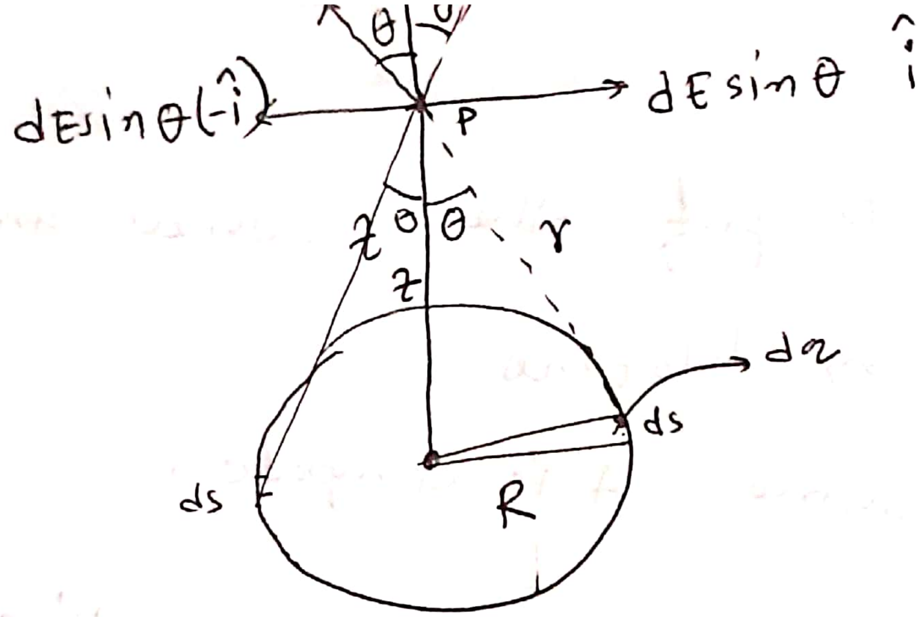
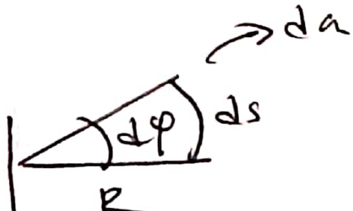
(a)





$$\lambda = \frac{dq}{ds} = \frac{dq}{R\,d\varphi}$$

$$\Rightarrow dq = \lambda R\,d\varphi.$$

$$dE = \frac{1}{4\pi\epsilon_0}\frac{dq}{r^2}$$

$$E = \int_0^{2\pi} \frac{1}{4\pi\epsilon_0}\frac{dq}{r^2}\cdot\cos\theta$$

$$= \int_0^{2\pi} \frac{1}{4\pi\epsilon_0}\frac{\lambda R\,d\varphi}{\left(\sqrt{R^2+z^2}\right)^2}\hat{i}\ \frac{z}{\sqrt{R^2+z^2}}$$

$$= \int_0^{2\pi} \frac{1}{4\pi\epsilon_0}\frac{z\cdot\lambda R\,d\varphi}{(R^2+z^2)^{3/2}}$$

$$= \frac{1}{4\pi\epsilon_0}\frac{z}{(R^2+z^2)^{3/2}}\cdot 2\pi R\lambda$$

$$= \frac{1}{4\pi\epsilon_0}\frac{zq}{(R^2+z^2)^{3/2}}$$

$$\left[\lambda = \frac{q}{2\pi R}\right]$$

$t = 6 \times 10^{-2}$, $q = 7.81 \times 10^{-12}$

$R = 14.5 \times 10^{-2}$.

$E = 1.09$ N/C

(b) As the direction of E towards x axis cancels out so the direction is towards z axis as we can see from the figure.

(c) $\sigma = \frac{q}{\pi R^2} = 1.182 \times 10^{-10}$ C/m².

$$E = \frac{\sigma}{2\epsilon_0}\left[1 - \frac{z}{\sqrt{z^2+R^2}}\right]$$

$= 4.115$ N/C .

(d)

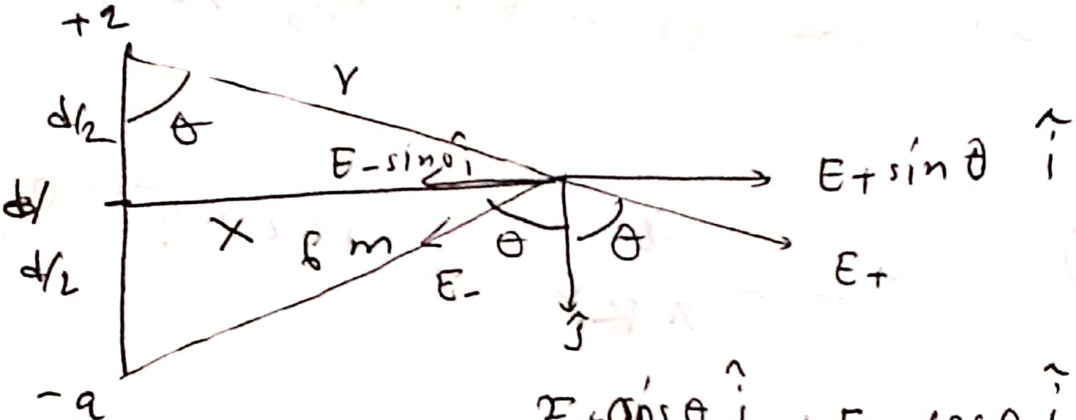
$$E = \frac{\sigma}{2\epsilon_0}$$

$$\Rightarrow \sigma = E \times 2\epsilon_0$$

$$= 7.3 \times 10^{-11} \ C/m^2 .$$

(2)

(a)



$E_+\cos\theta\,\hat{j} + E_-\cos\theta\,\hat{j}$

$$E = \frac{1}{4\pi\epsilon_0} \frac{qd}{(x^2+(d/2)^2)^{3/2}} \quad [p = qd]$$

$$= 2.08 \times 10^{7} \ N/C .$$

$$\vec{E} = 2.08 \times 10^{7}\,\hat{j}$$

(b)

$$E = \frac{1}{4\pi\epsilon_0} \frac{qd}{((d/2)^2)^{3/2}} \quad \text{as } x = 0$$

$$= \frac{1}{4\pi\epsilon_0} \quad \frac{qd}{(d/2)^{3/2}}.$$

$$= 3.6 \times 10^{3}$$

(c) $$E = \frac{\sigma}{2\epsilon_0}$$

$$\Rightarrow \sigma = E \times 2\epsilon_0$$

$$\Rightarrow \sigma = 6.37 \times 10^{2}\ C/m^2.$$

$$= 637\ C/m^2.$$