugate base of a tertiary alcohol.



The electron-withdrawing effects of the chlorine atoms stabilize the conjugate base.

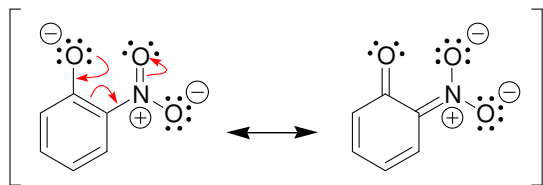


The conjugate base is more highly stabilized by resonance, with the negative charge spread over two oxygen atoms, rather than just one oxygen atom.

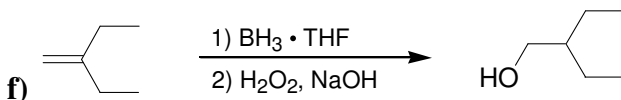
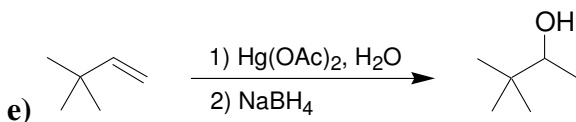
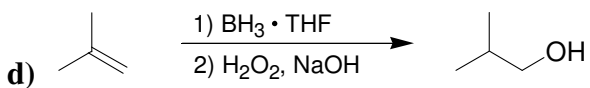
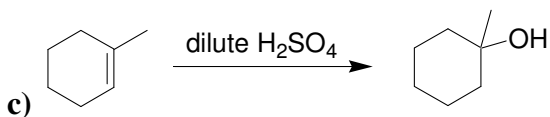
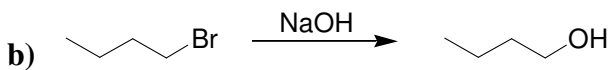
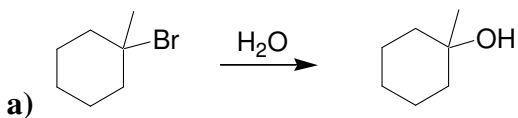


The conjugate base is stabilized by resonance.

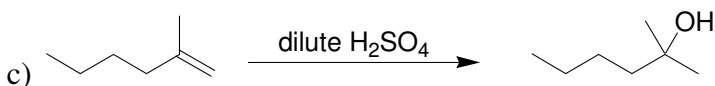
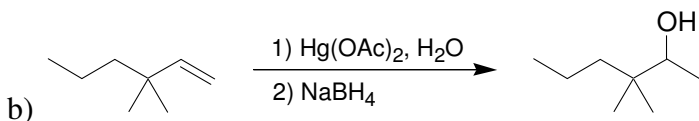
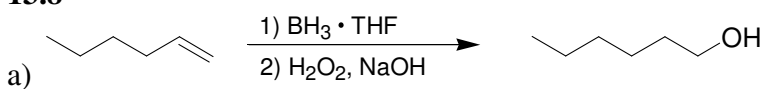
13.6. 2-nitrophenol is expected to be more acidic (lower pK_a) because the conjugate base has a resonance structure in which the negative charge is spread onto an oxygen atom of the nitro group, shown below. In contrast, 3-nitrophenol does not have such a resonance structure:



13.7.



13.8



13.9.

a) $(+2) \rightarrow (+2)$. The starting material is neither oxidized nor reduced.

b) $(+1) \rightarrow (+3)$. The starting material is oxidized.

c) $(+3) \rightarrow (-1)$. The starting material is reduced.

d) $(+3) \rightarrow (+3)$. The starting material is neither oxidized nor reduced.

e) $(0) \rightarrow (+2)$. The starting material is oxidized.

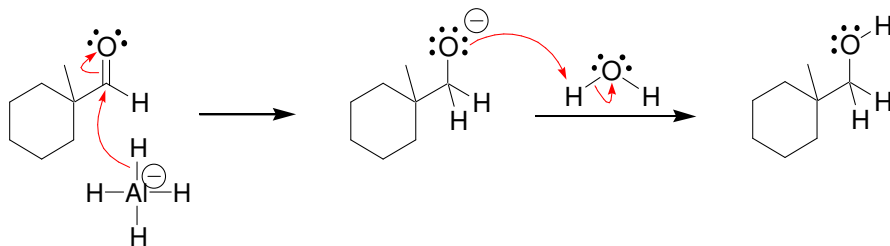
f) $(+2) \rightarrow (+3)$. The starting material is oxidized.

13.10. One carbon atom is reduced from an oxidation state of 0 to an oxidation state of -1, while the other carbon atom is oxidized from an oxidation state of 0 to an oxidation state of +1. Overall, the starting material does not undergo a net change in oxidation state and is, therefore, neither reduced nor oxidized.

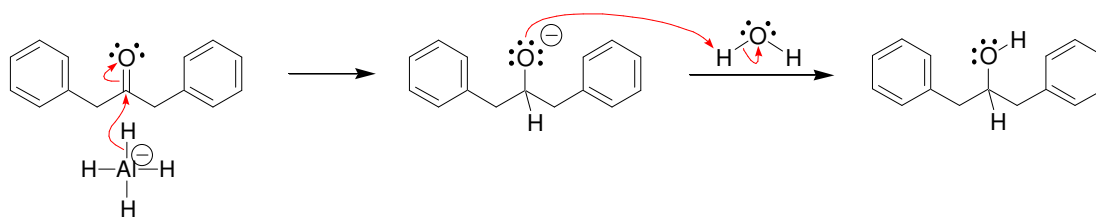
13.11. One carbon atom is reduced from an oxidation state of 0 to an oxidation state of -2, while the other carbon atom is oxidized from an oxidation state of 0 to an oxidation state of +2. Overall, the starting material does not undergo a net change in oxidation state and is, therefore, neither reduced nor oxidized.

13.12.

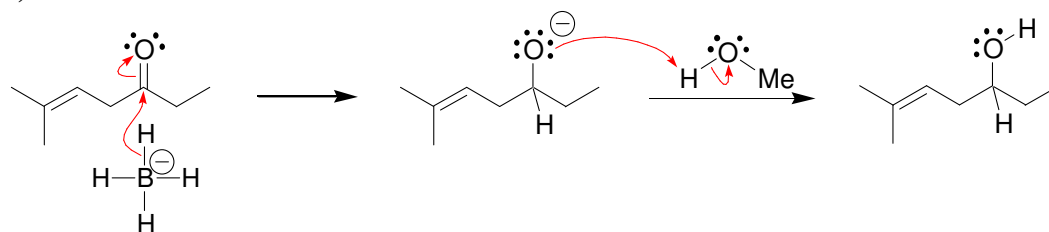
a)



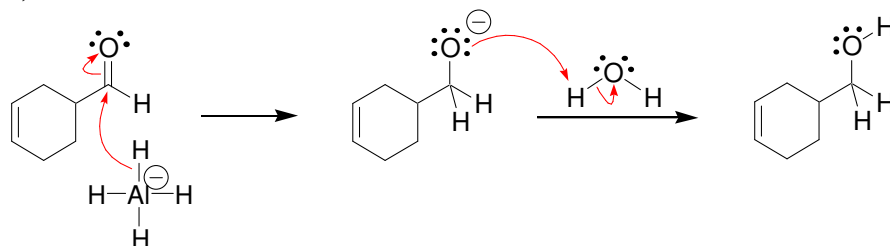
b)



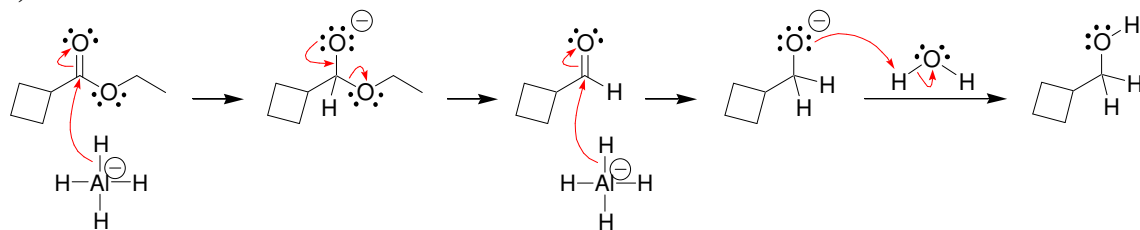
c)



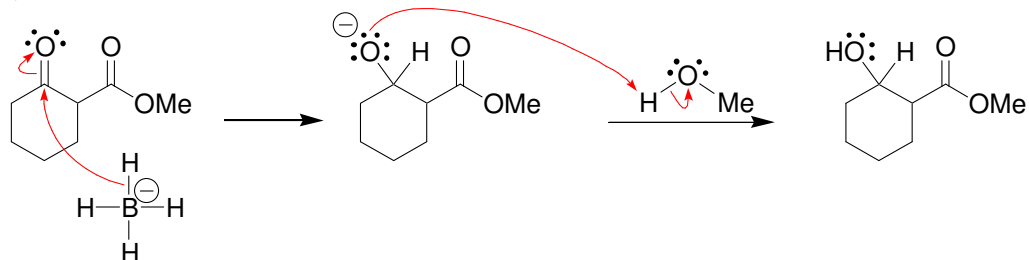
d)



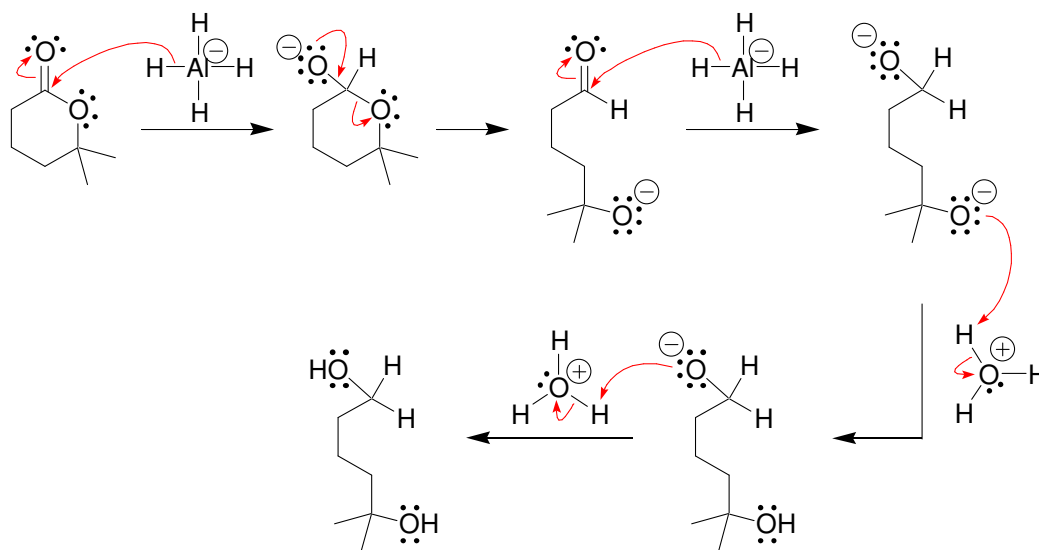
e)



f)

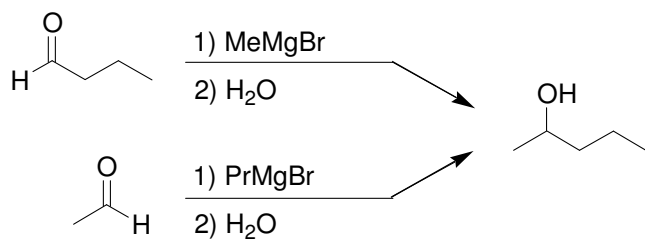


13.13.

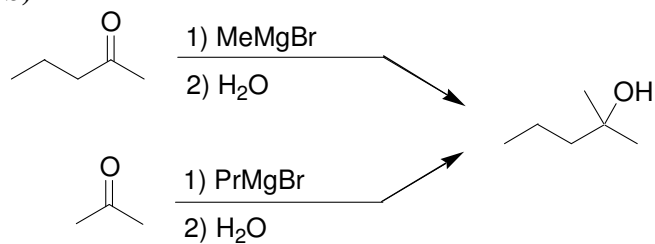


13.14.

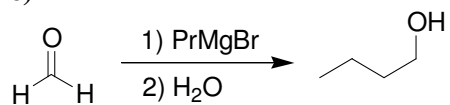
a)



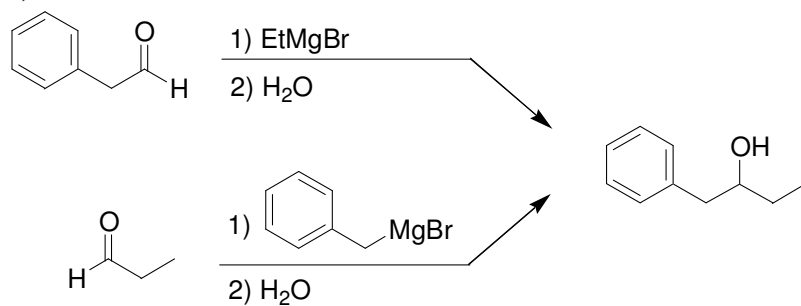
b)



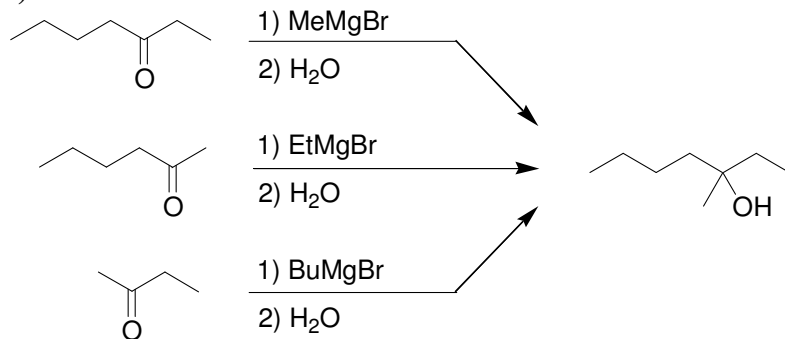
c)



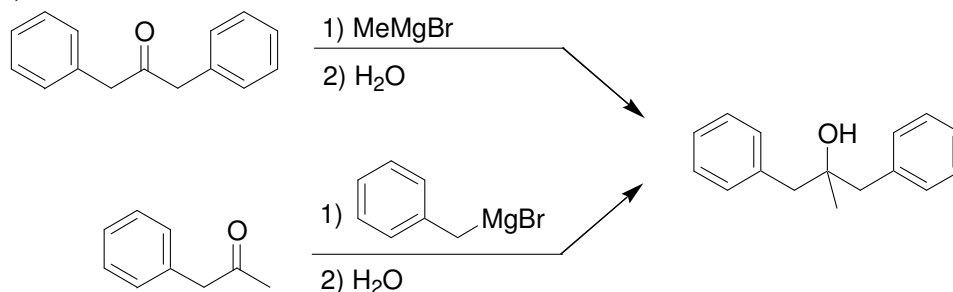
d)



e)



f)

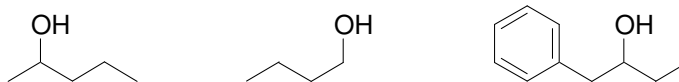


13.15 Each of the following two compounds can be prepared from the reaction between a Grignard reagent and an ester, because each of these compounds has two identical groups connected to the α position:



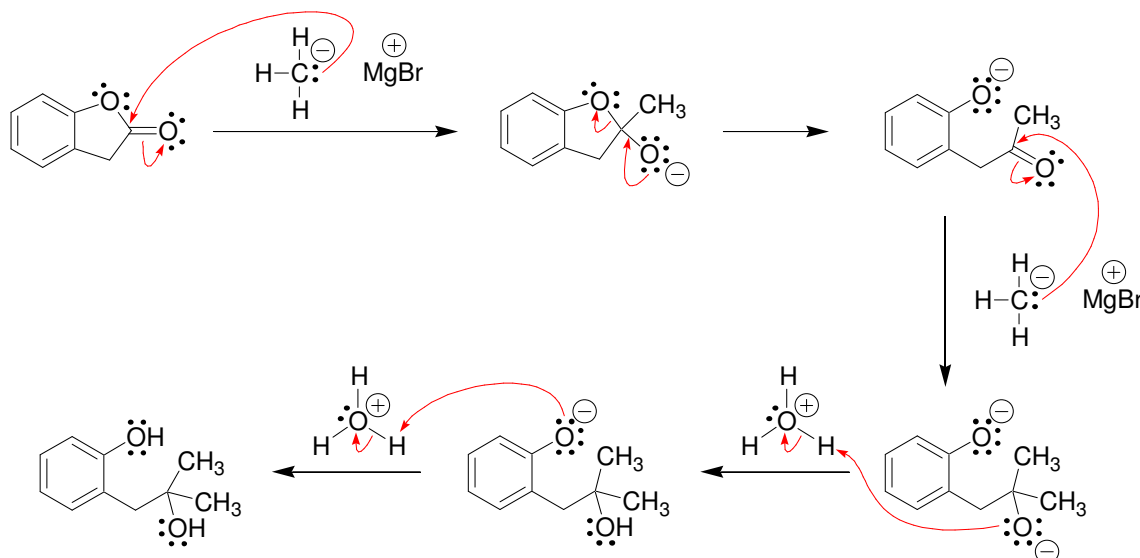
The other four compounds from Problem 13.14 do not contain two identical groups connected to the α position, and cannot be prepared from the reaction between an ester and a Grignard reagent.

13.16 Each of the following three compounds can be prepared from the reaction between a hydride reducing agent (NaBH_4 or LAH) and a ketone or aldehyde, because each of these compounds has a hydrogen atom connected to the α position:



The other three compounds from Problem 13.14 do not contain a hydrogen atom connected to the α position and, therefore, cannot be prepared from the reaction between a hydride reducing agent (NaBH_4 or LAH) and a ketone or aldehyde.

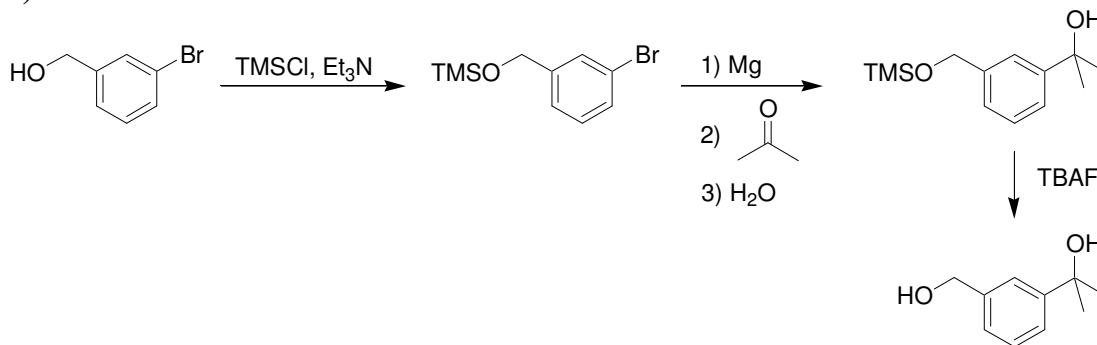
13.17.

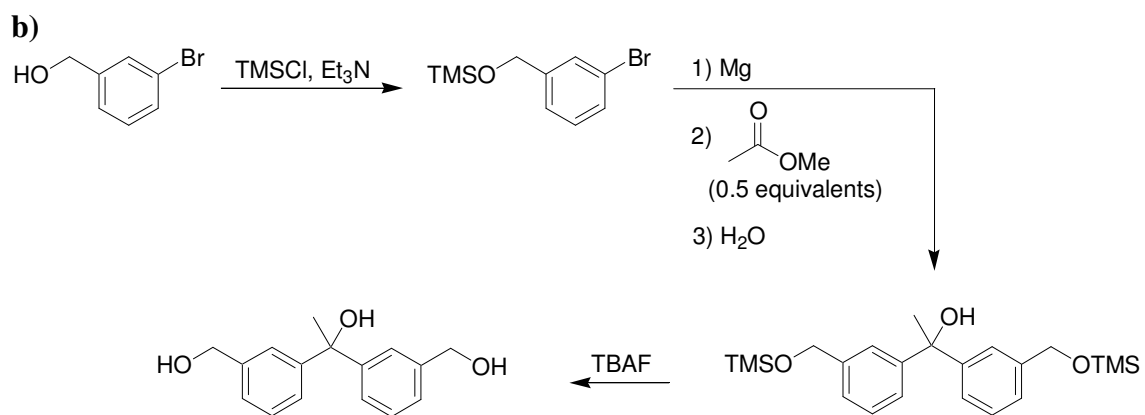


In this case, H_3O^+ must be used as a proton source because water is not sufficiently acidic to protonate a phenolate ion (see Section 13.2, Acidity of Alcohols and Phenols).

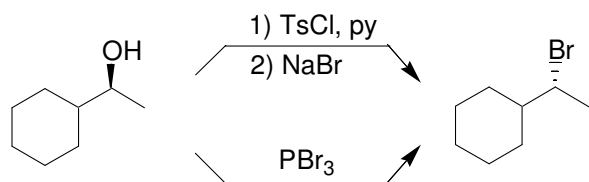
13.18.

a)

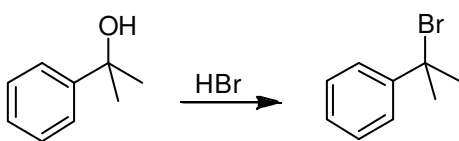



13.19.

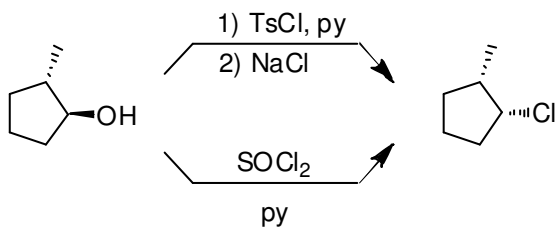
a)



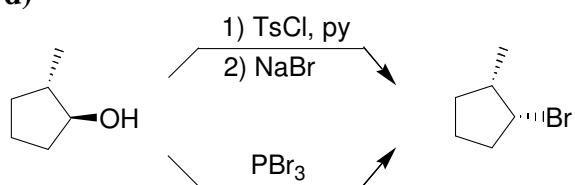
b)



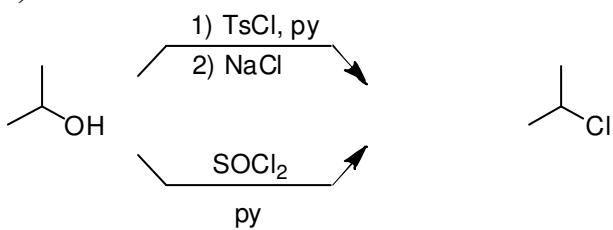
c)



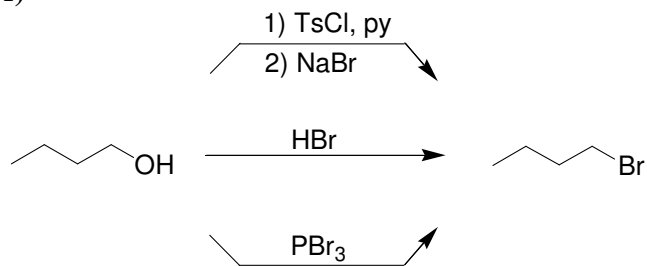
d)



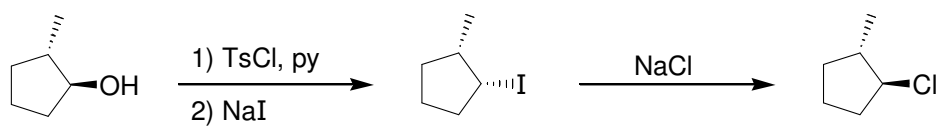
e)



f)

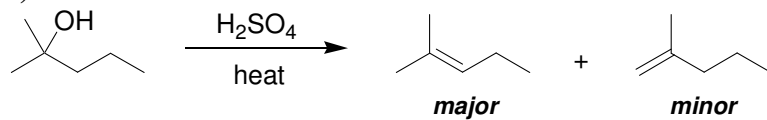


13.20.

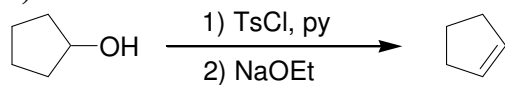


13.21.

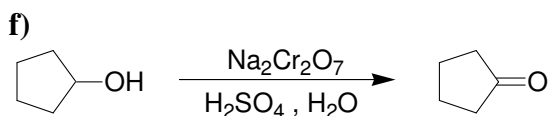
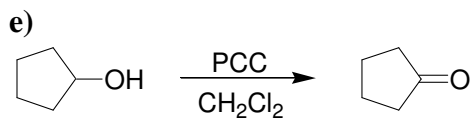
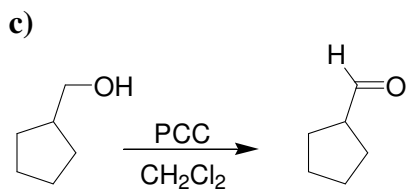
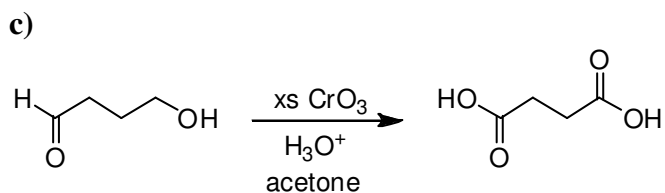
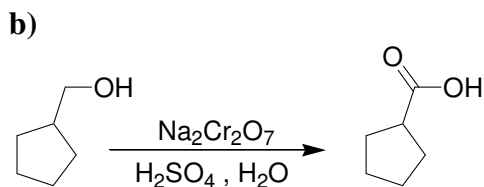
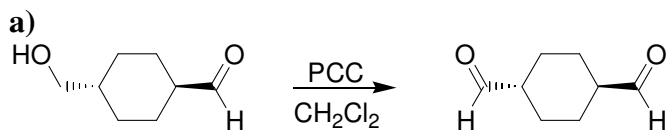
a)



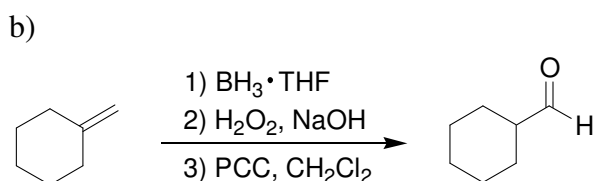
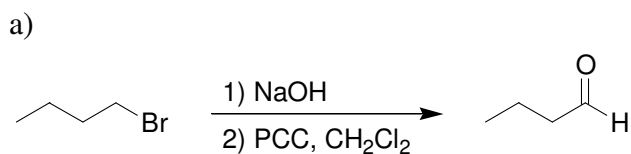
b)



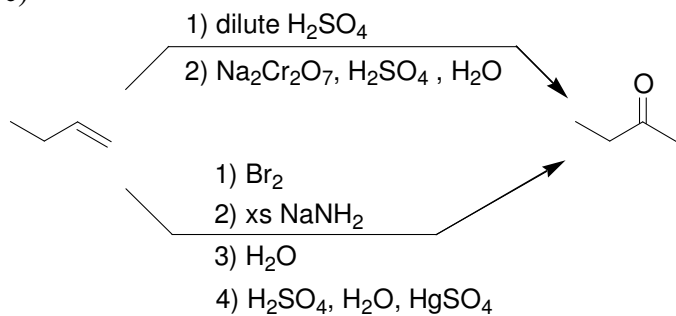
13.22.



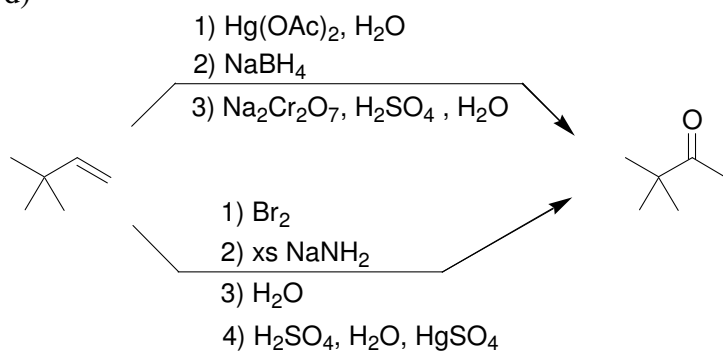
13.23.



c)

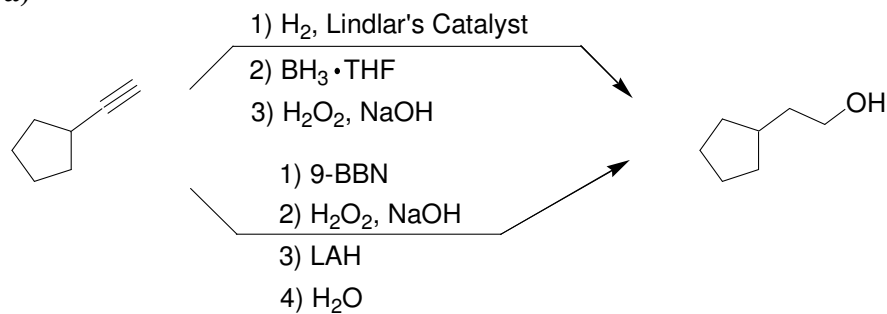


d)

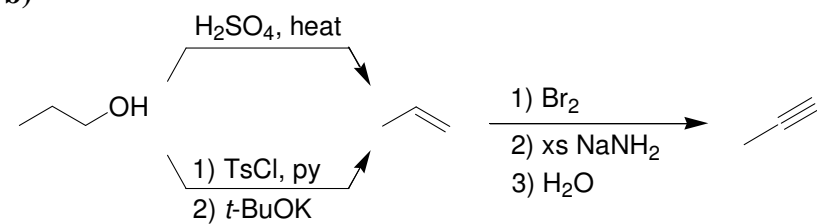


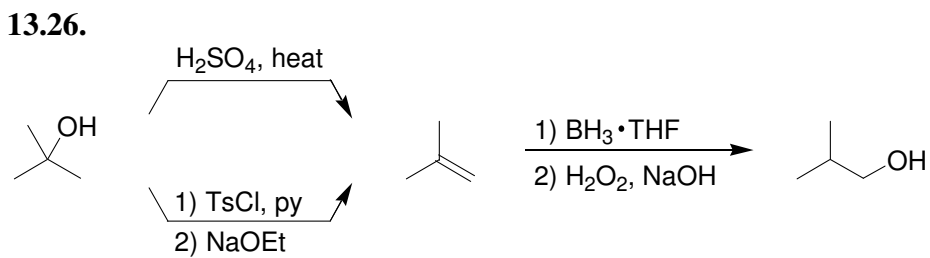
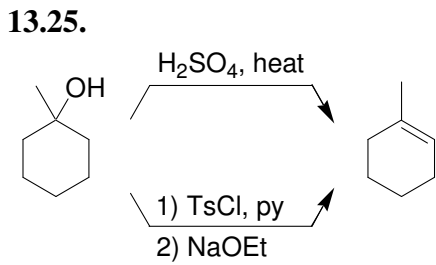
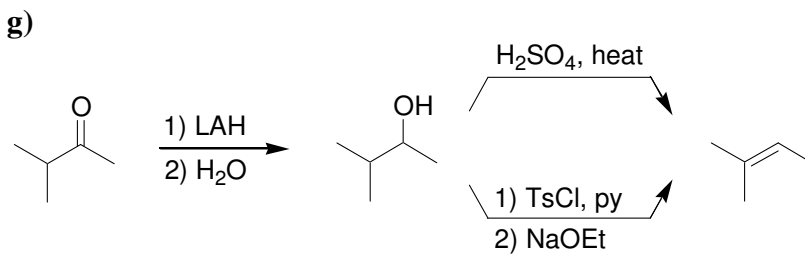
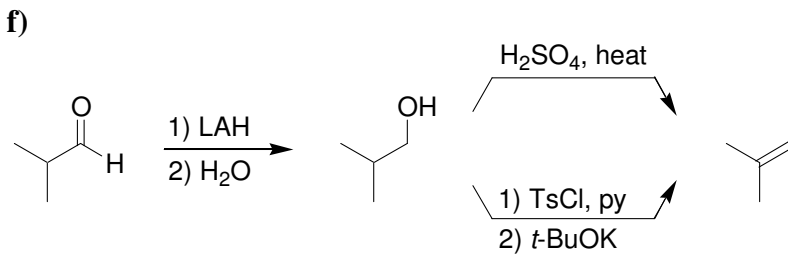
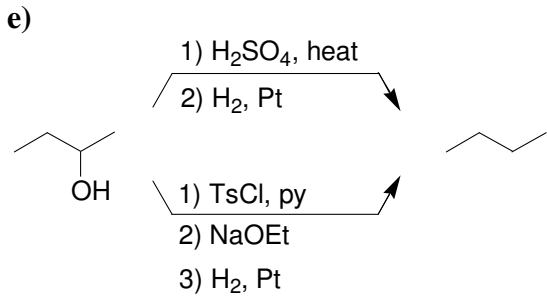
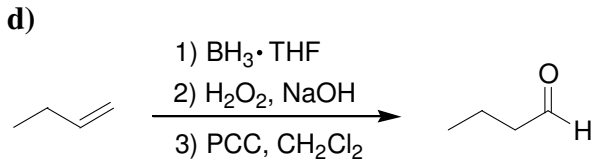
13.24.

a)

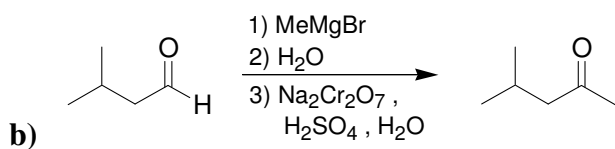
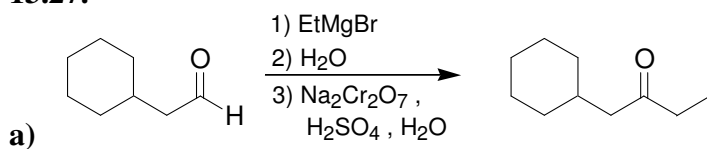


b)

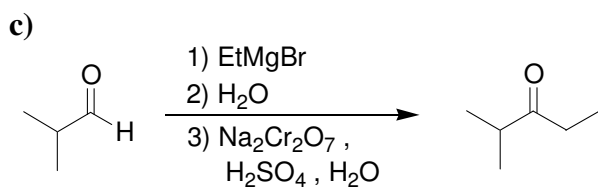
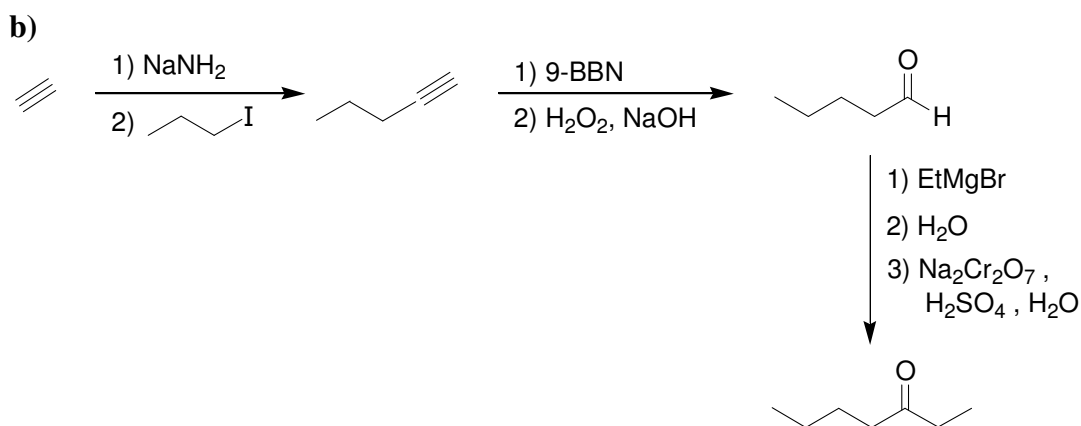
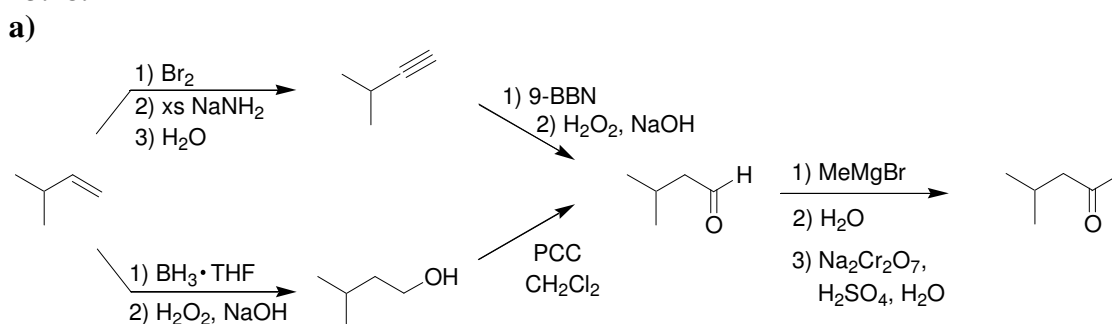


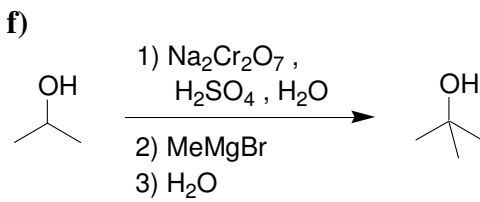
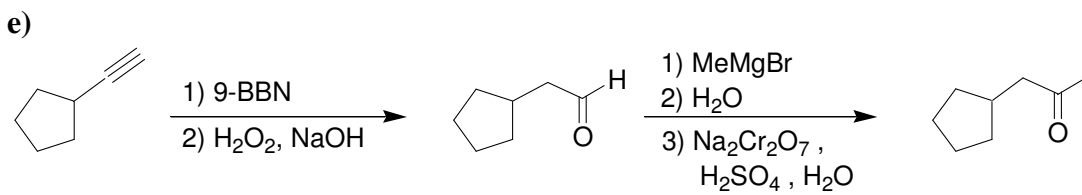
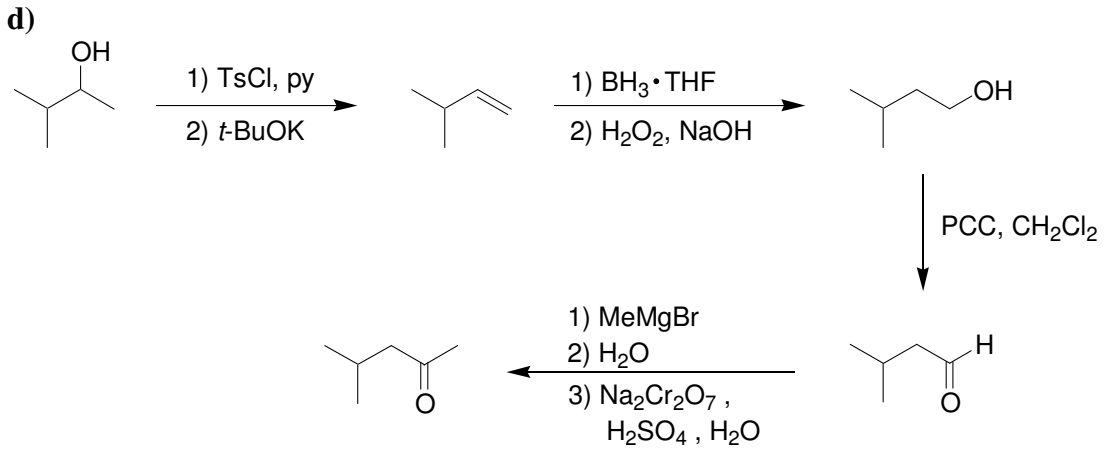


13.27.

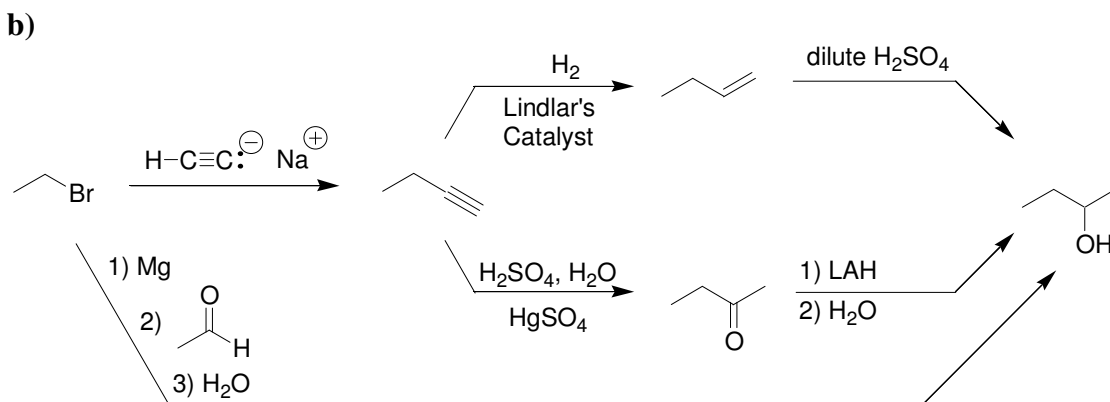
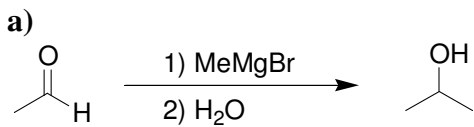


13.28.

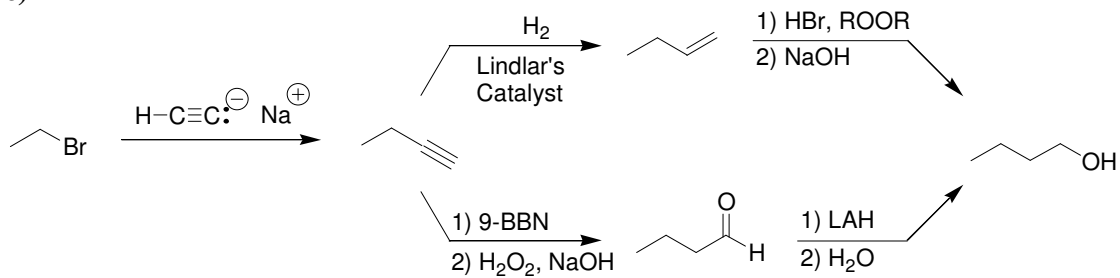




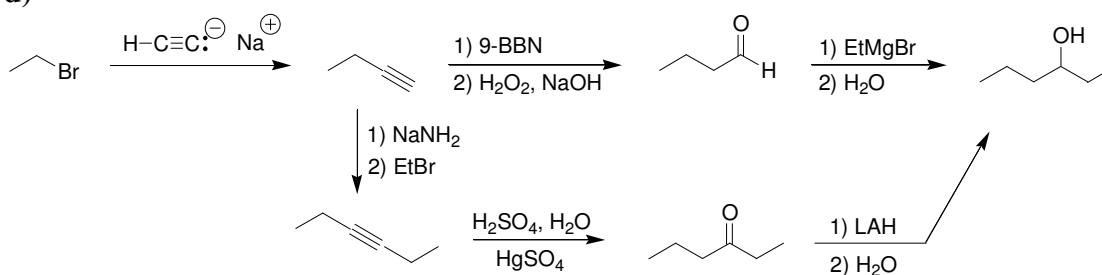
13.29.



c)



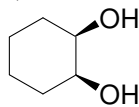
d)

**13.30.**

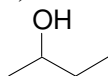
- 2-propyl-1-pentanol
- (*R*)-4-methyl-2-pentanol
- 2-bromo-4-methylphenol
- (*1R,2R*)-2-methylcyclohexanol

13.31.

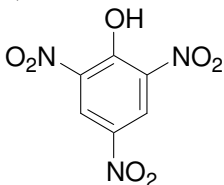
a)

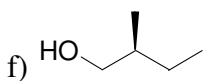
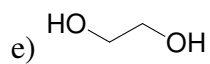
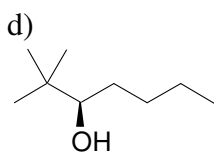


b)

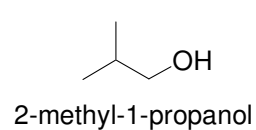
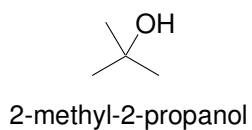
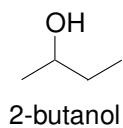
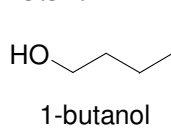


c)

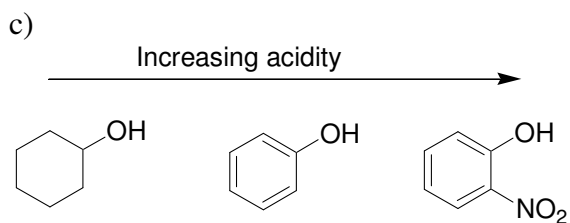
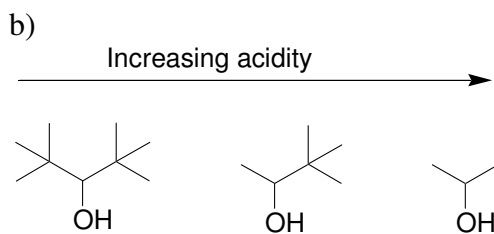
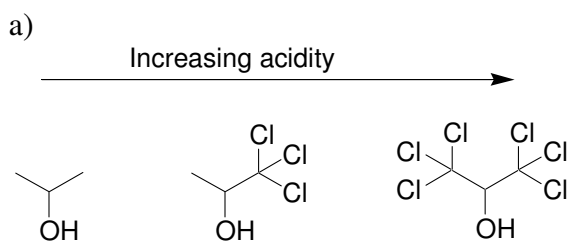




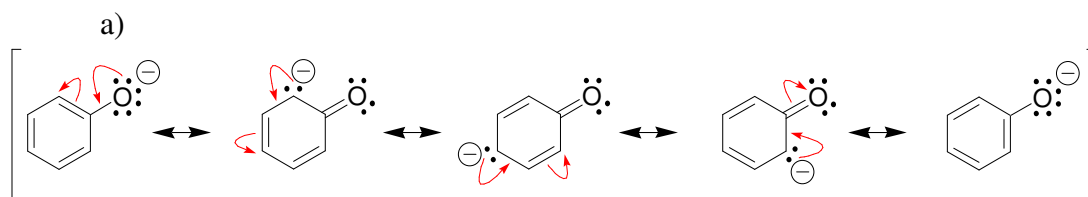
13.32.



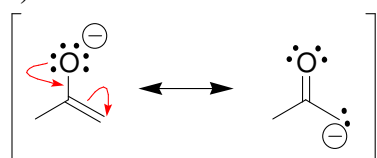
13.33.



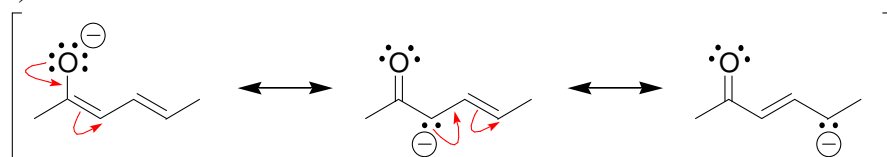
13.34.



b)



c)

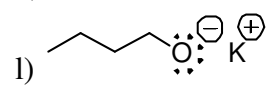
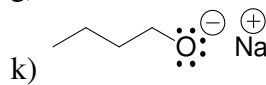
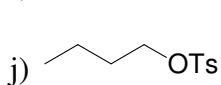
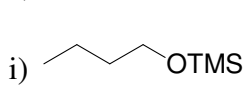
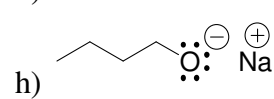
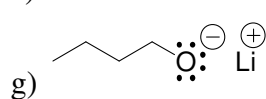
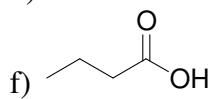
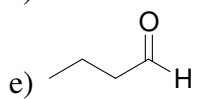


13.35.

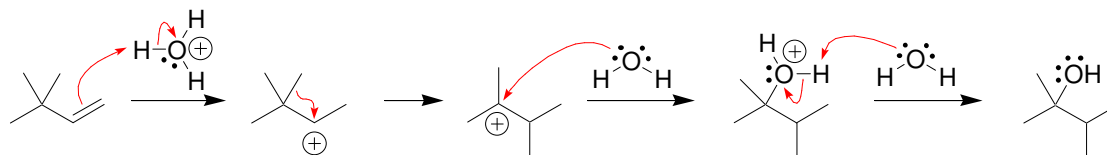
a) 1-bromobutane

b) 1-chlorobutane

c) 1-chlorobutane

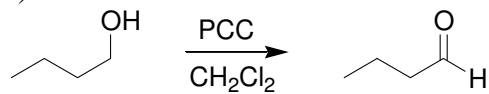
d) *trans*-2-butene

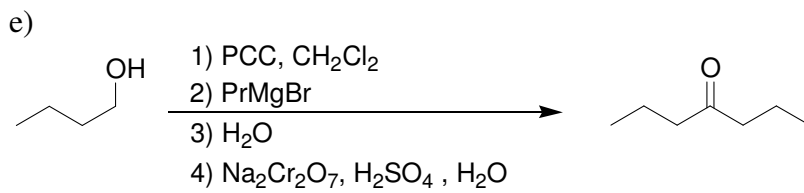
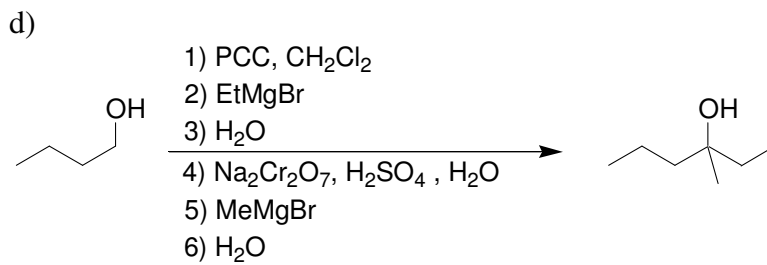
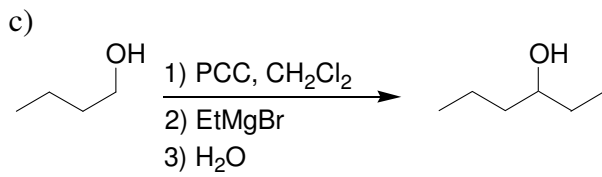
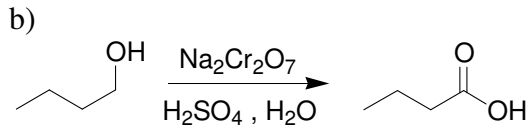
13.36.



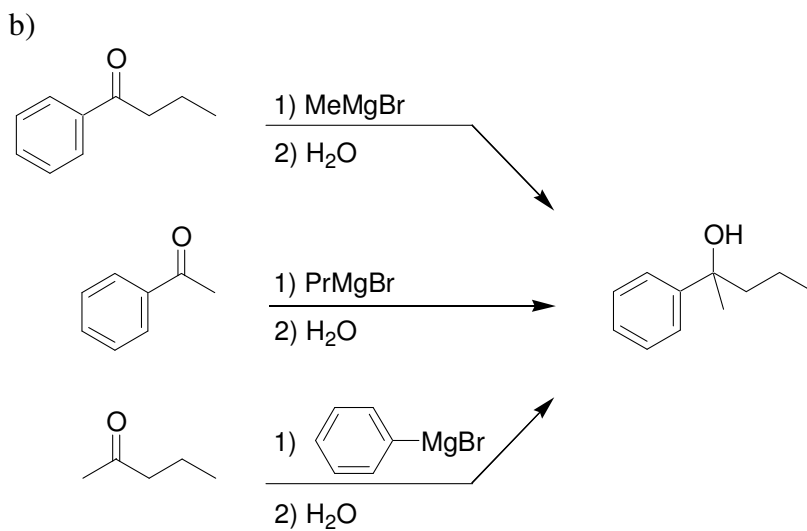
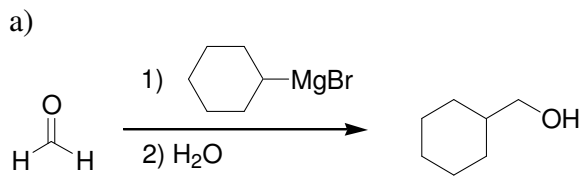
13.37.

a)

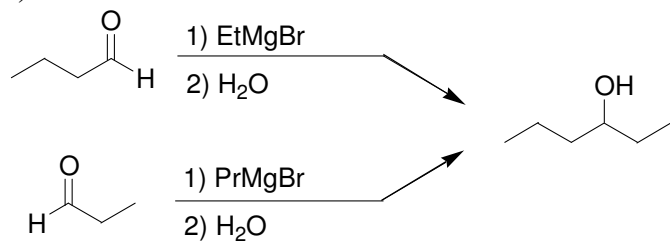




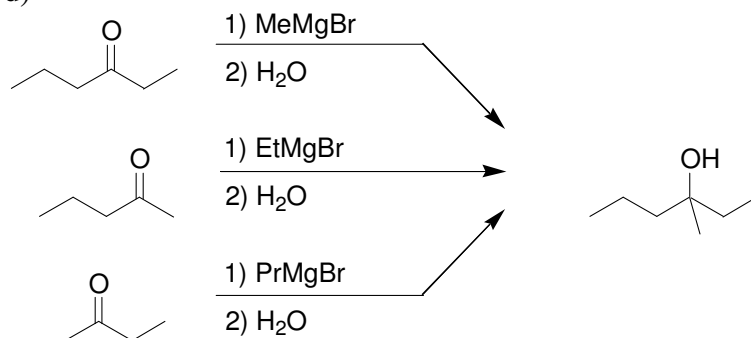
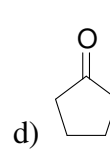
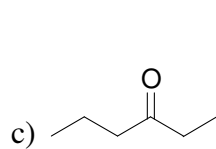
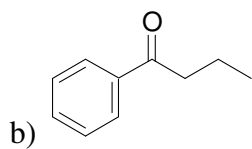
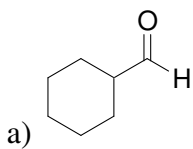
13.38.



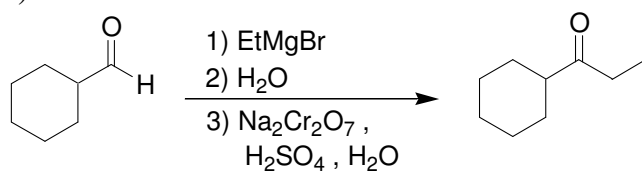
c)

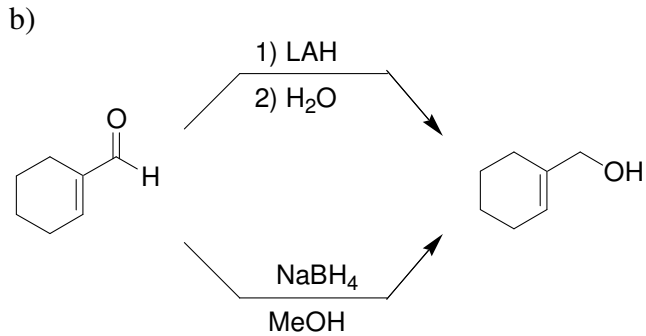


d)

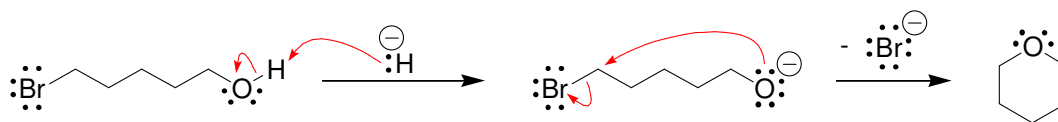
**13.39.****13.40.**

a)



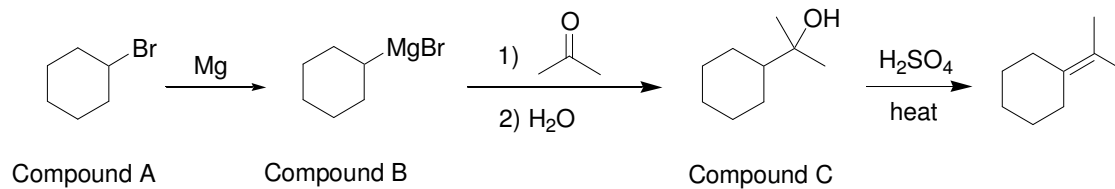


13.41.

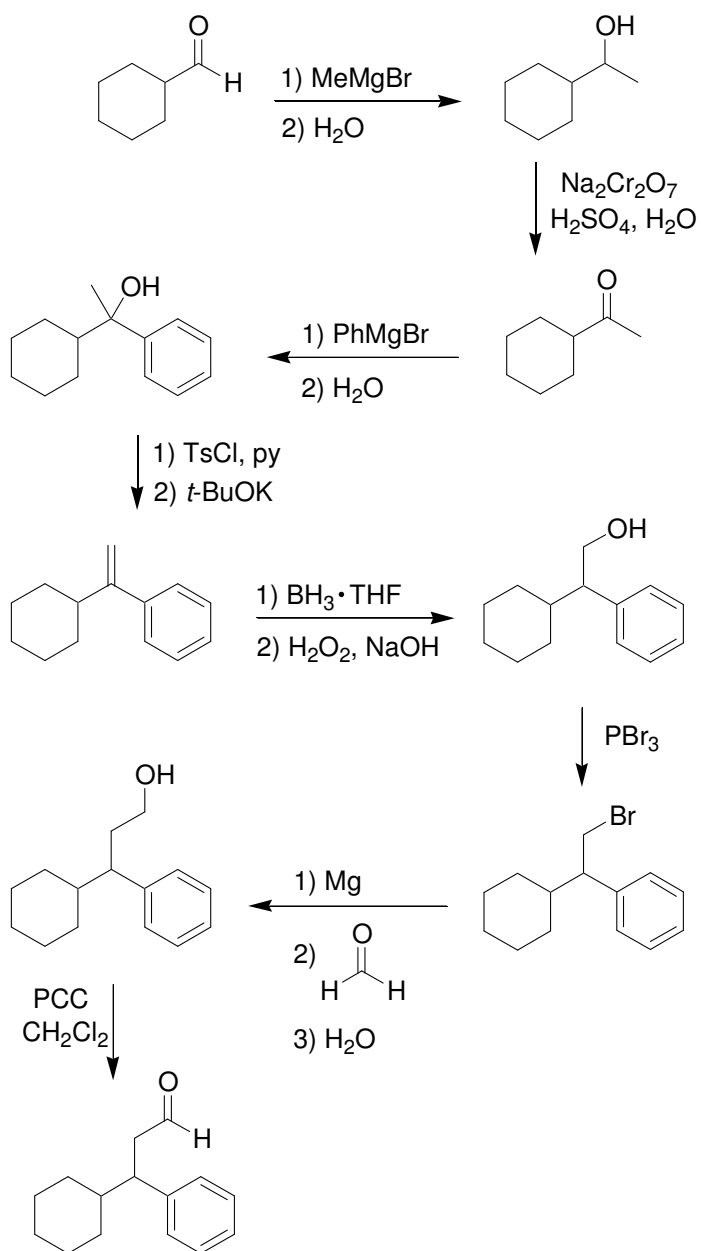


13.42. The major product is 1-methylcyclohexanol (resulting from Markovnikov addition), which is a tertiary alcohol. Tertiary alcohols do not generally undergo oxidation. The minor product (2-methylcyclohexanol) is a secondary alcohol and can undergo oxidation to yield a ketone.

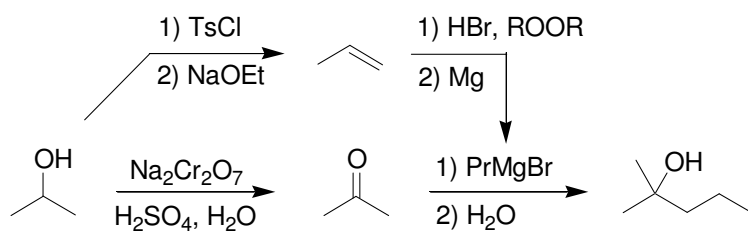
13.43.



13.44.

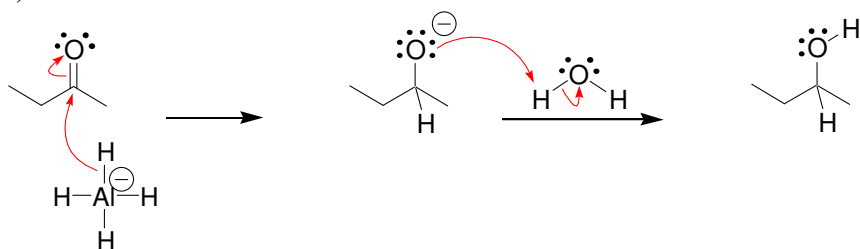


13.45.

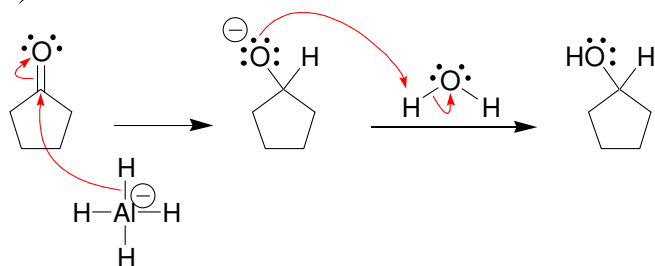


13.46.

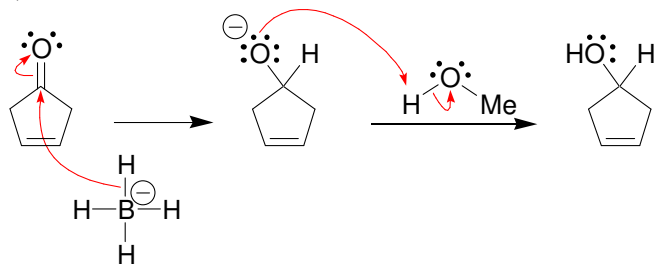
a)



b)

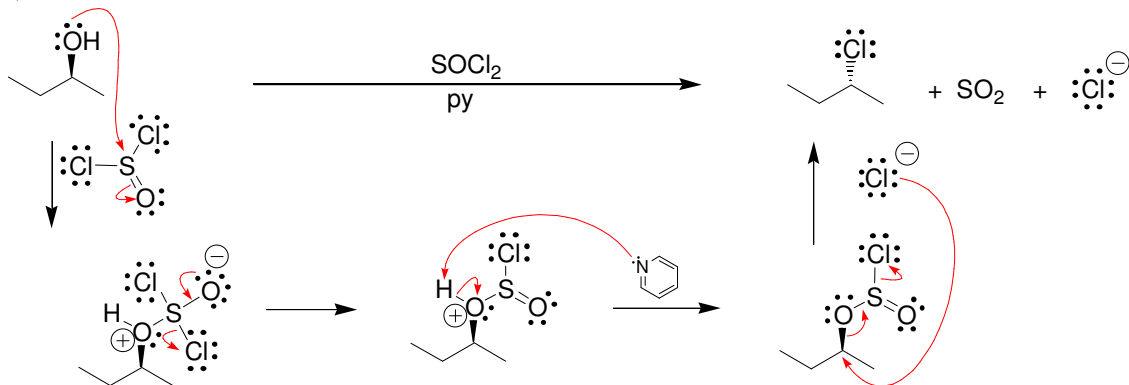


c)

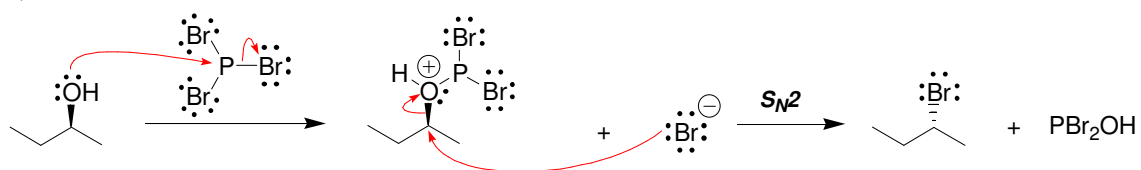


13.47.

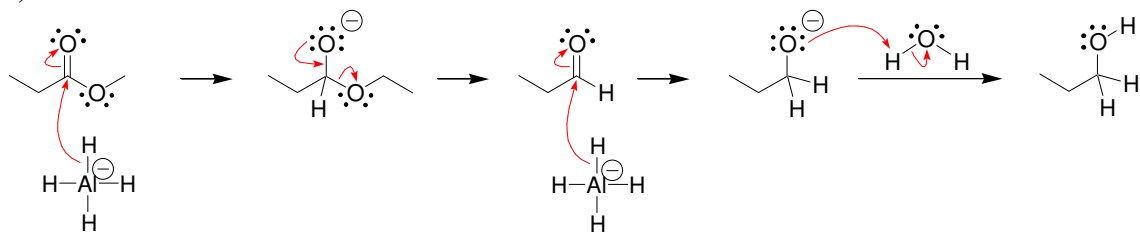
a)



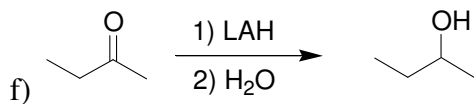
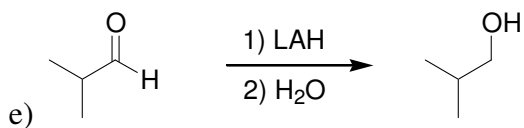
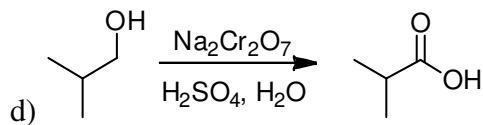
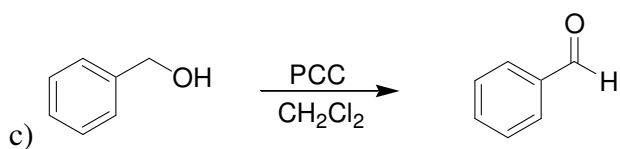
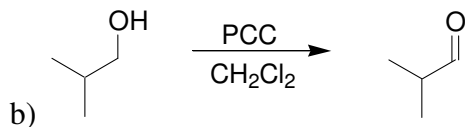
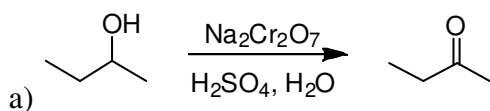
b)



c)

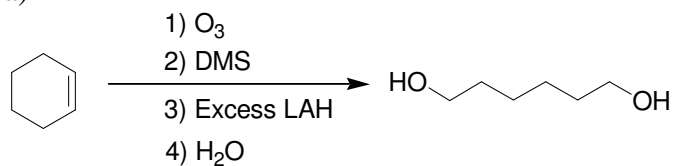


13.48.

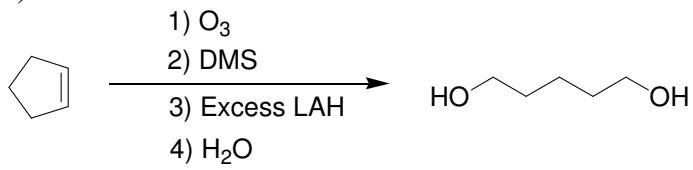


13.49

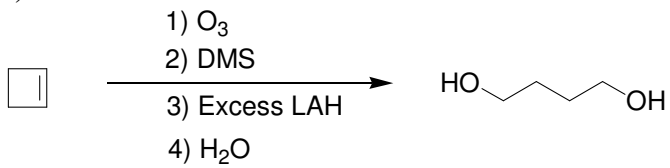
a)



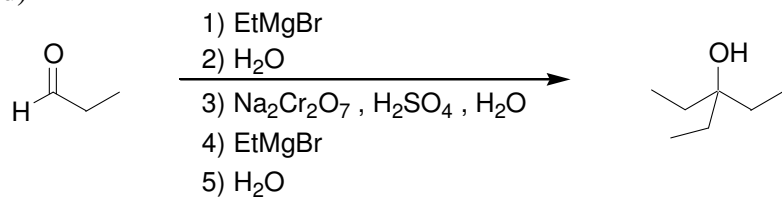
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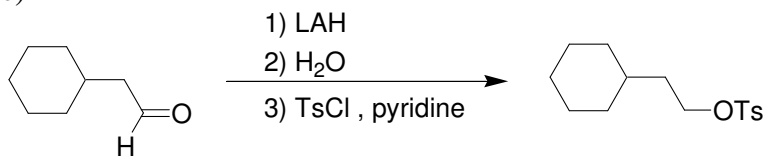
c)



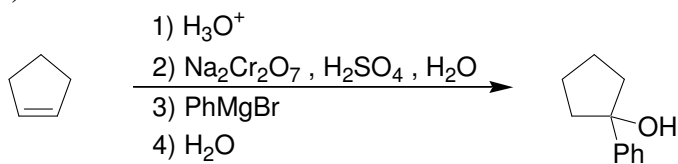
d)



e)

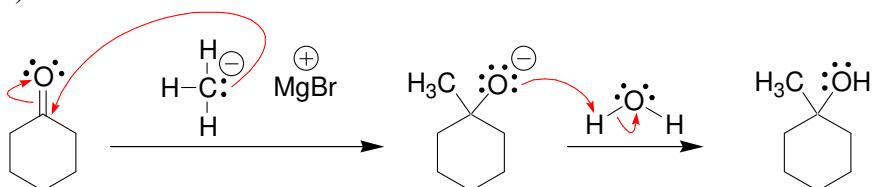


f)

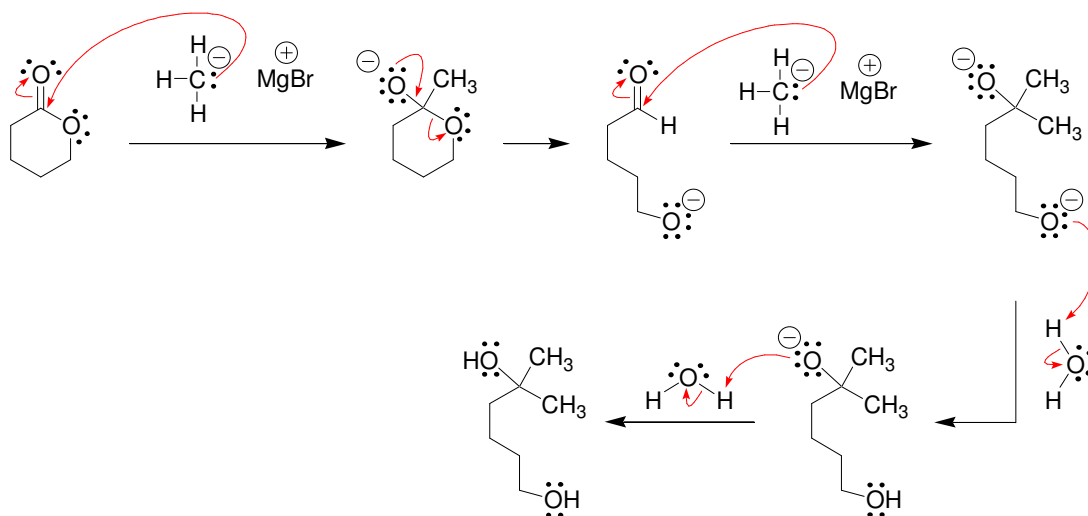


13.50.

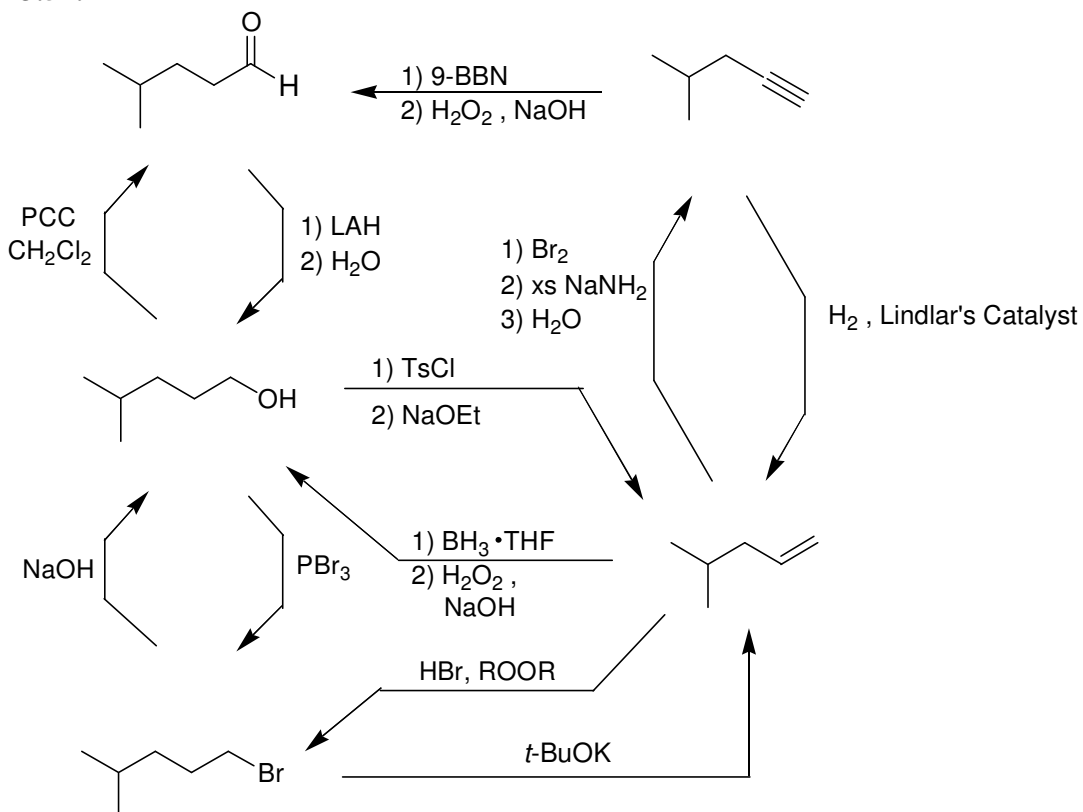
a)



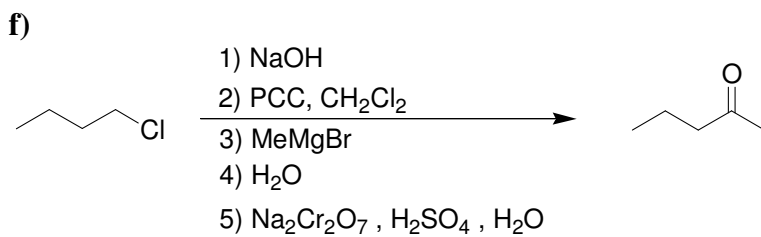
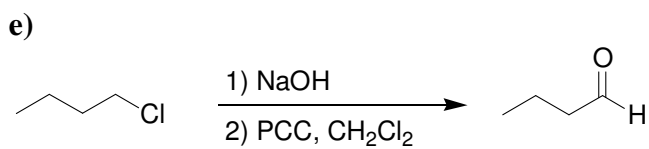
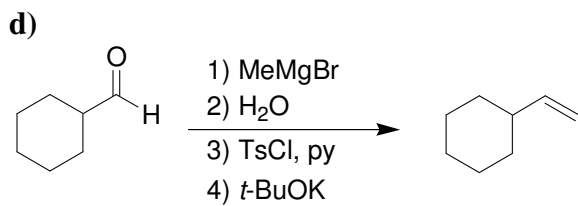
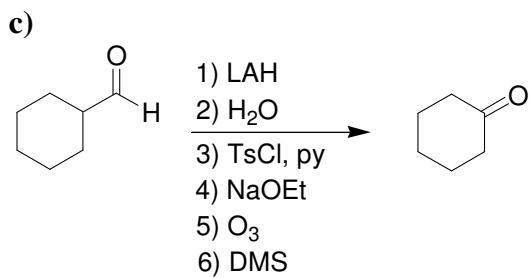
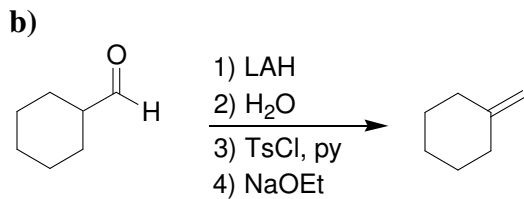
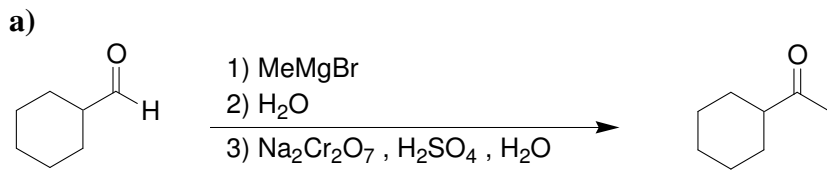
b)



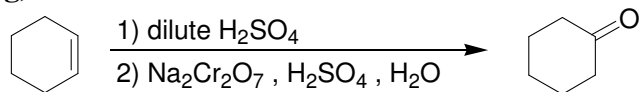
13.51.



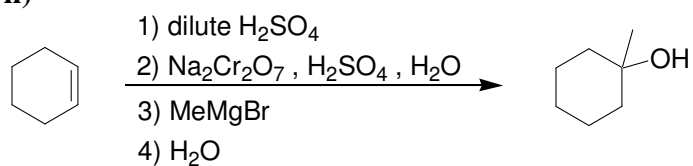
13.52.



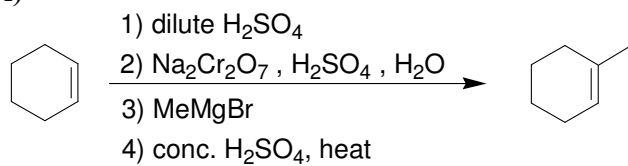
g)



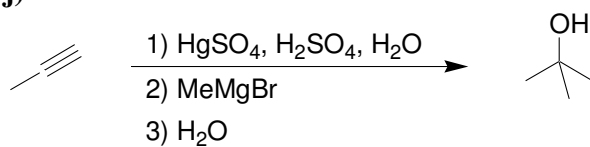
h)



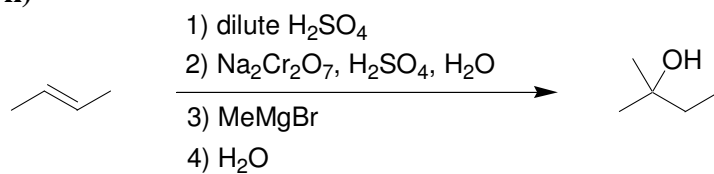
i)



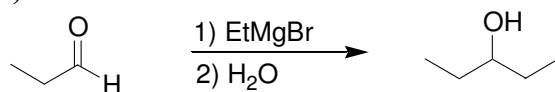
j)



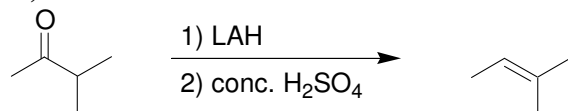
k)



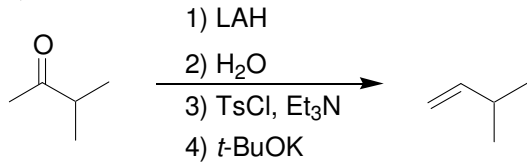
l)



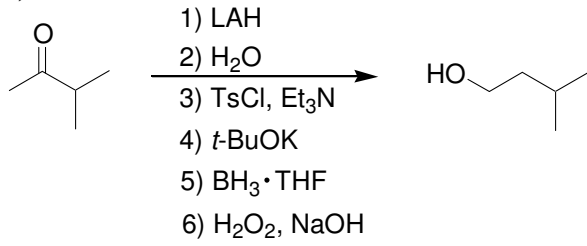
m)



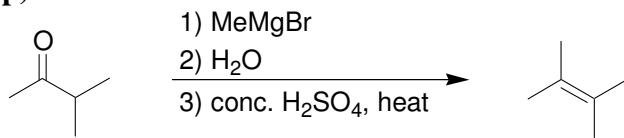
n)



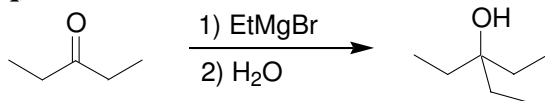
o)



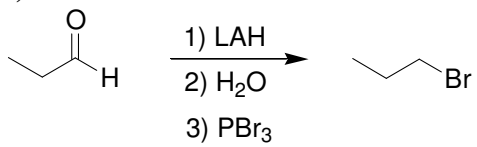
p)



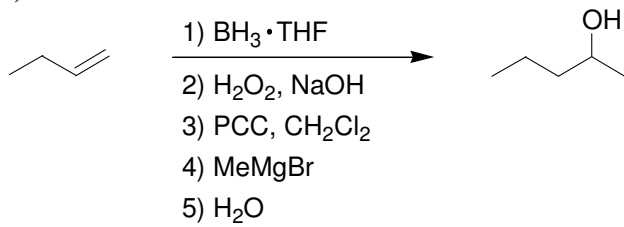
q)



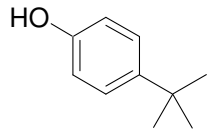
r)



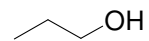
s)



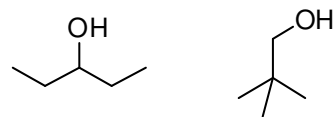
13.53.



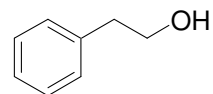
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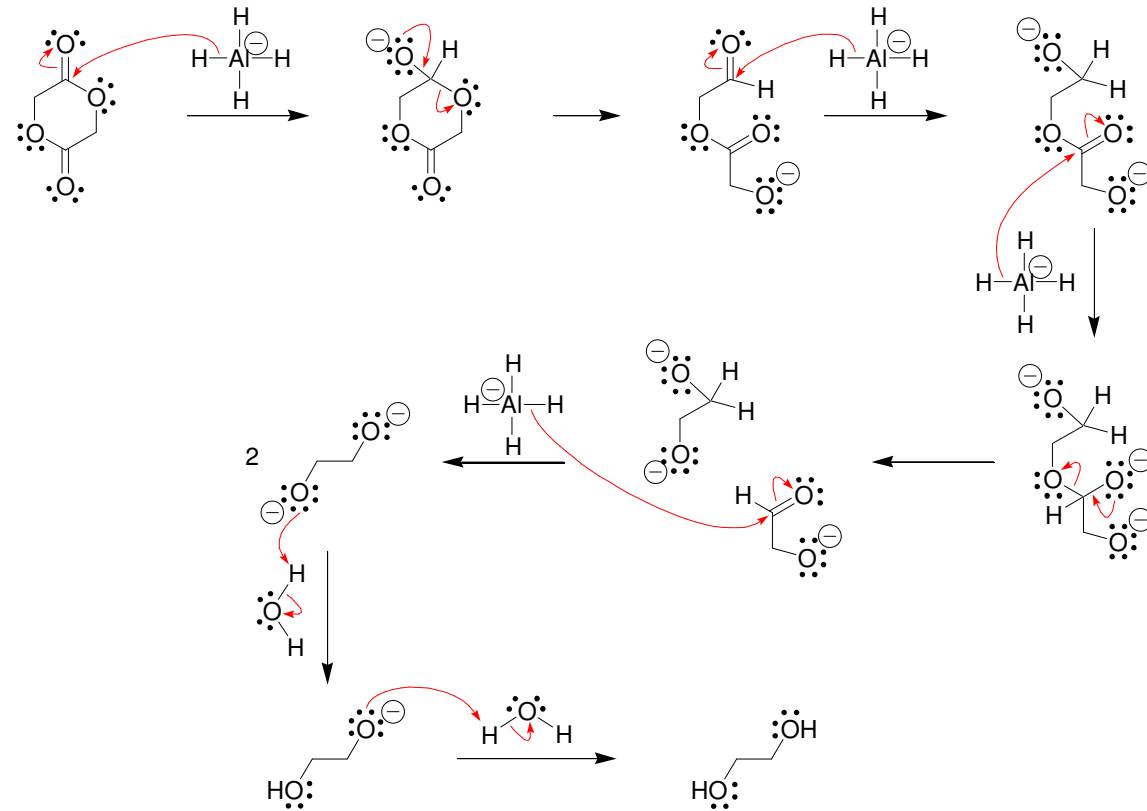
13.55.



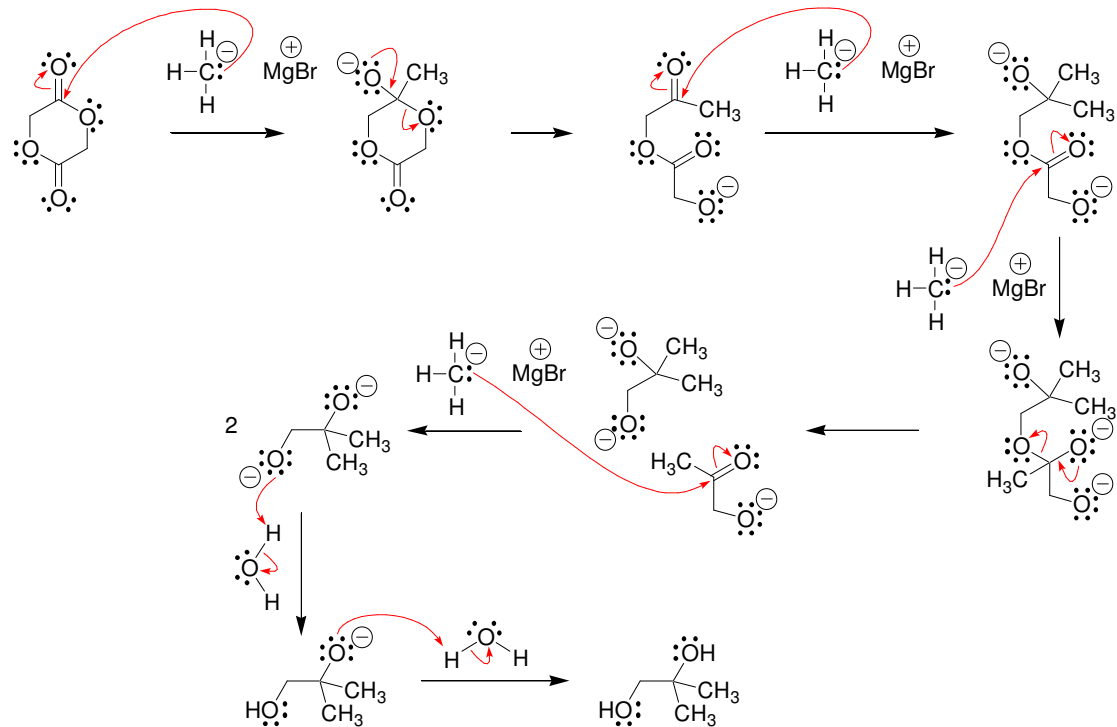
13.56.



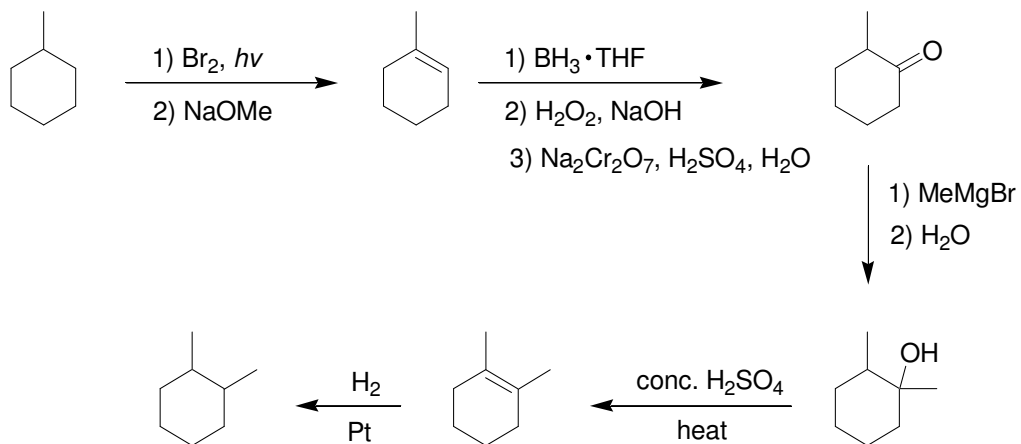
13.57



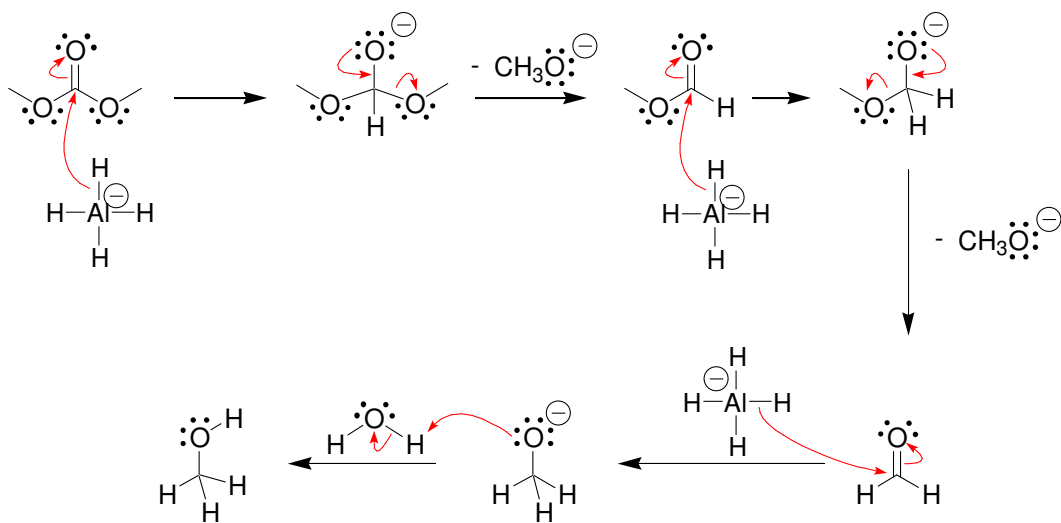
13.58



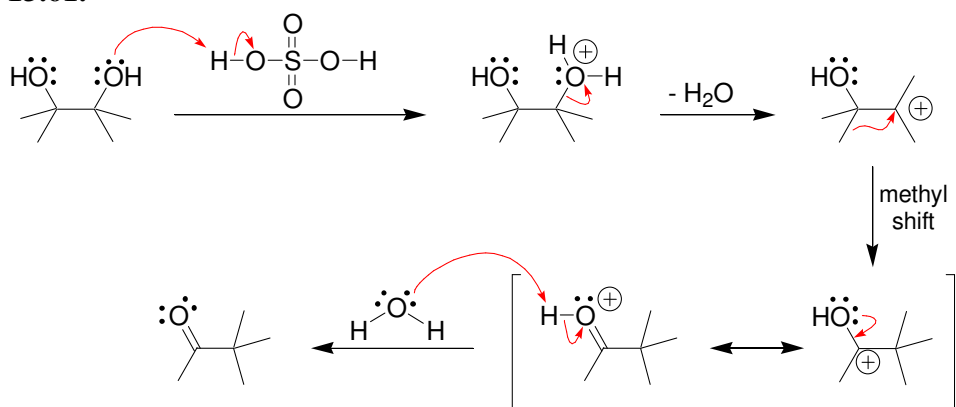
13.59



13.60.



13.61.



13.62. One carbon atom is oxidized from an oxidation state of +1 to an oxidation state of +2, while the other carbon atom is reduced from an oxidation state of +1 to an oxidation state of 0. Overall, the starting material does not undergo a net change in oxidation state and is, therefore, neither reduced nor oxidized.