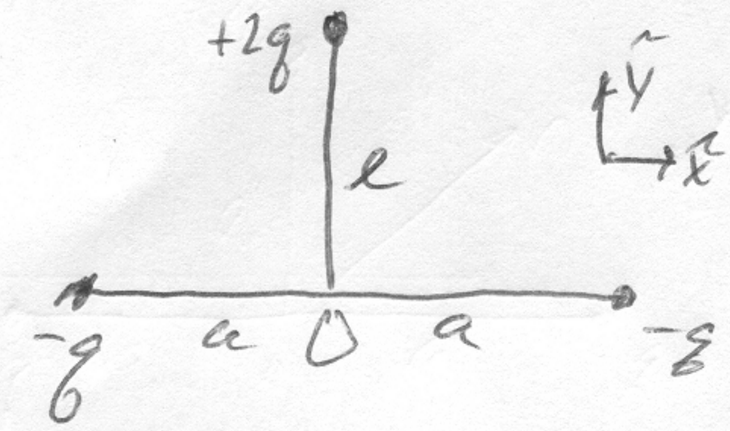
Physics 3305 HW#7 Solutions

1. 8-4



$Q_{tot} = 2q - q - q = 0$

$\vec{p} = \sum_i q_i \vec{r}_i = 2q\ell\hat{y} - qa\hat{x} + qa\hat{x}$

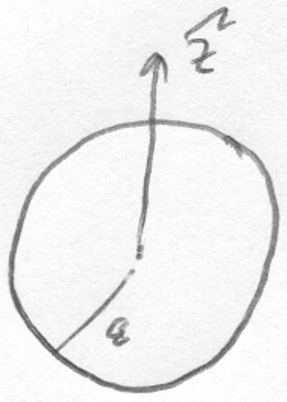
$\vec{p} = 2q\ell\hat{y} = 2q\ell\hat{y}$ legible

$\phi(\vec{r}) \simeq \frac{1}{4\pi\epsilon_0}\frac{\vec{p}\cdot\hat{r}}{r^2} = \frac{\vec{p}}{4\pi\epsilon_0}\cdot\frac{\vec{r}}{r^3} = \frac{2q\ell\hat{y}}{4\pi\epsilon_0}\cdot\frac{x\hat{x}+y\hat{y}+z\hat{z}}{(x^2+y^2+z^2)^{3/2}}$

$\phi(\vec{r}) \simeq \frac{2q\ell y}{4\pi\epsilon_0(x^2+y^2+z^2)^{3/2}}$

oops

~~2.~~ 3. 8-8



$\sigma = \sigma_0\cos\theta$

$Q = \int_S \sigma\, da = \sigma_0 \int_0^{2\pi}\int_0^{\pi} \cos\theta\, a^2 \sin\theta\, d\theta\, d\varphi$

$= 2\pi\sigma_0 \int_0^{\pi} \sin\theta\cos\theta\, d\theta = 2\pi\sigma_0 \tfrac{1}{2}\sin^2\theta\Big|_0^{\pi}$

$Q = 0$

$\vec{p} = \int_S \sigma\vec{r}\, da = \sigma_0 \int_0^{2\pi}\int_0^{\pi} a\hat{r}\cos\theta\sin\theta\, a^2\, d\theta\, d\varphi$

$= \sigma_0 a^3 \left\{ \int_0^{2\pi}\int_0^{\pi} \sin^2\theta\cos\varphi\cos\theta\, d\theta\, d\varphi\, \hat{x} + \int_0^{2\pi}\int_0^{\pi} \sin^2\theta\cos\theta\sin\varphi\, d\theta\, d\varphi\, \hat{y} \right.$

$\left. + \int_0^{2\pi}\int_0^{\pi} \cos^2\theta\sin\theta\, d\theta\, d\varphi\, \hat{z} \right\}$

$\hat{x}, \hat{y} = 0$ from φ integrals

$\vec{p} = 2\pi\sigma_0 a^3 \int_0^{\pi} \cos^2\theta\sin\theta\, d\theta\, d\varphi\, \hat{z} = -2\pi\sigma_0 a^3 \tfrac{1}{3}\cos^3\theta\Big|_0^{\pi}\hat{z}$ ($= -\frac{2}{3}$)

$= \frac{4\pi}{3}\sigma_0 a^3 \hat{z}$

$\phi(\vec{r}) = \frac{\frac{4\pi}{3}\sigma_0 a^3}{4\pi\epsilon_0}\frac{\hat{z}\cdot\hat{r}}{r^2} = \frac{\sigma_0 a^3}{3\epsilon_0}\frac{\cos\theta}{r^2}$