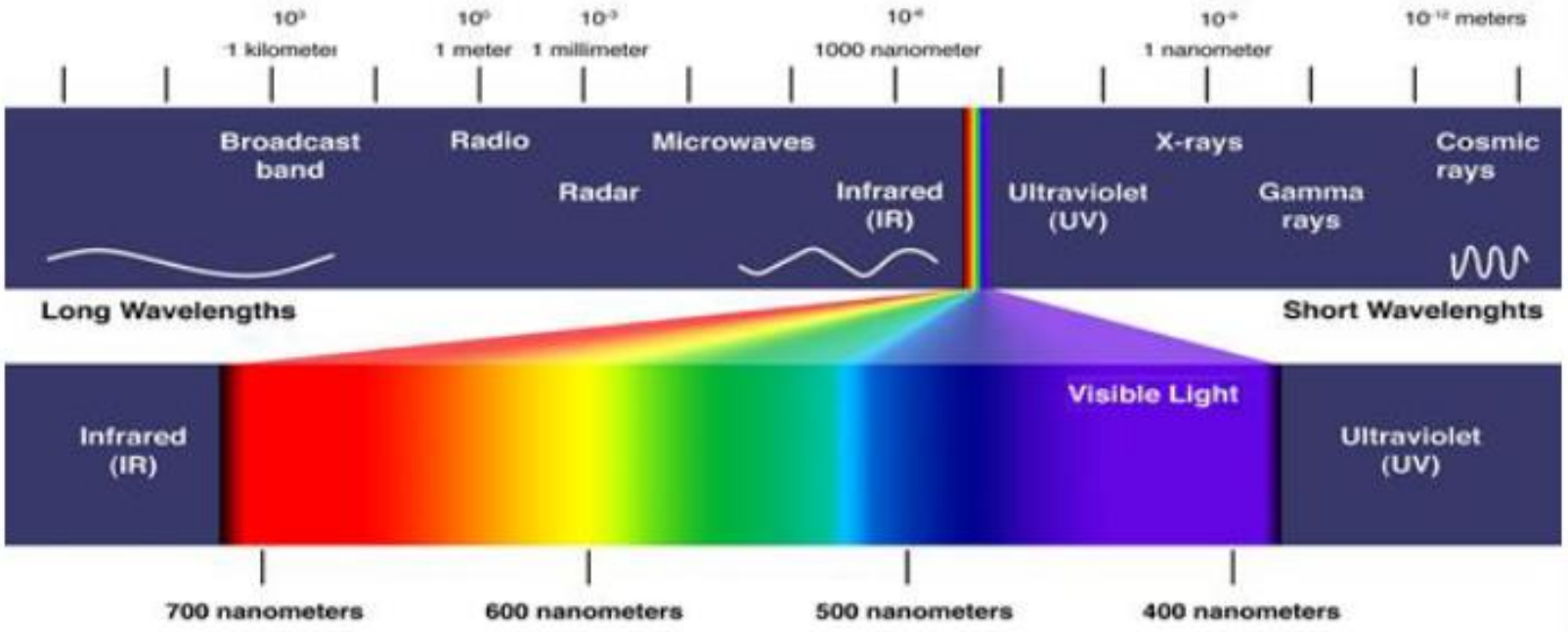
SPECTROSCOPIC METHODS OF ORGANIC MOLECULES

UV SPECTROSCOPY



WHAT IS SPECTROSCOPY?

The study of the interaction between
ELECTROMAGNETIC (EM) RADIATION and MATTER

The Electromagnetic spectrum

- The electromagnetic spectrum, in simple terms, is defined as the range of all types of electromagnetic radiation.
- The electromagnetic spectrum is a range of frequencies, wavelengths, and photon energies covering frequencies from **below 1 hertz to above 1025 Hz**, corresponding to **wavelengths that are a few kilometers to a fraction of the size of an atomic nucleus** in the spectrum of electromagnetic waves.

The Electromagnetic spectrum

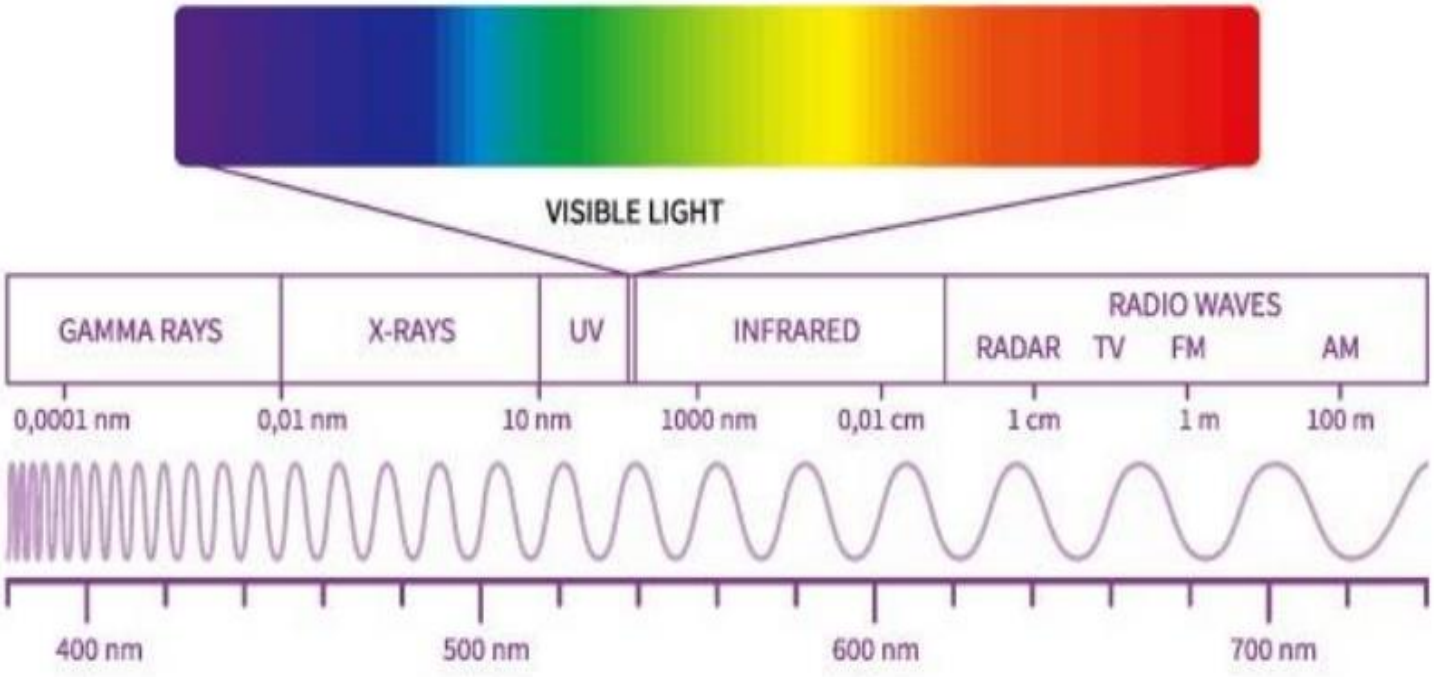
- Generally, in a vacuum, electromagnetic waves tend to travel at speeds similar to that of light. However, they do it at various wavelengths, frequencies, and photon energies.
- The electromagnetic spectrum consists of all electromagnetic radiation.
- These can be further classified as infrared radiation, visible light, or ultraviolet radiation.

The Electromagnetic spectrum

- The entire range (electromagnetic spectrum) is given by
- radio waves
- microwaves
- infrared radiation
- visible light
- ultra-violet radiation
- X-rays
- gamma rays
- cosmic rays

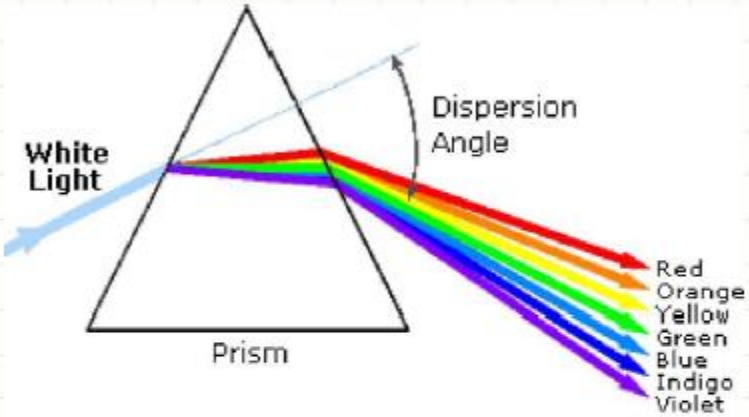
The increasing order of frequency and decreasing order of wavelength. The type of radiation and their frequency and wavelength ranges are as follows:

The Electromagnetic spectrum



Type of Radiation	Frequency Range (Hz)	Wavelength Range
Gamma-rays	$10^{20} - 10^{24}$	$< 10^{-12}$ m
X-rays	$10^{17} - 10^{20}$	1 nm – 1 pm
Ultraviolet	$10^{15} - 10^{17}$	400 nm – 1 nm
Visible	$4 \times 10^{14} - 7.5 \times 10^{14}$	750 nm – 400 nm
Near-infrared	$1 \times 10^{14} - 4 \times 10^{14}$	2.5 µm – 750 nm
Infrared	$10^{13} - 10^{14}$	25 µm – 2.5 µm
Microwaves	$3 \times 10^{11} - 10^{13}$	1 mm – 25 µm
Radio waves	$< 3 \times 10^{11}$	> 1 mm

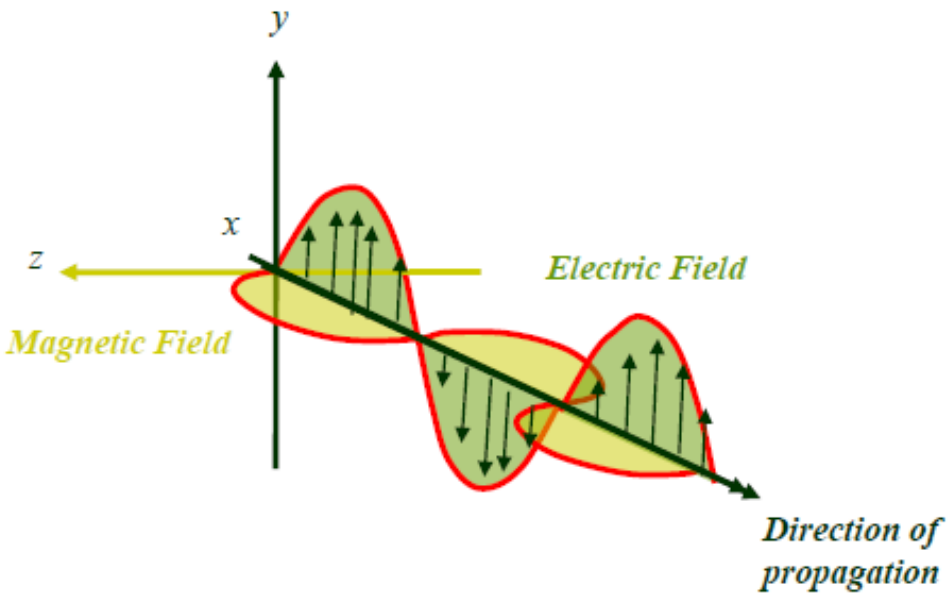
Electromagnetic Radiation



Violet0	400 - 420 nm	Yellow	570 - 585 nm
Indigo	420 - 440 nm	Orange	585 - 620 nm
Blue	440 - 490 nm	Red	620 - 780 nm
Green	490 - 570 nm		

WAVE PROPERTIES

- EM radiation is conveniently modeled as waves consisting of perpendicularly oscillating electric and magnetic fields, as shown below.



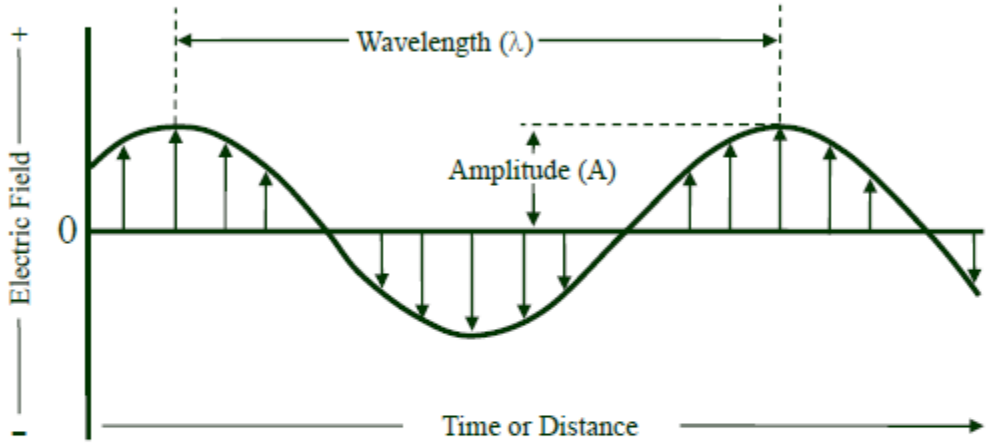
Wave parameters

حيث h هو ثابت بلانك. وقيمته=$6.624*10^{-27}$ ارك /ثانية
E=الطاقة بالارك

$$E = h\upsilon$$

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

$$E = \frac{hc}{\lambda}$$



We Use Symbols to Designate the Various Properties of Waves

- λ is the wavelength of the waves
- υ *is the frequency of the waves*
- *c is the speed of light*

ومن ملاحظاتنا على هذه الخصائص الفيزيائية نلاحظ أن الطاقة الضوئية تتناسب طردياً مع التردد وعكسياً مع طول الموجة ي أن الأشعة التي لها أطوال موجات قصيرة لها طاقة عالية والعكس صحيح

Definitions:

- ***Period*** **(p)** – the time required for one cycle to pass a fixed point in space.

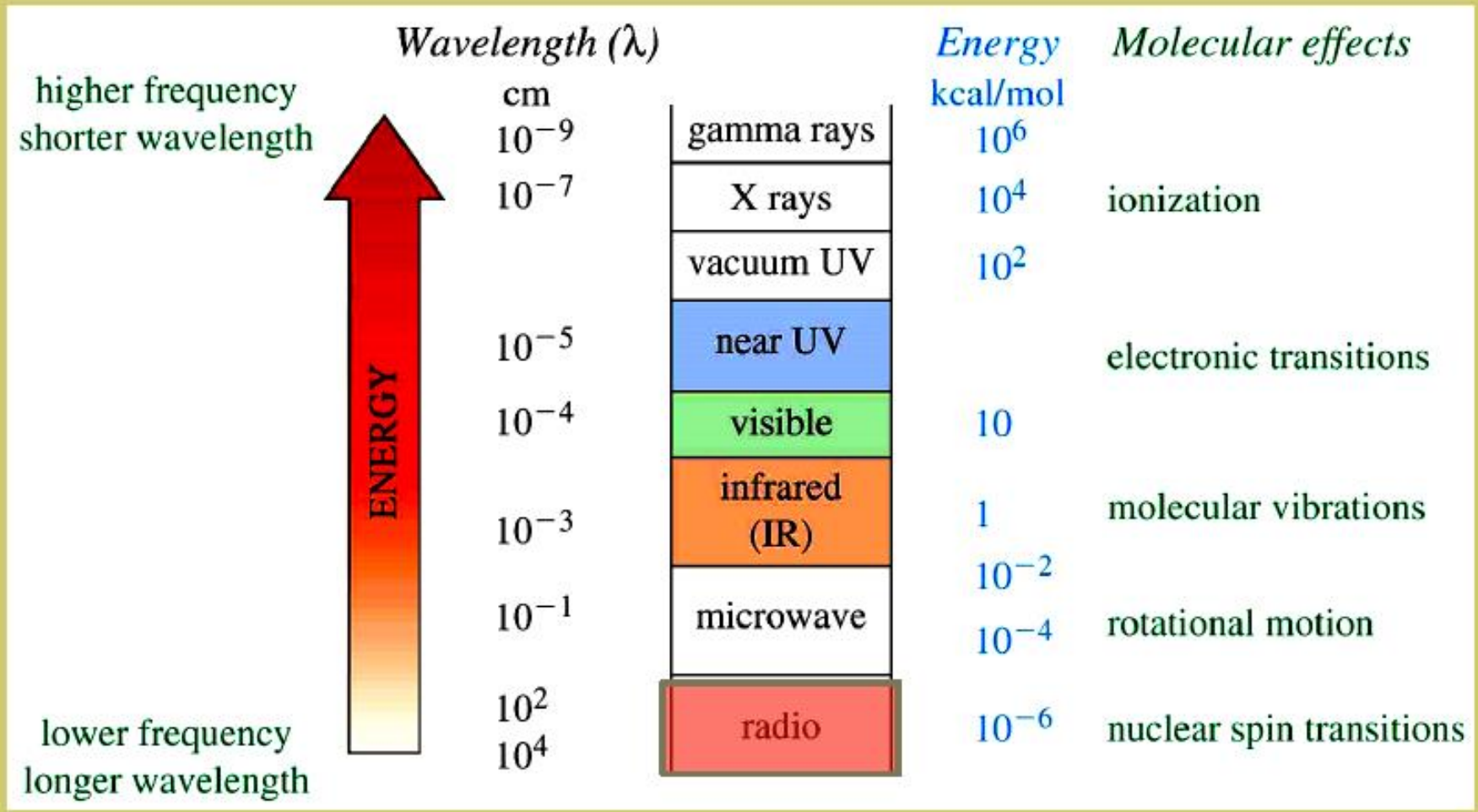
- ***Frequency*** **(ν)** – the number of cycles which pass a fixed point in space per second.

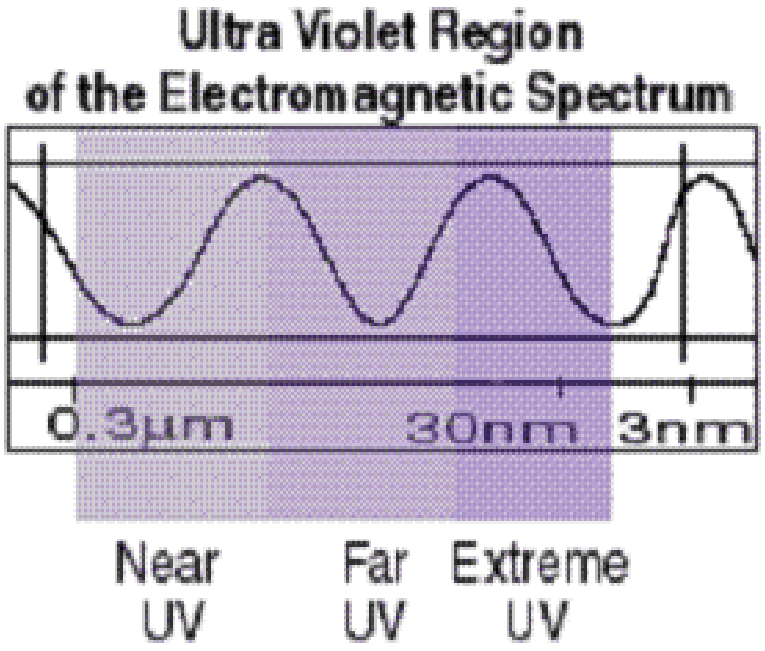
- ***Amplitude*** **(A)** – The maximum length of the electric vector in the wave (Maximum height of a wave).

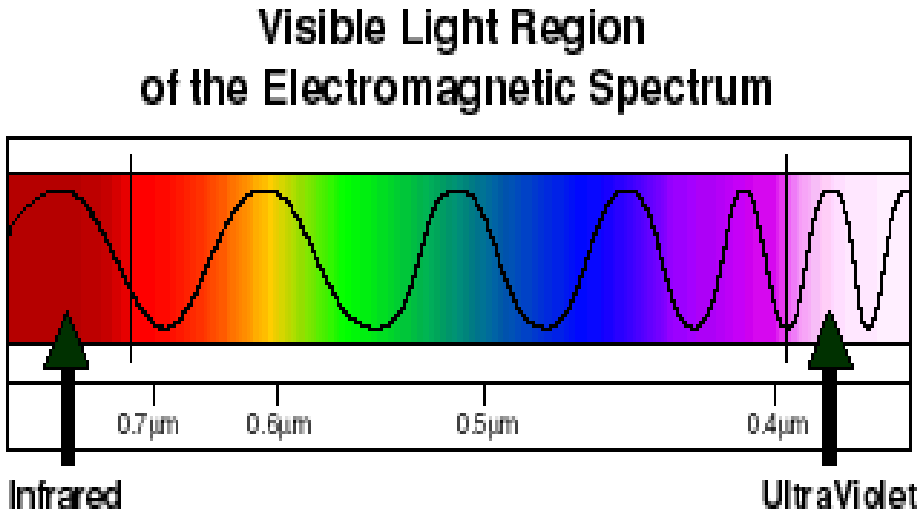
- ***Wavelength*** **(λ)** – The distance between two identical adjacent points in a wave (usually maxima or minima).

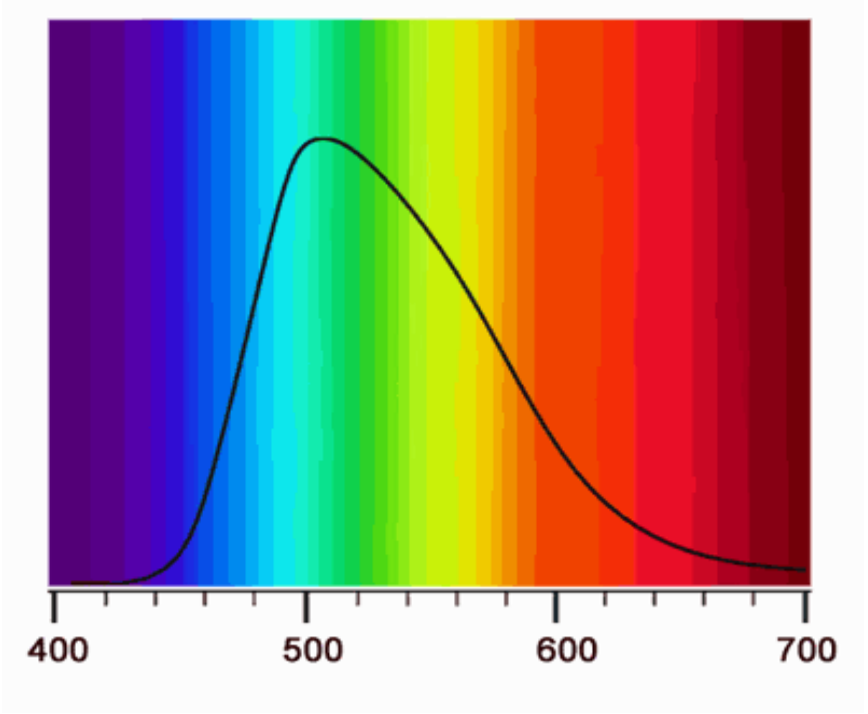
- ***Wavenumber*** **($\bar{\nu}$)** - The number of waves per cm in units of cm^{-1}.

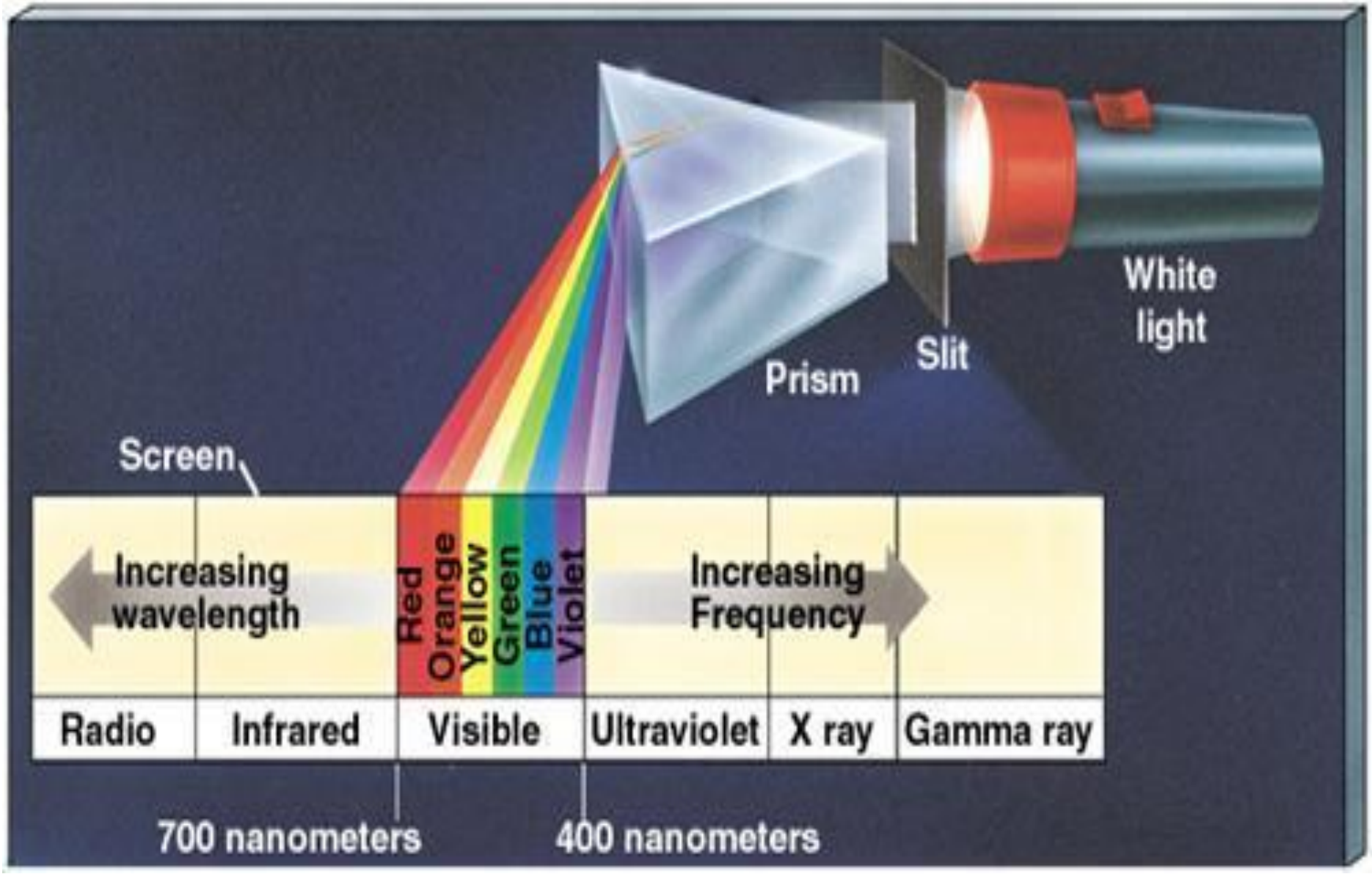
- **Purpose of each Electromagnetic Radiation**




Ultra Violet Region
of the Electromagnetic Spectrum
0.3µm
30nm
3nm
Near
UV
Far
UV
Extreme
UV


Visible Light Region
of the Electromagnetic Spectrum
0.7µm
0.6µm
0.5µm
0.4µm
Infrared
UltraViolet


400
500
600
700


White light
Slit
Prism
Screen
Increasing wavelength
Red
Orange
Yellow
Green
Blue
Violet
Increasing Frequency
Radio
Infrared
Visible
Ultraviolet
X ray
Gamma ray
700 nanometers
400 nanometers

Ultraviolet – visible spectroscopy

- **Ultraviolet – visible spectroscopy** (λ 200 - 800 nm) studies the changes in electronic energy levels within the molecule arising due to transfer of electrons from π- or non-bonding orbitals. It commonly provides the knowledge about π-electron systems, conjugated unsaturations, aromatic compounds and conjugated non-bonding electron systems etc.