

1. Jackson 3.20 (In (a) calculate the answer from first principles. You don't need to connect your answers to other problems in (b) and (c).)
2. Consider an infinite cylindrical conductor of radius "a" which is sliced at  $z = \pm L/2$ . The segment  $|z| < L/2$  is maintained at a potential  $V$ . The remainder of the cylinder is grounded.
  - (a) Sketch the electric field  $E$  in the region  $\rho = \sqrt{x^2 + y^2} > a$ .
  - (b) Consider the limit in which  $a \gg L$ . Sketch the electric field in the region  $\rho > a$  in this limit. Estimate the magnitude of the electric field at the surface in the region  $|z| \sim 0$  and the force per unit area acting on the conductor in this region. What is the direction of the force? Over what scale length does the potential fall off in the radial and axial directions?
  - (c) Derive an exact expression for the potential  $\Phi$  in the region  $\rho > a$  for arbitrary  $L/a$ . The solution takes the form of an integral.
  - (d) Now take the limiting case where  $a \gg L$ . What is the characteristic scale length remaining in the problem? What physical system does the solution represent? Explicitly evaluate the radial electric field just outside of the cylinder for  $z \sim 0$ . The integration in this case can be completed. Check your previous estimate of  $E$  from part (b).