Phys. 221 – E & M- I – Test 2 – Mar. 19, 2004

1.(25 pts) A metal sphere of radius *R* carries a total charge *Q*. What is the force of repulsion between the "northern" hemisphere and the "southern" hemisphere?

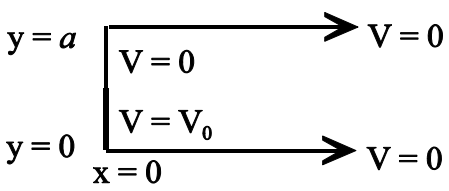
2.(25 pts) A point charge *q* is held a distance *d* above an infinite grounded conducting plane.

a) Identify the physical and nonphysical regions in the system. What is the potential in the physical region?

b) Determine the induced surface charge density on the infinite grounded conducting plane.

c) What is the force on the point charge? What is the energy stored in the system, *i.e.*, the work required to bring *q* in from infinity?

3.(25 pts) Two infinite, grounded, metal plates lie parallel to the *xz* plane, one at $y = 0$, the other at $y = a$. The left end, at $x = 0$, is closed off with two metal strips: One, from $y = 0$ to $y = a/2$, is held at constant potential V_0, and the other, from $y = a/2$ to $y = a$ is also grounded.



Determine the potential within the "slot".

4.(25 pts) The charge density at the surface of a sphere of radius *R* is given by $\sigma(\theta) = \sigma_0 P_2(\cos\theta)$, where σ_0 is a constant and $P_2(\cos\theta) = \frac{1}{2}(3\cos^2\theta - 1)$.

Determine the potential inside and outside the sphere.