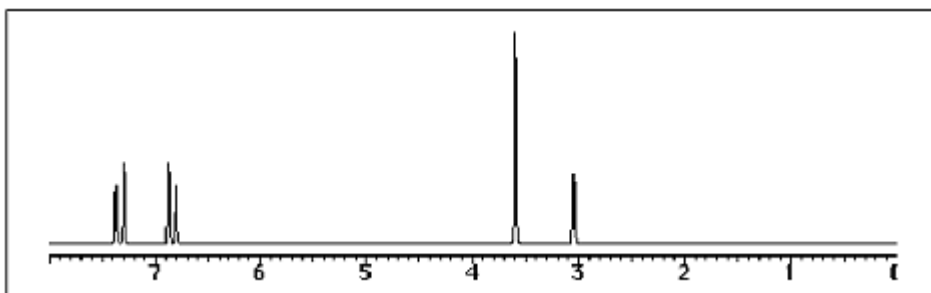
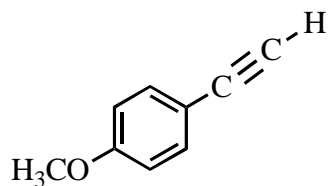


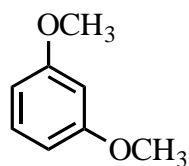
1. The following $^1\text{H-NMR}$ spectrum was most likely obtained from which of the compounds listed below?



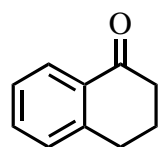
A)



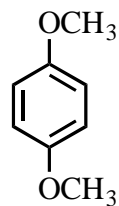
B)



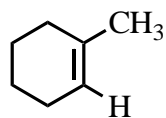
C)



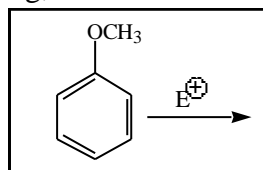
D)



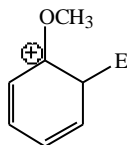
E)



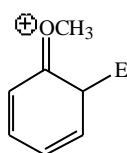
2. Considering the intermediate formed upon addition of an electrophile to this aromatic ring, which of the following is **not** a correct resonance structure:



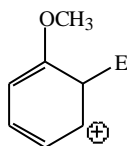
A)



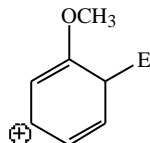
B)



C)

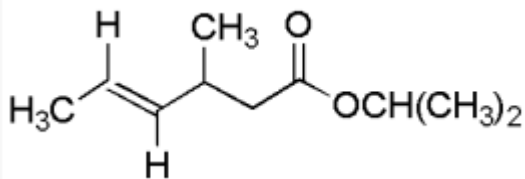


D)



E) All of these are correct.

3. How many signals will be present in a decoupled ^{13}C NMR spectrum for the molecule below?



A) 9

B) 7

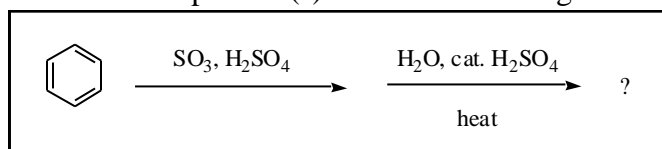
C) 10

D) 8

E) none of the above

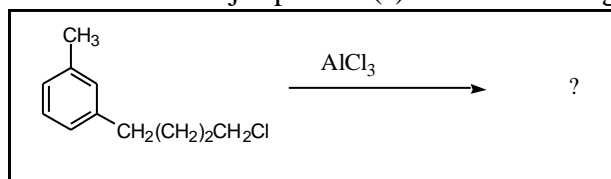
4. What functional group would be indicated by an IR absorption at 2150 cm^{-1} ?
- A) NH
 - B) C=O
 - C) C=C
 - D) $\text{C}\equiv\text{C}$
 - E) OH

5. What is/are the product(s) from the following reaction?

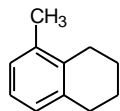


- A)
- B)
- C)
- D)
- E)

6. What is/are the major product(s) in the following reaction?

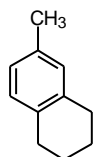


A)



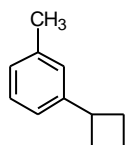
B) No Reaction

C)

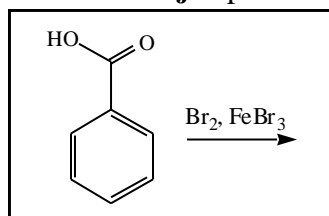


D) Both A and C

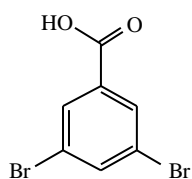
E)



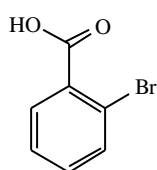
7. Predict the **major** product of the following reaction:



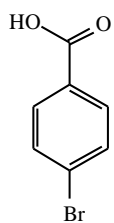
A)



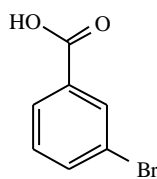
B)



C)



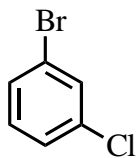
D)



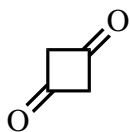
E) none of these

8. Which of the following structures will give **three** signals (not counting TMS) in the proton decoupled ^{13}C NMR?

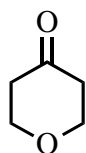
A)



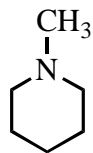
B)



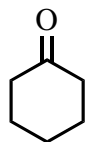
C)



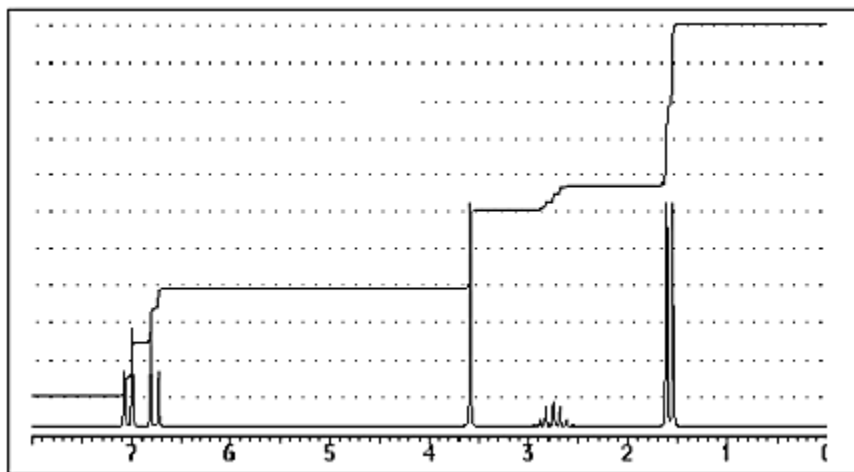
D)



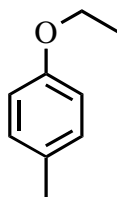
E)



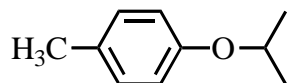
9. The following $^1\text{H-NMR}$ was most likely obtained from which of the compounds listed below?



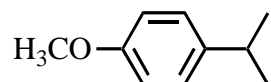
A)



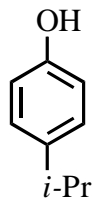
B)



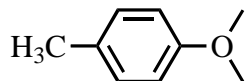
C)



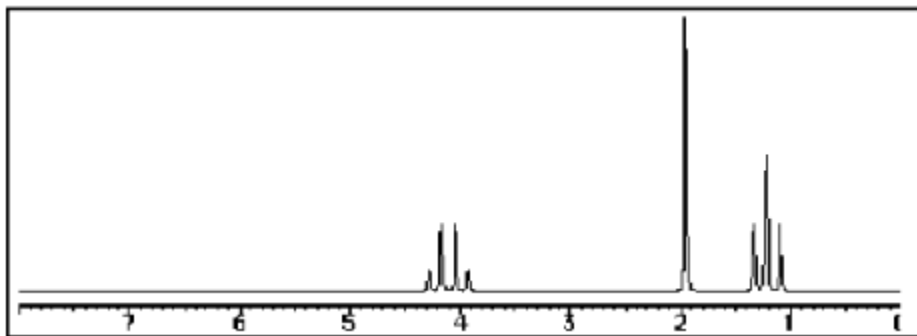
D)



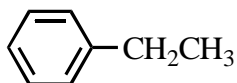
E)



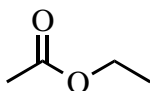
10. Which compound most likely exhibits the following proton NMR?



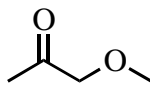
A)



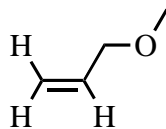
B)



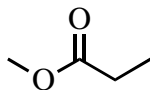
C)



D)



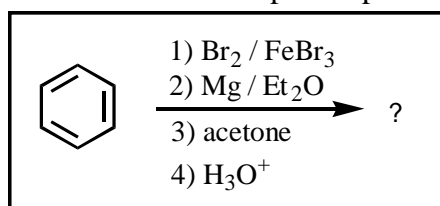
E)



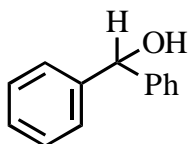
11. A compound which shows a molecular ion at m/z 84 could plausibly have what formula?

- A) $C_5H_{10}O$
- B) $C_5H_{10}N$
- C) C_5H_{24}
- D) $C_4H_{20}O$
- E) C_6H_{12}

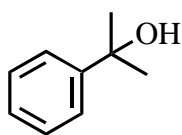
12. What would be the expected product of the following reactions?



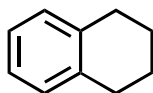
A)



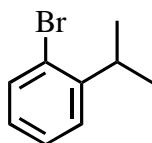
B)



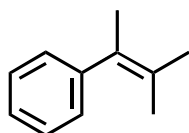
C)



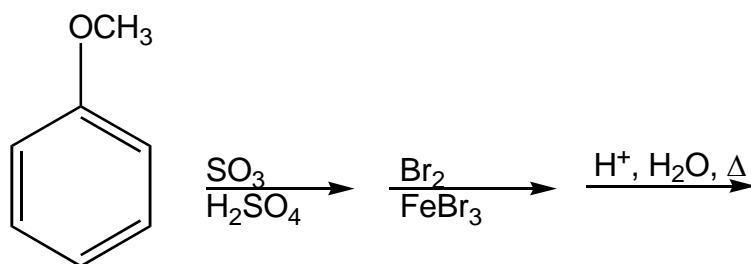
D)



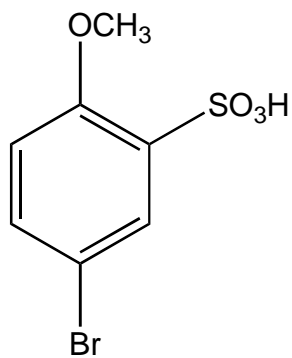
E)



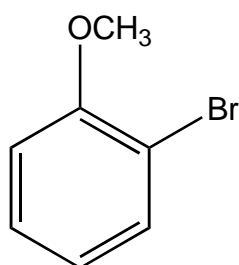
13. What would be the **major** product from the following reaction sequence?



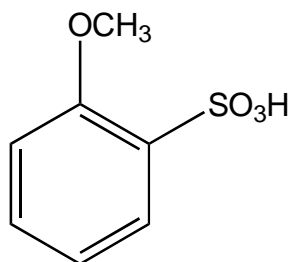
A)



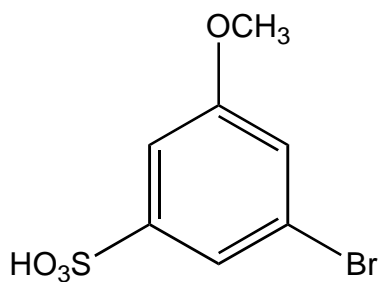
B)



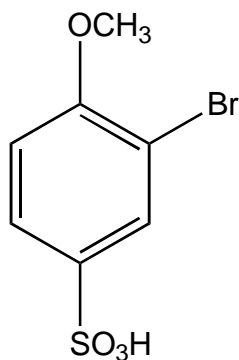
C)



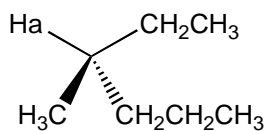
D)



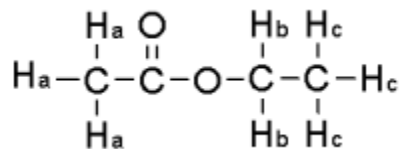
E)



14. Describe the splitting that would be observed by H_a in the proton NMR spectrum, assuming H_a is coupled to all its neighboring protons in an equivalent manner.



- A) H_a will be split into a sextet.
 B) H_a will be split into a septet.
 C) H_a will be split into an octet.
 D) H_a will be split into a pentet.
 E) none of the above
15. For the compound below give the spin-spin splitting that would be observed for each of the protons sets in the 1H NMR spectrum.

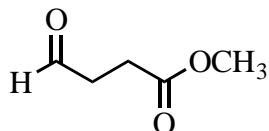


- A) H_a = triplet H_b = quartet, H_c = singlet
 B) H_a = singlet H_b = pentet, H_c = quartet
 C) H_a = triplet H_b = doublet, H_c = quartet
 D) H_a = singlet H_b = quartet, H_c = triplet
 E) none of the above

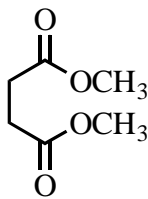
16. The following spectra data was most likely obtained from which compound?

IR Bands (cm^{-1})	proton NMR		Carbon-13 NMR
	Chemical shift (ppm)	Multiplicity	Chemical shift (ppm)
3000	3.85	Singlet	200
1740	2.70	Triplet	170
1695	2.25	Triplet	70
			35
			30

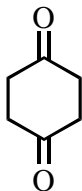
A)



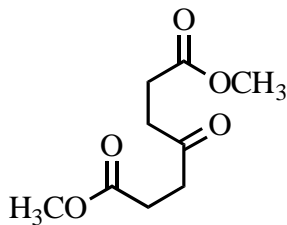
B)



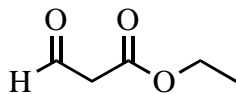
C)



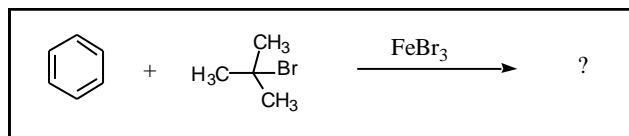
D)



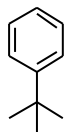
E)



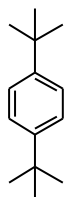
17. What is/are the product(s) in the following Friedel-Crafts Reaction?



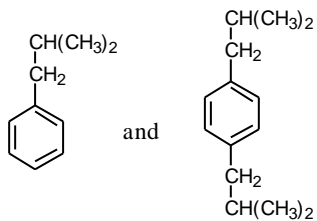
A)



B)



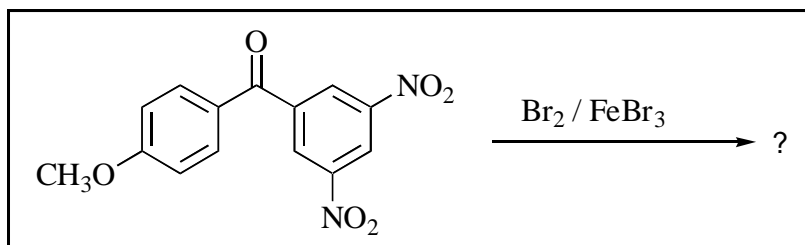
C)



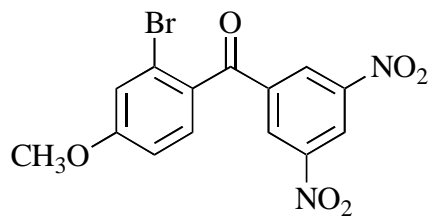
D) both A and B

E) all of the above

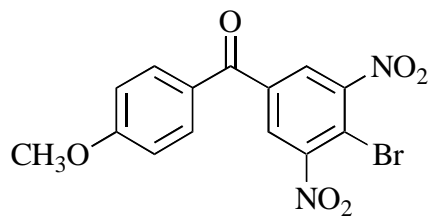
18. Predict the major organic product of the following reaction.



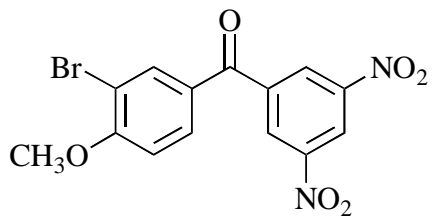
A)



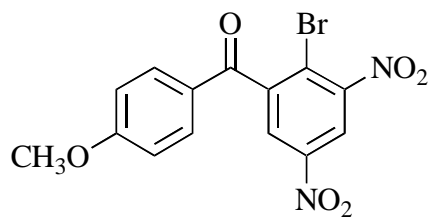
B)



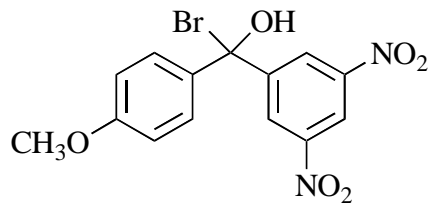
C)



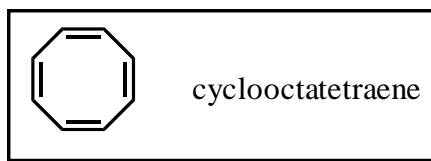
D)



E)

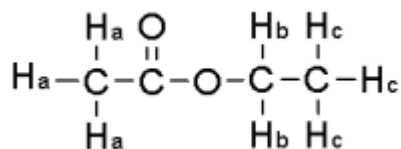


19. Which of the following best describes the electronic nature of cyclooctatetraene?



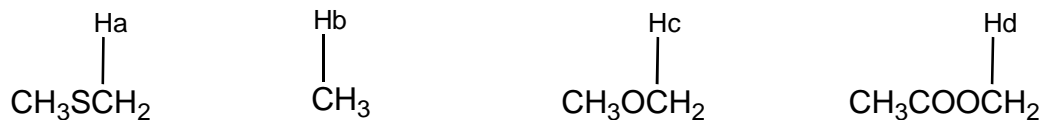
- A) Not all of the carbon atoms possess the π -orbital required for conjugation.
- B) This compound is non-planar and non-aromatic.
- C) This compound is predicted to be aromatic.
- D) This compound is anti-aromatic and very unstable.
- E) None of these are true.

20. For the compound below give the integration ratio that would be observed for each of the protons sets in the ^1H NMR spectrum.



- A) $\text{H}_a = 1$ $\text{H}_b = 1$, $\text{H}_c = 1$
- B) $\text{H}_a = 3$, $\text{H}_b = 2$, $\text{H}_c = 1$
- C) $\text{H}_a = 1$ $\text{H}_b = 2$, $\text{H}_c = 1$
- D) $\text{H}_a = 3$ $\text{H}_b = 2$, $\text{H}_c = 3$
- E) none of the above

21. Arrange each of the following labeled hydrogens in the order of increasing chemical shift.



- A) $\text{H}_b < \text{H}_c < \text{H}_a < \text{H}_d$
- B) $\text{H}_b < \text{H}_a < \text{H}_c < \text{H}_d$
- C) $\text{H}_a < \text{H}_b < \text{H}_c < \text{H}_d$
- D) $\text{H}_b < \text{H}_a < \text{H}_d < \text{H}_c$
- E) $\text{H}_d < \text{H}_c < \text{H}_a < \text{H}_b$

Answer Key

1. A
2. E
3. A
4. D
5. B
6. D
7. D
8. C
9. C
10. B
11. E
12. B
13. B
14. C
15. D
16. D
17. D
18. C
19. B
20. D
21. B