Chapter 36 Problem 51 [†]

Given

$$\begin{split} \lambda &= 30.0 \; \mu m \\ h &= 6.63 \times 10^{-34} \; J \cdot s \\ c &= 3.0 \times 10^8 \; m/s \\ P &= 2.0 \; mW \end{split}$$

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 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