Do problems 4.8, 4.9 and 4.15 of Chapter 4 plus the following two problems.

**Problem A.** Consider a grounded perfectly conducting metal object from which an ellipsoidal cavity is hollowed out. The dielectric constant inside the cavity is \( \varepsilon_0 \), and the cavity is filled with a uniform charge density \( \rho = \rho_0 \). If the cavity is located in the region \( (x/a)^2 + (y/b)^2 + (z/b)^2 < 1 \), verify that the electrostatic potential can be expressed in the form

\[ V(x, y, z) = K_1 + K_2 \left[ (x/a)^2 + (y/b)^2 + (z/b)^2 \right], \]

and determine the constants \( K_1 \) and \( K_2 \). What is the surface charge density at the point \((0,0,b)\) on the surface of the conductor?

**Problem B.** A circular line charge of density \( \rho_c = Q/2\pi a \) and radius \( a \) is situated in the plane \( z = a \) in vacuum. The region \( z < 0 \) is occupied by a grounded perfect conductor.

(a) What is the potential at the center of the circle?
(b) What is the force on a point charge of \(-2Q\), situated at the center of the circle?

Diagram for problem A

Diagram for problem B