The Nature of Light: Exercise

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The wavelength of a light beam is λ=560 nm. Determine:

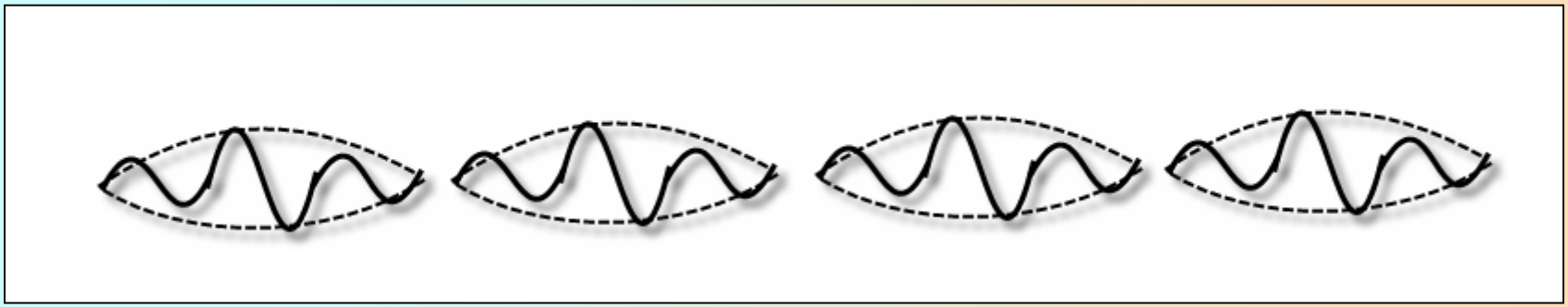
- **the wavelength in angstroms (Å)**
- **the wavelength in meters (m)**
- **the period of the wave in seconds (s)**
- **the frequency in Hertz (Hz)**
- **the energy of each photon in Joules (J)**
- **the energy of each photon in electron-volts (eV)**

Solutions:
λ=5600 Å
$\lambda=5.6\times10^{-7}$ m
$T=1{,}87\times10^{-15}$ s
$f=5{,}35\times10^{14}$ Hz
$E=3{,}55\times10^{-19}$ J
E=2,21 eV
$x=5.63\times10^{15}$ photons/s

If the power of the light-emitting source is 2 mW (miliwatts; 1 Watt=1 Joule/second), determine

- **the amount of photons emitted each second**

Data:
1 J = $6{,}24\times10^{18}$ eV
$h=6{,}62\times10^{-34}$ J.s
1 Å = 10^{-10} m



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The wavelength of a light beam is λ=560 nm. Determine:

- **the wavelength in angstroms (Å)**

$$\lambda = 560\ \text{nm}\ \frac{1\ \text{m}}{10^9\ \text{nm}}\ \frac{10^{10}\ \text{Å}}{1\ \text{m}} = 5600\ \text{Å}$$

- **the wavelength in meters (m)**

$$\lambda = 560\ \text{nm}\ \frac{1\ \text{m}}{10^9\ \text{nm}} = 5.6 \times 10^{-7}\ \text{m}$$

- **the period of the wave in seconds (s)**

$$c = \frac{\lambda}{T} \xrightarrow{\text{Applying the formula to our case}} 3 \times 10^8\ \frac{\text{m}}{\text{s}} = \frac{5.6 \times 10^{-7}\ \text{m}}{T}$$

$$\rightarrow T = \frac{5.6 \times 10^{-7}\ \text{m}}{3 \times 10^8\ \frac{\text{m}}{\text{s}}} = 1.87 \times 10^{-15}\ \text{s}$$

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The wavelength of a light beam is λ=560 nm. Determine:

- **the frequency in Hertz (Hz)**

$$f = \frac{1}{T} = \frac{1}{1.87 \times 10^{-15}\ s} = 5.35 \times 10^{14}\ Hz$$

- **the energy of each photon in Joules (J)**

$$E = h.f = \left(6.62 \times 10^{-34}\ J.s\right) x \left(5.35 \times 10^{14}\ Hz\right) = 3.54 \times 10^{-19}\ J$$

- **the energy of each photon in electron-volts (eV)**

$$E = 3.54 \times 10^{-19}\ J \frac{6.24 \times 10^{18}\ eV}{1\ J} = 2.21\ eV$$

If the power of the light-emitting source is 2 mW (miliwatts; 1 Watt=1 Joule/second), determine

- **the amount of photons emitted each second**

$$P = 2 \times 10^{-3}\ \frac{J}{s}\ \frac{1\ photon}{3.54 \times 10^{-19}\ J} = 5.65 \times 10^{15}\ \frac{photons}{s}$$