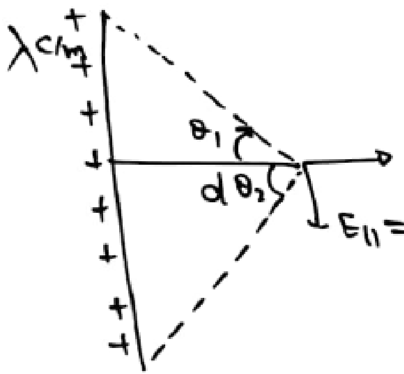
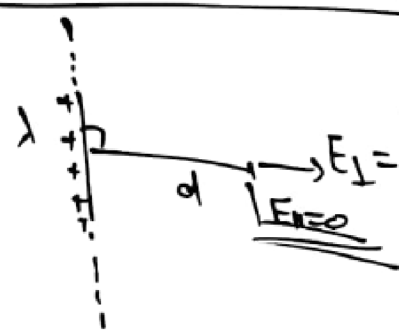
⇒ Electric field due to finite rod having λ charge density :-



$$E_{\perp} = \frac{k\lambda}{d}(\sin\theta_1 + \sin\theta_2)$$

$$E_{\parallel} = \frac{k\lambda}{d}[\cos\theta_2 - \cos\theta_1]$$

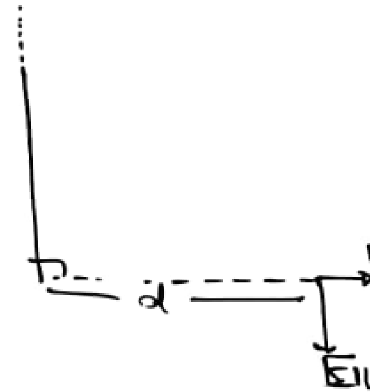
for infinite wire :-



$$E_{\perp} = \frac{2k\lambda}{d}$$

$$E_{\parallel} = 0$$

#3) for semi-infinite wire



$$E_{\perp} = \frac{k\lambda}{d}$$

$$E_{\parallel} = \frac{k\lambda}{d}$$

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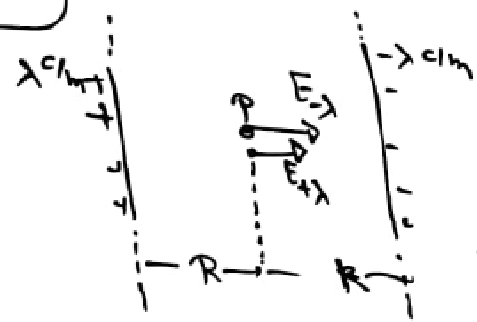


$$E_{net} = E_{+\lambda} + E_{-\lambda}$$

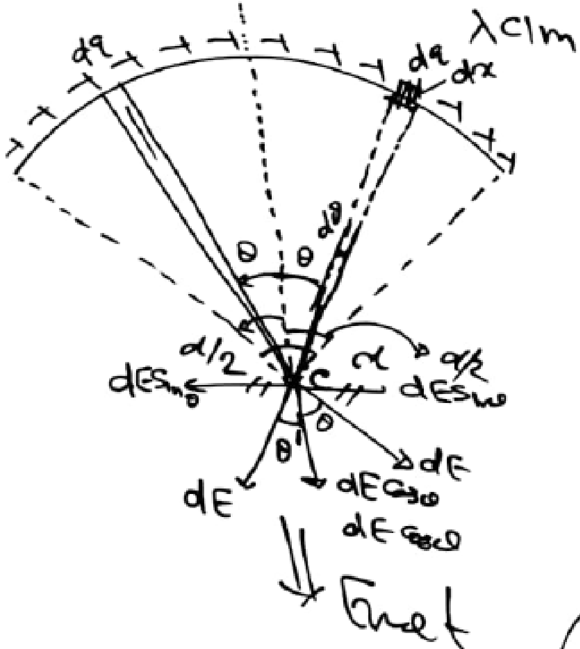
$$= \frac{2k\lambda}{d} + \frac{2k\lambda}{d}$$

$$= \frac{4k\lambda}{d}$$

$$= \frac{4 \times 1\,\lambda}{4\pi\varepsilon_0 d} = \frac{\lambda}{\pi\varepsilon_0 d}$$

⇒ Electric field due to Circular arc:

$$\xrightarrow[r]{q} E = \frac{Kq}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$



$E_c = ?$

$dx = R\,d\theta$

$dq = \lambda R\,d\theta$

Electric field at c due to small element dq.

$$dE = \frac{K\,dq}{R^2} = \frac{K\lambda R\,d\theta}{R^2} = \frac{K\lambda}{R}d\theta.$$

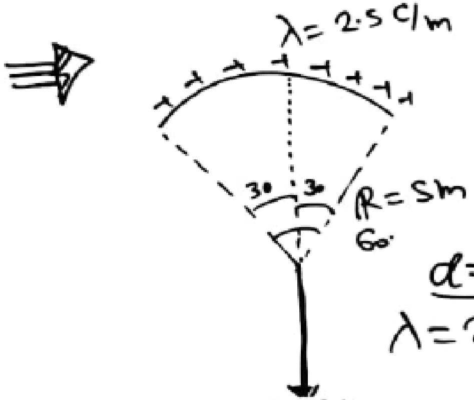
$$E_{net} = \int dE\cos\theta = \frac{K\lambda}{R}\int \cos\theta\,d\theta$$

$$E_{net} = \frac{K\lambda}{R}\int_{-\alpha/2}^{\alpha/2}\cos\theta\,d\theta = \frac{K\lambda}{R}\left[\sin\theta\right]_{-\alpha/2}^{\alpha/2}$$

$$= \frac{2K\lambda}{R}\sin\alpha/2$$

$$E_{net} = \frac{2K\lambda}{R}\sin\alpha/2$$

Find Electric field at Centre!



$\alpha = 60^\circ$

$\lambda = 2.5\ C/m$

$$E = \frac{2K\lambda}{R}\sin\left(\frac{\alpha}{2}\right)$$

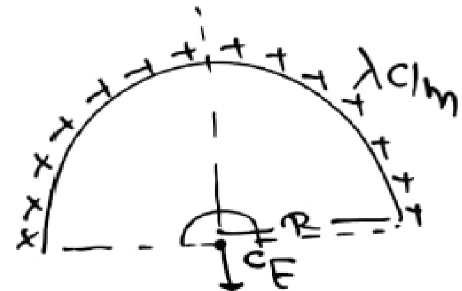
$$= \frac{2\times 9\times 10^9\times 2.5}{5}\sin\left(\frac{60}{2}\right)$$

$$= 9\times 10^9\times \sin 30$$

$$= 9\times 10^9\times \frac{1}{2} = 4.5\times 10^9\ N/C$$

$$E = \frac{2K\lambda}{R}\sin\left(\frac{\alpha}{2}\right)$$

Q2)



$\alpha = 180$

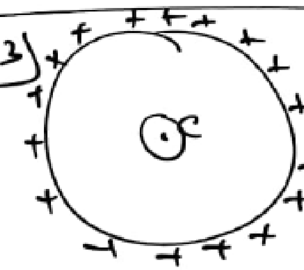
$\lambda \rightarrow$

$$E_C = \frac{2K\lambda}{R}\sin\frac{\alpha}{2}$$

$$E_C = \frac{2K\lambda}{R}\sin\left(\frac{180}{2}\right)$$

$$E_C = \frac{2K\lambda}{R}\sin 90 = \frac{2K\lambda}{R}$$

Q3)



$E = 0 \qquad \alpha = 360$

$$E_C = \frac{2K\lambda}{R}\sin\frac{\alpha}{2}$$

$$= \frac{2K\lambda}{R}\sin\frac{360}{2}$$

$$= \frac{2K\lambda}{R}\sin 180$$

$$= 0$$

AIPMT

Q) Electric field at centre O of semicircle of radius a having linear charge density (λ) as

(a) $\frac{2\lambda}{\varepsilon_0 a}$.

(b) $\frac{\lambda\pi}{\varepsilon_0 a}$.

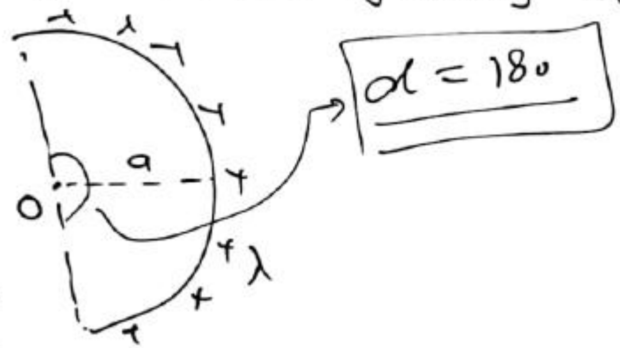
(c) $\frac{\lambda}{2\pi\varepsilon_0 a}$.

(d) $\frac{\lambda}{\pi\varepsilon_0 a}$.

$$E_O = \frac{2K\lambda}{a}\sin\left(\frac{180}{2}\right)$$

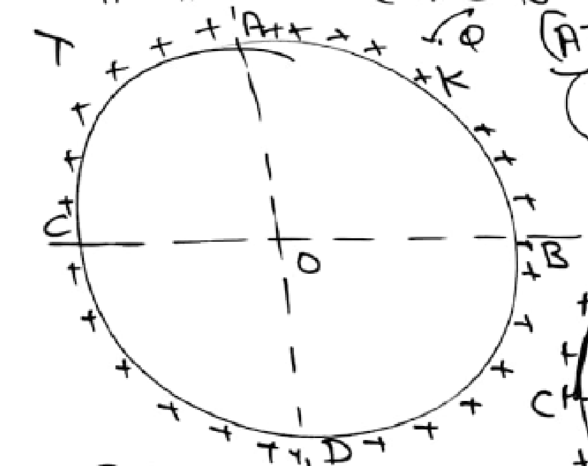
$$= \frac{2\lambda}{4\pi\varepsilon_0 a}\sin 90^\circ$$

$$= \frac{\lambda}{2\pi\varepsilon_0} \times 1$$

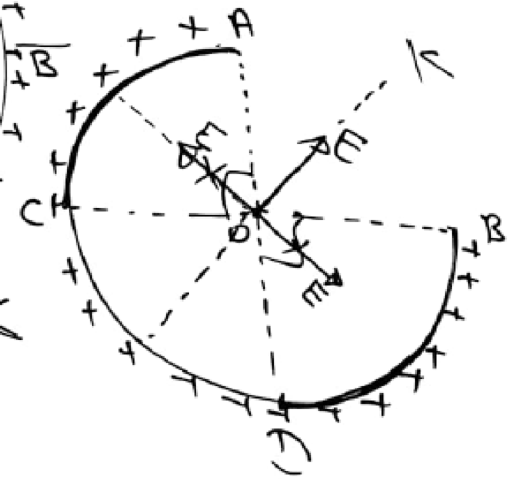


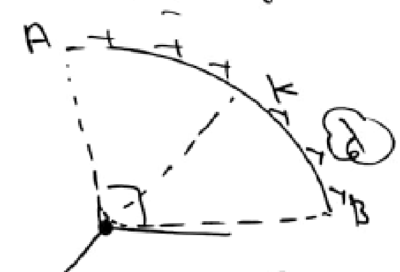
A thin Conducting ring of radius R is given a charge +Q. The electric field at the Centre O of the ring due to the charge on the part of ring AKB of the ring is E. The electric field at the Centre due to the charge on the part ACDB of the ring is [AIPMT 2008]

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



E along OK





$$E = \frac{2k\lambda}{R}\sin\left(\frac{90}{2}\right)$$

$$E = \frac{2k\lambda}{R}\sin 45$$

#

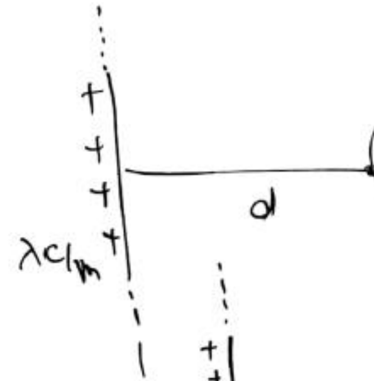
q_1 —— r —— q_2

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

q —— r ——

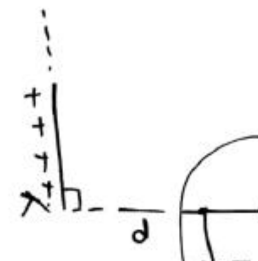
$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$

#



$$E_\perp = \frac{2K\lambda}{d}$$

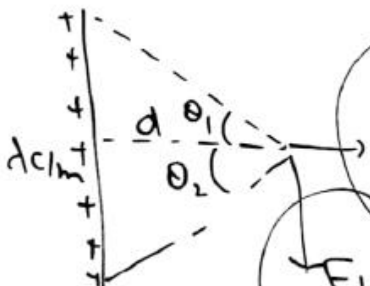
#



$$E_\perp = \frac{K\lambda}{d}$$

$$E_\parallel = \frac{K\lambda}{d}$$

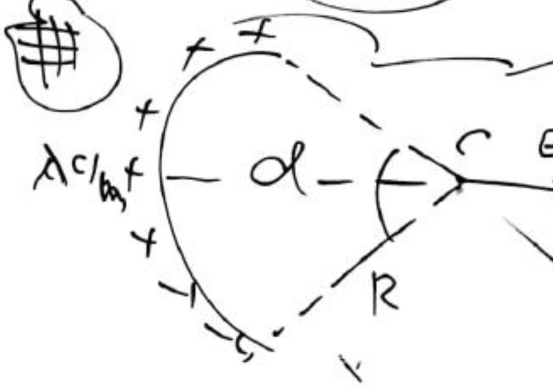
#



$$E_\perp = \frac{K\lambda}{d}(\sin\theta_1 + \sin\theta_2)$$

$$E_\parallel = \frac{K\lambda}{d}(\cos\theta_2 - \cos\theta_1)$$

#



$$E_c = \frac{2K\lambda}{R}\sin\left(\frac{\alpha}{2}\right)$$