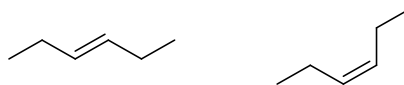




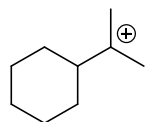
Circle the single best answer to each multiple choice question (1-15). (4 pts each)

1. Consider the two alkene isomers shown.

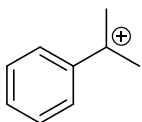


Which of the following statements is *true*?

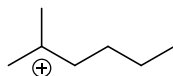
- The two isomers cannot interconvert because the  $\pi$  bond has a high rotational barrier.
  - The trans isomer has more van der Waals interactions, or steric strain, than the cis isomer.
  - The cis isomer has no eclipsing interactions.
  - The two isomers are equal in energy.
  - These compounds are heptenes.
2. A regioselective reaction
- must have a carbocation intermediate.
  - forms a mixture of constitutional isomers.
  - forms one constitutional isomer in preference to others possible.
  - can only be performed in particular regions of the country.
  - is one that undergoes a rearrangement.
3. Which of the following structures is the **most stable** carbocation?



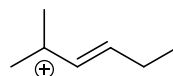
**A**



**B**



**C**

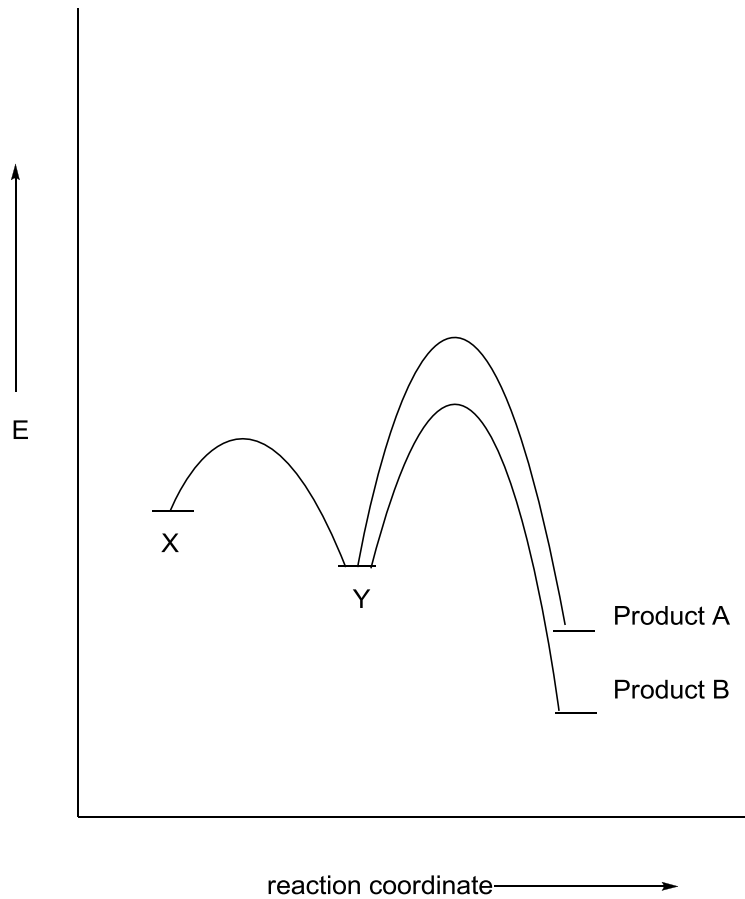


**D**

They are all equally stable.

**E**

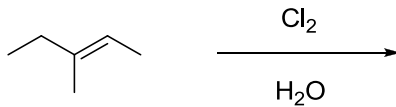
4. Consider the energy vs. reaction coordinate diagram shown below:



Which of the following statements about this reaction is *false*?

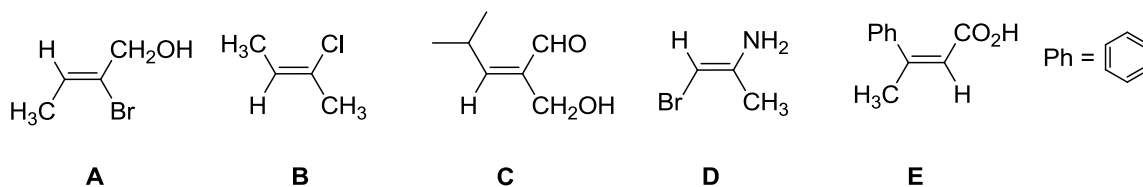
- a. The reaction has one intermediate.
- b. The reaction has two mechanistic steps.
- c. The reaction forms Product A in preference to Product B.
- d. The second step is rate determining.
- e. The overall reaction is exothermic.

5. What is the major product of the reaction shown?

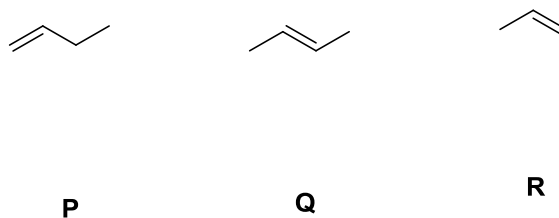


- a. 3-methyl-3-pentanol
- b. 3-chloro-3-methyl-2-pentanol
- c. 2,3-dichloro-3-methylpentane
- d. 2-chloro-3-methyl-3-pentanol
- e. 3-chloro-3-methylpentane

6. Which of these alkenes is an *E* alkene?

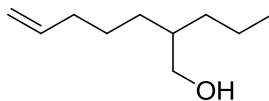


7. Rank the following  $\text{C}_4$  alkene isomers in order of *decreasing* stability.



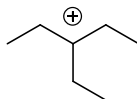
- a.  $\text{P} > \text{Q} > \text{R}$
- b.  $\text{R} > \text{Q} > \text{P}$
- c.  $\text{P} > \text{R} > \text{Q}$
- d.  $\text{R} > \text{P} > \text{Q}$
- e.  $\text{Q} > \text{R} > \text{P}$

8. What is the correct IUPAC name for this compound?



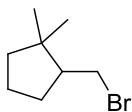
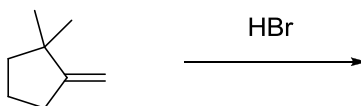
- a. 6-propyl-1-hepten-7-ol
- b. 2-propyl-6-hepten-1-ol
- c. 6-methylenol-1-nonene
- d. 5-heptene-2-ethyl-1-hexanol
- e. none of these names is correct

9. The carbocation shown is stabilized by hyperconjugation. Which of the following choices correctly describes one set of orbitals involved in this stabilization?



- a. C-C  $\sigma$  and C-H  $\sigma^*$
- b.  $p$  and  $sp^3$
- c.  $p$  and  $sp^2$
- d.  $p$  and C-C  $\sigma$
- e.  $p$  and C-H  $\sigma^*$

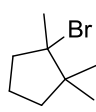
10. What is the product of the reaction shown?



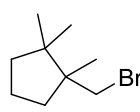
A



B



C

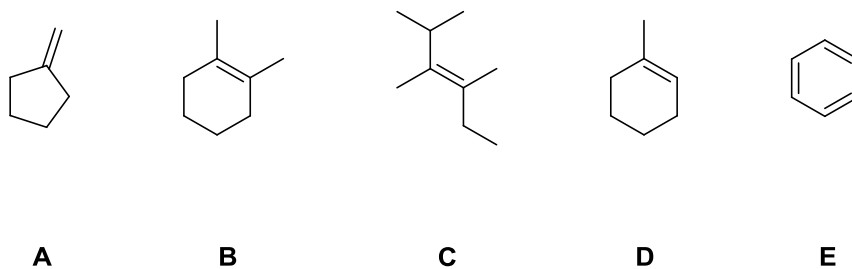


D

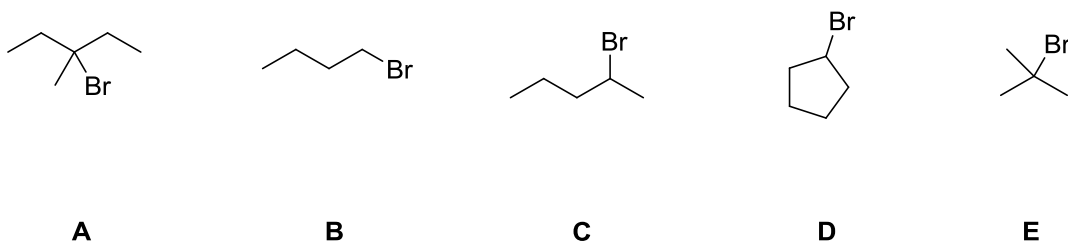
None of these is the product of this reaction.

E

11. Which of these alkenes would likely give more than one product on treatment with HCl?



12. Which of these alkyl bromides could *not* be made using a Markovnikov addition of HBr to an alkene?

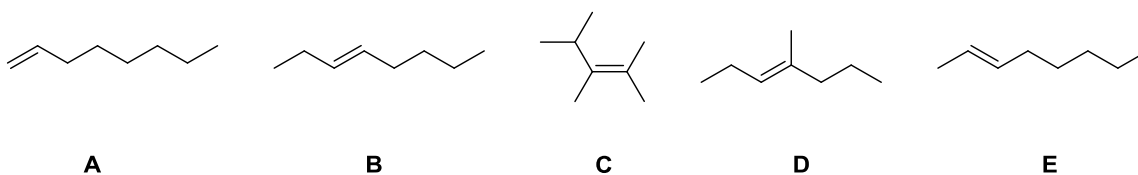


13. What is the name of this compound?

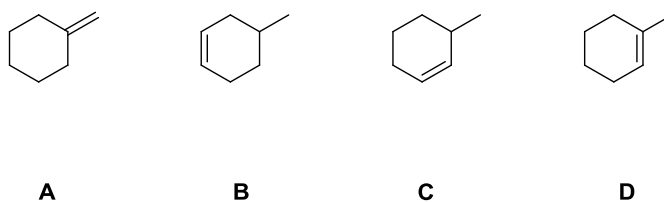
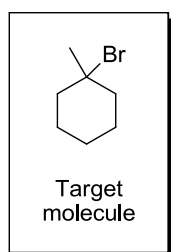


- a. *sec*-butyl alcohol
- b. *tert*-butyl alcohol
- c. isopropyl alcohol
- d. isobutyl alcohol
- e. neopentyl alcohol

14. Which of the following C<sub>8</sub> alkene isomers has the *largest negative value* for its standard heat of formation,  $\Delta H_f^\circ$ ?



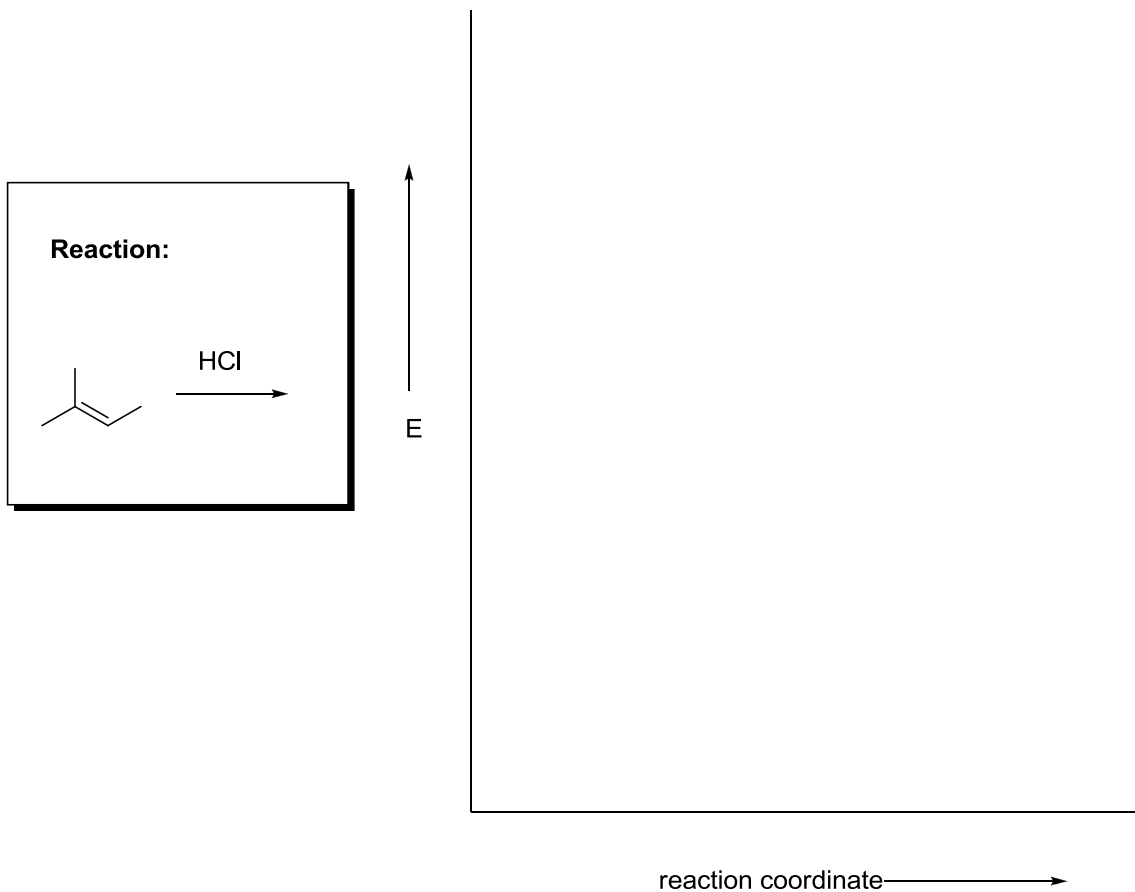
15. Which of the following alkenes would not generate *any* of the target molecule (product) shown when treated with HBr?



All of these alkenes would be converted to the target using HBr.

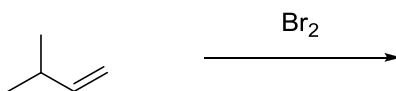
**E**

16. Draw an energy vs. reaction coordinate diagram for the *rate-determining step only* for the reaction shown. All chemical species involved in the rate-determining step should be drawn at the appropriate relative energy levels, with any non-zero formal charges included. Clearly identify the activation energy and the transition state. Do not draw any mechanisms in response to this question. Do not draw any steps other than the one requested. (10 pts)

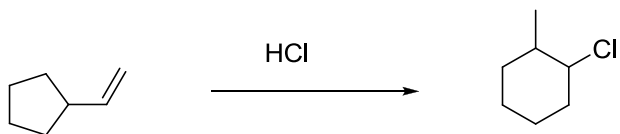




17. Predict the product of this reaction and draw a mechanism to show how the product is formed. Include all curved arrows, necessary lone pairs and non-zero formal charges for full credit. (10 pts)



18. Propose a mechanism for the reaction shown to illustrate the conversion of reactants to the product. Include all curved arrows, necessary lone pairs, and non-zero formal charges for full credit. (10 pts)



19. Explain the formation of two products in the following reaction. Your explanation must include appropriate mechanisms showing the formation of each product. (Hint: Start with the product on the left. Carefully study the key intermediate leading to this product.) (10 pts)

