IR Spectroscopy

around 3000 cm^{-1}

- to left, broad — OH or NH
- to left, sharp — sp^2 or sp CH
- to right — sp^3 CH

around 1700 cm^{-1}

- to left (1700-1800 cm^{-1}) — C=O
- to right (1600-1680 cm^{-1}) — C=C

between 1700 and 3000 cm^{-1}

- ~2200 cm^{-1} — C≡C or C≡N

(know that can use CH oop to tell sub. pattern of alkene (1000-600 cm^{-1}))

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^1H NMR Spectroscopy

- 0-2.5 ppm — sp^3 CH's
- 2.5-5.0 ppm — H-C-A (A is a heteroatom)
- 5.0-6.0 ppm — H-C=C
- 6.0-8.0 ppm — H-aromatic
- past 9.0 ppm — (sharp) or  (broad)

H's on O or N usually broad, 1-5 ppm, can be absent

splitting (n+1) / integration

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^{13}C NMR Spectroscopy

- 0-60 ppm — sp^3 C
- 60-100 ppm — C-A
- 100-165 ppm —  sp^2 C (both alkene & aromatic)
- 165-200 ppm — 
- past 200 ppm — or 

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using unsaturation number (determined from molecular formula)

$$U = \frac{(2 \times \text{number of C} + 2) - (\text{number of H})}{2}$$

for halogen, count as a hydrogen.
for oxygen, ignore it
for each N, subtract 1 hydrogen