Experiment 23

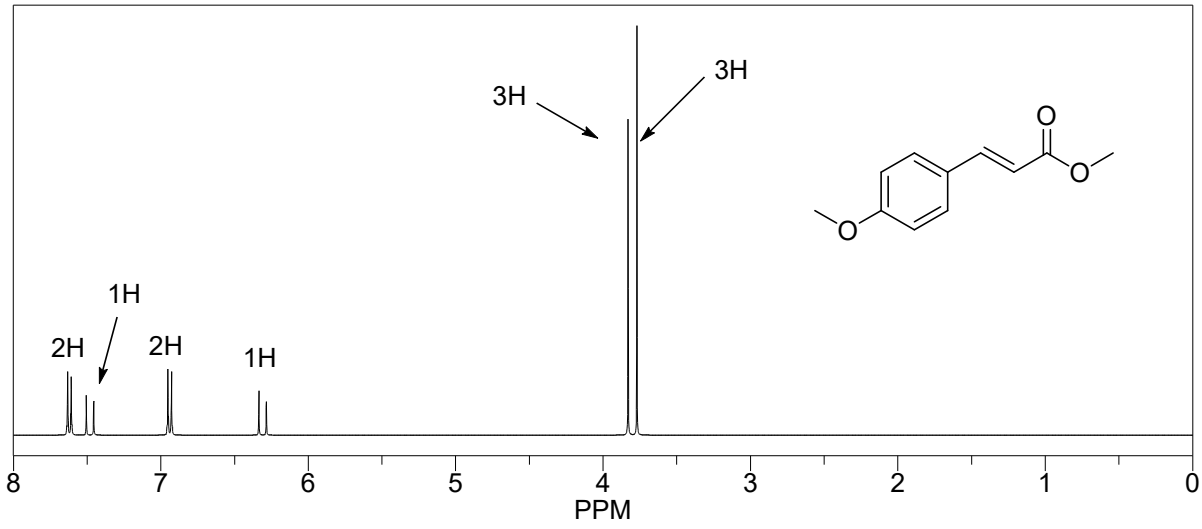
Fischer Esterification: Synthesizing Esters from Acids and Alcohols

Study Questions

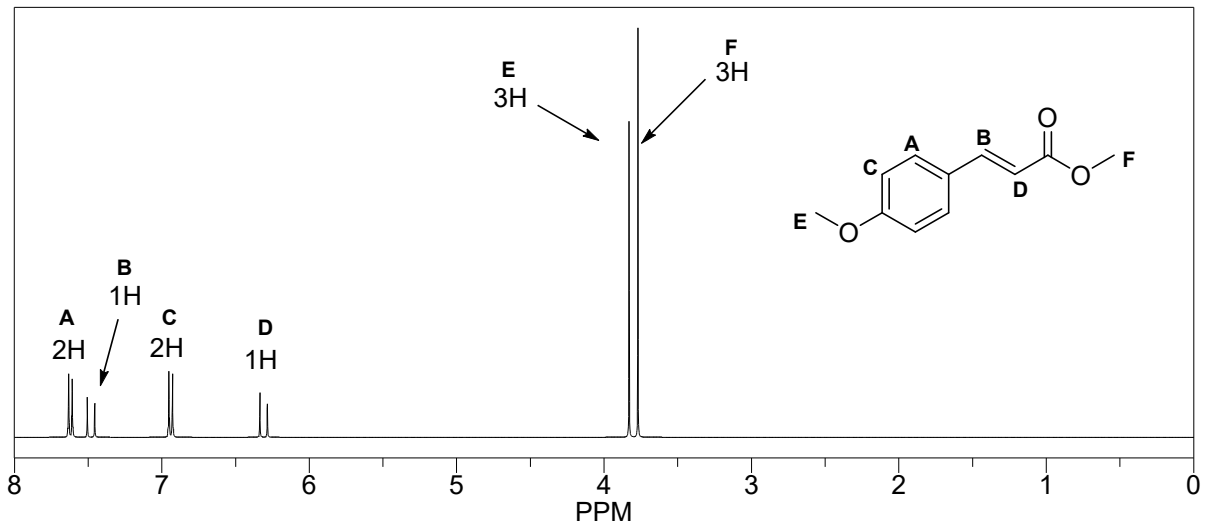
1) Explain why concentrated H_2SO_4 (98% solution in water) is a far superior esterification catalyst compared with concentrated HCl (37% solution in water). **Answer:** H_2SO_4 is 96% by weight in aqueous solution, and HCl is 37% by weight in aqueous solution. Therefore, sulfuric acid has less water; water would drive the equilibrium towards the reactants. (You can also argue that sulfuric acid has a higher concentration of H^+ and is therefore a more powerful acid catalyst.) Another reason that sulfuric acid is a better catalyst is that sulfuric acid is dehydrating, or has a great affinity to water. Since it is a powerful dehydrator which binds water, it drives the equilibrium to the right.

2) Compared to the starting carboxylic acid, the corresponding ester will always have a lower melting point. A major determinant in the melting point of a compound is its ability to interact with other molecules in the crystal lattice. By esterifying your acid, what key property or ability have you reduced or eliminated from your starting acid? **Answer:** The ability to hydrogen-bond into dimers.

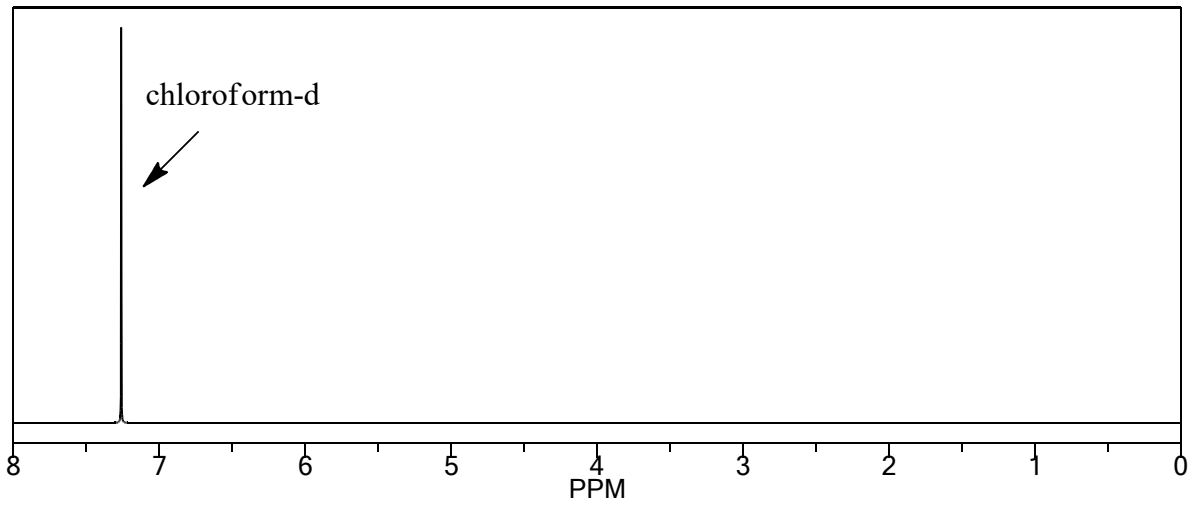
3) Interpret the NMR spectra of methyl 4-methoxycinnamate below:



Answer:



4) Predict the ^{1}H-NMR spectrum (using $CDCl_3$ as solvent) of the ester that you will synthesize. Draw in the peaks you would expect for your ester, paying special attention to splitting and integrations.



Answer: See NMR spectra on orgchem website.