[TP] Which has the highest frequency (of jiggling)?

25% 1. An antisymmetric H stretch at 9×10^{13}/s
25% 2. A sulfide, C–S, stretch at 600 cm^{-1}
25% 3. Red light at 700 nm
25% 4. Visible light at 6×10^{14}/s

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Response Counter 10

Lecture 8 CH101 A1 (MWF 9 am)

Friday, September 23, 2016

For today ...

- Practice: wavelength, frequency, and wavenumber
- IR spectra

Next lecture (Wednesday!): Complete IR spectra. Begin ch4: only sections 4.1, 4.3, and 4.4

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Wavelength, frequency, and wavenumber

One cycle of oscillation of the electric field (tugs!) that is light takes place in time τ (the period of oscillation).

And so the number of oscillations in one second is the frequency $\nu = 1/\tau$.

The speed that light moves through space is

c = distance / time
= wavelength / period
= λ / τ

And so we have the fundamental relation

$c = \lambda \nu$

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What's "nu"?

Frequency $\nu = c / \lambda$

Speed of light c = 299792458 m/s ($\approx 3 \times 10^8$ m/s)

Energy exchanged with matter $\propto \nu$

Since $1 / \lambda \propto \nu$, energy exchanged with matter also $\propto$ wavenumber $1 / \lambda$

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What's "nu"? $\nu = c / \lambda$, c = 299792458 m/s

Get practice by working through tutorials e3.15 (p 75)

What is the frequency of orange light, $\lambda = 600$ nm?
Answer: $c / \lambda = 5 \times 10^{14}$/s

Wavelength (in nm) and visibility of 2×10^{15}/s light?
Answer: $\lambda = c / (2.0 \times 10^{15}\text{/s}) = 150$ nm ; in UV so not visible

What is frequency of motion at $\tilde{\nu} = 3000$ cm^{-1}?
Answer: $c \times 1 / \lambda = 9$ x 10^{13}/s ; in IR so not visible

wavelength λ versus wavenumber $\tilde{\nu} = 1 / \lambda$

Given wavelength λ, get frequency ν by dividing it into c.
$\lambda = 3000$ nm $\rightarrow \nu = c / \lambda = \ldots$
$\nu = (3 \times 10^{8}$ m/s) / $(3000 \times 10^{-9}$ m) = $1 \times 10^{+14}$/s

Given wavenumber $\tilde{\nu} = 1 / \lambda$, get ν by multiplying it by c.
$\tilde{\nu} = 3000$ cm^{-1} $\rightarrow \nu = c \times \tilde{\nu} = \ldots$
$\nu = (3 \times 10^{10}$ cm/s) $\times$ (3000 cm^{-1}) = $9 \times 10^{+13}$/s

[TP] Which has the highest frequency (of jiggling)?

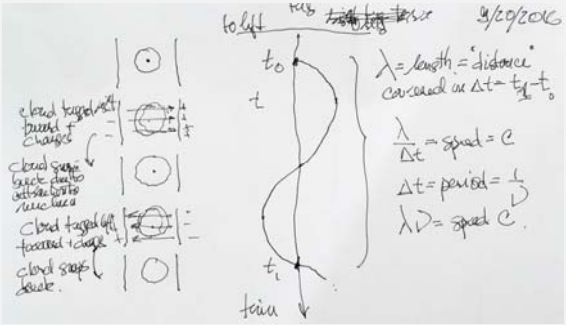
25% 1. An antisymmetric H stretch at 9×10^{13}/s
25% 2. A sulfide, C–S, stretch at 600 cm^{-1}
25% 3. Red light at 700 nm
25% 4. Visible light at 6×10^{14}/s

[Quiz] Which has the lowest frequency (of jiggling)?

25% 1. An antisymmetric H stretch at 9×10^{13}/s
25% 2. A sulfide, C–S, stretch at 600 cm^{-1}
25% 3. Red light at 700 nm
25% 4. Visible light at 6×10^{14}/s

Infrared (IR) spectra

What is light?



Resonance in light-matter interaction

Demonstration: Tale of three frequencies

Frequencies match → response
Frequencies do not match → "transparency"

