

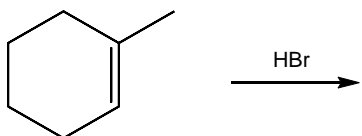
Practice Test Questions 11

Organic Reactions

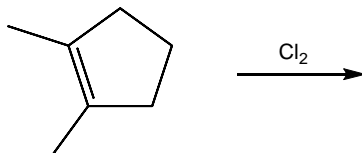
1. Which is the better nucleophile, water or hydroxide? **Briefly**, justify your answer (making sure to clearly define the term “nucleophile”).

2. For each of the reactions below, draw the major organic product(s).

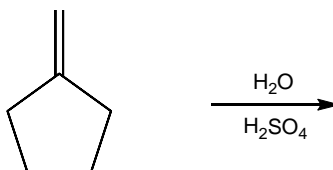
(a)



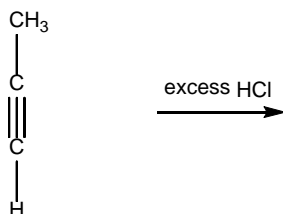
(b)



(c)

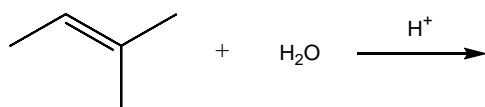


(d)



3.

(a) Draw the major organic product(s) of the following reaction:



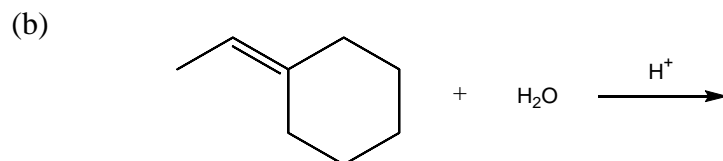
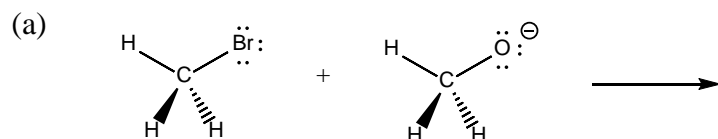
(b) The acid used in this reaction is frequently H₂SO₄. **Briefly**, explain why HCl would be a poor choice of acid for this reaction.

4. There are six isomers (including both structural isomers and stereoisomers) with the molecular formula C_4H_8 .
- Draw all six isomers of C_4H_8 .
 - Identify which isomers will react with HCl . For those reactions which proceed, draw the product.
 - Identify which isomers will react with Br_2 . For those reactions which proceed, draw the product.

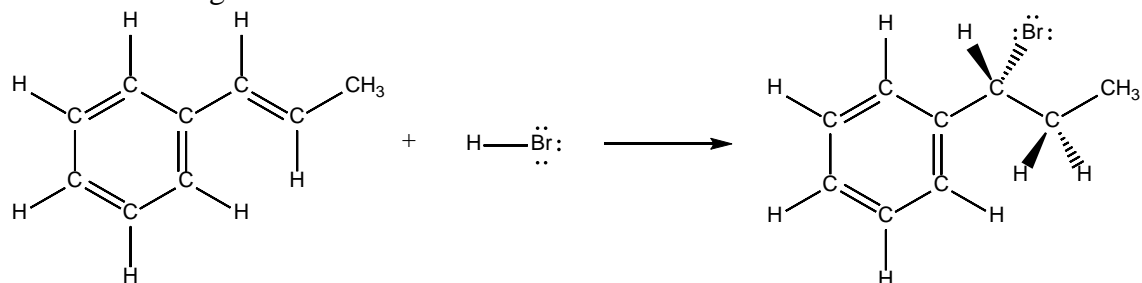
5.

- There are three alkynes with the molecular formula C_5H_8 . Draw all three.
- Draw an alkene with the molecular formula C_5H_8 . Your answer should not be a diene.
- Write a balanced chemical equation (using structures not formulas) for the reaction between your answer to part (b) and Br_2 .
- Write a balanced chemical equation (using structures not formulas) for the reaction between your answer to part (b) and water in the presence of an acid catalyst.

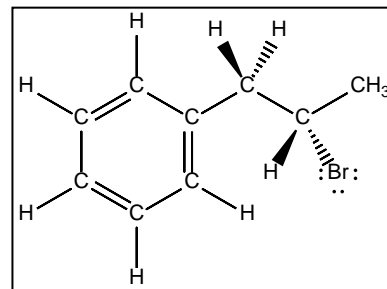
6. Draw the major product(s) of the following reactions and classify each reaction type.



7. Consider the following reaction:



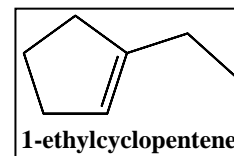
- To which of the main categories of organic reaction does this belong?
- Draw a mechanism using curly arrows to show electron movement for this reaction.
- Explain why the product above is formed rather than the product in the box below.



8. As you learned in CHEM 2000, alkenes react with HCl, HBr or HI to give the corresponding addition product.

(a) Give a balanced chemical equation for the reaction between 1-ethylcyclopentene (*structure shown below*) and HBr. You must draw the structures of all organic reactants and products. No credit will be given for molecular formulas of organic compounds.

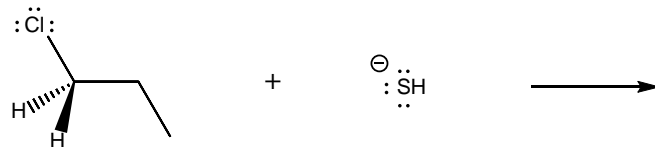
(b) Briefly explain why alkenes do not react in the same way with HF.



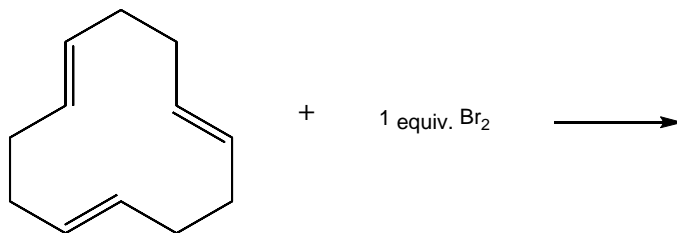
9.

(a) Predict the major organic product(s) for each of the following reactions:

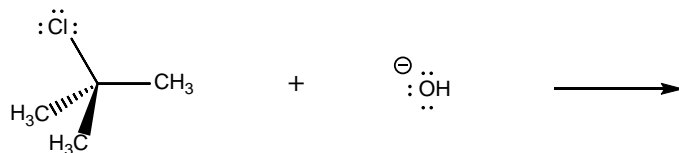
i. Substitution:



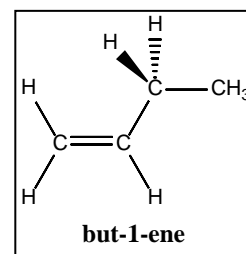
ii. Addition:



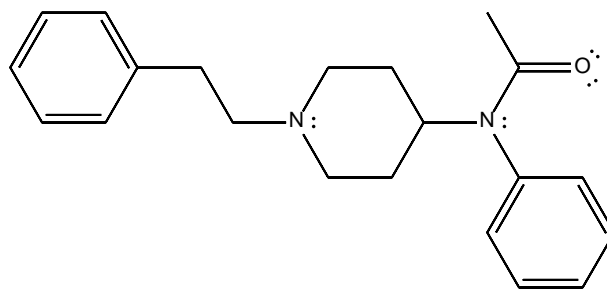
iii. Elimination



(b) State Markovnikov's rule and explain why it usually works. Use the addition of HCl to but-1-ene to illustrate your answer.

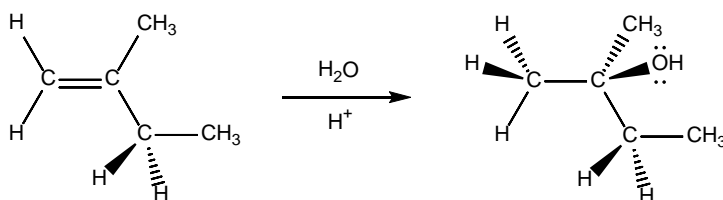


10. Fentanyl is an opioid pain medication. Fentanyl abuse is killing many Canadians. The structure of fentanyl is given below.

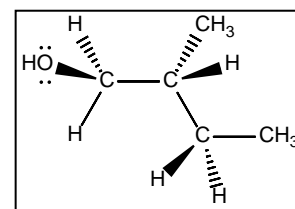


- (a) Identify (by circling the appropriate atoms on the structure) and name (either on the structure or below) all functional groups present in the fentanyl structure.
- (b) Specify which atom(s) of the C=O moiety (component) will be electrophilic and which will be nucleophilic.

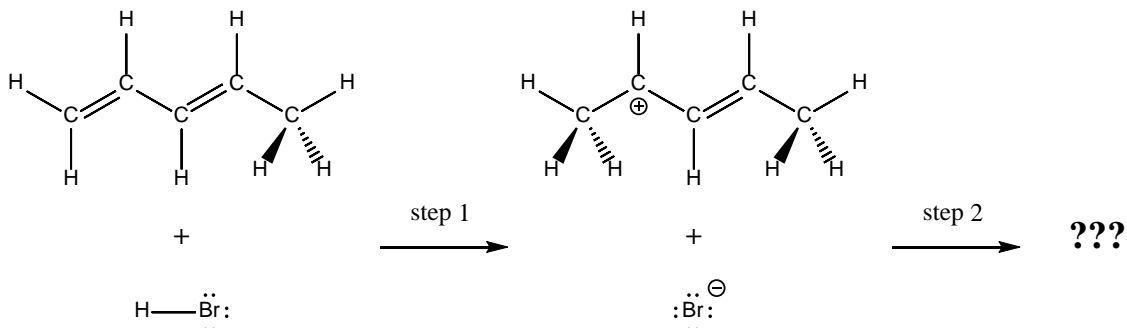
11. Consider the following reaction:



- (a) To which of the main categories of organic reactions does this belong?
- (b) Draw a stepwise mechanism using curly arrows to show electron movement for this reaction.
- (c) Explain why the product above is formed rather than the product shown in the box below.



12. Consider the following two-step reaction:



- (a) Add curly arrows to show the movement of electrons in the first step of this reaction. Do this directly on the drawing above.
- (b) Draw a valence π molecular orbital energy level diagram for the CATION shown as the product of step 1. Your diagram must include:
- electrons
 - name for each molecular orbital
 - picture of each molecular orbital
 - identification of the HOMO and LUMO
- (c) Use your answer to part (b) to show which carbon atom(s) of the cation can react with the bromide anion in step 2, and draw the final product(s) of this reaction.