## 12.2.2 Exercises on Electrostatics

Ex 12.47: A rod of uniform line charge density  $\lambda$  lies along the x-axis from x = -L to x = 0. What is its electrostatic force on a charge q at  $x = x_0$  for  $x_0 > 0$ ?

Ex 12.48: An infinite cylindrical shell of inner radius  $R_1$  and outer radius  $R_2$  carries a uniform volume charge density  $\rho = c$ . Find  $V(\mathbf{r})$  and  $E(\mathbf{r})$  in space.

**HW:** (2-4) An infinite conducting cylindrical shell shares its axis with an infinite straight conducting wire. The wire has the uniform line charge density  $\lambda_1$  and the line charge density on the cylindrical shell is  $\lambda_2$ . Let the inner and outer radii of the cylindrical shell be  $R_1$  and  $R_2$ , respectively. Find V and E in space.

**Ex 12.49:** What is the charge distribution and electric potential for the electric field  $\mathbf{E} = \hat{\mathbf{r}} \frac{ar}{r^2 + c^2}$  for constants a and c?

**HW:** (2-5) For the given electric potential  $V(\mathbf{r}) = \frac{1}{\epsilon_0} \frac{Q}{r+c^2}$  (for constants Q and c), what is the charge density  $\rho(\mathbf{r})$  in space?

Ex 12.50: What is the potential energy for the charge distribution  $\rho(\mathbf{r}) = e^{-ar}$ ?

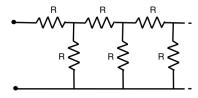
Ex 12.51: The gap between two concentric spherical shells of radii  $R_1$  and  $R_2$  ( $R_2 > R_1$ ) (with negligible thickness) is filled with a dielectric of dielectric constant  $\epsilon$ . (i) What is the capacity of the shells as a capacitor? (ii) When the total charge on the outer (inner) shell is Q(-Q), what is the pressure on the outer and inner surfaces of the dielectric shell?

Ex 12.52: (Benson, Chap. 27, Prob. 3)

Use a material of resistivity  $\rho$  to make a cylinder of length L with inner and outer radii a and b. If the current flows evenly from the inner surface to the outer surface, show that its resistance is

$$R = \frac{\rho}{2\pi L} \log\left(\frac{b}{a}\right). \tag{12.50}$$

Ex 12.53: What is the effective resistance of the circuit (see below) with infinitely many resistors indefinitely extended to the right?



**Ex 12.54:** In the figure of HW (2-3), add a battery of voltage  $V_0$  under  $C_2$  in series. What should be  $V_1(t)$  for t < 0? What is V(t) for t > 0?

Instead of using eq.(12.32), one can also use eq.(12.21) and differentiate.