Electric Fields

Electric Fields

- Exists around any electrical charge causing an electric force on other charges around it.

Electric Fields

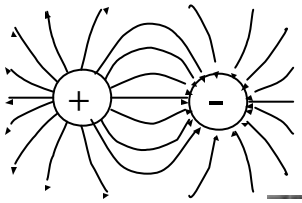
- Determining intensity
  - Uses a positive test charge

$$E = \frac{F}{q} \quad \text{or} \quad E = \frac{kq}{r^2}$$

k= 9.0 x 10^9 N·m^2/C^2

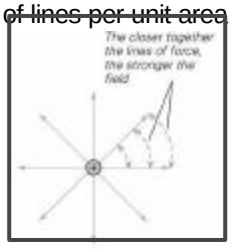
Electric Field Lines

- Point away from positive charges and towards negative charges



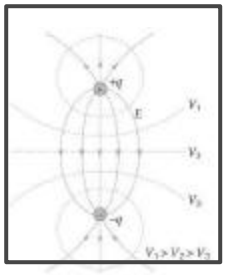
Electric Field Lines

- Intensity of force is symbolized by the number ~~of lines per unit area~~



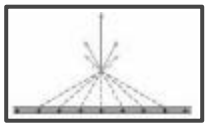
Electric Field Lines and Equipotential Lines

- Since electric field lines are not easily seen or measured, equipotential lines can be used to determine the shape of the electric field.
- The electric field is perpendicular to the equipotential lines



Electric Fields and Plates

- When a charge is placed close to a charged plate, the horizontal components of the individual charges cancel, causing the charge to move perpendicular to the plate.



Electric Fields and Plates

- Parallel Plates
  - The electric field between two oppositely charged parallel plate can be found using:

$$E = \frac{4\pi kQ}{A}$$

Q = Total Amount of Charge on the Plate
A = Area of the Plate

Sheet Lightning

- Most common form
- Charges separate within the cloud
- When the charge differential becomes great enough, a bolt of lightning within the cloud creates a path to balance the charge.

Lightning Channels

- Charges separate within the cloud
- The excess charges at the bottom of the cloud separate charges on the surface through polarization.
- When the charge is great enough a bolt of lightning "grounds" the cloud

Distribution of Charges on Conductors

- All static charge lies on the surface
- Charges try to spread out as much as possible to decrease the amount of energy on a conductor
- The charges are equally distributed
- The surface is equipotential
- Charges and e-fields are more highly concentrated on sharp parts of objects
- Example: Lightning Rod

Grounding

- The earth is considered to be an unlimited source of electrons, and a limitless sink that electrons can be "poured" into without changing the potential.
- The earth and any conductor attached to the earth is given a potential of zero, and is said to be grounded.

Conductors and E-Fields

- The electric field is zero everywhere inside a charged conductor
- This concept can be used to shield equipment from stray electric fields or can cause problem in receiving signals inside metal cages

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