Homework

(EXAMPLE 4-5) A point charge Q is at a distance d from the center of a grounded conducting sphere of radius a $(a < d)$. Determine (a) the charge distribution induced on the surface of the sphere, and (b) the total charge induced on the sphere.

(EXAMPLE 4-8) Consider a very long coaxial cable. The inner conductor has a radius a and is maintained at a potential V_0. The outer conductor has an inner radius b and is grounded. Determine the potential distribution in the space between the conductors.

(EXAMPLE 4-10) An uncharged conducting sphere of radius b is placed in an initially uniform electric field $\vec{E}_0 = \hat{a}_z E_0$. Determine (a) the potential distribution $V(R,\theta)$, and (b) the electric field intensity $\vec{E}(R,\theta)$ after the introduction of the sphere.

Homework

P.4-5 Assume a point charge Q above an infinite conducting plane at $y = 0$.

a) Prove that $V(x, y, z)$ in Eq. (4-37) satisfies Laplace's equation if the conducting plane is maintained at zero potential.

b) What should the expression for $V(x, y, z)$ be if the conducting plane has a nonzero potential V_0?

c) What is the electrostatic force of attraction between the charge Q and the conducting plane?

P.4-17 Two dielectric media with dielectric constants ε_1 and ε_2 are separated by a plane boundary at $x = 0$, as shown in Fig. 4-23. A point charge Q exists in medium 1 at distance d from the boundary

a) Verify that the field in medium 1 can be obtained from Q and an image charge $-Q_1$, both acting in medium 1.

b) Verify that the field in medium 2 can be obtained from Q and an image charge $+Q_2$, both acting in medium 2.

c) Determine Q_1 and Q_2. (*Hint* : Consider neighboring points P_1 and P_2 in media 1 and 2, respectively, and require the continuity of the tangential component of the $\vec{E}$-field and of the normal component of the $\vec{D}$-field.)

Homework

P.5-9 Two lossy dielectric media with permittivities and conductivities $(\varepsilon_1, \sigma_1)$ and $(\varepsilon_2, \sigma_2)$ are in contact. An electric field with a magnitude E_1 is incident from medium 1 upon the interface at an angle α_1 measured from the common normal, as in Fig. 5-10.

a) Find the magnitude and direction of E_2 in medium 2.

b) Find the surface charge density at the interface.

c) Compare the results in parts (a) and (b) with the case in whice both media are perfect dielectrics.

P.5-10 The space between two parallel conducting plates each having an area S is filled with an inhomogeneous ohmic medium whose conductivity varies linearly from σ_1 at one plate($y = 0$) to σ_2 at the other plate($y = d$). A d-c voltage V_0 is applied across the plates as in Fig. 5-11. Determine

a) the total resistance between the plates,

b) the surface charge densities on the plates,

c) the volume charge density and the total amount of charge between the plates.

P.5-21 A ground connection is made by burying a hemispherical conductor of radius 25(mm) in the earth with its base up, as shown in Fig. 5-13. Assuming the earth conductivity to be 10^{-6}(S/m), find the resistance of the conductor to far-away points in the ground. (*Hint*: Use the image method in P.5-20.)