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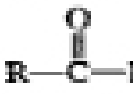
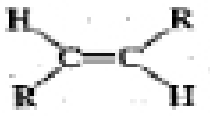
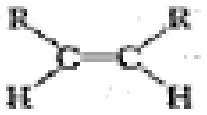
Table 13.4 Important IR Stretching Frequencies

Type of bond	Wavenumber (cm^{-1})	Intensity
C≡N	2260–2220	medium
C≡C	2260–2100	medium to weak
C=C	1680–1600	medium
C=N	1650–1550	medium
	~1600 and ~1500–1430	strong to weak
C=O	1780–1650	strong
C—O	1250–1050	strong
C—N	1230–1020	medium
O—H (alcohol)	3650–3200	strong, broad
O—H (carboxylic acid)	3300–2500	strong, very broad → very broad
N—H	3500–3300	medium, broad
C—H	3300–2700	medium

Table 13.5 IR Absorptions of Carbon–Hydrogen Bonds

Carbon–Hydrogen Stretching Vibrations	Wavenumber (cm^{-1})
C≡C—H	~3300
C=C—H	3100–3020
C—C—H	2960–2850
	~2820 and ~2720

Carbon–Hydrogen Bending Vibrations		Wavenumber (cm^{-1})
CH_2— —CH_2— —CH—		1450–1420
CH_3—		1385–1365
	trans	980–960
	cis	730–675
	trisubstituted	840–800
	terminal alkene	890
	terminal alkene	990 and 910

From P.Y. Bruice, *Organic Chemistry*, 4th edition, Pearson Education, Inc., Upper Saddle River, NJ, 2004, pages 502, 508

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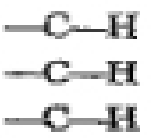
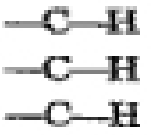
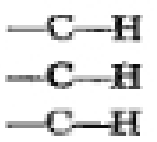
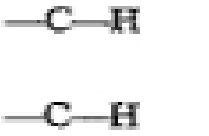
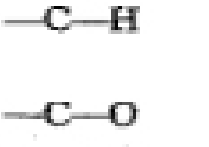
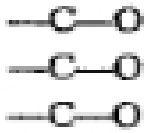
Table 11.2 Structural Units and Absorption Frequencies

BOND		TYPE OF COMPOUND	FREQUENCY (CM^{-1})
	(stretch)	Alkane	2800–3000
	(stretch)	Alkenes, aromatics	3000–3100
≡C—H	(stretch)	Alkynes	3300
—O—H	(stretch)	Alcohols, phenols	3600–3650 (free) 3200–3500 (H-bonded) (broad)
	(stretch)	Carboxylic acids	2500–3300
	(stretch)	Amines	3300–3500 (doublet for NH_2)
	(stretch)	Aldehyde	2720 and 2820
	(stretch)	Alkenes	1600–1680
	(stretch)	Aromatic	1500 and 1600
—C≡C—	(stretch)	Alkynes	2100–2270
	(stretch)	Aldehydes, ketones	1680–1740
—C≡N	(stretch)	Nitriles	2220–2260
C—N	(stretch)	Amines	1180–1360
—C—H	(bending)	Alkane	1375 (methyl)
—C—H	(bending)	Alkane	1460 (methyl and methylene)
—C—H	(bending)	Alkane	1370 and 1385 (isopropyl split)
—C—H	(bending)	R—CH═CH_2	1000–960 and 940–900
—C—H	(bending)	R_2C═CH_2	915–870
—C—H	(bending)	*cis* RCH═CHR	790–650
—C—H	(bending)	*trans* RCH═CHR	990–940
—C—H	(out-of-plane bending)	*mono* subst. benzene	770–730 and 710–690
—C—H	(out-of-plane bending)	*o*-subst. benzene	770–735
—C—H	(out-of-plane bending)	*m*-subst. benzene	810–750 and 710–690
—C—H	(out-of-plane bending)	*p*-subst. benzene	860–800
—C—O	(stretch)	Primary alcohol	1050–1085
—C—O	(stretch)	Secondary alcohol	1085–1125
—C—O	(stretch)	Tertiary alcohol	1125–1200
—C—O	(stretch)	Phenol	1180–1260

From C.E. Bell, D.F. Taber and A.K. Clark, *Organic Chemistry Laboratory with Qualitative Analysis*, 3rd edition, Brooks/Cole-Thomson Learning, Pacific Grove, CA 2001, page 95.