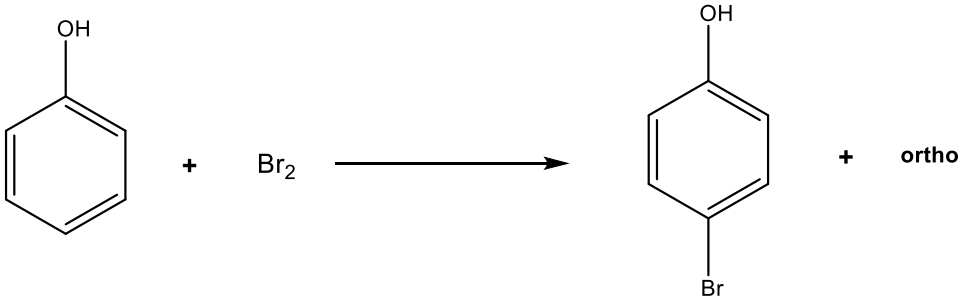
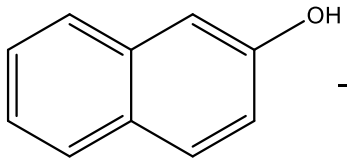
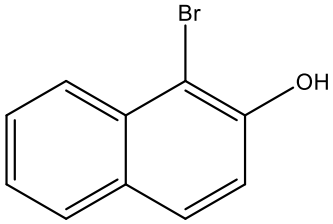
1. Phenol is sufficiently reactive in electrophilic aromatic substitution that it undergoes bromination even in the absence of a Lewis acid catalyst. Draw the structure of the arenium ion intermediate, $[C_6H_6BrO]^+$, in bromination at the para position and draw all of the important resonance structures for this intermediate.

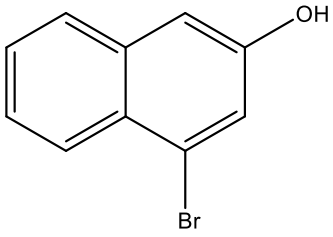


2. Choose the mono bromonaphthlene that would be predicted not to be a major product of the bromination of β-naphthol. (hint: examine the relative stabilities of the intermediates).

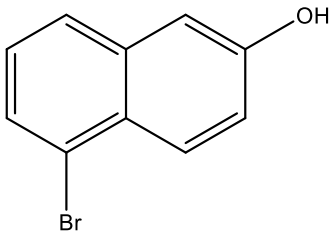




i



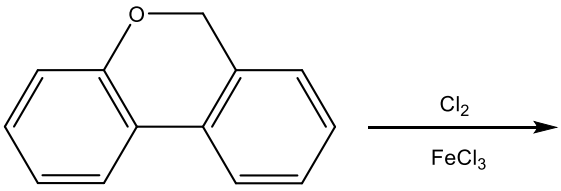
ii

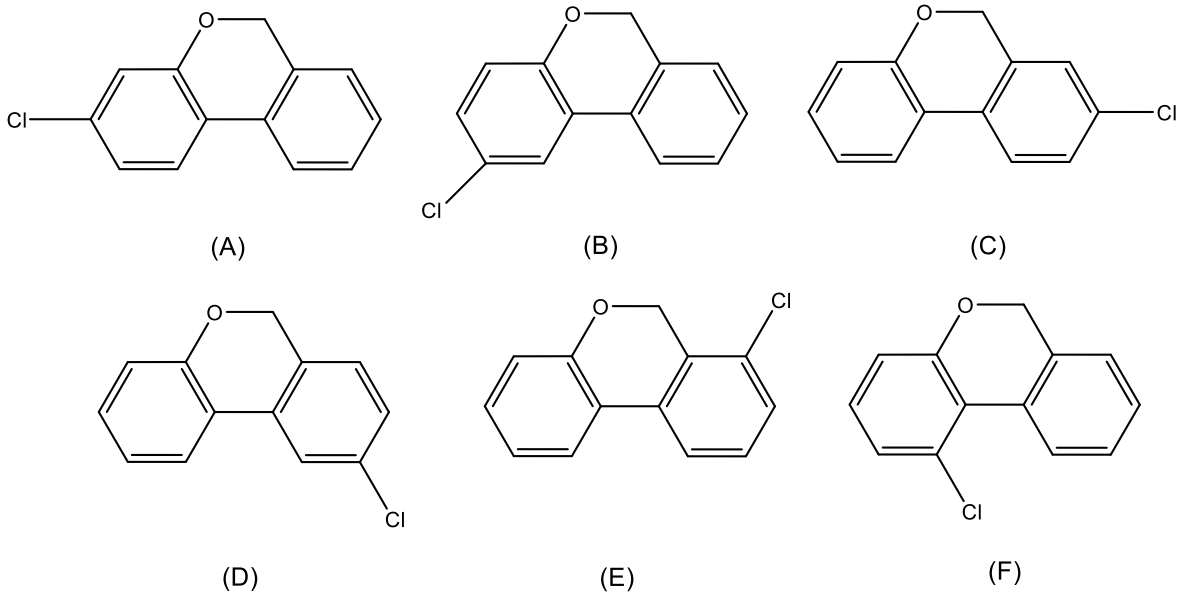


iii

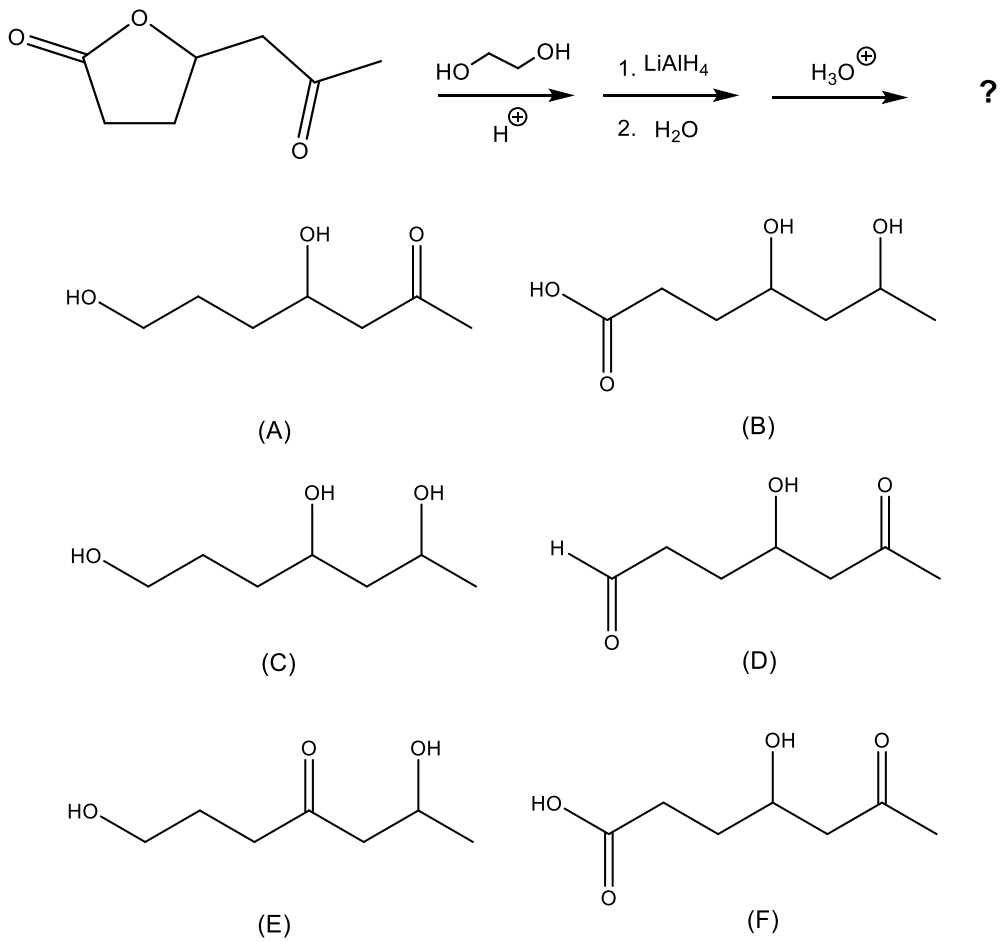
(A) i (B) ii (C) iii (D) ii +iii (E) i + ii (F) i + iii

3. Choose the major product of the following reaction.

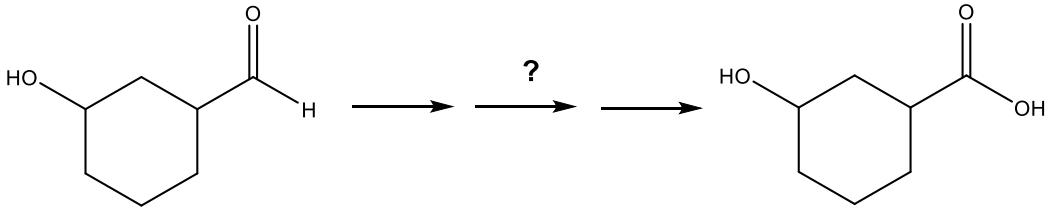




4. Choose the major product of the following reaction sequence.



5. Using only the oxidation and reduction reagents shown below, complete the following synthetic transformation.

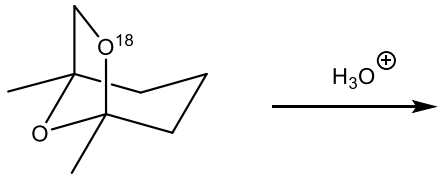


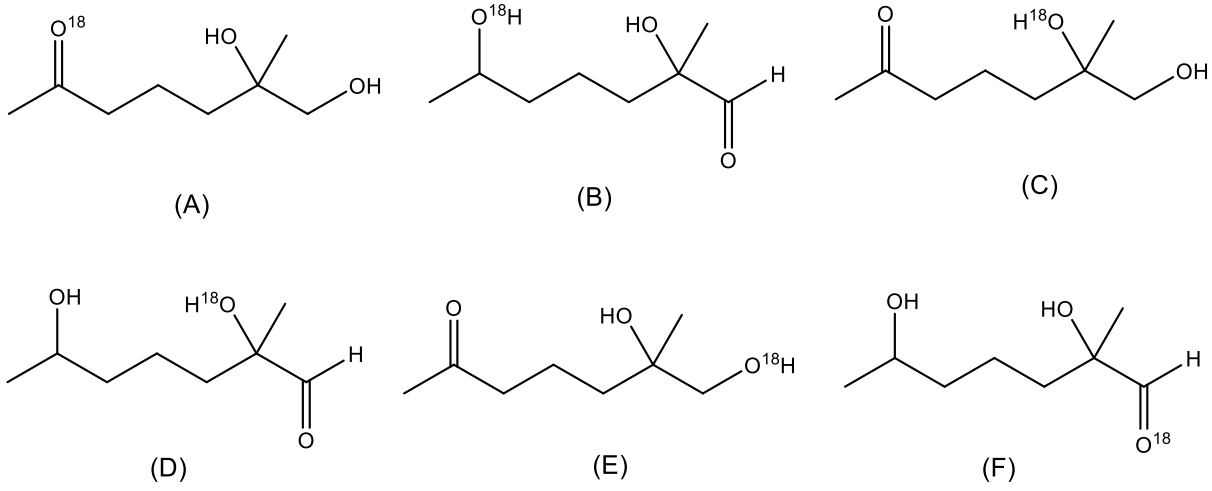
1. $NaBH_4$ 2. H_2O → 1. $LiAlH_4$ 2. H_2O → 1. DIBAL-H 2. H_2O → PCC → 1. H_2CrO_4 2. H_2O, acetone

1 **2** **3** **4** **5**

(A) 4 only (B) 5 only (C) 2, then 5
(D) 4, then 3 (E) 5, then 1 (F) 1, then 4

6. Choose the major product formed by hydrolysis of radiolabeled frontalin.

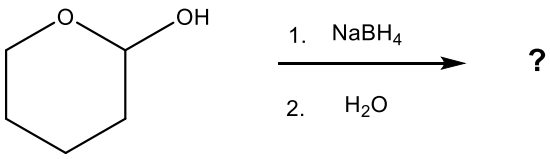




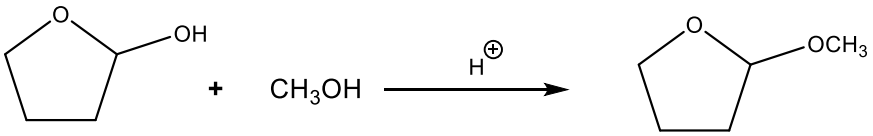
(A) (B) (C)

(D) (E) (F)

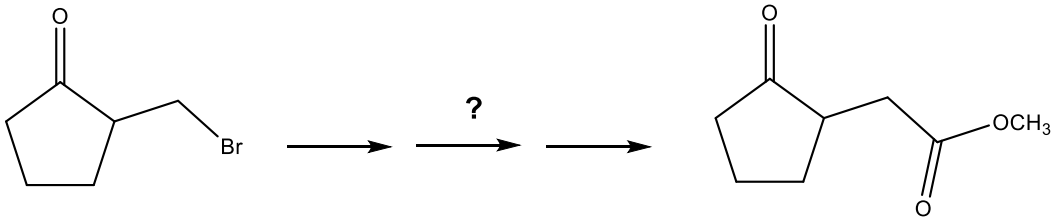
7. Predict and draw the major product of the following reaction.



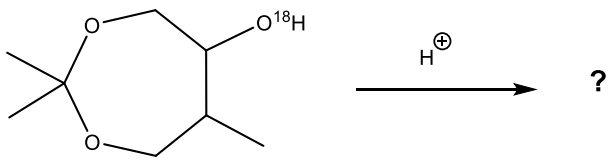
8. Using the curved arrow formalism, draw a stepwise mechanism showing all the bond breaking and bond making steps of the following acid-catalyzed conversion of the cyclic hemiacetal to the acetal shown. Draw all important intermediates.

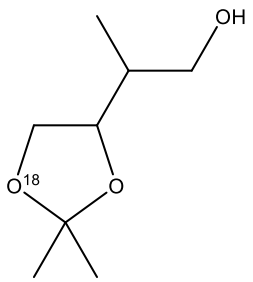


9. Propose a synthesis of the following keto ester starting from the bromide shown. You may use any reagents.

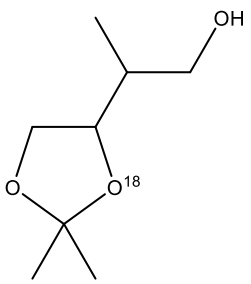


10. Select the major product(s) of the following isomerization reaction, which utilizes radiolabeling.

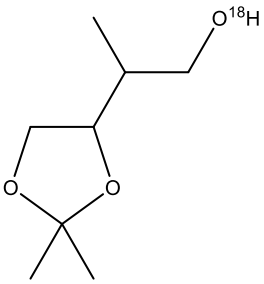




1



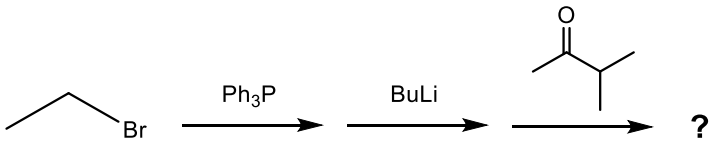
2

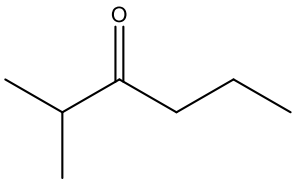


3

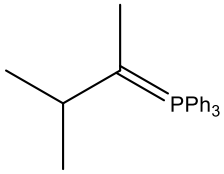
(A) 1 (B) 2 (C) 3 (D) 1 + 2 (E) 1 + 3 (F) 2 + 3

11. Choose the major product of the following reaction sequence.

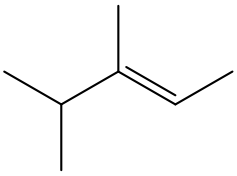




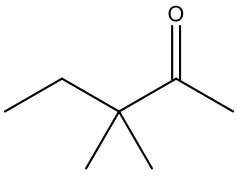
(A)



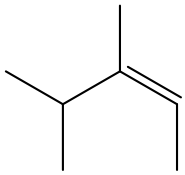
(B)



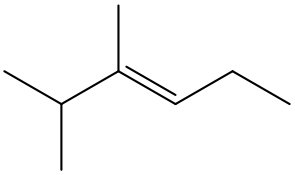
(C)



(D)

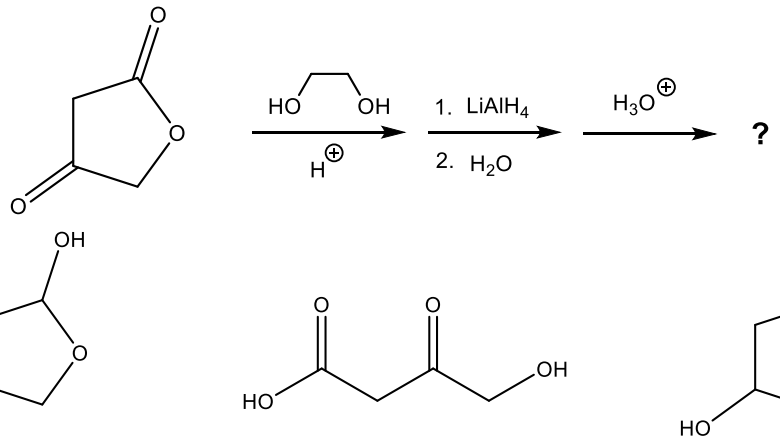


(E)

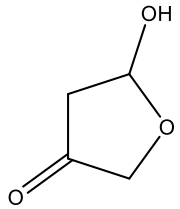


(F)

12. Select the major product of the following reaction sequence.

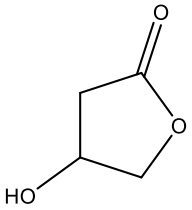


(A)

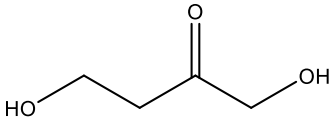


(B)

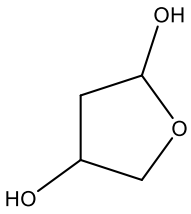
(C)



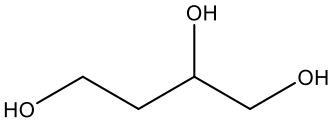
(D)



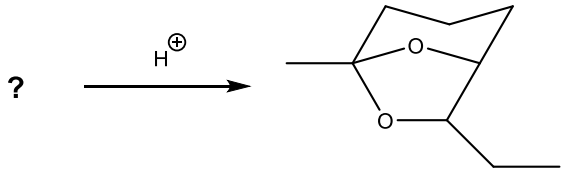
(E)



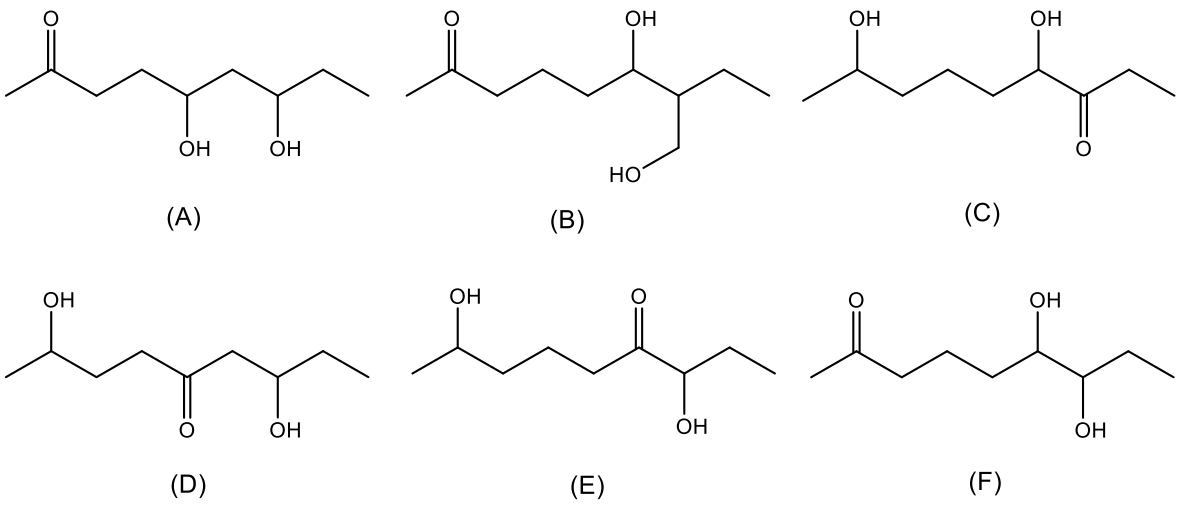
(F)



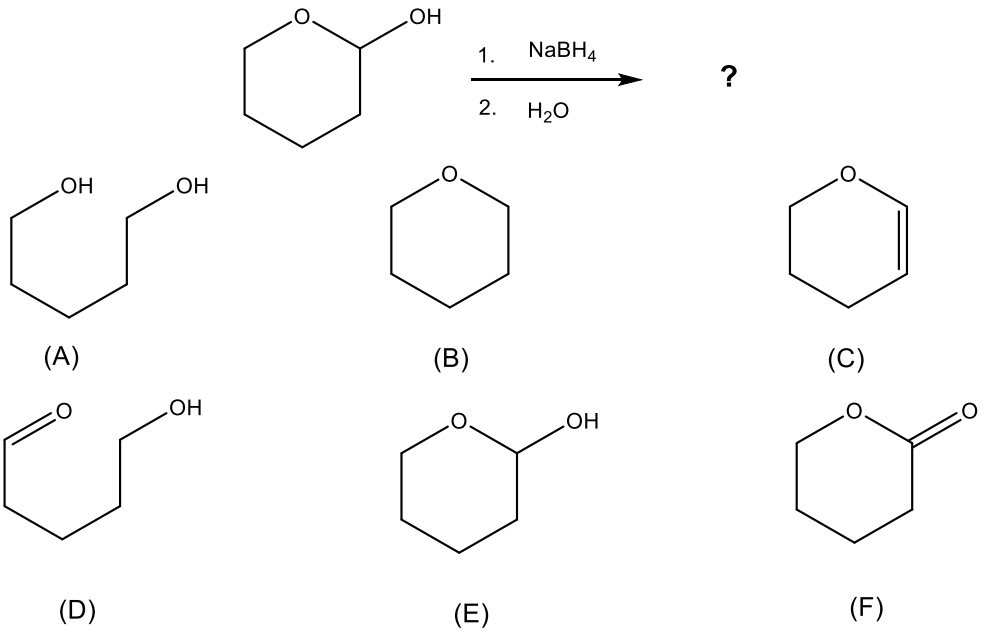
13. Choose the correct reactant to produce brevicomin, a natural product found in western pine beetles, upon reaction with concentrated acid.



brevicomin



14. Select the major product of the following reaction.

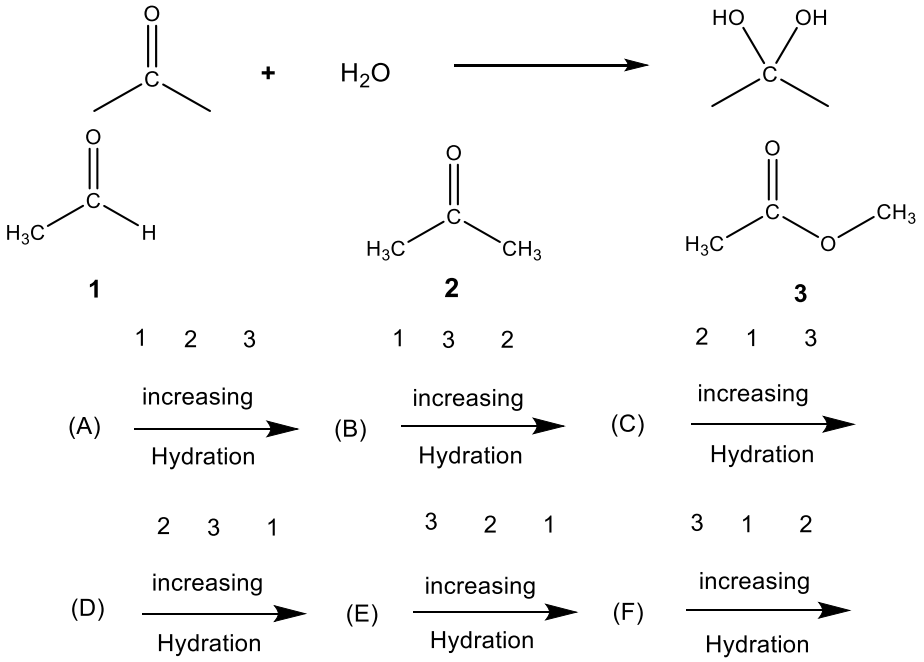


15. What is the value of n for Rh to have the Xe noble gas configuration?

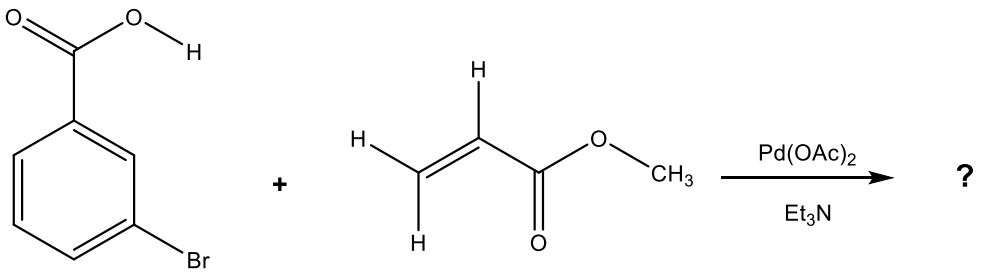
$$RhH_2Cl(PPh_3)_n$$

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4 (F) 5

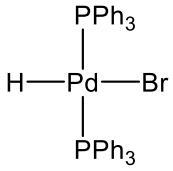
16. Choose the order that has the following carbonyl compounds correctly arranged with respect to increasing hydration.



17. Give the major product of the following reaction.

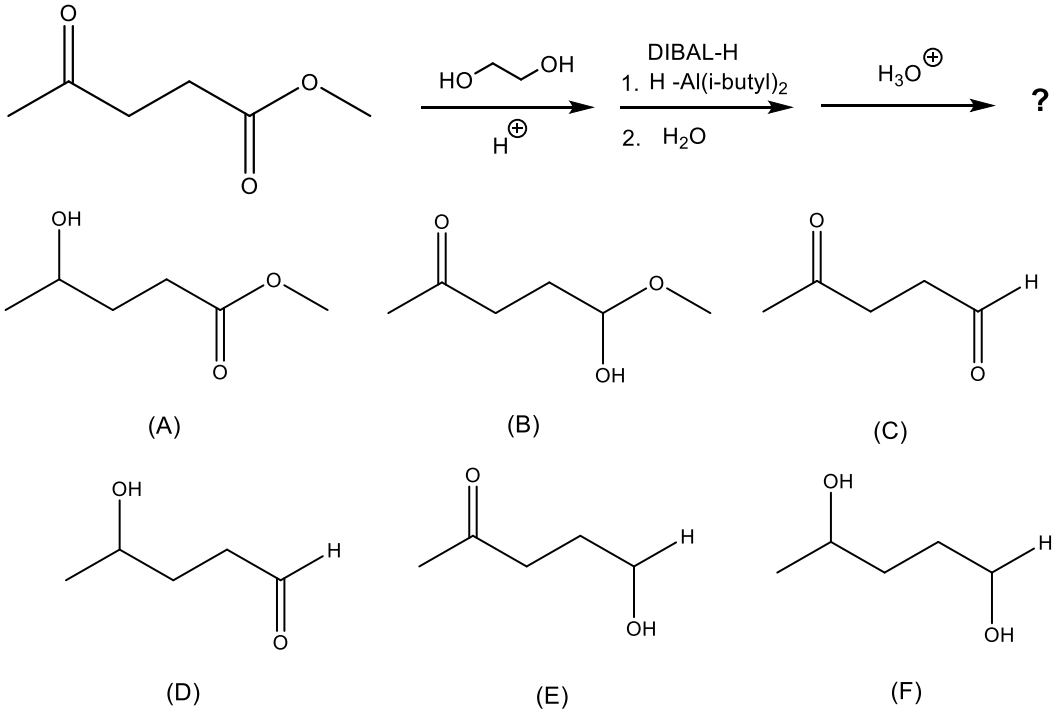


18. Choose the correct number of valence electrons palladium has in the following compound. Class quiz

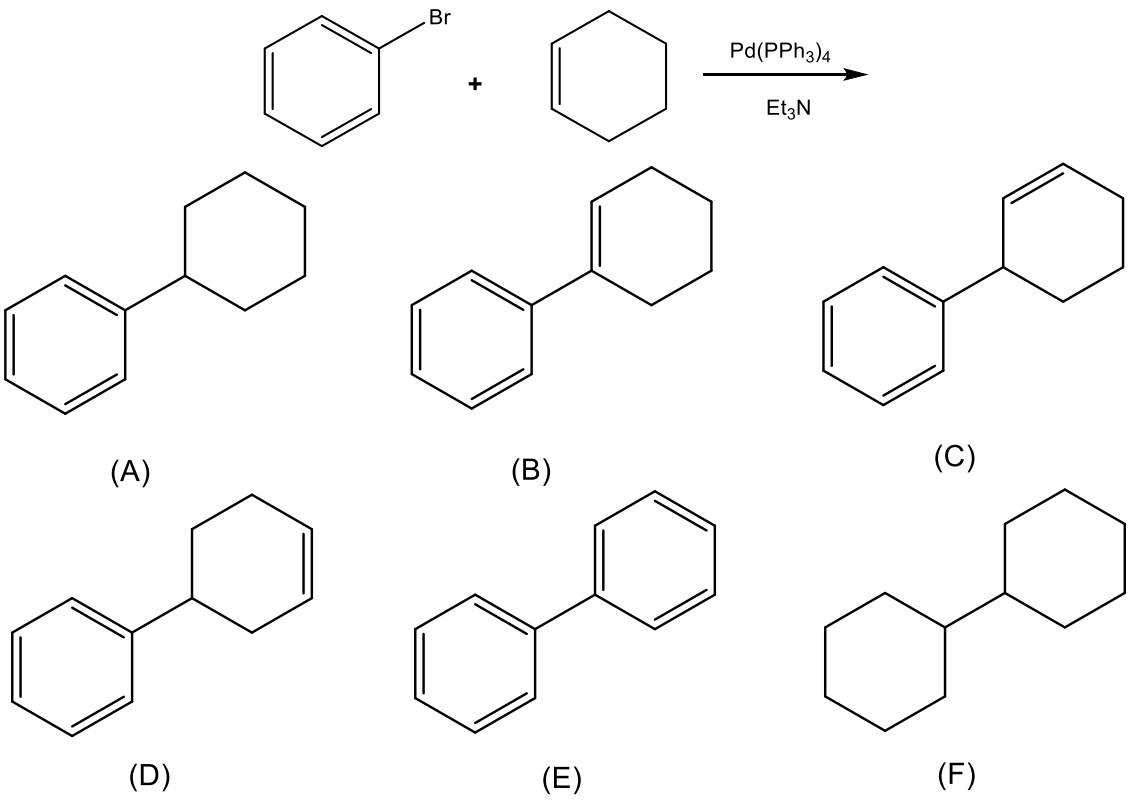


(A) 10 (B) 11 (C) 14 (D) 16 (E) 18 (F) 20

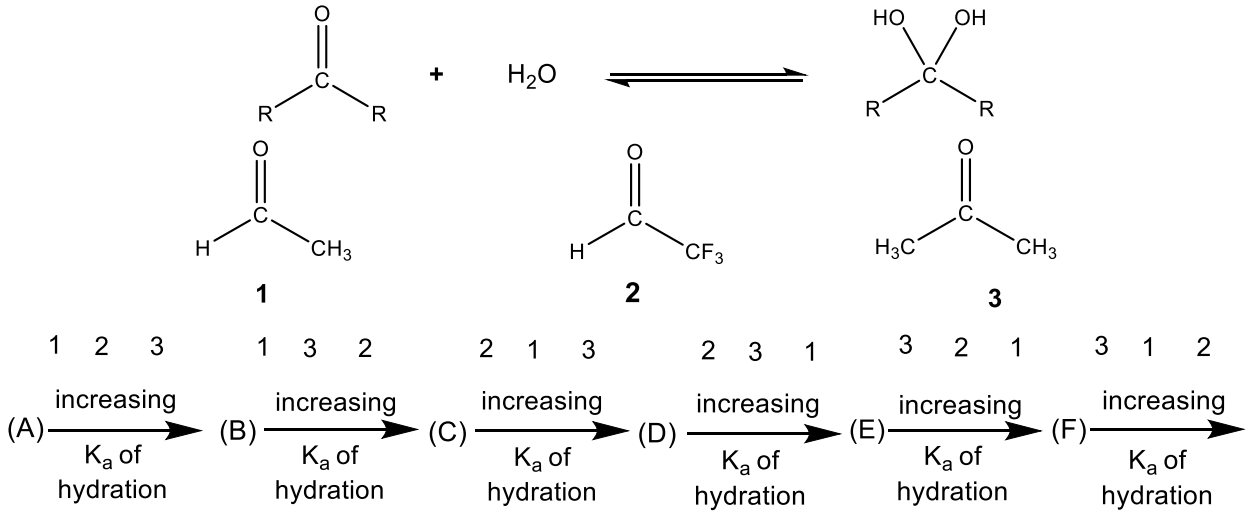
19. Select the major product of the following reaction sequence. (WS6 online quiz; q4)



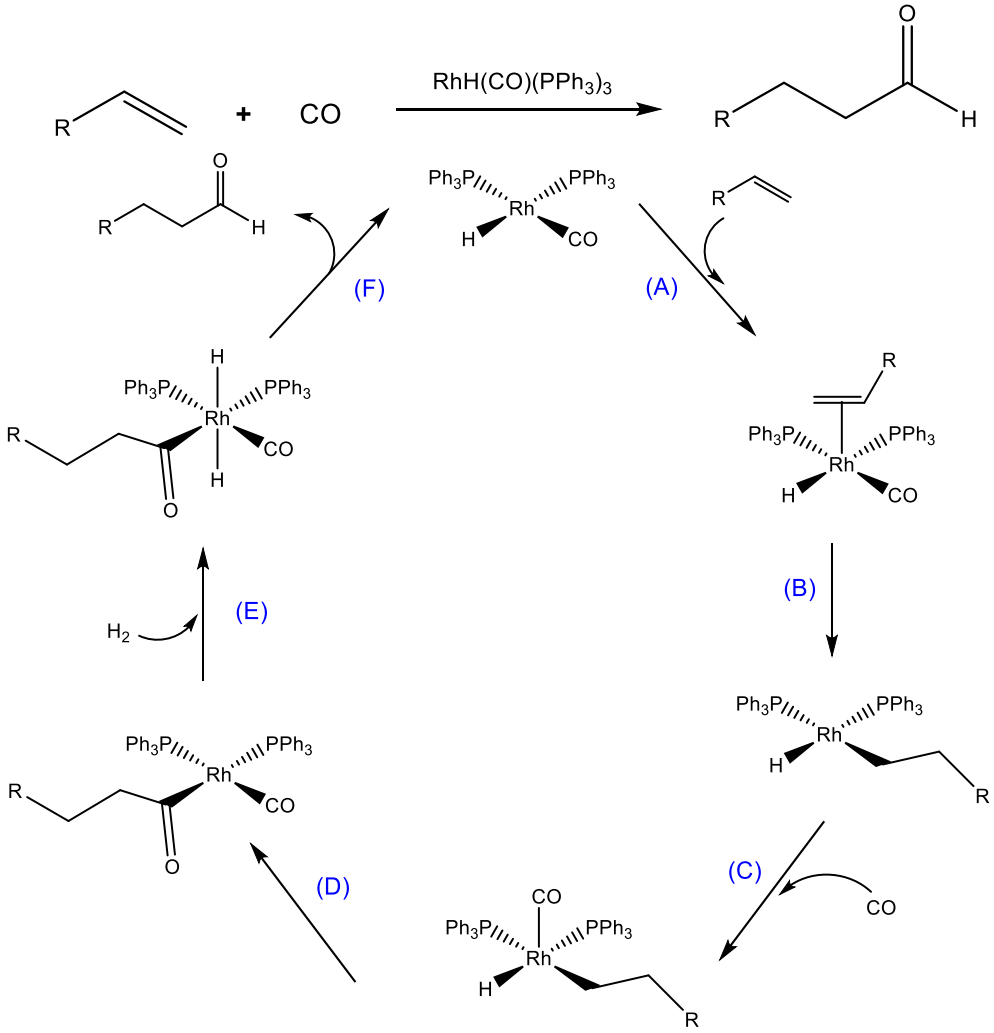
20. Choose the major product of the following reaction (hint: pay attention to the stereochemistry of the addition and elimination reactions).



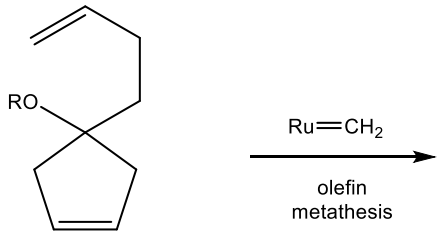
21. Choose the order that has the following carbonyl compounds correctly arranged with respect to their K_a of hydration.



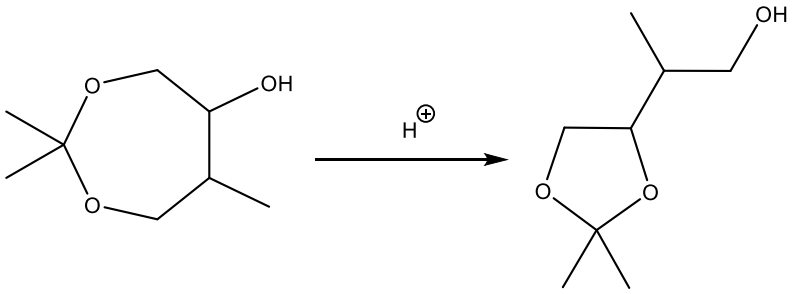
22. Select the reductive elimination step in the following organometallic reaction.



23. Predict the major product of the following reaction.



24. Using the curved arrow formalism show how the bond making and bond breaking occurs in the following reaction.



25. Frontalin is a chemical message of musk in Asian elephants. Propose a synthesis of frontalin from compounds containing four carbon atoms or less.