PHYS 301 Electricity and Magnetism

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Today!

- Electric fields
 - ➤ Electric potential
 - **≻**Conductors

Fundamental Equations of Electrostatics

$$\vec{\nabla} \cdot \vec{E} = \rho / \varepsilon_o \qquad \vec{\nabla} \times \vec{E} = 0$$

• In terms of potential:

In terms of potential:
$$\vec{E} = -\vec{\nabla}V$$

$$\vec{\nabla} \cdot (-\vec{\nabla}V) = -\nabla^2 V = \rho / \varepsilon_o$$

$$\nabla^2 \mathbf{V}$$

Poisson's equation

$$\nabla^2 V = -\rho / \varepsilon_o \qquad \text{if } \rho = 0 \qquad \nabla^2 V = 0$$

LaPlace's equation

Electric Potential

ELECTROSTATICS

 The workhorse of electric potential looks a lot like its electric field counter part:

$$V(\vec{r}) = \frac{1}{4\pi\varepsilon_o} \frac{q}{\mathbf{r}} \quad \begin{array}{c} \text{point} \\ \text{charge} \end{array}$$

$$V(\vec{r}) = \frac{1}{4\pi\varepsilon_o} \int \frac{\rho(\vec{r}')}{|\vec{\mathbf{z}}|} d\tau'$$

$$V(\vec{r}) = \frac{1}{4\pi\varepsilon_o} \int \frac{\sigma(\vec{r}')}{|\vec{\mathbf{z}}|} dA'$$

$$V(\vec{r}) = \frac{1}{4\pi\varepsilon_o} \int \frac{\delta(\vec{r}')}{|\vec{\mathbf{z}}|} dI'$$

$$infinity!$$