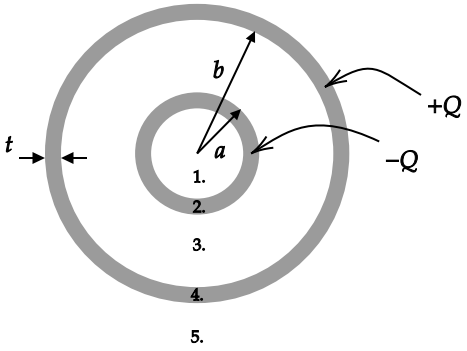
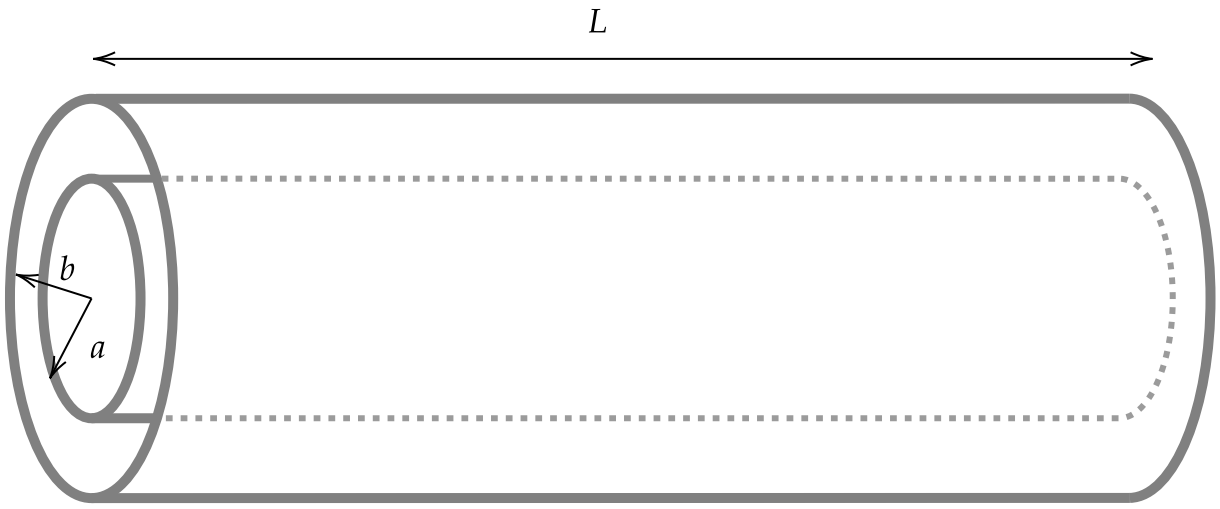
Capacitance Part II

1 Cylindrical

Charge placed on two long cylindrical conducting shells, the cross–section of which is shown. Both shells have a thickness of t. The inner shell has an outer radius of a and a net charge of $-Q$. The outer shell has an inner radius of b and a net charge of $+Q$. Assume that Q is positive and the cylinders have length L.





1. How will the charges distribute on each surface (assume no charge appears on the ends of the cylinders)? That is, what is the total charge on
   - the inner surface of the inner cylinder,
   - the outer surface of the inner cylinder,
   - the inner surface of the outer cylinder, and
   - the outer surface of the outer cylinder.

   Answer:

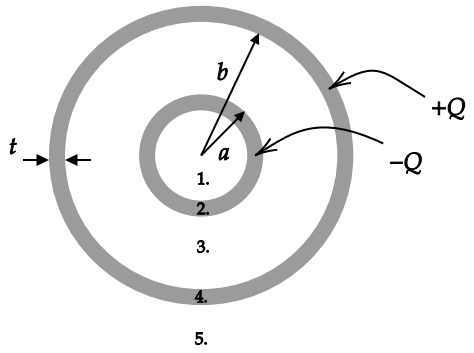


Figure from previous page is repeated above.

2. What is the electric field in each of the five regions? (Hint: Use Gauss's law.)

   Answer:

3. What is the electric potential difference, $V(b) - V(a)$, between the outer an inner cylinder? (Make sure the sign of your result matches your expectation based on the techniques covered in the last activity.)

   Answer:

4. Find the capacitance in terms of ϵ_o, L, a, and b.

   Answer:

5. How much work would the electric field do on a charge q_o moved from $r = a$ to $r = b$? What would be the change in q_o's electric potential energy?

   Answer: