Homework Assignment #2

Do the following problems:

3-6, 3-7, 3-9
4-1, 4-3, 4-6

and the following problem:

A pure-electron plasma consists of a collection of electrons (density about $10^{12} \text{ m}^{-3}$) surrounded by a cylindrical conducting wall and confined radially by a magnetic field in the $z$ direction. The $z$ confinement is provided by large negative potentials that are applied to sections of the wall near the ends of the cylinder. Even though there is only one sign of charge, and therefore a fairly large equilibrium electric field, this collection of electrons exhibits the collective effects of a plasma.

Consider the equilibrium of a pure electron plasma in the geometry described above. Use the momentum equation and Poisson’s equation to derive the equation that the potential must satisfy in order for the charge distribution to be in equilibrium. The resulting equation that you get can be applied separately along each field line. Make any simplifying assumptions that you need to, but state explicitly what they are. (Axisymmetry is a good assumption, for example.) Hint: Separate the momentum equation into parallel and perpendicular parts and solve them sequentially, perpendicular first.

Note: All problems from the text are worth 5 points. The additional problem is worth 10 points.