

PHYS-2201 Electricity and Magnetism

Assignment 10

Due: Tuesday, Jan. 12, 2015, by 3pm (at dropbox outside 3L24)

- (5 points) An aluminium wire having a cross-sectional area of $7.50 \times 10^6 \text{ m}^2$ carries a current of 8.00 A. The density of aluminium is 2.70 g/cm^3 . Assume each aluminium atom supplies one conduction electron per atom. Find the drift speed of the electrons in the wire.
- (5 points) Lightbulb A is marked “25 W 120 V,” and lightbulb B is marked “100 W 120 V.” These labels mean each lightbulb has its respective power delivered to it when it is connected to a constant 120-V source.
 - Find the resistance of each lightbulb.
 - During what time interval does 1.00 C pass into lightbulbs A and B?
 - How long does it take for 1.00 J of energy to convert to heat in lightbulb A?
 - Find the cost of running lightbulbs A and B separately assuming a cost of \$0.15 per kWh.
- (5 points) The resistor combinations shown in FIG. 1 are called *delta* and *weye* circuits respectively. What values of R_1 , R_2 and R_3 should be chosen (in terms of R_a , R_b , and R_c), such that the resistance between any two terminals is the same for both circuits?

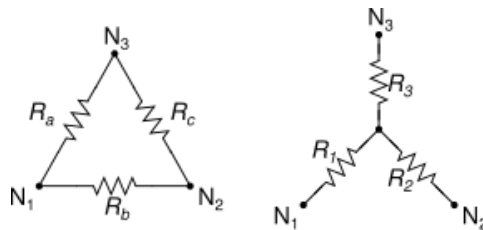


Figure 1: Problem 3.

- (5 points) A spherical resistor problem. The region between two concentric spherical shells is filled with a material with resistivity ρ . The inner radius is r_1 , and the outer radius, r_2 is much larger than r_1 . Show that the resistance between the shells is essentially equal to $\rho/(4\pi r_1)$.
- (5 points) An electric kettle has a multi-position switch and two heating coils. When only one coil is on, the well insulated kettle brings a full pot of water to a boil in a time T. When using only the other coil, the full pot of water takes a time $3.5T$ to boil. Find the time interval to boil a full pot using both coils if:
 - the coils are connected in parallel,
 - the coils are connected in series.