

## OC2 Practice 1

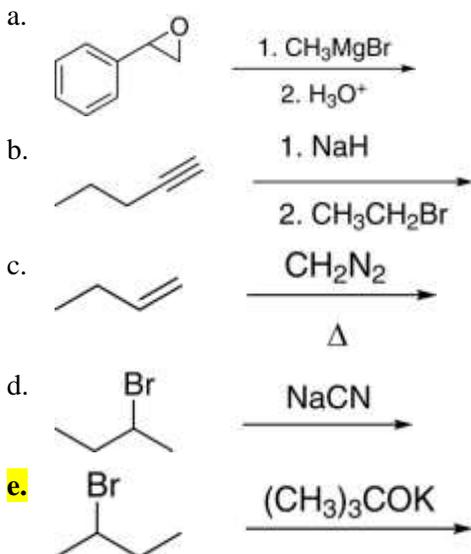
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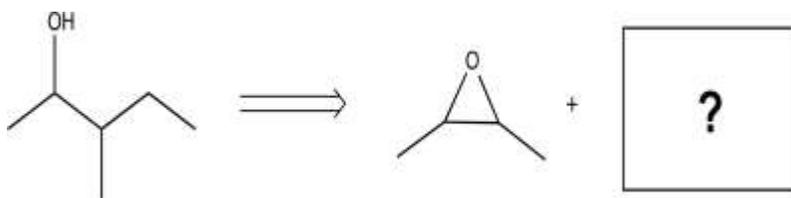
### Multiple Choice

- \_\_\_ 1. Which of the following is appropriate to include in a synthetic step but should NOT be included in the mechanism for a reaction?
- a. starting materials
  - b. mechanism arrows
  - c. products
  - d. reaction temperature**
  - e. necessary reagents

- \_\_\_ 2. Which of the following synthetic steps would be classified as a functional group conversion?

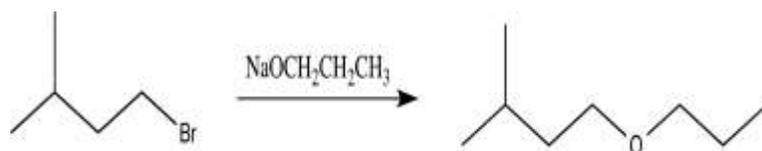


- \_\_\_ 3. Fill in the missing precursor to complete the following transform.



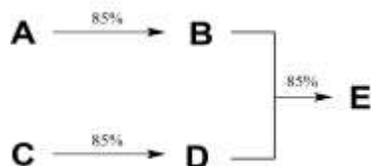
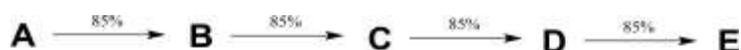
- a.  $\text{CH}_3\text{Br}$
- b.  $\text{CH}_3\text{MgBr}$
- c.  $(\text{CH}_3)_3\text{CMgBr}$
- d.  $\text{CH}_3\text{CH}_2\text{Br}$
- e.  $\text{CH}_3\text{CH}_2\text{MgBr}$**

4. Which of the following solvents would NOT be a good choice to use when carrying out the following reaction?



- a. DMSO  
 b.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$   
 c.  **$\text{CH}_3\text{OH}$**   
 d. DMF  
 e. acetonitrile

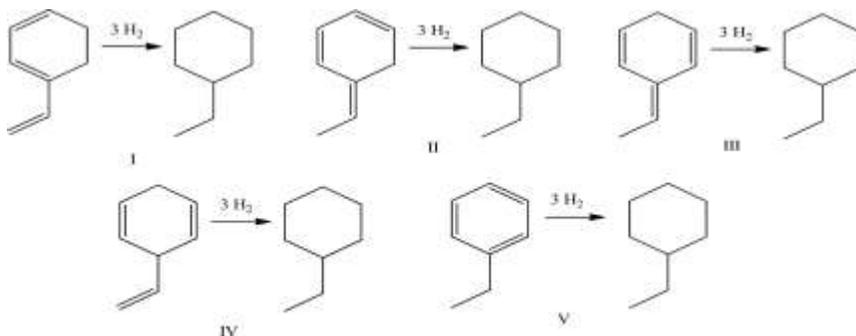
5. How do the overall percent yields of the following linear and convergent syntheses compare?



- a. **The convergent synthesis has a higher overall percent yield than the linear synthesis.**  
 b. The linear synthesis has a higher overall percent yield than the convergent synthesis.  
 c. Both synthetic schemes result in the same overall percent yield.  
 d. It is not possible to determine how yields compare based on the information given.  
 e. It depends on how many carbons are in each compound.

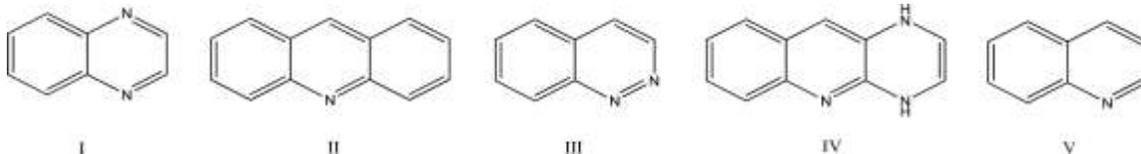
6. Which molecular orbital has the lowest energy?  
 a. the highest bonding MO  
 b. the highest antibonding MO  
 c. **the lowest bonding MO**  
 d. HOMO  
 e. LUMO

7. Which of the following reactions releases the least amount of heat upon hydrogenation?



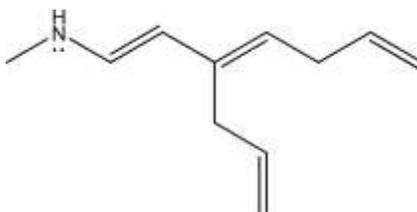
- a. I
- b. II
- c. III
- d. IV
- e. **V**

8. Assuming all of the following molecules are planar, which one can be labeled antiaromatic?



- a. I
- b. II
- c. III
- d. **IV**
- e. V

9. How many electrons are in the following molecule's largest conjugated pi system?

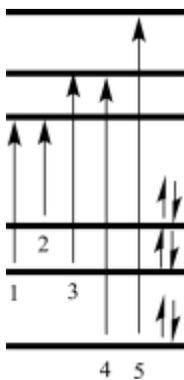


- a. 2
- b. 4
- c. **6**
- d. 8
- e. 10

10. Which of the following corresponds to the greatest proportion of light absorbed by a sample?

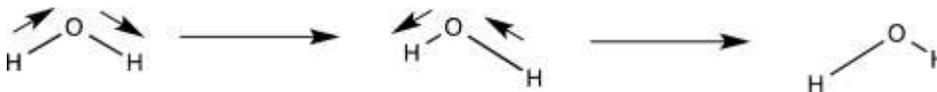
- a. 50% *T*
- b. 75% *T*
- c. 25% *T*
- d. 100% *T*
- e. **15% *T***

11. Which of the electron transitions shown in the figure below would correspond to the UV-vis absorption band at the shortest wavelength?



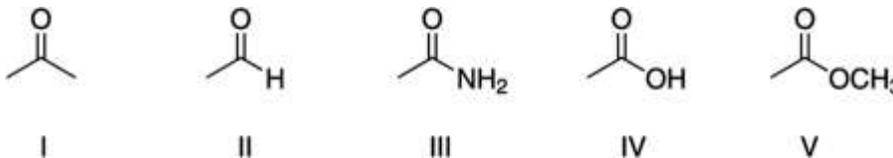
- a. 1
- b. 2
- c. 3
- d. 4
- e. **5**

\_\_\_ 12. Identify the following vibrational mode.



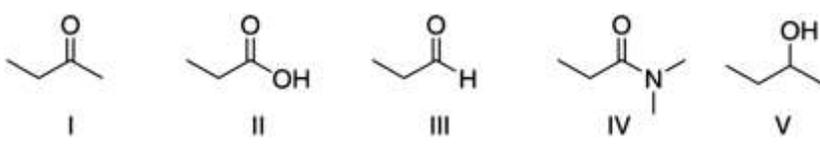
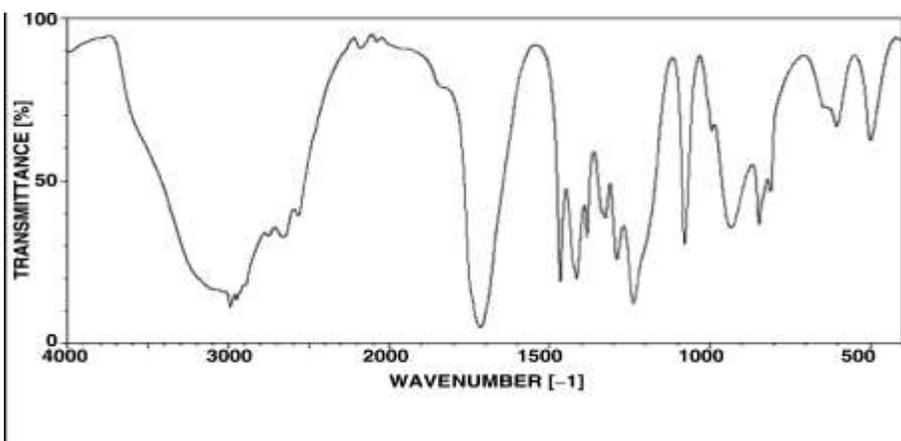
- a. symmetric stretch
- b. asymmetric stretch**
- c. out-of-phase bend
- d. in-phase bend
- e. more than one of the above

\_\_\_ 13. Which of the following would show a C=O stretch at the lowest frequency in its IR spectrum?



- a. I
- b. II
- c. III**
- d. IV
- e. V

\_\_\_ 14. Which structure is most consistent with the following IR spectrum?

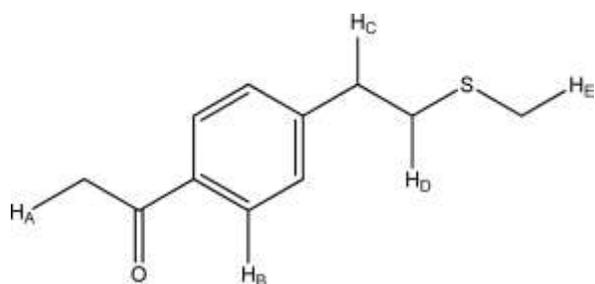


- a. I
- b. II**
- c. III
- d. IV
- e. V

\_\_\_ 15. Nuclear magnetic resonance spectroscopy is generated using which type of electromagnetic radiation?

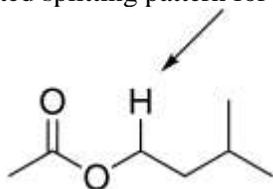
- a. microwaves
- b. radio waves**
- c. visible light
- d. gamma rays
- e. No electromagnetic radiation is used.

\_\_\_ 16. Which hydrogen atom has the greatest chemical shift?



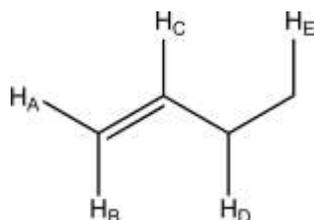
- a.  $H_A$
- b.  $H_B$**
- c.  $H_C$
- d.  $H_D$
- e.  $H_E$

\_\_\_ 17. What is the expected splitting pattern for the indicated hydrogen?



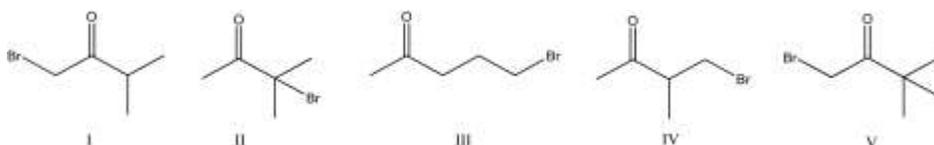
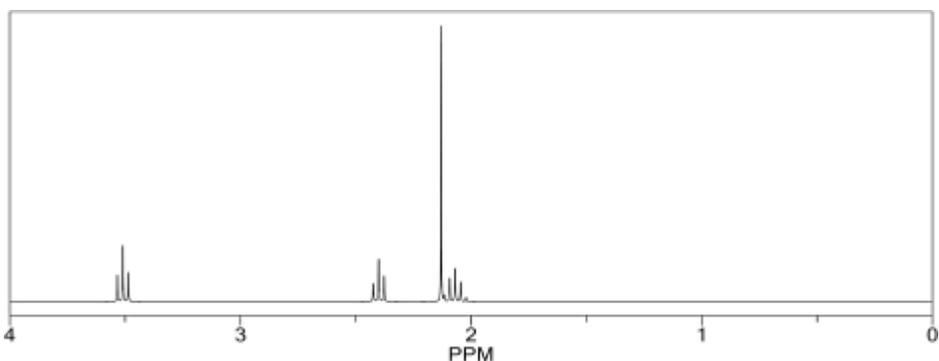
- a. singlet
- b. doublet
- c. triplet**
- d. quartet
- e. quintet

\_\_\_ 18. Which will produce the largest coupling constant?



- a.  $H_A$  coupling to  $H_B$
- b.  $H_A$  coupling to  $H_C$
- c.  $H_B$  coupling to  $H_C$**
- d.  $H_C$  coupling to  $H_D$
- e.  $H_D$  coupling to  $H_E$

\_\_\_ 19. Which compound would produce the following  $^1H$  NMR spectrum?

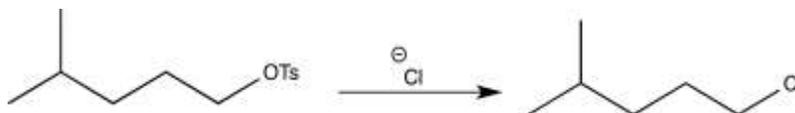


- a. I  
 b. II  
 c. III  
 d. IV  
 e. V

20. The mass spectrum for an unknown molecule has an  $M^+$  peak with a relative intensity of 100 and an  $M + 1$  peak with a relative intensity of 9.905. How many carbons are in the unknown molecule?
- a. 1 carbon  
 b. 5 carbons  
 c. 9 carbons  
 d. 10 carbons  
 e. 100 carbons

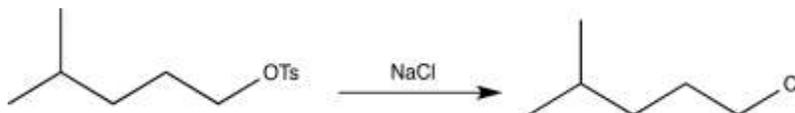
### Short Answer

1. Briefly explain why the following synthetic step is incorrect, and rewrite it so that it is correct.



ANS:

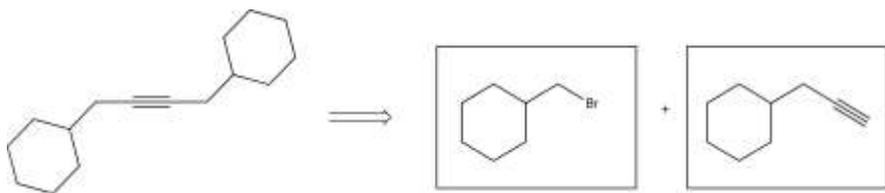
The step shown here is incorrect because chloride does not exist in a pure form; a counterion (potassium, sodium, etc.) must be included in order to maintain electrical neutrality. The corrected synthetic step follows.



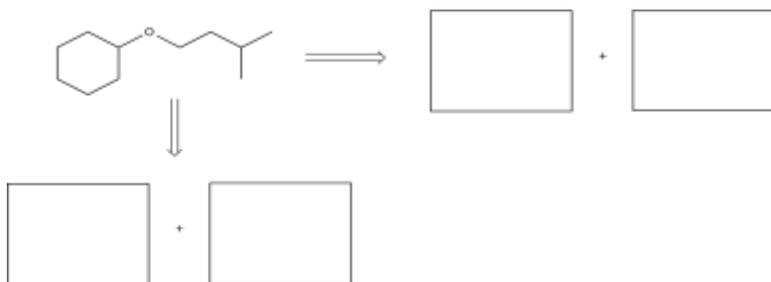
2. Determine the alkyl bromide and alkyne that could be used to synthesize the following target molecule.



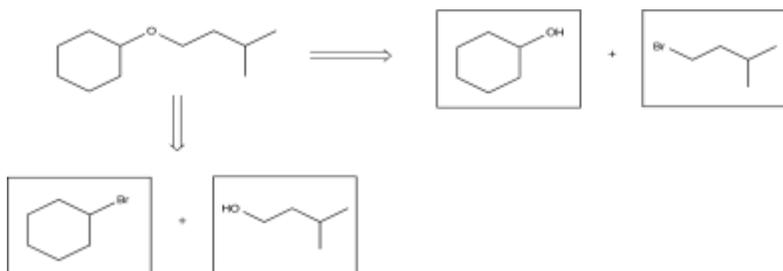
ANS:



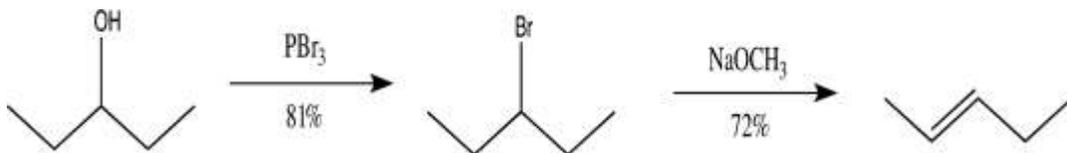
3. Draw two possible sets of precursors that could be used to synthesize the following target molecule.



ANS:



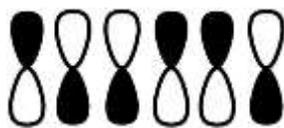
4. Calculate the overall percent yield of the following synthetic sequence.



ANS:

The overall yield for the two-step synthesis would be  $0.81 \times 0.72 = 0.58$ , or 58%.

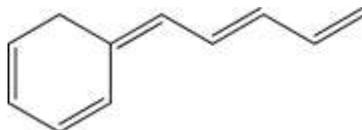
5. Would you expect the following atomic contributor to result in a bonding, antibonding, or nonbonding molecular orbital?



ANS:

2 bonding interactions and 3 antibonding interactions = antibonding

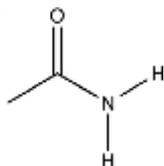
6. Is the following compound aromatic, antiaromatic, or nonaromatic? Explain your answer.



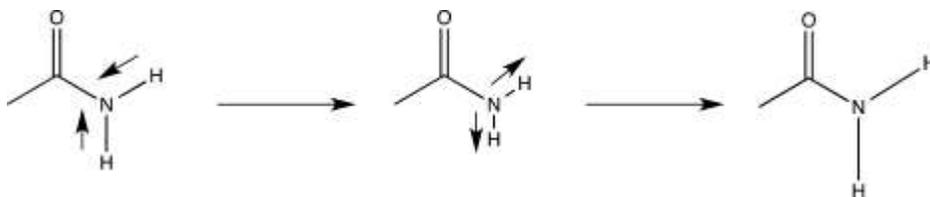
ANS:

Although the compound has  $4n + 2$  pi electrons ( $n = 2$ ), they are not part of a completely conjugated planar ring. Thus, the compound is nonaromatic.

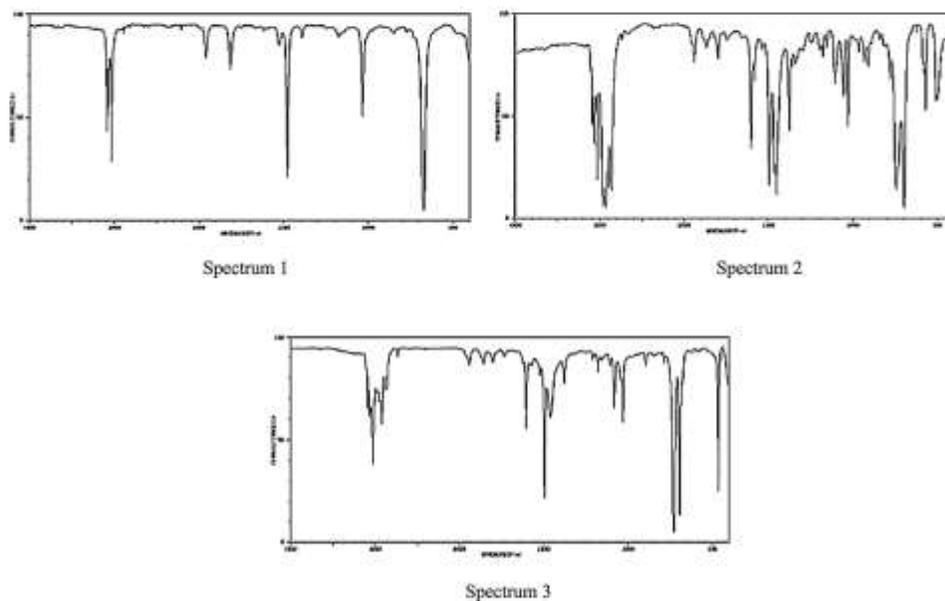
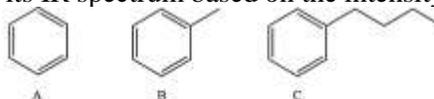
7. Draw the symmetric N—H stretch that would occur in the following molecule.



ANS:



8. Match each compound below to its IR spectrum based on the intensity of the alkane C—H stretch absorption



band.

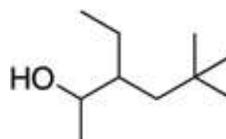
ANS:

Spectrum 1 = compound A (benzene)

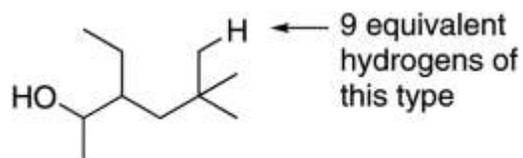
Spectrum 2 = compound C (butylbenzene)

Spectrum 3 = compound B (toluene)

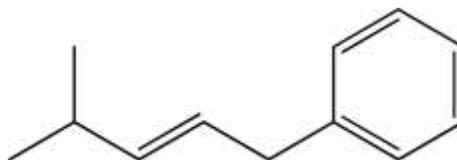
9. Which hydrogen in the following molecule has the greatest integration value?



ANS:



10. How many distinct  $^{13}\text{C}$  NMR signals are expected for the following compound?



ANS:

Nine