IR Interpretation if Carbonyl Absorption is Present

C=O stretching frequency range from 1850-1650 cm^{-1}

C=O band at 1815-1785 cm^{-1}

- no C-O band as in anhydride or ester
- → **acid chloride**

1820-1750 cm^{-1}

- **two C=O bands**
  the C=O symmetrical stretch and the asymmetric stretch produce two bands partly overlapped
  - also look for
  - the C-O band at 1100-1050 cm^{-1}
  - → **anhydride**

highest frequency C=O bands

1750-1730 cm^{-1}

- also look for
- **C-O band**
  C-O band medium intensity at 1300-900 cm^{-1}
  No OH band present
  - → **ester**

1740-1720 cm^{-1}

- also look for
- **C-H band**
  C-H stretch for the hydrogen attached to carbonyl carbon at 2700-2900 cm^{-1}
  - C-H absorption is usually two bands of medium intensity; one or both may be buried under aliphatic C-H bands
  - → **aldehyde**

1725-1715 cm^{-1}

- no other absorptions for other carbonyl functional groups
- → **ketone**

1720-1705 cm^{-1}

- also look for
- **O-H band**
  intense, broad band at 3300-2700 cm^{-1}
  band may overlap with C-H stretches
  - → **carboxylic acid**
  carboxylic acids usually dimerize; monomer C=O absorption at 1760 cm^{-1}

1695-1650 cm^{-1}

- also look for
- C=O stretch and C-NH_2 bend often overlap to resemble an anhydride, i.e, two bands in carbonyl region
  - also look for
  - **N-H bands**
  One (RN-H) or two (H-N-H) bands, medium or weak absorption at 3300-3500 cm^{-1}
  - → **amide**

lowest-frequency C=O bands

for all carbonyl compounds:

conjugation with C=O lowers frequency of C=O band

carbonyl in strained ring increases frequency of C=O band
(aldehydes, acid chlorides and carboxylic acids cannot be cyclic)