

N16 – Atomic Structure

and Periodicity

Waves and Math

Electromagnetic Radiation

Propagates through space as a wave
– moving at the speed of light

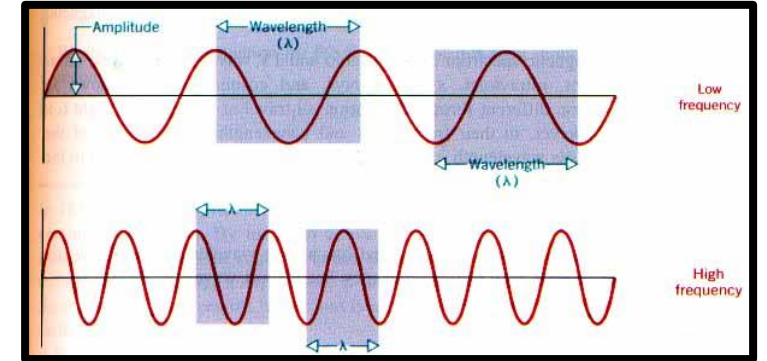
$$c = v\lambda$$

c = speed of light, a constant (3.00×10^8 m/s)

v = frequency, in units of hertz (hz, sec^{-1})

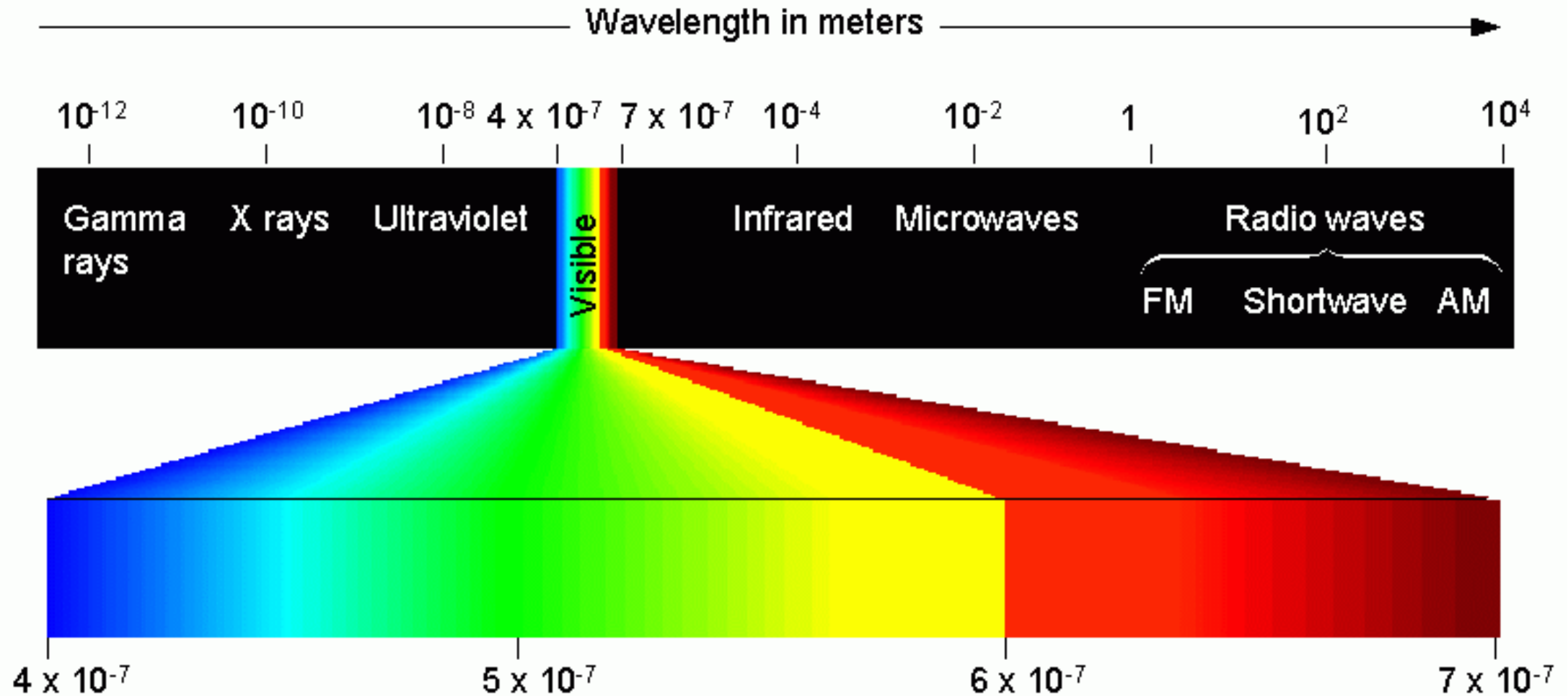
λ = wavelength, in meters

Careful! Sometimes in
nm = $\times 10^{-9}$ m



Careful!
Sometimes in
MHz = $\times 10^6$ Hz

Types of Electromagnetic Radiation



Energy of EMR

Energy (E) is directly proportional to the frequency (ν) of the radiation

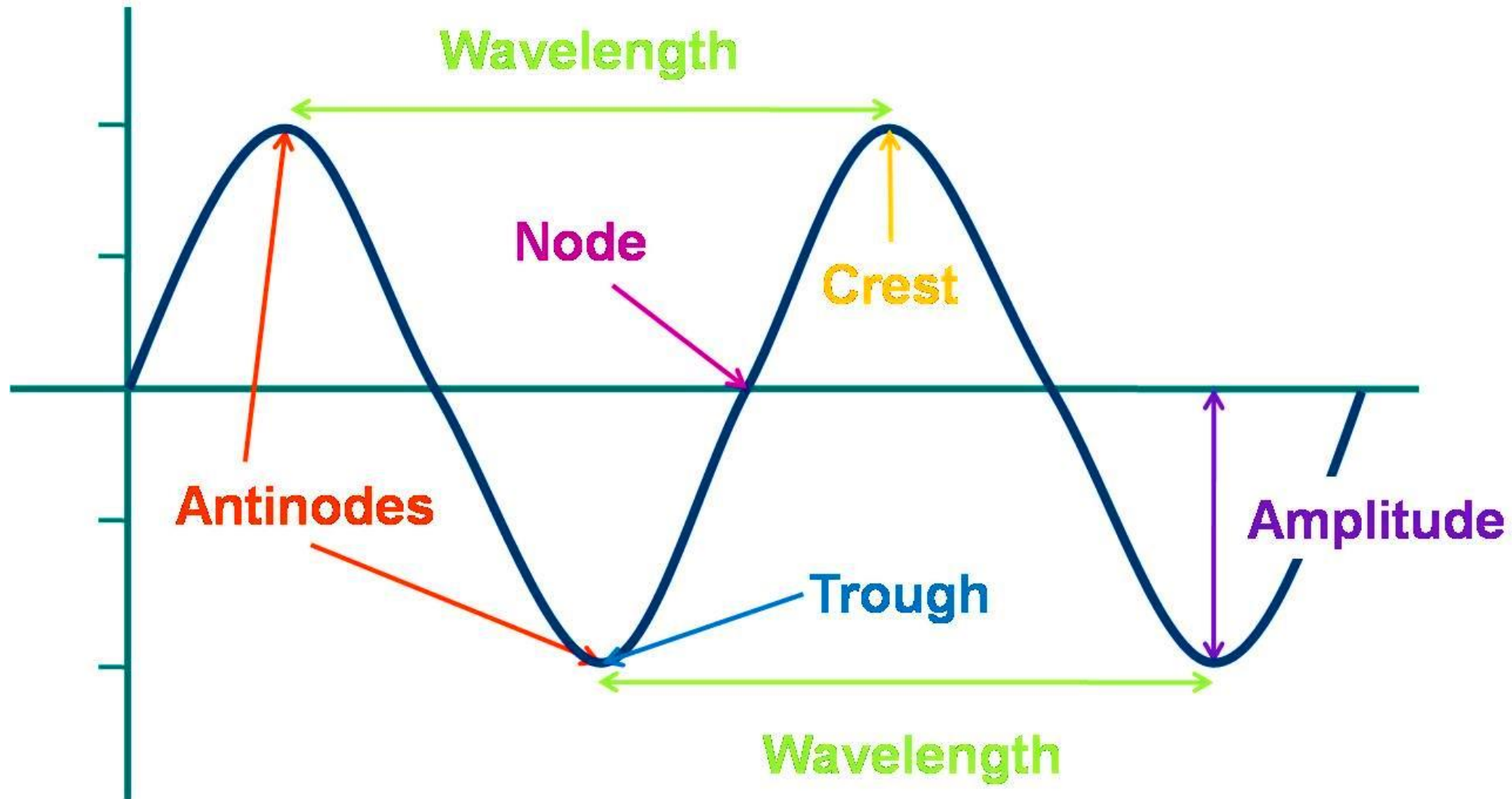
$$E = h \nu$$

E = Energy, in units of Joules ($\text{kg}\cdot\text{m}^2/\text{s}^2$)

h = Planck's constant ($6.626 \times 10^{-34} \text{ J}\cdot\text{s}$)

ν = frequency, in units of hertz (hz , sec^{-1})

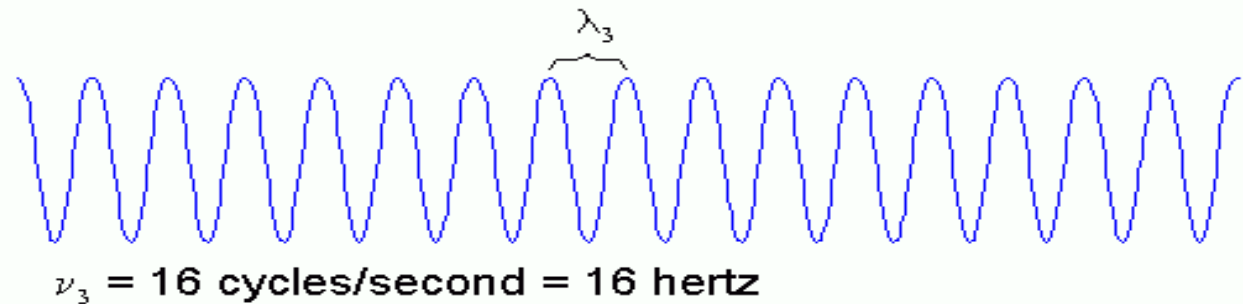
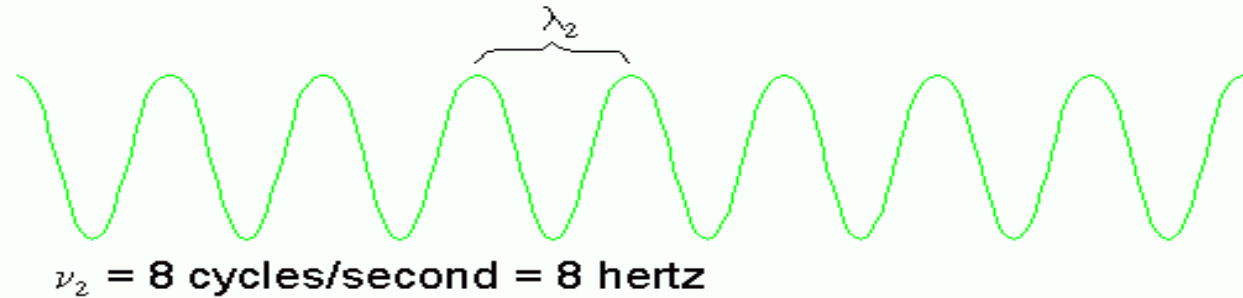
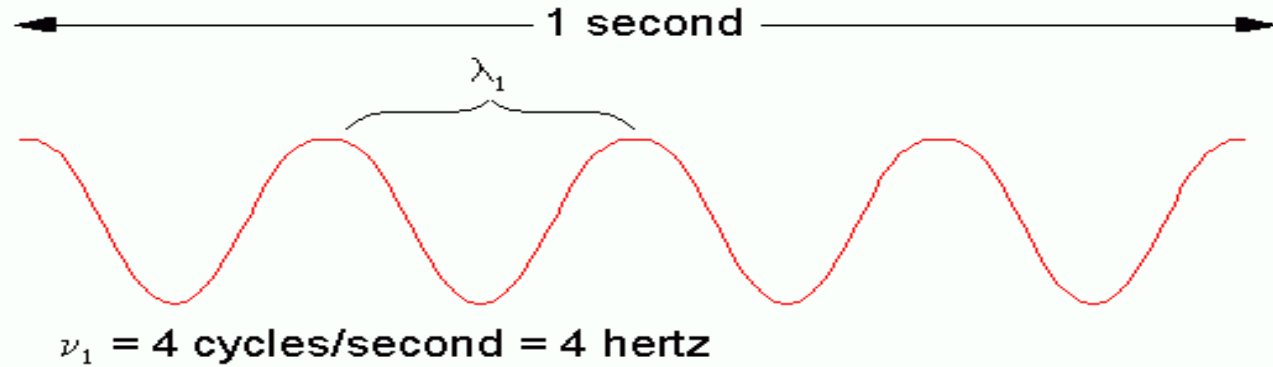
Parts of a Wave



Relationship between λ , ν and E

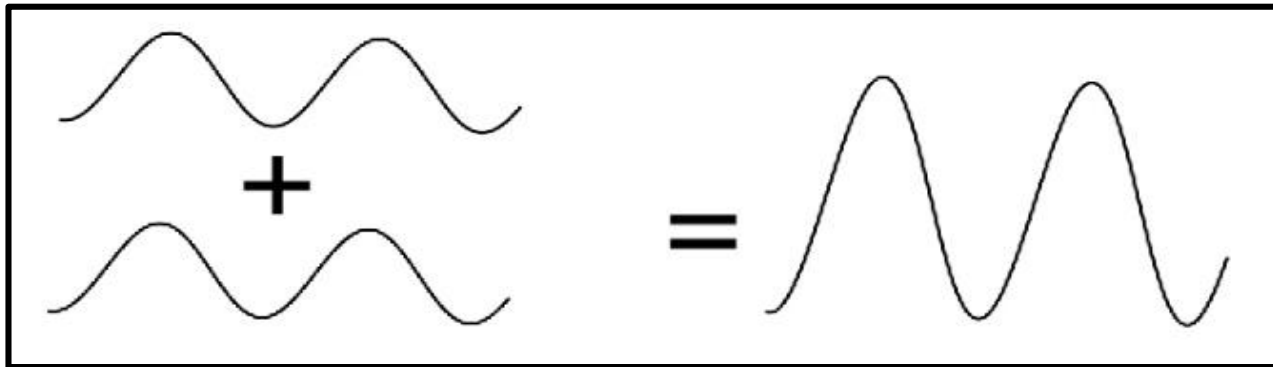
Long
Wavelength
=
Low Frequency
=
Low ENERGY

Short
Wavelength
=
High Frequency
=
High ENERGY

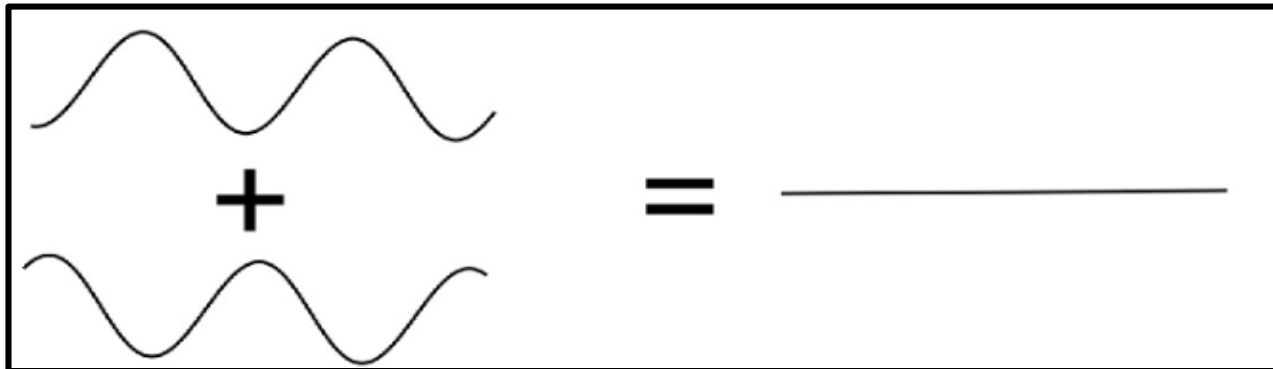


Wave Interference

Linear Superposition – when waves come together the result is the sum of the waves



In Phase
Constructive Interference
Additive



Out of Phase
Destructive Interference
Cancellation

Game of Rearranging and Substitution!

Common Arrangements:

$$c = \nu \lambda$$

$$E = h \nu$$

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

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

Game of Rearranging and Substitution!

Other Useful Equations:

de Broglie Equation

$$\lambda = \frac{h}{mv}$$

m = particle mass

Bohr Equation

$$E = -2.178 \times 10^{-18} J \left(\frac{Z^2}{n^2} \right)$$

Z = nuclear charge

n = energy level

Energy Change Between Two Energy Levels

$$E = -2.178 \times 10^{-18} J \left(\frac{Z^2}{n_{final}^2} - \frac{Z^2}{n_{initial}^2} \right)$$