Electric field lines

• The electric field is a VECTOR– specified at each point in space according to

\[
\vec{E}(\vec{r}) = \frac{1}{4\pi\varepsilon_0} \int \frac{\rho(\vec{r}')}{|\vec{r} - \vec{r}'|^3} (\vec{r} - \vec{r}') \, d\tau'
\]

• Electric field ‘lines’ is a concept introduced by Faraday to help us visualize the electric field

• The field lines are not the same as the field
Rules for drawing field lines

• How many lines? Total number, $N \propto Q$
  – start on a + and end on a – charge
  – start on a + and go out to $\infty$
  – start at $\infty$ and stop on a –

• Magnitude of $E \propto$ the number of lines crossing a area perpendicular to $E$ per unit area; $E \propto N/A_{\perp}$, so that $E A_{\perp} \propto Q$ (Gauss’s Law)

• The electric field is everywhere tangent to the field lines
Electric Field Line Patterns for Objects with Unequal Amounts of Charge