CUMA

Undergraduate Microbiology Association

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Lecture 19 | OCSP 2020

Please fill out our testimonial/questionnaire form!

- For TAs, students, and anyone who has been watching our recorded lectures
  - Available on Canvas and in the Youtube video description below
- We are hoping to share some of your thoughts on our social media accounts!
  - Instagram: ocspcornell
  - Facebook: Organic Chemistry Summer Program for Cornell Students

Today’s Agenda

- Intro to Spectroscopy
- What is IR Spectroscopy?
- Locations for functional groups on IR spectra

What is spectroscopy?

- Uses different forms of electromagnetic radiation and observe how they interact with matter to determine specifics about it
- Shine an energy wave through a sample of a compound, look for different results as the light is absorbed/transmitted

Types of Spectroscopy

- Mass spectroscopy (fluorescent light)
  - Measures mass to charge ratio of ions
- H NMR and C^{13} NMR (radio waves)
  - Used to identify molecular structure and purity of a compound
- IR spectroscopy (infrared light)
  - Identifies the presence of different functional groups

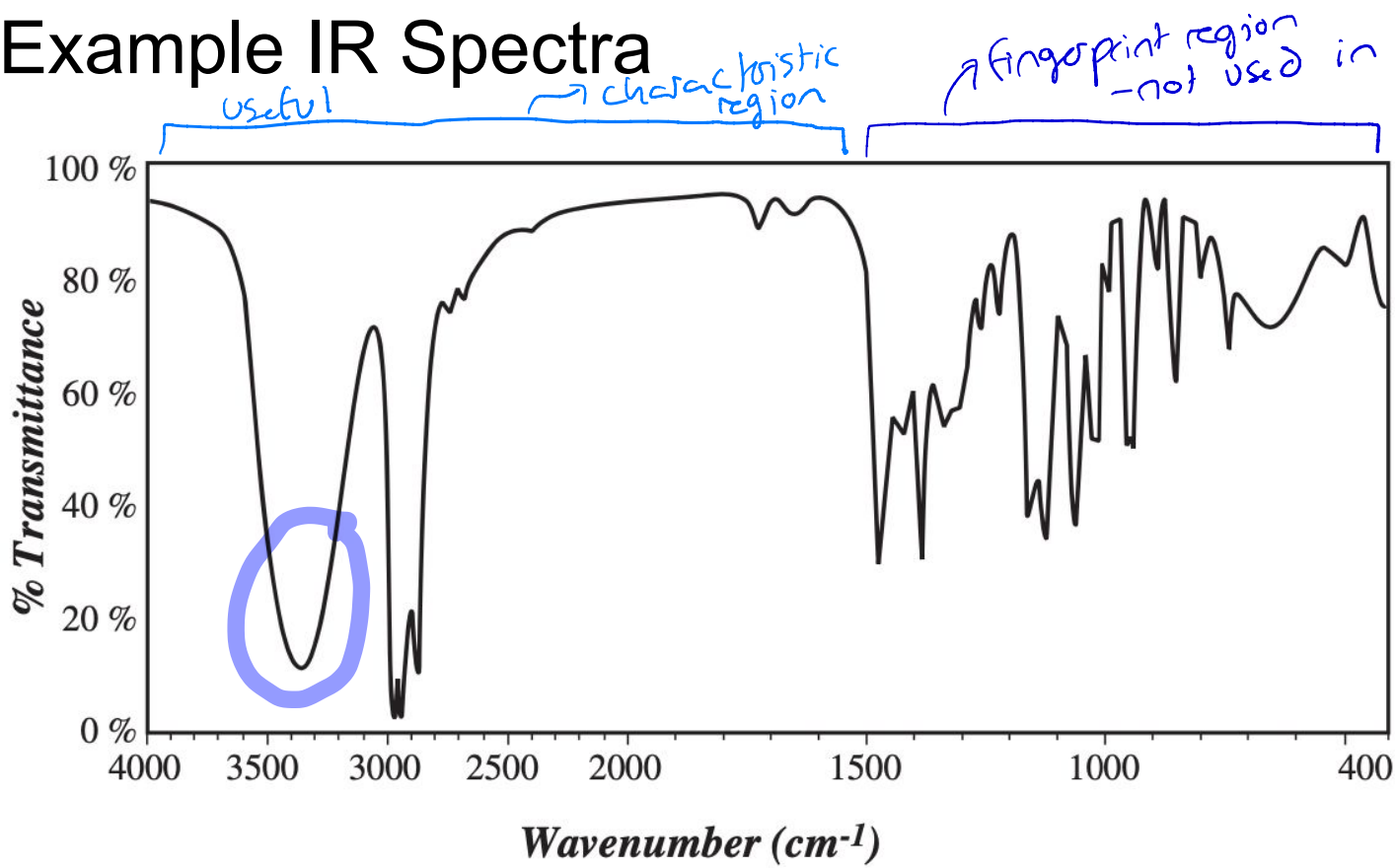
IR Spectroscopy

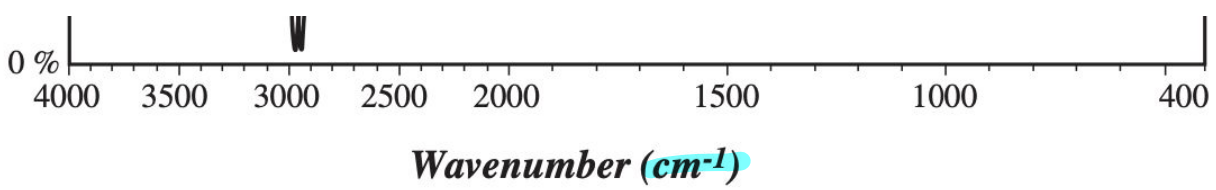
- Measures molecular vibrations as infrared light is passed through sample
  - Vibrations = bonds stretching or bending
- Absorptions of light are recorded if bond results in change in the bond dipole moment

C–Br ✓ Br–Br → IR spectroscopy can't be used to detect symmetrical bonds

- Different functional groups absorb infrared light at different frequencies
- You can use this fact to determine which functional groups are present in a molecule

Example IR Spectra





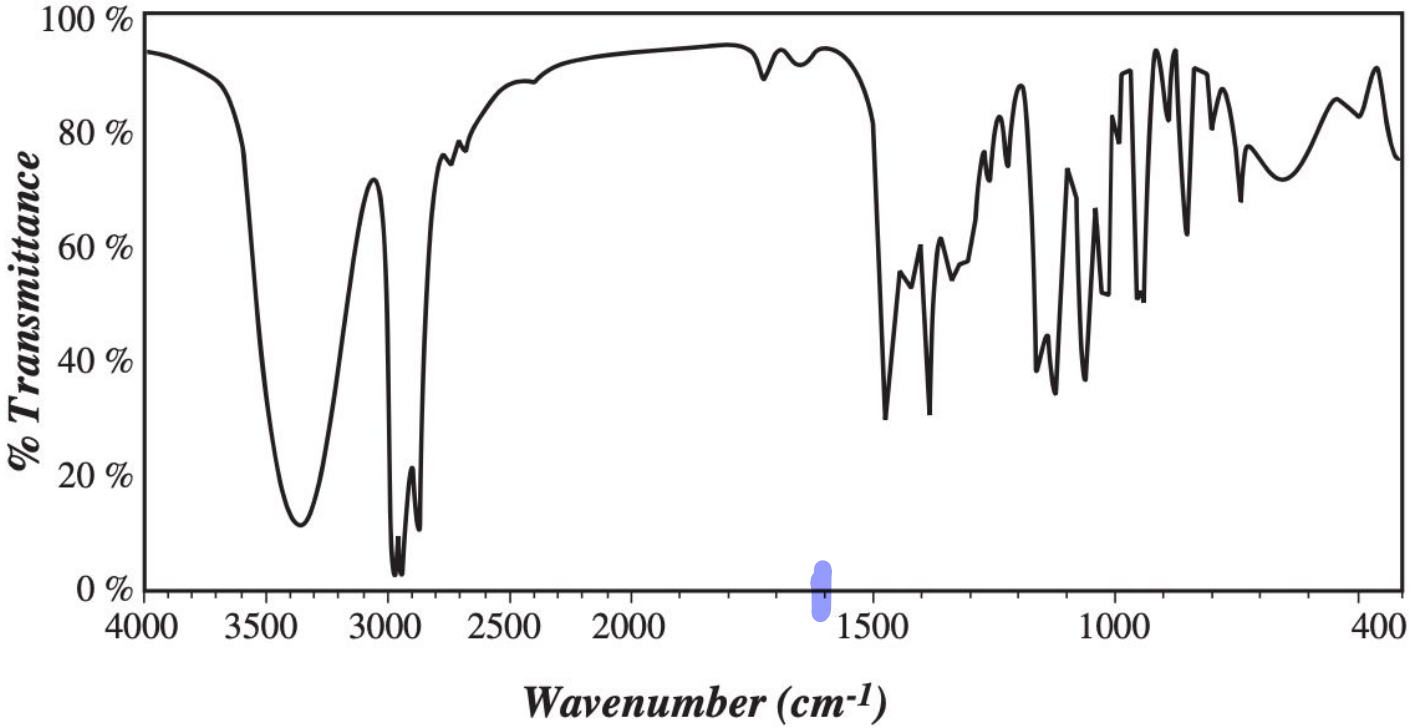
Wavenumbers

- Wavenumber = $\tilde{\nu} = \frac{\nu}{c}$ → frequency of light; → speed of light

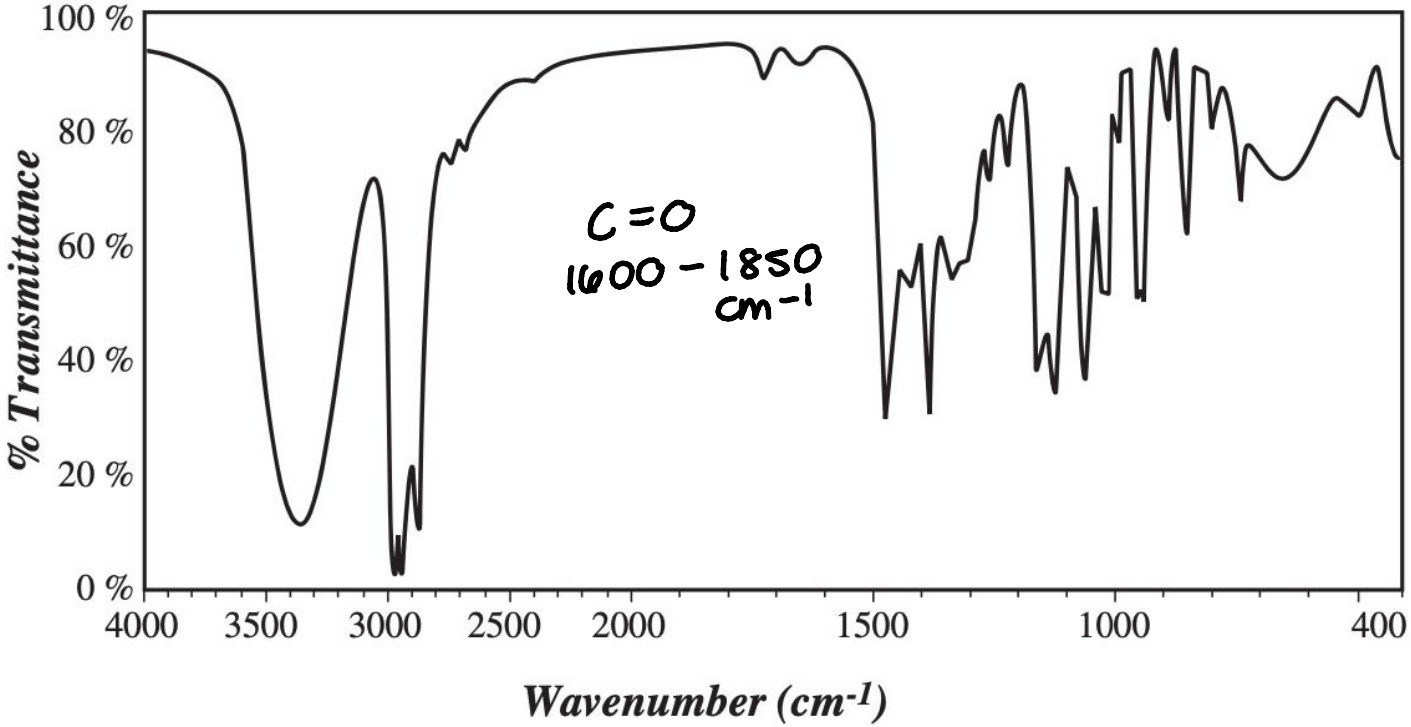
$\tilde{\nu} = \nu \cdot \frac{1}{c}$

High wavenumber = high frequency

Regions of IR spectra



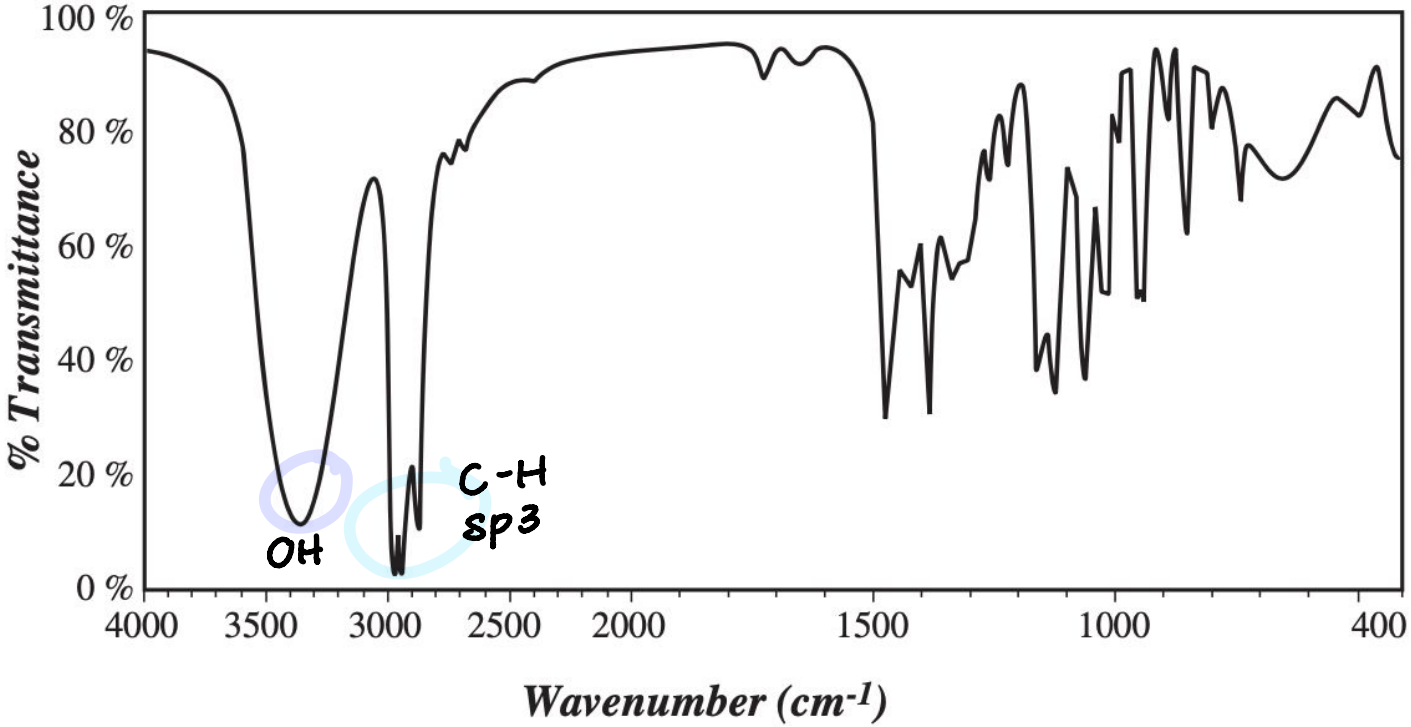
Factor 1: Wavenumber location



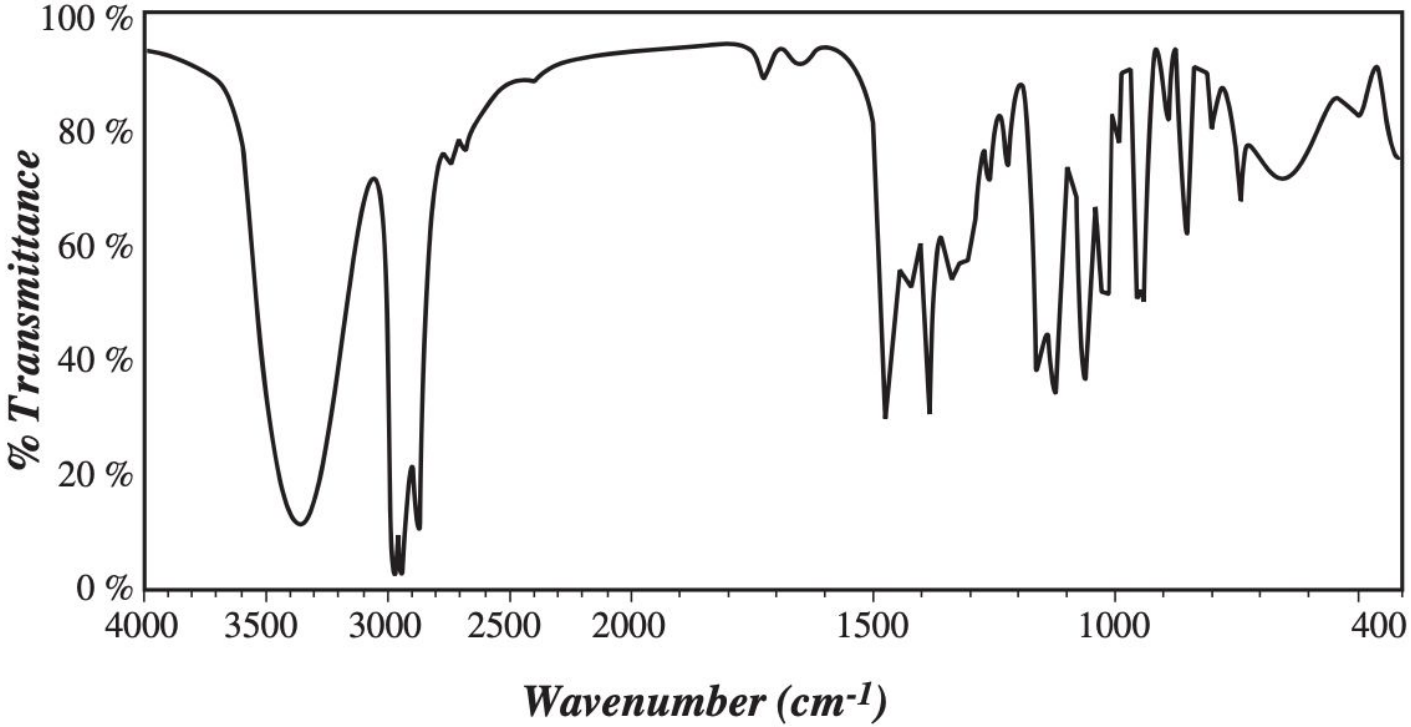
Factor 2: Peak Shape

OH → smooth
C-H → spiky

double peaks
↳ aldenydes (C-H)

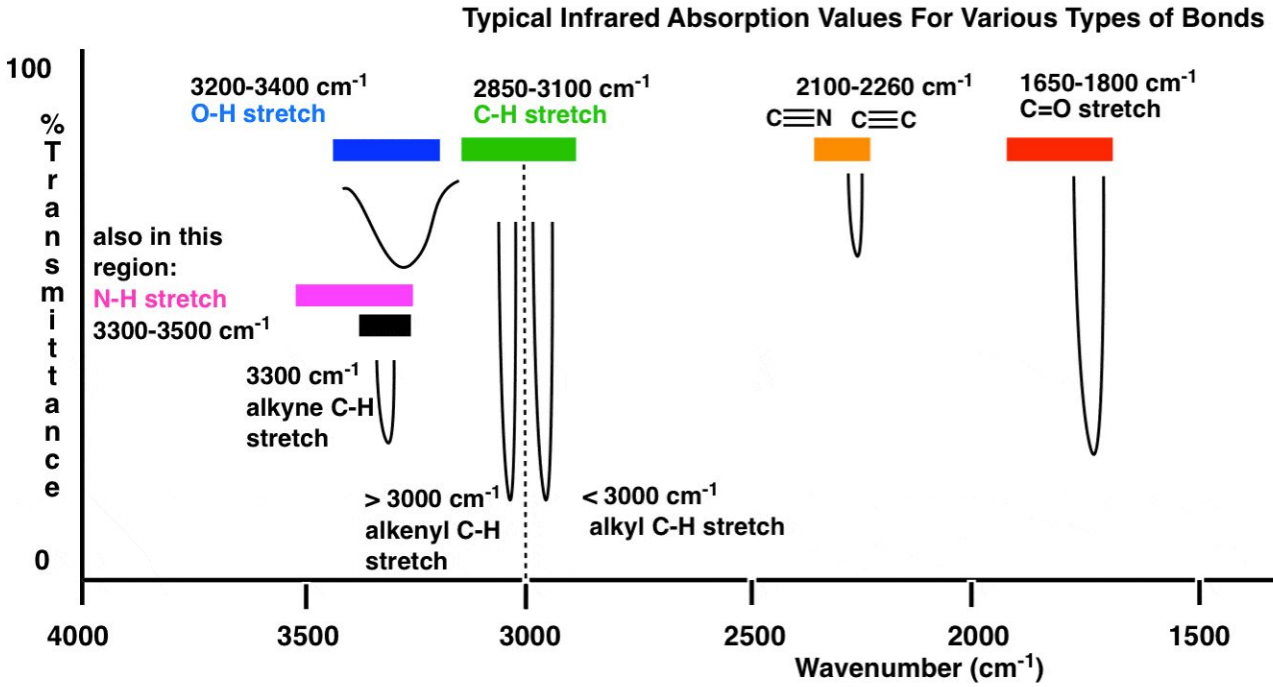


Factor 3: Intensity of Peak



Some Quick Guides to Interpreting

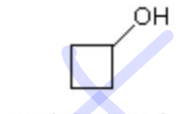
Source: Master Organic Chemistry



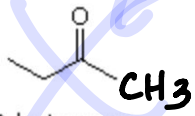
[400-1600 fingerprint region]

- 1650-1800 C=O
- ~1650 C=C
- 2100-2260 C≡N C≡C
- < 3000 C-H for aldehydes (double peaks)
- 2850-3100 C-H (sp3)
- > 3000 C-H (sp2) AKA =C-H
- 3200-3400 O-H

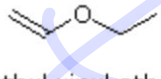
Practice #1



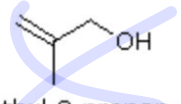
cyclobutanol



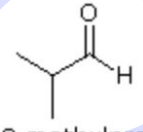
2-butanone



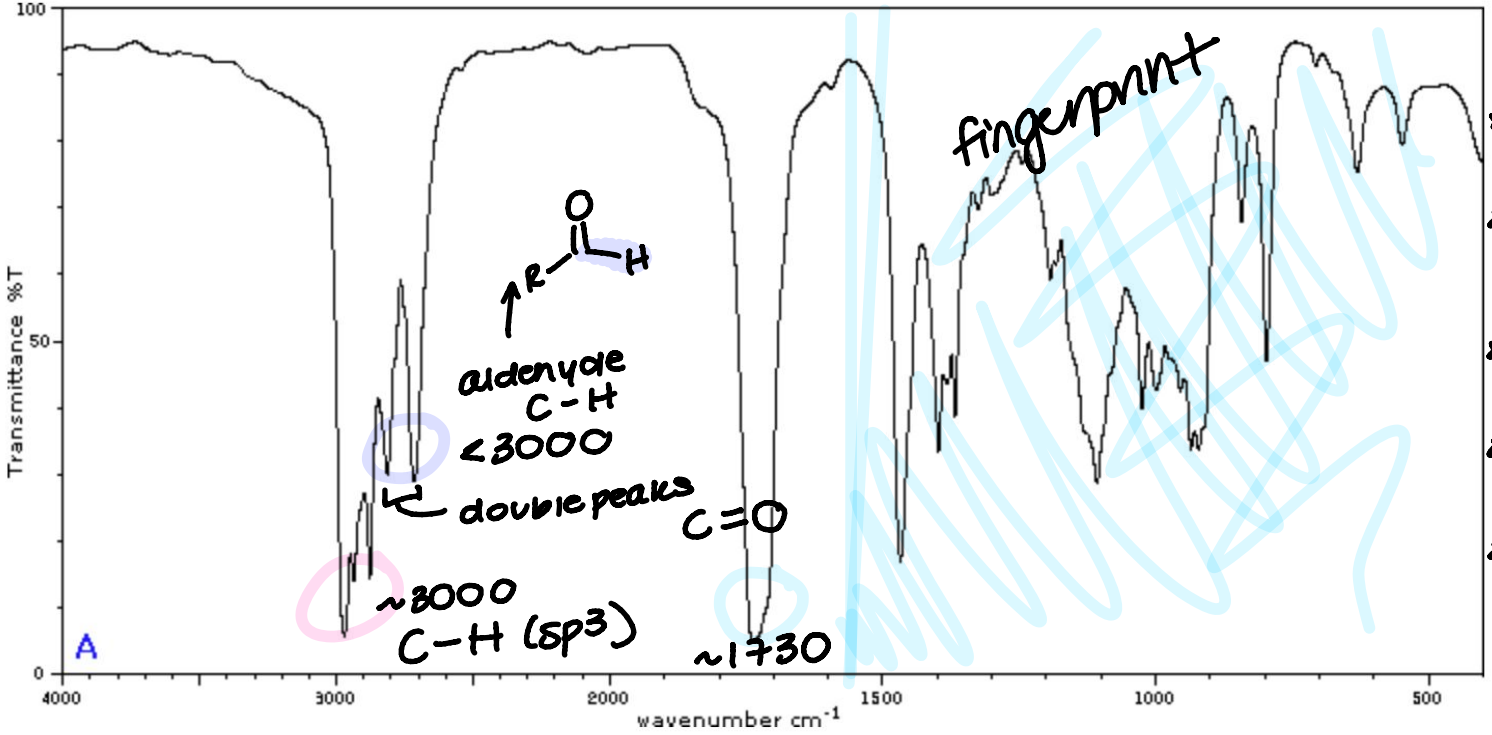
ethyl vinyl ether



2-methyl-2-propen-1-ol



2-methylpropanal

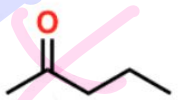


[400-1600 ignore!]

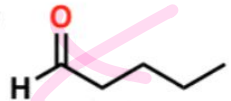
* 1650-1800 C=O
* ~1650 C=C
* 2100-2260 C≡N, C≡C
* <3000 C-H
  foraldehyde
  (double peaks)
* 2850-3100 sp3 C-H
* >3000 sp² C-H (=C-H)
* 3200-3400 O-H

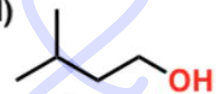
NOTE: I meant 12H's NOT 12C's sorry :,)
(special thanks to amber!)

Practice #2

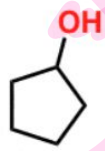
a) 

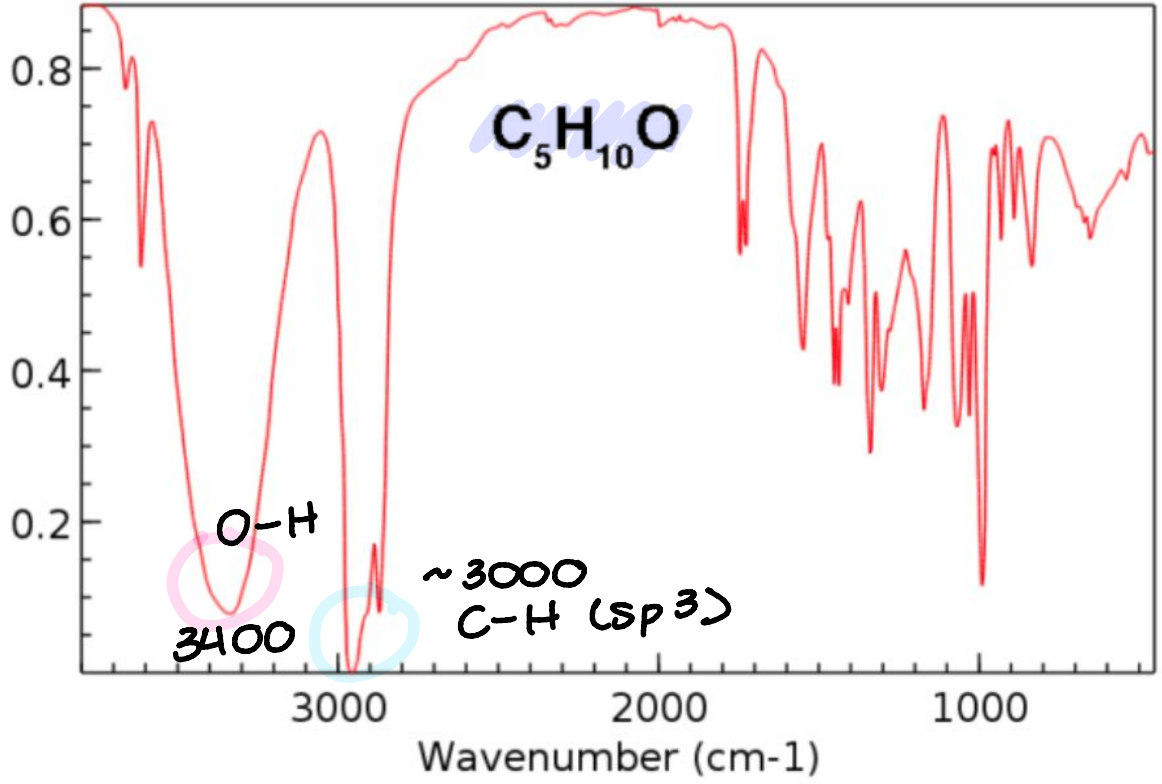
b) 

c) 

d) 

12H

e) 



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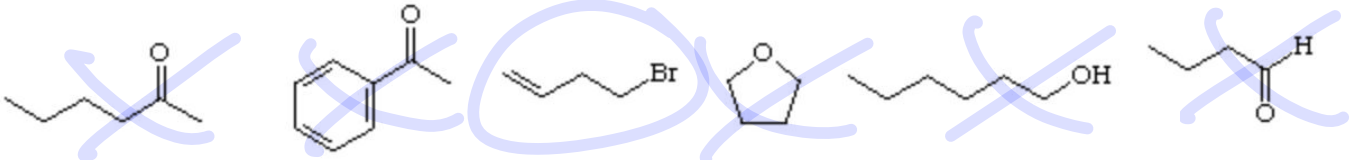
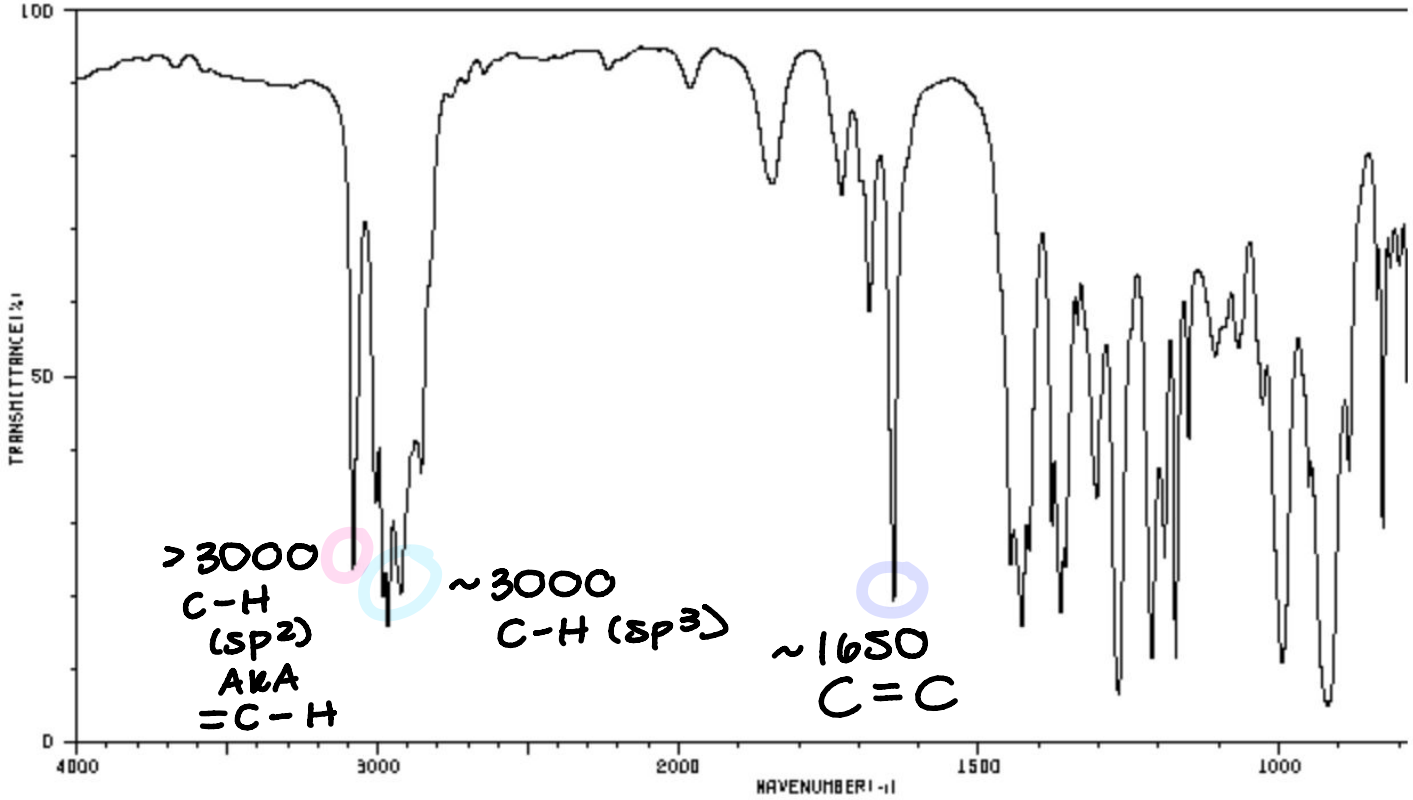
* >3000 sp^2 C-H
  (=C-H)
* 3200-3400 O-H

Practice #3





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