# Poisson's and Laplace's Equations (H.1)

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Based on
Engineering Electromagnetics
Hayt & Buck

$$\nabla^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = -\frac{\rho_v}{\varepsilon}$$

$$\nabla^2 V = 0$$

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

$$\nabla^2 V = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho \frac{\partial V}{\partial \rho}\right) + \frac{1}{\rho^2}\left(\frac{\partial V}{\partial \phi^2}\right) + \frac{\partial V}{\partial z^2}$$

$$\nabla^2 V = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2 \frac{\partial V}{\partial r}\right) + \frac{1}{r^2 \sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta \frac{\partial V}{\partial \theta}\right) + \frac{1}{r^2 \sin^2\theta}\frac{\partial^2 V}{\partial \phi^2}$$

$$V = \frac{V_0 x}{d}$$

$$C = \frac{|Q|}{V_0} = \frac{\epsilon S}{d}$$

$$V = V_0 \frac{\ln(b/\rho)}{\ln(b/a)}$$

$$C = \frac{2\pi\epsilon_0 L}{\ln(b/a)}$$

$$V = V_0 \frac{\phi}{\alpha}$$

$$\mathbf{E}_r = -\frac{V_0 \mathbf{a}_\phi}{\alpha\rho}$$

$$V = \frac{\frac{1}{r} - \frac{1}{b}}{\frac{1}{a} - \frac{1}{b}}$$

$$C = \frac{4\pi\varepsilon}{\frac{1}{a} - \frac{1}{b}}$$

$$V = V_0 \frac{\ln\left(\tan\frac{\theta}{2}\right)}{\ln\left(\tan\frac{\alpha}{2}\right)}$$

$$C = \frac{2\pi\varepsilon r_1}{\ln\left(\cot\frac{\alpha}{2}\right)}$$

$$V_0 = \frac{1}{4}\left(V_1 + V_2 + V_3 + V_4\right)$$