LIGHT AND QUANTIZED ENERGY PROBLEMS

CONSTANTS: speed of light (c) = 3.00×10^8 m/s Planck's constant (h) = 6.63×10^{-34} J·s

1) X rays can penetrate body tissues and are widely used to diagnose and treat disorders of internal body structures. What is the frequency of an X ray with a wavelength of 1.15×10^{-10} m?

$c = \lambda \cdot \nu$

$3.00 \times 10^8 \text{ m/s} = (1.15 \times 10^{-10} \text{ m})\,\nu$

$2.61 \times 10^{18} \frac{1}{s}$ or s^{-1} or Hz

2) Microwaves are used to cook food and transmit information. What is the wavelength of a microwave that has a frequency of 3.44×10^9 Hz?

$c = \lambda \cdot \nu$

$(3.00 \times 10^8 \text{ m/s}) = \lambda\,(3.44 \times 10^9 \text{ Hz})$

8.72×10^{-2} m

3) A new sunscreen is reputed to protect against the UV-A waves that can cause skin cancer. How much energy is possessed by a single photon of UV-A electromagnetic radiation with a frequency of 9.231×10^{14} Hz?

$E = h\nu$

$E = (6.63 \times 10^{-34} \text{ J·s})(9.231 \times 10^{14} \text{ Hz})$

$E = 6.12 \times 10^{-19}$ J

4) Every object gets its color by reflecting a certain portion of incident light. The color is determined by the wavelength of the reflected photons, thus by their energy. What is the energy of a photon from the violet portion of the Sun's light if it has a frequency of 7.230×10^{14} Hz?

4.79×10^{-19} J

5) The blue color in some fireworks occurs when copper (I) chloride is heated to approximately 1500 K and emits blue light of wavelength 4.50×10^2 nm. How much energy does one photon of this light carry?

$\lambda = 4.50 \times 10^2 \text{ nm}$

$4.50 \times 10^2 \text{ nm} \times \frac{10^{-9} \text{ m}}{1 \text{ nm}}$

$\lambda = 4.50 \times 10^{-7}$ m

$E = h\nu$ (freq.)

$c = \lambda \cdot \nu$

$(3.00 \times 10^8 \text{ m/s}) = (4.50 \times 10^{-7} \text{ m})(\nu)$

$6.67 \times 10^{14} \text{ Hz} = \nu$

$E = h \cdot \nu$

$E = (6.63 \times 10^{-34} \text{ J·s})(6.67 \times 10^{14} \text{ Hz})$

$E = 4.42 \times 10^{-19}$ J