A twin-lead transmission line is made of brass wires with diameters of 1.2 mm, separated by 8 mm center-to-center, embedded in a dielectric insulator characterized by $\varepsilon = 1.6\varepsilon_0$, $\mu = \mu_0$, and $\sigma = 5 \times 10^{-6}$ S/m. Determine the skin depth δ and per-unit-length parameters R, L, C, and G at a frequency of 530 MHz.

$\sigma_{Brass} = 1.1 \times 10^7$ S/m per Appendix B

$\mu_{Brass} = \mu_0$, $\epsilon_{Brass} = \epsilon_0$

Use equations from Table 11.1

$R = \frac{1}{\pi a \delta \sigma_c}$ where $\delta = \frac{1}{\sqrt{\pi f \mu_c \sigma_c}}$

$\delta = \frac{1}{\sqrt{\pi (530\times10^6)(4\pi\times10^{-7})(1.1\times10^7)}} = 6.519152 \times 10^{-6}$ m

$R = \frac{1}{\pi \left(\frac{1.2\times10^{-3}}{2}\right) 6.519152\times10^{-6} (1.1\times10^7)} = 7.3168$ Ω/m

$L = \frac{\mu}{\pi} \cosh^{-1}\left(\frac{d}{2a}\right) = \frac{4\pi\times10^{-7}}{\pi} \cosh^{-1}\left(\frac{8}{1.2}\right)$

$L = 1.0338 \times 10^{-6}$ H/m $= 1.034$ μH/m

$G = \frac{\pi\sigma}{\cosh^{-1}(d/2a)} = \frac{\pi(5\times10^{-6})}{\cosh^{-1}(8/1.2)} = 6.0775\times10^{-6}$ S/m

$G = 6.0775$ μS/m

$C = \frac{\pi\epsilon}{\cosh^{-1}(d/a)} = \frac{\pi(8.8542\times10^{-12})1.6}{\cosh^{-1}(8/1.2)} = 1.722\times10^{-11}$ F/m

$C = 17.22$ pF/m