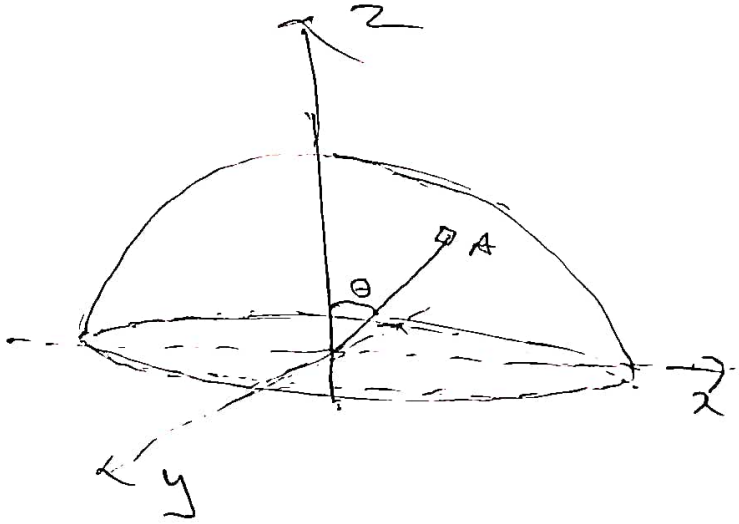
Priyansh

Physics presentation

Que:- Find the electric field of hemisphere of radius R. centre at origing & rim on x-y plane charge at surface with $\sigma(\theta) = \sigma_0 \cos\theta$, θ is the angle made by radius with Z-axis.

Solution:



Here charge density vary with 'θ' angle,

$$E(r) = \frac{Kq\,(\bar{r}-\bar{r}')}{(|r-r'|)^3}$$

So we need q at A point to find E.F by this small charge,

$$\sigma = \frac{Q}{A}$$

$$\sigma = \frac{dQ}{dA}$$

area of rectangle $= dA$

$$dA = R\,d\theta \times R\sin\theta\, d\phi$$

$$dQ = \sigma_0 \cos\theta\, R^2 \sin\theta\, d\theta\, d\phi$$

$$\bar{r} = 0$$

$$\bar{r}' = R\sin\theta\cos\phi\,\hat{i} + R\sin\theta\sin\phi\,\hat{j} + R\cos\theta\,\hat{k}$$

$$dE_x = \int_{\theta=0}^{\pi/2} \int_{\phi=0}^{2\pi} K \sigma_0 R^2 \sin^2\theta \, d\theta \cos\phi \, d\phi$$

$$dE_x = \int_{0}^{\pi/2} \sin^2\theta \cos\theta \, d\theta \int_{0}^{2\pi} \cos\phi \, d\phi$$

$$E_x = 0$$

Similary after calculation

$$E_y = 0$$

$$\boxed{E_z = -\frac{\sigma_0}{\delta \varepsilon_0} \hat{k}}$$

it shows dir