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

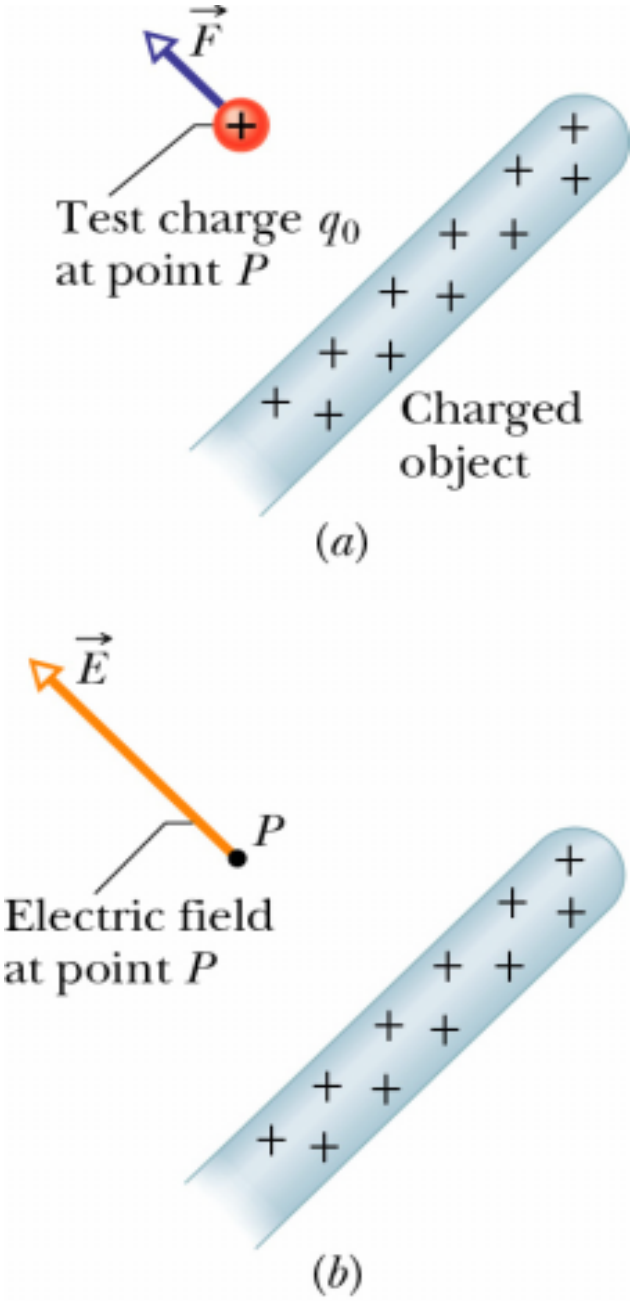
- What happens to the field if q_1 moves?

- 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


$\vec{F}$
Test charge q_0
at point P
Charged
object
(a)
$\vec{E}$
P
Electric field
at point P
(b)

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

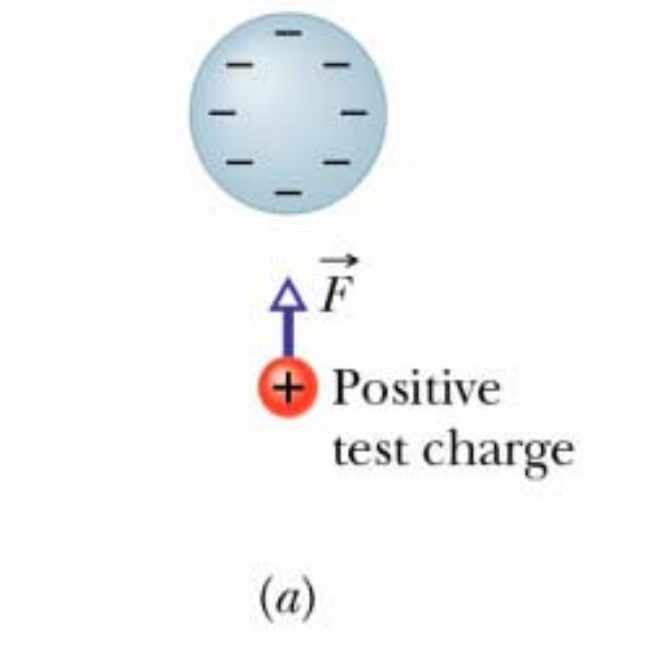
- The magnitude of the electric field, *E*, is the magnitude of the force per unit test charge

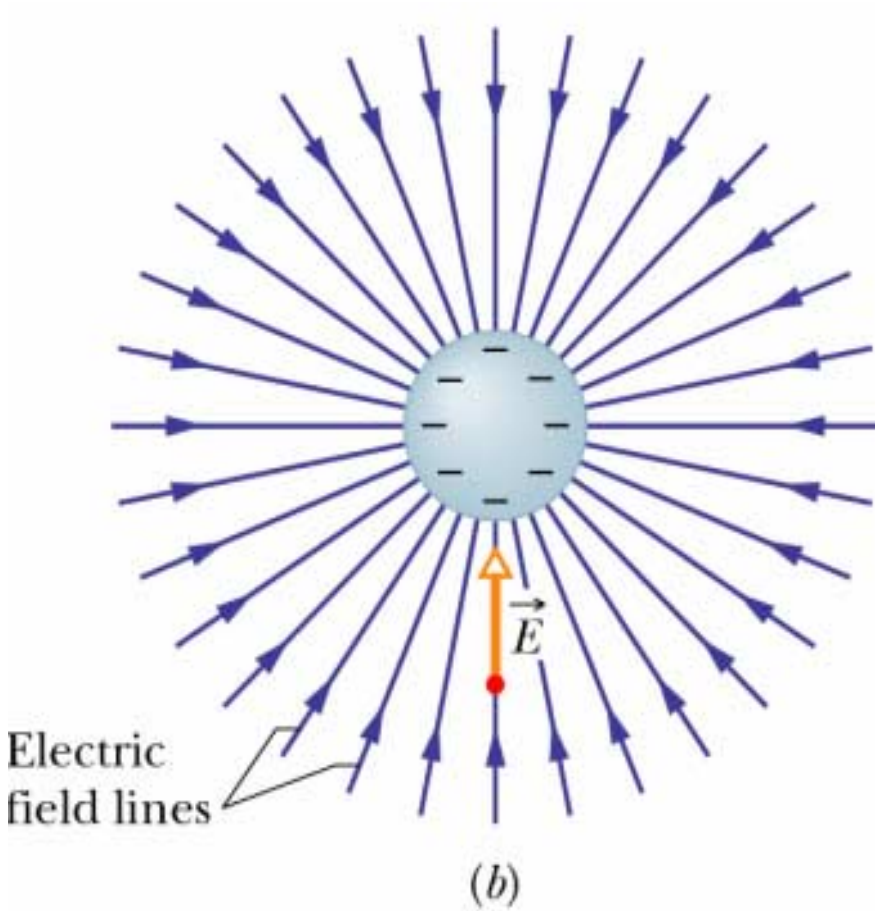
$$\vec{E} = \frac{\vec{F}}{q_0}$$

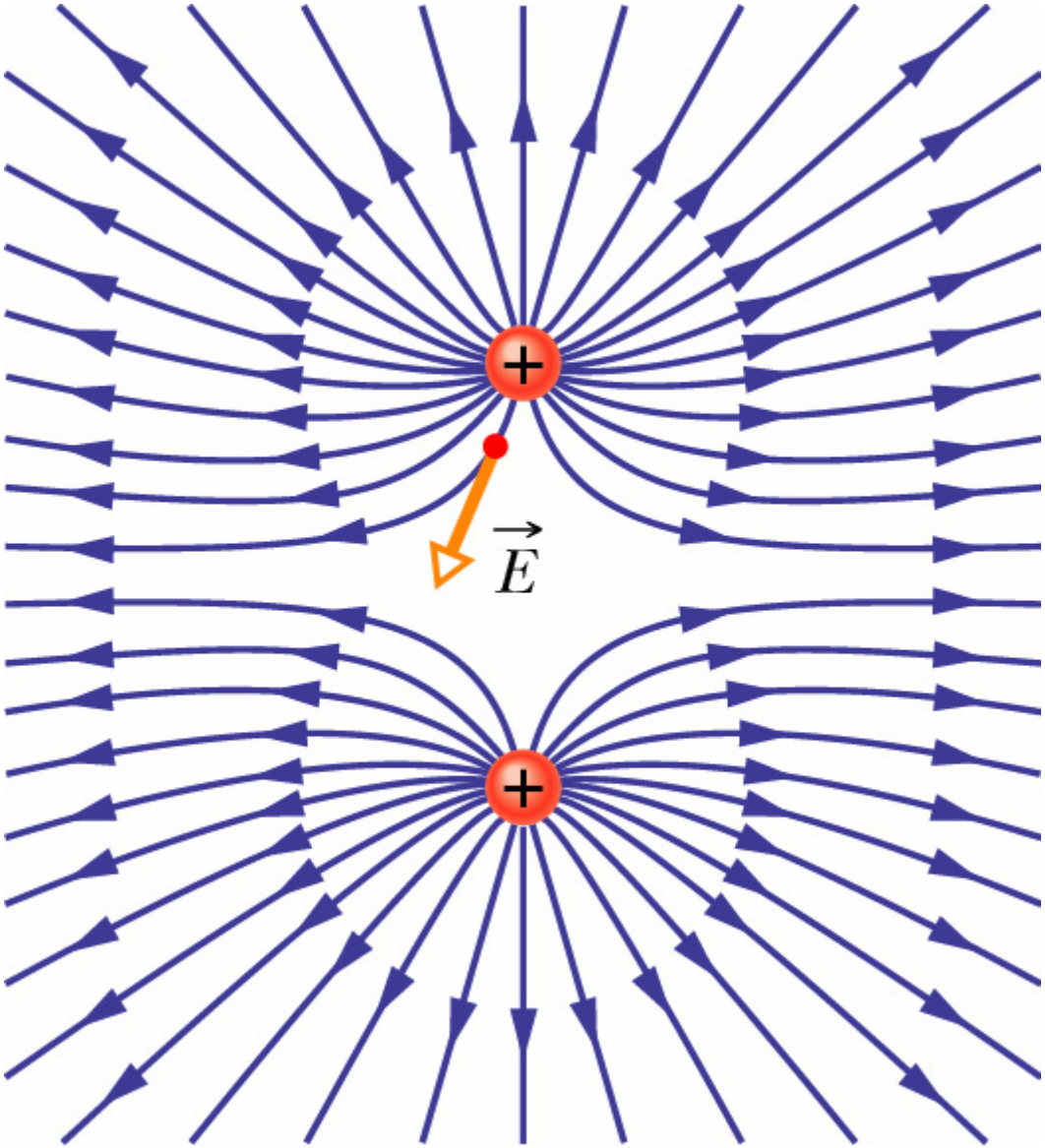
- SI unit for *E* field is *N/C*
- Direction of *E* is the direction of *F* for the positive test charge

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


$\vec{F}$
Positive
test charge
(a)


$\vec{E}$
Electric
field lines
(b)


+
+
$\vec{E}$

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