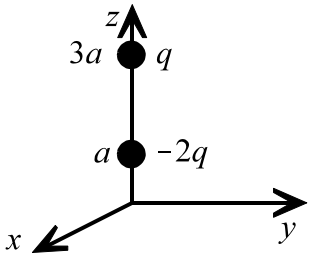
Phys 221 – E&M I – Test 2 – March 11, 2005

1. (25 pts) Find the force on the $-2q$ charge in the figure. The xy plane is a grounded conductor.



2. (25 pts) A spherical shell of radius R has a potential V_0 on the "northern" hemisphere and a zero potential on the "southern" hemisphere. That is:

$$V_0(\theta) = \begin{cases} V_0 = \text{constant} & 0 \le \theta \le \frac{\pi}{2} \\ 0 & \frac{\pi}{2} \le \theta \le \pi \end{cases}$$

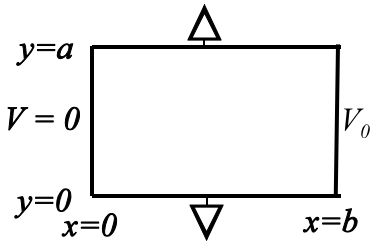
Find the potential inside and outside the sphere. Calculate the coefficients explicitly up to A_2 and B_2.

3. (25 pts) An uncharged (grounded) metal sphere of radius R is placed in a uniform electric field given by $\vec{E} = E_0\hat{z}$.

a) Determine the potential inside and outside the metal sphere.

b) Determine the induced surface charge density $\sigma(\theta)$ on the metal sphere.

4. (25 pts) A rectangular metal pipe, running parallel to the z-axis (from $-\infty$ to $+\infty$), has three grounded metal sides, at $y = 0$, $y = a$, and $x = 0$. The fourth side, at $x = b$, is maintained at a constant potential V_0.
Note that the symbol for ground or $V = 0$ is



a) Determine an expression for the potential in the region enclosed by the pipe.

b) Determine an expression for the charge density $\sigma(x)$ on the bottom plate at $y = 0$.