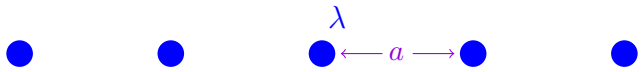
# Shielding with Wire Mesh

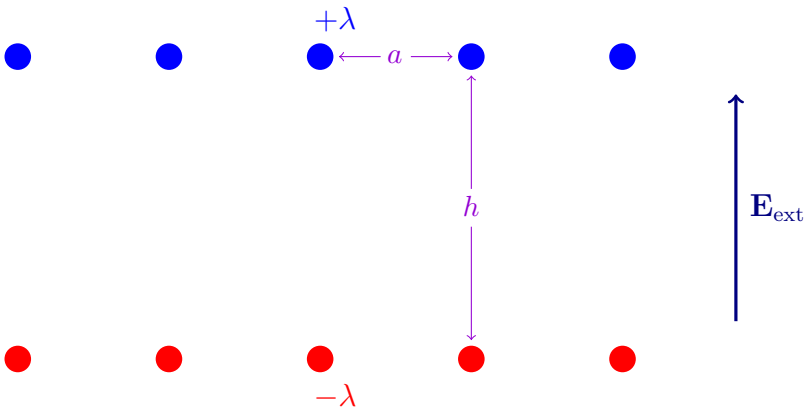
Consider an infinite array of parallel line charges, each with charge per unit length $\lambda$, separated by a distance $a$. For convenience, assume the charges run parallel to the $z$-axis and are located at $x = \ldots, -a,\ 0,\ a, \ldots$.




(a) Show that the potential $\varphi(x, y)$ is exactly given by

$$\varphi(x,y) = -\frac{\lambda}{4\pi} \log\left[2\cosh\frac{2\pi y}{a} - 2\cos\frac{2\pi x}{a}\right].$$

(b) Suppose that two such arrays of charge, of equal and opposite charge are separated by a vertical distance $h$.




There is also a uniform electric field

$$\mathbf{E}_{\text{ext}} = \frac{\lambda}{a}\hat{\mathbf{y}}.$$

Show that for $0 < y < h/2$ the potential is approximately given by

$$\varphi \approx -\frac{\lambda}{4\pi} \mathrm{e}^{-4\pi(h/2-y)/a}$$

as long as $h/2 - y \gtrsim a$ and $h \gg a$.

This result explains why it is not necessary to use a sheet of metal to shield electronics from external electric fields, which can damage them: as long as a reasonably tight wire mesh is placed around it, the fields inside will be negligible.