August 28th/29th

Electric Fields – Chapter 23
Electric Field

- How does a charge, $q_1$, exert a force on another charge, $q_2$, when the charges don’t touch?
- The charge, $q_1$, sets up an electric field in its surrounding space.
- This electric field has both magnitude and direction which determine the magnitude and direction of the force acting on $q_2$. 
Electric Field

- What happens to the field if $q_1$ moves?

- Info about $q_1$ travels outward from it as an electromagnetic wave at speed of light, $c$
Electric Field

- Electric field is a vector field
  - Consists of a distribution of vectors

- Define electric field at a point near the charged object by using a positive test charge, \( q_0 \)
Test charge $q_0$ at point $P$

charged object

Electric field at point $P$
Electric Field

- Test charge - charge which feels forces of other charges but exerts no force on them
  - Mathematical construct

- Electric field exists independently of the test charge
Electric Field

- The magnitude of the electric field, \(E\), is the magnitude of the force per unit test charge

\[
\hat{E} = \frac{\vec{F}}{q_0}
\]

- SI unit for \(E\) field is \(N/C\)

- Direction of \(E\) is the direction of \(F\) for the positive test charge
Electric Field

- Use electric field lines to visualize $E$ field
- Field lines point away from positive charges and towards negative charges
- At any point, the tangent to the field line is the direction of the $E$ field at that point
- Density of field lines is proportional to the magnitude of the $E$ field
Electric Field

- Electric field lines:
  - Close to a point charge are radial in direction
  - Do not intersect in a charge-free region
  - Do not begin or end in a charge-free region