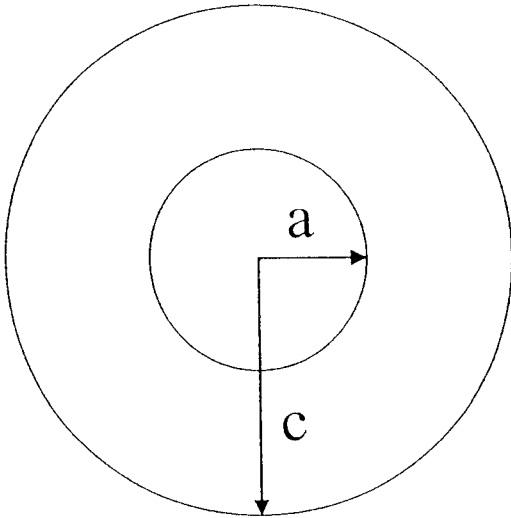


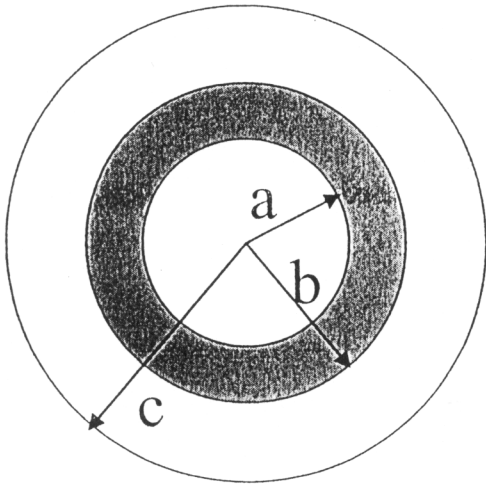
This problem has cylindrical geometry. The  $x$ - $y$  plane is assumed to coincide with the plane of the page, while the  $z$ -axis points out of the page. Consider a system of two conductors, of radius  $a$  and  $c$  as shown in the figure. The conductors are of infinite extent in the  $z$ -direction. The space between them is vacuum. The inner and outer conductors carry opposite charges, such that the inner conductor is at a positive voltage  $V$  with respect to the outer conductor.



- (a) Find the electric field in the region between the two conductors.
- (b) Find the charge/length which resides on the inner conductor, where the charge/length is measured along the  $z$ -axis.

**Information:**

Now a material of dielectric constant  $\kappa$  is wrapped around the inner conductor. The dielectric has radius  $b$ , where  $a < b < c$ . During insertion of the dielectric, the charge on the inner and outer conductors remains the same as in (a) and (b).



(c) Find the electric fields in the regions  $a < r < b$  and  $b < r < c$ , after the dielectric has been put in place.

**Information:** In addition to having a dielectric constant  $\kappa$ , the material in the region  $a < r < b$  becomes conducting at time  $t=0$ , with conductivity  $\sigma$ . Subsequently charge can move off the surface of the inner conductor.

(d) Describe the charge distribution of the system at infinite time, and also sketch the corresponding electric field lines at infinite time.

(e) Regarding the fields you found in part (c) as the initial values, find the electric fields in the regions  $a < r < b$  and  $b < r < c$  as a function of time for  $t > 0$ .