


**TABLE 13.1**  
Chemical Shifts of Representative Types of Protons

Type of proton	Chemical shift ( $\delta$ ), ppm*	Type of proton	Chemical shift ( $\delta$ ), ppm*
$\text{H}-\text{C}-\text{R}$	0.9–1.8	$\text{H}-\text{C}-\text{NR}$	2.2–2.9
$\text{H}-\text{C}-\text{C}=\text{C}$	1.6–2.6	$\text{H}-\text{C}-\text{Cl}$	3.1–4.1
$\text{H}-\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-$	2.1–2.5	$\text{H}-\text{C}-\text{Br}$	2.7–4.1
$\text{H}-\text{C}\equiv\text{C}-$	2.5	$\text{H}-\text{C}-\text{O}$	3.3–3.7
$\text{H}-\text{C}-\text{Ar}$	2.3–2.8	$\text{H}-\text{NR}$	1–3†
$\text{H}-\text{C}=\overset{\text{C}}{\diagup}$	4.5–6.5	$\text{H}-\text{OR}$	0.5–5†
$\text{H}-\text{Ar}$	6.5–8.5	$\text{H}-\text{OAr}$	6–8†
$\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-$	9–10	$\text{H}-\overset{\text{O}}{\parallel}{\text{OC}}-$	10–13†

**TABLE 13.3**  
Chemical Shifts of Representative Carbons

Type of carbon	Chemical shift ( $\delta$ ), ppm*	Type of carbon	Chemical shift ( $\delta$ ), ppm*
$\text{RCH}_3$	0–35	$\text{C}=\text{C}$	100–150
$\text{R}_2\text{CH}_2$	15–40		110–175
$\text{RCH}_2\text{Br}$	20–40	$\text{C}=\text{O}$	190–220
$\text{R}_3\text{CH}$	25–50	$\text{C}\equiv\text{C}$	65–90
$\text{RCH}_2\text{Cl}$	25–50		
$\text{RCH}_2\text{NH}_2$	35–50		
$\text{RCH}_2\text{OH}$	50–65		
$-\text{C}\equiv\text{C}-$	65–90		