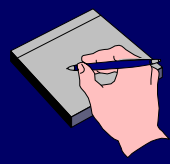
Energy Density



Example

Calculate the average electric and magnetic energy density of sunlight hitting the earth with E_{rms} = 720 N/C

$$\bar{u}_E = \frac{1}{2}\varepsilon_0 E_{rms}^2 = \frac{1}{2}\left(8.85\times10^{-12}\ \frac{\mathrm{C}^2}{\mathrm{Nm}^2}\right)\left(720\ \frac{\mathrm{N}}{\mathrm{C}}\right)^2 = 2.3\times10^{-6}\ \frac{\mathrm{J}}{\mathrm{m}^3}$$

$$\bar{u}_B = \frac{1}{2}\frac{B_{rms}^2}{\mu_0} = \frac{1}{2}\frac{E_{rms}^2}{\mu_0 c^2}$$

Use $$c = \frac{1}{\sqrt{\varepsilon_0\mu_0}}$$

$$\bar{u}_B = \frac{1}{2}\varepsilon_0 E_{rms}^2 = \bar{u}_E$$

$$\bar{u}_{total} = \bar{u}_E + \bar{u}_B = 2\bar{u}_E = 4.6\times10^{-6}\ \frac{J}{m^3}$$