Physics 333 **Electromagnetic Theory I** **Fall 2022**

Equations

$$\mathbf{F}(\mathbf{r}) = \frac{1}{4\pi\epsilon_0}\frac{Qq}{\mathscr{r}^2}\hat{\boldsymbol{\mathscr{r}}} \qquad \mathbf{F} = Q\mathbf{E} \qquad \hat{\boldsymbol{\mathscr{r}}} = \mathbf{r} - \mathbf{r}'$$

$$\mathbf{E}(\mathbf{r}) = \frac{1}{4\pi\epsilon_0}\sum_i \frac{q_i}{\mathscr{r}_i^2}\hat{\boldsymbol{\mathscr{r}}}_i \qquad \mathbf{E}(\mathbf{r}) = \frac{1}{4\pi\epsilon_0}\int \frac{\mathrm{d}q}{\mathscr{r}^2}\hat{\boldsymbol{\mathscr{r}}} \qquad \oint_{\mathcal{S}} \mathbf{E}\cdot d\mathbf{a} = \frac{1}{\epsilon_0}Q_{\text{enc}} \qquad \nabla\cdot\mathbf{E} = \frac{1}{\epsilon_0}\rho$$

$$\mathbf{E} = \frac{\sigma}{2\epsilon_0}\,\hat{\mathbf{n}} \qquad \nabla\times\mathbf{E} = 0 \qquad V(\mathbf{r}) = -\int_{\mathcal{O}}^{\mathbf{r}} \mathbf{E}\cdot d\mathbf{l} \qquad \mathbf{E} = -\nabla V$$

$$\nabla^2 V = -\frac{\rho}{\epsilon_0} \qquad V(\mathbf{r}) = \frac{1}{4\pi\epsilon_0}\int \frac{\rho(\mathbf{r}')}{\mathscr{r}}\,d\tau' \qquad \mathbf{E}_{\text{above}} - \mathbf{E}_{\text{below}} = \frac{\sigma}{\epsilon_0}\,\hat{\mathbf{n}}$$

$$W = \frac{1}{2}\int_{\mathcal{V}} \rho V\,d\tau = \frac{\epsilon_0}{2}\int_{\text{all space}} E^2\,d\tau$$

$$d\tau = dx\,dy\,dz = s\,ds\,d\phi\,dz = r^2\sin\theta\,dr\,d\theta\,d\phi$$