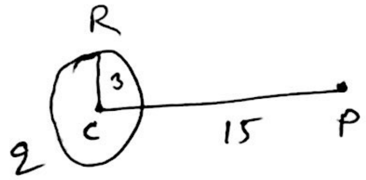
Assigment - 2

(1)



E for RING:

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

$R = \frac{3}{100}$ m, $z = \frac{15}{100}$ m

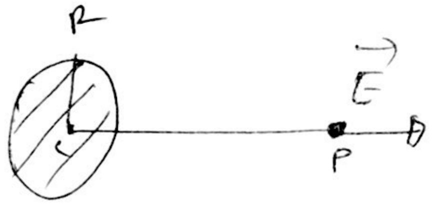
$\lambda = \frac{q}{2\pi R}$

$\therefore q = \lambda 2\pi R$

$$E = \frac{1}{4\pi\epsilon_0} \cdot \frac{\lambda 2\pi R \cdot \left(\frac{15}{100}\right)}{\left[\left(\frac{3}{100}\right)^2 + \left(\frac{15}{100}\right)^2\right]^{3/2}}$$

$= \ldots$ Simplify.

(2)



E for DISK:

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

$\sigma = 4\ \mu C/m^2$

$\sigma = 4 \times 10^{-6} C/m^2$

$R = \frac{13}{100}$

Substitute value for σ, z, R & ϵ_0 here.

& Simplify.

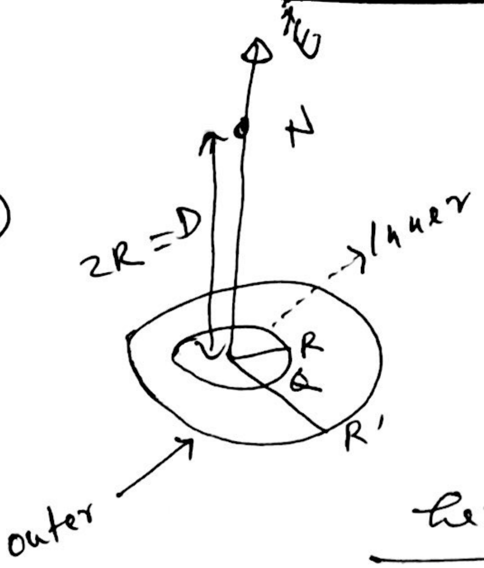
Now if you place a proton at point P, force on that proton is $\vec{F}$.

& $\vec{F} = q\vec{E}$; q is the charge of proton $q = +1.6 \times 10^{-19} C$.

$\vec{F} = 1.6 \times 10^{-19} \vec{E}$

$|F| = 1.6 \times 10^{-19} E$. Simplify.

3



E due to Ring of radius R at z.

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

here;

For small (inner ring) Ring:

charge = Q ; z = D = 2R

$$E_{\text{inner RING}} = E_{inn} = \frac{1}{4\pi\epsilon_0} \frac{Q \cdot 2R}{[(R^2 + (2R)^2)]^{3/2}}$$

$$= \frac{1}{4\pi\epsilon_0} \frac{Q2R}{(5R^2)^{3/2}}$$ DIR: UPWARD.

If you want to balance this Electric Field you need a downward Electric Field created by the outer ring of equal magnitude.

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

here use: $z = D = 2R$

$R = R' = 3R$

$$E_{outer} = \frac{1}{4\pi\epsilon_0} \frac{q \cdot 2R}{[(3R)^2 + (2R)^2]^{3/2}}$$

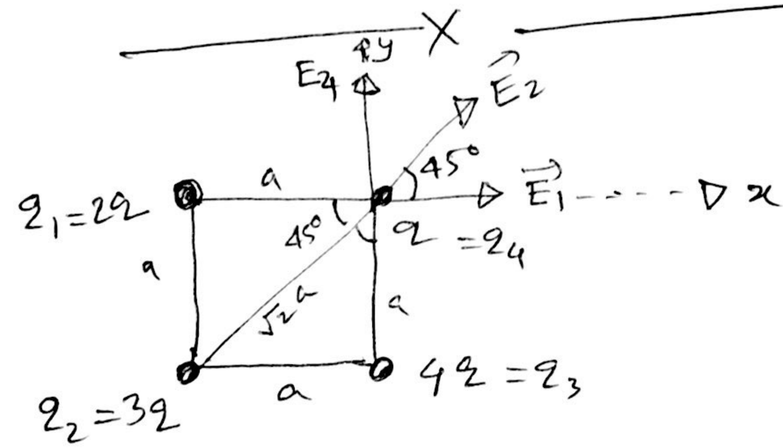
$$E_{outer} = \frac{1}{4\pi\epsilon_0} \frac{2qR}{[13R^2)^{3/2}}$$

$$E_{outer} = E_{iner}$$

$$\frac{1}{\cancel{4\pi\epsilon_0}} \frac{2q\cancel{R}}{(13R^2)^{3/2}} = \frac{1}{\cancel{4\pi\epsilon_0}} \frac{Q2\cancel{R}}{(5R^2)^{3/2}}$$

$$\therefore \quad q = Q\left(\frac{13\cancel{R^2}}{5\cancel{R^2}}\right)^{3/2} = \left(\frac{13}{5}\right)^{3/2} Q.$$

(19)



E_1 by $q_1 = 2q$; $E_1 = \frac{1}{4\pi\epsilon_0} \frac{2q}{a^2}$

E_2 by $q_2 = 3q$; $E_2 = \frac{1}{4\pi\epsilon_0} \frac{3q}{(\sqrt{2}a)^2}$

E_3 " $q_3 = 4q$; $E_3 = \frac{1}{4\pi\epsilon_0} \frac{4q}{a^2}$

$\vec{E_1} = \hat{i} \frac{1}{4\pi\epsilon_0} \frac{2q}{a^2}$; $\vec{E_3} = \hat{j} \frac{1}{4\pi\epsilon_0} \frac{4q}{a^2}$

x comp. of $E_{2x} = \frac{1}{4\pi\epsilon_0} \frac{3q}{2a^2} \cos 45°$, y comp. $E_y = \frac{1}{4\pi\epsilon_0} \frac{3q}{2a^2} \sin 45°$

$$\vec{E} = \hat{i}\,\frac{1}{4\pi\epsilon_0}\frac{2q}{a^2} + \hat{i}\,\frac{1}{4\pi\epsilon_0}\frac{3q}{2a^2}\cos 45^\circ$$

$$+ \hat{j}\,\frac{1}{4\pi\epsilon_0}\frac{4q}{a^2} + \hat{j}\,\frac{1}{4\pi\epsilon_0}\frac{3q}{2a^2}\sin 45^\circ$$

... simplify.

Force on q : $\vec{F} = \vec{E}\,q$.

$\vec{F} =$ substitute. $\vec{E}$ & q .

——— X ———

33.

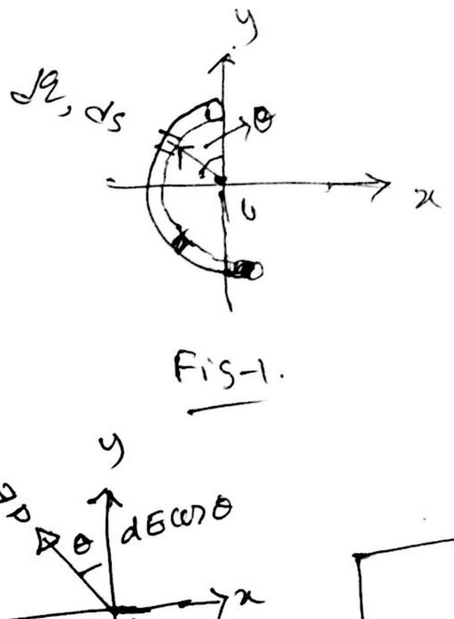
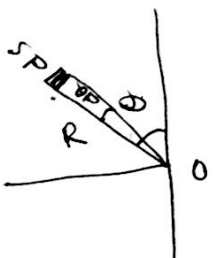


Fig-1.

Fig-2



$ds = R\,d\theta$

ds, subtends $d\theta$ at O.

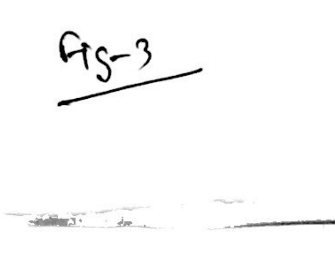


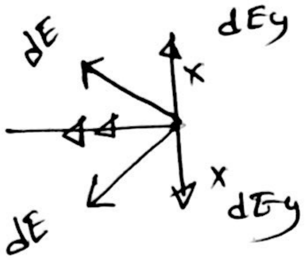
Fig-3

$$\boxed{\begin{aligned} dE &= \frac{1}{4\pi\epsilon_0}\frac{dq}{R^2} \\ &= \frac{1}{4\pi\epsilon_0}\frac{\lambda\,ds}{R^2} \end{aligned}}$$

$$= \frac{1}{4\pi\epsilon_0}\frac{\lambda R\,d\theta}{R^2} \quad (ds = R\,d\theta)$$

$dE\cos\theta = dE_y$ & $dE_x = dE\sin\theta$

dE_y will vanish from contribution ~~of~~ from lower side.



$$E_x = \int dE_x = \int dE\sin\theta$$

$$= \int_{\theta=0}^{\theta=\pi} \frac{1}{4\pi\epsilon_0} \frac{\lambda \cancel{R} d\theta}{\cancel{R^2} R} \sin\theta$$

$$= \frac{\lambda}{4\pi\epsilon_0 R}(-\cos\theta)\Big|_0^{\pi}$$

$l = 14\,cm =$ half circle

$$14\,cm = \frac{2\pi R}{2}$$

$\therefore R =$ Solve.

$$\lambda = \frac{q}{l} = \frac{-7.5\mu c}{l = 14\,cm} \quad \text{Solve.}$$

Then sub. in $E_x =$

A-2 P-6

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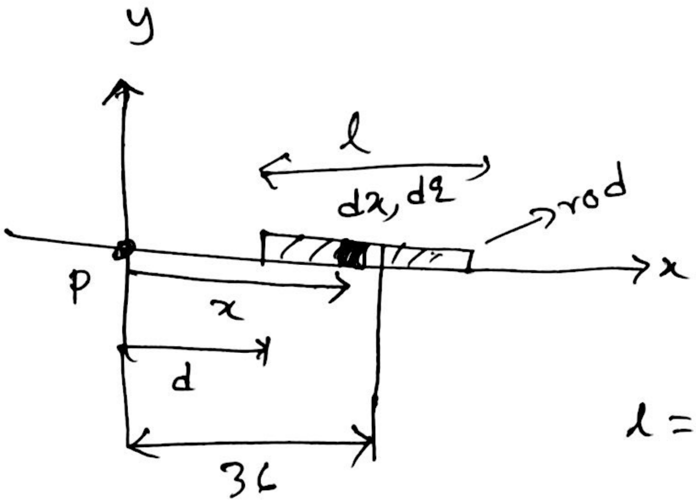
$\vec{E}$ at P)



l = length of rod = 14 cm

d = 29 cm

$\lambda = \frac{q}{l}$

$\therefore q = \lambda l$

$$dE = \frac{1}{4\pi\epsilon_0} \frac{\lambda dx}{x^2}$$

$$E = \int_{x=d}^{x=d+l} \frac{1}{4\pi\epsilon_0} \frac{\lambda dx}{x^2}$$

$$= \frac{\lambda}{4\pi\epsilon_0} \left. \frac{x^{-2+1}}{-2+1} \right|_d^{d+l}$$

$$= \frac{\lambda}{4\pi\epsilon_0} \frac{x^{-1}}{-1} = \frac{\lambda}{4\pi\epsilon_0} \left. \left(-\frac{1}{x}\right) \right|_d^{d+l}$$

$$= \frac{\lambda}{4\pi\epsilon_0} \left(\frac{1}{d} - \frac{1}{d+l}\right)$$

$$= \frac{\lambda}{4\pi\epsilon_0} \left(\frac{d+l-d}{d(d+l)}\right)$$

$$E = \frac{\lambda}{4\pi\epsilon_0} \frac{l}{d(d+l)} = \cancel{9\times10^9 \times 22\times10^{-6}} = \frac{q}{4\pi\epsilon_0 d(d+l)}$$

$$= \frac{1}{4\pi\epsilon_0} \frac{22\times10^{-6}}{.29(.29+.14)} = \text{solve}$$