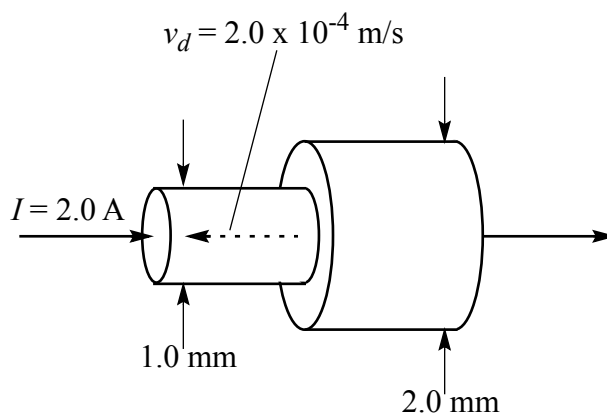


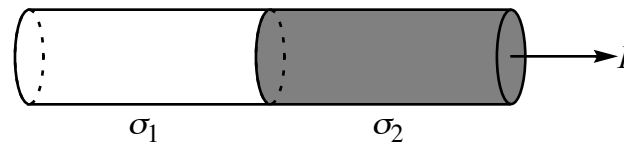
Problem Session

Current and resistance

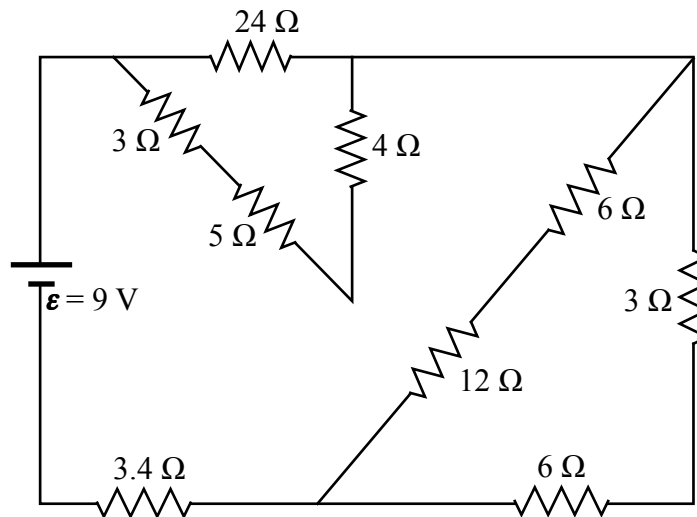
1. The quantity of charge q (in C) passing through a point in a conductor varies with time as $q = 4t^3 + 5t + 6$, where t is in seconds. What is the instantaneous current in the conductor at $t = 2$ s.
2. Suppose that the current through a conductor decreases exponentially with time according to: $I(t) = I_0 e^{-t/\tau}$, where $I_0 = 5$ A is the initial current (at $t = 0$ s) and $\tau = 0.01$ s. Consider a fixed point within the conductor,
 - a) how much charge passes through this point from $t = 0$ s to $t = 0.01$ s?
 - b) from $t = 0.01$ s to $t = \infty$
3. A copper wire with a resistivity of $17 \text{ n}\Omega\text{m}$ at 20°C , is 4 m long and has a diameter of 0.16 mm. A potential difference of 12 V is applied across the ends of the wire and it causes a uniform electric field along its entire length. The temperature of the wire is 45°C .
 - a) What is the resistivity of the wire?
 - b) Determine the total current in the wire.
 - c) What is the electric field strength within the wire?
4. An electric heater operating at full power draws a current of 8 A from a 110 V circuit.
 - a) What is the resistance of the heater?
 - b) Assuming constant R, how much current should the heater draw in order to dissipate 750 W?
5. The two wires in the figure below are made of the same material. What are the current and the electron drift speed in the 2.0 mm-diameter segment of wire? The two segments are considered to be in series.



6. The two segments of wire in the figure below have equal diameters but different conductivities σ_1 and σ_2 . A Current I passes through this wire. If the conductivities have the ratio $\sigma_2/\sigma_1 = 2$, what is the ratio E_2/E_1 of the electric field strengths in the two segments of wire?



7. For the circuit shown below, the internal resistance of the battery is 0.6Ω . Determine:
- the total resistance of the circuit,
 - the terminal voltage of the battery,
 - the energy dissipated in the 12Ω resistor.



8. In the circuit shown below, the current through the 12Ω resistor is 0.24 A .
- Determine the voltage of the source, and
 - the energy dissipated in the 15Ω resistor.

