Today

Infrared Spectroscopy

Next Class

Spectroscopy Practice?

Chapter 21

Second Class from Today

Chapter 21

Third Class from Today

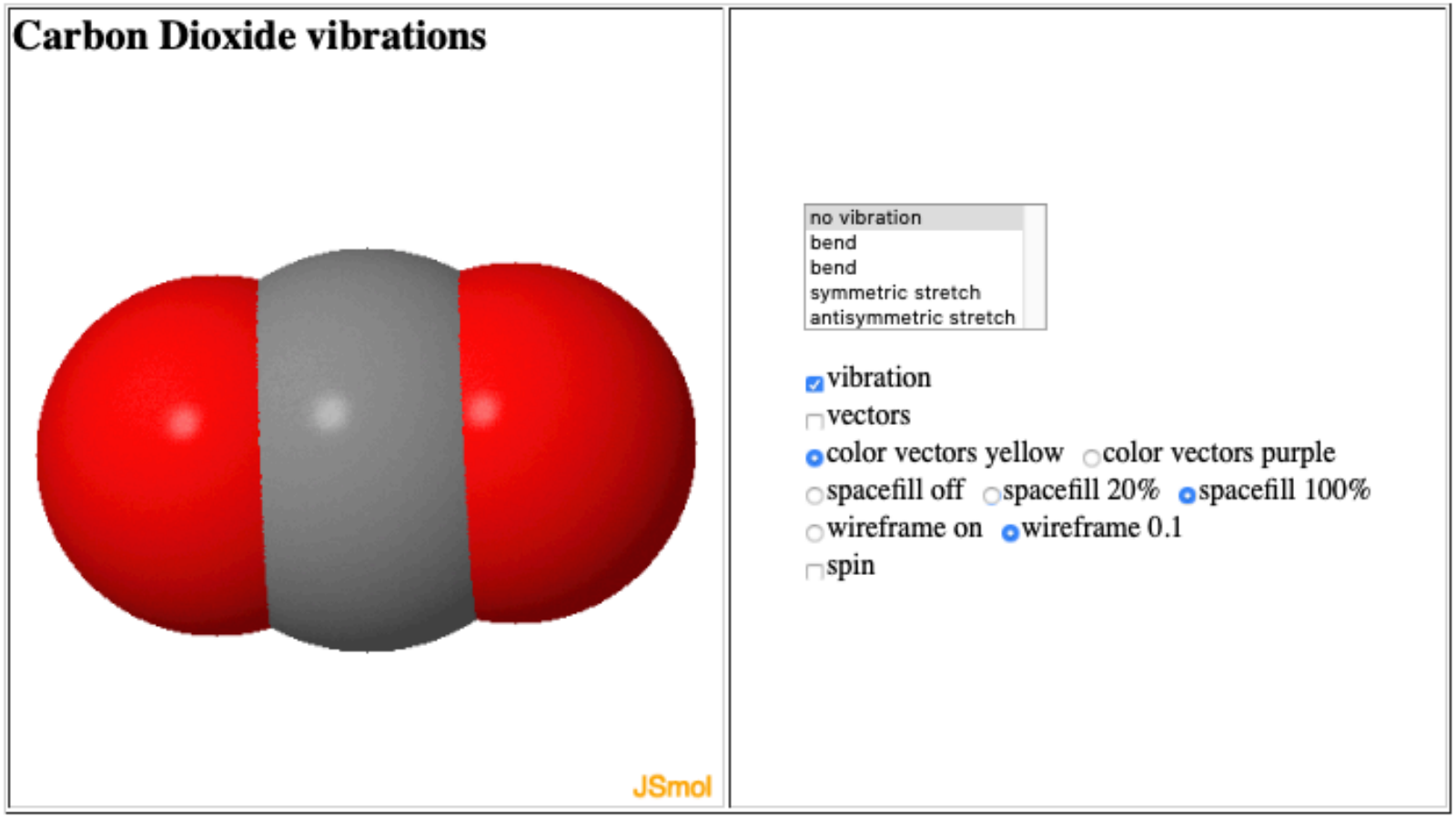
Chapter 21

Monday office hours rescheduled to 1:10 to 2:10 from now on.

Please rework, on a separate piece of paper, test 1 and hand in on Wednesday, March 19.

Rework means for each question that your did not receive full credit provide a more complete answer.

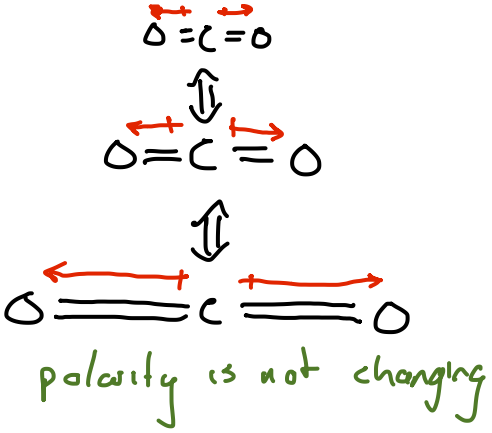
I do not need your test back, please just hand in the reworked answers.



O=C=O

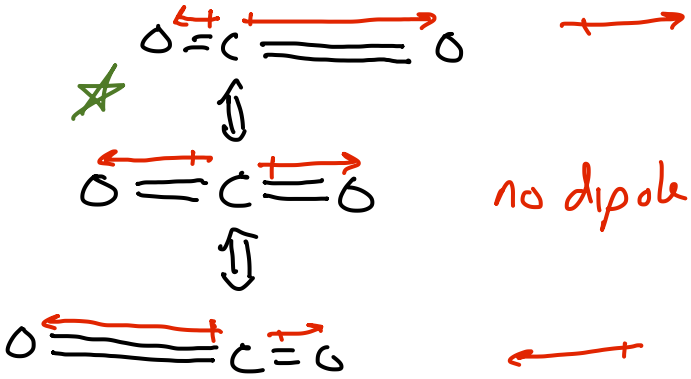
https://www.westfield.ma.edu/cmasi/organic2/vibrations/co2_vibrations.html

A **vibration** that **changes the dipole of a molecule** creates an oscillating electric field that **can interact with Infra-red light.** Consider the vibrations of the greenhouse gas CO_2.



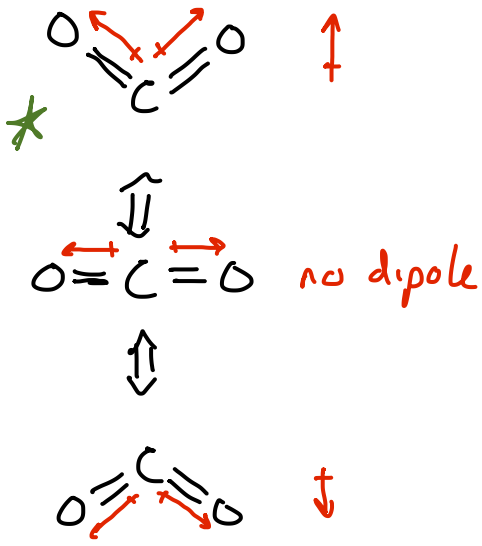
polarity is not changing

trying to show snapshots of the C=O stretching vibration



no dipole

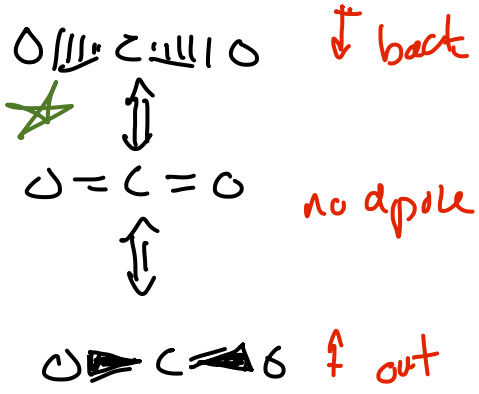
dipole is changing as bond stretches



no dipole

dipole is changing as bond bends

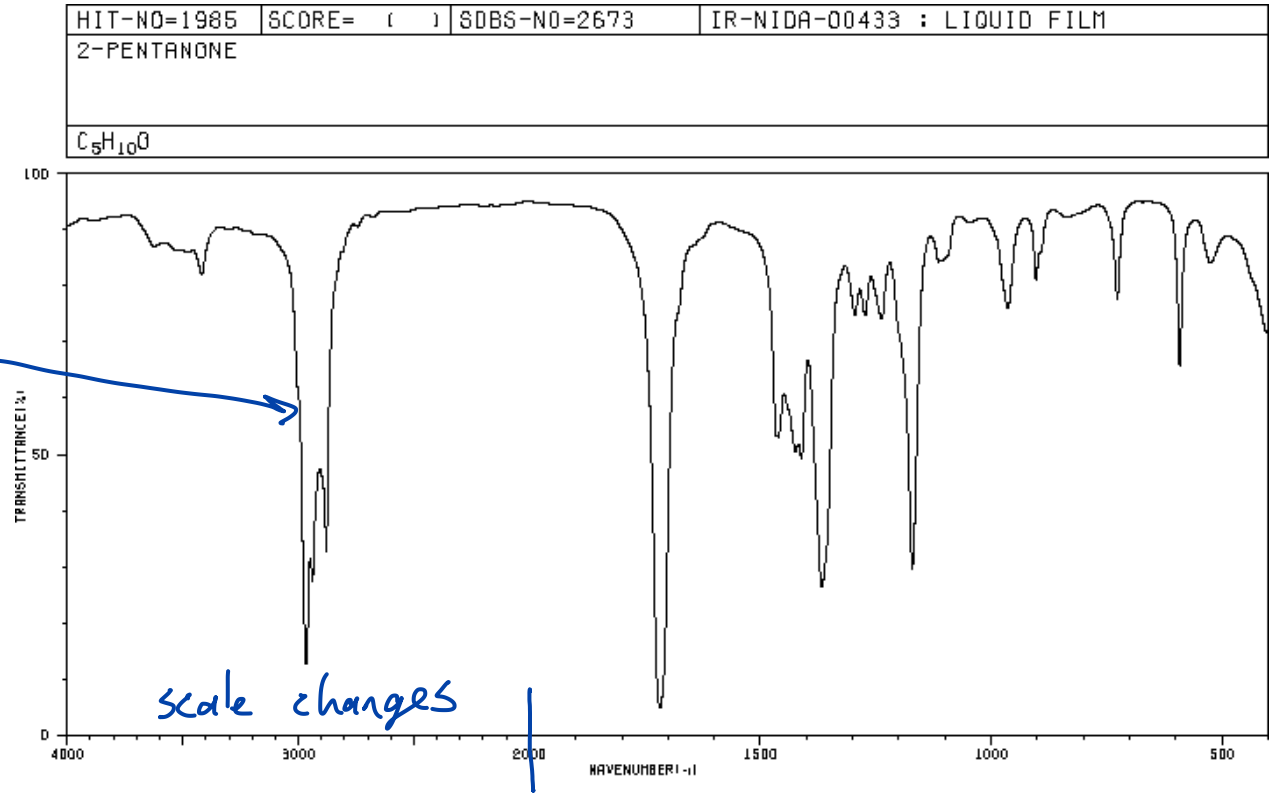
these oscillating electromagnetic fields can interact with electromagnetic radiation... IR



dipole is changing as bond bends

An Example Spectrum

Section

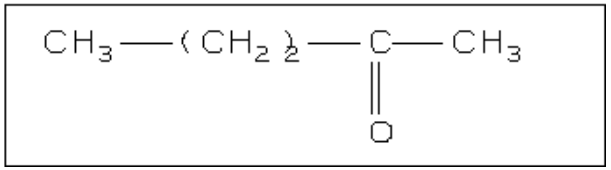


100% of IR light transmitted

"Peaks" point down

scale changes

3419	79	1426	49	1114	81	692	64
2966	12	1412	47	1105	81	526	81
2939	26	1367	25	1100	81		
2879	31	1296	72	964	72		
1717	4	1274	72	903	79		
1467	50	1237	72	894	81		
1461	50	1172	28	727	74		



wave numbers are "convient"... ∝ to energy

an 3500 cm^{-1} is easier to write than the measurement in μm, of H_2

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Hooke's Law

$$F = kx$$

force

displacement

spring constant

force constant

Harmonic Oscillator

$$\bar{\nu} = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

frequency

force constant

mass of the object

Frequency of IR Absorbed

$$\bar{\nu} = \frac{1}{2\pi c}\left[\frac{f(m_1 + m_2)}{m_1 m_2}\right]$$

strong bond

higher frequency vibrations

weak bond lower freq vibrations

force constant related to the strength of the bond

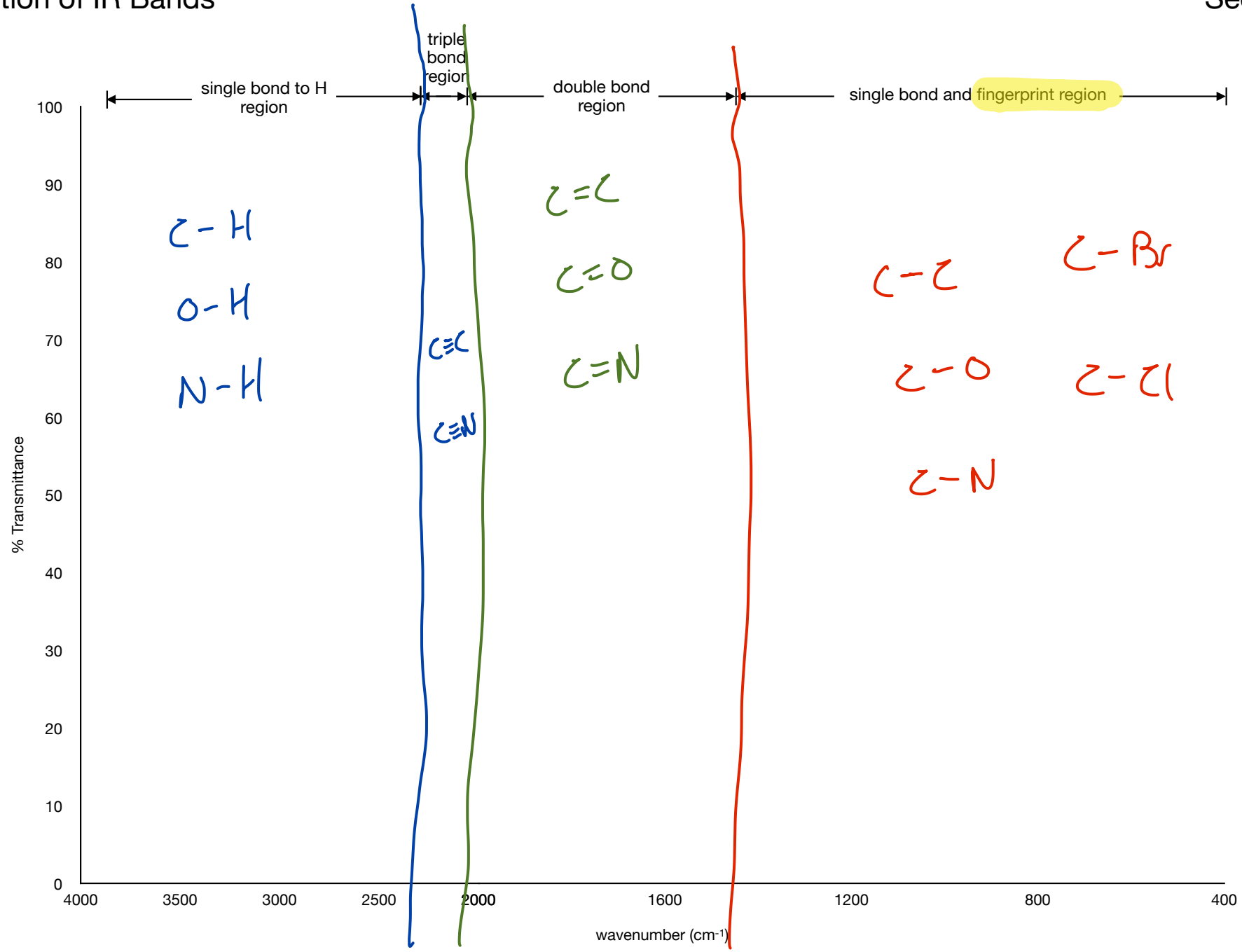
mass is the mass of the atoms

small masses higher freq

larger masses lower freq

Position of IR Bands

Section

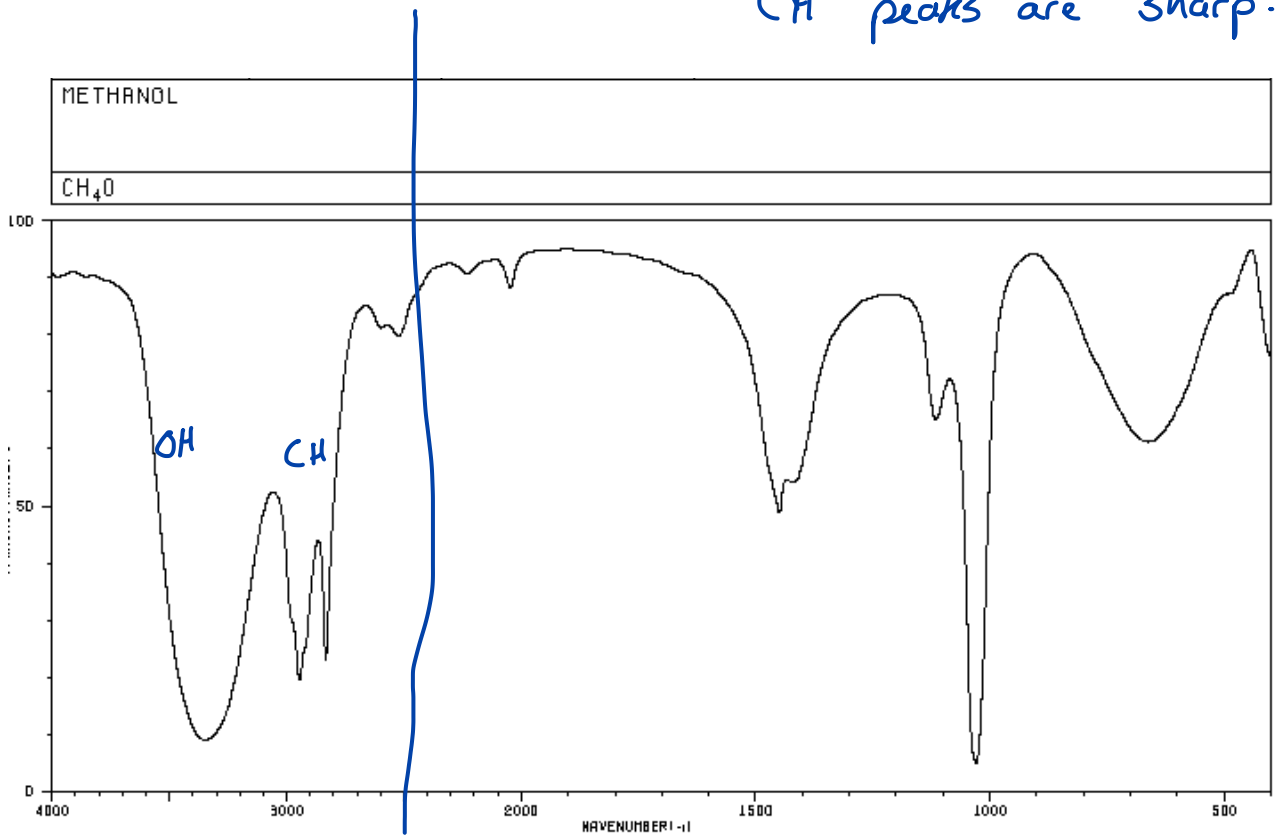


Intensity and Shape, OH vs CH

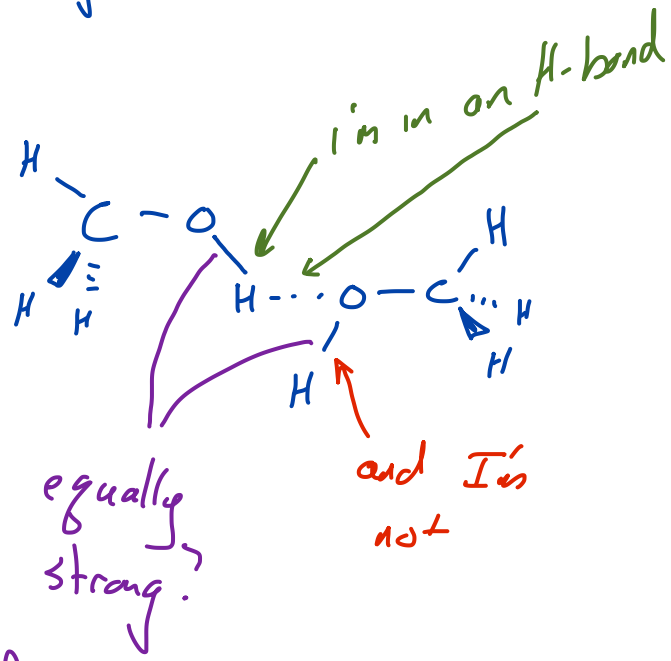
OH peaks tend to be broad.

CH peaks are sharp. Why the difference?

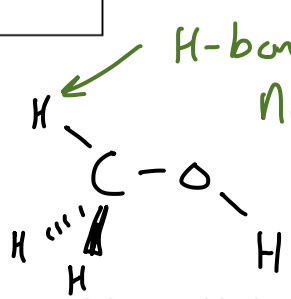
Section



3347	8	1116	62
3336	8	1030	4
2945	16	662	56
2833	22		
2522	77		
2046	84		
1460	47		



Because the H's in OH are H-bonding to other O atoms the O-H bonds are the have a variety of strengths... sometimes stronger... sometimes weaker



NO... leave me alone

C-H's have the same strength

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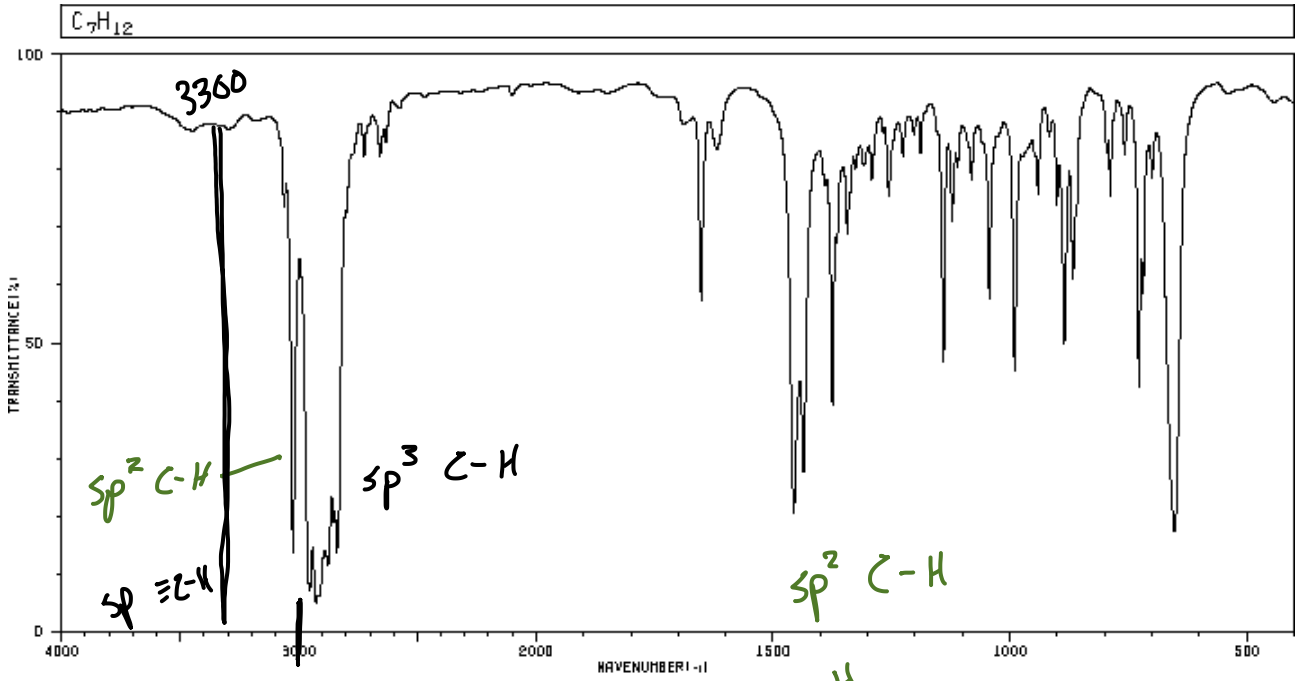
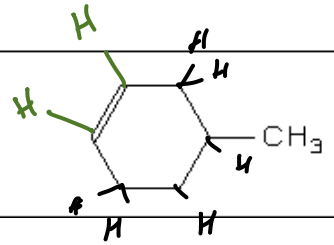
Fine Tuning Position, CH's

Section



3063	70	2839	19	1344	66	1122	68	886	47
3025	13	1651	55	1326	77	1111	77	867	58
2954	6	1456	20	1309	77	1081	74	789	72
2928	4	1436	26	1292	74	1044	66	728	41
2915	6	1390	74	1256	72	990	43	719	57
2878	10	1375	37	1227	79	941	72	701	74
2852	18	1366	64	1141	44	901	70	653	16



sp³ C-H

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