Tools we can use if we want to find electric field $\vec{E}(\vec{r})$ or potential $V(\vec{r})$

- Coulomb's Law: $\vec{E}(\vec{r}) = \frac{1}{4\pi\varepsilon_0}\int \frac{\rho(\vec{r}')}{r^2}\hat{r}\, d\tau'$ (2.8)
- First find potential V,then get $\vec{E}(\vec{r})$:

$$V(\vec{r}) = \frac{1}{4\pi\varepsilon_0}\int \frac{\rho(\vec{r}')}{r} d\tau' \quad (2.29) \quad \text{then} \quad \vec{E}(\vec{r}) = -\vec{\nabla}V(\vec{r})$$

- Gauss' Law (if symmetry permits) $\frac{Q_{enc}}{\varepsilon_0} = \oint_S \vec{E}\cdot d\vec{a}$ (2.13)
- Poisson's equation $\nabla^2 V = -\frac{\rho}{\varepsilon_0}$ (2.24)

  (solve differential equation with boundary conditions)
- Method of Images (replace equipotential surfaces)
- Use Separation of Variables to solve Laplace's Equation
- Multipole Expansion (approximation)