PHYS 301
Electricity and Magnetism

Dr. Gregory W. Clark

Fall 2019

Today!

- Electric fields
  - ➢Electric potential
  - ➢Conductors

Fundamental Equations of Electrostatics

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

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

- In terms of potential:

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

$$\nabla^2 V = -\rho/\varepsilon_o$$

Poisson's equation

if ρ = 0 →

$$\nabla^2 V = 0$$

LaPlace's equation

Electric Potential

ELECTROSTATICS

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

$$V(\vec{r}) = \frac{1}{4\pi\varepsilon_o}\frac{q}{\mathscr{r}}$$

point charge

continuous charge distributions

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

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

$$V(\vec{r}) = \frac{1}{4\pi\varepsilon_o}\int\frac{\lambda(\vec{r}\,')}{|\vec{\mathscr{r}}|}dl'$$

relative to what?

infinity!