$$\cancel{\phi_E = \iint \vec{E}\cdot d\vec{s}}$$

$$I = \int \underbrace{\frac{dx}{(x^2+a^2)\sqrt{x^2+b^2}}}_{dF}$$

$$\frac{x}{b} = tg\theta \rightarrow dx = b(tg^2\theta+1)\,d\theta$$

$$dF = \frac{\cancel{b}(tg^2\theta+1)\,d\theta}{(\cancel{b}^2 tg^2\theta + a^2)\sqrt{tg^2\theta+1}} = \frac{\sqrt{tg^2\theta+1}}{b^2 tg^2\theta + a^2}$$

$$= \frac{\sqrt{\frac{1}{\cos^2\theta}}\,d\theta}{b^2\frac{\sin^2\theta}{\cos^2\theta}+a^2} = \frac{\cos\theta\,d\theta}{b^2\sin^2\theta + a^2\underbrace{\cos^2\theta}_{1-\sin^2\theta}}$$

$$= \frac{\cos\theta\,d\theta}{(b^2-a^2)\sin^2\theta + a^2}$$

$$d\theta = \frac{du}{\cos\theta}$$

par $u = \sin\theta$, $du = \cos\theta\,d\theta$,

$$dF = \frac{du}{(b^2-a^2)u^2+a^2}$$

$$du = \sqrt{\frac{a^2}{b^2-a^2}}\,dv$$

kake $v = \sqrt{\frac{b^2-a^2}{a^2}}\,u$

$$dF = \frac{\sqrt{\frac{a^2}{b^2-a^2}}\,dv}{a^2(v^2+1)} = \frac{1}{a\sqrt{b^2-a^2}}\cdot\frac{1}{v^2+1}$$

its primitive is Arctg v

$$I = \int dF = \frac{1}{a\sqrt{b^2-a^2}}\,\mathrm{Arctg}\,v$$

$$= \frac{1}{a\sqrt{b^2-a^2}}\,\mathrm{Arctg}\left(\sqrt{\frac{b^2-a^2}{a^2}}\,u\right) = \frac{1}{a\sqrt{b^2-a^2}}\,\mathrm{Arctg}\left(\sqrt{\frac{b^2-a^2}{a^2}}\sin\theta\right)$$

$$x = b\,\mathrm{tg}\theta = b\,\frac{\sin\theta}{\sqrt{1-\sin^2\theta}}$$

$$x^2 = \frac{b^2\sin^2\theta}{1-\sin^2\theta} \longrightarrow \sin^2\theta = \frac{x^2}{b^2+x^2}$$

$$\sin\theta = \sqrt{\frac{x^2}{b^2+x^2}} = \frac{x}{\sqrt{x^2+b^2}}$$

$$\boxed{I = \frac{1}{a\sqrt{b^2-a^2}}\,\mathrm{Arctg}\left(\sqrt{\frac{b^2-a^2}{a^2}}\cdot\frac{x}{\sqrt{x^2+b^2}}\right)}\Bigg|_{-l}^{l}$$

$$b = \sqrt{2}\,l\ ,\quad a = l$$

$$= \frac{1}{l\sqrt{2l^2-l^2}}\left[\mathrm{Arctg}\left(\underbrace{\cancel{\sqrt{\frac{2l^2-l^2}{l^2}}}}_{1}\cdot\frac{x}{\sqrt{x^2+b^2}}\right)\right]_{-l}^{l}$$

$$= \frac{1}{l^2}\cdot\left[\mathrm{Arctg}\left(\frac{l}{\sqrt{3l^2}}\right) - \mathrm{Arctg}\left(\frac{-l}{\sqrt{3l^2}}\right)\right]$$

$$= \frac{1}{l^2}\left[\underbrace{\mathrm{Arctg}\left(\frac{1}{\sqrt{3}}\right)}_{=\frac{\pi}{6}} - \underbrace{\mathrm{Arctg}\left(-\frac{1}{\sqrt{3}}\right)}_{=-\frac{\pi}{6}}\right]$$

$$= \frac{1}{l^2}\cdot\frac{\pi}{3}$$

$$\Phi = \frac{Q\cdot l^2}{2\pi\varepsilon_0}\cdot\frac{1}{l^2}\cdot\frac{\pi}{3} = \frac{Q}{6\varepsilon_0}$$