Infrared Spectroscopy

IR LIGHT

•IR light is low energy light that is in the frequency domain as bond vibrations
•E = hν E = energy of light
h = Planck's Constant
ν = frequency of light

As FREQUENCY increases, ENERGY increases

$c = \lambda\nu$ c = speed of light
$\nu = c/\lambda$ λ = wavelength of light
$E = h\nu = hc/\lambda$

SO: As wavelength increases, energy decreases

UNITS USED IN IR SPECTROSCOPY

IR Frequencies are expressed in units of reciprocal centimeters (cm^{-1}) (this term is frequently called "wavenumbers."

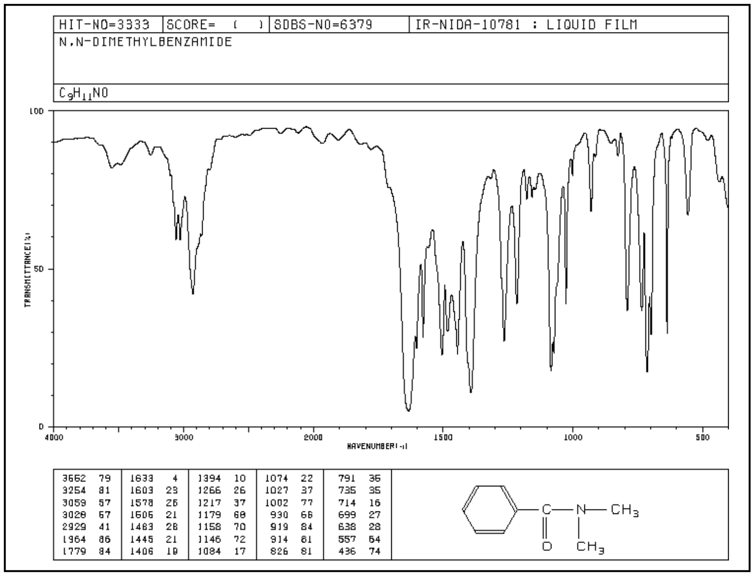
ν (cm^{-1}) = $1/\lambda$ (cm)

Interaction of IR Light with Molecules

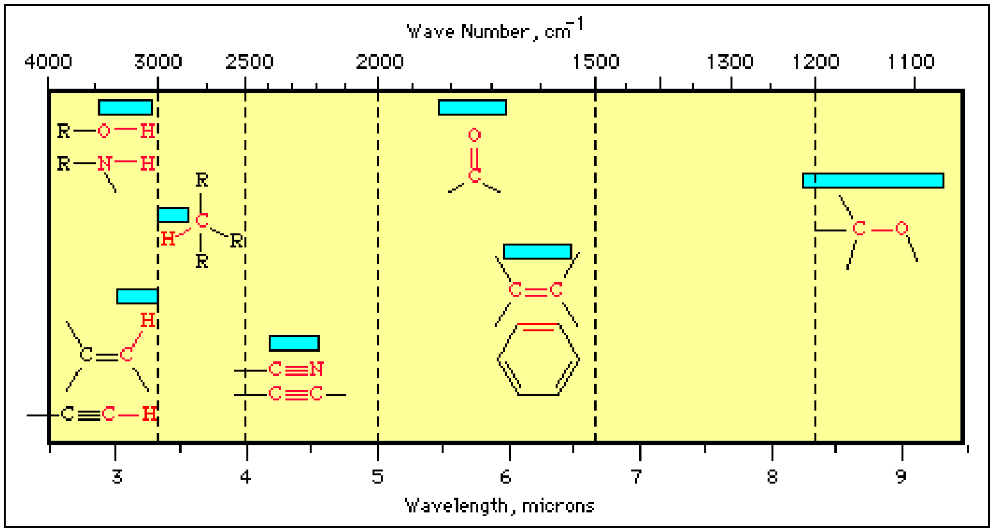
Bonds vibrate with a frequency that is in the IR region of the electromagnetic spectrum

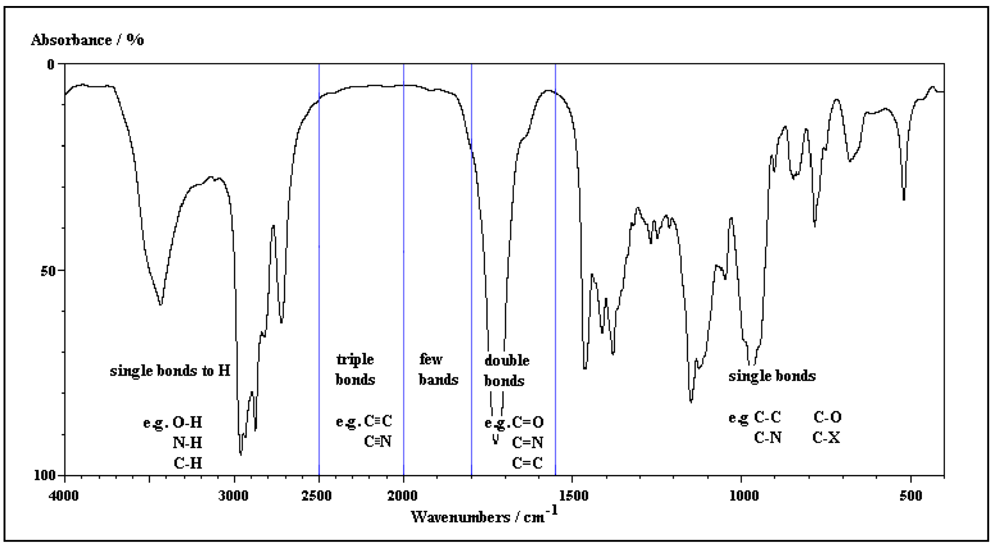
If light has the exact same frequency as the vibrational frequency of a bond, that light is absorbed if this causes a change in the dipole moment of the molecule

By seeing which frequencies of light are absorbed we can figure out which functional groups are present

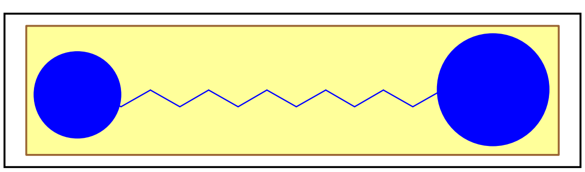


Basic IR Chart





Why are the peaks where they are? Consider Hooke's Law



Vibrational frequency of the spring depends on the mass of the two balls at the end of the spring and the spring constant

Hooke's Law as it applies to vibration of bonds in molecules

$$\bar{\nu} = \frac{1}{2\pi c}\sqrt{\frac{K}{u}}$$

ν = frequency in cm^{-1}
C = speed of light
K = Force Constant
u = reduced mass

$$u = \frac{m1 \times m2}{m1 + m2}$$

Consider effect of masses
Consider effect of spring constant

What can you tell about your IR spectrum at First Glance

•BOOKMARK PAGE 28 -29, learn that first!
••BOOKMARK PAGE 26 for a good correlation table.