Q- Lasers can be used to drill or cut material. One such laser generates a series of high-intensity pulses rather than a continuous beam of light. Each pulse contains 420 mJ of energy and lasts 10 ns. The laser fires 10 such pulses per second.
(a) What is the peak power of the laser light? The peak power is the power output during one of the 10 ns pulses.

The peak power will be

Energy of the pulse/pulse duration = $(420*10^{-3}\ J)/(10*10^{-9}\ s)$

$= 4.2*10^{7}$ W

(b) What is the average power output of the laser? The average power is the total energy delivered per second.

Total energy delivered per second will be the energy of ten pulses

$= (10/s)*420*10^{-3}\ J = 4.2$ W

(c) A lens focuses the laser beam to a 8 μm diameter circle on the target. During a pulse, what is the average light intensity on the target?

The intensity of light is the energy incident per unit area per unit time or the power incident per unit area.

The power of the laser during the pulse is the peak power = $4.2*10^{7}$ W

The area on which the energy delivered is

$$A = \pi R^2 = \pi \frac{D^2}{4} = 3.14 * \frac{\left(8*10^{-6}\,m\right)^2}{4} = 5.024*10^{-11} m^2$$

Hence the average intensity on the target will be given by

$$I = \frac{P}{A} = \frac{4.2*10^{7}}{5.024*10^{-11}} = 8.36*10^{17}\ \text{W/m}^2$$

(d) The intensity of sunlight at midday is about 1100 W/m^2. What is the ratio of the laser intensity on the target (?) to the intensity of the midday sun?

$$\frac{I_{Laser}}{I_{sun}} = \frac{8.36*10^{17}}{1100} = 7.6*10^{14}$$