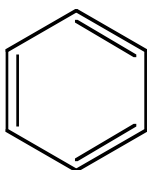


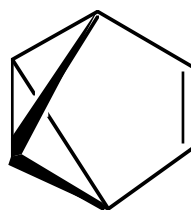
Problem 20, Chemistry 301X - 2006

In the old days, it was thought that benzvalene, compound **1** below, might be the structure of benzene.



benzene?

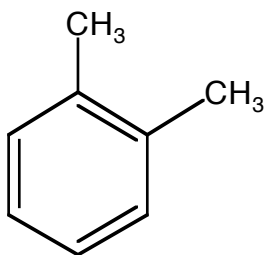
or



1

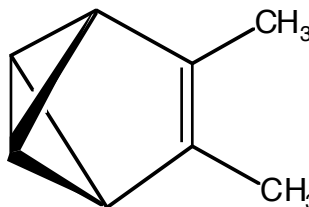
is this benzene?

(a) If you had a bottle of the disubstituted benzene **2** or **3**, could you use ^{13}C NMR spectroscopy to tell which was the real structure of benzene?



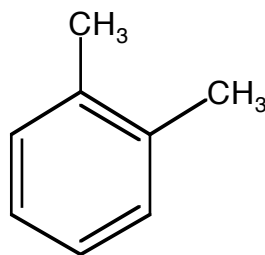
2

or



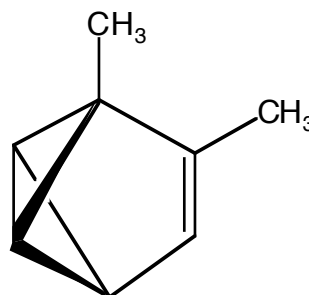
3

(b) How about **4**? Could ^{13}C NMR spectroscopy tell the difference between **2** and **4**?



2

or



4