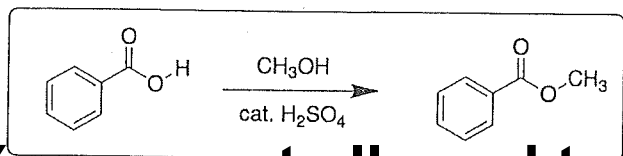


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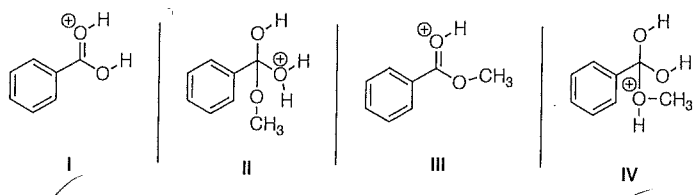
Questions 1 to 11, 2 pts each: Please use the front of the Scantron form.

1. Consider the reaction in the box:



**You are not allowed to post this key on the internet!**

The following structures are important intermediates in the mechanism of the reaction:



In what order do these intermediates appear in the mechanism of this reaction?

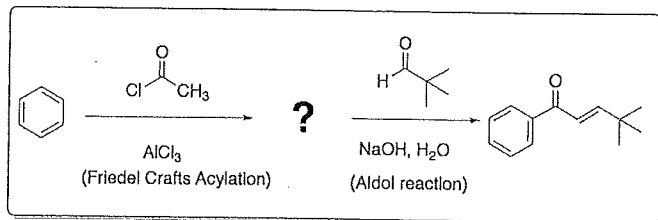
A) I followed by II followed by IV followed by III.

**B) I followed by IV followed by II followed by III.**

C) III followed by IV followed by II followed by I.

D) I followed by IV followed by III followed by II.

2. What is name of the intermediate of the reaction sequence shown in the box?



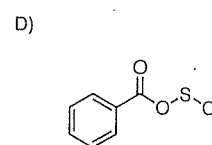
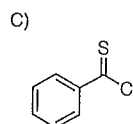
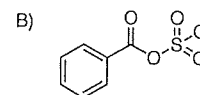
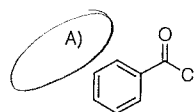
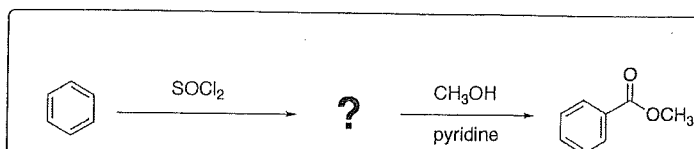
A) Benzoic acid

B) Benzaldehyde

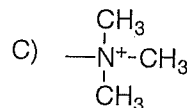
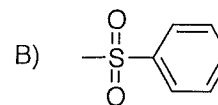
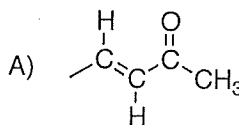
C) Aniline

**D) Acetophenone**

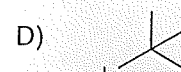
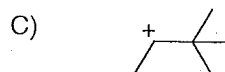
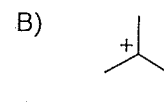
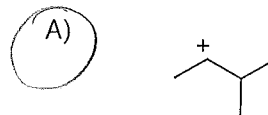
3. What is the structure of intermediate of the reaction sequence shown in the box?



4. Predict which of the following groups will be ortho/para-directing in the electrophilic aromatic substitution reaction?

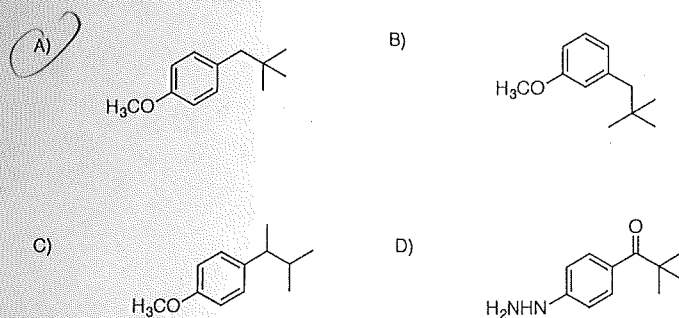
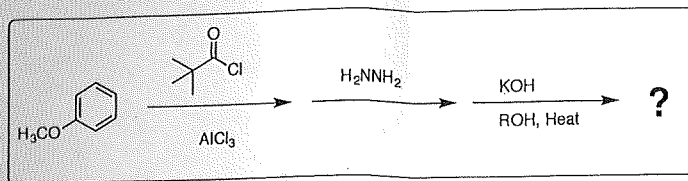


5. Which of the following is most likely to rearrange via **1,2-hydride shift** to form a more stable carbocation?

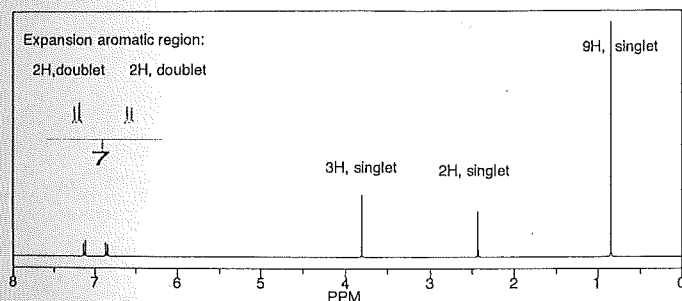


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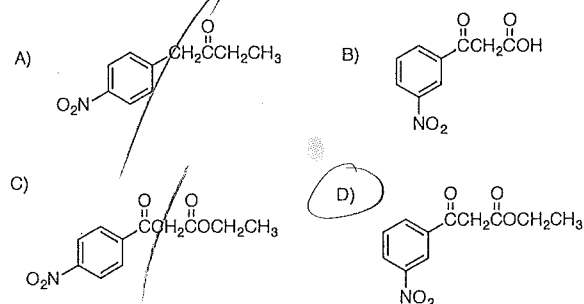
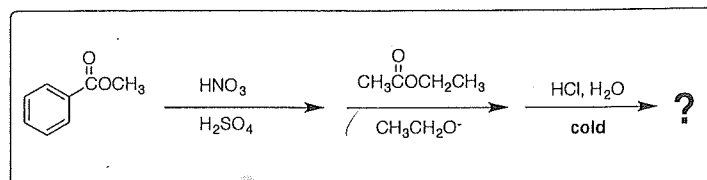
6. Which of the following is a major product of the reaction sequence shown in the box?



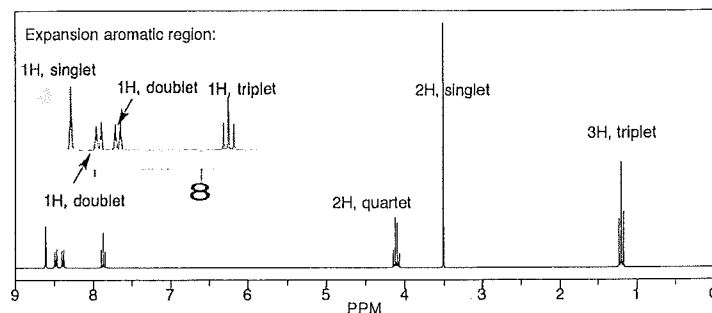
$^1\text{H}$  NMR of the major product:



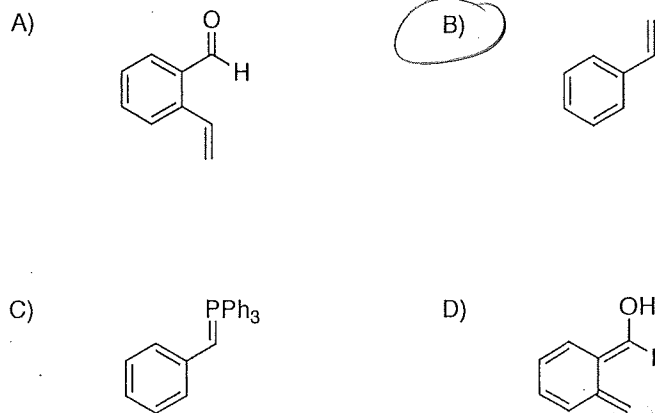
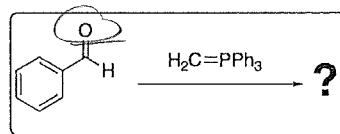
8. Which of the following is a major product of the reaction sequence shown in the box?



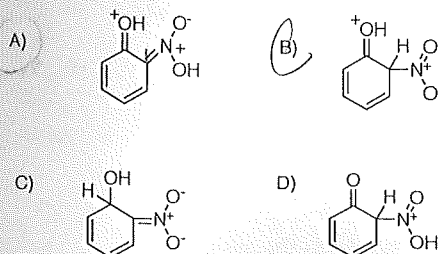
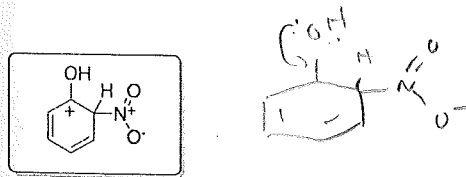
$^1\text{H}$  NMR of the major product:



9. What is a major product of the Wittig reaction in the box? –  $^{13}\text{C}$  NMR: 6 signals

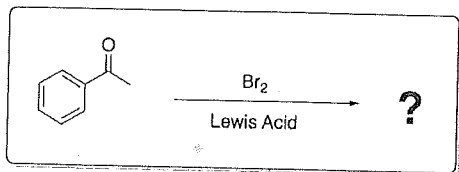


7. Which of the following is a resonance structure of the carbocation shown in the box?

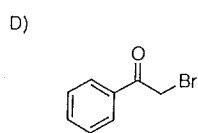
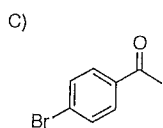
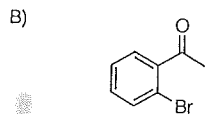
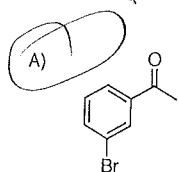


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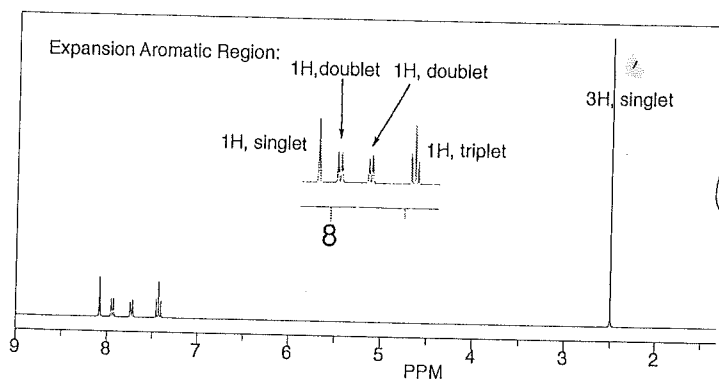
10. What is the major product of the reaction shown in the box?



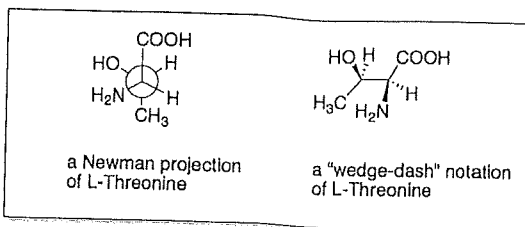
Br-Br



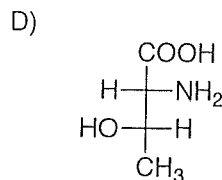
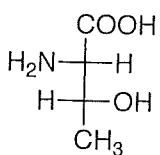
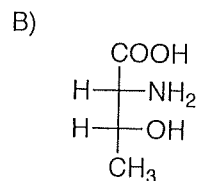
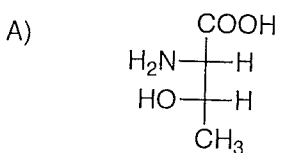
$^1\text{H}$  NMR spectrum of the major product:



11. The structures in the box depict a Newman projection and "wedge-dash" notation of L-Threonine (IUPAC name: 2S,3R-2-amino-3-hydroxy-butanoic acid).



Which of the following depicts a Fischer projection of L-Threonine?



Question 12: Please use the back of the Scantron form.

12. (2 pts) On the back of the Scantron form please provide the reactants or reagent.

