

Chapter 36 Problem 53 †

Given

$$\lambda = 30.0 \mu m$$

$$h = 6.63 \times 10^{-34} J \cdot s$$

$$c = 3.0 \times 10^8 m/s$$

$$P = 2.0 mW$$

Solution

Find the number of transitions made in the laser every second.

Since power is energy per time, the energy released by the laser each second is $2.0 mJ$.

The energy in each transition is given by the relationship

$$E = \frac{hc}{\lambda}$$

Substituting in the the appropriate values gives

$$E = \frac{(6.63 \times 10^{-34} J \cdot s)(3.0 \times 10^8 m/s)}{30.0 \times 10^{-6} m} = 6.63 \times 10^{-21} J$$

Therefore, the number of transitions is given by

$$transitions = (2.0 \times 10^{-3} J) \left(\frac{1 trans}{6.63 \times 10^{-21} J} \right)$$

$$transitions = 3.02 \times 10^{17} trans$$

†Problem from Essential University Physics, Wolfson