

Electric Field

- We can use a _____ charge to determine how the surrounding _____ generate a _____
 - Pick a small test charge so it doesn't _____ the surrounding charge _____

A test charge ($q_0 = 1.0 \times 10^{-10} \text{ C}$) experiences a force of $2 \times 10^{-9} \text{ N}$ when placed near a charged sphere. Determine the Force per Coulomb that the charge experiences and predict the force on a 2 C charge.

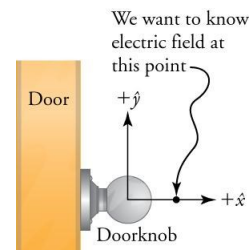
Electric Field Definition

$$E = \frac{F}{q_0} = \frac{kq}{r^2}$$

- _____ per _____
- Vector: Same _____ as the force on a _____ test charge
- Unit: N/C

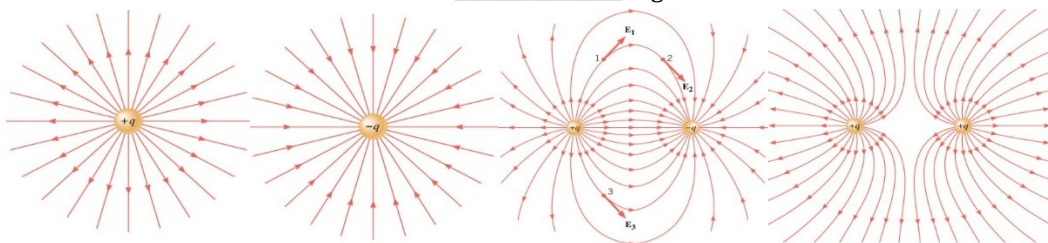
There are two point charges of $q_1 = 4 \text{ C}$ and $q_2 = 8 \text{ C}$ and they are 10 m apart. Find point where $E = 0$ between them.

A doorknob, which can be taken to be a spherical metal conductor, acquires a static electricity charge of -1.5 nC What is the electric field 1.0 cm in front of the doorknob? The diameter of the doorknob is 5.0 cm.

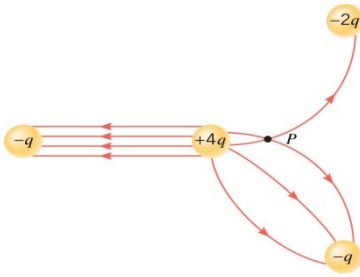


Electric Field Lines

- Map to show the _____ in _____
- Rules
 - Lines begin at _____ charges only
 - Lines end at _____ charges only
 - The number of lines entering or leaving a charge is _____ to the _____ of charge
 - Lines don't _____ each other
 - Lines leave surfaces at _____ degrees

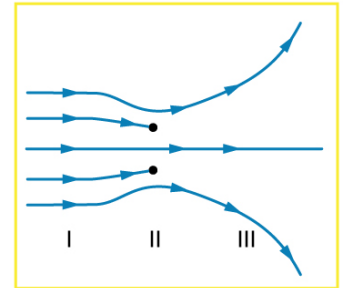


What is wrong here?



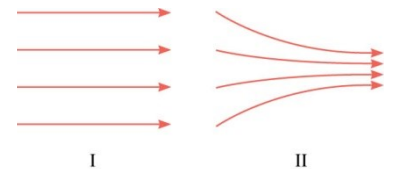
Practice Work

- Why must the test charge q_0 in the definition of the electric field be vanishingly small?
- Explain how electric monopole (single charge) and dipole (two charges) create different electric fields. Sketch examples of each.
- The figure shows an electric field extending over three regions, labeled I, II, and III. Answer the following questions. (a) Are there any isolated charges? If so, in what region and what are their signs? (b) Where is the field strongest? (c) Where is it weakest? (d) Where is the field the most uniform?



- There is an electric field at point P. A very small charge is placed at this point and experiences a force. Another very small charge is then placed at this point and experiences a force that differs in both magnitude and direction from that experienced by the first charge. How can these two different forces result from the single electric field that exists at point P?

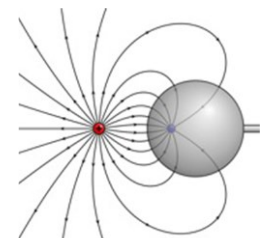
- Drawings I and II show two examples of electric field lines. Decide which of the following statements are true and which are false, defending your choice in each case. (a) In both I and II the electric field is the same everywhere. (b) As you move from left to right in each case, the electric field becomes stronger. (c) The electric field in I is the same everywhere but becomes stronger in II as you move from left to right. (d) The electric fields in both I and II could be created by negative charges located somewhere on the left and positive charges somewhere on the right. (e) Both I and II arise from a single positive point charge located somewhere on the left.



- What is the magnitude and direction of an electric field that exerts a 2.00×10^{-5} N upward force on a $-1.75 \mu\text{C}$ charge? (OpenStax 18.27) **-11.4 N/C downward**
- What is the magnitude and direction of the force exerted on a $3.50 \mu\text{C}$ charge by a 250 N/C electric field that points due east? (OpenStax 18.28) **$8.75 \times 10^{-4} \text{ N}$**
- Calculate the magnitude of the electric field 2.00 m from a point charge of 5.00 mC (such as found on the terminal of a Van de Graaff). (OpenStax 18.29) **$1.12 \times 10^7 \text{ N/C}$**
- (a) What magnitude point charge creates a $10,000 \text{ N/C}$ electric field at a distance of 0.250 m ? (b) How large is the field at 10.0 m ? (OpenStax 18.30) **$6.95 \times 10^{-8} \text{ C}$, 6.25 N/C**
- (a) Find the direction and magnitude of an electric field that exerts a $4.80 \times 10^{-17} \text{ N}$ west force on an electron. (b) What magnitude and direction force does this field exert on a proton? (OpenStax 18.32) **300 N/C east, $4.80 \times 10^{-17} \text{ N}$ east**
- (a) Sketch the electric field lines near point charge $+q$. (b) Do the same for point charge $-3.00q$. (OpenStax 18.33) **below**

- Sketch the electric field lines a long distance from the charge distributions shown in Figure 18.26 (a) and (b) (OpenStax 18.34) **see below**

- The figure shows the electric field lines near two charges q_1 and q_2 . (a) What is the ratio of their magnitudes? (b) Sketch the electric field lines a long distance from the charges shown in the figure. (OpenStax 18.35) **$-1.9:1$, like a point charge**



- Sketch the electric field lines in the vicinity of two opposite charges, where the negative charge is three times greater in magnitude than the positive. (See Figure 18.47 for a similar situation).

