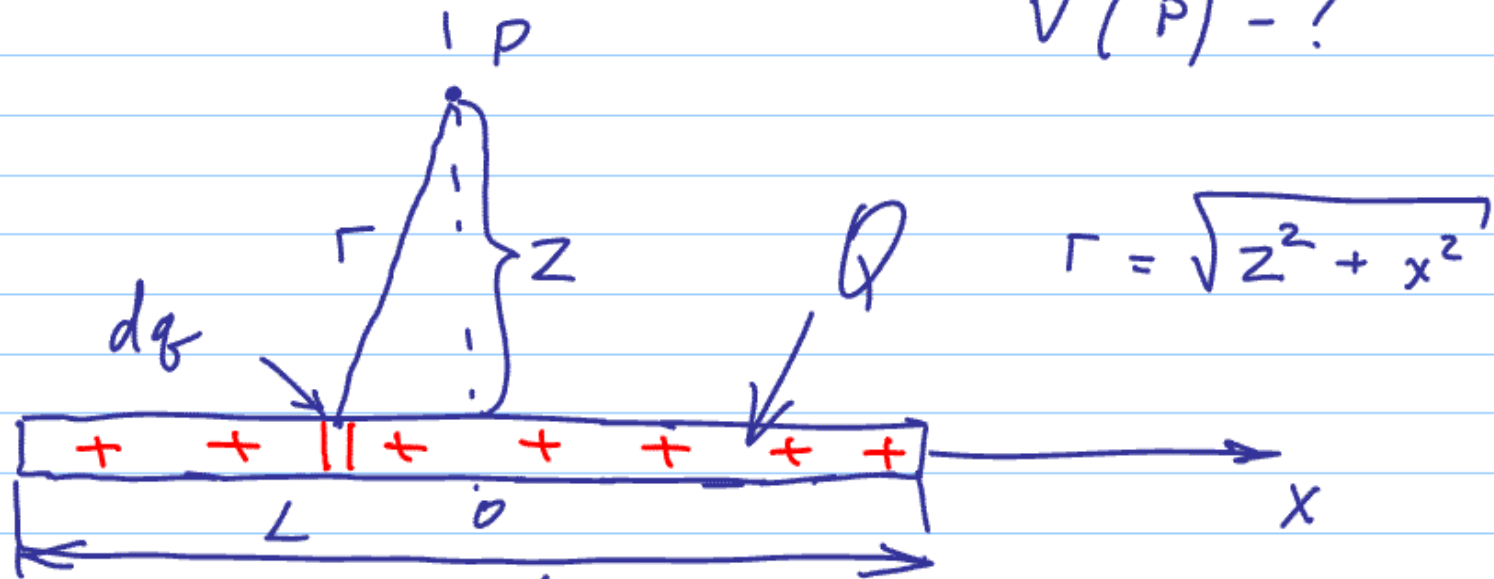


Review for Quiz 4: Problem 70, Chapter 29

$V(P) = ?$



$$r = \sqrt{z^2 + x^2}$$

$$dV = \frac{1}{4\pi\epsilon_0} \frac{dq}{r}$$

$$V = \int_{-\frac{L}{2}}^{\frac{L}{2}} dV = \int_{-\frac{L}{2}}^{\frac{L}{2}} \frac{1}{4\pi\epsilon_0} \frac{dq}{r} =$$

$$dq = \lambda \cdot dx = \frac{Q}{L} dx$$

$$r = \sqrt{z^2 + x^2}$$

$$= \int_{-\frac{L}{2}}^{\frac{L}{2}} \frac{1}{4\pi\epsilon_0} \frac{Q \cdot dx}{L \cdot \sqrt{z^2 + x^2}} = \frac{Q}{4\pi\epsilon_0 \cdot L} \int_{-\frac{L}{2}}^{\frac{L}{2}} \frac{dx}{\sqrt{z^2 + x^2}}$$

$$\int \frac{dx}{\sqrt{x^2 + a^2}} = \ln(x + \sqrt{x^2 + a^2}) - \text{Table 5}$$

$$= \frac{Q}{4\pi\epsilon_0 \cdot L} \ln(x + \sqrt{x^2 + z^2}) \Big|_{-\frac{L}{2}}^{\frac{L}{2}} =$$

$$\frac{Q}{4\pi\epsilon_0 \cdot L} \left[\ln \left(\frac{L}{2} + \sqrt{\left(\frac{L}{2}\right)^2 + z^2} \right) - \ln \left(-\frac{L}{2} + \sqrt{\left(\frac{L}{2}\right)^2 + z^2} \right) \right]$$

$$= \frac{Q}{4\pi\epsilon_0 \cdot L} \ln \left(\frac{\frac{L}{2} + \sqrt{\left(\frac{L}{2}\right)^2 + z^2}}{-\frac{L}{2} + \sqrt{\left(\frac{L}{2}\right)^2 + z^2}} \right)$$