

# CLASSICAL ELECTRODYNAMICS I

## Homework Set 3

February 10, 2017

1. Consider a point charge  $q$  placed between two semi-infinite grounded conducting sheets that intersect at an angle  $\theta$ .
  - (a) Carefully draw large diagrams showing the positions and sizes of all image charges for the three cases,  $\theta = 45^\circ$ ,  $60^\circ$ , and  $90^\circ$ . (*Hint: In each case, the number of image charges is an odd integer.*) For a general angle,  $0^\circ < \theta \leq 180^\circ$ , discuss under what conditions the boundary-value problem may be solved with an odd number of image charges. Discuss how this odd number of image charges is related to the angle  $\theta$  and describe, in general, the locations of the image charges.
  - (b) Without drawing a diagram, use your conclusions from part (a) to determine  $\theta$  for the case requiring nine image charges.
  - (c) Without drawing a diagram, use your conclusions from part (a) to determine the number of image charges required if  $\theta = 10^\circ$ .
2. A grounded spherical conductor of radius  $R$  is centered at the origin. Near the sphere is a thin, nonconducting, infinite sheet. The sheet lies in the  $z = a$  plane and a finite amount of charge is distributed over its surface. Prove that the image of the charged sheet is a spherical shell of charge, and determine its radius and location.