67. (a) The intensity at the target is given by $I = P/A$, where P is the power output of the source and A is the area of the beam at the target. We want to compute I and compare the result with $10^8\,\mathrm{W/m^2}$. The beam spreads because diffraction occurs at the aperture of the laser. Consider the part of the beam that is within the central diffraction maximum. The angular position of the edge is given by $\sin\theta = 1.22\lambda/d$, where λ is the wavelength and d is the diameter of the aperture (see Exercise 61). At the target, a distance D away, the radius of the beam is $r = D\tan\theta$. Since θ is small, we may approximate both $\sin\theta$ and $\tan\theta$ by θ, in radians. Then, $r = D\theta = 1.22D\lambda/d$ and

$$\begin{aligned} I &= \frac{P}{\pi r^2} = \frac{Pd^2}{\pi(1.22D\lambda)^2} \\ &= \frac{(5.0\times10^6\,\mathrm{W})(4.0\,\mathrm{m})^2}{\pi\left[1.22(3000\times10^3\,\mathrm{m})(3.0\times10^{-6}\,\mathrm{m})\right]^2} \\ &= 2.1\times10^5\ \mathrm{W/m^2}\ , \end{aligned}$$

not great enough to destroy the missile.

(b) We solve for the wavelength in terms of the intensity and substitute $I = 1.0\times10^8\,\mathrm{W/m^2}$:

$$\begin{aligned} \lambda &= \frac{d}{1.22D}\sqrt{\frac{P}{\pi I}} = \frac{4.0\,\mathrm{m}}{1.22(3000\times10^3\,\mathrm{m})}\sqrt{\frac{5.0\times10^6\,\mathrm{W}}{\pi(1.0\times10^8\,\mathrm{W/m^2})}} \\ &= 1.4\times10^{-7}\,\mathrm{m} = 140\ \mathrm{nm}\ . \end{aligned}$$