Quiz 24.1C

The Sun radiates power at a rate of 4.00 x 10^{26} Watts. That energy is spread uniformly over all space, and the planet Mars receives some fraction of that energy.

a) Assuming Mars is at a distance of 138 million miles from the Sun, calculate the **intensity of light** from the Sun at this distance. Answer with 3 SF, and show all work.

b) What is the rms value of the electric field of light from the Sun, as seen from Mars?

c) Suppose we design an orbiting solar panel for Mars that can collect the Sun's energy with 100% efficiency. This circular array of solar panels has a radius of 25.0 km. How much ~~power~~ energy would this array collect in one hour?

a) $r = 138 \times 10^6 \text{ mi} \cdot \frac{1609 \text{ m}}{\text{mi}} = 2.22 \times 10^{11} \text{ m}$

$S = \frac{\text{Power}}{4\pi r^2} = \frac{4.00 \times 10^{26}}{4\pi (2.22 \times 10^{11})^2} = \boxed{646 \text{ W/m}^2}$

b) $S = c * U_{TOT} \Rightarrow U_{TOT} = \frac{646}{3 \times 10^8} = 2.15 \times 10^{-6} \text{ J/m}^3$

$U_{TOT} = \epsilon_0 E_{rms}^2 \Rightarrow E_{rms}^2 = \frac{2.15 \times 10^{-6}}{8.85 \times 10^{-12}}$

$\Rightarrow \boxed{E_{rms} = 493 \text{ N/C}}$

c) Power = S * Area ↙ "circular array"

$= 646 * \pi (25000)^2 = 1.27 \times 10^{12} \text{ W}$

$E = P * t = (1.27 \times 10^{12})(3600 \text{ s}) = \boxed{4.57 \times 10^{15} \text{ J}}$