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[TP] Express 2000 $\text{cm}^{-1}$ = 2000/cm in $\text{m}^{-1}$.

20% 1. 2000 $\text{m}^{-1}$ = 2000/m
20% 2. 200000 $\text{m}^{-1}$ = 200000/m
20% 3. 0.05 $\text{m}^{-1}$ = 0.05/m
20% 4. 0.0005 $\text{m}^{-1}$ = 0.0005/m
20% 5. Something else

1

## Lecture 8 CH101 A1 (MWF 9:05 am)

Friday, September 21, 2018

- Wavelength, frequency, and wavenumber
- Jiggling of bonded atoms

Next lecture: IR spectra; ch4: (secs 1, 3, and 4 only): Atmospheric warming

Representative questions: On IR: 3.25, 3.59, 3.61

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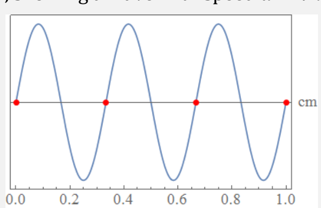
## wavelength $\lambda$, frequency $\nu$, wavenumber $\tilde{\nu}$ = 1 / $\lambda$

Wavenumber is the number of waves (wavelengths) that fit in one cm.

The figure spans 1 cm, showing a wave with speed $u = \nu\lambda = 1$ cm/s.




So, $\nu = 3/\text{s}$ and $\lambda = 1/3$ cm.

4

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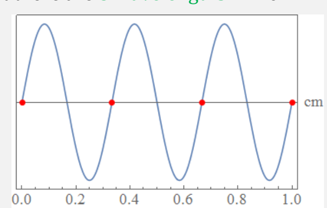
## wavelength $\lambda$, frequency $\nu$, wavenumber $\tilde{\nu}$ = 1 / $\lambda$

Wavenumber is the number of waves (wavelengths) that fit in one cm.

The figure shows that there are 3 wavelengths in 1 cm.




So, in this case the wavenumber is $\tilde{\nu} = 3/\text{cm}$.

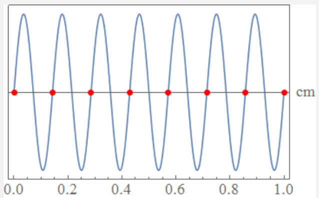
5

Lecture 8 CH101 A1 (MWF 9:05 am) Fall 2018 

## wavelength $\lambda$, frequency $\nu$, wavenumber $\tilde{\nu} = 1 / \lambda$

Wavenumber is the number of waves (wavelengths) that fit in one cm.

This figure shows that there are 7 wavelengths in 1 cm.




So, in this case the wavenumber is $\tilde{\nu} = 7/\text{cm}$.

6

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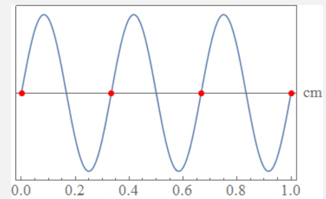
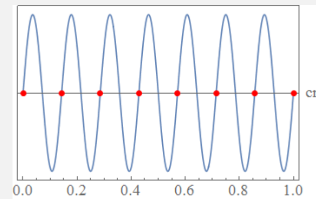
## wavelength $\lambda$, frequency $\nu$, wavenumber $\tilde{\nu} = 1 / \lambda$

Wavenumber is the number of waves (wavelengths) that fit in one cm.

Larger wavenumber means smaller wavelength.




$\tilde{\nu} = 3/\text{cm}, \lambda = 1/3$ cm




$\tilde{\nu} = 7/\text{cm}, \lambda = 1/7$ cm

7

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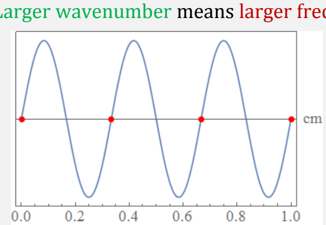
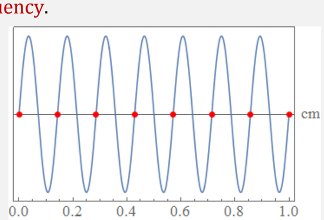
## wavelength $\lambda$, frequency $\nu$, wavenumber $\tilde{\nu} = 1 / \lambda$

Wavenumber is the number of waves (wavelengths) that fit in one cm.

Larger wavenumber means larger frequency.




$\tilde{\nu} = 3/\text{cm}, \nu = 3/\text{s}$




$\tilde{\nu} = 7/\text{cm}, \nu = 7/\text{s}$

8

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0% 4. 0.0005 $\text{m}^{-1} = 0.0005/\text{m}$
0% 5. Something else

9

[Quiz] Which has the lowest frequency?

0% 1. An antisymmetric H stretch at $9 \times 10^{13}$/s
0% 2. A sulfide, C—S, stretch at 600 $cm^{-1}$
0% 3. Red light at 700 nm
0% 4. Visible light at $6 \times 10^{14}$/s

12

# Jiggling of bonded atoms

Lighter faster; stronger faster; dissimilar approaches lighter

Interactive exploration

13

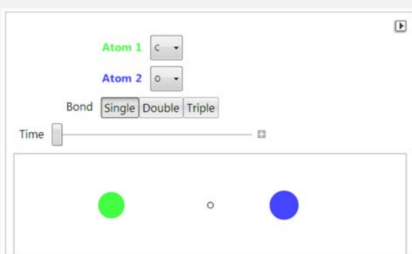
 

# Jiggling of bonded atoms

Lighter faster; stronger faster; dissimilar approaches lighter

Interactive exploration

http://quantum.bu.edu/CDF/101/IRFrequency.cdf

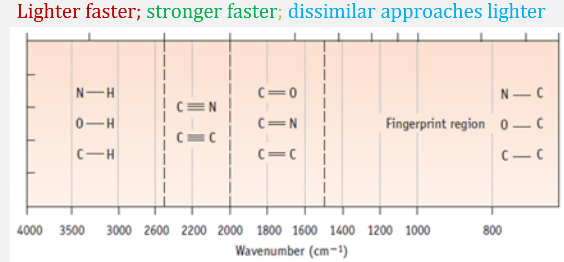



14

# IR spectra detect function groups

Lighter faster; stronger faster; dissimilar approaches lighter




15

Lecture 8 CH101 A1 (MWF 9:05 am) Fall 2018


# Jiggling of bonded atoms

O—H is at about 3500 $cm^{-1}$

C—H is at about 3000 $cm^{-1}$

This is reverse of what we predict based on mass.



What could account for this reversal?

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16

 