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Metode Penentuan Potensial

1) Persamaan laplace

$\oint \vec{E} \cdot d\vec{e} = 0$, untuk $\vec{E}$ konservatif

$\oint \vec{E} \cdot d\vec{p} = \int \nabla \times \vec{E}\, d\vec{A} = 0$

$\nabla \times \vec{E} = 0,$

$\nabla E = \rho / \varepsilon_0$

$E = -\nabla V$

$\frac{1}{\varepsilon_0} \rho = -\nabla^2 V$

$\nabla^2 V = -\frac{1}{\varepsilon_0} \rho$ (Hukum Poisson)

$\nabla^2 V = 0 \Rightarrow$ persamaan laplace

$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0$$

$$\frac{\partial^2 V}{\partial x^2} = 0; \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial y^2} = 0;$$

$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0$$

Persamaan laplace 1 dimensi, untuk menghitung potensial listrik dari rumus poisson.

$$\nabla^2 V = \frac{1}{\varepsilon_0} \rho$$

* Dalam persamaan laplace $\rho = 0$, E_0 = konstan
  $\nabla^2 V = 0$ (untuk 1 dimensi),
  maka: $\frac{\partial^2 V_x}{\partial x^2} = 0$

  karena v fungsi dari x, maka:

$$\frac{d^2 V_x}{dx^2} = \frac{d}{dx}\left(\frac{dv}{dx}\right) = 0$$

$$\frac{d V_x}{dx} = k, \quad k = \text{konstan}$$

* Untuk koordinat bola, maka persamaan laplace satu dimensi

$\nabla^2 V = 0$

$$\frac{1}{r^2} \frac{\partial}{\partial r}\left(r^2 \frac{\partial v}{\partial r}\right) = 0$$

$$r^2 \frac{\partial v}{\partial r} = r^2 \frac{dv}{\partial r} = k$$

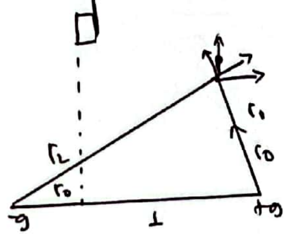
$$dr = \frac{1}{r^2} k\, dr$$

$$V(r) = \frac{1}{r^2} k\, dr$$

$$V(r) = -\frac{1}{r} k + C$$

* Metode bayangan.

a) muatan titik batang konduktor :



$$V_p = ? \quad E_r = \frac{-\partial V}{\partial r};$$

$$E_0 = \frac{\partial V}{\partial r}$$

$$V_p = \frac{1}{4\pi\varepsilon_0} + \frac{q}{r_1} + \frac{(-q)}{4\pi\varepsilon_0 r_2}$$

$$= \frac{q}{4\pi\varepsilon_0}\left(\frac{r_2 - r_1}{r_1 r_2}\right)$$

" Penjumlahan biasa "

$$V_p = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r} - \frac{1}{r_1}\right)$$

$$V_p = \frac{q}{4\pi\varepsilon_0}\left(\frac{r' - r}{r \cdot r}\right)$$