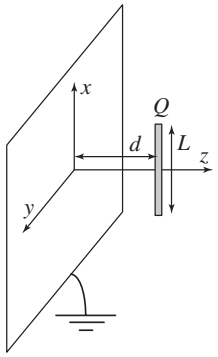
Physics 503 **Homework Set 10** **Fall 2016**

Zangwill 8.3 Rod and Plane The diagram below shows a rod of length L and net charge Q (distributed uniformly over its length) oriented parallel to a grounded infinite conducting plane at the distance d from the plane.



(a) Evaluate a double integral to find the exact force exerted on the rod by the plane.
(b) Simplify your answer in part (a) in the limit $d \gg L$. Give a physical argument for your result.
(c) Find the charge density $\sigma(x, y)$ induced on the conducting plane.
(d) Find the total charge induced on the plane without integrating $\sigma(x, y)$.

Zangwill 8.7 Images in Spheres I A point charge q is placed at a distance $2R$ from the center of an isolated, conducting sphere of radius R. The force on q is observed to be zero at this position. Now move the charge to a distance $3R$ from the center of the sphere. Show that the force on q at its new position is repulsive with magnitude

$$F = \frac{1}{4\pi\epsilon_0}\frac{173}{5184}\frac{q^2}{R^2}.$$

Hint: A spherical equipotential surface remains an equipotential surface if an image point charge is placed at its center.

Zangwill 8.15 The Potential of a Voltage Patch The plane $z = 0$ is grounded except for an finite area S_0 which is held at potential ϕ_0. Show that the electrostatic potential away from the plane is

$$\varphi(x, y, z) = \frac{\varphi_0|z|}{2\pi}\int\limits_{S_0}\frac{d^2r'}{|\mathbf{r} - \mathbf{r}'|}.$$