Chapter 1: The Schrödinger Equation

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Problem 1.1.

(a) *Calculate the energy of one photon of infrared radiation whose wavelength is* 1064 *nm.*

(b) *An Nd:YAG laser emits a pulse of* 1064*-nm radiation of average power* $5 \times 10^6 W$ *and duration* $2 \times 10^{-8} s$*. Find the number of photons emitted in this pulse. (Recall that* $1W = 1J/s$*.)*

Solution of (a).

$$\begin{aligned}
E_{\text{photon}} &= h\nu && \text{(Equation (1.1))} \\
&= \frac{hc}{\lambda} && \text{(Equation (1.3))} \\
&= \frac{(6.626 \times 10^{-34} Js)(2.998 \times 10^8 m/s)}{1064 \times 10^{-9} m} \\
&= 1.867 \times 10^{-19} J.
\end{aligned}$$

□

Solution of (b). Total energy in one pulse is $E = (5 \times 10^6 W)(2 \times 10^{-8} s) = 0.1J$. By (a), the energy of one photon $E_{\text{photon}} = 1.867 \times 10^{-19} J$. So the number of photons is

$$n = \frac{E}{E_{\text{photon}}} = \frac{0.1J}{1.867 \times 10^{-19} J} = 5 \times 10^{17}.$$

□