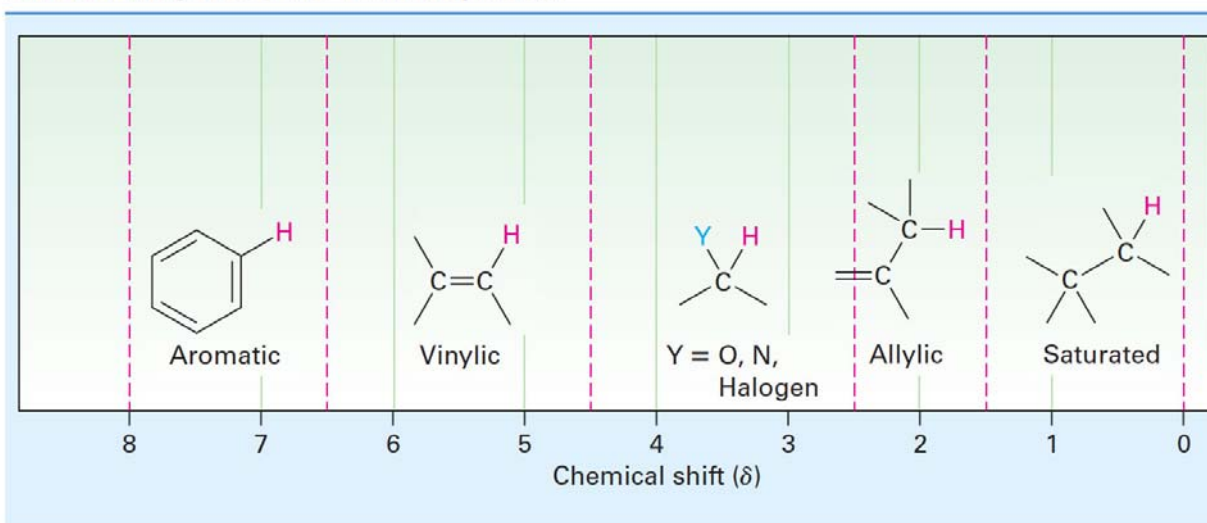



Table 13.3 Correlation of ^1H Chemical Shift with Environment

Type of hydrogen	Chemical shift (δ)	Type of hydrogen	Chemical shift (δ)
Reference	$\text{Si}(\text{CH}_3)_4$ 0	Alcohol	$\begin{array}{c} \\ -\text{C}-\text{O}-\text{H} \\ \end{array}$ 2.5–5.0
Alkyl (primary)	$-\text{CH}_3$ 0.7–1.3	Alcohol, ether	$\begin{array}{c} \text{H} \\ \\ -\text{C}-\text{O}- \\ \end{array}$ 3.3–4.5
Alkyl (secondary)	$-\text{CH}_2-$ 1.2–1.6	Vinylic	$\begin{array}{c} \text{H} \\ \\ \text{C}=\text{C} \\ \end{array}$ 4.5–6.5
Alkyl (tertiary)	$\begin{array}{c} \\ -\text{CH}- \\ \end{array}$ 1.4–1.8	Aryl	$\text{Ar}-\text{H}$ 6.5–8.0
Allylic	$\begin{array}{c} \text{H} \\ \\ \text{C}=\text{C}-\text{C}- \\ \end{array}$ 1.6–2.2	Aldehyde	$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{H} \end{array}$ 9.7–10.0
Methyl ketone	$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{CH}_3 \end{array}$ 2.0–2.4	Carboxylic acid	$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{O}-\text{H} \end{array}$ 11.0–12.0
Aromatic methyl	$\text{Ar}-\text{CH}_3$ 2.4–2.7		
Alkynyl	$-\text{C}\equiv\text{C}-\text{H}$ 2.5–3.0		
Alkyl halide	$\begin{array}{c} \text{H} \\ \\ -\text{C}-\text{Hal} \\ \end{array}$ 2.5–4.0		

Table 13.2 Regions of the ^1H NMR Spectrum



C-13 CHEMICAL SHIFTS

Type of carbon	Approximate chemical shift (ppm)	Type of carbon	Approximate chemical shift (ppm)
$(\text{CH}_3)_4\text{Si}$	0	$\text{C}-\text{I}$	0–40
$\text{R}-\text{CH}_3$	8–35	$\text{C}-\text{Br}$	25–65
$\text{R}-\text{CH}_2-\text{R}$	15–50	$\text{C}-\text{Cl}$	35–80
$\begin{array}{c} \text{R} \\ \\ \text{R}-\text{CH}-\text{R} \end{array}$	20–60	$\text{C}-\text{N}$	40–60
$\begin{array}{c} \text{R} \\ \\ \text{R}-\text{C}-\text{R} \\ \\ \text{R} \end{array}$	30–40	$\text{C}-\text{O}$	50–80
$\equiv\text{C}$	65–85	$\begin{array}{c} \text{R} \\ \diagup \\ \text{C}=\text{O} \\ \diagdown \\ \text{R} \end{array}$	165–175
$=\text{C}$	100–150	$\begin{array}{c} \text{R} \\ \diagup \\ \text{C}=\text{O} \\ \diagdown \\ \text{RO} \end{array}$	165–175
	110–170	$\begin{array}{c} \text{R} \\ \diagup \\ \text{C}=\text{O} \\ \diagdown \\ \text{HO} \end{array}$	175–185
		$\begin{array}{c} \text{R} \\ \diagup \\ \text{C}=\text{O} \\ \diagdown \\ \text{H} \end{array}$	190–200
		$\begin{array}{c} \text{R} \\ \diagup \\ \text{C}=\text{O} \\ \diagdown \\ \text{R} \end{array}$	205–220

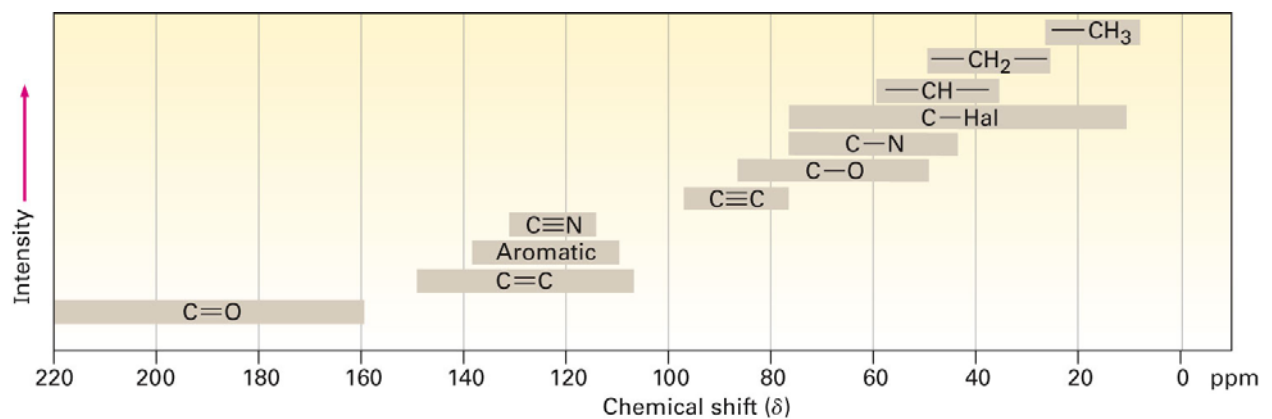


Table 12.1 Characteristic IR Absorptions of Some Functional Groups

Functional Group	Absorption (cm ⁻¹)	Intensity	Functional Group	Absorption (cm ⁻¹)	Intensity
Alkane			Amine		
C-H	2850–2960	Medium	N-H	3300–3500	Medium
Alkene			C-N	1030–1230	Medium
=C-H	3020–3100	Medium	Carbonyl compound		
C=C	1640–1680	Medium	C=O	1670–1780	Strong
Alkyne			Aldehyde	1730	Strong
≡C-H	3300	Strong	Ketone	1715	Strong
C≡C	2100–2260	Medium	Ester	1735	Strong
Alkyl halide			Amide	1690	Strong
C-Cl	600–800	Strong	Carboxylic acid	1710	Strong
C-Br	500–600	Strong	Carboxylic acid		
Alcohol			O-H	2500–3100	Strong, broad
O-H	3400–3650	Strong, broad	Nitrile		
C-O	1050–1150	Strong	C≡N	2210–2260	Medium
Arene			Nitro		
C-H	3030	Weak	NO ₂	1540	Strong
Aromatic ring	1660–2000	Weak			
	1450–1600	Medium			