Chapter 38

38-2

\[ \lambda = 652 \text{ nm} \]

\[ \Delta t = 20.0 \text{ ms}, \quad P_{av} = 0.600 \text{ W} = 60 \text{ mW} \]

a) How much energy in each pulse (in J)?

Definition of Power is energy per time of \( P = \frac{E}{t} \).

\[ E = P \Delta t = (0.600 \text{ W})(20 \times 10^{-3} \text{ s}) = 0.012 \text{ J} = 12 \text{ mJ} \]

b) How much energy in each photon (in J and eV)?

\[ E_p = h\nu = \frac{hc}{\lambda} \]

\[ E_p = \frac{(6.63 \times 10^{-34} \text{ J} \cdot \text{s})(3 \times 10^8 \text{ m/s})}{652 \times 10^{-9} \text{ m}} = 3.05 \times 10^{-19} \text{ J} \]

\[ 1.602 \times 10^{-19} \text{ J} = 1 \text{ eV} \] so

\[ E_p = \frac{3.05 \times 10^{-19} \text{ J}}{1.602 \times 10^{-19} \text{ J/eV}} = 1.90 \text{ eV} \]

c) How many photons in each pulse?

\[ \# \text{photons} = \frac{\text{Total energy}}{\text{Energy/photon}} = \frac{E}{h\nu} = \frac{P \Delta t}{h\nu} = \frac{12 \times 10^{-3} \text{ J}}{3.05 \times 10^{-19} \text{ J}} \]

\[ = 3.93 \times 10^{16} \text{ photons in one pulse} \]

\[ 3.94 \times 10^{16} \]