SHORT → धनात्मक, ऋणात्मक, शून्य

(1) कार्य = बल सदिश • विस्थापन सदिश

$$W = \vec{F} \cdot \Delta\vec{S} = |\vec{F}| \cdot |\Delta\vec{S}| \cos\theta$$

$$= FS\cos\theta$$

ⓐ बल
ⓑ विस्थापन
ⓒ θ

$0^\circ \le \theta < 90^\circ$ → Positive

$\theta = 90^\circ$ → Zero

$90^\circ < \theta \le 180$ → Negative

② कार्य - ऊर्जा प्रमेय (Work Energy theorem)

$$W_{Total} = \Delta K$$

कूल कार्य = गतिज ऊर्जा में परिवर्तन

$$= K_f - K_i$$

$$\boxed{W = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2}$$

③ गतिज ऊर्जा (Kinetic energy)

$$K = \frac{1}{2}mv^2 = \frac{p^2}{2m}$$ .....

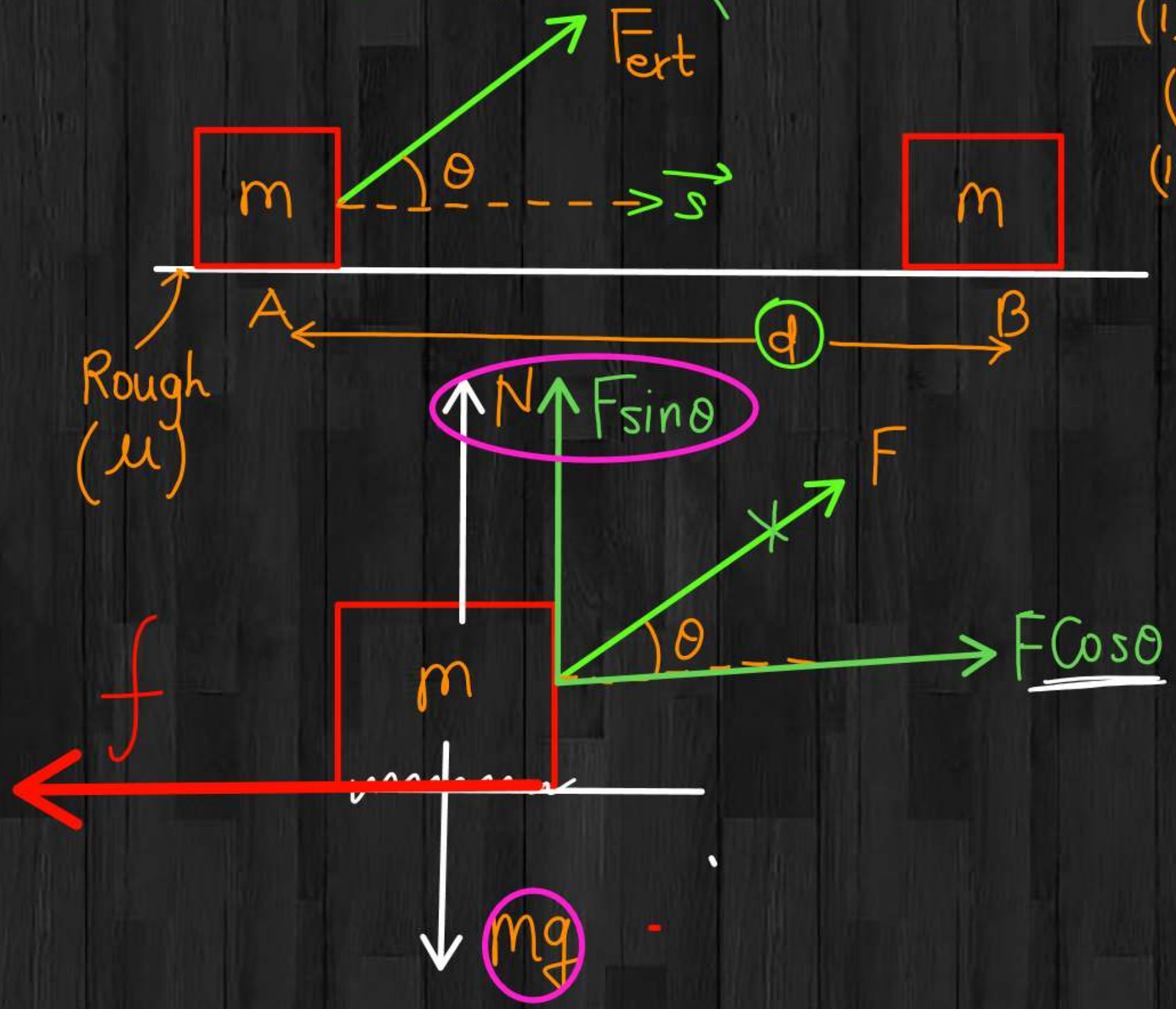
P = संवेग
= mv.

④ स्थितिज ऊर्जा (U)

- mgh
- $\frac{1}{2}kx^2$ (spring)

k = spring constant (N/m)

Question: दिए गए आकृति के अनुसार बाह्य बल के द्वारा किया गया कार्य ज्ञात करें :-



(i) Workdone by external force = ?

(ii) Workdone by force of friction (−)

(iii) W by normal force = ? (0)

$$N + F\sin\theta = mc$$

$$N = mg - F\sin\theta \quad \text{——— (1)}$$

$$f = F\cos\theta$$

$$\mu(N) = F\cos\theta$$

$$\mu(mg - F\sin\theta) = F\cos\theta$$

$$\mu mg - \mu F\sin\theta = F\cos\theta$$

$$\mu mg = F\cos\theta + \mu F\sin\theta$$

$$\mu mg = F(\cos\theta + \mu\sin\theta)$$

$$F = \frac{\mu mg}{\cos\theta + \mu\sin\theta}$$

$$W = FS\cos\theta$$

$$= \frac{\mu mg}{\cos\theta + \mu\sin\theta} \times d \times \cos\theta$$

$$W_{ext} = \frac{\mu mgd\cos\theta}{\cos\theta + \mu\sin\theta}$$

Workdone by external force = ?

बाह्य बल द्वारा किया कार्य = ?

$$W = \Delta K = \frac{1}{2} m v_f^2 - \frac{1}{2} m u_i^2$$

$$= \frac{1}{2} m \{ v_f^2 - v_i^2 \}$$

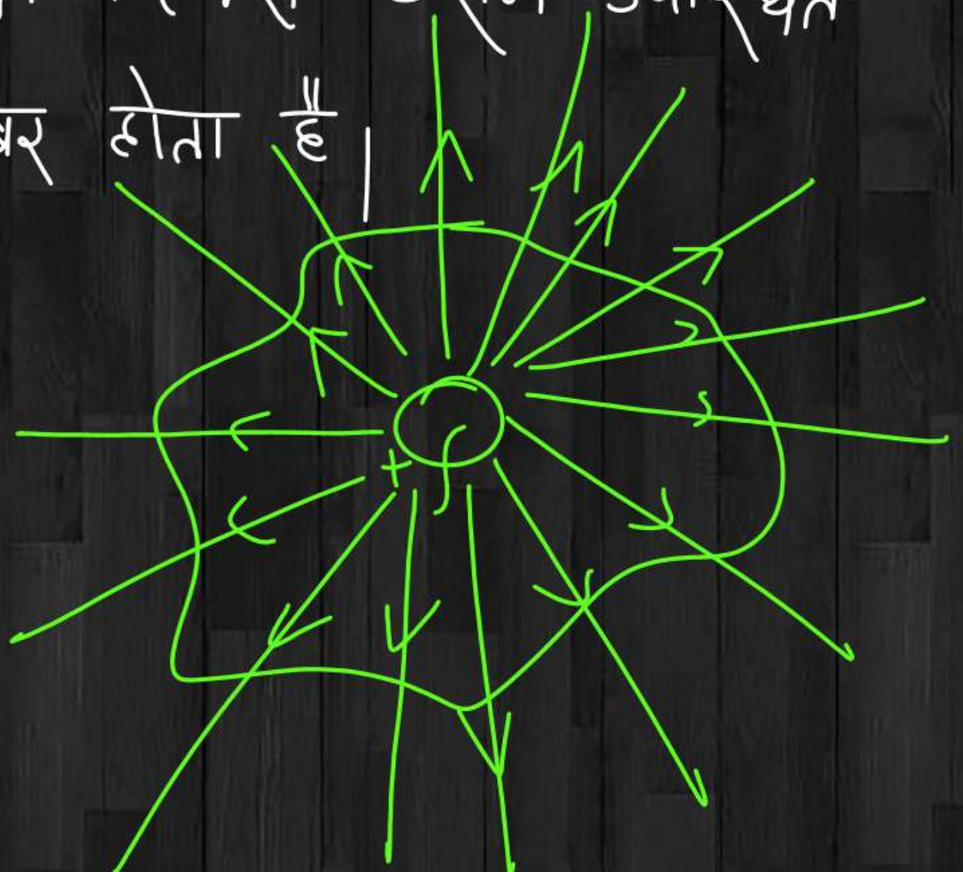
$$= \frac{1}{2} \times 2 \{ 40^2 - 10^2 \} = 1600 - 100 = \boxed{1500 J}$$

Gauss' theorem
गॉस प्रमेय

$\epsilon_0 = 8.85 \times 10^{-12} \frac{C^2}{Nm^2}$ or $\frac{\text{Farad}}{\text{meter}}$

किसी बन्द सतह का कूल विद्युत फलक्स उसमें उपस्थित कूल आवेश का $\frac{1}{\epsilon_0}$ गुणा के बराबर होता है।

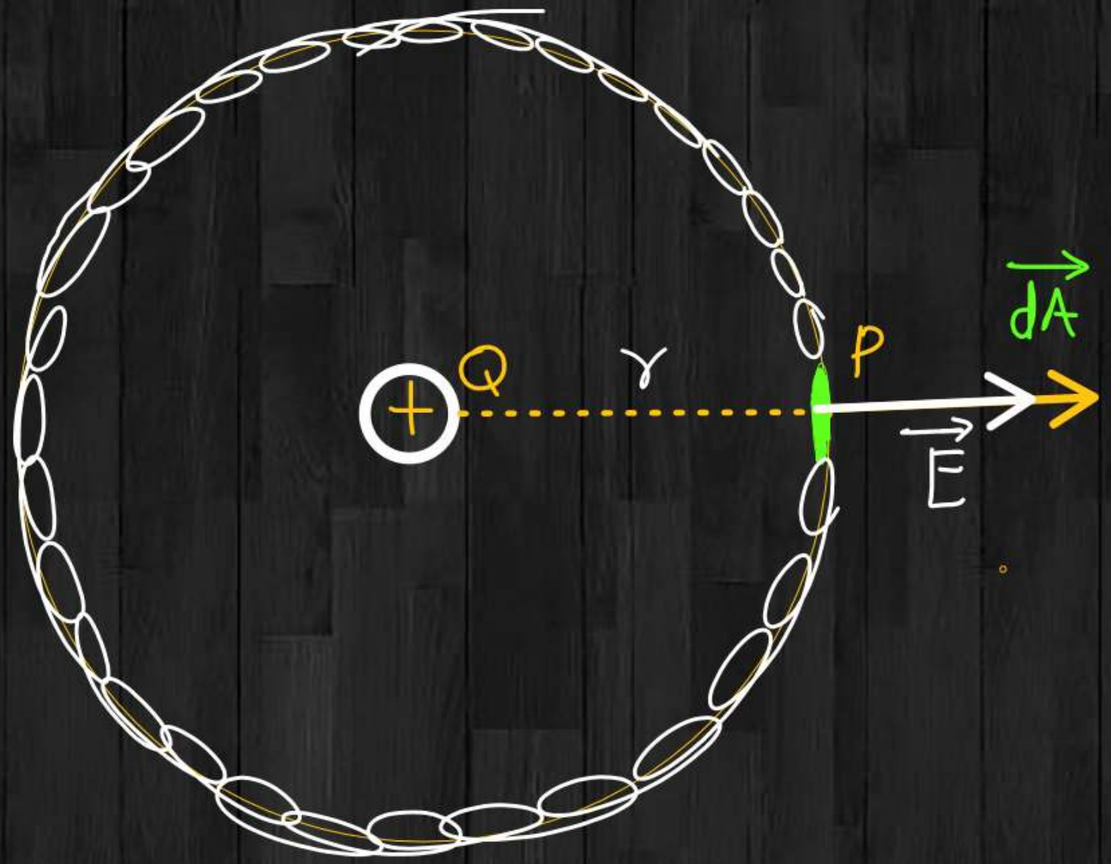
$$\phi_{total} = \frac{Q_{enclosed}}{\epsilon_0}$$



$$\oint \vec{E} \cdot \vec{dA} = \frac{Q}{\epsilon_0}$$

Application of Gauss' law

① Electric field due to point charge
बिन्दु आवेश के कारण विद्युत क्षेत्र :



$$\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$$

$$\oint E\, dA \cos\theta = \frac{Q}{\epsilon_0}$$

$$\oint E\, dA \cos 0^\circ = \frac{Q}{\epsilon_0}$$

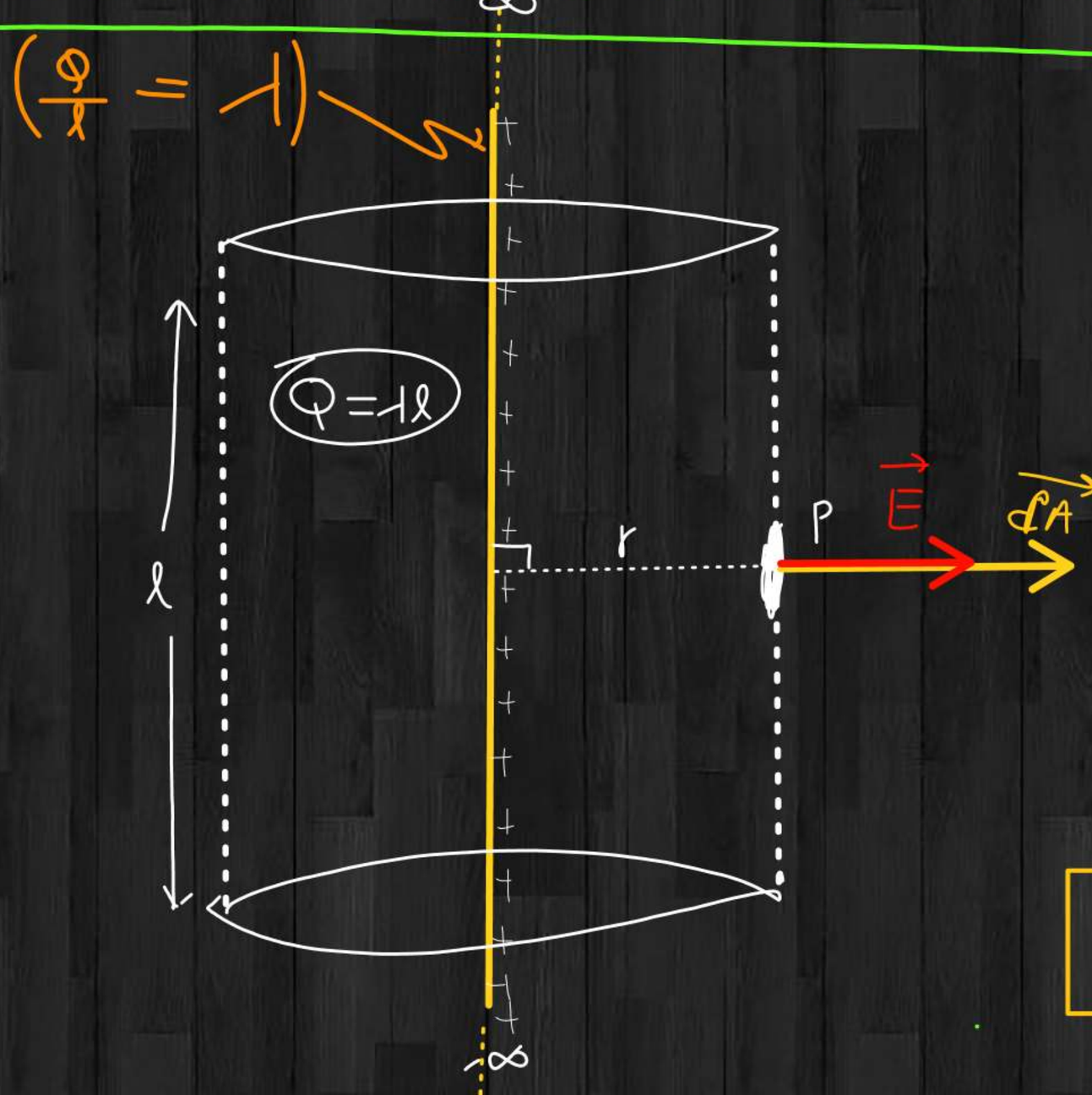
$$E \oint dA = \frac{Q}{\epsilon_0}$$

$$E \cdot \Delta A = \frac{Q}{\epsilon_0}$$

$$E \times 4\pi r^2 = \frac{Q}{\epsilon_0}$$

$$\boxed{E = \frac{Q}{4\pi\epsilon_0 r^2}}$$

② अनन्त लम्बाई वाले सीधी चालक के कारण विद्युत क्षेत्र



$$\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$$

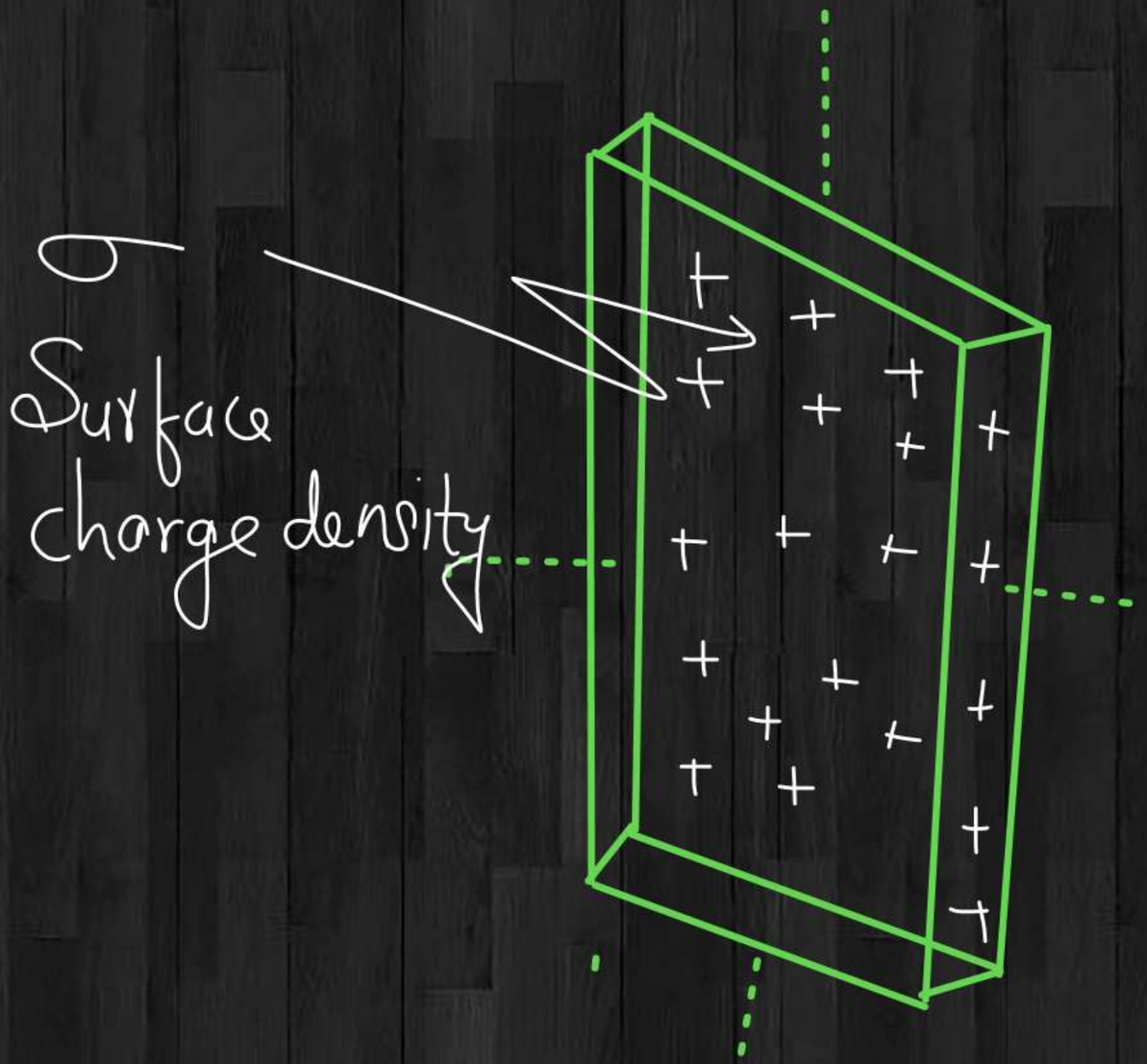
$$\oint E dA \cos 0^\circ = \frac{\lambda l}{\epsilon_0}$$

$$\oint E dA = \frac{\lambda l}{\epsilon_0}$$

$$E \times \Delta A = \frac{\lambda l}{\epsilon_0}$$

$$E \times 2\pi r l = \frac{\lambda l}{\epsilon_0}$$

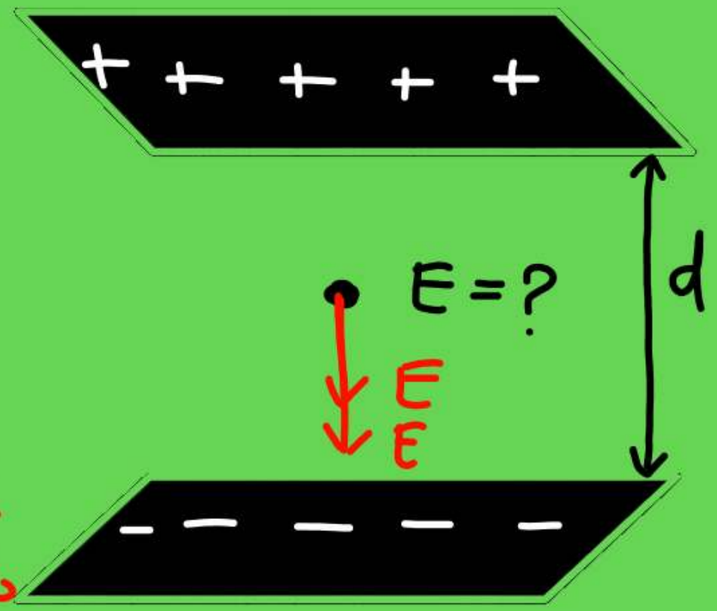
$$\boxed{E = \frac{\lambda}{2\pi\epsilon_0 r} = \frac{2k\lambda}{r}}$$



Just above the plate:

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

Example :-



$E_{net} = 2E$

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

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

☆ आवेशित खोखला गोला :