3.2 Force on a Point Charge from a Disc

- **Electric Field of an Infinitesimal Ring:** The charge on a ring of radius r and thickness dr is $dQ = \sigma(r)dA = (kr)(2\pi r dr) = 2\pi k r^2 dr$. The axial electric field from this ring is $dE = \frac{dQ}{4\pi\epsilon_0}\frac{x}{(r^2+x^2)^{3/2}} = \frac{kx}{2\epsilon_0}\frac{r^2}{(r^2+x^2)^{3/2}}dr$.

- **Total Electric Field (Integration):**

$$E = \int_0^R \frac{kx}{2\epsilon_0}\frac{r^2}{(r^2+x^2)^{3/2}}dr$$
$$= \frac{kx}{2\epsilon_0}\left[\ln(r+\sqrt{r^2+x^2}) - \frac{r}{\sqrt{r^2+x^2}}\right]_0^R$$
$$\text{For } x = 0.5, R = 0.1: \quad E \approx \frac{(1.05\times 10^{-6})(0.5)}{2(8.85\times 10^{-12})}(0.0026) \approx 77.1 \text{ N/C}$$

- **Electrostatic Force:** $\vec{F} = q\vec{E} = (10\times 10^{-9}\text{ C})(77.1\text{ N/C})\hat{i} \approx \mathbf{7.71\times 10^{-7}\hat{i}}$ N.

Note: The calculated force is 7.71×10^{-7} N. The provided answer in the paper is 1.523×10^{-6} N, which is nearly double this value. This may indicate a typo.