

Conductors and Capacitors

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10.1 - Electrostatics with Conductors

- Insulators - materials in which electrons are not able to move freely
- Conductors - materials in which electrons are able to move freely
 - When charge is added to a conductor, the electrons will spread out as much as possible over the surface of the object, which occurs in a negligible amount of time. The charge inside the object will be zero.
 - In a solid conductor with a uniform surface (a surface with a constant curvature such as a sphere or a plane), charge will be uniformly distributed over the surface.
 - In a solid conductor with a nonuniform surface, the charge density will increase as the surface becomes more curved.

In the real world, this property can be used to gradually discharge objects, preventing charge from building up.

10.2 - Redistribution of Charge Between Conductors

In conductors, charge may be transferred through conduction, when two objects are touching, or induction, when two objects are near each other but not touching.

In E&M, "ground" is a reference point where electric potential is zero. It can also be an infinite source or receptacle for electrons. For example, if a positively charged object were said to be grounded, electrons would flow from ground to the object, making it neutral. The opposite would happen if the object were negative: electrons would flow from the object to ground, resulting in the object still being neutral.

Problem

An insulating sphere with radius a has a uniform charge density with a total charge of $+5q$. The sphere is surrounded by a conducting shell with inner radius b and outer radius c . The shell carries an overall

charge $-2q$.

Determine the charge:

- a) Inside the conductor, between radii b and c
- b) On the inner surface of the conducting shell
- c) On the outer surface of the conducting shell

Solution.

- a) The charge inside a conductor is always 0.
- b) The conducting shell will become polarized, drawing electrons to the inner surface to counter the positive charge from the sphere. The answer is $-5q$.
- c) Since the shell has a $-2q$ net charge and the charge inside a conductor is 0, the charge on the outer surface must be $+3q$.