Electromagnetism
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4. Electrostatics with Conductors
Chapter Summary

• General statements about $\mathbf{E}(\mathbf{x})$ in the presence of a conductor:

‡ $\mathbf{E}$ is 0 inside the conducting material.

‡ $\mathbf{E}$ is normal at the surface.

‡ The surface charge density is $\sigma = \epsilon_0 E_n$.

‡ The conductor is an equipotential.

• The method of images:

‡ For a planar conducting surface the image of a charge q is $q' = -q$ located at an equal distance on the opposite side of the surface.

‡ For a spherical conducting surface of radius a, the image of a charge q at radius r is $q' = -qa/r$ located at the conjugate point, i.e., at radius $r' = a^2/r$.

• In some simple, azimuthally symmetric problems involving a spherical conducting boundary, the potential in a charge-free region takes the form

$$V(r,\theta) = \frac{A}{r} + \frac{B\cos\theta}{r^2} + C + Dr\cos\theta, \tag{4.23}$$

where A, B, C, and D are appropriate constants. These are determined by the relevant boundary conditions. Then the electric field is $\mathbf{E}(\mathbf{x}) = -\boldsymbol{\nabla} V$.