Electrodynamics 1, problem set 1

1. Find the net force that the southern hemisphere of a uniformly charged sphere exerts on the northern hemisphere. Express your answer in terms of the radius R_0 and the total charge Q.
2. The electrical potential of some configuration is given by the expression

$$V(\mathbf{R}) = A\frac{\exp\left(-\lambda R\right)}{R},$$

where A and λ are constants. Find the electric field $\mathbf{E}(\mathbf{R})$, the charge density $\rho(R)$, and the total charge Q.

Viðar Guðmundsson, 07.01.2008

Electrodynamics 1, problem set 2

1. A dipole $\mathbf{p}$ is a distance $\mathbf{d}$ from an infinite grounded plane. The angle between $\mathbf{p}$ and $\mathbf{d}$ is $\theta = 60°$.
   (a) Find the energy of the system.
   (b) Find the force on the dipole.
   (c) Find the torque $\vec{\tau}_E = \mathbf{p} \times \mathbf{E}$ on the dipole.
   (d) Describe briefly the motion of the dipole if it is released from rest.
2. A point charge q is a distance $d\ (> a)$ from the center of a grounded conducting sphere of radius a.
   (a) Find the surface charge density on the surface of the sphere.
   (b) Integrate the surface charge to find the total charge induced on the sphere.
   (c) Find the energy of the system in eV if the particle is an electron and $d = 2$ Å, and $a = 1$ Å.

Viðar Guðmundsson, 07.01.2008

Electrodynamics 1, problem set 3

1. Calculate the capacitance of two concentric spherical shells of radii a and b using Laplace's equation. The inner shell is at a potential of V_0, and the outer shell is grounded. What is the surface charge density of the inner shell? Obtain the expression for the capacitance of the system.

2. Two conducting planes of infinite extent in the z-direction are arranged at an angle of 30° and are bounded by grounded cylindrical surfaces at $r = a$ and $r = b > a$, that are isolated from the plates. One plate is grounded and the other one is held at V_0. Find the potential distribution, the electric field, and the displacement field, in the free-space region between the plates, and the capacitance per unit length of the system.

Viðar Guðmundsson, 16.01.2008

Electrodynamics 1, problem set 4

1. A material with conductivity $\sigma = m/r+k$, where m and k are constants, fills the space between two concentric, cylindrical conductors of radii a and b. If V_0 is the potential difference between the two conductors, and L is the length of each of them, find expressions for the resistance of the material, the current density, and the electric field intensity in the material.

2. P.5-23 in David K. Cheng.

Viðar Guðmundsson, 22.01.2008

Electrodynamics 1, problem set 5

1. A coaxial conductor has the length L. The inner conductor of radius a carries a current I in the z direction. The outer conductor is very thin and has the radius b. Calculate the total magnetic flux enclosed within the conductors.
2. P.6-10 in David K. Cheng.

Viðar Guðmundsson, 31.01.2008

Electrodynamics 1, problem set 6

1. A closely wound toroidal with N turns is wound in the form of a ring. The inner and the outer radii of the ring are a and b, respectively. The height of the ring is h. The winding carries a current I.
   (a) Find the magnetic field intensity within the ring.
   (b) Find the magnetic flux density within the ring.
   (c) Find the total magnetic flux enclosed by the ring.
   (d) Calculate the energy stored in the magnetic field.
2. P.6-40 in David K. Cheng.

Viðar Guðmundsson, 31.01.2008

Electrodynamics 1, problem set 7

1. P.7-10 in David K. Cheng.
2. P.7-11 in David K. Cheng.

Viðar Guðmundsson, 12.02.2008

Electrodynamics 1, problem set 8

1. P.7-28 in David K. Cheng.
2. P.8-11 in David K. Cheng.

Viðar Guðmundsson, 20.02.2008

Electrodynamics 1, problem set 9

1. P.8-25 in David K. Cheng.
2. P.8-46 in David K. Cheng.

Viðar Guðmundsson, 20.02.2008