

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

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

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