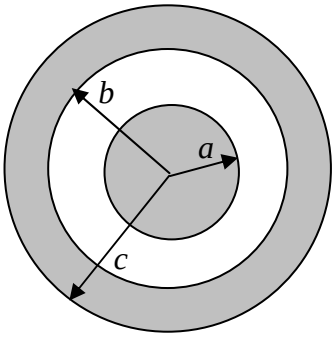
Phys 221 – E & M I – Test 2 -- March 9, 2007

1.(25 pts) A metal sphere of radius *a*, carrying a charge *q*, is surrounded by a thick concentric metal spherical shell of inner radius *b* and outer radius *c*. The thick shell carries no net charge.



a) Find the surface charge density σ at *a*, *b*, and *c*.

b) Determine the electric field as a function of *r*.

c) Determine the electric potential as a function of *r*.

d) If the outer surface at $r = c$ is grounded, how do the results above change?

2.(25 pts) A surface charge density is glued over the surface of a metal sphere of radius *R* such that the electric potential on the surface is given by $V(\theta) = V_0 \sin^2(\theta)$.

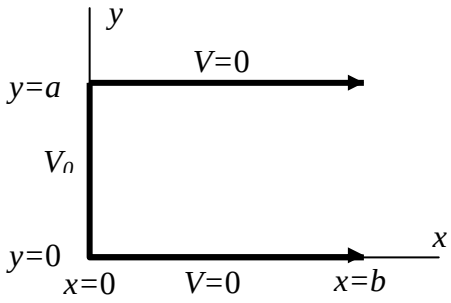
Determine the potential inside and outside the metal sphere.

3.(25 pts) An "infinitely" long neutral (or grounded) metal cylinder of radius *R* is placed at right angles to an otherwise uniform electric field given by $\vec{E} = E_0 \hat{x}$.

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

b) Determine the surface charge density induced on the metal cylinder.

4.(25 pts) An "infinitely" long rectangular metal slot, running parallel to the *z*-axis, has two grounded metal sides at $y = 0$ and $y = a$.. The side at $x = 0$ is maintained at a constant potential V_0.



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

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