In the interior of a metal in static equilibrium the charge density ρ is:

A. zero always.
B. never zero.
C. sometimes zero, sometime non-zero, depending on the conditions.

ANNOUNCEMENTS

- Homework 1 graded
  - Use GitHub Desktop to sync for feedback
  - Please come see me ASAP if you need help with GitHub
- Homework 2 posted; due Monday
- Quiz 1 on Friday
  - Last 20 minutes of class
  - No cheat sheets; all formulas will be provided
  - Solve a Gauss' Law Problem with spherical symmetry
  - Sketch a graph of the resulting electric field

Which of the following is a correct statement of charge conservation?

A. $\frac{dQ_{enc}}{dt} = -\int \mathbf{J} \cdot d\mathbf{l}$
B. $\frac{dQ_{enc}}{dt} = -\int \mathbf{J} \cdot d\mathbf{A}$
C. $\frac{dQ_{enc}}{dt} = -\int \nabla \cdot \mathbf{J}\, d\tau$
D. $\frac{dQ_{enc}}{dt} = -\nabla \cdot \mathbf{J}$
E. None of these or *more* than one of these

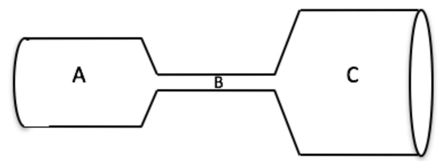
For everyday currents in home electronics and wires, which answer is the order of magnitude of the instantaneous speed of the electrons in the wire?

A. more than km/s
B. m/s
C. mm/s
D. μm/s
E. nm/s

An electric current I flows along a copper wire (low resistivity) into a resistor made of carbon (high resistivity) then back into another copper wire. In which material is the electric field largest?

A. In the copper wire
B. In the carbon resistor
C. It's the same in both copper and carbon
D. It depends on the sizes of the copper and carbon

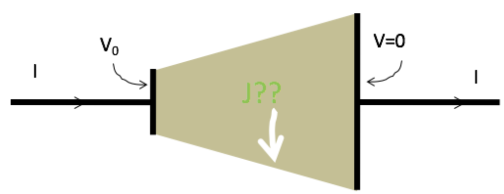
Activity: A copper cylinder is machined to have the following shape. The ends are connected to a battery so that a current flows through the copper.



Rank order (from greatest to smallest, e.g. A=C>B)

Magnitude of E field, Conductivity, Current, & Current Density

Inside this resistor setup, what can you conclude about the current density $\mathbf{J}$ near the side walls (in steady state)?



A. Must be exactly parallel to the wall
B. Must be exactly perpendicular to the wall
C. Could have a mix of parallel and perp components
D. No obvious way to decide!?

Activity: Consider two cylinders (radii a and b with b>a) that are constructed so that the larger one surrounds the smaller one. Between them is a material with conductivity σ. The cylinders are long, but we consider just a length L. A potential difference of V is maintained between them with the inner cylinder at higher potential.

- What is the current I flowing between them in terms of the known variables?
- How does your result relate to Ohm's Law?

Hint: Assume a uniform $+\lambda$ for the inner cylinder and use Gauss' Law to find $\mathbf{E}$.