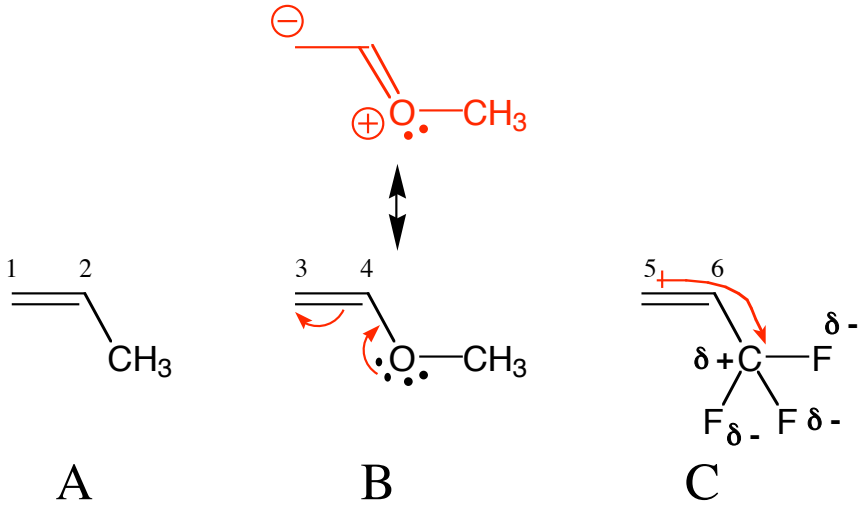
1. Answer the following questions concerning the three alkenes shown below. Your answer should use words and illustrations.



a) Which alkene would be *most* reactive with H^+? Why?

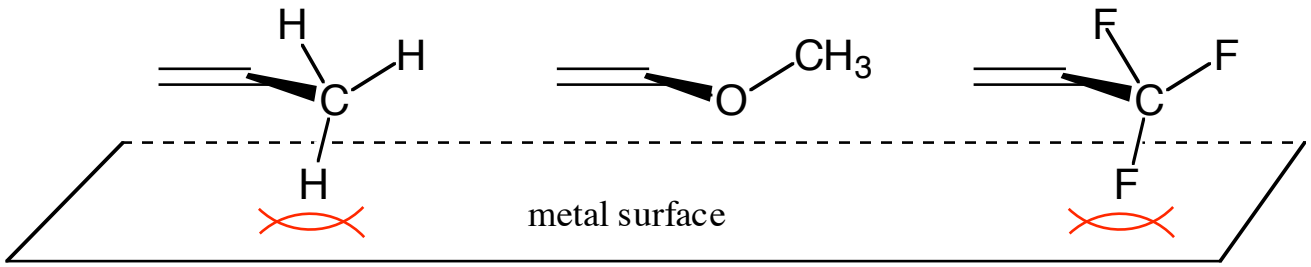
B – Resonance places a large amount of negative character on the double bond, making it a good nucleophile.

b) Which alkene would be *least* reactive with H^+? Why?

C – Induction electron density from the double bond, making it a poor nucleophile.

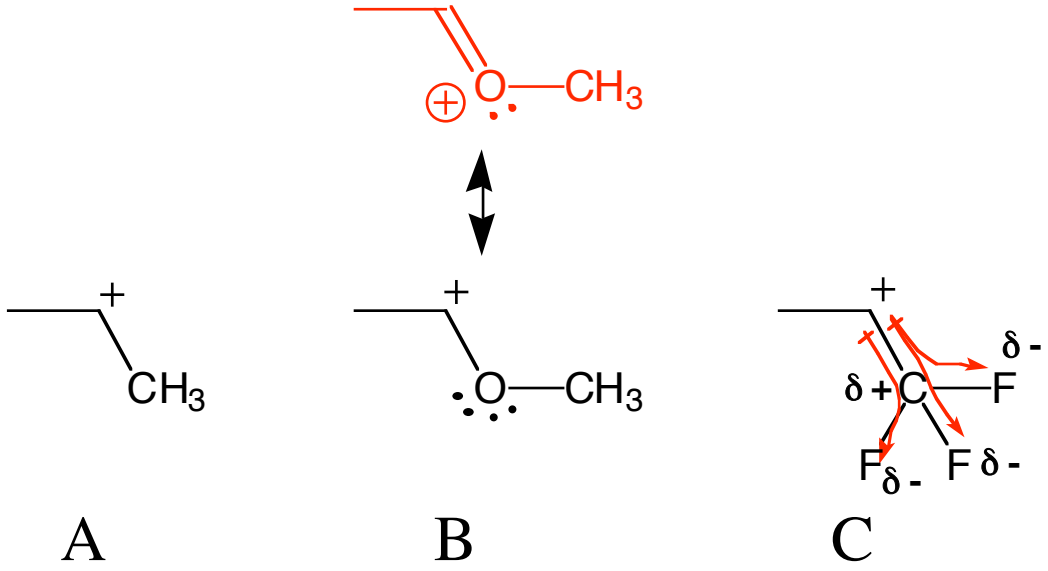
c) Which alkene would be most reactive under conditions of catalytic hydrogenation? Why?

Since no charges are formed in catalytic hydrogenation, the electrostatic arguments used above are less valid. One factor that may play a part is steric hindrance. Since the alkene must approach the metal surface to react, any bulky groups that might prevent the alkene from approaching the metal surface might slow down the reaction. B would be the least hindered since the methyl group can be pointed away from the metal, while the other substituents always have some part of it pointing towards the catalytic surface.

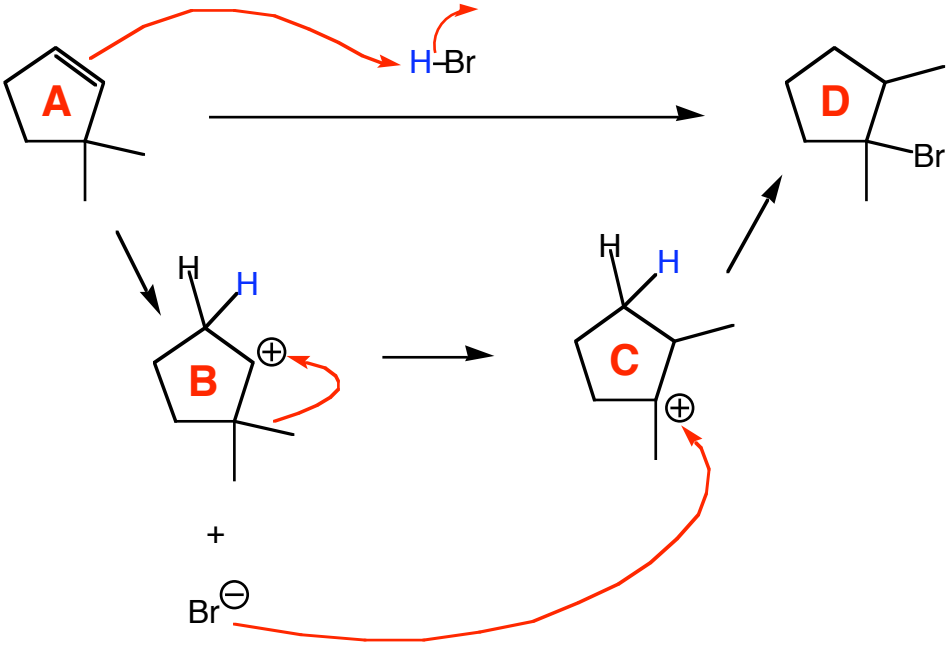


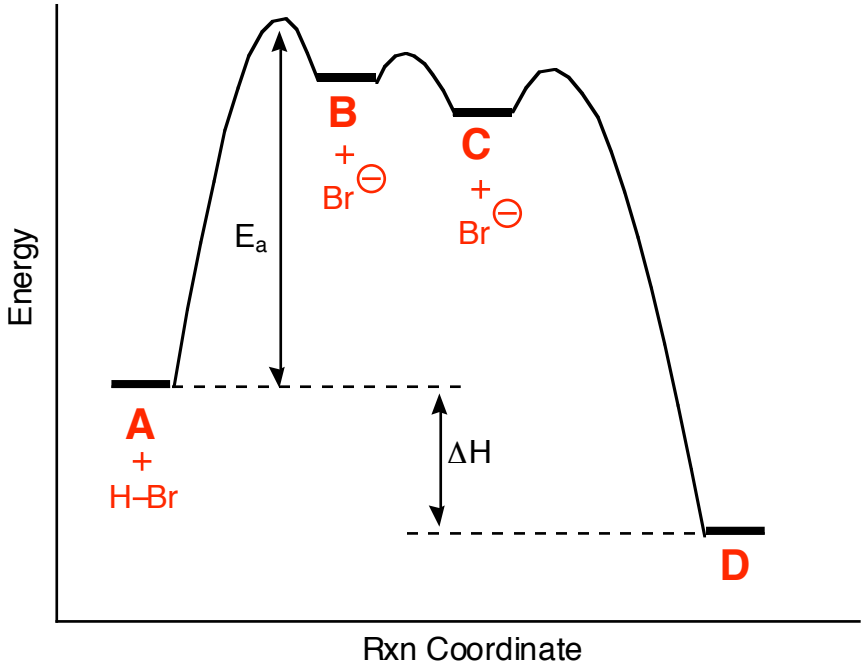
d) Will all three alkenes undergo Markovnikov addition of HBr? If not, which alkene or alkenes won't and why?

In both *A* and *B*, the carbocation leading to Markovnikov product is more stable than that leading to the anti-Markovnikov product. However, in *C*, the positive charge is even more localized by induction, making it the less stable carbocation. The stability favors the carbocation on the other carbon, leading to the correct product.

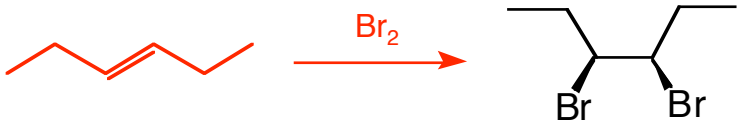


2. Provide a mechanism for the following reaction. Then, predict the reaction energy diagram for the entire reaction in the space provided. In your diagram, you must indicate the ΔH of the reaction, label the activation energy (E_a) of the rate-determining step, and clearly identify all intermediates and products of the reaction.



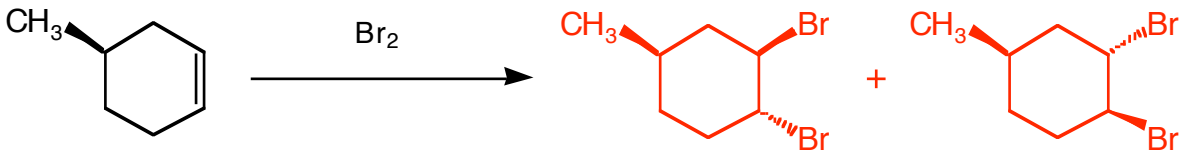


3. What starting materials & reagents are needed to produce the following compound?

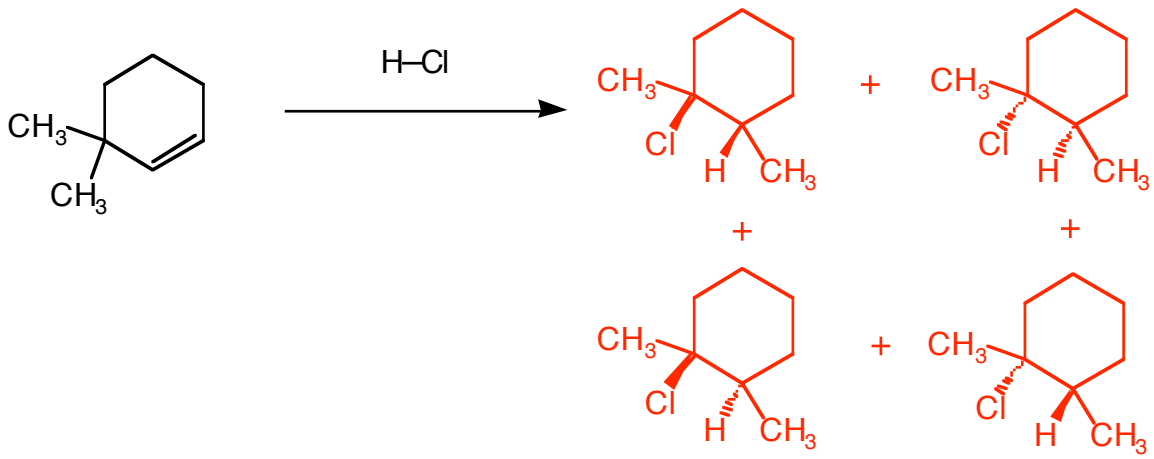


4. Draw the **major product** of each of the following reactions. *Be sure to include stereochemistry in your answers where appropriate.*

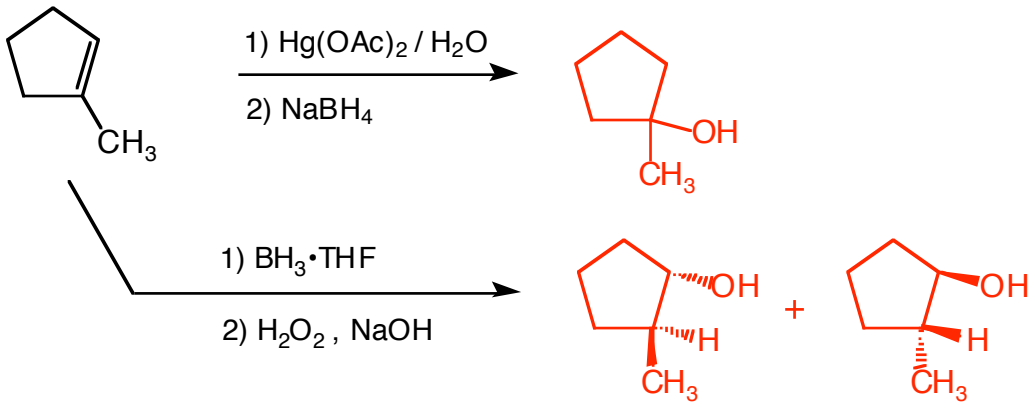
a)



b)



c)



d)