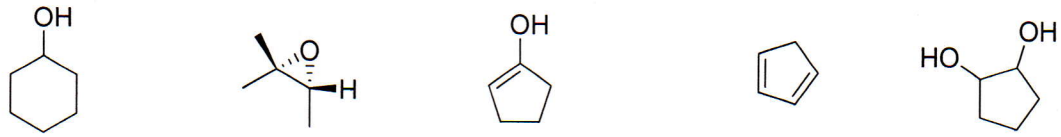
1. Which of these structures will tautomerize to a ketone in aqueous acid?

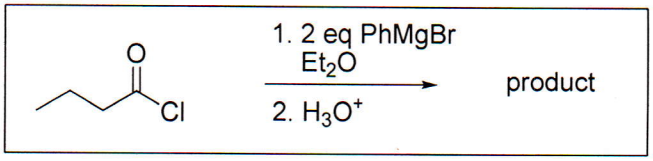
C

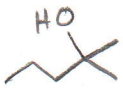



A B C D E

enol

2. Which of the following compounds is the product of this reaction?



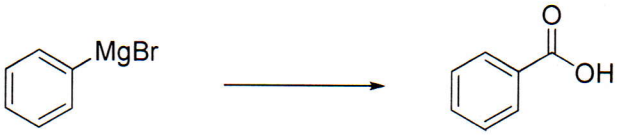




D

a. Ketone
b. Primary alcohol
c. Secondary alcohol
d. Tertiary alcohol
e. Ester

3. Select the reagent that will successfully convert the starting material to the product. Assume the reaction is carried out in an appropriate solvent and with an appropriate workup.

C




a. MCPBA
b. Jones reagent ($H_2CrO_4$, acetone, water)
c. $CO_2$, then $H_3O^+$
d. $O_3$, then $H_2O_2$
e. $H_2O$

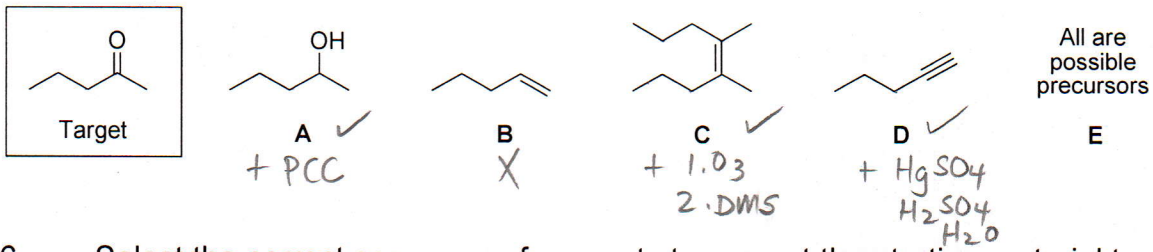
4. Which of these reagents is not used to convert the OH group to a better leaving group?

B

a. $PBr_3$
b. MCPBA
c. $SOCl_2$
d. TsCl
e. Any of these reagents will convert an OH to a better leaving group

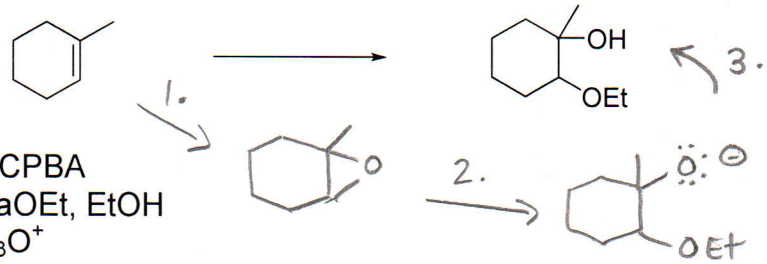
5. The ketone in the box is the target molecule. From which of the compounds shown can you NOT make this ketone in one synthetic step, including workup?

B




6. Select the correct sequence of reagents to convert the starting material to the target in the highest possible yield.

A




a. 1. MCPBA
2. NaOEt, EtOH
3. $H_3O^+$

b. 1. MCPBA
2. EtOH, $H_2SO_4$

c. 1. $OsO_4$, TBHP
2. NaH
3. EtBr

d. 1. MCPBA
2. $H_3O^+$
3. NaH
4. EtMgBr, then $H_3O^+$

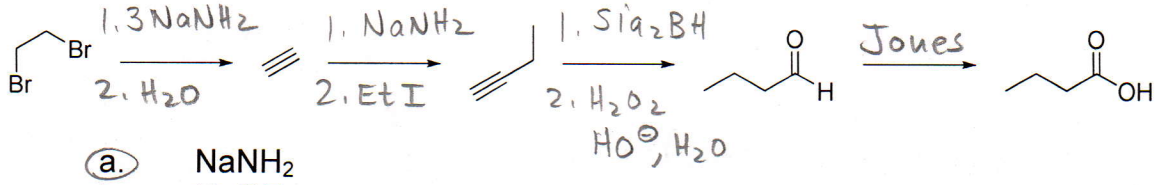
e. None of these sequences can be used to synthesize the target

7. Select the reagent that will successfully convert the starting material to the product. Assume the reaction is carried out in an appropriate solvent and with an appropriate workup.

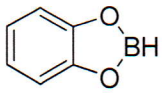
B


a. $NaBH_4$
b. LAH, then $H_3O^+$
c. $BH_3$-THF, then $H_2O_2$, NaOH, $H_2O$
d. $HgSO_4$, $H_2SO_4$, $H_2O$
e. $SOCl_2$

8. Which of the reagents listed could be used in two different steps in this multistep synthesis? (Consider only this synthesis, not alternative ways to make the target from the starting material.)




A

a. $NaNH_2$
b. NaOH
c. PCC
d. Catechol borane, 

e. $NaBH_4$

9. In class we discussed the fact that the terms "Markovnikov" and "anti-Markovnikov" hydration have meaning only for terminal alkynes. However, internal alkynes can also be hydrated using either of the conditions presented in class to produce ketones.

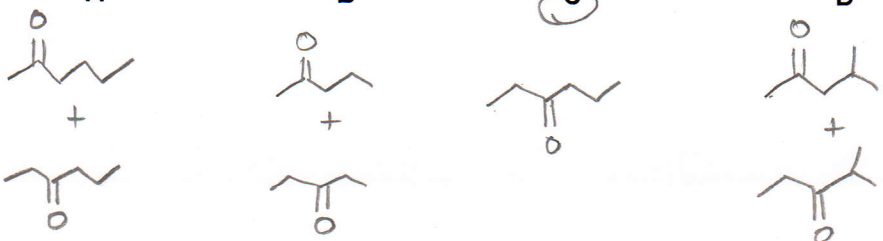
C

Which of these alkynes would produce <u>only one</u> ketone product if treated with hydrating conditions?

All would give only one ketone product

Symmetrical

A B C D E



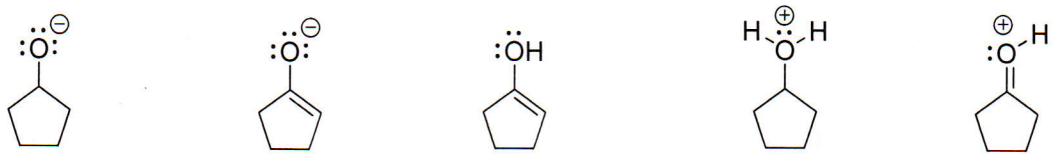
10. Select the reagent that will successfully convert the starting material to the product. Assume the reaction is carried out in an appropriate solvent and with an appropriate workup.


A

a. $BH_3$-THF, then $H_2O_2$, NaOH, $H_2O$
b. $CH_3MgBr$ or $CH_3Li$, then $H_3O^+$
c. $OsO_4$, TBHP, $H_2O$
d. $NaNH_2$
e. $PBr_3$

11. Which of these is a mechanistic intermediate in keto-enol tautomerization in aqueous base?

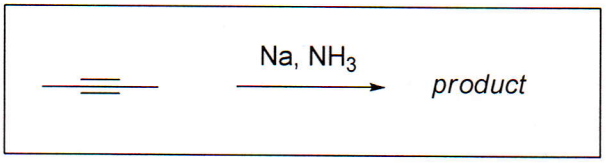
B



A B C D E

12. Which of these structures is a mechanistic intermediate in the dissolving metal reduction of 2-butyne using sodium in liquid ammonia?

D




A B C D

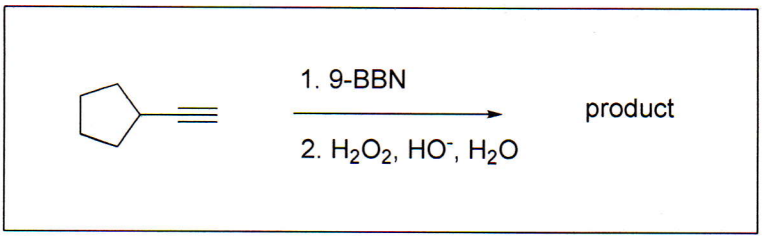
None of these structures are intermediates

E

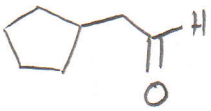
This is the last intermediate before the product

13. Which of the following compounds will be produced by the conditions shown?

B

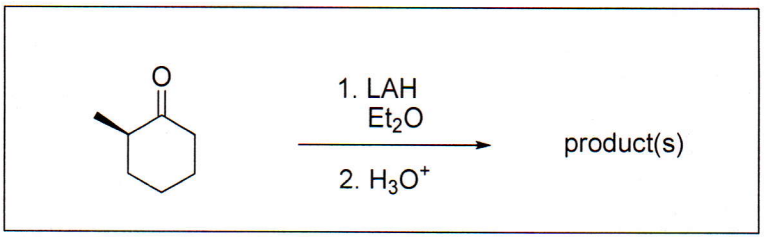


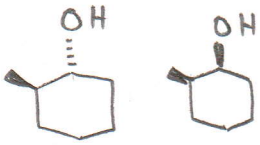

a. Alcohol
b. Aldehyde
c. Alkene
d. Ketone
e. Vicinal diol




14. What will be the stereochemical outcome of this reaction?

B

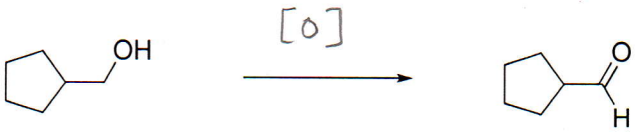



a. Racemic mixture
b. Diastereomers in unequal amounts
c. A single chiral molecule
d. A single achiral molecule
e. Enantiomers in unequal amounts

15. Select the reagent that will successfully convert the starting material to the product. Assume the reaction is carried out in an appropriate solvent and with an appropriate workup.

C



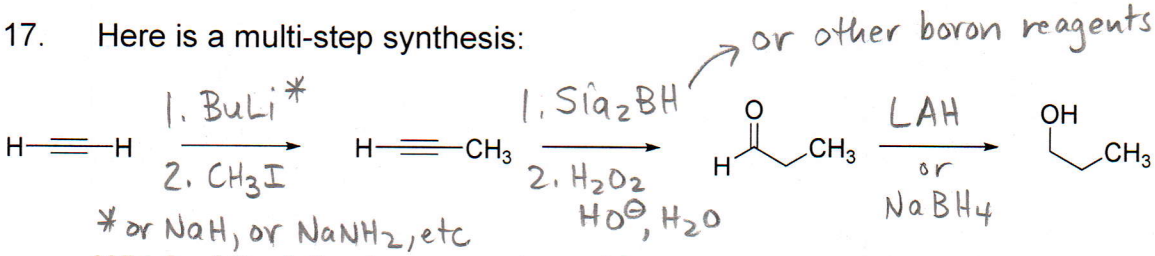

a. LAH
b. Jones reagent ($H_2CrO_4$, acetone, water)
c. PCC
d. $O_3$, then DMS
e. BuLi

16. Select the reagent that will successfully convert the starting material to the product. Assume the reaction is carried out in an appropriate solvent and with an appropriate workup.

D


a. $NaBH_4$, MeOH
b. LAH, then $H_3O^+$
c. NaH
d. Raney Ni, $H_2$
e. Any of these reagents would work

17. Here is a multi-step synthesis:



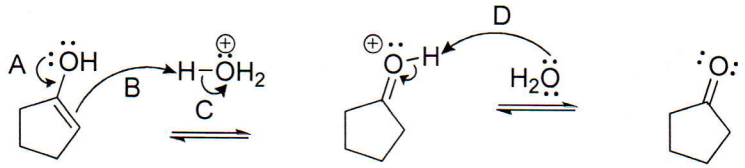

B

Which of the following reagents could not be involved in any of the steps shown above? (Note that you must consider only this synthesis, not alternative ways to make the target from the starting material.)

~~a.~~ BuLi
b. $OsO_4$, TBHP, $H_2O$ Could not be involved because at no step are you making a diol
~~c.~~ $Sia_2BH$
~~d.~~ LAH
e. All of these reagents could be involved

18. Some of the curved arrows in this mechanism are labeled with letters, "A" through "D". Select any arrow that is drawn incorrectly for this mechanism.

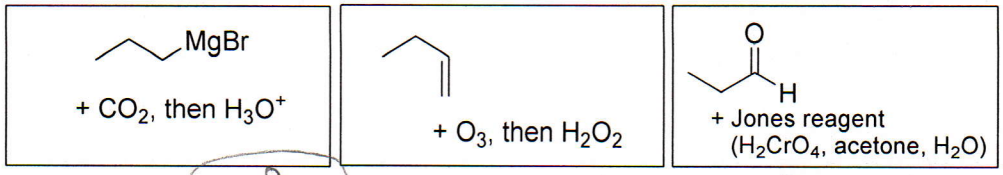
E

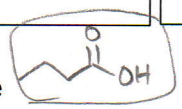


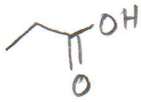

a. A
b. B
c. C
d. D
e. All these arrows are drawn correctly.

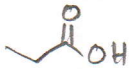
19. *True or false.* The three syntheses shown here all produce the same compound.

B



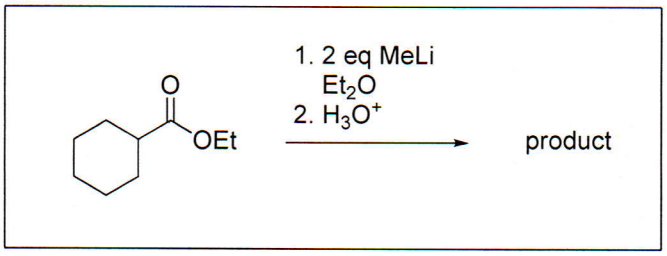



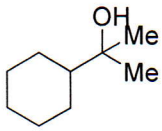

a. True
b. False

Not same as the others

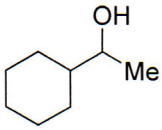
20. Which of these structures is a mechanistic intermediate under these reaction conditions?

C

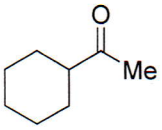


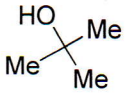

A



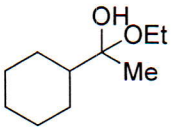

B




C




D




E

Ketone is attacked by 2nd equiv of MeLi

21. Which of these reagents <u>must</u> be used in this multi-step synthesis?

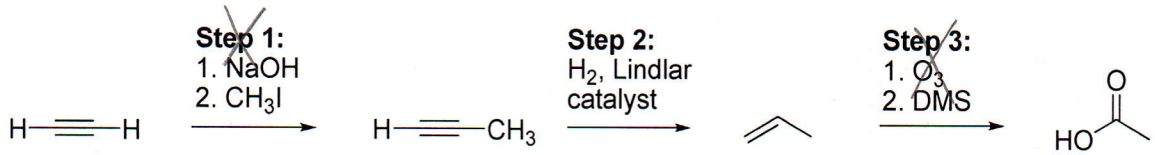
B

a. HBr, $CH_3OOCH_3$
b. $H_2$, Lindlar catalyst
c. PCC
d. $CH_3Li$, then $H_3O^+$
e. MCPBA

cis alkene only accessible using $H_2$/Lindlar

22. Justin Bieber, in collaboration with his pet monkey, designed the following multi-step synthesis that is doomed to failure (since most of the intellectual contribution came from the monkey, who has taken only general chemistry):

D




Identify any and all steps that involve reactions that will NOT go to completion or that will NOT provide the indicated product of a particular step.

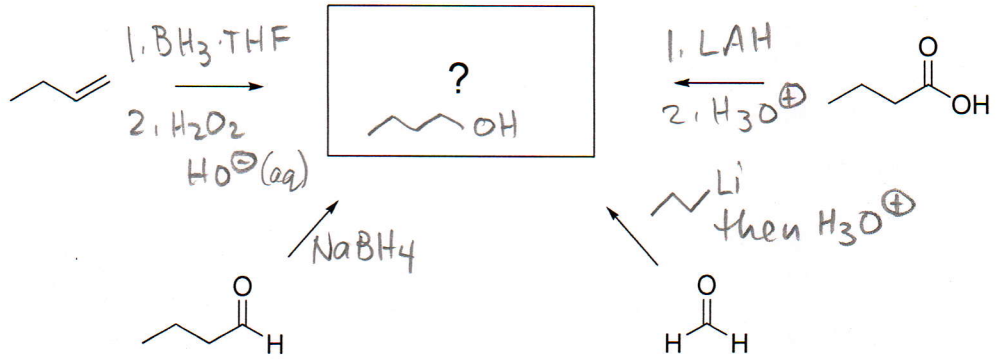
Step 1: NaOH not strong enough to deprotonate acetylene

Step 3: DMS is the wrong workup – it would give an aldehyde

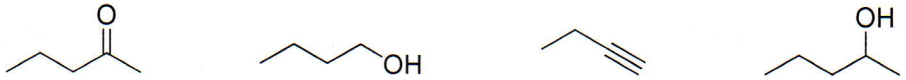
a. Step 1
b. Step 2
c. Steps 1 and 2
d. Steps 1 and 3
e. Steps 1, 2 and 3

23. The four molecules shown can all be used to synthesize the same target in one synthetic operation (i.e., one reaction, including any necessary workup). Which target can be made from all four of these starting materials?

B




Choose the common target from this set:




A B C D

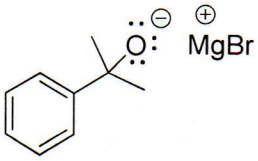
24. Which of the following cannot be used to reduce an alkyne?

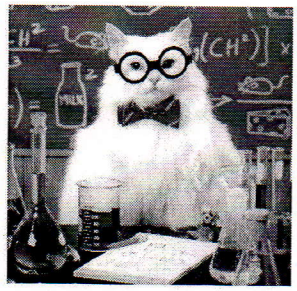
A

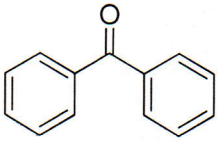
a. BuLi
b. $H_2$, Pd/C ✓ to alkane
c. $H_2$, Lindlar catalyst ✓ to cis-alkene
d. Na, $NH_3$ ✓ to trans-alkene
e. All of these can be used to reduce an alkyne

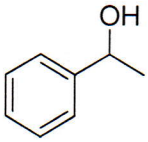
25. A student, trying to get extra technique points in lab, smugly cleaned a test tube with dry acetone (acetone containing no traces of water) prior to preparing a Grignard reaction. Using the "clean" test tube, he attempted the reaction shown in the box. Which of the following could be found in the test tube?

A

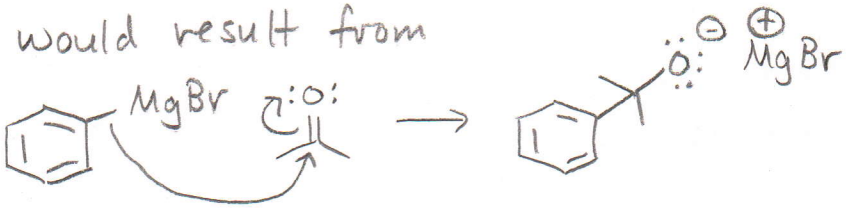





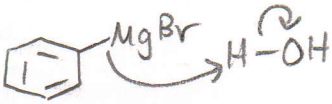




A B C D

This would result from




(with no water present, there could be no protonation; also, Grignard reagent can react with acetone there is no water to do this



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