

## Electric Potential / Voltage

**Reading assignment**

Ulaby, 4-5

Connor and Salon, II-10 → II-26

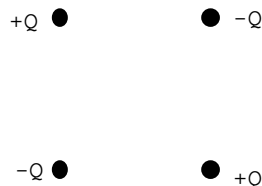
**Problem 1 - Determine V from E**

Take the electric field from Lesson 2.2, Problem 3. Assume that the outer cylinder is grounded.

- Find the voltage as a function of  $r$  for  $r > b$  and  $b > r > a$ .
- Check your result by evaluating  $-\nabla V$ .
- Find the voltage at  $r=0$ .

**Problem 2 - Equipotential lines**

Plot a set of electric field lines and equipotential lines for the quadrupole set of charges below. Dipole equipotentials can be viewed with the Mathcad worksheet for 3.6.2.

**Problem 3 - Find V from charge-Analytic and Approximation**

- Approximate the line charge as a set of 4 point charges. Calculate the voltage from the 4 point charges in the plane  $z = 0$ .
- When  $\rho_l = 10^{-10}$  C/m and  $L = 0.2$  m, numerically evaluate  $V$  at  $r = 0.1$  m and  $r = 0.11$  m.
- Using your results from part b, estimate the electric field at  $r = 0.105$  m.
- Find the exact expression for the electric potential at  $z = 0$  as a function of  $r$  due to a line charge  $\rho_l$  that extends from  $z = -L/2 \rightarrow L/2$ . You'll probably want to use Maple.
- Find the  $E$  on the  $z = 0$  plane. Using the values from part b, obtain an exact expression for the field at  $r = 0.105$ . How does this answer compare with part c?

