# Potential


$$\Delta V = V_B - V_A = -\int_A^B \vec{E}\cdot d\vec{l}$$

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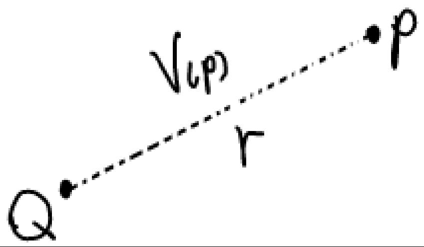
ref. at $\infty$




$$V(p)\Big|_Q = \frac{Q}{4\pi\epsilon_0 r}$$

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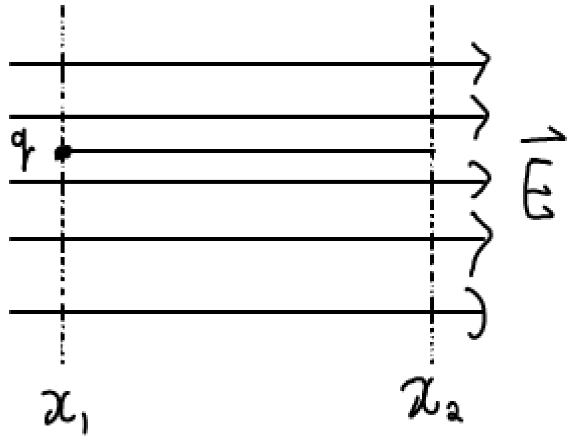



$$\frac{-W(x_1 \to x_2)}{q}$$

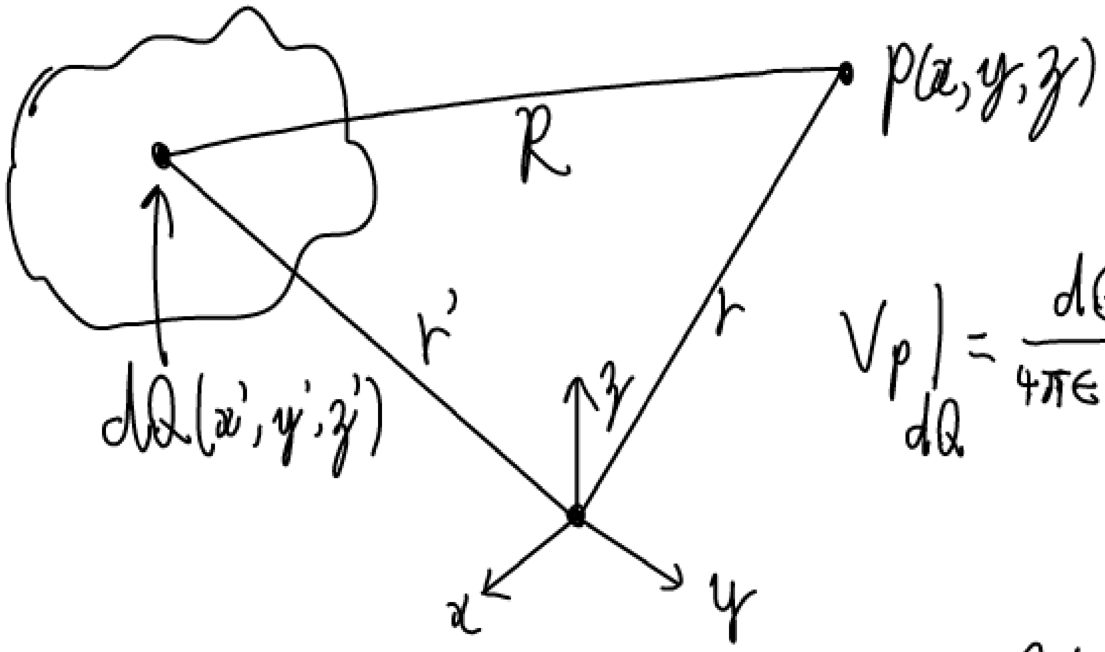
$$= -\frac{1}{q}\int_{x_1}^{x_2} \vec{F}\cdot\vec{dx}$$

$$= -\frac{1}{q}(x_2 - x_1)Eq$$

$$= (x_1 - x_2)E$$

$$= V(x_1) - V(x_2)$$


$$V_p = \frac{dQ}{4\pi\epsilon_0 r}$$

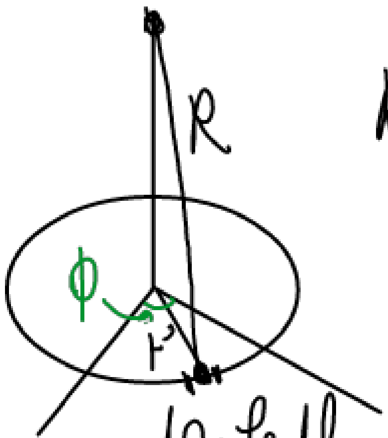



$$V_p\Big|_{dQ} = \frac{dQ}{4\pi\epsilon_0 R}$$

$$V_{(p)}\Big|_{dQ} = \frac{dQ}{4\pi\epsilon_0 |\vec{r}-\vec{r}'|}$$

$$dQ \begin{cases} \rho_v\, dv \\ \rho_s\, dA \\ \rho_l\, dl \end{cases}$$

V due to charge disk




$R = \sqrt{r'^2 + z^2}$

$dQ = \rho_l\, dl$

$dl = r'\, d\phi$

$$V = k\int \frac{dQ}{R}$$

$$= k\int_{all} \frac{\rho_l\, dl}{\sqrt{r'^2+z^2}}$$

$$= k\rho_l \int \frac{r'\, d\phi}{\sqrt{r'^2+z^2}}$$

$$= \frac{k\rho_l\, a(2\pi)}{\sqrt{a^2+z^2}} = \frac{kQ}{\sqrt{a^2+z^2}}$$