

## Act 2: Solution

Which emits more photons, a 1-mW cell phone ( $f = 830 \text{ MHz} \rightarrow \lambda = 0.36 \text{ m}$ ) or a 1-mW laser ( $\lambda = 635 \text{ nm}$ )?

- a) Laser emits more
- b) They emit the same number
- c) Cell phone emits more

Because the cell frequency is much less than the optical frequency, each cell-phone photon has much less energy. Therefore, you need many more of them to get the same total energy.

$$\text{Rate} \propto \lambda \quad \therefore \frac{\text{Rate}_{\text{cell}}}{\text{Rate}_{\text{laser}}} = \frac{\lambda_{\text{cell}}}{\lambda_{\text{laser}}} = \frac{0.36 \text{ m}}{635 \times 10^{-9} \text{ m}} = 5.7 \times 10^5$$

Cell phones actually emit  $\sim 1\text{W} \rightarrow \sim 10^{24}$  photons/sec