Electric Fields

A charged particle exerts a force on other charged particles even if they are not touching. This is accomplished by the electric field produced by the charged particle. All charged particles create electric fields. You can kinda think of it as a sphere of influence. The electric field is larger closer to the particle and also increases if the charge on the particle increases.

The only way to measure electric fields is by putting another charge (a test charge) in the field and measuring the force on the test charge. The electric field is the force felt by the test charge divided by the test charge's charge.

Electric Field
force per
unit charge

$E=F/q_{test}$

$$E = \frac{F}{q_{test}}$$

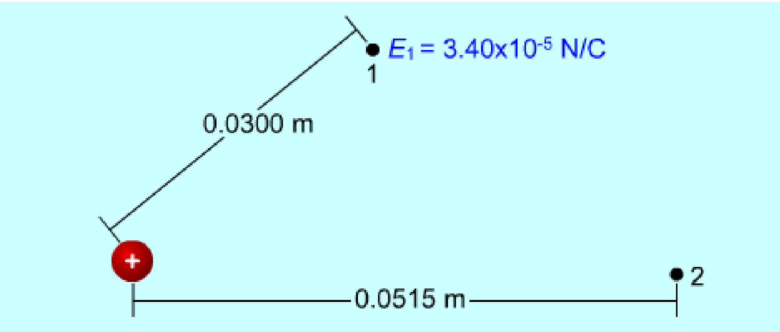
$$E = \frac{F}{q_{test}}$$

$$F = k\frac{q_1 \cdot q_2}{r^2} \leftarrow q_2 = q_{test}$$

$$E = \frac{k q_1 \cdot \cancel{q_{test}}}{r^2} \cdot \frac{1}{\cancel{q_{test}}}$$

$$\boxed{E = \frac{k q_1}{r^2}}$$

$$E=F/q_{test}$$



A point charge rests in an otherwise charge-free region. Locations 1 and 2 are 0.0300 m and 0.0515 m from the charge, respectively. If the electric field at location 1 is 3.40×10^{-5} N/C, what is the electric field at location 2?

$$E = \frac{F}{q_{test}} = \frac{k q_1}{r^2}$$

$$E_1 = 3.40 \cdot 10^{-5} \text{ N/C}$$

$$r = 0.03 \text{ m}$$

$$3.4 \cdot 10^{-5} = \frac{8.89 \cdot 10^{9} (q_1)}{(.03)^2}$$

$$3.4 \cdot 10^{-5} = 9.88 \cdot 10^{12} q_1$$

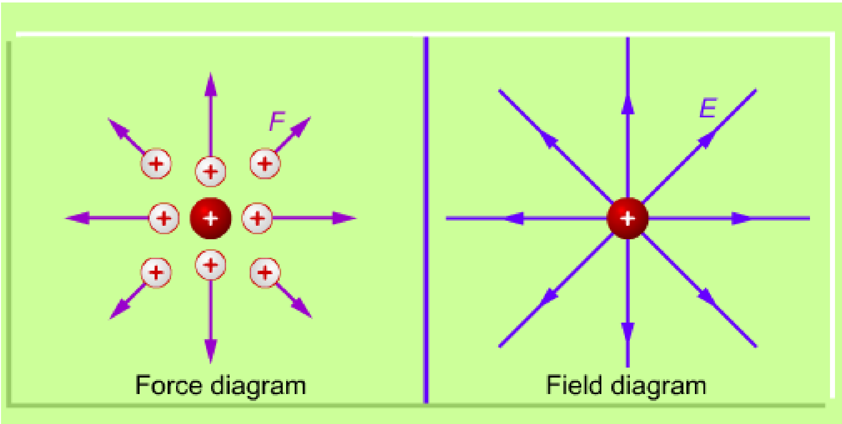
$$q_1 = 3.44 \cdot 10^{-18} \text{ C}$$

$$E = \frac{k q_1}{r^2} = \frac{8.89 \cdot 10^{9} (3.44 \cdot 10^{-18})}{(.0515)^2}$$

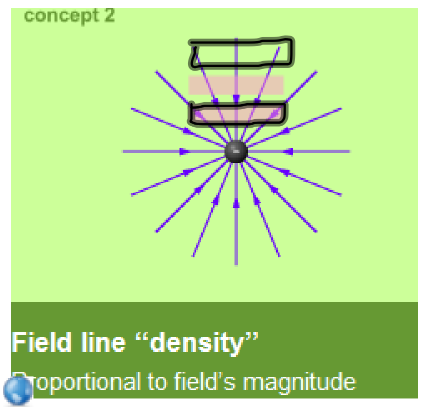
$$E = \frac{3.06 \cdot 10^{-8}}{.0026}$$

$$E = 1.15 \cdot 10^{-3} \text{ N/C}$$

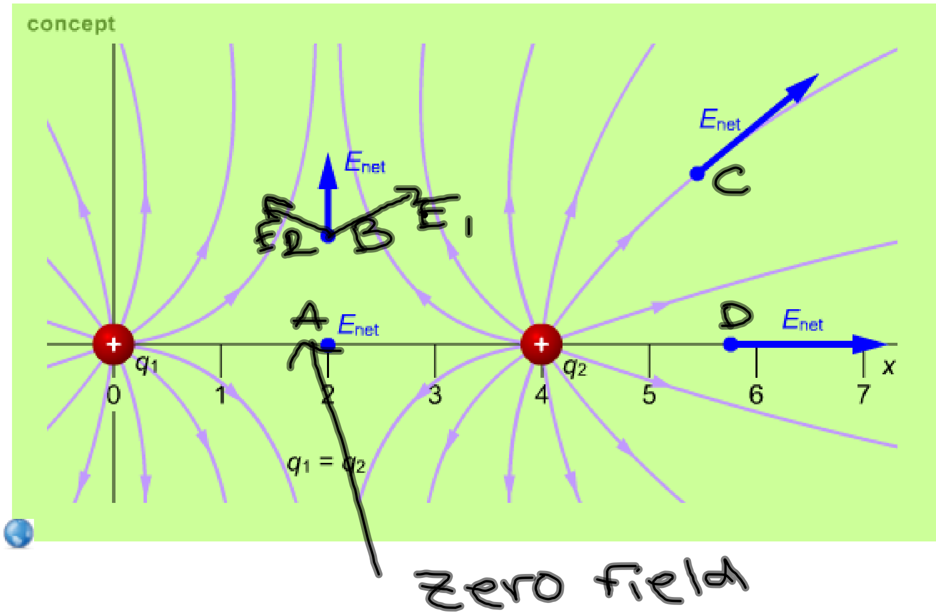
Electric Field Diagrams

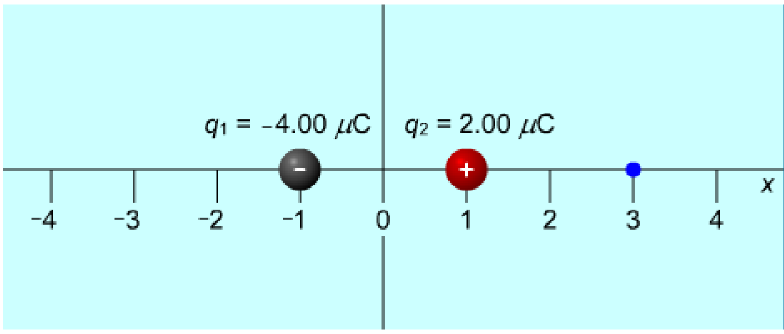


pos charge field lines go out



neg charge field lines go in.


concept
Enet
E2
B
E1
Enet
C
A
Enet
D
Enet
q1
q2
0
1
2
3
4
5
6
7
x
q1 = q2
zero field



Two charged particles are placed as shown at −1.00 m and +1.00 m on the *x* axis.

Calculate the combined field due to these charges at the indicated point, (3.00 m, 0.00 m).