441 Chem

CH-1

Introduction to Spectroscopy

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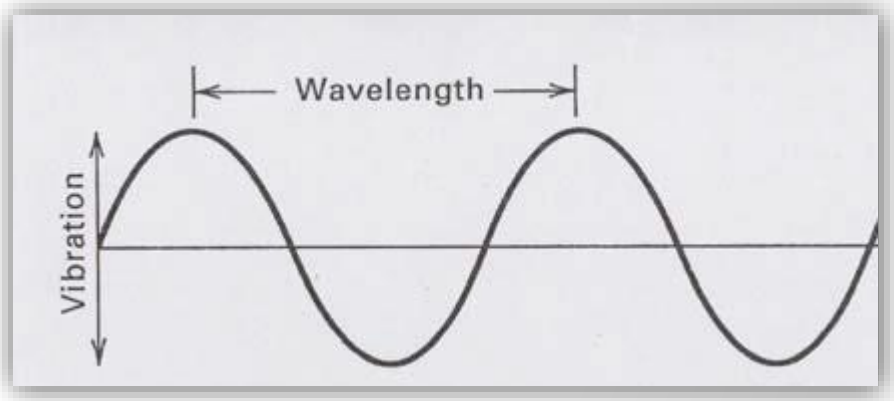
Set of methods where interaction of electromagnetic radiation with chemical molecules.

Electromagnetic Radiation

$$\upsilon = \frac{C}{\lambda}$$

$$V = \frac{\upsilon}{C} = \frac{1}{\lambda}$$



υ = Frequency of Radiation (Hertz or S^{-1})

λ = Wave Length (cm)

V = Wave Number (cm^{-1})

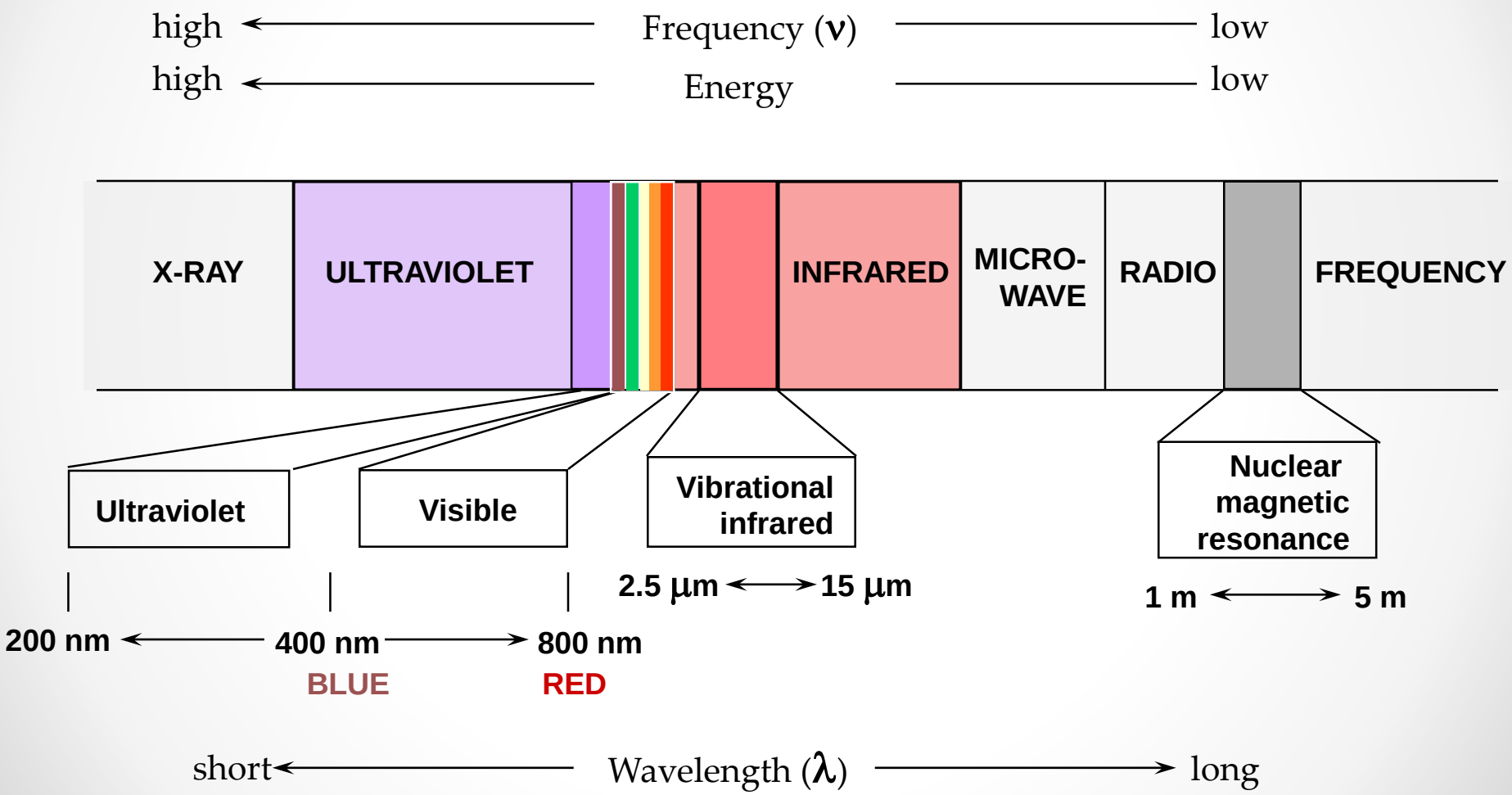
C = Velocity of light (constant) = 3 x 10^{10} cm/sec

The energy of quantum:

$$E = h\upsilon = h\frac{C}{\lambda}$$

h (Planck's constant) = 6.62×10^{-27} (Erg/sec)

The Electromagnetic Spectrum

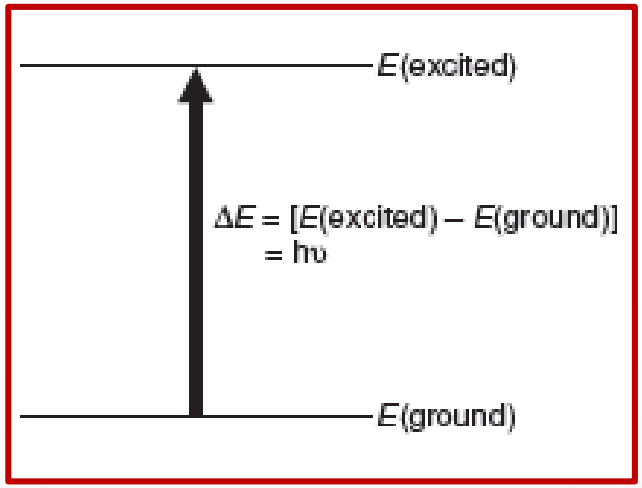


Internal Energy of Molecules:

$$E_{total} = E_{elec} + E_{vib} + E_{rot}$$

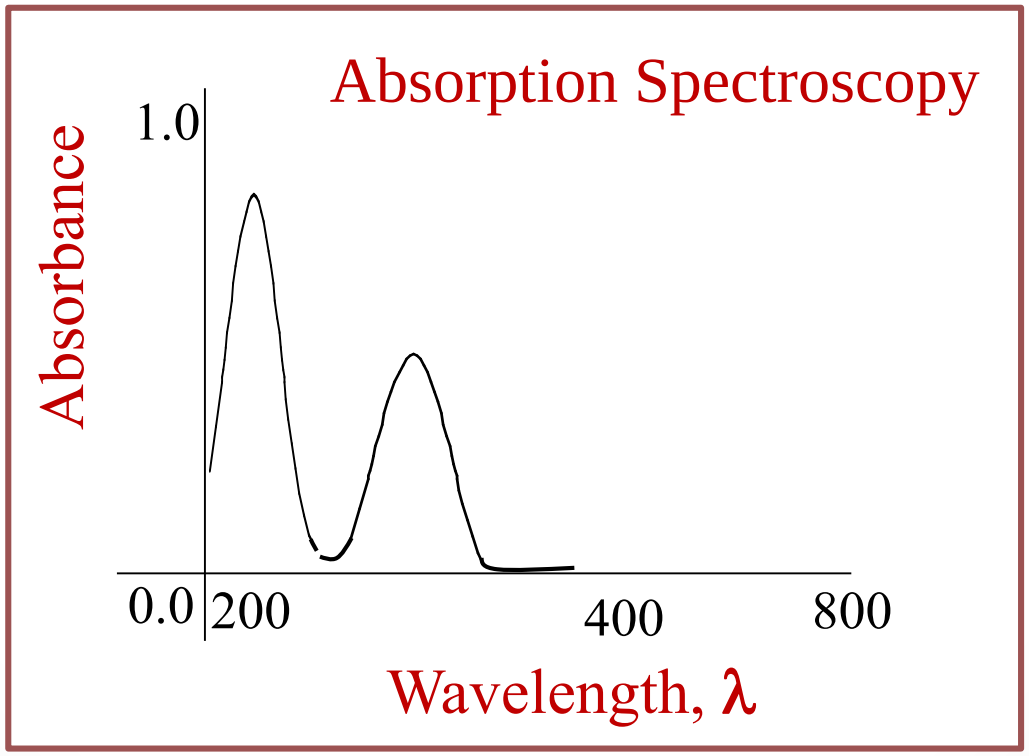
E_{elec}: Electronic transitions
E_{vib}: Vibrational transitions
E_{rot}: Rotational transitions

The Excitation process



Type of Spectroscopy:

1- Emission Spectroscopy
2- Absorption Spectroscopy



Types of Energy Transitions in Each Region of the Electromagnetic Spectrum

REGION	ENERGY TRANSITIONS
X-ray	Bond-breaking
UV/Visible	Electronic
Infrared	Vibrational
Microwave	Rotational
Radio Frequency	Nuclear and Electronic Spin

Summary of Spectroscopic Methods in Organic Chemistry

Electromagnetic Radiation	Wavelength And (Frequency)	The effect of radiation on molecular	Information learned
Ultraviolet and Visible	200-800 nm ($1.5x10^{15}$-$3.7x10^{14}$Hz)	Changes in the electronic energy levels within the molecule	Unsaturated bonds alternating with nonbonding electrons
Infrared	2.5-15 um ($1.2x10^{14}$-$2.0x10^{13}$Hz)	Changes in the vibrational and rotational energy levels in the molecule	Detection of functional groups in the compound
Radio Frequency Nuclear Magnetic Resonance	5-0.5 m (60-600 MHz)	Changes in the magnetic properties of some nuclei of atoms	Detect the type and number of hydrogen and carbon atoms in the compound and find out different chemical environments
Mass Spectrum	---	Ionization and fragmentation of compound to ions Broken	Determination of Molecular weight of the compound and detection of the molecular structure from broken molecules resulting