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Problem 52.24 (RHK)

A ruby laser emits light at wavelength 694.4 nm. *A laser pulse is emitted for* 12.0 ps *and the energy release per pulse is* 150 mJ. (a) *We have to find the length of the pulse*, and (b) *the number of photons contained in each pulse*.

Solution:

Energy of a photon of wavelength $\lambda = 694.4 \text{ nm}$ will be

$$E = \frac{hc}{\lambda} = \frac{6.63\times10^{-34}\times3\times10^{8}}{694.4\times10^{-9}} \text{ J}$$

$$= 2.86\times10^{-19} \text{ J} = \frac{2.86\times10^{-19}}{1.6\times10^{-19}} \text{ eV} = 1.79 \text{ eV}.$$

(a)

As the laser pulse is emitted for 12.0 ps, the length of the pulse will be

$L = 3\times10^{8}\times12.0\times10^{-12} \text{ m} = 3.6 \text{ mm}.$

(b)

As the energy release per pulse is 150 mJ, the number of photons of energy 2.86×10^{-19} J contained in each pulse will be

$$N = \frac{150\times10^{-3}}{2.86\times10^{-19}} = 5.24\times10^{17} \text{ photons .}$$