Reading

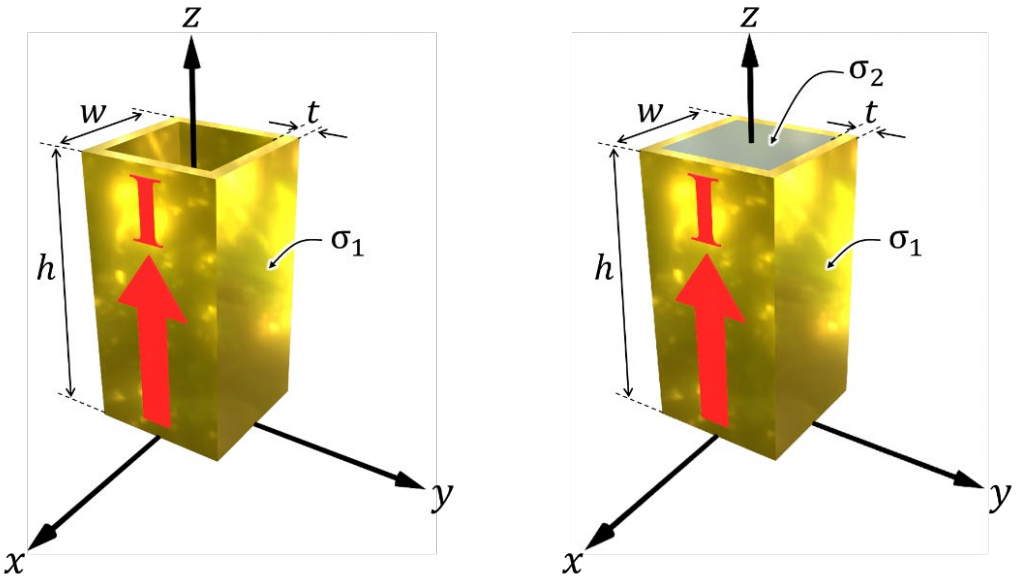
Required Reading

- Chapter 6, pp. 224 - 281.

Resistance

Problem 1 – Voltage Drop

A hollow tube with a square cross section is made of brass, which is known to have a conductivity of $\sigma_1 = 1.5 \times 10^7$ S/m. The height of the tube is $h = 2.4$ in, the edge length is $w = 0.50$ in, the wall thickness is $t = 0.10$ in, and the device is carrying a current of $I = 100$ A.

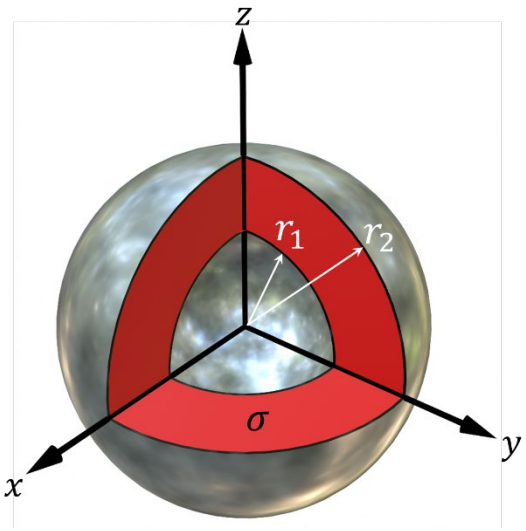


(a) Calculate the voltage drop across the tube when fill with air (shown in left of above figure).

(b) Calculate the voltage drop if the interior of the tube is filled with a partially conducting medium with conductivity $\sigma_2 = 2.7 \times 10^5$ S/m.

Problem 2 – Spherical Resistor

Two perfectly conducting spherical surfaces are located at $r_1 = 3.0$ cm and $r_2 = 5.0$ cm. They are separated by a resistive medium with conductivity $\sigma = 5.7 \times 10^{-2}$ S/m. Calculate the resistance R of this device between the conducting plates.



Capacitance

Problem 3 – Parallel Plate Capacitor

The parallel plate capacitor shown below is filled with a functionally-graded dielectric where the dielectric constant changes in the x direction. The permittivity gradient is characterized by $\varepsilon_r(x) = \varepsilon_{r0} + \Delta\varepsilon_r x^2$, where $\varepsilon_{r0} = 2.1$ and $\Delta\varepsilon_r = 1.2 \times 10^5$ 1/m^2. This device has width $w = 2.0$ cm and a plate separation of $h = 0.5$ mm. Calculate the overall capacitance C of this device.