THE CITADEL
THE MILITARY COLLEGE OF SOUTH CAROLINA

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Spring 2015

ELEC 318 – *Electromagnetic Fields*

Lecture 4(g)

Additional Chapter 4 Examples

THE CITADEL, THE MILITARY COLLEGE OF SOUTH CAROLINA
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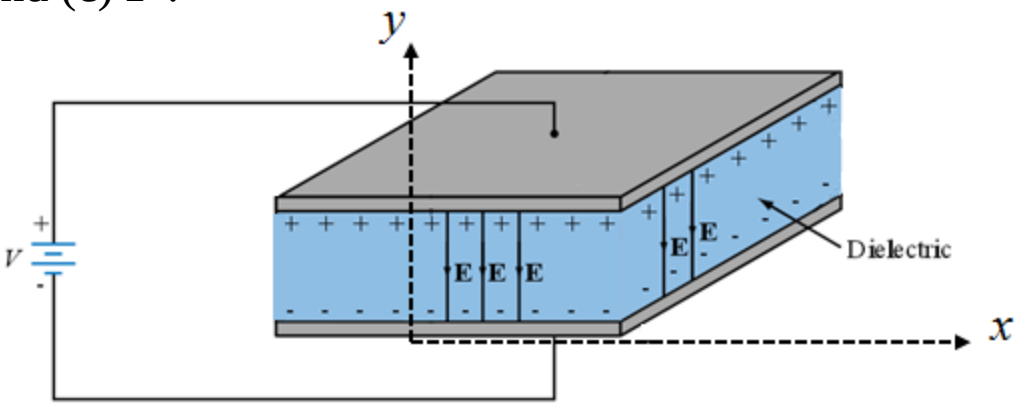
Example: Polarization Field

The voltage difference applied to a parallel-plate capacitor is 6 V.
The distance between the two plates is 2 mm.
The dielectric placed between the plates is polystyrene, $\varepsilon_r = 2.55$.

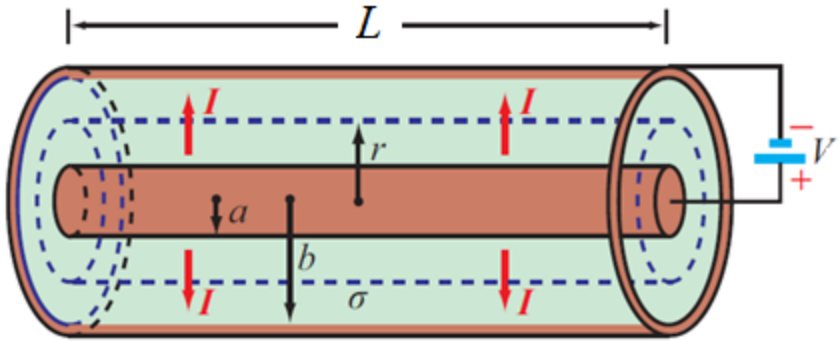
Within the plates, calculate (a) **E** , (b) **D** , and (c) **P** .



Example: Resistance, Coaxial

Determine the total resistance between the inner conductor at radius a and the outer conductor at radius b .

The length of the structure is L and the conductivity of the material between radius a and radius b is σ .



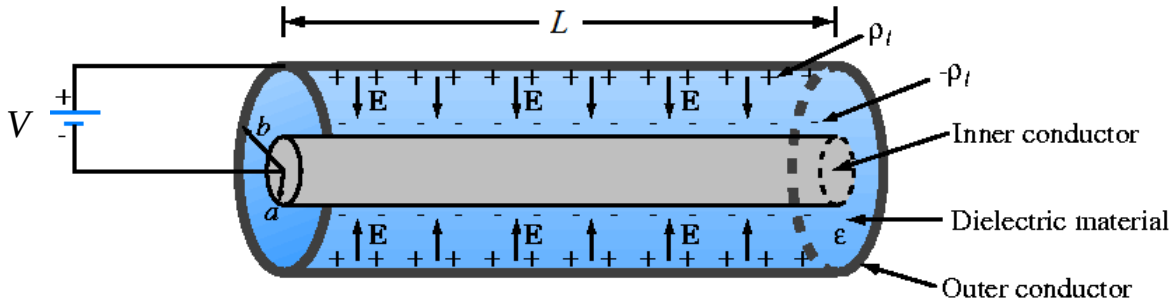
Example: Vector Field, Sketch

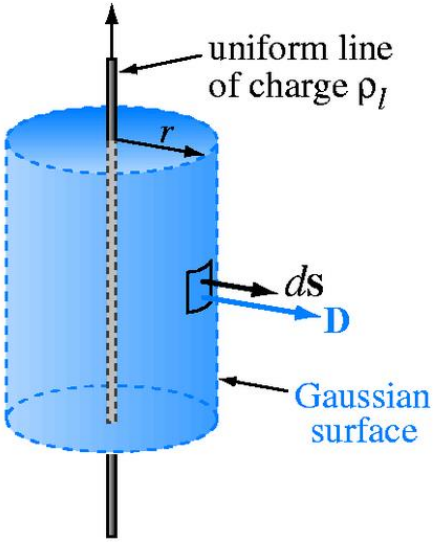
Sketch this vector field:

$$\mathbf{J} = \begin{cases} 0 \ \dfrac{\text{mA}}{\text{mm}^2} & |y| > 2 \\ 100 e^{-|y|} \ \hat{\mathbf{x}} \ \dfrac{\text{mA}}{\text{mm}^2} & |y| \le 2 \end{cases}$$

Example: Capacitance, Coaxial

Determine the capacitance of this coaxial structure (in terms of a, b, L, and ε) .

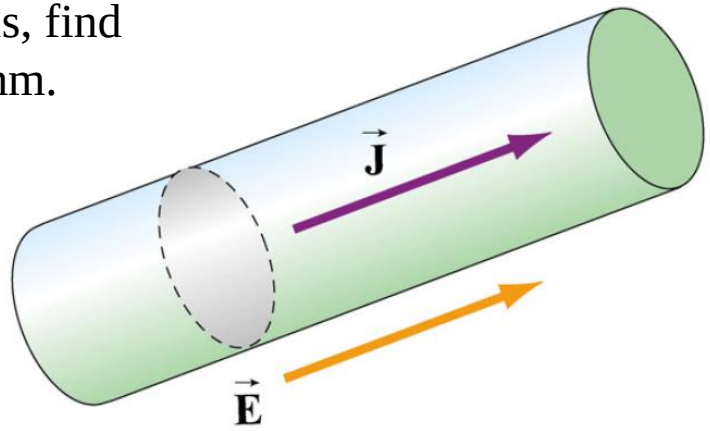




$$\mathbf{E} = -\frac{\rho_l}{2\pi\varepsilon\, r}\,\hat{\mathbf{r}}$$

Example: Current Density

If $\mathbf{J} = \mathbf{z}\, 25/r$ (mA/mm^2) inside a wire centered on the z axis, find the current I flowing through the wire if its radius is 5 mm.



$$I = \int_S \mathbf{J} \cdot d\mathbf{S}$$

Example: Grounded Conductor

The space $x \leq 0$, $y \leq 0$ is occupied by a grounded conductor.
(In other words, Quadrant I is the only quadrant that is not grounded.)

A charge of 100 nC is placed at (3 m, 4 m, 0).

At the point (3 m, 5 m, 0), determine (a) the absolute electric potential and
(b) the electric field intensity.

Assume $\varepsilon = \varepsilon_0$.