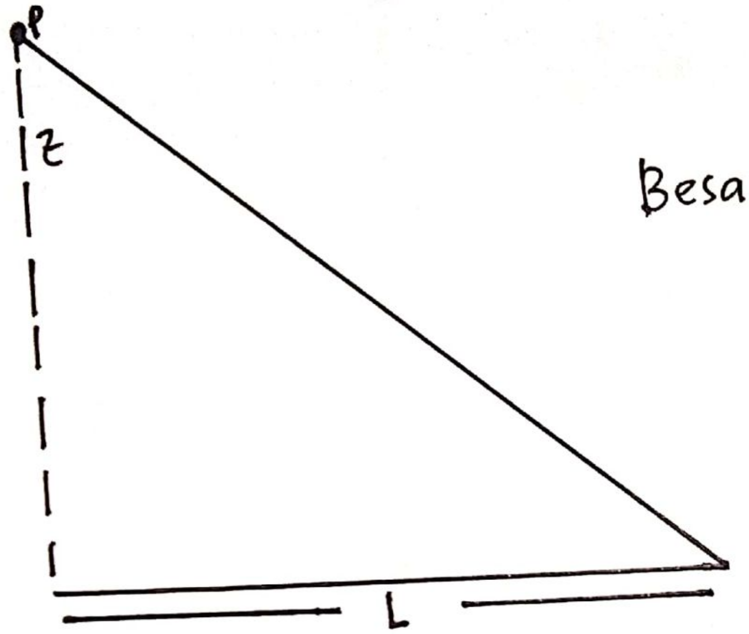
Khalisma (Tugas)



Besar E, jika $z >> L$ ... ?

$\rightarrow dq = \lambda\, dx$ $\rightarrow dE = \frac{1}{4\pi\varepsilon_0} \frac{dq}{r^2} \rightarrow dE = \frac{1}{4\pi\varepsilon_0} \frac{\lambda\, dx}{z^2}$

$r = z$

Integrasikan medan ~~magnet~~ listrik dE dari $x = 0$ hingga $x = L$

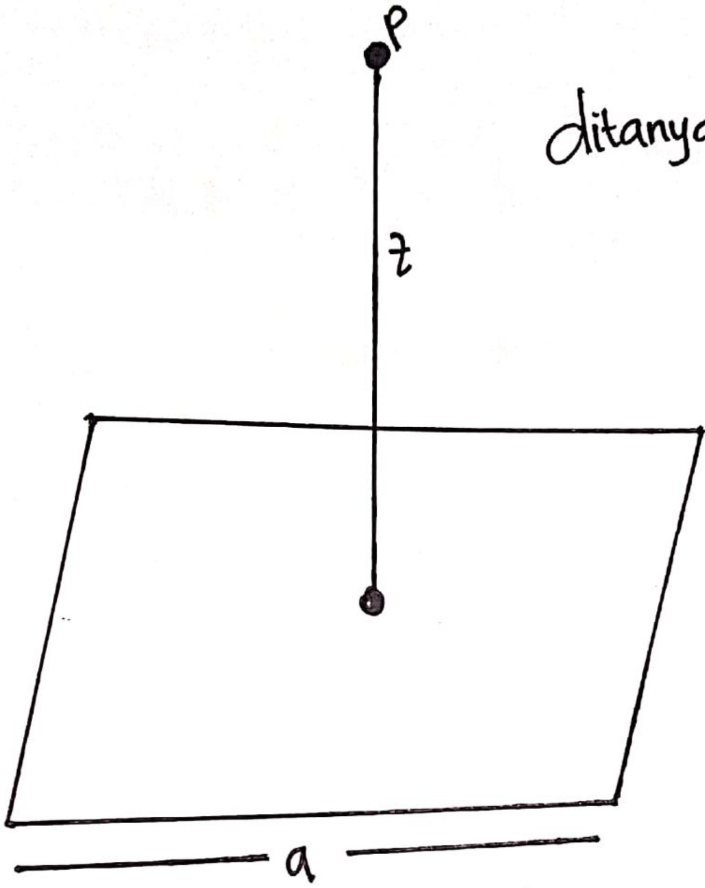
$$E = \int_0^L \frac{\lambda}{4\pi\varepsilon_0 z^2}\, dx$$

$$= \frac{\lambda}{4\pi\varepsilon_0 z^2} \int_0^L dx$$

$$= \frac{\lambda}{4\pi\varepsilon_0 z^2} \left[x \right]_0^L$$

$$= \frac{\lambda}{4\pi\varepsilon_0 z^2} \cdot L \rightarrow E = \frac{\lambda}{4\pi\varepsilon_0 z^2}$$

2)



ditanya E ... ?

$$\rightarrow dE = \frac{1}{4\pi\varepsilon_0}\left(\frac{\lambda\, dx}{r^2}\right) \qquad r^2 = \sqrt{z^2 + x^2}$$

$$E = \int_0^{a/2} \frac{1}{4\pi\varepsilon_0} \frac{\lambda\, dx}{z^2 + x^2} \qquad \begin{aligned} x &= z \tan\theta \\ dx &= z \sec^2\theta\, d\theta \\ \sqrt{z^2 + x^2} &= z \sec\theta \end{aligned}$$

$$E = \int_0^{\frac{\pi}{4}} \frac{1}{4\pi\varepsilon_0} \frac{\lambda \cdot z \sec^2\theta}{z^2 + z^2 \tan^2\theta}\, d\theta$$

$$E = \frac{\lambda}{4\pi\varepsilon_0} \int_0^{\frac{\pi}{4}} \frac{z \sec^2\theta}{z^2 + (1 + \tan^2\theta)}\, d\theta$$

$$= \frac{\lambda}{4\pi\varepsilon_0} \int_0^{\frac{\pi}{4}} \frac{\sec^2\theta\, d\theta}{z}\, d\theta$$

$$E = \frac{\lambda}{4\pi\varepsilon_0 z}\int_0^{\frac{\pi}{4}} \sec^2\theta \, d\theta \longrightarrow$$ Integrasi dari $\sec^2\theta =$ $\tan\theta$

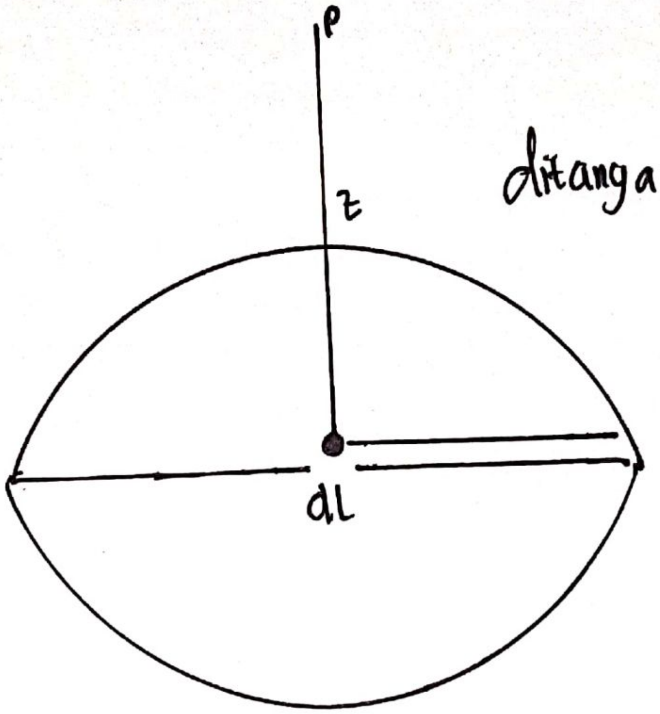
$$E = \frac{\lambda}{4\pi\varepsilon_0 z}\left[\tan\theta\right]_0^{\pi/4}$$

$$= \frac{\lambda}{4\pi\varepsilon_0 z}\left[\tan(\pi/4) - \tan(0)\right]$$

$$= \frac{\lambda}{4\pi\varepsilon_0 z}(1-0)$$

$$E = \frac{\lambda}{4\pi\varepsilon_0 z}$$

3.



ditanya E .... ?

$$\rightarrow dE = \frac{1}{4\pi\varepsilon_0} \frac{dq}{r^2} \rightarrow dq = \lambda dL$$

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

$$dE = \frac{1}{4\pi\varepsilon_0} \frac{\lambda dL}{r^2 + z^2}$$

$$E = \int_0^{2\pi r} \frac{\lambda}{4\pi\varepsilon_0 (r^2 + z^2)} dL$$

$$= \frac{\lambda}{4\pi\varepsilon_0 (r^2 + z^2)} \int_0^{2\pi r} dL$$

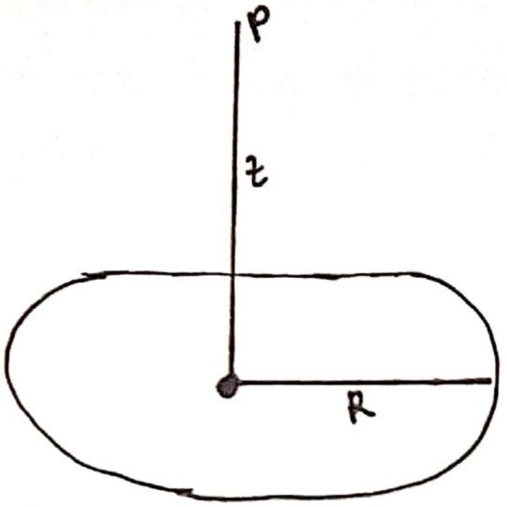
$$= \frac{\lambda}{4\pi\varepsilon_0 (r^2 + z^2)} \left[dL \right]_0^{2\pi r}$$

$$= \frac{\lambda}{4\pi\varepsilon_0 (r^2 + z^2)} \cdot 2\pi r$$

$$= \frac{\cancel{2} \lambda r}{\cancel{4}\pi\varepsilon_0 (r^2 + z^2)} \pi$$

$$= \frac{\lambda r}{2\varepsilon_0 (r^2 + z^2)} \pi$$

$$E = \frac{\lambda r \pi}{2\varepsilon_0 (r^2 + z^2)}$$



- Elemen kecil dA pada Permukaan plat lingkaran
- r . z karena jaraknya sejauh z

$\rightarrow dE \cdot \frac{1}{4\pi\varepsilon_0} \frac{da}{r^2} \rightarrow dE = \frac{1}{4\pi\varepsilon_0} \cdot \frac{\sigma dA}{z^2}$

$E = \int \frac{\sigma}{4\pi\varepsilon_0 z^2} dA \rightarrow$ karena permukaan bidang datar menggunakan koordinat polar.

$dA = R d\theta dr$

Jarak dari pusat lingkaran ke-permukaan.

$$E = \int_0^{2\pi}\int_0^R \frac{\sigma}{4\pi\varepsilon_0 z^2} R dr d\theta$$

$$= \frac{\sigma R}{4\varepsilon_0 z^2} \int_0^{2\pi}\int_0^R dr d\theta$$

$$= \frac{\sigma R}{4\varepsilon_0 z^2} \int_0^{2\pi} R d\theta$$

$$= \frac{\sigma R}{2\varepsilon_0 z^2} \int_0^{2\pi} d\theta$$

$$= \frac{\sigma R}{2\varepsilon_0 z^2} \cdot 2\pi$$

$\rightarrow E = \frac{\sigma R^2 \pi}{\varepsilon_0 z^2}$

medan listrik diatas plat lingkaran sejauh z yang membawa muatan seragam σ

→ Besar E jika ($R \to \infty$)

$\lim_{R \to \infty} E = \lim_{R \to \infty} \frac{\sigma R^2 \pi}{\varepsilon_0 z^2} = 0$

Jika R semakin besar maka banyak muatan yang tesebar dipermukaan plat, dan medan listrik akan semakin mendekati nol.

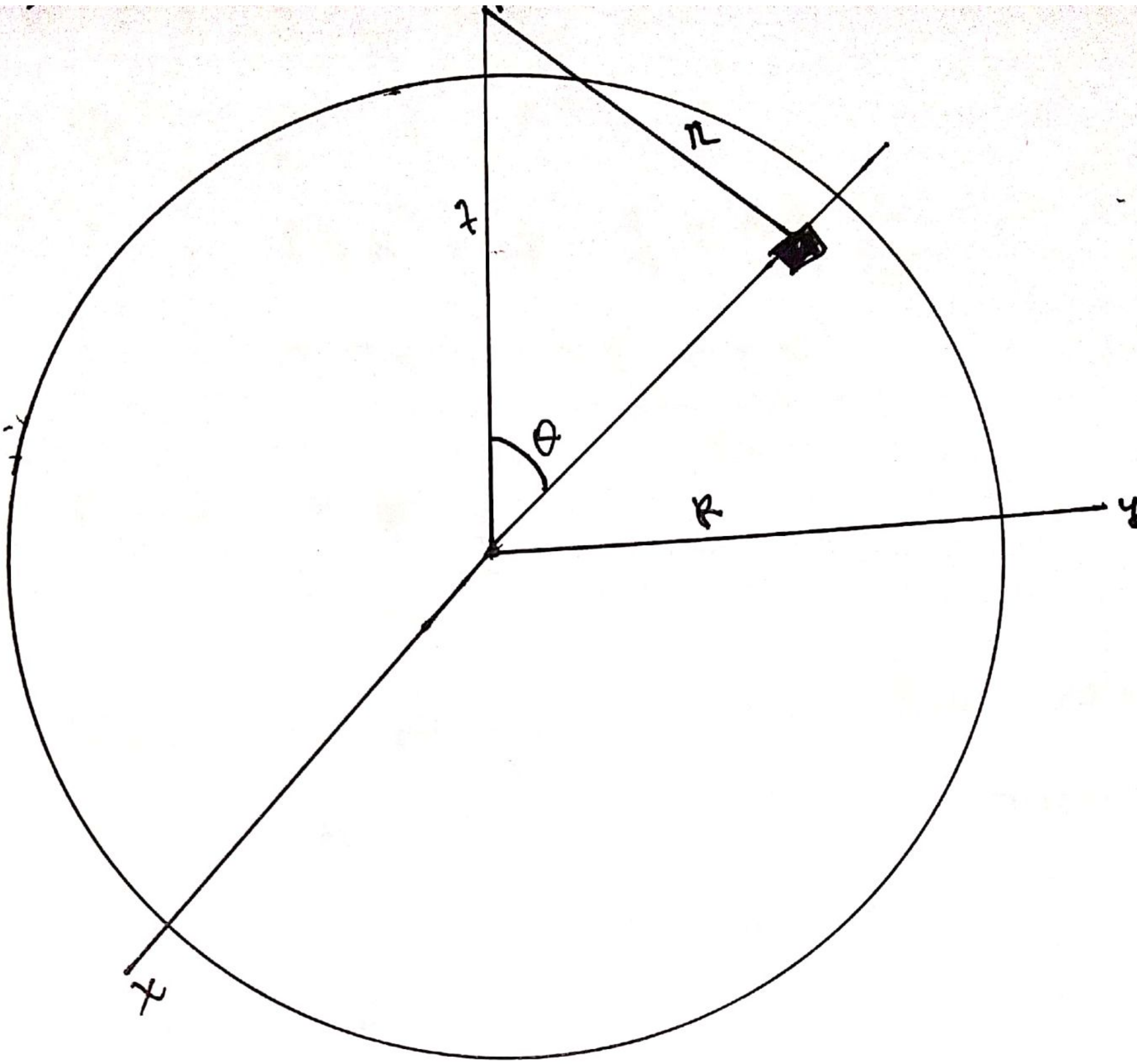
→ $z \gg R$

Menggunakan pendekatan $\lim_{R \to \infty}$

Sehingga R^2 dalam penyebut akan menjadi besar dibandingkan dengan z^2 sehingga ~~z²~~ medan listrik akan menjadi nol.

Maka $E \approx 0$

$= \frac{\quad}{4\pi\varepsilon_0 z}$ //.



$$\rightarrow \phi_E = \oint \vec{E} \cdot dA$$

$$= E \oint dA$$

diketahui bahwa fluks medan listrik melalui Permukaan tertutup yaitu.

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

$$\phi_E = \frac{Q_{in}}{\varepsilon_0}$$

$$Q = \rho \cdot \frac{4}{3} \pi R^3$$

$$\rightarrow \Phi E = E \cdot 4 \pi R^2$$

$$E = 4 \pi R^2 = \Phi \cdot \frac{4}{3} \pi R^3 \cdot \frac{1}{\varepsilon_0}$$

$$E = 4 \pi R^2 = \frac{3 \Phi \, 4 \pi R^3}{\varepsilon_0}$$

$$E = \frac{3 \Phi R}{\varepsilon_0}$$

Jadi E didarac pusat bola dengan Jejari R yang membawa muatan seragam desitas σ adalah

$$E = \frac{3 \sigma R}{\varepsilon_0} \quad //.$$

khalisma

Hukum Gauss

$\tau = V$

$$\oint_S \vec{E} \cdot d\vec{a} = \int_V (\nabla \cdot \vec{E}) \, d\tau .$$

$$\oint \vec{E} \cdot da = \oint \frac{q}{4\pi \varepsilon_0 r^2} r^2 \sin\theta \, d\theta \, d\phi$$

$$= \frac{q}{4\pi \varepsilon_0} \int_0^{\pi} \int_0^{2\pi} \sin\theta \, d\theta \, d\phi$$

$$= \frac{4\pi (q)}{4\pi \varepsilon_0} \int_0^{\pi} \sin\theta \, d\theta$$

$$\oint \vec{E} \, d\vec{a} = \frac{\cancel{4}\pi q}{\cancel{4}\pi \varepsilon_0} \; //.$$

$$\oint_S E \, da = \frac{q}{\varepsilon_0}$$ = Persamaan Gauss dalam bentuk deferensial.

$\int_V (\nabla \cdot \vec{E})\, d\tau$ Rapat muatan $= \lambda$

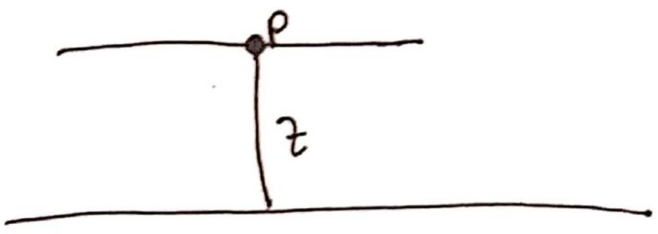
$Q = \int \rho\, d\tau$

$\int (\nabla \cdot \vec{E})\, d\tau = \frac{Q}{\varepsilon_0}$

$\rightarrow = \frac{1}{\varepsilon_0} \int_V \rho\, d\tau$

$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0} \rightarrow$ Hk. Gauss dalam bentuk deferensial

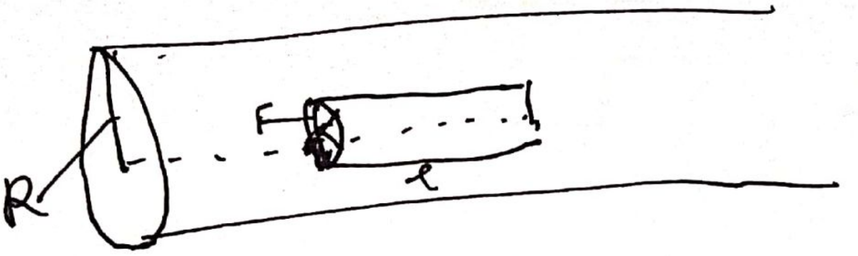
$\oint_S \vec{E} \cdot da = \int (\nabla \cdot E)\, d\tau$



$\oint \vec{E} \cdot da = \frac{q}{\varepsilon_0}$

$\vec{E}(2\pi z \cdot l) = \frac{\lambda\, l}{\varepsilon_0}$

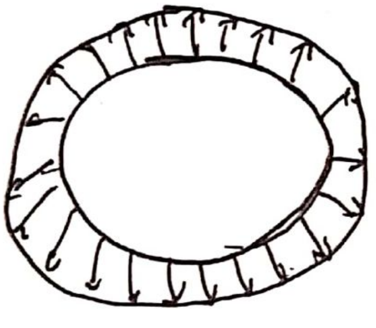
$E = \frac{\lambda}{2\pi\varepsilon_0 z} \hat{z}_0$



$$\oint E \cdot da = \frac{Q}{\epsilon_0}$$

$$\vec{E}\,(2\pi r . l) = \frac{Q}{\epsilon_0}$$

$$\vec{E} = \frac{Q}{2\pi\epsilon_0 r l}\,\hat{r}_0$$



$$\oint \vec{E}\, da = \frac{Q}{\epsilon_0}$$

$$E = (4\pi r^2) = \frac{1}{\epsilon_0} \iiint \rho\, d\epsilon_0$$

$$= \frac{1}{\epsilon_0} \int_0^{a}\int_0^{2\pi}\int_0^{\pi} \rho\, r^2 \sin\theta\, d\theta\, d\phi\, dr$$

$$= \frac{4\pi\rho}{\epsilon_0} \int_0^{a} r^2\, dr$$

$$=$$

$$E(4\pi r^2) = \frac{4\pi\rho}{\varepsilon_0}\int_0^a r^2\,dr$$

$$= \frac{4\pi\rho}{\varepsilon_0}\left(\frac{1}{3}r^3\right)_0^a$$

$$= \frac{4}{3}\frac{\pi a^3}{\varepsilon_{0 3}}$$

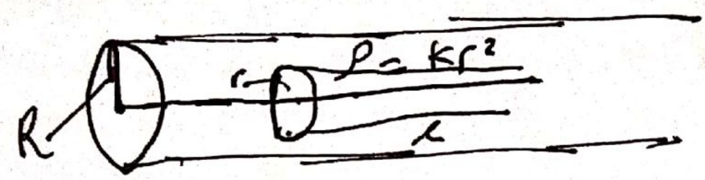
$$E = \frac{\rho r^3}{3\varepsilon_0 r^2}\,\hat{r}$$

$$\oint E\,da = \frac{Q}{\varepsilon_0}$$

$$= \frac{1}{\varepsilon_0}\int_a^b\int_0^{2\pi}\int_0^{\pi}\sin\theta\,d\theta\,d\phi\,dr$$

$$= \frac{4\pi\rho}{\varepsilon_0}\int_a^b r^2\,dr$$

$$= \frac{4\pi\rho}{\varepsilon_0}\left(\frac{1}{3}r^3\Big|_a^b\right).$$



1) $\rho < R$

2) $r > R$

$$\oint E\, da = \frac{1}{\epsilon_0}\iiint \rho\, d\tau$$

$$E(\cancel{2\pi r l}) = \cancel{\frac{1}{\epsilon_0}\iiint (kr^2)\, r^2 \sin\theta\, d\theta\, d\phi\, dr}$$

$$= \cancel{\frac{k(4\pi)}{\epsilon_0}\int_0^a r^4\, dr}$$

$$E(2\pi r l) = \frac{1}{\epsilon_0} = \int_0^{2\pi}\int_0^{l}\int_0^{R} (k\rho^2)\, r\, d\phi\, dz\, dr$$

$$= \frac{2\pi k}{\epsilon_0}\int_0^{l} dz \int_0^{R} r^3\, dr$$

Potensial = muatan listri }
beda -"- = atus listrik } y

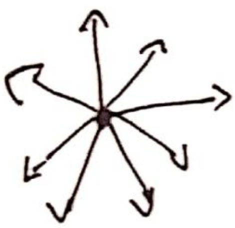
listrik = usaha membawa muatan dari jauh ke titik tertentu /
kerja per satuan muatan.

$$W = F.s$$

$$V = \frac{W}{q} = \frac{F.s}{q} = \frac{k\frac{q.q}{r}}{q}$$

$$V = k\frac{q}{r}$$

$$dv = -\int_{r_1}^{r_2} \bar{E}\, dr$$



$$= V_1 - V_2 = -\int \bar{E}\, dr$$

$$\Delta V = -\int_{r_1}^{r_2} \frac{q^{r_1}}{4\pi\varepsilon_0 r^2}\, dr$$

$$= \frac{q}{4\pi\varepsilon_0}\int_{r_1}^{r_2} r^{-2}\, dr$$

$$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r} = k\frac{q}{r}$$

$$\Delta V = E\, dv$$

$$= -\square\int_{r_1}^{r_1} r^{-2}\, dr$$

$$= -\square\left(-\frac{1}{r}\Big|_{r_1}^{r_2}\right) = \square\left(\frac{1}{r_2} - \frac{1}{r_1}\right)$$