PHY505 - Classical Electrodynamics
Hour Exam No. 1
Friday, Oct. 11, 2002

1. (a) Show that the tangential component of a static electric field vanishes just *outside* the surface of a conductor.

   (b) An empty region of space is surrounded by a conductor. Use Gauss's Law and a Green Identity to show that the electric field vanishes everywhere in the interior region.

2. Assume space is filled by a spherically symmetric charge distribution,

$$\rho(\vec{r}) = \frac{Q}{8\pi r_o^3} \exp(-r/r_0)\,.$$

   What is the electrostatic potential produced by this charge distribution normalized to

$$\lim_{r\to\infty} \phi(\vec{r}) = 0.$$

3. Two infinite grounded conducting planes (x-z plane and y-z plane) intersect perpendicularly. A point charge q is placed at $(a, b, 0)$ where a and b are positive.

   (a) Use the method of images to find the potential for the region $x > 0,\ y > 0$.

   (b) Find the force that the conducting planes exert on the point charge when it is placed at the position $(a, a, 0)$.

Some Vector Integral Formulas:

$$\int \nabla \cdot \vec{A}\, dV = \oint \hat{n} \cdot \vec{A}\, dS$$

$$\int \hat{n} \cdot \nabla \times \vec{A}\, dS = \oint \vec{A} \cdot d\vec{l}$$

$$\int \left[\phi \nabla^2 \chi + \nabla\phi \cdot \nabla\chi\right] dV = \oint \phi(\hat{n} \cdot \nabla\chi)\, dS$$