

Problem 1. Jackson 3.3

3.3 A thin, flat, conducting, circular disc of radius R is located in the x - y plane with its center at the origin, and is maintained at a fixed potential V . With the information that the charge density on a disc at fixed potential is proportional to $(R^2 - \rho^2)^{-1/2}$, where ρ is the distance out from the center of the disc,

(a) show that for $r > R$ the potential is

$$\Phi(r, \theta, \phi) = \frac{2V}{\pi} \frac{R}{r} \sum_{l=0}^{\infty} \frac{(-1)^l}{2l+1} \left(\frac{R}{r}\right)^{2l} P_{2l}(\cos \theta)$$

(b) find the potential for $r < R$.

(c) What is the capacitance of the disc?