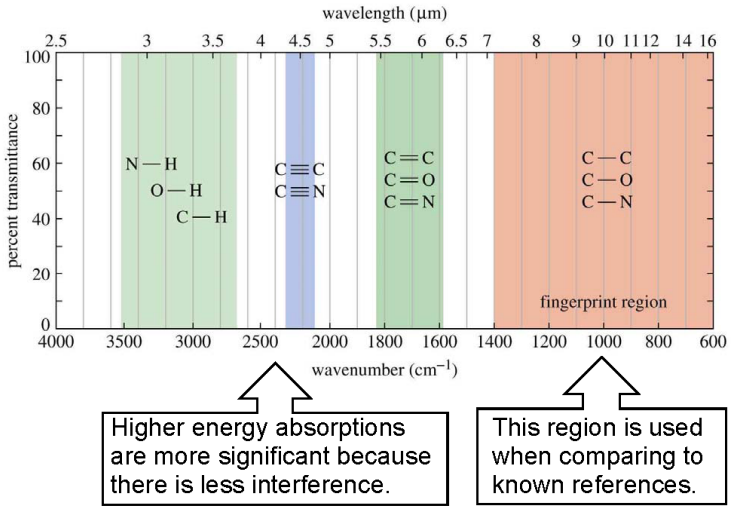
11.6: SUMMARY AND TIPS TO DISTINGUISH BETWEEN CARBONYL FUNCTIONAL GROUPS

Summary for Interpreting IR Spectra



IR Absorption Bands to Memorize

- ≈ 3400 cm^{-1}: O-H and N-H stretch
- ≈ 3100 cm^{-1}: sp and sp^2 C-H stretch
- ≈ 2900 cm^{-1}: sp^3 C-H stretch
- ≈ 2700 cm^{-1}: aldehyde C-H stretch (fangs)
- ≈ 2200 cm^{-1}: C≡C & C≡N stretch
  (primarily for terminal C≡C & C≡N)
- ≈ 1700 cm^{-1}: C=O stretch
- ≈ 1600 cm^{-1}: C=C stretch (primarily for terminal C=C)
- ≈ 1200 cm^{-1}: C-O stretch

Distinguishing between Functional Groups with Carbonyls C=O's

While there may subtle differences in the wavenumbers of the carbonyl stretch between some of the functional groups, it is the secondary features of the IR spectrum that help with discernment.

Functional Grp	Carbonyl Stretch	Secondary IR Spectral Feature
Aldehyde	1710 cm^{-1}	fangs at 2700 & 2800 cm^{-1}
Ketone	1710 cm^{-1}	
Acid	1710 cm^{-1}	broad O-H stretch between 3500-2500 cm^{-1}
Ester	1735 cm^{-1}	C-O stretch ≈ 1200 cm^{-1}
Amide	1660 cm^{-1} (doublet)	N-H stretch ≈ 3300 cm^{-1} 2 peaks for $RCONH_2$ 1 peak for RCONHR'
Acid Chloride	1800 cm^{-1}	energy of carbonyl stretch
Anhydride	1800 & 1750 cm^{-1}	energy of carbonyl doublet