Homework No. 10 (2018 Fall)

PHYS 320: Electricity and Magnetism I

Due date: Friday, 2018 Nov 2, 2:00 PM, in class

1. (**20 points.**) A grounded perfect electric conductor with a planar surface occupies half of space. Two identical positive charges are placed a distance a in front of the conductor such that the distance between the two charges is $2a$. Determine the magnitude and direction of electric field at the point midway between the two charges.

2. (**20 points.**) A thin grounded perfect conductor occupies the $z = 0$ plane. A point charge q_1 is placed on one side of this conductor and another point charge q_2 is placed on the other side. The line connecting the position of the two charges is not necessarily perpendicular to the conducting plane. Let us ignore forces other than electrostatic forces in this analysis.

    (a) Identify and list the forces acting on charge q_1. Qualitatively determine the total force on charge q_1.

    (b) Identify and list the forces acting on charge q_2. Qualitatively determine the total force on charge q_2.

    (c) Identify and list the forces acting on the conductor. Qualitatively determine the total force on the conductor.

    (d) Does the conductor experience a torque?

3. (**20 points.**) Consider two grounded, thin, perfect conductors occupying half planes extending radially outward from the z axis. Let these planes intersect at the z axis making an angle of 120° between them. That is, say, the two planes are $\theta = \pi/3$ and $\theta = -\pi/3$. Place a point charge on the plane $\theta = \pi/6$ as described in Figure 1. Determine the resulting image charge configuration, assuming that the method of images extends to these configurations analogous to optical images in a mirror.
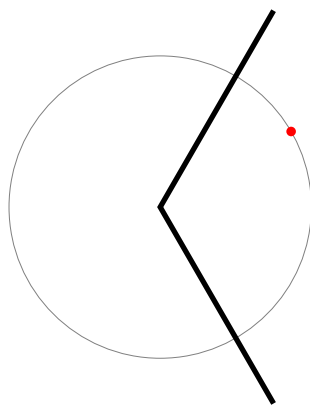
Figure 1: A charge near two intersecting grounded perfect conductors.