1. Describe the appearance of the methine proton in 1 under conditions of

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[a] rapid exchange – doublet of doublets (dd) [coupling to adjacent axial and equatorial protons]. If the OH is axial, then there will be two small couplings (~4 Hz each … think of the Karplus relationship), since the dihedral angle between the H’s on the adjacent centers will be 60° (axial-equatorial and diequatorial). If the OH is equatorial, then there will be one large coupling (~8-10 Hz) between the diaxial H’s and one small coupling (~4 Hz) between the axial and equatorial H’s.

[b] slow exchange – a doublet of doublet of doublets (abbreviated “ddd”). Coupling to the axial and equatorial H’s as well as to the H of the OH. Thus, each of the lines predicted in part ‘a’ would be split into doublets.

What would it look like after the addition of 2 drops of D2O? The H of the OH would wash out. Only the coupling to the adjacent axial and equatorial H’s would remain. Therefore, one would observe the same spectrum as indicated in part ‘a’.

   [solution is given on the web site]

   [b] Predict the appearance of the APT spectrum for this substance. Two “down-signals” (the two methyl groups) and two “up-signals” … one each for the carbonyl carbon that appears far downfield and the other for the CH2-carbon.

   [c] Where, in wavenumber units, would one expect to find the carbonyl and C(sp³)-H stretching frequencies in the IR spectrum for this substance? C=O ~ 1710 and the C-H ~2950 cm⁻¹.