

# CLASSICAL ELECTRODYNAMICS I

## Homework Set 2

February 3, 2017

1. Two long, cylindrical nonconductors of radii  $a_1$  and  $a_2$  are parallel with their axes along the  $z$  direction. The cylinder with radius  $a_1$  has charge per unit length  $+\lambda$  and the cylinder with radius  $a_2$  has charge per unit length  $-\lambda$ ; the distance between the centers of the cylinders is  $d$ . Calculate an expression for the capacitance per unit length  $C$  and show that if  $d \gg a_1$  and  $d \gg a_2$ , then

$$C \approx \pi\epsilon_0 \left( \ln \frac{d}{a} \right)^{-1},$$

where  $a = \sqrt{a_1 a_2}$  is the geometrical mean of the two radii.

2. A grounded conducting spherical shell of radius  $R$  is located with its center at the origin. A point charge  $q$  is located inside of the shell at a distance  $a$  from the center of the shell. Use the method of images to find the electrostatic potential everywhere inside the shell. As a special case, give an explicit formula for the potential when  $q$  is located at the center of the shell.