

Lecture 7 CH101 A1 (MWF 9:05 am) Fall 2018 Copyright © 2018 Dan Dill dan@bu.edu

**[TP]** What is the relative height of the molecular ion peak in the mass spectrum of dichloromethane,  $\text{CH}_2\text{Cl}_2$ , with  $m/z = 86$ ?

20% 1. 1/16  
 20% 2. 3/16  
 20% 3. 6/16  
 20% 4. 9/16  
 20% 5. Something else

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Response Counter 10 1

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 Wednesday, September 19, 2018

- Review: Mass spectra of compounds with Br (or Cl)
- Complete: What is light

**Next lecture:** Wavelength, frequency, and wavenumber; Jiggling of bonded atoms; Infrared (IR) spectra  
<http://quantum.bu.edu/CDF/101/IRFrequency.cdf> ;

**Memorize:** Figs 3.19 (p75) and 3.24 (p 80)  
**Do not memorize:** Table 3.5 (p 78)

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**Molecular ions of dichloromethane,  $\text{CH}_2\text{Cl}_2$**

... $^{35}\text{Cl} \frac{3}{4} \times ^{35}\text{Cl} \frac{3}{4} = 9/16$  at  $m/z = 84$   
 ... $^{35}\text{Cl} \frac{3}{4} \times ^{37}\text{Cl} \frac{1}{4} = 3/16$  at  $m/z = 86$   
 ... $^{37}\text{Cl} \frac{1}{4} \times ^{35}\text{Cl} \frac{3}{4} = 3/16$  at  $m/z = 86$   
 ... $^{37}\text{Cl} \frac{1}{4} \times ^{37}\text{Cl} \frac{1}{4} = 1/16$  at  $m/z = 88$

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### What is light?

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### What is light?

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### What is light?

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### What is light?

A "light wave" is a graph of how the strength and direction of tugging changes with time. This direction and strength is proportional to the **electric field**.

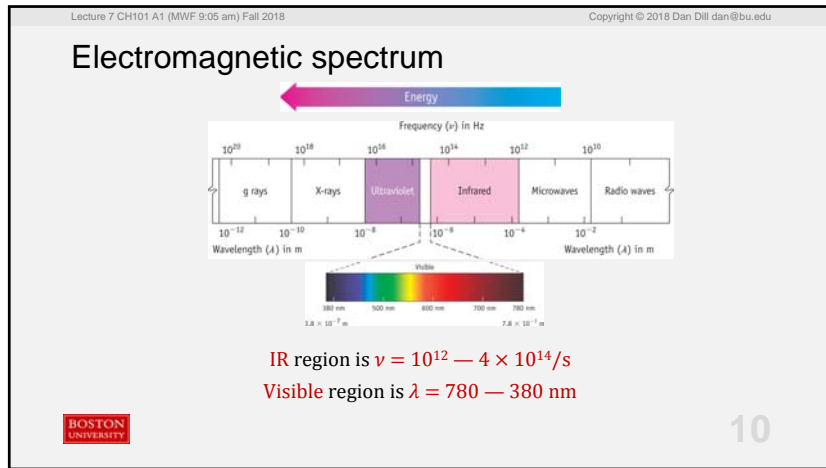
For this reason we say that "light is an oscillating electric field" that exerts **rhythmic tugs** on matter.

In the **visible region** of oscillations, the tugs are on **electron clouds**. Such tugging produces **color** that we see.

In the **IR region of oscillations**, the tugs are on the **bonds between atoms**. Such tugging is responsible for the **warmth** we feel.

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### What's "nu"?

Frequency  $\nu = c/\lambda$   
Speed of light  $c = 299792458 \text{ m/s} (\approx 3 \times 10^8 \text{ m/s})$   
**Energy exchanged with matter  $\propto \nu$**   
Since  $1/\lambda \propto \nu, \dots$   
**energy exchanged with matter also  $\propto$  wavenumber  $1/\lambda$**

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### What's "nu"? $\nu = c/\lambda, c = 299792458 \text{ m/s}$

Get practice by working through [tutorials e3.15](#) (p 75)  
What is the frequency of orange light,  $\lambda = 600 \text{ nm}$ ?  
Answer:  $c/\lambda = 5 \times 10^{14}/s$

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### What's "nu"? $\nu = c/\lambda, c = 299792458 \text{ m/s}$

Get practice by working through [tutorials e3.15](#) (p 75)  
Wavelength (in nm) and visibility of  $2 \times 10^{15}/s$  light?  
Answer:  $\lambda = c/(2.0 \times 10^{15}/s) = 150 \text{ nm}$  ; in UV so **not visible**

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[Quiz] Which of the following statements is correct?

- 13% 1. The electric field of visible light changes direction at least  $10^{14}$  times a second.
- 13% 2. The wavelength of UV light is less than  $380 \text{ nm} = 380 \times 10^{-9} \text{ m}$ .
- 13% 3. The wavelength of microwave light is longer than that of IR light.
- 13% 4. The wavelength of visible light is about the size of an atom,  $8 \times 10^{-8} \text{ cm}$ .
- 13% 5. 1 and 2
- 13% 6. 2 and 3
- 13% 7. 1, 2, and 3
- 13% 8. 1, 2, 3, and 4

Response  
Counter

10 14