

1- Gauss - law :-

Electric flux $\leftarrow \int \vec{E} \cdot d\vec{A} = Q_{\text{net}} = Q_{\text{total}}$

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2- Electric flux density:-

$\vec{D}$ C/m²

$$\vec{D} = \epsilon_0 \vec{E}$$



$$\oint \vec{D} \cdot d\vec{A} = Q_{\text{net}}$$

$$\oint \vec{D} \cdot r^2 \sin \theta d\theta d\phi = Q$$

$$\vec{D} r^2 \int \sin \theta d\theta d\phi = Q$$

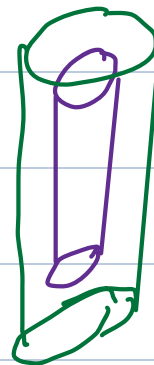
$$\vec{D} 4\pi r^2 = Q$$



$$\vec{D} 2\pi r L = Q$$



$$\vec{D} 4\pi r^2 = \underline{\rho_v}$$



$$\rho 2\pi r L = \rho_v$$

$$\phi = \oint_C \vec{D} \cdot d\vec{s} = Q_{net}$$

$$\vec{D} 4\pi r^2$$

$$\vec{D} 2\pi r L$$

$$* \quad \nabla \cdot \vec{D} = \rho_v \quad \textcircled{1} \quad \text{Maxwell}$$

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3- potential:- $V(r)$ Volt

$$\vec{E} = -\nabla V$$

$$V_{AB} = - \int_A^B \vec{E} \cdot d\vec{L} = V_B - V_A$$

special cases:-

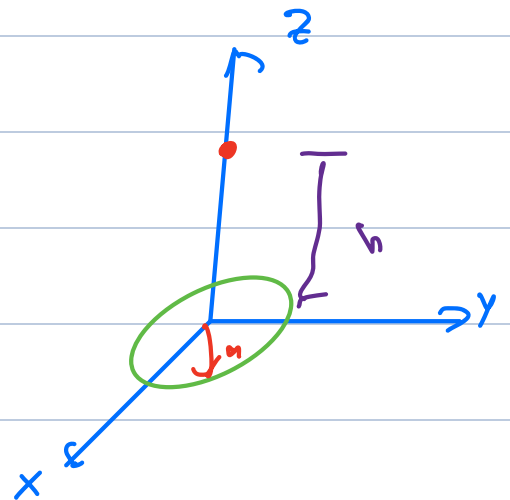
i) $V_{AB} = V_B - V_A = \frac{Q}{4\pi\epsilon_0} \left[\frac{1}{r_B} - \frac{1}{r_A} \right]$ Point charge

ii) $V_{AB} = V_B - V_A = \frac{-P_L}{2\pi\epsilon_0} \ln \frac{r_B}{r_A}$ line charge

iii) $V_{AB} = V_B - V_A = \frac{-P_s}{2\epsilon_0} [z_B - z_A]$ sheet charge

X potential for ring:-

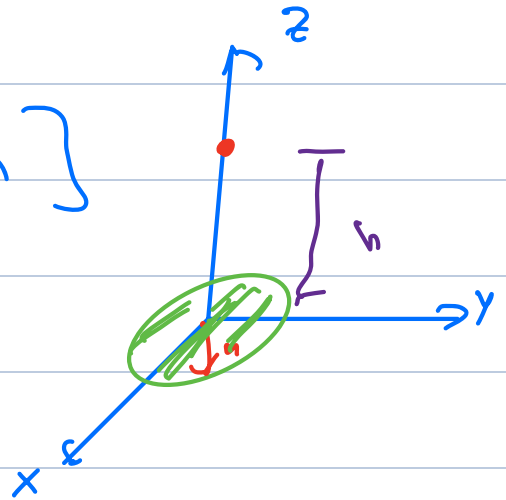
$$V = \frac{P_L a}{2\epsilon_0 \sqrt{a^2 + h^2}}$$



potential for disk :-

$$V = \frac{\rho_s}{2\epsilon_0} \left[\sqrt{a^2 + h^2} - h \right]$$

$$\rho_s = \frac{1}{\rho}$$



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