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3.1 Persamaan Laplace

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

$\oint \vec{E} \cdot d\vec{r} = \int \nabla \times \vec{E} \cdot d\vec{a} = 0$

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

$\nabla \cdot E = \frac{\rho}{\varepsilon_0}$

$E = -\nabla V$

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

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

$\nabla^2 V = \frac{1}{\varepsilon_0}\rho$ → Hk. Poisson

$\nabla^2 V = 0$ → Pers Laplace

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

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

Pembahasan ini dibatasi pada pers Laplace satu dimensi, untuk menghitung Potensial listrik, dari rumusan Poisson.

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

Dalam pers laplace $\rho = 0$, ε_0 = konstan

$\nabla^2 V = 0$; untuk 1 dimensi, maka

$\frac{d^2 V_x}{dx^2} = k$, k = konstan

$dV_x = k\,dx$

$V_x = kx + b$, b = hsl integrasi

$V(x) = kx + b$

Untuk koordinat bola, Pers Laplace 1 dimensi

$\nabla^2 V = 0$

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

$r^2 \frac{\partial V}{\partial r} = r^2 \frac{dV}{dr} = A$

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

$V(r) = \frac{1}{r} A + c$

$V_a = 10V$

$V_b = 20V$

$x_a = 0$

$x_b = 10$

$x_p = 5$