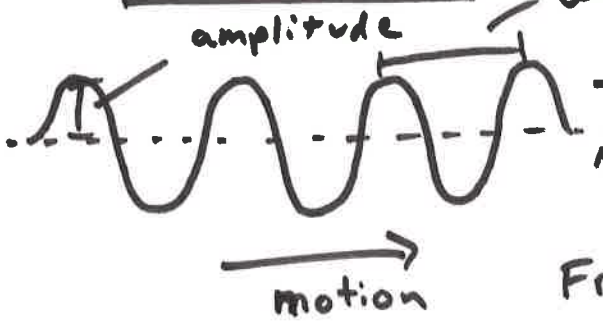
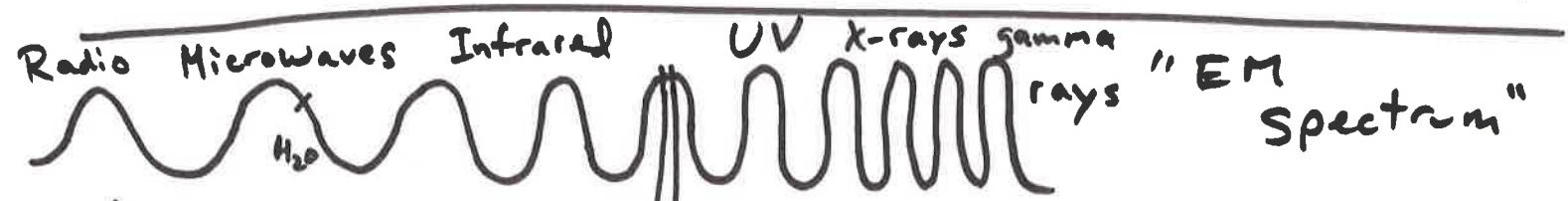
Ch 13 Electromagnetic Radiation

AS WAVE



Frequency (ν) (nu) = waves / sec = Hertz (Hz)



long λ
low ν
low energy photons

ROYGBIU
λ = 780 nm ⟷ 380 nm

DANGER

short λ
high ν
high E photons

All EM radiation travels at (c) = 3.00×10^8 m/sec

Wave Speed EQ: $c = \lambda \cdot \nu$

Speed = WL · Freq.

$\frac{m}{s} = m \cdot \frac{1}{sec}$

$\lambda = \frac{c}{\nu}$ or $\nu = \frac{c}{\lambda}$

1) Red light has λ = 750. nm. Find ν.

$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m/s}}{7.50 \times 10^{-7} \text{ m}} = 4.00 \times 10^{14} \text{ } \frac{1}{sec} \text{ (Hz)}$$

$$750.\text{ nm}\left(\frac{1\text{ m}}{10^9\text{ nm}}\right) = 7.50 \times 10^{-7}\text{ m}$$

2) KRUM has freq. of 91.9 MHz. Find λ.

$$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \text{ m/s}}{9.19 \times 10^7 \text{ 1/s}}$$

$$91.9 \text{ MHz}\left(\frac{10^6 \text{ Hz}}{1 \text{ MHz}}\right) = 9.19 \times 10^7 \text{ Hz}$$

$$\boxed{\lambda = 3.26 \text{ m}}$$

AS PARTICLE - photon - massless
- quanta

$$\boxed{E = h \cdot \nu}$$ ← frequency ($\frac{1}{\text{sec}}$)

↑ photon energy

↑ Planck's constant (6.63×10^{-34} J·s)

Joules (J)

$$J = J \cdot s\left(\frac{1}{\text{sec}}\right)$$

Find E of one photon from KRUM

$\lambda = 3.26$ m

$\nu = 9.19 \times 10^7$ Hz

$$\frac{E}{h} = \nu$$

$$E = h \cdot \nu$$

$$E = 6.63 \times 10^{-34} \text{ J·s}\left(9.19 \times 10^7 \frac{1}{\text{s}}\right)$$

$$E = h(\nu)$$

$$E = \frac{h \cdot c}{\lambda}$$

$$\boxed{E = 6.09 \times 10^{-26} \text{ J}}$$