Potential

1 – ELECTRIC CIRCUITS

Potential Difference

- A charge in an electric field experiences a force according to Coulomb's law
  - If the charge moves in response to force, then **work** is done **by** the electrical **field** and **Energy** is removed from the system.
  - If charge is moved against the coulomb force (the field), work is done on the field by **Energy** from some outside source, Energy is stored.

Potential Difference

- If work is done as a charge moves from 1 point to another in an electric field, or if work is required to move a charge from 1 point to another, these 2 points differ in **electric potential**.
- Magnitude of the work is a measure of this difference of potential

Potential Difference

- **Potential Difference**, **V**, between 2 points in an electric field is the **work** done per unit charge as a charge is moved between these points:
- $$V = \frac{work}{charge} = \frac{w}{q} = \frac{PE}{q}$$
- Volt – V between two points in an electric field such that 1 joule of work is done per in moving a charge of 1 coulomb between these points:
- $$1volt = \frac{1\,joule}{1coulomb}$$

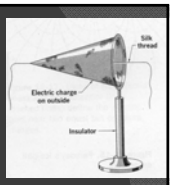
Potential and Voltage

- If V = 6.0V and q = $3x10^2$ μC
- V = w/q
- W=Vq
- Since 1 Joule = 1 Nm
- V = J/C = (Nm)/C Therefore
- $$E = \frac{V}{m} = \frac{N}{C}$$
- **E** is the **potential gradient** and is expressed in V/m $E=\Delta V/x$

Ground

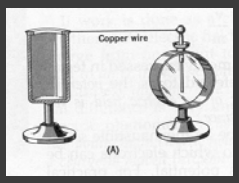
- Earth is a source and a sink for electrons.
  - It can give up and accept an "infinite" number of electrons.
- Any conductor connected to the Earth has E = 0 and is **grounded**.

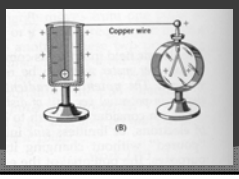
Distribution of Charge



- Michael Faraday
  - He charged a conical silk bag and found that the charge was on the outside of the bag.
  - Pull on the silk thread and turn the bag inside out and the charge was again on the outside of the bag.
  - Either way charge is on the **outside of the silk bag.**

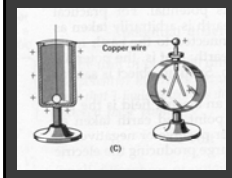
Distribution of Charge

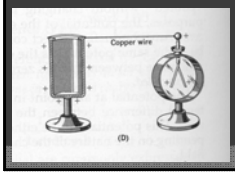




- 1. **NO** redistribution of positive charge on outside surface of pail.
- 2. outside of pail acquired a net charge equal to charge originally placed on the ball.

Distribution of Charge





- <u>We can *Conclude:*</u>
- a. all static charge on a conductor lies on its surface
- b. there can be no V between 2 points on the surface of a charged conductor
- c. The surface of a conductor is an equipotential surface
- d. electric lines of force are normal to equipotential surface
- e. lines of force originate or terminate normal to the conductive surface of a charged object

Effect of Shape

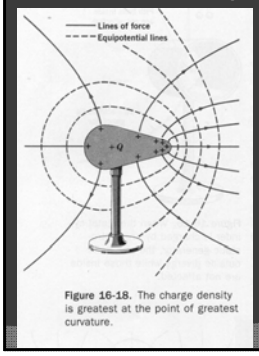


Figure 16-18. The charge density is greatest at the point of greatest curvature.

- 1. Sphere has a uniform charge density (charge/area)
- 2. Charge acquired by nonconductor is confined to its original region until it gradually leaks away.
- 3. Charge acquired by a conductor distributes itself according to the surface curvature, concentrating around points.