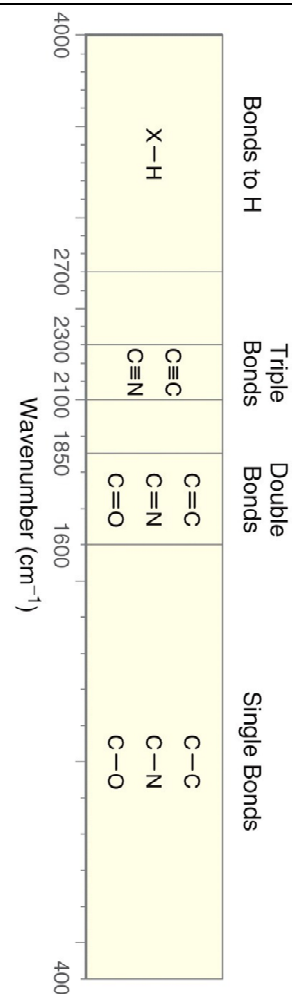


TABLE 16.2 CHEMICAL SHIFTS FOR PROTONS IN DIFFERENT ELECTRONIC ENVIRONMENTS

TYPE OF PROTON	CHEMICAL SHIFT (δ)	TYPE OF PROTON	CHEMICAL SHIFT (δ)
Methyl	$R-CH_3$ ~0.9	Alkyl halide	$R-\overset{H}{\underset{R}{C}}-X$ 2-4
Methylene	$\text{>}CH_2$ ~1.2	Alcohol	$R-O-H$ 2-5
Methine	$-CH$ ~1.7	Vinylic	=CH 4.5-6.5
Allylic	=CH-CH_2-H ~2	Aryl	C_6H_5-H 6.5-8
Alkynyl	$R-C\equiv C-H$ ~2.5	Aldehyde	$R-C(=O)-H$ ~10
Aromatic methyl	$\text{C}_6\text{H}_5-CH_3$ ~2.5	Carboxylic acid	$R-C(=O)-O-H$ ~12

TYPE OF PROTON	CHEMICAL SHIFT (δ)
Allylic	=CH-CH_2-H ~2
Alkynyl	$R-C\equiv C-H$ ~2.5
Aromatic methyl	$\text{C}_6\text{H}_5-CH_3$ ~2.5

TYPE OF PROTON	CHEMICAL SHIFT (δ)
Methyl	$R-CH_3$ ~0.9
Methylene	$\text{>}CH_2$ ~1.2
Methine	$-CH$ ~1.7



Carbon atoms of carbonyl groups. These carbon atoms are highly deshielded.	sp^2 -hybridized carbon atoms.	sp -hybridized carbon atoms as well as sp^3 -hybridized carbon atoms that are deshielded by electronegative atoms.	sp^3 -hybridized carbon atoms (methyl, methylene, and methine groups).

220 150 100 50 0 ppm

