Phsx 2220 - Homework #5

27-1. A current of 5.0 A exists in a 10 Ω resistor for 4.0 minutes. How many (a) coulombs and (b) electrons pass through any cross section of the resistor in this time?

27-2. A fuse in an electric circuit is a wire that is designed to melt, and thereby open the circuit, if the current exceeds a predetermined value. Suppose that the material to be used in a fuse melts when the current density rises to 440 A/cm^2. What diameter of cylindrical wire should be used to limit the current to 0.50 A?

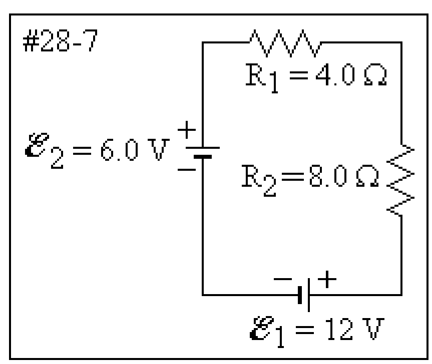
27-3. A wire 4.00 m long and 6.00 mm in diameter has a resistance of 15.0 mΩ. A potential difference of 23.0 V is applied between the ends. (a) What is the current in the wire? (b) What is the current density? (c) Calculate the resistivity of the wire material. Identify the material. (Use Table 27-1.)

27-4. In Earth’s lower atmosphere there are negative and positive ions, created by radioactive elements in the soil and cosmic rays from space. In a certain region, the atmospheric electric field strength is 120 V/m, directed vertically down. This field causes singly charged positive ions, 620 per cm^3, to drift downward and singly charged negative ions, 550 per cm^3, to drift upward. The measured conductivity is 2.70×10^{-14} 1/Ω·m. Calculate (a) the ion drift speed, assumed to be the same for positive and negative ions, and (b) the current density.

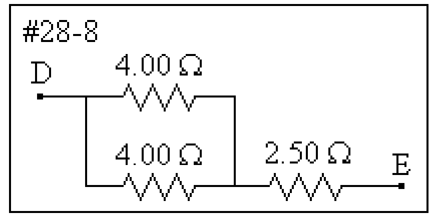
27-5. A student kept his 9.0 V, 7.0 W radio turned on at full volume from 9:00 p.m. until 2:00 a.m. How much charge went through it?

27-6. A linear accelerator produces a pulsed beam of electrons. The pulse current is 0.50 A, and the pulse duration is 0.10 μs. (a) How many electrons are accelerated per pulse? (b) What is the average current for a machine operating at 500 pulses/s? (c) If the electrons are accelerated to an energy of 50 MeV, what are the average and peak powers of the accelerator?

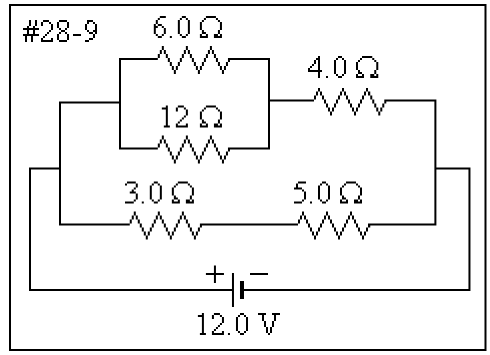
28-7. Assume that the batteries in the figure at right have negligible internal resistance. Find (a) the current in the circuit, (b) the power of each battery, stating whether energy is supplied to or absorbed by it.



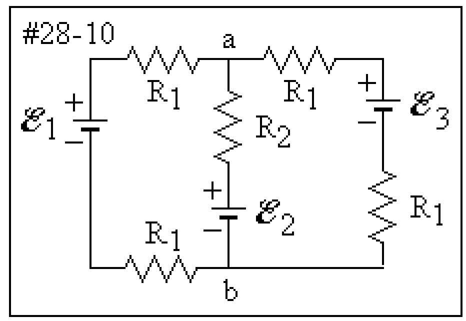
28-8. In the figure at right, find the equivalent resistance between points D and E. (*Hint*: Imagine that a battery is connected between points D and E.)



28-9. A circuit containing five resistors connected to a battery with a 12.0 V emf is shown at right. What is the potential difference across the 5.0 Ω resistor?



28-10. (a) Calculate the current through each ideal battery in the figure at right. Assume that R_1 = 1.0 Ω, R_2 = 2.0 Ω, $\mathcal{E}_1$ = 2.0 V, and $\mathcal{E}_2 = \mathcal{E}_3$ = 4.0 V.
(b) Calculate $V_a - V_b$.



28-11. In an RC series circuit, $\mathcal{E}$ = 12.0 V, R = 1.40 MΩ, and C = 1.80 μF, (a) Calculate the time constant. (b) Find the maximum charge that will appear on the capacitor during charging. (c) How long does it take for the charge to build up to 16.0 μC?

28-12. A capacitor with an initial potential difference of 100 V is discharged through a resistor when a switch between them is closed at t = 0. At t = 10.0 s, the potential difference across the capacitor is 1.00 V. (a) What is the time constant of the circuit? (b) what is the potential difference across the capacitor at t = 17.0 s?