

Part I. Multiple choice. (4 points each.) Choose the one best answer and mark your answer on the ScanTron sheet. (Grading will be based on the ScanTron.)

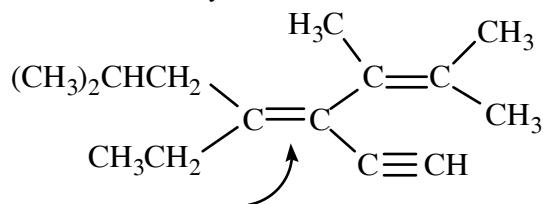
1. Which compound below is expected to have the lowest (i.e., least negative) heat of hydrogenation?

- a) 2,3-dimethyl-1-pentene
- b) 2,3-dimethyl-2-pentene
- c) 3,4-dimethyl-2-pentene
- d) 2-ethyl-3-methyl-1-butene
- e) 3,4-dimethyl-1-pentene.

2. What is the degree of unsaturation in $C_9H_{16}Cl_3NO$?

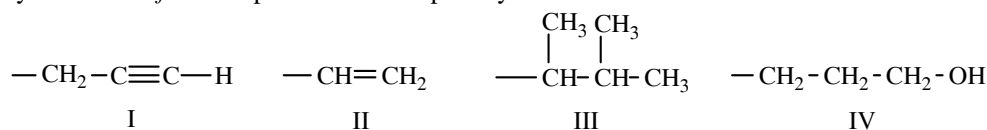
- a) 1
- b) 2
- c) 3
- d) 4
- e) 5

3. What is the best way to describe the stereochemistry of the double bond indicated in the compound below?



- a) E
- b) Z
- c) cis
- d) trans
- e) anti

4. Rank the following sets of substituents in order of priority according to the Cahn-Ingold-Prelog sequence rules. Place the *highest* priority substituent *first* and place the *lowest* priority substituent *last*.

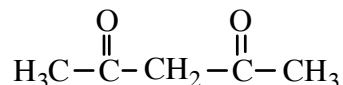


- a) II > III > IV > I
- b) II > III > I > IV
- c) I > II > IV > III
- d) IV > I > II > III
- e) III > II > I > IV

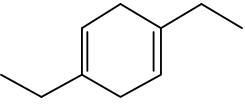
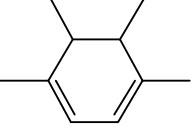
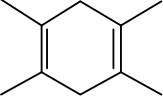
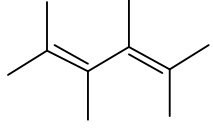
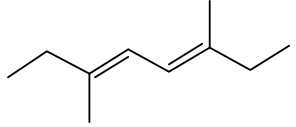
5. A compound of formula $C_{12}H_{12}BrCl_2N$ has two rings. How many molar equivalents of hydrogen does it absorb if all of the remaining unsaturations are double bonds?

- a) 2
- b) 3
- c) 4
- d) 5
- e) 6

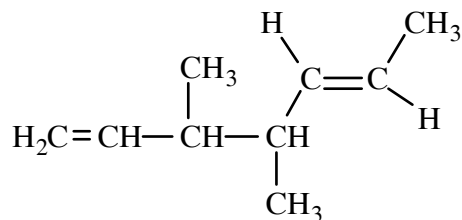
6. Which compound below is *most likely* to undergo a hydride shift when allowed to react with HBr in ether?
- 3-methyl-1-butene
 - 2-methyl-2-butene
 - 2,3-dimethyl-1-butene
 - 2,3-dimethyl-2-butene
 - 3,3-dimethyl-1-butene
7. Compound A has the formula $C_{10}H_{16}$. On catalytic hydrogenation over palladium, it reacts with two molar equivalents of H_2 . Compound A also undergoes reaction with ozone, followed by treatment with Zn, to yield the following diketone:



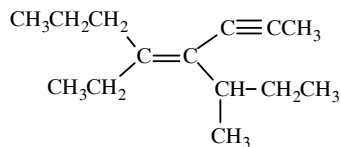
What is the structure of compound A?

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- 
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- 
- 

8. What is the IUPAC name of the following compound?

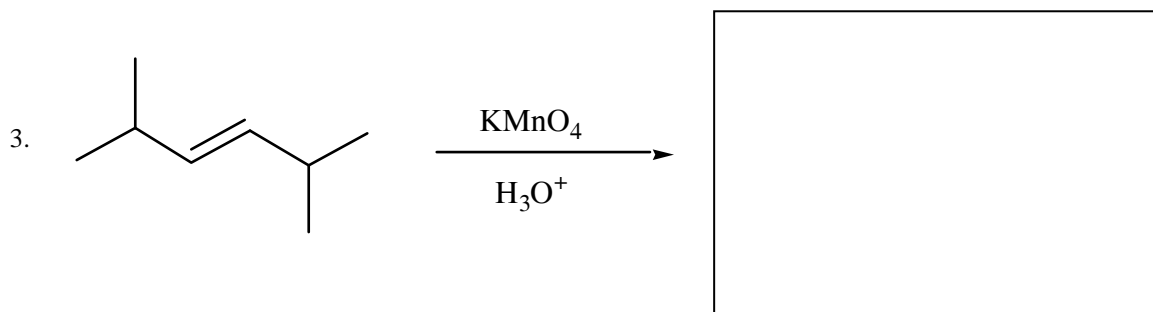
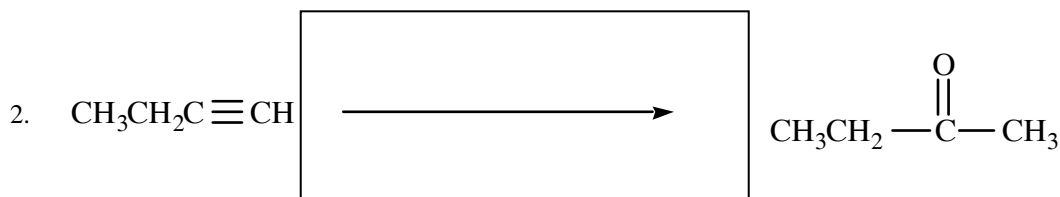
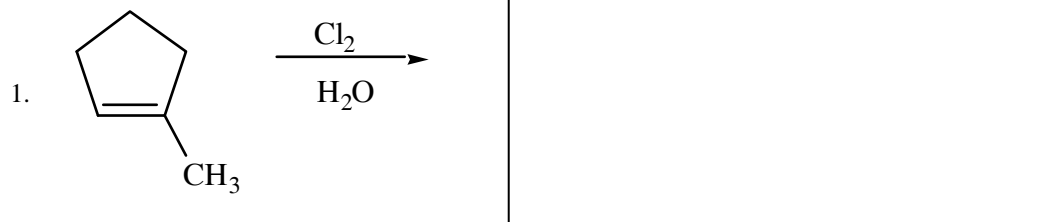


- (Z)-3,4,6-trimethyl-1,5-hexadiene
 - (E)-3,4,6-trimethyl-1,5-hexadiene
 - (E)-1,3,4-trimethyl-1,5-hexadiene
 - (E)-3,4-dimethyl-1,5-heptadiene
 - (Z)-3,4-dimethyl-1,5-heptadiene
9. What is the IUPAC name of the following compound?



- (Z)-4-(2-butyl)-5-ethyl-2-alkynyl-4-octene
 - (Z)-5-ethyl-4-(1-methylpropyl)-4-alkenyl-2-octyne
 - (Z)-4-(2-butyl)-5-ethyl-4-octen-2-yne
 - (E)-4-(2-butyl)-5-ethyl-4-octen-2-yne
 - (Z)-5-ethyl-4-(1-methylpropyl)-4-octen-2-yne
10. Which of the following best describes the regiochemistry and stereochemistry of hydroboration/oxidation of alkenes?
- non-Markovnikov syn addition
 - Markovnikov syn addition
 - non-Markovnikov anti addition
 - Markovnikov anti addition

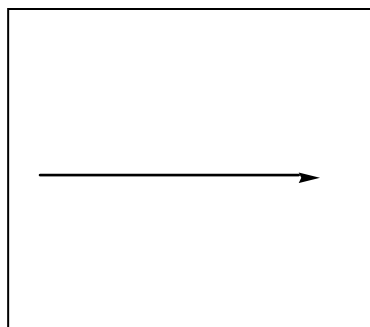
Part II. Reactions. (Each box is worth 4 points.) Draw the reactant, product, or reagents in the boxes as indicated. Clearly indicate the regiochemistry and stereochemistry when appropriate.



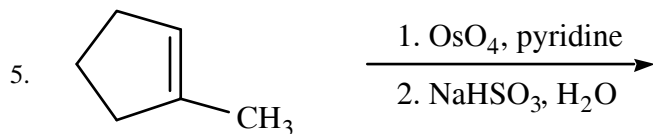
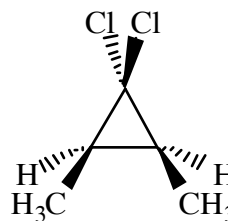
4. What starting hydrocarbon would you use (A), and what reagents would be used (B) to synthesize the compound below?



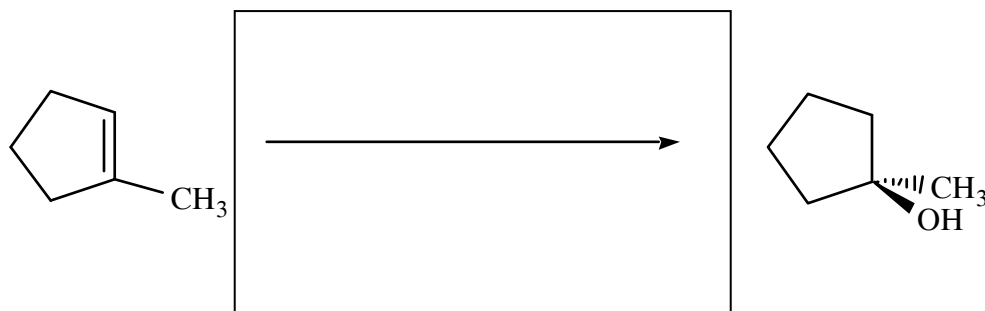
A



B



6. What reagents would be used to synthesize the alcohol shown below using oxymercuration?



Part III. Mechanisms. (5 points each.)

1. Draw the complete mechanism for the reaction of 2-butyne with lithium in ammonia. Use the curved arrow formalism to indicate every bond broken and every bond formed.
2. When 3,3-dimethyl-1-butene reacts with HBr in ether, one product is 2-bromo-2,3-dimethylbutane. Show the complete mechanism for the formation of this product using the curved arrow formalism.
3. Draw the structure of the *intermediate* that is formed when *trans*-2-butene reacts with Cl₂ in CH₂Cl₂. (Draw *only* the intermediate; do *not* draw the complete mechanism.)

Part IV. Synthesis. (5 points each.) Show how the following syntheses could be performed. More than one step may be required. Show all reagents and all intermediate compounds in your synthetic scheme.

1. *trans*-2-butene $\xrightarrow{??}$ *cis*-2-butene.
2. acetylene $\xrightarrow{??}$ 3-bromohexane
3. CH3CH2CH2CH2Br $\xrightarrow{??}$ CH3CH2CH2CHO

