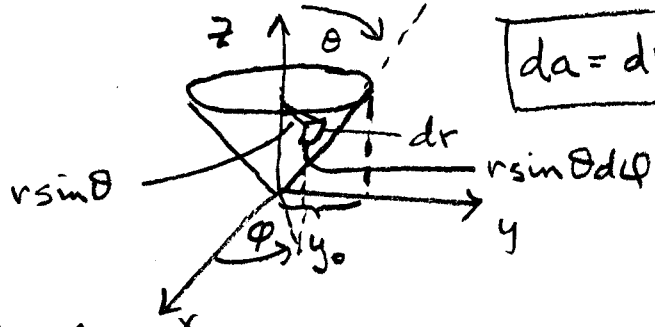
PHGN361 2009 Exam 1: NAME KEY

1. For charge configuration shown derive an integral expression for the electric field at an arbitrary point.

$$\vec{E}(x,y,z) = \int k \frac{dq}{r^3} \vec{\pi}$$



$$da = dr\, r\sin\theta\, d\varphi$$

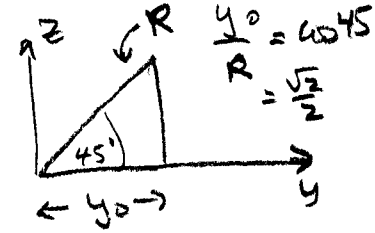
$$dq = \sigma\, da$$

$$\vec{\pi} = \vec{r} - \vec{r}' \begin{cases} \vec{r} = x\hat{x} + y\hat{y} + z\hat{z} \\ \vec{r}' = r\sin\theta\cos\varphi\,\hat{x} + r\sin\theta\sin\varphi\,\hat{y} + r\cos\theta\,\hat{z} \end{cases}$$

$$|\vec{\pi}| = \left[(x - r\sin\theta\cos\varphi)^2 + (y - r\sin\theta\sin\varphi)^2 + (z - r\cos\theta)^2 \right]^{1/2}$$

limits on φ integral are 0 to 2π

limits on r integral are 0 to $R = \sqrt{2}\,y_0$



2. How would you find the energy stored in a sphere of radius R and charge density $\rho = kr$?

See video on problem 2.45