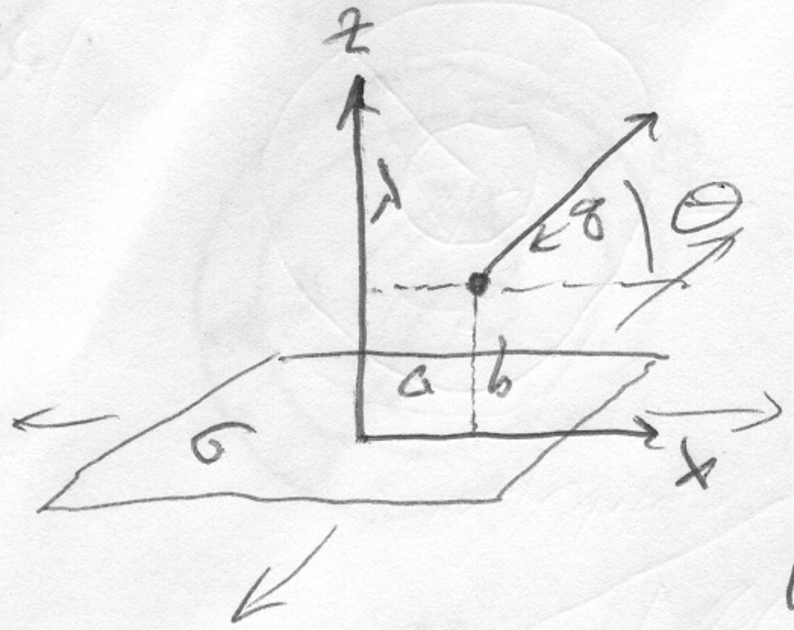

$$\vec{E}_{sheet} = \frac{\sigma}{2\varepsilon_0}\hat{z}$$

$$\vec{E}_{w.c.} = \frac{\lambda}{2\pi\varepsilon_0 a}\hat{x}$$

$$\vec{F} = q\left[\frac{\lambda}{2\pi\varepsilon_0 a}\hat{x} + \frac{\sigma}{2\varepsilon_0}\hat{z}\right]$$

$$|\vec{F}| = \frac{q}{2\varepsilon_0}\left[\left(\frac{\lambda}{\pi a}\right)^2 + \sigma^2\right]^{1/2}$$

θ (in x-z plane)

$$\theta = \tan^{-1}\left(\frac{\sigma}{\lambda/\pi a}\right) = \tan^{-1}\left(\frac{\pi a \sigma}{\lambda}\right)$$

7. Results of 3.

$$E_{in} = \frac{3Q}{\pi a^3 \varepsilon_0}\left[\frac{1}{3}r - \frac{1}{4a}r^2\right]$$

$$E_{out} = \frac{Q}{4\pi\varepsilon_0 r}$$

$r > a$ $\quad \Phi_{out} = \dfrac{Q}{4\pi\varepsilon_0 r} = \dfrac{Aa^3}{12\varepsilon_0}\dfrac{1}{r}$

$r < a$ $\quad \Delta\phi = -\int \vec{E}\cdot d\vec{r} \qquad d\vec{r} = dr\,\hat{r}$

$$\Delta\phi = -\int_a^r \frac{3Q}{\pi a^3\varepsilon_0}\left[\frac{1}{3}r - \frac{1}{4a}r^2\right]dr$$

$$= -\frac{3Q}{\pi a^3\varepsilon_0}\left[\frac{1}{6}r^2 - \frac{1}{12a}r^3\right]\Big|_a^r$$

$$= -\frac{3Q}{\pi a^3\varepsilon_0}\left[\frac{1}{6}r^2 - \frac{1}{6}a^2 - \frac{1}{12a}r^3 + \frac{1}{12}a^2\right]$$

$$= -\frac{3Q}{\pi a^3\varepsilon_0}\left[\frac{1}{6}\left(r^2 - \frac{r^3}{2a}\right) - \frac{1}{12}a^2\right]$$

$$\phi_{in} = \Delta\phi + \Phi_{out}\ (\text{at } r=a)$$

$$= \frac{Q}{4\pi\varepsilon_0 a} - \frac{3Q}{\pi a^3\varepsilon_0}\left[\frac{1}{6}\left(r^2 - \frac{r^3}{2a}\right) - \frac{1}{12}a^2\right]$$

in terms of A

$$\phi_{in} = \frac{\pi a^2 A}{12\pi\varepsilon_0} - \frac{A}{\varepsilon_0}\left[\frac{1}{6}\left(r^2 - \frac{r^3}{2a}\right) - \frac{1}{12}a^3\right]$$