Problem 23.68

A disk with radius R has uniform surface charge density σ.

Part A

By regarding the disk as a series of thin concentric rings, calculate the electric potential V at a point on the disk's axis a distance x from the center of the disk. Assume that the potential is zero at infinity. (*Hint:* Use the result that potential at a point on the ring axis at a distance x from the center of the ring is $V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{\sqrt{x^2+a^2}}$ where Q is the charge of the ring and *a* is the radius of the ring.)

Part B

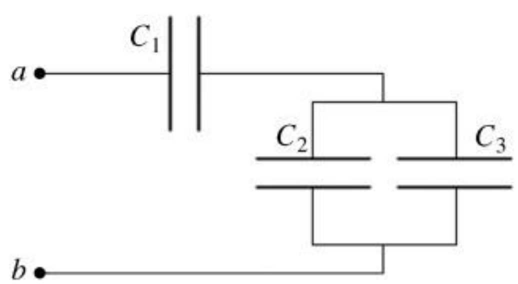
Calculate $-\partial V/\partial x$.

Problem 23.20.

A positive charge +q is located at the point x = 0, y = -a, and a negative charge –q is located at the point x = 0, y = +a. (a) Derive an expression for the potential V at points on the y-axis as a function of the coordinate y. Take V to be zero at an infinite distance from the charges. (b) Graph V at points on the y-axis as a function of y over the range from y = -4a to y = +4a. (c) Show that for y > a, the potential at a point on the positive y-axis is given by $V = -\left(\frac{1}{4\pi\epsilon_0}\right)\frac{2qa}{y^2}$.

Problem 24.12

Three capacitors, with capacitances C_1 = 2.2 μF, C_2 = 2.9 μF, and C_3 = 4.6 μF, are connected to a 18 V voltage source, as shown in the figure. What is the charge on capacitor C_2 ?



Problem 24.17

The network shown in the figure is assembled with uncharged capacitors *X*, *Y*, and *Z*, with C_X = 3 μF, C_Y = 6 μF, and C_Z = 7 μF and open switches, S_1 and S_2. A potential difference V_{ab} = +120 V is applied between points *a* and *b*. After the network is assembled, switch S_1 is closed for a long time, but switch S_2 is kept open. Then switch S_1 is opened and switch S_2 is closed. What is the final voltage across capacitor *X*?