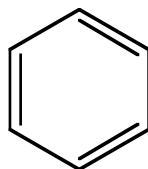
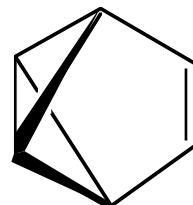


Problem 20, Chemistry 301X - 2006

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



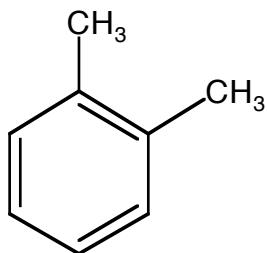
benzene? or



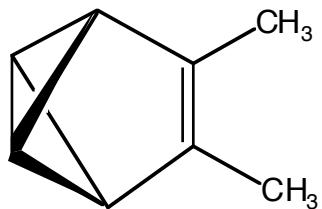
**1**

is this benzene?

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



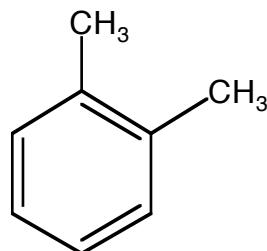
or



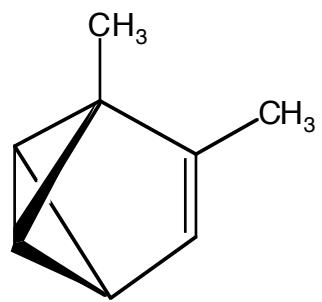
**2**

**3**

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



or



**2**

**4**