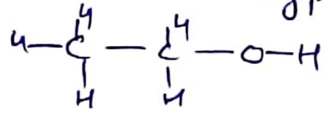
NMR spectra of ethyl alcohol

The pure sample of ethyl alcohol shows three peaks. This indicates three types of protons.



The CH_3 group is a triplet due to coupling by CH_2. The CH_3 peak is at δ 1.2.

The O-H signal is also a triplet at δ. 5.2 due to coupling by CH_2 neighbour.

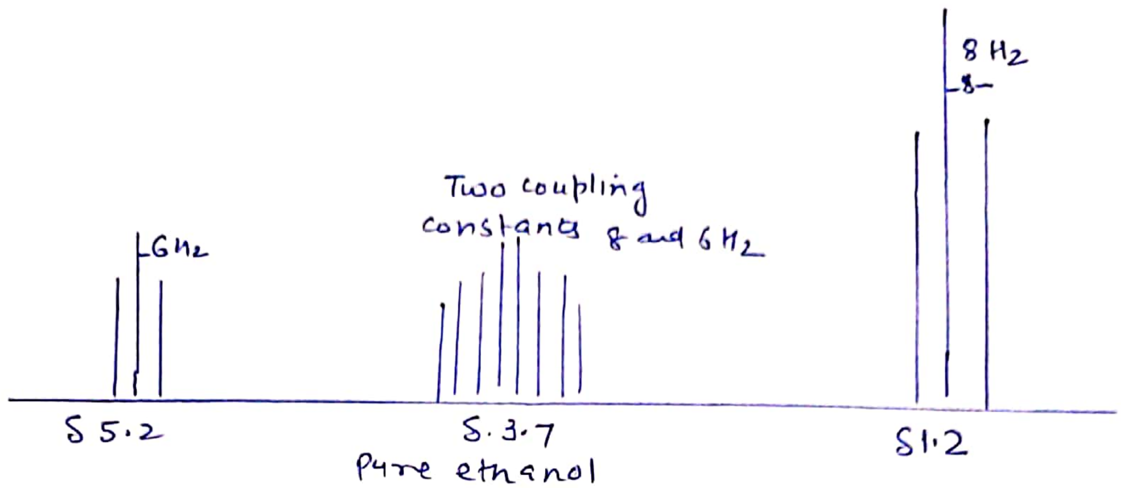
The most interesting peak is of CH_2 which gives eight peaks. This is because the CH_2 is split into quartet by the methyl CH_3 group. and then each line is split into two by the OH proton. There are two different coupling constants involved (8 Hz and 6 Hz). This appears at δ 3.7.

In case of impure ethanol, the O-H coupling is not observed. The acidic proton of ethanol i.e the hydrogen attached to oxygen keeps on exchanging. This exchange is so rapid that one particular proton does not reside for sufficiently long time on a particular oxygen atom for the nuclear coupling to be observed.

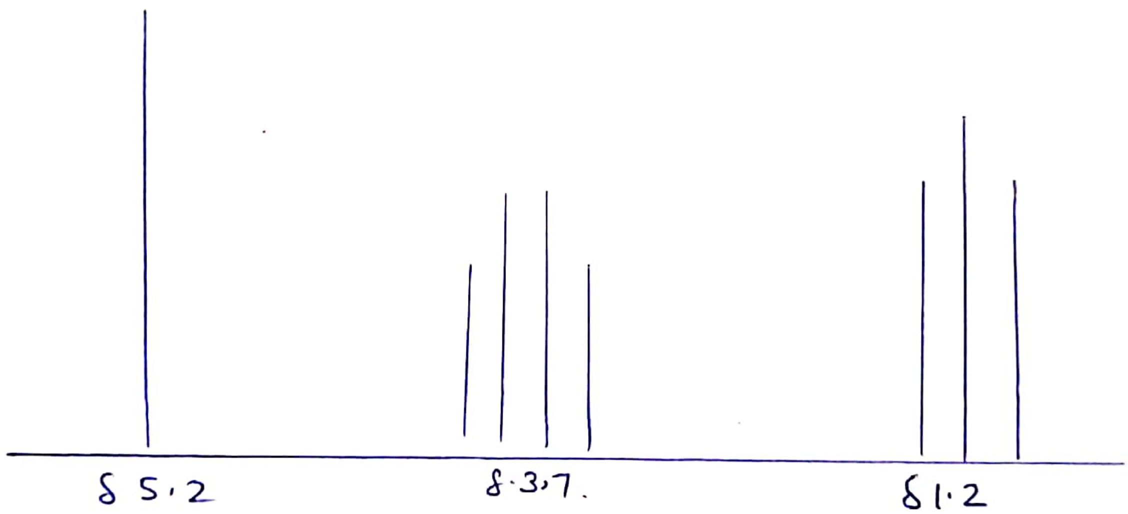
$$R-O-H + R-O-H^{*} \rightleftharpoons R-O-H^{*} + R-O-H.$$

$\Delta t \cdot \Delta \nu \simeq 1/2\pi$. Δt is the time needed to resolve accurately the multiplicity in the CH_2 and OH groups brought about by their coupling and $\Delta\nu$ is the coupling constant. The coupling can only be observed when Δt is sufficiently long. This is residence time.

Thus, in case of impure alcohol, the CH_3 group is a triplet due to coupling by CH_2- at δ.1.2 as above. Here a quartet is observed for CH_2 due to coupling by CH_3- gp only. at δ.3.7. while a singlet at δ 5.2 due to —OH group. The —O—H does not stay for enough time for it to be splitted by CH_2- gp neighbour.



Pure ethanol



impure ethanol

The −OH coupling in ethanol is best observed by recording the spectrum at low temperatures where the exchange is ~~recorded~~ retarted. The use of solvents like dimethylsulphoxide, Me_2SO where strong solvation presumably stabilize individual molecules and reduces exchange.

No coupling is observed in carboxylic acids, Phenols, amines, amides and thiols due to rapid exchange of their acidic protons.