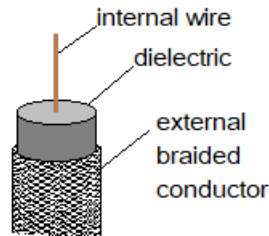


# Physics II

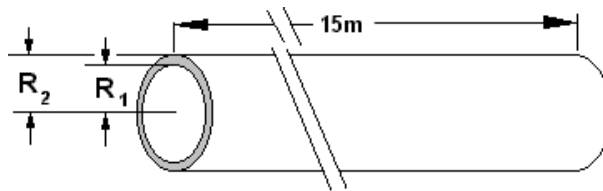
## Resistivity

Resistivity of copper  $\rho_{Cu} = 1.68 \times 10^{-8} \Omega m$

**Problem 1.-** A coaxial cable has an internal copper wire of 0.5mm diameter and an outer cylindrical braided conductor of diameter 5.5mm. Calculate the resistance between the two conductors, if the length of the wire is 20m and the resistivity of the dielectric in the gap between the conductors is 250,000  $\Omega m$ .



**Problem 1a.-** What is the electric resistance *radially* through a pipe made of copper that has a length of 15m, internal radius  $R_1=10\text{mm}$  and external radius  $R_2=12\text{mm}$ .



**Problem 2.-** Find the resistance of a tapered copper wire that has a radius of 1mm on one end and 1.5mm on the other. Consider the length of the wire to be 10m.

**Problem 2a.-** A wire is uniformly tapered from a radius  $R_1=1\text{mm}$  to a final radius  $R_2=3.0\text{mm}$ . The length of the wire is 20 m, so the equation that describes the radius is

$$r = 0.001 + 0.0001x$$

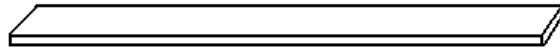
Calculate the resistance of the wire.

**Problem 3.-** Two wires, one of copper and one of aluminum have the same length and same electric resistance. Which one is thicker? why?

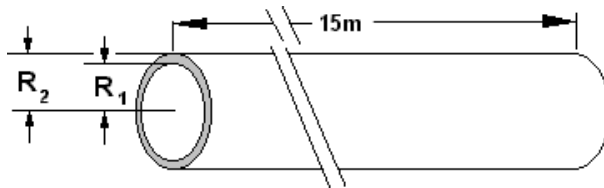
**Problem 4.-** Find the resistance of a 25m length of copper wire of diameter 2.85 mm and compute the voltage drop when carrying a current of 12A.

**Problem 4a.-** A coil is made with 10 meters of copper wire with diameter 0.65 mm. Calculate the voltage drop in the wire with a current of  $I=2.5$  Amps.

**Problem 5.-** What is the electric resistance along a 20m-long bar of copper that has a thickness of 0.5cm and a width of 4cm.



**Problem 6.-** What is the electric resistance along a pipe made of copper that has a length of 15m, internal radius  $R_1 = 10\text{mm}$  and external radius  $R_2 = 12\text{mm}$ .

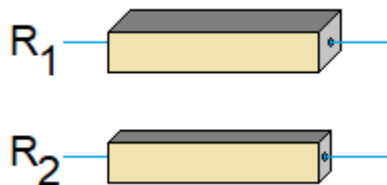


**Problem 7.-** Explain the reason why metals have higher resistance at higher temperatures.

**Problem 8.-** What is superconductivity?

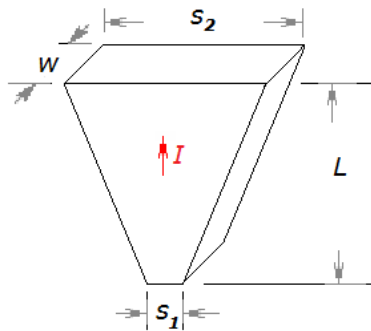
**Problem 9.-** In what units do you measure resistivity, electric field and electric potential?

**Problem 10.-** Two resistors  $R_1$  and  $R_2$  are made of the same material and have the same length, but  $R_2$  has half the cross section than  $R_1$ . If they are connected in parallel to a battery and the power consumed by  $R_1$  is 1W, what is the power consumed by  $R_2$ ?

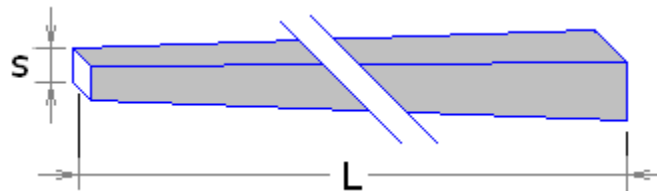


**Problem 11.-** An atomic microscope has a tip made of copper foil (resistivity  $\rho_{Cu}$ ) cut in the shape of a triangle as shown in the figure. Calculate the resistance of the tip assuming the current flows uniformly through its cross section from the small rectangular end to the large one.

*Hint:* The width of the cross section can be written as:  $s = s_1 + \left(\frac{s_2 - s_1}{L}\right)x$ , where  $x$  is the distance to the end of the tip.



**Problem 12.-** Find the resistance of a copper connector whose shape has a square cross section. The conductor is tapered, so one end has a side  $s=1\text{mm}$  and the other  $s=1.5\text{mm}$ . Consider the length of the wire to be  $10\text{m}$  and resistivity of copper  $\rho_{Cu} = 1.68 \times 10^{-8} \Omega\text{m}$



**Hint:** Notice that the side “s” as a function of the distance to the smaller end is:  
 $s = 0.001 + 0.00005x$

**Problem 13.-** Determine a formula for the total resistance of a spherical shell made of a material whose resistivity is  $\rho$  and whose inner and outer radius are  $r_1$  and  $r_2$ . Assume the current flows radially outward.