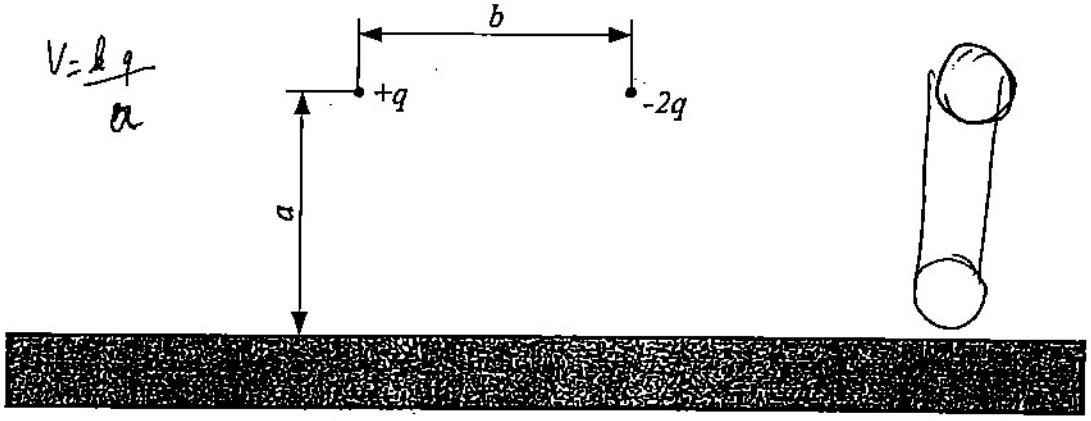
NDU
Faculty of Natural and Applied Sciences
Department of Sciences

PHS 212 - Electricity & Magnetism
Midterm Exam - Fall 2003
Duration: 2 hours

Solve all problems

1. Two charges q and $-2q$ are located above a grounded infinite conducting plane, as shown in the figure. Find the potential V for the space above the plane, and the charge distribution on the surface of the plane.



2. An infinite cylinder of radius R carries a volume charge distribution $\rho=\rho_0(1-\frac{r}{R})$, where ρ_0 is constant.
   a. Find the electric field inside and outside of the cylinder.
   b. Find the potential difference between the axis and the surface of the cylinder.

3. A spherical capacitor is made from a metallic sphere of radius 0.5 cm and a metallic shell of radius 0.53 cm. The charge on the capacitor is 0.2 μC.
   a. Find the potential difference between the plates of the capacitor.
   b. Find the force per unit area f_s exerted on the on the surface of the sphere, and f_c exerted on the shell.

4. In a given region of space, the electric field in spherical coordinates is given by
$$\vec{E}=[2ar\sin 2\theta(1-\frac{cr}{2})+b\cos\phi(1-cr)]e^{-cr}\hat{r}+(\frac{ar}{2}\cos 2\theta)e^{-cr}\hat{\theta}-(\frac{b}{\sin\theta}\sin\phi)e^{-cr}\hat{\phi}$$
   where a, b and c are constants.
   a. Show that this is a valid expression for an electric field
   b. Find an expression for the potential V.
   c. Find the charge density ρ in that region.