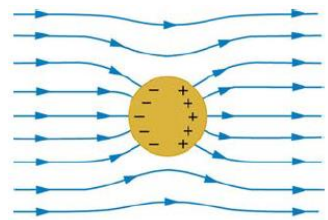
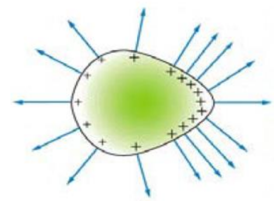
Physics 08-04 Conductors and Electric Fields in Equilibrium and Applications Name: ____________________

Conductors in Equilibrium



- Conductors contain ____________ charges that move ____________
- When ____________ charges are present, they quickly ____________ to places where the electric field is ________________ to the surface
- Then they ____________ moving
- This is electrostatic ____________

- Conductor in electric field will ____________
- Inside conductor, ____________
- Just outside of conductor, E-field is ________________ to ____________
- Any excess ____________ resides on ____________
- They get as far ____________ as ____________



- If the surface is ____________, more charge will collect near the area of most ____________
- If the curve is great enough, the E-field can be ____________ enough to ____________ excess charge

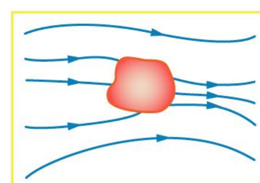
Shielding

- A conductor ____________ any charge ____________ it from ____________ electrical fields
- ____________ electrical equipment is ____________ by putting in a metal box called a ____________ Cage
- ____________ ____________ is shielded by a metal ____________ around the central metal wire. This reduces ________________ and ____________ ____________.

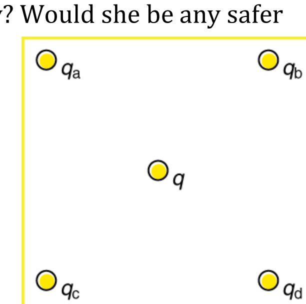
Applications

- Copy Machine
- Laser Printer
- Ink Jet Printer

Homework

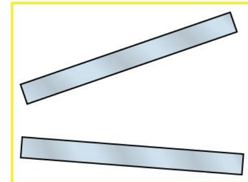


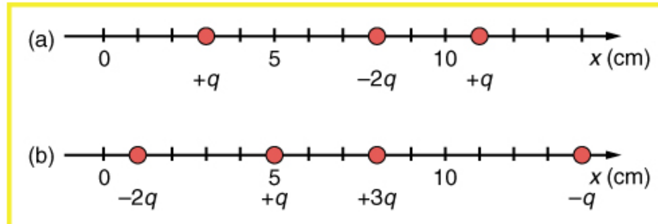
1. Is the object in the figure a conductor or an insulator? Justify your answer.
2. If the electric field lines in the figure above were perpendicular to the object, would it necessarily be a conductor? Explain.
3. Why is a golfer with a metal club over her shoulder vulnerable to lightning in an open fairway? Would she be any safer under a tree?



4. Are you relatively safe from lightning inside an automobile? Give two reasons.
5. Considering the figure, suppose that $q_a = q_d$ and $q_b = q_c$. First show that q is in static equilibrium. (You may neglect the gravitational force.) Then discuss whether the equilibrium is stable or unstable, noting that this may depend on the signs of the charges and the direction of displacement of q from the center of the square.
6. If $q_a = 0$ in the figure, under what conditions will there be no net Coulomb force on q?
7. Sketch the electric field lines in the vicinity of the conductor in the figure given the field was originally uniform and parallel to the object's long axis. Is the resulting field small near the long side of the object? (OpenStax 18.37) **See other side**

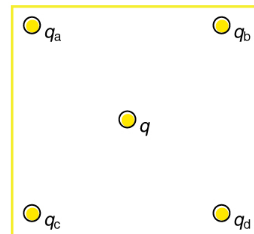
8. Sketch the electric field between the two conducting plates shown in the figure, given the top plate is positive and an equal amount of negative charge is on the bottom plate. Be certain to indicate the distribution of charge on the plates. (OpenStax 18.39) **See below**



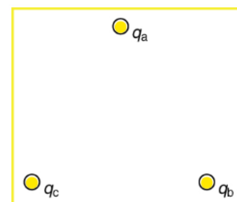


9. What is the force on the charge located at x = 8.00 cm in figure (a) given that q = 1.00 μC? (OpenStax 18.41) **12.8 N**

10. (a) Find the total electric field at x = 1.00 cm in figure (b) given that q = 5.00 nC. (b) Find the total electric field at x = 11.00 cm in figure (b). (c) If the charges are allowed to move and eventually be brought to rest by friction, what will the final charge configuration be? (That is, will there be a single charge, double charge, etc., and what will its value(s) be?) (OpenStax 18.42) $-\infty$, $\mathbf{2.12\times10^5}$ **N/C,** $\boldsymbol{+q}$

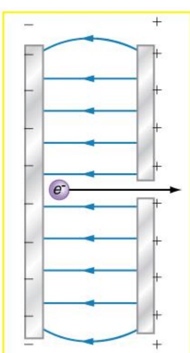


11. Using the symmetry of the arrangement, determine the direction of the force on q in the figure below, given that $q_a = q_b = +7.50\ \mu C$ and $q_c = q_d = -7.50\ \mu C$. (b) Calculate the magnitude of the force on the charge q, given that the square is 10.0 cm on a side and $q = 2.00\ \mu C$. (OpenStax 18.45) **down, 76.3 N downward**

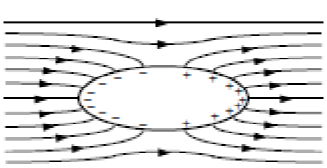


12. (a) Find the electric field at the location of q_a in the figure if it is an equilateral triangle with sides 25 cm, given that $q_b = +10.00\ \mu C$ and $q_c =-5.00\ \mu C$. (b) What is the force on q_a, given that $q_a = +1.50\ nC$? (OpenStax 18.49) $\mathbf{1.25\times10^6}$ **N/C at 30° above the –x-axis,** $\mathbf{1.88\times10^{-3}}$ **N at 30° above the –x-axis**

13. A simple and common technique for accelerating electrons is shown in the figure, where there is a uniform electric field between two plates. Electrons are released, usually from a hot filament, near the negative plate, and there is a small hole in the positive plate that allows the electrons to continue moving. (a) Calculate the acceleration of the electron if the field strength is 2.50×10^4 N/C. (b) Explain why the electron will not be pulled back to the positive plate once it moves through the hole. (OpenStax 18.53) $\mathbf{4.39\times10^{15}}$ **m/s²,** $\boldsymbol{E=0}$



Answer to #7



Answer to #8