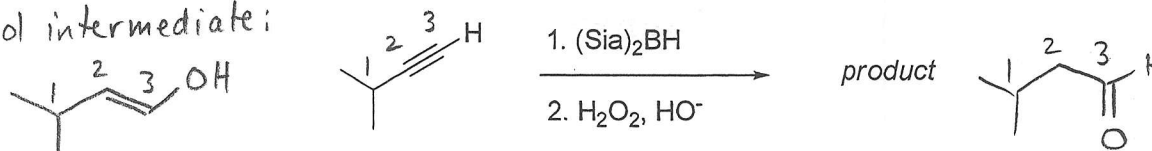


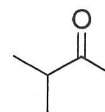
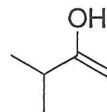
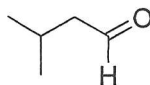
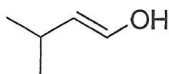
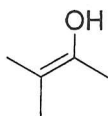
Circle the single best answer to each multiple choice question (1-15). (4 pts each)

- B 1. A terminal alkyne is treated with $(\text{Sia})_2\text{BH}$, then with hydrogen peroxide and sodium hydroxide:

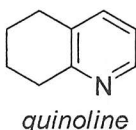
enol intermediate:



Which of the following is an intermediate that would be generated in this reaction?



- E 2. The Lindlar catalyst is composed of a number of reagents used in combination. Which of the following chemicals is not part of the reaction mixture containing the Lindlar catalyst?



B $\text{H}_2(\text{g})$

C A metal catalyst such as Pd

D BaSO_4 or CaCO_3



A

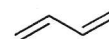
B

C

D

E

- C 3. Which of these compounds will not react in a Diels Alder reaction?



A

B

C

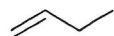
D

E

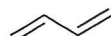
Benzene is
inert to
Diels Alder

4. The heat of hydrogenation of 1-butene is approximately 30 kcal/mol. What do you expect will be the heat of hydrogenation of 1,3-butadiene? (Recall that hydrogenation is an exothermic reaction, and that the heat of hydrogenation is often reported as the absolute value of the heat released in the reaction.)

D



1-butene

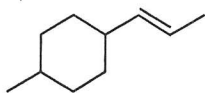
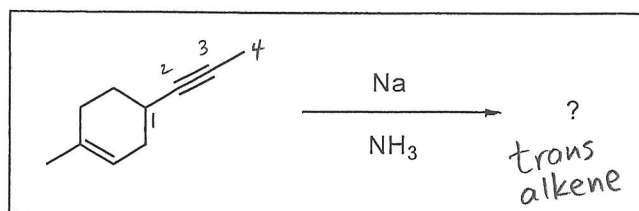


1,3-butadiene

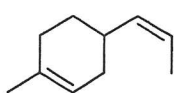
- a. 30 kcal/mol
- b. 60 kcal/mol
- c. More than 60 kcal/mol
- ☒ d. Less than 60 kcal/mol
- e. There is not enough information provided to answer the question.

5. Which of these compounds is the major product of the reaction conditions shown?

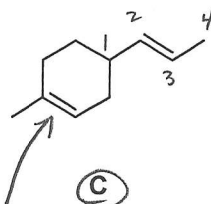
C



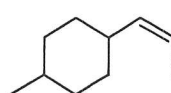
A



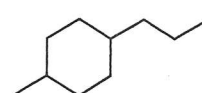
B



☒ C



D



E

Dissolving metal reduction
does not reduce alkene

6. Which of the following bases can deprotonate acetylene?

D

LDA

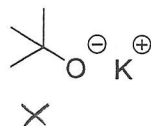


P

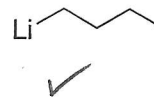
NaNH_2



Q



R



S

NaOH



T

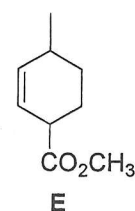
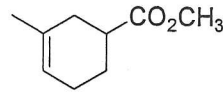
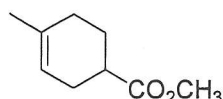
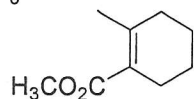
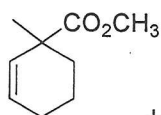
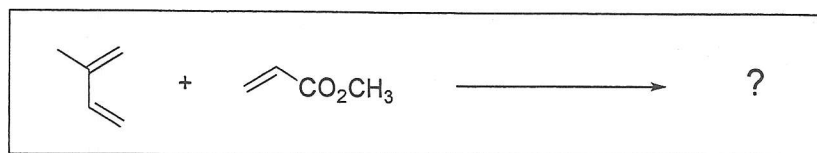
- a. All of these bases can deprotonate acetylene
- b. None of these bases can deprotonate acetylene
- c. P, Q, R
- ☒ d. P, Q, S
- e. P, Q, R, S

P, Q, S



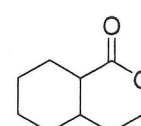
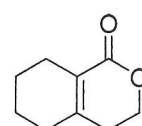
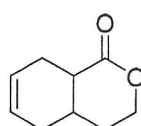
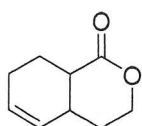
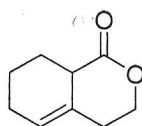
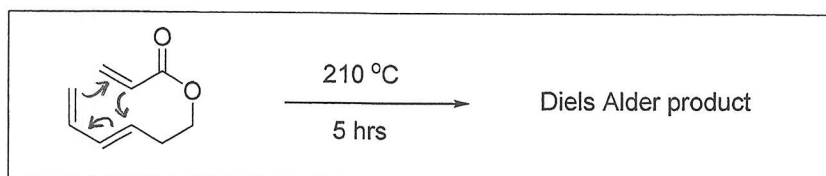
7. What is the major product of this reaction?

C



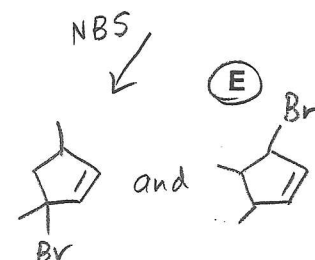
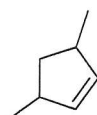
8. There are many examples of intramolecular Diels Alder reactions, including the one shown here. What is the product of this reaction?

B



9. Which of the following molecules, when treated with NBS and dimethyl peroxide in carbon tetrachloride solvent (NBS, CH_3OOCH_3 in CCl_4) and heated, would generate more than one product?

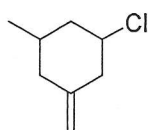
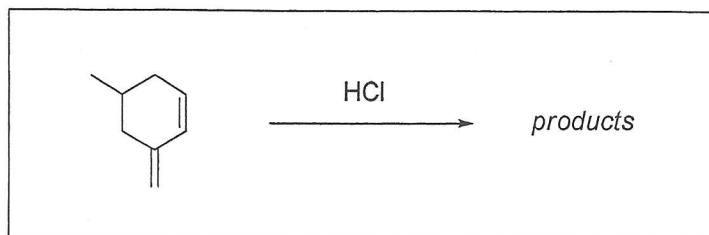
E



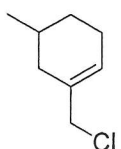
10. Which of these structures is the thermodynamic product of the reaction?

E

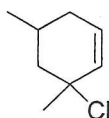
See below



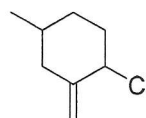
A



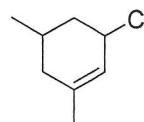
B



C



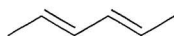
D



E

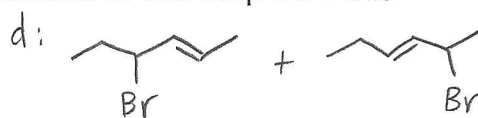
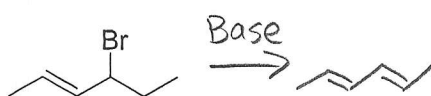
11. Consider this molecule:

C



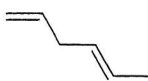
Which of these statements is false?

- T a. This molecule is drawn in its most stable conformation. *s-trans*
- T b. This molecule contains conjugated double bonds.
- F c. This molecule would not react in a Diels Alder reaction. *Can adopt s-cis conf.*
- T d. When this molecule is reacted with HBr, at least two products can form. *see below:*
- T e. This molecule could have been synthesized in one step from this compound:

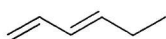


12. Which of the following C₆H₁₀ isomers is *least* stable?

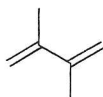
D



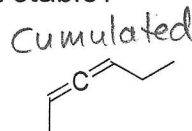
A



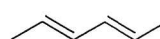
B



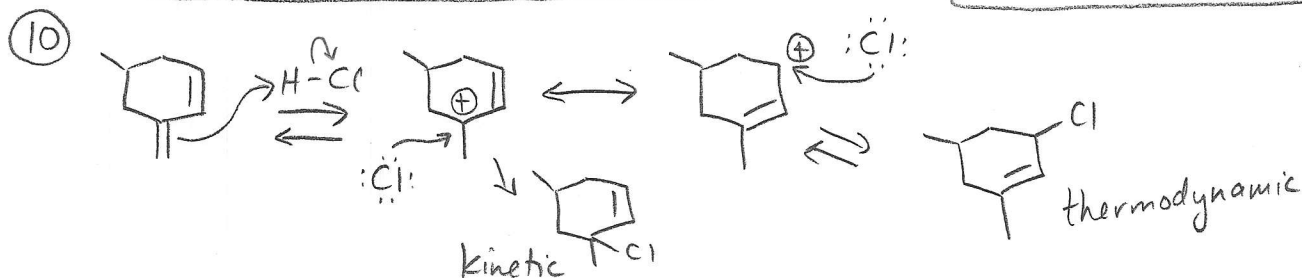
C



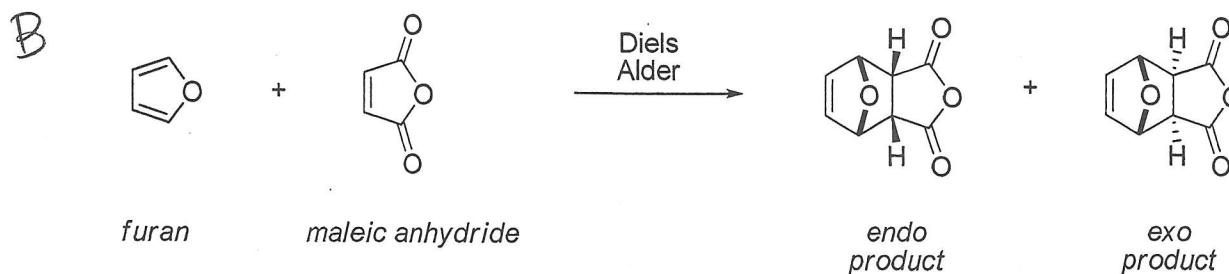
D



E



13. Consider the Diels Alder reaction between furan and maleic anhydride:



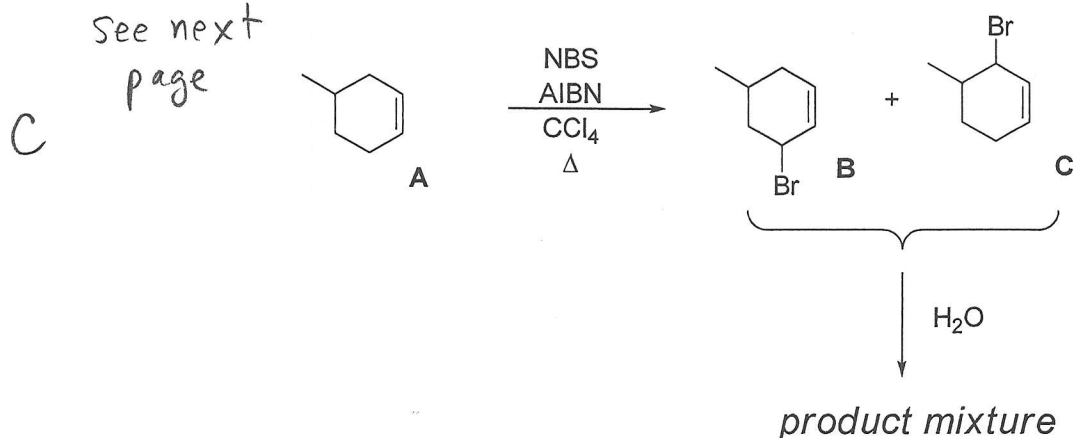
In this reaction, the endo product is the kinetic product. The Diels Alder is reversible; i.e., the endo product can revert to starting materials.

What conditions would you use to produce the maximum possible yield of the exo product?

- Long reaction time, low temperature
- ☒ Long reaction time, high temperature
- Short reaction time, low temperature
- Short reaction time, high temperature
- It is not possible to make the exo product.

14. Compound **A** was treated with NBS and AIBN in carbon tetrachloride solvent and heated, producing two compounds, **B** and **C**. The mixture of compounds **B** and **C** was then placed in water (solvolysis conditions) and generated a mixture of products.

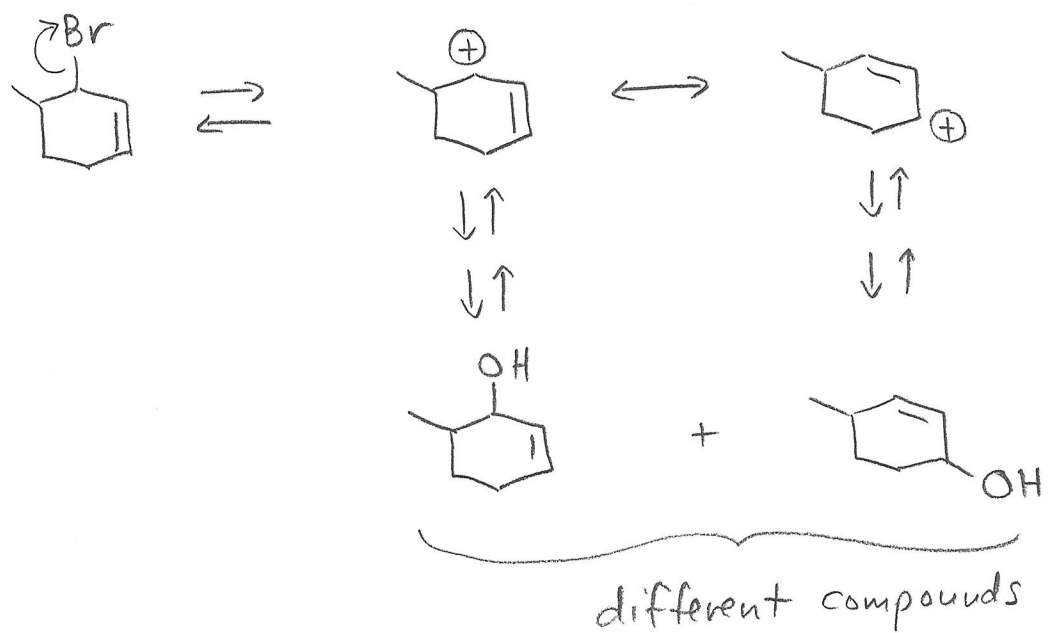
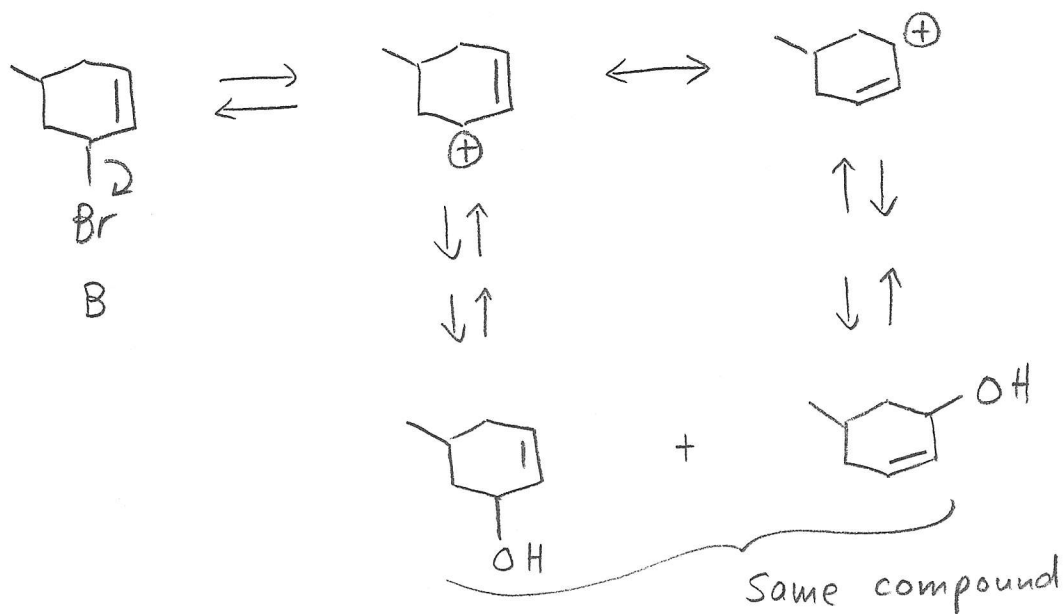
See next page



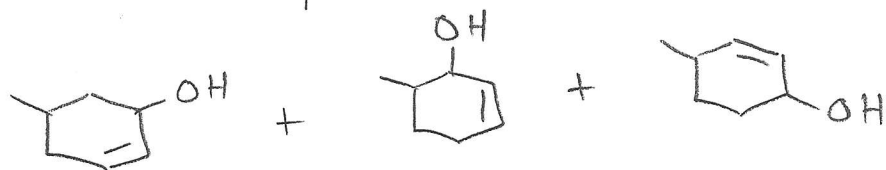
How many S_N1 products could form under these conditions?

- 1
- 2
- ☒ 3
- 4
- None of these numbers

14



So the three S_N1 products are:



15. Which of the following syntheses is unlikely to give good yields of the final alkylated product?

B

A



1. NaNH_2 $\leftarrow$ forms acetylide ion

2.



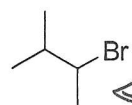
1° , good leaving group

B



1. NaNH_2

2.



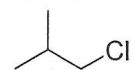
$\leftarrow 2^\circ$ substrate will give competing $\text{E}2$ with the strongly basic acetylide ion

C



1. LDA $\leftarrow$ forms acetylide

2.



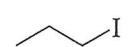
1° , OK leaving group

D



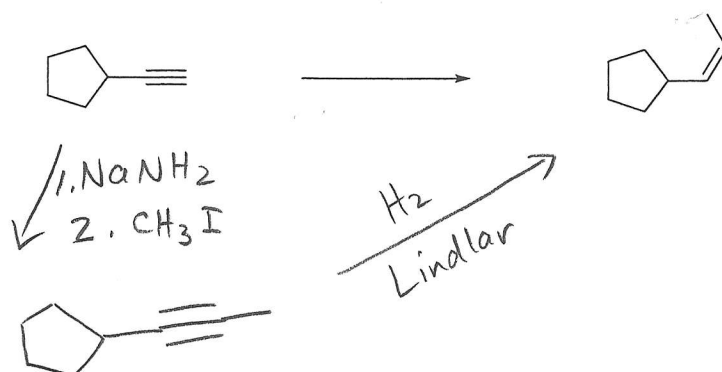
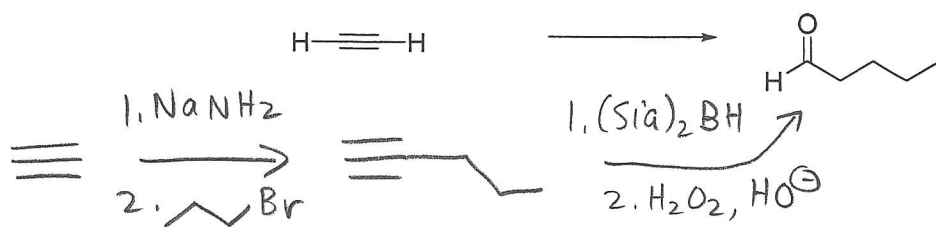
1. $n\text{-BuLi}$ $\leftarrow$ forms acetylide

2.

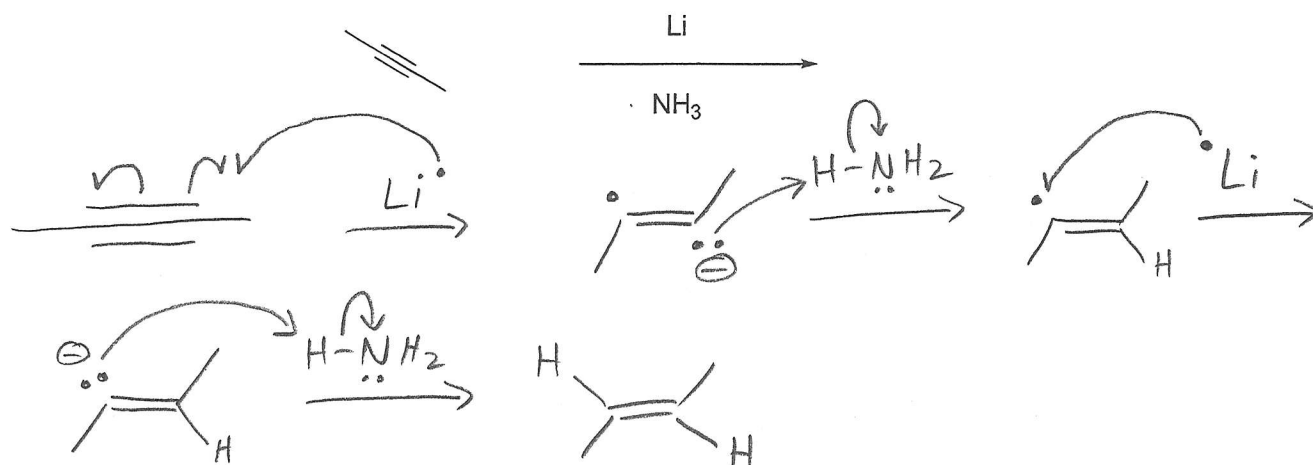


1° , good leaving group

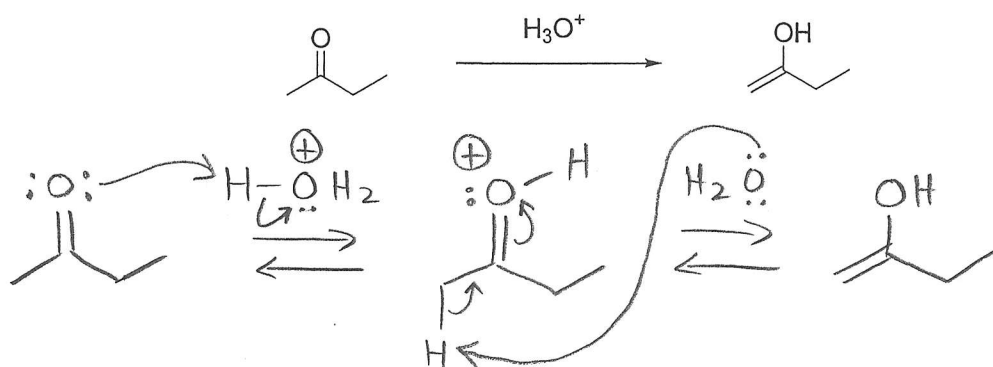
16. Propose a multi-step synthesis for each target molecule from the indicated starting material. Show the reagents needed for each step and the product of each step. Do not show any mechanisms. Do not simply give a list of reagents, or you will not receive full credit. (10 pts)



17. Predict the product of the following reaction conditions and draw a mechanism to illustrate its formation. Include all necessary electrons, curved arrows, and nonzero formal charges. (10 pts)



18. Draw a mechanism to illustrate the following transformation. Include all necessary electrons, curved arrows and nonzero formal charges. (10 pts)



19. Design a multistep synthesis to synthesize the target molecule, 2,7-dimethyl-4-octanone, from any necessary organic or inorganic reagents. **Your organic reagents may only contain 4 carbons or less.** Show the reagents needed for each step and the product of each step. Do not just give a list of reagents between starting material and target, or you will not receive full credit. (*Hint:* Because you are not given any starting materials, you will need to approach the problem retrosynthetically and work backwards to reagents containing 4 carbons or less. Then show the synthesis in the forward direction.) (10 pts)

