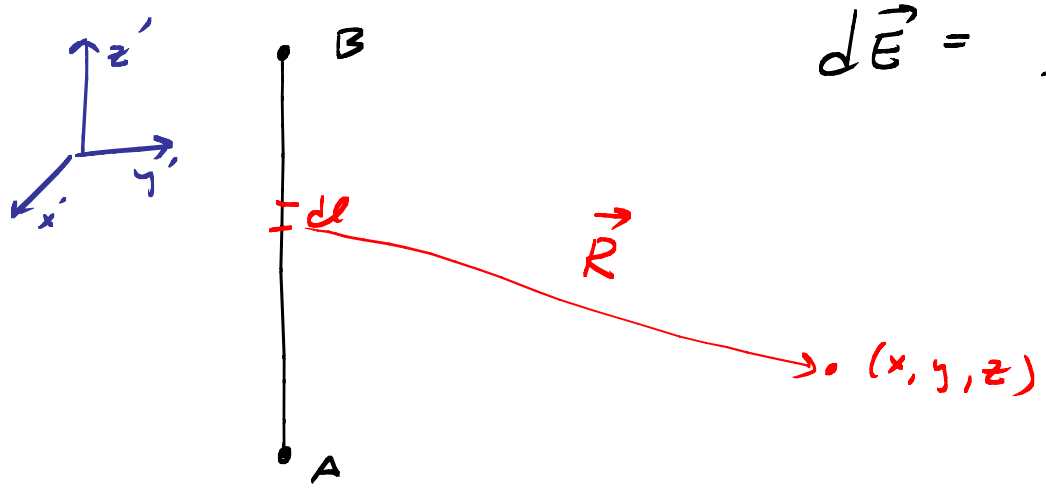
E-Field due to a line charge (ρ_L)



$$d\vec{E} = \frac{\rho_L \, dl}{4\pi\varepsilon} \frac{\vec{R}}{R^3}$$

$$dl = dz'$$

$$\vec{R} = (x - x')\vec{a_x} + (y - y')\vec{a_y} + (z - z')\vec{a_z}$$

$$\vec{R} = x\vec{a_x} + y\vec{a_y} + (z - z')\vec{a_z}$$

$$R = [x^2 + y^2 + (z - z')^2]^{1/2}$$

$$R^3 = [x^2 + y^2 + (z - z')^2]^{3/2}$$

$$d\vec{E} = \frac{\rho_L \, dl}{4\pi\varepsilon} \frac{\vec{R}}{R^3}$$

$$d\vec{E} = \frac{\rho_L \, dz'}{4\pi\varepsilon} \frac{[x\vec{a_x} + y\vec{a_y} + (z - z')\vec{a_z}]}{[x^2 + y^2 + (z - z')^2]^{3/2}}$$

$$\vec{E} = \int_A^B \frac{\rho_L}{4\pi\varepsilon} \frac{(x\vec{a_x} + y\vec{a_y} + (z - z')\vec{a_z}) \, dz'}{[x^2 + y^2 + (z - z')^2]^{3/2}}$$