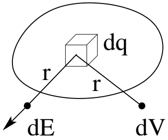
Electric Field and Electric Potential

Determine the field or the potential from the source (charge distribution):

$$\vec{E} = \frac{1}{4\pi\epsilon_0}\int \frac{dq}{r^2}\hat{r}$$



$$V = \frac{1}{4\pi\epsilon_0}\int \frac{dq}{r}$$

Determine the field from the potential: $\vec{E} = -\frac{\partial V}{\partial x}\hat{\imath} - \frac{\partial V}{\partial y}\hat{\jmath} - \frac{\partial V}{\partial z}\hat{k}$

Determine the potential from the field: $V = -\int_{\vec{r}_0}^{\vec{r}} \vec{E}\cdot d\vec{s}$

- Systems with $\vec{E} = E_x(x)\hat{\imath}$: $E_x = -\frac{dV}{dx} \quad \Leftrightarrow \quad V(x) = -\int_{x_0}^{x} E_x dx$
- Application to charged ring: $E_x = \frac{kQx}{(x^2+a^2)^{3/2}} \Leftrightarrow V = \frac{kQ}{\sqrt{x^2+a^2}}$
- Application to charged disk (at $x > 0$): $E_x = 2\pi\sigma k\left[1 - \frac{x}{\sqrt{x^2+R^2}}\right] \Leftrightarrow V = 2\pi\sigma k\left[\sqrt{x^2+R^2} - x\right]$