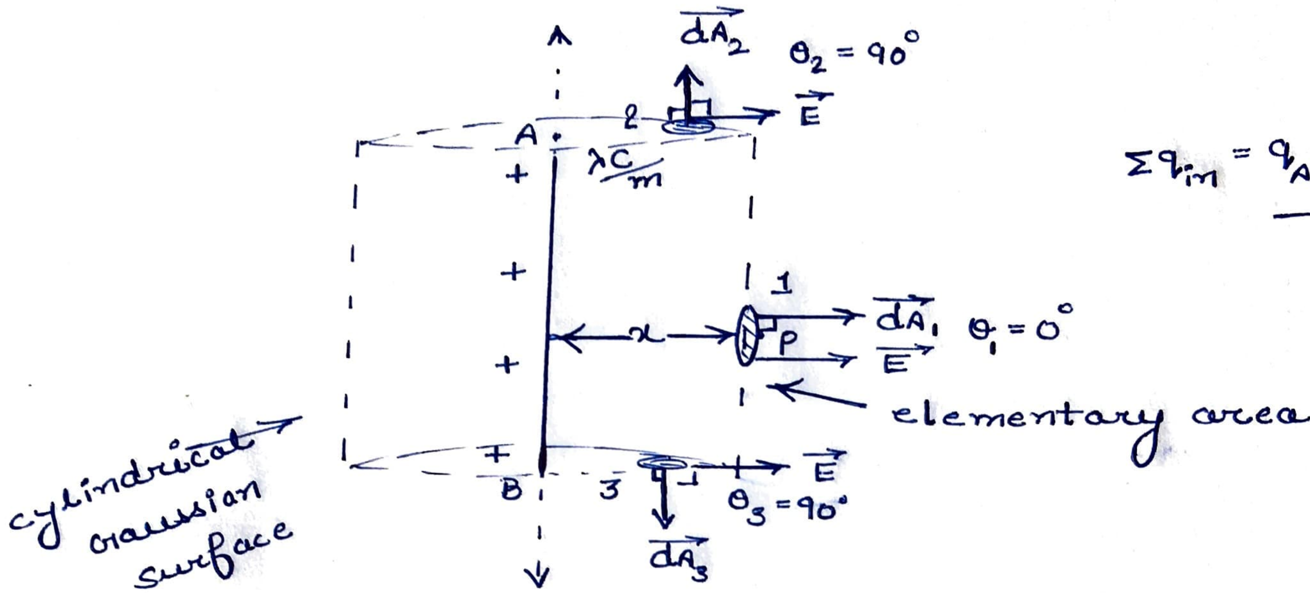
Electric field due to an infinitely long wire



$\Sigma q_{in} = q_{AB} = \lambda \cdot L$ — ①

from Gauss Law :→

$$\oint \vec{E}\cdot\vec{dA} = \frac{\Sigma q_{in}}{\varepsilon_0}$$

$$\Rightarrow \oint_1 \vec{E}\cdot\vec{dA_1} + \oint_2 \vec{E}\cdot\vec{dA_2} + \oint_3 \vec{E}\cdot\vec{dA_3} = \frac{\Sigma q_{in}}{\varepsilon_0}$$

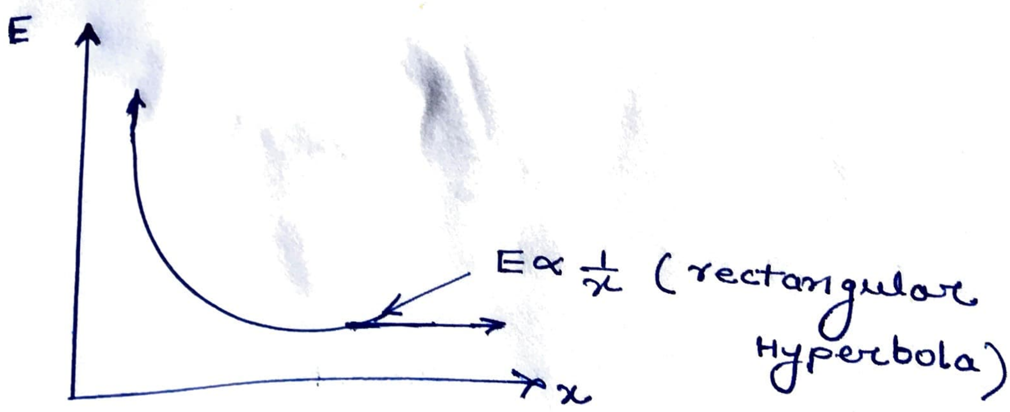
$$\Rightarrow \oint E\cdot dA\cdot\cos 0^\circ + \oint_2 E\cdot dA\cdot\cos 90^\circ + \oint_3 E\cdot dA\cdot\cos 90^\circ = \frac{\lambda\cdot l}{\varepsilon_0}$$

$$\Rightarrow E\oint_1 dA + 0 + 0 = \frac{\lambda\cdot l}{\varepsilon_0}$$

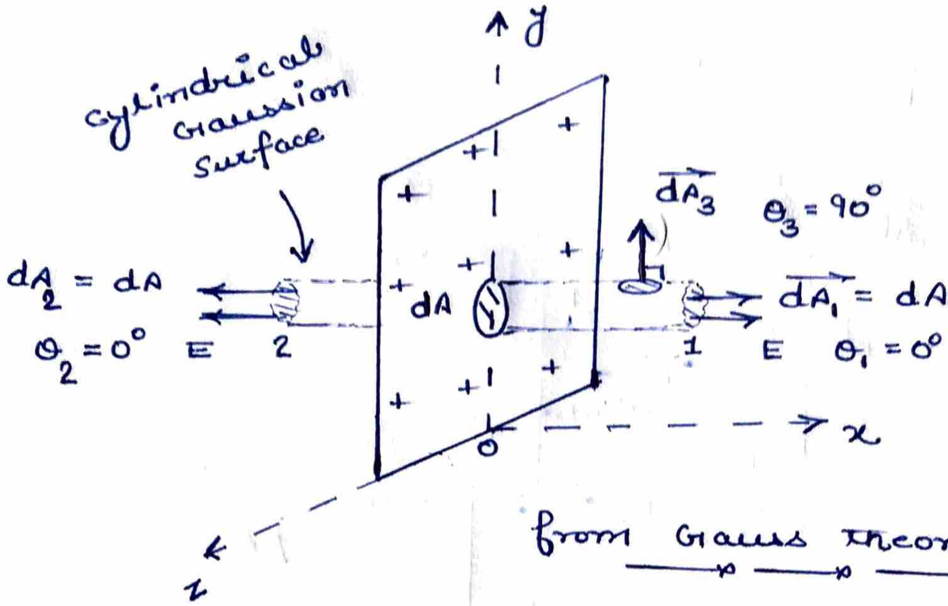
(as $E = const.$)

$$\Rightarrow E\times 2\pi x\cdot\cancel{l} = \frac{\lambda\cdot\cancel{l}}{\varepsilon}$$

$$\Rightarrow \boxed{E = \frac{\lambda}{2\pi\varepsilon x} = \frac{2K\lambda}{x}}\ N/C$$



Electric field due to an infinitely charged thin conducting sheet



$\Sigma q_{in} = \sigma . dA$ —— ①

from Gauss theorem

$$\oint \vec{E} \cdot \vec{dA} = \frac{\Sigma q_{in}}{\epsilon}$$

$$\Rightarrow \oint_1 E . dA . \cos 0^\circ + \oint_2 E . dA . \cos 0^\circ + \oint_3 E . dA . \cos 90^\circ$$

$$= \frac{\sigma . dA}{\epsilon}$$

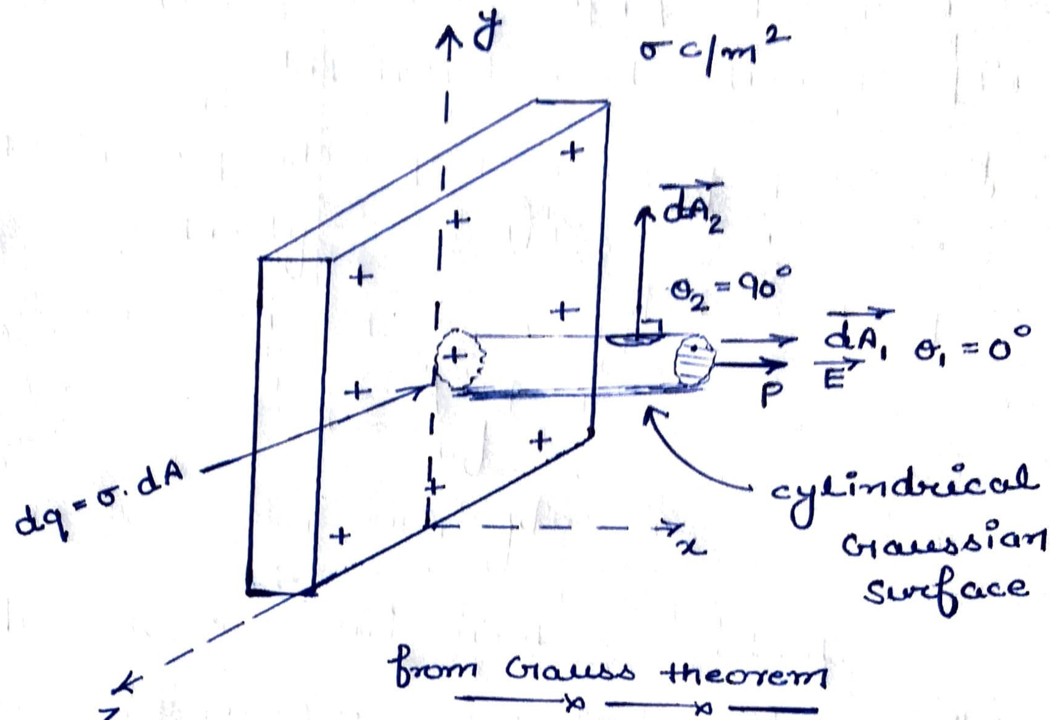
as $E = \text{const.}$

$$\Rightarrow E \oint_1 dA + E \oint_2 dA + 0 = \frac{\sigma . dA}{\epsilon}$$

$$\Rightarrow 2 . E . \cancel{dA} = \frac{\sigma . \cancel{dA}}{\epsilon}$$

so $\boxed{E = \frac{\sigma}{2\epsilon} \; N/C}$ —— ⊛

Electric field due to an infinitely charge non-conducting plate



from Gauss theorem

$$\oint \vec{E}\cdot\vec{dA} = \frac{\Sigma q_{in}}{\varepsilon_0}$$

$$\Rightarrow \oint_1 \vec{E}\cdot\vec{dA_1} + \oint_2 \vec{E}\cdot\vec{dA_2} = \frac{\sigma . dA}{\varepsilon_0}$$

$$\Rightarrow \oint_1 E\cdot dA \cdot \cos 0^\circ + \oint_2 E\cdot dA_2 \cdot \cos 90^\circ = \frac{\sigma . dA}{\varepsilon_0}$$

$\because$ E = const.

$$\Rightarrow E \oint_1 dA = \frac{\sigma . dA}{\varepsilon_0}$$

$$\Rightarrow E\cdot \cancel{dA} = \frac{\sigma . \cancel{dA}}{\varepsilon_0}$$

$$\Rightarrow E = \frac{\sigma}{\varepsilon_0} = \text{const}$$ & independent of distance

N/C.