

Example of work - Color to Energy Problem - Flame Test Lab

If you expose a sample that contains a specific atom/ion and a yellow-green color ($\lambda = 562 \text{ nm}$) was emitted. What is the frequency (Hz) and energy (J) of this light?

$$\lambda = 562 \text{ nm}$$

$$c = 3.00 \times 10^8 \text{ m} \cdot \text{Hz}$$

$$h = 6.60 \times 10^{-34} \frac{\text{J}}{\text{Hz}}$$

BY Dimensional Analysis

? f (Hz)

? E (J)

$$\left(\frac{1}{562 \text{ nm}} \right) \left(\frac{1 \times 10^9 \text{ nm}}{1 \text{ m}} \right) (3.00 \times 10^8 \text{ m} \cdot \text{Hz}) = 5.338 \times 10^{14} \text{ Hz}$$
$$= 5.34 \times 10^{14} \text{ Hz}$$

$$\left(\frac{1}{562 \text{ nm}} \right) \left(\frac{1 \times 10^9 \text{ nm}}{1 \text{ m}} \right) (3.00 \times 10^8 \text{ m} \cdot \text{Hz}) / \left(6.60 \times 10^{-34} \frac{\text{J}}{\text{Hz}} \right) = 3.523 \times 10^{-19} \text{ J}$$
$$= 3.52 \times 10^{-19} \text{ J}$$

BY Equation

$$\lambda = 562 \text{ nm} \left(\frac{1 \text{ m}}{1 \times 10^9 \text{ nm}} \right) = 5.62 \times 10^{-7} \text{ m}$$

$$c = 3.00 \times 10^8 \text{ m} \cdot \text{Hz}$$

? f (Hz)

$$c = \lambda f \Rightarrow f = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m} \cdot \text{Hz}}{5.62 \times 10^{-7} \text{ m}}$$
$$= 5.338 \times 10^{14} \text{ Hz}$$

? E (J)

$$= 5.34 \times 10^{14} \text{ Hz}$$

$$h = 6.60 \times 10^{-34} \frac{\text{J}}{\text{Hz}}$$

$$E = h \cdot f = \left(6.60 \times 10^{-34} \frac{\text{J}}{\text{Hz}} \right) (5.338 \times 10^{14} \text{ Hz}) = 3.523 \times 10^{-19} \text{ J}$$
$$= 3.52 \times 10^{-19} \text{ J}$$