12.2.2 Exercises on Electrostatics

Ex 12.47: A rod of uniform line charge density λ 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 λ_1 and the line charge density on the cylindrical shell is λ_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?

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

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?

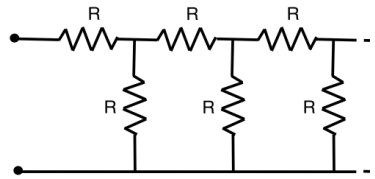
Ex 12.50: What is the potential energy for the charge distribution $\rho(\mathbf{r}) = e^{-ar}$?

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 ϵ. (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 ρ 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 $t > 0$?