Laser Pointer

A 0.24 mW red laser pointer (λ = 655 nm) is focused onto a spot 3 cm^2 a distance 5.0 m away. What is the frequency of the light wave? What is the intensity of the laser? What are the maximum values of the electric and magnetic field in the spot?

$\lambda = 655\,nm = 655 \times 10^{-9}\,m$

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

$f = c/\lambda = \frac{3.0 \times 10^{8}\,m/s}{655 \times 10^{-9}\,m} = 4.58 \times 10^{14}\,Hz$

area $A = 3.0\,cm^2 \times \left(\frac{1\,m}{100\,cm}\right)^2 = 3 \times 10^{-4}\,m^2$

$P = 0.24\,mW = 0.24 \times 10^{-3}\,W$

$I = \frac{P}{A} = \frac{0.24 \times 10^{-3}\,W}{3 \times 10^{-4}\,m^2} = 0.8\,W/m^2$

$I = \frac{1}{2}\epsilon_0 c E^2 \Rightarrow E = \sqrt{\frac{2I}{\epsilon_0 c}} = 24.6\,V/m$

$B = \frac{E}{c} = \frac{24.6\,V/m}{3.0 \times 10^{8}\,m/s} = 8.19 \times 10^{-8}\,T$

Lastly, note solar intensity on Earth's surface is ~ 1000 W/m^2 on a sunny day in Easton.