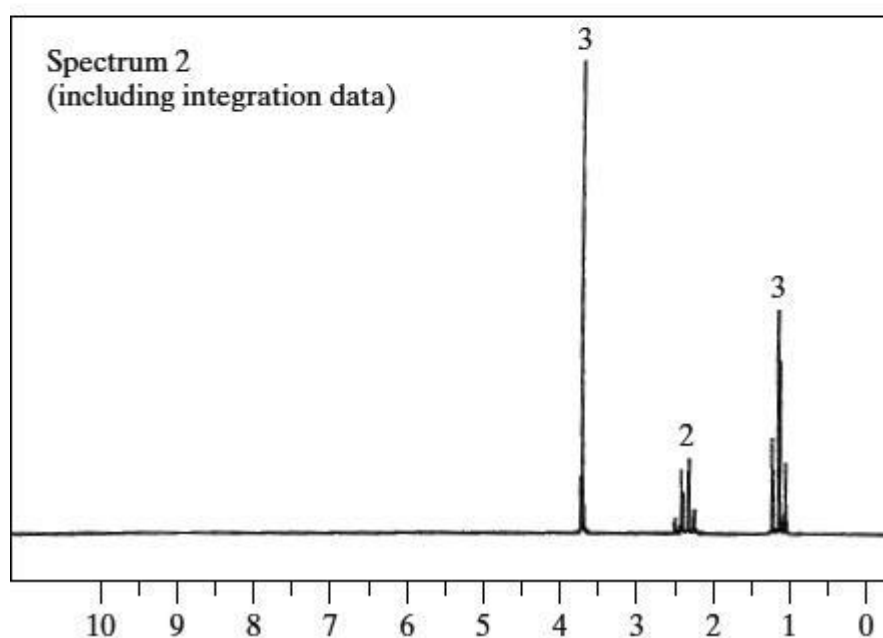
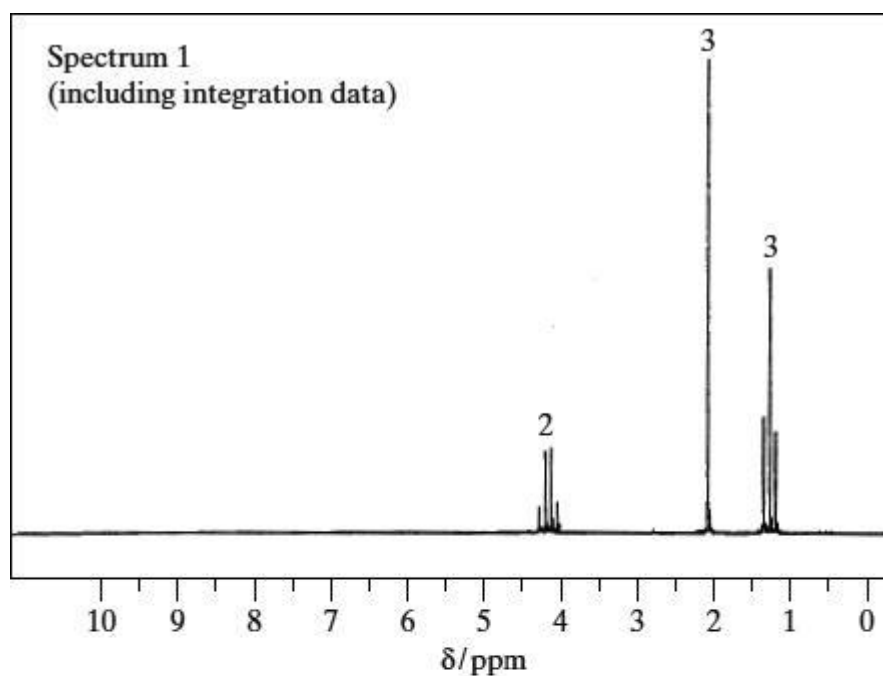




(4)
(Total 10 marks)

Q2.

Butenedioic acid, $\text{HOOCCH}=\text{CHCOOH}$, occurs as two stereoisomers. One of the isomers readily forms the acid anhydride $\text{C}_4\text{H}_2\text{O}_3$ when warmed.

- (a) Draw the structures of the two isomers of butenedioic acid and name the type of isomerism shown.
Use the structures of the two isomeric acids to suggest why only one of them readily forms an acid anhydride when warmed. Draw the structure of the acid anhydride formed.

(6)

- (b) Identify one electrophile which will react with butenedioic acid and outline a mechanism for this reaction.

(4)

- (c) Write an equation for a reaction which occurs when butenedioic acid is treated with an excess of aqueous sodium hydroxide.

(2)

- (d) Describe and explain the appearance of the proton n.m.r. spectrum of butenedioic acid.

(3)

(Total 15 marks)