

The Amazing Spectral Line

1. What is the frequency of a light wave with a wavelength of 5.50×10^{-7} meters?
2. What is the energy of a light wave with a frequency of 4.50×10^{14} hertz?
3. What is the energy of light wave with a wavelength of 7.50×10^{-7} meters?
4. The molecules listed on slide 9 have spectral lines with frequencies in the MHz (10^6 Hz) or GHz (10^9 Hz). Formaldehyde's characteristic spectral line has a frequency of 829.66 MHz. At what wavelength would you expect to see the spectral line? What part of the electromagnetic spectrum is this?
5. An ambulance travels at 30 m/s. Its siren sounds a note with wavelength 0.35 meters. The velocity of a sound wave is 343 m/s.
 - a) What is the change in wavelength of the note due to the Doppler shift?
 - b) When the ambulance is traveling towards you, what wavelength (and frequency) do you hear?
 - c) When the ambulance is traveling away from you, what wavelength (and frequency) do you hear?

6. Spectral lines can be used to measure the temperature, density, pressure and other properties of a region of space. What are some common methods used to measure each of the following on Earth:

- a) Temperature
- b) Velocity
- c) Rate of Rotation
- d) Pressure
- e) Density
- f) Electric Field
- g) Magnetic Field

7. Because astronomers can rarely touch what they are studying, they rely on indirect measurements. Let's imagine that you needed to rely on this type of measurement. You are a census taker and your job is to count the number of people in a town. The day before you arrive at the town, however, every single resident decides to take a vacation at the beach. Could you still count the number of people in the town? How? What other information could you still find out about these people?