Practice Problems: ***Wavelength, Frequency, Energy content of One Quantum of Light.***

Examples:

I. A certain photon of light has a wavelength of 422 nm. **What is the frequency** of the light?

$$\frac{422\ nm}{} \times \frac{1\ m}{10^9\ nm} = 4.22\times10^{-7}\ m$$

$$\nu = \frac{C}{\lambda} = \frac{3.00\times10^8\ \frac{m}{\text{sec}}}{4.22\times10^{-7}\ m} = \frac{3.00\times10^8\ m}{4.22\times10^{-7}\ m\ (\text{sec})} = 7.11\times10^{14}\ \frac{1}{\text{sec}}$$

$c = \lambda\nu$

$E = h\nu$

$E = mc^2$

$c = 3.00 \times 10^8\ {}^{m}/_{\text{sec}}$

$h = 6.626 \times 10^{-34}\ \text{J} \bullet \text{sec}$

$\text{Hz} = {}^{1}/_{\text{sec}}$

II. **What is the energy** of a quantum of light from part I.

$$E = h\nu = \left(6.626\times10^{-34}\ J\cdot\text{sec}\right)\left(7.11\times10^{14}\ \frac{1}{\text{sec}}\right) = 4.71\times10^{-19}\ J$$

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1. **What is the energy** of a quantum of light with a frequency of 7.39×10^{14} Hz?

$$E = h\nu = \left(6.626\times10^{-34}\ J\cdot\text{sec}\right)\left(7.39\times10^{14}\ \frac{1}{\text{sec}}\right) = 4.90\times10^{-19}\ J$$

2. **What is the wavelength** of the quantum of light in question 1?

$$\lambda = \frac{C}{\nu} = \frac{3.00\times10^8\ \frac{m}{\text{sec}}}{7.39\times10^{14}\ \frac{1}{\text{sec}}} = \frac{3.00\times10^8\ m\ (\text{sec})}{7.39\times10^{14}\ (\text{sec})} = 4.06\times10^{-7}\ m$$

3. A certain red light has a wavelength of 680 nm. **What is the frequency** of the light?

$$\frac{680\ nm}{} \times \frac{1\ m}{10^9\ nm} = 6.80\times10^{-7}\ m$$

$$\nu = \frac{C}{\lambda} = \frac{3.00\times10^8\ \frac{m}{\text{sec}}}{6.80\times10^{-7}\ m} = \frac{3.00\times10^8\ m}{6.80\times10^{-7}\ m\ (\text{sec})} = 4.41\times10^{14}\ \frac{1}{\text{sec}}$$

4. **What is the energy** of a quantum of light from question 3?

$$E = h\nu = \left(6.626\times10^{-34}\,J\cdot\sec\right)\left(4.41\times10^{14}\,\frac{1}{\sec}\right) = 2.92\times10^{-19}\,J$$

5. A certain blue light has a frequency of 6.91 x 10^{14} Hz. **What is the wavelength** of the light?

$$\lambda = \frac{C}{\nu} = \frac{3.00\times10^{8}\,\frac{m}{\sec}}{6.91\times10^{14}\,\frac{1}{\sec}} = \frac{3.00\times10^{8}\ m\ (\sec)}{6.91\times10^{14}\ (\sec)} = 4.34\times10^{-7}\,m$$

6. **What is the energy** of a quantum of light from question 5?

$$E = h\nu = \left(6.626\times10^{-34}\,J\cdot\sec\right)\left(6.91\times10^{14}\,\frac{1}{\sec}\right) = 4.58\times10^{-19}\,J$$

7. The energy for a quantum of light is 2.84 x 10^{-19} J. **What is the wavelength** of this light?

$$E = h\nu \quad ;$$

$$\nu = \frac{E}{h} = \frac{2.84\times10^{-19}\ J}{6.626\times10^{-34}\ J\cdot\sec} = \frac{2.84\times10^{-19}\ J}{6.626\times10^{-34}\,J\ (\sec)} = 4.29\times10^{14}\,\frac{1}{\sec}\ ;$$

$$C = \lambda\nu \quad ; \quad \lambda = \frac{C}{\nu} = \frac{3.00\times10^{8}\,\frac{m}{\sec}}{4.29\times10^{14}\,\frac{1}{\sec}} = \frac{3.00\times10^{8}\ m\ (\sec)}{4.29\times10^{14}\ (\sec)} = 7.00\times10^{-7}\,m$$